Technical Report No. 14-05

Aquatic Biomonitoring at Greens Creek Mine, 2013

by

Katrina M. Kanouse and

Benjamin P. Brewster

April 2014

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 of 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
parts per billion	ppb
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

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

Measures (fisheries)

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

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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Cover: Habitat Biologist Ben Brewster processing juvenile Dolly Varden char captured at Greens Creek Site 48, 2013.

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The Alaska Department of Fish and Game thanks Hecla Greens Creek Mining Company for contracting with the Division of Habitat to perform the aquatic studies for the Greens Creek Mine. Hecla Greens Creek Mining Company Environmental staff Mitch Brooks, Robyn Jung, Ted Morales, and Chris Wallace provided logistical and field support, and water quality data. We also thank Dennis Reed, U.S. Forest Service Fishery Biologist, and Hannah Perez, Hecla Greens Creek Mining Company Environmental Intern, who assisted with field sampling in 2013.

We thank habitat biologists Gordon Willson-Naranjo and Greg Albrecht for assisting with this year's sampling and sample processing. Division of Habitat Deputy Director Dr. Al Ott and Southeast Regional Supervisor Jackie Timothy reviewed the draft report and Amy Carroll of the Commercial Fisheries Division prepared the report for publication. Nora Foster of NRF Taxonomic Services identified the benthic macroinvertebrates.

EXECUTIVE SUMMARY

In 2001, the Alaska Department of Fish and Game (ADF&G) Division of Habitat began the aquatic biomonitoring program the Alaska Department of Environmental Conservation (ADEC) and the U.S. Forest Service (USFS) require for the Greens Creek Mine. The biomonitoring program provides ADF&G the opportunity to gather and review aquatic information and identify, assess, and resolve issues that could affect aquatic resources near the mine site.

The purpose of the aquatic biomonitoring program is to annually document stream health in Greens Creek and Tributary Creek, two streams near mine development and operations. The program includes sampling three trophic levels of aquatic productivity: periphyton (attached algae), benthic macroinvertebrates (aquatic insects), and juvenile fish. Estimates of periphyton biomass, benthic macroinvertebrate density and community composition, juvenile fish populations, and concentrations of five heavy metals and selenium in whole body juvenile fish, provide information we use to assess stream health. In 2012 and 2013, we also weighed captured juvenile fish to evaluate fish condition and measured juvenile fish whole body total mercury.

In 2013, we sampled Greens Creek sites 48 and 54, and Tributary Creek Site 9. Most sample results for each site were similar to results observed since 2001. Of note in 2013 and relative to data collected at each site, benthic macroinvertebrate densities were low at Site 54 and high at Site 9; juvenile fish populations were high at Site 48 and low at Site 9; we did not capture juvenile coho salmon *Oncorhynchus kitsutch* at Site 54; and median whole body fish concentrations of cadmium, lead, silver, and zinc were high at Site 9.

Per our recommendations in the 2012 report (Kanouse and Brewster 2013), we sampled stream sediment for cadmium, copper, lead, mercury, selenium, silver, and zinc, and found that copper and zinc were predominant at all three sites. Concentrations of all analytes were lowest at Site 9. We also investigated relationships between dissolved arsenic, cadmium, copper, lead, mercury, and zinc and periphyton biomass and benthic macroinvertebrate density and will continue to update the data set each year.

Among 2013 water, sediment, and whole body juvenile fish data collected at each site, cadmium, copper, and lead concentrations were greatest in sediment samples, and zinc concentrations were greatest in fish samples. Concentrations of all analytes were lowest in water samples.

INTRODUCTION

Greens Creek Mine is located near Hawk Inlet on the west side of Admiralty Island in southeast Alaska, about 29 km west of Juneau within the Tongass National Forest and the Admiralty Island National Monument. The mine has operated since 1989, except between 1993 and 1996 when the mine was temporarily closed, and produces export concentrates of gold, lead, silver, and zinc. Tailings are disposed at the dry-stack tailings disposal facility (TDF) near the headwaters of Tributary Creek, and mine facilities and production rock storage areas are adjacent to Greens Creek. Hecla Greens Creek Mining Company (Hecla) has owned and operated the mine since April 2008.

The aquatic biomonitoring program is included in the mine's Plan of Operations Fresh Water Monitoring Program (FWMP), required by the USFS and the ADEC. Reports summarizing previous biomonitoring work are available in Weber Scannell and Paustian (2002), Jacobs et al. (2003), Durst and Townsend (2004), Durst et al. (2005), and Durst and Jacobs (2006–2010), Kanouse (2011–2012), and Kanouse and Brewster (2013).

PURPOSE

The purpose of the Greens Creek Mine biomonitoring program is to document the condition of aquatic biological communities in Greens Creek and Tributary Creek downstream of mine development and operations. This report summarizes our 2013 aquatic study data.

2013 AQUATIC STUDIES

In 2013, we studied the following:[a]

- periphyton biomass and chlorophyll-type;
- benthic macroinvertebrate density and community composition;
- juvenile fish populations and fish condition;
- whole body juvenile Dolly Varden char concentrations of silver (Ag), cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), selenium (Se), and zinc (Zn); and
- stream sediment Ag, Cd, Cu, Hg, Pb, Se, and Zn concentrations.

STUDY AREA

In 2013, we completed aquatic studies at three sample sites (Figures 1–2):

1. Greens Creek Site 48, reference site upstream of mine activities;
2. Greens Creek Site 54, downstream of mine activities; and
3. Tributary Creek Site 9, downstream of the TDF.

We sampled sites 48, 54, and 9 annually since 2001. A fourth sample site, Greens Creek Site 6 located about 0.4 km upstream of Site 54, is sampled once every five years (2001, 2006, and 2011).[b] Hecla Environmental staff sample ambient water quality at Greens Creek sites 48 and 54 and Tributary Creek Site 9, and report results in their annual report.

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[a] Juvenile fish condition and stream sediment sampling are not required in the current FWMP (KGCMC 2000). Hecla is working to update their FWMP in 2014.

[b] Site 6 data are summarized in the 2011 technical report (Kanouse 2012).

Figure 1.–Map of Greens Creek aquatic biomonitoring sample sites 54, 6, and 48, and mine facilities.

Figure 2.–Map of Tributary Creek aquatic biomonitoring sample Site 9 and mine facilities.

Greens Creek

The Greens Creek watershed is about 22.3 km^2 (USGS 2014) and the main channel measures about 16 km long from the alpine headwaters to the mouth at tidewater. At each sample site, gradients range from 2% to 4%, cobble is the dominant substrate, and large woody debris is common. The creek is largely fed by snowmelt and other drainages, and the magnitude of peak discharge in early summer depends on snowpack depth. During the 2013 water year, USGS Gage 15101490 (USGS 2014) recorded mean daily peak snowmelt discharges early May through late June up to 209 ft^3/s. Rainfall events during the fall also cause peak discharges.

Greens Creek Site 48

Site 48 is located upstream of all mine activities, except exploratory drilling, near 265 m elevation and about 0.8 km upstream of the mine portal (Figure 3). Reference data collected at Site 48 are compared to data collected downstream at Site 54. Resident Dolly Varden char *Salvelinus malma* is the only fish species we have documented at Site 48; the infiltration gallery concrete weir near the mine portal blocks upstream fish passage. Periphyton and benthic macroinvertebrate sampling occurs in riffle habitats downstream of the fish sample reach.

Figure 3.–Greens Creek Site 48 middle of fish sample reach, 2013.

Greens Creek Site 54

Site 54 is located downstream of the Bruin Creek confluence and adjacent to waste rock storage Site 23, near 225 m elevation and about 1.8 km downstream of the mine portal (Figure 4). Data collected at Site 54 are compared to data collected at reference Site 48, and monitored to detect potential changes from waste rock storage areas, treatment ponds, and mine and mill facilities further upstream. We have documented coho salmon, Dolly Varden char, and cutthroat trout *O. clarkii* at this site. Anadromous fish access this site via the fish pass near river km 5.6, though only partial fish passage has been available since 2005.[c] Periphyton and benthic macroinvertebrate sampling occurs in riffle habitats upstream of the fish sample reach. Gallagher Creek enters Greens Creek within the fish sample reach.

Figure 4.–Greens Creek Site 54 downstream end of fish sample reach, 2013.

[c] In 1989, Greens Creek Mining Company installed an engineered fish pass as mitigation for impacts to Tributary Creek from the approved dry-stack TDF. Three timber and concrete weirs provided step pools for adult coho salmon passage upstream through a natural bedrock chute that prevents fish migration. In November 2005, flood flows damaged the fish pass during a heavy rainstorm when discharge measured up to 272 ft^3/s; discharge during November generally ranges 20–60 ft^3/s, and annual peak snowmelt discharge is usually < 200 ft^3/s (USGS 2007).

Tributary Creek

The Tributary Creek watershed is about 2 km^2 (USDA Forest Service 2003) and the main channel measures about 1.6 km between the wetland headwaters and the stream mouth confluence at Zinc Creek. The TDF occupies the original headwaters of the creek. Tributary Creek is a low-energy, lowland stream fed by groundwater, precipitation, and a few small hillside drainages. Stream gradient varies from 1% to 2%, organics and sand are the dominant substrates with gravel present near the mouth, and large and small woody debris are common. Tributary Creek provides habitat for pink salmon *O. gorbuscha*, chum salmon *O. keta*, coho salmon, cutthroat trout, rainbow trout *O. mykiss*, Dolly Varden char, and sculpin *Cottus* sp. Discharge estimates based on field measurements and limited gage data suggest annual stream flows range 1–5 ft^3/s (USDA Forest Service 2003).

Tributary Creek Site 9

Site 9 is located 1.2 km downstream of the TDF at about 25 m elevation, and monitored to detect potential changes from the TDF (Figure 5). We have documented coho salmon, Dolly Varden char, cutthroat and rainbow trout, and sculpin at this site. Periphyton and benthic macroinvertebrate sampling occurs within the fish sample reach after the juvenile fish population study is complete.

Figure 5.–Tributary Creek Site 9 middle of fish sample reach, 2013.

METHODS

Deviations to the methods described are specified in footnotes listed in the *Results* section. In addition to the sample methods described in this section, at each site we also measured water depth and velocities of benthic macroinvertebrate sample sites, and flow across each site to estimate discharge.

DATA ANALYSES

We performed data analyses using Statistix® 9 (Analytical Software. 2008. Statistix 9 User's Manual. Analytical Software, Tallahassee, Florida, http://www.statistix.com/features.html).

We used the Kruskal-Wallis One-Way Analysis of Variance by ranks test, a nonparametric alternative to a one-way analysis of variance, to test for equality of population medians between years and sites (Neter et al. 1990) for the periphyton and juvenile fish whole body metals data. We used all-pairwise comparisons on the mean ranks for each group to test for homogeneity between years and sites. We used nonparametric tests because these tests are robust when the distributions of parameters being estimated differ greatly from a Normal probability distribution. For data comparisons of whole body metals and nonmetals concentrations, we used the laboratory minimum reporting limit for results reported as not detected. Significant differences are reported when $p \leq 0.05$.

We occasionally review the long-term dataset to ensure accuracy, and report corrections in the document and appendices. The most recent technical report presents the current dataset and should be used to analyze the data from previous years. In this report, we corrected periphyton data errors for the years 2002–2007 and sites 48, 54, and 9, and corrected the estimated detection limits for chlorophyll *a* sample densities previously reported as not detected, for all years.

WATER QUALITY

Hecla personnel used field meters to characterize basic water quality at each site during sampling, including temperature, pH, and conductivity. The 2013 results for each site are included in this report.

PERIPHYTON BIOMASS AND COMMUNITY COMPOSITION

Requirement FWMP 6.8

Periphyton are primary producers and include algae, cyanobacteria, and heterotrophic microbes attached to the submerged surfaces of aquatic ecosystems. These organisms have short life cycles (e.g., 1 mo) and monitoring active biomass provides information on recent water quality (Barbour et al. 1999). Periphyton produce a variety of chlorophyll pigments that we use to evaluate community composition. Chlorophyll *a* is produced by all plants, while chlorophylls *b* and *c* provide information on the types of organisms present.

The FWMP requires we measure chlorophyll *a* density to estimate active algal biomass, and monitor biomass and proportions of accessory pigments, chlorophylls *b* and *c*, to detect change in biomass and community composition over time. We compare Greens Creek Site 48 reference data to Greens Creek Site 54 data, and track change overtime at all sample sites. There are no reference data to compare Tributary Creek Site 9 data.

Sample Collection and Analysis

We attempt to sample periphyton at low flow and not within three weeks after a high-flow event, which can scour the substrate and reduce biomass. We collected 10 smooth, flat, undisturbed, perennially wetted rocks in riffle habitats in < 0.45 m water depth using the collection methods described in Ott et al. (2010). We placed a 5×5 cm square of high-density foam on each rock and scrubbed the area around the foam with a toothbrush to remove attached algae outside the covered area. We rinsed the rock by dipping it with foam intact in the stream.

We removed the foam square and scrubbed the sample area with a rinsed toothbrush over a 1 µm, 0.47 mm glass fiber filter attached to a vacuum pump. We used stream water in a wash bottle and rinsed the loosened periphyton from the rock, the toothbrush, and the inside of the vacuum pump onto the filter. We pumped most of the water through the filter then added a few drops[d] of saturated magnesium carbonate ($MgCO_3$) to the filter to prevent acidification and conversion of chlorophyll to phaeophyton, before we pumped the sample dry. We removed the glass fiber filter, folded it in half with the sample on the inside, and wrapped it in a large paper 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 gel packs in the field, and in a camp freezer while onsite. Once we returned to the office, we locked the samples in a –20°C freezer until we processed them in our laboratory.

We followed U.S. Environmental Protection Agency (1997) protocol for chlorophyll extraction and measurement, and instrument detection limit and error.[e] We removed the samples from the freezer, cut them into small pieces, and transferred the filter pieces for each sample into centrifuge tubes containing 10 ml of 90% buffered acetone. We capped the centrifuge tubes, placed them in a rack, covered them with aluminum foil, and stored them in a refrigerator for < 24 h to extract the chlorophyll. We centrifuged the samples for 20 min at 1,600 rpm and read them on a Shimadzu UV-1800 Spectrophotometer at optical densities (OD) 664 nm, OD 647 nm, and OD 630 nm, and used an acetone blank to correct for the solvent. We also read the samples at OD 750 nm to correct for turbidity. We treated the samples with 80 µl of 0.1 N hydrochloric acid to convert the chlorophyll to phaeophytin, and read each sample again at OD 665 nm and OD 750 nm.

Data Presentation

We include a figure of Greens Creek annual mean daily discharge three weeks prior to field sampling; discharge data is not available for Tributary Creek.

For each sample site, we present a figure of annual mean chlorophyll *a* density (mg/m^2) ± one standard deviation, excluding potential outliers. A star (∗) in the figure represents a possible outlier, where chlorophyll *a* density in the sample exceeded the mean for the typical range of data that year by more than three times. We also present a figure of annual mean proportions of chlorophylls *a*, *b* and *c*. We include possible outlier values in the annual mean calculation, statistical analyses, and the raw data set (Appendix A).

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[d] This measurement is not exact as the amount of water used to saturate the magnesium carbonate is not exact and fixes the sample regardless of the concentration and without affecting data integrity.

[e] Except, we stored our samples longer than 3.5 weeks and we cut our filters rather than homogenized them due to risk of acetone exposure (Ott et al. 2010).

We compare annual periphyton density data and chlorophyll proportions among Greens Creek sites 48 and 54 in *Comparison Among Greens Creek Sites*. We do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity.

BENTHIC MACROINVERTEBRATE DENSITY AND COMMUNITY COMPOSITION

Requirement FWMP 6.9

Benthic macroinvertebrates classified in the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT taxa, have limited mobility, complex and short life cycles (e.g., 1 yr), and most genera are sensitive to changes in water quality (Barbour et al. 1999). The FWMP requires we estimate benthic macroinvertebrate density and evaluate community composition at each site each year and over time. We compare among Greens Creek sites 48 and 54 data and track changes in the data at all sites over time. There are no reference data to compare Tributary Creek Site 9 data.

Sample Collection and Analysis

We collected five benthic macroinvertebrate samples from each site using a Hess sampler in riffles with different velocities, habitat with the greatest taxonomic density and richness (Barbour et al. 1999). We do not sample other habitat types (e.g., pools) to reduce variability.

The Hess stream bottom sampler has a 0.086 m^2 sample area and a 363 μm mesh net and cod end. After we pushed the sampler into the stream bottom, we used a brush and scrubbed rocks within the sample area and disturbed gravels, sand, and silt to about 10 cm depth to dislodge macroinvertebrates into the net. We transferred each sample from the cod end of the sampler to a prelabeled 500 mL plastic bottle and preserved the samples with minimum 70% denatured ethanol. After we returned to the office, we added ethanol to each bottle to achieve a three parts ethanol to one part sample preservation ratio, and shipped the samples to a NRF Taxanomic Services in Fairbanks, Alaska, for sorting and taxonomic identification to the lowest practical level.[f] For quality assurance and control, a Habitat Biologist identified, counted, and compared numbers of insects in two random samples (>10% of samples collected in 2013).

We calculate benthic macroinvertebrate density in each sample by dividing the number of aquatic insects by 0.086 m^2, the Hess sample area. We estimate annual benthic macroinvertebrate density for each site by calculating the mean number of insects per m^2 amongst the five samples. We report richness as the total number of taxa observed among the five samples.

Data Presentation

We include a figure of annual mean benthic macroinvertebrate density ± one standard deviation with taxa richness, and a figure illustrating percent community composition, for each site. Annual data summaries are included in Appendix B.

[f] EPT and Diptera insects to genus, except nonbiting midges to family Chironomidae; all other insects are usually identified to phylum, order, or class level.

We compare annual benthic macroinvertebrate density and taxa richness data among Greens Creek sites 48 and 54 in *Comparison Among Greens Creek Sites*. We do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity.

JUVENILE FISH POPULATIONS

Requirement FWMP 6.10

The FWMP requires estimating annual juvenile fish populations by species at each site to monitor changes in populations over time. Juvenile fish populations are influenced by many natural factors (e.g., stream flow and available rearing fish habitat) that affect study results each year. We sample populations during late July, as the FWMP requires, when Greens Creek discharge has been stable for several weeks to reduce the variability of natural conditions. Valid population estimates are subject to our ability to satisfy assumptions of the study design each year, and comparison of population estimates at each site and among Greens Creek sites 48 and 54 overtime relies on similar variability across years.

Sample Collection and Analysis

We sampled 50 m reaches[g] isolated by natural features, such as shallow riffles and debris jams, with 6.35 mm (0.25 in) minnow traps baited with whirl packs containing disinfected salmon roe (Magnus et al. 2006). To improve sample reach isolation, prior to each study we opportunistically set several baited minnow traps within 15 m of the upstream and downstream sample reach boundaries to capture potential migrants.[h] The minnow traps remained undisturbed during the study, and upon completion we recorded fish captures by species and released fish at capture sites. Fish captured in these traps were not included in the population estimates.

We sampled juvenile fish populations using a modification[i] of a depletion method described by Bryant (2000). We saturated the sample reach with baited minnow traps set opportunistically in all habitat types where water depth and flow allowed, and moved away from the sample site to avoid disturbing fish while the traps soaked for 1.5 h. We retrieved each trap, transferred captured fish into plastic buckets, removed the spent bait, rebaited the trap, and reset each trap in the same location, as quickly as possible. We allowed the trap to soak another 1.5 h, then completed the sequence a third time.

Between trapping events, we processed captured fish. Biologists anesthetized fish in an aerated bucket with clove oil,[j] measured and recorded FL to the nearest 1 mm, weight to the nearest 0.1 g, and species (Pollard et al. 1997). We retained captured fish in perforated plastic buckets

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[g] We have never used a 100 m fish sample reach at any sample site as the FWMP specifies. A 28 m reach was sampled at Greens Creek Site 54 2001–2010.

[h] Greens Creek discharge is usually too high to efficiently and effectively isolate sample reaches with a 6.35 mm (0.25 in) mesh net. Though a mesh net could effectively isolate the Tributary Creek Site 9 sample reach, we also used baited minnow traps for consistency.

[i] We sampled shorter reaches, used more minnow traps, and completed three passes instead of four.

[j] Clove oil prepared as recommended by Anderson et al. (1997). In 2014, we may use AQUI-S® 20E (10% eugenol) to anesthetize fish.

secured in the stream during the sample event, and returned captured fish[k] to the sample reach after all three passes were complete.

We collected data to meet the assumptions of closure and equal probability of capture (Lockwood and Schneider 2000) during all three sampling events by ensuring the following:

- Fish emigration and immigration during the sampling period was negligible.
    - Sample reaches were isolated by natural stream features, and we used block traps to capture potential migrants.
- All fish were equally vulnerable to capture during a pass.
    - Baited minnow traps were set in all habitat types where water depth and flow allowed.
- Fish did not become more wary of capture with each pass.
    - Trap numbers and placement remained constant during all three capture events.
    - Field crew completed all three capture events as quickly possible.
    - Field crew moved away from sample reaches so fish were not disturbed while the traps soaked each 1.5 h capture event.
- Collection effort and conditions which affect collection efficiency remained constant.
    - Field crew divides among the upstream and downstream boundaries to set, retrieve, and replace traps as quickly as possible.
    - Data recorder notes time between capture events in data sheets.
    - Field crew replaced the spent bait with fresh bait and reset each trap in the same location.

We estimated resident fish populations using the multiple-pass depletion method developed by Lockwood and Schneider (2000), based on methods developed by Carle and Strub (1978). The repetitive method produces a maximum likelihood estimate (MLE) of fish with a 95% confidence interval.

Let X represent an intermediate sum statistic where the total number of passes, k, is reduced by the pass number, i, and multiplied by the number of fish caught in the pass, C_i, for each pass,

$$X = \sum_{i=1}^{k} (k - i) C_i$$

Let T represent the total number of fish captured in the minnow traps for all passes. Let n represent the predicted population of fish, using T as the initial value tested. Using X, the MLE,

[k] Except we retained six fish for whole body metals concentrations at each sample site.

N, is calculated by repeated estimations of *n*. The MLE is the smallest integer value of *n* greater than or equal to *T* which satisfies[1] the following:

$$\left[\frac{n+1}{n-T+1}\right]\prod_{i=1}^{k}\left[\frac{kn-X-T+1+(k-i)}{kn-X+2+(k-i)}\right]^{i} \leq 1.000$$

The probability of capture, *p*, is given by the total number of fish captured, divided by an equation where the number of passes is multiplied by the MLE and subtracted by the intermediate statistic, *X*,

$$p = \frac{T}{kN-X}$$

The variance of *N*, a measure of variability from the mean, is given by,

$$\frac{N(N-T)T}{T^2 - N(N-T)\left[\frac{(kp)^2}{(1-p)}\right]}$$

We determined the standard error (SE) of *N* by calculating the square root of the variance of *N*, and the 95% confidence interval for the MLE using: $\pm$ 2(SE). Small 95% confidence intervals result when fewer captures steadily occur with each pass; large confidence intervals result when captures do not steadily decrease or when the number of fish captured on the second or third pass exceed the number of fish captured on the previous pass. In addition, a MLE cannot be generated from samples from small populations if few fish are captured during the three sample events; in these cases, we present the number of fish captured as the result and do not include a MLE.

Calculating a MLE using three-pass depletion data relies heavily on equal capture probability among passes (Bryant 2000, Carle and Strub 1978, Lockwood and Schneider 2000). To evaluate equal capture probability, we use the goodness of fit test in White et al. (1982), recommended by Lockwood and Schneider (2000), which follows the χ^2 test form. If the goodness of fit test indicates we did not achieve equal capture probability, the MLE will be biased low. We first calculate expected numbers of fish captured for each pass ($C_1, C_{2.}, C_3$) using variables previously described:

$$E(C_1) = N(1-p)^{i-1}p$$

Then we calculate χ^2,

$$\chi^2 = \frac{[\mathrm{C_1} - \mathrm{E(C_1)}]^2}{\mathrm{E(C_1)}} + \frac{[\mathrm{C_2} - \mathrm{E(C_2)}]^2}{\mathrm{E(C_2)}} + \frac{[\mathrm{C_3} - \mathrm{E(C_3)}]^2}{\mathrm{E(C_3)}}$$

[1] Lockwood and Schneider (2000) suggest the result should be rounded to one decimal place (1.0). We use three decimal places (1.000), which is an option in Carle and Strub (1978).

Data Presentation

We present a figure illustrating annual juvenile fish population estimates by species for each sample site. We also present a comparison of Greens Creek sites 48 and 54 population estimates over time in *Comparison Among Greens Creek Sites.* We do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity. Capture data summaries and length frequencies of captured fish from each site and each year are included in Appendix C.

JUVENILE FISH CONDITION

We used juvenile fish population capture length and weight data to calculate Fulton's condition factor (*K*), an index of fish health. Age, sex, season, maturation, diet, gut fullness, fat reserve, and muscular development affect fish condition. This study is not required in the FWMP; 2012 was the first year we recorded juvenile fish weight to evaluate fish condition.

Sample Collection and Analysis

We weighed fish captured in our juvenile fish population surveys to the nearest 0.1 g and measured FL to the nearest 1 mm. We used this data to calculate Fulton's condition factor (*K*) using the equation given in Anderson and Neumann (1996) where the weight (g) of each fish is divided by the cubed length (mm) of the fish (*L*), and the product multiplied by 100,000,

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

Data Presentation

We present mean fish condition by species for each site, and compare fish condition among Greens Creek sites 48 and 54 in *Comparison Among Greens Creek Sites.*

JUVENILE FISH METALS CONCENTRATIONS

Requirement FWMP 6.11

The FWMP requires we sample six juvenile Dolly Varden char within the size class 85–125 mm for whole body concentrations of Ag, Cd, Cu, Pb, Se, and Zn at each site, each year.[m] This sample size is used for aquatic studies at other mines in Alaska and provides information without being cost prohibitive. 85 mm FL is the minimum amount of tissue (about 5 g) required for the laboratory to conduct the analyses; the maximum size of 125 mm FL improves the likelihood of sampling less than 3-year-old resident fish at sites 54 and 9 where anadromous Dolly Varden char may be present. We evaluate data for each site over time and compare data among all three sites each year.

Sample Collection and Analysis

We captured fish during the juvenile fish population survey, individually packed the samples in clean, prelabeled plastic bags, and measured fish FL to 1 mm. We stored the samples in a cooler containing gel ice packs, then in a camp freezer until we returned to our laboratory and weighed each fish in the sealed bags, correcting for bag weight. We froze the samples at –20 °C in our

[m] In addition, we began testing for total Hg in 2012.

locked laboratory freezer until we shipped them to ALS Environmental in Kelso, Washington, where they were individually digested, dried, and analyzed for Ag, Cd, Cu, Hg, Pb, Se, and Zn on a dry weight basis.

We maintained written chain of custody documentation for the samples. The analytical laboratory provided Tier II quality assurance/quality control validation information for each analyte including matrix spikes, standard reference materials, laboratory calibration data, sample blanks and duplicates.

Data Presentation

We present a figure illustrating maximum, median, and minimum whole body concentrations for each analyte, each site. In the figures, the dashed lines represent the laboratory minimum reporting limit. Raw data and the current year laboratory report are included in Appendix D. We also compare data among sample sites in *Comparison Among Sites.*

SEDIMENT METALS CONCENTRATIONS

Per our recommendations in the 2012 report (Kanouse and Brewster 2013), we sampled fine (< 2 mm) sediment at each site to investigate relationships between sediment, water, and whole body fish concentrations of Ag, Cd, Cu, Hg, Pb, Se, and Zn. This study is not required in the FWMP. Sediment metals concentrations are influenced by a variety of factors, such as sediment grain size, organic content, and minerals.

Sample Collection and Analysis

We collected sediment opportunistically in areas with fine sediment deposition, usually along the perimeter of the stream and in eddies. We collected the top 4 cm of sediment and retained the sediment that passed through a 1.7 mm sieve in a new, clean plastic bucket, and transferred the sediment sample to a 100 mL glass jar the laboratory provided. Between sites, we rinsed our equipment in stream water. We stored the samples in coolers on ice during transport between the mine and our laboratory, then in a refrigerator until we shipped the samples on ice to AECOM Environmental Toxicology in Fort Collins, Colorado for analyses.

Data Presentation

We present sediment metals and Se concentrations in a figure for each sample site. In *Comparison Among Sites,* we present a table summarizing the data for all sites, and figures comparing water, sediment, and whole body juvenile Dolly Varden char Cd, Cu, Pb, and Zn concentrations. The laboratory report is included in Appendix E.

RESULTS AND DISCUSSION

Within three weeks prior to sampling Greens Creek, mean daily discharges in 2013 were generally less than the means of the last 23 years (Figure 6), and the range of discharges that occurred were similar to ranges observed in previous years (Figure 7). During this period, scour and bedload movement were unlikely to affect periphyton, benthic macroinvertebrate, or juvenile fish densities, though increasing stream flow during sampling at Greens Creek Site 48 may have affected sample results—described in *Greens Creek Site 48*. The USDA Natural Resources Conservation Service (2013) Alaska snow pack map suggests the remaining snowpack near Greens Creek mine and throughout southeast Alaska on May 1, 2013 was greater than 150% of the 30-year average (1981–2010); peak snowmelt occurred in Greens Creek between May 10 and June 21, 2013, according to USGS Gage 15101490 (USGS 2014).

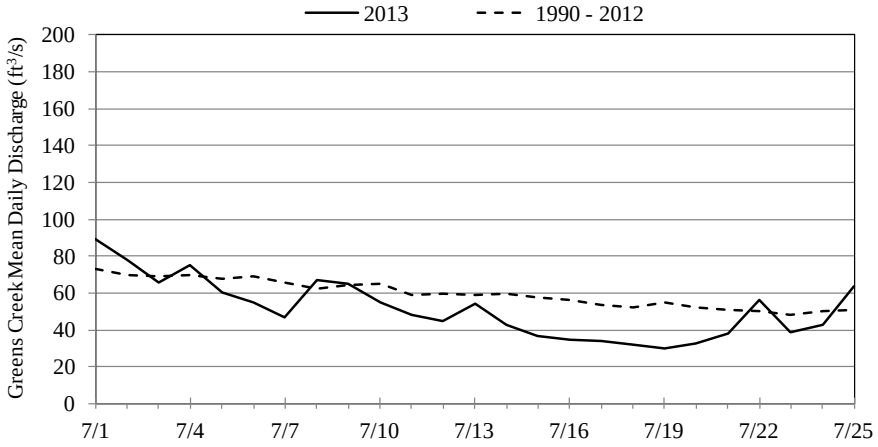

Figure 6.–Greens Creek mean daily discharges (ft^3/s) three weeks prior to sampling in 2013, and mean daily discharges, 1990–2012. *Source*: USGS Gage 15101490 (USGS 2014).

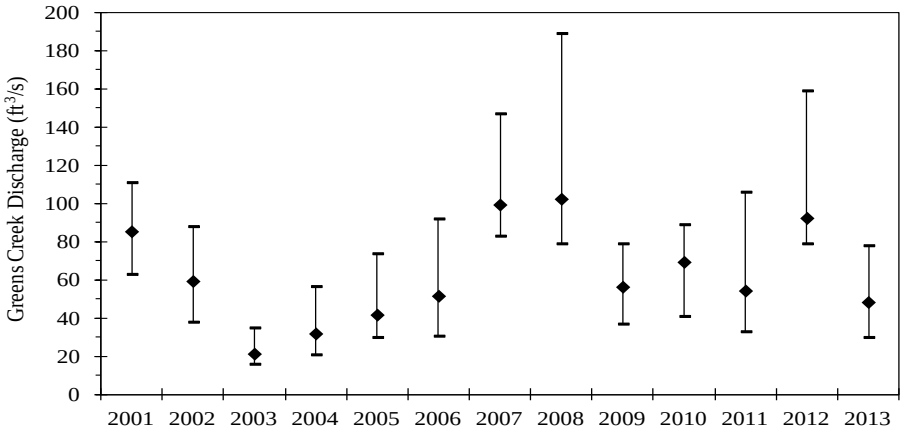

Figure 7.–Greens Creek (USGS Gage 15101490) range of mean daily discharges (ft^3/s), and the median value (♦), three weeks prior to sampling, 2001–2013. *Source*: USGS Gage 15101490 (USGS 2014).

GREENS CREEK SITE 48

We sampled Greens Creek Site 48 on July 25, 2013. Hecla personnel recorded the following water quality measurements at 0845: water temperature 8.96 °C, conductivity 109 µS/cm, pH 7.98 units, and turbidity 3.3 nephelometric turbidity units (NTU). Using our flow survey data, we estimate discharge at the sample site was about 112 ft^3/s after sampling.

Heavy precipitation tripled stream discharge during sampling, which measured about 30 ft^3/s at 0900 and 93 ft^3/s at 1530 at the stream gage located 0.8 km downstream of the sample site. The increase in discharge may have affected our sample results: periphyton samples were clogged with fine sediment that reduced sampling efficiency and accuracy;[n] benthic macroinvertebrate sampling occurred after periphyton sampling when discharge was greater, which limited the number of suitable sample sites (Figure 8);[o] and several minnow traps were displaced or crushed during the third pass of our juvenile fish population study.

