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Technical Report Overview

Report: 2018 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

Overview: This report presents the 2018 results of the local aquatic effects monitoring program developed for Teck's Line Creek Operations. The purpose of this program in the first year was to develop a better understanding of a side channel that lies between Greenhills Operations and the Elk River. This is the first report for this program.

This report was prepared for Teck by Minnow Environmental Inc. and Lotic Environmental Ltd.

For More Information

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2018 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

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2018 Greenhills Operation Local Aquatic Effects Monitoring Program (LAEMP) Report

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EXECUTIVE SUMMARY

The 2018 Greenhills Operations (GHO) Local Aquatic Effects Monitoring Program (LAEMP) is designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension at GHO. The GHO LAEMP focuses on the side channel of the Elk River and its adjacent floodplain complex (i.e., local study area) because they receive flows, either via surface water or groundwater, from the mine influenced west-side tributaries (e.g., Thompson, Wolfram, Leask and creeks). The Elk River side channel is located between the Elk River and the west side of the Greenhills Ridge. It branches off from the Elk River just south of Leask Creek, flows south, and converges back with the Elk River roughly 1.2 km downstream from Thompson Creek.

Six study questions (discussed in detail in the paragraphs that follow) were developed to address concerns related to the local study area (i.e., Elk River side channel). The study questions focused on characterization and understanding of the Elk River side channel hydrology, water quality, habitat quality/availability, and benthic invertebrate community structure and tissue chemistry.

Hydrology data collected from 2017 to 2018 answered study question #1 (What is the relationship between flows in the main stem Elk River and flows [including connectivity, intermittence, and pools] in the Elk River side channel?). The Elk River side channel was observed to undergo seasonal flooding and braiding, with variable flow throughout the year, which was generally consistent between 2017 and 2018. Flows in the main stem Elk River and flows in the Elk River side channel were strongly correlated. Water from the main stem Elk River flowed overland into the side channel from freshet until winter, during which time, stream flow decreased both in the main stem Elk River and at the three side channel stations. Stream flow was lowest in the main stem Elk River from winter until freshet; at this time the side channel became disconnected from the main stem Elk River and Reach 1 (the downstream end of the side channel) and Reach 3 (the upstream end of the side channel) slowly dried. Isolated pools were documented as drying occurred, but typically persisted for less than a month, suggesting that the pools were stagnant water resulting from dewatering of the side channel. Reach 2, located in the middle of the side channel at the confluence with Thompson Creek, remained wetted throughout the year due to overland flows via Thompson Creek and potentially due to groundwater inputs.

Within the side channel and its floodplain complex, surveys were completed to identify and document habitat and occurrences of aquatic-dependent biota. These data were used to answer study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel?). Results of 2018 surveys were generally consistent with 2017. Seasonal changes in flow (described above) affected habitat

availability (e.g., lentic habitat only present in fall and winter, and only in Reach 2). The Elk River side channel was not considered suitable breeding habitat for amphibians, as much of the side channel and floodplain complex were flooded and swiftly flowing in the spring and early summer. However, a few adult amphibians (Columbia spotted frog, western toad, and long-toed salamander) were observed throughout the side channel in late spring and summer. Suitable habitat was available for all life stages of fish and aquatic-dependent birds in the side channel and floodplain complex from spring through fall (where water persisted), as well as in Reach 2 during winter. The side channel was being used by a variety of fish (bull trout, eastern brook trout, longnose sucker, mountain whitefish, and westslope cutthroat trout) and birds (American bittern, American dipper, bald eagle, bank swallow, belted kingfisher, blue heron, Canada goose, common yellowthroat, killdeer, northern waterthrush, spotted sandpiper, mallard).

Water quality data were assessed for stations in the main stem Elk River, Elk River side channel, and isolated pools to address study question #3 (What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?). Water quality at stations in the lower side channel was influenced by Wolfram and Thompson creeks. Concentrations of constituents were typically lower at the upstream side channel station, located upstream of Wolfram and Thompson creeks. Within the side channel and main stem Elk River, the highest concentrations of constituents generally occurred in Reach 2, which receives flow directly from Thompson Creek. Water quality in pools was highly dependent on location, with the highest concentrations of constituents generally occurring in pools downstream of Reach 2. Discharges from the west-side tributaries contribute to higher concentrations of some mine-related constituents in the main stem Elk River downstream of GHO relative to the upstream reference; however, with the exception of selenium, concentrations measured at the downstream main stem Elk River station were typically below benchmarks, screening values, and/or British Columbia Water Quality Guidelines (BCWQG), or were comparable to the upstream reference for most constituents.

To answer study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?), a hydrogeological review and analysis of available groundwater and surface water data for the west side of GHO was conducted. The review confirmed that water in the Elk River side channel likely recharges groundwater across the length of the side channel, with the exception of localized areas of groundwater discharge. Leask, Wolfram, and Thompson creeks contributed loadings to the Elk River and side channel through overland flow paths (Wolfram and Thompson creeks only) as well as through shallow groundwater flow paths. Groundwater wells in the vicinity of the side channel indicated mine influence on water quality. Isolated pools in the side channel were interpreted to result from dewatering of the side channel and not from groundwater discharge, with the possible exception of a single pool located at the downstream end of the side channel. Recommendations were made to address gaps and uncertainties.

Benthic invertebrate community and tissue chemistry (selenium) data collected in 2017 and 2018 furthered the understanding of study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?). Ten out of fourteen benthic invertebrate tissue samples collected in 2018 from the side channel were below the Elk Valley Water Quality Plan (EVWQP) Level 1 selenium benchmarks for either benthic invertebrates, dietary effects to juvenile fish, and/or dietary effects to birds. Out of the remaining four samples, the highest concentrations occurred in samples collected from Reach 2. Selenium concentrations in benthic invertebrates at the downstream main stem Elk River station were similar to concentrations at the upstream reference station. Despite some elevated selenium concentrations in benthic invertebrates from the side channel, benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem stations, and side channel stations. Abundance, richness, percent Ephemeroptera (%E; mayflies), percent Plecoptera (%P; stoneflies), percent Trichoptera (%T; caddisflies), and combined % EPT were within or above the normal range for main stem Elk River and side channel stations. Benthic invertebrate selenium concentrations in tissue and community structures were similar in the side channel and the main stem location downstream of the side channel, community endpoints were within normal range (and similar to upstream reference), and selenium concentrations were mostly below EVWQP Level 1 benchmarks, with the exception of Reach 2. Overall, benthic invertebrate communities did not appear to be adversely affected by mine-related discharges. However, selenium concentration in some benthic invertebrate samples from Reach 2 were greater than Level 1 benchmarks for invertebrates, juvenile fish, and juvenile aquatic-feeding birds. These concentrations would indicate a potential for up to 20% effects on chronic, sub-lethal endpoints for sensitive species (if any are present), but would not be expected to result in population- or community-level changes.

In support of study question #5, sediment quality was assessed in the main stem Elk River upstream and downstream of the side channel, and in Reach 2 of the side channel. With the exception of arsenic and magnesium in two of ten samples from Reach 2, concentrations of constituents were within the normal range. Concentrations of constituents were also below the upper or only sediment quality guidelines (SQG), with the exception of selenium and 2-methylnaphthalene in Reach 2. In general, sediment quality data indicated limited influence of mine-related discharges on sediment chemistry in the main stem Elk River downstream of the side channel.

Data collected from Reach 2 in 2017 and 2018 for the GHO LAEMP were combined with data collected in 2018 for the Lentic Area Supporting Study to address study question #6 (Is the mine related influence on [Reach 2] having an effect on aquatic dependent biota [benthic invertebrates, fish, amphibians, and aquatic-feeding birds]?). Surveys confirmed that Reach 2 provides some habitat for fish, adult amphibians, and aquatic dependent birds, but does not provide habitat for breeding amphibians. Aqueous concentrations of total dissolved solids, sulphate, and total uranium were frequently above the BCWQG and/or EVWQP Level 1 benchmarks, while aqueous concentrations of nitrate and total selenium were frequently above the EVWQP Level 2 benchmarks. However, most constituents were below BCWQG and/or EVWQP Level 1 water benchmarks. In sediment, 2-methylnaphthalene concentrations exceeded the upper SQG in five out of ten samples. All other parameters were below the upper SQG (or only SQG, for selenium), and concentrations were either similar to the upstream reference or were within the normal range. Benthic invertebrate tissue selenium varied greatly, with five samples below all Level 1 benchmarks, one higher than the Level 1 dietary benchmark for fish only, and one higher than the Level 1 benchmark for benthic invertebrates, and dietary benchmarks for fish and birds. The results for Reach 2 indicate potential for localized exposure to elevated dietary selenium to fish, amphibians, and aquatic-feeding birds. For mobile biota utilizing additional habitat beyond Reach 2 (e.g., the rest of the side channel and the main stem Elk River), the potential for effects would be minimal.

The GHO LAEMP will continue to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into the RAEMP.

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ACRONYMS AND ABBREVIATIONS

AMP – Adaptive Management Plan

ANOVA – Analysis of Variance

BCWQG - British Columbia Water Quality Guidelines

CABIN – Canadian Aquatic Biomonitoring Network

CI – Calcite Index

CMO – Coal Mountain Operation

CPUE – Catch-per-unit-effort

CRC ICP-MS – Collision Reaction Cell Inductively Coupled Plasma-Mass Spectrophotometry

CSM – Conceptual Site Model

CVAAS – Cold Vapor-Atomic Absorption

DO – Dissolved Oxygen

DW – Dry Weight

EMC – Environmental Monitoring Committee

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

EPT – Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies)

EVO – Elkview Operation

EVWQP – Elk Valley Water Quality Plan

EWT - Early Warning Trigger

FHAP – Fish Habitat Assessment Procedure

FRO – Fording River Operation

GC/MS – Gas Chromatography with Mass Spectrometric Detection

GHO – Greenhills Operation

GPS – Global Positioning System

ICP-MS – Inductively Coupled Plasma Mass Spectrometry

ICPOES – Inductively Coupled Plasma - Optical Emission Spectrophotometry

KNC – Ktunaxa Nation Council

LAEMP – Local Aquatic Effects Monitoring Program

LCO – Line Creek Operation

LPL – Lowest Practical Level, referring to taxonomic identification of benthic invertebrates

LSU – Longnose Sucker

MOD – Magnitude of Difference

NAD – North American Datum

PAH – Polycyclic Aromatic Hydrocarbon

PEL – Probable Effect Level

PVC – Polyvinyl Chloride

QA/QC – Quality Assurance / Quality Control

RAEMP – Regional Aquatic Effects Monitoring Program

RISC – Resource Information Standards Committee

SEL – Severe Effect Level

SRC – Saskatchewan Research Council

SQG – Sediment Quality Guideline

TKN – Total Kjeldahl Nitrogen

TOC - Total Organic Carbon

UTM – Universal Transverse Mercator System

WSC – Water Survey of Canada

1 INTRODUCTION

1.1 Background

Teck Coal Limited (Teck) operates five steelmaking coal mines in the Elk River watershed, which are the Fording River Operation (FRO), Greenhills Operation (GHO), Line Creek Operation (LCO), Elkview Operation (EVO), and Coal Mountain Operation (CMO; Figure 1.1). Discharges from the mines to the Elk River watershed are authorized by the British Columbia Ministry of Environment and Climate Change Strategy (ENV; formerly Ministry of Environment [BCMOE]) through permits that are issued under provisions of the *Environmental Management Act*. Permit 107517, issued November 19, 2014 and amended as required, specifies the terms and conditions associated with discharges from the five mine operations.

Through issuance of Permit 107517, ENV required that Teck develop a local aquatic effects monitoring program (LAEMP) related to GHO (Figure 1.2). Section 9.3.3 of Permit 107517 outlines the LAEMP requirements as follows:

> *The Permittee must complete to the satisfaction of MOE a study design for an LAEMP which will focus on the upper Elk River and the Elk River side channel and tributaries located on the west side of GHO between sites 0200389 [GH_ER2] and E3000090 [GH_ERC][1] for 2017-2020 by June 1, 2017[2]. The study design must be reviewed by the EMC[3] and be designed to an appropriate temporal scale to capture short term, local effects to the immediate receiving environment.*

In addition to monitoring under the LAEMP, Teck's Regional Aquatic Effects Monitoring Program (RAEMP) is a requirement under Permit 107517, and provides comprehensive routine monitoring and assessment of potential mine-related effects on the aquatic environment downstream from Teck's mines in the Elk Valley (i.e., annual sampling and more comprehensive monitoring every three years, with the next cycle of sampling to be completed in September 2019). Teck conducts a variety of additional programs to monitor, evaluate, and/or manage the aquatic effects of mining operations within the Elk Valley at local and regional scales, including:

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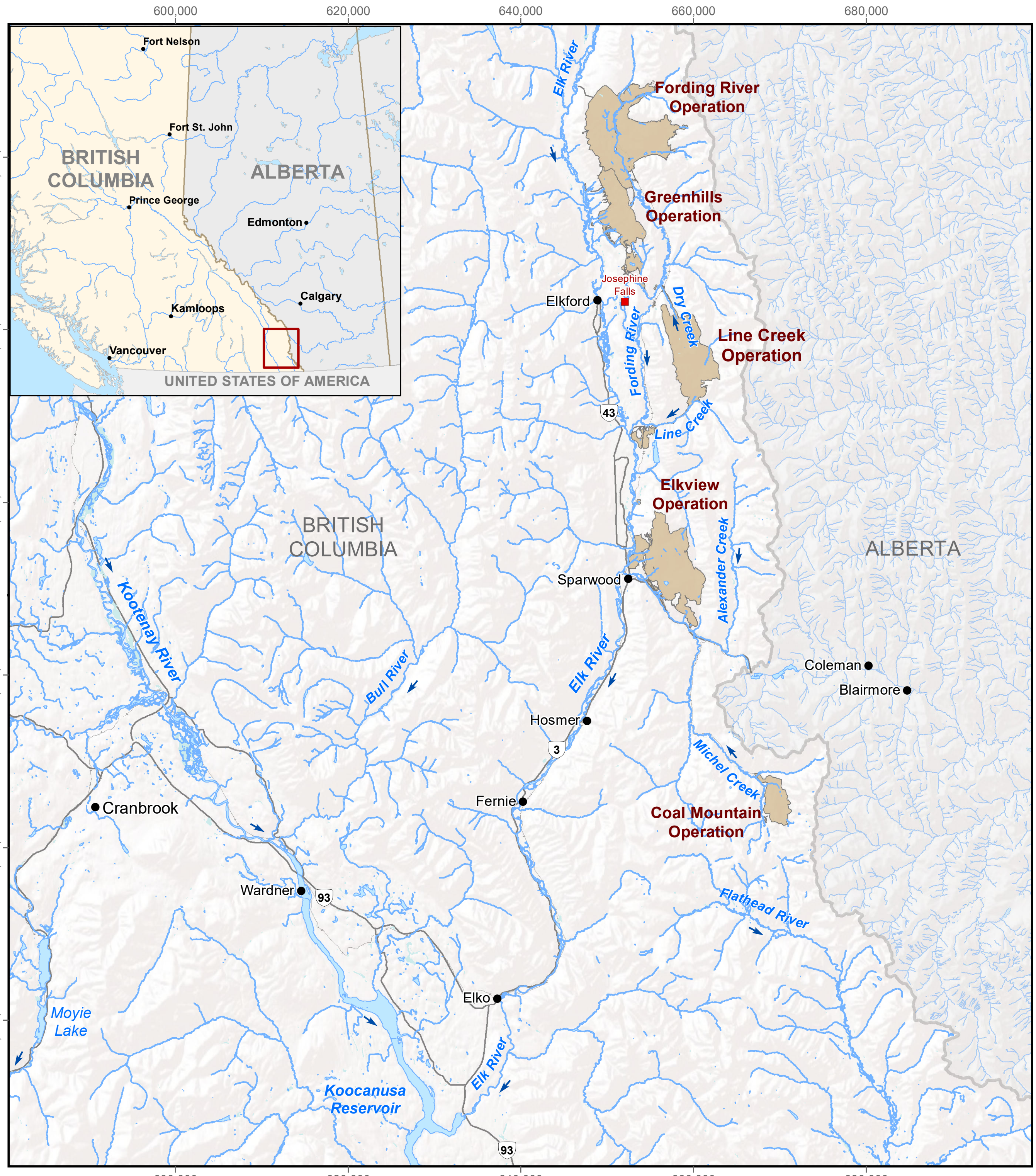
[1] Herein referred to as the west-side tributaries.

[2] A study design for the 2017 LAEMP was submitted May 31, 2017.

[3] EMC refers to the Environmental Monitoring Committee, which Teck was required to form as per Permit 107517. 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. Environment Canada has also agreed to provide its perspectives on matters related to Permit 107517 and the Committee's activities, on a case-by-case basis when requested by the Committee. To date, the Committee has not called on Environment Canada to participate. The EMC reviews submissions and provides technical advice to Teck and the ENV Director regarding monitoring programs as stipulated in Section 12.2 of Permit 107517.



LEGEND

Teck Coal Mine Operation

Teck's Coal Mine Operations within the Elk River Watershed, Southeast British Columbia

0 10 20 40 km

N W E S

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Figure 1.1

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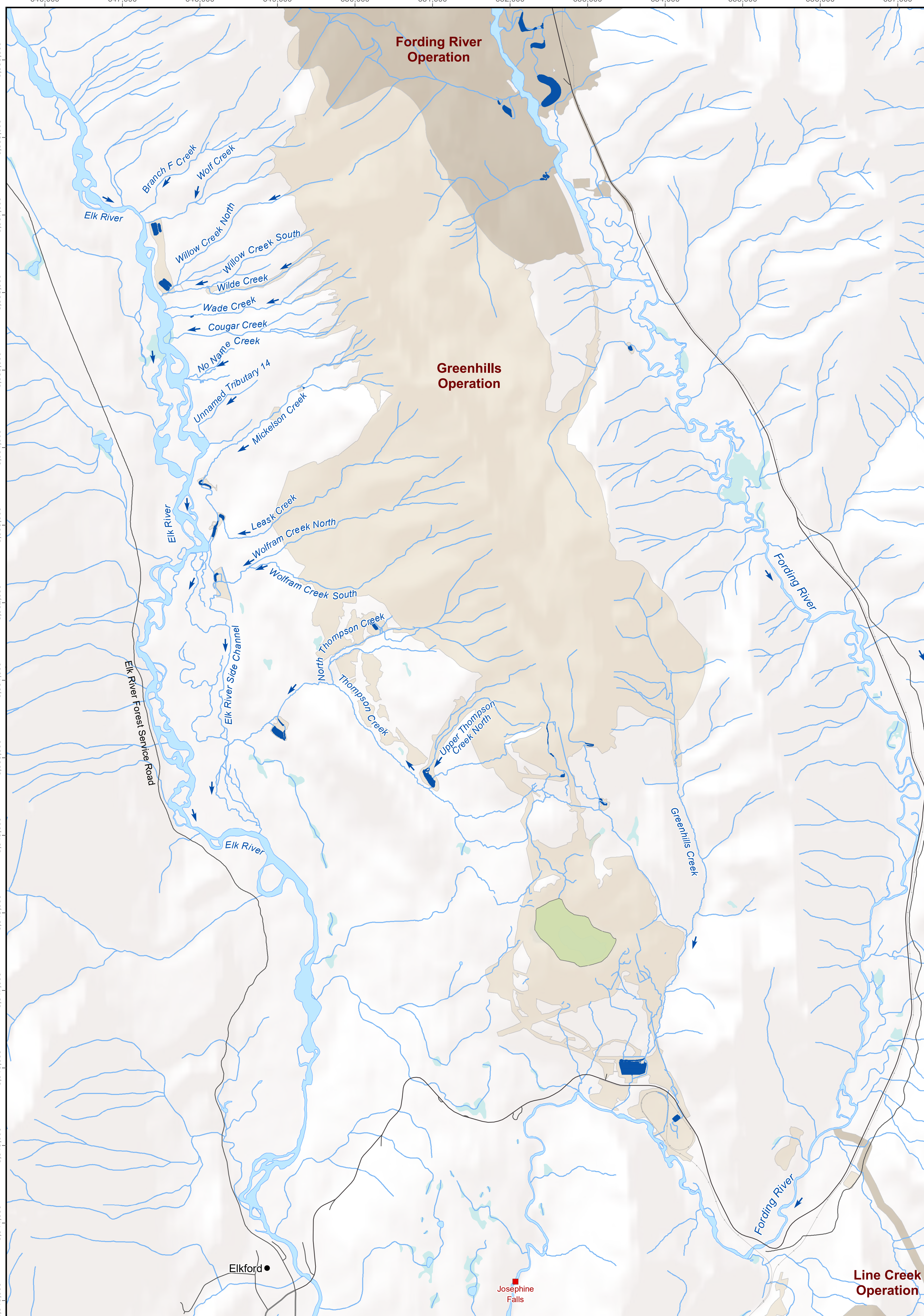

LEGEND

Settling Pond

Tailings Pond

Teck's Greenhills Operation

0 0.75 1.5 3
km

N W E S

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Figure 1.2

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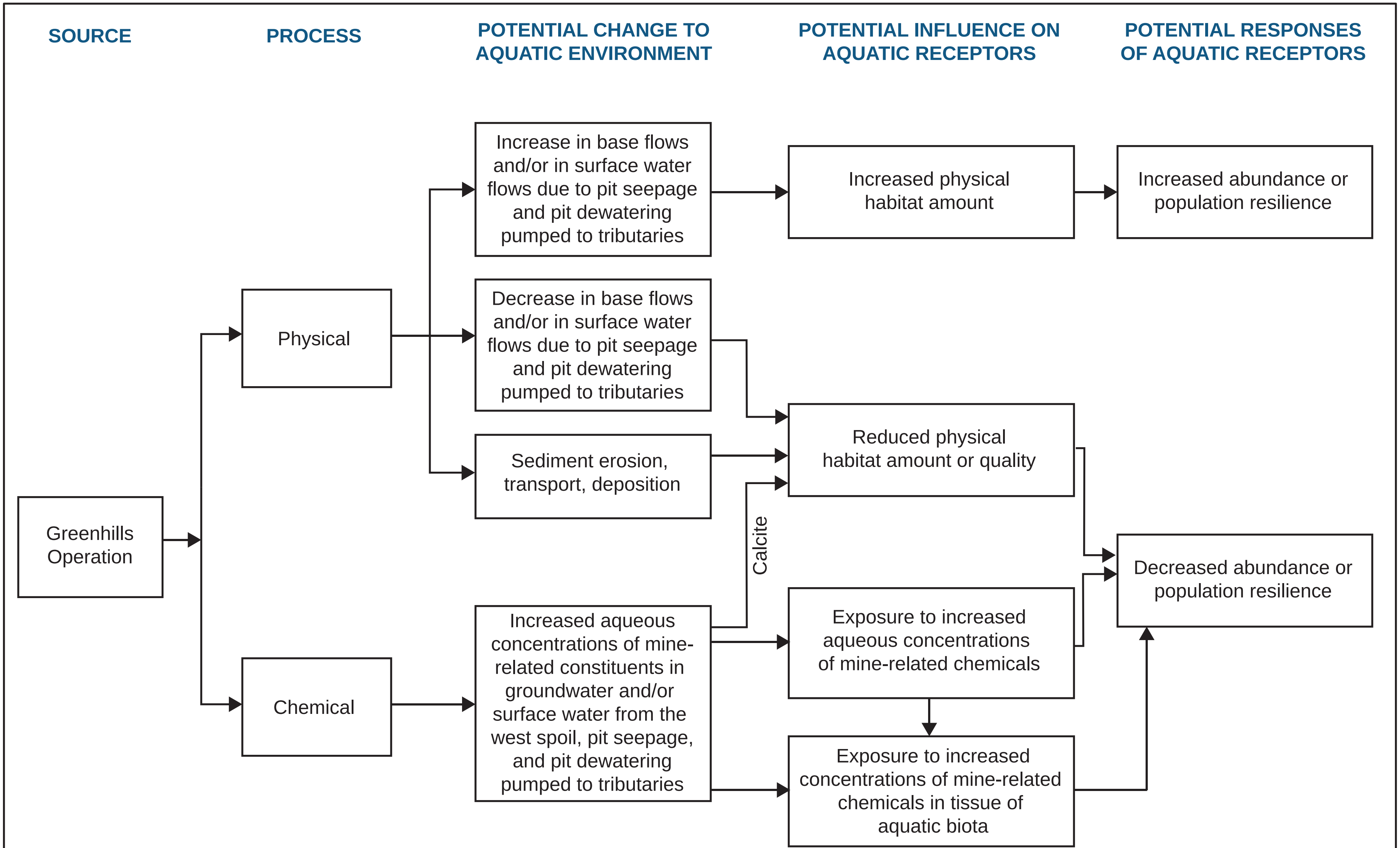
- water quality monitoring,
- calcite monitoring,
- chronic toxicity testing,
- fish and fish habitat management,
- Tributary Management Plan, and
- various supporting studies.

Following discussion with and advice from the Environmental Monitoring Committee (EMC), a phased approach to the GHO LAEMP study design was approved by ENV. A study design (Minnow and Lotic 2017) was submitted May 31st, 2017, and preliminary reconnaissance work was conducted from May 2017 to April 2018. An updated study design was submitted May 31st, 2018 that covered the 2018 to 2020 period (Minnow and Lotic 2018b). The GHO LAEMP is designed to address questions associated with potential aquatic effects at a localized area downstream of the west spoil development and Cougar Pit extension at GHO. The study questions focus on furthering the understanding of hydrology, habitat use by biota, water quality, surface water/groundwater interactions, benthic invertebrate communities and tissue chemistry, and investigating whether biota in Reach 2 (formerly referred to as the "side channel wetland") are being influenced by mine-related activities. The results of the data collected from January to December 2018 are described herein.

1.2 Conceptual Site Model

A conceptual site model (CSM) is a written and/or illustrative depiction of relationships between human activities that disturb the environment and the ways such disturbances can alter the ecosystem and affect biological receptors. Figure 1.3 presents a CSM for potential effects on aquatic receptors related to the Elk River, Elk River side channel, and the west-side tributaries associated with Greenhills Operation. As illustrated by the CSM, mining may affect aquatic receptors through physical and/or chemical processes; these general processes are explained in-depth in the RAEMP Study Design (Minnow 2018c). With respect to this LAEMP, mine-related physical and chemical stresses in the west-side tributaries, upper Elk River, and Elk River side channel arise from:

- landscape restructuring, potentially occurring due to re-location of soils and rock material (e.g., waste rock piles), re-sloping of the topography, and diversion of water;
- sediment transport in streams, potentially occurring as a combination of:
    - bedload (the coarsest transported material, moving along the bottom),



Conceptual Site Model for Potential Mine-Related Effects on the Aquatic Ecosystem

Date: May 2019 Project 187202.0018	minnow environmental inc.	Figure 1.3

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- suspended load (materials lifted above the bed by the flow and transported in the water column), and
- washload (the finest-grained fraction of the suspension; Polzin 1998);

- increases or decreases to base flow and surface water flows, potentially occurring due to pit seepage and pit water pumped to tributaries; and
- increased concentrations of mine-related constituents in water and sediment, potentially originating from the West spoil, pit seepage, and pit water pumped to tributaries.

The CSM identified potential influences of mining activities on aquatic receptors (Figure 1.3), which were used to develop study questions (Section 1.3) and assessment endpoints based on responses (Table 1.1). As illustrated in the CSM (Figure 1.3), potential mining effects on receptors may manifest as changes in population abundance of sensitive receptors, which also results in changes to relative community abundance. Therefore, the GHO LAEMP study questions focus on assessing potential mine-related effects on focal species or population groups (Table 1.1), while also allowing for collection of relevant background information (i.e., characterization of side channel hydrology and aquatic-dependent biota distributions; Section 1.3).

1.3 Study Questions

In order to focus the scope of the 2018 to 2020 study design, study questions were developed in consultation with the EMC. The study questions and associated sub-questions are as follows:

1. What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel?
2. What is the seasonal habitat availability for aquatic-dependent biota (i.e., fish, amphibians, and aquatic-feeding birds) in the Elk River side channel?
3. What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?
    a. What is the water quality in the west-side tributaries, and how is it changing over time?
    b. What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?
    c. What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?

Table 1.1: Summary of Receptors, Assessment Endpoints, Measurement Endpoints, and Evaluation Criteria for the GHO LAEMP, 2018

Receptor Group	Assessment Endpoint	Measurement Endpoint[a]	Evaluation Criteria[a,b]	Indicator Type[c]
Fish	Population abundance or resilience	Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and 6)	Indirect
Benthic Invertebrates	Benthic invertebrate abundance and assemblage (lotic habitats)	Abundance	Comparison to reference areas and past observations (SQ #5)	Direct
		Richness		
		% EPT		
		% Ephemeroptera		
		Tissue selenium concentrations	Concentrations relative to effect benchmarks and past observations (SQ #5)	Indirect
		Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Calcite	Calcite index relative to known or suspected effect levels and past observations (SQ #5)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and #6)	Indirect
	Benthic invertebrate abundance and assemblage (lentic habitats)	Tissue selenium concentrations	Concentrations relative to effect benchmarks and past observations (SQ #5)	Direct
		Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Calcite	Calcite index relative to known or suspected effect levels and past observations (SQ #5)	Indirect
		Sediment chemistry	Concentrations of constituents relative to guidelines, reference areas, and past observations (SQ #5 and #6)	Indirect
Amphibians	Amphibian population effects related to selenium	Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Benthic invertbebrate tissue selenium concentrations	Concentrations relative to effect benchmarks (SQ #5)	Direct
Birds	Bird population effects related to selenium	Surface water chemistry	Concentrations of constituents relative to effect benchmarks and past observations (SQ #1, #3, and #4)	Indirect
		Benthic invertbebrate tissue selenium concentrations	Concentrations relative to effect benchmarks (SQ #5)	Direct

[a] Some endpoints/criteria apply to only selected habitats or sampling areas. See text for details.

[b] (SQ #) indicates the study question(s) that are addressed (directly or indirectly) by the listed evaluation criteria.

[c] Indicators (i.e., Measurement endpoints) are identified as either direct or indirect. Direct indicators are biological measurements that relate directly to the populations or communities of benthic invertebrates. Indirect indicators are abiotic endpoints measuring mine-related physical and chemical stressors, and act as corroborating or explanatory evidence of observed effects or lack of effects on receptors. See the Study Design for the RAEMP 2018 to 2020 (Minnow 2018c) for further detail.

   d. What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates (i.e., fish, amphibians, and aquatic-feeding birds)?

4. What is the interaction between surface water and groundwater in the Elk River side channel?

5. What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?

6. Is the mine-related influence on the side channel wetland[4] having an effect on aquatic-dependent biota (benthic invertebrates, fish, amphibians, and aquatic-feeding birds)?

This report describes the approach, methods, and results used to address the study questions associated with the 2018 data collection.

1.4 Summary of the 2017 GHO LAEMP

A side channel of the Elk River and its adjacent floodplain complex were identified as the local study area because they receive flows, either via surface water or groundwater, from the mine-influenced west-side tributaries (e.g., Thompson Creek, Wolfram Creek, Leask Creek, and likely also Mickelson Creek; Figure 1.2). Located between the Elk River and the west side of the Greenhills Ridge, the Elk River side channel branches off from the Elk River just south of Leask Creek, flows south, and converges back with the Elk River roughly 1.2 km downstream from Thompson Creek. The Elk River side channel was observed to undergo seasonal flooding and braiding, with variable flow throughout the year. In addition to mine-related influences, the area is also used by the forestry industry (i.e., logging) and as rangeland for livestock.

Results from the first year of the GHO LAEMP indicated that the west-side tributaries had no effect on biota in the main stem Elk River, and minimal effects on biota within the Elk River side channel and isolated pools (Minnow and Lotic 2018a). Data suggested that the area most likely to experience mine-related effects was Reach 2 (the side channel area at the confluence with Thompson Creek), based on its lentic nature during part of the year[5]. Data collected to date

[4] The area that has previously been referred to as the "side channel wetland" is herein called Reach 2, as it is not a true wetland (see Section 8).

[5] Reach 2 displays characteristics of both lotic and lentic systems, depending on the season. Lotic ecosystems are flowing freshwater systems with unidirectional water movement along a slope in response to gravity. In contrast, lentic ecosystems are differentiated by still water. Reach 2 was swiftly flowing from freshet until early summer (lotic), had moderate channelization with slow flow from late summer until fall, and, once the area became isolated in late fall through winter, water pooled at the mouth of Thompsons Creek (lentic). See Section 3 and Section 8.

indicate this area is perennially-wetted, and, relative to other side channel stations, has elevated concentrations of one or more mine-related constituents in water, sediment, and benthic invertebrate tissue (Minnow and Lotic 2018a).

1.5 Linkages to the Adaptive Management Plan for Teck Coal in the Elk Valley

As required in Permit 107517 Section 11, Teck has developed an Adaptive Management Plan (AMP) to support implementation of the Elk Valley Water Quality Plan (EVWQP; Teck 2014) to achieve water quality and calcite targets, protect human health, groundwater and aquatic ecosystem health (Teck 2018b). Following an adaptive management framework, the AMP identifies six Management Questions that will be re-evaluated at regular intervals as part of AMP updates throughout EVWQP implementation. The AMP also identifies key uncertainties that need to be reduced or evaluated to fill gaps in current understanding and support achievement of the EVWQP objectives.

The GHO LAEMP was designed to monitor conditions associated with the West spoil development and historical mining operations at GHO and answer specific questions on an annual basis (Section 1.3). During or at the conclusion of each annual LAEMP cycle (results are reported on May 31st of each year for the preceding calendar year), management actions may be triggered, depending on the answers to those questions. For example, during the 2017 GHO LAEMP, monitoring of surface water hydrology and the formation of isolated pools in the side channel lead to questions regarding water losses to ground and the potential for groundwater to contribute to the formation of pools (Minnow and Lotic 2018a). This prompted the addition of a new study question: “What is the interaction between surface water and groundwater in the Elk River side channel?” which was added to the 2018 to 2020 GHO LAEMP study design (Minnow and Lotic 2018b). This also prompted Teck to initiate gap analyses of the regional groundwater monitoring program, the GHO site-specific groundwater monitoring program, and the GHO LAEMP. The gap analyses resulted in recommended modifications for the approach to hydrological and groundwater monitoring, which will be considered for implementation (SNC 2019; Section 6). Monitoring and data analysis will continue to adapt to findings in the field, and data and information needs associated with Teck’s operations.

In addition to addressing questions specific to the GHO LAEMP on an annual basis, monitoring data from the LAEMP will contribute to the broader data set assessed every three years within the RAEMP. The RAEMP is designed to evaluate AMP Management Question #5 (i.e., Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?). During the development of the AMP, a number of uncertainties related to Management Question #5 were identified that were summed up as Key Uncertainty 5.1 (i.e., How will monitoring data be used to identify potentially important mine-related effects on the aquatic ecosystem?). Teck is working with its consultants and the EMC to develop the methodology that will address Key Uncertainty 5.1 and its underlying uncertainties prior to the next RAEMP report in 2020.

LAEMP and RAEMP data will also contribute to answering AMP Management Question #2, (i.e., Will aquatic ecosystem health be protected by meeting the long-term site performance objectives?). A Key Uncertainty associated with Management Question #2 is "How will the science-based benchmarks be validated and updated?" with underlying uncertainty about how aquatic monitoring data will be used to validate and update the benchmarks. Progress on reducing these uncertainties, and associated learnings, will be described in Annual AMP Reports.

Please refer to the AMP (Teck 2018b) for more information on the adaptive management framework, the Management Questions, the Key Uncertainties, the response framework, continuous improvement, and linkages between the AMP and other EVWQP programs.

2 METHODS

2.1 Overview

Monitoring of the upper Elk River, the Elk River side channel, and west-side tributaries is currently conducted under a number of programs (Tables 2.1 to 2.3), including the GHO LAEMP, regional and site-specific groundwater monitoring programs, RAEMP, and Lentic Area Supporting Study. Routine water quality and flow data are also monitored weekly/monthly[6] by Teck for the Elk River (water quality only), Elk River side channel, and west-side tributaries, as per Permit 107517 and Permit 6428 requirements.

Under the annual GHO site-specific groundwater monitoring program, groundwater quality and interactions with surface water will continue to be monitored (Section 6).

For the RAEMP, the main stem Elk River stations and Thompson Creek were sampled in September 2018 for benthic invertebrate community composition and tissue chemistry, as well as supporting habitat and substrate information (Sections 2.6, 2.7, and 7). In 2018, the Lentic Area Supporting Study (Minnow 2018b) investigated the use of Reach 2 by aquatic-dependent biota (i.e., amphibians, aquatic-feeding birds, and fish; Section 8).

Data specific to the GHO LAEMP were collected monthly from January to December 2018 to characterize the Elk River side channel hydrology and seasonality of wet and dry sections (Section 2.2 and 3), habitat availability (Section 2.3 and 4), and use by aquatic dependent-biota (Section 2.3 and 4). In September 2018, benthic invertebrate community composition (Sections 2.6 and 7), tissue chemistry (Sections 2.7 and 7), and supporting data were collected (Sections 2.8 and 7.4). All relevant monitoring data is compiled herein for 2018 to address the study questions (Section 1.3), as summarized in Tables 2.1 to 2.3.

2.2 Hydrology (Question #1)

2.2.1 Overview

Hydrology data were primarily collected to address study question #1: What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel? Data collection was consistent with 2017, and followed methods described in the 2018 to 2020 Program Study Design (Minnow and Lotic 2018a). Data collection continued from January 2018 through to December 2018, and included: water levels in the side channel and main stem Elk River, flow in the side channel (i.e., discharge), and

[6] Sampling is done on a monthly basis (August – March) and/or weekly/monthly basis (March 15 – July 15), as required by Permit 107517 and Permit 6428.

Table 2.1: Summary of Hydrology and Biota Surveys, Water and Sediment Quality Sampling, and Biological Sampling Conducted for the GHO LAEMP, 2018 to 2020

Exposure Type	Stream Type[a]	Stream Name	Water Station Code	Biological Area Code	ENV EMS Number	Area Description	UTM for Biological Area Code (NAD83, 11U)		Status	Hydrology	Habitat	Ground-water	Surface Water	Substrate			Benthic Invertebrates		Amphibians		Birds	Fish
										Water Level, Flow, and Temperature Monitoring	Monthly Habitat and Biota Survey	Chemistry	Chemistry	Calcite Index	Sediment Physical-chemical Attributes	Sediment Toxicity	Community Endpoints	Tissue Chemistry (Composite taxa)	Survey	Egg Tissue	Survey	Survey
							Easting	Northing		2018	2018	Annually 2018-2020	Annually 2018-2020	Annually 2018-2020	2018	2019	Annually 2018-2020	Annually 2018-2020	2018	2018	2018	2018
Reference	M	Elk River	GH_ER2	ELUGH	200389	u/s Branch Cr. and GHO	646739	5557609	Core RAEMP Reference	-	-	-[b]	monthly, concurrently[c]	3 Annually	3	-	3 Annually	3 Annually	-	-	-	-
	M	Elk River	-	ERUS	-	Elk River u/s side channel	648114	5552674	GHO LAEMP	monthly/ continuous	-	-	-	-	-	-	-	-	-	-	-	-
Mine-exposed	S	Elk River Side Channel	GH_ERSC4	GH_ERSC4	E305878	Elk River side channel u/s of Wolfram Creek	648111	5552522	GHO LAEMP	monthly/ continuous	side channel survey	-[b]	monthly, concurrently[c]	3 Annually	-	-	3 Annually	3 Annually	-	-	-	-
	S	Elk River Side Channel	GH_ER1A	GH_ER1A	E305876	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648379	5551653	GHO LAEMP	monthly/ continuous		-[b]	monthly, concurrently[c]	3 Annually	-	-	3 Annually	3 Annually	-	-	-	-
	S	Elk River Side Channel	RG_ERSC5	RG_ERSC5	-	Elk River side channel d/s of Wolfram Creek, u/s of wetland	648275	5550608	GHO LAEMP	-		-[b]	concurrently[c]	3 Annually	-	-	3 Annually	3 Annually	-	-	-	-
	T	Mickelson Creek	GH_MC1	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862	GHO LAEMP	-	-	-[b]	monthly[c]	-	-	-	-	-	-	-	-	-
	T	Leask Creek	GH_LC1	GH_LC1	E257796	Leask Creek Sed. Pond Decant	648153	5552859	GHO LAEMP	-	-	-[b]	monthly[c]	-	-	-	-	-	-	-	-	-
	T	Wolfram Creek	GH_WC1	GH_WC1	E257795	Wolfram Creek Sed. Pond Decant	648222	5552086	GHO LAEMP	-	-	-[b]	monthly[c]	-	-	-	-	-	-	-	-	-
	T	Thompson Creek	GH_TC2	THCK	E207436	lower creek	648596	5550237	RAEMP	-	-	-[b]	monthly, concurrently[c]	1 Annually	-	-	1 Annually	1 Annually	-	-	-	-
	Le	Elk River Side Channel Wetland	RG_GH-SCW3	RG_GH-SCW3	-	wetland in the Elk River side channel downstream of Thompson Creek	648332	5550166	Lentic Area Supporting Study	-	side channel survey	-[b]	concurrently[c]	3 Annually	5	-	-	3 Annually	June, July (targeting different life stages)	-[d]	2 surveys in June	July/ August
	S	Elk River Side Channel	GH_ERSC2	GH_ERSC2	E305877	Elk River side channel d/s of Thompson Creek	648341	5549812	GHO LAEMP	monthly/ continuous		-[b]	monthly, concurrently[c]	3 Annually[e]	-	-	3 Annually[e]	3 Annually[e]		-	-	-
	S	Elk River Side Channel	-	RG_SCDTC	-	Elk River side channel d/s of Thompson Creek	648226	5549603	GHO LAEMP	-		-[b]	concurrently[c]	3 Annually	-	-	3 Annually	3 Annually		-	-	-
	M	Elk River	GH_ERC (Compliance)	EL20	E300090	d/s Thompson Cr. and GHO	649146	5548514	Core RAEMP Mine-exposed	monthly/ continuous	-	-[b]	monthly/weekly, concurrently[c]	5 Annually	5	-	5 Annually	5 Annually	-	-	-	-

Sampling conducted for, and reported under, the GHO LAEMP 2018 to 2020.
Sampling conducted for, and reported under, the Lentic Area Suppoting Study (Minnow 2018b). Data also reported and interpreted under the GHO LAEMP 2018 to 2020.
Sampling conducted for, and reported under, the RAEMP. Data also reported and interpreted under the GHO LAEMP 2018 to 2020.
Sampling conducted for, and reported under, the site-specific GHO groundwater program. As required, data may be included in the GHO LAEMP to help address the key questions.

[a] M-main stem (lotic); S-side channel (lotic); Le - side channel (semi-lentic); T-tributary (lotic).
[b] The site-specific GHO groundwater program will be updated to address GHO LAEMP data needs.
[c] Concurrently - water chemistry sampling will be conducted concurrent with sediment and biological sampling. Weekly/monthly - water chemistry sampling and flow monitoring are conducted weekly or monthly through Permit 107517 and Permit 6428.
[d] Area was swiftly flowing and inaccessible in June 2018, and therefore likely provided limited breeding habitat. No eggs were found or sampled in 2018.
[e] Was not wetted during Septmeber 2018 and therefore could not be sampled.

Table 2.2: Pools assessed for Habitat, Biota, and Water Chemistry, GHO LAEMP

General Pool Area Description	Water Station Code			UTM (NAD83, 11U)	
	EQuIS	2018 GHO LAEMP Report	2017 GHO LAEMP Report	Easting	Northing
Side channel upstream of station GH_ER1A	RG_GH-SC3-P7	SC3-P7	Pool-U-1	647843	5552016
	RG_GH-SC3-P6	SC3-P6	Pool-U-2	647833	5551900
	RG_GH-SC3-P10	SC3-P10	Pool-U-3	647873	5551838
	RG_GH-SC3-P14	SC3-P14	- [b]	648076	5551622
	RG_GH-SC3-P13	SC3-P13	- [b]	648271	5551718
	RG_GH-SC3-P9	SC3-P9	Pool-U-4	647906	5551710
	RG_GH-SC3-P8	SC3-P8	Pool-U-5	648214	5551721
Side channel downstream of station GH_ER1A, upstream of Thompson wetland	RG_GH-SC3-P11	SC3-P11	- [b]	648374	5551627
	RG_GH-SC3-P12	SC3-P12	- [b]	648336	5551170
	RG_GH-SC3-P4	SC3-P4	Pool-M-2	648255	5550781
	RG_GH-SC3-P3	SC3-P3	Pool-M-1	648299	5550743
Western channel downstream of Thompson wetland	RG_GH-SC1-P2	SC1-P2	Pool-W-1	648749	5549094
	RG_GH-SC1-P1	SC1-P1	Pool-W-2	648380	5549321
Middle channel downstream of Thompson wetland	RG_GH-SC4-P1	SC4-P1	- [b]	648589	5549393
Eastern channel downstream of Thompson wetland	RG_GH-SC2-P4	SC2-P4	Pool-E-1	648492	5549728
	RG_GH-SC2-P1	SC2-P1	Pool-E-2	648559	5549470
	RG_GH-SC2-P5	SC2-P5	Pool-E-3	648592	5549424
	RG_GH-SC2-P6	SC2-P6	- [b]	648609	5549390
	RG_GH-SC2-P2	SC2-P2	Pool-E-6	648668	5549294
	RG_GH-SC2-P3	SC2-P3	Pool-E-7	648782	5549097

[a] Relative to this report, a different naming convention was used in the 2017 GHO LAEMP, and is provided here for context. Pool samples are listed with the prefix "RG_GH-" in EQuIS, but for simplicity the prefix is not displayed in the 2018 GHO LAEMP. The 2018 naming convention follows "field logic" and pools were numbered as the were observed.
[b] Pool was not sampled for the 2017 GHO LAEMP (Minnow and Lotic 2018a).

Table 2.3: West-side Tributary Water Quality Monitoring Stations in the GHO LAEMP, 2018

Exposure Type	Tributary Name	Water Station Code	ENV EMS Number	Area Description	UTM (NAD83, 11U)	
					Easting	Northing
Reference	Branch F Creek	GH_BR_F	E287437	Branch F at LRP Road	647423	5557155
Mine-exposed	Wolf Creek	GH_WOLF	E305855	Wolf Creek Sed. Pond Decant	647490	5556959
	Willow Creek	GH_WILLOW	-[a]	Willow Creek at LRP Road	647654	5556061
		GH_WILLOW_SP1	E305854	Willow Sediment Pond Decant	647604	5556029
		GH_WILLOW_S	-[a]	Willow South Creek at LRP Road	647663	5556006
	Wade Creek	GH_WADE	E287433	Wade Creek at LRP Road	647723	5555707
	Cougar Creek	GH_COUGAR	E287432	Cougar Creek at LRP Road	647765	5555457
	No Name Creek	GH_NNC	E305875	No Name Creek	648055	5554967
	Mickelson Creek	GH_MC1	0200388	Mickelson Creek at LRP Road	648209	5553862
	Leask Creek	GH_LC2	-[a]	Leask Creek upstream of Sed. Pond	648297	5553064
		GH_LC1	E257796	Leask Creek Sed. Pond Decant	648153	5552859
	Wolfram Creek	GH_WC2	-[a]	Wolfram Creek upstream of Sed. Pond	648347	5552251
		GH_WC1	E257795	Wolfram Creek Sed. Pond Decant	648222	5552086
	Thompson Creek	GH_TC2	E207436	Thompson Creek Sed. Pond Decant	648596	5550237
		GH_TC1	E102714	Thompson Creek at LRP Road	648550	5550221

[a] Monitoring is not required under 107517.
Note: The west-side tributaries are listed from upstream to downstream. The side channel branches off from the main stem Elk River downstream of Leask Creek and upstream of Wolfram Creek (see Figure 2.2).

characterization of side channel hydrology features (dry sections, braids, isolated pools, and tributary surface connectivity).

2.2.2 Side Channel Mapping

Monthly surveys were completed by a crew along the Elk River side channel from the downstream outlet at the Elk River to the side channel inlet near Leask Creek, covering roughly 7.3 km. Monthly surveys were used to evaluate the seasonality of surface flow conditions within the side channel. Extent of wetted and dry areas were marked with a handheld Global Positioning System (GPS) unit (in Universal Transverse Mercator [UTM] coordinates, using North American Datum [NAD] 83) to facilitate mapping. Characteristics of primary interest included:

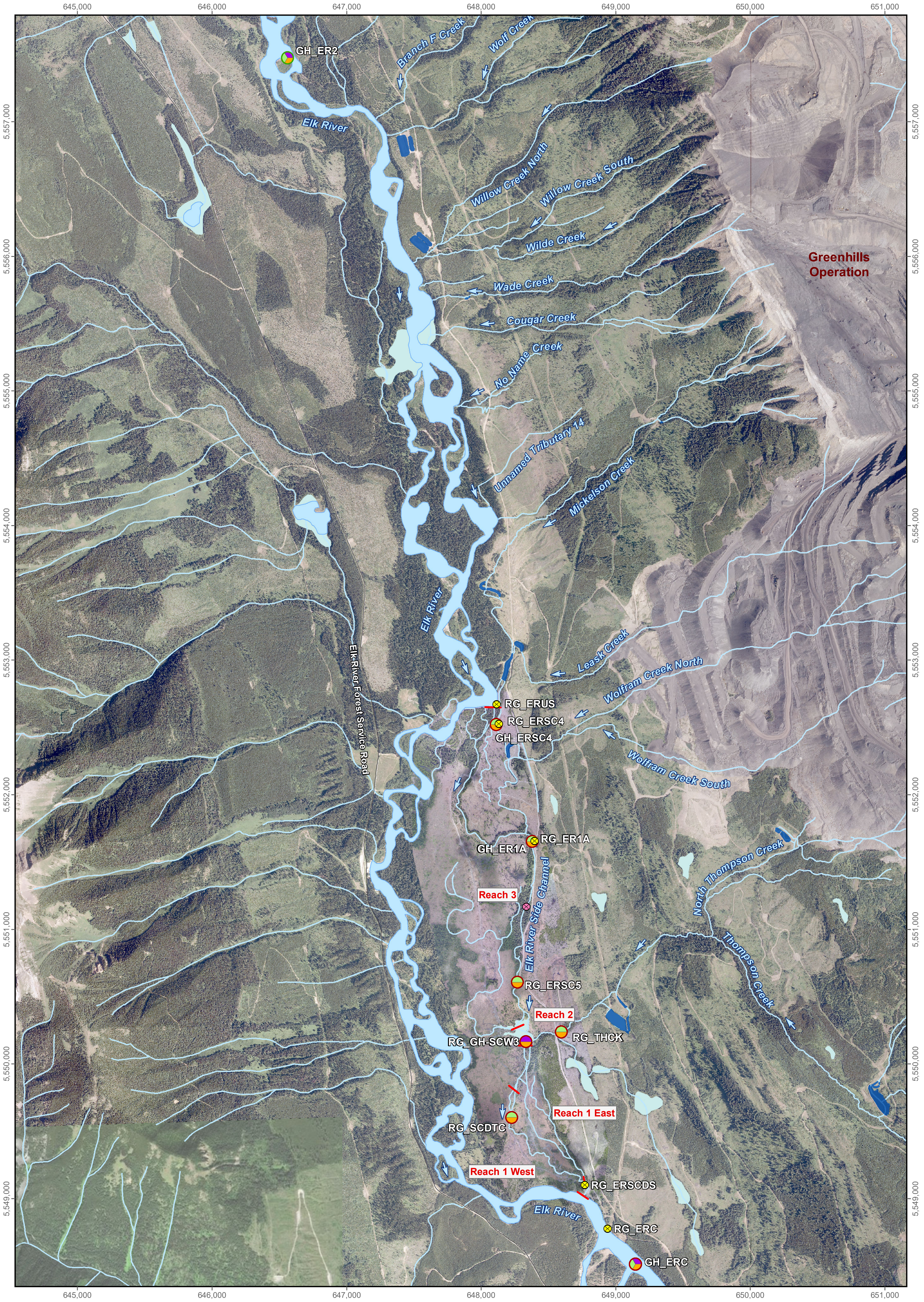
- dry sections,
- braided or flooded sections,
- isolated pools, and
- surface connectivity between tributaries (Wolfram Creek and Thompson Creek), the Elk River, and the Elk River side channel.

Maps were created to display monthly conditions in terms of wetted and dry sections of the side channel, flooded areas, the surface connectivity of tributaries to the side channel, and between the side channel and main stem Elk River. The percentage of the side channel length (not area) that was wetted was calculated monthly.

2.2.3 Hydrometric and Water Temperature Monitoring

2.2.3.1 Field Monitoring

Water levels were assessed in the Elk River side channel and main stem Elk River upstream and downstream of the side channel to characterize the relationship between flows in the side channel and in the main stem Elk River. In 2017, water level and temperature loggers (Onset Hobo U 20 Level loggers) were installed at RG_ERUS, GH_ERSC4, GH_ER1A, RG_ERSCDS, and GH_ERC (Figure 2.1). Additionally, a barometric logger was installed at GH_ER1A (Minnow and Lotic 2018a). Temperature data were used to confirm dry periods. Barometric data were used to correct the water level data for barometric atmospheric pressure, as submerged water level loggers can detect changes in atmospheric pressure. Loggers were housed in a stilling well made of polyvinyl chloride (PVC) piping, attached to an angle iron, to which a staff gauge (i.e., a ruler to measure water surface elevation) was also attached. Loggers and staff gauges were maintained through 2018. The staff gauge at RG_ERSCDS was damaged in late April and was submerged in a pool until it could be reinstalled in July. Benchmark surveys were completed



LEGEND

Sampling Type

- Mine-exposed
- Reference
- Sediment Quality
- Benthic Invertebrate Tissue Chemistry
- Benthic Invertebrate Community
- Staff Gauge Location
- Barometric Logger
- Reach Break
- Settling Pond
- Semi-lentic Area

Staff Gauge Locations, and Sediment Quality, Benthic Invertebrate Community, and Benthic Invertebrate Tissue Chemistry Sampling Stations

0 0.5 1 2
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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Figure 2.1

Document Path: S:\Projects\187202\187202.0018 - Teck GHO LAEMP Implementation 2018\4 - GIS\LAEMP Report\18-18 Fig 2.1 Staff Gauge Locations.mxd throughout the sampling period to comply with Resources Information Standards Committee (RISC) standards (RISC 2009). Data were downloaded routinely from the loggers to avoid data loss. Loggers were winterized before winter to prevent freezing and damage. They were de-winterized and downloaded in April 2018. Loggers were also downloaded in October 2018 prior to being re-winterized.

Water levels (i.e., stream stage) and temperature were recorded at 15-minute intervals at the three stations within the Elk River side channel throughout 2018. Flow measurements were completed at all water level logger stations on the side channel (RG_ERSCDS, GH_ER1A, GH_ERSC4; Figure 2.1) during monthly visits when sites were free from ice and could be measured safely. Flow measurements were not collected at the Elk River main stem sites due to deep water and high flow conditions. Streamflow measurements followed the Manual of British Columbia Hydrometric Standards (RISC 2009). Stream depth (m) and velocity (m/s) were measured using a Hach FH950 flow meter or salting. Velocity measurements were collected with the Hach meter at a depth of 60% of the total depth from the water surface. Salting was required during the high flow periods of May and June when it was unsafe to wade in the stream. Salting was conducted by adding a salt solution to the stream and observing conductivity background, peak, and return to background levels using a YSI Pro Plus multi-probe water quality meter (Moore 2004). These flow measurements, combined with staff gauge readings, were used to build stage-discharge measurements.

2.2.3.2 Data Analysis

Water level data were collected and corrected for barometric pressure using Onset Hoboware Pro (version 3.7.13) and a reference water stage relative to the staff gauge. Water stage was then converted to a discharge from site-specific stage discharge rating curves. A log-linear stage-discharge curve was generated using manual stage and discharge measurements for each site. Stage (m) and discharge (m^3/s) values were manually verified and qualitatively determined outliers or measurements with high uncertainty were removed from further analyses. All stage measurements below 0.001 m were treated as ‘dry’ and were excluded. A discharge time series (i.e., hydrograph) was plotted for each site and qualitatively assessed for locations along the side channel locations.

In order to ascertain the hydrological signal of the side channel hydrometric gauges, daily streamflow records were compared with records from the Elk River near Natal Water Survey of Canada (WSC) hydrometric gauge (08NK016). Daily data were available until the end of 2017 from wateroffice.gc.ca and preliminary (hourly) data were available for 2018.

MacHydro (the hydrological consulting company retained by Lotic for senior review) reviewed the hydrological data and assigned a grade value for the quality of the data. Grades were assigned following British Columbia Ministry of Environment Hydrological RISC Standards (RISC 2009). The rating curves produced a varying quality grade of B or C (Appendix Table A.1). Instrumentation and field procedures were of good quality, while the discharge curve accuracy grade was good for GH_ER1A and modest for GH_ERSC4 and RG_ERSCDS. Caution is required, with regards to the modest grades of these interim curves, given the relatively few manual observations used to derive each stage-discharge curve, especially with limited observations during high flow conditions.

2.3 Habitat and Biota (Question #2)

2.3.1 Overview

Habitat and observations of aquatic-dependent biota were documented during monthly surveys to address study question #2 (What is the seasonal habitat availability for aquatic-dependent biota (i.e., fish, amphibians, and aquatic-feeding birds) in the Elk River side channel?). Previous studies have shown that the majority of the GHO west-side tributaries have steep gradients, are ephemeral, and, with the exception of Thompson Creek, are not fish bearing (Lotic 2015; Minnow 2016a). Prior to the GHO LAEMP, the habitat of the Elk River side channel had not been formally assessed. Therefore, monthly surveys conducted for the GHO LAEMP targeted the side channel and its floodplain complex. Monthly surveys were completed in 2018 from January to December. These data, along with 2017 observations (Minnow and Lotic 2018a), provide information about seasonal habitat availability for different aquatic-dependant biota.

2.3.2 Habitat Availability

Habitat was assessed as a component of monthly surveys. Field crews walked the entire channel from the downstream outlet to the Elk River to the inlet near Leask Creek and documented general habitat conditions (e.g., presence of vegetation, bank condition, and substrate type), stream morphology/hydrology observations, as well as any updates of information gathered in the 2017 Fish Habitat Assessment Procedures (FHAP) survey (Minnow and Lotic 2018b). Habitat suitable for amphibians (e.g., ponds) and aquatic-feeding birds were also recorded. Potential fish spawning habitat and any observed redds were documented for both spring and fall spawners that may be present in side channel, and overwintering habitat was documented during the winter. The 2017 FHAP survey map is provided (Appendix Figure B.1). *In situ* water quality parameters were also measured monthly in isolated pools and at the level logger locations and compared to British Columbia Water Quality Guidelines (BCWQG; ENV 2018).

2.3.3 Distribution of Aquatic-dependent Biota

During monthly surveys, the side channel was traversed to document any aquatic or aquatic-dependant species utilizing the side channel. This included observations of fish (including eggs, fry, young-of-the year, juveniles, and adults), visual and auditory detections of amphibians (including eggs, tadpoles, and adults), and visual and auditory detections of aquatic-dependent birds (including nests, eggs, chicks, and adults). In addition to the monthly side channel surveys, additional aquatic dependant species surveys were conducted in Reach 2 as part of the Lentic Area Supporting Study (Minnow 2018b; see Section 8 herein).

Fish habitat and use surveys of the side channel were conducted in the spring and fall. Typical spring spawning fish include westslope cutthroat trout and longnose sucker, while eastern brook trout, bull trout, and mountain whitefish are species found in the side channel that spawn in the fall. Redd locations were described by habitat type, water depth, velocity, and association with cover. All fish and fish habitat use features were photographed and described, with coordinates recorded with a hand-held GPS. Amphibian, aquatic dependent bird, and fish observations are displayed on maps in Section 4.

2.4 Water Quality (Questions #3 and #4)

2.4.1 Overview

Water quality data were used to address three study questions (Section 1.3):

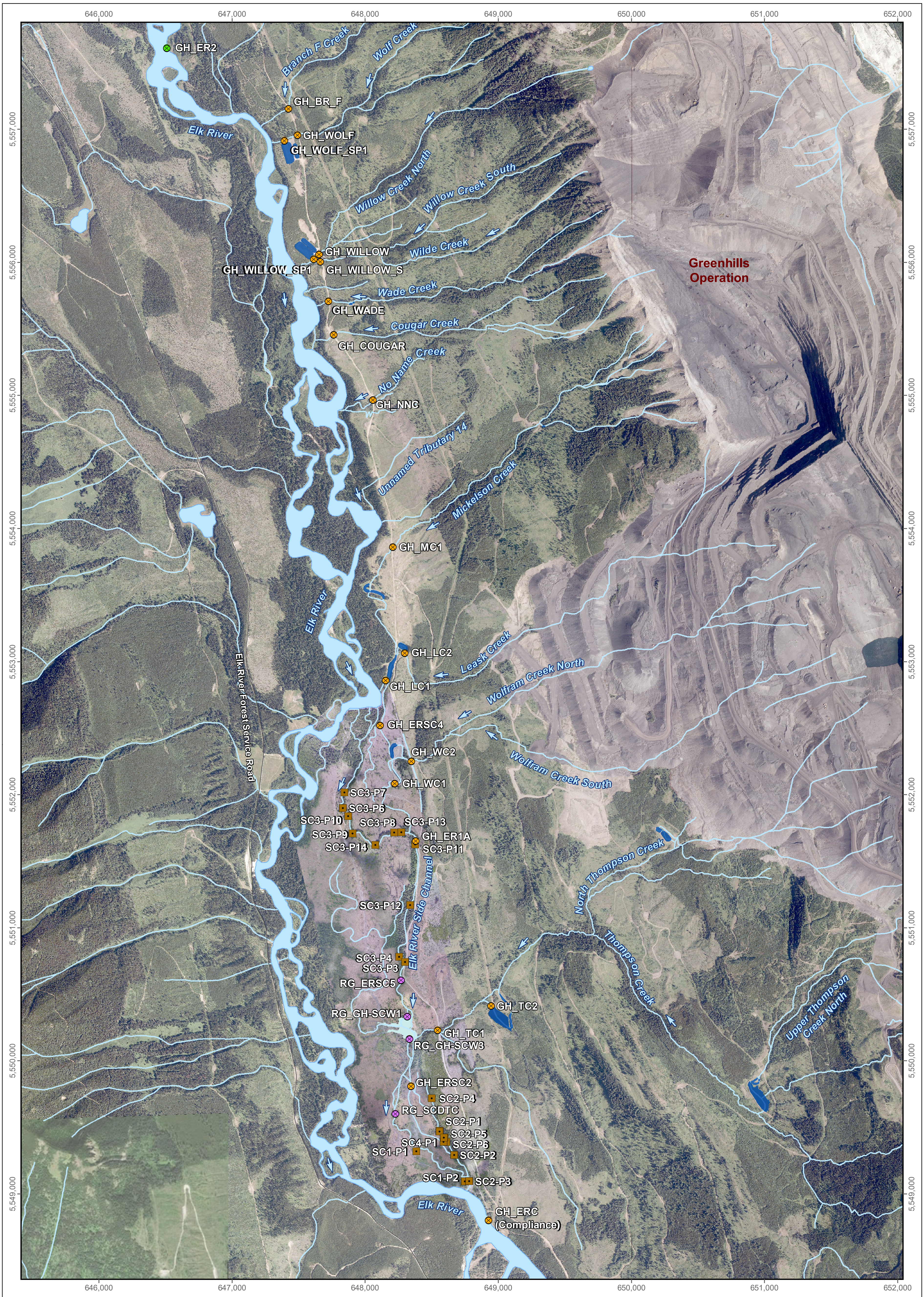
- What is the influence of GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel? (study question #3),
- What is the interaction between surface water and groundwater in the Elk River side channel? (study question #4), and
- Is the mine-related influence on the side channel wetland having an effect on aquatic-dependent biota (benthic invertebrates, fish, amphibians, and aquatic-feeding birds)? (study question #6).

Data were evaluated from Teck's surface water quality monitoring under Permit 107517 and Permit 6428 and from supplementary sampling conducted concurrent with field sampling (Tables 2.1 to 2.3).

2.4.2 Sample and Data Collection

Water quality samples were collected weekly/monthly[7] by Teck as part of the permitted water quality sampling program. Water quality data were downloaded from Teck's EQuIS™ database for the water quality stations in the west-side tributaries, the upper Elk River, and the Elk River side channel (Figure 2.2).

[7] Sampling is conducted on a monthly basis (August to March) and/or weekly/monthly basis (March 15 to July 15), as required by Permit 107517 and Permit 6428.



LEGEND

- Routine Water Quality Monitoring Station (Permit 107517), Reference
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Isolated Pool
- Settling Pond
- Semi-lentic Area

Surface Water Quality Monitoring Stations

0 0.5 1 2
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 11
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Figure 2.2

Document Path: S:\Projects\187202\187202.0018 - Teck GHO LAEMP Implementation 2018\4 - GIS\LAEMP Report\18-18 Fig 2.2 Surface WQ.mxd

Additional water quality samples were collected specifically for the GHO LAEMP to evaluate the influence of the tributaries and mainstem Elk River on the side channel throughout the year. Between January 2018 and December 2018, grab samples were collected from sixteen isolated pools along the Elk River side channel. Larger pools and pools containing fish were targeted. Samples were collected monthly following initial identification of isolated pools, until the pools became dry or froze to the bottom. The location of each pool was marked in UTMs using a handheld GPS and notes on fish presence, pool size, and depth were recorded during ice-free conditions. Water quality samples were also collected concurrent with benthic invertebrate community and tissue chemistry samples in September 2018 (Section 2.6 and 2.7), and monthly at the outlet of Reach 2 at station RG_GHSCW3 (downstream of the confluence of the Elk River side channel and Thompson Creek) to support the assessment of water quality in the side channel (study question #2.b)

Water samples were collected into clean, pre-labelled containers provided by the analytical laboratory. Samples were preserved immediately as required, and once re-capped, bottles were inverted two or three times to mix the preservative with the water sample. Water samples were kept cold and shipped to the analytical laboratory. Concurrent with water quality sampling, *in situ* measurements of temperature, dissolved oxygen (DO), pH, and specific conductance were collected using a multi-probe water quality meter.

2.4.3 Laboratory Analysis

Water samples were analyzed by ALS Environmental for parameters consistent with Permit 107517 (i.e., conventional parameters, major ions, nutrients, and total and dissolved metals, Table 2.4) using standard methods (Table 2.5). Quality assurance and quality control (QA/QC) associated with water sampling are reported by Teck in the annual reports for Permits 107517 and 6248.

Table 2.4: Water Sample Analyses

Category	Parameters (as per Permit 107517, Appendix 2, Table 25)
Field Parameters	temperature, specific conductance, dissolved oxygen (DO), pH
Conventional Parameters	specific conductance, total dissolved solids, total suspended solids, hardness, alkalinity, dissolved organic carbon, total organic carbon, turbidity
Major Ions	bromide, fluoride, calcium, chloride, magnesium, potassium, sodium, sulphate
Nutrients	ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), orthophosphate, total phosphorus
Total and Dissolved Metals	aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, zinc

Table 2.5: Analytical Methods for Water Samples

Analyte	Units	Method	Reference
Turbidity	NTU	Nephelometric	APHA 2130 Turbidity
Hardness (as $CaCO_3$)	mg/L	Calculation	APHA 2340B
Total Suspended Solids	mg/L	Gravimetric	APHA 2540 D
Total Dissolved Solids	mg/L	Gravimetric	APHA 2540 C
Alkalinity	mg/L	Potentiometric Titration	APHA 2320
Ammonia (as N)	mg/L	Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
Bromide (Br)	mg/L	Ion Chromatography	APHA 4110 B
Chloride (Cl)	mg/L	Ion Chromatography	APHA 4110 B
Fluoride (F)	mg/L	Ion Chromatography	APHA 4110 B
Total Kjeldahl Nitrogen	mg/L	Fluorescence	APHA 4500-NORG D.
Nitrate (as N)	mg/L	Ion Chromatography	EPA 300.0
Nitrite (as N)	mg/L	Ion Chromatography	EPA 300.0
Phosphorus (P)-Total	mg/L	Colourimetrically	APHA 4500-P Phosphorous
Orthophosphate	mg/L	Colourimetrically	APHA 4500-P Phosphorous (Filter through 0.45 um filter)
Sulphate (SO_4)	mg/L	Ion Chromatography	APHA 4110 B
Dissolved Organic Carbon	mg/L	Combustion	APHA 5310 TOTAL ORGANIC CARBON (Filter through 0.45 um membrane filter)
Total Organic Carbon	mg/L	Combustion	APHA 5310 TOC
Total & Dissolved Metals	mg/L	CRC ICPMS (collision cell inductively coupled plasma - mass spectrometry) ICPOES (inductively coupled plasma - optical emission spectrophotometry)	APHA 3030 B&E / EPA SW-846 6020A EPA 3005A/6010B Dissolved metals filtered through a 0.45 um filter

2.4.4 Screening and Plotting of Water Quality Constituents

Water quality assessment focused on constituents with early warning triggers (EWTs; i.e., dissolved cadmium, nitrate, total selenium, sulphate, 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) and total mercury. Total mercury data were assessed herein because concentrations were occasionally greater than the BCWQG in 2017 and 2018 (Teck 2018b and 2019b), and additional screening was requested by the EMC in the review of the 2017 GHO LAEMP. However, separate evaluation of the methyl mercury and total mercury data collected over the 2015 to 2018 period has concluded that mercury concentrations observed in the Elk Valley are not mining related (Teck 2019a). Therefore, future water quality assessment for the GHO LAEMP will not include total mercury.

Constituents with EWTs and total mercury were compared to BCWQG and/or EVWQP benchmarks and interim screening benchmarks for nickel, as applicable, for the 2018 calendar year. Within the GHO LAEMP, the most conservative (i.e., lowest) EVWQP Level 1 and Level 2 Benchmarks were used for screening. The Level 1 benchmark for cadmium is hardness-based and is a based on reproductive toxicity to planktonic crustacean *Daphnia magna* (HDR 2014). For nitrate, the Level 1 and Level 2 benchmarks are based on reproductive toxicity to the water flea *Ceriodaphnia dubia* (Golder 2014b). For total selenium, the Level 1 and Level 2 benchmarks are based on reproductive toxicity to sensitive fish species (Golder 2014a). The Level 1 and Level 2 benchmarks for sulphate are hardness-based, and are based on toxicity to rainbow trout early life-stage survival and development (Golder 2014b). Plots of constituent concentrations from 2012 to 2018 were prepared individually for each monitoring station relative to BCWQG and benchmarks (where applicable), and also as combined plots to allow for visual comparison among stations. Plots were qualitatively assessed for seasonal and temporal patterns. Water quality data were assessed for:

- the west-side tributaries (study question #3a),
- the Elk River side channel (study question #3b) lotic stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Reach 2 (RG_GH-SCW3),
- the main stem Elk River downstream (GH_ERC) and upstream (GH_ER2) of the west-side tributaries (study question #3c), and
- isolated pools in the Elk River side channel (study question #3.d)

2.4.5 Statistical Analyses

2.4.5.1 Main Stem Elk River versus the Side Channel (Question #3.b)

Statistical comparisons of water quality between the side channel stations (GH_ERSC2, GH_ER1A, GH_ERSC4) and the upstream (GH_ER2) and downstream (GH_ERC) stations were conducted to assess differences between years (from 2016 to 2018) and among stations. Statistical analysis of water quality data focussed on monthly mean concentrations of constituents with EWTs and total mercury. The statistical comparisons were conducted on the mathematical differences (side channel – downstream, and side channel – upstream) in $\log_{10}$ monthly mean concentrations to remove the influence of season. The differences in $\log_{10}$ monthly mean concentrations between areas were tested using a two-way Analysis of Variance (ANOVA) with factors Year, Area (the three side channel stations), and the Area x Year interaction.

The side channel versus upstream and side channel versus downstream comparisons were conducted by testing whether differences in $\log_{10}$ monthly mean concentrations between stations were different from zero using a one-sample t-test by testing the hypothesis:

$$H_{01}: \mu d = 0$$

where µd represented the difference in monthly means between side channel stations and upstream or downstream stations. The tests for H_{01} were conducted by (1) pooling three years of data and stations when the Area x Year interaction (P-value > 0.1) and Area (P-value > 0.1) factors were not significant, (2) pooling three years of data, but separately by side channel station when the Area x Year interaction (P-value > 0.1) was not significant, but Area was significant (P-value < 0.1), or (3) separately by station and year when the Area x Year interaction (P-value < 0.1) term was significant.

When the differences in monthly mean concentrations between the side channel and upstream or downstream stations were significant, the magnitude of difference (MOD) was calculated as:

$$MOD = \frac{(MCT_{SC} - MCT_{US})}{MCT_{US}} \times 100\%$$

or

$$MOD = \frac{(MCT_{SC} - MCT_{DS})}{MCT_{DS}} \times 100\%$$

where MCT_{SC}, MCT_{US} and MCT_{DS} were the geometric mean for the side channel, downstream, and upstream stations, respectfully.

2.4.5.2 Main Stem Elk River Downstream versus Upstream of the West-Side Tributaries (Question #3.c)

Concentrations at the downstream station (GH_ERC) were compared to upstream (GH_ER2) using the difference in $\log_{10}$ monthly mean concentrations between stations in a one sample t-test (i.e., paired t-test). Potential changes over time at the downstream station compared to upstream were tested using an ANOVA on the differences in $\log_{10}$ monthly mean concentrations between stations, with Year as a co-variable. When the Year term was not significant, the difference between the upstream and downstream stations was tested using a using a one sample t-test (see section 2.4.4.5). When Year was significant, it suggested the difference between the upstream and downstream stations varied by year, and a t-test was run separately for each year. When the differences in monthly mean concentrations between the upstream and downstream stations was significant overall, or for an individual year, the magnitude of difference (MOD) was calculated as:

$$MOD = \frac{(MCT_{DS} - MCT_{US})}{MCT_{US}} \times 100\%$$

where MCT_{DS}, and MCT_{US} were the geometric means for the downstream and upstream stations, respectively.

2.5 Surface Water and Groundwater Interaction (Question #4)

To support the GHO LAEMP, as well as the GHO Annual Site-specific Groundwater Monitoring Program (SSGMP) and the Regional Groundwater Monitoring Program (RGMP), SNC Lavalin conducted a hydrogeological review and analysis of available groundwater and surface water data for the west side of GHO in the vicinity of the Elk River side channel (SNC Lavalin 2019). The objective of the review was to assess whether existing data are sufficient to address study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?), and if data gaps exist, to make recommendations for additional work to improve the assessment. Detailed methods are provided in Appendix D (SNC Lavalin 2019).

The hydrogeological review (SNC Lavalin 2019) included:

- review of surficial geology and hydrogeology;
- review of the groundwater conceptual model;
- compilation of available groundwater data from monitoring wells
- compilation of available surface water data from surface water stations in the Elk River and side channel and isolated pools;
- spatial and temporal comparison of groundwater elevations in monitoring wells to surface water levels in the adjacent side channel and the Elk River;
- spatial and temporal comparison of groundwater chemistry (including mine-related constituents and major ions) from monitoring wells to surface water chemistry data from the side channel, tributaries, isolated pools, and the Elk River;
- assessment of the seasonality of the presence of isolated pools and wetted areas with respect to the potential for groundwater to be contributing as base flow for these areas;
- assessment of the spatial distribution of wetted areas over time;
- identification of gaps and uncertainties; and
- recommendations to address data gaps.

2.6 Benthic Invertebrate Community (Question #5)

2.6.1 Overview

Benthic invertebrate community structure data were assessed to address study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

2.6.2 Sample Collection

Benthic invertebrate community samples were collected from four areas in the side channel connected to the Elk River (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC[8]; Figure 2.1). Samples were also collected from two stations in the main stem Elk River: downstream of the west-side tributaries (GH_ERC) and upstream of mine influence (GH_ER2; Figure 2.1). Based on power analysis in the RAEMP study Design, it was determined that five samples would be collected at core RAEMP monitoring areas (i.e., Compliance and Order stations; GH_ERC), three samples would be collected at core RAEMP reference areas (i.e., GH_ER2), and only a single sample would be collected at non-core RAEMP sampling areas (i.e., THCK; Minnow 2018c). Additional replicates (three samples) were added to support the GHO LAEMP at side channel stations GH_ERSC4, GH_ER1A, and RG_ERSC5 to give greater power to detect changes over time. A single benthic invertebrate community sample was collected at station RG_SCDTC, as the area had only one small riffle that could be sampled. Samples were collected using the Canadian Aquatic Biomonitoring Network (CABIN) protocol for kick and sweep (Environment Canada 2012a, 2014). For the CABIN protocol, the field technician conducted a 3-minute travelling kick into a net with a triangular aperture measuring 36 cm per side and mesh having 400 µm openings (Environment Canada 2012a). During sampling, the technician moved across the stream channel (from bank to bank, depending on stream depth and width) in an upstream direction. With the net held immediately downstream of the technician's feet, the detritus and invertebrates disturbed from the substrate were passively collected in the kick-net by the stream current. After three minutes of sampling time, the sampler returned to the stream bank with the sample.

Organisms collected into the kick net were carefully rinsed into a labelled wide-mouth plastic jar. Internal labels were used to confirm the correct identity of each sample. Samples were preserved

[8] The study design proposed benthic invertebrate tissue chemistry sampling locations at GH_ERSC4, GH_ER1A, RG_ERSC5, and GH_ERSC2; however, GH_ERSC2 was dry at the time of sampling, and therefore a new station downstream of Thompson Creek, RG_SCDTC, was sampled.

to a level of 10% buffered formalin in ambient water within approximately six hours of collection to ensure that organisms were not lost through predation or decomposition of tissues.

Supporting information was collected concurrent with, and at the same locations as, benthic invertebrate community samples, including habitat characteristics, calcite coverage, water quality samples (Section 2.4), and sediment quality samples (Section 2.8.3).

2.6.3 Laboratory Analysis

Benthic invertebrate community samples were shipped to Cordillera Consulting Inc. (Summerland, BC) for sorting and taxonomic identification. Organisms were identified to the lowest practical level (LPL; typically genus or species) using up-to-date taxonomic keys. At the beginning of the sorting process, each sample was examined and evaluated to estimate total invertebrate numbers. If the total number was estimated to be greater than 600, then samples were sub-sampled for sorting and enumeration. A minimum of 5% of each sample was sorted, consistent with requirements specified by Environment Canada (2012b, 2014). Following identification, representative specimens of each taxon were placed in separate vials to create a reference collection for the project. Sorting efficiency and sub-sampling accuracy and precision were quantified using methods specified by Environment Canada (2014) (Appendix E).

2.6.4 Data Analysis

For benthic invertebrate community samples, total abundance, richness (LPL), Ephemeroptera, Plecoptera, and Trichoptera (EPT) proportion (% EPT), % Ephemeroptera, % Plecoptera, %Trichoptera, and relative abundance of major taxonomic groups were determined and compared within and among areas. Community endpoints were also compared to normal ranges[9] defined in the RAEMP based on samples collected from regional reference areas in 2012 and 2015 (Minnow 2018a), as well as to the upstream main stem Elk River reference station (GH_ER2). Benthic invertebrate community endpoints were compared from 2012 to 2018, where data were available.

2.7 Benthic Invertebrate Tissue Chemistry (Question #5)

2.7.1 Overview

Benthic invertebrate tissue chemistry data were assessed to address study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side

[9] The reference area normal range was defined as the 2.5th and 97.5th percentiles of the distribution of reference area (pooled 2012 and 2015 data) reported in the RAEMP (Minnow 2018a).

channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

2.7.2 Sample Collection

Benthic invertebrate tissue samples were collected in September 2018 from four lotic areas in the side channel that were connected to the main stem Elk River (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC[10]), the main stem Elk River stations (GH_ERC and GH_ER2), and Reach 2 of the side channel (RG_GH-SCW3; Figure 2.1). Samples were taxa-composites collected in triplicate at each area using the kick and sweep method. The taxa present in the samples were documented. Benthic invertebrates were picked free of debris in the field, placed into a sterile labelled cryovial, and stored in a cooler with ice packs until transfer to a freezer later in the day.

Supporting information was collected concurrent with, and at the same locations as, benthic invertebrate tissue samples, including habitat characteristics, calcite coverage, water quality samples (Section 2.4), and sediment quality samples (Section 2.8.3).

2.7.3 Laboratory Analysis

Benthic invertebrate tissue samples were kept in a freezer until they were shipped in coolers to the Saskatchewan Research Council (SRC) laboratory in Saskatoon, Saskatchewan. At the laboratory, the samples were freeze-dried and then analyzed for metals using Inductively Coupled Plasma-Mass Spectrophotometry (ICP-MS). Results were reported on a dry weight (dw) basis, along with moisture content (based on the difference between wet and freeze-dried sample weights).

The QA/QC procedures for benthic invertebrate tissue samples included the assessment of laboratory duplicates, and quality control reference materials and standards. Based on the results provided for QA/QC samples, the benthic invertebrate tissue data collected for the GHO LAEMP were judged to be of acceptable quality (Appendix F).

2.7.4 Data Analysis

Benthic invertebrate tissue selenium concentrations were compared to EVWQP Level 1 and Level 2 benchmarks as well as normal ranges[11] defined in the RAEMP. Tissue selenium

[10] The study design proposed benthic invertebrate tissue selenium sampling locations at GH_ERSC4, GH_ER1A, RG_ERSC5, and GH_ERSC2; however, GH_ERSC2 was dry at the time of sampling, and therefore a new station, RG_SCDTC, was sampled.

[11] The reference area normal range for composite benthic invertebrate tissues samples is defined as the 2.5th and 97.5th percentiles of the distribution of reference area (pooled 1996 to 2015 data) reported in the RAEMP (Minnow 2018a).

concentrations were also plotted and spatially compared within and among areas, and were compared to the selenium bioaccumulation model (Golder 2018).

2.8 Supporting Information

2.8.1 Habitat

Habitat characteristic were documented, including: photographs, channel depth and velocity (measured using a Hach FH950 flow meter, 15 cm above the substrate), substrate characteristics (i.e., 100 pebble count, consistent with CABIN protocol), surrounding land use, anthropogenic activity, bank stability, bankfull width, and wetted width.

2.8.2 Calcite

Calcite coverage was assessed at the two main stem stations (GH_ER2 and GH_ERC), the three side channel stations (GH_ERSC4, GH_ER1A, RG_GH-SCW3, and RG_SCDTC), and Thompson Creek (RG_THCK) in September 2018. Field measurements were consistent with calcite monitoring conducted for the RAEMP (Minnow 2018a), and followed a modified 100-particle pebble count method developed for Teck's Calcite Monitoring Program (Robinson and Atherton 2016, Teck 2016). For this modified approach, calcite was measured only in riffle habitats on undisturbed substrate in the immediate vicinity of where benthic invertebrate community samples were collected (e.g., roughly 10 m distance). One hundred streambed particles were randomly selected over the study area and were measured for calcite presence/absence and concretion. The presence (score = 1) or absence (score = 0) of calcite was recorded for each of the 100 particles. The degree of concretion was also assessed by determining if the particle was removed with negligible resistance (not concreted; score = 0), noticeable resistance but removable (partially concreted; score = 1), or immovable (fully concreted; score = 2). 100-particles were measured for each Calcite Index (CI) determination. Consistent with the RAEMP, CI was determined for each benthic invertebrate community sampling location, and therefore were collected in triplicate for most GHO LAEMP stations, except RG_GH-SCW3, RG_THCK, and RG_SCDTC (where single calcite index counts were conducted), and GH_ERC (where five calcite index counts were conducted).

The results for the 100 particles surveyed for calcite were expressed as a CI based on the following equation:

$$CI = CI_p + CI_c$$

Where:

$$CI = Calcite\ Index$$

$$CI_p = Calcite\ Presence\ Score = \frac{Number\ of\ particles\ with\ calcite}{Number\ of\ particles\ counted}$$

$$CI_c = Calcite\ Concretion\ Score = \frac{Sum\ of\ particle\ concretion\ scores}{Number\ of\ particles\ counted}$$

2.8.3 Sediment Quality

2.8.3.1 Sample Collection

Sediment quality samples were collected concurrent with benthic invertebrate samples at the two main stem Elk River stations (GH_ER2 and GH_ERC) and at Reach 2, the semi-lentic depositional area of the side channel (RG_GH-SCW3; Figure 2.1). Sediment samples were collected using a stainless steel spoon and were transferred into glass jars for analysis of polycyclic aromatic hydrocarbons (PAHs), and into polyethylene bags for all other analyses (see Section 2.8.3.2). Samplers took care to only remove the top 1 to 2 cm of sediment, and continued to collect sediment until sufficient sample volume was retrieved. For QA/QC purposes, duplicate (split) samples were collected at a frequency of approximately 10% of the total number of samples to assess field precision (i.e., two sets of field duplicate samples). Following collection, samples were placed in a refrigerator at approximately 4°C until submission to the analytical laboratory.

2.8.3.2 Laboratory Analysis

Samples for chemical analysis were sent to ALS Environmental (Calgary, AB). The laboratory was instructed to thoroughly homogenize each sediment sample (according to standard laboratory protocols), to ensure the aliquots taken for analysis were representative and comparable.

Sediment samples were analyzed for metals, mercury, total organic carbon (TOC), PAHs, particle size distribution, and moisture content using standard methods (Table 2.6).

In addition to collection of field duplicate samples, QA/QC included assessment of laboratory duplicates, spike recoveries, and certified reference materials. Based on the results provided, the sediment data were judged to be of acceptable quality (Appendix G).

Table 2.6: Analytical Methods for Sediment Samples

Analyte	Units	Method	Reference
Metals	mg/kg	Collision Reaction Cell Inductively Coupled Plasma-Mass Spectrophotometry (CRC ICP-MS)	EPA 200.2/6020A
Mercury	mg/kg	Cold Vapor-Atomic Absorption (CVAAS)	EPA 200.2/1631E (mod)
Total Organic Carbon (TOC)	%	TOC is calculated by the difference between total carbon and total inorganic carbon	CSSS (2008) 21.2
Polycyclic Aromatic Hydrocarbons (PAHs)	mg/kg %	Rotary extraction using hexane/acetone followed by capillary column gas chromatography with mass spectrometric detection (GC/MS)	EPA 3570/8270
Particle Size Distribution	%	Dry sieving (coarse particles), wet sieving (sand), and the pipette sedimentation method (fine particles)	SSIR-51 METHOD 3.2.1
Moisture Content	%	Determined gravimetrically by drying the sample at 105 °C	CWS for PHC in Soil - Tier 1

2.8.3.3 Data Analysis

Sediment quality data were evaluated relative to BC working sediment quality guidelines (SQG) and, where applicable, the reference area normal range (i.e., the 2.5th and 97.5th percentiles of 2013 and 2015 reference area data reported in the RAEMP for lentic stations; Minnow 2018a). Two levels of guideline are typically defined: a lower SQG and an upper SQG. The lower SQG represents concentrations below which adverse biological effects would not be expected to occur. In contrast, the upper SQGs (i.e., probable effect level [PEL] or severe effect level [SEL]) represent concentrations above which effects may be frequently observed. The SQGs are not based on cause-effect studies, but rather on levels of toxic substances found in the sediment where biological effects have been measured (ENV 2017); such that the exceedance of individual SQGs cannot be interpreted as strong evidence for biological response.

3 STUDY QUESTION #1

3.1 Overview

Data evaluated in this section pertain to study question #1 (What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel?). The following data were collected in support of this question:

- side channel hydrology features (wetted areas, dry sections, braids, isolated pools, and tributary surface connectivity),
- flow in the side channel, and
- water levels in the side channel and main stem Elk River.

3.2 Side Channel Mapping

Monthly surveys of the side channel were used to document wetted areas, dry areas, and isolated pools, and provide monthly estimates of side channel wetted lengths. Side channel wetted lengths included the lengths of wetted isolated pools.

Similar to 2017 (Minnow and Lotic 2018a), in 2018 the Elk River side channel displayed flooding of the floodplain complex during freshet (Appendix Figure A.4), which then receded throughout the summer, and was confined to the channel during summer and fall (Appendix Figures A.1 to A.11). The most downstream section of the side channel (Reach 1) had three larger channels with minor braiding. The middle section (Reach 2) had both lotic and lentic characteristics, depending on the time of year (previously referred to as the “side channel wetland”), and remained wetted all year. The most upstream section (Reach 3) was confined to a single channel at the upstream end of the side channel.

The side channel was completely wetted in 2017 from May to August, and again in 2018 from May to July (Table 3.1; Appendix Figures A.4 to A.6; Minnow and Lotic 2018a). In both 2017 and 2018, Reach 1 (the downstream end of the side channel) began to dry earlier than Reach 3 (Table 3.1), such that the side channel was connected to the main stem Elk River at the upstream end, but not the downstream end. As sections of the side channel dried, isolated pools were formed. In 2017, the first pools were observed in September in Reach 1, which then was fully dry by October (i.e., from the downstream end of Reach 2 to the downstream end of the side channel; Table 3.1; Minnow and Lotic 2018a). In August 2018, the first pools were observed in Reach 1 (Appendix Figure A.7), and by November 2018 all of Reach 1 was dry (Appendix Figure A.10). The side channel was almost completely dry from January to April 2018, with only 2% (<200 m) of the length being wetted (attributable to isolated pools and Reach 2; Table 3.1;

Table 3.1: Monthly Wetted Length Percentage, Elk River Side Channel, 2017 and 2018

Reach	Year	Month	Total Reach Length (m)	Total Wetted Length (m)	Total Wetted Percent (%)
Reach 1[a]	2017	May	3,609	3,609	100
		June		3,609	100
		July		3,609	100
		August		3,609	100
		September		80	2.2
		October		3	<0.1
		November		3	<0.1
		December		14	0.4
	2018	January	3,740	15	0.4
		February		3	<0.1
		March		3	<0.1
		April		10	0.3
		May		3,740	100
		June		3,740	100
		July		3,740	100
		August		3,352	90
		September		1,617	43
		October		1,143	31
		November		3,702	99
		December		3,720	100
Reach 2	2017 - 2018	All year	145	145	100
Reach 3	2017	May	3,396	3,396	100
		June		3,396	100
		July		3,396	100
		August		3,396	100
		September		3,396	100
		October		2,714	80
		November		560	17
		December		932	27
	2018	January		0	0
		February		0	0
		March		0	0
		April		22	0.6
		May		3,396	100
		June		3,396	100
		July		3,396	100
		August		3,396	100
		September		3,396	100
		October		3,396	100
		November		1,458	43
		December		693	20
Total Side Channel	2017	May	7,150	7,150	100
		June		7,150	100
		July		7,150	100
		August		7,150	100
		September		3,621	51
		October		2,862	40
		November		708	10
		December		1,091	15
	2018	January	3,885	160	4
		February		148	4
		March		148	4
		April		177	5
		May		7,281	187
		June		7,281	187
		July		7,281	187
		August		6,893	177
		September		5,158	133
		October		4,684	121
		November		5,305	137
		December		4,558	117

[a] Reach lengths were first determined during the 2017 FHAP assessment (Minnow and Lotic 2018a). In 2017, Reach 1 total length was determined to be 3,609 m (the combined lengths of the east and west channels plus the length of the middle channel and two seepage channels). In 2018, an additional 131 m was added to the Reach 1 total length to reflect the new overflow channel that was discovered in May 2018 west of RG_ERSCDS.

Appendix Figure A.1 to A.3). Throughout 2017 and 2018, Reach 2 remained wetted and received surface water flows from Thompson Creek (Minnow and Lotic 2018a). From fall (starting in October in 2017 and November in 2018) until spring (late April), Reach 2 was not connected to the main stem Elk River or side channel (Table 3.1; Minnow and Lotic 2018a).

3.3 Connectivity to Side Channel

The main stem Elk River flowed overland into the upstream end the side channel from May 2017 to January 2018. From February 2018 to April 2018 Reach 3 was dry and received no inputs from the main stem Elk River. From May 2018 until December 2018, water was flowing from the main stem Elk River into Reach 3. Reach 1 flowed overland into the downstream main stem Elk River from May to August in 2017, and May to July in 2018. Reach 1 was dry (i.e., not flowing) from September 2017 to April 2018 and again from August 2018 until December 2018.

Three of the west-side tributaries (Leask, Wolfram, and Thompson creeks) have the potential to contribute loadings directly to the Elk River side channel (Figure 2.2). From May 2017 to December 2018, Leask Creek Sedimentation Pond was not observed to connect overland to the Elk River side channel during monthly monitoring (Minnow and Lotic 2018a). In contrast, Wolfram Creek (downstream of the sedimentation pond) had an overland connection to the side channel upstream of GH_ER1A in May 2018 (but not from May 2017 through April 2018 and not from June 2018 to December 2018; Minnow and Lotic 2018a). The overland connection appeared to result from backwater and flooding of the adjacent cut block. From June to December 2018, Wolfram Creek (downstream of the sedimentation pond) went to ground where the creek met a logging road (Photo 3.1; Appendix Figures A.1 to A.11). Even when dry overland, water from Wolfram Creek may still be entering the side channel via shallow subsurface pathways. In 2017 and 2018, Thompson Creek surface water flowed into Reach 2 of the side channel via two channels, roughly 25 m apart. Of the two Thompson Creek channels, one was always wetted and flowing, whereas the other was only flowing from May 2017 to July 2018, then was dry for the rest of 2018.

Photo 3.1: Wolfram Creek Goes to Ground Adjacent to a Logging Road (Red Circle)

3.4 Hydrometric and Water Temperature Monitoring

Consistent with monthly survey observations (Section 3.2), level logger data collected in 2018 indicated that water started flowing through RG_ERSCDS on April 26, and the station became dry around August 30; that water started flowing through RG_ER1A around April 24 and the station became dry sometime between October 10 and November 19; and that water started flowing through RG_ERSC4 on April 23 and was still wetted when the level loggers were downloaded in October.

Using level logger data, log-linear stage-discharge curves were created for the three side channel sites (RG_ERSCDS, GH_ER1A, and GH_ERSC4; Figures 3.1 to 3.3). When the water discharge-stage values for GH_ER1A and GH_ERSC4 were plotted against the stage of the Elk River, strong relationships were found (Figures 3.4). The furthest downstream site on the side channel (RG_ERSCDS) had a weaker relationship with the Elk River near Natal stage compared to the two upper sites (Figure 3.4), likely due to the influence of Thompson Creek inputs, and possibly due pooling in the vicinity of this station (SNC-Lavalin 2019).

Hydrographs (displaying discharge rate over time) indicated that the side channel stations and the Water Survey of Canada at Elk River near Natal station (WSC 08NK016) exhibited the same temporal patterns in discharge rate from 2017 to 2018 (Figure 3.5). The timing of peak flows and

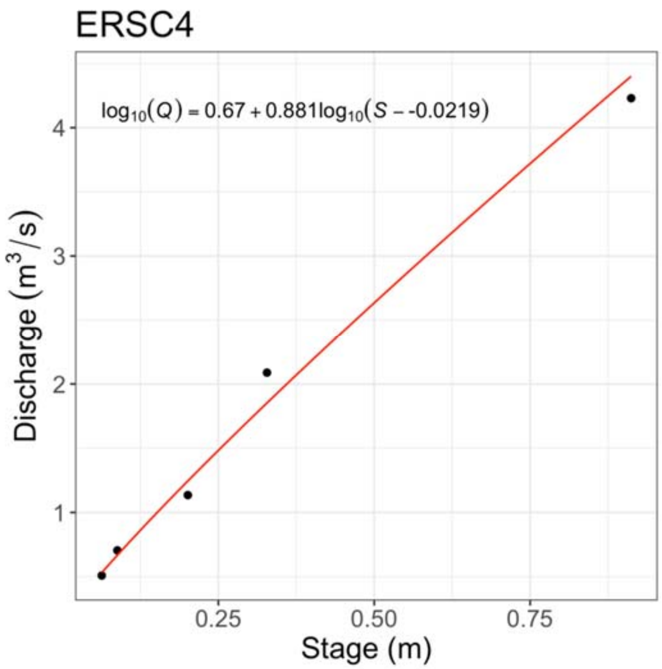


Figure 3.1: Stage-discharge Graph for RG_ERSC4 (Located in Reach 3 of the Side Channel)

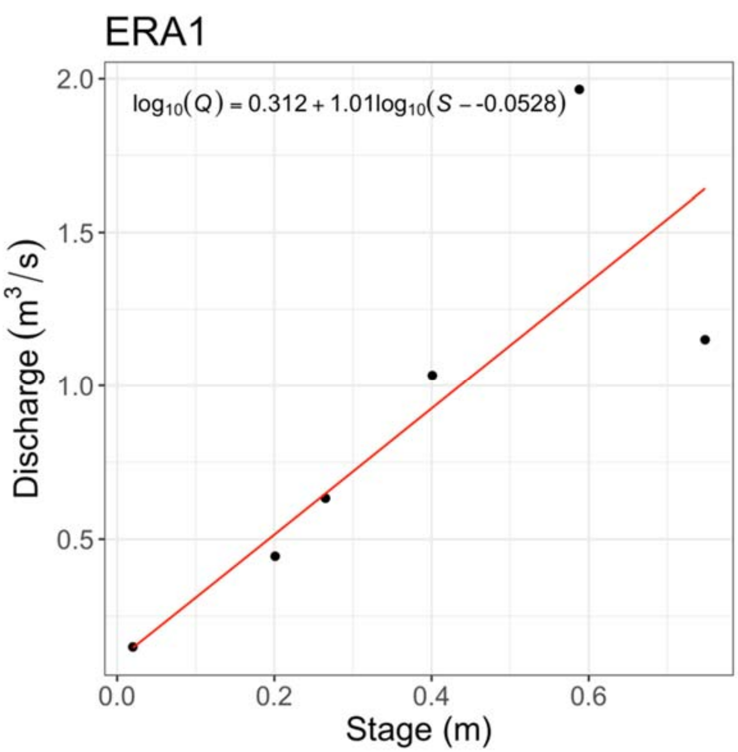


Figure 3.2: Stage-discharge Graph for RG_ER1A (Located in Reach 3 of the Side Channel)

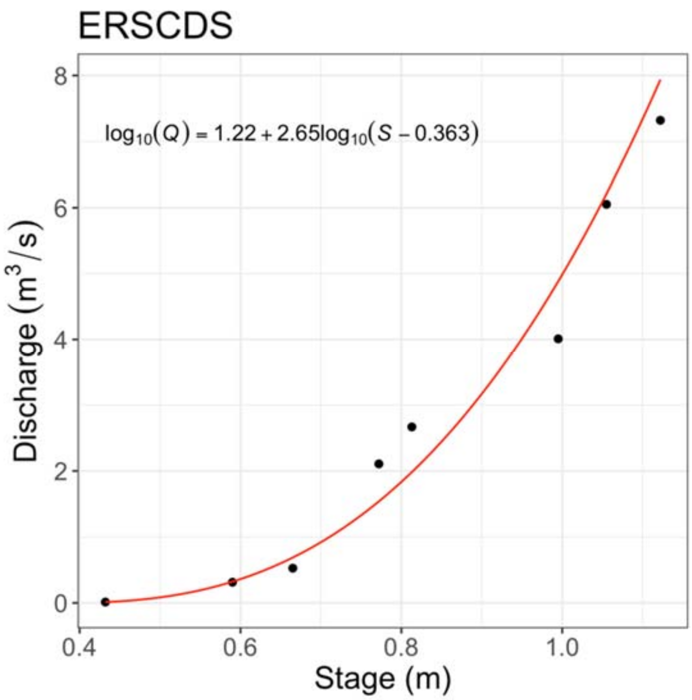


Figure 3.3: Stage-discharge Graph for RG_ERSCDS (Located in Reach 1 of the Side Channel)

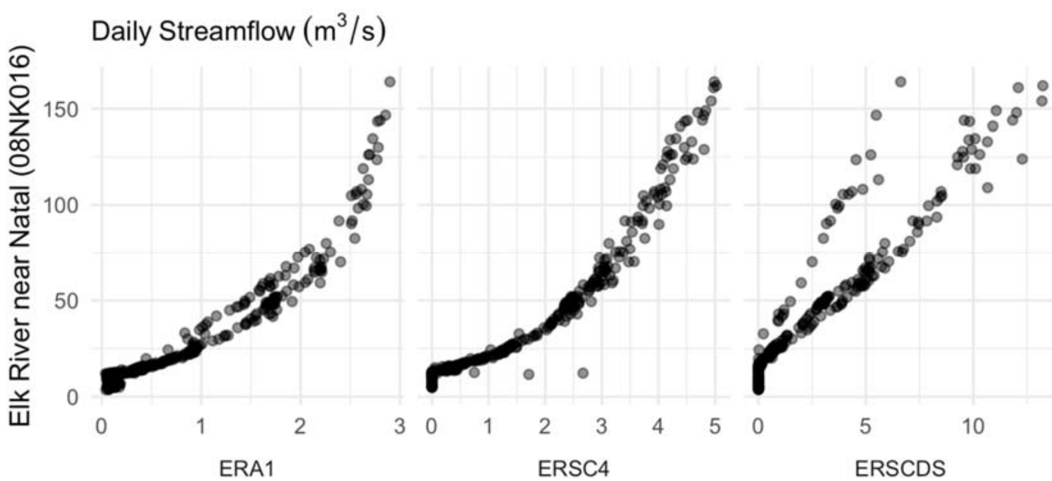


Figure 3.4: Daily Streamflow (Discharge) Comparison between the Side Channel Sites and the Main Stem Elk River (WSC 08NK016)

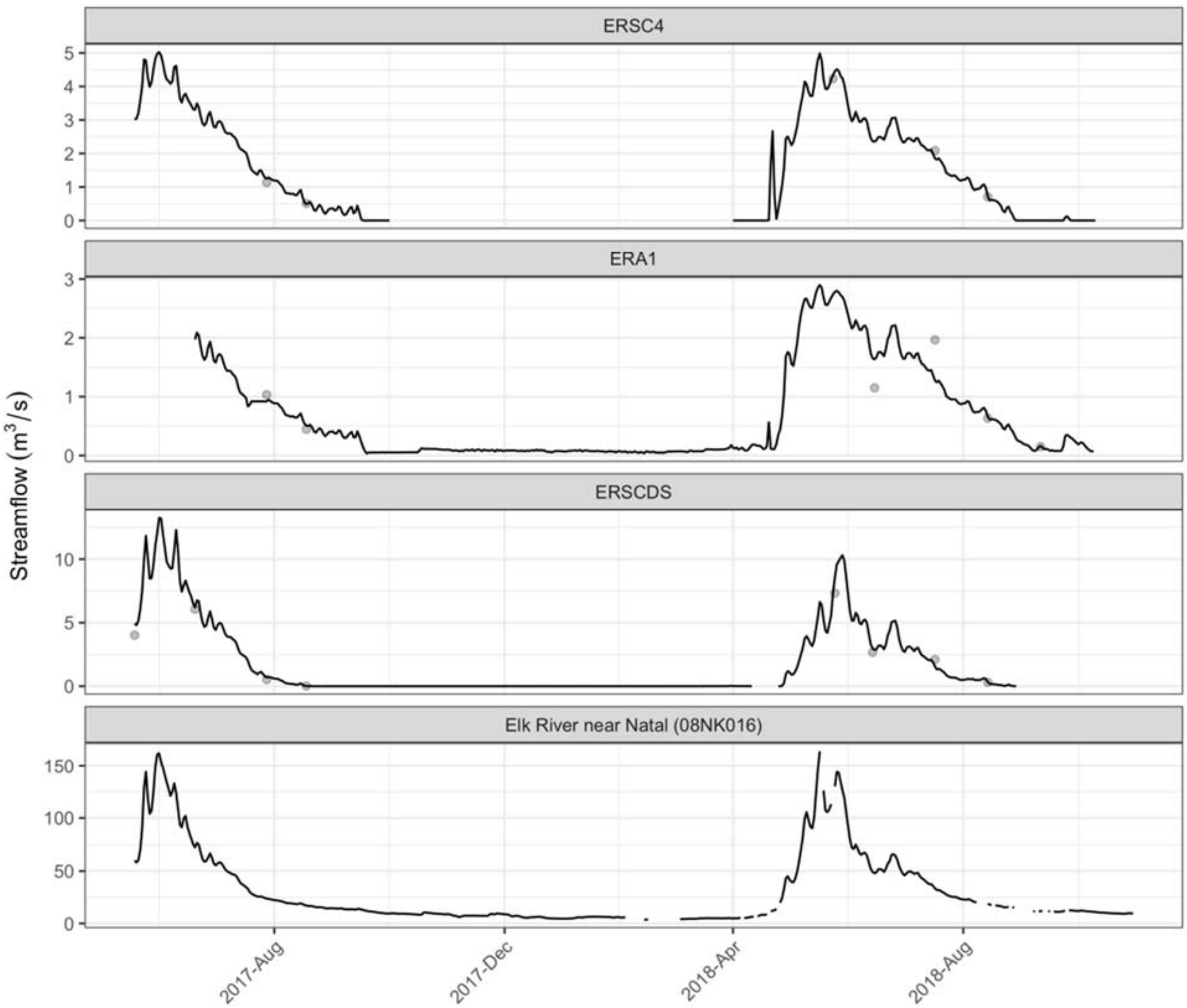


Figure 3.5: Streamflow Comparison between the Side Channel Sites and the Elk River near Natal

low flows generally aligned among stations and between years. Periods when the side channel was dry coincided with the lowest discharge rates in the main stem Elk River.

Overall, 2017 and 2018 data showed strong similarity between discharge rates in the side channel and that within the Elk River.

3.5 Summary

Data collected in 2017 and 2018 answered study question #1 (What is the relationship between flows in the main stem Elk River and flows [including connectivity, intermittence, and pools] in the Elk River side channel?). Flows in the main stem Elk River and flows in the Elk River side channel were strongly correlated. Water from the main stem Elk River flowed overland into the side channel from freshet until winter, during which time, stream flow deceased both in the main stem Elk River and at the three side channel stations. Stream flow was lowest in the main stem Elk River from winter until freshet; at this time the side channel became disconnected from the main stem Elk River and Reaches 1 and 3 slowly dried. Isolated pools were documented as areas dried, but typically persisted for less than a month, suggesting that the pools were stagnant water resulting from dewatering of the side channel. Reach 2 at the confluence of the side channel and Thompson Creek remained wetted throughout the year due to flows from Thompson Creek.

4 STUDY QUESTION #2

4.1 Overview

Data were evaluated to address study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel?). These data provide information about seasonal habitat availability for different biota in the side channel, which gives context for understanding the potential exposure pathways. Habitat data were collected during monthly surveys since May 2017.

4.2 Habitat Availability

The 2018 FHAP survey confirmed the results of the 2017 GHO LAEMP (Minnow and Lotic 2018a; Appendix Figure B.1). Briefly, the fish habitat assessment indicated:

- Reaches 1 and 3 (downstream and upstream of Reach 2, respectively) had riffle-pool morphology;
- Reach 1 had multiple channels, seven pools deeper than 1 m (appropriate for holding adult fish), and only a few areas of suitable salmonid spawning habitat (i.e., substrate was predominantly fines with limited spawning gravel);
- Reach 1 fish habitat quality was considered to be poor-fair and poor-degraded in the main two channels of this reach;
- Reach 3 was a single channel, had 16 pools deeper than 1 m, had a greater proportion of suitable salmonid spawning habitat compared to Reach 1, and overall fish habitat quality was considered to be poor-fair;
- Reach 2 provided overwintering habitat, remained wetted throughout the study period, and consistently received flows from Thompson Creek.

Fish spawning surveys were conducted in spring and fall. Possible redds were observed in September 2017 in Reach 3 (Minnow and Lotic 2018a), but no redds were observed in 2018. Spring spawning surveys were challenging in 2018, as substrate observations were obscured by high turbidity levels in water. The high turbidity was likely caused by overland flows in the surrounding floodplain where there were extensive areas of exposed soil and limited riparian buffer. These floodplain conditions resulted from logging operations that occurred independent of Teck throughout the winter 2017/2018 and spring 2018.

Monthly habitat assessments of available wetted areas were generally consistent from 2017 to 2018 (Minnow and Lotic 2018a; Appendix Figures A.1 to A.11). As noted in Section 3, the entire side channel was swiftly flowing and flooded into the adjacent floodplain complex during the spring. From late summer through winter, Reach 2 was more lentic in character. In August/September of each year, Reach 1 began to dry, while Reach 3 (which is connected to the main stem at the upstream end) remained wetted longer. In September 2017 and 2018, Reach 1 was mostly dry on the first day of the monthly field survey, but had flooded again on the second day of the survey. Damage to the beaver impoundment at the downstream end of Reach 2 was a possible cause. Reach 1 and Reach 3 were predominantly or completely dry from November to April, and covered with snow and ice. As sections of the side channel went dry, isolated pools remained wetted and typically persisted for less than a month. One pool remained wetted all year, providing a small potential overwintering area (rough surface area of 6.7 x 2.5 m, and approximately 0.2 m at the deepest). In 2018, side channel stations and pools were typically well oxygenated (i.e., dissolved oxygen concentrations above the BCWQG value of 5 mg/L) and had appropriate pH for aquatic life (i.e., pH between 6.5 and 9.0; Appendix Tables B.1 to B.16). Overall, most of the isolated pools persisted for less than a month, and therefore offered limited habitat to aquatic dependent biota.

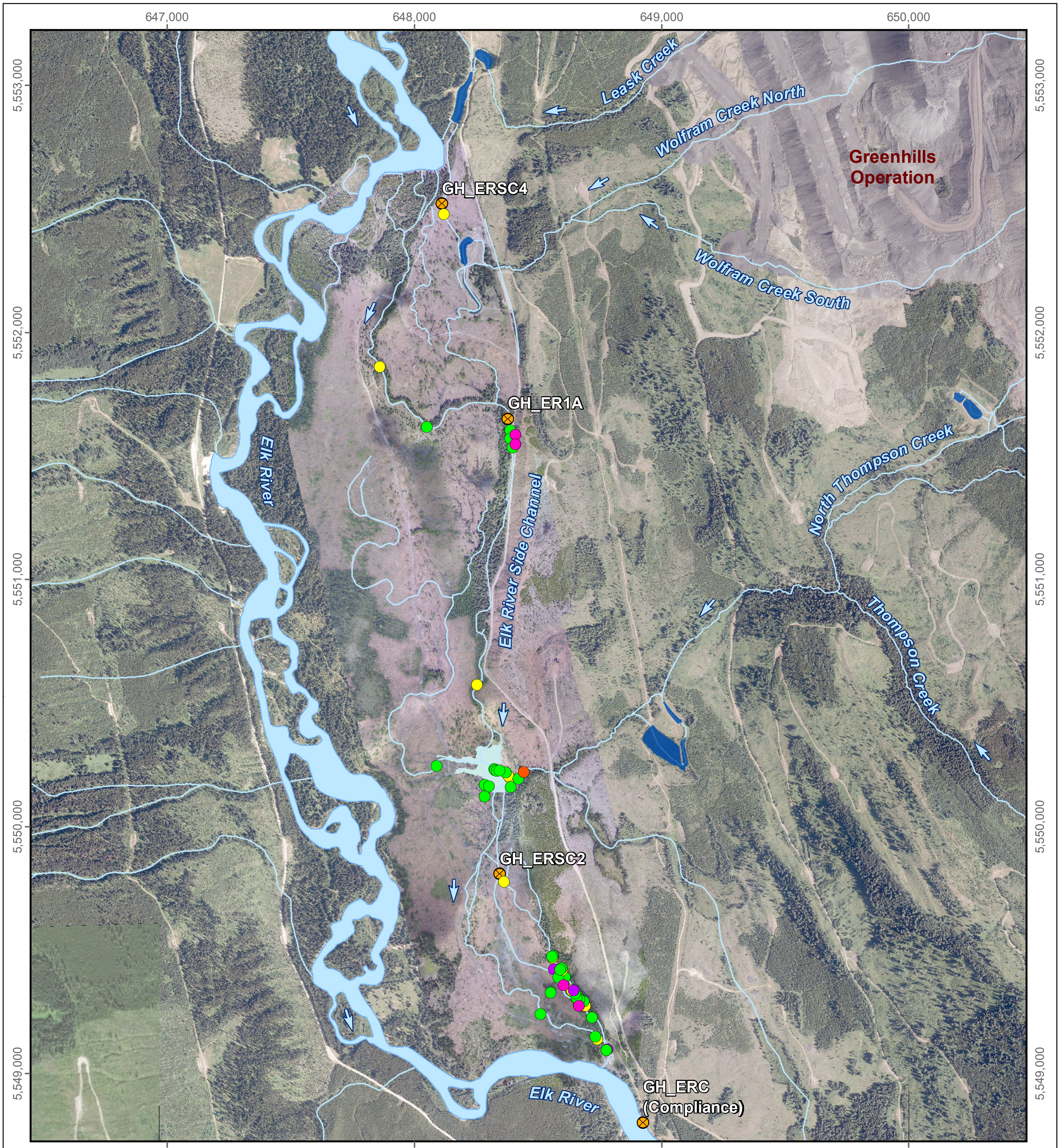
In spring and early summer, high velocity conditions in the side channel resulted in limited lentic habitat for amphibian breeding and early life stages. From spring to fall, side channel connectivity allowed for fish passage from the main stem Elk River. Summer through winter, the wetted areas of the side channel provided suitable habitat for fish, adult amphibians, and aquatic-dependent birds. Wetted habitat was sparse in fall and winter. Reach 2 provided the greatest amount of aquatic habitat, as it was wetted all year.

4.3 Distribution of Biota

Aquatic dependant biota observed in and along the Elk River and the Elk River side channel during monthly surveys were documented (Appendix Tables B.17 to B.19). Distribution maps were created to assist with visualizing the distribution of biota (Figures 4.1 to 4.3), which include observations from the 2017 GHO LAEMP (Minnow and Lotic 2018a) and integrate observations from the Lentic Area Supporting Study (see Section 8 herein). Snow and ice covering the stream from January to April, and November to December made it more difficult to observe fish.

The side channel was being used by a variety of fish species (i.e., bull trout, eastern brook trout, longnose sucker, mountain whitefish, and westslope cutthroat trout; Figure 4.1; Appendix Table B.17). As flows decreased in the side channel, isolated pools were found to contain stranded fish. Most fish observed were in the fry or juvenile age classes, and mountain whitefish fry were the most abundant fish observed.

Adult amphibians (Columbia spotted frog, western toads, and long-toed salamanders) were observed throughout the side channel, with the majority of observations occurring in Reach 1 and Reach 2 from June to September (Figure 4.2; Appendix Table B.18). Western toads were the



LEGEND

- Mountain Whitefish
- Unidentified
- Westslope Cutthroat Trout
- Longnose Sucker
- Eastern Brook Trout
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond
- Semi-lentic Area

Fish Observations, May 2017 to December 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
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Figure 4.1

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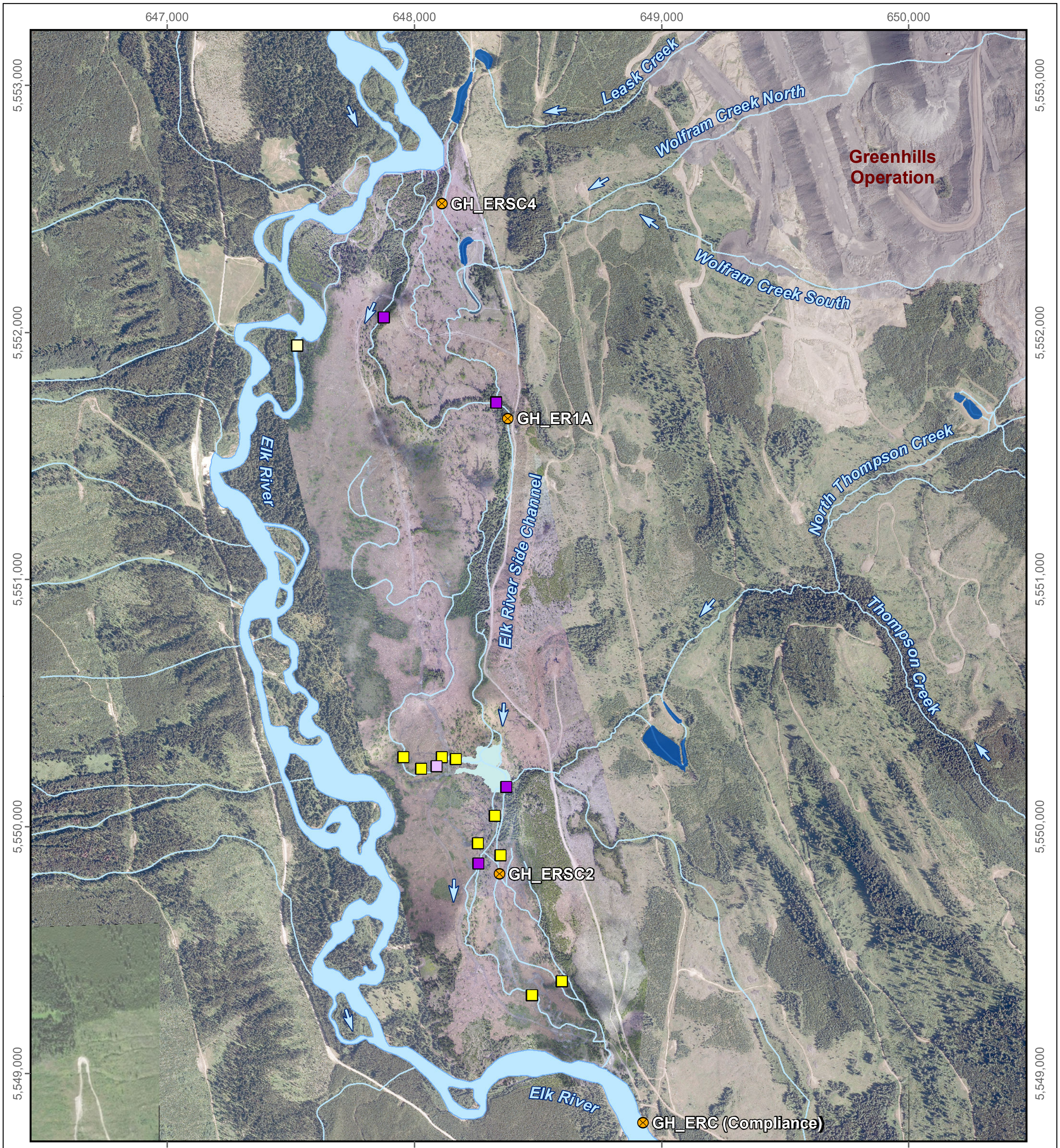

LEGEND

- Long-toed Salamander
- Columbia Spotted Frog
- Unidentified Frog/Toad
- Western Toad
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond
- Semi-lentic Area

Amphibian Observations, May 2017 to December 2018

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11
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Figure 4.2

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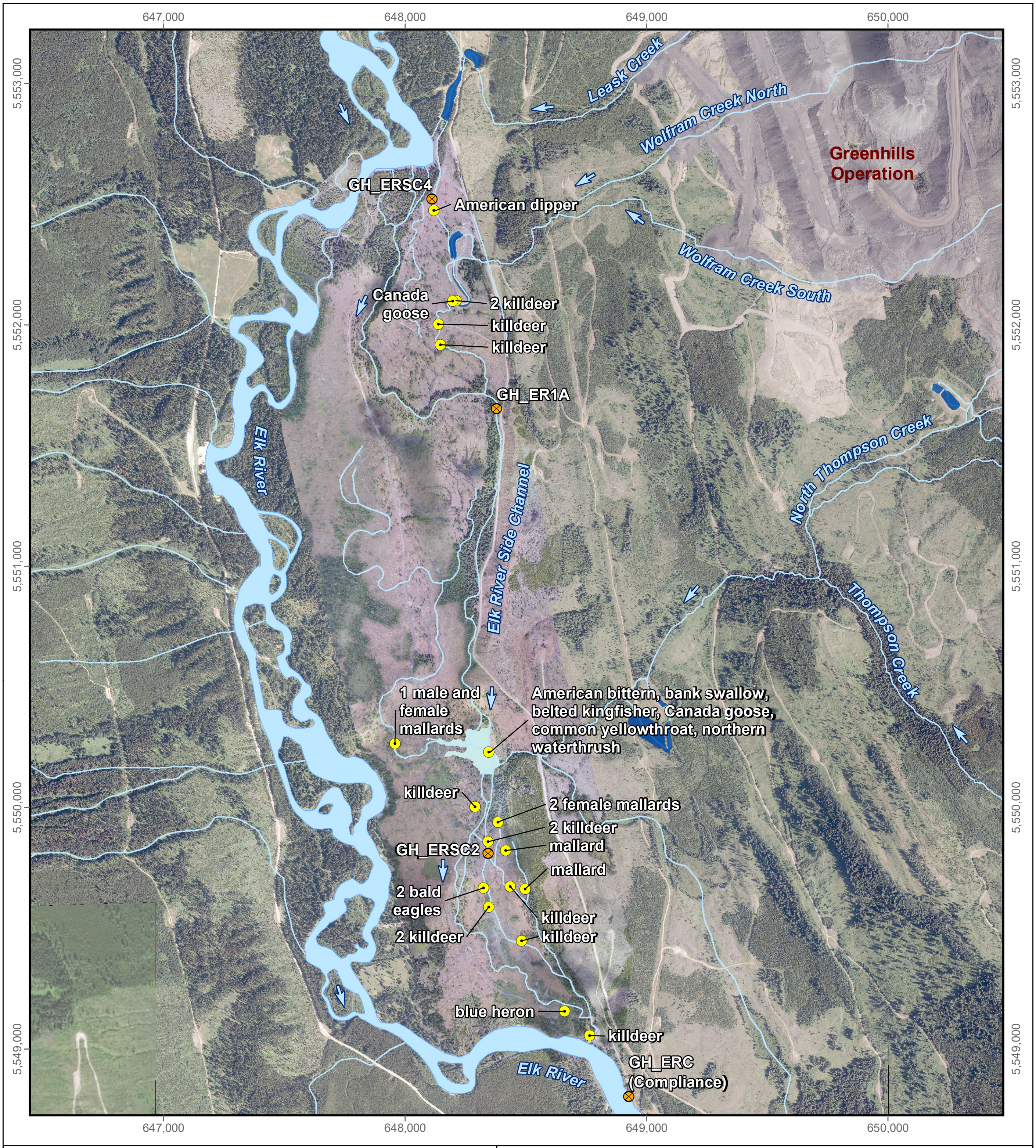

LEGEND

- Aquatic-dependent Bird Observation
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- Settling Pond
- Semi-lentic Area

Bird Observations, May 2017 to December 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

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Figure 4.3

most common amphibian species, being observed nine times during the two years of study (Appendix Table B.18). In September 2018, 10 larval-stage long-toed salamanders were found stranded and dead in a dewatered section at the edge of the wetted area of Reach 2.

Aquatic-dependent birds were also observed throughout the side channel in spring and summer (Figure 4.3; Appendix Table B.19). Species detected using visual and auditory surveys included: American bittern, American dipper, bald eagle, bank swallow, belted kingfisher, blue heron, Canada goose, common yellowthroat, killdeer, northern waterthrush, spotted sandpiper, and mallard. Killdeer, bank swallow, and Canada goose were the most common bird species observed (respectively nine, eight, and eight individuals observed over two years of monitoring).

4.4 Summary

Observations from 2017 and 2018 were generally consistent, and answered study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel?). The side channel was flowing and connected to the main stem Elk River from spring to summer. Starting in September of both years, the downstream end of the side channel was dry. Later in the fall, the side channel sections downstream and upstream of Reach 2 were dry and remained dry throughout the winter. Reach 2 remained wetted throughout both years of the study and consistently received flows from Thompson Creek, providing some lentic habitat in the fall and winter. Additional sparse/patchy habitat was provided by ephemeral isolated pools that were created as the side channel dried, and typically persisted for less than a month.

Reach 2 was not considered suitable breeding habitat for amphibians, as much of the side channel and floodplain complex were flooded and swiftly flowing in the spring and early summer. However, a few adults were observed throughout the side channel in late spring and summer. Suitable habitat was available for all life stages of fish and aquatic-dependent birds in the side channel and floodplain complex from spring through fall, as well as in Reach 2 during winter.

5 STUDY QUESTION #3

5.1 Overview

Data evaluated in this section are related to study question #3:

What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?

a. What is the water quality in the west-side tributaries, and how is it changing over time?

b. What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?

c. What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?

d. What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates (i.e., fish, amphibians, and aquatic-feeding birds)?

Evaluation of water quality included assessment of constituents with early warning triggers (EWTs; i.e., dissolved cadmium, nitrate, total selenium, sulphate, 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) and total mercury. Total mercury data were included because concentrations were occasionally greater than the BCWQG in 2017 and 2018 (Teck 2018b and 2019b), and additional screening was requested by the EMC in the review of the 2017 GHO LAEMP. However, separate evaluation of methyl mercury and total mercury data collected over the 2015 to 2018 period concluded that mercury concentrations observed in the Elk Valley are not mining related (Teck 2019a). Therefore, future water quality assessments for the GHO LAEMP will not include total mercury.

5.2 West-side Tributaries

When flowing, Branch F, Wolf, Willow, Wade, Cougar, and No Name creeks flowed into the Elk River upstream from the Elk River side channel (Figure 2.2). The downstream ends of Mickelson and Leask creeks are sedimentation ponds that did not connect overland to the Elk River or Elk River side channel from May 2017 to December 2018 (Figure 2.2, Appendix Figures A.1 to A.11; Minnow and Lotic 2018a); instead, loading likely occurred through groundwater flow paths (SNC-Lavalin 2019). Wolfram Creek (downstream of the sedimentation pond) connected to the side channel overland during May 2018 only (Section 3.3). Thompson Creek flowed into Reach 2 of the Elk River side channel all year, located downstream of GH_ER1A and upstream of GH_ERSC2 (Figure 2.2).

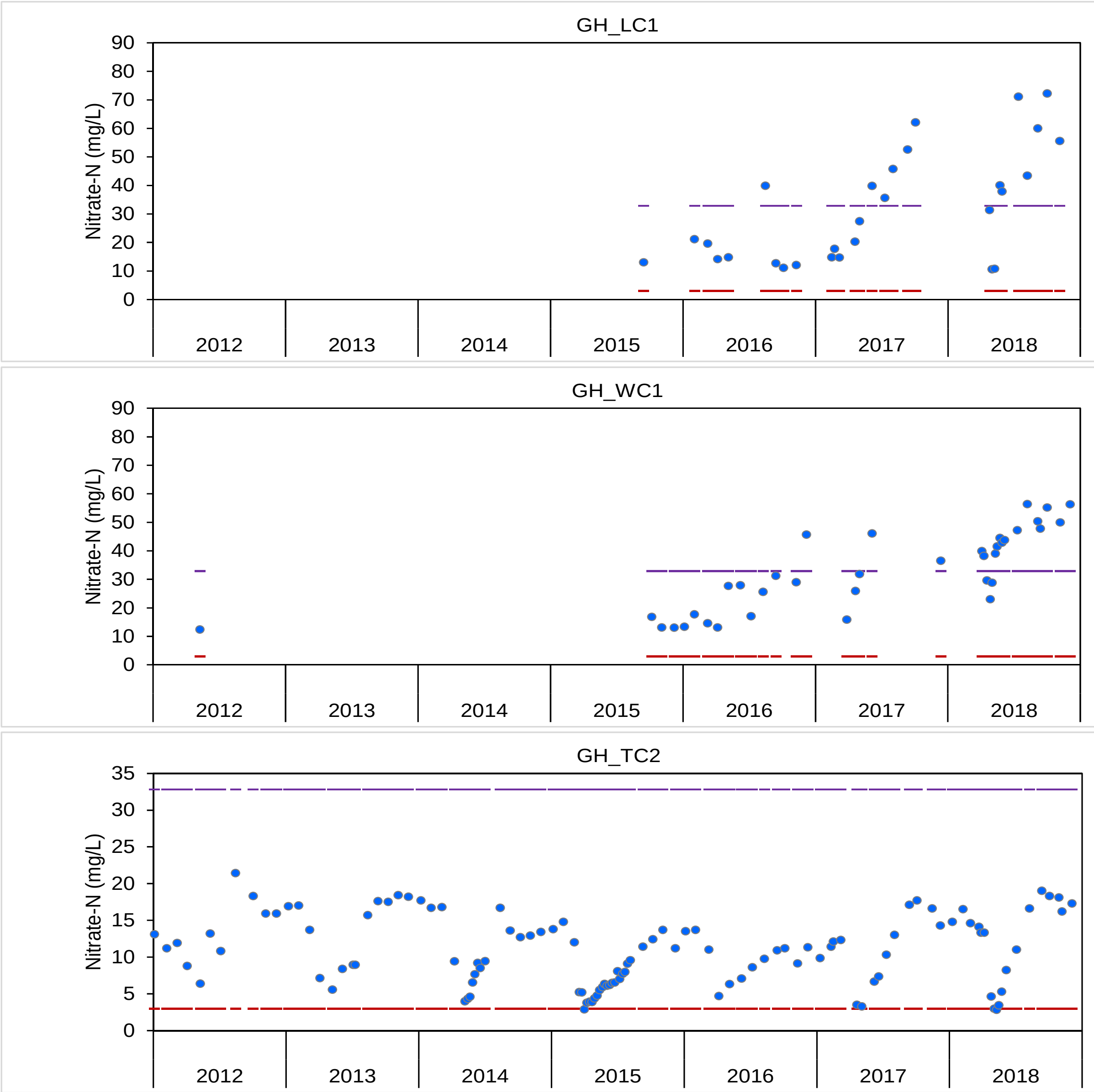
Water quality data from 2018 for the west-side tributaries were compared to applicable BCWQG and benchmarks (Appendix Table C.1; Appendix Figures C.1 to C.17 and C.35 to C.51). In each of the west-side tributaries, concentrations were always or typically below applicable guidelines and benchmarks for dissolved oxygen, pH, alkalinity, ammonia, total beryllium, total chloride, total fluoride, total antimony, total arsenic, total barium, total boron, total chromium, total cobalt, total copper, total iron, total lead, total lithium, total manganese, total molybdenum, total sliver, total thallium, total zinc, dissolved cadmium, dissolved cobalt, and dissolved iron (Appendix Table C.1). Total mercury was frequently above the BCWQG in tributaries (Appendix Table C.1); however, concentrations were generally within range of the upstream main stem reference station (Appendix Figure C.37). Water quality in Leask (GH_LC1, GH_LC2), Wolfram (GH_WC1, GH_WC2), and Thompson (GH_TC1, GH_TC2) creeks indicated mine influence based on concentrations of total dissolved solids, nitrate, sulphate, total nickel, and total selenium (Appendix Table C.1), which were frequently above BCWQG and/or applicable benchmarks or screening values (Appendix Table C.1; Appendix Figures C.2, C.3, C.4, C.12, and C.14).

