Technical Report No. 26-06

Aquatic Biomonitoring at Red Dog Mine, 2025

A requirement under Alaska Pollution Discharge Elimination System Permit No. AK0038652

by

Chelsea M. Clawson

May 2026

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

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by Habitat Section and the Divisions of Sport Fish, and Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, Technical Reports and Special Publications. 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 figure 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 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)

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

TECHNICAL REPORT NO. 26-06

AQUATIC BIOMONITORING AT RED DOG MINE, 2025

A REQUIREMENT UNDER ALASKA POLLUTION DISCHARGE ELIMINATION SYSTEM PERMIT NO. AK0038652

By
Chelsea M. Clawson
Habitat Section, Fairbanks

Alaska Department of Fish and Game
Habitat Section
1300 College Rd, Fairbanks, Alaska, 99701

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Cover: Station 160 on Ikalukrok Creek. Photo by Audra Brase.

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Chelsea M. Clawson
Alaska Department of Fish and Game, Habitat Section
1300 College Rd., Fairbanks, AK 99701-1599, USA

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From the Fairbanks ADF&G Habitat Section: Chad Bear and Todd “Nik” Nichols conducted the June field work. Chelsea Clawson, Olivia Edwards, and Lauren Yancy conducted the July field work. Audra Brase and Lauren Yancy conducted the August field work. Chad Bear conducted the fall aerial survey for Dolly Varden and ensuing data entry. Olivia Edwards and Lauren Yancy performed the laboratory analyses for periphyton data.

Brendan Scanlon and Joe Spencer with ADF&G Division of Sport Fish assisted with adult Dolly Varden dissections and aging.

Matt Kern (Alder Grove Farm) sorted and identified aquatic invertebrates. ACZ Laboratories analyzed the whole-body fish and fish tissues for element concentrations. Al Ott, Audra Brase, Lauren Yancy, Robert Napier, Carla Nelson, and Joe Diehl provided constructive reviews of this report.

EXECUTIVE SUMMARY

● Median element concentrations of aluminum, cadmium, nickel, and zinc in water quality samples from Mainstem Red Dog Creek (Station 151) in 2025 were comparable to 2024 concentrations. Since 2018, these element concentrations have remained higher than the values recorded during 1999–2017. Median selenium concentration has been generally increasing since 2018, but the increase is not as pronounced as other elements. Lead, pH, and total dissolved solids (TDS) levels in 2025 were consistent with past years.

● Median element concentrations (lead, zinc, selenium, cadmium) in water quality samples from Buddy Creek and Bons Pond were consistent with past years' results. In North Fork Red Dog Creek, cadmium and zinc increased in 2019 and have remained at levels higher than 2001–2018 values. Lead and selenium values were consistent with past years.

● Periphyton standing crop, as estimated by chlorophyll-a concentration, is determined each year in drainages near the Red Dog Mine. In 2025, the highest mean chlorophyll-a concentration was in Bons Creek above the pond, and the lowest mean concentrations were in Middle Fork Red Dog Creek (Station 20), Ikalukrok Creek (Station 9), Mainstem Red Dog Creek (Station 10), and lower Ikalukrok Creek (Station 160). Chlorophyll-a concentrations in Ikalukrok Creek at Station 9 continue to exhibit an inverse relationship with zinc and cadmium in the water.

● Benthic macroinvertebrate (BMI) densities are used as an index of stream productivity and health. In 2025, the BMI density was highest at Buddy below the falls. Overall taxa richness varied from 5 to 17 taxa per site. Sampling method was changed from drift nets to Hess samplers in 2022 to better depict the in-situ aquatic community and evaluate potential changes.

● Minnow trap catches were generally low in 2025, with the most juvenile Dolly Varden captured at North Fork Red Dog Creek (33 fish). In all other years Buddy and Anxiety Ridge creek have had the highest catches.

● Juvenile Dolly Varden from Red Dog, Buddy, and Anxiety Ridge creeks have been analyzed for whole body element concentrations in 2005–2011, 2014–2023, and 2025. Cadmium is highest in fish from Red Dog Creek, lead values are similar between fish from Buddy and Red Dog creeks and lower in Anxiety Ridge Creek fish, selenium values are similar among fish from all three creeks, zinc is highest in Red Dog Creek fish, and mercury is highest in Anxiety Ridge Creek fish.

● Juvenile Arctic grayling from Bons Pond have been analyzed for selected whole body element concentrations in 2004, 2007, 2010, and 2014–2025. In 2025, the mean concentrations of cadmium, lead, mercury, selenium, and zinc in Arctic grayling juveniles were consistent with previous years.

● Adult Dolly Varden captured in the Wulik River during the fall of 2025 were analyzed for cadmium, copper, lead, selenium, zinc, and mercury in kidney, liver, ovary, testes, and muscle tissues. Various elements concentrate in specific tissues at different rates. None of the analytes measured concentrate in muscle.

● Aerial surveys are used each fall to estimate the number of overwintering Dolly Varden in the Wulik River. In 2025, a total of 59,307 Dolly Varden were counted in the Wulik River, although this should be considered a minimum estimate due to reduced visibility from turbidity.

● The estimated Arctic grayling population in Bons Pond in 2024 was 151 fish (95% CI, 60–243 fish) $\geq$200 mm fork length (FL). This is a decrease from the previous population estimates.

INTRODUCTION

The Red Dog zinc and lead deposit is located in northwestern Alaska, about 130 km north of Kotzebue and 75 km inland from the Chukchi Sea coast (Figure 1). Mine operations, facilities, surrounding vegetation, and wildlife are described in the Alaska Department of Fish and Game (ADF&G) technical report: *Fisheries Resources and Water Quality, Red Dog Mine* (Weber-Scannell and Ott 1998). A chronology of development and operations at the Red Dog Mine for 2014 through 2025 is presented in Appendix 1. The summary of previous years of mine development and operations (1982–2013) can be found in Ott and Morris (2014). Aquatic resources in the Wulik River drainage are described in the ADF&G technical report: *Fish and Aquatic Taxa Report at Red Dog Mine, 1998–1999* (Weber-Scannell et al. 2000).

Aquatic biomonitoring has been conducted annually at the Red Dog Mine since 1995, with core components of periphyton, aquatic invertebrate, and fish sampling. Additionally, tissue and whole-body element analyses for Dolly Varden (*Salvelinus malma*) and spawning season monitoring for Arctic grayling (*Thymallus arcticus*) are performed annually. This long-term monitoring effort helps assess the ecological health of the drainages and track changes over time. This report presents data collected during summer 2025 and where applicable, these data are compared with previous years.

On April 9, 2026, the Alaska Department of Environmental Conservation (ADEC) reissued Alaska Pollution Discharge Elimination System Permit (APDES) No. AK0038652, with an effective date of May 1, 2026, to Teck Alaska Incorporated (Teck) with an allowable discharge of up to 2.418 billion gallons of treated effluent per year into Middle Fork Red Dog Creek. The APDES Permit requires the continuation of the bioassessment program including monitoring periphyton, aquatic invertebrates, and fish in selected streams near the Red Dog Mine (Table 1). Also contained in the APDES Permit is a 10-year Compliance Schedule for Teck to investigate, determine, and implement a long-term solution to the loss of TDS assimilative capacity in Red Dog and Ikalukrok creeks due to naturally occurring permafrost degradation. To satisfy conditions of the ADEC permit, ADF&G submitted Technical Report No. 26-03: *Methods for Aquatic Life Monitoring at the Red Dog Mine Site: A requirement of the 2026 APDES Permit AK0038652* (Clawson 2026).

On September 23, 2021, the ADEC issued Waste Management Permit (WMP) No. 2021DB0001 for the Red Dog Mine that included a condition that Teck adhere to the requirements of the

Monitoring Plan contained in the Integrated Waste Management Plan submitted by Teck in September 2021. Teck's Monitoring Plan outlines sample sites, sampling frequency, and parameters for all aquatic sites, including those required by the APDES Permit (Table 1).

Teck's Monitoring Plan is incorporated by reference into the Alaska Department of Natural Resources (ADNR) Reclamation Plan Approval (F20219958) dated September 23, 2021. On March 10, 2010, the U.S. Department of the Army issued permit POA-1984-12-M45 to Teck which authorized development of the Aqqaluk Pit. This permit was extended in 2014 under POA-1984-0012-M46, with new permit POA-2024-00116 issued and effective July 1, 2025. Active mining in the Aqqaluk Pit began during 2012.

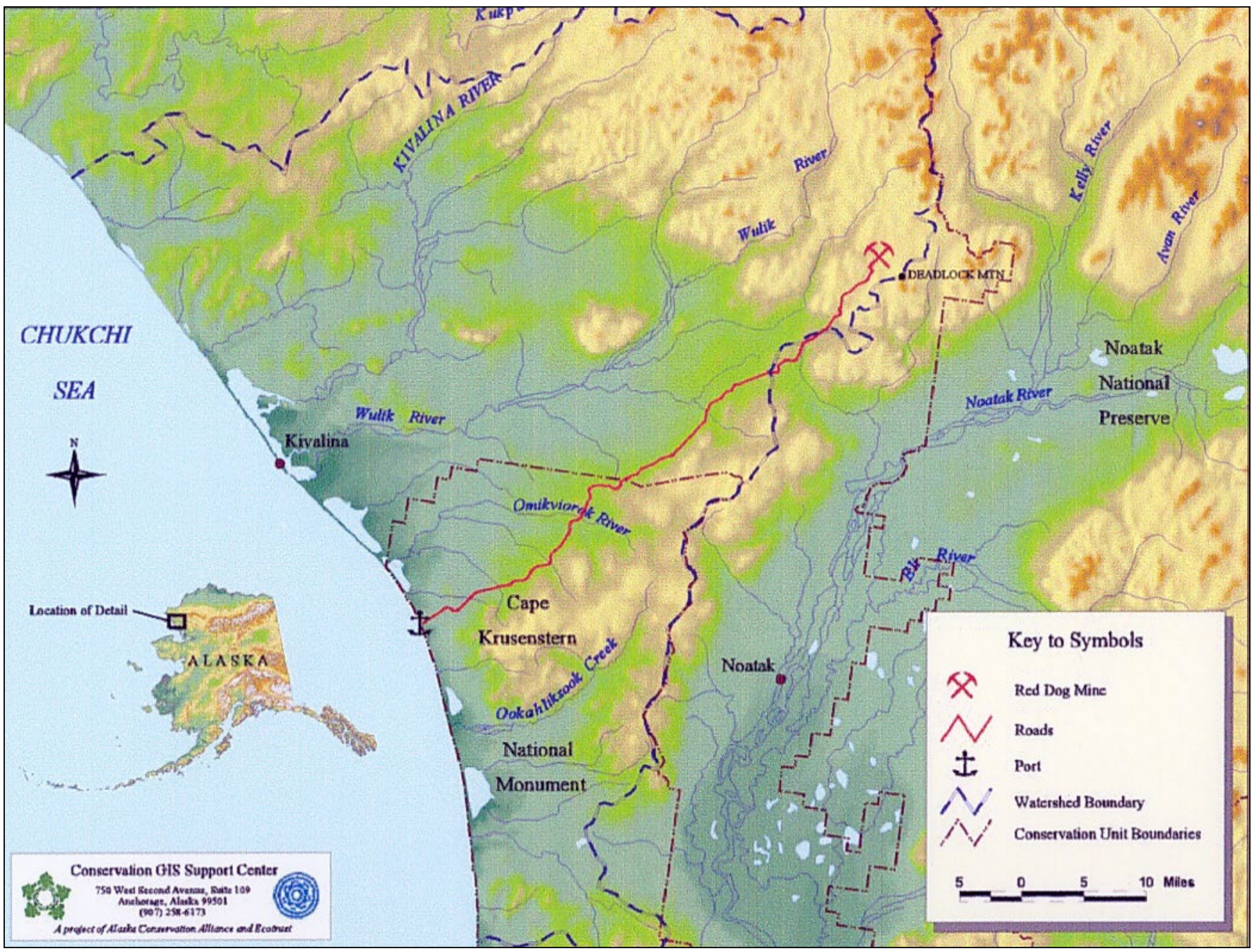

Figure 1.–Location of the Red Dog Mine in northwestern Alaska.[1]

[1] Map used with permission of Conservation GIS Support Center, Anchorage, Alaska.

Table 1.–Location of biological sample sites and factors measured at the Red Dog Mine, 2025.

Location	APDES/WMP	Location Description	Parameters
Wulik River	WMP	Kivalina Lagoon to 10 km past mouth of Ikalukrok Creek	Fall aerial surveys for overwintering Dolly Varden
Ikalukrok Creek	WMP	Lower Ikalukrok Creek to mouth of Dudd Creek	Fall aerial surveys for adult chum salmon
Ikalukrok below Dudd	WMP	Lower Ikalukrok Creek, Station 160	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use
Ikalukrok above Red Dog	APDES/WMP	Ikalukrok Creek upstream of confluence with Red Dog Creek, Station 9	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use
Red Dog Lower	APDES/WMP	Mouth of Red Dog Creek, Station 10	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use Juvenile Dolly Varden elements in tissue
Middle Fork Red Dog	WMP	Middle Fork Red Dog Creek above fish weir, Station 20	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates
North Fork Red Dog	APDES/WMP	North Fork Red Dog Creek above confluence with Mainstem Red Dog, Station 12	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use Record of spawning activity Capture/mark Arctic grayling
Upper NFRD	APDES	Upper North Fork Red Dog Creek, above Aqqaluk	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use
Bons above pond	WMP	Bons Creek above pond	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates
Bons below pond	WMP	Bons Creek below pond, Station 220	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates
Buddy above road	WMP	Buddy Creek above haul road, Station 221	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates
Buddy below falls	WMP	Below falls, about 1.5 km downstream of haul road	Periphyton (as chlorophyll-a concentration) Benthic macroinvertebrates Fish presence and use Juvenile Dolly Varden elements in tissue
Red Dog Station 151	APDES	Upper mainstem Red Dog Creek	Fish presence and use
Anxiety Ridge	WMP	Anxiety Ridge Creek below haul road	Fish presence and use Juvenile Dolly Varden elements in tissue
Evaingiknuk	WMP	Evaingiknuk Creek	Fish presence and use
Bons Pond	WMP	Above reservoir spillway	Juvenile Arctic grayling elements in tissue Arctic grayling population estimate

STRUCTURE OF REPORT

This report is presented in sections as follows:

1) Overview of sampling sites and general methods;
2) Water quality;
3) Periphyton standing crop;
4) Benthic macroinvertebrates;
5) Juvenile Dolly Varden catches and element concentration data;
6) Element concentration data for juvenile Arctic grayling collected from Bons Pond;
7) Element concentration data for adult Dolly Varden collected from the Wulik River;
8) Aerial survey estimates of overwintering Dolly Varden in the Wulik River and chum salmon (*Oncorhynchus keta*) spawners in Ikalukrok Creek; and
9) Biological monitoring data for Arctic grayling

LOCATION AND DESCRIPTION OF SAMPLE SITES

Biomonitoring is conducted annually in streams near the Red Dog Mine as required under the APDES Permit No. AK0038652 and by the ADEC Waste Management Permit and the ADNR Reclamation Plan Approval (Table 1 and Figure 2). Water quality and fish data collected during four years of baseline studies (1979–1982) represent pre-mining conditions. Comparisons of existing conditions relative to baseline data should consider that there is a much longer time series of data since mining began (1990–2025) when compared to the pre-development baseline data. All streams in the study area are in the Wulik River drainage, except for Evaingiknuk Creek, which is in the Noatak River drainage. Station numbers correspond either to those used by Dames and Moore (1983) during baseline work or to the current water quality program being conducted by Teck.

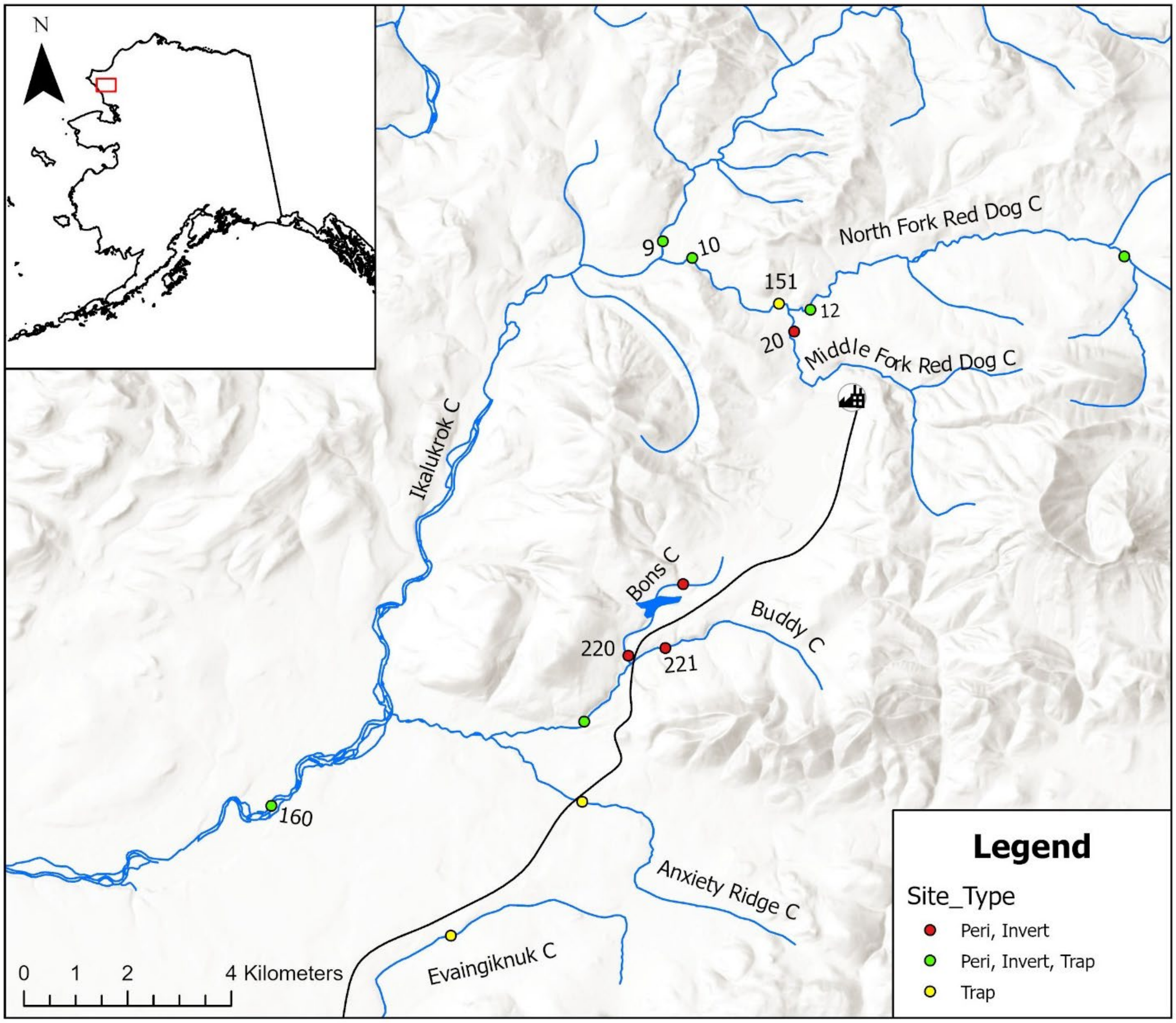

Figure 2.–Location of sample sites near Red Dog Mine.

Of the thirteen established biomonitoring sites, six are sampled for fish presence, periphyton, and aquatic macroinvertebrates; four for periphyton and aquatic macroinvertebrates only; and three for fish presence only (Table 1).

- **Ikalukrok Creek downstream of Dudd Creek, Station 160:** This site is on lower Ikalukrok Creek, a major tributary of the Wulik River, approximately 33 km upstream of its confluence with the Wulik River. There are large pools connected by riffles and runs, with substrate composed primarily of gravel and cobble. Riparian habitat consists of tundra, with willows, alders, and occasional cottonwoods along the stream bank (Figure 3).

- **Ikalukrok Creek, Station 9:** This site is upstream of Red Dog Creek and the treated water discharge. Aquatic habitat consists of large pools and riffles connected by runs flowing over gravel and cobble, with intermittent boulders. Riparian habitat consists of tundra with willows lining the stream banks (Figure 3).
- **Red Dog Creek, Station 10:** This sample site is located just upstream of the creek mouth on Ikalukrok Creek. The sample site is predominantly riffles and runs, and riparian vegetation consists of tundra with willows lining the stream banks (Figure 4).
- **Middle Fork Red Dog Creek, Station 20:** Middle Fork Red Dog Creek originates above the active mining area and is routed around the existing pit via a series of lined ditches and pipes. The treated water discharge point (Outfall 001) is approximately 1.7 km upstream of this sample site. This stream was historically fishless, but after the mine commenced operation and began discharging treated water into Middle Fork Red Dog Creek, water quality improved and a fish weir was constructed near the mouth of Middle Fork Red Dog Creek to prevent fish passage up into the diversion system. Red staining and precipitate is common on the streambed. Aquatic habitats are composed of riffles and runs with gravel and cobble substrate. Riparian vegetation is tundra with willows lining the stream banks (Figure 4).
- **North Fork Red Dog Creek, Station 12:** North Fork Red Dog Creek joins with Middle Fork Red Dog Creek to form mainstem Red Dog Creek. This sample site is approximately 150 m above that confluence, above the influence of mine discharge. Riparian vegetation consists of tundra and willows (Figure 5).
- **Upper North Fork Red Dog Creek:** This sample site is located approximately 8 km upstream of Station 12, right below the confluence of two tributaries. Substrate consists of gravel and small cobbles, with riffles, runs, and small pools. Adult Arctic grayling are often visually observed at this site. There are mossy rocks and willows lining the banks with some overhanging riparian vegetation (Figure 5).
- **Bons Creek above the pond:** This sample site is located approximately 160 m upstream of the inlet on Bons Pond, the freshwater reservoir that provides potable water for various mine uses. This section of Bons Creek is incised with streambanks vegetated with willows and sedges. The substrate consists of gravel in riffles, with fine sediments and organics in

the pools (Figure 6). In addition to periphyton and benthic macroinvertebrate sampling, a fyke net is also set here every spring to capture Arctic grayling for the population estimate.

- **Bons Creek, Station 220:** This sample site is below Bons Pond approximately 150 m above the confluence of Bons and Buddy creeks, 1.4 km above the falls on Buddy Creek that prevent upstream fish passage (Figure 6). Substrate is primarily cobble with some gravel, and the sample location is in the middle of a long stretch of riffle-run habitat. There is typically green filamentous algae and moss on the substrate. Willows are tall here, often overhanging the edges of the creek or completely closing in the canopy. The only fish at this sample site are Arctic grayling that have left Bons Pond, as the falls on lower Buddy Creek are a barrier to upstream fish passage.
- **Buddy Creek, Station 221:** This sample site is located 45 m upstream from the Haul Road crossing. Substrate is gravel and cobble, with shrubby willows along the banks (Figure 7).
- **Buddy Creek below falls:** This sample site is located approximately 0.5 km below a series of falls that form a barrier to upstream fish passage. The substrate is primarily cobble, with moderate gradient riffles and runs. The creek is incised with overhanging willows on the banks. There is often filamentous green algae on the substrate (Figure 7).
- **Red Dog Creek, Station 151:** This site is located 0.5 km downstream of the confluence of the Middle and North Forks of Red Dog Creek. The sample site is on a riffle-run sequence just downstream of a large pool at the base of a bluff, with predominantly cobble substrate (Figure 8).
- **Anxiety Ridge Creek:** This site is located at the Anxiety Ridge Creek Haul Road bridge. Minnow traps are set upstream and downstream of the bridge. Substrate is gravel, cobble, and some small boulders, with depositional gravel bars along the meandering stream. Aquatic habitat is riffle-run sequences and frequent pools (Figure 8).
- **Evaingiknuk Creek:** This sample site is the Noatak River drainage on the east side of the Haul Road and is crossed by a material site access road. The creek is narrow and incised at the sample location, and the water is often tannic. Minnow traps are placed both upstream and downstream of the access road crossing. Substrate is gravel and cobble, with overhanging vegetation (Figure 9).

Figure 3.–Ikalukrok Station 160 below Dudd (left) and Ikalukrok Station 9 above Red Dog (right).

Figure 4.–Mainstem Red Dog Creek Station 10 (left) and Middle Fork Red Dog Station 20 (right).

Figure 5.–North Fork Red Dog Creek Station 12 (left) and Upper North Fork Red Dog Creek (right).

Figure 6.–Bons upstream (left) and Bons downstream of the pond Station 220 (right).

Figure 7.– Buddy above Haul Road Station 221 (left) and Buddy below falls (right).

Figure 8.–Red Dog Creek Station 151 (left) and Anxiety Ridge Creek (right).

Figure 9.–Evangiknuk Creek upstream of the road (left) and downstream of the road (right).

METHODS

Four sampling events occurred in 2025 including the spring Arctic grayling population estimate and adult Dolly Varden tissue sampling (June 10–16), mid-summer benthic macroinvertebrates and periphyton sampling (June 30–July 7), late summer juvenile Dolly Varden sampling (July 29–August 5), and fall aerial surveys of Dolly Varden in the Wulik River and adult Dolly Varden tissue sampling (September 28–30).

Methods used for the 2025 Red Dog Mine aquatic biomonitoring study are fully described by ADF&G in Technical Report No. 26-03: *Methods for Aquatic Life Monitoring at the Red Dog Mine Site: A requirement of the 2026 APDES Permit AK0038652* (Clawson 2026).

All 2025 water quality sampling was performed by Red Dog Mine personnel following their standard methodology. Water quality analysis was performed by independent laboratories and results were provided to ADF&G for inclusion in this report. All water quality presented in this report are for “total recoverable” unless otherwise specified. The number of water quality samples taken each year varies depending upon duration of the open water season, and are collected according to Red Dog Mine’s APDES permit and WMP. Baseline water quality pre-mining data presented in the report were collected from 1979 to 1982.

Additionally, ADF&G staff collected point measurements of water temperature (°C), dissolved oxygen (mg/L), specific conductance (µS/cm), conductivity (µS/cm), and pH using a handheld multiparameter YSI at each site concurrent with invertebrate and periphyton sampling. The probe was placed in flowing water, and measurements were allowed to equilibrate before being recorded. An Orion AQUAfast Turbidity meter was used to measure turbidity (NTU). At each site, the sample vial was rinsed with sample water three times, then filled with flowing water. Three turbidity readings of the sample were taken, and the average value of those readings was recorded.

Periphyton (attached microalgae) biomass samples have been collected annually since 1999. Under the program initiated in 2010, sampling occurred at a minimum of nine sites (Table 1). In 2025, samples were collected at all nine standard sites, with the addition of Upper North Fork Red Dog Creek (Appendix 2). Periphyton samples were processed in the laboratory and standing crop biomass was determined as mg/m^2 chlorophyll-a, corrected for phaeophytin.

Benthic macroinvertebrate (BMI) samples are collected annually using Hess samplers (Appendix 3). The purpose is to evaluate variations in BMI populations across sampling sites and to monitor changes between and among sample sites over time. Prior to 2022 macroinvertebrate samples were collected using drift nets. Hess samplers are more accurate at identifying the in-situ benthic community, rather than the drifting invertebrate community from upstream. This provides a more accurate baseline for evaluating changes at each site, rather than changes occurring upstream. However, since sampling methodology is different, previous years' results are not directly comparable to the results from 2022 onward.

Fish sampling is conducted with baited minnow traps targeting juvenile Dolly Varden for fish presence and use and whole-body element analyses. Limited pre-mining juvenile Dolly Varden distribution data are available for streams in the Red Dog Mine area. Houghton and Hilgert (1983) identified Anxiety Ridge Creek as the most productive system in the project area. They also reported finding only one juvenile Dolly Varden in the North Fork Red Dog Creek drainage and presumed it was a resident fish. Surveys along Mainstem Red Dog Creek reported either few fish or no fish, and in some cases mortalities of small juvenile Dolly Varden and Arctic grayling fry (Ward and Olson 1980; EVS Consultants Ltd and Ott Water Engineers 1983).

Juvenile Dolly Varden have been sampled in streams within the Red Dog Mine area since 1990. In 1992, the number of minnow traps set was increased from five to 10 per sample reach. From 1990–2009, not all sites were sampled in all years. Under the modified program that began in 2010, the sites listed in Table 2 are sampled every year with 10 minnow traps per sample reach, typically with 24 hours of effort in early-to-mid August (Table 2, Appendix 8). No sampling occurred in 2012, 2013, and 2024 due to high water. Seven of these sites are unchanged in location from the 1990–2009 sampling. In 2010, Station 7 on lower Ikalukrok Creek was replaced with Station 160. Station 160 is about 7 km downstream of Dudd Creek whereas Station 7 is immediately downstream of Dudd Creek. Upper North Fork Red Dog Creek was added in 2014.

Table 2.–Location of juvenile Dolly Varden sample sites.

Site Name	Station #	Year Sampling Began
Evaingiknuk Creek		1990
Anxiety Ridge Creek		1990
Buddy Creek below falls		1996
North Fork Red Dog Creek	12	1993
Mainstem Red Dog Creek Upper	151	1995
Mainstem Red Dog Creek Lower	10	1996
Ikalukrok Creek above Red Dog Cr	9	1996
Ikalukrok Creek below Dudd	7/160	1990
Upper North Fork Red Dog Creek		2014

Juvenile Dolly Varden and juvenile Arctic grayling are sampled to determine whole-body concentrations of selected elements. The purposes of this effort are to: (1) determine if differences exist in element concentrations in fish among sample sites that can be linked with background water quality; and (2) track changes over time. Juvenile Dolly Varden are collected from Anxiety Ridge, Buddy, and Mainstem Red Dog creeks during the minnow trap sampling event in late summer.

Juvenile Arctic grayling were selected for long-term monitoring in Bons Pond after a self-sustaining population became established. Arctic grayling captured in Bons Pond have been in the pond system, including upstream tributaries, for their entire life cycle. Arctic grayling that leave Bons Pond go over a waterfall that prohibits upstream movement of fish. Therefore, Arctic grayling serve as an indicator of the varying conditions in Bons Pond over time. Fish samples are typically collected during the spring sampling event when fish are moving from Bons Pond into Bons Creek. Fyke nets are used to capture Arctic grayling for the population estimate and element concentration analyses. The abundance of Arctic grayling is estimated using Chapman's modification of the Lincoln-Petersen two-sample mark-recapture model (Chapman 1951).

Hook and line sampling is used to collect adult Dolly Varden for element analyses, and aerial surveys are used to enumerate Dolly Varden and chum salmon in the fall.

RESULTS AND DISCUSSION

WATER QUALITY

Water quality data collected in Mainstem Red Dog Creek prior to 2010 were from Station 10, located near the mouth of the creek. Data from 2010 to 2025 were collected at Station 151 located about 2 km upstream from Station 10. Station 151 is at the downstream end of the mixing zone in Mainstem Red Dog Creek (Figure 8). There are no defined drainages entering Mainstem Red Dog Creek between these two water quality stations. Mainstem Red Dog Creek is directly affected by the treated mine wastewater effluent and by discharge from the clean water bypass. North Fork Red Dog Creek Station 12 is an upstream reference site with no direct effects from the mine.

In 2025, Teck continued to maintain the mine's non-contact water bypass system which picks up non-mining impacted water from Sulfur, Shelly, Connie, Rachel, and Upper Middle Fork Red Dog creeks (Figure 10). This water is moved through the mine pit area, including the currently active Aqqaluk pit, to its original channel via a combination of culverts and lined open ditches. These bypass conveyance structures serve to isolate the non-contact water from areas disturbed by mining activities.

In 2020, a new seep emerged on Middle Fork Red Dog Creek above Station 145, named Kaviqsaaq Seep. This seep greatly increased the metals in Middle Fork Red Dog Creek, and in 2021 a diversion was installed to capture the seep output and route it to the tailings facility.

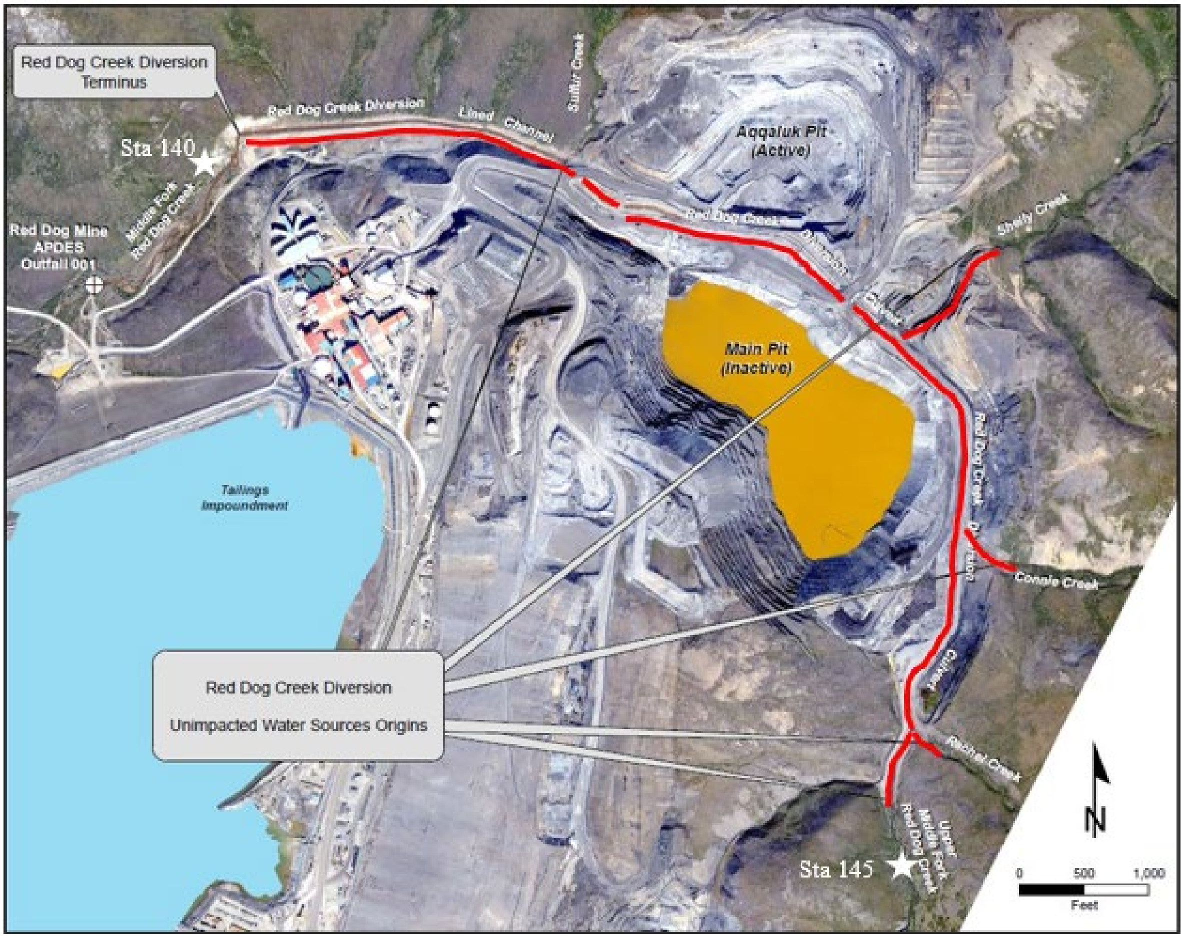

Figure 10.–Clean water bypass system at the Red Dog Mine. The Red Dog Creek diversion structure is shown in red.[2]

In 2025, the median lead concentration in Mainstem Red Dog Creek (Station 151/10), downstream of the non-contact water bypass system, remained lower than the pre-mining (1979–1983) median concentration. The maximum lead concentration in 2025 was also lower than the pre-mining median, although in some years the maximum lead concentration has exceeded the pre-mining maximum (Figure 11). The maximum lead concentration in 2025 was 24.6 µg/L and the median concentration remained steady at 6.0 µg/L.

[2] Figure provided by Teck with modifications made by ADF&G.

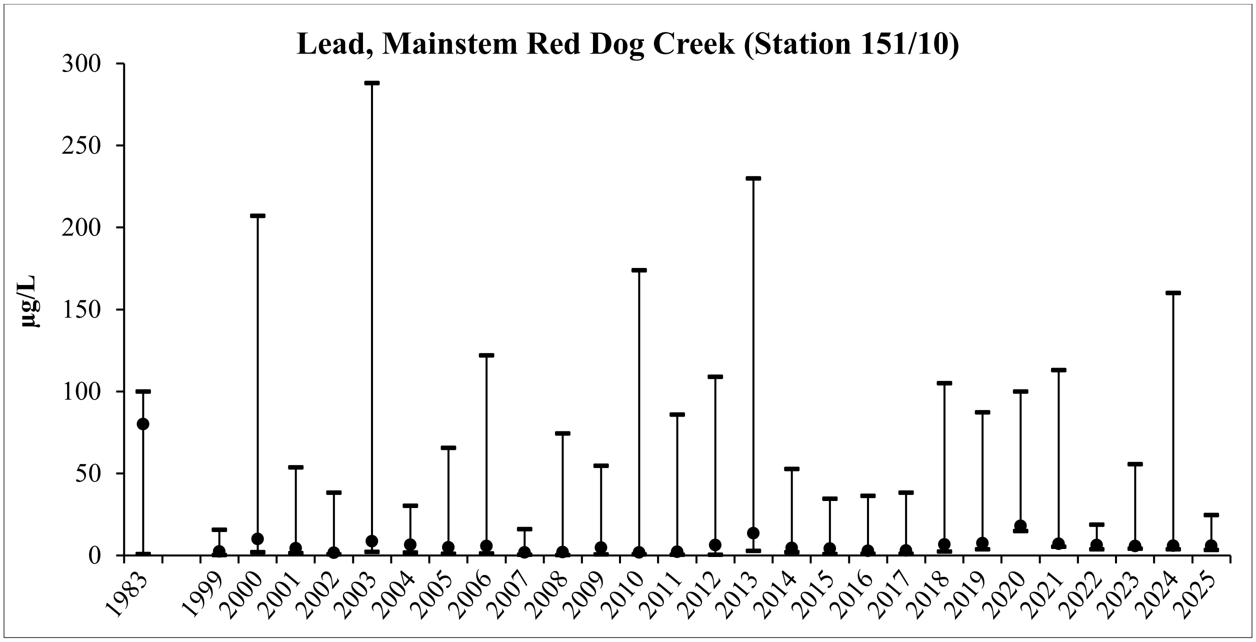

Figure 11.–Median, maximum, and minimum lead concentrations at Station 151/10.

