Teck Coal Limited
Water Quality Management
P.O. Box 1777
421 Pine Avenue
Sparwood, B.C. Canada V0B 2G0

+1 250 425 8086 Tel
www.teck.com

Technical Report Overview

Report: Koocanusa Reservoir Monitoring Program Annual Data Summary Report - 2022

Overview: This annual report provides an overview of the environmental monitoring activities that were conducted in 2022 in the Canadian portion of the Koocanusa Reservoir and a summary of the associated results. This report is required under Permit 107517.

This report was prepared for Teck by Minnow Environmental Inc.

For More Information

If you have questions regarding this report, please:

- Phone toll-free to 1.855.806.6854
- Email **feedbackteckcoal@teck.com**

Future studies will be made available at **teck.com/elkvalley.**

Koocanusa Reservoir Monitoring Program Annual Data Summary Report - 2022

Prepared for:
Teck Coal Limited
Sparwood, British Columbia

Prepared by:
Minnow Environmental Inc.
Georgetown, Ontario

June 2023

Koocanusa Reservoir Monitoring Program
Annual Summary Report – 2022

Noel Soogrim, B.Sc.
Project Manager

Heidi Currier, Ph.D., R.P.Bio.
Senior Project Advisor

EXECUTIVE SUMMARY

The Koocanusa Reservoir Monitoring Program was conducted in 2022 to assess spatial differences in physico-chemical and biological conditions in Koocanusa Reservoir. In accordance with this monitoring program and conditions of British Colombia Ministry of Environment and Climate Change Strategy Permit 107517 (Section 9.8), this annual report provides an overview of the environmental monitoring activities conducted in Koocanusa Reservoir, together with a summary of the associated results. The principal findings from the Koocanusa Reservoir Monitoring Program in 2022 are summarized below.

Study Area

Koocanusa Reservoir is approximately 145 km in length and straddles the Canada-United States (British Columbia-Montana) border. The Elk River flows southwesterly into Koocanusa Reservoir approximately 20 kilometres (km; 12 miles) upstream from the border between Canada and the United States. The southern section of the reservoir downstream of the mouth of the Elk River represents the mine-influenced area and includes the Elk River (RG_ER) and Gold (RG_GC) study areas, and the downstream biological transect RG_T4. The northern section of the reservoir upstream of the Elk River represents the area not directly influenced by mine activity, and includes the Sand Creek study area (RG_SC) and the upstream biological transect RG_TN. Although the upstream study areas are upstream of mine-influence associated with the Elk River, they cannot be considered true reference areas due to potential groundwater influence from the Elk Valley via Kikomun Creek. These areas are respectively referred to as downstream and upstream of the Elk River.

The Koocanusa Reservoir is a managed reservoir that was created to provide flood protection and hydroelectric power. As such, water levels within Koocanusa Reservoir are generally lowest in late winter/early spring (i.e., February through April) and highest in summer/early fall. Management of water levels within Koocanusa Reservoir likely influences biological community structure, and thus must also be taken into consideration when evaluating potential biological effects.

Water Quality

Water levels in the reservoir in 2022 were low during the spring (April to end of June), resulting in the inability to conduct the April sampling event due to riverine conditions (i.e., strong flow, large floating woody debris, and dry sediment bars). The first sampling event was therefore conducted in May 2022.

Order constituents (except for selenium), as well as non-order constituents had monthly average concentrations below or equal to applicable BC water quality guidelines and applicable Site Performance Objectives (SPOs) throughout 2022 at all permitted water quality stations. Monthly average concentrations of selenium in water were above the guideline on at least one occasion at RG_GRASMERE, RG_USGOLD, and RG_BORDER, and exceeded the SPO in April at RG_DSELK.

Productivity assessment indicated annual median nitrogen:phosphorus (N:P) ratios were consistently ≤15 throughout the water column at all permitted water quality stations in 2022, and thus indicative of phosphorus limitation. Trophic status classification suggest Koocanusa was primarily oligotrophic to mesotrophic most of the year.

Monthly loadings of nitrate and selenium from the Elk River to the reservoir were highest from May to July, with the peak coinciding with freshet in June. In the Kootenay River, May to August showed the highest loadings for nitrate and selenium, with peak loadings occurring in June. Loadings of both nitrate and selenium to Koocanusa Reservoir were higher from the Elk River than from the Kootenay River on both a monthly and annual timescale.

Sediment

Sediment downstream and upstream of the Elk River was primarily composed of silt-sized material and lesser amounts of clay-sized material. Lower proportions of clay and higher proportion of silt and total organic carbon were present downstream of the Elk River compared to upstream. No differences in proportions of sand or gravel were recorded between areas. Arsenic, iron, manganese, nickel, and zinc concentrations in sediment were elevated above the lower Working Sediment Quality Guideline (WSQG) at one or more stations downstream of the Elk River. Of these metals, sediment concentrations of arsenic, iron, manganese, and nickel were also above the lower WSQG at the upstream area suggesting relatively elevated background concentrations of these four parameters. Several metals and polycyclic aromatic hydrocarbons (PAHs) occurred at significantly higher concentrations in sediment downstream of the Elk River compared to upstream in 2022, but their concentrations were not elevated above respective guidelines.

Zooplankton Community and Tissue Chemistry

In 2022, within the zooplankton community, the overall density was significantly higher, and the overall biomass was significantly lower downstream of the Elk River compared to upstream, and no difference in overall community richness was indicated between transects. The density and biomass of Cladocera and Rotifera was lower and higher, respectively, downstream of the Elk River compared to upstream. There was no spatial difference in Copepoda biomass and density.

Zooplankton tissue selenium concentrations were below the BC chronic interim guideline both downstream and upstream of the Elk River. Selenium concentrations in zooplankton tissue were higher downstream of the Elk River compared to upstream.

Benthic Invertebrate Tissue Chemistry

Benthic invertebrate tissue collected downstream and upstream of the Elk River in June and August 2022 contained selenium concentrations that were above the BC interim guideline but below the Elk Valley Water Quality Plan (EVWQP) Level 1 benchmark.

Fish Tissue Chemistry

Mean selenium concentration in muscle tissue of all fish sampled were below the applicable BC interim fish muscle tissue guideline and United Stated Environmental Protection Agency (US EPA) criterion at all areas in 2022, except for RSC in June at RG_ER, which was above the BC interim guideline but below the US EPA criterion. Peamouth chub (PCC) and redside shiner (RSC) captured downstream showed significantly higher muscle selenium concentrations than upstream in 2022, but concentrations were lower than guidelines (apart from RSC in June at RG_ER), and therefore the differences are not to be expected ecologically significant.

PCC were targeted in May 2022, as it provided the best opportunity to capture gravid females for the collection of ripe ovaries. RSC were targeted in June 2022 to collect females with higher gonadosomatic index (GSI) than in previous years. GSI targets for PCC (between 13 to 15%) and RSC (>14%) were not met for all individuals captured for the study. For PCC, individuals from each study area were captured in or near the target GSI, whereas for RSC, only individuals captured at RG_GC were in or near the target GSI. Mean selenium concentrations in the ovaries of PCC samples at all three study areas in May, and both downstream and upstream, were below the BC ovary/egg tissue guideline, US EPA criterion, and EVWQP Level 1 benchmark and had no significant spatial difference. Mean selenium concentration in ovaries of RSC collected at all three study locations in June were greater than the BC guideline and US EPA criterion downstream and upstream but were below the species-specific threshold for no observable effects. Furthermore, selenium concentrations in RSC ovary tissue collected downstream of the Elk River were lower compared to upstream. Historical ovary selenium concentrations in PCC and RSC were generally not collected within the target GSI range creating uncertainty in temporal comparisons. This issue and associated uncertainty will be explored during the three-year temporal analysis.

Conclusion

This annual summary report provides an overview of environmental monitoring activities conducted in Koocanusa Reservoir, along with the associated results from 2022. The next annual summary report will cover data from 2023 and is due to ENV in June 2024. Data collected from 2020 to 2022 will be used to address key questions related to changes over time and will be presented in the three-year interpretive report due to ENV in December 2023. Environmental Monitoring Committee (EMC) Advice and Input will be addressed in the three-year interpretive report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AMP – Adaptive Management Plan

AB – Alberta

ALS – ALS Environmental

ANOVA – Analysis of Variance

ANCOVA – Analysis of Covariance

BC – British Columbia

BCMOE – British Columbia Ministry of Environment

BCWQG – British Columbia Water Quality Guidelines

BT – Bull Trout

CALA – Canadian Association for Laboratory Accreditation

CES – Critical Effect Size

CMm – Coal Mountain Mine

CPUE – Catch-Per-Unit-Effort

CRM – Certified Reference Material

CSU – Largescale Sucker

DELT - Deformities, Erosions, Lesions, and Tumors

DO – Dissolved Oxygen

DQO – Data Quality Objectives

DQR – Data Quality Review

dw – Dry Weight

EBT – Eastern Brook Trout

EEM – Environmental Effects Monitoring

EMC – Environmental Monitoring Committee

ENV – British Columbia Ministry of Environment and Climate Change Strategy (formerly BCMOE)

EVWQP – Elk Valley Water Quality Plan

EWT – Early Warning Trigger

Golder – Golder Associates Ltd.

GPS – Global Positioning System

GSI – Gonadosomatic Index

HSD – Honestly Significant Difference

IS – Independent Scientist

K-M – Kaplan-Meier

KNC – Ktunaxa Nation Council

KO - Kokanee

KS – Kolmogorov-Smirnov

LA-ICPMS - Laser Ablation Inductively Coupled Plasma Mass Spectrometry

LCS – Laboratory Control Samples

LEL – Lowest Effect Level

LPL – Lowest Practical Level

LRL – Laboratory Reporting Limit

LSU – Longnose Sucker

MAD – Median Absolute Deviation

MB – Manitoba

MCT – Measure of Central Tendency

Minnow – Minnow Environmental Inc.

MOD – Magnitude of Difference

MQ – Management Question

MW – Mountain Whitefish

MS – Matrix Spikes

NELAP – National Environmental Laboratory Accreditation Program

NMDS – Non-metric Multi-dimensional Scaling

N:P – Nitrogen to Phosphorous Ratio

NSC – Northern Pikeminnow

ORP – Oxidation-reduction Potential

PAH – Polycyclic Aromatic Hydrocarbon

PCC – Peamouth Chub

PEL – Probable Effect Level

QA/QC – Quality Assurance / Quality Control

QC – Quality Control

RAEMP – Regional Aquatic Effects Monitoring Program

RB – Rainbow Trout

RM – Reference Materials

RSC – Redside Shiner

SD – Standard Deviation

SEL – Severe Effect Level

SPO – Site Performance Objective

TDS – Total Dissolved Solids

Teck – Teck Coal Limited

TEL – Threshold Effect Level

TOC – Total Organic Carbon

Trich – TrichAnalytics Inc.

TSI – Trophic Status Index

TSS – Total Suspended Solids

US – United States

US ACE – United States Army Corps of Engineers

US EPA – United States Environmental Protection Agency

USGS – United Stated Geological Survey

UTM – Universal Transverse Mercator

WCT – Westslope Cutthroat Trout

WSC – Water Survey of Canada

WSQG – Working Sediment Quality Guidelines

YP – Yellow Perch

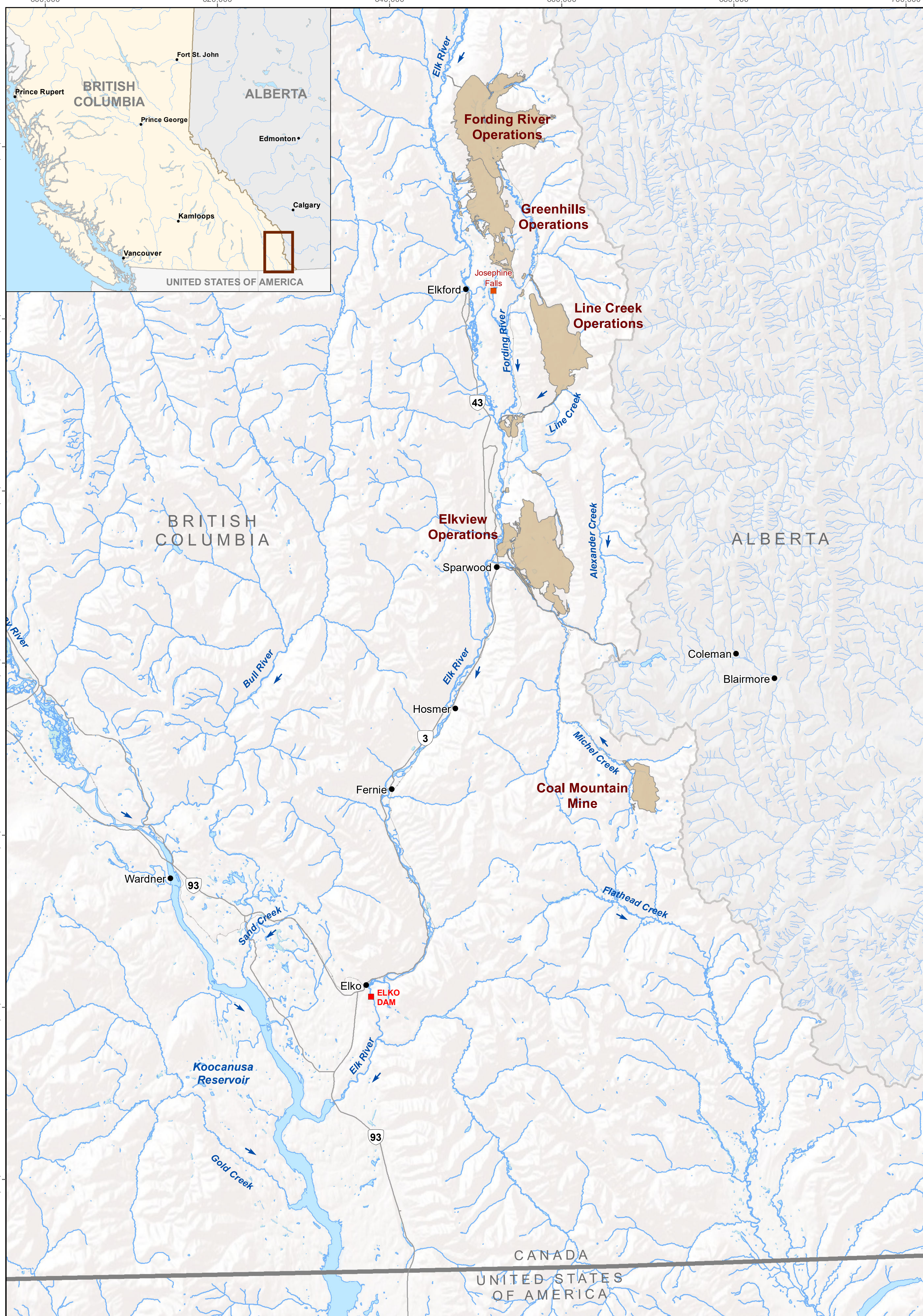
1 INTRODUCTION

1.1 Background

Teck Coal Limited (Teck) owns and operates four steelmaking coal mines within the Elk River watershed of southeastern British Columbia (BC; Figure 1.1). A fifth mine, Coal Mountain Mine (CMm), is also owned by Teck and located in the Elk River watershed; however, it is no longer in operation and has been moved into the care and maintenance designation. Koocanusa Reservoir was created by the construction of Libby Dam in Montana and is operated by the United States Army Corps of Engineers (US ACE) to provide flood protection, hydroelectric power, and recreational benefits. At full pool, the reservoir is 155 km (96 miles) in length, of which, approximately 68 km (42 miles) occurs within Canada and the remainder within the United States (Figure 1.1).

From its headwaters near Elk Lakes, the Elk River flows southwesterly into Koocanusa Reservoir approximately 20 kilometres (km; 12 miles) upstream from the border between Canada and the United States (US; Figure 1.1). The southern section of the reservoir downstream of the mouth of the Elk River represents the mine-influenced area and includes the Elk River (RG_ER) and Gold Creek (RG_GC) study areas, and the downstream biological transect RG_T4 (Figure 1.2). The northern section of the reservoir upstream of the Elk River represents the area not directly influenced by mine activity and includes the Sand Creek study area (RG_SC) and the upstream biological transect RG_TN (Figure 1.2). Although the upstream study areas are upstream of mine-influence associated with the Elk River, they cannot be considered true reference areas due to potential groundwater influence from the Elk Valley via Kikomun Creek. These areas are respectively referred to as downstream and upstream of the Elk River.

In addition to the Elk River, the Kootenay (Kootenai) and Bull rivers supply the majority of inflow to the reservoir (26%, 62%, and 11%, respectively, of mean annual inflow; Woods 1982; Hamilton et al. 1990). Water levels within Koocanusa Reservoir are generally lowest in late winter/early spring (March through May) and highest in summer/early fall (August and September). Normal annual pool fluctuation of the reservoir is about 25 metres (m). At maximum drawdown, a reduction in reservoir total length up to 53%, volume up to 85%, mean depth up to 51%, and total surface area up to 69% generally occurs, with the largest relative changes occurring in the Canadian portion of the reservoir (Hamilton et al. 1990). This results in riverine conditions during low pool for the section of the reservoir that extends below Sand Creek. Management of water levels within the reservoir likely influences biological community structure, and thus needs to be considered in the evaluation of potential biological effects.



LEGEND

Teck Coal Mine Operations

Location of Teck Coal Mine Operations Relative to Koocanusa Reservoir

0 5 10 20
km

N W E S

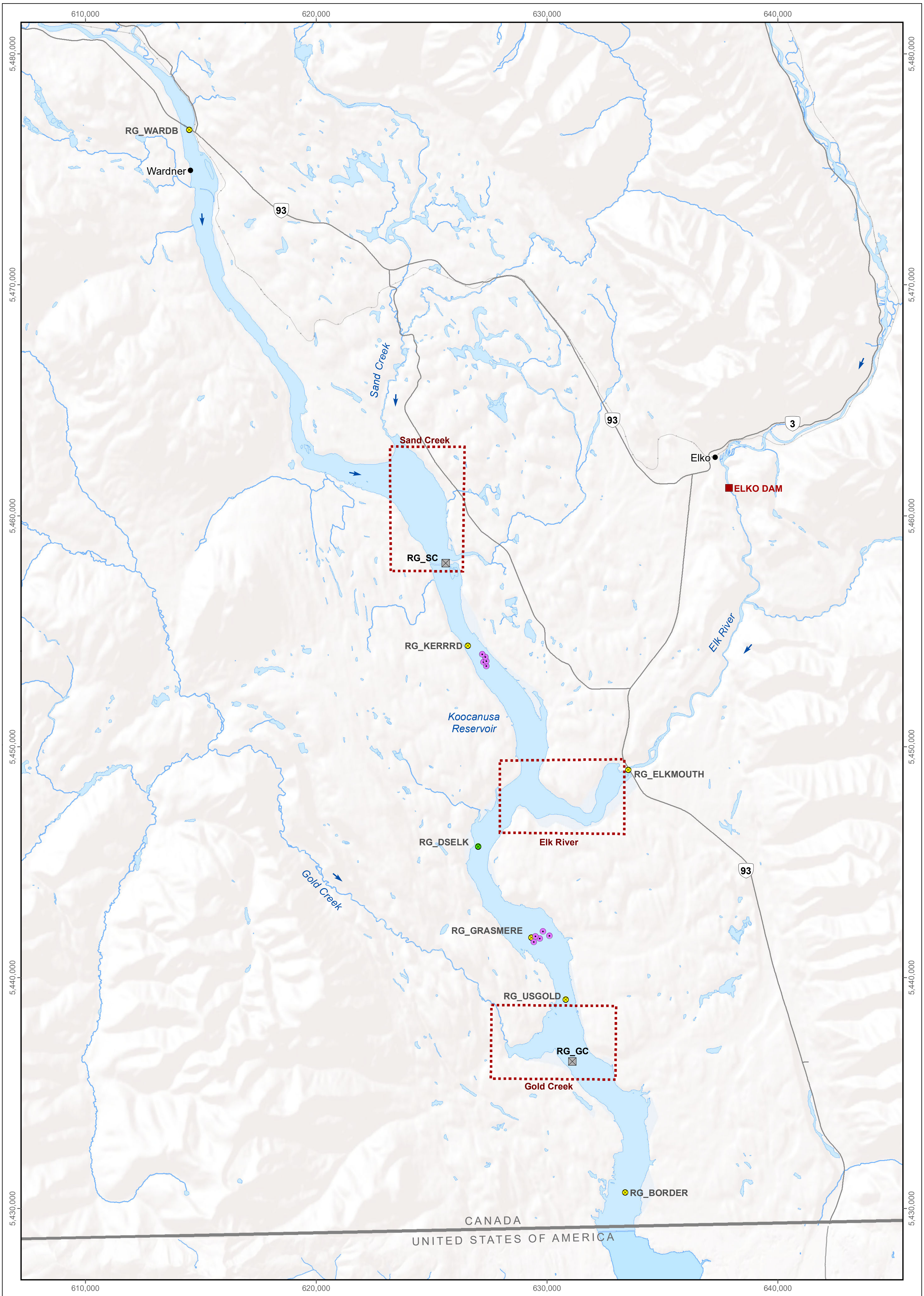
Projection: North American Datum 1983 UTM Zone 11
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Date: January 2023
Project 227202.0031

minnow environmental inc.

Figure 1.1

Document Path: C:\Users\CApol\Trinity Consultants, Inc\Teck - 227202.0031 - Koocanusa 2022\D - GIS\Annual Report\22-31 Figure 1.1 Teck Coal Limited Operation.mxd



LEGEND

- Permitted Water Quality Station
- Order Water Quality Station
- Profundal Sediment, Zooplankton (Community and Tissue Chemistry), and Benthic Invertebrate (Community and Tissue Chemistry) Sampling Location
- Water Chemistry and In Situ Monitoring Station
- Approximate Fish (fish tissue and health) Sampling Area

Sampling Locations in Koocanusa Reservoir, 2022

0 2.5 5 10 km

N W E S

Projection: North American Datum 1983 UTM Zone 11
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Date: January 2023
Project 227202.0031

minnow environmental inc.

Figure 1.2

Document Path: C:\Users\CApol\Trinity Consultants, Inc\Teck - 227202.0031 - Koocanusa 2022\D - GIS\Annual Report\22-31 Figure 2.1 Sampling Locations in Koocanusa Reservoir, 2022.mxd

In 2014, the Elk Valley Water Quality Plan (EVWQP; Teck 2014) was developed and served as the basis for the issuance of Permit 107517 (the Permit) from the British Columbia Ministry of Environment and Climate Change Strategy (ENV). The Permit specifies water quality limits and site performance objectives (SPOs) for monitoring stations located downstream from the mines and the requirement to implement a Regional Aquatic Effects Monitoring Program (RAEMP). The overarching objectives of the RAEMP are to monitor, assess, and interpret indicators of aquatic ecosystem condition related to mine operations, and to inform adaptive management relative to expectations established in approved plans for mine development. The Koocanusa Reservoir Monitoring Program objectives are consistent with the RAEMP and are used to inform adaptive management relative to expectations established in approved plans for mine development and in the Permit. In accordance with the Permit and the RAEMP, annual monitoring programs were designed, accepted by ENV, and implemented for Koocanusa Reservoir beginning in 2013, which was followed by the development of a comprehensive three-year monitoring program referred to as the Koocanusa Reservoir Monitoring Program. To date, the Koocanusa Reservoir Monitoring Program has been implemented over two 'cycles,' from 2014 to 2016 and from 2018 to 2020 (Minnow 2014, 2015a, 2016, 2018, 2019, 2020). The third cycle of the three-year monitoring program (2021 to 2023) was initiated in April 2021 (Minnow 2021). This program is used to assess whether physio-chemical and biological conditions in Koocanusa Reservoir differ within the Canadian portion of the reservoir downstream of the Elk River confluence compared to upstream, and whether these conditions are changing over time. Questions specific to the evaluation of potential mine-related effects in the Canadian portion of the reservoir that served as the basis for the development of the monitoring program include:

- Are mine-related water quality constituents different downstream of the Elk River compared to upstream, influenced by differences in reservoir levels, are they changing over time, are the changes consistent with expectations, and are levels below respective guidelines and SPOs?
- Is productivity (based on nutrient concentration in the water) different downstream of the Elk River compared to upstream, influenced by differences in reservoir levels (i.e., low-, -high-pool, and transitional period), and is productivity changing over time?
- Are concentrations of mine-related constituents in sediment that benthic invertebrates are exposed to different downstream of the Elk River compared to upstream and are concentrations changing over time?
- Do zooplankton and/or benthic invertebrate community structure differ downstream of the Elk River compared to upstream, and are the differences changing over time?

- Are selenium concentrations in zooplankton different downstream of the Elk River compared to upstream, and are the differences changing over time?
- Are selenium concentrations in benthic invertebrates greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?
- Is fish health different downstream of the Elk River compared to upstream, and are differences in fish health endpoints changing over time?
- Are selenium concentrations in fish tissue greater than guidelines or effect thresholds, do they differ downstream of the Elk River compared to upstream, and are the differences changing over time?

The Koocanusa Reservoir Monitoring Program was designed with technical advice and input from the Environmental Monitoring Committee (EMC)[1], whose role includes review of submissions and provision of technical advice and input to Teck and the ENV Director as a condition under the Permit. Permit 107517 (updated May 18, 2023) Section 9.8 outlines:

> *"The Permittee must prepare on an annual basis a report summarizing activities and monitoring results. The report must be submitted to the Koocanusa Reservoir Monitoring and Research Working Group (Koocanusa Reservoir Working Group) and the EMC by June 30 of each year."*

Accordingly, this report provides an overview of environmental monitoring activities conducted in the Canadian portion of Koocanusa Reservoir, along with the associated results, from 2022. In this annual data report, results from 2022 are presented and spatially compared between areas located downstream and upstream of the Elk River confluence. Questions related to assessment of changes occurring over time are addressed separately in the three-year interpretive reports (e.g., Minnow 2016, 2020). The next three-year interpretive report will contain data from 2020 to 2022.

1.2 Linkages to Teck's Adaptive Management Plan

As required in Section 11 of the Permit, Teck has developed an Adaptive Management Plan (AMP) to support implementation of the EVWQP in achieving water quality and calcite targets, protect human health and the environment, and facilitate continuous improvement of water quality in the Elk Valley (Teck 2018a). Following an adaptive management framework, the AMP identifies six Management Questions (MQ) that are re-evaluated with each AMP update.

[1] The EMC consists of representatives from Teck, ENV, the Ministry of Energy and Mines, the Ktunaxa Nation Council (KNC), Interior Health Authority, and an Independent Scientist (IS).

The AMP also identifies key uncertainties that need to be reduced to fill gaps in current understanding and support achievement of the EVWQP objectives.

The Koocanusa Reservoir Monitoring Program (under the umbrella of the RAEMP) is designed to evaluate AMP Management Question #5 (MQ5; i.e., "Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?") through the evaluation of the study questions. Biological monitoring data are evaluated in an integrated manner with other types of monitoring data (e.g., water quality and sediment quality) to address questions specific to the Koocanusa Reservoir Monitoring Program and MQ5. During development of the AMP, several uncertainties related to MQ5 were identified that were summarized as Key Uncertainty 5.1 (i.e., "How will monitoring data be used to identify potentially important mine-related effects on the aquatic ecosystem?") and its corresponding Underlying Uncertainties (Teck 2018a). With the understanding that the Koocanusa Reservoir is a different environment and requires different monitoring endpoints than the RAEMP, the Koocanusa Reservoir Monitoring Program was designed to answer different key questions than outlined under the RAEMP. These seven key questions (see Section 1.1) guide data analyses to address specific aspects of MQ5. The overall role of the Koocanusa Reservoir Monitoring Program in the AMP process is through the identification of unexpected conditions (chemical and biological) based on projections and/or expectations, and whether the unexpected conditions are mine-related. In a scenario where the cause of an unexpected condition cannot be determined through the data evaluation process, an Adaptive Management Response framework is initiated to determine if management actions are required.

Two supporting studies were conducted in Koocanusa Reservoir in 2022 to better address study questions, MQ2and MQ5 key uncertainties (Teck 2018a) regarding fish tissue selenium concentrations, as well as potential impacts of groundwater selenium inputs on biological data collected upstream of the Elk River. The first study, which was initiated in 2019 (and has subsequently been conducted in 2021 and 2022), comprised of targeted fish tissue sampling as part of the Northern Pikeminnow Selenium Toxicity study, which was completed to further understand the relationship between selenium concentrations and ovary development in resident Koocanusa Reservoir fish[2] (Brix et al. 2020, Minnow 2022a). Tissue chemistry results from this program are combined with fish tissue data collected on the Koocanusa Monitoring Program to provide a fulsome dataset and understanding of fish health in Koocanusa Reservoir.

The second supporting study was initiated to investigate benthic invertebrate tissue data measured in the biological station upstream of the Elk River inflow, and to evaluate the

[2] At the time of this report, conclusions regarding maternally transferred selenium in northern pikeminnow have not been finalized and therefore are not discussed further in this report.

appropriateness of the spatial extent upstream and the value in downstream versus upstream comparisons (Minnow 2023).

2 METHODS

2.1 General Overview

The Koocanusa Reservoir Monitoring Program was designed to evaluate changes in water quality, sediment quality, and/or biota in the reservoir downstream relative to upstream of the Elk River confluence, and whether any identified changes can be attributed to influences from mining activities within the Elk River watershed for the Canadian portion of the reservoir.

Objectives of this annual monitoring report are to provide an overview of environmental monitoring activities conducted in 2022 in the Canadian portion of Koocanusa Reservoir (Table 2.1; Figure 1.2; Minnow 2021) and where applicable, supplement this information with publicly available data collected from the Montana portion of the reservoir in 2022. Data analyses included statistical evaluations to identify potential differences in key endpoints between areas located downstream and upstream of the Elk River confluence, and brief qualitative comparisons to results from the previous three years of monitoring (Minnow 2021)[3]. Field sampling was conducted during two spring sampling events (May and June) and one late summer (August) sampling event (Table 2.2). The initial spring sampling event, which was planned for April 2022, could not be conducted due to riverine conditions (i.e., strong flows, large floating woody debris, exposed sediment) and low water levels (Figure 2.1). The first spring sampling event was therefore conducted from May 24th to 27th, which included water quality and targeted fish tissue sampling of peamouth chub (PCC) and sport fish. Water levels were still too low in May to collect benthic invertebrate tissue samples that were scheduled for April, therefore, the second spring sampling event conducted from June 20th to 23rd, included water quality, benthic invertebrate tissue, and targeted fish tissue sampling of redside shiner (RSC), and sport fish.[4] During the June sampling program, water levels in the reservoir were the lowest observed since 2014 (Figure 2.1). The late summer sampling event conducted from August 23rd to 27th included water quality, sediment quality, zooplankton community and tissue, and benthic invertebrate tissue. Sport fish tissue sampling could not be conducted in August as water temperatures were too warm and exceeded the provincial fish sampling permit limit.

[3] A comprehensive temporal analysis of data collected from 2014 to 2022 will be provided in the next three-year report.

[4] Zooplankton tissue sampling was attempted, however, due to high turbidity, the samples were too fouled with sediment. This would have confounded the analysis of zooplankton tissue.

Table 2.1: Summary of Receptors, Assessment Endpoints, Measurement Endpoints, and Evaluation Criteria, Koocanusa Reservoir Monitoring Program, 2021 to 2023

Receptor Group	Focal Species (if Relevant)	Assessment Endpoint	Measurement Endpoint	Evaluation Criteria	Indicator Type
All	Not specific	Not specific	Sediment chemistry	Comparison of results relative to guidelines, between upstream and downstream of the Elk River, and to past observations	Indirect
			Water chemistry	Comparison of concentrations of mine-related constituents relative to SPOs and guidelines, nutrients relative to trophic classifications, between upstream and downstream of the Elk River, and to past observations	Indirect
Zooplankton	Not applicable	Abundance and assemblage	Density	Comparison of results between upstream and downstream of the Elk River and to past observations	Direct
			Richness		
			Biomass		
			Major community group		
		Chemistry	Tissue selenium concentrations	Comparison of results relative to guidelines and effect benchmarks, between upstream and downstream of the Elk River, and to past observations	Indirect
Benthic invertebrates	Not applicable	Abundance and assemblage	Density	Comparison of results between upstream and downstream of the Elk River and to past observations	Direct
			Richness		
			Major community group		
		Chemistry	Tissue selenium concentrations	Comparison of results relative to guidelines and effect benchmarks, between upstream and downstream of the Elk River, and to past observations	Indirect
Fish	Peamouth chub and Redside shiner	Population health assessment	Survival (age)	Comparison of results between upstream and downstream of the Elk River and to past observations	Direct
			Growth (body weight against age)		
			Reproduction (gonad weight against body weight)		
			Energy storage (condition - body weight against length and liver weight against body weight)		
		Chemistry	Tissue selenium concentrations	Comparison to guidelines and effect benchmarks, between upstream and downstream of the Elk River, and to past observations	Indirect
	Sport fish	Fish health, and human health risk from fish consumption	Tissue chemistry	Comparisons to guidelines and effect benchmarks, between upstream and downstream of the Elk River, to past observations, and to human health effect benchmarks (evaluated outside of the monitoring program)	Indirect

Table 2.2: Overview of the 2022 to 2023 Koocanusa Reservoir Monitoring Program Study Design

Study Area	Biological Area Code	Biological Area Description	UTMs – Easting	UTMs – Northing	2022 and 2023 – April – Water – Chemistry	April – Water – *In Situ* Water Quality	April – Benthic Invertebrates – Tissue Chemistry	April – Fish – Sport Fish Tissue Chemistry [a]	May – Water – Chemistry	May – Water – *In Situ* Water Quality	May – Fish [b] – Tissue Chemistry – Peamouth Chub	May – Fish [b] – Tissue Chemistry – Sport Fish [a]	June – Water – Chemistry	June – Water – *In Situ* Water Quality	June – Plankton – Zooplankton Tissue Chemistry	June – Fish [b] – Tissue Chemistry – Redside Shiner	June – Fish [b] – Tissue Chemistry – Sport Fish [a]	August – Water – Chemistry	August – Water – *In Situ* Water Quality	August – Sediment – Quality (Chemistry and Composition)	August – Plankton – Zooplankton Tissue Chemistry	August – Plankton – Zooplankton Community	August – Benthic Invertebrates – Tissue Chemistry	August – Fish – Sport Fish Tissue Chemistry [a]
Upstream of the Elk River	RG_SC	near the mouth of Sand Creek	625624	5457296	1	1	-	up to 8	1	1	10	up to 8	1	1	-	10	up to 8	1	1	-	-	-	-	up to 8
	RG_TN	near the RG_KERRRD permitted water quality station	627112	5453380	R	5	1	-	R	1	-	-	R	5	5	-	-	R	5	5	5	5	1	-
Elk River	RG_ER	near the mouth of Elk River	627959	5447572	R	-	-	up to 8	R	1	10	up to 8	R	1	-	10	up to 8	R	1	-	-	-	-	up to 8
Downstream of the Elk River	RG_T4	near the RG_GRASMERE permitted water quality station	629235	5441654	R	5	1	-	R	1	-	-	R	5	5	-	-	R	5	5	5	5	1	-
	RG_GC	near the mouth of Gold Creek	630926	5436344	1	1	-	up to 8	1	1	10	up to 8	1	1	-	10	up to 8	1	1	-	-	-	-	up to 8

Notes: "'-" indicates that no sampling is occurring for a specific monitoring component during that time period. "number" indicates number of samples collected. "R" indicates routine sampling by Teck. Tissue samples for northern pikeminnow collected during the Northern Pikeminnow Toxicity Study will be included in analysis. Water quality data from Teck routine stations will be collected under the Routine Water Quality Program.

[a] Up to 8 individuals of each sport fish (bull trout, Kokanee, mountain whitefish, rainbow trout, westslope cutthroat trout, yellow perch) species were captured over the course of the sampling year.

[b] Timing for peamouth chub dependent on findings from 2021, and could occur in April, May, or June in 2022 and 2023.

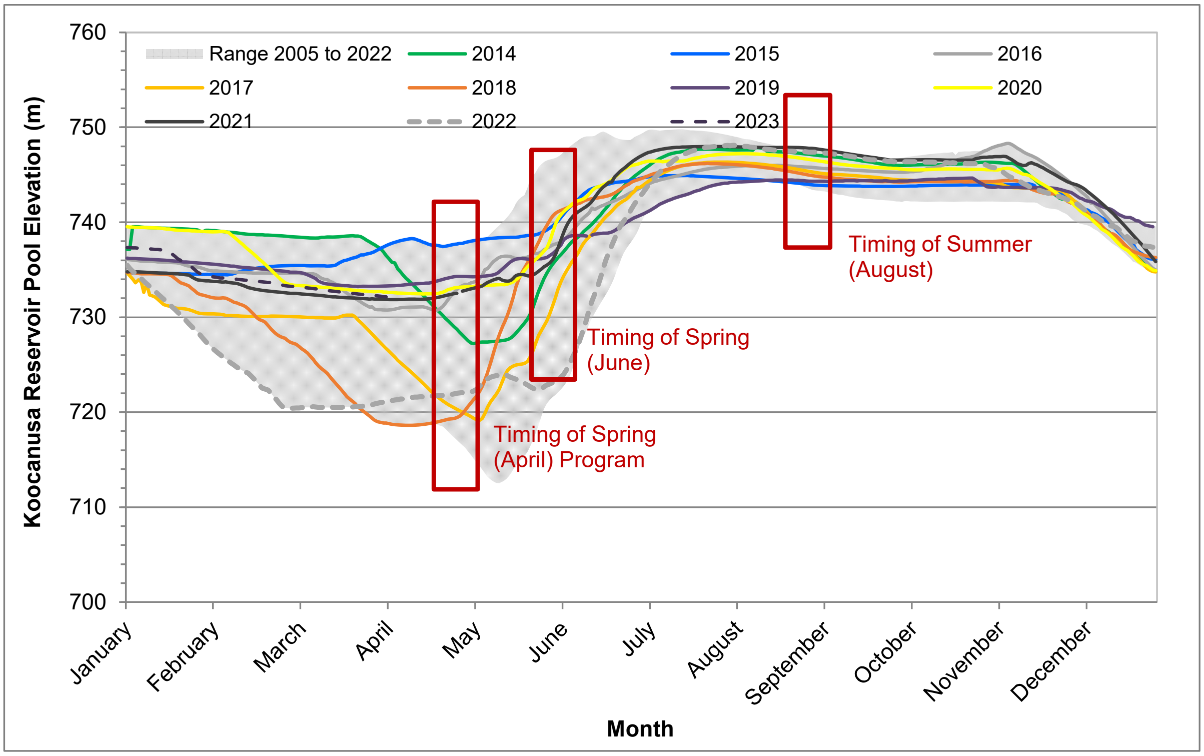


Figure 2.1: Koocanusa Reservoir Water Surface (Pool) Elevation, Koocanusa Reservoir Monitoring Program, 2014 to 2023

Notes: Shaded area indicates the historical daily range of water levels from 2005 to 2022. Data taken from United States Army Corps of Engineers (USACE 2020).

Sampling locations used in 2022 were consistent with those outlined under the accepted 2021 to 2023 study design, and the same as those used in previous monitoring years (2014 to 2016, and 2018 to 2020; Minnow 2021). Sampling of profundal sediment quality, zooplankton community and tissue, and benthic invertebrate tissue was completed at one transect downstream of the Elk River (RG_T4) and one transect upstream of the Elk River (RG_TN), with each transect including five sampling stations (Figure 2.1; Minnow 2021). Routine water quality monitoring data collected by Teck at permitted downstream water quality monitoring stations (RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER) and an upstream water quality monitoring station (RG_KERRRD; Figure 2.1; Teck 2019) in 2022 are also summarized in this annual report. In addition, water quality data available from stations in Montana (International Boundary, Tenmile, and Forebay) collected in 2022 are summarized.

2.2 Water Quality

Water quality was assessed through the collection of water chemistry samples and *in situ* field measures. Water chemistry data collected by Teck for their permitted surface water quality monitoring program (i.e., stations RG_KERRRD, RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER; see Figure 1.2) are summarized herein. RG_DSELK (EMS E300230) is an order station for which SPOs for selenium, nitrate, sulphate, and cadmium have been established. Two additional water quality samples (RG_SC and RG_GC) were collected separately for the Koocanusa Reservoir Monitoring Program concurrent with biological sampling events conducted in May, June, and August. Water chemistry data collected during Teck's routine water quality monitoring program were also used to evaluate productivity. In addition, as per the ENV (2018) study design approval letter, monthly nitrate and selenium loadings to Koocanusa Reservoir were calculated and are summarized in this report. Routine water quality monitoring data collected by the United States Geological Survey (USGS) from the Montana portion of the reservoir (stations: International Boundary, Tenmile, and Forebay) were also included in evaluations for this 2022 annual report. Consistent with monitoring completed previously within the Canadian portion of the reservoir, *in situ* water quality (field parameters) data were collected at each biological monitoring study area/station upstream and downstream of the Elk River confluence in May, June, and August 2022 (Table 2.2). See Appendix G for a detailed description of water quality collection, laboratory analysis, and data analysis.

2.3 Sediment Quality

Sediment quality was assessed in 2022 to characterize substrate chemistry and support interpretation of benthic invertebrate data. Sediment was sampled in August at each transect area downstream (RG_T4) and upstream (RG_TN) of the Elk River (Figure 1.2; Table 2.2).

See Appendix G for a detailed description of sediment sample collection, laboratory analysis and data analysis.

2.4 Zooplankton

Zooplankton community[5] and tissue samples were collected in August 2022 to assess differences in community endpoints and selenium concentrations in tissue, respectively, between study locations downstream (RG_T4) and upstream (RG_TN) of the Elk River (ENV 2018; Figure 1.2, Table 2.2). Zooplankton tissue sampling was attempted in June 2022, however, due to high turbidity, the samples contained too much particulate matter and suspended sediment and could not be analyzed. See Appendix G for detailed description of zooplankton sample collection, laboratory analysis, and data analysis.

2.5 Benthic Invertebrates

Benthic invertebrate tissue samples were collected in June and August 2022 from profundal areas downstream (RG_T4) and upstream (RG_TN) of the Elk River (Table 2.2; Figure 1.2). April tissue samples could not be collected due to low reservoir levels and exposure of the upstream transect (RG_TN). Samples were collected in June instead when conditions allowed. See Appendix G for a detailed description of benthic invertebrate sample collection, laboratory analysis, and data analysis.

2.6 Fish

Collection of fish is an integral component of the Koocanusa Reservoir Monitoring Program (Table 2.2). Peamouth Chub (PCC) and Redside Shiner (RSC), represent key food sources for piscivorous fish (Lotic 2017), were collected near the mouths of Sand Creek, Elk River, and Gold Creek (RG_SC, RG_ER, and RG_GC respectively; Figure 1.2, Table 2.2) using lethal methods. PCC were collected in May, and RSC were collected in June for fish tissue assessment. The timing of these tissue sampling events was changed from previous years to target species-specific spawning windows and gather a greater number of meaningful tissue samples from ripe females. Peamouth chub were targeted within a timeframe where they were suspected to be ripe (i.e., had an increased probability of higher maturity). Eggs were not flowing (i.e., expressing and/or easily releasing upon slight pressure to the abdomen) upon capture in 2022, or any previous years. Sport fish (e.g., bull trout [BT; *Salvelinus confluentus*]) reflect the highest trophic level in the reservoir and are an important resource for human consumption (Lotic 2017, Ramboll Environ 2016), and for the latter reason, sport fish muscle tissue samples

[5] Two zooplankton community samples (RG_TN-3 and RG_TN-4) collected in August 2022 were destroyed during transit to the lab. No analyses were completed, and they are not included in the dataset for 2022.

were collected using non-lethal methods (i.e., muscle plug) from May to June. Additionally, samples collected during the northern pikeminnow fishing programs in June and July 2022 were incorporated into the data set (Minnow 2022b). No sampling was completed in April 2022 due to low reservoir levels (i.e., late spring freshet caused high flow, turbid water, low pool elevation, and abundant large and small floating woody debris), nor in August due to warm water temperatures that exceeded scientific collection permit limits. See Appendix G for a detailed description of fish tissue sample collection, laboratory analysis, and data analysis.

3 WATER QUALITY AND PRODUCTIVITY

3.1 Water Quality

3.1.1 Water Chemistry

In 2022, among the order constituents (i.e., total selenium, nitrate, sulphate, and dissolved cadmium), monthly average concentrations of nitrate, sulphate, and dissolved cadmium at RG_KERRRD, RG_GRASMERE, RG_USGOLD, and RG_BORDER were equal to or below respective BC water quality guidelines (Appendix Figures B.4, B.11, and B.14). Selenium was above the BC guideline on at least one occasion at RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER (Appendix Figure B.13). At water quality stations INTERNATIONAL_BOUNDARY, TENMILE_CREEK, and FOREBAY in the US portion of the reservoir, monthly average concentrations of order constituents' nitrate and sulphate were below the BC water quality guidelines in 2022 (Appendix Figures B.4, B.11, and B.14). No data was collected in 2022 for dissolved cadmium at the US water quality stations. At the order station RG_DSELK, monthly average concentrations of nitrate, sulphate, and dissolved cadmium did not exceed the SPOs. Similarly, and with one exception (April), monthly average selenium concentrations were below the SPO (Table 3.1)[6].

Non-order constituents (i.e., total antimony, total barium, total boron, dissolved cobalt, total lithium, total manganese, total molybdenum, total or dissolved nickel, nitrite, total dissolved solids (TDS), total uranium, and total zinc) occurred at concentrations below applicable BC water quality guidelines throughout 2022 at all the permitted water quality stations in the reservoir (Appendix Table B.1; Appendix Figures B.1 to B.17). Concentrations of order and non-order constituents in water samples taken during biological monitoring were also below applicable BC water quality guidelines. The one exception was zinc, which was above the long-term BCWQG at RG_SC in June (Appendix Table B.2).

Comparison of monthly mean concentrations of order and non-order constituents between downstream and upstream of the Elk River, indicated that total barium, lithium, molybdenum, nitrate, nitrite, selenium, and TDS were significantly higher downstream of the Elk River compared to upstream at RG_KERRRD (Table 3.2). Conversely, significantly lower monthly mean concentrations of total boron and zinc were indicated downstream of the Elk River (Table 3.2). No differences in monthly mean concentrations of total antimony, dissolved cadmium, cobalt, total manganese, total and dissolved nickel, sulphate, and uranium were found between the

[6] In this table, the number of decimal places displayed for monthly mean concentrations were rounded to match the number of significant digits specified for the applicable provincial guideline or SPO.

Table 3.1: Monthly Mean Water Quality at the Order Station (RG_DSELK) Screened Against SPOs, Koocanusa Reservoir Monitoring Program, 2022

Date	Total Selenium (µg/L)	Sulphate (mg/L)	Nitrate (mg/L as N)	Dissolved Cadmium (ug/L)
SPO	**2**	**308**	**3**	**0.19**
January	1	42	0.3	0.0051
February	2	46	0.5	0.0050
March	2	42	0.4	0.0050
April	3	48	0.6	0.0057
May	2	28	0.5	0.0050
June	1	13	0.3	0.0052
July	1	15	0.2	0.0050
August	1	19	0.2	0.0050
September	1	22	0.2	0.0050
October	1	29	0.2	0.0052
November	1	32	0.2	0.0052
December	2	39	0.3	0.0051

Highlighted values above the SPO.
Note: SPO = Site Performance Objectives.

Table 3.2: **Comparison of Aqueous Concentrations of Order and Non-Order Parameters between Water Quality Stations Downstream and Upstream (RG_KERRRD) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022**

Parameter[a]	Station	ANOVA[b]	Q1. Is there a difference in concentrations downstream compared to RG_KERRRD?[c] Magnitude of Difference (%)
Total Antimony (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER	0.898	ns
Total Barium (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER	0.987	16
Total Boron (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD	0.965	-12
Total Lithium (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER	0.791	14
Total Manganese (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER FOREBAY	0.890	ns
Total Molybdenum (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER	0.840	3.3
Total Nickel (mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER	0.837	ns
Nitrate (NO_3 mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER FOREBAY INTERNATIONAL_BOUNDARY	0.948	153
Nitrite (NO_2 mg/L)	RG_DSELK RG_GRASMERE RG_USGOLD RG_BORDER FOREBAY INTERNATIONAL_BOUNDARY	0.486	19

Station difference P-value < 0.05.
Downstream value higher than upstream.
Downstream value lower than upstream.

Notes: "ns" indicates non-significant difference (p-value > 0.05) between upstream and downstream. Insufficient sample size (<3) for values above detection limits to complete analyses for total antimony and dissolved cobalt.

[a] Dissolved cadmium, dissolved cobalt, and dissolved nickel were not included in this table as comparisons could not be made due to values < LRL.

[b] ANOVA Conducted on the difference in $\log_{10}$ concentrations Upstream (RG_KERRRD) and Downstream to test for differences among stations (RG_DSELK, RG_GRASMERE, RG_USGOLD, RG_BORDER) of the Elk River ($\log_{10}$[DS]-$\log_{10}$[US]. If significant, each station was compared to Upstream separately.

[c] Post-hoc contrasts testing the difference in $\log_{10}$(DS)-$\log_{10}$(US) against zero with the magnitude of difference (MOD) calculated as (DS-US)/US*100% and application of geometric means for concentrations. Post-hoc tests were adjusted from the number of comparisons using Tukey's Honestly Significant Difference (HSD) tests.

Table 3.2: Comparison of Aqueous Concentrations of Order and Non-Order Parameters between Water Quality Stations Downstream and Upstream (RG_KERRRD) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Station	ANOVA[a]	Q1. Is there a difference in concentrations downstream compared to RG_KERRRD?[b] Magnitude of Difference (%)
Total Selenium (mg/L)	RG_DSELK	0.859	290
	RG_GRASMERE		
	RG_USGOLD		
	RG_BORDER		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		
Sulphate (mg/L)	RG_DSELK	0.081	ns
	RG_GRASMERE		
	RG_USGOLD		
	RG_BORDER		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		
Uranium (mg/L)	RG_DSELK	0.188	ns
	RG_GRASMERE		
	RG_USGOLD		
	RG_BORDER		
Zinc (mg/L)	RG_DSELK	0.379	-31.1
	RG_GRASMERE		
	RG_USGOLD		
	RG_BORDER		
Total Dissolved Solids (mg/L)	RG_DSELK	0.918	5.91
	RG_GRASMERE		
	RG_USGOLD		
	RG_BORDER		
Nitrogen:Phosphorous	RG_DSELK	0.497	163
	RG_GRASMERE		
	RG_USGOLD		
	RG_GRASMERE		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		

Station difference P-value < 0.05.

Downstream value higher than upstream.

Downstream value lower than upstream.

Notes: "ns" indicates non-significant difference (p-value > 0.05) between upstream and downstream. Insufficient sample size (<3) for values above detection limits to complete analyses for total antimony and dissolved cobalt.

[a] Dissolved cadmium, dissolved cobalt, and dissolved nickel were not included in this table as comparisons could not be made due to values < LRL.

[b] ANOVA Conducted on the difference in $\log_{10}$ concentrations Upstream (RG_KERRRD) and Downstream to test for differences among stations (RG_DSELK, RG_GRASMERE, RG_USGOLD, RG_BORDER) of the Elk River ($\log_{10}$[DS]-$\log_{10}$[US]. If significant, each station was compared to Upstream separately.

[c] Post-hoc contrasts testing the difference in $\log_{10}$(DS)-$\log_{10}$(US) against zero with the magnitude of difference (MOD) calculated as (DS-US)/US*100% and application of geometric means for concentrations. Post-hoc tests were adjusted from the number of comparisons using Tukey's Honestly Significant Difference (HSD) tests.

downstream and upstream stations (Table 3.2). Concentrations of all constituents were typically highest in the winter and spring months at all stations in 2022, and generally followed the same seasonal pattern observed in previous years (Appendix Figures B.1 to B.17). This seasonal change is likely reflective of the reservoir drawdown and lower water levels in the winter months, which is meant to accommodate the forthcoming spring freshet. For both order and non-order constituents, concentrations at all permitted water quality stations both downstream and upstream of the Elk River in 2022 were within the respective seasonal ranges shown from 2014 to 2016, and from 2018 to 2021 (Appendix Figure B1 to B.17).

3.1.2 Productivity

At all permitted water quality stations, annual median N:P ratios were consistently <15 in 2022 both downstream and upstream of the Elk River indicating phosphorus limitation (Figure 3.1; Appendix Tables B.18 to B.20). The N:P ratios at RG_WARDB and RG_ELKMOUTH were indicative of phosphorus limitation, with the highest N:P ratio among all stations observed at RG_ELKMOUTH (Figure 3.1; Appendix Tables B.18 to B.20). The Trophic Status Index (TSI) classification (Carlson 1977) suggests that Koocanusa Reservoir was primarily oligotrophic to mesotrophic most of the year (Table 3.3). Although assessment of productivity using Secchi depth suggested eutrophic conditions from late fall (December) through spring, and mesotrophic conditions over the rest of the year with oligotrophic conditions present in September (Table 3.3), the reservoir trophic status based on Secchi depth should not be considered an accurate representation of the reservoir productivity. Rather, it is likely reflective of changes in turbidity associated with sediment loads introduced to the reservoir during the various seasons (i.e., freshet), and annual drawdown of the reservoir levels. Overall, the seasonal variability in the trophic status of the reservoir in 2022 is reflective of the rapid changes in water levels/flow characteristics that take place over the year.

3.1.3 Loadings

Monthly nitrate and selenium loadings were estimated based on total monthly flow and monthly average nitrate and selenium concentrations at stations RG_ELKMOUTH (Elk River) and RG_WARDB (Kootenay River). In both the Elk River and Kootenay River, the highest average monthly loadings of nitrate and selenium occurred from May to July, and May to August, respectively, with the peak occurring in June of 2022 in both rivers aligning with the timing of peak freshet (Table 3.4). Loadings of both nitrate and selenium to Koocanusa Reservoir were higher from the Elk River than from the Kootenay River on both a monthly and annual timescale in 2022. Overall, annual loadings of both parameters were higher in 2022 in the Elk River compared to 2020 and 2021, and higher in 2022 than in 2021 for the Kootenay River, but lower than those observed in 2020 (Table 3.4).

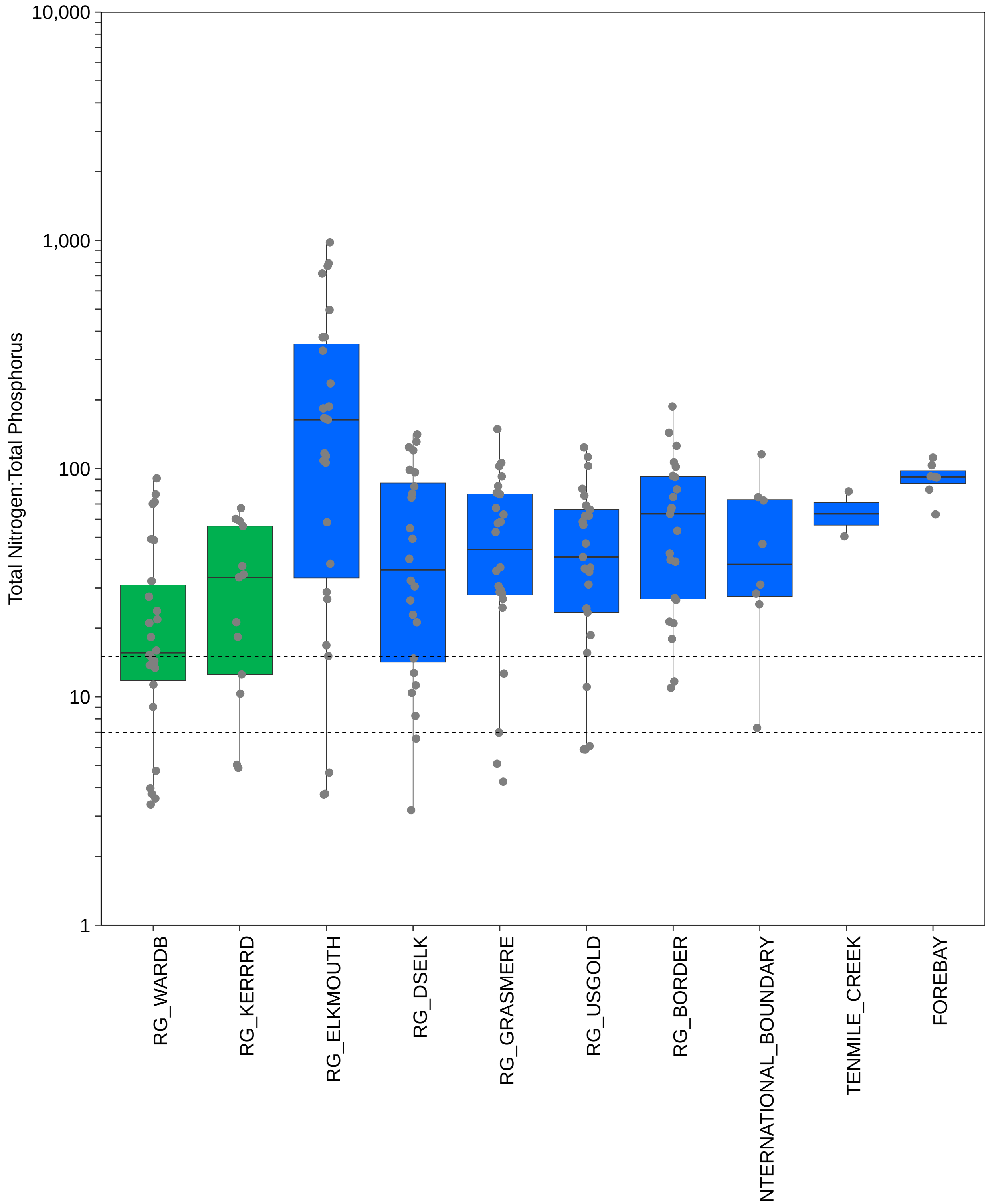


Figure 3.1: Ratio of Total Nitrogen to Total Phosphorus Downstream (Blue) and Upstream (Green) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Concentrations are averaged across depths when data for multiple depths are available. Total N:P ratios > 15 (hatched line) are indicative of phosphorus limited systems. Total N:P ratios < 7 (hatched line) are indicative of nitrogen limited systems. Total N:P ratios in between 7 and 15 indicate co−limitation.

Table 3.3: Trophic Level Classification for Water Quality Stations Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Unit	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phosphorus TSI	RG_WARDB	44.0	**36.9**	87.7	**38.0**	**35.3**	60.2	51.4	25.2	**30.5**	**34.5**	22.2	25.8
	RG_KERRRD	-	42.0	**32.8**	41.4	43.8	40.7	21.7	26.4	19.3	24.1	**38.3**	29.2
	RG_ELKMOUTH	17.4	14.1	19.1	29.5	49.4	55.1	**31.5**	14.1	18.5	20.9	27.9	**33.8**
	RG_DSELK	26.5	23.7	26.5	**37.1**	41.9	46.3	24.1	23.0	23.4	21.0	25.0	**37.4**
	RG_GRASMERE	28.5	**31.8**	25.8	**35.7**	**38.2**	40.6	20.4	16.2	19.7	17.6	20.9	**33.6**
	RG_USGOLD	25.6	24.0	23.8	**32.5**	**35.0**	**36.0**	17.2	17.3	20.7	**34.0**	21.0	**37.4**
	RG_BORDER	20.6	16.3	16.7	23.8	**30.6**	**39.7**	17.7	25.0	23.7	19.5	17.8	26.3
	INT_BOUNDARY	-	-	-	27.4	**38.7**	42.7	24.1	20.0	20.0	20.0	24.1	-
	TENMILE_CREEK	-	-	-	-	-	-	-	-	-	-	-	-
	RG_USGOLD	-	-	-	20.0	20.0	27.4	28.7	20.0	20.0	24.1	-	-
Chlorophyll TSI	RG_WARDB	-	-	-	-	-	-	-	-	-	-	-	-
	RG_KERRRD	-	**30.2**	**33.3**	**34.5**	**33.6**	19.0	29.4	**32.2**	**36.5**	**38.2**	**39.6**	**31.7**
	RG_ELKMOUTH	-	-	-	-	-	-	-	-	-	-	-	-
	RG_DSELK	26.2	27.8	**33.0**	**37.8**	**30.6**	**33.5**	**33.4**	**33.2**	**36.8**	**36.8**	42.3	27.9
	RG_GRASMERE	**30.6**	**32.0**	48.9	41.2	**33.1**	**38.4**	**32.8**	**35.4**	**37.5**	**37.8**	**38.2**	**39.0**
	RG_USGOLD	29.7	**37.3**	46.0	41.8	**31.3**	**39.4**	**32.0**	**32.6**	-14.6	40.2	40.9	42.3
	RG_BORDER	**36.0**	**38.0**	46.0	40.2	**30.2**	40.9	**34.5**	28.5	**34.3**	**36.0**	40.8	**39.2**
	INT_BOUNDARY	-	-	-	**39.4**	27.1	43.2	41.4	**36.4**	**36.4**	**38.3**	**34.6**	-
	TENMILE_CREEK	-	-	**33.2**	-	-	-	-	-	-	-	-	-
	RG_USGOLD	-	-	28.4	**31.5**	42.6	42.3	41.4	**35.2**	42.0	43.2	-	-
Secchi Depth TSI	RG_WARDB	-	-	-	-	-	-	-	-	-	-	-	-
	RG_KERRRD	-	-	-	71.0	77.1	69.4	50.0	44.7	**35.4**	**37.4**	60.0	54.2
	RG_ELKMOUTH	-	-	-	-	-	-	-	-	-	-	-	-
	RG_DSELK	-	-	-	70.7	76.2	55.0	44.7	**38.3**	**34.8**	**34.7**	40.0	65.1
	RG_GRASMERE	56.2	-	-	67.1	71.9	53.6	45.7	40.4	**34.2**	**35.7**	**37.5**	61.5
	RG_USGOLD	53.2	-	-	63.4	66.8	50.6	45.2	**39.0**	**33.9**	**38.3**	**38.3**	54.6
	RG_BORDER	48.64	-	-	53.5	59.5	50.3	45.3	44.7	**34.7**	**38.3**	41.0	53.7
	INT_BOUNDARY	-	-	-	-	-	-	-	-	-	-	-	-
	TENMILE_CREEK	-	-	-	-	-	-	-	-	-	-	-	-
	RG_USGOLD	-	-	-	-	-	-	-	-	-	-	-	-

(green) Indicates oligotrophic status based on TSI < 30 based on Carlson (1977).

(blue) Indicates mesotrophic status based on 40 < TSI < 50 based on Carlson (1977).

(pink) Indicates eutrophic status based on 50 < TSI < 60 based on Carlson (1977).

Notes: "-" = no data. TSI = Trophic Status Index. Bolded values fall in between the oligotrophic and mesotrophic ranges (30 - 40) and were rounded up or down to classify them.

Table 3.4: Average Monthly Nitrate and Selenium Loadings to the Koocanusa Reservoir, 2020 to 2022

Source	Month	Average Nitrate (mg/L)			Average Selenium (mg/L)			Total Volume (m^3)			Nitrate Loadings (kg/day)			Selenium Loadings (kg/day)		
		2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Elk River (RG_ELKMOUTH)	January	1.2	1.34	1.84	0.0067	0.00698	0.00623	48,394,337	64,988,801	79,054,442	2,286	2,225	5,743	12	11.5	19.4
	February	1.1	1.48	1.38	0.0058	0.00840	0.00738	56,775,739	44,707,887	49,875,881	2,226	2,620	2,885	12	14.9	15.4
	March	1.3	1.74	1.13	0.0070	0.00850	0.00613	52,504,309	76,160,216	62,825,097	2,532	3,896	2,230	13	19	12.3
	April	1.31	1.50	1.52	0.0067	0.00770	0.00853	106,641,372	132,515,186	100,433,928	4,558	5,452	5,113	23	28	28.7
	May	0.88	1.02	1.10	0.0045	0.00498	0.00537	484,319,053	499,136,356	313,917,857	11,803	11,712	10,292	59	58	49.7
	June	0.73	0.978	0.675	0.0035	0.00445	0.00343	773,942,850	738,472,331	938,455,335	20,277	18,899	22,548	101	86	113
	July	0.87	1.16	0.816	0.0044	0.00558	0.00435	334,850,680	267,942,826	438,039,260	11,136	9,906	15,408	56	48	81.7
	August	1.0	1.30	1.12	0.0052	0.00626	0.00654	136,535,838	166,877,672	153,147,599	5,977	5,815	5,567	31	28	32.5
	September	1.3	1.65	1.40	0.0063	0.00790	0.00728	84,817,692	109,068,998	98,940,327	4,224	5,309	5,317	20	25	27.6
	October	1.3	1.47	1.58	0.0067	0.00742	0.00812	72,923,120	94,856,565	73,907,400	2,918	3,694	4,174	15	19	21.5
	November	1.4	0.795	1.46	0.0074	0.00352	0.00755	82,188,770	169,187,952	46,222,273	2,970	2,422	2,230	16	11	11.5
	December	1.3	0.734	1.50	0.0072	0.00357	0.00754	59,893,579	157,389,247	33,246,614	2,773	4,207	1,513	16	20	7.61
Kootenay River (RG_WARDB)	January	0.15	0.139	0.163	0.00015	0.000121	0.000141	123,777,596	144,468,909	147,830,400	462	666	769	0.64	0.58	0.666
	February	0.16	0.170	0.156	0.00014	0.000115	0.000144	118,503,031	107,048,522	115,562,592	546	713	719	0.51	0.48	0.664
	March	0.11	0.135	0.123	0.00015	0.000122	0.000131	114,618,235	132,039,997	143,579,002	424	508	564	0.56	0.45	0.606
	April	0.10	0.100	0.0688	0.00011	0.000108	0.000118	208,341,668	257,804,963	182,025,101	905	796	413	0.80	0.83	0.705
	May	0.23	0.183	0.162	0.00010	0.0000880	0.000123	1,262,368,091	1,343,839,932	717,191,539	8,712	5,964	4,431	3.6	2.9	2.72
	June	0.09	0.108	0.117	0.000130	0.0000960	0.0000993	2,341,943,377	2,321,325,566	2,608,849,728	8,200	6,489	10,853	12.8	5.8	9.37
	July	0.08	0.0797	0.0682	0.000088	0.0000870	0.0000795	1,266,608,591	896,088,077	1,743,888,960	3,801	2,220	4,983	4.0	2.4	5.85
	August	0.056	0.0337	0.0604	0.00009	0.0000820	<0.00005	489,963,503	446,737,017	545,851,008	1,322	478	1,090	2.2	1.2	0.902
	September	0.053	0.0294	0.0544	0.000109	0.000116	0.000103	261,827,109	308,221,117	290,104,416	525	236	643	1.07	0.9	1.22
	October	0.061	0.0448	0.0416	0.000125	0.000101	0.0000850	229,833,222	282,626,496	191,883,859	449	388	295	0.92	0.9	0.603
	November	0.05	0.0782	0.0964	0.000139	0.0000710	0.000134	235,085,097	343,172,443	132,741,504	330	549	391	0.85	0.50	0.544
	December	0.11	0.164	0.130	0.00012	0.0000960	0.000146	145,291,916	351,453,995	106,070,861	547	1,912	404	0.57	1.12	0.454

Notes: "-" indicates no available data. Values below LRL were subbed in at the detection limit.

3.2 *In Situ* Water Quality Profiles

In situ water quality profiles conducted in August 2022 under full-pool conditions indicated warmer temperatures downstream of the Elk River (~21˚C) compared to the upstream transect (~19.5˚C), and development of the thermocline at a lesser depth (i.e., around 8 m) downstream of the Elk River compared to upstream (i.e., around 10 m; Figure 3.2). Dissolved oxygen concentration profiles were similar downstream and upstream of the Elk River and reflected well-oxygenated conditions throughout the entire water column (Figure 3.2). Profiles for pH indicated similar changes in pH through the water column at both transects in August 2022, with higher pH observed near the surface and slightly decreasing pH occurring with greater depth below the epilimnion (Figure 3.2). Specific conductivity profiles identified lower specific conductivity downstream of the Elk River compared to upstream, but similar changes over the water column depth for both areas (Figure 3.2).

3.3 RG_SAND Additional Investigation Summary

Sediment and benthic invertebrate community[7] and tissue samples were collected at the transects downstream (RG_T4) and upstream (RG_TN) of the Elk River, as well as at the temporarily established transect RG_SAND further upstream from RG_TN. Results from the 2021 study indicated that there were no differences in sediment quality or benthic invertebrate community and tissue selenium concentrations between RG_TN and RG_SAND (Minnow 2022). Results from the 2022 study corroborate these findings, with minimal or no differences in sediment quality and benthic tissue selenium concentrations, respectively, between RG_TN and RG_SAND (Minnow 2023). In both years, it was noted that the location of the RG_SAND transect was in an unfavorable location for spring sampling requirements due to the low-pool and riverine conditions (i.e., strong flow carrying wooden debris) experienced in the area during April to May. These conditions pose both a safety hazard to crews and impact their ability to conduct necessary sampling requirements, thus making RG_SAND disadvantageous for use in the Koocanusa Reservoir Monitoring Program. Furthermore, use of RG_SAND would mean the loss of the established long-term dataset existing for RG_TN (2015 to 2022).

Water quality[8] samples collected upstream of the Elk River in 2022 suggest that backflow from the Elk River can occur during full-pool conditions resulting in measurable selenium concentrations within the water column at upstream transects, likely sourced from the Elk River (Minnow 2023). Overall, although the results from the sediment and benthic invertebrate tissue

[7] Benthic invertebrate community samples were only collected in 2021.

[8] The water quality study was completed by Teck and was summarized in the RG_SAND Investigation Memo (Minnow 2023).

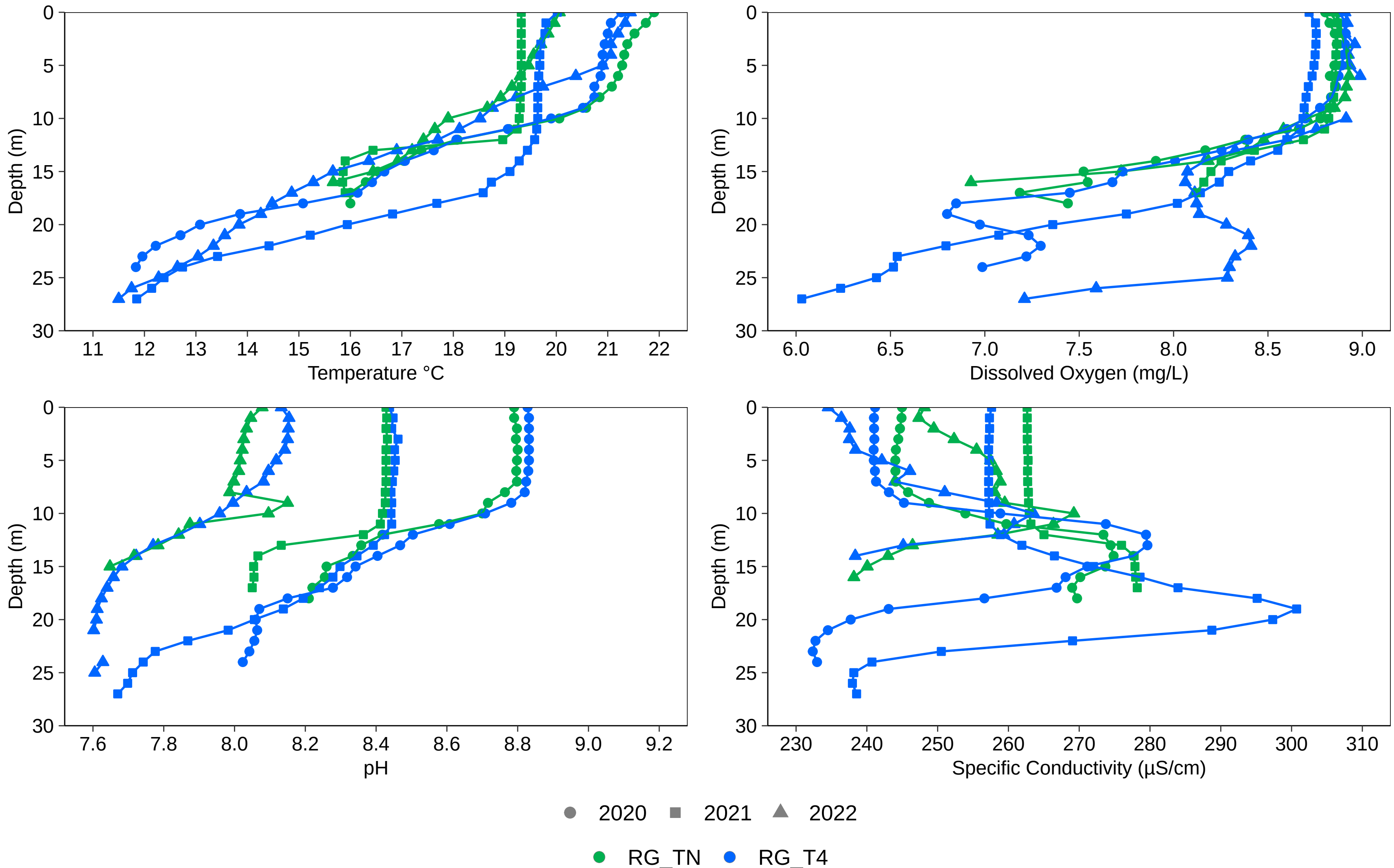


Figure 3.2: Mean Across−Transect *In Situ* Water Quality Profiles Downstream (RG_T4) and Upstream (RG_TN) of the Elk River in Koocanusa Reservoir Measured Annually in August, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Note: n=5 stations per transect.

samples do not identify any differences between RG_SAND or RG_TN, results from Teck's water quality study indicates that the current RG_TN transect may be influenced by the Elk River as well (although further investigation is required). However, the identified difficulties RG_SAND presents for spring field programs, as well as lack of representative reservoir habitat upstream of Sand Creek must ultimately be considered, and it is not recommended to relocate the upstream transect (RG_TN) for future monitoring programs. Investigations on potential groundwater influence in Kikomun Creek is ongoing.

4 SEDIMENT QUALITY

4.1 Sediment Particle Size and Chemistry

Sediment from both downstream and upstream of the Elk River was primarily composed of silt-sized material followed by clay-sized material (Figure 4.1). The proportion of clay-sized material was significantly lower, whereas the proportion of silt-sized material and TOC was significantly higher in sediment downstream of the Elk River compared to upstream, but no significant differences in the proportion of sand-sized and gravel-sized material were indicated between areas (Table 4.1).

Metals occurring at concentrations elevated above the lower working sediment quality guidelines (WSQG) at one or more stations downstream of the Elk River included arsenic, iron, manganese, nickel, and zinc (Appendix Table C.1); however, except for zinc, these metals were also elevated above the lower WSQG at one or more stations upstream of the Elk River as well. Concentrations of all metals were below the upper WSQG both downstream and upstream of the Elk River (Appendix Table C.1). Sediment concentrations of phenanthrene were elevated above the lower WSQG downstream of the Elk River at one station, whereas sediment concentrations of acenaphthene and acenaphthylene were elevated above the lower WSQG at one station upstream of the Elk River (Appendix Table C.1). Although sediment from downstream of the Elk River had significantly higher concentrations of several metals (antimony, barium, cadmium, molybdenum, phosphorus, potassium, selenium, thallium, and vanadium) and PAHs (chrysene, naphthalene, and phenanthrene), none of these metals were elevated above guidelines. No difference was observed in any of the metals that were elevated above guidelines (arsenic, iron, manganese, nickel, and zinc [Table 4.1; Figure 4.2]). Higher concentrations of metals and PAHs typically observed downstream of the Elk River were likely also related to the significantly higher TOC concentrations measured downstream as well.

Sediment concentrations of arsenic, iron, manganese, nickel, and zinc in August 2022 were lower than concentrations observed in 2021 downstream of the Elk River and similar to concentrations observed in 2020, and concentrations in sediment in the upstream areas were within respective ranges shown in 2020 and 2021 (Figure 4.2; Appendix Figure C.1). In addition, sediment concentrations of selenium were lower in 2022 compared to 2021, and similar to those observed in 2020 downstream of the Elk River. Overall, metal concentrations in sediment that were significantly higher downstream of the Elk River were not above the BC WSQ guidelines.

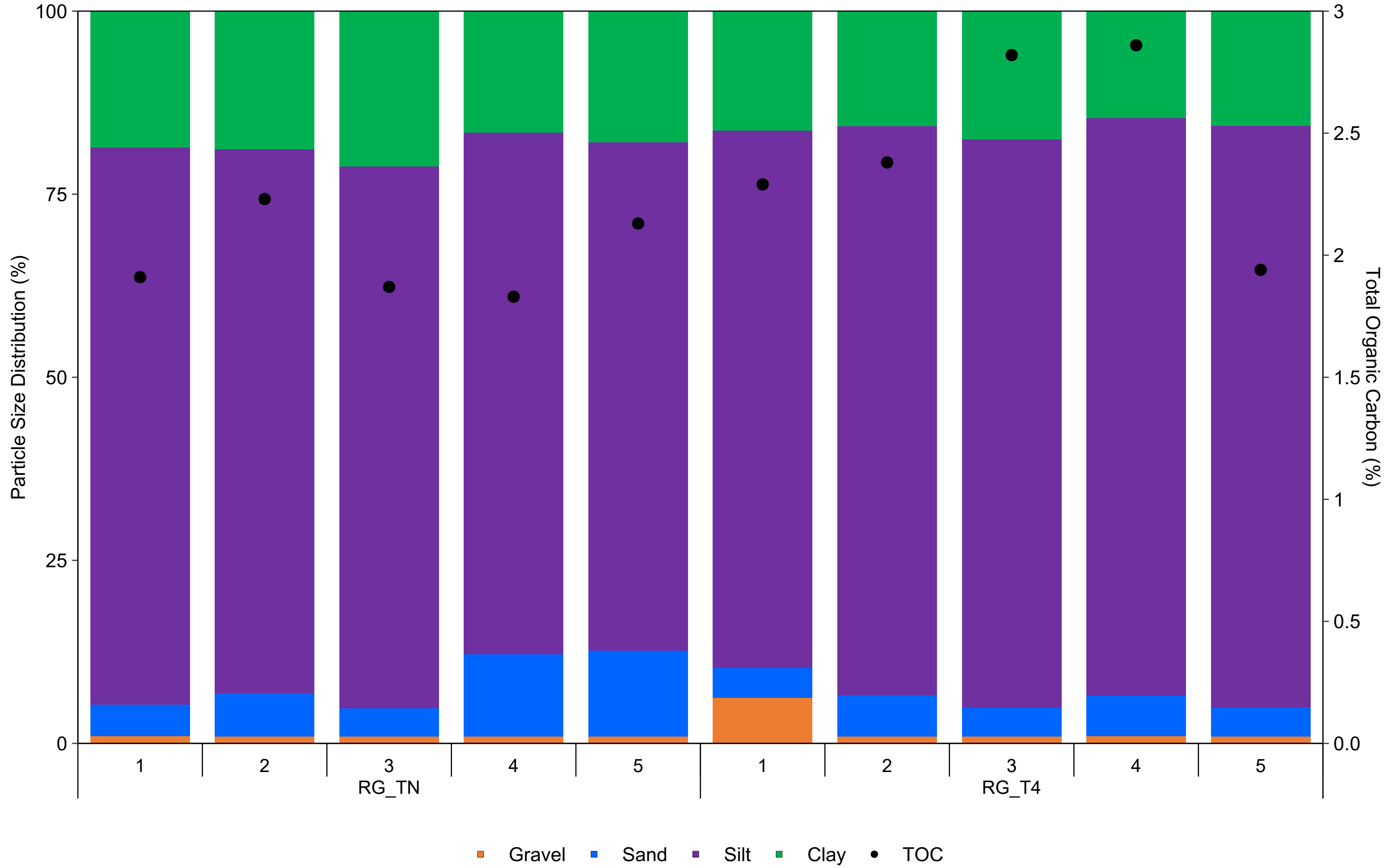


Figure 4.1: Sediment Particle Size Distribution and Total Organic Carbon (TOC) Content Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Particle groups were summed and concentrations below the laboratory reporting limit (LRL) were substituted by the detection limit. Numbers on x-axis (1 to 5) represent unique stations within downstream (RG_T4) and upstream (RG_TN) transects.

Table 4.1: Statistical Comparisons of Physical Properties and Concentrations of Metals and PAHs in Sediment Between Areas Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, August 2022

Parameter	Units	Test [a]	Summary Statistics	Test P-value	Measure of Central Tendency		Magnitude of Difference [b]
					RG_TN	RG_T4	
Moisture	%	tequal	Mean	0.050	43.2	46.3	ns
pH	pH unit	tequal	Mean	0.625	8.37	8.40	ns
Gravel	%	M-W	Median	0.424	1.00	1.00	-
Clay	%	tequal	Mean	0.022	19.3	16.5	-14
Sand	%	tequal	Mean	0.151	7.62	4.80	ns
Silt	%	tequal	Mean	0.038	75.5	80.1	6.1
Total Organic Carbon	%	tequal	Mean	0.040	1.99	2.46	23
Aluminum	mg/kg	M-W	Median	0.295	11,700	10,400	ns
Antimony	mg/kg	tequal	Geometric Mean	0.036	0.274	0.404	48
Arsenic	mg/kg	tequal	Geometric Mean	0.460	4.95	5.62	ns
Barium	mg/kg	M-W	Median	0.008	72.8	121	66
Beryllium	mg/kg	tequal	Geometric Mean	0.070	0.373	0.505	ns
Bismuth	mg/kg	M-W	Median	1.000	0.200	0.200	ns
Cadmium	mg/kg	tequal	Mean	0.001	0.184	0.424	131
Calcium	mg/kg	M-W	Median	0.142	106,000	95,400	ns
Chromium	mg/kg	M-W	Median	1.000	17.3	16.1	ns
Cobalt	mg/kg	M-W	Median	0.841	8.37	7.89	ns
Copper	mg/kg	tequal	Geometric Mean	0.303	14.3	16.7	ns
Iron	mg/kg	M-W	Median	0.346	20,900	19,400	ns
Lead	mg/kg	M-W	Median	0.675	12.3	12.9	ns
Lithium	mg/kg	M-W	Median	0.421	23.7	22.2	ns
Magnesium	mg/kg	M-W	Median	0.249	23,100	21,600	ns
Manganese	mg/kg	M-W	Median	0.222	448	472	ns
Mercury	mg/kg	nt	-	-	-	-	-
Molybdenum	mg/kg	M-W	Median	0.034	0.540	0.740	37
Nickel	mg/kg	M-W	Median	0.841	19.7	19.8	ns
Phosphorus	mg/kg	M-W	Median	0.016	477	687	44
Potassium	mg/kg	M-W	Median	0.032	740	940	27
Selenium	mg/kg	M-W	Median	0.010	0.200	0.460	130
Sodium	mg/kg	M-W	Median	0.917	72.0	72.0	ns
Strontium	mg/kg	M-W	Median	0.151	262	217	ns
Thallium	mg/kg	M-W	Median	0.008	0.0580	0.0980	69
Tin	mg/kg	nt	-	-	-	-	-
Titanium	mg/kg	tequal	Geometric Mean	0.596	68.3	62.0	ns
Uranium	mg/kg	M-W	Median	0.151	0.562	0.700	ns
Vanadium	mg/kg	M-W	Median	0.032	12.8	16.6	30
Zinc	mg/kg	M-W	Median	0.222	65.4	75.8	ns
Zirconium	mg/kg	M-W	Median	1.000	1.30	1.20	ns
Anthracene	mg/kg	nt	-	-	-	-	-
Benz(a)anthracene	mg/kg	nt	-	-	-	-	-
Benzo(b&j)fluoranthene	mg/kg	M-W	Median	0.072	0.0100	0.0120	ns
Benzo(e)pyrene	mg/kg	nt	-	-	-	-	-
Chrysene	mg/kg	M-W	Median	0.007	0.0100	0.0160	60
Fluoranthene	mg/kg	M-W	Median	0.180	0.0100	0.0100	ns
Naphthalene	mg/kg	M-W	Median	0.010	0.0100	0.0220	120
Phenanthrene	mg/kg	M-W	Median	0.010	0.0100	0.0330	230
Pyrene	mg/kg	M-W	Median	0.180	0.0100	0.0100	ns

Indicates significant difference between study areas at a P-value < 0.05.

Pairwise comparison is significant (α = 0.05) and MOD is positive (values higher downstream vs upstream).

Pairwise comparison is significant (α = 0.05) and MOD is negative (values lower downstream vs upstream).

Notes: values <LDL were substituted with LDL before analysis. ns = not significant; nt = not tested due to insufficient data; tequal = T-test for equal variances, M-W = Mann–Whitney U test.

[a] Some parameters were not tested because more than 80% of the values were below the laboratory detection limit. These parameters are not shown.

[b] Magnitude of difference calculated as $(MCT_{downstream} - MCT_{upstream})/(MCT_{upstream}) \times 100\%$, where MCT is the measure of central tendency = mean (ANOVA, tunequal, and tequal), geometric mean ($ANOVA_{log}$), or median (Mann–Whitney or KW tests).

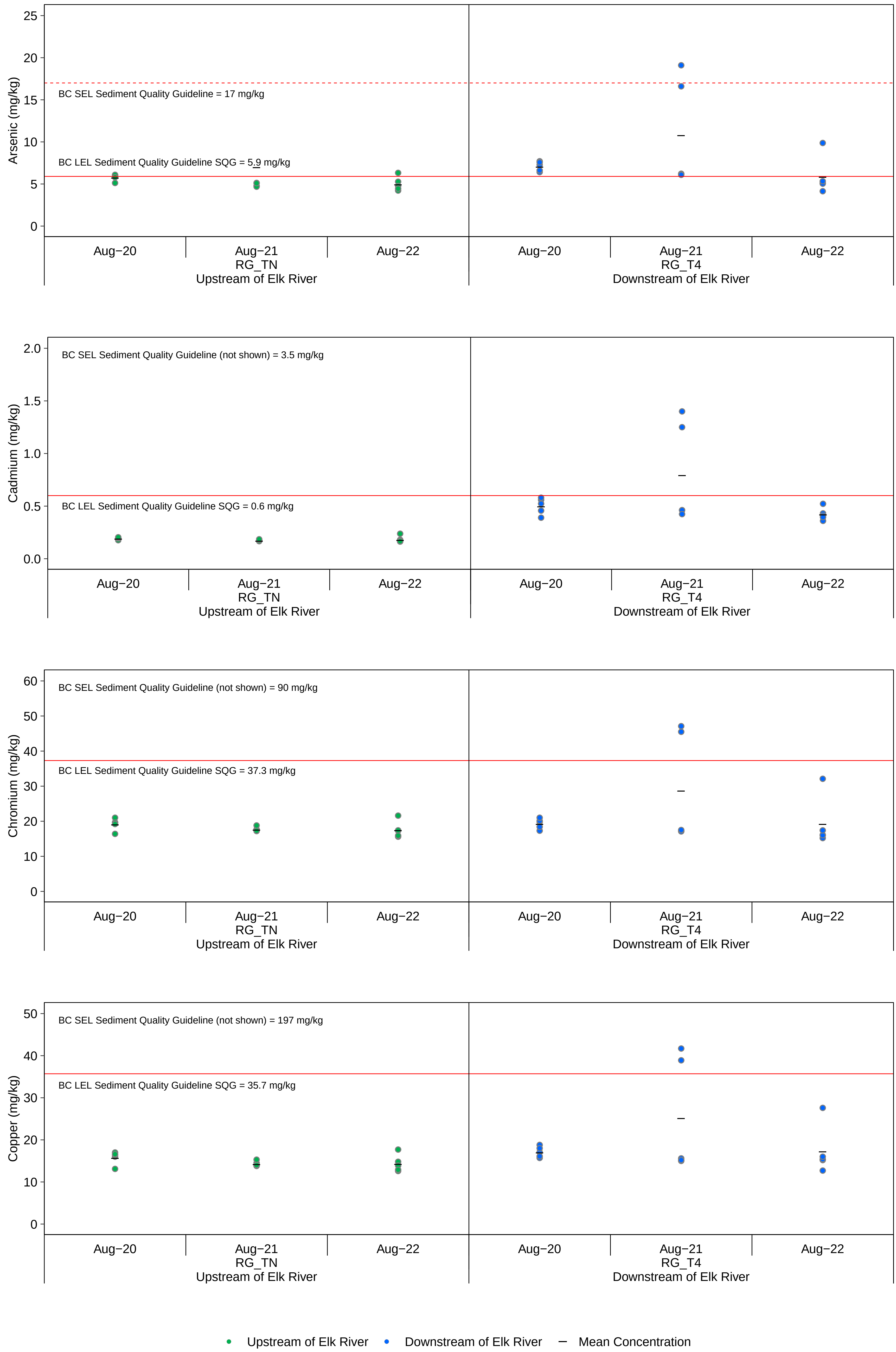


Figure 4.2: Sediment Parameters Occurring at Concentrations that were Elevated above the Sediment Quality Guideline Lowest Effects Level (LEL) Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.

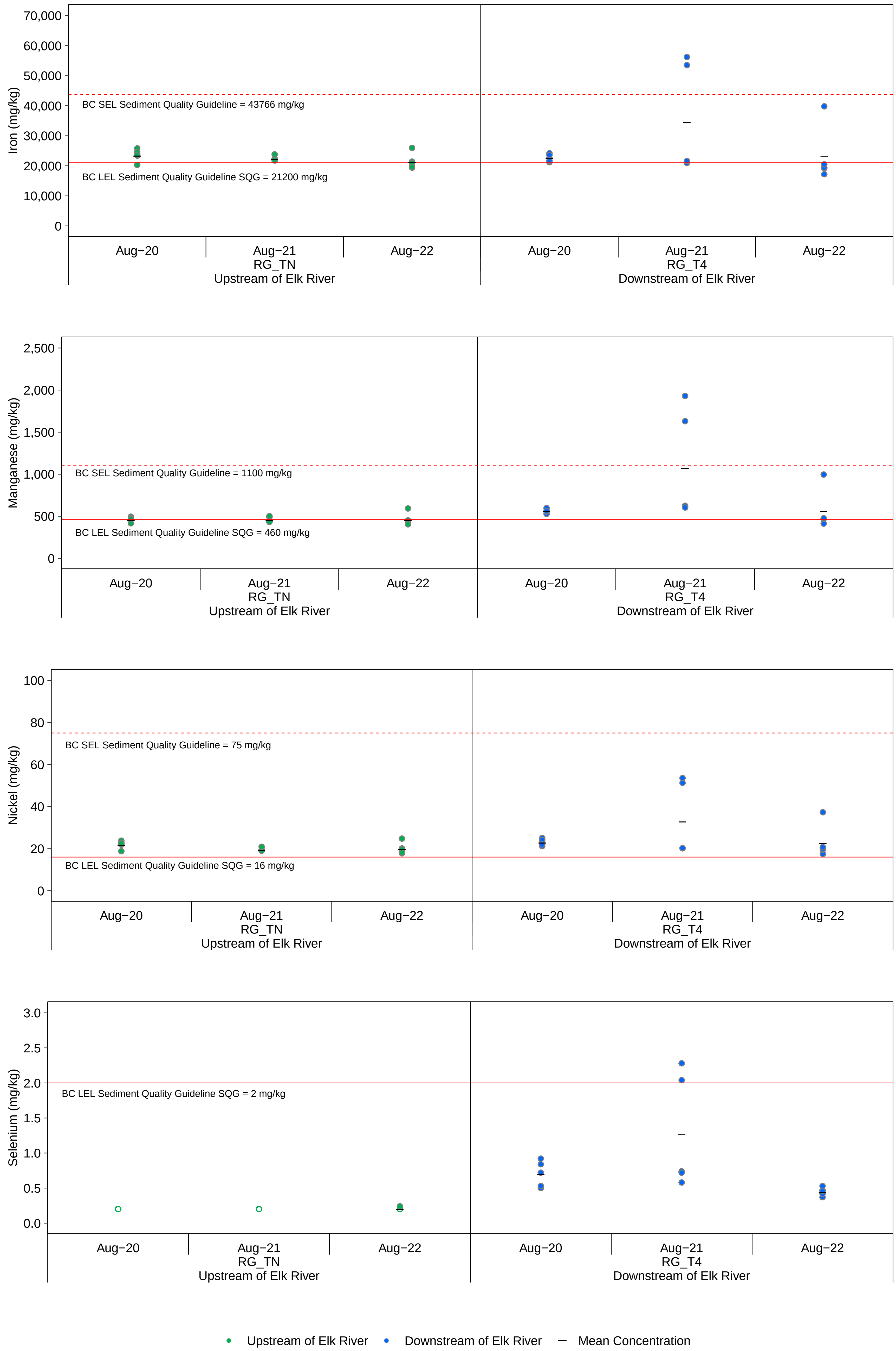


Figure 4.2: Sediment Parameters Occurring at Concentrations that were Elevated above the Sediment Quality Guideline Lowest Effects Level (LEL) Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.

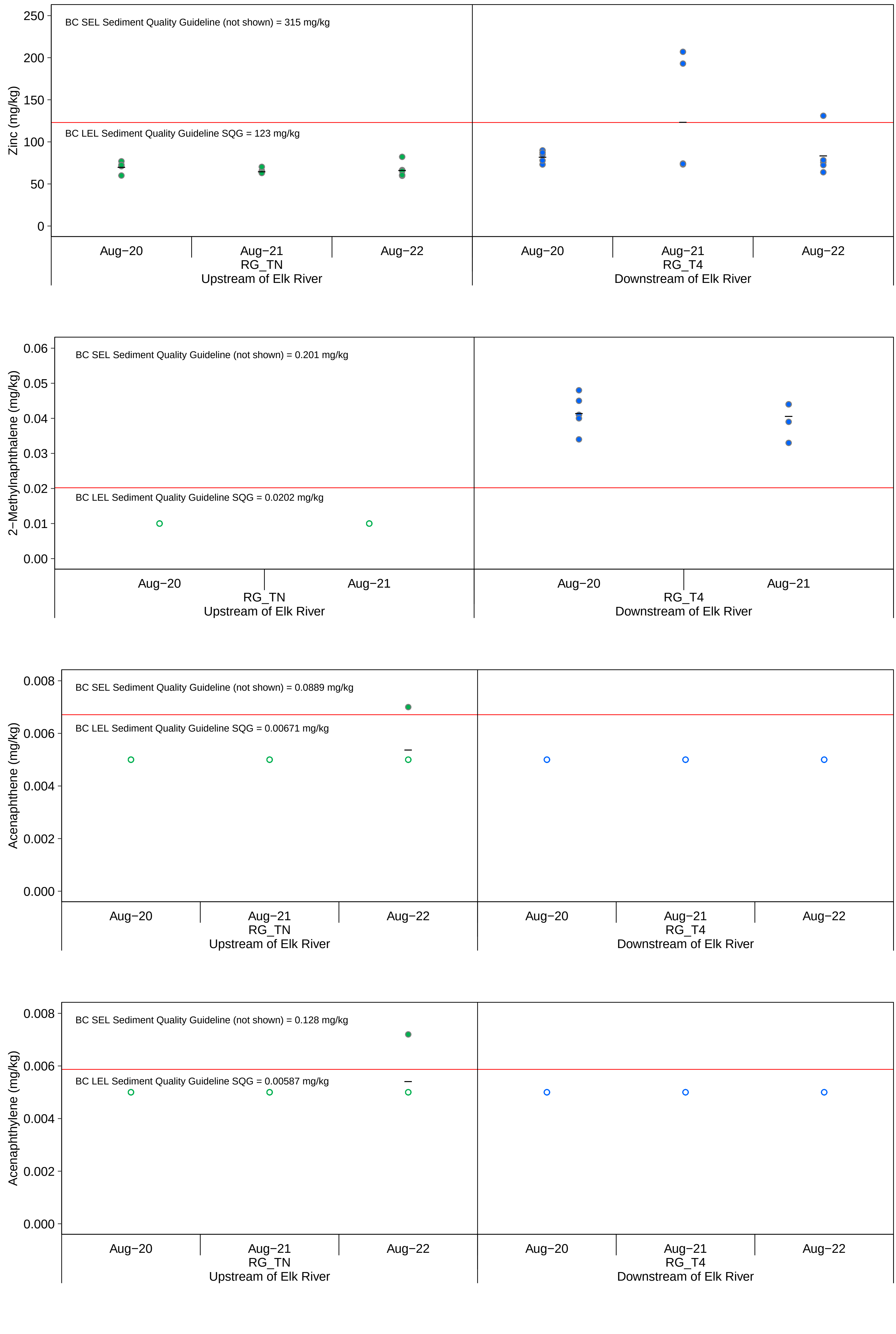


Figure 4.2: Sediment Parameters Occurring at Concentrations that were Elevated above the Sediment Quality Guideline Lowest Effects Level (LEL) Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.

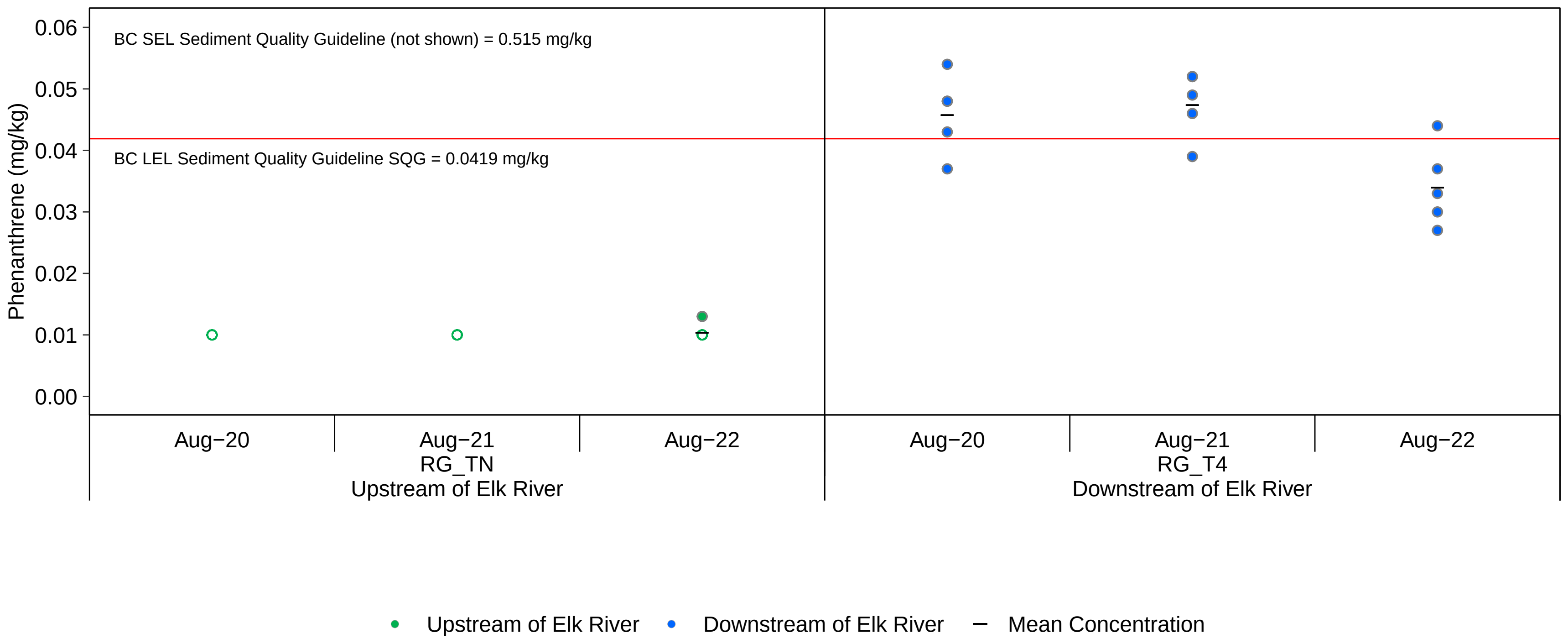


Figure 4.2: Sediment Parameters Occurring at Concentrations that were Elevated above the Sediment Quality Guideline Lowest Effects Level (LEL) Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values are plotted. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1.

5 ZOOPLANKTON

5.1 Community Composition

In August 2022 when the reservoir was at full pool, the zooplankton community was dominated by Rotifera downstream of the Elk River and Copepoda upstream of the Elk River (Figure 5.1; Appendix Figure D.1). Lower proportions of Cladocera were observed throughout the reservoir relative to Rotifera and Copepoda. Zooplankton density and biomass were significantly higher and lower, respectively, downstream of the Elk River compared to upstream, but no significant spatial difference was indicated for community richness (Table 5.1; Figure 5.2; Appendix Table D.1 to D.8). Density and biomass of Cladocera were significantly lower, whereas the density and biomass of Rotifera were significantly higher downstream of the Elk River compared to upstream (Table 5.1; Figure 5.2; Appendix Table D.1 to D.8). No differences were observed in the density or biomass of Copepoda between areas (Table 5.1; Figure 5.2; Appendix Table D.1 to D.8).

Overall, the differences observed in zooplankton communities between downstream and upstream of the Elk River in August 2022 were comparable to differences observed in previous years. The increased directional change in zooplankton community composition in 2022 compared to 2020 and 2021 both downstream and upstream of the Elk River suggested that the changes were unrelated to mine operations, but rather reflective of differences in reservoir levels measured between 2020 to 2022.

5.2 Tissue Selenium Concentrations

In 2022, selenium concentration in zooplankton tissue both downstream and upstream of the Elk River were below the BC chronic interim guideline (4 µg/g dw) and the EVWQP Level 1 benchmarks for dietary effects to fish (11 µg/g dw) and to invertebrate reproduction (13 µg/g dw) (Figure 5.3). Spatially, selenium concentrations of zooplankton tissue collected downstream of the Elk River were significantly higher than those collected upstream in August 2022 (Table 5.2). Overall, selenium concentrations in zooplankton tissue in August are comparable over time and consistently below guidelines and benchmarks both downstream and upstream of the Elk River suggesting no changes over time or mine-related influence is occurring (Figure 5.3).

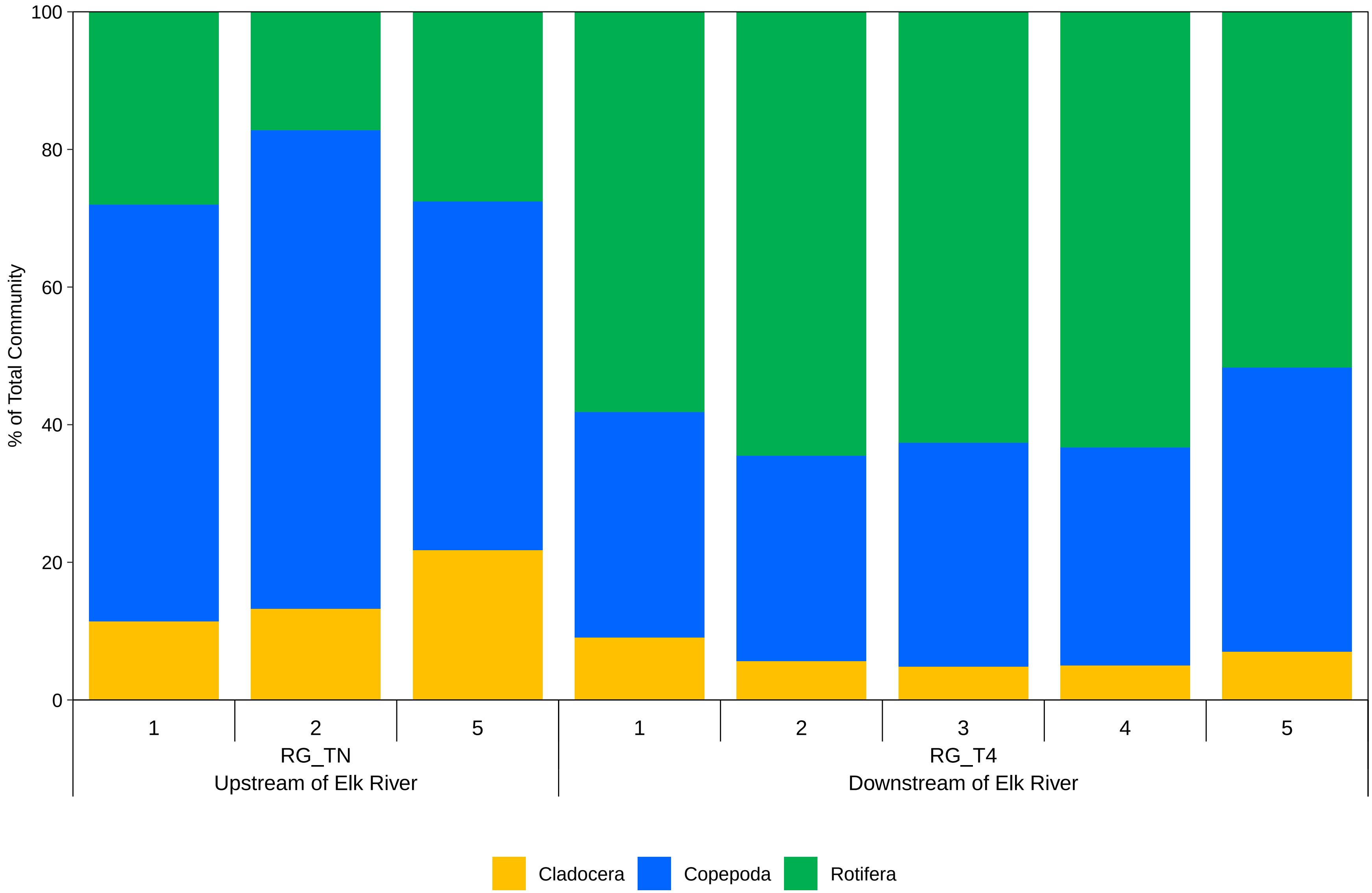


Figure 5.1: Relative Density of Major Zooplankton Groups Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, August 2022

Note: numbers along the x-axis represent transect stations.