Figure 8.–Habitat Biologist Kate Kanouse sampling benthic macroinvertebrates at Greens Creek Site 48 during high flow, 2013.

[n] Fine sediment clogged sample filters and impaired vacuum pump function. While vacuum sample processing generally requires only a few minutes, most samples collected at Site 48 in 2013 required over an hour for this work, despite minimal water use. We attempted to use a bike tire pump to increase vacuum suction, which was ineffective as the suction broke the filters—causing sample loss. We were able to collect most samples following our methods, but decanted a few mL of the last two samples which may have resulted in partial sample loss. Detritus and other fine particles present may have also impaired sample processing.

[o] High stream flow in the main channel limited the number of sample sites that were perennially wetted. We collected one of the five benthic macroinvertebrate samples in an ephemerally wetted split channel where flow was dependent on greater discharge.

Periphyton Biomass and Composition

Mean periphyton biomass (3.57 mg/m^2) among samples collected in 2013 was similar to mean densities observed in previous years and greater than the lowest mean density observed in 2012 (Figure 9).[p] Mean proportions of chlorophylls *a*, *b*, and *c* densities were similar to previous years (Figure 10).

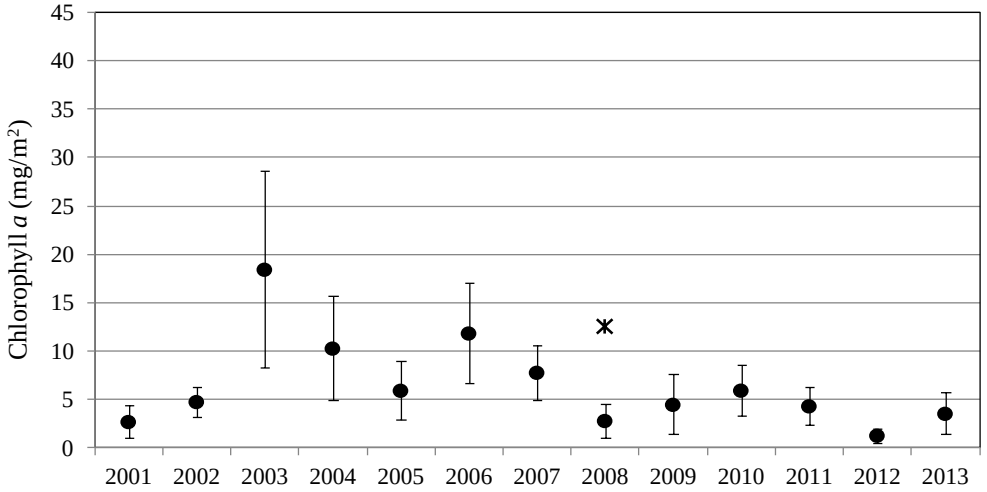

Figure 9.–Greens Creek Site 48 mean periphyton biomass ± one standard deviation, excluding potential outliers (∗), 2001–2013.

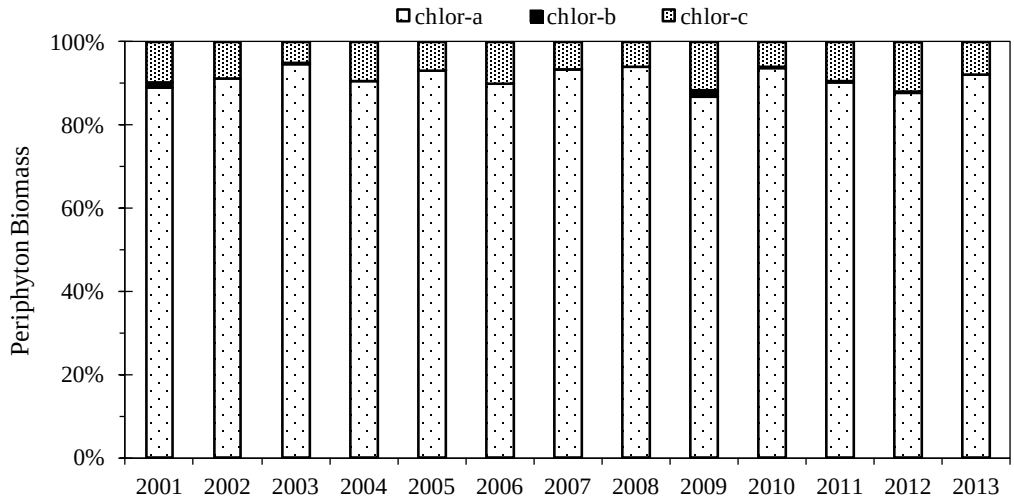

Figure 10.–Greens Creek Site 48 proportions of mean chlorophylls *a*, *b*, and *c* densities, 2001–2013.

[p] The mean rank of 2013 chlorophyll *a* sample densities was significantly ($p \leq 0.05$) less than the 2003 and 2006 mean ranks—years when biomass was greatest.

Benthic Macroinvertebrate Density and Community Composition

Mean benthic macroinvertebrate density among the 2013 Site 48 samples was 1,988 insects/m^2, similar to densities observed in previous years (Figure 11). We identified 20 taxa among the samples, the second lowest number observed since sampling began in 2001.

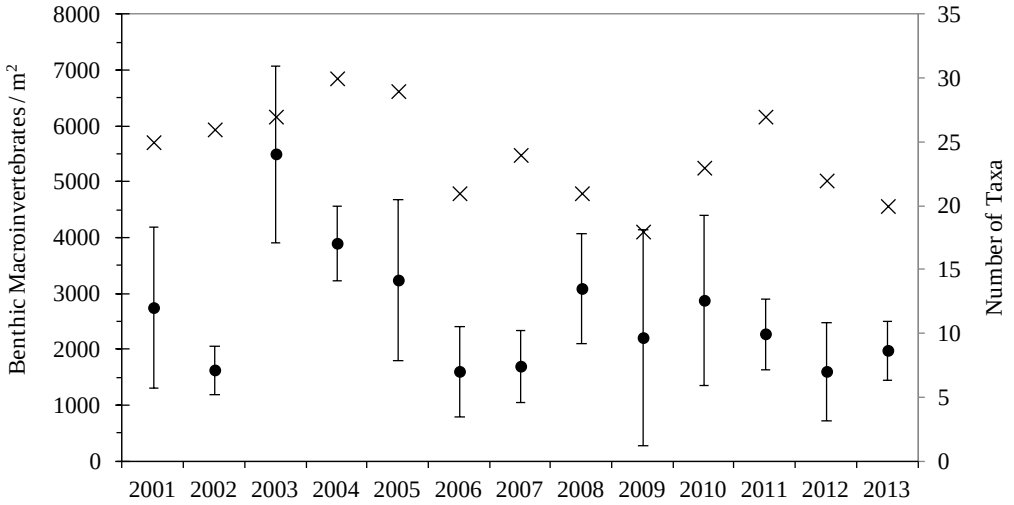

Figure 11.–Greens Creek Site 48 mean benthic macroinvertebrate density ± one standard deviation, and taxa richness (×), 2001–2013.

About 88% of the benthic macroinvertebrates collected at Site 48 in 2013 were EPT taxa, similar to sample results from previous years (Figure 12). Dominant taxa among samples were Ephemeroptera: *Cinygmula* (24%) and *Baetis* (21%).

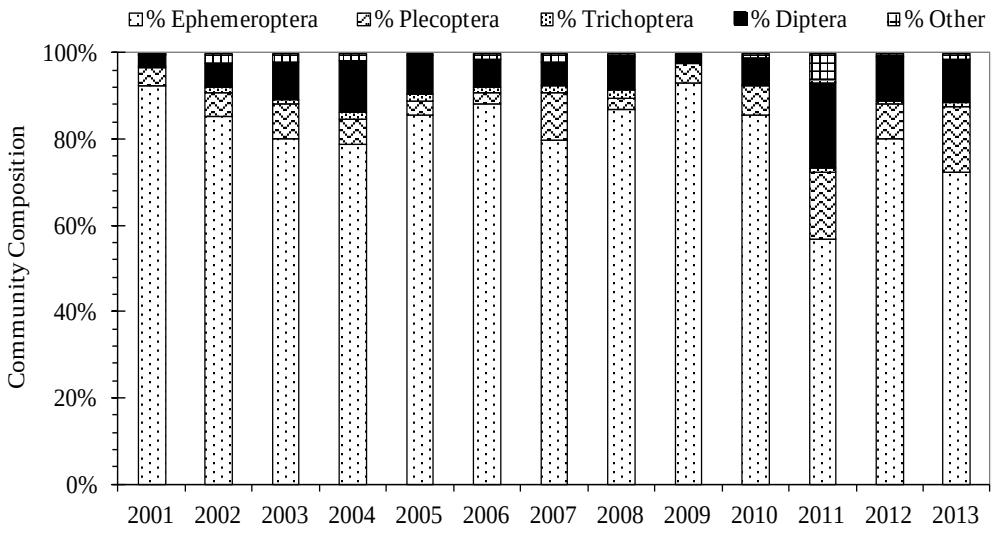

Figure 12.–Greens Creek Site 48 benthic macroinvertebrate community composition, 2001–2013.

Juvenile Fish Populations and Fish Condition

The 2013 Site 48 Dolly Varden char population estimate was 267 ± 11 fish, the second greatest population estimate since sampling began in 2001 (Figure 13). The population estimate is biased low as several minnow traps and block traps were displaced or crushed during the third pass due to increased stream flow and bedload movement.

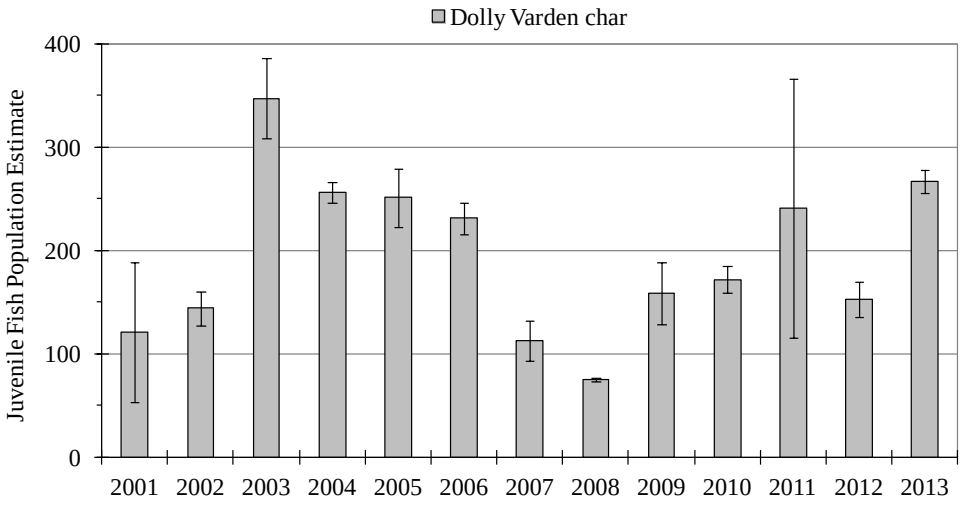

Figure 13.–Greens Creek Site 48 juvenile Dolly Varden char population estimates, 2001–2013.

A length frequency plot of Dolly Varden char captured at Site 48 in 2013 (Appendix C) suggests multiple age classes were present, as in most years, except in 2008 and 2012 when young-of-year were not captured. It is possible young-of-year Dolly Varden char escaped our 6.35 mm mesh minnow traps both years. Mean fish condition among the 253 Dolly Varden char we captured was 1.01 g/mm^3.

Juvenile Fish Metals Concentrations

The 2013 median concentrations of Hg and Se among whole body Dolly Varden char samples were the greatest we have observed (Figure 14). Median concentrations of Cd, Cu, and Pb were lower in the 2013 samples than in the 2012 samples, which were the greatest observed since sampling began in 2001, and median Zn concentration was greater than most years.

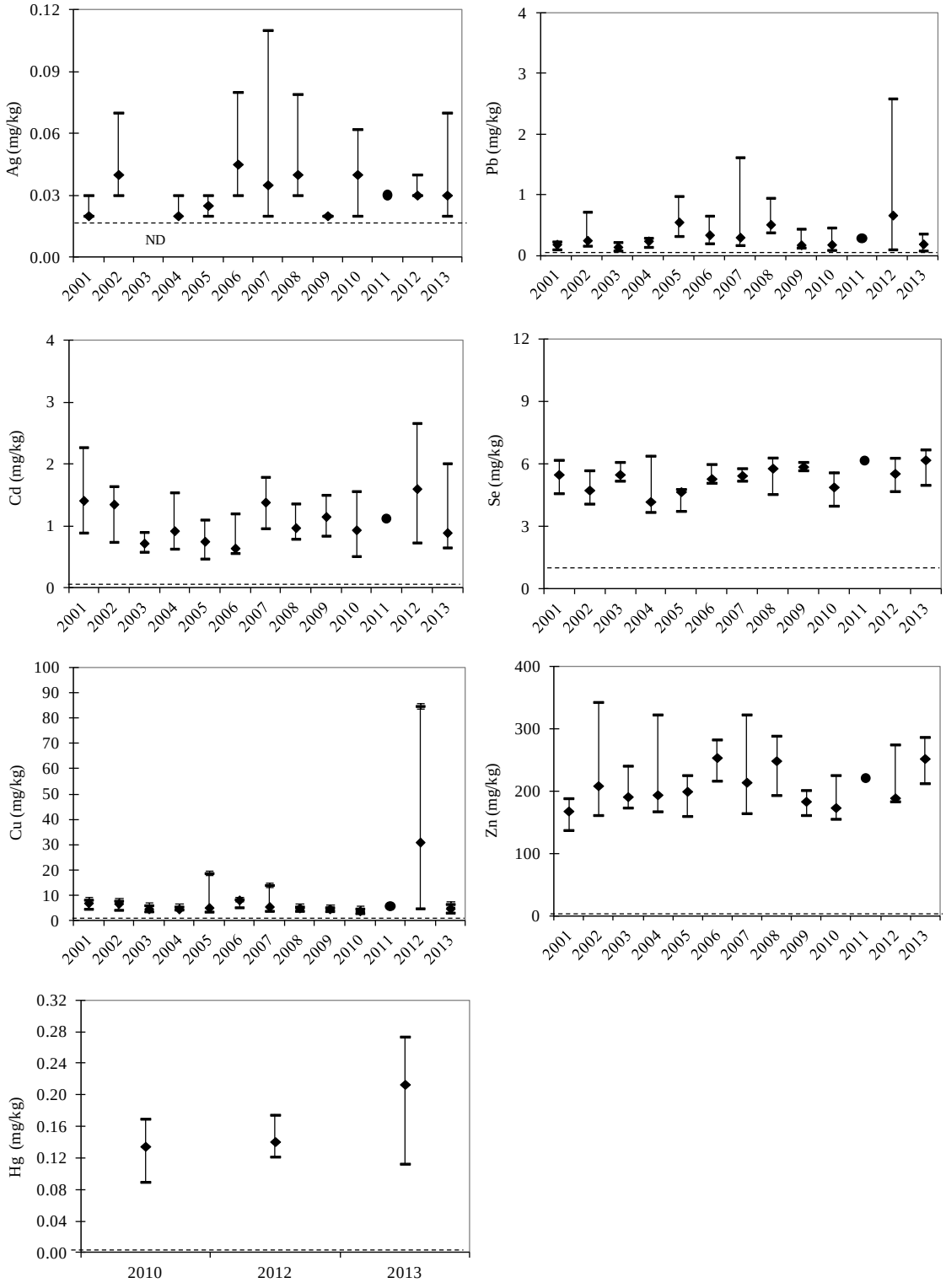

Figure 14.–Greens Creek Site 48 whole body Dolly Varden char maximum, median, and minimum concentrations (mg/kg) of Ag, Cd, Cu, Hg, Pb, Se, and Zn, 2001–2013.

Sediment Metals Concentrations

Concentrations of Ag, Cd, Cu, Hg, Pb, Se, and Zn in the Site 48 sediment sample are illustrated in Figure 15. The predominant metals were Cu and Zn, which made up about 94% of the analytes. The sediment sample contained 90% sand and 1.99 µmoles/g acid volatile sulfide.

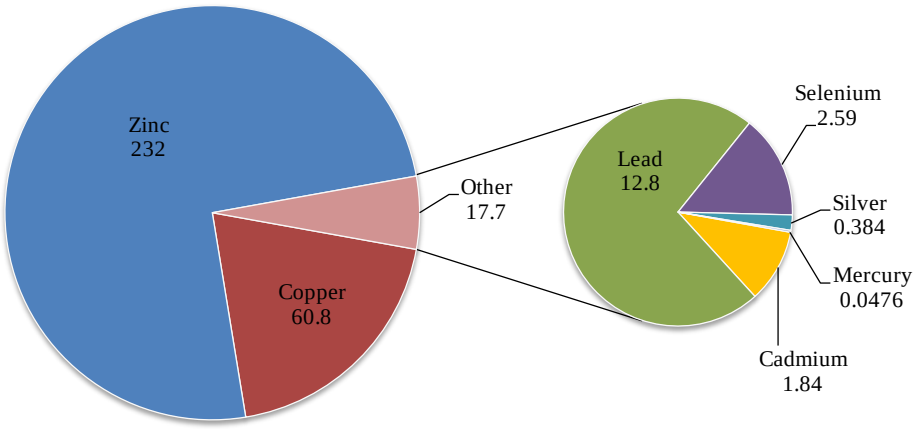

Figure 15.–Greens Creek Site 48 sediment metals and Se concentrations (mg/kg), 2013.

2013 Greens Creek Site 48 Summary

- Mean periphyton biomass was similar to means observed in previous years.
- Mean benthic macroinvertebrate abundance and %EPT were similar to those observed in previous years.
- The juvenile Dolly Varden char population estimate was the second largest observed.
- Median whole body juvenile fish Se and Hg concentrations were the greatest observed.
- Cu and Zn made up 94% of the seven analytes measured in stream sediment.

GREENS CREEK SITE 54

We sampled Greens Creek Site 54 on July 24, 2013. Hecla personnel recorded the following water quality measurements at 1045: water temperature 9.45°C, conductivity 125 µS/cm, pH 8.16 units, and turbidity 5.5 NTU. Using our flow survey data, we estimate discharge at the sample site was about 58 ft^3/s during sampling.

Periphyton Biomass and Community Composition

Mean periphyton biomass (2.12 mg/m^2) among samples collected in 2013 was similar to mean densities observed in previous years (Figure 16).[q] Mean proportions of chlorophylls *a*, *b*, and *c* densities were similar to previous years (Figure 17).

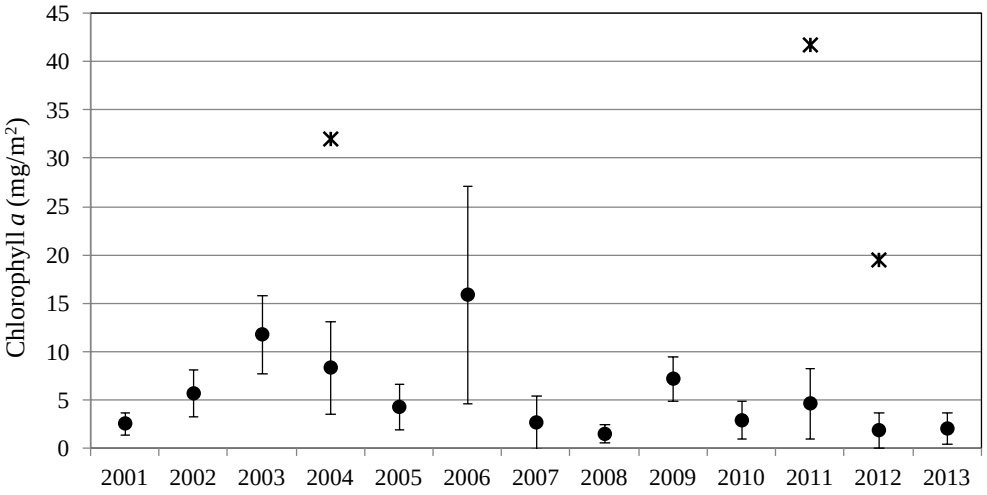

Figure 16.–Greens Creek Site 54 mean periphyton biomass ± one standard deviation, excluding potential outliers (∗), 2001–2013.

[q] The mean rank of 2013 chlorophyll *a* sample densities was significantly ($p \leq 0.05$) less than the 2003, 2004, and 2006 mean ranks—years when biomass was greatest.

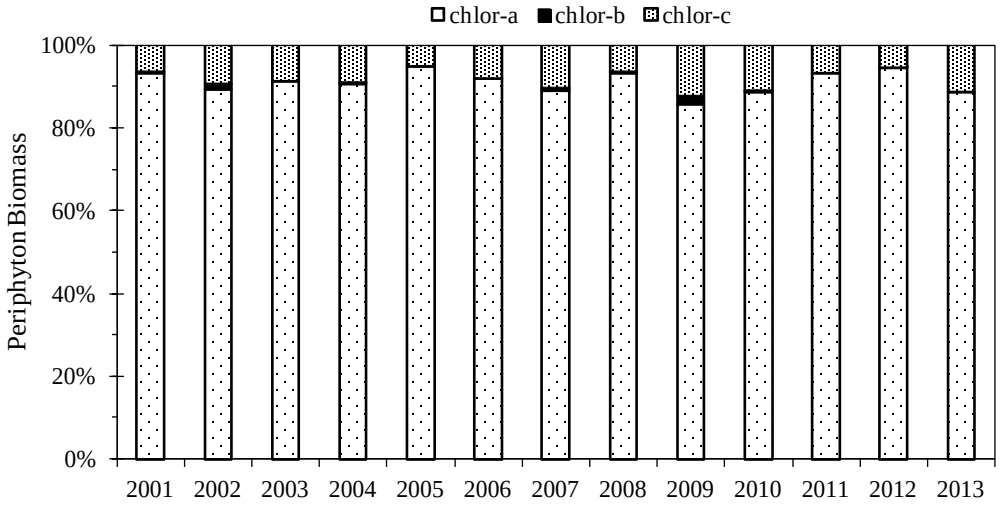

Figure 17.–Greens Creek Site 54 proportions of mean chlorophylls *a*, *b*, and *c* densities, 2001–2013.

Benthic Macroinvertebrate Density and Community Composition

Mean benthic macroinvertebrate density among the 2013 Site 54 samples was 1,014 insects/m^2, the lowest density observed since 2007 (Figure 18). We identified 19 taxa among the samples, also the lowest number observed since 2007.

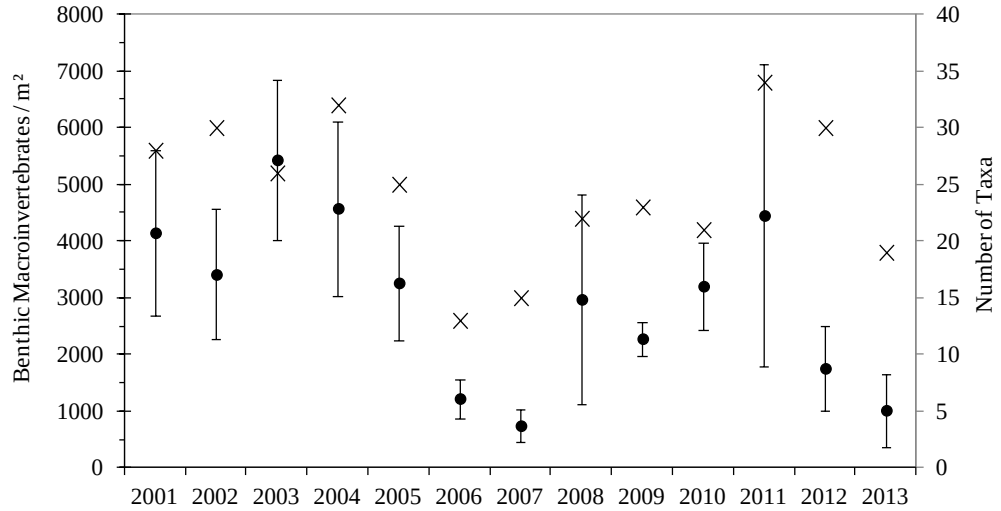

Figure 18.–Greens Creek Site 54 mean benthic macroinvertebrate density ± one standard deviation, and taxa richness (×), 2001–2013.

About 84% of benthic macroinvertebrates collected in 2013 were EPT taxa, the lowest percent observed since sampling began in 2001, yet still a large portion of the aquatic insect community (Figure 19). Numbers of Ephemeroptera (mayfly) insects were lower among the 2012 and 2013 samples compared to most previous years, similar to numbers observed in 2006 and 2007 when

densities and taxa richness were also low. Ephemeroptera: *Drunella* (28%) and *Baetis* (14%) were the dominant taxa among the 2013 samples.

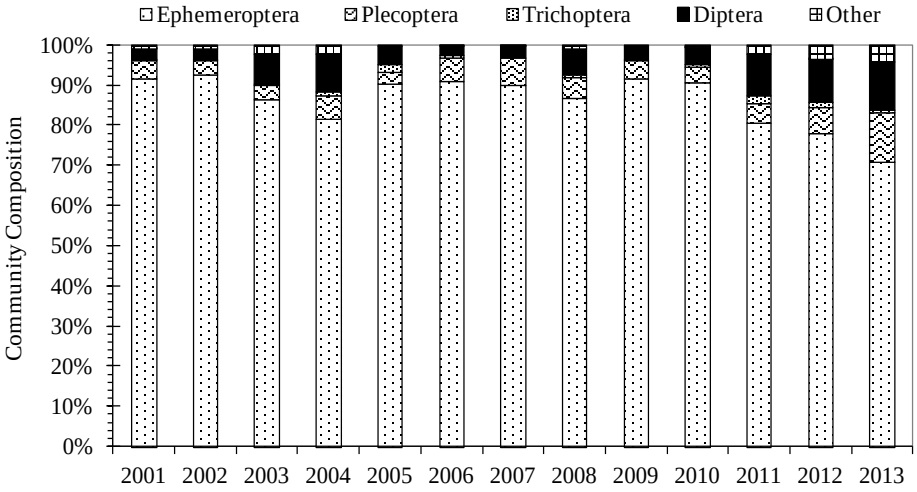

Figure 19.–Greens Creek Site 54 benthic macroinvertebrate community composition, 2001–2013.

Juvenile Fish Populations and Fish Condition

The 2013 Site 54 Dolly Varden char population estimate was 323 ± 17 fish, similar to population estimates for 2011–2012[r] (Figure 20). We did not catch juvenile coho salmon in 2013, and have not captured many juvenile coho salmon since 2005, when the fish pass was damaged during a heavy November rainstorm.

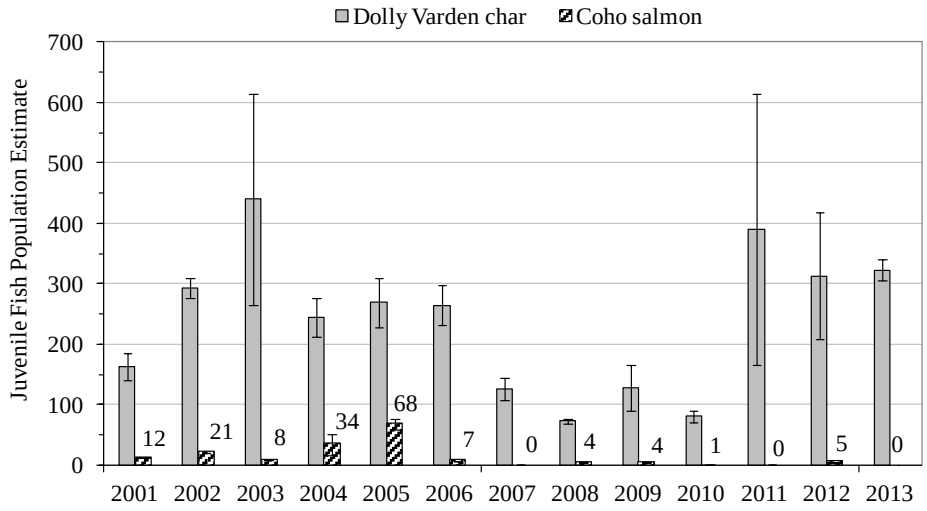

Figure 20.–Greens Creek Site 54 juvenile fish population estimates, 2001–2013.

Note: 2001–2010 data from 28 m sample reach, 2011–2013 data from 50 m sample reach.

[r] 2001–2010 data from a 28 m sample reach; 2011–2012 data from a 50 m sample reach.

A length frequency plot of Dolly Varden char captured at Site 54 in 2013 (Appendix C) suggests multiple age classes were present, as in previous years. Mean fish condition among the 297 Dolly Varden char we captured in 2013 was 1.06 g/mm^3.

Juvenile Fish Metals Concentrations

The 2013 median concentration of Zn among whole body Dolly Varden char samples was the greatest observed since sampling began in 2001 (Figure 21). Median concentrations of Cd and Cu were lower among the 2013 samples than the 2012 samples, which were the greatest observed since sampling began. Median concentrations of Ag, Pb, and Se were similar to previous years.

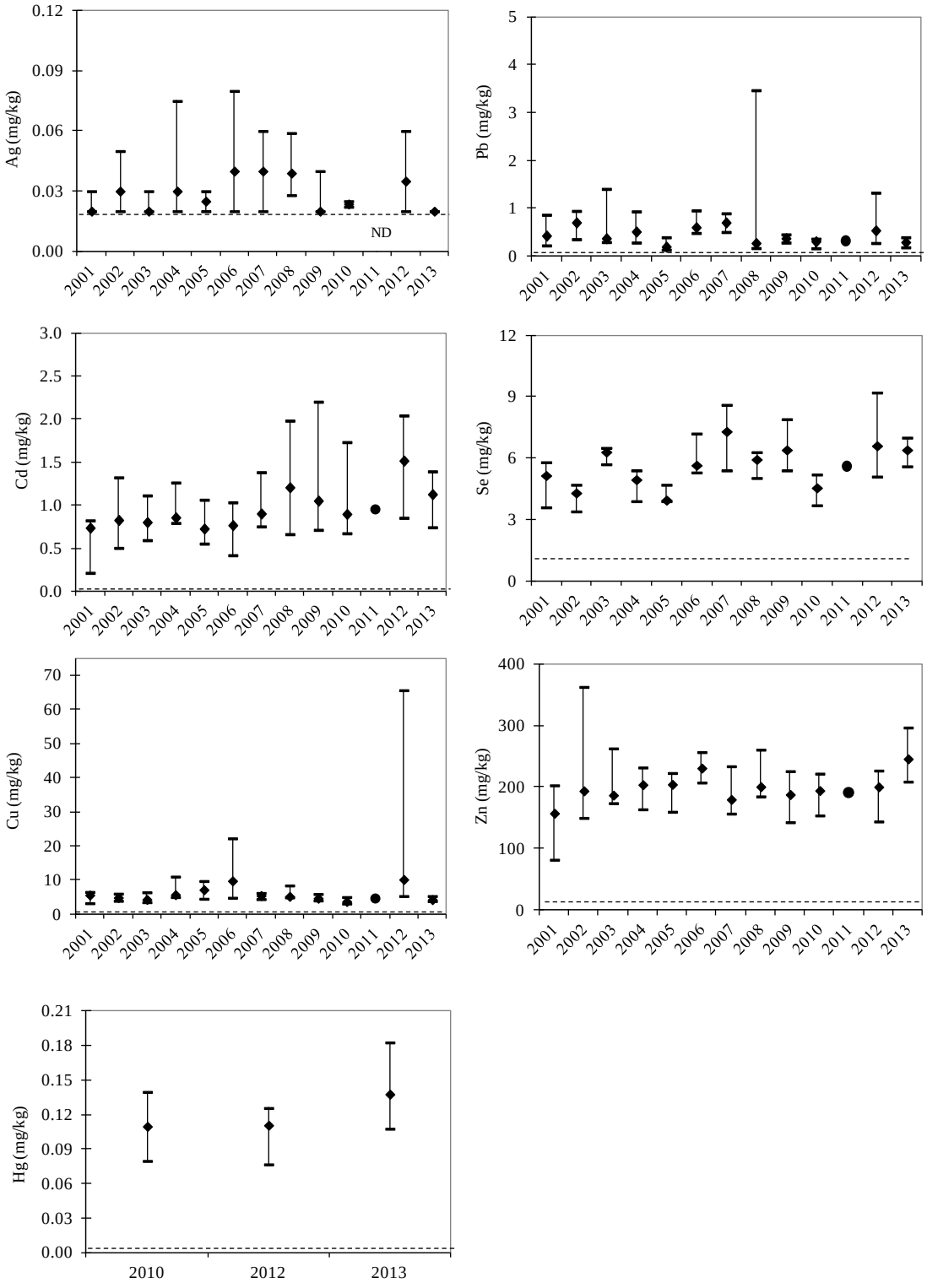

Figure 21.–Greens Creek Site 54 whole body juvenile Dolly Varden char maximum, median, and minimum concentrations (mg/kg) of Ag, Cd, Cu, Hg, Pb, Se, and Zn, 2001–2013.

Sediment Metals Concentrations

Concentrations of Ag, Cd, Cu, Hg, Pb, Se, and Zn in the Site 54 sediment sample are illustrated in Figure 22. The predominant metals were Cu and Zn, which made up about 88% of the analytes. The sediment sample contained 94% sand and 2.18 µmoles/g acid volatile sulfide.