In 2025, the component of the non-contact water bypass system with the highest concentration of lead was Station 145 on Middle Fork Red Dog Creek above the bypass, with a median lead concentration of 80.5 µg/L (Figure 12). Typically, the component of the bypass system with the highest median lead concentration is Sulfur Creek, but the median concentration there decreased to 48.2 µg/L in 2025. In the last 10 years, median lead concentrations in Sulfur Creek have ranged from 71.9 to 1550.0 µg/L (Figure 13). Flows in Sulfur Creek are typically low, so although lead concentrations are often high in Sulfur Creek, it does not have much effect on overall lead concentrations in Mainstem Red Dog Creek. At Station 145, lead concentrations have decreased from a peak of 215.0 µg/L in 2020, following the diversion of Kaviqsaaq Seep in 2021. However, lead levels remain above pre-2020 levels, possibly due to additional mineralized seeps that have emerged above Station 145.

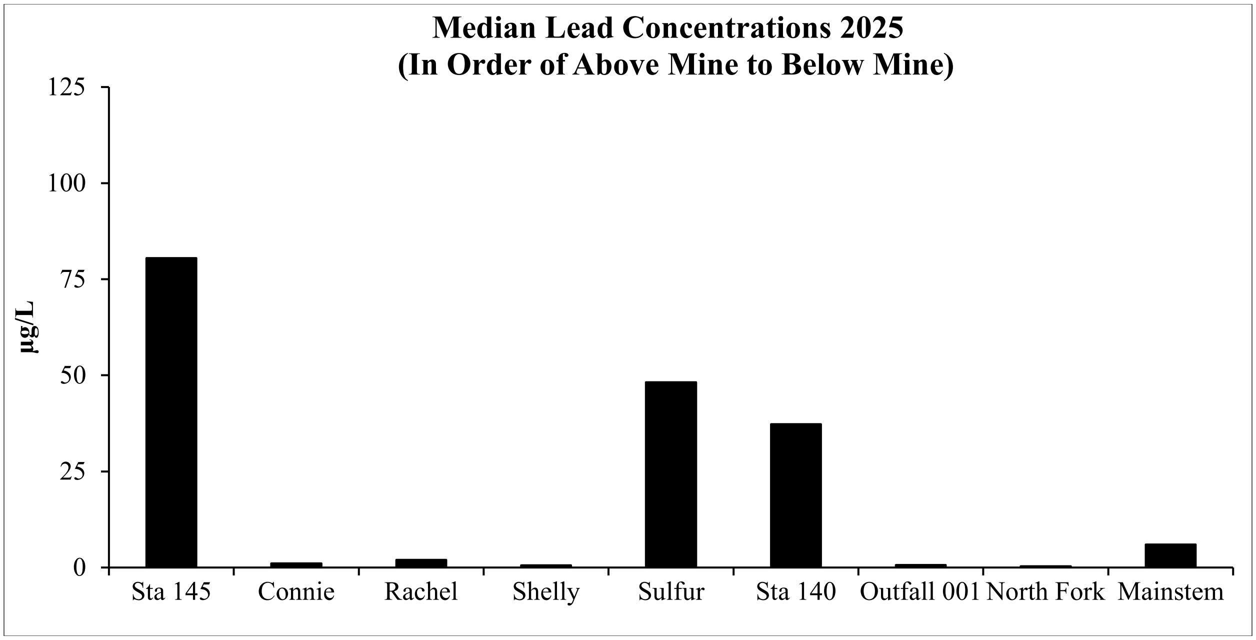

Figure 12.–Median lead concentrations in 2025 from upstream (Station 145) of the non-contact water bypass, including tributaries to the bypass (Connie, Rachel, Shelly, and Sulfur creeks), Station 140 (above Outfall 001), Outfall 001, and North Fork Red Dog and Mainstem Red Dog creeks.

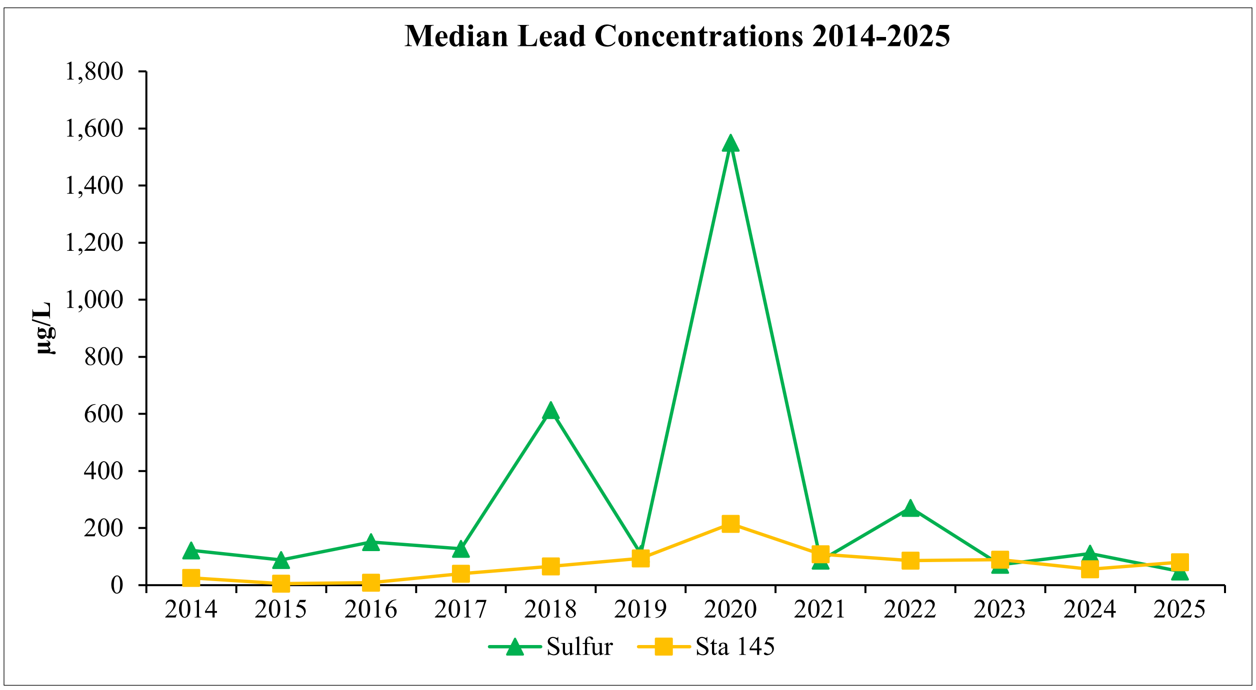

Figure 13.–Median lead concentrations from Sulfur Creek and Station 145 on Middle Fork Red Dog Creek.

The median zinc concentration in Mainstem Red Dog Creek (Station 151/10) increased slightly in 2025, but the range of values has been consistent since 2022 (Figure 14). Zinc levels from 2018–

2025 have been higher than values observed from 1999–2017, with median concentrations exceeding pre-mining some years. Station 140 on Middle Fork Red Dog Creek, upstream of the treated mine discharge Outfall 001 and downstream of the non-contact water diversion, increased in 2025 to a median concentration of 24,300 µg/L (Figure 15).

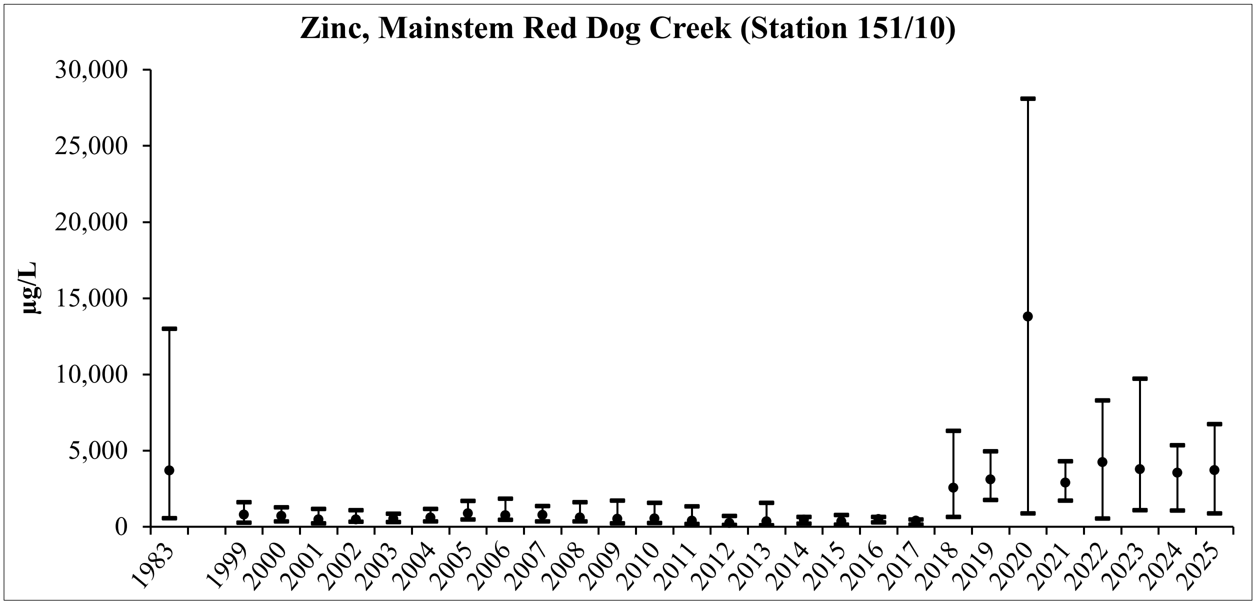

Figure 14.–Median, maximum, and minimum zinc concentrations at Station 151/10, 1983 and 1999–2025.

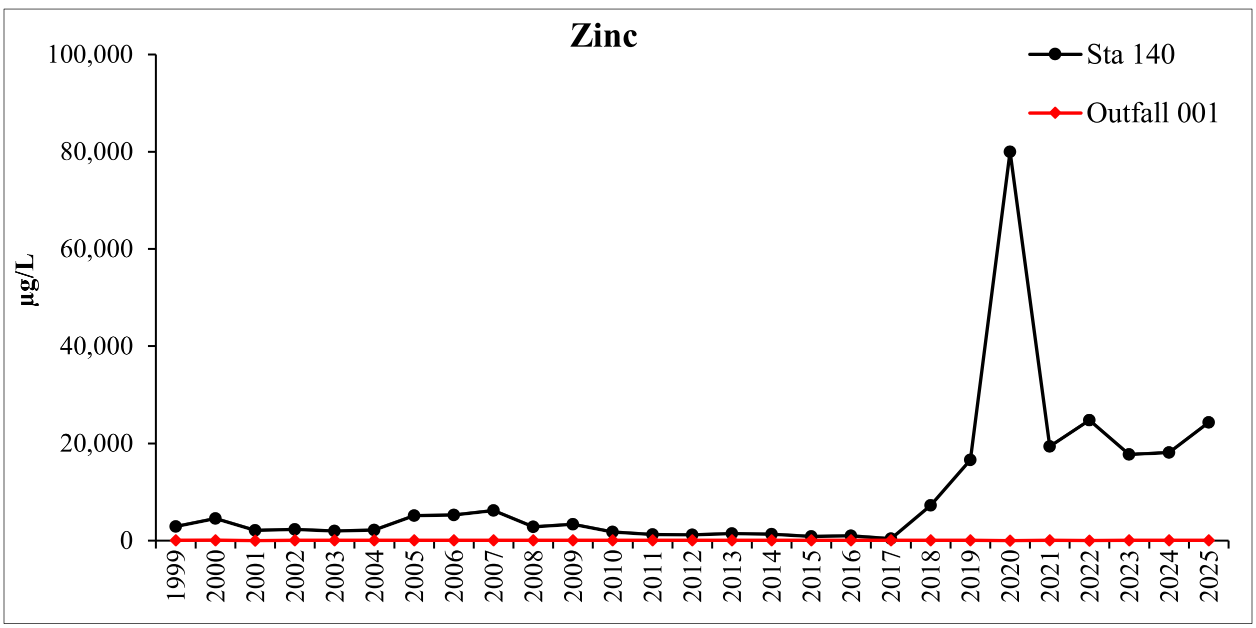

Figure 15.–Median zinc concentration in water samples from Station 140 and Outfall 001, 1999–2025.

After decreasing in 2022–2024, zinc levels at Station 145 above the non-contact water bypass increased in 2025 up to a median concentration of 72,100 µg/L (Figure 16). The sharp decrease in zinc levels from the spike in 2020 was due to the capture and diversion of Kaviqsaaq seep in 2021, but the increase in 2025 could be due to additional mineralized seeps emerging upstream of Station 145. The other component creeks of the non-contact water bypass (Connie, Rachel, Shelly, and Sulfur creeks) have lower zinc concentrations, and all decreased slightly in 2025 (Figure 16).

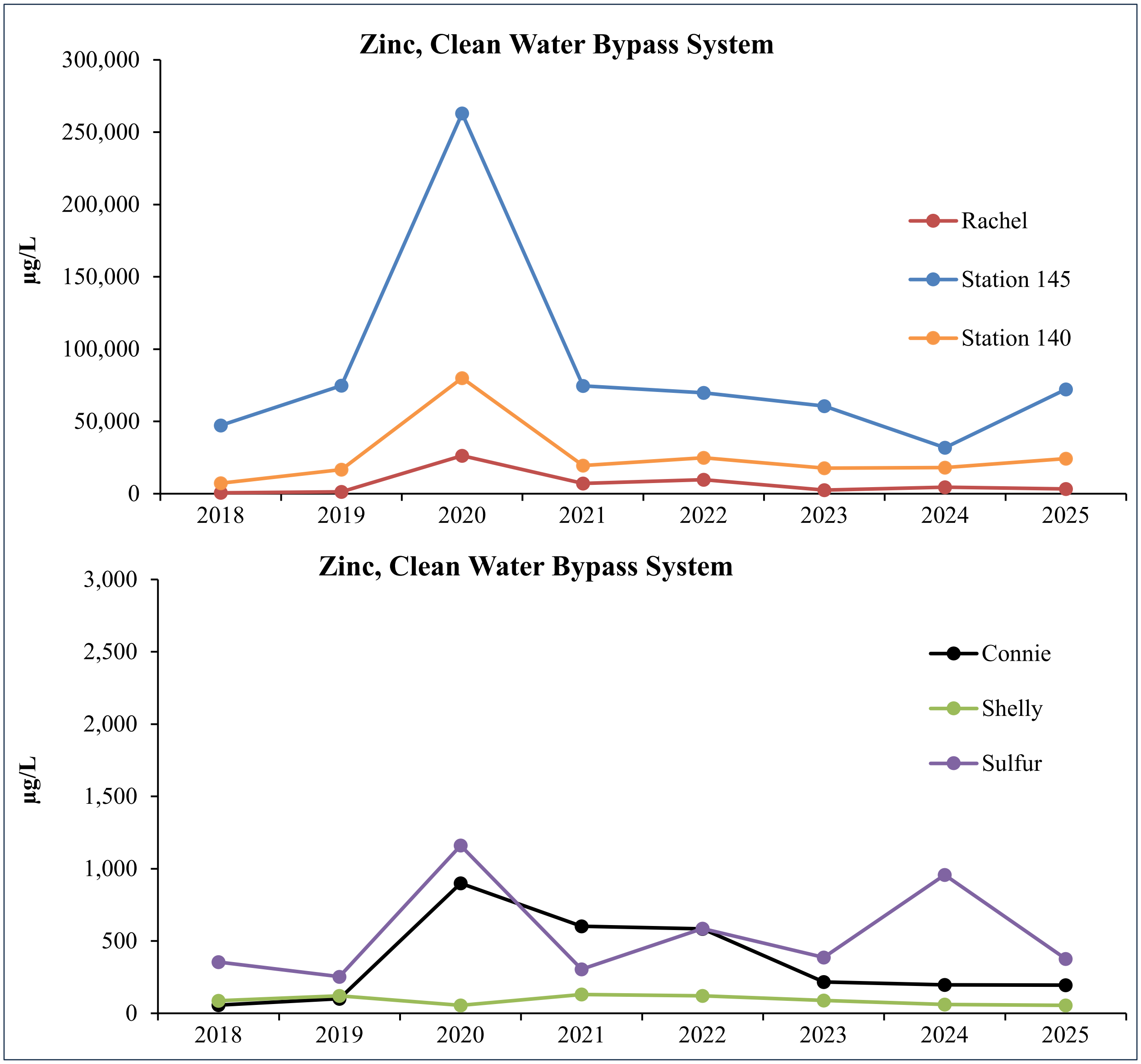

Figure 16.–Median zinc concentrations in water samples from Sulfur, Shelly, Connie, and Rachel creeks, and Stations 145 and 140 on Middle Fork Red Dog Creek, 2018–2025. Station 145 is on Middle Fork Red Dog Creek, downstream of the Kaviqsaaq Seep but before the non-contact water bypass begins, and Station 140 is below the non-contact water bypass but above Outfall 001. Note the different y-axis scales.

The median aluminum concentration in mainstem Red Dog Creek (Station 151/10) was 441 µg/L in 2025, a decrease from the median concentrations in 2022–2024, although levels are still higher than pre-2018 concentrations (Figure 17). The median cadmium concentration of 13.1 µg/L in 2025 was consistent with levels seen since 2018, aside from the sharp spike in 2020 (Figure 18). Similar to aluminum, cadmium levels have been consistently higher from 2018 on when compared with pre-2018 values.

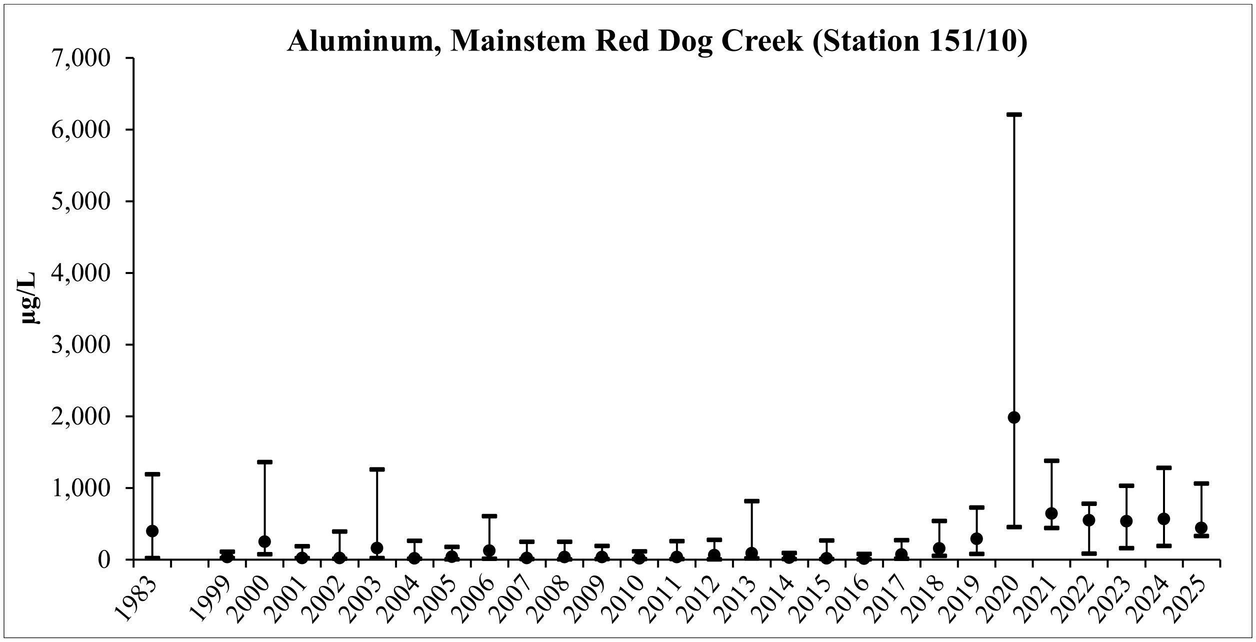

Figure 17.–Median, maximum, and minimum aluminum concentrations at Station 151/10.

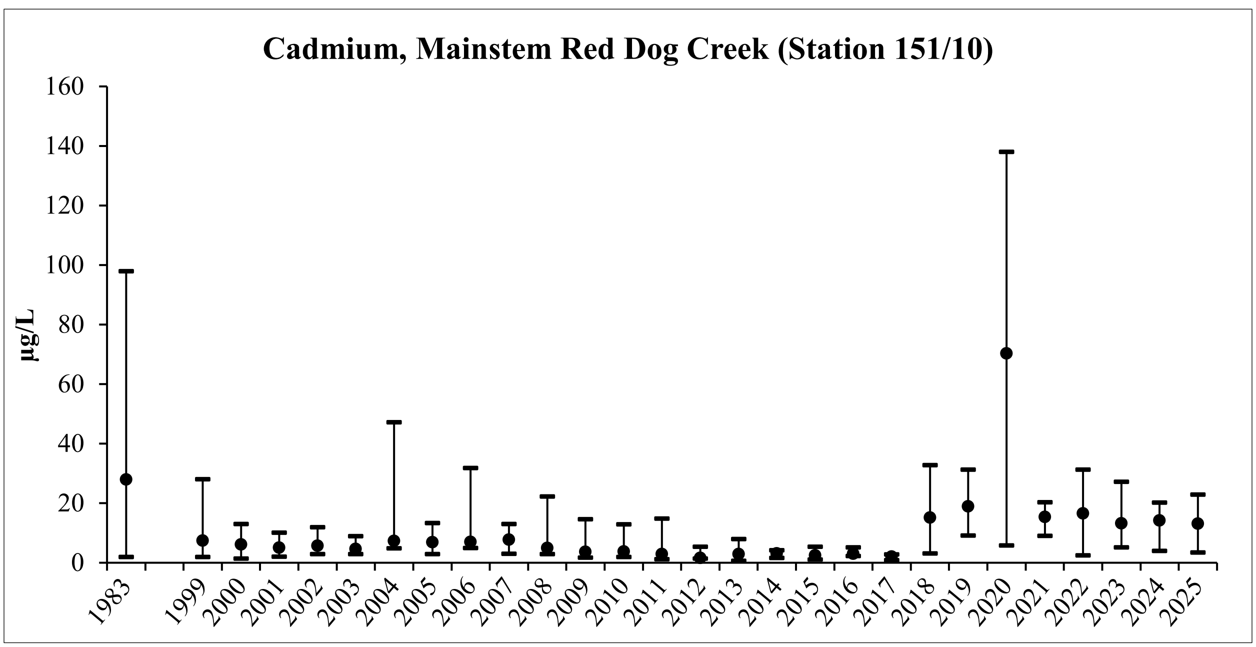

Figure 18.–Median, maximum, and minimum cadmium concentrations at Station 151/10.

Pre-mining data for selenium are not available. In 2012, discharge of treated water to Middle Fork Red Dog Creek was stopped on June 8 due to elevated selenium and was not resumed for the remainder of 2012. After selenium decreased in treated water and a mixing zone was authorized in Mainstem Red Dog Creek, discharge resumed in 2013. Selenium remained low from 2014–2017, then began to increase in 2018 to a median selenium concentration of 3.2 µg/L in 2020 and 3.1 µg/L in 2021 (Figure 19). The median selenium concentration slightly decreased in 2022–2024 but increased again in 2025 to 3.3 µg/L, the highest median concentration since sampling began.

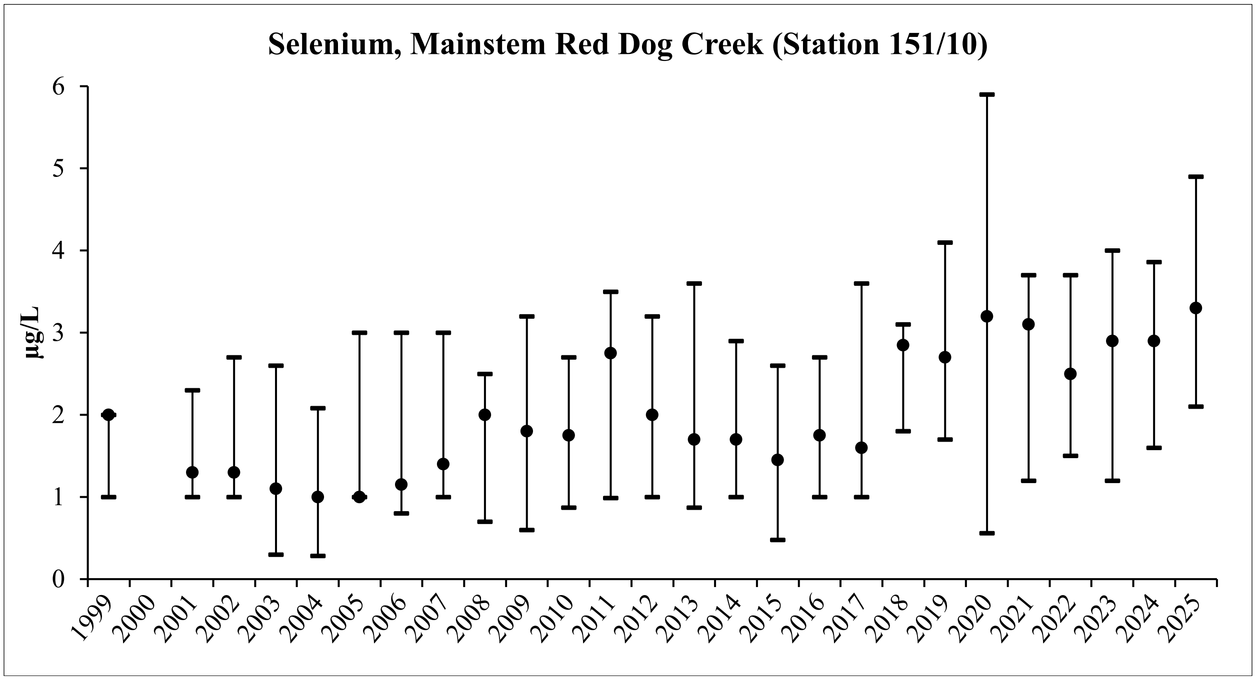

Figure 19.–Median, maximum, and minimum selenium concentrations at Station 151/10.

Pre-mining data for nickel are not available. Median nickel concentration in Mainstem Red Dog Creek (Station 151/10) increased sharply in 2020 to 394 µg/L, the highest median concentration since 1999, and an order of magnitude greater than any previously recorded value (Figure 20). Median nickel concentration has decreased since then but remains higher than pre-2020 values. The median concentration in 2025 was 94.2 µg/L. The component creeks of the non-contact water bypass system were not analyzed for nickel in recent years, so the source of the increased nickel concentration is unknown. In years when the component creeks were sampled for nickel, Rachel Creek was the primary source of nickel to the clean water bypass system (Ott and Morris 2010).

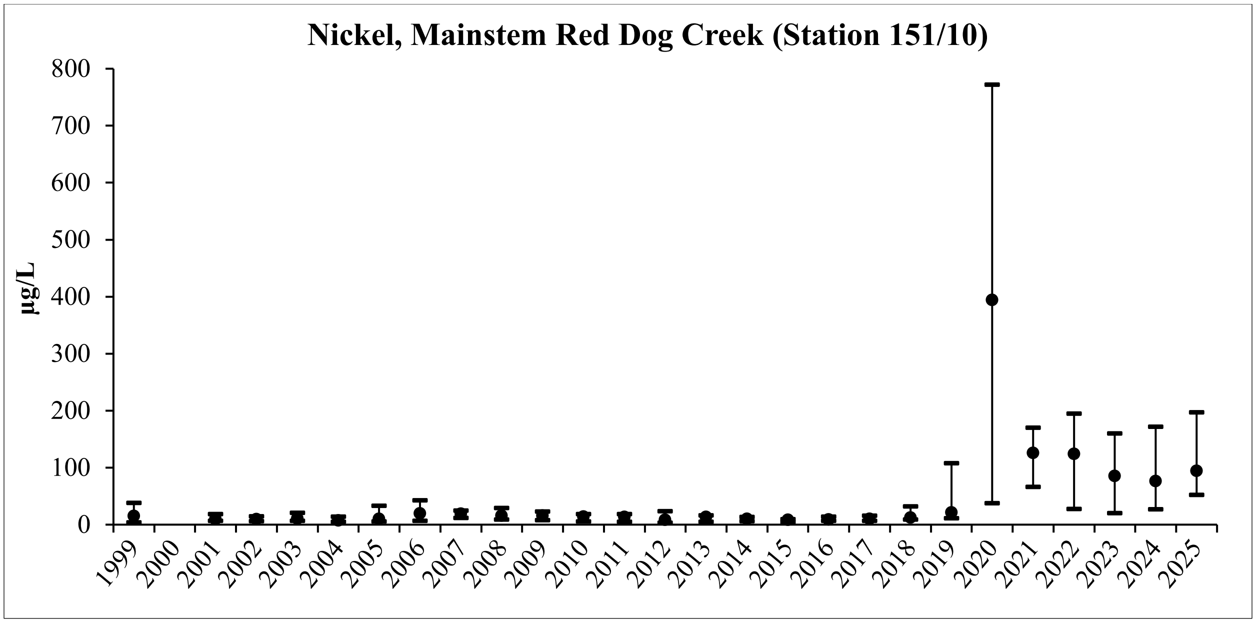

Figure 20.–Median, maximum, and minimum nickel concentrations at Station 151/10.

In 2025, the median pH in Mainstem Red Dog Creek (Station 151/10) was slightly higher (more basic) compared to pre-mining values, a trend consistently observed since 1999 (Figure 21). The median pH dropped in 2020 to 7.17, the lowest median value since mining began. Median pH increased the following year (2021) to 7.53, and the median value in 2025 was similar at 7.58. The non-contact water bypass system was built and operational prior to spring breakup in 1991, and since then the minimum pH value has only dropped below 6.0 once, in 2011. The 1990 data set is during mining, but prior to construction of the non-contact water bypass system.

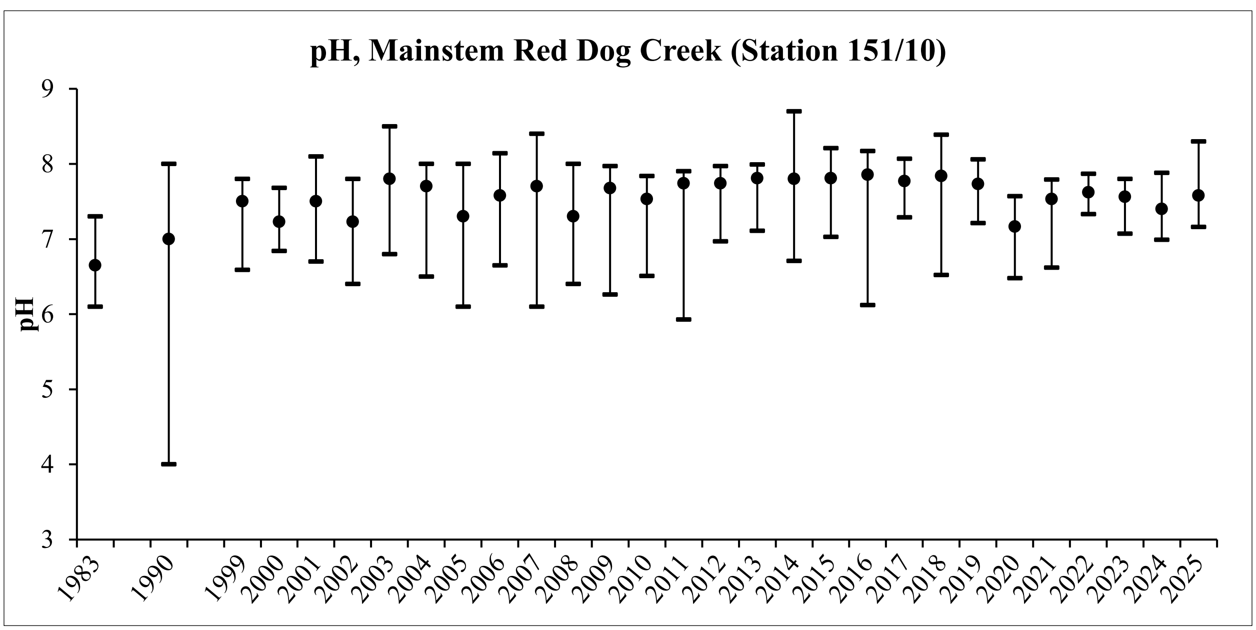

Figure 21.–Median, maximum, and minimum pH values at Station 151/10.

Total dissolved solids (TDS) in Mainstem Red Dog Creek (Station 151/10) are higher than pre-mining levels (Figure 22). TDS are directly related to high concentrations of calcium and sulfates in the treated wastewater discharge at Outfall 001. During water treatment, calcium hydroxide is added to the tailings water to precipitate metals as metal hydroxides so they can be collected and removed prior to discharge. Sulfates released in this process along with the calcium result in elevated TDS concentrations, however natural changes in water quality attributed to permafrost thaw are also increasing TDS levels throughout the Ikalukrok Creek drainage (Clawson 2023). The changes in water clarity that were initially observed throughout the Ikalukrok Creek drainage in 2019 have continued, with some seeps and tributaries changing from clear to very turbid and either milky-white or yellowish-orange (Clawson and Ott 2020). Median TDS was 1,190 mg/L in 2025, higher than the 2024 median value when high precipitation likely diluted the TDS in Red Dog Creek (Figure 22).

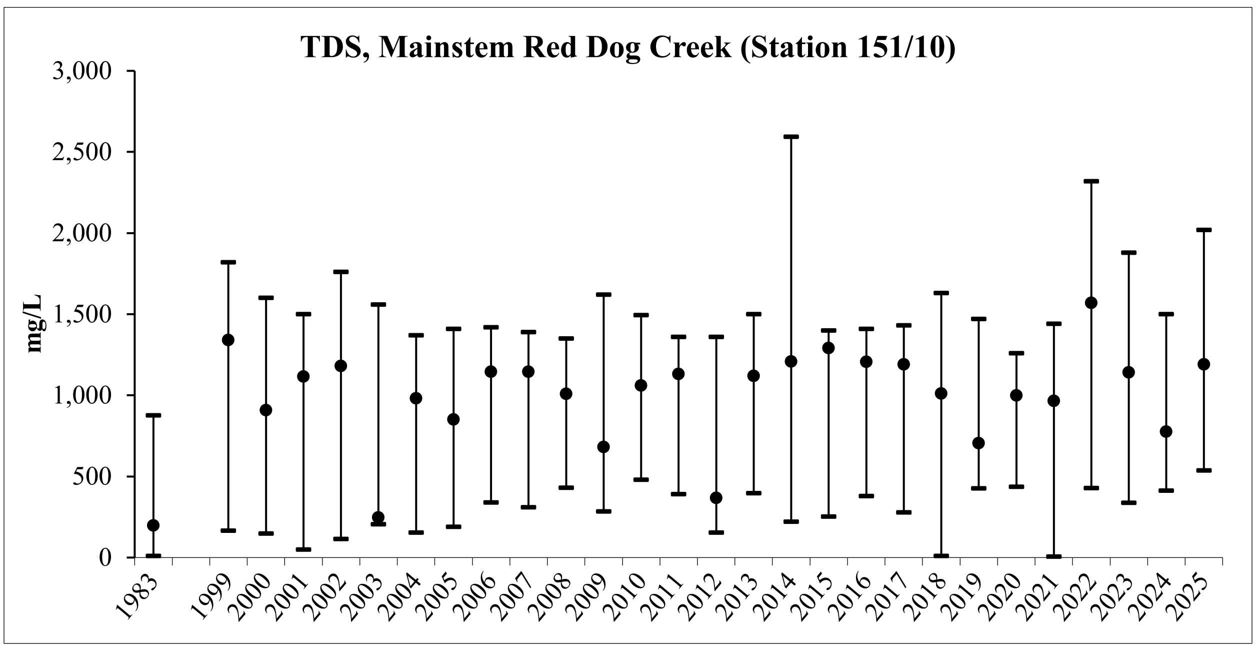

Figure 22.–Median, maximum, and minimum TDS concentrations at Station 151/10.

Cadmium, lead, zinc, and selenium concentrations in Mainstem Red Dog Creek (Station 151/10) were compared with those found in North Fork Red Dog Creek, Buddy Creek (below the confluence of Bons and Buddy creeks), and Bons Pond. Sites in North Fork Red Dog and Buddy creeks and Bons Pond were selected because they are reference sites with no direct effects from the mine process or discharge. Mainstem Red Dog Creek (Station 151/10) is directly downstream of the mine clean water bypass and wastewater effluent discharge at Outfall 001. Buddy Creek and

Bons Pond are reference sites but have the potential to be affected by the road, airport, overburden stockpile, and they are down gradient from the tailing impoundment backdam. Cadmium, lead, zinc, and selenium were selected for comparison because these elements are also analyzed for whole-body element concentrations in juvenile Arctic grayling from Bons Pond and juvenile Dolly Varden from Mainstem Red Dog, Anxiety Ridge, and Buddy creeks.