Table 5.1: Spatial Differences in Zooplankton Community Endpoints Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, August 2022

Endpoint	Transformation	MCT[a]		Area P-Value	Magnitude of Difference[b]
		RG_TN	RG_T4		
Density (ind/L)	log10	25.0	39.2	0.039	1.4
Biomass (µg/L)	none	1,051	546	0.010	-1.8
Richness (# Taxa)	log10	35.0	35.1	0.988	ns
Cladocera (ind/L)	log10	3.72	2.40	0.060	-5.2
Copepoda (ind/L)	log10	14.9	13.1	0.620	ns
Rotifera (ind/L)	log10	5.92	23.5	<0.001	3.3
Cladocera (µg/L)	none	867	378	0.003	-2.5
Copepoda (µg/L)	none	181	163	0.710	ns
Rotifera (µg/L)	none	2.48	5.06	0.014	3.2
MDS1	none	0.371	-0.223	<0.001	-5.7
MDS2	none	0.0103	-0.00618	0.885	ns
MDS3	none	0.0209	-0.0125	0.760	ns

P-value < 0.1.

MOD > 0 indicates values were higher downstream relative to upstream.

MOD < 0 indicates values were lower downstream relative to upstream.

Notes: ns = non-significant.

[a] MCT = geometric mean for log10-transformed, median for rank-transformed and mean for untransformed data from the full ANOVA model.

[b] Magnitude of Difference (MOD) = $MCT_{downstream}$ - $MCT_{upstream}/SD_{upstream}$, where $MCT_{downstream}$ and $MCT_{upstream}$ are the measures of central tendency for the downstream and upstream sites, respectively.

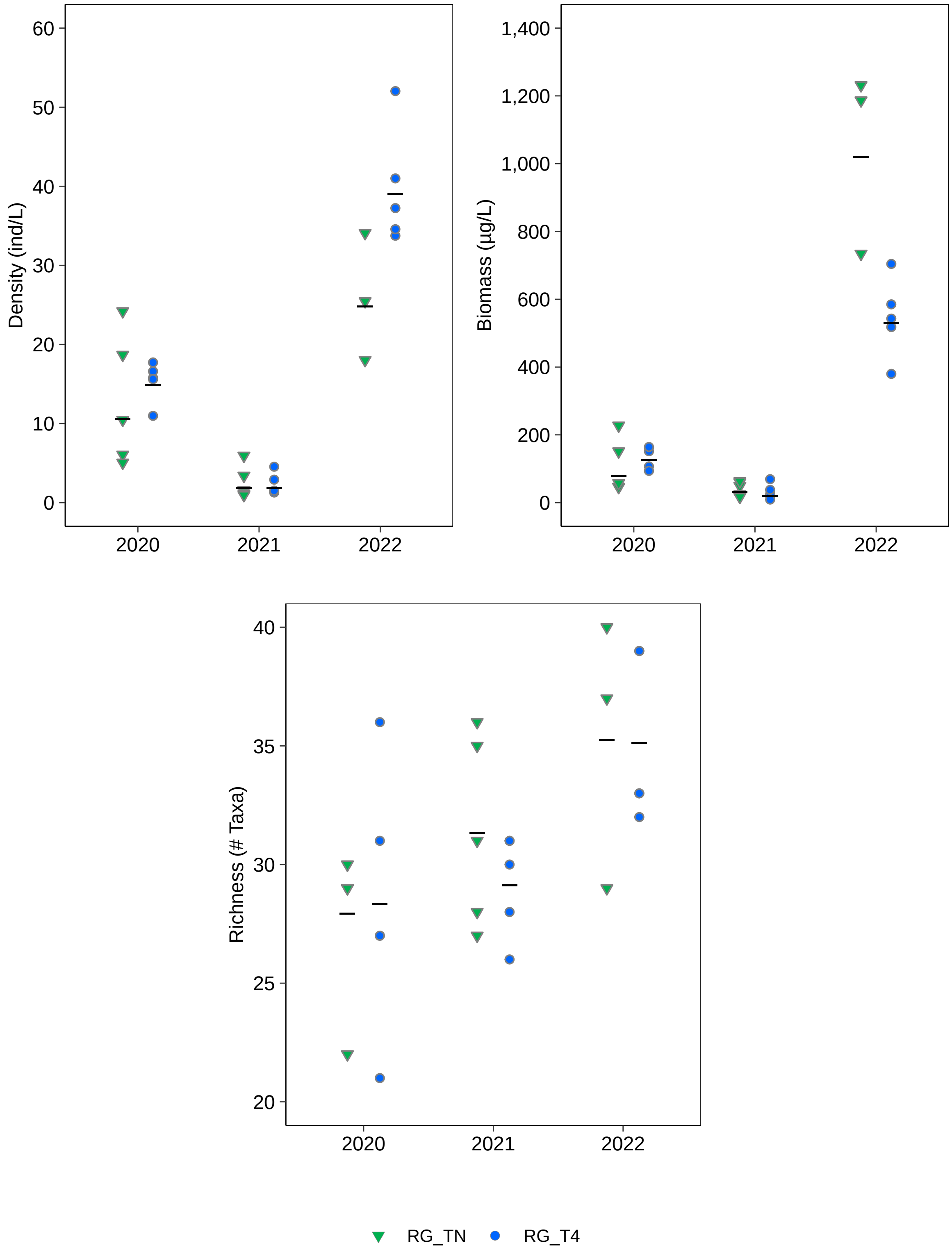


Figure 5.2: Zooplankton Community Endpoints from Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Measures of Central Tendency (geometric mean for biomass and density, otherwise mean) are plotted as horizontal lines.

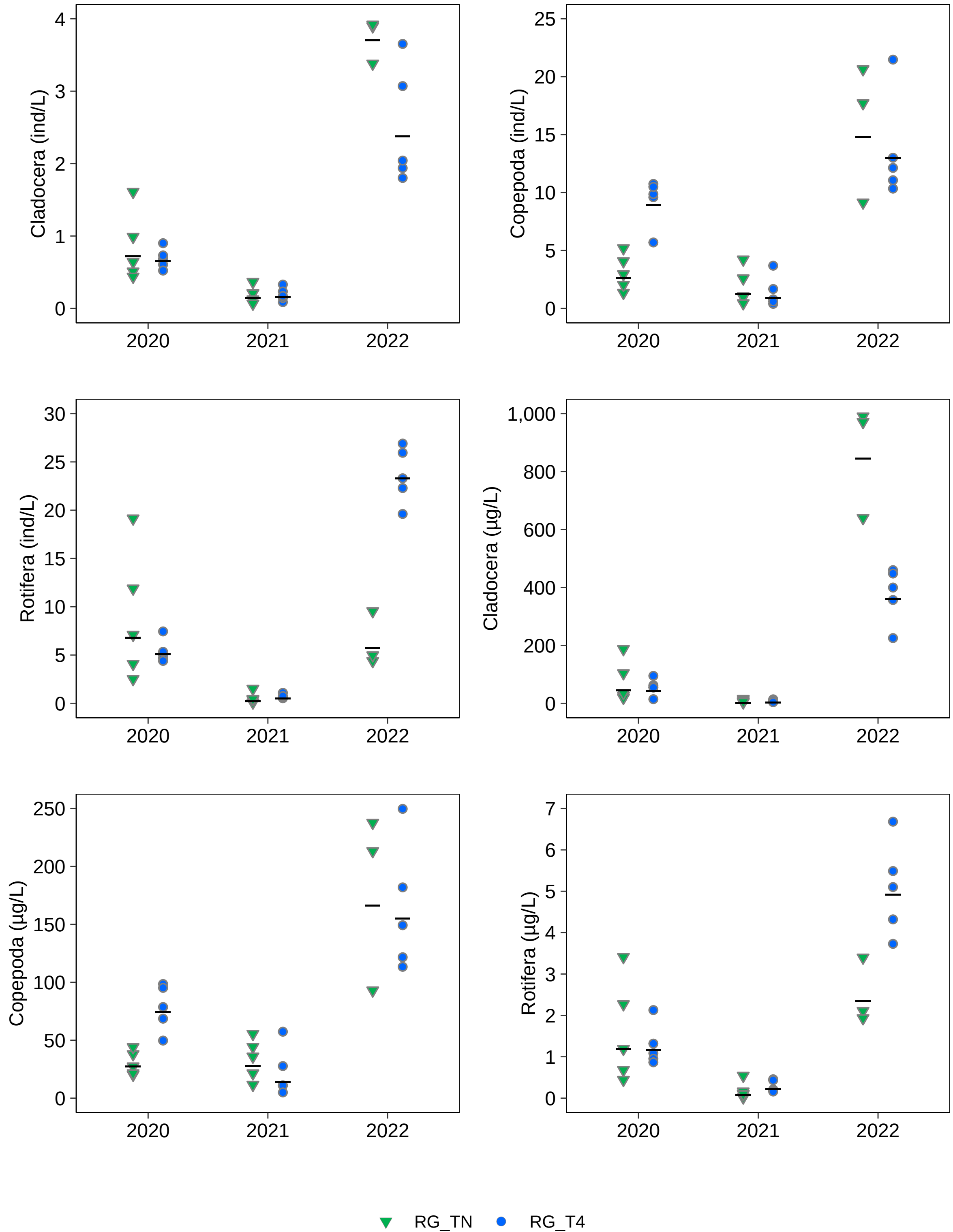


Figure 5.2: Zooplankton Community Endpoints from Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Measures of Central Tendency (geometric mean for biomass and density, otherwise mean) are plotted as horizontal lines.

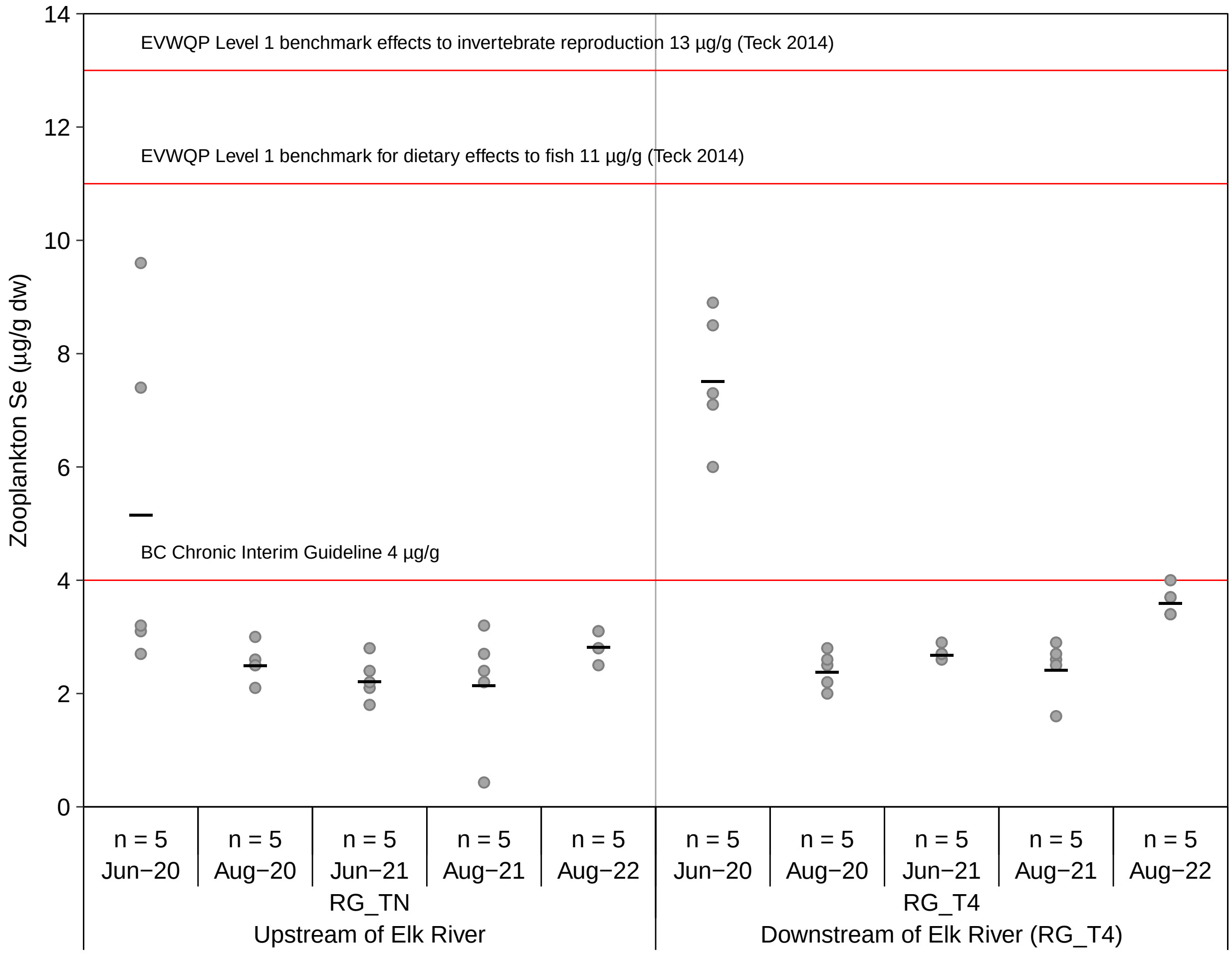


Figure 5.3: Concentration of Selenium in Zooplankton Tissue Samples Collected Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Table 5.2: Spatial Differences in Selenium Concentration in Zooplankton Tissue Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, August 2022

Endpoint	Transformation	MCT[a]		Area P-Value	Magnitude of Difference[b]
		RG_TN	RG_T4		
Selenium (µg/g)	none	2.86	3.64	0.001	27

P-value < 0.05.

MOD > 0 indicates values were higher downstream relative to upstream.

MOD < 0 indicates values were lower downstream relative to upstream.

Notes: ns = non-significant

[a] MCT = geometric mean for log10-transformed, median for rank-transformed and mean for untransformed data from the full ANOVA model.

[b] Magnitude of Difference (MOD) = $MCT_{downstream}$ - $MCT_{upstream}$/$MCT_{upstream}$ *100, where $MCT_{downstream}$ and $MCT_{upstream}$ are the measures of central tendency for the downstream and upstream sites, respectively.

6 BENTHIC INVERTEBRATES

6.1 Tissue Selenium Concentrations

Concentrations of selenium in benthic invertebrate tissue collected downstream and upstream of the Elk River in June and August 2022 were above the BC interim guideline (4 µg/g dw) but below the EVWQP Level 1 benchmark for fish, and although concentrations in June were similar between areas, concentrations in August appeared to be higher downstream of the Elk River (Figure 6.1). Qualitative temporal comparisons of August data indicate concentrations of selenium in benthic invertebrate tissue downstream of the Elk River were comparable to concentrations observed in 2021 and lower than those observed in 2020, whereas concentrations upstream of the Elk River appear to be higher than those observed in 2020 and 2021 (Figure 6.1).

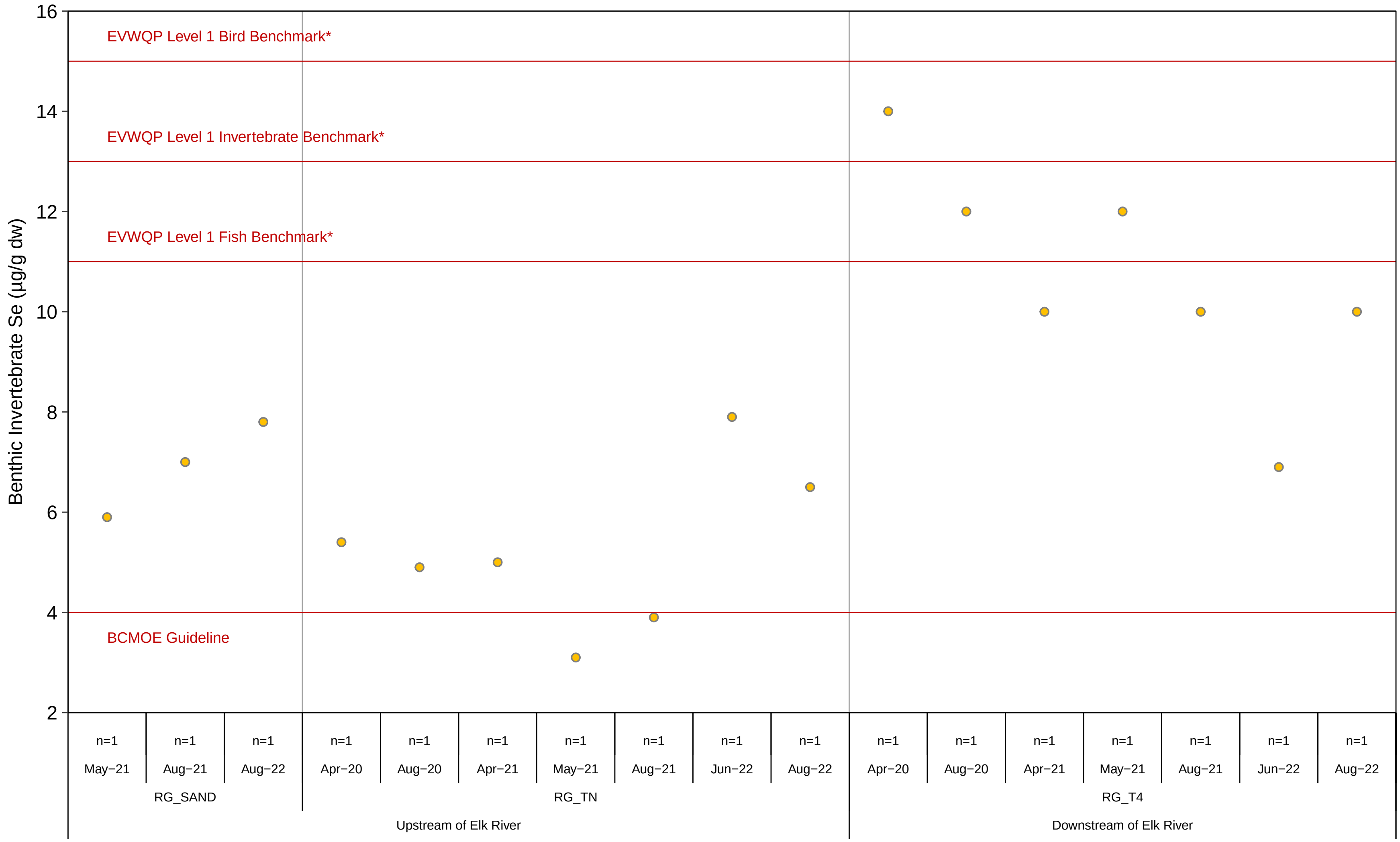


Figure 6.1: Selenium Concentration in Composite Benthic Invertebrate Tissue Samples Collected Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Monitoring Program, 2020 to 2022

Notes: Means of individual values are plotted as horizontal lines when n > 1. 15 µg/g Level 1 Benchmark for dietary effects to juvenile birds; 13 µg/g Level 1 Benchmark for growth, reproduction, and survival of benthic invertebrates; 11 µg/g Level 1 Benchmark for dietary effects to juvenile fish (Elk Valley Water Quality Plan [EVWQP]; Golder, 2014); 4 µg/g BC Chronic Interim Guideline for dietary effects to benthic invertebrates (BCMOE 2006). Open circles represent values below the laboratory reporting limit, and were substituted at the LRL. RG_SAND samples collected as part of the additional investigations in 2022.

7 FISH

7.1 Tissue Selenium Concentrations

7.1.1 Muscle

Mean selenium concentration in the muscle of all fish species sampled (PCC and RSC, BT, KO, MW, RB, Northern Pikeminnow [NSC], WCT, and Yellow Perch [YP]) in 2022 were below the BC interim guideline (4 µg/g dw), except for RSC where the mean concentration was 4.3 µg/g dw at RG_ER. Mean selenium muscle concentrations in RSC were however below the US EPA criterion (11.3 µg/g dw) (Figure 7.1; Appendix Tables E.7 to E.9). Sample sizes were sufficient for BT, NSC, PCC, and RSC to allow for downstream to upstream comparisons in 2022. Muscle tissue selenium concentrations were significantly higher in PCC at RG_GC and in RSC at RG_ER and RG_GC than observed upstream (RG_SC; Table 7.1). There were no significant spatial differences of muscle tissue selenium concentrations in BT or NSC in 2022 between areas (Table 7.1). Since selenium concentrations in muscle tissue of PCC and RSC were largely below applicable guidelines (with the exception of RSC at RG_ER, which were slightly above the BC guideline), the occurrence of significantly higher concentrations of selenium in muscle tissue of PCC and/or RSC at the downstream study area (or areas) compared to upstream is not considered to be ecologically significant.

Concentrations of selenium in muscle tissue of all fish species sampled in 2022 appeared to be within respective ranges shown in previous years for like-species suggesting no substantial changes in selenium concentrations in muscle tissue over time at Koocanusa Reservoir downstream and upstream of the Elk River.

7.1.2 Ovary

Ovary tissue samples were collected from PCC and RSC in May and June 2022, respectively, as these periods provide the best highest probability to capture ripe females (indicated by higher gonadosomatic index [GSI]) for collection of ripe ovaries (Minnow 2022). However, due to annual variation in environmental variables (i.e., water temperature), sampled ovaries are not necessarily within the target GSI range indicative of spawning condition. Selenium concentrations in well-developed (i.e., ripe) ovary/egg tissue provide the most direct predictor for potential reproductive effects in fish (Janz et al. 2010, DeForest and Adams 2020) and the basis for develop of the BC water quality guidelines for chronic effects related to selenium. Ovaries of PCC within the GSI range of 13 and 15% are considered to be ready to spawn (Gray and Dauble 2001). The mean GSI for PCC sampled in May 2022 ranged from 9.8% to 10.6% among the three study areas (Figure 7.2; Appendix Table E.4). Some individual PCC collected from each study area

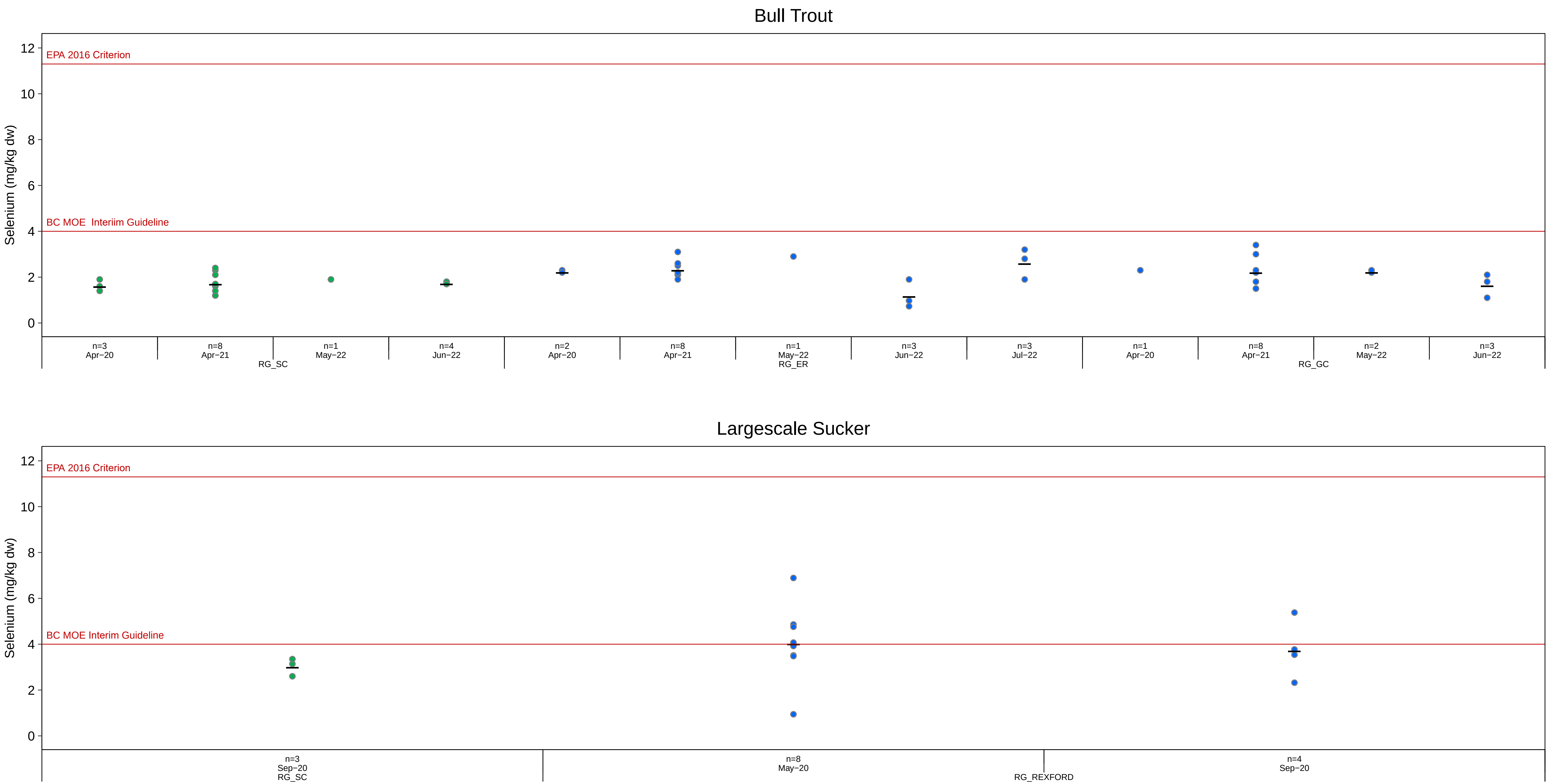
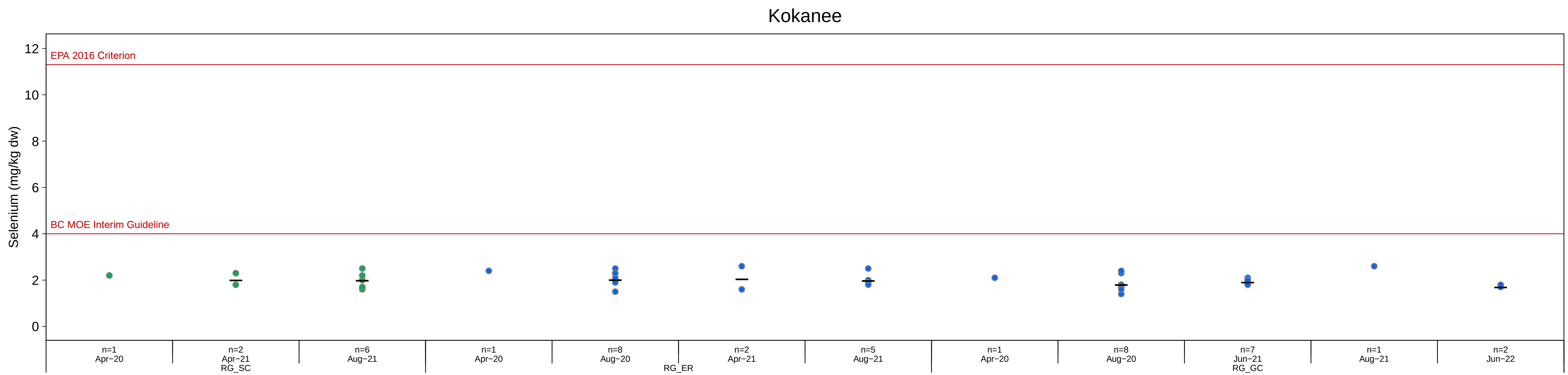


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.



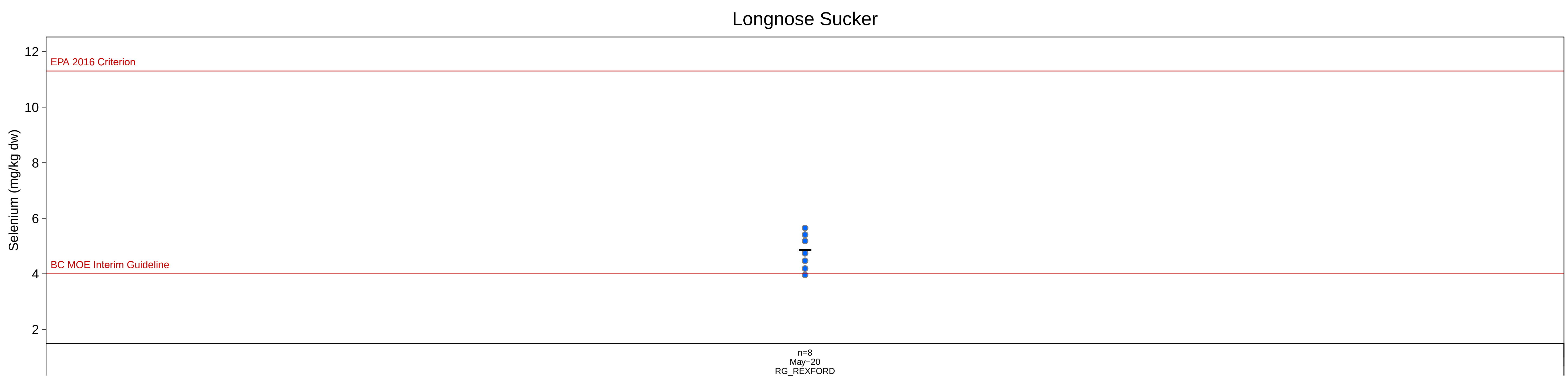


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.

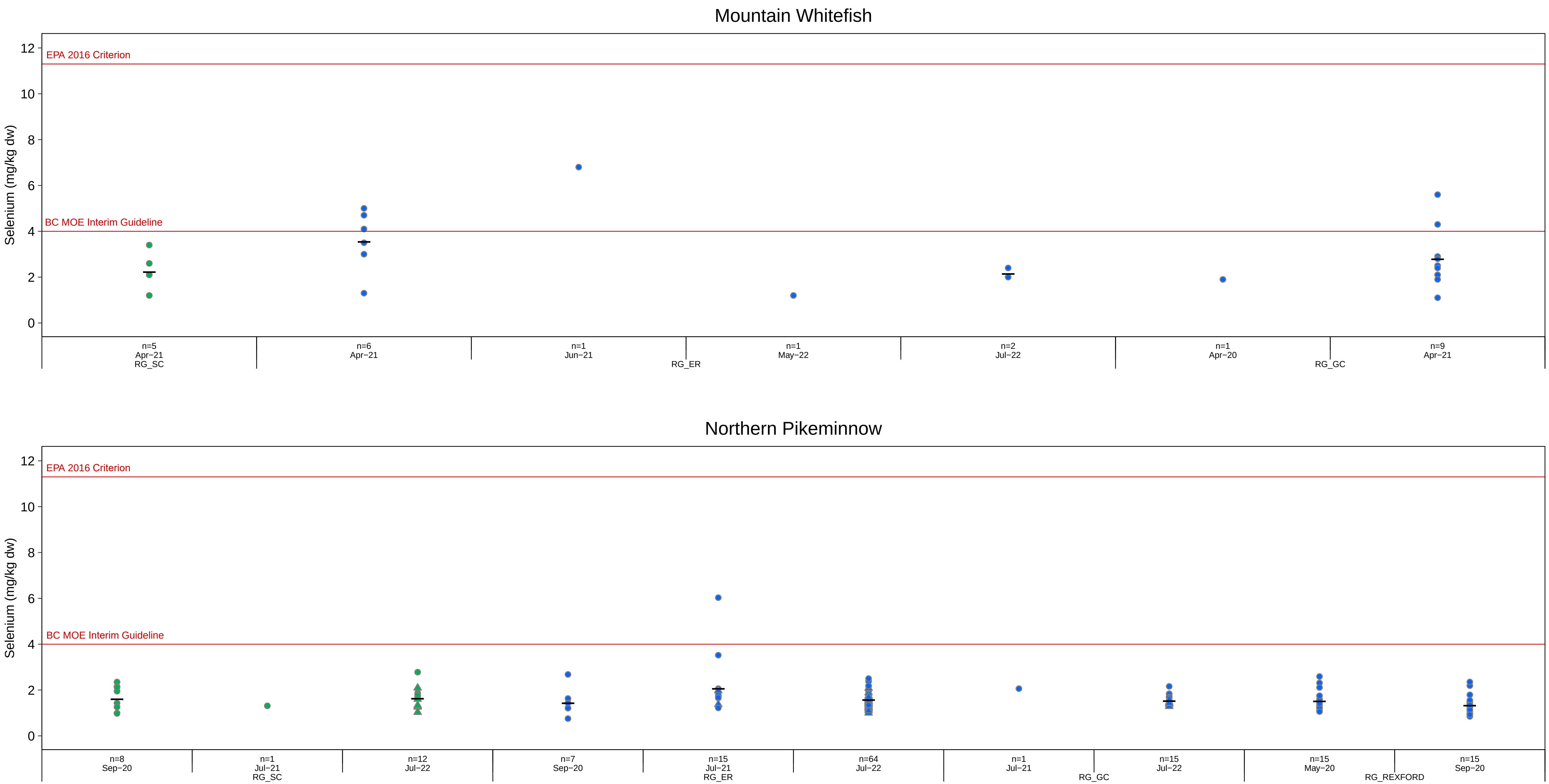


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.

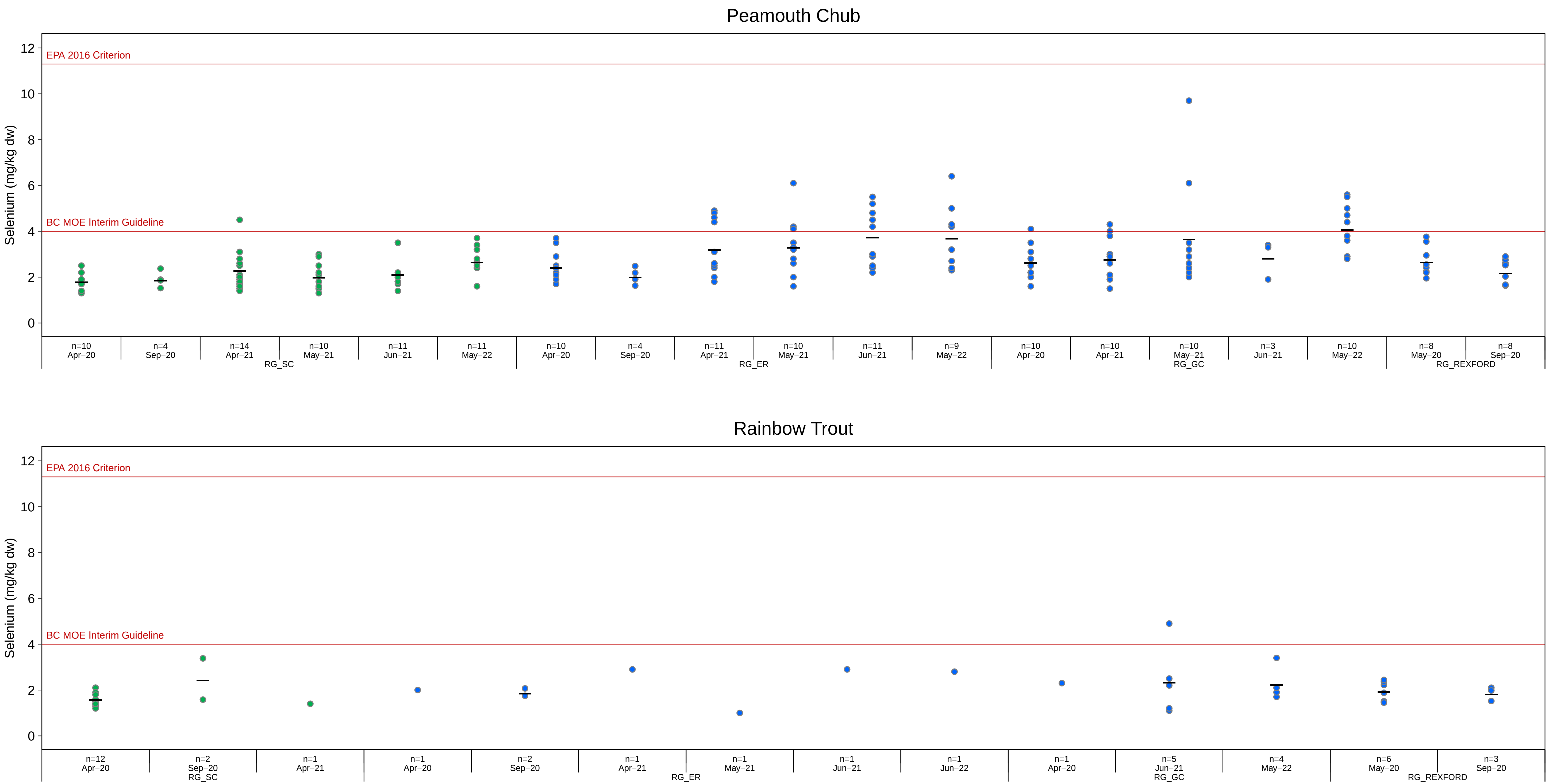


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.

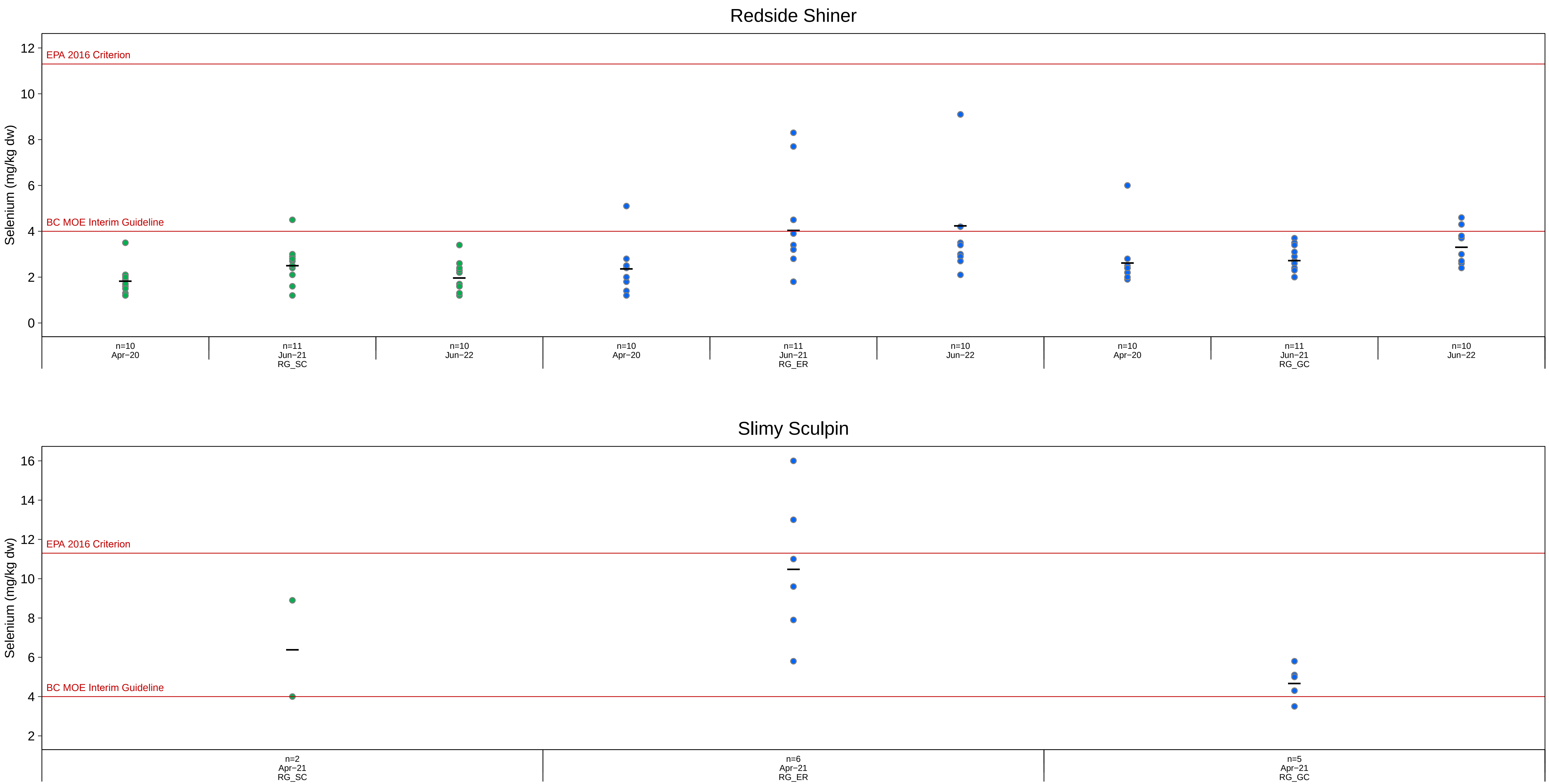
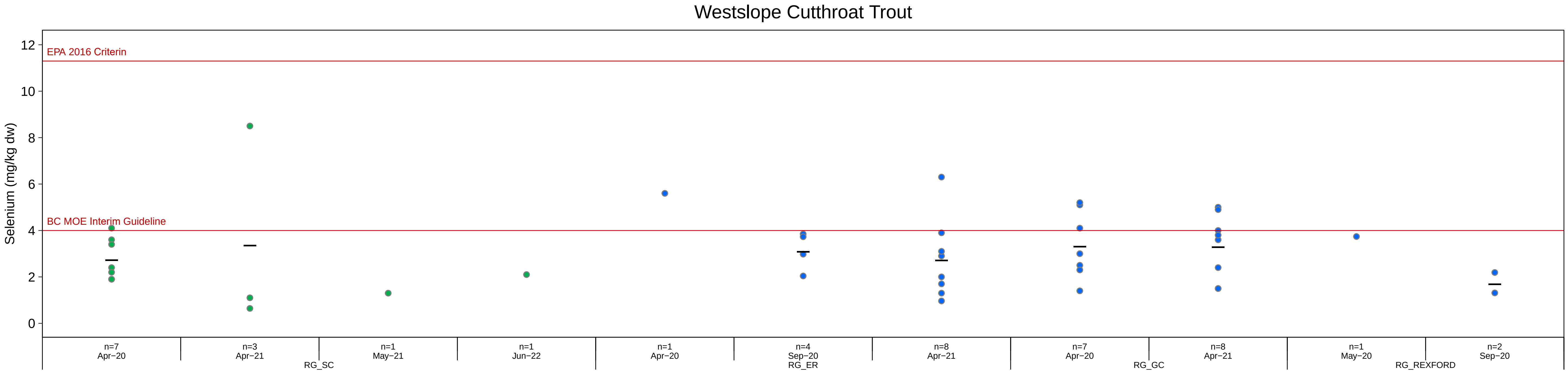


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.



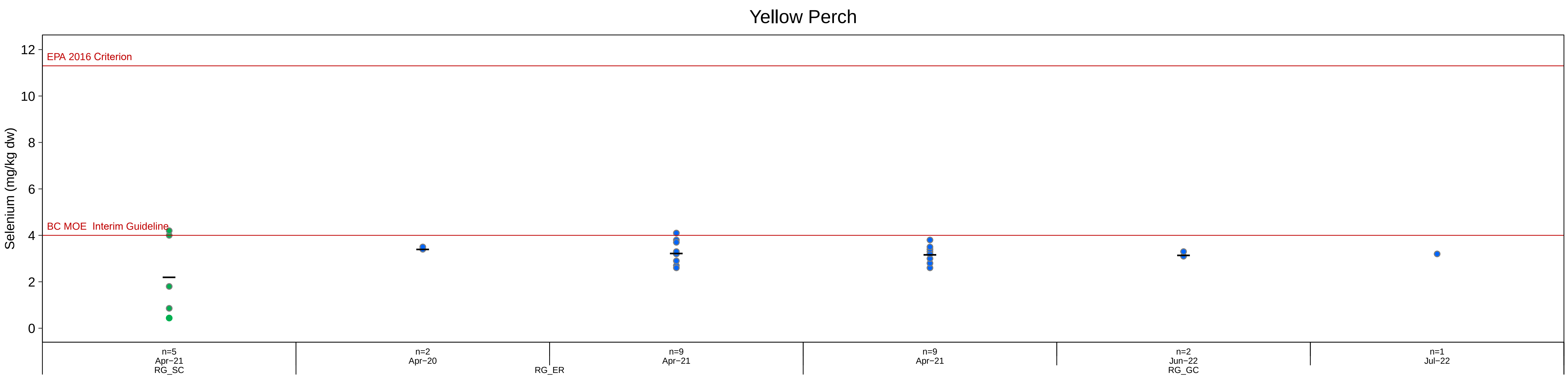


Figure 7.1: Concentrations of Selenium (mg/kg dry weight) in Fish Muscle Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from muscle are plotted as circles and values from whole body are plotted as triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MFWP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MFWP.

Table 7.1: Statistical Comparison of Selenium Concentrations in Fish Tissue Collected Downstream (RG_ER and RG_GC) and Upstream (RG_SC) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Fish Species	Tissue	ANOVA P-Value	Sample Size			Measure of Central Tendency			Comparison to RG_SC			
									RG_ER		RG_GC	
			RG_SC	RG_ER	RG_GC	RG_SC	RG_ER	RG_GC	P-Value	MOD	P-Value	MOD
Bull Trout	Muscle	0.991	5	7	5	1.78	1.82	1.84	ns	ns	ns	ns
Northern Pikeminnow	Muscle	0.515	6	33	8	1.89	1.76	1.71	ns	ns	ns	ns
Peamouth Chub	Muscle	0.007	11	9	10	2.64	3.54	3.99	0.051	ns	0.004	51.1
Redside Shiner	Muscle	<0.001	10	10	10	1.93	3.79	3.28	<0.001	96.1	0.007	69.7
Northern Pikeminnow	Ovary	0.945	6	32	10	3.86	3.74	3.90	ns	ns	ns	ns
Peamouth Chub	Ovary	0.362	11	9	10	8.29	10.1	9.59	ns	ns	ns	ns
Redside Shiner	Ovary	0.009	10	10	10	15.8	16.4	11.3	0.939	ns	0.019	-28.4

P-value < 0.05.

MOD > 0 indicates values were higher downstream relative to upstream.

MOD < 0 indicates values were lower downstream relative to upstream.

Notes: Post-hoc p-values were calculated using a Dunnett Correction for multiple comparisons. MOD = Magnitude of Difference = MCT_{Exp} - MCT_{RG_SC} / MCT_{RG_SC}*100.

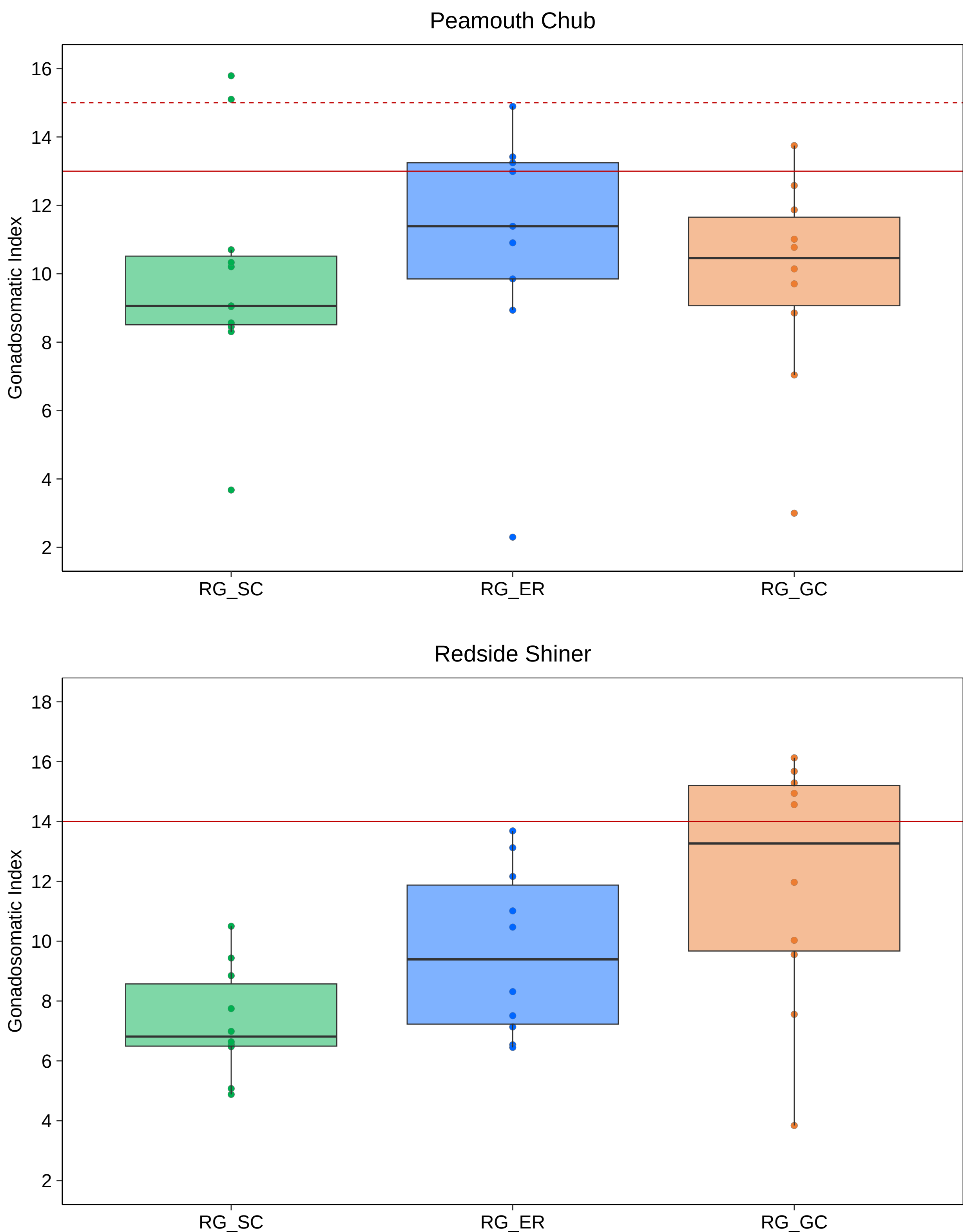


Figure 7.2: Gonadosomatic Index (GSI) of Peamouth Chub (PCC) and Redside Shiner (RSC) Collected Downstream (RG_ER and RG_GC) and Upstream (RG_SC) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Red lines indicate the GSI target range for ripe ovaries by species (13 to 15% for PCC, >14% for RSC). Peamouth chub were collected in May and redside shiner were collected in June.

were within the target GSI range in 2022, however, the majority were not (Figure 7.2; Appendix Table E.4). For female RSC, GSI near 14% reflect ripe ovaries at the time of spawning (Golder 2020), and in June 2022 GSI measures ranging from 7.3% to 11.9% were observed among downstream (RG_ER and RG_GC) and upstream (RG_SC) locations (Figure 7.2; Appendix Table E.5). Of the three study areas, only RSC collected from RG_GC were within the target GSI range, (Figure 7.2; Appendix Table E.5).

Mean ovary selenium concentrations in PCC were below the BC ovary tissue guideline (11 µg/g dw), the US EPA criterion (15.1 µg/g dw) for selenium, and the EVWQP Level 1 benchmark for reproductive effects to fish (18 µg/g dw) for all areas considered (Figure 7.3; Appendix Tables E.7 to F.9). Conversely, mean selenium concentrations in the ovaries of RSC collected at all three study locations in June 2022 were greater than the BC guideline (11 µg/g dw) and exceeded the US EPA criterion (15.1 µg/g dw) both downstream (RG_ER) and upstream (RG_SC) of the Elk River, but were below the species-specific threshold identified during the RSC Selenium Toxicity study[9] (28 µg/g dw ; Figure 7.3; Golder 2020). Spatial comparisons indicated no significant differences in selenium concentrations in PCC and NSC ovary tissue between study areas; however, significantly lower ovary selenium concentrations in RSC were observed downstream of the Elk River (RG_GC) compared to upstream (RG_SC; Table 7.1).

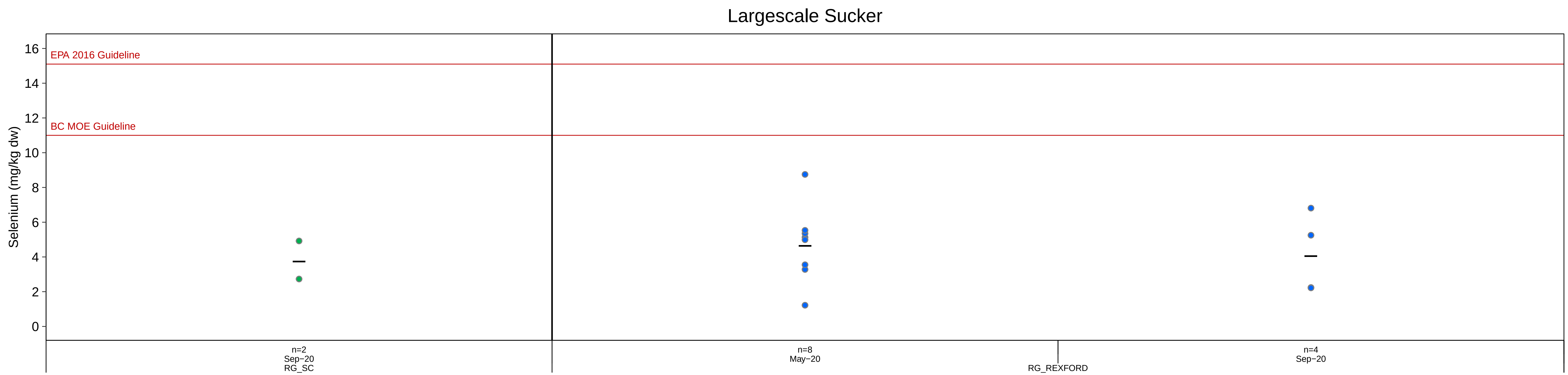
Overall, concentrations of selenium in ovary tissue from PCC and RSC sampled in 2022 appeared to be within respective ranges shown in previous years for like-species suggesting no substantial changes in selenium concentrations in ovary tissue over time at Koocanusa Reservoir downstream and upstream of the Elk River. However, since PCC and RSC were targeted in 2022 during months in which their GSI would be highest based on previous sampling efforts (Minnow 2022), concentrations of selenium in ovary tissues observed in 2022 should not be compared to concentrations previously observed (prior to 2021) without taking historical gonadal development into consideration. Furthermore, since PCC and RSC target GSI ranges used as indicators of ripeness were not met for most individuals sampled in 2022, comparisons to guidelines should also be considered with caution. This will be explored during the three-year temporal analysis.

7.2 Tissue Mercury Concentrations

Mercury concentrations in muscle from all fish sampled downstream and upstream of the Elk River in 2022 were above the BC guideline for the protection of wildlife (0.165 µg/g dw[10]) apart

[9] Note that this threshold was established for egg tissue selenium concentrations (Golder 2020).

[10] The BC guideline for the protection of wildlife (0.033 µg/g ww) was converted to a dry weight basis using the average moisture content in fish muscle in Koocanusa Reservoir of approximately 80%.



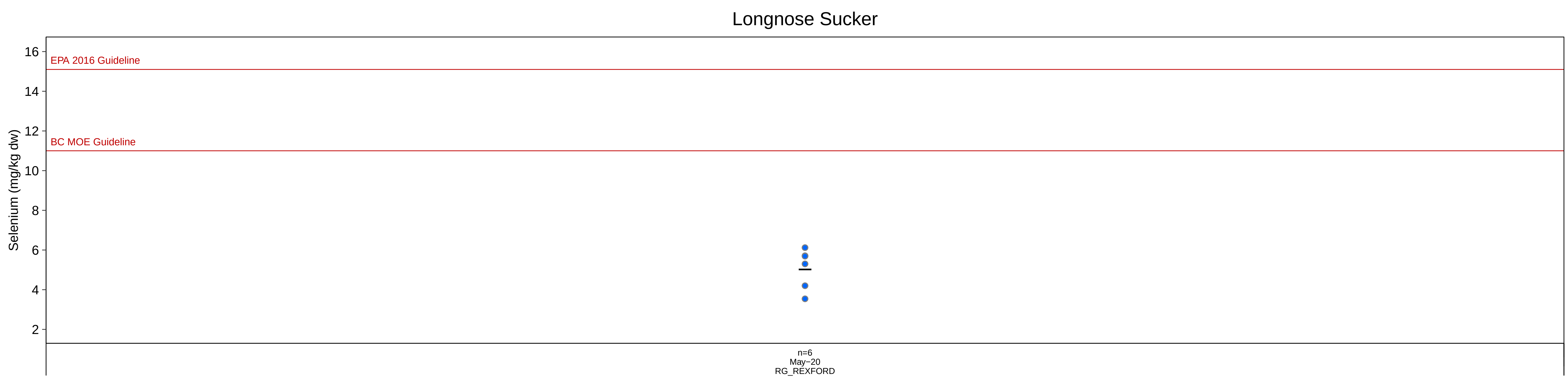
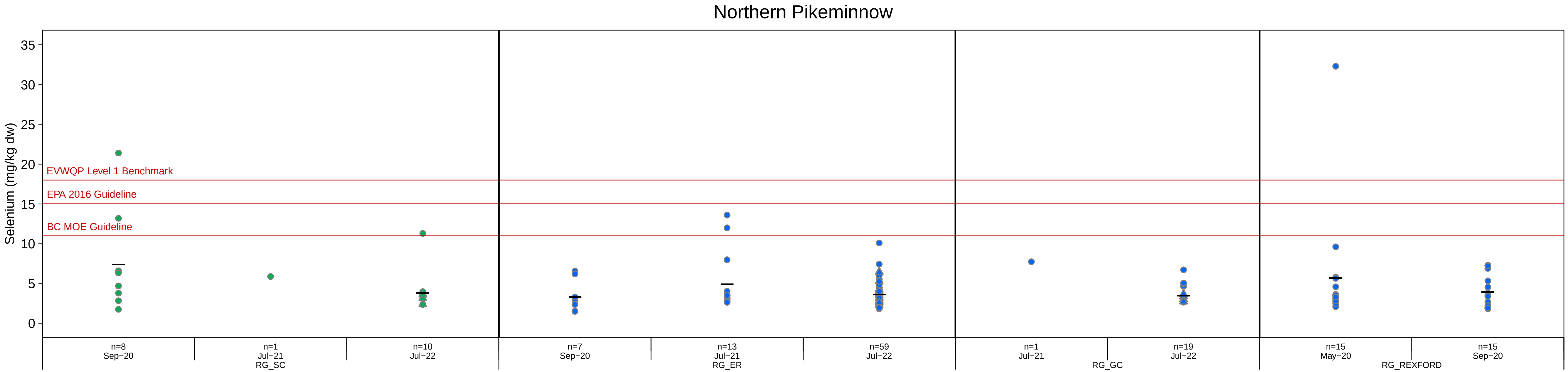


Figure 7.3: Concentrations of Selenium (mg/kg dry weight) in Fish Ovary Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from ovaries are plotted with circles and eggs are plotted with triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. GSI for peamouth chub, redside shiner, and northern pikeminnow were all well below gonadosomatic indices representative of ripe ovaries, therefore, sample selenium concentrations should be interpreted with caution when comparing to guidelines and benchmarks which are shown for context only. This applies to all species represented. The species specific benchmark for redside shiner was established during the Redside Shiner Toxicity Study implemented by Teck in 2019 and applies to egg concentrations, not ovary, however they are included for reference (Golder 2020). The Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MWFP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MWFP.



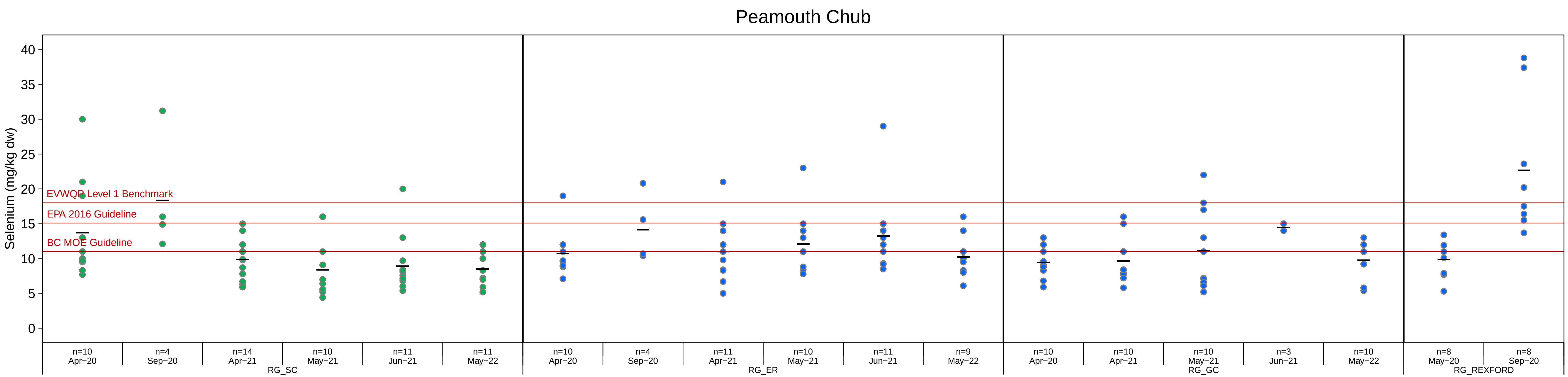
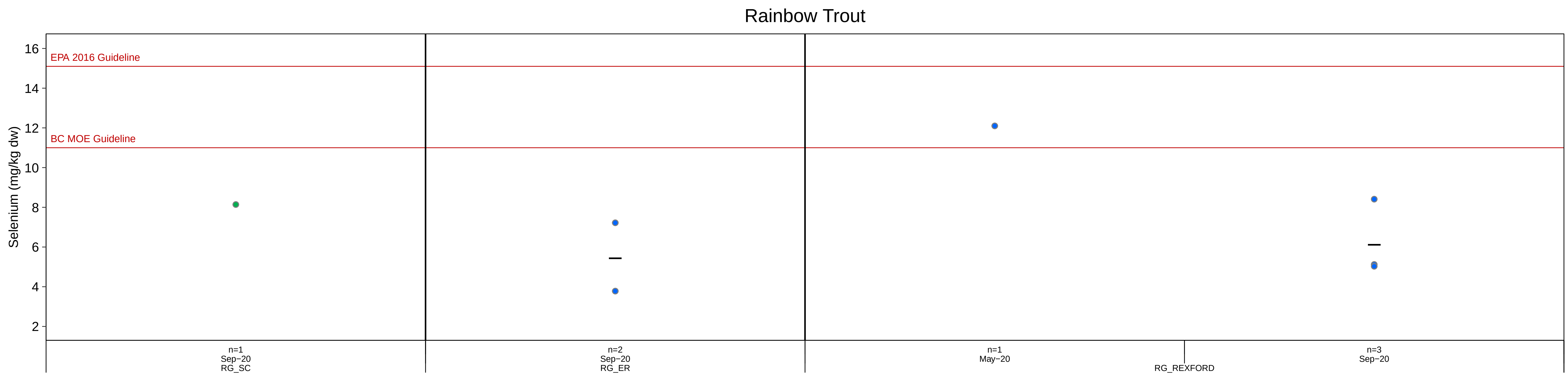


Figure 7.3: Concentrations of Selenium (mg/kg dry weight) in Fish Ovary Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from ovaries are plotted with circles and eggs are plotted with triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. GSI for peamouth chub, redside shiner, and northern pikeminnow were all well below gonadosomatic indices representative of ripe ovaries, therefore, sample selenium concentrations should be interpreted with caution when comparing to guidelines and benchmarks which are shown for context only. This applies to all species represented. The species specific benchmark for redside shiner was established during the Redside Shiner Toxicity Study implemented by Teck in 2019 and applies to egg concentrations, not ovary, however they are included for reference (Golder 2020). The Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MWFP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MWFP.



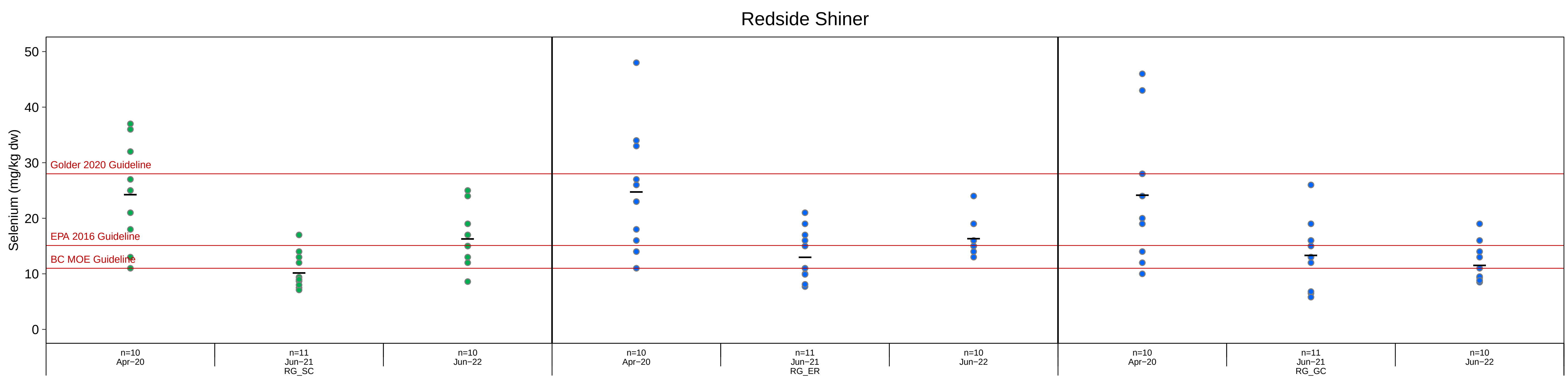
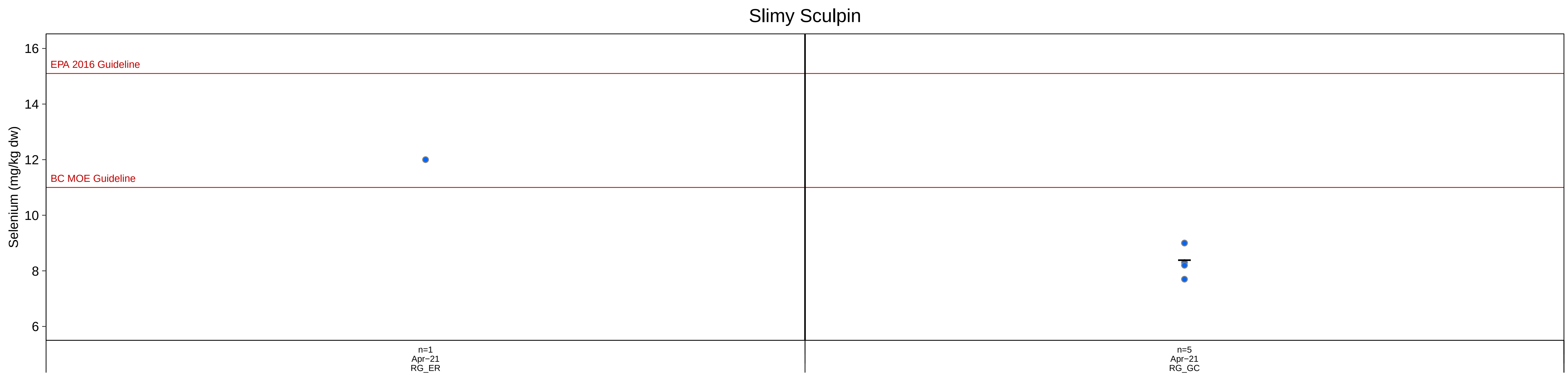


Figure 7.3: Concentrations of Selenium (mg/kg dry weight) in Fish Ovary Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from ovaries are plotted with circles and eggs are plotted with triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. GSI for peamouth chub, redside shiner, and northern pikeminnow were all well below gonadosomatic indices representative of ripe ovaries, therefore, sample selenium concentrations should be interpreted with caution when comparing to guidelines and benchmarks which are shown for context only. This applies to all species represented. The species specific benchmark for redside shiner was established during the Redside Shiner Toxicity Study implemented by Teck in 2019 and applies to egg concentrations, not ovary, however they are included for reference (Golder 2020). The Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MWFP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MWFP.



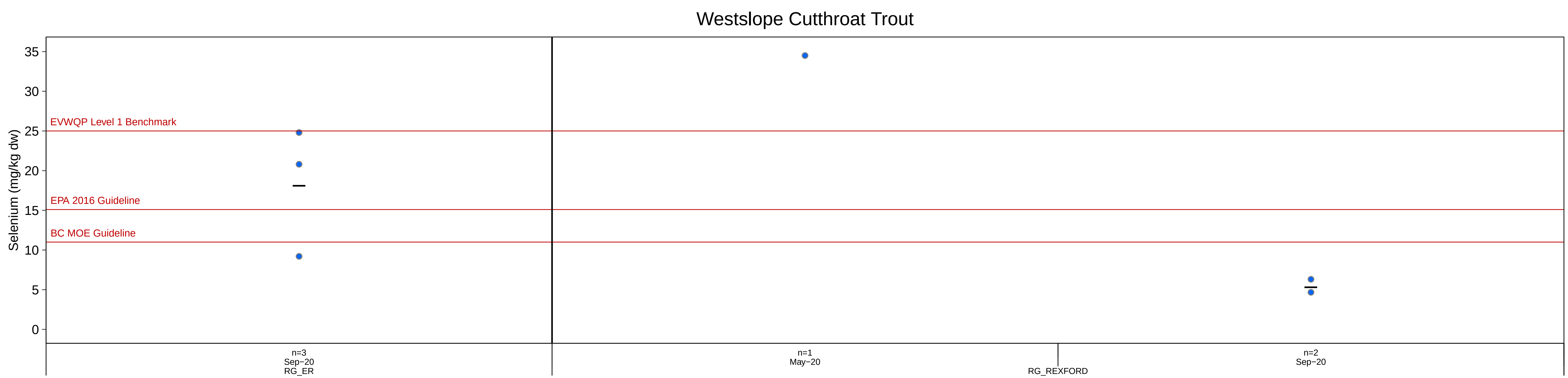


Figure 7.3: Concentrations of Selenium (mg/kg dry weight) in Fish Ovary Tissue, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Notes: Individual values from ovaries are plotted with circles and eggs are plotted with triangles. Areas downstream of the Elk River are shown in blue and areas upstream of the Elk River are shown in green. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Means are plotted as horizontal lines when n > 1. GSI for peamouth chub, redside shiner, and northern pikeminnow were all well below gonadosomatic indices representative of ripe ovaries, therefore, sample selenium concentrations should be interpreted with caution when comparing to guidelines and benchmarks which are shown for context only. This applies to all species represented. The species specific benchmark for redside shiner was established during the Redside Shiner Toxicity Study implemented by Teck in 2019 and applies to egg concentrations, not ovary, however they are included for reference (Golder 2020). The Sand Creek study area is upstream of the Elk River confluence, while the Elk River and Gold Creek study areas are downstream of the Elk River. Sand Creek, Elk River, and Gold Creek samples were collected by Teck, with the exception of some samples for Sand Creek that were collected by MWFP. All other sampling areas in the Koocanusa Reservoir are in the United States and samples were collected by MWFP.

from one MW sample (Figure 7.4). Sample sizes were sufficient to allow for statistical comparison of mercury concentrations in tissues of PCC and NSC between study areas located downstream and upstream of the Elk River in 2022. Relative mercury concentrations in PCC and NSC muscle tissue (i.e., mercury concentration-at-length relationship) showed no significant difference between study areas located downstream and upstream of the Elk River in 2022 (Table 7.2). Overall, mercury concentrations in fish tissue collected from Koocanusa Reservoir in 2022 showed no difference between downstream and upstream of the Elk River and concentrations were below BC guidelines.

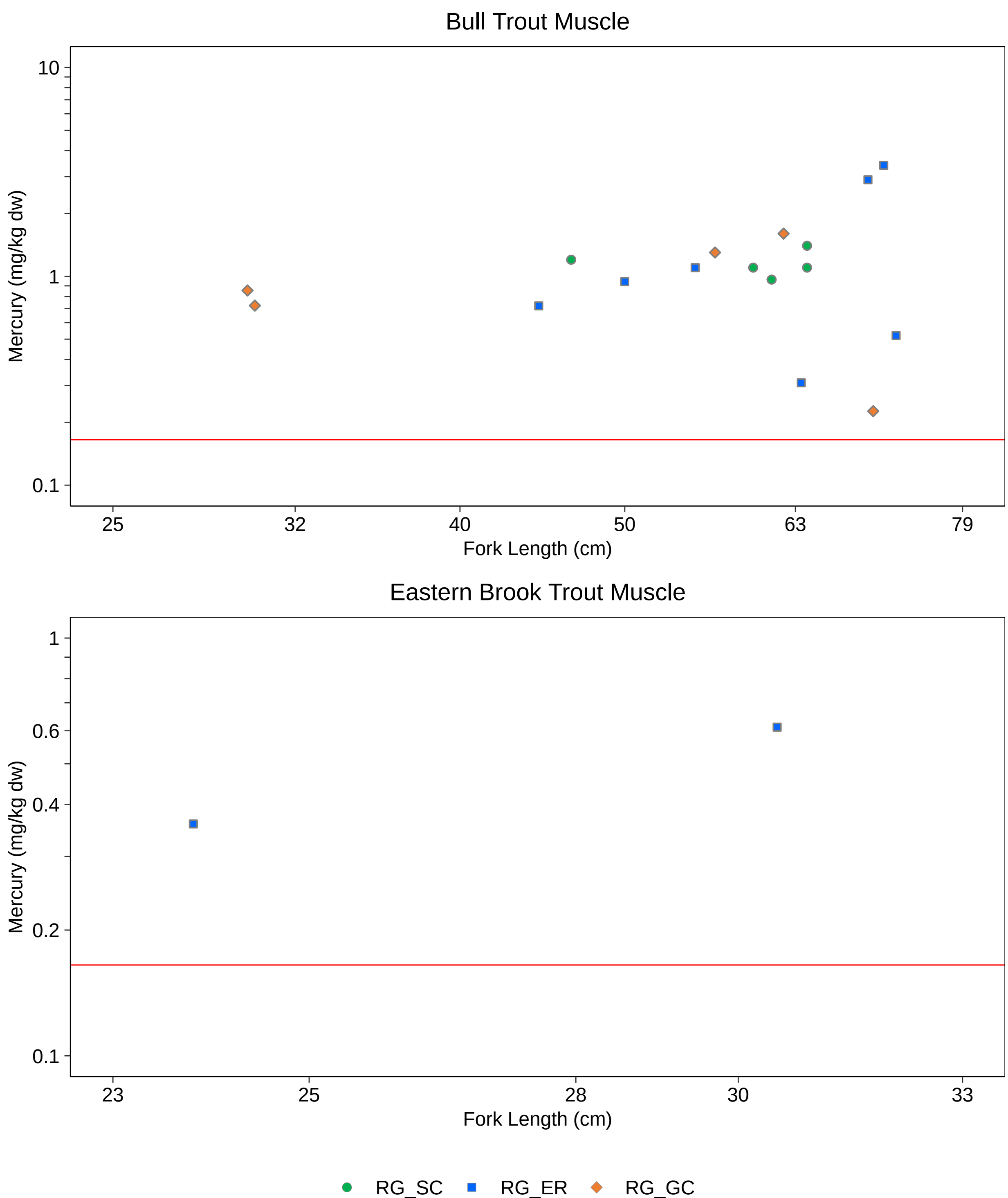


Figure 7.4: Concentrations of Mercury in Fish Muscle Tissue Relative to Fork Length Collected Downstream (RG_ER and RG_GC) and Upstream (RG_SC) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Concentrations of mercury are measured as mg/kg dry weight (dw). Red line = BC Guideline for the Protection of Wildlife = 0.165 mg/kg dw. Values below the laboratory detection limit are shown as open symbols.

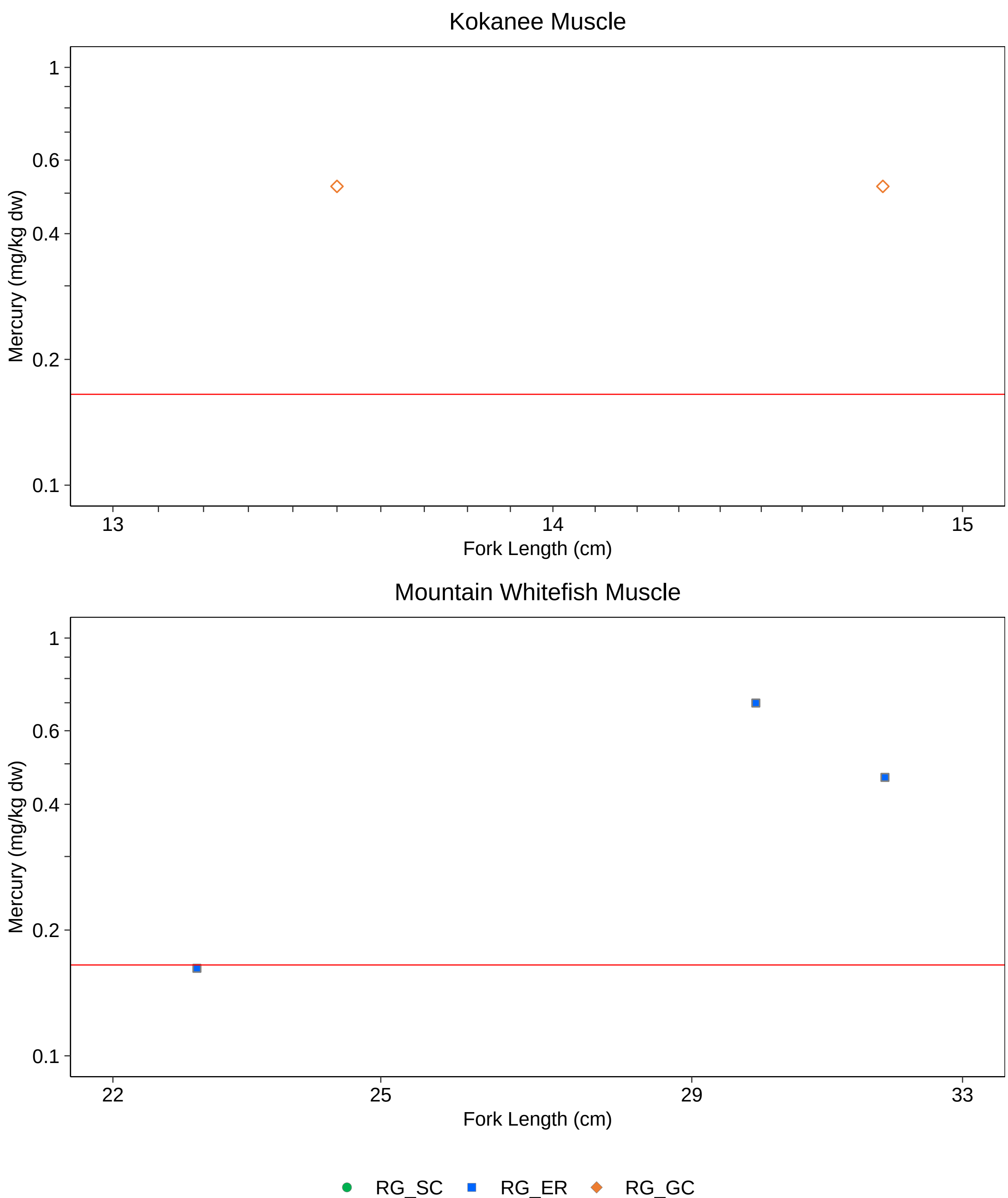


Figure 7.4: Concentrations of Mercury in Fish Muscle Tissue Relative to Fork Length Collected Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Concentrations of mercury are measured as mg/kg dry weight (dw). Red line = BC Guideline for the Protection of Wildlife = 0.165 mg/kg dw. Values below the laboratory detection limit are shown as open symbols.

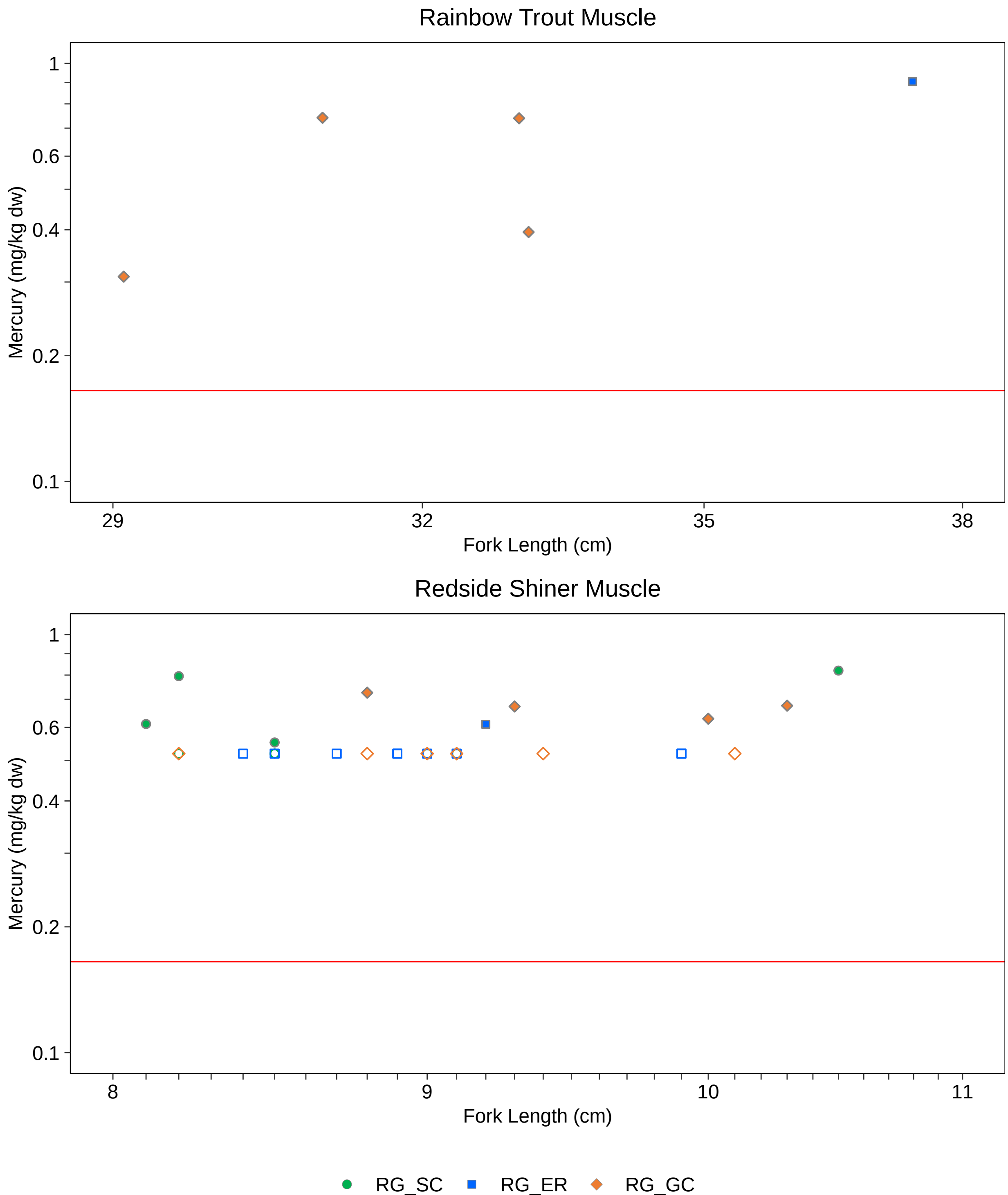


Figure 7.4: Concentrations of Mercury in Fish Muscle Tissue Relative to Fork Length Collected Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Concentrations of mercury are measured as mg/kg dry weight (dw). Red line = BC Guideline for the Protection of Wildlife = 0.165 mg/kg dw. Values below the laboratory detection limit are shown as open symbols.

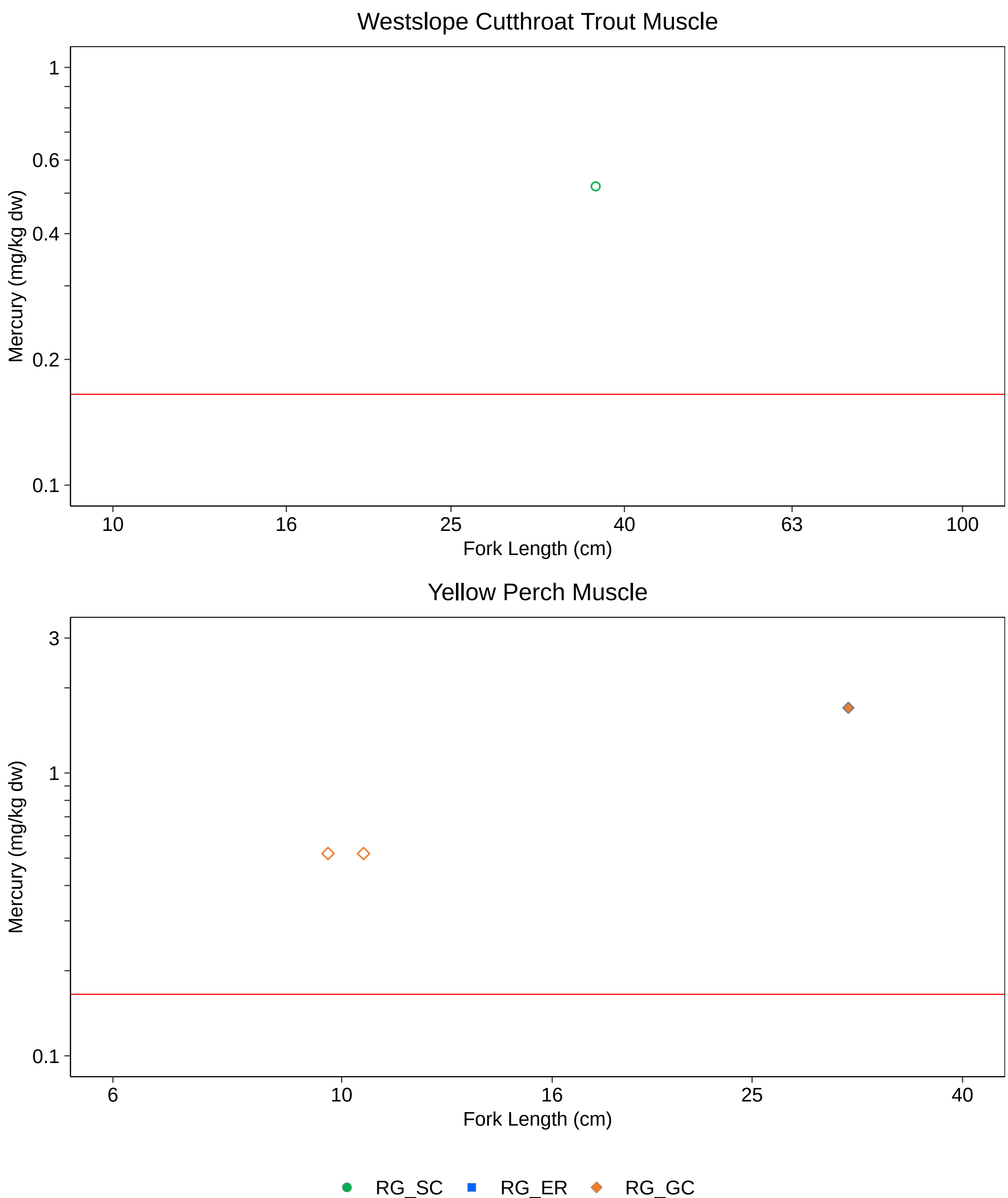


Figure 7.4: Concentrations of Mercury in Fish Muscle Tissue Relative to Fork Length Collected Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Notes: Concentrations of mercury are measured as mg/kg dry weight (dw). Red line = BC Guideline for the Protection of Wildlife = 0.165 mg/kg dw. Values below the laboratory detection limit are shown as open symbols.

Table 7.2: Statistical Comparison of Mercury Concentrations in Fish Tissue Relative to Fork Length Downstream (RG_ER and RG_GC) and Upstream (RG_SC) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Species	Tissue	Sample Size			ANCOVA Model Statistics			Measure of Central Tendency[b]				Overall Test P-value (Area)	Pairwise Comparisons[c]			
					Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]						Sand Creek vs. Elk River		Sand Creek vs. Gold Creek	
		RG_SC	RG_ER	RG_GC	Interaction P-value	Covariate P-value		Statistic	RG_SC	RG_ER	RG_GC		P-value	Magnitude of Difference (%)[d]	P-value	Magnitude of Difference (%)[d]
Northern Pikeminnow	Muscle	6	33	8	0.159	0.001	47.0	Adjusted Mean	1.83	1.40	1.44	0.070	ns	ns	ns	ns
Peamouth Chub	Muscle	11	9	10	0.093	0.031	23.2	Adjusted Mean	1.35	1.14	0.874	0.051	ns	ns	ns	ns

Significant P-value (P-value < 0.05).

Non-significant covariate (P-value > 0.05).

MOD > 0 indicate values were higher downstream relative to upstream.

MOD < 0 indicate values were lower downstream relative to upstream.

Note: ns = not significant.

[a] The mean value of the covariate (that corresponds to the adjusted means for the response variable) for the parallel slope ANCOVA model or the minimum and maximum values of the overlap in covariate values for the interaction ANCOVA model.

[b] The geometric mean. The predicted means of the regression line equations are reported for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVA when a significant interaction is observed.

[c] Pairwise comparisons conducted using Tukey's Honestly Significant Differences (differences in means for parallel slope models; differences in slopes for interaction models).

[d] Calculated as the difference in Measure of Central Tendency (MCT) between areas (downstream minus upstream), expressed as a percentage of the upstream area MCT.

8 INTEGRATED CONCLUSION AND SUMMARY

The Koocanusa Reservoir Monitoring Program was conducted in 2022 to assess spatial differences in physico-chemical and biological conditions in Koocanusa Reservoir. In accordance with this monitoring program and conditions of British Colombia Ministry of Environment and Climate Change Strategy Permit 107517 (Section 9.8), this annual report provides an overview of the environmental monitoring activities conducted in Koocanusa Reservoir, together with a summary of the associated results. The principal findings from the Koocanusa Reservoir Monitoring Program in 2022 are summarized below.

Study Area

Koocanusa Reservoir is approximately 145 km in length and straddles the Canada-United States (British Columbia-Montana) border. The Elk River flows southwesterly into Koocanusa Reservoir approximately 20 kilometres (km; 12 miles) upstream from the border between Canada and the United States. The southern section of the reservoir downstream of the mouth of the Elk River represents the mine-influenced area and includes the Elk River (RG_ER) and Gold (RG_GC) study areas, and the downstream biological transect RG_T4. The northern section of the reservoir upstream of the Elk River represents the area not directly influenced by mine activity, and includes the Sand Creek study area (RG_SC) and the upstream biological transect RG_TN. Although the upstream study areas are upstream of mine-influence associated with the Elk River, they cannot be considered true reference areas due to potential groundwater influence from the Elk Valley via Kikomun Creek. These areas are respectively referred to as downstream and upstream of the Elk River.

The Koocanusa Reservoir is a managed reservoir that was created to provide flood protection and hydroelectric power. As such, water levels within Koocanusa Reservoir are generally lowest in late winter/early spring (i.e., February through April) and highest in summer/early fall. Management of water levels within Koocanusa Reservoir likely influences biological community structure, and thus must also be taken into consideration when evaluating potential biological effects.

Water Quality

Water levels in the reservoir in 2022 were low during the spring (April to end of June), resulting in the inability to conduct the April sampling event due to riverine conditions (i.e., strong flow, large floating woody debris, and dry sediment bars). The first sampling event was therefore conducted in May 2022.

Order constituents (except for selenium), as well as non-order constituents had monthly average concentrations below or equal to applicable BC water quality guidelines and applicable Site Performance Objectives (SPOs) throughout 2022 at all permitted water quality stations. Monthly average concentrations of selenium in water were above the guideline on at least one occasion at RG_GRASMERE, RG_USGOLD, and RG_BORDER, and exceeded the SPO in April at RG_DSELK.

Productivity assessment indicated annual median nitrogen:phosphorus (N:P) ratios were consistently ≤15 throughout the water column at all permitted water quality stations in 2022, and thus indicative of phosphorus limitation. Trophic status classification suggest Koocanusa was primarily oligotrophic to mesotrophic most of the year.

Monthly loadings of nitrate and selenium from the Elk River to the reservoir were highest from May to July, with the peak coinciding with freshet in June. In the Kootenay River, May to August showed the highest loadings for nitrate and selenium, with peak loadings occurring in June. Loadings of both nitrate and selenium to Koocanusa Reservoir were higher from the Elk River than from the Kootenay River on both a monthly and annual timescale.

Sediment

Sediment downstream and upstream of the Elk River was primarily composed of silt-sized material and lesser amounts of clay-sized material. Lower proportions of clay and higher proportion of silt and total organic carbon were present downstream of the Elk River compared to upstream. No differences in proportions of sand or gravel were recorded between areas. Arsenic, iron, manganese, nickel, and zinc concentrations in sediment were elevated above the lower Working Sediment Quality Guideline (WSQG) at one or more stations downstream of the Elk River. Of these metals, sediment concentrations of arsenic, iron, manganese, and nickel were also above the lower WSQG at the upstream area suggesting relatively elevated background concentrations of these four parameters. Several metals and polycyclic aromatic hydrocarbons (PAHs) occurred at significantly higher concentrations in sediment downstream of the Elk River compared to upstream in 2022, but their concentrations were not elevated above respective guidelines.

Zooplankton Community and Tissue Chemistry

In 2022, within the zooplankton community, the overall density was significantly higher, and the overall biomass was significantly lower downstream of the Elk River compared to upstream, and no difference in overall community richness was indicated between transects. The density and biomass of Cladocera and Rotifera was lower and higher, respectively, downstream of the

Elk River compared to upstream. There was no spatial difference in Copepoda biomass and density.

Zooplankton tissue selenium concentrations were below the BC chronic interim guideline both downstream and upstream of the Elk River. Selenium concentrations in zooplankton tissue were higher downstream of the Elk River compared to upstream.

Benthic Invertebrate Tissue Chemistry

Benthic invertebrate tissue collected downstream and upstream of the Elk River in June and August 2022 contained selenium concentrations that were above the BC interim guideline but below the Elk Valley Water Quality Plan (EVWQP) Level 1 benchmark.

Fish Tissue Chemistry

Mean selenium concentration in muscle tissue of all fish sampled were below the applicable BC interim fish muscle tissue guideline and United Stated Environmental Protection Agency (US EPA) criterion at all areas in 2022, except for RSC in June at RG_ER, which was above the BC interim guideline but below the US EPA criterion. Peamouth chub (PCC) and redside shiner (RSC) captured downstream showed significantly higher muscle selenium concentrations than upstream in 2022, but concentrations were lower than guidelines (apart from RSC in June at RG_ER), and therefore the differences are not to be expected ecologically significant.

PCC were targeted in May 2022, as it provided the best opportunity to capture gravid females for the collection of ripe ovaries. RSC were targeted in June 2022 to collect females with higher gonadosomatic index (GSI) than in previous years. GSI targets for PCC (between 13 to 15%) and RSC (>14%) were not met for all individuals captured for the study. For PCC, individuals from each study area were captured in or near the target GSI, whereas for RSC, only individuals captured at RG_GC were in or near the target GSI. Mean selenium concentrations in the ovaries of PCC samples at all three study areas in May, and both downstream and upstream, were below the BC ovary/egg tissue guideline, US EPA criterion, and EVWQP Level 1 benchmark and had no significant spatial difference. Mean selenium concentration in ovaries of RSC collected at all three study locations in June were greater than the BC guideline and US EPA criterion downstream and upstream but were below the species-specific threshold for no observable effects. Furthermore, selenium concentrations in RSC ovary tissue collected downstream of the Elk River were lower compared to upstream. Historical ovary selenium concentrations in PCC and RSC were generally not collected within the target GSI range creating uncertainty in temporal comparisons. This issue and associated uncertainty will be explored during the three-year temporal analysis.

Conclusion

This annual summary report provides an overview of environmental monitoring activities conducted in Koocanusa Reservoir, along with the associated results from 2022. The next annual summary report will cover data from 2023 and is due to ENV in June 2024. Data collected from 2020 to 2022 will be used to address key questions related to changes over time and will be presented in the three-year interpretive report due to ENV in December 2023. Environmental Monitoring Committee (EMC) Advice and Input will be addressed in the three-year interpretive report.

9 REFERENCES

Azimuth (Azimuth Consulting Group Partnership). 2018. Proposed Water Quality Triggers for the Elk Valley Adaptive Management Plan. Prepared for Teck Resources Limited, Vancouver, British Columbia. June 2018.

BCMOE (British Columbia Ministry of Environment). 2019. Approved Water Quality Guidelines for British Columbia. Available from http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines [Accessed February 2021].

BCMOE. 2021. British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Protection & Sustainability Branch. Available from http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/bc_env_working_water_quality_guidelines.pdf [Accessed February 2021].

Brix, K.V., M. Hecker, M. Carr. 2020. Evaluation of Selenium Reproductive Effects on Northern Pikeminnow (*Ptychocheilus oregonesis*), Draft Report. Submitted to Teck Coal Limited. Dated February 2020.

Brooks, J. L. 1957. The systematics of North American Daphnia. Mem. Conn. Acad. Arts Sci. 13: 1-80.

Carlson R. 1977. A Trophic State Index for Lakes. Limnol. Oceanogr. 22(2).361-362.

Clarke, SE. 1993. Non-parametric multivariate analyses of changes in community structure. Aus. J. Ecol. 18: 117:143.

DeForest, D. and W.J. Adams. 2020. Comments on Koocanusa Reservoir Selenium Modeling and Recommendations for Site-specific Selenium Criteria. Prepared for MT DEQ and BC ENV August 2020.

ENV (British Columbia Ministry of Environment and Climate Change Strategy). 2018. Re: Final Koocanusa Reservoir Study Design, 2018 – 2020. Received June 8, 2018.

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. ISBN 978-1-100-20496-3.

Golder (Golder Associates Ltd.). 2014. Benchmark Derivation Report for Selenium. Annex E of the Elk Valley Water Quality Plan. Prepared for Teck Coal Limited. July 2014.

Golder. 2020. Study of the Reproductive Effects of Selenium on Redside Shiner (*Richardsonius balteatus*). Prepared for Teck Coal Limited. August 2020.

Gray, R.H., and D.D. Dauble. 2001. Some Life History Characteristics of Cyprinids in the Hanford Reach, Mid-Columbia River. Northwest Sci. (75): 122-136

Hamilton, H.R., L.R. Linton, P. Chow-Fraser, B. Taylor, and D. Fernet. 1990. Koocanusa Reservoir State of the Aquatic Environment 1972-1988. Prepared by HydroQual Canada Limited, Calgary, for Waste Management Branch, B.C. Ministry of Environment, Cranbrook. March.

Janz, D.M., D.K. DeForest, M.L. Brooks, P.M. Chapman, G. Gilron, D. Hoff, W.A Hopkins, D. O McIntyre, C.A. Mebane, V.P. Palace, J.P. Skorupa, and M. Wayland. 2010. Selenium Toxicity to Aquatic Organisms. Pages 139-230 in P.M. Chapman, W.J. Adams, M.L.Brooks, C.G. Delos, S.N. Luoma, W.A. Maher, H.M. Ohlendorf, T.S. Presser, and

D.P. Shaw, editors. Ecological Assessment of Selenium in the Aquatic Environment. Society of Environmental Toxicology and Chemistry (SETAC), Pensacola, Florida.

Kirchner W.B. 1975. The effect of oxidized material on the vertical distribution of freshwater benthic fauna. Freshwat. Biol. 5:423-429.

Lotic (Lotic Environmental Ltd). 2017. Lake Koocanusa Food Web. Prepared for the B.C. Ministry of Environment by Lotic Environmental Ltd. Cranbrook, B.C. 19 pp.

Malley, D.F., S.G. Lawrence, M.A. MacIver, and W.J. Findlay. 1989. Range of variation in estimates of dry weight for planktonic Crustacea and Rotifera from temperate North American lakes. Can. Tech. Rep. Fish. Aquat. Sci. 1666: iv+49p.

McDowell, R.W., S.T. Larned, and D.J. Houlbrooke. 2009. Nitrogen and phosphorous in New Zealand streams and rivers: Control and impact of eutrophication and the influence of land management. New Zeal. J Mar. Fresh. 43: 985-995.

Minnow (Minnow Environmental Inc.). 2014. Lake Koocanusa Sediment Quality Characterization – 2013. Prepared for Teck Coal Limited, Sparwood BC. February. Project #2490.

Minnow. 2015a. Lake Koocanusa 2014 Biological Monitoring Program Report. Prepared for Teck. March. Project #2509.

Minnow. 2015b. Burbot Monitoring in Lake Koocanusa 2014 and 2015. Prepared for Teck Coal Limited, Sparwood, British Columbia. July. Project #2557.

Minnow. 2016. Lake Koocanusa 2015 Biological Monitoring Program Report. Prepared for Teck. March. Project #2564.

Minnow. 2018. Koocanusa Reservoir Monitoring Report, 2014 to 2016. Prepared for Teck Coal Limited, Sparwood, British Columbia. January. Project #167202.0049

Minnow. 2019. Koocanusa Reservoir Monitoring Program Annual Report, 2018. Prepared for Teck Coal Limited, Sparwood, British Columbia. June 2019. Project #187202.0007

Minnow. 2020. Koocanusa Reservoir Monitoring Program Annual Report, 2019. Prepared for Teck Coal Limited, Sparwood, British Columbia. June 2020. Project #197202.0008

Minnow. 2021. Koocanusa Reservoir Monitoring Program Study Design, 2021 to 2023. Prepared for Teck Coal Limited, Sparwood, British Columbia, February 2021. Project #207202.0012

Minnow. 2022. Koocanusa Reservoir Monitoring Program Annual Report, 2021. Prepared for Teck Coal Limited, Sparwood, British Columba. June 2022. Project#217202.0017

Minnow. 2022a. Summary of Northern Pikeminnow Studies in Koocanusa Reservoir, 2021. Prepared for Teck Coal Limited, Sparwood, British Columbia. June 2022. Project#217202.0042

Minnow. 2022b. Study Design for the Evaluation of Maternally Transferred Selenium on Early Life Stage Development of Northern Pikeminnow (*Ptychocheilus orgonensis*). Prepared for Teck Coal Limited, Sparwood, British Columbia. June 2022.

Minnow. 2023. RG_SAND Feasibility Investigation. Prepared for Teck Coal Limited, Sparwood, British Columbia. April 2023. Project#227202.0031.

Province of BC (Province of British Columbia). 2013. British Columbia Field Sampling Manual (complete). Available from https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual?keyword=field&keyword=sampling&keyword=manual. Accessed December 15, 2017.

Province of BC. 2020. British Columbia Environmental Laboratory Manual (complete). Available from https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-environmental-laboratory-manual. Accessed November 2020.

Ramboll Environ (Ramboll Environ US Corporation). 2016. Elk Valley Permit 107517. Section 9.9 Human health risk assessment (revision). September 14, 2016 (updates)

Ruxton, Graeme D. 2006. The unequal variance t-test is an underused alternative to Student's t-test and the Mann–Whitney U test. Behavioral Ecology 17.4: 688-690.

Sanders, R.E., R.J. Miltner, C.O. Yoder, and E.T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: A case study of seven Ohio streams. In: T.P. Simon (Ed.), pp: 225-246, Assessing the sustainability, and biological integrity of water resources using fish communities. CRC Press, Boca Raton, FL.

Teck (Teck Coal Limited). 2014. Elk Valley Water Quality Plan. Submitted to the British Columbia Minister of Environment for Approval on July 22, 2014.

Teck (Teck Resources Limited). 2018a. Water Quality Adaptive Management Plan for Teck Coal Operations in the Elk Valley. December

Teck (Teck Resources Ltd.). 2018b. Permit 107517 2017 Summary Report of Monitoring Results in the Koocanusa Reservoir. June 28, 2018.

Teck (Teck Coal Limited). 2019. Permit 107517 Annual Water Quality Monitoring Report. Submitted to BCMOE on March 29, 2019.

Teck (Teck Coal Limited). 2020. Permit 107517 Annual Water Quality Monitoring Report. Submitted to BCMOE on March 31, 2020.

Teck. 2022. Permit 107517 Annual Water Quality Monitoring Report. Submitted to ENV on March 31, 2022.

Therneau, T.M. 2017. Survival analysis. Package "survival" for R. April 4, 2017. URL https://cran.r-project.org/web/packages/survival/survival.pdf

US ACE (United States Army Corps of Engineers). 2023. Columbia River Basin Water Management Division, Northwestern Division, Data Query 2.0 [online]. Available from https://www.nwd-wc.usace.army.mil/dd/common/dataquery/www/?k=libby# [accessed April 2023].