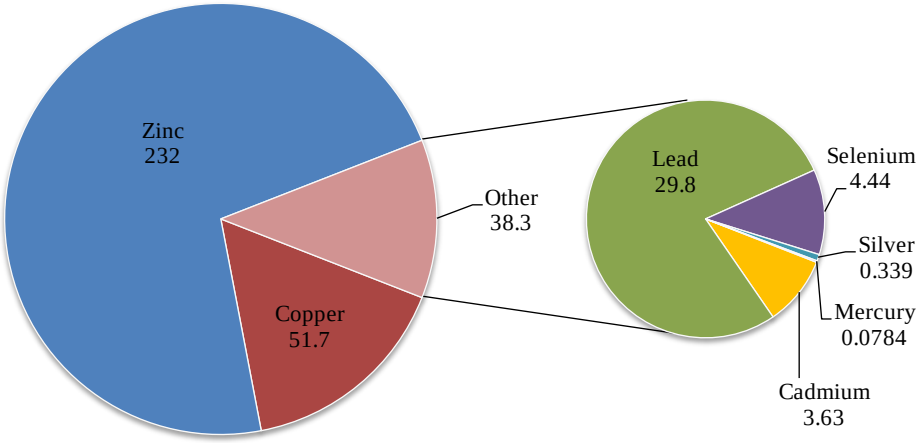

Figure 22.–Greens Creek Site 54 sediment metals and Se concentrations (mg/kg), 2013.

2013 Greens Creek Site 54 Summary

- Mean periphyton biomass was similar to values observed in previous years.
- Mean benthic macroinvertebrate density and % EPT were lower than we usually observe.
- The juvenile Dolly Varden char population estimate was similar to estimates from 2011 and 2012, years when we sampled the same 50 m reach.
- Median whole body juvenile fish Zn concentration was the greatest observed.
- Cu and Zn made up 88% of the seven analytes measured in stream sediment.

TRIBUTARY CREEK SITE 9

We sampled Tributary Creek Site 9 on July 23, 2013. Hecla personnel recorded the following water quality measurements at 1355: water temperature 13.13°C, conductivity 86 µS/cm, pH 7.17 units, and turbidity 7.1 NTU. Using our flow survey data, we estimate discharge was about 1.25 ft^3/s during sampling, greater than the previous several years. This was the first year we observed adult salmon during sampling: three pink salmon within our sample reach (Figure 23) and several fresh pink salmon carcasses on the stream banks (Figure 24).

Figure 24.–Adult pink salmon in Tributary Creek, 2013.

Figure 23.–Adult pink salmon carcass in Tributary Creek, 2013.

Periphyton Biomass and Composition

Mean periphyton biomass (4.57 mg/m^2) among samples collected in 2013 was similar to mean densities observed in previous years (Figure 25).[s] Mean proportions of chlorophylls *a*, *b*, and *c* densities were similar to previous years (Figure 26).

[s] The mean rank of 2013 chlorophyll *a* sample densities was significantly ($p \leq 0.05$) less than the mean rank for the 2003 densities—when biomass was greatest.

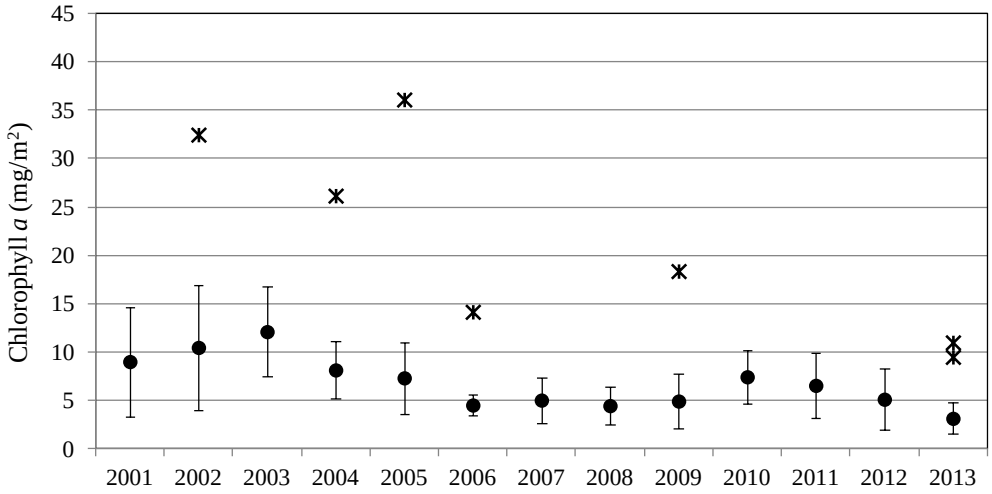

Figure 25.–Tributary Creek Site 9 mean periphyton biomass ± one standard deviation, excluding potential outliers (∗), 2001–2013.

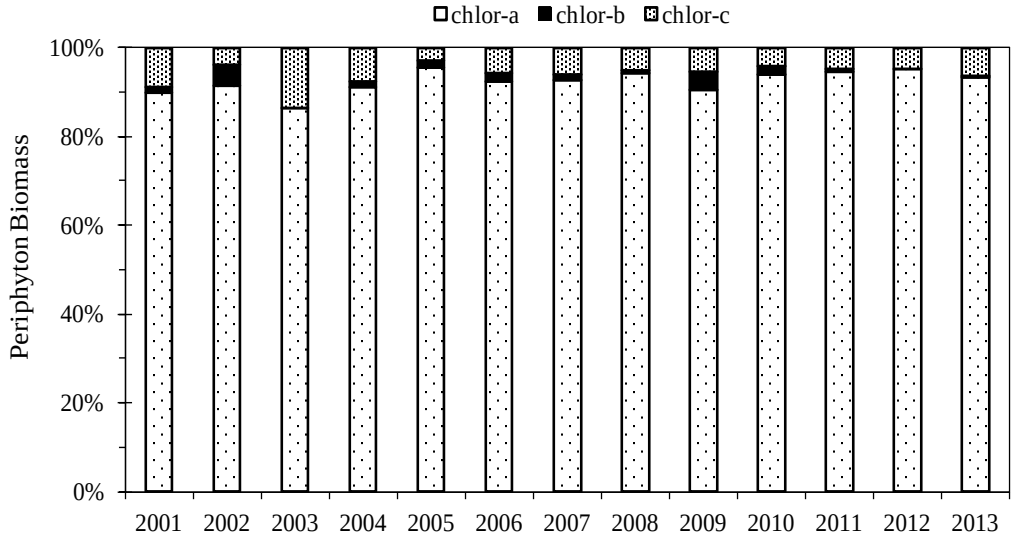

Figure 26.–Tributary Creek Site 9 proportions of mean chlorophylls *a*, *b*, and *c* densities, 2001–2013.

Benthic Macroinvertebrate Density and Community Composition

Mean benthic macroinvertebrate density among the 2013 Site 9 samples was 2,393 insects/m^2, the greatest density observed since 2003–2004 (Figure 27). We identified 20 taxa among the samples, the same as in 2008 and the lowest observed.

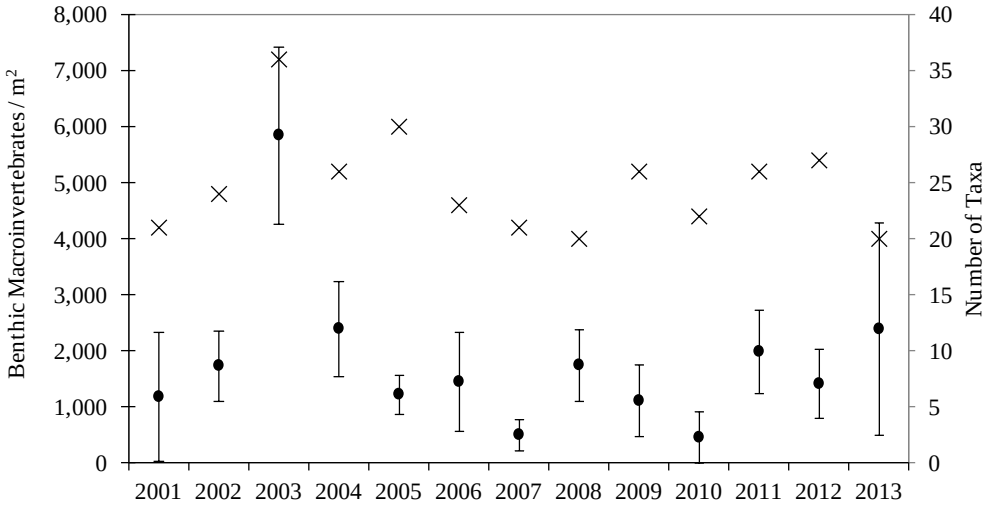

Figure 27.–Tributary Creek Site 9 mean benthic macroinvertebrate density ± one standard deviation, and taxa richness (×), 2001–2013.

About 83% of benthic macroinvertebrates collected in 2013 were EPT taxa, the greatest percent observed (Figure 28). The increase was largely due to greater presence of Ephemeroptera (mayfly) taxa, which accounted for about 70% of all insects. In most previous years, Ephemeroptera made up 40–50% of all insects. Ephemeroptera: *Paraleptophlebia* (36%) was the dominant taxon, and Diptera: Chironomidae accounted for about 11% of insects among samples, the lowest percent observed since 2009.

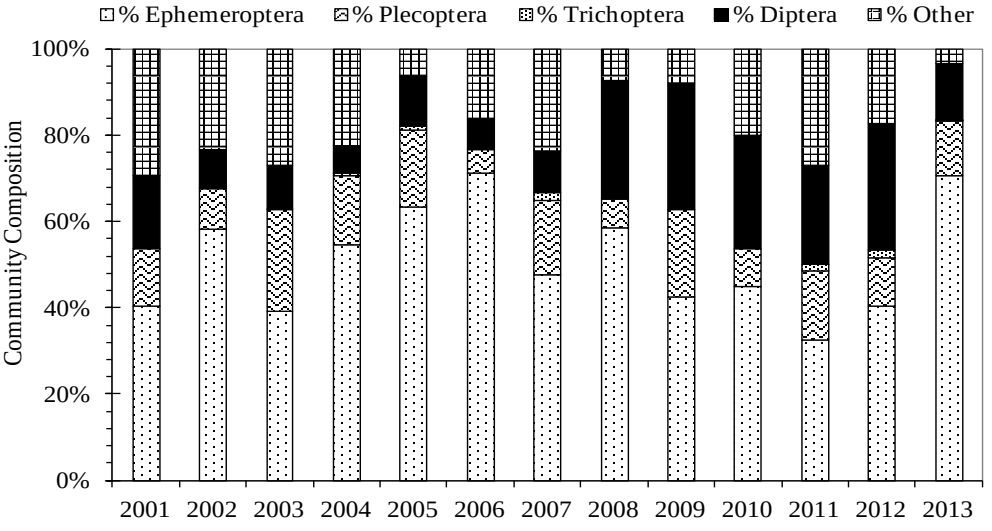

Figure 28.–Tributary Creek Site 9 benthic macroinvertebrate community composition, 2001–2013.

Juvenile Fish Populations and Fish Condition

The 2013 Site 9 Dolly Varden char population estimate was 13 fish, and the coho salmon population estimate was 20 ± 4 fish, the lowest population estimates since 2006–2007 (Figure 29). The length frequency plot of Dolly Varden char captured at Site 9 in 2013 (Appendix C) suggests a few age classes were present, as in previous years. Mean fish condition among the 13 Dolly Varden char we captured in 2013 was 1.23 g/mm^3, and mean fish condition among the 18 coho salmon we captured was 1.43 g/mm^3.

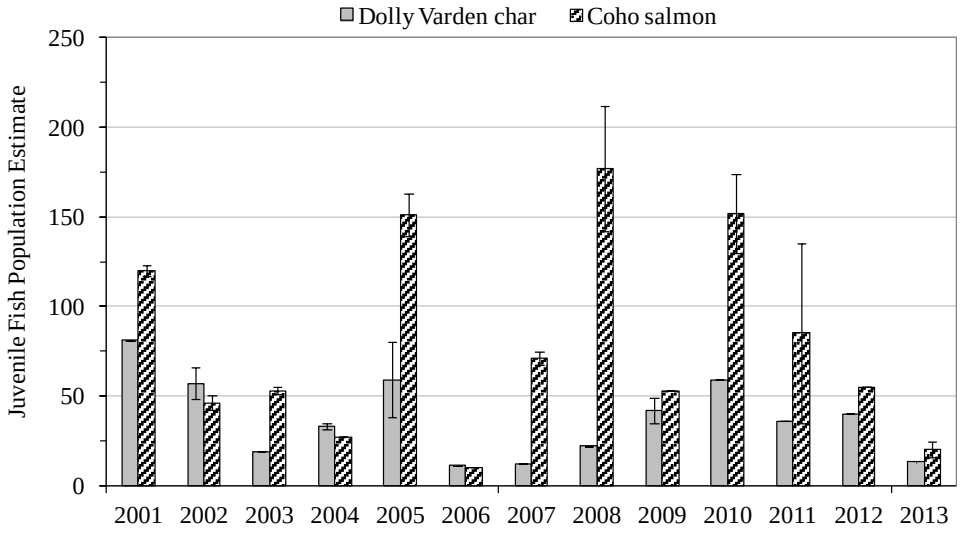

Figure 29.–Tributary Creek Site 9 juvenile fish population estimates, 2001–2013.

Juvenile Fish Metals Concentrations

The 2013 median concentrations of Ag, Cd, Pb, and Zn among whole body Dolly Varden char samples were the greatest observed since sampling began (Figure 30). Median Se concentration was the second greatest observed, and median concentrations of Cu and Hg were within the range of previous years.

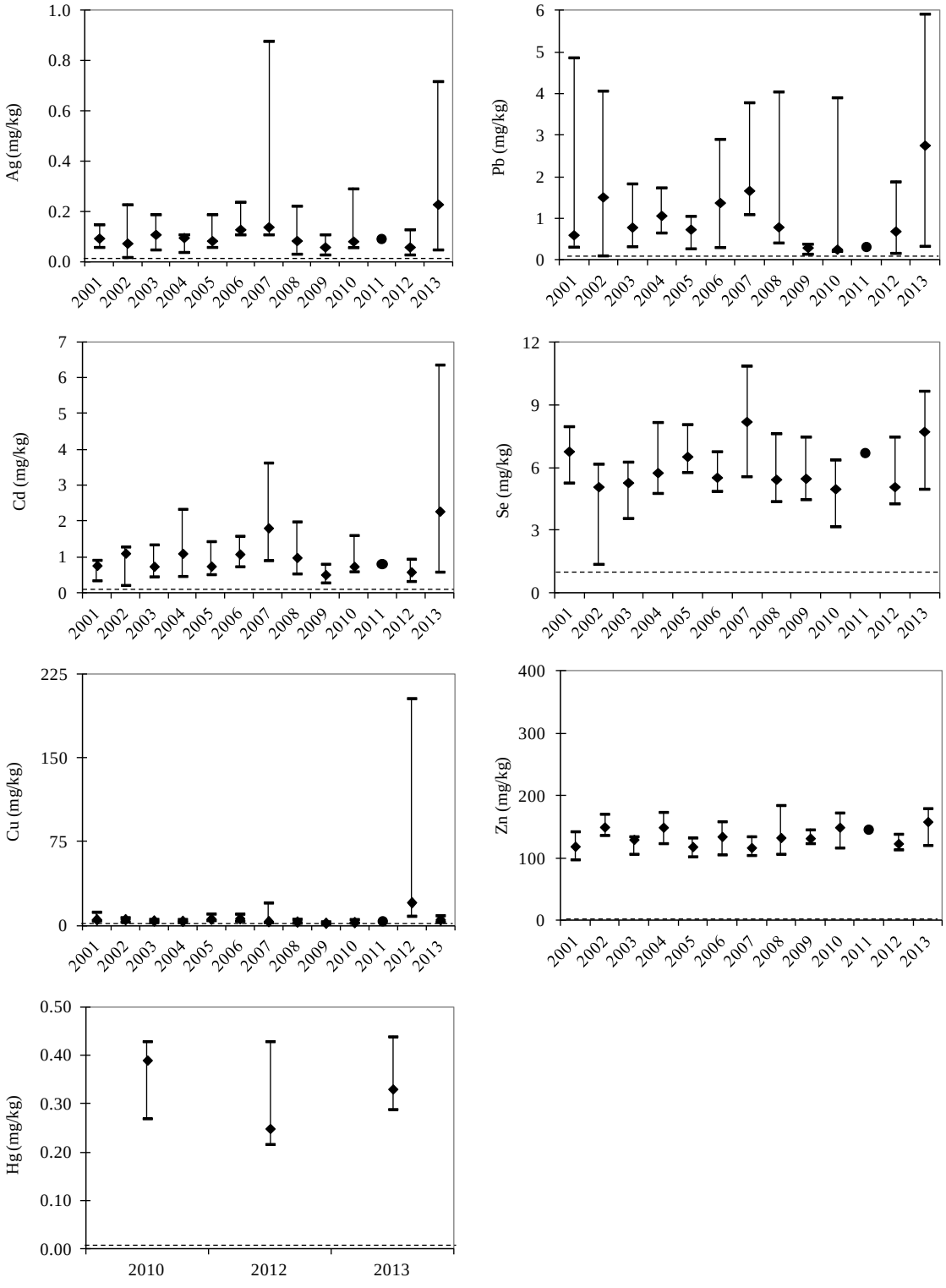

Figure 30.–Tributary Creek Site 9 whole body juvenile Dolly Varden char maximum, median, and minimum concentrations (mg/kg) of Ag, Cd, Cu, Hg, Pb, Se, and Zn, 2001–2013.

Sediment Metals Concentrations

Concentrations of Ag, Cd, Cu, Hg, Pb, Se, and Zn in the Site 9 sediment sample are illustrated in Figure 31. The predominant metals were Cu and Zn, which made up about 87% of the analytes. The sediment sample contained 90% sand and 2.00 µmoles/g acid volatile sulfide.

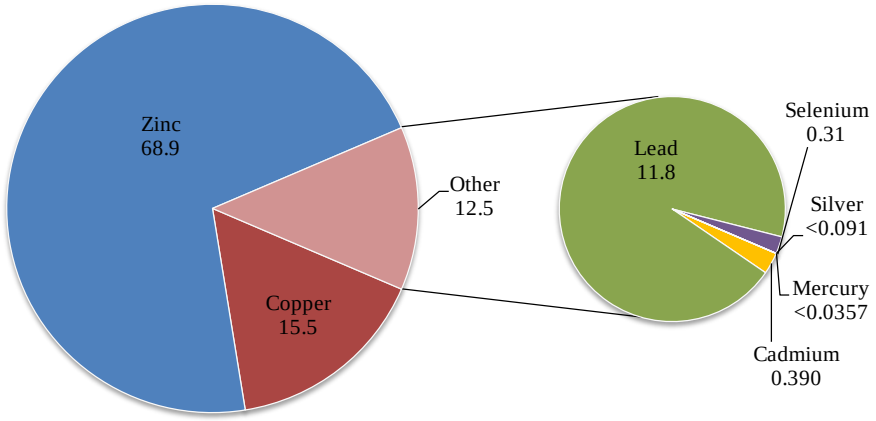

Figure 31.–Tributary Creek Site 9 sediment metals and Se concentrations (mg/kg), 2013.

2013 Tributary Creek Site 9 Summary

- 2013 was the first year we observed adult pink salmon during sampling.
- Periphyton biomass was similar to values observed in previous years.
- Benthic macroinvertebrate density was the greatest observed since 2003–2004 and %EPT was the greatest observed since sampling began in 2001.
- Juvenile fish population estimates were lower than observed in most previous years.
- Median whole body juvenile fish concentrations of Ag, Cd, Pb, Zn were the greatest observed since sampling began.
- Cu and Zn made up 87% of the seven analytes measured in stream sediment.

COMPARISON AMONG GREENS CREEK SITES

Periphyton Biomass and Community Composition

Periphyton biomass among the 2013 samples from Greens Creek sites 48 and 54 were not significantly different (p = 0.2868). Periphyton biomass at sites 48 and 54 generally followed a similar trend from 2001 to 2013, with peak densities observed in 2003, 2004 and 2006 (Figure 32). Greens Creek discharge prior to sampling 2003–2004 were the lowest observed, and may explain the greater periphyton densities those years. Greatest discharges observed prior to sampling in 2007, 2008, and 2012 may explain the lower biomass observed those years.

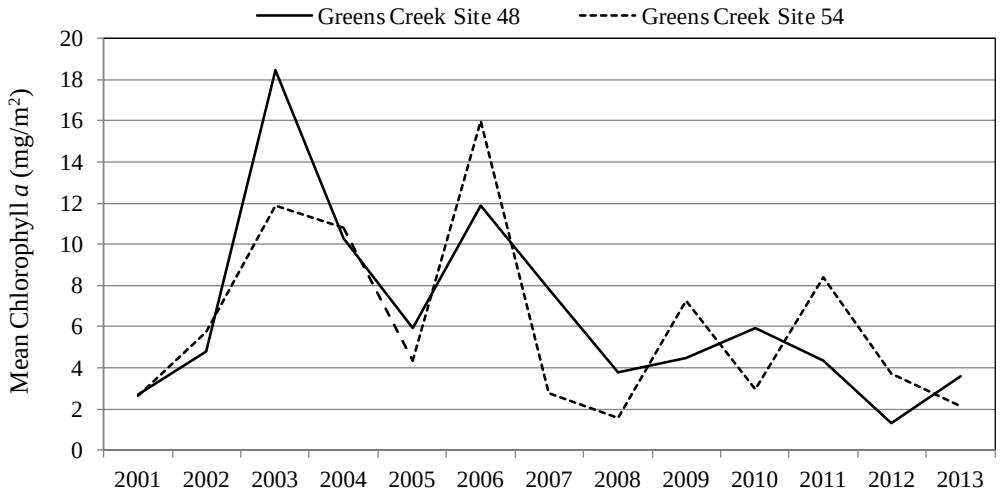

Figure 32.–Greens Creek sites 48 and 54 periphyton biomass, 2001–2013.

Since 2001, periphyton samples collected at Greens Creek sites 48 and 54 generally contained more than 90% chlorophyll *a*, zero or nearly zero chlorophyll *b*, and less than 10% chlorophyll *c*. Little presence of chlorophyll *b* at these sites suggest organisms such as green algae are occasionally present in the periphyton community, while presence of chlorophyll *c* in all years indicates organisms such as diatoms are a common in the periphyton community.

Benthic Macroinvertebrate Density and Community Composition

Mean benthic macroinvertebrate density (Figure 33) and taxonomic richness (Figure 34) among samples collected at Greens Creek sites 48 and 54 each year generally followed a similar pattern during the sample period 2001–2013. Samples from both sites often contained > 90% EPT insects.

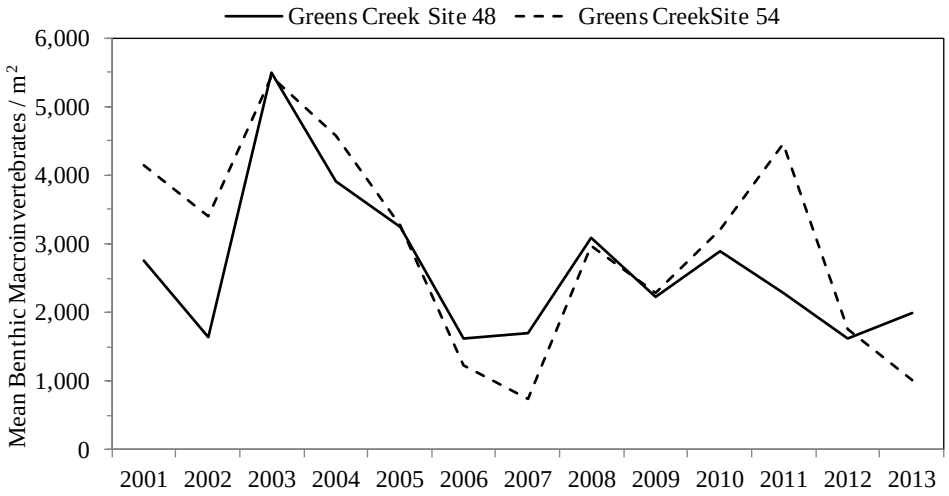

Figure 33.–Greens Creek sites 48 and 54 benthic macroinvertebrate densities, 2001–2013.

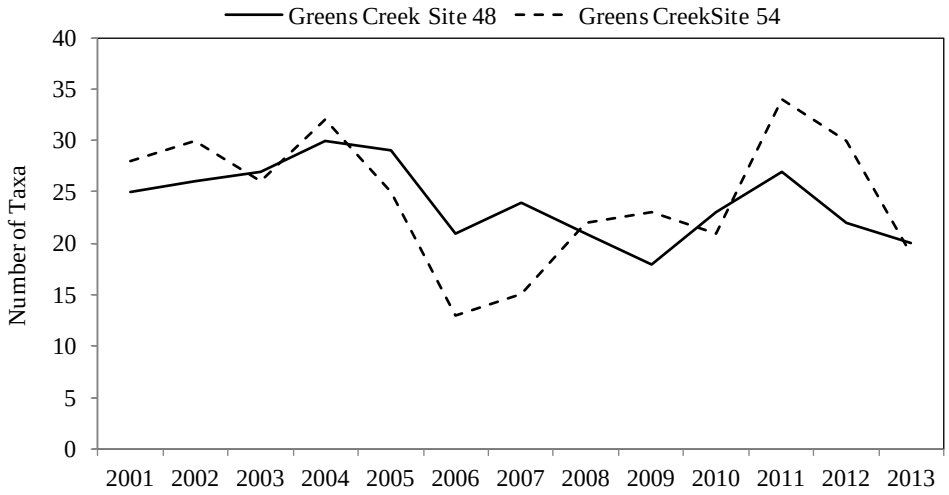

Figure 34.–Greens Creek sites 48 and 54 benthic macroinvertebrate taxa richness, 2001–2013.

Juvenile Fish Populations and Fish Condition

The 2013 Site 54 juvenile Dolly Varden char population estimate was significantly greater than the Site 48 population estimate. Population estimates among sites followed a similar trend 2001–2013 (Figure 35).[t] We captured several age classes of Dolly Varden char at both sites most years; some years we do not catch young-of-year fry, though we often observe them in side channels and tributaries. Fish condition of captured Dolly Varden char was similar among sites in 2013, both about 1.0 g/mm^3.

[t] To evaluate the trend, we extrapolated the 2001–2010 Greens Creek Site 54 population estimates to a 50 m sample reach, shown in Figure 35.

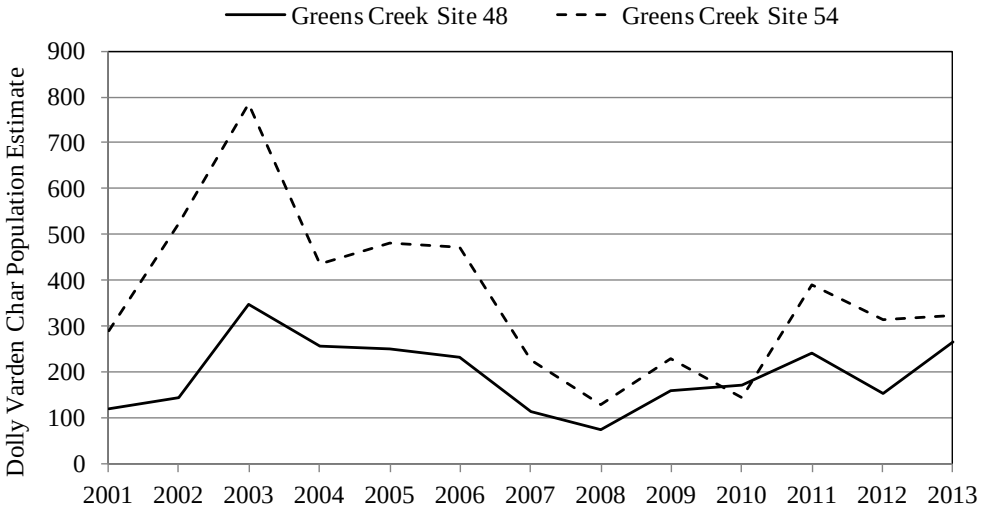

Figure 35.–Greens Creek sites 48 and 54 juvenile Dolly Varden char population estimates, 2001–2013.

Note: Site 54 2001–2010 data extrapolated to 50 m sample each for comparison.

COMPARISON AMONG SITES

Juvenile Fish Metals Concentrations

We did not find relationships between juvenile Dolly Varden char FL and metals and Se concentrations among whole body fish samples collected 2001–2013.

Comparing only the 2013 Greens Creek data, we did not find significant differences between the Site 48 and Site 54 data. Median concentrations of Ag, Cu, Hg, and Zn were greatest among samples from Site 48, while Cd, Pb, and Se were greater among samples from Site 54. Comparing the 2013 Greens Creek with Tributary Creek Site 9 data, median concentrations were greatest among Site 9 samples, except Zn which was greatest among Site 48 samples. Comparing all the 2013 data with Upper Slate Creek data collected near Kensington Gold Mine in 2013 (Timothy and Kanouse 2014), median values among the Upper Slate Creek samples were similar to or less than all the median Greens Creek and Tributary Creek values.

During the period 2001–2013, Tributary Creek Site 9 samples had greater concentrations and variability than Greens Creek samples, except Cu and Zn which were generally greater at Site 48 (Figure 37).

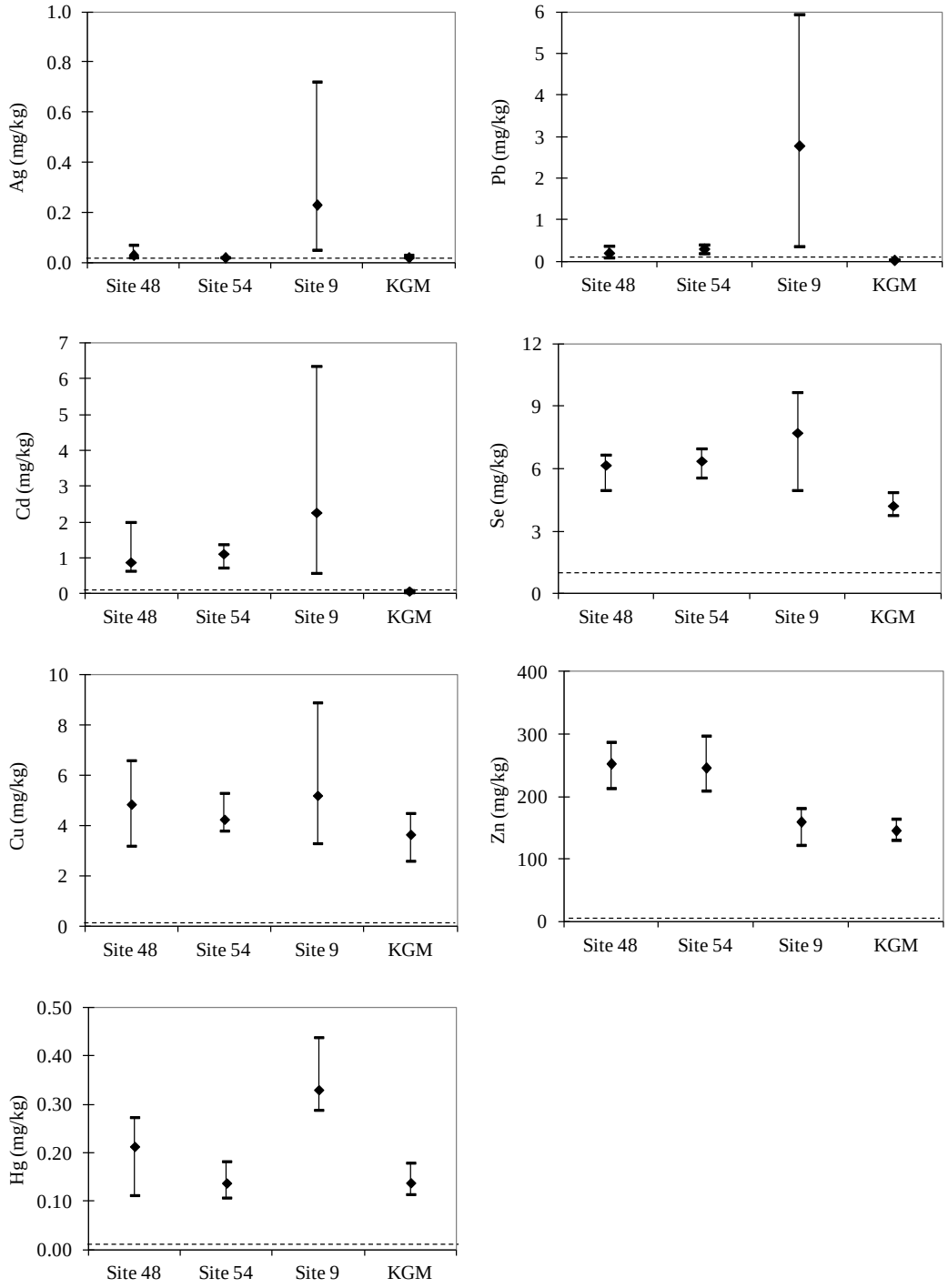

Figure 36.–Greens Creek sites 48 and 54 and Tributary Creek Site 9 whole body juvenile Dolly Varden char maximum, median, and minimum concentrations (mg/kg) of Ag, Cd, Cu, Hg, Pb, Se, and Zn, 2013.