Water quality of the west-side tributaries was qualitatively assessed for temporal trends using data from January 2012 to December 2018, as available (Appendix Figures C.19 to C.36). Generally, there were no obvious long-term temporal trends, with the exception of increasing nitrate and total selenium at Leask, Wolfram, and Thompson creeks since 2016 (Figures 5.1 and 5.2). In 2018, concentrations of nitrate were typically above the short-term BCWQG for Leask and Wolfram Creeks (but not Thompson Creek), while concentrations of total selenium were typically above the EVWQP level 2 benchmark in the three creeks (Figures 5.1 and 5.2).

5.3 Side Channel Monitoring Stations

In 2018, most water quality constituents were lower than BCWQG and/or applicable benchmarks in the side channel monitoring stations (i.e., GH_ERSC4, GH_ER1A, GH_ERSC2), with the exception of total mercury and total selenium (Appendix Table C.2, Appendix Figures C.18 to C.51). Concentrations of total mercury were generally within range of the upstream main stem reference station (Appendix Figures C.34 and C.52). Concentrations of total dissolved solids, nitrate, sulphate, and total selenium generally increased from GH_ERSC4 to GH_ER1A to GH_ERSC2 (i.e., from upstream to downstream) likely associated with the influence of Wolfram and Thompson creeks (Figure 5.3; Appendix Table C.2; Section 5.2). There were no obvious long-term temporal trends from 2015 to 2018 (Appendix Figures C.19 to C.36).

Water quality in the side channel stations was also compared to the main stem stations upstream (GH_ER2) and downstream (GH_ERC) of the side channel, using data from 2016 to 2018.



= BCWQG (long term) and the Level 1 Benchmark; = BCWQG (short term).

Figure 5.1: Time Series Plots for Aqueous Nitrate-N Concentrations from Mine-exposed Tributary Stations in Leask Creek (GH_LC1), Wolfram Creek (GH_WC1), and Thompson Creek (GH_TC2), 2012 to 2018

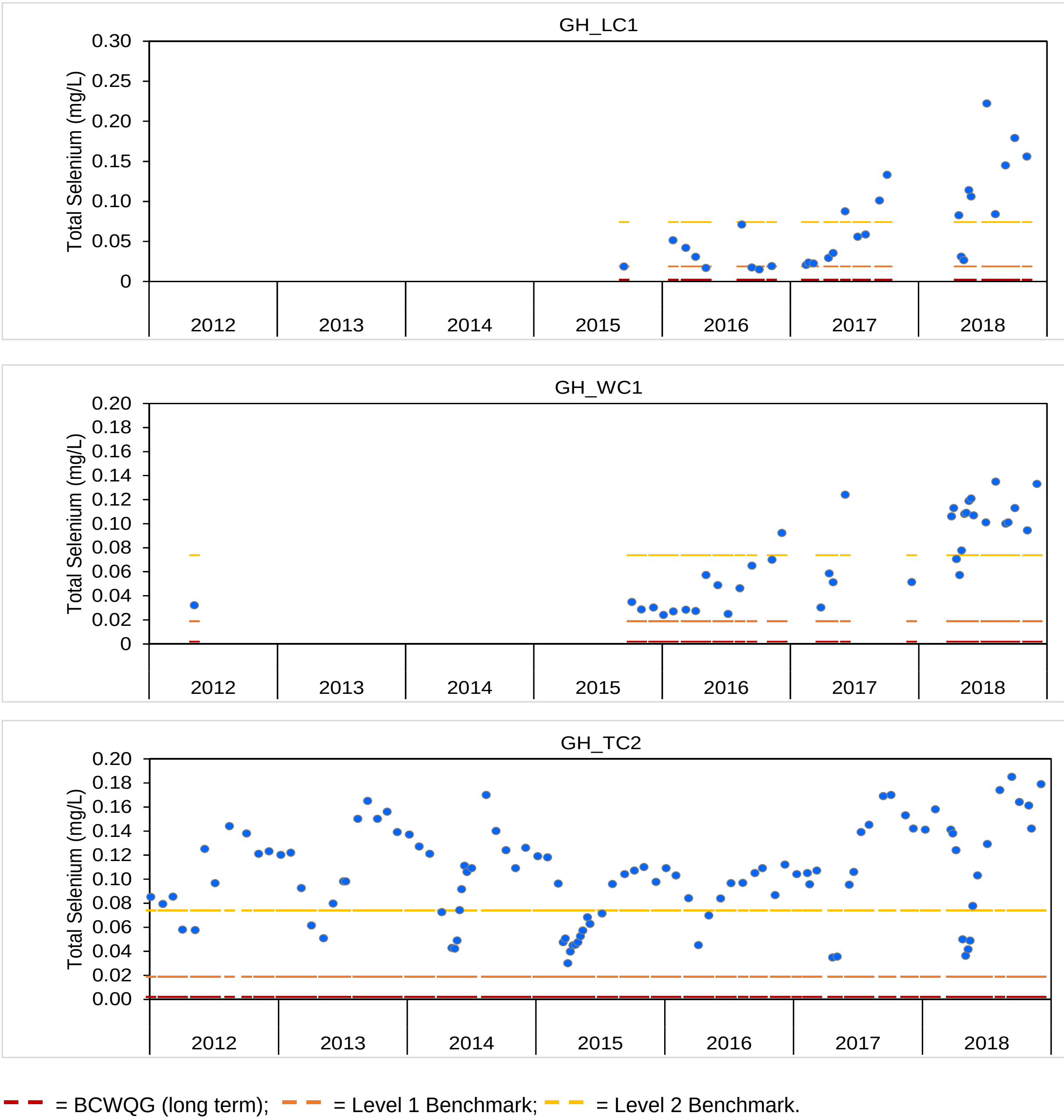
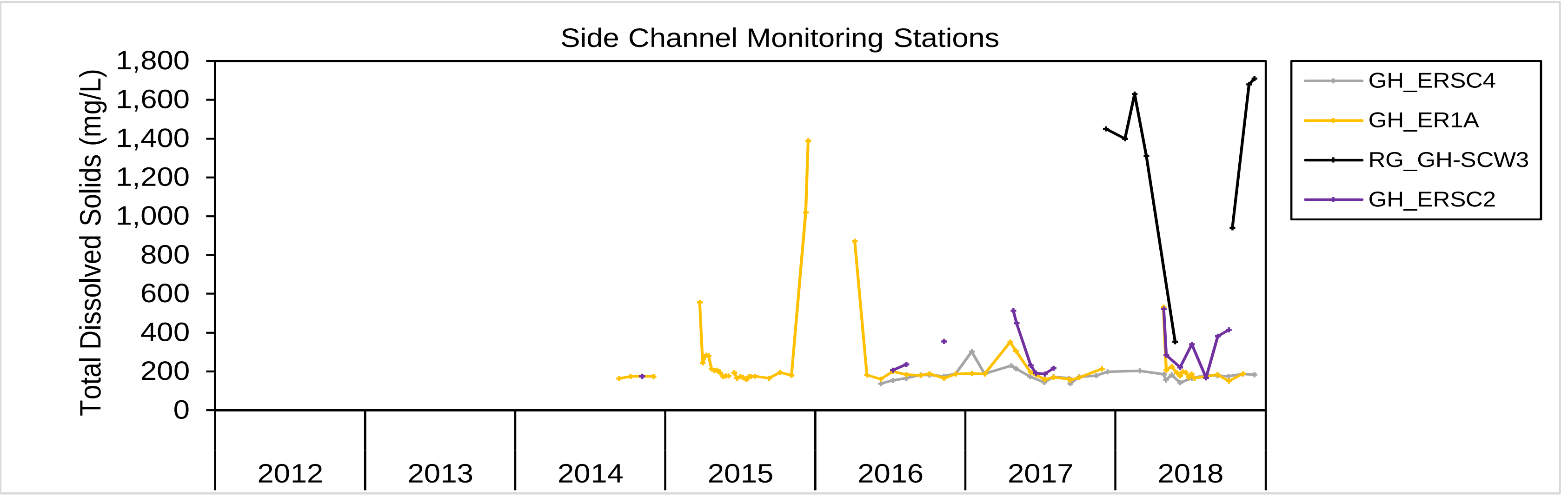
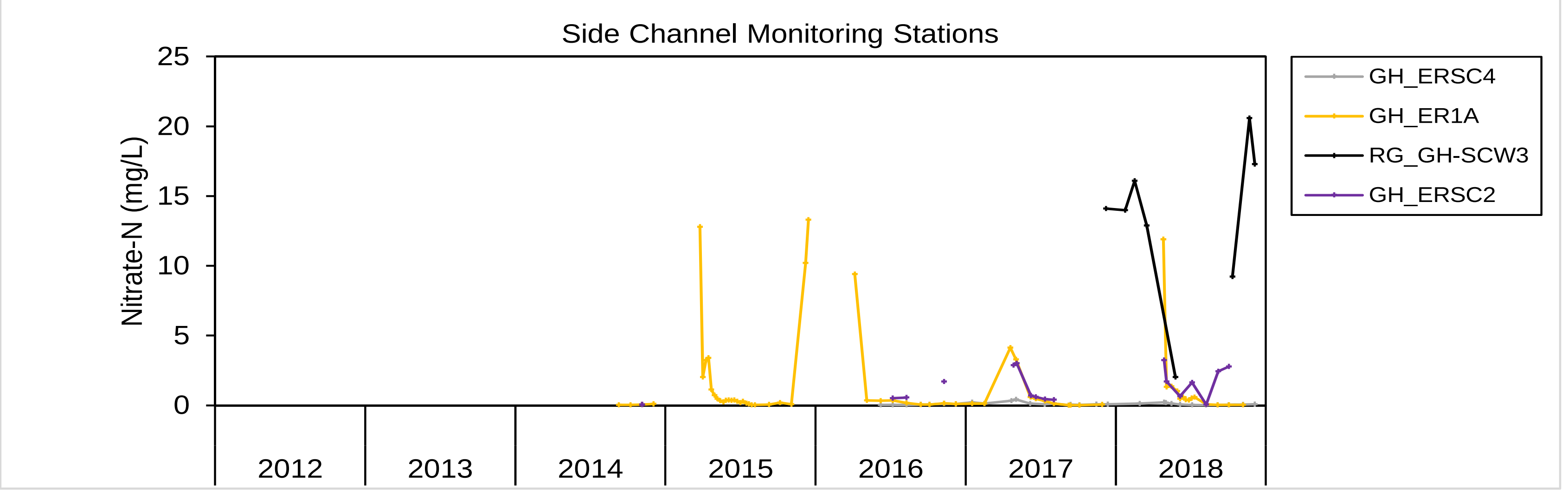
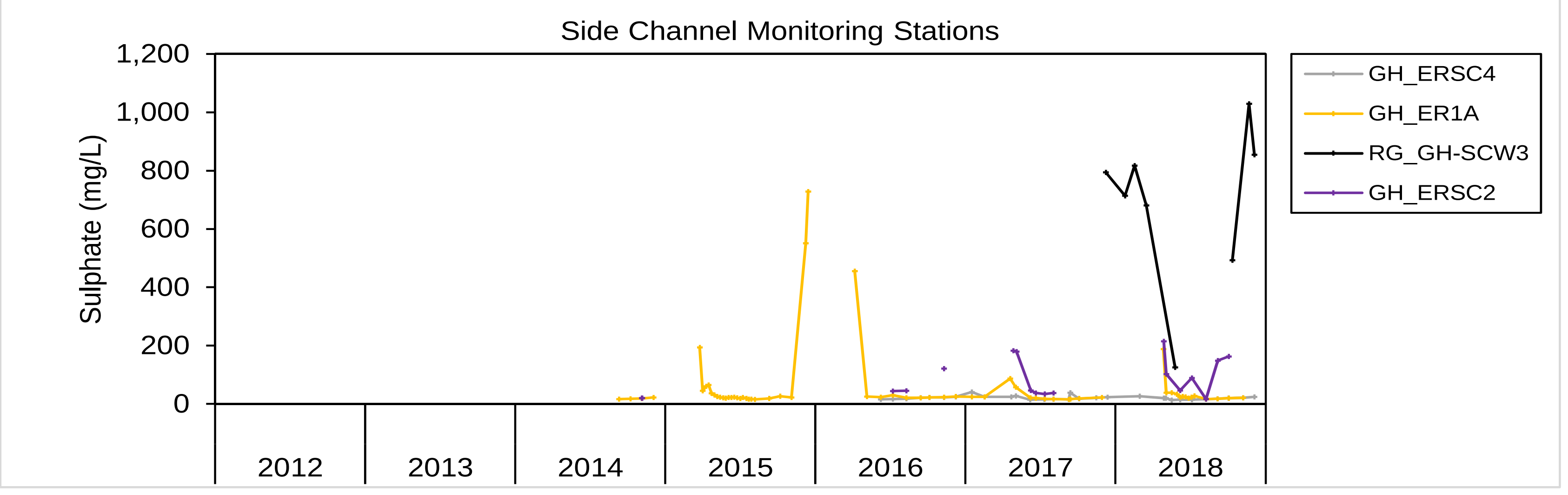


Figure 5.2: Time Series Plots for Aqueous Total Selenium Concentrations from Mine-exposed Tributary Stations in Leask Creek (GH_LC1), Wolfram Creek (GH_WC1), and Thompson Creek (GH_TC2), 2012 to 2018







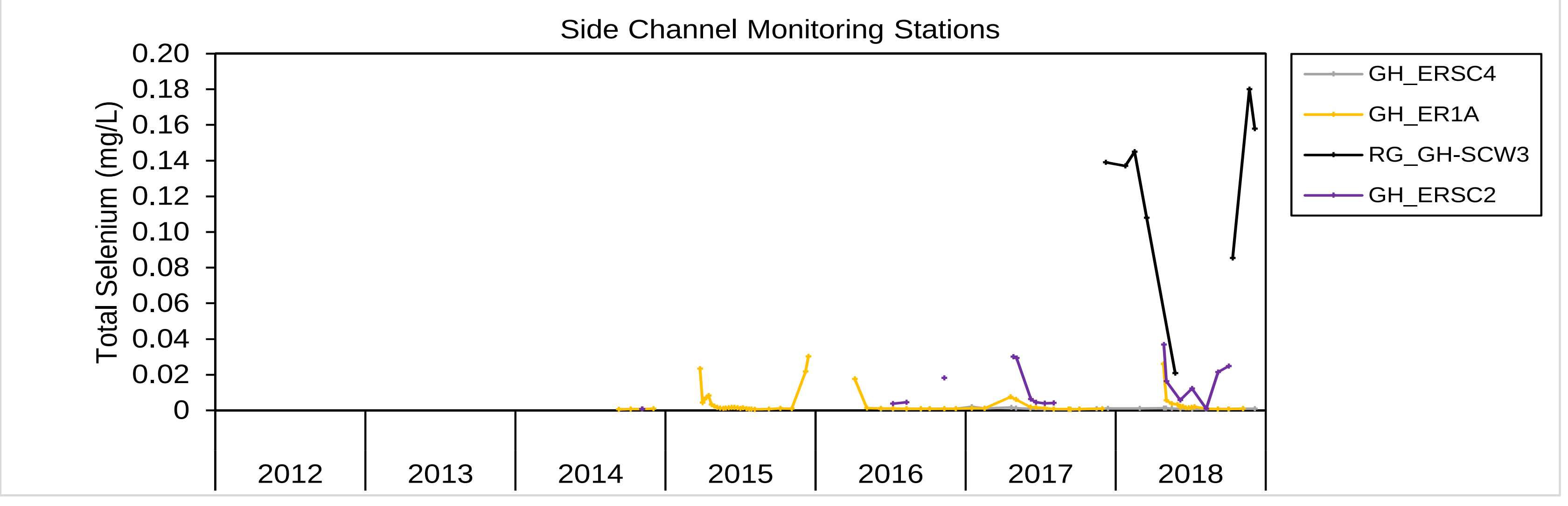


Figure 5.3: Times Series Plots for Aqueous Total Dissolved Solids, Nitrate, Sulphate, and Total Selenium for Side Channel Monitoring Stations, 2012 to 2018

Concentrations of constituents with EWTs were typically higher in the side channel compared to the upstream main stem reference station (GH_ER2), with nitrate, nitrite, sulphate, total dissolved solids, dissolved cadmium, total lithium, and total selenium having the greatest magnitude of difference (Appendix Table C.3). At the most upstream side channel station (GH_ERSC4, which is upstream of the influence of Wolfram and Thompson creeks), nitrate, sulphate, total dissolved solids, total lithium, and total selenium were significantly less than concentrations at the downstream main stem station (GH_ERC; Appendix Table C.4). Station GH_ER1A was not significantly different from GH_ERC for constituents with EWTs and total mercury (Appendix Table C.4). At the most downstream side channel station (GH_ERSC2), nitrate, sulphate, total dissolved solids, dissolved cadmium, total lithium, total selenium, and total uranium were significantly greater than downstream GH_ERC (Appendix Table C.4). This is likely a result of GH_ERSC2 being more directly influenced by surface water flows from Thompson Creek, and possibly through groundwater.

5.4 Reach 2

In 2018, concentrations of constituents with EWTs and total mercury were below applicable BCWQG and/or benchmarks at RG_GH-SCW3, except for total dissolved solids, nitrate, sulphate, total chromium, total iron, total mercury, total selenium, and total uranium (Appendix Table C.2). Total chromium, total iron, and total mercury each only exceeded the BCWQG in one out of seven samples (Appendix Table C.2).

For most constituents with EWTs, concentrations were typically higher at RG_GH-SCW3 compared to the lotic side channel stations located upstream (GH_ER1A) and downstream (GH_ERSC2), likely due to the influence of surface water flows via Thompson Creek, and possibly through groundwater (Figure 5.3; Appendix Table C.2; Appendix Figures C.18 to C.34). There were no obvious long-term temporal trends in water quality at RG_GH-SCW3 (Appendix Figures C.18 to C.34).

5.5 Main Stem Elk River Downstream versus Upstream of the West-Side Tributaries

Data from 2016 to 2018 for the monitoring station in the main stem Elk River downstream of the west side tributaries (GH_ERC) was compared to the Elk River station upstream of mine influence (GH_ER2) to assess the overall influence of GHO on water quality in the upper Elk River (Figure 2.2). Concentrations of constituents with EWTs were below applicable BCWQG and benchmarks, with the exception of total beryllium, total chromium, total iron, total nickel, and total selenium (Appendix Table C.5). Total chromium, total iron, and total mercury were greater than BCWQG, benchmarks or screening values at both the downstream and upstream stations, suggesting these constituents are naturally elevated (Appendix Table C.5).

Concentrations at the downstream station (GH_ERC) were significantly greater than at the reference station (GH_ER2; Appendix Table C.6) for nitrate, sulphate, total dissolved solids, dissolved cadmium, total barium, total lithium, total mercury, total molybdenum, total selenium, and total uranium due to the influence of GHO via the west-side tributaries. There were no obvious long-term temporal trends in water quality at the main stem Elk River stations (Appendix Figure C.37).

5.6 Isolated Pools

Flow in the Elk River side channel was observed to vary on a seasonal basis in both 2017 and 2018 (Minnow and Lotic 2018a). In spring, portions of the channel overflowed and flooded the adjacent forest, resulting in surface connectivity to the main stem Elk River. Conversely, by fall, water levels were much lower and there was no longer surface flow connecting to the main stem Elk River, resulting in the formation of isolated pools (Figure 2.2).

Sixteen isolated pools were sampled for water quality in 2018. Most pools existed for less than a month and thus were only sampled once. Pools SC2-P3 and SC2-P2, which are located at the downstream end of the side channel and upstream from the confluence with the main stem Elk River (Figure 2.2), persisted from September 2018 through December 2018. Concentrations of constituents with EWTs in isolated pools were typically below applicable BCWQG and/or benchmarks, with the exception of nitrate, total selenium, sulphate, and total dissolved solids, which were frequently greater in pools downstream of the confluence with Thompson Creek and GH_ERSC2 (Figure 2.2; Appendix Figures C.53 to C.69). Pools located upstream of Reach 2 generally had water quality comparable to GH_ERSC4 and GH_ER1A (Appendix Figures C.53 to C.69). Overall, most of the isolated pools persisted for less than a month, and therefore, despite higher concentrations of some constituents, are likely a minor exposure pathway to aquatic-dependent biota.

5.7 Summary

Water quality in the more northern west-side tributaries (i.e., Branch F, Wolf Creek, Willow Creek, Wade Creek, Cougar Creek, No Name Creek, and Mickelson Creek) was typically below BCWQG and/or applicable benchmarks, with the exception of total mercury, which frequently exceeded the BCWQG, but was generally within range of the upstream main stem reference station and therefore not mine influenced. Water quality in Leask, Wolfram, and Thompson creeks showed evidence of mine influence based on concentrations of total dissolved solids, nitrate, sulphate, total nickel, and total selenium, which were frequently above BCWQG and/or applicable benchmarks/screening values. Nitrate and total selenium concentrations appeared to be increasing at Leask and Wolfram creeks from 2016 to 2018.

Water quality at side channel stations GH_ER1A and GH_ERSC2 was influenced by Wolfram and Thompson creeks, showing occasional concentrations of nitrate, total chromium, and total selenium that were greater than BCWQG and/or applicable benchmarks. The highest concentrations of mine-related constituents occurred in Reach 2 at the confluence of Thompson Creek and the Elk River side channel. Side channel stations showed no obvious temporal trends from 2015 to 2018. Water quality at side channel station GH_ER1A was comparable to the downstream main stem Elk River station, whereas further downstream at side channel station GH_ERSC2, concentrations of some mine-related constituents were higher than the downstream main stem Elk River station (due to the influence of Thompson Creek).

Water quality in the main stem Elk River station downstream of the side channel had higher concentrations of nitrate, sulphate, total dissolved solids, dissolved cadmium, total barium, total lithium, total mercury, total molybdenum, total selenium, and total uranium relative to the main stem upstream reference station. However, concentrations of constituents in the main stem Elk River stations were below BCWQG and/or applicable benchmarks/screening values, with the exception of selenium. No obvious long-term temporal trends were noted.

The Elk River side channel has been observed to have highly variable flow throughout the year, with the creation of isolated pools during drier months. Water quality in these pools was highly dependent on location. Pools located upstream of Reach 2 had water quality comparable to GH_ERSC4 and GH_ER1A, whereas pools downstream of Reach 2 exhibited influence from Thompson Creek. Pools downstream of Reach 2 had concentrations of nitrate, total selenium, sulphate, and total dissolved solids that were frequently higher than BCWQG and/or benchmarks/screening values.

6 STUDY QUESTION #4

This section relates to study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?). A hydrogeological review and analysis of available groundwater and surface water data was conducted by SNC-Lavalin in 2019, using data from the west side of GHO along the Elk River side channel. Detailed interpretation and conclusions are provided in Appendix D (SNC-Lavalin 2019), and a brief summary is provided below.

Groundwater sampled from monitoring wells in the vicinity of Leask, Wolfram, and Thompson creeks indicate influence of mine-influenced surface water. Water quality data from the monitoring wells near Leask Creek and Thompson Creek indicated a greater proportion of the Elk River water and less mine-influenced surface water in recent years compared to previous years. Conversely, the water quality data from the monitoring well near Wolfram Creek indicated greater influence of mine-influenced surface water in 2017 and 2018 compared to previous years. Groundwater chemistry from the monitoring well located downstream of the Elk River side channel was consistent with Elk River water chemistry, and suggested only periodic mine influence. The cause of periodic mine influence at this well is unknown at this time.

Water from the Elk River is interpreted to influence surface water quality along the side channel. Surface water from the side channel is inferred to recharge groundwater across the length of the side channel, with the exception of localized areas of potential groundwater discharge. Increasing concentrations of constituents of interest along the side channel flow path were inferred to result predominantly from loading from mine-exposed tributaries, which feed into the side channel. Leask Creek was not observed to connect overland to the side channel during monthly monitoring, and Wolfram Creek only connected overland during May 2018 (Section 3.3), indicating that surface water from these creeks infiltrates to ground. Concentrations of constituents of interest and major ion chemistry indicate that inputs to the side channel from mine-influenced groundwater originating from the Leask Creek drainage is minimal. During Wolfram Creek peak flows, mine-influenced water from the Wolfram Creek drainage is inferred to influence side channel surface water quality, likely occurring predominantly through groundwater flow paths.. Mine-influenced Thompson Creek was a permanent source of surface water to the side channel; however, there may also be a contribution from mine-influenced groundwater in this area. Groundwater from the Thompson Creek drainage may also be influencing Reach 2.

Based on water chemistry of mine-related constituents as well as major ion chemistry, most isolated pools in the side channel were interpreted to result from natural dewatering of the side channel (i.e., recharging groundwater) and not from groundwater discharge. The possible exception to this is pool SC2-P3 (referred to as Pool-E-7 in Minnow and Lotic 2018a, and

SNC-Lavalin 2019), which is located at the downstream end of the side channel, roughly 77 m from the main stem Elk River. Pool SC2-P3 remained wetted year-round and had elevated concentrations of mine-related constituents, suggesting groundwater discharge may be occurring, possibly originating from the Thompson Creek drainage (the closest west-side tributary).

Overall, the hydrogeological review indicated some gaps and uncertainties associated with addressing study question #4 (SNC-Lavalin 2019), which were used to provide recommendations for future monitoring (Section 9.2).

7 STUDY QUESTION #5

7.1 Overview

Data evaluated in this section pertain to study question #5: What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?

7.2 Benthic Invertebrate Community Composition

Benthic invertebrate community samples were compared between and within stations in the main stem Elk and Elk River side channel (Figure 2.1 and 7.1; Appendix Table E.1). In general, community endpoints did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC), and side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC), except for a greater proportion of Coleoptera in samples from the side channel. Compared to the main stem and side channel stations, the sample collected from Thompson Creek (RG_THCK) had a much greater proportion of Coleoptera and no Ephemeroptera (Figure 7.1). Percent Diptera was higher in the main stem downstream of the side channel compared to the main stem reference station in two out of five samples (Figure 7.2).

At all main stem and side channel stations, total abundance, LPL richness, % EPT, % Ephemeroptera (% E), % Plecoptera (% P), and % Trichoptera (% T) were within or above the normal range (Figures 7.3 to 7.5). Total abundance and LPL richness were slightly higher than the normal range at the main stem Elk River station downstream of the side channel (Figure 7.3). At Thompson Creek (RG_THCK), most endpoints were within the normal range, with the exception of % E and % EPT (which were below normal range).

There were no apparent temporal trends in benthic invertebrate community endpoints from 2012 to 2018, except at the downstream main stem station GH_ERC, where there was an apparent decrease in % P and % T from 2015 to 2018, and concurrent increase in % Diptera (Appendix Figures E.1 to E.8). Single samples were collected each year from 2015 to 2017, so the apparent trends may simply be natural variation (as demonstrated by the within station variability measured in 2018 at GH_ERC). The % P and % T at GH_ERC remained within the normal range as well as within the range observed at the upstream main stem reference station, GH_ER2.

Overall, the data indicate that the benthic invertebrate communities in the side channel and at the main stem location downstream of the side channel are not adversely affected by mine-related discharges. The only temporal change observed was a decrease in % P and % T, and concurrent increase in % Diptera at the downstream main stem Elk River station, but in all cases, endpoints remained within or slightly greater than the normal range.

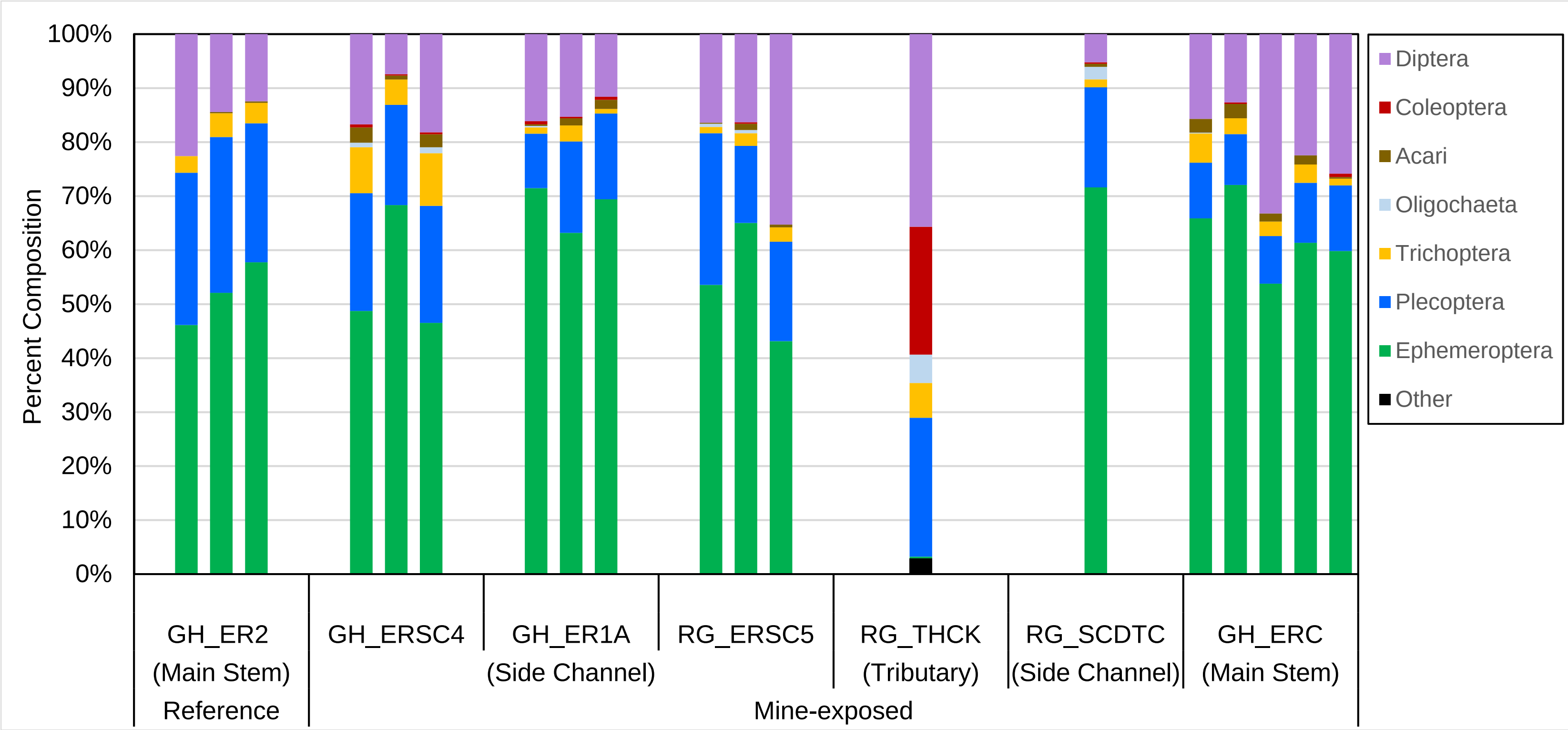


Figure 7.1: Benthic Invertebrate Community Composition, GHO LAEMP, 2018

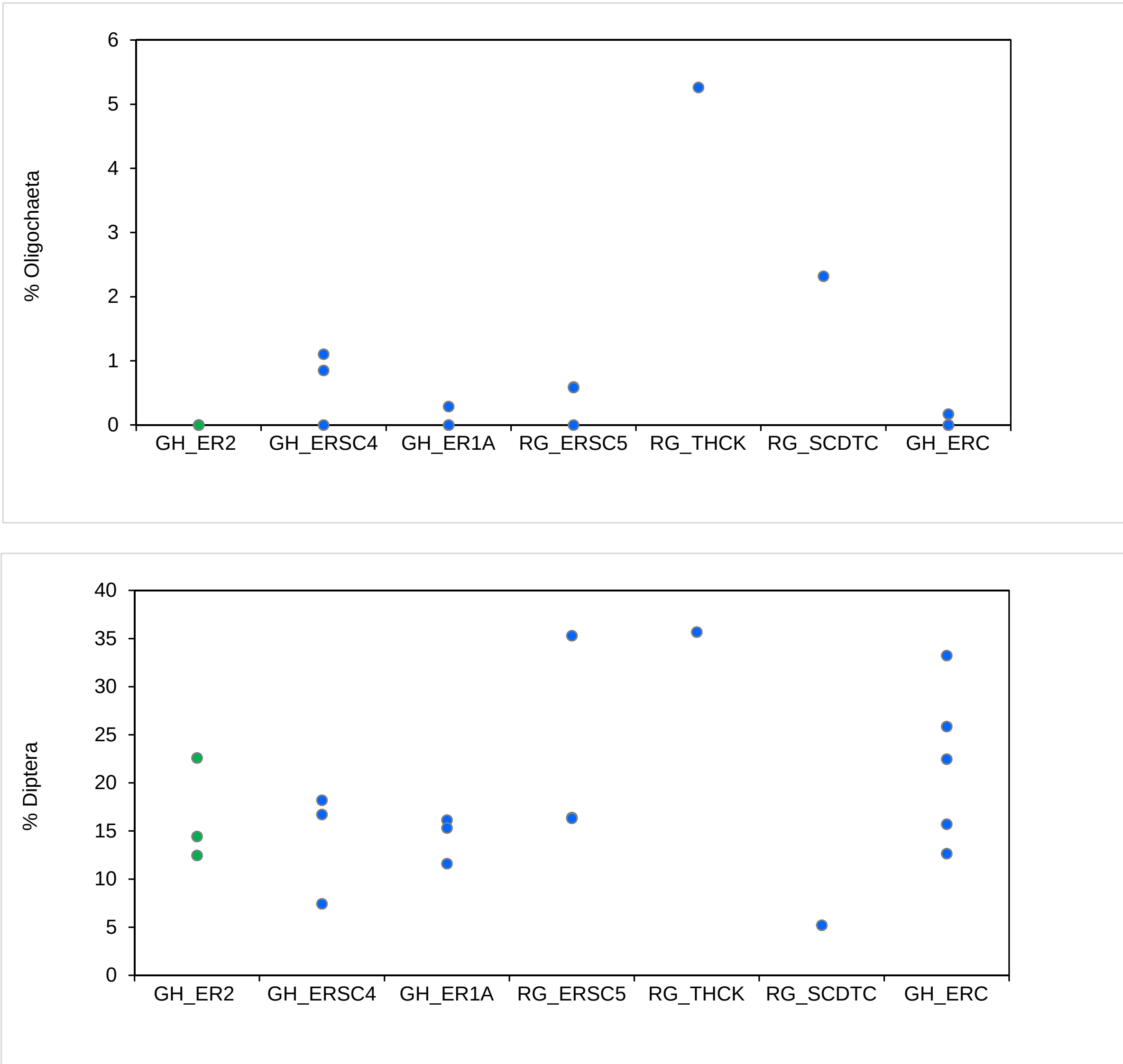
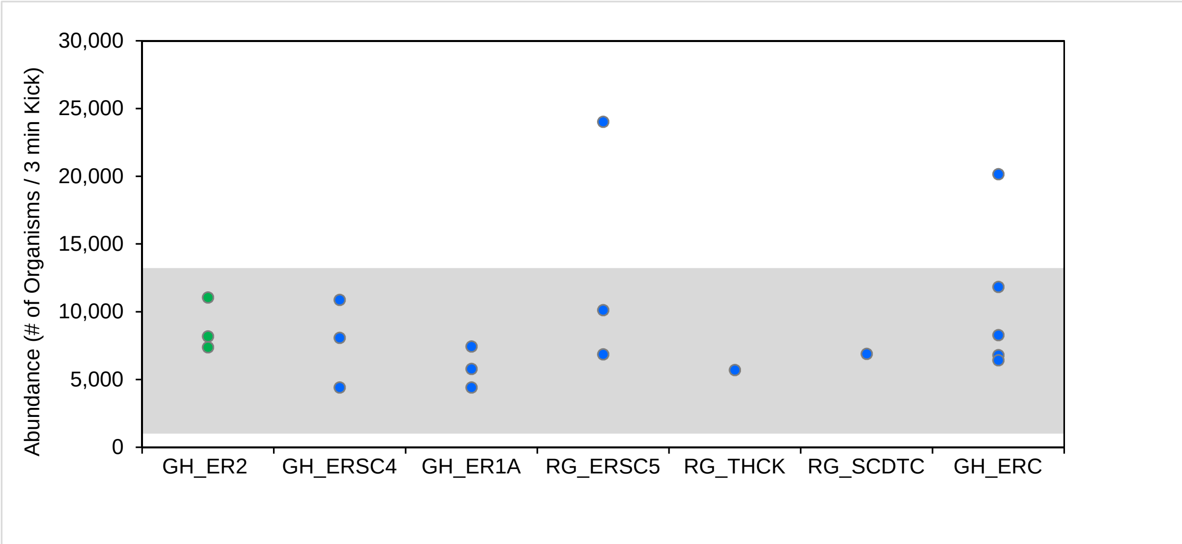


Figure 7.2: Benthic Invertebrate Community % Oligochaeta and % Diptera, GHO LAEMP, 2018



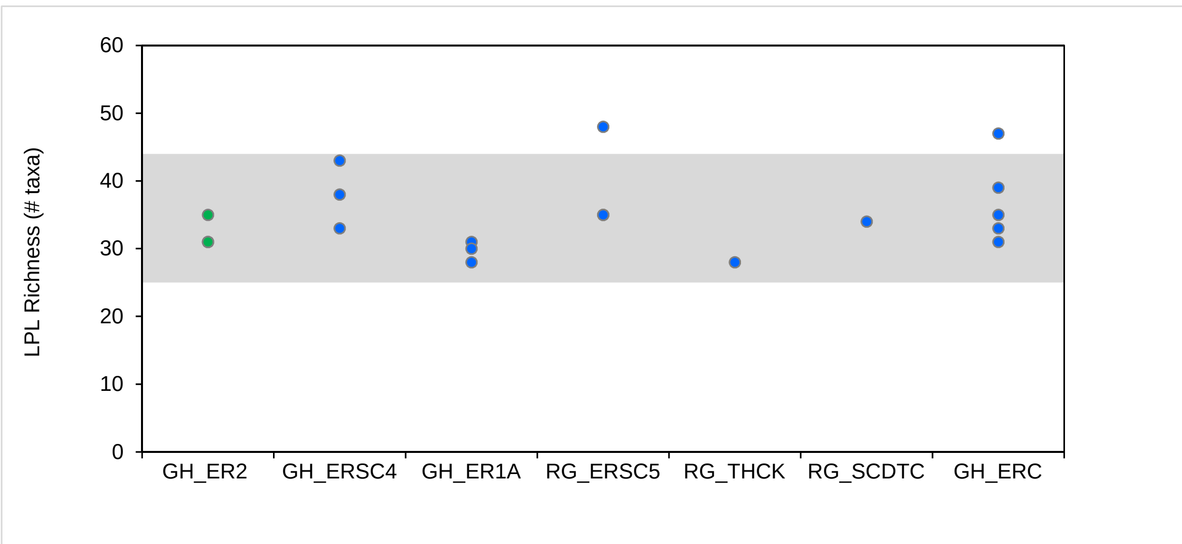
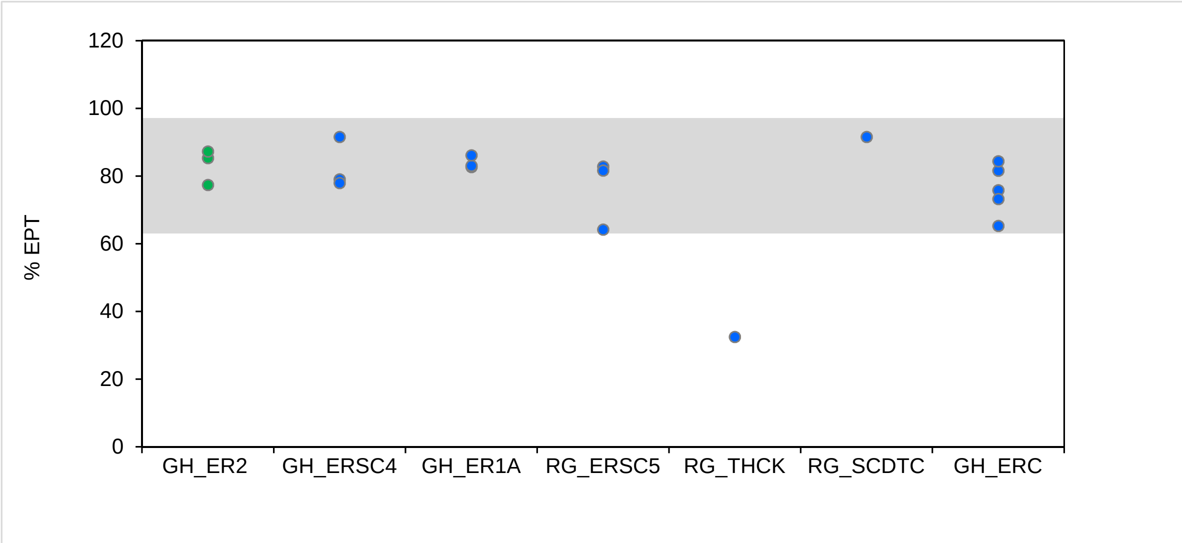


Figure 7.3: Benthic Invertebrate Community Abundance and LPL Richness, GHO LAEMP, 2018

Note: Grey shading represent the upper and lower limits of the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).



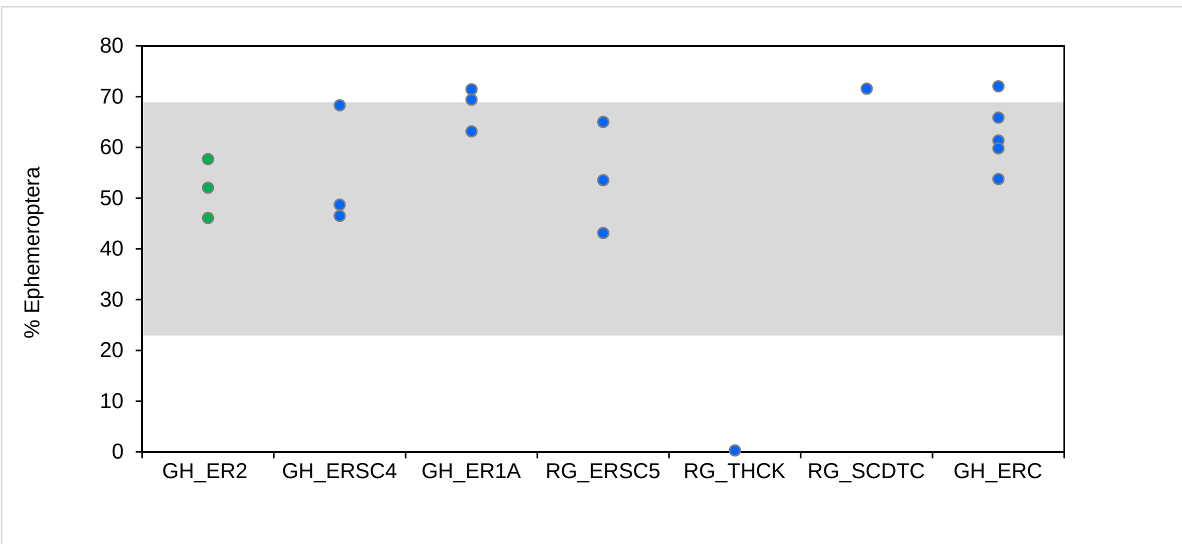
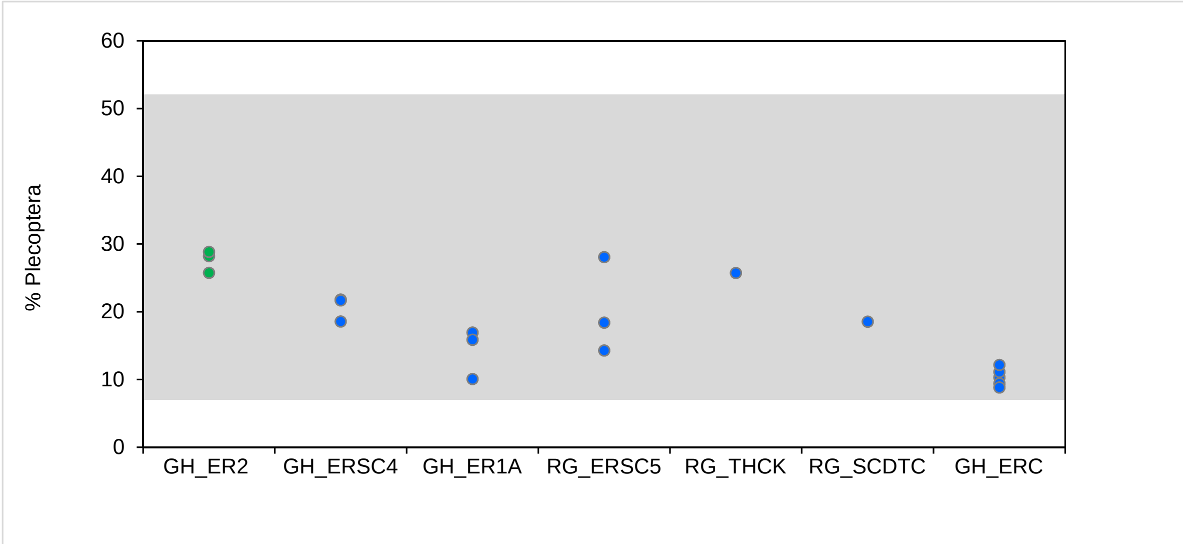


Figure 7.4: Benthic Invertebrate Community % EPT and % Ephemeroptera, GHO LAEMP, 2018

Note: Grey shading represent the upper and lower limits of the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).



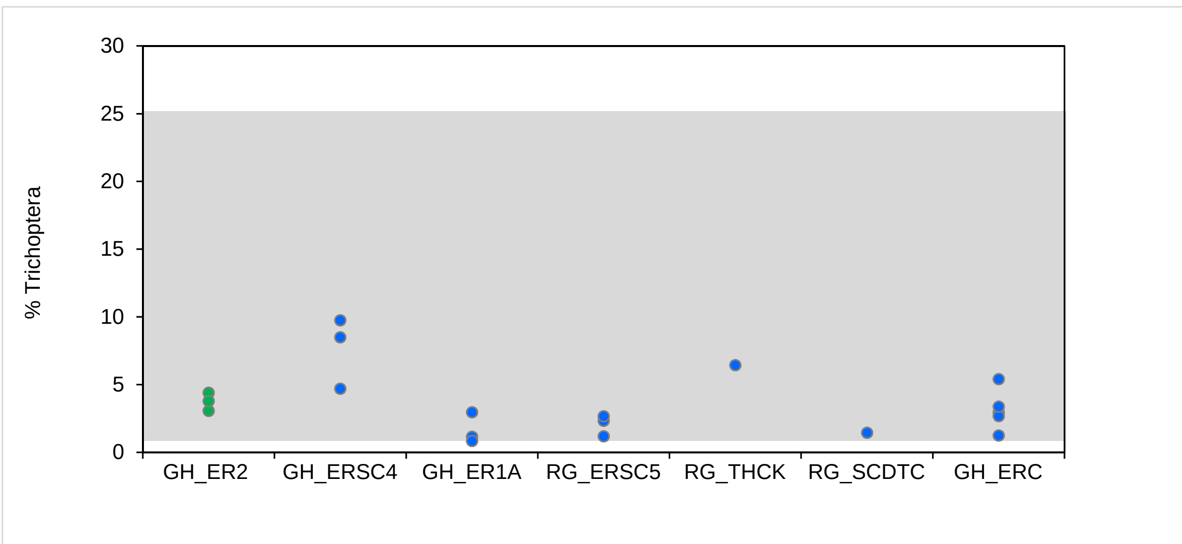


Figure 7.5: Benthic Invertebrate Community %Plecoptera and % Tricoptera, GHO LAEMP, 2018

Note: Grey shading represent the upper and lower limits of the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

7.3 Concentrations of Selenium in Benthic Invertebrate Tissue

Selenium concentrations in samples collected in 2017 and 2018 from the main stem Elk River upstream (GH_ER2) and downstream (GH_ERC) of mine influence, and from the most-upstream side channel station (GH_ERSC4) were below all benchmarks.

Selenium concentrations in benthic invertebrate tissue collected in 2018 from GH_ER1A, RG_ERSC5, and RG_SCDTC were higher than the EVWQP Level 1 dietary benchmark for fish in one of three replicates from each area; whereas all others were below the Level 1 benchmarks (Figure 2.1 and 7.6; Appendix Table F.1). The highest selenium concentrations measured were in the samples collected from Thompson Creek (RG_THCK) and Reach 2 (RG_GH-SCW3), which is directly influenced by Thompson Creek (Figure 7.6). The selenium concentration in the sample from Thompson Creek was higher than Level 2 benchmark for benthic invertebrates, and dietary benchmarks for fish and birds (Figure 7.6; Appendix Table F.1). One sample from Reach 2 was below all Level 1 benchmarks, one was higher than the Level 1 dietary benchmark for fish only, and one was higher than all three Level 1 benchmarks (Figure 7.6; Appendix Table F.1).

Concentrations of selenium in tissues were variable within stations, but generally similar in 2017 and 2018, with the exception of RG_ERSC5 (Figure 7.6). The higher concentrations measured at RG_ERSC5 in 2017 compared to 2018 were likely due to a higher proportion of annelids (segmented worms) in the samples relative to other areas. Annelids have previously been shown to exhibit higher concentrations of selenium compared to other benthic organisms, even at reference areas (Minnow 2016b, 2018a). Annelids were not present in the 2018 samples.

Selenium concentrations were generally within the 95% prediction limits for the selenium bioaccumulation model (Figure 7.7; Golder 2018). Several samples from RG_ERSC5 from 2017 were outside of the prediction limits, indicating higher concentrations of selenium in benthic invertebrate tissue relative to the predicted value. As noted in the 2017 report and above (Minnow and Lotic 2018a), the three higher concentrations measured at RG_ERSC5 in 2017 were likely due to a higher proportion of annelids (segmented worms) in the samples relative to other areas.

7.4 Supporting Information

7.4.1 Habitat

In situ water quality was similar between stations at the time of benthic invertebrate sampling (Appendix Table G.2), with all stations being well-oxygenated. Generally, water in the side channel was warmer than the main stem Elk River. Specific conductance was highest in Thompson Creek and in the side channel downstream of Thompson Creek. The mine-exposed and reference main stem Elk River stations were well matched, with similar sized channels and cobble dominated substrates (Appendix Table G.7). Compared to the main stem stations, side

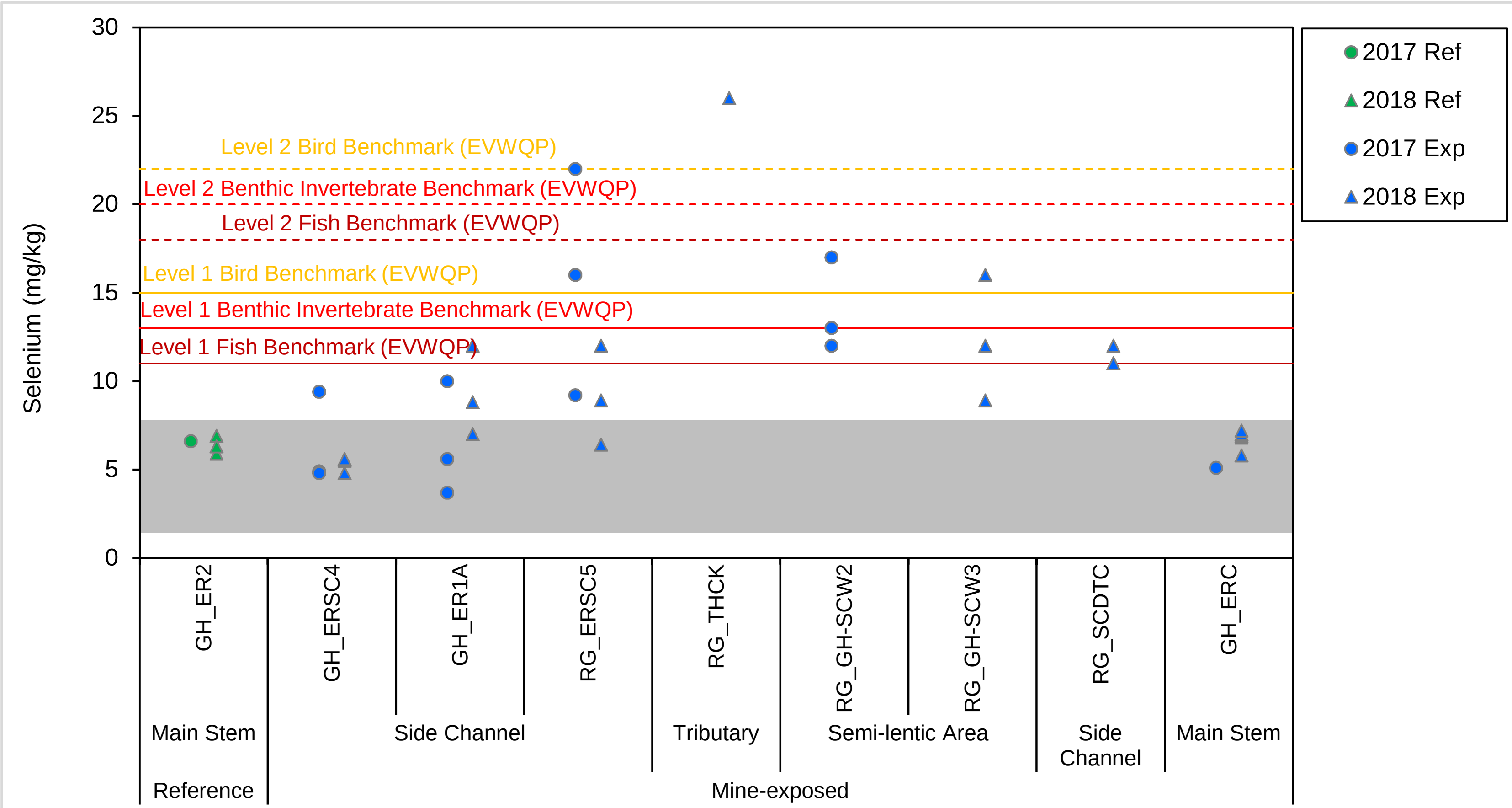


Figure 7.6: Selenium Concentrations in Benthic Invertebrate Samples, 2017 to 2018

Note: Gray shading represents the reference area normal range defined as the 2.5th and 97.5th percentiles of the distribution of reference area (pooled 1996 to 2015 data) reported in the RAEMP (Minnow 2018). The reference area normal range was calculated for community composite samples.

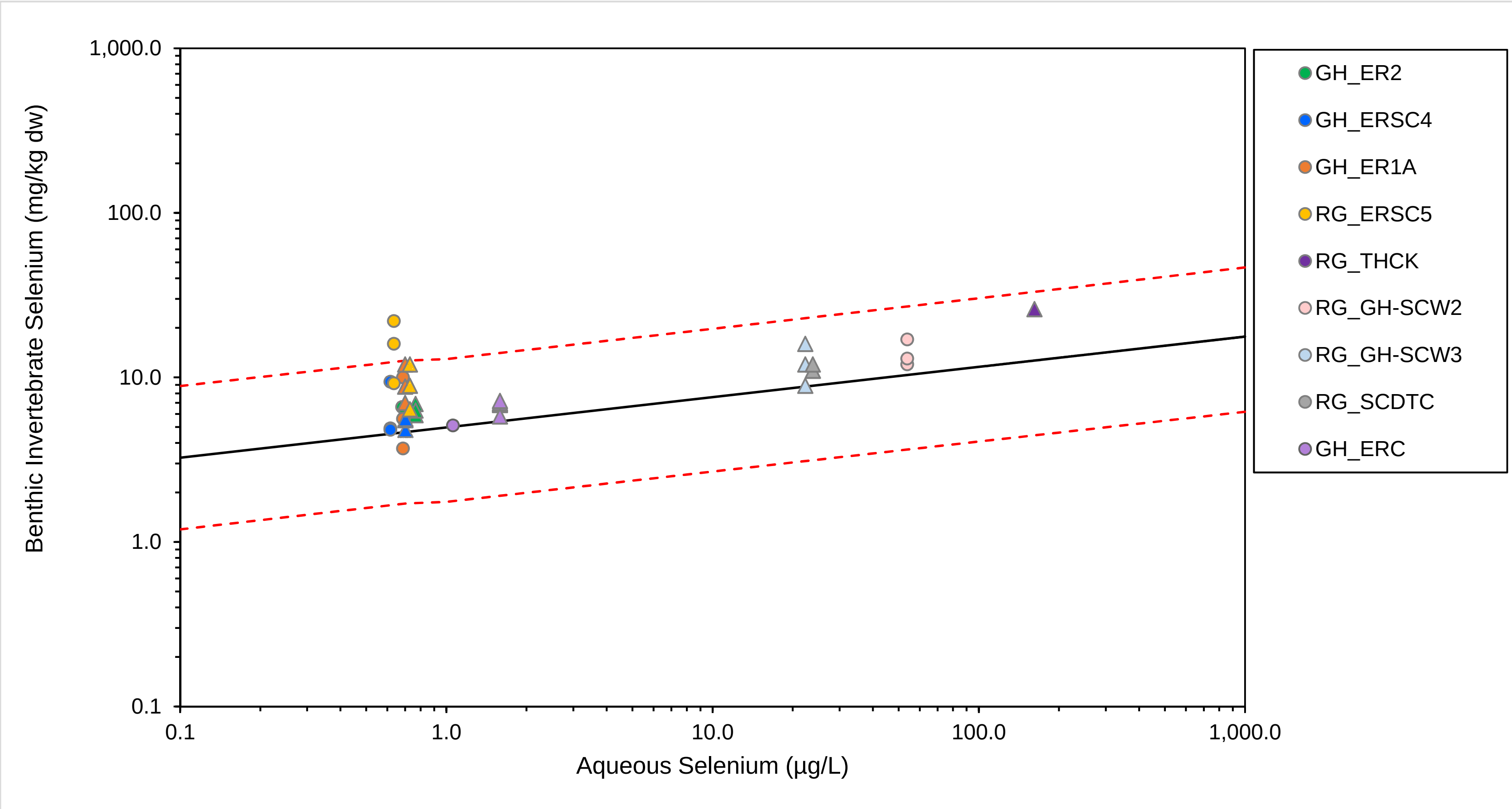


Figure 7.7: Observed and Modelled[a] Selenium Concentrations in Benthic Invertebrate Composite Samples Relative to Aqueous Selenium Concentrations, September 2017 (circles) and September 2018 (triangles)

[a] Mean benthic invertebrate selenium concentrations (solid black line) were estimated using a one-step water to benthic invertebrate selenium accumulation model: log10[Se]benthicinvertebrate=0.696+0.184×log10$[Se]_{aq}$ (Golder 2018). The 95% prediction limits for a single value from the one-step water to benthic invertebrate selenium accumulation model are plotted as dashed red lines.

channel stations had much narrower wetted widths and a greater proportion of sand and fines (Appendix Tables G.5 to G.7). Reach 2 was predominantly fines.

7.4.2 Calcite

Calcite indices measured at the downstream main stem Elk River station (GH_ERC) in September 2018 were comparable to reference (calcite index ranged from 0 to 0.04; Appendix Table G.5). Calcite was present but not concreted in Thompson Creek (calcite index = 0.8). Calcite was not observed at any of the stations in the Elk River side channel.

7.4.3 Sediment Quality

Sediment quality samples were collected in the main stem Elk River upstream (GH_ER2) and downstream of the west side tributaries (GH_ERC), as well as Reach 2 (RG_GH-SCW3; Figure 2.1). Sediment TOC and particle size were generally similar between areas, except for the presence of gravel in samples collected at GH_ERC (Figure 7.8).

Concentrations of parameters with SQGs were less than the upper SQG, except for 2-methylnaphthalene in four out of five samples collected from Reach 2 at the mouth of Thompson Creek (RG_GH-SCW3; Figure 7.9; Appendix Table G.3). Sediment quality was within the normal range, except for manganese concentrations in one of three samples from the reference station (GH_ER2; Figure 7.9). Sediment quality was similar in the main stem Elk River upstream (GH_ER2) and downstream of the west side tributaries (GH_ERC; Figure 7.9). Sediment quality in Reach 2 (RG_GH-SCW3) was generally similar to the two main stem Elk River stations, but with higher concentrations of selenium, chrysene, 2-methylnaphthalene, naphthalene, and phenanthrene (Figure 7.9), likely as a result of inputs from Thompson Creek. Overall, the data suggest sediment quality in the main stem Elk River main downstream of the side channel (GH_ERC) is not adversely affected by mine-related discharges. However, sediment quality in Reach 2 is influenced by GHO tributaries, having higher concentrations of selenium and some PAHs relative to Elk River stations (though still within the normal range).

7.5 Summary

Data collected in 2017 and 2018 furthered the understanding of study question #5 - What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?

Selenium concentrations in benthic invertebrate tissue from side channel stations were higher than main stem stations. Concentrations increased from upstream to downstream, from GH_ERSC4 (upstream of Wolfram Creek) to GH_ER1A and GH_ERSC5 (both downstream of

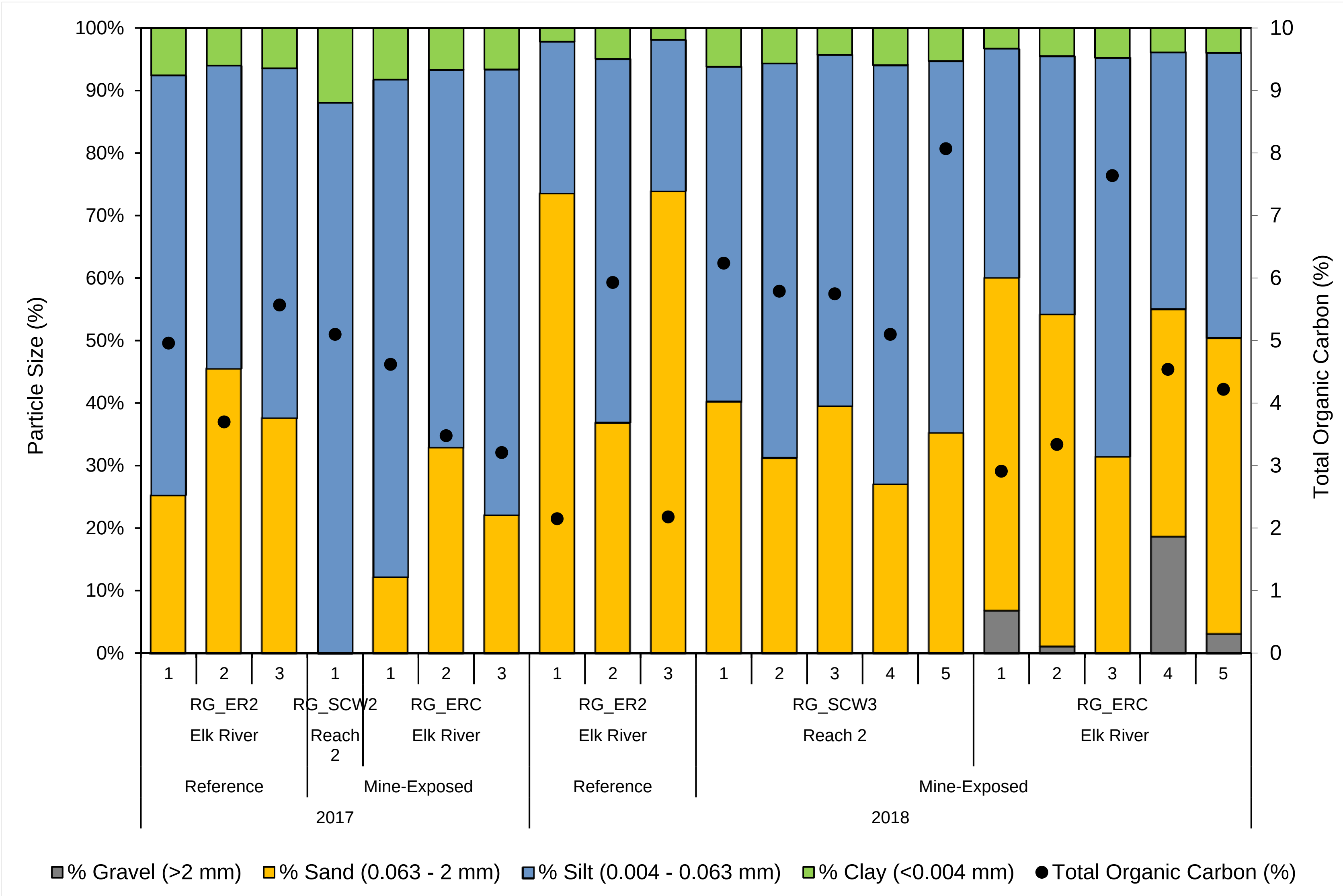


Figure 7.8: Mean Particle Size (%) and Total Organic Carbon Content (%) in Sediments, September 2017 and 2018

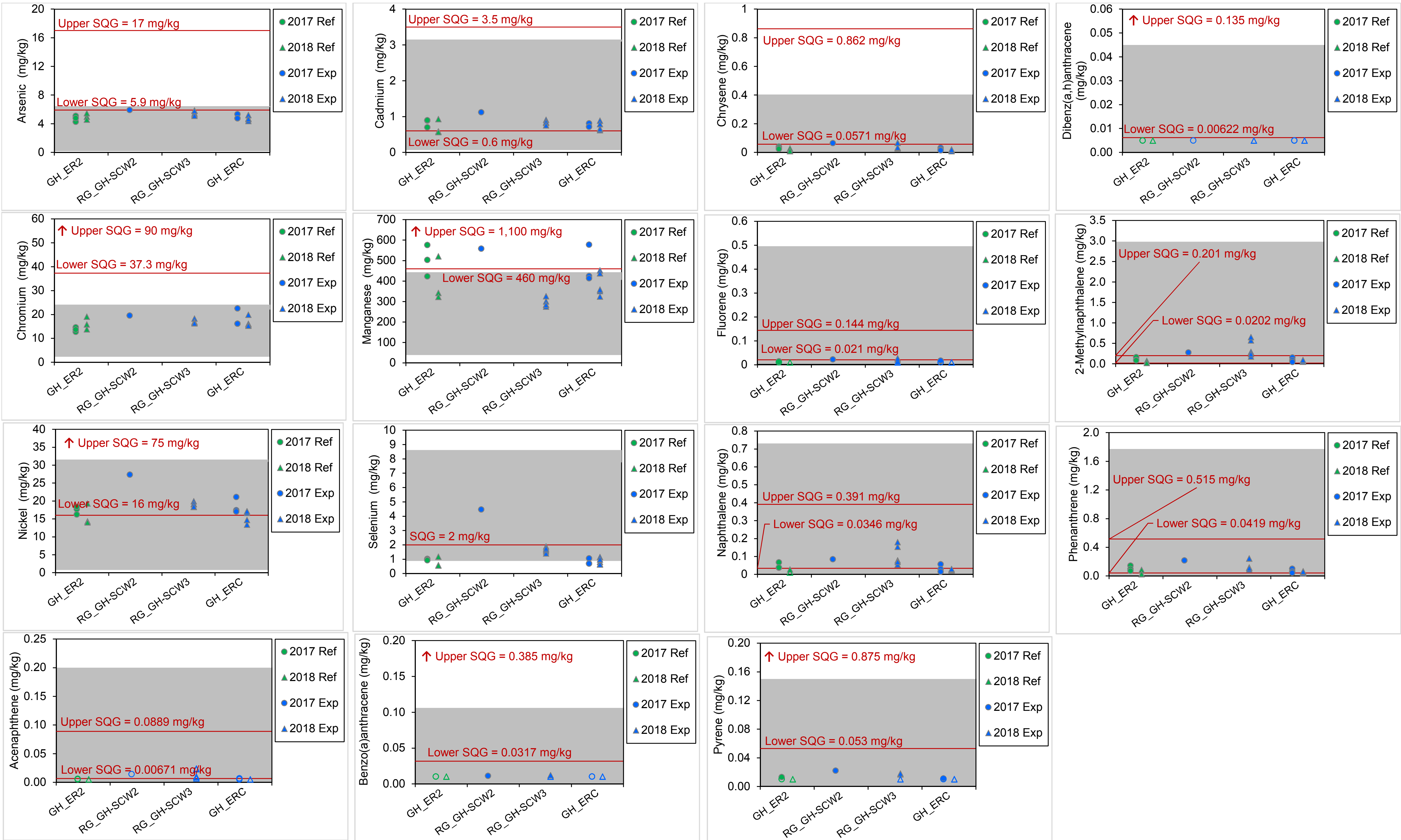


Figure 7.9: Sediment Metal and Polycyclic Aromatic Hydrocarbons Concentrations Relative to BC Sediment Quality Guidelines (SQG) and Normal Ranges, 2017 to 2018

Notes: Symbols differentiate year with circles (○) representing 2017 and triangles (Δ) representing 2018. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL value. Shading represents the normal range (2.5th and 97.5th percentiles of 2013 and 2015 reference area data collected in the RAEMP, Minnow 2018).

Wolfram Creek) to Reach 2 (RG_GH-SCW3, immediately downstream of Thompson Creek). Further downstream in the side channel at station RG_SCDTC, concentrations were similar to GH_ER1A and RG_ERSC5.

Despite higher selenium concentrations in side channel samples, benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC), and side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC). Abundance, richness, %EPT, %E, %P, and %T were within or above the normal range for main stem Elk River and side channel stations.

Benthic invertebrate community structure and tissue chemistry were similar at the downstream main stem station (GH_ERC) and the upstream main stem reference station (GH_ER2), suggesting no influence of GHO and the west-side tributaries on benthic invertebrate community endpoints and tissue chemistry in the main stem Elk River.

8 STUDY QUESTION #6

8.1 Overview

Data evaluated in this section pertain to study question #6: Is the mine-related influence on the side channel wetland having an effect on aquatic-dependent biota (benthic invertebrates, fish, amphibians, and aquatic-feeding birds)?

During the 2017 GHO LAEMP, the area at the confluence of Thompson Creek and the Elk River side channel (previously referred to as "the side channel wetland", herein referred to as Reach 2) was identified as an area of particular concern, as it was one of the few areas of the side channel that remained wetted all year, and was the location with the highest concentrations of selenium in benthic invertebrate tissue (Minnow and Lotic 2018a). A recommendation was made to complete an in-depth assessment of the area and as work was just initiating on the Lentic Area Supporting Study (Minnow 2018b), Teck integrated the assessment into that study, and results were used to support the GHO LAEMP. The Lentic Area Supporting Study was initiated in 2018, and was designed to address the following objectives:

- improve the understanding of lentic habitat use by aquatic-dependent organisms (i.e., amphibians, birds, and fish) in the Elk River watershed; and
- characterize the relationships between exposure to mine-related constituents and potential effects in aquatic-dependent organisms that use lentic areas in the Elk River watershed.

Reconnaissance surveys were completed for the Lentic Area Supporting Study in 2018 to collect:

- habitat data that was used to confirm and classify lentic habitat and evaluate habitat suitability for amphibians, aquatic-dependent birds, and fish;
- records of habitat use by breeding amphibians and aquatic-dependent birds;
- records of presence/absence and catch-per-unit-effort (CPUE) for potential sentinel fish species;
- water and sediment quality data; and
- amphibian egg and benthic invertebrate tissue chemistry data.

8.2 Habitat

In 2018, detailed habitat data were collected in Reach 2 during visits in May, June, and late July/early August, which were used to confirm and classify habitat and evaluate habitat suitability for fish, amphibians, and aquatic-feeding birds (Appendix Table H.1). In May and June, the area was swiftly flowing and inaccessible (i.e., lotic; Figure 8.1; Section 3.2), and therefore the area was characterized as lotic, and a detailed assessment could not be completed. In late July/early August, there was still flow, but not as swift or deep, and the area was characterized as a side-channel or a beaver pond/impoundment (Figure 8.1; Warner and Rubec 1997). Reach 2 displays characteristics of both lotic and lentic systems, depending on the season. Lotic ecosystems are flowing freshwater systems with unidirectional water movement along a slope in response to gravity. In contrast, lentic ecosystems are differentiated by still water. Reach 2 was swiftly flowing from freshet until early summer (lotic), and therefore it cannot be considered a lentic area. Consequently, Reach 2 was removed from the Lentic Area Supporting Study in the 2019 study design (Minnow 2019). Under the GHO LAEMP, Reach 2 will continue to be monitored for water quality (monthly), sediment quality (September), and benthic invertebrate tissue chemistry (September).

8.3 Biota Surveys

Fish surveys associated with the Lentic Area Supporting Study were conducted in Reach 2 in August 2018 using minnow traps and hoop nets (Appendix Tables H.2 and H.3), and confirmed the presence of longnose sucker and mountain whitefish in Reach 2 (Appendix Tables H.2 and H.3). In addition to work conducted for the Lentic Area Supporting Study, longnose sucker, mountain whitefish, and westslope cutthroat trout were previously documented in the area during monthly surveys conducted as part of the LAEMP (Section 4.3; Figure 4.1; Appendix Table B.17).

Amphibian surveys were planned for 2018 as part of the Amphibian Occurrence and Distribution Study (being completed by VAST Resource Solutions as part of the Lentic Area Supporting Study) but could not be completed due to swiftly flowing water in May and June (Appendix Table H.1). Adult western toads (five individuals), a Columbia spotted frog (one individual), and long-toed salamanders (10 individuals in the same location) were observed in Reach 2 in June, July, August, and/or September during 2017 and 2018 monthly surveys conducted for the GHO LAEMP (Section 4.3; Figure 4.2; Appendix Table B.18). Overall, the area was not considered to be breeding habitat for amphibians, and thus after the 2018 field season was completed, was removed from both the Amphibian Occurrence and Distribution Study, and the Lentic Area Supporting Study.

Two avian surveys were conducted in Reach 2 in June 2018 as part of the Lentic Area Supporting Study (Appendix Table H.4). Six species were confirmed by visual and auditory observations (American bittern, bank swallow, belted kingfisher, Canada goose, common yellowthroat, and northern waterthrush; Appendix Table H.5). Monthly surveys also documented the presence of mallards in Reach 2 (Section 4.3; Figure 4.3; Appendix Table B.19).

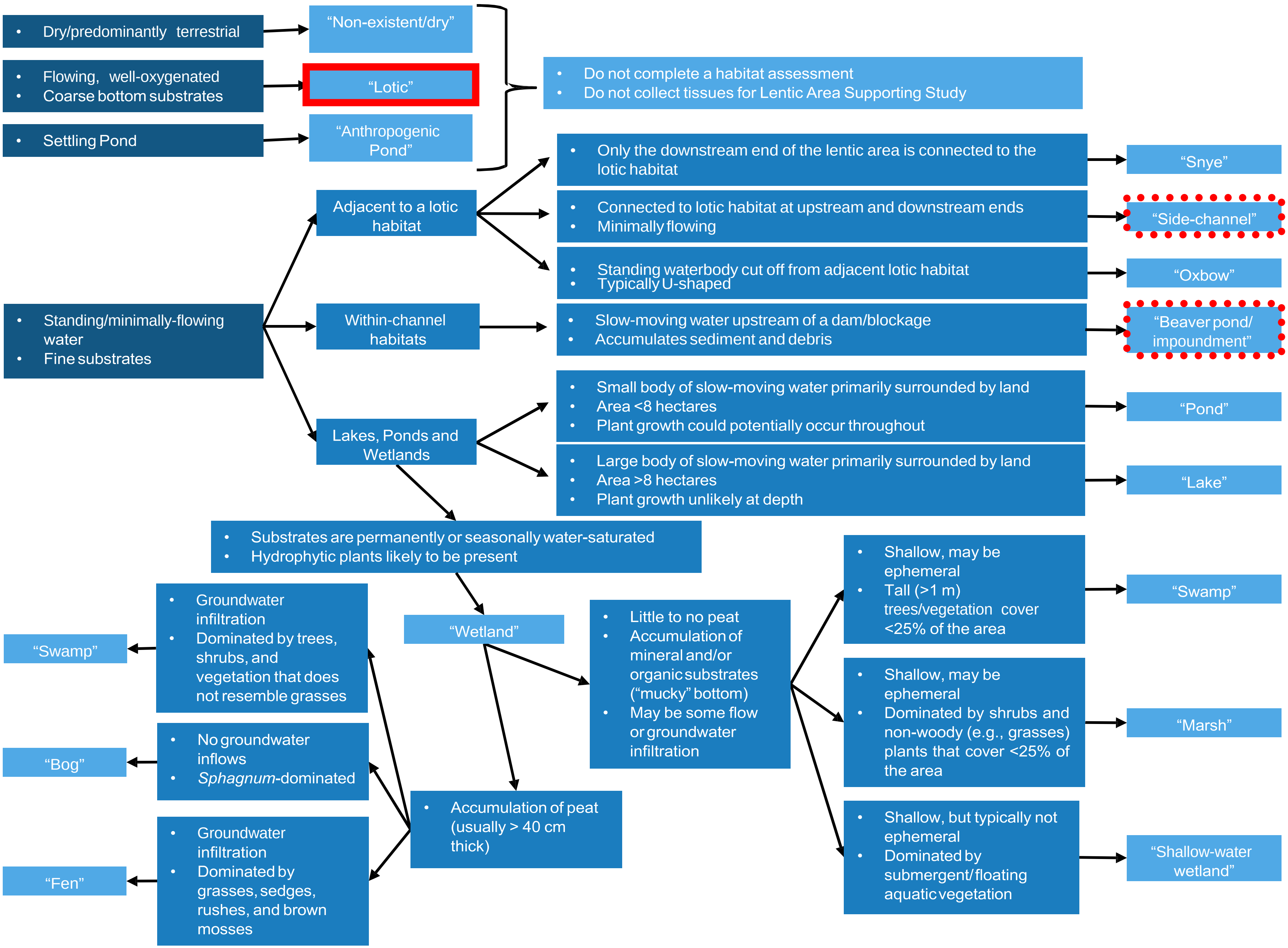
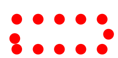


Figure 8.1: Classification of Waterbodies (adapted from Warner and Rubec 1997)

 Red solid box indicates appropriate classification in spring.

 Red dashed box indicates appropriate classification in fall/winter.

8.4 Water and Sediment Quality

Water quality in Reach 2 at RG_GH-SCW3 was reflective of inputs from Thompson Creek (Sections 5.4 and 7.4.3). Specific conductivity was an order of magnitude higher at the Reach 2 outlet compared to the inlet, but temperature, dissolved oxygen, and pH were comparable (Appendix Tables B.6 and B.7). In 2018, concentrations of constituents in water with EWTs and total mercury were always or typically below applicable BCWQG and/or benchmarks/screening values at RG_GH-SCW3, except for total dissolved solids, sulphate, and total uranium (frequently above the BCWQG and/or EVWQP Level 1 benchmark), and nitrate and total selenium (frequently above the Level 2 benchmark; Appendix Table C.2). There were no obvious temporal trends in water quality (Appendix Figures C.18 to C.34).

Sediment quality samples were collected in Reach 2 in July and September 2018, with five replicate samples collected each month (Appendix Table H.6). Sediment quality was generally similar to the two main stem Elk River stations (both reference and mine-exposed), but with higher concentrations of selenium, chrysene, 2-methylnaphthalene, naphthalene, and phenanthrene (Appendix Table H.6). Concentrations of constituents were within the normal range (Appendix Table H.6), with the exception of arsenic and magnesium in two samples collected in July. Concentrations of arsenic, cadmium, nickel, selenium, chrysene, 2-methylnaphthalene, naphthalene, and phenanthrene each exceeded the lower (or only, in the case of selenium) SQG in at least one of the ten samples (Appendix Table H.6). Concentrations of 2-Methylnaphthalene exceeded the upper SQG in five out of ten samples (Appendix Table H.6).

8.5 Amphibian and Benthic Invertebrate Tissue Chemistry Data

Reach 2 was swiftly flowing and inaccessible during spring; therefore the area was not surveyed for amphibian eggs, and was not considered suitable breeding habitat for amphibians.

Three benthic invertebrate tissue samples were collected from Reach 2 in July and September 2018 (Appendix Table H.7). Concentrations of selenium in tissue were comparable to concentrations measured in 2017 (Section 7.2; Appendix Table H.7). Selenium concentrations exceeded the normal range in all samples, and exceeded one or more of the EVWQP Level 1 benchmarks for benthic invertebrates and dietary effects to birds and juvenile fish benchmarks in two samples from September (Appendix Table H.7). Based on comparison of selenium concentrations in benthic invertebrate tissue to the EVWQP benchmarks, there is potential for localized adverse effects to fish, benthic invertebrates, and aquatic-dependent birds.

8.6 Summary

Data collected in 2017 and 2018 were evaluated to address study question #6: Is the mine-related influence on [Reach 2] having an effect on aquatic dependent biota (benthic invertebrates, fish, amphibians, and aquatic-feeding birds)? Data confirmed that Reach 2 of the side channel provides some habitat for fish, adult amphibians, and aquatic-dependent birds, but does not provide habitat for breeding amphibians. Aqueous concentrations of total dissolved solids, sulphate, and total uranium were frequently above the BCWQG and/or EVWQP Level 1 benchmarks, while aqueous concentrations of nitrate and total selenium were frequently above the EVWQP Level 2 benchmarks. However, most water constituents with EWT were always or typically below BCWQG and/or EVWQP Level 1 benchmarks. In sediment, 2-methylnaphthalene concentrations exceeded the upper SQG in five out of ten samples. All other concentrations were below the upper SQG (or only SQG, for selenium), and concentrations were either similar to the upstream reference or were within the normal range. Benthic invertebrate tissue selenium varied greatly, with five samples below Level 1 benchmarks for benthic invertebrates and dietary effects to birds and juvenile fish, one higher than the Level 1 dietary benchmark for juvenile fish only, and one higher than all three Level 1 benchmarks.

9 INTEGRATED SUMMARY AND RECOMMENDATIONS

9.1 Summary

The 2018 GHO LAEMP focused on six study questions designed to address localized concerns in a side channel of the Elk River and its adjacent floodplain complex on the west side of GHO. The study questions focused on characterization and understanding of the Elk River side channel hydrology, water quality, habitat quality/availability, and benthic invertebrate community structure and tissue chemistry.

Hydrology data collected from 2017 to 2018 answered study question #1 (What is the relationship between flows in the main stem Elk River and flows [including connectivity, intermittence, and pools] in the Elk River side channel?). The Elk River side channel was observed to undergo seasonal flooding and braiding, with variable flow throughout the year, which was generally consistent between 2017 and 2018. Flows in the main stem Elk River and flows in the Elk River side channel were strongly correlated. Water from the main stem Elk River flowed overland into the side channel from freshet until winter, during which time, stream flow decreased both in the main stem Elk River and at the three side channel stations. Stream flow was lowest in the main stem Elk River from winter until freshet; at this time the side channel became disconnected from the main stem Elk River and Reach 1 (the downstream end of the side channel) and Reach 3 (the upstream end of the side channel) slowly dried. Isolated pools were documented as drying occurred, but typically persisted for less than a month, suggesting that the pools were stagnant water resulting from dewatering of the side channel. Reach 2, located in the middle of the side channel at the confluence with Thompson Creek, remained wetted throughout the year due to overland flows from Thompson Creek and potentially groundwater inputs.

Within the side channel and its floodplain complex, surveys were completed to identify and document habitat and occurrences of aquatic-dependent biota. These data were used to answer study question #2 (What is the seasonal habitat availability for aquatic-dependent biota [i.e., fish, amphibians, and aquatic-feeding birds] in the Elk River side channel?). Results of 2018 surveys were generally consistent with 2017. Seasonal changes in flow (described above) affected habitat availability (e.g., lentic habitat only present in fall and winter, and only in Reach 2). The Elk River side channel was not considered suitable breeding habitat for amphibians, as much of the side channel and floodplain complex were flooded and swiftly flowing in the spring and early summer. However, a few adult amphibians (Columbia spotted frog, western toad, and long-toed salamander) were observed throughout the side channel in late spring and summer. Suitable habitat was available for all life stages of fish and aquatic-dependent birds in the side channel and floodplain complex from spring through fall, as well as in Reach 2 during winter. The side channel was being used by a variety of fish (bull trout, eastern brook trout, longnose sucker, mountain whitefish, and westslope cutthroat trout) and birds (American bittern, American dipper, bald eagle, bank swallow, belted kingfisher, blue heron, Canada goose, common yellowthroat, killdeer, northern waterthrush, spotted sandpiper, mallard).

Water quality data were assessed for stations in the main stem Elk River, Elk River side channel, and isolated pools to address study question #3 (What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?). Water quality at side channel stations GH_ER1A and GH_ERSC2 was influenced by Wolfram and Thompson creeks. Concentrations of constituents were typically lower at the side channel station GH_ERSC4, located upstream of Wolfram and Thompson creeks. Within the side channel and main stem Elk River, the highest concentrations of constituents generally occurred in Reach 2 (RG_GH-SCW3), which receives flow directly from Thompson Creek. Water quality in pools was highly dependent on location, with the highest concentrations of constituents generally occurring in pools downstream of Reach 2. Discharges from the west-side tributaries contribute to higher concentrations of some mine-related constituents in the main stem Elk River (GH_ERC) downstream of GHO relative to the upstream reference; however, with the exception of selenium, concentrations measured at GH_ERC were typically below benchmarks, screening values, and/or BCWQG, or were comparable to the upstream reference for most constituents.

To answer study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?), a hydrogeological review and analysis of available groundwater and surface water data was conducted by SNC Lavalin in 2019, using data from the west side of GHO along the Elk River side channel. The review confirmed that water in the side channel likely recharges groundwater across the length of the side channel, with the exception of localized areas of groundwater discharge. Leask, Wolfram, and Thompson creeks contributed loadings to the side channel through overland flow paths (Wolfram and Thompson creeks only) as well as through shallow groundwater flow paths. Groundwater wells in the vicinity of the side channel indicated mine influence. Isolated pools in the side channel were interpreted to result from dewatering of the side channel and not from groundwater discharge, with the possible exception of pool SC2-P3. Recommendations were made to address gaps and uncertainties.

Benthic invertebrate community and tissue chemistry (selenium) data collected in 2017 and 2018 furthered the understanding of study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?). Within the side channel, selenium concentrations in benthic invertebrates increased from GH_ERSC4 (upstream of Wolfram Creek) to GH_ER1A and GH_ERSC5 (both downstream of Wolfram Creek) to Reach 2 (RG_GH-SCW3, immediately downstream of Thompson Creek). Further downstream in the side channel at station RG_SCDTC, concentrations were similar to GH_ER1A and RG_ERSC5. Some benthic invertebrate tissue samples collected in 2018 from RG_ERSC5 (one sample out of three), RG_GH-SCW3 (two out of three samples), and RG_SCDTC (one out of three samples) were above the EVWQP Level 1 selenium benchmarks for either benthic invertebrates, dietary effects to juvenile fish, and/or dietary effects to birds. Selenium concentrations in benthic invertebrates at the downstream main stem Elk River station (GH_ERC) were similar to concentrations at the upstream reference station (GH_ER2). Despite higher selenium concentrations in benthos from the side channel, benthic invertebrate community endpoints did not differ greatly between perennially-wetted main stem stations (GH_ER2 and GH_ERC), and side channel stations (GH_ERSC4, GH_ER1A, RG_ERSC5, and RG_SCDTC). Abundance, richness, %EPT, %E, %P, and %T were within or above the normal range for main stem Elk River and side channel stations. Benthic invertebrate selenium concentrations in tissue and community structures were similar in the side channel and the main stem location downstream of the side channel, community endpoints were within normal range (and similar to upstream reference), and selenium concentrations were mostly below EVWQP Level 1 dietary benchmarks, with the exception of Reach 2. Overall, benthic invertebrate communities did not appear to be adversely affected by mine-related discharges. However, selenium concentration in some benthic invertebrate samples from Reach 2 were greater than Level 1 benchmarks for invertebrates, juvenile fish, and juvenile aquatic-feeding birds. These concentrations would indicate a potential for up to 20% effects on chronic, sub-lethal endpoints for sensitive species (if any are present), but would not be expected to result in population- or community-level changes.

In support of study question #5, sediment quality was assessed in the main stem Elk River upstream and downstream of the side channel, and in Reach 2 of the side channel. With the exception of arsenic and magnesium in two of ten samples from Reach 2, concentrations of constituents were within the normal range. Concentrations of constituents were below the upper or only SQG, with the exception of selenium and 2-methylnaphthalene in Reach 2. In general, sediment quality data indicated limited influence of mine-related discharges on sediment chemistry in the main stem Elk River downstream of the side channel.

Data collected from Reach 2 in 2017 and 2018 for the GHO LAEMP were combined with data collected in 2018 for the Lentic Area Supporting Study to address study question #6 (Is the mine-related influence on [Reach 2] having an effect on aquatic dependent biota [benthic invertebrates, fish, amphibians, and aquatic-feeding birds]?). Surveys confirmed that Reach 2 provides some habitat for fish, adult amphibians, and aquatic-dependent birds, but does not provide habitat for breeding amphibians. Aqueous concentrations of total dissolved solids, sulphate, and total uranium were frequently above the BCWQG and/or EVWQP Level 1 benchmarks, while aqueous concentrations of nitrate and total selenium were frequently above the EVWQP Level 2 benchmarks. However, most constituents were below BCWQG and/or EVWQP Level 1 benchmarks. In sediment, 2-methylnaphthalene concentrations exceeded the upper SQG in five out of ten samples. All other parameters were below the upper SQG (or only SQG, for selenium), and concentrations were either similar to the upstream reference or were within the normal range. Benthic invertebrate tissue selenium varied greatly, with five samples below all Level 1 benchmarks, one higher than the Level 1 dietary benchmark for juvenile fish only, and one higher than the Level 1 benchmarks for benthic invertebrates and dietary effects to birds and juvenile fish. The results for Reach 2 indicate potential for localized exposure to elevated dietary selenium to fish, amphibians, and aquatic feeding birds. For mobile biota utilizing additional habitat beyond Reach 2 (e.g., the rest of the side channel and the main stem Elk River), the potential for effects would be minimal.

9.2 Recommendations

The following modifications are recommended for the 2018 to 2020 GHO LAEMP study design and will be discussed with the EMC prior to fall 2019 sampling:

- The seasonality of wet and dry areas and the formation of isolated pools in the Elk River side channel, as well as the relationship between flows in the side channel and the main stem Elk River have been documented monthly over two years. The data indicate that side channel flow is predominantly influenced by the Elk River itself, rather than the tributaries, with the exception of Reach 2 at the mouth of Thompson Creek.
    - Recommend removing study question #1 (What is the relationship between flows in the main stem Elk River and flows [including connectivity, intermittence, and pools] in the Elk River side channel?).
    - Monthly recording of wet and dry areas, water level logging, flows, and recording of isolated pools will continue to be conducted to support answering study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?).
- The habitat of the Elk River side channel has been documented monthly over two years of study. Surveys for aquatic-dependent biota in 2017 and 2018 determined that the side channel was being used by a variety of fish, amphibians, and birds. Additional years of surveys would not further the understanding of how mine-related discharges might affect aquatic-dependent biota.
    - Recommend removing study question #2 (What is the seasonal habitat availability for aquatic dependent biota [i.e., fish, amphibians, and aquatic feeding birds] in the

Elk River side channel?) and cease monthly documentation of habitat and biota observations.

- Continue to monitor substrate, calcification, and general habitat annually in September in support of benthic invertebrate community monitoring (study question #5).

- Continue to monitor water quality in the west-side tributaries, Elk River side channel (including Reach 2), and the main stem Elk River, in support of study question #3a, #3b, and #3c.
- Recommendations for study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?; SNC-Lavalin 2019).
  - Survey surface water and groundwater stations to a common datum.
  - Based on the results of a seep survey of the west side of GHO:
    - Obtain shallow groundwater levels and groundwater quality through the installation of an improved groundwater monitoring network upgradient of surface water station GH_ER1A.
    - Improve the groundwater monitoring network in the vicinity of the confluence with Thompson Creek and further to the south where pooled areas have been mapped and sampled and an influence from Thompson Creek suspected.
    - Improve the groundwater monitoring network upgradient of monitoring well GH_MW-ERSC-1.
  - Review 2018 water quality and major ion hydrochemistry for isolated pools.
    - If uncertainties remain after review of data from May 2017 to December 2018, continue to document pool presence and size, and sample water quality monthly for one additional year.
- Continue to monitor benthic invertebrate community, benthic invertebrate tissue chemistry, and supporting data (i.e., habitat data, calcite index, and, for some areas, sediment quality) to address study question #5.
- Continue to monitor water quality, sediment quality (September), and benthic invertebrate tissue chemistry (September) in Reach 2 of the side channel at the mouth of Thompson Creek. This area is not included in the Lentic Area Supporting Study in 2019.

- Recommend removing study question #6 (Is the mine-related influence on the side channel wetland having an effect on aquatic dependent biota [benthic invertebrates, fish, amphibians, and aquatic-feeding birds]?), so that data are assessed within the context of the rest of the side channel, as follows:
    - Water quality will be assessed under study question #3b (What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem Elk River?) and study question #4 (What is the interaction between surface water and groundwater in the Elk River side channel?).
    - Sediment quality and benthic invertebrate tissue chemistry will be assessed under study question #5 (What are the benthic invertebrate community structures and tissue chemistry in the Elk River side channel and the main stem Elk River upstream and downstream of the side channel, and are they changing over time?).

The program will continue to assess relevant site-specific issues, as required, until sufficient data have been collected, concerns no longer exist, or monitoring can be incorporated into the RAEMP.

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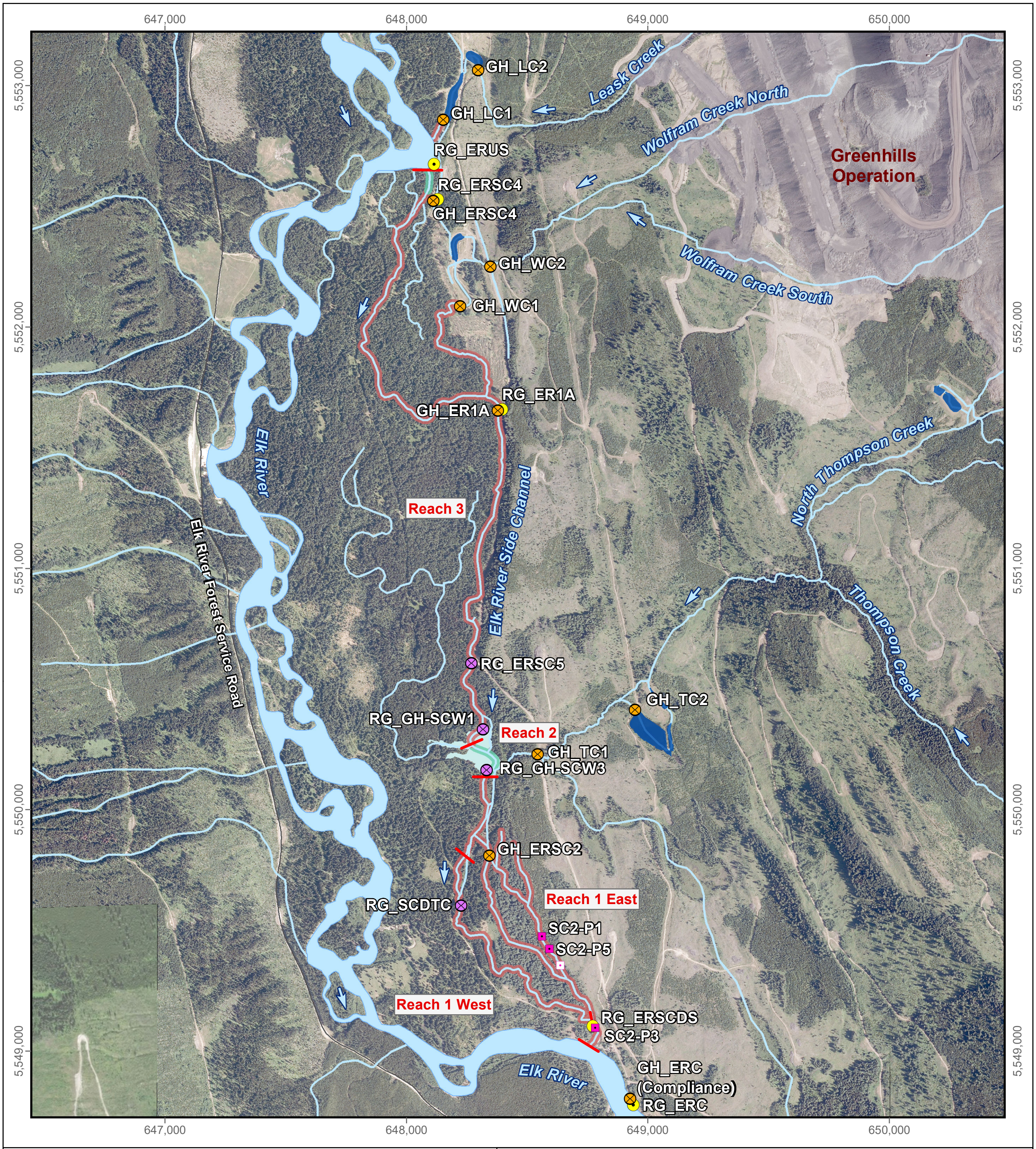
APPENDIX A
HYDROLOGY



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, January 2018

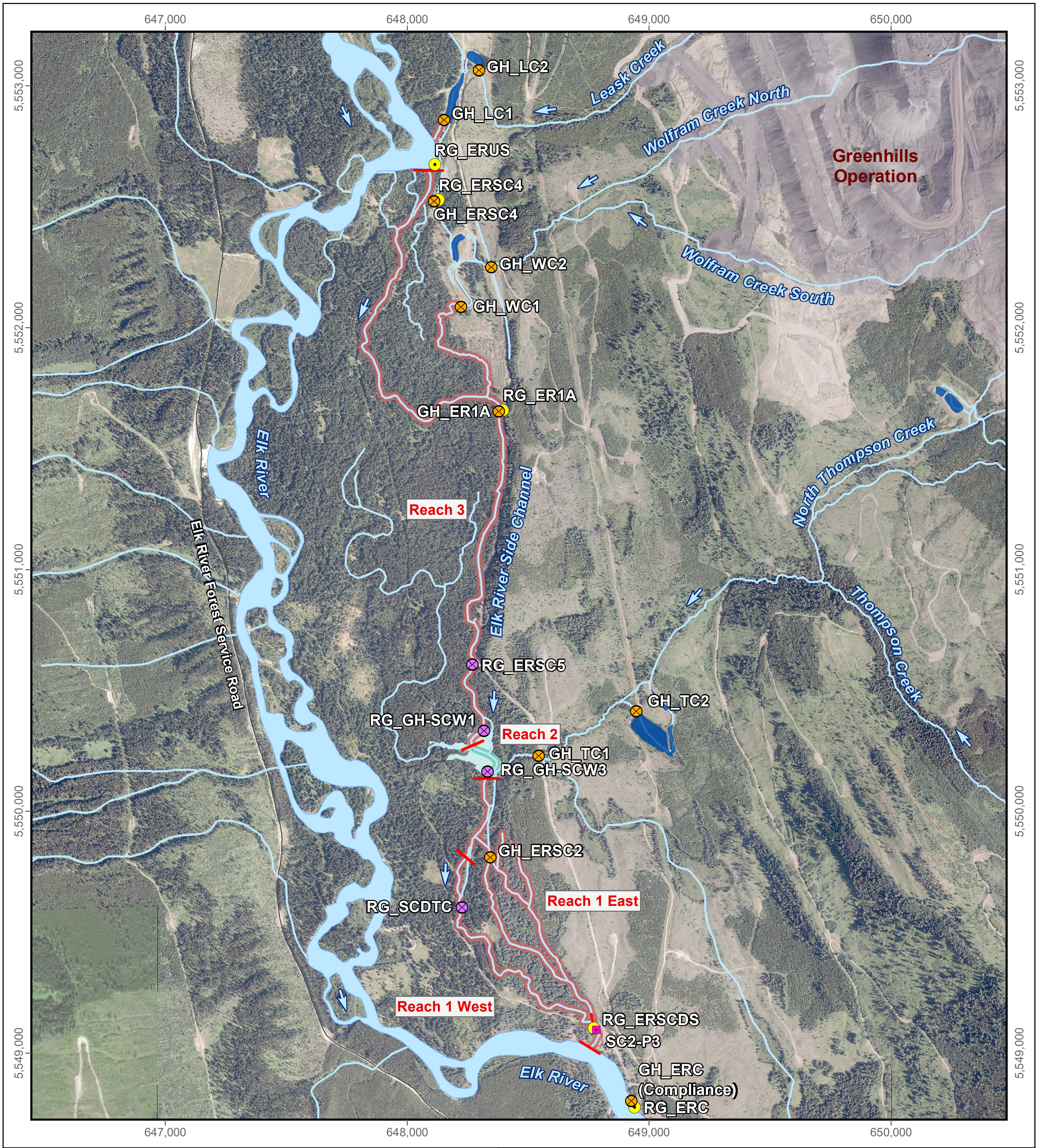
0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

N W E S

Date: May 2019
Project 187202.0018

Figure A.1



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- Pool, Water Quality Sampling
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- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, February to March 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

N E S W

Date: May 2019
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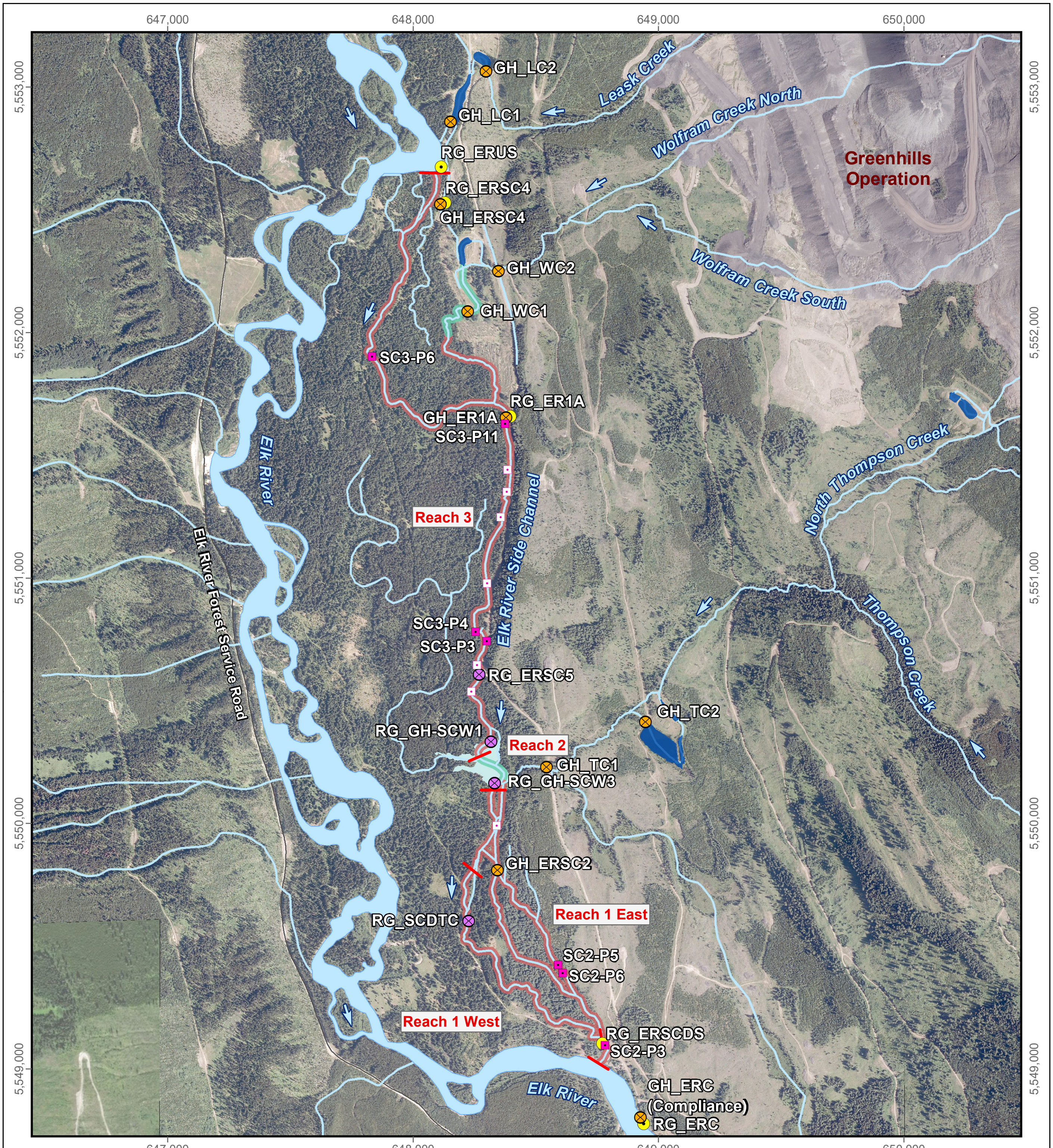
Figure A.2



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, April 2018

0 250 500 1,000 Meters

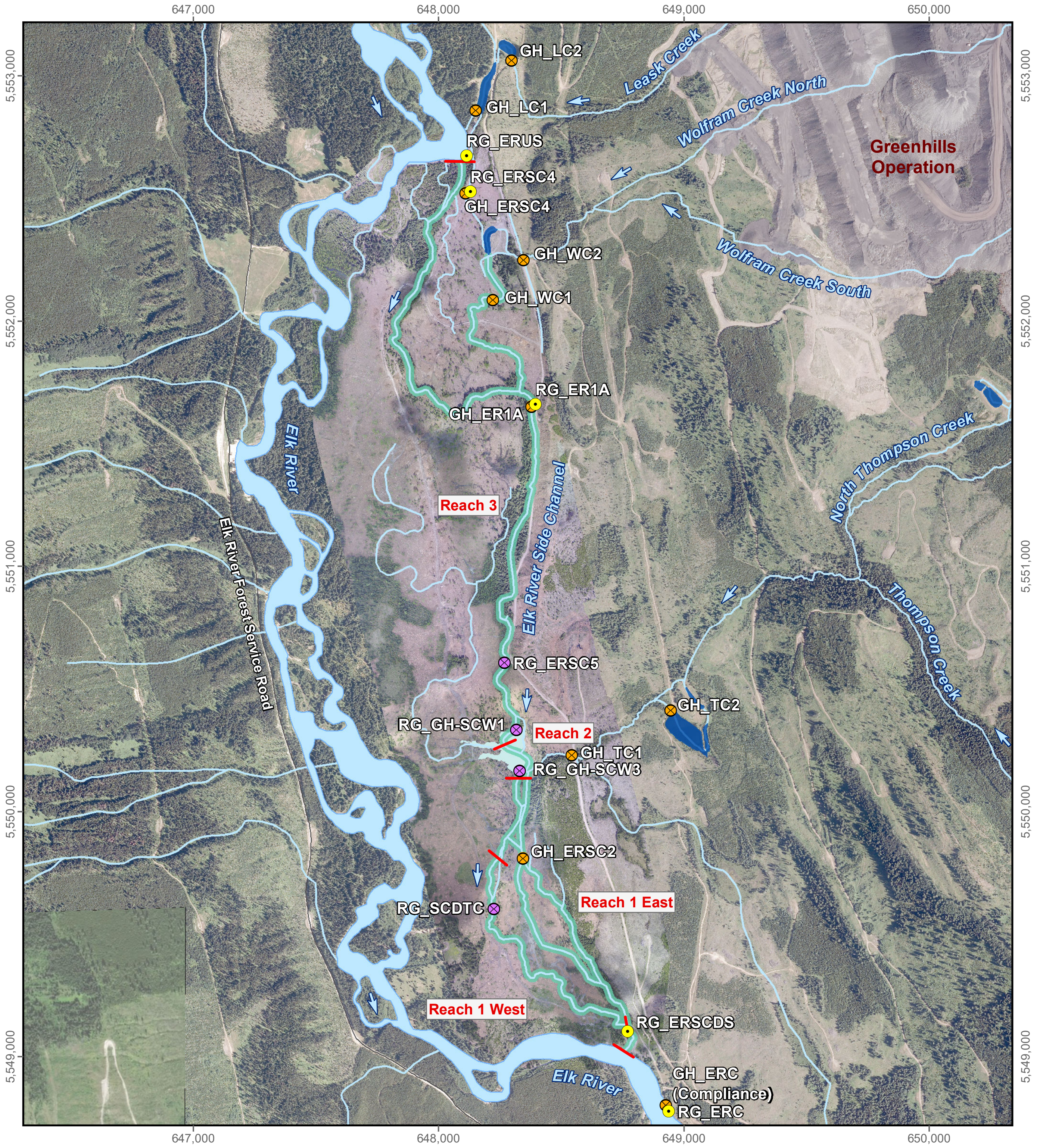
N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

minnow environmental inc. A Tetra Tech Company

Figure A.3



LEGEND

- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, May 2018

0 250 500 1,000 Meters

N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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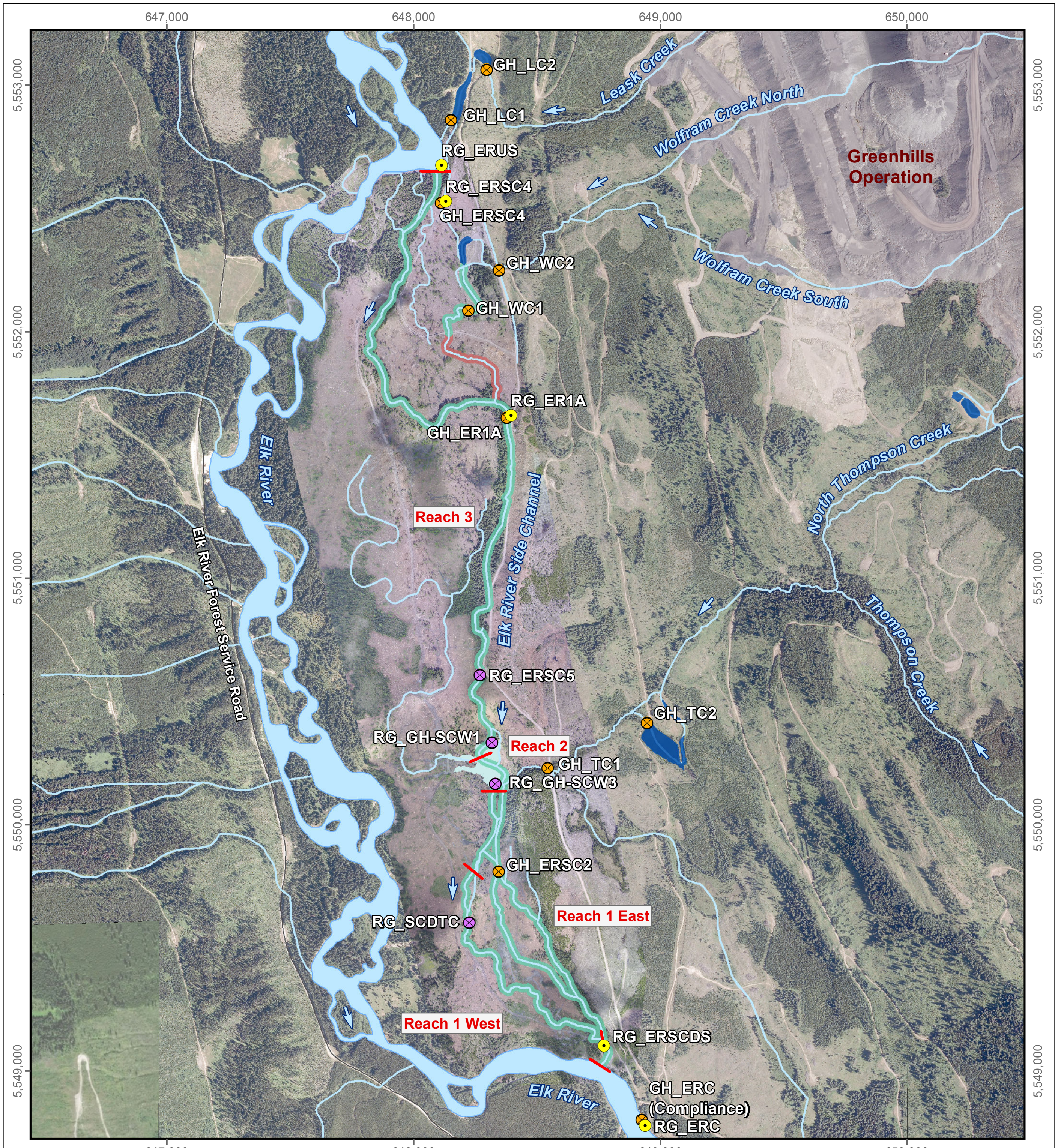
Figure A.4



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, June 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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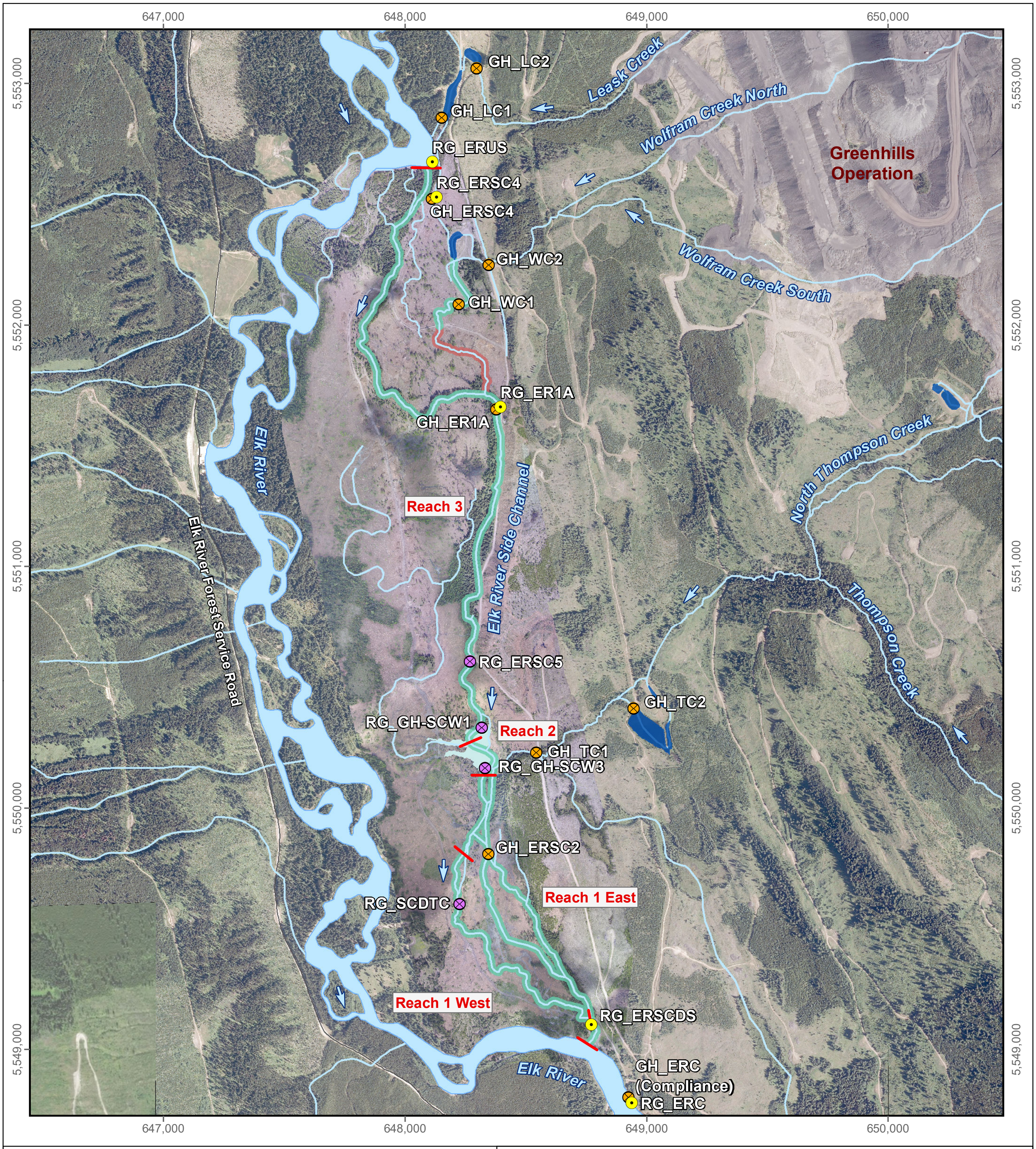
Figure A.5



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, July 2018

0 250 500 1,000 Meters

N E S W

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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Figure A.6

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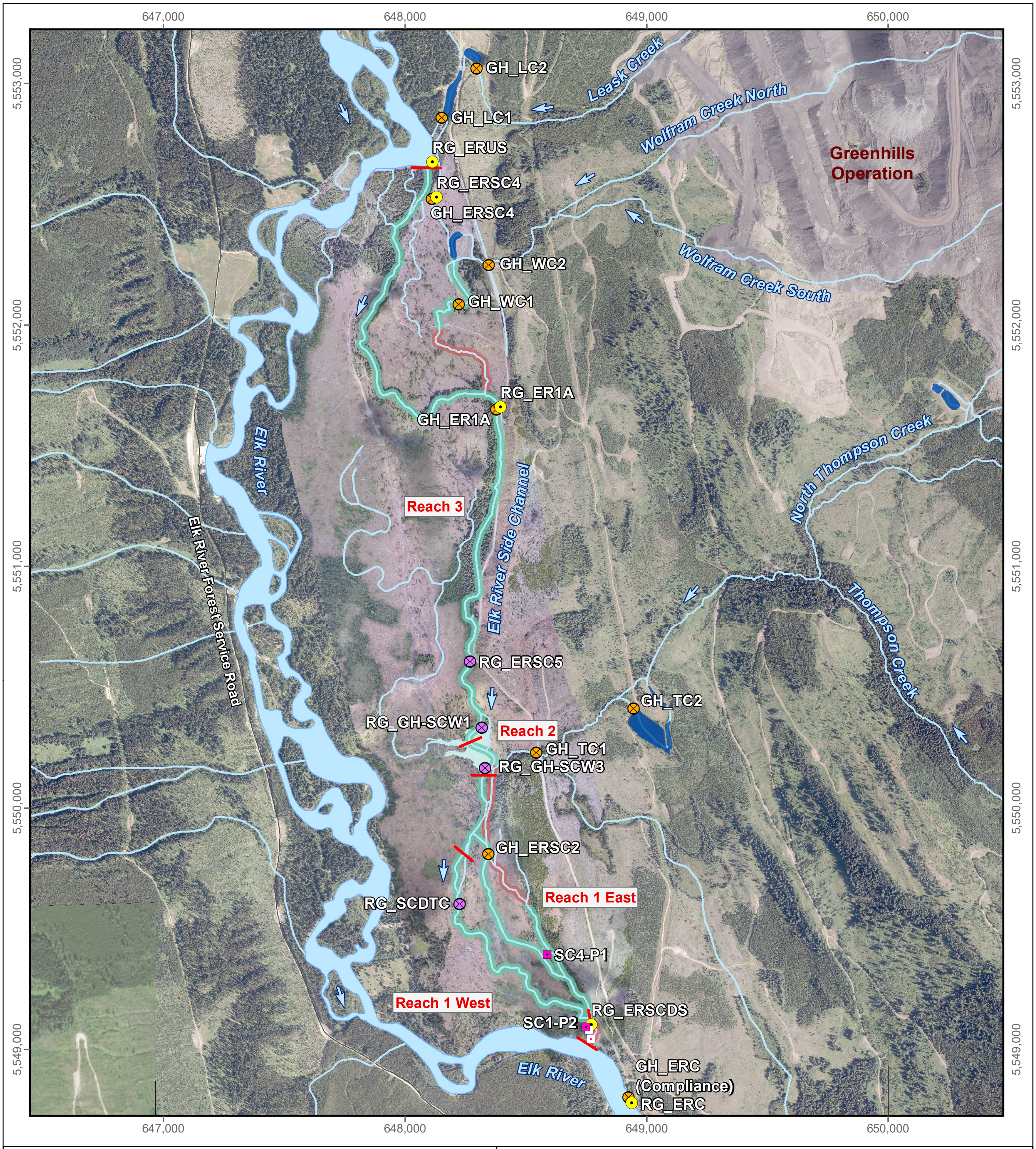

LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, August 2018

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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Figure A.7

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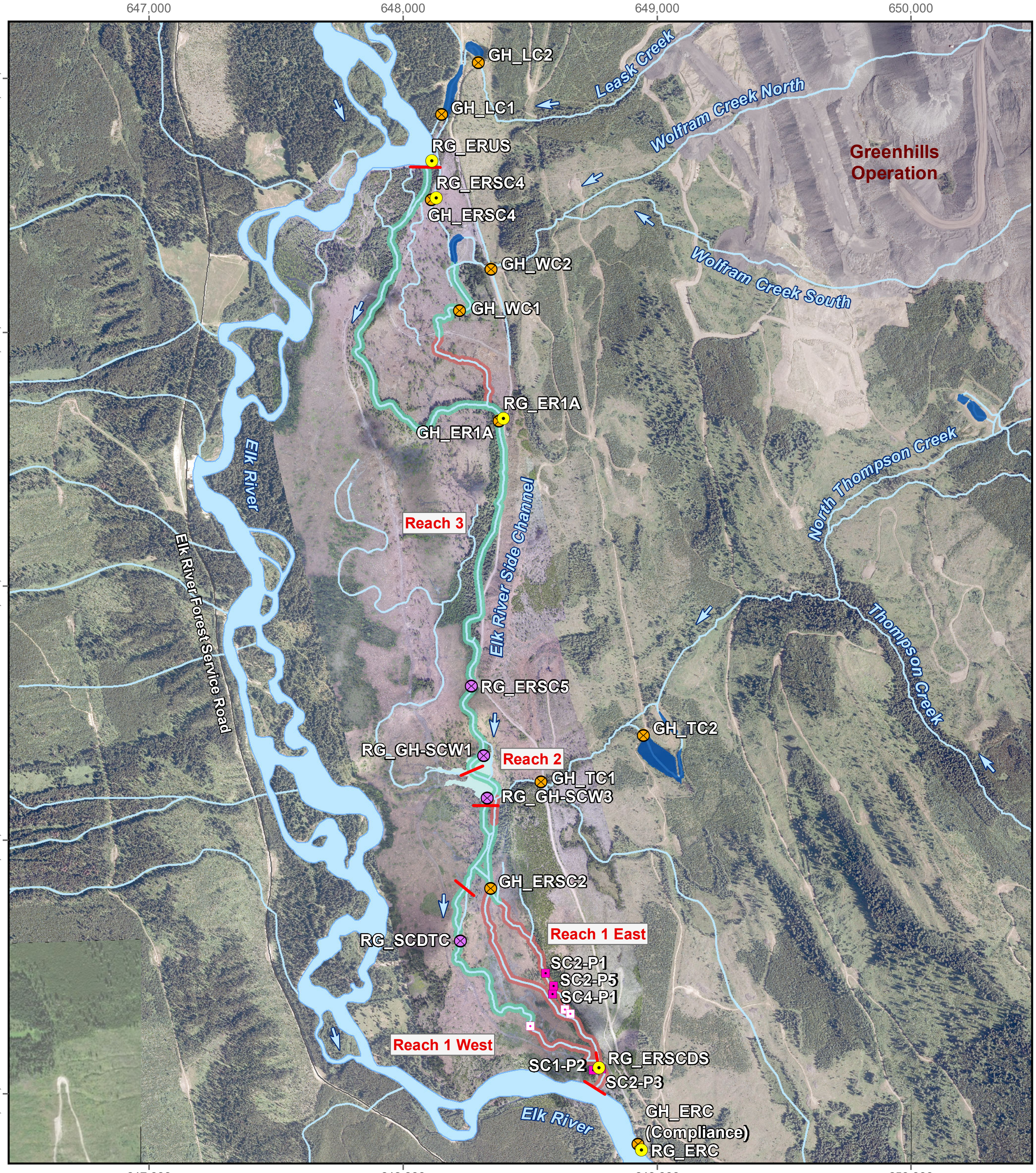

LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, September 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11
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Figure A.8

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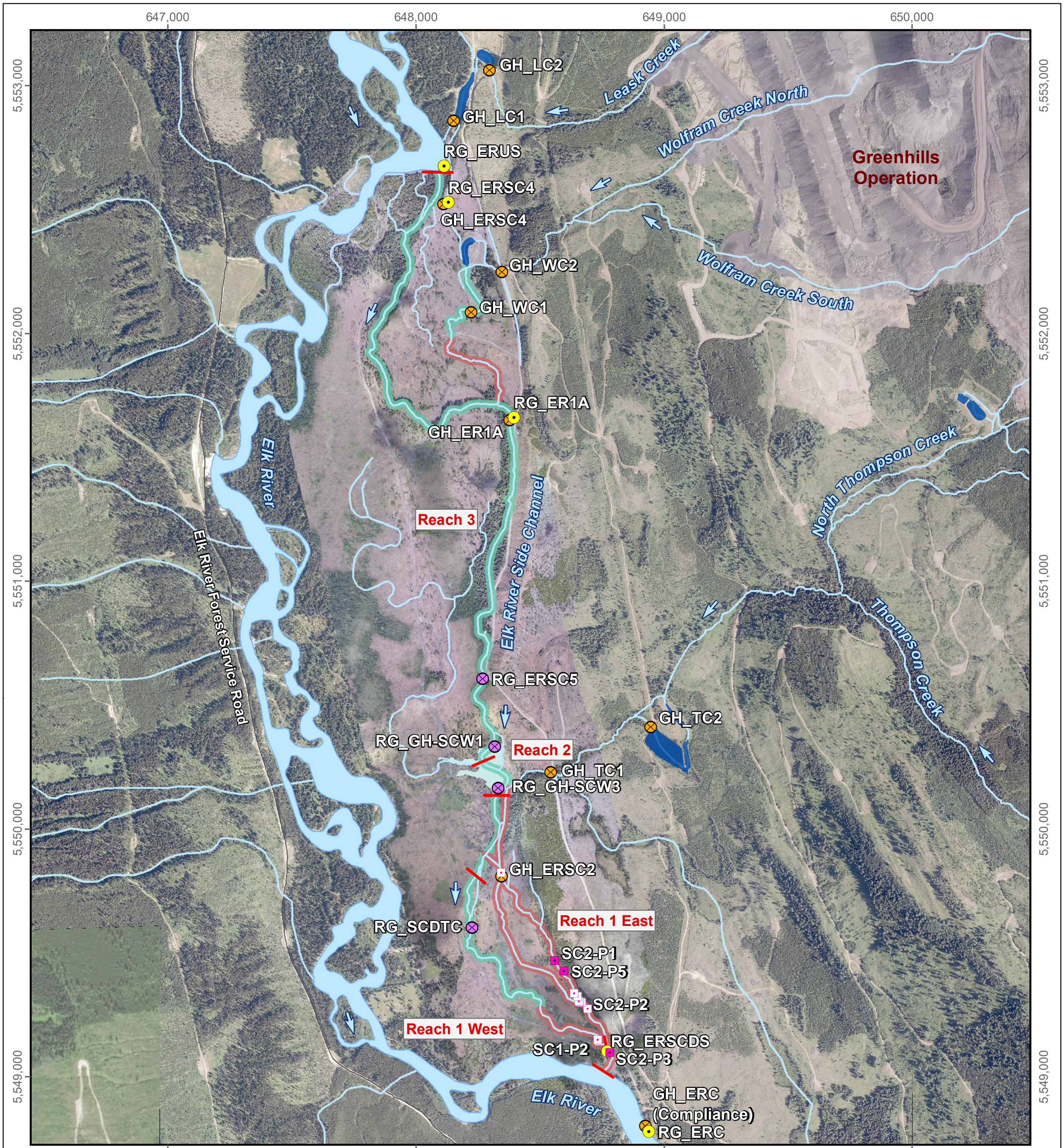

LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, October 2018

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11

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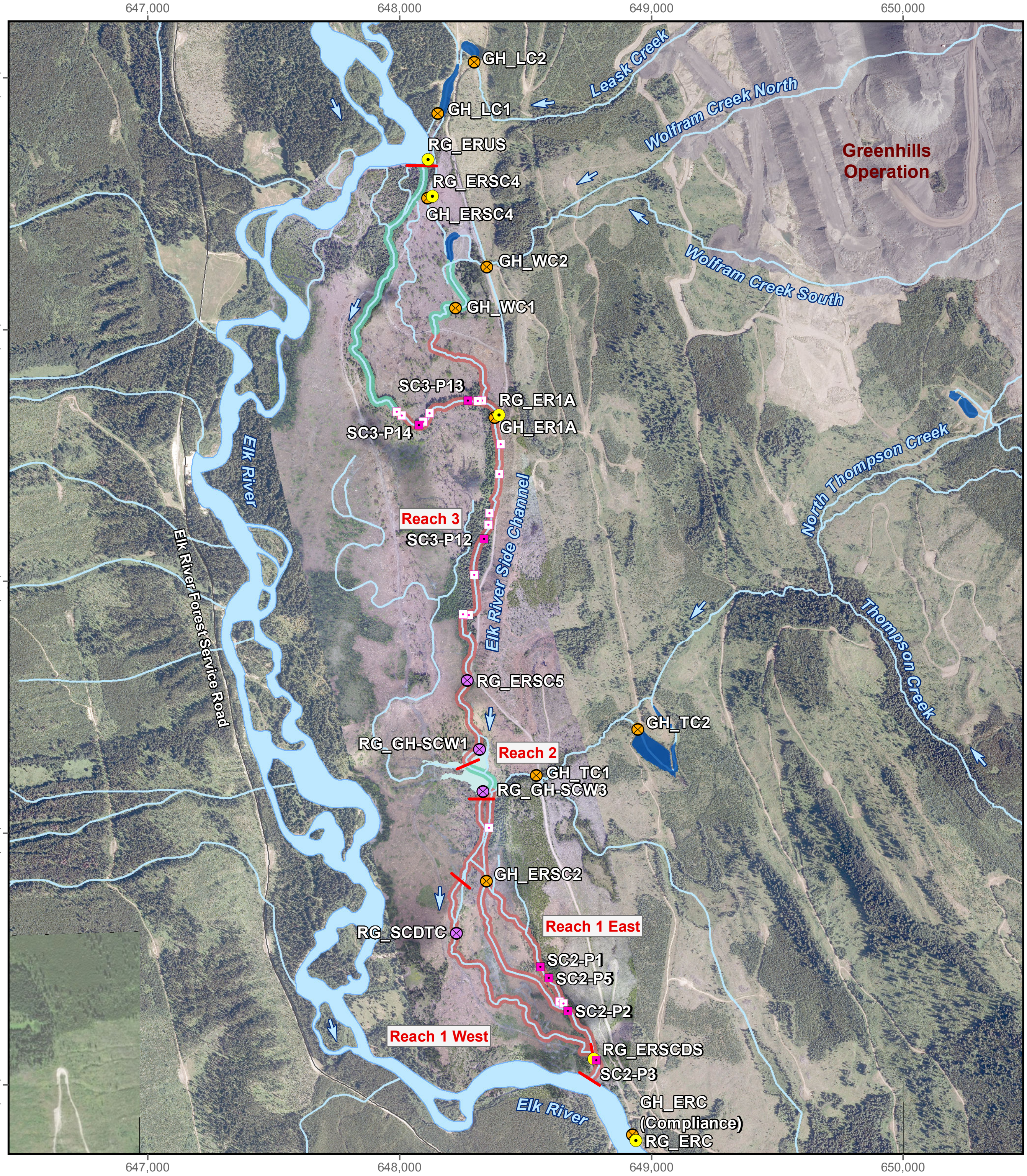
Figure A.9

Document Path: S:\Projects\187202\187202.0018 - Teck GHO LAEMP Implementation 2018\4 - GIS\LAEMP Report\18-18 Fig A.9 Elk River Side Channel-Oct.mxd



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, November 2018

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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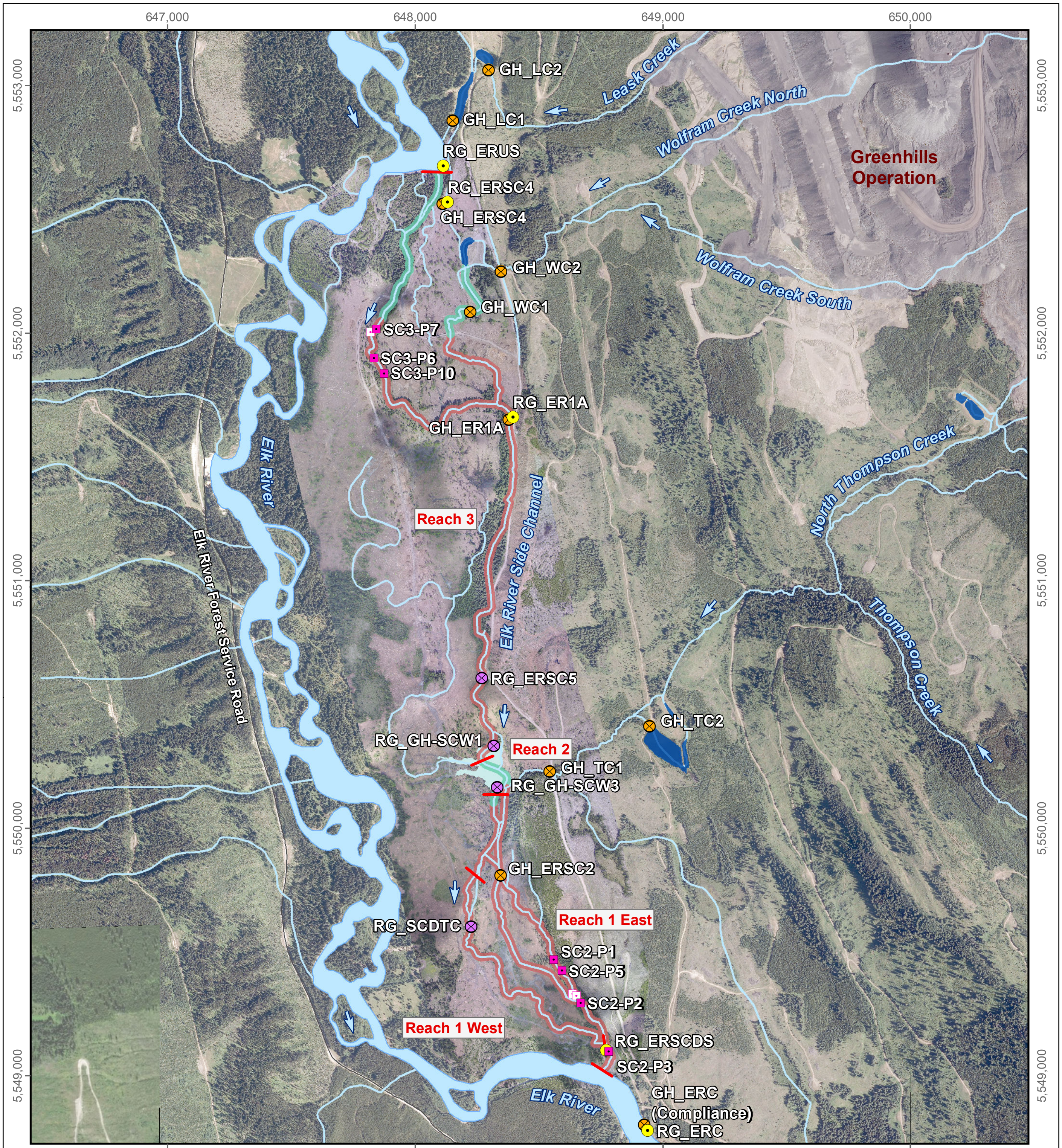
Figure A.10



LEGEND

- Pool, Water Quality Sampling
- Pool
- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed
- GHO LAEMP Mine-exposed Water Quality Sampling Location, Flowing
- Staff Gauge Location
- Reach Break
- Dry Channel
- Wetted Channel
- Settling Pond
- Semi-lentic Area

Elk River Side Channel Wet and Dry Locations, December 2018

0 250 500 1,000 Meters

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
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Figure A.11

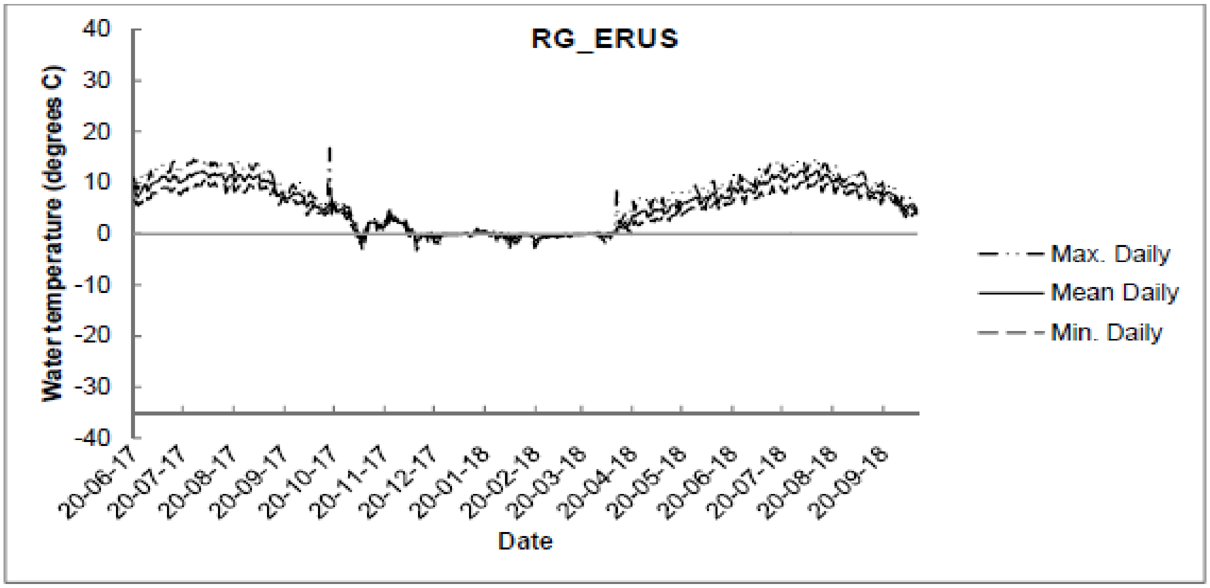


Figure A.12: Temperature Logger Data for RG_ERUS

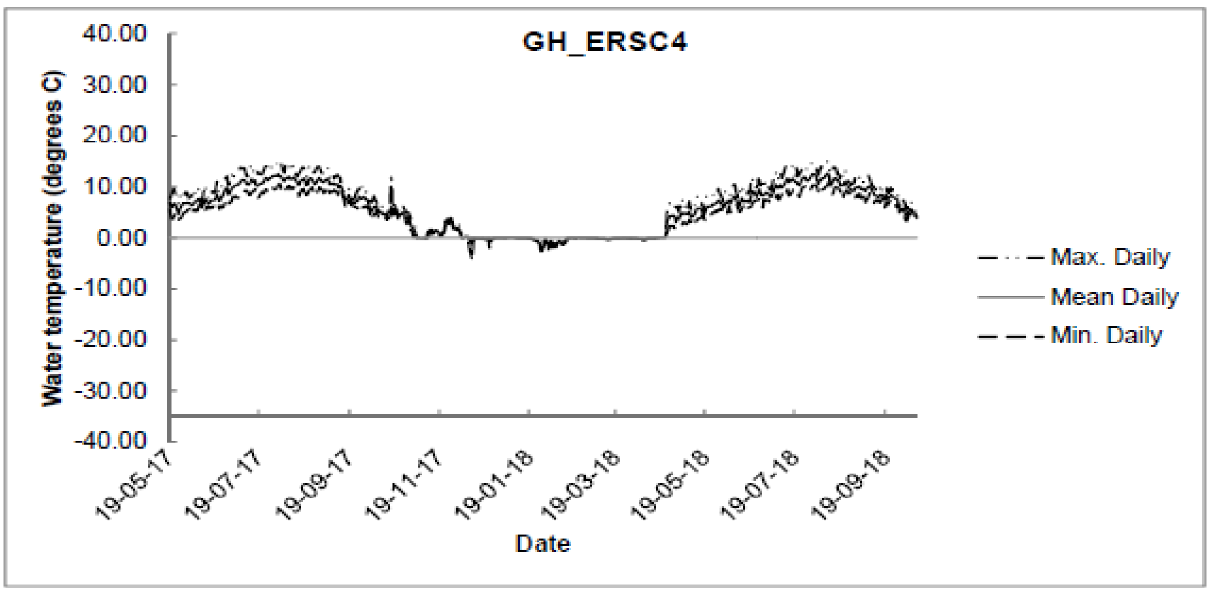


Figure A.13: Temperature Logger Data for GH_ERSC4

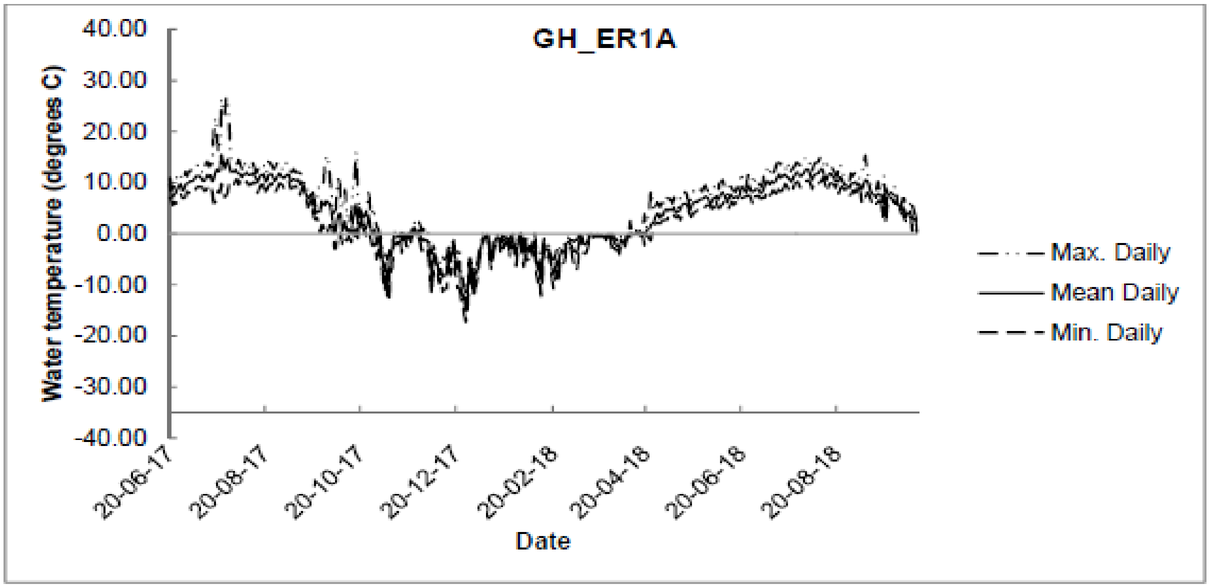


Figure A.14: Temperature Logger Data for GH_ER1A

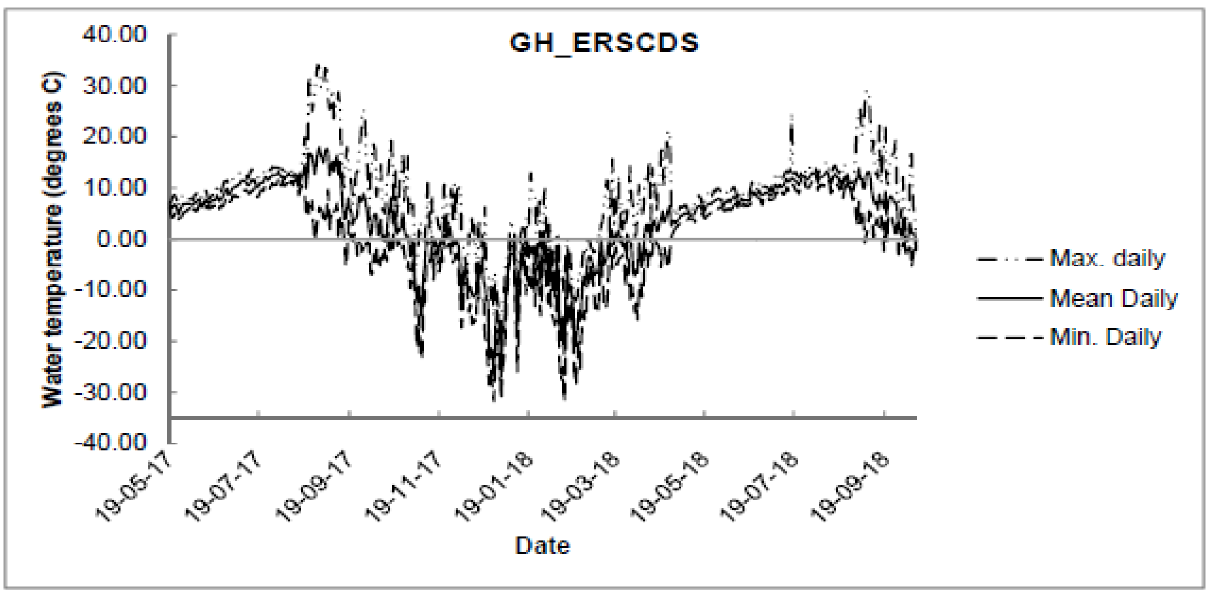


Figure A.15: Temperature Logger Data for GH_ERSDCDS

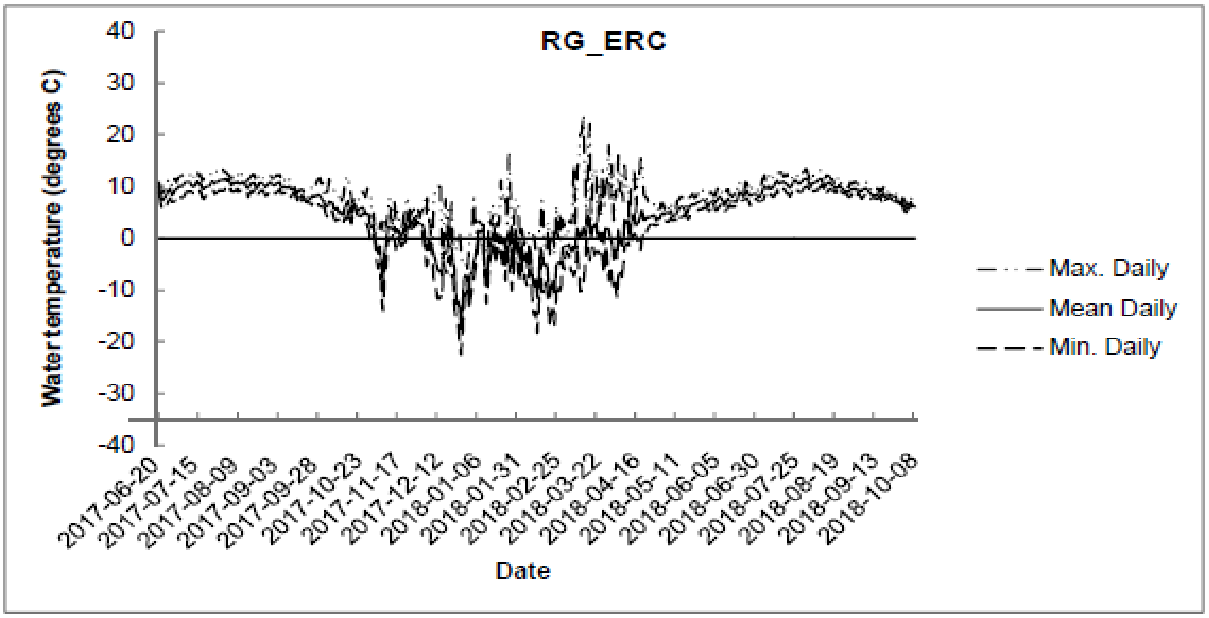


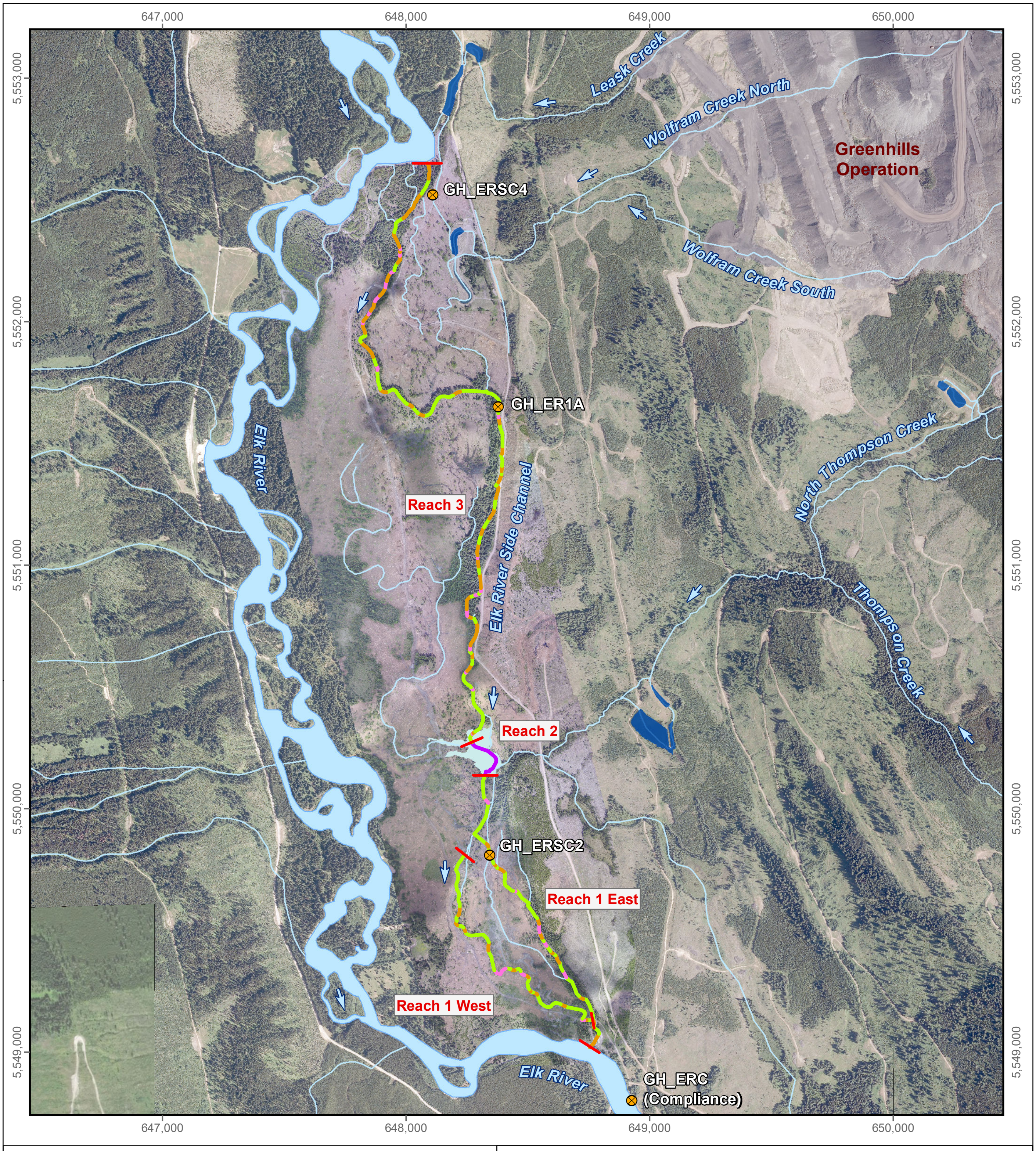
Figure A.16: Temperature Logger Data for GH_ERC

Table A.1: **QA/QC Grading of Three Elk River Side Channel stations with RISC standards (Chernos 2019)**

Station	ERSC4	ER1A	ERSCDS
Instrumentation			
Meter calibration	A	A	A
Meter field verification	A	A	A
Water level gauge type	A	A	A
Water level gauge sensor accuracy	B	B	B
Stream Channel Condition			
Erosion, stability, vegetation	B	B	C
Field Procedures			
# Bench marks	A	A	A
# Manual flow measurement panels	C	C	C
# Manual flow measurement per year	A	A	A
# Level checks per year	B	B	B
Data Calculation and Assessment			
Discharge rating accuracy	A	C	B
Reviewed for anomalies	A	A	A
Stations/years compared as checks	A	A	A

APPENDIX B

HABITAT AND BIOTA



LEGEND

- Routine Water Quality Monitoring Station (Permit 107517), Mine-exposed

Habitat Type

- Glide
- Other: Semi-lotic Side Channel / Beaver Impoundment
- Pool
- Riffle
- Reach Break
- Settling Pond
- Semi-lentic Area

Habitat of the Elk River Side Channel (Original FHAP Survey Completed July 2017)

0 250 500 1,000 Meters

N W E S

Projection: North American Datum 1983 UTM Zone 11

Date: May 2019
Project 187202.0018

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Figure B.1

Table B.1: ***In Situ*** **Water Quality Measurements for Staff Gauge Location RG_ERC, Collected during Monthly Surveys, 2018**

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (μs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
23-Jan-18	3.0	93.6	12.56	336	7.11
14-Jun-18	7.0	89.0	10.78	296	7.85
17-Jul-18	12.1	88.9	9.58	295	7.98
14-Aug-18	9.9	71.7	8.10	284	-
11-Sep-18	9.0	76.4	8.91	337	7.79
9-Oct-18	6.4	76.3	9.37	326	7.63
20-Nov-18	4.2	80.2	10.46	309	7.91
4-Dec-18	4.2	83.0	10.76	343	7.77

[a] *In situ* water quality was collected opportunistically for RG_ERC, and therefore were not measured monthly.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.2: *In Situ* Water Quality Measurements for Staff Gauge Location RG_ERSCDS, Collected during Monthly Surveys, 2018

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
14-Jun-18	7.0	85.6	10.37	329	7.81
17-Jul-18	11.7	85.5	9.23	336	7.83
14-Aug-18	11.5	72.5	7.89	359	8.12

[a] From January 2018 to April 2018, station RG_ERSCDS was dry.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.3: *In Situ* Water Quality Measurements for Staff Gauge Location RG_ER1A, Collected during Monthly Surveys, 2018

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
15-Jun-18	5.8	89.7	11.20	266	7.89
17-Jul-18	10.1	95.3	10.73	280	8.17
14-Aug-18	9.4	79.1	9.05	260	8.30
11-Sep-18	8.1	89.7	10.58	311	8.14
10-Oct-18	3.2	72.8	9.76	310	7.75

[a] From January 2018 to April 2018, station RG_ER1A was dry.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.4: *In Situ* Water Quality Measurements for Staff Gauge Location RG_ERSC4, Collected during Monthly Surveys, 2018

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
24-May-18	5.4	98.6	12.47	255	8.04
15-Jun-18	5.7	92.1	11.54	247	7.99
17-Jul-18	9.5	94.5	10.79	272	8.18
14-Aug-18	9.2	78.7	8.97	260	8.27
11-Sep-18	8.7	87.4	10.16	312	8.16
10-Oct-18	4.6	84.1	10.86	302	8.25
20-Nov-18	0	84.8	12.39	297	8.13
4-Dec-18	0	89.3	13.02	333	8.00

[a] From January 2018 to April 2018, station RG_ERSC4 was dry.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.5: *In Situ* Water Quality Measurements for Staff Gauge Location RG_ERUS, Collected during Monthly Surveys, 2018

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
23-Jan-18	1.2	100.5	14.17	314	7.85
14-Jun-18	6.4	90.5	11.20	274	7.94
17-Jul-18	9.3	91.4	10.48	272	8.11
14-Aug-18	9.1	77.5	8.95	261	8.17
11-Sep-18	8.7	88.0	10.22	312	8.13
10-Oct-18	4.1	79.2	10.41	308	7.92
20-Nov-18	1.1	89.9	12.81	293	8.13
4-Dec-18	0.3	95.2	13.77	327	7.99

[a] *In situ* water quality was collected opportunistically for RG_ERUS, and therefore were not measured monthly.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.6: ***In Situ*** **Water Quality Measurements for the Reach 2 Outlet (SCW3), Collected during Monthly Surveys, 2018**

Date	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
24-Jan-18	0.3	86.8	12.5	1,709	7.71
15-Feb-18	-0.1	78.9	11.36	1,912	8.09
15-Mar-18	0.4	61.9	8.75	1,636	8.32
16-Apr-18	0.3	71.2	10.25	1,322	7.02
24-May-18	7.5	98.6	11.81	400	8.2
14-Jun-18	6.5	94.0	11.58	294	7.90
18-Jul-18	10.3	92.6	10.39	315	8.20
14-Aug-18	13	83.3	8.76	484	8.39
12-Sep-18	7.9	96.5	11.44	561	8.18
11-Oct-18	2.4	84.7	11.56	1,046	8.36
21-Nov-18	-0.1	68.5	9.86	1,986	7.05
4-Dec-18	-0.01	93.6	13.61	2,007	8.00

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.7: *In Situ* Water Quality Measurements for the Reach 2 Inlet (SCW1), Collected during Monthly Surveys, 2018

Date [a]	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH
BCWQG Minimum	-	-	5	-	6.5
BCWQG Maximum	19	-	-	-	9.0
24-May-18	6.5	100.0	12.37	301	8.08
14-Jun-18	6.5	94.1	11.56	293	8.10
18-Jul-18	10	94.6	10.68	277	8.18
14-Aug-18	11.9	82.2	8.81	260	8.30
12-Sep-18	7.5	96.7	11.56	310	8.07
11-Oct-18	2.4	80.8	10.98	293	7.91

[a] From January 2018 to April 2018, station SCW1 was dry.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.8: *In Situ* Water Quality Measurements[a] and Dimensions of Isolated Pools Observed in January, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P1	24-Jan-18	Yes	1.0	66.7	9.38	1,350	7.1	No	3	3	0.20
SC2-P5	24-Jan-18	Yes	1.1	53.3	7.63	677	7.2	No	7	1.5	0.30
Pool1	23-Jan-18	No	-	-	-	-	-	No	-[b]	-[b]	<0.10
SC2-P3	24-Jan-18	Yes	3.2	70.3	9.31	1,445	7.1	No	3	2	0.20

[a] *In situ* water quality was only measured in pools where water quality samples were collected.
[b] Length and width could not be determined due to snow cover.
Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.9: *In Situ* Water Quality Measurements and Dimensions of Isolated Pools Observed in February, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (μs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	14-Feb-18	Yes	-0.1	50.9	6.98	1,374	6.8	No	3	2	0.20

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.10: ***In Situ*** **Water Quality Measurements and Dimensions of Isolated Pools Observed in March, 2018**

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	15-Mar-18	Yes	0.3	40.8	5.66	1,341	7.1	No	3	2	0.20

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.11: *In Situ* Water Quality Measurements[a] and Dimensions of Isolated Pools Observed in April, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (μs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	16-Apr-18	Yes	3.6	67.4	8.88	1,011	- [b]	No	3	2	0.20
April-E-P1	15-Apr-18	No	-	-	-	-	- [b]	No	1	1.5	- [c]
SC2-P5	16-Apr-18	Yes	0.3	71.2	10.34	327	- [b]	No	3.5	0.5	0.15
SC2-P6	16-Apr-18	Yes	0.5	38.6	5.53	219	- [b]	No	2.25	1	0.30
SC3-P11	16-Apr-18	Yes	0.4	60.3	8.71	173	- [b]	No	2.25	1.5	0.20
April-3-P1	15-Apr-18	No	-	-	-	-	- [b]	No	2	3	- [c]
April-3-P2	15-Apr-18	No	-	-	-	-	- [b]	No	2	1.5	- [c]
April-3-P3	15-Apr-18	No	-	-	-	-	- [b]	No	1.75	0.4	- [c]
April-3-P4	15-Apr-18	No	-	-	-	-	- [b]	No	1.5	1	- [c]
SC3-P4	16-Apr-18	Yes	0.2	33.7	4.88	154	- [b]	No	1	1	- [c]
SC3-P3	16-Apr-18	Yes	0.4	60.6	8.77	199	- [b]	No	2	1	- [c]
April-3-P5	15-Apr-18	No	-	-	-	-	- [b]	No	2	1.25	- [c]
April-3-P6	15-Apr-18	No	-	-	-	-	- [b]	No	4.5	1.5	- [c]
SC3-P6	15-Apr-18	No	-	-	-	-	- [b]	No	3	3	- [c]

[a] *In situ* water quality was only measured in pools where water quality samples were collected.
[b] pH probe was damaged.
[c] Ice cover prevented an estimate of deepest depth.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.12: *In Situ* Water Quality Measurements and Dimensions of Isolated Pools Observed in August, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC1-P2	14-Aug-18	Y	10.6	39.1	4.34	402	7.4	no	10	2.5	0.50
SC4-P1	14-Aug-18	Y	9.6	16.8	1.91	414	7.4	no	2	1	0.4

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.13: *In Situ* Water Quality Measurements and Dimensions of Isolated Pools Observed in September, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	12-Sep-18	Y	8.8	32.8	3.79	890	6.9	yes	10	2.5	0.4
SC1-P2	12-Sep-18	Y	8.9	45.9	5.32	698	7.1	no	3	1.5	0.2
SC4-P1	12-Sep-18	Y	7.7	57.0	6.77	967	7.0	no	3.5	1.5	0.2
SC2-P5	12-Sep-18	Y	7.9	71.5	8.43	838	7.1	yes	18	3	0.5
SC2-P1	10-Sep-18	N	9.3	57.0	6.47	1,025	7.2	yes	8.7	2.5	0.2
Sept-2-P1	10-Sep-18	N	10.1	53.1	5.95	918	7.2	no	6.5	3	0.3
Sept-2-P2	10-Sep-18	N	10.1	46.8	5.24	902	7.1	yes	9	2.5	0.2

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.14: *In Situ* Water Quality Measurements[a] and Dimensions of Isolated Pools Observed in October, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	11-Oct-18	Y	4.3	44.8	5.80	1,102	7.2	yes	7.0	2.5	-
Oct-2-P1	11-Oct-18	N	2.3	45.1	6.16	1,096	6.8	yes	1.0	3	-
SC2-P2	11-Oct-18	Y	1.8	45.2	6.25	1,033	7.1	yes	2.0	10.0	-
Oct-2-P3	11-Oct-18	N	5.3	41.6	5.11	1,005	7.3	yes	5	5	-
Oct-2-P4	11-Oct-18	N	2.4	33.4	4.57	1,006	7.3	no	1	1	-
Oct-2-P5	11-Oct-18	N	1.7	42.5	5.87	1,081	7.4	yes	1.5	8	-
Oct-2-P6	11-Oct-18	N	3.2	49.7	6.56	963	7.5	yes	1.75	4.5	-
Oct-2-P7	11-Oct-18	N	3.2	47.1	6.29	804	7.5	yes	3	5	-
SC2-P5	11-Oct-18	N	4.5	64.0	8.23	871	7.6	yes	2.5	15	-
SC2-P1	11-Oct-18	Y	2.3	54.6	7.43	1,252	7.6	yes	3	7	-
SC1-P2	11-Oct-18	Y	4.9	39.6	5.05	807	6.7	no	0.5	1.5	-
Oct-1-P2	11-Oct-18	N	2.9	45.7	6.13	702	6.6	yes	2.5	10	-

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.15: *In Situ* Water Quality Measurements and Dimensions of Isolated Pools Observed in November, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	19-Nov-18	Y	2.2	60.7	8.31	487	6.4	no	10	2.0	0.20
Nov-2-P1	19-Nov-18	N	-0.1	101.2	14.75	1,964	8.2	no	8	2.5	0.15
SC2-P1	19-Nov-18	Y	0.3	57.8	8.35	1,320	7.3	yes	3	2	0.10
SC2-P5	19-Nov-18	Y	1.7	44.4	6.19	555	7.3	no	4	1.5	0.30
Oct-2-P7	19-Nov-18	N	0.7	70.3	10.03	1,246	7.3	no	4	1.5	0.10
Oct-2-P6	19-Nov-18	N	2.3	69.1	9.41	1,177	7.3	no	3	1.5	0.15
SC2-P2	19-Nov-18	Y	2	49.5	6.81	1,114	7.2	no	6	1.5	0.35
SC3-P5	19-Nov-18	N	0	100.9	14.7	343	8.0	no	3	1	0.15
Nov-3-P2	19-Nov-18	N	0	95.3	13.88	330	7.9	no	4	2	0.25
Nov-3-P3	19-Nov-18	N	0.1	99.8	14.52	328	8.0	no	10	3	0.30
SC3-P12	19-Nov-18	Y	0	102.8	14.97	325	8.1	no	32	3	0.35
Nov-3-P5	19-Nov-18	N	0.1	101.7	14.82	322	8.1	no	25	3	0.10
Nov-3-P6	19-Nov-18	N	0	103.6	15.03	333	8.1	no	15	3	0.10
Nov-3-P7	19-Nov-18	N	0.3	108.8	15.75	342	8.1	no	5	3	0.10
Nov-3-P8	19-Nov-18	N	0	91.0	13.34	330	7.1	no	5	3	0.15
Nov-3-P9	19-Nov-18	N	0	79.6	11.64	344	7.6	no	5	2	0.15
Nov-3-P10	19-Nov-18	N	0	89.6	13.09	340	7.9	no	10	2.5	0.10
SC3-P13	19-Nov-18	Y	0	85.0	12.40	335	7.1	no	108	2	0.10
Nov-3-P12	19-Nov-18	N	0	90.0	13.16	330	8.0	no	15	2	0.10
Nov-3-P13	19-Nov-18	N	0	85.5	12.49	326	8.0	no	4	1.5	0.05
SC3-P14	19-Nov-18	Y	0	91.9	13.48	312	8.1	no	55	3	0.15
Nov-3-P15	19-Nov-18	N	0	96.7	14.14	364	8.1	no	12	3	0.08
Nov-3-P16	19-Nov-18	N	0.2	99.2	14.45	341	8.1	no	7	3	0.08

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.16: *In Situ* Water Quality Measurements[a] and Dimensions of Isolated Pools Observed in December, 2018

Pool Name	Date	Water Quality Sample Collected (yes/no)	Temperature (°C)	DO (%)	DO (mg/L)	Specific Conductivity (µs/cm)	pH	Observed Fish Presence (yes/no)	Length (m)	Width (m)	Deepest Depth (m)
BCWQG Minimum	-	-	-	-	5	-	6.5	-	-	-	-
BCWQG Maximum	-	-	19	-	-	-	9.0	-	-	-	-
SC2-P3	3-Dec-18	Y	1.3	46.4	6.48	1,322	6.8	no	2.0	3.5	0.07
SC2-P5	3-Dec-18	Y	1.2	22.5	3.17	531	7.0	no	- [a]	- [a]	0.23
Oct-2-P7	3-Dec-18	N	1.1	57.4	8.06	1,273	7.1	yes	- [a]	- [a]	0.08
Oct-2-P6	3-Dec-18	N	2.6	63.2	-	1,296	7.1	yes	- [a]	- [a]	0.15
SC2-P2	3-Dec-18	Y	2.6	42.0	5.68	1,204	7.0	no	5	1	0.2
SC3-P10	3-Dec-18	Y	0.2	73.8	10.72	350	7.6	no	8	2	0.3
SC3-P6	3-Dec-18	Y	0	80.6	11.74	357	7.6	no	3	1	0.15
Dec-3-P3	3-Dec-18	N	0.1	90.7	13.18	348	7.8	no	6	2	0.3
SC3-P7	3-Dec-18	Y	0.1	74.0	10.76	341	7.6	no	5	2	0.3

[b] Length and width could not be determined due to snow cover.

Value less than the BCWQG minimum or greater than the BCWQG maximum.

Table B.17: GHO LAEMP Fish Observations, January 2018 to December 2018

Species	Number	Life Stage	Month	Location	Easting	Northing
Unidentified	<10	Fry	June	Reach 2	648385	5550197
MW	~30	Fry	July	Reach 2	648284	5550122
MW	5	Fry	July	Reach 2 (1st finger)	648284	5550168
Unidentified	~30	Fry	July	Reach 2	648380	5550206
WCT	15 - 20	Juvenile / adult	August	Reach 1	648782	5549097
MW	5	Fry	August	Reach 1 (west channel)	648511	5549241
MW	~50	Fry	August	Reach 2 (1st finger)	648303	5550163
Unidentified	<10	Fry	August	Reach 1	648363	5549777
5 MW fry	5	Fry	August	Reach 1 (east channel)	648719	5549228
Unidentified	1	Adult	August	Reach 3 (near ERSC4)	648111	5552523
MW	~40	Fry	September	Reach 1 (SC2-P3)	648777	5549096
MW	~20	Fry	September	Reach 1 (west channel)	648741	5549139
WCT	1	Juvenile	September	Reach 1 (west channel)	648741	5549139
MW [a]	125	Fry	September	Reach 2 (2nd finger)	648090	5550244
MW	5	Fry	September	Reach 1 (pool SC2-P5)	648598	5549419
Unidentified	1	Juvenile	September	Reach 1 (pool SC2-P5)	648598	5549419
MW	~40	Fry	September	Reach 1 (pool SC2-P1)	648561	5549473
Unidentified	1	Juvenile	September	Reach 1 (pool SC2-P1)	648561	5549473
MW	20	Fry	September	Reach 1 (pool SC2-P7)	648638	5549332
MW	~25	Fry	September	Reach 1 (east channel)	648658	5549316
Unidentified	1	Juvenile	September	Reach 3	648254	5550573
MW	2	Fry	September	Reach 3	648050	5551618
MW	~30	Fry	October	Reach 1 (SC2-P3)	648777	5549096
MW	~25	Fry	October	Reach 1 (east channel pool)	648691	5549275
WCT	5	Juvenile	October	Reach 1 (east channel pool)	648691	5549275
MW	~30	Fry	October	Reach 1 (east channel pool)	648685	5549293
MW	15	Fry	October	Reach 1 (east channel pool)	648669	5549299
MW	2	Fry	October	Reach 1 (east channel pool)	648657	5549306
MW	~50	Fry	October	Reach 1 (east channel pool)	648650	5549326
MW	23	Fry	October	Reach 1 (SC2-P2)	648638	5549336
WCT	7	Juvenile	October	Reach 1 (SC2-P2)	648638	5549336
MW fry	~30	Fry	October	Reach 1 (east channel pool)	648596	5549426
MW (most abundant), WCT and EB (present)	~200	Fry / Juvenile	October	Reach 1 (pool SC2-P1)	648559	5549470
MW	~20	Fry	October	Reach 1 (west channel pool)	648733	5549150
MW	~10	Fry	November	Reach 1 (SC2-P1)	648561	5549477
Unidentified	2	Juvenile	November	Reach 3	647861	5551860
Unidentified	~20 - 30	Fry / juvenile	December	Reach 1 (pool SC2-P1)	648559	5549470
WCT	4	Fry / juvenile	December	Reach 1 (east channel pool)	648645	5549336
WCT	5	Fry / juvenile	December	Reach 1 (east channel pool)	648552	5549328

Note: MW = mountain whitefish. WCT = westslope cutthroat trout. EB = eastern brook trout.
[a] The 125 MW were deseased and were found in the naturally dewatering area off of Reach 2.

Table B.18: GHO LAEMP Amphibian Observations, May 2017 to December 2018

Observation	Number	Year	Month	Location	Easting	Northing
Western toad	1	2017	June	Reach 1	-	-
Columbia spotted frog	1	2017	July	Reach 1	-	-
Western toad	1	2017	July	Reach 2	-	-
Columbia spotted frog	1	2017	August	Reach 1	-	-
Columbia spotted frog	1	2017	August	Reach 3	-	-
Unidentified frog/toad	1	2017	August	Elk River	-	-
Columbia spotted frog	1	2018	June	Reach 2	648373	5550161
Western toad	1	2018	July	Reach 1/2 break	648257	5549933
Western toad	1	2018	July	Reach 2	648325	5550044
Western toad	1	2018	July	Reach 2 (2nd finger)	648112	5550281
Western toad	1	2018	July	Reach 2	648167	5550274
Western toad	1	2018	August	Reach 1 (west channel)	648476	5549317
Western toad	1	2018	August	Reach 2 (2nd finger)	647955	5550282
Western toad	1	2018	August	Reach 1 (east channel)	648597	5549374
Long-toed salamander[a]	10	2018	September	Reach 2 (2nd finger)	648090	5550244

[a] The 10 salamanders (larva life stage) were found deseased in the naturally dewatering area off of Reach 2.

Table B.19: GHO LAEMP Aquatic-dependent Bird Observations, May 2017 to December 2018

Observation	Number	Year	Month	Location	Easting	Northing
Mallard	multiple	2017	August	Reach 1	-	-
American dipper	multiple	2017	August	Reach 3	-	-
Killdeer	1	2018	May	Reach 3 near Wolfram	648146	5551918
Killdeer	1	2018	June	Reach 1 (east channel)	648436	5549673
Female mallard	2	2018	June	Reach 1 (east channel)	648384	5549941
Killdeer	2	2018	June	Reach 1 (middle channel)	648346	5549588
Bald eagle	2	2018	June	Reach 1 (middle channel)	648324	5549668
Killdeer	1	2018	June	Reach 1 (west channel)	648764	5549055
Killdeer	1	2018	June	Reach 2	648290	5550004
Male mallard	1	2018	June	Reach 2	647958	5550266
Female mallard	1	2018	June	Reach 2	647958	5550266
Killdeer	1	2018	June	Wolfram Pond	648137	5552003
American bittern	1	2018	June	Reach 2	-	-
Bank swallow	8	2018	June	Reach 2	-	-
Canada goose	8	2018	June	Reach 2	-	-
Common yellowthroat	2	2018	June	Reach 2	-	-
Northern waterthrush	5	2018	June	Reach 2	-	-
Belted kingfisher	1	2018	June	Reach 2	-	-
Common yellowthroat	1	2018	June	Reach 2	-	-
Northern waterthrush	3	2018	June	Reach 2	-	-
Blue heron	1	2018	July	Reach 1	648661	5549156
Killdeer	2	2018	July	Reach 1	648343	5549859
Mallard	1	2018	July	Reach 1	648416	5549822
Killdeer	2	2018	July	Reach 3 near Wolfram	648210	5552101
Mallard	1	2018	August	Reach 1 (east channel)	648497	5549663
Killdeer	1	2018	August	Reach 1	648482	5549449
Canada goose	1	2018	August	Reach 3 near Wolfram	648197	5552099

APPENDIX C

WATER QUALITY

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)
GH_BR_F	n	7	7	7	7	7	7	7
	Annual Minimum	115	8.09	8.03	8.70	84.3	0.0125	<0.00100
	Annual Maximum	176	8.28	8.73	11.4	162	0.393	<0.00100
	Annual Mean	137	8.23	8.32	10.2	108	0.184	<0.00100
	Annual Median	123	8.24	8.26	10.5	93.3	0.172	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WOLF	n	15	15	15	15	15	15	15
	Annual Minimum	149	8.20	8.06	9.20	110	0.0316	<0.00100
	Annual Maximum	275	8.70	8.46	12.1	223	0.772	0.00300
	Annual Mean	205	8.40	8.32	10.6	173	0.253	0.00114
	Annual Median	210	8.37	8.38	10.4	189	0.155	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0%	80%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WILLOW	n	21	21	21	21	21	21	21
	Annual Minimum	155	8.22	7.64	8.30	120	0.00610	<0.00100
	Annual Maximum	280	8.71	8.31	12.1	251	0.412	<0.00100
	Annual Mean	243	8.47	8.11	10.4	207	0.143	<0.00100
	Annual Median	261	8.46	8.15	10.2	218	0.0801	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WILLOW_SP1	n	7	7	7	7	7	7	7
	Annual Minimum	143	8.30	7.98	8.30	123	<0.00500	<0.00100
	Annual Maximum	246	8.48	8.37	11.6	265	0.259	<0.00100
	Annual Mean	194	8.39	8.18	10.2	177	0.133	<0.00100
	Annual Median	199	8.40	8.17	10.4	144	0.163	<0.00100
	% < LRL	0%	0%	0%	0%	0%	29%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WADE	n	15	15	15	15	15	15	15
	Annual Minimum	187	8.26	8.01	8.70	143	0.0600	<0.00100
	Annual Maximum	344	8.66	8.50	12.5	310	1.82	0.00240
	Annual Mean	277	8.48	8.30	11.0	224	0.744	0.00111
	Annual Median	284	8.49	8.29	11.7	240	0.685	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	80%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_COUGAR	n	7	7	7	7	7	7	7
	Annual Minimum	171	8.31	8.05	8.50	122	0.120	<0.00100
	Annual Maximum	252	8.50	8.41	12.4	270	0.764	<0.00100
	Annual Mean	205	8.41	8.23	10.6	170	0.444	<0.00100
	Annual Median	191	8.43	8.24	11.4	151	0.429	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	100%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_NNC	n	20	20	20	20	20	20	20
	Annual Minimum	180	8.26	7.71	7.60	126	0.110	<0.00100
	Annual Maximum	318	8.74	8.09	11.5	328	1.68	<0.00500
	Annual Mean	257	8.46	7.94	9.49	223	0.775	0.00171
	Annual Median	270	8.46	7.95	9.15	228	0.720	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	60%
	% > BCWQG[a]	-	0%	0%	10%	0%	0%	0%
	% > BCWQG[b]	-	-	-	10%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_BR_D	n	13	13	13	13	13	13	13
	Annual Minimum	186	8.22	7.64	6.00	108	0.0236	<0.00100
	Annual Maximum	293	8.74	8.15	11.9	279	2.13	0.00970
	Annual Mean	250	8.43	7.93	9.24	212	0.427	0.00167
	Annual Median	265	8.43	7.98	8.97	217	0.121	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	92%
	% > BCWQG[a]	-	0%	0%	23%	0%	0%	0%
	% > BCWQG[b]	-	-	-	23%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)
GH_MC1	n	19	19	18	18	19	19	19
	Annual Minimum	251	8.36	7.89	8.10	160	0.00910	<0.00100
	Annual Maximum	436	8.76	8.62	12.3	268	1.14	<0.00500
	Annual Mean	358	8.52	8.38	10.4	232	0.337	0.00101
	Annual Median	363	8.51	8.48	10.4	241	0.166	<0.00100
	% < LRL	0%	0%	0%	0%	0%	0.0%	89%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_LC2	n	25	25	23	23	25	25	25
	Annual Minimum	1,390	8.18	7.95	3.90	201	33.9	<0.00500
	Annual Maximum	2,200	8.52	8.49	12.6	354	83.7	0.184
	Annual Mean	1,800	8.32	8.30	10.4	270	59.3	0.0164
	Annual Median	1,790	8.34	8.34	10.5	275	55.8	0.00780
	% < LRL	0%	0%	0%	0%	0%	0.0%	36%
	% > BCWQG[a]	-	0%	0%	4%	0%	100%	8%
	% > BCWQG[b]	-	-	-	4%	-	100%	4%
	% > Level 1 Benchmark	100%	-	-	-	-	100%	-
	% > Level 2 Benchmark	-	-	-	-	-	100%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_LC1	n	10	10	10	10	10	10	10
	Annual Minimum	528	8.15	7.99	8.00	168	10.6	0.00750
	Annual Maximum	2,040	8.47	8.39	11.9	325	72.2	0.202
	Annual Mean	1,460	8.33	8.19	10.2	226	43.3	0.0898
	Annual Median	1,690	8.35	8.20	10.4	226	41.8	0.0886
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	70%
	% > BCWQG[b]	-	-	-	0%	-	70%	10%
	% > Level 1 Benchmark	70%	-	-	-	-	100%	-
	% > Level 2 Benchmark	-	-	-	-	-	100%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WC2	n	25	25	24	24	25	25	25
	Annual Minimum	832	8.00	8.23	8.50	168	22.3	<0.00500
	Annual Maximum	2,110	8.54	8.49	70.0	291	67.5	0.0187
	Annual Mean	1,740	8.24	8.36	13.1	247	48.1	0.0101
	Annual Median	1,900	8.23	8.39	10.4	253	45.7	0.00910
	% < LRL	0%	0%	0%	0%	0%	0.0%	16%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%
	% > BCWQG[b]	-	-	-	0%	-	92%	0%
	% > Level 1 Benchmark	96%	-	-	-	-	100%	-
	% > Level 2 Benchmark	-	-	-	-	-	100%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_WC1	n	17	17	19	19	17	17	17
	Annual Minimum	874	7.85	7.80	8.10	191	23.0	0.00810
	Annual Maximum	2,150	8.52	8.47	11.7	275	56.4	0.0460
	Annual Mean	1,710	8.24	8.23	9.95	243	43.2	0.0214
	Annual Median	1,840	8.25	8.28	9.87	243	43.8	0.0199
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	100%	0%
	% > BCWQG[b]	-	-	-	0%	-	82%	0%
	% > Level 1 Benchmark	94%	-	-	-	-	100%	-
	% > Level 2 Benchmark	-	-	-	-	-	100%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_TC2	n	19	19	23	24	19	19	19
	Annual Minimum	470	8.18	7.82	10.1	151	2.80	0.00180
	Annual Maximum	1,740	8.53	8.53	15.3	309	19.0	0.0458
	Annual Mean	1,220	8.34	8.25	11.8	211	12.1	0.0115
	Annual Median	1,370	8.35	8.23	11.5	227	14.1	0.00990
	% < LRL	0%	0%	0%	0%	0%	0.0%	0%
	% > BCWQG[a]	-	0%	0%	0%	0%	89%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%
	% > Level 1 Benchmark	74%	-	-	-	-	89%	-
	% > Level 2 Benchmark	-	-	-	-	-	89%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-
GH_TC1	n	25	25	25	25	25	25	25
	Annual Minimum	212	8.25	8.10	7.30	147	0.00550	<0.00100
	Annual Maximum	1,670	8.53	8.59	14.0	237	19.8	0.0439
	Annual Mean	1,200	8.39	8.34	10.6	204	11.2	0.0108
	Annual Median	1,290	8.39	8.33	11.2	213	11.4	0.0100
	% < LRL	0%	0%	0%	0%	0%	0.0%	12%
	% > BCWQG[a]	-	0%	0%	4%	0%	92%	0%
	% > BCWQG[b]	-	-	-	4%	-	0%	0%
	% > Level 1 Benchmark	72%	-	-	-	-	92%	-
	% > Level 2 Benchmark	-	-	-	-	-	92%	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Ammonia (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)
	n	7	7	7	7	7	7	7	7
	Annual Minimum	<0.00500	3.22	<0.500	0.101	0.000110	0.000190	0.0969	<0.0000200
	Annual Maximum	0.0187	5.99	<0.500	0.124	0.000150	0.000400	0.130	0.0000320
	Annual Mean	0.0125	4.20	<0.500	0.112	0.000131	0.000273	0.111	0.0000234
	Annual Median	0.0136	3.56	<0.500	0.107	0.000130	0.000220	0.105	<0.0000200
GH_BR_F	% < LRL	14%	0%	100%	0%	0%	0%	0%	57%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	15	15	15	15	15	15	15	15
	Annual Minimum	0.00540	7.12	0.210	0.0960	<0.000100	0.000170	0.0920	<0.0000200
	Annual Maximum	0.0172	19.0	<0.500	0.143	0.000140	0.000440	0.139	0.0000540
	Annual Mean	0.0106	12.9	0.210	0.124	0.000110	0.000237	0.112	0.0000262
	Annual Median	0.0106	13.5	0.210	0.127	<0.000100	0.000190	0.112	<0.0000200
GH_WOLF	% < LRL	0%	0%	93%	0%	53%	0%	0%	73%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	21	21	21	21	21	21	21	21
	Annual Minimum	<0.00500	8.01	0.250	0.112	<0.000100	0.000170	0.117	<0.0000200
	Annual Maximum	0.113	38.2	0.830	0.165	0.000160	0.000500	0.247	0.0000420
	Annual Mean	0.0143	22.3	0.394	0.143	0.000109	0.000243	0.195	0.0000215
	Annual Median	0.00940	19.3	0.250	0.143	<0.000100	0.000220	0.205	<0.0000200
GH_WILLOW	% < LRL	29%	0%	62%	0%	62%	0%	0%	86%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	7	7	0	7	7	7	7	7
	Annual Minimum	<0.00500	6.52	-	0.0670	<0.000100	0.000200	0.0978	<0.0000200
	Annual Maximum	0.0185	21.7	-	0.145	0.000150	0.000320	0.181	0.0000230
	Annual Mean	0.0108	12.7	-	0.119	0.000117	0.000259	0.138	0.0000207
	Annual Median	0.0107	11.9	-	0.119	0.000120	0.000240	0.138	<0.0000200
GH_WILLOW_SP1	% < LRL	14%	0%	-	0%	29%	0%	0%	57%
	% > BCWQG[a]	0%	0%	-	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	-	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	15	15	15	15	15	15	15	15
	Annual Minimum	<0.00500	18.9	0.280	0.0840	0.000140	0.000240	0.0990	<0.0000200
	Annual Maximum	0.0249	41.3	0.710	0.178	0.000220	0.000620	0.150	0.0000560
	Annual Mean	0.00925	31.7	0.403	0.143	0.000183	0.000349	0.126	0.0000263
	Annual Median	0.00700	31.0	0.280	0.149	0.000180	0.000320	0.133	<0.0000200
GH_WADE	% < LRL	40%	0%	60%	0%	7%	0%	0%	73%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	7	7	7	7	7	7	7	7
	Annual Minimum	<0.00500	9.81	0.400	0.0980	0.000110	0.000250	0.0945	<0.0000200
	Annual Maximum	0.0166	17.3	0.780	0.115	0.000250	0.00167	0.174	0.000207
	Annual Mean	0.00983	12.7	0.454	0.107	0.000141	0.000504	0.115	0.0000497
	Annual Median	0.00920	11.4	0.400	0.106	0.000120	0.000290	0.106	<0.0000200
GH_COUGAR	% < LRL	14%	0%	71%	0%	0%	0%	0%	71%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	14%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	20	20	19	20	20	20	20	20
	Annual Minimum	<0.00500	6.31	0.360	0.0960	<0.000100	0.000170	0.0685	<0.0000200
	Annual Maximum	0.0532	16.1	0.680	0.145	0.000140	0.000680	0.139	0.0000400
	Annual Mean	0.0178	10.4	0.465	0.122	0.000106	0.000286	0.108	0.0000215
	Annual Median	0.0144	10.6	0.360	0.123	<0.000100	0.000230	0.110	<0.0000200
GH_NNC	% < LRL	10%	0%	53%	0%	70%	5%	0%	90%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
	n	13	13	12	13	13	13	13	13
	Annual Minimum	<0.00500	3.57	<0.500	0.0730	0.000105	0.000260	0.0665	<0.0000200
	Annual Maximum	0.0271	11.3	0.710	0.121	0.000170	0.000410	0.165	0.0000390
	Annual Mean	0.0133	5.83	0.528	0.101	0.000137	0.000293	0.127	0.0000215
	Annual Median	0.0120	5.51	<0.500	0.102	0.000140	0.000270	0.137	<0.0000200
GH_BR_D	% < LRL	15%	0%	67%	0%	0%	8%	0%	92%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Ammonia (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)
GH_MC1	n	19	19	19	19	19	19	19	19
	Annual Minimum	<0.00500	50.8	0.550	0.161	0.000230	0.000200	0.0625	<0.0000200
	Annual Maximum	0.0359	133	4.21	0.226	0.000460	0.000460	0.0880	0.0000340
	Annual Mean	0.0122	87.1	1.84	0.190	0.000338	0.000282	0.0758	0.0000211
	Annual Median	0.0108	81.8	1.54	0.182	0.000340	0.000260	0.0754	<0.0000200
	% < LRL	21%	0%	0%	0%	0%	5%	0%	89%
	% > BCWQG[a]	0%	0%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	0%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_LC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	<0.00500	566	<2.50	0.140	0.00202	0.000390	0.0448	<0.0000200
	Annual Maximum	0.0524	910	8.10	0.480	0.00703	0.000780	0.0749	<0.0000400
	Annual Mean	0.0116	802	4.92	0.231	0.00339	0.000523	0.0574	0.0000200
	Annual Median	0.00810	798	5.00	0.220	0.00302	0.000500	0.0574	<0.0000200
	% < LRL	20%	0%	4%	20%	0%	4%	0%	96%
	% > BCWQG[a]	0%	100%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	100%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_LC1	n	10	10	10	10	10	10	10	10
	Annual Minimum	0.00710	203	0.980	0.150	0.00121	0.000340	0.0390	<0.0000200
	Annual Maximum	0.0601	907	6.20	0.320	0.00655	0.000540	0.0721	<0.0000200
	Annual Mean	0.0239	684	3.94	0.221	0.00356	0.000441	0.0530	<0.0000200
	Annual Median	0.0184	812	4.90	0.205	0.00338	0.000455	0.0539	<0.0000200
	% < LRL	0%	0%	0%	0%	0%	0%	0%	100%
	% > BCWQG[a]	0%	70%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	70%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	<0.00500	371	<2.50	0.160	0.00217	<0.000200	0.0533	<0.0000200
	Annual Maximum	0.0261	1,070	5.50	0.340	0.00515	0.00244	0.750	0.000381
	Annual Mean	0.0101	858	4.05	0.236	0.00394	0.000515	0.137	0.0000521
	Annual Median	0.00810	925	4.00	0.231	0.00398	0.000300	0.0697	<0.0000200
	% < LRL	28%	0%	4%	0%	0%	4%	0%	72%
	% > BCWQG[a]	8%	96%	0%	-	0%	-	0%	12%
	% > BCWQG[b]	8%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	96%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WC1	n	17	17	17	17	17	17	17	17
	Annual Minimum	<0.00500	371	<2.50	0.190	0.00243	<0.000200	0.0464	<0.0000200
	Annual Maximum	0.0578	1,050	4.90	0.320	0.00525	0.000710	0.113	0.0000470
	Annual Mean	0.0130	827	3.87	0.237	0.00394	0.000314	0.0647	0.0000216
	Annual Median	0.00930	906	4.10	0.240	0.00401	0.000290	0.0619	<0.0000200
	% < LRL	18%	0%	6%	0%	0%	6%	0%	94%
	% > BCWQG[a]	0%	94%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	94%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_TC2	n	19	19	19	19	18	18	18	18
	Annual Minimum	0.00590	208	6.12	<0.100	0.000120	0.000180	0.0663	<0.0000200
	Annual Maximum	0.0460	1,030	17.6	<0.200	<0.000200	0.000420	0.0891	0.0000560
	Annual Mean	0.0161	666	12.9	0.109	0.000152	0.000264	0.0768	0.0000230
	Annual Median	0.0140	740	14.9	0.102	0.000150	0.000250	0.0758	<0.0000200
	% < LRL	0%	0%	0%	32%	6%	6%	0%	83%
	% > BCWQG[a]	11%	79%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	11%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	74%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_TC1	n	25	25	25	25	24	24	24	24
	Annual Minimum	<0.00500	19.5	<0.500	<0.100	<0.000100	0.000160	0.0634	<0.0000200
	Annual Maximum	0.0324	996	17.4	<0.200	0.000230	0.000870	0.0927	0.0000840
	Annual Mean	0.0124	641	12.2	0.112	0.000158	0.000269	0.0788	0.0000242
	Annual Median	0.00980	706	12.8	0.110	0.000160	0.000230	0.0773	<0.0000200
	% < LRL	16%	0%	4%	40%	4%	0%	0%	88%
	% > BCWQG[a]	0%	88%	0%	-	0%	-	0%	0%
	% > BCWQG[b]	0%	-	0%	0%	-	0%	-	-
	% > Level 1 Benchmark	-	84%	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)
GH_BR_F	n	7	7	7	7	7	7	7	7
	Annual Minimum	<0.0100	<0.000100	<0.000100	0.000710	0.0170	<0.0000500	0.00410	0.000480
	Annual Maximum	0.0110	0.00122	0.000290	0.00196	0.624	0.000410	0.00850	0.00986
	Annual Mean	0.0101	0.000421	0.000163	0.00120	0.251	0.000176	0.00570	0.00429
	Annual Median	<0.0100	0.000230	0.000120	0.00108	0.163	0.000108	0.00510	0.00251
	% < LRL	86%	43%	43%	0%	0%	43%	0%	0%
	% > BCWQG[a]	0%	14%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WOLF	n	15	15	15	15	15	15	15	15
	Annual Minimum	0.0120	<0.000100	<0.000100	<0.000500	0.0210	<0.0000500	0.00540	0.000510
	Annual Maximum	0.0280	0.00101	0.000530	0.00203	1.07	0.000769	0.0134	0.0307
	Annual Mean	0.0190	0.000308	0.000193	0.000892	0.247	0.000205	0.00937	0.00808
	Annual Median	0.0200	0.000120	<0.000100	0.000670	0.0600	0.0000580	0.00950	0.00192
	% < LRL	0%	33%	67%	20%	0%	40%	0%	0%
	% > BCWQG[a]	0%	7%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	7%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WILLOW	n	21	21	21	21	21	21	21	21
	Annual Minimum	0.0110	<0.000100	<0.000100	<0.000500	<0.0100	<0.0000500	0.00560	<0.000400
	Annual Maximum	0.0150	0.000810	0.000370	0.00153	0.751	0.000541	0.0129	0.0178
	Annual Mean	0.0125	0.000197	0.000125	0.000652	0.124	0.000107	0.0104	0.00342
	Annual Median	0.0120	0.000110	<0.000100	<0.000500	0.0640	<0.0000500	0.0114	0.00199
	% < LRL	0%	48%	81%	62%	14%	57%	0%	5%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WILLOW_SP1	n	7	7	7	7	7	7	7	7
	Annual Minimum	0.0120	0.000120	<0.000100	<0.000500	0.0310	<0.0000500	0.00540	0.00135
	Annual Maximum	0.0140	0.000610	0.000190	0.00134	0.473	0.000258	0.00860	0.00620
	Annual Mean	0.0129	0.000334	0.000134	0.000837	0.210	0.000140	0.00709	0.00362
	Annual Median	0.0130	0.000210	0.000100	0.000700	0.140	0.000106	0.00760	0.00307
	% < LRL	0%	0%	43%	14%	0%	43%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WADE	n	15	15	15	15	15	15	15	15
	Annual Minimum	0.0310	<0.000100	<0.000100	<0.000500	<0.0100	<0.0000500	0.0113	0.000410
	Annual Maximum	0.0520	0.000970	0.000600	0.00216	0.901	0.000905	0.0235	0.0288
	Annual Mean	0.0402	0.000300	0.000195	0.000965	0.239	0.000212	0.0170	0.00675
	Annual Median	0.0400	0.000130	<0.000100	0.000680	0.0590	0.0000550	0.0176	0.00222
	% < LRL	0%	47%	60%	27%	20%	47%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_COUGAR	n	7	7	7	7	7	7	7	7
	Annual Minimum	0.0130	<0.000100	<0.000100	0.000550	0.0240	<0.0000500	0.00370	0.000750
	Annual Maximum	0.0170	0.00259	0.00206	0.00731	3.16	0.00301	0.00610	0.101
	Annual Mean	0.0157	0.000566	0.000421	0.00188	0.607	0.000548	0.00486	0.0183
	Annual Median	0.0160	0.000160	0.000100	0.000870	0.116	0.0000800	0.00460	0.00386
	% < LRL	0%	43%	43%	0%	0%	43%	0%	0%
	% > BCWQG[a]	0%	14%	0%	14%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	14%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_NNC	n	20	20	20	20	20	20	20	20
	Annual Minimum	0.0170	<0.000100	<0.000100	<0.000500	0.0280	<0.0000500	0.00450	0.000870
	Annual Maximum	0.0360	0.000590	0.000250	0.00175	0.600	0.000369	0.0106	0.203
	Annual Mean	0.0272	0.000143	0.000123	0.000667	0.107	0.0000819	0.00744	0.0260
	Annual Median	0.0270	<0.000100	<0.000100	0.000520	0.0640	<0.0000500	0.00750	0.0105
	% < LRL	0%	65%	70%	40%	0%	70%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_BR_D	n	13	13	13	13	13	13	13	13
	Annual Minimum	<0.0100	<0.000100	<0.000100	0.000590	0.0200	<0.0000500	0.00210	0.00124
	Annual Maximum	0.0240	0.000520	0.000300	0.00187	0.577	0.000472	0.00390	0.0525
	Annual Mean	0.0180	0.000155	0.000115	0.000911	0.0768	0.0000828	0.00327	0.00626
	Annual Median	0.0200	<0.000100	<0.000100	0.000780	0.0330	<0.0000500	0.00350	0.00250
	% < LRL	8%	54%	92%	0%	0%	85%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Boron (mg/L)	Total Chromium (mg/L)	Total Cobalt (mg/L)	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)
GH_MC1	n	19	19	19	19	19	19	19	19
	Annual Minimum	0.0180	<0.000100	<0.000100	<0.000500	<0.0100	<0.0000500	0.0161	0.000170
	Annual Maximum	0.0420	0.000690	0.000750	0.00287	0.655	0.000447	0.0380	0.0190
	Annual Mean	0.0306	0.000203	0.000208	0.000888	0.106	0.000110	0.0292	0.00392
	Annual Median	0.0310	<0.000100	<0.000100	0.000630	0.0230	<0.0000500	0.0311	0.00153
	% < LRL	0%	58%	53%	37%	47%	63%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_LC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	0.0220	<0.000100	0.000230	0.000700	<0.0100	<0.0000500	0.126	0.000420
	Annual Maximum	0.0340	0.000750	0.00328	0.00251	0.536	0.000296	0.248	0.0227
	Annual Mean	0.0286	0.000151	0.000645	0.00124	0.0434	0.0000633	0.173	0.00302
	Annual Median	0.0290	<0.000100	0.000460	0.00122	<0.0100	<0.0000500	0.169	0.00150
	% < LRL	0%	64%	0%	0%	64%	88%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_LC1	n	10	9	10	10	10	10	10	10
	Annual Minimum	0.0150	<0.000100	0.000320	0.000740	<0.0100	<0.0000500	0.0662	0.000690
	Annual Maximum	0.0320	0.000290	0.000970	0.00121	0.188	0.000154	0.249	0.00821
	Annual Mean	0.0272	0.000158	0.000599	0.000946	0.0502	0.0000652	0.162	0.00318
	Annual Median	0.0285	0.000110	0.000610	0.000910	0.0115	<0.0000500	0.182	0.00173
	% < LRL	0%	44%	0%	0%	50%	80%	0%	0%
	% > BCWQG[a]	0%	0%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	0.0160	<0.000100	0.000350	<0.000500	<0.0100	<0.0000500	0.0763	0.000910
	Annual Maximum	0.0280	0.00559	0.00617	0.0165	3.82	0.00575	0.193	0.0651
	Annual Mean	0.0207	0.000765	0.00176	0.00212	0.485	0.000612	0.147	0.0110
	Annual Median	0.0210	0.000100	0.00142	0.000620	0.0170	<0.0000500	0.147	0.00276
	% < LRL	4%	44%	0%	36%	36%	56%	0%	0%
	% > BCWQG[a]	0%	24%	4%	4%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	16%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_WC1	n	17	17	17	17	17	17	17	17
	Annual Minimum	0.0160	<0.000100	0.000460	<0.000500	<0.0100	<0.0000500	0.0782	0.000660
	Annual Maximum	0.0240	0.00114	0.00325	0.00201	1.16	0.000554	0.185	0.0169
	Annual Mean	0.0201	0.000226	0.00159	0.000685	0.121	0.000106	0.148	0.00533
	Annual Median	0.0210	0.000130	0.00132	0.000560	0.0370	<0.0000500	0.149	0.00438
	% < LRL	6%	41%	0%	35%	29%	65%	0%	0%
	% > BCWQG[a]	0%	6%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	6%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_TC2	n	18	18	18	18	18	18	18	18
	Annual Minimum	0.0170	<0.000100	<0.000100	<0.000500	<0.0100	<0.0000500	0.00910	0.00116
	Annual Maximum	0.0270	0.00181	0.000290	0.00130	0.750	0.000345	0.0254	0.0243
	Annual Mean	0.0211	0.000268	0.000131	0.000636	0.124	0.0000968	0.0178	0.00748
	Annual Median	0.0190	<0.000100	<0.000100	<0.000500	0.0140	<0.0000500	0.0176	0.00647
	% < LRL	6%	56%	78%	67%	33%	72%	0%	0%
	% > BCWQG[a]	0%	6%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	0%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-
GH_TC1	n	24	24	24	24	24	24	24	24
	Annual Minimum	<0.0100	<0.000100	<0.000100	<0.000500	<0.0100	<0.0000500	0.00320	0.00132
	Annual Maximum	0.0270	0.00170	0.000690	0.00256	1.62	0.000906	0.0243	0.0374
	Annual Mean	0.0213	0.000230	0.000130	0.000636	0.116	0.0000994	0.0177	0.00571
	Annual Median	0.0217	0.000110	<0.000100	<0.000500	0.0320	<0.0000500	0.0183	0.00392
	% < LRL	4%	46%	88%	71%	8%	83%	0%	0%
	% > BCWQG[a]	0%	4%	0%	0%	-	0%	-	0%
	% > BCWQG[b]	-	-	0%	0%	4%	0%	-	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)
	n	7	7	7	7	7	7	7	7
	Annual Minimum	0.00000248	0.000312	0.000700	0.000413	<0.0000100	<0.0000100	0.000113	<0.00300
	Annual Maximum	0.0000128	0.000381	0.00206	0.000615	0.0000350	0.0000210	0.000214	0.00510
	Annual Mean	0.00000679	0.000348	0.00129	0.000575	0.0000179	0.0000140	0.000145	0.00343
	Annual Median	0.00000662	0.000357	0.00124	0.000600	0.0000100	0.0000120	0.000127	<0.00300
GH_BR_F	% < LRL	0%	0%	0%	0%	43%	43%	0%	71%
	% > BCWQG[a]	100%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	15	15	15	15	15	15	15	15
	Annual Minimum	0.00000114	0.000303	<0.000500	0.000594	<0.0000100	<0.0000100	0.000138	<0.00300
	Annual Maximum	0.00000843	0.000472	0.00202	0.00109	0.0000230	0.0000230	0.000479	0.00600
	Annual Mean	0.00000318	0.000404	0.000900	0.000779	0.0000121	0.0000117	0.000267	0.00346
	Annual Median	0.00000215	0.000421	0.000710	0.000785	<0.0000100	<0.0000100	0.000266	<0.00300
GH_WOLF	% < LRL	0%	0%	20%	0%	80%	80%	0%	67%
	% > BCWQG[a]	93%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	21	21	21	21	21	21	21	21
	Annual Minimum	0.000000625	0.000339	<0.000500	0.000336	<0.0000100	<0.0000100	0.000176	<0.00300
	Annual Maximum	0.0000110	0.000640	0.00180	0.00328	0.0000270	0.0000210	0.000656	0.0224
	Annual Mean	0.00000269	0.000506	0.000717	0.00153	0.0000118	0.0000109	0.000470	0.00407
	Annual Median	0.00000185	0.000526	0.000560	0.00147	<0.0000100	<0.0000100	0.000518	<0.00300
GH_WILLOW	% < LRL	0%	0%	29%	0%	76%	86%	0%	86%
	% > BCWQG[a]	76%	0%	0%	19%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	7	7	7	7	7	7	7	7
	Annual Minimum	0.00000198	0.000431	<0.000500	0.00131	<0.0000100	<0.0000100	0.000220	<0.00300
	Annual Maximum	0.00000666	0.000511	0.00124	0.00249	0.0000180	0.0000150	0.000336	0.00400
	Annual Mean	0.00000398	0.000457	0.000826	0.00199	0.0000129	0.0000119	0.000284	0.00319
	Annual Median	0.00000400	0.000456	0.000750	0.00203	<0.0000100	<0.0000100	0.000282	<0.00300
GH_WILLOW_SP1	% < LRL	0%	0%	14%	0%	57%	57%	0%	71%
	% > BCWQG[a]	100%	0%	0%	57%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	15	15	15	15	15	15	15	15
	Annual Minimum	0.000000695	0.000888	0.000630	0.00125	<0.0000100	<0.0000100	0.000554	<0.00300
	Annual Maximum	0.00000958	0.00147	0.00252	0.00572	0.0000340	0.0000420	0.00159	0.0210
	Annual Mean	0.00000309	0.00125	0.00120	0.00266	0.0000136	0.0000162	0.000965	0.00498
	Annual Median	0.00000165	0.00133	0.000990	0.00207	<0.0000100	<0.0000100	0.000861	<0.00300
GH_WADE	% < LRL	0%	0%	0%	0%	73%	60%	0%	67%
	% > BCWQG[a]	67%	0%	0%	53%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	6	7	7	7	7	7	7	7
	Annual Minimum	0.00000163	0.000623	0.000620	0.000513	<0.0000100	<0.0000100	0.000164	<0.00300
	Annual Maximum	0.0000172	0.00124	0.00791	0.000977	0.0000740	0.000203	0.000516	0.0423
	Annual Mean	0.00000566	0.000843	0.00200	0.000712	0.0000201	0.0000481	0.000268	0.00934
	Annual Median	0.00000322	0.000757	0.000970	0.000715	<0.0000100	0.0000190	0.000219	<0.00300
GH_COUGAR	% < LRL	0%	0%	0%	0%	71%	14%	0%	57%
	% > BCWQG[a]	100%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	14%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	20	20	20	20	20	20	20	20
	Annual Minimum	0.000000580	0.000498	<0.000500	0.000134	<0.0000100	<0.0000100	0.000122	<0.00300
	Annual Maximum	0.00000663	0.00356	0.00186	0.000561	0.0000150	0.0000530	0.000619	0.0176
	Annual Mean	0.00000190	0.00115	0.000760	0.000263	0.0000104	0.0000140	0.000299	0.00395
	Annual Median	0.00000125	0.000977	0.000570	0.000220	<0.0000100	<0.0000100	0.000282	<0.00300
GH_NNC	% < LRL	0%	0%	40%	0%	90%	70%	0%	85%
	% > BCWQG[a]	50%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
	n	13	13	13	13	13	13	13	13
	Annual Minimum	0.000000690	0.000592	<0.000500	0.000144	<0.0000100	<0.0000100	0.0000780	<0.00300
	Annual Maximum	0.00000900	0.00111	0.00222	0.000278	0.0000200	0.0000460	0.000357	0.00660
	Annual Mean	0.00000220	0.000935	0.000828	0.000184	0.0000110	0.0000133	0.000235	0.00343
	Annual Median	0.00000136	0.000961	0.000710	0.000159	<0.0000100	<0.0000100	0.000236	<0.00300
GH_BR_D	% < LRL	0%	0%	8%	0%	85%	62%	0%	85%
	% > BCWQG[a]	62%	0%	0%	0%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)
GH_MC1	n	19	19	19	19	19	19	19	19
	Annual Minimum	<0.000000500	0.00119	0.00144	0.00150	<0.0000100	<0.0000100	0.000841	<0.00300
	Annual Maximum	0.00000494	0.00345	0.00502	0.0105	0.0000150	0.0000350	0.00306	0.00710
	Annual Mean	0.00000170	0.00243	0.00265	0.00350	0.0000104	0.0000135	0.00193	0.00350
	Annual Median	0.00000114	0.00253	0.00239	0.00217	<0.0000100	0.0000100	0.00174	<0.00300
	% < LRL	5%	0%	0%	0%	84%	47%	0%	74%
	% > BCWQG[a]	42%	0%	0%	58%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	0%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
GH_LC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	<0.000000500	0.0134	0.0383	0.0885	<0.0000100	0.0000260	0.00744	<0.00300
	Annual Maximum	0.00000201	0.0353	0.119	0.248	<0.0000200	0.0000670	0.0135	0.0347
	Annual Mean	0.000000995	0.0196	0.0689	0.167	0.0000101	0.0000442	0.0110	0.00900
	Annual Median	0.000000890	0.0184	0.0757	0.157	<0.0000100	0.0000480	0.0113	<0.00300
	% < LRL	4%	0%	0%	0%	96%	0%	0%	52%
	% > BCWQG[a]	16%	0%	0%	100%	0%	0%	92%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	100%	100%	-	-	-	-
	% > Level 2 Benchmark	-	-	100%	100%	-	-	-	-
	% > Level 3 Benchmark	-	-	100%	-	-	-	-	-
GH_LC1	n	10	10	10	10	10	10	10	10
	Annual Minimum	0.000000700	0.00865	0.0209	0.0266	<0.0000100	0.0000240	0.00267	<0.00300
	Annual Maximum	0.00000279	0.0348	0.106	0.222	<0.0000100	0.0000710	0.0122	0.00990
	Annual Mean	0.00000137	0.0195	0.0666	0.115	<0.0000100	0.0000433	0.00864	0.00499
	Annual Median	0.000000975	0.0190	0.0731	0.110	<0.0000100	0.0000425	0.00989	<0.00300
	% < LRL	0%	0%	0%	0%	100%	0%	0%	60%
	% > BCWQG[a]	30%	0%	0%	100%	0%	0%	70%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	100%	100%	-	-	-	-
	% > Level 2 Benchmark	-	-	100%	80%	-	-	-	-
	% > Level 3 Benchmark	-	-	90%	-	-	-	-	-
GH_WC2	n	25	25	25	25	25	25	25	25
	Annual Minimum	<0.000000500	0.0128	0.0590	0.0567	<0.0000100	0.0000330	0.00521	<0.00300
	Annual Maximum	<0.0000500	0.0341	0.183	0.190	0.000260	0.000227	0.0152	0.0677
	Annual Mean	0.00000137	0.0212	0.119	0.113	0.0000339	0.0000661	0.0125	0.0171
	Annual Median	<0.000000500	0.0209	0.127	0.110	<0.0000100	0.0000550	0.0131	0.0116
	% < LRL	64%	0%	0%	0%	72%	0%	0%	16%
	% > BCWQG[a]	36%	0%	24%	100%	0%	0%	96%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	100%	100%	-	-	-	-
	% > Level 2 Benchmark	-	-	100%	96%	-	-	-	-
	% > Level 3 Benchmark	-	-	100%	-	-	-	-	-
GH_WC1	n	17	17	17	17	17	17	17	17
	Annual Minimum	<0.000000500	0.0127	0.0480	0.0573	<0.0000100	0.0000340	0.00515	<0.00300
	Annual Maximum	0.00000352	0.0311	0.171	0.135	<0.0000200	0.0000720	0.0149	0.0351
	Annual Mean	0.000000829	0.0201	0.120	0.104	0.0000105	0.0000535	0.0121	0.0101
	Annual Median	<0.000000500	0.0196	0.123	0.107	<0.0000100	0.0000560	0.0135	0.00400
	% < LRL	53%	0%	0%	0%	88%	0%	0%	47%
	% > BCWQG[a]	18%	0%	29%	100%	0%	0%	82%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	100%	100%	-	-	-	-
	% > Level 2 Benchmark	-	-	100%	88%	-	-	-	-
	% > Level 3 Benchmark	-	-	100%	-	-	-	-	-
GH_TC2	n	18	18	18	18	18	18	18	18
	Annual Minimum	<0.000000500	0.00105	0.00116	0.0362	<0.0000100	<0.0000100	0.00126	<0.00300
	Annual Maximum	0.00000420	0.00167	0.00239	0.185	<0.0000200	0.0000320	0.00621	<0.00600
	Annual Mean	0.00000126	0.00126	0.00149	0.122	0.0000109	0.0000125	0.00396	0.00321
	Annual Median	0.000000585	0.00121	0.00142	0.140	<0.0000100	<0.0000100	0.00416	<0.00300
	% < LRL	39%	0%	0%	0%	78%	67%	0%	83%
	% > BCWQG[a]	22%	0%	0%	100%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	100%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	78%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-
GH_TC1	n	24	24	24	24	24	24	24	24
	Annual Minimum	<0.000000500	0.000936	<0.000500	0.000101	<0.0000100	<0.0000100	0.0000890	<0.00300
	Annual Maximum	0.00000716	0.00161	0.00388	0.175	0.0000190	0.0000570	0.00573	0.0116
	Annual Mean	0.00000110	0.00132	0.00152	0.114	0.0000107	0.0000129	0.00379	0.00372
	Annual Median	0.000000675	0.00132	0.00145	0.122	<0.0000100	<0.0000100	0.00401	<0.00300
	% < LRL	33%	0%	4%	0%	92%	67%	0%	83%
	% > BCWQG[a]	13%	0%	0%	96%	0%	0%	0%	0%
	% > BCWQG[b]	-	0%	-	-	0%	-	-	0%
	% > Level 1 Benchmark	-	-	0%	96%	-	-	-	-
	% > Level 2 Benchmark	-	-	0%	88%	-	-	-	-
	% > Level 3 Benchmark	-	-	0%	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Cobalt (mg/L)	Dissolved Iron (mg/L)
GH_BR_F	n	7	7	7	7
	Annual Minimum	0.00660	0.00000990	<0.000100	<0.0100
	Annual Maximum	0.252	0.0000608	0.000260	0.270
	Annual Mean	0.0678	0.0000216	0.000123	0.0774
	Annual Median	0.0350	0.0000152	<0.000100	0.0370
	% < LRL	0%	0%	86%	43%
	% > BCWQG[a]	43%	0%	-	-
	% > BCWQG[b]	14%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WOLF	n	15	15	15	15
	Annual Minimum	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.466	0.0000943	0.000530	0.655
	Annual Mean	0.0397	0.0000160	0.000129	0.0584
	Annual Median	0.00430	0.0000103	<0.000100	<0.0100
	% < LRL	27%	7%	93%	67%
	% > BCWQG[a]	7%	0%	-	-
	% > BCWQG[b]	7%	0%	0%	7%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WILLOW	n	21	21	21	21
	Annual Minimum	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.0457	0.0000145	<0.000100	0.0460
	Annual Mean	0.00916	0.0000103	<0.000100	0.0142
	Annual Median	0.00430	0.0000111	<0.000100	<0.0100
	% < LRL	48%	5%	100%	76%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WILLOW_SP1	n	7	7	7	7
	Annual Minimum	0.00610	0.00000600	<0.000100	<0.0100
	Annual Maximum	0.263	0.0000482	0.000190	0.214
	Annual Mean	0.0539	0.0000177	0.000113	0.0509
	Annual Median	0.0212	0.0000126	<0.000100	0.0200
	% < LRL	0%	0%	86%	43%
	% > BCWQG[a]	14%	0%	-	-
	% > BCWQG[b]	14%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WADE	n	15	15	15	15
	Annual Minimum	<0.00300	0.00000640	<0.000100	<0.0100
	Annual Maximum	0.0376	0.0000264	<0.000100	0.0510
	Annual Mean	0.00995	0.0000164	<0.000100	0.0161
	Annual Median	0.00450	0.0000175	<0.000100	<0.0100
	% < LRL	27%	0%	100%	60%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_COUGAR	n	7	7	7	7
	Annual Minimum	0.00460	0.0000234	<0.000100	<0.0100
	Annual Maximum	0.0372	0.0000452	<0.000100	0.0530
	Annual Mean	0.0159	0.0000342	<0.000100	0.0236
	Annual Median	0.00990	0.0000337	<0.000100	0.0120
	% < LRL	14%	0%	100%	29%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_NNC	n	20	20	20	20
	Annual Minimum	<0.00300	0.00000550	<0.000100	<0.0100
	Annual Maximum	0.0179	0.0000443	0.000200	0.0450
	Annual Mean	0.00543	0.0000178	0.000106	0.0149
	Annual Median	0.00320	0.0000161	<0.000100	<0.0100
	% < LRL	40%	0%	90%	60%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_BR_D	n	13	13	13	13
	Annual Minimum	0.00310	0.0000105	<0.000100	<0.0100
	Annual Maximum	0.0217	0.0000327	<0.000100	0.0270
	Annual Mean	0.00695	0.0000240	<0.000100	0.0115
	Annual Median	0.00520	0.0000240	<0.000100	<0.0100
	% < LRL	8%	0%	100%	77%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-

Table C.1: Summary of Water Chemistry Data for Key Parameters for the West-Side Tributary Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Cobalt (mg/L)	Dissolved Iron (mg/L)
GH_MC1	n	19	19	19	19
	Annual Minimum	<0.00300	0.0000199	<0.000100	<0.0100
	Annual Maximum	0.0222	0.0000325	0.000120	0.0320
	Annual Mean	0.00521	0.0000271	0.000102	0.0122
	Annual Median	<0.00300	0.0000274	<0.000100	<0.0100
	% < LRL	79%	0%	89%	84%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_LC2	n	25	25	25	25
	Annual Minimum	<0.00300	0.00000570	0.000210	<0.0100
	Annual Maximum	0.00570	0.000523	0.00307	<0.0200
	Annual Mean	0.00314	0.0000548	0.000580	0.0101
	Annual Median	<0.00300	0.0000166	0.000440	<0.0100
	% < LRL	92%	16%	0%	96%
	% > BCWQG[a]	0%	4%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	4%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_LC1	n	10	10	10	8
	Annual Minimum	<0.00300	<0.00000500	0.000310	<0.0100
	Annual Maximum	0.00930	0.000160	0.000820	0.0140
	Annual Mean	0.00396	0.0000422	0.000512	0.0105
	Annual Median	<0.00300	0.00000820	0.000500	<0.0100
	% < LRL	80%	20%	0%	88%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WC2	n	25	25	25	25
	Annual Minimum	<0.00300	<0.00000500	0.000260	<0.0100
	Annual Maximum	0.0427	0.000435	0.00289	0.144
	Annual Mean	0.00496	0.0000467	0.00125	0.0154
	Annual Median	<0.00300	0.00000750	0.000960	<0.0100
	% < LRL	72%	48%	0%	96%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	4%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_WC1	n	17	17	17	17
	Annual Minimum	<0.00300	<0.00000500	0.000420	<0.0100
	Annual Maximum	0.0429	0.000316	0.00315	0.153
	Annual Mean	0.00682	0.0000532	0.00142	0.0184
	Annual Median	<0.00300	0.00000540	0.00106	<0.0100
	% < LRL	76%	47%	0%	88%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_TC2	n	18	18	18	18
	Annual Minimum	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.00830	0.0000209	<0.000200	0.0210
	Annual Mean	0.00409	0.0000153	<0.000100	0.0116
	Annual Median	<0.00300	0.0000180	<0.000100	<0.0100
	% < LRL	72%	6%	100%	78%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-
GH_TC1	n	24	24	24	24
	Annual Minimum	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.00840	0.0000286	<0.000100	0.0220
	Annual Mean	0.00386	0.0000163	<0.000100	0.0113
	Annual Median	<0.00300	0.0000166	<0.000100	<0.0100
	% < LRL	67%	4%	100%	79%
	% > BCWQG[a]	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	0%
	% > Level 1 Benchmark	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.2: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (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 (mg/L)
GH_ERSC4	n	11	11	12	12	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Annual Minimum	142	8.20	7.82	4.80	131	0.0285	<0.00100	<0.00500	13.4	<0.500	0.135	<0.000100	0.000100	0.0399	<0.0000200	<0.0100	0.000200	<0.000100
	Annual Maximum	204	8.47	8.80	66.0	162	0.223	<0.00100	0.0346	27.0	0.680	0.176	0.000200	0.00175	0.0777	0.000175	<0.0100	0.00499	0.00137
	Annual Mean	176	8.35	8.24	14.3	144	0.0945	<0.00100	0.0148	19.2	0.516	0.162	0.000109	0.000356	0.0519	0.0000358	<0.0100	0.000979	0.000255
	Annual Median	180	8.39	8.22	10.1	141	0.0665	<0.00100	0.0152	19.8	<0.500	0.168	<0.000100	0.000230	0.0491	<0.0000200	<0.0100	0.000620	<0.000100
	% < LRL	0%	0%	0%	0%	0%	0%	100%	9%	0%	91%	0%	91%	0%	0%	73%	100%	9%	55%
	% > BCWQG[a]	-	0%	0%	8%	0%	0%	0%	18%	0%	0%	-	0%	-	0%	9%	0%	27%	0%
	% > BCWQG[b]	-	-	-	8%	-	0%	0%	18%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_ER1A	n	14	14	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	Annual Minimum	150	8.20	7.44	8.90	125	0.0380	<0.00100	<0.00500	17.2	<0.500	0.132	<0.000100	0.000120	0.0396	<0.0000200	<0.0100	0.000210	<0.000100
	Annual Maximum	532	8.48	8.47	11.3	198	11.9	0.0322	0.0232	188	1.45	0.171	0.000510	0.000950	0.0937	0.000116	0.0110	0.00274	0.000910
	Annual Mean	210	8.33	8.15	10.1	145	1.34	0.00346	0.0122	37.0	0.569	0.156	0.000149	0.000300	0.0514	0.0000364	0.0101	0.000784	0.000217
	Annual Median	187	8.32	8.18	9.95	140	0.496	<0.00100	0.0123	23.8	<0.500	0.158	<0.000100	0.000260	0.0461	<0.0000200	<0.0100	0.000585	0.000150
	% < LRL	0%	0%	0%	0%	0%	0%	64%	14%	0%	86%	0%	64%	0%	0%	71%	93%	0%	43%
	% > BCWQG[a]	-	0%	0%	0%	0%	7%	7%	0%	0%	0%	-	0%	-	0%	0%	0%	14%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	0%	-	-	-	-	7%	-	-	0%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	7%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RG_GH-SCW3	n	7	7	4	4	7	7	7	7	7	7	7	4	7	7	7	7	7	7
	Annual Minimum	354	8.17	8.18	8.76	164	2.03	<0.00100	0.00830	126	2.28	0.0720	0.000120	0.000190	0.0613	<0.0000200	0.0100	<0.000100	<0.000100
	Annual Maximum	1,710	8.45	8.39	11.6	285	20.6	0.0346	0.0562	1,030	19.2	0.130	0.000170	0.000730	0.106	0.0000550	0.0290	0.00158	0.000420
	Annual Mean	1,290	8.37	8.28	10.5	228	13.2	0.0140	0.0318	674	13.8	0.0946	0.000135	0.000294	0.0753	0.0000250	0.0180	0.000334	0.000146
	Annual Median	1,400	8.39	8.28	10.9	223	14.0	0.0126	0.0237	714	16.4	0.100	0.000125	0.000220	0.0712	<0.0000400	0.0170	<0.000200	<0.000200
	% < LRL	0%	0%	0%	0%	0%	0.0%	14%	0%	0%	0%	0%	0%	14%	0%	86%	14%	71%	86%
	% > BCWQG[a]	-	0%	0%	0%	0%	86%	0%	0%	86%	0%	-	0%	-	0%	0%	0%	14%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	71%	-	-	-	-	86%	-	-	86%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	86%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_ERSC2	n	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	Annual Minimum	167	8.27	7.46	4.32	138	0.0550	<0.00100	0.00790	16.7	<0.500	0.108	<0.000100	0.000130	0.0433	<0.0000200	<0.0100	0.000230	<0.000100
	Annual Maximum	522	8.49	8.35	11.2	166	3.25	0.00610	0.0256	215	5.87	0.177	0.000180	0.000570	0.0754	0.0000300	0.0180	0.00348	0.000490
	Annual Mean	333	8.40	8.14	9.36	150	1.79	0.00314	0.0173	112	2.23	0.141	0.000123	0.000264	0.0556	0.0000223	0.0111	0.000936	0.000179
	Annual Median	340	8.41	8.26	9.98	147	1.71	0.00280	0.0157	103	2.11	0.142	<0.000100	0.000180	0.0541	<0.0000200	<0.0100	0.000330	<0.000100
	% < LRL	0%	0%	0%	0%	0%	0%	14%	0%	0%	14%	0%	71%	0%	0%	71%	86%	0%	57%
	% > BCWQG[a]	-	0%	0%	14%	0%	14%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	29%	0%
	% > BCWQG[b]	-	-	-	14%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	0%	-	-	-	-	14%	-	-	0%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	14%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.2: Summary of Water Chemistry Data for Key Parameters for the Side Channel Stations of the GHO LAEMP Monitoring, 2018

Station	Summary Statistic	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Cobalt (mg/L)	Dissolved Iron (mg/L)
GH_ERSC4	n	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Annual Minimum	<0.000500	<0.0100	<0.0000500	0.00170	0.000610	<0.000000500	0.000930	<0.000500	0.000683	<0.0000100	<0.0000100	0.000661	<0.00300	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.00404	3.34	0.00228	0.00420	0.165	0.0000111	0.00117	0.00630	0.00125	0.0000630	0.000105	0.00109	0.0277	0.00590	0.0000116	<0.000100	<0.0100
	Annual Mean	0.000908	0.494	0.000356	0.00227	0.0245	0.00000210	0.00102	0.00123	0.000926	0.0000150	0.0000211	0.000793	0.00611	0.00368	0.00000789	<0.000100	<0.0100
	Annual Median	<0.000500	0.169	0.000166	0.00190	0.00959	0.000000690	0.00102	0.000570	0.000883	<0.0000100	<0.0000100	0.000766	<0.00300	<0.00300	0.00000720	<0.000100	<0.0100
	% < LRL	55%	18%	45%	0%	0%	45%	0%	45%	0%	82%	55%	0%	55%	55%	9%	100%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	45%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	-
	% > BCWQG[b]	0%	9%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	9%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_ER1A	n	14	14	14	14	14	13	14	14	14	14	14	14	14	14	14	14	14
	Annual Minimum	<0.000500	<0.0100	<0.0000500	0.00190	0.000940	<0.000000500	0.000904	<0.000500	0.000693	<0.0000100	<0.0000100	0.000673	<0.00300	<0.00300	0.00000530	<0.000100	<0.0100
	Annual Maximum	0.00240	1.60	0.00143	0.0335	0.130	0.0000101	0.00390	0.00490	0.0261	0.0000270	0.0000540	0.00282	0.0187	0.0498	0.0000232	0.000120	0.0740
	Annual Mean	0.000736	0.350	0.000271	0.00569	0.0235	0.00000188	0.00130	0.00131	0.00374	0.0000116	0.0000157	0.000990	0.00669	0.00671	0.0000104	0.000101	0.0146
	Annual Median	<0.000500	0.232	0.000185	0.00315	0.0104	0.000000630	0.00109	0.000755	0.00168	<0.0000100	<0.0000100	0.000800	0.00310	<0.00300	0.00000875	<0.000100	<0.0100
	% < LRL	57%	7%	21%	0%	0%	31%	0%	43%	0%	86%	64%	0%	43%	64%	0%	93%	93%
	% > BCWQG[a]	0%	-	0%	-	0%	38%	0%	0%	43%	0%	0%	0%	0%	0%	0%	-	-
	% > BCWQG[b]	0%	14%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	0%	7%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
RG_GH-SCW3	n	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7
	Annual Minimum	<0.000500	<0.0100	<0.0000500	0.00810	0.00123	<0.000000500	0.00111	0.00112	0.0209	<0.0000100	<0.0000100	0.00146	<0.00300	<0.00300	0.00000920	<0.000100	<0.0100
	Annual Maximum	0.00137	1.07	0.000663	0.0274	0.0519	0.00000384	0.00159	0.00283	0.180	0.0000180	0.0000380	0.00709	0.00910	0.00460	0.0000272	<0.000200	<0.0200
	Annual Mean	0.000624	0.186	0.000150	0.0182	0.00983	0.00000112	0.00127	0.00165	0.119	0.0000120	0.0000140	0.00421	0.00471	0.00323	0.0000163	<0.000100	<0.0100
	Annual Median	<0.00100	0.0340	<0.0000500	0.0192	0.00323	0.000000610	0.00125	0.00160	0.137	<0.0000100	<0.0000200	0.00384	<0.00600	<0.00300	0.0000148	<0.000100	<0.0100
	% < LRL	86%	29%	71%	0%	0%	29%	0%	0%	0%	75%	86%	0%	71%	86%	14%	100%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	14%	0%	0%	100%	0%	0%	86%	0%	0%	0%	-	-
	% > BCWQG[b]	0%	14%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	0%	100%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	86%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
GH_ERSC2	n	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7
	Annual Minimum	<0.000500	<0.0100	<0.0000500	0.00170	0.000110	<0.000000500	0.000991	<0.000500	0.000839	<0.0000100	<0.0000100	0.000666	<0.00300	<0.00300	0.00000770	<0.000100	<0.0100
	Annual Maximum	0.00186	0.950	0.000585	0.0109	0.0336	0.00000318	0.00120	0.00343	0.0369	0.0000200	0.0000320	0.00147	0.00700	0.00800	0.0000199	<0.000100	0.0240
	Annual Mean	0.000759	0.280	0.000189	0.00577	0.0112	0.00000111	0.00111	0.00111	0.0169	0.0000114	0.0000141	0.00113	0.00374	0.00406	0.0000130	<0.000100	0.0136
	Annual Median	<0.000500	0.136	0.000102	0.00520	0.00638	0.000000605	0.00115	0.000540	0.0163	<0.0000100	<0.0000100	0.00113	<0.00300	0.00300	0.0000108	<0.000100	<0.0100
	% < LRL	57%	14%	43%	0%	0%	33%	0%	43%	0%	86%	57%	0%	71%	43%	0%	100%	71%
	% > BCWQG[a]	0%	-	0%	-	0%	33%	0%	0%	86%	0%	0%	0%	0%	0%	0%	-	-
	% > BCWQG[b]	0%	0%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	0%	43%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

Table C.3: Statistical Comparisons of Differences in Monthly Mean Concentrations of Water Quality Parameters Between GHO LAEMP Side Channel Stations and the Main Stem Station Upstream of Mine Operation (GH_ER2), 2016 to 2018

ANOVA Model[a]					Post-hoc Contrasts with Upstream Station (GH_ER2)[b] and Magnitude of Difference (MOD) by Station[c]						T-Test for Overall Difference	
					GH_ERSC4		GH_ER1A		GH_ERSC2			
Parameter	Model Term	DF	F	P-Value	P-Value	MOD	P-Value	MOD	P-Value	MOD	P-Value	MOD
Nitrate-N	Year	2	0.06	0.946	-						-	
	Station	2	26	<0.001	0.003	30%	<0.001	273%	<0.001	1,678 %		
	Year x Station	4	0.53	0.717	-							
	Error	61	-									
Nitrite-N	Year	2	0.08	0.924	-						0.012	84%
	Station	2	0.48	0.631								
	Year x Station	4	0.5	0.710								
	Error	12	-									
Sulphate	Year	2	0.07	0.935	-						-	
	Station	2	28	<0.001	0.010	10%	0.003	60%	<0.001	354%		
	Year x Station	4	0.45	0.769	-							
	Error	61	-									
Total Dissolved Solids	Year	2	0.40	0.673	-						-	
	Station	2	14	<0.001	0.264	3%	0.020	20%	<0.001	73%		
	Year x Station	4	0.42	0.793	-							
	Error	61	-									
Cadmium (Dissolved)	Year	2	0.242	0.786	-						-	
	Station	2	6.1	0.004	0.044	11%	0.006	38%	<0.001	79%		
	Year x Station	4	0.87	0.485	-							
	Error	52	-									
Cobalt (Dissolved)	Year	Concentrations < LRL			-							
	Station											
	Year x Station											
	Error	-	-									
Antimony (Total)	Year	2	0.59	0.568	-						0.067	-
	Station	2	1	0.380								
	Year x Station	4	0.2	0.922								
	Error	14	-									
Barium (Total)	Year	2	1.14	0.328	-						<0.001	9%
	Station	2	0.9	0.396								
	Year x Station	4	0.9	0.497								
	Error	61	-									
Boron (Total)	Year	Concentrations < LRL			-							
	Station											
	Year x Station											
	Error	-	-									
Lithium (Total)	Year	2	0.15	0.857	-						<0.001	70%
	Station	2	9	<0.001	0.010	15%	0.002	93%	<0.001	177%		
	Year x Station	4	0.4	0.816	-							
	Error	58	-									
Manganese (Total)	Year	2	0.22	0.806	-						0.6	-
	Station	2	1	0.547								
	Year x Station	4	0.6	0.647								
	Error	61	-									
Mercury (Total)	Year	2	3.31	0.051	-						0.014	43%
	Station	2	0.36	0.701								
	Year x Station	4	1.3	0.277								
	Error	29	-									
Molybdenum (Total)	Year	2	0.11	0.894	-						<0.001	14%
	Station	2	2	0.134								
	Year x Station	4	0.5	0.712								
	Error	61	-									
Nickel (Total)	Year	2	1.31	0.285	-						<0.001	55%
	Station	2	0	0.771								
	Year x Station	4	0.1	0.972								
	Error	31	-									
Selenium (Total)	Year	2	0.66	0.520	-						-	
	Station	2	49	<0.001	0.014	11%	0.001	91%	<0.001	1,159%		
	Year x Station	4	0.2	0.924	-							
	Error	61	-									
Uranium (Total)	Year	2	0.06	0.946	-						-	
	Station	2	5	0.009	0.014	7%	0.012	27%	<0.001	46%		
	Year x Station	4	0.6	0.673	-							
	Error	61	-									
Zinc (Total)	Year	2	2.53	0.104	-						0.667	-
	Station	2	1	0.603								
	Year x Station	3	0.6	0.652								
	Error	21	-									

P-value < 0.05.

Positive MOD (higher concentration of analyte at side-channel station relative to GH_ER2).

Negative MOD (lower concentration of analyte at side-channel station relative to GH_ER2).

Note: "-" (dash) presented instead of calculated endpoint when the p-value was >0.05 or test was not relevant (see footnote c).

[a] Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as $\log_{10}$(Side Channel) − $\log_{10}$(GH_ER2) with Year, Station and Year x Station as model terms. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc calculated as a one-sample t-test on the relative differences between each station [$\log_{10}$(Side Channel) − $\log_{10}$(GH_ER2)] for parameters with a significant station term in the ANOVA model. If station was not signifcant, this test was not conducted and an overall t-test for all stations was performed.

[c] Magnitude of difference (MOD) calculated as the side channel concentration (10^[$\log_{10}$(side-channel)]) minus the upstream concentration (10^[$\log_{10}$(GH_ER2)]) divided by the upstream concentration (10^[$\log_{10}$(GH_ER2)]) and multiplied by 100 to represent the percent difference between the side channel station and upstream, relative to upstream.

Table C.4: Statistical Comparisons of Differences in Monthly Mean Concentrations of Water Quality Parameters Between GHO LAEMP Side Channel Stations and the Main Stem Station Downstream of Mine Operation, 2016 to 2018

ANOVA Model[a]					Post-hoc Contrasts with Downstream Station (GH_ERC)[b] and Magnitude of Difference (MOD) by Station[c]						T-Test for Overall Difference	
					GH_ERSC4		GH_ER1A		GH_ERSC2			
Parameter	Model Term	DF	F	P-Value	P-Value	MOD	P-Value	MOD	P-Value	MOD	P-Value	MOD
Nitrate-N	Year	2	0.17	0.846	-						-	
	Station	2	23	<0.001	<0.001	-73%	0.416	-	<0.001	253%		
	Year x Station	4	0.45	0.775	-							
	Error	61	-									
Nitrite-N	Year	2	0.70	0.513	-						0.022	65%
	Station	2	0.75	0.491								
	Year x Station	3	1.1	0.367								
	Error	15	-									
Sulphate	Year	2	0.53	0.589	-						-	
	Station	2	33	<0.001	<0.001	-25%	0.648	-	<0.001	206%		
	Year x Station	4	0.46	0.766	-							
	Error	61	-									
Total Dissolved Solids	Year	2	0.84	0.435	-	-	-	-	-	-	-	
	Station	2	16	<0.001	0.004	-7%	0.275	-	<0.001	59%		
	Year x Station	4	0.38	0.821	-							
	Error	61	-									
Cadmium (Dissolved)	Year	2	0.081	0.923	-						-	
	Station	2	6.8	0.002	0.333	-	0.221	-	0.003	56%		
	Year x Station	4	0.56	0.694	-							
	Error	61	-									
Cobalt (Dissolved)	Year	Concentrations < LRL			-						-	
	Station											
	Year x Station											
	Error	-	-									
Antimony (Total)	Year	2	0.44	0.655	-						0.365	-
	Station	2	1	0.257								
	Year x Station	4	0.3	0.841								
	Error	15	-									
Barium (Total)	Year	2	1.17	0.317	-						<0.001	-8%
	Station	2	2.1	0.131								
	Year x Station	4	0.8	0.501								
	Error	61	-									
Boron (Total)	Year	Concentrations < LRL			-						-	
	Station											
	Year x Station											
	Error	-	-									
Lithium (Total)	Year	2	1.07	0.350	-						0.402	-
	Station	2	10	<0.001	<0.001	-27%	0.326	-	<0.001	85%		
	Year x Station	4	0.4	0.798	-							
	Error	61	-									
Manganese (Total)	Year	2	0.28	0.758	-						0.3	-
	Station	2	1	0.244								
	Year x Station	4	0.3	0.883								
	Error	61	-									
Mercury (Total)	Year	2	3.23	0.056	-						0.097	-
	Station	2	0.63	0.539								
	Year x Station	4	1.3	0.291								
	Error	26	-									
Molybdenum (Total)	Year	2	0.24	0.787	-						0.016	8%
	Station	2	2	0.116								
	Year x Station	4	0.5	0.765								
	Error	61	-									
Nickel (Total)	Year	2	0.95	0.397	-						0.003	36%
	Station	2	0	0.773								
	Year x Station	4	0.2	0.945								
	Error	32	-									
Selenium (Total)	Year	2	0.10	0.905	-						0.159	-
	Station	2	56	<0.001	<0.001	-40%	0.939	-	<0.001	512%		
	Year x Station	4	0.2	0.918	-							
	Error	61	-									
Uranium (Total)	Year	2	0.42	0.659	-						0.005	12%
	Station	2	5	0.009	0.386	-	0.085	-	<0.001	33%		
	Year x Station	4	0.5	0.717	-							
	Error	61	-									
Zinc (Total)	Year	2	0.12	0.891	-						0.142	-
	Station	2	1	0.407								
	Year x Station	3	0.4	0.778								
	Error	25	-									

P-value < 0.05.

Positive MOD (higher concentration of analyte at side-channel station relative to GH_ERC).

Negative MOD (lower concentration of analyte at side-channel station relative to GH_ERC).

Note: "-" (dash) presented instead of calculated endpoint when the p-value was >0.05 or test was not relevant (see footnote c).

[a] Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as log10(Side Channel) − log10(GH_ERC) with Year, Station and Year x Station as model terms. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc calculated as a one-sample t-test on the relative differences between each station [$\log_{10}$(Side Channel) − $\log_{10}$(GH_ER2)] for parameters with a significant station term in the ANOVA model. If station was not signifcant, this test was not conducted and an overall t-test for all stations was performed.

[c] Magnitude of difference (MOD) calculated as the side channel concentration (10^[log10(side-channel)]) minus the downstream concentration (10^[log10(GH_ERC)]) divided by the downstream concentration (10^[log10(GH_ERC)]) and multplied by 100 to represent the percent difference between the side channel station and downstream, relative to downstream

Table C.5: Summary of Water Chemistry Data for Key Parameters for the Main Stem Elk River Stations Upstream (GH_ER2) and Downstream (GH_ERC) of Mine Operations, GHO LAEMP 2018

Station	Summary Statistic	Total Dissolved Solids (mg/L)	Lab pH	Field pH	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Ammonia (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 (mg/L)
GH_ER2	n	34	34	31	31	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	Annual Minimum	148	8.15	7.72	9.50	125	0.0226	<0.00100	<0.00500	11.9	0.250	0.133	<0.000100	<0.000100	0.0356	<0.0000200	<0.0100	0.000220	<0.000100
	Annual Maximum	228	8.58	8.37	12.6	159	0.152	0.00710	0.0234	23.9	0.530	0.180	0.000210	0.00125	0.0672	0.000124	<0.0100	0.00380	0.000940
	Annual Mean	174	8.31	8.06	10.6	143	0.0801	0.00120	0.0110	19.1	0.292	0.162	0.000105	0.000246	0.0471	0.0000278	<0.0100	0.000587	0.000167
	Annual Median	172	8.28	8.05	10.4	144	0.0878	<0.00100	0.0102	20.3	0.280	0.161	<0.000100	0.000140	0.0474	<0.0000200	<0.0100	0.000310	<0.000100
	% < LRL	0%	0%	0%	0%	0%	0%	94%	35%	0%	62%	0%	88%	6%	0%	85%	100%	6%	79%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	0%	0%	12%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GH_ERC	n	32	32	29	29	32	32	32	32	32	32	32	33	33	33	33	33	33	33
	Annual Minimum	141	8.08	7.69	8.87	127	0.161	<0.00100	<0.00500	18.1	0.350	0.127	<0.000100	<0.000100	0.0412	<0.0000200	<0.0100	0.000210	<0.000100
	Annual Maximum	216	8.50	8.23	11.4	167	0.709	0.00370	0.0333	38.5	0.740	0.190	0.000240	0.00184	0.0942	0.000196	<0.0100	0.00477	0.00161
	Annual Mean	188	8.32	8.01	10.5	147	0.391	0.00116	0.0113	26.8	0.410	0.158	0.000110	0.000299	0.0564	0.0000334	<0.0100	0.000783	0.000220
	Annual Median	193	8.35	8.01	10.5	148	0.390	<0.00100	0.00805	27.1	0.380	0.160	<0.000100	0.000150	0.0559	<0.0000200	<0.0100	0.000340	<0.000100
	% < LRL	0%	0%	0%	0%	0%	0%	88%	34%	0%	63%	0%	85%	9%	0%	79%	100%	0%	70%
	% > BCWQG[a]	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	-	0%	6%	0%	18%	0%
	% > BCWQG[b]	-	-	-	0%	-	0%	0%	0%	-	0%	0%	-	0%	-	-	-	-	0%
	% > Level 1 Benchmark	0%	-	-	-	-	0%	-	-	0%	-	-	-	-	-	-	-	-	-
	% > Level 2 Benchmark	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

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

Table C.5: Summary of Water Chemistry Data for Key Parameters for the Main Stem Elk River Stations Upstream (GH_ER2) and Downstream (GH_ERC) of Mine Operations, GHO LAEMP 2018

Station	Summary Statistic	Total Copper (mg/L)	Total Iron (mg/L)	Total Lead (mg/L)	Total Lithium (mg/L)	Total Manganese (mg/L)	Total Mercury (mg/L)	Total Molybdenum (mg/L)	Total Nickel (mg/L)	Total Selenium (mg/L)	Total Sliver (mg/L)	Total Thallium (mg/L)	Total Uranium (mg/L)	Total Zinc (mg/L)	Dissolved Aluminum (mg/L)	Dissolved Cadmium (mg/L)	Dissolved Cobalt (mg/L)	Dissolved Iron (mg/L)
	n	34	34	34	34	34	33	34	34	34	34	34	34	34	34	34	34	34
	Annual Minimum	<0.000500	<0.0100	<0.0000500	<0.00100	0.000810	<0.000000500	0.000608	<0.000500	0.000608	<0.0000100	<0.0000100	0.000591	<0.00300	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.00283	2.34	0.00164	0.00330	0.121	0.00000765	0.00110	0.00447	0.00122	0.0000510	0.0000830	0.00103	0.0185	0.00750	0.0000103	<0.000100	<0.0100
	Annual Mean	0.000673	0.222	0.000187	0.00179	0.0142	0.00000101	0.000974	0.000834	0.000862	0.0000118	0.0000144	0.000749	0.00408	0.00331	0.00000646	<0.000100	<0.0100
	Annual Median	<0.000500	0.0265	<0.0000500	0.00175	0.00213	<0.000000500	0.000984	<0.000500	0.000881	<0.0000100	<0.0000100	0.000760	<0.00300	<0.00300	0.00000605	<0.000100	<0.0100
GH_ER2	% < LRL	79%	35%	62%	3%	0%	64%	0%	68%	0%	91%	85%	0%	82%	85%	26%	100%	100%
	% > BCWQG[a]	0%	-	0%	-	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	-
	% > BCWQG[b]	0%	6%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-
	n	33	33	33	33	33	31	33	33	33	33	33	33	33	33	33	33	33
	Annual Minimum	<0.000500	<0.0100	<0.0000500	0.00210	0.000220	<0.000000500	0.000864	<0.000500	0.00115	<0.0000100	<0.0000100	0.000694	<0.00300	<0.00300	<0.00000500	<0.000100	<0.0100
	Annual Maximum	0.00434	3.50	0.00264	0.00520	0.200	0.0000104	0.00123	0.00692	0.00460	0.0000690	0.000109	0.00128	0.0424	0.0850	0.0000358	0.000140	0.169
	Annual Mean	0.000818	0.366	0.000283	0.00288	0.0198	0.00000134	0.00106	0.00104	0.00189	0.0000138	0.0000184	0.000829	0.00627	0.00589	0.00000817	0.000101	0.0148
	Annual Median	<0.000500	0.0260	<0.0000500	0.00260	0.00283	<0.000000500	0.00106	<0.000500	0.00175	<0.0000100	<0.0000100	0.000828	<0.00300	<0.00300	0.00000650	<0.000100	<0.0100
GH_ERC	% < LRL	76%	36%	61%	0%	0%	61%	0%	73%	0%	85%	76%	0%	67%	79%	15%	97%	97%
	% > BCWQG[a]	0%	-	0%	-	0%	19%	0%	0%	27%	0%	0%	0%	0%	3%	0%	-	-
	% > BCWQG[b]	0%	12%	0%	-	0%	-	0%	-	-	0%	-	-	0%	0%	0%	0%	0%
	% > Level 1 Benchmark	-	-	-	-	-	-	-	6%	0%	-	-	-	-	-	0%	-	-
	% > Level 2 Benchmark	-	-	-	-	-	-	-	0%	0%	-	-	-	-	-	-	-	-
	% > Level 3 Benchmark	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-

> 5% of samples exceed the guideline or benchmark.

> 50% of samples exceed the guideline or benchmark.

> 95% of samples exceed the guideline or benchmark.

Notes: "LRL" = laboratory reporting limit. "BCWQG" = British Columbia Working or Accepted Water Quality Guideline

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

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

Table C.6: Difference in Monthly Mean Concentrations of Water Quality Parameters Between Stations Downstream (GH_ERC) and Upstream (GH_GH2) of Mining Operations in the GHO LAEMP, 2016 to 2018

ANOVA Model Testing for Relative Difference Between Areas (Downstream − Upstream) Among Years [a]					Post-hoc Contrasts[b] (Downstream vs. Upstream) and Magnitude of Difference (MOD[c]) (Downstream Relative to Upstream)		
					P-value (MOD)		
Parameter	**Model Term**	**DF**	**F**	**P-value**	**2016**	**2017**	**2018**
Nitrate-N	Year	2	1.8	0.189	<0.001 (394%)		
	Error	33		-			
Nitrite-N	Year	Concentrations < LRL			Concentrations < LRL		
	Error						
Sulphate	Year	2	7.0	0.003	<0.001 (84%)	<0.001 (47%)	<0.001 (39%)
	Error	33		-			
Total Dissolved Solids	Year	2	4.3	0.023	<0.001 (20%)	<0.001 (10.2%)	<0.001 (9.5%)
	Error	33		-			
Cadmium (Dissolved)	Year	2	0.07	0.932	<0.001 (15%)		
	Error	31		-			
Cobalt (Dissolved)	Year	Concentrations < LRL			Concentrations < LRL		
	Error						
Antimony (Total)	Year	2	0.20	0.822	0.364 (8.4%)		
	Error	7		-			
Barium (Total)	Year	2	2.1	0.140	<0.001 (22%)		
	Error	33		-			
Boron (Total)	Year	Concentrations < LRL			Concentrations < LRL		
	Error						
Lithium (Total)	Year	2	3.8	0.032	<0.001 (43%)	<0.001 (77%)	<0.001 (54%)
	Error	32		-			
Manganese (Total)	Year	2	1.1	0.347	0.19 (-18%)		
	Error	33		-			
Methylmercury (Total)	Year	Concentrations < LRL			Concentrations < LRL		
	Error						
Mercury (Total)	Year	2	0.41	0.672	0.011 (20%)		
	Error	13		-			
Molybdenum (Total)	Year	2	8.8	<0.001	0.107 (-4.5%)	0.025 (5.4%)	0.001 (7.6%)
	Error	33		-			
Nickel (Total)	Year	2	0.58	0.576	0.099 (13%)		
	Error	12		-			
Selenium (Total)	Year	2	2.3	0.116	<0.001 (89%)		
	Error	33		-			
Uranium (Total)	Year	2	1.4	0.259	<0.001 (9.4%)		
	Error	33		-			
Zinc (Total)	Year	2	0.90	0.433	0.176 (18%)		
	Error	12		-			

P-value < 0.05.

Positive MOD (higher concentration of analyte at the Downstream station relative to Upstream).

Negative MOD (lower concentration of analyte at Downstream station relative to Upstream).

[a] One way Analysis of Variance (ANOVA) conducted on the relative differences between areas, calculated as $\log_{10}$(downsteam) − $\log_{10}$(upstream) with year. Values less than the laboratory reporting limit (LRL) were replaced with the LRL when only one of the two paired samples was < LRL. No difference was calculated when both paired samples were < LRL. Only comparisons with more than three difference values for all time periods were included.

[b] Post-hoc calculated as a one-sample t-test on the relative differences between stations [$\log_{10}$(downstream) − $\log_{10}$(upstream)]. Conducted separately by year when there was a significant year term in the ANOVA model.

[c] Magnitude of difference (MOD) calculated as the downstream concentration 10^(Mean$_{GH_ERC}$] minus the upstream concentration 10^(Mean$_{GH_GH2}$) divided by the upstream concentration 10^(Mean$_{GH_GH2}$) and multplied by 100% (Mean$_{GH_XXX}$ is in $\log_{10}$ units) to represent the percent difference between the downstream and upstream stations, relative to upstream.

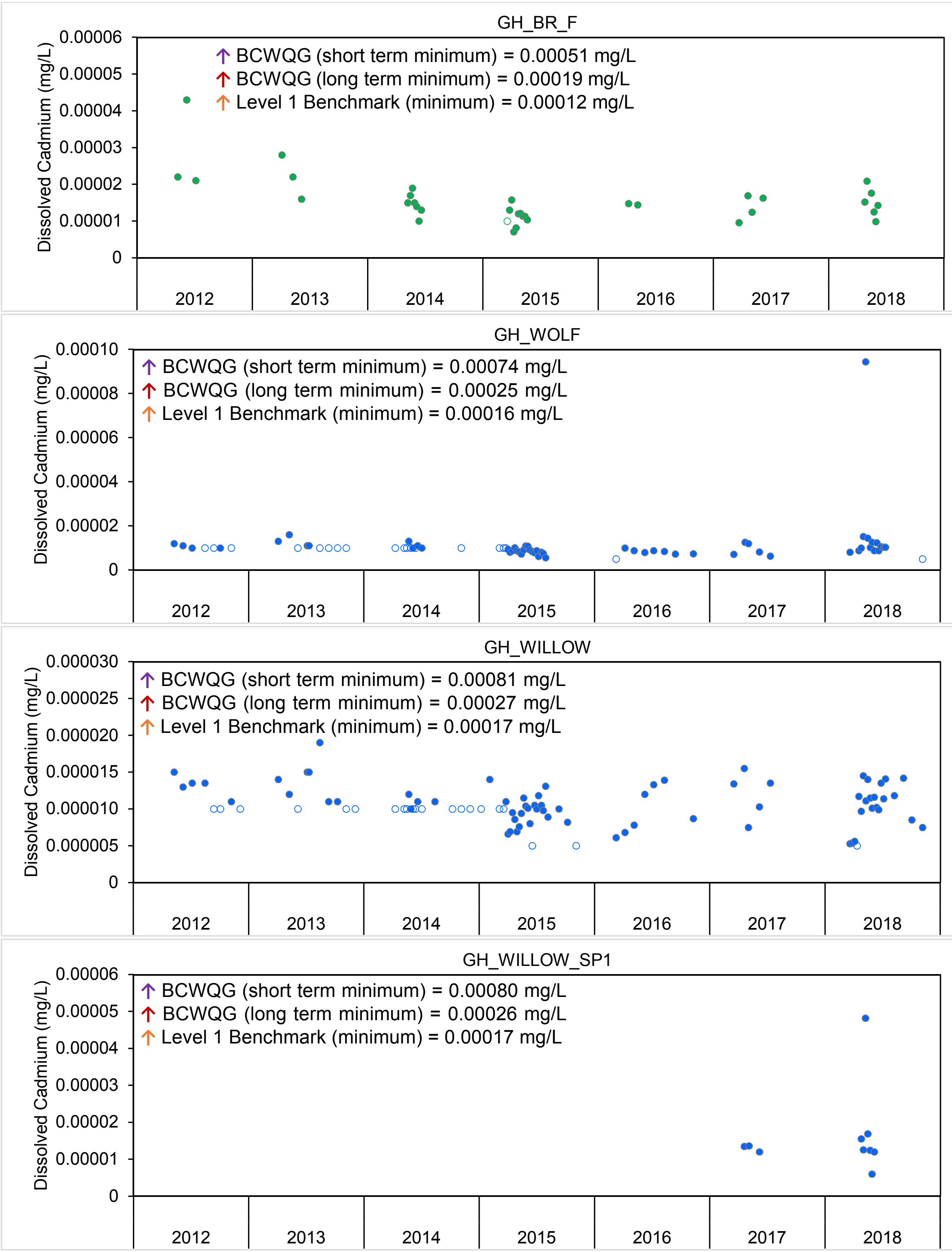

Figure C.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

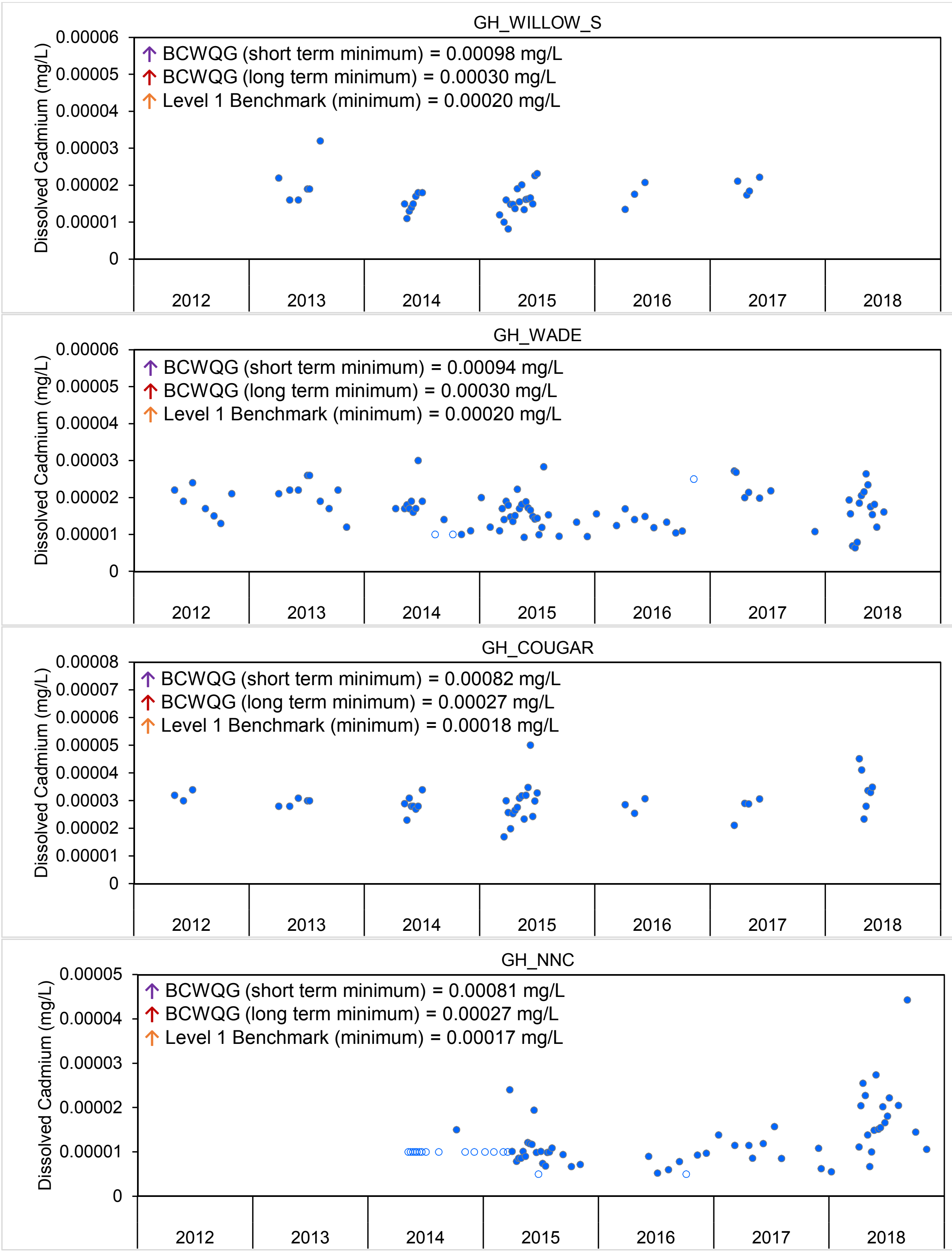

Figure C.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark.