US EPA (United States Environmental Protection Agency). 2007. Carlson's Trophic State Index. Aquatic Biodiversity. Http://www.epa.gov/bioindicators/aquatic/carlson.html

US EPA. 2016. Aquatic Life Ambient Water Quality Criterion for Selenium - Freshwater. EPA 822-R-16-006

Wilson, M.S. 1959. Calanoida, p. 738-794. In W.T. Edmondson [ed.] Freshwater Biology. 2nd ed. John Wiley & Sons, New York, NY.

Woods, P.F. 1982. Annual nutrient loadings, primary productivity, and trophic state of Lake Koocanusa, Montana and British Columbia, 1972-80. Geological Survey Professional Paper 1283. Prepared for the U.S. Army Corps of Engineers. Seattle District.

Yeatman, H. C. 1959. Cyclopoida, p. 795-815. In W.T. Edmondson [ed.] Freshwater Biology. 2nd ed. John Wiley & Sons, New York, NY.

Table of Contents: Appendix Figures

Table of Contents: Appendix Tables

APPENDIX A

DATA QUALITY REVIEW

APPENDIX A DATA QUALITY REVIEW

A1 INTRODUCTION

A1.1 Background

A variety of factors can influence the physical, chemical, and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on their magnitude, inaccuracy or imprecision have the potential to affect the reliability of conclusions made from data. Therefore, it is important to ensure that programs incorporate appropriate steps to control non-natural sources of data variability (i.e., minimize variability that does not reflect authentic spatial and temporal variability in the environment) and thus assure the quality of the data. Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. A Data Quality Review (DQR) involves the comparison of field and laboratory measurement performance to Data Quality Objectives (DQOs) established for a particular study, such as evaluation of Laboratory Reporting Limits (LRLs), blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). Trusted analytical laboratories certified by Canadian Association for Laboratory Accreditation (CALA) or the National Environmental Laboratory Accreditation Program (NELAP) with a rigorous internal quality assurance program were selected to ensure the highest possible data quality. Data Quality Objectives were established *a priori* to reflect reasonable and achievable performance expectations (Table A.1). Programs involving many samples and analytes usually yield some results that exceed DQOs. This is particularly so for multi-element scans, as the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet DQOs. Overall, the intent of a DQR is not to reject any measurement that did not meet a DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of the project.

A1.2 Quality Control Samples

A DQR was conducted on all laboratory data collected as part of the 2022 Koocanusa Reservoir Monitoring Program. The objective of a DQR is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions. A DQR involves the examination of analytical results associated

Table A.1: Laboratory Data Quality Objectives for the Koocanusa Monitoring Program, 2022

Quality Control Measure	Quality Control Sample Type/Check	Study Component					
		Water Chemistry	Selenium Speciation	Sediment Chemistry	Benthic Invertebrate Community	Benthic Invertebrate, Fish, and Zooplankton Tissue Chemistry	Zooplankton Community
		ALS Environmental	**Brooks Applied Labs**	**ALS Environmental**	**Cordillera Consulting**	**TrichAnalytics**	**Salki**
Analytical Laboratory LRLs	Comparison of actual LRL versus target LRL	LRL for each parameter should be at least as low as applicable guidelines, benchmarks, and screening values	LRL for each parameter should be at least as low as applicable guidelines, benchmarks, and screening values	LRL for each parameter should be at least as low as applicable guidelines and benchmarks	-	LRL for each parameter should be at least as low as applicable guidelines and benchmarks	-
Blank Analysis	Field, Trip, or Laboratory Blank	Concentrations measured in blank samples should be < LRL	Concentrations measured in blank samples should be < LRL	Concentrations measured in blank samples should be < LRL	-	-	-
Laboratory Precision	Laboratory Duplicates	< 4% (pH) <10% (conductivity) ≤15% RPD or <2x LRL (ORP, turbidity) ≤20% RPD or <2x LRL (all remaining analytes)	≤25% RPD (selenium species) ≤20% RPD (total selenium)	≤ 5% RPD (pH 1:2soil:water) ≤20% RPD (inorganic carbon, moisture) ≤30% RPD, 40% RPD or diff < 2x LOR (total metals) ≤ 50% RPD, 60-130% RPD or diff < 2xLOR RPD (PAHs)	-	≤60% RPD (calcium and strontium) ≤40% RPD (all remaining analytes)	-
	Organism Sorting Efficiency	-	-	-	≥ 95%	-	-
	Organism Sub-Sampling Precision and Accuracy	-	-	-	< 20% between subsamples	-	≤20% difference between sub-samples; minimum of 5% of each sample must be analyzed
Accuracy	Recovery of Blank Spike	-	75 to 125% (methylseleninic acid, selenate, selenite, selenocyanate, selenomethionine, total selenium)	-	-	-	-
	Recovery of Matrix Spike	70 to 130% (TKN, orthophosphate, phosphorus, TOC, DOC, total and dissolved metals) 75 to 125% (ammonia, bromide, chloride, fluoride, nitrate, nitrite, sulphate)	75 to 125% (selenate, selenite, selenocyanate, selenomethionine, total selenium)	-	-	-	-
	Matrix Spike Duplicate	-	75 to 125% (selenate, selenite, selenocyanate, selenomethionine, total selenium)	-	-	-	-
	Recovery of Certified Reference Material	-	75 to 125% (total selenium)	40 - 160 % (boron, thallium) 70 130 % (all other analytes) 80 - 120 % (inorganic carbon, total carbon) 96 - 104 % (pH)	-	60 to 140% (antimony, barium, boron, silver, tin, titanium) 90 to 110% (selenium) 70 to 130% (all remaining analytes)	
	Laboratory Control Sample	75 to 125% (TKN) 80 to 120% (orthophosphate, phosphorus, DOC, TOC, total and dissolved metals) 85 to 115% (acidity, alkalinity, ammonia, bromide, TDS, TSS, turbidity) 90 to 110% (conductivity, chloride, fluoride, nitrate, nitrite, sulphate) 98.6-101% (pH), 95.4 to 104% (ORP)	-	50 - 130% (naphthalene, naphthalene-d8) 60 - 130% (PAHs) 80 - 120% (all other analytes) 90 - 110% (inorganic carbon, moisture) 97 - 103% (pH 1:2 soil:water)	-	-	-
	Taxonomic Accuracy	-	-	-	< 5% TIR	-	-

Notes: LRL = Laboratory Reporting Limit; "-" = not applicable; < = less than; ≤ = less than or equal to; % = percent; RPD = Relative Percent Difference; ORP = oxidation-reduction potential; TKN = Total Kjeldahl Nitrogen; TOC = total organic carbon; DOC = dissolved organic carbon; TSS = total suspended solids; TDS = total dissolved solids; mg/kg dw = milligrams per kilogram dry weight; TIR = total identification error rate.

with several types of Quality Control (QC) samples collected or prepared in the field and laboratory. General QC samples collected for this project include the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed in the same way as regular samples. These samples will reflect any contamination of samples occurring in the field (in the case of field or travel blanks) or in the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be below detection.
- **Laboratory Duplicates** are replicate sub-samples created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.
- **Field Duplicates** are samples collected from a randomly selected field station that are homogenized to the extent possible, split and analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory.
- **Certified Reference Materials (CRM) or Reference Materials (RM)** are commercially prepared (or commercially homogenized) samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to the known concentrations to provide a measure of analytical accuracy. The results are reported as the percent of the known concentration that was recovered in the analysis.
- **Laboratory Control Samples** are created in the laboratory to have a known analyte concentration in a matrix free of interferences, such as deionized water or reference sand. The sample results are compared to the target results to confirm that the analytical method is accurate in a purified reference sample. The results are reported as the percent of the known concentration that was recovered in the analysis.
- **Laboratory Sorting Duplicates** are randomly selected grabs of the initially sorted community material. These samples are recounted and the number of invertebrates that were not recovered during the initial sort was determined. In order to reduce bias, recounting is conducted by an analyst uninvolved in the initial sample processing. This check is performed on 10% of samples and determines the accuracy through assessment of recovery (sorting) efficiency and quantifies any under-estimation of organism enumeration.

- **Taxonomic Quality Control Samples** are a randomly selected portion of a benthic invertebrate community field sample to be assessed by the laboratory using an internal quality control audit. A blind re-enumeration and re-identification of random samples is performed by an analyst uninvolved in the original sample processing. This assessment quantifies taxonomic misidentification among laboratory analysts and ensures accurate organism identities are reported.
- **Laboratory Subsamples** are community samples prepared by the laboratory to ensure that the fraction of the total sample examined was an accurate representation of the total number of organisms. By comparing the amount recovered between at least two subsamples, one can assess the analytical precision. In addition, comparisons of the subsamples from the whole community sample allows for an evaluation of subsampling accuracy.

A2 WATER CHEMISTRY

A2.1 Laboratory Reporting Limits

The analytical reports for water chemistry from ALS Environmental (see laboratory reports CG2206286, CG2206374, CG2207968, CG2207971, and CG2211307 in Appendix A) were examined to assess laboratory reporting limits (LRLs) relative to analyte concentrations and applicable guidelines (Table A.2). The range of reported LRLs for water quality analytes were assessed relative to British Columbia Water Quality Guidelines (BC WQG; BCMOECCS 2021a,b) for the protection of freshwater aquatic life, Elk Valley Water Quality Plan (EVWQP; Teck 2014) benchmarks, screening values for water quality (Teck 2020), and relevant site-specific benchmarks. Several analytes were reported at concentrations below the LRL in 100% of samples (Table A.2). For those analytes with one or more result(s) below the LRL, achieved LRLs were consistently lower than applicable BC WQG, EVWQP benchmarks, and screening values for water quality, except for total mercury and dissolved cadmium in 100% of samples. The LRL for all total mercury samples was 0.000005 µg/L, which is higher than the BC WQG of 0.00000125 µg/L; however, Azimuth (2019) determined that mercury inputs (total and methyl) in the Elk Valley Area are not related to mining activities. It is also important to note that the benchmarks and screening guidelines presented are the most conservative (lowest) based on *in situ* measures of temperature and pH. These LRLs below guidelines for total mercury and cadmium will be considered during interpretation of results. Overall, the achieved LRLs for all other analytes were appropriate for this study.

A2.2 Laboratory, Field, and Trip Blanks

A total of 93 method blank (MB) samples for water chemistry were analyzed by ALS (see laboratory reports CG2206286, CG2206374, CG2207968, CG2207971, and CG2211307 in Appendix A). Out of 508 individual analyte results, only one result was above detection and therefore did not meet the laboratory DQO (total sodium; see laboratory report CG2206286 in Appendix A). As this result only represents 0.20% of all MB results, these results were determined to have a negligible impact on data interpretability and laboratory precision was considered excellent.

Two field blank samples and two trip blank samples were submitted to ALS for water chemistry analyses to assess the potential for field sampling contamination (see laboratory reports CG2206374, and CG2211307 in Appendix A). The same DQOs that were used for laboratory blanks were also used for field blanks (i.e., concentrations should be below the LRL). Out of 194 individual analyte results measured in field blanks, only two (1.03% of results) were above

Table A.2: Laboratory Reporting Limit (LRL) Evaluation for Water Chemistry Analyses, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Units	BC WQG[a]		EVWQP Level 1 Benchmarks /Relevant Screening Values	Range of LRLs	No. Sample Results <LRL	No. LRLs > Guideline
		Long-term	Short-term				
Physical Tests							
Total Suspended Solids	mg/L	-	-	-	1	3 (25.0%)	-
Acidity (as $CaCO_3$)	mg/L	-	-	-	2	12 (100%)	-
Alkalinity, Carbonate (as CO_3)	mg/L	-	-	-	1	11 (91.7%)	-
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	-	-	-	1	10 (83.3%)	-
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	-	-	-	1	12 (100%)	-
Alkalinity, Hydroxide (as OH)	mg/L	-	-	-	1	12 (100%)	-
Anions And Nutrients							
Bromide	mg/L	-	-	-	0.050	12 (100%)	-
Ammonia, Total (as N)	mg/L	0.491	3.61	-	0.005	8 (66.7%)	0
Nitrite (as N)	mg/L	0.020	0.060	-	0.001	7 (58.3%)	0
Total Kjeldahl Nitrogen	mg/L	-	-	-	0.500	12 (100%)	-
Orthophosphate	mg/L	-	-	-	0.001	9 (75.0%)	-
Phosphorus, Total	mg/L	-	-	-	0.002	0	-
Organic/Inorganic Carbon							
Dissolved Organic Carbon	mg/L	-	-	-	0.500	6 (50.0%)	-
Total Organic Carbon	mg/L	-	-	-	0.500	6 (50.0%)	-
Total Metals							
Antimony	mg/L	0.01	-	-	0.0001	10 (83.3%)	0
Beryllium	µg/L	0.130	-	-	0.020	8 (66.7%)	0
Bismuth	mg/L	-	-	-	0.00005	12 (100%)	-
Boron	mg/L	1.20	-	-	0.01	12 (100%)	0
Cadmium	µg/L	-	-	-	0.005	6 (50.0%)	-
Chromium	mg/L	0.001	-	-	0.0001	2 (16.7%)	0
Cobalt	µg/L	4.00	0.110	-	0.100	6 (50.0%)	0
Copper	mg/L	-	-	-	0.0005	6 (50.0%)	-
Iron	mg/L	-	1.00	-	0.01	1 (8.33%)	0
Lead	mg/L	0.00615	0.003	-	0.00005	2 (16.7%)	0
Mercury	mg/L	0.00000125	-	-	0.000005	12 (100%)	12 (100%)
Nickel	mg/L	0.025	-	-	0.0005	8 (66.7%)	0
Silver	mg/L	0.00005	0.0001	-	0.00001	10 (83.3%)	0
Thallium	mg/L	0.0008	-	-	0.00001	8 (66.7%)	0
Tin	mg/L	-	-	-	0.0001	12 (100%)	-
Titanium	mg/L	-	-	-	0.0003 to 0.0018	5 (41.7%)	-
Vanadium	mg/L	-	-	-	0.0005	7 (58.3%)	-
Zinc	mg/L	0.0075	0.033	-	0.003	8 (66.7%)	0
Dissolved Metals							
Antimony	mg/L	-	-	-	0.0001	12 (100%)	-
Beryllium	µg/L	-	-	-	0.020	12 (100%)	-
Bismuth	mg/L	-	-	-	0.00005	12 (100%)	-
Boron	mg/L	-	-	-	0.01	12 (100%)	-
Cadmium	µg/L	0.018	0.038	0.002	0.005	11 (91.7%)	12 (100%)
Chromium	mg/L	-	-	-	0.0001	10 (83.3%)	-
Cobalt	µg/L	-	-	-	0.100	12 (100%)	-
Iron	mg/L	-	0.350	-	0.01	10 (83.3%)	0
Lead	mg/L	-	-	-	0.00005	12 (100%)	-
Lithium	mg/L	-	-	-	0.001	1 (8.33%)	-
Manganese	mg/L	-	-	-	0.0001	1 (8.33%)	-
Mercury	µg/L	-	-	-	0.000005	12 (100%)	-
Nickel	mg/L	-	-	0.001	0.0005	12 (100%)	0
Silver	mg/L	-	-	-	0.00001	12 (100%)	-
Thallium	mg/L	-	-	-	0.00001	12 (100%)	-
Tin	mg/L	-	-	-	0.0001	12 (100%)	-
Titanium	mg/L	-	-	-	0.0003	12 (100%)	-
Vanadium	mg/L	-	-	-	0.0005	12 (100%)	-
Zinc	mg/L	-	-	-	0.001	11 (91.7%)	-

Notes: Only analytes with at least one result < Laboratory Reporting Limit (L RL) or LRL were above guidelines were displayed. Where more than one guideline was applicable, the most conservative (lowest) value was used. The total number of samples in 2022 (n) was 12. " - " indicates no data

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (BCMOECCS 2021a,b).

the LRL and so did not meet the laboratory DQO (one result each for acidity [as $CaCO_3$] and dissolved molybdenum; Table A.3). All 134 individual analyte results for trip blank samples were below the LRL, meeting the laboratory DQO (Table A.3). As there was generally good conformity between the laboratory and trip blanks meeting DQO, field and laboratory contamination of water samples was considered to be good, especially for order and non-order constituents.

A2.3 Data Precision

A total of 19 laboratory duplicate samples were used to evaluate precision within the ALS laboratory reports (see laboratory reports CG2206286, CG2206374, CG2207968, CG2207971, and CG2211307 in Appendix A). Out of 521 individual analyte results, only one result did not meet the laboratory DQO due to sample heterogeneity (total titanium; see laboratory report CG2206374 in Appendix A). As this result only represents 0.19% of laboratory duplicate results, ALS laboratory analytical precision was considered excellent.

A2.4 Data Accuracy

Data accuracy within the ALS laboratory reports was evaluated based on results of 110 Laboratory Control Samples (LCS) and 18 Matrix Spike (MS) samples (see laboratory reports CG2206286, CG2206374, CG2207968, CG2207971, and CG2211307 in Appendix A). All 506 LCS results met the laboratory DQO. Recovery could not be calculated in several MS samples as background levels were greater than or equal to one-times spike levels. However, as several other QC tests were successful and do not imply uncertainties as to ALS data accuracy, there was no concern regarding MS recovery calculations. All of the 383 MS results that could be calculated met the laboratory DQO. Overall, ALS laboratory analytical precision and accuracy was considered excellent.

A2.5 Hold Times

The recommended hold times for pH and oxidation-reduction potential (ORP) analyses (0.25 hrs) were exceeded in all samples collected. As *in situ* pH was used for data interpretation, these pH exceedances had no impact on data interpretability. Additionally, ORP is not used in any analyses. Overall, hold time exceedances are expected to have no effect on the interpretation of results.

A2.6 Data Quality Statement

Water chemistry data collected for the 2022 Koocanusa Reservoir Monitoring Program were of good quality as characterized by excellent detectability, generally appropriate LRLs, negligible analyte concentrations in MBs, and excellent laboratory precision and accuracy.

Table A.3: **Water Chemistry Blanks, Koocanusa Reservoir Monitoring Program, 2022**

Parameter	No. Field Blank Results > LRL	No. Trip Blank Results > LRL
Physical Tests		
Acidity (as $CaCO_3$)	1 (50.0%)	0
Dissolved Metals		
Molybdenum	1 (50.0%)	-

Notes: LRL = Laboratory Reporting Limit; "-" = data not collected. Two field blank samples and two trip blank samples were collected in 2022. Only analytes with at least one results > LRL were displayed. Calcium, magnesium, potassium, and sodium are the only dissolved metals measured in most trip blank samples.

Recommended hold times were met for all analytes that are used in data interpretation. Therefore, the associated data are considered acceptable for this study.

A3 SEDIMENT CHEMISTRY

A3.1 Laboratory Reporting Limits

The analytical report for sediment chemistry from ALS (see laboratory report CG2211711 in Appendix A) was examined to assess LRLs relative to analyte concentrations and applicable guidelines (Table A.4). The LRLs for these analytes were assessed relative to existing British Columbia Working Sediment Quality Guidelines (BC WSQG; BCMOECCS 2021a,b). Several analytes were reported at concentrations below the LRL in 100% of samples (Table A.4). All analytes with one or more result below the LRL had LRLs above relevant guidelines. Therefore, LRLs were considered appropriate for this study.

A3.2 Laboratory Blanks

A total of eight MB samples were analyzed in the ALS laboratory report (see laboratory report CG2211711 in Appendix A). All 93 individual analyte results met the laboratory DQO, indicating no inadvertent contamination of sediment samples during analysis. Therefore, laboratory precision as determined by laboratory blanks was considered excellent.

A3.3 Data Precision

Five laboratory duplicate samples were used to evaluate precision within the ALS laboratory reports (see laboratory report CG2211711 in Appendix A). All 98 individual analyte results met the laboratory DQO. Therefore, ALS laboratory analytical precision was considered excellent.

One set of field duplicate samples was collected to assess field sampling precision for sediment chemistry (Table A.5). Several RPDs could not be calculated as both analyte concentrations in the pair were below the LRL. Of the 41 RPDs that could be calculated, only one was greater than 30% (sand [0.125mm - 0.063mm]; Table A.5). As this only represents 2.44% of field duplicate comparisons, sediment data was overall considered to have excellent field precision and reproducibility.

A3.4 Data Accuracy

Data accuracy for sediment chemistry analyses completed by ALS was evaluated based on the analysis of 10 LCS samples and one MS sample. All 95 LCS and 16 MS individual analyte results met the laboratory DQO. Therefore, the accuracy achieved by the laboratory was considered excellent.

Table A.4: Laboratory Reporting Limit (LRL) Evaluation for Sediment Chemistry Analyses, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Units	BC WSQGs[a]		Range of LRLs	No. LRLs > ISQG	No. LRLs > PEL	No. Sample Results < LRL
		ISQG	PEL				
Physical Tests							
Moisture	%	-	-	NA	-	-	-
pH (1:2 Soil:Water)	pH	-	-	0.1	-	-	-
Particle Size							
Gravel (>2mm)	%	-	-	1	-	-	14 (93.3%)
Sand (2.00mm - 1.00mm)	%	-	-	1	-	-	15 (100%)
Sand (1.00mm - 0.50mm)	%	-	-	1	-	-	15 (100%)
Sand (0.50mm - 0.25mm)	%	-	-	1	-	-	15 (100%)
Sand (0.25mm - 0.125mm)	%	-	-	1	-	-	11 (73.3%)
Sand (0.125mm - 0.063mm)	%	-	-	1	-	-	3 (20.0%)
Silt (0.063mm - 0.0312mm)	%	-	-	1	-	-	-
Silt (0.0312mm - 0.004mm)	%	-	-	1	-	-	-
Clay (<4um)	%	-	-	1	-	-	-
Organic/Inorganic Carbon							
Total Organic Carbon	%	-	-	0.554 to 0.648	-	-	-
Carbon, inorganic (IC), <63µm	%	-	-		-	-	-
Carbon, Inorganic (IC; as $CaCO_3$ equivalent)	%	-	-	0.4	-	-	-
Metals							
Aluminum	mg/kg	-	-	50	-	-	-
Antimony	mg/kg	-	-	0.1	-	-	-
Arsenic	mg/kg	5.9	17	0.1	0	0	0
Barium	mg/kg	-	-	0.5	-	-	-
Beryllium	mg/kg	-	-	0.1	-	-	-
Bismuth	mg/kg	-	-	0.2	-	-	11 (73.3%)
Boron	mg/kg	-	-	5	-	-	14 (93.3%)
Cadmium	mg/kg	0.6	3.5	0.02	0	0	-
Calcium	mg/kg	-	-	50	-	-	-
Chromium	mg/kg	37.3	90	0.5	0	0	-
Cobalt	mg/kg	-	-	0.1	-	-	-
Copper	mg/kg	35.7	197	0.5	0	0	-
Iron	mg/kg	21,200	43,766	50	0	0	-
Lead	mg/kg	35	91.3	0.5	0	0	-
Lithium	mg/kg	-	-	2	-	-	-
Magnesium	mg/kg	-	-	20	-	-	-
Manganese	mg/kg	460	1,100	1	0	0	-
Mercury	mg/kg	0.17	0.486	0.005	0	0	15 (100%)
Molybdenum	mg/kg	0.025	23	0.1	0	0	-
Nickel	mg/kg	16	75	0.5	0	0	-
Phosphorus	mg/kg	-	-	50	-	-	-
Potassium	mg/kg	-	-	100	-	-	-
Selenium	mg/kg	2	-	0.2	0	-	7 (46.7%)
Silver	mg/kg	0.5	-	0.1	0	-	14 (93.3%)
Sodium	mg/kg	-	-	50	-	-	-
Strontium	mg/kg	-	-	0.5	-	-	-
Sulphur	mg/kg	-	-	1,000	-	-	15 (100%)
Thallium	mg/kg	-	-	0.05	-	-	-
Tin	mg/kg	-	-	2	-	-	15 (100%)
Titanium	mg/kg	-	-	1	-	-	-
Tungsten	mg/kg	-	-	0.5	-	-	15 (100%)
Uranium	mg/kg	-	-	0.05	-	-	-
Vanadium	mg/kg	-	-	0.2	-	-	-
Zinc	mg/kg	123	315	2	0	0	-
Zirconium	mg/kg	-	-	1	-	-	1 (6.67%)
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	0.00671	0.0889	0.005	0	0	14 (93.3%)
Acenaphthylene	mg/kg	0.00587	0.128	0.005	0	0	14 (93.3%)
Anthracene	mg/kg	0.0469	0.245	0.004	0	0	14 (93.3%)
Benzo(a)anthracene	mg/kg	-	-	0.01	-	-	15 (100%)
Benzo(a)pyrene	mg/kg	0.0319	0.782	0.01	0	0	15 (100%)
Benzo(b&j)fluoranthene	mg/kg	-	-	0.01	-	-	11 (73.3%)
Benzo(g,h,i)perylene	mg/kg	0.17	0.32	0.01	0	0	15 (100%)
Benzo(k)fluoranthene	mg/kg	0.24	13.4	0.01	0	0	15 (100%)
Chrysene	mg/kg	0.0571	0.862	0.01	0	0	10 (66.7%)
Dibenz(a,h)anthracene	mg/kg	0.00622	0.135	0.005	0	0	14 (93.3%)
Fluoranthene	mg/kg	0.111	2.36	0.01	0	0	11 (73.3%)
Fluorene	mg/kg	0.0212	0.144	0.01	0	0	15 (100%)
Indeno(1,2,3-C,D)pyrene	mg/kg	0.2	3.2	0.01	0	0	15 (100%)
Naphthalene	mg/kg	0.0346	0.391	0.01	0	0	9 (60.0%)
Phenanthrene	mg/kg	0.0419	0.515	0.01	0	0	9 (60.0%)
Pyrene	mg/kg	0.053	0.875	0.01	0	0	12 (80.0%)
B(a)P Total Potency Equivalent	mg/kg	-	-	0.02	-	-	15 (100%)

Notes: Only analytes with at least one result < Laboratory Reporting Limit (LRL) or LRL were above guidelines were displayed. The total number of samples in 2022 (n) was 15. "-" = no applicable guideline exists; ISQG = Interim Sediment Quality Guideline; PEL = Probable Effects Limit; LRL = Laboratory Reporting Limit.

[a] British Columbia Sediment Quality Guidelines (BCMOECCS 2021a).

Table A.5: **Comparisons of Sediment Chemistry Duplicates, Koocanusa Reservoir Monitoring Program, 2022**

Parameter	Unit	RG_TN_SE-2_2022-08-25_N	RG_RIVER_SE_2022-08-25_N	RPD (%)
Physical Tests				
Moisture	%	43.4	37.5	14.6
pH (1:2 Soil:Water)	pH units	8.37	8.49	1.42
Particle Size				
Clay (<0.002mm)	%	24	21	13.3
Clay (<0.004mm)	%	19.5	16.5	16.7
Gravel (>2mm)	%	<1.0	<1.0	-
Sand (0.125mm - 0.063mm)	%	3.1	5.8	60.7
Sand (0.25mm - 0.125mm)	%	<1.0	<1.0	-
Sand (0.5mm - 0.25mm)	%	<1.0	<1.0	-
Sand (1.0mm - 0.50mm)	%	<1.0	<1.0	-
Sand (2.0mm - 0.05mm)	%	9.8	9.2	6.32
Sand (2.0mm - 1.0mm)	%	<1.0	<1.0	-
Silt (0.0312mm - 0.004mm)	%	57.1	53.9	5.77
Silt (0.05mm - 0.002mm)	%	66.2	69.7	5.15
Silt (0.063mm - 0.0312mm)	%	19.7	23.1	15.9
Organic/Inorganic Carbon				
Carbon, Inorganic (IC)	%	3.4	3.5	2.90
Carbon, Total (TC)	%	5.63	5.54	1.61
Carbon, Total Organic (TOC)	%	2.23	2.04	8.90
Carbon, Inorganic (IC; as $CaCO_3$ equivalent)	%	28.3	29.2	3.13
Metals				
Aluminum	mg/kg	11,700	11,700	0
Antimony	mg/kg	0.28	0.29	3.51
Arsenic	mg/kg	5.27	5.56	5.36
Barium	mg/kg	74.7	79.4	6.10
Beryllium	mg/kg	0.39	0.4	2.53
Bismuth	mg/kg	<0.20	<0.20	-
Boron	mg/kg	<5.0	<5.0	-
Cadmium	mg/kg	0.18	0.187	3.81
Calcium	mg/kg	106,000	118,000	10.7
Chromium	mg/kg	17.3	18.3	5.62
Cobalt	mg/kg	8.55	9.06	5.79
Copper	mg/kg	14.8	15.4	3.97
Iron	mg/kg	21,400	22,900	6.77
Lead	mg/kg	13.4	14	4.38
Lithium	mg/kg	24.6	26.6	7.81
Magnesium	mg/kg	23,100	25,100	8.30
Manganese	mg/kg	448	473	5.43
Mercury	mg/kg	<0.0050	<0.0050	-
Molybdenum	mg/kg	0.6	0.61	1.65
Nickel	mg/kg	20.1	20.8	3.42
Phosphorus	mg/kg	489	575	16.2
Potassium	mg/kg	740	780	5.26
Selenium	mg/kg	<0.20	0.21	4.88
Silver	mg/kg	<0.10	<0.10	-
Sodium	mg/kg	72	75	4.08
Strontium	mg/kg	270	281	3.99
Sulfur	mg/kg	<1,000	<1,000	-
Thallium	mg/kg	0.062	0.067	7.75
Tin	mg/kg	<2.0	<2.0	-
Titanium	mg/kg	69.4	71.8	3.40
Tungsten	mg/kg	<0.50	<0.50	-
Uranium	mg/kg	0.61	0.655	7.11
Vanadium	mg/kg	12.9	13.8	6.74
Zinc	mg/kg	66.5	70.9	6.40
Zirconium	mg/kg	1.3	1.3	0
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/kg	<0.0050	<0.0050	-
Acenaphthylene	mg/kg	<0.0050	<0.0050	-
Anthracene	mg/kg	<0.0040	<0.0040	-
Benz(a)anthracene	mg/kg	<0.010	<0.010	-
Benzo(a)pyrene	mg/kg	<0.010	<0.010	-
Benzo(b+j)fluoranthene	mg/kg	<0.010	<0.010	-
Benzo(g,h,i)perylene	mg/kg	<0.010	<0.010	-
Benzo(k)fluoranthene	mg/kg	<0.010	<0.010	-
Chrysene	mg/kg	<0.010	<0.010	-
Dibenz(a,h)anthracene	mg/kg	<0.0050	<0.0050	-
Fluoranthene	mg/kg	<0.010	<0.010	-
Fluorene	mg/kg	<0.010	<0.010	-
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.010	<0.010	-
Naphthalene	mg/kg	<0.010	<0.010	-
Phenanthrene	mg/kg	<0.010	<0.010	-
Pyrene	mg/kg	<0.010	<0.010	-
B(A)P Total Potency Equivalents (B(A)P tpe)	mg/kg	<0.020	<0.020	-
Iacr Ab (Coarse)	NA	<0.10	<0.10	-
Iacr Ab (Fine)	NA	<0.10	<0.10	-

Value did not meet the data quality objective of ≤ 30% Relative Percent Difference (RPD).

Notes: LRL = Laboratory Reporting Limit. If one result in a duplicate pair was below the LRL, RPD was calculated using the LRL in place of the value below detection results. RPD was not calculated if both results were < LRL. "-" indicates that the RPD was not calculated.

A3.5 Hold Times

Recommended holding times for mercury (28 days) were exceeded by one day in all 15 samples. This may have decreased detectable mercury concentrations in sediment samples as mercury concentrations in all samples from 2022 were below detection while mercury concentrations in sediment samples from the same areas in 2021 ranged from 0.0185 to 0.0364 mg/kg. This potential effect on mercury concentrations will be considered during the interpretation of the results.

A3.6 Data Quality Statement

Sediment chemistry data collected for the 2022 Koocanusa Reservoir Monitoring Program were of acceptable quality as characterized by appropriate LRLs, good detectability, excellent laboratory precision and accuracy, excellent field precision and reproducibility. Mercury concentrations in all sediment samples may have been reduced to below detection as they exceeded hold times by one day. Overall, the associated data were considered acceptable for this study.

A4 BENTHIC INVERTEBRATE, FISH, AND ZOOPLANKTON TISSUE CHEMISTRY

A4.1 Laboratory Reporting Limits

Analytical reports of benthic invertebrate, fish, and zooplankton tissue metal concentrations from Trich Analytics (see laboratory reports 2022-348, 2022-381, 2022-349, 2022-341, 2022-369, 2022-377, and 2022-381 in Appendix A) were examined to provide an inventory of analyte results below the LRL and to compare the LRLs for these analytes to available benchmarks (Table A.6). All analytes in benthic invertebrate and zooplankton tissue samples were above detection limits. Several analytes were below detection in several fish tissue samples (Table A.6). However, no analyte was below detection in all fish tissue samples. Additionally, the primary focus of interpretation of benthic invertebrate, fish, and zooplankton tissue chemistry results for the 2022 Koocanusa Reservoir Monitoring Program involves selenium, which was detectable (i.e., above the LRL) in all samples. Additionally, all benthic invertebrate, fish, and zooplankton LRLs were lower than the applicable selenium guidelines. Overall, the achieved LRLs were suitable for the study.

A4.2 Data Accuracy and Precision

Data accuracy and precision were evaluated based on the analysis of 15 CRM samples (see laboratory reports 2022-348, 2022-381, 2022-349, 2022-341, 2022-369, 2022-377, and 2022-381 in Appendix A). All 812 CRM results met the laboratory DQO for precision and accuracy. Therefore, the laboratory accuracy and precision as determined by CRM analyses was considered excellent.

Laboratory precision was also evaluated by laboratory duplicate analysis of one benthic invertebrate tissue sample, eight fish tissue samples, and three zooplankton tissue samples (see laboratory reports 2022-348, 2022-381, 2022-349, 2022-341, 2022-369, 2022-377, and 2022-381 in Appendix A). All 29 individual analyte results for benthic invertebrate tissue samples and 482 results for fish tissue met the laboratory DQO. Of the 90 zooplankton tissue individual analyte results, seven did not meet the laboratory DQO (7.78% of results for zooplankton tissue). All DQOs were met for selenium. As only a small number of results did not meet the laboratory DQO, laboratory accuracy and precision were considered to be good.

Field precision was evaluated by one set of zooplankton tissue duplicate samples (Table A.7). Of the 30 individual duplicate results, 15 did not meet the DQO of 30%. Tissue samples can be highly variable due to heterogeneity of the samples, and this will be considered when analyzing the data. As the field duplicate result for selenium met the DQO, zooplankton tissue

Table A.6: Benthic Invertebrate, Fish, and Zooplankton Tissue LRLs, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Units	BC WQG[a]		EVWQP Level 1 Benchmarks/ Relevant Screening Values[b]	No. LRLs > Guideline	BIT		Fish Tissue		Zooplankton Tissue	
		Long-term	Short-term			Range of LRLs	No. Sample Results < LRL	Range of LRLs	No. Sample Results < LRL	Range of LRLs	No. Sample Results < LRL
Aluminum	mg/kg dw	-	-	-	-	0.124 to 0.811	0	0.033 to 1.3	19 (12.4%)	0.124	0
Antimony	mg/kg dw	-	-	-	-	0.003	0	0.002 to 0.003	65 (42.5%)	0.003	0
Arsenic	mg/kg dw	-	-	-	-	0.353 to 0.526	0	0.397 to 0.507	149 (97.4%)	0.353	0
Boron	mg/kg dw	-	-	-	-	0.062 to 0.098	0	0.065 to 0.094	63 (41.2%)	0.062	0
Cadmium	mg/kg dw	-	-	-	-	0.042 to 0.053	0	0.037 to 0.065	85 (55.6%)	0.053	0
Cobalt	mg/kg dw	-	-	-	-	0.007 to 0.013	0	0.008 to 0.015	8 (5.23%)	0.013	0
Lead	mg/kg dw	-	-	-	-	0.002	0	0.001 to 0.002	1 (1.22%)	0.002	0
Lithium	mg/kg dw	-	-	-	-	0.01 to 0.012	0	0.011 to 0.04	81 (52.9%)	0.012	0
Mercury	mg/kg dw	-	-	-	-	0.019 to 0.108	0	0.031 to 0.519	72 (47.1%)	0.019	0
Molybdenum	mg/kg dw	-	-	-	-	0.001	0	0.001 to 0.011	63 (41.2%)	0.001	0
Nickel	mg/kg dw	-	-	-	-	0.036 to 0.042	0	0.027 to 0.045	15 (9.80%)	0.036	0
Silver	mg/kg dw	-	-	-	-	0.001	0	0.001	58 (37.9%)	0.001	0
Tin	mg/kg dw	-	-	-	-	0.013 to 0.021	0	0.016 to 0.033	2 (1.31%)	0.021	0
Uranium	mg/kg dw	-	-	-	-	0.001	0	0.001	85 (55.6%)	0.001	0
Vanadium	mg/kg dw	-	-	-	-	0.038 to 0.051	0	0.027 to 0.058	107 (69.9%)	0.038	0

Notes: Only analytes with at least one result < Laboratory Reporting Limit (L RL) or LRL were above guidelines were displayed. The total number of samples in 2022 (n) for benthic invertebrate tissue (BIT), fish, and zooplankton tissue were 5, 153, and 10, respectively. " - " = no data available/not applicable.

[a] British Columbia Water Quality Guidelines for the protection of Aquatic Life (BCMOECCS 2021a,b).

[b] Where more than one EVWQP Level 1 Benchmark or screening value was applicable, the most conservative (lowest) value was used.

Table A.7: Comparisons of Zooplankton Tissue Chemistry Duplicates, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Units	RG_TN_ZOOT-1_2022-08-25_N	RG_RIVER_ZOOT-1_2022-08-25_N	RPD (%)
Aluminum	mg/kg	2,178	4,339	66.3
Antimony	mg/kg	2.0	2.2	9.52
Arsenic	mg/kg	2.7	2.6	3.77
Barium	mg/kg	212	292	31.7
Boron	mg/kg	2.4	3.7	42.6
Cadmium	mg/kg	0.723	0.831	13.9
Calcium	mg/kg	54,778	76,310	32.9
Chromium	mg/kg	6.3	16	87.0
Cobalt	mg/kg	1.2	1.6	28.6
Copper	mg/kg	7.9	8.4	6.13
Iron	mg/kg	1,395	2,433	54.2
Lead	mg/kg	0.138	0.109	23.5
Lithium	mg/kg	1.1	2.2	66.7
Magnesium	mg/kg	2,222	2,424	8.70
Manganese	mg/kg	53	80	40.6
Mercury	mg/kg	0.043	0.073	51.7
Molybdenum	mg/kg	0.229	0.252	9.56
Nickel	mg/kg	7.9	19	82.5
Phosphorus	mg/kg	16,732	24,441	37.4
Potassium	mg/kg	5,383	6,198	14.1
Selenium	mg/kg	3.1	3.1	0
Silver	mg/kg	0.035	0.041	15.8
Sodium	mg/kg	1,461	2,166	38.9
Strontium	mg/kg	137	180	27.1
Thallium	mg/kg	0.035	0.056	46.2
Tin	mg/kg	3.1	2.6	17.5
Titanium	mg/kg	148	335	77.4
Uranium	mg/kg	0.130	0.163	22.5
Vanadium	mg/kg	2.0	3.9	64.4
Zinc	mg/kg	79	74	6.54

Value did not meet the data quality objective of ≤ 30% Relative Percent Difference (RPD).

Notes: LRL = Laboratory Reporting Limit. If one result in a duplicate pair was below the LRL, RPD was calculated using the LRL in place of the value below detection results. RPD was not calculated if both results were < LRL.

field precision and reproducibility were considered adequate. Field duplicate samples were not collected for benthic invertebrate and fish tissue.

A4.3 Data Quality Statement

Benthic invertebrate, fish, and zooplankton tissue data collected for the 2022 Koocanusa Reservoir Monitoring Program were of good quality as characterized by appropriate LRLs, good detectability, good laboratory precision and accuracy, and adequate field sampling precision and reproducibility. Overall, the associated data can be used with a good level of confidence in the derivation of conclusions for this study.

A5 FISH AGING

A5.1 Laboratory accuracy

Analytical reports of fish age estimates from AAE Tech Services Inc. (see laboratory reports in Appendix A) were examined to evaluate data accuracy. To determine the accuracy of redside shiner and peamouth chub age estimates, approximately 50% of aging structures that were analyzed by AAE Technical Service were re-processed by a second analyst (n = 30). The first and second analyst assigned an age and confidence index to each age estimate. Original and re-assessed age estimates agreed, except for two peamouth chub samples where age estimates differed by one year. As these disagreements occurred in a small number of samples (6.67% of all re-processed results), overall accuracy achieved by the laboratory in this study was considered good.

A6 ZOOPLANKTON COMMUNITY COMPOSITION

A6.1 Field Sampling Precision

One duplicate field zooplankton community sample was analyzed by Salki Consultants Inc. to assess the precision of zooplankton identification and enumeration by the laboratory (see laboratory report in Appendix A). Of the 60 RPDs that were calculated for abundance within a Lowest Practical Level (LPL; species or genus), 24 RPDs were greater than 30% (40.0% of RPDs; Table A.8). Of the RPDs greater than 30%, 13 (21.7% of calculable RPDs) resulted from no individuals in an LPL being identified in one of the duplicate samples and a low number of individuals in that LPL being identified in the other duplicate sample. This indicates that several RPDs that did not meet the DQO may be due to rare species and limitations associated with subsampling rather than inconsistencies in identification. The relatively high number of RPDs greater than 30% also highlights the sample heterogeneity inherent to community samples. Overall, zooplankton community field precision and reproducibility were considered adequate.

Table A.8: Comparisons of Zooplankton Community Duplicates, Koocanusa Reservoir Monitoring Program, 2022

Sample ID	3 MINNOW RGTN5	3x MINNOW RGTN5	RPD (%)
Units	Ind/L	Ind/L	
CALANOIDA			
Epischura nevadensis **Lilljeborg**	-	-	-
E.n. adult female 2.0mm	0.02	0.0219	0
E.n. adult male 1.8mm	0.022	0.110	133
E.n. immature 0.5-1.0 mm	0	0.097	200
Total *E. nevadensis*	0.044	0.229	136
Diaptomus tyrrelli **Poppe**	-	-	-
D.t. adult female 1.39mm	0.022	0	200
D.t. gravid female 1.39 mm	0	0	-
D.t. adult male 1.21mm	0.097	0	200
D.t. immature 1.16mm	0	0	-
D.t. immature 1.0 mm	0	0	-
D.t. immature 0.75 mm	0	0	-
D.t. immature 0.5 mm	0	0	-
Total *D. tyrrelli*	0.119	0	200
Diaptomus pallidus **Herrick**	-	-	-
D.p. adult female 1.25mm	0	0	-
D.p. gravid female	0	0.0049	200
D.p. adult male 0.97mm	0.292	0.292	0
D.p. immature 2.0 mm	0.097	0	200
D.p. immature 1.0 mm	0.097	0	200
D.p. immature 0.75 mm	0	0.292	200
D.p. immature 0.5 mm	0.292	0.681	80.0
Calanoid nauplius	0.973	1.36	33.3
CYLOPOIDA			
Cyclops scutifer **Sars**	-	-	-
C. s.adult female	0	0	0
C. s. gravid female	0	0	0
C. s. male	0	0	0
C. s. immature 1.3 mm	0	0	0
C. s. immature 0.99 mm	0	0	0
C. s. immature 0.75mm	0	0	0
C. s. immature 0.5 mm	0	0	0
Total *C. scutifer*	-	-	-
C.vernalis **(?) immature**	0.097	0	200
Cyclops bicuspidatus thomasi **S.A.Forbes**	-	-	-
C. b. t. adult female 0.92mm	0.681	0.487	33.3
C. b. t. gravid female 0.92mm	0.022	0.022	0
C. b. t. adult male 0.77mm	0	0.292	200
C. b. t. immature 1.0 mm	0	0	0
C. b. t. immature 0.75 mm	0.389	0.292	28.6
C. b. t. immature 0.5 mm	1.85	2.63	34.8
Total *C. b. thomasi*	2.94	3.72	23.4
Cyclopoid nauplius	4.19	3.89	7.23
Total *Cyclopoida* ind/L	7.23	7.61	5.25
CLADOCERA			
Leptodora kindtii **Focke**	0.0024	0.0024	0
Holopedium gibberum **Zaddach**	0	0	0
Sida crystallina **(O.F.Muller)???**	0	0	0
Diaphanosoma leuchtenbergianum **Fisher**	0.195	0.195	0
Daphnia schoedleri **Sars**	0	0	0
Daphnia galeata mendotae **Birge**	-	-	-
D. g. m. 2.5 mm	0.097	0	200
D. g. m. 2.0 mm	0.584	0.681	15.4
D. g. m. 1.5 mm	0.779	1.75	76.9
D. g. m. 1.0 mm	1.36	1.07	24.0
D. g. m. 0.5 mm	0.876	0.681	25.0
Total *D. g. mendotae*	3.70	4.19	12.3
Daphnia longiremis **Sars**	-	-	-
D. l. mature 1.0 mm	0	0	0
D. l. immature 0.5 mm	0	0	0
Total *D. longiremis*	-	-	-
Daphnia retrocurva **Forbes**	-	-	-
D. r. 1.52 mm	0	0	0
D. r. 1.24 mm	0.022	0.195	160
Total *D. retrocurva*	0.022	0.195	160
Bosmina longirostris **O. F. Mueller**	-	-	-
B. l. 0.5 mm	0	0	0
B. l. 0.25 mm	0	0	0
Chydorus sps	0	0	0
Total Cladocera Ind/L	3.92	4.58	15.5
TOTAL CRUSTACEA Ind/L	13.1	15.1	14.2
ROTIFERA			
Kellicottia sps	0.292	0.195	40.0
Keratella sps	1.46	1.07	30.8
Polyarthra sps	2.14	2.04	4.65
Conochilus sps	0.195	0	200
Gastropus sps	0.779	0.876	11.8
Pleosoma sps	0.097	0	200
Lecane sps	0	0	0
TOTAL ROTIFERA Ind/L	4.96	4.19	17.0

Value did not meet the data quality objective of ≤ 30% Relative Percent Difference (RPD).

A7 DATA QUALITY REVIEW SUMMARY

Overall, the quality of the data collected for this project was considered acceptable for the derivation of conclusions associated with the objectives of the 2022 Koocanusa Reservoir Monitoring Program. Mercury hold times were exceeded in all sediment samples, which may have resulted in inaccurate mercury measurements in sediment samples. This will be taken into consideration during data interpretation.

A8 REFERENCES

Azimuth. 2019. Evaluation of water quality data mercury and methyl mercury in the Elk Valley. Technical Memorandum. March 5th, 2019.

BCMOECCS (British Columbia Ministry of Environment and Climate Change Strategy). 2021a. Working Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture. Water Quality Guideline Series, WQG-08. Water Protection and Sustainability Branch, Province of British Columbia, Victoria, B.C.

BCMOECCS. 2021b. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture – Guideline Summary. Water Quality Guideline Series, WQG-20. Water Protection and Sustainability Branch, Province of British Columbia, Victoria, B.C.

B.C. Ministry of Water, Land, and Resource, Stewardship, 2023. Aluminum Water Quality Guidelines – Freshwater Aquatic Life. Water Quality Guideline Series, WQG-09-1. Prov. B.C., Victoria B.C.

Teck (Teck Coal Limited). 2014. Elk Valley Water Quality Plan. Submitted to the British Columbia Minister of Environment for approval on July 22, 2014.

Teck. 2020. Water Quality Adaptive Management Plan for Teck Coal Operations in the Elk Valley – 2019 Annual Report. Prepared by Teck Coal Limited. July 31, 2020.

APPENDIX B

WATER

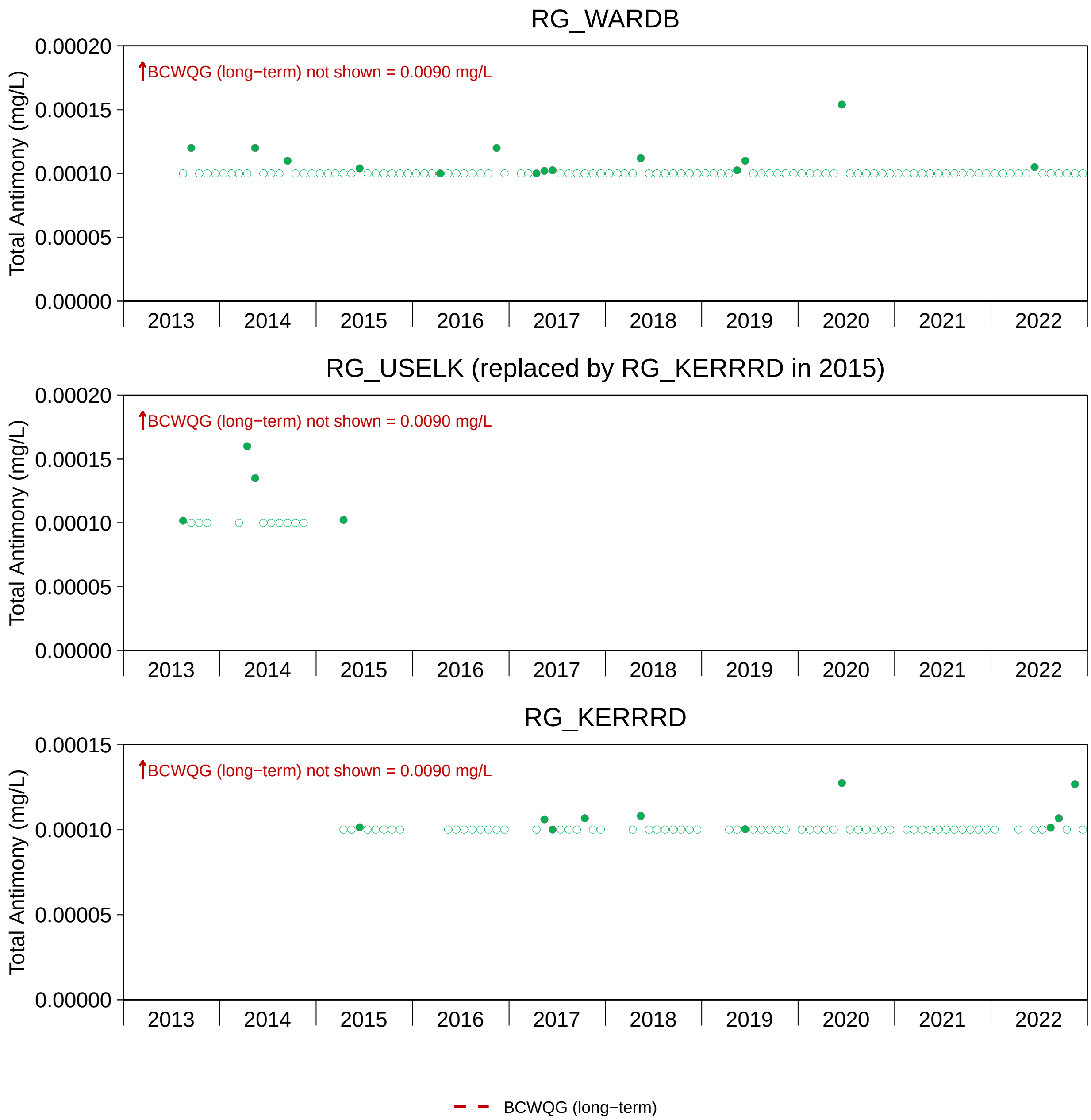


Figure B.1: Monthly Average Concentrations of Total Antimony at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

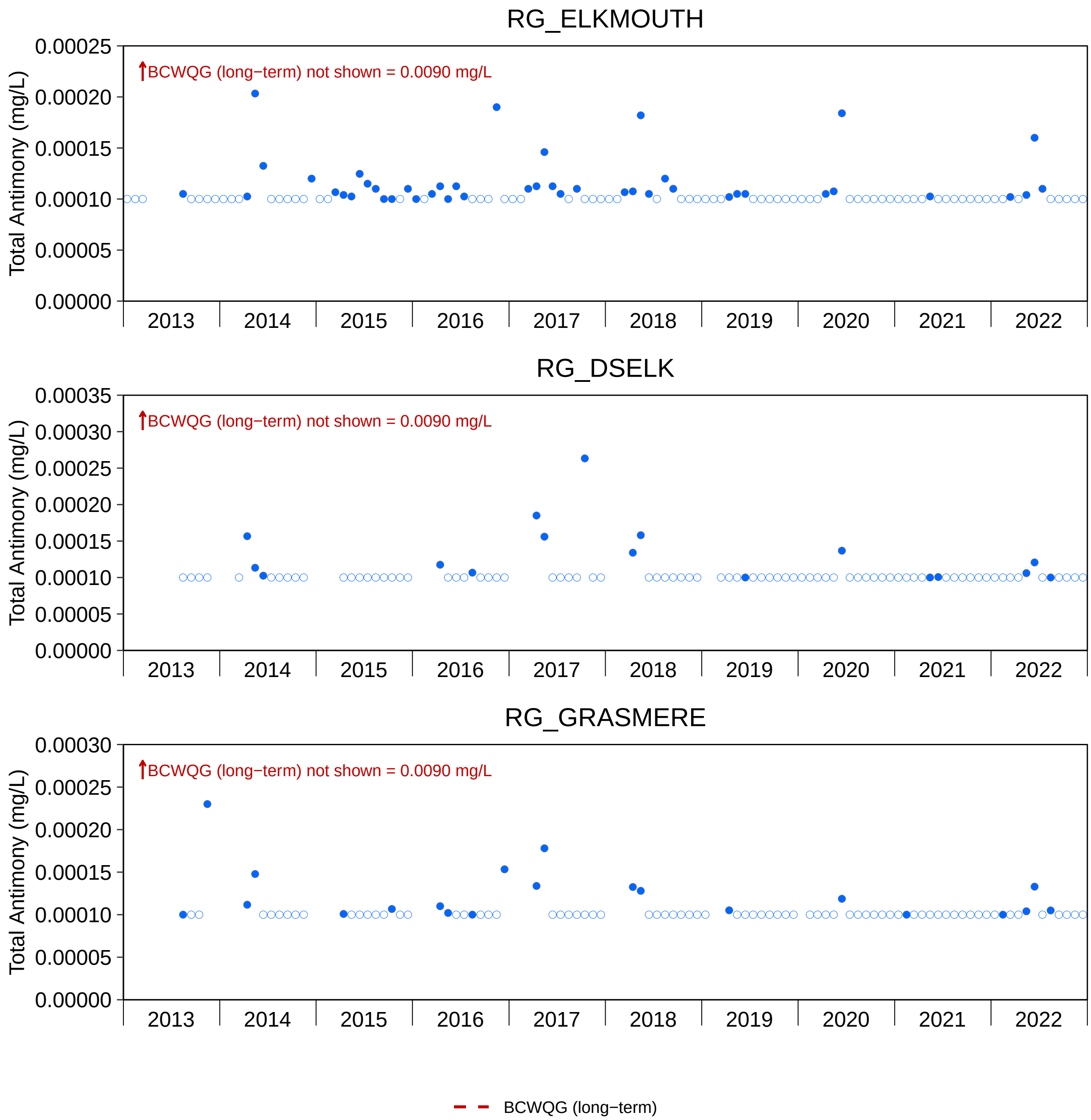


Figure B.1: Monthly Average Concentrations of Total Antimony at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

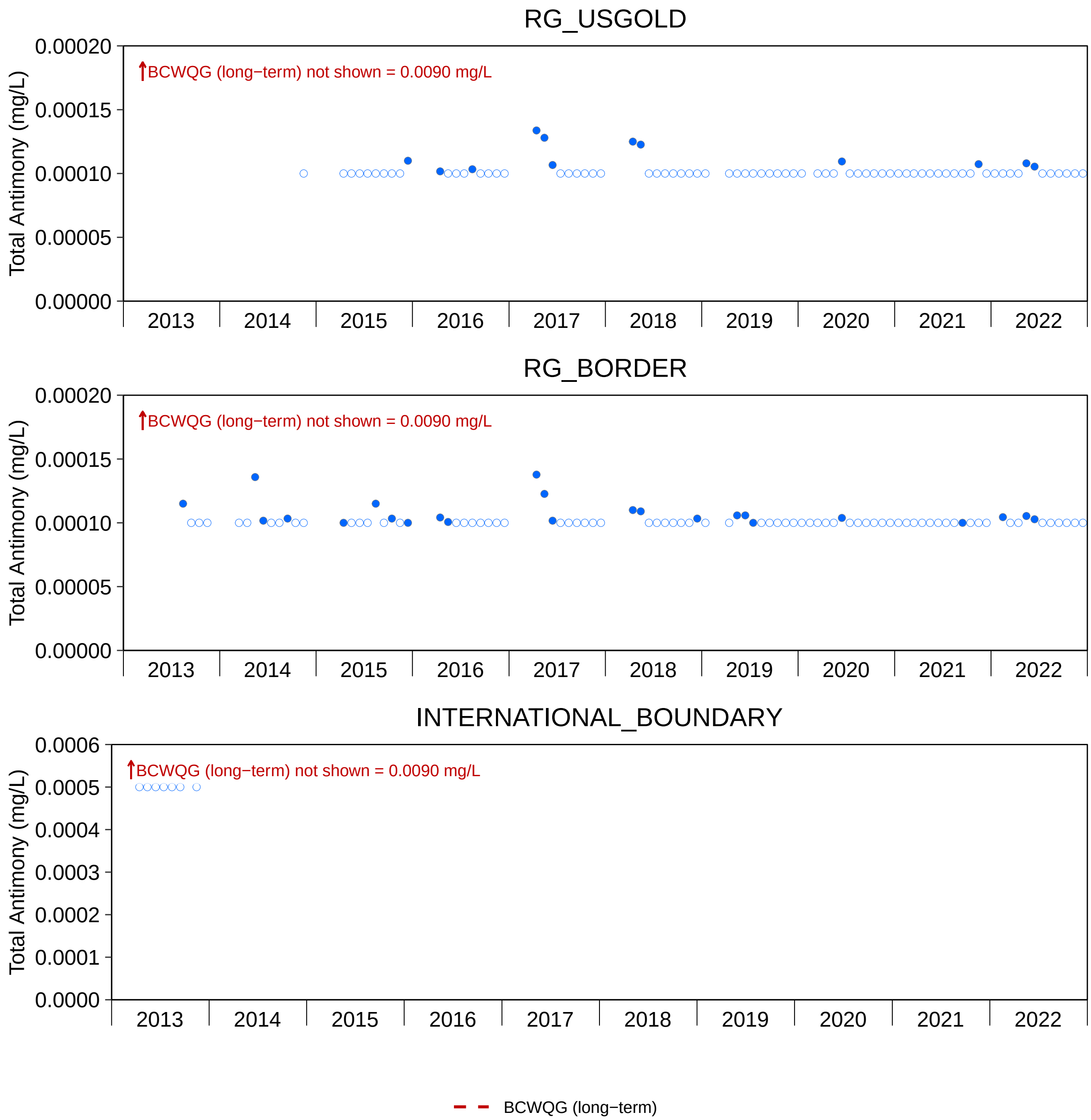


Figure B.1: Monthly Average Concentrations of Total Antimony at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

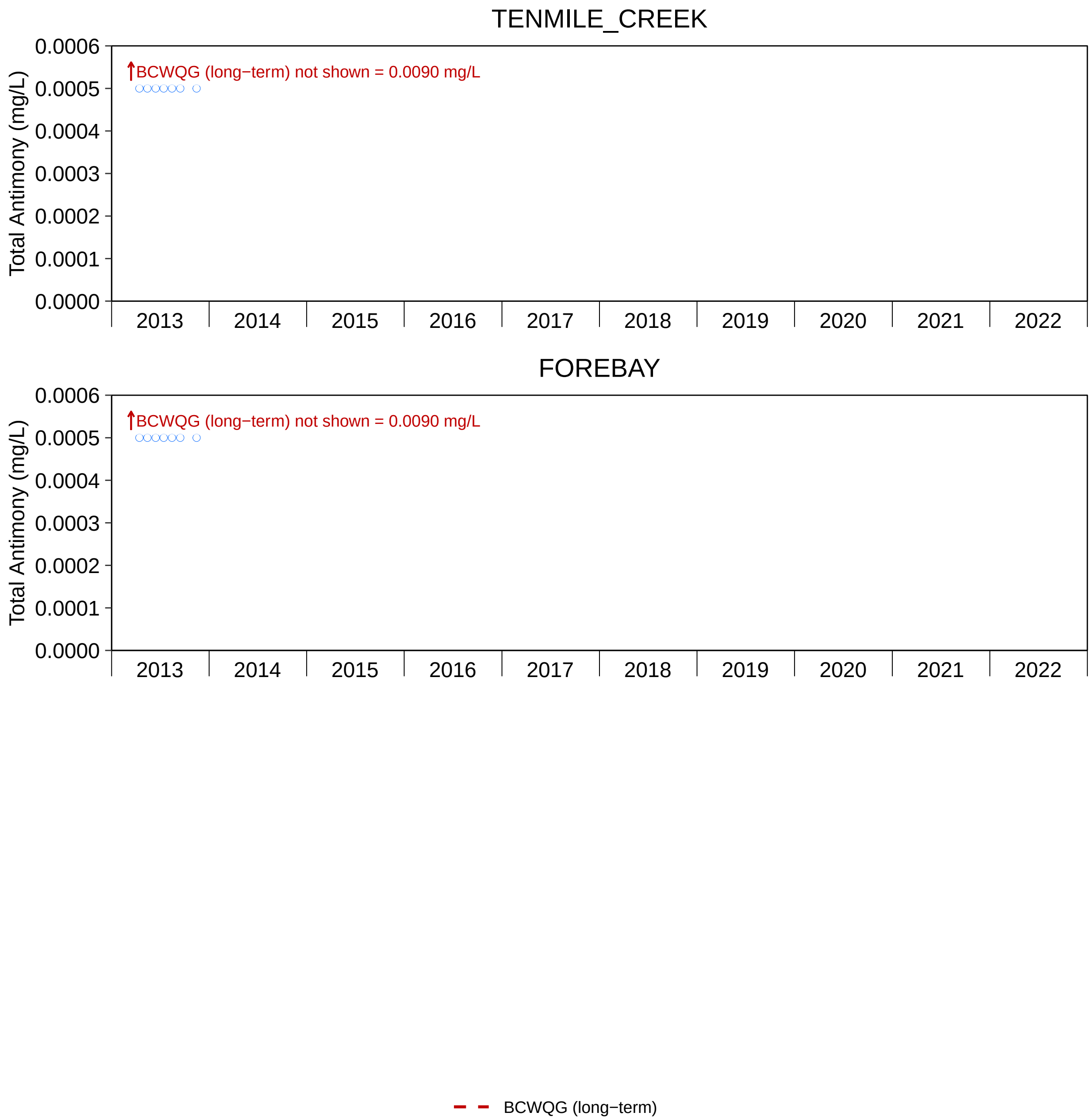


Figure B.1: Monthly Average Concentrations of Total Antimony at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

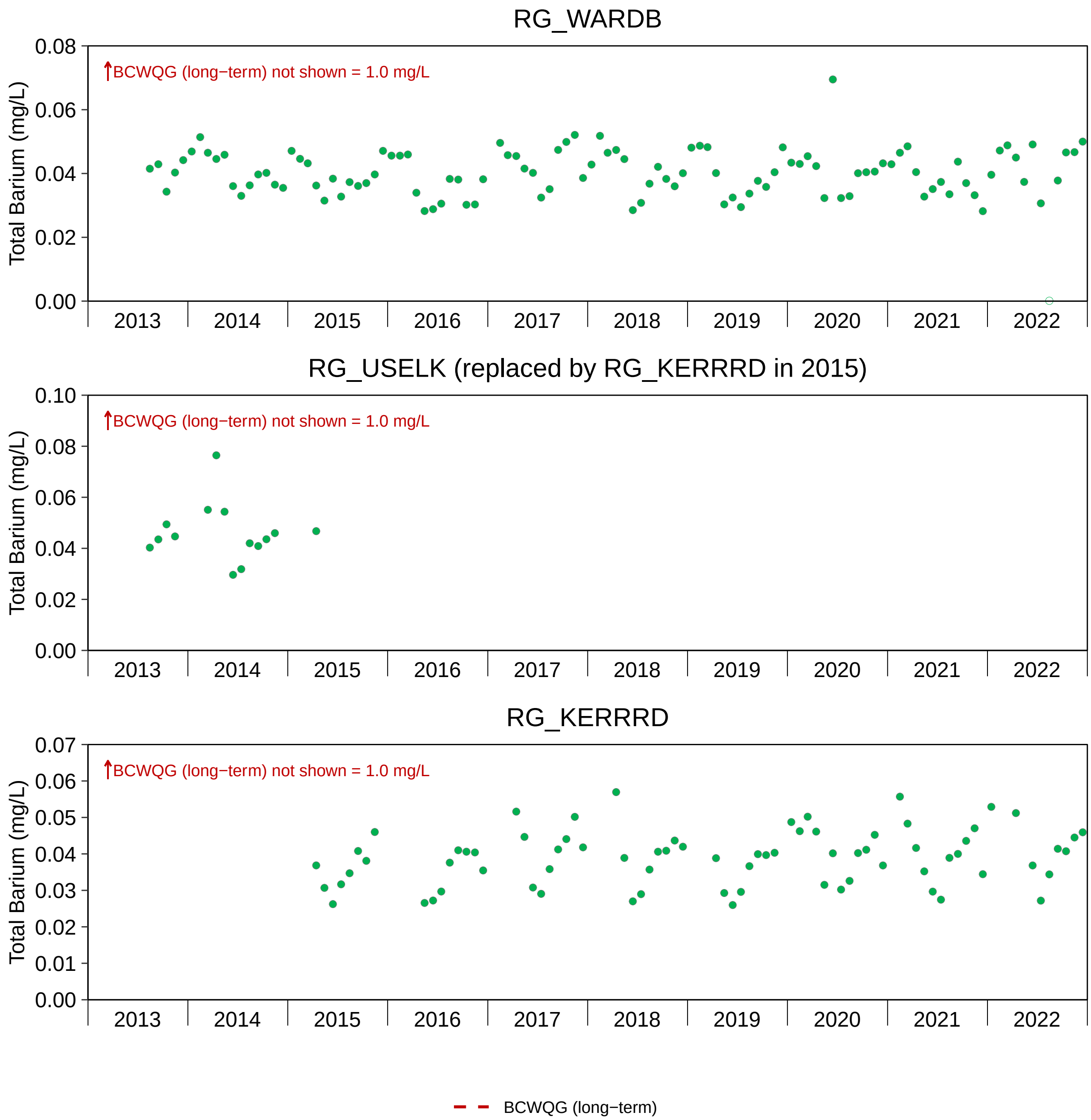


Figure B.2: Monthly Average Concentrations of Total Barium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

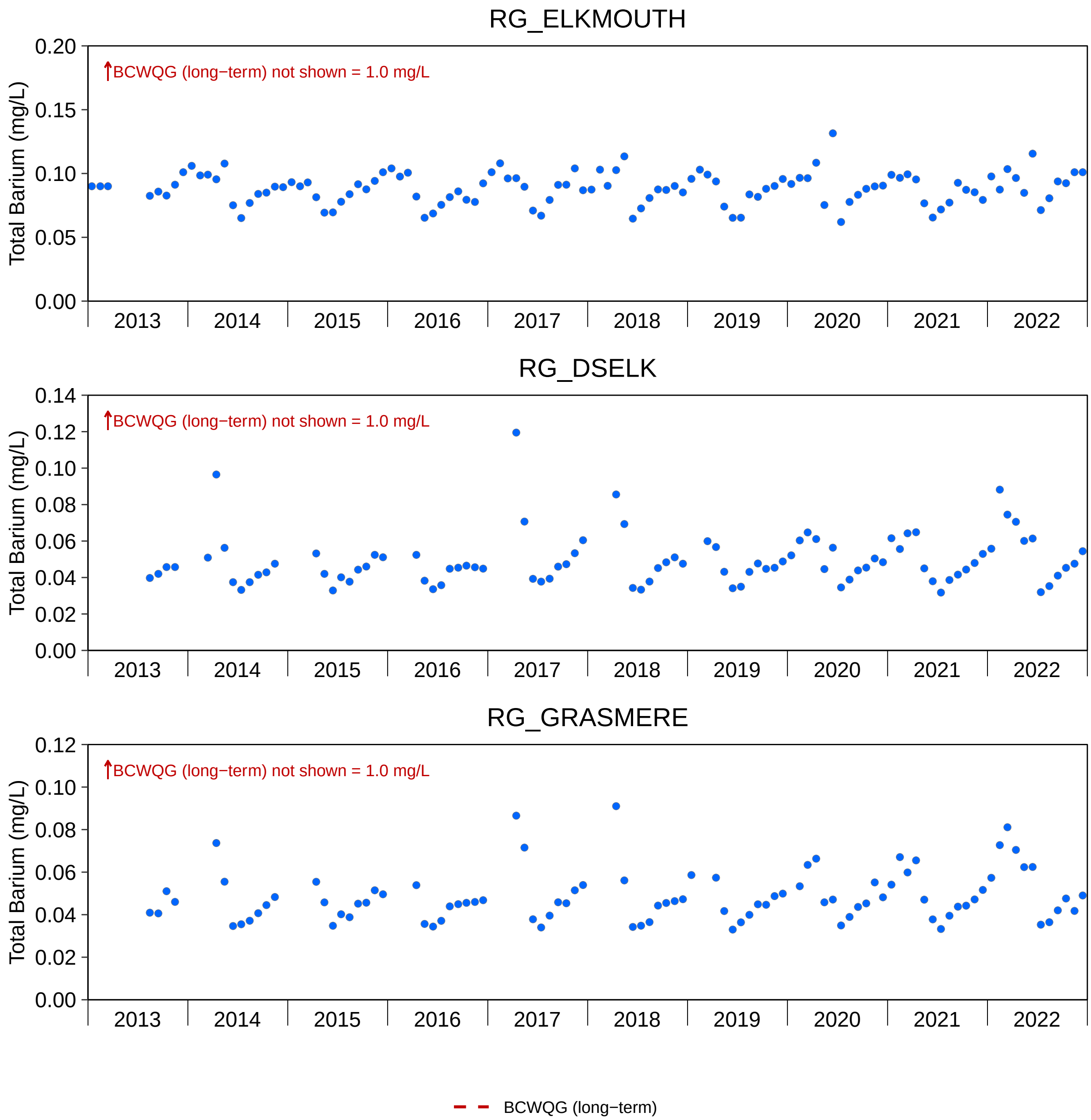


Figure B.2: Monthly Average Concentrations of Total Barium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

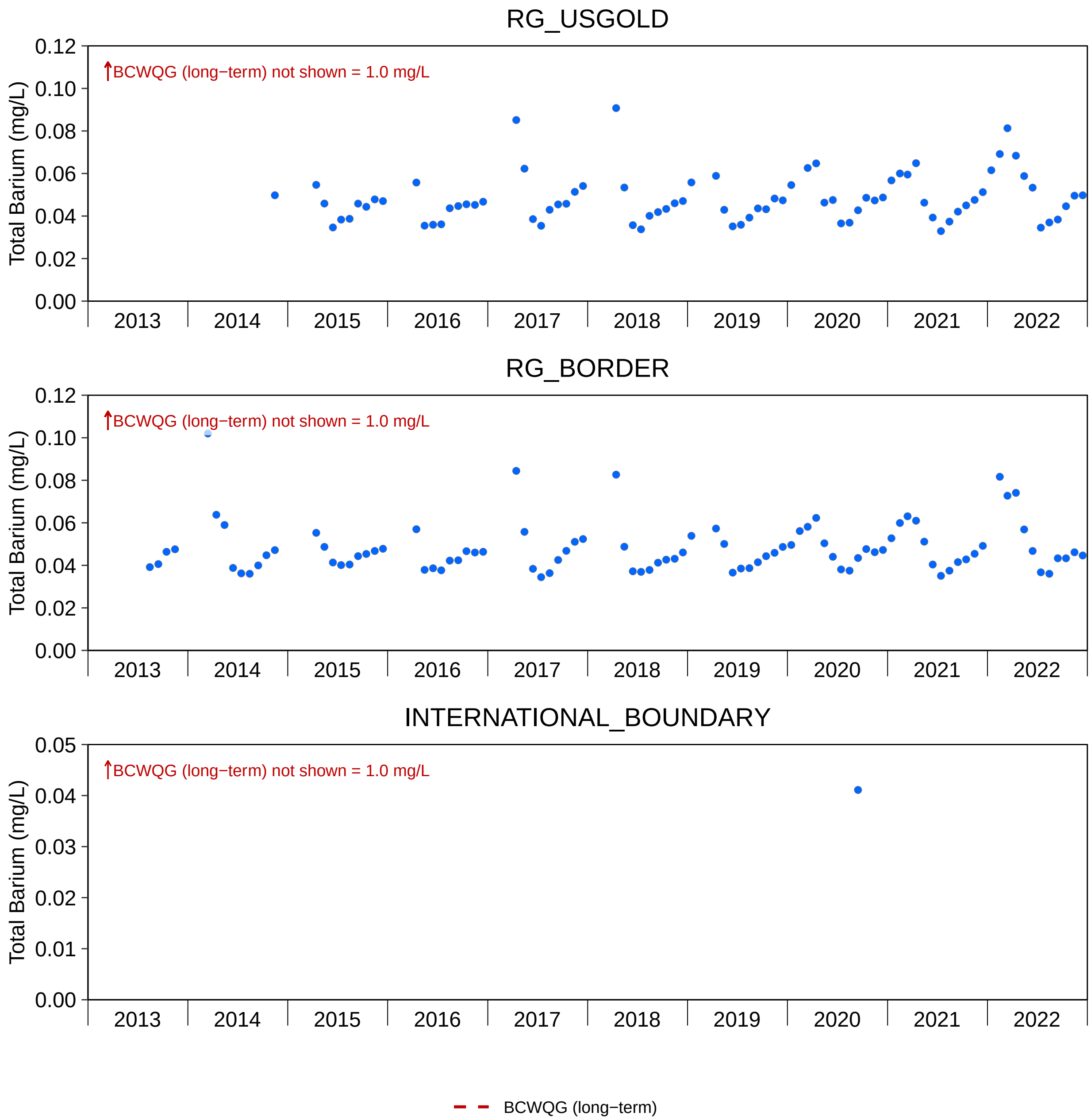


Figure B.2: Monthly Average Concentrations of Total Barium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

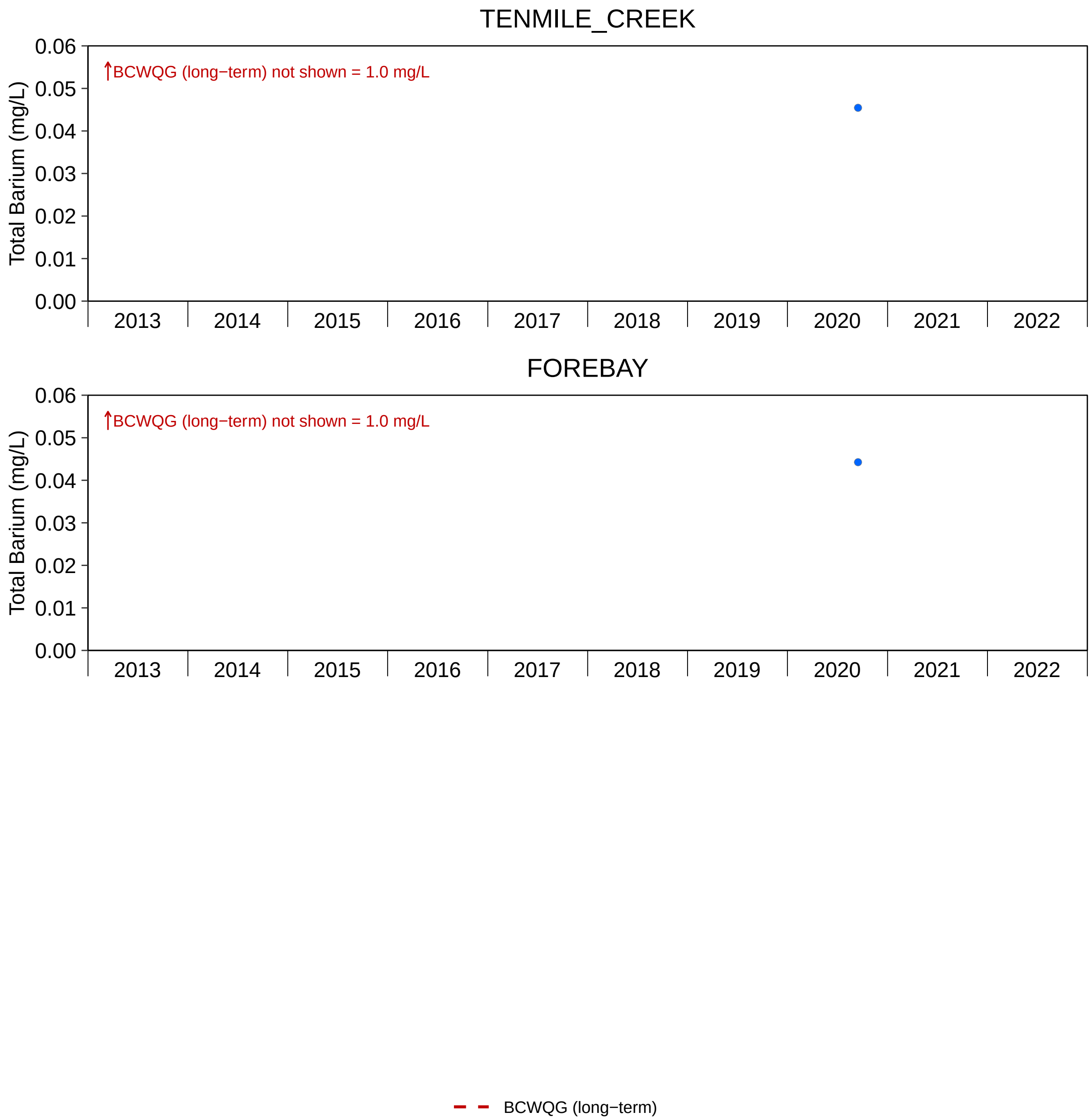


Figure B.2: Monthly Average Concentrations of Total Barium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

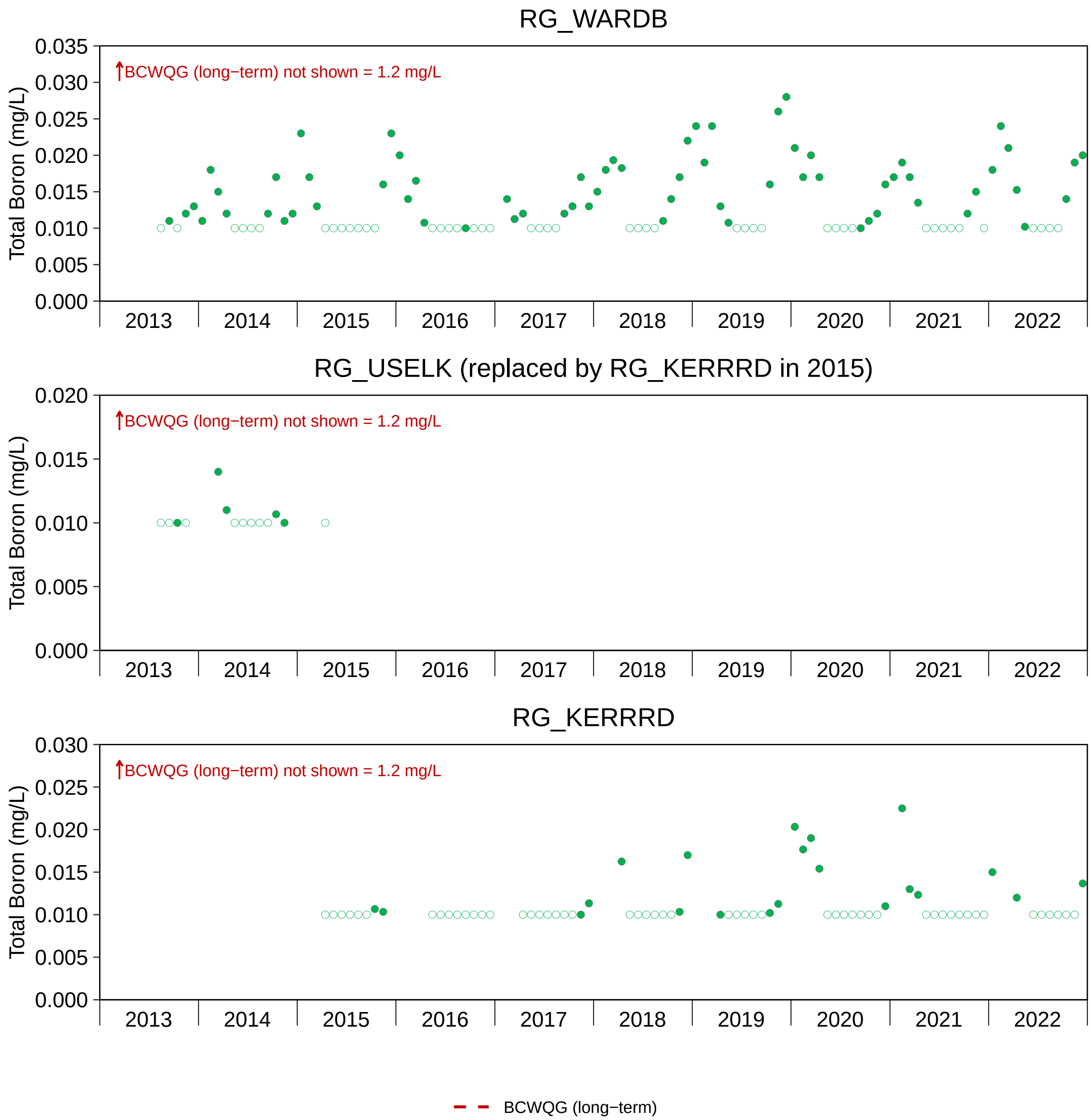


Figure B.3: Monthly Average Concentrations of Total Boron at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

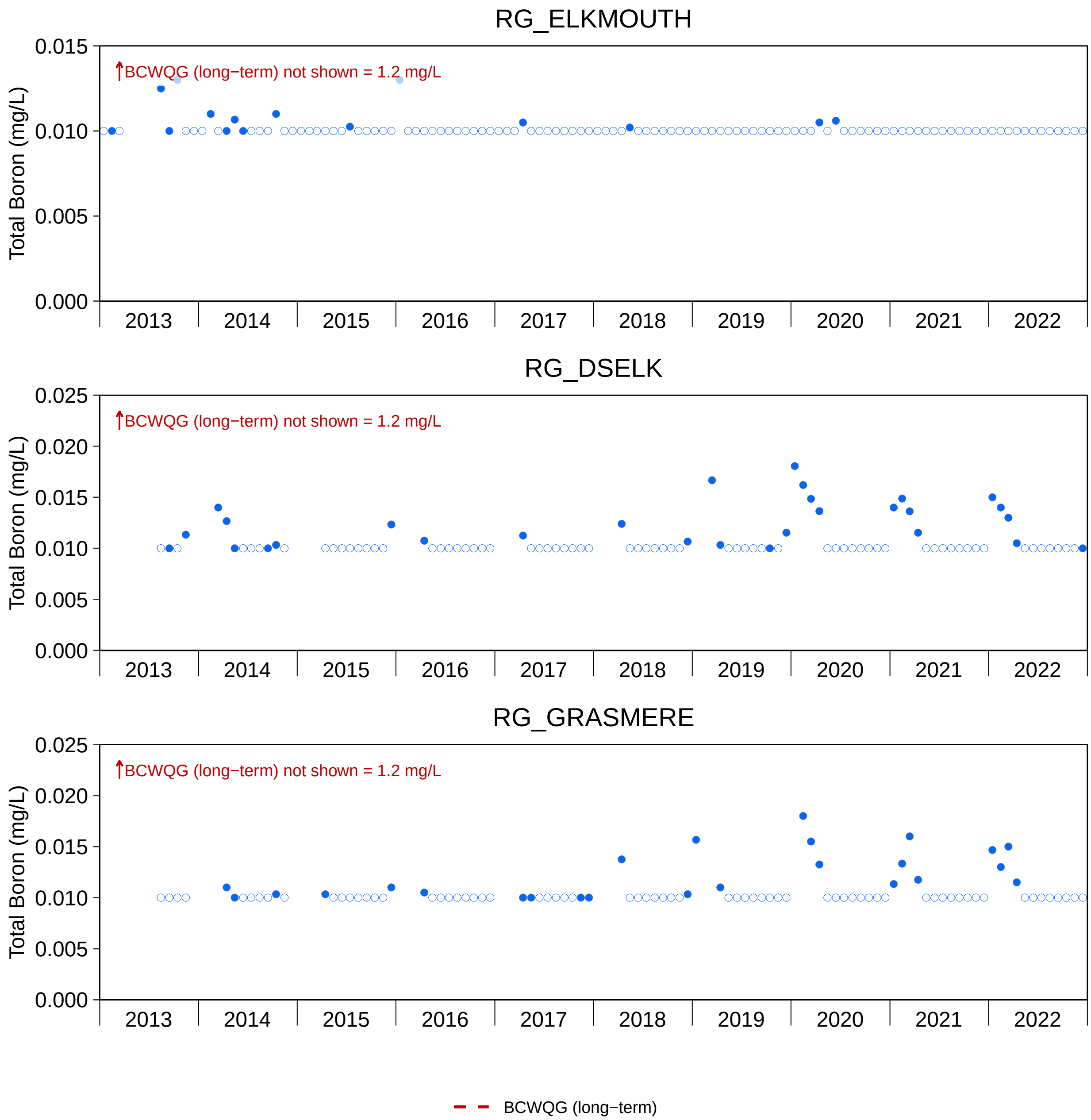


Figure B.3: Monthly Average Concentrations of Total Boron at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

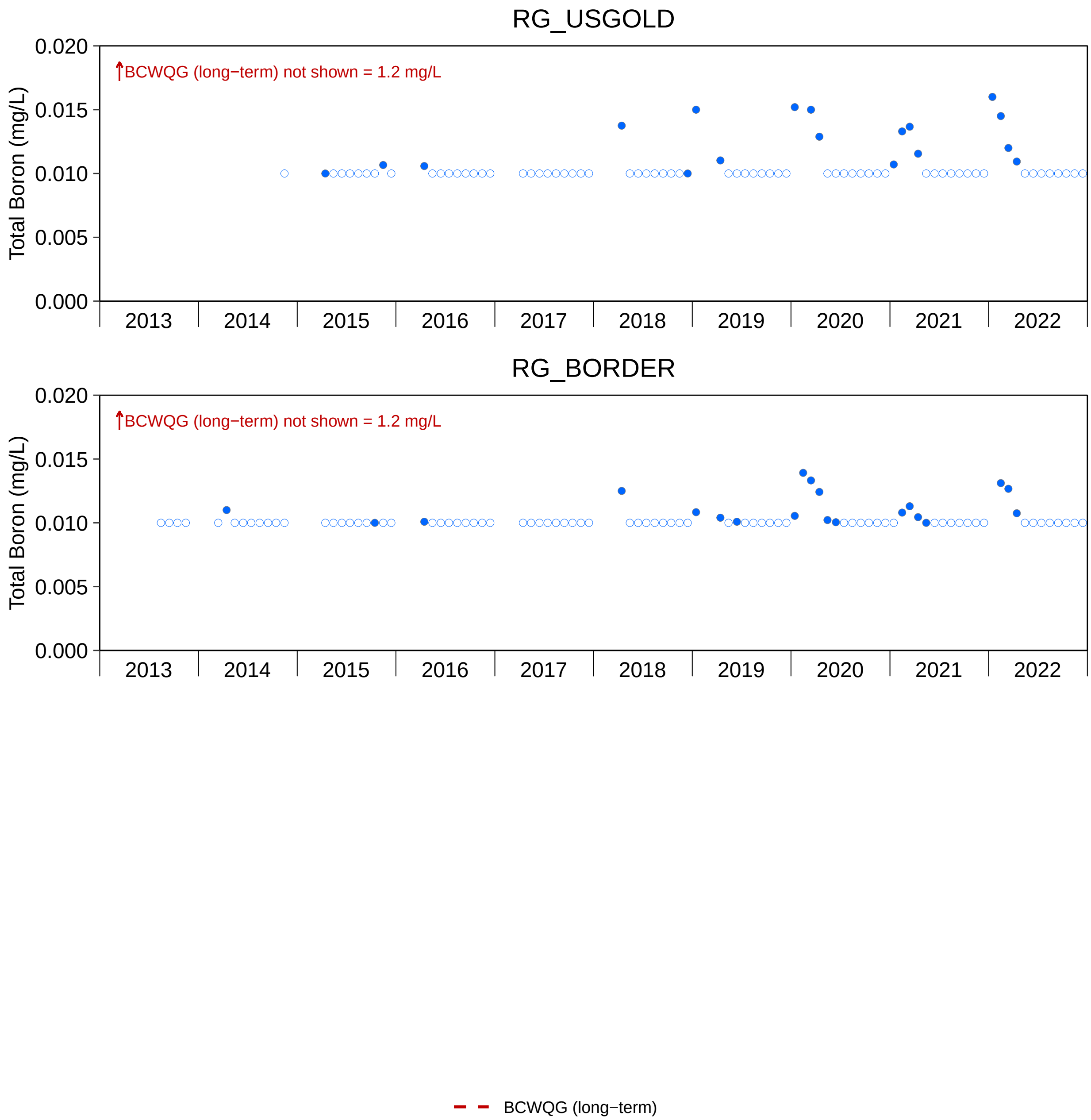


Figure B.3: Monthly Average Concentrations of Total Boron at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

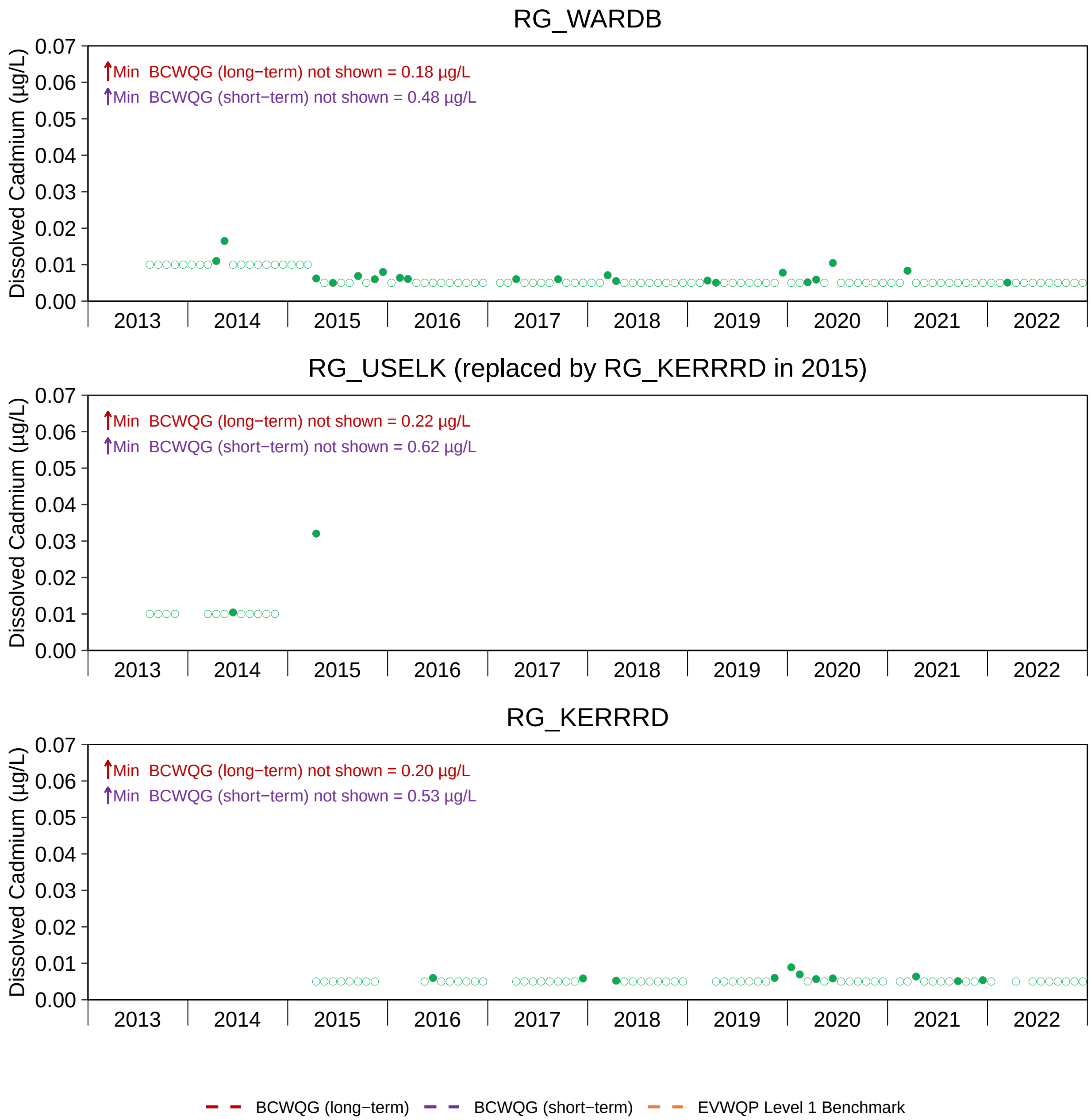


Figure B.4: Monthly Average Concentrations of Dissolved Cadmium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

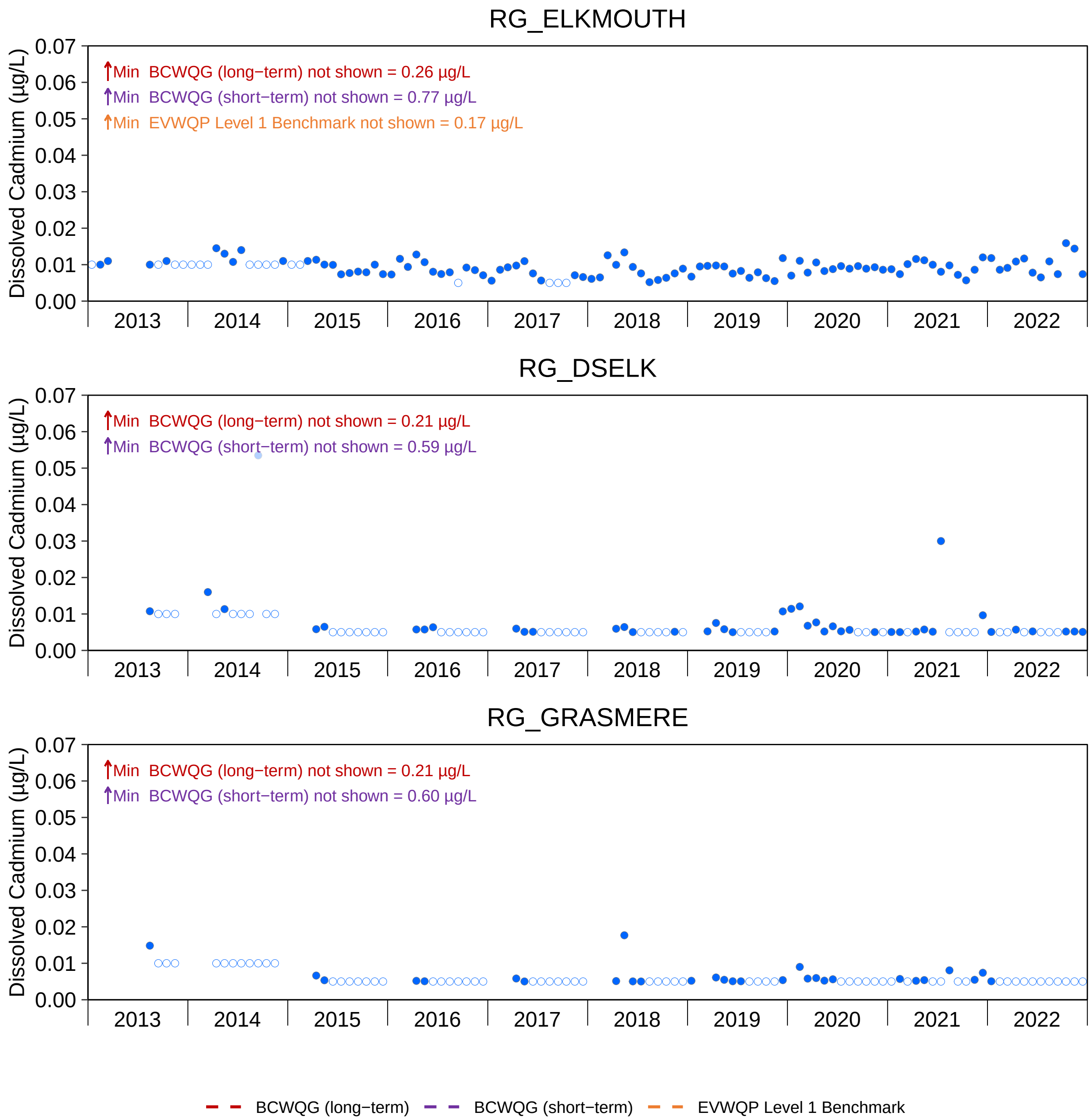


Figure B.4: Monthly Average Concentrations of Dissolved Cadmium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

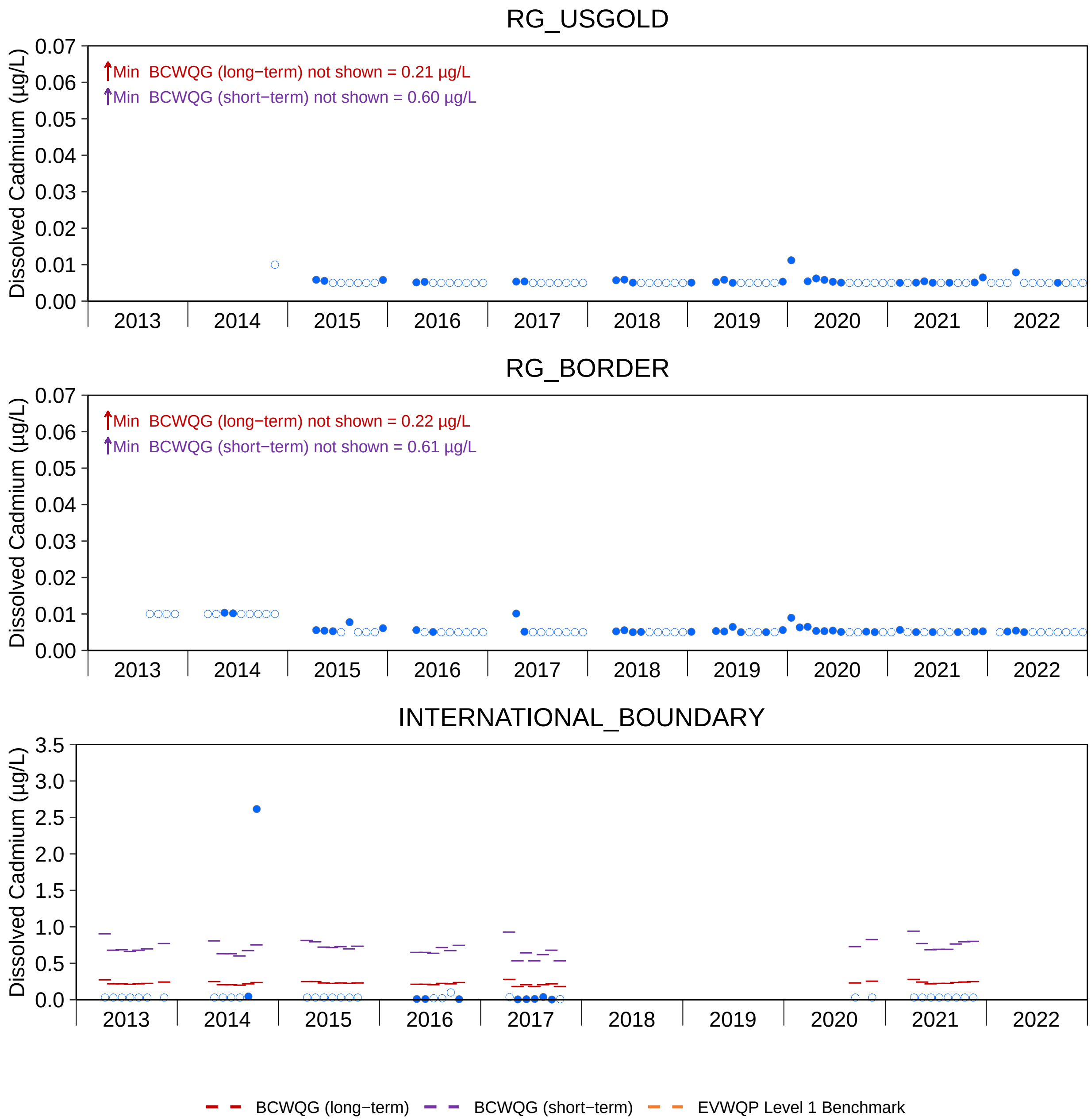


Figure B.4: Monthly Average Concentrations of Dissolved Cadmium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

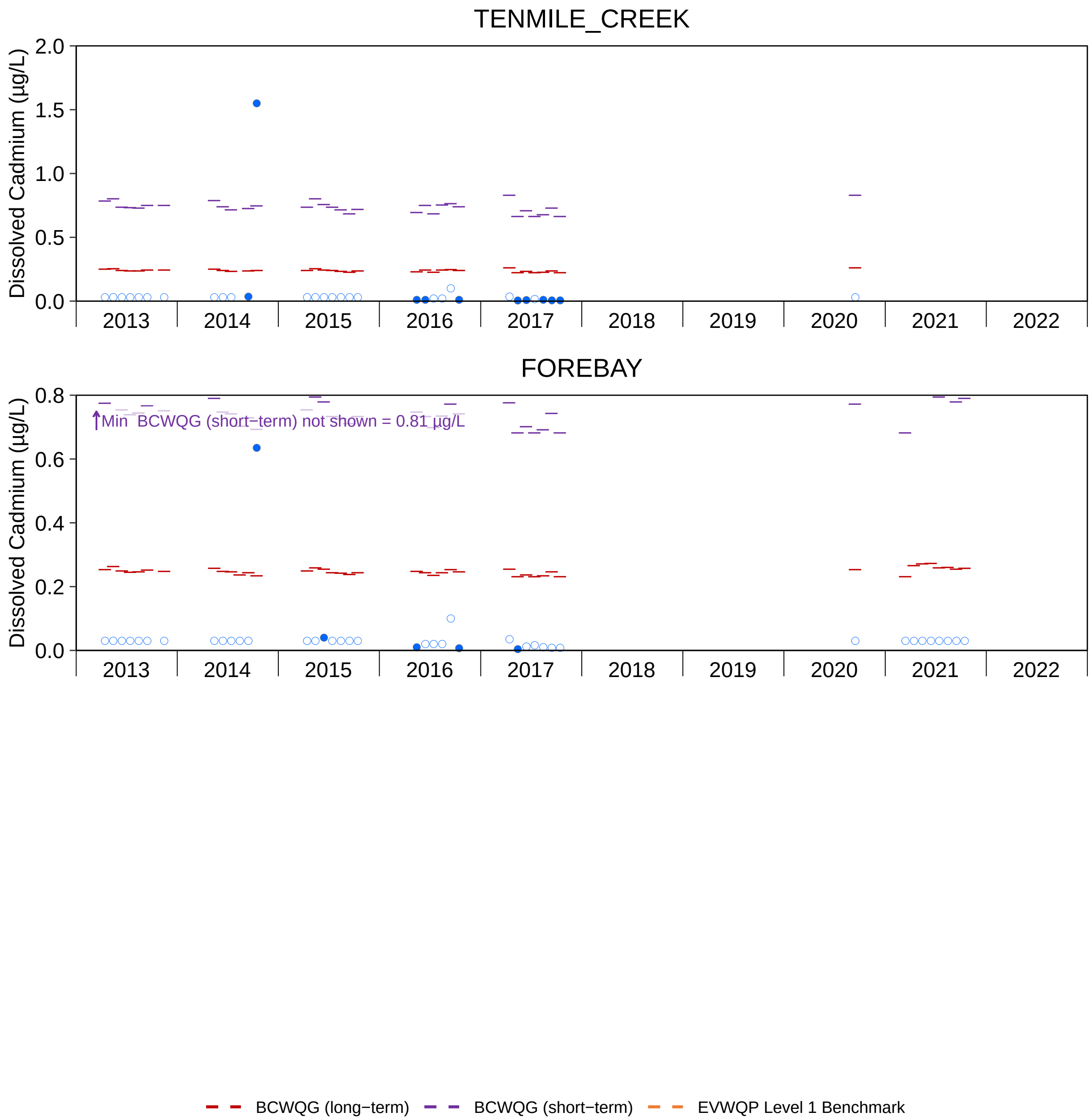


Figure B.4: Monthly Average Concentrations of Dissolved Cadmium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