Note: Reference data (KGM) are 2013 whole body juvenile Dolly Varden char maximum, median, and minimum concentrations among samples collected in Upper Slate Creek, near Kensington Gold Mine (Timothy and Kanouse 2014).

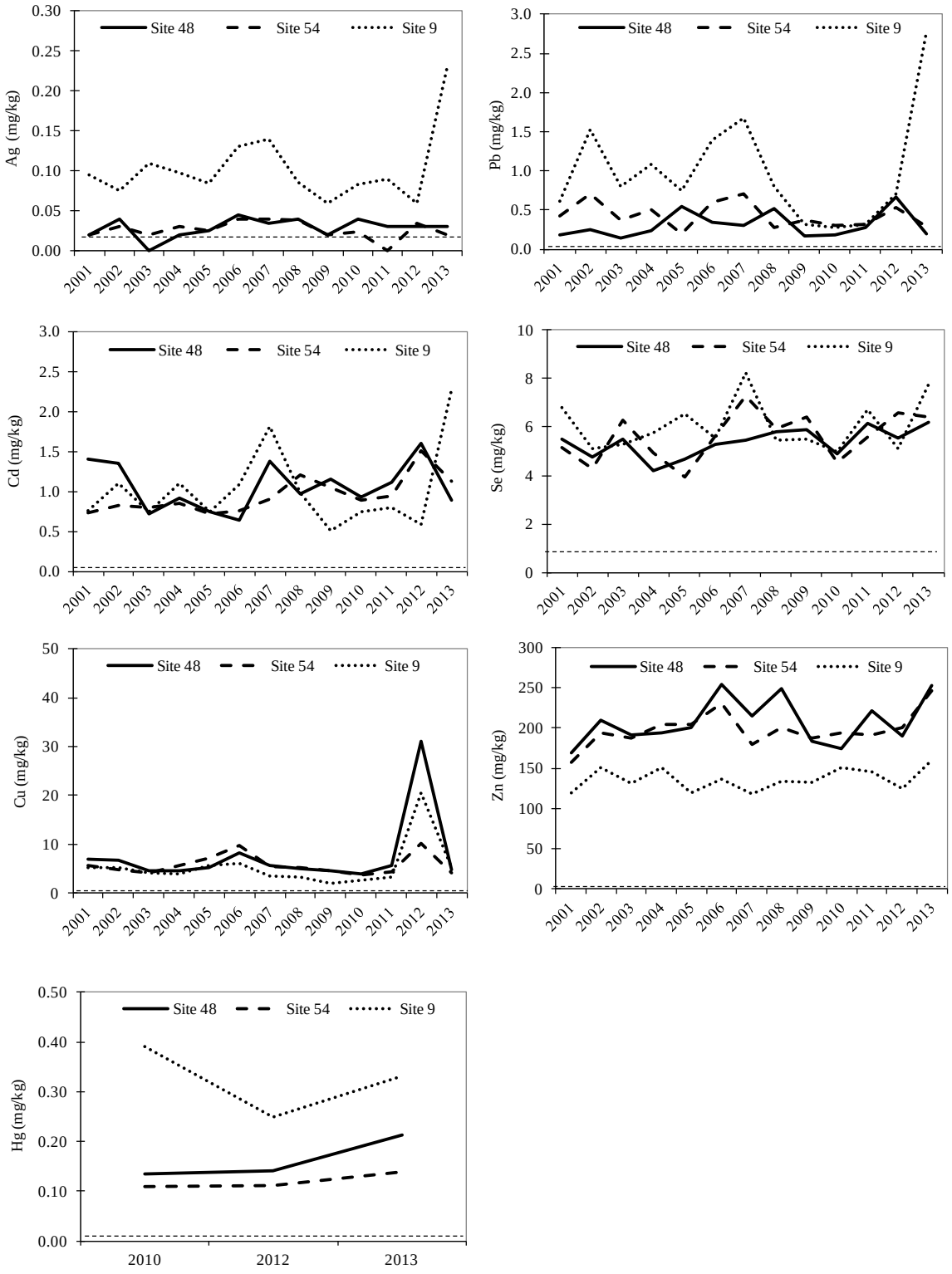

Figure 37.–Greens Creek sites 48 and 54 and Tributary Creek Site 9 whole body juvenile Dolly Varden char median concentrations (mg/kg) of Ag, Cd, Cu, Hg, Pb, Se, and Zn, 2001–2013.

Sediment Metals Concentrations

Among the Greens Creek sites 48 and 54 stream sediment samples, Cu concentration was greatest in the Site 48 sample, and Cd, Hg, Pb, and Se concentrations were nearly double in the Site 54 sample. Ag and Zn concentrations were about the same among the two sites. Comparing the Greens Creek and Tributary Creek Site 9 sample data, Cu and Zn were predominant and all metals and Se concentrations were lowest in the Site 9 sample, most by at least a factor of three (Table 1). Sample composition and acid volatile sulfide content were similar among the three samples.

Table 1.–Greens Creek sites 48 and 54 and Tributary Creek Site 9 stream sediment data, 2013.

Parameter	Site 48	Site 54	Site 9
Metals[a] (mg/kg dry weight)			
Cadmium	1.84	3.63	0.390
Copper	60.8	51.7	15.5
Lead	12.8	29.8	11.8
Mercury	0.0476	0.0784	0.0357
Selenium	2.6	4.440	0.309
Silver	0.384	0.339	0.091
Zinc	232	232	68.9
Particle Size[b] (%)			
Clay	3.0	5.0	3.0
Sand	92.0	94.0	90.0
Silt	5.0	1.0	7.0
Coarse Material (> 2 mm)	< 0.05	0.06	0.10
Soil Class	Sand	Sand	Sand
Acid Volatile Sulfide (µmoles/g)	1.99	2.18	2.00

[a] Ag, Cd, Cu, Pb, Se, and Zn determined by SW-846 Method 6020; Hg determined by SW-846 7471B.

[b] Particle size determined by ASTM Method D422 and Modified ASA 15-5.

We evaluated the sediment metals and Se data using the Screening Quick Reference Tables (SQuiRTs) developed by the National Oceanic and Atmospheric Administration (Buchman 2008), and found the Greens Creek sites 48 and 54 Cd, Cu, and Zn concentrations were above the Threshold Effects Concentrations (TEC) and below the Probable Effects Concentrations (PEC).[u] All Hg and Pb concentrations were below the TEC values.[v]

In our 2012 report (Kanouse and Brewster 2013), we recommended comparing stream sediment concentrations with whole body juvenile fish and water sample data to investigate relationships. We compared the 2013 data among sample sites, and found water samples[w] contained the lowest concentrations of Cd, Cu, Pb, and Zn, and sediment contained the greatest concentrations of Cd,

[u] Metals concentrations below the TEC rarely affect aquatic life survival and growth. Metals concentrations above the PEC affect aquatic life survival and growth more often than not.

[v] TEC and PEC values are not available for Ag and Se.

[w] We used the mean concentration among samples collected in May and July, 2013.

Cu and Pb, except Cd was greatest in Tributary Creek Dolly Varden char (Figures 38–41). Zn concentrations were greatest in Dolly Varden char[x] at all sites.

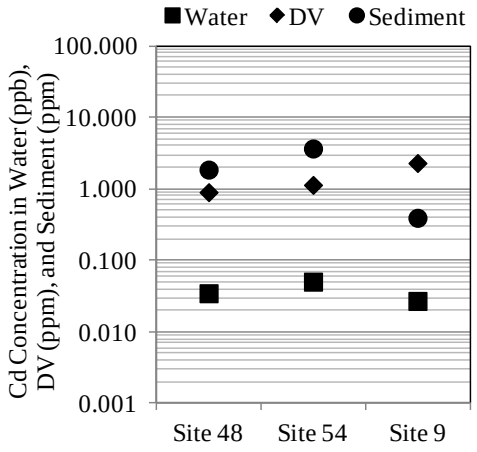

Figure 38.–2013 Cd concentrations in water, Dolly Varden char, and sediment.

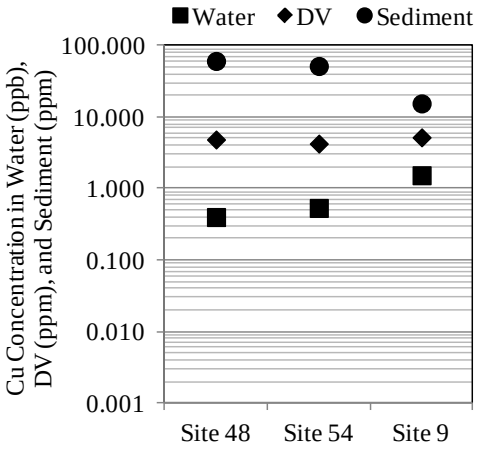

Figure 41.–2013 Cu concentrations in water, Dolly Varden char, and sediment.

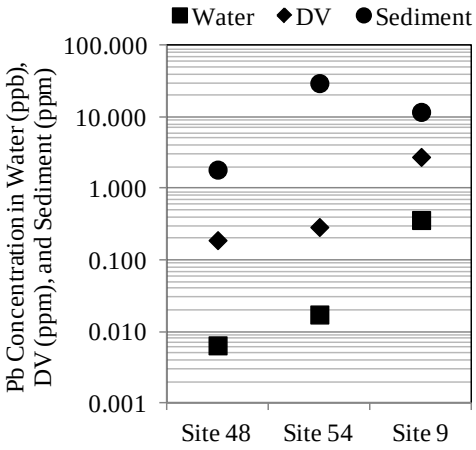

Figure 39.–2013 Pb concentrations in water, Dolly Varden char, and sediment.

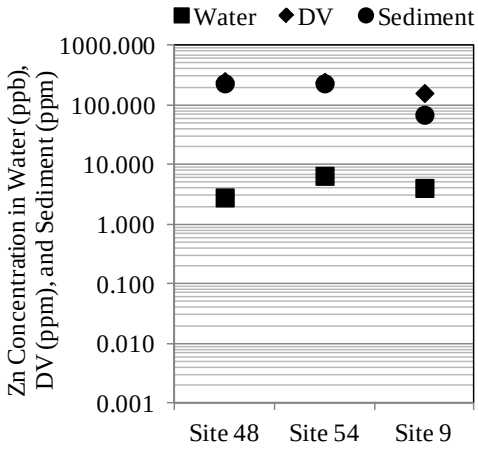

Figure 40.–2013 Zn concentrations in water, Dolly Varden char, and sediment.

[x] Median concentrations (mg/kg or ppm) among fish samples collected in 2013.

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APPENDIX A: PERIPHYTON BIOMASS DATA

Appendix A.–Greens Creek Site 48 chlorophylls *a*, *b*, and *c* densities, 2001–2013.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	1.91	0.01	0.14	5.34	0.00	0.29	12.92	0.00	1.26	18.05	0.00	2.03
	1.83	0.00	0.18	4.27	0.00	0.21	8.65	0.03	1.57	6.73	0.00	0.69
	5.61	0.00	0.69	6.62	0.00	0.71	3.84	0.09	0.39	8.97	0.00	0.90
	0.31	0.08	0.06	2.99	0.00	0.25	12.18	0.01	0.64	12.82	0.00	1.45
	2.96	0.04	0.36	5.34	0.00	0.75	17.19	0.00	0.72	5.45	0.00	0.62
	5.44	0.00	0.62	6.62	0.00	0.75	17.19	0.02	0.86	20.40	0.00	2.15
	3.38	0.00	0.47	6.09	0.00	0.73	33.21	0.00	2.14	6.30	0.00	0.45
	1.87	0.03	0.15	---	---	---	24.24	0.13	0.99	11.64	0.00	1.38
	2.63	0.14	0.14	2.99	0.00	0.36	19.76	0.00	0.57	7.48	0.00	0.65
	1.23	0.02	0.16	2.78	0.00	0.15	35.35	0.00	0.89	5.23	0.00	0.55
mean	2.72	0.03	0.30	4.78	0.00	0.47	18.46	0.03	1.00	10.31	0.00	1.09
median	2.27	0.02	0.17	5.34	0.00	0.36	17.19	0.00	0.88	8.22	0.00	0.79
max	5.61	0.14	0.69	6.62	0.00	0.75	35.35	0.13	2.14	20.40	0.00	2.15
min	0.31	0.00	0.06	2.78	0.00	0.15	3.84	0.00	0.39	5.23	0.00	0.45

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	0.85	0.00	0.01	8.33	0.00	0.80	6.62	0.00	0.16	1.50	0.00	0.09
	4.70	0.00	0.51	11.43	0.00	0.71	5.55	0.00	0.23	4.70	0.00	0.16
	6.62	0.00	0.27	10.68	0.00	1.25	7.48	0.00	0.33	2.67	0.00	0.24
	6.19	0.00	0.51	20.08	0.00	2.04	11.64	0.00	1.39	2.14	0.00	0.17
	11.11	0.00	0.92	10.57	0.00	0.98	6.94	0.00	0.47	0.85	0.00	0.02
	5.66	0.00	0.51	14.10	0.00	1.72	11.11	0.00	0.54	12.60	0.00	0.33
	7.69	0.00	0.53	16.98	0.00	1.76	11.75	0.01	0.60	2.78	0.00	0.19
	5.13	0.00	0.29	5.23	0.00	1.74	4.81	0.00	0.29	6.30	0.00	0.74
	2.46	0.02	0.28	16.87	0.00	1.73	8.12	0.00	1.10	1.28	0.00	0.14
	9.08	0.00	0.63	4.38	0.00	0.54	4.06	0.00	0.43	3.20	0.00	0.37
mean	5.95	0.00	0.45	11.87	0.00	1.33	7.81	0.00	0.55	3.80	0.00	0.25
median	5.93	0.00	0.51	11.05	0.00	1.49	7.21	0.00	0.45	2.73	0.00	0.18
max	11.11	0.02	0.92	20.08	0.00	2.04	11.75	0.01	1.39	12.60	0.00	0.74
min	0.85	0.00	0.01	4.38	0.00	0.54	4.06	0.00	0.16	0.85	0.00	0.02

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	3.20	0.00	0.49	8.54	0.00	0.44	4.49	0.00	0.50	**0.36**	0.05	0.06
	1.50	0.00	0.25	4.59	0.00	0.61	6.51	0.00	0.59	0.69	0.00	0.10
	4.17	0.11	0.59	5.13	0.00	0.27	2.88	0.00	0.30	1.29	0.00	0.12
	5.66	0.07	0.73	3.10	0.00	0.26	2.59	0.17	0.05	2.56	0.00	0.39
	3.42	0.06	0.50	7.58	0.00	0.29	3.31	0.00	0.36	0.85	0.00	0.00
	8.22	0.13	0.95	5.55	0.00	0.55	5.13	0.00	0.55	1.60	0.00	0.26
	0.43	0.11	0.11	10.68	0.00	0.64	7.16	0.00	1.06	1.82	0.00	0.29
	1.39	0.18	0.29	7.69	0.00	0.41	5.66	0.00	0.49	1.92	0.00	0.28
	7.80	0.00	0.89	3.63	0.00	0.25	0.85	0.00	0.11	0.32	0.00	0.08
	9.18	0.17	1.19	3.10	0.02	0.15	4.81	0.00	0.49	1.60	0.00	0.16
mean	4.50	0.08	0.60	5.96	0.00	0.39	4.34	0.02	0.45	1.30	0.01	0.17
median	3.79	0.09	0.55	5.34	0.00	0.35	4.65	0.00	0.49	1.45	0.00	0.14
max	9.18	0.18	1.19	10.68	0.02	0.64	7.16	0.17	1.06	2.56	0.05	0.39
min	0.43	0.00	0.11	3.10	0.00	0.15	0.85	0.00	0.05	0.32	0.00	0.00

	2013		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*
	2.03	0.00	0.12
	1.50	0.00	0.11
	4.59	0.00	0.33
	2.03	0.00	0.19
	6.94	0.00	0.38
	6.62	0.00	0.39
	1.60	0.00	0.26
	1.39	0.00	0.07
	3.74	0.00	0.46
	5.23	0.00	0.70
mean	3.57	0.00	0.30
median	2.88	0.00	0.29
max	6.94	0.00	0.70
min	1.39	0.00	0.07

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

Appendix A2.–Greens Creek Site 54 chlorophylls *a*, *b*, and *c* densities, 2001–2013.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	1.60	0.01	0.15	2.88	0.00	0.30	13.24	0.00	1.05	17.19	0.00	2.02
	3.10	0.05	0.41	9.61	0.00	1.02	8.33	0.00	0.79	9.72	0.00	0.93
	3.61	0.00	0.21	8.12	0.00	0.24	14.20	0.00	1.45	8.76	0.00	0.67
	2.97	0.00	0.29	4.49	0.00	0.38	6.09	0.00	0.62	32.04	0.00	3.66
	1.88	0.00	0.01	5.34	0.00	0.53	15.49	0.00	1.74	5.23	0.00	0.42
	1.78	0.00	0.19	2.46	0.87	1.26	10.68	0.00	1.06	3.74	0.00	0.31
	4.95	0.00	0.22	6.51	0.00	0.64	5.55	0.00	0.39	12.82	0.00	1.35
	1.46	0.00	0.10	4.91	0.00	0.40	16.34	0.00	1.72	1.92	0.03	0.09
	1.69	0.00	0.14	4.81	0.00	0.45	12.60	0.00	1.07	10.47	0.00	1.09
	3.48	0.00	0.16	8.44	0.00	0.79	16.02	0.00	1.75	5.98	0.00	0.53
mean	2.65	0.01	0.19	5.76	0.09	0.60	11.85	0.00	1.16	10.79	0.00	1.11
median	2.42	0.00	0.17	5.13	0.00	0.49	12.92	0.00	1.07	9.24	0.00	0.80
max	4.95	0.05	0.41	9.61	0.87	1.26	16.34	0.00	1.75	32.04	0.03	3.66
min	1.46	0.00	0.01	2.46	0.00	0.24	5.55	0.00	0.39	1.92	0.00	0.09

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	10.36	0.00	0.54	19.54	0.00	1.62	0.43	0.04	0.04	2.99	0.00	0.29
	2.56	0.00	0.26	5.66	0.00	0.76	**0.24**	0.00	0.00	1.17	0.02	0.00
	3.31	0.00	0.17	28.73	0.00	1.19	1.39	0.04	0.11	1.50	0.00	0.19
	2.88	0.00	0.12	23.28	0.00	2.63	4.27	0.00	0.48	1.71	0.00	0.13
	5.66	0.00	0.38	4.59	0.00	0.47	**0.24**	0.09	0.02	2.24	0.00	0.09
	2.99	0.00	0.13	27.34	0.00	2.22	3.31	0.00	0.38	2.14	0.00	0.11
	4.27	0.00	0.18	4.27	0.00	0.38	8.01	0.00	0.98	2.46	0.00	0.25
	4.38	0.00	0.31	8.86	0.00	0.94	**0.24**	0.00	0.00	0.96	0.00	0.01
	4.06	0.00	0.16	31.72	0.00	3.17	2.99	0.00	0.39	**0.24**	0.05	0.00
	3.10	0.00	0.16	5.55	0.00	0.68	6.41	0.00	0.81	**0.24**	0.00	0.03
mean	4.36	0.00	0.24	15.96	0.00	1.40	2.75	0.02	0.32	1.57	0.01	0.11
median	3.68	0.00	0.17	14.20	0.00	1.06	2.19	0.00	0.25	1.61	0.00	0.10
max	10.36	0.00	0.54	31.72	0.00	3.17	8.01	0.09	0.98	2.99	0.05	0.29
min	2.56	0.00	0.12	4.27	0.00	0.38	0.24	0.00	0.00	0.24	0.00	0.00

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	8.01	0.11	1.06	2.67	0.00	0.29	9.61	0.00	0.64	5.54	0.00	0.24
	7.58	0.11	1.13	6.73	0.00	0.69	0.43	0.00	0.06	0.11	0.00	0.04
	6.84	0.07	0.89	4.38	0.00	0.74	3.42	0.00	0.32	2.65	0.00	0.11
	9.18	0.09	0.96	2.14	0.00	0.25	3.42	0.00	0.33	1.82	0.00	0.10
	---	0.47	2.21	5.23	0.00	0.67	41.76	0.00	3.02	1.07	0.00	0.04
	8.33	0.15	1.11	1.71	0.04	0.25	5.23	0.00	0.64	1.17	0.00	0.13
	11.32	0.20	1.57	1.39	0.02	0.11	10.36	0.00	0.45	0.75	0.00	0.06
	5.34	0.17	0.66	3.20	0.00	0.46	7.16	0.00	0.53	19.54	0.00	1.10
	4.49	0.10	0.63	2.03	0.00	0.21	0.64	0.00	0.07	4.06	0.00	0.30
	4.38	0.10	0.43	0.21	0.01	0.05	2.24	0.00	0.29	0.43	0.01	0.04
mean	7.27	0.16	1.06	2.97	0.01	0.37	8.43	0.00	0.64	3.71	0.00	0.22
median	7.58	0.11	1.01	2.41	0.00	0.27	4.33	0.00	0.39	1.50	0.00	0.10
max	11.32	0.47	2.21	6.73	0.04	0.74	41.76	0.00	3.02	19.54	0.01	1.10
min	4.38	0.07	0.43	0.21	0.00	0.05	0.43	0.00	0.06	0.11	0.00	0.04

	2013		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*
	2.56	0.00	0.26
	2.14	0.00	0.23
	1.28	0.00	0.24
	2.14	0.00	0.37
	0.53	0.00	0.02
	0.43	0.00	0.07
	---	---	---
	2.03	0.00	0.28
	5.87	0.00	0.76
	2.14	0.00	0.21
mean	2.12	0.00	0.27
median	2.14	0.00	0.24
max	5.87	0.00	0.76
min	0.43	0.00	0.02

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

Appendix A3.–Tributary Creek Site 9 chlorophylls *a*, *b*, and *c* densities, 2001–2013.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	6.62	0.00	0.79	8.91	0.00	0.52	9.61	0.00	1.26	9.40	0.22	0.80
	11.15	0.00	1.20	16.43	0.95	1.28	17.19	0.00	0.79	5.77	0.00	0.42
	15.05	0.00	1.47	12.65	0.17	0.00	7.69	0.00	0.29	5.45	0.00	0.48
	16.58	0.23	1.51	5.44	0.45	0.07	8.76	0.00	1.11	6.09	0.03	0.38
	3.15	0.00	0.33	23.72	1.21	0.84	10.47	0.00	1.92	14.52	0.02	1.40
	2.59	0.06	0.28	12.75	0.40	0.22	10.79	0.00	1.88	6.51	0.17	0.40
	1.61	0.00	0.01	32.53	0.00	1.89	22.64	0.00	3.98	10.36	0.13	0.80
	6.66	0.00	0.43	4.40	1.50	0.00	12.39	0.00	2.43	6.84	0.04	0.36
	15.21	0.81	1.44	2.94	0.30	0.17	8.54	0.00	1.69	26.17	0.51	2.61
	11.55	0.00	1.51	8.01	1.47	0.27	13.03	0.00	3.86	8.44	0.22	0.53
mean	9.02	0.11	0.90	12.78	0.64	0.53	12.11	0.00	1.92	9.95	0.14	0.82
median	8.90	0.00	0.99	10.78	0.43	0.25	10.63	0.00	1.78	7.64	0.09	0.51
max	16.58	0.81	1.51	32.53	1.50	1.89	22.64	0.00	3.98	26.17	0.51	2.61
min	1.61	0.00	0.01	2.94	0.00	0.00	7.69	0.00	0.29	5.45	0.00	0.36

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	6.09	0.00	0.25	3.42	0.25	0.19	---	---	---	2.35	0.00	0.12
	8.01	1.28	0.18	4.08	0.40	0.20	5.45	0.08	0.23	6.94	0.00	0.27
	1.82	0.13	0.07	6.94	0.00	0.40	7.26	0.00	0.54	6.30	0.24	0.34
	9.08	0.06	0.29	4.11	0.01	0.32	---	---	---	6.41	0.00	0.25
	4.70	0.00	0.10	4.17	0.00	0.39	---	---	---	2.46	0.12	0.19
	4.70	0.00	0.12	4.78	0.00	0.29	0.85	0.16	0.11	6.19	0.05	0.39
	7.80	0.00	0.20	14.16	0.00	0.57	6.41	0.06	0.24	4.06	0.00	0.13
	14.85	0.00	0.46	4.34	0.01	0.21	7.05	0.24	0.65	4.59	0.00	0.37
	36.10	0.10	1.12	5.23	0.00	0.56	5.02	0.00	0.26	1.60	0.00	0.00
	8.97	0.00	0.26	3.66	0.37	0.26	3.20	0.00	0.23	3.74	0.00	0.28
mean	10.21	0.16	0.31	5.49	0.10	0.34	5.03	0.08	0.32	4.46	0.04	0.23
median	7.90	0.00	0.23	4.25	0.00	0.30	5.45	0.06	0.24	4.33	0.00	0.26
max	36.10	1.28	1.12	14.16	0.40	0.57	7.26	0.24	0.65	6.94	0.24	0.39
min	1.82	0.00	0.07	3.42	0.00	0.19	0.85	0.00	0.11	1.60	0.00	0.00

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	2.03	0.10	0.16	12.82	0.00	0.39	4.81	0.47	0.08	3.63	0.00	0.25
	5.45	0.17	0.38	6.62	0.00	0.39	3.84	0.00	0.12	8.97	0.00	0.33
	4.38	0.24	0.30	7.69	0.00	0.43	4.91	0.00	0.34	10.68	0.00	0.48
	7.05	0.58	0.33	5.66	0.12	0.32	10.47	0.03	0.50	3.74	0.00	0.25
	9.08	0.36	0.49	9.72	0.88	0.40	5.13	0.00	0.37	1.28	0.00	0.04
	8.76	0.41	0.62	5.98	0.00	0.20	1.71	0.00	0.01	1.71	0.00	0.12
	2.14	0.08	0.09	5.55	0.00	0.40	6.30	0.00	0.44	5.66	0.00	0.29
	18.37	0.66	0.78	10.57	0.28	0.34	9.61	0.00	0.35	6.09	0.00	0.26
	2.35	0.18	0.16	4.06	0.05	0.16	12.50	0.00	0.87	2.14	0.00	0.21
	3.20	0.20	0.33	5.77	0.00	0.32	6.30	0.00	0.17	7.37	0.00	0.40
mean	6.28	0.30	0.36	7.44	0.13	0.34	6.56	0.05	0.33	5.13	0.00	0.26
median	4.91	0.22	0.33	6.30	0.00	0.37	5.71	0.00	0.35	4.70	0.00	0.26
max	18.37	0.66	0.78	12.82	0.88	0.43	12.50	0.47	0.87	10.68	0.00	0.48
min	2.03	0.08	0.09	4.06	0.00	0.16	1.71	0.00	0.01	1.28	0.00	0.04

	2013		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*
	11.00	0.00	0.64
	2.88	0.00	0.19
	5.45	0.00	0.40
	5.02	0.00	0.40
	2.24	0.00	0.15
	2.99	0.00	0.17
	9.51	0.00	0.66
	0.32	0.05	0.15
	3.52	0.00	0.19
	2.78	0.00	0.17
mean	4.57	0.00	0.31
median	3.26	0.00	0.19
max	11.00	0.05	0.66
min	0.32	0.00	0.15

APPENDIX B: BENTHIC MACROINVERTEBRATE DATA

Appendix B1.–Greens Creek Site 48 benthic macroinvertebrate data summaries, 2001–2013.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Aquatic Insect Taxa Counted	25	26	27	30	29	21	24	21	18	23	27	22	20
Total Ephemeroptera	1,094	599	1,897	1,034	902	495	428	887	852	937	558	555	618
Total Plecoptera	49	41	191	74	36	10	75	20	40	81	151	55	131
Total Trichoptera	7	9	20	22	15	7	8	24	1	4	12	5	8
Total Aquatic Diptera	31	39	206	169	101	38	34	79	15	71	193	73	86
Total Other	3	16	53	25	5	10	15	11	2	8	68	5	12
% Ephemeroptera	92%	85%	80%	79%	86%	88%	80%	87%	93%	86%	57%	80%	72%
% Plecoptera	4%	6%	8%	6%	3%	3%	11%	2%	5%	7%	15%	8%	15%
% Trichoptera	1%	1%	1%	2%	2%	1%	2%	2%	0%	0%	1%	1%	1%
% Aquatic Diptera	3%	6%	9%	12%	9%	6%	6%	8%	2%	6%	20%	11%	10%
% Other	0%	2%	2%	2%	1%	1%	2%	1%	0%	1%	7%	1%	1%
% EPT	97%	92%	89%	86%	90%	92%	92%	92%	98%	93%	73%	89%	88%
% Chironomidae	1%	4%	7%	11%	8%	3%	4%	6%	1%	5%	17%	9%	9%
% Dominant Taxon	41%	35%	30%	28%	30%	37%	36%	58%	46%	31%	21%	37%	25%
Total Terrestrial Insects Counted	0	4	5	1	24	5	2	8	2	11	4	0	855
Total Aquatic Insects Counted	1,184	704	2,367	1,679	1,396	693	733	1,331	953	1,240	982	693	14
Total Insects Counted	1,184	708	2,372	1,680	1,420	698	735	1,339	955	1,251	986	693	869
% Sample Aquatic	100%	99%	100%	100%	98%	99%	100%	99%	100%	99%	100%	100%	98%
% Sample Terrestrial	0%	1%	0%	0%	2%	1%	0%	1%	0%	1%	0%	0%	2%
Total Sample Area (m^2)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Mean Number of Total Insects / m^2	2,753	1,647	5,516	3,907	3,302	1,623	1,709	3,114	2,221	2,909	2,293	1,612	2,021
Mean Number of Aquatic Insects / m^2	2,753	1,637	5,505	3,905	3,247	1,612	1,705	3,095	2,216	2,884	2,284	1,612	1,988
± 1 Standard Deviation	1,435	434	1,579	677	1,441	807	648	980	1,939	1,530	630	872	526

Appendix B2.– Greens Creek Site 54 benthic macroinvertebrate data summaries, 2001–2013.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Aquatic Insect Taxa Counted	28	30	26	32	25	13	15	22	23	21	34	30	19
Total Ephemeroptera	1,627	1,352	2,011	1,601	1,265	477	286	1,105	895	1,247	1,536	591	308
Total Plecoptera	80	54	82	117	37	30	22	65	43	53	96	49	54
Total Trichoptera	7	6	12	19	31	4	0	9	4	8	32	9	3
Total Aquatic Diptera	53	39	173	184	65	13	10	85	32	61	203	81	52
Total Other	15	15	57	46	4	1	1	13	5	8	46	24	19
% Ephemeroptera	91%	92%	86%	81%	90%	91%	90%	87%	91%	91%	80%	78%	71%
% Plecoptera	4%	4%	4%	6%	3%	6%	7%	5%	4%	4%	5%	6%	12%
% Trichoptera	0%	0%	1%	1%	2%	1%	0%	1%	0%	1%	2%	1%	1%
% Aquatic Diptera	3%	3%	7%	9%	5%	2%	3%	7%	3%	4%	11%	11%	12%
% Other	1%	1%	2%	2%	0%	0%	0%	1%	1%	1%	2%	4%	4%
% EPT	96%	96%	90%	88%	95%	97%	97%	92%	96%	95%	87%	86%	84%
% Chironomidae	2%	2%	6%	8%	4%	2%	2%	5%	2%	3%	9%	9%	10%
% Dominant Taxon	52%	43%	40%	38%	40%	31%	34%	53%	40%	35%	43%	30%	30%
Total Terrestrial Insects Counted	0	4	7	1	3	1	6	1	8	9	14	3	8
Total Aquatic Insects Counted	1,782	1,466	2,335	1,967	1,402	525	319	1,277	979	1,377	1,913	764	436
Total Insects Counted	1,782	1,470	2,342	1,968	1,405	526	325	1,278	987	1,386	1,927	797	444
% Sample Aquatic	100%	100%	100%	100%	100%	100%	98%	100%	99%	99%	99%	100%	98%
% Sample Terrestrial	0%	0%	0%	0%	0%	0%	2%	0%	1%	1%	1%	0%	2%
Total Sample Area (m^2)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Mean Number of Total Insects / m^2	4,144	3,419	5,447	4,577	3,267	1,223	756	2,972	2,295	3,223	4,481	1,765	1,033
Mean Number of Aquatic Insects / m^2	4,144	3,409	5,430	4,575	3,260	1,221	742	2,970	2,277	3,202	4,449	1,753	1,014
± 1 Standard Deviation	1,464	1,148	1,422	1,540	1,016	345	293	1,855	297	772	2,668	738	642

Appendix B3.–Tributary Creek Site 9 benthic macroinvertebrate data summaries, 2001–2013.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Aquatic Insect Taxa Counted	21	24	36	26	30	23	21	20	26	22	26	27	20
Total Ephemeroptera	205	436	981	562	334	444	104	441	203	89	277	245	726
Total Plecoptera	68	69	593	166	95	35	37	50	97	17	138	69	130
Total Trichoptera	0	2	7	5	4	2	4	1	0	0	13	10	2
Total Aquatic Diptera	86	66	256	66	60	42	21	206	141	52	196	179	135
Total Other	150	175	679	233	35	102	52	55	38	40	232	106	36
% Ephemeroptera	40%	58%	39%	54%	63%	71%	48%	59%	42%	45%	32%	40%	71%
% Plecoptera	13%	9%	24%	16%	18%	6%	17%	7%	20%	9%	16%	11%	13%
% Trichoptera	0%	0%	0%	0%	1%	0%	2%	0%	0%	0%	2%	2%	0%
% Aquatic Diptera	17%	9%	10%	6%	11%	7%	10%	27%	29%	26%	23%	29%	13%
% Other	30%	23%	27%	23%	7%	16%	24%	7%	8%	20%	27%	17%	3%
% EPT	54%	68%	63%	71%	82%	77%	67%	65%	63%	54%	50%	53%	83%
% Chironomidae	7%	5%	5%	5%	8%	4%	1%	1%	22%	23%	21%	26%	11%
% Dominant Taxon	26%	29%	26%	44%	37%	40%	26%	33%	32%	32%	24%	30%	38%
Total Terrestrial Insects Counted	0	5	15	3	12	33	1	5	50	22	2	9	13
Total Aquatic Insects Counted	509	748	2,516	1032	528	625	218	753	479	198	856	609	1,029
Total Insects Counted	509	753	2,531	1035	540	658	219	758	529	220	858	618	1,042
% Sample Aquatic	100%	99%	99%	100%	98%	95%	100%	99%	91%	90%	100%	99%	99%
% Sample Terrestrial	0%	1%	1%	0%	2%	5%	0%	1%	10%	11%	0%	1%	1%
Sample Area (m^2)	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
Mean Number of Total Insects / m^2	1,184	1,751	5,886	2,407	1,256	1,530	509	1,763	1,230	512	1,995	1,437	2,423
Mean Number of Aquatic Insects / m^2	1,184	1,740	5,851	2,400	1,228	1,453	507	1,751	1,114	460	1,991	1,416	2,393
± 1 Standard Deviation	1,148	620	1,579	851	357	878	268	631	636	463	447	615	1,897

APPENDIX C: JUVENILE FISH CAPTURE DATA

Appendix C1.–Greens Creek Site 48 juvenile fish capture data, 2001–2013.