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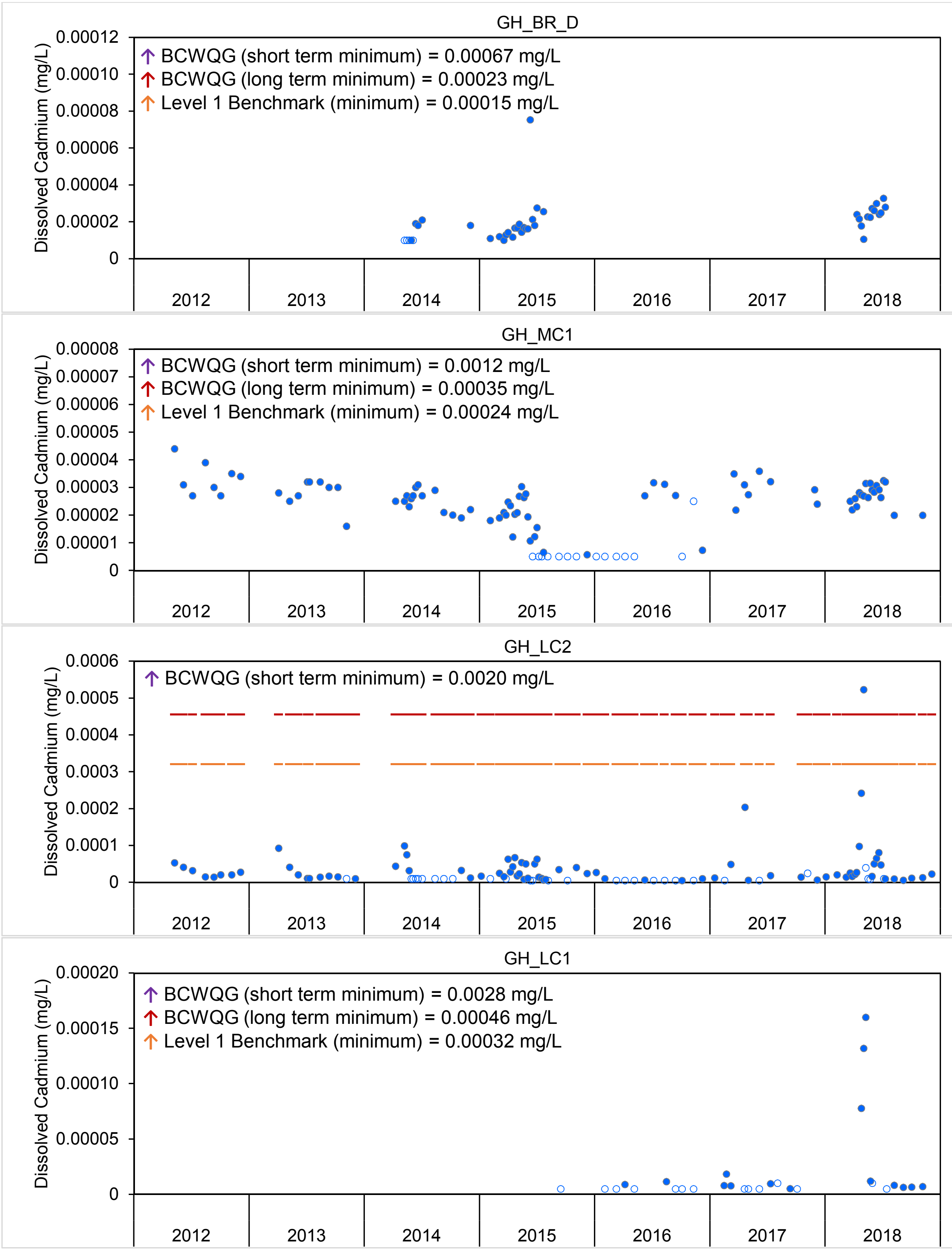

Figure C.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the West-side Tributaries, 2012 to 2018

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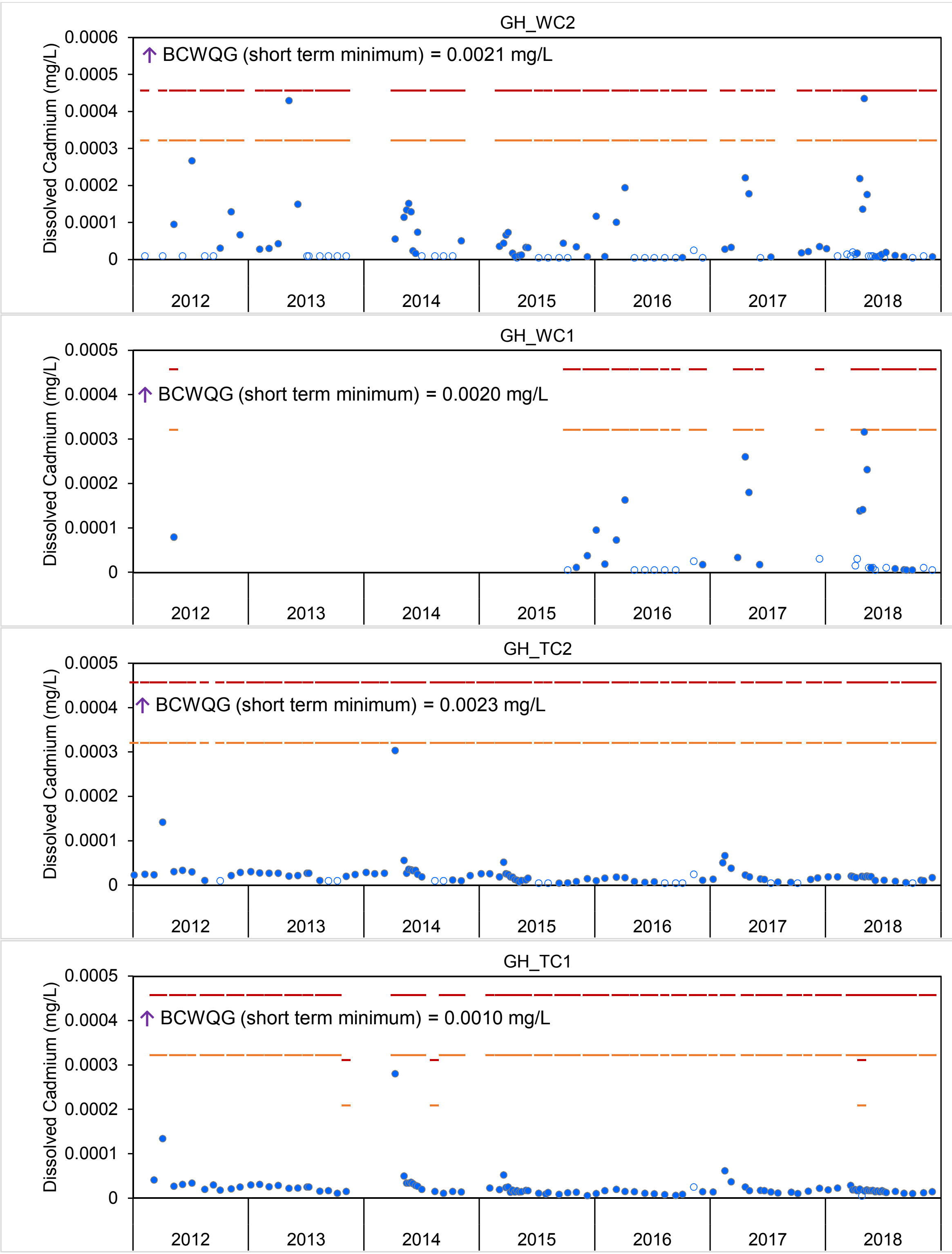

Figure C.1: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the West-side Tributaries, 2012 to 2018

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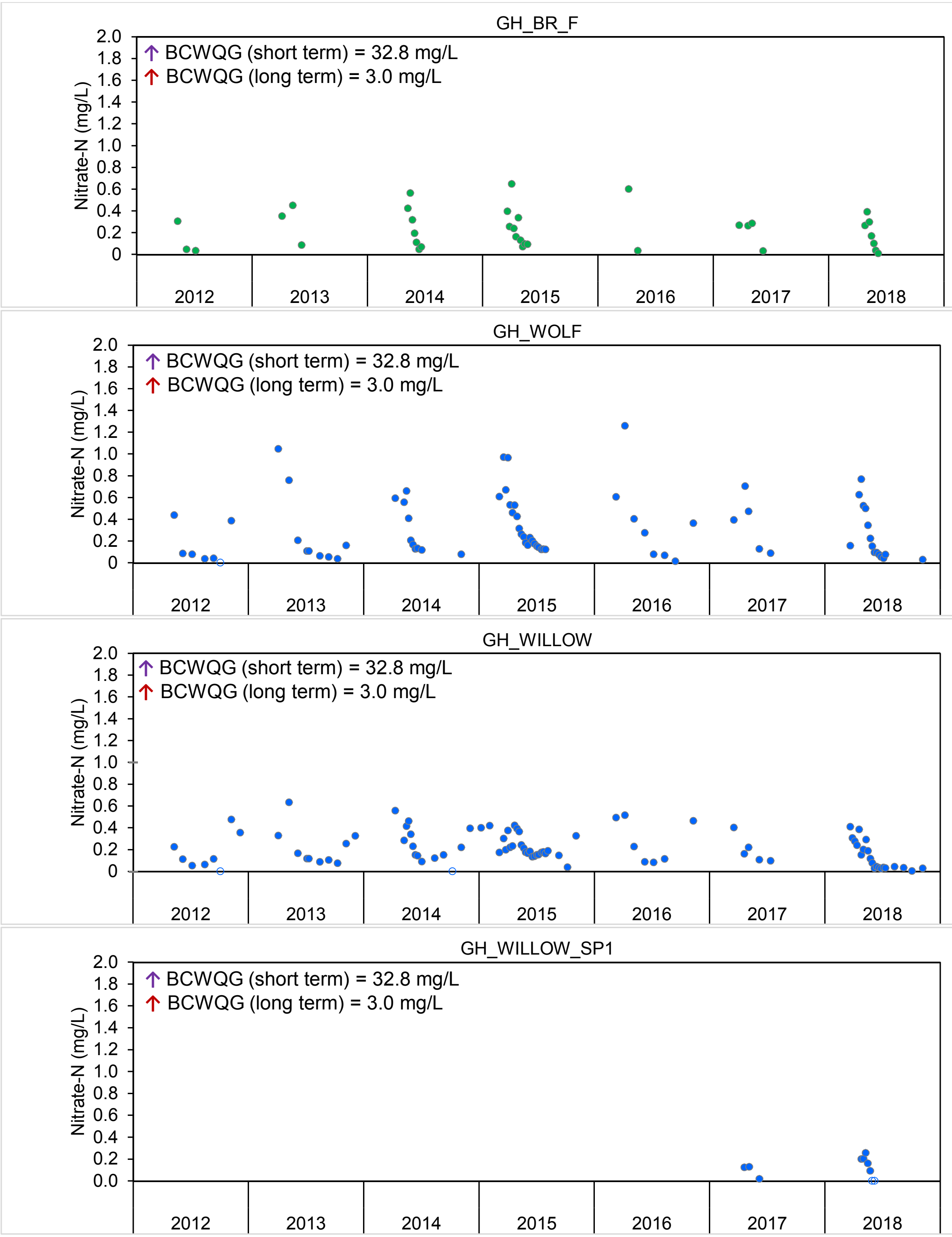

Figure C.2: Time Series Plots for Aqueous Nitrate-N Concentrations from West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

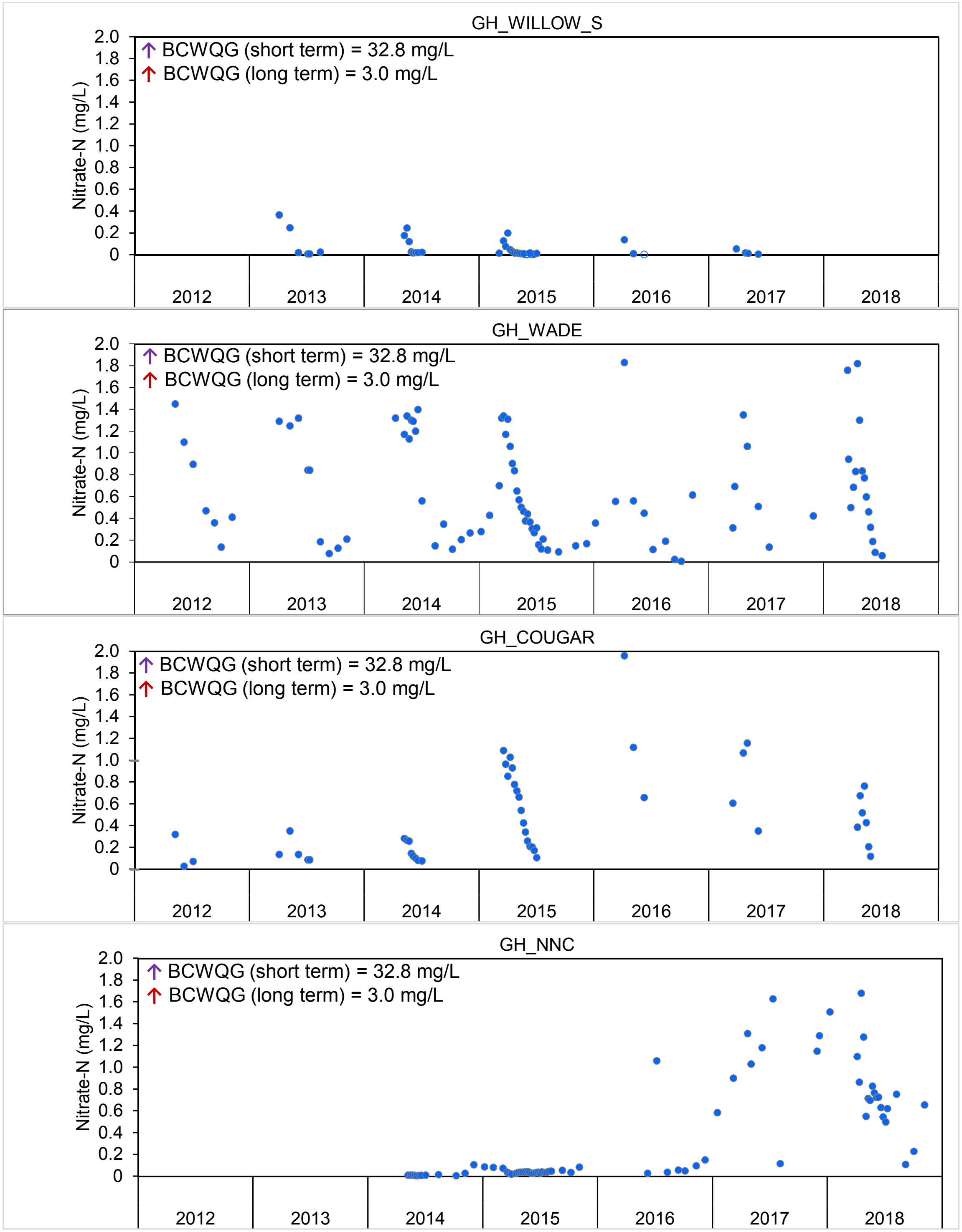

Figure C.2: Time Series Plots for Aqueous Nitrate-N Concentrations from West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

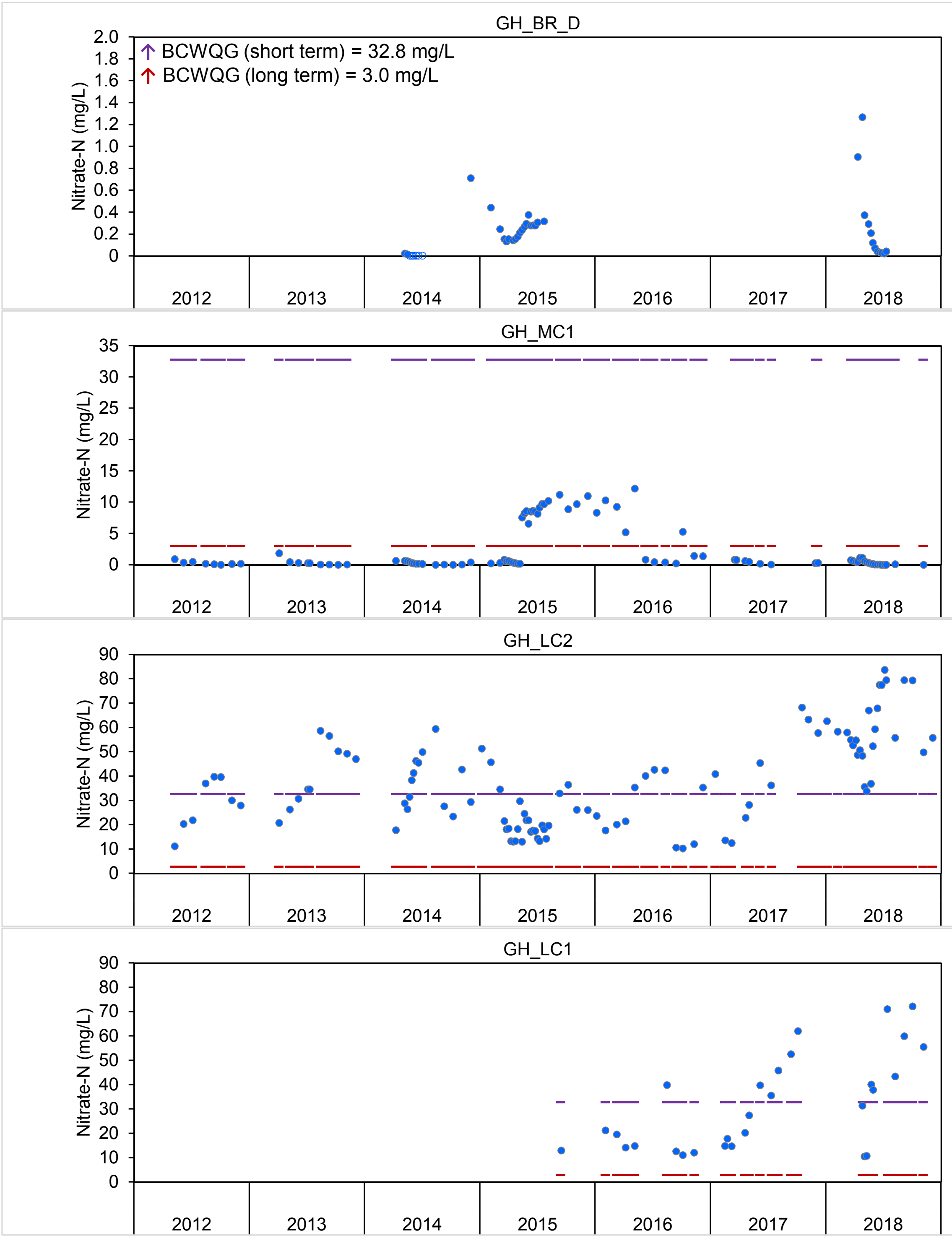

Figure C.2: Time Series Plots for Aqueous Nitrate-N Concentrations from West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term)

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

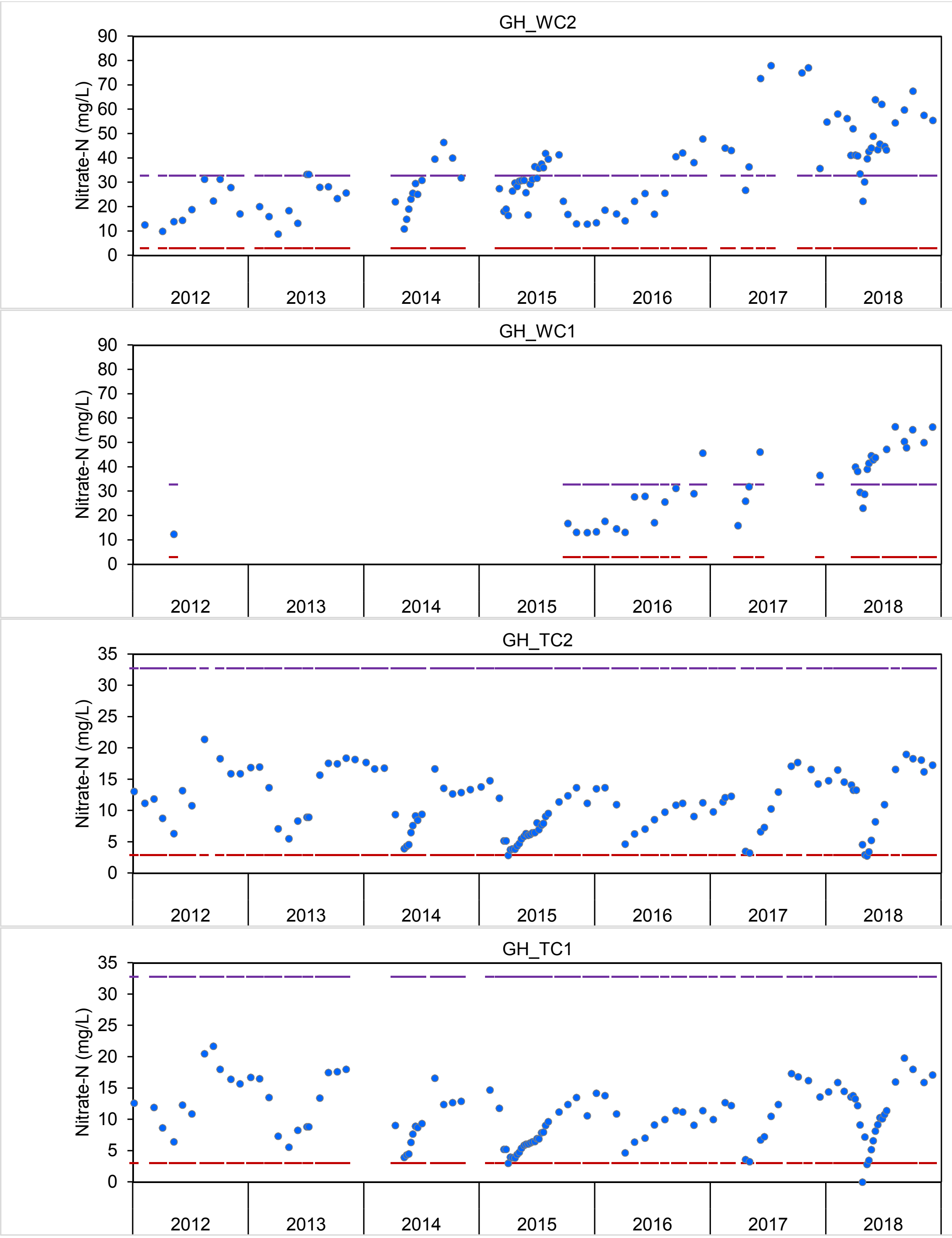

Figure C.2: Time Series Plots for Aqueous Nitrate-N Concentrations from West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term)

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Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

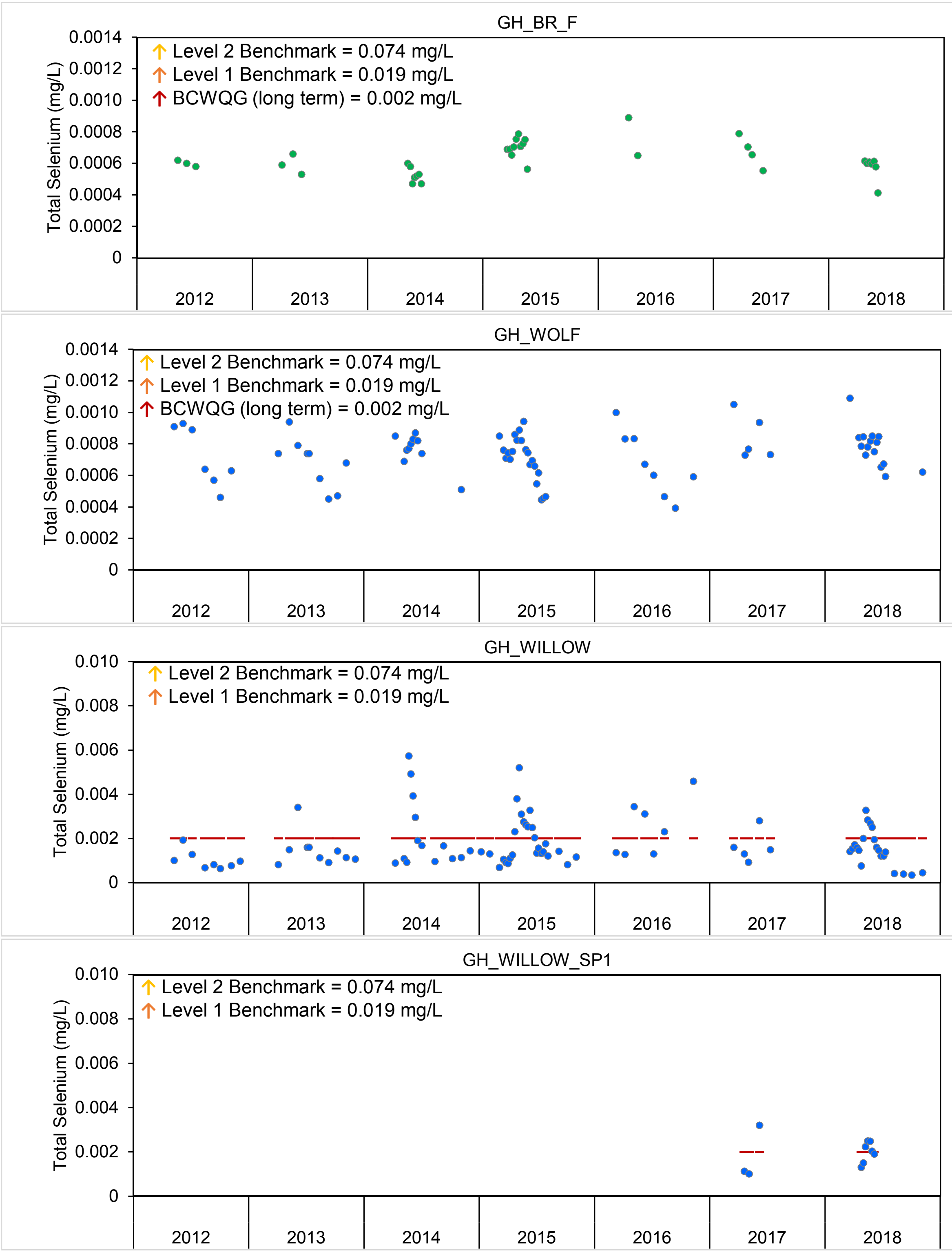


Figure C.3: Time Series Plots for Aqueous Total Selenium Concentrations from West-side Tributaries, 2012 to 2018

— — = BCWQG (long term); — — = Level 1 Benchmark; — — = Level 2 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

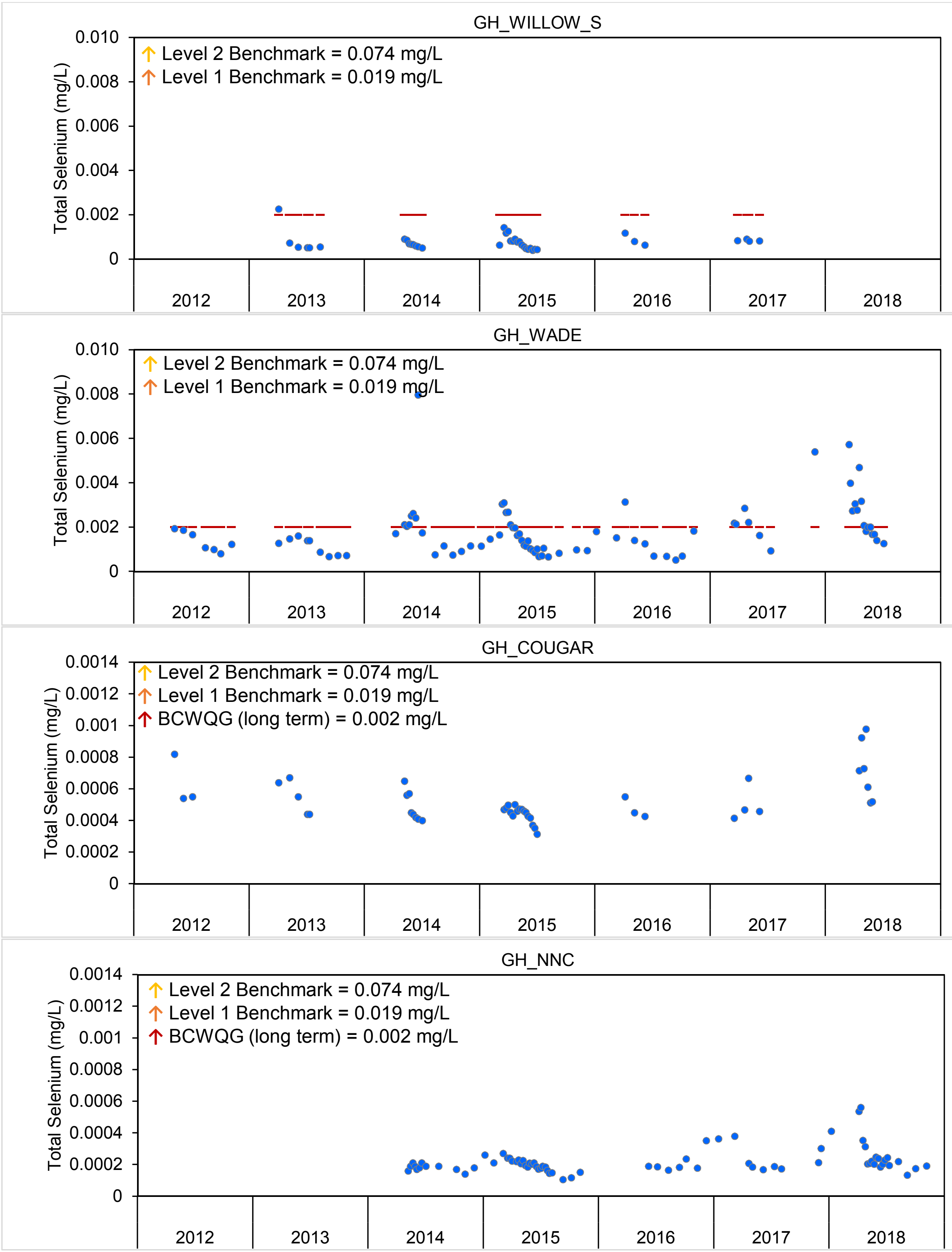


Figure C.3: Time Series Plots for Aqueous Total Selenium Concentrations from West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

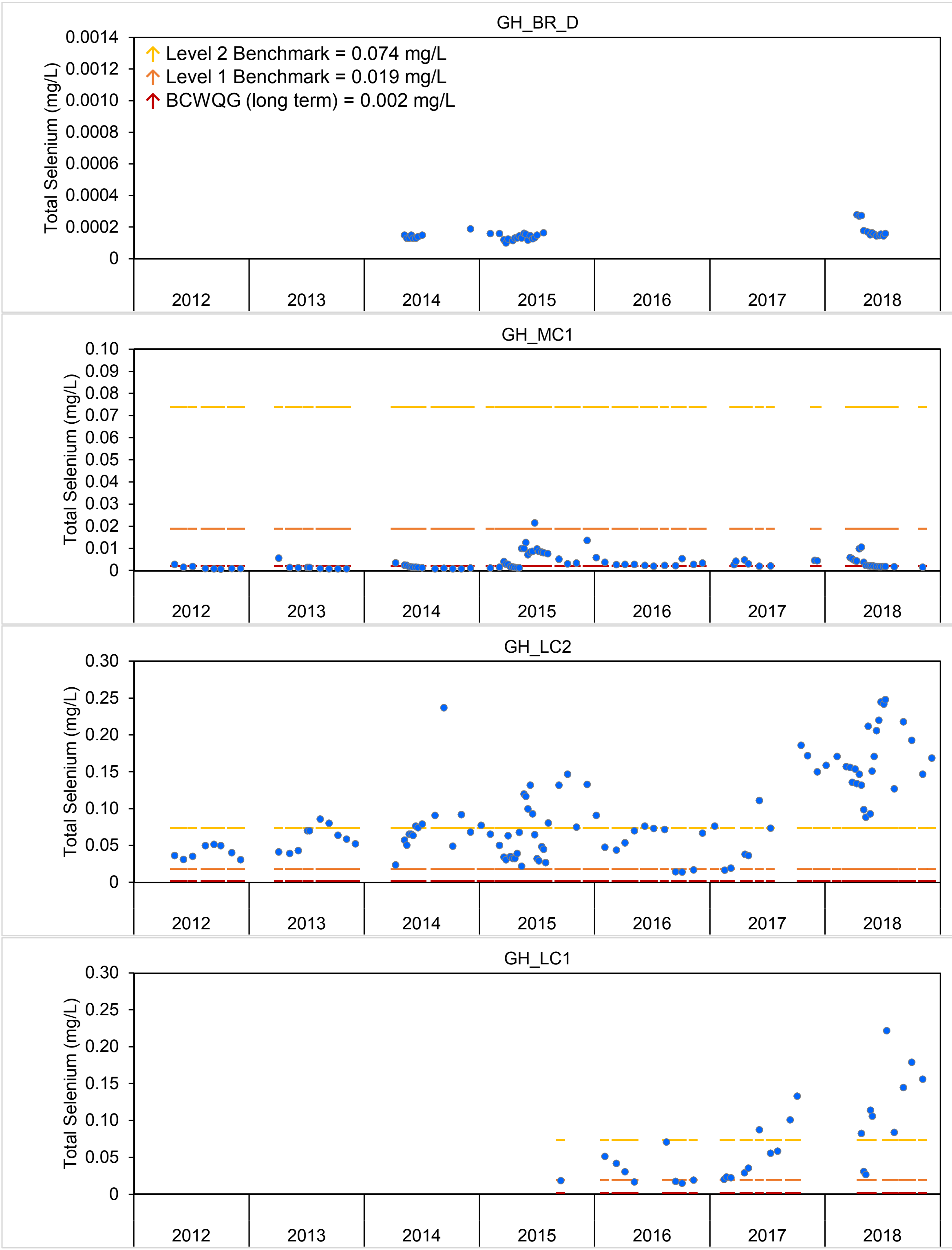


Figure C.3: Time Series Plots for Aqueous Total Selenium Concentrations from West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

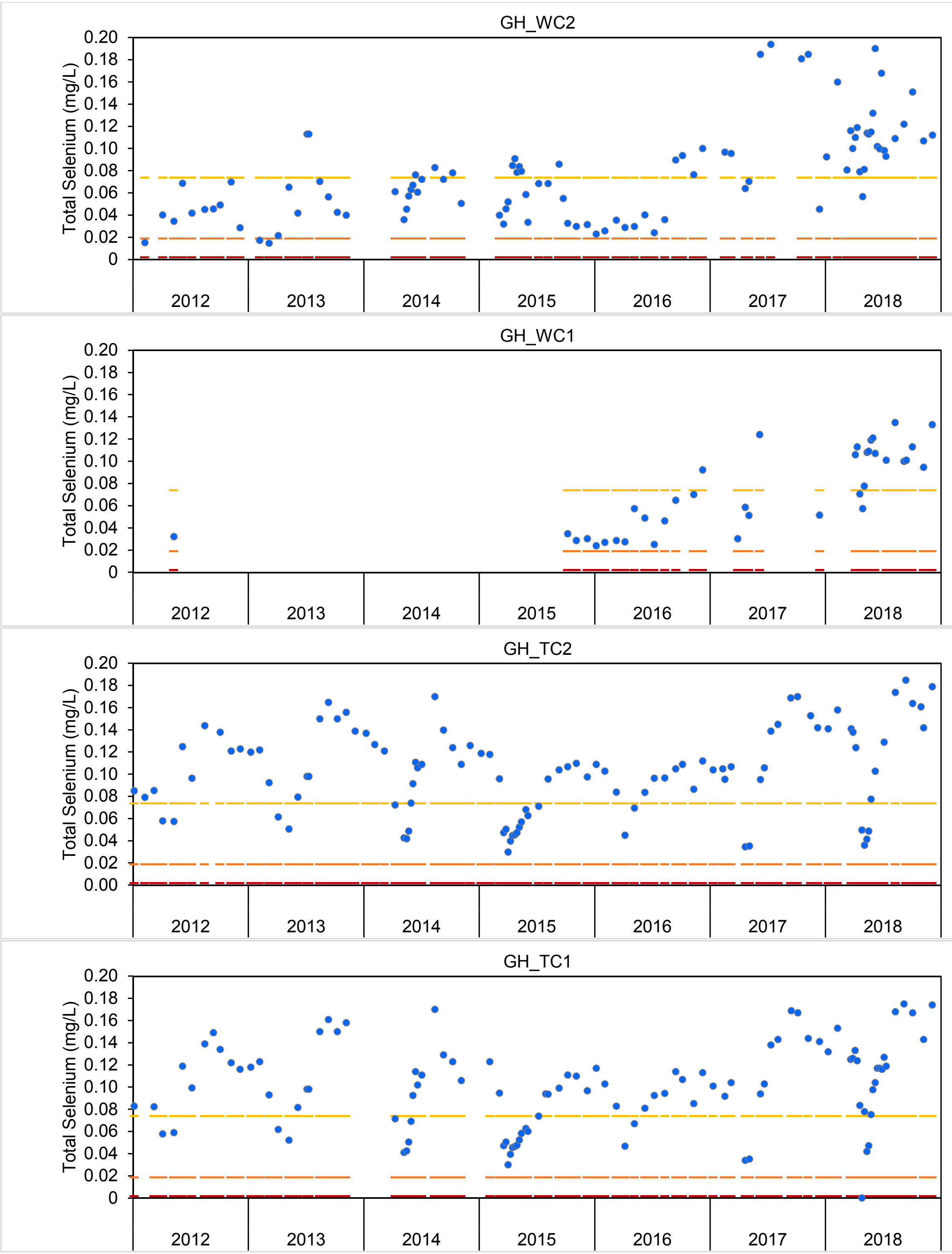


Figure C.3: Time Series Plots for Aqueous Total Selenium Concentrations from West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

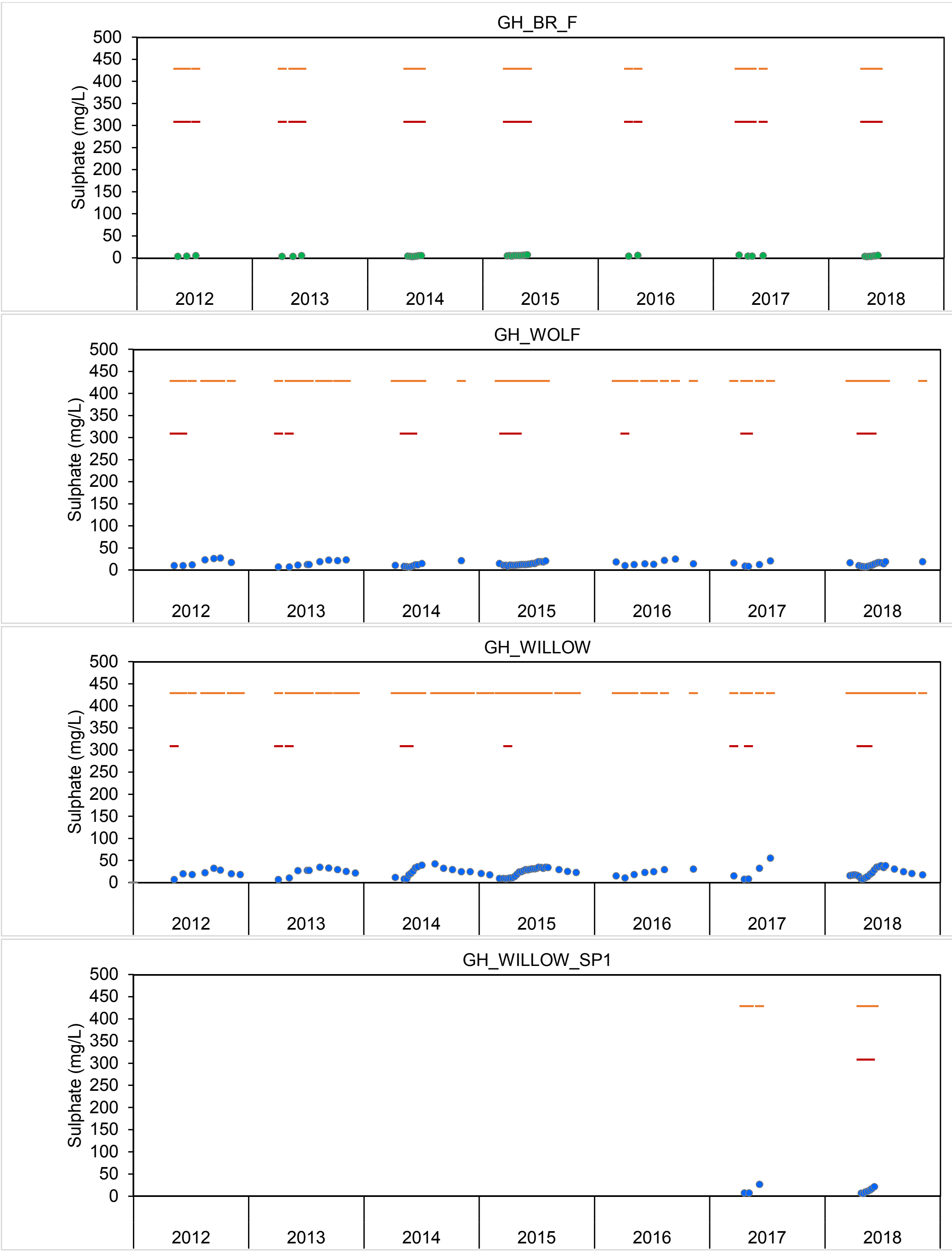


Figure C.4: Time Series Plots for Aqueous Sulphate Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

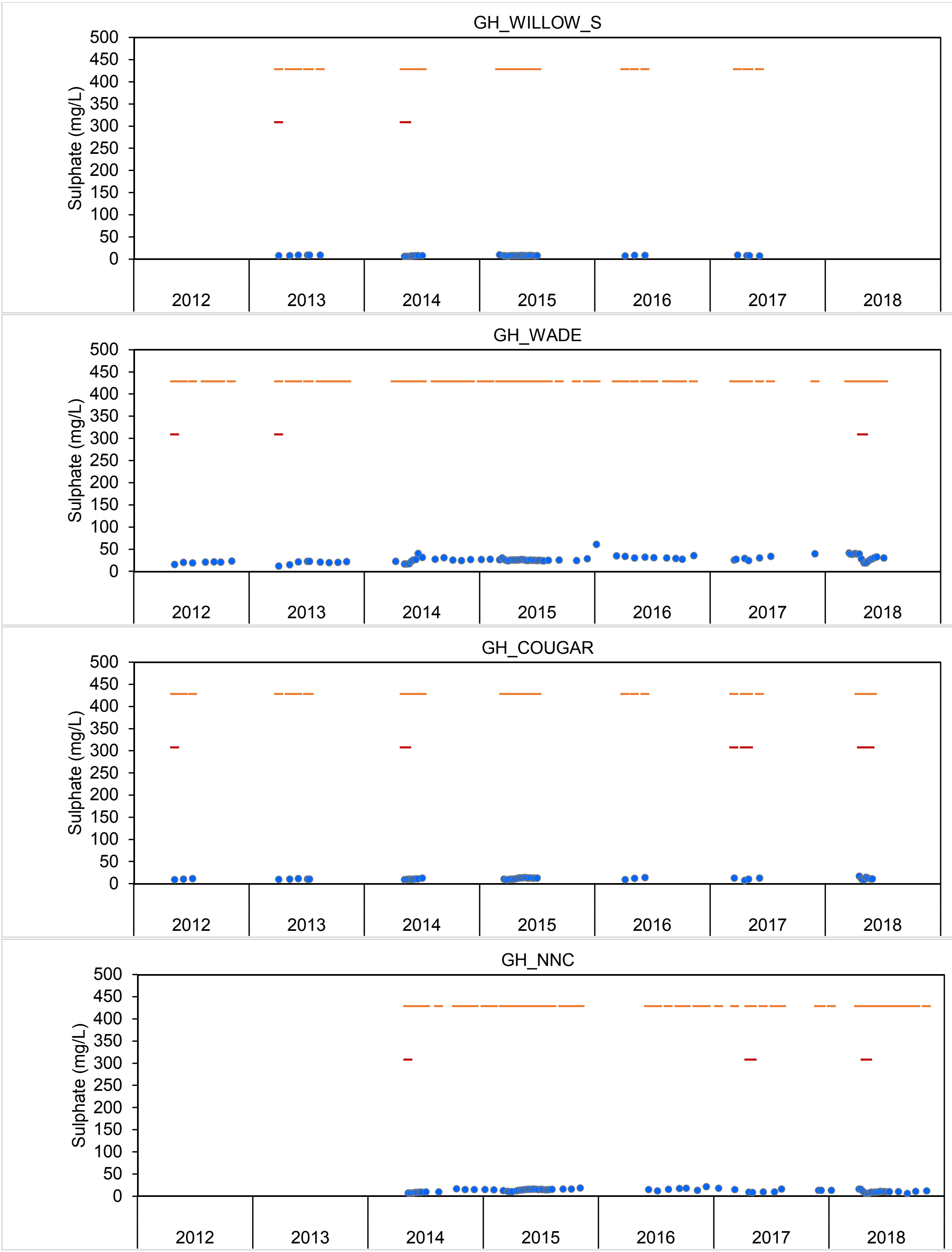


Figure C.4: Time Series Plots for Aqueous Sulphate Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

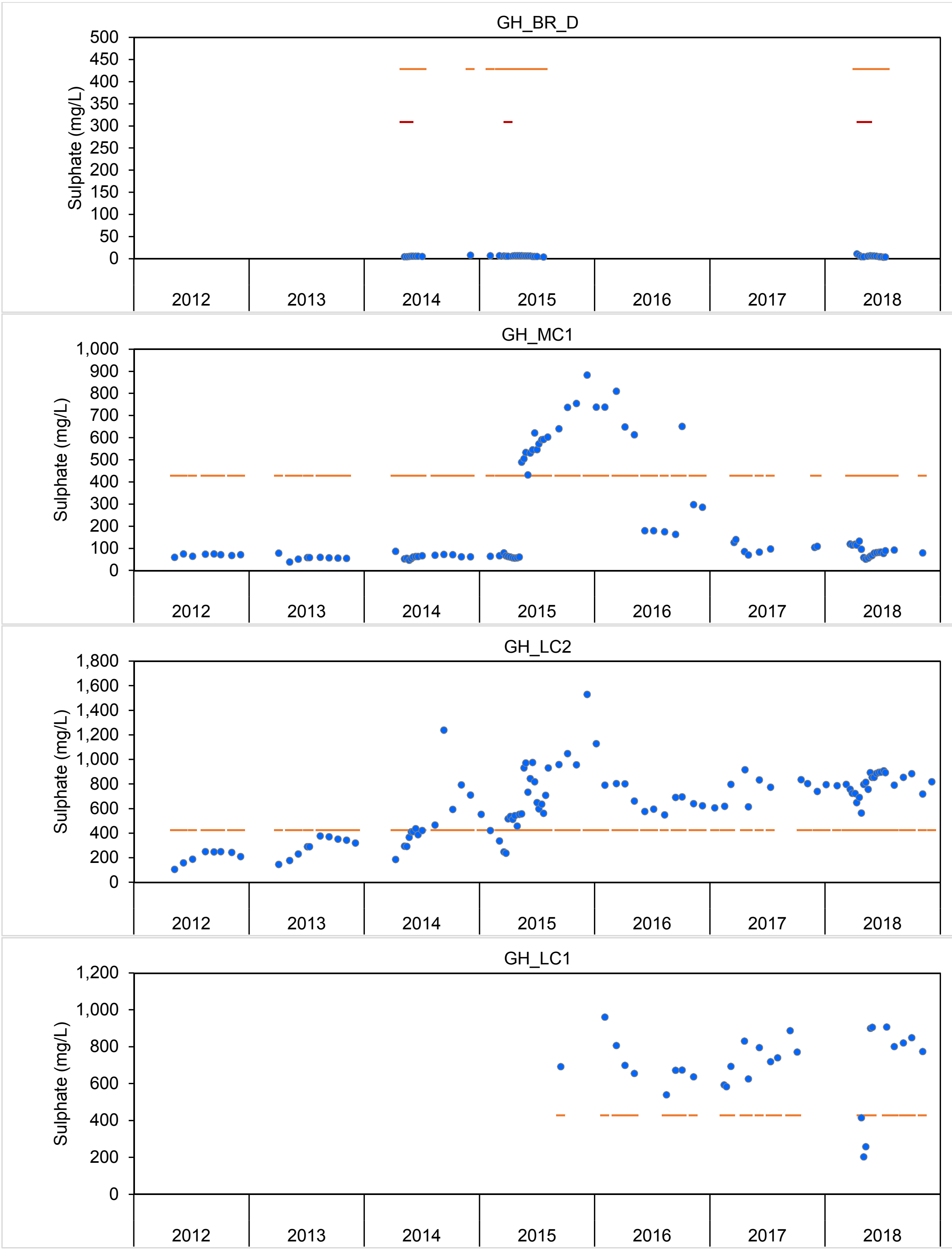


Figure C.4: Time Series Plots for Aqueous Sulphate Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

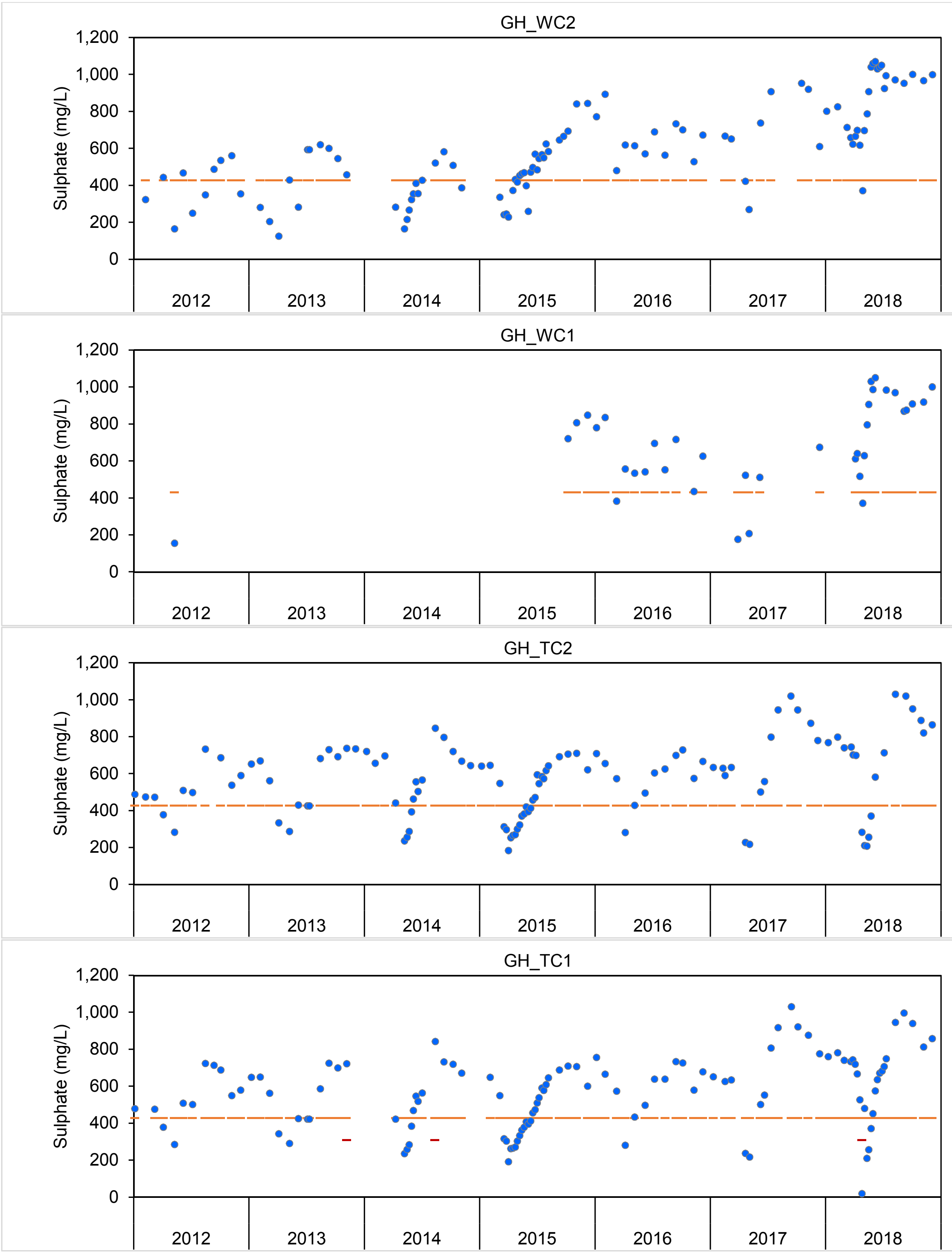


Figure C.4: Time Series Plots for Aqueous Sulphate Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

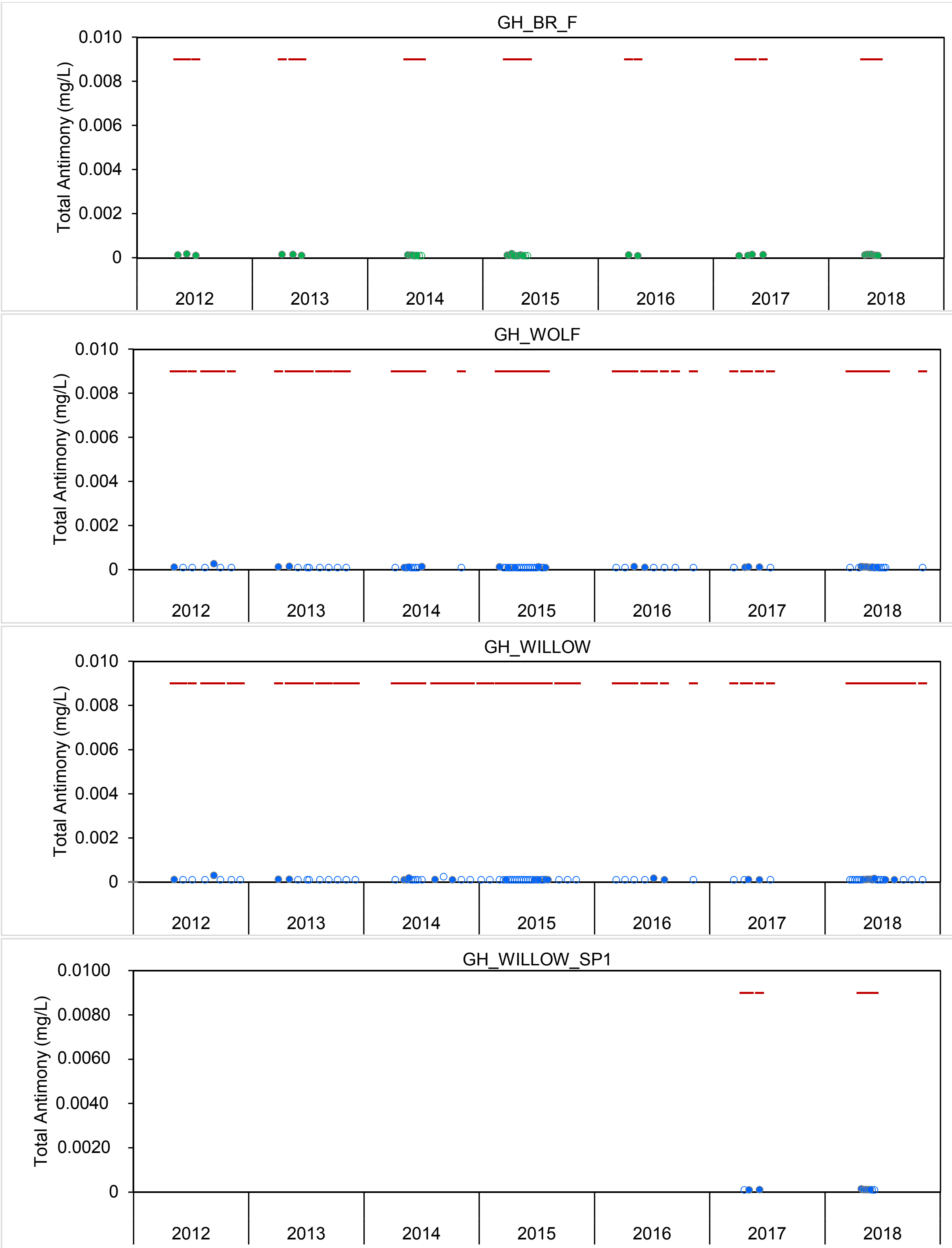


Figure C.5: Time Series Plots for Aqueous Total Antimony Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

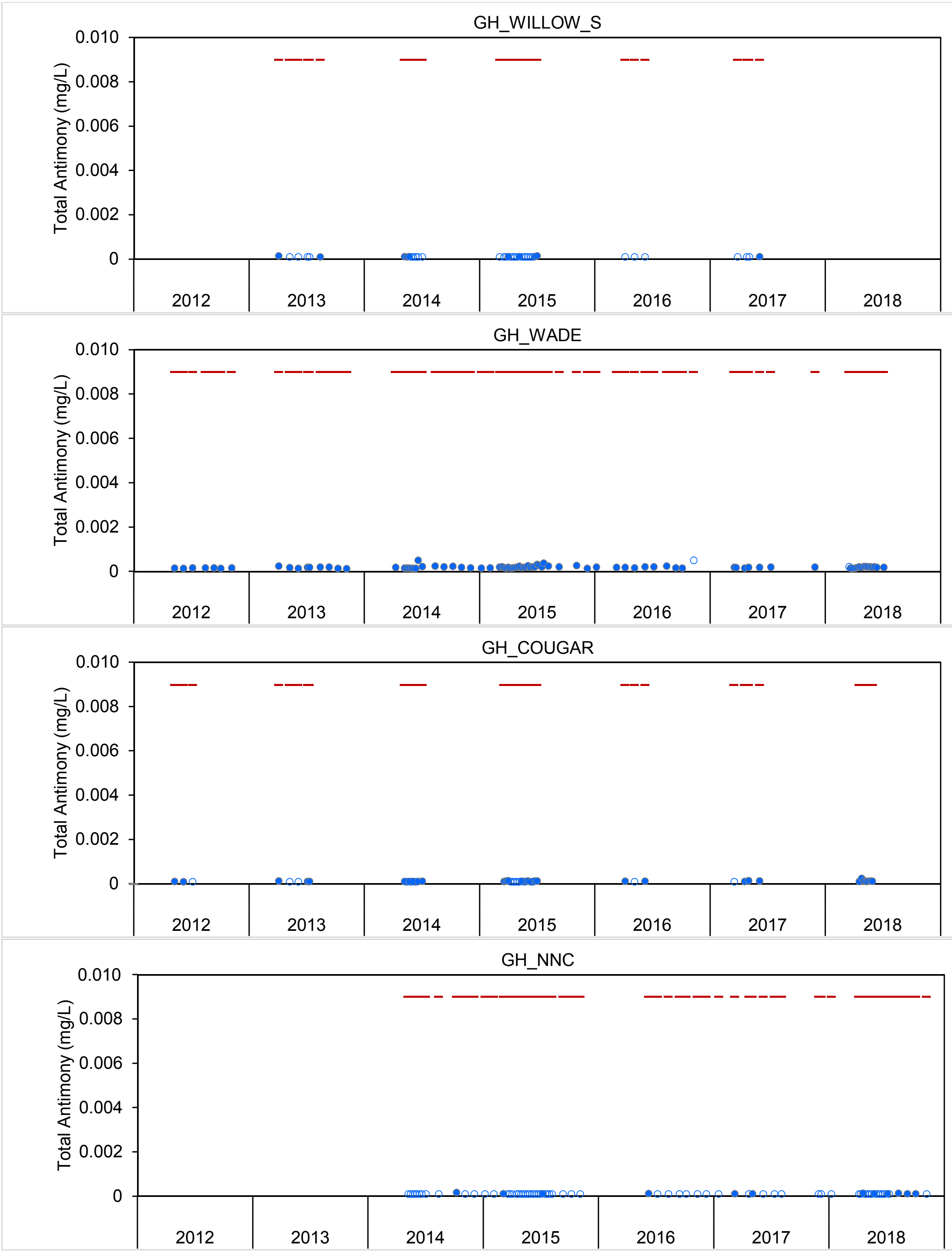


Figure C.5: Time Series Plots for Aqueous Total Antimony Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

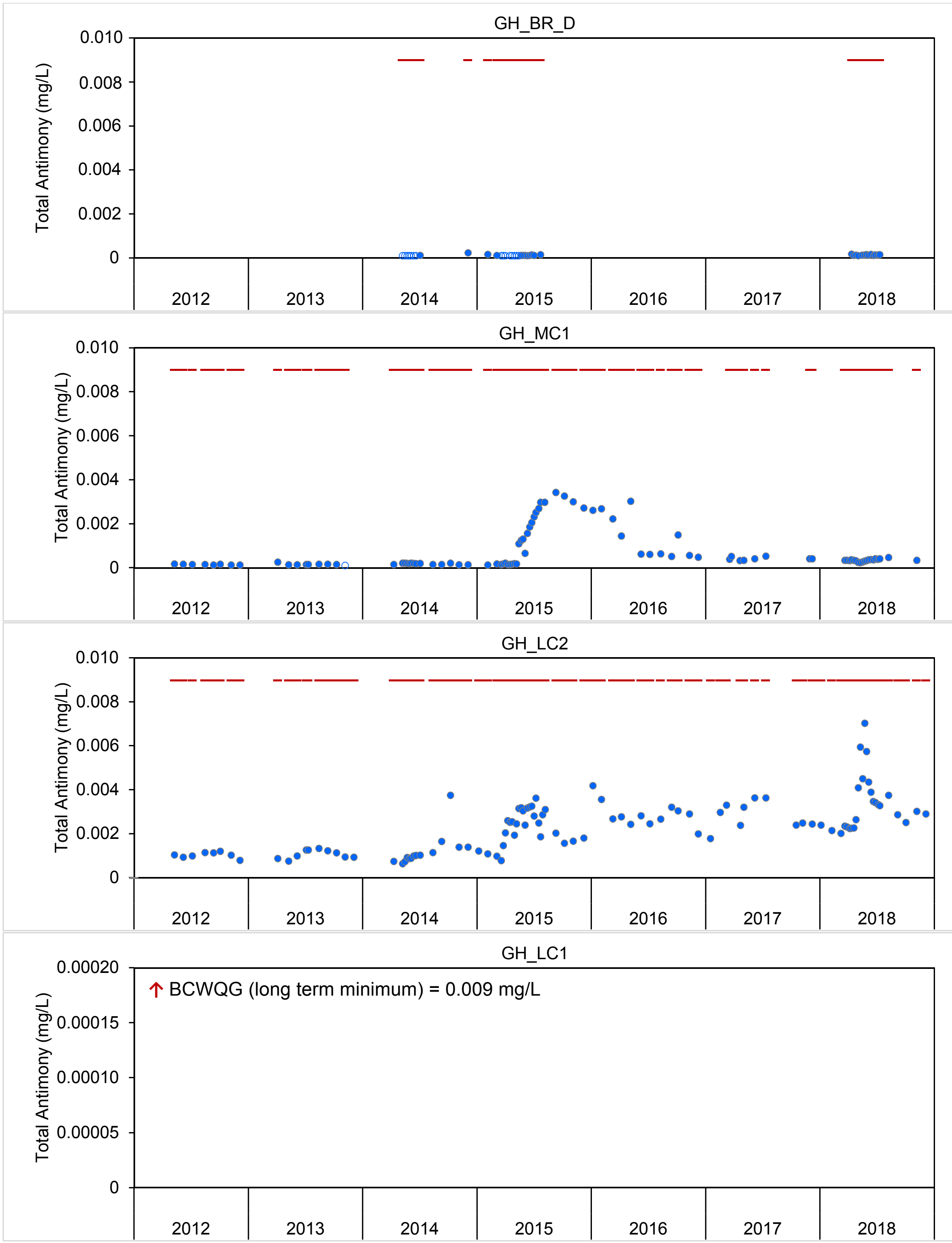


Figure C.5: Time Series Plots for Aqueous Total Antimony Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

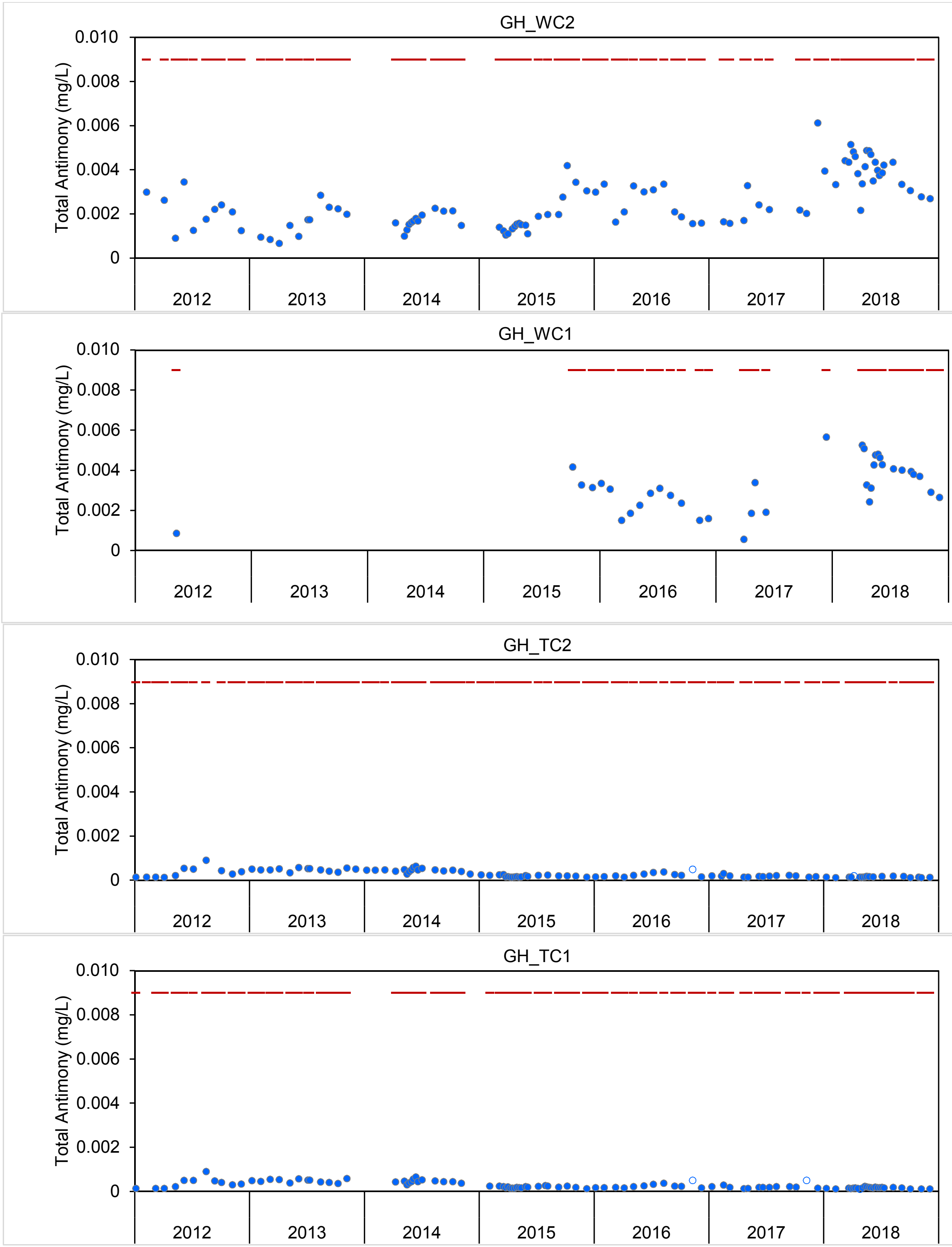


Figure C.5: Time Series Plots for Aqueous Total Antimony Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

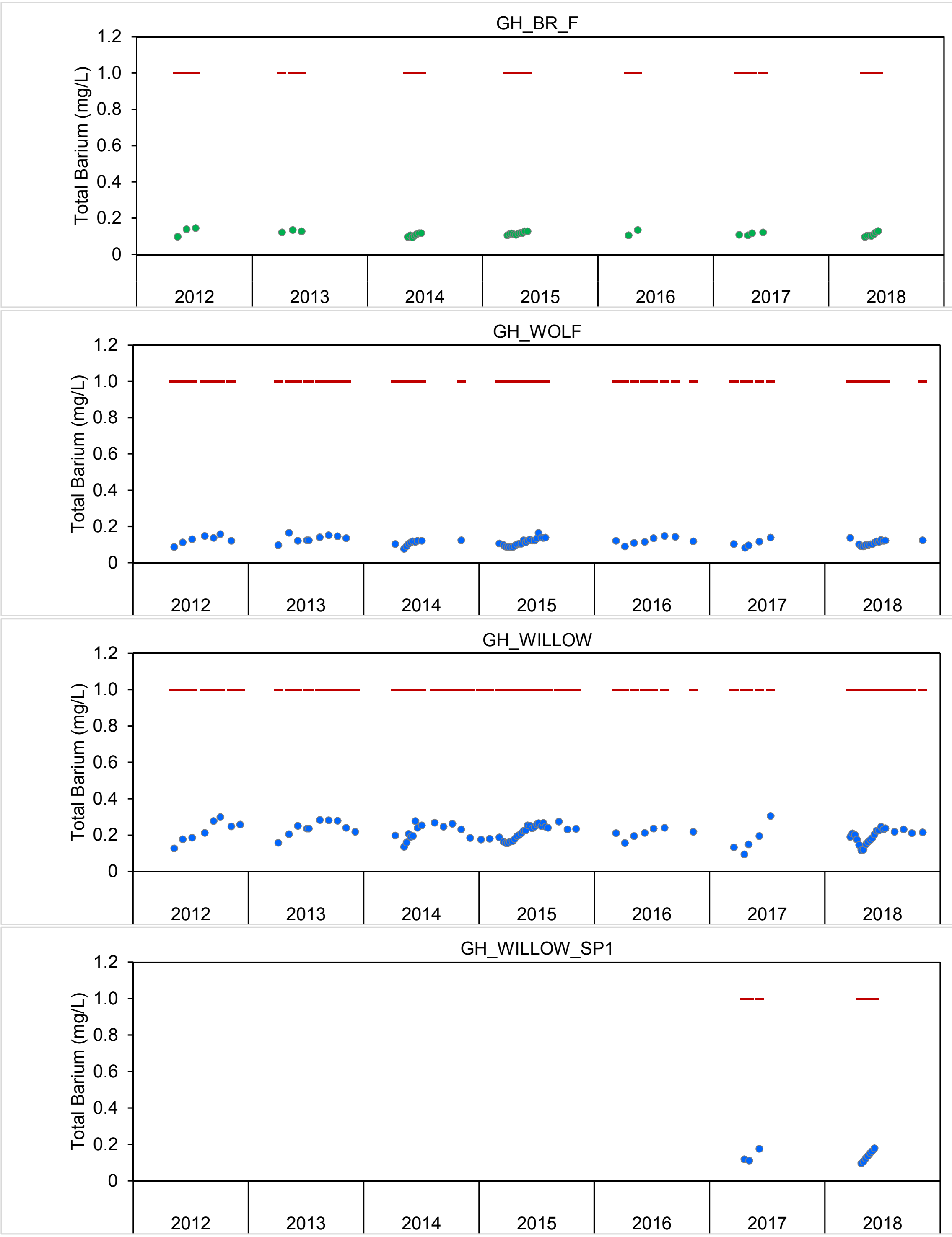


Figure C.6: Time Series Plots for Aqueous Total Barium Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values

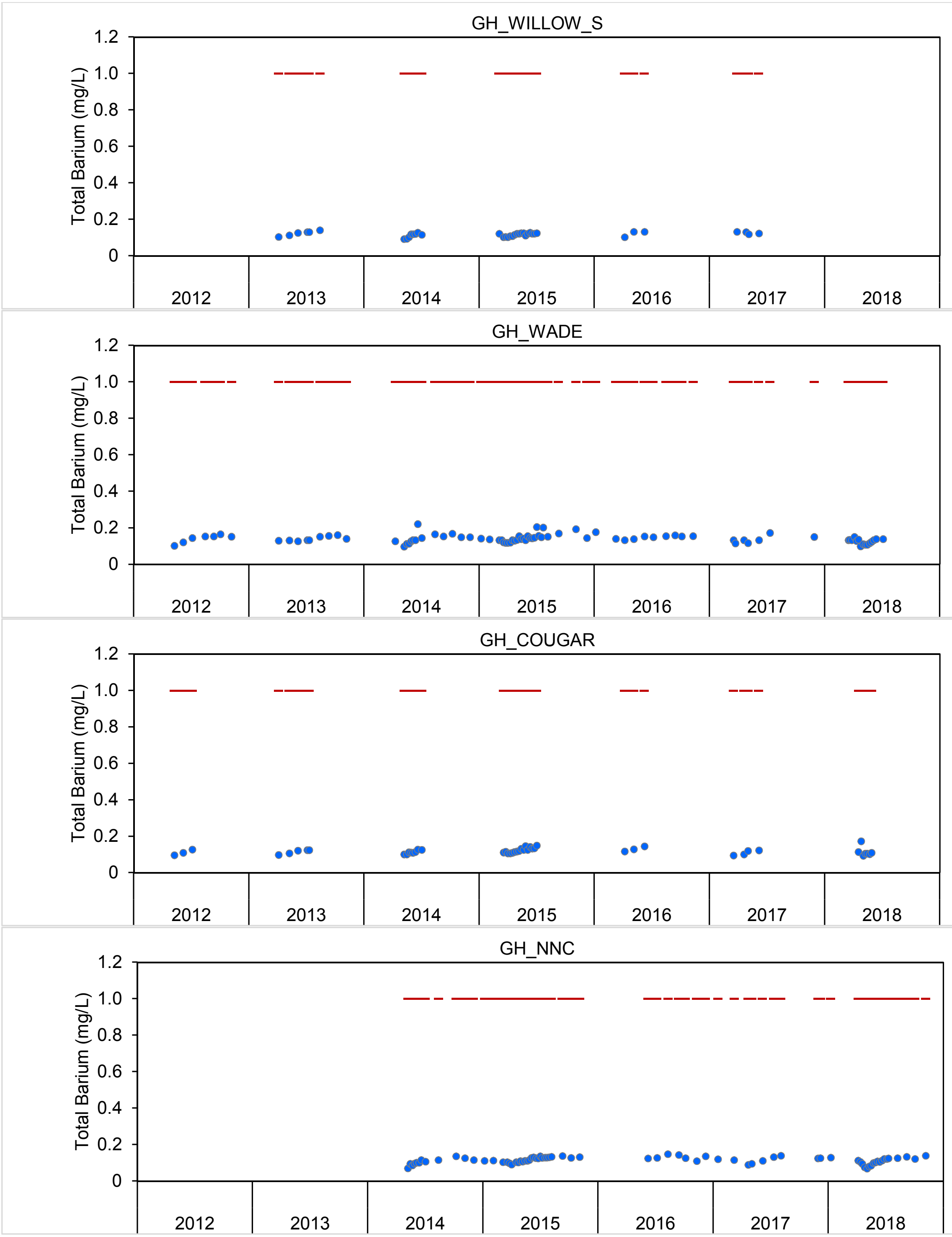


Figure C.6: Time Series Plots for Aqueous Total Barium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values

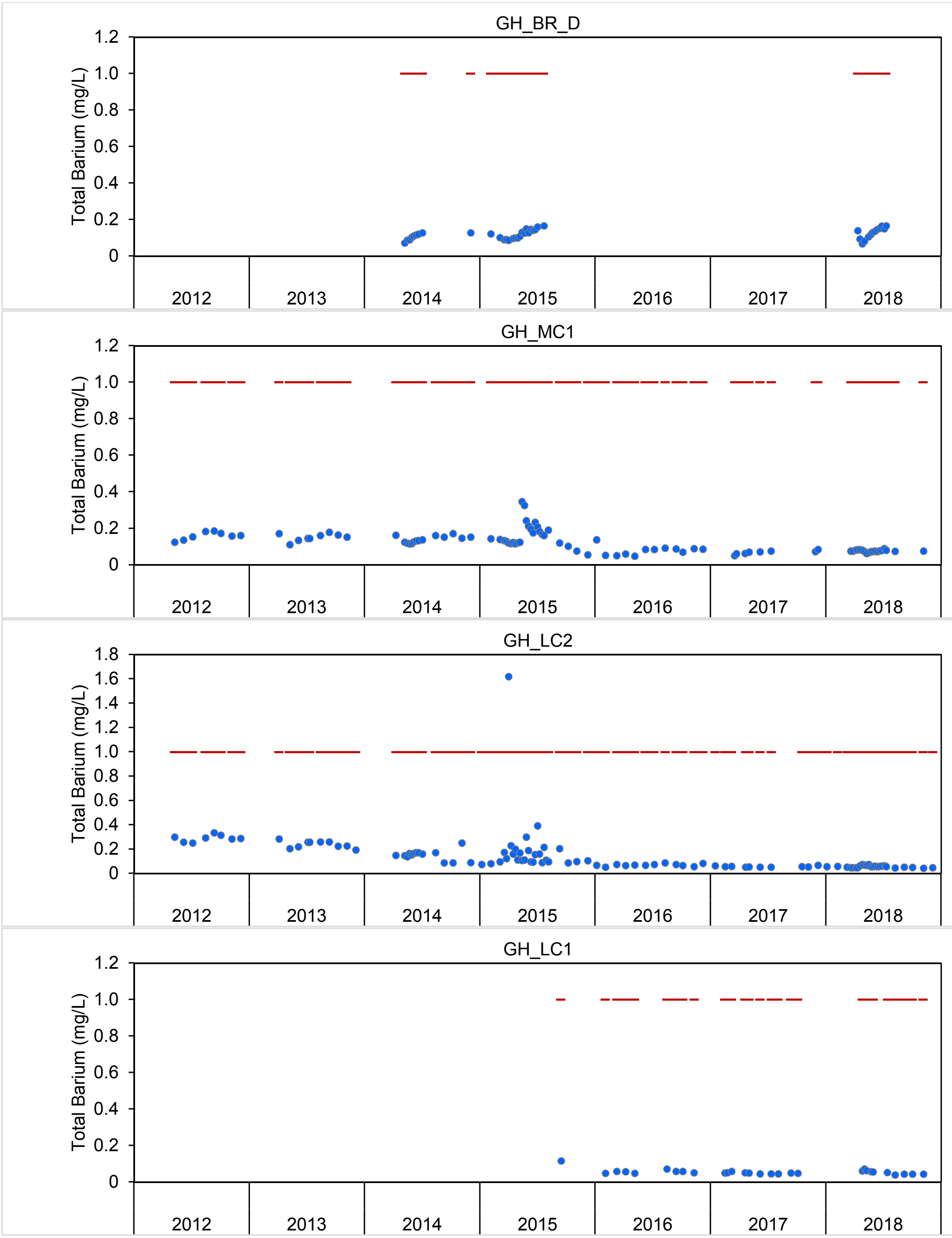


Figure C.6: Time Series Plots for Aqueous Total Barium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values

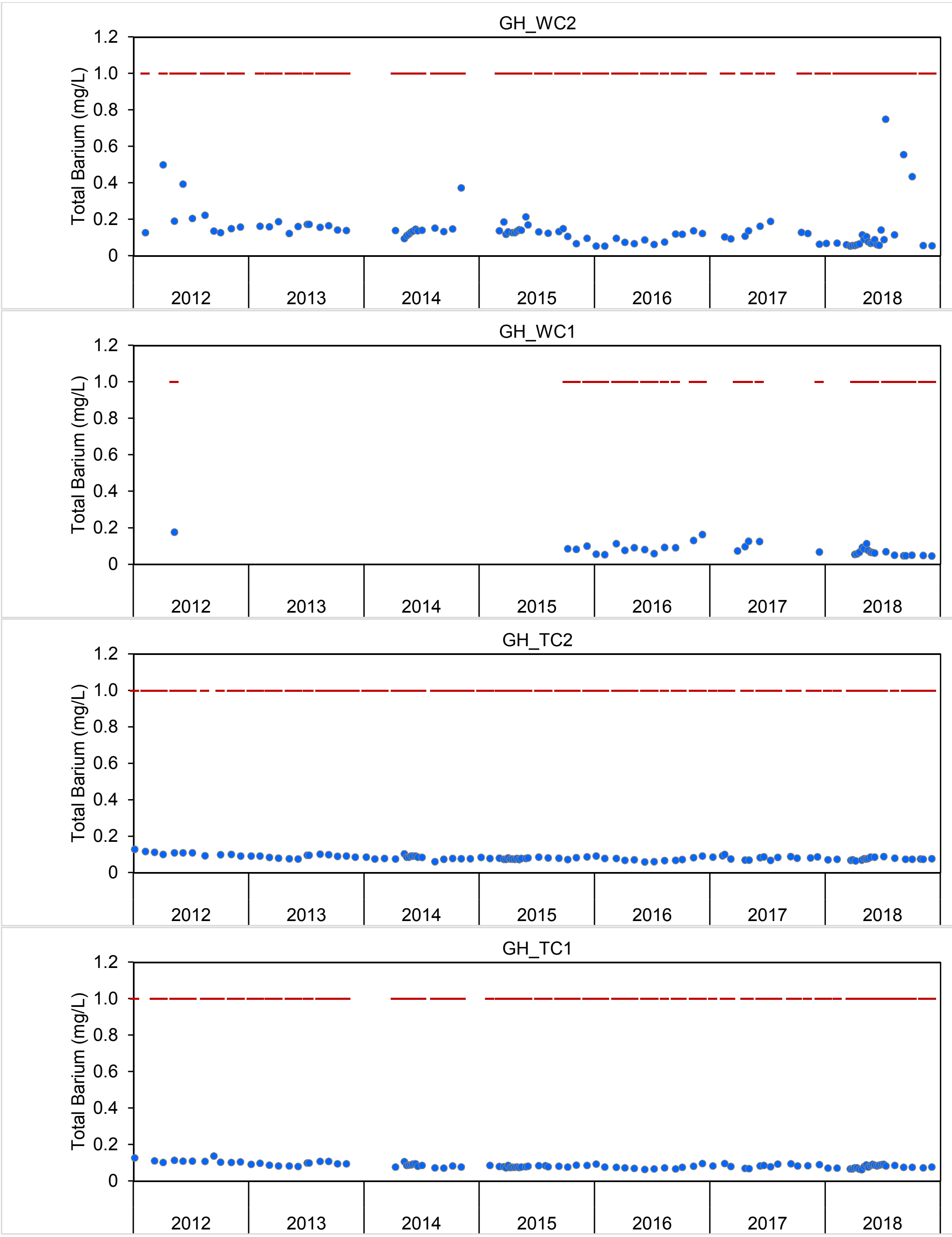


Figure C.6: Time Series Plots for Aqueous Total Barium Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values

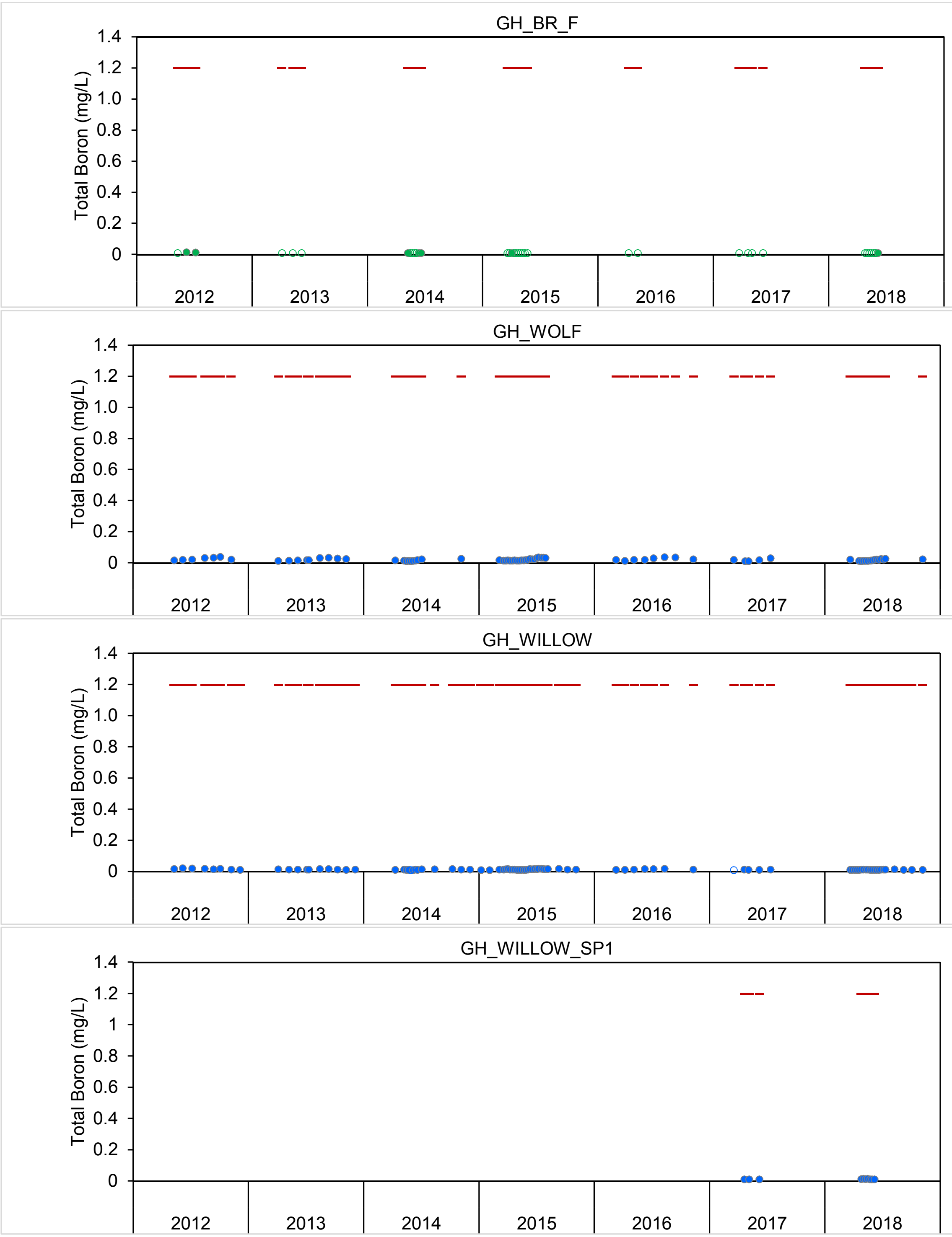


Figure C.7: Time Series Plots for Aqueous Total Boron Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

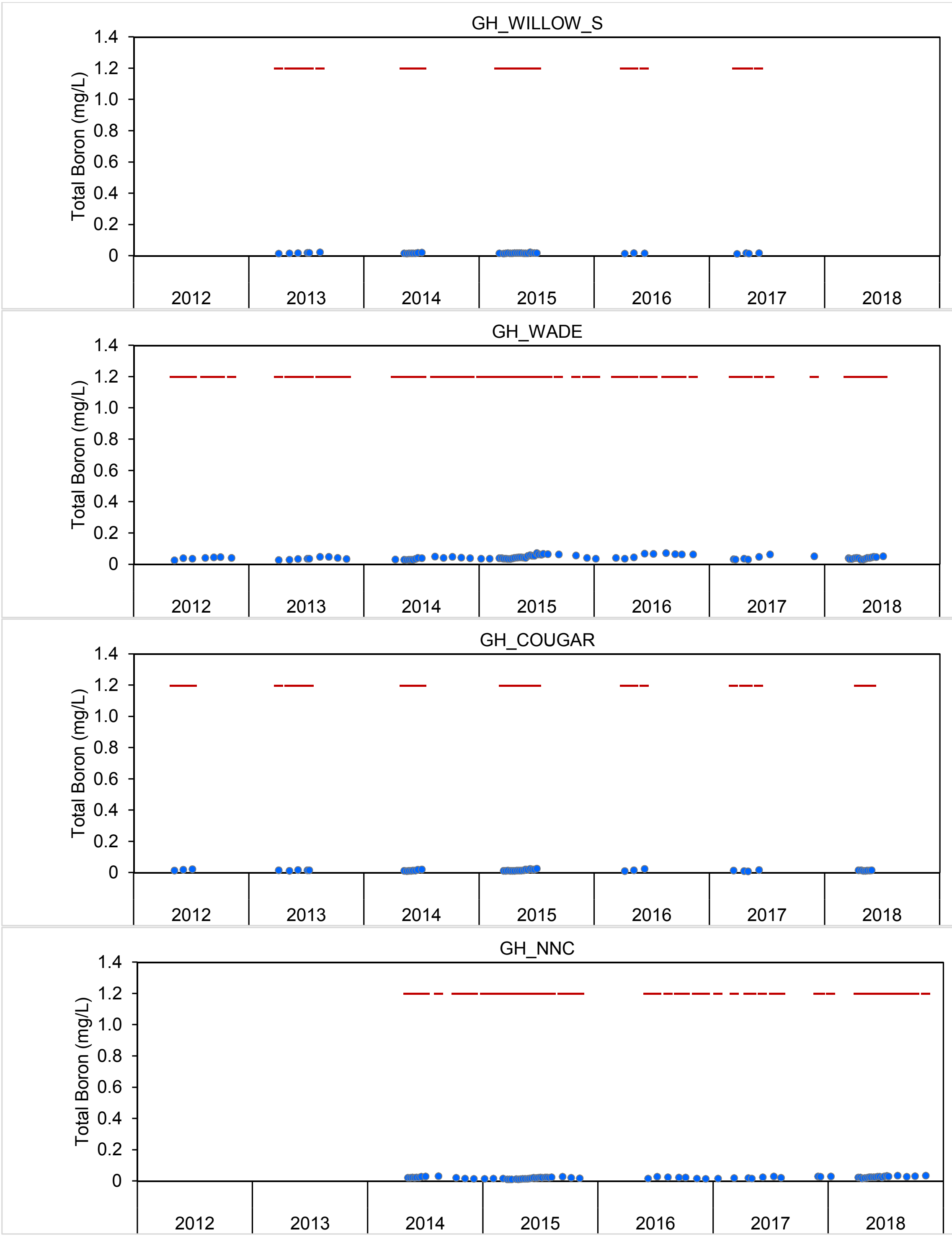


Figure C.7: Time Series Plots for Aqueous Total Boron Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

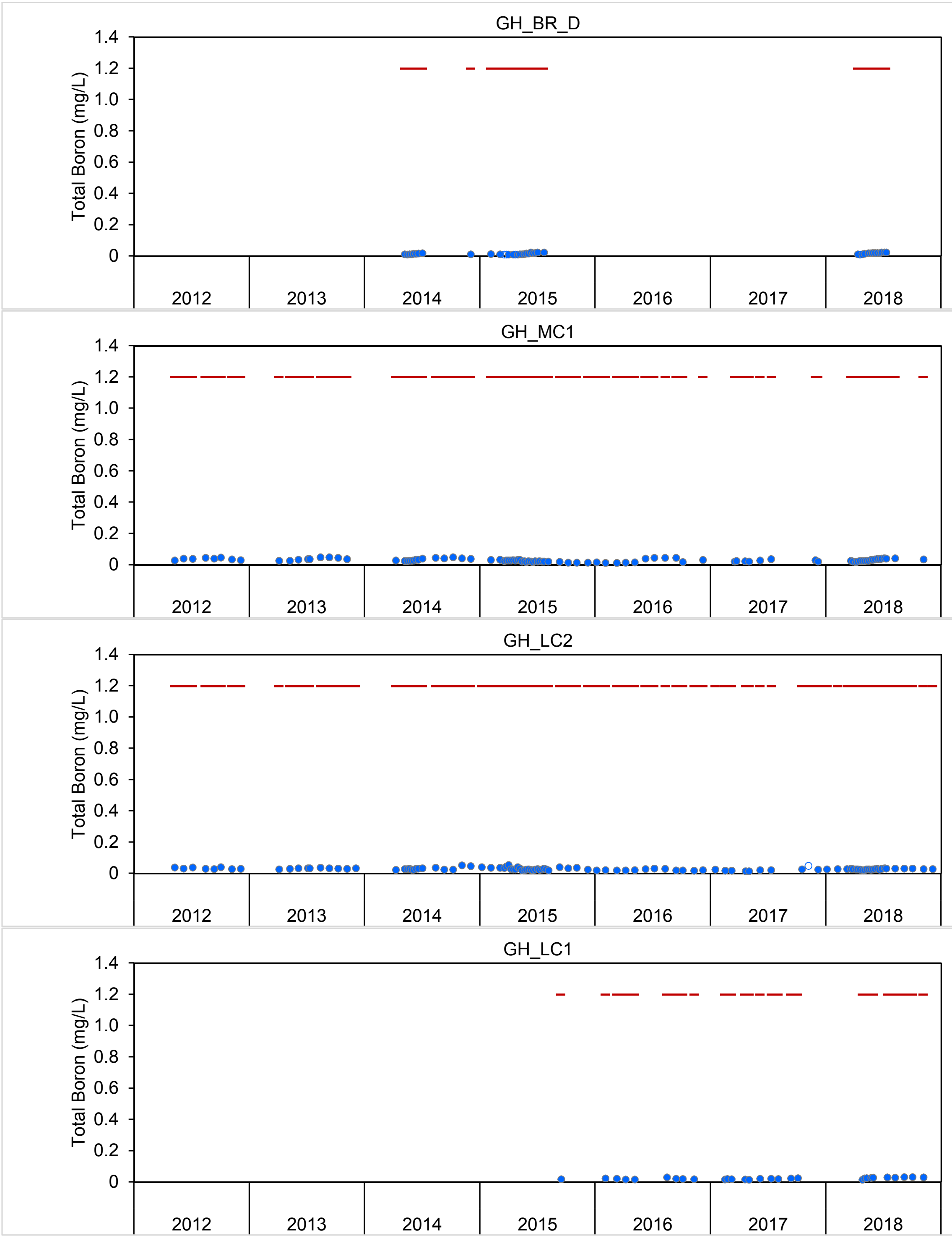


Figure C.7: Time Series Plots for Aqueous Total Boron Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

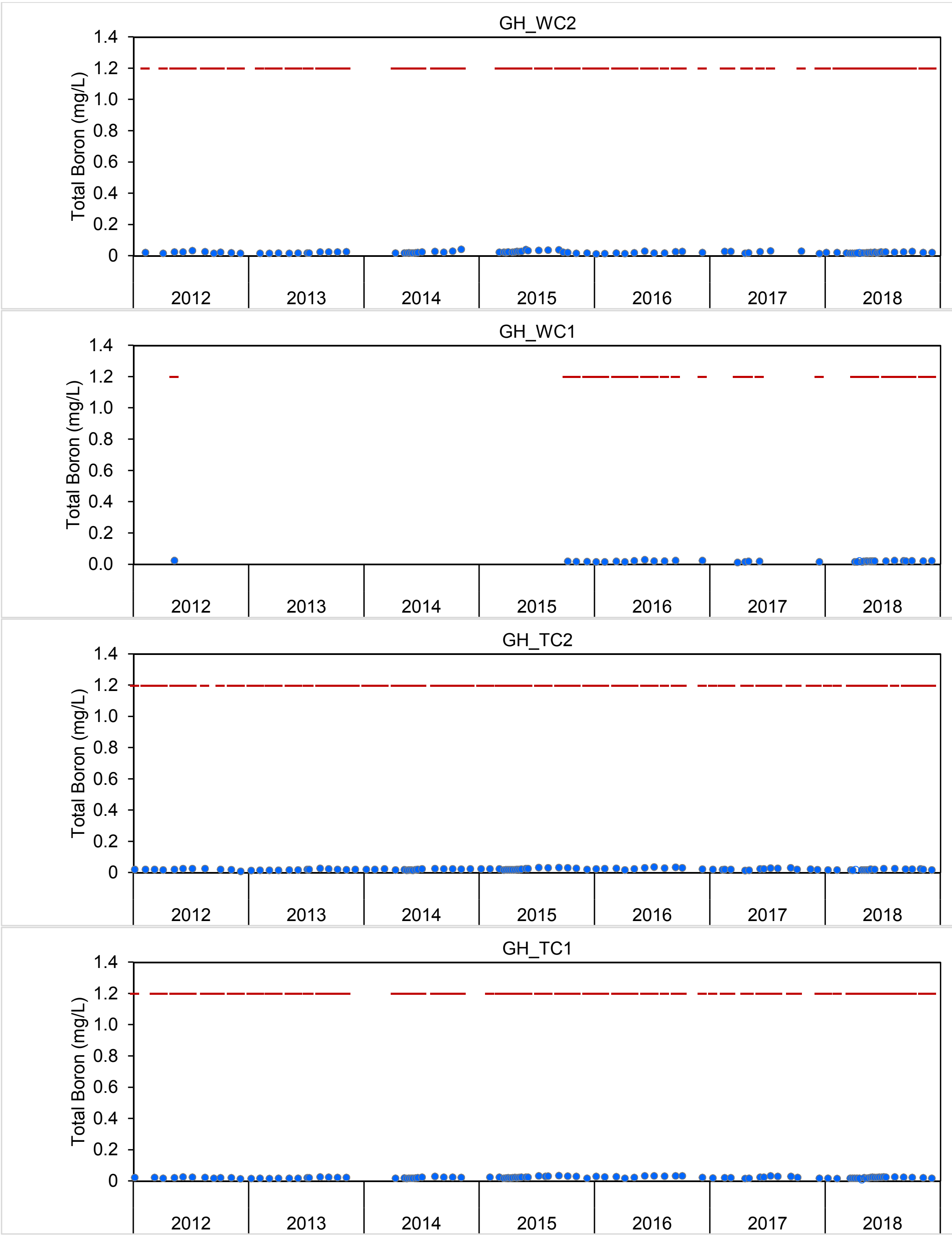


Figure C.7: Time Series Plots for Aqueous Total Boron Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

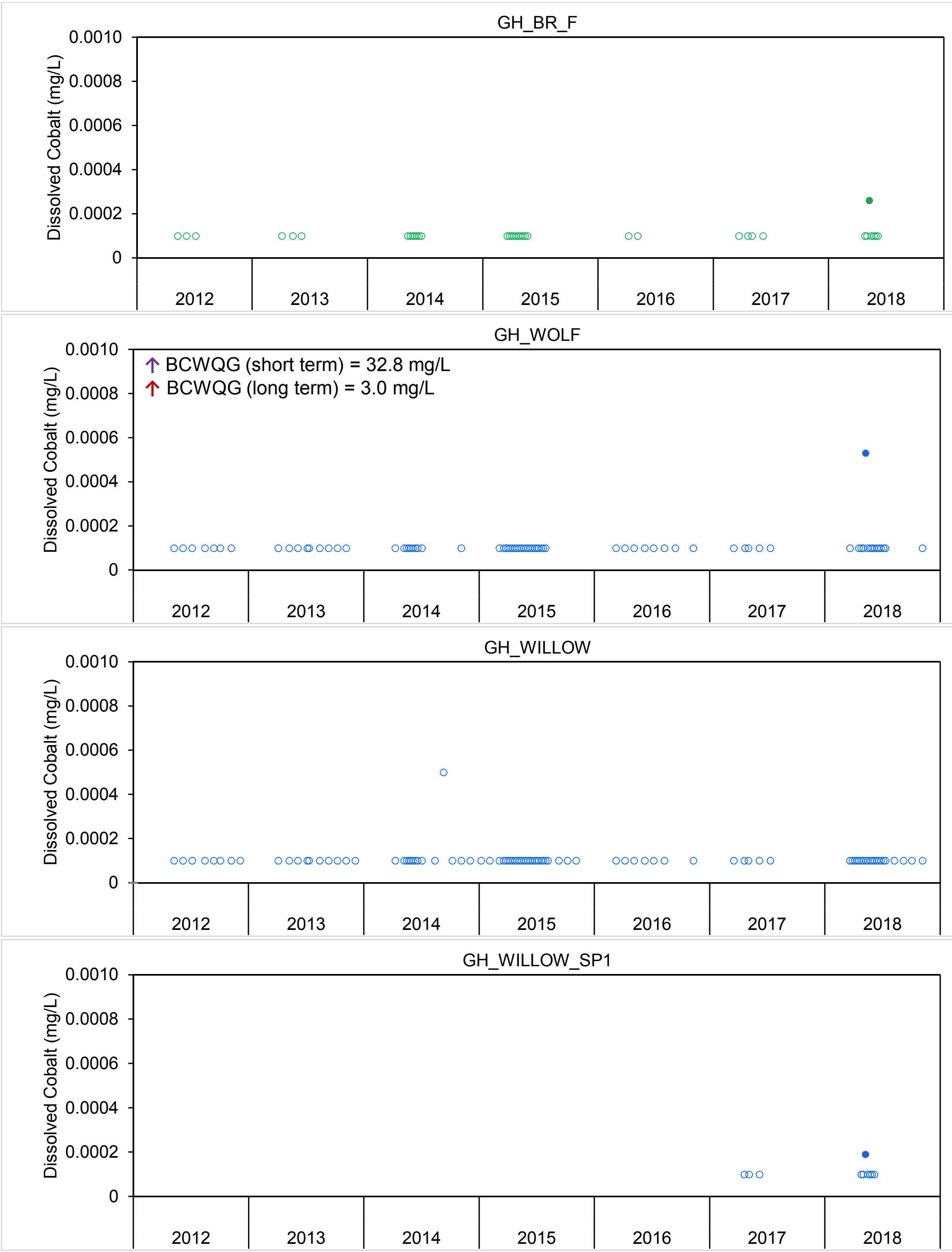


Figure C.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

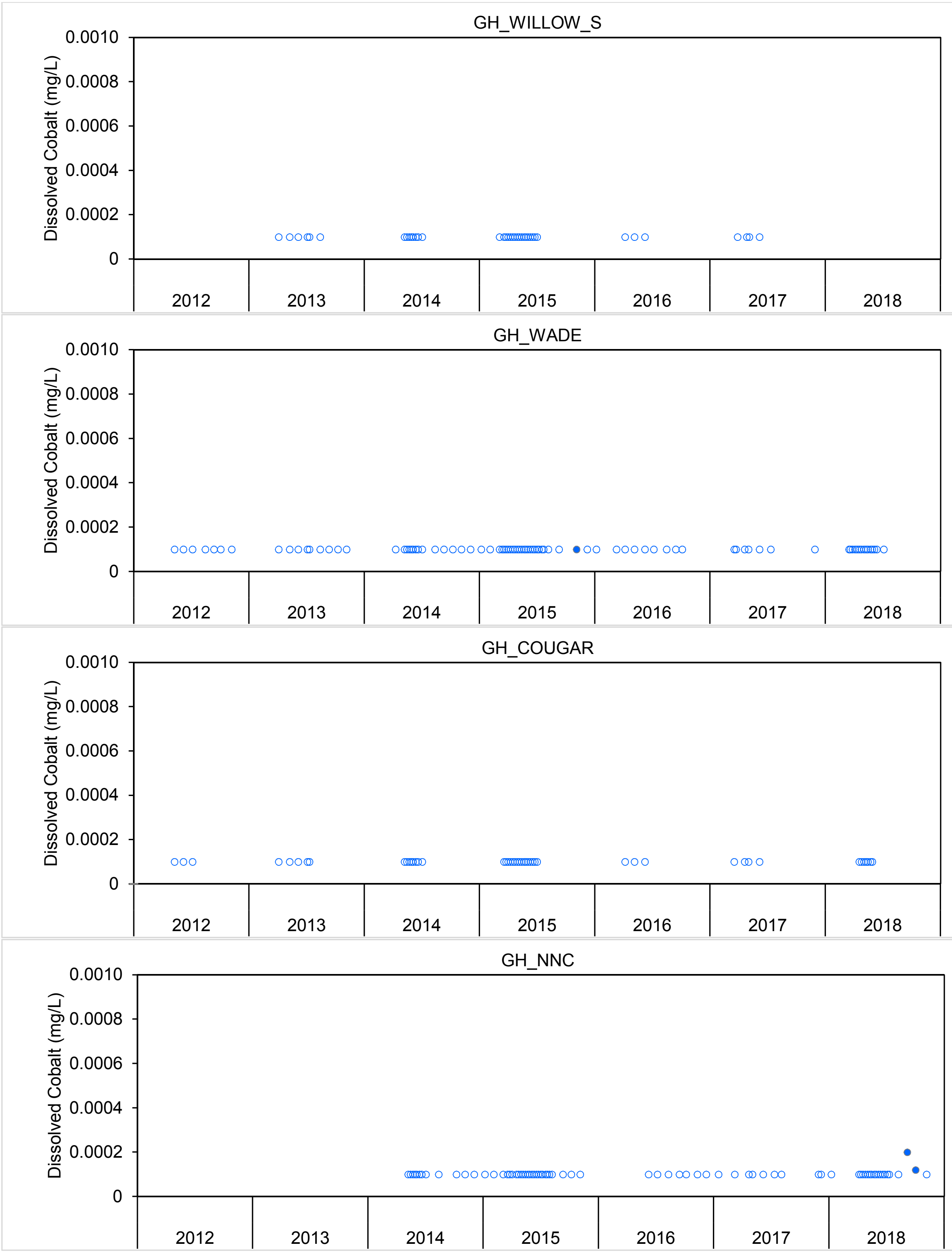


Figure C.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

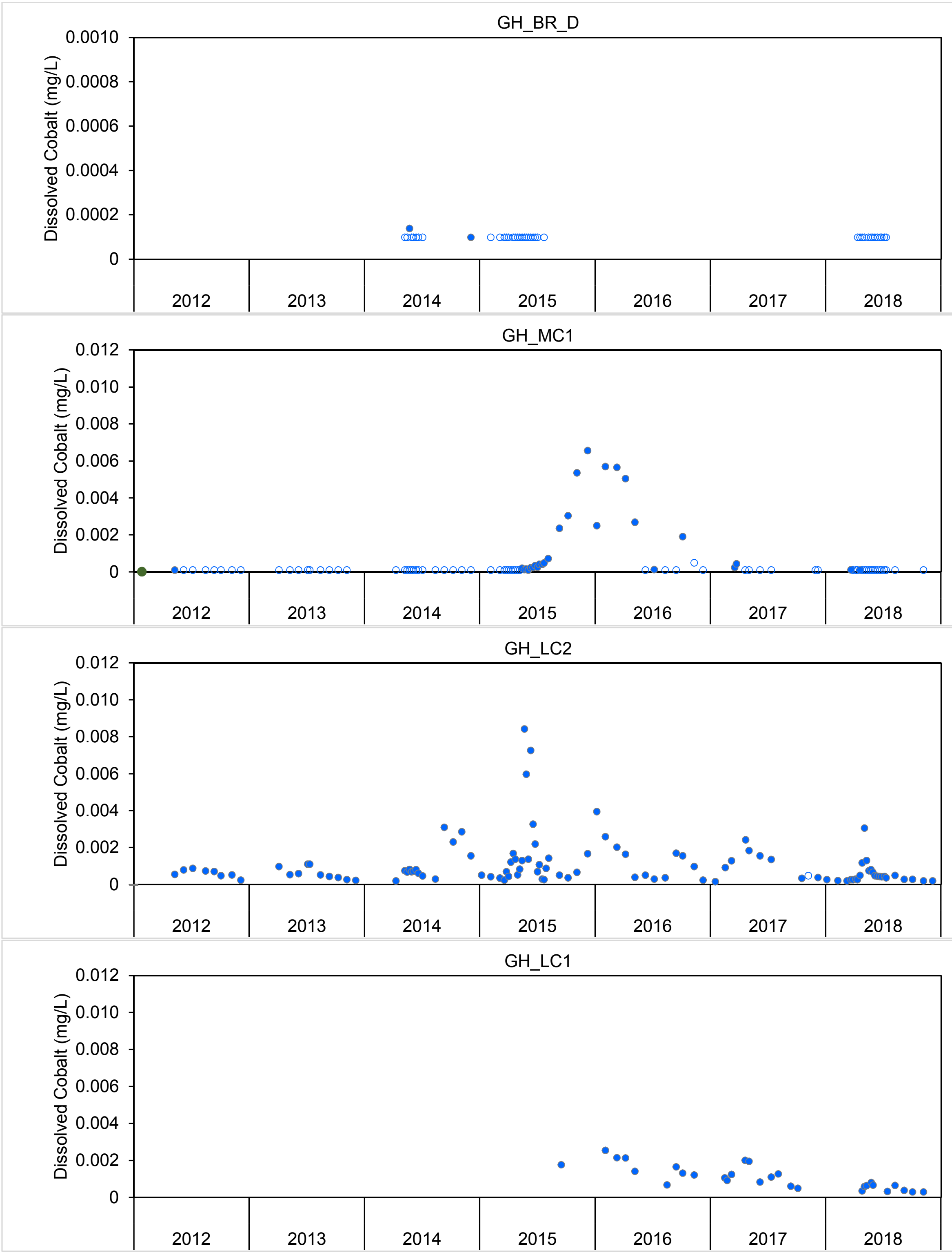


Figure C.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

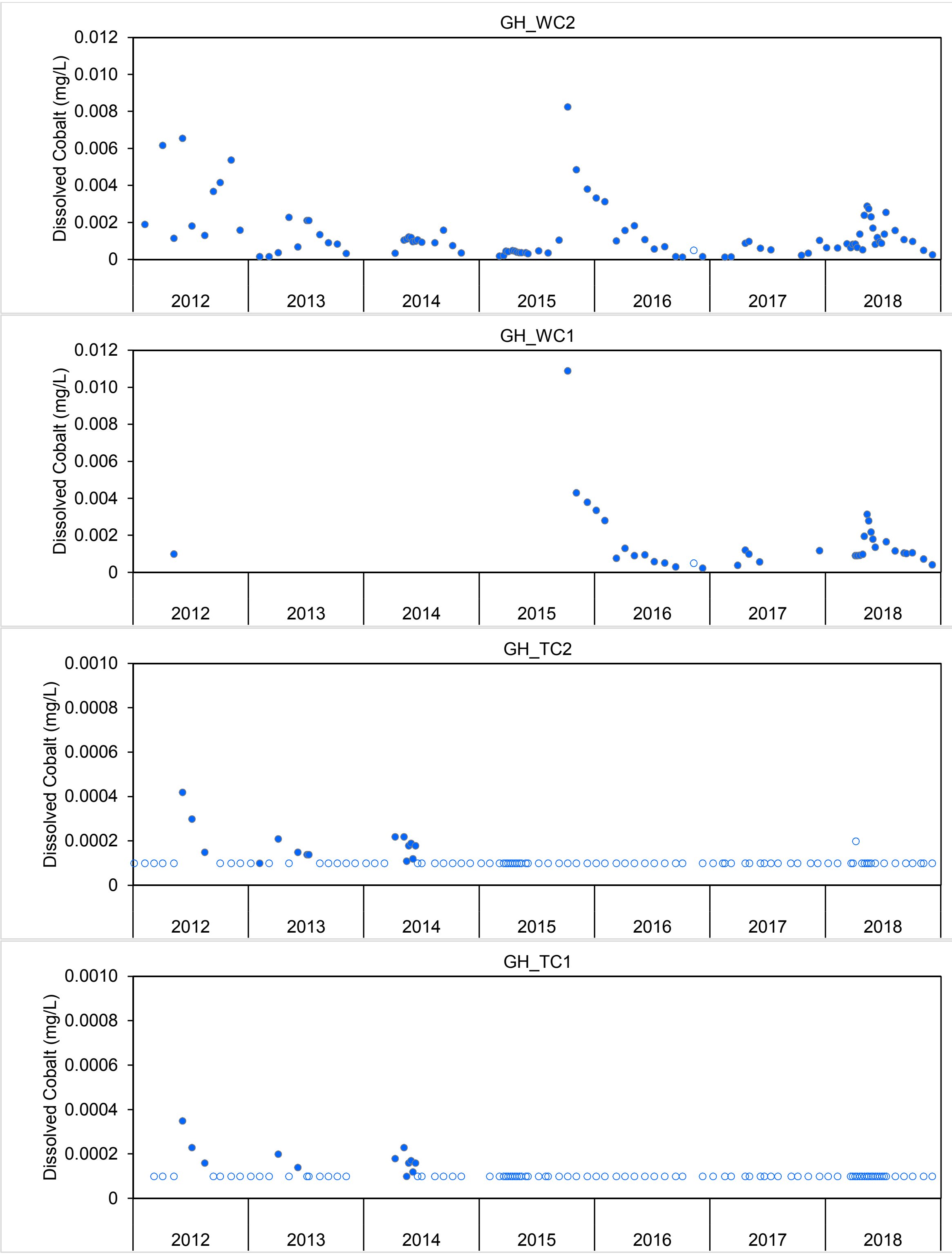


Figure C.8: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

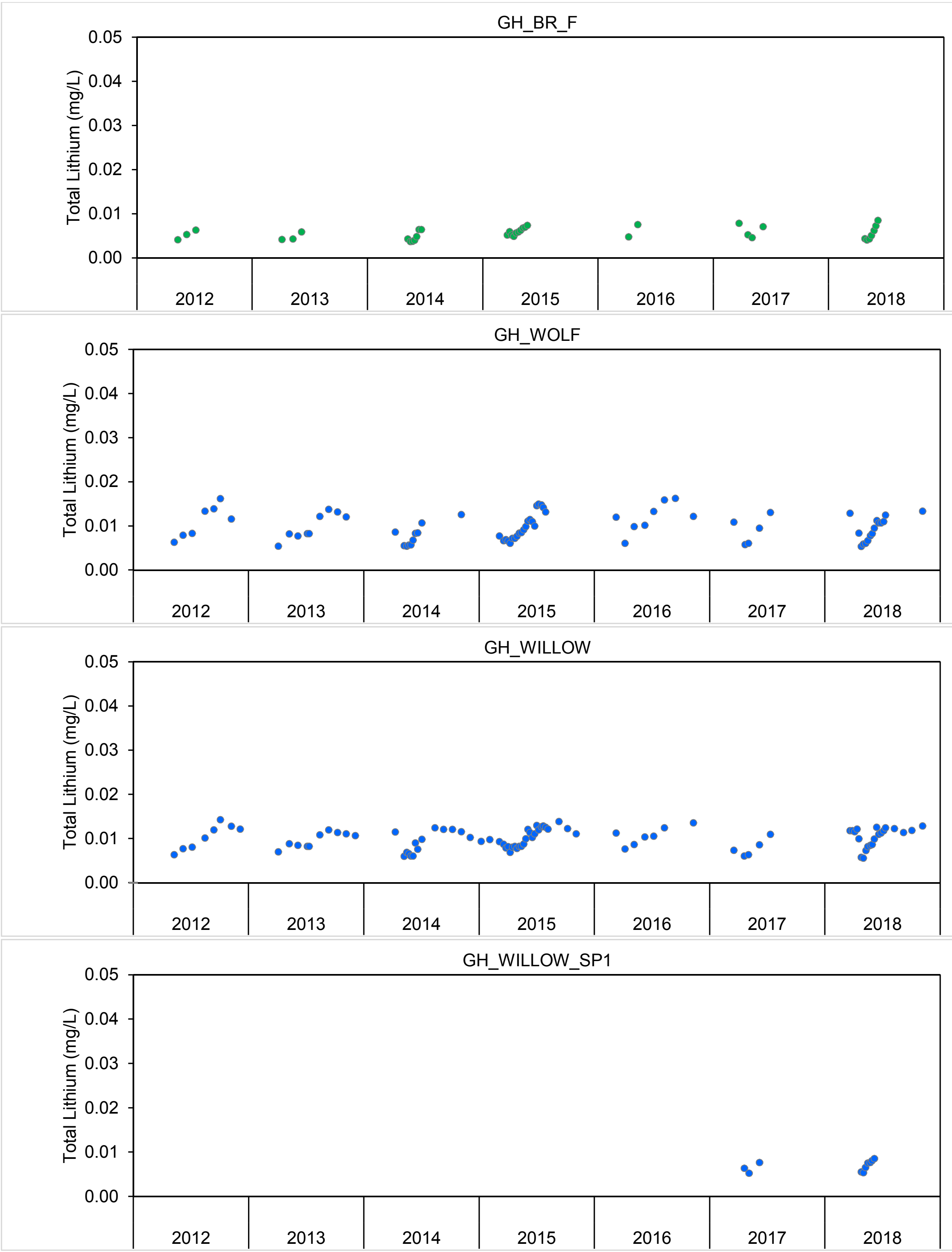


Figure C.9: Time Series Plots for Aqueous Total Lithium Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

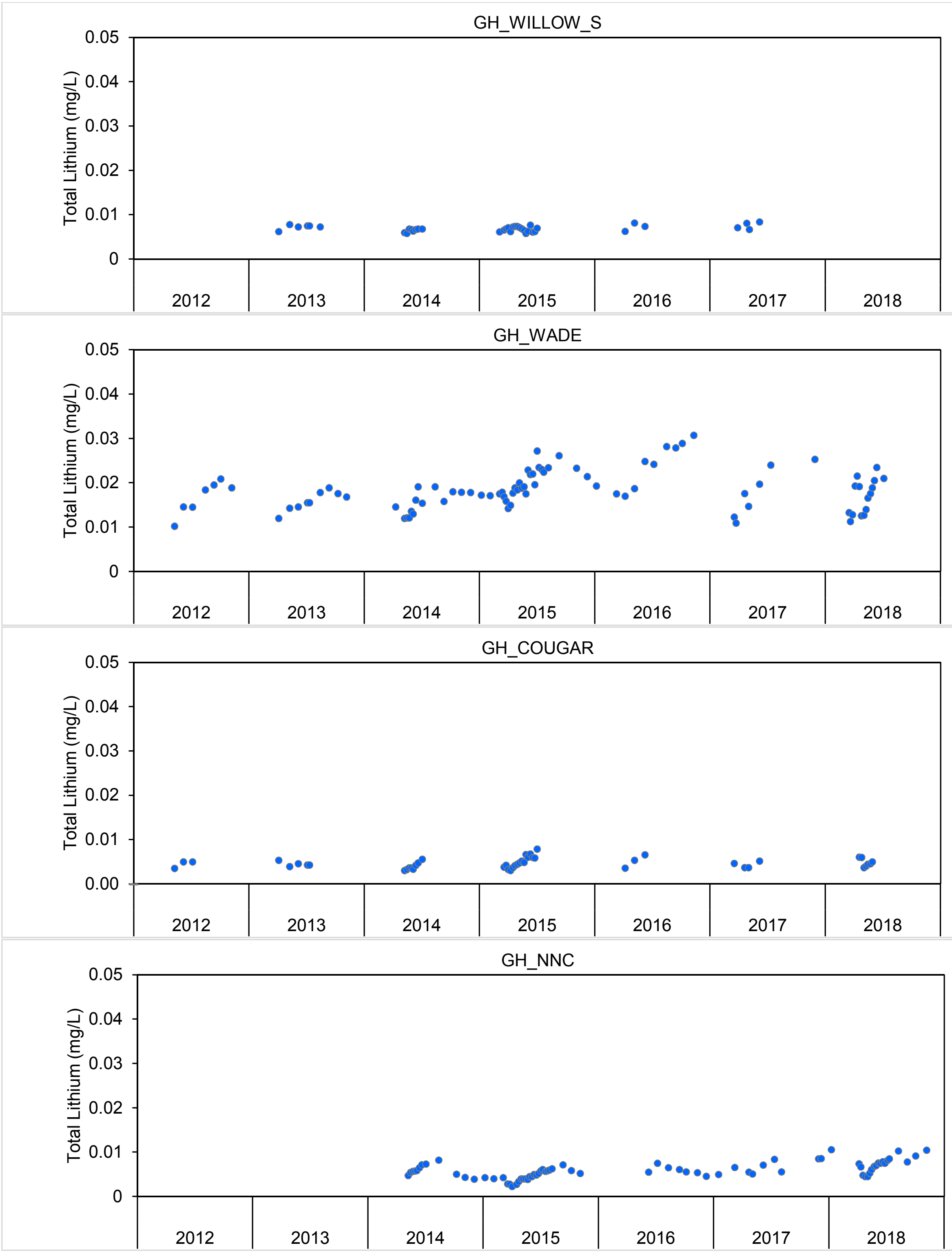


Figure C.9: Time Series Plots for Aqueous Total Lithium Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

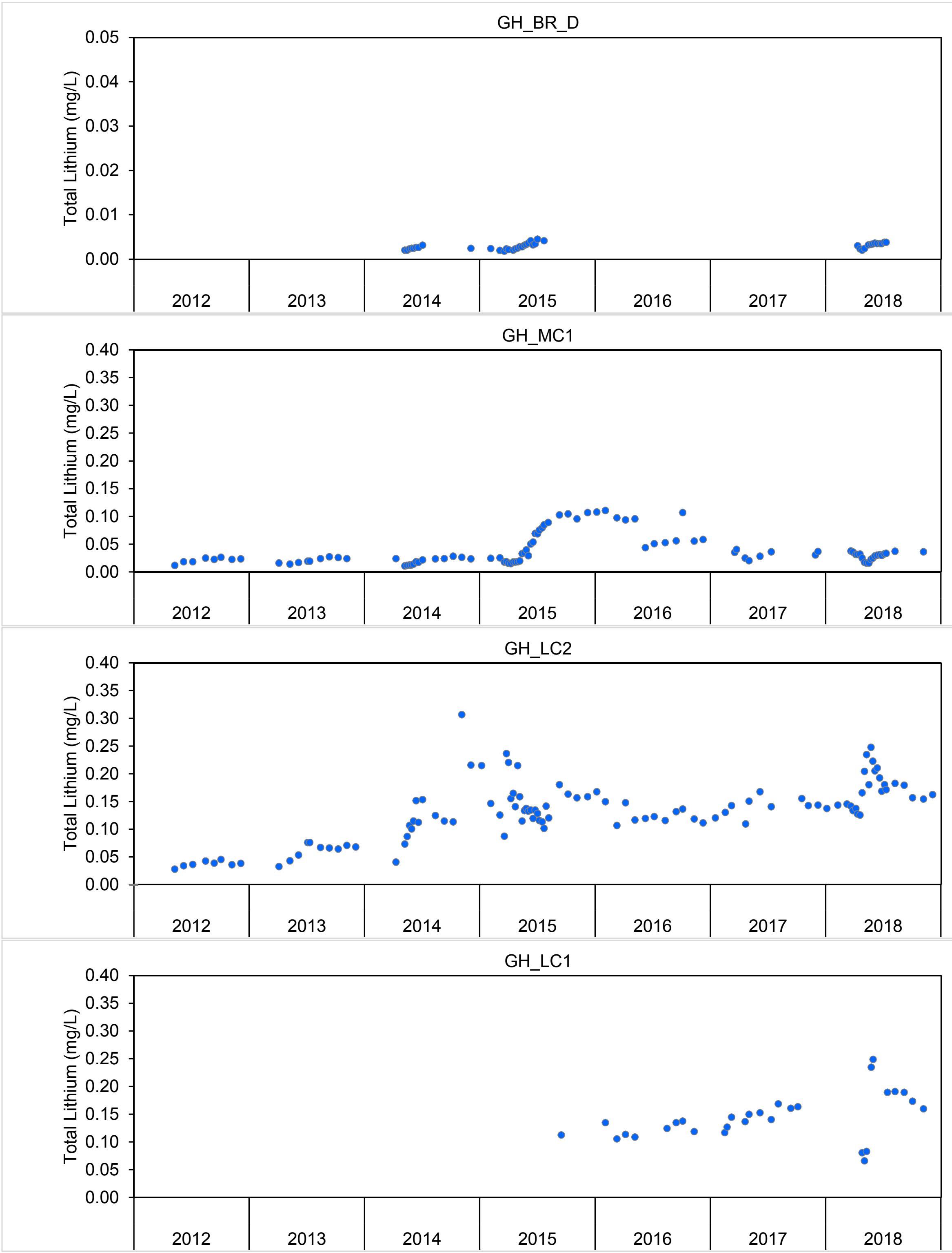


Figure C.9: Time Series Plots for Aqueous Total Lithium Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

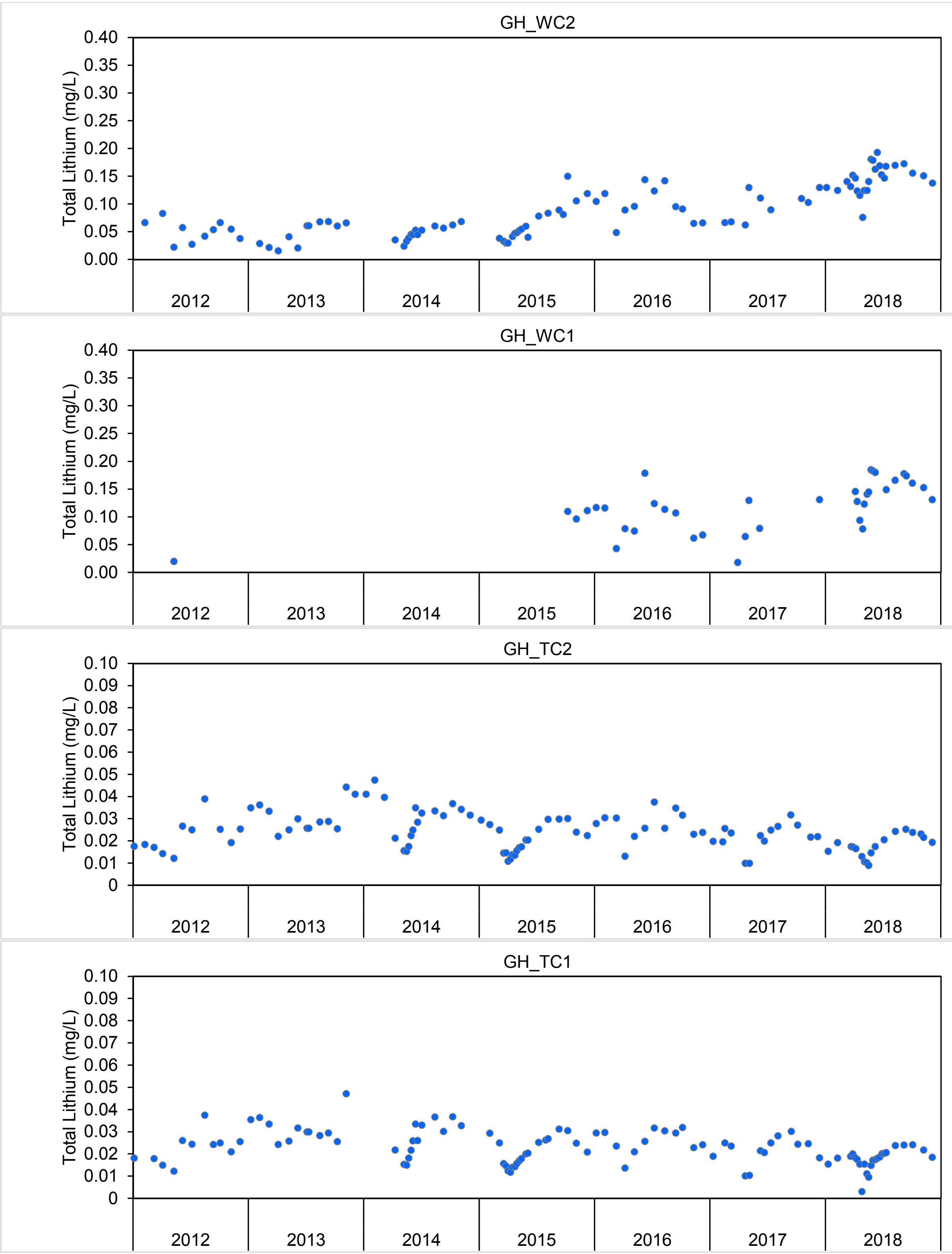


Figure C.9: Time Series Plots for Aqueous Total Lithium Concentrations from the West-side Tributaries, 2012 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

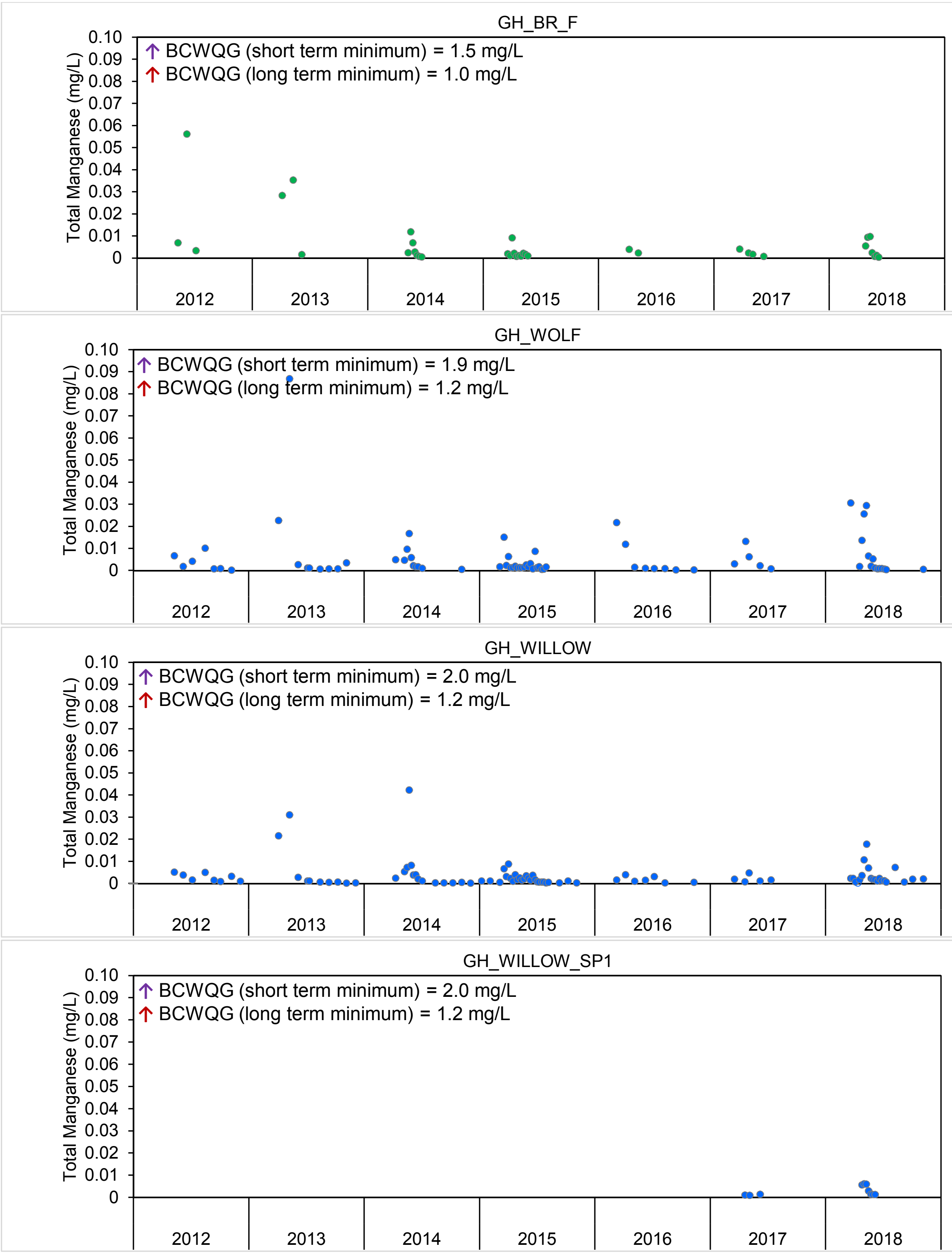


Figure C.10: Time Series Plots for Aqueous Total Manganese Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