Cadmium, lead, and zinc median concentrations are highest in Mainstem Red Dog Creek. The mine discharge of treated water at Outfall 001 has very low concentrations of these elements, so the major sources of these elements are the clean water bypass and other locations in the Red Dog Creek drainage. Cadmium was low and stable in North Fork Red Dog Creek, Buddy Creek, and Bons Pond from 2001–2018. From 2019–2025, cadmium levels remained low in Buddy Creek and Bons Pond but increased in North Fork Red Dog Creek. Cadmium in Mainstem Red Dog Creek is higher than the other creeks, and has increased beginning in 2018, with a spike to 70.3 µg/L in 2020. Median concentrations have decreased since that peak, but remain higher than pre-2018 values. The median cadmium concentration in Mainstem Red Dog Creek was 13.1 µg/L in 2025 (Figure 23). Lead concentrations demonstrate more variability than cadmium but are consistently highest in Mainstem Red Dog Creek (Figure 24). Zinc concentrations have followed the same pattern as cadmium, where zinc levels are highest in Mainstem Red Dog Creek with a spike in 2020. Buddy Creek and Bons Pond have remained fairly stable but levels in North Fork Red Dog Creek have increased beginning in 2019 (Figure 25). Selenium concentrations are similar among these sites and variable among years, although the general trend appears to be increasing (Figure 26). The median selenium concentrations in Mainstem Red Dog, North Fork Red Dog, and Buddy creeks and Bons Pond in summer 2025 were 3.3 µg/L, 2.0 µg/L, 2.6 µg/L, and 2.2 µg/L, respectively.

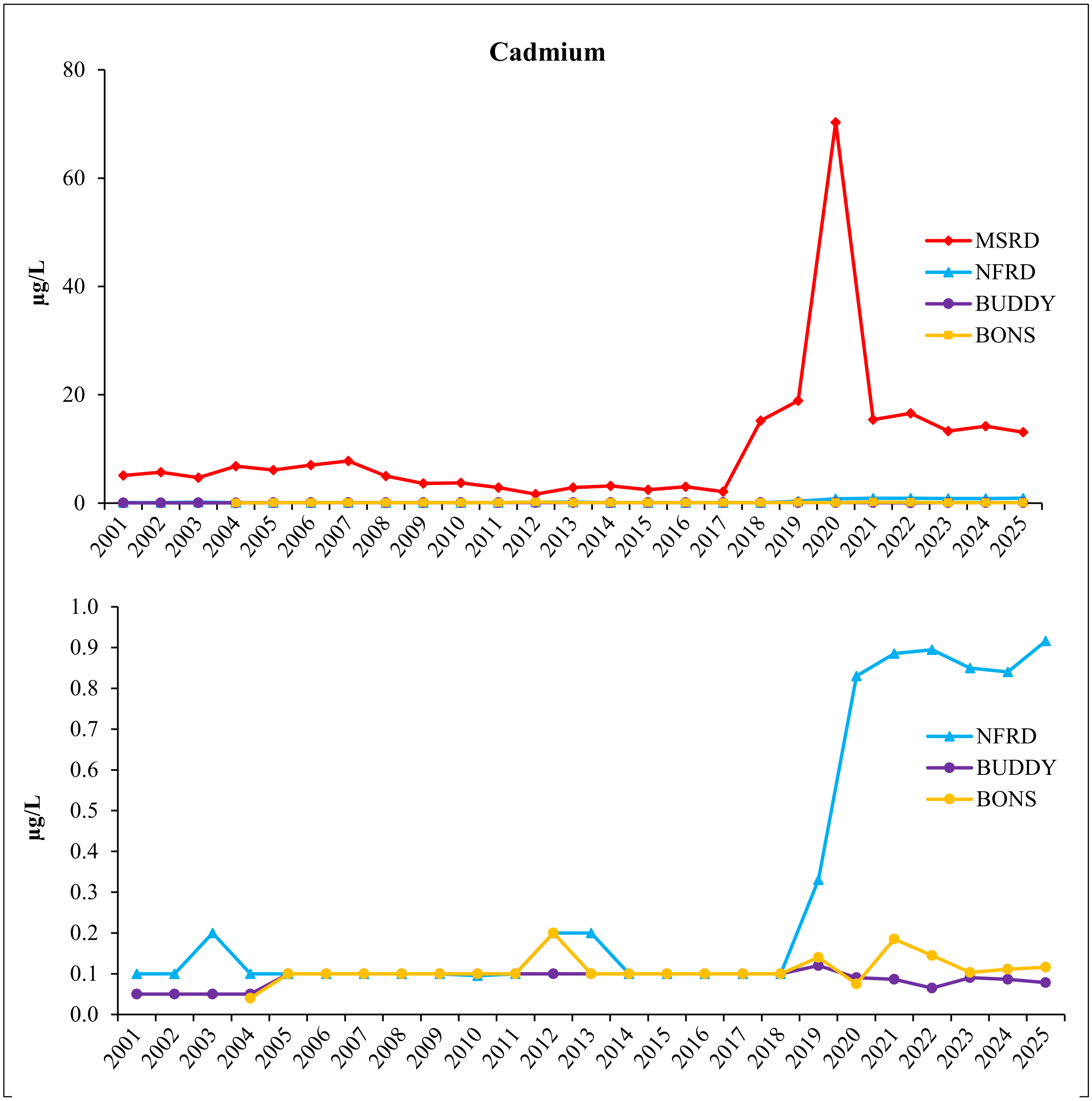

Figure 23.–Median cadmium concentrations in Mainstem Red Dog (MSRD), North Fork Red Dog (NFRD), and Buddy creeks and Bons Pond (2001–2025). Two graphs are presented, the bottom graph presents the same data but uses a different y-axis scale as it does not include Mainstem Red Dog Creek.

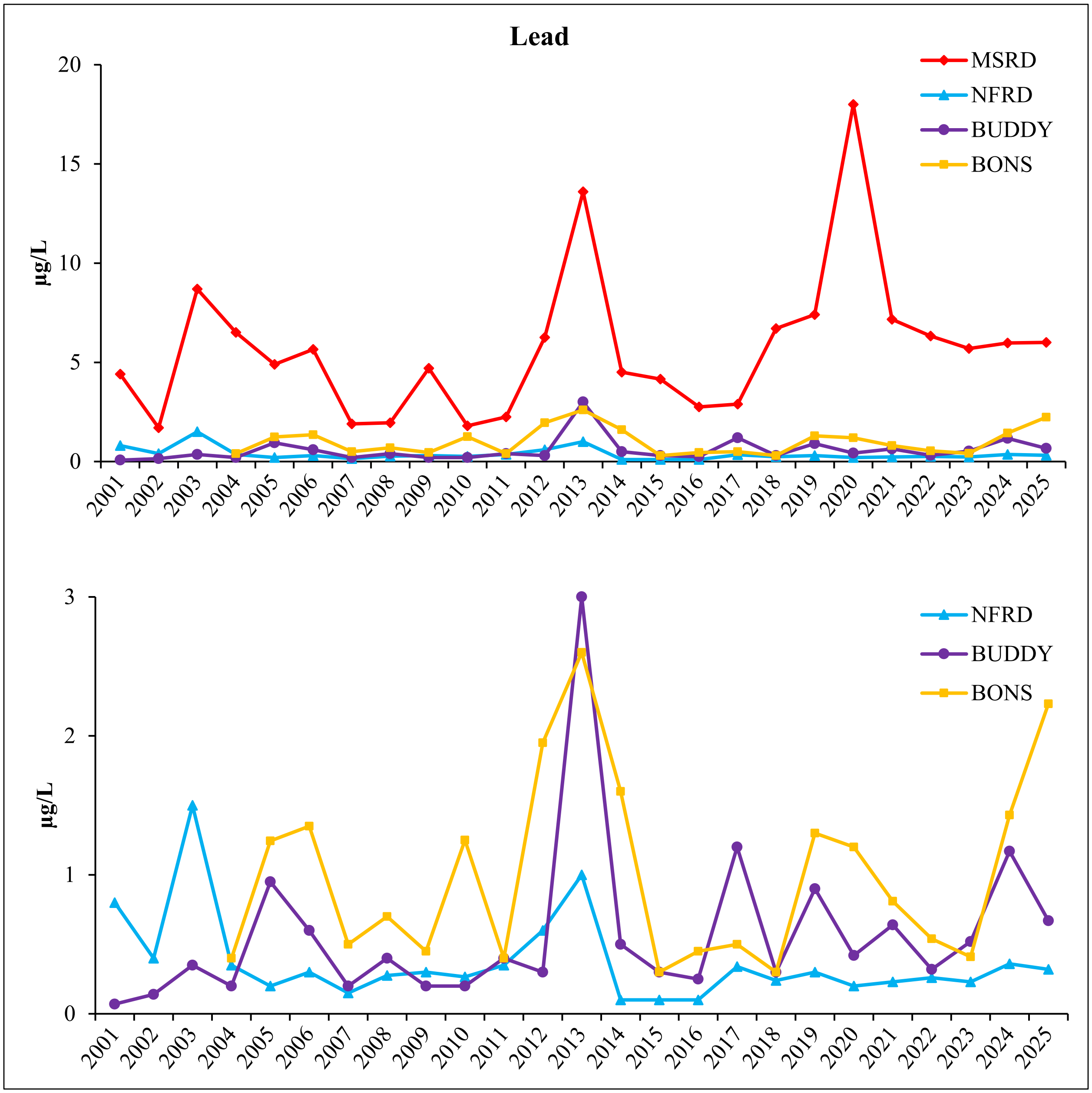

Figure 24.–Median lead concentrations in Mainstem Red Dog (MSRD), North Fork Red Dog (NFRD), and Buddy creeks and Bons Pond (2001–2025). Two graphs are presented, the bottom graph presents the same data but uses a different y-axis scale as it does not include Mainstem Red Dog Creek.

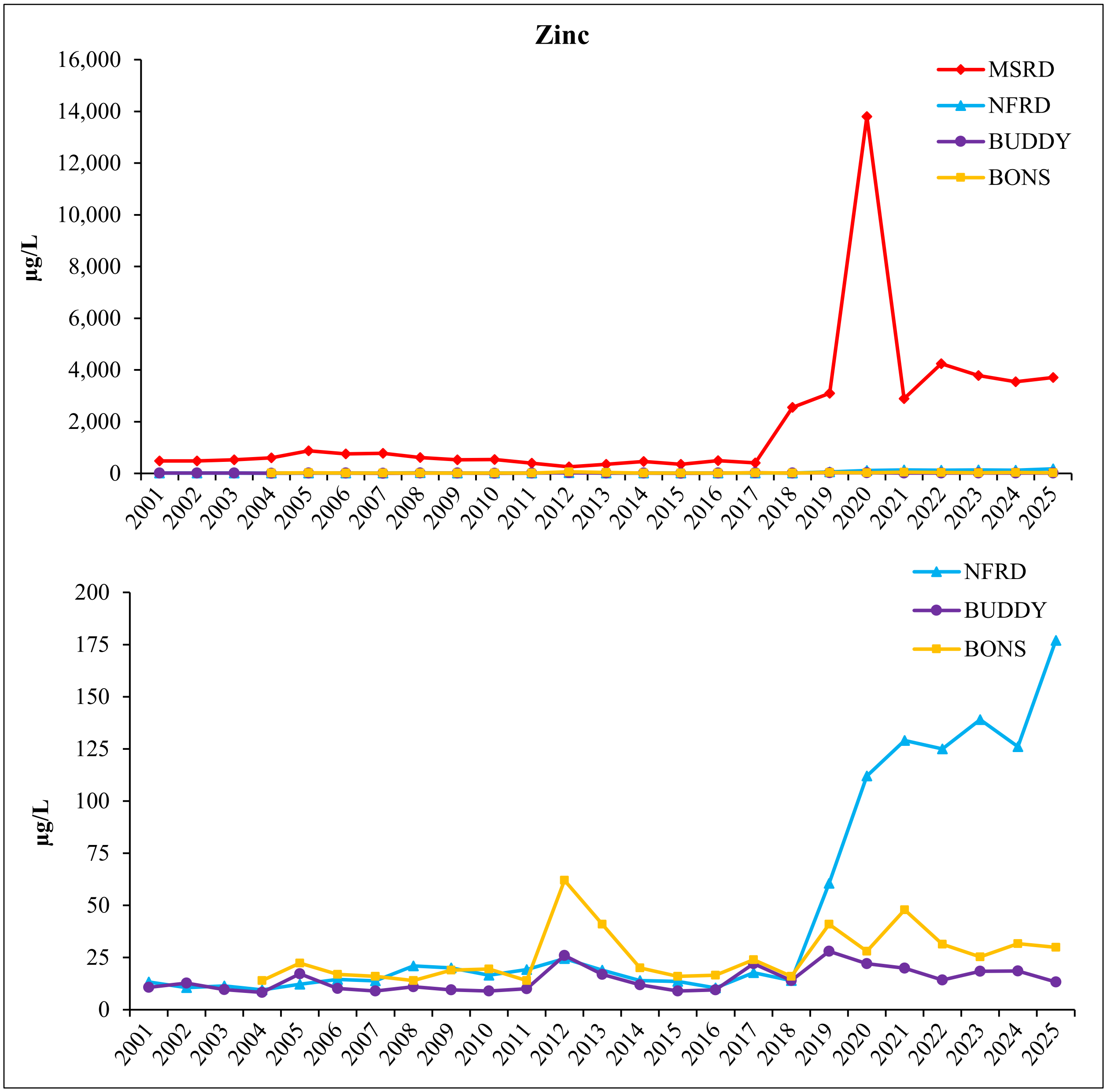

Figure 25.–Median zinc concentrations in Mainstem Red Dog (MSRD), North Fork Red Dog (NFRD), and Buddy creeks and Bons Pond (2001–2025). Two graphs are presented, the bottom graph presents the same data but uses a different y-axis scale as it does not include Mainstem Red Dog Creek.

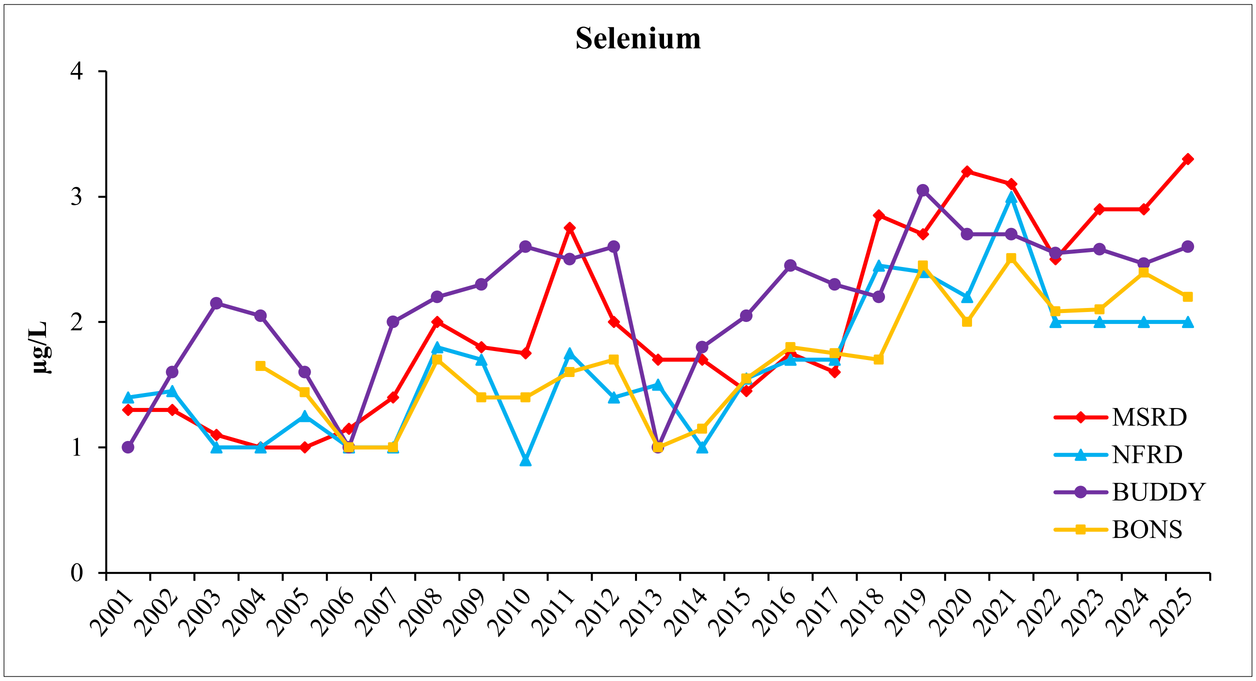

Figure 26.–Median selenium concentrations in Mainstem Red Dog (MSRD), North Fork Red Dog (NFRD), and Buddy creeks and Bons Pond (2001–2025).

Point measurements of in-situ water quality collected by ADF&G staff concurrent with periphyton and benthic macroinvertebrate sampling are presented in Table 3. Water temperature varied from a high of 13.4°C at Bons Creek below Bons Pond (Station 220) to a low of 5.6°C at Upper North Fork Red Dog Creek. Air temperatures were high during our sampling period, with maximum daily temperatures as high as 29°C, resulting in higher than usual water temperatures. Dissolved oxygen was lowest in Bons Creek below Bons Pond (Station 220) at 7.77 mg/L, likely due to the lower oxygen content in lentic environments. The sample site is approximately 1.25 km below the outlet of Bons Pond. Dissolved oxygen was lower in 2025 than 2024, which could be related to the higher water temperatures. Specific conductivity and conductivity were highest at Middle Fork Red Dog Creek (Station 20), which is to be expected as that site is downstream of the treated water discharge, which has high concentrations of calcium and sulfates. The measured pH values at all sites were very similar, ranging from 7.38 to 7.87. The U.S. Environmental Protection Agency (EPA) standard for aquatic life in freshwater is 6.5 to 9, and all point measurements in 2025 fall within that range (EPA 1986). Turbidity values were generally low, ranging from 0.01 NTU in Bons Creek below the pond to 5.25 NTU in North Fork Red Dog Creek.

Table 3.–In-situ measurements of water quality collected during July 2025.

Date	Site	Temp (°C)	DO (mg/L)	SPC (µS/cm)	Conductivity (µS/cm)	pH	Turbidity (NTU)
7/1/25	Buddy below falls	11.4	9.13	373	277	7.82	0.10
7/1/25	Ikalukrok Sta 9	10.2	9.75	598	430	7.64	3.18
7/1/25	Ikalukrok Sta 160	13.1	9.05	821	635	7.60	3.73
7/2/24	Red Dog Sta 10	11.9	9.26	1705	1279	7.48	4.33
7/1/25	MFRD Sta 20	12.1	8.42	2476	1864	7.76	4.74
7/1/25	NFRD Sta 12	7.5	10.23	654	436	7.81	5.25
7/2/25	Upper NFRD	5.6	10.60	461	290	7.87	0.25
7/5/25	Bons above pond	7.9	9.21	461	310	7.38	1.64
7/6/25	Bons Sta 220	13.4	7.77	401	312	7.77	0.01
7/6/25	Buddy Sta 221	10.2	9.82	359	258	7.55	0.03

PERIPHYTON STANDING CROP

Mean chlorophyll-a concentration in 2025 was highest at Bons Creek above the pond (11.74 mg/m^2, SD = 9.34), closely followed by Station 220 on Bons Creek below the pond (11.48 mg/m^2, SD = 7.04) (Figure 27). Mean chlorophyll-a concentration was lowest at Station 20 on Middle Fork Red Dog Creek (0.01 mg/m^2, SD = 0.03). Mean chlorophyll-a concentration was also very low at Station 9 on Ikalukrok Creek above the mouth of Red Dog Creek (0.06 mg/m^2, SD = 0.05), and Station 10 on Red Dog Creek (0.07 mg/m^2, SD = 0.05) (Figure 27).

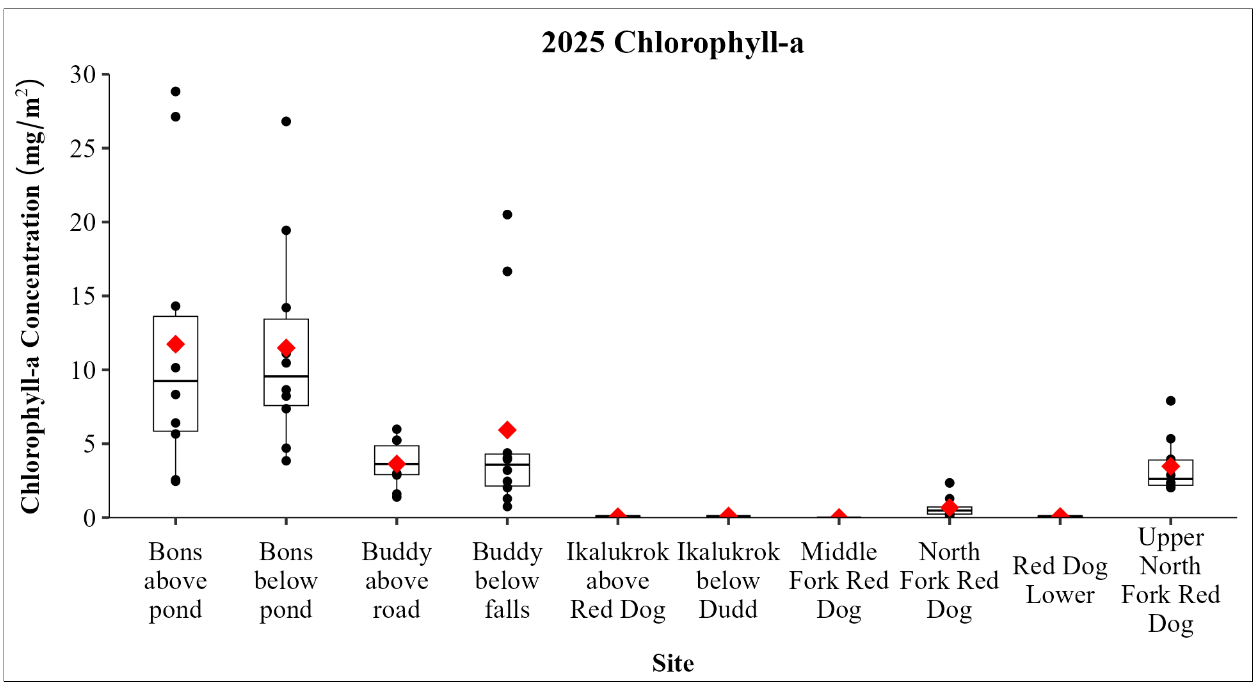

Figure 27.–Chlorophyll-a concentration boxplot at Red Dog Mine sample sites, 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

The increasing occurrence of natural mineral seeps throughout the Ikalukrok Creek drainage has impacted both water quality and periphyton standing crop. On Ikalukrok Creek, the chlorophyll-a levels at Station 160 and Station 9 show a similar pattern of variable levels from 2006 through 2016, decreases in 2017 and 2018, and then bottoming out to levels at or below the detection limit from 2019 through 2025 (Figures 28 and 29). Mainstem Red Dog Creek at Station 10 did not exhibit the same decrease in chlorophyll-a levels in 2017 and 2018, but instead had a drastic decrease in 2019 with very low levels in all years since (Figure 30). Middle Fork Red Dog Creek at Station 20 has generally had low chlorophyll-a levels likely due to higher TDS and metals concentrations in the creek. Most of the metals in Middle Fork Red Dog Creek originate from the clean water bypass and its tributaries, as metals concentrations in the treated effluent discharge from Outfall 001 are very low, although Outfall 001 does contribute TDS to the creek. However, even with these generally low chlorophyll-a levels, there has been a perceptible decrease in chlorophyll-a beginning in 2016. In 2020, there was virtually no detectable chlorophyll-a, which coincided with the high metals levels in the creek originating from the Kaviqsaaq Seep above the clean water bypass (Figure 31).

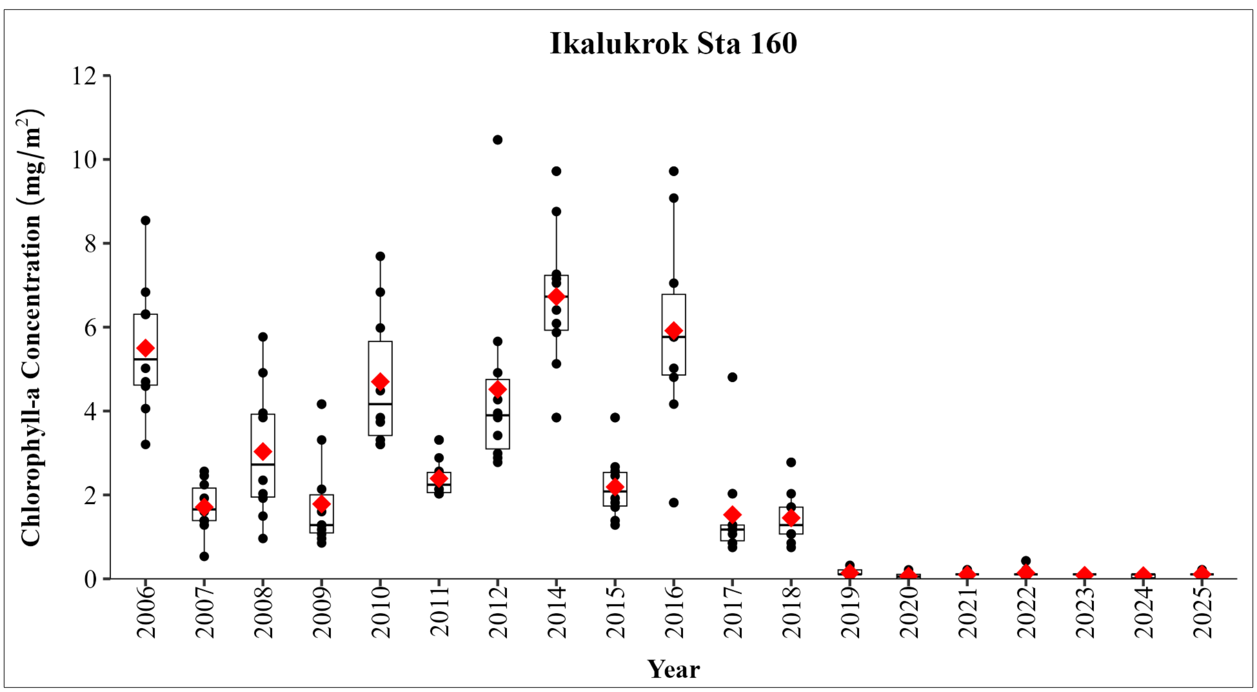

Figure 28.–Chlorophyll-a concentrations at Ikalukrok Creek Station 160 from 2006 to 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

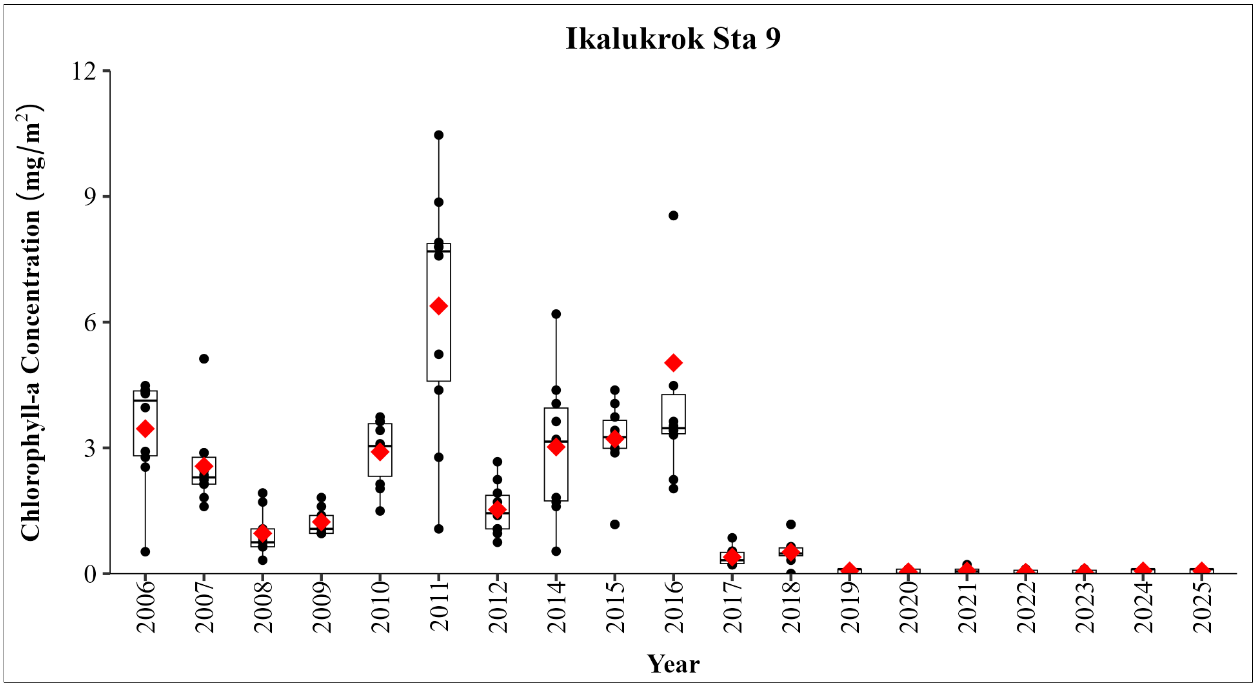

Figure 29.–Chlorophyll-a concentrations at Ikalukrok Creek Station 9 from 2006 to 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

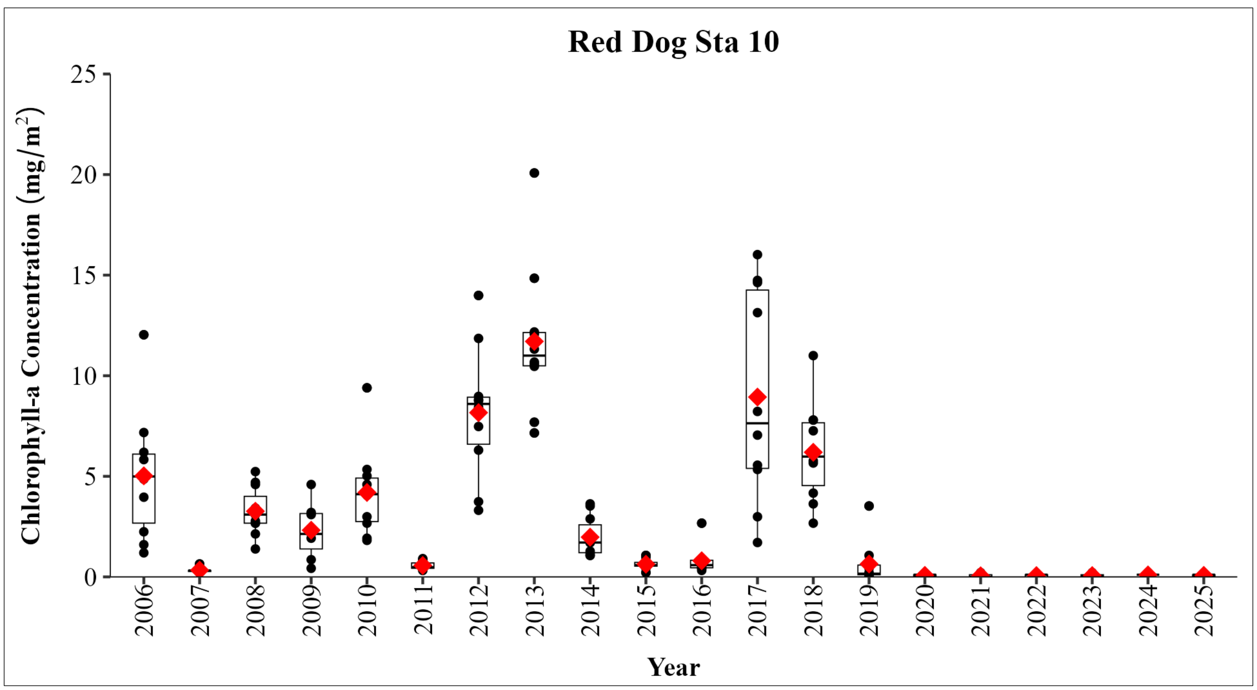

Figure 30.–Chlorophyll-a concentrations at Red Dog Creek Station 10 from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

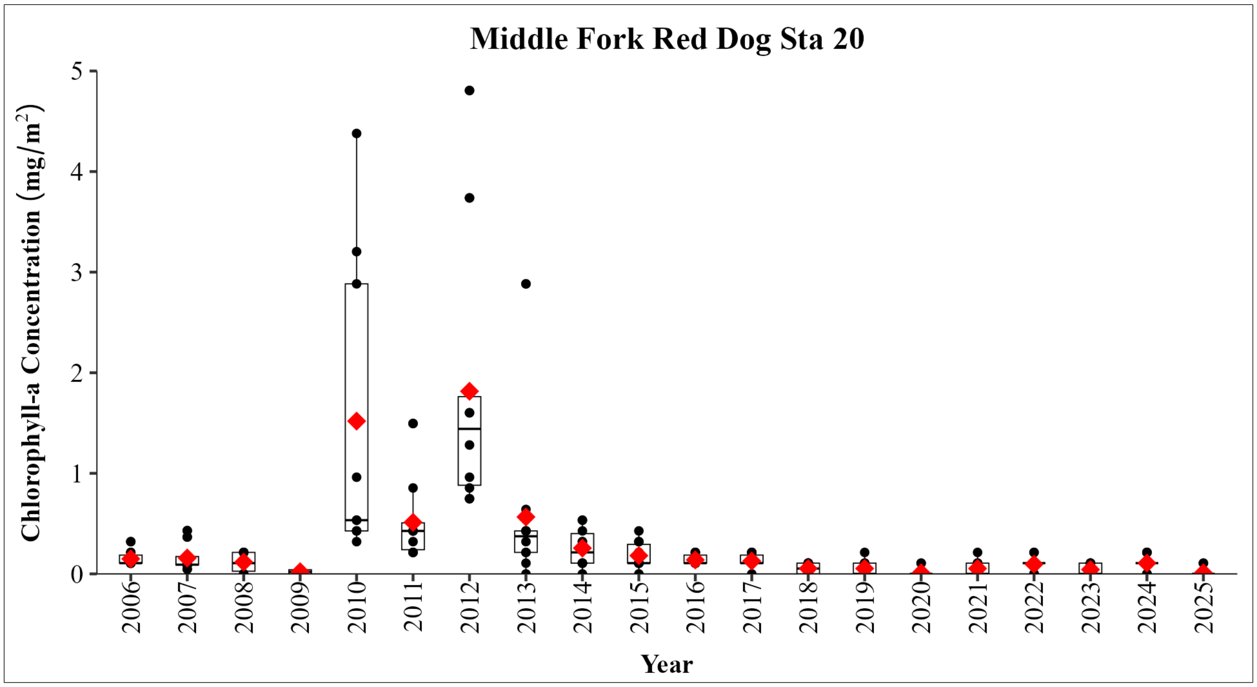

Figure 31.–Chlorophyll-a concentrations at Middle Fork Red Dog Creek Station 20 from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

While there have been drastic changes to water quality in some of the streams in the Red Dog area, with corresponding decreases in chlorophyll-a levels, other streams remain unimpaired. North Fork Red Dog Creek Station 12 has not exhibited the same pronounced declines in water quality and chlorophyll-a seen downstream in Mainstem Red Dog Creek, although chlorophyll-a levels appear to be decreasing in recent years with increasing observations of mineral seeps in the drainage (Figure 32). Chlorophyll-a levels at Upper North Fork Red Dog Creek dipped in 2020–2022, but have increased since, and visual water quality remains stable and clear (Figure 33).

Bons and Buddy creeks typically have the highest chlorophyll-a levels and are highly productive creeks (Figures 34, 35, 36, and 37). Buddy Creek Station 221 is above the haul road and generally has lower chlorophyll-a levels than Buddy Creek below the falls. Bons Creek Station 220 also has very high chlorophyll-a values which are likely related to the nutrient input from Bons Pond and the high organics load in Bons Creek. Chlorophyll-a is likely higher at Buddy Creek below the falls when compared to Station 221 due to the input of Bons Creek, which joins Buddy Creek below the haul road.