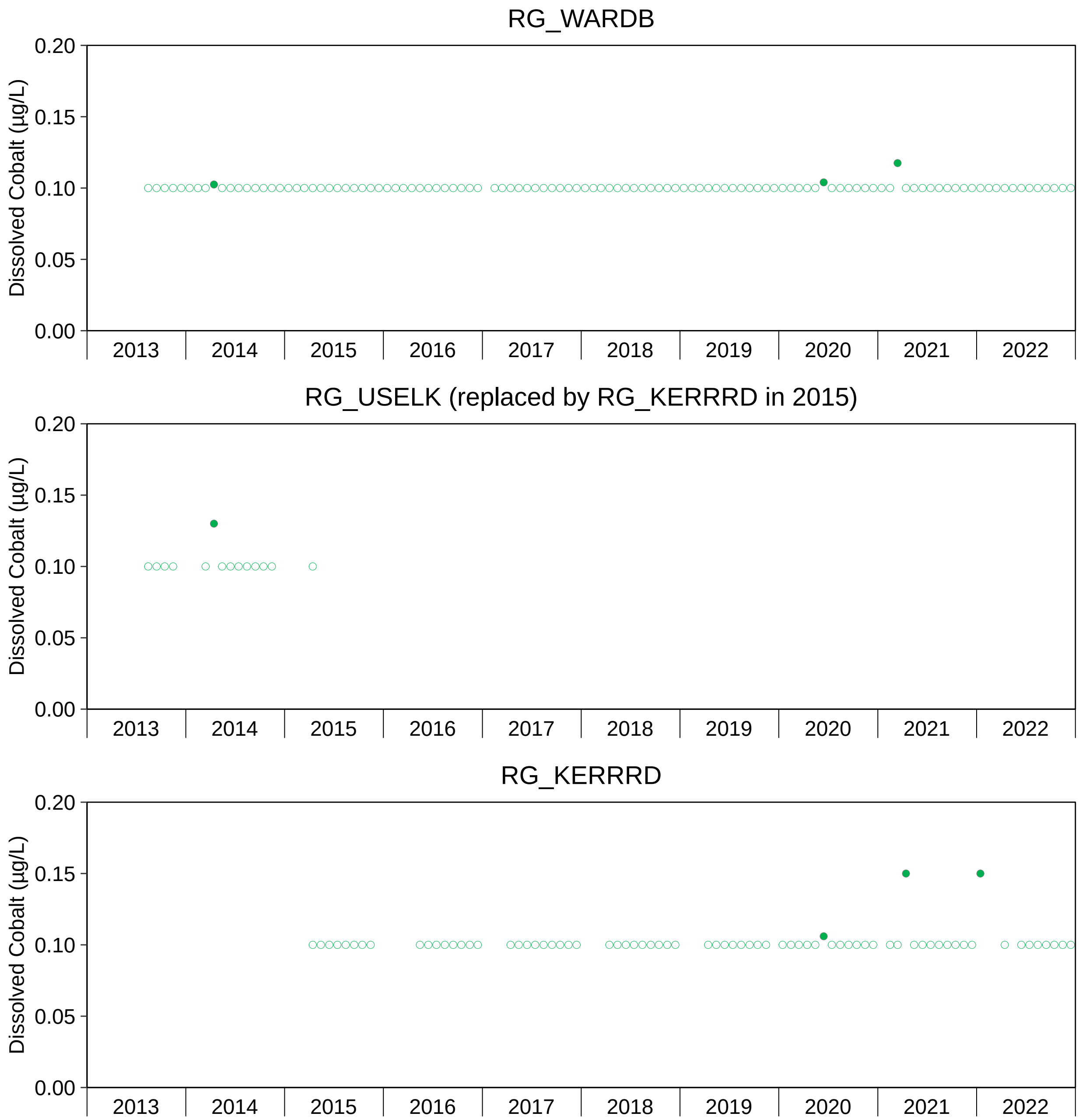


Figure B.5: Monthly Average Concentrations of Dissolved Cobalt at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved cobalt was used because bioavailability and toxicity has been associated with the dissolved fraction (Environment Canada 2017; Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

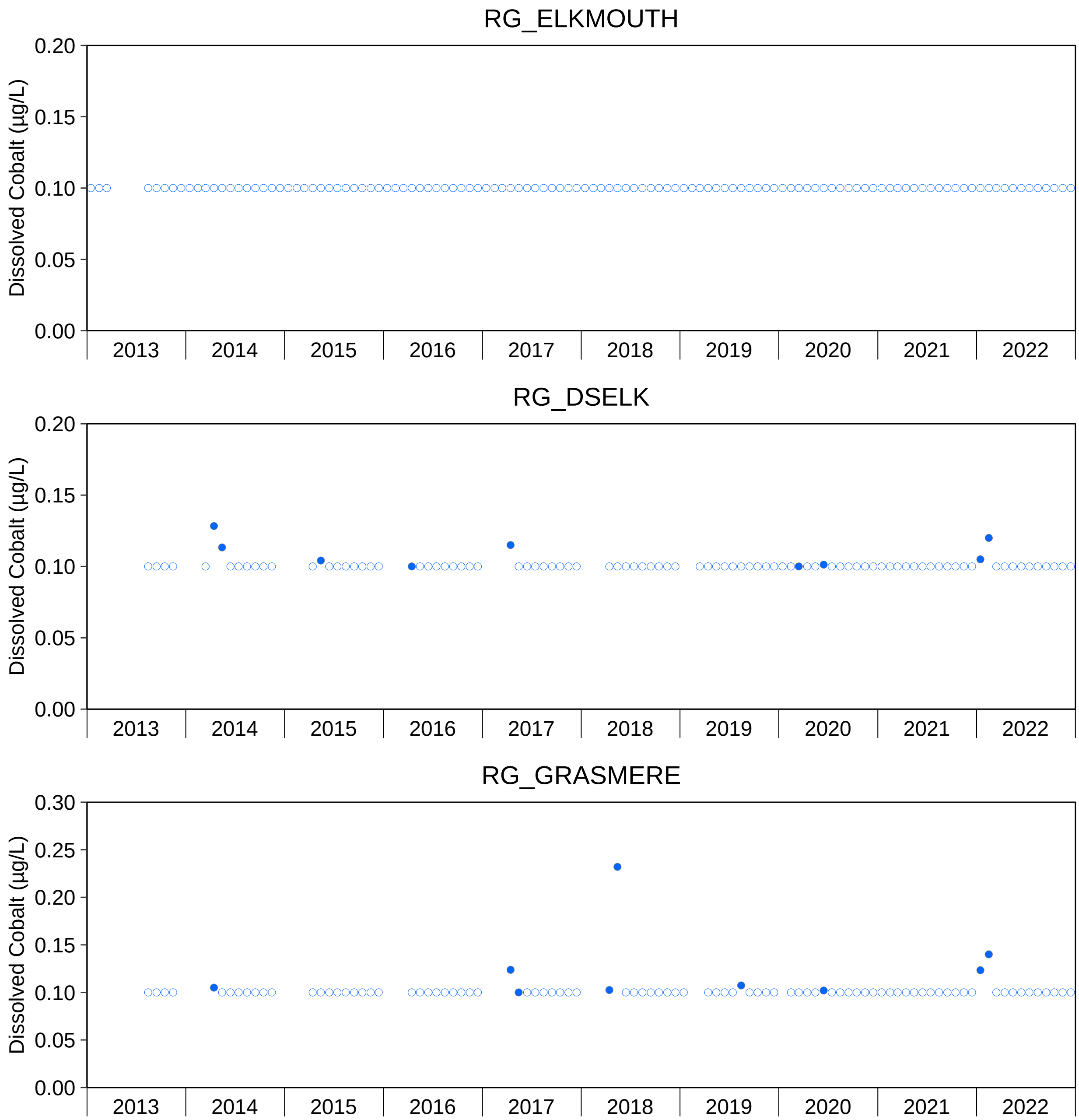


Figure B.5: Monthly Average Concentrations of Dissolved Cobalt at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved cobalt was used because bioavailability and toxicity has been associated with the dissolved fraction (Environment Canada 2017; Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

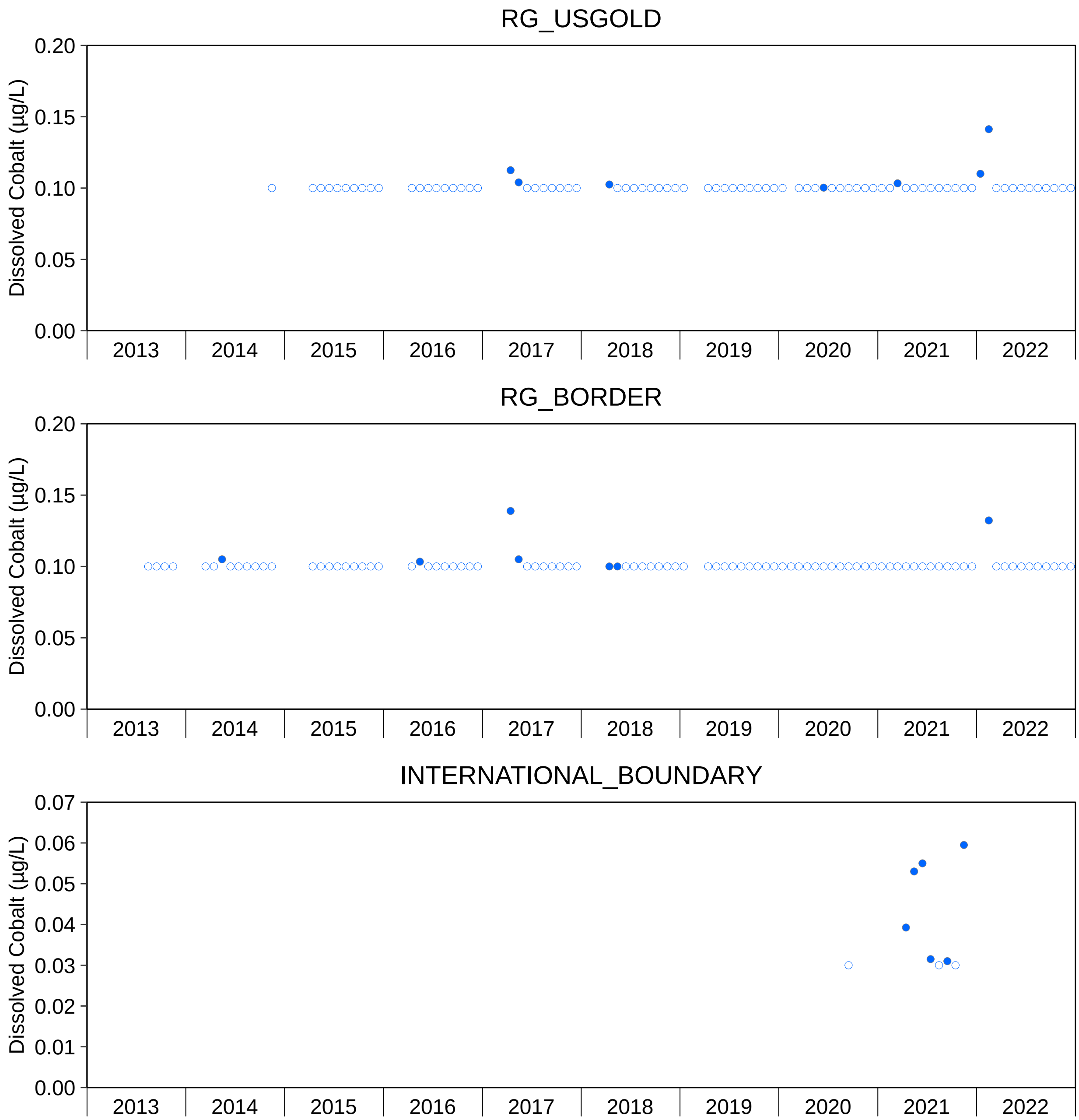


Figure B.5: Monthly Average Concentrations of Dissolved Cobalt at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved cobalt was used because bioavailability and toxicity has been associated with the dissolved fraction (Environment Canada 2017; Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

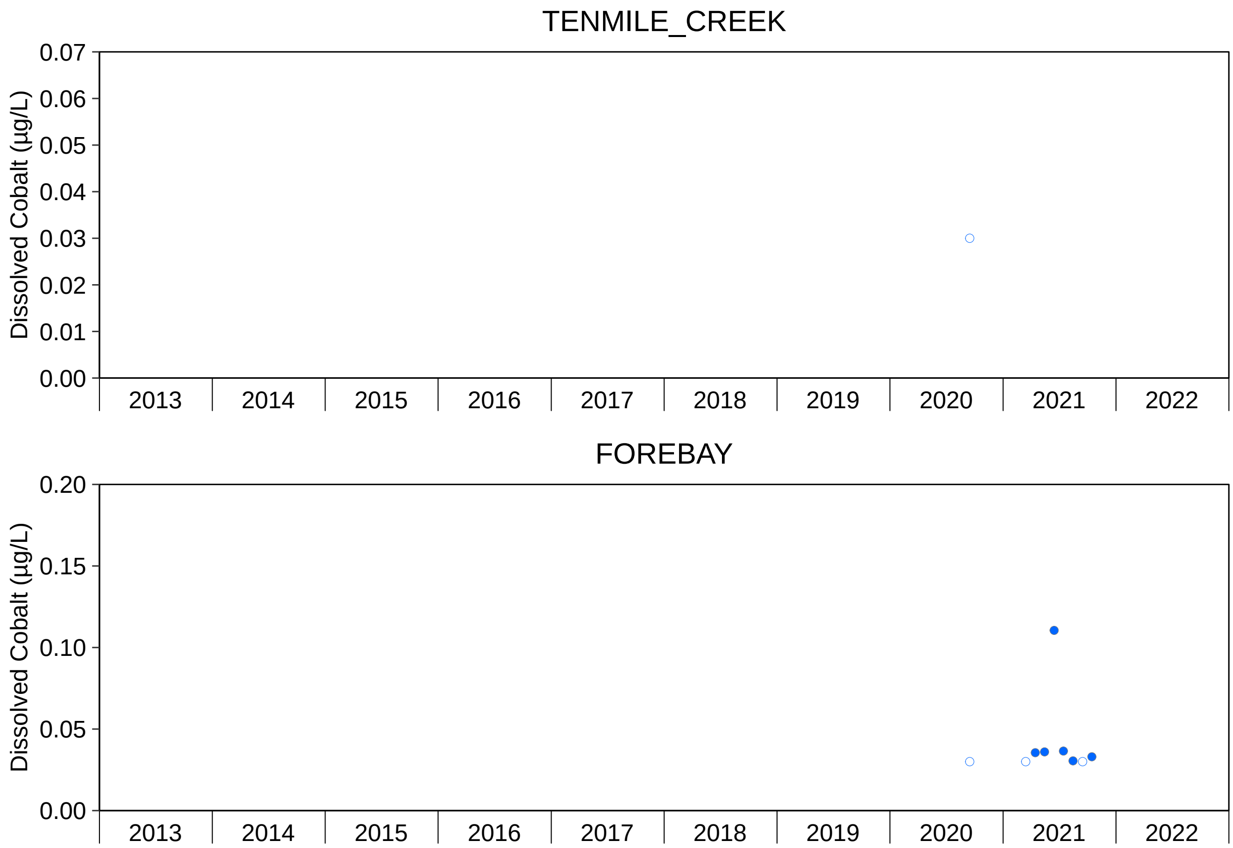


Figure B.5: Monthly Average Concentrations of Dissolved Cobalt at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Dissolved cobalt was used because bioavailability and toxicity has been associated with the dissolved fraction (Environment Canada 2017; Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

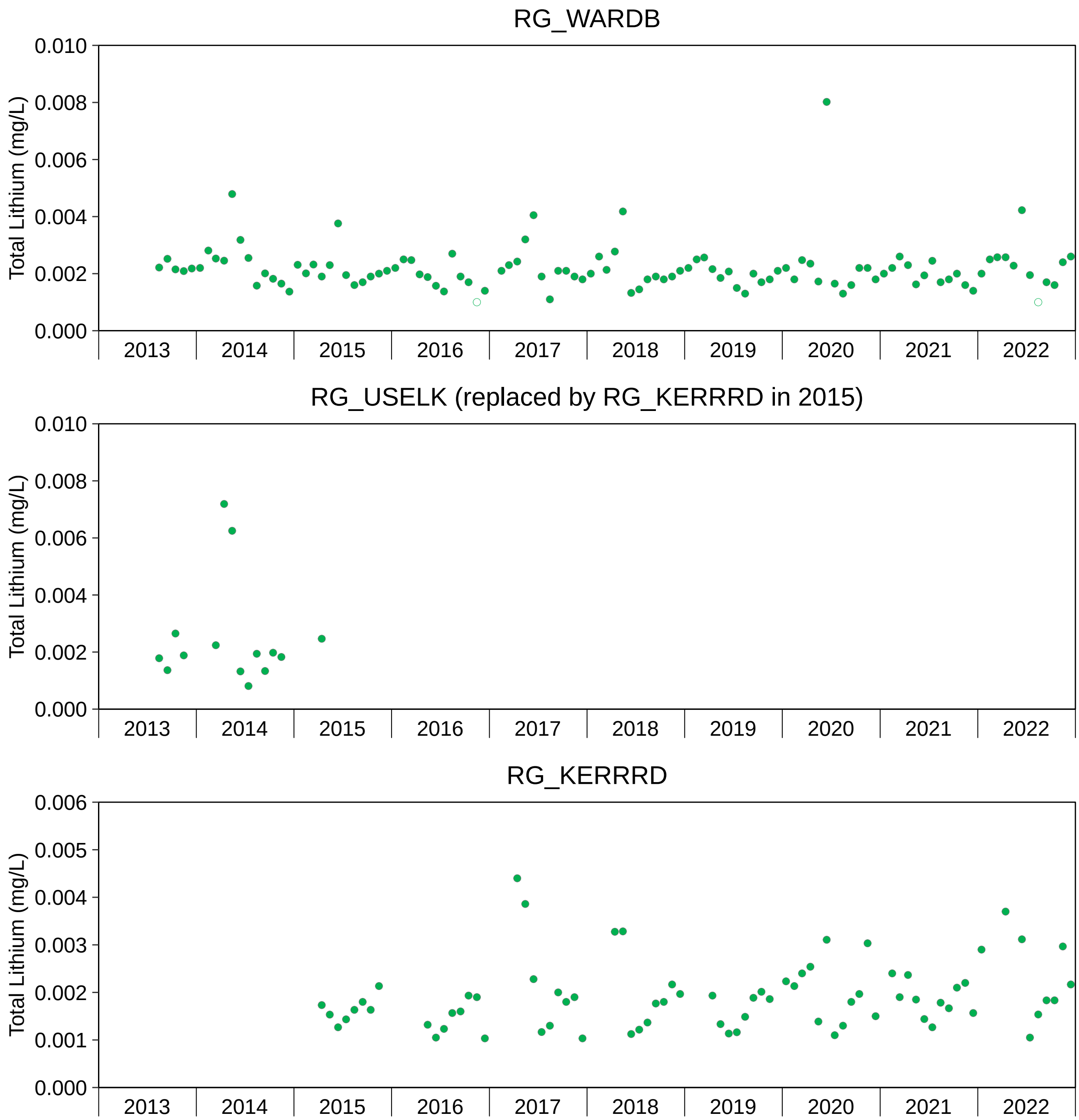


Figure B.6: Monthly Average Concentrations of Total Lithium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

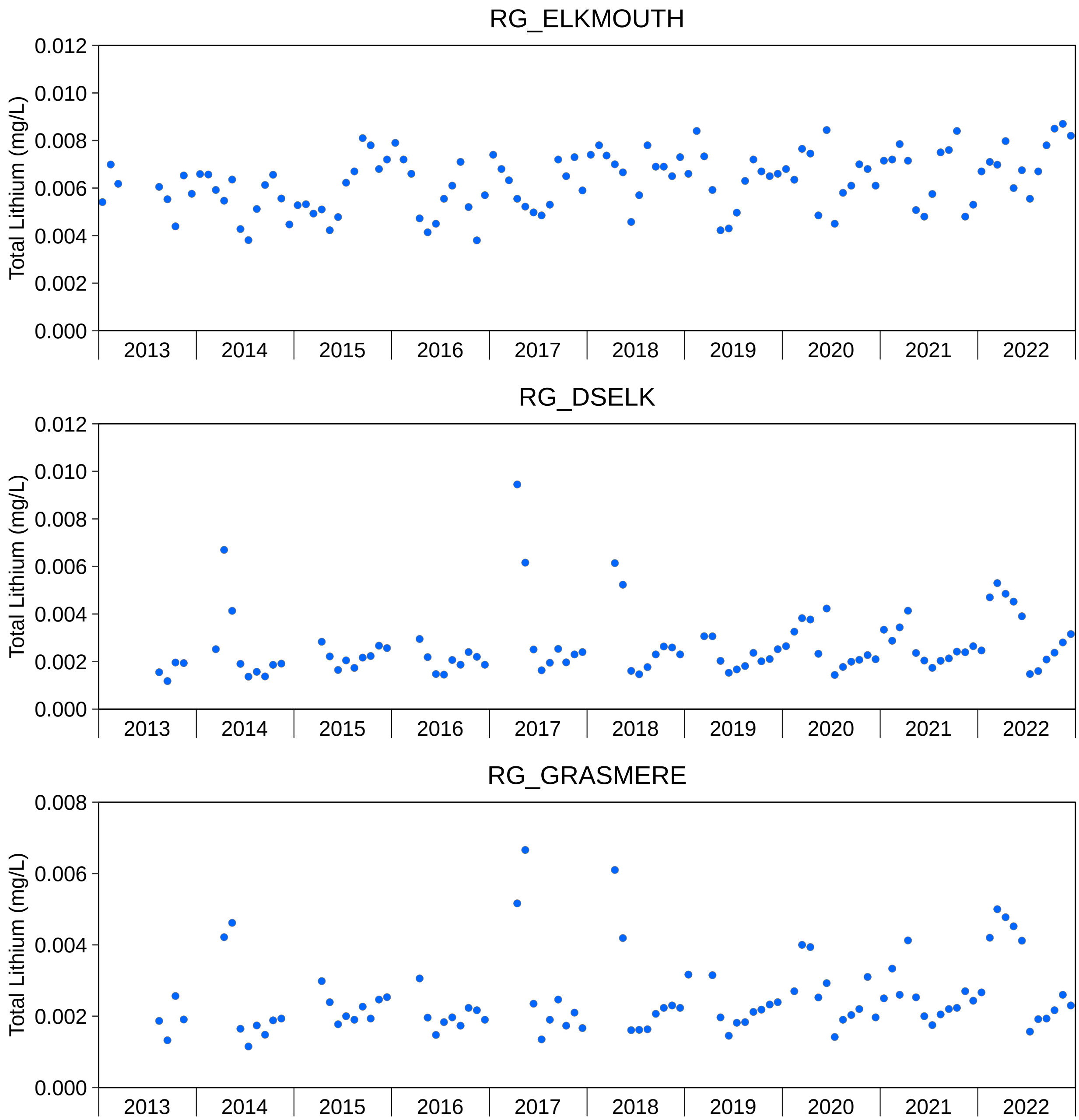


Figure B.6: Monthly Average Concentrations of Total Lithium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

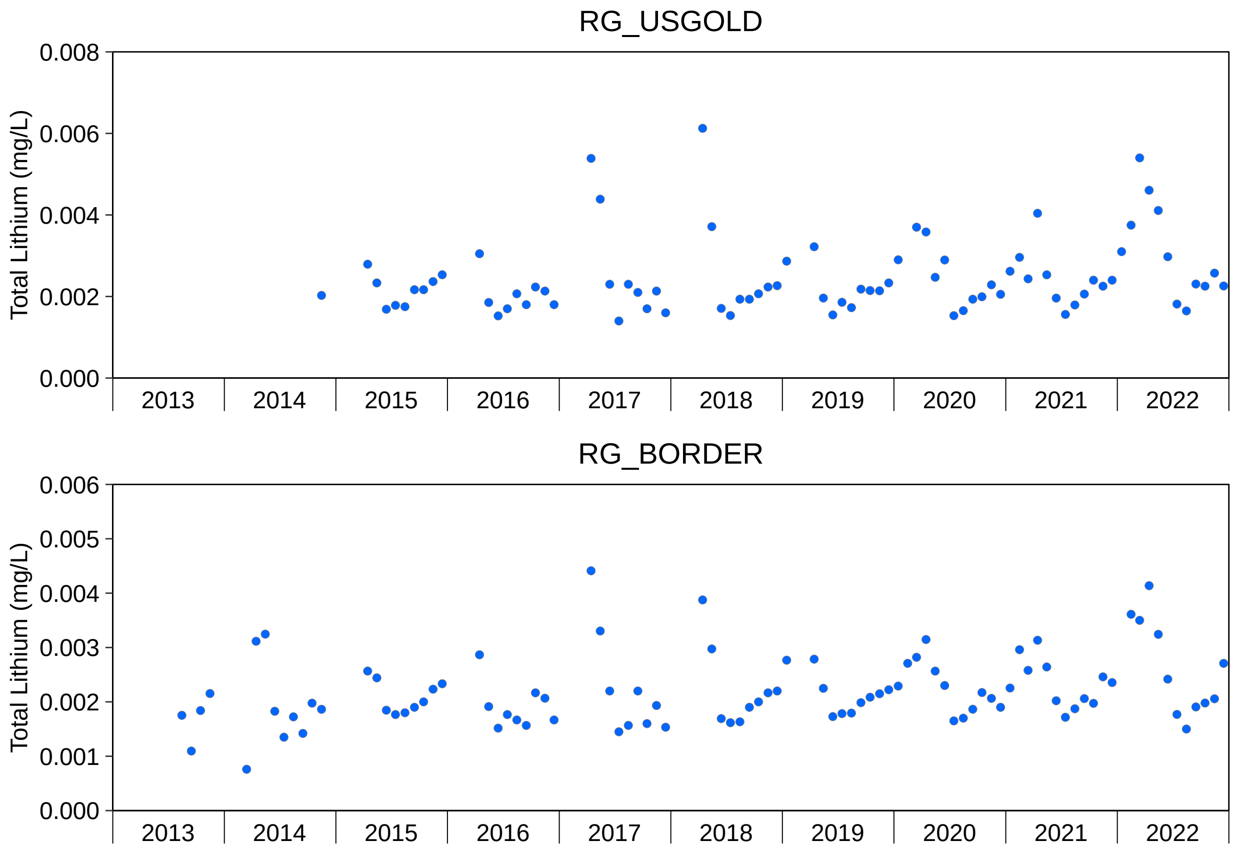


Figure B.6: Monthly Average Concentrations of Total Lithium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

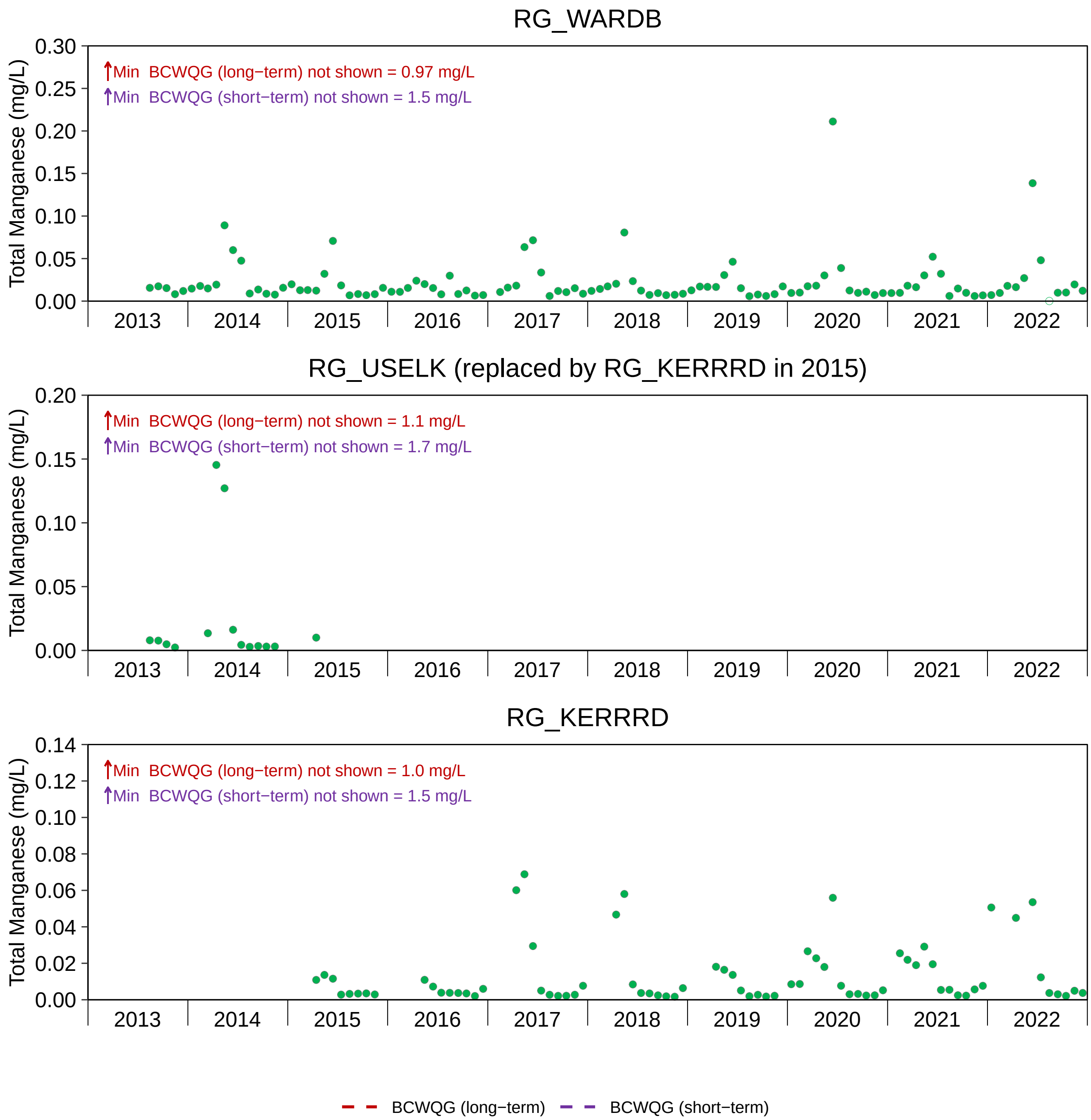


Figure B.7: Monthly Average Concentrations of Total Manganese at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

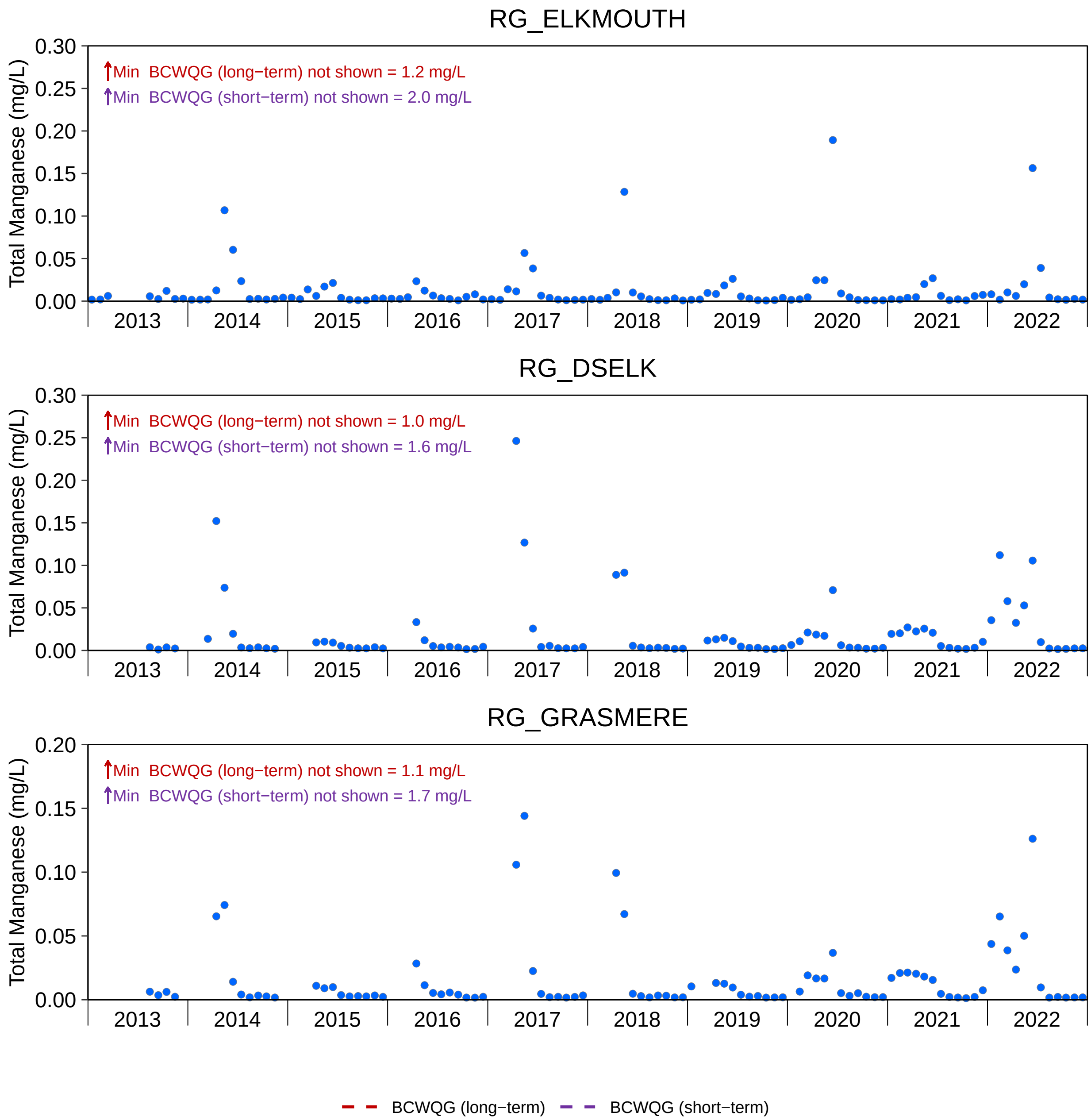


Figure B.7: Monthly Average Concentrations of Total Manganese at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

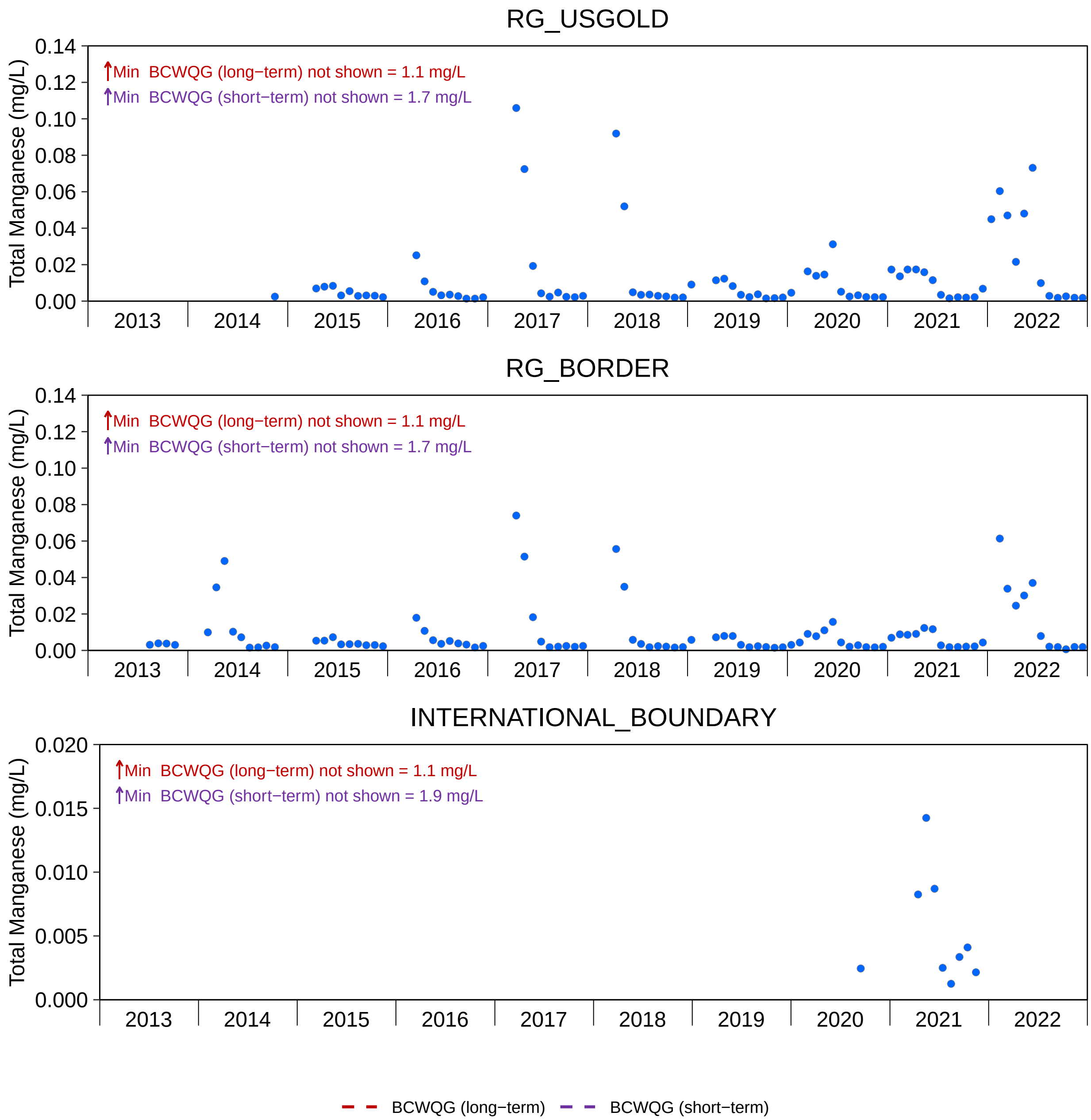


Figure B.7: Monthly Average Concentrations of Total Manganese at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

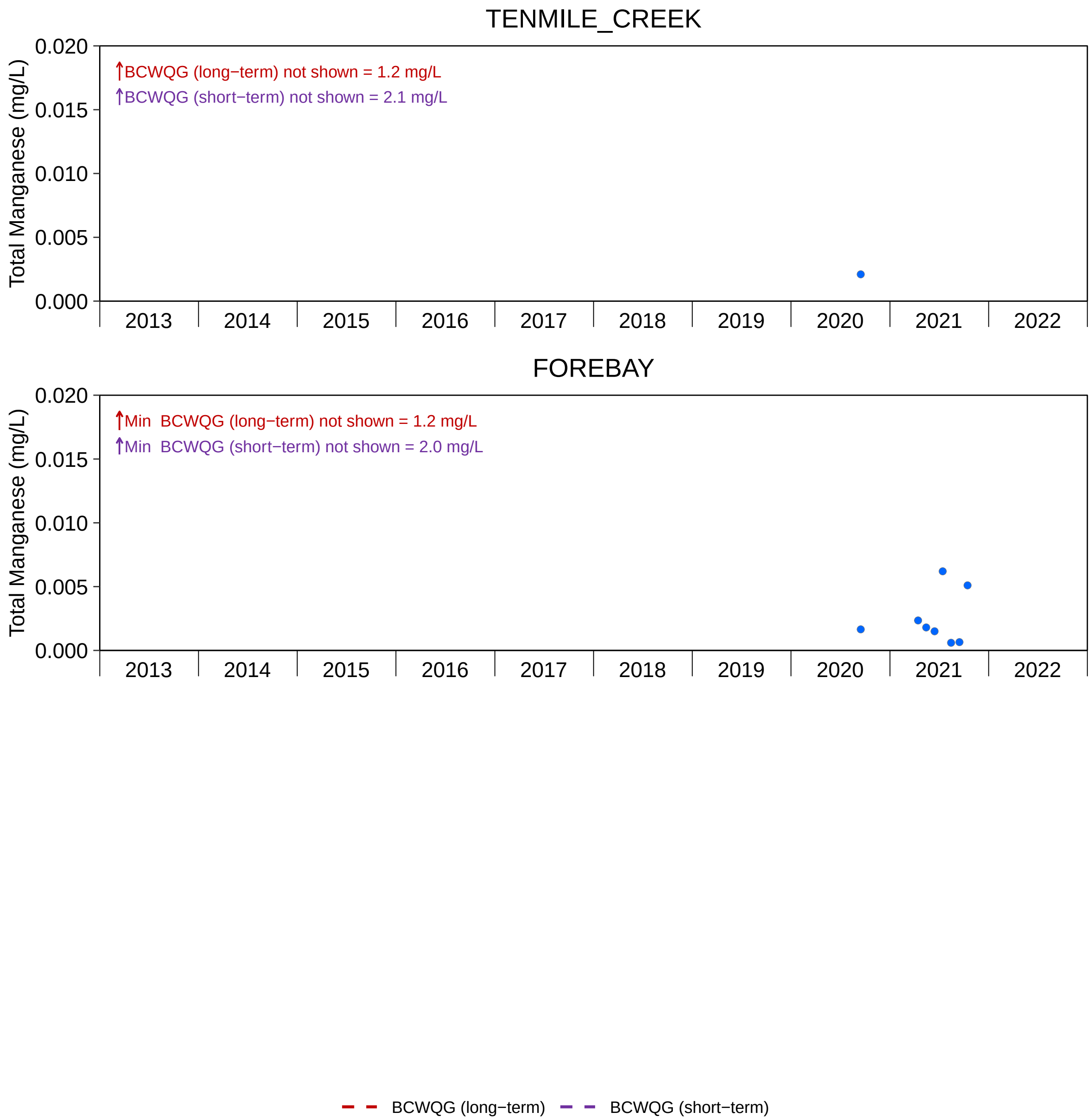


Figure B.7: Monthly Average Concentrations of Total Manganese at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

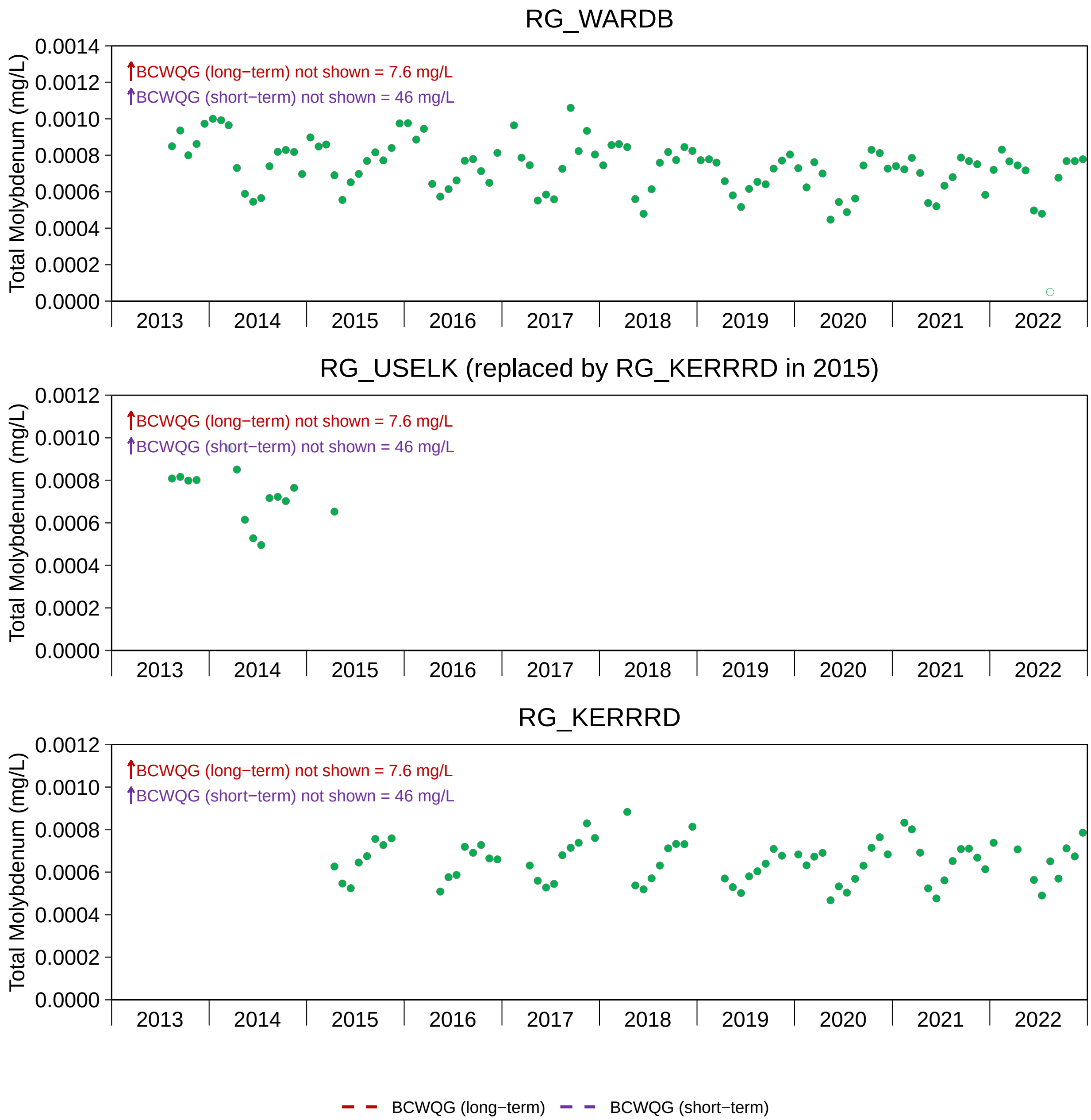


Figure B.8: Monthly Average Concentrations of Total Molybdenum at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

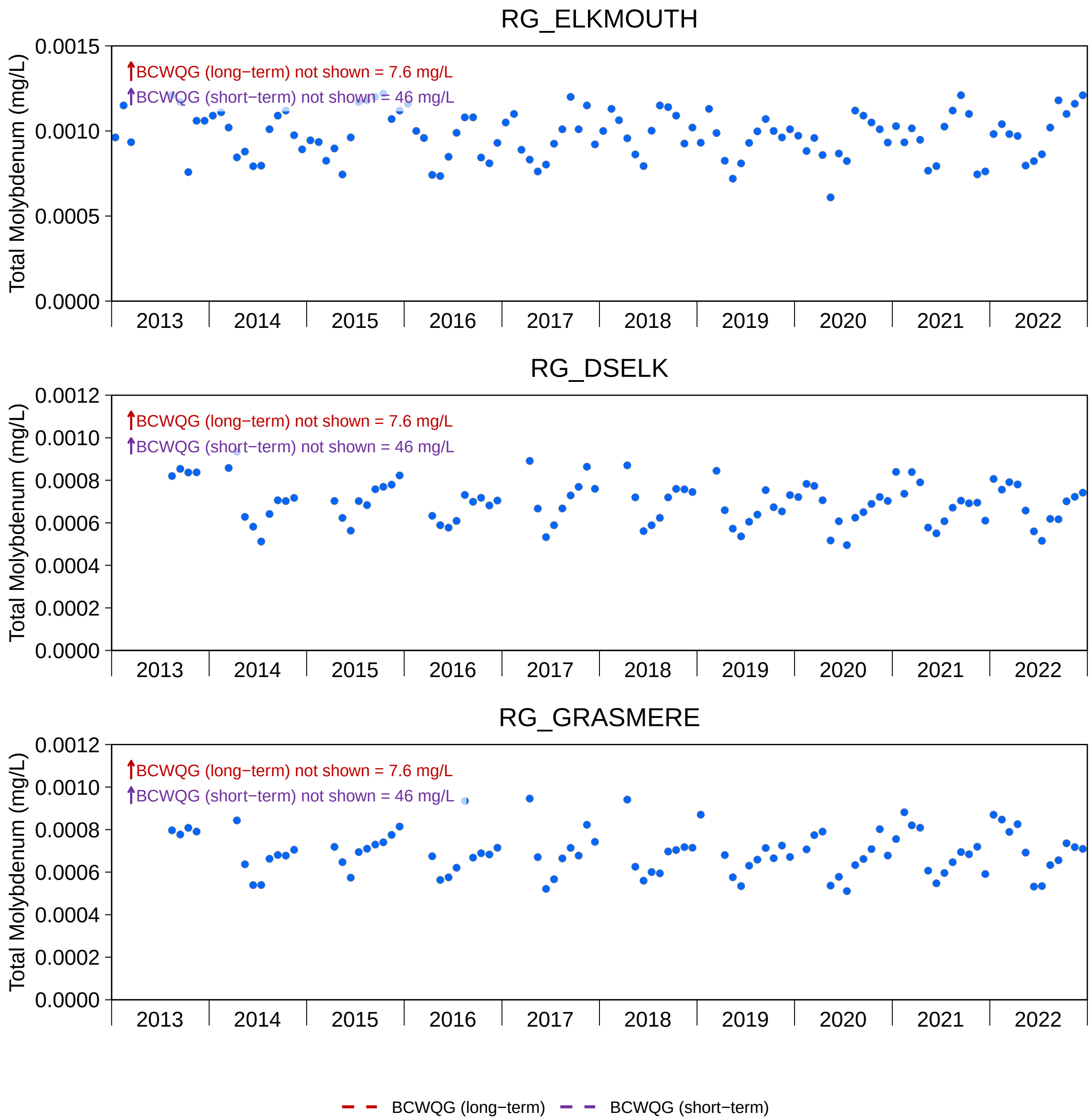


Figure B.8: Monthly Average Concentrations of Total Molybdenum at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

Figure B.8: Monthly Average Concentrations of Total Molybdenum at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

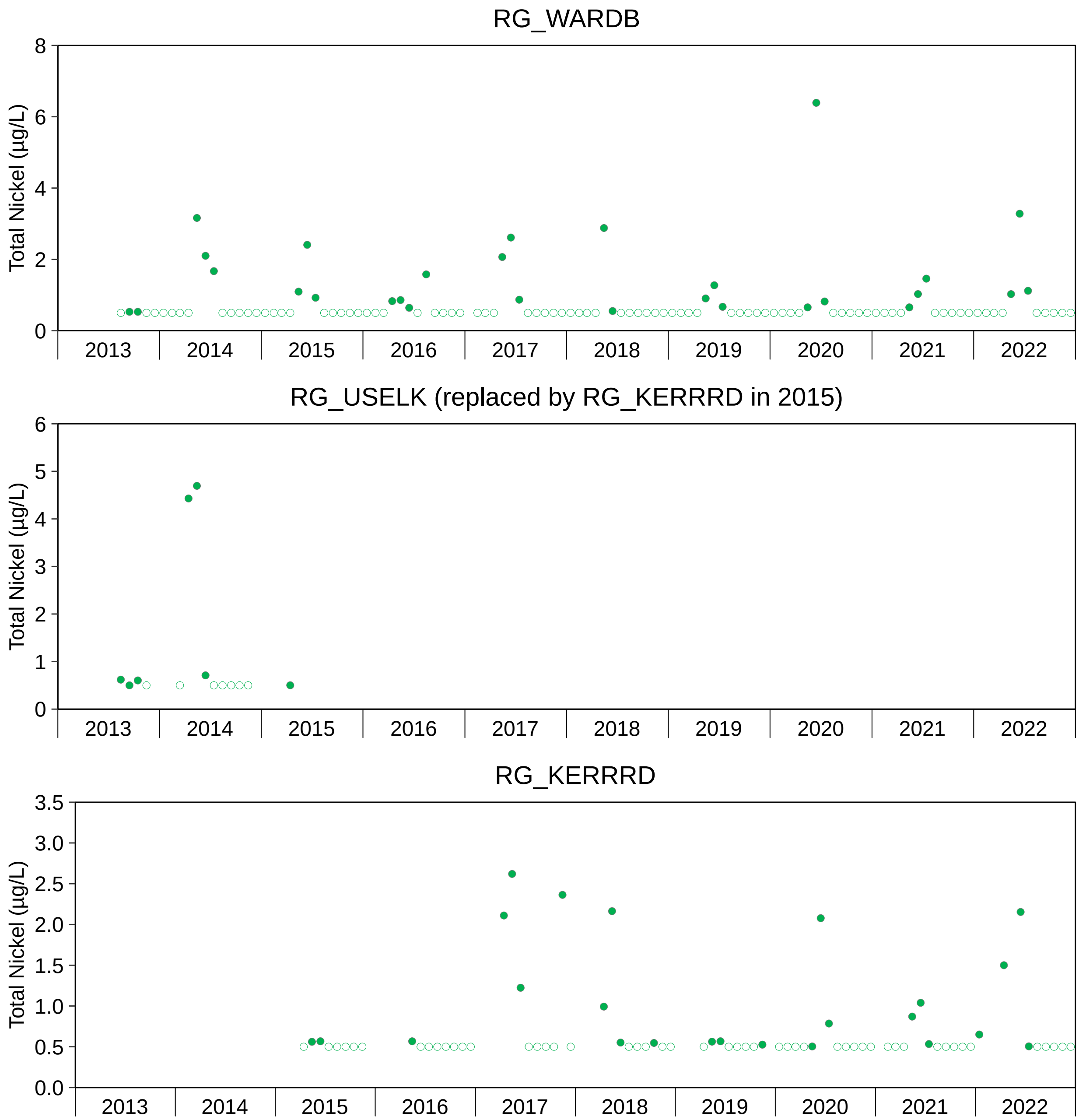


Figure B.9: Monthly Average Concentrations of Total Nickel at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

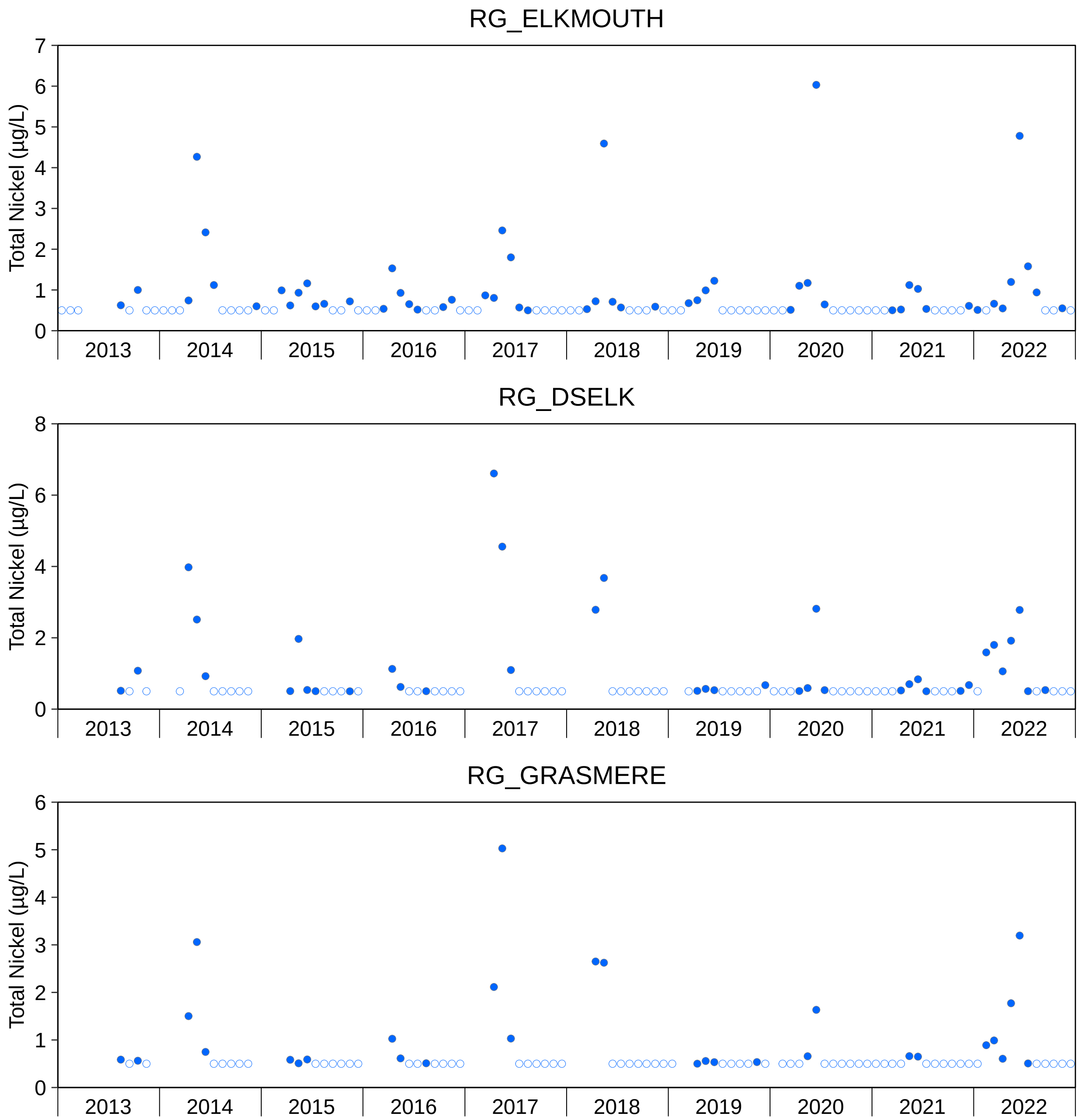


Figure B.9: Monthly Average Concentrations of Total Nickel at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

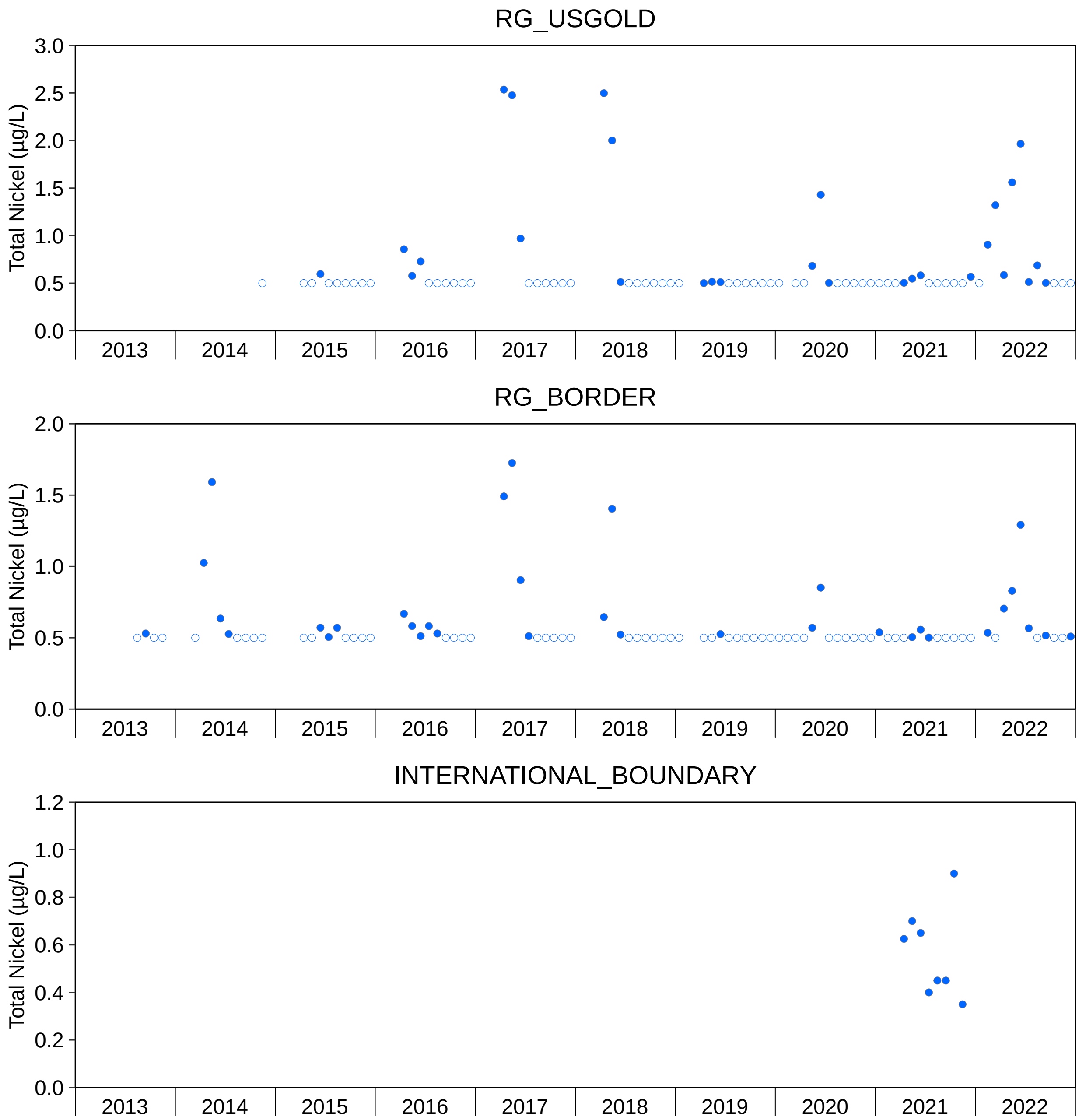


Figure B.9: Monthly Average Concentrations of Total Nickel at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

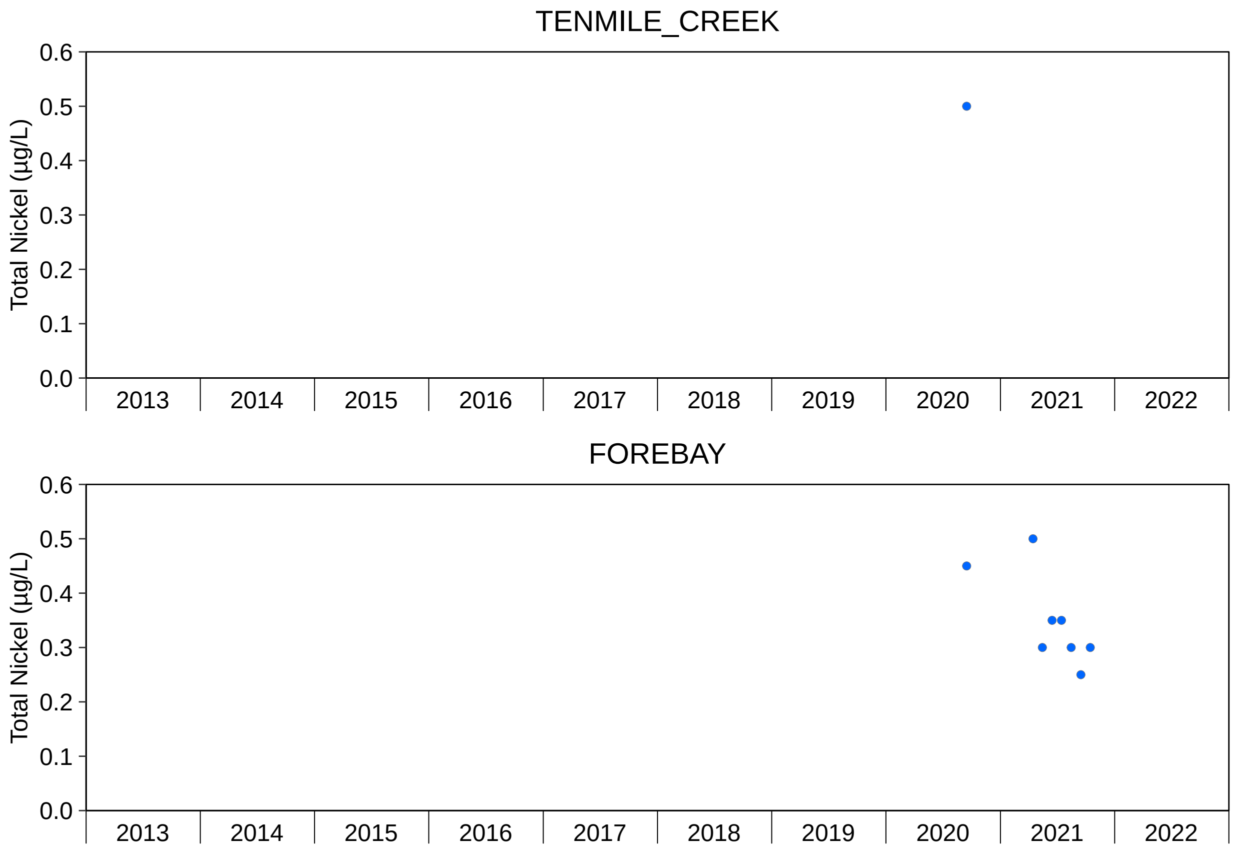


Figure B.9: Monthly Average Concentrations of Total Nickel at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

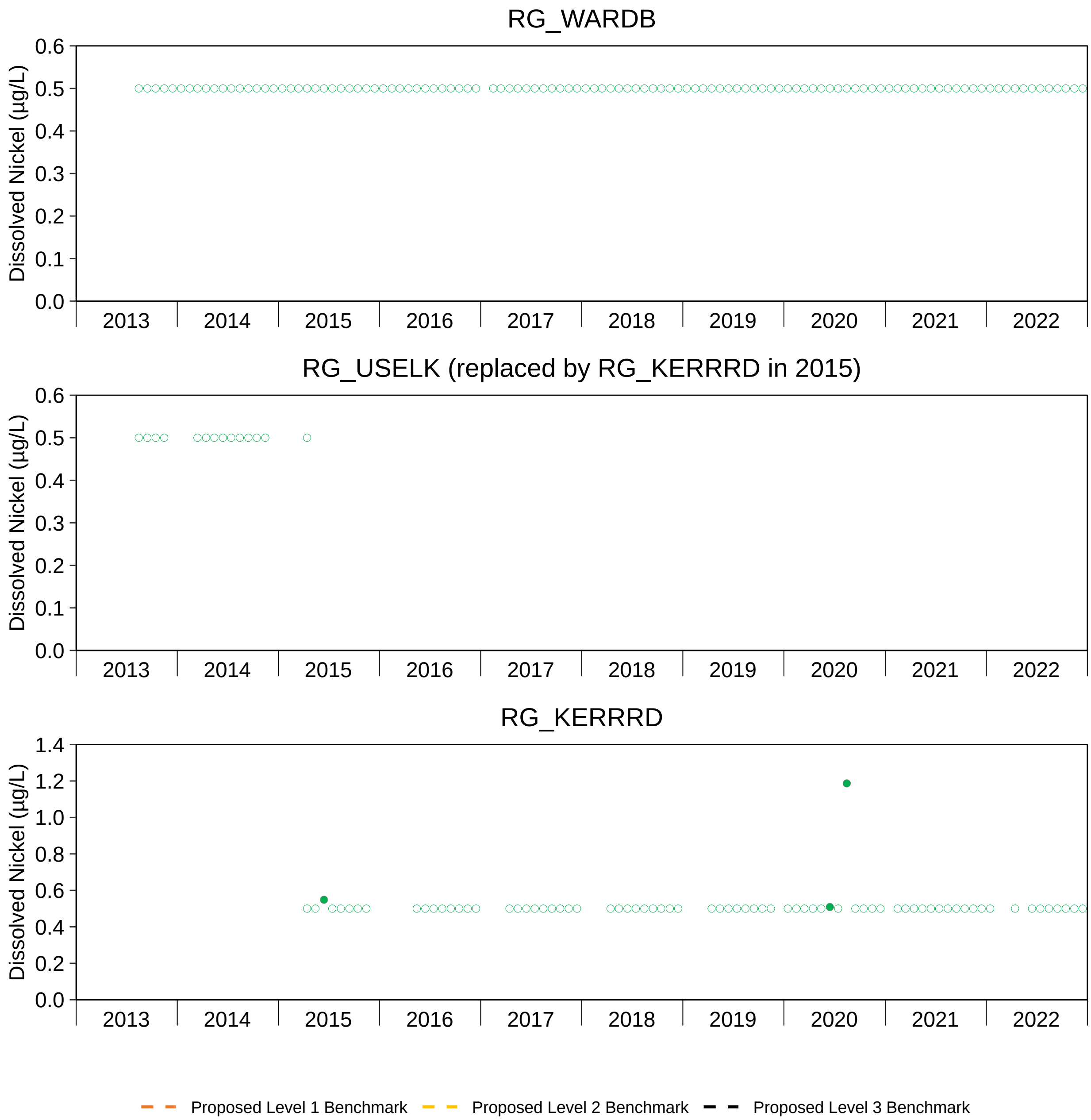


Figure B.10: Monthly Average Concentrations of Monthly Mean Dissolved Nickel Concentrations at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on dissolved organic carbon, water hardness and bicarbonate concentrations. Values and effects concentrations were averaged by month according to screening guidance. Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

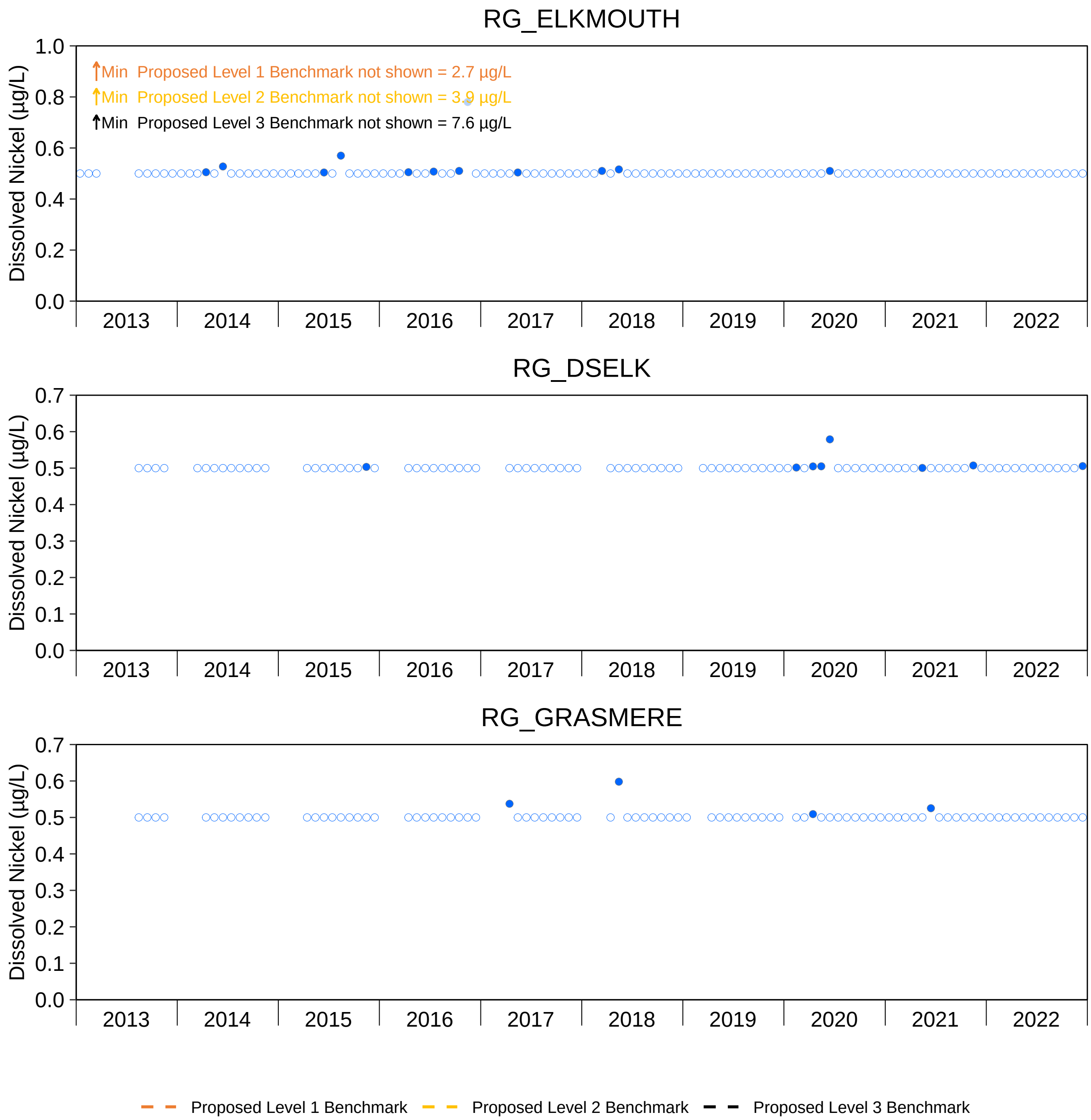


Figure B.10: Monthly Average Concentrations of Monthly Mean Dissolved Nickel Concentrations at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on dissolved organic carbon, water hardness and bicarbonate concentrations. Values and effects concentrations were averaged by month according to screening guidance. Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

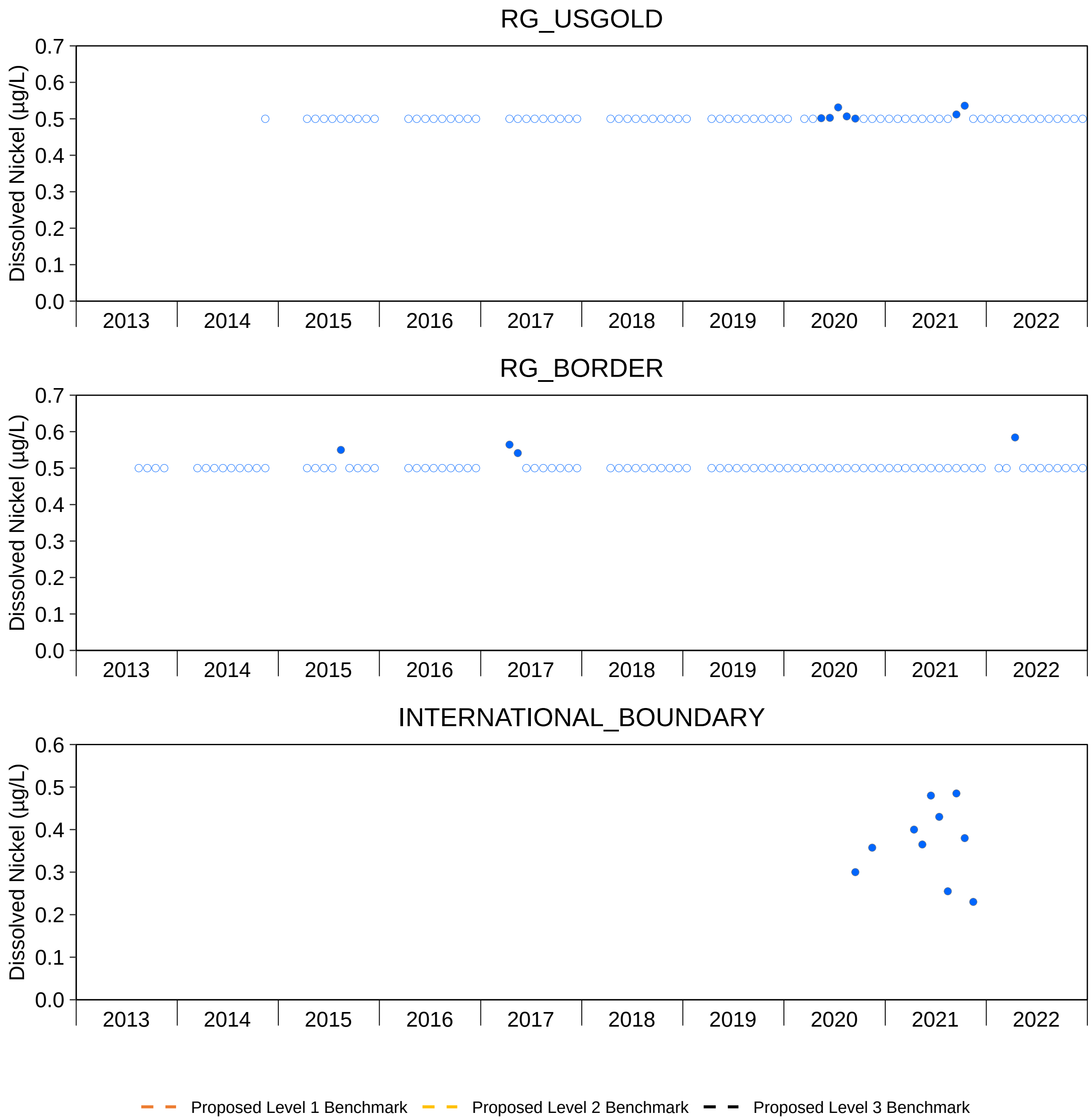
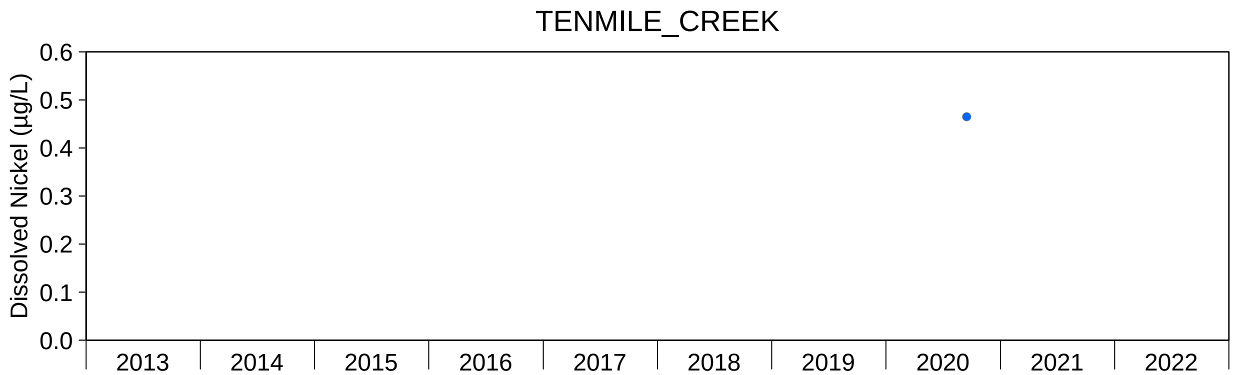
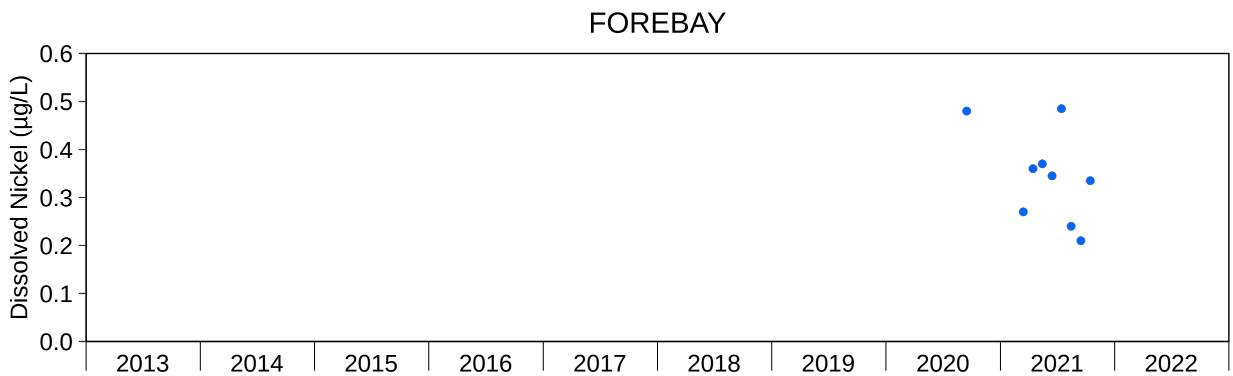


Figure B.10: Monthly Average Concentrations of Monthly Mean Dissolved Nickel Concentrations at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on dissolved organic carbon, water hardness and bicarbonate concentrations. Values and effects concentrations were averaged by month according to screening guidance. Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.





Proposed Level 1 Benchmark   Proposed Level 2 Benchmark   Proposed Level 3 Benchmark

Figure B.10: Monthly Average Concentrations of Monthly Mean Dissolved Nickel Concentrations at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on dissolved organic carbon, water hardness and bicarbonate concentrations. Values and effects concentrations were averaged by month according to screening guidance. Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

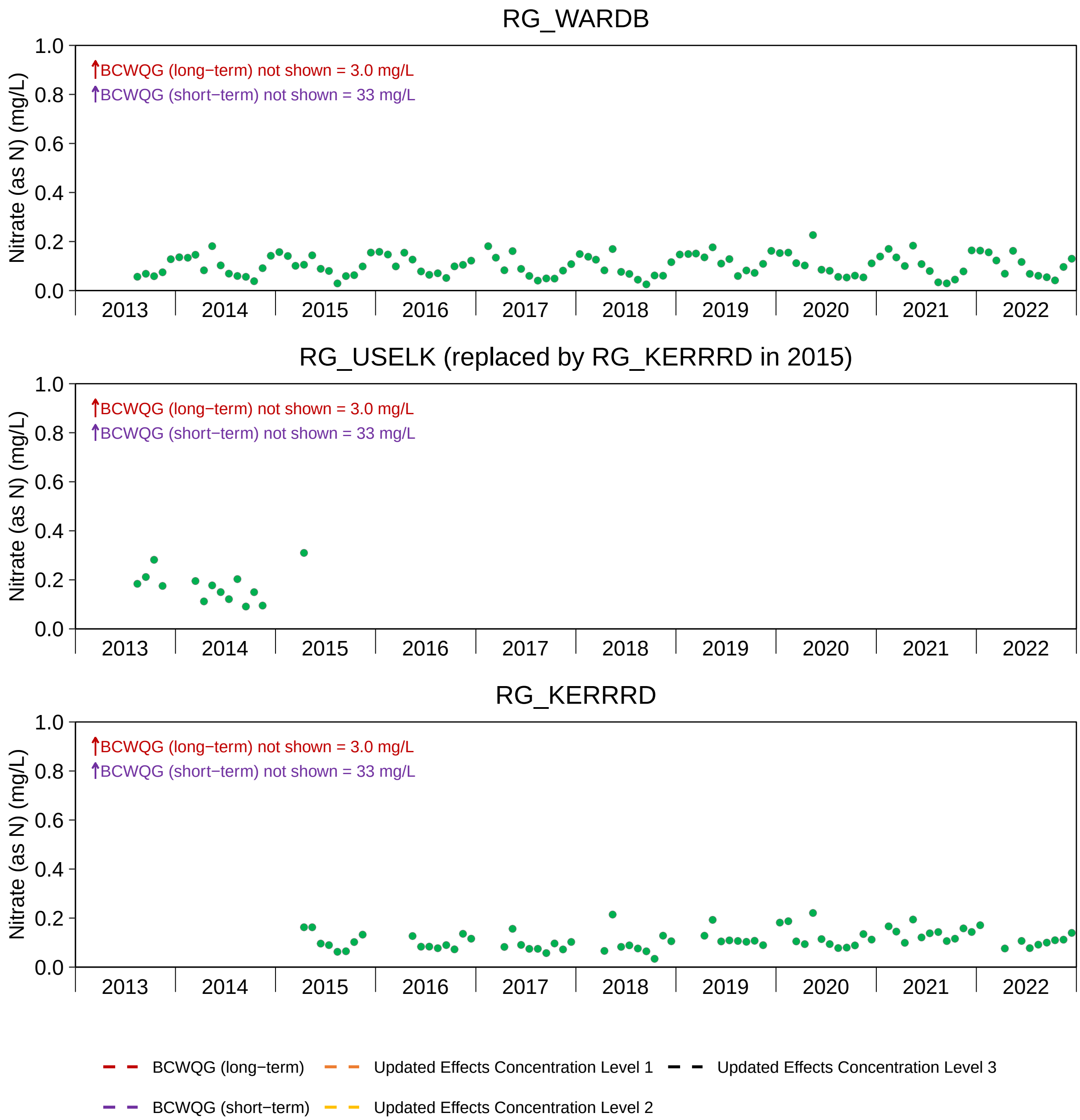


Figure B.11: Monthly Average Concentrations of Nitrate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

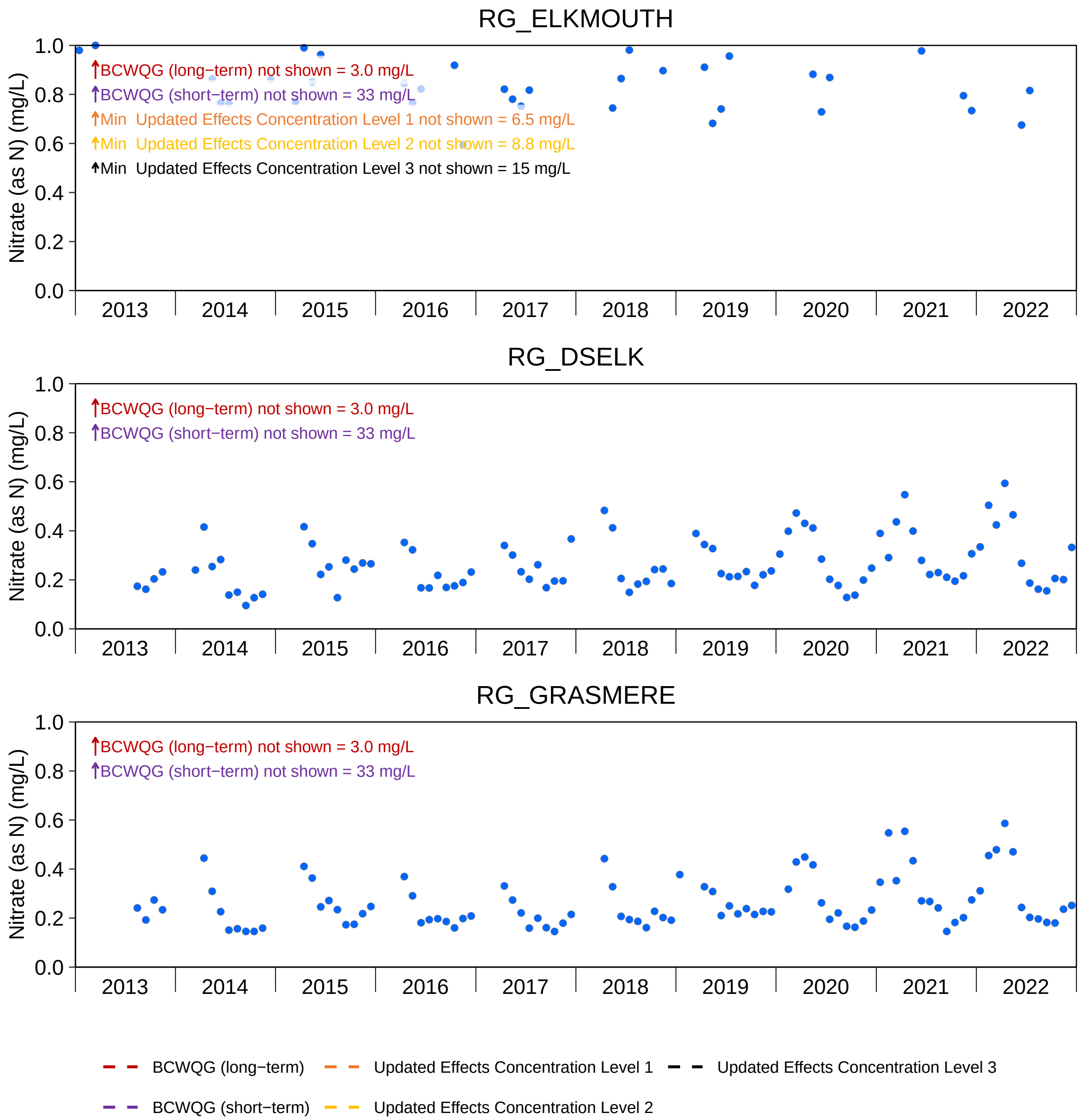


Figure B.11: Monthly Average Concentrations of Nitrate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

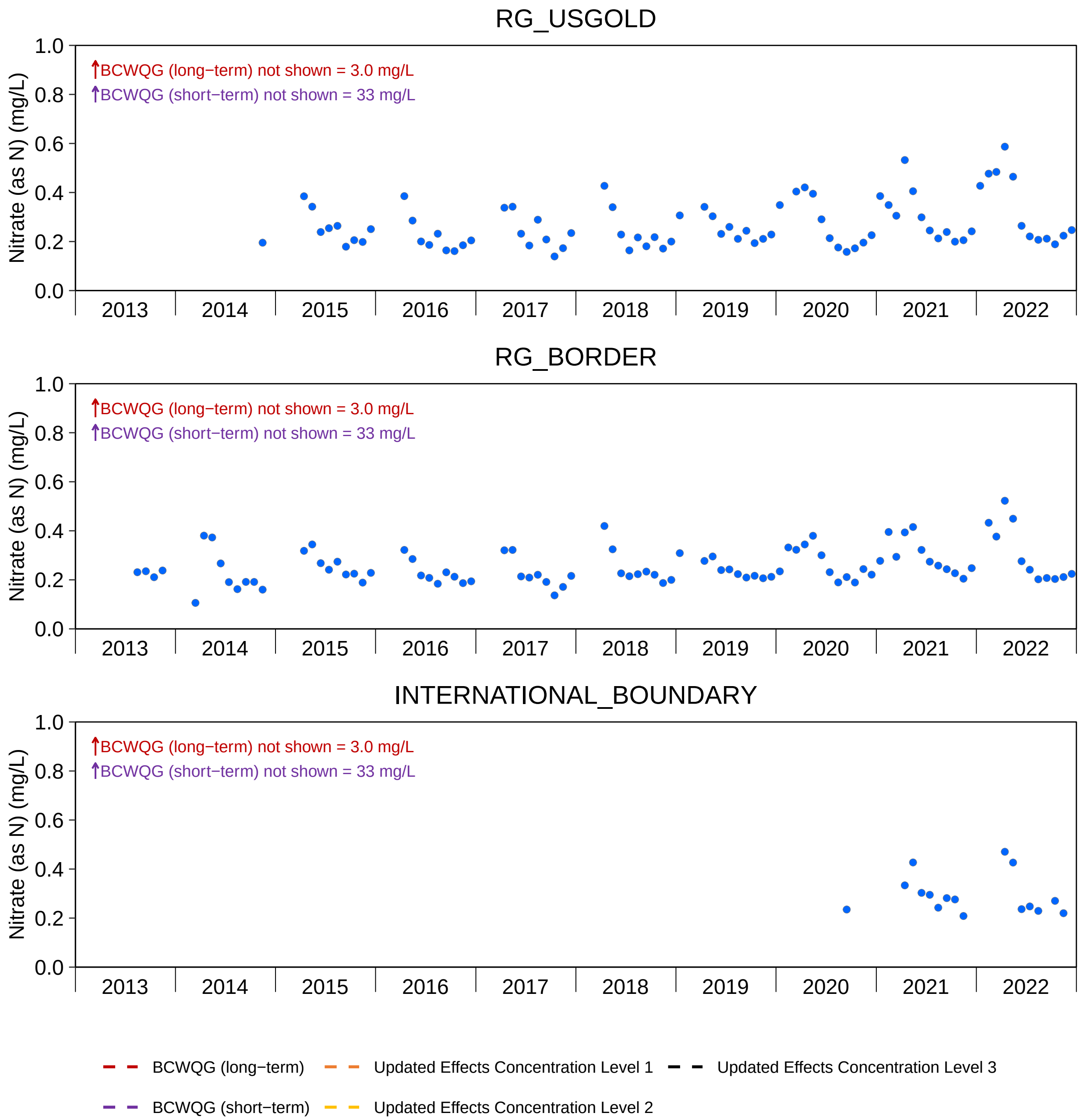


Figure B.11: Monthly Average Concentrations of Nitrate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

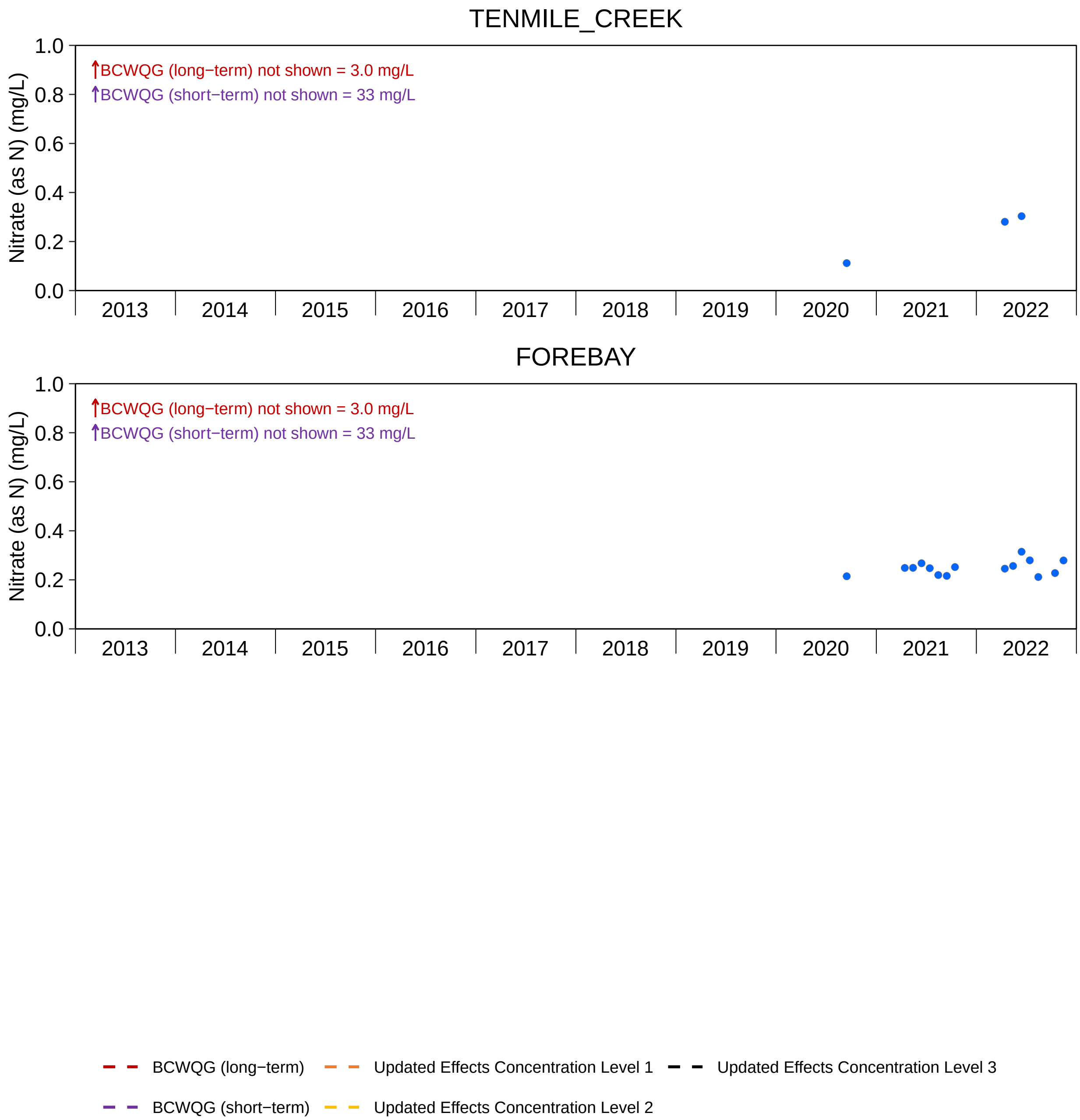


Figure B.11: Monthly Average Concentrations of Nitrate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used fordownstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

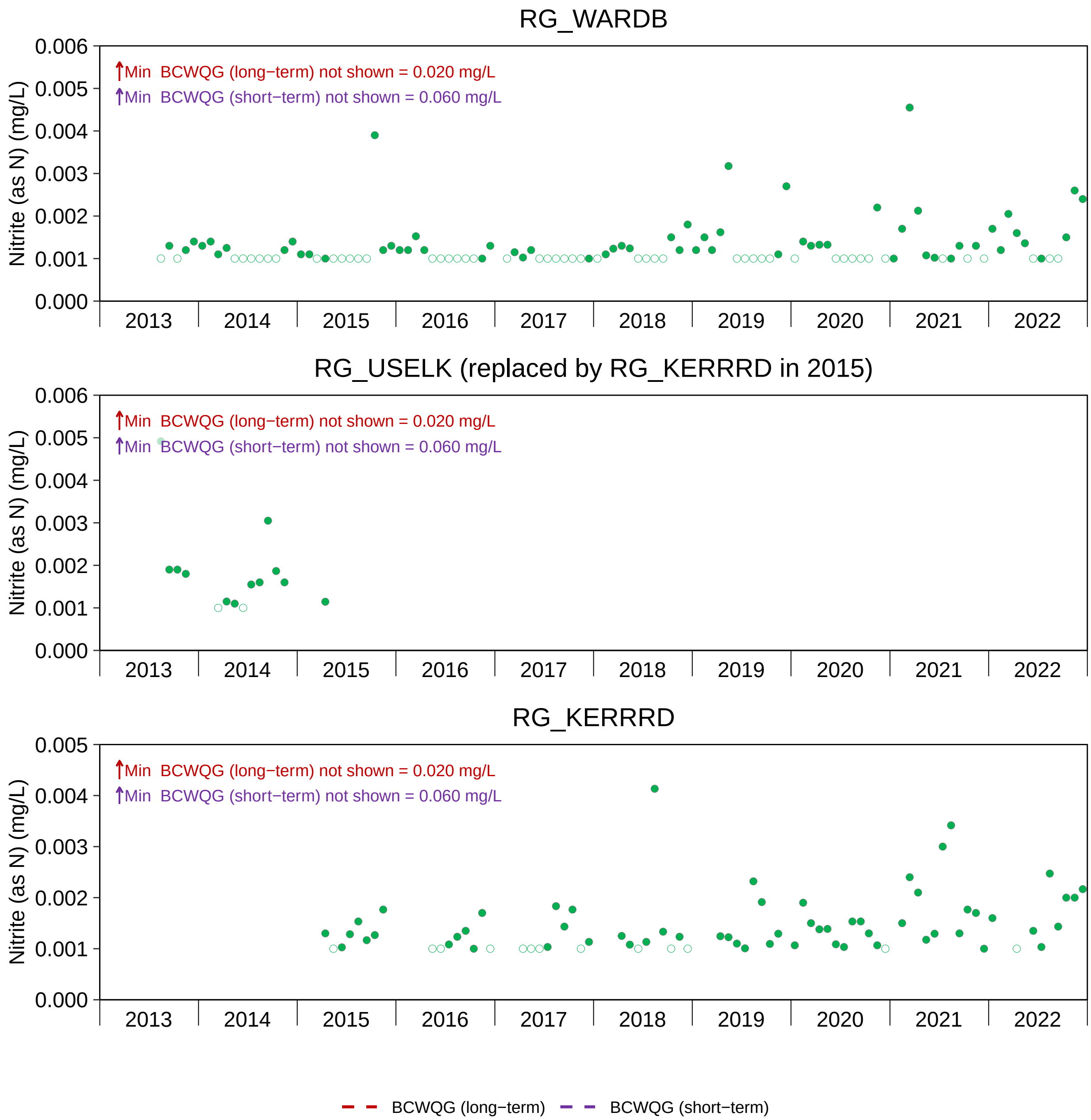


Figure B.12: Monthly Average Concentrations of Nitrite at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

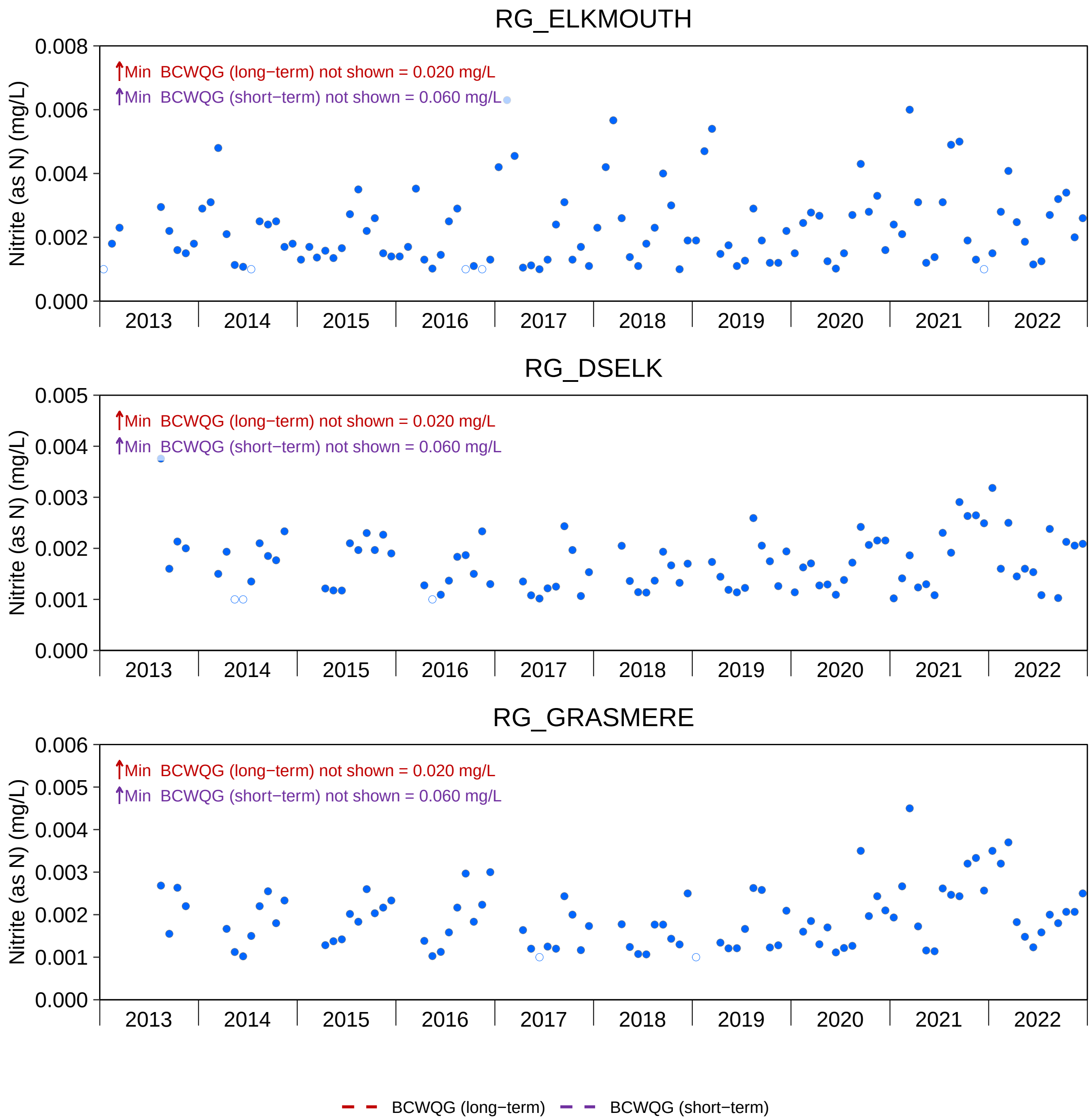


Figure B.12: Monthly Average Concentrations of Nitrite at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

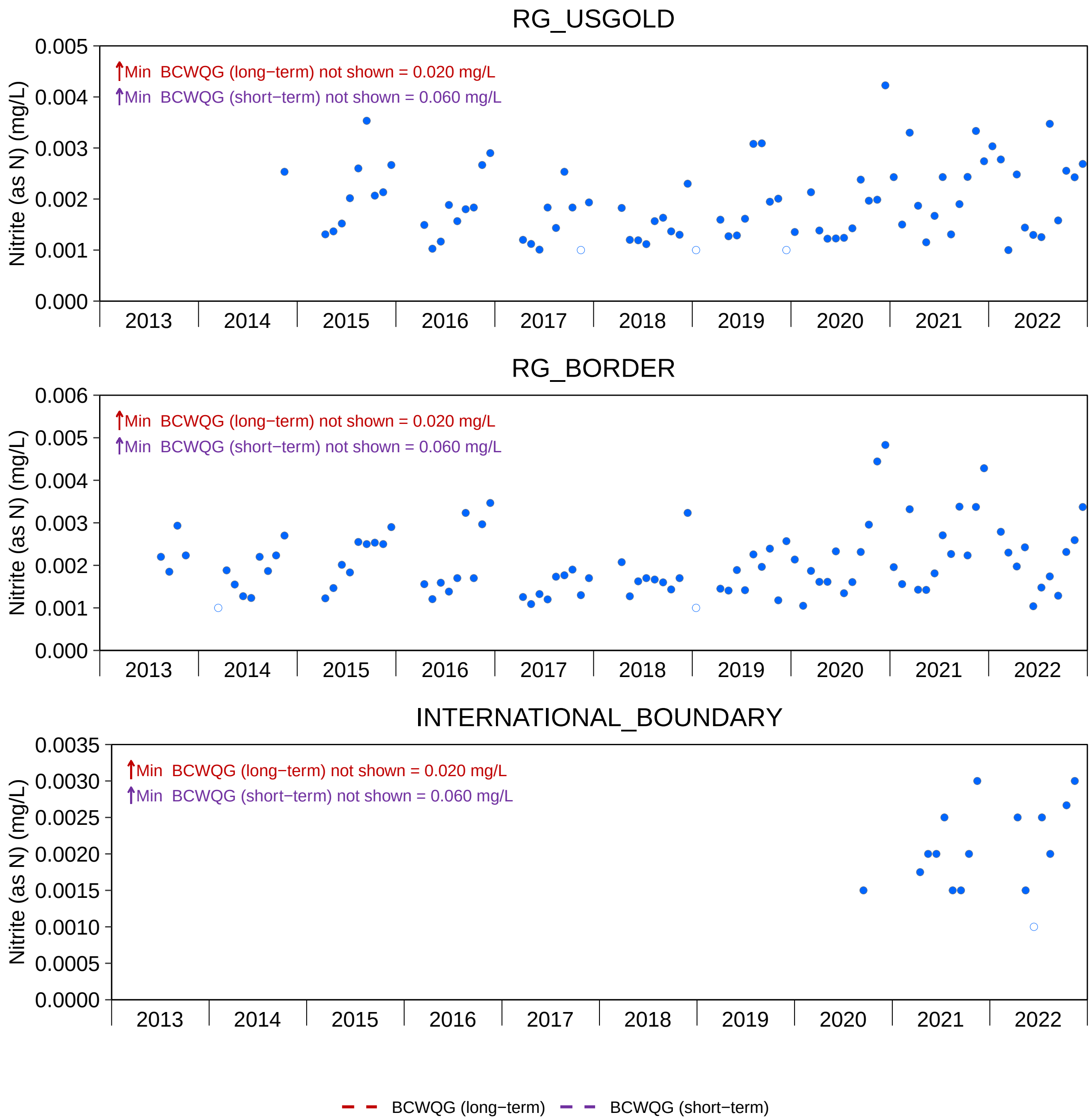


Figure B.12: Monthly Average Concentrations of Nitrite at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