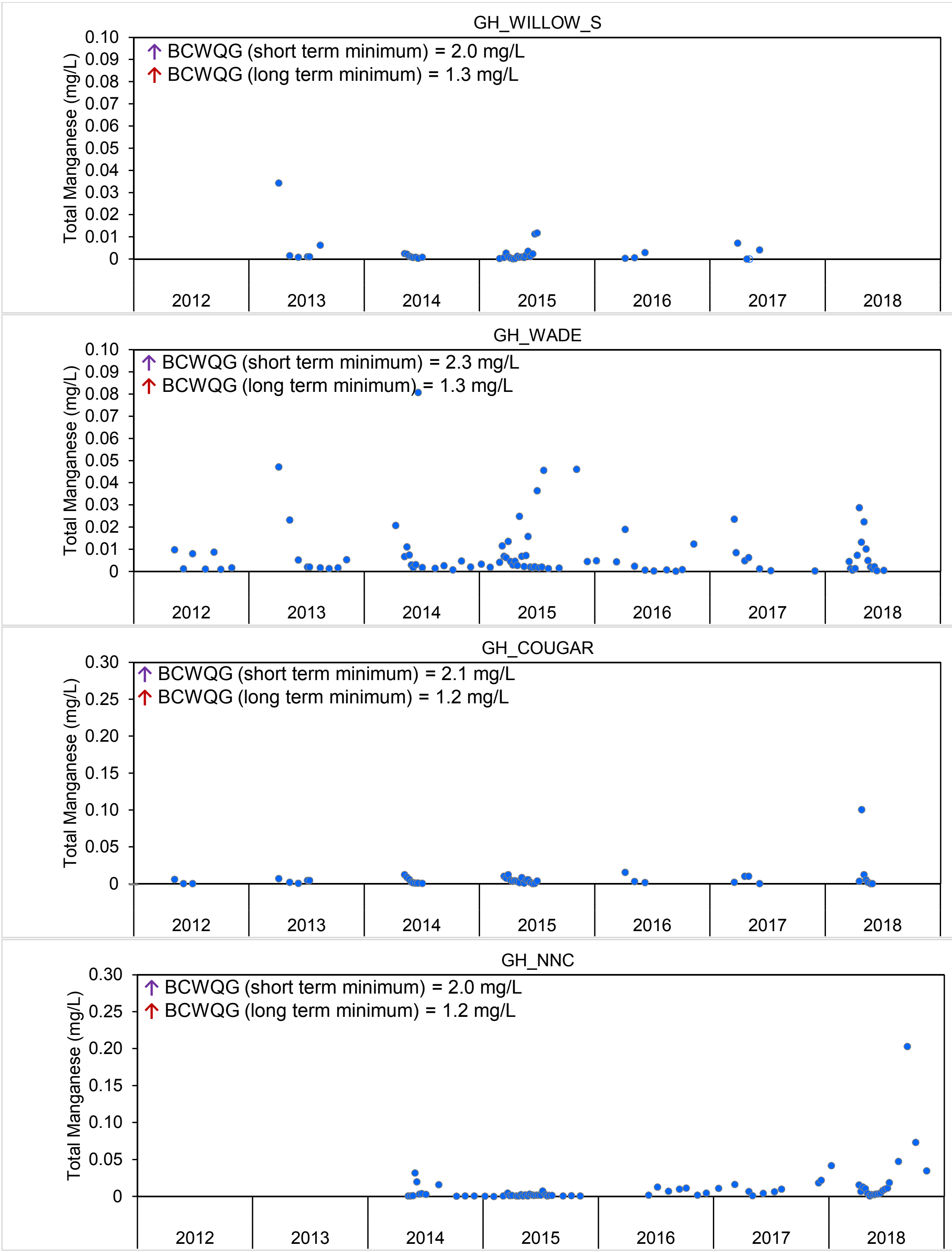


Figure C.10: Time Series Plots for Aqueous Total Manganese Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

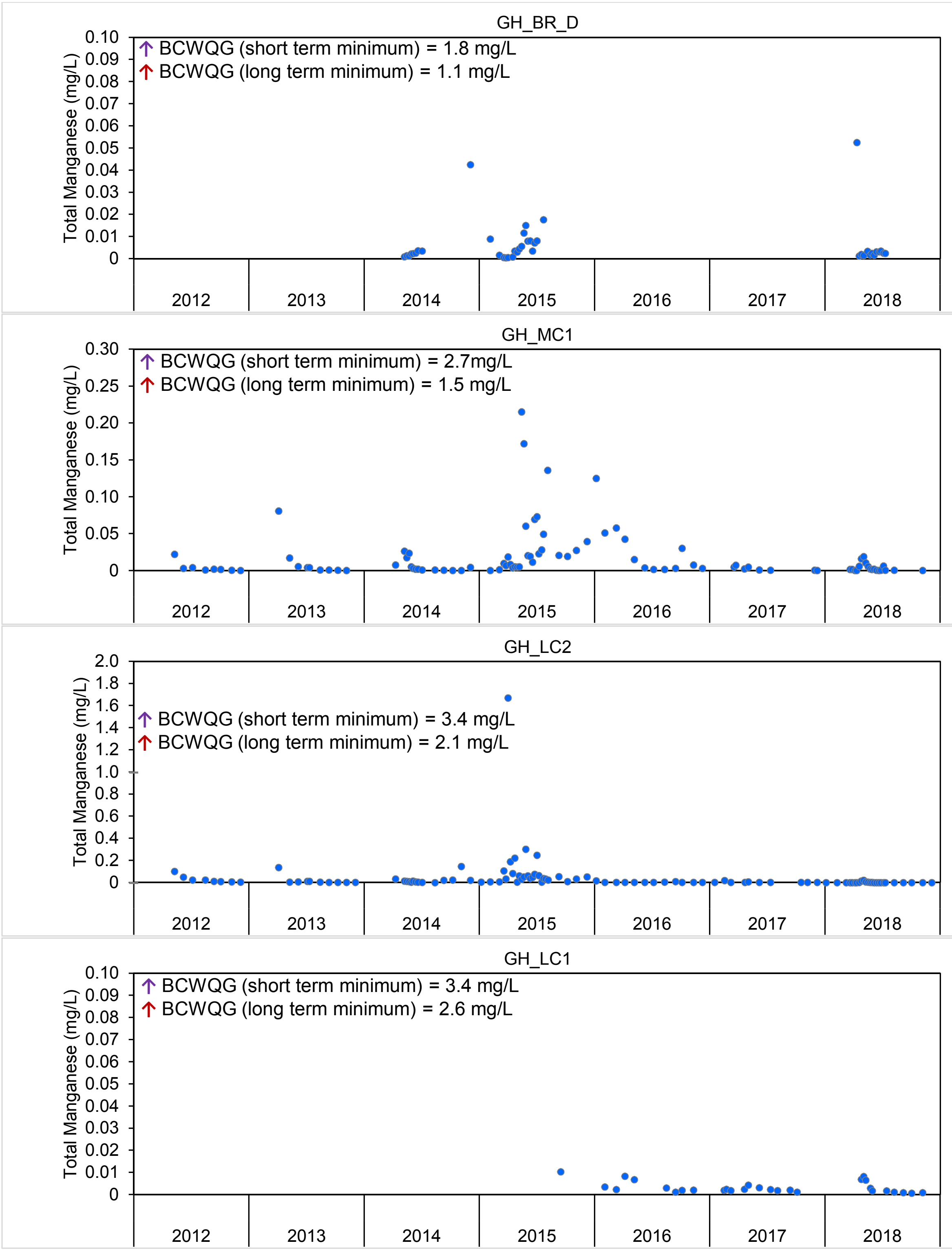


Figure C.10: Time Series Plots for Aqueous Total Manganese Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

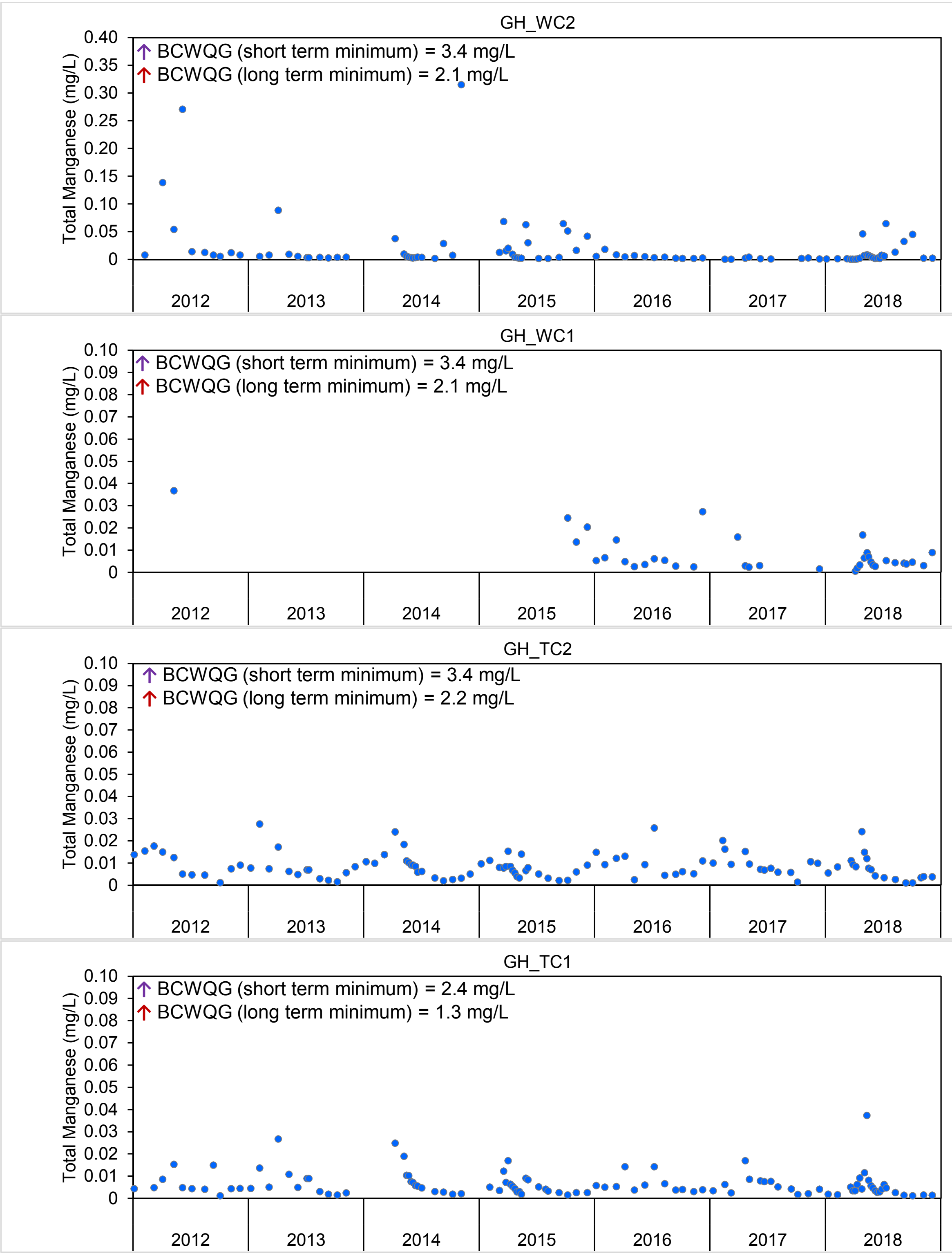


Figure C.10: Time Series Plots for Aqueous Total Manganese Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

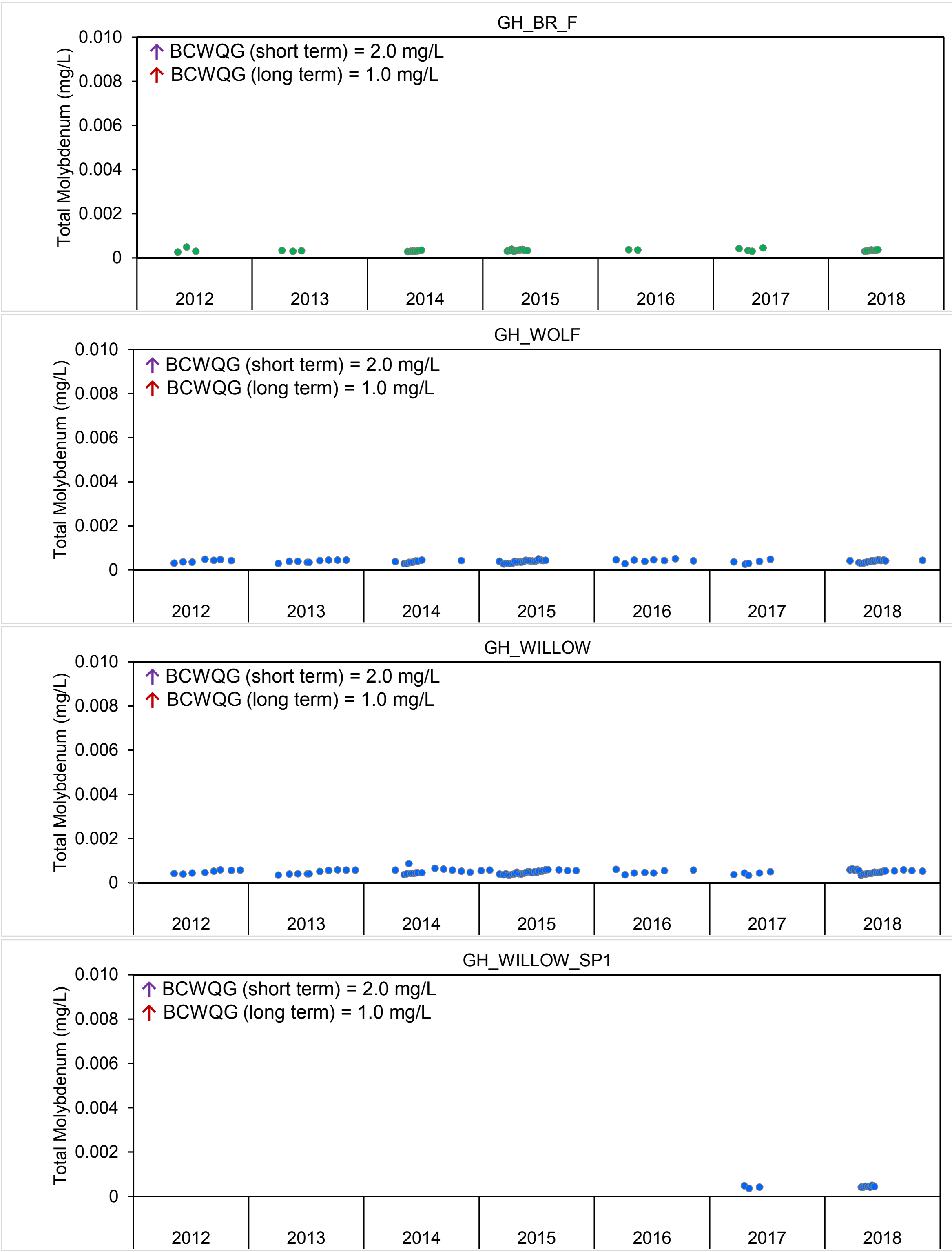


Figure C.11: Time Series Plots for Aqueous Total Molybdenum Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

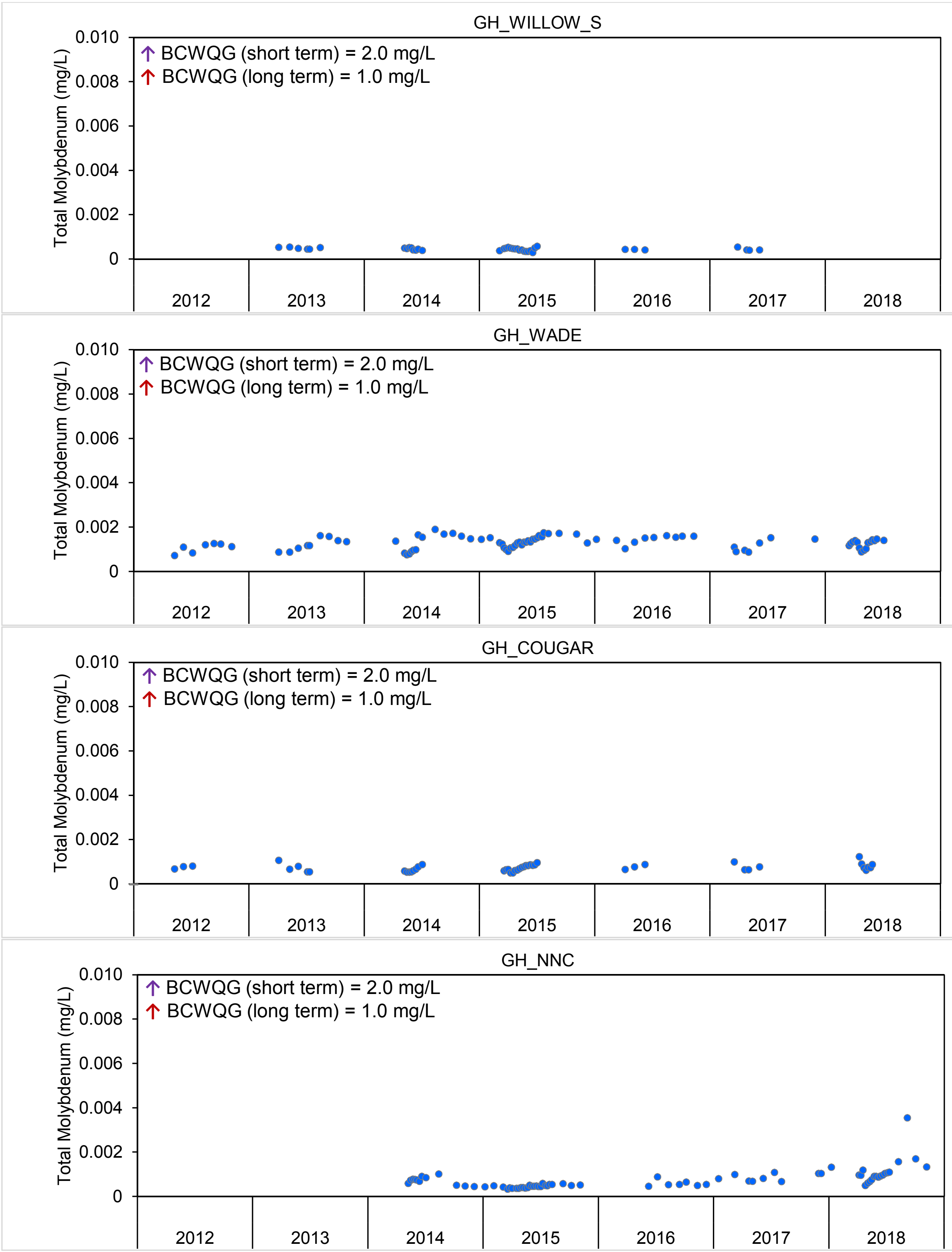


Figure C.11: Time Series Plots for Aqueous Total Molybdenum Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

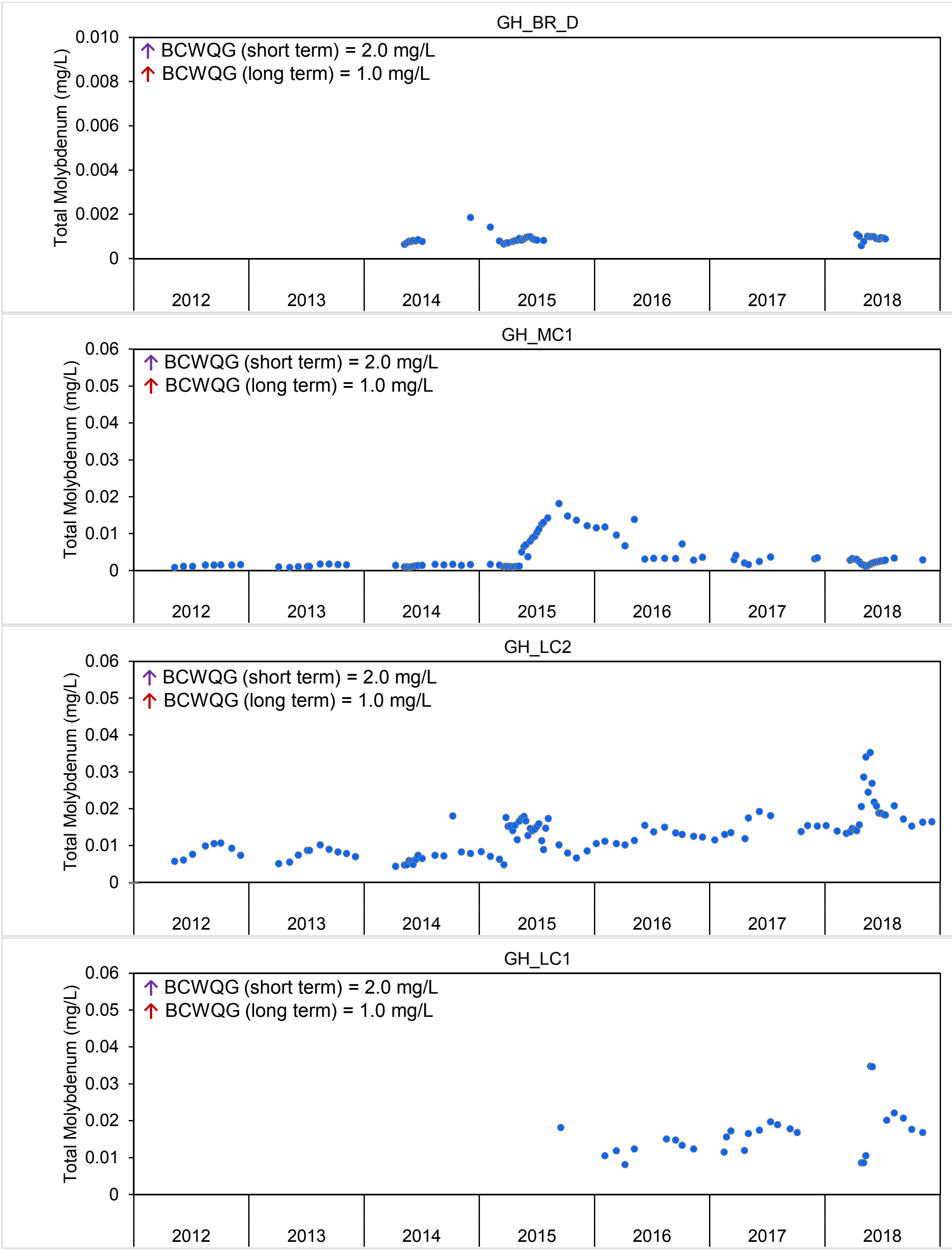


Figure C.11: Time Series Plots for Aqueous Total Molybdenum Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

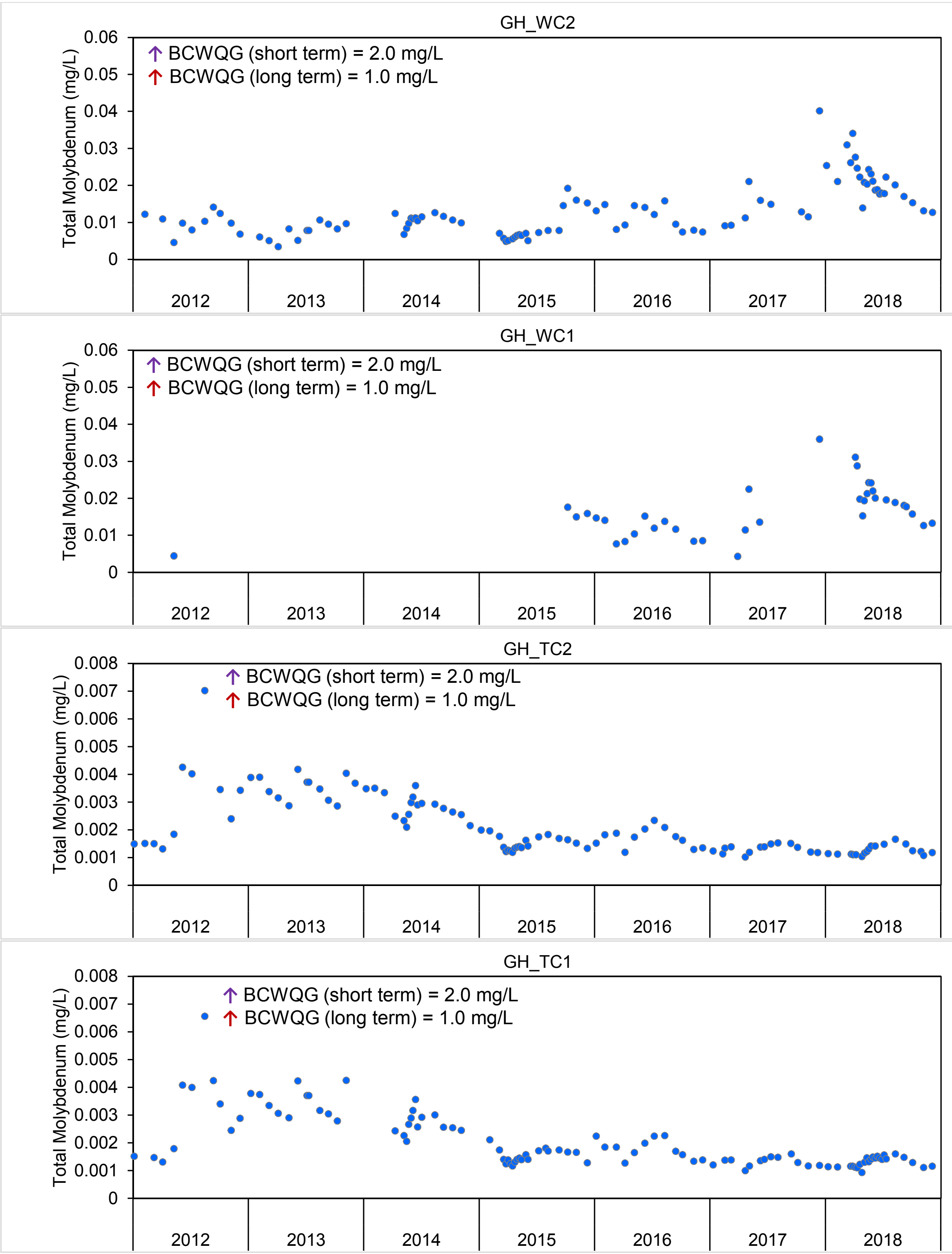


Figure C.11: Time Series Plots for Aqueous Total Molybdenum Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

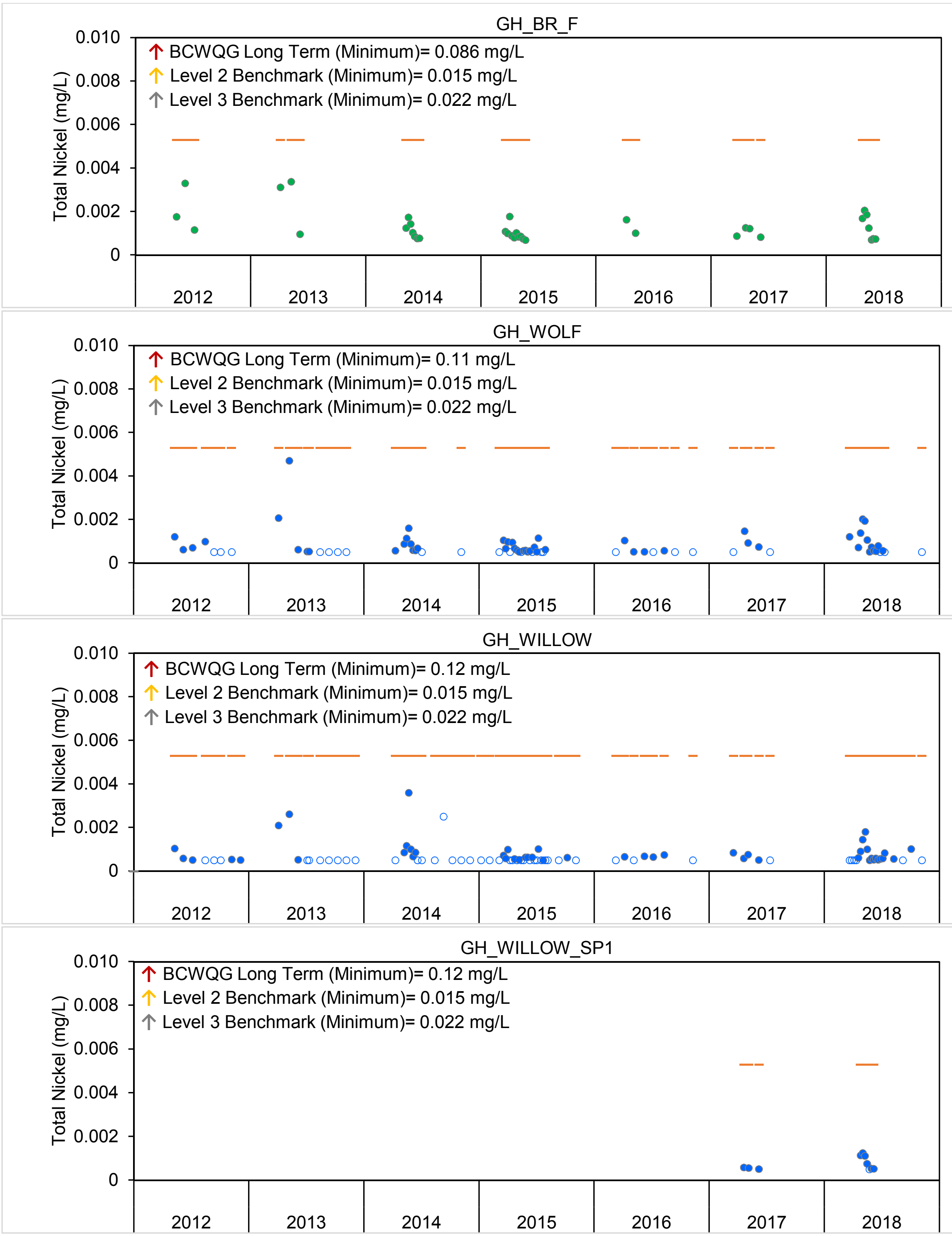


Figure C.12: Time Series Plots for Aqueous Total Nickel Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

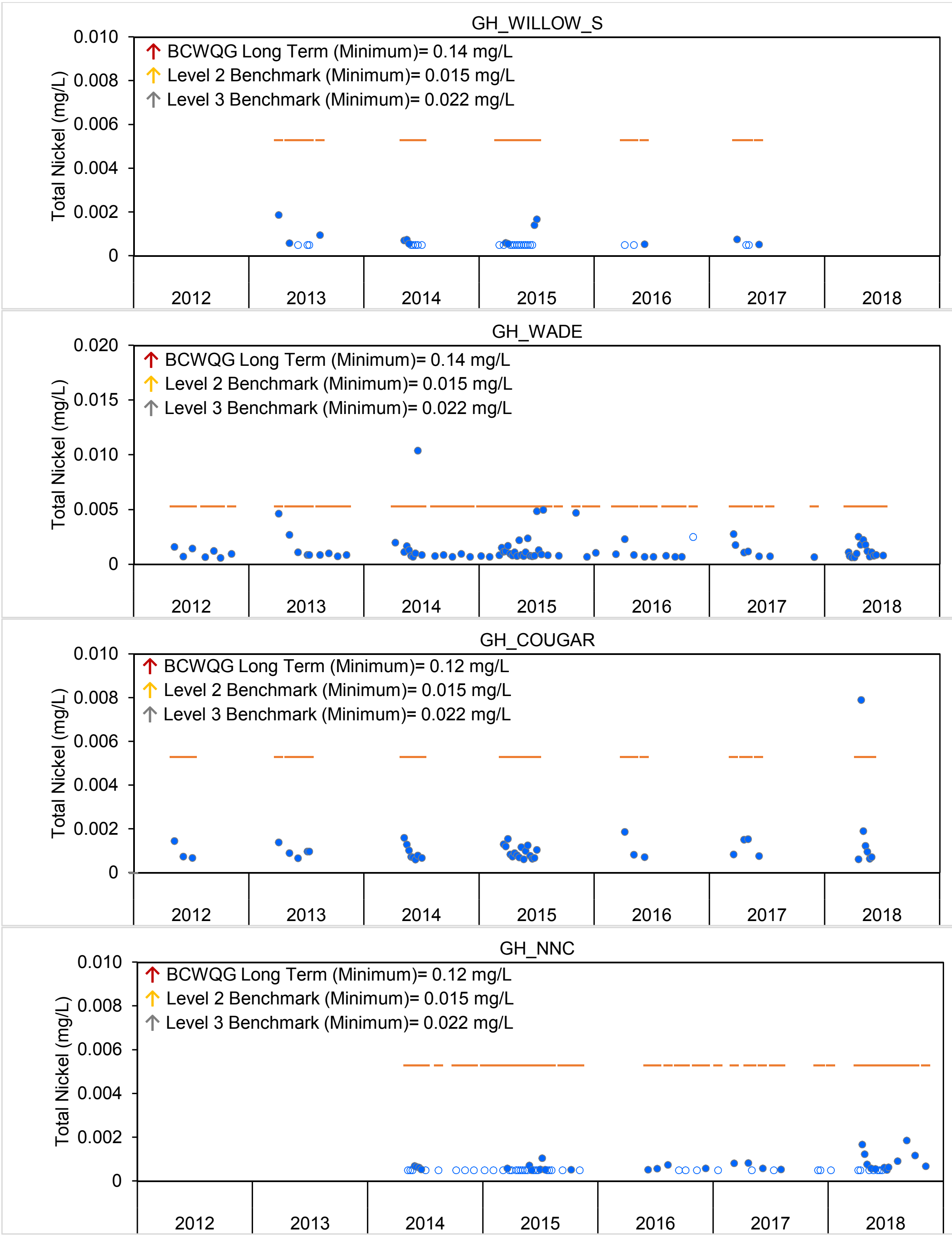


Figure C.12: Time Series Plots for Aqueous Total Nickel Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

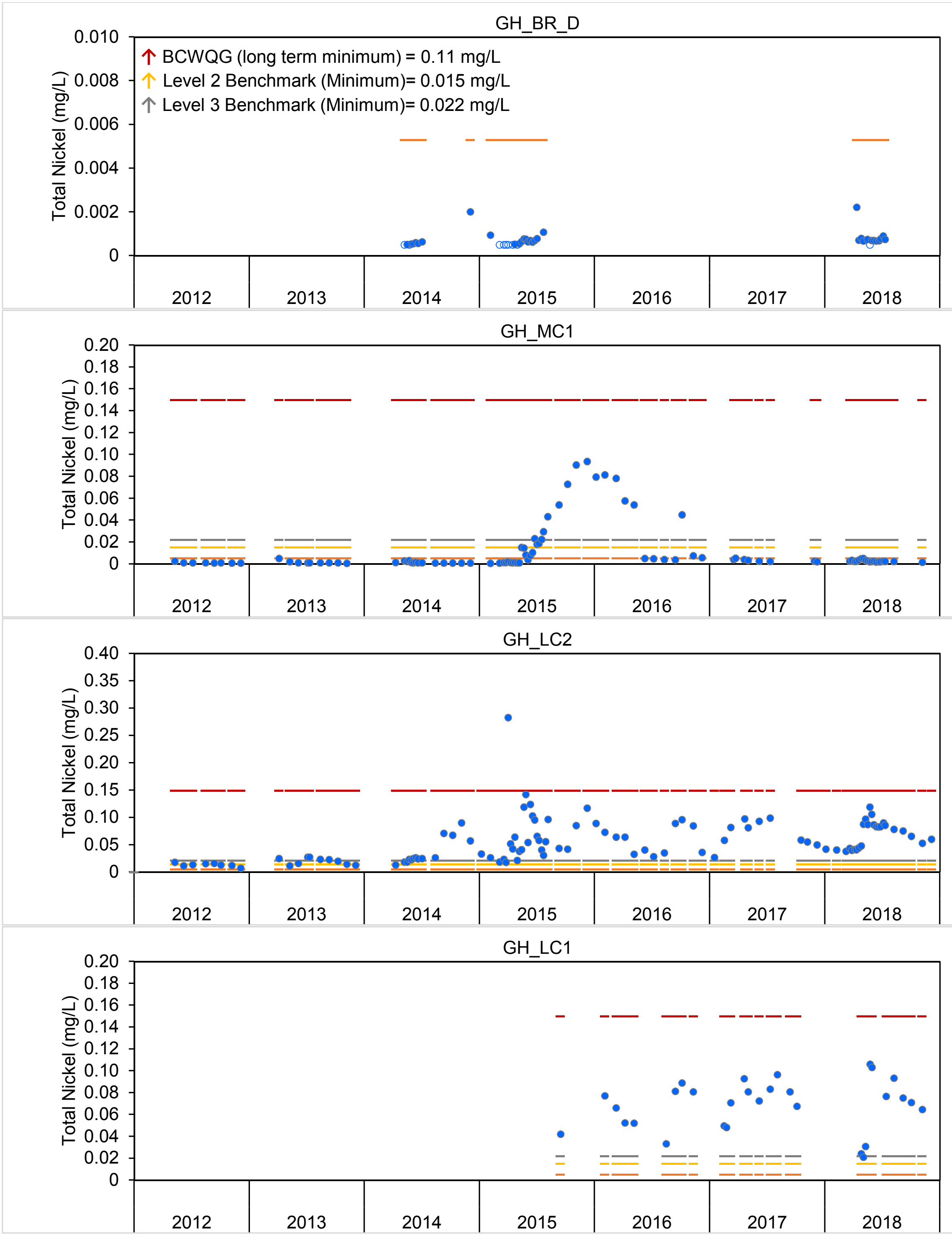


Figure C.12: Time Series Plots for Aqueous Total Nickel Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

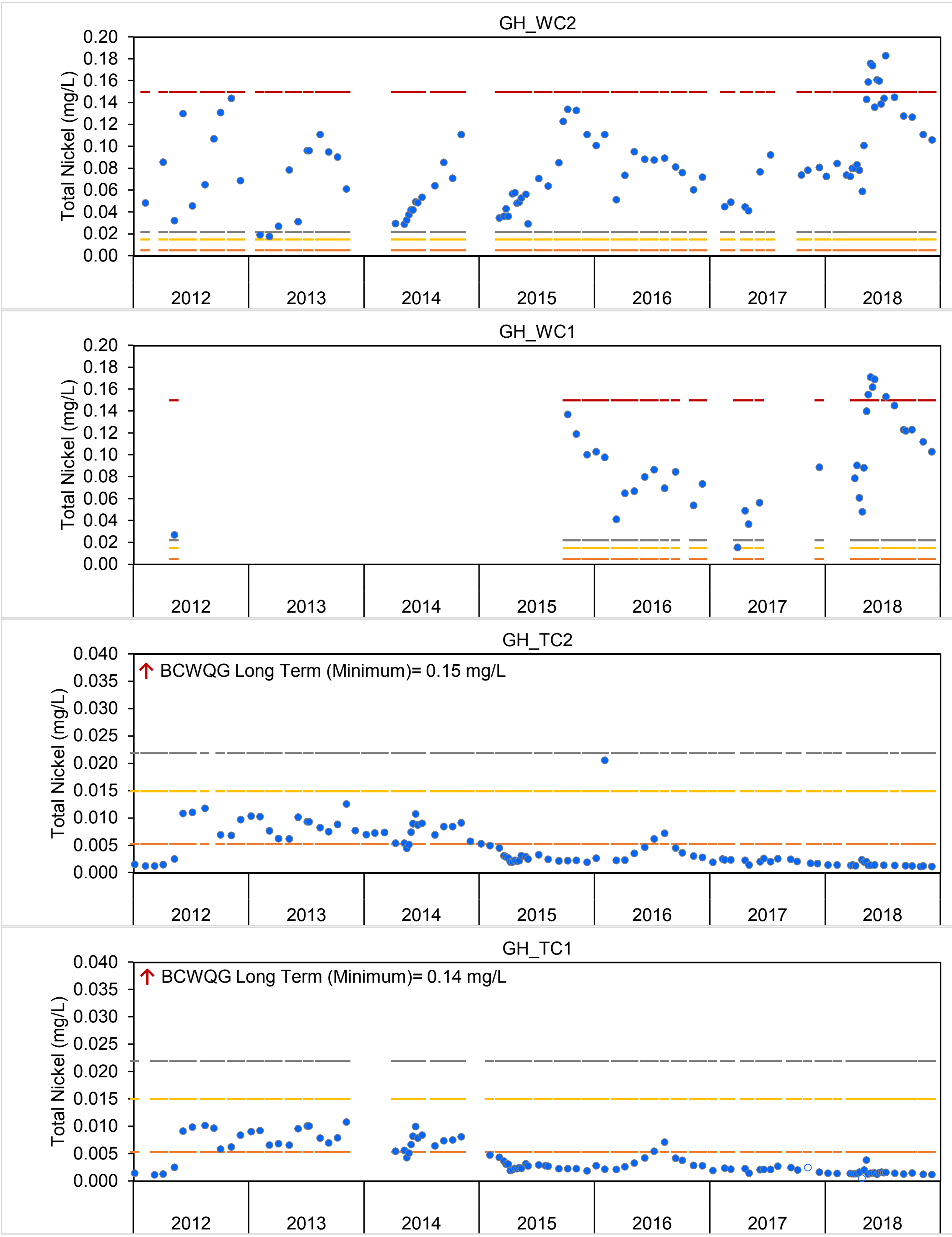


Figure C.12: Time Series Plots for Aqueous Total Nickel Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

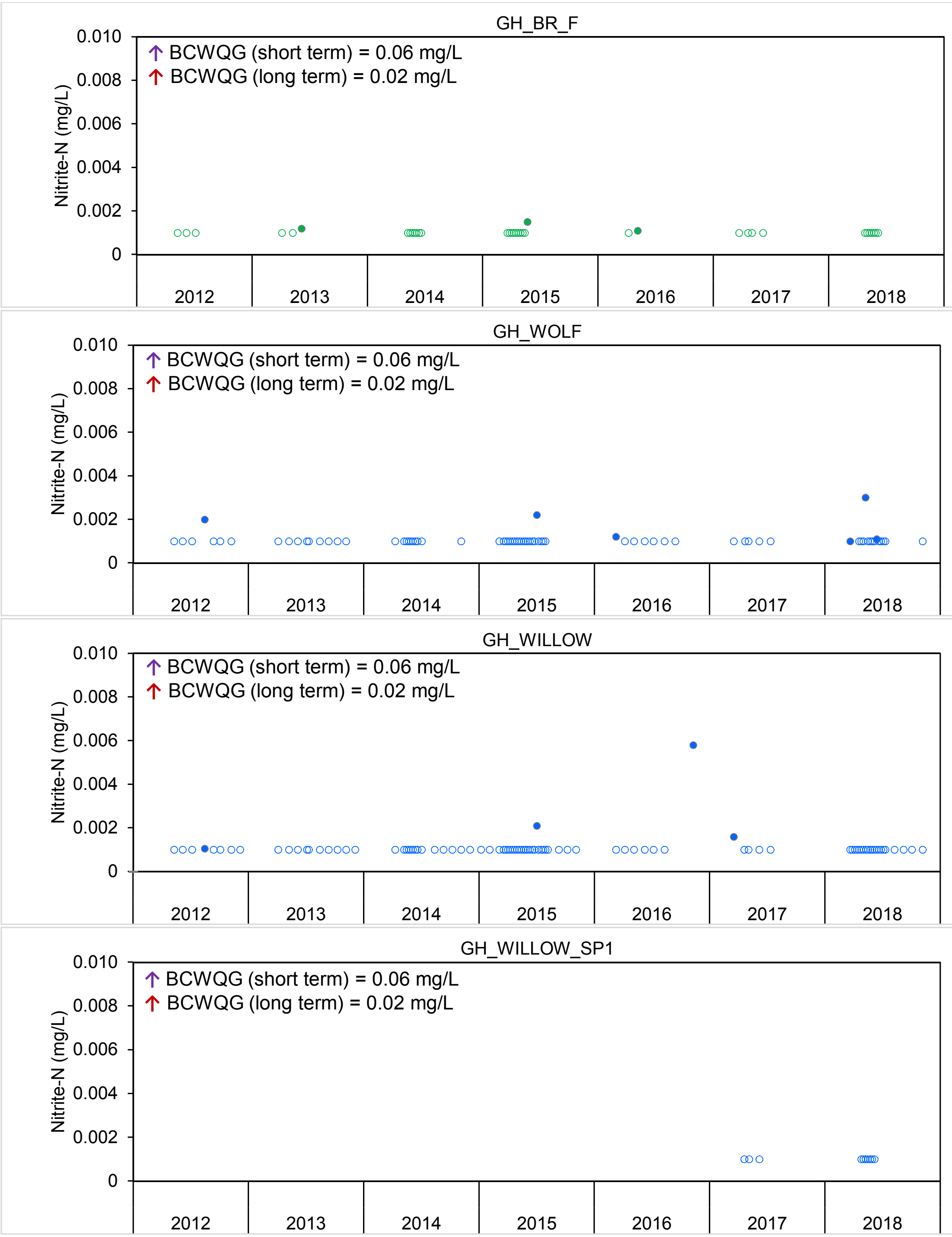


Figure C.13: Time Series Plots for Aqueous Nitrite-N Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on aqueous chloride concentrations.

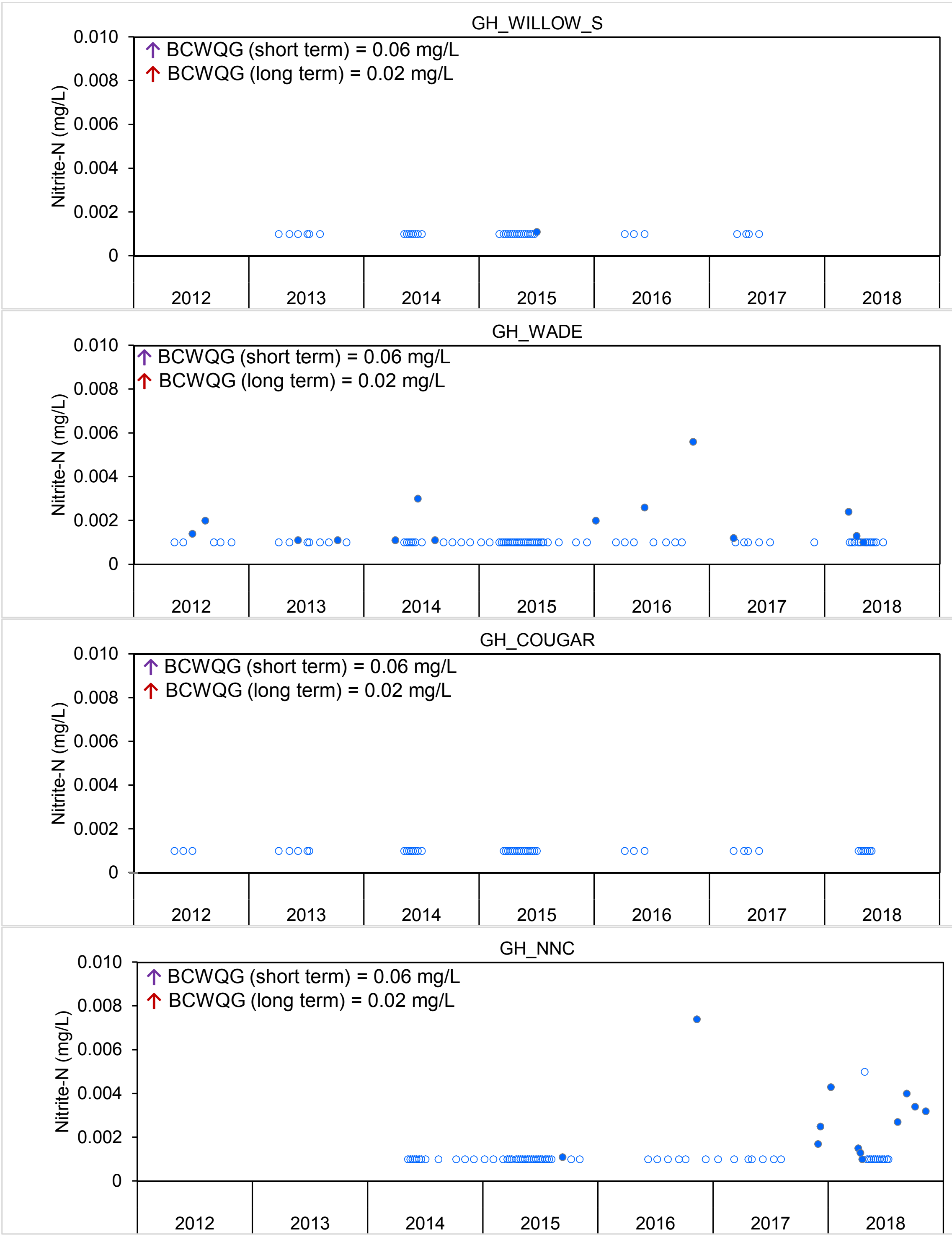


Figure C.13: Time Series Plots for Aqueous Nitrite-N Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on aqueous chloride concentrations.

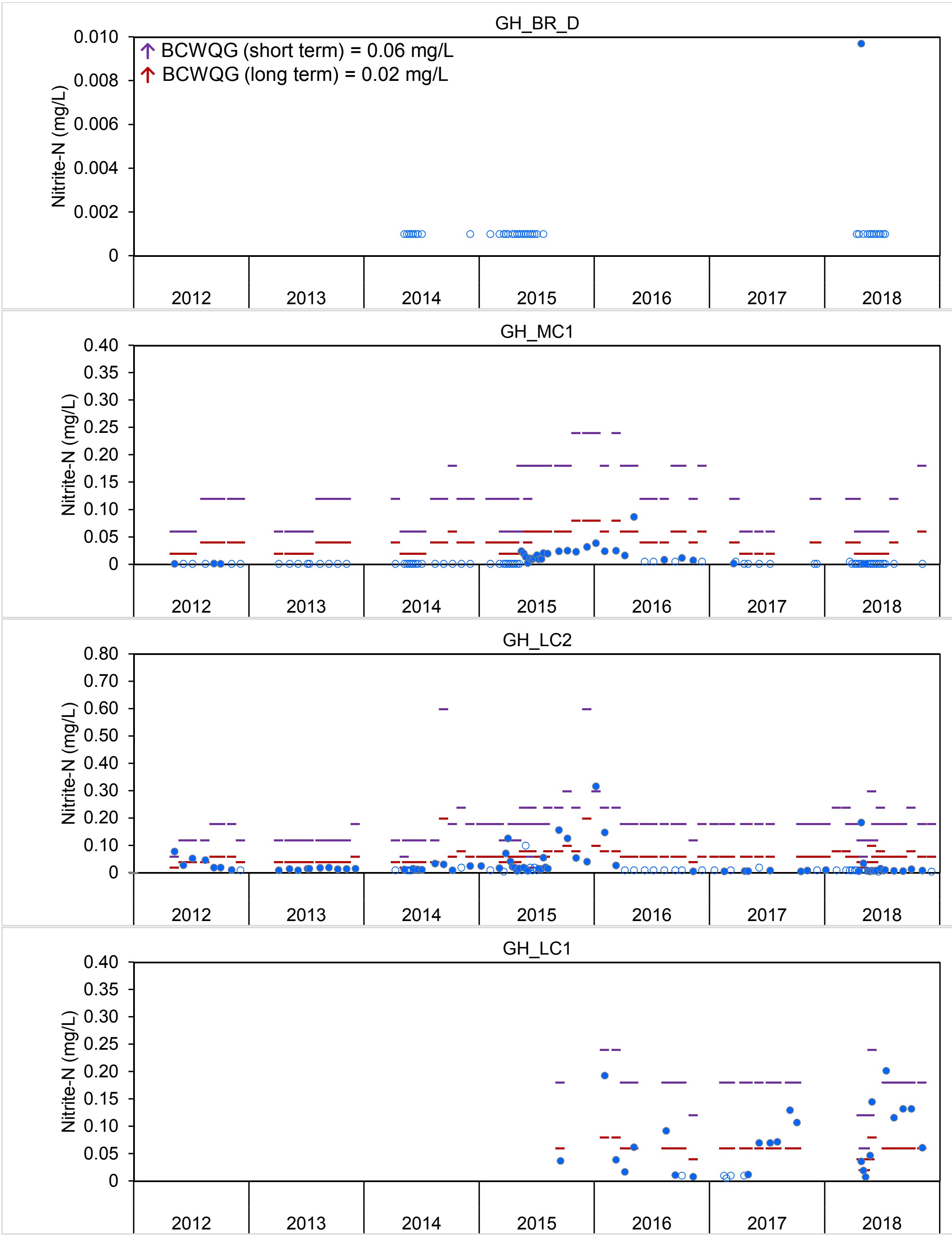


Figure C.13: Time Series Plots for Aqueous Nitrite-N Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on chloride concentrations.

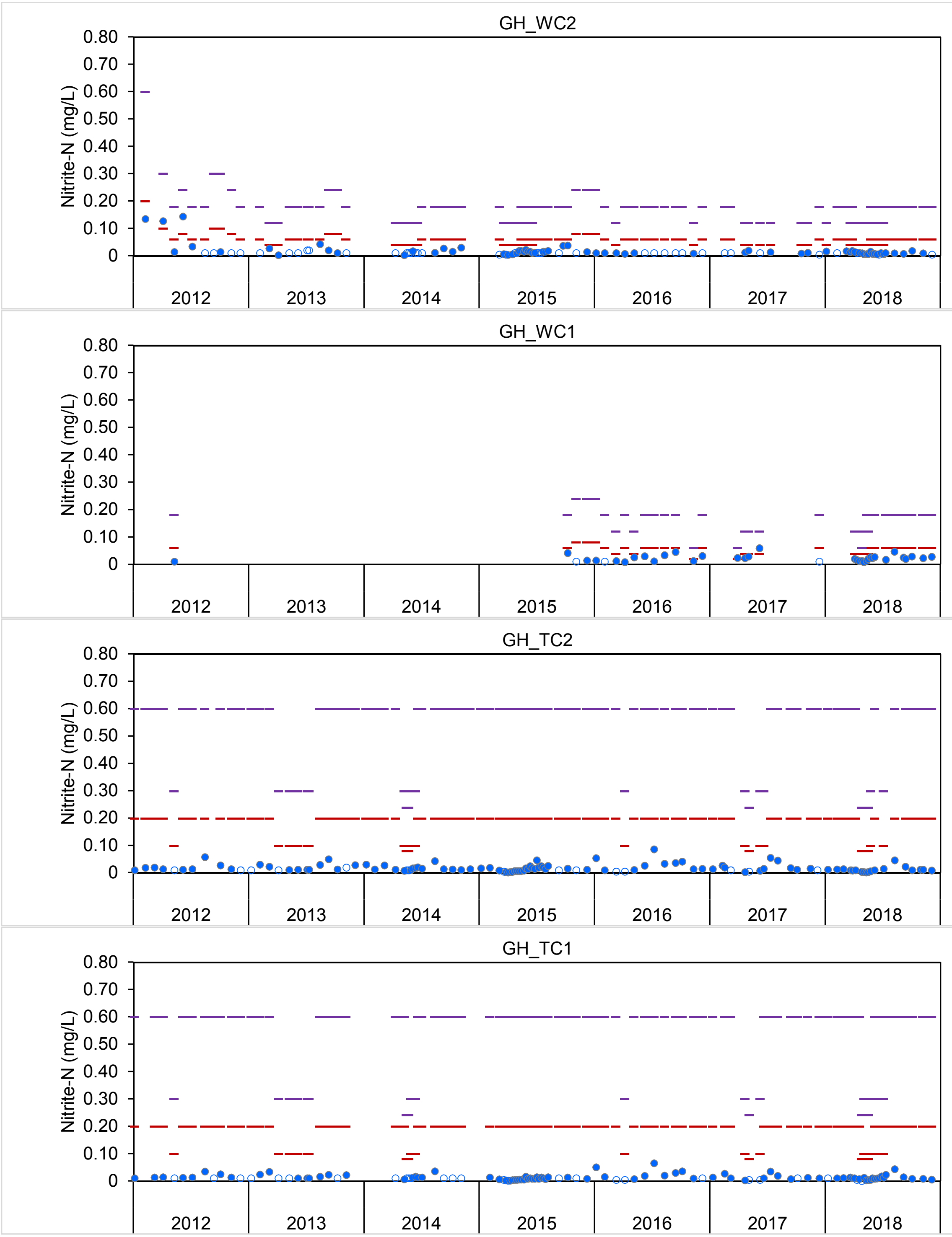


Figure C.13: Time Series Plots for Aqueous Nitrite-N Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on aqueous chloride concentrations.

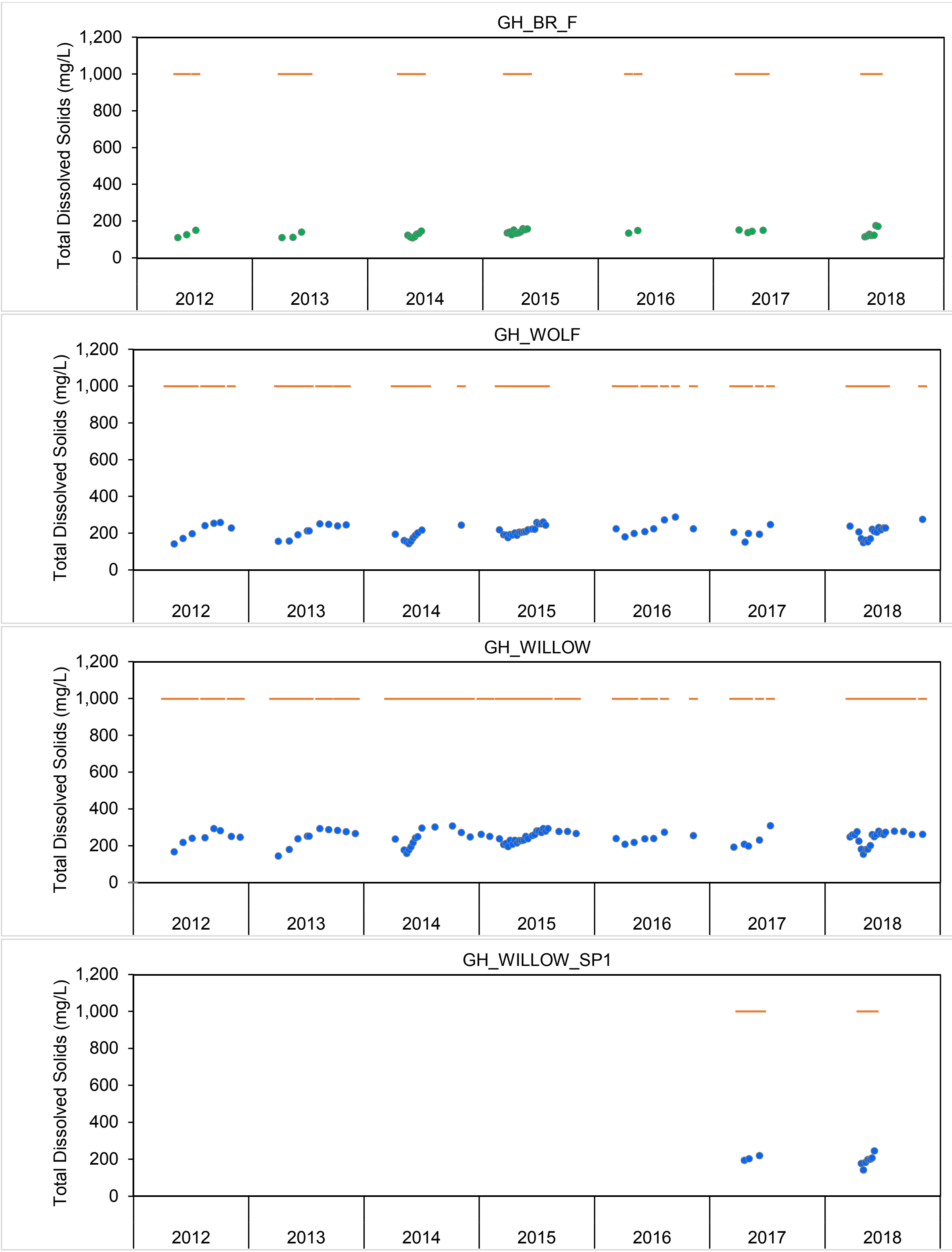


Figure C.14: Time Series Plots for Total Dissolved Solids Concentrations from the West-side Tributaries, 2012 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

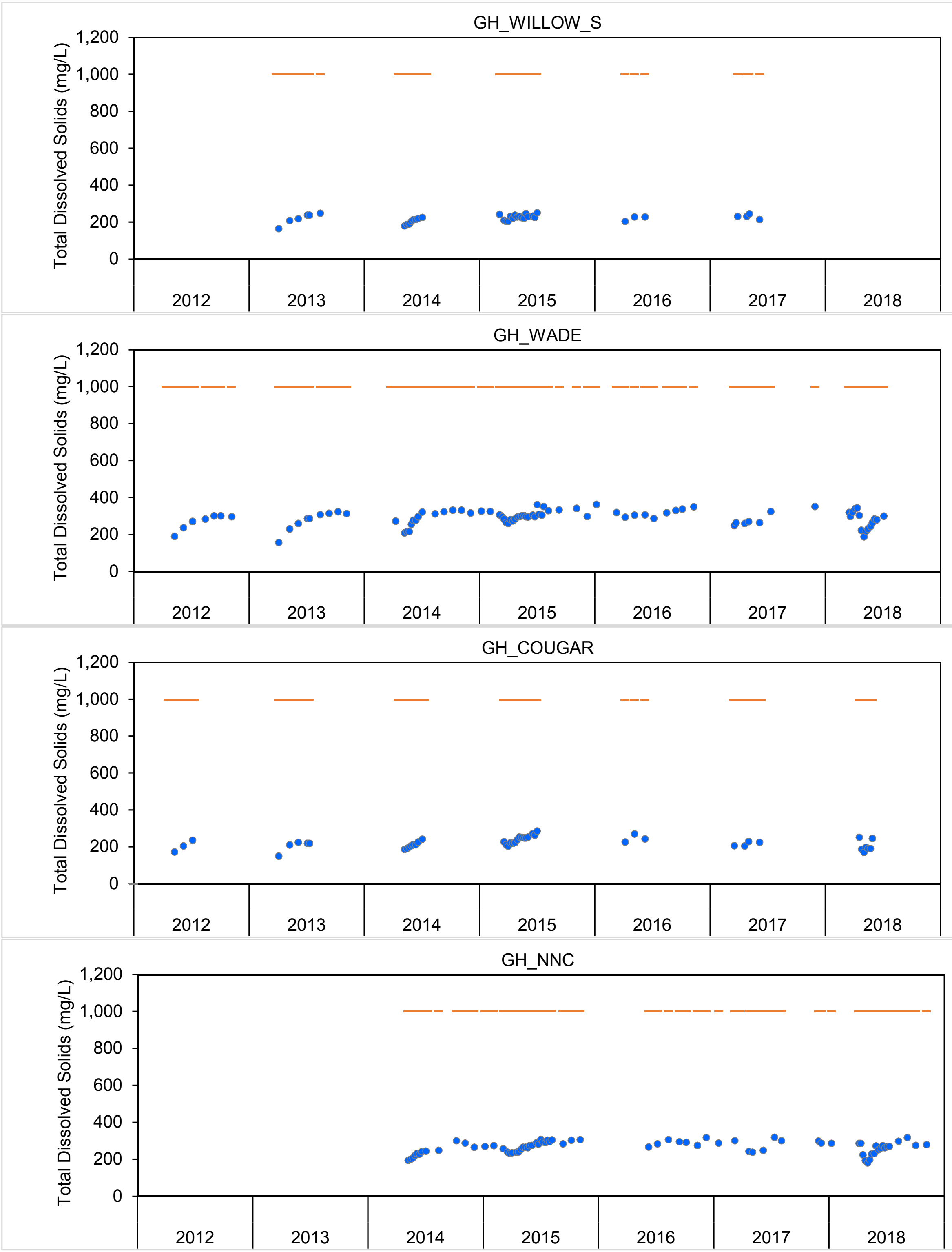


Figure C.14: Time Series Plots for Total Dissolved Solids Concentrations from the West-side Tributaries, 2012 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

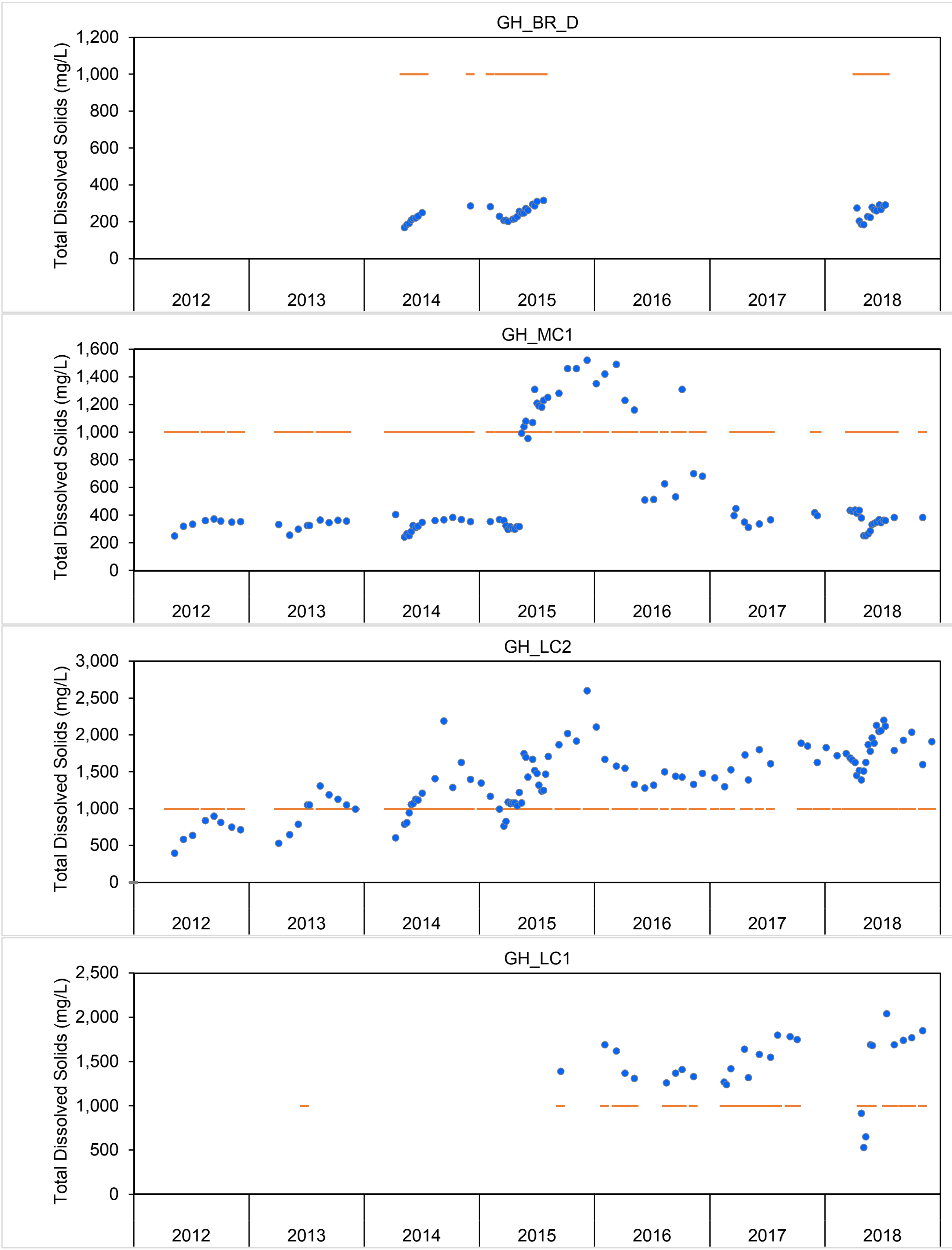


Figure C.14: Time Series Plots for Total Dissolved Solids Concentrations from the West-side Tributaries, 2012 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

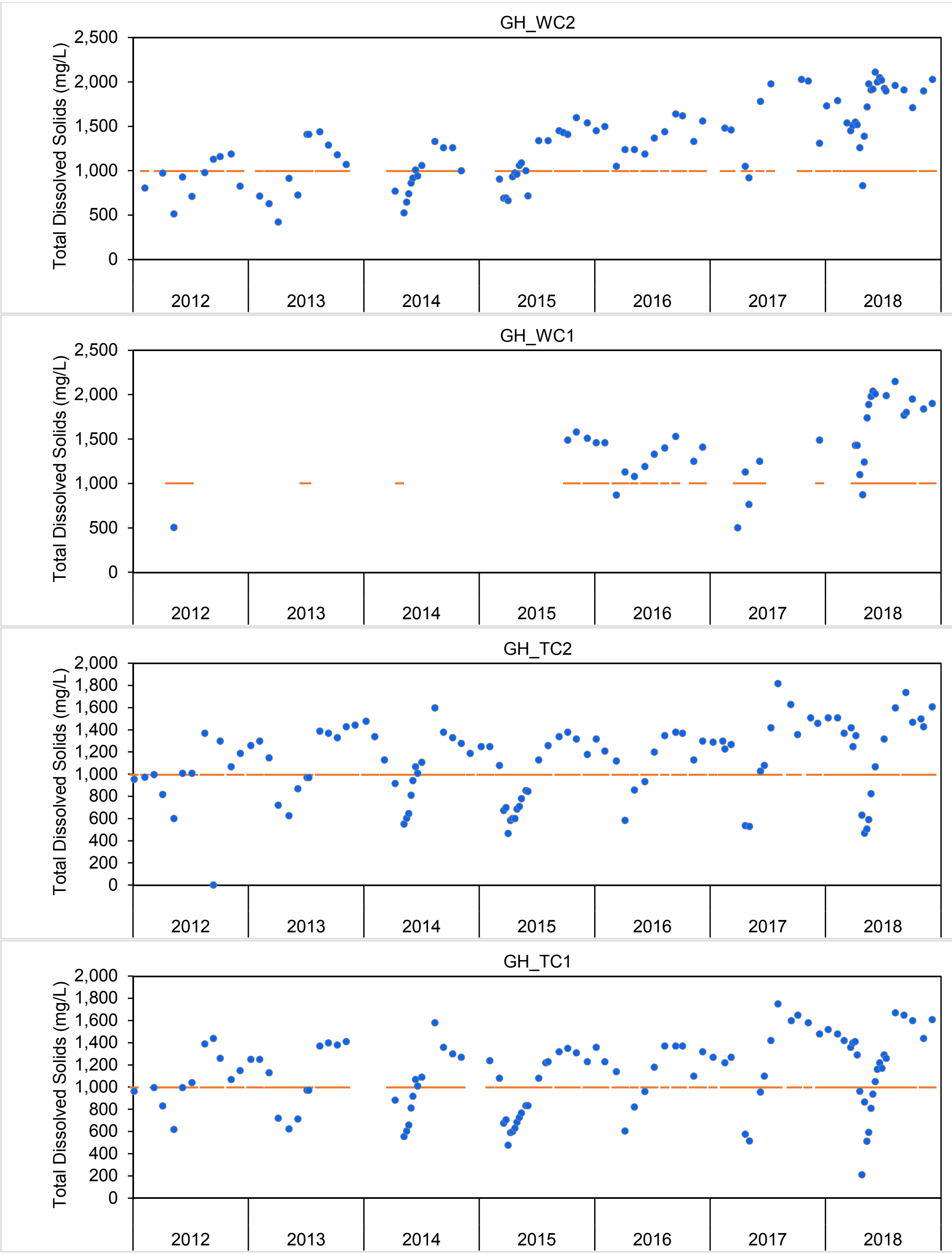


Figure C.14: Time Series Plots for Total Dissolved Solids Concentrations from the West-side Tributaries, 2012 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

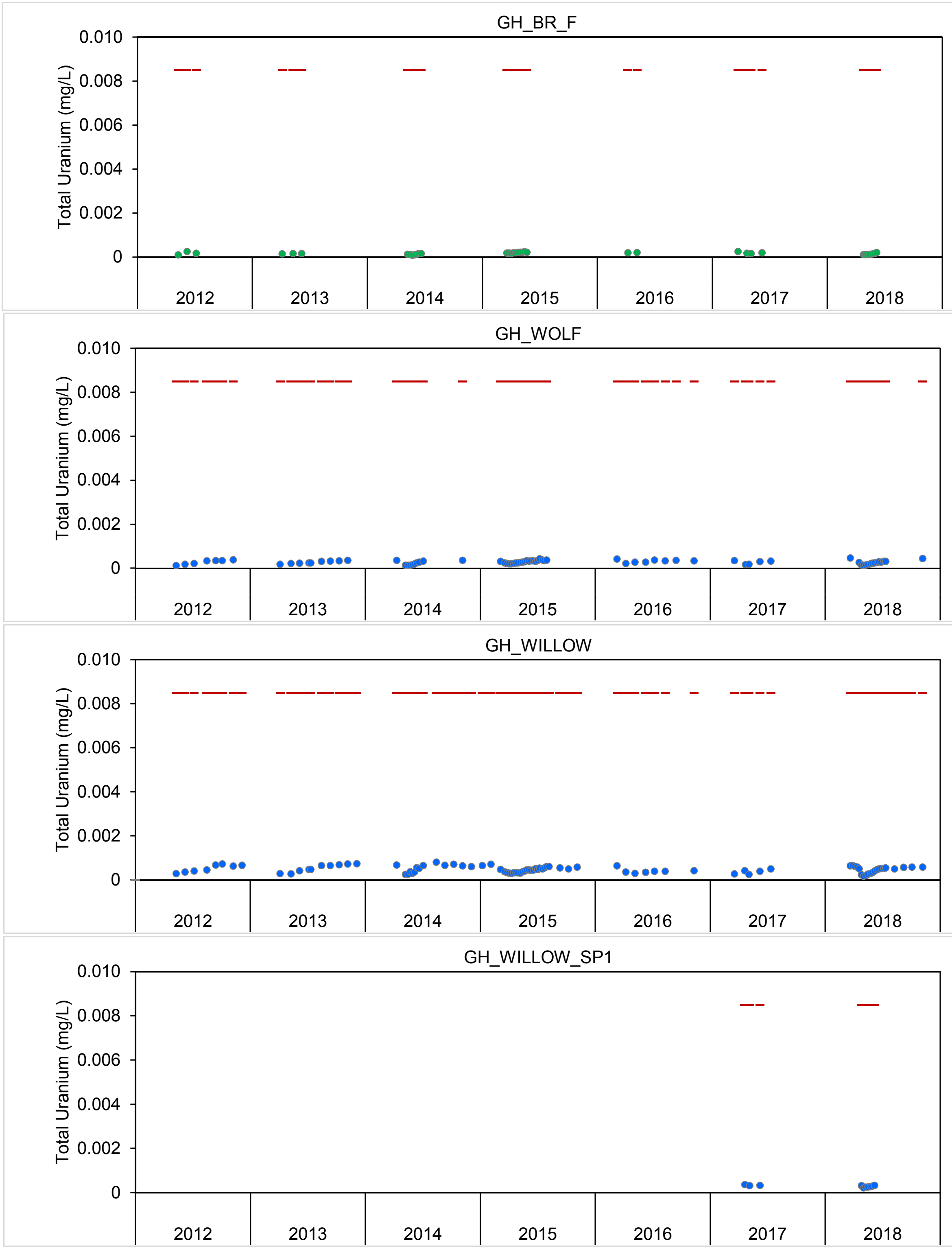


Figure C.15: Time Series Plots for Aqueous Total Uranium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

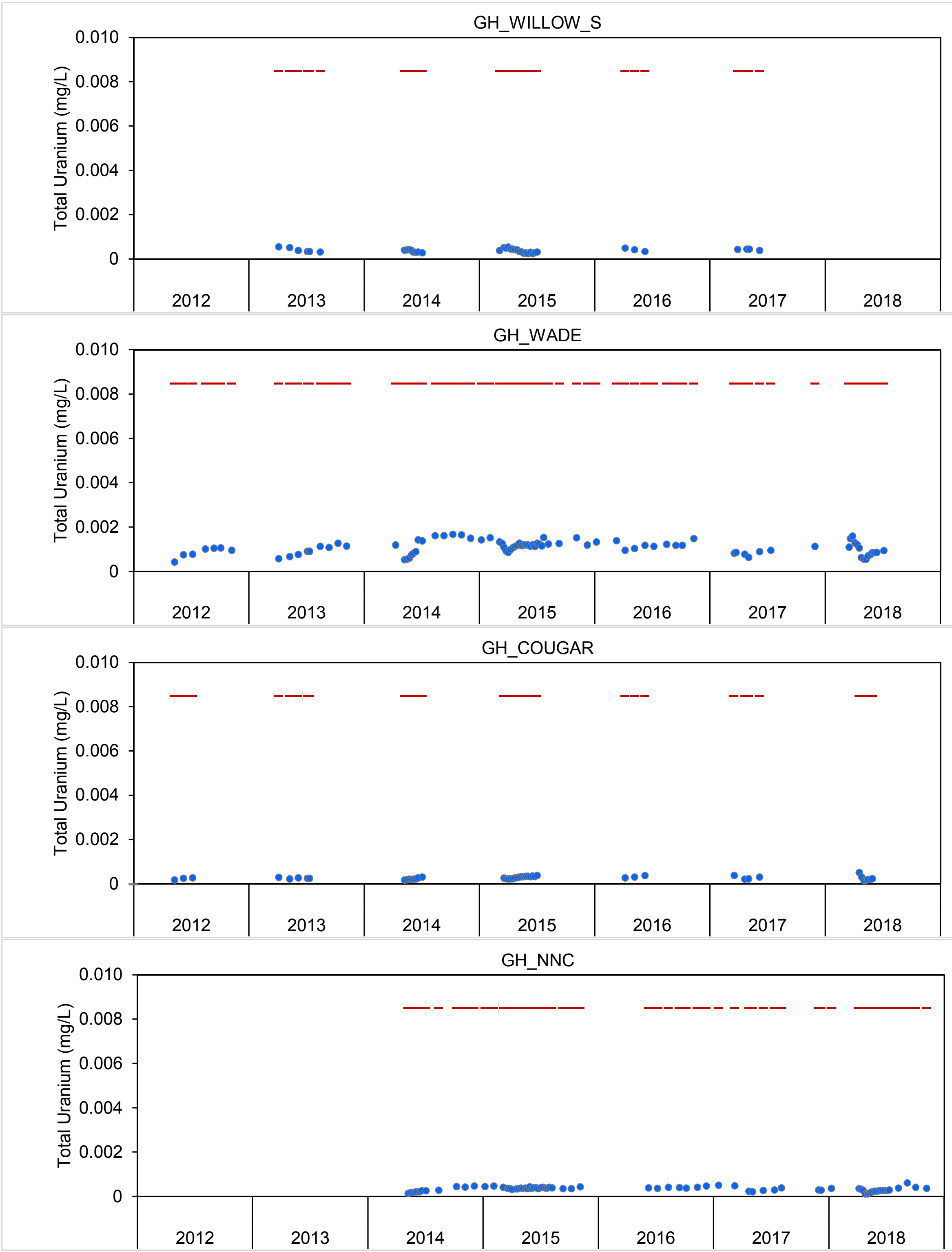


Figure C.15: Time Series Plots for Aqueous Total Uranium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

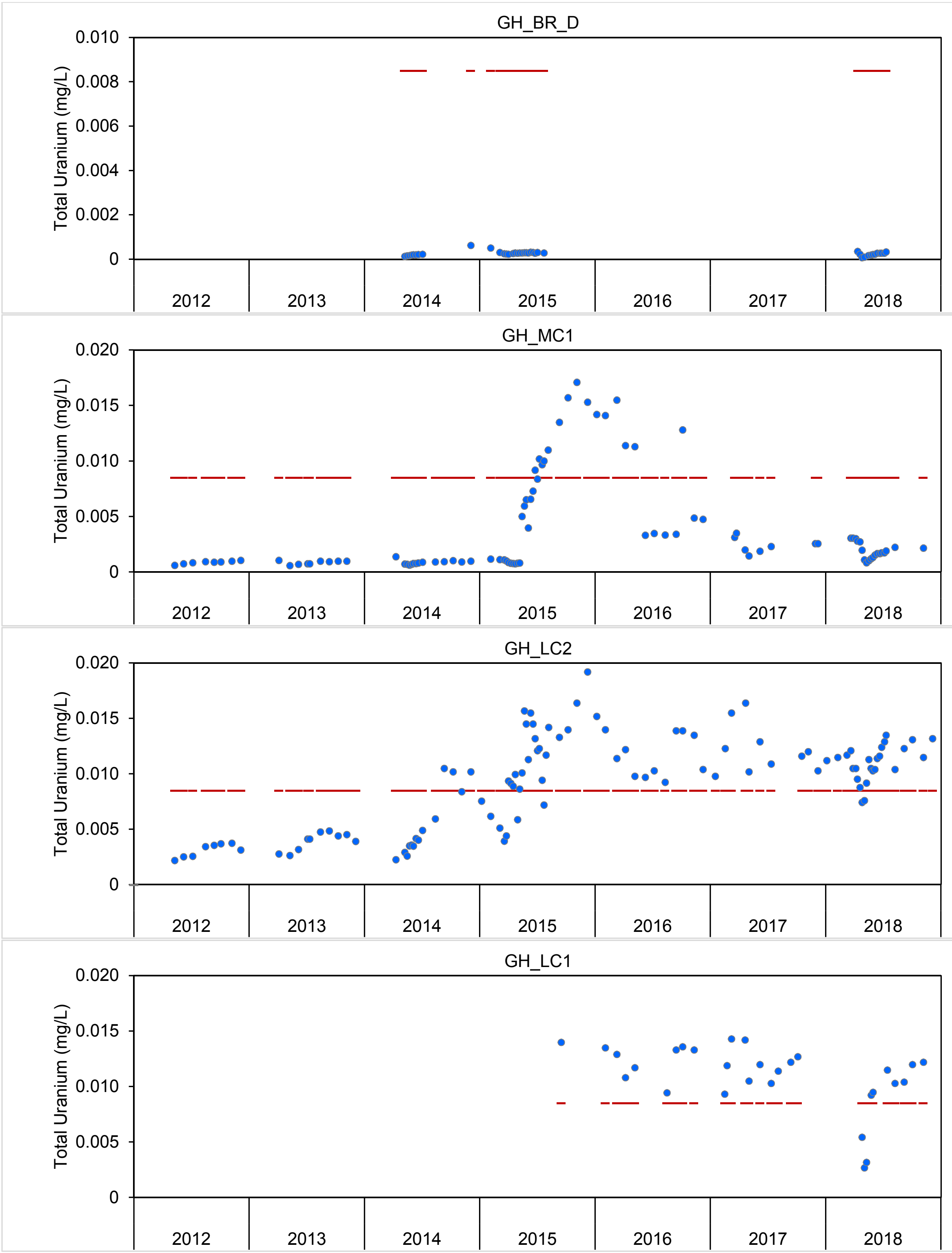


Figure C.15: Time Series Plots for Aqueous Total Uranium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

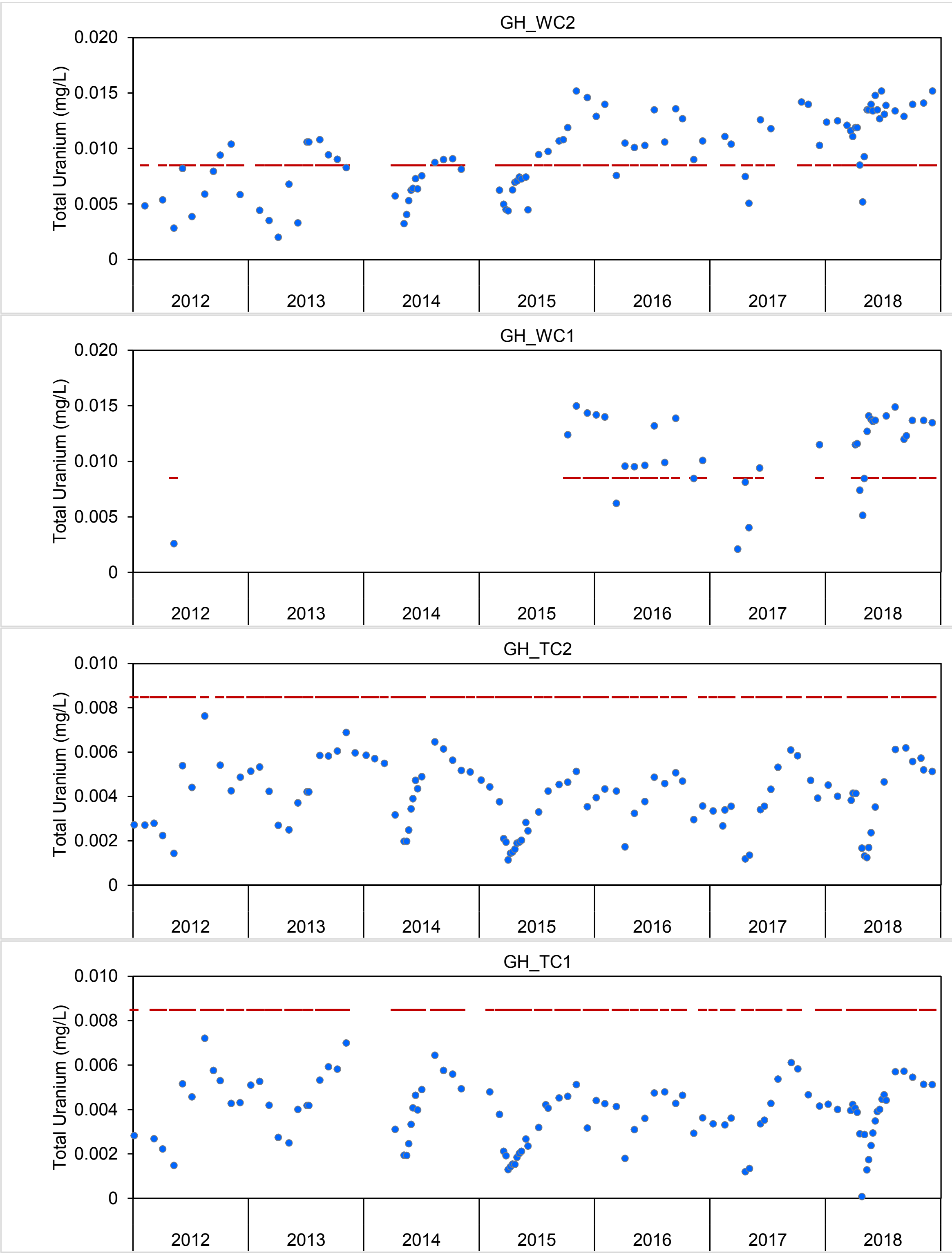


Figure C.15: Time Series Plots for Aqueous Total Uranium Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

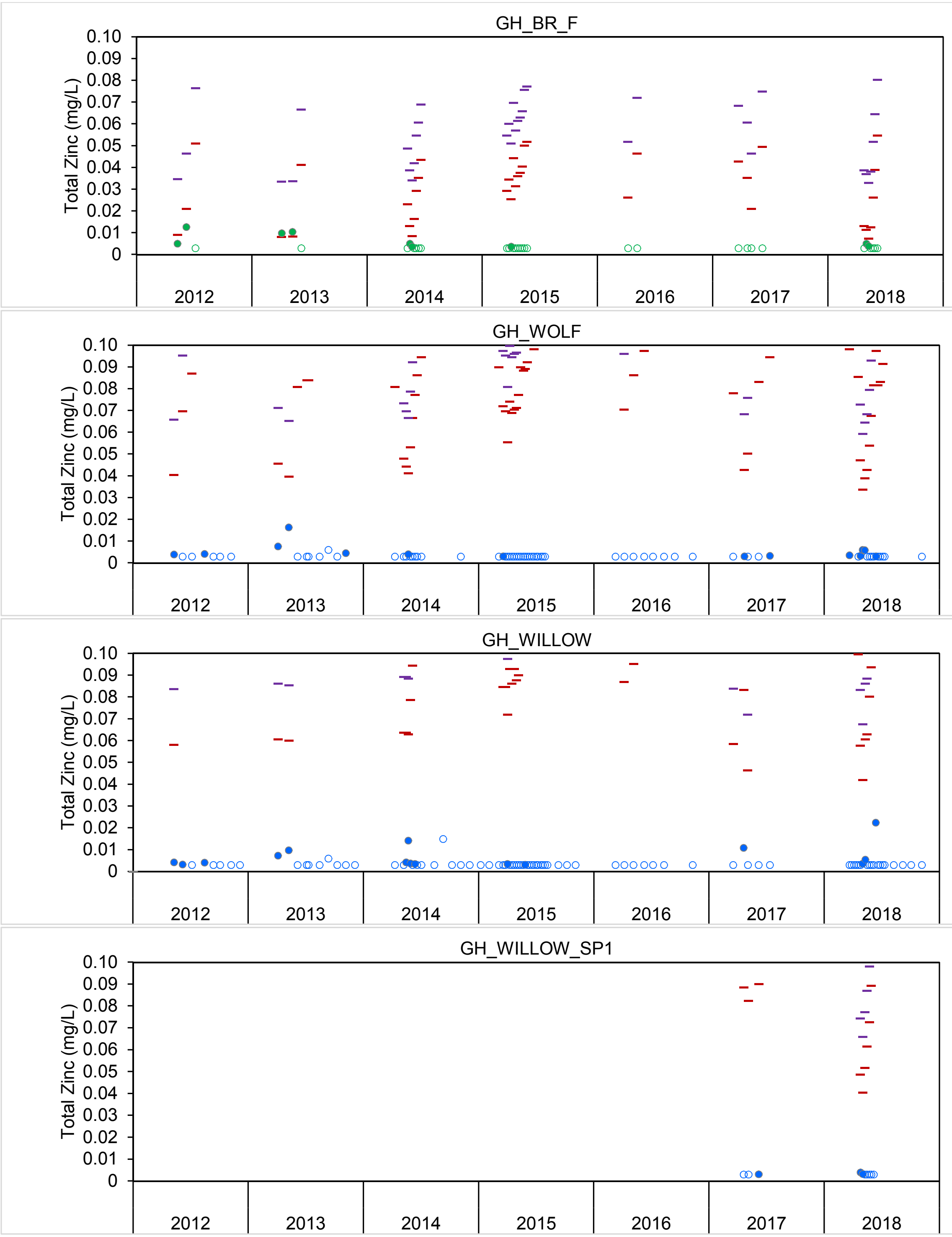


Figure C.16: Time Series Plots for Aqueous Total Zinc Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

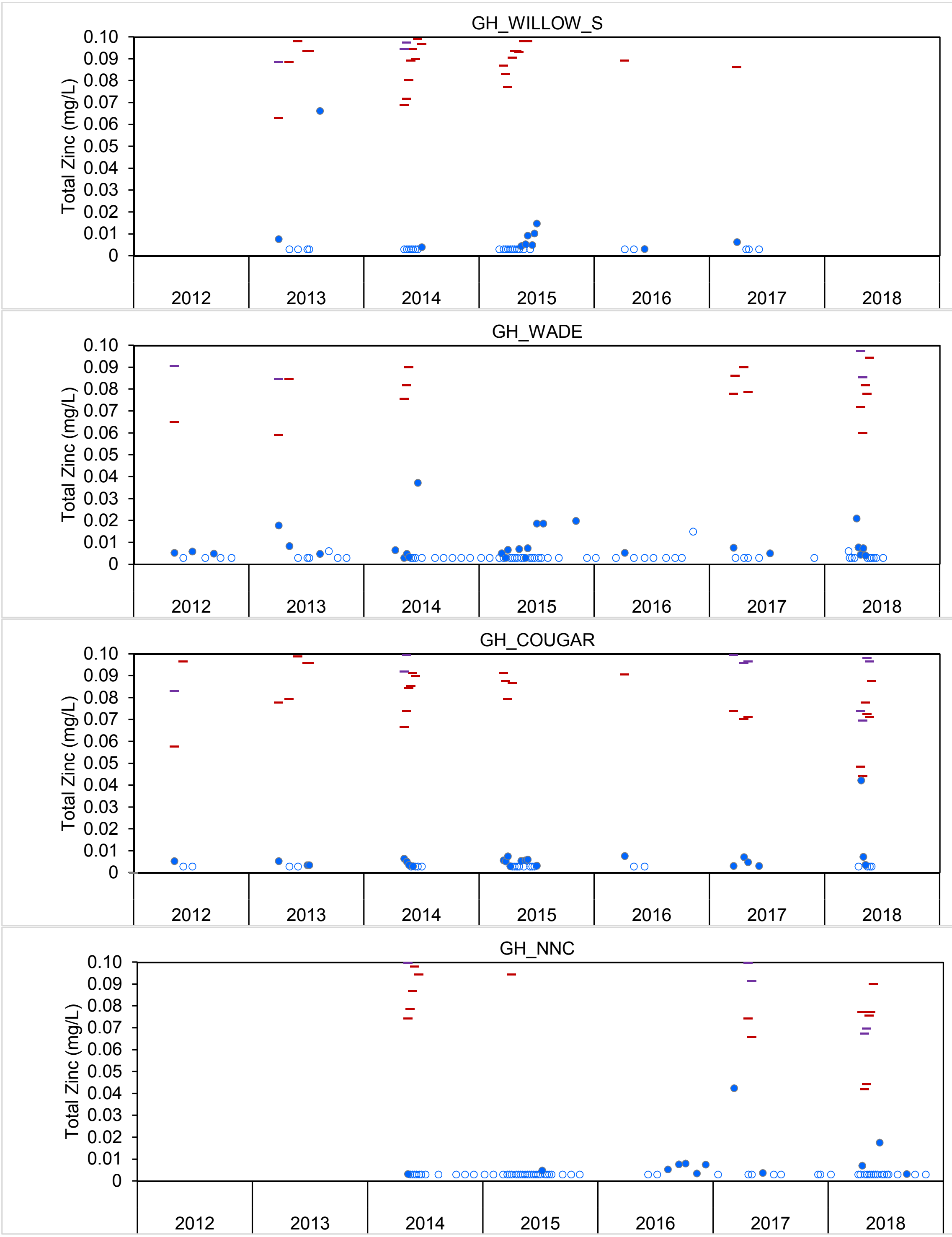


Figure C.16: Time Series Plots for Aqueous Total Zinc Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

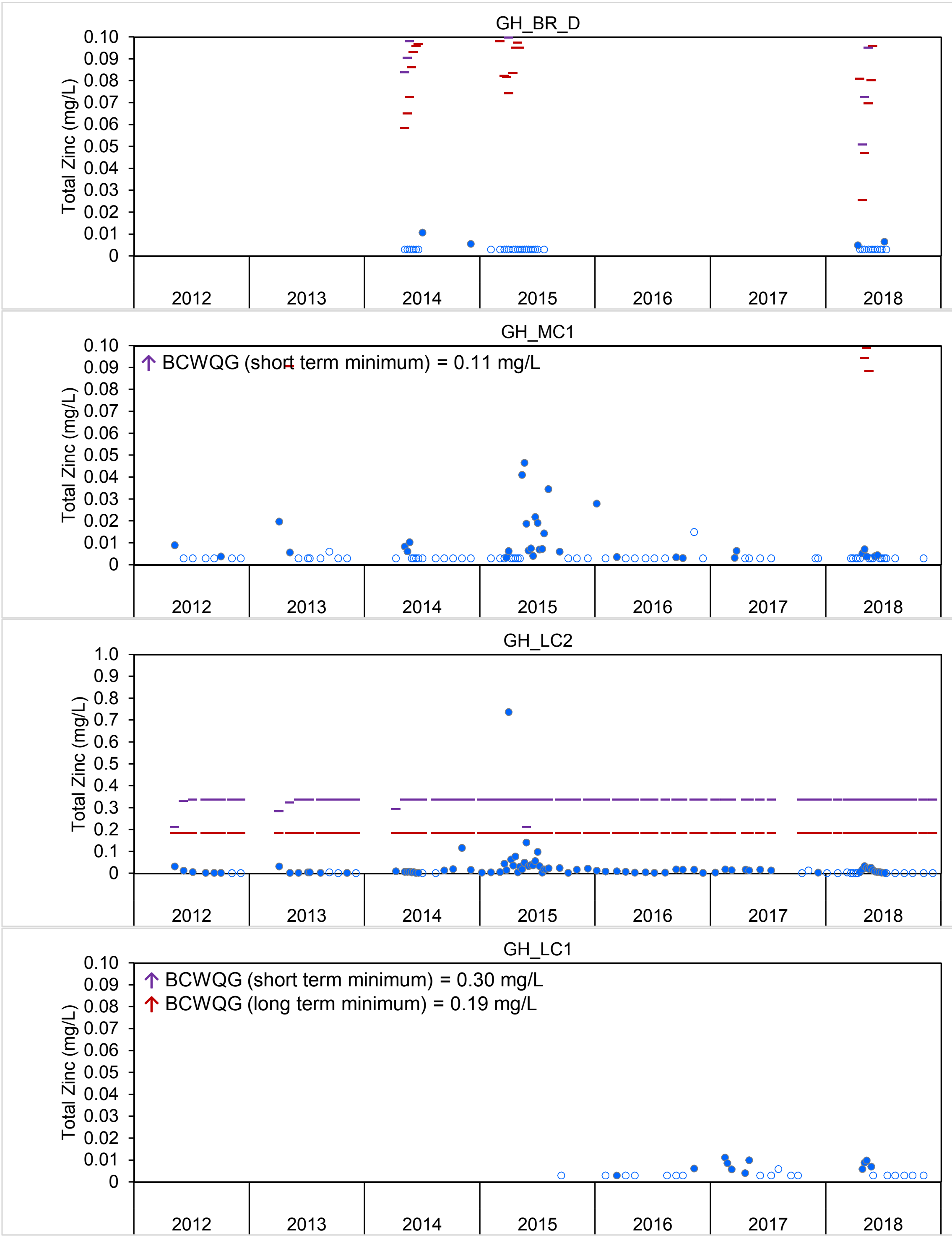


Figure C.16: Time Series Plots for Aqueous Total Zinc Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

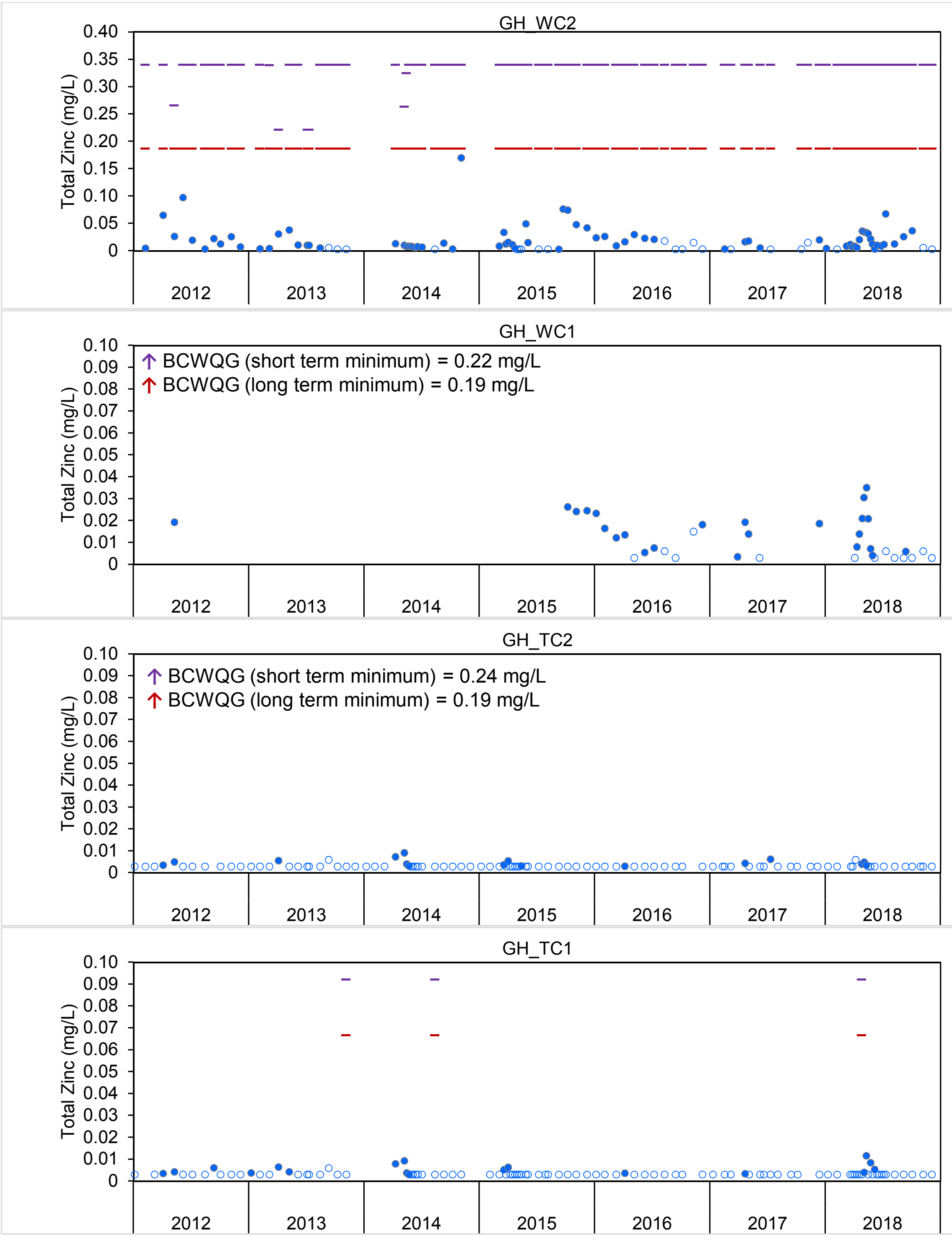


Figure C.16: Time Series Plots for Aqueous Total Zinc Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

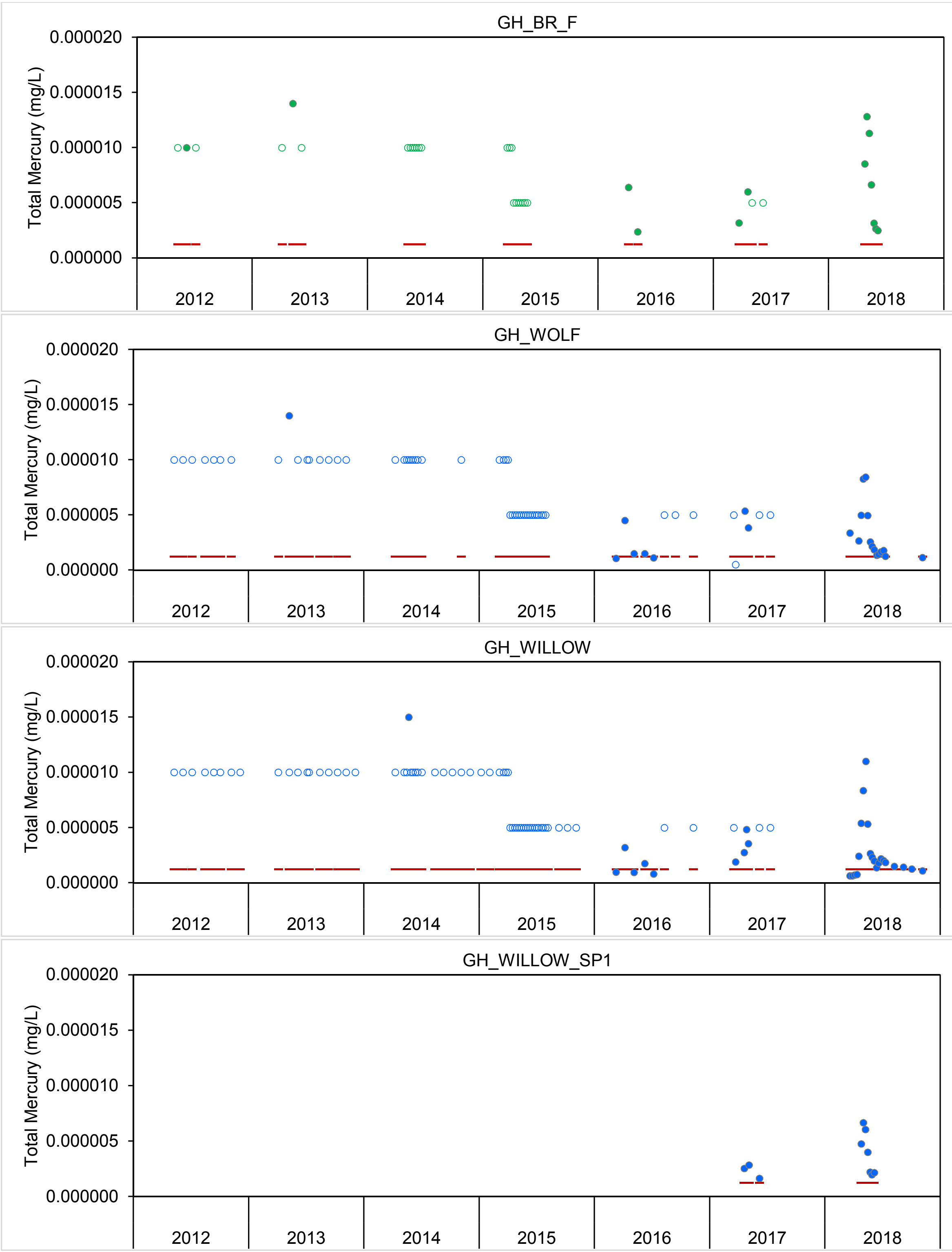


Figure C.17: Time Series Plots for Aqueous Total Mercury Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

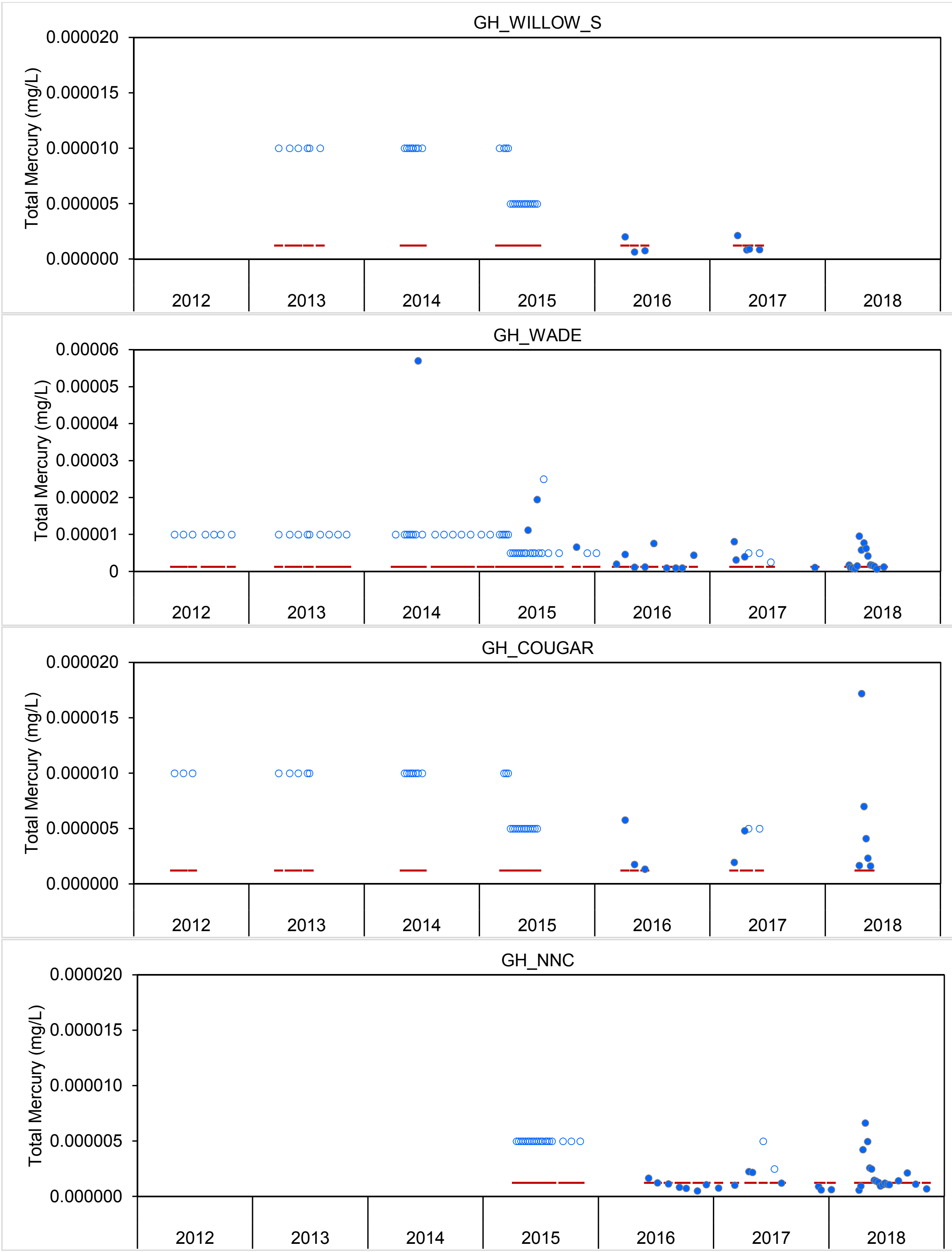


Figure C.17: Time Series Plots for Aqueous Total Mercury Concentrations from the West-side Tributaries, 2012 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

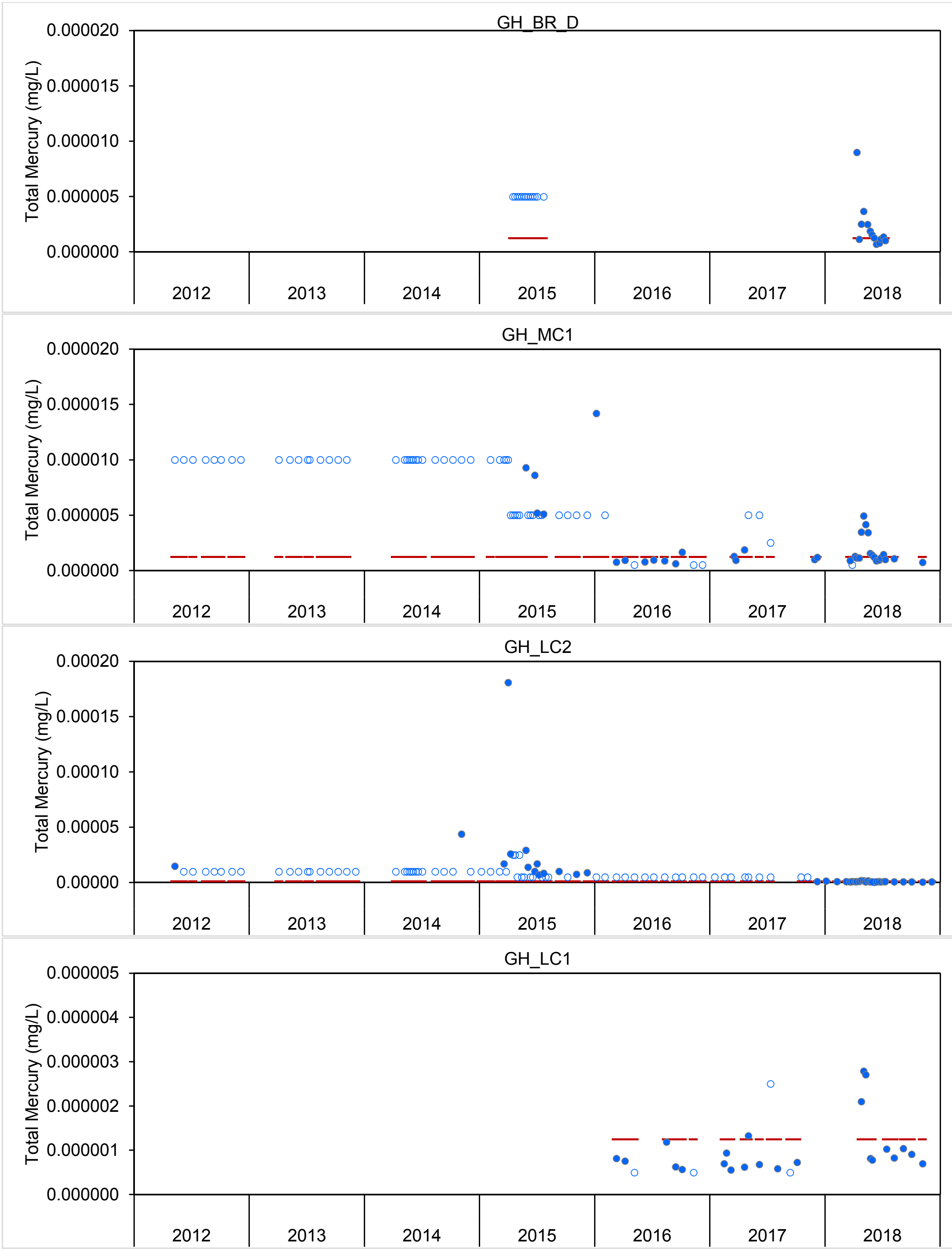


Figure C.17: Time Series Plots for Aqueous Total Mercury Concentrations from the West-side Tributaries, 2012 to 2018

— — = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

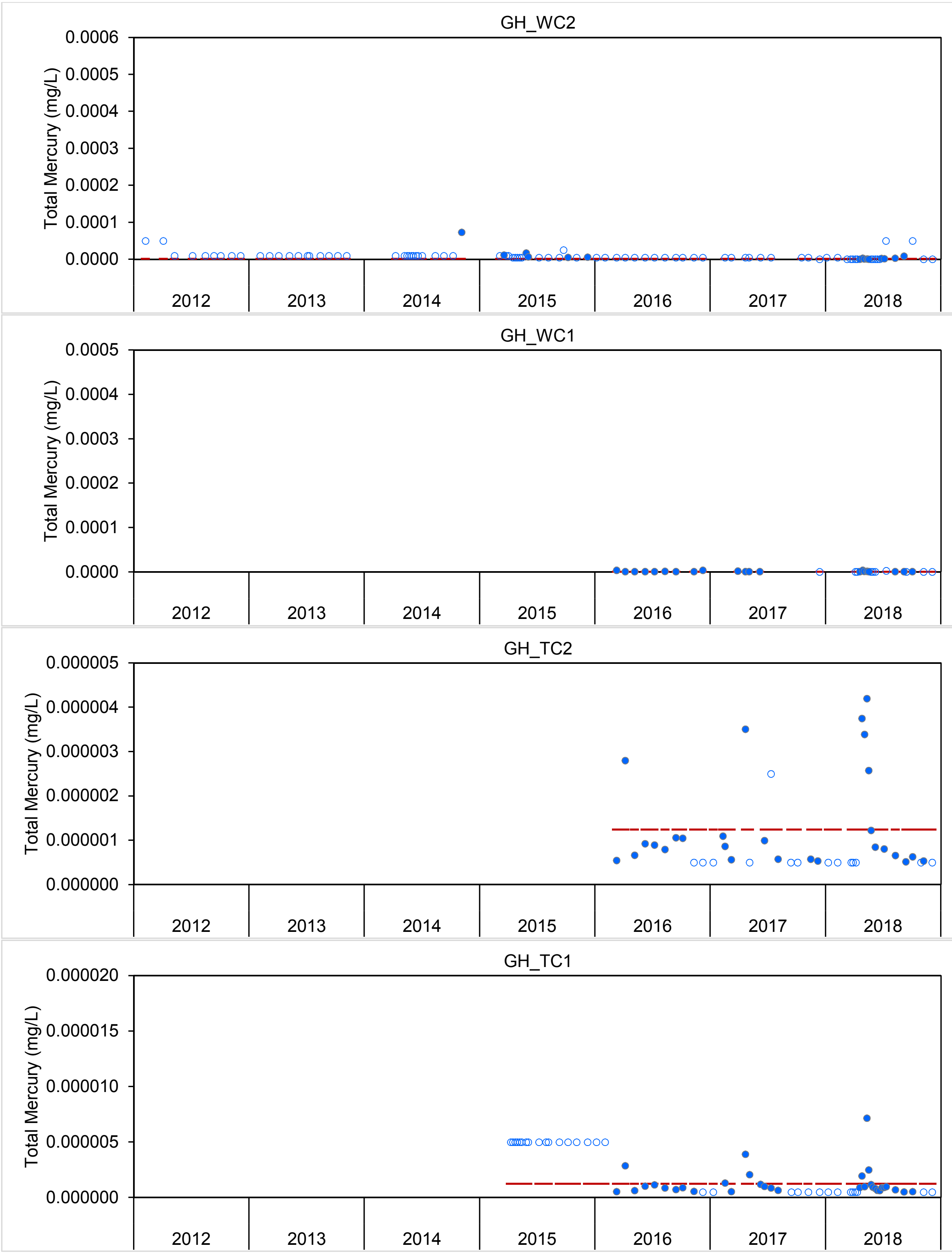


Figure C.17: Time Series Plots for Aqueous Total Mercury Concentrations from the West-side Tributaries, 2012 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

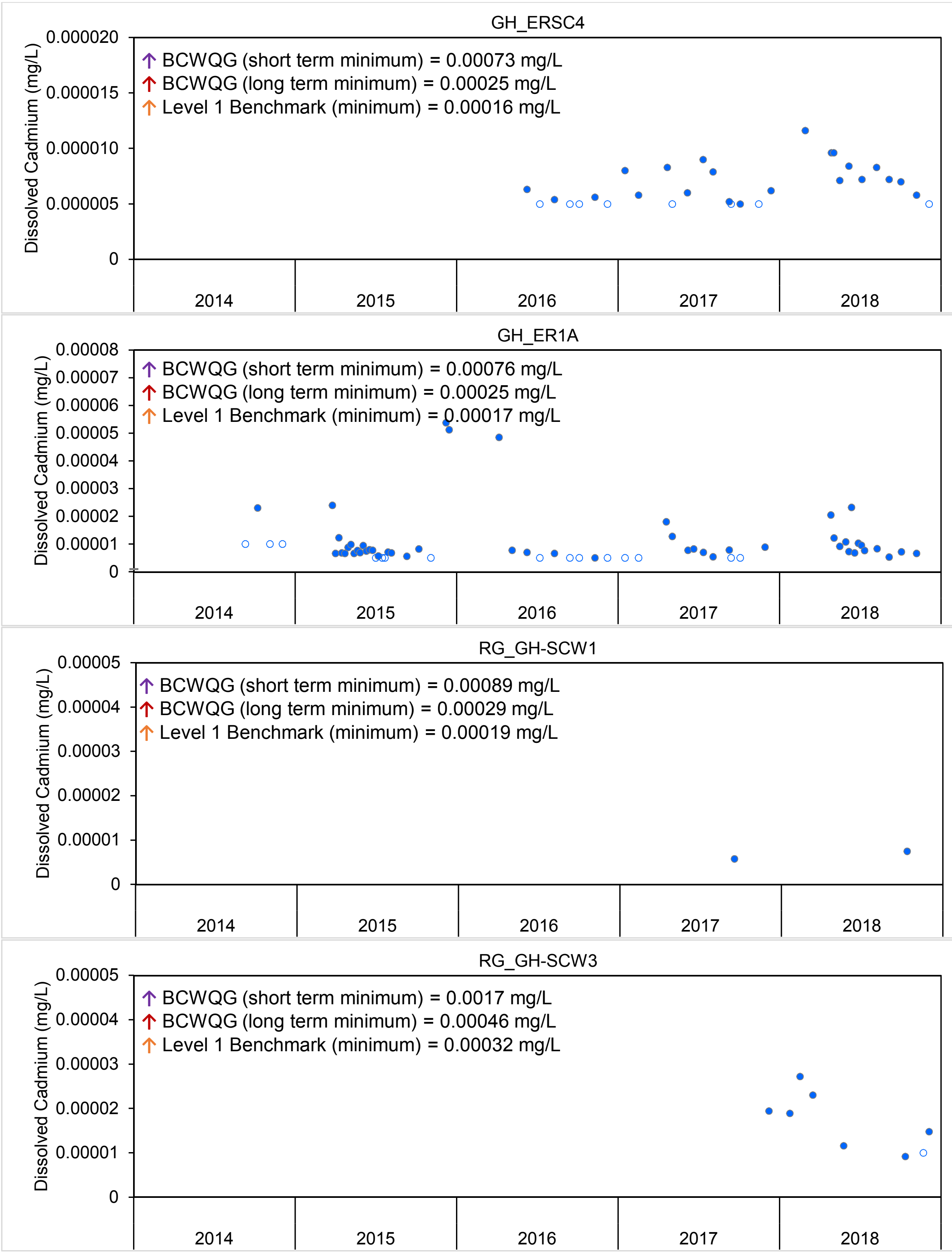


Figure C.18: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

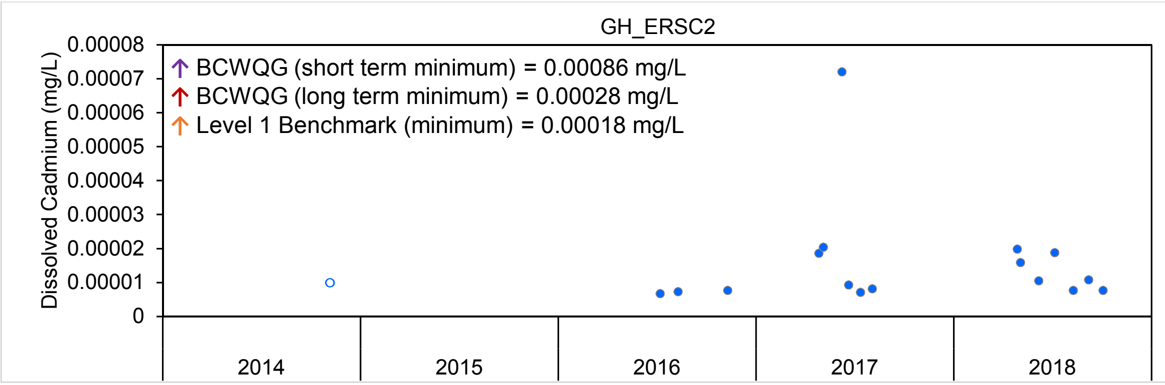


Figure C.18: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark.
● = Mine-exposed; ● = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

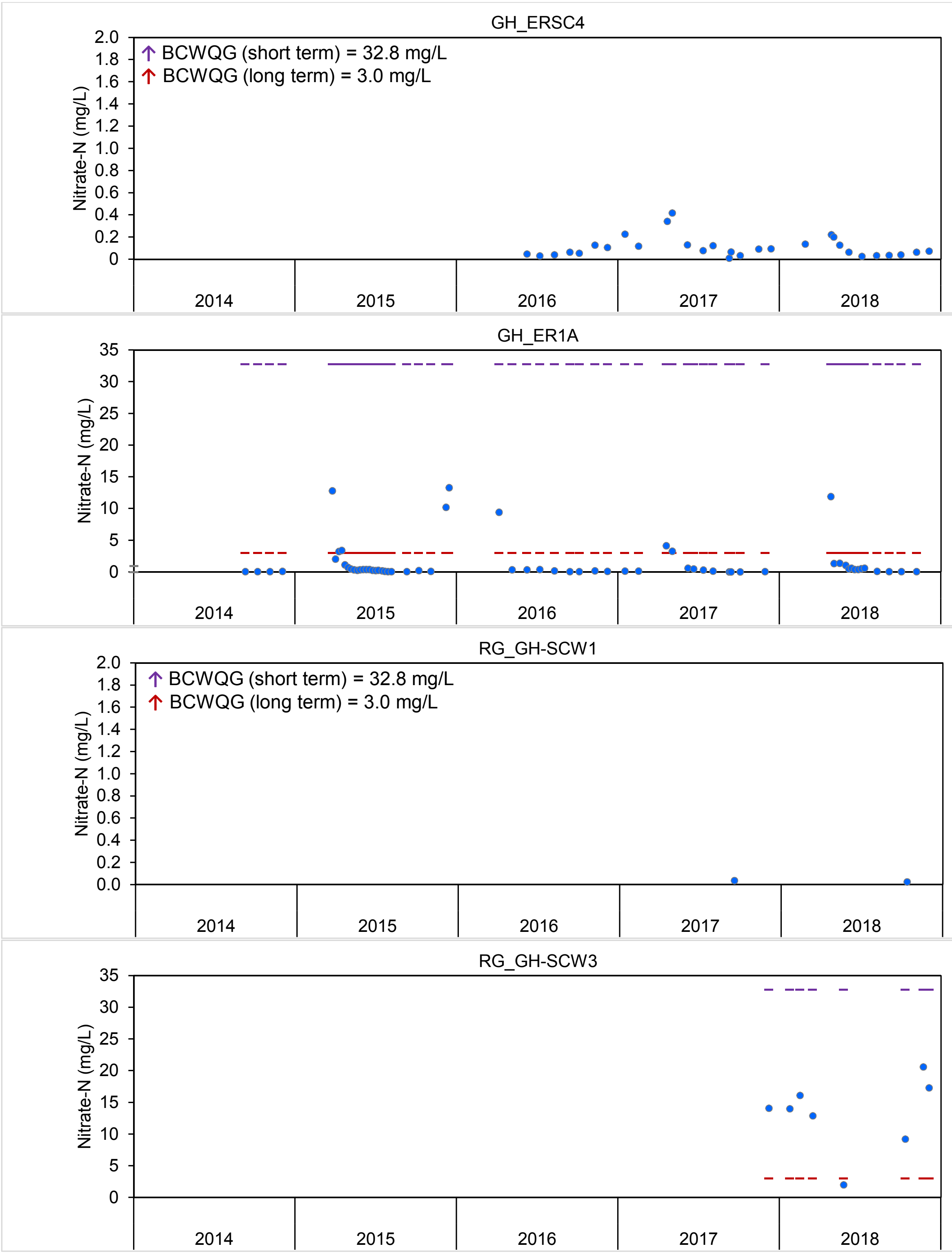


Figure C.19: Time Series Plots for Aqueous Nitrate-N Concentrations from the Elk River Side Channel Monitoring Stations, 2012 to 2018

= BCWQG (long term); = BCWQG (short term)

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

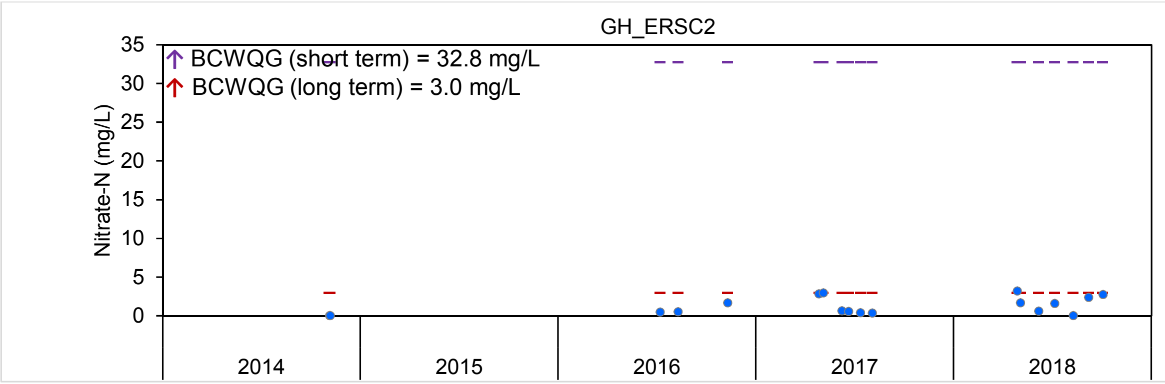


Figure C.19: Time Series Plots for Aqueous Nitrate-N Concentrations from the Elk River Side Channel Monitoring Stations, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term)

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

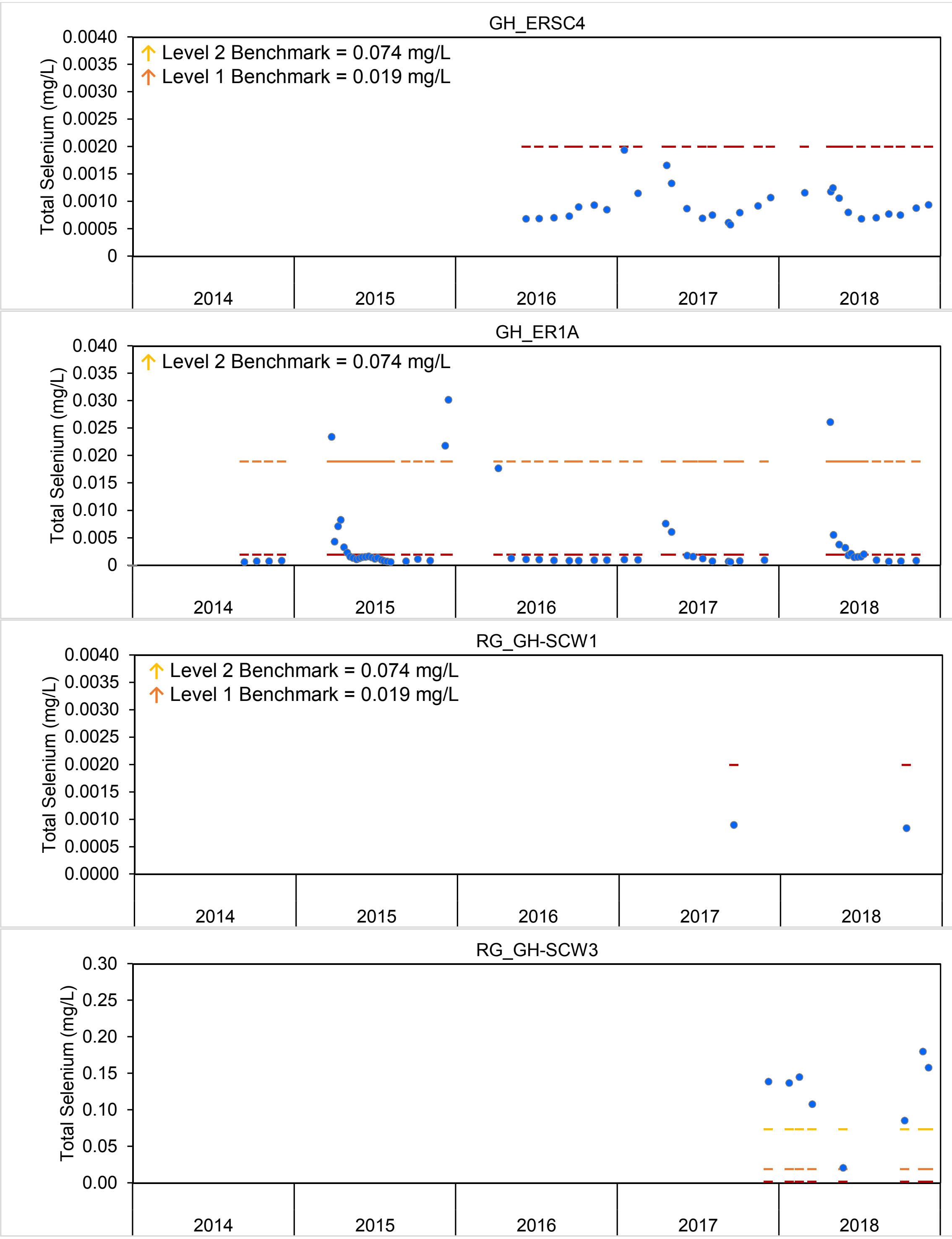


Figure C.20: Time Series Plots for Aqueous Total Selenium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

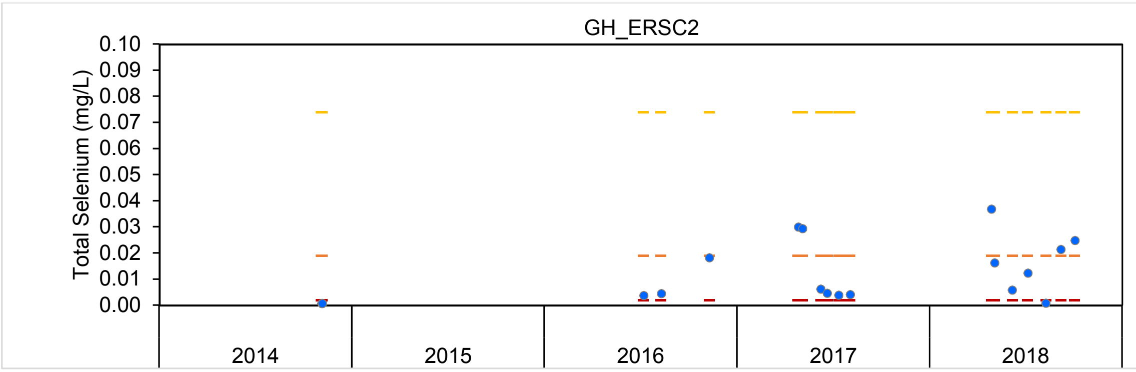


Figure C.20: Time Series Plots for Aqueous Total Selenium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark.
= Mine-exposed; = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

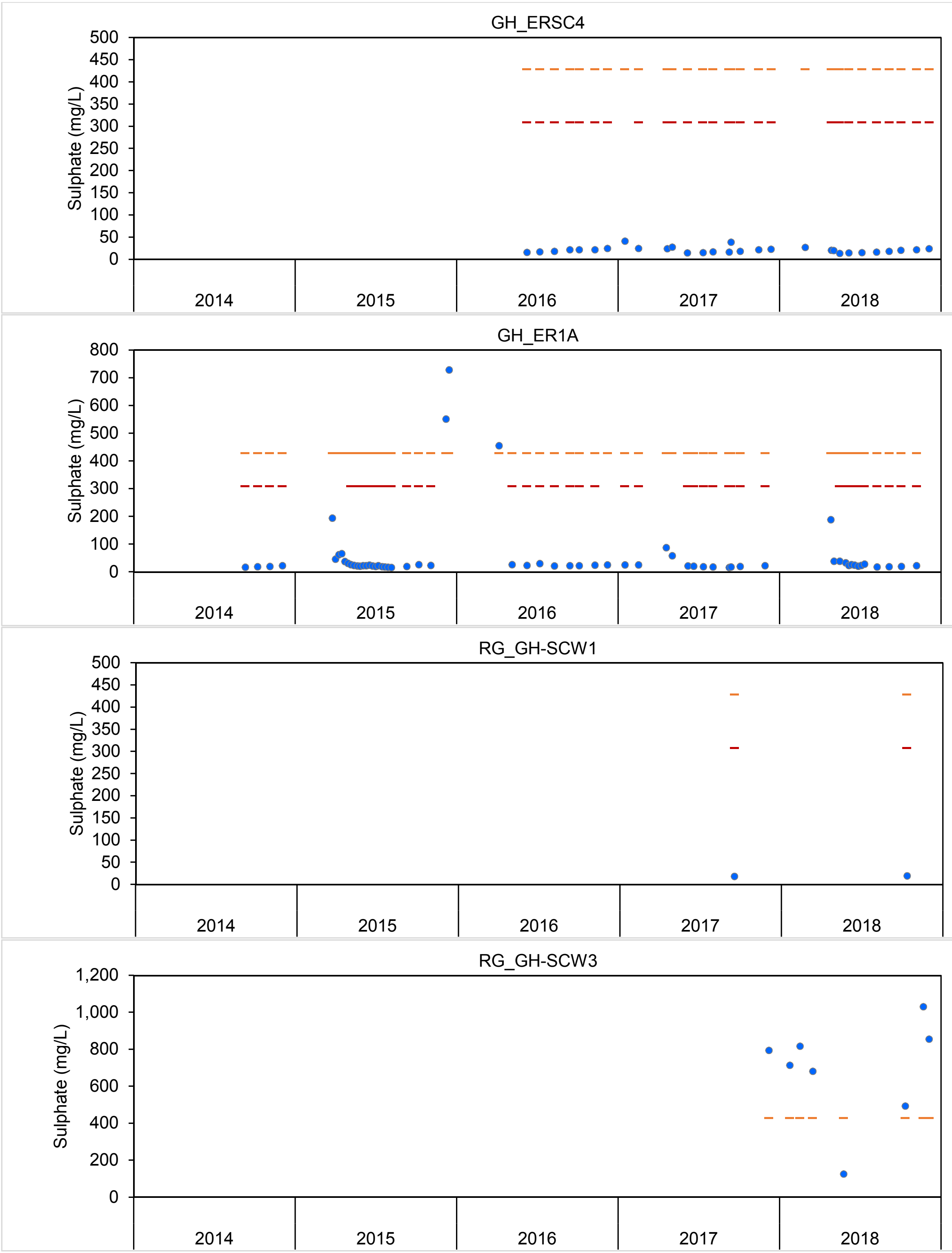


Figure C.21: Time Series Plots for Aqueous Sulphate Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = Level 1 Benchmark.