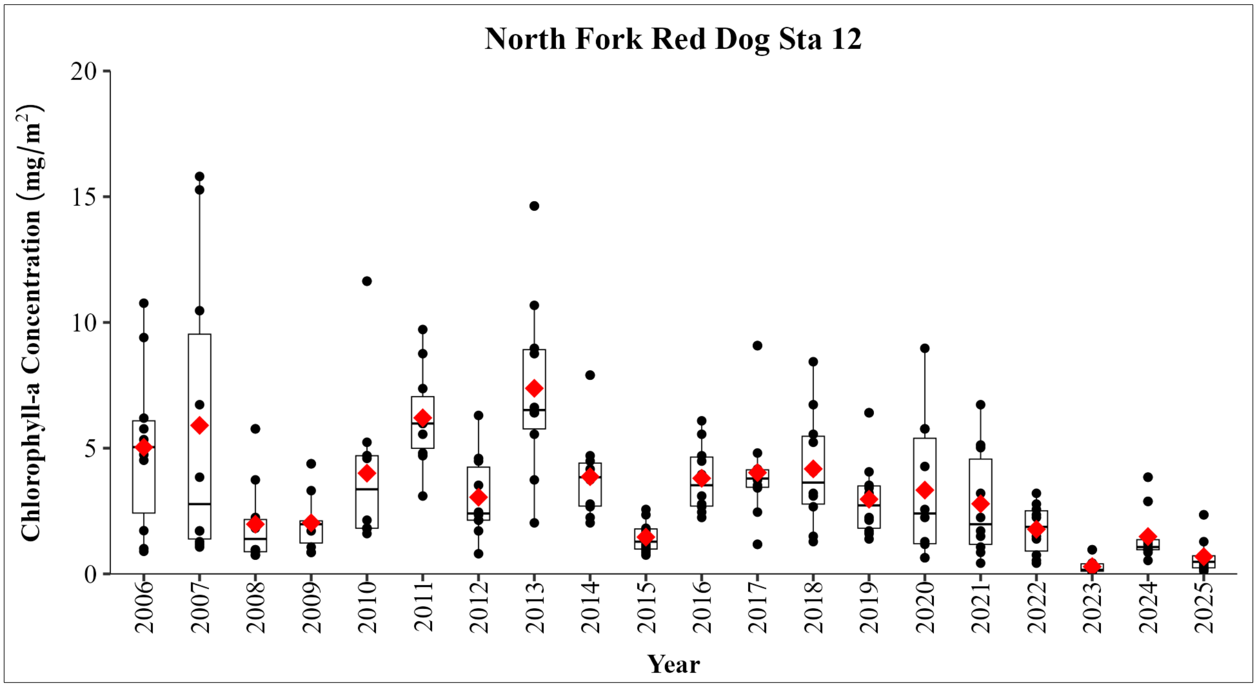

Figure 32.–Chlorophyll-a concentrations at North Fork Red Dog Creek Station 12 from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

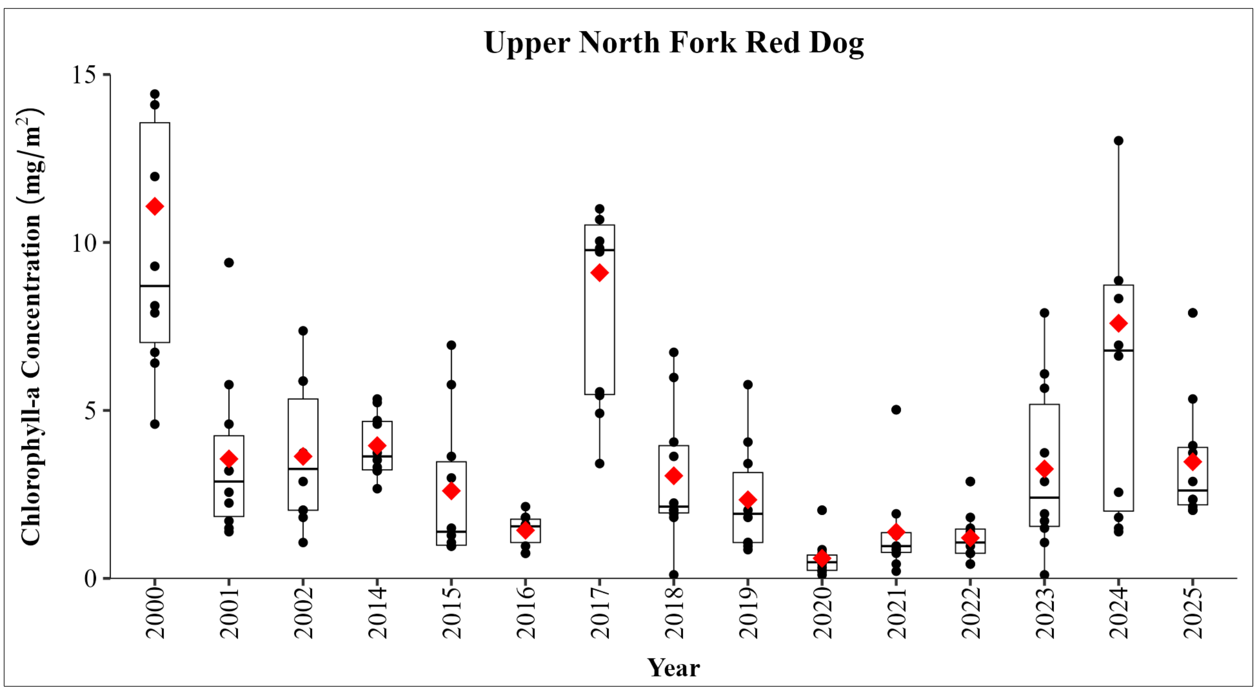

Figure 33.–Chlorophyll-a concentrations at Upper North Fork Red Dog Creek from 2000 to 2002 and 2014 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

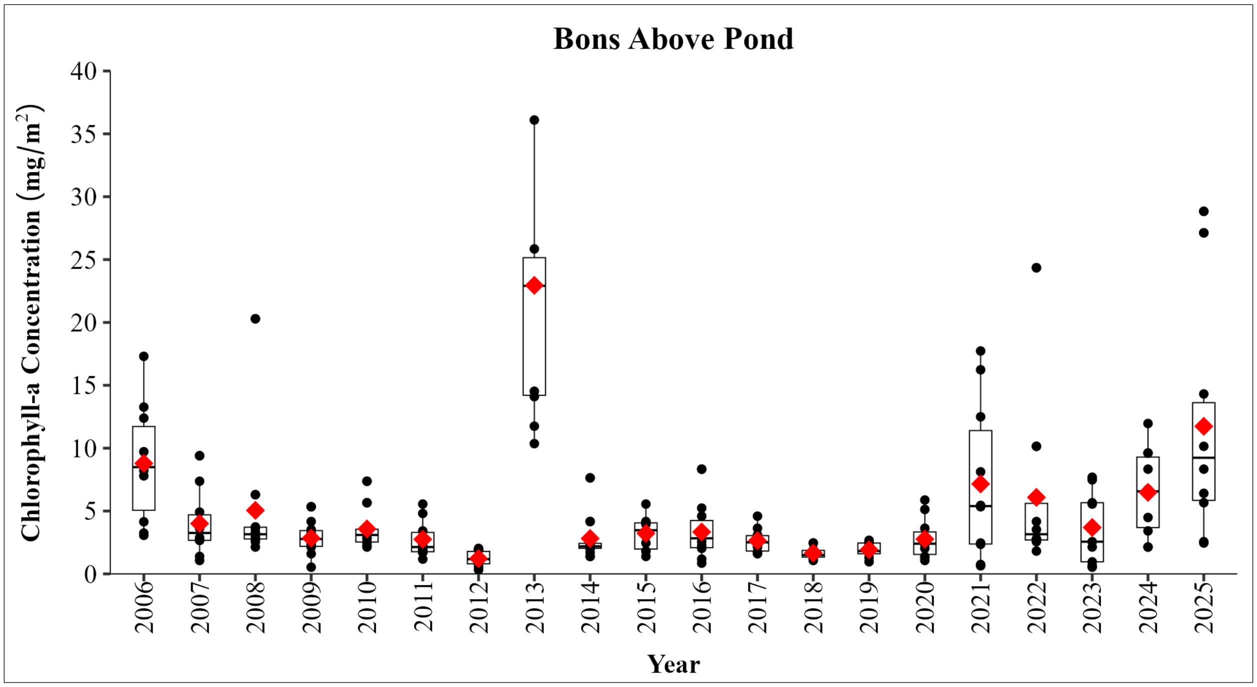

Figure 34.–Chlorophyll-a concentrations at Bons Creek above the Pond from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

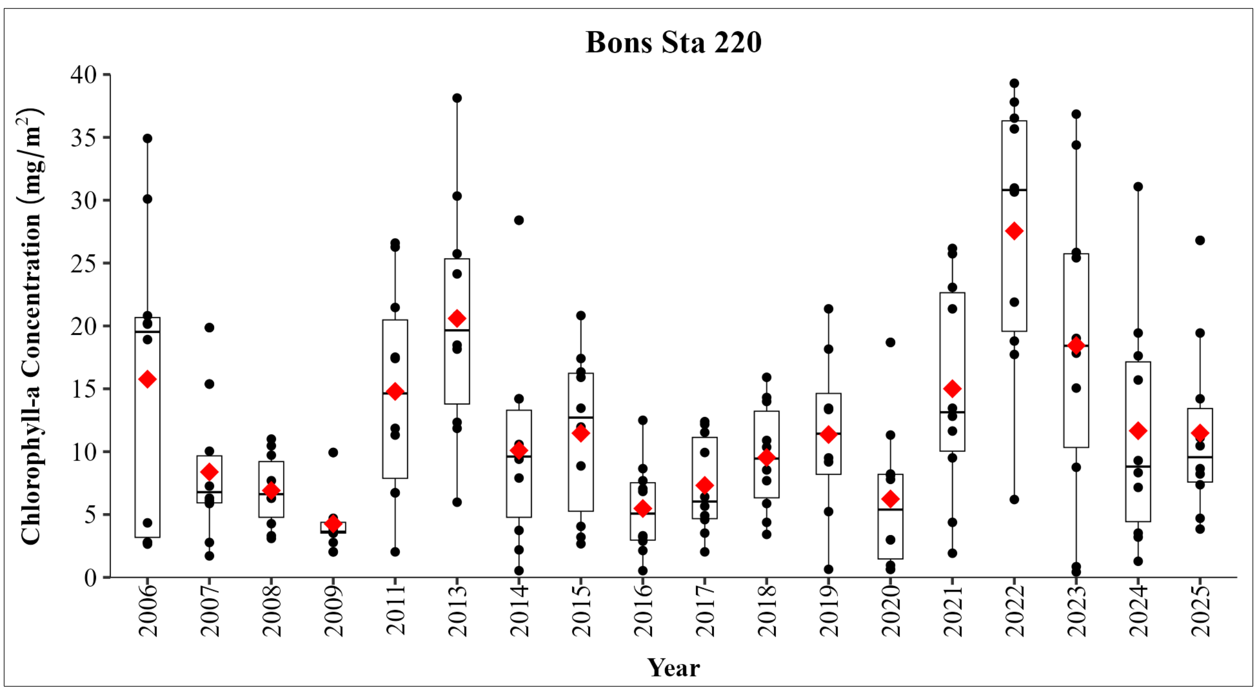

Figure 35.–Chlorophyll-a concentrations at Bons Creek Station 220 below the pond from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

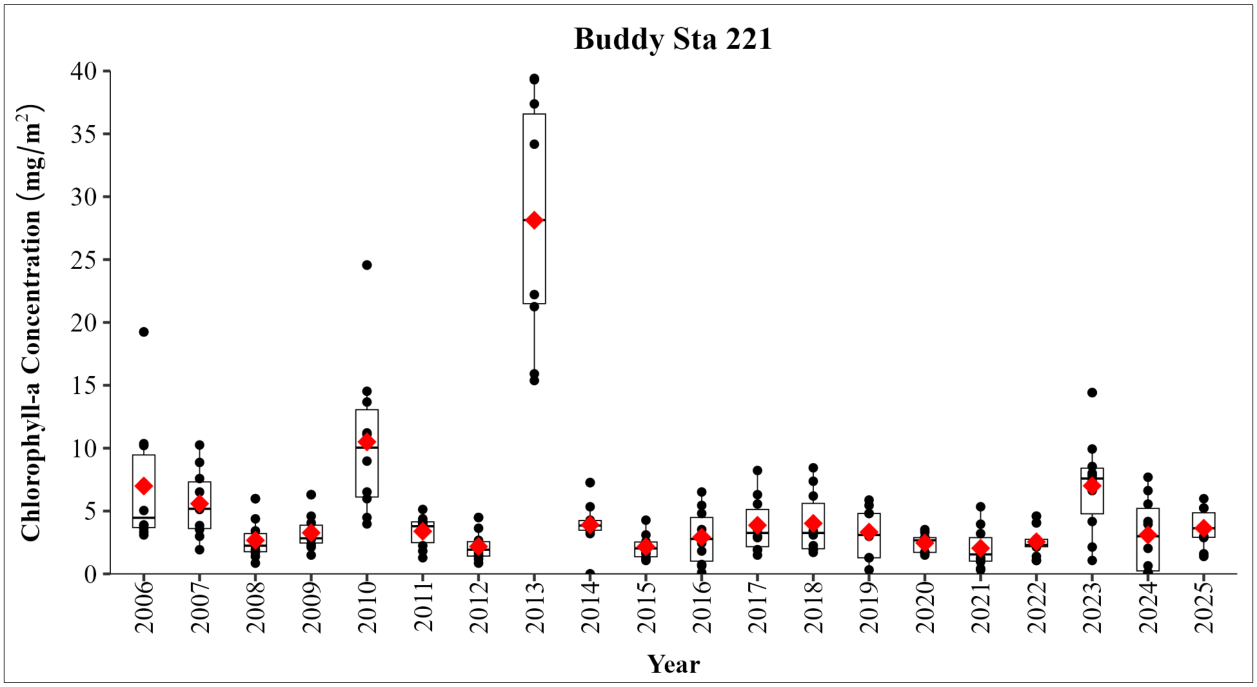

Figure 36.–Chlorophyll-a concentrations at Buddy Creek Station 221 above the haul road from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

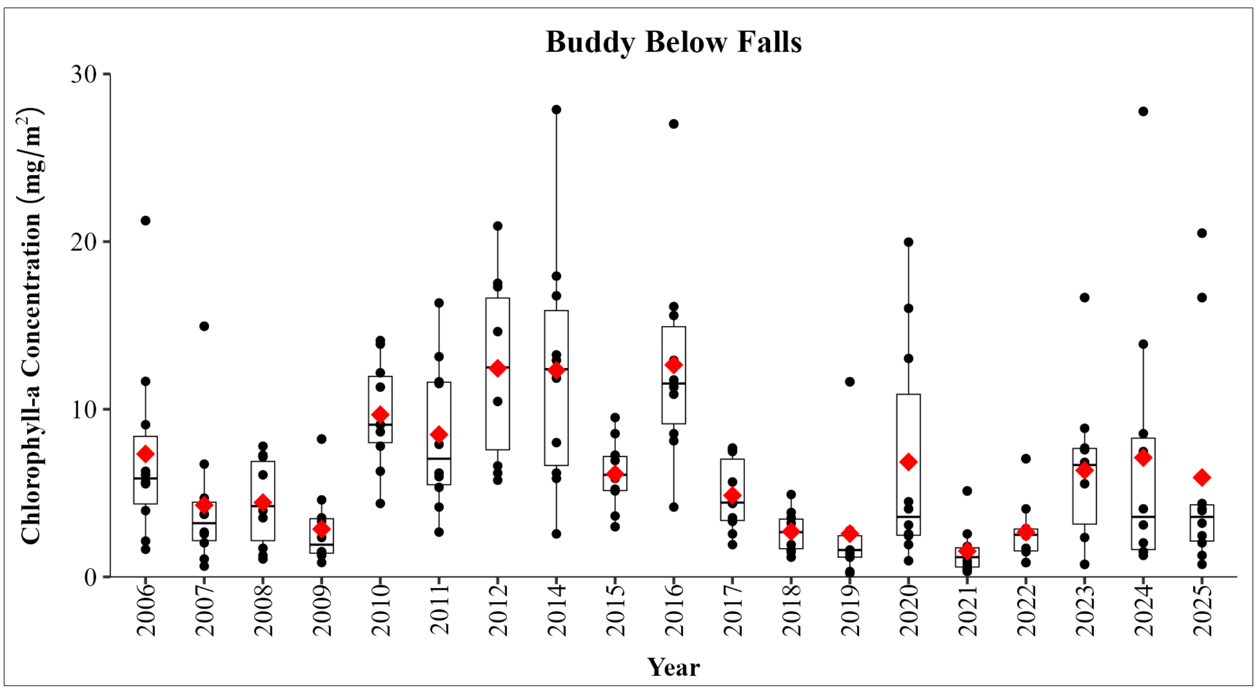

Figure 37.–Chlorophyll-a concentrations at Buddy Creek below the falls from 2006 through 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

Periphyton standing crop has an inverse relationship with zinc and cadmium in Ikalukrok Creek at Station 9, which is just upstream of the mouth of Mainstem Red Dog Creek. Water quality at this site is not affected by water from the Red Dog Mine but is affected by natural mineral seeps located upstream and along Ikalukrok Creek (Ott and Morris 2007). Based on water quality sampling conducted by Red Dog Mine, the major source of zinc and cadmium to Ikalukrok Creek is the Cub Creek seep, although additional seeps have emerged in recent years throughout the drainage which are potential sources (Figure 38).The concentration of chlorophyll-a is higher when zinc and cadmium concentrations are lower (Figure 39 and Figure 40). Both zinc and cadmium increased beginning in 2019, with a notable spike in 2020, and chlorophyll-a concentrations dropped to below detection limits. The variability in chlorophyll-a concentrations from 2006–2017 is likely due to other factors such as water temperature and flow as both cadmium and zinc concentrations were consistently low during this period.

Figure 38.–Ikalukrok Creek at the Cub Creek seep about 10 km upstream of Station 9, July 2017. The Cub Creek seep originates at the top of this image and enters Ikalukrok Creek, which flows from left to right.

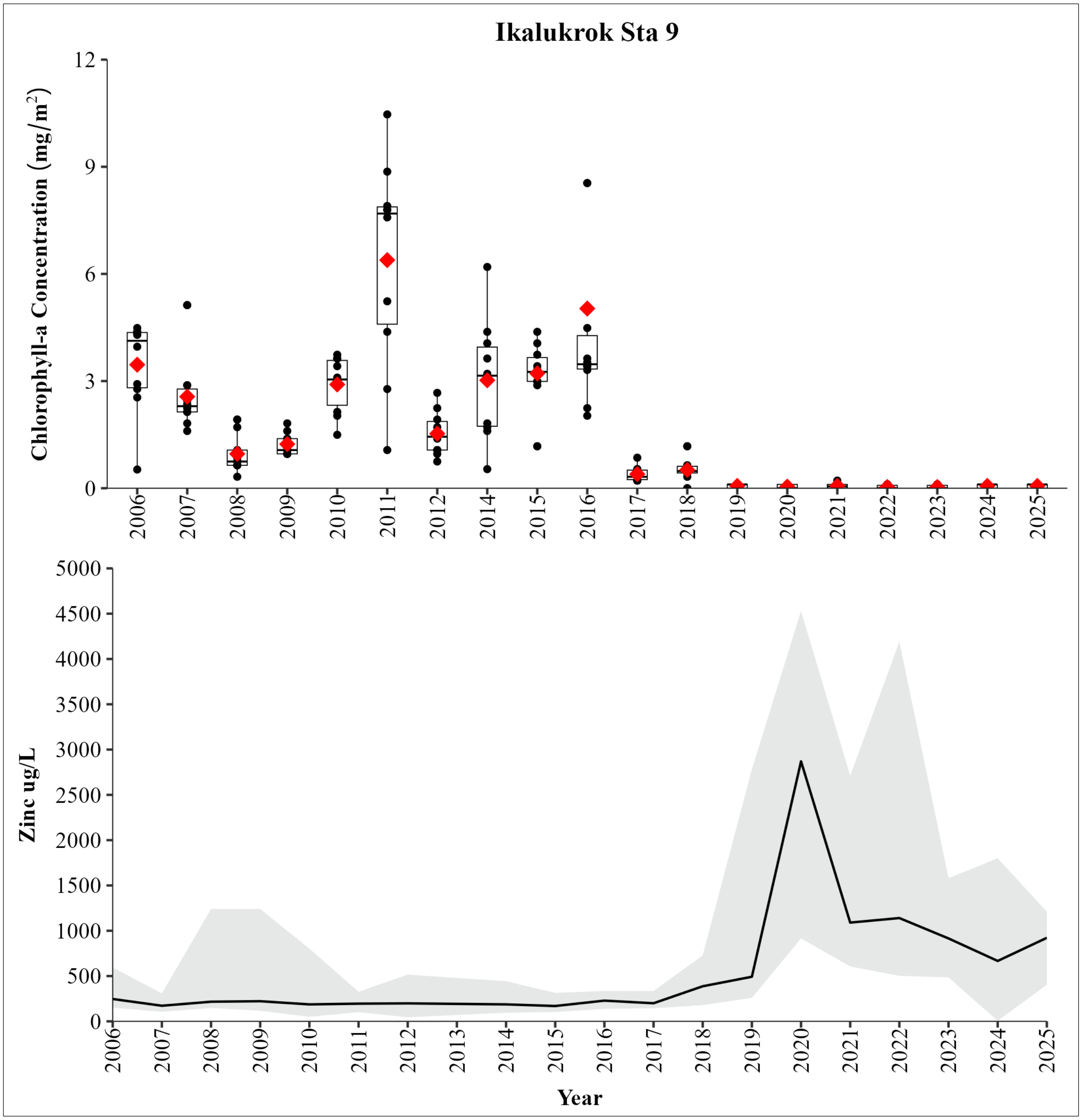

Figure 39.–Chlorophyll-a and zinc in Ikalukrok Creek at Station 9, 2006–2025. In the chlorophyll-a plot on the top, raw data are depicted by black dots and mean values are depicted as red diamonds. In bottom plot, the median value for each year's water samples is depicted in the black line, with the gray ribbon showing minimum and maximum values. In both 2023 and 2024 there was a single very high zinc outlier that is not depicted on this graph, but was included in the calculation of the median value.

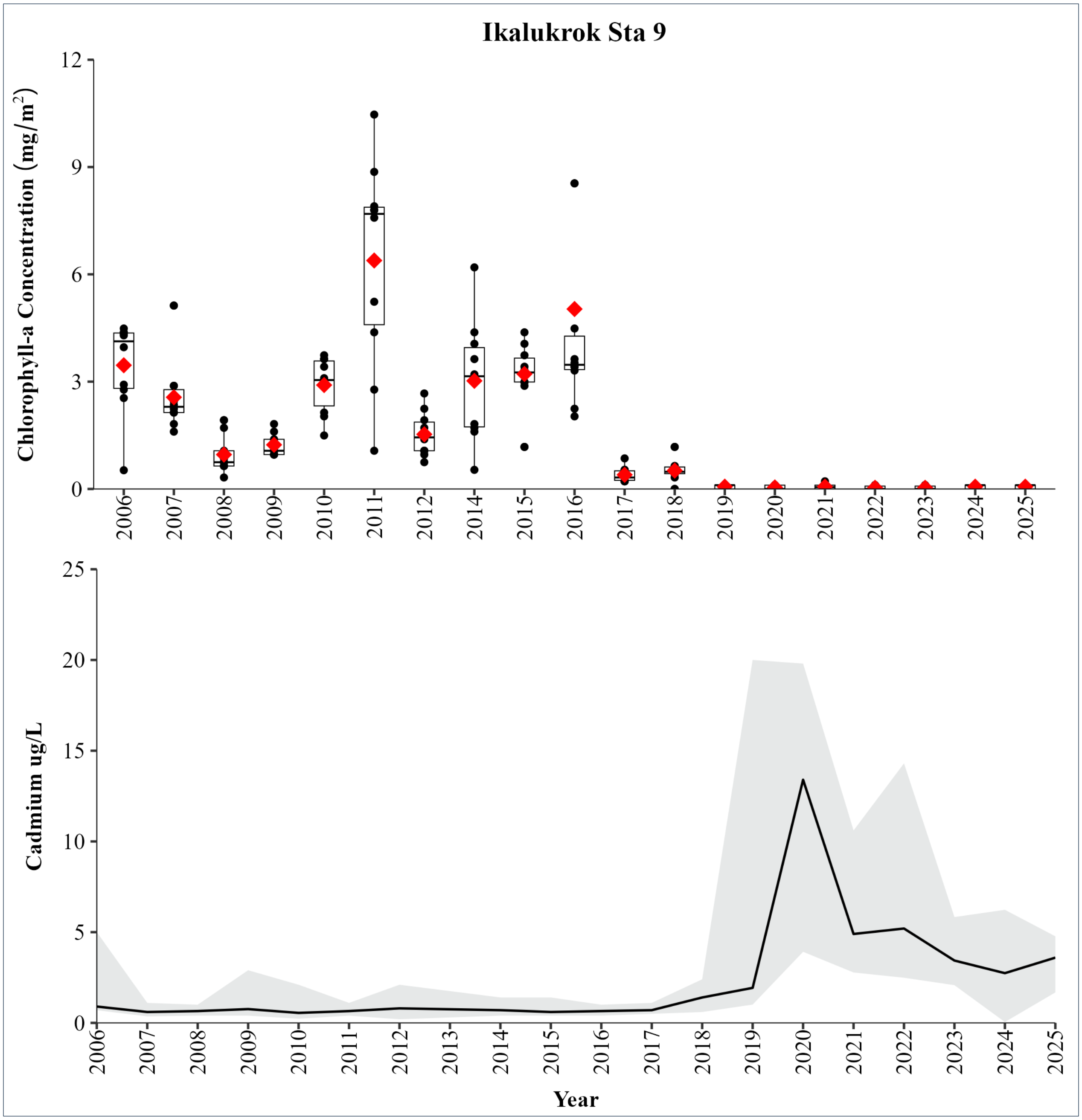

Figure 40.–Chlorophyll-a and cadmium in Ikalukrok Creek at Station 9, 2006–2025. In the chlorophyll-a plot on the top, raw data are depicted by black dots and mean values are depicted as red diamonds. In bottom plot, the median value for each year's water samples is depicted in the black line, with the gray ribbon showing minimum and maximum values.

BENTHIC MACROINVERTEBRATES

In 2025, mean BMI density was highest in Buddy Creek below the falls, with 16,470 BMI/m^2 (Figure 41). Bons Creek above the pond also had high BMI density with 12,432 BMI/m^2, followed closely by Buddy Creek Station 221 with 11,729 BMI/m^2. Across years and sampling methods, Bons and Buddy creeks consistently support the highest BMI densities. In the Red Dog Creek drainage, BMI densities are typically higher at the North Fork Red Dog Creek sample sites (Upper NFRD and Station 12) than in Mainstem Red Dog Creek (Figure 42). In 2025, Upper North Fork Red Dog had 9,155 BMI/m^2 and BMI density at North Fork Red Dog Creek Station 12 was much lower than at Upper North Fork Red Dog, with 488 BMI/m^2. In 2022, the sample method was changed from drift nets to Hess samplers, so any comparisons with past years' results should account for the change in collection method.

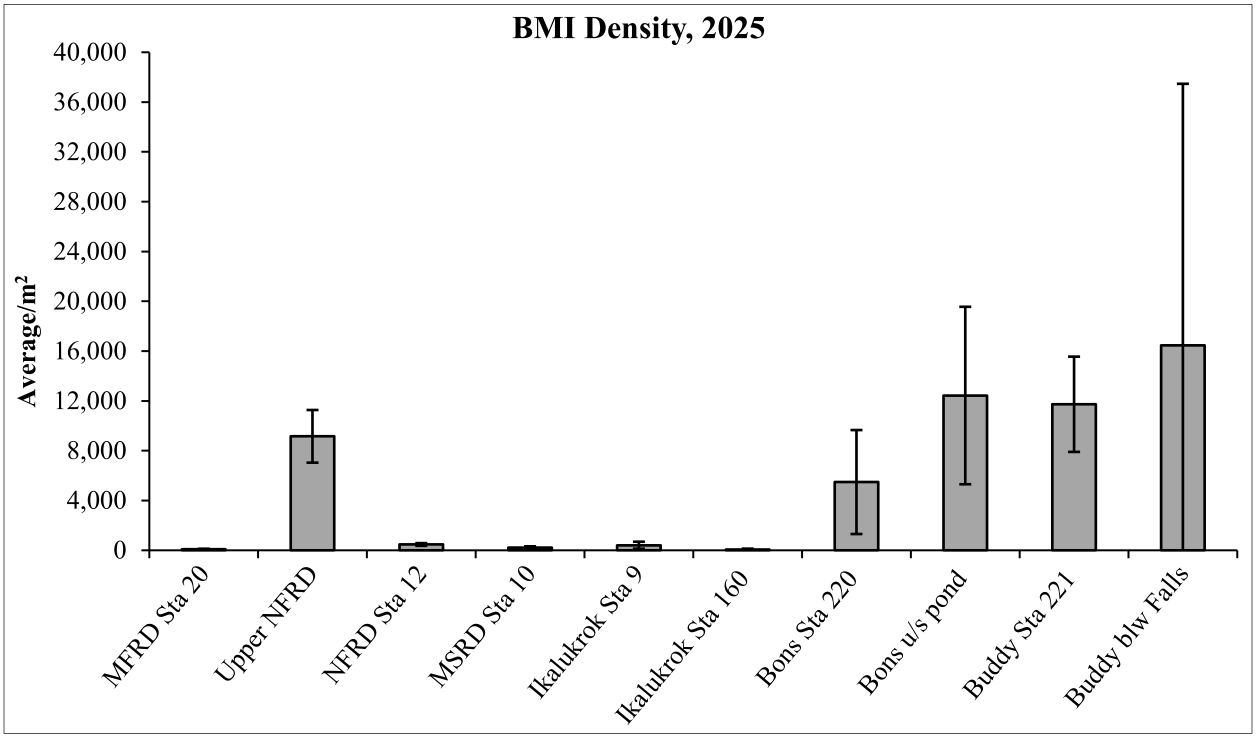

Figure 41.–Mean BMI densities (± 1 SD) in all sample sites near the Red Dog Mine, July 2025.

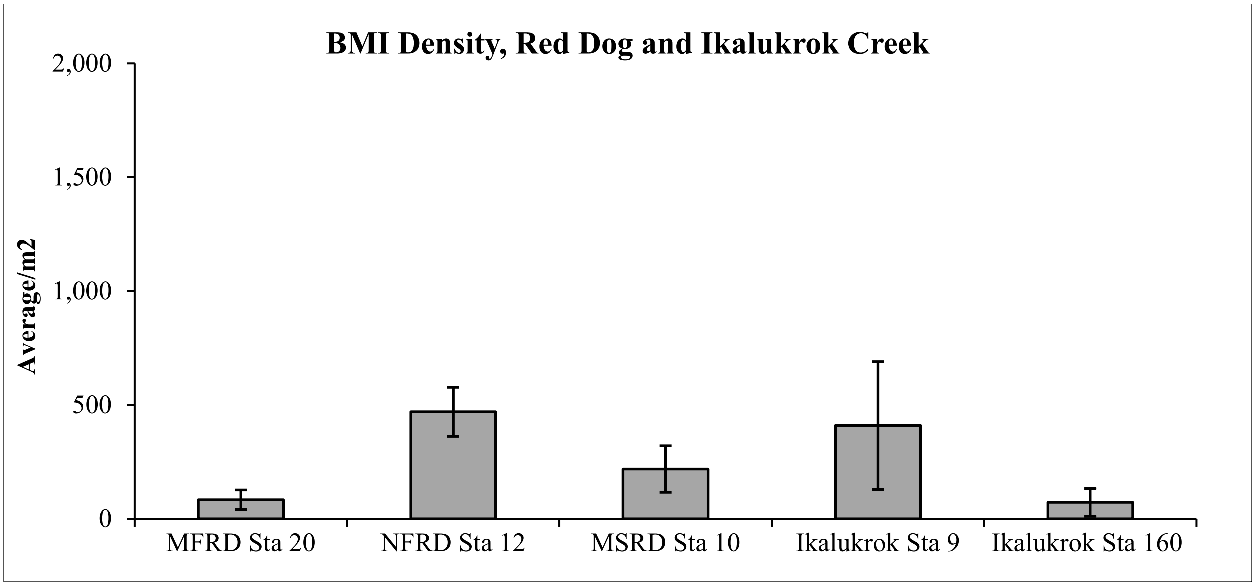

Figure 42.–A zoomed in view of the mean BMI density (± 1 SD) at sample sites in the Red Dog and Ikalukrok creek drainages, July 2025.

The percent Ephemeroptera, Plecoptera, and Trichoptera (EPT) and the percent Chironomidae for sample sites in 2025 are presented in Figure 43. Trichoptera are not common in the samples and are not a substantial contributor to EPT. Typically, the percentage of Chironomidae is higher than EPT at most sample sites. In 2025 only one sample site, Bons Creek Station 220, had a higher proportion of EPT than Chironomidae.

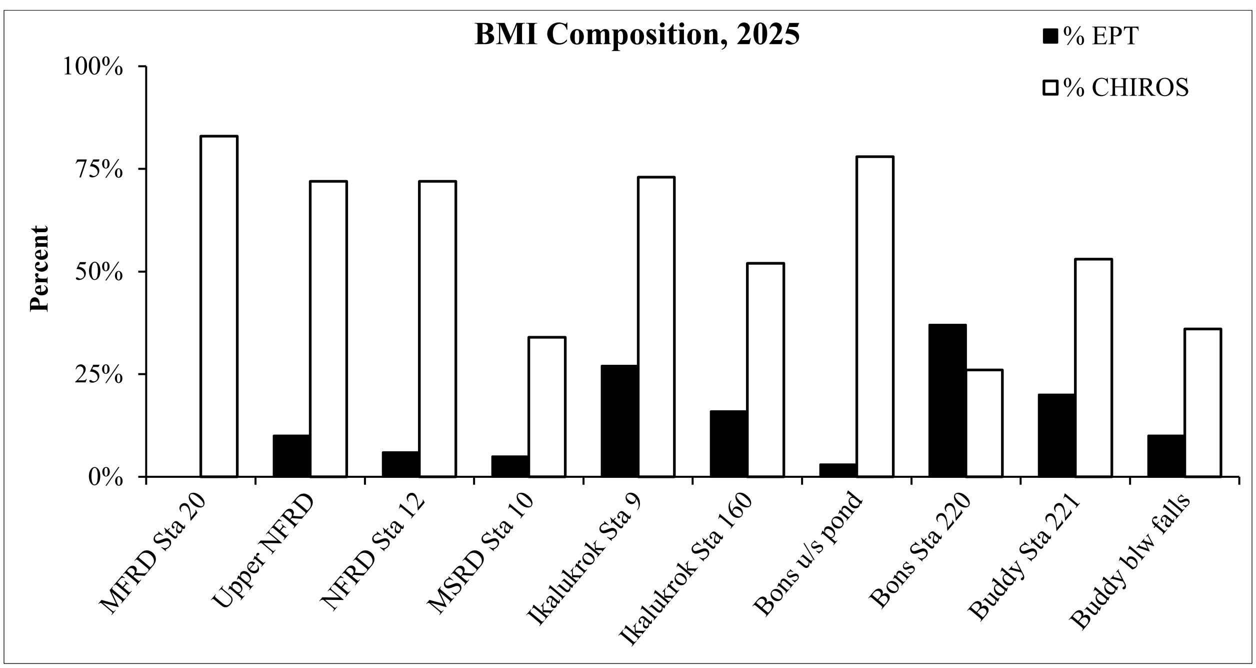

Figure 43.–Percent EPT and Chironomidae in the BMI samples at all sample sites Red Dog Mine, July 2025.

North Fork Red Dog Creek has highly variable percent EPT, ranging from 3% to 57% (Figure 44). Mainstem Red Dog Creek also has highly variable percent EPT, ranging from 0% to 55% (Figure 44). Since 2007, percent Chironomidae is typically higher than percent EPT at North Fork and Mainstem Red Dog Creek (Figure 44). Buddy Creek at Station 221 has had a much higher percentage of EPT in certain years (Figure 44).

Mainstem Red Dog Creek samples have been dominated by Oligochaetes since 2022; likely due to the change in sampling method to Hess samplers and the degraded water quality from increased input of mineral-rich seeps. In 2025, Oligochaetes accounted for 57% of the total BMI sample in Mainstem Red Dog Creek. Oligochaetes, which are small slender worms that live in sediment, are unlikely to be captured in drift nets but are easily captured with Hess samplers as the stream bed is disturbed as part of sampling. Larger numbers of Oligochaetes have been captured at Buddy Creek Station 221 since 2022, but they do not dominate the sample as they have for Mainstem Red Dog Creek (Figure 44).

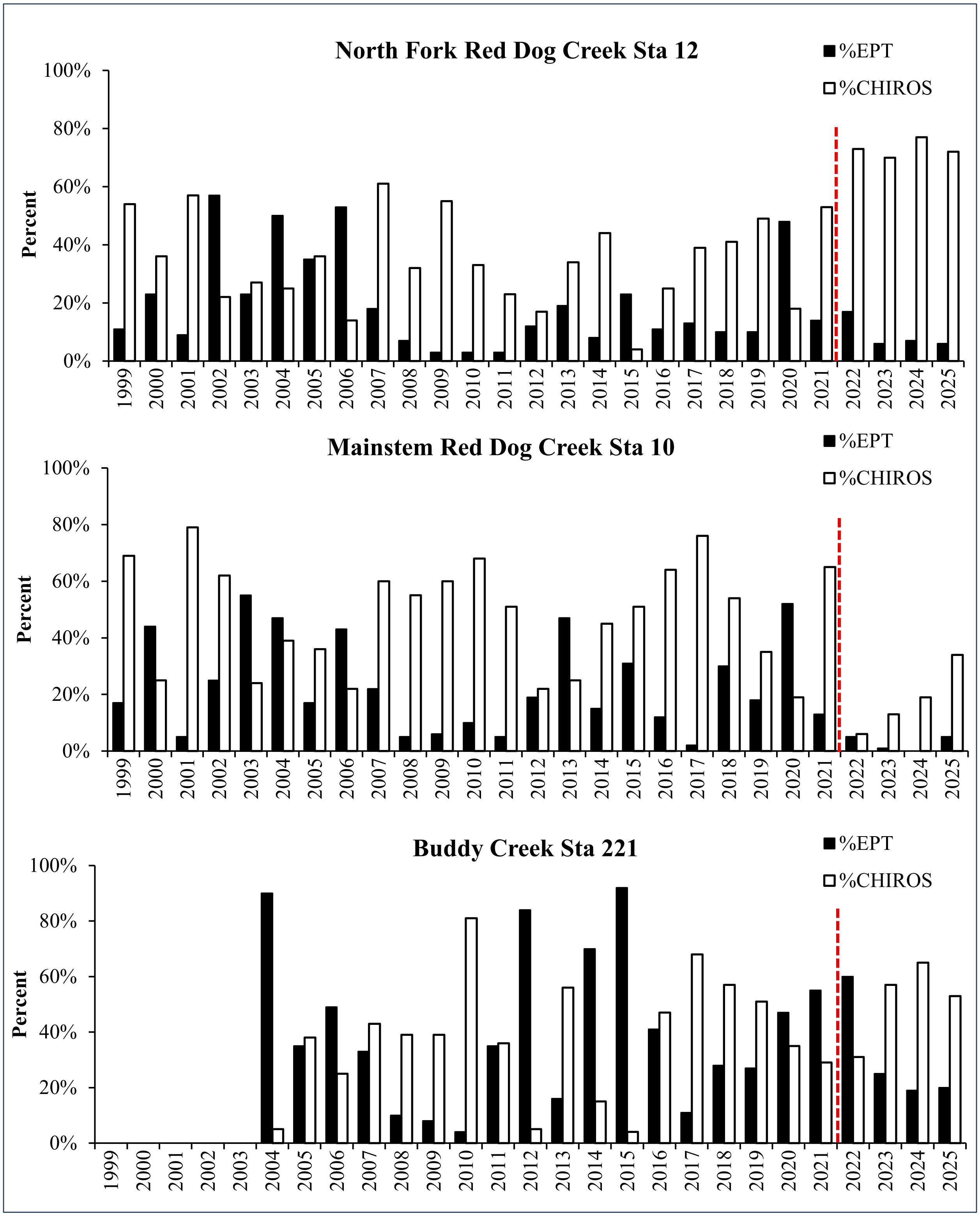

Figure 44.–Percent EPT and Chironomidae in North Fork Red Dog (top), Mainstem Red Dog (middle), and Buddy (bottom) creeks 1999–2025. Aquatic invertebrate sampling in Buddy Creek drainage began in 2004. Sampling method change is depicted with the red dashed line.