Year	Species	FL (mm)	Number of Fish Captured				Population Estimate	Condition (g/mm^3)
			Set 1	Set 2	Set 3	Total		
2001	DV	48-139	30	16	22	68	121±68	n/a
2002	DV	45-160	74	29	23	126	144±17	n/a
2003	DV	54-180	157	72	56	285	347±39	n/a
2004	DV	54-158	168	48	28	244	256±10	n/a
2005	DV	50-149	118	56	38	212	251±28	n/a
2006	DV	49-150	138	40	34	212	231±15	n/a
2007	DV	53-154	50	29	16	95	113±19	n/a
2008	DV	77-137	54	10	9	73	75±4	n/a
2009	DV	47-142	67	31	28	126	159±30	n/a
2010	DV	47-170	97	41	20	158	172±13	n/a
2011	DV	54-155	56	28	41	125	241±125	n/a
2012	DV	64-148	85	22	28	135	153±17	1.03
2013	DV	35-154	167	61	25	253	267±11	1.01

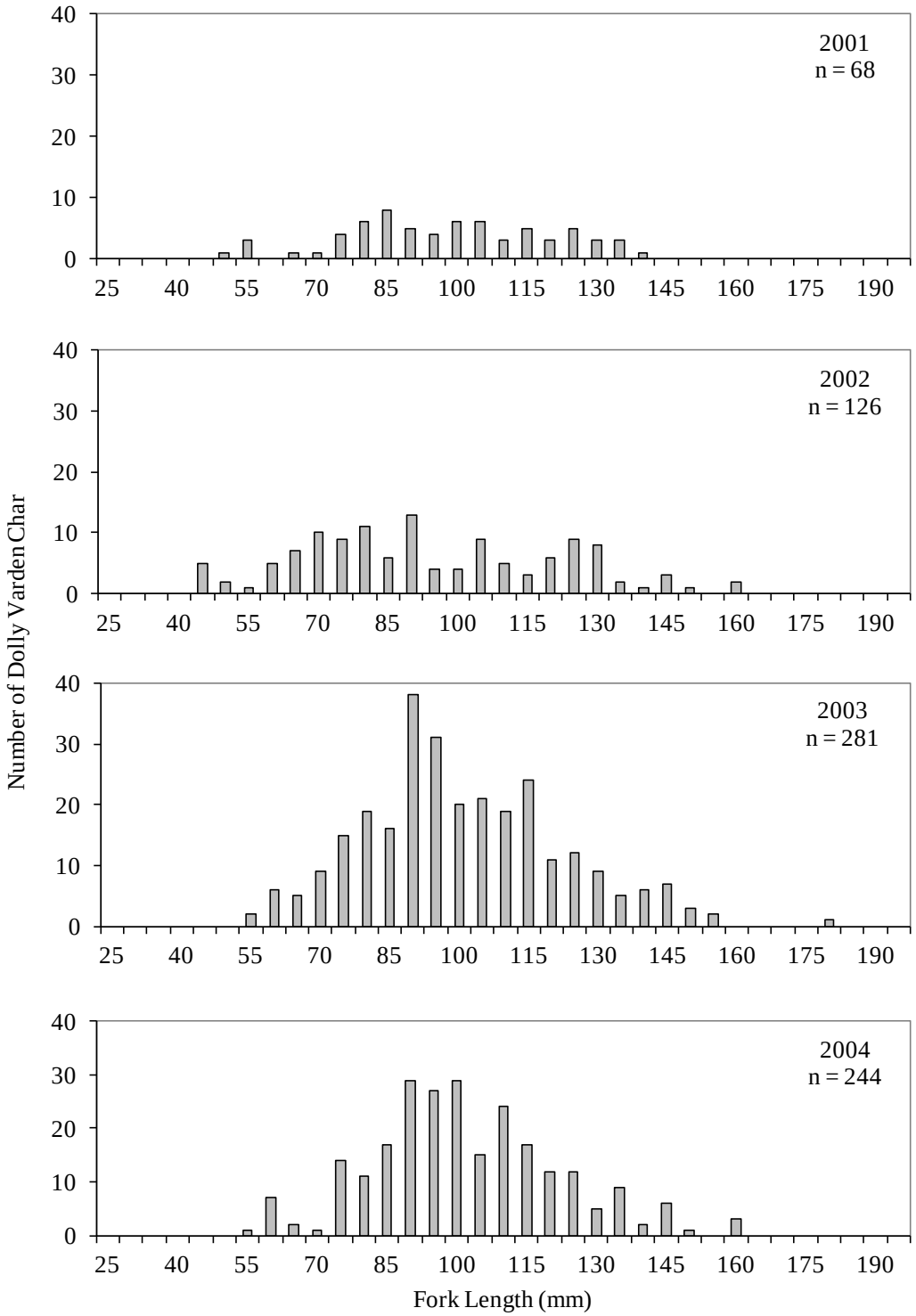
Appendix C2.–Greens Creek Site 54 juvenile fish capture data, 2001–2013.

Year	Species	FL (mm)	Number of Fish Captured				Population Estimate	Condition (g/mm^3)
			Set 1	Set 2	Set 3	Total		
2001	DV	27-162	70	49	19	138	163±21	n/a
	CO	32-95	2	6	4	12	---	n/a
2002	DV	33-160	168	72	31	271	293±16	n/a
	CO	59-85	14	6	1	21	21	n/a
2003	DV	51-184	92	81	59	232	440±175	n/a
	CO	44-52	5	3	0	8	---	n/a
2004	DV	52-161	118	36	47	201	244±32	n/a
	CO	70-95	9	9	6	24	34±17	n/a
2005	DV	52-146	111	59	43	213	269±40	n/a
	CO	66-93	33	20	8	61	68±9	n/a
2006	DV	49-158	116	61	40	217	264±33	n/a
	CO	62-88	6	0	1	7	---	n/a
2007	DV	50-145	64	19	24	107	126±19	n/a
	CO	---	0	0	0	0	---	n/a
2008	DV	45-131	50	15	6	71	73	n/a
	CO	53-69	4	0	0	4	---	n/a
2009	DV	47-101	42	32	19	93	128±37	n/a
	CO	67-73	2	2	0	4	---	n/a
2010	DV	52-151	46	13	14	73	81±10	n/a
	CO	77	1	0	0	1	---	n/a
2011	DV	43-150	73	43	57	173	390±224	n/a
	CO	---	0	0	0	0	---	n/a
2012	DV	47-143	92	39	58	189	313±105	0.99
	CO	67-71	0	3	2	5	---	1.08
2013	DV	50-150	188	67	42	297	323±17	1.05
	CO	---	0	0	0	0	---	n/a

Appendix C3.–Tributary Creek Site 9 juvenile fish capture data, 2001–2013.

Year	Species	FL (mm)	Number of Fish Captured				Population Estimate	Condition (g/mm^3)
			Set 1	Set 2	Set 3	Total		
2001	DV	58-110	70	4	7	81	81	n/a
	CO	39-101	89	18	11	118	120±3	n/a
	CT	124	1	0	0	1	---	n/a
2002	DV	38-147	29	14	8	51	57±9	n/a
	CO	27-85	29	9	6	44	46±4	n/a
	CT	124	0	0	1	1	---	n/a
2003	DV	54-114	13	4	2	19	19	n/a
	CO	46-88	37	11	4	52	53±2	n/a
	CT	122	1	0	0	1	---	n/a
2004	DV	64-109	21	6	5	32	33±2	n/a
	CO	40-94	23	2	2	27	27	n/a
	CT	122	1	0	0	1	---	n/a
	RT	86-106	3	1	0	4	---	n/a
2005	DV	59-131	21	12	11	44	59±21	n/a
	CO	39-103	82	42	15	139	151±12	n/a
	CT	91-103	1	1	0	2	---	n/a
2006	DV	85-117	7	3	1	11	---	n/a
	CO	69-108	5	4	1	10	---	n/a
	CT	---	0	0	0	0	---	n/a
2007	DV	81-158	7	5	0	12	---	n/a
	CO	38-104	50	10	9	69	71±4	n/a
	CT	138	0	0	1	1	---	n/a
2008	DV	60-108	15	4	3	22	22	n/a
	CO	41-100	72	44	26	142	177±30	n/a
	CT	82-112	1	0	2	3	---	n/a
2009	DV	48-98	24	5	9	38	42±7	n/a
	CO	38-116	42	9	2	53	53	n/a
	CT	97	1	0	0	1	---	n/a
2010	DV	58-108	21	7	31	59	59	n/a
	CO	39-90	77	21	30	128	152±22	n/a
	CT	64-89	4	1	0	5	---	n/a
2011	DV	50-125	15	7	14	36	36	n/a
	CO	38-100	18	18	13	49	85±50	n/a
	CT	115	1	0	0	1	---	n/a
2012	DV	66-112	17	11	12	40	40	1.00
	CO	46-105	39	9	7	55	55	1.14
	CT	63-93	4	0	1	5	---	0.97
2013	DV	52-92	9	2	2	13	---	1.23
	CO	50-91	9	6	3	18	20±4	1.43
	CT	73-80	0	2	0	2	---	0.97

Appendix C4.–Length frequency diagrams for Dolly Varden char captured at Greens Creek Site 48, 2001–2013.



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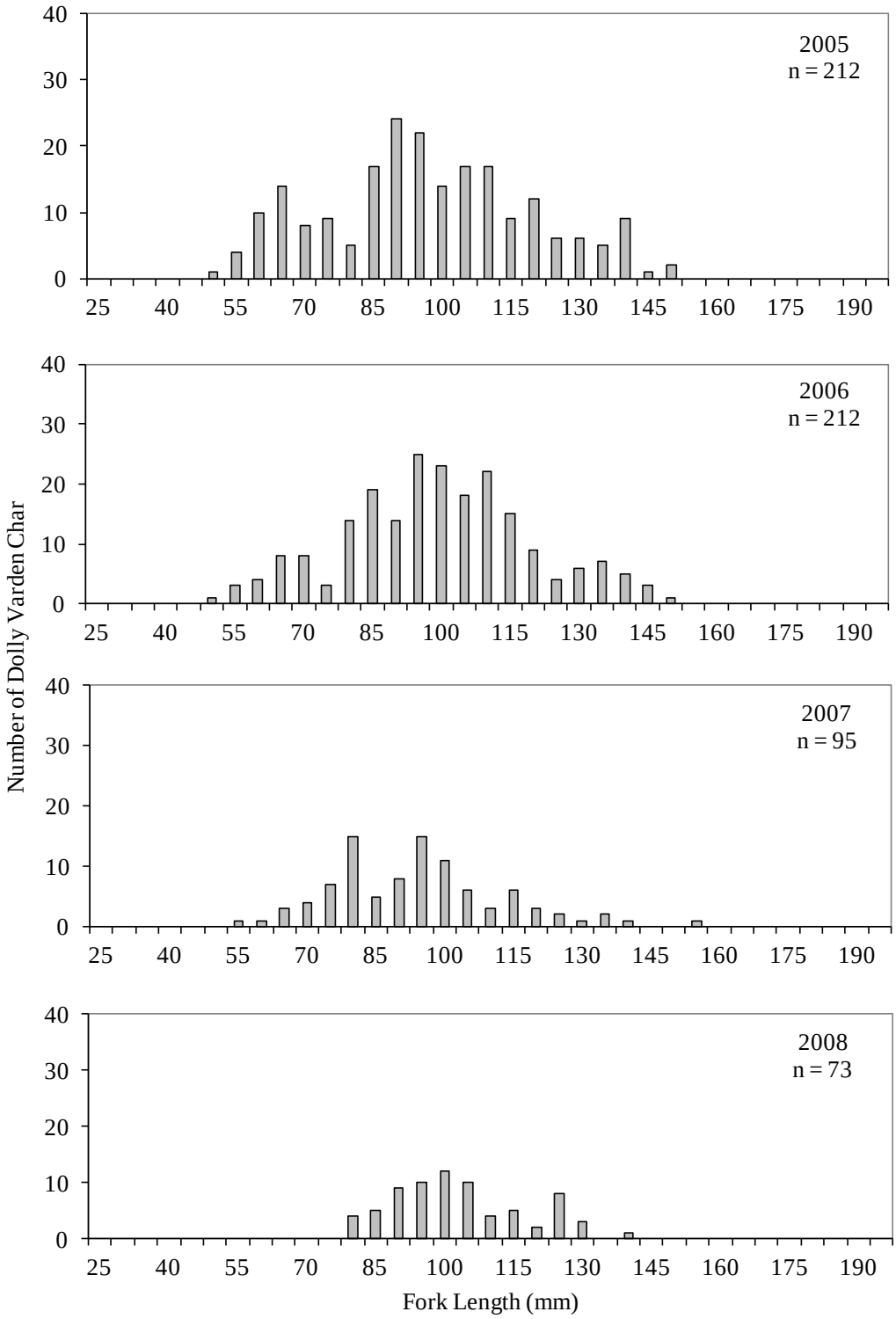
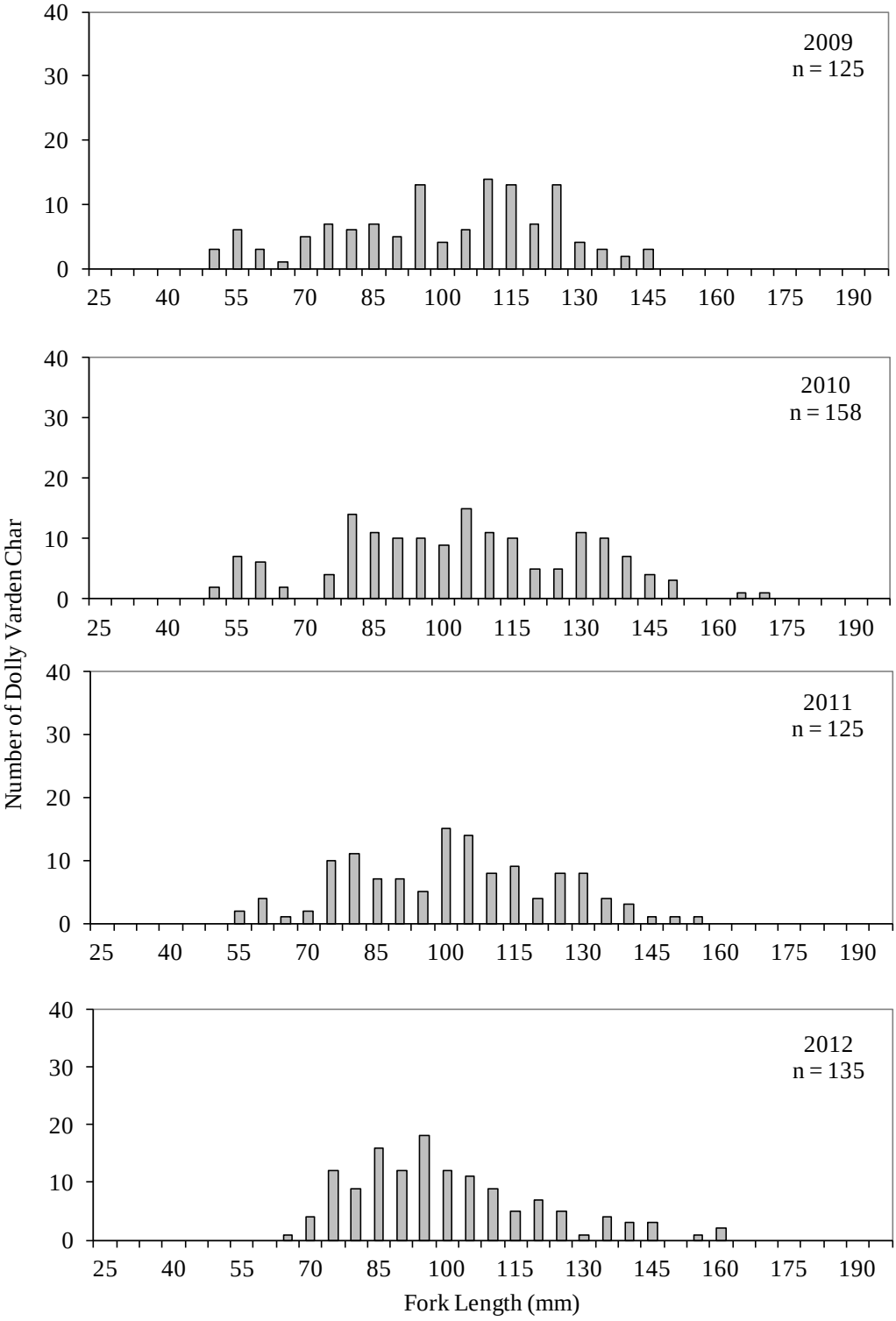
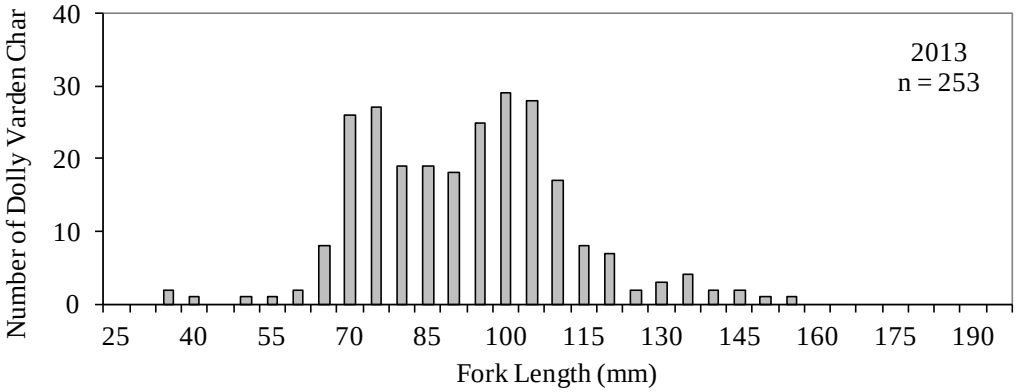

2005
n = 212
2006
n = 212
2007
n = 95
2008
n = 73
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

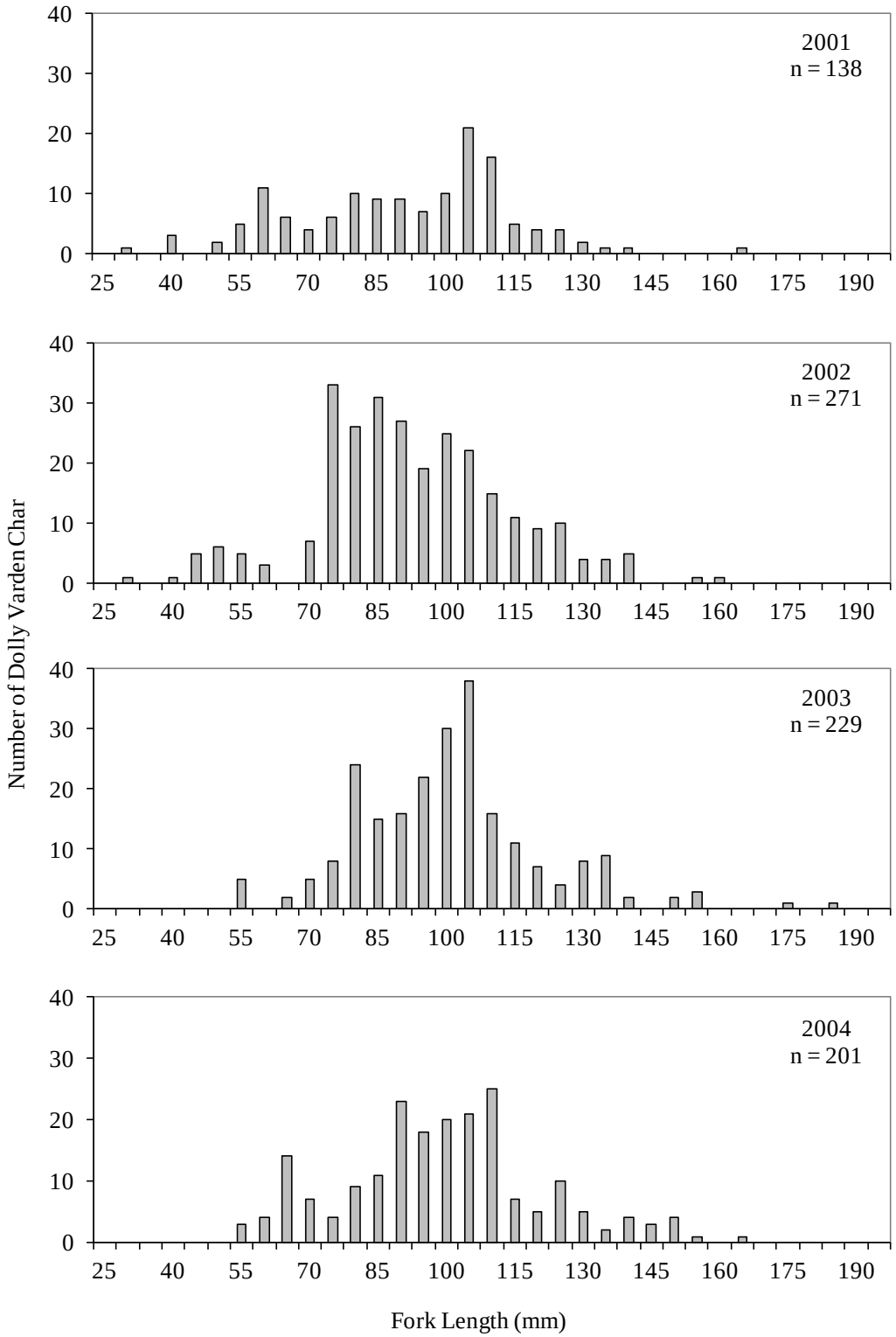
-continued-


2009
n = 125
2010
n = 158
2011
n = 125
2012
n = 135
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


Number of Dolly Varden Char
40
30
20
10
0
2013
n = 253
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C5.–Length frequency diagrams for Dolly Varden char captured at Greens Creek Site 54, 2001–2013.



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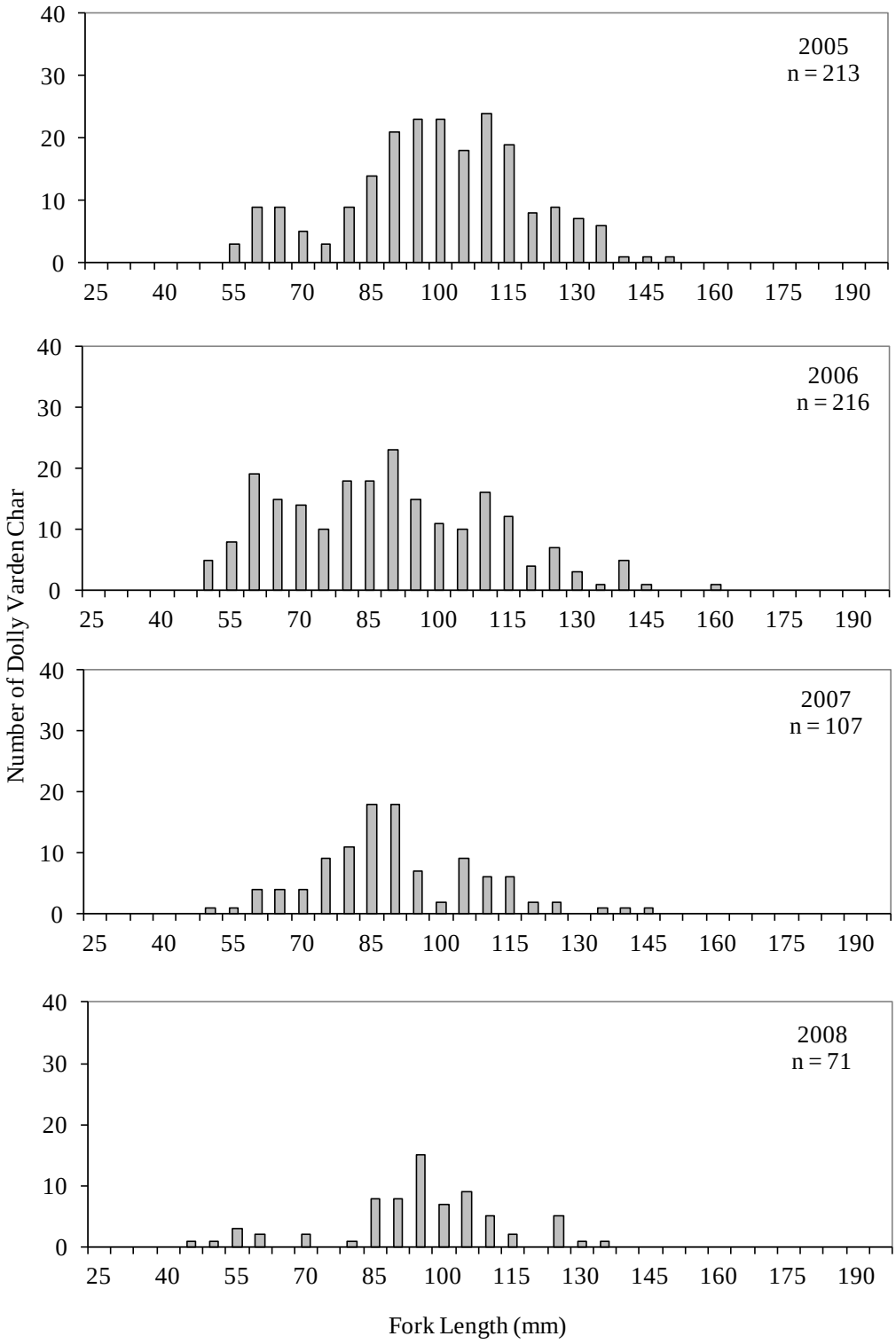
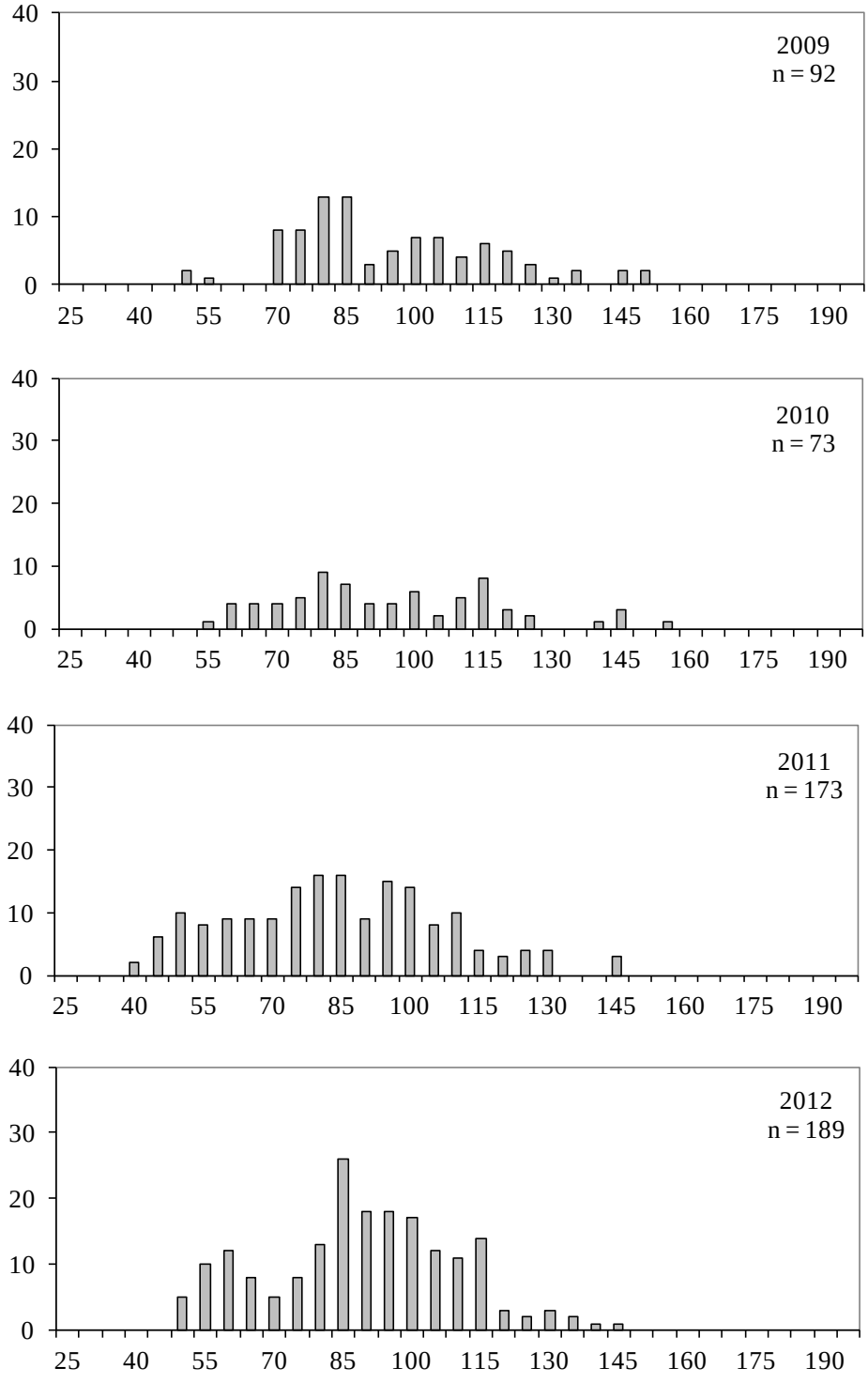
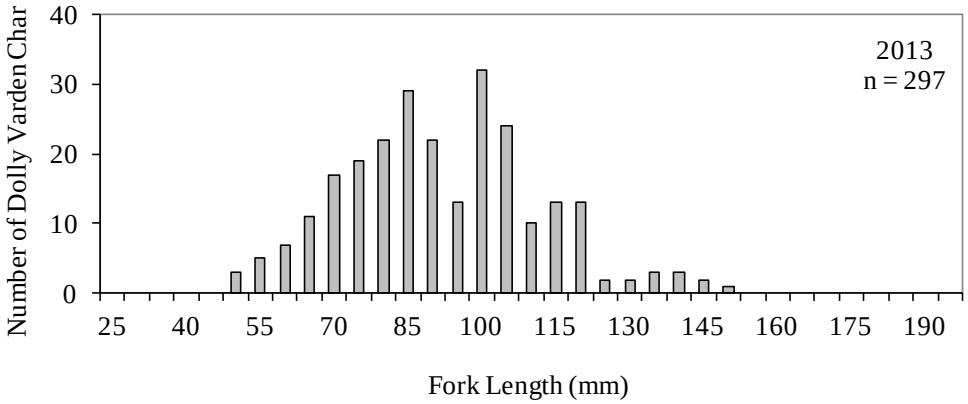

2005
n = 213
2006
n = 216
2007
n = 107
2008
n = 71
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

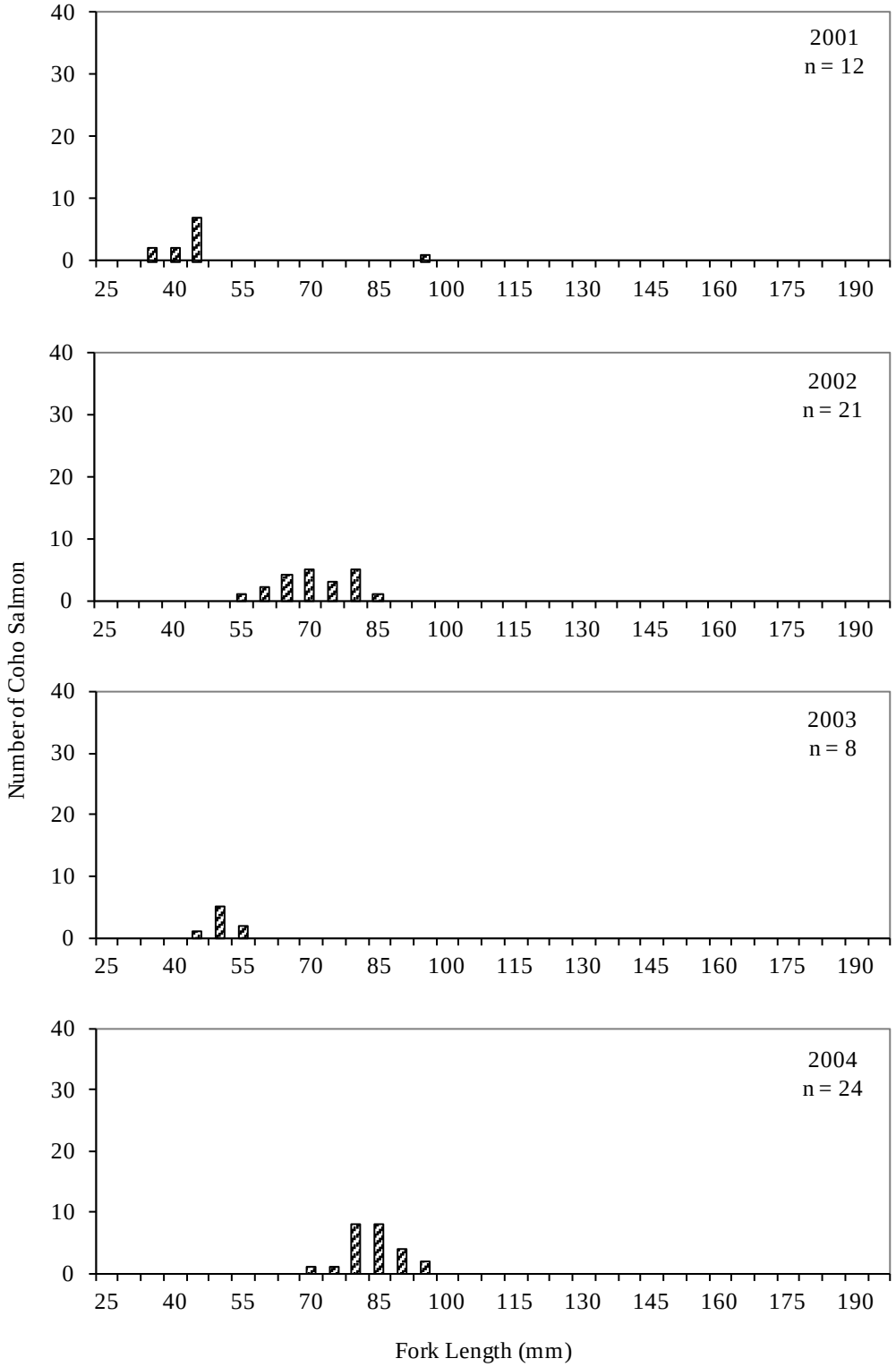
-continued-


2009
n = 92
2010
n = 73
2011
n = 173
2012
n = 189
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

-continued-


Number of Dolly Varden Char
40
30
20
10
0
2013
n = 297
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C6.–Length frequency diagrams for coho salmon captured at Greens Creek Site 54, 2001–2013.