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

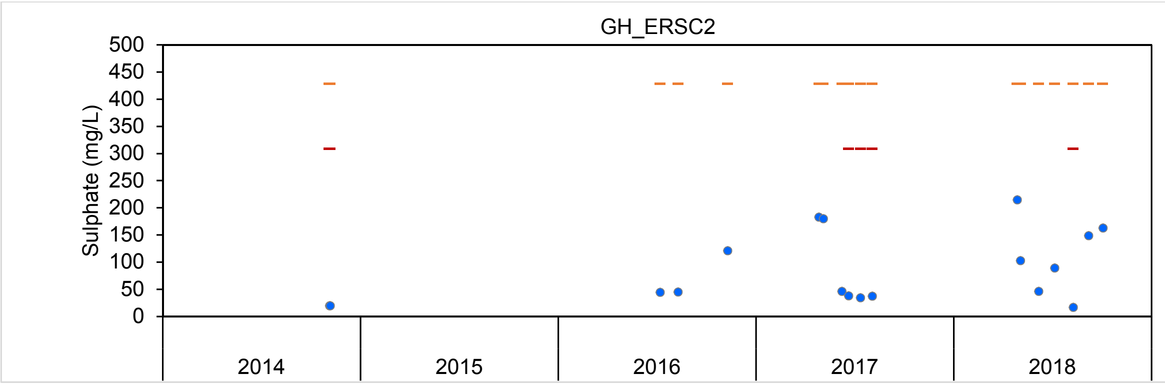


Figure C.21: Time Series Plots for Aqueous Sulphate Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = Level 1 Benchmark.
= Mine-exposed; = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness and guidelines that overlap may not be visible.

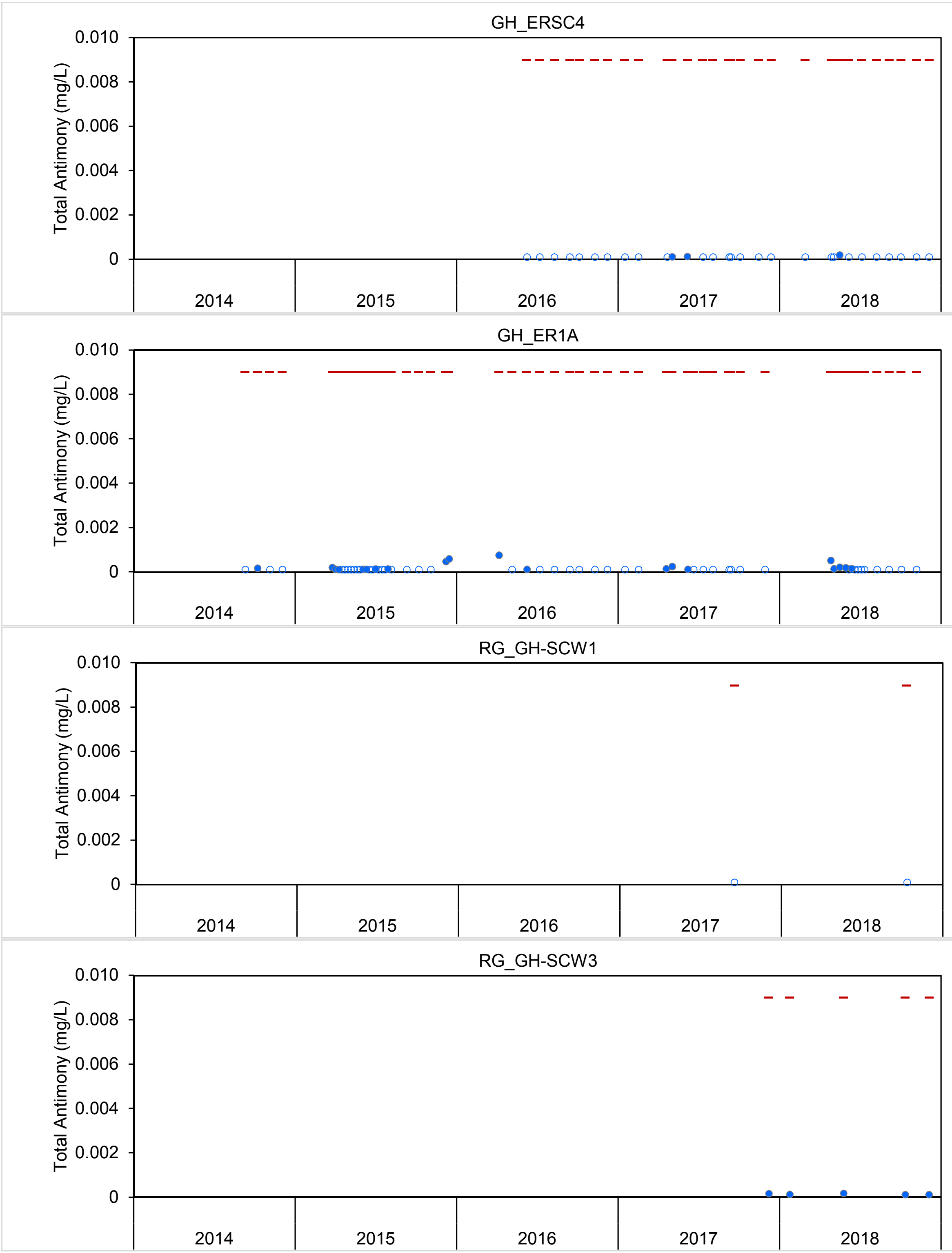


Figure C.22: Time Series Plots for Aqueous Total Antimony Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

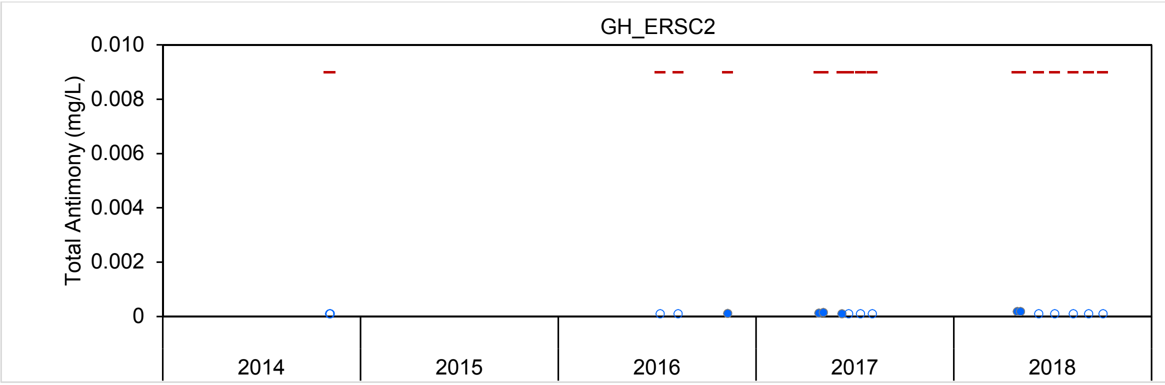


Figure C.22: Time Series Plots for Aqueous Total Antimony Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

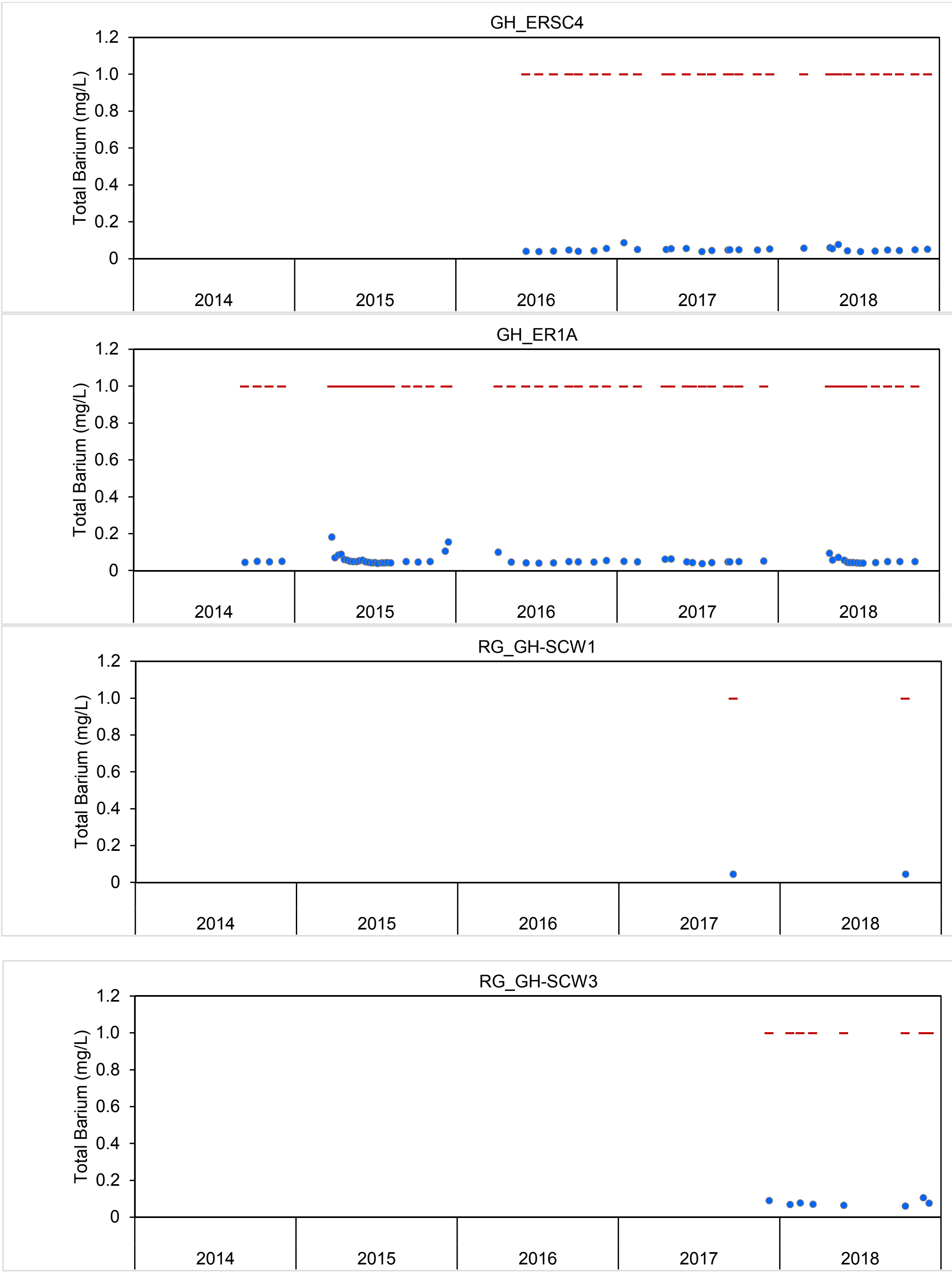


Figure C.23: Time Series Plots for Aqueous Total Barium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

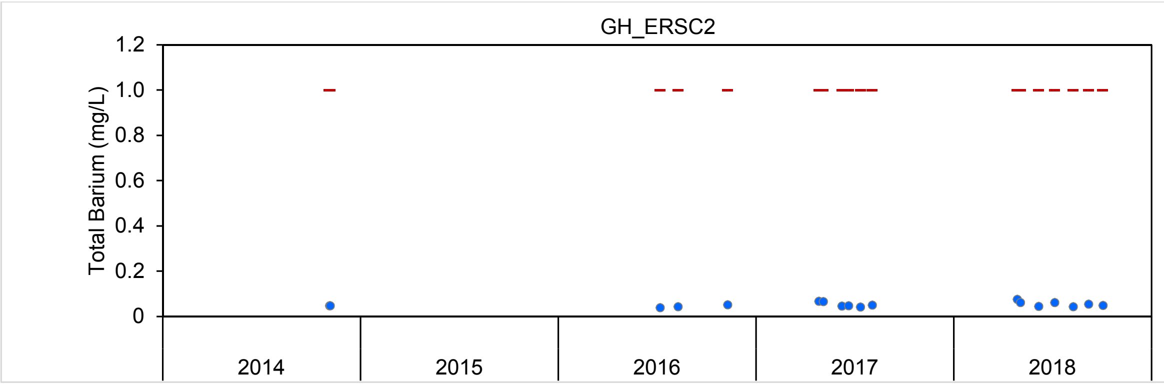


Figure C.23: Time Series Plots for Aqueous Total Barium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

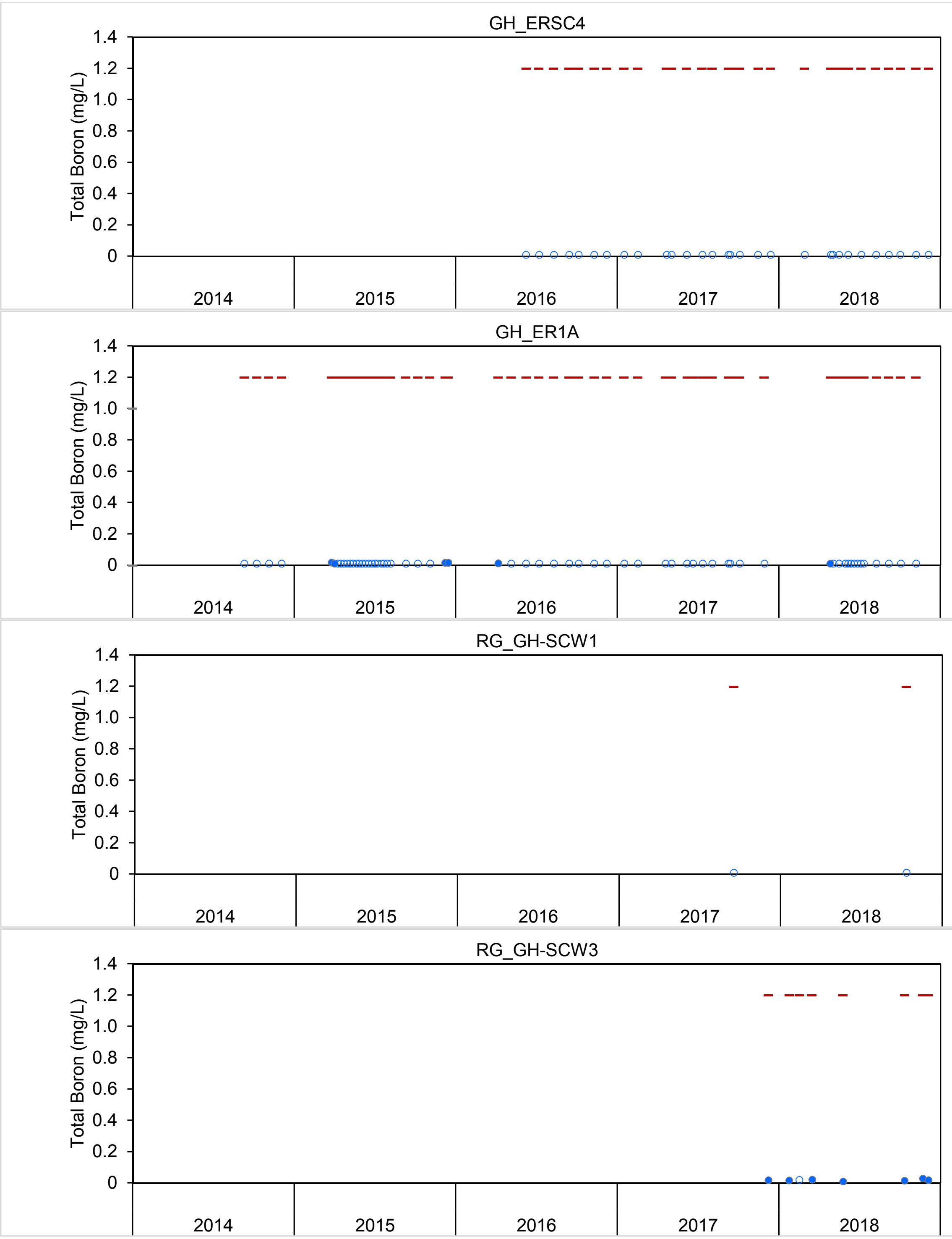


Figure C.24: Time Series Plots for Aqueous Total Boron Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term).

= Mine-exposed; = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

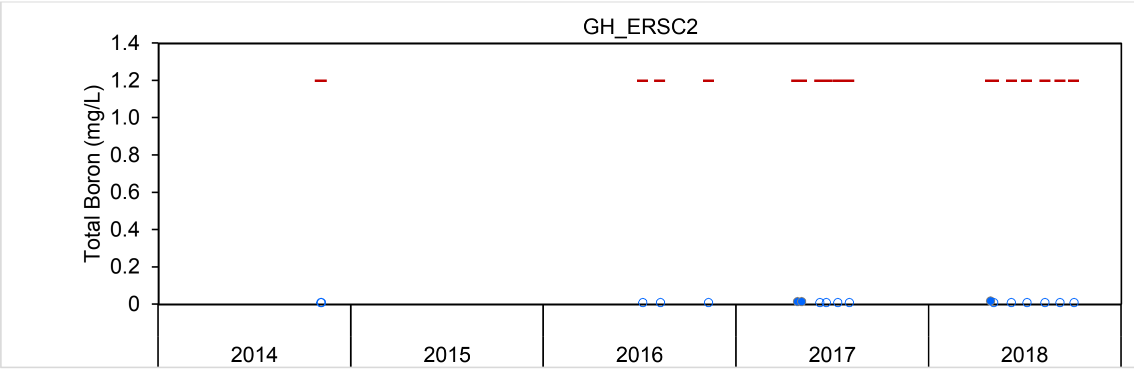


Figure C.24: Time Series Plots for Aqueous Total Boron Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

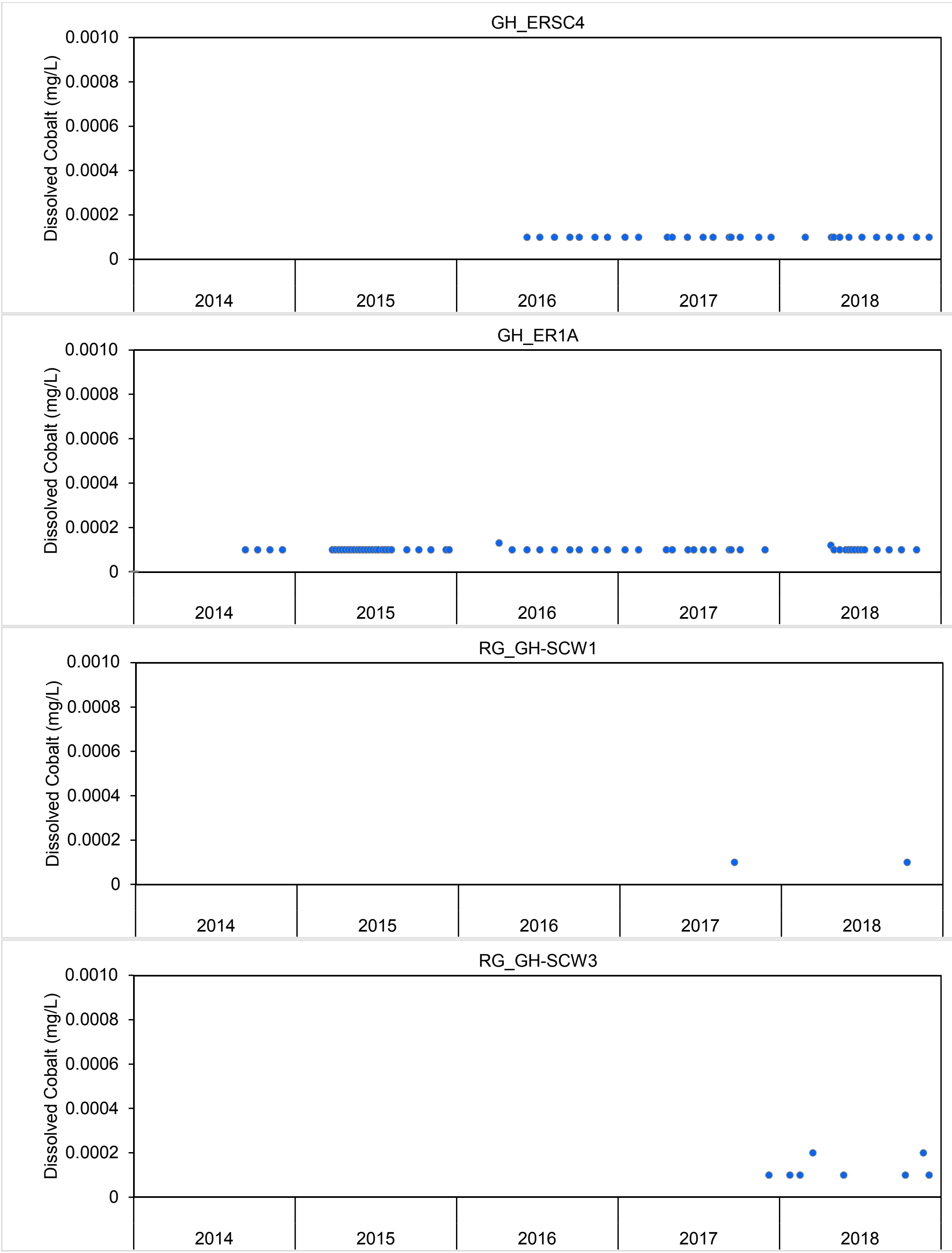


Figure C.25: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

● = Mine-exposed; ● = Reference.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

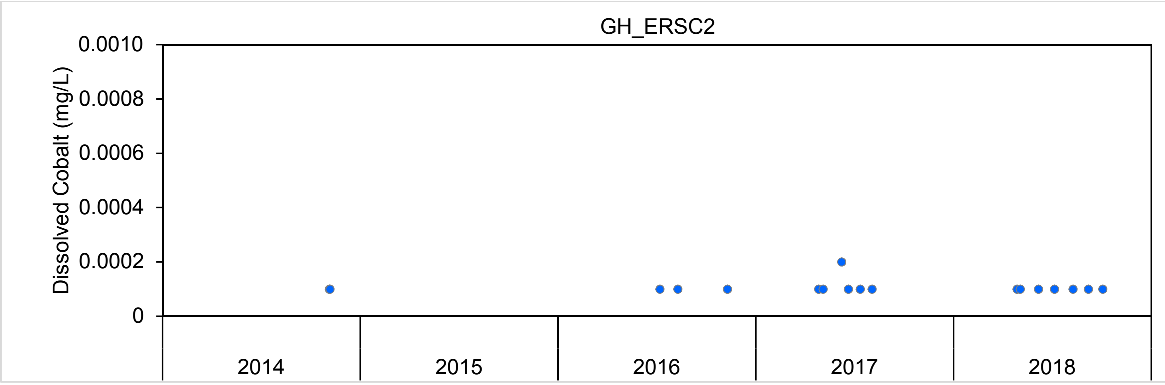


Figure C.25: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

● = Mine-exposed; ● = Reference.
Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

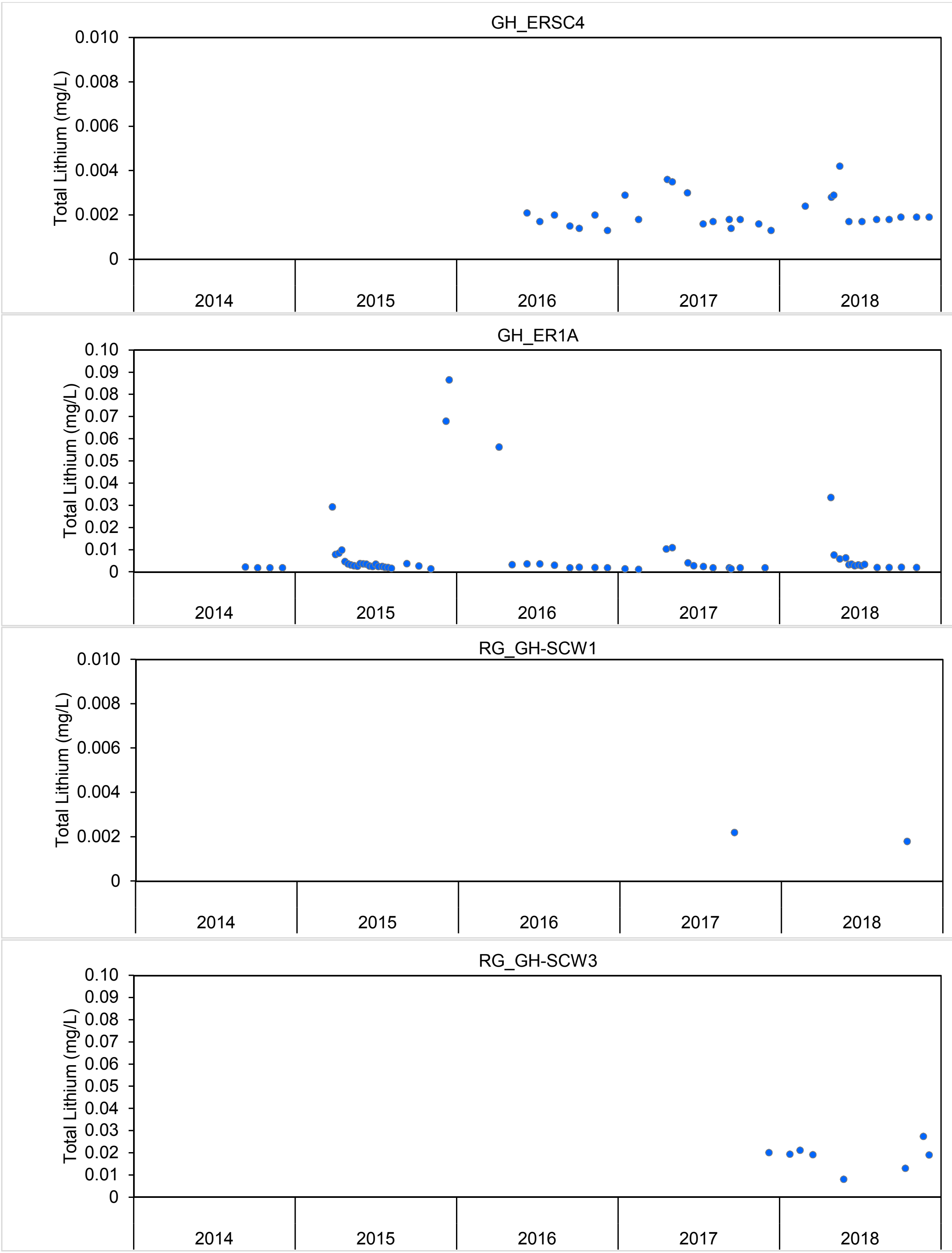


Figure C.26: Time Series Plots for Aqueous Total Lithium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

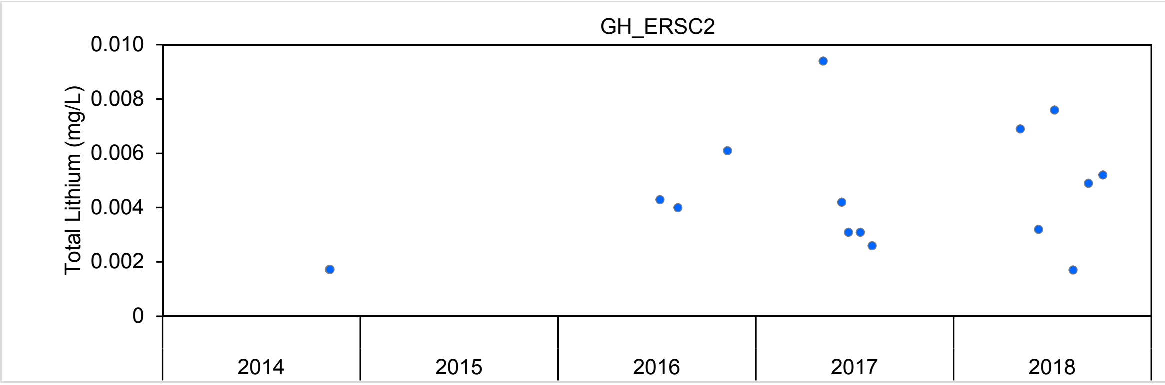


Figure C.26: Time Series Plots for Aqueous Total Lithium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

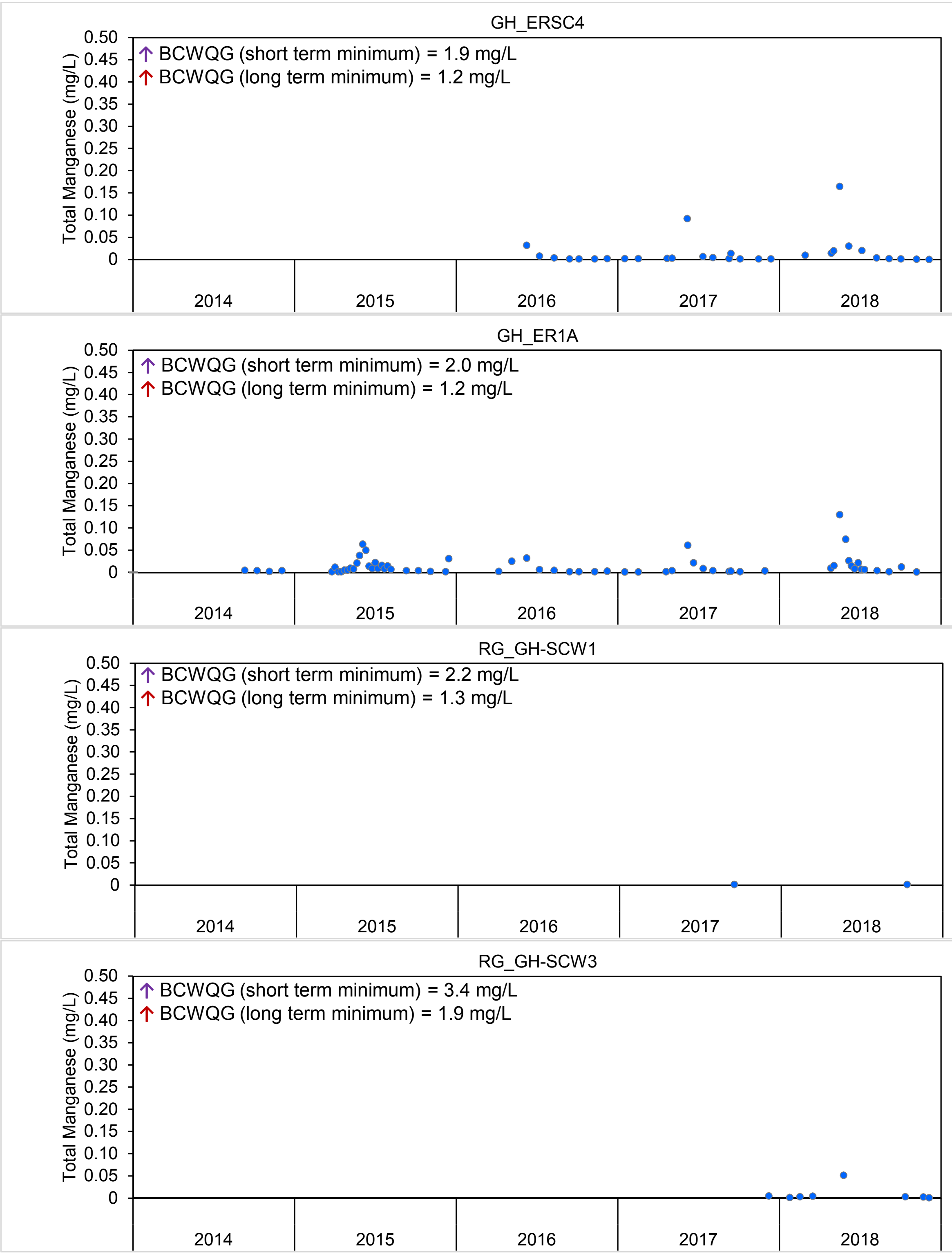


Figure C.27: Time Series Plots for Aqueous Total Manganese Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

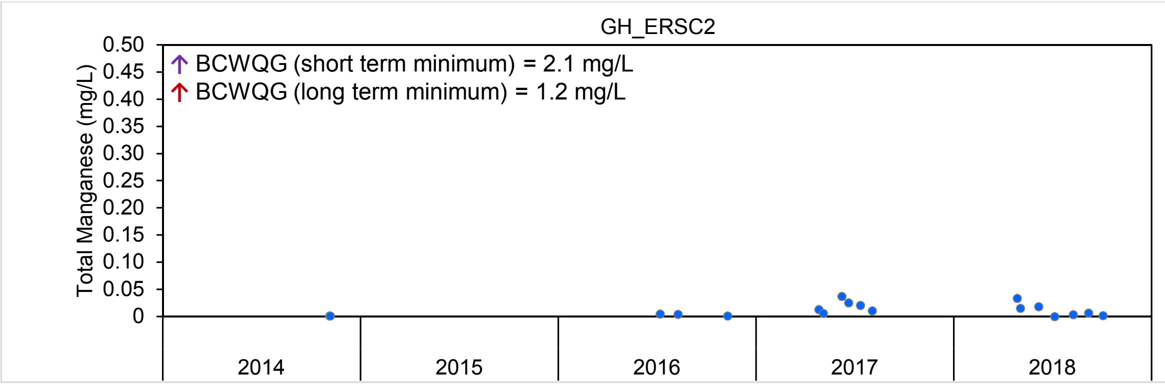


Figure C.27: Time Series Plots for Aqueous Total Manganese Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = BCWQG (short term).

= Mine-exposed; = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Water quality guidelines depend on water hardness.

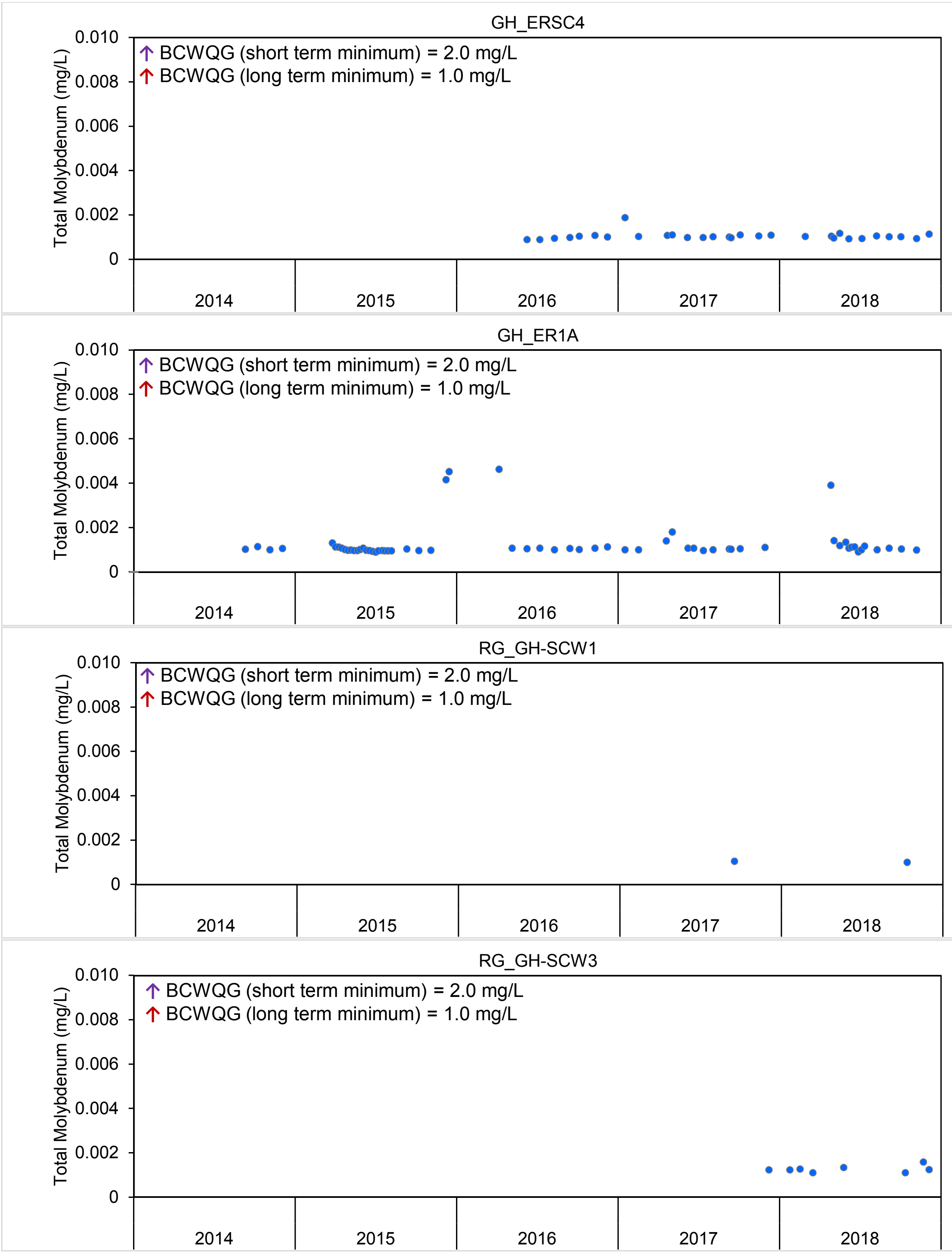


Figure C.28: Time Series Plots for Aqueous Total Molybdenum Cadmium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

— — = BCWQG (long term); — — = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

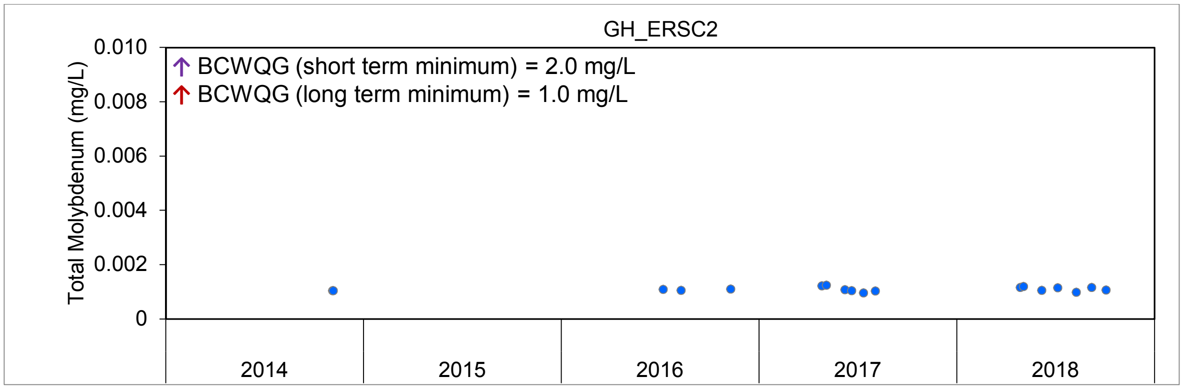


Figure C.28: Time Series Plots for Aqueous Total Molybdenum Cadmium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

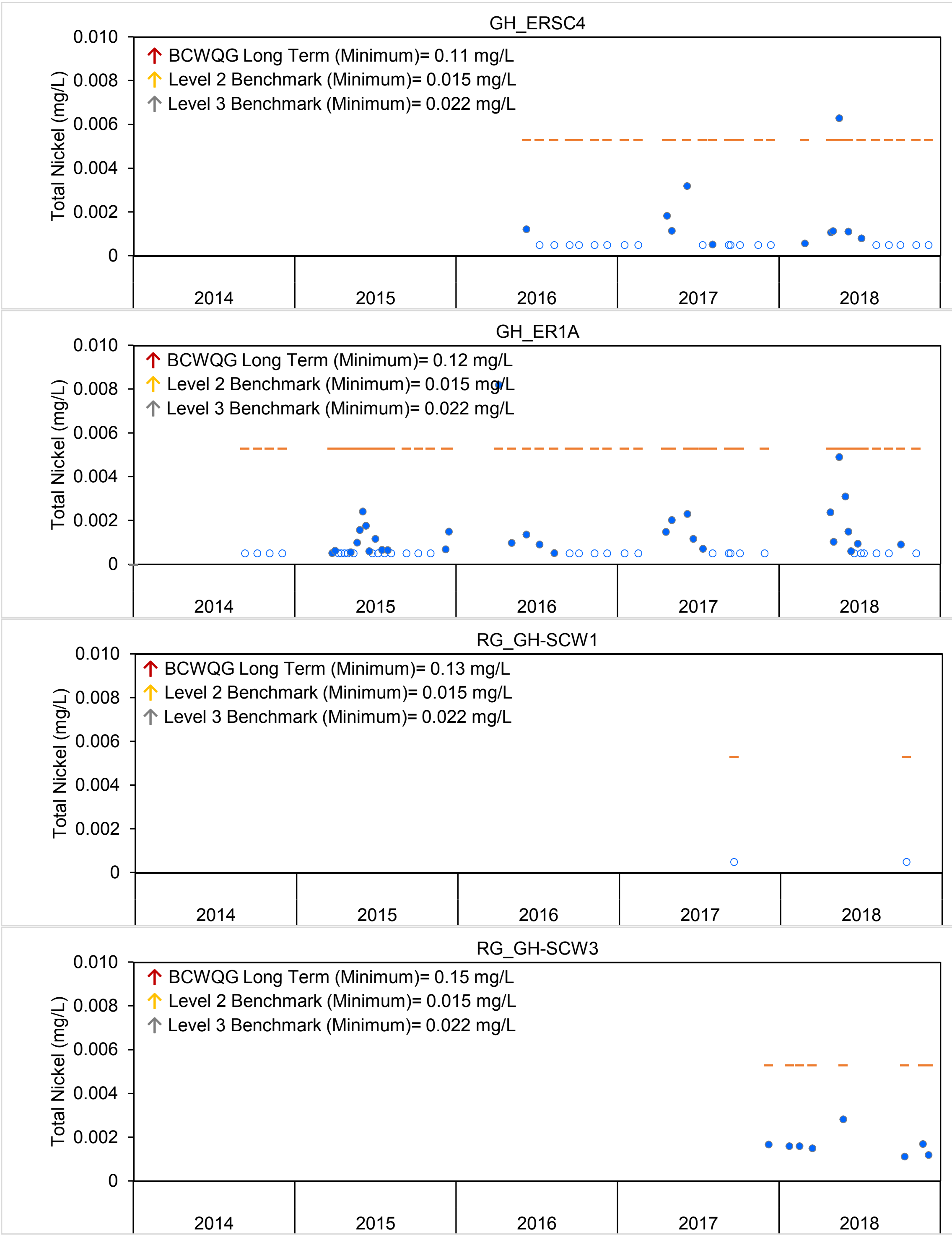


Figure C.29: Time Series Plots for Aqueous Total Nickel Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = Level 1 Benchmark; – – = Level 2 Benchmark; – – = Level 3 Benchmark.

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

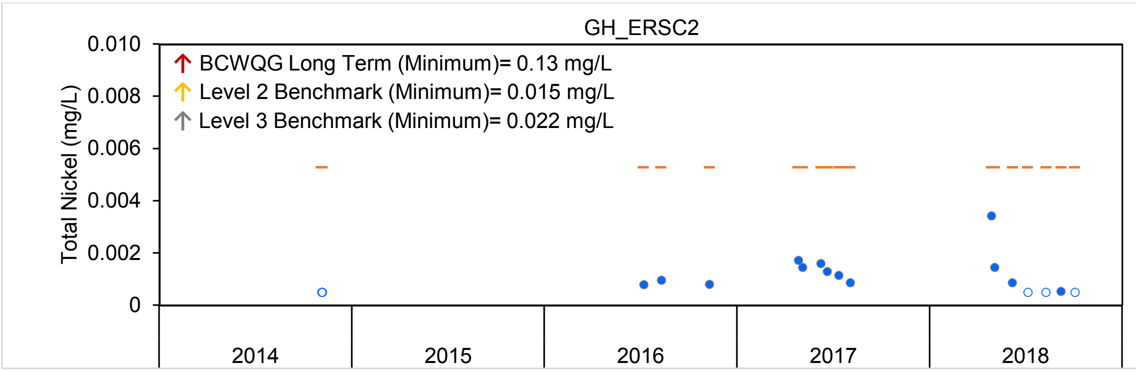


Figure C.29: Time Series Plots for Aqueous Total Nickel Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.
● = Mine-exposed; ● = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots. Some water quality guidelines depend on water hardness.

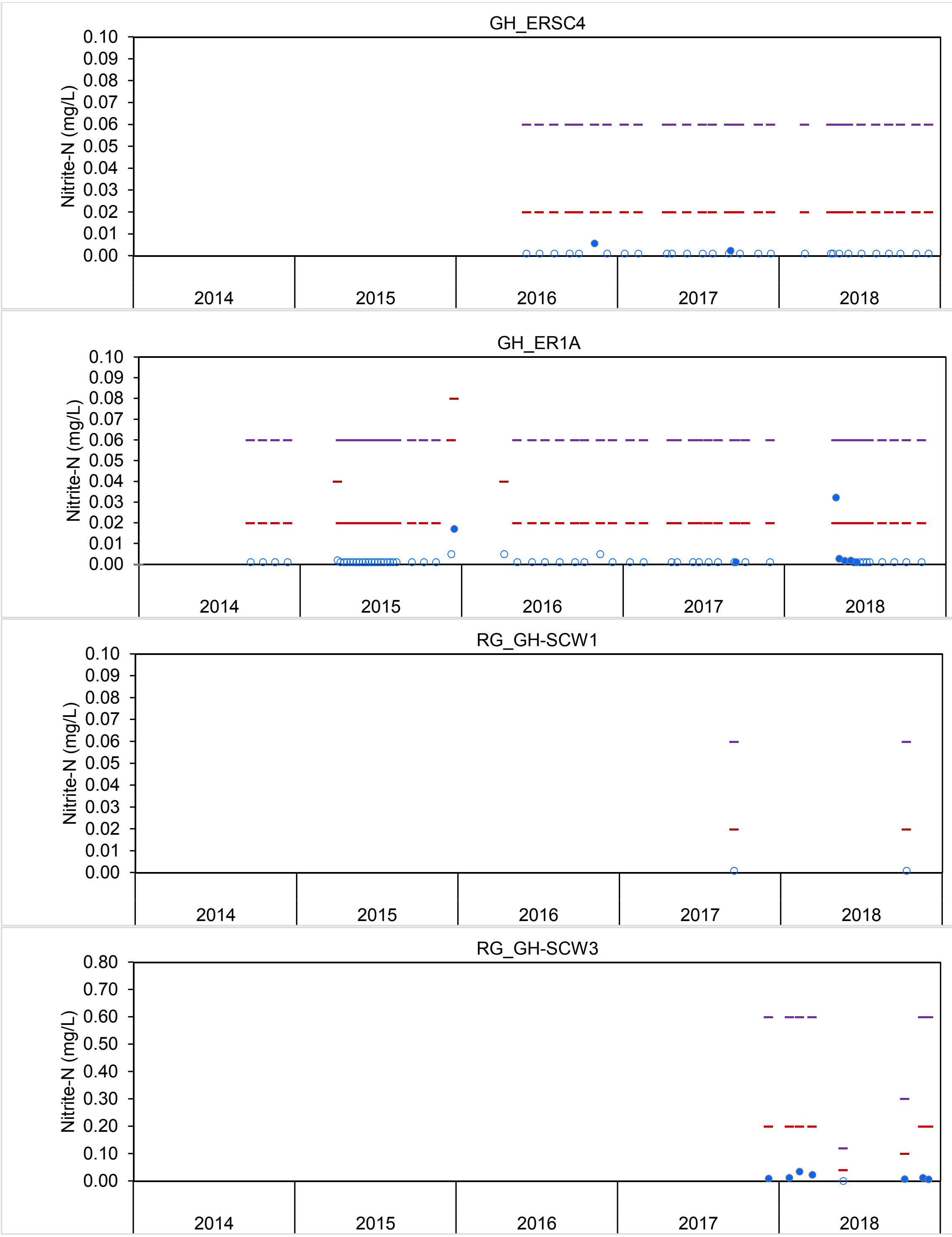


Figure C.30: Time Series Plots for Aqueous Nitrite-N Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Water quality guidelines depend on aqueous chloride concentrations.

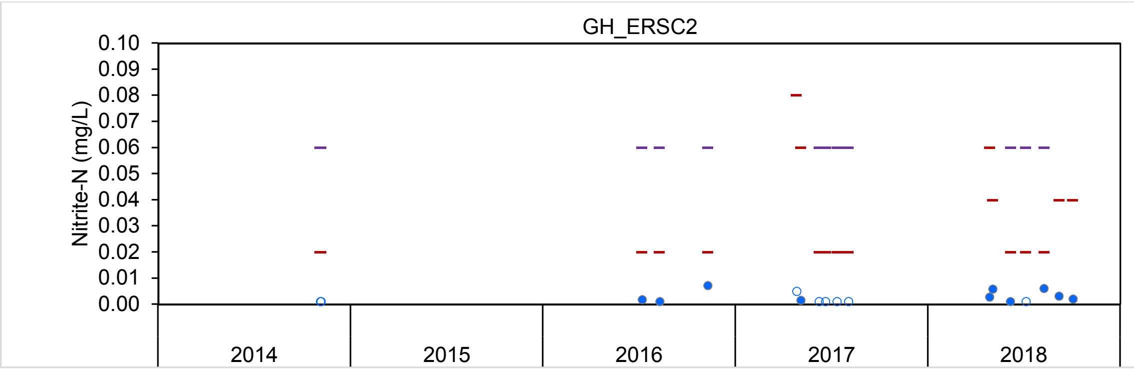


Figure C.30: Time Series Plots for Aqueous Nitrite-N Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Water quality guidelines depend on aqueous chloride concentrations.

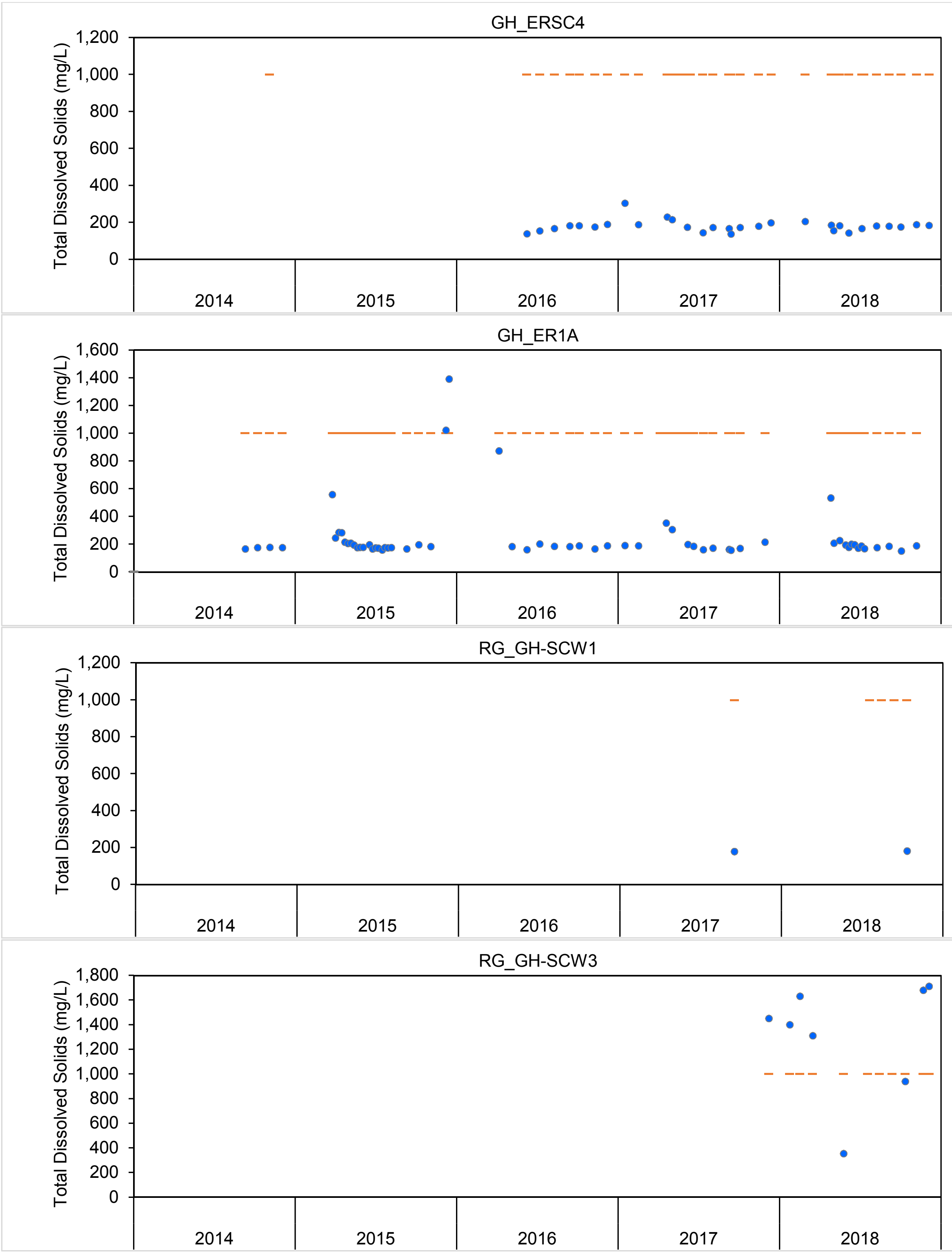


Figure C.31: Time Series Plots for Total Dissolved Solids Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

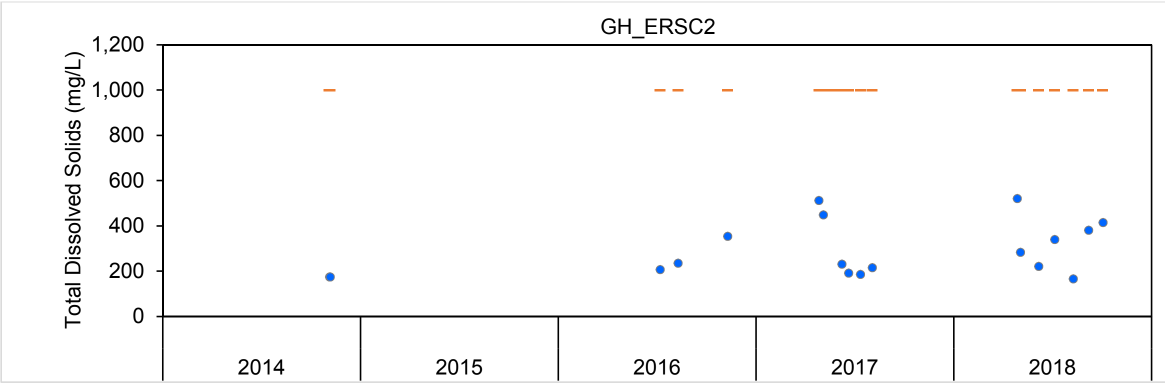


Figure C.31: Time Series Plots for Total Dissolved Solids Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = Level 1 Benchmark.

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

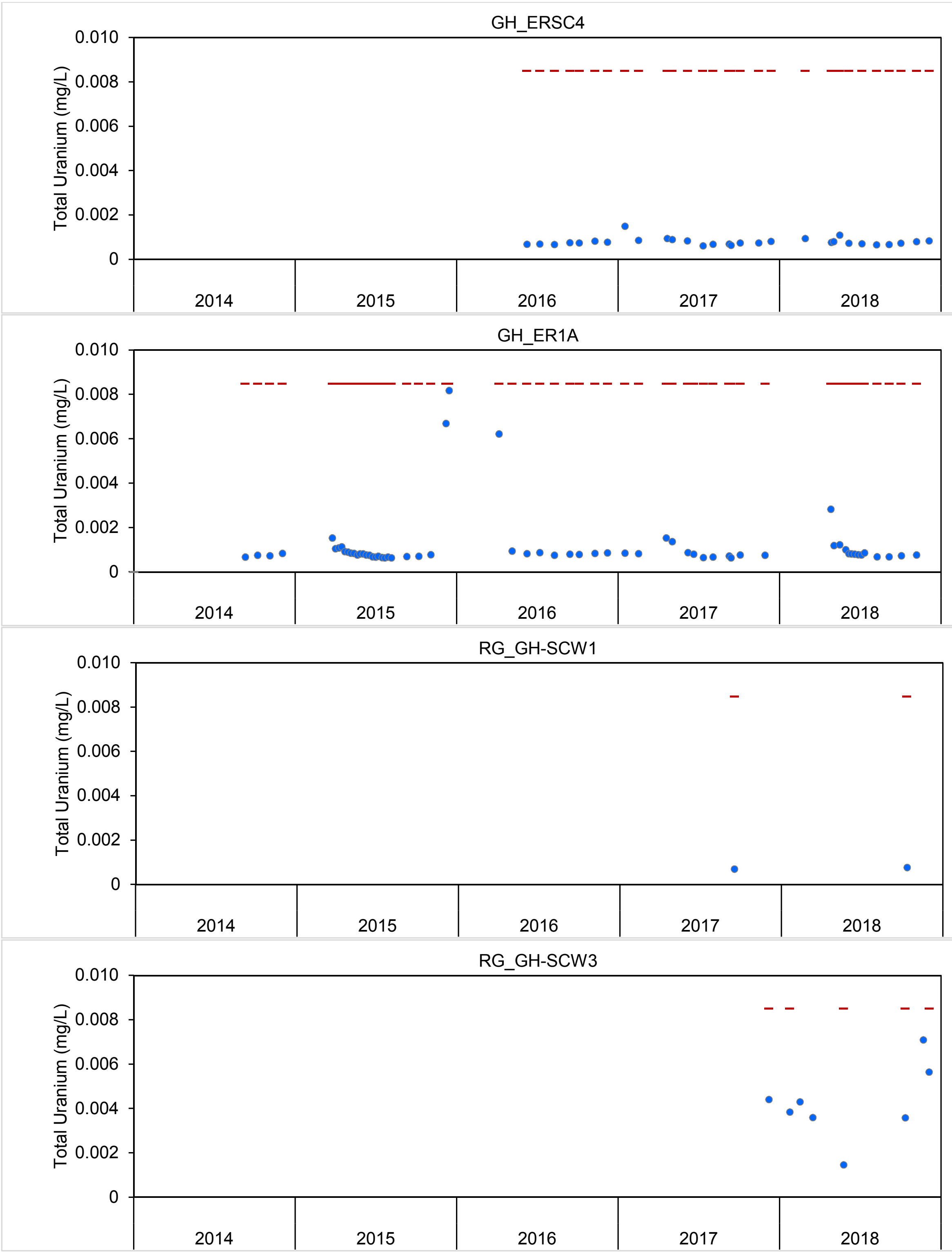


Figure C.32: Time Series Plots for Aqueous Total Uranium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term)

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

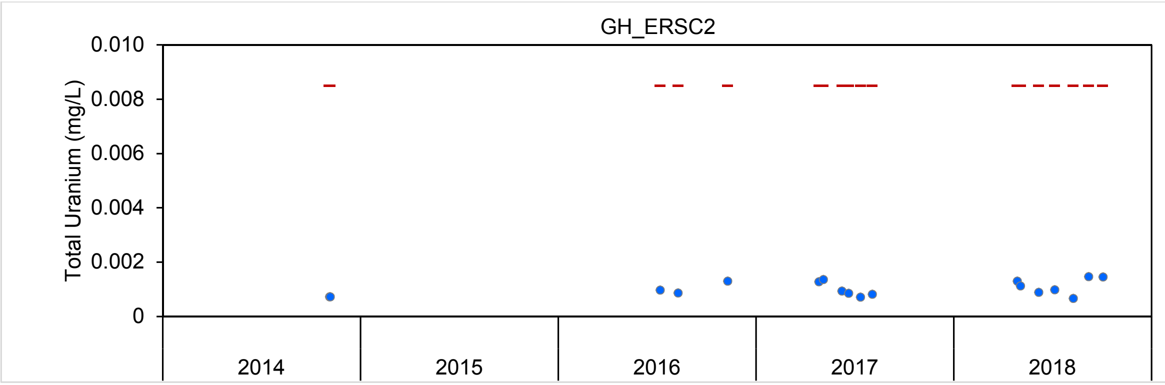


Figure C.32: Time Series Plots for Aqueous Total Uranium Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term)

● = Mine-exposed; ● = Reference.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

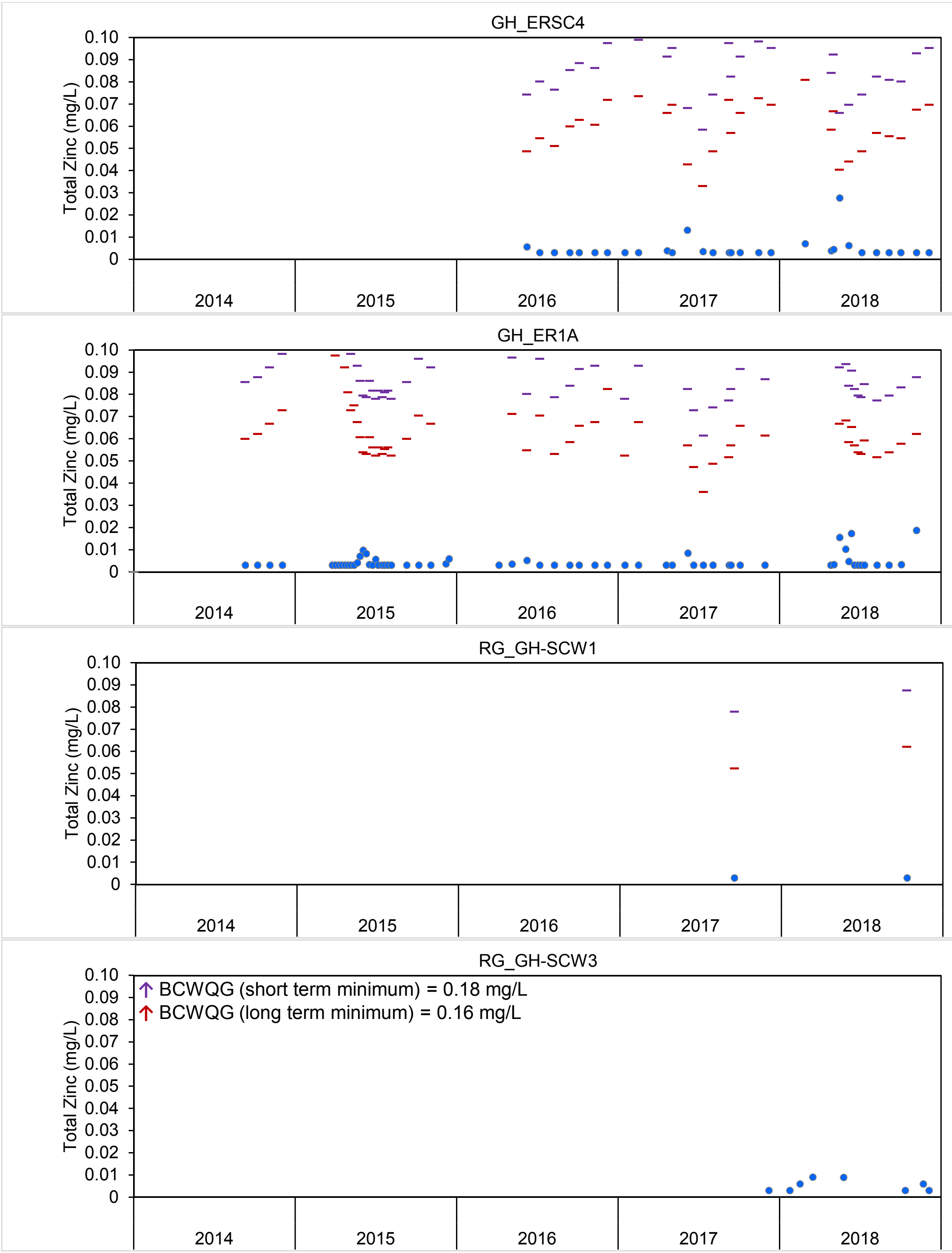


Figure C.32: Time Series Plots for Aqueous Total Zinc Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Water quality guidelines depend on water hardness.

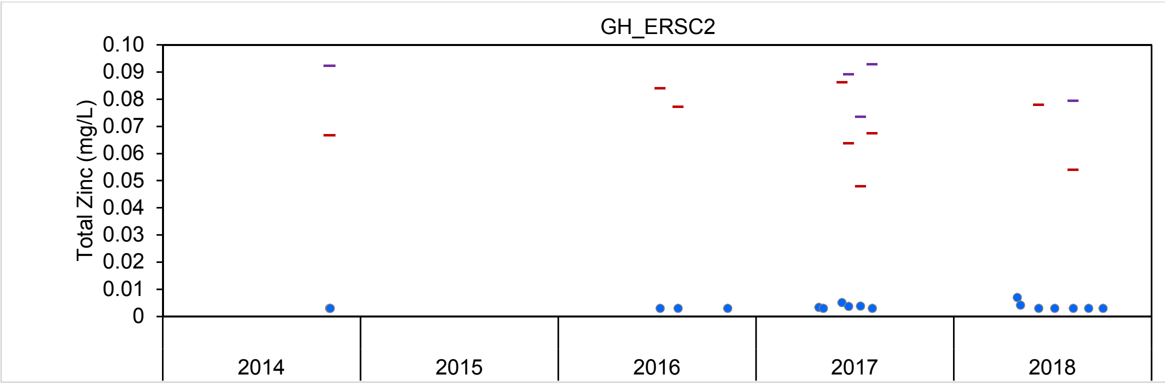


Figure C.32: Time Series Plots for Aqueous Total Zinc Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).
● = Mine-exposed; ● = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Water quality guidelines depend on water hardness.

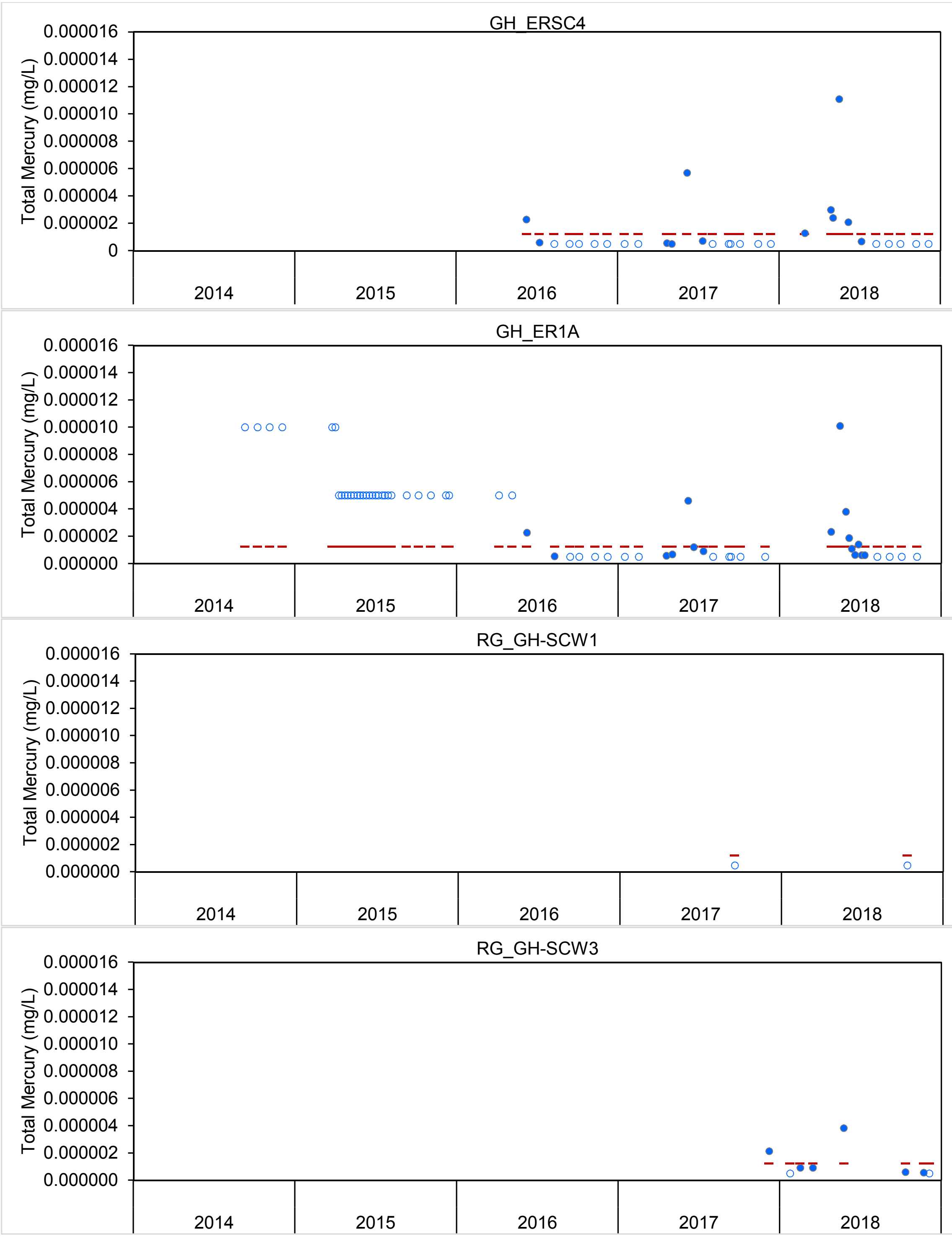


Figure C.18: Time Series Plots for Aqueous Total Mercury Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).

● = Mine-exposed; ● = Reference.

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

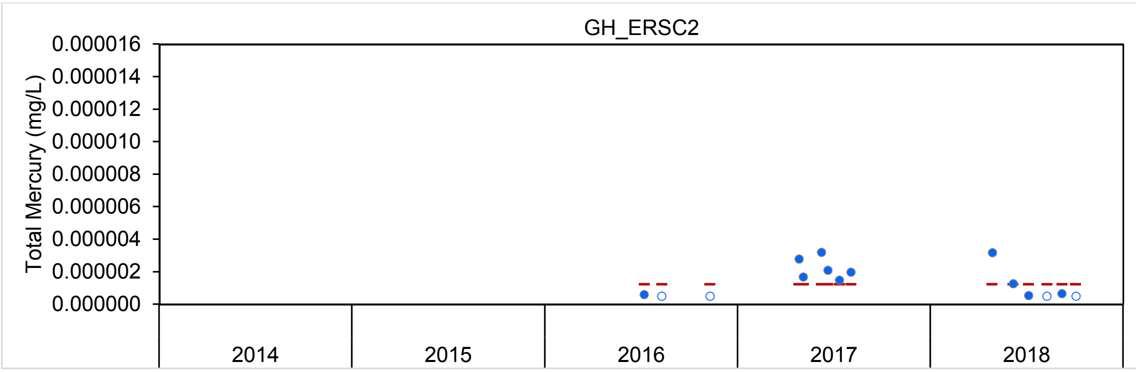


Figure C.18: Time Series Plots for Aqueous Total Mercury Concentrations from the Elk River Side Channel Monitoring Stations, 2014 to 2018

– – = BCWQG (long term).
● = Mine-exposed; ● = Reference.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Maximum Y-axis values differ between some plots.

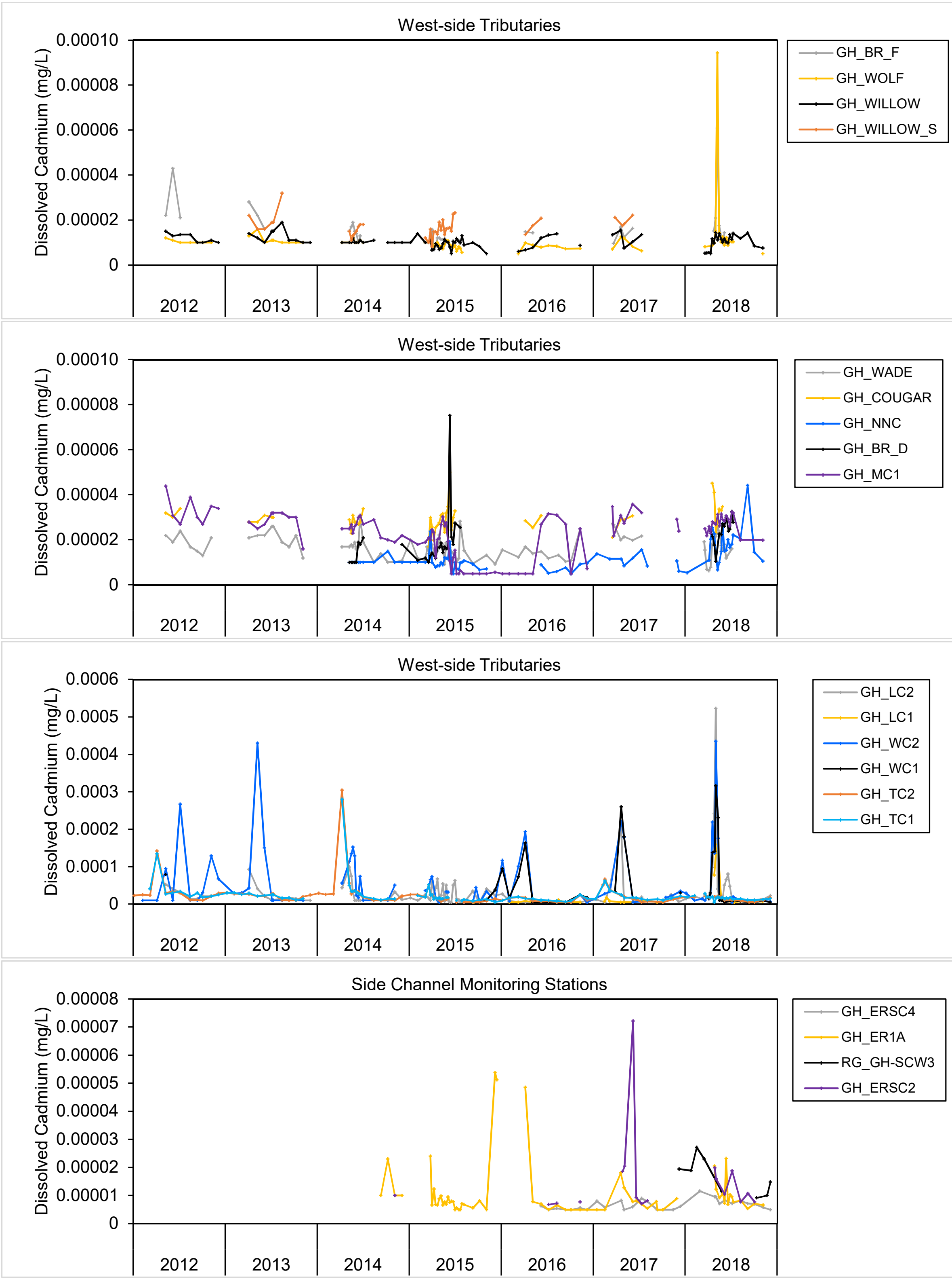


Figure C.35: Times Series Plots for Aqueous Dissolved Cadmium from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.000005 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

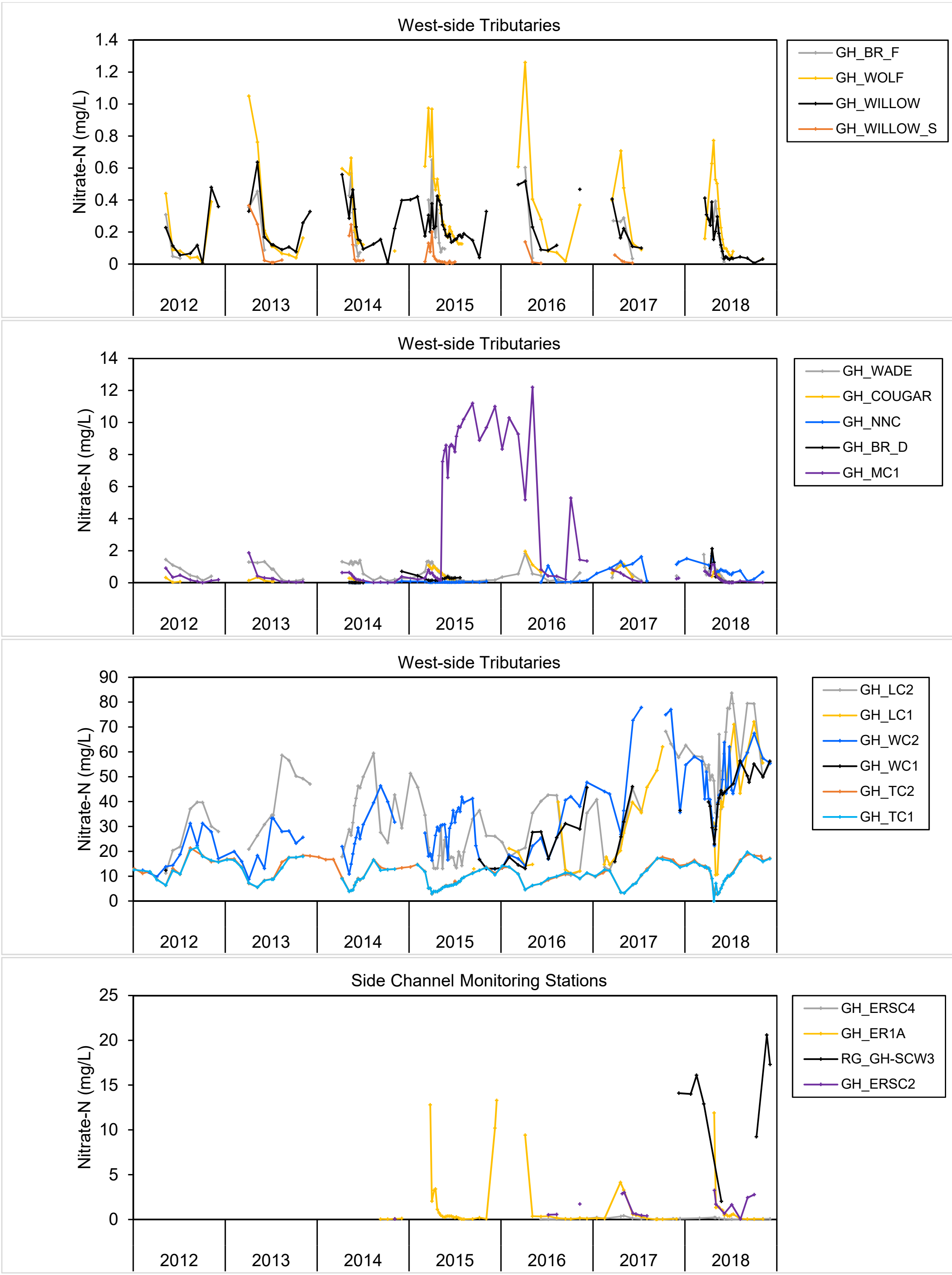


Figure C.36: Times Series Plots for Aqueous Nitrate-N from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.005 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

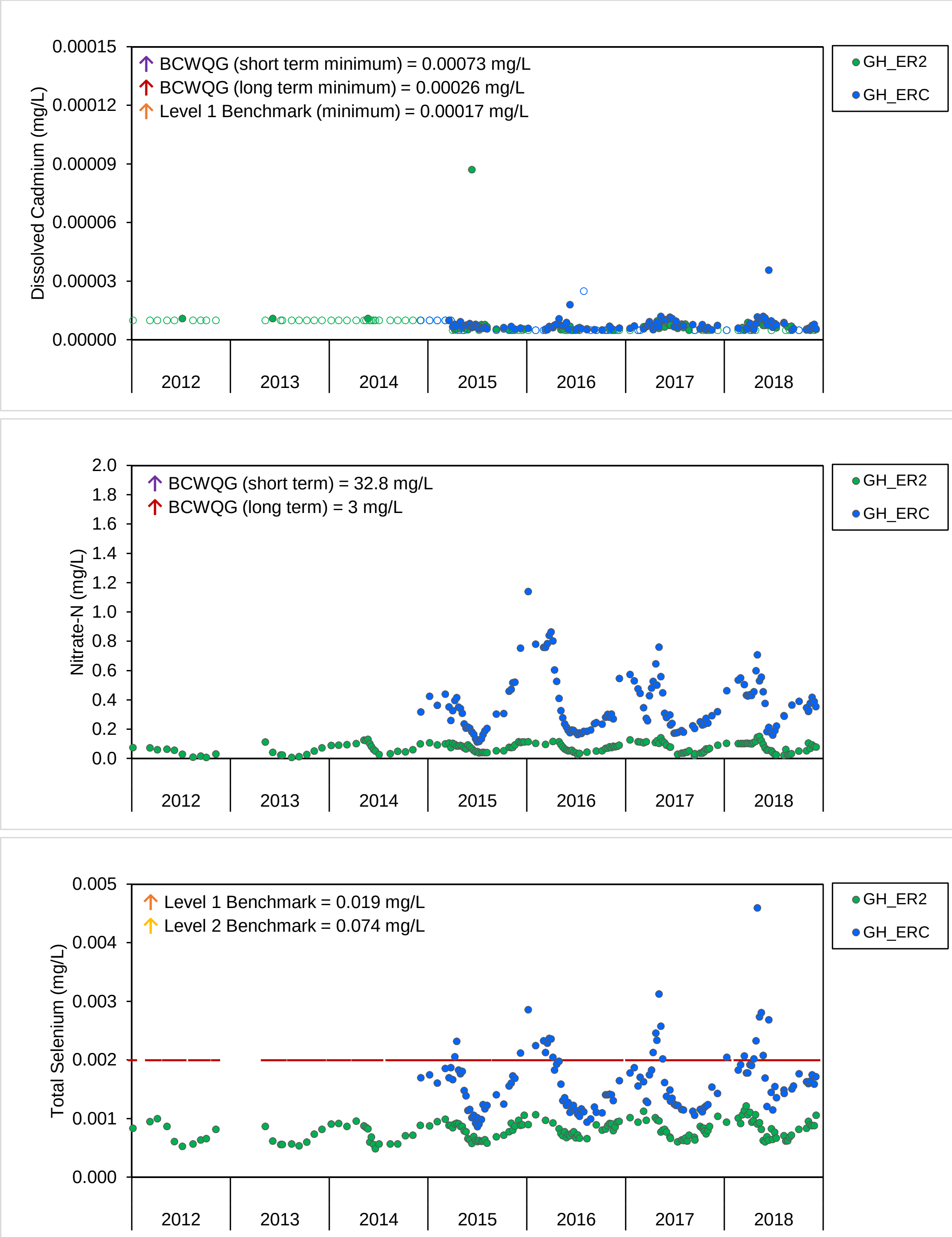


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

= BCWQG (long term); = BCWQG (short term); = Level 1 Benchmark; = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines for cadmium are dependent on water hardness.

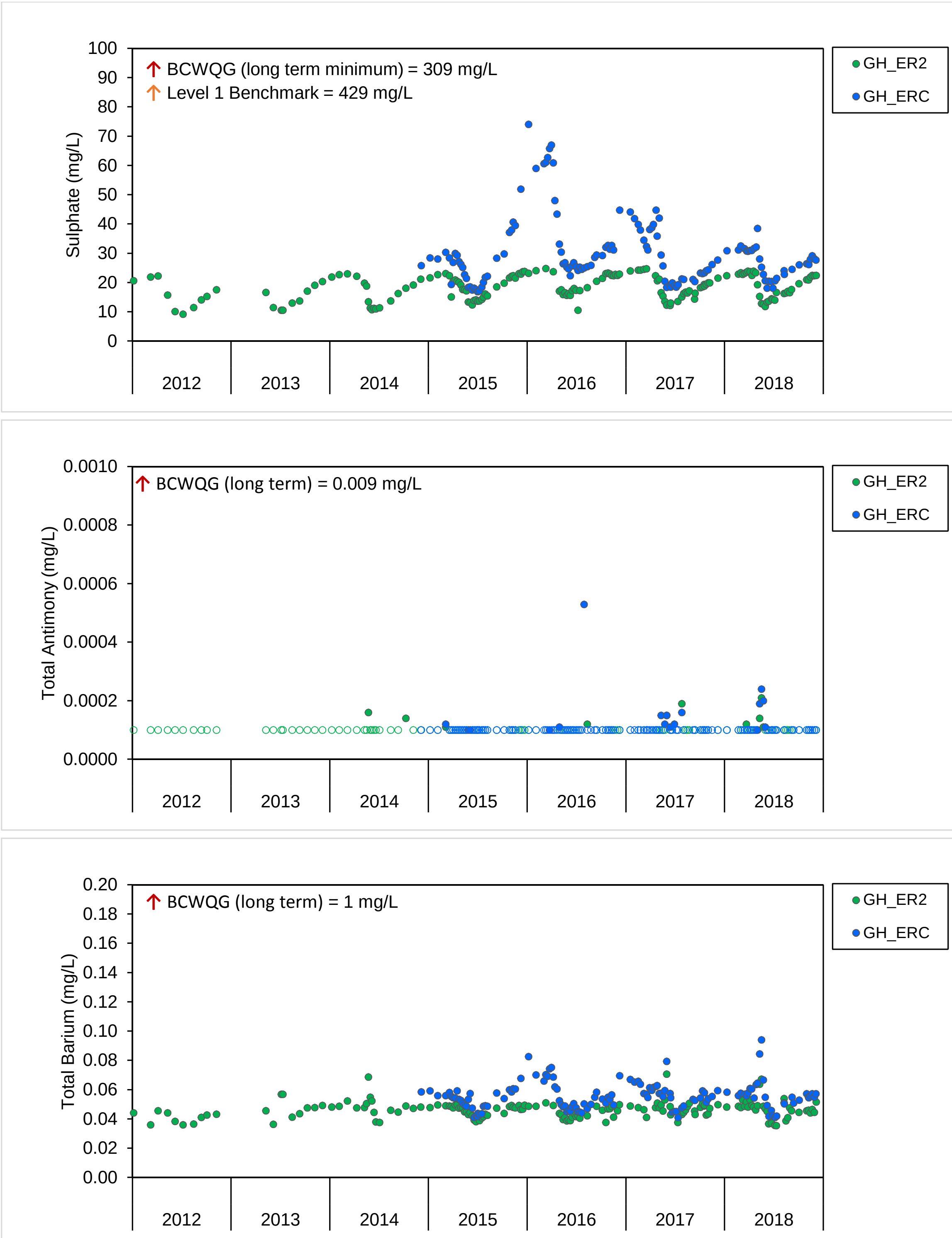


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

= BCWQG (long term); = BCWQG (short term); = Level 1 Benchmark; = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines for sulphate are dependent on water hardness.

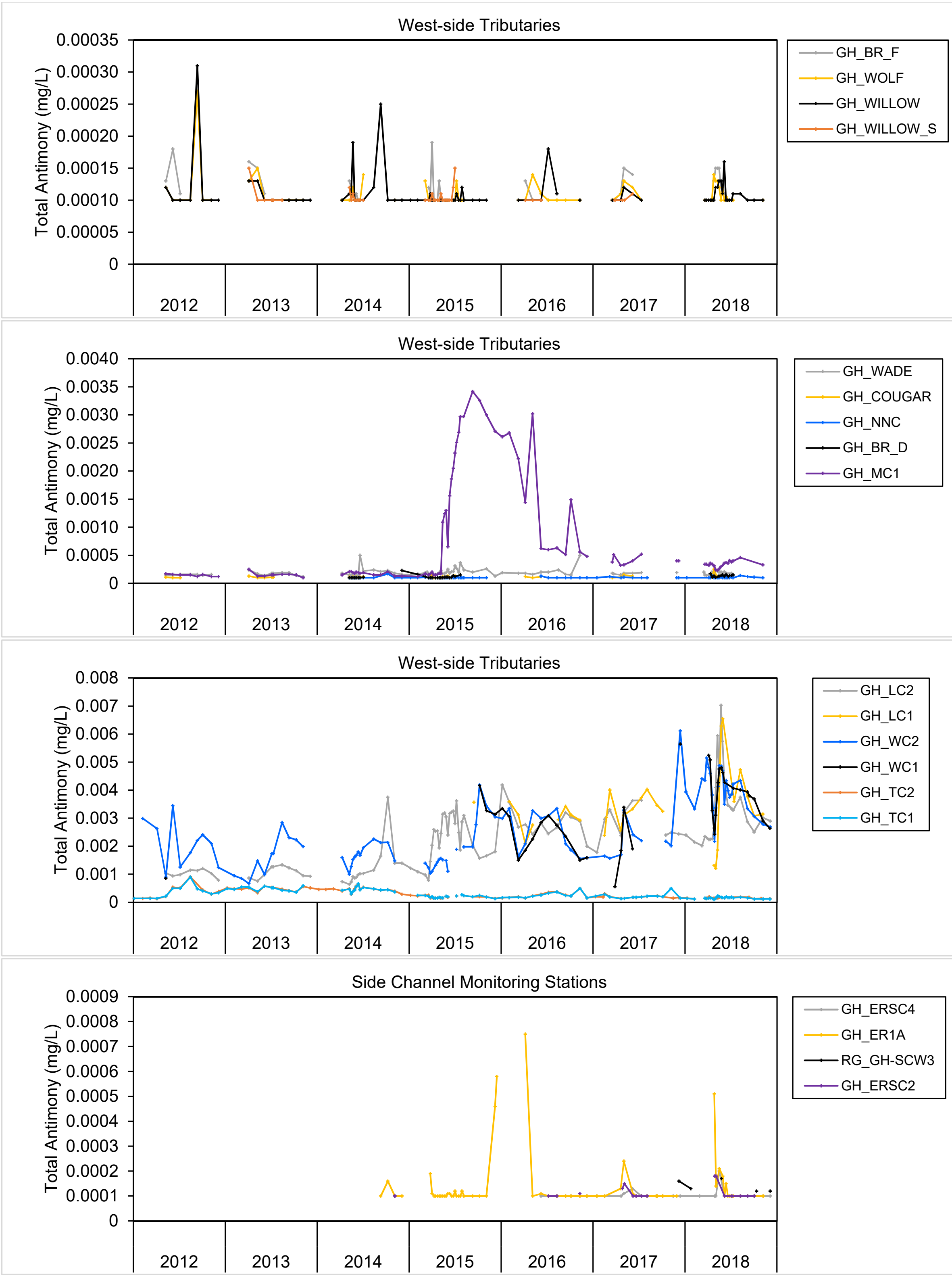


Figure C.37: Times Series Plots for Aqueous Total Antimony from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.0001 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

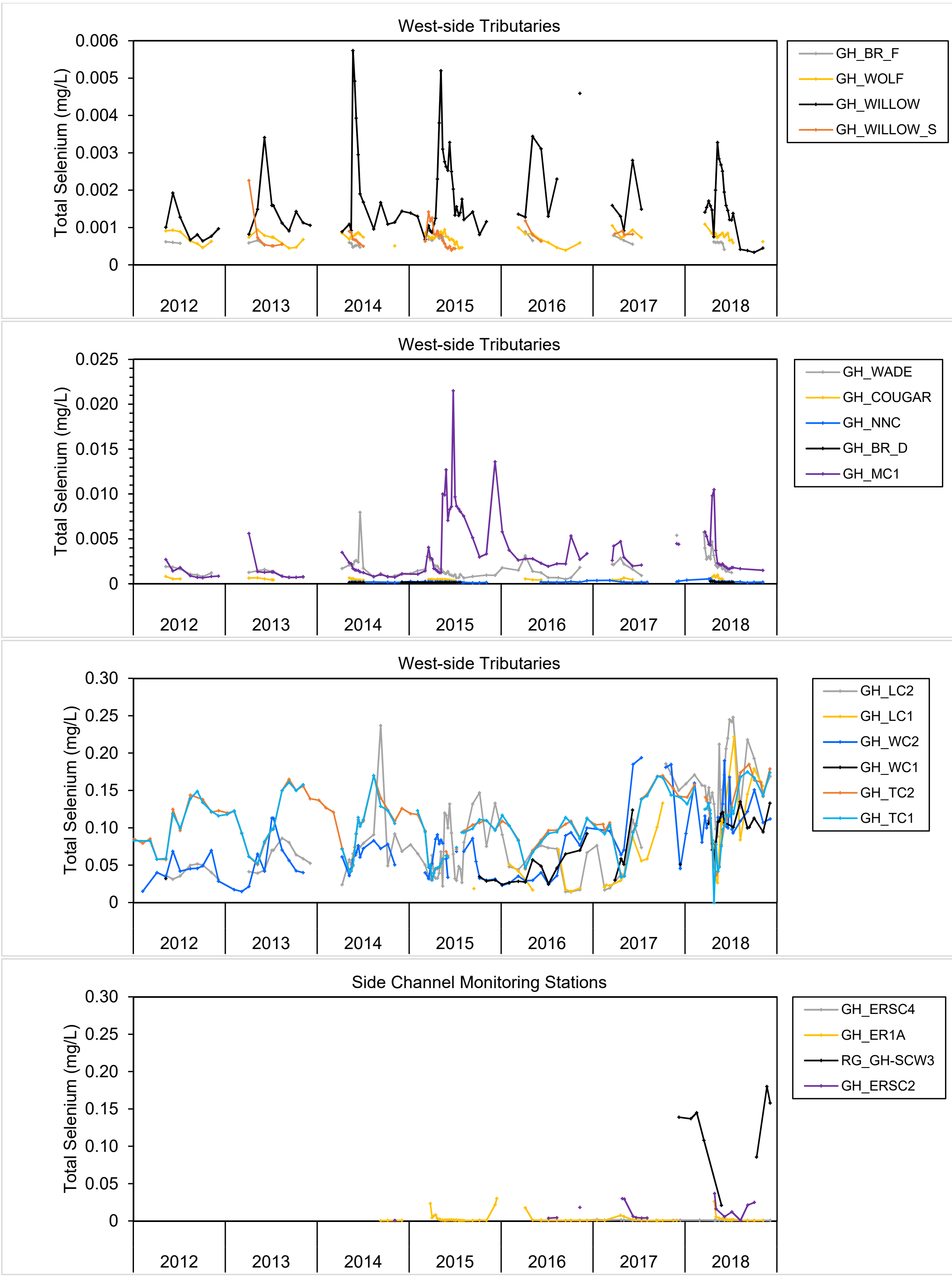


Figure C.38: Times Series Plots for Aqueous Total Selenium from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

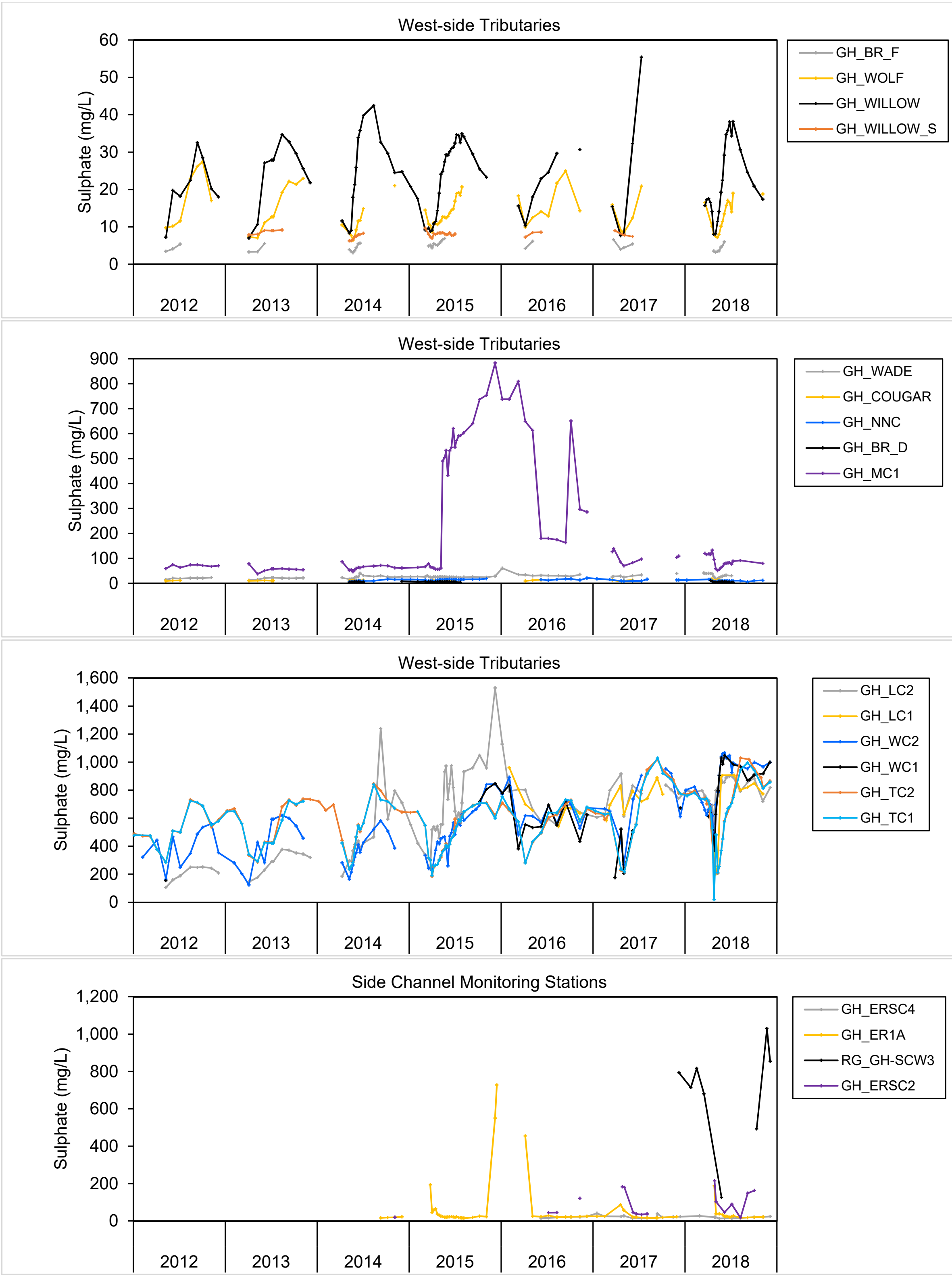


Figure C.39: Times Series Plots for Aqueous Sulphate from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

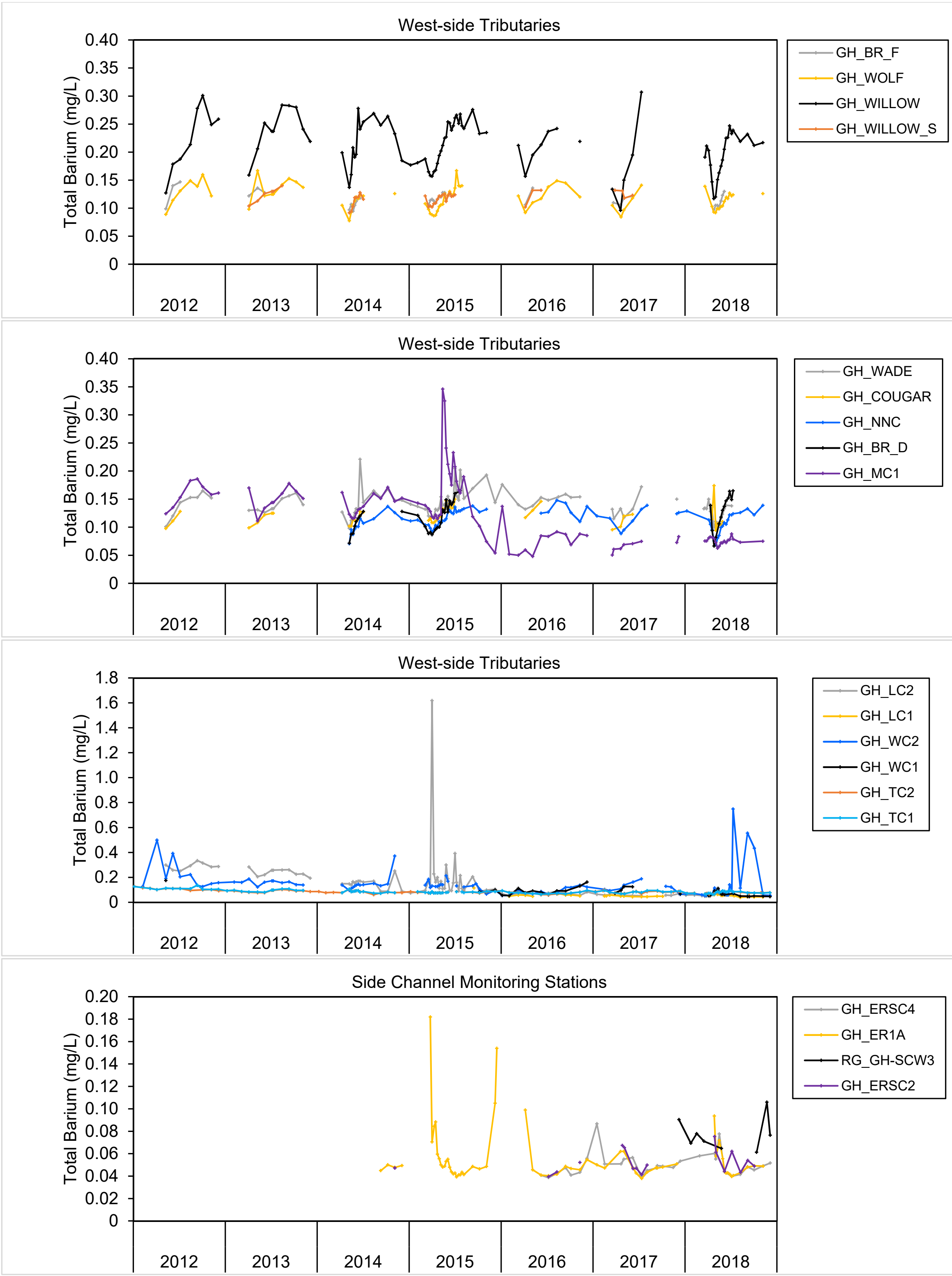


Figure C.40: Times Series Plots for Aqueous Total Barium from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

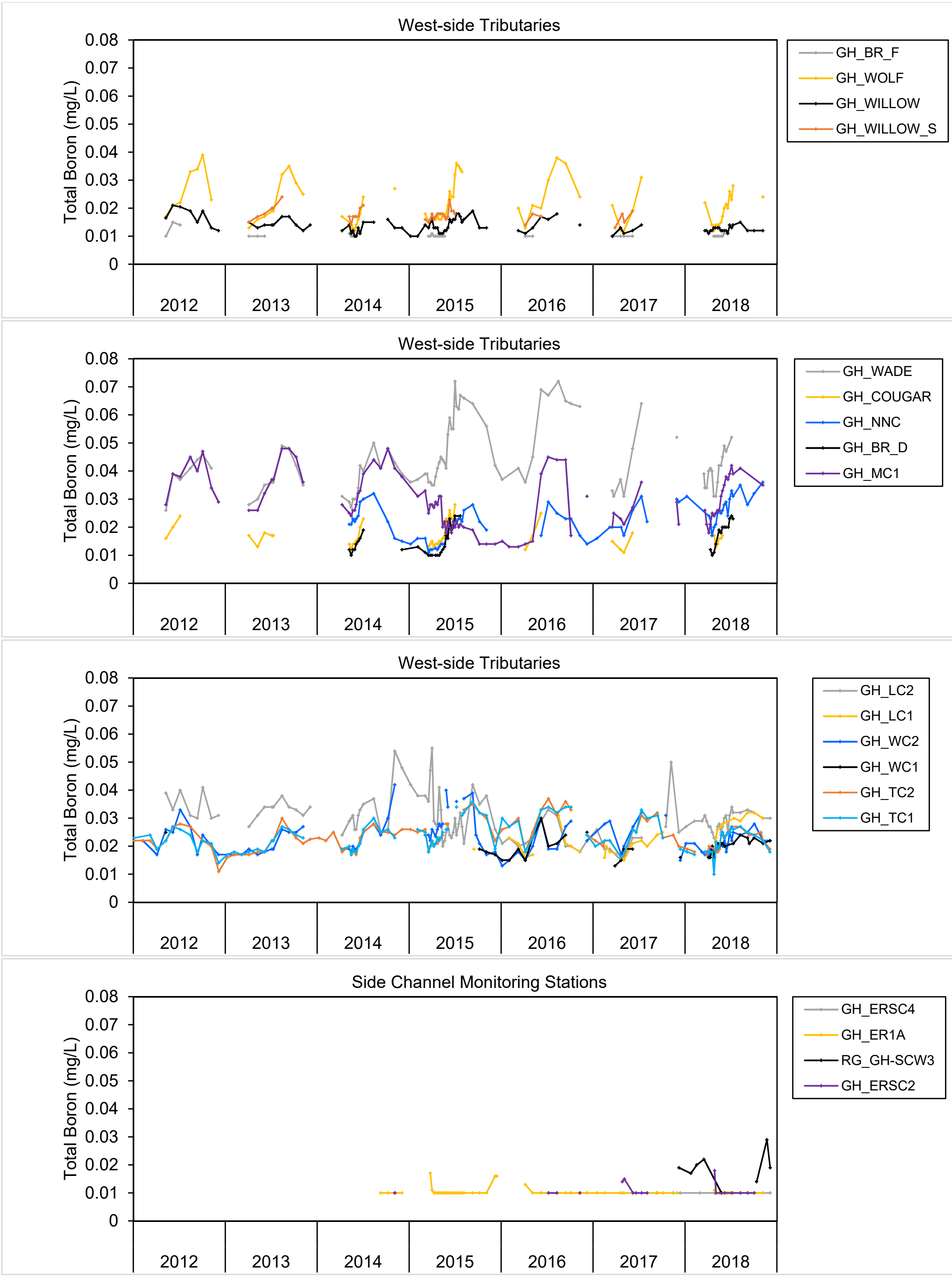


Figure C.41: Times Series Plots for Aqueous Total Boron from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.01 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

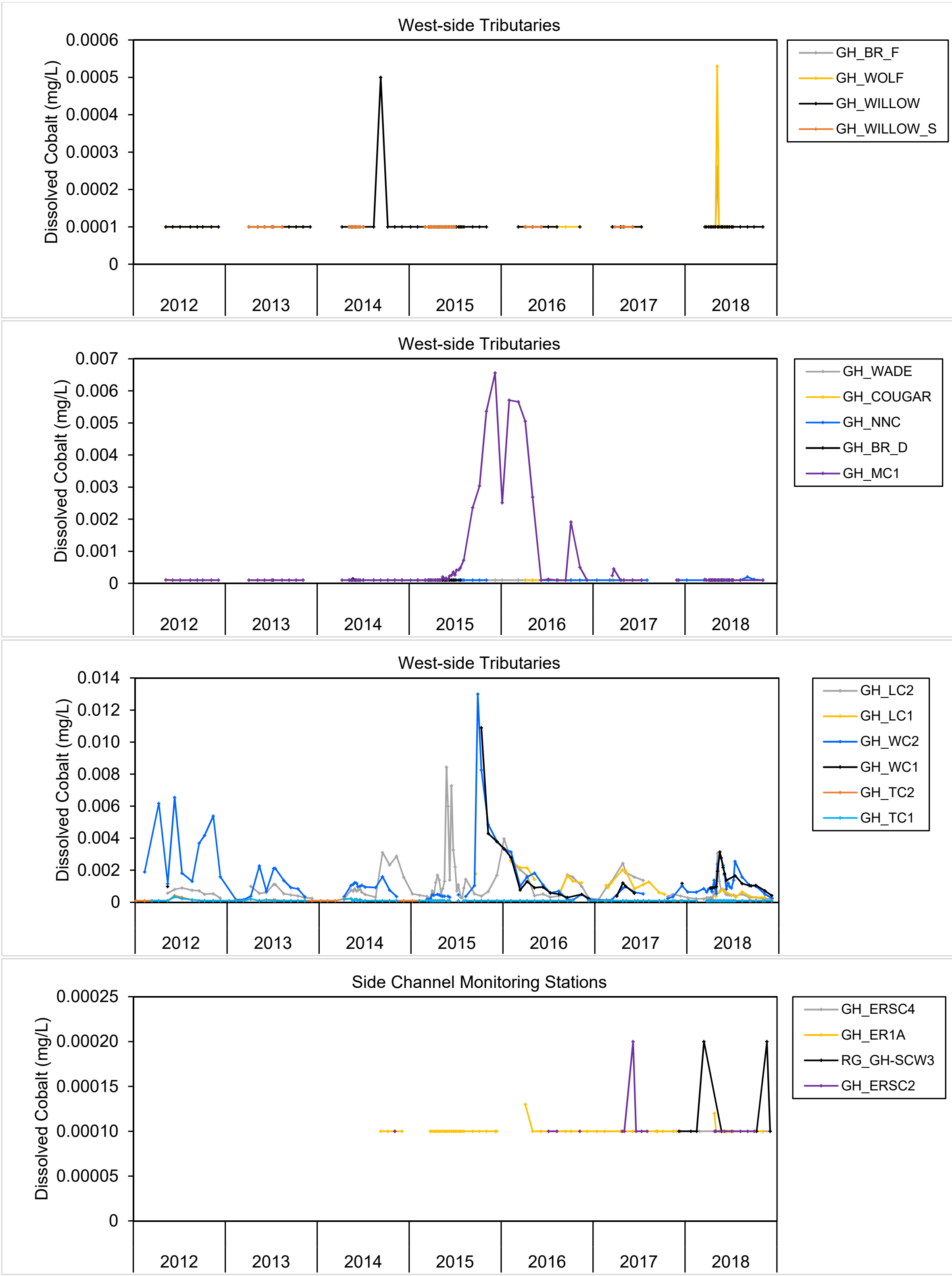


Figure C.42: Times Series Plots for Aqueous Dissolved Cobalt from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.0001 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

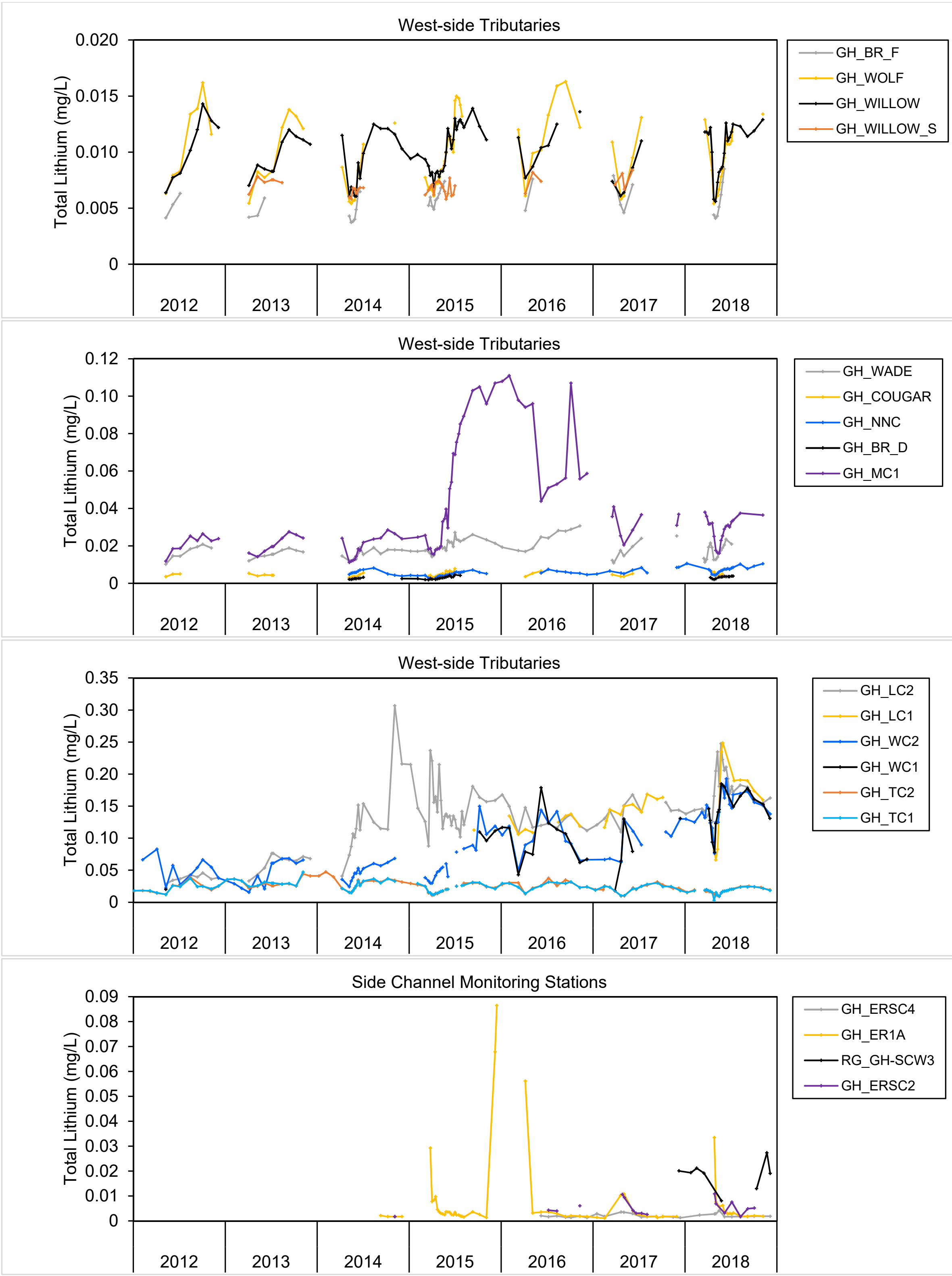


Figure C.43: Times Series Plots for Aqueous Total Lithium from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.001 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

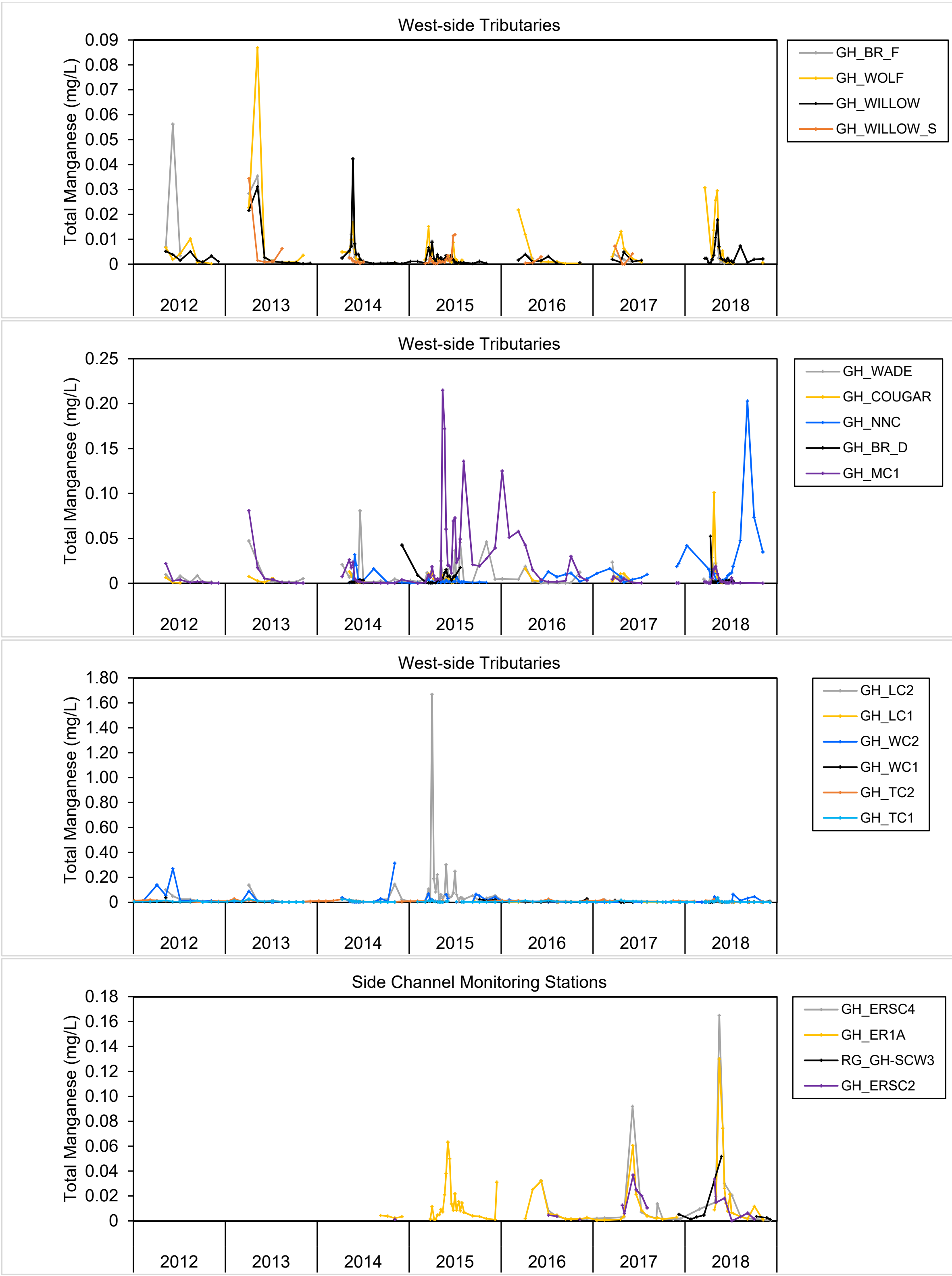


Figure C.44: Times Series Plots for Aqueous Total Manganese from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.0001 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

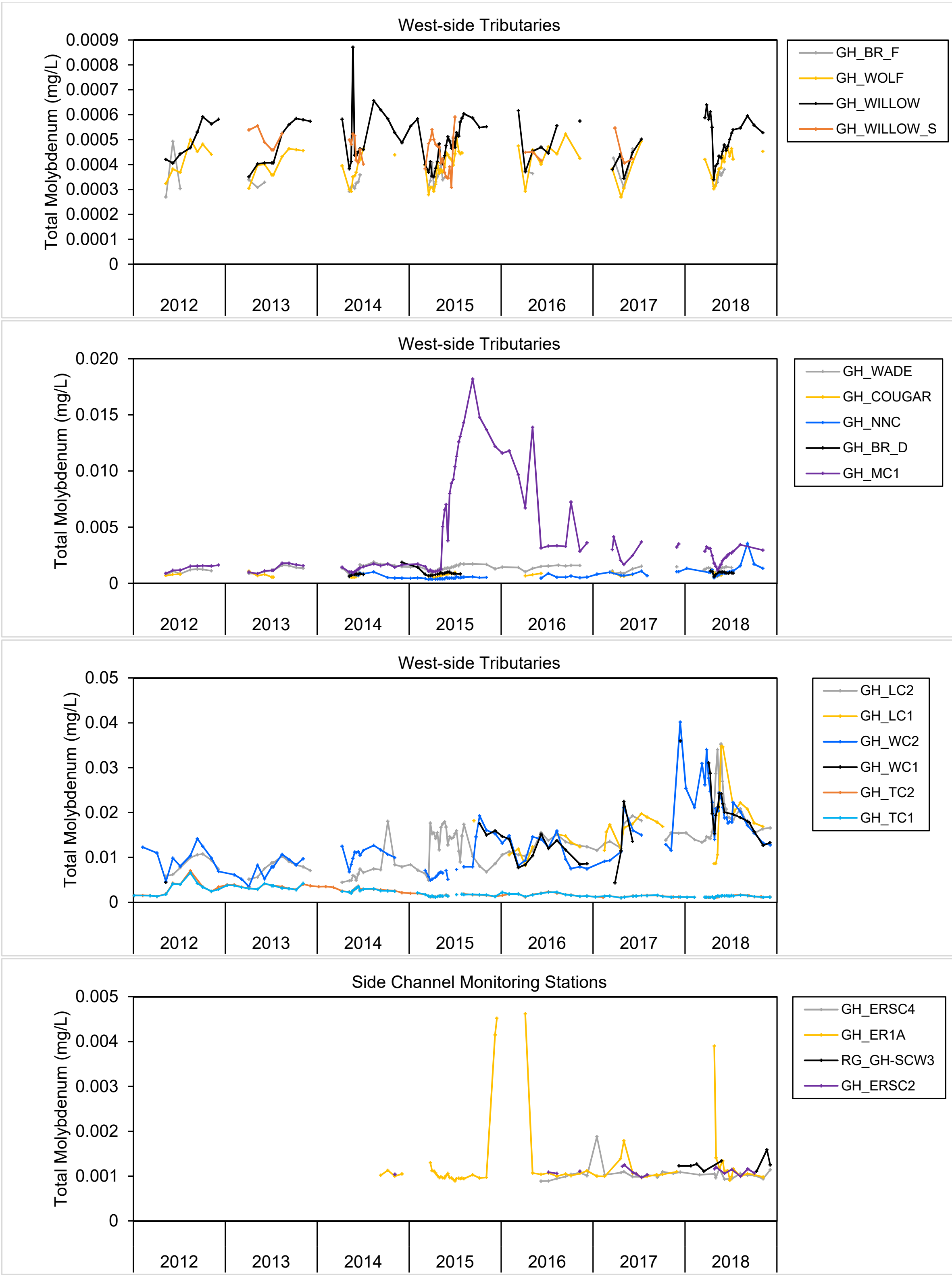


Figure C.45: Times Series Plots for Aqueous Total Molybdenum from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

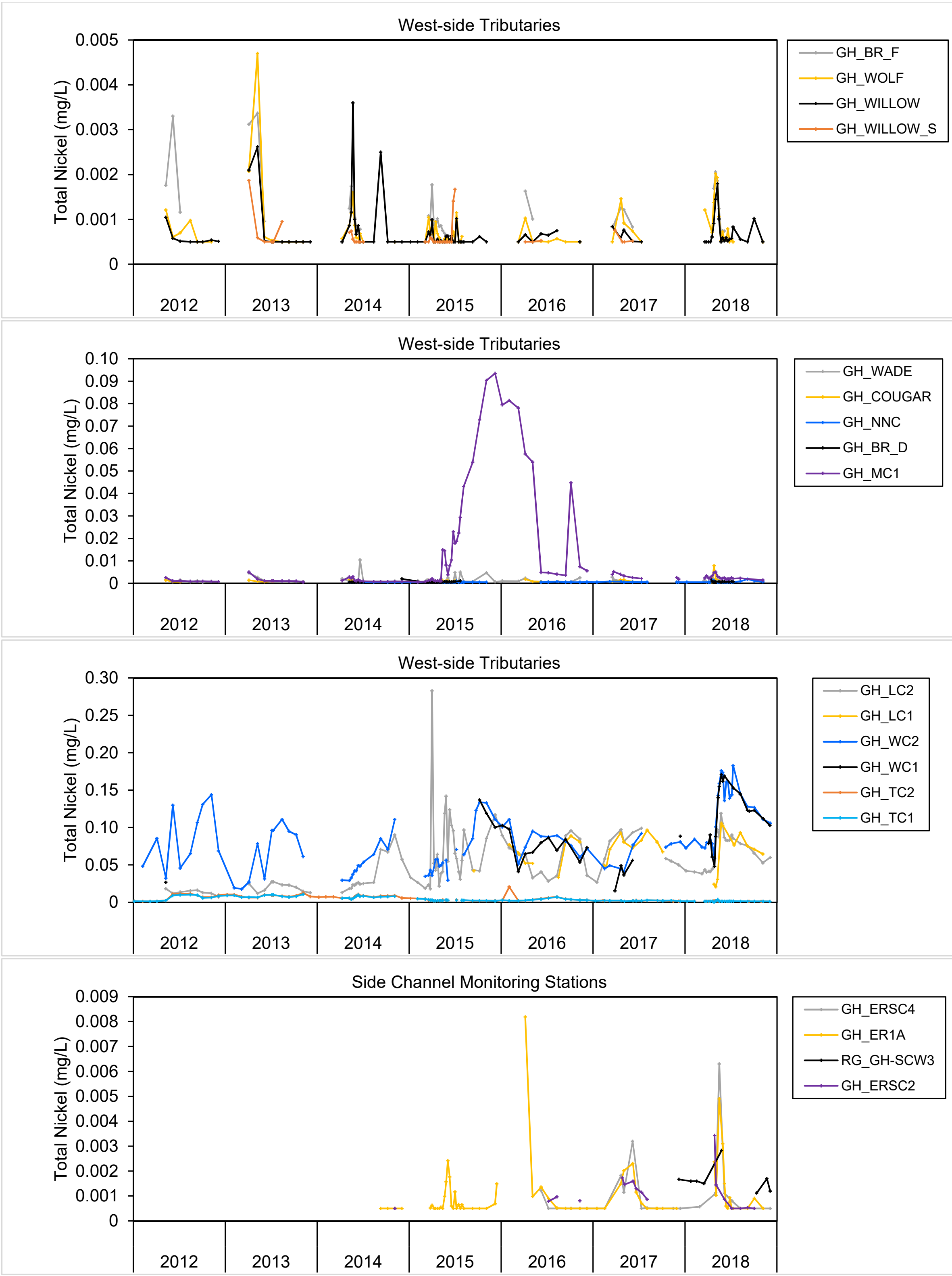


Figure C.46: Times Series Plots for Aqueous Total Nickel from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.0005 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

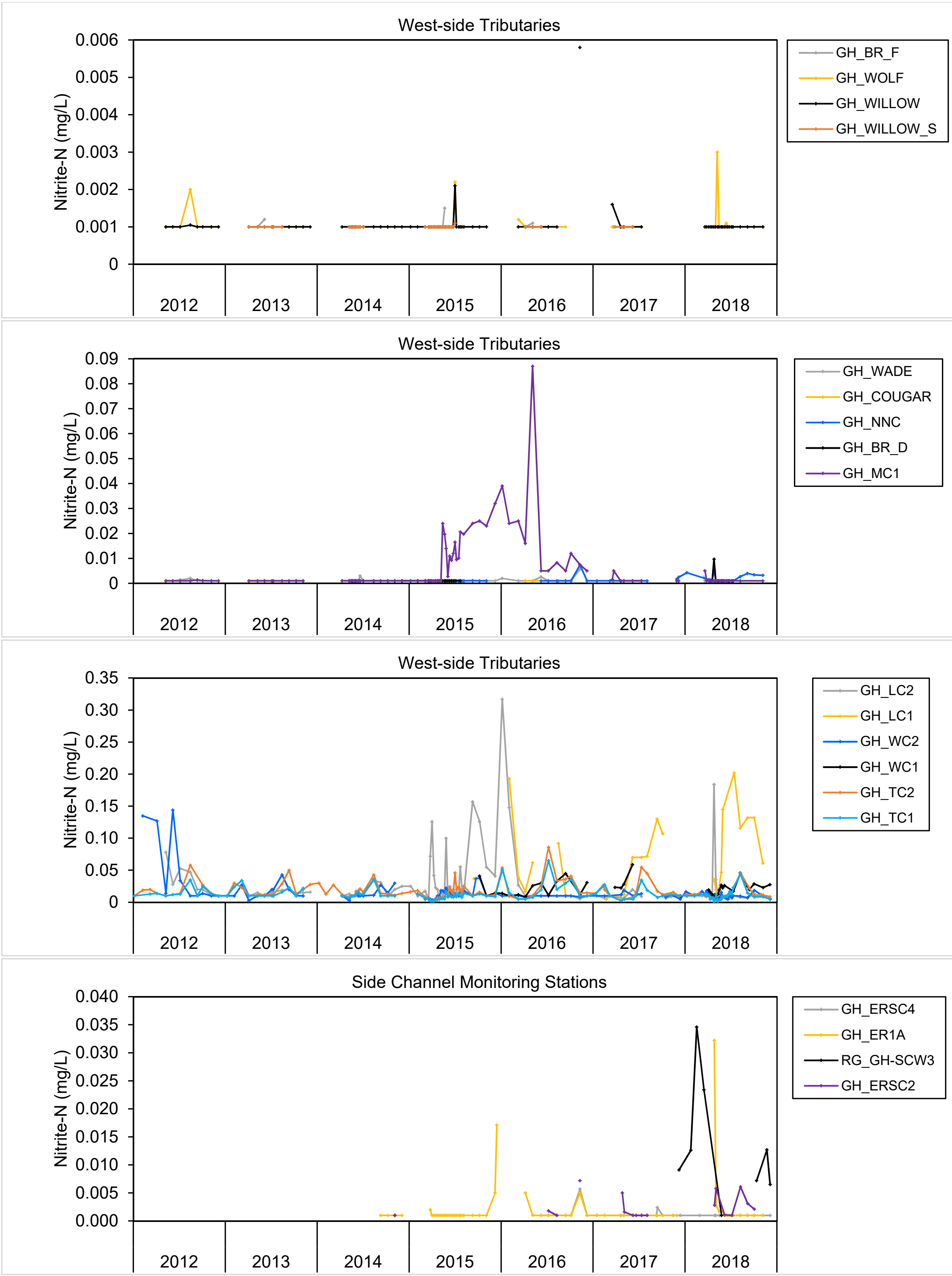


Figure C.47: Times Series Plots for Aqueous Nitrite-N from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.001 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

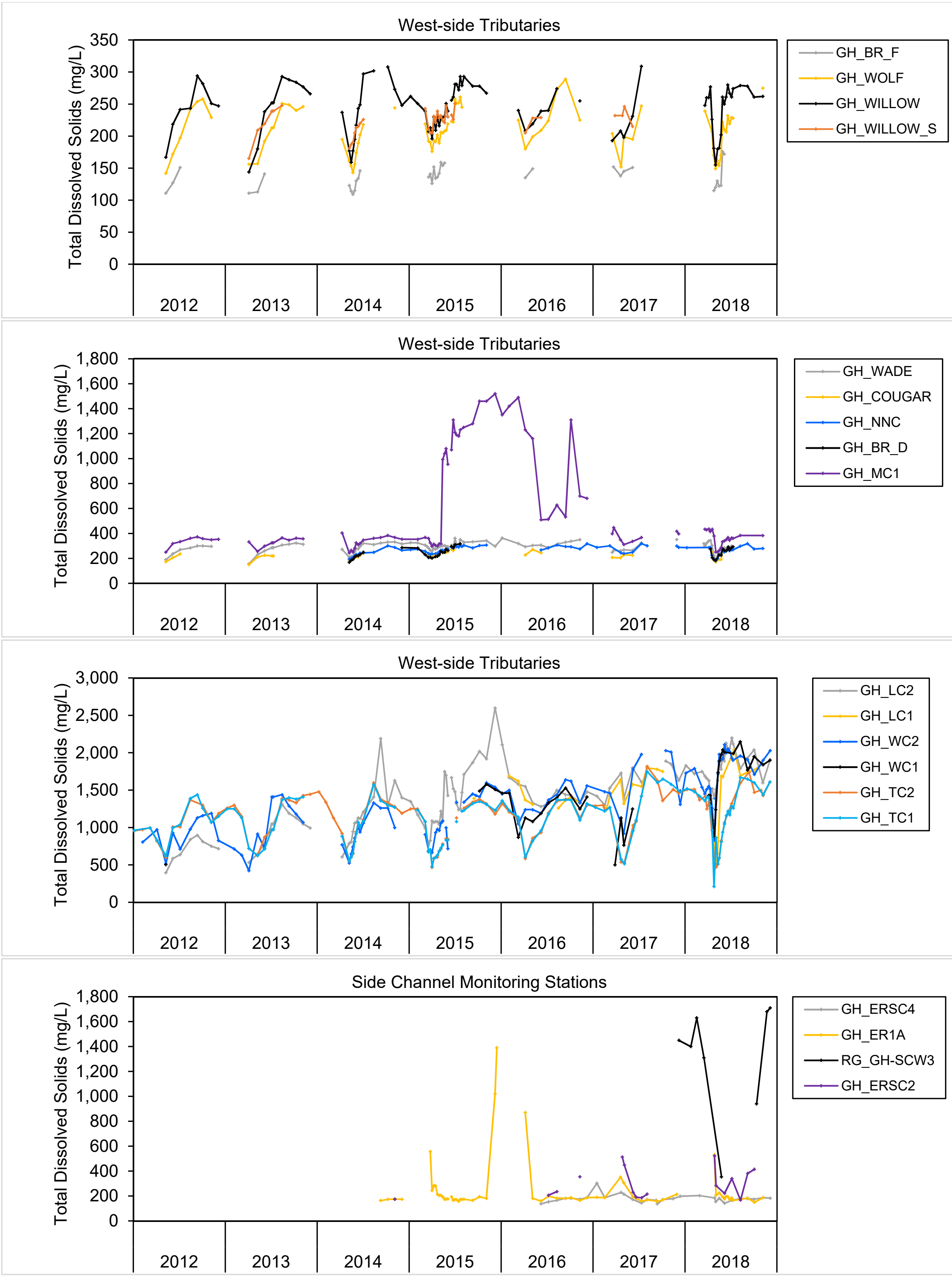


Figure C.48: Times Series Plots for Aqueous Total Dissolved Soilds from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

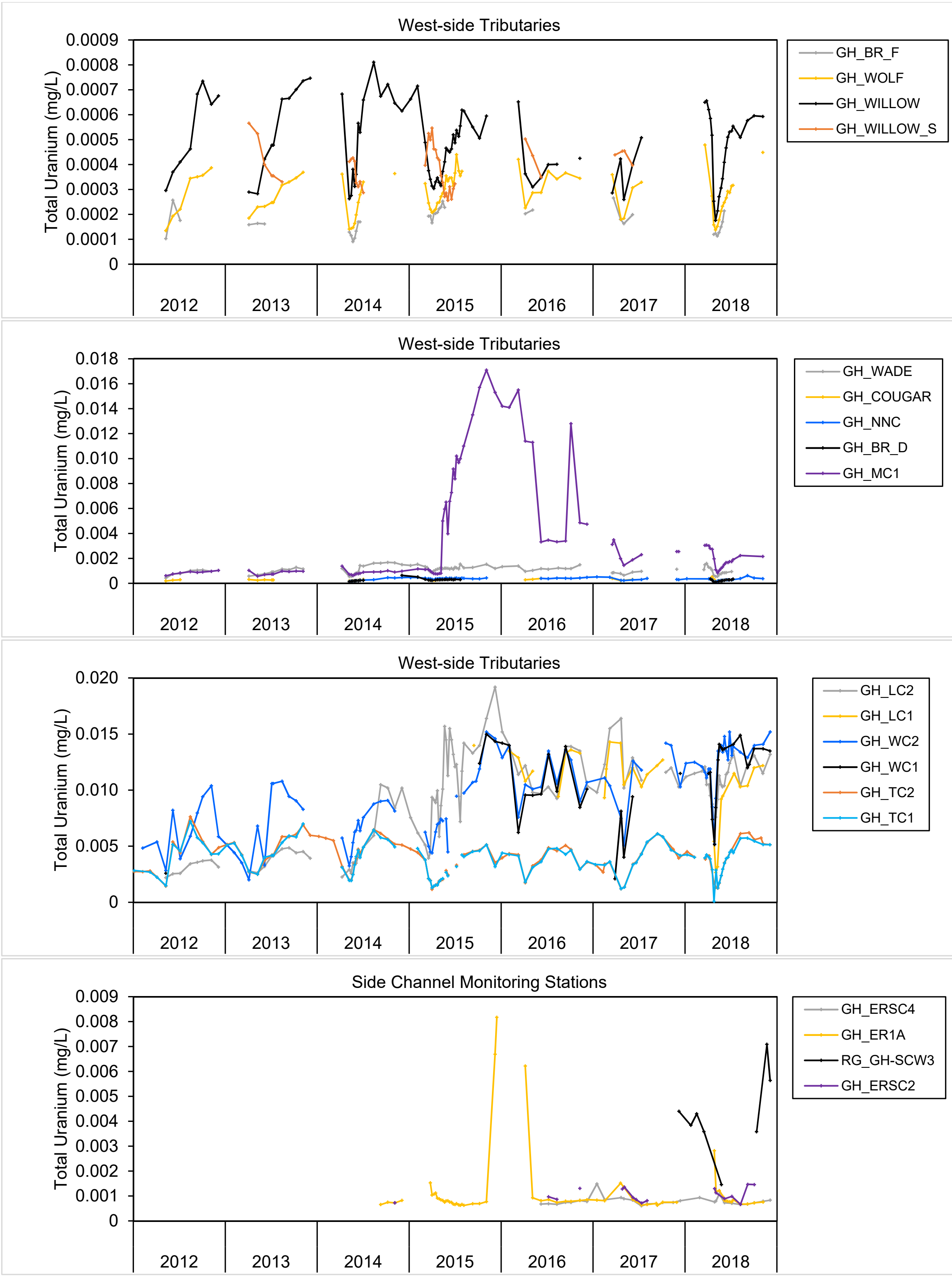


Figure C.49: Times Series Plots for Aqueous Total Uranium from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Note: Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

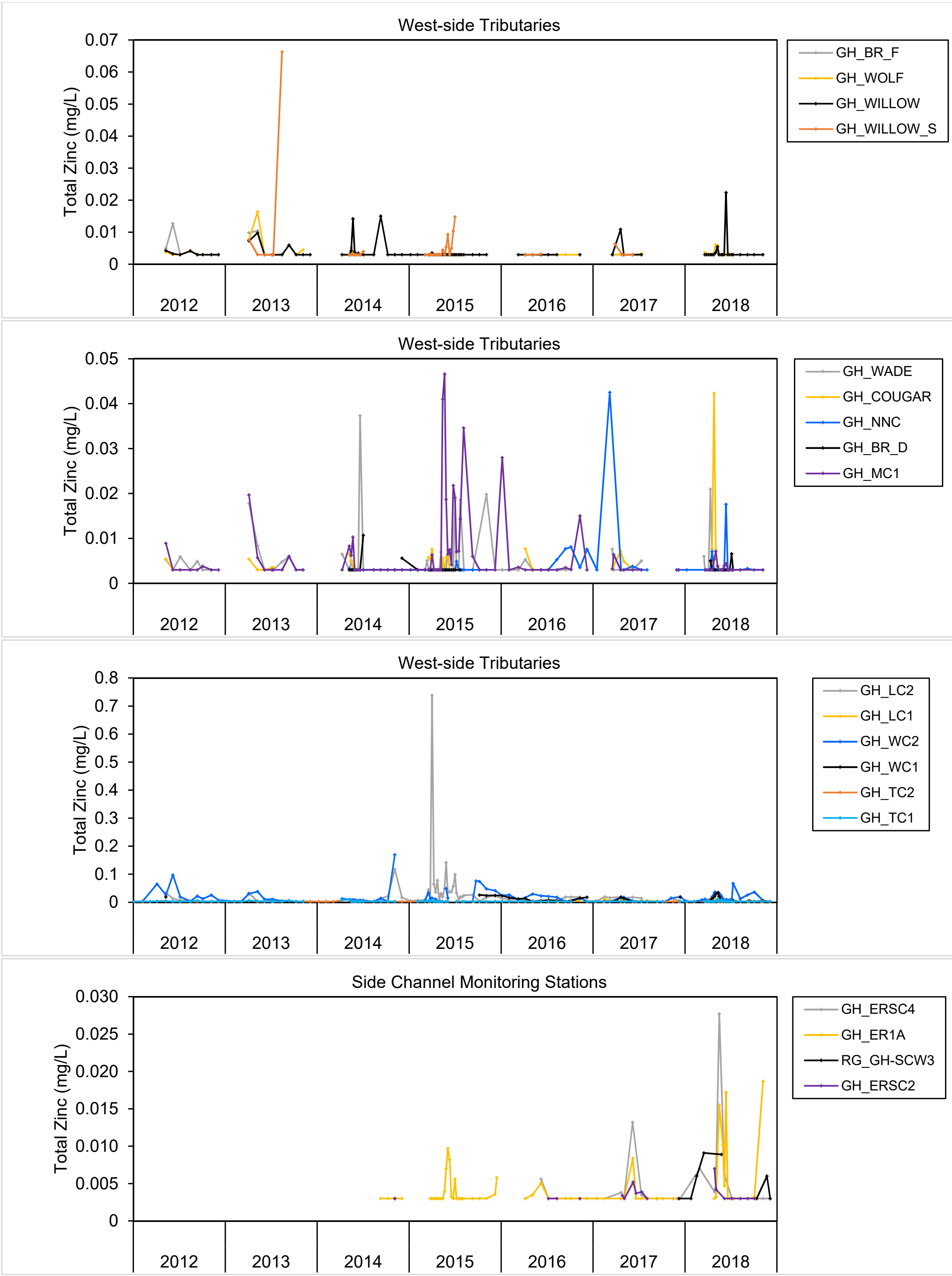


Figure C.50: Times Series Plots for Aqueous Total Zinc from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.003 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

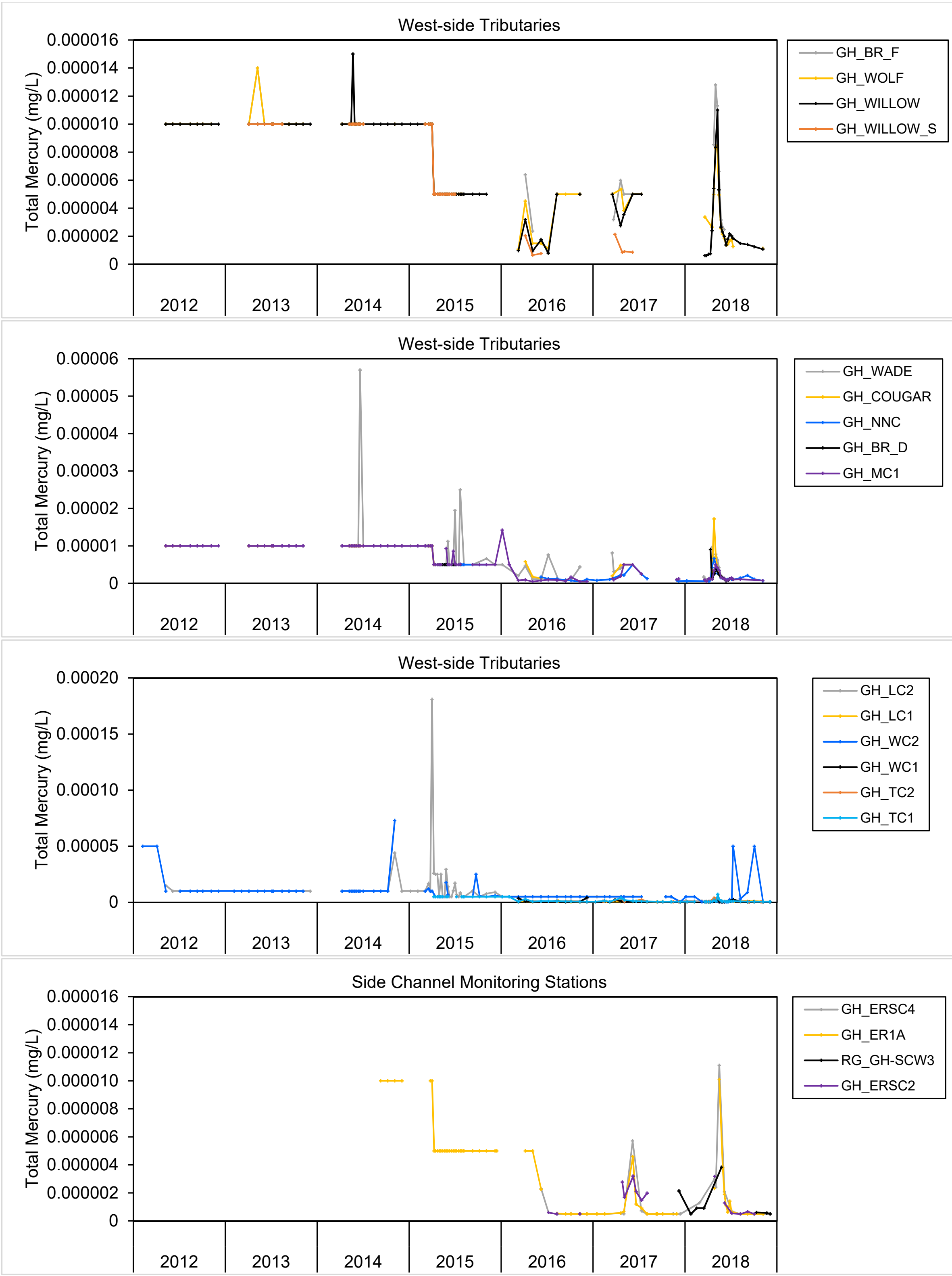


Figure C.51: Times Series Plots for Aqueous Total Mercury from West-side Tributaries and Side Channel Monitoring Stations, 2012 to 2018

Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted at the LRL (minimum LRL = 0.0000005 mg/L). Maximum Y-axis values differ between some plots. Station descriptions provided in Tables 2.1 to 2.3.