Taxa richness was compared between North Fork Red Dog, Mainstem Red Dog, and Buddy creeks (Figure 45). In 2025, taxa richness was highest in Bons Creek Station 220 with 17 taxa identified. Buddy Creek Station 221 had 15 taxa, and Bons above Bons Pond had 12 taxa. Taxa richness in 2025 was generally similar or lower than taxa richness in 2022–2024. Since sampling method changed in 2022, comparisons to historical data at all sites should be evaluated with caution.

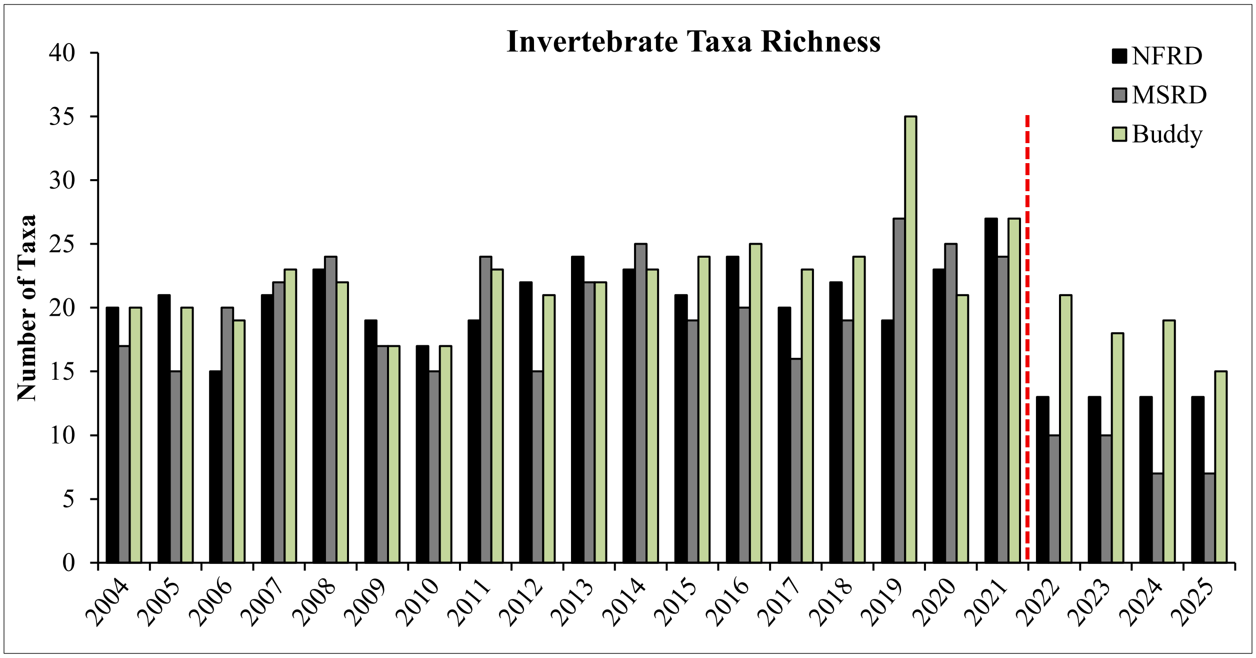

Figure 45.–BMI taxa richness in North Fork Red Dog (Station 12), Mainstem Red Dog (Station 10), and Buddy (Station 221) creeks 2004–2025. Sampling method change is depicted with the red dashed line.

DOLLY VARDEN, JUVENILES

Juvenile Dolly Varden Catches and Metrics

The relative abundance of juvenile Dolly Varden varies considerably among sample years (Appendix 8); however, the catches among the sample sites follow similar patterns. Generally, the CPUE (number of fish caught in 10 traps per 24-hour period) in Anxiety and Buddy creeks is higher than other sample sites. However, in 2025, the CPUE was highest in North Fork Red Dog Creek (33 fish), followed by Buddy (24 fish) and Anxiety Ridge creeks (23 fish) (Figure 46).

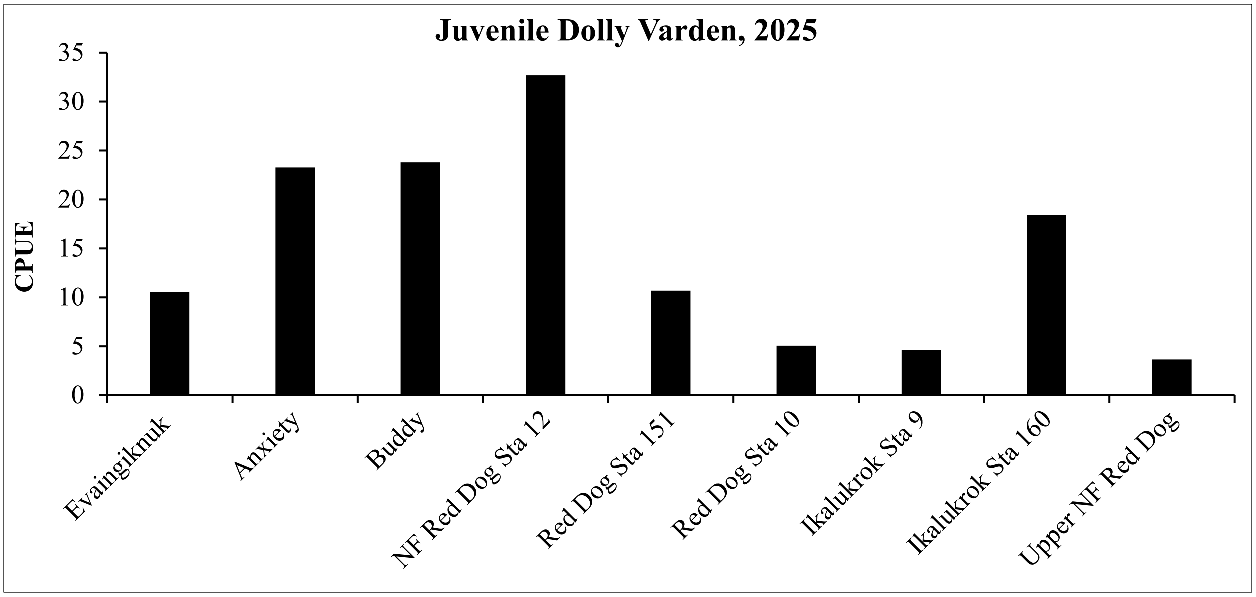

Figure 46.–CPUE of juvenile Dolly Varden at the 2025 Red Dog sample sites.

Natural environmental variability such as duration of breakup, patterns and magnitude of rainfall, ambient air temperatures, and the strength of the age-1 cohort affect distribution of juveniles and relative abundance. The most important factor is likely the strength of the age-1 cohort, which is directly related to number of spawners, spawning success, and survival the previous winter. The CPUE for juvenile Dolly Varden in Anxiety Ridge and Buddy creeks from 1997 to 2025 reflects the high degree of variability among sample years (Figure 47).

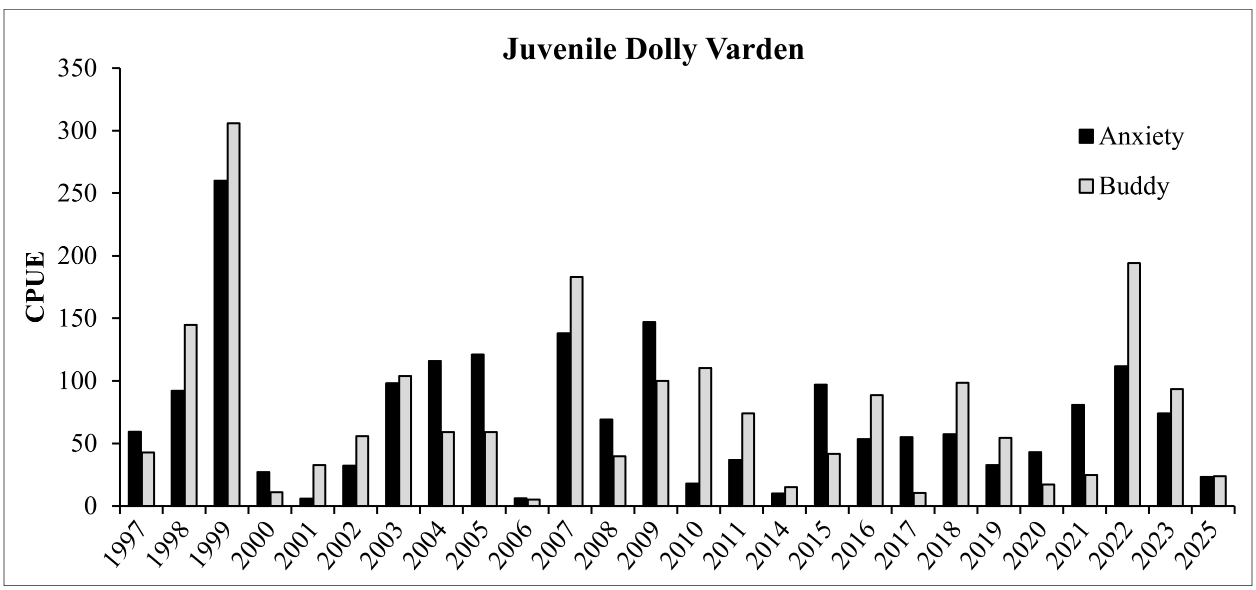

Figure 47.–CPUE of juvenile Dolly Varden in Anxiety Ridge and Buddy creeks, 1997–2025.

CPUE in lower Mainstem Red Dog Creek has ranged from a low of 0 to a high of 73 in 1999 (Figure 48). Abnormally high catches were recorded for Anxiety Ridge, Buddy, and Mainstem Red Dog creeks in 1999 as well. Use of lower Mainstem Red Dog Creek by juvenile Dolly Varden has generally been greater than what was found by Houghton and Hilgert (1983) during baseline studies before mine development. Catches from 2000 to 2019 in lower Mainstem Red Dog Creek were low, but relatively consistent. Then in 2020, metals in the water quality samples spiked and no fish were caught. Kaviqsaaq Seep was captured and diverted in June 2021 and metal levels decreased, although they remain higher than pre-2020 levels. Fish were caught in Red Dog Creek two months after the Kaviqsaaq Seep was diverted. In 2025, CPUE for Red Dog Creek was 16 juvenile Dolly Varden, 5 at lower Mainstem (Station 10) and 11 at the upper Mainstem (Station 151) sample site. Since 2023, some of the fish captured in Red Dog Creek have exhibited signs of poor health, such as discoloration and abnormal growths on gills (Figure 49). The cause of these issues is unknown, although it could be related to high levels of metals in the water. In 2025, 20 fish exhibiting external abnormalities were retained from Red Dog Creek, and gill and liver tissue samples were preserved for histopathological analysis. Results are not yet available but will be included in the 2026 report.

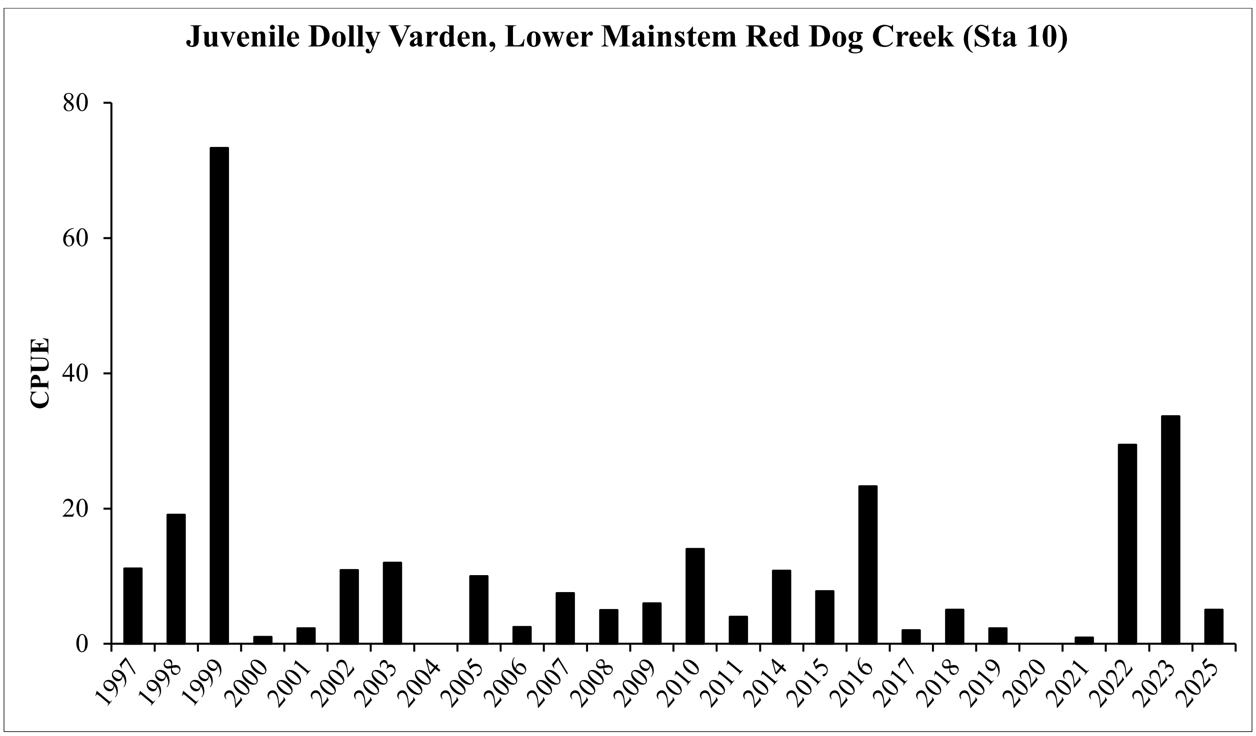

Figure 48.–CPUE of juvenile Dolly Varden in Lower Mainstem Red Dog Creek, 1997–2025.

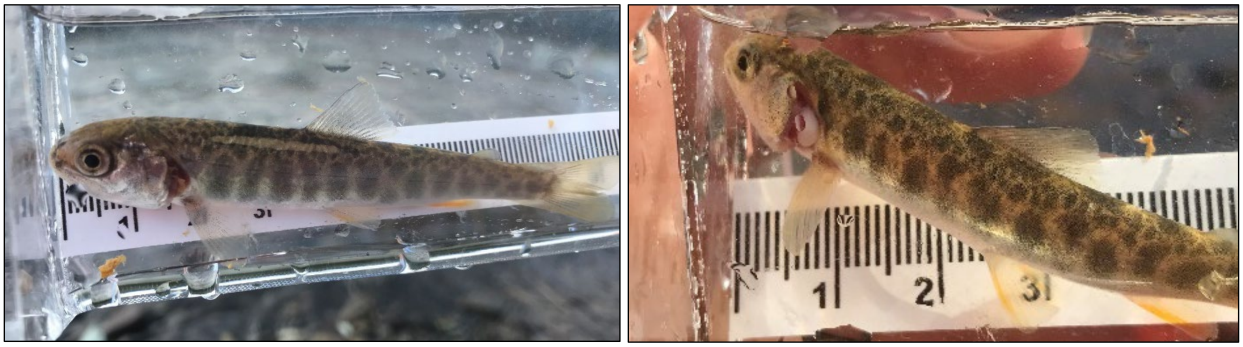

Figure 49.–Juvenile Dolly Varden captured at Station 10 on Red Dog Creek with deformed opercula and gill growths.

Anadromous Dolly Varden spend at least one year in freshwater before their migration to the marine environment (DeCicco 1996). Microchemical analyses of different Dolly Varden populations in Alaska indicate that most fish first migrate to sea at ages 2 or 3 (Hart et al. 2015; Bond et al. 2015). In the Wulik River drainage, fish around 70–80 mm FL are likely age 1+, while fish greater than 100 mm FL are likely age 2+ (Figure 50). Occasionally, young of the year Dolly Varden have been caught in drift nets in early July, with an average length of 28 mm FL (A. G. Ott, Habitat Operations Manager, ADF&G, Fairbanks, personal communication). Often there are clear clusters of fish centered around 75 mm FL and 120 mm FL representing multiple age classes (Clawson 2023). In 2025 there were some intermediate size fish captured, but there were two clear peaks around 85 mm FL and 125 mm FL.

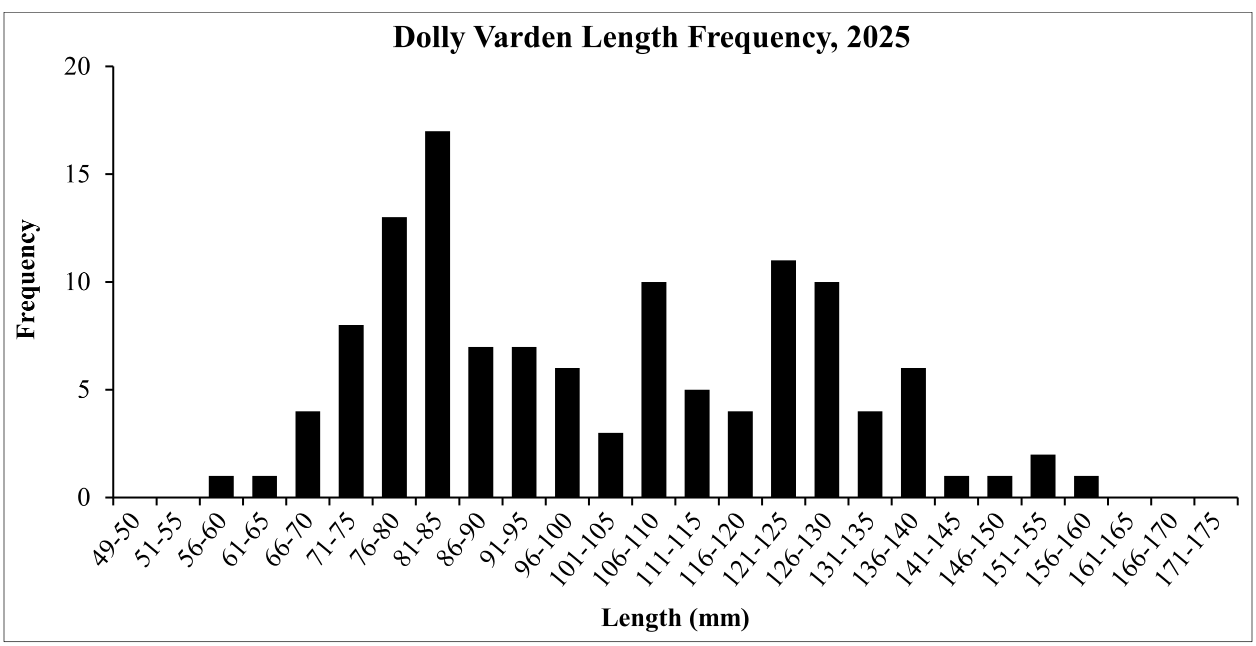

Figure 50.–Length frequency distribution of Dolly Varden in the Ikalukrok Creek drainage in August 2025.

Element Concentrations in Juvenile Dolly Varden and Juvenile Arctic Grayling

Juvenile Dolly Varden

In August 2025, juvenile Dolly Varden were collected from Buddy (n = 15), Anxiety Ridge (n = 15), and Mainstem Red Dog (n = 15) creeks for whole-body element analysis (Appendix 5).

Since water quality concentrations of cadmium, lead, and zinc are highest in Mainstem Red Dog Creek, higher concentrations of these metals in whole-body samples of juvenile Dolly Varden are expected. The main sources of cadmium, lead, and zinc to Mainstem Red Dog Creek are the contributing streams of the clean water bypass (Figure 10).

Whole-body cadmium concentrations are typically highest in juvenile Dolly Varden collected from Mainstem Red Dog Creek and consistently lowest in Anxiety Ridge Creek (Figure 51). Peak mean cadmium concentration for Mainstem Red Dog Creek occurred in 2007 (3.41 mg/kg), for Buddy Creek the peak was in 2022 (1.85 mg/kg), and for Anxiety Ridge Creek the peak was in 2006 (0.49 mg/kg). Mean cadmium concentrations were at or below 1.00 mg/kg in fish from Buddy Creek from 2007–2020, increased above 1.00 mg/kg from 2021 and 2022, but then decreased to 0.98 mg/kg in 2025. Anxiety Ridge Creek concentrations have remained low since 2005. In Mainstem Red Dog Creek, the sharp increase in cadmium in the water quality data beginning in 2018 is not evident in the whole-body cadmium concentration, although the lack of fish captures in 2020 may be related to the extremely high cadmium concentrations in the water that year (Figure 18). No fish kills were observed in 2020, so the assumption is that fish avoided Red Dog Creek and moved to other areas in the Ikalukrok Creek drainage.

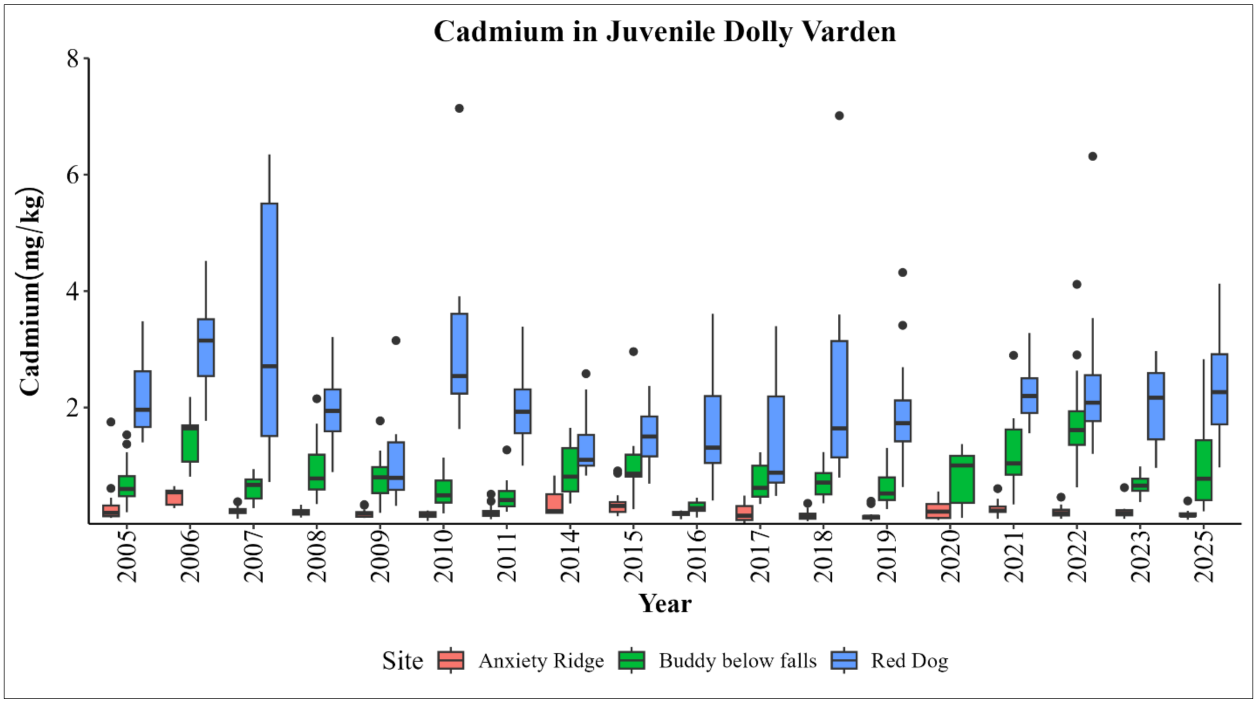

Figure 51.–Boxplot for whole-body cadmium concentrations in juvenile Dolly Varden from 2005–2025. No sampling occurred in 2012, 2013, or 2024 due to high water. No fish were captured in Mainstem Red Dog Creek in 2020. Note that one high value from Red Dog Creek from 2018 (11.36 mg/m^2) is excluded from this plot but not from statistical analyses.

Prior to 2019, whole-body lead concentrations in juvenile Dolly Varden were consistently highest in Mainstem Red Dog Creek, and lower in Buddy and Anxiety Ridge creeks, but since 2021 lead concentrations have been higher in Buddy Creek fish (Figure 52). Lead concentrations in the water of Mainstem Red Dog Creek have been highly variable since 2005 and there does not seem to be a relationship between lead in the water and lead in whole-body samples from Mainstem Red Dog Creek juvenile Dolly Varden (Figure 11).

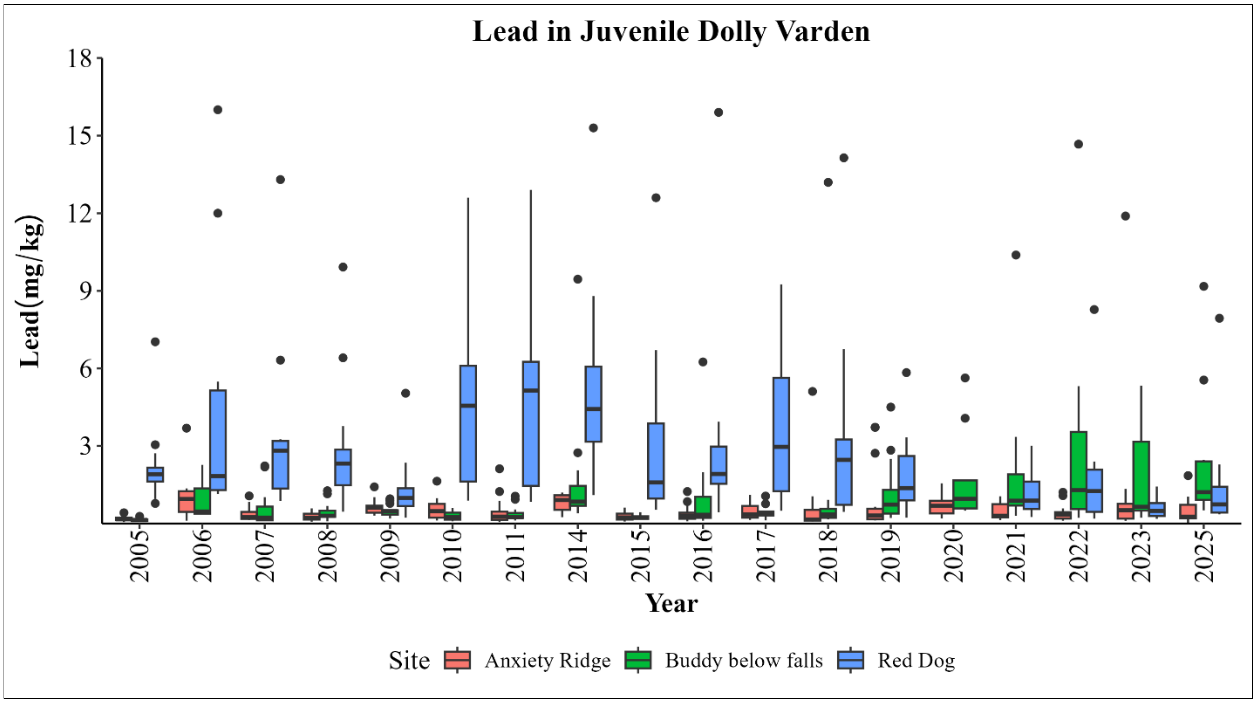

Figure 52.–Boxplot for whole-body lead concentrations in juvenile Dolly Varden from 2005–2025. No sampling occurred in 2012, 2013, or 2024 due to high water. No fish were captured in Mainstem Red Dog Creek in 2020.

Whole-body selenium concentrations in juvenile Dolly Varden have historically been lowest in fish from Anxiety Ridge Creek, but since 2020 the mean whole-body concentrations for fish from the three systems have converged (Figure 53). There is no clear relationship in Mainstem Red Dog Creek between selenium concentrations in the water and in whole-body juvenile Dolly Varden (Figure 19).

Whole-body zinc concentrations are generally highest in fish from Mainstem Red Dog Creek and lowest in fish from Anxiety Ridge Creek (Figure 54). Zinc whole-body concentrations in fish from Mainstem Red Dog Creek decreased from a mean of 358 mg/kg in 2006 to a low of 158 mg/kg in 2009, remained low until 2017, then increased to a high of 405 mg/kg in 2025. Whole-body zinc concentrations in fish from Mainstem Red Dog Creek have generally mirrored the trends in water concentration from 2005 to 2017, but the magnitude of the increase in water zinc levels that began in 2018 has not been reflected in the whole-body concentration, although it may be related to the lack of fish captures in 2020 (Figure 14).

Mean mercury concentrations in juvenile Dolly Varden are consistently highest in Anxiety Ridge Creek and very similar between Buddy and Mainstem Red Dog creeks (Figure 55). The highest recorded mean concentration of mercury was 0.18 mg/kg in Anxiety Ridge Creek in 2025.

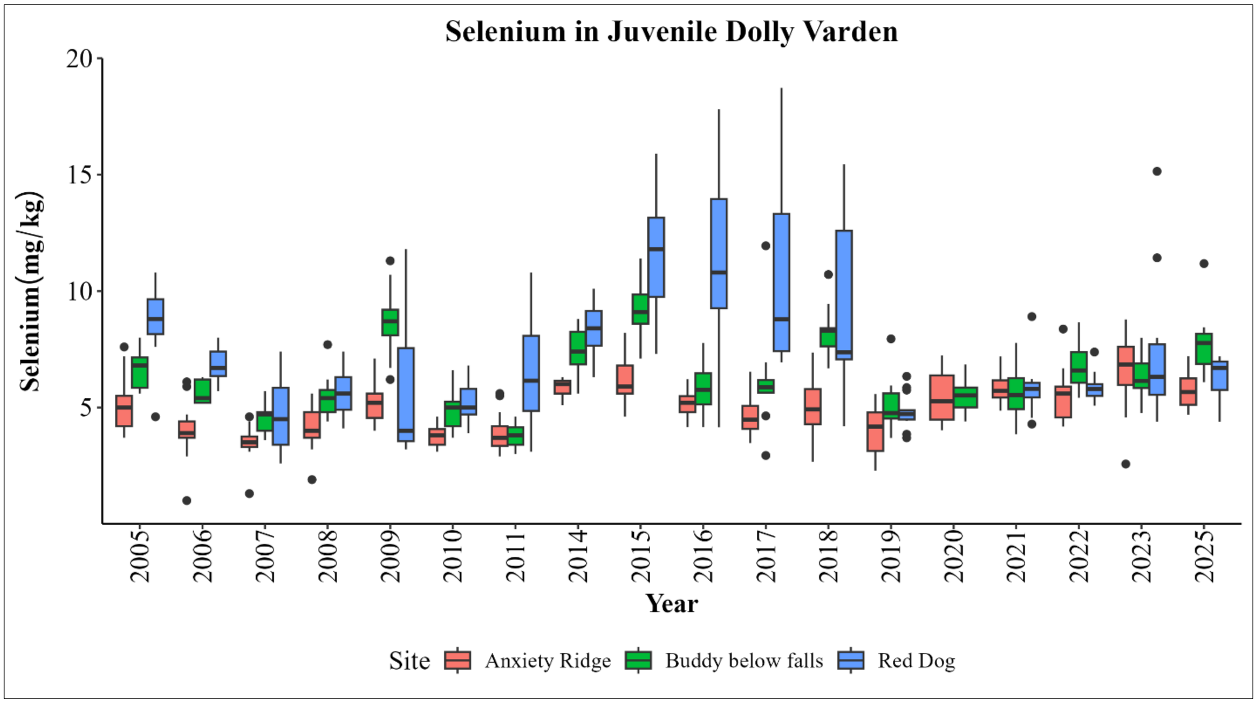

Figure 53.–Boxplot for whole-body selenium concentrations in juvenile Dolly Varden from 2005–2025. No sampling occurred in 2012, 2013, or 2024 due to high water. No fish were captured in Mainstem Red Dog Creek in 2020.

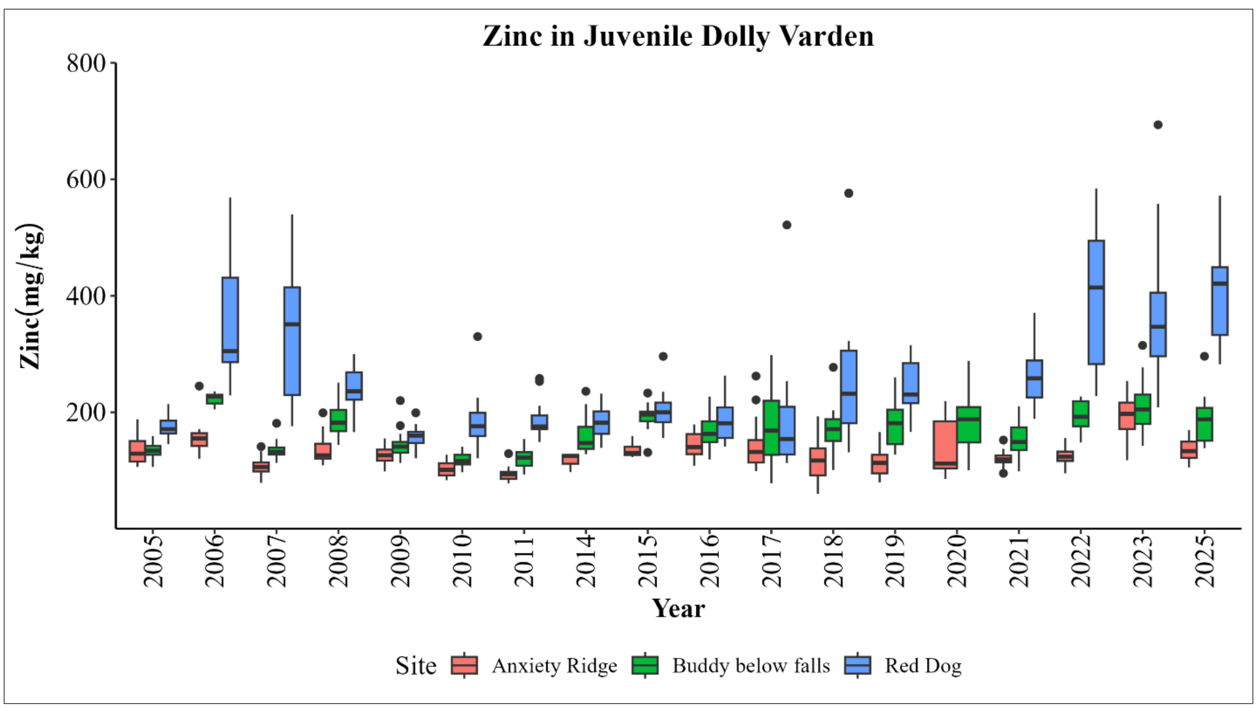

Figure 54.–Boxplot for whole-body zinc concentrations in juvenile Dolly Varden from 2005–2025. No sampling occurred in 2012, 2013, or 2024 due to high water. No fish were captured in Mainstem Red Dog Creek in 2020.

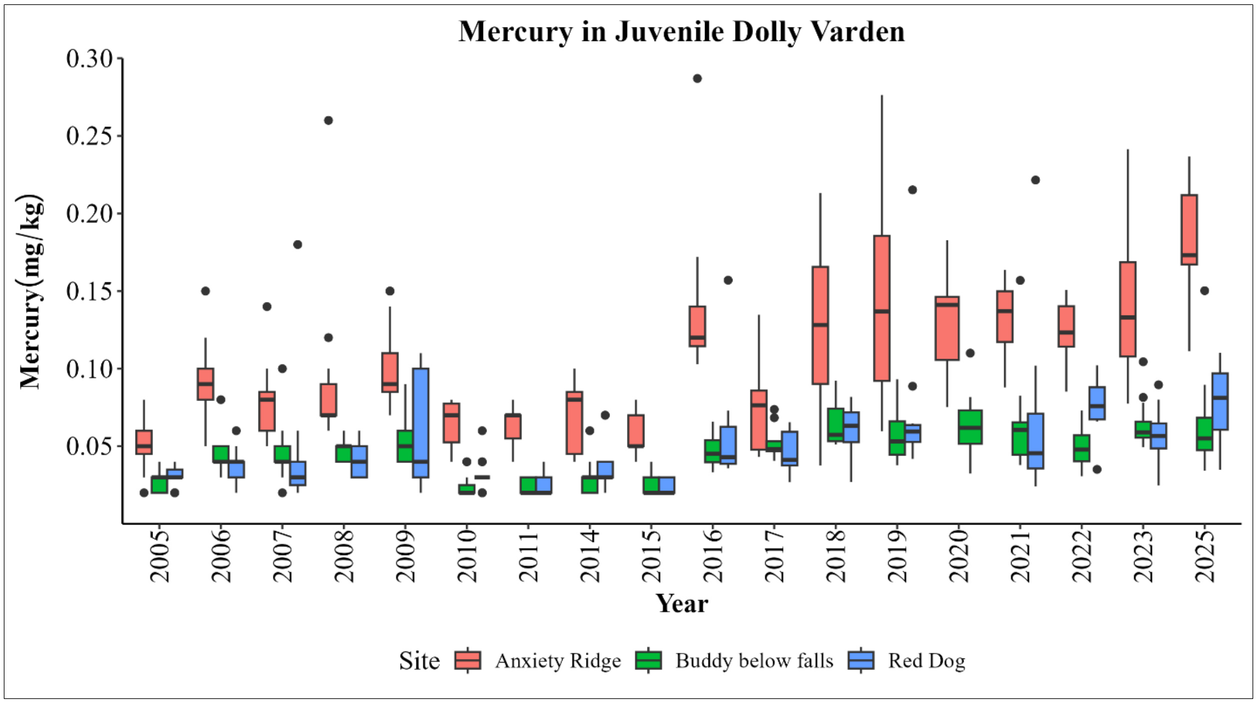

Figure 55.–Boxplot for whole-body mercury concentrations in juvenile Dolly Varden from 2005–2025. No sampling occurred in 2012, 2013, or 2024 due to high water. No fish were captured in Mainstem Red Dog Creek in 2020.