Figure B.12: Monthly Average Concentrations of Nitrite at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water chloride concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

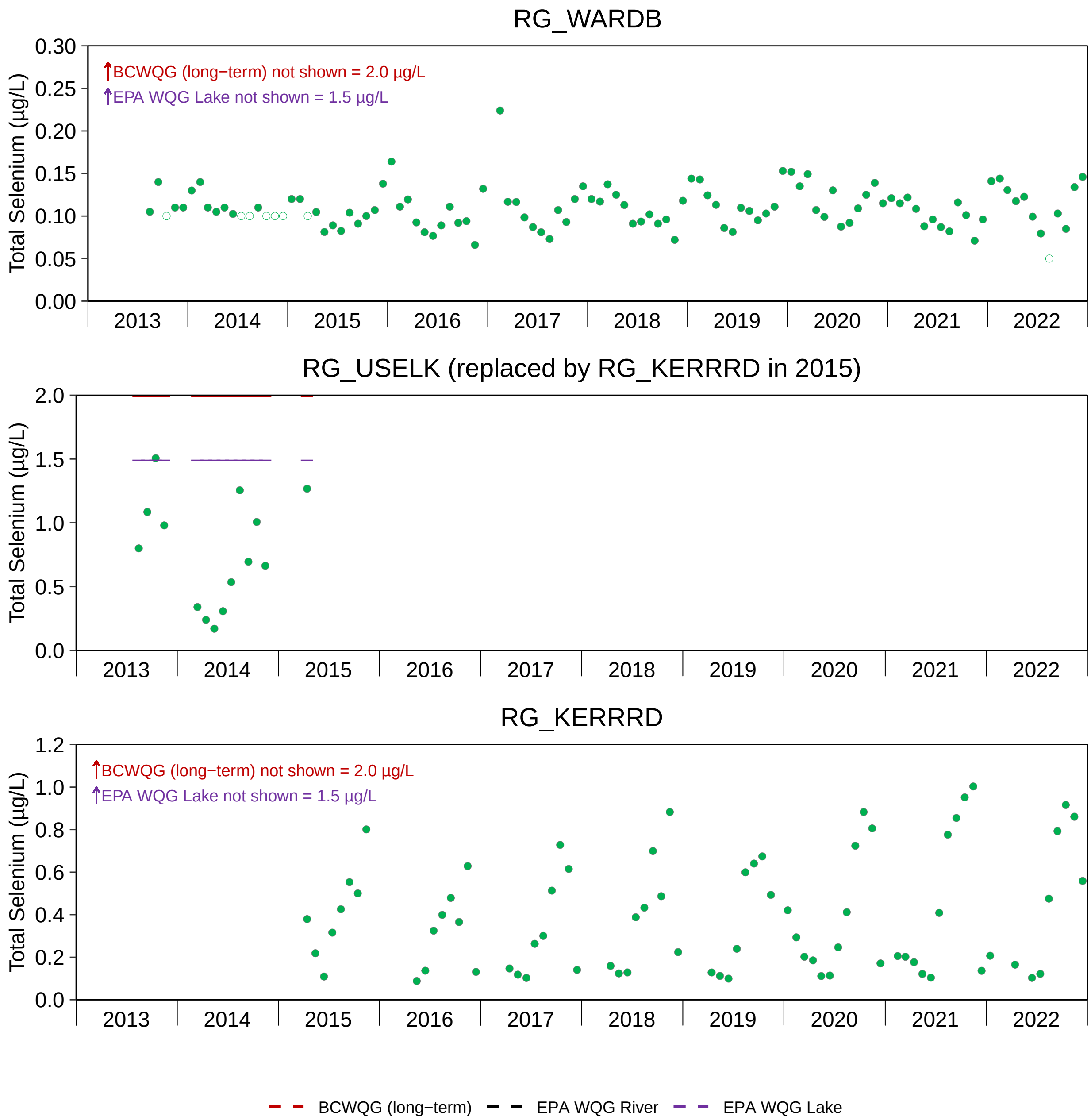


Figure B.13: Monthly Average Concentrations of Total Selenium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

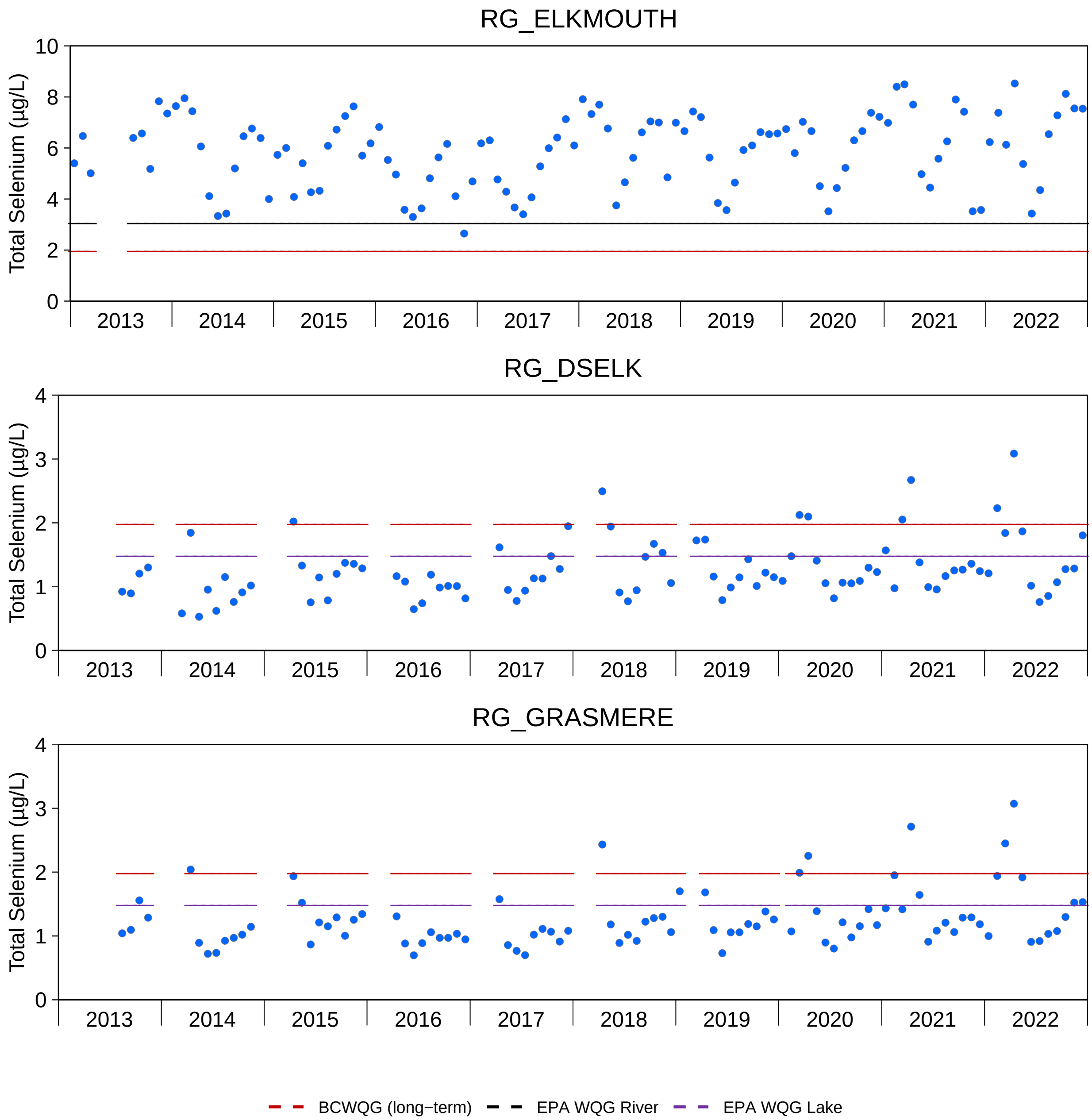


Figure B.13: Monthly Average Concentrations of Total Selenium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

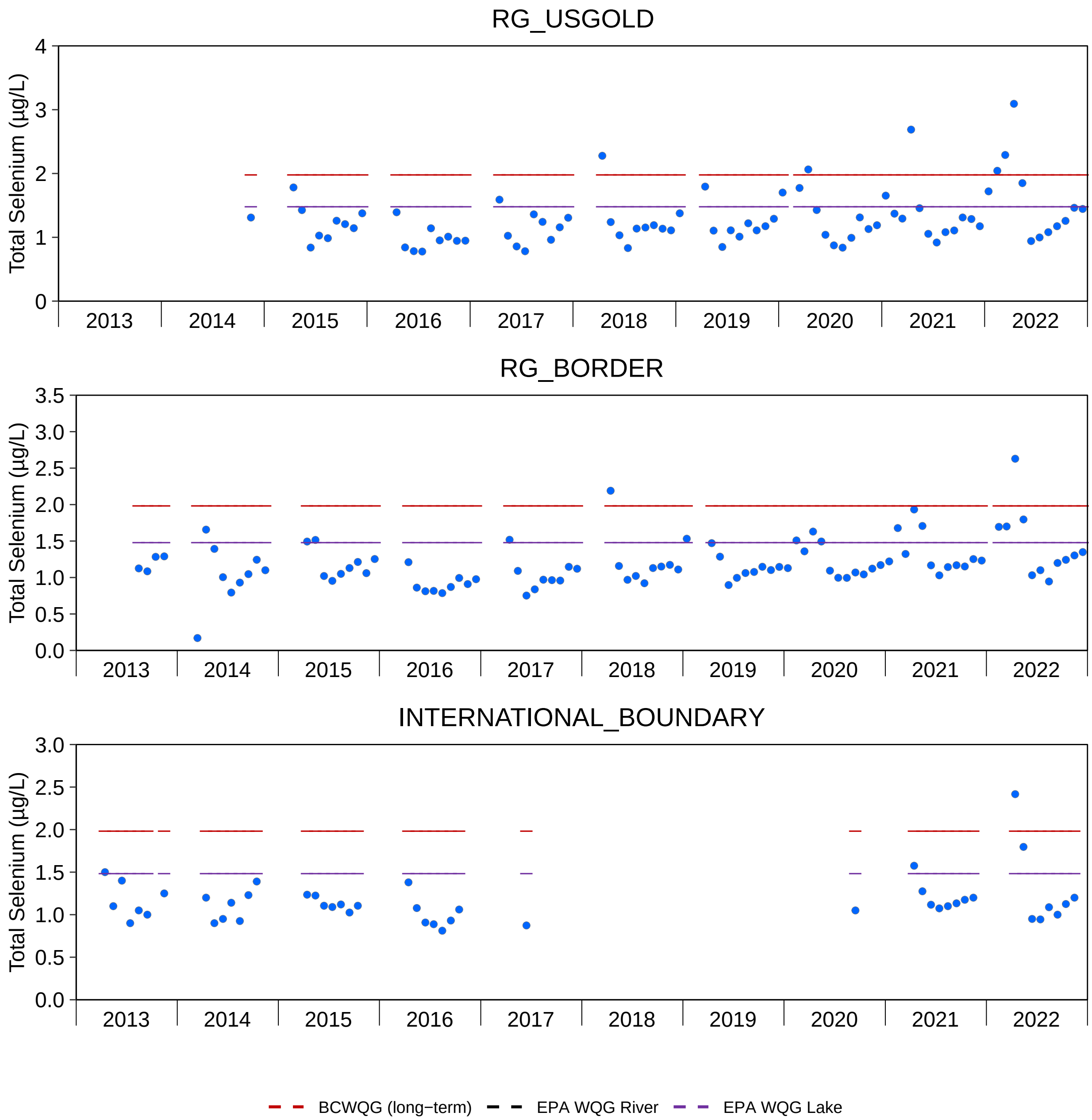


Figure B.13: Monthly Average Concentrations of Total Selenium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

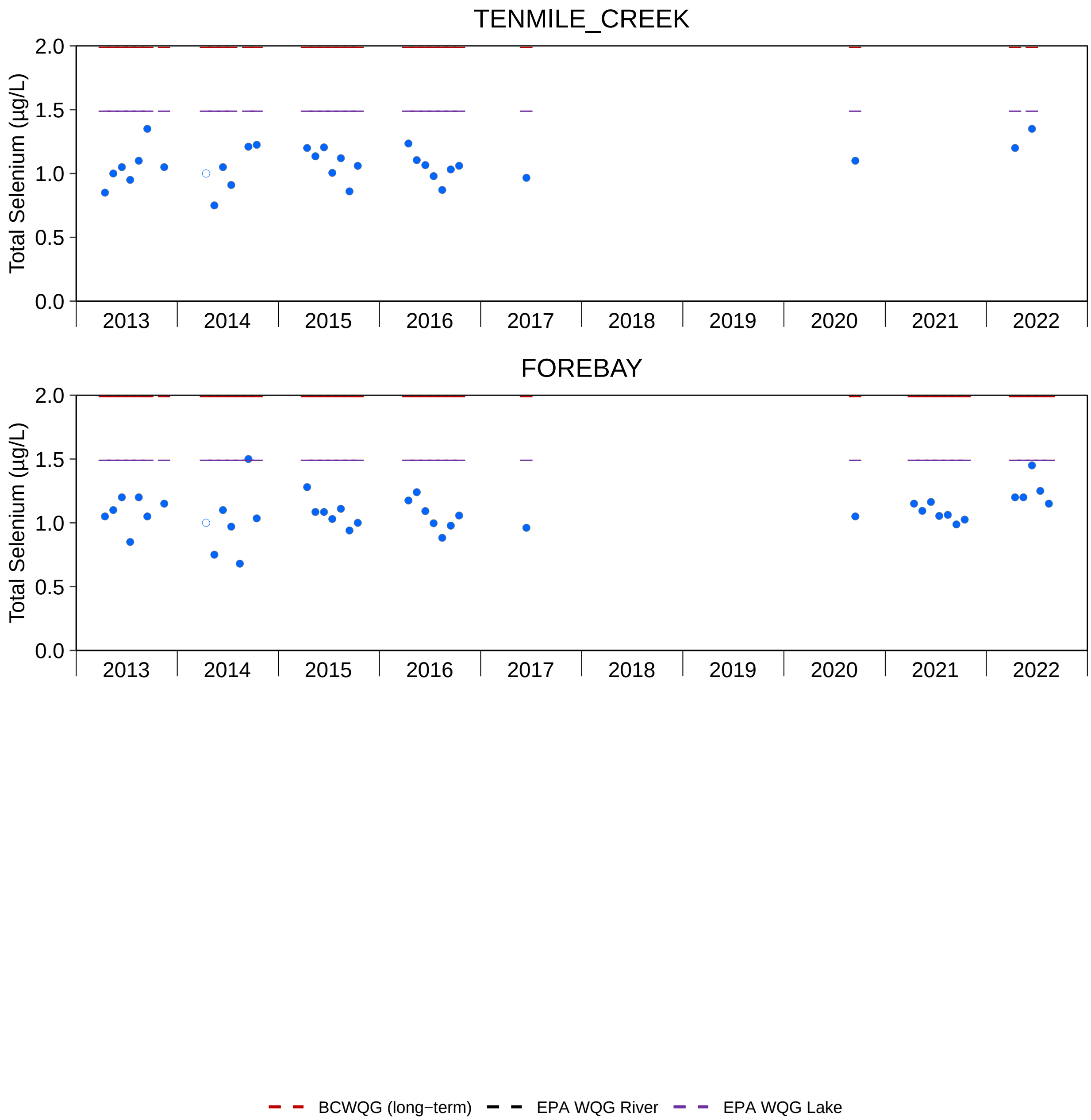


Figure B.13: Monthly Average Concentrations of Total Selenium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

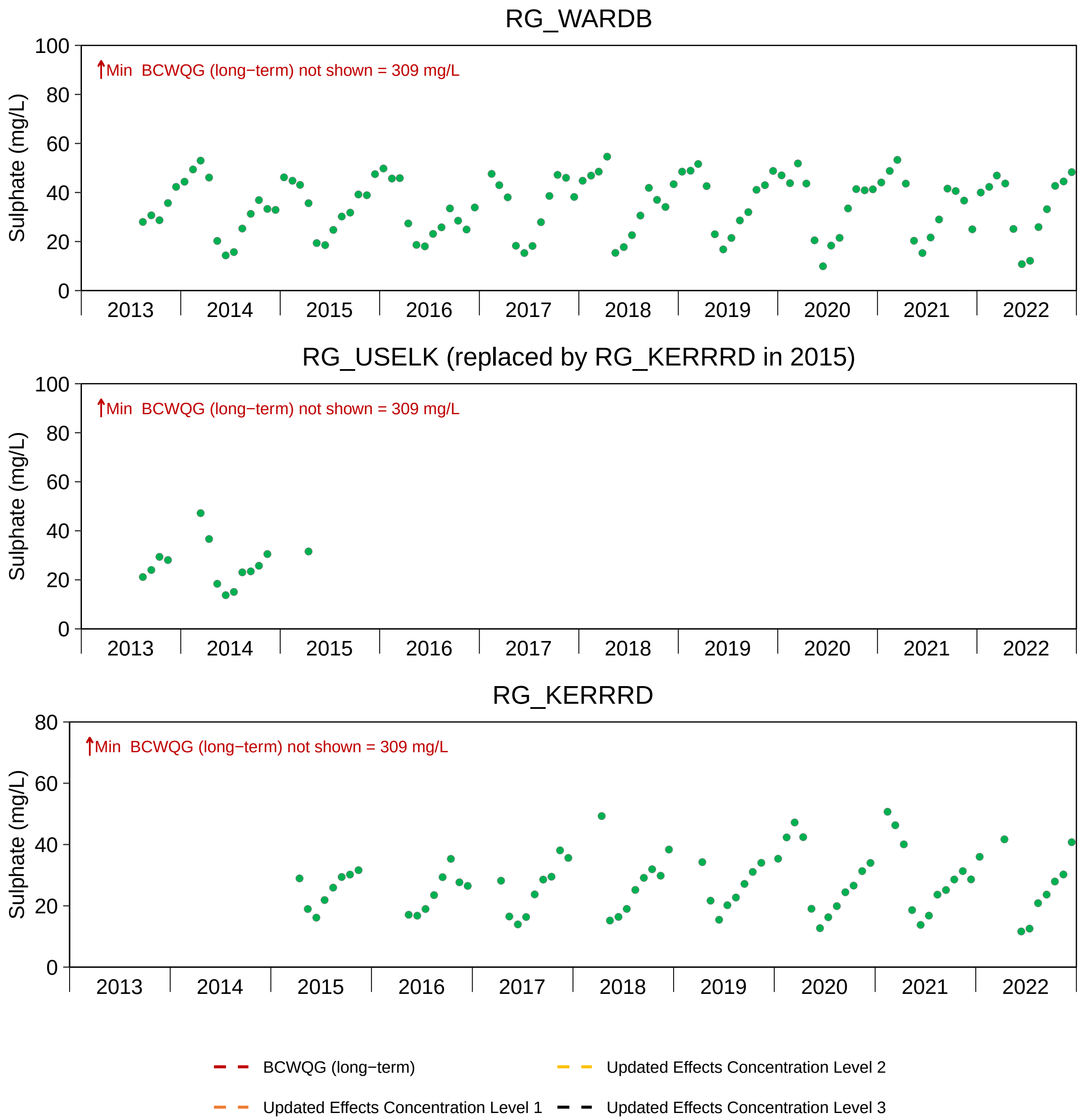


Figure B.14: Monthly Average Concentrations of Sulphate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. EVWQP Level 1 Benchmark is shown in plots where the EVWQP Level 1 Benchmark and the BCWQG are equal. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

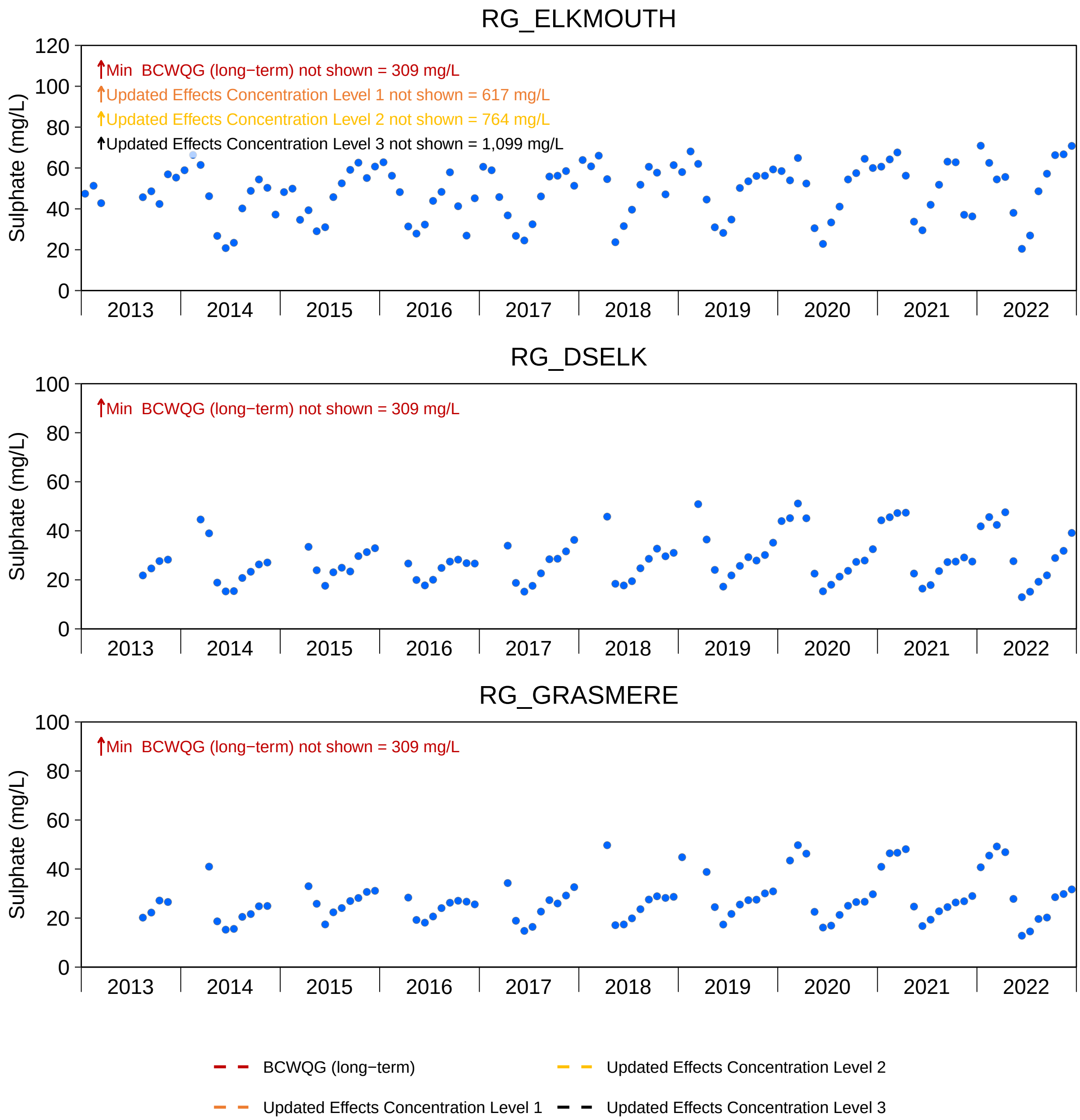


Figure B.14: Monthly Average Concentrations of Sulphate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. EVWQP Level 1 Benchmark is shown in plots where the EVWQP Level 1 Benchmark and the BCWQG are equal. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

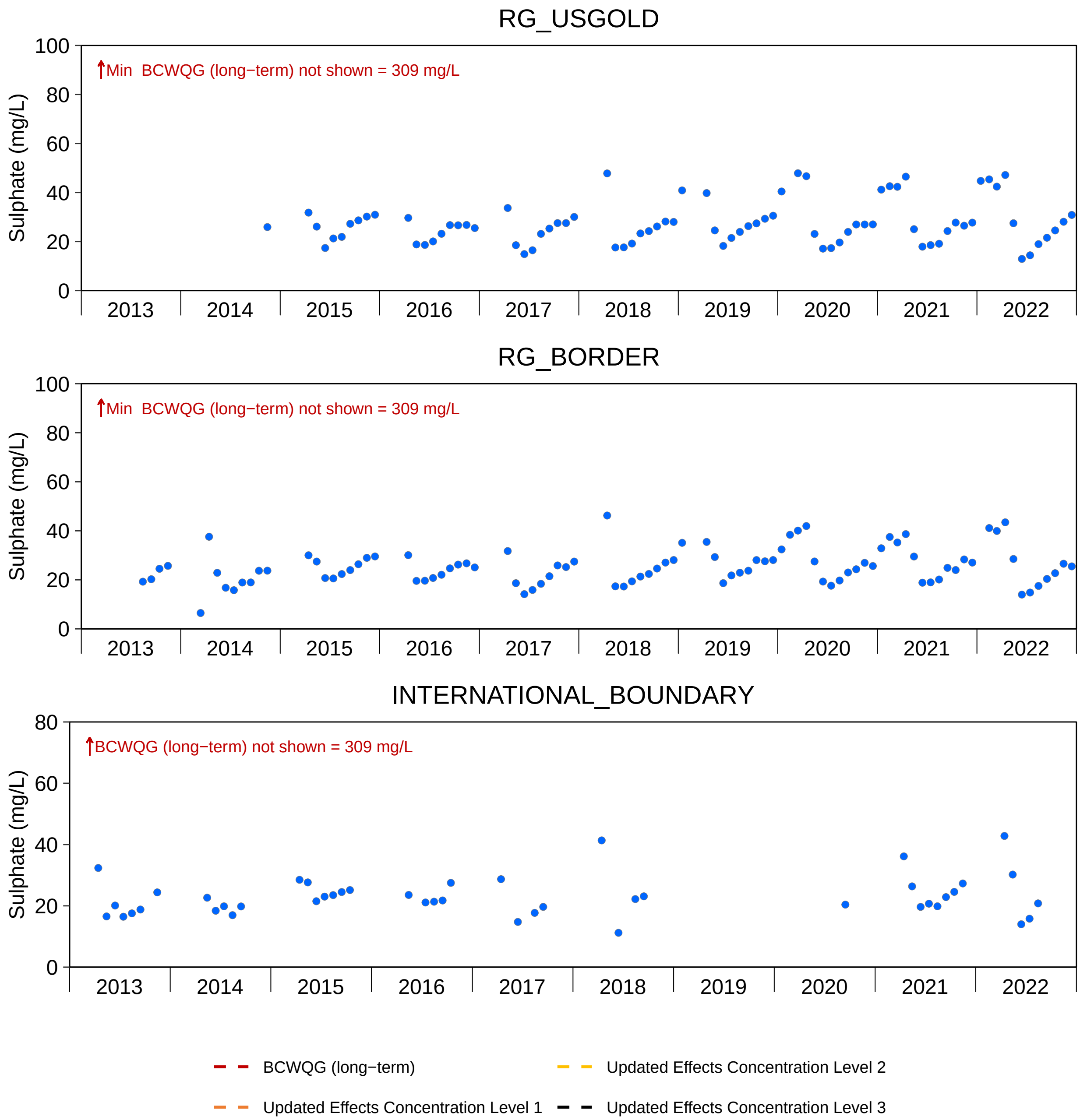


Figure B.14: Monthly Average Concentrations of Sulphate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. EVWQP Level 1 Benchmark is shown in plots where the EVWQP Level 1 Benchmark and the BCWQG are equal. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

Figure B.14: Monthly Average Concentrations of Sulphate at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. EVWQP Level 1 Benchmark is shown in plots where the EVWQP Level 1 Benchmark and the BCWQG are equal. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

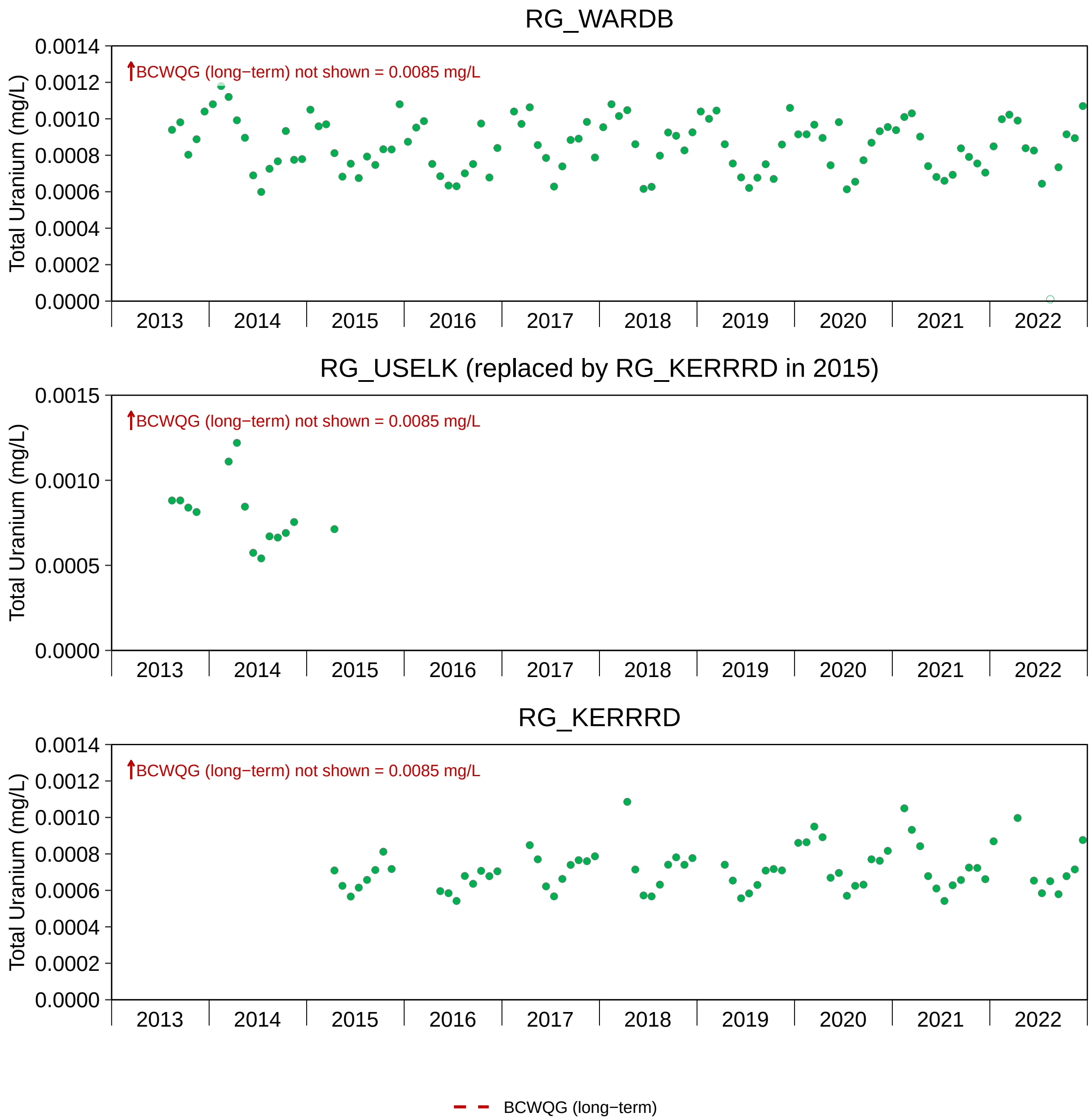


Figure B.15: Monthly Average Concentrations of Total Uranium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

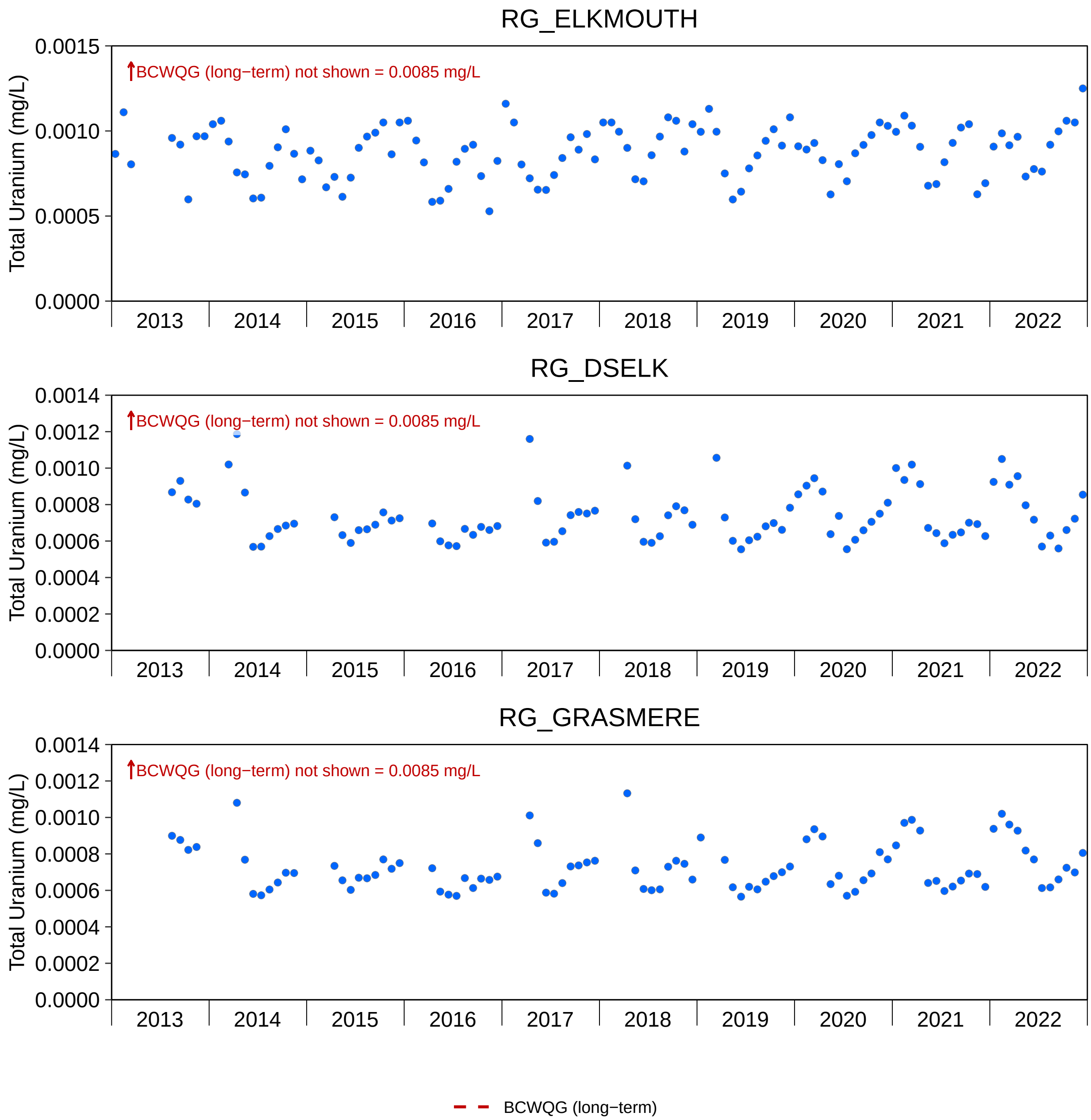


Figure B.15: Monthly Average Concentrations of Total Uranium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

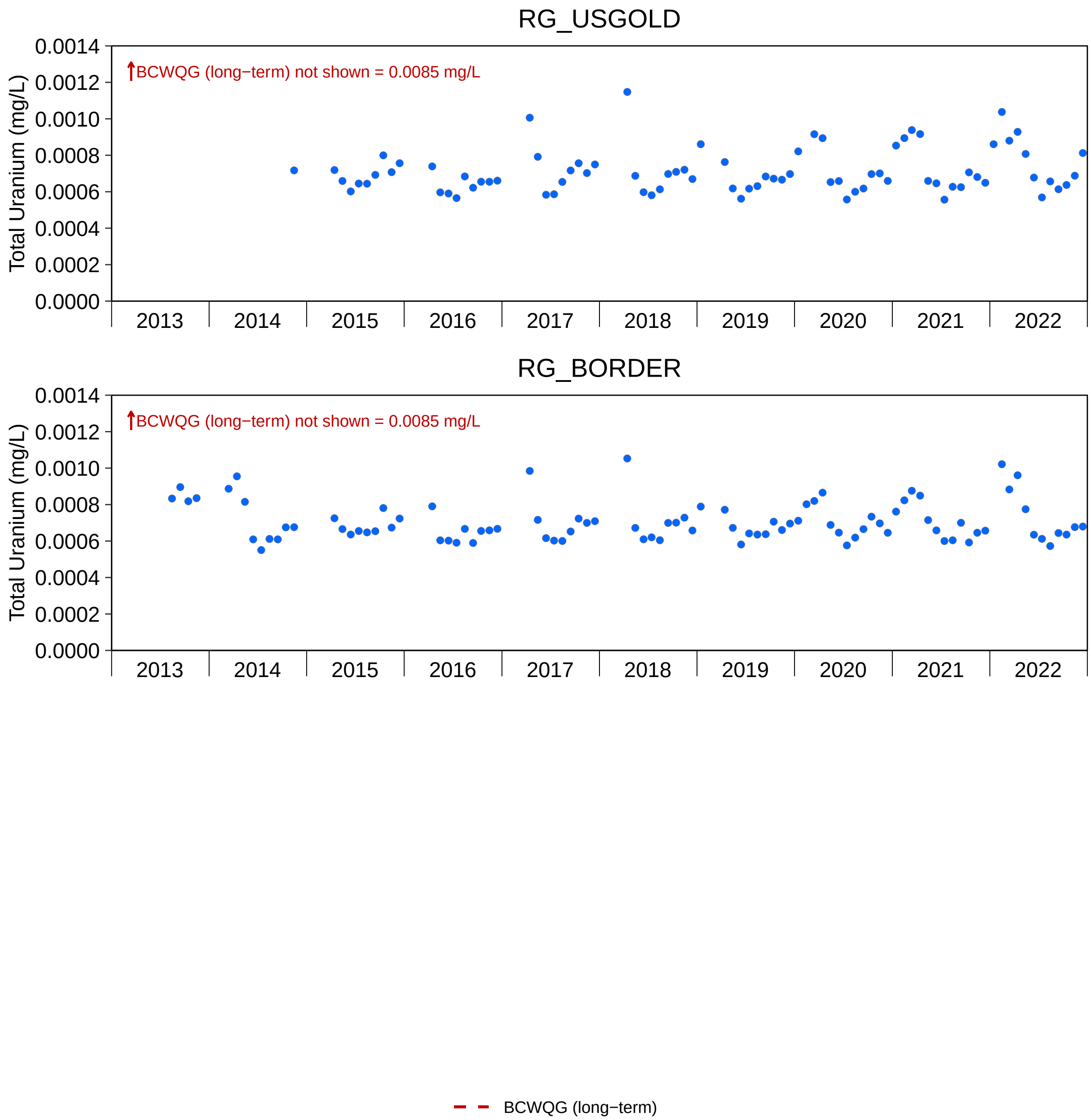


Figure B.15: Monthly Average Concentrations of Total Uranium at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

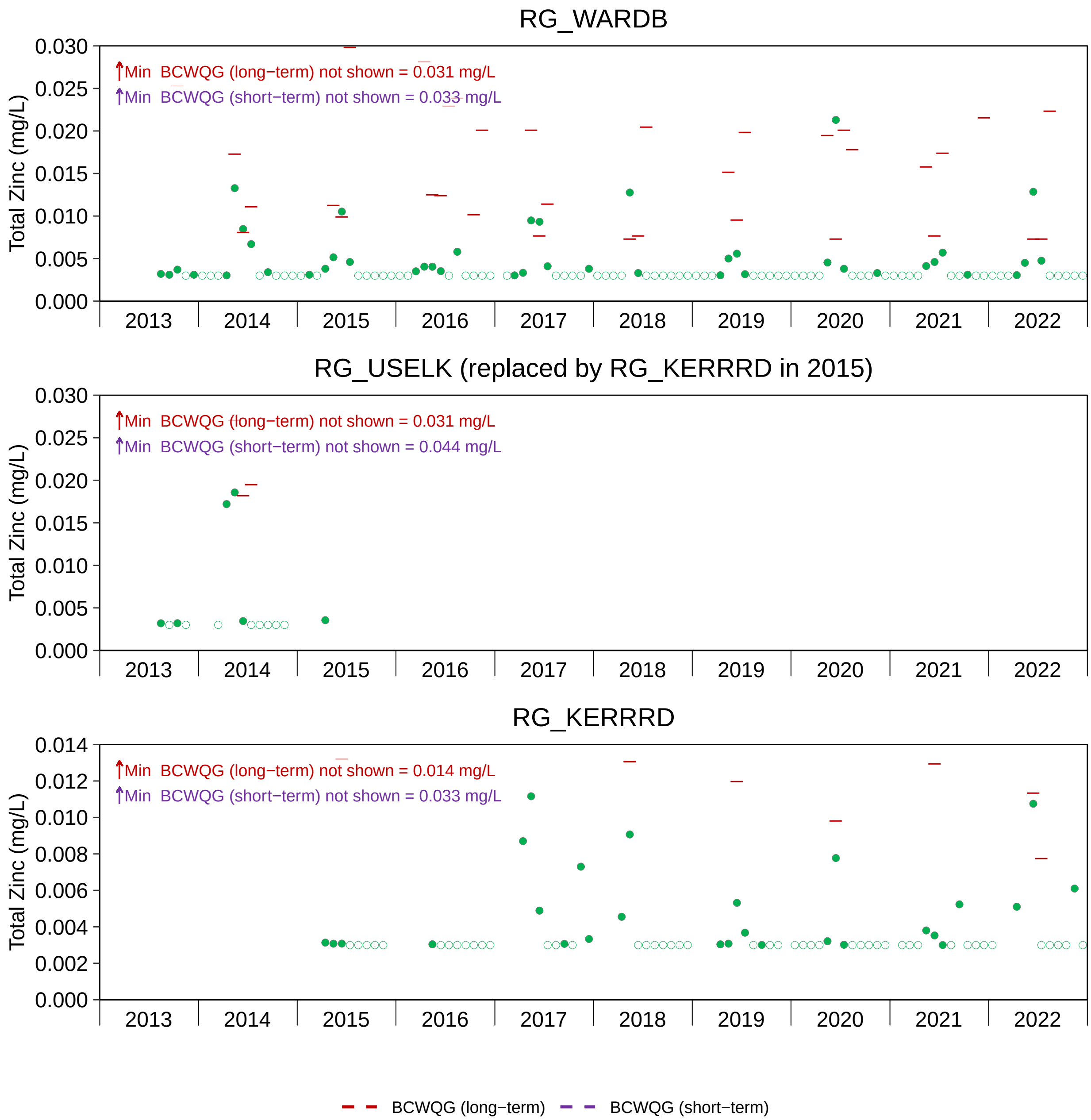


Figure B.16: Monthly Average Concentrations of Total Zinc at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

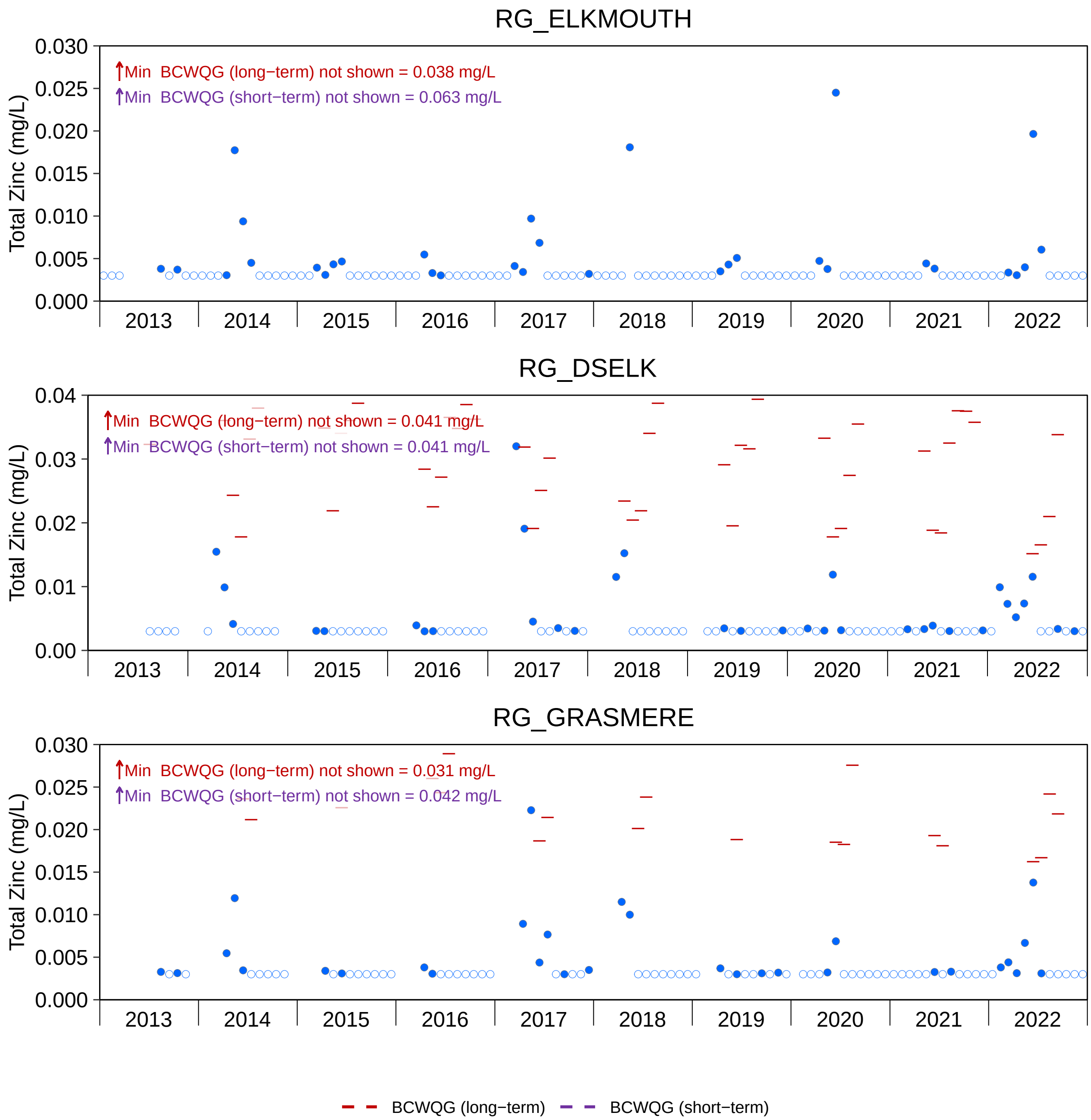


Figure B.16: Monthly Average Concentrations of Total Zinc at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

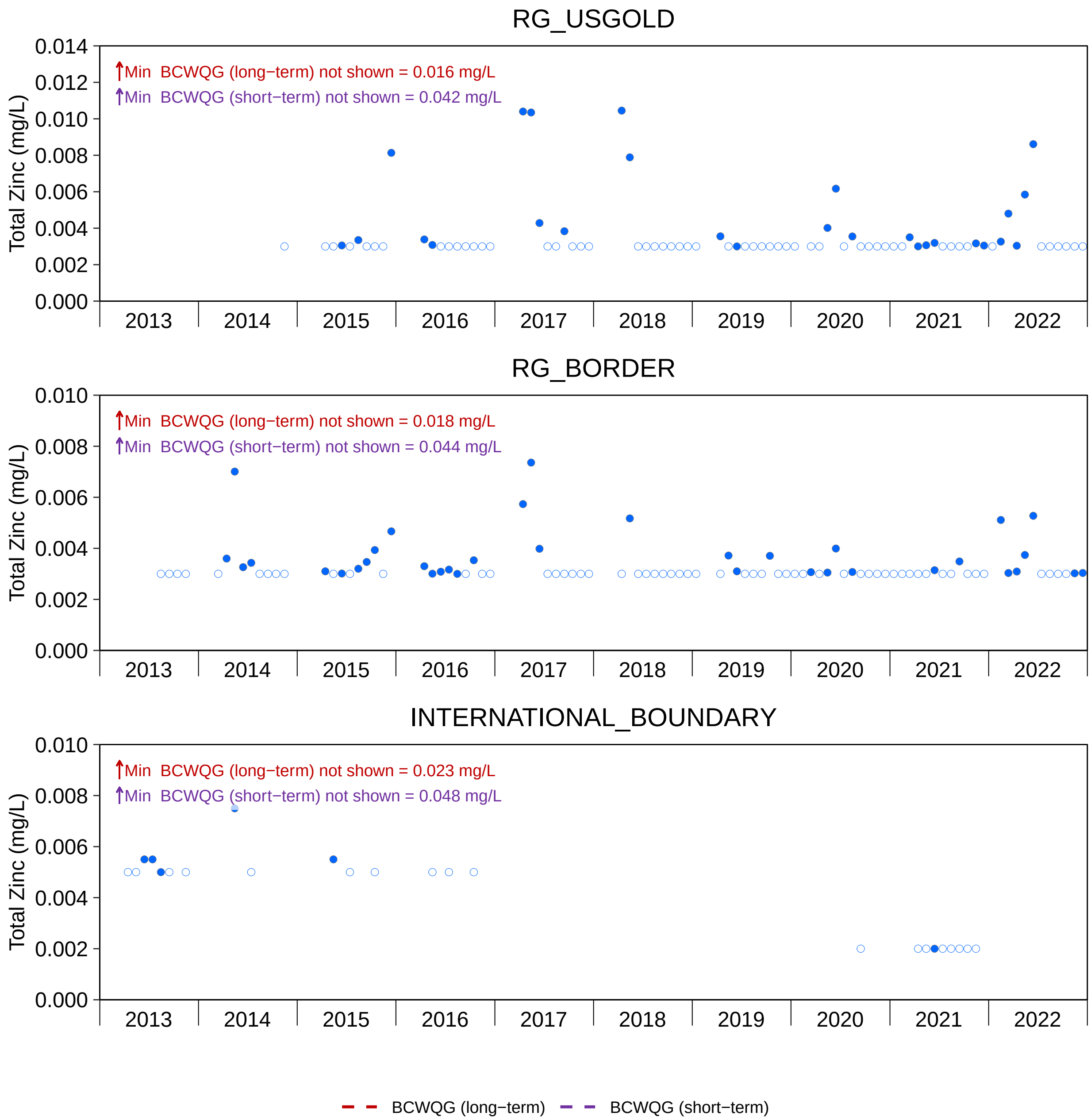


Figure B.16: Monthly Average Concentrations of Total Zinc at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

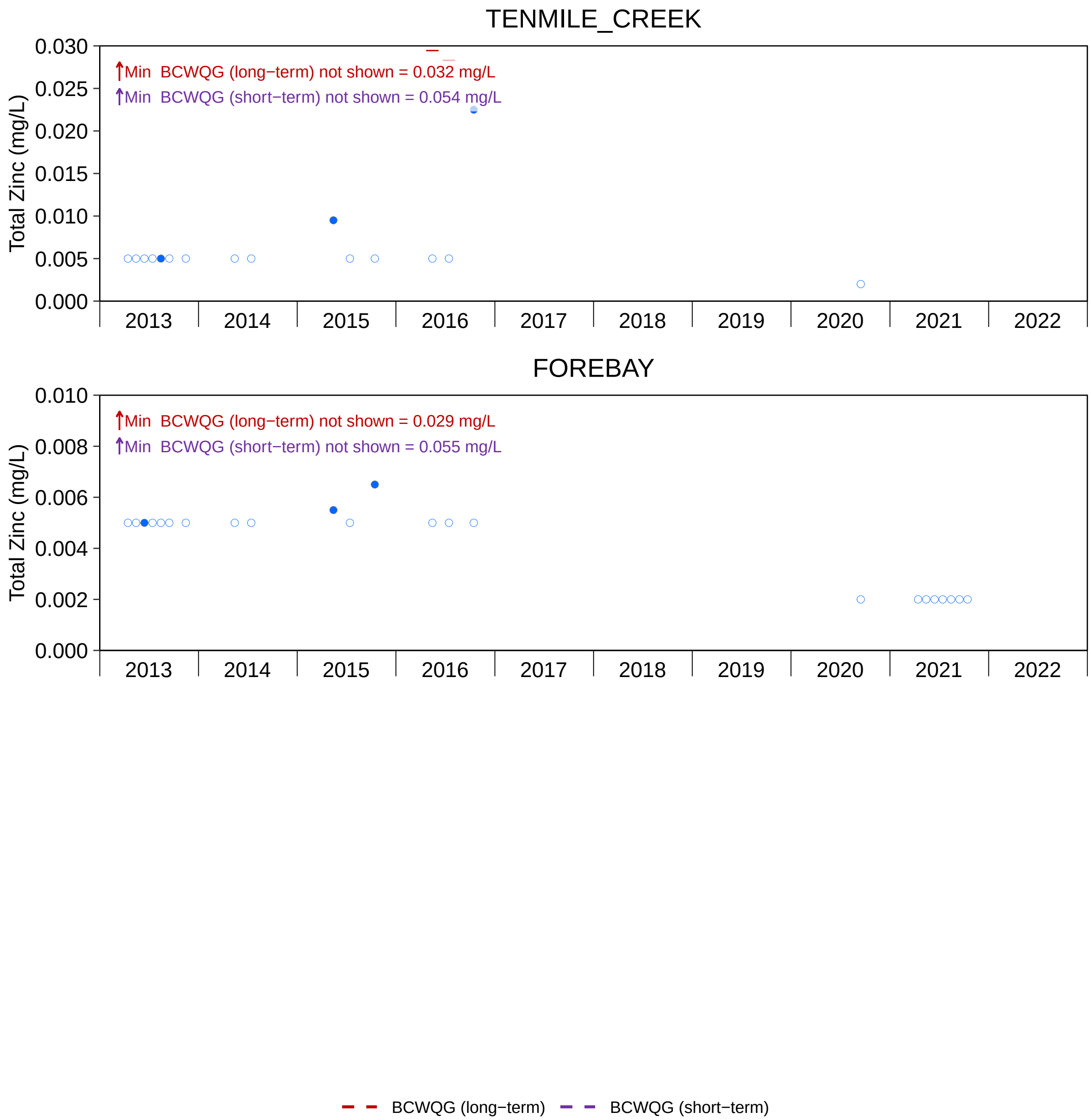


Figure B.16: Monthly Average Concentrations of Total Zinc at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines are dependent on water hardness concentrations. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available. Long-term BCWQGs are evaluated against 30 day averages (with at least 5 samples). Monthly averages are shown.

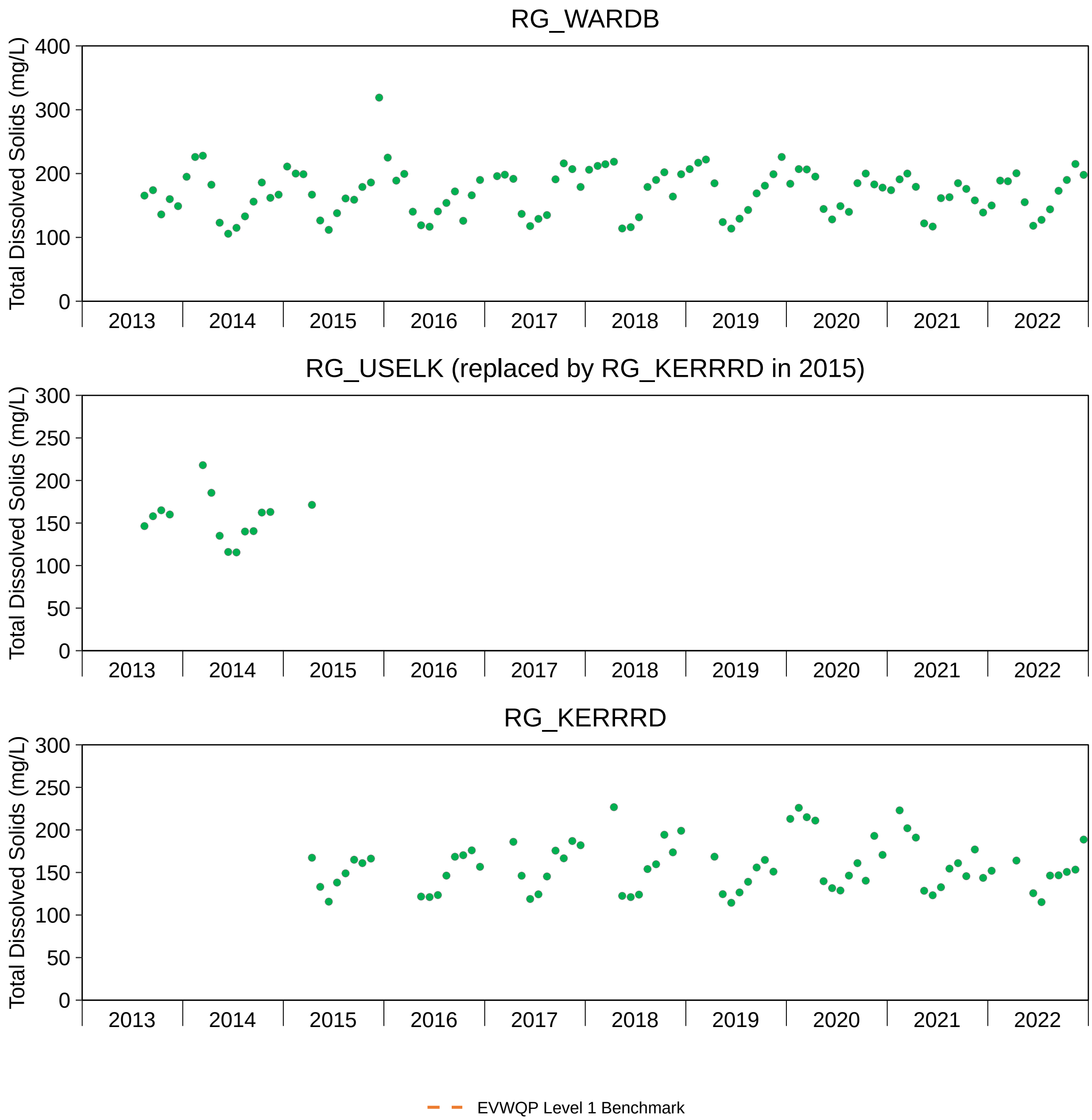


Figure B.17: Monthly Average Concentrations of Total Dissolved Solids at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available.

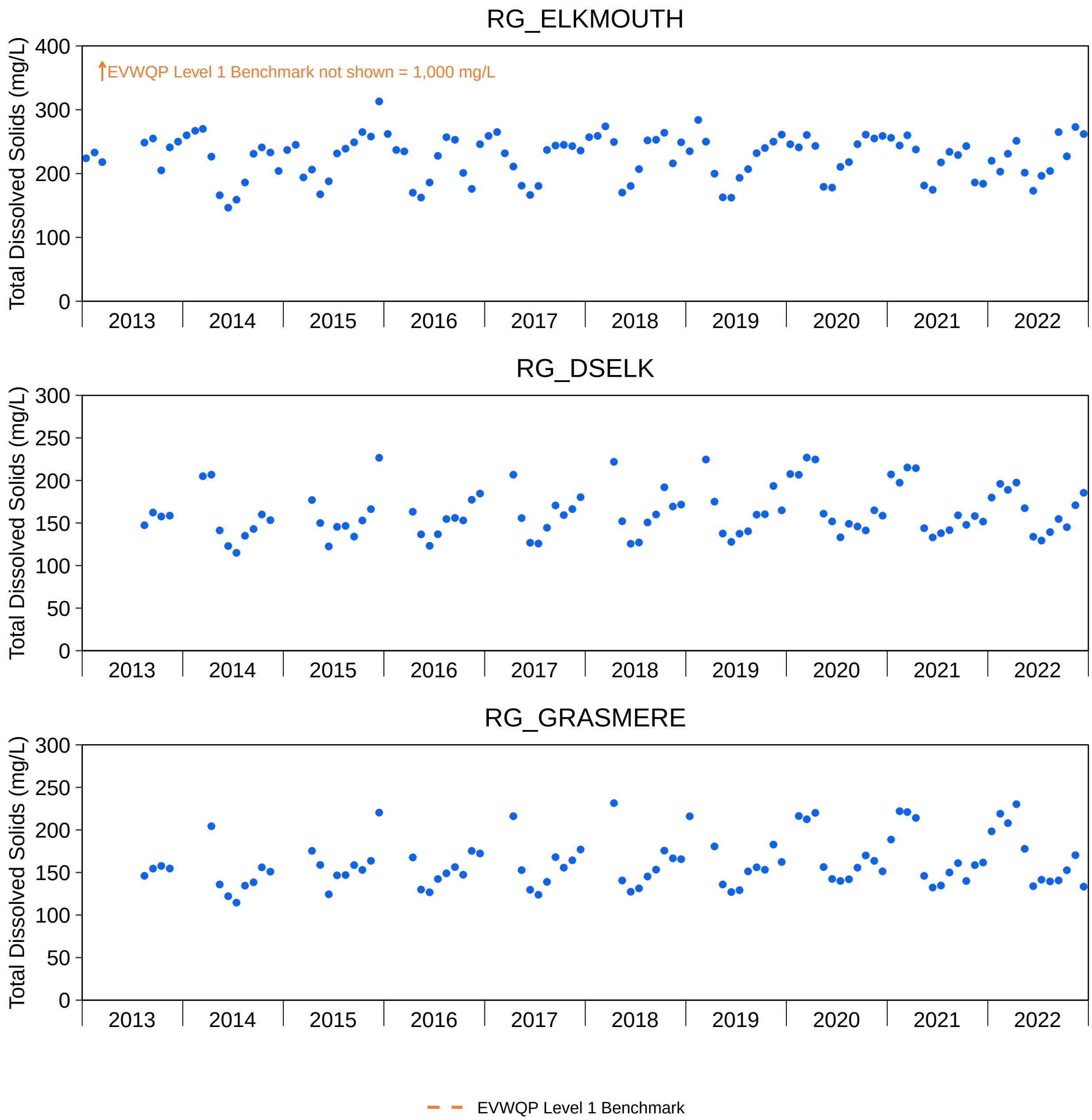


Figure B.17: Monthly Average Concentrations of Total Dissolved Solids at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available.

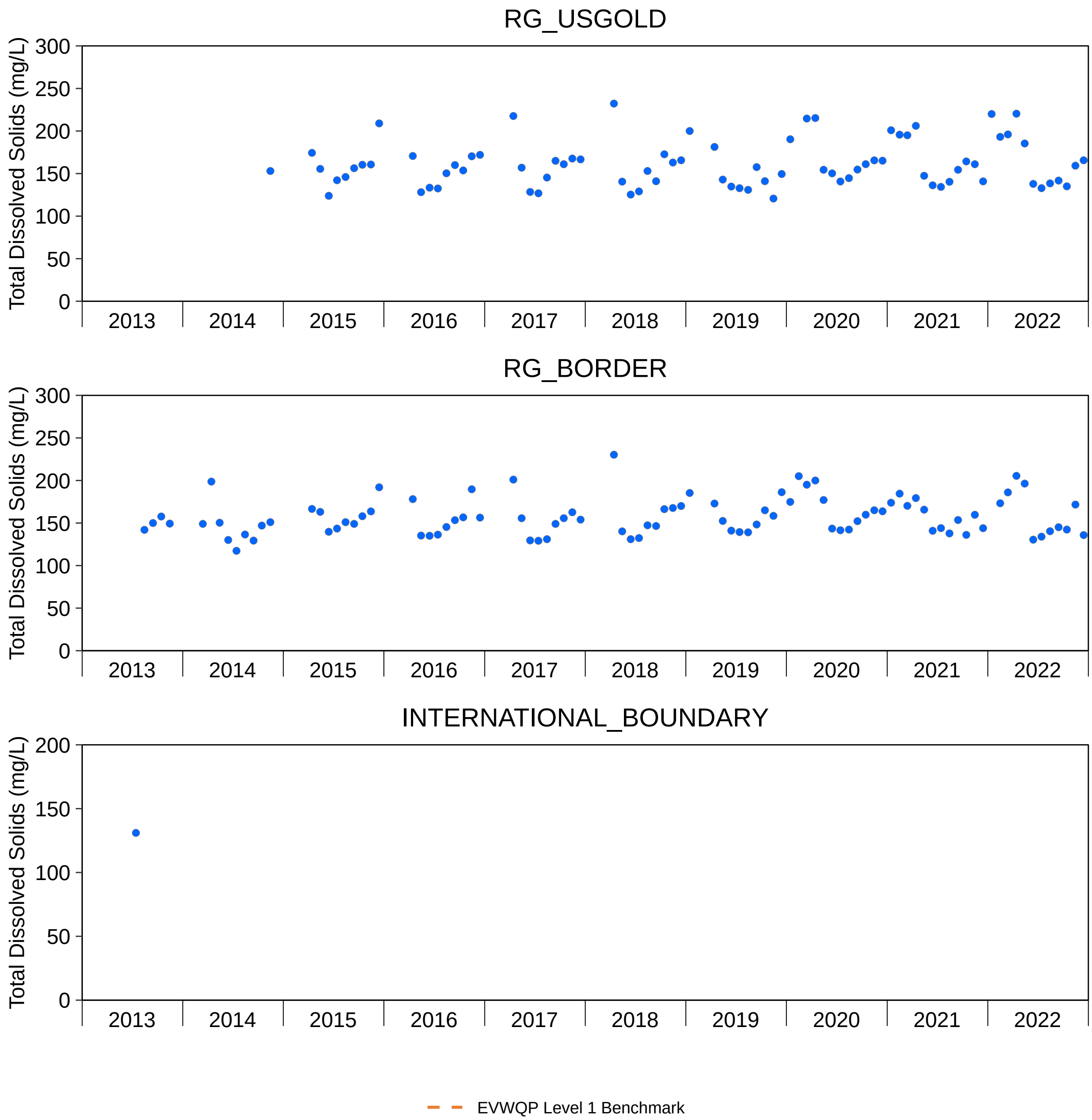


Figure B.17: Monthly Average Concentrations of Total Dissolved Solids at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available.

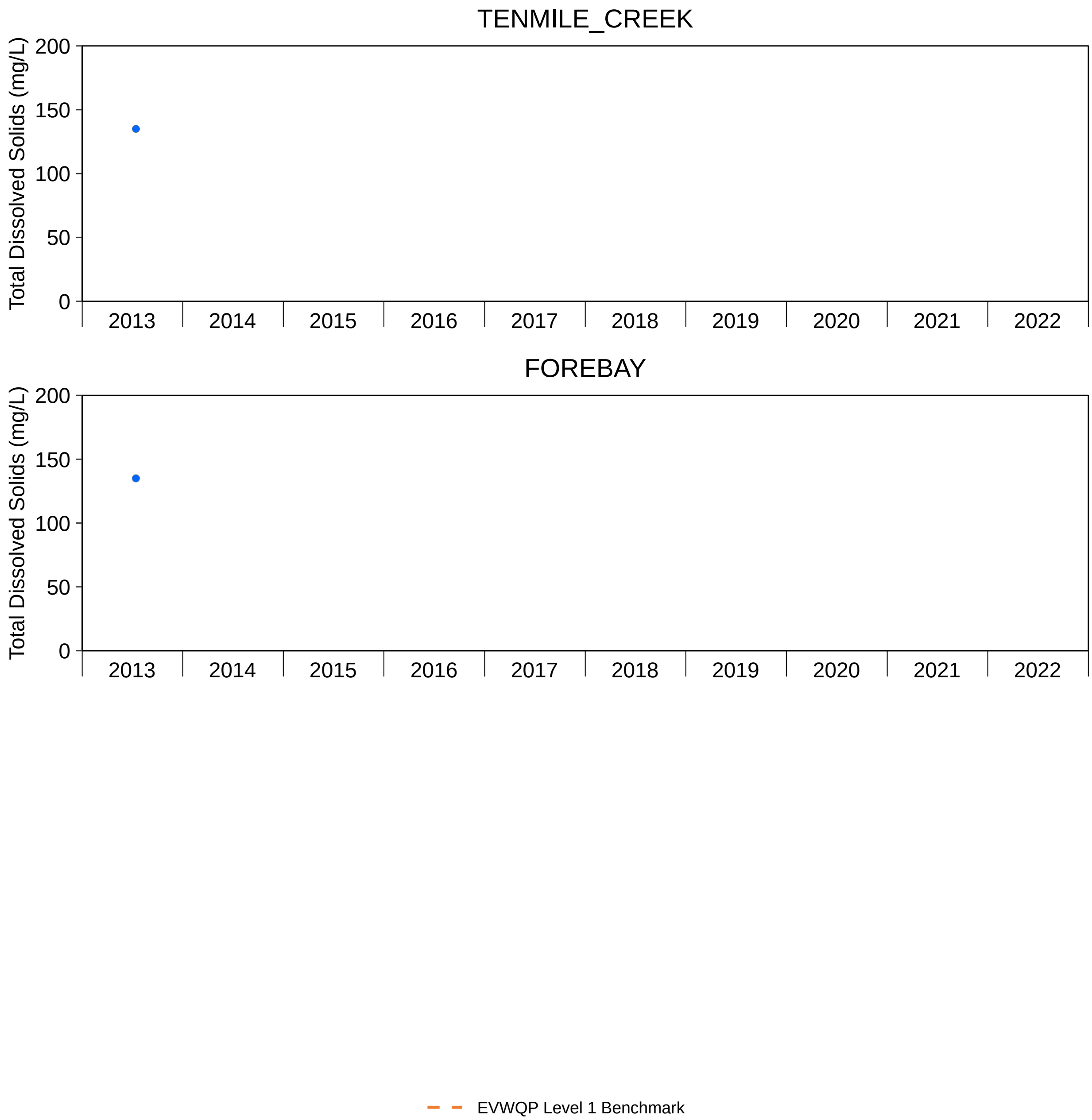


Figure B.17: Monthly Average Concentrations of Total Dissolved Solids at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Constituent was plotted because it was identified as a mine−related constituent in the Adaptive Management Plan and an early warning trigger was defined (Azimuth 2018). Starting in 2019, transect location data were included in monthly mean calculations when data were available.

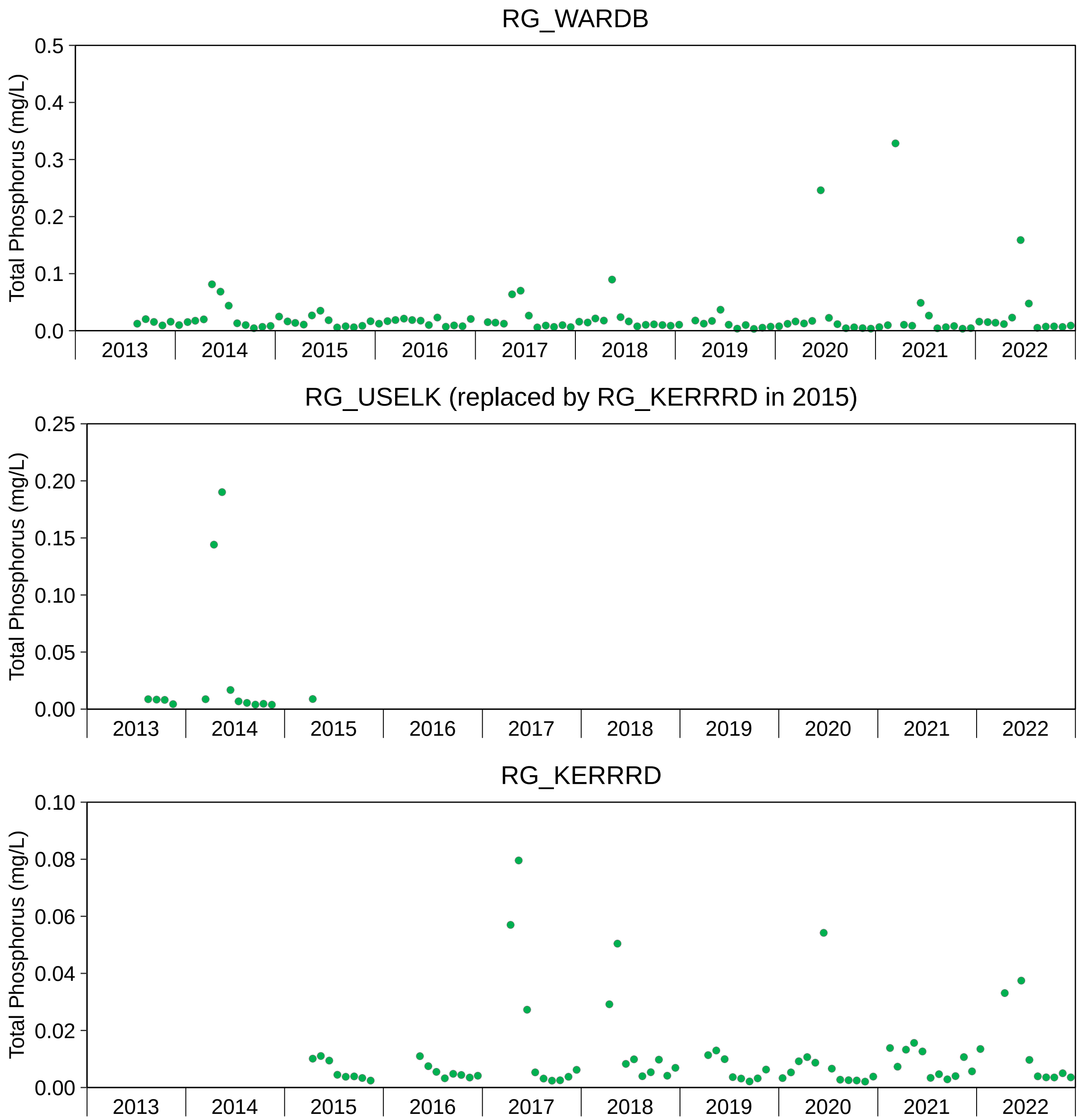


Figure B.18: Monthly Average Concentrations of Total Phosphorus at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. The interim screening values for total phosphorus (0.03 mg/L) and orthophosphate (0.006 mg/L) represent the 97.5th percentile of concentrations observed in reference areas over the growing season (Minnow 2020). Values with high LRLs of 0.3 mg/L in 2012 are not shown. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

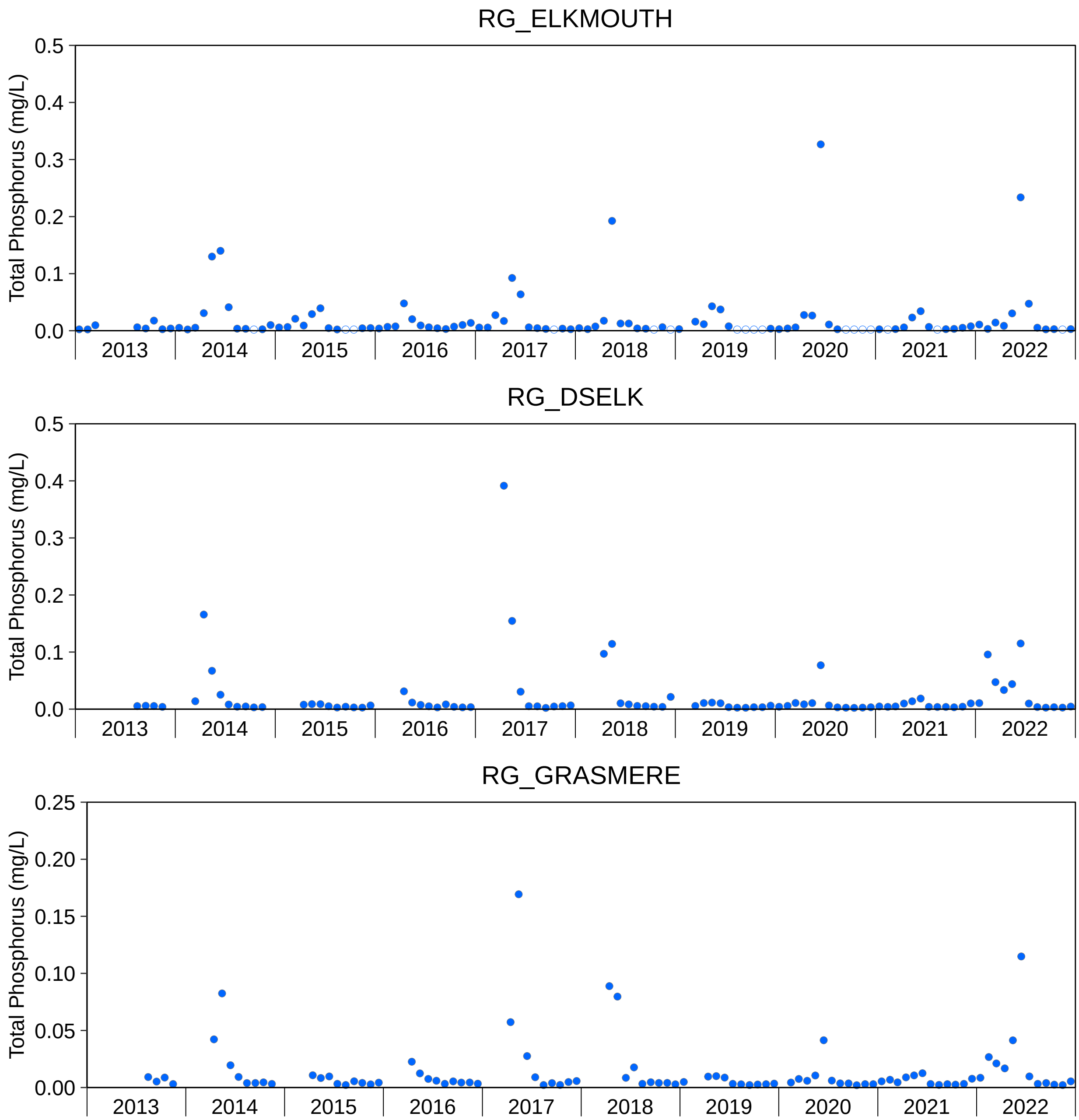


Figure B.18: Monthly Average Concentrations of Total Phosphorus at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. The interim screening values for total phosphorus (0.03 mg/L) and orthophosphate (0.006 mg/L) represent the 97.5th percentile of concentrations observed in reference areas over the growing season (Minnow 2020). Values with high LRLs of 0.3 mg/L in 2012 are not shown. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

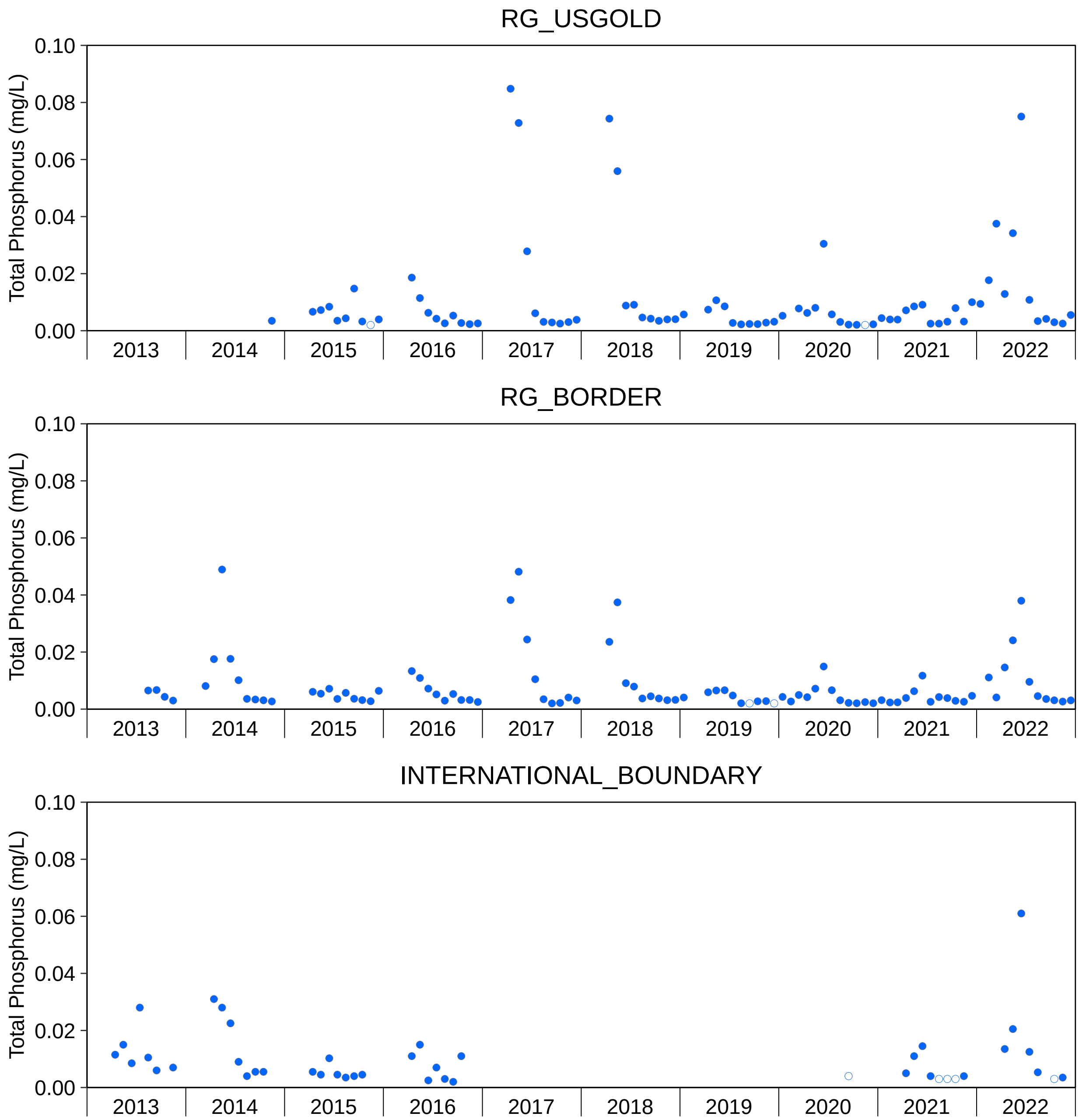


Figure B.18: Monthly Average Concentrations of Total Phosphorus at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. The interim screening values for total phosphorus (0.03 mg/L) and orthophosphate (0.006 mg/L) represent the 97.5th percentile of concentrations observed in reference areas over the growing season (Minnow 2020). Values with high LRLs of 0.3 mg/L in 2012 are not shown. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

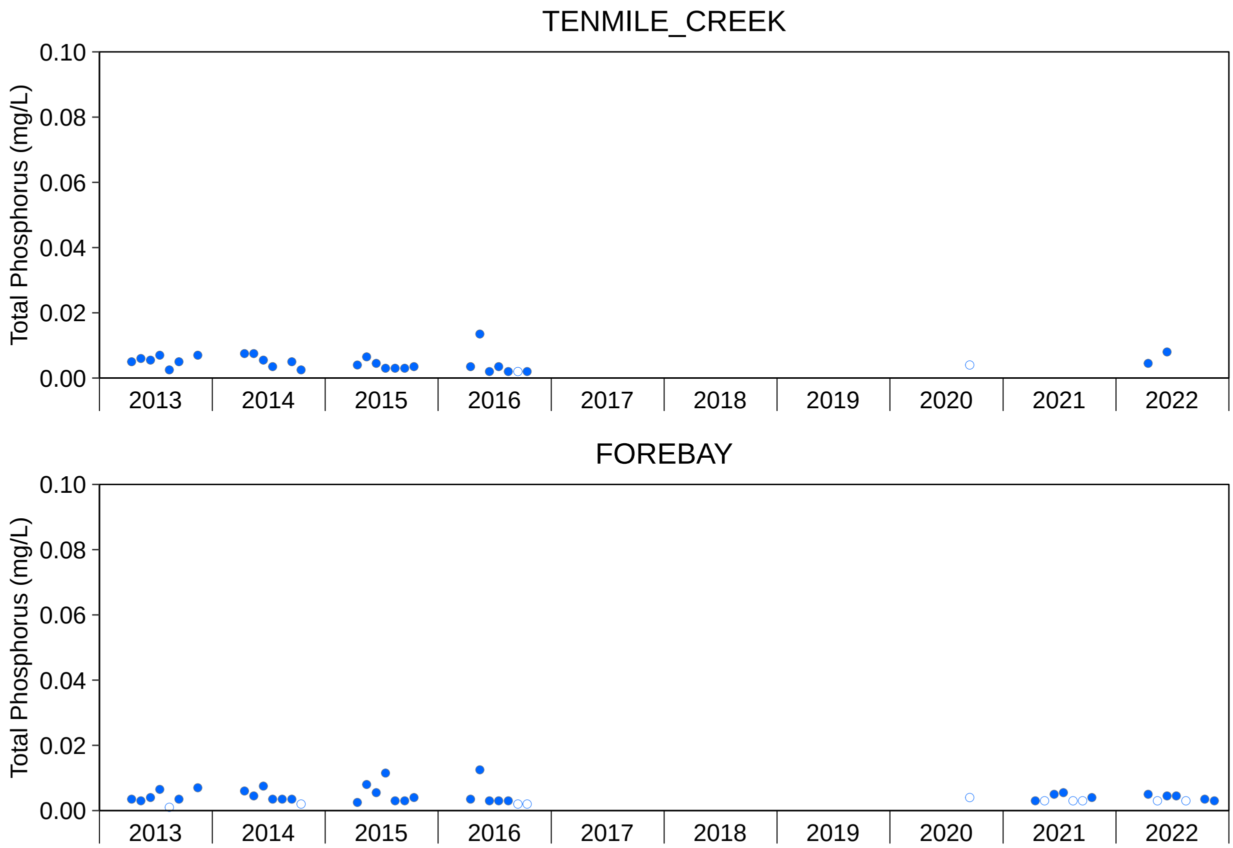


Figure B.18: Monthly Average Concentrations of Total Phosphorus at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. The interim screening values for total phosphorus (0.03 mg/L) and orthophosphate (0.006 mg/L) represent the 97.5th percentile of concentrations observed in reference areas over the growing season (Minnow 2020). Values with high LRLs of 0.3 mg/L in 2012 are not shown. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

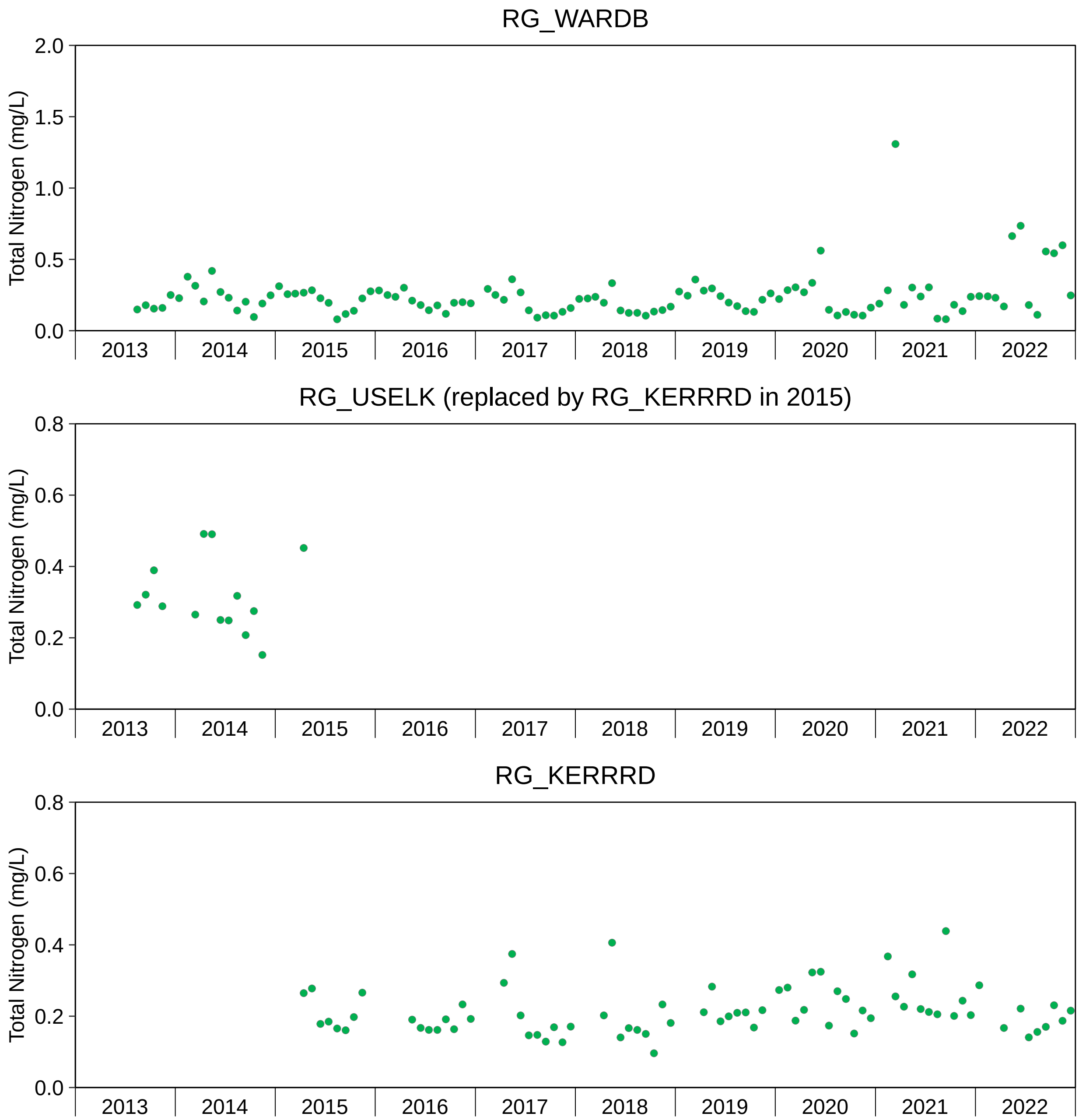


Figure B.19: Monthly Average Concentrations of Total Nitrogen at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

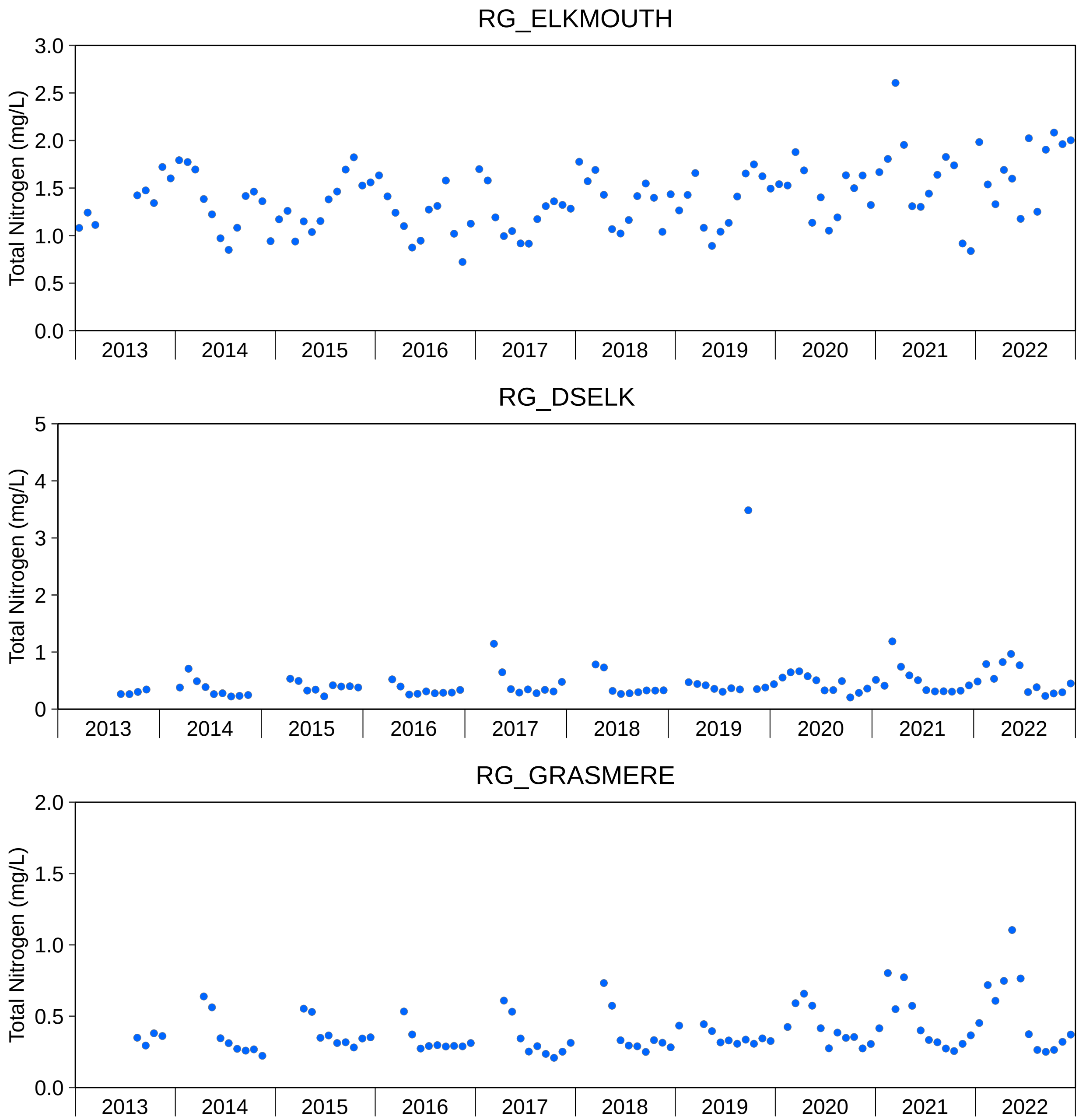


Figure B.19: Monthly Average Concentrations of Total Nitrogen at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

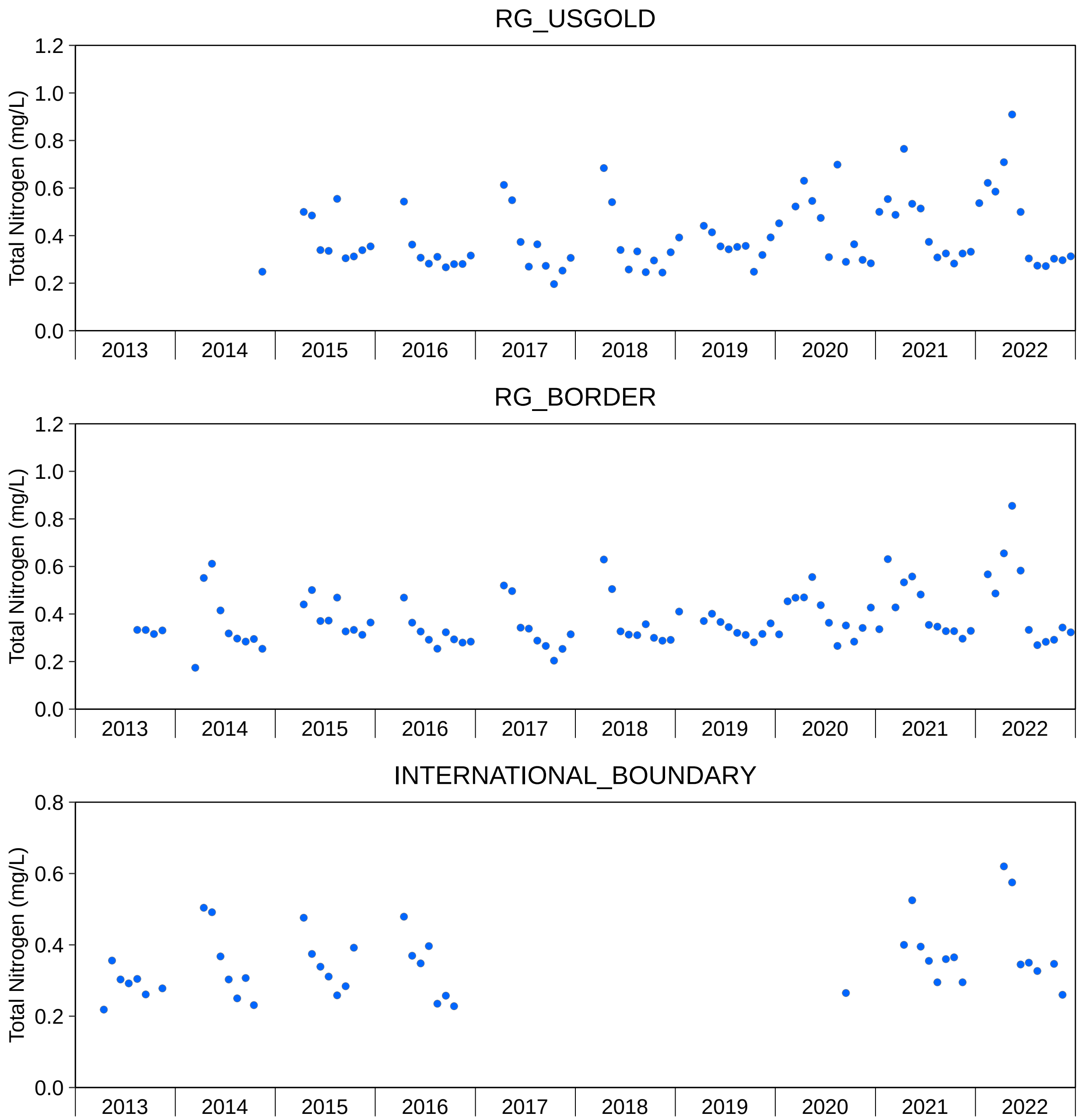


Figure B.19: Monthly Average Concentrations of Total Nitrogen at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

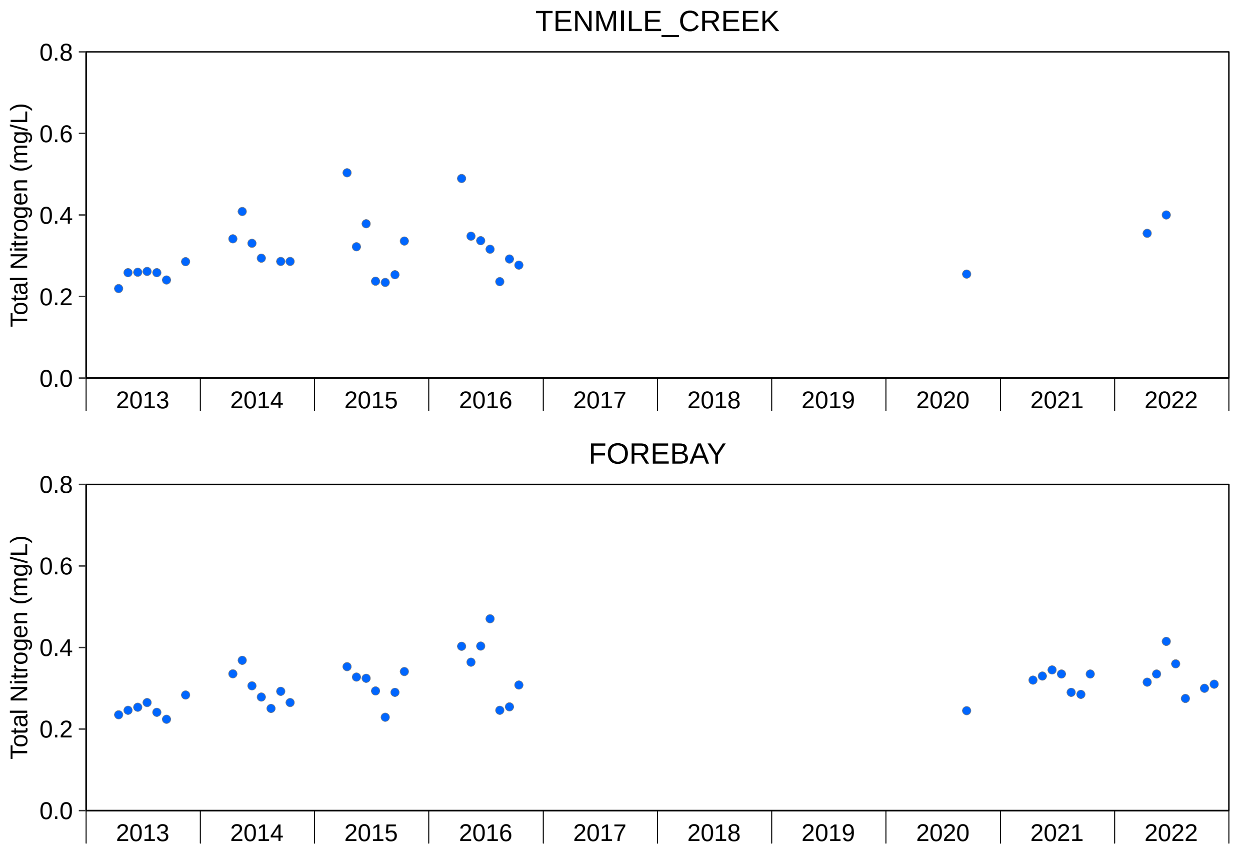


Figure B.19: Monthly Average Concentrations of Total Nitrogen at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

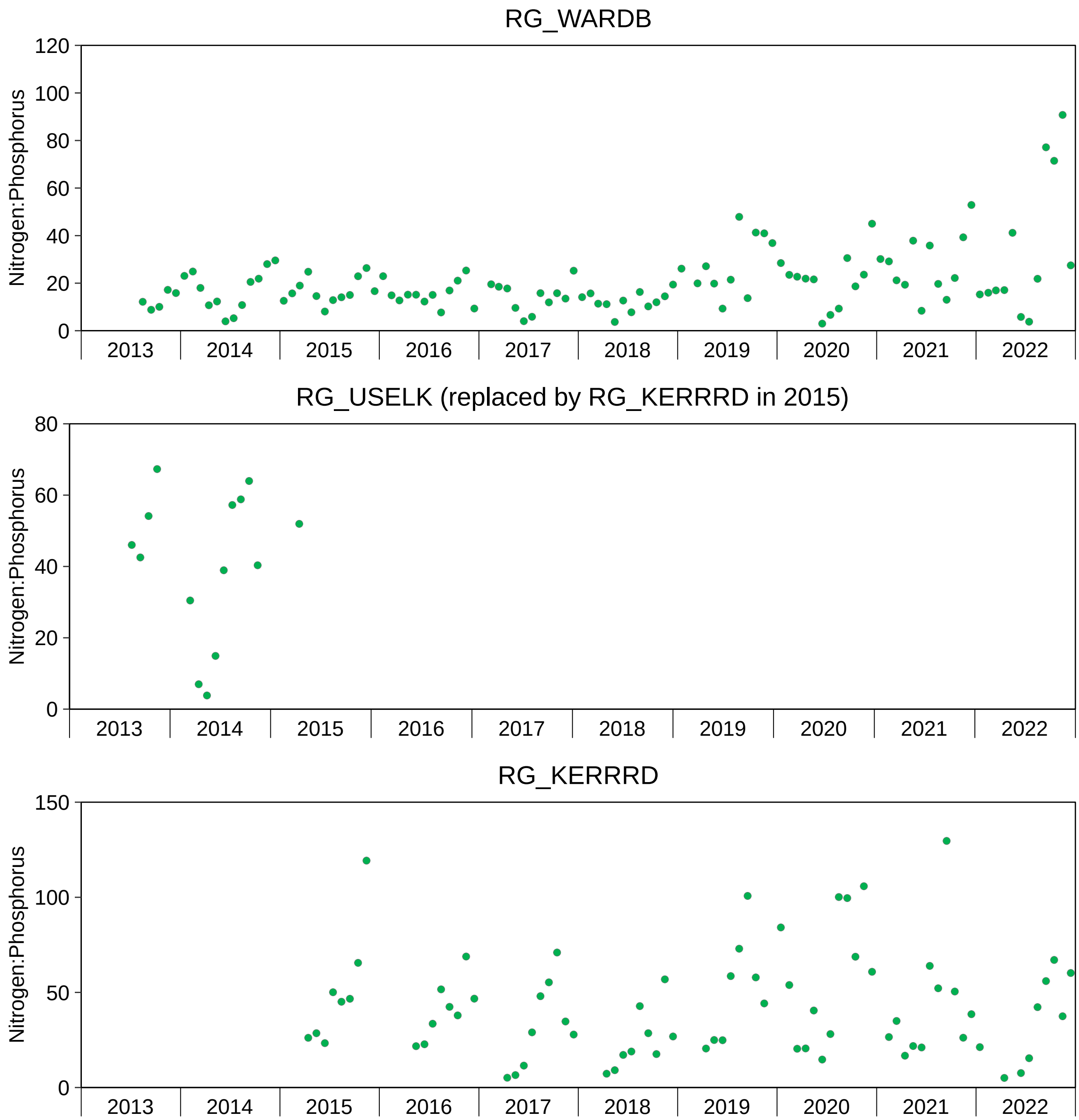


Figure B.20: Monthly Average Total Nitrogen:Total Phosphorus Ratio at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