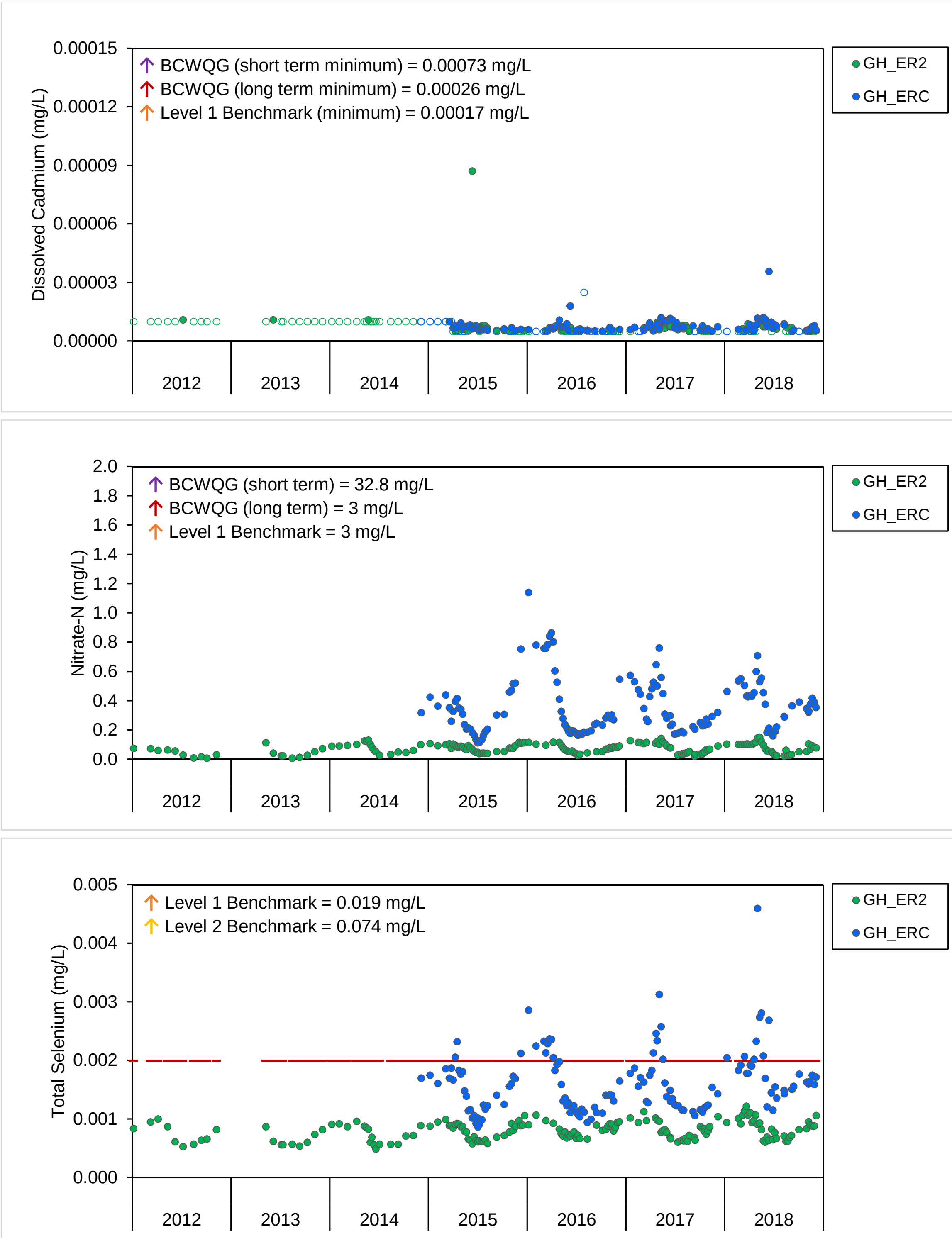


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark; – – = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines for cadmium are dependent on water hardness.

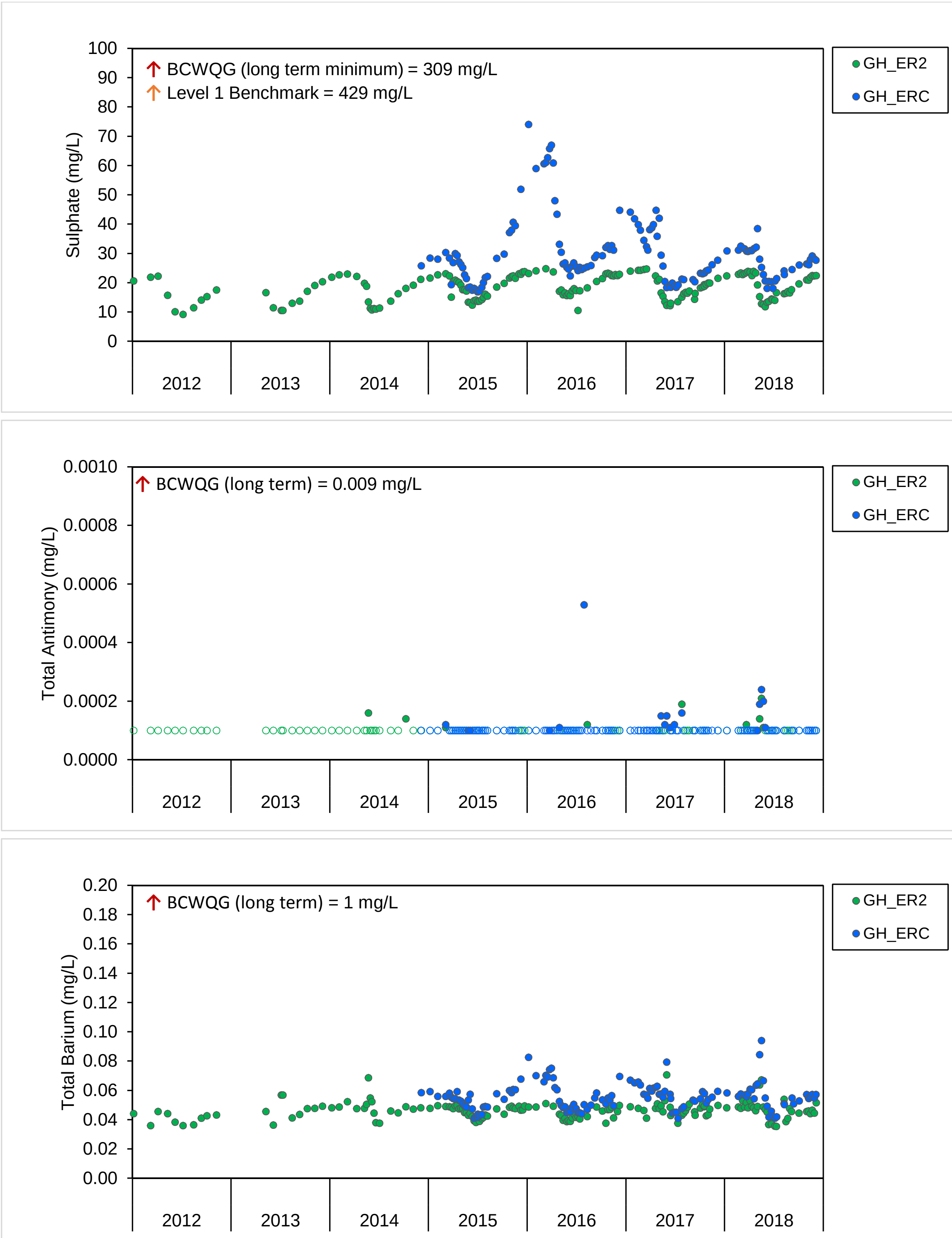
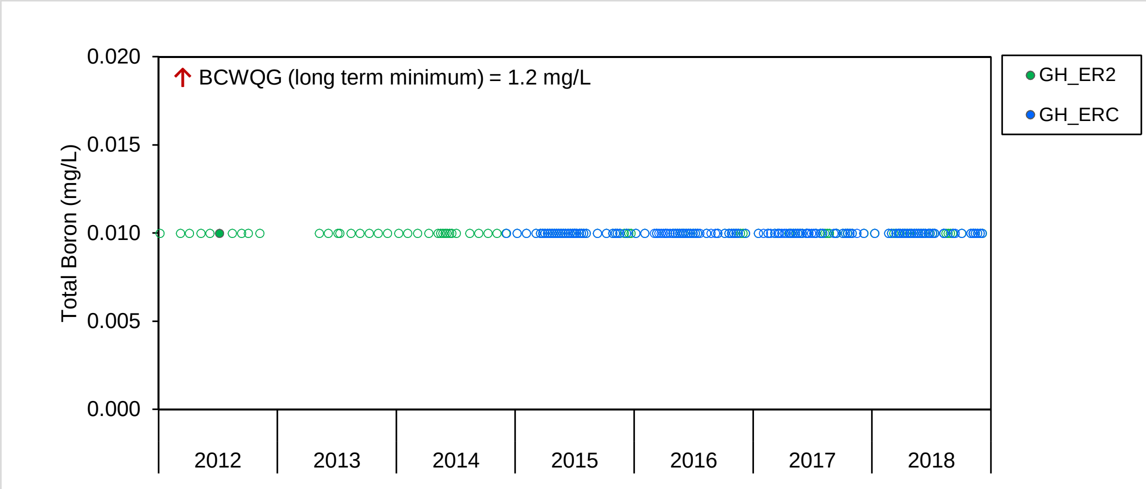
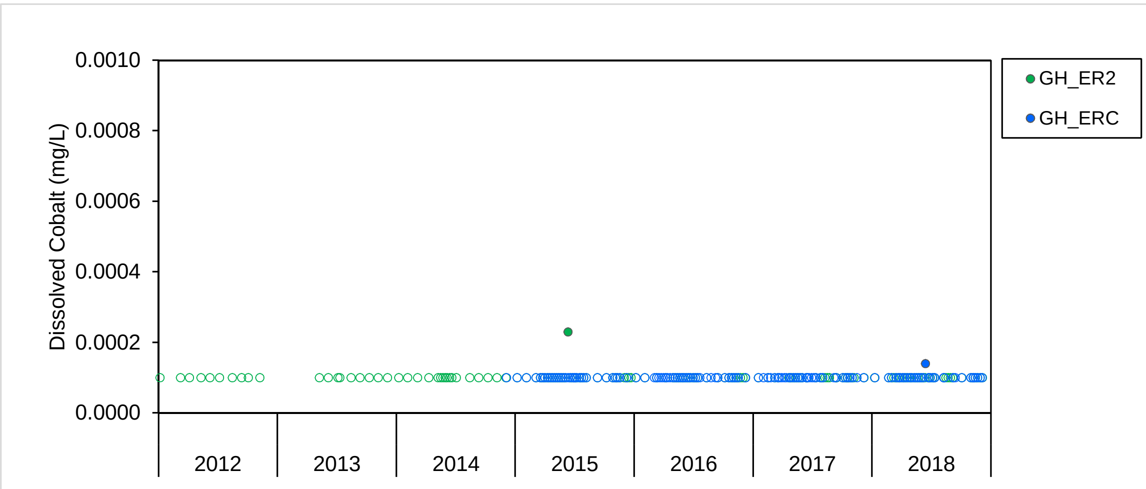


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

= BCWQG (long term); = BCWQG (short term); = Level 1 Benchmark; = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines for sulphate are dependent on water hardness.





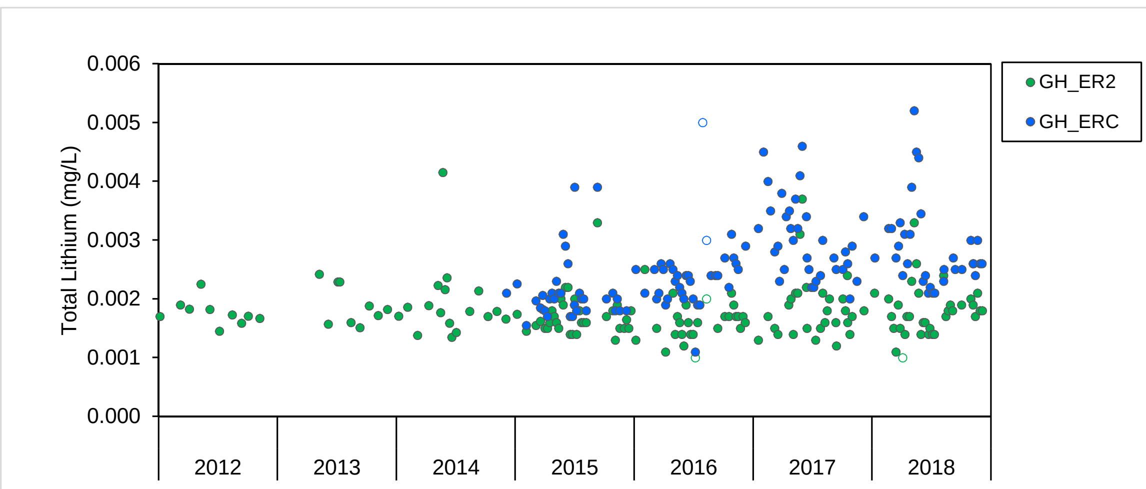


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark; – – = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL.

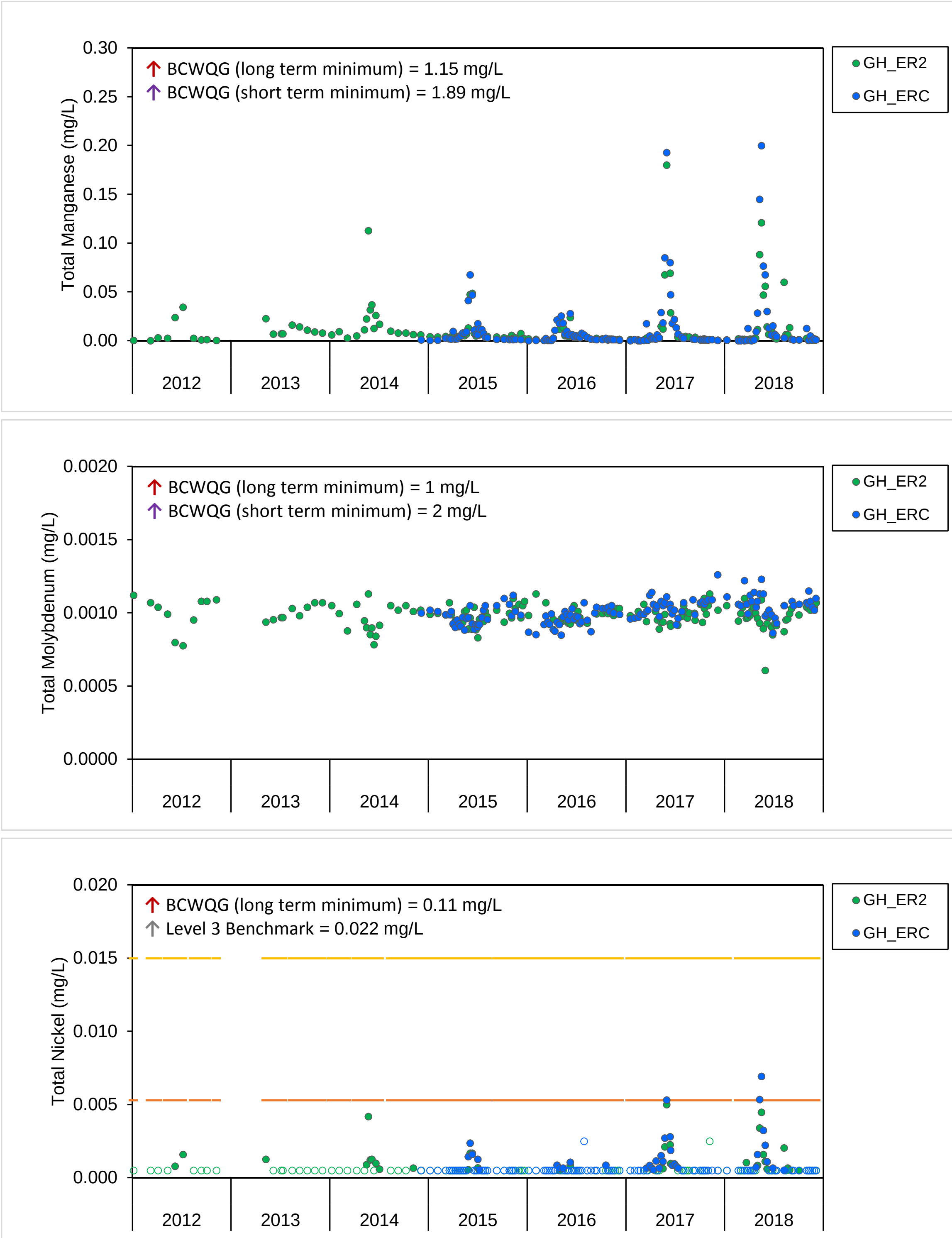
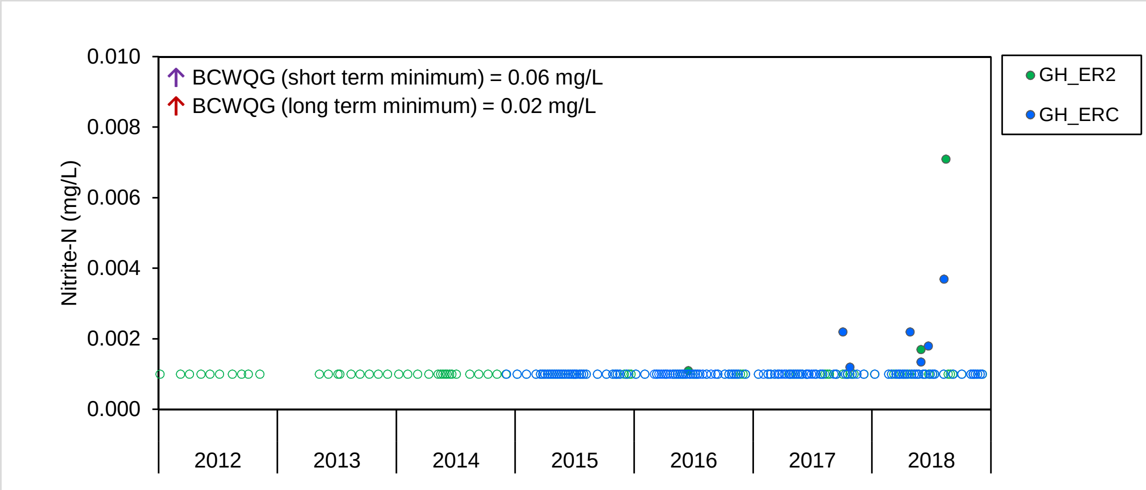
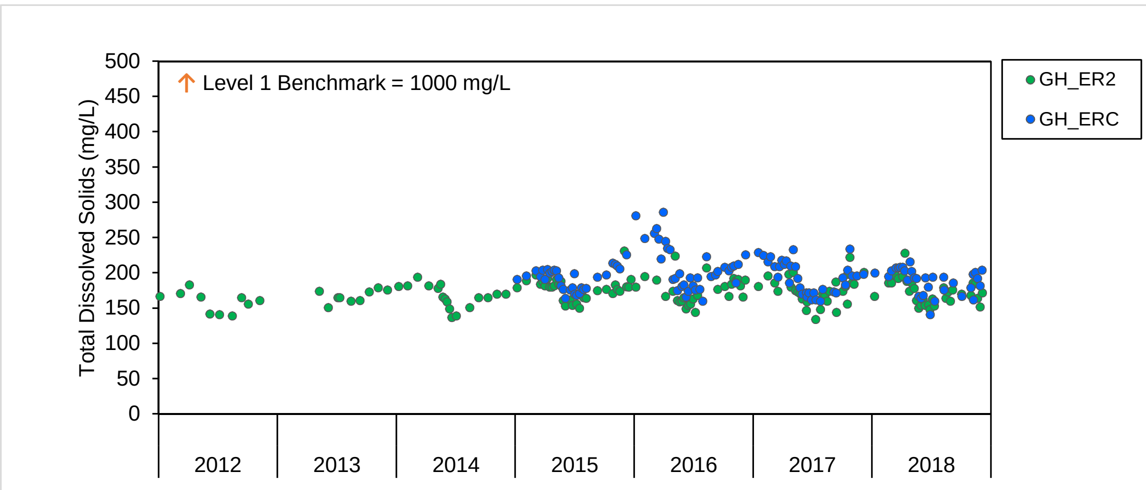


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

– –= BCWQG (long term); – –= BCWQG (short term); – –= Level 1 Benchmark; – –= Level 2 Benchmark; – –= Level 3 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Some guidelines for nickel are dependent on water hardness.





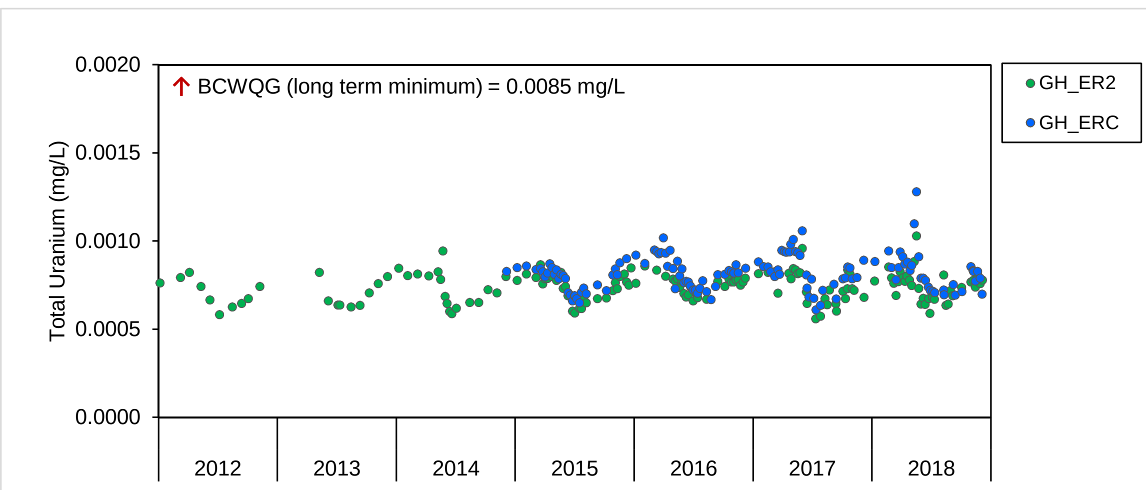
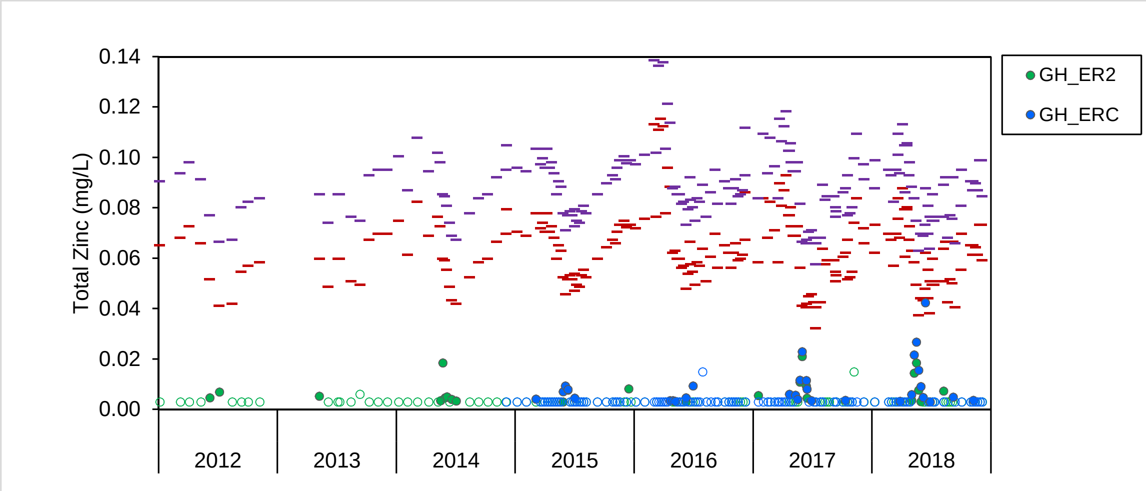


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark; – – = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Guidelines for nitrite are dependent on chloride concentration.



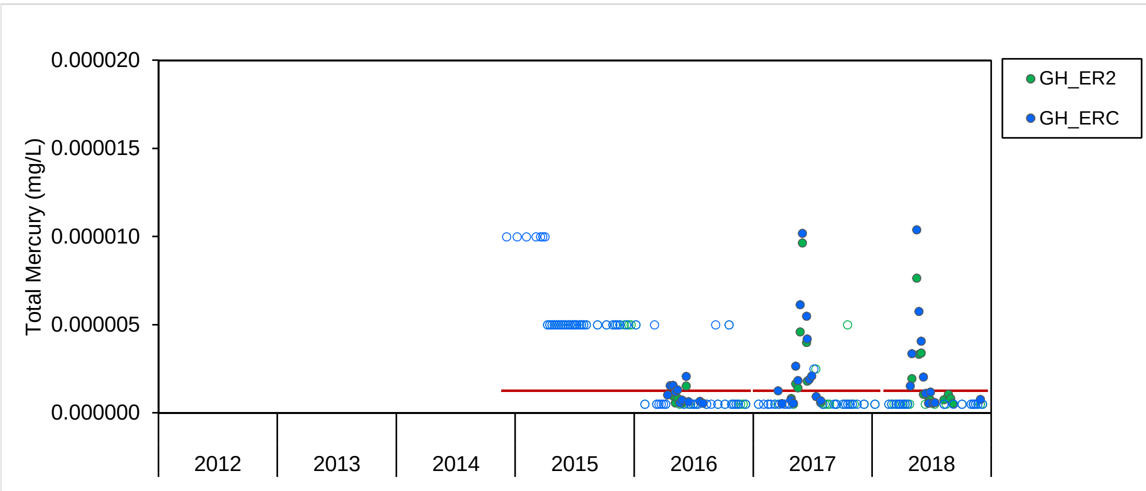


Figure C.52: Time Series Plots for Analytes from Main Stem Elk River Stations Upstream (Reference, GH_ER2) and Downstream (Mine-Exposed, GH_ERC) of the Elk River Side Channel, 2012 to 2018

= BCWQG (long term); = BCWQG (short term); = Level 1 Benchmark; = Level 2 Benchmark.
Notes: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Most conservative guideline of 0.00000125 mg/L was plotted for Total Mecury. Guidelines for zinc are dependent on water hardness.

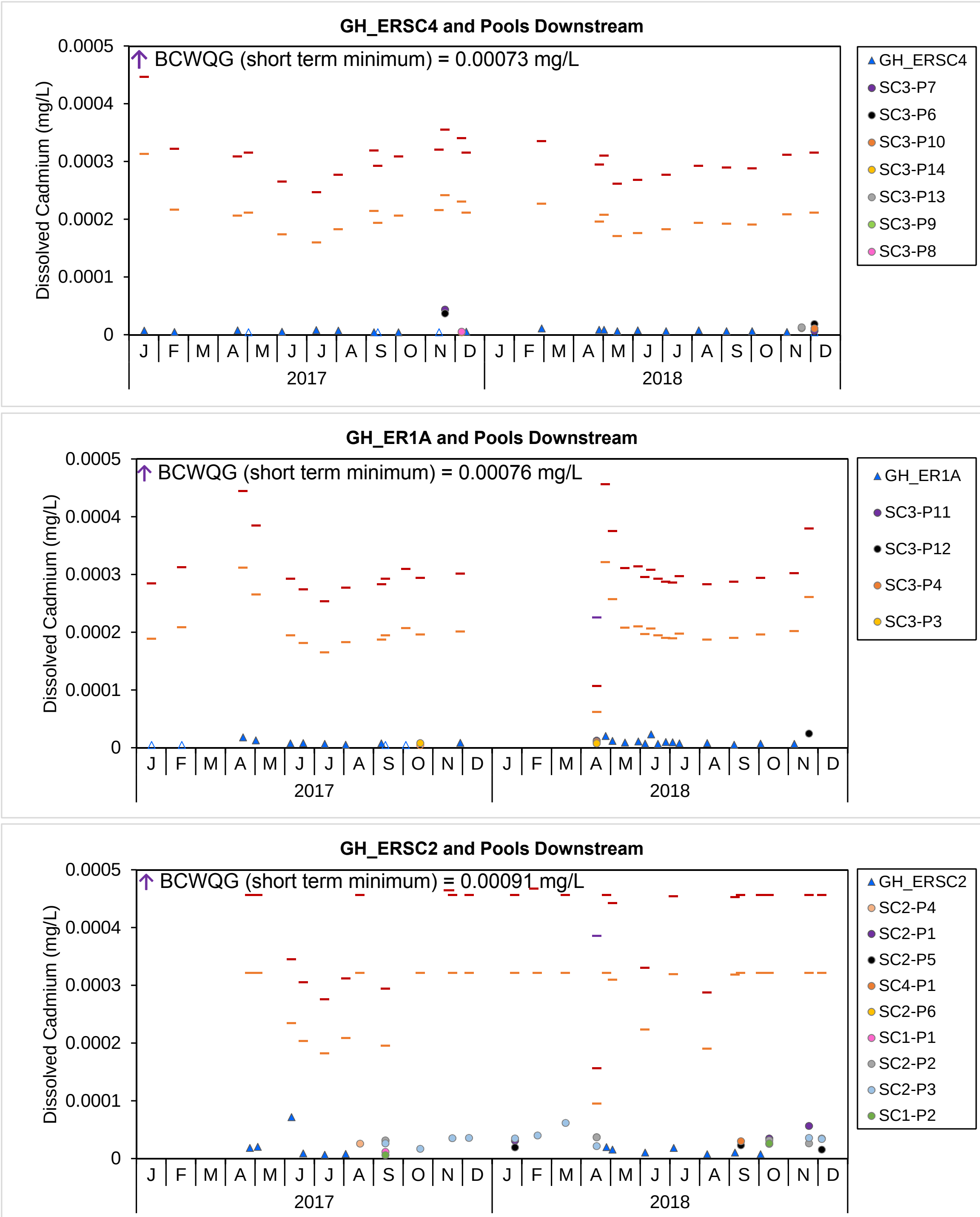


Figure C.53: Time Series Plots for Aqueous Dissolved Cadmium Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term); – – = BCWQG (short term); – – = Level 1 Benchmark.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream. Guidelines are dependent on water hardness.

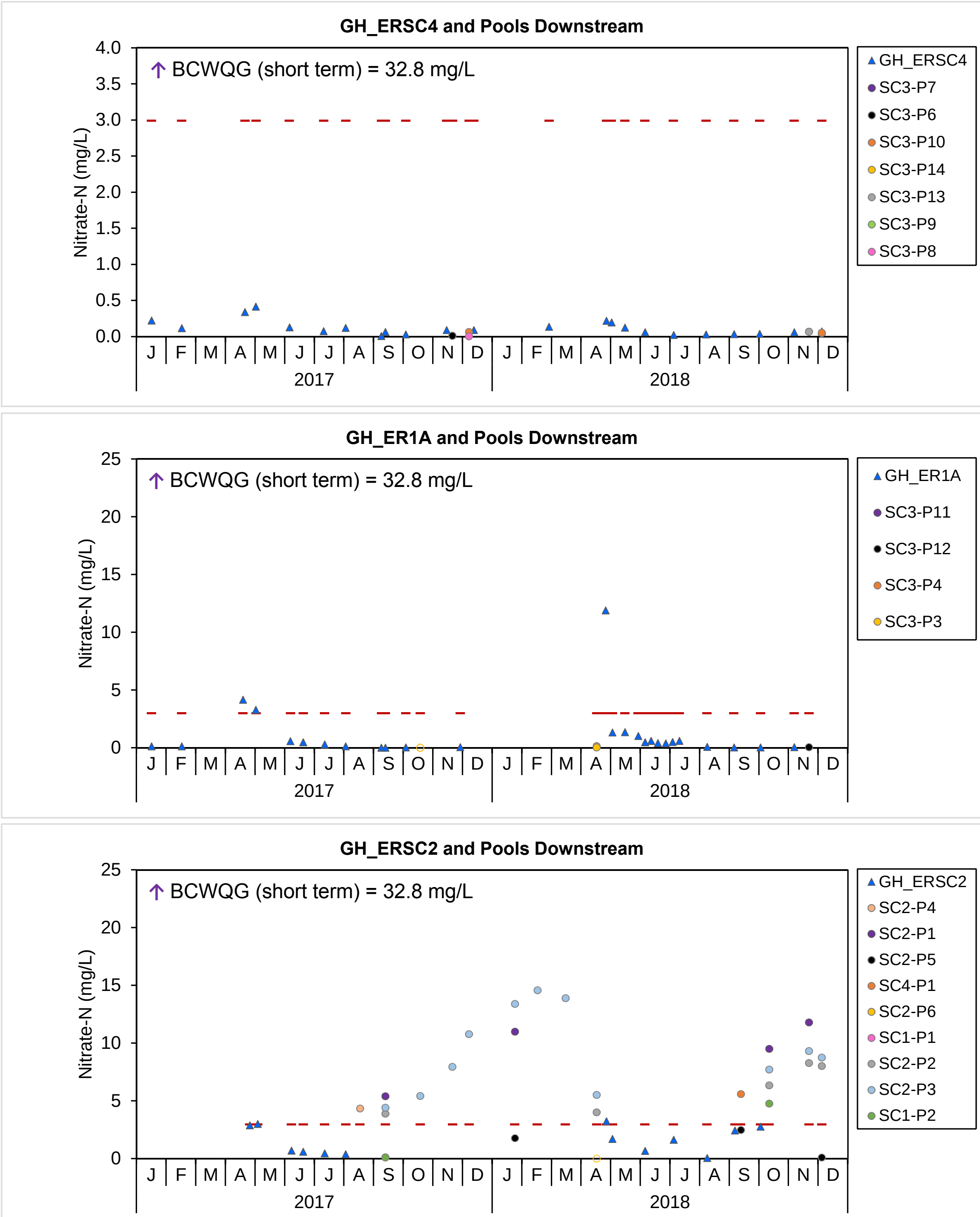


Figure C.54: Time Series Plots for Aqueous Nitrate-N Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

= BCWQG (long term); = BCWQG (short term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

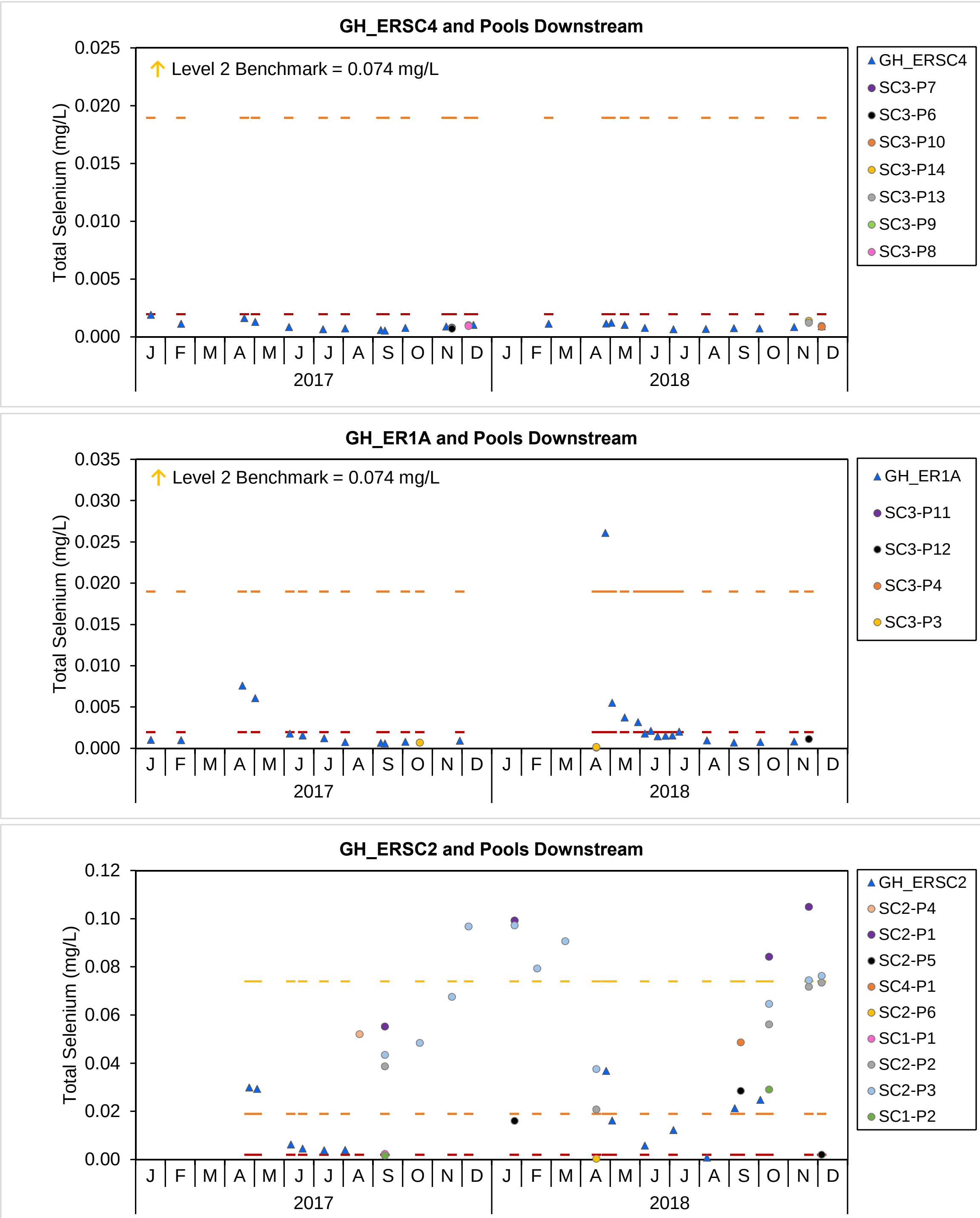
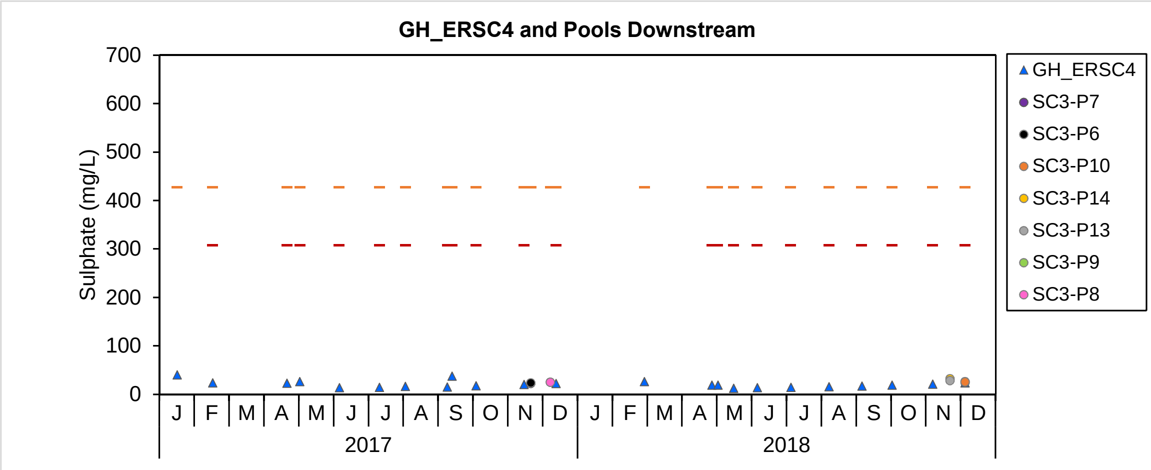
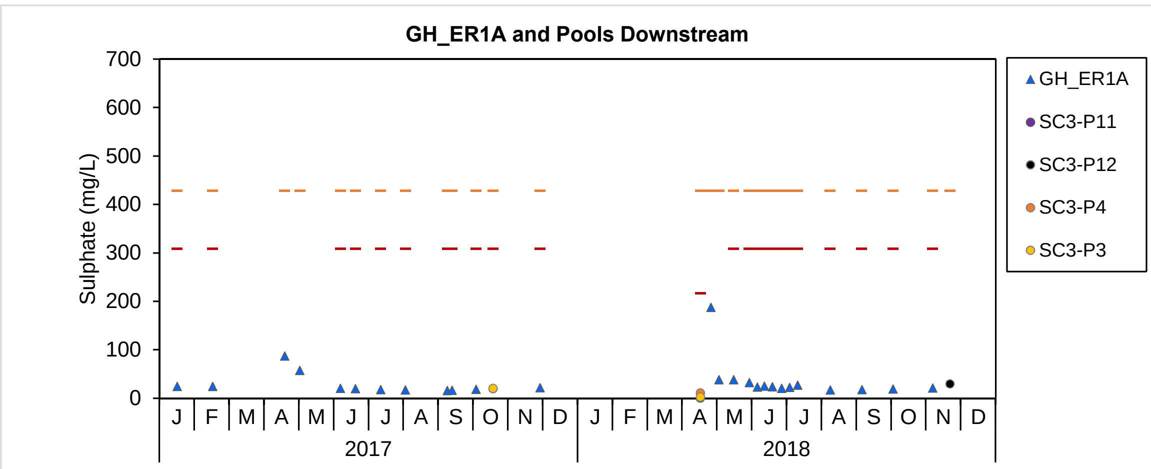


Figure C.55: Time Series Plots for Aqueous Total Selenium Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term); – – = Level 1 Benchmark; – – = Level 2 Benchmark.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.





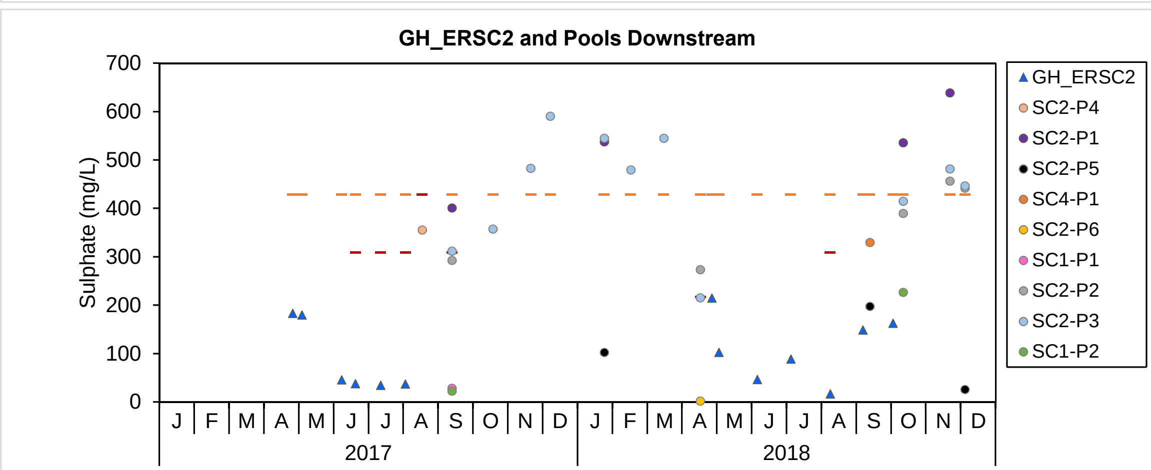


Figure C.56: Time Series Plots for Aqueous Sulphate Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term); – – = Level 1 Benchmark.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream. Some guidelines are dependent on water hardness.

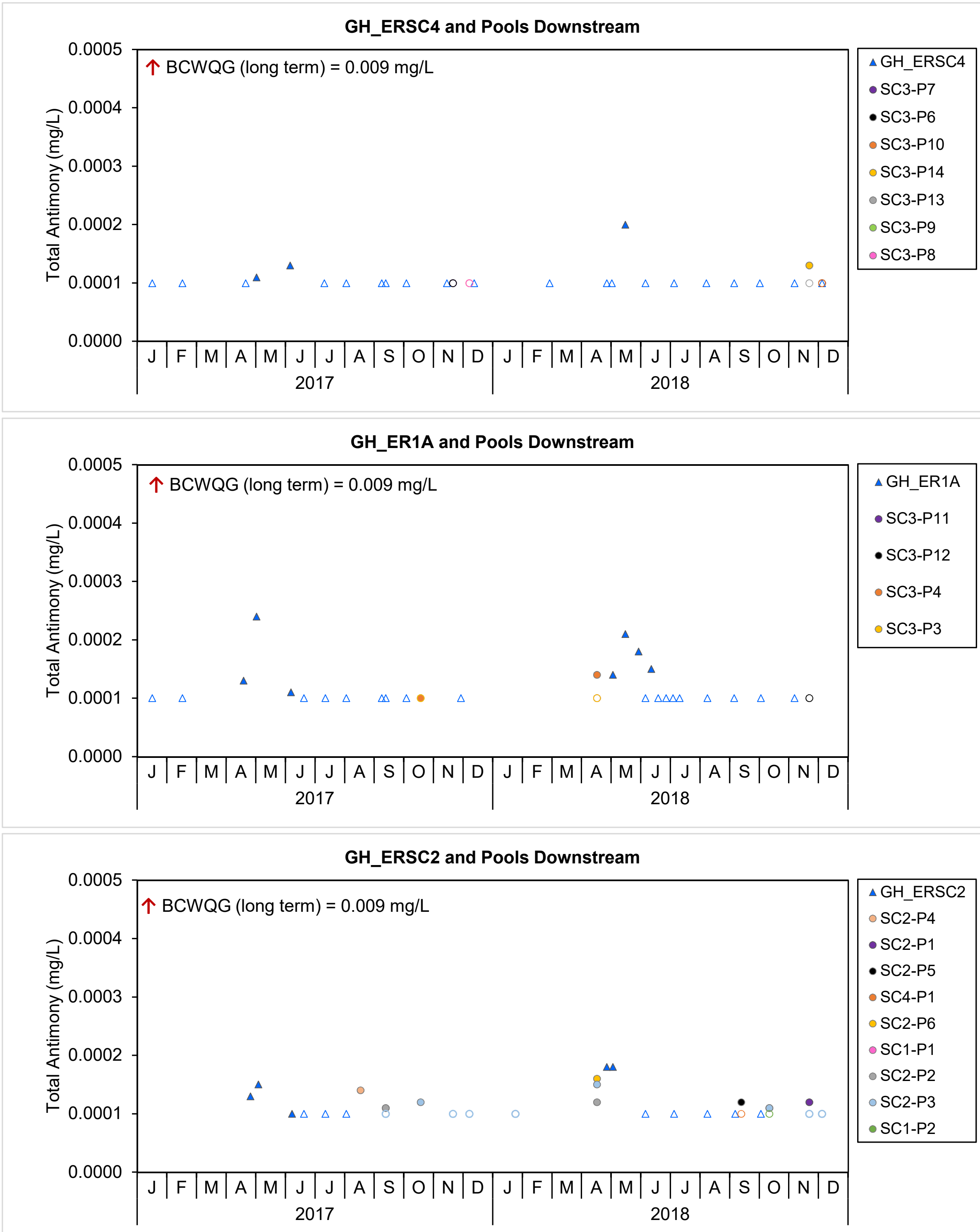


Figure C.57: Time Series Plots for Aqueous Total Antimony Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

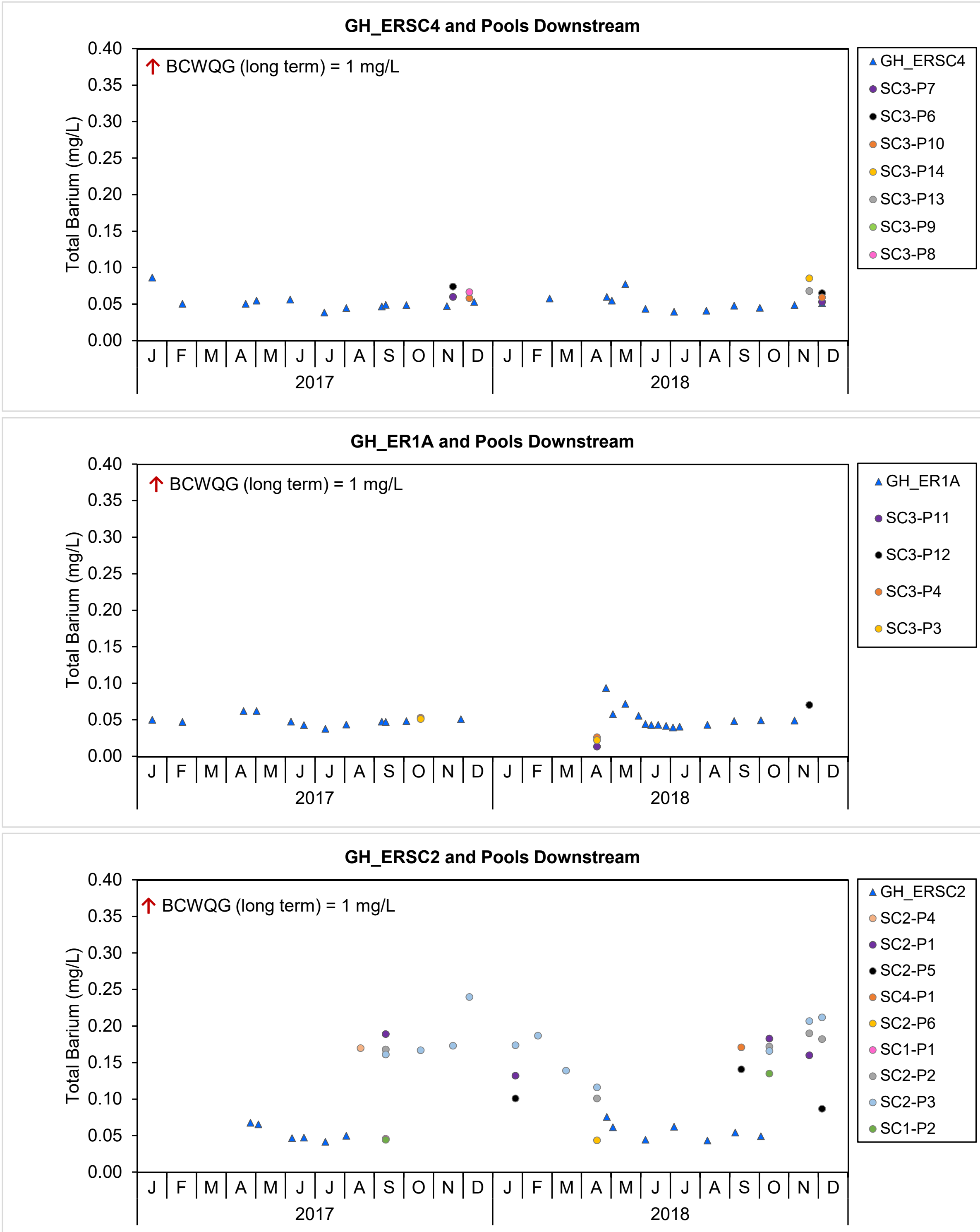


Figure C.58: Time Series Plots for Aqueous Total Barium Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

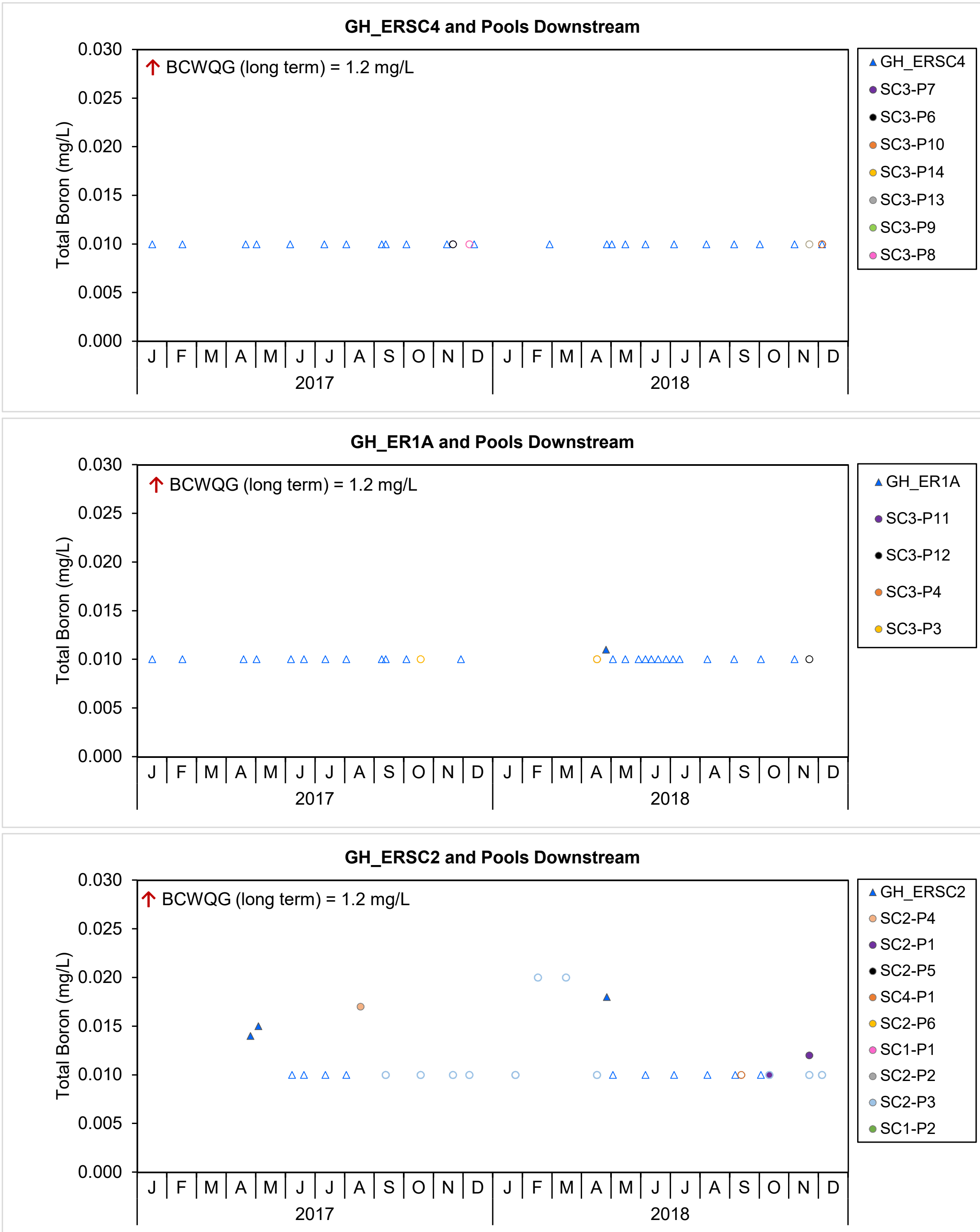


Figure C.59: Time Series Plots for Aqueous Total Boron Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

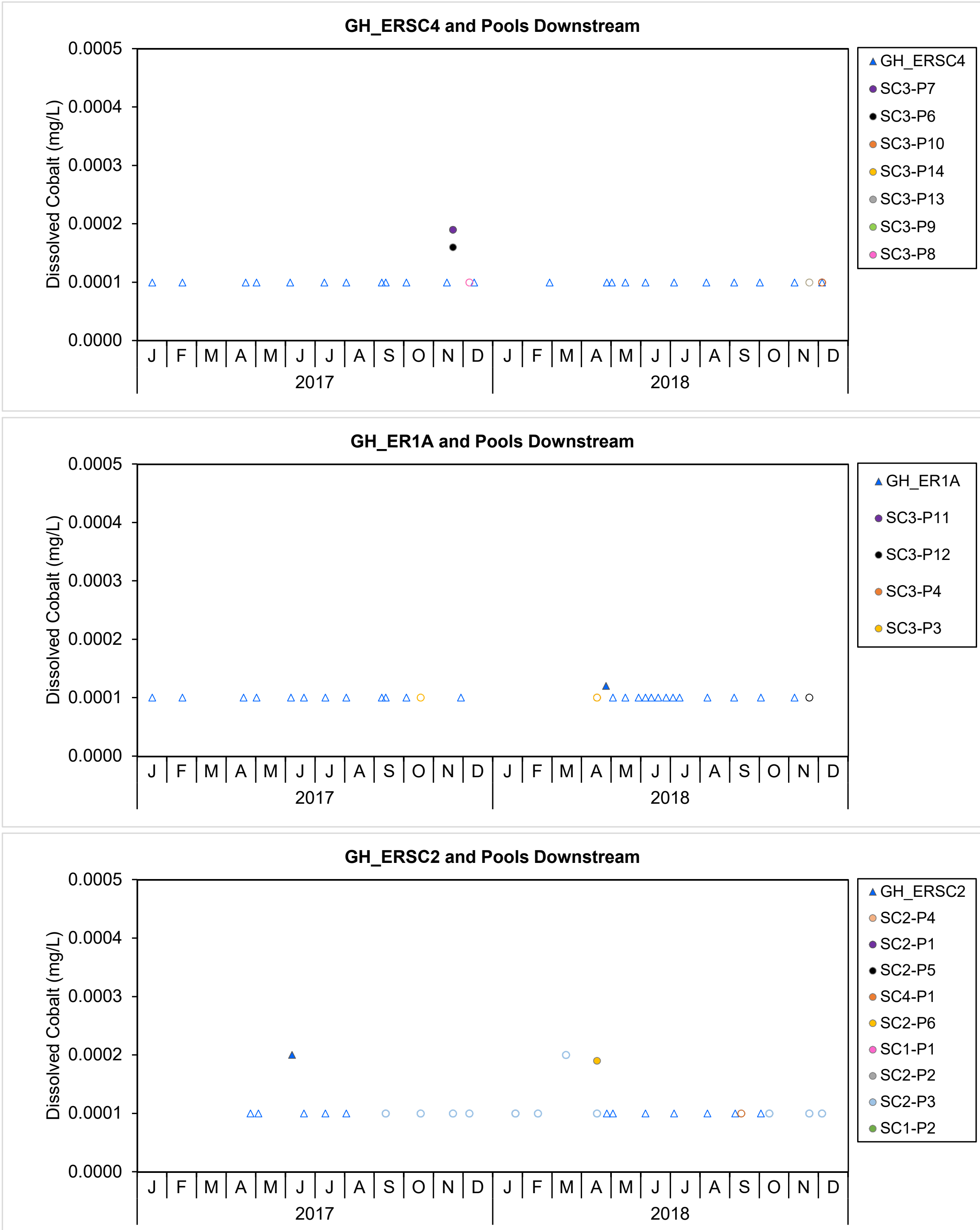


Figure C.60: Time Series Plots for Aqueous Dissolved Cobalt Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

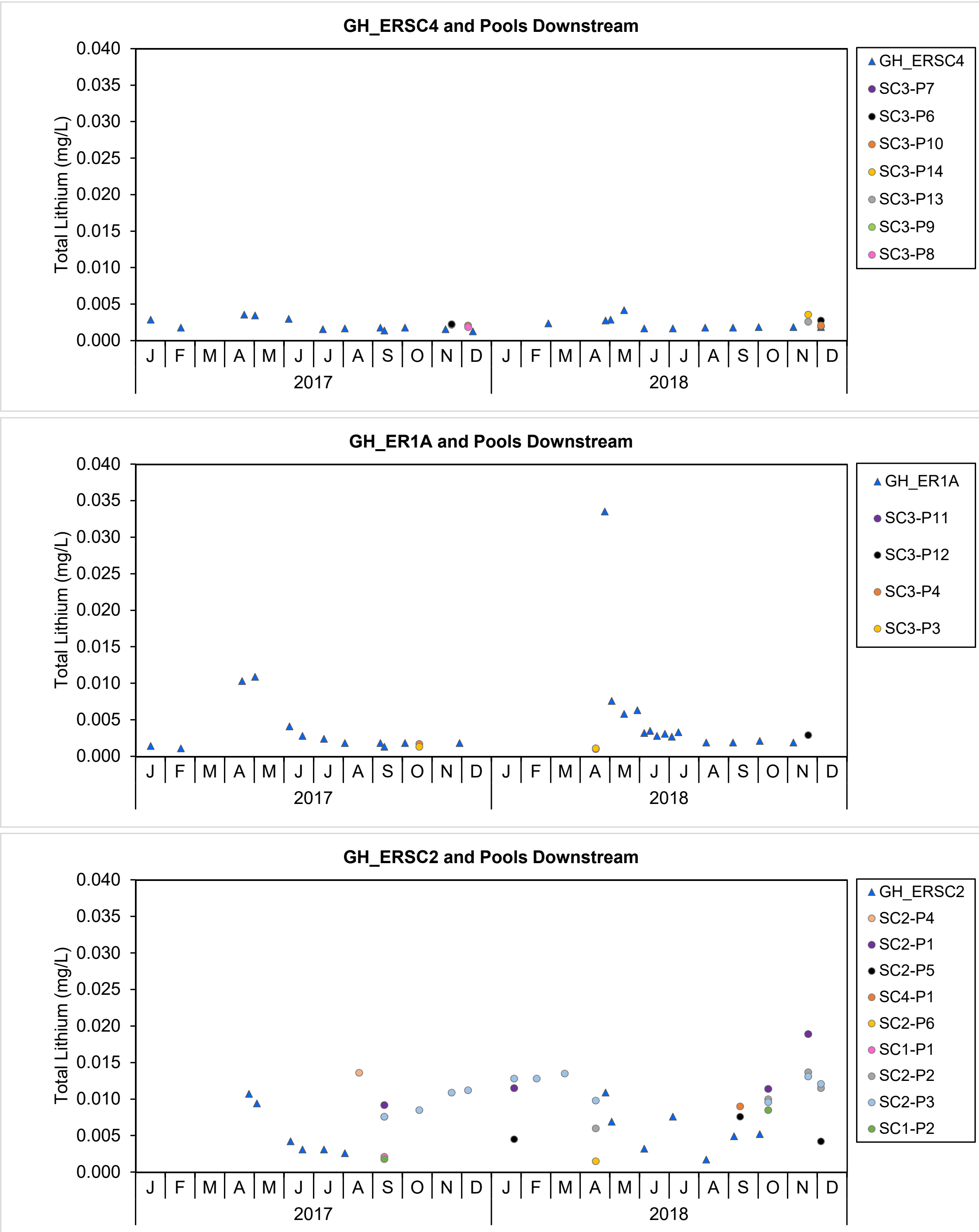


Figure C.61: Time Series Plots for Aqueous Total Lithium Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

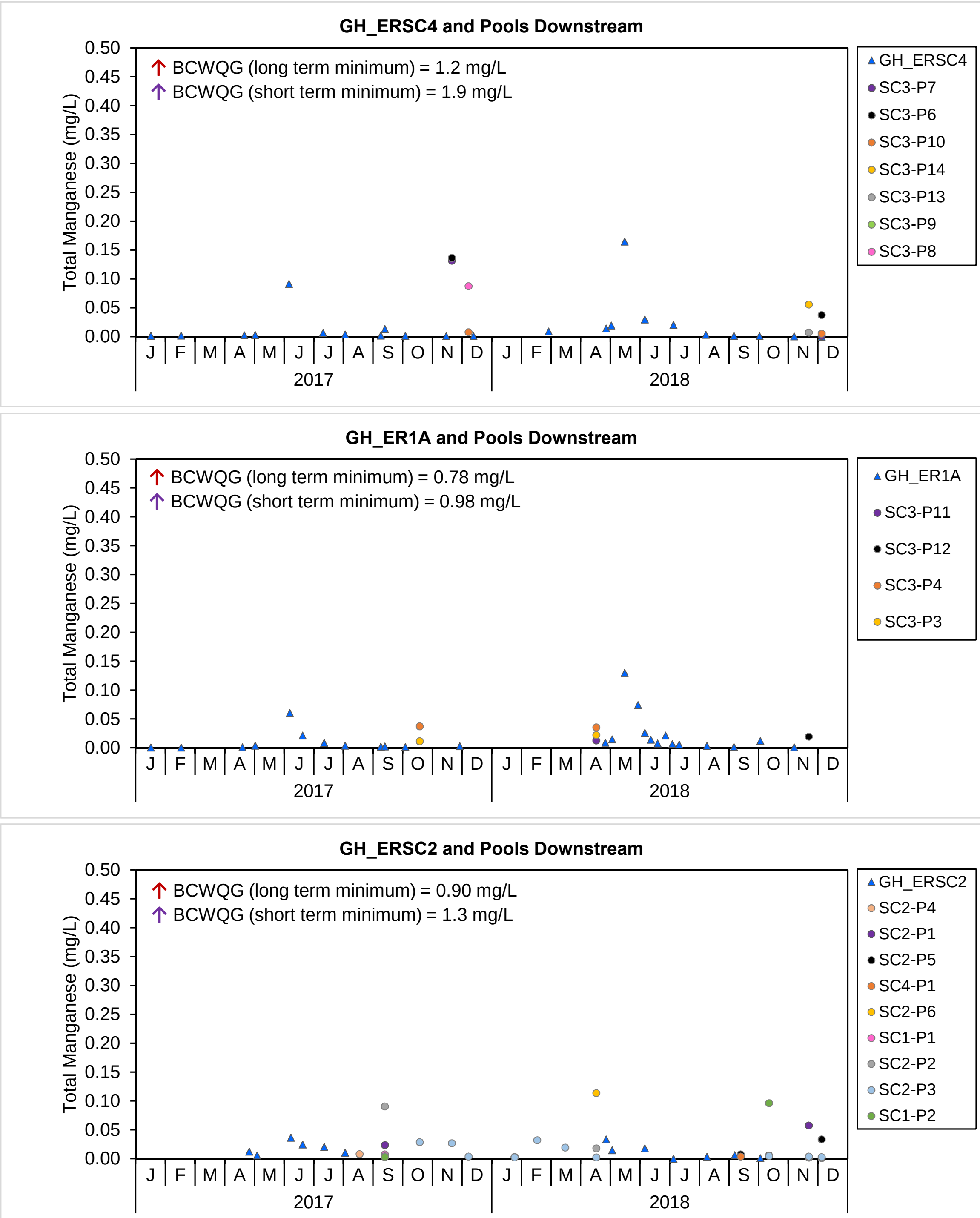


Figure C.62: Time Series Plots for Aqueous Total Manganese Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

= BCWQG (long term); = BCWQG (short term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream. Guidelines are dependent on water hardness.

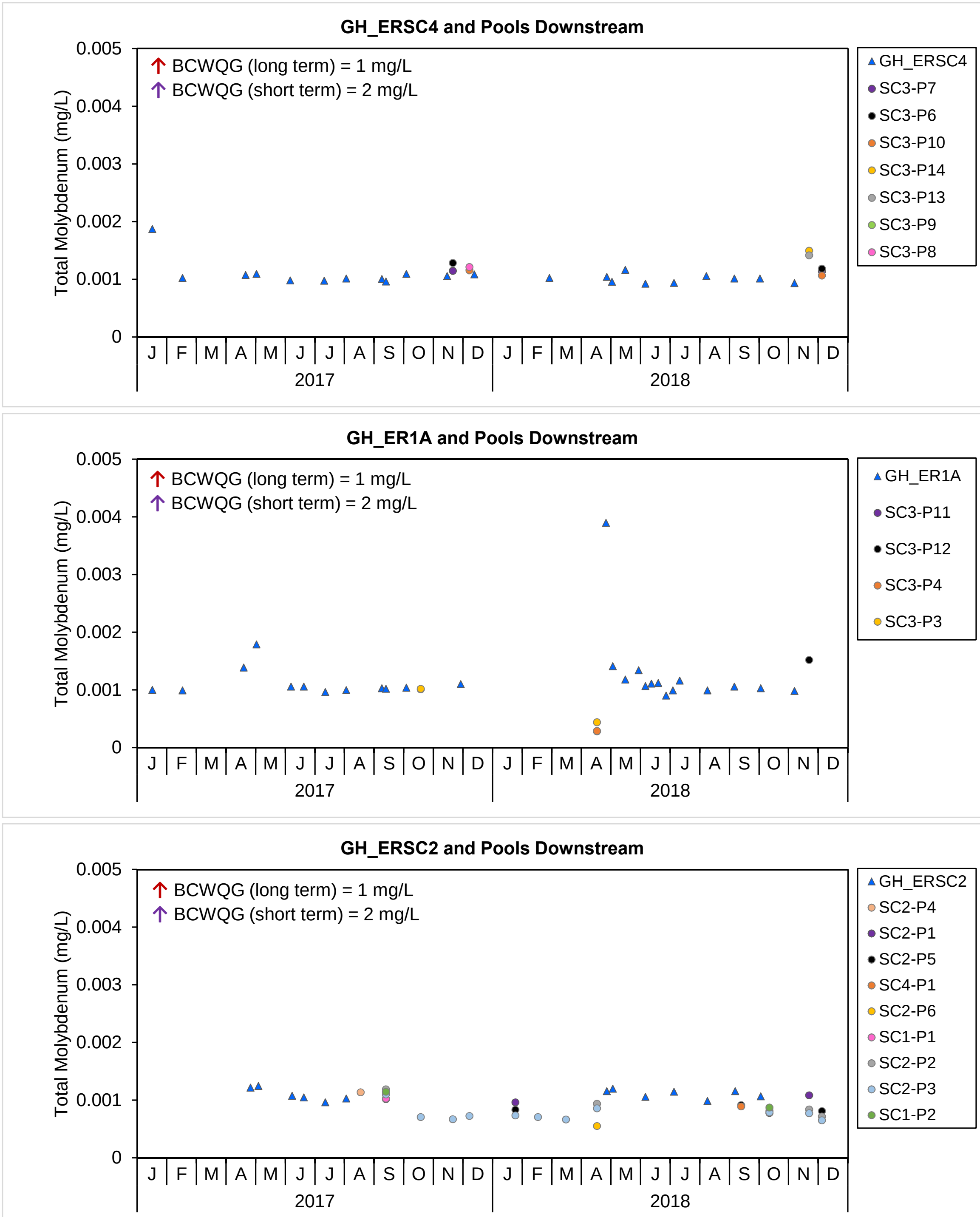
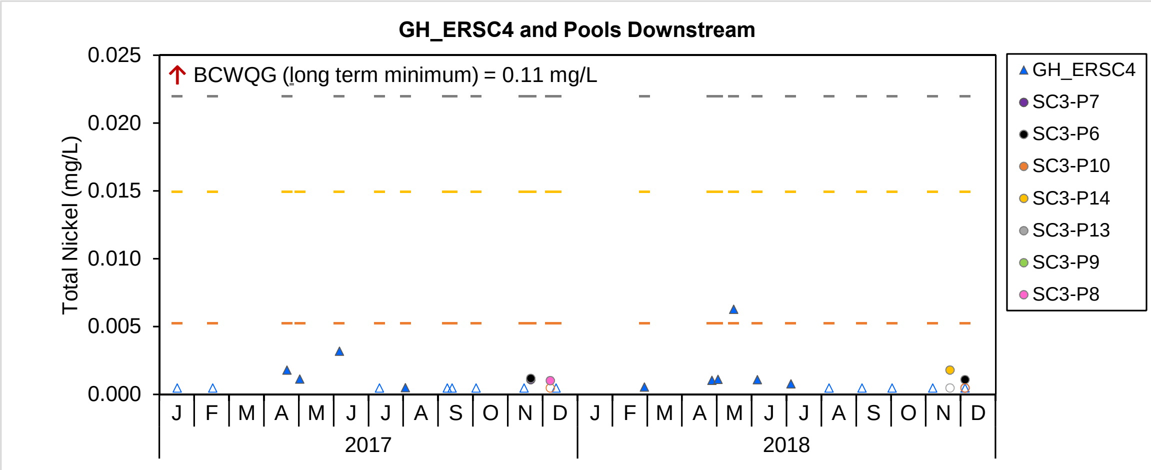
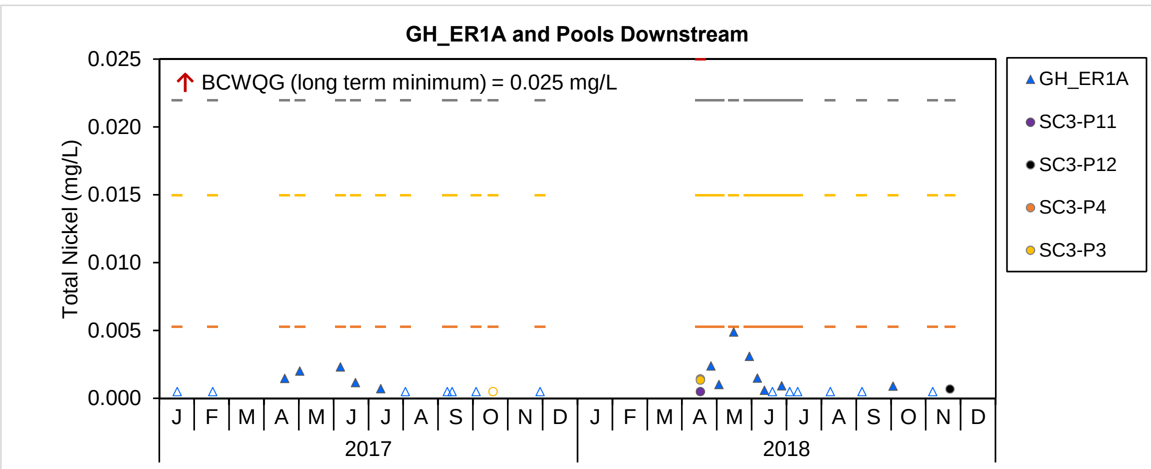


Figure C.63: Time Series Plots for Aqueous Total Molybdenum Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.





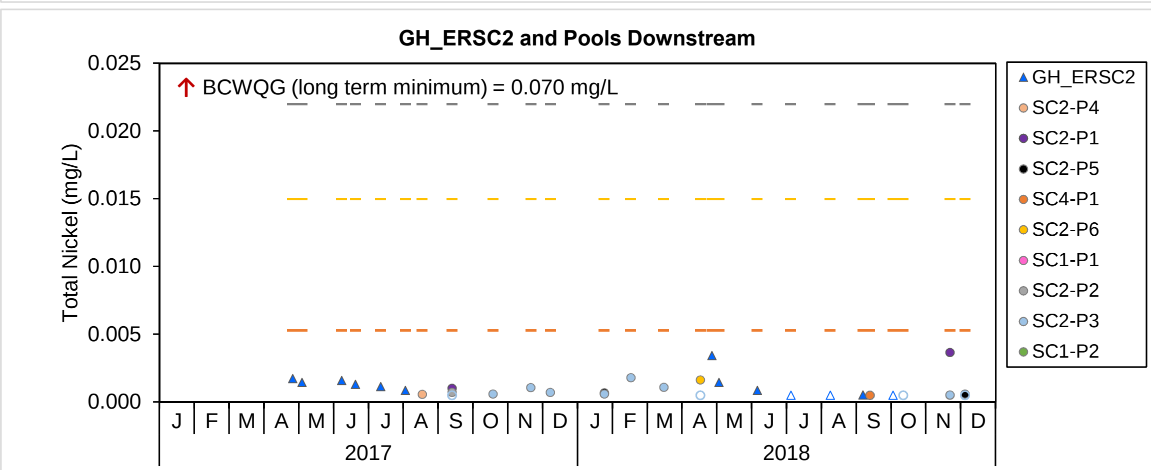


Figure C.64: Time Series Plots for Aqueous Total Nickel Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

= BCWQG (long term); = Level 1 Benchmark; = Level 2 Benchmark; = Level 3 Benchmark.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream. Some guidelines are hardness dependent.

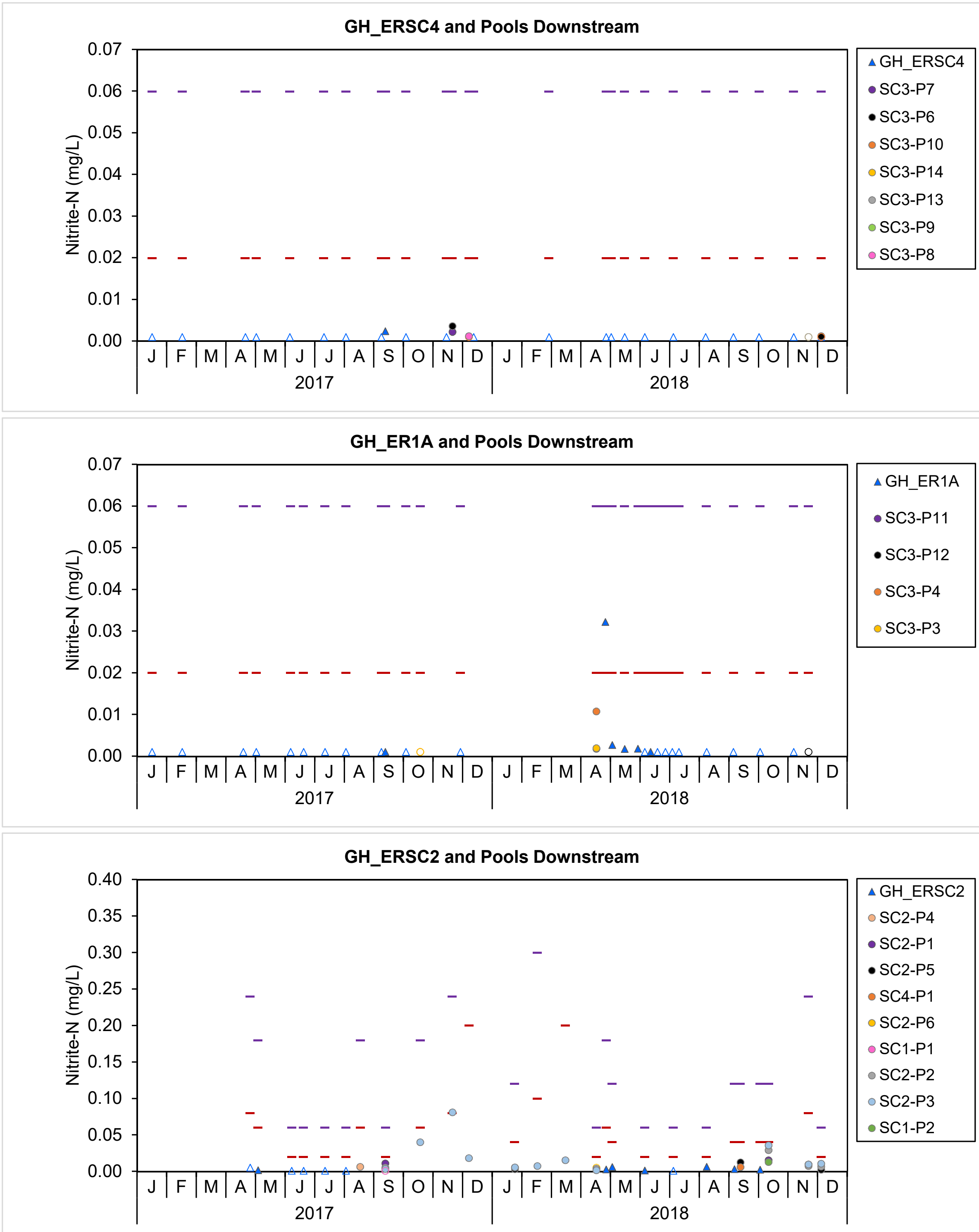
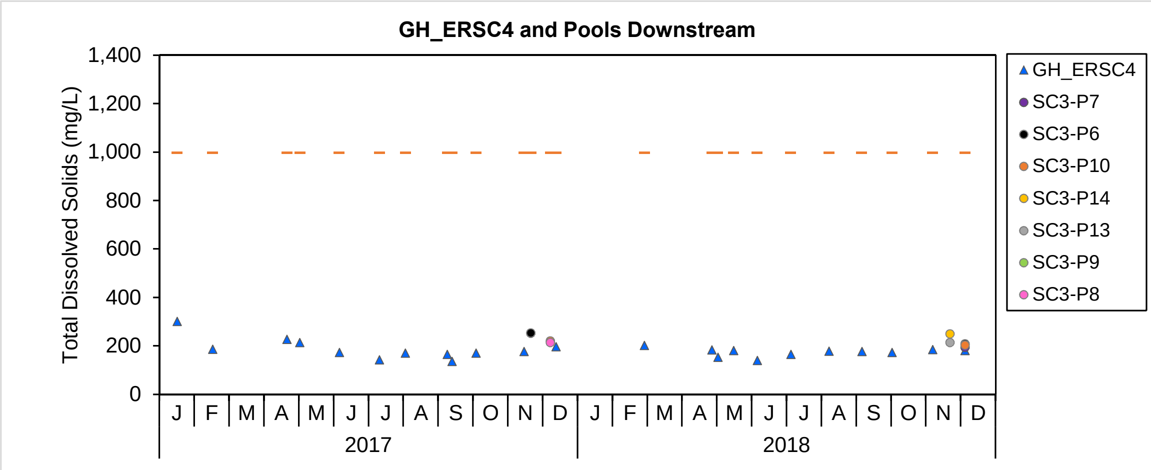
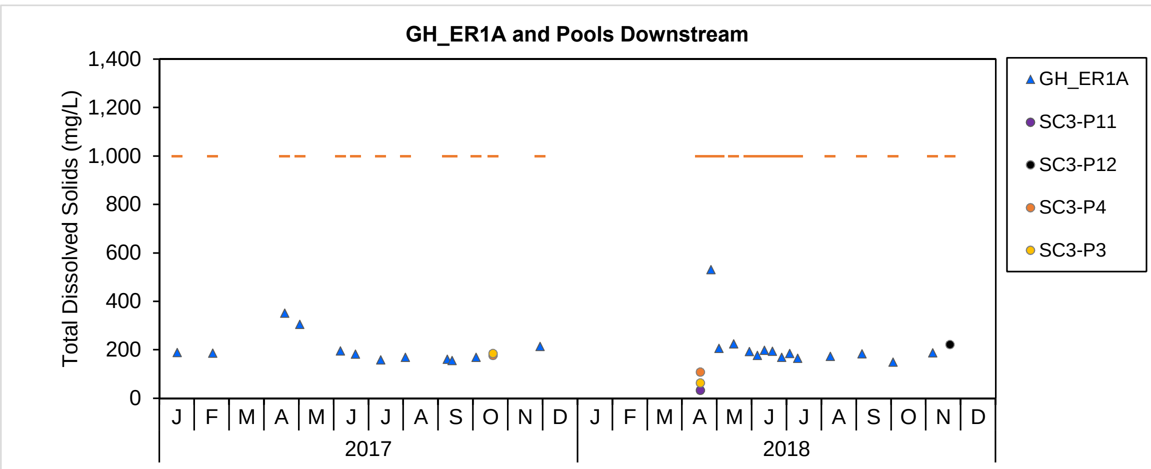


Figure C.65: Time Series Plots for Aqueous Nitrite-N Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term); – – = BCWQG (short term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream. Water quality guidelines dependent on chloride concentration.





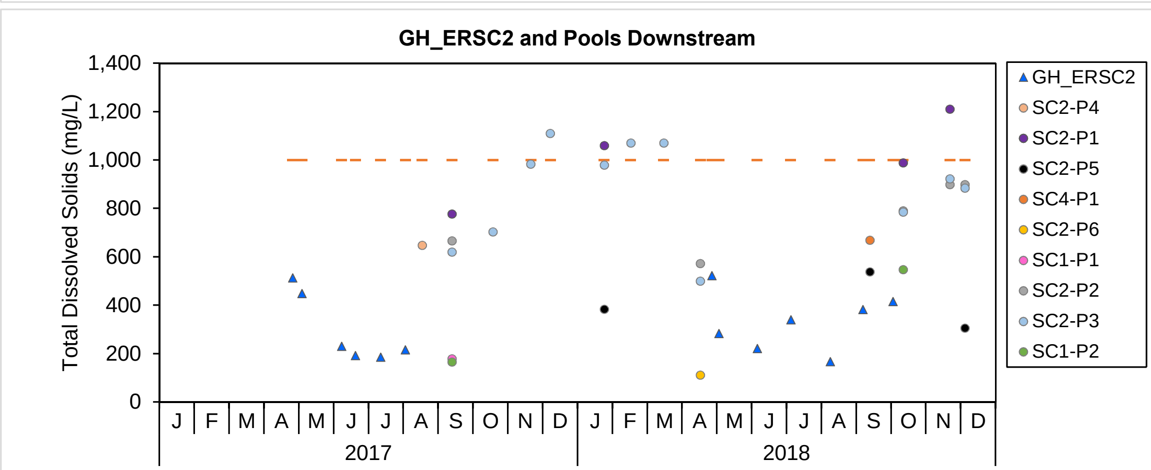


Figure C.66: Time Series Plots for Aqueous Total Dissolved Solids Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = Level 1 Benchmark.

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

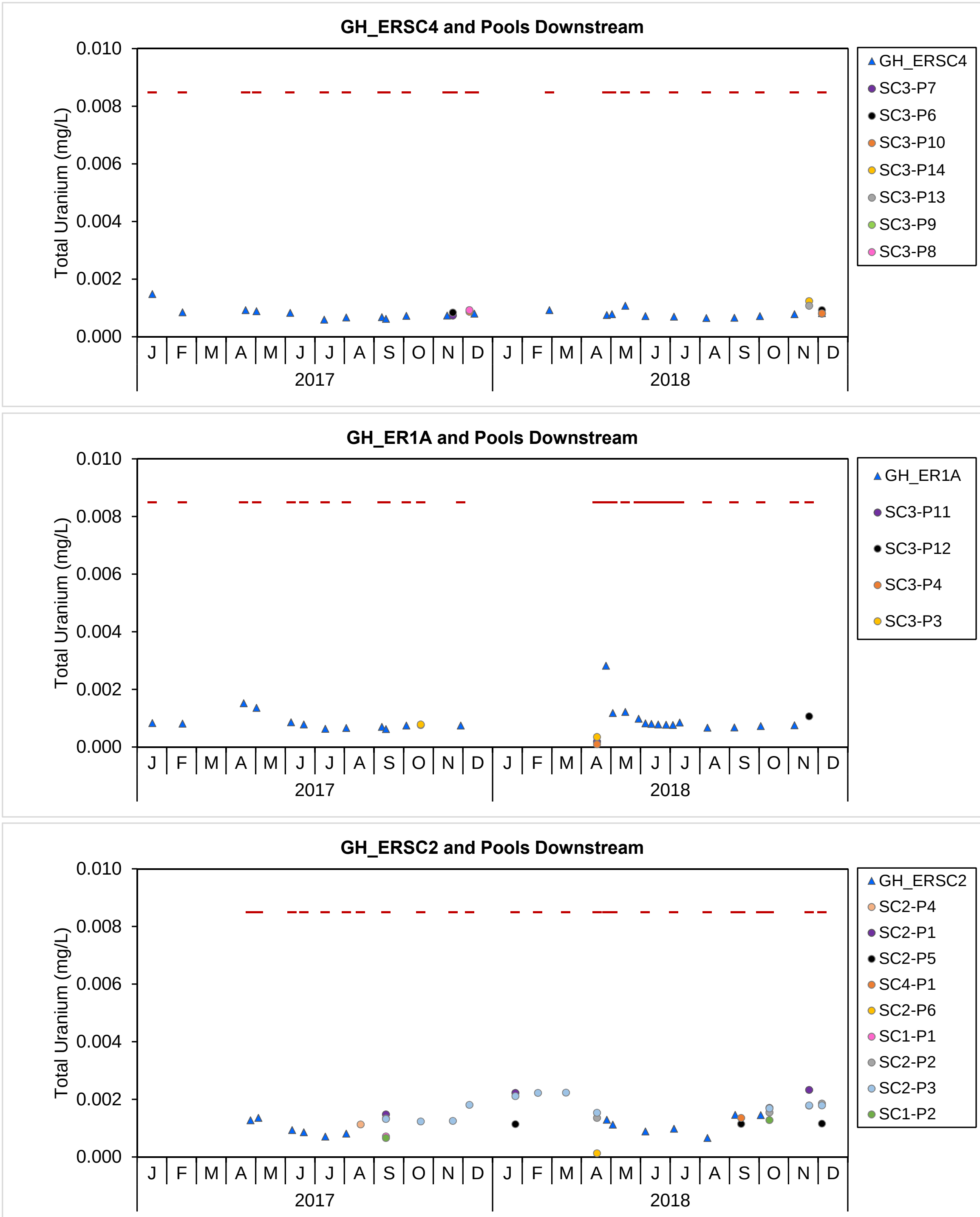


Figure C.67: Time Series Plots for Aqueous Total Uranium Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

– – = BCWQG (long term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

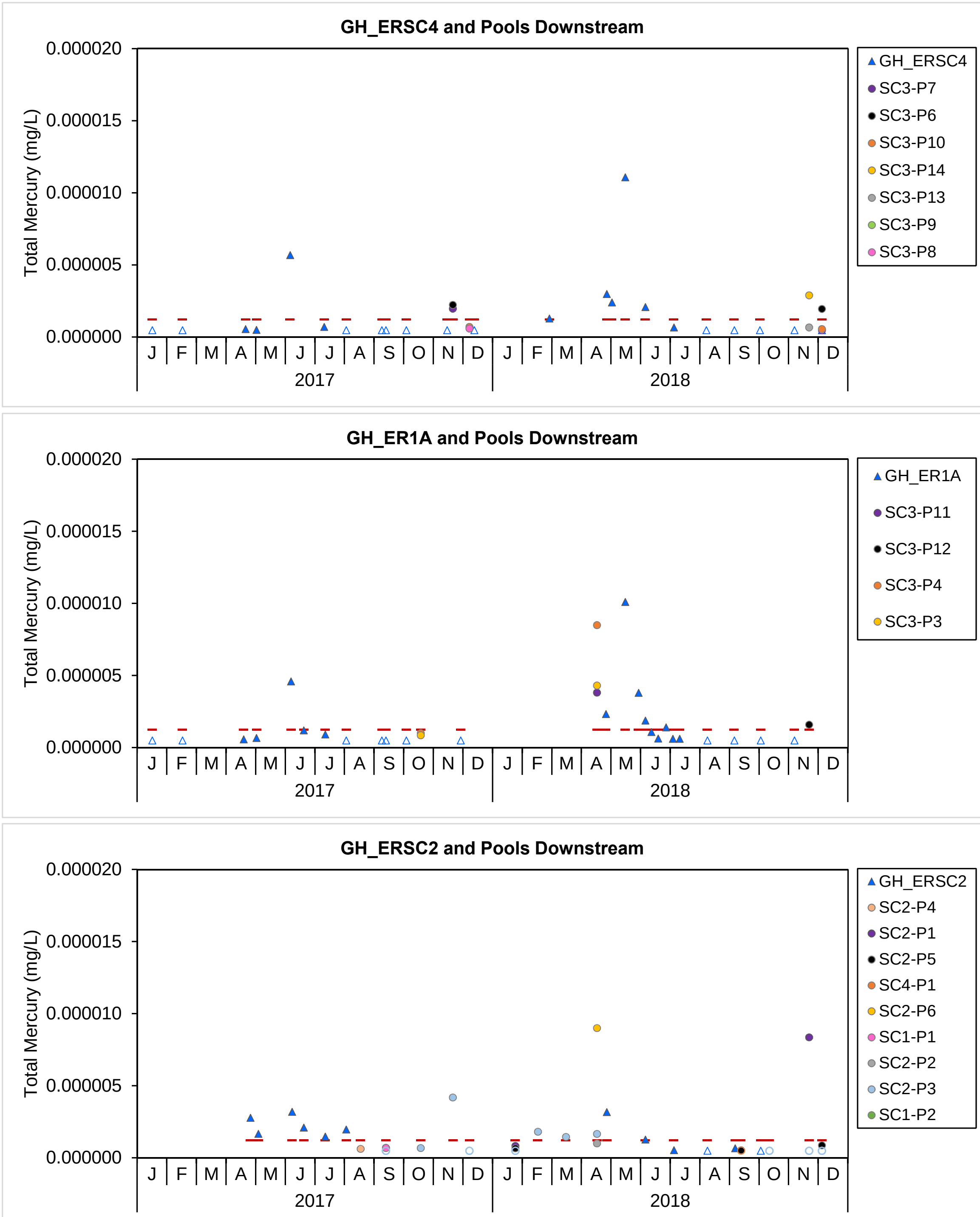


Figure C.69: Time Series Plots for Aqueous Total Mercury Concentrations from Side Channel Monitoring Stations (GH_ERSC4, GH_ER1A, GH_ERSC2) and Isolated Pools, 2017 to 2018

= BCWQG (long term).

Note: Concentrations reported below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Pools are listed in the legend from upstream to downstream.

APPENDIX D
ASSESSMENT OF GROUNDWATER-SURFACE WATER INTERACTION FOR LAEMP WEST SIDE OF GHO
(SNC-LAVALIN 2019)

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May 30, 2019 Project: 655483

Teck Coal Limited
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Sparwood, BC V0B 2G0

ATTENTION: Cait Good, Lead Regional Water Monitoring.

REFERENCE: **Assessment of Groundwater-Surface Water Interaction for LAEMP West Side of GHO**

1 Introduction

SNC-Lavalin Inc. (SNC-Lavalin) has evaluated groundwater and surface water interactions using current information for the west side of Greenhills Operations (GHO) on behalf of Teck Coal Limited (Teck) in support of the GHO Local Aquatic Effects Monitoring Program (LAEMP); herein referred to as 'the Project'. An understanding of local aquatic effects of the west side tributaries of GHO to immediate receiving environments is required in Section 9.3.3 of Permit 107517[1].

GHO is located approximately 8 km northeast of Elkford, BC and south of the Fording River Operations (FRO). GHO straddles the drainage divide between the Elk River to the west, and the Fording River to the east and south (shown on Drawing 655483-001). The majority of GHO is located in the southwestern portion of Management Unit (MU) 1, while the southwest portion of GHO is located in MU3.

1.1 Background and Project Understanding

GHO is one of Teck's five active coal mines in the Elk Valley. The mine-permitted area at GHO covers approximately 11,806 hectares (ha) and mining is focused along Greenhills Ridge. Elevations at GHO range from approximately 1,300 metres above sea level (m asl), in the valley bottom along the flanks of the Greenhills Ridge adjacent to the Elk River, to upwards of 2,200 m asl at the ridge tops. The Elk River side channel is located between the Elk River and the western flank of the Greenhills Ridge and flows from directly south of Leask Creek to south of Thompson Creek, where it converges with the Elk River (Drawing 655483-001).

SNC-Lavalin understands that the BC Ministry of Environment & Climate Change Strategy (ENV)[2] requires a Regional Aquatics Effects Monitoring Program (RAEMP) for the Elk Valley Region and a LAEMP for GHO be completed under Permit 107517. Section 9.3.3 of Permit 107517 states:

1 Permit 107517, amended August 25, 2018.
2 Formerly known as the BC Ministry of Environment (MoE).

The Permittee must complete to the satisfaction of ENV a study design for a LAEMP which will focus on the upper Elk River and the Elk River side channel and tributaries located on the west side of GHO between sites 0200389 [GH_ER2] and E3000090 [GH_ERC] for 2017-2020 by June 1, 2017. The study design must be reviewed by the Environmental Monitoring Committee (EMC) and be designed to an appropriate temporal scale to capture short term, local effects to the immediate receiving environment.

In order to fulfill conditions in Permit 107517, Minnow Environmental Inc. (Minnow) and Lotic Environmental Ltd. (Lotic) completed a Study Design for the GHO LAEMP in 2017 (Minnow and Lotic, 2017). The 2017 LAEMP Study Design recommended evaluating Teck's routine water quality monitoring and supplementary sampling data collected as part of the GHO LAEMP field component. The Program also suggests that monitoring data should be collected from water quality stations in the upper Elk River and Elk River side channel for evaluation relative to the site-specific benchmarks or water quality guidelines. In addition, monthly sampling of water collected from isolated pools located along the Elk River side channel (if present) are to be collected and analyzed for select parameters. Selection of isolated pools should be focussed on large pools containing fish, if possible.

The EMC provided input on the Study Design, which included a number of comments and questions relating to surface water and groundwater interaction and the influence of groundwater on surface water quality. As a result of the input we understand that Teck requires a greater understanding of the relationship between groundwater and surface water and ultimately, what role groundwater plays in water quality in Elk River side channel.

A field program was carried out in 2017/2018 to address some of the input on the Study Design; however, no field work associated with groundwater investigations was performed (Minnow and Lotic, 2018a). The field program included assessing surface water chemistry from Elk River stations GH_ER2 and GH_ERC, surface water flow, water levels from five stations (three within the side channel: GH_ERSC4, GH_ER1A, ERSCDS, one upstream: GH_ERUS, and one downstream from the confluence between the side channel and the Elk River), and mapping of isolated pools and dewatering areas.

1.2 Objective

The objective of this study is to develop an understanding of groundwater-surface water interactions along the west side of GHO, including side channels and tributaries, based on existing information. The EMC posed comments relating to how groundwater flow and quality may affect surface water quantity and quality. Key questions were subsequently developed and presented in the 2018 to 2020 GHO LAEMP Study Design (Minnow and Lotic, 2018b). The key question this study is focused towards addressing is:

- *What is the interaction between surface water and groundwater in the Elk River side channel?*

In addition to the question above, the results of the Project and follow up studies may provide information to support to the following additional study questions presented in the 2018 to 2020 GHO LAEMP Study Design (Minnow and Lotic, 2018b):

- *What is the relationship between flows in the main stem Elk River and flows (including connectivity, intermittence, and pools) in the Elk River side channel?*
- *What is the influence of the GHO discharges from the west-side tributaries on water quality in the Elk River and Elk River side channel?*
  - *(a) What is the water quality in the west-side tributaries, and how is it changing over time?*
  - *(b) What is the water quality at monitoring stations in the Elk River side channel, is it changing over time, and how does it compare to water quality in the main stem of the Elk River?*
  - *(c) What is the water quality at monitoring stations in the Elk River downstream versus upstream of the west-side tributaries, and is it changing over time?*
  - *(d) What is the water quality in isolated pools in the Elk River side channel that provide potential aquatic habitat for aquatic and/or aquatic-dependent vertebrates (i.e., fish, amphibians, and aquatic-feeding birds)?*

This assessment assists Teck in meeting their commitments to the EMC to consider groundwater as part of the LAEMP, as well as to identify any data gaps in the groundwater understanding. As such, we understand that data gaps may exist and additional work may be required to improve the assessment.

2 Desktop Review of Existing Information

Known available groundwater and surface water information was reviewed and compiled. To date, groundwater results (water level and water chemistry data), surface water chemistry and instantaneous flow data up to December 2018 have been included in the Project. A total of two years of analytical water chemistry data (2017 to 2018) from the side channel and isolated pools (identified in the 2017 LAEMP), spatial distribution of wetted areas (identified in the 2017 LAEMP) and surface water levels up to October 2018 have also been incorporated into this assessment. SNC-Lavalin understands that additional isolated pools were identified and sampled during the 2018 LAEMP field program; however, these results along with the 2018 spatial distribution of wetted areas were not included in this assessment as the data were not finalized. A summary of previous investigations reviewed is summarized in Section 2.1. A summary of existing wells and groundwater data along the west side of GHO is provided in Section 2.2, and a summary of existing surface water data is provided in Section 2.3.

2.1 Previous Investigations

Previous investigations of groundwater within and proximal to the west side of GHO have been conducted by SNC-Lavalin and other consultants between 2012 and 2018. Detailed references to these investigations can be found in the References section of this report (Section 6). Hydrogeology-related information for these investigations was reviewed and compiled; a chronological summary of relevant previous hydrogeological investigations is found in Table A below. In addition, information related to surface water was also reviewed and is summarized in Table B below.

Table A: Summary of Relevant Hydrogeological Investigations

Source	Description of Hydrogeological Information
Hemmera, 2014	› Greenhills Operations Groundwater Monitoring Program.
Golder, 2015	› Hydrogeology Baseline Report, which summarized groundwater and surface water interaction and sources of contact water, such as waste rock spoils in relation to the Cougar Pit Extension Project.
Hemmera, 2015	› 2014 Monitoring Well Installation and Groundwater Sampling Program for GHO, which presented the results of the drilling program. The program included drilling and well installation, hydraulic conductivity testing, and groundwater sampling in 2014.
SNC-Lavalin, 2015	› Regional Synthesis Report for the Elk Valley, which summarized and compiled available groundwater information available for all Teck Coal Operations and presented a Regional Conceptual Model.
Hemmera, 2016	› 2015 Annual Groundwater Report for GHO, which presented results from groundwater samples collected in 2015.
SNC-Lavalin, 2016	› 2015 Annual Report, Regional Groundwater Monitoring Program, which presented results from groundwater samples collected in 2015 from the Elk Valley.
Hemmera, 2017a	› 2016 Annual Groundwater Report for GHO, which presented results from groundwater samples collected in 2016.
Hemmera, 2017b	› 2016 Monitoring Well Installation and Groundwater Sampling Report for GHO, which presented results from the drilling program. The program included drilling and well installation, hydraulic conductivity testing, a seismic refraction survey program and groundwater sampling in 2016.
SNC-Lavalin, 2017a	› 2016 Annual Report, Regional Groundwater Monitoring Program, which presented results from groundwater samples collected in 2016 from the Elk Valley.
SNC-Lavalin, 2017b	› Regional Groundwater Monitoring Program for the Elk Valley, which presented an update to the Regional conceptual site model (CSM) addressing conditions listed in the 2017 ENV Approval letter.
SNC-Lavalin, 2018a	› 2017 Annual Groundwater Monitoring Report, Regional Groundwater Monitoring Program (RGMP), which presented results from groundwater samples collected in 2017 from the Elk Valley.
SNC-Lavalin, 2018b	› 2017 Annual Groundwater Report for GHO, which presented results from groundwater samples collected in 2017.
SNC-Lavalin, 2018c	› An update to the GHO Site Specific Groundwater Monitoring Program (SSGMP), which presented results from the SSGMP between 2015 and 2017 and an updated monitoring program for GHO.
SNC-Lavalin, 2019a	› 2018 Annual Groundwater Monitoring Report for GHO, which presented results from groundwater samples collected in 2018.
SNC-Lavalin, 2019b	› 2018 Regional Groundwater Monitoring Program Annual Report, which presented results from groundwater samples collected in 2018.

Table B: Summary of Relevant Information Relating to Surface Water

Source	Description of Hydrogeological Information
Minnow and Lotic, 2017	› 2017 Study Design for the LAEMP Program at GHO.
Lotic, 2018	› Side-channel monitoring summary for May 2018 for the GHO LAEMP Program.
Minnow and Lotic, 2018a	› 2017 GHO LAEMP Report, which provides the results from the 2017 Program, including monthly aquatic habitat surveys, hydrology, water quality, and substrate quality assessments in the Elk River side-channel.
Minnow and Lotic, 2018b	› Study Design for the GHO LAEMP Program for 2018 to 2020.

In addition to the above listed reports, the 2017 Regional Water Quality Model (RWQM) Update was reviewed to develop an insight into the hydrology of the west side of GHO (Teck, 2017). Additional 2017 and 2018 surface water data (including chemistry and instantaneous flow data) were provided by Teck.

2.2 Summary of Existing Wells and Groundwater Data

A summary of existing wells along the west side of GHO and associated groundwater data available is provided below in Table C. The location of referenced wells proximal to The Project is shown on Drawing 655483-002. A summary of groundwater information (monitoring well installation details, water level, measurements and hydraulic conductivity measurements) is presented in the 2018 Site-Specific Groundwater Monitoring Program (SSGMP) Update, the 2018 SSGMP, and the 2018 Regional Groundwater Monitoring Program (RGMP) (SNC-Lavalin, 2018c, 2019a, 2019b).

Table C: Compilation of Existing Overburden Wells and Available Groundwater Data

Well ID	Source	BH Logs	Water Level Data	Chemistry Data	Physical Aquifer Parameters
GH_GA-MW-1, GH_GA-MW-2, GH_GA-MW-3, and GH_GA-MW-4	Hemmera 2014, 2016, 2017a; Golder 2015; SNC-Lavalin 2016, 2017b, 2018a, 2018b, 2018c, 2019a, 2019b	Y	Y	Y	Y
GH_MW-ERSC-1	Hemmera, 2015; SNC-Lavalin 2017a, 2017b, 2018a, 2018c, 2019b	Y	Y	Y	Y
GH_MW-UTC-1S/D	Hemmera 2017a, 2017b; SNC-Lavalin 2018b, 2018c, 2019a	Y	Y	Y	Y

Notes:
'BH' denotes Borehole.
'Y' indicates data were available.

2.3 Summary of Existing Relevant Surface Water Data

A summary of existing surface water data relevant to the groundwater understanding in the Project area is provided below in Table D. The locations of relevant surface water sampling stations, including permanently wetted areas and isolated pools in Reach 1 East, Reach 1 West, Reach 2, and Reach 3 along the side channel at GHO are shown on Drawing 655483-002.

Table D: Compilation of Available Surface Water Data

Surface Water Body	Surface Water Station and Location	Water Level Data	Flow Data	Chemistry Data
Elk River Main Stem				
Elk River	› Upstream of GHO (GH_ER2) › Upstream of the side channel (GH_ERUS) › Downstream of GHO (GH_ERC)	Y[a]	-	Y[b]
Leask Creek	› Downstream of Leask Pond (GH_LC1) › Inlet to Leask Creek Settling Pond (GH_LC2)	-	Y	Y
Wolfram Creek	› Downstream of Wolfram Pond (GH_WC1) › Wolfram Creek Settling Pond (GH_WC2)	-	Y	Y
Thompson Creek	› Thompson Creek, downstream of Lower Thompson Pond (GH_TC1) › Decant at Lower Thompson Pond (GH_TC2)	-	Y	Y
Elk River Side Channel				
Side Channel	› Downstream of the confluence with Leask Creek (GH_ERSC4) › Downstream of the confluence with Wolfram Creek (GH_ER1A) › Downstream of Thompson Creek (GH_ERSC2 and ERSCDS)	Y[c]	Y[d]	Y[d]
Permanently Wetted Area	› Reach 2: RG_GH-SCW1, RG_GH-SCW2, RG_GH-SCW3	-	-	Y
Isolated Pools	› Reach 1 West: Pool-W-1, Pool-W-2 › Reach 1 East: Pool-E-1 through -3, Pool-E-6, Pool-E-7 › Reach 3: Pool-U-1 through -5; Pool-M-1, Pool-M-2	-	-	Y

Notes:
'-' indicates data not available and 'Y' indicates data were available.
a. All surface water locations except GH_ER2.
b. All surface water locations except GH_ERUS.
c. All surface water locations except GH_ERSC2 and the permanently wetted area.
d. All surface water locations except ERSCDS and the permanently wetted area.

3 Data Compilation and Interpretation

The approach to this section was to provide a summary of compiled groundwater and relevant surface water data focussing on the west portion of GHO, along the Elk River. In addition to data presentation, some interpretation is provided in order to assess data gaps associated with groundwater-surface water interaction in the area.

3.1 Compilation and Interpretation of Existing Surficial Hydrogeology Data

A review of surficial geology and the groundwater conceptual model for GHO outlined in SNC-Lavalin (2018c) was performed and briefly described here. The differences in permeability between bedrock and surficial materials and steep topographic gradients mean the surficial (i.e., overburden) materials are the main pathways of mine-influenced groundwater, with minor potential contribution through bedrock. Groundwater occurrence in surficial units can be separated into:

- Upland setting (i.e., valley flanks): The groundwater flow regime in the upland setting is generally governed by the surface of low permeability units and groundwater flows to the valley-bottom surficial deposits, either as surface water or groundwater; and
- Valley-bottom setting: The main aquifers are in the valley bottoms in fluvial and glaciofluvial deposits. Locally, groundwater flow patterns converge into the valley bottom from bedrock and upland units and discharge to surface water. However, there can be local-scale down-valley flow in the main stem valley bottoms, resulting in groundwater recharge from a losing stream.

These settings are typical for groundwater in mountainous regions and can be generally defined based on differences in recharge, groundwater flow regime and aquifer saturated thicknesses, all of which are ultimately a function of topographic relief.

The majority of groundwater flow in the vicinity of the side channel will occur within high permeability surficial materials such as fluvial or glaciofluvial deposits. These deposits are expected to be relatively heterogeneous and interbedded finer-grained units are expected. Where the side channel loses water to ground, it is expected that infiltration of surface water in the side channel will be governed by the distribution of coarser-and finer-grained units at surface. Alluvial or glaciofluvial deposits are present near the valley flanks and infiltration of the creeks that flow on the west side of GHO may occur. Surficial geology maps and hydrogeological interpretations at GHO is described in detail in the GHO SSGMP Update (SNC-Lavalin, 2018c).

3.2 Groundwater and Surface Water Data Compilation

Seasonal variability and long-term data for groundwater elevations were reviewed for wells situated proximal to the Elk River side channel. These data were compared to continuously logged water levels at surface water stations established for the LAEMP along the Elk River and side channel.

Groundwater elevations from January 2015 to December 2018 were plotted against surface water levels from May/June 2017 to October 2018 on time-series graphs and included as Figures 1 through 3. At the time of reporting, surface water stations were not surveyed to a common datum; therefore, only surface water levels were plotted. The scales of the primary and secondary y-axes for the time-series graphs have been made consistent to compare the magnitude of change in water levels.

Groundwater elevations at GH_GA-MW-4, located downgradient of Leask Creek exhibited a seasonal trend with generally higher groundwater elevations during the spring from mid-March to June (Figure 1). Surface water stations GH_ERUS (Elk River) and GH_ERSC4 (side channel) are located downgradient of GH_GA-MW-4. Based on available LiDAR data, the ground surface in the vicinity of GH_ERUS and GH_ERSC4 is approximately 1,307.4 m asl and 1,307.6 m asl, respectively, which are generally consistent with elevations measured in groundwater at GH_GA-MW-4. Water levels at GH_ERUS and GH_ERSC4 exhibit a similar trend to groundwater levels, with higher levels measured in the spring from April to June and freshet in the Elk River. In addition to the seasonal trend, the magnitude of the water level fluctuations between seasons is similar, suggesting a strong hydraulic connection between shallow groundwater and surface water in this area. On average, water levels in the Elk River at GH_ERUS were approximately 0.4 m higher than downgradient in the side channel at GH_ERSC4.

Figure 2 presents groundwater elevations at GH_GA-MW-2 and water levels at surface water location GH_ER1A in the side channel, located approximately 400 m to the south of GH_GA-MW-2. Monitoring well GH_GA-MW-2 is located downgradient of Wolfram Creek and exhibited a seasonal trend with higher groundwater elevations measured during the spring (April to June). Groundwater elevations fluctuated a maximum of approximately 3.5 m over the course of the monitoring period whereas surface water levels fluctuated by only 1.5 m. Based on available LiDAR data, the ground surface at GH_ER1A is approximately 1,299.8 m asl, which is about one metre lower than the lowest historically recorded groundwater elevation at GH_GA-MW-2. A seasonal trend in surface water data from GH_ER1A, located downgradient of GH_GA-MW-2 was identified, with greater water levels measured in the spring (late-April to July), consistent with freshet in the Elk River. Between late-September 2017 and late-April 2018, the water level was logged to be zero, which suggests no flow at this location; it is therefore assumed that there is no groundwater base flow component. This is consistent with the 2017 LAEMP, which identified this area of the side channel was dry between November 2017 and March 2018 (Attachment 1).

Monitoring well GH_GA-MW-3 is located downgradient of Thompson Creek, directly upgradient of the permanently wetted area (i.e., Reach 2 was previously described as a wetland in 2017 LAEMP) in the side channel. Groundwater elevations fluctuated a maximum of approximately 7.5 m over the course of the monitoring period, with greater elevations measured between March and June. Surface water levels at ERSCDS, located in the side channel, approximately 1.2 km downgradient of GH_GA-MW-3, fluctuated by approximately one metre, with the greatest levels measured between late-April and late-July (Figure 3). Based on available surface water data, the side channel appeared to be dry during the fall/winter months (late-August to April), which is generally consistent with results from the 2017 LAEMP (Attachment 1).