Juvenile Arctic Grayling

Fifteen juvenile Arctic grayling were captured in Bons Pond in early June 2025 with a mean length of 171 mm FL ± 9 mm (Appendix 4). These fish were analyzed for whole-body concentrations of cadmium, lead, mercury selenium, and zinc in mg/kg dry weight.

In 2025, the mean cadmium concentration was 0.13 mg/kg (SD = 0.04) (Figure 56). The highest mean cadmium concentration observed since sampling began was 0.27 mg/kg in 2014. Cadmium concentrations have been fairly stable since 2019. The mean lead concentration in 2025 was 0.93 mg/kg (SD = 0.59), a decrease from the peak mean concentration of 1.29 mg/kg in 2024 (Figure 56). Mean mercury concentrations in juvenile Arctic grayling from Bons Pond have been variable and ranged from a high of 0.06 mg/kg in 2018 and 2019 to a low of the detection limit of 0.02 mg/kg in 2004 and 2014 (Figure 56).

In 2025, the mean selenium concentration was 12.16 mg/kg (SD = 1.83) (Figure 56). Mean selenium concentrations have been variable over the sample years, but with generally overlapping standard deviations. Selenium concentrations in Bons Pond juvenile Arctic grayling have often been higher than the EPA chronic aquatic freshwater life criterion for whole-body fish, which is

8.5 mg/kg dry weight (EPA 2016). All of the 2025 Bons Pond juvenile Arctic grayling exceeded this limit. However, a 2017 study evaluated the effects of selenium concentrations on Arctic grayling embryo and fry using Arctic grayling embryos from Bons Pond, Red Dog Creek, and Fish Creek (Ft. Knox mine outside Fairbanks). There were no statistically significant relationships between selenium concentrations in Arctic grayling from the three water bodies and embryo/fry survival, development, and growth (Brix et al 2021). While selenium concentrations are naturally high in Arctic grayling from Bons Pond, there are no observed negative effects on survival and reproduction.

In 2025, the mean zinc concentration in juvenile Arctic grayling from Bons Pond was 94.93 mg/kg (SD = 15.77), a decrease from the high mean value of 124.76 mg/kg in 2023 (Figure 56).

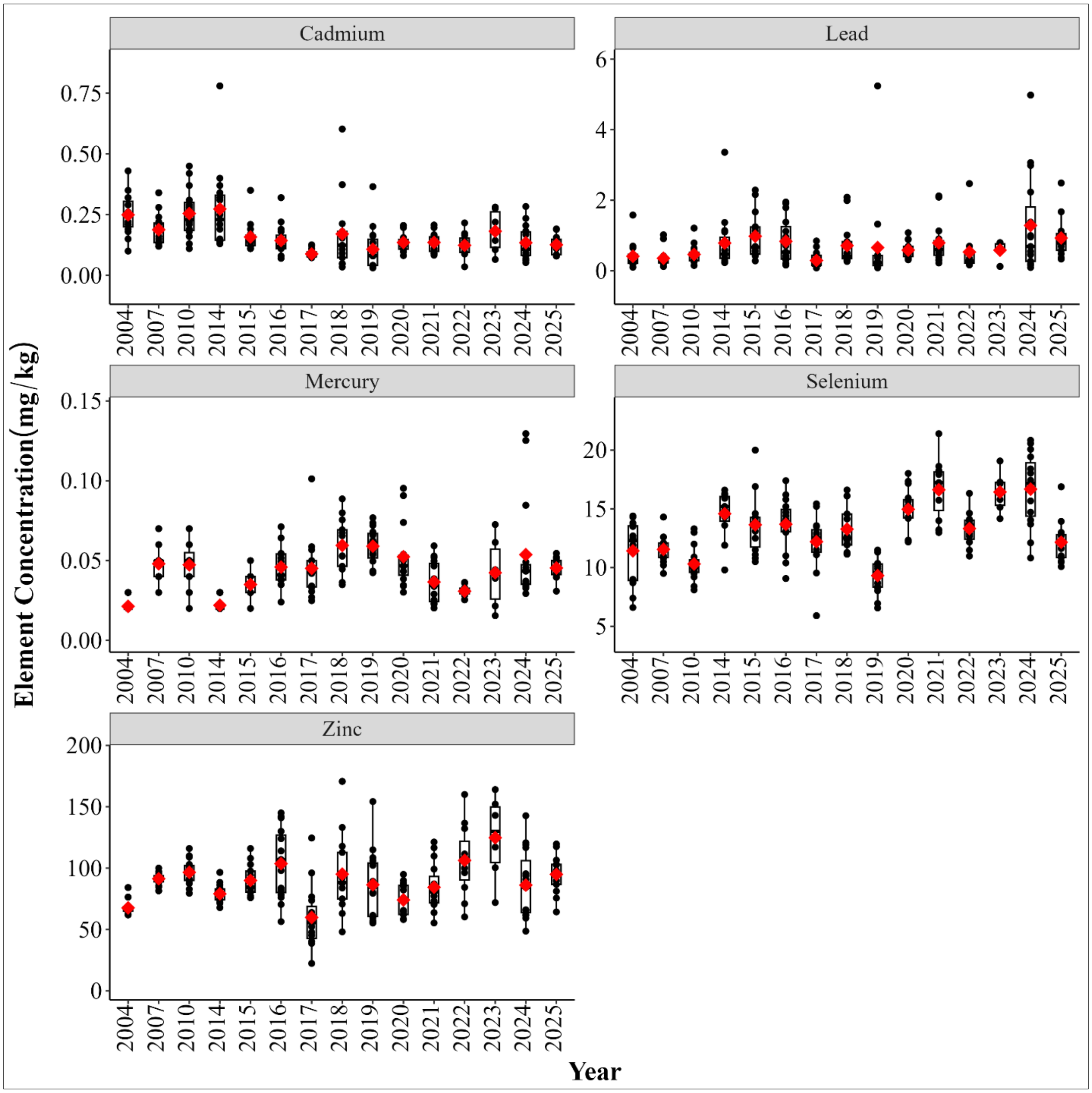

Figure 56.–Element concentrations in whole-body juvenile Arctic grayling from Bons Pond from 2004 to 2025. Raw data are depicted by black dots and mean values are depicted as red diamonds.

Element Concentrations in Adult Dolly Varden

In 2025, adult Dolly Varden were collected from the Wulik River about 2 km downstream from the mouth of Ikalukrok Creek, near Tutak Creek, to be sampled for selected element concentrations in kidney, liver, muscle, and reproductive tissue. Seven fish were collected in fall 2025. No fish were caught in the spring, despite repeated efforts.

The purpose of sampling adult Dolly Varden for element concentrations is to monitor these concentrations over time in the various tissues and to provide a database for use by other professionals. It is unlikely that element concentrations in adult fish tissues could be related to events at the Red Dog Mine since most Dolly Varden growth occurs in the marine environment. All laboratory work was done with Level III Quality Assurance. Raw data for 2025 fish are presented in Appendices 5 and 6.

Certain elements are known to concentrate in certain organs; however, the relationship of organ concentration to ambient environmental concentrations is unknown. Concentrations of selected elements vary with season, age, size, weight, and feeding habits (Jenkins 1980) and in the case of anadromous Dolly Varden, the element concentrations vary with time spent in freshwater and marine environments. None of the analytes measured appear to concentrate in muscle tissue.

In Wulik River Dolly Varden sampled from 1999 to 2025 cadmium was highest in kidney samples (Figure 57), copper was highest in liver samples (Figure 58), lead was highest in reproductive tissue (Figure 59), mercury was highest in kidneys (Figure 60), selenium was highest in reproductive tissue and kidneys (Figure 61), and zinc was highest in reproductive tissue (Figure 62).

Cadmium concentrations in adult Dolly Varden kidney tissue have been variable since 1999 (Figure 57). Concentrations of cadmium slightly increased from 1999 to 2002, then abruptly decreased and remained around 1.00 mg/kg through spring of 2009. Mean cadmium concentrations doubled in fall of 2009 to 1.99 mg/kg, increased to 2.96 mg/kg in spring 2011, then have generally remained intermediate and variable since 2013. The mean cadmium concentration in fish from the spring 2023 sample was higher than any seen previously, but all samples since then have returned to within the historical range.

The mean selenium concentration in adult Dolly Varden ovaries is higher for fish sampled in the fall (9.99 mg/kg) than for fish sampled in the spring (5.57 mg/kg) (Figure 61). An unpaired two-sample Wilcoxon test indicated a significant difference between seasons for the ovary samples ($p = 2.2 \times 10^{-16}$). The cause of this difference is unknown but likely is due to the environment the fish inhabited in the months prior to being caught. The spring fish would have overwintered in freshwater in the Wulik River since the previous fall, while the Dolly Varden sampled in the fall would have recently returned from the marine environment, which is likely where they acquired the selenium.

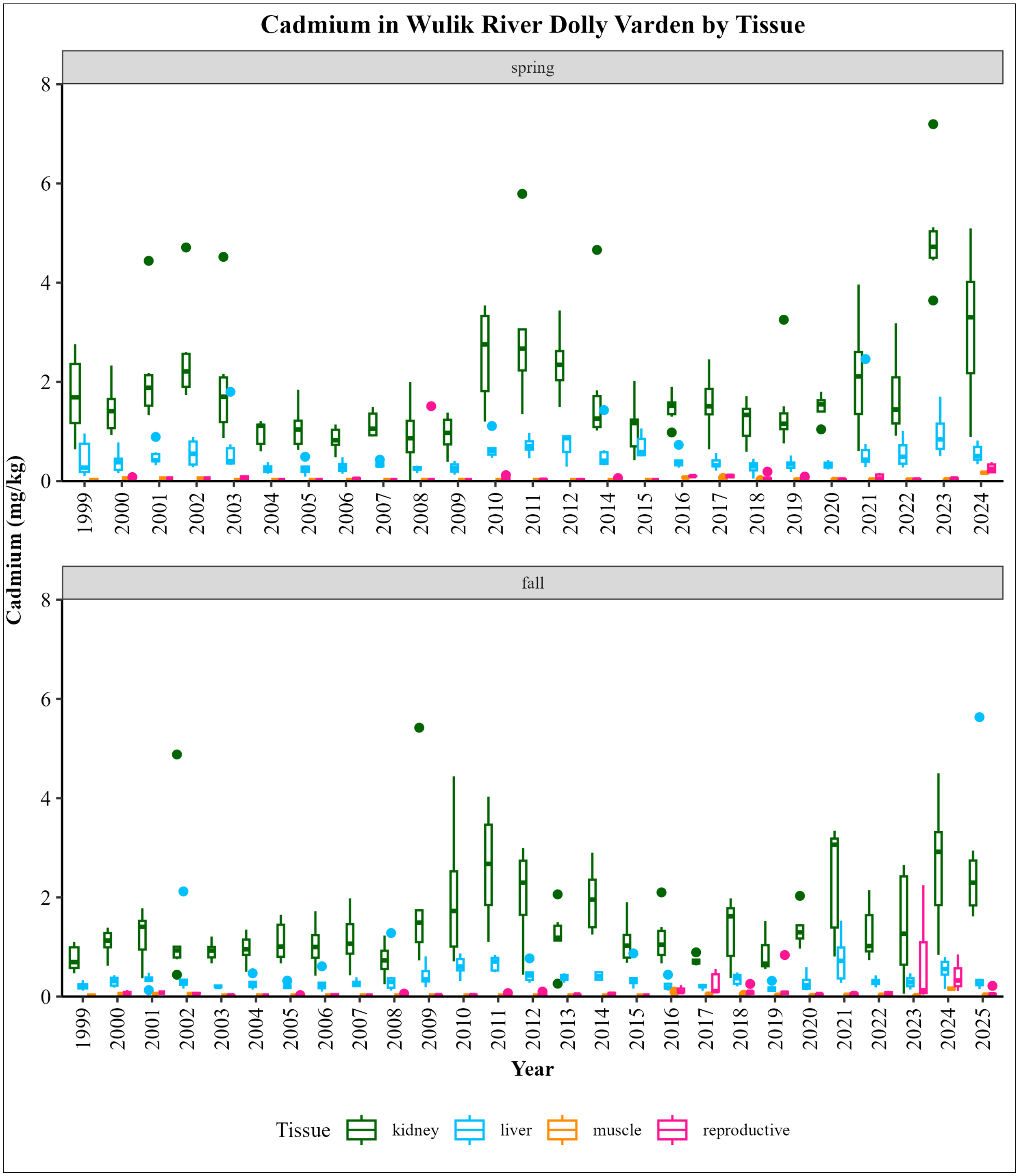

Figure 57.–Boxplot of cadmium concentrations in adult Dolly Varden tissues from 1999 to 2025. All muscle sample results were near or below the detection limit. One outlier in kidney tissue from spring 2023 of 12.83 mg/kg is excluded from this plot but not from statistical analysis.

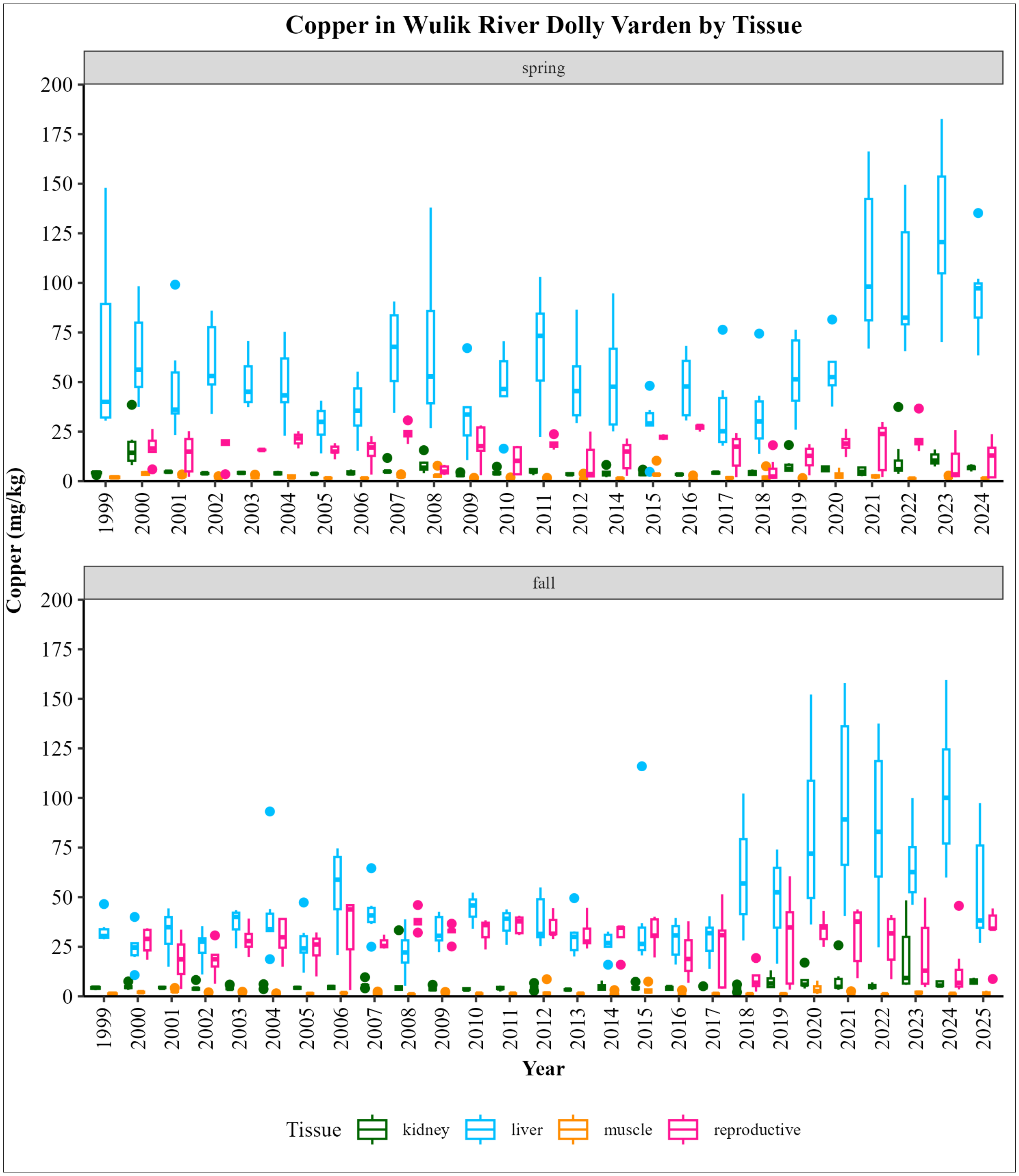

Figure 58.–Boxplot of copper concentrations in adult Dolly Varden tissues from 1999 to 2025.

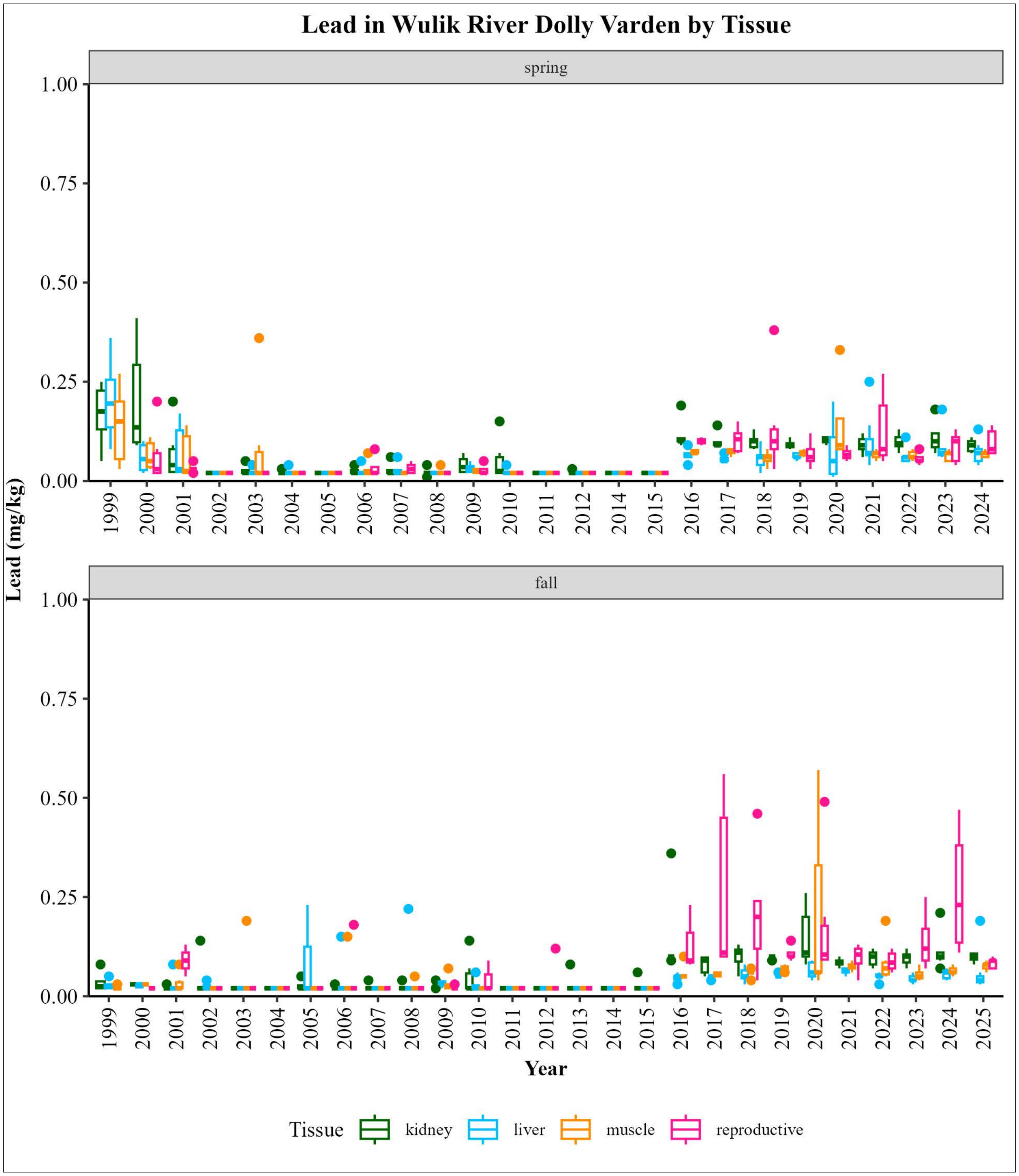

Figure 59.–Boxplot of lead concentrations in adult Dolly Varden tissues from 1999 to 2025. One outlier in a kidney sample from fall 2024 of 1.69 mg/kg is excluded from this plot but not from statistical analysis.

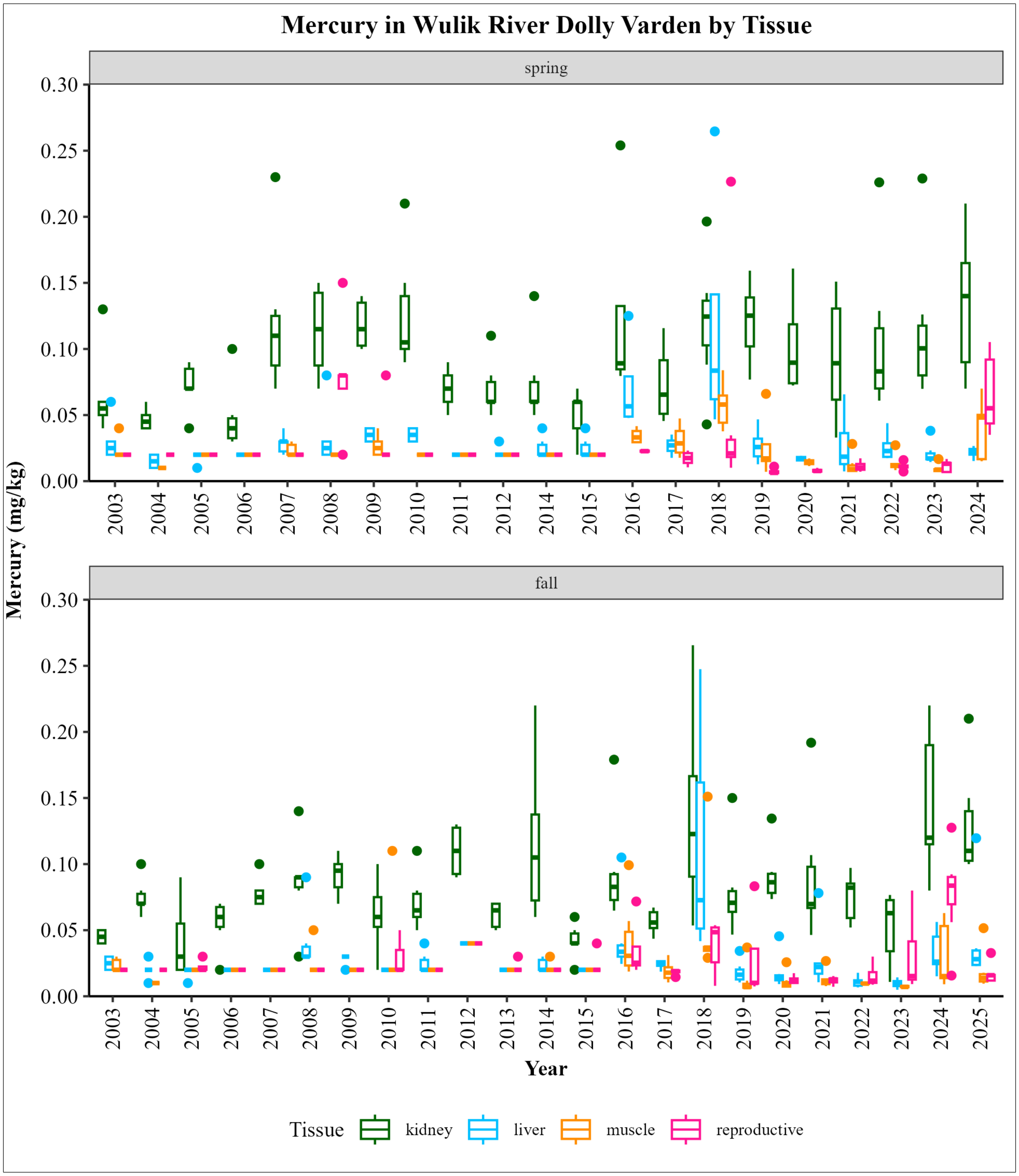

Figure 60.–Boxplot of mercury concentrations in adult Dolly Varden tissues from 1999 to 2025.

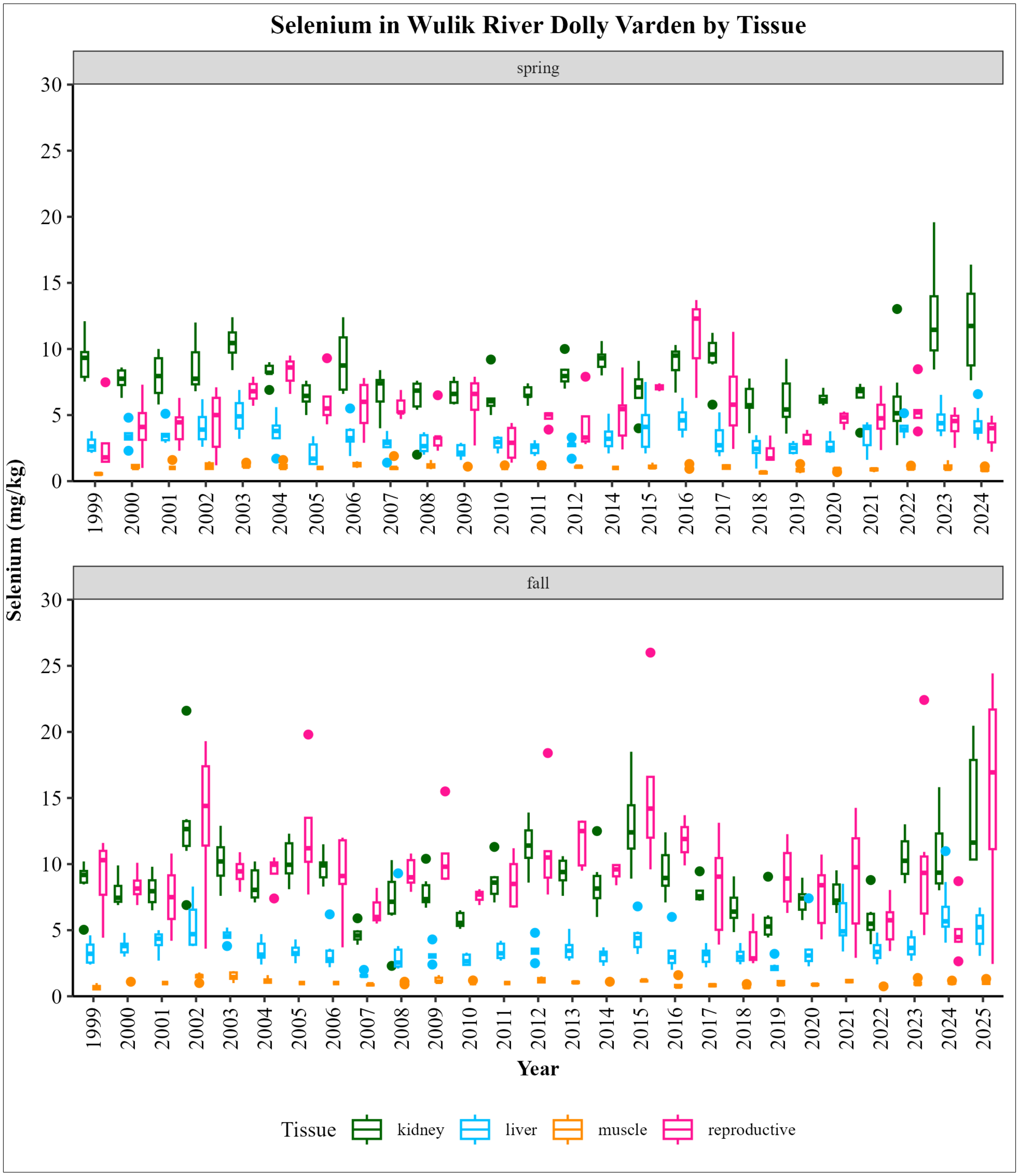

Figure 61.–Boxplot of selenium concentrations in adult Dolly Varden tissues from 1999 to 2025.

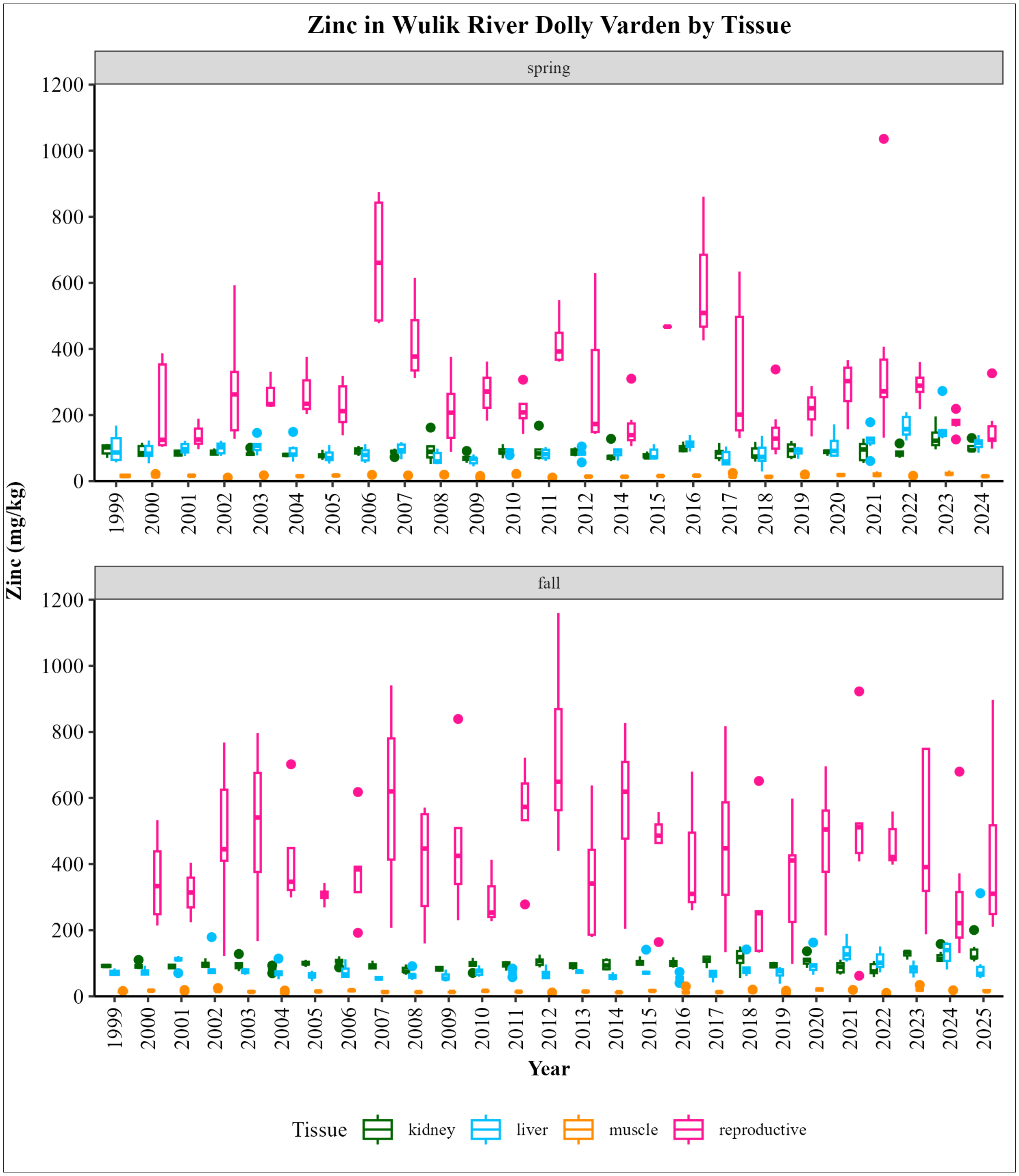

Figure 62.–Boxplot of zinc concentrations in adult Dolly Varden tissues from 1999 to 2025.

DOLLY VARDEN, OVERWINTERING

An aerial survey was conducted using a helicopter on September 29, 2025, to estimate the number of overwintering Dolly Varden in the Wulik River (Figure 63). Lower Ikalukrok Creek was also surveyed, but Dolly Varden observed here are considered fall spawning fish and are not included in the count of overwintering fish. Turbidity from Ikalukrok Creek was lower than recent years but still slightly affected visibility in deep water. Dark colored mineral precipitates were still present in some areas of the riverbed, which also hindered fish detection. A total of 59,307 Dolly Varden were counted in the Wulik River, although this should be considered a minimum estimate due to reduced water clarity (Figure 64).

On average, 94.5% of Dolly Varden observed have been downstream of the mouth of Ikalukrok Creek (40 surveys 1979–2025; Table 4). However, in 2019–2021 and 2023–2024 a higher percentage of fish were counted upstream of the mouth of Ikalukrok Creek, although impaired water visibility downstream of Ikalukrok Creek made it difficult to accurately enumerate fish in those survey zones. In 2025, water clarity in the Wulik River during the aerial survey had improved, and the percentage of fish counted upstream of Ikalukrok Creek was in line with the 6% historical average.

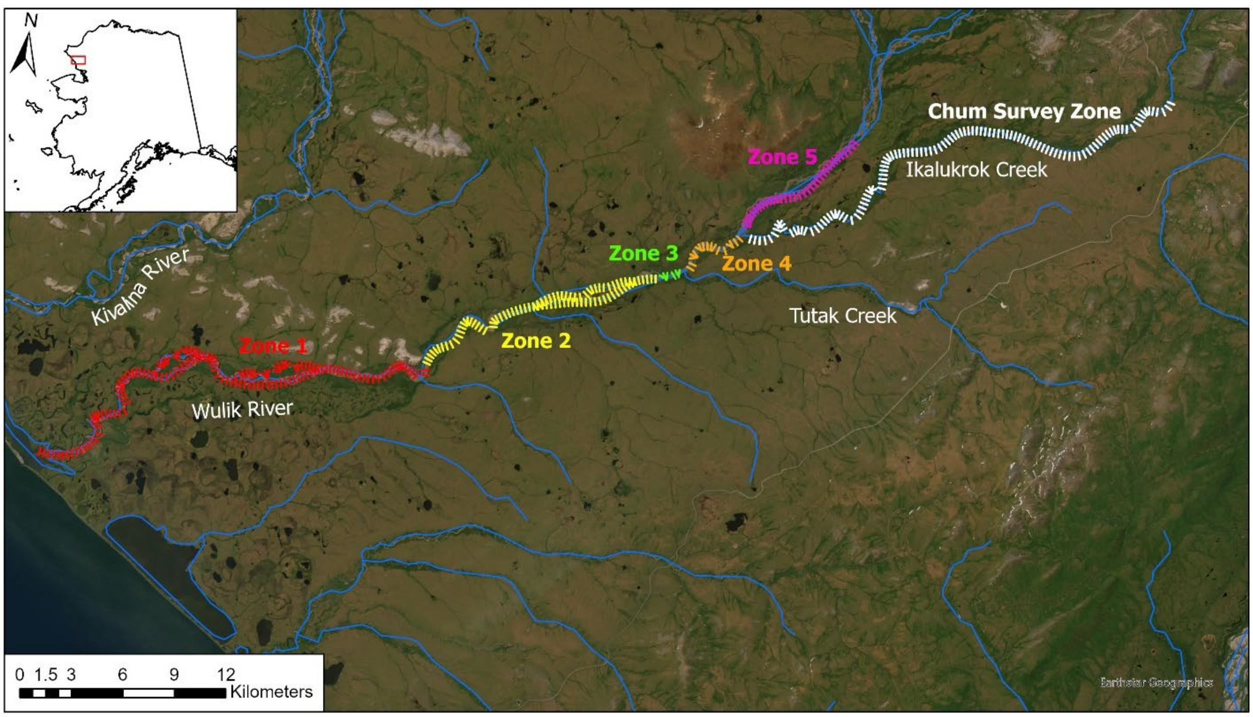

Figure 63.–Dolly Varden (Zones 1–5) and chum salmon aerial survey areas.