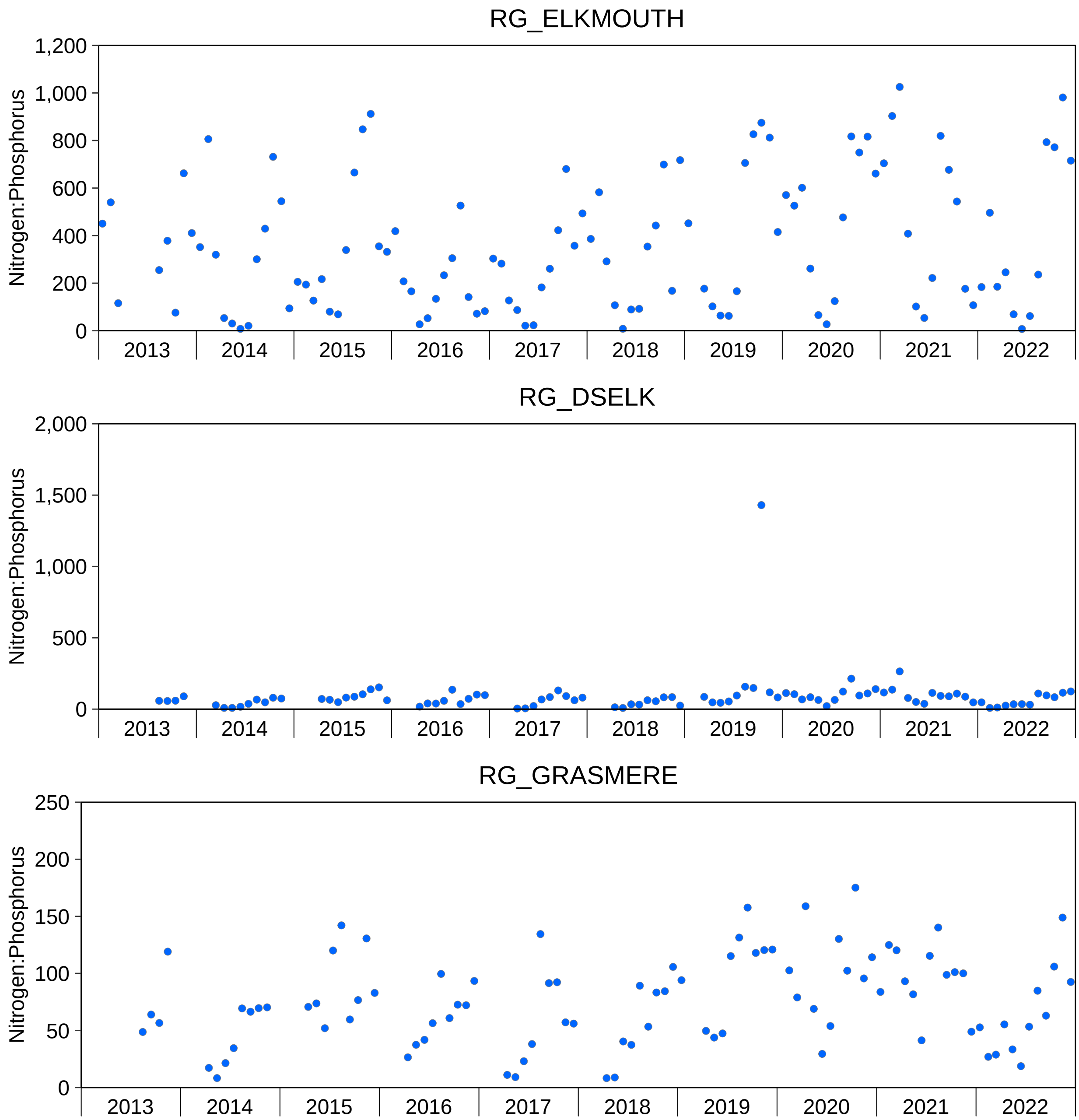


Figure B.20: **Monthly Average Total Nitrogen:Total Phosphorus Ratio at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022**

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

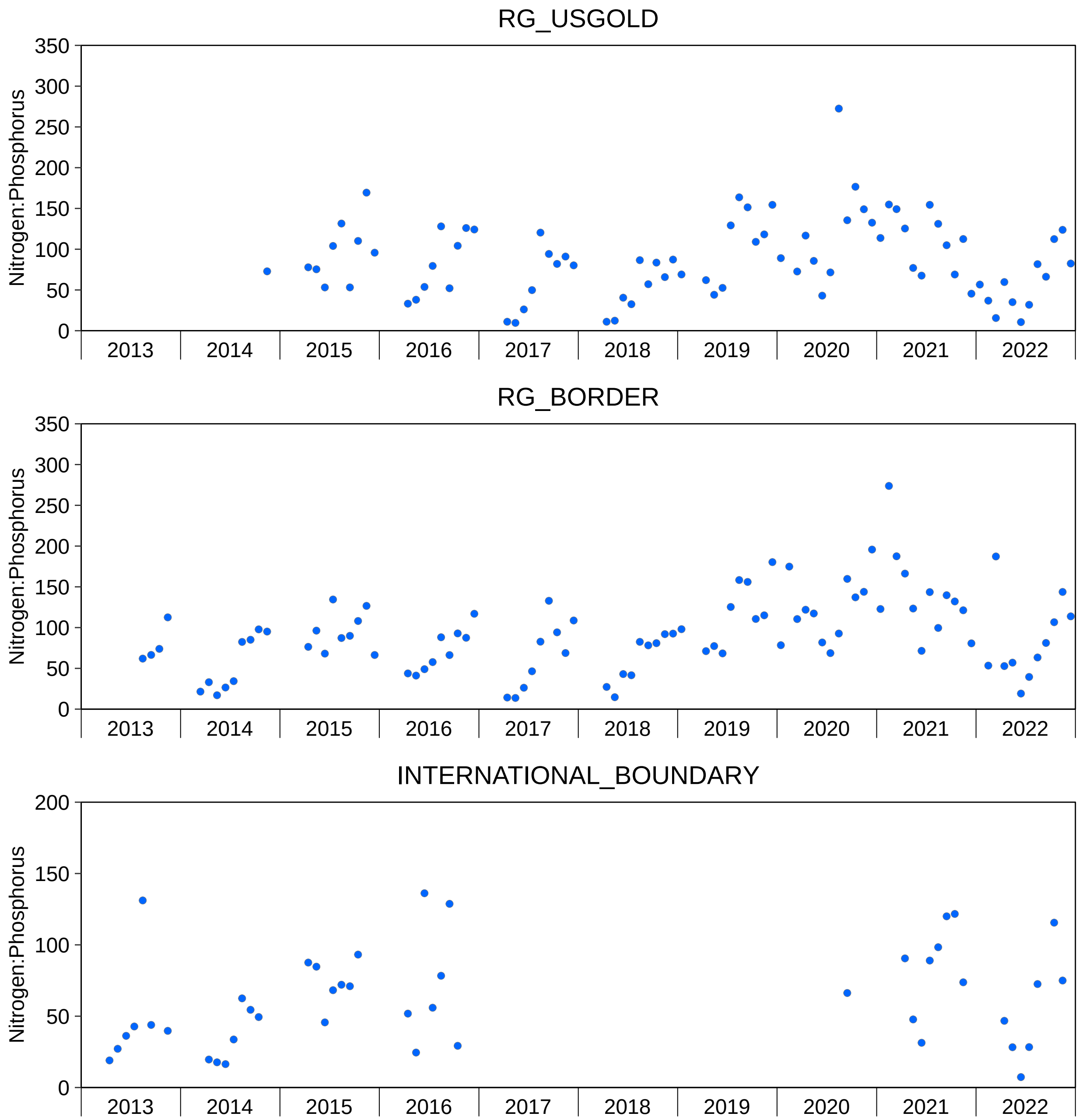


Figure B.20: Monthly Average Total Nitrogen:Total Phosphorus Ratio at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

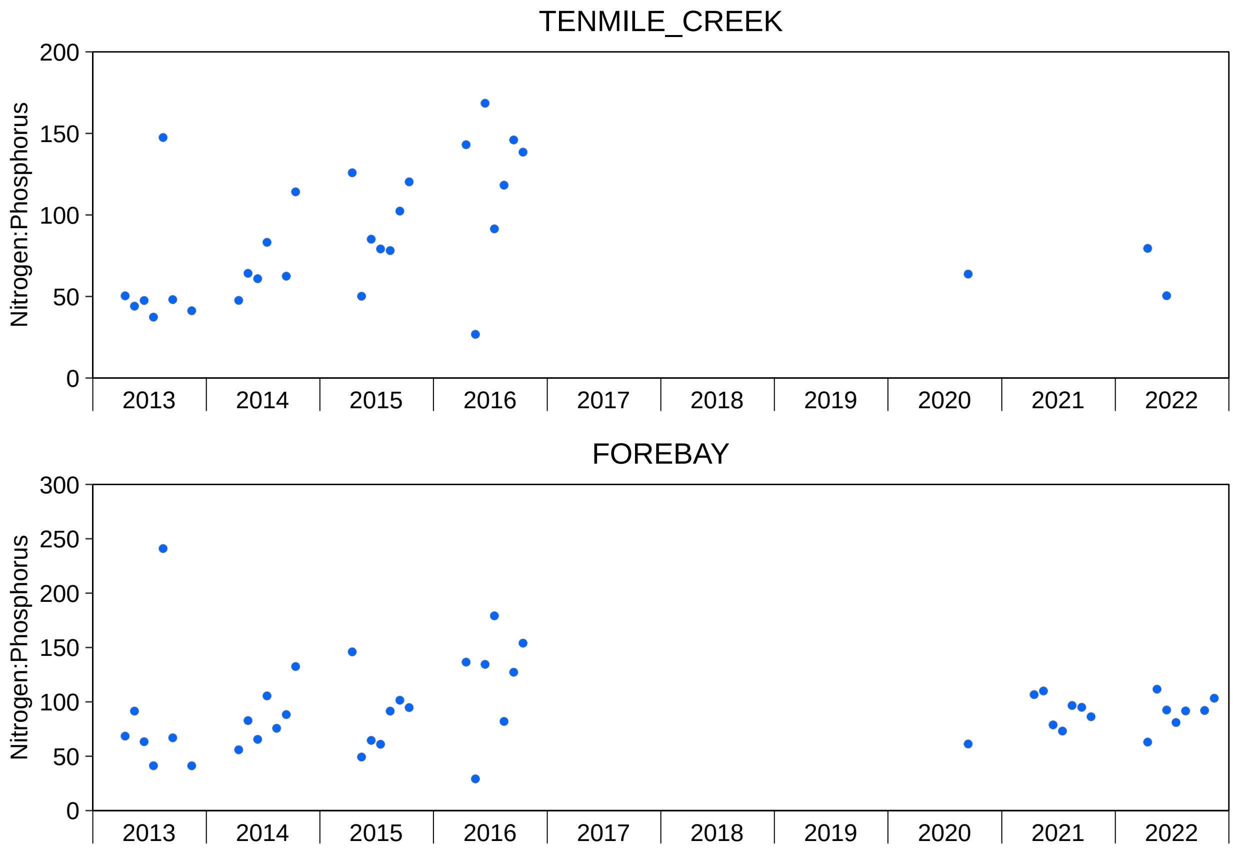


Figure B.20: Monthly Average Total Nitrogen:Total Phosphorus Ratio at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

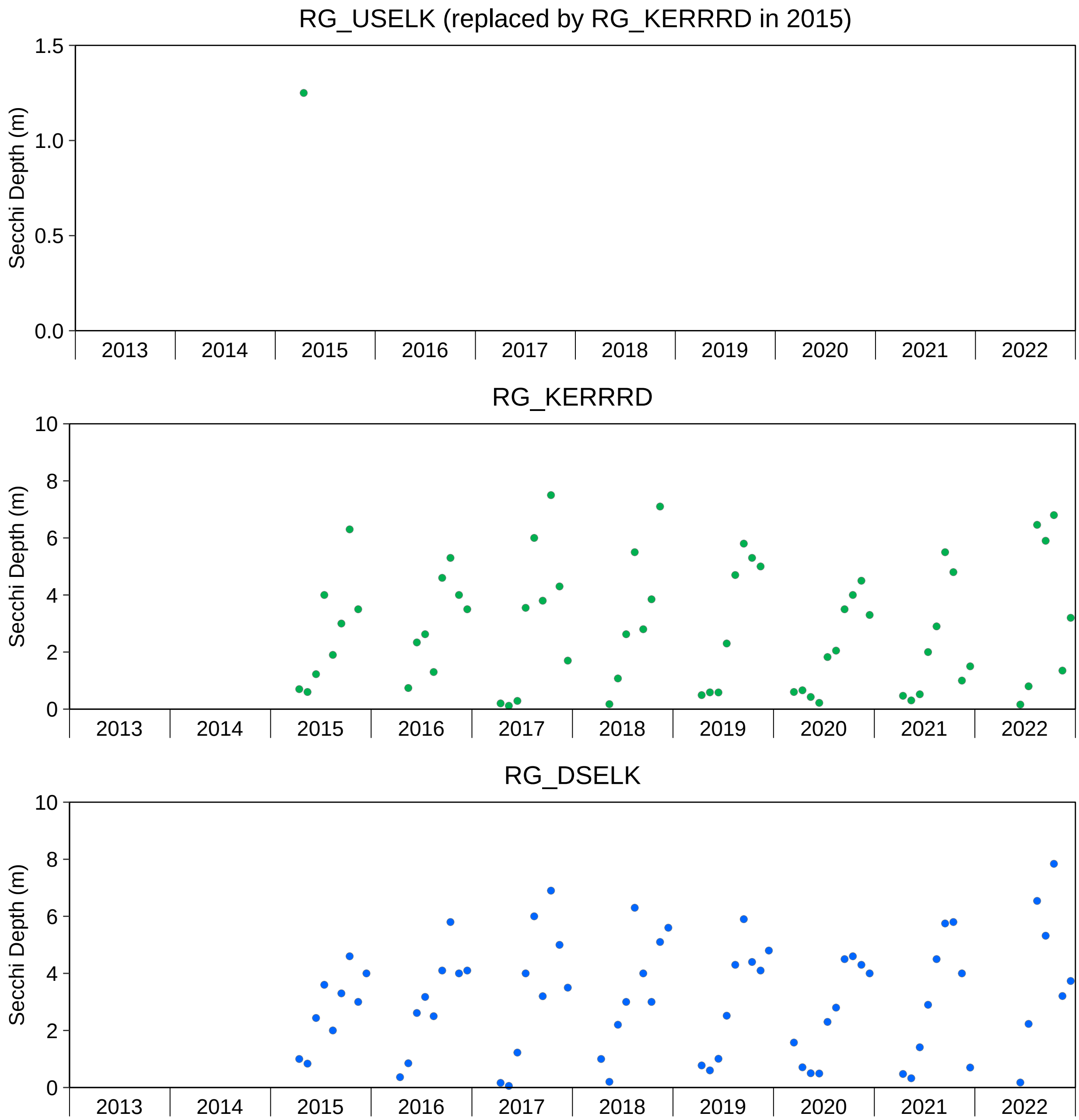


Figure B.21: Monthly Average Secchi Depth at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

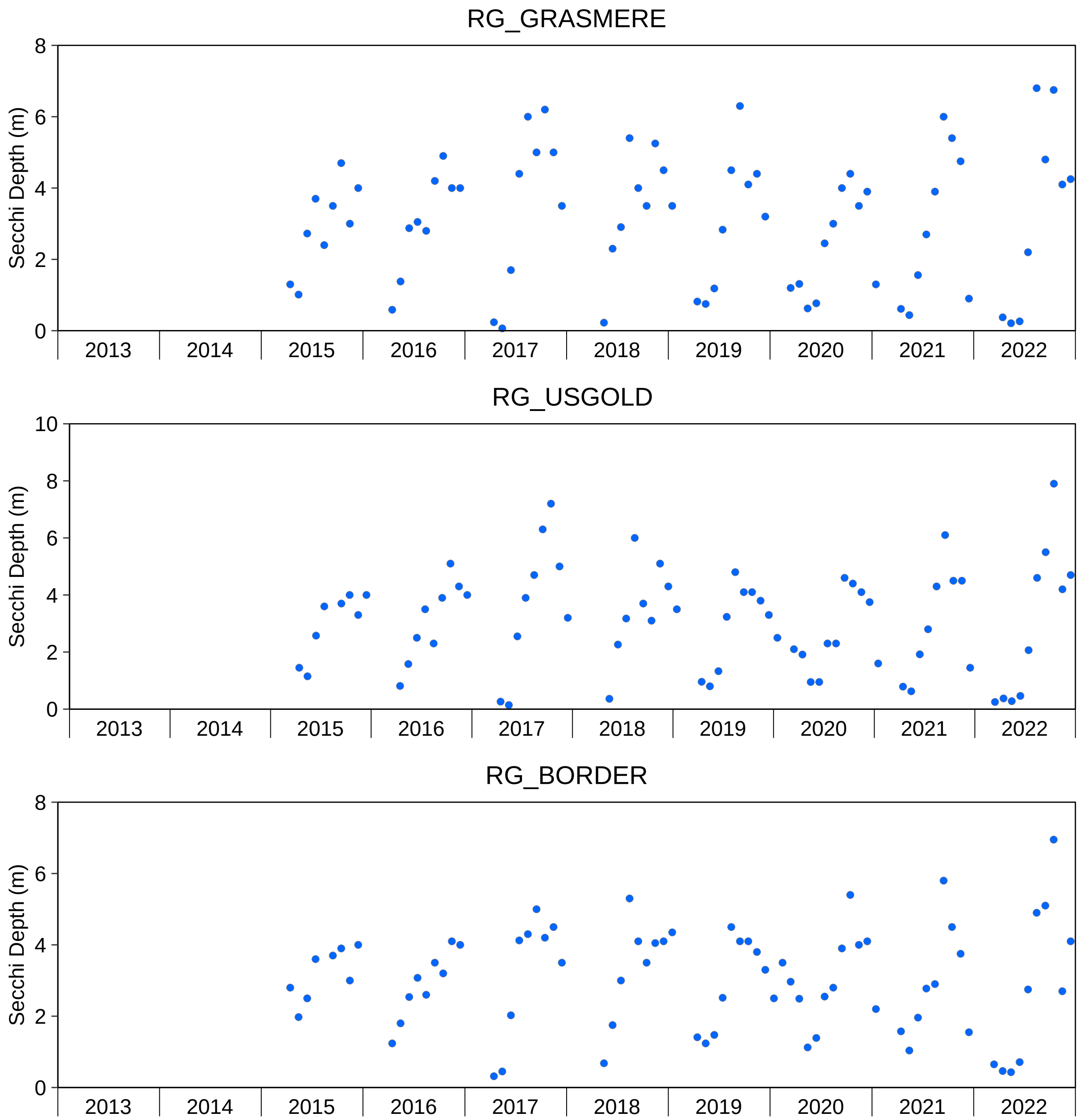


Figure B.21: Monthly Average Secchi Depth at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

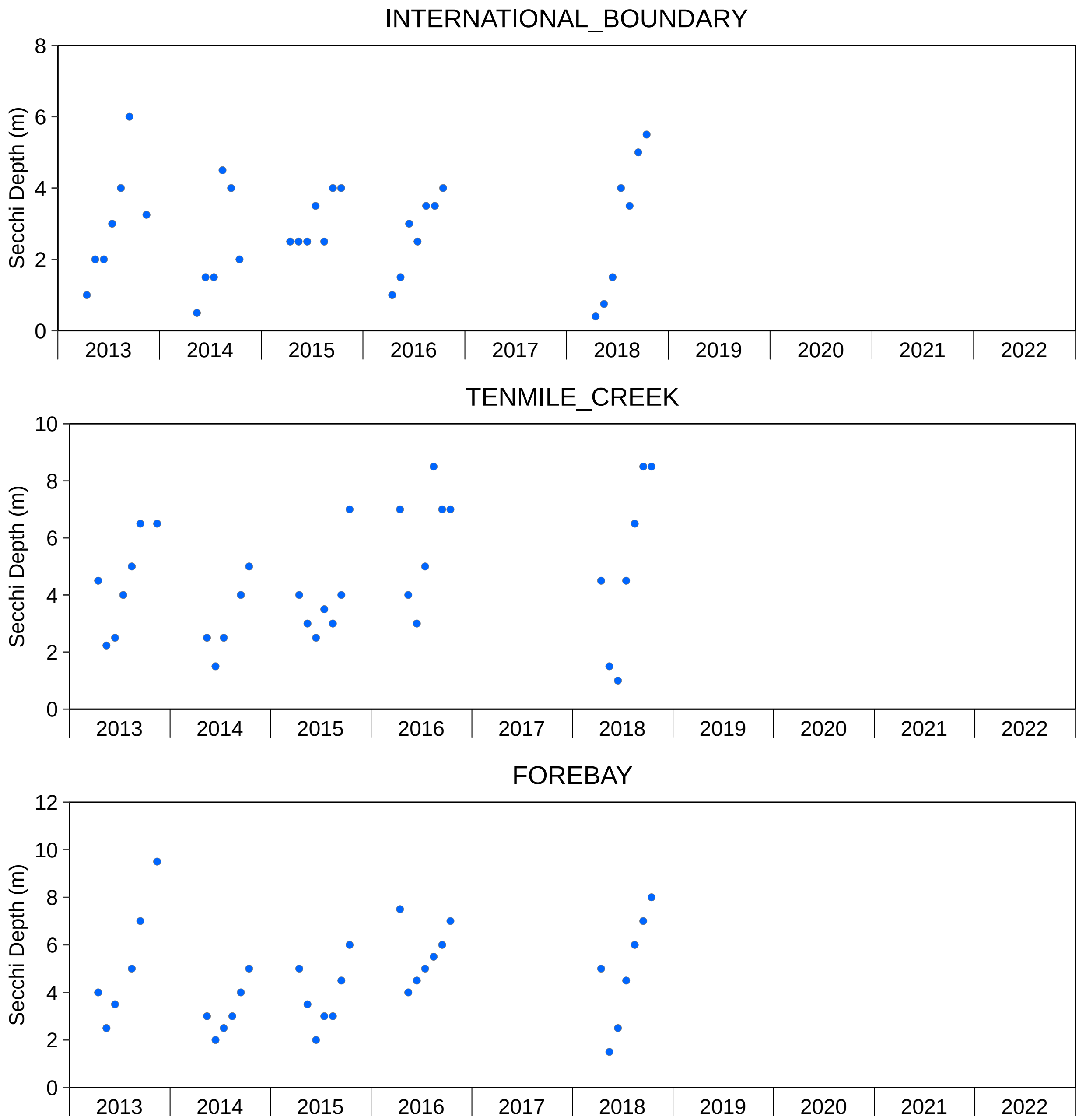


Figure B.21: Monthly Average Secchi Depth at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

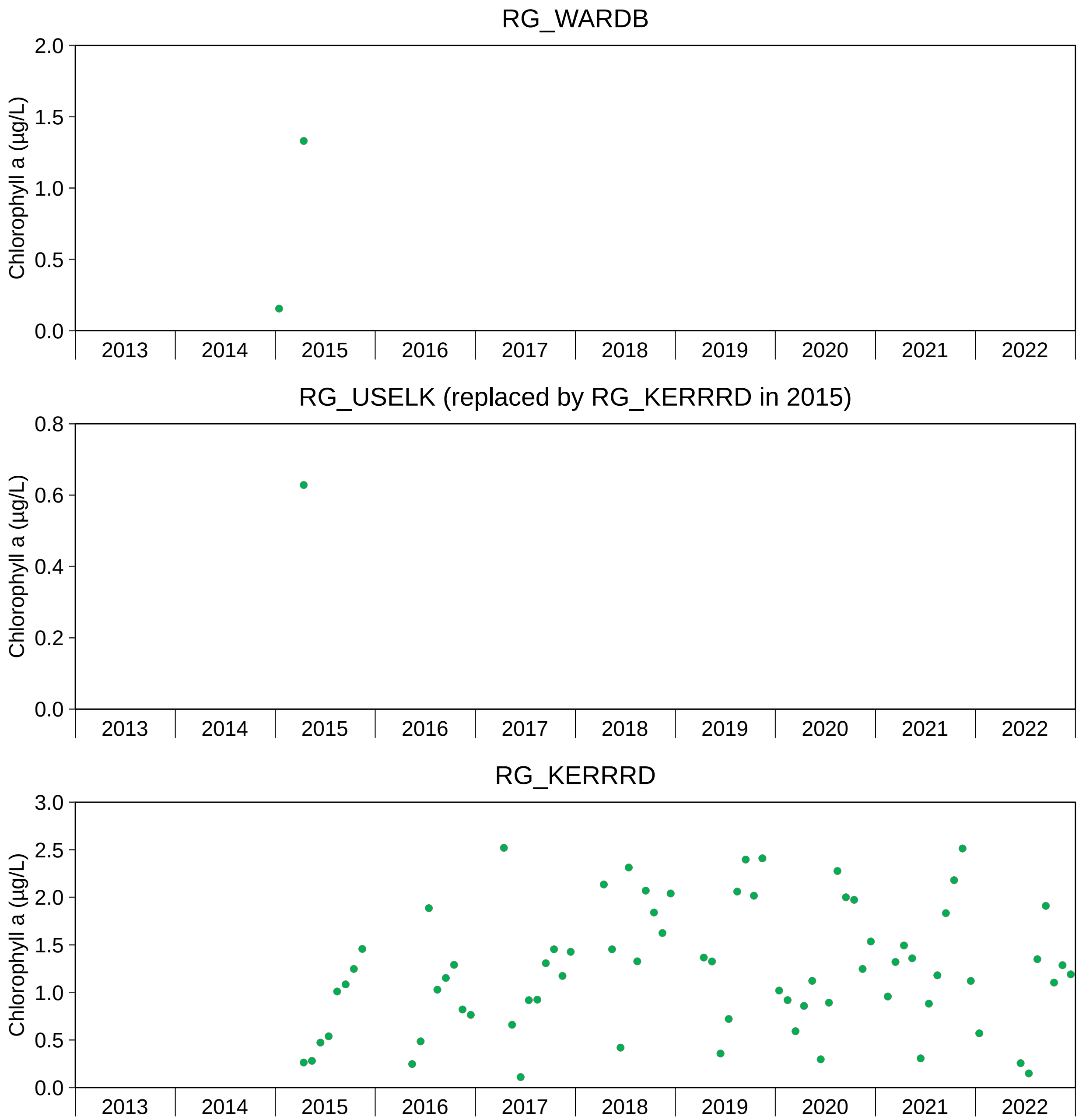


Figure B.22: Monthly Average Concentrations of Chlorophyll-a at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

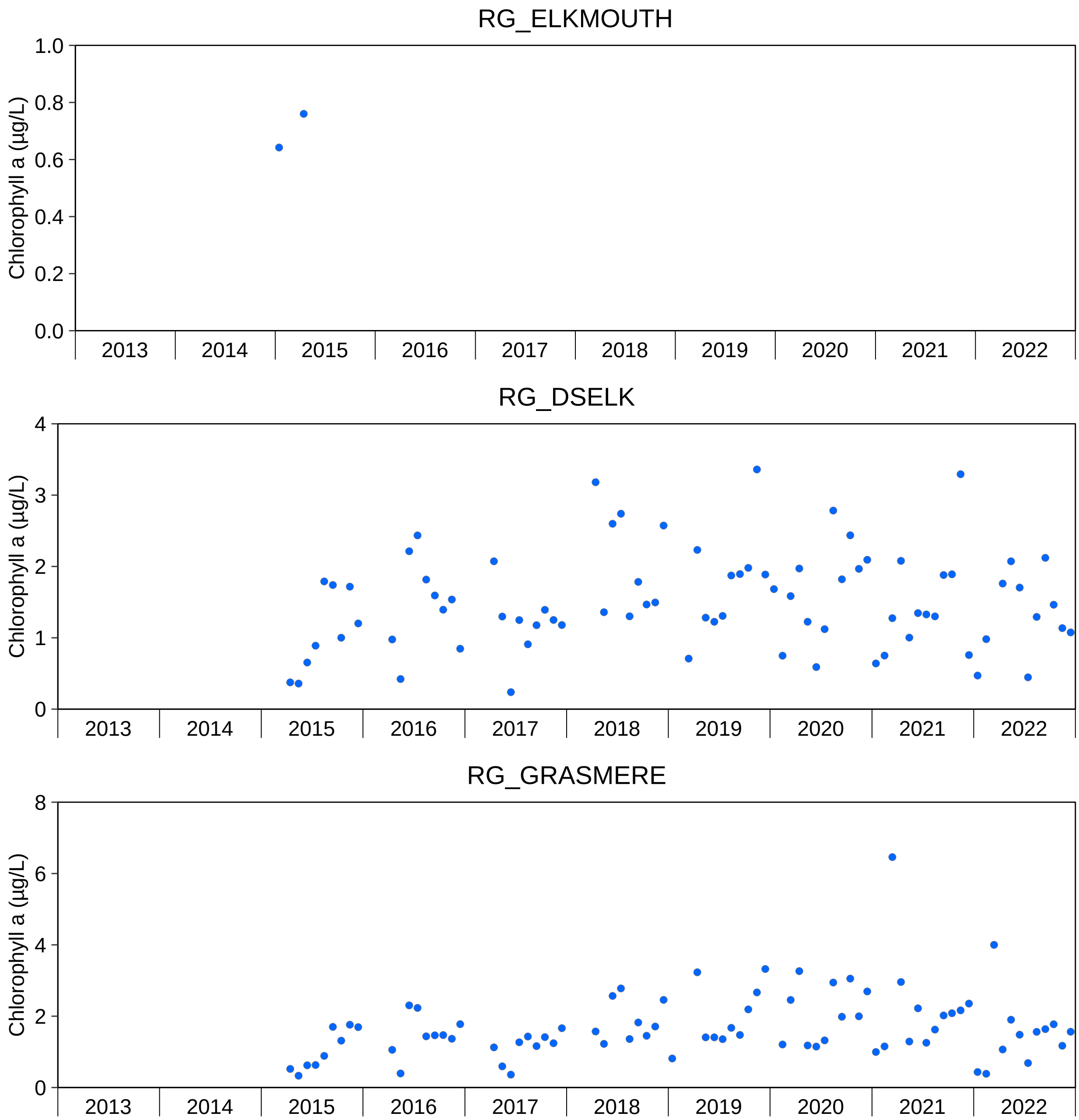


Figure B.22: Monthly Average Concentrations of Chlorophyll-a at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

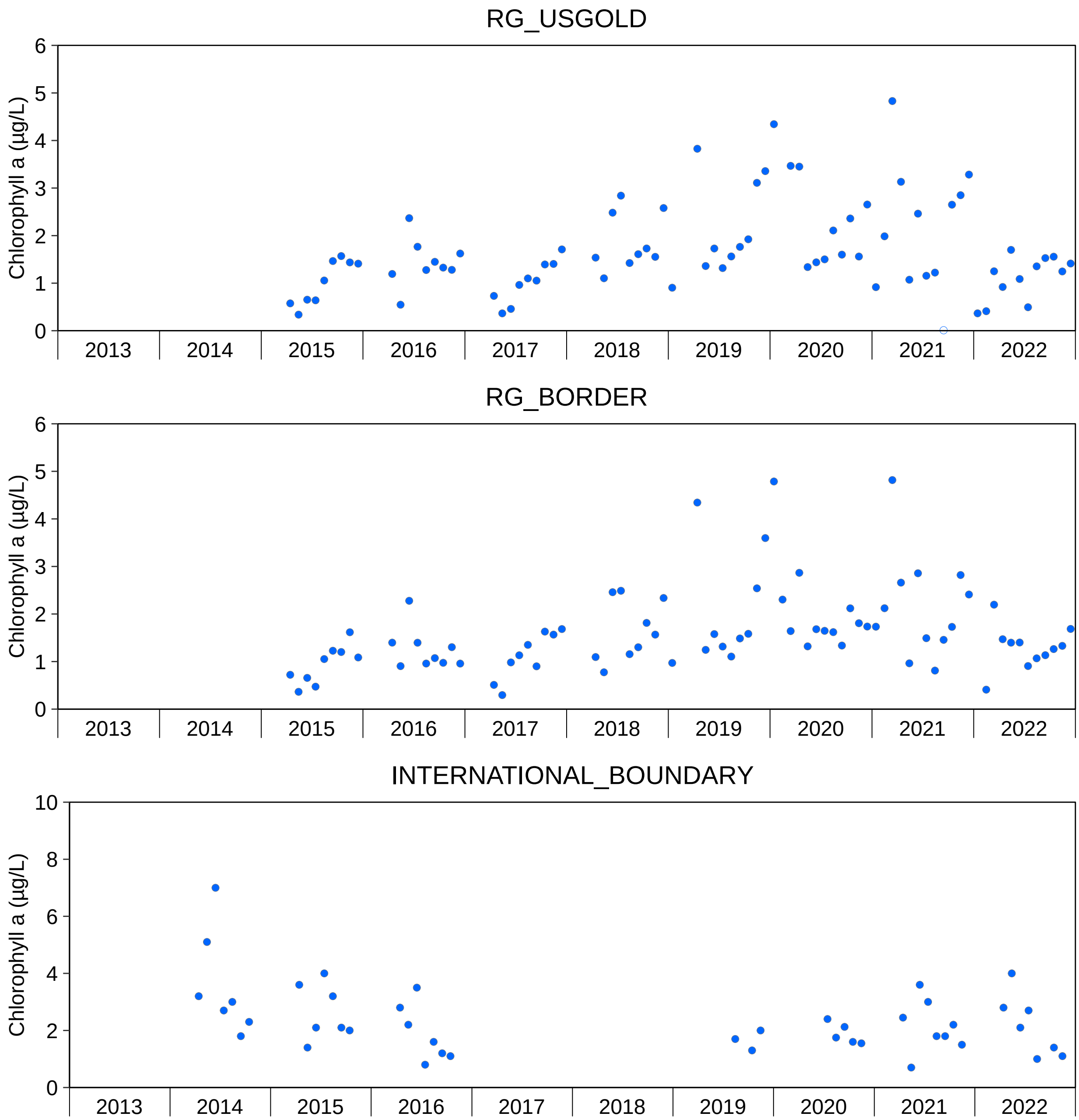


Figure B.22: Monthly Average Concentrations of Chlorophyll-a at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

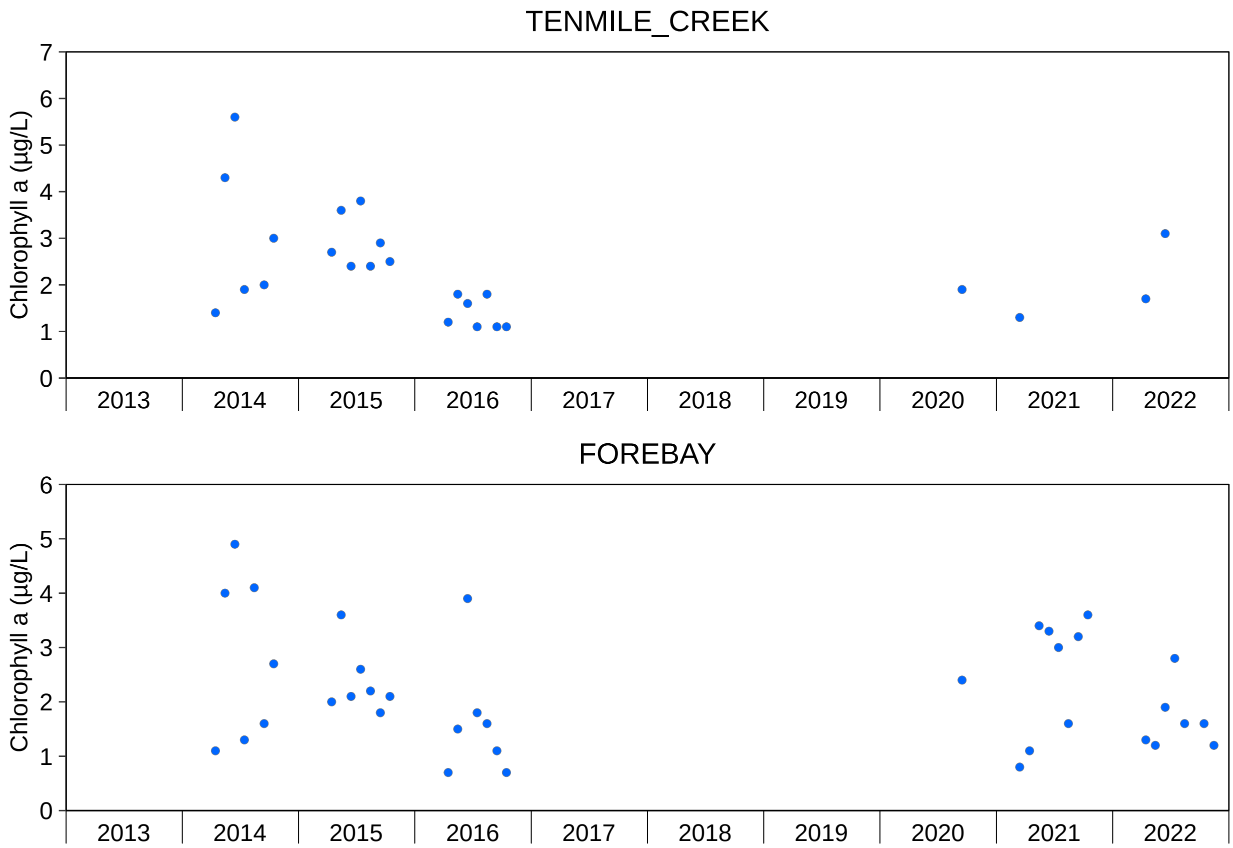


Figure B.22: Monthly Average Concentrations of Chlorophyll-a at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2013 to 2022

Notes: Green data points are used for upstream sites and blue data points are used for downstream sites. Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Starting in 2019, transect location data were included in monthly mean calculations when data were available.

Table B.1: Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Station	Summary Statistic	Total Hardness (mg/L)	Temperature °C	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Orthophosphate (mg/L)
	n	12	12	12	12	12	16	12	12	12	12	12	12	12
	Annual Minimum	83	0	118	7.5	8	8.5	<0.5	82	0.042	<0.001	<0.005	<0.05	<0.001
	Annual Maximum	170	17	215	8.3	8.4	93	2	134	0.16	0.0026	0.031	0.62	0.0086
	Annual Mean	133	7	171	8.1	8.2	30	1.2	115	0.1	0.0015	0.011	0.14	0.0025
RG_WARDB	Annual Median	139	7.8	180	8.1	8.2	12	1.2	119	0.11	0.0014	0.0065	0.1	0.0013
	% < LRL	0%	0%	0%	0%	0%	0%	8%	0%	0%	25%	17%	42%	25%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA River Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	9	9	9	9	9	17	9	9	9	9	9	9	9
	Annual Minimum	90	0.14	115	7.5	7.7	8.3	0.51	93	0.076	<0.001	<0.005	0.062	<0.001
	Annual Maximum	163	20	189	8.4	8.3	102	2	136	0.17	0.0025	0.058	0.12	0.0024
	Annual Mean	130	10	149	8	7.9	51	1.1	114	0.11	0.0017	0.014	0.086	0.0013
RG_KERRRD	Annual Median	134	10	151	8.2	7.9	12	1.2	114	0.11	0.0016	0.0068	0.074	0.001
	% < LRL	0%	0%	0%	0%	0%	0%	0%	0%	0%	11%	33%	0%	56%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	12	12	12	12	12	16	12	12	12	12	12	12	12
	Annual Minimum	130	0	173	7.9	8.2	9	<0.5	122	0.68	0.0012	<0.005	0.13	<0.001
	Annual Maximum	239	15	273	8.4	8.6	100	1.9	174	1.8	0.0041	0.028	1.2	0.0045
	Annual Mean	200	5.9	226	8.2	8.4	34	0.9	156	1.3	0.0024	0.014	0.25	0.0017
	Annual Median	213	5.9	224	8.3	8.4	13	0.6	160	1.4	0.0025	0.013	0.16	0.001
	% < LRL	0%	0%	0%	0%	0%	0.0%	50%	0%	0%	0%	17%	50%	67%
RG_ELKMOUTH	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA River Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 1 Benchmark/UEC	-	-	0%	-	-	-	-	-	0%	-	-	-	-
	% > Level 2 Benchmark/UEC	-	-	-	-	-	-	-	-	0%	-	-	-	-
	% > Level 3 Benchmark/UEC	-	-	-	-	-	-	-	-	0%	-	-	-	-
	n	12	12	12	12	12	24	12	12	12	12	12	12	12
	Annual Minimum	101	0.26	129	7.6	7.8	8.4	0.69	99	0.15	0.001	0.0051	0.067	<0.001
	Annual Maximum	176	20	198	8.3	8.2	104	2.1	156	0.59	0.0032	0.049	0.28	0.0021
	Annual Mean	141	8.8	166	8.1	8	54	1.2	124	0.32	0.0019	0.017	0.13	0.0013
RG_DSELK	Annual Median	140	8	169	8.2	8	48	1.3	122	0.3	0.0018	0.0093	0.11	0.001
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%	0%	0%	0%	0%	17%	50%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
	n	12	12	12	12	12	24	12	12	12	12	12	12	12
	Annual Minimum	102	0.34	133	7.7	7.8	8.1	0.7	98	0.18	0.0012	<0.005	0.065	<0.001
	Annual Maximum	182	18	230	8.3	8.3	105	2.3	153	0.59	0.0037	0.087	0.63	0.0018
	Annual Mean	140	8.8	170	8.1	8	53	1.3	123	0.32	0.0022	0.019	0.2	0.0011
RG_GRASMERE	Annual Median	138	7.9	162	8.2	8	47	1.3	120	0.25	0.002	0.011	0.12	0.001
	% < LRL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	75%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.1: Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Station	Summary Statistic	Total Hardness (mg/L)	Temperature °C	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Orthophosphate (mg/L)
RG_USGOLD	n	12	12	12	12	12	24	12	12	12	12	12	12	12
	Annual Minimum	102	0.31	133	7.8	7.6	8.3	0.61	103	0.19	0.001	<0.005	0.058	<0.001
	Annual Maximum	191	18	220	8.4	8.2	105	2.5	156	0.59	0.0035	0.064	0.23	0.0022
	Annual Mean	140	8.9	169	8.1	8	53	1.4	126	0.33	0.0022	0.018	0.11	0.0012
	Annual Median	136	8.1	162	8.2	8	47	1.3	122	0.26	0.0025	0.0082	0.1	0.001
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%	0%	0%	0%	8%	0%	50%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_BORDER	n	11	11	11	11	11	22	11	11	11	11	11	11	11
	Annual Minimum	104	0.74	130	7.7	7.8	8.3	0.76	101	0.2	0.001	0.0051	0.065	<0.001
	Annual Maximum	174	18	205	8.3	8.2	104	2.4	150	0.52	0.0034	0.064	0.21	0.0018
	Annual Mean	134	10	160	8.1	8	53	1.4	120	0.3	0.0021	0.014	0.11	0.0011
	Annual Median	129	10	145	8.2	8	45	1.3	114	0.24	0.0023	0.0082	0.11	0.0011
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%	0%	0%	0%	0%	0%	45%
	% > BCWQG[a]	-	-	-	-	0%	0%	-	0%	0%	0%	0%	-	-
	% > BCWQG[b]	-	-	-	-	-	0%	-	-	0%	0%	0%	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
INTERNATIONAL_BOUNDARY	n	-	8	-	-	8	-	-	-	7	7	-	-	7
	Annual Minimum	-	7.2	-	-	8.2	-	-	-	0.22	<0.001	-	-	<0.004
	Annual Maximum	-	19	-	-	8.5	-	-	-	0.47	0.003	-	-	<0.004
	Annual Mean	-	13	-	-	8.3	-	-	-	0.3	0.0022	-	-	<0.004
	Annual Median	-	12	-	-	8.3	-	-	-	0.25	0.0025	-	-	<0.004
	% < LRL	-	0%	-	-	0%	-	-	-	0%	14%	-	-	100%
	% > BCWQG[a]	-	-	-	-	0%	-	-	-	0%	0%	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	0%	0%	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE_CREEK	n	-	2	-	-	2	-	-	-	2	2	-	-	2
	Annual Minimum	-	3.4	-	-	8.1	-	-	-	0.28	0.0015	-	-	<0.004
	Annual Maximum	-	8.2	-	-	8.3	-	-	-	0.3	0.002	-	-	<0.004
	Annual Mean	-	5.8	-	-	8.2	-	-	-	0.29	0.0018	-	-	<0.004
	Annual Median	-	5.8	-	-	8.2	-	-	-	0.29	0.0018	-	-	<0.004
	% < LRL	-	0%	-	-	0%	-	-	-	0%	0%	-	-	100%
	% > BCWQG[a]	-	-	-	-	0%	-	-	-	0%	0%	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	0%	0%	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	n	-	7	-	-	7	-	-	-	7	7	-	-	7
	Annual Minimum	-	3.6	-	-	7.8	-	-	-	0.21	0.001	-	-	<0.004
	Annual Maximum	-	12	-	-	8.2	-	-	-	0.31	0.002	-	-	<0.004
	Annual Mean	-	8.5	-	-	8.1	-	-	-	0.26	0.0016	-	-	<0.004
	Annual Median	-	7.6	-	-	8.1	-	-	-	0.26	0.0015	-	-	<0.004
	% < LRL	-	0%	-	-	0%	-	-	-	0%	0%	-	-	100%
	% > BCWQG[a]	-	-	-	-	0%	-	-	-	0%	0%	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	0%	0%	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.1: **Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022**

Station	Summary Statistic	Total Phosphorus (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (µg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)
RG_WARDB	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0051	11	1.1	0.04	<0.0001	<0.0001	<0.0001	<0.00002	<0.01	<0.0001	<0.0001	<0.0005	<0.01	<0.00005	<0.001
	Annual Maximum	0.16	48	7.4	0.1	0.0001	0.0015	0.05	0.00011	0.024	0.0025	0.0019	0.0039	3.4	0.0039	0.0042
	Annual Mean	0.027	35	5.2	0.077	0.0001	0.00061	0.04	0.00003	0.015	0.00049	0.00033	0.00092	0.53	0.00062	0.0023
	Annual Median	0.013	41	6.1	0.08	0.0001	0.00056	0.046	0.00002	0.015	0.00021	0.00012	0.0005	0.15	0.00022	0.0023
	% < LRL	0%	0%	0%	0%	92%	8%	8%	75%	33%	8%	50%	58%	8%	8%	8%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	8%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	17%	0%	-
	EPA River Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_KERRRD	n	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	Annual Minimum	0.0035	12	1.2	0.051	<0.0001	0.00038	0.027	<0.00002	<0.01	0.00011	<0.0001	<0.0005	0.017	0.000053	0.001
	Annual Maximum	0.037	42	5.2	0.089	0.00013	0.00095	0.053	0.000062	0.015	0.0018	0.001	0.0021	2	0.0016	0.0037
	Annual Mean	0.013	27	3.2	0.077	0.0001	0.00057	0.042	0.000027	0.011	0.00049	0.0003	0.00082	0.49	0.0005	0.0023
	Annual Median	0.005	28	2.9	0.084	0.0001	0.00043	0.041	0.00002	0.01	0.00017	0.0001	0.00056	0.1	0.00014	0.0022
	% < LRL	0%	0%	0%	0%	67%	0%	0%	67%	67%	0%	44%	33%	0%	0%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	22%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	22%	0%	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_ELKMOUTH	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	<0.002	20	0.69	0.092	<0.0001	0.00018	0.071	<0.00002	<0.01	0.00024	<0.0001	<0.0005	0.016	<0.00005	0.0056
	Annual Maximum	0.23	71	7.1	0.18	0.00016	0.0017	0.12	0.00017	<0.01	0.0031	0.0015	0.0037	3	0.0025	0.0087
	Annual Mean	0.03	53	2.8	0.14	0.00011	0.00044	0.094	0.000036	<0.01	0.00066	0.00026	0.00087	0.42	0.00036	0.0072
	Annual Median	0.0069	56	2.9	0.15	0.0001	0.0003	0.095	0.00002	<0.01	0.00032	0.0001	0.0005	0.085	0.000081	0.007
	% < LRL	8%	0%	0%	0%	67%	0%	0%	67%	100%	0%	67%	67%	0%	42%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	8%	0%	17%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	8%	0%	-
	EPA River Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 1 Benchmark/UEC	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark/UEC	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark/UEC	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_DSELK	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0026	13	0.95	0.058	<0.0001	0.00037	0.032	<0.00002	<0.01	0.00011	<0.0001	<0.0005	0.016	<0.00005	0.0015
	Annual Maximum	0.12	48	5.6	0.11	0.00012	0.0013	0.088	0.00011	0.015	0.0022	0.0013	0.0031	2.4	0.0031	0.0053
	Annual Mean	0.031	31	3.1	0.08	0.0001	0.00067	0.056	0.000037	0.011	0.00072	0.00042	0.0011	0.72	0.00091	0.0033
	Annual Median	0.01	30	3	0.078	0.0001	0.00048	0.055	0.00002	0.01	0.00022	0.00015	0.00055	0.19	0.00026	0.003
	% < LRL	0%	0%	0%	0%	75%	0%	0%	58%	58%	0%	42%	42%	0%	8%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	33%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	33%	0%	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_GRASMERE	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0022	13	0.89	0.056	<0.0001	0.00034	0.035	<0.00002	<0.01	0.00011	<0.0001	<0.0005	0.011	0.000052	0.0016
	Annual Maximum	0.11	49	5.5	0.11	0.00013	0.0015	0.081	0.00013	0.015	0.0024	0.0017	0.0037	2.9	0.0042	0.005
	Annual Mean	0.021	31	3	0.082	0.0001	0.00061	0.055	0.000034	0.011	0.0006	0.00036	0.00096	0.58	0.00089	0.0031
	Annual Median	0.0091	29	2.8	0.081	0.0001	0.00046	0.053	0.00002	0.01	0.00025	0.00016	0.00053	0.19	0.00026	0.0026
	% < LRL	0%	0%	0%	0%	67%	0%	0%	50%	67%	0%	42%	50%	0%	0%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	17%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	17%	0%	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.
> 50% of samples exceed the guideline or benchmark.
> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.1: Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Station	Summary Statistic	Total Phosphorus (mg/L)	Sulphate (mg/L)	Total Chloride (mg/L)	Total Fluoride (mg/L)	Total Antimony (mg/L)	Total Arsenic (mg/L)	Total Barium (mg/L)	Total Beryllium (mg/L)	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (µg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)
RG_USGOLD	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0025	13	0.9	0.055	<0.0001	0.00034	0.035	<0.00002	<0.01	0.00011	<0.0001	<0.0005	0.012	0.000051	0.0016
	Annual Maximum	0.075	47	4.8	0.12	0.00011	0.0011	0.081	0.000075	0.016	0.01	0.00095	0.0023	1.7	0.0021	0.0054
	Annual Mean	0.018	30	2.9	0.085	0.0001	0.00058	0.054	0.000028	0.011	0.0014	0.00029	0.00086	0.46	0.00059	0.0031
	Annual Median	0.01	28	2.6	0.085	0.0001	0.00045	0.052	0.00002	0.01	0.00035	0.00016	0.00056	0.17	0.00027	0.0028
	% < LRL	0%	0%	0%	0%	83%	0%	0%	50%	67%	0%	33%	25%	0%	0%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	25%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	25%	0%	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_BORDER	n	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Annual Minimum	0.0026	14	1	0.055	<0.0001	0.00035	0.036	<0.00002	<0.01	0.00012	<0.0001	<0.0005	0.013	0.00005	0.0015
	Annual Maximum	0.038	43	4.9	0.098	0.00011	0.00082	0.082	0.000048	0.013	0.00096	0.00052	0.0014	1	0.0011	0.0041
	Annual Mean	0.011	27	2.6	0.08	0.0001	0.00053	0.053	0.000023	0.011	0.00039	0.00019	0.00065	0.24	0.00038	0.0026
	Annual Median	0.0046	25	2.4	0.08	0.0001	0.0004	0.046	0.00002	0.01	0.00024	0.00013	0.00052	0.17	0.00025	0.0024
	% < LRL	0%	0%	0%	0%	73%	0%	0%	64%	73%	0%	45%	36%	0%	0%	0%
	% > BCWQG[a]	-	0%	0%	-	0%	-	0%	0%	0%	0%	0%	-	-	0%	-
	% > BCWQG[b]	-	-	0%	0%	-	0%	-	-	-	-	0%	-	9%	0%	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INTERNATIONAL_BOUNDARY	n	7	5	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	<0.003	14	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	0.061	43	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Mean	0.017	25	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Median	0.012	21	-	-	-	-	-	-	-	-	-	-	-	-	-
	% < LRL	14%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TENMILE_CREEK	n	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	0.0045	27	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	0.008	30	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Mean	0.0062	29	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Median	0.0062	29	-	-	-	-	-	-	-	-	-	-	-	-	-
	% < LRL	0%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREBAY	n	7	5	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	<0.003	24	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	0.005	30	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Mean	0.0038	27	-	-	-	-	-	-	-	-	-	-	-	-	-
	Annual Median	0.0035	27	-	-	-	-	-	-	-	-	-	-	-	-	-
	% < LRL	29%	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.1: Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Station	Summary Statistic	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Cobalt (µg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)	Dissolved Nickel (µg/L)
RG_WARDB	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	<0.0001	<0.0000005	<0.00005	<0.5	<0.05	<0.00001	<0.00001	<0.00001	<0.003	0.0024	<0.005	<0.1	<0.0002	0.01	<0.5
	Annual Maximum	0.14	0.0000054	0.00083	3.3	0.15	0.000012	0.000022	0.0011	0.013	0.018	0.0051	<0.1	0.00035	0.024	<0.5
	Annual Mean	0.026	0.00000094	0.00065	0.83	0.11	0.00001	0.000011	0.00082	0.0041	0.0073	0.005	<0.1	0.00023	0.014	<0.5
	Annual Median	0.014	0.00000051	0.00073	0.5	0.12	0.00001	0.00001	0.00087	0.003	0.0048	0.005	<0.1	0.0002	0.011	<0.5
	% < LRL	8%	75%	8%	75%	8%	92%	75%	8%	67%	0%	92%	100%	58%	33%	100%
	% > BCWQG[a]	0%	67%	0%	-	0%	0%	0%	0%	8%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA River Guideline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_KERRRD	n	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	Annual Minimum	0.0021	<0.0000005	0.00049	<0.5	0.1	<0.00001	<0.00001	0.00058	<0.003	0.002	<0.005	<0.1	<0.0002	<0.01	<0.5
	Annual Maximum	0.054	0.00000091	0.00079	2.2	0.92	<0.00001	0.000018	0.001	0.011	0.014	<0.005	0.15	0.00033	0.024	<0.5
	Annual Mean	0.02	0.0000007	0.00065	0.81	0.47	<0.00001	0.000012	0.00073	0.0044	0.0059	<0.005	0.11	0.00025	0.012	<0.5
	Annual Median	0.0049	0.0000007	0.00067	0.5	0.48	<0.00001	0.00001	0.00068	0.003	0.004	<0.005	0.1	0.00024	0.01	<0.5
	% < LRL	0%	89%	0%	56%	0%	100%	67%	0%	67%	0%	100%	89%	22%	78%	100%
	% > BCWQG[a]	0%	78%	0%	-	0%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA Lake Guideline	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
RG_ELKMOUTH	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0015	<0.0000005	0.0008	<0.5	3.4	<0.00001	<0.00001	0.00073	<0.003	<0.001	0.0065	<0.1	<0.0002	<0.01	<0.5
	Annual Maximum	0.16	0.0000095	0.0012	4.8	8.5	0.000037	0.000069	0.0012	0.02	0.0088	0.016	<0.1	0.0003	0.01	<0.5
	Annual Mean	0.021	0.0000014	0.001	1.1	6.5	0.000013	0.000017	0.00094	0.0048	0.0038	0.01	<0.1	0.00023	0.01	<0.5
	Annual Median	0.0051	0.00000074	0.001	0.55	6.9	0.00001	0.00001	0.00094	0.003	0.0034	0.01	<0.1	0.0002	0.01	<0.5
	% < LRL	0%	75%	0%	33%	0%	67%	67%	0%	58%	8%	0%	100%	58%	92%	100%
	% > BCWQG[a]	0%	67%	0%	-	100%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA River Guideline	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	-
	% > Level 1 Benchmark/UEC	-	-	-	-	-	-	-	-	-	-	0%	-	-	-	0%
	% > Level 2 Benchmark/UEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%
	% > Level 3 Benchmark/UEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0%
RG_DSELK	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0016	0.00000052	0.00052	<0.5	0.76	<0.00001	<0.00001	0.00056	<0.003	0.0022	<0.005	<0.1	0.0002	<0.01	<0.5
	Annual Maximum	0.11	0.0000062	0.00081	2.8	3.1	0.000021	0.000033	0.001	0.012	0.012	0.0057	0.12	0.00038	0.02	0.51
	Annual Mean	0.035	0.0000028	0.00069	1.1	1.5	0.000012	0.000014	0.00078	0.0052	0.0056	0.0051	0.1	0.00027	0.012	0.5
	Annual Median	0.021	0.0000025	0.00071	0.52	1.3	0.00001	0.00001	0.00076	0.0032	0.0044	0.005	0.1	0.00025	0.01	0.5
	% < LRL	0%	58%	0%	42%	0%	75%	50%	0%	42%	0%	50%	83%	8%	58%	92%
	% > BCWQG[a]	0%	92%	0%	-	17%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA Lake Guideline	-	-	-	-	42%	-	-	-	-	-	-	-	-	-	-
RG_GRASMERE	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0017	0.00000051	0.00053	<0.5	0.91	<0.00001	<0.00001	0.00061	<0.003	0.0018	<0.005	<0.1	0.0002	<0.01	<0.5
	Annual Maximum	0.13	0.0000063	0.00087	3.2	3.1	0.000015	0.000031	0.001	0.014	0.014	0.0051	0.14	0.00034	0.023	<0.5
	Annual Mean	0.031	0.0000012	0.00071	0.91	1.6	0.000011	0.000012	0.0008	0.0044	0.0056	0.005	0.11	0.00026	0.012	<0.5
	Annual Median	0.017	0.0000007	0.00071	0.5	1.4	0.00001	0.00001	0.00079	0.0031	0.0046	0.005	0.1	0.00025	0.01	<0.5
	% < LRL	0%	58%	0%	50%	0%	83%	75%	0%	50%	0%	92%	83%	0%	58%	100%
	% > BCWQG[a]	0%	75%	0%	-	17%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA Lake Guideline	-	-	-	-	50%	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.1: Summary of Water Chemistry Data for Key Parameters at Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Station	Summary Statistic	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (µg/L)	Total Selenium (µg/L)	Total Silver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Cobalt (µg/L)	Dissolved Copper (mg/L)	Dissolved Iron (mg/L)	Dissolved Nickel (µg/L)
RG_USGOLD	n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Annual Minimum	0.0018	<0.0000005	0.00051	<0.5	0.94	<0.00001	<0.00001	0.00057	<0.003	0.002	<0.005	<0.1	<0.0002	<0.01	<0.5
	Annual Maximum	0.073	0.0000051	0.00089	2	3.1	0.000018	0.000021	0.001	0.0086	0.012	0.0079	0.14	0.0004	0.016	<0.5
	Annual Mean	0.026	0.0000012	0.0007	0.84	1.6	0.000011	0.000012	0.00076	0.0039	0.0057	0.0052	0.1	0.00027	0.011	<0.5
	Annual Median	0.016	0.00000097	0.00069	0.55	1.5	0.00001	0.00001	0.00075	0.003	0.0052	0.005	0.1	0.00026	0.01	<0.5
	% < LRL	0%	75%	0%	33%	0%	75%	58%	0%	58%	0%	83%	83%	8%	67%	100%
	% > BCWQG[a]	0%	75%	0%	-	25%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA Lake Guideline	-	-	-	-	42%	-	-	-	-	-	-	-	-	-	-
RG_BORDER	n	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Annual Minimum	0.00062	0.00000061	0.00055	<0.5	0.95	<0.00001	<0.00001	0.00057	<0.003	0.0022	<0.005	<0.1	0.00022	<0.01	<0.5
	Annual Maximum	0.061	0.0000051	0.00089	1.3	2.6	0.000011	0.000016	0.001	0.0053	0.011	0.0054	0.13	0.00046	0.012	0.58
	Annual Mean	0.018	0.0000011	0.00067	0.63	1.5	0.00001	0.000011	0.00074	0.0035	0.0057	0.0051	0.1	0.00031	0.01	0.51
	Annual Median	0.0079	0.00000063	0.00066	0.52	1.3	0.00001	0.00001	0.00068	0.003	0.0034	0.005	0.1	0.0003	0.01	0.5
	% < LRL	0%	64%	0%	36%	0%	73%	55%	0%	36%	0%	73%	91%	0%	64%	91%
	% > BCWQG[a]	0%	73%	0%	-	9%	0%	0%	0%	0%	0%	0%	-	0%	-	-
	% > BCWQG[b]	0%	-	0%	-	-	0%	-	-	0%	0%	0%	-	0%	0%	-
	EPA Lake Guideline	-	-	-	-	36%	-	-	-	-	-	-	-	-	-	-
INTERNATIONAL_BOUNDARY	n	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	-	-	-	-	0.94	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	-	-	-	-	2.4	-	-	-	-	-	-	-	-	-	-
	Annual Mean	-	-	-	-	1.3	-	-	-	-	-	-	-	-	-	-
	Annual Median	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-	-
	% < LRL	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	-	-	-	12%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	25%	-	-	-	-	-	-	-	-	-	-
TENMILE_CREEK	n	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-
	Annual Mean	-	-	-	-	1.3	-	-	-	-	-	-	-	-	-	-
	Annual Median	-	-	-	-	1.3	-	-	-	-	-	-	-	-	-	-
	% < LRL	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
FOREBAY	n	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
	Annual Minimum	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-
	Annual Maximum	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-
	Annual Mean	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-
	Annual Median	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-
	% < LRL	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[a]	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-
	% > BCWQG[b]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	EPA Lake Guideline	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-

> 5% of samples approached or exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "UEC" = Updated Effects Concentration. "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline. UEC's are shown for Nitrate, Sulphate, and Dissolved Nickel; and EVWQP benchmarks are shown for all other relevant parameters. For guidelines dependent on other analytes (e.g., hardness or chloride), guidelines were screened using concurrent concentrations. When concurrent hardness or chloride concentrations were not measured, the most conservative concentration observed for that station was used to estimate the guidelines or benchmark. All summary statistics are reported to 3 significant figures. The rounding factor applied to constituents with site performance objective (i.e., dissolved cadmium, nitrate, selenium, and sulphate) is not applied for comparison to BC WQGs. Water quality data for RG_TN and RG_T4 are collected from Teck permitted water quality stations RG_KERRRD and RG_GRASMERE, respectively.

[a] Long-term average BCQWG for the Protection of Aquatic Life.

[b] Short-term maximum BCQWG for the Protection of Aquatic Life.

Table B.2: Summary of Water Chemistry Data for Key Parameters at Non-Permitted Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

	Analyte	Units	Long-term BC Guideline	Short-term BC Guideline	RG_GC_U1 24-May-22	RG_GC_U1 20-Jun-22	RG_GC_U2 20-Jun-22	RG_GC_U3 20-Jun-22	RG_GC_U1 22-Aug-22	RG_GC_U2 22-Aug-22	RG_GC_U3 22-Aug-22	RG_SC_U1 25-May-22	RG_SC_U1 21-Jun-22	RG_SC_U1 22-Aug-22
Physical Characteristics	Hardness (as CaCO3)	mg/L	-	-	104	99	99	101	107	116	103	123	91	114
	pH, Field	pH	6.5 - 9.0	-	8.1	7.9	8.0	8.0	8.0	7.7	7.5	8.0	8.0	7.9
	pH, Lab	pH	6.5 - 9.0	-	8.1	8.1	8.1	8.1	8.4	8.1	8.0	8.3	8.2	8.2
	Total Suspended Solids, Lab	mg/L	-	-	12	63	94	100	<1	<1	<1	38	214	1.3
	Total Dissolved Solids	mg/L	-	-	120	138	137	127	154	158	136	159	129	160
	Dissolved Oxygen-Field	mg/L	>8	>5	11	11	11	11	8.4	8.5	8.8	11	11	8.3
	Dissolved Oxygen-Field	%	-	-	11	11	11	11	8.4	8.5	8.8	11	11	8.3
	Temperature-Field	C	-	-	9.1	10	10	10	23	18	11	9.8	9.5	22
Anions and Nutrients	Ammonia as N	mg/L	0.61 to 1.8	4.5 to 11	<0.005	<0.005	<0.005	0.046	<0.005	<0.005	<0.005	0.0052	0.087	<0.005
	Bromide (Br)	mg/L	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Chloride (Cl)	mg/L	150	600	1.4	0.78	0.79	0.80	1.4	2.4	1.1	3.0	1.1	2.7
	Fluoride (F)	mg/L	-	1.3 to 1.4	0.055	0.049	0.051	0.051	0.071	0.081	0.073	0.062	0.044	0.077
	Nitrate (as N)	mg/L	3.0	33	0.21	0.21	0.20	0.21	0.10	0.16	0.29	0.17	0.10	0.049
	Nitrite (as N)	mg/L	0.020 to 0.040	0.060 to 0.12	0.0014	<0.001	<0.001	<0.001	0.0018	0.0023	0.0012	<0.001	<0.001	<0.001
	Phosphorus (P)-Total	mg/L	-	-	0.010	0.043	0.045	0.047	0.0022	0.0036	0.0029	0.021	0.056	0.0025
	Sulphate (SO_4)	mg/L	309	-	15	12	12	12	18	24	16	22	10	22
Total Metals	Aluminum (Al)	mg/L	-	-	0.13	1.1	1.4	1.5	0.015	0.017	0.028	0.25	2.2	0.014
	Antimony (Sb)	mg/L	0.0090	-	<0.0001	<0.0001	<0.0001	0.00010	0.00010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Arsenic (As)	mg/L	-	0.0050	0.00032	0.00094	0.0011	0.0011	0.00036	0.00037	0.00030	0.00050	0.0013	0.00038
	Barium (Ba)	mg/L	1.0	-	0.046	0.043	0.046	0.047	0.039	0.036	0.033	0.040	0.043	0.033
	Beryllium (Be)	mg/L	0.00013	-	<0.00002	0.000062	0.000078	0.000082	<0.00002	<0.00002	<0.00002	<0.00002	0.00011	<0.00002
	Bismuth (Bi)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	1.2	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Cadmium (Cd)	mg/L	-	-	0.0000071	0.000048	0.000059	0.000061	<0.000005	<0.000005	<0.000005	0.0000093	0.000040	<0.000005
	Calcium (Ca)	mg/L	-	-	30	36	38	40	32	33	31	39	51	32
	Chromium (Cr)	mg/L	0.0010	-	0.00021	0.0015	0.0018	0.0020	<0.0001	0.00026	0.00016	0.00043	0.0030	<0.0001
	Cobalt (Co)	mg/L	0.0040	0.11	0.00013	0.00072	0.00089	0.00097	<0.0001	<0.0001	<0.0001	0.00022	0.0017	<0.0001
	Copper (Cu)	mg/L	-	-	0.00055	0.0018	0.0021	0.0023	<0.0005	<0.0005	<0.0005	0.00068	0.0032	<0.0005
	Iron (Fe)	mg/L	-	1.0	0.18	1.5	2.0	2.2	<0.01	0.016	0.023	0.39	3.6	0.012
	Lead (Pb)	mg/L	0.0062 to 0.0075	0.073 to 0.11	0.00034	0.0012	0.0015	0.0017	<0.00005	<0.00005	0.000058	0.00054	0.0025	0.000069
	Lithium (Li)	mg/L	-	-	0.0016	0.0029	0.0034	0.0036	0.0017	0.0016	0.0017	0.0018	0.0049	0.0014
	Magnesium (Mg)	mg/L	-	-	8.6	8.4	8.9	8.9	9.0	9.8	8.2	11	10	9.4
	Manganese (Mn)	mg/L	1.0 to 1.1	1.5 to 1.9	0.015	0.045	0.054	0.058	0.0013	0.0015	0.0023	0.016	0.086	0.0013
	Mercury (Hg)	mg/L	0.0000013	-	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
	Molybdenum (Mo)	mg/L	7.6	46	0.00031	0.00052	0.00055	0.00058	0.00058	0.00070	0.00058	0.00052	0.00058	0.00061
	Nickel (Ni)	mg/L	-	-	<0.0005	0.0019	0.0023	0.0025	<0.0005	<0.0005	<0.0005	<0.0005	0.0038	<0.0005
	Potassium (K)	mg/L	-	-	0.55	0.75	0.83	0.85	0.47	0.47	0.41	0.57	0.82	0.49
	Selenium (Se)	mg/L	0.0020	-	0.00085	0.00063	0.00072	0.00073	0.0010	0.00071	0.0010	0.00029	0.00013	0.00030
	Silicon (Si)-Total	mg/L	-	-	3.9	3.9	4.2	4.4	1.4	2.2	2.2	3.1	5.0	1.9
	Silver (Ag)	mg/L	0.000050 to 0.0015	0.00010 to 0.0030	<0.00001	<0.00001	0.000011	0.000012	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Sodium (Na)	mg/L	-	-	2.3	1.4	1.4	1.4	2.0	2.9	1.5	3.6	1.5	3.3
	Strontium (Sr)	mg/L	-	-	0.083	0.11	0.12	0.12	0.10	0.13	0.10	0.14	0.16	0.13
	Thallium (Tl)	mg/L	0.00080	-	<0.00001	0.000023	0.000025	0.000029	<0.00001	<0.00001	<0.00001	<0.00001	0.000022	<0.00001
	Tin (Sn)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Titanium (Ti)	mg/L	-	-	0.0020	0.0085	0.0099	0.011	<0.0003	<0.0003	<0.0003	0.0064	0.015	<0.0003
	Uranium (U)	mg/L	0.0085	-	0.00050	0.00059	0.00060	0.00063	0.00061	0.00065	0.00060	0.00067	0.00067	0.00063
	Vanadium (V)	mg/L	-	-	<0.0005	0.0019	0.0024	0.0026	<0.0005	<0.0005	<0.0005	0.00051	0.0026	<0.0005
	Zinc (Zn)	mg/L	0.0086 to 0.032	0.034 to 0.058	<0.003	0.0067	0.0085	0.0091	<0.003	<0.003	<0.003	<0.003	0.011	<0.003

Exceeds BC Long Term Guideline.

Exceeds BC Short Term Guideline.

Notes: "-" indicates no data.

Table B.2: Summary of Water Chemistry Data for Key Parameters at Non-Permitted Water Quality Stations Located Downstream and Upstream of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

	Analyte	Units	Long-term BC Guideline	Short-term BC Guideline	RG_GC_U1 24-May-22	RG_GC_U1 20-Jun-22	RG_GC_U2 20-Jun-22	RG_GC_U3 20-Jun-22	RG_GC_U1 22-Aug-22	RG_GC_U2 22-Aug-22	RG_GC_U3 22-Aug-22	RG_SC_U1 25-May-22	RG_SC_U1 21-Jun-22	RG_SC_U1 22-Aug-22
Dissolved Metals	Aluminum (Al)	mg/L	0.050	0.10	0.0091	0.015	0.016	0.015	0.0052	0.0048	0.0087	0.0056	0.012	0.0050
	Antimony (Sb)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Arsenic (As)	mg/L	-	-	0.00028	0.00029	0.00032	0.00032	0.00036	0.00035	0.00028	0.00034	0.00032	0.00038
	Barium (Ba)	mg/L	-	-	0.047	0.029	0.029	0.029	0.042	0.038	0.034	0.032	0.021	0.035
	Beryllium (Be)	mg/L	-	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
	Bismuth (Bi)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Cadmium (Cd)	mg/L	0.00020 to 0.00025	0.00054 to 0.00073	<0.000005	0.0000053	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
	Calcium (Ca)	mg/L	-	-	28	28	28	30	29	30	28	33	26	30
	Chromium (Cr)	mg/L	-	-	0.00060	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00016	<0.0001	<0.0001	<0.0001
	Cobalt (Co)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Copper (Cu)	mg/L	0.00020 to 0.0017	0.0011 to 0.010	0.00033	0.00039	0.00038	0.00037	0.00034	0.00025	0.00038	0.00025	0.00033	0.00024
	Iron (Fe)	mg/L	-	0.35	0.012	0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Lead (Pb)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Lithium (Li)	mg/L	-	-	0.0015	0.0012	0.0012	0.0011	0.0016	0.0017	0.0017	0.0012	<0.001	0.0013
	Magnesium (Mg)	mg/L	-	-	8.3	6.9	6.8	6.5	8.6	9.9	8.0	9.8	6.2	9.6
	Manganese (Mn)	mg/L	-	-	0.0090	0.0027	0.0025	0.0025	0.00016	<0.0001	0.00044	0.0028	0.0019	0.00022
	Mercury (Hg)	mg/L	-	-	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
	Molybdenum (Mo)	mg/L	-	-	0.00031	0.00050	0.00054	0.00054	0.00059	0.00067	0.00058	0.00053	0.00051	0.00063
	Nickel (Ni)	mg/L	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Potassium (K)	mg/L	-	-	0.47	0.45	0.44	0.44	0.46	0.48	0.40	0.47	0.42	0.50
	Selenium (Se)	mg/L	-	-	0.00092	0.00067	0.00066	0.00066	0.0013	0.00091	0.0014	0.00020	0.000095	0.00038
	Silicon (Si)	mg/L	-	-	3.5	2.2	2.1	2.1	1.4	2.1	2.1	2.4	2.0	1.9
	Silver (Ag)	mg/L	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Sodium (Na)	mg/L	-	-	2.5	1.3	1.3	1.3	1.9	2.9	1.5	3.2	1.4	3.3
	Strontium (Sr)	mg/L	-	-	0.077	0.099	0.10	0.10	0.11	0.13	0.11	0.14	0.11	0.13
	Thallium (Tl)	mg/L	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Tin (Sn)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Titanium (Ti)	mg/L	-	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
	Uranium (U)	mg/L	-	-	0.00049	0.00054	0.00057	0.00055	0.00061	0.00064	0.00058	0.00064	0.00057	0.00062
	Vanadium (V)	mg/L	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Zinc (Zn)	mg/L	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001	<0.001	<0.001	<0.001

Exceeds BC Long Term Guideline.

Exceeds BC Short Term Guideline.

Notes: "-" indicates no data.

Table B.3: Comparison of Trophic Status Index Parameters between Water Quality Stations Downstream and Upstream (RG_KERRRD) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Station	ANOVA[a]	Q1. Is there a difference in concentrations downstream compared to RG_KERRRD?[b] Magnitude of Difference (%)
Total Phosphorus (mg/L)	RG_DSELK	0.047	ns
	RG_GRASMERE		ns
	RG_USGOLD		ns
	RG_GRASMERE		ns
	FOREBAY		-61
	INTERNATIONAL_BOUNDARY		ns
Total Nitrogen (mg/L)	RG_DSELK	0.994	96
	RG_GRASMERE		
	RG_USGOLD		
	RG_GRASMERE		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		
Secchi Depth (m)	RG_DSELK	0.951	52
	RG_GRASMERE		
	RG_USGOLD		
	RG_GRASMERE		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		
Chlorophyll a (mg/L)	RG_DSELK	0.632	73
	RG_GRASMERE		
	RG_USGOLD		
	RG_GRASMERE		
	FOREBAY		
	INTERNATIONAL_BOUNDARY		

Station difference P-value < 0.05.

Downstream value higher than upstream.

Downstream value lower than upstream.

Notes: "ns" indicates non-significant difference (p-value > 0.05) between upstream and downstream. Insufficient sample size (<3) for values above detection limits to complete analyses for total antimony and dissolved cobalt.

[a] ANOVA Conducted on the difference in $\log_{10}$ concentrations Upstream (RG_KERRRD) and Downstream to test for differences among stations (RG_DSELK, RG_GRASMERE, RG_USGOLD, RG_BORDER) of the Elk River ($\log_{10}$[DS]-$\log_{10}$[US]. If significant, each station was compared to Upstream separately.

[b] Post-hoc contrasts testing the difference in $\log_{10}$(DS)-$\log_{10}$(US) against zero with the magnitude of difference (MOD) calculated as (DS-US)/US*100% and application of geometric means for concentrations. Post-hoc tests were adjusted from the number of comparisons using Tukey's Honestly Significant Difference (HSD) tests.

APPENDIX C

SEDIMENT

Table C.1: Profundal Sediment Quality at Downstream (RG_T4) and Upstream (RG_TN) Study Areas, Koocanusa Reservoir Monitoring Program, August 2022

Analyte		Units	BC Sediment Quality Guidelines		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
			Lower SQG	Upper SQG	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
					25-Aug-22	25-Aug-22	25-Aug-22	24-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22
Physical Tests	Moisture	%	-	-	44.6	43.4	44.7	43.2	39.9	49.4	43.0	46.7	46.7	45.6
	pH(1:2 Soil:Water)	pH	-	-	8.29	8.37	8.27	8.41	8.50	8.38	8.32	8.30	8.49	8.50
Particle Size	% Gravel (>2 mm)	%	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	6.40	<1.00	<1.00	<1.00	<1.00
	% Sand (2.00 mm - 1.00 mm)	%	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	% Sand (1.00 mm - 0.50 mm)	%	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	% Sand (0.50 mm - 0.25 mm)	%	-	-	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	% Sand (0.25 mm - 0.125 mm)	%	-	-	<1.00	<1.00	<1.00	1.30	1.10	<1.00	<1.00	<1.00	<1.00	<1.00
	% Sand (0.125 mm - 0.063 mm)	%	-	-	1.50	3.10	<1.00	8.20	8.90	1.20	2.90	<1.00	2.80	1.10
	% Silt (0.063 mm - 0.0312 mm)	%	-	-	20.0	19.7	15.2	21.1	19.0	20.7	25.1	22.0	25.6	23.6
	% Silt (0.0312 mm - 0.004 mm)	%	-	-	58.8	57.1	62.0	52.2	52.2	54.7	55.4	58.4	55.9	58.9
	% Clay (<4 µm)	%	-	-	19.3	19.5	22.2	17.1	18.4	16.8	16.3	18.2	15.1	16.3
	Texture	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Organic Carbon	Total Organic Carbon	%	-	-	1.91	2.23	1.87	1.83	2.13	2.29	2.38	2.82	2.86	1.94
Metals	Aluminum (Al)	mg/kg	-	-	14500	11700	11700	10600	10700	9200	10400	10300	11000	22000
	Antimony (Sb)	mg/kg	-	-	0.340	0.280	0.230	0.250	0.280	0.300	0.380	0.360	0.380	0.690
	Arsenic (As)	mg/kg	5.9	17	6.32	5.27	4.76	4.22	4.45	4.14	5.12	5.04	5.33	9.87
	Barium (Ba)	mg/kg	-	-	102	74.7	72.8	67.6	67.8	106	128	118	121	197
	Beryllium (Be)	mg/kg	-	-	0.460	0.390	0.330	0.340	0.360	0.380	0.470	0.460	0.480	0.830
	Bismuth (Bi)	mg/kg	-	-	0.220	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	0.360
	Boron (B)	mg/kg	-	-	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	5.40
	Cadmium (Cd)	mg/kg	0.60	3.5	0.238	0.180	0.163	0.171	0.166	0.360	0.431	0.410	0.395	0.522
	Calcium (Ca)	mg/kg	-	-	134000	106000	100000	106000	105000	81300	92000	95400	98300	201000
	Chromium (Cr)	mg/kg	37	90	21.6	17.3	17.4	15.6	15.9	15.2	16.1	16.0	17.4	32.1
	Cobalt (Co)	mg/kg	-	-	10.5	8.55	8.37	7.71	7.79	6.75	7.86	7.89	8.21	15.6
	Copper (Cu)	mg/kg	36	197	17.7	14.8	13.9	12.6	12.9	12.7	15.2	15.4	16.0	27.6
	Iron (Fe)	mg/kg	21,200	43,766	26000	21400	20900	19400	19600	17200	19200	19400	20500	39800
	Lead (Pb)	mg/kg	35	91	16.3	13.4	11.4	11.5	12.3	10.7	12.9	12.9	14.0	26.5
	Lithium (Li)	mg/kg	-	-	32.4	24.6	23.1	23.3	23.7	19.2	22.2	22.1	24.0	47.3
	Magnesium (Mg)	mg/kg	-	-	29300	23100	22800	22900	23200	18800	21300	21600	22900	43300
	Manganese (Mn)	mg/kg	460	1,100	593	448	451	412	404	413	472	469	476	996
	Mercury (Hg)	mg/kg	0.17	0.49	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
	Molybdenum (Mo)	mg/kg	25	23,000	0.740	0.600	0.510	0.520	0.540	0.640	0.750	0.740	0.740	1.24
	Nickel (Ni)	mg/kg	16	75	24.8	20.1	19.7	17.8	18.2	17.5	19.6	19.8	20.7	37.3
	Phosphorus (P)	mg/kg	-	-	619	489	451	477	465	547	676	687	698	1120
	Potassium (K)	mg/kg	-	-	880	740	760	660	670	800	940	860	960	1680
	Selenium (Se)	mg/kg	2.0	-	0.240	<0.200	<0.200	<0.200	<0.200	0.370	0.470	0.420	0.460	0.530
	Silver (Ag)	mg/kg	0.50	-	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0.130
	Sodium (Na)	mg/kg	-	-	87.0	72.0	73.0	65.0	68.0	62.0	72.0	70.0	76.0	145
	Strontium (Sr)	mg/kg	-	-	343	270	256	262	261	186	206	217	225	449
	Sulfur (S)	mg/kg	-	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl)	mg/kg	-	-	0.0830	0.0620	0.0560	0.0570	0.0580	0.0850	0.106	0.0980	0.0960	0.152
	Tin (Sn)	mg/kg	-	-	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
	Titanium (Ti)	mg/kg	-	-	71.4	69.4	67.3	63.0	70.9	42.4	48.4	54.3	71.9	114
	Tungsten (W)	mg/kg	-	-	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
	Uranium (U)	mg/kg	-	-	0.757	0.610	0.530	0.537	0.562	0.572	0.685	0.700	0.721	1.27
	Vanadium (V)	mg/kg	-	-	16.2	12.9	12.8	12.1	12.2	14.1	16.6	15.6	17.0	28.4
	Zinc (Zn)	mg/kg	123	315	82.2	66.5	65.4	59.7	60.6	63.9	75.8	72.4	78.3	131
	Zirconium (Zr)	mg/kg	-	-	1.50	1.30	1.10	1.10	1.30	<1.00	1.20	1.20	1.30	2.30

Value > Lower BCMOECCS Working Sediment Quality Guideline (WSQG; BCMOECCS 2021).

Value > Upper BCMOECCS WSQ guidelines (BCMOECCS 2021).

Notes: "-" = no data. All WSQG and CCME Guidelines are the same except for the Iron there is no CCME guideline for Iron.

Table C.1: Profundal Sediment Quality at Downstream (RG_T4) and Upstream (RG_TN) Study Areas, Koocanusa Reservoir Monitoring Program, August 2022

	Analyte	Units	BC Sediment Quality Guidelines		Upstream of Elk River (RG_TN)					Downstream of Elk River (RG_T4)				
			Lower SQG	Upper SQG	TN-1	TN-2	TN-3	TN-4	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
					25-Aug-22	25-Aug-22	25-Aug-22	24-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22	25-Aug-22
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0067	0.089	0.00700	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
	Acenaphthylene	mg/kg	0.0059	0.13	0.00720	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
	Acridine	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.047	0.25	0.00820	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400	<0.00400
	Benz(a)anthracene	mg/kg	0.032	0.39	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Benzo(a)pyrene	mg/kg	0.032	0.78	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Benzo(b,j)fluoranthene	mg/kg	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0120	0.0160	0.0100	0.0150	<0.0100
	Benzo(b,j,k)fluoranthene	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(e)pyrene	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(g,h,i)perylene	mg/kg	0.17	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Benzo(k)fluoranthene	mg/kg	0.24	13	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Chrysene	mg/kg	0.057	0.86	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0160	0.0220	0.0150	0.0160	0.0120
	Dibenz(a,h)anthracene	mg/kg	0.0062	0.14	0.00600	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500
	Fluoranthene	mg/kg	0.11	2.4	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0100	0.0180	0.0120	0.0100	<0.0100
	Fluorene	mg/kg	0.021	0.14	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.20	3.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	1-Methylnaphthalene	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	2-Methylnaphthalene	mg/kg	0.020	0.20	-	-	-	-	-	-	-	-	-	-
	Naphthalene	mg/kg	0.035	0.39	0.0150	<0.0100	<0.0100	<0.0100	<0.0100	0.0220	0.0240	0.0230	0.0200	0.0170
	Perylene	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	Phenanthrene	mg/kg	0.042	0.52	0.0130	<0.0100	<0.0100	<0.0100	<0.0100	0.0330	0.0440	0.0370	0.0300	0.0270
	Pyrene	mg/kg	0.053	0.88	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0110	0.0150	<0.0100	0.0100	<0.0100
	Quinoline	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
	d9-Acridine	%	-	-	94.2	91.5	97.2	93.8	98.8	91.0	93.9	90.2	90.4	96.0
	d12-Chrysene	%	-	-	111	106	109	107	114	106	110	105	102	113
	d8-Naphthalene	%	-	-	113	110	113	113	118	111	114	110	106	119
	d10-Phenanthrene	%	-	-	105	102	103	103	111	100	104	100	97.3	105
	B(a)P Total Potency Equivalent	mg/kg	-	-	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200

Value > Lower BCMOECCS Working Sediment Quality Guideline (WSQG; BCMOECCS 2021).

Value > Upper BCMOECCS WSQ guidelines (BCMOECCS 2021).

Notes: "-" = no data. All WSQG and CCME Guidelines are the same except for the Iron there is no CCME guideline for Iron.

APPENDIX D

ZOOPLANKTON

Table D.1: Zooplankton Community Endpoints Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Year	Month	Station	Replicate	Density (ind/L)	Biomass (µg/L)	Richness (# Taxa)	Density			Relative Density			Biomass			Relative Biomass		
							Cladocera (ind/L)	Copepoda (ind/L)	Rotifera (ind/L)	Cladocera (% ind)	Copepoda (% ind)	Rotifera (% ind)	Cladocera (µg/L)	Copepoda (µg/L)	Rotifera (µg/L)	Cladocera (% biomass)	Copepoda (% biomass)	Rotifera (% biomass)
2020	June	RG_T4	1	354	1,386	37.0	51.8	64.0	238	0.146	0.181	0.673	654	688	44.2	0.472	0.496	0.0319
			2	320	1,396	41.0	67.9	72.5	180	0.212	0.226	0.561	369	987	38.9	0.265	0.708	0.0279
			3	461	1,169	29.0	50.5	81.9	328	0.110	0.178	0.713	402	689	77.5	0.344	0.590	0.0663
			4	480	1,662	30.0	62.5	102	316	0.130	0.212	0.658	857	739	66.1	0.516	0.444	0.0398
			5	418	1,032	28.0	38.6	74.7	305	0.0925	0.179	0.729	455	507	70.5	0.440	0.491	0.0682
		RG_TN	1	50.9	771	26.0	11.4	20.6	18.9	0.224	0.404	0.372	491	277	3.99	0.636	0.359	0.00518
			2	80.0	2,233	26.0	30.9	33.4	15.7	0.387	0.417	0.196	1,777	452	3.16	0.796	0.203	0.00142
			3	33.8	477	27.0	6.02	15.6	12.2	0.178	0.461	0.361	189	286	2.28	0.397	0.599	0.00478
			4	54.3	726	28.0	8.29	24.8	21.2	0.153	0.456	0.391	380	342	4.96	0.523	0.470	0.00683
			5	89.7	826	23.0	4.07	39.6	46.1	0.0453	0.441	0.513	286	531	9.54	0.346	0.642	0.0115
	August	RG_T4	1	17.7	162	31.0	0.684	9.60	7.44	0.0386	0.542	0.420	62.1	98.5	1.32	0.384	0.608	0.00814
			2	11.0	107	27.0	0.606	5.69	4.68	0.0552	0.519	0.426	56.1	49.7	1.09	0.525	0.465	0.0102
			3	15.8	152	36.0	0.901	9.87	5.01	0.0571	0.626	0.317	54.3	95.2	2.13	0.358	0.628	0.0140
			4	16.6	93.8	21.0	0.523	10.7	5.33	0.0315	0.647	0.321	14.2	78.6	0.951	0.151	0.839	0.0101
			5	15.6	164	27.0	0.732	10.5	4.39	0.0469	0.672	0.281	94.7	68.6	0.866	0.577	0.418	0.00528
			1X	17.4	148	29.0	0.855	9.24	7.27	0.0493	0.532	0.419	70.4	76.5	1.37	0.475	0.516	0.00927
			5X	17.0	81.9	28.0	0.209	10.6	6.27	0.0123	0.620	0.368	13.4	67.2	1.24	0.164	0.821	0.0152
		RG_TN	1	6.07	46.4	30.0	0.642	1.34	4.08	0.106	0.221	0.673	25.5	20.2	0.680	0.550	0.436	0.0147
			2	5.05	46.5	29.0	0.510	2.03	2.51	0.101	0.402	0.497	18.7	27.4	0.441	0.402	0.589	0.00948
			3	10.5	57.6	29.0	0.438	2.95	7.09	0.0419	0.281	0.677	34.9	21.5	1.19	0.607	0.373	0.0207
			4	18.7	227	30.0	1.61	5.19	11.9	0.0861	0.278	0.636	187	37.9	2.27	0.823	0.167	0.00999
			5	24.2	151	22.0	0.988	4.07	19.1	0.0408	0.168	0.791	104	44.0	3.41	0.686	0.291	0.0226
2021	August	RG_T4	1	4.54	69.3	31.0	0.330	3.69	0.523	0.0727	0.812	0.115	11.7	57.4	0.209	0.169	0.828	0.00302
			2	1.45	18.8	31.0	0.0869	0.783	0.575	0.0601	0.542	0.398	7.72	10.9	0.182	0.410	0.581	0.00963
			3	1.28	24.8	26.0	0.233	0.395	0.651	0.182	0.309	0.509	13.6	11.0	0.160	0.550	0.443	0.00645
			4	2.91	37.7	30.0	0.145	1.68	1.09	0.0499	0.577	0.373	9.59	27.7	0.456	0.254	0.734	0.0121
			5	1.52	9.15	28.0	0.172	0.601	0.746	0.113	0.396	0.491	3.77	4.95	0.435	0.412	0.541	0.0476
			4X	3.03	48.1	24.0	0.265	1.51	1.25	0.0877	0.500	0.413	23.1	24.5	0.449	0.481	0.510	0.00935
		RG_TN	1	5.93	59.9	36.0	0.213	4.22	1.50	0.0359	0.711	0.253	15.1	44.2	0.541	0.252	0.739	0.00903
			2	1.61	49.2	35.0	0.207	1.05	0.353	0.129	0.652	0.219	13.2	35.9	0.108	0.269	0.729	0.00220
			3	1.18	24.6	28.0	0.125	0.969	0.0830	0.106	0.824	0.0705	3.20	21.4	0.0178	0.130	0.869	0.000722
			4	3.40	63.1	31.0	0.366	2.59	0.441	0.108	0.762	0.130	7.47	55.4	0.160	0.118	0.879	0.00254
			5	0.954	16.9	27.0	0.0662	0.447	0.441	0.0694	0.468	0.462	5.31	11.5	0.0945	0.314	0.680	0.00559
2022	August	RG_T4	1	33.7	585	39.0	3.07	11.1	19.6	0.0910	0.328	0.581	460	122	3.73	0.786	0.208	0.00637
			2	34.6	543	32.0	1.94	10.3	22.3	0.0561	0.299	0.645	357	182	4.32	0.657	0.335	0.00796
			3	37.2	518	33.0	1.80	12.1	23.3	0.0484	0.326	0.626	400	113	5.10	0.771	0.219	0.00985
			4	41.0	380	33.0	2.04	13.0	25.9	0.0498	0.317	0.633	225	149	5.49	0.593	0.393	0.0144
			5	52.0	704	39.0	3.65	21.5	26.9	0.0702	0.413	0.517	448	250	6.68	0.636	0.355	0.00949
		RG_TN[a]	1	34.1	1,231	37.0	3.90	20.6	9.54	0.114	0.606	0.280	990	238	3.40	0.804	0.193	0.00276
			2	25.5	1,187	29.0	3.38	17.7	4.37	0.133	0.696	0.172	971	213	2.11	0.819	0.180	0.00177
			5	18.0	734	40.0	3.92	9.14	4.96	0.217	0.507	0.275	639	92.9	1.93	0.871	0.127	0.00263
			5X	19.2	1,065	31.0	4.58	10.5	4.19	0.238	0.544	0.218	958	106	1.60	0.899	0.0990	0.00150

[a] Two samples (RG_TN-3 and RG_TN-4) were destroyed during transit.

Table D.2: Summary Statistics for Seasonal Zooplankton Community Endpoints Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Endpoint	Year	Month	Station	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Density (ind/L)	2020	June	RG_T4	5	407	68.4	30.6	320	418	480
			RG_TN	5	61.8	22.7	10.2	33.8	54.3	89.7
		August	RG_T4	5	15.3	2.58	1.15	11.0	15.8	17.7
			RG_TN	5	12.9	8.30	3.71	5.05	10.5	24.2
	2021	August	RG_T4	5	2.34	1.39	0.623	1.28	1.52	4.54
			RG_TN	5	2.61	2.09	0.934	0.954	1.61	5.93
	2022	August	RG_T4	5	39.7	7.44	3.33	33.7	37.2	52.0
			RG_TN	3	25.9	8.04	4.64	18.0	25.5	34.1
Biomass (µg/L)	2020	June	RG_T4	5	1,329	241	108	1,032	1,386	1,662
			RG_TN	5	1,007	698	312	477	771	2,233
		August	RG_T4	5	136	33.0	14.7	93.8	152	164
			RG_TN	5	106	80.9	36.2	46.4	57.6	227
	2021	August	RG_T4	5	32.0	23.3	10.4	9.15	24.8	69.3
			RG_TN	5	42.7	20.9	9.34	16.9	49.2	63.1
	2022	August	RG_T4	5	546	117	52.4	380	543	704
			RG_TN	3	1,051	275	159	734	1,187	1,231
Richness (# Taxa)	2020	June	RG_T4	5	33.0	5.70	2.55	28.0	30.0	41.0
			RG_TN	5	26.0	1.87	0.837	23.0	26.0	28.0
		August	RG_T4	5	28.4	5.55	2.48	21.0	27.0	36.0
			RG_TN	5	28.0	3.39	1.52	22.0	29.0	30.0
	2021	August	RG_T4	5	29.2	2.17	0.970	26.0	30.0	31.0
			RG_TN	5	31.4	4.04	1.81	27.0	31.0	36.0
	2022	August	RG_T4	5	35.2	3.49	1.56	32.0	33.0	39.0
			RG_TN	3	35.3	5.69	3.28	29.0	37.0	40.0
Cladocera (ind/L)	2020	June	RG_T4	5	54.3	11.4	5.09	38.6	51.8	67.9
			RG_TN	5	12.1	10.9	4.86	4.07	8.29	30.9
		August	RG_T4	5	0.689	0.143	0.0637	0.523	0.684	0.901
			RG_TN	5	0.838	0.481	0.215	0.438	0.642	1.61
	2021	August	RG_T4	5	0.193	0.0927	0.0415	0.0869	0.172	0.330
			RG_TN	5	0.195	0.113	0.0506	0.0662	0.207	0.366
	2022	August	RG_T4	5	2.50	0.817	0.365	1.80	2.04	3.65
			RG_TN	3	3.73	0.305	0.176	3.38	3.90	3.92
Copepoda (ind/L)	2020	June	RG_T4	5	78.9	14.2	6.34	64.0	74.7	102
			RG_TN	5	26.8	9.68	4.33	15.6	24.8	39.6
		August	RG_T4	5	9.28	2.06	0.920	5.69	9.87	10.7
			RG_TN	5	3.12	1.55	0.692	1.34	2.95	5.19
	2021	August	RG_T4	5	1.43	1.35	0.606	0.395	0.783	3.69
			RG_TN	5	1.85	1.55	0.691	0.447	1.05	4.22
	2022	August	RG_T4	5	13.6	4.52	2.02	10.3	12.1	21.5
			RG_TN	3	15.8	5.98	3.45	9.14	17.7	20.6
Rotifera (ind/L)	2020	June	RG_T4	5	273	62.9	28.1	180	305	328
			RG_TN	5	22.8	13.4	6.01	12.2	18.9	46.1
		August	RG_T4	5	5.37	1.21	0.542	4.39	5.01	5.01
			RG_TN	5	8.94	6.73	3.01	2.51	7.09	19.1
	2021	August	RG_T4	5	0.716	0.223	0.0997	0.523	0.651	1.09
			RG_TN	5	0.564	0.544	0.243	0.0830	0.441	1.50
	2022	August	RG_T4	5	23.6	2.92	1.31	19.6	23.3	26.9
			RG_TN	3	6.29	2.83	1.63	4.37	4.96	9.54
Cladocera (% ind)	2020	June	RG_T4	5	0.138	0.0461	0.0206	0.0925	0.130	0.212
			RG_TN	5	0.197	0.125	0.0557	0.0453	0.178	0.387
		August	RG_T4	5	0.0459	0.0109	0.00487	0.0315	0.0469	0.0571
			RG_TN	5	0.0751	0.0316	0.0142	0.0408	0.0861	0.106
	2021	August	RG_T4	5	0.0957	0.0541	0.0242	0.0499	0.0727	0.182
			RG_TN	5	0.0895	0.0369	0.0165	0.0359	0.106	0.129
	2022	August	RG_T4	5	0.0631	0.0178	0.00797	0.0484	0.0561	0.0910
			RG_TN	3	0.155	0.0550	0.0318	0.114	0.133	0.217
Copepoda (% ind)	2020	June	RG_T4	5	0.195	0.0225	0.0101	0.178	0.181	0.226
			RG_TN	5	0.436	0.0246	0.0110	0.404	0.441	0.461
		August	RG_T4	5	0.601	0.0672	0.0301	0.519	0.626	0.672
			RG_TN	5	0.270	0.0871	0.0390	0.168	0.278	0.402
	2021	August	RG_T4	5	0.527	0.193	0.0863	0.309	0.542	0.812
			RG_TN	5	0.683	0.136	0.0608	0.468	0.711	0.824
	2022	August	RG_T4	5	0.337	0.0441	0.0197	0.299	0.326	0.413
			RG_TN	3	0.603	0.0943	0.0544	0.507	0.606	0.696
Rotifera (% ind)	2020	June	RG_T4	5	0.667	0.0655	0.0293	0.561	0.673	0.729
			RG_TN	5	0.367	0.113	0.0507	0.196	0.372	0.513
		August	RG_T4	5	0.353	0.0657	0.0294	0.281	0.321	0.426
			RG_TN	5	0.655	0.106	0.0472	0.497	0.673	0.791
	2021	August	RG_T4	5	0.377	0.158	0.0705	0.115	0.398	0.509
			RG_TN	5	0.227	0.150	0.0671	0.0705	0.219	0.462
	2022	August	RG_T4	5	0.600	0.0524	0.0235	0.517	0.626	0.645
			RG_TN	3	0.242	0.0612	0.0354	0.172	0.275	0.280

Table D.2: Summary Statistics for Seasonal Zooplankton Community Endpoints Downstream (RG_T4) and Upstream (RG_TN) of the Elk River, Koocanusa Reservoir Monitoring Program, 2020 to 2022

Endpoint	Year	Month	Station	N	Mean	Standard Deviation	Standard Error	Minimum	Median	Maximum
Cladocera (µg/L)	2020	June	RG_T4	5	548	205	91.9	369	455	857
			RG_TN	5	624	654	292	189	380	1,777
		August	RG_T4	5	56.3	28.7	12.8	14.2	56.1	94.7
			RG_TN	5	74.0	71.8	32.1	18.7	34.9	187
	2021	August	RG_T4	5	9.28	3.80	1.70	3.77	9.59	13.6
			RG_TN	5	8.86	5.11	2.29	3.20	7.47	15.1
	2022	August	RG_T4	5	378	94.7	42.3	225	400	460
			RG_TN	3	867	197	114	639	971	990
Copepoda (µg/L)	2020	June	RG_T4	5	722	173	77.2	507	689	987
			RG_TN	5	377	111	49.5	277	342	531
		August	RG_T4	5	78.1	20.0	8.96	49.7	78.6	98.5
			RG_TN	5	30.2	10.4	4.66	20.2	27.4	44.0
	2021	August	RG_T4	5	22.4	21.3	9.53	4.95	11.0	57.4
			RG_TN	5	33.7	17.5	7.85	11.5	35.9	55.4
	2022	August	RG_T4	5	163	55.3	24.7	113	149	250
			RG_TN	3	181	77.5	44.7	92.9	213	238
Rotifera (µg/L)	2020	June	RG_T4	5	59.4	16.9	7.58	38.9	66.1	77.5
			RG_TN	5	4.79	2.83	1.27	2.28	3.99	9.54
		August	RG_T4	5	1.27	0.509	0.228	0.866	1.09	2.13
			RG_TN	5	1.60	1.23	0.552	0.441	1.19	3.41
	2021	August	RG_T4	5	0.288	0.145	0.0648	0.160	0.209	0.456
			RG_TN	5	0.184	0.206	0.0920	0.0178	0.108	0.541
	2022	August	RG_T4	5	5.06	1.13	0.507	3.73	5.10	6.68
			RG_TN	3	2.48	0.800	0.462	1.93	2.11	3.40
Cladocera (% biomass)	2020	June	RG_T4	5	0.407	0.102	0.0455	0.265	0.440	0.516
			RG_TN	5	0.540	0.183	0.0816	0.346	0.523	0.796
		August	RG_T4	5	0.399	0.166	0.0744	0.151	0.384	0.577
			RG_TN	5	0.613	0.157	0.0701	0.402	0.607	0.823
	2021	August	RG_T4	5	0.359	0.149	0.0668	0.169	0.410	0.550
			RG_TN	5	0.217	0.0875	0.0392	0.118	0.252	0.314
	2022	August	RG_T4	5	0.689	0.0855	0.0382	0.593	0.657	0.786
			RG_TN	3	0.831	0.0350	0.0202	0.804	0.819	0.871
Copepoda (% biomass)	2020	June	RG_T4	5	0.546	0.105	0.0468	0.444	0.496	0.708
			RG_TN	5	0.455	0.180	0.0803	0.203	0.470	0.642
		August	RG_T4	5	0.592	0.165	0.0738	0.418	0.608	0.839
			RG_TN	5	0.371	0.158	0.0706	0.167	0.373	0.589
	2021	August	RG_T4	5	0.625	0.154	0.0690	0.443	0.581	0.828
			RG_TN	5	0.779	0.0895	0.0400	0.680	0.739	0.879
	2022	August	RG_T4	5	0.302	0.0835	0.0373	0.208	0.335	0.393
			RG_TN	3	0.166	0.0352	0.0203	0.127	0.180	0.193
Rotifera (% biomass)	2020	June	RG_T4	5	0.0468	0.0192	0.00858	0.0279	0.0398	0.0682
			RG_TN	5	0.00595	0.00370	0.00165	0.00142	0.00518	0.0115
		August	RG_T4	5	0.00955	0.00321	0.00143	0.00528	0.0101	0.0140
			RG_TN	5	0.0155	0.00600	0.00268	0.00948	0.0147	0.0226
	2021	August	RG_T4	5	0.0157	0.0181	0.00810	0.00302	0.00963	0.0476
			RG_TN	5	0.00402	0.00332	0.00148	0.00072	0.00254	0.00903
	2022	August	RG_T4	5	0.00962	0.00303	0.00135	0.00637	0.00949	0.0144
			RG_TN	3	0.00239	0.00054	0.00031	0.00177	0.00263	0.00276

Note: Two samples (RG_TN-3 and RG_TN-4) were destroyed during transit in August 2022. No duplicates are included in these summary statistic calculations.

Table D.3: Zooplankton Density (no. of organisms/L) Organized by Major Groups, Koocanusa Reservoir Monitoring Program, August 2022

Group	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Cladocera	3.896	3.381	3.920	3.070	1.9384	1.802	2.042	3.653
Copepoda	20.65	17.71	9.140	11.07	10.340	12.132	13.01	21.477
Rotifera	9.54	4.371	4.964	19.611	22.292	23.304	25.95	26.900
Total number of organisms/L	**34.08**	**25.46**	**18.025**	**33.75**	**34.57**	**37.24**	**40.99**	**52.03**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Two Samples (RG_TN-3 and RG_TN-4) were destroyed during transit to the lab.

Table D.4: Zooplankton Biomass (µg/L) Organized by Major Groups, Koocanusa Reservoir Monitoring Program, August 2022

Group	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)				
	TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Cladocera	990.3	971.3	639.44	459.7	356.71	399.6	225.12	447.90
Copepoda	237.6	213.2	92.9	121.6	181.9	113.4	149.2	249.70
Rotifera	3.397	2.106	1.9318	3.729	4.320	5.101	5.489	6.682
Total number of organisms/L	**1,231.28**	**1,186.58**	**734.29**	**585.01**	**542.95**	**518.03**	**379.85**	**704.29**
Total number of groups	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

[a] Two Samples (RG_TN-3 and RG_TN-4) were destroyed during transit to the lab.