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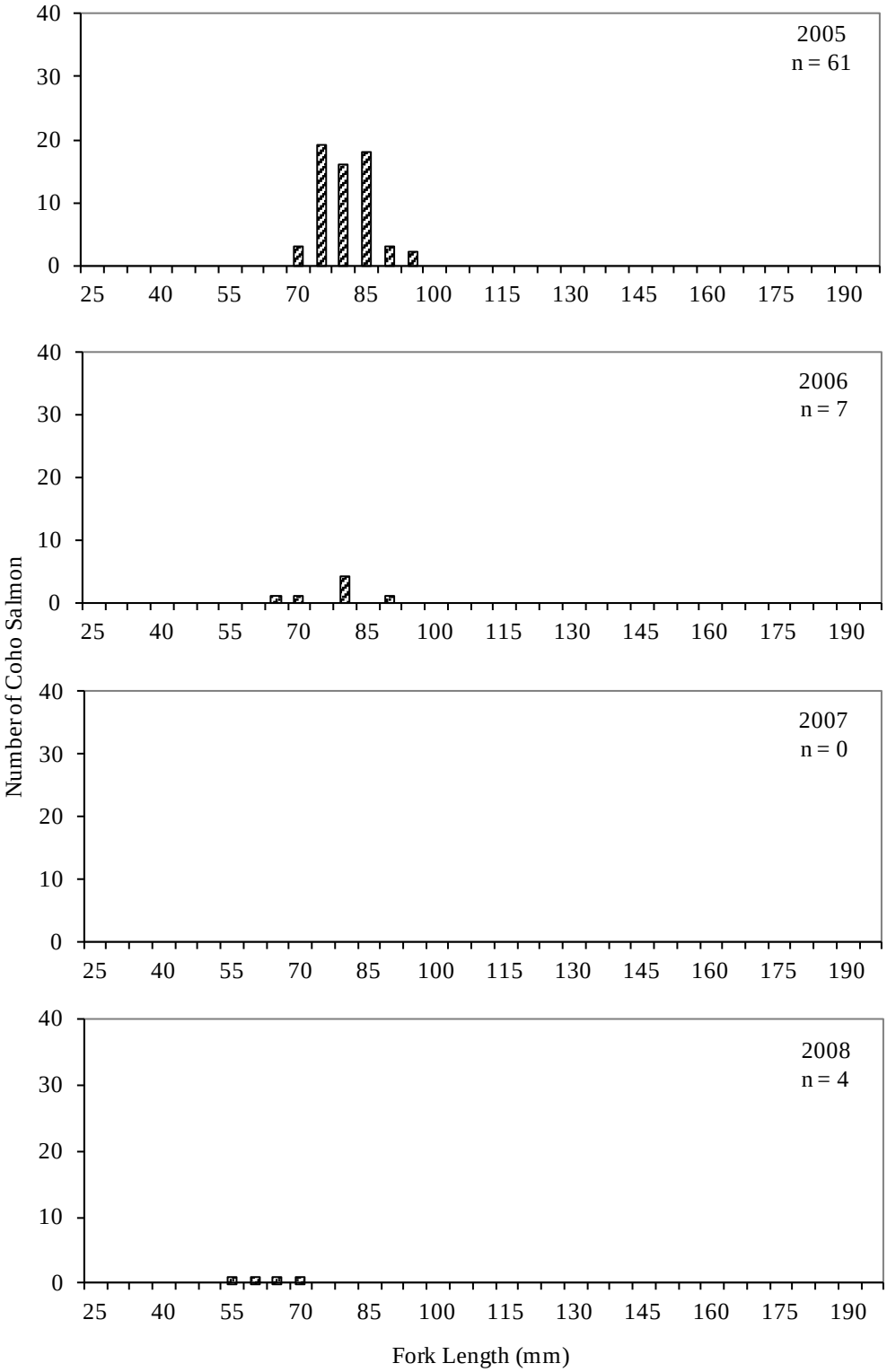
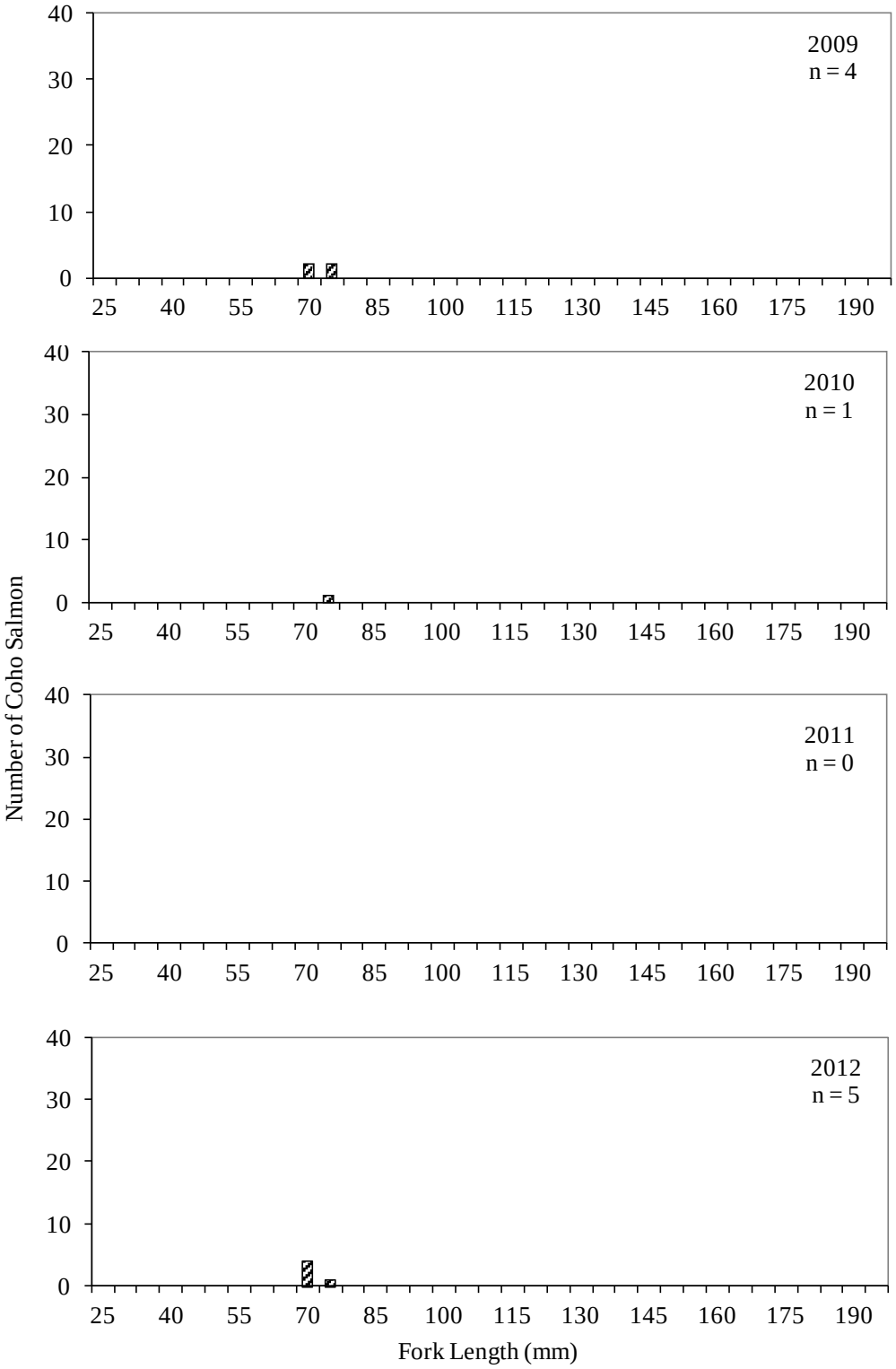
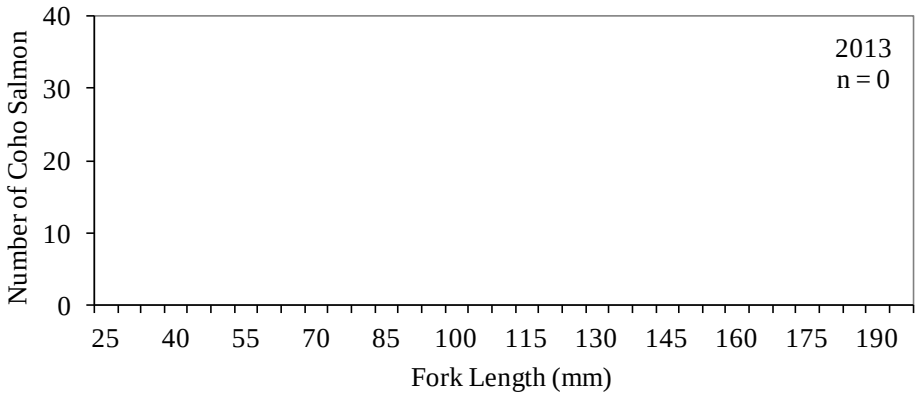

2005
n = 61
2006
n = 7
2007
n = 0
2008
n = 4
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

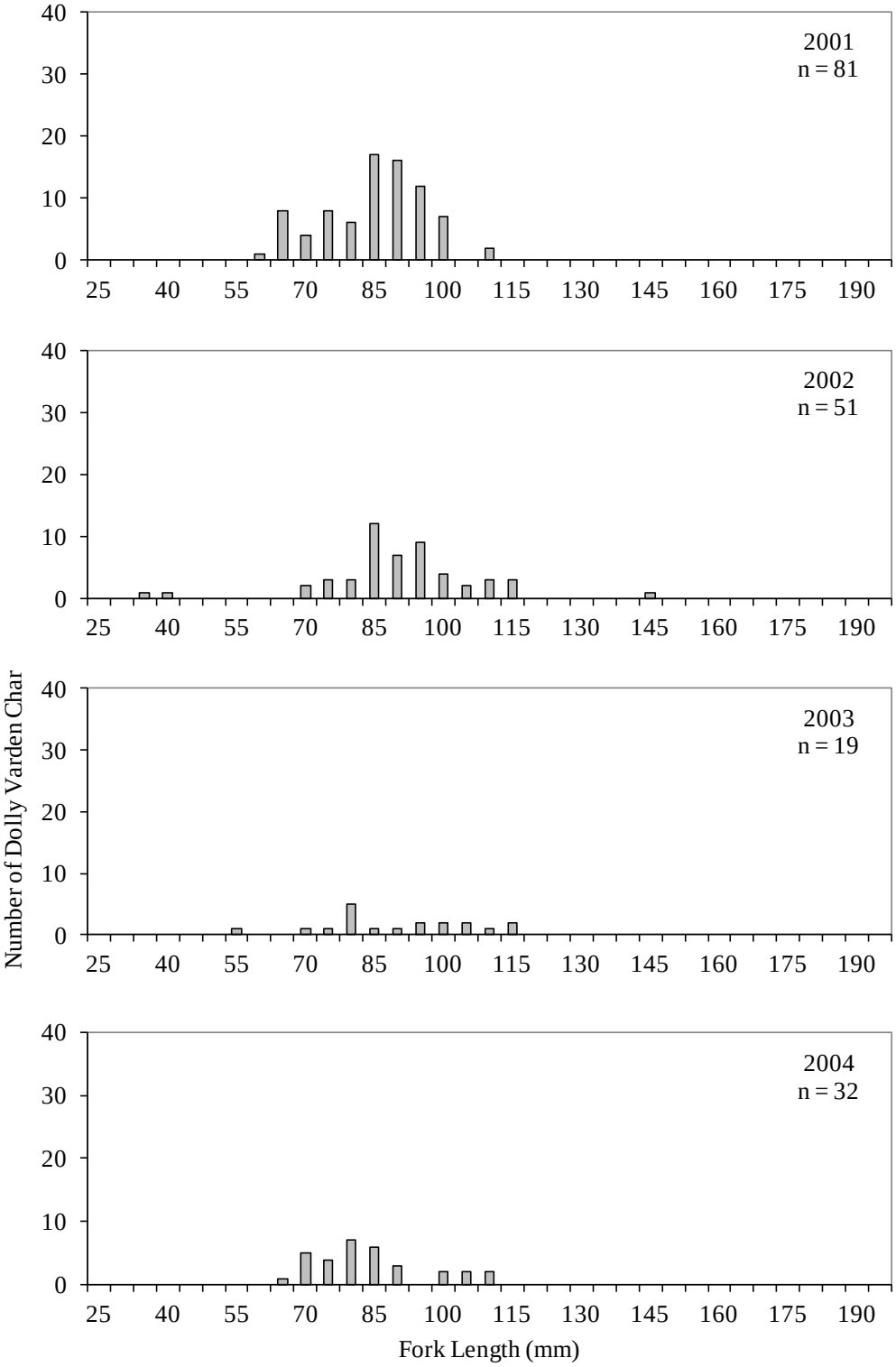
-continued-


2009
n = 4
2010
n = 1
2011
n = 0
2012
n = 5
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

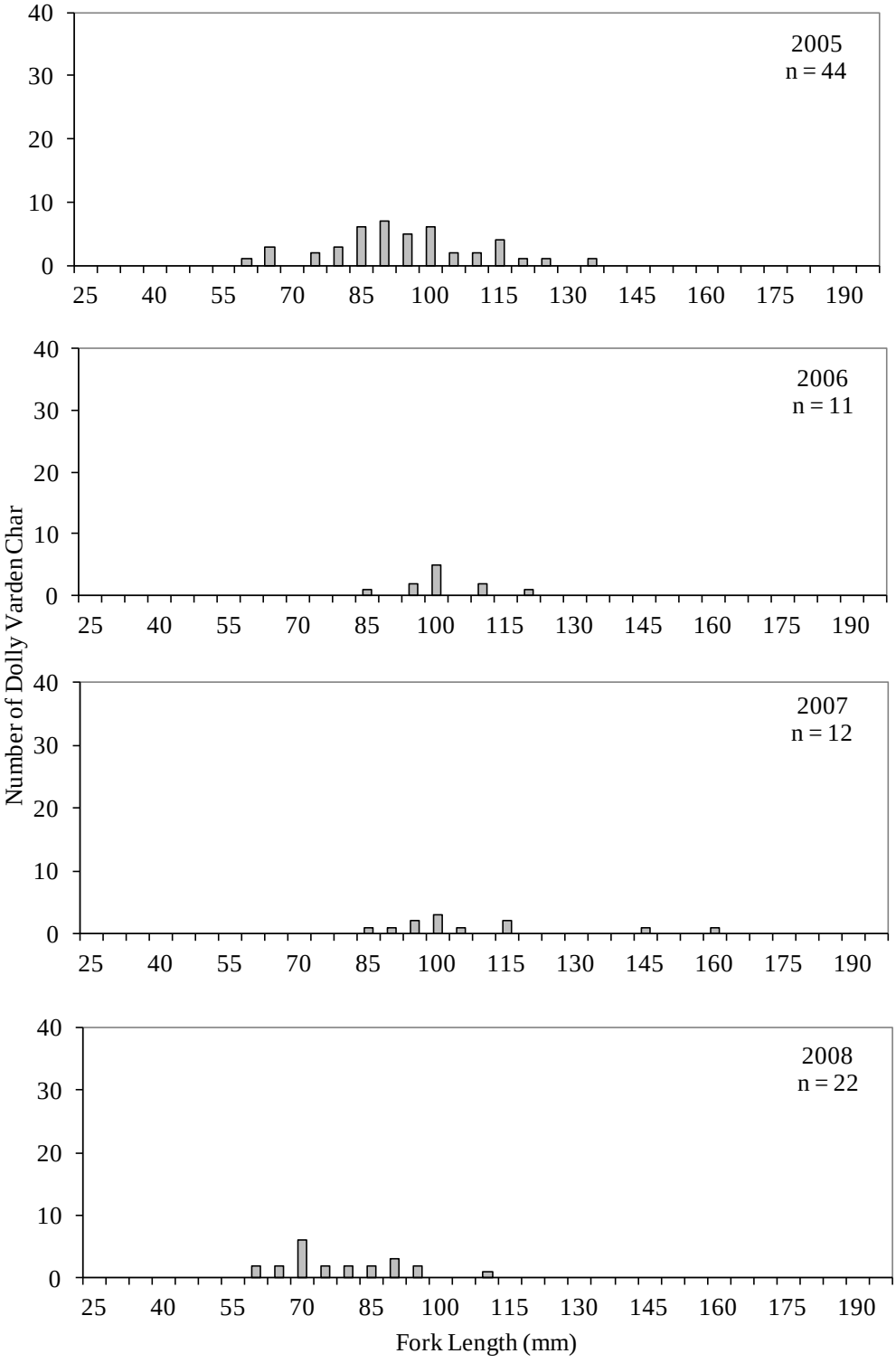
-continued-


Number of Coho Salmon
40
30
20
10
0
2013
n = 0
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

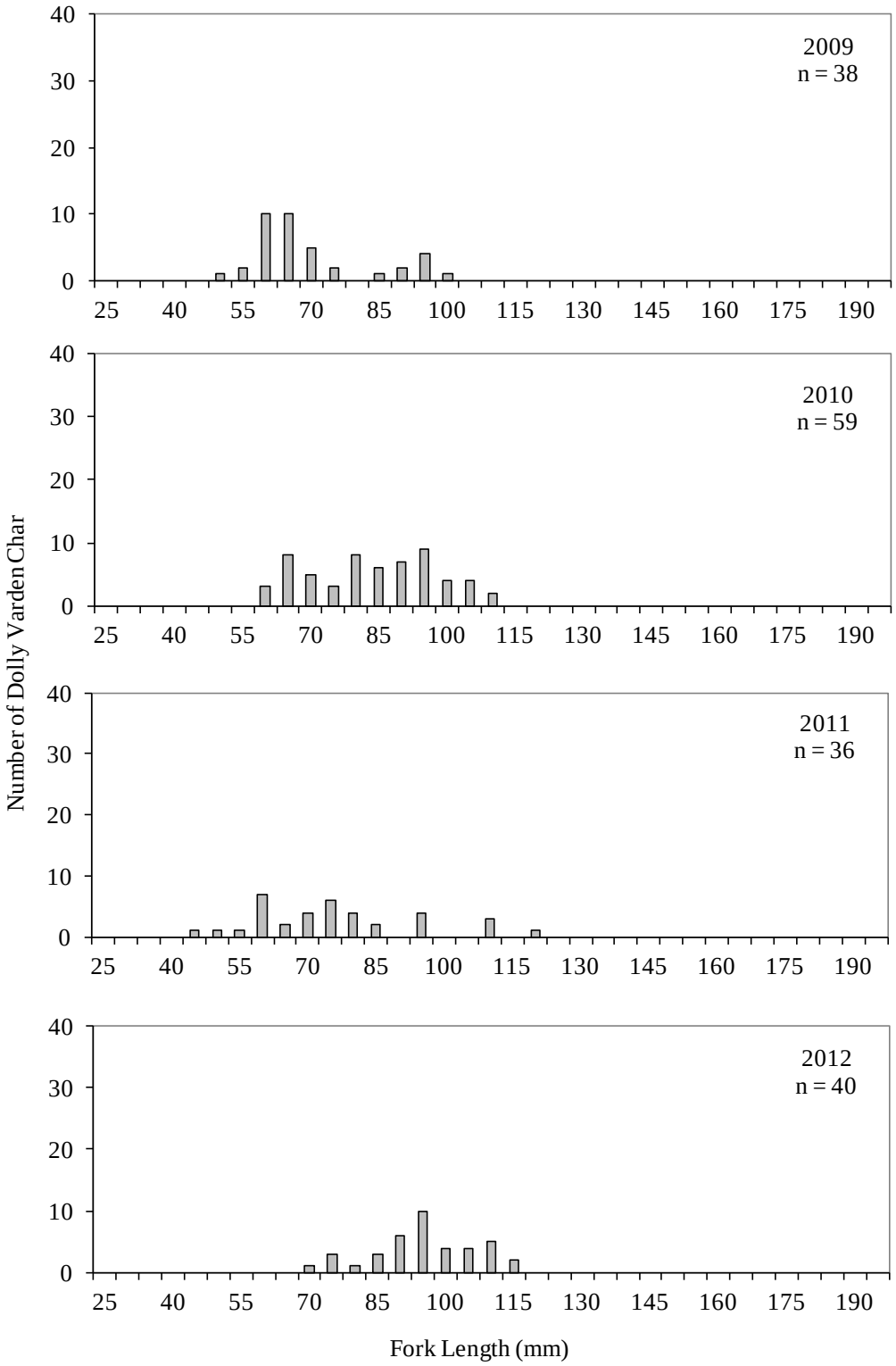
Appendix C7.–Length frequency diagrams for Dolly Varden char captured at Tributary Creek Site 9, 2001–2013.



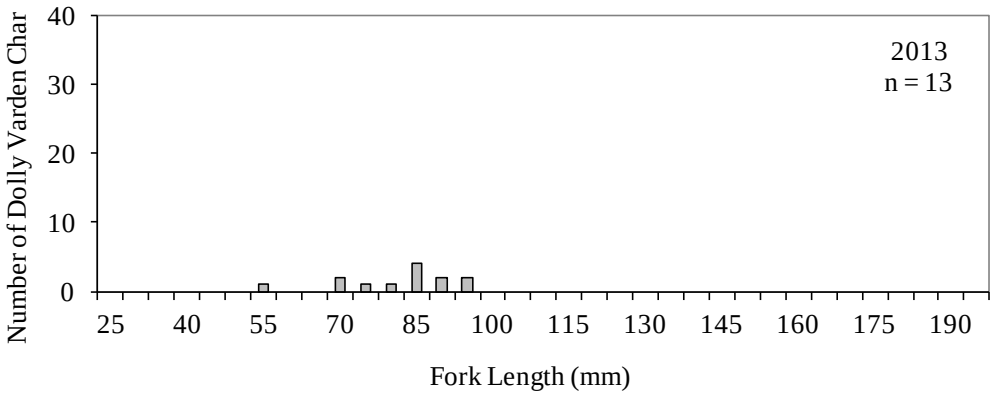
-continued-


2005
n = 44
2006
n = 11
2007
n = 12
2008
n = 22
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

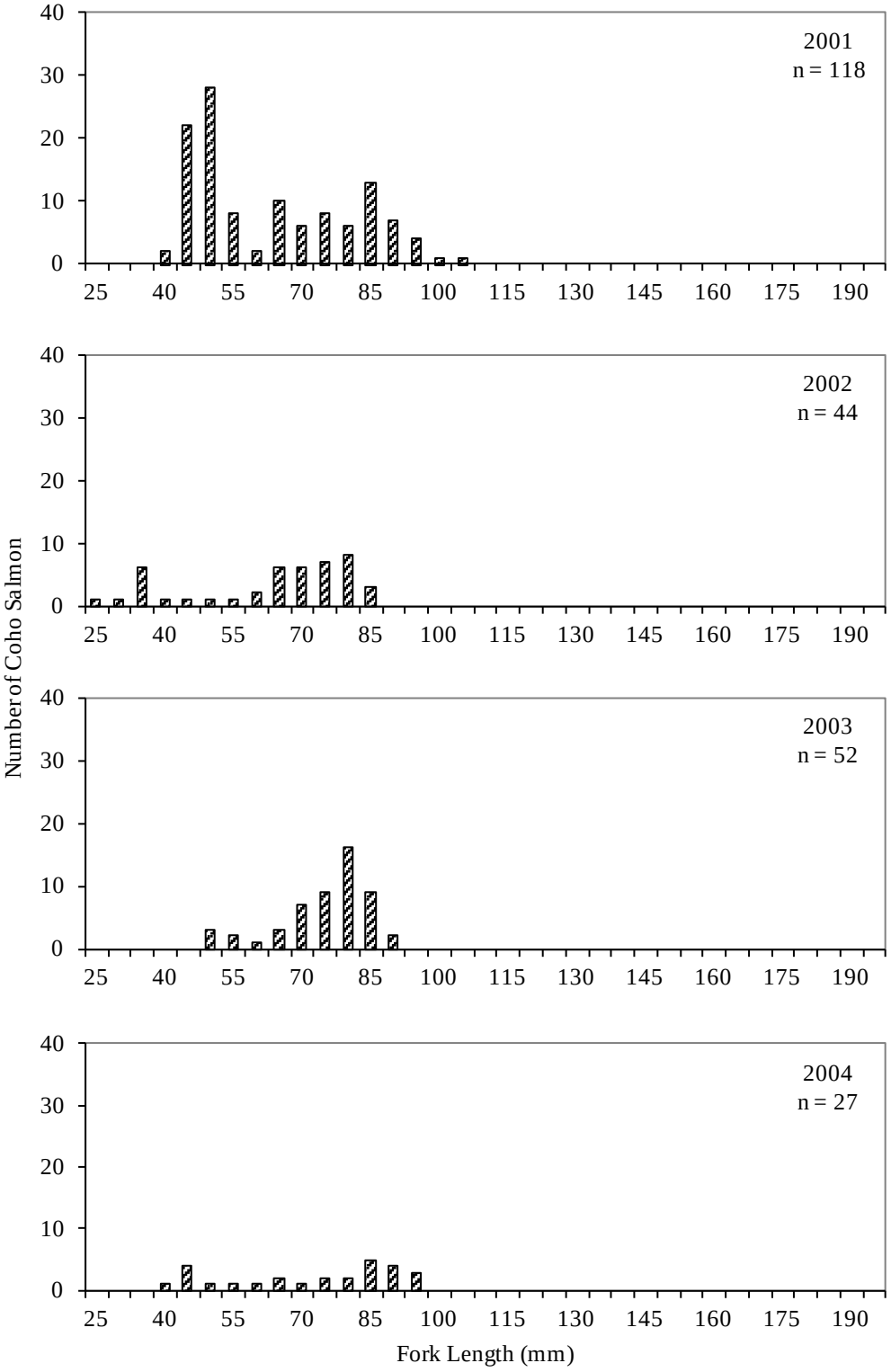
-continued-


2009
n = 38
2010
n = 59
2011
n = 36
2012
n = 40
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


Number of Dolly Varden Char
40
30
20
10
0
2013
n = 13
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C8.–Length frequency diagrams for coho salmon captured at Tributary Creek Site 9, 2001–2013.