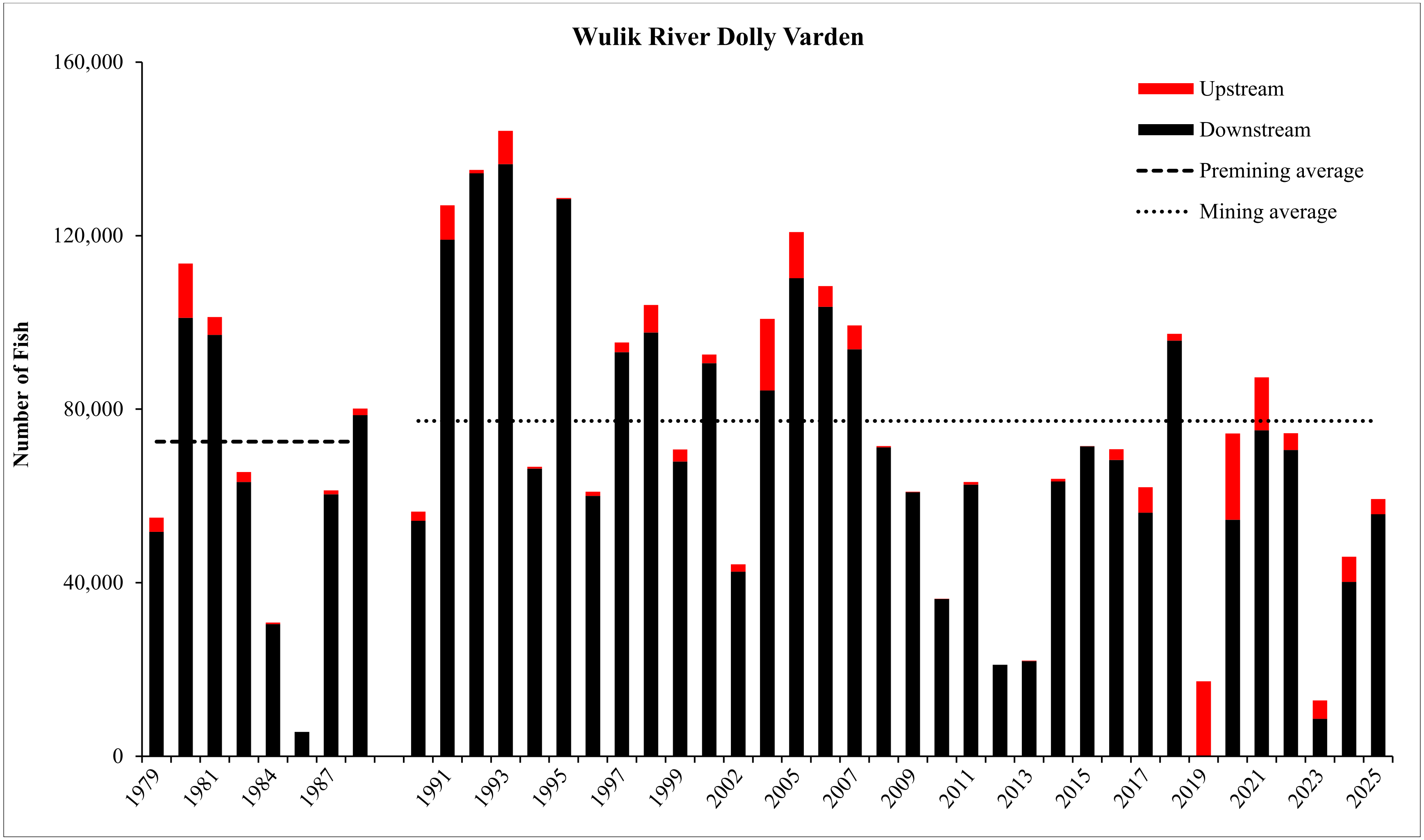

Figure 64.–Aerial survey estimates of the number of Dolly Varden in the Wulik River just prior to freeze up, 1979–2025. "Upstream" fish are those counted on the Wulik River upstream of the mouth of Ikalukrok Creek.

Table 4.–Number of overwintering Dolly Varden counted in the Wulik River. Fall 2000 and 2003 aerial surveys did not occur due to weather.

Year	Wulik River u/s Ikalukrok Creek	Wulik River d/s of Ikalukrok Creek	Total Fish	% of Fish d/s of Ikalukrok Creek
Before Mining 1979	3,305	51,725	55,030	94
1980	12,486	101,067	113,553	89
1981	4,125	97,136	101,261	96
1982	2,300	63,197	65,497	97
1984	370	30,483	30,853	99
1986			5,590	unknown
1987	893	60,397	61,290	99
1988[1]	1,500	78,644	80,144	98
During Mining 1989	2,110	54,274	56,384	96
1991	7,930	119,055	126,985	94
1992	750	134,385	135,135	99
1993	7,650	136,488	144,138	95
1994[2]	415	66,337	66,752	99
1995	240	128,465	128,705	99
1996	1,010	59,995	61,005	98
1997	2,295	93,117	95,412	98
1998	6,350	97,693	104,043	94
1999	2,750	67,954	70,704	96
2001	2,020	90,594	92,614	98
2002	1,675	42,582	44,257	96
2004	16,486	84,320	100,806	84
2005	10,645	110,203	120,848	91
2006	4,758	103,594	108,352	96
2007	5,503	93,808	99,311	94
2008	271	71,222	71,493	99
2009	122	60,876	60,998	99
2010	70	36,248	36,318	99
2011	637	62,612	63,249	99
2012	0	21,084	21,084	100
2013	114	21,945	22,059	99
2014	610	63,341	63,951	99
2015	10	71,474	71,484	100
2016	2,490	68,312	70,802	96
2017	5,856	56,173	62,029	91
2018	1,590	95,795	97,385	98
2019	17,308	too turbid	incomplete	unknown
2020*	19,860	54,546	74,406	73
2021*	12,201	75,160	87,361	86
2022*	3,887	70,595	74,482	95
2023*	4,245	8,653	12,898	67
2024*	5,762	40,214	45,976	87
2025*	3,534	55,773	59,307	94

[1]The population estimate (mark/recapture) for winter 1988/1989 for fish >400 mm was 76,892 (DeCicco 1990).
[2]The population estimate (mark/recapture) for winter 1994/1995 for fish >400 mm was 361,599 (DeCicco 1996).
*Turbidity from Ikalukrok Creek impacted visibility downstream from the mouth, so counts should be considered a minimum number.

CHUM SALMON, SPAWNING

Spawning chum salmon are counted annually in Ikalukrok Creek from its confluence with the Wulik River upstream to Dudd Creek. In 2025 the survey was flown on September 29, but similar to recent years, turbidity was high in Ikalukrok Creek, preventing fish counts in the mainstem. Chum salmon carcasses were observed on gravel bars in the lower section of the creek, indicating that some chum salmon spawning is still occurring in Ikalukrok Creek.

ARCTIC GRAYLING, BONS POND

Bons Pond is an impoundment created by construction of an earthen dam placed on Bons Creek. Dam construction was completed in 1988 to provide potable and make-up water for operational activities. Prior to construction of the dam, there were no fish present in Bons Creek due to a series of impassable waterfalls and bedrock chutes about 1 km downstream of the dam (Figure 65). Bons Creek flows into Buddy Creek and eventually into Ikalukrok Creek.

A diversion ditch was constructed in 1997 to carry surface water around the overburden stockpile. Thermal and hydraulic erosion in the diversion ditch contributes seasonally to the sediment and organic load in Bons Creek. Generally, there is a high input of sediments and organics to Bons Creek, particularly during rainfall events.

Figure 65.–The impassible barrier on the outlet of Bons Pond.

The Arctic grayling population in Bons Pond is the result of fish transplant events conducted in 1994 and 1995 (Ott and Townsend 2003). In 1994, 102 Arctic grayling from North Fork Red Dog Creek (158–325 mm FL) and 5 Arctic grayling from Ikalukrok Creek (350–425 mm FL) were transplanted to Bons Pond. In 1995, about 200 Arctic grayling fry were caught in North Fork Red Dog Creek and moved to Bons Pond.

In 1996 and 1997 visual observations and fyke net sampling in Bons Pond were conducted but no fish were caught or observed. From 1995 to 1997, 12 Arctic grayling transplanted to Bons Pond were recaptured in North Fork Red Dog Creek. Initially, it was believed that the fish transplant was unsuccessful since no fish were observed in Bons Pond. However, in 2001 and 2002 Arctic grayling juveniles were observed in Bons Creek upstream from Bons Pond. In summer 2003, fish sampling was conducted in Bons Pond to determine fish use; the estimated Arctic grayling population was 6,773 fish ≥200 mm FL (Ott and Townsend 2003).

Since 2003, Bons Pond and Bons Creek have been sampled in the spring, with additional sampling later in the ice-free season as needed to increase the number of marked fish and catch juveniles for element analysis. Spawning has been observed in Bons Creek and in the outlet of Bons Pond. The current program in Bons Pond includes a mark–recapture study to estimate the population size and the collection of juvenile Arctic grayling for whole-body element analysis.

In 2025, three fyke nets were set from June 11 to June 16 in Bons Creek, Bons Pond outlet, and in Bons Pond by the pumphouse. A total of 191 Arctic grayling were captured, including 30 fish ≥200 mm FL and 161 <200 mm FL. Fish ≥200 mm FL received a T-bar anchor tag if not already tagged. Of those 30 fish, 3 were recaptures from 2024, 4 were recaptures from years prior to 2024, and 23 were <250 mm and excluded from population estimates as they would have been too small to have been tagged the previous year.

In 2025, the CPUE for the Bons Creek fyke net was 8 fish/day, including 6 fish/day for individuals <200 mm FL (Figures 66 and 67). Catches were overall very low in 2025 compared to previous years. The length frequency distribution for Arctic grayling caught in all three fyke nets in spring 2025 is presented in Figure 68. In 2025, very few large mature fish were captured and the majority of catch was subadult fish, contrary to previous years. The reason for this difference is unknown, but it is possible that the timing of sampling missed the spawning period when fish move up into the creek and into the outlet to spawn.

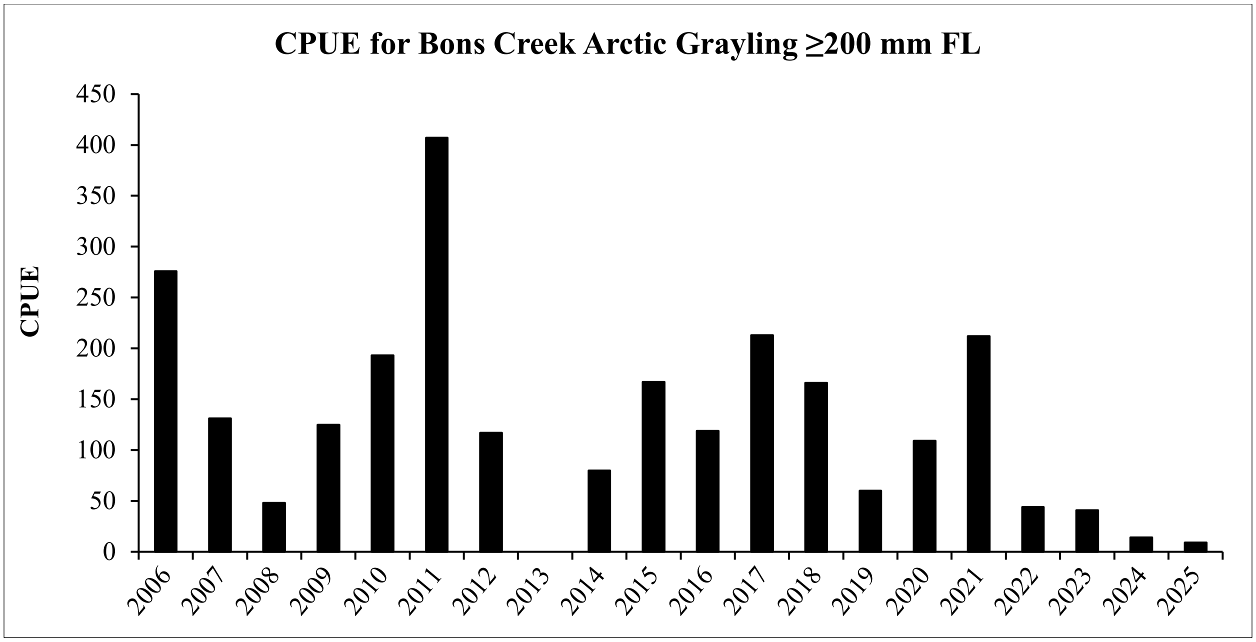

Figure 66.–CPUE for Arctic grayling ≥200 mm FL in Bons Creek 2006–2025. Sampling was not done in 2013 due to high water.

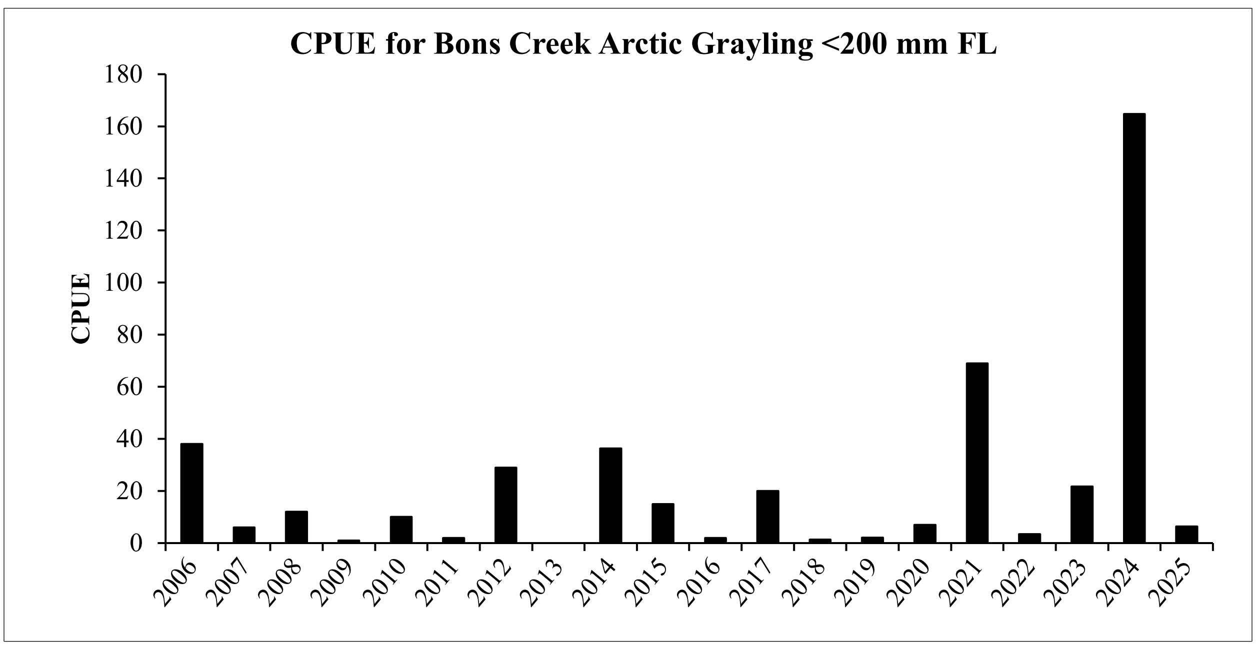

Figure 67.–CPUE for Arctic grayling <200 mm FL in Bons Creek 2006–2025. Sampling was not done in 2013 due to high water.

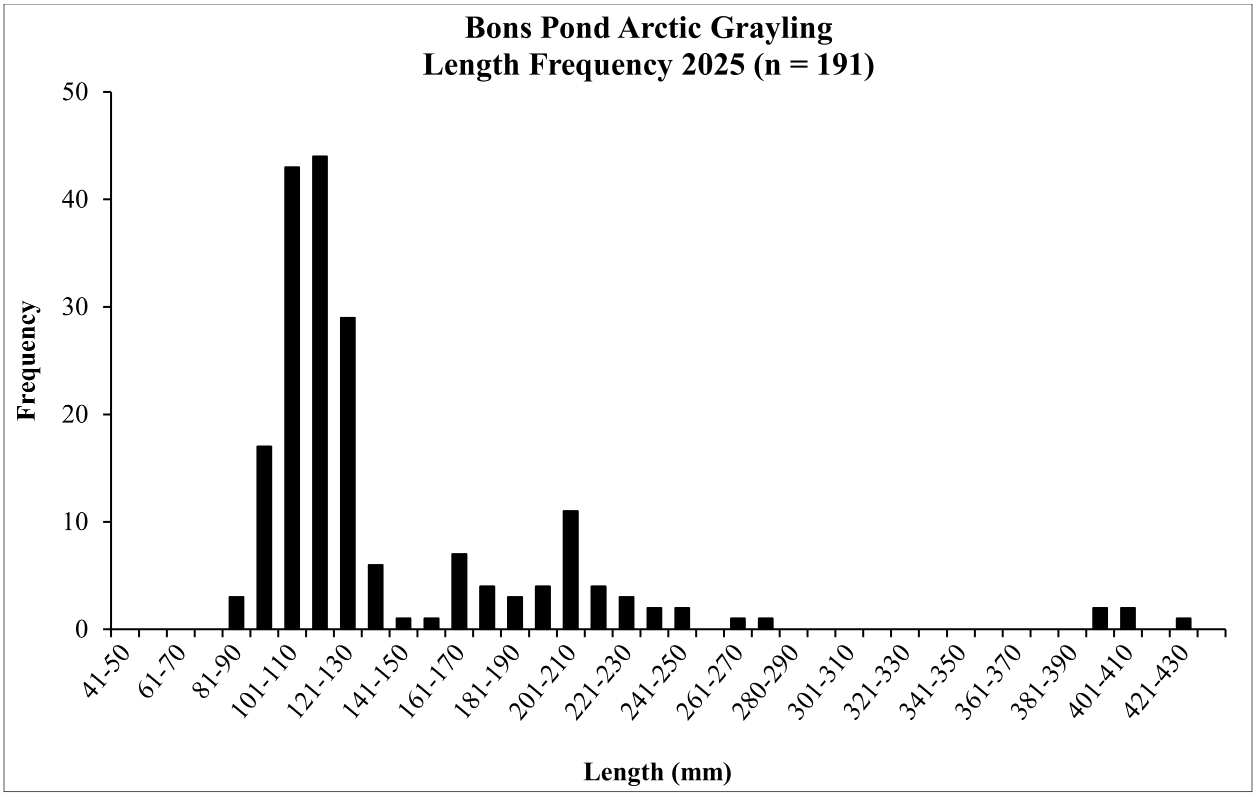

Figure 68.–Length frequency distribution of all captured Arctic grayling from Bons Pond and Bons Creek, June 2025.

Since 2019, many small fish 50–150 mm FL have been captured; however, these large numbers of age-1 and age-2 fish have not carried over into captures of subadult fish 200–250 mm FL in subsequent years. Studies of other Arctic fish populations in lakes have documented bimodal length frequency distributions, with many small, few intermediate, and many large fish (Power 1978). In these studies, fish populations have an initial high mortality rate that declines rapidly to a low rate for most of the life span and the resulting population has a bimodal length frequency distribution (Power 1978). It is also possible that intermediate fish leave Bons Pond due to competition for food. Numerous Arctic grayling in the intermediate size range were observed in Bons Creek downstream of the waterfall in July 2022. If there has been a decrease in the number of large mature fish in Bons Pond, there could be less pressure for subadult fish to leave, resulting in an increase of subadult fish in the pond.

Growth rates for Bons Pond Arctic grayling have generally been higher since 2011 than for the time period immediately following colonization (2003–2010). Only growth data for fish ≥250 mm FL at the time of marking are presented (Figure 69). Of the three recaptures in 2025 that were seen in 2024, one was ≥250 mm FL (at the time of marking) with growth of 18 mm, one was less than 250 mm FL at the time of marking, and one did not receive a length measurement. The smaller fish was tagged in 2024 at 203 mm FL and was 264 mm FL when recaptured in 2025, for a growth of 61 mm. Higher growth rates since 2011 could be related to the population decline which has resulted in decreased competition leading to increased food availability (Figure 70).

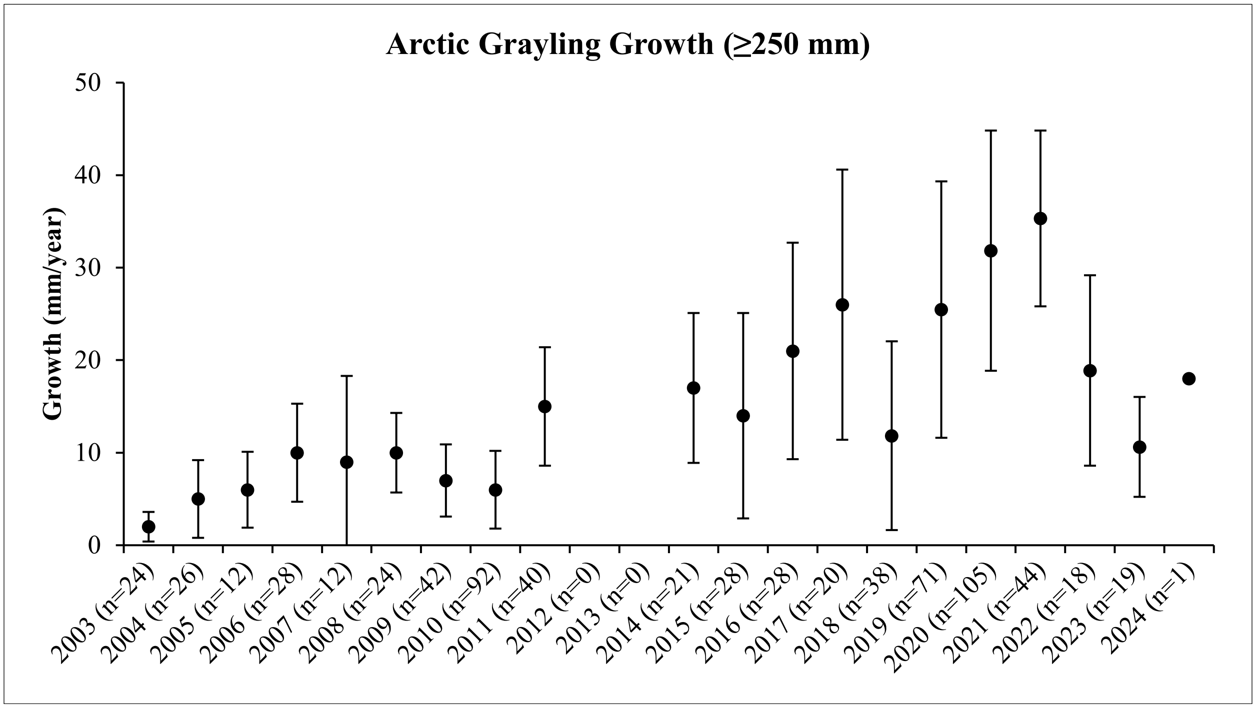

Figure 69.–Average annual growth (± 1 SD) of Arctic grayling ≥250 mm FL at time of marking.

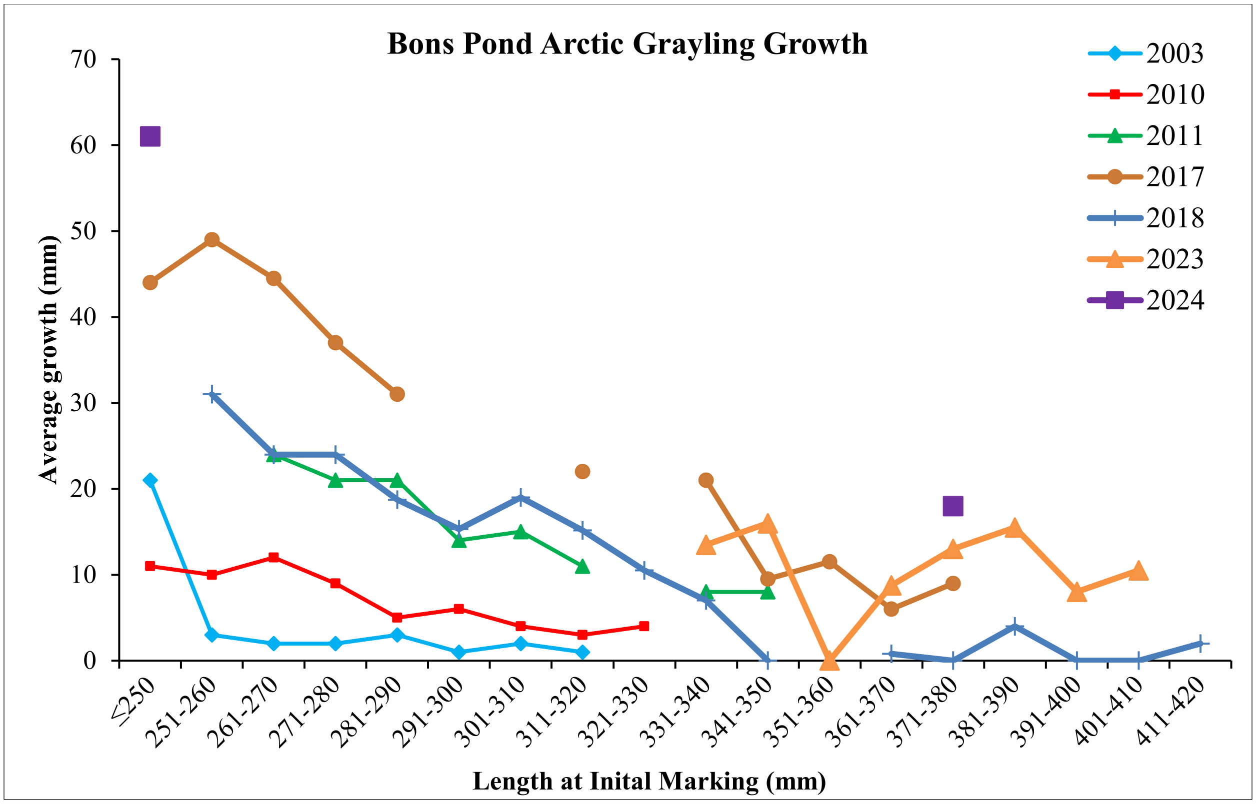

Figure 70.–Bons Pond Arctic grayling annual growth rates by size class for select years from 2003–2024.

The 2024 Arctic grayling population in Bons Pond was estimated by using spring 2024 as the mark event (n = 75) and spring 2025 as the recapture event (n = 7). The 2025 recapture number does not include fish <250 mm FL, as they were likely too small to tag in 2024. In spring 2025, 3 of the captured fish were seen during the spring 2024 mark event. Based on these numbers, the estimated Arctic grayling population for 2024 was 151 fish (95% CI, 60–243 fish) ≥200 mm FL. This is a decrease from the 2023 population estimate of 347 fish (95% CI, 237–457 fish), and the lowest population estimate since sampling began in 2003 (Figure 71). Future years of sampling will assist in determining if the low catches in 2025 were due to sampling timing, or if other factors are impacting fish numbers.

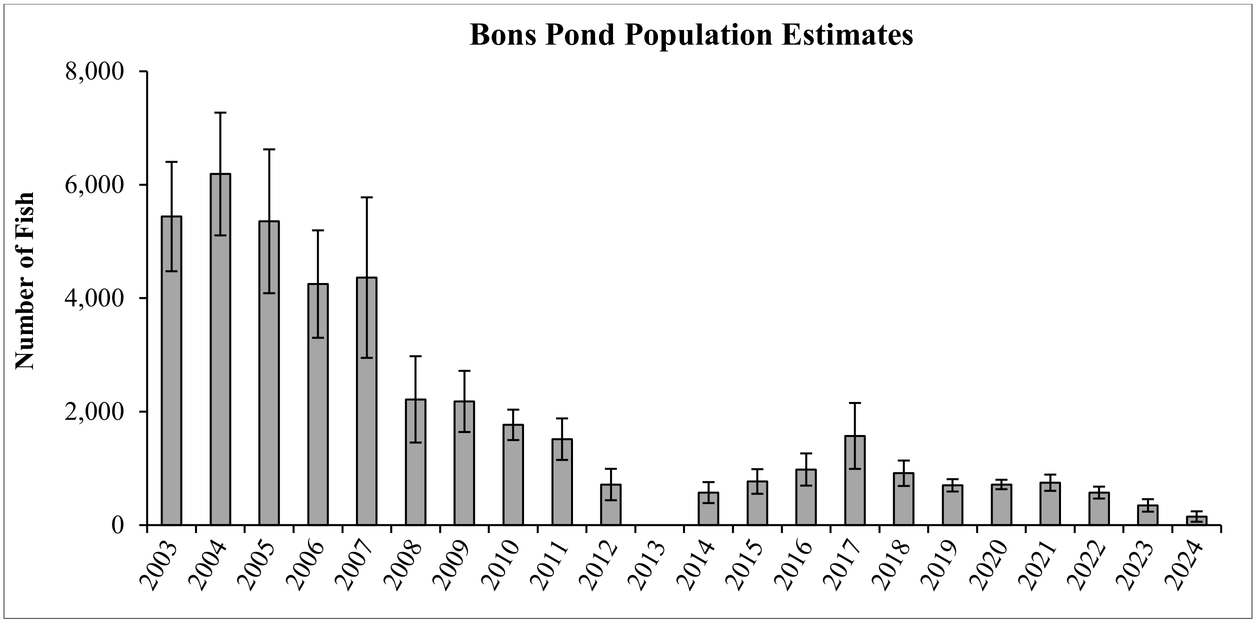

Figure 71.–Estimated Arctic grayling population (95% CI) in Bons Pond for fish ≥ 200 mm FL.

CONCLUSION

In the area surrounding Red Dog Mine there are several highly productive creeks characterized by high levels of chlorophyll-a, high density of BMI, and relatively high minnow trap catches. The sample sites on Buddy and Bons creeks consistently have the highest chlorophyll-a levels and BMI densities. Buddy Creek below the falls and Anxiety Ridge Creek typically have the highest minnow trap catches, but this was not the case for 2025 when the highest CPUE was at North Fork Red Dog Creek. While the sample sites in Mainstem Red Dog Creek at Station 10 and Ikalukrok Creek at Station 9 have historically had lower chlorophyll-a concentrations and aquatic invertebrate densities than Buddy and Bons creeks, the difference between the low and high productivity sites has become more pronounced in recent years. This decrease in productivity is likely linked to an increase of mineral seeps resulting from permafrost thaw, leading to observable and measurable changes in water quality in Ikalukrok and Red Dog creeks. These changes in water quality and corresponding decreases in stream productivity are occurring in streams both upstream and downstream of mine influence and have been documented in other drainages throughout northern Alaska (O'Donnell et al. 2024).

While water quality data show increasing levels of elements in the waters impacted by mineral seeps, those same order of magnitude increases are not reflected in the whole-body element analyses of juvenile Dolly Varden. While metals such as cadmium and zinc have greatly increased in Red Dog Creek, the levels of those metals in juvenile Dolly Varden from Red Dog Creek have remained relatively stable, although whole-body burden of zinc has increased somewhat in recent years. Since these fish only reside in Red Dog Creek during the open water season and overwinter lower in the drainage, their exposure to the poor water quality is limited in duration, which could moderate the amount of the elements that are incorporated into their tissues. However, no fish were captured in Red Dog Creek in 2020, when water quality was notably poor with extremely high levels of metals, although no fish kills were observed.

The diminished water quality in Ikalukrok Creek has prevented enumeration of spawning chum salmon since 2019, but spawned out adults are still observed on gravel bars, indicating that some amount of chum salmon spawning is still occurring in Ikalukrok Creek. The turbidity from Ikalukrok Creek has also impeded enumeration of overwintering Dolly Varden in the Wulik River, but counts of overwintering Dolly Varden in the Wulik River since 2019 have been within the range of counts seen in previous years (1979–2018). The concentrations of various analytes in adult Dolly Varden tissues have been variable over the sample years, though none of the tested elements appear to concentrate in muscle tissue. Since Dolly Varden are anadromous and generally spend summers in the marine environment and overwinter in freshwater, they are exposed to a variety of different element concentrations in different locations.

The Arctic grayling population in Bons Pond has been decreasing in recent years, though many age-1 and age-2 fish are captured each year. Growth rates of adult fish indicate that food availability is not a limiting factor, at least for larger fish. Future sampling efforts will continue to assess the population size and recruitment dynamics. The whole-body element concentrations in juvenile Arctic grayling from Bons Pond remained stable or slightly decreased in 2025.

The ongoing natural water quality changes in the Ikalukrok Creek drainage, coupled with the range of natural variability across years of sampling, emphasize the importance of long term, ongoing aquatic biomonitoring.

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APPENDIX 1. SUMMARY OF RED DOG MINE DEVELOPMENT AND OPERATIONS, 2020–2025.[3]

2020

- January 8, Golder Associates Inc. issued "Summary Report of Zinc Concentrations, Red Dog Creek and Tributaries."
- February 14, DNR Amendment 3 to Reclamation Plan F20169958 to amend the closure design of the Main Waste Stockpile from an engineered compacted soil cover to a geosynthetic liner and cover design.
- February 19, DEC-Water issued addendum 2 to APDES Permit AK0038652 after determining that commissioning of a Reverse Osmosis Water Treatment Facility would have no or de minimis impacts to wastewater discharge.
- February 28, Teck submitted the Stage XIA Interim Dam Raise Design Report to DNR-Dam Safety.
- April 27, insulating cover rock placed over the regraded Qanaiyaq 1500' level to help address Kaviqsaaq Seep drainage.
- May 8, DNR issued Entry Authorization ADL 725670, authorizing tailings placement in the Millsite Lease Area.
- May 10, discharge through Outfall 001 to Red Dog Creek initiated under APDES Permit Number AK0038652.
- May 19, DNR-Dam Safety issued Certificate of Approval to Modify a Dam FY2020-23-AK00201 authorizing Teck to raise the nominal crest elevation of the Tailings Main Dam to 991 feet.
- May 19, Reverse Flow Pumping System shut down. Between December 2019 and May 19, 2020, 397 million gallons of reclaim water were removed from the Tailings Storage Facility with the Reverse Flow Pumping System and temporary winter water storage (TWUA F2019-134).
- May 28, DNR DMLW signed and executed Millsite Lease ADL 233521 for tailings placement.
- May 28, DNR-Mining issued Plan of Operations Approval F20209958POOA.
- June 1–9, the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek and North Fork Red Dog Creek was sampled. Adult Dolly Varden were collected for tissue element analyses and juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis.
- June 21–28, treated water discharge temporarily halted due to increased background total dissolved solids (TDS) and decreased stream flow.
- July 6–11, periphyton and aquatic invertebrate sampling was done at all ten sites in accordance with permit requirements. In addition, aquatic biomonitoring (periphyton and aquatic invertebrates) was conducted at nine sites near the Anarraaq Prospect.
- July 6, treated water discharge halted due to increased background total dissolved solids (TDS) and decreased stream flow.
- July 10, DEC-Water issued minor modification to APDES Permit No. AK0038652, adding end of pipe TDS limits to Outfall 001 when naturally occurring in-stream TDS encroaches on the permitted in-stream TDS limit at Stations 151 and 160.

[3] Previous years' summaries can be found in Clawson and Ott 2020.

- August 1–6, juvenile Dolly Varden sampling performed at all the APDES sample sites and sites located in the vicinity of the Anarraaq/Aktigiruq prospect.
- August 7, DEC-Water issued Installation Approval for the Reverse Osmosis wastewater treatment plant.
- August 26, discharge initialized from the Reverse Osmosis water treatment system.
- September 13, DeCicco and ADF&G conducted aerial surveys for Dolly Varden in the Wulik River and chum salmon in Ikalukrok Creek. Seven adult Dolly Varden were collected from the Wulik River for tissue analyses.
- September 22, DNR-Dam Safety issued Temporary Certificate of Approval to Operate a Dam FY2021-3-AK00201 for the Tailings Main Dam, and Temporary Certificate of Approval to Operate a Dam FY2020-4-AK00303 for the Tailings Back Dam.
- September 26, discharge halted for the season. Approximately 870 million gallons were discharged into Red Dog Creek from Outfall 001 under APDES Permit No. AK0038652.
- October 5–8, ADF&G conducted aerial surveys for Dolly Varden in Wulik and Kivalina rivers.

2021

- February 26, ADEC issued minor amendment to Red Dog Operations Oil Discharge Prevention and Contingency Plan #17-CP-3050.
- April 4, ADF&G Habitat issued Fish Habitat Permit #FH21-III-0078 for the low water vehicle and equipment crossing on the spillway of Bons Pond.
- April 9, ADNR Water issued Temporary Water Use Authorization F2020-090, authorizing the capture and diversion of the Kaviqsaaq Seep.
- April 30, DNR-Dam Safety issued Certificate of Approval to Operate a Dam FY2021-27-AK00200 for the Water Supply Dam on Bons Creek.
- May 19, discharge through Outfall 001 to Red Dog Creek initiated under APDES Permit Number AK0038652.
- May 19, ADEC issued minor modification to APDES Permit No. AK0038652, adding a TDS Compliance Schedule and Action Items. Specifically, when water in the TSF approaches within 15 feet of the freeboard limit, discharge of high quality treated wastewater is allowed as in the past even though the natural TDS concentration of the receiving water is increasing.
- May 27–June 3, the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek and North Fork Red Dog Creek was sampled. Adult Dolly Varden were collected for tissue element analyses and juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis.
- June 10, diversion of the Kaviqsaaq Seep to the TSF was completed.
- June 22, ADNR issued a 5-year Land Use Permit (LAS 33736) for installation of a radio tower on top of Volcano Mountain.
- July 1–10, periphyton and aquatic invertebrate sampling was done at all eleven sites in accordance with permit requirements. In addition, aquatic biomonitoring (periphyton and aquatic invertebrates) was conducted at 13 sites near the Anarraaq Prospect.
- August 5–12, juvenile Dolly Varden sampling performed at all the APDES sample sites and sites located in the vicinity of the Anarraaq/Aktigiruq prospect.
- August 23–September 2, additional juvenile fish sampling and gamete collection for chum salmon and Dolly Varden fertilization tests. Adult Dolly Varden were collected for tissue element analyses.