Table D.5: **Zooplankton Community Density Data (no. organisms/L), Koocanusa Reservoir Monitoring Program, August 2022**

Taxa Group	Species	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)				
		TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Cladocera	*Daphnia galeata mendotae*	3.89	3.38	3.7	1.68	1.09	1.2	1.2	1.77
	Daphnias longiremis	0	0	0.0219	0.594	0.485	0.24	0.36	0.443
	Diaphanosoma leuchtenbergianum	0.00243	0	0.195	0.693	0.363	0.36	0.36	1.44
	Holopedium gibberum	0	0	0	0	0	0	0.12	0
	Leptodora kindtii	0	0	0.00487	0	0	0	0	0
	Sida crystallina	0	0	0	0.099	0	0	0	0
Copepoda	*Calanoid nauplii*	1.17	2.91	0.973	1.68	1.09	1.68	1.56	5.98
	Cyclopoid nauplii	10.3	6.37	4.19	4.16	2.54	5.29	6.13	5.31
	Cyclops bicuspidatus	6.34	4.55	2.94	3.3	3.92	3.3	3.48	5.76
	Cyclops vernalis	0	0	0.0973	0.099	0	0.12	0	0
	Diaptomus pallidus	1.82	3.28	0.779	1.69	2.57	1.6	1.69	4.24
	Diaptomus tyrrelli	0.00487	0.00683	0.119	0	0	0	0	0.0125
	Epischura nevadensis	0.995	0.587	0.0438	0.132	0.217	0.146	0.147	0.173
	Mesocyclops leuckarti	0.00243	0	0	0	0	0	0	0
Rotifera	*Conochilus sps*	0	0.182	0.195	0.099	0	0	0	0
	Gastropus sps	1.75	0	0.779	1.29	0.485	0	0.721	0.775
	Kellicottia sps	0.779	0.182	0.292	1.09	1.09	0.841	1.44	1.66
	Keratella sps	2.92	0.911	1.46	16.1	19	19.2	20.8	18.8
	Lecane sps	0	0	0	0	0	0	0	0.111
	Monostyla sps	0	0	0	0	0	0	0	0.111
	Pleosoma sps	0	0	0.0973	0	0	0	0	0
	Polyarthra sps	4.09	3.1	2.14	1.09	1.7	3.24	3	5.42
Total Number of Organisms/L:		34.1	25.5	18.0	33.8	34.6	37.2	41.0	52.0
Total Number of Taxa:		13	11	17	15	12	12	13	15

[a] Two samples (RG_TN-3 and RG_TN-4) were destroyed during transit to the lab.

Table D.6: **Zooplankton Community Biomass Data (µg/L), Koocanusa Reservoir Monitoring Program, August 2022**

Taxa Group	Species	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)				
		TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5
Cladocera	*Daphnia galeata mendotae*	990	971	632	397	308	368	183	370
	Daphnias longiremis	0	0	1.45	45.3	39.3	23	31	42.5
	Diaphanosoma leuchtenbergianum	0.0602	0	4.82	17.2	9	8.92	8.92	35.6
	Holopedium gibberum	0	0	0	0	0	0	2.49	0
	Leptodora kindtii	0	0	0.834	0	0	0	0	0
	Sida crystallina	0	0	0	0	0	0	0	0
Copepoda	*Calanoid nauplii*	3.42	8.53	2.85	4.93	3.19	4.92	4.57	17.5
	Cyclopoid nauplii	28.4	17.5	11.5	11.4	6.99	14.5	16.8	14.6
	Cyclops bicuspidatus	74.4	59.7	31.6	48.3	52.5	33.8	48	68.1
	Cyclops vernalis	0	0	0.537	0.547	0	0.663	0	0
	Diaptomus pallidus	34.4	84.2	21	41.3	86.2	45.8	36.8	126
	Diaptomus tyrrelli	0.434	0.609	13.7	0	0	0	0	1.5
	Epischura nevadensis	96.3	42.6	11.7	15.1	33.1	13.7	43	21.6
	Mesocyclops leuckarti	0.294	0	0	0	0	0	0	0
Rotifera	*Conochilus sps*	0	0.109	0.117	0.0594	0	0	0	0
	Gastropus sps	0.375	0	0.167	0.276	0.104	0	0.154	0.166
	Kellicottia sps	0.167	0.039	0.0626	0.233	0.234	0.18	0.309	0.356
	Keratella sps	0.459	0.143	0.229	2.52	2.99	3.02	3.27	2.96
	Lecane sps	0	0	0	0	0	0	0	0.0237
	Monostyla sps	0	0	0	0	0	0	0	0
	Pleosoma sps	0	0	0.101	0	0	0	0	0
	Polyarthra sps	2.4	1.81	1.25	0.638	0.994	1.9	1.76	3.18
	Total Biomass:	1,231.1	1,186.2	733.9	584.8	542.6	518.4	380.1	704.1

[a] Two samples (RG_TN-3 and RG_TN-4) were destroyed during transit to the lab.

Table D.7: **Relative Density (%) of Zooplankton Taxa, Koocanusa Reservoir Monitoring Program, August 2022**

Species	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)					Summary Statistics									
									Minimum		Median		Maximum		Mean		Standard Deviation	
	TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Calanoid nauplii	3.43	11.4	5.40	4.99	3.15	4.52	3.81	11.5	3.43	3.15	5.40	4.52	11.4	11.5	6.74	5.59	4.15	3.37
Conochilus sps	-	0.715	1.08	0.293	-	-	-	-	0.715	0.293	0.898	0.293	1.08	0.293	0.898	0.293	0.258	-
Cyclopoid nauplii	30.3	25.0	23.2	12.3	7.36	14.2	14.9	10.2	23.2	7.36	25.0	12.3	30.3	14.9	26.2	11.8	3.69	3.08
Cyclops bicuspidatus	18.6	17.9	16.3	9.78	11.3	8.85	8.50	11.1	16.3	8.50	17.9	9.78	18.6	11.3	17.6	9.91	1.18	1.27
Cyclops vernalis	-	-	0.540	0.293	-	0.323	-	-	0.540	0.293	0.540	0.308	0.540	0.323	0.540	0.308	-	0.0212
Daphnia galeata mendotae	11.4	13.3	20.5	4.99	3.15	3.23	2.93	3.40	11.4	2.93	13.3	3.23	20.5	4.99	15.1	3.54	4.80	0.828
Daphnias longiremis	-	-	0.122	1.76	1.40	0.645	0.879	0.851	0.122	0.645	0.122	0.879	0.122	1.76	0.122	1.11	-	0.459
Diaphanosoma leuchtenbergianum	0.00714	-	1.08	2.05	1.05	0.968	0.879	2.77	0.00714	0.879	0.544	1.05	1.08	2.77	0.544	1.54	0.759	0.833
Diaptomus pallidus	5.33	12.9	4.32	5.00	7.44	4.30	4.12	8.16	4.32	4.12	5.33	5.00	12.9	8.16	7.52	5.80	4.69	1.87
Diaptomus tyrrelli	0.0143	0.0268	0.662	-	-	-	-	0.0239	0.0143	0.0239	0.0268	0.0239	0.662	0.0239	0.234	0.0239	0.370	-
Epischura nevadensis	2.92	2.31	0.243	0.393	0.626	0.391	0.359	0.332	0.243	0.332	2.31	0.391	2.92	0.626	1.82	0.420	1.40	0.118
Gastropus sps	5.14	-	4.32	3.82	1.40	-	1.76	1.49	4.32	1.40	4.73	1.63	5.14	3.82	4.73	2.12	0.580	1.15
Kellicottia sps	2.28	0.715	1.62	3.23	3.15	2.26	3.52	3.19	0.715	2.26	1.62	3.19	2.28	3.52	1.54	3.07	0.786	0.476
Keratella sps	8.57	3.58	8.10	47.5	55.0	51.6	50.7	36.2	3.58	36.2	8.10	50.7	8.57	55.0	6.75	48.2	2.76	7.22
Leptodora kindtii	-	-	0.0270	-	-	-	-	-	0.0270	-	0.0270	-	0.0270	-	0.0270	-	-	-
Mesocyclops leuckarti	0.00714	-	-	-	-	-	-	-	0.00714	-	0.00714	-	0.00714	-	0.00714	-	-	-
Pleosoma sps	-	-	0.540	-	-	-	-	-	0.540	-	0.540	-	0.540	-	0.540	-	-	-
Polyarthra sps	12.0	12.2	11.9	3.23	4.91	8.71	7.33	10.4	11.9	3.23	12.0	7.33	12.2	10.4	12.0	6.92	0.153	2.88

Note: "-" indicates no available data.

[a] Two samples (RG_TN-3 and RG_TN-4) were destroyed in transit to the lab.

Table D.8: **Relative Biomass (%) of Zooplankton Taxa, Koocanusa Reservoir Monitoring Program, August 2022**

Species	Upstream of Elk River (RG_TN)[a]			Downstream of Elk River (RG_T4)					Summary Statistics									
									Minimum		Median		Maximum		Mean		Standard Deviation	
	TN-1	TN-2	TN-5	T4-1	T4-2	T4-3	T4-4	T4-5	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4	RG_TN	RG_T4
Calanoid nauplii	0.278	0.719	0.388	0.843	0.588	0.951	1.20	2.49	0.278	0.588	0.388	0.951	0.719	2.49	0.462	1.21	0.230	0.746
Conochilus sps	-	0.00921	0.0159	0.0102	-	-	-	-	0.00921	0.0102	0.0126	0.0102	0.0159	0.0102	0.0126	0.0102	0.00473	-
Cyclopoid nauplii	2.30	1.48	1.57	1.95	1.29	2.80	4.43	2.07	1.48	1.29	1.57	2.07	2.30	4.43	1.78	2.51	0.450	1.20
Cyclops bicuspidatus	6.04	5.03	4.30	8.25	9.67	6.52	12.6	9.67	4.30	6.52	5.03	9.67	6.04	12.6	5.12	9.34	0.874	2.24
Cyclops vernalis	-	-	0.0732	0.0934	-	0.128	-	-	0.0732	0.0934	0.0732	0.111	0.0732	0.128	0.0732	0.111	-	0.0245
Daphnia galeata mendotae	80.4	81.8	86.1	67.9	56.8	71.0	48.1	52.5	80.4	48.1	81.8	56.8	86.1	71.0	82.8	59.3	2.97	9.86
Daphnias longiremis	-	-	0.198	7.74	7.24	4.45	8.17	6.03	0.198	4.45	0.198	7.24	0.198	8.17	0.198	6.73	-	1.50
Diaphanosoma leuchtenbergianum	0.00489	-	0.656	2.93	1.66	1.72	2.35	5.06	0.00489	1.66	0.330	2.35	0.656	5.06	0.330	2.74	0.460	1.39
Diaptomus pallidus	2.80	7.10	2.87	7.06	15.9	8.83	9.70	17.9	2.80	7.06	2.87	9.70	7.10	17.9	4.26	11.9	2.46	4.74
Diaptomus tyrrelli	0.0352	0.0513	1.86	-	-	-	-	0.213	0.0352	0.213	0.0513	0.213	1.86	0.213	0.649	0.213	1.05	-
Epischura nevadensis	7.82	3.59	1.60	2.58	6.09	2.65	11.3	3.07	1.60	2.58	3.59	3.07	7.82	11.3	4.34	5.14	3.18	3.74
Gastropus sps	0.0305	-	0.0227	0.0472	0.0191	-	0.0407	0.0236	0.0227	0.0191	0.0266	0.0322	0.0305	0.0472	0.0266	0.0327	0.00552	0.0134
Kellicottia sps	0.0136	0.00329	0.00852	0.0399	0.0430	0.0348	0.0813	0.0505	0.00329	0.0348	0.00852	0.0430	0.0136	0.0813	0.00847	0.0499	0.00516	0.0185
Keratella sps	0.0373	0.0121	0.0312	0.431	0.551	0.583	0.860	0.420	0.0121	0.420	0.0312	0.551	0.0373	0.860	0.0269	0.569	0.0131	0.178
Leptodora kindtii	-	-	0.114	-	-	-	-	-	0.114	0	0.114	0	0.114	0	0.114	-	-	-
Mesocyclops leuckarti	0.0239	-	-	-	-	-	-	-	0.0239	0	0.0239	0	0.0239	0	0.0239	-	-	-
Pleosoma sps	-	-	0.0138	-	-	-	-	-	0.0138	0	0.0138	0	0.0138	0	0.0138	-	-	-
Polyarthra sps	0.195	0.153	0.171	0.109	0.183	0.367	0.463	0.451	0.153	0.109	0.171	0.367	0.195	0.463	0.173	0.315	0.0211	0.160

Note: "-" indicates no available data.

[a] Two samples (RG_TN-3 and RG_TN-4) were destroyed in transit to the lab.

APPENDIX E

FISH

Table E.1: **Gill Net Records for Fish Caught in Sand Creek, Koocanusa Reservoir Monitoring Program, 2022**

Area	Station ID	UTM (NAD83, 11U)		Set Date	Lift Date	Set Time	Lift Time	Effort (Fishing Hours)	Net Information				Bull Trout			Largescale Sucker			Longnose Sucker			Northern Pikeminnow			Peamouth Chub			Redside Shiner			Westslope Cutthroat Trout		
		Easting	Northing						Depth Range (m)		Length (ft)	Mesh (inches)	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Lethally Sacrificed as per Study Design	CPUE [a]	Catch	Lethally Sacrificed as per Study Design	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]
May	RG_SC_GN-01	625685	5457892	25-May-22	25-May-22	10:20:00	10:50:00	0.50	3.0	5.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	2.0	1	1	2.0	0	0	0.0	0	0	0.0
	RG_SC_GN-02	625687	5457919	25-May-22	25-May-22	11:32:00	11:48:00	0.27	0.5	2.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-03	625670	5457949	25-May-22	25-May-22	12:02:00	12:18:00	0.27	0.5	2.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	3.8	0	0	0.0	0	0	0.0
	RG_SC_GN-04	625672	5457980	25-May-22	25-May-22	12:32:00	12:48:00	0.27	0.5	2.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.8	2	2	7.5	0	0	0.0	0	0	0.0
	RG_SC_GN-05	625671	5457472	25-May-22	25-May-22	12:54:00	13:08:00	0.23	1.0	4.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-06	625671	5457472	25-May-22	25-May-22	13:13:00	13:24:00	0.18	1.0	4.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-07	625671	5457960	25-May-22	25-May-22	13:40:00	13:57:00	0.28	1.0	3.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	3.5	0	0	0.0	0	0	0.0
	RG_SC_GN-08	625671	5457960	25-May-22	25-May-22	14:03:00	14:18:00	0.25	1.0	3.0	50	1	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-09	625671	5457960	25-May-22	25-May-22	14:32:00	14:46:00	0.23	1.0	3.0	50	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-10	625674	5457941	26-May-22	26-May-22	8:18:00	8:37:00	0.32	1.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-11	625667	5458007	26-May-22	26-May-22	09:20:00	09:33:00	0.22	2.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	3	13.8	0	0	0.0	0	0	0.0
	RG_SC_GN-12	625667	5458007	26-May-22	26-May-22	09:45:00	10:00:00	0.25	2.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	2	8.0	0	0	0.0	0	0	0.0
	RG_SC_GN-13	625667	5458007	26-May-22	26-May-22	10:07:00	10:24:00	0.28	2.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-14	625674	5457941	26-May-22	26-May-22	10:30:00	10:45:00	0.25	1.0	4.0	75	1	0	0	0.0	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-15	625674	5457941	26-May-22	26-May-22	10:53:00	11:10:00	0.28	1.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-16	625666	5458049	26-May-22	26-May-22	11:32:00	11:47:00	0.25	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-17	625695	5458135	26-May-22	26-May-22	11:54:00	12:10:00	0.27	1.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-18	625695	5458135	26-May-22	26-May-22	12:13:00	12:28:00	0.25	1.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-19	625761	5458160	26-May-22	26-May-22	12:35:00	12:50:00	0.25	0.5	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-20	625672	5457983	26-May-22	26-May-22	13:02:00	13:17:00	0.25	1.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	3	12.0	0	0	0.0	0	0	0.0
	RG_SC_GN-21	625672	5457983	26-May-22	26-May-22	13:20:00	13:36:00	0.27	1.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	3.8	0	0	0.0	0	0	0.0
	RG_SC_GN-22	625672	5457983	26-May-22	26-May-22	13:41:00	13:52:00	0.18	1.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	4	21.8	0	0	0.0	0	0	0.0
June	RG_SC_GN-01	625885	5458086	21-Jun-22	21-Jun-22	11:33:00	11:39:00	0.18	2.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	0	20.0	0	0	0.0	0	0	0.0
	RG_SC_GN-02	626006	5458090	21-Jun-22	21-Jun-22	11:44:00	12:00:00	0.28	2.0	3.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	0	15.0	2	2	7.5	0	0	0.0
	RG_SC_GN-03	625912	5458073	21-Jun-22	21-Jun-22	11:52:00	12:09:00	0.25	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	0	7.1	0	0	0.0	0	0	0.0
	RG_SC_GN-04	626018	5458082	21-Jun-22	21-Jun-22	12:06:00	12:33:00	0.23	0.5	1.5	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	7	0	15.6	4	4	8.9	0	0	0.0
	RG_SC_GN-05	626147	5458124	21-Jun-22	21-Jun-22	12:18:00	12:34:00	0.32	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.8	13	0	48.8	20	8	75.0	0	0	0.0
	RG_SC_GN-06	626147	5458124	21-Jun-22	21-Jun-22	12:54:00	13:10:00	0.22	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	13	0	48.8	7	2	26.3	0	0	0.0
	RG_SC_GN-07	626147	5458124	21-Jun-22	21-Jun-22	13:25:00	13:40:00	0.25	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0	1	0	4.0	0	0	0.0	0	0	0.0
	RG_SC_GN-08	626099	5458264	21-Jun-22	21-Jun-22	13:45:00	14:00:00	0.28	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0	10	0	40.0	2	1	8.0	0	0	0.0
	RG_SC_GN-09	626144	5458258	21-Jun-22	21-Jun-22	13:48:00	14:05:00	0.25	0.5	2.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.5	35	0	123.5	3	1	10.6	0	0	0.0
	RG_SC_GN-10	626045	5458276	22-Jun-22	22-Jun-22	13:24:00	13:40:00	0.28	0.5	3.0	75	3	0	0	0.0	1	0	3.8	0	0	0.0	1	0	3.8	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-11	625703	5458128	22-Jun-22	22-Jun-22	13:50:00	14:05:00	0.25	0.5	3.0	75	3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-12	626164	5458283	22-Jun-22	22-Jun-22	14:10:00	14:27:00	0.27	1.0	4.0	75	3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-13	626248	5458192	22-Jun-22	22-Jun-22	14:30:00	14:46:00	0.25	1.0	4.0	75	3	0	0	0.0	2	0	7.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-14	626172	5458166	22-Jun-22	22-Jun-22	14:52:00	15:05:00	0.25	1.0	3.0	75	3	1	0	4.62	2	0	9.23	0	0	0.00	1	0	4.6	0	0	0.0	0	0	0.00	0	0	0.00
	RG_SC_GN-01	625736	5458487	23-Jun-22	23-Jun-22	09:09:00	09:24:00	0.25	0.5	1.5	150	3-5	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-02	625706	5458500	23-Jun-22	23-Jun-22	09:38:00	09:53:00	0.27	5.0	6.0	150	3-5	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-03	625885	5458456	23-Jun-22	23-Jun-22	9:45:00	10:00:00	0.18	5.0	6.0	100	4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-04	625650	5459232	23-Jun-22	23-Jun-22	10:15:00	10:30:00	0.10	6.0	7.0	100	4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-05	625608	5459369	23-Jun-22	23-Jun-22	10:19:00	10:34:00	0.27	5.8	6.8	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-06	625563	5459670	23-Jun-22	23-Jun-22	10:45:00	11:00:00	0.28	5.0	6.0	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-07	625574	5459994	23-Jun-22	23-Jun-22	10:51:00	11:06:00	0.45	5.0	6.0	100	4	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-08	624095	5459356	23-Jun-22	23-Jun-22	11:25:00	11:40:00	0.27	3.0	4.0	100	4	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-09	624085	5459483	23-Jun-22	23-Jun-22	11:30:00	11:45:00	0.27	3.2	4.2	150	3-5	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-10	624188	5459288	23-Jun-22	23-Jun-22	12:36:00	12:51:00	0.25	2.0	3.0	150	3-5	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-11	624293	5459081	23-Jun-22	23-Jun-22	12:43:00	12:58:00	0.25	5.1	6.1	100	4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-12	624337	5459057	23-Jun-22	23-Jun-22	13:16:00	13:31:00	0.28	4.7	5.7	100	4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-13	624167	5459163	23-Jun-22	23-Jun-22	13:24:00	13:39:00	0.27	3.4	4.4	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	2	0	8.0	0	0	0.0	0	0	0.0	1	0	4.0
	RG_SC_GN-14	624077	5459449	23-Jun-22	23-Jun-22	14:05:00	14:20:00	0.25	4.0	5.0	150	3-5	2	0	8.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-15	624115	5459507	23-Jun-22	23-Jun-22	14:10:00	14:25:00	0.28	4.0	5.0	100	4	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-16	624085	5459413	23-Jun-22	23-Jun-22	14:49:00	15:04:00	0.27	3.5	4.5	100	4	0	0	0.0	0	0	0.0	0	0	0.0	2	0	8.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_SC_GN-17	624238	5459157	23-Jun-22	23-Jun-22	14:55:00	15:10:00	0.22	4.2	5.2	150	3-5	0	0	0.0	0	0	0.0	1	0	4.0	2	0	8.0	0	0	0.0	0	0	0.0	0	0	0.0
							May Total	**5.80**			-		**1**	**0**	**0.172**	**0**	**0**	**0**	**1**	**0**	**0.172**	**2**	**0**	**0.3448**	**18**	**18**	**3.103**	**0**	**0**	**0**	**0**	**0**	**0**
							June Total	**7.97**			-		**5**	**0**	**0.628**	**10**	**0**	**1.255**	**1**	**0**	**0.126**	**12**	**0**	**1.5063**	**87**	**0**	**10.92**	**38**	**18**	**4.77**	**1**	**0**	**0.126**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the gill net sets in one area.

Table E.2: Gill Net Records for Fish Caught in Elk River, Koocanusa Reservoir Monitoring Program, 2022

Area	Station ID	UTM (NAD83, 11U)		Set Date	Lift Date	Set Time	Lift Time	Effort (Fishing Hours)	Net Information				Bull Trout			Burbot			Eastern Brook Trout			Kokanee			Largescale Sucker		
		Easting	Northing						Depth Range (m)		Length (ft)	Mesh (inches)	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]
May	RG_ER_GN-01	627170	5446452	25-May-22	25-May-22	11:16:00	11:30:00	0.23	0.5	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-02	627168	5446458	25-May-22	25-May-22	11:40:00	11:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-03	627209	5446498	25-May-22	25-May-22	12:15:00	12:30:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-04	627260	5446487	25-May-22	25-May-22	12:40:00	12:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-05	627260	5446487	25-May-22	25-May-22	13:05:00	13:20:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-06	627409	5446690	25-May-22	25-May-22	13:45:00	14:00:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-07	627560	5446856	25-May-22	25-May-22	14:10:00	14:25:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-08	627260	5446487	25-May-22	25-May-22	14:40:00	14:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-09	626969	5446435	26-May-22	26-May-22	8:27:00	8:42:00	0.25	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-10	626770	5446355	26-May-22	26-May-22	8:57:00	9:15:00	0.30	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-11	626770	5446355	26-May-22	26-May-22	09:20:00	09:35:00	0.25	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-12	626770	5446355	26-May-22	26-May-22	9:44:00	9:59:00	0.25	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-13	627160	5446480	26-May-22	26-May-22	10:30:00	10:45:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-14	627166	5446455	26-May-22	26-May-22	10:50:00	11:05:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-15	627256	5446487	26-May-22	26-May-22	11:15:00	11:30:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0	0	0	0.0
	RG_ER_GN-16	627256	5446487	26-May-22	26-May-22	11:40:00	11:55:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-17	627256	5446487	26-May-22	26-May-22	12:00:00	12:15:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-18	626854	5446191	26-May-22	26-May-22	13:10:00	13:25:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0
	RG_ER_GN-19	626854	5446191	26-May-22	26-May-22	13:30:00	13:45:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-20	626900	5446096	26-May-22	26-May-22	14:00:00	14:25:00	0.42	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-21	626900	5446096	26-May-22	26-May-22	14:25:00	14:40:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-22	626951	5445977	26-May-22	26-May-22	14:40:00	14:58:00	0.30	1.0	1.5	75	2	0	0	0.0	0	0	0.0	1	0	3.3	0	0	0.0	0	0	0.0
	RG_ER_GN-23	626759	5446343	27-May-22	27-May-22	08:50:00	09:05:00	0.25	1.0	1.5	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-24	626759	5446343	27-May-22	27-May-22	09:20:00	09:35:00	0.25	1.0	1.5	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-25	626759	5446343	27-May-22	27-May-22	10:15:00	10:30:00	0.25	0.5	0.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-26	627402	5446678	27-May-22	27-May-22	11:30:00	11:45:00	0.25	0.5	0.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-27	627402	5446678	27-May-22	27-May-22	12:00:00	12:15:00	0.25	1.0	1.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-28	626759	5446343	27-May-22	27-May-22	13:00:00	13:15:00	0.25	1.0	1.5	150	3-5	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-29	626759	5446343	27-May-22	27-May-22	13:30:00	13:45:00	0.25	1.0	1.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
June	RG_ER_GN-01	628564	5447359	21-Jun-22	21-Jun-22	11:45:00	12:00:00	0.25	4.4	5.4	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-02	628688	5447515	21-Jun-22	21-Jun-22	12:17:00	12:32:00	0.25	3.9	4.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-03	629235	5447300	21-Jun-22	21-Jun-22	12:58:00	13:13:00	0.25	4.6	5.6	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-04	629434	5447102	21-Jun-22	21-Jun-22	13:09:00	13:34:00	0.42	0.9	1.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-05	629247	5447283	21-Jun-22	21-Jun-22	13:29:00	13:44:00	0.25	3.5	4.5	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-06	629212	5447333	21-Jun-22	21-Jun-22	13:37:00	13:52:00	0.25	3.9	4.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0
	RG_ER_GN-07	629938	5448171	21-Jun-22	21-Jun-22	14:09:00	14:24:00	0.25	1.5	2.8	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-08	629918	5448191	21-Jun-22	21-Jun-22	14:13:00	14:30:00	0.28	1.8	2.8	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-01	626905	5445858	23-Jun-22	23-Jun-22	14:47:00	15:04:00	0.28	1.0	3.0	75	3	0	0	0.0	2	0	7.1	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-02	626977	5446725	23-Jun-22	23-Jun-22	15:15:00	15:30:00	0.25	2.0	5.0	75	3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
							May Total	**7.50**		**-**			**1**	**0**	**0.133**	**0**	**0**	**0**	**2**	**0**	**0.267**	**1**	**0**	**0.133**	**0**	**0**	**0**
							June Total	**2.7**		**-**			**0**	**0**	**0**	**2**	**0**	**0.732**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0.366**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the gill net sets in one area.

Table E.2: Gill Net Records for Fish Caught in Elk River, Koocanusa Reservoir Monitoring Program, 2022

Area	Station ID	UTM (NAD83, 11U)		Set Date	Lift Date	Set Time	Lift Time	Effort (Fishing Hours)	Net Information				Longnose Sucker			Mountain Whitefish			Northern Pikeminnow			Peamouth Chub			Redside Shiner		
		Easting	Northing						Depth Range (m)		Length (ft)	Mesh (inches)	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Lethally Sacrificed as per Study Design	CPUE [a]	Catch	Lethally Sacrificed as per Study Design	CPUE [a]
May	RG_ER_GN-01	627170	5446452	25-May-22	25-May-22	11:16:00	11:30:00	0.23	0.5	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-02	627168	5446458	25-May-22	25-May-22	11:40:00	11:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-03	627209	5446498	25-May-22	25-May-22	12:15:00	12:30:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-04	627260	5446487	25-May-22	25-May-22	12:40:00	12:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	2	2	8.0	0	0	0.0
	RG_ER_GN-05	627260	5446487	25-May-22	25-May-22	13:05:00	13:20:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-06	627409	5446690	25-May-22	25-May-22	13:45:00	14:00:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-07	627560	5446856	25-May-22	25-May-22	14:10:00	14:25:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	1	1	4.0	0	0	0.0
	RG_ER_GN-08	627260	5446487	25-May-22	25-May-22	14:40:00	14:55:00	0.25	1.0	2.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-09	626969	5446435	26-May-22	26-May-22	8:27:00	8:42:00	0.25	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-10	626770	5446355	26-May-22	26-May-22	8:57:00	9:15:00	0.30	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-11	626770	5446355	26-May-22	26-May-22	09:20:00	09:35:00	0.25	1.0	1.0	75	2	2	0	8.0	0	0	0.0	0	0	0.0	1	1	4.0	0	0	0.0
	RG_ER_GN-12	626770	5446355	26-May-22	26-May-22	9:44:00	9:59:00	0.25	1.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-13	627160	5446480	26-May-22	26-May-22	10:30:00	10:45:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-14	627166	5446455	26-May-22	26-May-22	10:50:00	11:05:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-15	627256	5446487	26-May-22	26-May-22	11:15:00	11:30:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	1	1	4.0	0	0	0.0
	RG_ER_GN-16	627256	5446487	26-May-22	26-May-22	11:40:00	11:55:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	1	1	4.0	0	0	0.0
	RG_ER_GN-17	627256	5446487	26-May-22	26-May-22	12:00:00	12:15:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-18	626854	5446191	26-May-22	26-May-22	13:10:00	13:25:00	0.25	0.0	1.0	75	2	0	0	0.0	1	0	4.0	0	0	0.0	2	2	8.0	0	0	0.0
	RG_ER_GN-19	626854	5446191	26-May-22	26-May-22	13:30:00	13:45:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0
	RG_ER_GN-20	626900	5446096	26-May-22	26-May-22	14:00:00	14:25:00	0.42	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-21	626900	5446096	26-May-22	26-May-22	14:25:00	14:40:00	0.25	0.0	1.0	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-22	626951	5445977	26-May-22	26-May-22	14:40:00	14:58:00	0.30	1.0	1.5	75	2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-23	626759	5446343	27-May-22	27-May-22	08:50:00	09:05:00	0.25	1.0	1.5	75	2	0	0	0.0	0	0	0.0	2	0	8.0	5	5	20.0	0	0	0.0
	RG_ER_GN-24	626759	5446343	27-May-22	27-May-22	09:20:00	09:35:00	0.25	1.0	1.5	75	2	0	0	0.0	0	0	0.0	0	0	0.0	2	2	8.0	0	0	0.0
	RG_ER_GN-25	626759	5446343	27-May-22	27-May-22	10:15:00	10:30:00	0.25	0.5	0.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	2	1	8.0	0	0	0.0
	RG_ER_GN-26	627402	5446678	27-May-22	27-May-22	11:30:00	11:45:00	0.25	0.5	0.5	150	3-5	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-27	627402	5446678	27-May-22	27-May-22	12:00:00	12:15:00	0.25	1.0	1.5	150	3-5	2	0	8.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-28	626759	5446343	27-May-22	27-May-22	13:00:00	13:15:00	0.25	1.0	1.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-29	626759	5446343	27-May-22	27-May-22	13:30:00	13:45:00	0.25	1.0	1.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
June	RG_ER_GN-01	628564	5447359	21-Jun-22	21-Jun-22	11:45:00	12:00:00	0.25	4.4	5.4	75	1	0	0	0.0	0	0	0.0	0	0	0.0	6	0	24.0	0	0	0.0
	RG_ER_GN-02	628688	5447515	21-Jun-22	21-Jun-22	12:17:00	12:32:00	0.25	3.9	4.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-03	629235	5447300	21-Jun-22	21-Jun-22	12:58:00	13:13:00	0.25	4.6	5.6	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	4.0
	RG_ER_GN-04	629434	5447102	21-Jun-22	21-Jun-22	13:09:00	13:34:00	0.42	0.9	1.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-05	629247	5447283	21-Jun-22	21-Jun-22	13:29:00	13:44:00	0.25	3.5	4.5	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-06	629212	5447333	21-Jun-22	21-Jun-22	13:37:00	13:52:00	0.25	3.9	4.9	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-07	629938	5448171	21-Jun-22	21-Jun-22	14:09:00	14:24:00	0.25	1.5	2.8	75	1	0	0	0.0	0	0	0.0	2	1	8.0	2	0	8.0	13	12	52.0
	RG_ER_GN-08	629918	5448191	21-Jun-22	21-Jun-22	14:13:00	14:30:00	0.28	1.8	2.8	75	1	0	0	0.0	0	0	0.0	1	0	3.5	3	0	10.6	1	1	3.5
	RG_ER_GN-01	626905	5445858	23-Jun-22	23-Jun-22	14:47:00	15:04:00	0.28	1.0	3.0	75	3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_ER_GN-02	626977	5446725	23-Jun-22	23-Jun-22	15:15:00	15:30:00	0.25	2.0	5.0	75	3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
							May Total	**7.50**		**-**			**5**	**0**	**0.667**	**1**	**0**	**0.133**	**3**	**0**	**0.4**	**17**	**16**	**2.267**	**0**	**0**	**0**
							June Total	**2.7**		**-**			**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**1.098**	**11**	**0**	**4.024**	**15**	**14**	**5.488**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the gill net sets in one area.

Table E.3: Gill Net Records for Fish Caught in Gold Creek, Koocanusa Reservoir Monitoring Program, 2022

Area	Station ID	UTM (NAD83, 11U)		Set Date	Lift Date	Set Time	Lift Time	Effort (Fishing Hours)	Net Information				Bull Trout			Kokanee			Largescale Sucker			Longnose Sucker			Northern Pikeminnow		
		Easting	Northing						Depth Range (m)		Length (ft)	Mesh (inches)	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]
May	RG_GC_GN-01	630838	5436490	27-May-22	27-May-22	10:32:00	10:48:00	0.27	2.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-02	630813	5436632	27-May-22	27-May-22	10:48:00	11:05:00	0.28	2.0	4.0	100	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.5	0	0	0.0
	RG_GC_GN-03	630813	5436632	27-May-22	27-May-22	11:34:00	11:48:00	0.23	2.0	4.0	100	1	1	0	4.3	0	0	0.0	0	0	0.0	1	0	4.3	0	0	0.0
	RG_GC_GN-04	630813	5436632	27-May-22	27-May-22	12:10:00	12:26:00	0.27	2.0	4.0	100	1	1	0	3.8	0	0	0.0	0	0	0.0	2	0	7.5	0	0	0.0
	RG_GC_GN-05	630813	5436632	27-May-22	27-May-22	12:36:00	12:50:00	0.23	2.0	4.0	100	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-06	630786	5436741	27-May-22	27-May-22	12:57:00	13:12:00	0.25	1.0	4.0	100	1	0	0	0.0	0	0	0.0	0	0	0.0	3	0	12.0	0	0	0.0
	RG_GC_GN-07	630786	5436741	27-May-22	27-May-22	13:23:00	13:38:00	0.25	2.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0
	RG_GC_GN-08	630790	5436651	27-May-22	27-May-22	13:10:00	13:25:00	0.25	1.0	4.0	100	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	4.0	1	0	4.0
	RG_GC_GN-09	630819	5436635	27-May-22	27-May-22	13:33:00	13:50:00	0.28	2.0	4.0	75	1	0	0	0.0	0	0	0.0	0	0	0.0	1	0	3.5	0	0	0.0
June	RG_GC_GN-01	629312	5437071	22-Jun-22	22-Jun-22	09:29:00	09:44:00	0.25	0.4	1.4	75	1	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0	1	0	4.0
	RG_GC_GN-02	629338	5437102	22-Jun-22	22-Jun-22	10:11:00	10:26:00	0.25	0.5	1.5	150	3-5	2	0	8.0	0	0	0.0	3	0	12.0	1	0	4.0	0	0	0.0
	RG_GC_GN-03	629336	5437108	22-Jun-22	22-Jun-22	10:57:00	11:12:00	0.25	0.6	1.6	75	1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	5	1	20.0
	RG_GC_GN-04	629836	5436831	22-Jun-22	22-Jun-22	11:31:00	11:46:00	0.25	7.0	8.0	150	3-5	1	0	4.0	0	0	0.0	2	0	8.0	1	0	4.0	1	0	4.0
	RG_GC_GN-05	629388	5437211	22-Jun-22	22-Jun-22	12:32:00	12:47:00	0.25	0.9	1.9	75	1	0	0	0.0	1	0	4.0	1	0	4.0	0	0	0.0	0	0	0.0
	RG_GC_GN-06	630259	5436980	22-Jun-22	22-Jun-22	13:17:00	13:32:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	1	0	4.0	0	0	0.0	0	0	0.0
	RG_GC_GN-07	630076	5436867	22-Jun-22	22-Jun-22	13:44:00	13:59:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	4	0	16.0	0	0	0.0	0	0	0.0
	RG_GC_GN-08	629678	5437351	22-Jun-22	22-Jun-22	14:19:00	14:34:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	7	0	28.0	2	0	8.0	0	0	0.0
							May Total	**2.32**		**-**			**2**	**0**	**0.9**	**0**	**0**	**0.0**	**0**	**0**	**0.0**	**9**	**0**	**3.9**	**2**	**0**	**0.9**
							June Total	**2.00**		**-**			**3**	**0**	**1.5**	**2**	**0**	**1.0**	**18**	**0**	**9.0**	**4**	**0**	**2.0**	**7**	**1**	**3.5**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the gill net sets in one area.

Table E.3: Gill Net Records for Fish Caught in Gold Creek, Koocanusa Reservoir Monitoring Program, 2022

Area	Station ID	UTM (NAD83, 11U)		Set Date	Lift Date	Set Time	Lift Time	Effort (Fishing Hours)	Net Information				Peamouth Chub			Rainbow Trout			Redside Shiner			Westslope Cutthroat Trout			Yellow Perch		
		Easting	Northing						Depth Range (m)		Length (ft)	Mesh (inches)	Catch	Lethally Sacrificed as per Study Design	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Lethally Sacrificed as per Study Design	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]	Catch	Bycatch Mortality	CPUE [a]
May	RG_GC_GN-01	630838	5436490	27-May-22	27-May-22	10:32:00	10:48:00	0.27	2.0	4.0	75	1	14	14	52.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-02	630813	5436632	27-May-22	27-May-22	10:48:00	11:05:00	0.28	2.0	4.0	100	1	22	6	77.6	2	0	7.1	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-03	630813	5436632	27-May-22	27-May-22	11:34:00	11:48:00	0.23	2.0	4.0	100	1	9	0	38.6	1	0	4.3	0	0	0.0	0	0	0.0	2	2	8.6
	RG_GC_GN-04	630813	5436632	27-May-22	27-May-22	12:10:00	12:26:00	0.27	2.0	4.0	100	1	10	0	37.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-05	630813	5436632	27-May-22	27-May-22	12:36:00	12:50:00	0.23	2.0	4.0	100	1	6	0	25.7	0	0	0.0	0	0	0.0	1	0	4.3	0	0	0.0
	RG_GC_GN-06	630786	5436741	27-May-22	27-May-22	12:57:00	13:12:00	0.25	1.0	4.0	100	1	9	0	36.0	0	0	0.0	0	0	0.0	3	0	12.0	0	0	0.0
	RG_GC_GN-07	630786	5436741	27-May-22	27-May-22	13:23:00	13:38:00	0.25	2.0	4.0	75	1	12	0	48.0	2	0	8.0	0	0	0.0	0	0	0.0	1	0	4.0
	RG_GC_GN-08	630790	5436651	27-May-22	27-May-22	13:10:00	13:25:00	0.25	1.0	4.0	100	1	4	0	16.0	1	0	4.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-09	630819	5436635	27-May-22	27-May-22	13:33:00	13:50:00	0.28	2.0	4.0	75	1	5	0	17.6	2	0	7.1	0	0	0.0	0	0	0.0	0	0	0.0
June	RG_GC_GN-01	629312	5437071	22-Jun-22	22-Jun-22	09:29:00	09:44:00	0.25	0.4	1.4	75	1	3	0	12.0	0	0	0.0	10	6	40.0	0	0	0.0	1	1	4.0
	RG_GC_GN-02	629338	5437102	22-Jun-22	22-Jun-22	10:11:00	10:26:00	0.25	0.5	1.5	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-03	629336	5437108	22-Jun-22	22-Jun-22	10:57:00	11:12:00	0.25	0.6	1.6	75	1	6	0	24.0	0	0	0.0	2	2	8.0	0	0	0.0	0	0	0.0
	RG_GC_GN-04	629836	5436831	22-Jun-22	22-Jun-22	11:31:00	11:46:00	0.25	7.0	8.0	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-05	629388	5437211	22-Jun-22	22-Jun-22	12:32:00	12:47:00	0.25	0.9	1.9	75	1	11	1	44.0	0	0	0.0	21	9	84.0	0	0	0.0	1	1	4.0
	RG_GC_GN-06	630259	5436980	22-Jun-22	22-Jun-22	13:17:00	13:32:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-07	630076	5436867	22-Jun-22	22-Jun-22	13:44:00	13:59:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
	RG_GC_GN-08	629678	5437351	22-Jun-22	22-Jun-22	14:19:00	14:34:00	0.25	4.0	5.0	150	3-5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
							May Total	**2.32**		**-**			**91**	**20**	**39.3**	**8**	**0**	**3.5**	**0**	**0**	**0.0**	**4**	**0**	**1.7**	**3**	**2**	**1.3**
							June Total	**2.00**		**-**			**20**	**1**	**10.0**	**0**	**0**	**0.0**	**33**	**17**	**16.5**	**0**	**0**	**0.0**	**2**	**2**	**1.0**

[a] Total catch-per-unit-effort (CPUE) calculated as the total catch of a single species over the total effort for all the gill net sets in one area.

Table E.4: Fish Meristics Data for Peamouth Chub, Koocanusa Reservoir Monitoring Program, May 2022

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g) [b]	Fulton's Condition Factor(K)	Gonado-somatic Index	Hepato-somatic Index	Anomalies[c] 0	1	2	3	Worm Weight (g)	Tissue Collected	Comment
Sand Creek	25-May-22	RG_SC_PCC-01	24.5	23.3	104	OT, SC	8	F	9.401	4.069	90.530	0.82	0.090	0.039	-	L	-	-	-	O,M	-
	25-May-22	RG_SC_PCC-02	26.1	23.5	124	OT, SC	9	F	10.300	1.341	112	0.96	0.083	0.011	-	-	-	-	-	O,M	-
	25-May-22	RG_SC_PCC-03	26.6	23.6	133	OT, SC	9	F	13.572	1.611	118	1.01	0.102	0.012	-	-	-	-	-	O,M	-
	25-May-22	RG_SC_PCC-04	26.0	22.9	141	OT, SC	7	F	14.564	1.954	124	1.17	0.103	0.014	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-05	25.6	23.1	125	SC	6	F	19.735	1.960	103	1.01	0.158	0.016	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-06	24.6	22.2	120	OT, SC	6	F	18.120	1.287	101	1.10	0.151	0.011	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-07	24.5	22.3	105	OT, SC	9	F	11.237	0.978	93	0.95	0.107	0.009	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-08	24.4	22.7	103	OT, SC	8	F	8.704	1.077	93	0.88	0.085	0.010	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-09	26.4	22.6	148	OT, SC	10	F	12.674	1.776	134	1.28	0.086	0.012	-	-	-	-	-	O,M	-
	26-May-22	RG_SC_PCC-10	28.9	24.7	187	OT, SC	13	F	16.943	1.813	168	1.24	0.091	0.010	-	-	-	-	-	O,M	-
		total sample size	**10**	**10**	**10**	-	**10**	-	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**25.8**	**23.1**	**129**	-	**8.5**	-	**13.525**	**1.787**	**113.688**	**1.04**	**0.106**	**0.014**	-	-	-	-	-	-	-
		median	**25.8**	**23.0**	**124.5**	-	**8.5**	-	**13.123**	**1.694**	**107.832**	**1.01**	**0.096**	**0.011**	-	-	-	-	-	-	-
		standard deviation	**1.40**	**0.74**	**25.6**	-	**2.07**	-	**3.787**	**0.876**	**23.985**	**0.1529**	**0.027**	**0.0089**	-	-	-	-	-	-	-
		standard error	**0.442**	**0.234**	**8.09**	-	**0.65**	-	**1.197**	**0.277**	**7.585**	**0.0483**	**0.0086**	**0.0028**	-	-	-	-	-	-	-
		minimum	**24.4**	**22.2**	**103**	-	**6**	-	**8.704**	**0.978**	**90.530**	**0.822**	**0.083**	**0.009**	-	-	-	-	-	-	-
		maximum	**28.9**	**24.7**	**187**	-	**13**	-	**19.735**	**4.069**	**168.244**	**1.28**	**0.158**	**0.039**	-	-	-	-	-	-	-
Elk River	25-May-22	RG_ER_PCC-01	25.8	22.3	113	OT, SC	5	F	4.155	1.368	107	1.02	0.037	0.012	-	-	L	-	12.093	O,M	-
	26-May-22	RG_ER_PCC-02	23.7	21.5	90	OT, SC	6	F	2.069	1.454	86	0.91	0.023	0.016	-	-	F,L	-	8.687	O,M	-
	26-May-22	RG_ER_PCC-03	26.7	23.0	148	OT, SC	9	F	13.223	3.187	132	1.22	0.089	0.022	-	-	F	-	-	O,M	-
	26-May-22	RG_ER_PCC-04	24.4	20.9	111	OT, SC	9	F	10.932	2.122	98	1.22	0.098	0.019	-	F	-	-	-	O,M	-
	26-May-22	RG_ER_PCC-05	25.5	23.0	122	OT, SC	8	F	13.894	1.940	106	1.00	0.114	0.016	-	-	F	-	-	O,M	-
	27-May-22	RG_ER_PCC-06	24.5	21.9	110	OT, SC	9	F	14.759	2.278	93	1.05	0.134	0.021	-	-	-	-	-	O,M	-
	27-May-22	RG_ER_PCC-07	27.3	24.7	154	OT, SC	9	F	22.935	1.690	129	1.02	0.149	0.011	-	-	-	-	-	O,M	-
	27-May-22	RG_ER_PCC-08	28.1	25.4	168	OT, SC	14	F	21.821	2.748	143	1.03	0.130	0.016	-	-	-	-	-	O,M	-
	27-May-22	RG_ER_PCC-09	27.2	24.5	134	OT, SC	8	F	14.612	2.070	117	0.91	0.109	0.015	-	-	-	-	-	O,M	-
	27-May-22	RG_ER_PCC-10	26.8	23.6	155	OT, SC	7	F	20.530	2.317	132	1.18	0.132	0.015	-	-	-	-	-	O,M	-
		total sample size	**10**	**10**	**10**	-	**10**	-	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**26.0**	**23.1**	**131**	-	**8.4**	-	**13.893**	**2.117**	**114.490**	**1.05**	**0.102**	**0.016**	-	-	-	-	-	-	-
		median	**26.3**	**23.0**	**128**	-	**8.5**	-	**14.253**	**2.096**	**112.398**	**1.02**	**0.111**	**0.016**	-	-	-	-	-	-	-
		standard deviation	**1.46**	**1.47**	**25.2**	-	**2.41**	-	**6.942**	**0.560**	**19.183**	**0.11**	**0.042**	**0.003**	-	-	-	-	-	-	-
		standard error	**0.460**	**0.466**	**7.96**	-	**0.76**	-	**2.195**	**0.177**	**6.066**	**0.04**	**0.013**	**0.001**	-	-	-	-	-	-	-
		minimum	**23.7**	**20.9**	**90**	-	**5**	-	**2.069**	**1.368**	**86.477**	**0.91**	**0.023**	**0.011**	-	-	-	-	-	-	-
		maximum	**28.1**	**25.4**	**168.0**	-	**14**	-	**22.935**	**3.187**	**143.431**	**1.22**	**0.149**	**0.022**	-	-	-	-	-	-	-
Gold Creek	27-May-22	RG_GC_PCC-01	24.8	22.2	120	OT, SC	5	F	3.599	1.613	115	1.10	0.030	0.013	-	-	L	-	12.089	O,M	-
	27-May-22	RG_GC_PCC-02	28.5	25.1	174	OT, SC	10	F	23.919	2.302	148	1.10	0.137	0.013	-	-	-	-	-	O,M	-
	27-May-22	RG_GC_PCC-03	26.5	23.6	140	OT, SC	9	F	15.080	2.997	122	1.07	0.108	0.021	-	-	-	-	-	O,M	-
	27-May-22	RG_GC_PCC-04	23.8	21.2	113	OT, SC	8	F	10.003	3.585	99	1.19	0.089	0.032	-	L	-	-	2.030	O,M	-
	27-May-22	RG_GC_PCC-05	26.5	23.6	142	OT, SC	7	F	9.997	1.952	130	1.08	0.070	0.014	-	L	-	-	6.715	O,M	black spots on liver
	27-May-22	RG_GC_PCC-06	25.3	22.6	135	OT, SC	7	F	13.692	2.506	119	1.17	0.101	0.019	-	-	-	-	-	O,M	-
	27-May-22	RG_GC_PCC-07	25.0	22.5	129	OT, SC	7	F	15.309	2.780	111	1.13	0.119	0.022	-	-	-	-	-	O,M	-
	27-May-22	RG_GC_PCC-08	28.1	25.5	165	OT, SC	8	F	16.012	2.500	146	1.00	0.097	0.015	-	L	-	-	-	O,M	fatty liver, tiny worms
	27-May-22	RG_GC_PCC-09	28.6	25.8	190	OT, SC	9	F	23.900	3.480	163	1.11	0.126	0.018	-	-	-	-	-	O,M	-
	27-May-22	RG_GC_PCC-10	27.0	24.0	140	OT, SC	10	F	15.414	2.858	122	1.01	0.110	0.020	-	-	-	-	-	O,M	black spots on liver
		total sample size	**10**	**10**	**10**	-	**10**	-	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**26.4**	**23.6**	**145**	-	**8**	-	**14.693**	**2.657**	**127.450**	**1.09**	**0.099**	**0.019**	-	-	-	-	-	-	-
		median	**26.5**	**23.6**	**140**	-	**8**	-	**15.195**	**2.643**	**121.826**	**1.10**	**0.105**	**0.018**	-	-	-	-	-	-	-
		standard deviation	**1.67**	**1.52**	**24.3**	-	**1.56**	-	**6.154**	**0.621**	**19.372**	**0.06**	**0.031**	**0.006**	-	-	-	-	-	-	-
		standard error	**0.527**	**0.481**	**7.70**	-	**0.49**	-	**1.946**	**0.196**	**6.126**	**0.02**	**0.010**	**0.002**	-	-	-	-	-	-	-
		minimum	**23.8**	**21.2**	**113**	-	**5**	-	**3.599**	**1.613**	**99.412**	**1.00**	**0.030**	**0.013**	-	-	-	-	-	-	-
		maximum	**28.6**	**25.8**	**190**	-	**10**	-	**23.919**	**3.585**	**162.620**	**1.19**	**0.137**	**0.032**	-	-	-	-	-	-	-

Note: M = Muscle, O = Ovary, "-" = no data.

[a] Age structures collected: sc - scales, oto - otoliths.

[b] Adjusted Body Weight = Body Weight - Liver Weight - Gonad Weight.

[c] Severity assessment for anomalies noted during fish health assessment. Anomalies are rated on a scale of 0 to 3, with 0 being no anomaly, 1 being slight, 2, being moderate, and 3 being severe. Anomalies are categorized based on the characteristic affected, and are noted by a letter (A = body surface, B = body form, C = lesions, D = tumors, F = fins, G = lips/jaws/snout, H = eyes, I = gills, J = opercula, K = bacterial/fungal/viral infection, L = parasites).

Table E.5: Fish Meristics Data for Redside Shiner, Koocanusa Reservoir Monitoring Program, June 2022

Area	Processing Date	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Age Structure Collected [a]	Age	Sex	Gonad Weight (g)	Liver Weight (g)	Adjusted Body Weight (g)[b]	Fulton's Condition Factor (K)	Gonado-somatic Index	Hepato-somatic Index	Anomalies[c]				Worm Weight (g)	Tissue Collected	Comment
															0	1	2	3			
Sand Creek	21-Jun-22	RG_SC_RSC-01	9.7	8.5	8.953	OT, SC	3	F	0.940	0.135	7.878	1.46	0.105	0.015	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-02	10.1	8.2	8.148	OT, SC	3	F	0.769	0.108	7.271	1.48	0.094	0.013	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-03	10.3	9.0	8.059	OT, SC	4	F	0.409	0.032	7.618	1.11	0.051	0.004	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-04	9.7	8.5	7.191	OT, SC	3	F	0.471	0.087	6.633	1.17	0.065	0.012	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-05	10.4	9.1	9.642	OT, SC	4	F	0.747	0.065	8.830	1.28	0.077	0.007	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-06	9.9	8.5	8.480	OT, SC	4	F	0.549	0.136	7.795	1.38	0.065	0.016	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-07	9.7	8.5	8.047	OT, SC	3	F	0.712	0.103	7.232	1.31	0.088	0.013	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-08	9.2	8.1	6.441	OT, SC	3	F	0.450	0.110	5.881	1.21	0.070	0.017	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-09	9.6	8.2	6.947	OT, SC	4	F	0.339	0.055	6.553	1.26	0.049	0.008	-	-	-	-	-	O,M	-
	21-Jun-22	RG_SC_RSC-10	11.6	10.5	13.496	OT, SC	5	F	0.896	0.190	12.410	1.17	0.066	0.014	-	-	-	-	-	O,M	-
		total sample size	**10**	**10**	**10**	**-**	**10**	**-**	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**10.0**	**8.7**	**9**	**-**	**3.6**	**-**	**0.628**	**0.102**	**7.810**	**1.28**	**0.073**	**0.012**	-	-	-	-	-	-	-
		median	**9.8**	**8.5**	**8.1035**	**-**	**3.5**	**-**	**0.631**	**0.106**	**7.445**	**1.27**	**0.068**	**0.013**	-	-	-	-	-	-	-
		standard deviation	**0.66**	**0.71**	**2.0**	**-**	**0.70**	**-**	**0.212**	**0.046**	**1.812**	**0.1257**	**0.018**	**0.0043**	-	-	-	-	-	-	-
		standard error	**0.208**	**0.224**	**0.63**	**-**	**0.22**	**-**	**0.067**	**0.014**	**0.573**	**0.0397**	**0.0058**	**0.0014**	-	-	-	-	-	-	-
		minimum	**9.2**	**8.1**	**6**	**-**	**3**	**-**	**0.339**	**0.032**	**5.881**	**1.105**	**0.049**	**0.004**	-	-	-	-	-	-	-
		maximum	**11.6**	**10.5**	**13.496**	**-**	**5**	**-**	**0.940**	**0.190**	**12.410**	**1.48**	**0.105**	**0.017**	-	-	-	-	-	-	-
Elk River	21-Jun-22	RG_ER_RSC-01	11.2	9.9	15.141	OT, SC	4	F	1.987	0.189	12.965	1.56	0.131	0.012	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-02	10.4	9.1	10.002	OT, SC	4	F	0.654	0.112	9.236	1.33	0.065	0.011	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-03	9.7	8.5	9.582	OT, SC	4	F	0.618	0.174	8.790	1.56	0.064	0.018	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-04	10.2	9.0	10.007	OT, SC	4	F	0.832	0.150	9.025	1.37	0.083	0.015	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-05	10.5	9.9	11.233	OT, SC	4	F	1.237	0.287	9.709	1.16	0.110	0.026	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-06	9.9	8.7	8.999	OT, SC	4	F	0.642	0.130	8.227	1.37	0.071	0.014	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-07	10.0	8.9	9.931	OT, SC	3	F	1.359	0.066	8.506	1.41	0.137	0.007	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-08	10.2	9.2	8.535	OT, SC	3	F	0.641	0.235	7.659	1.10	0.075	0.028	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-09	10.0	8.4	8.587	OT, SC	4	F	0.899	0.186	7.502	1.45	0.105	0.022	-	-	-	-	-	O,M	-
	21-Jun-22	RG_ER_RSC-10	9.5	8.9	8.962	OT, SC	3	F	1.090	0.205	7.667	1.27	0.122	0.023	-	-	-	-	-	O,M	-
		total sample size	**10**	**10**	**10**	**-**	**10**	**-**	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**10.2**	**9.1**	**10**	**-**	**3.7**	**-**	**0.996**	**0.173**	**8.929**	**1.36**	**0.096**	**0.018**	-	-	-	-	-	-	-
		median	**10.1**	**9.0**	**9.7565**	**-**	**4**	**-**	**0.866**	**0.180**	**8.648**	**1.37**	**0.094**	**0.017**	-	-	-	-	-	-	-
		standard deviation	**0.47**	**0.51**	**2.0**	**-**	**0.48**	**-**	**0.438**	**0.063**	**1.596**	**0.15**	**0.028**	**0.007**	-	-	-	-	-	-	-
		standard error	**0.150**	**0.162**	**0.62**	**-**	**0.15**	**-**	**0.139**	**0.020**	**0.505**	**0.05**	**0.009**	**0.002**	-	-	-	-	-	-	-
		minimum	**9.5**	**8.4**	**8.535**	**-**	**3**	**-**	**0.618**	**0.066**	**7.502**	**1.10**	**0.064**	**0.007**	-	-	-	-	-	-	-
		maximum	**11.2**	**9.9**	**15.1**	**-**	**4**	**-**	**1.987**	**0.287**	**12.965**	**1.56**	**0.137**	**0.028**	-	-	-	-	-	-	-
Gold Creek	22-Jun-22	RG_GC_RSC-01	10.1	9.0	10.737	OT, SC	3	F	1.683	0.158	8.896	1.47	0.157	0.015	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-02	9.2	8.2	8.333	OT, SC	3	F	0.320	0.124	7.889	1.51	0.038	0.015	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-03	12.3	10.3	15.677	OT, SC	4	F	2.342	0.407	12.928	1.43	0.149	0.026	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-04	10.2	9.1	10.001	OT, SC	4	F	1.003	0.149	8.849	1.33	0.100	0.015	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-05	10.5	10.0	12.330	OT, SC	3	F	1.885	0.119	10.326	1.23	0.153	0.010	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-06	10.6	9.4	11.807	OT, SC	4	F	1.128	0.257	10.422	1.42	0.096	0.022	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-07	11.1	10.1	14.340	OT, SC	5	F	1.716	0.545	12.079	1.39	0.120	0.038	-	-	-	-	-	O,M	liver very fatty
	22-Jun-22	RG_GC_RSC-08	11.2	9.3	12.325	OT, SC	4	F	1.795	0.157	10.373	1.53	0.146	0.013	-	-	-	-	-	O,M	-
	22-Jun-22	RG_GC_RSC-09	10.2	8.8	10.853	OT, SC	3	F	0.820	0.264	9.769	1.59	0.076	0.024	L	-	-	-	0.214	O,M	fatty liver
	22-Jun-22	RG_GC_RSC-10	9.9	8.8	10.783	OT, SC	3	F	1.739	0.257	8.787	1.58	0.161	0.024	-	-	-	-	-	O,M	-
		total sample size	**10**	**10**	**10**	**-**	**10**	**-**	**10**	**10**	**10**	**10**	**10**	**10**	-	-	-	-	-	-	-
		average	**10.5**	**9.3**	**12**	**-**	**3.6**	**-**	**1.443**	**0.244**	**10.032**	**1.45**	**0.120**	**0.020**	-	-	-	-	-	-	-
		median	**10.4**	**9.2**	**11**	**-**	**3.5**	**-**	**1.700**	**0.208**	**10.048**	**1.45**	**0.133**	**0.018**	-	-	-	-	-	-	-
		standard deviation	**0.85**	**0.66**	**2.1**	**-**	**0.70**	**-**	**0.605**	**0.138**	**1.558**	**0.11**	**0.041**	**0.008**	-	-	-	-	-	-	-
		standard error	**0.268**	**0.210**	**0.67**	**-**	**0.22**	**-**	**0.191**	**0.044**	**0.493**	**0.04**	**0.013**	**0.003**	-	-	-	-	-	-	-
		minimum	**9.2**	**8.2**	**8.333**	**-**	**3**	**-**	**0.320**	**0.119**	**7.889**	**1.23**	**0.038**	**0.010**	-	-	-	-	-	-	-
		maximum	**12.3**	**10.3**	**15.677**	**-**	**5**	**-**	**2.342**	**0.545**	**12.928**	**1.59**	**0.161**	**0.038**	-	-	-	-	-	-	-

Note: M = Muscle, O = Ovary, "-" = no data.

[a] Age structures collected: sc - scales, oto - otoliths

[b] Adjusted Body Weight = Body Weight - Liver Weight - Gonad Weight

[c] Severity assessment for anomalies noted during fish health assessment. Anomalies are rated on a scale of 0 to 3, with 0 being no anomaly, 1 being slight, 2, being moderate, and 3 being severe. Anomalies are categorized based on the characteristic affected, and are noted by a letter (A = body surface, B = body form, C = lesions, D = tumors, F = fins, G = lips/jaws/snout, H = eyes, I = gills, J = opercula, K = bacterial/fungal/viral infection, L = parasites).

Table E.6: Fish Meristics Data for Sport Fish, Koocanusa Reservoir Monitoring Program, May to July 2022

Area	Species	Month	Fish ID	Total Length (cm)	Fork Length (cm)	Body Weight (g)	Anomalies[a]				Tissue Collected	Comment
							0	1	2	3		
RG_SC	Bull Trout	May	RG_SC_BT-01_2022-05-25	49.1	46.5	1,050	-	F	-	-	MP	torn caudal fin
		June	RG_SC_BT-2_2022-06-22	66.0	64.0	2,400	-	-	-	-	MP	-
			RG_SC_BT-5_2022-06-23	65.0	64.0	2,600	-	-	-	-	MP	-
			RG_SC_BT-6_2022-06-23	63.0	61.0	2,350	-	-	-	-	MP	-
			RG_SC_BT-7_2022-06-23	61.5	59.5	2500	-	-	-	-	MP	-
RG_GC	Bull Trout	May	RG_GC_BT-01_2022-05-27	32.2	30	265	-	-	-	-	MP	-
			RG_GC_BT-02_2022-05-27	79.1	62	3600	-	-	-	-	MP	-
		June	RG_GC_BT-3_2022-06-22	59	56.5	2200	-	-	-	-	MP	-
			RG_GC_BT-4_2022-06-22	38.5	30.3	480	-	-	-	-	MP	-
			RG_GC_BT-8_2022-06-29	71.5	70	3510	-	-	-	-	MP	-
	Rainbow Trout	May	RG_GC_RB-01_2022-05-27	31.3	29.1	235	-	-	-	-	MP	-
			RG_GC_RB-02_2022-05-27	35.5	33.1	390	-	-	-	-	MP	-
			RG_GC_RB-03_2022-05-27	33.5	31	280	-	-	-	-	MP	-
			RG_GC_RB-04_2022-05-27	35	33	325	-	-	-	-	MP	-
	Westslope Cutthroat Trout	June	RG_GC_WCT-1_2022-06-23	39	37	495	-	-	-	-	MP	-
	Kokanee		RG_GC_KO-1_2022-06-22	15.0	13.5	25	-	-	-	-	MP	-
			RG_GC_KO-2_2022-06-22	16.4	14.8	27	-	-	-	-	MP	-
	Yellow Perch		RG_GC_YP-1_2022-06-22	11.2	10.5	25	-	-	-	-	MP	-
			RG_GC_YP-2_2022-06-22	10.2	9.7	10	-	-	-	-	MP	-
		July	RG_GC_YP-3_2022-07-12	32.4	31	400	-	-	-	-	MP	-
RG_ER	Bull Trout	May	RG_ER_BT-01_2022-05-27	71.0	69.5	3,100	-	-	-	-	MP	-
		June	RG_ER_BT-6_2022-06-25	58.3	55.0	2,000	-	-	-	-	MP	-
			RG_ER_BT-7_2022-06-25	66.4	63.5	3,100	-	-	-	-	MP	-
			RG_ER_BT-8_2022-06-25	76.3	72.2	3,550	-	-	-	-	MP	-
		July	RG_ER_BT-9_2022-07-12	75	71	-	-	-	-	-	MP	no body weight taken
			RG_ER_BT-10_2022-07-14	42.5	44.5	1,000	-	-	-	-	MP	-
			RG_ER_BT-11_2022-07-14	52.5	50.0	1,300	-	-	-	-	MP	-
	Eastern Brook Trout	May	RG_ER_EB-01_2022-05-26	25.0	23.8	-	-	-	-	-	MP	-
			RG_ER_EB-02_2022-05-26	32.5	30.5	-	-	-	-	-	MP	-
	Mountain Whitefish		RG_ER_MW-01_2022-05-26	-	22.9	-	-	-	-	F	MP	missing tail fin
		July	RG_ER_MW-2_2022-07-17	34.4	31.8	375	-	-	-	-	MP	-
			RG_ER_MW-3_2022-07-17	32.3	29.9	310	-	-	-	-	MP	-
	Rainbow Trout	June	RG_ER_RBT-1_2022-06-25	40.0	37.4	1,500	-	-	-	-	MP	-

Notes: "-" = no available data; MP = muscle plug.

[a] Severity assessment for anomalies noted during fish health assessment. Anomalies are rated on a scale of 0 to 3, with 0 being no anomaly, 1 being slight, 2, being moderate, and 3 being severe. Anomalies are categorized based on the characteristic affected, and are noted by a letter (A = body surface, B = body form, C = lesions, D = tumors, F = fins, G = lips/jaws/snout, H = eyes, I = gills, J = opercula, K = bacterial/fungal/viral infection, L = parasites).

APPENDIX F

TISSUE

Table F.1: Tissue Metals Analysis for Benthic Invertebrates and Zooplankton Samples Downstream (RG_T4) and Upstream (RG_TN and RG_SAND) of the Elk River, Koocanusa Reservoir Monitoring Program, 2022

Parameter	Unit	Benthic Invertebrates			Zooplankton									
		August			August									
		RG_SAND	RG_TN	RG_T4	RG_TN					RG_T4				
		RG_SAND_INV-1_2022-08-27	RG_TN_INV-1_2022-08-25	RG_T4_INV-1_2022-08-26	RG_TN_ZOOT-1_2022-08-25	RG_TN_ZOOT-2_2022-08-25	RG_TN_ZOOT-3_2022-08-25	RG_TN_ZOOT-4_2022-08-25	RG_TN_ZOOT-5_2022-08-25	RG_T4_ZOOT-1_2022-08-26	RG_T4_ZOOT-2_2022-08-26	RG_T4_ZOOT-3_2022-08-26	RG_T4_ZOOT-4_2022-08-26	RG_T4_ZOOT-5_2022-08-26
Wet Weight	g	0.0138	0.0649	0.0669	0.835	2.01	2.43	0.576	1.40	3.02	1.19	2.40	1.40	4.91
Dry Weight	g	0.00320	0.0224	0.0165	0.0289	0.108	0.0795	0.0422	0.0559	0.114	0.0795	0.0965	0.0810	0.194
Moisture	%	76.8	65.5	75.3	96.5	94.7	96.7	92.7	96.0	96.2	93.3	96.0	94.2	96.1
Aluminum	mg/kg	32,565	36,524	30,043	2,178	2,275	3,289	1,762	3,044	1,412	1,969	2,295	2,419	1,639
Antimony	mg/kg	0.610	0.499	0.639	0.138	0.0650	0.158	0.0710	0.101	0.0860	0.0850	0.0740	0.0700	0.0320
Arsenic	mg/kg	12.0	18.0	10.0	2.70	2.80	2.30	2.90	2.70	3.50	3.10	2.90	3.00	2.60
Barium	mg/kg	605	633	646	212	148	266	217	262	133	223	178	192	138
Boron	mg/kg	19.0	19.0	20.0	2.40	1.70	2.40	1.60	2.80	1.20	1.80	2.10	2.10	2.20
Cadmium	mg/kg	1.60	0.253	2.90	0.723	0.759	1.30	0.849	0.940	1.20	1.10	1.10	1.00	0.867
Calcium	mg/kg	35,173	38,954	27,863	54,778	44,559	65,495	66,310	66,491	39,930	62,206	43,241	46,158	34,376
Chromium	mg/kg	10.0	171	424	6.30	2.60	5.80	5.10	8.30	4.70	10.0	7.40	12.0	7.30
Cobalt	mg/kg	8.50	13.0	18.0	1.20	0.854	1.20	0.877	0.962	0.786	1.10	0.799	0.956	0.782
Copper	mg/kg	24.0	18.0	41.0	7.90	7.80	11.0	9.10	9.10	8.30	8.60	7.70	7.30	7.70
Iron	mg/kg	15,998	15,466	18,255	1,395	1,087	1,738	1,167	1,748	737	1,265	1,278	1,269	969
Lead	mg/kg	20.0	18.0	16.0	2.00	1.40	2.10	1.30	1.90	1.50	1.00	1.40	1.30	0.898
Lithium	mg/kg	16.0	16.0	15.0	1.10	1.10	1.40	0.914	1.50	0.718	1.10	1.10	1.30	0.866
Magnesium	mg/kg	7,921	8,488	7,501	2,222	1,833	1,970	1,944	2,040	1,952	2,278	1,986	2,025	1,794
Manganese	mg/kg	239	228	267	53.0	48.0	75.0	55.0	74.0	39.0	52.0	56.0	62.0	36.0
Mercury	mg/kg	0.119	0.172	0.172	0.0430	0.0460	0.0690	0.0590	0.0590	0.0860	0.119	0.0990	0.0860	0.0790
Molybdenum	mg/kg	0.687	0.733	2.10	0.229	0.275	0.263	0.252	0.275	0.275	0.252	0.252	0.229	0.229
Nickel	mg/kg	12.0	201	412	7.90	3.80	7.30	6.40	9.80	5.30	11.0	9.10	13.0	8.90
Phosphorus	mg/kg	8,720	8,059	9,570	16,732	14,425	26,182	18,481	21,869	15,870	26,076	18,593	20,131	14,564
Potassium	mg/kg	16,530	15,764	16,908	5,383	10,221	3,470	8,926	6,980	8,418	5,581	5,463	6,716	4,984
Selenium	mg/kg	7.80	6.50	10.0	3.10	2.80	3.10	2.80	2.50	3.70	4.00	3.70	3.40	3.40
Silver	mg/kg	0.0870	0.0810	0.180	0.0350	0.0350	0.0470	0.0290	0.0350	0.0410	0.0440	0.0470	0.0350	0.0350
Sodium	mg/kg	4,167	3,708	5,483	1,461	4,084	1,030	3,624	2,506	2,893	2,137	1,959	2,485	1,962
Strontium	mg/kg	97.0	108	66.0	137	103	152	159	160	89.0	141	101	105	85.0
Thallium	mg/kg	0.344	0.279	0.320	0.0350	0.0420	0.0540	0.0480	0.0450	0.0380	0.0400	0.0400	0.0420	0.0310
Tin	mg/kg	1.60	2.00	1.90	3.10	1.80	2.50	1.20	1.50	3.40	1.90	2.40	1.50	2.00
Titanium	mg/kg	2,379	2,991	2,368	148	154	228	122	221	69.0	119	158	140	114
Uranium	mg/kg	0.781	0.951	0.718	0.130	0.0930	0.148	0.0820	0.125	0.0930	0.118	0.136	0.129	0.102
Vanadium	mg/kg	26.0	32.0	39.0	2.00	1.70	2.40	1.70	2.70	1.30	1.60	2.00	2.30	1.30
Zinc	mg/kg	104	73.0	104	79.0	54.0	95.0	80.0	74.0	96.0	84.0	75.0	78.0	61.0

Table F.2: Analysis for Peamouth Chub Muscle and Ovary Tissue Samples, Koocanusa Reservoir Monitoring Program, May 2022

Tissue	Area	Sample ID	Wet Weight	Dry Weight	Moisture	Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium
			g	g	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Muscle	RG_SC	RG_SC_PCC_M-01_2022-05-25_NP	5.4792	1.1727	78.6	8.0	0	<0.487	3.9	0	0	1,308	1.8	0.145	1.5	45	0.429	0.037	1,146
		RG_SC_PCC_M-02_2022-05-25_NP	5.0716	1.0337	79.6	7	0	<0.487	4	0.433	0.182	1,813	2.3	0.322	2.1	93	0.381	0.088	1,199
		RG_SC_PCC_M-03_2022-05-25_NP	4.6203	0.9831	78.7	13.000	0	<0.487	8.1	0	0	1,410	1.7	0.199	2.0	54	1	0.081	1,323
		RG_SC_PCC_M-04_2022-05-25_NP	6.1752	1.3375	78.3	7.200	0.049	<0.487	7.8	0	0	1,709	1.6	0.173	1.7	46	0.299	0.047	1,715
		RG_SC_PCC_M-05_2022-05-26_NP	1.6303	0.3729	77.1	9.100	0	<0.487	6.3	0	0	1,941	2.1	0.179	1.8	51	0.286	0	1,808
		RG_SC_PCC_M-06_2022-05-26_NP	2.3784	0.5261	77.9	29.000	0	<0.487	3.3	0	0	1,611	2.2	0.100	1.9	60	0.115	0	1,566
		RG_SC_PCC_M-07_2022-05-26_NP	3.5435	0.7648	78.4	7.700	0	<0.487	4.4	0	<0.037	1,449	2.1	0.100	2.1	49	0.113	0	1,104
		RG_SC_PCC_M-08_2022-05-26_NP	2.3302	0.4962	78.7	72.0	0	1	16.0	0	0	1,672	4.1	0.699	5.3	101	1.700	0	1,563
		RG_SC_PCC_M-09_2022-05-26_NP	3.9413	0.8308	78.9	2.000	0	<0.487	1.9	<0.091	0	1,268	1.7	0.140	1.1	46	0.087	0.042	1,062
		RG_SC_PCC_M-10_2022-05-26_NP	7.0780	1.3715	80.6	8.0	0	0	7.8	0	0.184	1,538	2.0	0.261	1.9	83	0.495	0.075	1,517
	RG_ER	RG_ER_PCC_M-01_2022-05-25_NP	2.6913	0.5678	78.9	1.8	0	<0.487	4.0	0.286	0	1,379	1.6	0.093	1.6	25	0.110	0	1,517
		RG_ER_PCC_M-02_2022-05-26_NP	5.2089	1.1073	78.7	4.2	0	<0.487	6.5	0	0	1,374	2.0	0.198	1.6	34	0.256	0	1,447
		RG_ER_PCC_M-03_2022-05-26_NP	7.0049	1.5079	78.5	7.4	0	<0.487	16.0	0	0	764	1.7	0.155	8.8	103	0.105	0	1,338
		RG_ER_PCC_M-04_2022-05-26_NP	6.3411	1.3317	79	9.2	0	<0.487	3.3	0	0	1,267	1.6	0.056	1.4	36	0.216	0.040	1,525
		RG_ER_PCC_M-05_2022-05-26_NP	6.5231	1.3377	79.5	15.0	0	<0.487	4.4	0	0	1,133	1.7	0.059	1.6	57	0.174	0.080	1,275
		RG_ER_PCC_M-06_2022-05-27_NP	3.6382	0.7899	78.3	.5	0.018	<0.487	2.1	0	<0.037	943	1.4	0.035	1.9	30	0.011	0.032	1,460
		RG_ER_PCC_M-07_2022-05-27_NP	4.8208	0.9793	79.7	3.5	0	<0.487	3.9	0	0	1,107	1.5	0.061	3.3	62	0.131	0.048	1,380
		RG_ER_PCC_M-08_2022-05-27_NP	7.8505	1.6103	79.5	3.2	0	<0.487	2.8	0	0	1,166	1.6	0.084	1.3	26	0.101	0	1,400
		RG_ER_PCC_M-09_2022-05-27_NP	6.8736	1.4065	79.5	2.400	0	<0.487	4.8	0	1	1,477	1.5	0.075	1.800	41	0	0	1,679
		RG_ER_PCC_M-10_2022-05-27_NP	5.3752	1.1693	78.2	.5	0	<0.487	1.1	<0.091	0	905	1.2	0.012	1	13	0.009	0.024	1,277
	RG_GC	RG_GC_PCC_M-01_2022-05-27_NP	6.9443	1.5491	77.7	6.7	0	<0.487	5.4	0.201	0	1,725	1.5	0.129	1.2	46	0.263	0.052	1,810
		RG_GC_PCC_M-02_2022-05-27_NP	9.2044	1.9860	78.4	6.0	0	1	6.3	0	0	1,633	2.0	0.268	2.2	39	0.381	0.078	2,034
		RG_GC_PCC_M-03_2022-05-27_NP	3.6201	0.7836	78.4	15.0	0	<0.487	8.1	0.482	0	1,879	1.9	0.186	2.2	45	0.370	0.044	2,085
		RG_GC_PCC_M-04_2022-05-27_NP	5.0025	1.1204	77.6	7.400	0	<0.487	2.400	0	0	1,399	1.5	0.038	2.0	42	0	0.017	1,723
		RG_GC_PCC_M-05_2022-05-27_NP	3.3415	0.7309	78.1	4.9	0.016	<0.487	1.9	0.201	1	1,150	1.3	0.044	1.1	25	0.076	0.026	1,199
		RG_GC_PCC_M-06_2022-05-27_NP	5.9756	1.3229	77.9	24.000	0	<0.487	9.6	0	0	1,295	1.5	0.057	1.5	44	0.047	0	1,693
		RG_GC_PCC_M-07_2022-05-27_NP	4.6466	1.0448	77.5	22.000	0	<0.487	3.6	0	0	1,189	1.6	0.063	1.8	53	0.104	0	1,303
		RG_GC_PCC_M-08_2022-05-27_NP	5.4029	1.1826	78.1	2.000	0	<0.487	1.7	0	0	988	1.5	0.038	1.3	16	0.049	0	1,254
		RG_GC_PCC_M-09_2022-05-27_NP	4.2897	0.9430	78	12.000	0	<0.487	2.8	0	0	1,215	1.6	0.107	1.6	36	0.163	0	1,625
		RG_GC_PCC_M-10_2022-05-27_NP	2.7904	0.6102	78.1	18.000	0	<0.487	6.9	0	0	1,794	2.0	0.104	2.0	66	0.450	0	1,857
Ovary	RG_SC	RG_SC_PCC_O-01_2022-05-25_NP	9.0336	3.4317	62.0	3.7	0	<0.487	4.7	0	0.063	744	1.7	0.103	5.1	118	0.090	0.020	1,085
		RG_SC_PCC_O-02_2022-05-25_NP	9.4727	3.3920	64.2	0.675	0	<0.487	1.7	<0.091	<0.037	530	1.4	0.079	3.5	67	0.016	<0.016	877
		RG_SC_PCC_O-03_2022-05-25_NP	12.9903	4.8658	62.5	1.3	0	<0.487	3.9	0	0	579	1.4	0.119	3.5	72	0.063	0	732
		RG_SC_PCC_O-04_2022-05-25_NP	13.9723	5.3821	61.5	2.9	0	<0.487	3.4	0	0	649	1.7	0.115	4.9	57	0.092	0	963
		RG_SC_PCC_O-05_2022-05-26_NP	18.9951	7.8851	58.5	1.3	0.018	<0.487	1.9	0	0	535	1.5	0.085	2.8	52	0.082	0	714
		RG_SC_PCC_O-06_2022-05-26_NP	17.1246	6.7213	60.8	1.1	0.007	<0.487	1.8	<0.091	0	367	1.2	0.056	3.1	58	0.013	<0.016	779
		RG_SC_PCC_O-07_2022-05-26_NP	10.6300	3.9813	62.5	2.000	0	<0.487	2.5	<0.091	0	461	1.2	0.054	2.5	48	0	<0.016	870
		RG_SC_PCC_O-08_2022-05-26_NP	8.3272	2.9935	64.1	0.973	0	<0.487	2.4	<0.091	0	613	1.5	0.070	4.9	57	0.024	<0.016	1,158
		RG_SC_PCC_O-09_2022-05-26_NP	12.1089	4.3332	64.2	7.4	0	<0.487	3.2	<0.091	<0.037	545	1.2	0.068	3.0	96	0.024	0	972
		RG_SC_PCC_O-10_2022-05-26_NP	16.1928	5.8498	63.9	7.6	0.031	<0.487	8.6	0.1	0.07	654	1.7	0.119	4.3	148	0.112	0.027	1149
	RG_ER	RG_ER_PCC_O-01_2022-05-25_NP	3.9695	1.1762	70.4	.6	0	<0.487	1.9	<0.091	0	878	1.5	0.070	4.400	114	0	0.017	1,639
		RG_ER_PCC_O-02_2022-05-26_NP	1.6741	0.3673	78.1	62.000	0	<0.487	19.0	1	1	1,430	2.3	0.163	5.2	263	0	0.092	1,349
		RG_ER_PCC_O-03_2022-05-26_NP	12.7270	4.4621	64.9	4.2	0	<0.487	5.7	0	0	877	1.3	0.056	3.4	79	0.022	0.025	1,044
		RG_ER_PCC_O-04_2022-05-26_NP	10.4871	3.8559	63.2	7.2	0.007	<0.487	6.3	<0.091	0	611	1.3	0.065	4.500	130	0.030	0.017	1,062
		RG_ER_PCC_O-05_2022-05-26_NP	13.1447	4.8811	62.9	9.800	0	<0.487	2.4	<0.091	0	490	1.4	0.051	2.600	48	0.028	0	836
		RG_ER_PCC_O-06_2022-05-27_NP	13.7738	5.4448	60.5	.9	0	<0.487	4.1	0.122	0	363	1.6	0.093	3.8	59	0.067	0.021	992
		RG_ER_PCC_O-07_2022-05-27_NP	21.5427	8.5357	60.4	.6	0	<0.487	4.0	<0.091	<0.037	407	1.5	0.051	3.5	57	0.007	0.017	880
		RG_ER_PCC_O-08_2022-05-27_NP	21.1134	8.1187	61.5	0.952	0	<0.487	6.6	<0.091	0	624	1.5	0.091	4.300	63	0	0.017	1,154
		RG_ER_PCC_O-09_2022-05-27_NP	14.0323	5.3765	61.7	1.700	0	<0.487	4.9	0	0	402	1.7	0.084	4.5	74	0.026	0	976
		RG_ER_PCC_O-10_2022-05-27_NP	19.7097	7.8288	60.3	.5	0.006	<0.487	2.0	<0.091	0	286	1.4	0.047	2.5	55	0.006	<0.016	790
	RG_GC	RG_GC_PCC_O-01_2022-05-27_NP	3.2241	0.8356	74.1	1.000	0	<0.487	3.0	<0.091	0	964	1.1	0.061	5.1	119	0.017	0	1,564
		RG_GC_PCC_O-02_2022-05-27_NP	22.3984	8.5604	61.8	2.500	0	<0.487	4.0	<0.091	<0.037	470	1.1	0.047	2.9	51	0.006	<0.016	687
		RG_GC_PCC_O-03_2022-05-27_NP	14.0564	5.2176	62.9	0.802	0	<0.487	3.5	<0.091	<0.037	356	1.3	0.047	3.5	50	0.013	0	958
		RG_GC_PCC_O-04_2022-05-27_NP	9.3248	3.6113	61.3	2.6	0	<0.487	8.5	0	<0.037	498	1.4	0.103	2.9	86	0.032	0.016	1,084
		RG_GC_PCC_O-05_2022-05-27_NP	9.4678	3.3805	64.3	.8	0	<0.487	3.800	<0.091	0	503	1.2	0.059	5.2	57	0.010	<0.016	995
		RG_GC_PCC_O-06_2022-05-27_NP	13.0249	4.8446	62.8	.4	0	<0.487	9.1	<0.091	<0.037	354	1.2	0.073	3.3	53	0.008	<0.016	840
		RG_GC_PCC_O-07_2022-05-27_NP	14.4329	5.5763	61.4	1.600	0	<0.487	5.4	0	0	483	1.4	0.084	3.4	74	0.033	0	895
		RG_GC_PCC_O-08_2022-05-27_NP	15.1592	5.6878	62.5	0.705	0	<0.487	2.7	<0.091	0	465	1.0	0.047	3.7	43	0.005	<0.016	820
		RG_GC_PCC_O-09_2022-05-27_NP	22.1422	8.6221	61.1	2.8	0	<0.487	4.4	<0.091	<0.037	413	1.3	0.056	2.3	59	0.028	0.016	826
		RG_GC_PCC_O-10_2022-05-27_NP	14.4168	5.2942	63.3	12.0	0	<0.487	7.7	0	0	664	1.7	0.066	4.2	92	0.033	0.022	1,074

Table F.2: Analysis for Peamouth Chub Muscle and Ovary Tissue Samples, Koocanusa Reservoir Monitoring Program, May 2022

Tissue	Area	Sample ID	Manganese mg/kg	Mercury mg/kg	Molybdenum mg/kg	Nickel mg/kg	Phosphorus mg/kg	Potassium mg/kg	Selenium mg/kg	Silver mg/kg	Sodium mg/kg	Strontium mg/kg	Thallium mg/kg	Tin mg/kg	Titanium mg/kg	Uranium mg/kg	Vanadium mg/kg	Zinc mg/kg
		RG_SC_PCC_M-01_2022-05-25_NP	4.5	2	0.031	0.904	10,969	26,415	2.4	0.007	1,287	0.870	0.010	0.291	2.100	0.011	0.096	30
		RG_SC_PCC_M-02_2022-05-25_NP	9	1	0.062	1.3	15,833	34,156	3	0.023	1,478	1.400	0.017	0	2.2	0.025	0.125	36
		RG_SC_PCC_M-03_2022-05-25_NP	9.1	1	0.031	1	10,588	21,360	2.4	0.020	1,159	1.400	0.014	0	1.800	0.020	0	25
		RG_SC_PCC_M-04_2022-05-25_NP	5.6	1	0.047	0.504	11,713	19,690	3	0.007	1,279	0.716	0.018	0	1.800	0.015	0	39
	RG_SC	RG_SC_PCC_M-05_2022-05-26_NP	5.8	1	0.031	2	11,776	18,943	1.6	0.007	1,003	2.100	0.007	0.232	3	0.022	0	29
		RG_SC_PCC_M-06_2022-05-26_NP	2.1	2	0.030	0.388	27,142	60,912	3	0.009	2,866	0.814	0.018	0.750	2.300	0.003	0	41
		RG_SC_PCC_M-07_2022-05-26_NP	2.1	1	0.040	0.507	17,874	43,421	3	0.004	2,185	0.836	0.015	0	1.800	0.008	0	29
		RG_SC_PCC_M-08_2022-05-26_NP	18.0	2	0.138	3.200	13,657	29,593	3.4	0.035	1,993	3.900	0.038	0	9.600	0.073	1	66
		RG_SC_PCC_M-09_2022-05-26_NP	2.5	1	0.030	0.462	13,338	31,534	3	0.004	1,374	1.300	0.013	0.191	1.800	0.004	0	22
		RG_SC_PCC_M-10_2022-05-26_NP	3.4	3	0.040	1.600	10,923	21,063	2.4	0.017	1,480	1.300	0.017	0.246	2.7	0.012	0.136	53
		RG_ER_PCC_M-01_2022-05-25_NP	2.200	0.711	0	0.239	10,405	20,407	3.7	0	1,111	0.788	0.015	0.451	1.800	0	<0.040	33
		RG_ER_PCC_M-02_2022-05-26_NP	4.200	.7	0	0.626	10,148	18,211	2.3	0	1,070	1.400	0.016	0.325	5.7	0	0	38
		RG_ER_PCC_M-03_2022-05-26_NP	1.300	1.7	0	0.541	15,267	31,780	3.2	0	1,999	0.542	0.023	0.326	1.5	0	0	120
		RG_ER_PCC_M-04_2022-05-26_NP	3.700	1.700	0	0.433	7,939	14,245	2.7	0	882	1.100	0.025	0.085	1.5	0	0	27
Muscle	RG_ER	RG_ER_PCC_M-05_2022-05-26_NP	2.100	1.400	0	0.680	11,548	23,347	4.2	0	1,384	0.865	0.013	0.134	2.9	0	0	22
		RG_ER_PCC_M-06_2022-05-27_NP	0.507	0.875	<0.011	0.124	11,882	22,362	2.4	0	1,275	0.390	0.007	0.094	1.1	0	<0.040	27
		RG_ER_PCC_M-07_2022-05-27_NP	1.700	1.400	0	0.324	12,337	22,960	5.0	0	1,426	0.489	0.012	0.139	1.1	0	0	46
		RG_ER_PCC_M-08_2022-05-27_NP	1.700	0.908	0	0.479	11,125	23,338	6.4	0	1,477	0.670	0.013	0.141	1.3	0	0	22
		RG_ER_PCC_M-09_2022-05-27_NP	1.400	1.300	0	0.433	10,063	18,050	3.2	0	1,220	1.300	0.013	0.194	1.600	0	0	41
		RG_ER_PCC_M-10_2022-05-27_NP	0.357	0.643	<0.011	0.077	11,793	26,355	4.3	0	1,315	0.368	0.007	0.128	.7	<0.001	<0.040	26
		RG_GC_PCC_M-01_2022-05-27_NP	4.000	0.484	0	0.498	11,660	24,190	4.4	0	1,216	2.000	0.013	0.246	1.9	0	0	36
		RG_GC_PCC_M-02_2022-05-27_NP	5.600	1.500	0	0.652	12,795	25,733	5.0	0	1,379	1.400	0.023	0.309	2.100	0	0	64
		RG_GC_PCC_M-03_2022-05-27_NP	6.000	1.500	0	0.628	12,706	21,419	2.8	0	1,248	2.000	0.018	0.266	1.700	0	0	40
		RG_GC_PCC_M-04_2022-05-27_NP	1.600	.6	0	0.172	14,303	26,852	5.5	<0.001	992	0.944	0.021	0.203	1.700	0	<0.040	43
	RG_GC	RG_GC_PCC_M-05_2022-05-27_NP	0.860	.8	0	0.223	8,051	14,994	4.7	0	726	0.631	0.010	0.320	1.3	0	0.042	17
		RG_GC_PCC_M-06_2022-05-27_NP	1.3	1	0.022	0.155	10,598	26,587	3.8	0.005	1,059	0.842	0.009	0.237	1.700	0.003	0	29
		RG_GC_PCC_M-07_2022-05-27_NP	1.5	0	0.022	0.343	8,301	14,786	5.6	0.010	773	0.707	0.013	0.089	2.8	0.007	0	22
		RG_GC_PCC_M-08_2022-05-27_NP	.9	1	0.022	0.206	8,726	18,171	3.6	0.005	1,103	0.538	0.015	0.180	1.300	<0.001	<0.040	32
		RG_GC_PCC_M-09_2022-05-27_NP	3.7	1	0.022	0	12,832	25,144	3	0.010	1,080	1.100	0.013	0.218	1.700	0.006	0	24
		RG_GC_PCC_M-10_2022-05-27_NP	2.2	1.400	0.045	1.300	13,117	24,874	2.9	0.020	1,319	1.800	0.019	0	2.100	0.023	0	31
		RG_SC_PCC_O-01_2022-05-25_NP	7.5	0.077	0.140	0.336	13,094	8,243	12.0	0.033	1,258	0.753	0.009	0.134	1.400	0.018	0	110
		RG_SC_PCC_O-02_2022-05-25_NP	5	0	0.186	0.233	10,670	7,271	7.2	0.026	1,517	0.298	0.005	0.067	1.100	0.006	0	88
		RG_SC_PCC_O-03_2022-05-25_NP	5.5	<0.047	0.093	0.233	11,521	8,071	8	0.026	1,131	0.415	0.006	0	1.100	0.008	0	94
		RG_SC_PCC_O-04_2022-05-25_NP	5.6	0	0.109	0.220	12,290	6,681	11.0	0.049	1,109	0.540	0.007	0.118	1.400	0.007	0	107
	RG_SC	RG_SC_PCC_O-05_2022-05-26_NP	4.8	<0.047	0.078	0.155	11,902	6,347	6	0.016	903	0.406	0.003	0.147	1.100	0.008	<0.040	68
		RG_SC_PCC_O-06_2022-05-26_NP	3.4	<0.047	0.062	0.103	12,533	8,116	5.2	0.020	1,089	0.399	0.004	0.125	1.100	0.003	<0.040	63
		RG_SC_PCC_O-07_2022-05-26_NP	4.1	<0.047	0.078	0.103	10,427	6,281	12.0	0.020	838	0.417	0.007	0.161	1.100	0.003	<0.040	65
		RG_SC_PCC_O-08_2022-05-26_NP	7.5	0	0.124	0.155	13,192	6,713	7	0.036	1,111	0.621	0.006	0.192	1.1	0.004	0	104
		RG_SC_PCC_O-09_2022-05-26_NP	6.7	0	0.109	0.129	11,021	7,520	10	0.033	1,150	0.441	0.008	0.346	1.4	0.004	0	82
		RG_SC_PCC_O-10_2022-05-26_NP	4.9	0.15	0.14	0.21	13466	7153	5.2	0.028	1147	0.758	0.007	0.257	1.4	0.007	0.077	106
		RG_ER_PCC_O-01_2022-05-25_NP	13.000	<0.047	0	0.089	9,398	6,252	12.0	0	1,524	0.476	0.013	0.144	0.912	<0.001	<0.040	108
		RG_ER_PCC_O-02_2022-05-26_NP	8.200	0.106	0	1.500	11,973	7,961	11.0	0	4,204	2.700	0.013	0.230	4.800	0	0	210
		RG_ER_PCC_O-03_2022-05-26_NP	6.900	0.096	0	0.119	11,933	6,465	6.1	0	921	1.100	0.007	0.087	1.4	0	0	99
		RG_ER_PCC_O-04_2022-05-26_NP	8.300	0.102	0	0.179	12,095	5,875	16.0	0	778	0.786	0.010	0.084	.9	0.009	0	88
Ovary	RG_ER	RG_ER_PCC_O-05_2022-05-26_NP	5.600	<0.047	0	0.149	11,552	8,728	10.0	0	1,174	0.577	0.005	0.238	1.400	0	0	78
		RG_ER_PCC_O-06_2022-05-27_NP	4.700	<0.047	0	0.239	12,838	7,402	11.0	0	1,047	0.374	0.006	0.351	1.4	0.005	0	83
		RG_ER_PCC_O-07_2022-05-27_NP	6.800	<0.047	0	0.060	12,180	7,012	8.0	0	925	0.324	0.003	0.167	.9	0	<0.040	76
		RG_ER_PCC_O-08_2022-05-27_NP	9.600	<0.047	0	0.164	14,044	9,466	14.0	0	1,176	0.574	0.008	0.499	1.400	0	0	88
		RG_ER_PCC_O-09_2022-05-27_NP	8.000	0.069	0	0.149	13,265	7,367	8.3	0	1,039	0.457	0.010	0.298	1.800	0	0	100
		RG_ER_PCC_O-10_2022-05-27_NP	4.400	<0.047	0	0.060	12,901	9,691	9.5	0	1,188	0.256	0.005	0.030	.9	0	<0.040	76
		RG_GC_PCC_O-01_2022-05-27_NP	9.5	0	0.185	0	10,601	7,439	11.0	0.046	2,961	0.815	0.009	0.149	0.727	<0.001	<0.040	150
		RG_GC_PCC_O-02_2022-05-27_NP	3.4	<0.047	0.074	0.062	9,811	7,253	5.8	0.041	1,173	0.485	0.004	0.192	.7	0.002	<0.040	67
		RG_GC_PCC_O-03_2022-05-27_NP	6.8	<0.047	0.093	0.062	11,583	7,395	11	0.018	1,046	0.309	0.004	0.192	0.727	0.004	0	76
		RG_GC_PCC_O-04_2022-05-27_NP	4.7	<0.047	0.111	0.185	8,042	4,619	12	0.050	622	0.473	0.009	0.109	1.100	0.007	0	124
	RG_GC	RG_GC_PCC_O-05_2022-05-27_NP	6	0	0.157	0.093	13,568	11,149	12	0.023	1,513	0.437	0.015	0.177	0.727	0.002	<0.040	145
		RG_GC_PCC_O-06_2022-05-27_NP	6.5	<0.047	0.111	0.093	8,594	7,397	9	0.032	954	0.347	0.003	0.048	0.727	0.003	<0.040	86
		RG_GC_PCC_O-07_2022-05-27_NP	5.5	<0.047	0.093	0.216	12,436	8,949	11.0	0.034	1,150	0.408	0.005	0.169	1.100	0.007	0	92
		RG_GC_PCC_O-08_2022-05-27_NP	5	<0.047	0.083	0.062	10,294	4,317	5	0.032	614	0.419	0.005	0.090	.7	0.003	<0.040	76
		RG_GC_PCC_O-09_2022-05-27_NP	5.4	0	0.093	0.093	12,213	8,790	9	0.023	1,190	0.473	0.005	0	0.727	0.009	0	80
		RG_GC_PCC_O-10_2022-05-27_NP	12.0	0	0.178	0.137	14,271	9,120	13	0.040	1,319	0.548	0.009	0	1.300	0.009	0.072	110

Table F.3: Analysis for Redside Shiner Muscle and Ovary Tissue Samples, Koocanusa Reservoir Monitoring Program, 2022

Tissue	Area	Sample ID	Wet Weight	Dry Weight	Moisture	Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium
			g	g	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Muscle	RG_SC	RG_SC_RSC-M-1_2022-06-21_NP	0.595	0.147	75	5.70	0.0030	<0.507	1.20	0.151	<0.051	1,082	1.80	0.0330	1.20	28	0.0440	<0.020
		RG_SC_RSC-M-2_2022-06-21_NP	0.380	0.0993	74	7.50	<0.003	<0.507	1.30	0.100	<0.051	912	1.20	<0.013	1.00	18	0.0290	<0.020
		RG_SC_RSC-M-3_2022-06-21_NP	0.664	0.163	76	2.80	0.0030	<0.507	0.623	0.201	<0.051	920	0.959	0.0140	0.998	17	0.0150	<0.020
		RG_SC_RSC-M-4_2022-06-21_NP	0.364	0.0886	76	6.20	0.0040	<0.507	1.20	0.100	<0.051	935	2.30	0.0350	1.30	35	0.0220	0.0120
		RG_SC_RSC-M-5_2022-06-21_NP	0.689	0.175	75	23	0.0040	<0.507	1.30	0.176	<0.051	1,203	0.828	<0.013	0.929	25	0.0440	0.0250
		RG_SC_RSC-M-6_2022-06-21_NP	0.780	0.200	74	4.80	<0.003	<0.507	0.949	0.276	<0.051	953	1.40	0.0190	1.20	19	0.0210	<0.020
		RG_SC_RSC-M-7_2022-06-21_NP	0.761	0.176	77	4.20	<0.003	<0.507	1.20	0.126	<0.051	1,031	1.30	0.0140	1.60	22	0.0120	<0.020
		RG_SC_RSC-M-8_2022-06-21_NP	0.607	0.150	75	6.40	0.0030	<0.507	1.10	0.126	<0.051	908	1.10	0.0230	0.959	19	0.0240	<0.020
		RG_SC_RSC-M-9_2022-06-21_NP	0.434	0.104	76	11	<0.003	<0.507	2.30	0.171	<0.051	1,401	2.10	0.0480	1.70	50	0.0320	0.0230
		RG_SC_RSC-M-10_2022-06-21_NP	1.10	0.249	77	2.00	<0.003	<0.507	1.20	0.136	<0.051	1,083	1.40	0.0150	1.80	25	0.0110	0.0230
	RG_ER	RG_ER_RSC-M-1_2022-06-21_NP	0.812	0.201	75	<1.3	<0.003	<0.507	1.40	<0.094	<0.051	823	1.20	0.0210	1.70	25	0.0150	<0.020
		RG_ER_RSC-M-2_2022-06-21_NP	0.671	0.165	75	3.20	<0.003	<0.507	3.20	0.165	<0.051	1,357	1.50	0.0350	2.50	31	0.0170	0.0350
		RG_ER_RSC-M-3_2022-06-21_NP	0.523	0.127	76	6.90	<0.003	<0.507	2.30	0.165	<0.051	1,016	1.30	0.0140	1.30	17	0.0240	0.0230
		RG_ER_RSC-M-4_2022-06-21_NP	0.288	0.0673	77	6.70	<0.003	<0.507	1.40	<0.094	<0.051	868	1.30	0.0140	1.30	14	0.0100	<0.020
		RG_ER_RSC-M-5_2022-06-21_NP	0.721	0.183	75	2.70	<0.003	<0.507	0.999	0.248	<0.051	852	1.20	0.0140	1.40	17	0.0120	0.0230
		RG_ER_RSC-M-6_2022-06-21_NP	0.447	0.112	75	3.00	<0.003	<0.507	1.50	<0.094	<0.051	930	1.20	0.0170	1.50	21	0.0090	<0.020
		RG_ER_RSC-M-7_2022-06-21_NP	0.533	0.126	76	2.50	<0.003	<0.507	1.20	<0.094	<0.051	865	1.20	0.0210	1.70	18	0.0090	<0.020
		RG_ER_RSC-M-8_2022-06-21_NP	0.455	0.109	76	21	0.0060	<0.507	2.10	0.330	<0.051	1,114	1.60	0.0280	1.80	37	0.0210	0.0310
		RG_ER_RSC-M-9_2022-06-21_NP	0.339	0.0810	76	1.50	<0.003	<0.507	1.20	<0.094	<0.051	1,187	1.30	0.0280	1.30	16	0.0070	<0.020
		RG_ER_RSC-M-10_2022-06-21_NP	0.486	0.115	76	4.70	<0.003	<0.507	0.714	0.165	<0.051	1,031	1.40	0.0420	1.30	19	0.0090	0.0230
	RG_GC	RG_GC_RSC-M-1_2022-06-22_NP	0.422	0.0981	77	0.843	0.0060	<0.507	0.470	0.116	<0.051	1,070	0.890	0.0130	0.739	7.40	0.0200	<0.020
		RG_GC_RSC-M-2_2022-06-22_NP	0.295	0.0694	77	5.80	0.0050	<0.507	1.90	0.387	<0.051	1,317	1.70	0.0390	1.80	32	0.0320	<0.020
		RG_GC_RSC-M-3_2022-06-22_NP	0.331	0.0708	79	4.30	0.0040	<0.507	0.470	0.484	<0.051	926	1.20	0.0230	1.00	18	0.0290	<0.020
		RG_GC_RSC-M-4_2022-06-22_NP	0.704	0.162	77	<1.3	<0.003	<0.507	1.20	0.155	<0.051	1,106	1.20	<0.013	1.20	13	0.0050	<0.020
		RG_GC_RSC-M-5_2022-06-22_NP	0.279	0.0664	76	2.40	<0.003	<0.507	0.329	0.116	<0.051	931	1.20	0.0130	0.898	11	0.0100	<0.020
		RG_GC_RSC-M-6_2022-06-22_NP	0.882	0.209	76	3.10	<0.003	<0.507	2.60	0.310	<0.051	1,368	1.30	0.0130	1.60	23	0.0160	<0.020
		RG_GC_RSC-M-7_2022-06-22_NP	0.393	0.0880	78	16	<0.003	<0.507	0.517	0.155	<0.051	953	1.10	0.0130	1.00	19	0.0220	<0.020
		RG_GC_RSC-M-8_2022-06-22_NP	0.674	0.160	76	2.00	<0.003	<0.507	2.00	0.194	<0.051	1,238	1.60	0.0200	1.50	20	0.0070	<0.020
		RG_GC_RSC-M-9_2022-06-22_NP	0.223	0.0507	77	9.50	<0.003	<0.507	0.564	<0.094	<0.051	1,084	1.30	0.0200	1.10	19	0.0250	<0.020
		RG_GC_RSC-M-10_2022-06-22_NP	0.657	0.148	77	<1.3	<0.003	<0.507	1.30	<0.094	<0.051	1,060	1.40	0.0130	1.00	13	0.0050	<0.020
Ovary	RG_SC	RG_SC_RSC-O-1_2022-06-21_NP	0.727	0.256	65	<1.3	<0.003	<0.507	1.80	0.102	<0.051	711	1.20	0.0300	6.70	66	0.0170	<0.020
		RG_SC_RSC-O-2_2022-06-21_NP	0.609	0.196	68	7.30	0.0030	<0.507	2.60	0.171	<0.051	1,060	1.20	0.0680	5.70	95	0.0240	<0.020
		RG_SC_RSC-O-3_2022-06-21_NP	0.355	0.106	70	<1.3	<0.003	<0.507	2.00	0.102	0.161	1,089	1.30	0.0650	5.80	107	0.0080	<0.020
		RG_SC_RSC-O-4_2022-06-21_NP	0.434	0.139	68	<1.3	<0.003	<0.507	1.90	<0.094	<0.051	830	1.10	0.0600	5.00	86	0.0060	<0.020
		RG_SC_RSC-O-5_2022-06-21_NP	0.578	0.183	68	2.70	<0.003	<0.507	2.10	0.205	<0.051	1,280	1.00	0.0580	4.50	86	0.0090	<0.020
		RG_SC_RSC-O-6_2022-06-21_NP	0.462	0.168	64	<1.3	<0.003	<0.507	0.894	0.102	0.0600	987	1.20	0.0550	4.90	72	0.0050	<0.020
		RG_SC_RSC-O-7_2022-06-21_NP	0.596	0.207	65	<1.3	<0.003	<0.507	1.00	<0.094	<0.051	688	1.10	0.0550	5.50	78	0.0030	<0.020
		RG_SC_RSC-O-8_2022-06-21_NP	0.267	0.0956	64	3.50	0.0060	<0.507	2.90	0.371	<0.051	515	1.10	0.0690	4.30	49	0.0410	<0.020
		RG_SC_RSC-O-9_2022-06-21_NP	0.262	0.0739	72	6.40	0.0040	<0.507	1.80	<0.094	<0.051	1,470	1.10	0.0970	6.60	111	0.0290	<0.020
		RG_SC_RSC-O-10_2022-06-21_NP	0.740	0.244	67	<1.3	<0.003	<0.507	2.50	0.206	<0.051	1,491	1.10	0.0550	4.60	99	0.0090	<0.020
	RG_ER	RG_ER_RSC-O-1_2022-06-21_NP	1.19	0.474	60	1.40	<0.003	<0.507	0.666	<0.094	0.0590	444	1.30	0.0380	4.10	44	0.0100	<0.020
		RG_ER_RSC-O-2_2022-06-21_NP	0.482	0.166	66	2.20	<0.003	<0.507	2.10	0.289	0.0880	768	1.40	0.0800	6.00	85	0.0100	0.0230
		RG_ER_RSC-O-3_2022-06-21_NP	0.535	0.182	66	1.40	<0.003	<0.507	3.00	0.103	<0.051	840	1.20	0.0660	3.50	74	0.0100	<0.020
		RG_ER_RSC-O-4_2022-06-21_NP	0.730	0.243	67	<1.3	<0.003	<0.507	2.90	<0.094	<0.051	849	1.10	0.0620	5.00	81	0.0090	<0.020
		RG_ER_RSC-O-5_2022-06-21_NP	0.763	0.302	60	1.60	<0.003	<0.507	1.20	0.232	0.0590	464	1.20	0.0390	3.50	51	0.0050	<0.020
		RG_ER_RSC-O-6_2022-06-21_NP	0.572	0.175	69	<1.3	<0.003	<0.507	2.70	<0.094	<0.051	916	1.10	0.0690	6.00	99	0.0050	<0.020
		RG_ER_RSC-O-7_2022-06-21_NP	0.857	0.314	63	<1.3	<0.003	<0.507	1.60	<0.094	<0.051	663	1.20	0.0590	4.80	68	0.0070	<0.020
		RG_ER_RSC-O-8_2022-06-21_NP	0.428	0.124	71	2.10	<0.003	<0.507	3.40	0.271	0.0880	1,546	1.30	0.0990	5.70	128	0.0150	<0.020
		RG_ER_RSC-O-9_2022-06-21_NP	0.566	0.193	66	1.40	<0.003	<0.507	1.30	<0.094	0.0590	890	1.20	0.0560	3.90	77	0.0050	<0.020
		RG_ER_RSC-O-10_2022-06-21_NP	0.458	0.173	62	3.20	<0.003	<0.507	1.40	0.271	0.0590	631	1.10	0.0590	3.90	61	0.0100	<0.020
	RG_GC	RG_GC_RSC-O-1_2022-06-22_NP	0.793	0.318	60	<1.3	<0.003	<0.507	0.765	<0.094	<0.051	396	1.20	0.0380	4.10	48	0.0110	<0.020
		RG_GC_RSC-O-2_2022-06-22_NP	0.0863	0.0295	66	17	<0.003	<0.507	6.30	0.137	0.0820	2,111	1.70	0.118	4.40	99	0.0150	<0.020
		RG_GC_RSC-O-3_2022-06-22_NP	1.09	0.373	66	3.60	<0.003	<0.507	1.40	0.154	<0.051	864	1.10	0.0440	3.40	52	0.0150	<0.020
		RG_GC_RSC-O-4_2022-06-22_NP	0.600	0.229	62	<1.3	<0.003	<0.507	1.10	<0.094	<0.051	576	1.20	0.0440	4.00	58	0.0030	<0.020
		RG_GC_RSC-O-5_2022-06-22_NP	0.811	0.298	63	1.60	<0.003	<0.507	0.644	<0.094	0.109	546	1.20	0.0510	4.40	56	0.0080	<0.020
		RG_GC_RSC-O-6_2022-06-22_NP	0.800	0.295	63	1.80	<0.003	<0.507	2.10	<0.094	0.0550	1,024	1.20	0.0380	4.60	75	0.0050	<0.020
		RG_GC_RSC-O-7_2022-06-22_NP	0.840	0.294	65	1.90	<0.003	<0.507	0.845	<0.094	<0.051	584	1.00	0.0320	4.30	49	0.0110	<0.020
		RG_GC_RSC-O-8_2022-06-22_NP	0.826	0.319	61	<1.3	<0.003	<0.507	0.886	<0.094	0.137	406	1.20	0.0410	3.30	61	0.0030	<0.020
		RG_GC_RSC-O-9_2022-06-22_NP	0.589	0.185	69	3.40	<0.003	0.533	1.10	<0.094	<0.051	1,111	1.10	0.0590	6.50	101	0.0110	<0.020
		RG_GC_RSC-O-10_2022-06-22_NP	0.741	0.285	62	<1.3	<0.003	<0.507	1.30	<0.094	0.0580	514	1.10	0.0530	4.30	63	0.0050	<0.020