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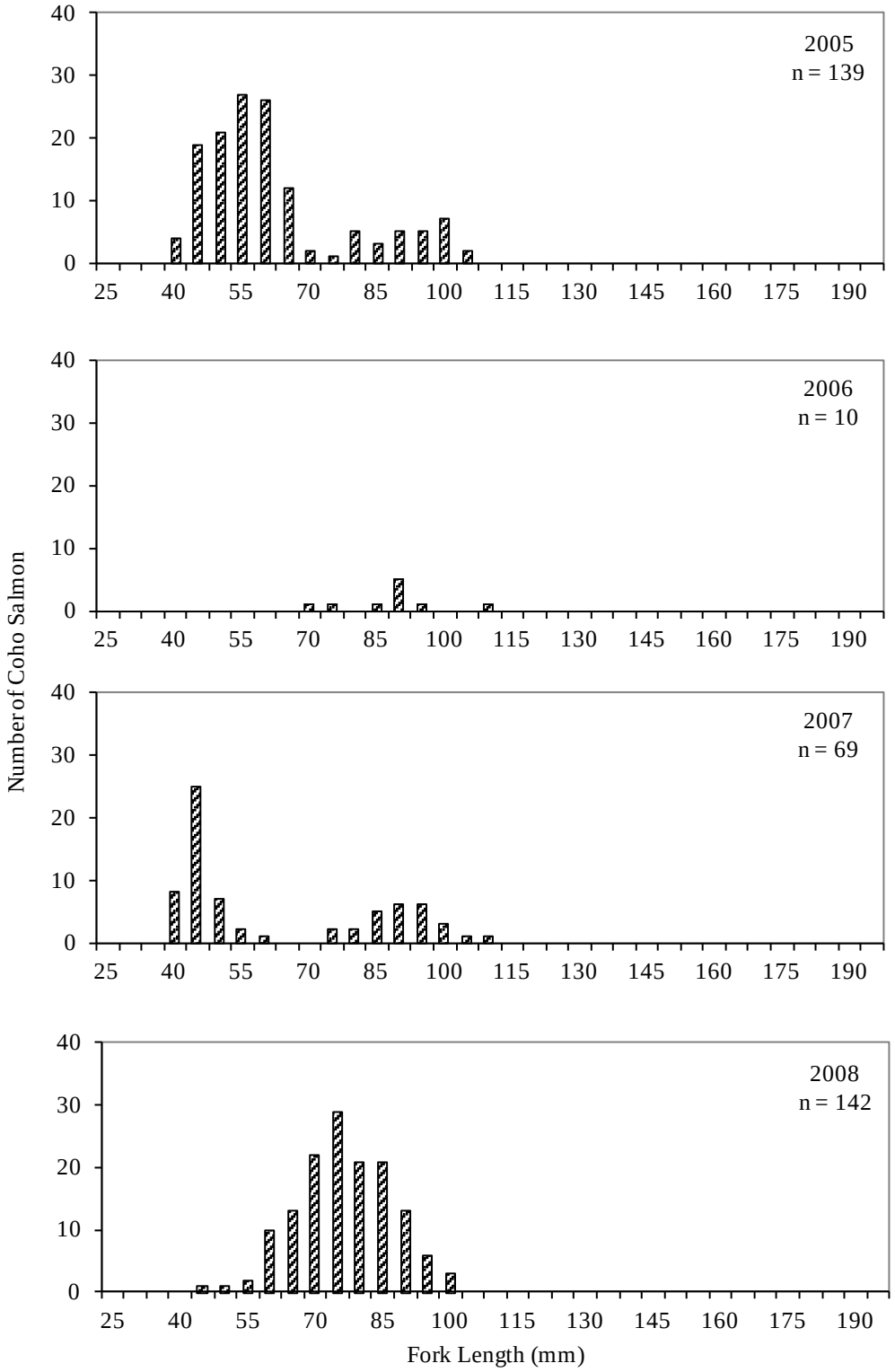
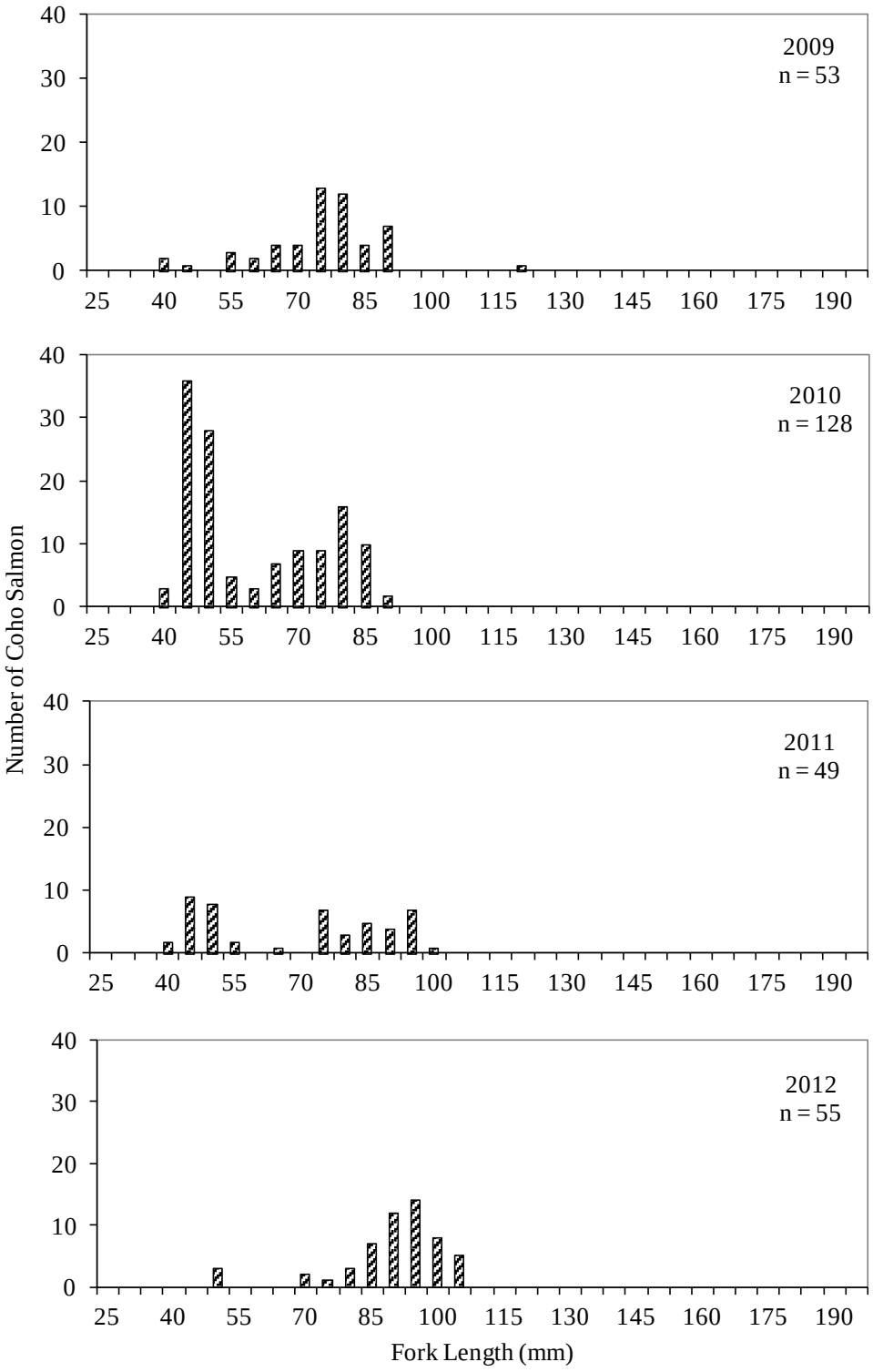
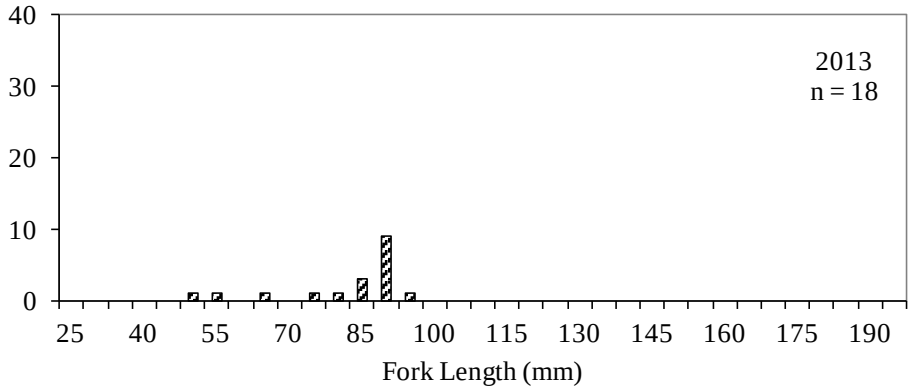

2005
n = 139
2006
n = 10
2007
n = 69
2008
n = 142
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2009
n = 53
2010
n = 128
2011
n = 49
2012
n = 55
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


40
30
20
10
0
2013
n = 18
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

APPENDIX D: JUVENILE FISH METALS CONCENTRATIONS DATA AND LABORATORY REPORT

Appendix D1.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Greens Creek Site 48, 2001–2013.

Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
Minimum Detection Limit			0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/23/01	131	26.0	0.020	1.76	8.3	n/a	0.20	6.1	180
7/23/01	137	28.8	0.030	0.89	7.2	n/a	0.17	4.6	146
7/23/01	119	18.8	0.020	2.27	5.7	n/a	0.20	6.2	189
7/23/01	121	21.1	0.020	1.56	6.9	n/a	0.17	5.2	182
7/23/01	111	13.7	0.030	0.89	4.7	n/a	0.23	5.4	138
7/23/01	121	21.1	<0.02	1.26	7.4	n/a	0.10	5.6	157
7/24/02	133	23.2	0.030	1.64	6.8	n/a	0.72	4.8	239
7/24/02	120	15.0	0.070	0.85	7.0	n/a	0.28	4.1	210
7/24/02	122	17.5	0.030	0.74	4.3	n/a	0.17	4.9	162
7/24/02	127	20.8	0.040	1.40	6.1	n/a	0.16	4.7	185
7/24/02	134	24.8	0.050	1.30	7.9	n/a	0.46	4.3	208
7/24/02	128	21.7	0.040	1.56	6.8	n/a	0.22	5.7	343
7/22/03	90	8.9	<0.02	0.65	4.2	n/a	0.14	5.6	191
7/22/03	98	9.9	<0.02	0.90	5.1	n/a	0.22	5.5	180
7/22/03	103	12.1	<0.02	0.82	5.6	n/a	0.16	5.4	241
7/22/03	112	12.5	<0.02	0.78	6.1	n/a	0.11	6.1	192
7/22/03	108	11.9	<0.02	0.63	3.9	n/a	0.14	5.2	174
7/22/03	100	10.5	<0.02	0.58	3.7	n/a	0.08	5.5	218
7/22/04	96	8.6	<0.02	0.63	4.7	n/a	0.15	4.3	206
7/22/04	88	6.8	<0.02	0.83	5.6	n/a	0.26	4.0	175
7/22/04	101	11.5	<0.02	1.54	4.6	n/a	0.21	4.1	183
7/22/04	98	9.3	<0.02	0.80	5.2	n/a	0.28	3.7	168
7/22/04	93	7.6	<0.02	1.25	4.4	n/a	0.14	6.4	220
7/22/04	91	7.5	0.030	1.01	4.5	n/a	0.29	5.6	323
7/22/05	103	19.7	0.020	0.66	4.4	n/a	0.44	4.2	183
7/22/05	96	13.1	<0.02	0.84	14.5	n/a	0.98	4.8	220
7/22/05	119	15.6	<0.02	0.89	4.4	n/a	0.66	4.8	226
7/22/05	114	17.1	0.020	0.59	6.0	n/a	0.32	4.8	178
7/22/05	111	15.3	0.030	1.10	18.8	n/a	0.79	4.6	217
7/22/05	125	16.9	0.030	0.47	3.6	n/a	0.36	3.8	161
7/20/06	110	15.8	0.040	0.56	8.5	n/a	0.37	5.4	244
7/20/06	110	15.4	0.050	1.20	8.3	n/a	0.31	6.0	217
7/20/06	113	16.1	0.040	0.65	6.3	n/a	0.24	5.4	264
7/20/06	132	25.0	0.056	0.63	8.1	n/a	0.66	5.2	232
7/20/06	104	12.8	0.080	0.96	8.5	n/a	0.37	5.1	283
7/20/06	114	16.7	0.030	0.63	5.3	n/a	0.20	5.1	270
7/21/07	122	17.9	0.030	1.16	5.5	n/a	0.17	5.5	221
7/21/07	95	10.4	0.020	1.42	3.9	n/a	0.29	5.8	165
7/21/07	135	22.8	0.085	1.35	14.1	n/a	1.37	5.3	166
7/21/07	98	9.9	0.030	0.96	5.7	n/a	0.27	5.2	269
7/21/07	105	13.2	0.110	1.79	11.4	n/a	1.62	5.4	323
7/21/07	99	10.0	0.040	1.43	5.2	n/a	0.31	5.7	208

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Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
	Minimum Detection Limit		0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/22/08	112	16.4	0.069	1.23	5.2	n/a	0.95	5.7	289
7/22/08	123	21.3	0.039	0.79	3.9	n/a	0.57	4.6	194
7/22/08	105	14.0	0.079	0.82	4.6	n/a	0.52	5.9	200
7/22/08	124	20.6	0.041	0.87	4.9	n/a	0.42	6.3	244
7/22/08	115	16.9	0.030	1.36	5.3	n/a	0.51	5.4	254
7/22/08	122	19.8	0.037	1.07	5.6	n/a	0.38	6.1	260
7/21/09	120	20.1	<0.02	1.05	5.2	n/a	0.22	5.9	186
7/21/09	121	20.7	<0.02	1.40	5.3	n/a	0.44	5.7	173
7/21/09	119	17.9	0.020	1.10	4.5	n/a	0.13	5.9	182
7/21/09	108	13.6	<0.02	1.20	4.1	n/a	0.15	5.7	162
7/21/09	109	14.6	<0.02	1.50	4.9	n/a	0.17	5.9	186
7/21/09	110	15.2	<0.02	0.84	3.8	n/a	0.18	6.1	202
7/21/10	103	11.9	0.020	1.56	4.8	0.090	0.16	5.0	226
7/21/10	109	16.1	<0.02	0.51	3.0	0.150	0.20	5.6	168
7/21/10	108	13.9	0.040	0.91	4.2	0.170	0.30	5.0	180
7/21/10	105	13.8	<0.02	0.98	3.4	0.130	0.09	4.6	163
7/21/10	98	10.8	0.062	0.90	4.8	0.140	0.46	4.8	213
7/21/10	93	9.1	<0.02	0.96	3.6	0.100	0.09	4.0	156
7/22/11	88-112	n/a	0.03	1.14	5.7	n/a	0.30	6.1	218
7/24/12	109	11.3	0.030	2.26	27.0	0.134	0.16	5.5	186
7/24/12	123	18.3	0.030	1.37	4.9	0.122	0.10	5.7	184
7/24/12	110	9.8	0.030	1.83	25.6	0.159	2.59	5.6	275
7/24/12	103	10.6	0.030	0.99	76.8	0.175	0.30	5.1	189
7/24/12	104	10.7	0.030	2.66	84.8	0.122	1.05	6.3	242
7/24/12	116	15.8	0.040	0.73	35.1	0.148	1.03	4.7	190
7/25/13	145	20.6	0.020	0.65	3.5	0.214	0.16	5.0	247
7/25/13	115	17.9	0.070	0.97	6.1	0.238	0.24	5.8	239
7/25/13	115	14.3	0.020	0.81	4.0	0.180	0.08	6.7	258
7/25/13	105	11.4	0.020	0.68	3.2	0.213	0.14	6.4	213
7/25/13	109	13.0	0.040	2.01	6.6	0.113	0.36	6.2	271
7/25/13	105	12.4	0.040	1.75	5.7	0.274	0.22	6.2	287

Appendix D2.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Greens Creek Site 54, 2001–2013.

Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
Minimum Detection Limit			0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/23/01	121	21.5	0.030	0.46	4.3	n/a	0.33	5.7	126
7/23/01	119	19.3	0.020	0.21	3.2	n/a	0.22	3.6	82
7/23/01	107	15.7	0.030	0.73	6.3	n/a	0.59	4.7	144
7/23/01	109	13.6	0.020	0.82	5.4	n/a	0.86	4.9	172
7/23/01	105	13.5	<0.02	0.79	6.5	n/a	0.45	5.8	203
7/23/01	138	27.5	<0.02	0.74	5.8	n/a	0.40	5.4	171
7/24/02	118	18.0	0.030	0.50	4.4	n/a	0.94	3.4	363
7/24/02	128	22.3	0.030	0.52	4.5	n/a	0.35	4.7	150
7/24/02	115	17.7	0.050	0.95	6.0	n/a	0.66	4.4	161
7/24/02	115	18.9	0.030	1.03	5.2	n/a	0.66	4.2	216
7/24/02	124	21.1	0.050	1.32	5.2	n/a	0.74	3.9	194
7/24/02	123	20.9	0.020	0.70	3.9	n/a	0.78	4.4	195
7/22/03	123	21.1	0.030	0.85	6.4	n/a	1.40	6.1	188
7/22/03	101	10.6	<0.02	0.67	4.2	n/a	0.32	6.4	174
7/22/03	88	9.2	<0.02	0.75	4.3	n/a	0.35	6.5	186
7/22/03	109	14.8	<0.02	1.11	5.8	n/a	0.38	5.7	188
7/22/03	95	10.6	<0.02	0.59	3.5	n/a	0.29	5.7	174
7/22/03	92	9.7	<0.02	0.91	4.1	n/a	0.43	6.5	263
7/21/04	103	9.9	0.020	0.79	11.0	n/a	0.57	4.6	232
7/21/04	104	10.0	<0.02	0.88	5.5	n/a	0.54	5.0	206
7/21/04	86	6.6	<0.02	1.26	5.1	n/a	0.36	5.3	164
7/21/04	96	9.3	0.030	0.79	5.9	n/a	0.28	5.4	191
7/21/04	93	9.9	<0.02	0.83	5.0	n/a	0.48	3.9	202
7/21/04	104	12.9	0.075	1.12	7.0	n/a	0.93	4.9	217
7/22/05	120	12.3	0.030	0.72	5.0	n/a	0.27	4.0	160
7/22/05	106	12.1	0.020	0.63	4.5	n/a	0.13	3.9	200
7/22/05	113	20.8	<0.02	0.73	8.8	n/a	0.17	4.7	223
7/22/05	114	17.9	<0.02	0.82	9.7	n/a	0.17	3.9	222
7/22/05	112	16.1	0.030	1.06	8.8	n/a	0.22	4.4	209
7/22/05	118	22.3	0.020	0.55	5.5	n/a	0.39	3.9	185
7/20/06	137	27.3	0.060	0.42	4.8	n/a	0.51	5.7	208
7/20/06	112	14.9	0.040	0.75	16.0	n/a	0.95	7.2	223
7/20/06	102	12.0	0.020	0.93	22.2	n/a	0.52	6.3	239
7/20/06	114	19.6	0.040	1.03	7.6	n/a	0.85	5.3	252
7/20/06	98	12.3	0.080	0.54	10.9	n/a	0.48	5.4	223
7/20/06	115	16.9	0.040	0.78	8.6	n/a	0.68	5.6	257
7/20/07	102	11.8	0.040	0.88	5.3	n/a	0.54	5.6	157
7/20/07	125	21.1	0.030	0.97	5.2	n/a	0.83	7.5	234
7/20/07	97	10.7	0.060	0.81	5.7	n/a	0.89	8.6	185
7/20/07	123	19.7	0.020	0.75	4.4	n/a	0.50	7.1	175
7/20/07	104	12.5	0.030	0.92	5.6	n/a	0.57	7.8	174
7/20/07	110	15.1	0.040	1.38	6.2	n/a	0.82	5.4	191

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Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
	Minimum Detection Limit		0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/22/08	123	21.9	0.039	0.66	5.3	n/a	0.26	5.5	185
7/22/08	94	10.8	0.039	1.04	5.1	n/a	0.28	6.1	203
7/22/08	123	21.5	0.028	1.53	4.9	n/a	3.46	6.3	261
7/22/08	97	11.2	0.029	1.34	5.0	n/a	0.17	5.9	199
7/22/08	108	16.0	0.045	1.98	6.3	n/a	0.23	6.0	220
7/22/08	108	14.2	0.059	1.07	8.4	n/a	1.31	5.0	195
7/21/09	132	26.9	0.040	1.10	4.8	n/a	0.33	5.4	213
7/21/09	141	32.3	0.020	0.71	4.5	n/a	0.45	7.9	143
7/21/09	116	17.9	<0.02	0.99	4.2	n/a	0.40	6.3	153
7/21/09	117	17.7	0.030	1.00	5.9	n/a	0.39	6.8	200
7/21/09	119	22.1	<0.02	1.20	4.0	n/a	0.28	6.5	176
7/21/09	103	13.0	0.020	2.20	5.3	n/a	0.35	5.9	226
7/20/10	115	16.0	<0.02	0.81	3.4	0.080	0.30	4.7	161
7/20/10	112	12.8	0.022	0.67	3.1	0.090	0.34	3.7	154
7/20/10	118	12.6	<0.02	0.98	3.6	0.120	0.25	5.2	190
7/20/10	108	10.6	<0.02	1.31	3.8	0.100	0.16	4.1	212
7/20/10	115	12.3	<0.02	1.73	5.0	0.120	0.36	4.4	222
7/20/10	94	9.0	0.025	0.77	4.0	0.140	0.31	4.8	199
7/21/11	95-117	n/a	<0.02	0.95	4.5	n/a	0.32	5.6	191
7/23/12	132	24.2	0.02	0.85	7.7	0.08	0.41	9.2	144
7/23/12	118	17.3	0.04	1.03	7.7	0.11	0.57	6.3	199
7/23/12	109	13.1	0.06	2.04	19.2	0.11	1.32	7.4	215
7/23/12	97	9.1	0.03	2.04	65.6	0.13	0.50	6.2	227
7/23/12	115	15.4	0.04	1.22	12.6	0.12	1.10	6.9	202
7/23/12	119	18.3	0.03	1.81	5.3	0.08	0.27	5.1	191
7/24/13	117	16.9	0.02	1.39	4.2	0.13	0.30	5.6	247
7/24/13	117	17.6	0.02	0.74	3.9	0.18	0.39	7.0	297
7/24/13	94	11.3	0.02	1.27	4.3	0.17	0.28	6.6	262
7/24/13	118	18.9	0.02	0.91	3.8	0.15	0.36	6.0	209
7/24/13	105	10.3	0.02	1.18	5.3	0.11	0.27	6.4	245
7/24/13	116	15.3	0.02	1.07	4.5	0.13	0.18	6.4	225

Appendix D3.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Tributary Creek Site 9, 2001–2013.

Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
Minimum Detection Limit			0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/21/01	97	9.1	0.090	0.35	4.3	n/a	0.56	6.8	127
7/21/01	97	9.7	0.100	0.77	5.2	n/a	0.67	8.0	118
7/21/01	97	9.5	0.150	0.92	5.4	n/a	4.88	5.3	144
7/21/01	98	10.4	0.150	0.86	6.7	n/a	2.19	---	99
7/21/01	86	6.4	0.080	0.76	4.9	n/a	0.33	6.2	106
7/21/01	93	7.8	0.060	0.37	12.0	n/a	0.38	6.8	122
7/24/02	103	10.8	0.020	0.22	3.7	n/a	0.12	1.4	144
7/24/02	97	10.4	0.070	1.20	5.5	n/a	1.66	3.3	172
7/24/02	100	11.2	0.130	1.06	6.1	n/a	3.40	5.0	138
7/24/02	90	7.9	0.230	1.29	7.1	n/a	4.08	5.2	168
7/24/02	90	9.2	0.080	1.15	5.2	n/a	1.39	6.2	150
7/24/02	100	9.3	0.040	0.84	3.2	n/a	0.33	5.4	152
7/23/03	106	10.7	0.060	0.46	2.8	n/a	0.34	6.3	134
7/23/03	89	6.8	0.100	1.01	4.0	n/a	0.82	6.0	131
7/23/03	112	17.4	0.160	1.35	4.4	n/a	1.85	5.7	108
7/23/03	95	11.6	0.190	0.69	5.6	n/a	1.30	3.6	136
7/23/03	91	9.5	0.050	0.72	4.4	n/a	0.56	4.9	131
7/23/03	84	8.4	0.120	0.76	3.9	n/a	0.78	4.7	125
7/21/04	84	5.5	0.100	0.96	3.2	n/a	1.19	5.4	169
7/21/04	96	8.5	0.100	1.24	3.8	n/a	0.67	5.9	138
7/21/04	105	14.1	0.095	2.02	4.0	n/a	1.76	5.8	125
7/21/04	85	5.8	0.040	0.47	3.7	n/a	0.93	4.8	175
7/21/04	81	6.4	0.090	2.34	4.3	n/a	1.44	8.2	140
7/21/04	86	10.4	0.110	0.83	5.5	n/a	0.97	5.8	161
7/23/05	97	11.1	0.060	0.70	10.4	n/a	0.29	6.4	104
7/23/05	113	16.8	0.100	0.63	4.7	n/a	0.97	6.1	122
7/23/05	115	18.8	0.070	0.52	6.3	n/a	0.53	5.8	109
7/23/05	117	20.5	0.190	0.79	9.9	n/a	1.07	6.7	117
7/23/05	101	11.7	0.070	1.44	5.2	n/a	1.00	8.1	130
7/23/05	107	13.7	0.100	1.29	4.6	n/a	0.46	8.0	134
7/21/06	99	12.9	0.120	0.74	4.0	n/a	0.32	6.3	120
7/21/06	96	11.6	0.120	0.76	7.7	n/a	1.32	6.8	157
7/21/06	94	10.9	0.180	1.59	10.3	n/a	2.48	4.9	160
7/21/06	100	10.9	0.110	1.34	8.5	n/a	1.46	5.2	142
7/21/06	97	11.7	0.140	0.88	4.6	n/a	0.96	5.2	107
7/21/06	117	20.8	0.240	1.29	4.3	n/a	2.92	5.9	130
7/20/07	98	12.4	0.110	0.91	2.7	n/a	1.11	7.8	106
7/20/07	89	8.9	0.120	1.72	3.3	n/a	1.80	5.6	136
7/20/07	114	14.1	0.150	2.76	3.4	n/a	1.28	8.7	122
7/20/07	81	7.1	0.140	1.90	4.2	n/a	2.03	7.0	114
7/20/07	114	14.6	0.880	3.63	3.9	n/a	1.56	10.9	131
7/20/07	93	10.6	0.140	1.50	20.3	n/a	3.80	9.4	107

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Appendix D3.–Page 2 of 2.

Sample Date	FL (mm)	Mass (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
	Minimum Detection Limit		0.02	0.02	0.1	0.02	0.02	1.0	0.50
7/23/08	103	12.9	0.224	1.99	4.2	n/a	3.47	7.7	169
7/23/08	108	14.8	0.095	0.96	3.2	n/a	0.86	5.8	143
7/23/08	88	8.9	0.076	0.93	3.3	n/a	0.75	4.4	186
7/23/08	86	9.3	0.220	1.91	5.7	n/a	4.06	5.7	119
7/23/08	92	9.6	0.073	1.01	2.7	n/a	0.61	5.2	125
7/23/08	90	8.7	0.033	0.54	2.2	n/a	0.43	4.8	108
7/22/09	83	6.9	0.040	0.29	1.7	n/a	0.24	5.4	127
7/22/09	91	8.6	0.060	0.55	2.1	n/a	0.16	5.1	137
7/22/09	91	8.5	0.110	0.36	2.0	n/a	0.23	7.5	138
7/22/09	98	10.3	0.090	0.81	3.4	n/a	0.38	5.8	147
7/22/09	91	8.6	0.030	0.47	2.2	n/a	0.40	4.5	125
7/22/09	90	7.8	0.060	0.60	2.2	n/a	0.38	5.6	129
7/20/10	87	7.4	0.293	1.61	5.4	0.430	3.92	6.4	151
7/20/10	94	10.9	0.124	0.82	2.5	0.580	0.24	5.7	174
7/20/10	90	8.5	0.084	0.73	2.9	0.350	0.29	5.3	125
7/20/10	90	8.2	0.059	0.60	2.3	0.270	0.33	4.7	151
7/20/10	108	13.5	0.081	0.66	2.6	0.540	0.25	3.2	118
7/20/10	105	11.6	0.076	0.75	3.1	0.270	0.23	3.9	150
7/21/11	85-115	n/a	0.090	0.80	3.4	n/a	0.32	6.7	146
7/26/12	89	7.3	0.020	0.33	18.4	0.429	0.18	4.3	123
7/26/12	122	16.5	0.030	0.60	8.4	0.257	0.54	4.8	126
7/26/12	149	8.1	0.050	0.76	42.4	0.217	1.65	4.9	140
7/26/12	105	11.7	0.130	0.57	22.6	0.241	0.74	7.5	128
7/26/12	98	9.9	0.070	0.95	203.0	0.235	1.90	5.5	115
7/26/12	198	20.2	0.060	0.53	8.5	0.278	0.67	5.3	116
7/23/13	90	10.1	0.72	6.36	7.5	0.418	5.93	9.7	179
7/23/13	92	10.4	0.27	1.57	3.8	0.329	1.60	6.9	122
7/23/13	85	7.8	0.19	2.41	5.8	0.297	3.90	8.6	153
7/23/13	82,52	7.4	0.05	0.59	3.3	0.439	0.35	5.0	152
7/23/13	82	6.6	0.48	4.67	8.9	0.332	4.87	9.6	181
7/23/13	81	5.5	0.13	2.14	4.6	0.289	1.64	5.6	166

October 4, 2013 Analytical Report for Service Request No: K1308602

Kate Kanouse
Alaska Department of Fish and Game
Division of Habitat
P.O. Box 110024
Juneau, AK 99811

RE: Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.

Dear Kate:

Enclosed are the results of the samples submitted to our laboratory on August 22, 2013. For your reference, these analyses have been assigned our service request number K1308602.

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 call if you have any questions. My extension is 3363. You may also contact me via Email at Lisa.Domenighini@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Lisa Domenighini
Project Manager

LD/mj

ADDRESS 1317 S. 13th Avenue, Kelso, WA 98626 USA | PHONE +1 360 577 7222 | FAX +1 360 636 1068
ALS Group USA, Corp. Part of the ALS Group An ALS Limited Company
Environmental www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

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 DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	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	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	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	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	4704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
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.caslab.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.

ALS ENVIRONMENTAL

Client:	Alaska Department of Fish and Game	**Service Request No.:**	K1308602
Project:	Greens Creek Biomonitoring 2013/ Hecla Greens Creek Mining Co.	**Date Received:**	08/22/13
Sample Matrix:	Animal Tissue		

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 Laboratory Control Sample (LCS).

Sample Receipt

Eighteen animal tissue samples were received for analysis at ALS Environmental on 08/22/13. The samples were received in good condition and consistent with the accompanying chain of custody form, except where noted on the cooler receipt and preservation form included in this report. The samples were stored frozen at –20ºC upon receipt at the laboratory.

Total Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Zinc for samples Greens Creek Site 78 sample #1 and Greens Creek Site 54 sample #4 were not applicable. The analyzed concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

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

Approved by_____

CHAIN OF CUSTODY

ALS Environmental

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

SR# K1318602

PAGE 1 OF 1 COC#

PROJECT NAME	Greens Creek Biomonitoring 2013
PROJECT NUMBER	Hecla Greens Creek Mining Co.
PROJECT MANAGER	Kate Kanouse ADFG Habitat
COMPANY NAME	Alaska Department of Fish and Game Hab.
ADDRESS	802 West 3rd St. 2n
CITY/STATE/ZIP	Juneau, AK, 99801
E-MAIL ADDRESS	benjamin.brewster@alaska.gov
PHONE #	907-465-6160 FAX # 907-465-4759
SAMPLER'S SIGNATURE	Benjamin Brewster

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO_4, PO4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases CO_2☐ RSK 175☐ Methane☐ Ethane☐ Ethene☐	Total Mercury 1631		REMARKS
See attached list of juvenile fish whole body samples					18								X								X			

REPORT REQUIREMENTS

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

INVOICE INFORMATION

P.O. # HGML Chris

Bill To: Wallace, P.O. Box 32199 Juneau, AK 99803

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.

___ 5 day

X Standard (15 working days)

___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

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

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

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

SPECIAL INSTRUCTIONS/COMMENTS:

Dry wgt Basis. Report % solids

Send eCopy to Kate Kanouse ADFG Habitat Kate.Kanouse@alaska.gov

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

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time	Signature	Date/Time	Signature	Date/Time	Signature	Date/Time
Benjamin Brewster	8/21/13 10:00	[illegible]	8/22/13 1010				
Printed Name	Firm	Printed Name	Firm	Printed Name	Firm	Printed Name	Firm
	ADFG		ALS				

PC Lis

Cooler Receipt and Preservation Form

Client / Project: ADPG Service Request K13 08602

Received: 8/22/13 Opened: 8/22/13 By: JW Unloaded: 8/22/13 By: JW

1. Samples were received via? *Mail* (*Fed Ex*) *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) (*Cooler*) *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA (Y) N If yes, how many and where? one, side
   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
-0.5	-1.0	—	—	-0.5	338		8009 6256 0815	
	—							

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. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
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 (Sue)
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: Site names (numbers) typo on COC
Site 48 logged per bags
Site 54 logged per bags
Sample "Tributary Creek Site 49 sample #4 listed twice on COC. Rec'd only one bag.