- September 5–6 and 10, Owl Ridge Natural Resource Consultants conducted aerial surveys for chum salmon and Dolly Varden in the Wulik and Kivalina rivers and Ikalukrok Creek.
- September 23, ADNR issued Reclamation Plan Approval No. F20219958RPA, Plan of Operations Approval No. F20219958POOA, and Waste Management Permit No. 2021DB0001.
- September 25, discharge into Red Dog Creek from Outfall 001 was halted for the season. Approximately 1.719 billion gallons were discharged under APDES Permit No. AK0038652**.** 173 million gallons of the discharge was from the RO plant.
- October 6–9, ADF&G conducted aerial surveys for Dolly Varden in Wulik and Kivalina rivers.
- November 18, ADNR issued an amendment to Reclamation Plan Approval No. F20219958.01RPA to delay covering a small section of the Main Waste Dump.
- November 29, DNR-Dam Safety issued Certificate of Approval to Operate a Dam FY2022-12-AK00201 for the Tailings Main Dam, and Certificate of Approval to Operate a Dam FY2021-13AK00200 for the Tailings Back Dam.

2022
- January 25, Red Dog Mine 2021 Environmental Audit finalized and published.
- April 1, ADEC approved the routine update for the Red Dog Operations Contingency Plan #17-CP-3050.
- May 9, discharge through Outfall 001 to Red Dog Creek initiated under APDES Permit Number AK0038652.
- May 16, ADNR Dam Safety issued a Certificate of Approval to Modify a Dam for Stage XII of the Red Dog Tailings Main Dam. This approved the construction of the Main Dam to the final elevation of 1,007.4 feet.
- May 17, ADNR Dam Safety issued a Certificate of Approval to Modify a Dam for the Red Dog Tailings Back Dam Stage V Raise.
- June 2–9, ADF&G sampled the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek and North Fork Red Dog Creek. Adult Dolly Varden were collected for tissue element analyses and juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis. ADF&G assisted Owl Ridge Natural Resource Consultants with Arctic grayling gamete collection for fertilization studies.
- July 7–14, ADF&G conducted periphyton and aquatic invertebrate sampling at all 10 sites in accordance with permit requirements. In addition, aquatic biomonitoring (periphyton and aquatic invertebrates) was conducted at 17 sites near the Anarraaq Prospect.
- August 1–6, ADF&G performed juvenile Dolly Varden sampling at all the APDES sample sites and sites located in the vicinity of the Anarraaq/Aktigiruq prospect.
- September 23, discharge into Red Dog Creek from Outfall 001 was halted for the season. Approximately 1.725 billion gallons were discharged under APDES Permit No. AK0038652**.**
- September 28, ADF&G issued Fish Habitat Permit FH22-III-0209 for water withdrawal from Bons Reservoir and Bons Creek under Water Right LAS 1453.
- October 1–3, ADF&G conducted aerial surveys for Dolly Varden in the Wulik and Kivalina rivers.
- December 29, ADNR Water issued water rights for five gravel pit ponds, Middle Fork Red Dog Creek, the Tailings Back Dam, South Fork Red Dog Creek Tailings Storage Facility, Middle Fork Red Dog Creek Bypass, and South Fork Red Dog Creek Bypass.

2023

- January 2, 700 gallons of zinc final concentrate was released on the ground under the mill building due to equipment failure.
- January 17, 2,000 pounds of copper sulfate was released to the ground outside the Reagents Building when a container broke during delivery.
- January 20, Minor Amendment to Red Dog Oil Discharge Prevention and Contingency Plan (ADEC Plan # 17-CP-3050) was approved.
- March 1, ADNR Water issued Temporary Water Use Authorization F2022-050A1 for the diversion of Willy Nilly, Sulfur, Shelly, Connie, and Rachel Creeks. The amendment also included water withdrawals from Sulfur Creek for drilling.
- March 31, a rabid fox attacked and bit a person outside the Personnel Accommodations Complex double doors and was subsequently dispatched by the Environmental Department. The carcass was shipped to ADF&G for necropsy and was confirmed to be rabid.
- May 1, ADF&G by email transmitted Technical Report No. 23-02 "Aquatic Biomonitoring at Red Dog Mine, 2022" to ADEC.
- May 22, discharge through Outfall 001 to Red Dog Creek initiated under APDES Permit Number AK0038652.
- June 15–21, the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek was sampled by ADF&G. Adult Dolly Varden were collected for tissue element analyses and juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis. Water was too high to sample North Fork Red Dog Creek.
- July 6–13 periphyton and aquatic invertebrate sampling was done at all eleven sites in accordance with permit requirements as well as at 13 sites near the Aktigirug/Anarraaq Exploration Project (AAEP).
- July 11, ADNR Water issued Temporary Water Use Authorization F2023-037 for water withdrawal from the Mill Pad Area Dewatering Well 1.
- August 3–8, juvenile Dolly Varden sampling performed at all the APDES sample sites and AAEP sites.
- September 19, discharge into Red Dog Creek from Outfall 001 was halted for the season. Approximately 1.776 billion gallons were discharged under APDES Permit No. AK0038652**.**
- October 3–5, ADF&G conducted aerial surveys for Dolly Varden in the Wulik and Kivalina rivers.
- October 18, a zinc concentrate truck rolled over at MP 14.5 on the DeLong Mountain Transportation System (Port Road). Approximately 1 ton of zinc concentrate was released onto the snow-covered tundra.
- November 27, ADNR Water issued water rights for the Main Waste Acid Rock Drainage Collection system, Dewatering Wells, Bons Creek, Red Dog Port, South Fork Red Dog Creek and Tailings, and Diversion Ditches #1, #2, and #4.
- December 7, three caribou were struck and killed on the DMTS at MP 36 and MP 37.
- December 8, ADEC approved Red Dog Operations Oil Discharge Prevention and Contingency Plan #23-CP-2050.

2024

- February 14, 10 tons of zinc concentrate was spilled onto the tundra when a haul truck went off the DeLong Mountain Transportation System road at MP 29. Concentrate was vacuumed up on 2/24 and 2/25, with final clean up completed on 4/26.
- February 26, ADNR Dam Safety issued a Certificate of Approval to Operate a Dam FY2024-13-AK00200r for the Red Dog Water Supply Dam on Bons Creek.
- May 3, additional clean up of the MP 14.5 zinc concentrate spill from 10/18/23 occurred.
- May 8, Teck Alaska requested an amendment to the Reclamation Plan Approval F20219958RPAfor construction of exploration roads and pads north of the existing Aqqaluk Pit, which would include extending the existing Sulfur Creek diversion and construction of a Sulfur Creek bypass west of the Aqqaluk pit.
- May 20, Red Dog initiated discharge from Outfall 001.
- May 24, Ailuuraq Creek breached the DMTS road just north of the bridge due to aufeis buildup underneath the bridge.
- May 28, the Red Dog clean water diversion at Shelly Creek developed a leak at a pipe section joint. The pipe section was within a lined ditch and water flowed into the Main Pit Water Reservoir.
- June 10–17, the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek was sampled by ADF&G. Adult Dolly Varden were collected for tissue element analyses and juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis.
- July 1–9, periphyton and aquatic invertebrate sampling was done at all 11 sites in accordance with permit requirements as well as sites near the Aktigirug/Anarraaq Extension Project (AAEP).
- July 5, ADEC issued an approval letter under ADEC ODPCP #23-CP-2050 for a construction project to replace pipelines and pipe runs near mine tanks M3 and M4.
- July 24, ADNR Large Mine Permitting Team and SOA Department of Law conducted a field inspection to ensure compliance with the Plan of Operations Approval F20219958POA and Reclamation Plan Approval F20219958RPA.2.
- July 24, additional clean up of the zinc concentrate spill at MP 14.5 on 10/18/23 occurred.
- August 12–15, juvenile Dolly Varden sampling was attempted but weather and water conditions did not allow for sampling.
- September 5–9, the chum salmon aerial survey, adult Dolly Varden collection, and water sample collection occurred.
- September 8, ADF&G assisted with euthanizing a moose that was injured in a collision with a haul truck on the DMTS.
- September 21, treated water discharge into Red Dog Creek from Outfall 001 was halted for the season. Approximately 1.735 billion gallons were discharged under APDES Permit No. AK0038652**.**
- September 25, final clean up of the zinc concentrate spill at MP 14.5 on 10/18/23 occurred.
- October 1–4, ADF&G conducted aerial surveys for Dolly Varden in the Wulik River.
- October 16, ADNR issued LAS 35236 for temporary installation of a 60-m meteorological tower adjacent to Material Site 12 at MP 43 on the DMTS road.
- November 15, a zinc concentrate truck rolled over at MP 2.5 on the DMTS road. Approximately 120,000 lbs of zinc concentrate was released onto the tundra.

- December 13, ADNR Dam Safety issued a Certificate of Approval to Operate a Dam FY2025-07-AK00302 for the Tailings Main Dam and Certificate of Approval to Operate a Dam FY2025-08-AK00303 for the Tailings Back Dam.
- December 20, ADNR Dam Safety issued a Certificate of Approval to Operate a Dam FY2025-10-AK00260 for the Red Dog Mine Water Diversion Dam.

2025

- January 20, a zinc concentrate truck rolled over at MP 31.4 on the DMTS road. Approximately 1,000 lbs of zinc concentrate was released onto the snow covered tundra.
- March 29, a red fox behaving abnormally was euthanized on the mine site and the carcass was shipped to ADF&G in Fairbanks.
- April 14, ADNR DMLW issued Reclamation Plan Approval F20219958RPA.3, approving a net reduction in the Financial Assurance in conjunction with the annual Consumer Price Index adjustment based on the placement of liner and earthworks conducted on 95 acres of the Main Waste Dump.
- April 13, a red fox behaving aggressively was euthanized at the Port Site and the carcass was shipped to ADF&G in Fairbanks.
- May 14, slurry pump failure resulted in the release of approximately 170,000 gallons of process water. A portion of that water left secondary containment, and of that, up to 1,000 gallons left the roadway and impacted tundra and Middle Fork Red Dog Creek. The creek was flowing, but it was likely too early in the year for fish to be present in Red Dog Creek at the mouth of Middle Fork Red Dog Creek. No impacts were observed on fish or wildlife.
- May 18, Red Dog initiated discharge from Outfall 001.
- June 10–16, the spring spawning migration of Arctic grayling in Bons Pond/Bons Creek was sampled by ADF&G. Juvenile Arctic grayling were retained from Bons Pond for whole-body element analysis. Adult Dolly Varden collection for element analyses was attempted in the Wulik River, but no fish were caught.
- June 30–July 7, periphyton and aquatic invertebrate sampling was done at all 11 sites in accordance with permit requirements as well as sites near the Aktigirug/Anarraaq Extension Project (AAEP).
- July 17, ADNR Dam Safety issued a Certificate of Approval to Modify a Dam for the Red Dog Tailings Main Dam (FY2026-01-AK00201) and the Red Dog Tailings Back Dam (FY2022-06-AK00303) for modifications to the instrumentation design for both dams.
- July 29, ADF&G Habitat and Sport Fish biologists presented on fish work in the Kivalina/Noatak area to the Joint Leadership Council meeting in Anchorage.
- July 29–August 5, juvenile Dolly Varden sampling performed at all the APDES sample sites and AAEP sites.
- August 14, high creek flows resulting from 2.25 inches of rain in 24 hours contributed to the failure of the fish weir on Middle Fork Red Dog Creek. Repairs were planned for after freeze up.
- September 17, Temporary Water Use Authorization TWUA F2025-091 was issued for water withdrawal from Avgun Creek to support the Qanaiyaq Instrumentation Drilling Project.
- September 20, treated water discharge into Red Dog Creek from Outfall 001 was halted for the season. Approximately 1.863 billion gallons were discharged under APDES Permit No. AK0038652.

- September 28C30, ADF&G conducted aerial surveys for Dolly Varden in the Wulik River.
- December 4–5, ADF&G Habitat and Sport Fish biologists attempted to travel to Kivalina to present on fish work in the Kivalina/Noatak area to the community, but the trip was canceled due to a death in the community. The trip was rescheduled for early 2026.

APPENDIX 2. CHLOROPHYLL-A, RED DOG MINE MONITORING SITES 2025

Results below the detection limit are shaded in gray.

2025 Chloro Results - Red Dog					Linear Check Maximum = 73.89 mg/m2				
IDL = 0.08 mg/m2									
EDL = 0.41 mg/m2						Phaeo Corrected			
Daily Vial #	Site	Station	Date Analyzed	Vial Chl a	Chl a mg/m2	**Chl a mg/m2**	**664/665 ratio**	Chl b mg/m2	Chl c mg/m2
2	Bons Crk us pond	400	10/6/2025	2.25	8.99	**8.33**	1.66	0.00	0.38
3	Bons Crk us pond	400	10/6/2025	0.66	2.65	**2.46**	1.66	0.00	0.14
5	Bons Crk us pond	400	10/6/2025	2.70	10.81	**10.15**	1.67	0.00	0.43
4	Bons Crk us pond	400	10/6/2025	1.48	5.90	**5.66**	1.70	0.00	0.29
6	Bons Crk us pond	400	10/6/2025	0.66	2.65	**2.56**	1.71	0.00	0.11
7	Bons Crk us pond	400	10/6/2025	7.85	31.39	**28.84**	1.65	0.00	1.07
8	Bons Crk us pond	400	10/6/2025	7.29	29.18	**27.13**	1.66	0.00	1.06
9	Bons Crk us pond	400	10/6/2025	3.23	12.91	**11.53**	1.62	0.00	0.51
10	Bons Crk us pond	400	10/6/2025	1.78	7.13	**6.41**	1.63	0.00	0.23
11	Bons Crk us pond	400	10/6/2025	3.78	15.13	**14.31**	1.68	0.00	1.23
12	NFRD Crk	12	10/3/2025	0.60	2.40	**2.35**	1.71	0.26	0.08
13	NFRD Crk	12	10/3/2025	0.22	0.86	**0.75**	1.58	0.05	0.08
14	NFRD Crk	12	10/3/2025	0.04	0.18	**0.21**	2.00	0.06	0.11
15	NFRD Crk	12	10/3/2025	0.17	0.67	**0.64**	1.67	0.15	0.01
16	NFRD Crk	12	10/3/2025	0.35	1.41	**1.28**	1.63	0.02	0.11
17	NFRD Crk	12	10/3/2025	0.07	0.27	**0.32**	2.00	0.02	0.10
18	NFRD Crk	12	10/3/2025	0.03	0.14	**0.11**	1.50	0.00	0.15
19	NFRD Crk	12	10/3/2025	0.14	0.54	**0.53**	1.71	0.05	0.00
20	NFRD Crk	12	10/3/2025	0.13	0.54	**0.43**	1.50	0.12	0.16
21	NFRD Crk	12	10/3/2025	0.08	0.31	**0.21**	1.40	0.08	0.06
22	Red Dog Crk	10	10/3/2025	0.00	0.00	**0.00**		0.00	0.00
23	Red Dog Crk	10	10/3/2025	0.00	0.00	**0.00**		0.00	0.00
24	Red Dog Crk	10	10/3/2025	0.01	0.04	**0.11**		0.04	0.16
25	Red Dog Crk	10	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
26	Red Dog Crk	10	10/3/2025	0.00	0.00	**0.00**		0.00	0.00
27	Red Dog Crk	10	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
28	Red Dog Crk	10	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
29	Red Dog Crk	10	10/3/2025	0.01	0.05	**0.11**		0.00	0.00
30	Red Dog Crk	10	10/3/2025	0.01	0.05	**0.11**		0.00	0.00
31	Red Dog Crk	10	10/3/2025	0.01	0.04	**0.11**		0.05	0.06

2025 Chloro Results - Red Dog					Linear Check Maximum = 73.89 mg/m2				
IDL = 0.08 mg/m2									
EDL = 0.41 mg/m2						**Phaeo Corrected**			
Daily Vial #	Site	Station	Date Analyzed	Vial Chl a	Chl a mg/m2	**Chl a mg/m2**	**664/665 ratio**	Chl b mg/m2	Chl c mg/m2
32	Buddy Crk blw falls	401	10/3/2025	1.04	4.16	**4.06**	1.72	0.00	0.43
33	Buddy Crk blw falls	401	10/3/2025	1.07	4.27	**3.95**	1.65	0.19	0.45
34	Buddy Crk blw falls	401	10/3/2025	0.64	2.54	**2.46**	1.70	0.18	0.16
35	Buddy Crk blw falls	401	10/3/2025	0.83	3.31	**3.20**	1.70	0.27	0.25
36	Buddy Crk blw falls	401	10/3/2025	0.20	0.81	**0.75**	1.64	0.07	0.09
37	Buddy Crk blw falls	401	10/3/2025	0.35	1.41	**1.28**	1.63	0.01	0.21
37	Buddy Crk blw falls	401	10/3/2025	4.51	18.04	**16.66**	1.65	0.00	1.04
38	Buddy Crk blw falls duplicate	401	10/3/2025	4.52	18.08	**16.45**	1.64	0.00	1.04
39	Buddy Crk blw falls	401	10/3/2025	1.12	4.48	**4.38**	1.71	0.40	0.40
40	Buddy Crk blw falls	401	10/3/2025	0.53	2.11	**2.03**	1.68	0.38	0.22
41	Buddy Crk blw falls	401	10/3/2025	5.39	21.54	**20.51**	1.69	0.00	1.72
42	Buddy above rd	221	10/3/2025	0.99	3.98	**3.74**	1.67	0.00	0.39
43	Buddy above rd	221	10/3/2025	0.79	3.15	**2.99**	1.68	0.00	0.24
44	Buddy above rd	221	10/3/2025	0.36	1.45	**1.39**	1.68	0.07	0.17
45	Buddy above rd	221	10/3/2025	0.42	1.69	**1.60**	1.68	0.00	0.14
46	Buddy above rd	221	10/3/2025	1.35	5.42	**5.23**	1.69	0.74	0.34
47	Buddy above rd	221	10/3/2025	0.96	3.82	**3.63**	1.68	0.10	0.35
48	Buddy above rd	221	10/3/2025	1.36	5.44	**5.23**	1.70	0.00	0.59
49	Buddy above rd	221	10/3/2025	0.76	3.05	**2.88**	1.68	0.08	0.32
50	Buddy above rd	221	10/3/2025	1.52	6.08	**5.98**	1.73	0.00	0.50
51	Buddy above rd	221	10/3/2025	0.95	3.78	**3.63**	1.69	0.05	0.29
52	Ik above RD	9	10/3/2025	0.01	0.05	**0.11**		0.00	0.09
53	Ik above RD	9	10/3/2025	0.00	0.00	**0.00**		0.00	0.00
54	Ik above RD	9	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
55	Ik above RD	9	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
56	Ik above RD	9	10/3/2025	0.00	0.00	**0.00**		0.00	0.00
57	Ik above RD	9	10/3/2025	0.00	0.00	**0.00**		0.00	0.10
58	Ik above RD	9	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
59	Ik above RD	9	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
60	Ik above RD	9	10/3/2025	0.00	0.00	**0.00**		0.00	0.10
61	Ik above RD	9	10/3/2025	0.01	0.04	**0.11**		0.05	0.06
2	Upper NFRD	402	10/6/2025	0.78	3.13	**2.88**	1.64	0.21	0.15
3	Upper NFRD	402	10/6/2025	1.05	4.22	**3.95**	1.66	0.32	0.13
5	Upper NFRD	402	10/6/2025	0.54	2.17	**2.03**	1.66	0.29	0.05
4	Upper NFRD	402	10/6/2025	0.60	2.40	**2.35**	1.71	0.25	0.18
6	Upper NFRD	402	10/6/2025	0.53	2.11	**2.03**	1.68	0.47	0.09
7	Upper NFRD	402	10/6/2025	1.01	4.03	**3.74**	1.65	0.41	0.16
8	Upper NFRD	402	10/6/2025	1.42	5.70	**5.34**	1.67	0.07	0.33
9	Upper NFRD	402	10/6/2025	0.58	2.30	**2.14**	1.65	0.30	0.09
10	Upper NFRD	402	10/6/2025	2.13	8.51	**7.90**	1.64	2.02	0.18
11	Upper NFRD duplicate	402	10/6/2025	2.12	8.47	**7.80**	1.63	2.03	0.29
11	Upper NFRD	402	10/6/2025	0.64	2.56	**2.35**	1.63	0.48	0.13

2025 Chloro Results - Red Dog					Linear Check Maximum = 73.89 mg/m2				
IDL = 0.08 mg/m2									
EDL = 0.41 mg/m2						Phaeo Corrected			
Daily Vial #	Site	Station	Date Analyzed	Vial Chl a	Chl a mg/m2	Chl a mg/m2	664/665 ratio	Chl b mg/m2	Chl c mg/m2
2	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.10
3	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
4	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
5	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
6	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
7	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
8	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
9	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
10	Middle Fork Red Dog	20	10/6/2025	0.00	0.00	**0.00**		0.00	0.00
11	Middle Fork Red Dog	20	10/6/2025	0.01	0.05	**0.11**		0.00	0.09
12	Ik ds Dudd	160	10/2/2025	0.01	0.05	**0.11**		0.00	0.09
13	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
14	Ik ds Dudd	160	10/2/2025	0.02	0.09	**0.21**		0.03	0.05
15	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
16	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
17	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
18	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
19	Ik ds Dudd	160	10/2/2025	0.01	0.04	**0.11**		0.05	0.06
20	Ik ds Dudd	160	10/2/2025	0.00	0.00	**0.00**		0.00	0.00
21	Ik ds Dudd	160	10/2/2025	0.03	0.14	**0.11**		0.01	0.05
22	Bons Crk blw pond	220	10/3/2025	1.87	7.50	**7.37**	1.69	2.74	0.14
23	Bons Crk blw pond	220	10/3/2025	2.13	8.52	**8.22**	1.69	0.73	0.59
24	Bons Crk blw pond	220	10/3/2025	5.17	20.66	**19.44**	1.66	3.58	0.89
25	Bons Crk blw pond	220	10/3/2025	2.77	11.09	**10.47**	1.68	0.00	0.95
26	Bons Crk blw pond	220	10/3/2025	7.21	28.86	**26.81**	1.65	3.18	1.08
27	Bons Crk blw pond	220	10/3/2025	2.88	11.51	**11.11**	1.67	4.57	0.23
28	Bons Crk blw pond	220	10/3/2025	0.99	3.96	**3.84**	1.71	0.03	0.33
29	Bons Crk blw pond	220	10/3/2025	2.27	9.08	**8.65**	1.64	4.72	0.09
30	Bons Crk blw pond	220	10/3/2025	3.77	15.08	**14.20**	1.67	0.74	1.22
31	Bons Crk blw pond	220	10/3/2025	1.21	4.82	**4.70**	1.70	0.72	0.26

APPENDIX 3. BENTHIC MACROINVERTEBRATES, 2025.

Year	Order	Family	Genus	Bons u/s Bons Pond	Bons u/s Buddy Sta 220	Buddy u/s road Sta 221	Buddy below falls	Ikalukrok u/s Red Dog Sta 9	Ikalukrok d/s Dudd Sta 160	Mainstem Red Dog Sta 10	Middle Fork Red Dog Sta 20	North Fork Red Dog Sta 12	Upper North Fork Red Dog
2025	Acari	Acarina	spp	277	8	14	9	0	0	0	0	0	39
2025	Coleoptera	Dytiscidae	spp	0	1	0	0	0	0	0	0	0	0
2025	Collembola	Entomobryidae	spp	0	0	3	1	0	0	0	0	1	0
2025	Collembola	Isotomidae	spp	0	0	1	0	0	0	0	1	0	0
2025	Copepoda	Cyclopoida	spp	0	0	0	0	0	2	0	0	0	0
2025	Diptera	Chironomidae	spp	4166	600	2666	2523	129	16	32	30	146	2849
2025	Diptera	Simuliidae	Simulium	388	857	1156	3678	0	0	1	2	1	142
2025	Diptera	Empididae	Clinocera	0	1	0	0	0	0	0	0	0	0
2025	Diptera	Tipulidae	Dicranota	5	0	0	0	0	0	0	0	0	0
2025	Diptera	Tipulidae	Tipula	0	0	0	7	0	0	1	0	1	3
2025	Diptera	Ceratopogonidae	spp	0	0	0	0	0	1	0	0	1	0
2025	Ephemeroptera	Baetidae	Baetis	12	46	411	111	2	0	0	0	0	8
2025	Ephemeroptera	Heptageniidae	Epeorus	0	517	169	405	0	0	1	0	1	18
2025	Ephemeroptera	spp	spp	0	2	0	0	0	0	0	0	0	0
2025	Ephemeroptera	Ameletidae	Ameletus	3	19	23	10	0	0	0	0	0	19
2025	Ephemeroptera	Baetidae	Acentrella	0	0	0	0	0	0	0	0	0	0
2025	Ephemeroptera	Ephemerellidae	spp	0	1	0	0	0	0	0	0	0	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	0	46	228	87	31	4	0	0	0	65
2025	Ephemeroptera	Heptageniidae	spp	0	38	37	15	2	0	0	0	0	10
2025	Lepidoptera	Pyralidae	spp	0	0	0	0	0	0	0	1	1	0
2025	Lepidoptera	Crambidae	spp	0	0	0	0	0	0	0	0	1	0
2025	Nematoda	spp	spp	1	0	0	0	0	0	0	0	0	0
2025	Oligochaeta	spp	spp	277	4	170	91	0	7	54	1	37	513
2025	Ostracoda	spp	spp	315	0	15	41	0	0	0	0	1	0
2025	Plecoptera	Capniidae	spp	0	0	0	0	4	0	1	0	2	5
2025	Plecoptera	Nemouridae	Zapada	116	137	34	27	0	0	0	0	0	37
2025	Plecoptera	spp	spp	10	3	5	0	0	0	2	0	0	0
2025	Plecoptera	Chloroperlidae	Suwallia	3	28	9	13	3	0	0	0	1	20
2025	Plecoptera	Chloroperlidae	spp	0	0	0	0	0	0	0	0	0	13
2025	Plecoptera	Perlodidae	spp	4	23	17	27	0	0	0	0	0	0
2025	Plecoptera	Nemouridae	spp	0	0	0	5	0	0	0	0	1	8
2025	Plecoptera	Perlodidae	Haploperla	0	0	0	0	0	0	0	0	0	0
2025	Plecoptera	Capniidae	Capnia	3	1	87	30	5	0	1	0	7	188
2025	Trichoptera	Limnephilidae	spp	3	3	0	0	0	1	0	0	0	3
2025	Trichoptera	Brachycentridae	Brachycentrus	0	3	0	0	0	0	0	0	0	0

APPENDIX 4. WHOLE-BODY ELEMENT CONCENTRATIONS IN JUVENILE ARCTIC GRAYLING FROM BONS CREEK, 2025.

Sample Number	Date Collected	Length (mm)	Weight (g)		Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	% Solids
061225BPAGJ01	6/12/2025	184	52.8		0.08	1.12	0.05	10.47	98.06	25.8
061225BPAGJ02	6/12/2025	179	63.1		0.09	1.67	0.04	10.53	106.53	24.5
061325BPAGJ03	6/13/2025	165	42.2		0.08	0.79	0.04	12.99	103.03	26.4
061325BPAGJ04	6/13/2025	166	45.9		0.16	2.49	0.04	12.11	102.53	23.7
061325BPAGJ05	6/13/2025	160	43.8		0.19	0.70	0.04	12.10	93.39	25.7
061325BPAGJ06	6/13/2025	170	47.3		0.15	0.48	0.04	12.81	89.72	25.3
061425BPAGJ07	6/14/2025	180	56.7		0.13	0.58	0.05	11.62	117.52	23.4
061425BPAGJ08	6/14/2025	180	52		0.19	1.05	0.04	11.00	81.20	25
061525BPAGJ09	6/15/2025	170	46.4		0.11	0.80	0.03	16.88	86.80	25.0
061525BPAGJ10	6/15/2025	162	37.8		0.11	0.77	0.05	12.70	95.71	23.3
061625BPAGJ11	6/16/2025	180	53.4		0.15	0.92	0.05	13.93	119.67	23.9
061625BPAGJ12	6/17/2025	162	43.4		0.08	0.37	0.05	10.86	64.31	26.9
061625BPAGJ13	6/18/2025	165	40.5		0.12	0.33	0.05	10.08	75.62	24.2

APPENDIX 5. WHOLE-BODY ELEMENT CONCENTRATIONS IN JUVENILE DOLLY VARDEN, 2025.

Red numbers indicate value was at or below method detection limit (MDL), so detection limit for that sample is reported. Detection limits for identified elements were based on % solids which varied for each fish. All results are mg/kg dry weight.

Sample Number	Date Collected	Length (mm)	Weight (g)	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	% Solids
080225BCDVJ01	8/2/2025	130	18.0	0.30	0.93	0.08	6.51	195.35	21.5
080225BCDVJ02	8/2/2025	109	11.6	1.95	0.57	0.03	7.77	296.12	20.6
080225BCDVJ03	8/2/2025	121	16.4	0.45	2.45	0.05	6.29	181.90	23.2
080225BCDVJ04	8/2/2025	97	7.9	1.14	1.21	0.06	8.21	204.02	22.4
080225BCDVJ05	8/2/2025	94	7.4	1.01	1.01	0.04	7.06	151.55	19.4
080225BCDVJ06	8/2/2025	127	19.1	0.22	0.91	0.05	6.68	138.59	24.1
080225BCDVJ07	8/2/2025	90	6.6	2.83	1.02	0.05	8.44	226.63	19.9
080225BCDVJ08	8/2/2025	100	10.3	0.37	1.34	0.15	7.79	178.46	19.5
080225BCDVJ09	8/2/2025	99	9.5	1.94	2.22	0.05	7.51	210.88	19.3
080225BCDVJ10	8/2/2025	85	6.9	1.73	2.37	0.06	8.12	211.11	20.7
080225BCDVJ11	8/2/2025	103	10.0	0.78	5.55	0.06	8.07	187.61	21.8
080225BCDVJ12	8/2/2025	110	12.3	0.46	2.46	0.07	7.50	150.93	21.6
080225BCDVJ13	8/2/2025	125	17.2	0.27	0.51	0.05	11.18	138.76	17.8
080225BCDVJ14	8/2/2025	113	14.0	0.46	9.17	0.06	6.09	138.26	23
080225BCDVJ15	8/2/2025	123	16.5	0.81	0.91	0.09	8.32	192.67	23.2
080325AXDVJ01	8/3/2025	130	19.4	0.14	0.24	0.19	6.20	148.87	22.1
080325AXDVJ02	8/3/2025	109	12.2	0.14	0.18	0.13	5.84	113.45	23.8
080325AXDVJ03	8/3/2025	109	12.4	0.39	0.38	0.22	7.21	169.37	22.2
080325AXDVJ04	8/3/2025	124	19.0	0.15	0.24	0.15	6.77	161.70	23.5
080325AXDVJ05	8/3/2025	128	19.3	0.21	0.47	0.23	7.18	119.80	20.2
080325AXDVJ06	8/3/2025	110	13.6	0.19	0.35	0.17	6.07	152.36	19.1
080325AXDVJ07	8/3/2025	131	21.8	0.14	0.13	0.11	5.54	128.38	22.2
080325AXDVJ08	8/3/2025	129	19.9	0.07	0.08	0.20	4.68	141.44	22.2
080325AXDVJ09	8/3/2025	129	19.7	0.14	0.99	0.17	5.66	123.11	21.2
080325AXDVJ10	8/3/2025	121	18.1	0.17	1.04	0.17	5.25	150.50	20.2
080325AXDVJ11	8/3/2025	127	18.8	0.13	1.86	0.17	4.81	133.18	21.4
080325AXDVJ12	8/3/2025	116	15.1	0.07	0.07	0.21	4.77	126.61	21.8
080325AXDVJ13	8/3/2025	110	13.8	0.22	1.03	0.17	6.29	144.67	19.7
080325AXDVJ14	8/3/2025	117	15.3	0.16	0.23	0.24	5.26	118.88	19.6
080325AXDVJ15	8/3/2025	138	25.4	0.11	0.27	0.22	4.98	105.50	20.0

Sample Number	Date Collected	Length (mm)	Weight (g)	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Zinc (mg/kg)	% Solids
073025RDDVJ01	7/30/2025	130	20.9	1.52	0.39	0.10	7.05	343.33	21.0
073025RDDVJ02	7/30/2025	122	16.7	2.43	0.42	0.09	6.82	451.87	21.4
073025RDDVJ03	7/30/2025	113	14.3	2.26	0.41	0.03	7.20	430.86	17.5
073025RDDVJ04	7/30/2025	124	19.7	1.62	0.55	0.07	6.89	440.00	18.0
080125RDDVJ05	8/1/2025	95	9.1	0.97	2.29	0.10	5.67	282.46	17.1
080325RDDVJ06	8/3/2025	114	13.5	2.44	0.44	0.10	5.70	354.40	19.3
080325RDDVJ07	8/3/2025	94	8.5	3.96	7.94	0.05	6.18	565.45	16.5
080325RDDVJ08	8/3/2025	125	20.5	4.13	1.59	0.08	5.80	446.41	18.1
080325RDDVJ09	8/3/2025	108	12.2	1.31	0.36	0.05	7.09	321.98	18.2
080325RDDVJ10	8/3/2025	93	7.6	2.86	0.43	0.09	6.39	420.77	18.3
080325RDDVJ11	8/3/2025	97	9.2	2.97	0.96	0.08	7.12	475.92	19.1
080325RDDVJ12	8/3/2025	128	17	1.80	0.74	0.11	5.12	373.40	20.3
080325RDDVJ13	8/3/2025	136	22.4	2.01	1.17	0.07	4.38	300.96	20.8
080325RDDVJ14	8/3/2025	120	15.3	2.05	1.55	0.05	6.70	301.03	19.4
080325RDDVJ15	8/3/2025	119	16.2	4.12	1.30	0.11	6.74	572.19	18.7

APPENDIX 6. ELEMENT CONCENTRATIONS IN ADULT DOLLY VARDEN FROM THE WULIK RIVER, SEPTEMBER 2025.

Red numbers indicate value was at or below method detection limit (MDL), so detection limit for that sample is reported. Detection limits for identified metals were based on % solids which varied for each fish.

Tissue	Sample Identification	Fish Species	Sex	Length (mm)	Weight (grams)	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Selenium mg/kg	Zinc mg/kg	Mercury mg/kg	% Solids
Kidney	092829WUDVA01K	DV	F	525	2040	2.94	9.38	0.10	11.63	200.48	0.15	20.9
Kidney	092829WUDVA02K	DV	F	545	2180	2.88	6.32	0.10	17.88	114.62	0.11	21.2
Kidney	092829WUDVA03K	DV	F	530	2220	1.70	6.53	0.09	10.33	116.90	0.11	21.3
Kidney	092829WUDVA04K	DV	F	640	2160							
Kidney	092829WUDVA05K	DV	F	565	2700	2.34	7.90	0.11	33.62	116.67	0.10	21.0
Kidney	092829WUDVA06K	DV	M	550	2380	2.25	8.74	0.08	20.47	149.53	0.21	21.4
Kidney	092829WUDVA07K	DV	M	545	2300	1.62	5.86	0.11	10.34	105.42	0.10	20.3
Kidney	092829WUDVA07K2	DV	M	545	2300	2.18	6.76	0.10	10.15	101.47	0.09	20.4
Liver	092829WUDVA01L	DV	F	525	2040	0.26	40.00	0.04	4.57	59.79	0.03	47.0
Liver	092829WUDVA02L	DV	F	545	2180	0.26	33.91	0.04	5.23	63.50	0.02	46.3
Liver	092829WUDVA03L	DV	F	530	2220	0.15	36.43	0.04	3.36	67.98	0.02	43.1
Liver	092829WUDVA04L	DV	F	640	2160	5.63	461.22	0.19	6.41	311.84	0.12	24.5
Liver	092829WUDVA05L	DV	F	565	2700	0.20	26.90	0.03	6.71	55.03	0.02	48.7
Liver	092829WUDVA06L	DV	M	550	2380	0.31	97.43	0.03	5.84	96.96	0.03	42.8
Liver	092829WUDVA07L	DV	M	545	2300	0.36	88.05	0.06	3.06	80.92	0.04	43.5
Liver	092829WUDVA07L2	DV	M	545	2300	0.34	80.88	0.03	3.14	74.07	0.02	45.5
Muscle	092829WUDVA01M	DV	F	525	2040	0.04	1.01	0.08	1.13	14.86	0.02	32.1
Muscle	092829WUDVA02M	DV	F	545	2180	0.04	1.05	0.07	0.96	13.14	0.01	32.2
Muscle	092829WUDVA03M	DV	F	530	2220	0.04	1.23	0.08	1.03	14.57	0.01	28.9
Muscle	092829WUDVA04M	DV	F	640	2160	0.05	1.97	0.09	0.86	19.80	0.05	19.6
Muscle	092829WUDVA05M	DV	F	565	2700	0.03	2.83	0.07	1.31	17.86	0.02	30.8
Muscle	092829WUDVA06M	DV	M	550	2380	0.03	1.95	0.06	1.05	21.17	0.01	36.0
Muscle	092829WUDVA07M	DV	M	545	2300	0.04	1.02	0.08	0.92	15.10	0.01	29.0
Muscle	092829WUDVA07M2	DV	M	545	2300	0.03	2.09	0.05	0.92	17.24	0.01	28.6
Reproductive	092829WUDVA01R	DV	F	525	2040	0.04	34.10	0.09	21.69	210.26	0.02	19.5
Reproductive	092829WUDVA02R	DV	F	545	2180	0.05	44.29	0.07	16.94	248.98	0.01	19.6
Reproductive	092829WUDVA03R	DV	F	530	2220	0.04	40.71	0.09	11.13	310.38	0.01	21.2
Reproductive	092829WUDVA04R	DV	F	640	2160	0.22	8.71	0.10	2.44	896.91	0.03	19.4
Reproductive	092829WUDVA05R	DV	F	565	2700	0.04	33.93	0.07	24.43	517.41	0.02	20.1
Reproductive	092829WUDVA06R	DV	M	550	2380							
Reproductive	092829WUDVA07R	DV	M	545	2300							