Table F.3: Analysis for Redside Shiner Muscle and Ovary Tissue Samples, Koocanusa Reservoir Monitoring Program, 2022

Tissue	Area	Sample ID	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Muscle	RG_SC	RG_SC_RSC-M-1_2022-06-21_NP	650	0.741	<0.519	<0.001	0.951	9,113	16,540	3.40	<0.001	662	0.616	0.0060	0.228	0.867	<0.001	<0.058	24
		RG_SC_RSC-M-2_2022-06-21_NP	919	0.542	<0.519	<0.001	0.346	7,218	13,906	1.70	<0.001	538	0.584	0.0050	0.212	0.867	<0.001	<0.058	20
		RG_SC_RSC-M-3_2022-06-21_NP	898	0.274	<0.519	<0.001	0.202	7,942	16,163	1.60	<0.001	614	0.592	0.0050	0.310	0.578	<0.001	<0.058	35
		RG_SC_RSC-M-4_2022-06-21_NP	788	0.420	<0.519	<0.001	1.20	6,447	14,457	1.20	<0.001	904	0.553	0.0050	0.354	1.20	<0.001	<0.058	29
		RG_SC_RSC-M-5_2022-06-21_NP	1,382	0.660	<0.519	<0.001	0.0860	6,713	11,220	2.60	<0.001	406	0.985	0.0050	0.212	1.70	<0.001	<0.058	20
		RG_SC_RSC-M-6_2022-06-21_NP	1,002	0.356	<0.519	<0.001	0.576	8,445	15,738	2.40	<0.001	628	0.433	0.0060	0.206	0.723	<0.001	<0.058	35
		RG_SC_RSC-M-7_2022-06-21_NP	935	0.664	0.552	<0.001	0.303	10,641	17,638	2.30	<0.001	936	0.505	0.0080	0.286	0.867	<0.001	<0.058	34
		RG_SC_RSC-M-8_2022-06-21_NP	634	0.342	0.611	<0.001	0.303	6,922	13,339	1.30	<0.001	807	0.565	0.0040	0.0500	0.867	<0.001	<0.058	30
		RG_SC_RSC-M-9_2022-06-21_NP	1,486	0.751	0.795	0.0260	1.20	10,078	19,592	2.20	<0.001	864	1.00	0.0070	0.389	1.70	<0.001	<0.058	69
		RG_SC_RSC-M-10_2022-06-21_NP	970	0.378	0.820	<0.001	0.206	10,631	23,235	1.60	<0.001	1,060	0.575	0.0070	0.0410	0.844	<0.001	<0.058	58
	RG_ER	RG_ER_RSC-M-1_2022-06-21_NP	969	0.548	<0.519	<0.001	0.202	9,791	17,352	2.70	<0.001	982	0.368	0.0160	0.0990	0.465	<0.001	<0.058	53
		RG_ER_RSC-M-2_2022-06-21_NP	1,279	0.602	<0.519	<0.001	0.283	12,601	20,727	2.90	<0.001	1,292	1.00	0.0230	0.191	0.930	<0.001	<0.058	67
		RG_ER_RSC-M-3_2022-06-21_NP	983	0.462	<0.519	<0.001	0.323	8,244	14,133	3.40	<0.001	636	0.558	0.0100	0.0410	0.930	<0.001	<0.058	58
		RG_ER_RSC-M-4_2022-06-21_NP	912	0.492	<0.519	<0.001	0.283	8,944	16,729	3.00	<0.001	548	0.532	0.0090	0.258	0.930	<0.001	<0.058	28
		RG_ER_RSC-M-5_2022-06-21_NP	868	0.291	<0.519	<0.001	0.242	8,846	14,959	3.00	<0.001	744	0.570	0.0100	0.134	0.930	<0.001	<0.058	44
		RG_ER_RSC-M-6_2022-06-21_NP	1,046	0.430	<0.519	<0.001	0.222	9,717	19,844	3.50	<0.001	802	0.552	0.0140	0.279	0.930	<0.001	<0.058	52
		RG_ER_RSC-M-7_2022-06-21_NP	839	0.409	<0.519	<0.001	0.161	11,795	22,405	4.20	<0.001	911	0.295	0.0150	0.330	0.465	<0.001	<0.058	61
		RG_ER_RSC-M-8_2022-06-21_NP	1,165	0.632	0.610	<0.001	0.484	11,285	19,052	2.10	<0.001	950	0.754	0.0100	0.208	2.80	<0.001	<0.058	52
		RG_ER_RSC-M-9_2022-06-21_NP	1,410	0.463	<0.519	<0.001	0.283	11,028	18,861	9.10	<0.001	825	0.627	0.0090	0.245	0.930	<0.001	<0.058	38
		RG_ER_RSC-M-10_2022-06-21_NP	940	0.428	<0.519	<0.001	0.323	10,621	18,363	9.10	<0.001	1,012	0.614	0.0170	0.170	0.930	<0.001	<0.058	28
	RG_GC	RG_GC_RSC-M-1_2022-06-22_NP	789	0.396	<0.519	<0.001	0.351	8,605	18,547	2.60	<0.001	676	0.470	0.0120	0.310	0.874	<0.001	<0.058	22
		RG_GC_RSC-M-2_2022-06-22_NP	1,479	0.656	<0.519	<0.001	0.605	11,435	21,122	4.30	<0.001	886	0.834	0.0210	0.281	1.30	0.0020	<0.058	87
		RG_GC_RSC-M-3_2022-06-22_NP	1,149	0.437	0.676	<0.001	0.390	11,346	20,198	2.70	<0.001	795	0.565	0.0170	0.199	1.30	<0.001	<0.058	23
		RG_GC_RSC-M-4_2022-06-22_NP	1,254	0.364	<0.519	<0.001	0.117	10,276	18,141	3.80	<0.001	1,015	0.560	0.0200	0.211	0.437	<0.001	<0.058	56
		RG_GC_RSC-M-5_2022-06-22_NP	1,162	0.380	0.629	<0.001	0.156	8,875	16,511	2.40	<0.001	498	0.535	0.0150	0.293	0.874	<0.001	<0.058	17
		RG_GC_RSC-M-6_2022-06-22_NP	1,151	0.531	<0.519	<0.001	0.234	12,815	25,320	3.80	<0.001	1,149	0.995	0.0110	0.126	0.874	0.0020	<0.058	64
		RG_GC_RSC-M-7_2022-06-22_NP	1,037	0.399	<0.519	<0.001	0.117	10,053	18,191	3.00	<0.001	854	0.468	0.0040	0.320	2.20	<0.001	<0.058	24
		RG_GC_RSC-M-8_2022-06-22_NP	1,628	0.520	0.673	<0.001	0.234	11,880	22,020	4.60	<0.001	1,001	0.736	0.0270	0.131	0.874	<0.001	<0.058	47
		RG_GC_RSC-M-9_2022-06-22_NP	1,327	0.549	<0.519	<0.001	0.175	10,837	12,664	3.70	<0.001	600	0.620	0.0190	0.851	1.30	<0.001	<0.058	26
		RG_GC_RSC-M-10_2022-06-22_NP	1,009	0.483	0.726	<0.001	0.195	12,464	25,985	2.70	<0.001	1,161	0.466	0.0170	0.227	0.874	<0.001	<0.058	37
Ovary	RG_SC	RG_SC_RSC-O-1_2022-06-21_NP	1,078	6.70	<0.519	0.132	0.103	11,845	10,878	19	0.0350	1,195	0.316	0.0060	0.324	0.844	<0.001	<0.058	188
		RG_SC_RSC-O-2_2022-06-21_NP	1,167	8.60	<0.519	0.132	0.138	11,534	11,938	13	0.0200	1,848	0.580	0.0100	0.148	1.30	<0.001	<0.058	171
		RG_SC_RSC-O-3_2022-06-21_NP	1,234	5.50	<0.519	0.132	0.206	10,700	10,587	25	0.0250	1,425	0.608	0.0070	0.185	0.844	<0.001	<0.058	239
		RG_SC_RSC-O-4_2022-06-21_NP	1,119	6.70	<0.519	0.105	0.138	9,394	8,992	17	0.0250	1,239	0.409	0.0070	0.100	0.844	<0.001	<0.058	169
		RG_SC_RSC-O-5_2022-06-21_NP	1,261	6.60	<0.519	0.132	0.0690	9,677	9,376	17	0.0150	1,278	0.567	0.0070	0.125	1.30	<0.001	<0.058	174
		RG_SC_RSC-O-6_2022-06-21_NP	1,058	5.50	<0.519	0.132	0.138	10,507	9,306	8.60	0.0300	1,274	0.419	0.0080	0.216	0.844	<0.001	<0.058	169
		RG_SC_RSC-O-7_2022-06-21_NP	1,074	7.50	<0.519	0.0750	<0.045	10,061	7,540	15	0.0250	1,114	0.348	0.0170	0.0750	0.465	<0.001	<0.058	165
		RG_SC_RSC-O-8_2022-06-21_NP	792	4.40	<0.519	0.0990	0.202	10,709	8,432	15	0.0250	982	0.445	0.0050	0.200	0.930	<0.001	<0.058	169
		RG_SC_RSC-O-9_2022-06-21_NP	1,126	7.70	<0.519	0.224	0.161	12,523	14,721	24	0.0320	2,074	0.598	0.0120	0.361	1.40	<0.001	<0.058	220
		RG_SC_RSC-O-10_2022-06-21_NP	1,443	7.90	<0.519	0.0990	0.0810	11,947	9,615	12	0.0190	1,660	0.673	0.0110	0.104	0.465	<0.001	<0.058	241
	RG_ER	RG_ER_RSC-O-1_2022-06-21_NP	718	6.00	<0.519	0.0620	<0.045	11,588	6,804	14	0.0190	993	0.285	0.0080	0.0650	0.465	<0.001	<0.058	110
		RG_ER_RSC-O-2_2022-06-21_NP	991	6.90	<0.519	0.124	0.161	15,573	13,763	19	0.0250	2,158	0.465	0.0190	0.136	0.930	<0.001	<0.058	217
		RG_ER_RSC-O-3_2022-06-21_NP	863	7.50	<0.519	0.0750	0.0810	10,225	10,289	24	0.0190	1,614	0.449	0.0130	0.0490	0.930	<0.001	<0.058	166
		RG_ER_RSC-O-4_2022-06-21_NP	924	8.10	<0.519	0.0990	<0.045	13,180	12,196	16	0.0320	1,979	0.509	0.0160	0.135	0.930	<0.001	<0.058	118
		RG_ER_RSC-O-5_2022-06-21_NP	754	4.40	<0.519	0.0510	<0.045	9,348	4,824	15	0.0230	717	0.462	0.0050	0.106	0.437	<0.001	<0.058	99
		RG_ER_RSC-O-6_2022-06-21_NP	1,330	14	<0.519	0.102	<0.045	11,754	7,497	19	0.0410	1,361	0.466	0.0190	0.0530	0.874	<0.001	<0.058	169
		RG_ER_RSC-O-7_2022-06-21_NP	959	5.90	<0.519	0.102	0.0780	12,367	9,861	16	0.0230	1,462	0.363	0.0120	0.170	0.874	<0.001	<0.058	152
		RG_ER_RSC-O-8_2022-06-21_NP	1,400	9.30	<0.519	0.102	0.0780	9,432	9,947	15	0.0290	1,721	1.20	0.0080	0.238	0.874	0.0010	<0.058	155
		RG_ER_RSC-O-9_2022-06-21_NP	1,003	4.50	<0.519	0.0770	<0.045	9,480	7,267	15	0.0230	1,044	0.492	0.0100	0.311	0.437	<0.001	<0.058	119
		RG_ER_RSC-O-10_2022-06-21_NP	1,149	5.00	<0.519	0.0510	0.0780	10,215	4,894	13	0.0120	672	0.592	0.0150	0.318	0.874	<0.001	<0.058	104
	RG_GC	RG_GC_RSC-O-1_2022-06-22_NP	729	4.20	<0.519	0.0580	<0.045	11,690	6,885	14	0.0210	715	0.267	0.0080	0.137	0.379	<0.001	<0.058	90
		RG_GC_RSC-O-2_2022-06-22_NP	995	5.70	<0.519	0.0580	0.669	10,418	9,594	16	0.0270	1,016	2.10	0.0270	0.249	1.50	0.0010	<0.058	218
		RG_GC_RSC-O-3_2022-06-22_NP	1,049	7.00	<0.519	0.0580	0.0790	10,910	7,458	8.50	0.0140	914	0.530	0.0140	0.188	0.757	<0.001	<0.058	100
		RG_GC_RSC-O-4_2022-06-22_NP	770	4.40	<0.519	0.0580	0.0790	12,131	8,443	19	0.0340	941	0.265	0.0120	0.250	0.379	<0.001	<0.058	125
		RG_GC_RSC-O-5_2022-06-22_NP	874	4.80	<0.519	0.0580	<0.045	9,729	6,449	9.30	0.0210	861	0.348	0.0150	0.101	0.379	<0.001	<0.058	104
		RG_GC_RSC-O-6_2022-06-22_NP	822	4.90	<0.519	0.0580	0.0790	10,517	6,479	11	0.0210	924	0.950	0.0070	0.245	0.379	<0.001	<0.058	135
		RG_GC_RSC-O-7_2022-06-22_NP	800	4.70	<0.519	0.0580	<0.045	10,915	6,759	8.80	0.0210	867	0.297	0.0050	0.245	0.379	<0.001	<0.058	102
		RG_GC_RSC-O-8_2022-06-22_NP	725	3.90	<0.519	0.0430	<0.045	11,954	7,422	8.80	0.0270	912	0.263	0.0100	0.225	0.379	<0.001	<0.058	98
		RG_GC_RSC-O-9_2022-06-22_NP	1,067	7.10	<0.519	0.124	<0.045	9,062	9,117	13	0.0210	1,071	0.696	0.0410	0.135	1.10	<0.001	<0.058	143
		RG_GC_RSC-O-10_2022-06-22_NP	969	5.00	<0.519	0.0620	<0.045	10,832	7,189	9.50	0.0210	899	0.430	0.0130	0.167	0.574	<0.001	<0.058	112

Table F.4: Analysis for Non-Lethal Sport Fish Muscle Tissue Samples, Koocanusa Reservoir Monitoring Program, 2022

Tissue	Month	Area	Sample ID	Wet Weight	Dry Weight	Moisture	Aluminum	Antimony	Arsenic	Barium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium
				g	g	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Bull Trout	May	RG_SC	RG_SC_BT_M-01_2022-05-25_NP	0.075	0.019	75	2.1	<0.003	<0.487	0.28	<0.091	<0.037	1,378	1.5	0.033	1.3	24	0.0090	<0.016
		RG_ER	RG_ER_BT_M-01_2022-05-27_NP	0.019	0.0049	75	0.28	0.0030	<0.487	0.23	<0.091	<0.037	938	1.2	0.044	1.7	297	0.0050	0.033
		RG_GC	RG_GC_BT_M-01_2022-05-27_NP	0.072	0.017	76	7.0	0.012	<0.487	0.93	<0.091	0.039	1,184	1.3	0.029	1.2	28	0.077	<0.016
			RG_GC_BT_M-02_2022-05-27_NP	0.081	0.059	27.3	4.5	0.0040	<0.487	0.37	<0.091	<0.037	1,273	1.4	0.036	1.6	32	0.013	<0.016
	June	RG_SC	RG_SC_BT-M-2_2022-06-22_NP	0.049	0.014	71.1	2.7	<0.003	<0.507	0.65	<0.094	<0.051	669	1.1	<0.013	1.1	18	0.025	<0.020
		RG_ER	RG_ER_BT-M-6_2022-06-25_NP	0.029	0.011	62	3.0	0.0040	<0.397	0.35	0.19	<0.039	378	1.4	0.012	0.77	14	0.013	0.012
			RG_ER_BT-M-7_2022-06-25_NP	0.0083	0.0031	63	3.2	0.0020	<0.397	0.16	0.13	0.75	294	1.9	0.012	0.74	11	0.016	<0.011
			RG_ER_BT-M-8_2022-06-25_NP	0.047	0.011	76	3.5	0.0050	<0.397	0.16	<0.065	<0.039	312	2.3	0.017	0.45	13	0.011	<0.011
		RG_GC	RG_GC_BT-M-3_2022-06-22_NP	0.037	0.007	82	<1.3	<0.003	<0.507	0.45	<0.094	<0.051	550	1.0	0.013	1.50	15	0.008	<0.020
			RG_GC_BT-M-4_2022-06-22_NP	0.073	0.011	85	24.0	<0.003	<0.507	1.50	0.1180	<0.051	876	0.8	0.023	1.00	16	0.190	0.0330
			RG_GC_BT-M-5_2022-06-23_NP	0.040	0.009	77	8.9	0.0050	<0.507	0.70	0.1970	<0.051	476	1.1	<0.013	0.73	18	0.426	<0.020
			RG_GC_BT-M-6_2022-06-23_NP	0.046	0.009	81	1.8	0.0050	<0.507	0.30	0.1580	<0.051	499	1.2	<0.013	1.20	12	0.024	<0.020
			RG_GC_BT-M-7_2022-06-23_NP	0.047	0.016	66	2.7	<0.003	<0.507	0.40	<0.094	<0.051	462	1.2	0.017	2.50	22	0.019	<0.020
			RG_GC_BT-M-8_2022-06-29_NP	0.025	0.0048	81	6.9	0.0060	<0.397	0.43	0.16	0.11	680	2.0	0.012	0.73	11	0.042	0.012
	July	RG_ER	RG_ER_BT-9-M_2022-07-12_NP	0.017	0.0070	59	0.29	0.0030	<0.475	0.12	0.11	<0.065	604	1.1	0.035	1.6	23	0.0070	<0.040
			RG_ER_BT-10-M_2022-07-14_NP	0.071	0.027	62	0.25	<0.003	<0.475	0.061	<0.074	<0.065	845	1.3	<0.015	0.94	8.9	0.0020	<0.040
			RG_ER_BT-11-M_2022-07-14_NP	0.13	0.035	74	1.8	0.0040	<0.475	0.31	0.088	<0.065	790	1.4	<0.015	1.2	15	0.066	<0.040
Eastern Brook Trout	May	RG_ER	RG_ER_EB_M-01_2022-05-26_NP	0.095	0.025	73	2.4	0.0050	<0.487	1.2	0.11	<0.037	1,167	1.9	0.027	1.3	48	0.032	0.033
			RG_ER_EB_M-02_2022-05-26_NP	0.061	0.017	73	0.43	0.0030	<0.487	0.070	<0.091	<0.037	780	1.3	0.022	1.2	14	0.0050	<0.016
Kokanee	June	RG_GC	RG_GC_KO-M-1_2022-06-22_NP	0.029	0.007	76	4.20	<0.003	<0.507	0.499	<0.094	<0.051	787	1.1	0.013	1.0	14	0.0160	<0.020
			RG_GC_KO-M-2_2022-06-22_NP	0.070	0.014	81	<1.3	<0.003	<0.507	0.199	0.1380	<0.051	323	1.0	0.020	0.9	10	0.0080	<0.020
Mountain Whitefish	May	RG_ER	RG_ER_MW_M-01_2022-05-26_NP	0.11	0.028	74	0.54	0.0080	<0.487	0.093	<0.091	<0.037	647	1.5	0.015	1.0	19	0.0060	0.055
	July		RG_ER_MW-2-M_2022-07-17_NP	0.019	0.0062	68	0.18	<0.003	<0.475	0.061	<0.074	<0.065	403	1.1	0.044	0.69	8.1	0.0020	<0.040
			RG_ER_MW-3-M_2022-07-17_NP	0.070	0.015	79	1.2	<0.003	<0.475	0.31	<0.074	<0.065	542	1.2	0.026	1.3	15	0.018	<0.040
Rainbow Trout	May	RG_GC	RG_GC_RBT_M-01_2022-05-27_NP	0.10	0.024	76	0.098	<0.003	<0.487	0.046	<0.091	<0.037	464	1.1	0.015	0.73	10	<0.002	<0.016
			RG_GC_RBT_M-02_2022-05-27_NP	0.092	0.021	77	0.39	<0.003	<0.487	0.093	<0.091	0.039	813	1.3	0.029	0.92	11	0.0050	0.022
			RG_GC_RBT_M-03_2022-05-27_NP	0.083	0.019	77	0.41	0.0040	<0.487	0.14	<0.091	0.51	1,129	1.2	0.022	1.1	19	0.0030	<0.016
			RG_GC_RBT_M-04_2022-05-27_NP	0.13	0.018	86	0.70	<0.003	<0.487	0.51	<0.091	<0.037	1,125	1.3	0.015	1.4	14	0.022	<0.016
	June	RG_ER	RG_ER_RBT-M-1_2022-06-25_NP	0.21	0.049	76	13	0.0050	<0.397	0.47	<0.065	<0.039	329	2.5	0.055	1.9	40	0.011	0.014
Westslope Cutthroat Trout	June	RG_GC	RG_GC_WCT-M-1_2022-06-23_NP	0.07	0.010	85	9	<0.003	<0.507	0.85	0.1180	<0.051	677	1.1	0.050	1.3	48	0.024	0.033
Yellow Perch	June	RG_GC	RG_GC_YP-M-1_2022-06-22_NP	0.08	0.020	75	2	<0.003	<0.507	0.40	<0.094	<0.051	1609	1.0	0.013	0.5	12	0.013	0.058
			RG_GC_YP-M-2_2022-06-22_NP	0.02	0.005	75	<1.3	<0.003	<0.507	0.20	0.1180	<0.051	593	1.0	0.013	0.5	9	0.003	0.025
	July	RG_GC	RG_GC_YP-3-M_2022-07-12_NP	0.030	0.0098	67	0.58	<0.003	<0.475	0.061	0.088	<0.065	593	1.4	0.026	0.70	16	0.0050	<0.040

Table F.4: Analysis for Non-Lethal Sport Fish Muscle Tissue Samples, Koocanusa Reservoir Monitoring Program, 2022

Tissue	Month	Area	Sample ID	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Bull Trout	May	RG_SC	RG_SC_BT_M-01_2022-05-25_NP	1,403	0.46	1.2	<0.011	0.33	10,352	18,287	1.9	<0.001	1,646	0.84	0.038	0.16	1.1	0.0010	<0.040	15
		RG_ER	RG_ER_BT_M-01_2022-05-27_NP	620	0.25	2.9	<0.011	0.23	7,625	15,676	2.9	<0.001	7,585	0.46	0.023	0.49	1.1	<0.001	<0.040	59
		RG_GC	RG_GC_BT_M-01_2022-05-27_NP	1,188	0.76	0.86	<0.011	0.23	11,825	22,116	2.3	<0.001	1,450	0.82	0.030	0.22	1.1	<0.001	<0.040	27
			RG_GC_BT_M-02_2022-05-27_NP	943	0.42	1.6	<0.011	0.23	9,273	15,931	2.2	<0.001	3,145	0.82	0.028	1.1	1.1	<0.001	<0.040	19
	June	RG_SC	RG_SC_BT-M-2_2022-06-22_NP	1197	0.53	1.1	<0.001	0.13	6,378	6,550	1.8	<0.001	520	0.57	0.028	0.1	0.6	<0.001	<0.058	15
		RG_ER	RG_ER_BT-M-6_2022-06-25_NP	982	0.37	1.1	<0.001	0.24	8,169	13,884	1.9	0.019	1,758	0.17	0.042	<0.029	0.69	<0.001	<0.027	15
			RG_ER_BT-M-7_2022-06-25_NP	272	0.21	0.31	<0.001	0.090	1,932	1,853	0.73	0.064	1,014	0.20	0.0090	0.091	1.0	<0.001	<0.027	11
			RG_ER_BT-M-8_2022-06-25_NP	431	0.26	0.52	<0.001	0.51	3,207	3,974	0.97	0.012	1,029	0.18	0.014	<0.029	1.4	<0.001	<0.027	8.9
		RG_GC	RG_GC_BT-M-3_2022-06-22_NP	756	0.21	1.30	<0.001	<0.045	5,233	9,862	1.80	<0.001	1,334	0.51	0.040	0.4050	0.6	0.0010	<0.058	24.0
			RG_GC_BT-M-4_2022-06-22_NP	979	1.40	0.72	<0.001	0.09	6,043	9,828	2.10	<0.001	843	0.70	0.024	0.1850	1.7	0.0010	<0.058	15.0
			RG_GC_BT-M-5_2022-06-23_NP	792	0.61	1.40	<0.001	<0.045	7,753	15,552	1.70	<0.001	2,252	0.71	0.043	0.1340	1.7	0.0010	<0.058	14.0
			RG_GC_BT-M-6_2022-06-23_NP	734	0.21	0.96	<0.001	<0.045	7,059	15,111	1.80	<0.001	2,175	0.59	0.043	0.2500	1.1	<0.001	<0.058	26.0
			RG_GC_BT-M-7_2022-06-23_NP	799	0.32	1.10	<0.001	0.09	4,770	6,452	1.70	<0.001	793	0.56	0.044	0.2710	0.6	<0.001	<0.058	23.0
			RG_GC_BT-M-8_2022-06-29_NP	317	0.27	0.23	<0.001	0.33	2,671	3,684	1.1	0.057	744	0.45	0.0070	0.13	1.4	0.0010	<0.027	10
	July	RG_ER	RG_ER_BT-9-M_2022-07-12_NP	941	0.28	3.4	<0.001	0.054	7,484	9,210	3.2	<0.001	4,411	0.27	0.024	0.17	0.63	<0.001	<0.031	28
			RG_ER_BT-10-M_2022-07-14_NP	1,020	0.17	0.72	<0.001	0.054	11,942	23,104	1.9	<0.001	2,169	0.32	0.048	0.11	0.63	<0.001	<0.031	12
			RG_ER_BT-11-M_2022-07-14_NP	1,196	0.36	0.94	<0.001	0.38	11,855	24,914	2.8	<0.001	1,908	0.46	0.031	0.084	0.63	<0.001	<0.031	16
Eastern Brook Trout	May	RG_ER	RG_ER_EB_M-01_2022-05-26_NP	1,402	0.83	0.36	<0.011	0.67	11,407	19,547	3.7	0.027	1,024	0.63	0.021	0.039	1.6	0.0030	0.070	40
			RG_ER_EB_M-02_2022-05-26_NP	1,167	0.34	0.61	<0.011	0.23	13,589	29,991	2.6	<0.001	899	0.24	0.031	0.12	1.1	<0.001	<0.040	13
Kokanee	June	RG_GC	RG_GC_KO-M-1_2022-06-22_NP	910	0.26	<0.519	<0.001	0.13	8,315	13,115	1.8	<0.001	580	0.71	0.037	0.43	1.1	<0.001	<0.058	24
			RG_GC_KO-M-2_2022-06-22_NP	1,185	0.30	<0.519	<0.001	0.13	11,270	22,490	1.7	<0.001	935	0.28	0.055	0.05	0.6	<0.001	<0.058	25
Mountain Whitefish	May	RG_ER	RG_ER_MW_M-01_2022-05-26_NP	1,063	0.69	0.16	<0.011	0.42	11,181	24,212	1.2	<0.001	843	0.13	0.014	0.041	0.53	<0.001	<0.040	13
	July		RG_ER_MW-2-M_2022-07-17_NP	1,227	0.34	0.46	<0.001	0.054	12,474	32,353	2.4	<0.001	1,507	0.12	0.017	0.12	0.63	<0.001	<0.031	19
			RG_ER_MW-3-M_2022-07-17_NP	1,282	0.32	0.70	<0.001	0.16	9,574	11,246	2.0	<0.001	686	0.30	0.0070	0.15	0.63	<0.001	<0.031	25
Rainbow Trout	May	RG_GC	RG_GC_RBT_M-01_2022-05-27_NP	1,427	0.23	0.31	<0.011	0.093	10,877	22,062	2.1	<0.001	891	0.14	0.012	0.030	0.79	<0.001	<0.040	12
			RG_GC_RBT_M-02_2022-05-27_NP	1,253	0.20	0.40	<0.011	0.19	11,485	25,021	3.4	<0.001	1,669	0.35	0.031	0.027	0.53	<0.001	<0.040	13
			RG_GC_RBT_M-03_2022-05-27_NP	1,352	0.27	0.74	<0.011	0.23	11,829	20,971	1.9	<0.001	830	0.56	0.023	0.17	1.1	<0.001	<0.040	16
			RG_GC_RBT_M-04_2022-05-27_NP	1,128	0.22	0.74	<0.011	0.046	11,341	22,654	1.7	<0.001	775	0.69	0.018	0.32	1.1	0.0010	<0.040	17
	June	RG_ER	RG_ER_RBT-M-1_2022-06-25_NP	1,253	0.77	0.91	0.020	1.7	15,106	25,054	2.8	0.0090	1,150	0.16	0.043	0.072	1.0	<0.001	0.038	22
Westslope Cutthroat Trout	June	RG_GC	RG_GC_WCT-M-1_2022-06-23_NP	1,048	0.46	<0.519	<0.001	0.2	8,531	15,256	2.1	<0.001	1,575	0.94	0.009	0.275	1.1	0.0020	<0.058	40
Yellow Perch	June	RG_GC	RG_GC_YP-M-1_2022-06-22_NP	1,082	0.97	<0.519	<0.001	0.2	10,259	15,822	3.3	<0.001	962	0.54	0.033	0.137	1.1	<0.001	<0.058	27
			RG_GC_YP-M-2_2022-06-22_NP	682	0.72	<0.519	<0.001	0.1	6,640	13,250	3.1	<0.001	607	0.17	0.027	0.186	0.6	<0.001	<0.058	13
	July	RG_GC	RG_GC_YP-3-M_2022-07-12_NP	90	0.37	1.7	<0.001	0.16	13,905	32,346	3.2	<0.001	2,066	0.13	0.018	0.034	1.3	<0.001	<0.031	53

APPENDIX G

METHODS

APPENDIX G METHODS

G1 OVERVIEW

The Koocanusa Reservoir Monitoring Program was designed to evaluate changes in water and sediment quality, as well as biota in the reservoir downstream relative to upstream of the Elk River confluence. The program addresses the study questions (described in section 1.1 of main body report), and includes the following components:

- Water quality (physical and chemical);
- Sediment Quality (physical and chemical);
- Zooplankton (community and tissue);
- Benthic invertebrate tissue; and
- Targeted fish tissue sampling.

Field sampling in Koocanusa Reservoir was conducted during two spring sampling events (May and June) and one late summer (August) sampling event (Table G.1). The first spring sampling event was conducted from May 24th to 27th, which included water quality and targeted fish tissue sampling of peamouth chub (PCC) and sport fish. The second spring sampling event was conducted from June 20th to 23rd, which included water quality, benthic invertebrate tissue, and targeted fish tissue sampling of redside shiner (RSC) and sport fish. The last sampling event was conducted from August 23rd to 27th and included water and sediment quality, zooplankton community and tissue, and benthic invertebrate tissue. No sport fish sampling was conducted in August due to surface water temperatures exceeding British Columbia scientific fish sampling permit stipulations. Sampling locations used in 2022 were consistent with those approved in the 2021 to 2023 study design and are the same as those used in previous monitoring years (2014 to 2020).

Table G.1: Overview of the 2022 to 2023 Koocanusa Reservoir Monitoring Program Study Design

Study Area	Biological Area Code	Biological Area Description	UTMs		2022 and 2023																			
					April				May				June					August						
					Water		Benthic Invertebrates	Fish	Water		Fish [b]		Water		Plankton	Fish [b]		Water		Sediment	Plankton		Benthic Invertebrates	Fish
					Chemistry	*In Situ* Water Quality	Tissue Chemistry	Sport Fish Tissue Chemistry [a]	Chemistry	*In Situ* Water Quality	Tissue Chemistry		Chemistry	*In Situ* Water Quality	Zooplankton Tissue Chemistry	Tissue Chemistry		Chemistry	*In Situ* Water Quality	Quality (Chemistry and Composition)	Zooplankton Tissue Chemistry	Zooplankton Community	Tissue Chemistry	Sport Fish Tissue Chemistry [a]
			Easting	Northing							Peamouth Chub	Sport Fish [a]				Redside Shiner	Sport Fish [a]							
Upstream of the Elk River	RG_SC	near the mouth of Sand Creek	625624	5457296	1	1	-	up to 8	1	1	10	up to 8	1	1	-	10	up to 8	1	1	-	-	-	-	up to 8
	RG_TN	near the RG_KERRRD permitted water quality station	627112	5453380	R	5	1	-	R	1	-	-	R	5	5	-	-	R	5	5	5	5	1	-
Elk River	RG_ER	near the mouth of Elk River	627959	5447572	R	-	-	up to 8	R	1	10	up to 8	R	1	-	10	up to 8	R	1	-	-	-	-	up to 8
Downstream of the Elk River	RG_T4	near the RG_GRASMERE permitted water quality station	629235	5441654	R	5	1	-	R	1	-	-	R	5	5	-	-	R	5	5	5	5	1	-
	RG_GC	near the mouth of Gold Creek	630926	5436344	1	1	-	up to 8	1	1	10	up to 8	1	1	-	10	up to 8	1	1	-	-	-	-	up to 8

Notes: "'-" indicates that no sampling is occurring for a specific monitoring component during that time period. "number" indicates number of samples collected. "R" indicates routine sampling by Teck. Tissue samples for northern pikeminnow collected during the Northern Pikeminnow Toxicity Study will be included in analysis. Water quality data from Teck routine stations will be collected under the Routine Water Quality Program.

[a] Up to 8 individuals of each sport fish (bull trout, Kokanee, mountain whitefish, rainbow trout, westslope cutthroat trout, yellow perch) species were captured over the course of the sampling year.

[b] Timing for peamouth chub dependent on findings from 2021, and could occur in April, May, or June in 2022 and 2023.

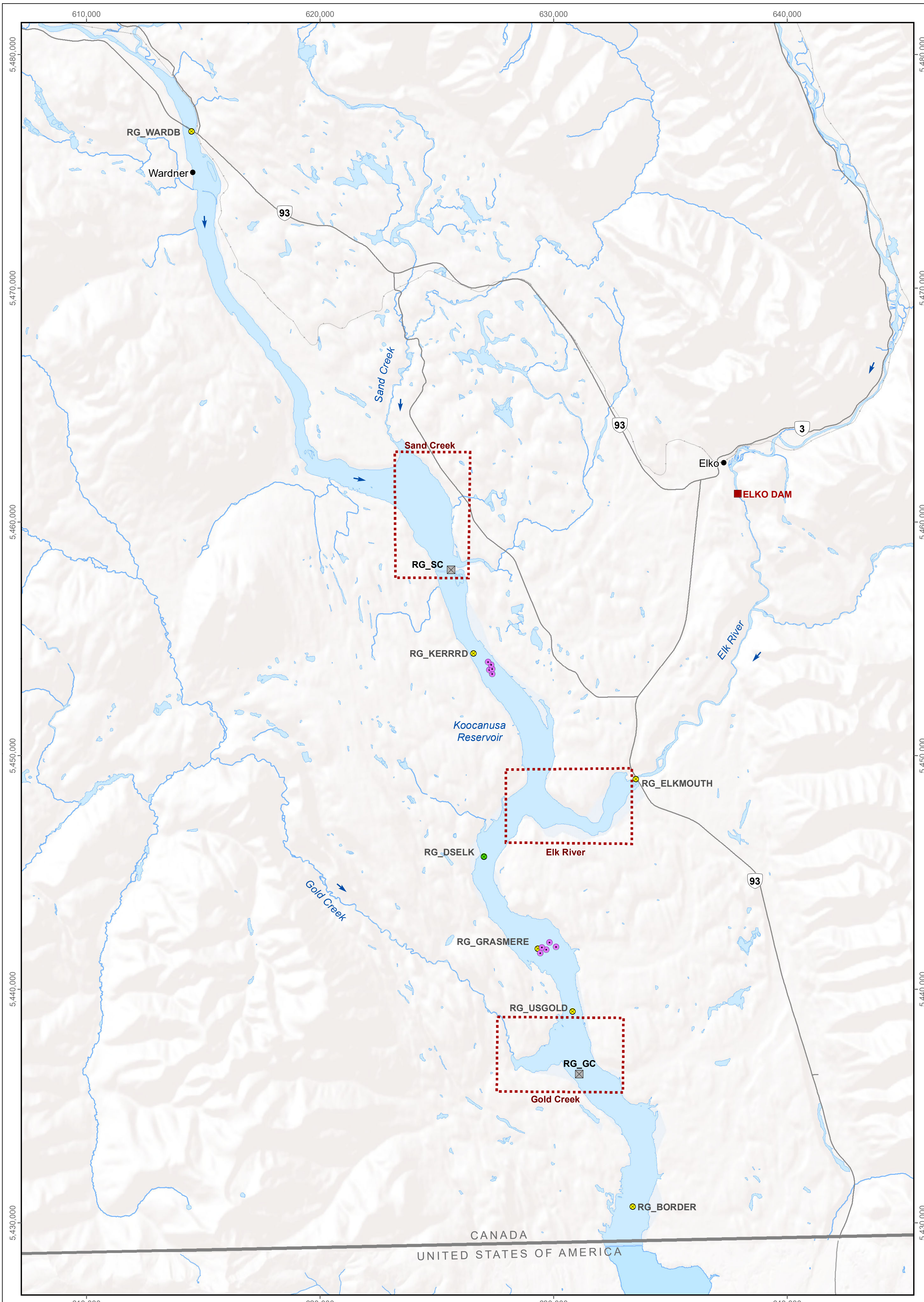
G2 WATER QUALITY

G2.1 Sample Collection and Laboratory Analysis

The Permit requires the collection of water samples at five stations located within the Canadian portion of the reservoir ('Permitted Water Quality Station' on Figure G.1). Water chemistry samples were collected weekly at these five locations from April 1st to July 15th and monthly outside of this period. When ice was present, through-ice samples were collected only after consideration of suitable ice thickness and other safety concerns (i.e., access and approach). Transects have been established at three of the permitted sites (RG_DSELK, RG_USGOLD, and RG_BORDER), where water chemistry samples were collected monthly throughout the year, when conditions allowed, to identify whether mixing was uniform across the reservoir at each transect. At RG_DSELK, weekly samples are typically collected along the transect from April 1 to about May 31 as conditions allow to better assess mixing of water from the Elk River across the reservoir and its effect on water quality conditions during low-pool conditions. However, in 2022, low water levels and riverine conditions persisted into June; thus, the first transect samples were collected in the third week in June and were discontinued the first week of July when the water appeared to be well-mixed. The justification for developing transects was to use systematic and grid sampling data as the basis for determining means, percentiles, and other summary metrics (and the variability associated with these metrics) useful for evaluating spatial patterns or trends over time. Such a design provides a practical and simple approach for ensuring uniform coverage of water quality across and within the reservoir.

Water quality samples were collected at two additional sampling locations (RG_SC and RG_GC; 'Water Quality Station' on Figure G.1) concurrent with sampling events in May, June, and August where samples could not be aligned with Teck routine water quality stations (see 'Water Quality Stations' on Figure G.1; Table G.1).

Methods used for the collection of all water chemistry samples were consistent with those outlined in the Koocanusa Reservoir Water Quality Monitoring Plan (Teck 2020; Minnow 2021). Water samples were analyzed for conventional parameters, major ions, nutrients, total and dissolved metals, and chlorophyll-a concentrations (Table G.2). All water chemistry samples were analyzed by ALS Environmental (ALS) at either their Burnaby, British Columbia (BC) or Calgary, Alberta (AB) locations. Analyses were completed in accordance with procedures described in the "British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials, and Discrete Ambient Air" (Province of British Columbia 2020) consistent with Permit requirements. Quality Assurance/Quality Control (QA/QC) applied to laboratory analyses included assessment of the ability to achieve minimum



LEGEND

- Permitted Water Quality Station
- Order Water Quality Station
- Profundal Sediment, Zooplankton (Community and Tissue Chemistry), and Benthic Invertebrate (Community and Tissue Chemistry) Sampling Location
- Water Chemistry and In Situ Monitoring Station
- Approximate Fish (fish tissue and health) Sampling Area

Sampling Locations in Koocanusa Reservoir, 2022

0 2.5 5 10
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 11

Date: January 2023
Project 227202.0031

minnow environmental inc.

Figure G.1

Document Path: C:\Users\CApol\Trinity Consultants, Inc\Teck - 227202.0031 - Koocanusa 2022\D - GIS\Annual Report\22-31 Figure 2.1 Sampling Locations in Koocanusa Reservoir, 2022.mxd

Table G.2: British Columbia Water Quality Guidelines, Site-Specific Elk Valley Water Quality Plan (EVWQP) Benchmarks, and Interim Screening Values Applicable to Surface Waters, Koocanusa Reservoir Monitoring Program, 2022

Variable		Units	British Columbia Water Quality Guidelines [a]				Site-Specific Benchmark or Water Quality Objective [b]
			Long-term Average	Short-term Maximum	Year	Status	Elk River
Non-Metals	Total Alkalinity	mg/L	For dissolved calcium = < 4mg/L, WQG = <10 For dissolved calcium = 4 to 8 mg/L, WQG = 10 to 20 For dissolved calcium = > 8 mg/L, WQG = > 20	-	2015	Working	-
Non-Metals	Unionized Ammonia [c]	mg/L	pH and Temperature dependent (tabular)	pH and Temperature dependent (tabular)	2009	Approved	-
Non-Metals	Chloride	mg/L	150	600	2003	Approved	-
Non-Metals	Fluoride	mg/L	-	For hardness ≤ 10 mg/L, WQG = 0.4 For hardness > 10 mg/L, WQG = [-51.73 + 92.57 × $\log_{10}$(hardness)]×0.01 Maximum applicable hardness = 385 mg/L	1990	Approved	-
Non-Metals	Nitrate-N	mg/L	3	33	2009	Approved	Level 1 EVWQP benchmark = 3 mg/L N[j] Level 2 EVWQP benchmark = 5 mg/L N[j] Level 3 EVWQP benchmark = 21 mg/L N[j]
Non-Metals	Nitrite-N [d]	mg/L	0.02 to 0.20	0.06 to 0.60	2009	Approved	-
Non-Metals	Dissolved oxygen [e]	mg/L	For buried embryo/alevin life stages, WQG (water column) = 11 WQG (interstitial) = 8 For other life stages, WQG (water column) = 8	For buried embryo/alevin life stages, WQG (water column) = 9 WQG (interstitial) = 6 For other life stages, WQG (water column) = 5	1997	Approved	-
Non-Metals	pH [f]	pH units	6.5 - 9.0		1991	Approved	-
Non-Metals	Sulphate [g]	mg/L	128 to 429 Maximum applicable hardness = 250 mg/L	-	2013	Approved	Level 1 EVWQP Benchmark = BCWQG = 429
Non-Metals	Total Dissolved Solids	mg/L	-	-	-	-	Level 1 Screening Value = 1000
Metals and Metalloids – Total	Antimony (III)	mg/L	0.009	-	2015	Working	-
Metals and Metalloids – Total	Arsenic	mg/L	-	0.005	2002	Approved	-
Metals and Metalloids – Total	Barium	mg/L	1	-	2015	Working	-
Metals and Metalloids – Total	Beryllium	mg/L	0.00013	-	2015	Working	-
Metals and Metalloids – Total	Boron	mg/L	1.2	-	2003	Approved	-
Metals and Metalloids – Total	Chromium [h]	mg/L	For Cr(VI), WQG = 0.001 For Cr(III), WQG = 0.0089	-	2015	Working	-
Metals and Metalloids – Total	Cobalt	mg/L	0.004	0.11	2004	Approved	-
Metals and Metalloids – Total	Iron	mg/L	-	1	2008	Approved	-

Note: "-" indicates no sample collected.
[a] British Columbia Working (BCMOE 2017) or Accepted (BCMOE 2019) Water Quality Guidelines for the Protection of Aquatic Life. For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.
[b] When appropriate, site-specific Elk Valley Water Quality Plan Benchmarks (EVWQP; Teck 2014) or interim screening values were applied in addition to or instead of BC water quality guidelines. Interim screening values are displayed for nickel (Golder 2017; Coal Mountain Operations Aquatic Health Assessment Report). Site specific Water Quality Objectives developed for Koocanusa will be used when finalized.
[c] Temperature and pH dependent; range of minimum and maximum values.
[d] Dependent on concurrent chloride, range of values reported (BCMOE 2019).
[e] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.
[f] Unrestricted change permitted within this pH range.
[g] For hardness-based guidelines, concurrent hardness values were used for calculating guidelines. If hardness values exceeding the maximum applicable hardness, then guidelines were determined using the maximum applicable hardness. If hardness values is lower than the minimum hardness, then guidelines were determined using the minimum hardness.
[h] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.
[i] The most conservative guideline (0.00000125 mg/L) was applied.
[j] at representative hardness of 200 mg/L as $CaCO_3$ for the Elk River.

Table G.2: British Columbia Water Quality Guidelines, Site-Specific Elk Valley Water Quality Plan (EVWQP) Benchmarks, and Interim Screening Values Applicable to Surface Waters, Koocanusa Reservoir Monitoring Program, 2022

Variable			Units	British Columbia Water Quality Guidelines [a]				Site-Specific Benchmark or Water Quality Objective [b]
				Long-term Average	Short-term Maximum	Year	Status	Elk River
Metals and Metalloids	Total	Lead [g]	mg/L	For hardness ≤ 8 mg/L, none proposed For hardness 8 to 360 mg/L, WQG = 0.001×{3.31+ exp[1.273 × ln(hardness) - 4.704]} No more than 20% of samples in a 30-d period should be >1.5X the guideline. Maximum applicable hardness = 360 mg/L	For hardness ≤ 8 mg/L, WQG ≤ 0.003 For hardness 8 to 360 mg/L, WQG = 0.001×{exp[1.273 × ln(hardness) - 1.460]} Maximum applicable hardness = 360 mg/L	1987	Approved	-
		Manganese [g]	mg/L	For hardness 37 to 450 mg/L, WQG ≤ 0.004 × hardness + 0.605 Maximum applicable hardness = 450 mg/L	For hardness 25 to 259 mg/L, WQG ≤ 0.01102 × hardness + 0.54 Maximum applicable hardness = 259 mg/L	2001	Approved	-
		Mercury [i]	mg/L	MeHg ≤ 0.5% of THg, WQG = 0.00002 Else, WQG = [0.0001/(MeHg/THg)] OR When MeHg = 0.5% of THg, WQG= 0.00002 When MeHg = 1.0% of THg, WQG = 0.00001 When MeHg = 8.0% of THg, WQG= 0.00000125	-	2001	Approved	-
		Molybdenum	mg/L	1	2	1986	Approved	-
		Nickel [g]	mg/L	-	-	-	-	Level 1 Interim Screening Value = 0.0053 Level 2 Interim Screening Value = 0.015 Level 3 Interim Screening Value = 0.022
		Selenium	µg/L	2	-	2014	Approved	Level 1 EVWQP Benchmark = 19 Level 2 EVWQP Benchmark = 74
		Silver [g]	mg/L	For hardness ≤ 100 mg/L, WQG = 0.00005 For hardness > 100 mg/L, WQG = 0.0015	For hardness ≤ 100 mg/L, WQG = 0.0001 For hardness > 100 mg/L, WQG = 0.003	1996	Approved	-
		Thallium	mg/L	0.0008	-	1997	Working	-
		Uranium	mg/L	0.0085	-	2011	Working	-
		Zinc [g]	mg/L	For hardness ≤ 90 mg/L, WQG = 0.0075 For hardness 90 to 330 mg/L, WQG = [7.5 + 0.75 (hardness - 90)]×0.001; Maximum applicable hardness = 330 mg/L	For hardness ≤ 90 mg/L, WQG = 0.033 For hardness 90 to 500 mg/L, WQG = [33 + 0.75 (hardness - 90)]×0.001; Maximum applicable hardness = 500 mg/L	1999	Approved	-
	Dissolved	Aluminum	mg/L	When pH ≥ 6.5, WQG = 0.05 When pH < 6.5, WQG = exp[1.6 - 3.327(median pH)+ 0.402(median pH)^2]	When pH ≥ 6.5, WQG = 0.1 When pH < 6.5, WQG = exp[1.209 - 2.426(pH)+ 0.286 (pH)^2]	2001	Approved	-
		Cadmium [g]	µg/L	For hardness = 3.4 to 285 mg/L, WQG = {exp[0.736×ln(hardness) - 4.943]} Maximum applicable hardness = 285 mg/L	For hardness = 7 to 455 mg/L, WQG = {exp[1.03×ln(hardness)-5.274]} Maximum applicable hardness = 455 mg/L	2015	Approved	Level 1 EVWQP Benchmark = $10^{0.83(\log(\text{hardness}))-2.53}$ Maximum applicable hardness = 285 mg/L
		Copper	mg/L	Biotic Ligand Model	Biotic Ligand Model	2019	Approved	-
		Iron	mg/L	-	WQG = 0.35 mg/L	2008	Approved	-

Note: "-" indicates no sample collected.

[a] British Columbia Working (BCMOE 2017) or Accepted (BCMOE 2019) Water Quality Guidelines for the Protection of Aquatic Life. For guidelines dependent on other analytes (e.g., hardness), guidelines were screened using concurrent values.

[b] When appropriate, site-specific Elk Valley Water Quality Plan Benchmarks (EVWQP; Teck 2014) or interim screening values were applied in addition to or instead of BC water quality guidelines. Interim screening values are displayed for nickel (Golder 2017; Coal Mountain Operations Aquatic Health Assessment Report). Site specific Water Quality Objectives developed for Koocanusa Reservoir will be used when finalized.

[c] Temperature and pH dependent; range of minimum and maximum values.

[d] Dependent on concurrent chloride, range of values reported (BCMOE 2019).

[e] Dissolved oxygen guidelines represent a minimum value, and so exceedances were quantified below this guideline.

[f] Unrestricted change permitted within this pH range.

[g] For hardness-based guidelines, concurrent hardness values were used for calculating guidelines. If hardness values exceeding the maximum applicable hardness, then guidelines were determined using the maximum applicable hardness. If hardness values is lower than the minimum hardness, then guidelines were determined using the minimum hardness.

[h] Chromium(VI) is the dominant oxidation state in oxygenated environments, and so its guideline was applied.

[i] The most conservative guideline (0.00000125 mg/L) was applied.

[j] at representative hardness of 200 mg/L as $CaCO_3$ for the Elk River.

laboratory reporting limits (LRLs; Table G.3), show undetectable parameter concentrations in blank samples, and evaluation of matrix spikes (MS), certified reference materials (CRMs), and laboratory duplicates, the latter of which was used to assess accuracy and precision of the laboratory data (Appendix A).

G2.2 Data Analysis

Assessment of water chemistry data included comparison to applicable provincial guidelines and EVWQP benchmarks, spatial comparisons between downstream and upstream stations, and qualitative comparisons to data collected during previous monitoring. Water chemistry evaluation included four order constituents (total selenium, nitrate, sulphate, and dissolved cadmium) and twelve non-order mining-related constituents (total antimony, total barium, total boron, dissolved cobalt, total lithium, total manganese, total molybdenum, total nickel, nitrite, total dissolved solids, total uranium, and total zinc).[1] The data used in this assessment included samples collected at the five permitted stations: RG_KERRRD, RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER, as well as the transect locations adjacent to RG_DSELK, RG_USGOLD, and RG_BORDER. Additional samples collected from the biological monitoring stations during the three biological sampling events in 2022 (RG_SC and RG_GC) were excluded from the water quality assessment due to limited sample sizes.[2] Under Permit 107517, transect data at RG_DSELK is included in the calculation of the monthly average concentration that is used to determine compliance with the SPOs[3]. Thus, the monthly averages for RG_DSELK used in plotting and screening were calculated using transect data following the formulas outlined in the permit:

$$CKMo = [\Sigma(\Sigma CD/ND)]/NMo$$

Where:

- CKMo is the monthly average concentration;
- CD are the concentrations of samples collected at transect locations at all depths sampled on the same day;
- ND are the number of samples collected at transect locations at all depths sampled on the same day; and,

[1] These twelve non-order constituents were selected based on the work done for the development of the surface water early warning triggers (EWT; Azimuth 2018).

[2] Data collected concurrently with biological monitoring samples are provided in Appendix B, and only used to support biological observations.

[3] As per the amendment to Permit 107517 dated June 1, 2022.

Table G.3: Laboratory Reporting Limits (LRLs) for Analytes Assessed in Water and Sediment Samples, Koocanusa Reservoir Monitoring Program, 2022

Analyte	Water [a]		Sediment	
	Units	LRL [b]	Units	LRL
Moisture	-	-	%	0.25
pH	-	-	pH	0.1
% Gravel	-	-	%	1.0
% Sand	-	-	%	1.0
% Silt	-	-	%	1.0
% Clay	-	-	%	1.0
Total Organic Carbon (TOC)	mg/L	0.5	%	0.05
Dissolved Organic Carbon (DOC)	mg/L	0.5	-	-
Hardness (as CaCO3)	mg/L	0.50	-	-
Turbidity	NTU	0.10		
Alkalinity	mg/L	1	-	-
Total Dissolved Solids (TDS)	mg/L	10	-	-
Total Suspended Solids (TSS)	mg/L	1.0	-	-
Ammonia, Total (as N)	mg/L	0.0050	-	-
Bromide (Br)	mg/L	0.050	-	-
Chloride (Cl)	mg/L	0.500	-	-
Fluoride (F)	mg/L	0.020	-	-
Nitrate (as N)	mg/L	0.0050	-	-
Nitrite (as N)	mg/L	0.001	-	-
Total Kjeldahl Nitrogen	mg/L	0.050	-	-
Phosphorus (P)-Total Dissolved	mg/L	0.0020	-	-
Phosphorus (P)-Total	mg/L	0.0020	-	-
Orthophosphate	mg/L	0.0010	-	-
Sulphate (SO4)	mg/L	0.30	-	-
Acenaphthylene	-	-	mg/kg dw	0.005
Anthracene	-	-	mg/kg dw	0.004
Benz(a)anthracene	-	-	mg/kg dw	0.01
Benzo(a)pyrene	-	-	mg/kg dw	0.01
Benzo(b)fluoranthene	-	-	mg/kg dw	0.01
Benzo(b+j+k)fluoranthene	-	-	mg/kg dw	0.01
Benzo(g,h,i)perylene	-	-	mg/kg dw	0.01
Benzo(k)fluoranthene	-	-	mg/kg dw	0.01
Chrysene	-	-	mg/kg dw	0.01
Dibenz(a,h)anthracene	-	-	mg/kg dw	0.005
Fluoranthene	-	-	mg/kg dw	0.01
Fluorene	-	-	mg/kg dw	0.01
Indeno(1,2,3-c,d)pyrene	-	-	mg/kg dw	0.01
2-Methylnaphthalene	-	-	mg/kg dw	0.01
Naphthalene	-	-	mg/kg dw	0.01
Phenanthrene	-	-	mg/kg dw	0.01
Pyrene	-	-	mg/kg dw	0.01
Aluminum (Al)	mg/L	0.003	mg/kg dw	50
Antimony (Sb)	mg/L	0.0001	mg/kg dw	0.1
Arsenic (As)	mg/L	0.0001	mg/kg dw	0.1
Barium (Ba)	mg/L	0.00005	mg/kg dw	0.5
Beryllium (Be)	mg/L	0.00002	mg/kg dw	0.1
Bismuth (Bi)	mg/L	0.00005	mg/kg dw	0.2
Boron (B)	mg/L	0.01	mg/kg dw	5
Cadmium (Cd)	mg/L	0.000005	mg/kg dw	0.02
Calcium (Ca)	mg/L	0.05	mg/kg dw	50
Chromium (Cr)	mg/L	0.0001	mg/kg dw	0.5
Cobalt (Co)	mg/L	0.0001	mg/kg dw	0.1
Copper (Cu)	mg/L	0.0005	mg/kg dw	0.5
Iron (Fe)	mg/L	0.01	mg/kg dw	50
Lead (Pb)	mg/L	0.00005	mg/kg dw	0.5
Lithium (Li)	mg/L	0.001	mg/kg dw	2
Magnesium (Mg)	mg/L	0.005	mg/kg dw	20
Manganese (Mn)	mg/L	0.0001	mg/kg dw	1
Mercury (Hg)	mg/L	0.000005	mg/kg dw	0.005
Molybdenum (Mo)	mg/L	0.00005	mg/kg dw	0.1
Nickel (Ni)	mg/L	0.0005	mg/kg dw	0.5
Phosphorus (P)	-	-	mg/kg dw	50
Potassium (K)	mg/L	0.05	mg/kg dw	100
Selenium (Se)	mg/L	0.00005	mg/kg dw	0.2
Silver (Ag)	mg/L	0.00001	mg/kg dw	0.1
Sodium (Na)	mg/L	0.05	mg/kg dw	50
Strontium (Sr)	mg/L	0.0002	mg/kg dw	0.5
Sulphur (S)	-	-	mg/kg dw	100
Thallium (Tl)	mg/L	0.00001	mg/kg dw	0.05
Tin (Sn)	mg/L	0.0001	mg/kg dw	2
Titanium (Ti)	mg/L	0.01	mg/kg dw	1
Uranium (U)	mg/L	0.00001	mg/kg dw	0.05
Vanadium (V)	mg/L	0.0005	mg/kg dw	0.2
Zinc (Zn)	mg/L	0.003	mg/kg dw	2

Note: "-" indicates no data available.

[a] Total and dissolved metals were analyzed for water samples. Laboratory reporting limits were the same for both fractions.

[b] These are expected detection limits but may be changed by lab due to sample conditions.

- NMo are the number of days sampled in the month.

Monthly mean concentrations were calculated for each order and non-order constituent using the Kaplan-Meier (K-M) method. This method involves transforming the left censored (i.e., < LRL value) dataset to a right censored (i.e., > LRL value) dataset, and then using the K-M estimator (used to estimate the mean survival time in survival analysis) to estimate the mean in the event that values below the LRL occurred within a data set. The calculation was conducted using the survfit() function in the survival package (Therneau 2017) in R. The K-M method is non-parametric and can accommodate multiple LRLs. The method of estimating the mean is equivalent to using the distribution of detectable values below the LRL to represent values that are less than the LRL. If there was only one LRL and no detected values below the LRL, then the K-M estimate of the mean was equivalent to replacing the value below the LRL with the LRL (i.e., the best estimate for the values less than the LRL is the LRL). The order and non-order constituents were screened against British Columbia Water Quality Guidelines (BCWQG; BCMOE 2019, 2021) and SPOs where applicable (i.e., for station RG_DSELK). Plots of monthly average concentrations of these constituents at each station, together with applicable BCWQGs and SPOs, were prepared as the basis for qualitative comparisons among stations[4].

Water quality data from Montana from 2022 were represented in the plots. These data were also compared to United States Environmental Protection Agency (US EPA) criteria for dissolved cadmium, dissolved selenium, and total zinc. Water chemistry data from major inflows into Koocanusa Reservoir, namely the Kootenay River (Station RG_WARDB) and the Elk River (Station RG_ELKMOUTH), which are monitored on a regular basis, were also included in the monthly plots with the permitted station data. Data for RG_USELK were included for historical reference only.[5]

Order and non-order constituent data were compared statistically between downstream (RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER) and upstream (RG_KERRRD) permit stations to evaluate potential mine-related influences on water quality of Koocanusa Reservoir. Statistical comparisons were conducted on the mathematical differences in monthly mean concentrations between stations (i.e., mean concentration downstream of the Elk River less the mean concentration upstream of the Elk River) to remove the potential influence associated with differing sampling season. Data from the additional

[4] Although chronic BCWQGs are based on 30-day averages, this evaluation used monthly mean concentrations.

[5] RG_USELK was the upstream station prior to 2015, but due to its proximity to the Elk River, this monitoring station was relocated farther upstream, renamed RG_KERRRD, and sampled as the upstream station thereafter.

transect stations were excluded from the monthly mean concentration calculations used in the statistical analysis since not all stations have transect data available.

Data from upstream and downstream stations were tested for whether differences in monthly mean parameter concentrations vary among the stations using an Analysis of Variance (ANOVA). Subsequently, the differences were to determine whether they were different from zero using a one-sample t-test by testing the hypothesis:

$$H_{01}: \mu_d = 0$$

The magnitude of difference (MOD) in parameter concentrations between stations was calculated if a significant difference was detected between stations as (using RG_USGOLD as an example):

$$\text{MOD} = \frac{(MCT_{RG\_USGOLD} - MCT_{RG\_KERRRD})}{MCT_{RG\_KERRRD}} \times 100\%$$

where MCT_{RG_USGOLD} and MCT_{RG_KERRRD} were the measure of central tendency (MCT) for the downstream and upstream stations, respectively. The statistical analyses were conducted using R statistical software.

Total nitrogen and phosphorus ratios were calculated for each of the five permitted water stations (RG_KERRRD, RG_DSELK, RG_GRASMERE, RG_USGOLD, and RG_BORDER) and major inputs (Kootenay River [RG_WARDB] and Elk River [RG_ELKMOUTH]) and plotted to qualitatively evaluate differences between downstream and upstream of the Elk River. Nitrogen and phosphorus ratios were also compared to categories defined by McDowell et al. (2009) using mass concentrations where ratios greater than 15 indicate phosphorus limitation, and ratios less than 7 indicate nitrogen limitation. The trophic status (e.g., oligo-, meso-, or eu-trophic) was calculated for permitted water sampling stations in both the Canadian and US portions of Koocanusa Reservoir based on a Trophic State Index developed by the US EPA (US EPA 2007) that uses phosphorus, Secchi depth, and chlorophyll-a measurements (Table G.4). The Trophic State Index (TSI) was used to evaluate whether trophic status differed downstream compared to upstream of the Elk River confluence.

Nitrate and selenium loadings to Koocanusa Reservoir were calculated using methods outlined in “Permit 107517 2017 Report of Monitoring Results in the Koocanusa Reservoir” (Teck 2018). Briefly, monthly average concentrations of nitrate and selenium measured at RG_ELKMOUTH and flow data prorated from applicable Water Survey of Canada (WSC) gauging stations on the Elk River were used to estimate loadings into the reservoir. A scaling method derived by Golder Associates Ltd. (Golder) used WSC hydrometric gauging stations located on the Elk River at Fernie (Station 08NK002; recent data) and at Phillips Bridge

Table G.4: Criteria for Trophic State Index, Koocanusa Reservoir Monitoring Program, 2022

Variable [a]	Oligotrophic	Mesotrophic	Eutrophic
Calculated Trophic State Index (TSI) [b]	<30	40 - 50	50 - 60
Total Phosphorus (µg/L)	<6	12 - 24	24 - 48
Chlorophyll-a (µg/L)	<0.95	2.6 - 7.3	7.3 - 20
Secchi Depth (m)	>8	4 - 2	2 - 1

[a] Carlson R. 1977. A Trophic State Index for Lakes. Limnol. Oceanogr. 22(2).361-362.

[b] TSI (Secchi Depth) = 60-14.41 ln(Secchi Depth).   TSI (Chlorophyll-a) = 9.81 ln(Chlorophyll-a) + 30.6. TSI (Total Phosphorus) = 14.42 ln(Total Phosphorus) + 4.15.

(Station 08NK005; historical data) to prorate monthly flow at the mouth of the Elk River as follows: RG_ELKMOUTH = Fernie (08NK002) x 1.53. The scaling factor developed by Golder was based on the relationship between monthly flows from each station as presented in the 2017 Permit Summary Report for Koocanusa Reservoir (Teck 2018). Similar scaling methods were used to calculate nitrate and selenium loadings to the reservoir from the Kootenay River at Station RG_WARDB using the WSC Kootenay River hydrometric gauging station located at Fort Steele (Station 08NG065) to prorate monthly flow based on the following relationship: RG_WARDB = 08NG065 x 1.18. Estimated loads of nitrate and selenium (in kg/month) were calculated by multiplying the calculated daily load by the number of days in each month to provide a monthly loading rate using the following formula:

Flow (m^3/s) * concentration (mg/L) * 86.4 = kg/day * number of days in each month

G3 SEDIMENT

G3.1 Sample Collection

Sediment samples for physical and chemical characterization were collected using a stainless-steel petite Ponar (0.023 m^2 sampling area) from each of the five stations located along transects downstream (RG_T4-1 to 5) and upstream of the Elk River (RG_TN-1 to 5; Figure G.1). Each sample consisted of three grabs to create a composite sediment sample, which was comprised of the top three centimetres (cm) of sediment (i.e., the sediment fraction in which most benthic fauna generally reside [Kirchner 1975]). If the grab was not complete to each edge of the sampler, or lacked an intact sediment-water surface layer, it was discarded, and a new grab was collected. If the grab was acceptable, the top three centimetres of sediment were removed and placed into a separate plastic tub. This procedure was repeated until three acceptable grabs were obtained, after which the sample was homogenized using a stainless-steel spoon. The homogenized sediment was then transferred to a glass jar (for analysis of polycyclic aromatic hydrocarbons [PAHs]) and a labelled polyethylene sealable bag (for analyses of moisture content, total organic carbon [TOC], total metals, and particle size, as described below). Sampling locations were recorded for each station using a handheld global positioning system (GPS) unit in Universal Transverse Mercator (UTM) coordinates. Following collection of each sediment sample, the sample was placed in a cooler containing ice and later transferred to a refrigerator for storage prior to shipment to a Canadian Association for Laboratory Accreditation (CALA) accredited analytical laboratory at the completion of the field study.

G3.2 Laboratory Analysis

Sediment samples (whole sample not field-sieved) were sent to ALS (Calgary, AB) for analysis of moisture content, particle size, TOC, metals/metalloids (hereafter collectively referred to as metals), and PAHs using analytical methods consistent with ENV laboratory guidance manual (Province of BC 2013, 2020) and the Permit. Sediment sampling QA/QC included the collection and analysis of field duplicate samples (on a minimum of 10% of the total number of samples collected), as well as an assessment of the accuracy and precision of laboratory data (Province of British Columbia 2020). Data quality was judged based on the ability to achieve minimum LRLs (Table G.3), and review of the results from laboratory duplicate, spike recovery sample, blank sample, and CRM analyses (Appendix A).

G3.3 Data Analysis

The assessment of sediment data included comparison to applicable guidelines, spatial comparisons between downstream and upstream areas, and qualitative comparisons to data from 2020 and 2021[6]. Sediment particle size distribution data were presented for each sampling event using a stacked bar graph with concentrations of TOC plotted on the secondary axis. Sediment chemistry data were compared to applicable BC Working Sediment Quality Guidelines (WSQGs). The lower WSQGs (i.e., lowest effect level/threshold effect level [LEL/TEL]) represent concentrations below which adverse biological effects would not be expected to occur (BCMOE 2021). In contrast, the upper sediment quality guidelines (i.e., probable effect level/severe effect level [PEL/SEL]) represent concentrations above which effects to sediment dwelling biota may be observed (BCMOE 2021). All parameters with concentrations that exceeded the lower WSQG were plotted. Selenium was plotted for all stations, even if concentrations were below the WSQG.

A pairwise t-test was used to evaluate differences in mean sediment chemistry between downstream (RG_T4) and upstream (RG_TN) transects for data collected in August. Data were $\log_{10}$-transformed as required to meet test assumptions of normality. If test assumptions of normality were not met for the pairwise t-test despite transformation, rank transformation for a non-parametric (Mann-Whitney U) test was used. A more conservative α of 0.5 was used for testing the assumptions to limit the use of the rank transformation in those instances where assumptions were violated. In instances where the assumption of homogeneity of variances was not met (Levene's test; $\alpha = 0.05$) but data were normally distributed, a two-sample t-test assuming unequal variances was conducted using transformed data (Ruxton 2006).

An observed effect size was calculated for each statistical comparison analyzed using a two-sample t-test as:

$$\text{Observed Effect Size} = (\bar{X}_{Downstream} - \bar{X}_{Upstream})/SD$$

where $\bar{X}_{Downstream}$ and $\bar{X}_{Upstream}$ were the downstream and upstream transect means and the standard deviation (SD) is an estimate of the upstream area standard deviation. The estimate of the upstream area standard deviation was either the pooled standard deviation from the two-sample t-test for equal variances, or the upstream area sample standard deviation when the two-sample t-test for unequal variances was applied. The effect size calculations were conducted on the transformed scale when the data were transformed for analysis. When the

[6] Statistical comparisons over time are completed only for the three-year report and were not conducted as part of this 2022 annual report.

Mann-Whitney test was used, the observed effect size was estimated using median values instead of means, and the Pooled Median Absolute Deviations (MAD) instead of SD as follows:

$$\text{MAD} = median(\left|x_{Area}^{i} - median(x_{Area})\right|)$$

where x_{Area}^{i} was each observation in the dataset, $median(x_{Area})$ was the median of the area to which x_{Area}^{i} belongs (i.e. downstream or upstream) and $|f(x)|$ was the absolute value of $f(x)$.

An MOD in parameter concentrations was calculated as a percentage difference in the measure of central tendency between the downstream area(s) and the upstream area as:

$$\text{MOD} = \frac{(MCT_{RG\_T4} - MCT_{RG\_TN})}{MCT_{RG\_TN}} \times 100\%$$

where MCT_{RG_T4} and MCT_{RG_TN} were the measures of central tendency for the downstream and upstream areas. Measures of central tendency were reported in the original data units as:

- means when no transformation was used;
- geometric means when a $\log_{10}$-transformation was used; and
- medians when a rank transformation was used.

Parameters with concentrations above the WSQG LEL guidelines in 2022 were qualitatively compared to values from 2020 and 2021.

G4 ZOOPLANKTON

G4.1 Sample Collection

Zooplankton community samples were collected using a 19 cm diameter, fine mesh (i.e., 60 micrometre [µm]) plankton net, that was hauled vertically through the entire water column at each sampling station based on methods described by the Province of British Columbia (2013)[7]. A composite sample, consisting of three vertical hauls of the plankton net lowered through the water column until approximately 1.5 m above the sediment-water interface (to avoid disturbing the sediment and potentially resulting in addition of benthic organisms into the sample), was collected at RG_TN (RG_TN-1 to RG_TN-5) and RG_T4 (RG_T4-1 to RG_T4-5). Upon retrieval of each vertical haul, the sample material was transferred into a pre-labelled plastic sampling jar and, following retrieval of the third vertical haul, preserved to a level of 10% buffered formalin in ambient water. Zooplankton community samples were collected along with supporting measures that included *in situ* water quality profile and Secchi depth (see Section G2). Preserved zooplankton community samples were stored at ambient temperature until shipment to the laboratory.

Zooplankton tissue samples were collected using an 80 µm mesh plankton net (30 cm diameter aperture) designed to target zooplankton and avoid collection of phytoplankton (i.e., the mesh size excluded phytoplankton from zooplankton tissue samples). One sample representing a composite of ten vertical hauls through the entire water column (beginning 1.5 m above the sediment-water interface to avoid disturbance of sediment) was collected at each RG_TN and RG_T4 transect station. Upon retrieval of each haul, as much water as possible was removed from the collected material before transferring the sample to a labelled sterile cryovial. Following transfer of material from the tenth haul, the sample was placed in a cooler on ice and, at the completion of daily field sampling, frozen.

G4.2 Laboratory Analysis

Zooplankton community samples were sent to Salki Consultants Inc. (Winnipeg, MB), where after being allowed to stand undisturbed for 72 hours, were decanted (60 µm filter on vacuum hose, back flushed) to 45 mL glass vials to standardize volume (40 mL) for analyses and long-term storage. Samples were analyzed for species composition, abundance, and biomass of crustaceans and rotifers. Each sample underwent the following three levels of analysis:

[7] Study design requirements to collect samples from 10 m below the surface were removed in 2019 based on recommendations from the EMC.

- 1/10, 1/20, 1/40, or 1/80 (depending on zooplankton abundance in sample) of each sample was examined under a compound microscope at 63× to 160× magnification, and a minimum of 200 organisms were identified to species (crustaceans) or lowest practical level (LPL; rotifers), and assigned to instar size categories. Additionally, lengths (± 15 µm) of female and male adult specimens (n=20) of dominant species were measured in representative samples for biomass determinations;
- a sub-sample, representing 10 to 20% of the sample volume, was examined under a stereoscope at 12× magnification to identify and enumerate mature and ripe individuals of larger-sized species and rare (i.e., less abundant) species, and to assign these individuals to size classes; and
- the entire sample was examined under a stereoscope at 1/10 magnification to improve abundance/biomass estimates for any large-sized, less abundant, species in the sample.

Under a compound microscope, Cyclopoida and Calanoida specimens (mature and immature) were identified to the species level with the exception of nauplii (N1-N6), which were classified as either Calanoida (small or large) or Cyclopoida (small or large). Cladocera were identified to the species level, while rotifers were identified to genus. Taxonomic identifications were conducted primarily using Brooks (1957), Wilson (1959), and Yeatman (1959) taxonomic keys. Digital microscopic images of selected specimens were provided with analytical data.

Zooplankton abundance was reported as individuals per litre (ind/L) based on volumes calculated from net mouth area, sample haul depth, and replication. Biomass estimates for each species were determined from:

- abundances of adults multiplied by mean adult wet weights developed from measured lengths (n=20 per adults of dominant species in representative samples), and length-weight relationships presented in Malley et al. (1989); and,
- abundances of various immature instar categories multiplied by weights of respective size categories determined from length-weight regressions (as per Malley et al. 1989).

Additional size measurements made on less common specimens were factored into the biomass calculations. Zooplankton biomass was reported in micrograms (wet weight) per litre (µg/L) of filtered water. Sub-sampling accuracy was assessed by performing replicate counts on 10% of samples. Replicate samples were chosen at random and processed at different times from the original sample to reduce bias.

Zooplankton tissue samples were shipped to TrichAnalytics Inc. (Trich; Saanichton, BC), for analysis of metals (including mercury) and selenium using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) consistent with ENV laboratory guidance as specified in Permit 107517 (Province of British Columbia 2020). At the laboratory, the samples were freeze dried prior to analysis, and thus concentrations were reported on a dry weight (dw) basis. Accuracy and precision of data was judged based on ability to achieve minimum LRLs (Table G.5), review of the results from laboratory duplicate analysis, as well as a comparison to CRMs (Appendix A).

G4.3 Data Analysis

Zooplankton community data were compared between downstream and upstream study areas, and qualitatively to data from previous monitoring periods (2020 to 2021) using primary metrics of mean taxonomic richness (as identified to lowest practical level [LPL]), mean organism density (average number of organisms per litre), and mean biomass (mass of organisms per litre). Relative density and relative biomass of dominant taxonomic groups were calculated as the density or biomass of each respective group relative to the total number of organisms or biomass in the sample, respectively. Dominant taxa were defined as taxa representing at least 5% of the total organism density at one or more stations. Community endpoints were summarized by reporting the minimum, maximum, mean, median, standard deviation (SD), and sample size for each sampling area. Zooplankton community data were compared between downstream (RG_T4) and upstream areas (RG_TN) using pairwise t-tests or Mann-Whitney U-tests as described previously (see Section G3.3). Differences in community composition were also assessed using non-metric multi-dimensional scaling (NMDS). The NMDS was used to reduce the zooplankton taxonomic data matrices to fewer dimensions, and to assist in the visualization of the level of similarity of communities based on the rank (e.g., Sample A is more similar to Sample B than to Sample C) of the similarities (Clarke 1993). The NMDS takes the N-dimensional (here N = number of taxa) coordinates of each sample (i.e., area) and defines a set of new N dimensional coordinates that reflect the locations (rank distances) among samples. Because the use of non-transformed data often leads "to shallow interpretation in which only the pattern of a few, very common species is represented" (Clarke 1993), a $\log_{10}$ transformation was applied to the data and the resulting matrix was assessed for normality based on average skewness and kurtosis. The NMDS was conducted on the lowest practical level taxonomic data matrix using relative abundances. The analysis used Bray-Curtis distance as the measure of relative community similarity or dissimilarity. A two-dimensional ordination solution was used when stress was less than 0.2, and additional

Table G.5: Minimum Laboratory Reporting Limits (LRLs) for Metal Concentrations in Tissue Samples, Koocanusa Reservoir Monitoring Program, 2022

Analyte	Units	Plankton, Benthic Invertebrate, and Fish Tissue LRL [a]
Moisture	%	-
Aluminum	mg/kg dw	0.052 to 0.296
Antimony	mg/kg dw	0.005 to 0.008
Arsenic	mg/kg dw	0.477 to 0.514
Barium	mg/kg dw	0.001
Boron	mg/kg dw	0.077 to 0.113
Cadmium	mg/kg dw	0.036 to 0.067
Calcium	mg/kg dw	15 to 55
Chromium	mg/kg dw	0.27 to 1.9
Cobalt	mg/kg dw	0.004 to 0.006
Copper	mg/kg dw	0.008 to 0.02
Iron	mg/kg dw	1.3 to 2.8
Lead	mg/kg dw	0.001 to 0.006
Lithium	mg/kg dw	0.006 to 0.008
Magnesium	mg/kg dw	0.024 to 0.03
Manganese	mg/kg dw	0.008 to 0.04
Mercury	mg/kg dw	0.025 to 0.071
Molybdenum	mg/kg dw	0.001 to 0.014
Nickel	mg/kg dw	0.001 to 0.07
Phosphorus	mg/kg dw	32 to 85
Potassium	mg/kg dw	3 to 15
Selenium	mg/kg dw	0.209 to 0.439
Silver	mg/kg dw	0.001
Sodium	mg/kg dw	0.781 to 2.5
Strontium	mg/kg dw	0.001
Thallium	mg/kg dw	0.001
Tin	mg/kg dw	0.03 to 0.043
Titanium	mg/kg dw	0.001 to 0.61
Uranium	mg/kg dw	0.001
Vanadium	mg/kg dw	0.053 to 0.077
Zinc	mg/kg dw	0.37 to 0.743

[a] Laboratory reporting limits provided by TrichAnalytics Inc. in Saanichton, British Columbia.

dimensions were used only when required to reduce the stress to less than 0.2. The NMDS analysis was conducted using the vegan package (version 2.5-1) in R.[8]

The assessment of zooplankton tissue data included comparison to the closest representative guidelines and benchmarks, and spatial comparisons between downstream and upstream areas of the reservoir. Concentrations of selenium in zooplankton tissues were compared to the interim chronic dietary BC guideline for invertebrate tissue (4 µg/g dry weight [dw]) and EVWQP Level 1 benchmarks for effects to benthic invertebrates (13 µg/g dw) and dietary effects to juvenile fish (11 µg/g dw). Zooplankton tissue data were also compared statistically using a pairwise t-test to compare downstream (RG_T4) and upstream (RG_TN) areas using methods outlined in Section G3.3.

[8] The NMDS analysis was attempted for zooplankton community samples collected in 2022, however, there was not enough variation in the data due to the loss of two samples from RG_TN, so the results were not presented in this report.

G5 BENTHIC INVERTEBRATES

G5.1 Sample Collection

A single composite benthic invertebrate tissue sample consisting of 20 petite Ponar grabs (i.e., a composite of four grabs from each of the five sampling stations [RG_T4-1 to RG_T4-5 and RG_TN-1 to RG_TN-5] in each study area) was collected in June and August 2022. Due to the low density of benthic invertebrates in the Koocanusa Reservoir, a composite sample collected across a transect provided a spatially representative sample for each of the downstream and upstream areas. Each grab was placed into and sieved through a 500 µm mesh bag. The remaining material was transferred to a white enamel tray for removal of benthic organisms using tweezers. Visible organisms were removed from the debris/sediment and rinsed clean using ambient water. Similar to sampling conducted previously, chironomids were targeted for tissue collection, but if chironomids were not present in sufficient numbers, other benthic invertebrates were included in the sample (and noted on field sheets) to achieve sufficient sample weight (approximately 0.5 grams [g]). Benthic invertebrate tissue samples were transferred to sterile cryovials, frozen, and submitted to a certified analytical laboratory (Trich; Saanichton, BC) for analysis. Supporting measures for each sample included *in situ* water quality measurements and Secchi depth measurements.

G5.2 Laboratory Analysis

Benthic invertebrate tissue samples were shipped to Trich (Saanichton, BC) for analysis of metals (including mercury) and selenium using LA-ICPMS consistent with ENV laboratory guidance specified in Permit 107517 (Province of BC 2020). At the laboratory, samples were freeze dried prior to analysis, and thus concentrations were reported on a dry weight basis. Accuracy and precision of data was judged based on ability to achieve minimum LRLs (Table G.5), review of the results from laboratory duplicate analysis, as well as a comparison to CRMs (Appendix A).

G5.3 Data Analysis

Selenium concentrations in benthic invertebrates were plotted and compared to the British Columbia Ministry of Environment (BCMOE 2019) interim guideline of 4 µg/g dw and to EVWQP Level 1 benchmarks for dietary effects to juvenile birds (15 µg/g dw), effects on benthic invertebrate reproduction (13 µg/g dw), and for dietary effects to juvenile fish (11 µg/g dw), respectively. Benthic invertebrate selenium concentrations were also compared qualitatively to data from 2020 and 2021.

G6 FISH

G6.1 Sample Collection

The targeted species, the number of samples collected, and the timing of collection for the fish tissue assessment were as follows:

- Peamouth chub (PCC) ovary and muscle tissues were collected from 10 females at three fish study areas (RG_SC, RG_ER, and RG_GC) in May 2022;
- Redside shiner (RSC) ovary and muscle tissues were collected from up to 10 females at three fish study areas (RG_SC, RG_ER, and RG_GC) in June 2022; and,
- Sport fish muscle tissue (non-lethal collection of muscle tissue plugs) collected from up to eight individuals per species at three fishing areas (RG_SC, RG_ER, and RG_GC) among sampling events in April, May, June, and August 2022 (Figure G.1)[9].

Female PCC and RSC were collected using gill nets set for very short periods (i.e., short-set gill nets) with a maximum set time of 15 minutes (min). Gill nets with mesh size specific for targeting PCC (2”) and RSC (1”) were set on the bottom of the reservoir. The geographic coordinates of each net set (UTM units), as well as the time of net deployment and retrieval, were recorded on field sheets. Captured PCC and RSC were sacrificed and transported to a dedicated field laboratory for processing as soon as possible following capture (i.e., within hours). At the field laboratory, PCC and RSC were subject to measurement of fork and total lengths to the nearest millimetre (mm) using a standard measuring board. Fish weights were measured using appropriately sized spring scales (e.g., 50 grams [g], 100 g, and 300 g) or a digital balance (± 0.001 g). The body cavity of each fish was opened and the sex and/or sexual maturity recorded. Whole gonads and livers were removed only from female fish and weighed to the nearest milligram (mg) using an analytical balance with a surrounding draft shield. Following these measurements, age structures (i.e., otoliths and scales) were removed from each fish. Each age structure was wrapped separately in waxed paper and placed inside a labelled envelope. Internal and external deformities, erosions (fin and gill), lesions, or tumours (DELT) observed during processing (Sanders et al. 1999) and the incidence of parasites (type and/or numbers) was recorded on laboratory bench sheets. In addition, number and combined weight of parasites was recorded and subtracted from the total body weight to get an accurate adjusted body weight of each fish. All DELTs were

[9] Sport fish muscle tissue plug samples were also collected during the Northern Pikeminnow Selenium Toxicity Study, which occurred in June and July 2022, if target species were incidentally captured. Although intended, sampling did not occur in August due to elevated surface water temperatures exceeding the stipulations outlined in the BC scientific fish collection permit CB22-705884.

classified on a scale of 0 (normal) to 3 (severe) and covered a more complete assessment of external anomalies (Table G.6). After dissection and measurements were taken, photographic documentation of each ovary was collected in case later verification of ovary development was required. Whole ovaries and a skinless, boneless muscle fillet sample were collected from sexually mature females and placed in separately labelled polyethylene (Whirl-Pak®) bags. Samples (i.e., ovaries and muscle) were stored frozen prior to shipment to the respective laboratory for analysis.

Sport fish targeted for tissue collection included species previously sampled in the Koocanusa Reservoir (i.e., Bull Trout [BT; *Salvelinus confluentus*], Kokanee [KO; *Oncorhynchus nerka*], Mountain Whitefish [MW; *Prosopium williamsoni*], Rainbow Trout [RB; *Oncorhynchus mykiss*], and Westslope Cutthroat Trout [WCT; *Oncorhynchus clarki lewisi*]; Minnow 2018). Yellow perch (YP; *Perca flavescen*s) are also lethally sampled when caught. These fish are an introduced species in the reservoir, and it is stipulated in the scientific collection permit that all yellow perch are sacrificed. Burbot (*Lota lota*) were not a target, and if caught, were immediately released.

Sport fish were collected using short-set gill nets (maximum set time of 15 minutes) to minimize the chance of adversely harming fish. Three foot-diameter hoop nets are typically used as a fishing method; however, reservoir levels and flows in May and June 2022 prevented their use. Angling was also not attempted in May and June due to flowing water conditions and high turbidity. The geographic coordinates (UTMs) of each net set or angling location, as well as the time of deployment and the time of retrieval, were recorded on field sheets. If necessary, sport fish were lightly anaesthetized in a dilute clove oil solution prior to processing. Each fish was weighed using appropriately sized spring scales near the top of the scale's range so that measurements achieved a resolution of approximately one percent or less. Total length and fork length were determined using a standard measuring board (± 1 mm). External anomalies were assessed for each sport fish per Sanders et al. (1999) and recorded on field sheets. A muscle sample was then collected using a biopsy punch (4 mm acu-punch). Following extraction of the biopsy sample, skin was removed from the sample using a scalpel and the remaining muscle placed into a sterile cryovial. Once each fish recovered from the anesthetic in a recovery bin, it was released back into the reservoir near its capture location. The muscle tissue samples were stored frozen until shipment to an accredited laboratory (Trich, Saanich, BC).

G6.2 Laboratory Analysis

Fish tissue samples were shipped to Trich for analysis of metals (including mercury) and selenium using LA-ICPMS consistent with ENV laboratory guidance specified in

Table G.6: Anomaly (Formerly D.E.L.T) Severity Assessment, Koocanusa Reservoir Monitoring Program, 2022

Scale	Body Surface	Body Form	Lesions	Tumours	Fins	Lips/Jaws/Snout	Eyes	Gills	Opercula	Infection (fungus, bacteria, virus)	Parasites
0	Normal; no aberrations	Normal	None	None	No active erosion	Normal, no lesions, swelling, tears etc.	No aberrations; good "clear" eye	Normal; No apparent aberrations	Normal; both opercula intact and complete	No observed infections	No observed parasites
1	Slight inflammation or reddening	Slight spinal curvature	Tears or wounds on caudal fins, pectoral or dorsal fins.	Tumour present, but localized and with no signs of sloughing/ ulceration	Light active erosion	Swelling on or around lips, mouth or snout	Swollen or protruding eyes	Gills with light, discolored margin along tips of the lamellae	Slight shortening of one or both opercula, gills covered	Minor, spatially isolated infection Note % of body covered:_____	Few observed parasites (#:_____)
2	Moderate inflammation or reddening	One of lordosis, kyphosis or scoliosis	Lesions or wounds on side of body	More than one tumour or one large tumour with no/minor sloughing/ ulceration	Moderate active erosion with some hemorrhaging	Small punctures or lesions	Hemorrhaging eye(s) or blind in one or both eyes	Frayed; erosion of tips of gill lamellae resulting in "ragged" gills	Moderate shortening of one or both opercula, gills exposed	Moderate infection or more than one body surface affected Note % of body covered:_____	Moderate parasite infestation (#:_____)
3	Severe inflammation or reddening	Signs of lordosis and kyphosis and scoliosis	Many lesions, rips or tears on body and on fins. Possibly on face as well.	One or more large tumour that may impair breathing/feeding/ swimming performance; signs of ulceration and/or sloughing	Severe active erosion with hemorrhaging	Tears, hanging maxilla, missing lips	Missing eye(s)	Clubbed; swelling of the tips of the gill lamellae	One or both opercula substantially shortened or missing, gills completely exposed	Infection covering large spatial area (>25% of surface) Note % of body covered:_____	Numerous parasites (#:_____)

Note: D.E.L.T = deformities, erosion, lesions, and tumors.

Permit 107517 (Province of BC 2020). At the laboratory, samples were freeze dried prior to analysis and concentrations reported on a dry weight basis. Accuracy and precision of data was judged based on ability to achieve minimum LRLs (Table G.5), review of the results from laboratory duplicate analysis, replicate analysis of a minimum of 10% of samples, as well as a comparison to CRMs (Appendix A).

Otoliths collected from lethally sampled fish (i.e., PCC and RSC) for age analysis were submitted to AAE Technical Services (Winnipeg, MB). Otoliths were prepared and then read under a compound microscope using transmitted light. For each structure, the age and edge condition were recorded along with a confidence rating for the age determination. For QA/QC purposes, age determinations from greater than 40% of samples were reassessed by a second individual at the laboratory to determine accuracy (Appendix A).

G6.3 Data Analysis

Selenium concentrations in fish tissues collected in spring 2022 (May to June) from downstream areas (RG_ER and RG_GC) were compared statistically to those from the upstream area (RG_SC) for PCC and RSC. Selenium concentrations in all fish tissues were plotted and compared to the interim BC guidelines (for muscle [4 µg/g dw] and ovary [11 µg/g dw] tissues), the US EPA (2016) criteria (for muscle [11.3 µg/g dw] and ovary [15.1 µg/g dw] tissues), the EVWQP Level 1 benchmark for reproduction (18 µg/g dw), and the species-specific threshold[10] for no observable effects identified during the RSC Se Toxicity study (28 µg/g dw; Golder 2020). Selenium concentrations in WCT tissue samples were also compared to a species specific EVWQP Level 1 benchmark for reproduction (25 µg/g dw; Table G.7). Selenium concentrations in tissue were compared among areas (RG_SC, RG_ER, RG_GC) using an analysis of variance (ANOVA) tests for species with sufficient sample sizes (n>3).

Data were $\log_{10}$ transformed (or $\log_{10}[x+1]$ for counts that contain 0) as necessary to meet assumptions of normality and homoscedasticity or rank transformed when these assumptions could not be met. When the *Area* term was significant a MOD between reference and exposed areas was calculated as:

$$\text{MOD} = \frac{(MCT_{Downstream} - MCT_{Upstream})}{MCTUpstream}$$

[10] This species-specific threshold was only applied to the ovary tissue plots as the threshold was established for RSC egg tissue samples (Golder 2020).

Table G.7: Selenium Benchmarks for Benthic Invertebrate and Fish Tissues in the Elk Valley, Koocanusa Reservoir Monitoring Program, 2022

Endpoint	Tissue Type	Benchmark			Source
		Value (µg/g dw)	Type	Description	
Benthic Invertebrates	Whole body	4[a]	BC guideline	Interim guideline for aquatic dietary tissue based on weight of evidence of lowest published toxicity thresholds and no uncertainty factor applied	BCMOE (2014)
	Whole body	13	Site-specific benchmark	Level 1 (~10% effect) benchmark for growth, reproduction and survival of invertebrates	Teck (2014)
	Whole body	20	Site-specific benchmark	Level 2 (~20% effect) benchmark for growth, reproduction and survival of invertebrates	Teck (2014)
	Whole body	27	Site-specific benchmark	Level 3 (~50% effect) benchmark for growth, reproduction and survival of invertebrates	Golder (2014)
	Whole body	11	Site-specific benchmark	Level 1 (~10% effect) benchmark for dietary effects to juvenile fish (growth)	Teck (2014)
	Whole body	18[b]	Site-specific benchmark	Level 2 (~20% effect) benchmark for dietary effects to juvenile fish (growth)	Teck (2014)
	Whole body	26	Site-specific benchmark	Level 3 (~50% effect) benchmark for dietary effects to juvenile fish (growth)	Golder (2014)
	Whole body	15	Site-specific benchmark	Level 1 (~10% effect) benchmark for dietary effects to juvenile birds	Teck (2014)
	Whole body	22	Site-specific benchmark	Level 2 (~20% effect) benchmark for dietary effects to juvenile birds	Teck (2014)
	Whole body	41	Site-specific benchmark	Level 3 (~50% effect) benchmark for dietary effects to juvenile birds	Golder (2014)
Westslope cutthroat trout	Egg/ovary	25	Site-specific benchmark	Level 1 (~10% effect) benchmark for westslope cutthroat trout reproduction	Teck (2014)
	Egg/ovary	27	Site-specific benchmark	Level 2 (~20% effect) benchmark for westslope cutthroat trout reproduction	Teck (2014)
	Egg/ovary	33	Site-specific benchmark	Level 3 (~50% effect) benchmark for westslope cutthroat trout reproduction	Golder (2014)
	Muscle/ muscle plug	15.5	Site-specific benchmark	Muscle equivalent to the 25 mg/kg dw ovary benchmark, based on the relationship observed between selenium in muscle and ovary in westslope cutthroat trout	Nautilus Environmental and Interior Reforestation (2011)
Redside Shiner	Egg	28	Species-specific threshold	Threshold for no observable effects to reproduction for redside shiner	Golder (2020)
Mountain whitefish	Egg/ovary	29.3	Site-specific benchmark	Conservative estimate of lower bound for potential effects	Nautilus (2017)
Other Fish	Egg/ovary	18	Site-specific benchmark	Level 1 (~10% effect) benchmark for reproduction effects to other species than westslope cutthroat trout	Teck (2014)
	Egg/ovary	22	Site-specific benchmark	Level 2 (~50% effect) benchmark for reproduction effects to other species than westslope cutthroat trout	Teck (2014)
	Egg/ovary	31	Site-specific benchmark	Level 3 (~50% effect) benchmark for reproduction effects to other species than westslope cutthroat trout	Golder (2014)
	Muscle	18	Site-specific benchmark	Muscle equivalent to the 18 mg/kg dw ovary benchmark, based on the relationship observed between selenium in muscle and ovary in longnose sucker	Minnow (2018a)
	Egg/ovary	11	BC guideline	Combination of weight of evidence and mean of published effects data with an uncertainty factor of 2 applied	BCMOE (2014)
	Whole body	4	BC guideline	Combination of weight of evidence and mean of published effects data with an uncertainty factor of 2 applied	BCMOE (2014)
	Muscle/ muscle plug	4	BC guideline	Whole-body translation to derive muscle benchmark with no additional uncertainty factor	BCMOE (2014)

[a] BC guidelines were not used in assessment of benthic invertebrate and fish tissue selenium concentrations. Assessment was completed relative to site-specific benchmarks only.

[b] Site-specific benchmark not applicable to dietary effects to juvenile westslope cutthroat trout for reasons outlined in Teck (2014).

where $MCT_{Downstream}$ and $MCT_{Upstream}$ were the measures of central tendency for the downstream and upstream areas for each year All *post hoc* contrasts were corrected for the number of tests using an α = 0.1 and Tukey's Honestly Significant Difference (HSD) correction.

Qualitative temporal comparisons were completed for selenium concentrations in muscle and ovary tissue from 2020 to 2022 for all species.[11]

Mercury concentrations in fish muscle relative to fish length were compared among study areas (RG_SC, RG_ER, and RG_GC) using an analysis of covariance (ANCOVA) to account for potential differences in fish body size/age. Prior to conducting the ANCOVA tests, data were assessed for normality and homogeneity of variance, and log transformed where appropriate. Scatterplots of variable and covariate combinations were examined to identify outliers, leverage values or other unusual data, to confirm there was adequate overlap of data between areas being compared, and that there was a linear relationship between the variable and the covariate. The first step in the ANCOVA analysis was to determine whether the slopes of the regression lines for both test areas were equal. This was accomplished by testing for a significant interaction term (dependent × covariate) in the ANCOVA model. If the interaction term was significant (i.e., regression slopes not equal, $p<0.05$), two methods were used to determine whether a full ANCOVA could proceed. In order of preference, these were 1) coefficients of determination that consider slopes equal regardless of an interaction effect (Environment Canada 2012), and 2) removal of influential points using Cook's distance and re-assessment of equality of slopes. If both methods proved unacceptable, the magnitude of difference calculation was estimated at both the minimum and maximum overlap of covariates between test areas (Environment Canada 2012). This resulted in a significant interaction effect (slopes are significantly different), but the calculation of the magnitude of difference at the minimum and maximum values of covariate overlap was not assigned statistical difference as it would for a full ANCOVA model. If the interaction term was not significant (i.e., homogeneous slopes between the two test populations), then the full ANCOVA model was run without the interaction term to test for differences in adjusted means between the two populations. The adjusted mean was then used as an estimate of the population mean based on the value of the covariate in the ANCOVA model. Tukey's Honestly Significance Difference tests (α = 0.1) were used to compare downstream and upstream areas when area terms were significant in the ANCOVA. Mercury concentrations in fish tissues were also compared to the BC tissue residue guideline for the protection of wildlife (0.033 µg/g ww; BCMOE 2019).

[11] Statistical evaluation of changes over time are to be completed for the three-year report only, and thus were not completed as part of this 2022 annual report.

The guideline was converted to a dry weight assuming a moisture content of 80% (average in muscle of all fish collected from Koocanusa Reservoir in 2020).

G7 REFERENCES

Azimuth (Azimuth Consulting Group Partnership). 2018. Proposed Water Quality Triggers for the Elk Valley Adaptive Management Plan. Prepared for Teck Resources Limited, Vancouver, British Columbia. June 2018.

BCMOE (British Columbia Ministry of Environment). 2019. Approved Water Quality Guidelines for British Columbia. Available from http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines [Accessed February 2021].

BCMOE. 2021. British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Water Protection & Sustainability Branch. Available from http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/bc_env_working_water_quality_guidelines.pdf [Accessed February 2021].

Brooks, J. L. 1957. The systematics of North American Daphnia. Mem. Conn. Acad. Arts Sci. 13: 1-80.

Clarke, SE. 1993. Non-parametric multivariate analyses of changes in community structure. Aus. J. Ecol. 18: 117:143.

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. ISBN 978-1-100-20496-3.

Golder (Golder Associates Ltd.). 2020. Study of the Reproductive Effects of Selenium on Redside Shiner (*Richardsonius balteatus*). Prepared for Teck Coal Limited. August 2020.

Kirchner W.B. 1975. The effect of oxidized material on the vertical distribution of freshwater benthic fauna. Freshwat. Biol. 5:423-429.

Malley, D.F., S.G. Lawrence, M.A. MacIver, and W.J. Findlay. 1989. Range of variation in estimates of dry weight for planktonic Crustacea and Rotifera from temperate North American lakes. Can. Tech. Rep. Fish. Aquat. Sci. 1666: iv+49p.

McDowell, R.W., S.T. Larned, and D.J. Houlbrooke. 2009. Nitrogen and phosphorous in New Zealand streams and rivers: Control and impact of eutrophication and the influence of land management. New Zeal. J Mar. Fresh. 43: 985-995.

Minnow (Minnow Environmental Inc.). 2018. Koocanusa Reservoir Monitoring Report, 2014 to 2016. Prepared for Teck Coal Limited, Sparwood, British Columbia. January. Project #167202.0049

Minnow. 2021. Koocanusa Reservoir Monitoring Program Study Design, 2021 to 2023. Prepared for Teck Coal Limited, Sparwood, British Columbia, February 2021. Project #207202.0012

Province of BC (Province of British Columbia). 2013. British Columbia Field Sampling Manual (complete). Available from https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual?keyword=field&keyword=sampling&keyword=manual. Accessed December 15, 2017.

Province of BC. 2020. British Columbia Environmental Laboratory Manual (complete). Available from https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-environmental-laboratory-manual. Accessed November 2020.

Ruxton, Graeme D. 2006. The unequal variance t-test is an underused alternative to Student's t-test and the Mann–Whitney U test. Behavioral Ecology 17.4: 688-690.

Sanders, R.E., R.J. Miltner, C.O. Yoder, and E.T. Rankin. 1999. The use of external deformities, erosion, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: A case study of seven Ohio streams. In: T.P. Simon (Ed.), pp: 225-246, Assessing the sustainability, and biological integrity of water resources using fish communities. CRC Press, Boca Raton, FL.

Teck (Teck Resources Ltd.). 2018. Permit 107517 2017 Summary Report of Monitoring Results in the Koocanusa Reservoir. June 28, 2018.

Teck (Teck Coal Limited). 2020. Permit 107517 Annual Water Quality Monitoring Report. Submitted to BCMOE on March 31, 2020.

Therneau, T.M. 2017. Survival analysis. Package "survival" for R. April 4, 2017. URL https://cran.r-project.org/web/packages/survival/survival.pdf

US EPA (United States Environmental Protection Agency). 2007. Carlson's Trophic State Index. Aquatic Biodiversity. Http://www.epa.gov/bioindicators/aquatic/carlson.html

US EPA. 2016. Aquatic Life Ambient Water Quality Criterion for Selenium - Freshwater. EPA 822-R-16-006

Wilson, M.S. 1959. Calanoida, p. 738-794. In W.T. Edmondson [ed.] Freshwater Biology. 2nd ed. John Wiley & Sons, New York, NY.

Yeatman, H. C. 1959. Cyclopoida, p. 795-815. In W.T. Edmondson [ed.] Freshwater Biology. 2nd ed. John Wiley & Sons, New York, NY.