Page ____ of ____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	07/23-25/13
Sample Matrix:	Animal tissue	**Date Received:**	08/22/13

Mercury, Total

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

Units: ng/g
Basis: Dry

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
Greens Creek Site 48 sample #1	K1308602-001	4.9	100	09/30/13	10/01/13	214	
Greens Creek Site 48 sample #2	K1308602-002	4.9	100	09/30/13	10/01/13	238	
Greens Creek Site 48 sample #3	K1308602-003	5.0	100	09/30/13	10/01/13	180	
Greens Creek Site 48 sample #4	K1308602-004	4.9	100	09/30/13	10/01/13	213	
Greens Creek Site 48 sample #5	K1308602-005	5.0	100	09/30/13	10/01/13	113	
Greens Creek Site 48 sample #6	K1308602-006	5.0	100	09/30/13	10/01/13	274	
Greens Creek Site 54 sample #1	K1308602-007	5.0	100	09/30/13	10/01/13	131	
Greens Creek Site 54 sample #2	K1308602-008	4.9	100	09/30/13	10/01/13	183	
Greens Creek Site 54 sample #3	K1308602-009	5.0	100	09/30/13	10/01/13	172	
Greens Creek Site 54 sample #4	K1308602-010	5.0	100	09/30/13	10/01/13	145	
Greens Creek Site 54 sample #5	K1308602-011	5.0	100	09/30/13	10/01/13	108	
Greens Creek Site 54 sample #6	K1308602-012	5.0	100	09/30/13	10/01/13	126	
Tributary Creek Site 9 sample #1	K1308602-013	5.0	100	09/30/13	10/01/13	418	
Tributary Creek Site 9 sample #2	K1308602-014	4.9	100	09/30/13	10/01/13	329	
Tributary Creek Site 9 sample #3	K1308602-015	4.9	100	09/30/13	10/01/13	297	
Tributary Creek Site 9 sample #4	K1308602-016	5.0	100	09/30/13	10/01/13	439	
Tributary Creek Site 9 sample #5	K1308602-017	5.0	100	09/30/13	10/01/13	332	
Tributary Creek Site 9 sample #6	K1308602-018	4.9	100	09/30/13	10/01/13	289	
Method Blank	K1308602-MB1	1.0	20	09/30/13	10/01/13	ND	
Method Blank	K1308602-MB2	1.0	20	09/30/13	10/01/13	ND	
Method Blank	K1308602-MB3	1.0	20	09/30/13	10/01/13	ND	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Sample Matrix:	Animal tissue	**Date Received:**	08/22/13
		Date Extracted:	09/30/13
		Date Analyzed:	10/01/13

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	Greens Creek Site 48 sample #2	Units:	ng/g
Lab Code:	K1308602-002MS, K1308602-002MSD	Basis:	Dry
Test Notes:			

									Percent Recovery				
				Spike Level		Sample	Spike Result				CAS Acceptance	Relative Percent	
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Result Notes**
Mercury	METHOD	1631E	5.0	247	249	238	461	459	90	89	70-130	2	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Sample Matrix:	Animal tissue	**Date Received:**	08/22/13
		Date Extracted:	09/30/13
		Date Analyzed:	10/01/13

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	Greens Creek Site 54 sample #6	Units:	ng/g
Lab Code:	K1308602-012MS, K1308602-012MSD	Basis:	Dry
Test Notes:			

									Percent Recovery				
				Spike Level		Sample	Spike Result				CAS Acceptance	Relative Percent	Result
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Notes**
Mercury	METHOD	1631E	5.0	248	250	126	378	387	102	104	70-130	3	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	10/01/13

Ongoing Precision and Recovery (OPR) Sample Summary

Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g

Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.09	102	70-130	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	10/01/13

Ongoing Precision and Recovery (OPR) Sample Summary

Total Metals

Sample Name: Ongoing Precision and Recovery (Final)

Units: ng/g

Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.06	101	70-130	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	09/30/13
		Date Analyzed:	10/01/13

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:			

Source: TORT-2

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	270	305	113	70-130	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	07/23-25/13
Sample Matrix:	Tissue	**Date Received:**	08/22/13

Solids, Total

Prep Method:	NONE	Units:	PERCENT
Analysis Method:	Freeze Dry	Basis:	Wet
Test Notes:			

Sample Name	Lab Code	Date Analyzed	Result	Result Notes
Greens Creek Site 48 sample #1	K1308602-001	09/18/13	21.8	
Greens Creek Site 48 sample #2	K1308602-002	09/18/13	22.3	
Greens Creek Site 48 sample #3	K1308602-003	09/18/13	21.0	
Greens Creek Site 48 sample #4	K1308602-004	09/18/13	22.9	
Greens Creek Site 48 sample #5	K1308602-005	09/18/13	23.4	
Greens Creek Site 48 sample #6	K1308602-006	09/18/13	21.1	
Greens Creek Site 54 sample #1	K1308602-007	09/18/13	22.1	
Greens Creek Site 54 sample #2	K1308602-008	09/18/13	23.8	
Greens Creek Site 54 sample #3	K1308602-009	09/18/13	21.3	
Greens Creek Site 54 sample #4	K1308602-010	09/18/13	23.8	
Greens Creek Site 54 sample #5	K1308602-011	09/18/13	22.7	
Greens Creek Site 54 sample #6	K1308602-012	09/18/13	21.0	
Tributary Creek Site 9 sample #1	K1308602-013	09/18/13	26.8	
Tributary Creek Site 9 sample #2	K1308602-014	09/18/13	24.4	
Tributary Creek Site 9 sample #3	K1308602-015	09/18/13	28.2	
Tributary Creek Site 9 sample #4	K1308602-016	09/18/13	23.2	
Tributary Creek Site 9 sample #5	K1308602-017	09/18/13	28.0	
Tributary Creek Site 9 sample #6	K1308602-018	09/18/13	25.8	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Sample Matrix:	Tissue	**Date Received:**	08/22/13
		Date Extracted:	NA
		Date Analyzed:	09/18/13

Duplicate Summary

Sample Name:	Greens Creek Site 48 sample #1	Units:	PERCENT
Lab Code:	K1308602-001D	Basis:	Wet
Test Notes:			

Analyte	Prep Method	Analysis Method	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
Solids, Total	NA	Freeze Dry	21.8	15.5	18.6	34	

ALS Group USA, Corp.
dba ALS Environmental

- Cover Page -
INORGANIC ANALYSIS DATA PACKAGE

Client: Alaska Department of Fish and Game
Project Name: Greens Creek Biomonitoring 2013
Project No.: Hecla Greens Creek Mining Co.

Service Request: K1308602

Sample Name:	Lab Code:
Greens Creek Site 48 sample #1	K1308602-001
Greens Creek Site 48 sample #1D	K1308602-001D
Greens Creek Site 48 sample #1S	K1308602-001S
Greens Creek Site 48 sample #2	K1308602-002
Greens Creek Site 48 sample #3	K1308602-003
Greens Creek Site 48 sample #4	K1308602-004
Greens Creek Site 48 sample #5	K1308602-005
Greens Creek Site 48 sample #6	K1308602-006
Greens Creek Site 54 sample #1	K1308602-007
Greens Creek Site 54 sample #2	K1308602-008
Greens Creek Site 54 sample #3	K1308602-009
Greens Creek Site 54 sample #4	K1308602-010
Greens Creek Site 54 sample #4D	K1308602-010D
Greens Creek Site 54 sample #4S	K1308602-010S
Greens Creek Site 54 sample #5	K1308602-011
Greens Creek Site 54 sample #6	K1308602-012
Tributary Creek Site 9 sample #1	K1308602-013
Tributary Creek Site 9 sample #2	K1308602-014
Tributary Creek Site 9 sample #3	K1308602-015
Tributary Creek Site 9 sample #4	K1308602-016
Tributary Creek Site 9 sample #5	K1308602-017
Tributary Creek Site 9 sample #6	K1308602-018
Method Blank	K1308602-MB

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #1** **Lab Code:** **K1308602-001**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.65		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.5		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.16		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	5.0		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	247		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #2** **Lab Code:** **K1308602-002**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.97		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	6.1		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.24		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	5.8		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.07		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	239		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #3** **Lab Code:** **K1308602-003**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.81		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	4.0		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.08		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.7		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	258		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #4** **Lab Code:** **K1308602-004**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.68		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.2		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.14		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.4		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	213		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #5** **Lab Code:** **K1308602-005**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	2.01		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	6.6		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.36		
Selenium	200.8	0.9	5.0	09/26/13	10/02/13	6.2		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.04		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	271		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/25/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 48 sample #6** **Lab Code:** **K1308602-006**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.75		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	5.7		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.22		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.2		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.04		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	287		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #1** **Lab Code:** **K1308602-007**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.39		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	4.2		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.30		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	5.6		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	247		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #2** **Lab Code:** **K1308602-008**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.74		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.9		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.39		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	7.0		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	297		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #3** **Lab Code:** **K1308602-009**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.27		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	4.3		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.28		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.6		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	262		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #4** **Lab Code:** **K1308602-010**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.91		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.8		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.36		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.0		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	209		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #5** **Lab Code:** **K1308602-011**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.18		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	5.3		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.27		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.4		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	245		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/24/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Greens Creek Site 54 sample #6** **Lab Code:** **K1308602-012**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.07		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	4.5		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.18		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.4		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	225		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-013**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	6.36		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	7.5		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	5.93		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	9.7		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.72		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	179		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-014**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	1.57		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.8		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	1.60		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	6.9		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.27		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	122		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-015**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	2.41		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	5.8		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	3.90		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	8.6		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.19		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	153		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-016**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.59		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	3.3		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.35		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	5.0		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.05		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	152		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-017**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	4.67		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	8.9		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	4.87		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	9.6		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.48		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	181		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1308602
Project No.:	Hecla Greens Creek Mining Co.	**Date Collected:**	07/23/13
Project Name:	Greens Creek Biomonitoring 2013	**Date Received:**	08/22/13
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Tributary Creek Site 9 sample #** **Lab Code:** **K1308602-018**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	2.14		
Copper	200.8	0.1	5.0	09/26/13	10/02/13	4.6		
Lead	200.8	0.02	5.0	09/26/13	10/02/13	1.64		
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	5.6		
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.13		
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	166		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Alaska Department of Fish and Ga
Service Request: K1308602
Project No.: Hecla Greens Creek Mining Co.
Date Collected:
Project Name: Greens Creek Biomonitoring 2013
Date Received:
Matrix: TISSUE
Units: mg/Kg
Basis: DRY

Sample Name: Method Blank
Lab Code: K1308602-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Copper	200.8	0.1	5.0	09/26/13	10/02/13	0.1	U	
Lead	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Selenium	200.8	1.0	5.0	09/26/13	10/02/13	1.0	U	
Silver	200.8	0.02	5.0	09/26/13	10/02/13	0.02	U	
Zinc	200.8	0.5	5.0	09/26/13	10/02/13	0.5	U	

Comments:

Metals
- 5A -
SPIKE SAMPLE RECOVERY

Client: Alaska Department of Fish and Ga **Service Request:** K1308602

Project No.: Hecla Greens Creek Mining Co. **Units:** MG/KG

Project Name: Greens Creek Biomonitoring 2013 **Basis:** DRY

Matrix: TISSUE

Sample Name: Greens Creek Site 48 sampl **Lab Code:** K1308602-001S

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Cadmium	70 - 130	5.86		0.65		4.84	107.6		200.8
Copper	70 - 130	27.0		3.5		24.2	97.1		200.8
Lead	70 - 130	47.09		0.16		48.39	97.0		200.8
Selenium	70 - 130	23.0		4.9		16.2	111.7		200.8
Silver	70 - 130	4.76		0.02	U	4.84	98.3		200.8
Zinc		277.6		247.4		48.4	62.4		200.8

An empty field in the Control Limit column indicates the control limit is not applicable

Metals
- 5A -
SPIKE SAMPLE RECOVERY

Client: Alaska Department of Fish and Ga **Service Request:** K1308602

Project No.: Hecla Greens Creek Mining Co. **Units:** MG/KG

Project Name: Greens Creek Biomonitoring 2013 **Basis:** DRY

Matrix: TISSUE

Sample Name: Greens Creek Site 54 sampl **Lab Code:** K1308602-010S

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Cadmium	70 - 130	6.17		0.91		4.79	109.8		200.8
Copper	70 - 130	27.8		3.8		23.9	100.4		200.8
Lead	70 - 130	48.01		0.36		47.88	99.5		200.8
Selenium	70 - 130	24.6		6.0		16.0	116.2		200.8
Silver	70 - 130	4.82		0.02	U	4.79	100.6		200.8
Zinc		286.5		208.7		47.9	162.4		200.8

An empty field in the Control Limit column indicates the control limit is not applicable

Metals

- 6 -

DUPLICATES

Client: Alaska Department of Fish and Ga **Service Request:** K1308602

Project No.: Hecla Greens Creek Mining Co. **Units:** MG/KG

Project Name: Greens Creek Biomonitoring 2013 **Basis:** DRY

Matrix: TISSUE

Sample Name: Greens Creek Site 48 samp **Lab Code:** K1308602-001D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Cadmium	30	0.65		0.71		8.8		200.8
Copper	30	3.5		3.9		10.8		200.8
Lead	30	0.16		0.18		11.8		200.8
Selenium		4.9		5.6		13.3		200.8
Silver		0.02	U	0.02	U			200.8
Zinc	30	247.4		227.3		8.5		200.8

An empty field in the Control Limit column indicates the control limit is not applicable.

Metals

- 6 -

DUPLICATES

Client: Alaska Department of Fish and Ga **Service Request:** K1308602

Project No.: Hecla Greens Creek Mining Co. **Units:** MG/KG

Project Name: Greens Creek Biomonitoring 2013 **Basis:** DRY

Matrix: TISSUE

Sample Name: Greens Creek Site 54 samp **Lab Code:** K1308602-010D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Cadmium	30	0.91		0.87		4.5		200.8
Copper	30	3.8		3.9		2.6		200.8
Lead	30	0.36		0.29		21.5		200.8
Selenium	30	6.0		5.9		1.7		200.8
Silver		0.02	U	0.02	U			200.8
Zinc	30	208.7		213.6		2.3		200.8

An empty field in the Control Limit column indicates the control limit is not applicable.

Metals

- 7 -

LABORATORY CONTROL SAMPLE

Client: Alaska Department of Fish and Ga **Service Request:** K1308602

Project No.: Hecla Greens Creek Mining Co.

Project Name: Greens Creek Biomonitoring 2013

Aqueous LCS Source: **CAS MIXED** **Solid LCS Source:**

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Cadmium	50.0	51.1	102.2					
Copper	250.0	258.8	103.5					
Lead	500.0	510.7	102.1					
Selenium	167.0	158.4	94.9					
Silver	50.0	43.3	86.6					
Zinc	500.0	542.0	108.4					

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/26/13
		Date Analyzed:	10/02/13

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K1308602-SRM1	Basis:	Dry
Test Notes:			

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

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	6020A	0.29	0.33	114	0.216 - 0.372	
Copper	PSEP Tissue	6020A	15.5	15.3	99	11.9 - 19.4	
Lead	PSEP Tissue	6020A	0.395	0.30	76	0.276 - 0.534	
Zinc	PSEP Tissue	6020A	51.3	55.5	108	38.6 - 65.3	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1308602
Project:	Greens Creek Biomonitoring 2013/Hecla Greens Creek Mining Co.	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/26/13
		Date Analyzed:	10/02/13

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K1308602-SRM2	Basis:	Dry
Test Notes:			

Source: N.R.C.C. Tort-2

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	6020A	26.7	29.6	111	20.9-32.8	
Copper	PSEP Tissue	6020A	106	106	100	77-139	
Lead	PSEP Tissue	6020A	0.35	0.36	103	0.18-0.58	
Selenium	PSEP Tissue	6020A	5.63	6.73	120	3.97-7.56	
Zinc	PSEP Tissue	6020A	180	210	117	139-223	

APPENDIX E: SEDIMENT METALS CONCENTRATIONS LABORATORY REPORT

AECOM
Environmental Toxicology
4303 West LaPorte Avenue, Fort Collins, Colorado 80521-2154
T 970.416.0916 F 970.490.2963 www.aecom.com

AECOM

September 16, 2013

Chris Wallace
Hecla Greens Creek Mining Co.
PO Box 32199
Juneau, AK 99803-2199

Subject: Analytical results of sediment samples

Dear Mr. Wallace:

Below are the analytical results for the sediment samples received at AECOM on August 2, 2013 from Hecla Greens Creek Mining Company sites. Samples were collected by the Alaska Department of Fish and Game and shipped to AECOM.

Parameter	Sample Identification		
	GCM Site #9 (AECOM #26958)	GCM Site #54 (AECOM #26959)	GCM Site #48 (AECOM #26960)
Metals (mg/kg-dry)			
Cadmium	0.390	3.63	1.84
Copper	15.5	51.7	60.8
Lead	11.8	29.8	12.8
Selenium	0.309	4.44	2.59
Silver	<0.091	0.339	0.384
Zinc	68.9	232	232
Mercury	<0.0357	0.0784	0.0476
Particle Size (%)			
Clay	3.0	5.0	3.0
Sand	90.0	94.0	92.0
Silt	7.0	1.0	5.0
Texture / Soil Class	Sand	Sand	Sand
Coarse Material (2 mm)	0.10	0.06	<0.05
Acid Volatile Sulfide (µmoles/g)	2.00	2.18	1.99

Note: Metals (Cd, Cu, Pb, Se, Zn, and Ag) analyses were determined by SW-846 Method 6020; Hg by SW-846 7471B (USEPA 1986); Particle size by ASTM Method D422 and Modified ASA 15-5. See attachment for more information.

We greatly appreciate the opportunity to provide our services for Hecla Greens Creek Mining Company. Do not hesitate to contact us if you have any questions regarding this work.

Sincerely,

Rami B. Naddy, Ph.D.
Study Director / Environmental Toxicologist
rami.naddy@aecom.com

Anita B. Rehner, M.S.
Aquatic Toxicologist / QA Officer
anita.rehner@aecom.com

60306603-100-001
Attachment

Wednesday, August 28, 2013

Analytical Laboratory

Rami Naddy
AECOM
4303 W Laporte Ave
Fort Collins, CO 80521

RE: Sediment Analysis

Work Order: 1308029

Dear Rami Naddy:

MSE Lab Services received 6 sample(s) on 8/6/2013 for the analyses presented in the following report.

Please find enclosed analytical results for the sample(s) received at the MSE Laboratory.

If you have any questions regarding these test results, please feel free to call.

Sincerely,

Sara Ward

Sara Ward
Laboratory Manager
406-494-7334

Enclosure

MSE Analytical Laboratory
P.O. Box 4078
200 Technology Way
Butte, MT 59701
Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-ta.com

RECEIVED
8/28/13

MSE Lab Services

Date: *28-Aug-13*

CLIENT: AECOM
Lab Order: 1308029
Project: Sediment Analysis
Lab ID: 1308029-001

Client Sample ID: SEDIMENT GCM SITE#9 26958
Collection Date: 7/23/2013 12:00:00 PM
Matrix: SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ICP-MS METALS, SOLID SAMPLES			**SW6020**	**SW3050B**			Analyst: **kgw**
Cadmium	0.390	0.007	0.025		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Copper	15.5	0.102	0.310		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Lead	11.8	0.011	0.050		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Selenium	0.309	0.168	0.495	J	mg/Kg-dry	2	8/14/2013 4:39:30 PM
Silver	ND	0.091	0.248		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Zinc	68.9	0.226	0.743		mg/Kg-dry	2	8/14/2013 4:39:30 PM
MERCURY IN SOIL/SEDIMENT - SW846 7471B			**SW7471**	**SW7471A**			Analyst: **jc**
Mercury	ND	0.0357	0.123		mg/Kg-dry	1	8/21/2013 1:15:00 PM
PERCENT COARSE MATERIAL			**ASTMD422**				Analyst: **df**
1" Gradation	ND	0.05	0.10		%	1	8/12/2013 12:00:00 PM
2mm Gradation	0.10	0.05	0.10	J	%	1	8/12/2013 12:00:00 PM
RAPID HYDROMETER (2 HOUR) MOD ASA 15-5			**MSA15-5**				Analyst: **df**
% Clay	3.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Sand	90.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Silt	7.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
Soil Class	SAND					1	8/13/2013 12:00:00 PM

Qualifiers:				
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

MSE Lab Services

Date: *28-Aug-13*

CLIENT: AECOM
Lab Order: 1308029
Project: Sediment Analysis
Lab ID: 1308029-002

Client Sample ID: GCM SITE#54 #26959
Collection Date: 7/24/2013 12:00:00 PM
Matrix: SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ICP-MS METALS, SOLID SAMPLES			**SW6020**	**SW3050B**			Analyst: **kgw**
Cadmium	3.63	0.007	0.025		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Copper	51.7	0.103	0.315		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Lead	29.8	0.011	0.050		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Selenium	4.44	0.171	0.504		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Silver	0.339	0.093	0.252		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Zinc	232	0.230	0.756		mg/Kg-dry	2	8/14/2013 4:39:30 PM
MERCURY IN SOIL/SEDIMENT - SW846 7471B			**SW7471**	**SW7471A**			Analyst: **jc**
Mercury	0.0784	0.0360	0.124	J	mg/Kg-dry	1	8/21/2013 1:15:00 PM
PERCENT COARSE MATERIAL			**ASTMD422**				Analyst: **df**
1" Gradation	ND	0.05	0.10		%	1	8/12/2013 12:00:00 PM
2mm Gradation	0.06	0.05	0.10	J	%	1	8/12/2013 12:00:00 PM
RAPID HYDROMETER (2 HOUR) MOD ASA 15-5			**MSA15-5**				Analyst: **df**
% Clay	5.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Sand	94.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Silt	1.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
Soil Class	SAND					1	8/13/2013 12:00:00 PM

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

MSE Lab Services

Date: *28-Aug-13*

CLIENT: AECOM
Lab Order: 1308029
Project: Sediment Analysis
Lab ID: 1308029-003

Client Sample ID: GCM SITE#48 #26960
Collection Date: 7/25/2013 12:00:00 PM
Matrix: SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ICP-MS METALS, SOLID SAMPLES			**SW6020**	**SW3050B**			Analyst: **kgw**
Cadmium	1.84	0.007	0.025		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Copper	60.8	0.104	0.317		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Lead	12.8	0.011	0.051		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Selenium	2.59	0.172	0.507		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Silver	0.384	0.093	0.253		mg/Kg-dry	2	8/14/2013 4:39:30 PM
Zinc	232	0.231	0.760		mg/Kg-dry	2	8/14/2013 4:39:30 PM
MERCURY IN SOIL/SEDIMENT - SW846 7471B			**SW7471**	**SW7471A**			Analyst: **jc**
Mercury	0.0476	0.0361	0.125	J	mg/Kg-dry	1	8/21/2013 1:15:00 PM
PERCENT COARSE MATERIAL			**ASTMD422**				Analyst: **df**
1" Gradation	ND	0.05	0.10		%	1	8/12/2013 12:00:00 PM
2mm Gradation	ND	0.05	0.10		%	1	8/12/2013 12:00:00 PM
RAPID HYDROMETER (2 HOUR) MOD ASA 15-5			**MSA15-5**				Analyst: **df**
% Clay	3.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Sand	92.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
% Silt	5.0	0.1	0.1		%	1	8/13/2013 12:00:00 PM
Soil Class	SAND					1	8/13/2013 12:00:00 PM

Qualifiers:				
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

MSE Lab Services

Date: *28-Aug-13*

CLIENT: AECOM
Lab Order: 1308029
Project: Sediment Analysis
Lab ID: 1308029-004

Client Sample ID: GCM SITE#9 #26958
Collection Date: 7/23/2013 12:00:00 PM
Matrix: SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ACID VOLATILE SULFIDE-SIM. EXT. METALS			**AVS-SEM**				Analyst: **kgw**
Sulfide	2.00	1.40	1.50		µmoles/g	1	8/22/2013 3:15:00 PM

Qualifiers:				
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

P.O. Box 4078
200 Technology Way
Butte, MT 59701

Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-la.com

MSE Lab Services

Date: *28-Aug-13*

CLIENT:	AECOM	**Client Sample ID:**	GCM SITE#54 #26959
Lab Order:	1308029	**Collection Date:**	7/24/2013 12:00:00 PM
Project:	Sediment Analysis		
Lab ID:	1308029-005	**Matrix:**	SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ACID VOLATILE SULFIDE-SIM. EXT. METALS			**AVS-SEM**				Analyst: **kgw**
Sulfide	2.18	1.40	1.50		µmoles/g	1	8/22/2013 3:15:00 PM

Qualifiers:				
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

MSE Lab Services

Date: *28-Aug-13*

CLIENT:	AECOM	**Client Sample ID:**	GCM SITE#48 #26960
Lab Order:	1308029	**Collection Date:**	7/25/2013 12:00:00 PM
Project:	Sediment Analysis		
Lab ID:	1308029-006	**Matrix:**	SOLID

Analyses	Result	MDL	Rpt Limit	Qualifier	Units	DF	Date Analyzed
ACID VOLATILE SULFIDE-SIM. EXT. METALS			**AVS-SEM**				Analyst: **kgw**
Sulfide	1.99	1.40	1.50		µmoles/g	1	8/22/2013 3:15:00 PM

Qualifiers:				
	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
	J	Analyte detected below the Reporting Limit	Limit	Reporting Limit
	MDL	Method Detection Limit	ND	Not Detected at the Method Detection Limit (MDL)

MSE Analytical Laboratory
P.O. Box 4078
200 Technology Way
Butte, MT 59701
Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-ta.com

Date: 28-Aug-13
Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Work Order: 1308029
Project: Sediment Analysis
BatchID: 7043

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
Sample ID: 7043-PB-FILTERED			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	ND	0.400	mg/Kg							
Copper	ND	2.00	mg/Kg							
Lead	ND	0.200	mg/Kg							
Selenium	ND	0.400	mg/Kg							
Silver	ND	0.200	mg/Kg							
Zinc	ND	10.0	mg/Kg							
Sample ID: 7043-PB-UNFILTERED			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	ND	0.400	mg/Kg							
Copper	ND	2.00	mg/Kg							
Lead	ND	0.200	mg/Kg							
Selenium	ND	0.400	mg/Kg							
Silver	ND	0.200	mg/Kg							
Zinc	ND	10.0	mg/Kg							
Sample ID: LCS-7043			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	192	0.400	mg/Kg	186.0	103	80	120			
Copper	68.4	2.00	mg/Kg	73.50	93.1	80	120			
Lead	242	0.200	mg/Kg	251.0	96.3	80	120			
Selenium	204	0.400	mg/Kg	213.0	95.9	80	120			
Silver	61.8	0.200	mg/Kg	57.40	108	80	120			
Zinc	509	10.0	mg/Kg	555.0	91.6	80	120			
Sample ID: 1308020-001A-MS			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	182	0.390	mg/Kg	186.0	97.9	75	125			
Copper	64.3	1.95	mg/Kg	73.50	78.1	75	125			
Lead	223	0.195	mg/Kg	251.0	87.3	75	125			
Selenium	169	0.390	mg/Kg	213.0	79.2	75	125			
Silver	53.5	0.195	mg/Kg	57.40	93.2	75	125			
Zinc	452	9.75	mg/Kg	555.0	78.7	75	125			
Sample ID: 1308020-001A-MSD			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	186	0.392	mg/Kg	186.0	99.9	75	125	1.98	20	
Copper	63.7	1.96	mg/Kg	73.50	77.1	75	125	1.06	20	
Lead	213	0.196	mg/Kg	251.0	83.0	75	125	4.86	20	
Selenium	165	0.392	mg/Kg	213.0	77.5	75	125	2.13	20	
Silver	53.4	0.196	mg/Kg	57.40	93.0	75	125	0.236	20	
Zinc	436	9.79	mg/Kg	555.0	75.7	75	125	3.79	20	
Sample ID: 1308020-001A-MST			*Method: SW6020*		*Batch ID: 7043*				*Analysis Date: 8/14/2013 4:39:30 PM*	
Cadmium	178	0.397	mg/Kg	186.0	95.3	75	125	2.70	20	
Copper	73.7	1.99	mg/Kg	73.50	90.7	75	125	13.5	20	
Lead	236	0.199	mg/Kg	251.0	92.3	75	125	5.56	20	

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

MSE Analytical Laboratory
P.O. Box 4078
200 Technology Way
Butte, MT 59701
Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-ta.com

Date: 28-Aug-13
Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Project: Sediment Analysis
Work Order: 1308029
BatchID: 7043

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
*Sample ID: **1308020-001A-MST***			*Method: **SW6020***	*Batch ID: **7043***				*Analysis Date: 8/14/2013 4:39:30 PM*		
Selenium	186	0.397	mg/Kg	213.0	87.4	75	125	9.92	20	
Silver	58.1	0.199	mg/Kg	57.40	101	75	125	8.20	20	
Zinc	487	9.94	mg/Kg	555.0	84.9	75	125	7.37	20	

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

MSE Analytical Laboratory
P.O. Box 4078
200 Technology Way
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Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-ta.com

Date: 28-Aug-13
Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Project: Sediment Analysis
Work Order: 1308029
BatchID: 7083

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
Sample ID: 7083-PB			*Method: SW7471*		*Batch ID: 7083*			*Analysis Date: 8/21/2013 1:16:00 PM*		
Mercury	ND	0.100	mg/Kg							
Sample ID: LCS-7083			*Method: SW7471*		*Batch ID: 7083*			*Analysis Date: 8/21/2013 1:16:00 PM*		
Mercury	19.3	1.17	mg/Kg	21.70	88.9	80	120			
Sample ID: 1308029-003A-MS			*Method: SW7471*		*Batch ID: 7083*			*Analysis Date: 8/21/2013 1:16:00 PM*		
Mercury	14.8	1.53	mg/Kg-dry	27.57	53.5	75	125			S*
Sample ID: 1308029-003A-MSD			*Method: SW7471*		*Batch ID: 7083*			*Analysis Date: 8/21/2013 1:16:00 PM*		
Mercury	15.1	1.54	mg/Kg-dry	27.57	54.8	75	125	2.35	35	S*

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

MSE Analytical Laboratory
P.O. Box 4078
200 Technology Way
Butte, MT 59701
Lab: 406-494-7334
Fax: 406-494-7230
labinfo@mse-ta.com

Date: 28-Aug-13
Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Project: Sediment Analysis
Work Order: 1308029
BatchID: R24166

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
Sample ID: 1308029-003A-D			*Method: ASTMD422*		*Batch ID: R24166*			*Analysis Date: 8/12/2013 12:00:00 PM*		
1" Gradation	ND	0.10	%					0	35	
2mm Gradation	ND	0.10	%					0	35	

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

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Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Project: Sediment Analysis
Work Order: 1308029
BatchID: R24189

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
Sample ID: 1308071-001A-D			*Method: MSA15-5*		*Batch ID: R24189*			*Analysis Date: 8/13/2013 12:00:00 PM*		
% Clay	11.0	0.1	%					0	35	
% Sand	72.0	0.1	%					0	35	
% Silt	17.0	0.1	%					0	35	
Soil Class	SANDY LOAM									

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

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Date: 28-Aug-13
Report Date: 28-Aug-13

QA/QC SUMMARY REPORT

Client: AECOM
Project: Sediment Analysis

Work Order: 1308029
BatchID: R24307

Analyte	Result	RL	Units	Spike Lvl	% Rec	Low Limit	High Limit	RPD	RPD Limit	Qualifier
Sample ID: 1308029-004A-D			*Method: AVS-SEM*		*Batch ID: R24307*			*Analysis Date: 8/22/2013 3:15:00 PM*		
Sulfide	1.65	1.50	µmoles/g					19.2	35	
Sample ID: LCS			*Method: AVS-SEM*		*Batch ID: R24307*			*Analysis Date: 8/22/2013 3:15:00 PM*		
Sulfide	7.18	1.50	µmoles/g	8.388	85.6	85	105			
Sample ID: PB			*Method: AVS-SEM*		*Batch ID: R24307*			*Analysis Date: 8/22/2013 3:15:00 PM*		
Sulfide	ND	1.50	µmoles/g							
Sample ID: 1308029-004A-S			*Method: AVS-SEM*		*Batch ID: R24307*			*Analysis Date: 8/22/2013 3:15:00 PM*		
Sulfide	6.19	1.50	µmoles/g	5.027	83.3	80	120			

Qualifiers:
NA Sample conc. is > 4*spike level
S* Spike Recovery outside limits; within Manufacturer Limits
Manufacturer Limits for Mercury 11.2 - 32.2 mg/kg

AECOM

CHAIN OF CUSTODY RECORD

1308029

Page 1 of 1

Client/Project Name:	Project Location: FCETL
Project Number: 058	Field Logbook No.:
Sampler (Print Name)/(Affiliation): Ben Brewster/ADFG (original) Amber Potts / AECOM	Chain of Custody Tape Nos.:
Signature: AmberPotts	Send Results/Report to: Rami Naddy — TAT: std.

Container Type: P – Plastic; A – Amber Glass; G – Clear Glass; V – VOA Vial; O – Other; E – Encore

Preservation: 1 – HCl, 4°; 2 – H2SO4, 4°; 3 – HNO3, 4°; 4 – NaOH, 4°; 5 – NaOH/ZnAc, 4°; 6 – Na2S2O3, 4°; 7 – 4°

Matrix Codes: DW – Drinking Water; WW – Wastewater; GW – Groundwater; SW – Surface Water; ST – Storm Water; W – Water; S – Soil; SL – Sludge; SD – Sediment; SO – Solid; A – Air; L – Liquid; P – Product

Field Sample No./Identification	Date	Time	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered	Analysis Requested: Total Metals: Ag, Cd, Cu, Pb, Se, Zn	Mercury	% Coarse Material	Rapid Hydrometer (% clay, silt, sand)	AVS	Lab I.D.	Remarks
Sediment GCM site #9 #26958	7/23/13	1200	X		500 ml squat	SD	7	NA	X	X	X	X		001A	
GCM site #54 #26959	7/24/13	1200	X		"	"	"	"	X	X	X	X		002A	
GCM site #48 #26960	7/25/13	1200	X		"	"	"	"	X	X	X	X		003A	
GCM site #9 #26958	7/23/13	1200	X		2oz glass	"	"	"					X	004A	
GCM site #54 #26959	7/24/13	1200	X		"	"	"	"					X	005A	
GCM site #48 #26960	7/25/13	1200	X		"	"	"	"					X	006A	

Relinquished by: (Print Name)/(Affiliation) Amber Potts / AECOM	Date: 8/5/13 Time: 1030	Received by: (Print Name)/(Affiliation) Sara Ward / MSETA	Date: 8/6/13 Time: 1027
Signature: AmberPotts		Signature:	
Relinquished by: (Print Name)/(Affiliation)	Date: Time:	Received by: (Print Name)/(Affiliation)	Date: Time:
Signature:		Signature:	
Relinquished by: (Print Name)/(Affiliation)	Date: Time:	Received by: (Print Name)/(Affiliation)	Date: Time:
Signature:		Signature:	

Analytical Laboratory (Destination):

AECOM Toxicology Lab
4303 W. Laporte Avenue
Fort Collins, CO 80521
(970) 416-0916
(970) 490-2963 (FAX)

Sample Shipped Via: UPS (FedEx) Courier Other

Temp blank: (Yes) No

Serial No. No 53572

MSE Lab Services

Sample Receipt Checklist

Client Name AECOM_INC Date and Time Received: 8/6/2013 10:27:00 AM

Work Order Number 1308029 RcptNo: 1 Received by SW

COC_ID: 1308029 CoolerID:

Checklist completed by Signature 8/6/13 Date Reviewed by SW Initials 8/7/13 Date

Matrix: Carrier name FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Blank ☐

Adjusted? NO Checked by NA/SOIL MLO 8/6/13

Any No and/or NA (not applicable) response must be detailed in the comments section be

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding: _____

Comments: FED EX TEMP=NA SOLID

Corrective Action _____