Overall, fluctuations of groundwater elevations appeared to be greatest in the Thompson Creek drainage (i.e., GH_GA-MW-3). In addition, the timing of peak groundwater levels at this location generally appears to be in April/May, which suggests more influence from recharge of snow melt in the catchment rather than from the side channel (Figure 3). Elevated groundwater elevations between March and early May in nested wells GH_MW-UTC-1S and GH_MW-UTC-1D, located in the Upper Thompson Creek, support this interpretation (SNC-Lavalin, 2019a). Surface water levels in the side channel appeared to follow more similar seasonal trends to groundwater at GH_GA-MW-4 near Leask Pond and GH_GA-MW-2 near Wolfram Pond.

In general, water levels at surface water stations along the Elk River (GH_ERUS and GH_ERC) and the Elk River side channel (GH_ERSC4, GH_ER1A) appear to follow a similar trend between May and September, which is expected as water enters down the side channel from the Elk River and flows along the side channel. Water levels at these locations decreased by approximately 1 m between May and September 2017 and 2018. Water levels at surface water station ERSCDS, located in the Elk River side channel near the confluence with the Elk River, also decreased between May and September, but only by approximately 0.5 m. ERSCDS is located in the vicinity of isolated Pool-E-7. Minnow and Lotic indicate that every isolated pool assessed dewatered at least once between August 2017 and March 2018, except Pool-E-7, which typically contained a thin layer of ice and snow over the majority of the Pool throughout the winter months (2018a). The pooling of water in the vicinity of ERSCDS may have resulted in the muted decrease in water levels between May and September (Minnow and Lotic, 2018a).

3.3 Groundwater and Surface Water Quality Summary

Available groundwater and surface water chemistry for the Project area was compiled and compared to the *Contaminated Sites Regulation* (CSR) Standards (ENV, 2019) and the *BC Water Quality Guidelines* (BCWQG) (ENV, 2018). These were primary screening criteria outlined in the RGMP and GHO SSGMP (SNC-Lavalin, 2019a and 2019b, respectively).

To understand potential groundwater pathways of mine-related constituents, select parameters (nitrate-N, sulphate, dissolved cadmium, and dissolved selenium) in groundwater and surface water have been assessed and are collectively identified as constituents of interest (CI). Water quality data for CI at available groundwater and surface water locations are presented in Table E and Table F, respectively. Water quality data for isolated pools in Reaches 1 and 3, and the permanently wetted area (Reach 2) are presented in Table G. The quarter containing the most comprehensive dataset for groundwater and surface water was Q4 in 2018; therefore, data presented in Table E are from this quarter. For surface water presented in Table F and Table G, a range of detectable concentrations in 2017 and 2018 are presented along with the highest concentrations measured in Q4 of 2018. Minnow and Lotic also presented temporal plots of monthly means for select CI parameters in the tributaries, Elk River side channel, and the Elk River (Minnow and Lotic, 2018a), included in Attachment 2.

Table E: Summary of Groundwater CI Concentrations in Overburden Wells in Q4, 2018

Setting	Well ID	Detectable Concentrations[a]			
		Nitrate-N (mg/L)	Sulphate (mg/L)	Dissolved Cadmium (µg/L)	Dissolved Selenium (µg/L)
Upland Setting	GH_MW-UTC-1S	0.0474	33.0	0.0087	2.06
	GH_MW-UTC-1D	< 0.025	13.6	0.0778	1.29
Valley-bottom Setting	GH_GA-MW-2	4.80	265	0.072	***<u>11.3</u>***
	GH_GA-MW-4	0.838	37.1	0.0067	2.61
	GH_GA-MW-3	0.0052	30.9	< 0.0050	***<u>10.3</u>***
	GH_MW-ERSC-1	0.0383	16.6	0.0497	0.73
	CSR AW	400	1,280 – 4,290[b]	0.5 – 4[b]	20
	CSR LW	100	1,000	80	30
	CSR IW	n/a	n/a	5	20
	CSR DW	10	500	5	10

Notes:
Primary screening criteria applied are CSR standards for Aquatic Life (AW), Livestock (LW), Irrigation (IW), and Drinking Water (DW).
a. ***<u>Bold, italicized, underlined</u>*** concentration indicates concentration above standard/guideline.
b. Hardness dependent standard/guideline.

Table F: Summary of Surface Water CI Concentrations in 2017 and 2018

Locations	# of Samples	Range of Detectable Concentrations[a]											
		Nitrate-N (mg/L)			Sulphate (mg/L)			Dissolved Cadmium (µg/L)			Dissolved Selenium (µg/L)		
		Min	Max	Q4 2018	Min	Max	Q4 2018	Min	Max	Q4 2018	Min	Max	Q4 2018
Elk River Main Stem													
GH_ER2	64	0.021	0.247	0.107	11.9	24.7	22.5	<0.005	0.010	0.006	0.599	1.50	0.953
GH_ERC[b]	67	0.161	0.762	0.418	18.1	44.8	29.2	<0.005	0.0358	0.008	0.984	***4.17***	1.81
Leask Creek													
GH_LC1	21	***10.6***	***72.2***	***72.2***	203	***907***	***850***	<0.005	0.183	0.0071	***22.1***	***232***	***183***
GH_LC2	35	***12.6***	***83.7***	***79.4***	***566***	***917***	***885***	<0.005	0.523	0.0229	***17.8***	***286***	***208***
Wolfram Creek													
GH_WC1	22	***15.9***	***56.4***	***56.3***	176	***1,050***	***1,000***	<0.003	0.316	0.005	***33.1***	***137***	***137***
GH_WC2	35	***22.3***	***77.9***	***67.5***	269	***1,070***	***1,000***	<0.005	0.435	0.0075	***47.7***	***216***	***158***
Thompson Creek													
GH_TC1	40	0.06	***19.8***	***18.0***	20	***1,030***	***940***	<0.005	0.0616	0.015	0.109	***184***	***184***
GH_TC2	33	2.8	***19.0***	***18.3***	208	***1,030***	***951***	<0.005	0.0667	0.0172	***37.3***	***191***	***180***
Elk River Side Channel													
GH_ERSC4	24	0.0123	0.418	0.0754	13.4	41.2	24.2	<0.005	0.018	0.0070	0.694	1.98	1.07
GH_ER1A	26	0.0075	***11.9***	0.048	15.9	188	21.7	0.0053	0.0232	0.0072	0.648	***31.2***	0.979
GH_ERSC2	14	0.055	***45.1***	2.78	16.7	215	163	0.0071	0.0721	0.0077	0.841	***112***	***24.6***
BCWQG AW (short-term max.)		32.8			n/a			0.734 – 16.86[c]			n/a		
BCWQG AW (long-term max.)		3			128 – 429[c]			0.248 – 2.33[c]			2		
BCWQG LW		100			1,000			80			30		
BCWQG IW		n/a			n/a			5.1			10		
BCWQG DW		10			500			5			10		

Notes:
Primary screening criteria applied are BCWQG for Aquatic Life (AW), Livestock (LW), Irrigation (IW), and Drinking Water (DW).
"-" denotes insufficient data.
a. ***Bold, italicized, underlined*** concentration indicates concentration above guideline.
b. CP; BCWQG do not apply.
c. Hardness dependent standard/guideline.

Table G: Summary of Isolated Pools and Permanently Wetted Area CI Concentrations in 2017 and 2018

Locations	# of Samples	Range of Detectable Concentrations[a]											
		Nitrate-N (mg/L)			Sulphate (mg/L)			Dissolved Cadmium (µg/L)			Dissolved Selenium (µg/L)		
		Min	Max	Q4 2018	Min	Max	Q4 2018	Min	Max	Q4 2018	Min	Max	Q4 2018
Isolated Pools (Reach 3)													
Pool-U-1	2	0.0147	0.0497	0.0497	23.2	25	25	0.0076	0.0442	0.0076	0.731	0.955	0.955
Pool-U-2	2	0.0168	0.0525	0.0525	24.5	27.3	27.3	0.0192	0.0377	0.0192	0.698	0.923	0.923
Pool-U-3	2	0.561	0.0688	0.0561	25.9	26.2	26.2	<0.005	0.0117	0.0117	0.937	0.992	0.937
Pool-U-4	1	-	-	<0.005[b]	-	-	26.1[b]	-	-	0.208[b]	-	-	0.927[b]
Pool-U-5	1	-	-	0.0078[b]	-	-	26[b]	-	-	0.006[b]	-	-	0.866[b]
Pool-M-1	2	<0.005	0.0223	0.223[c]	3.2	20.4	3.2[c]	0.0078	0.008	0.0078[c]	0.27	0.661	0.27[c]
Pool-M-2	2	<0.005	0.161	0.161[c]	11.3	20.1	11.3[c]	<0.005	0.0106	0.0106[c]	0.146	0.657	0.14[c]
Permanently Wetted Area (Reach 2)													
RG_GH-SCW1	2	0.0254	0.0383	0.0254	18.2	19.4	19.4	0.0058	0.0075	0.0075	-	-	0.942
RG_GH-SCW2	3	0.812	***8.59***	***8.59[c]***	27.4	***486***	***486[c]***	0.0099	0.0183	0.0183[c]	***2.34***	***83.8***	***83.8[c]***
RG_GH-SCW3	8	2.03	***20.6***	***20.6***	126	***1,030***	***1,030***	<0.010	0.0272	0.0148	***21.8***	***187***	***187***
Isolated Pools (Reach 1 West and East)													
Pool-W-1	4	0.102	***4.78***	***4.78***	23.1	227	227	0.0065	0.0267	0.0267	1.75	***34.4***	***34.4***
Pool-W-2	2	0.0895	0.134	0.134[d]	29.1	40.9	40.9[d]	0.0063	0.0119	0.0119[d]	***2.38***	***4.56***	***4.56[d]***
Pool-E-1	1	-	-	***4.36[d]***	-	-	356[d]	-	-	0.26[d]	-	-	***52.5[d]***
Pool-E-2	5	***5.41***	***11.8***	***11.8***	***401***	***639***	***639***	0.0289	0.0568	0.0568	***56.4***	***138***	***138***
Pool-E-3	3	0.0978	2.48	0.0978	26	198	26	0.0158	0.0234	0.0158	**2.21**	***26.1***	**2.21**
Pool-E-6	6	***3.66***	***8.3***	***8.3***	274	***457***	***568***	0.0248	0.0369	0.0352	***20.9***	***96.2***	***96.2***
Pool-E-7	13	***4.34***	***14.6***	***9.33***	216	***591***	***482***	0.0171	0.062	0.0361	***38.7***	***101***	***97.3***
BCWQG AW (short-term max.)		32.8			n/a			0.734 – 16.86[e]			n/a		
BCWQG AW (long-term max.)		3			128 – 429[e]			0.248 – 2.33[e]			2		
BCWQG LW		100			1,000			80			30		
BCWQG IW		n/a			n/a			5.1			10		
BCWQG DW		10			500			5			10		

Notes:
Primary screening criteria applied are BCWQG for Aquatic Life (AW), Livestock (LW), Irrigation (IW), and Drinking Water (DW).
"-" denotes insufficient data.
a. ***Bold, italicized, underlined*** concentration indicates concentration above guideline.
b. No data available for Q4 2018; Q4 2017 results presented.
c. No data available for Q4 2018; Q2 2018 results presented.
d. No data available for Q4 2018; Q3 2017 results presented.
e. Hardness dependent standard/guideline.

Overall, concentrations of Cl were greater in tributary surface water compared to groundwater sampled from the existing monitoring network, with the highest concentrations measured in surface water from Leask, Wolfram, and Thompson creeks. Based on review of time-series plots (Minnow and Lotic, 2018a; Attachment 2), concentrations of Cl in the tributaries appear to be highest during the winter months (October to April), with concentrations decreasing during freshet. Conversely, in the side channel and the Elk River, concentrations of Cl in GH_ERC, GH_ERSC4, GH_ER1A, and GH_ERSC2 appeared to be generally greatest between April and May (Minnow and Lotic, 2018a). However, Cl concentrations were relatively similar at GH_ERSC2 and in Thompson Creek during April/May suggesting this west side tributary influences the side channel at this location. It is also noted that elevated concentrations of nitrate, sulphate, and dissolved selenium [i.e., at or near Elk Valley Water Quality Plan (EVWQP) Level 1 Benchmark] at GH_ERSC2 were measured in November of 2016. The reason for this is unclear, but may be related to groundwater discharge originating from Thompson Creek.

Concentrations of Cl in surface water from the isolated pools within Reach 3 (Pool-U-series and Pool-M-series) were less than the applicable guidelines, with concentrations similar to those measured upgradient in the Elk River side channel at GH_ERSC4. This is indicative that surface waters in the pools are not mine-influenced and are inferred to be sourced from the Elk River. Surface water from pools located within Reach 1 (Pool-E-series and Pool-W-series), however, contained concentrations of Cl greater than the applicable guidelines, with higher concentrations measured along Reach 1 East.

3.4 Major Ion Hydrogeochemistry

Surface water major ion chemistry was assessed to evaluate groundwater–surface water interactions and are presented in Table H and Table I. The 2017 GHO SSGMP Update describes the major ion chemistry in detail and presents piper plots which show the evolution of groundwater chemistry at GHO (SNC-Lavalin, 2018c). These plots have been updated with 2018 major ion results for relevant surface water locations from the LAEMP and Teck’s surface water monitoring program. The updated plots have been separated by reaches, with isolated pools in Reach 3 (Figure 4) and permanently wetted areas in Reach 2 and isolated pools in Reach 1 (Figure 5). Consistent with Table E, Table F, and Table G, Q4 2018 results were utilized to generate the piper plots. For surface water, isolated pools, and permanently wetted area locations that were sampled more than once during Q4, average concentrations for the quarter were utilized to assess water type. Groundwater major ion chemistry is presented in the 2018 GHO SSGMP and have been included for comparison in Figures 4 and 5 (SNC-Lavalin, 2019a).

Table H: Summary of Water Types in Surface Water in Q4 2018

<table>
<tr><th>Location</th><th>Location ID</th><th>Water Type</th></tr>
<tr><td rowspan="2">Elk River Main Stem</td><td>GH_ER2</td><td rowspan="2">Calcium-bicarbonate</td></tr>
<tr><td>GH_ERC</td></tr>
<tr><td rowspan="2">Leask Creek</td><td>GH_LC1</td><td rowspan="2">Magnesium-calcium-sulphate</td></tr>
<tr><td>GH_LC2</td></tr>
<tr><td rowspan="2">Wolfram Creek</td><td>GH_WC1</td><td>Magnesium-calcium-sulphate</td></tr>
<tr><td>GH_WC2</td><td>Calcium-magnesium-sulphate</td></tr>
<tr><td rowspan="2">Thompson Creek</td><td>GH_TC1</td><td rowspan="2">Calcium-magnesium-sulphate</td></tr>
<tr><td>GH_TC2</td></tr>
<tr><td rowspan="3">Elk River Side Channel</td><td>GH_ER1A</td><td rowspan="2">Calcium-bicarbonate</td></tr>
<tr><td>GH_ERSC4</td></tr>
<tr><td>GH_ERSC2</td><td>Calcium-magnesium-sulphate-bicarbonate</td></tr>
</table>

Table I: Summary of Water Types in Isolated Pools and Permanently Wetted Areas in Q4 2018

<table>
<tr><th>Location</th><th>Location ID</th><th>Water Type</th></tr>
<tr><td rowspan="7">Isolated Pools (Reach 3)</td><td>Pool-U-1</td><td rowspan="5">Calcium-bicarbonate</td></tr>
<tr><td>Pool-U-2</td></tr>
<tr><td>Pool-U-3</td></tr>
<tr><td>Pool-U-4[a]</td></tr>
<tr><td>Pool-U-5[a]</td></tr>
<tr><td>Pool-M-1[b]</td><td rowspan="2">Calcium-bicarbonate</td></tr>
<tr><td>Pool-M-2[b]</td></tr>
<tr><td rowspan="3">Permanently Wetted Area (Reach 2)</td><td>RG_GH-SCW1</td><td>Calcium-bicarbonate</td></tr>
<tr><td>RG_GH-SCW2</td><td rowspan="2">Magnesium-calcium-sulphate</td></tr>
<tr><td>RG_GH-SCW3</td></tr>
<tr><td rowspan="7">Isolated Pools (Reach 1)</td><td>Pool-W-1</td><td>Calcium-sulphate-bicarbonate</td></tr>
<tr><td>Pool-W-2[a,c]</td><td>Calcium-bicarbonate</td></tr>
<tr><td>Pool-E-1[a,c]</td><td rowspan="2">Calcium-magnesium-sulphate</td></tr>
<tr><td>Pool-E-2</td></tr>
<tr><td>Pool-E-3</td><td>Calcium-bicarbonate</td></tr>
<tr><td>Pool-E-6</td><td rowspan="2">Calcium-sulphate</td></tr>
<tr><td>Pool-E-7</td></tr>
</table>

Notes:

a. No 2018 data available; results are based on 2017 analytical data.
b. No data available for Q4 2018; Q2 results presented.
c. No data available for Q4; Q3 results presented.

As shown in Figures 4 and 5, surface water collected from the Elk River and Elk River side channel were calcium-bicarbonate type water and are clearly distinct. Surface water collected from tributary creeks Leask, Wolfram, and Thompson, were predominantly calcium-magnesium-sulphate-bicarbonate type water. The tributaries are considered to be mine-influenced as evidenced by the sulphate-rich water type. It is noted that GH_ERSC2 has a slight sulphate enrichment, relative to other surface water locations in the Elk River and side channel, likely because it is more influenced by mine influenced water from Thompson Creek drainage, as discussed above (Figure 5).

SNC-Lavalin (2018c) interpreted that groundwater in the valley-bottom is affected by surface water from the tributary creeks. As shown in the piper plot in Figure 4, groundwater from monitoring wells in the vicinity of Wolfram Creek at GH_GA-MW-2 appears to be more reflective of mine-influence (i.e., more sulphate-rich) than in the vicinity of Leask Creek at GH_GA-MW-4 (Figure 4). Groundwater at GH_GA-MW-3, in the vicinity of Thompson Creek is not sulphate rich and does not appear to reflect mine-influence (Figure 5). Groundwater at GH_MW-ERSC-1 plots in the vicinity of the mine-influenced tributaries; however, it is not located immediately downgradient of any tributaries (Figure 5). The SSGMP (SNC-Lavalin, 2018) indicated that mine-influenced water appears to be only periodically present at this location; the reason for this is unclear.

Similar to surface water from the Elk River and the side channel, isolated pools in Reach 3 were predominantly calcium-bicarbonate type water. Further downstream, surface water collected from the wetted area in Reach 2 was calcium-bicarbonate type at RG_GH-SW1 and mixed cation-sulphate type at RG_GH-SW2 and -SW3. In Q4 of 2018, surface water along Reach 1 contained varying proportions of calcium, magnesium, sulphate, and bicarbonate. Surface water station RG_GH-SW1 is located upstream of the confluence with Thompson Creek, whereas the other two locations are at or near the confluence with Thompson Creek. Additional discussion is presented below.

3.5 Spatial Distribution of Wetted Areas

Between May 2017 and March 2018, Minnow and Lotic assessed monthly conditions in terms of wet and dry sections of the side channel and flood areas, surface connectivity to the side channel, and between the side channel and Elk River main stem (Minnow and Lotic, 2018a). Attachment 1 includes maps by Minnow and Lotic (2018b) presenting wet and dry locations at various times periods between May 2017 and March 2018. The side channel was wettest between May and August with all reaches (i.e., Reach 1 East, Reach 1 West, Reach 2, and Reach 3) all containing water. Pools were mapped in the reaches at various times of the year, typically after the channel had been wetted in the previous month, which suggests that the pools are stagnant water resulting from dewatering of the side channel (i.e., recharging groundwater).

During the fall and winter months, the wetted area decreased from south to north, as anticipated with the main water source of the side channel being the Elk River main stem. One exception of this was the area around the confluence with Thompson Creek (Reach 2), which was wet year-round. Throughout the entire assessment period of the 2017 LAEMP (May 2017 to March 2018), no overland connectivity between the side channel and Leask, and Wolfram creeks and ponds was observed (Minnow and Lotic, 2018a).

4 Discussion and Gap Analysis

The Elk River side channel undergoes seasonal flooding and braiding with variable flow throughout the year. The surficial deposits underlying the side channel generally comprise fluvial and glaciofluvial sand and gravels (SNC-Lavalin, 2018c). Review of the mapping performed by Minnow and Lotic (2018b) suggests that the seasonal flow in the side channel infiltrates to ground across the majority of the channel and develops isolated pools in seasons outside freshet. The exception to this is in the areas of Reach 2 and Pool-E-7, which appeared to be wetted year-round. A thin layer of ice and snow over the majority of Pool-E-7 was observed in winter months. The fact that limited ice develops on at Pool-E-7 suggests groundwater discharge is occurring to this pool.

Concentrations of CI increase along the side channel flow path, which is inferred to result from transport and loading of CI from mine-influenced tributaries on the west side of GHO. Since no significant overland flow has been identified from Leask and Wolfram Creeks towards the Elk River or side channel (Minnow and Lotic, 2018a), this suggests that the loading to the side channel is through groundwater flow paths in addition to Thompson Creek.

The following sections present more detailed interpretations of groundwater–surface water interaction from north to south along the Elk River side channel.

4.1 Leask Creek

Leask Creek is considered mine-influenced with elevated concentrations of CI above the BCWQG and flows along the valley flank across till/morainal deposits, over an alluvial fan into Leask Pond and to the valley bottom where glaciofluvial and fluvial deposits are present. Once the creek flows into the valley bottom across these deposits, losses to ground likely occur. Leask Pond decants to the main stem of the Elk River; however, the pond was not observed to connect overland to the Elk River or Elk River side channel during monitoring between May 2017 and April 2018 (Minnow and Lotic, 2018a). Leask Pond is known to have a high infiltration capacity and flows from Wolfram Creek and Mickelson Creek are diverted to this pond when infiltration capacity at their ponds is not sufficient (Hemmera, 2014; SNC-Lavalin, 2018c).

Water from Leask Creek and Pond is sulphate-rich and contains concentrations of CI greater than in groundwater at adjacent GH_GA-MW-4. In 2018, increases in concentrations of CI have been measured in surface water, which may be related to the re-direction of Phase 6 Pit dewatering to the Creek. Groundwater quality at adjacent GH_GA-MW-4 has historically appeared to be more influenced by Leask Creek. In recent years groundwater appears to have been more influenced by infiltration of the Elk River, as demonstrated through changes in water type and groundwater level fluctuations similar to the Elk River (a reversal in hydraulic gradient) (SNC-Lavalin, 2019a). In 2018, the water type at GH_GA-MW-4 was predominantly a mixed cation-bicarbonate water type and has been interpreted to be influenced more by mixing of the Elk River and less by mine-influenced surface water in 2018 (Figure 4).

Surface water location GH_ERSC4 is located in the side channel, downgradient of Leask Creek and a meander in the Elk River. Concentrations of Cl at GH_ERSC4 were less than the applicable criteria and similar to the Elk River (GH_ERC and GH_ER2). These results suggest that the contribution of mine-influenced groundwater originating from Leask Creek to the side channel is minimal.

Further downgradient, five pools (Pool-U-1 through -5) were sampled in the northern portion of Reach 3 during November 2018, December 2017, and December 2018. Cl in surface water at the isolated pools remained less than the applicable criteria, consistent with GH_ERSC4 and the Elk River (GH_ER2 and GH_ERC) and are interpreted to be a result of dewatering of the side channel (i.e., recharging groundwater) and not groundwater discharge. This interpretation is supported by the major ion hydrochemistry results, indicating that the water type at GH_ERSC4 and the isolated pools is calcium-bicarbonate, consistent with the water type in the Elk River (Figure 4). Inputs from the Elk River at this location are likely greater than from Leask Creek.

4.2 Wolfram Creek

Similar to Leask Creek, surface water in the headwaters of the catchment flow through waste rock from the West Spoil. Similar to Leask Creek, dewatering of Phase 6 pit is expected to contribute Cl to surface water. Surface water subsequently flows along till deposits on the valley flanks to the valley bottom where glaciofluvial deposits exist. Wolfram Pond is located at the base of Wolfram Creek which promotes surface water infiltration into the ground in this area. Although a defined channel exists near the outlet of Wolfram Ponds to the side channel, no overland flow was observed between May 2017 and March 2018. It is expected that at times of extreme flows, overland connection between Wolfram Ponds and the side channel may exist (Minnow and Lotic, 2018b). Surface water level results at GH_ER1A indicate that little or no flow in the side channel was observed between late September 2017 and mid April 2018.

Elevated concentrations of Cl have historically been measured in surface water in Wolfram Pond (GH_WC1) and downstream in Wolfram Creek (GH_WC2), with concentrations greater than the applicable criteria. Monitoring well GH_GA-MW-2, located in the vicinity of GH_WC1 contained measurable concentrations of Cl, but orders of magnitude below Wolfram Creek. However, since Q3 2017, groundwater at GH_GA-MW-2 appears to be influenced more by mine-influenced surface water from Wolfram Creek than in previous years (SNC-Lavalin, 2019a). Water from GH_GA-MW-2 was predominantly calcium bicarbonate-sulphate, which is indicative of potential mixing of sulphate rich water from Wolfram Creek and bicarbonate rich water from the Elk River and/or side channel (Figure 4). Although GH_GA-MW-2 is a deep well situated above bedrock with overlying silt and clay units and a direct hydraulic connection with this well is not expected, groundwater in this area does appear to be seasonally influenced by surface water (SNC-Lavalin, 2019a).

Surface water location GH_ER1A is located downgradient of the channel that connects Wolfram Creek to the side channel. Marginally elevated concentrations of Cl relative to the applicable criteria were measured at this surface water location in Q2 of 2017 and 2018 (Minnow and Lotic, 2018b; SNC-Lavalin, 2019a). Seasonal fluctuations of Cl in surface water are assumed to be coincident with snow melt in the Wolfram drainage, with elevated concentrations measured between April and June months, and step increases in April/May (Attachment 2). This suggests the loading of Cl from the mine-influenced creek to the side channel increases during these months. Concentrations subsequently decrease to be more reflective of conditions at GH_ERSC4 and the Elk River for the remainder of 2017 and 2018. Surface water level data documented by Minnow and Lotic (2018b) supports this interpretation, with greater surface water levels measured in the spring (late-April to July 2017), consistent with freshet in the Elk River. Between late-September 2017 and late-April 2018, water levels in the side channel were logged to be zero, indicative of no flow at this location; therefore, it is assumed that there is no added groundwater baseflow. Increases in Cl measured in the side channel in April/May 2018, during times of expected peak flows are interpreted to be related to surface water inputs from Wolfram Creek.

Two pools (Pools M-1 and M-2) were sampled between Wolfram and Thompson creeks in October 2017 and April 2018. Major ion chemistry for these pools are consistent with the distribution of ions measured in the side channel at GH_ERSC4 (calcium-bicarbonate; Figure 4). Similar to the isolated pools identified in the northern portion of Reach 3, the pools are interpreted to be a result of dewatering of the side channel and not groundwater discharge.

4.3 Thompson Creek

Surface water in the headwaters of the catchment flow through rock drains underneath the West Spoil in North Thompson Creek and Upper Thompson Creek. A permanently wetted area (Reach 2) is located at the confluence of Thompson Creek and the side channel. A greater mean flow through the winter months at Thompson Creek is interpreted to attenuate seasonality of water chemistry in Reach 2 compared to the remainder of the side channel and contribute to continued wetness in this area (Teck, 2017). Instantaneous flow measurements in 2017 and 2018, presented in Figure 6, were greatest overall at Thompson Creek compared to Leask and Wolfram Creeks. During winter months (December to early-March), maximum recorded flow at Thompson Creek (GH_TC2) was approximately 0.10 m^3/s. Instantaneous flow was measured during all of the winter field events at Thompson Creek, whereas times of no flow were measured at Leask and Wolfram during at least one field event. In 2017 and 2018, maximum flow recorded at Leask and Wolfram during winter months were significantly lower than at Thompson Creek (0.03 m^3/s and no flow, respectively) (Figure 6). Thompson Creek is an annual source of water feeding the side channel at the confluence with Thompson Creek, but data also suggest Thompson Creek is also an annual source of recharge to groundwater.

Seasonal fluctuations in groundwater levels at GH_GA-MW-3 (located along Thompson Creek, near the confluence with the side channel) suggest the well is predominantly influenced by snow melt in the upper catchment. Concentrations of Cl in groundwater have periodically been greater than the applicable criteria (SNC-Lavalin, 2019a); however, historical concentrations of Cl were an order of magnitude or greater in Thompson Creek (GH_TC1) and Lower Thompson Pond (GH_TC2) than at GH_GA-MW-3 suggesting either attenuation is occurring, or the well is not directly influenced by infiltration of the creek. Although groundwater concentrations have fluctuated since January 2015, an overall decreasing trend in nitrate, sulphate, and selenium has been identified, and the major ion chemistry at GH_GA-MW-3 has become increasingly more bicarbonate-rich (SNC-Lavalin, 2019a) becoming a mixed-cation bicarbonate (Figure 5). This change, as well as the consistency between groundwater and surface water levels in 2018 suggests a stronger influence from recharge from the Elk River side channel since 2015. However, during peak flow (typically Q2), the water type shifts at this well to predominantly calcium-sulphate type water, suggesting seasonal mine-influence still occurs (Figure 7).

Surface water samples (RG_GH-SCW1 through –SCW3) were collected in Reach 2 (the permanently wetted area) near the confluence of Thompson Creek in between September 2017 and December 2018 (Drawing 655483-002). Surface water samples at locations RG_GH-SCW2 and RG_GH-SCW3 contained concentrations of Cl and major ions similar to values measured in Thompson Creek (Figure 5 and Attachment 2), which suggests Thompson Creek is likely influencing water quality in the wetted area. Similar water types at these locations were also identified, indicative that the surface water in the wetted area has been mine-influenced (Figure 5). As Reach 2 was identified as wetted year-round, including times of low flow from Thompson Creek, groundwater may also influence water quality in the wetted area. Surface water from RG_GH-SCW1 contained lower concentrations of Cl relative to Thompson Creek and the major ion distribution at this location was more consistent with water originating upstream from the side channel. This surface water station is located slightly upstream of the confluence of Thompson Creek.

4.4 South of Thompson Creek Confluence

Surface water station GH_ERSC2 is located approximately 300 m to the south of the confluence with Thompson Creek and the side channel. Elevated concentrations of Cl relative to the applicable criteria have been measured at this location year-round, with concentrations in April/May being higher and more similar to Thompson Creek, resulting from a direct overland connection and suggesting little dilution. This is supported by a comparison of water types at GH_ERSC2 and GH_TC-1 and GH_TC2 presented in the Piper Plot on Figure 7, indicating a more similar water type. During freshet (i.e., June) and up to the month of August (Q3) in the side channel, the differences in chemistry between these stations suggests some dilution from water in the side channel as it was flowing during these months. The distribution of major ions in surface water during Q4 2018 (October to December) at GH_ERSC2 shifts and becomes more consistent with the major ion distribution at Thompson Creek, suggesting inputs from the creek increase relative to inputs from the Elk River in Q4. From September 2017 to March 2018, the side channel dries up downstream of Reach 2 (Attachment 1) and instantaneous flow data at GH_ERSC2 in 2017 and 2018 indicate no flow was measured during Q4 2017 or Q1 2018 (Minnow and Lotic, 2018a). The side channel is wetted between Reach 2 and station GH_ERCS2) and appears to receive flows from the groundwater-fed wetted area up until December 2017, which are flows are inferred to infiltrate to ground in this area.

Further south, Pools W-1, W-2, and E-1 to E-7 contained water for part of the year. Along Reach 1 West, surface water was predominantly calcium-bicarbonate since 2017 and contained low concentrations of CI relative to applicable screening criteria; however, in 2018, Pool-W-1 has become increasingly enriched in sulphate and in Q4 of 2018 a calcium-sulphate-bicarbonate water type was identified (Figure 8). In addition, concentrations of other CI (nitrate and dissolved selenium) also increased to above the applicable screening criteria in Q3 and Q4 of 2018. This is consistent with water collected adjacent to the pool in the side channel at GH_ERSC2 as well as water collected upgradient near the confluence with Thompson Creek and in the wetted area. No water quality data for Pool-W-2 was obtained in 2018. Similar water types suggest that the side channel influences Pool-W-1, which is influenced by inputs from Thompson Creek. Isolated pools along Reach 1 East were predominantly calcium-sulphate rich, with the exception of Pool-E-3 in Q4 2018 which contained higher bicarbonate content. The 2017 field mapping for Pools E-1 to E7 as well as 2017 and 2018 instantaneous flow measurements at surface water stations in Reach 1, suggest that the water sampled from these pools are a result of the natural dewatering of the side channel which receives mine-contact water from Thompson Creek. The exception to this appears to be at Pool E-7 as it is persistent year-round.

Overall, the pools in Reach 1 appear to be a result of natural dewatering of the side channel (i.e., recharging groundwater) and not groundwater discharge; however, mapping data from 2018 should be reviewed in conjunction with the above interpretation for 2018 to confirm. Pool E-7 is present year-round and contained elevated concentrations of CI above EVWQP Level 1 and 2 benchmarks (Minnow and Lotic, 2018a). The year-round presence of this pool and elevated concentrations suggest a groundwater pathway for mine-influenced water, possibly from originating from surface water in the Thompson Creek drainage.

Monitoring well GH_MW-ERSC-1 is located further south past the confluence of the side channel and Elk River. Groundwater from this location has only periodically contained elevated concentrations of CI above applicable criteria (typically between late Q4 and early Q2) that would be to reflective of mine-contact water (SNC-Lavalin, 2018c). The water type at this location is predominantly calcium-bicarbonate, consistent with the Elk River and side channel (Figure 5). In Q4 2017 and Q1 2018, the water type at this location shifted to calcium sulphate, suggesting a greater mine influence (SNC-Lavalin, 2019a). During this time period, increases in dissolved selenium and nitrate concentrations were also observed (SNC-Lavalin 2019a). At present the source of the periodic presence of mine-contact water at GH_MW-ERCS-1 and its relationship to the mine-influenced groundwater pathway at Pool E-7 is unknown.

4.5 Gaps and Uncertainties

The following section outlines gaps and uncertainties in the understanding of groundwater-surface water interactions as they relate to the objectives of the LAEMP, specifically relating to the question *"What is the interaction between surface water and groundwater in the Elk River side channel?"* The interpretations above indicate that surface water is recharging groundwater in the majority of the side channel, but there are some localized areas of groundwater discharge. The focus of this discussion will be on the discharge areas as they appear to affect water quality in the side channel. Based on this, the following is an analysis of gaps and uncertainties:

› Surface water stations should be surveyed to allow for a more quantitative comparison of surface water levels to groundwater elevations;
› Mine-influences in the Elk River side channel appear to increase south of the confluence with Wolfram Creek; therefore, no gap has been identified north of Wolfram Creek;
› A seasonal loading of mine-influenced water to the side channel appears to occur downgradient of Wolfram Creek drainage which is suspected to be from groundwater. Shallow groundwater chemistry and flow regime between Wolfram Pond and GH_ER1A is unknown and is identified as a gap that should be filled, ideally through the installation of monitoring wells;
› Between Wolfram and Thompson Creeks, Pools U-1 through U-5 and M-1 and M-2 are interpreted to result from dewatering of the side channel and not influenced by groundwater discharge; therefore, no gap has been identified;
› In the vicinity of Thompson Creek and to the south of the confluence with the side channel, groundwater influence on the side channel is interpreted to potentially occur in the following areas: Reach 2, upgradient of GH_ERSC2, and Pool E-7. Monitoring well GH_GA-MW-3 does not appear to intersect the groundwater flow path from Thompson Creek to the side channel. Shallow groundwater chemistry and flow regime in these areas is not known and is identified as a gap that could be filled through an improved monitoring network in this area;
› To the south of Thompson Creek, Pools W-1, W-2, and E-1 to E-6 are interpreted to be the result of dewatering of the side channel and not groundwater discharge. This interpretation is based on May 2017 to March 2018 field mapping and mine-influenced water inputs were identified as increasing in 2018 at a number of these pools. As such this interpretation should be cross-checked with field mapping showing the spatial distribution of wetted areas later in 2018 to confirm. If a monitoring well network is as part of addressing other gaps/uncertainties then sampling and field mapping of these pools should occur, ideally concurrent with groundwater monitoring and sampling events; and
› The cause of the periodic presence of mine-influenced water in monitoring well GH_MW-ERSC-1, located downstream of the side channel, was identified in the RGMP (SNC-Lavalin, 2018a). In relation to this study, understanding the causes of the periodic presence of mine-influenced water may assist with understanding the groundwater influences on the side channel upstream of the confluence.

5 Conclusions and Recommendations

SNC-Lavalin has reviewed and compiled groundwater and surface water information available from relevant previous investigations and current programs within and proximal to the Elk River side channel. This report presents a summary of existing groundwater and surface water data available, an assessment of the potential groundwater–surface water interactions and gaps identified. The conclusions of the study were:

- A similar water type of calcium-bicarbonate was identified in surface water sampled from the Elk River side channel and the Elk River at the majority of stations and pools, indicating a predominant an Elk River influence. Surface water types change to more calcium-sulphate type downstream of Thompson Creek in the wetted area, at GH_ERSC2, and pools father downstream, suggesting more of a mine-influence in these areas;
- Water in the Elk River side channel is inferred to recharge groundwater across the length of the side channel, with the exception of localized areas of groundwater discharge;
- No overland connection of tributary creeks and/or settling ponds to the side channel was observed between May 2017 and March 2018, with the exception of Thompson Creek, suggesting the mine-influenced creeks lose water to ground;
- Concentrations of Cl in surface water appear to increase along the side channel flow path, indicating loading from the mine-influenced tributaries is occurring; and
- Localized groundwater discharge areas in side channel appear to occur in the vicinity of Wolfram Creek, Thompson Creek and to the south of Thompson Creek. Gaps have been identified in each of these areas.

The conclusions, gaps identified and recommendations for each area associated with the Project are summarized in the table below.

Table J: Conclusions, Summary of Gaps and Recommendations for the Project

Area	Data Gap/Uncertainty	How the Gap Can Be Filled
Elk River Valley		
Side Channel and Associated Tributaries	Surface water stations are not surveyed to a common datum.	Surface water stations surveyed to a common with groundwater.
Wolfram Creek	Shallow groundwater conditions between Wolfram Pond and GH_ER1A are unknown and it is suspected that groundwater plays a role in water quality in the side channel, at least during certain conditions.	Shallow groundwater levels and quality should be obtained through the installation of an improved groundwater monitoring network upgradient of surface water station GH_ER1A. We understand a seep survey of the west side of GHO has been conducted; results from that should be reviewed before in advance of developing a well network.

Table J (Cont'd): Conclusions, Summary of Gaps and Recommendations for the Project

Area	Data Gap/Uncertainty	How the Gap Can Be Filled
Elk River Valley (Cont'd)		
Thompson Creek	Potential groundwater influence on the lower reaches of the side channel appears to be originating from Thompson Creek resulting in elevated Cl's and year-round pooling. The existing monitoring needs to be adjusted to understand the groundwater conditions in the vicinity of Thompson Creek confluence and further south in the side channel.	The groundwater monitoring network should be improved in the vicinity of the confluence with Thompson Creek and further to the south where pooled areas have been mapped and sampled and an influence from Thompson Creek suspected. We understand a seep survey of the west side of GHO has been conducted; results from the seep survey should be reviewed before in advance of developing a well network.
Pools and Permanently Wetted Area	The interpretation that the natural dewatering of the side channel is resulting in the majority of the pools is only based on a year of field mapping up to March 2018. There is increasing mine-influence in pools and the permanently wetted area noted in 2018 as compared to 2017 which is identified as an uncertainty.	Review of 2018 field mapping as well as analytical data associated with additional pools included in the 2018 program should address the uncertainty; however, if a groundwater monitoring well network is installed to address other gaps, another year of mapping and sampling focused on the pools and concurrent with groundwater monitoring events would further reduce the uncertainty.
Downgradient of the Side Channel (GH_MW-ERSC-1)	The origin of periodic mine-influenced water in monitoring well GH_MW-ERSC-1 is not well understood. It may be related to a groundwater flow path from Thompson Creek.	This gap was identified as part of the 2017 RGMP Update (SNC-Lavalin, 2017b). The gap could be filled by improving the groundwater monitoring network upgradient of this well. We understand a seep survey of the west side of GHO has been conducted; results from that should be reviewed to further the evaluation at this groundwater well.

Ideally, a monitoring network would consist of dedicated monitoring wells that can be instrumented and compared with future monitoring of the side channel; however, it is recognized that access to the area may be difficult. It may be necessary to install drive point piezometers or another less permanent monitoring tool if dedicated monitoring wells cannot be installed. As discussed above additional surface water sampling stations and field mapping may also be required. A site reconnaissance visit should occur to scope the appropriate groundwater-surface water assessment tools. It is noted that additional investigations to support GHO operations, water modelling and groundwater monitoring are being completed in and around the tributaries on the west side of GHO and side channel. This supplemental information including results from the seep survey needs to be reviewed before scoping of additional groundwater-surface water studies.

6 References

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Teck Coal Ltd., 2017. 2017 Elk Valley Regional Water Quality Model Update – Overview Report (with Annexes), dated October 2017.

We trust this provides you with the information you currently require. If you have any questions, please contact the undersigned at your earliest convenience.

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Project Scientist
Environment & Geoscience
Infrastructure

Stefan Humphries, M.Sc., P.Geo.
Senior Hydrogeologist/ Nelson Operations Manager
Environment & Geoscience
Infrastructure

KC/cmp
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Figures

1: Groundwater Elevation in the Elk River Valley at GH_GA-MW-4 and Surface Water Levels at GH_ERSC4 and GH_ERUS
2: Groundwater Elevation in the Elk River Valley at GH_GA-MW-2 and Surface Water Levels at GH_ER1A
3: Groundwater Elevation in the Elk River Valley at GH_GA-MW-3 and Surface Water Levels at ERSCDS and GH_ERC
4: Piper Plot: Elk River Drainage (Reach 3; Q4 2018)
5: Piper Plot: Elk River Drainage (Reach 1 and 2; Q4 2018)
6: Time-Series Graph of Instantaneous Flow
7: Piper Plot: Elk River Drainage (Thompson Creek and GH_ERSC2; 2018)
8: Piper Plot: Elk River Drainage (Reach 1 Pools, 2017 to 2018)

Drawings

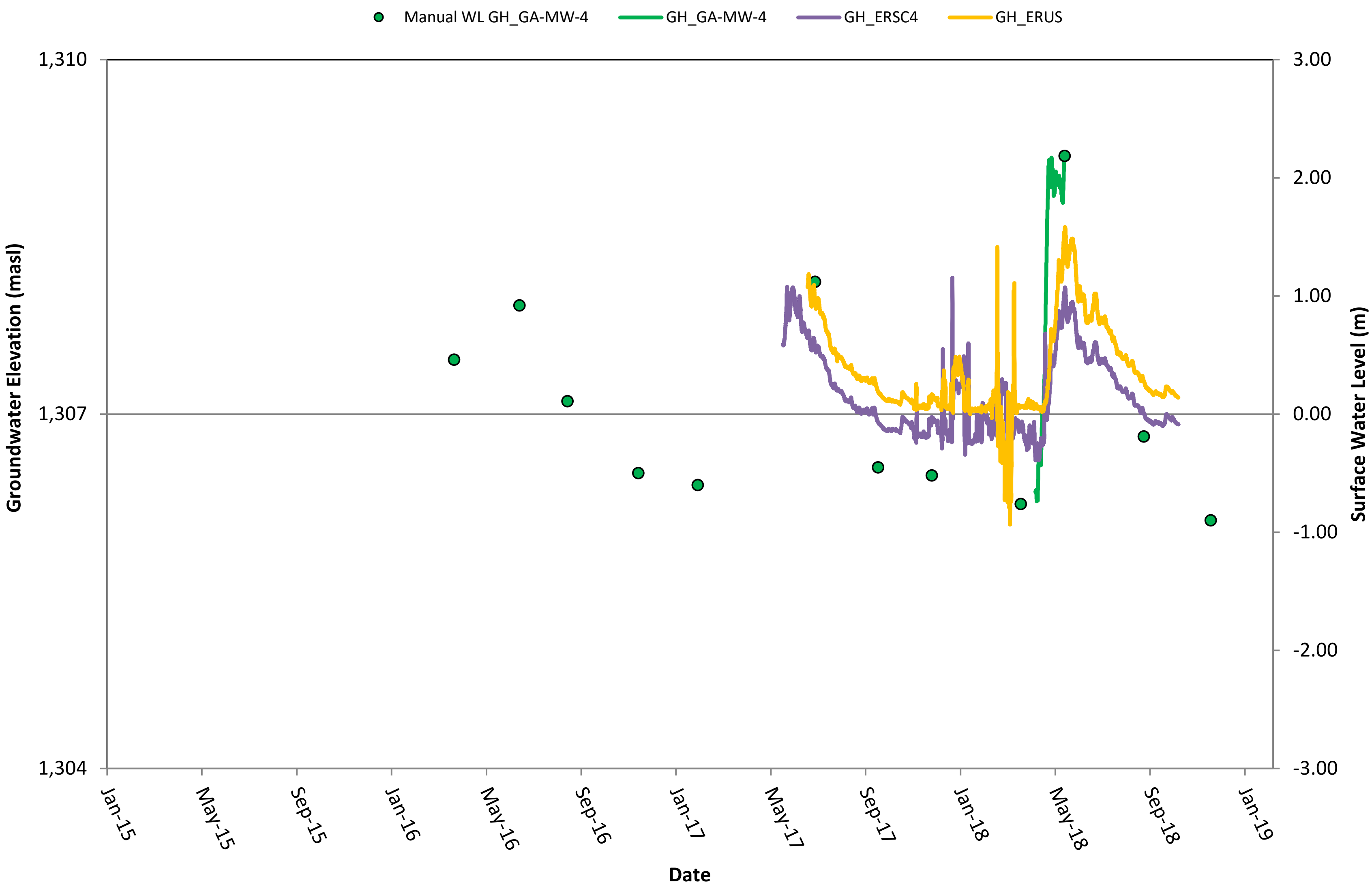
- 655483-001: Site Location Plan
- 655483-002: GHO Elk River Side Channel Site Plan

Attachments

1: Elk River Side Channel Wet and Dry Locations (Minnow, 2018a)
2: Temporal Graphs of Cl in Surface Water (Minnow, 2018a)

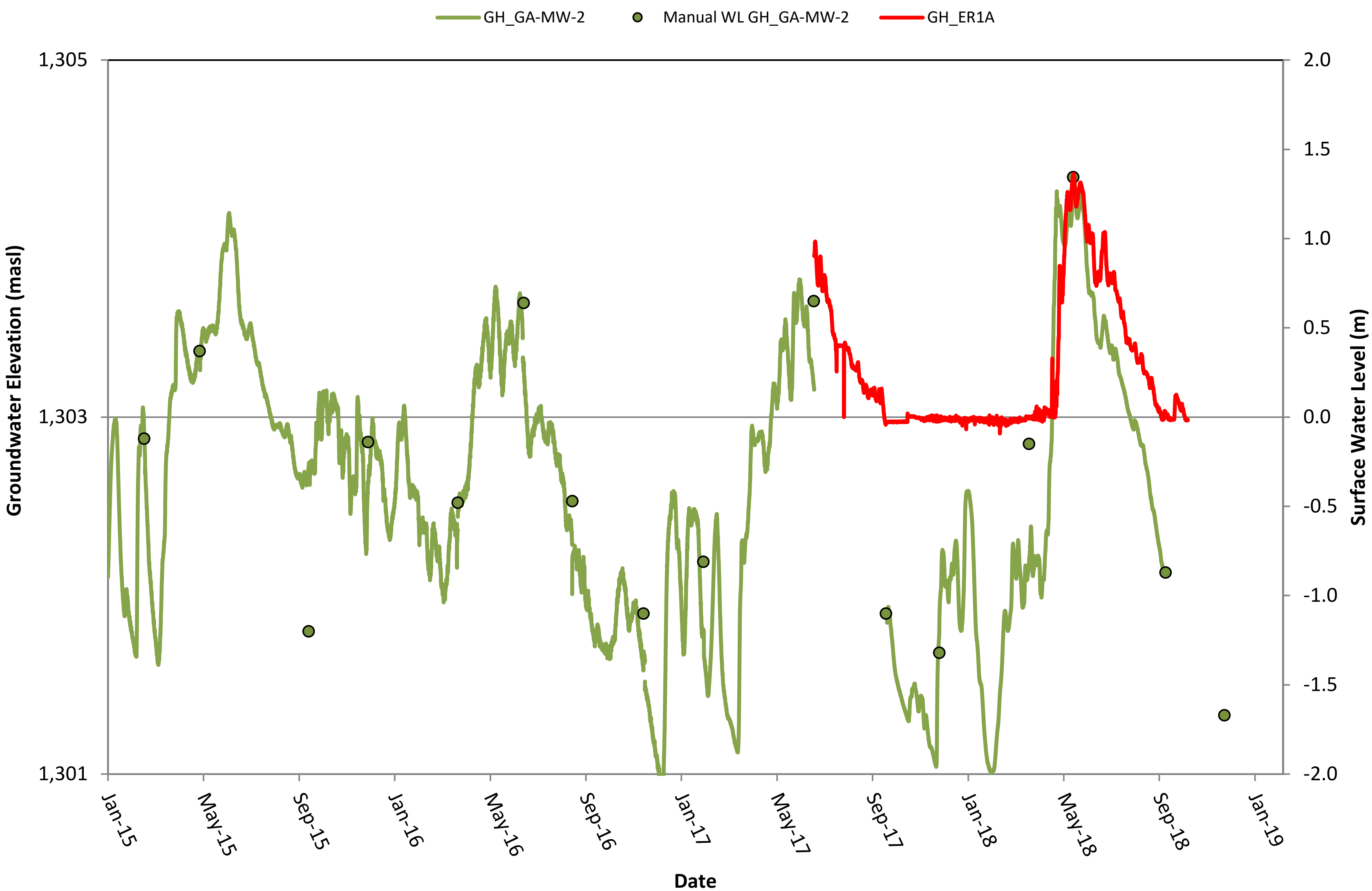
Figures

Figure 1: Groundwater Elevation in Elk River Valley at GH_GA-MW-4 and Surface Water Levels at GH_ERSC4 and GH_ERUS



Note: data was removed where suspected datalogger removal occured.

Figure 2: Groundwater Elevation in Elk River Valley at GH_GA-MW-2 and Surface Water Levels at GH_ER1A



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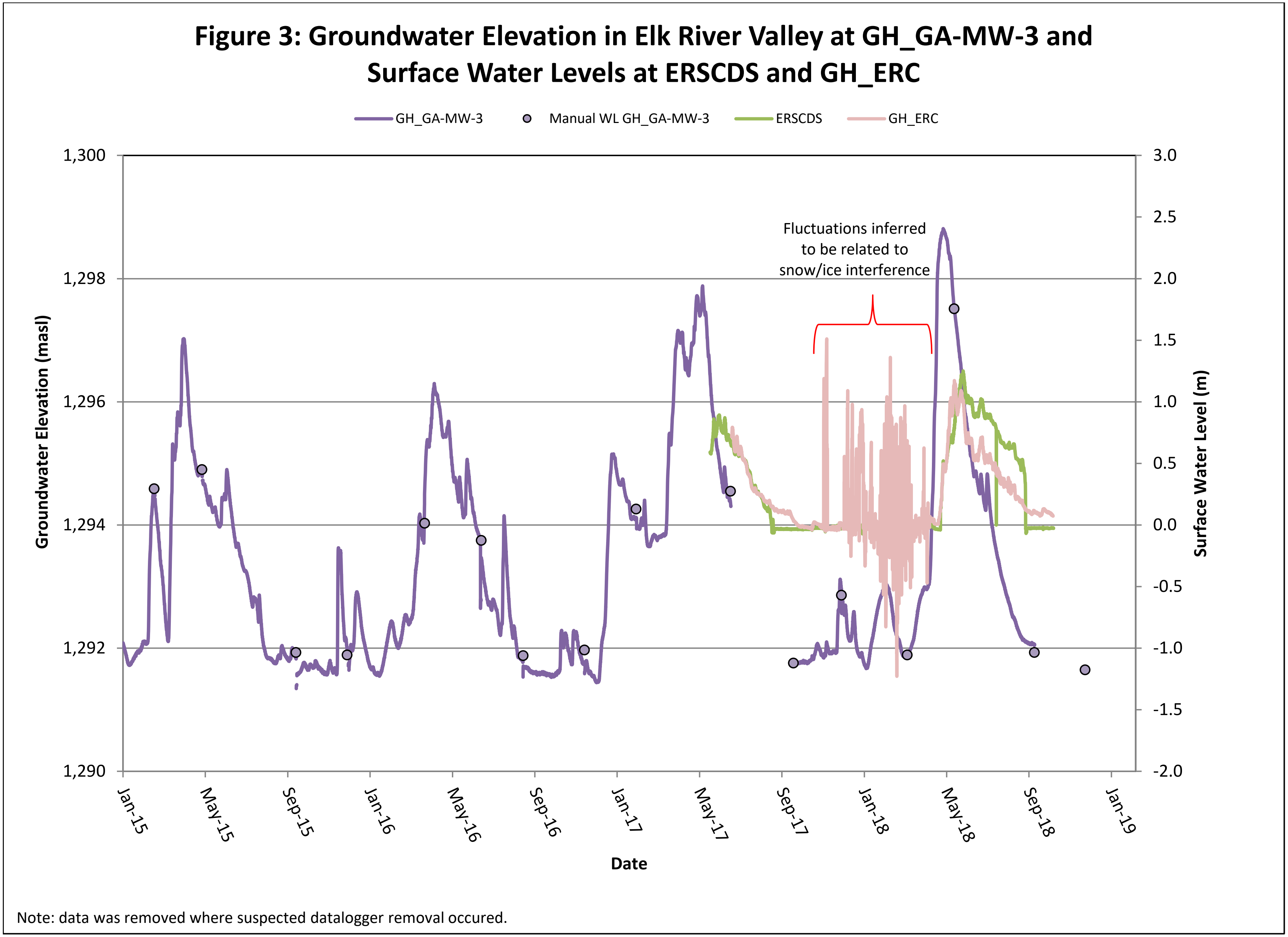
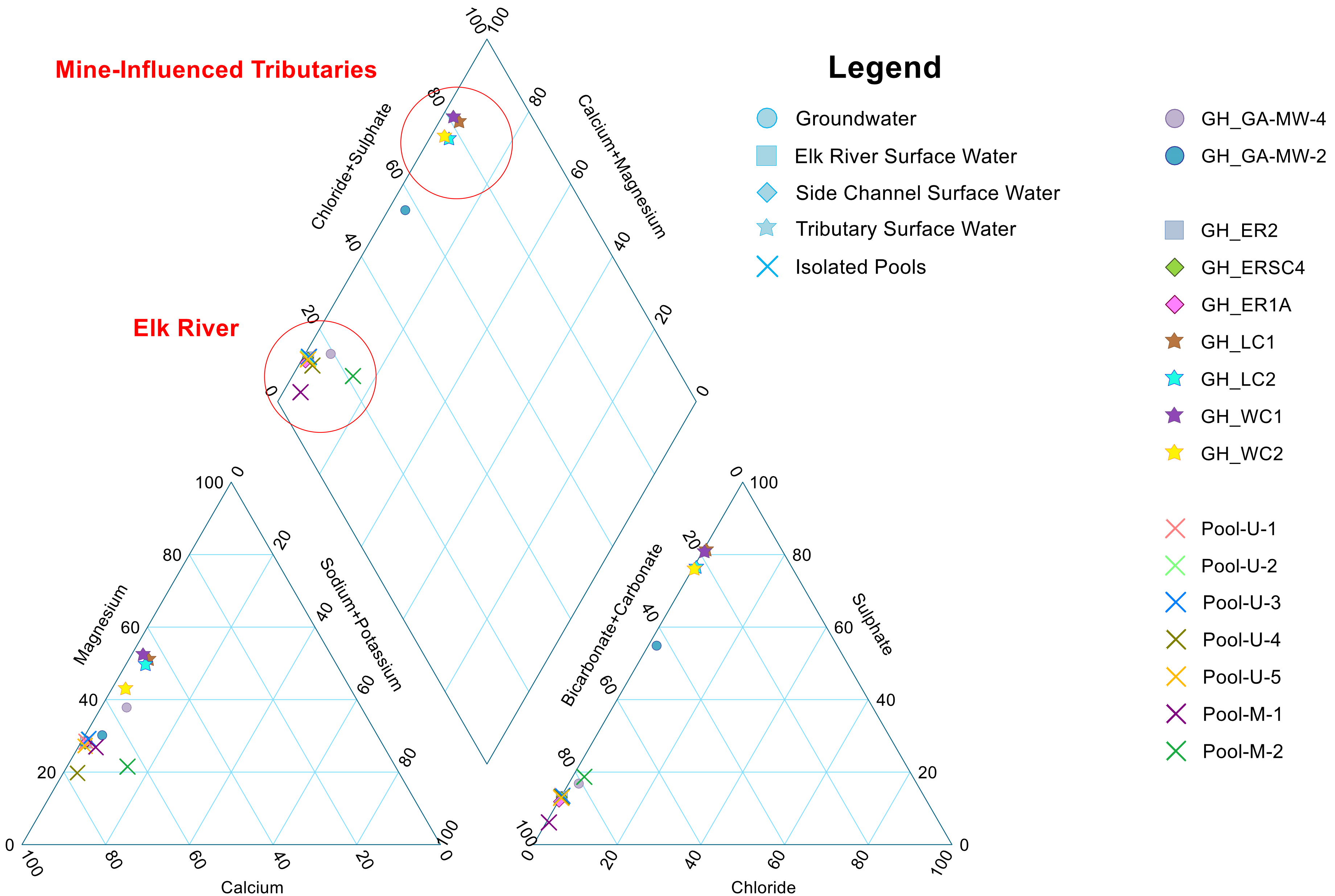


Figure 3: Groundwater Elevation in Elk River Valley at GH_GA-MW-3 and Surface Water Levels at ERSCDS and GH_ERC
GH_GA-MW-3
Manual WL GH_GA-MW-3
ERSCDS
GH_ERC
Groundwater Elevation (masl)
Surface Water Level (m)
Fluctuations inferred to be related to snow/ice interference
1,300
1,298
1,296
1,294
1,292
1,290
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
Jan-15
May-15
Sep-15
Jan-16
May-16
Sep-16
Jan-17
May-17
Sep-17
Jan-18
May-18
Sep-18
Jan-19
Date
Note: data was removed where suspected datalogger removal occured.

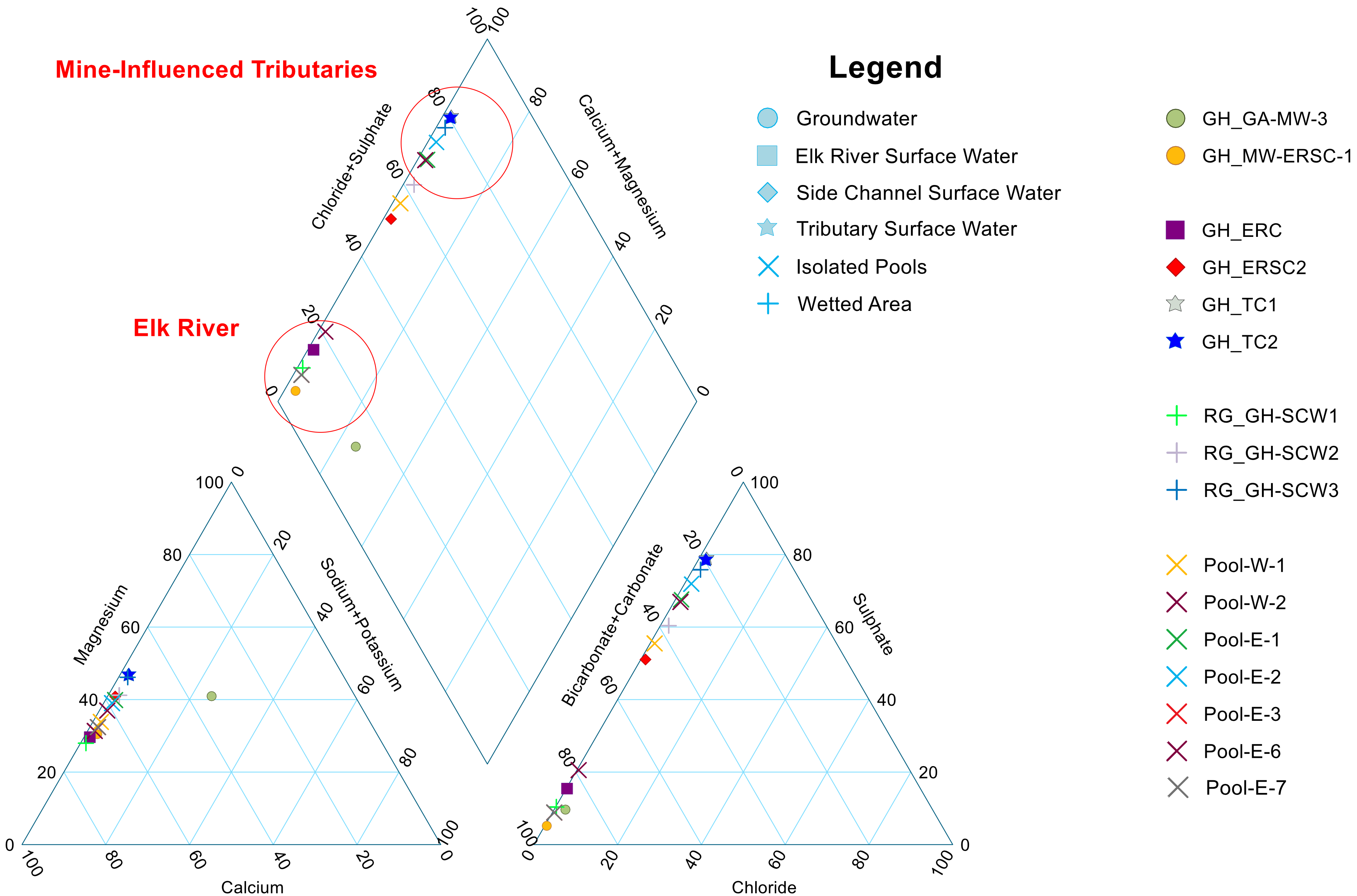
Figure 4 - Piper Plot
Elk River Drainage (Reach 3; Q4 2018)



Q4 2017 data is presented for Pool-U-4 and Pool-U-5; Q2 2018 data is presented for Pool-M-1 and Pool-M-2.

Figure 5 - Piper Plot

Elk River Drainage (Reach 1 and 2; Q4 2018)



Q2 2018 data is presented for RG_GH-SCW2 and Q3 2017 data is presented for Pool-W-2 and Pool-E-1.

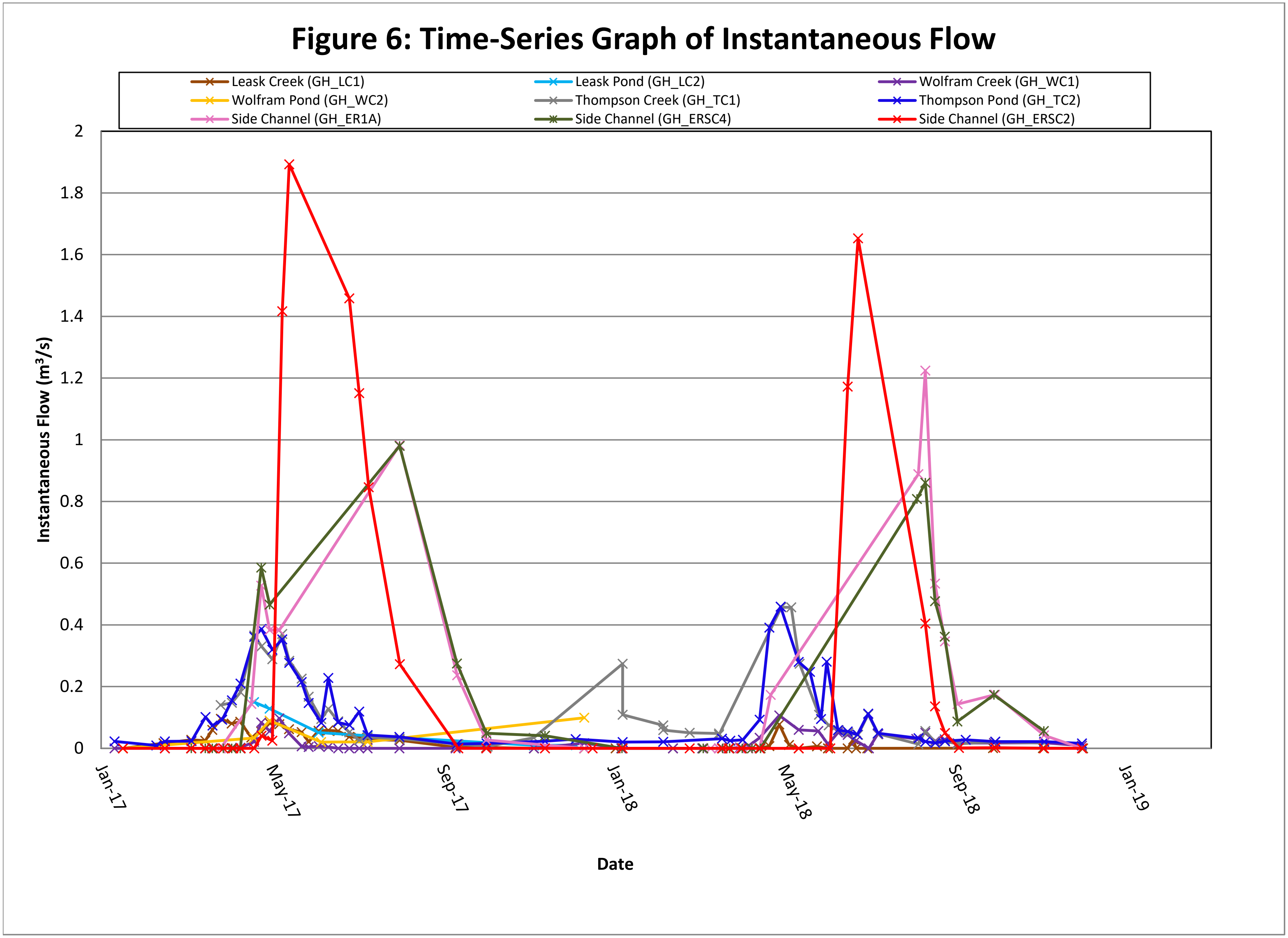


Figure 6: Time-Series Graph of Instantaneous Flow
Leask Creek (GH_LC1)
Leask Pond (GH_LC2)
Wolfram Creek (GH_WC1)
Wolfram Pond (GH_WC2)
Thompson Creek (GH_TC1)
Thompson Pond (GH_TC2)
Side Channel (GH_ER1A)
Side Channel (GH_ERSC4)
Side Channel (GH_ERSC2)
Instantaneous Flow (m3/s)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-17
May-17
Sep-17
Jan-18
May-18
Sep-18
Jan-19
Date

Figure 7 - Piper Plot
Elk River Drainage (Thompson Creek and GH_ERSC2; 2018)

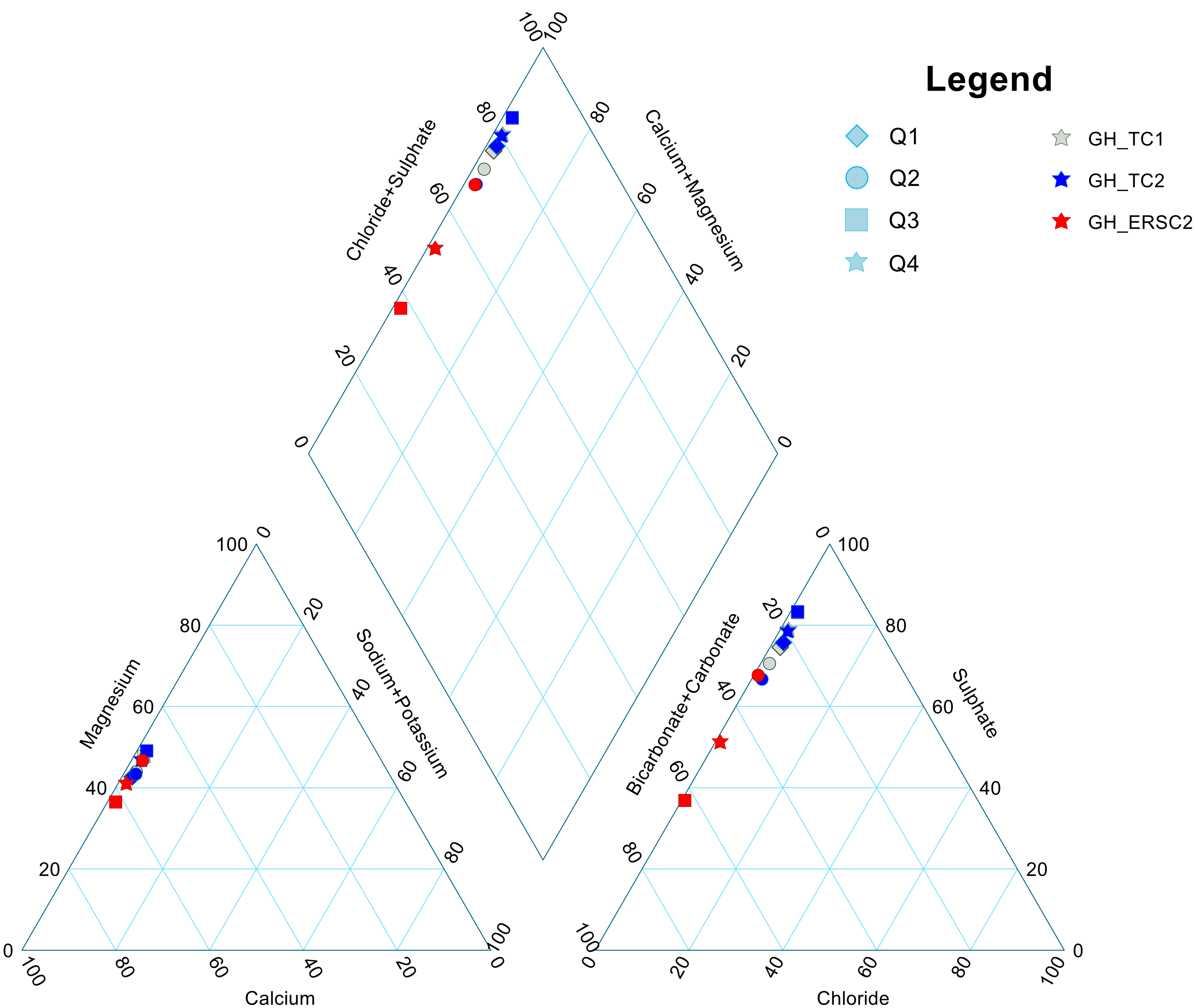
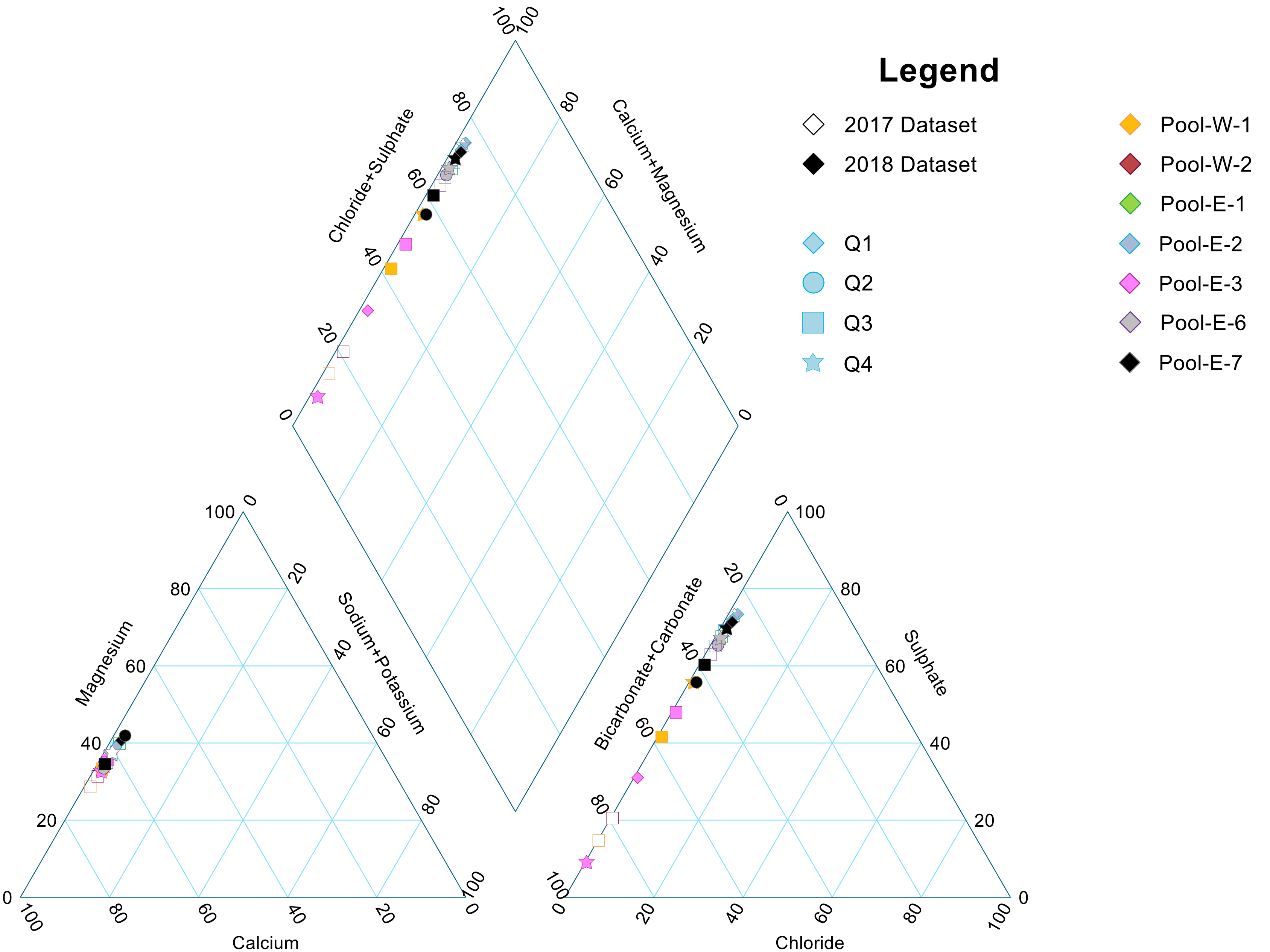
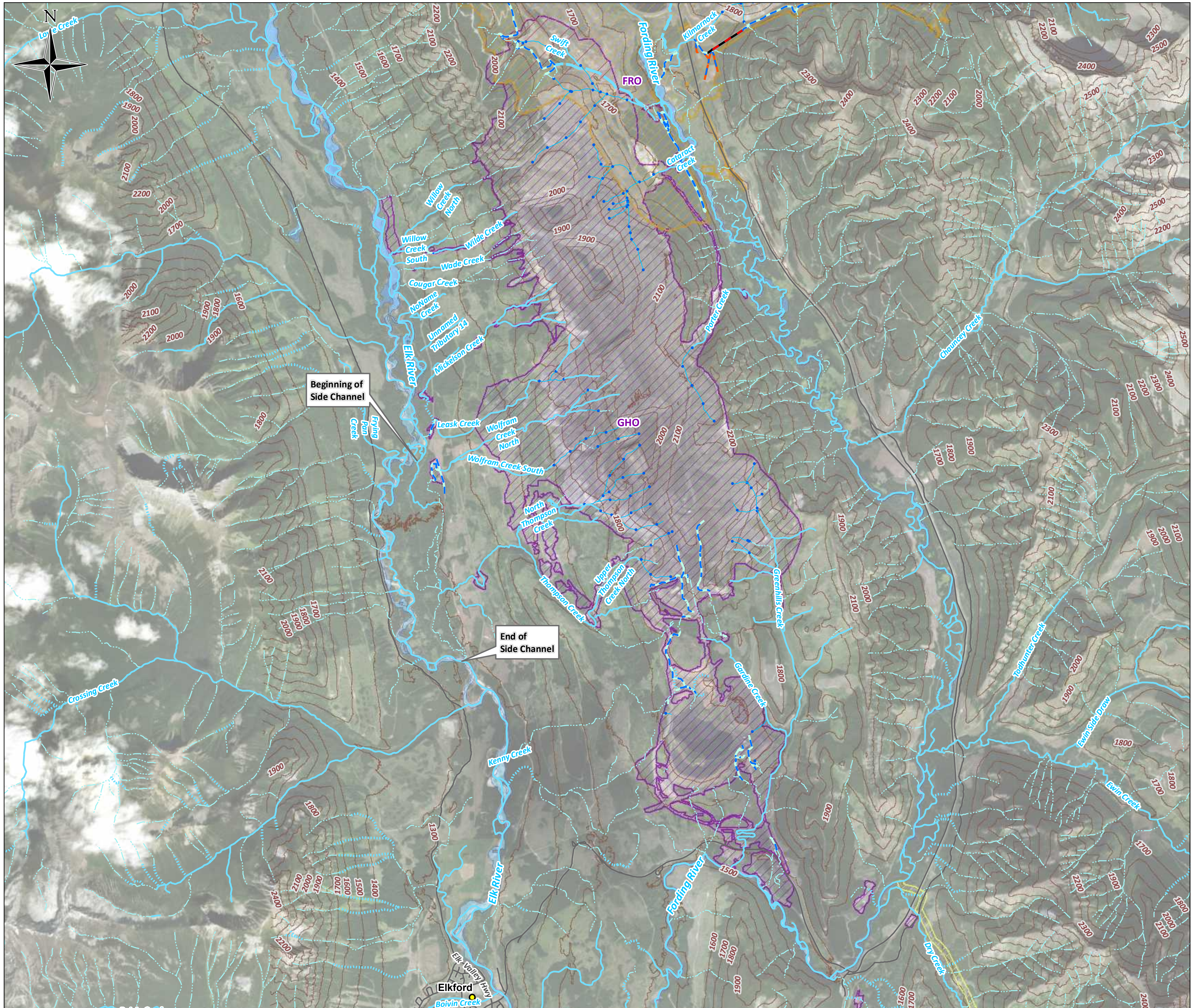


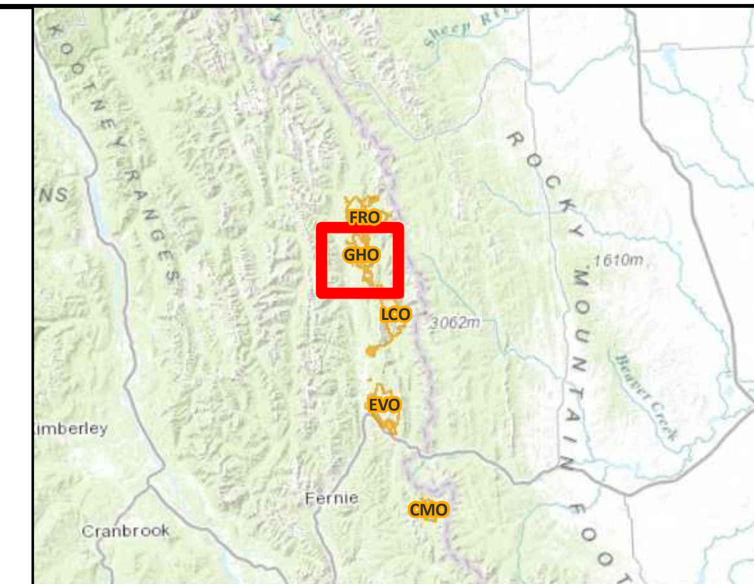
Figure 8 - Piper Plot
Elk River Drainage (Reach 1 Pools; 2017 to 2018)



Drawings

- 655483-001: Site Location Plan
- 655483-002: GHO Elk River Side Channel Site Plan





Legend

Water Features	Site Features
Intermittent Stream	Secondary Road
Stream Ditch	Topographic Contours (100m)
Indefinite Stream	FRO Permitted Boundary
Stream	GHO Permitted Boundary LCO
Subsurface	Permitted Boundary
Culvert	
Ditch	
Water Pipeline	
River Bed	

NOTES:
1. Original in colour.
2. Numerical scale reflects full-size print. Print scaling will distort this scale; however, scale bar will remain accurate.
3. Intended for illustration purposes. Accuracy has not been verified for construction or navigation purposes.

REFERENCES:
1. Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
2. Data provided by Teck Coal (2017).

REVISIONS:
0 - AO - 2018-10-09 - DRAFT - LH
1 - AO - 2018-10-25 - FINAL - KM

0 0.5 1 2 3 4 5 km

CLIENT:
Teck Coal Ltd.

PROJECT LOCATION:
Greenhills Operations, BC

SNC·LAVALIN

Site Location Plan

BY: AO	SCALE: 1:70,000	DATE: 2019/01/29	REF No: 655483-001	REV: 0
CHK'D: KC	Proj Coord Sys: NAD 1983 UTM Zone 11N			

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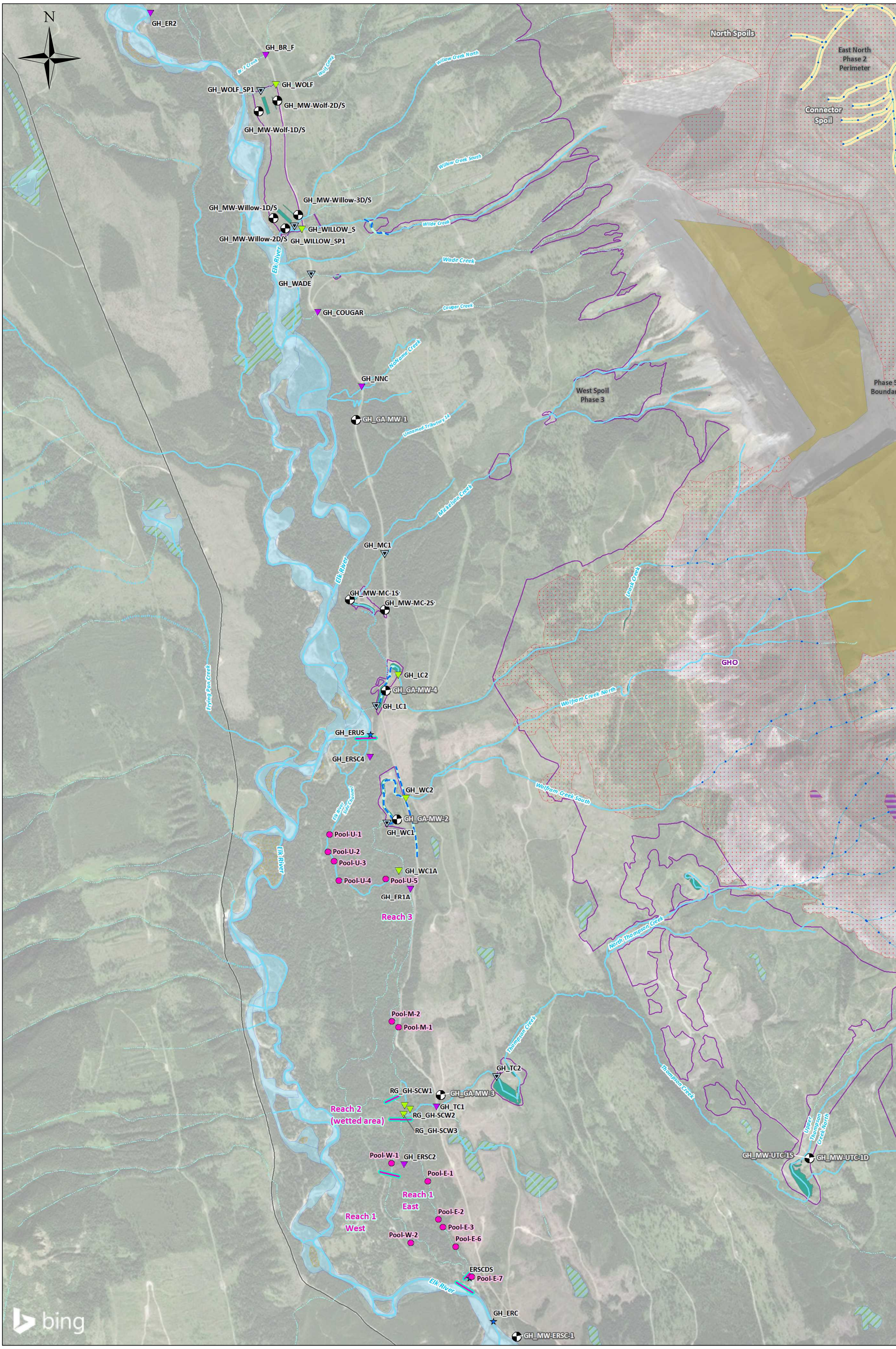

Legend
- Pools

Groundwater Stations
- Monitoring Well

Surface Water Stations
- Compliance Point
- Receiving Environment Surface Water Monitoring Station
- Authorized Discharge
- Permitted / non-permitted surface water monitoring station

Site Features
- Secondary Road
- Reaches
- GHO Permitted Boundary
- Pit
- Stockpiles
- Waste Dump (Spoils)
- Tailings/Settling Pond

Water Features
- Intermittent Stream
- Ditch
- Indefinite Stream
- Stream
- Subsurface
- Island
- Lake
- River Bed
- Wetland

Notes:
1. Intended for illustration purposes only.
2. Original in colour.
3. Site location is approximate.

References:
1. Information provided by Teck Coal Ltd.
2. Mapped Aquifers are from Water Resources Atlas (BC ENV)

Revisons:
0 - AO - 2019-01-09- DRAFT - KC

0 0.125 0.25 0.5 0.75 1 1.25 Kilometers

PROJECT LOCATION:
Greenhills Operations, BC

CLIENT NAME:
Teck Coal Ltd.

SNC·LAVALIN

GHO Elk River Side Channel Site Plan

CHK'D: KC	DATE: 2019/05/30	SCALE: 1:20,000	Ref Num:	REV: 0
BY: AO	COORD SYS: NAD 1983 UTM Zone 11N		653246-002	

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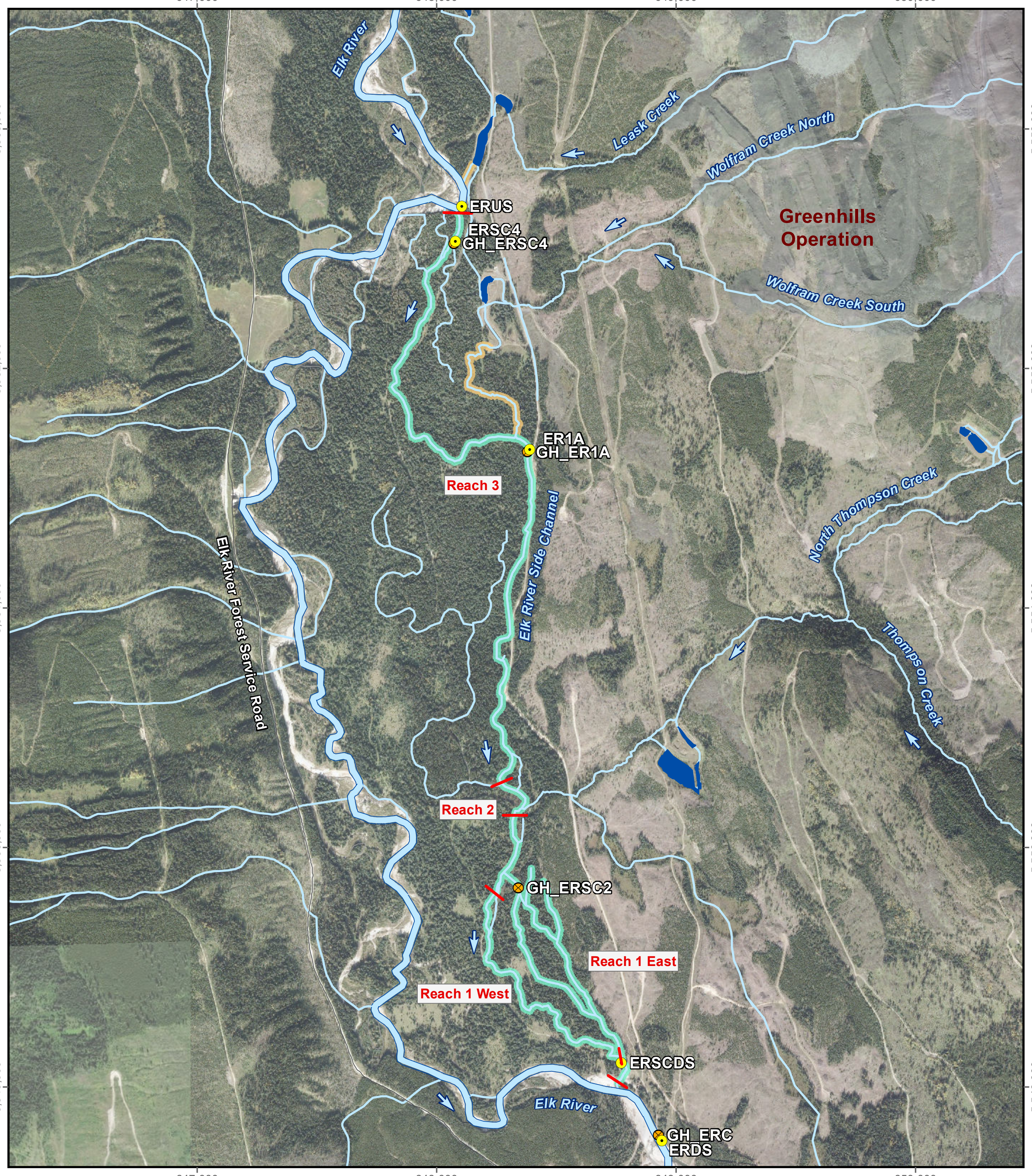
Project Path: P:\Current Projects\Teck Coal Ltd\GIS\Exports\655483_GHO

Attachment 1

Elk River Side Channel Wet and Dry Locations
(Minnow and Lotic, 2018a)



LEGEND

- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Wetted channel
- Dry channel
- Settling pond

Elk River Side Channel Wet and Dry Locations, May to July 2017

0 375 750 1,500 Meters

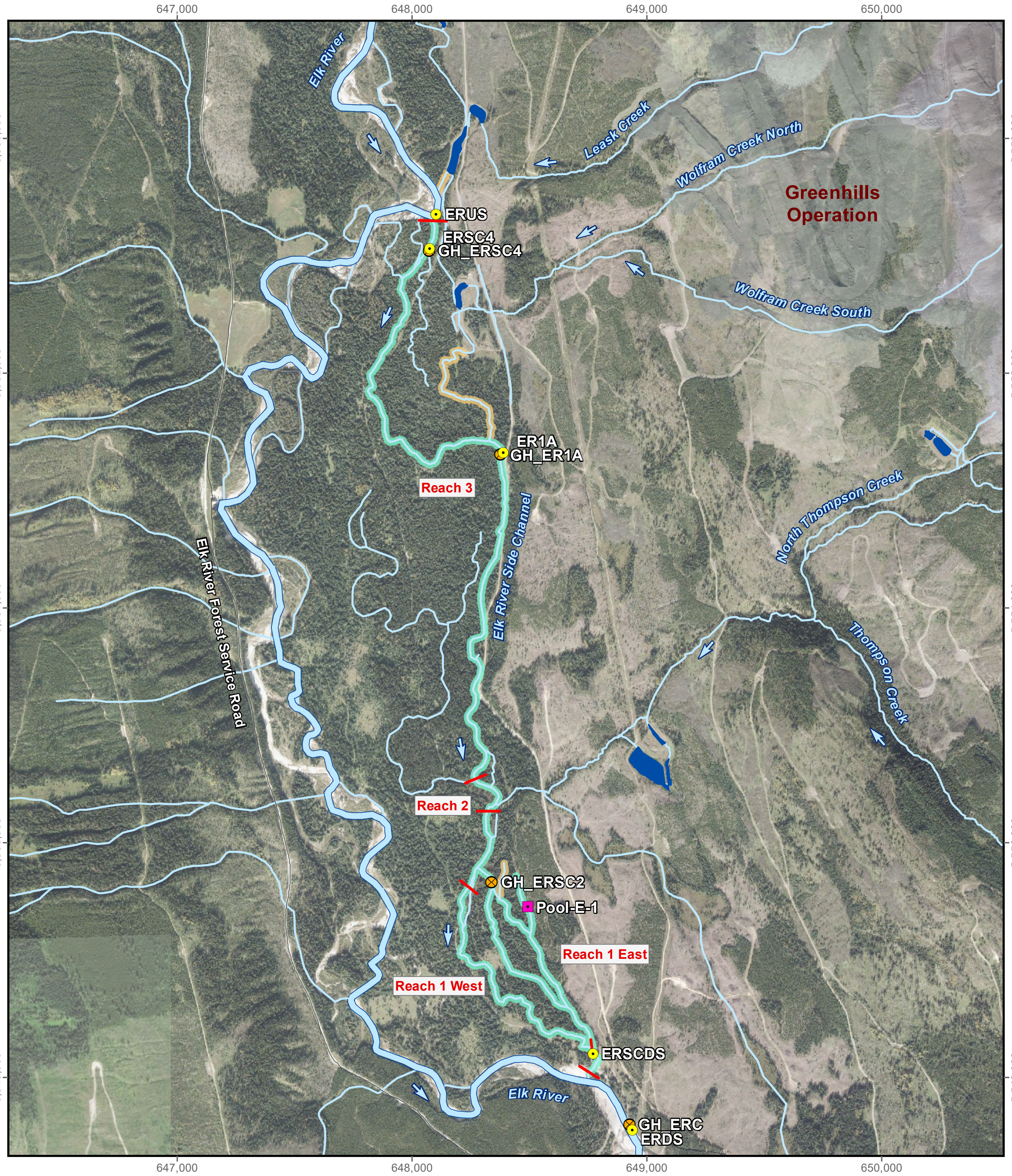
Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.1

Document Path: S:\Projects\177202\177202.0024 - Teck 2017 GHO LAEMP Implementation\6 - GIS\Report\17-24 Fig A.1 Elk Side Channel Wet and Dry.mxd



LEGEND

- Pool, water quality sampling
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, August 2017

0 375 750 1,500 Meters

Datum: NAD 83 Map Projection: UTM Zone 11N
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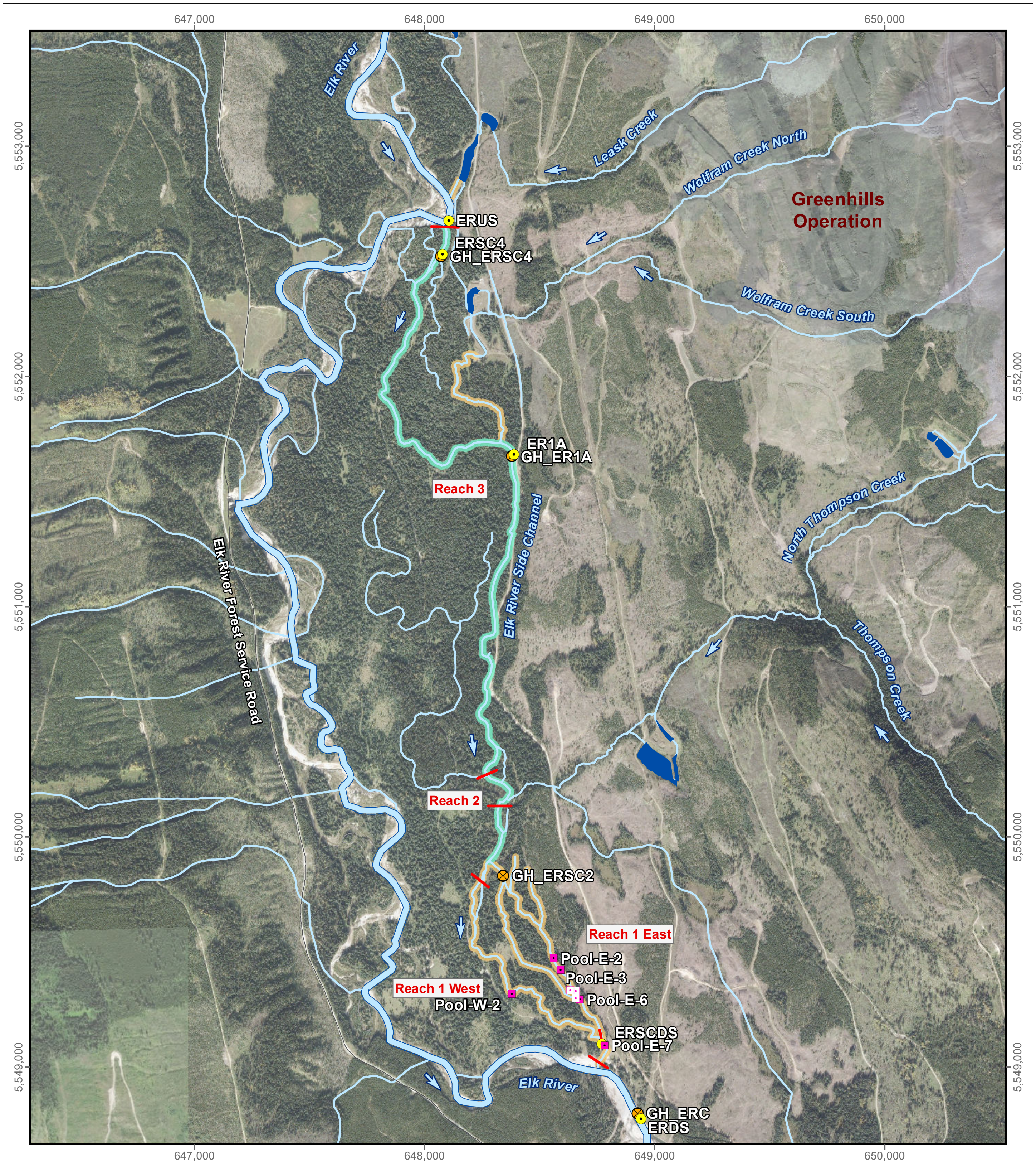
Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.2

Document Path: S:\Projects\177202\177202.0024 - Teck 2017 GHO LAEMP Implementation\6 - GIS\Report\17-24 Fig A.2 Elk Side Channel Wet and Dry.mxd



LEGEND

- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, September 2017

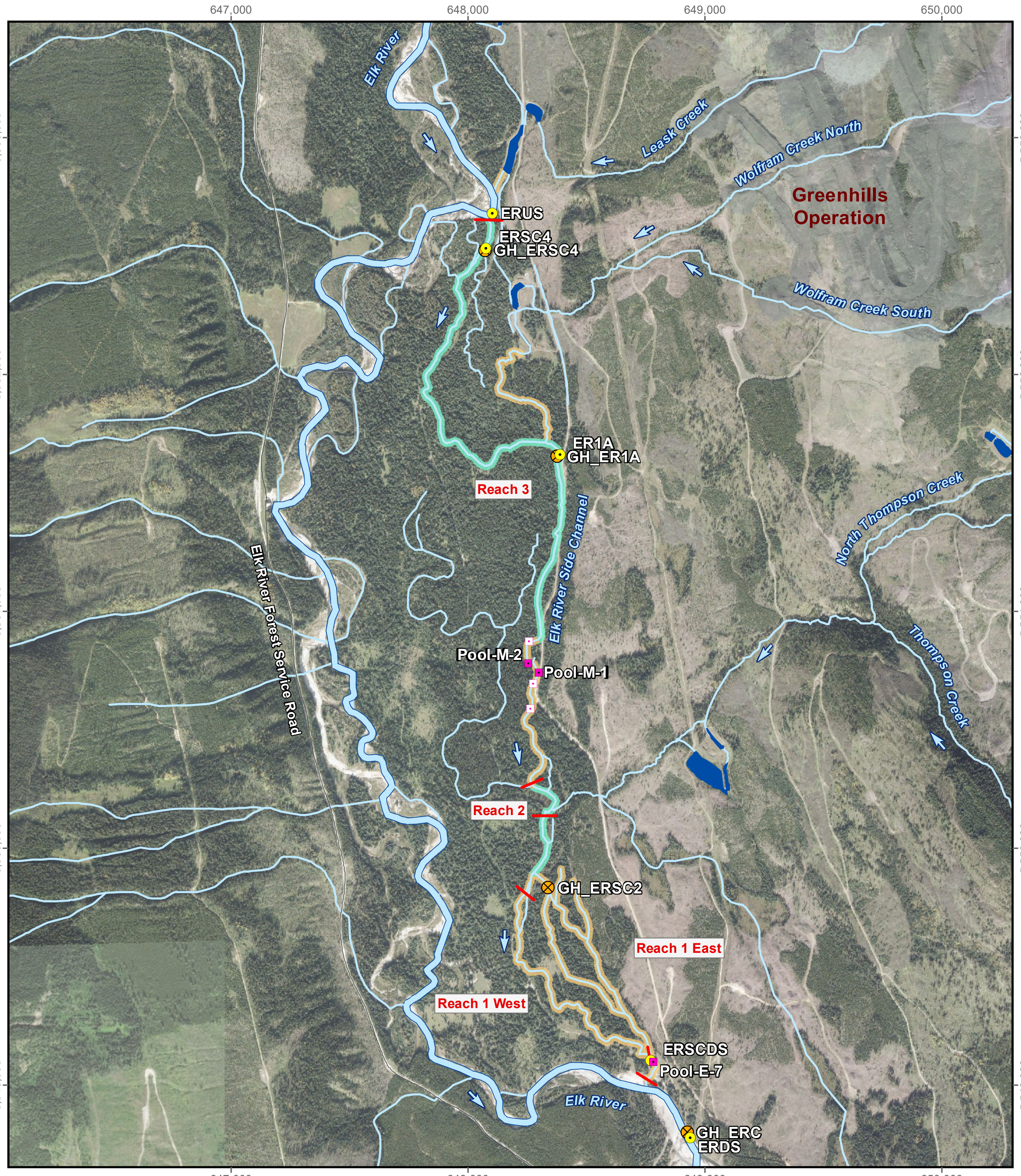
0 375 750 1,500 Meters

Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.3



LEGEND

- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, October 2017

0 0.4 0.8 1.6 km

N W E S

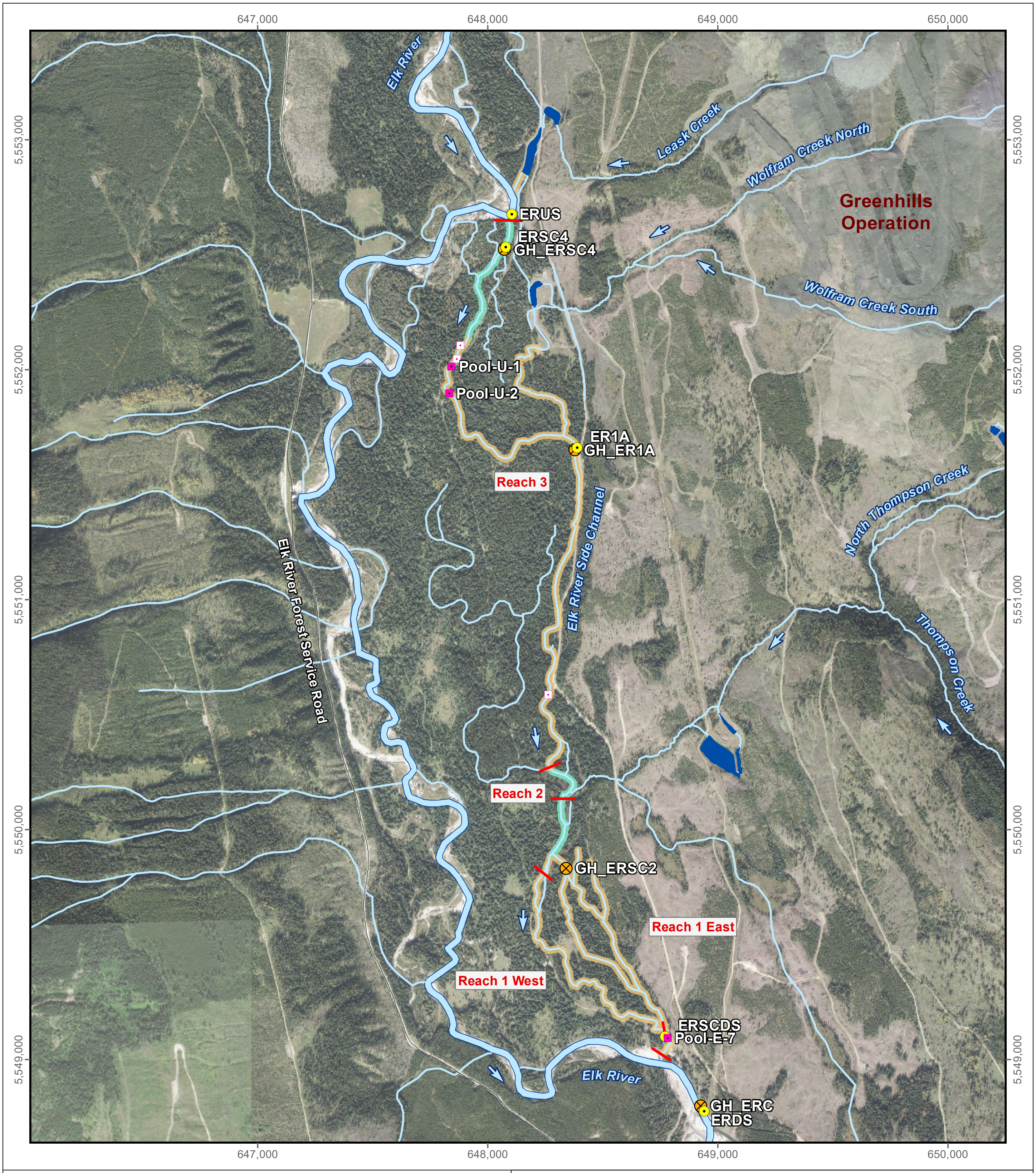
Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.4

Document Path: S:\Projects\177202\177202.0024 - Teck 2017 GHO LAEMP Implementation\6 - GIS\Report\17-24 Fig A.4 Elk Side Channel Wet and Dry.mxd



LEGEND

- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, November 2017

0 375 750 1,500 Meters

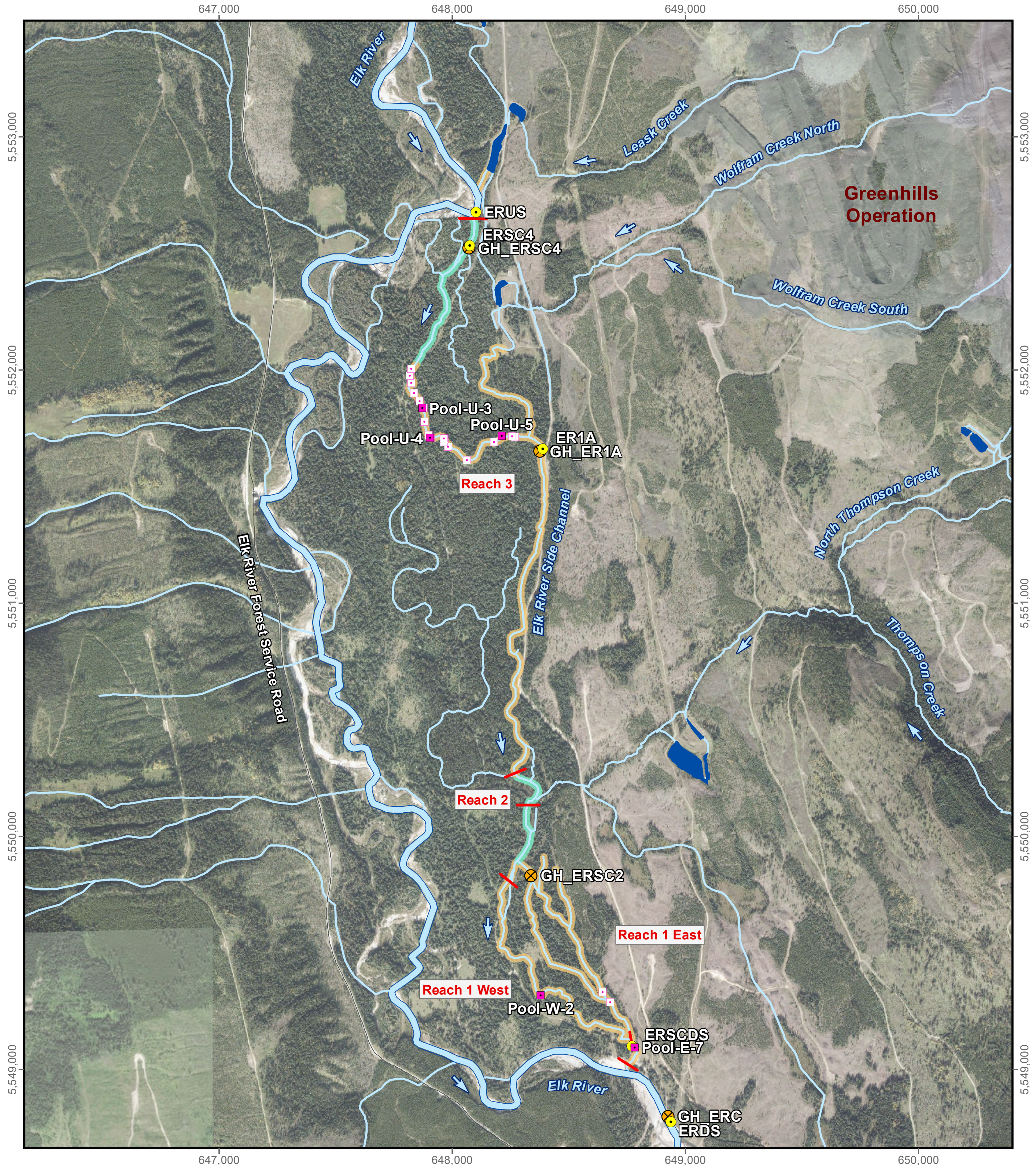
N W E S

Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.5



LEGEND

- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, December 2017

0 375 750 1,500 Meters

Datum: NAD 83 Map Projection: UTM Zone 11N
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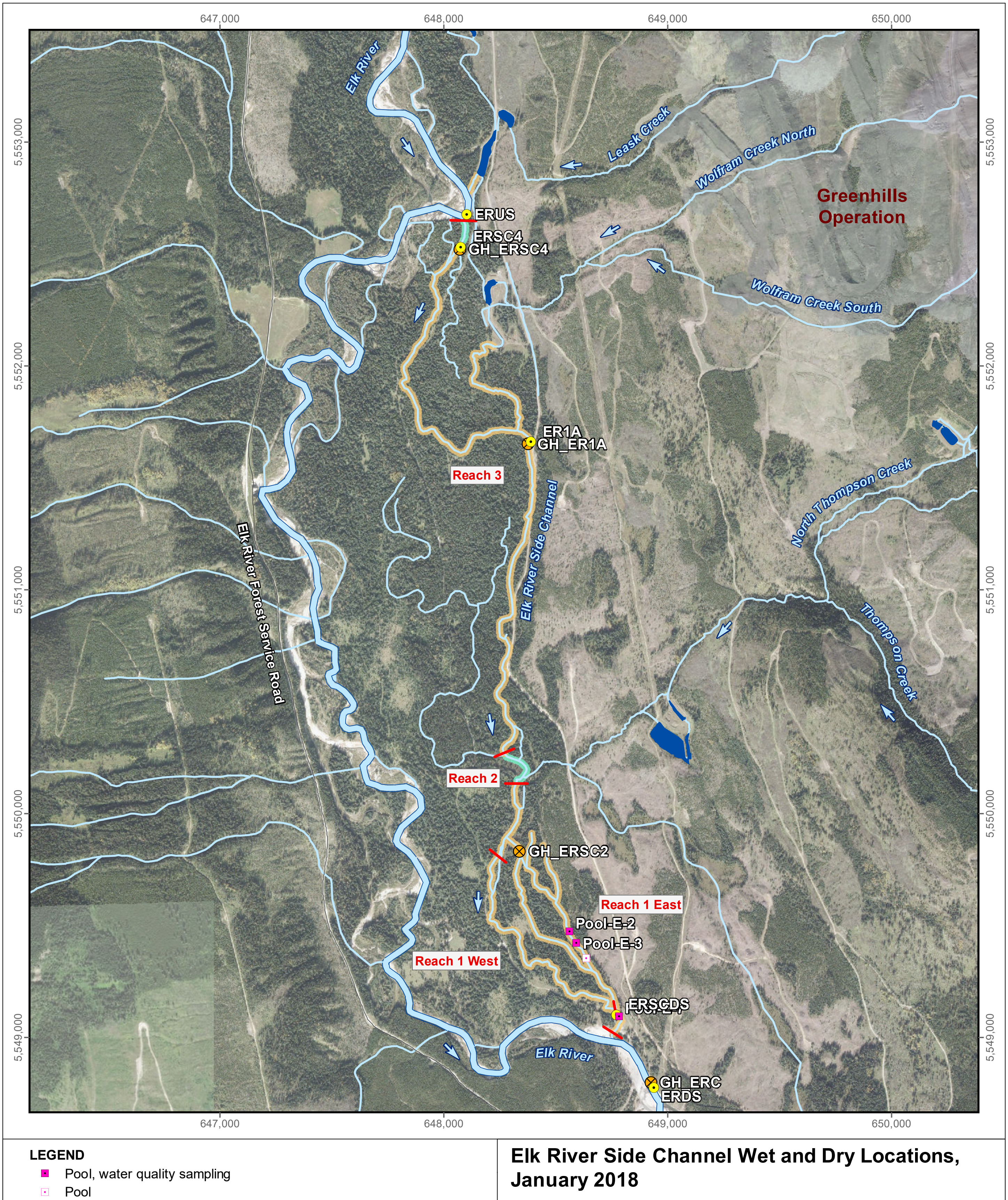
Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.6

Document Path: S:\Projects\177202\177202.0024 - Teck 2017 GHO LAEMP Implementation\6 - GIS\Report\17-24 Fig A.6 Elk Side Channel Wet and Dry.mxd



LEGEND

- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Reach break
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, January 2018

0 0.4 0.8 1.6 km

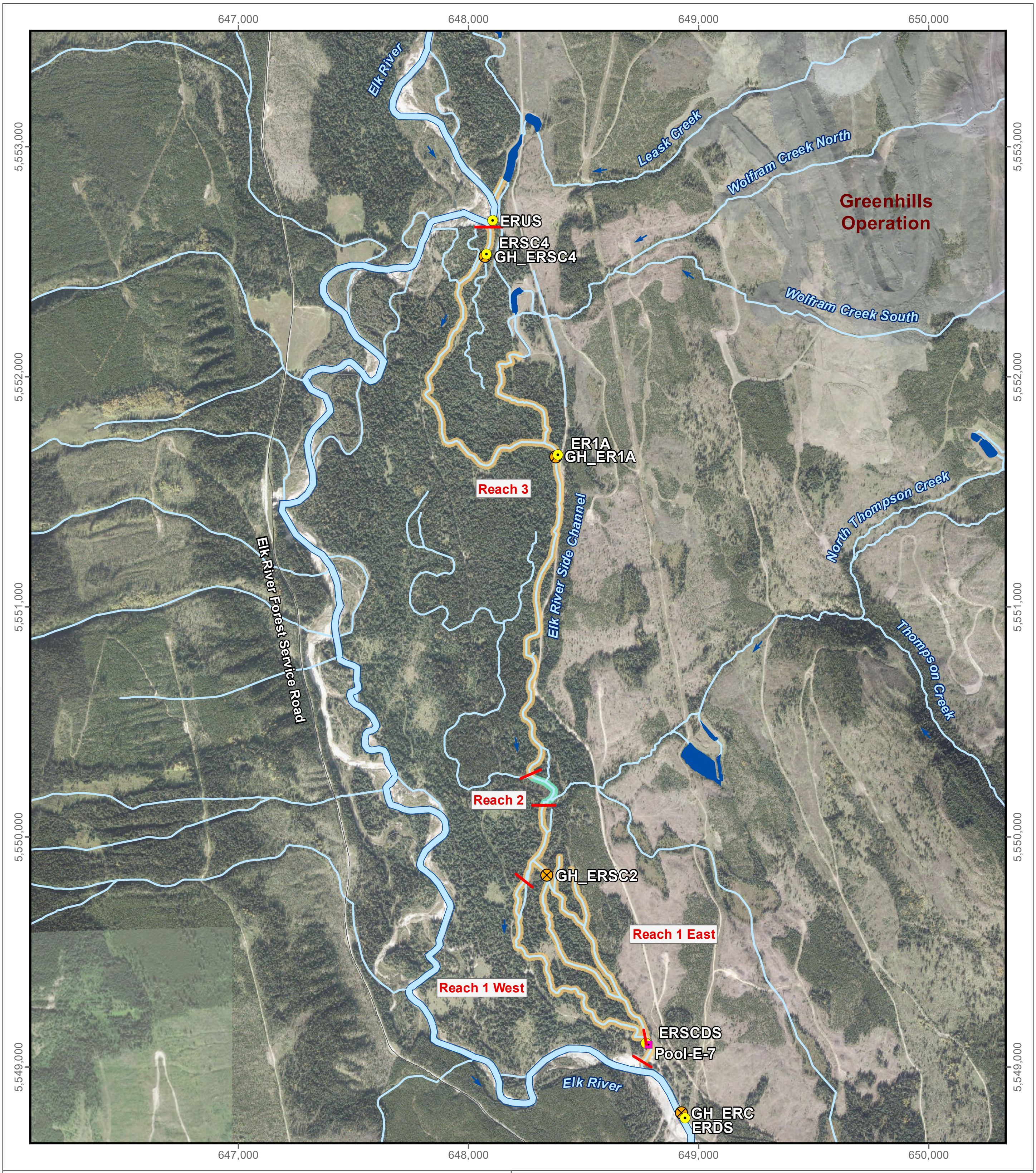
N W E S

Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.7



LEGEND

- Reach break
- Pool, water quality sampling
- Pool
- Water level and temperature loggers, flow monitoring
- Routine water quality monitoring stations (Permit 107517), Mine-exposed
- Settling pond
- Wetted channel
- Dry channel

Elk River Side Channel Wet and Dry Locations, February to March 2018

0 375 750 1,500 Meters

N W E S

Datum: NAD 83 Map Projection: UTM Zone 11N

Date: May 2018
Project 177202.0024

minnow environmental inc.

Figure A.8

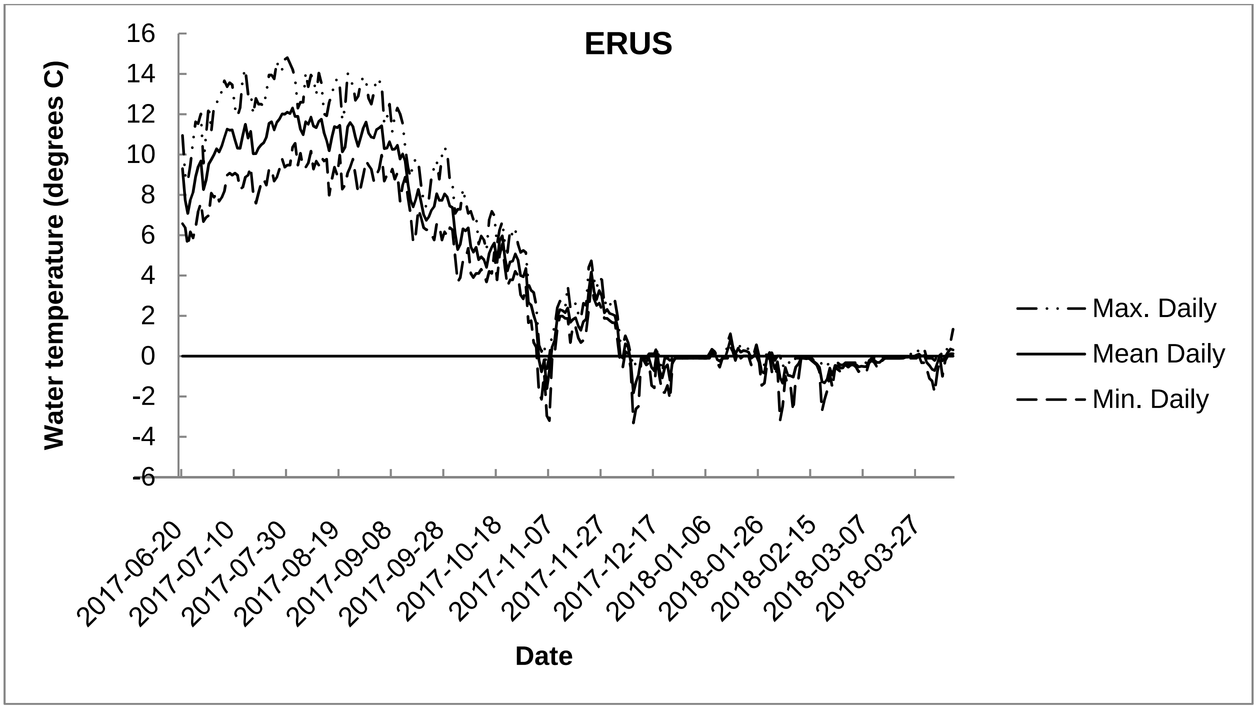


Figure A.9: Water Temperature Record for ERUS

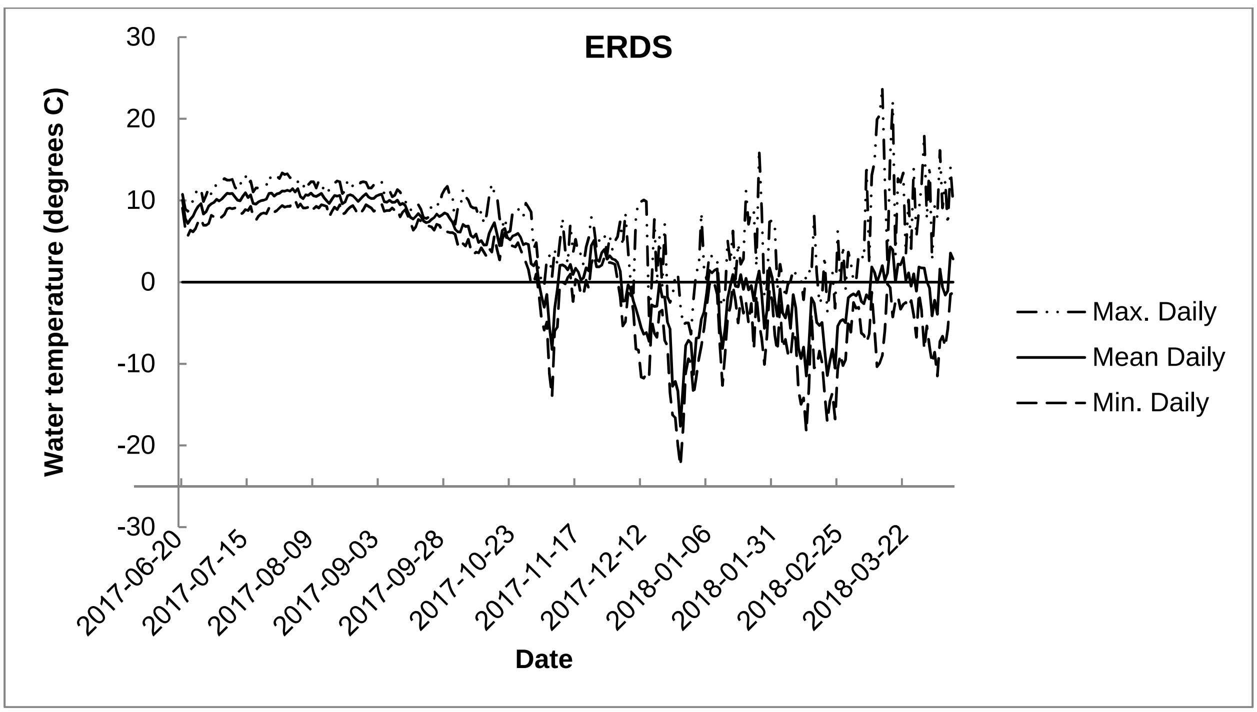


Figure A.10: Water Temperature Record for ERDS

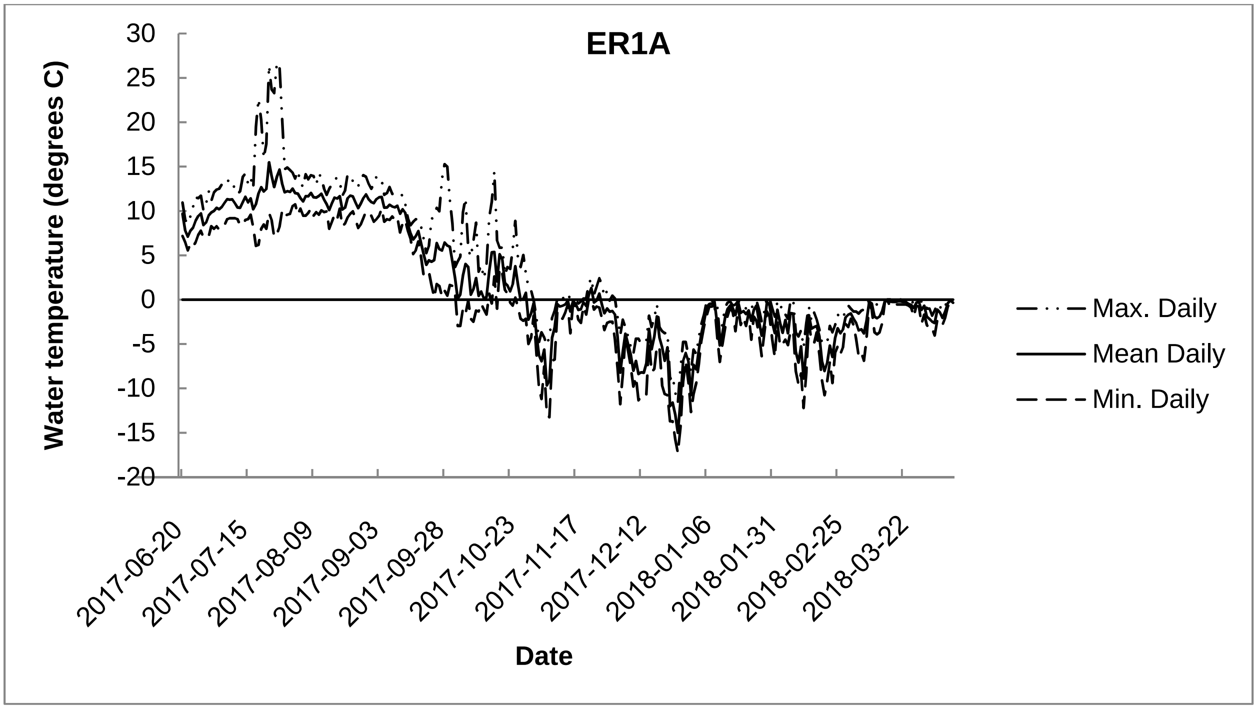


Figure A.11: **Water Temperature Record for ER1A**

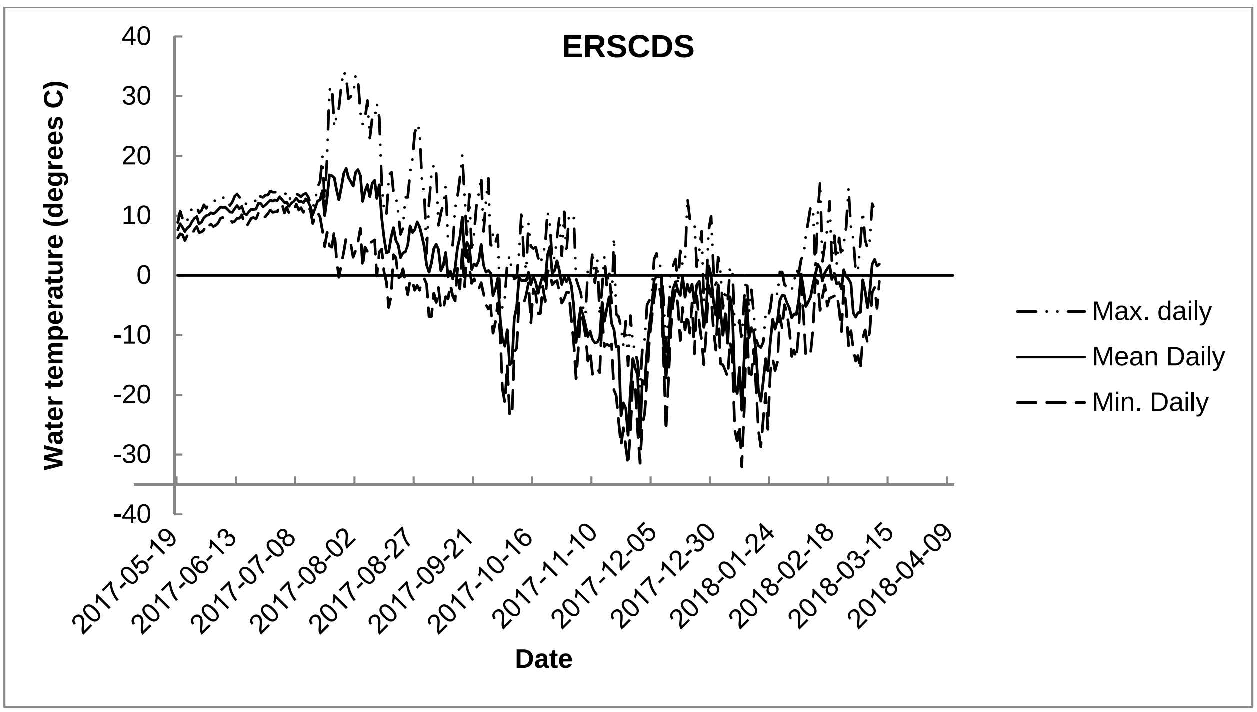


Figure A.12: **Water Temperature Record for ERSCDS**

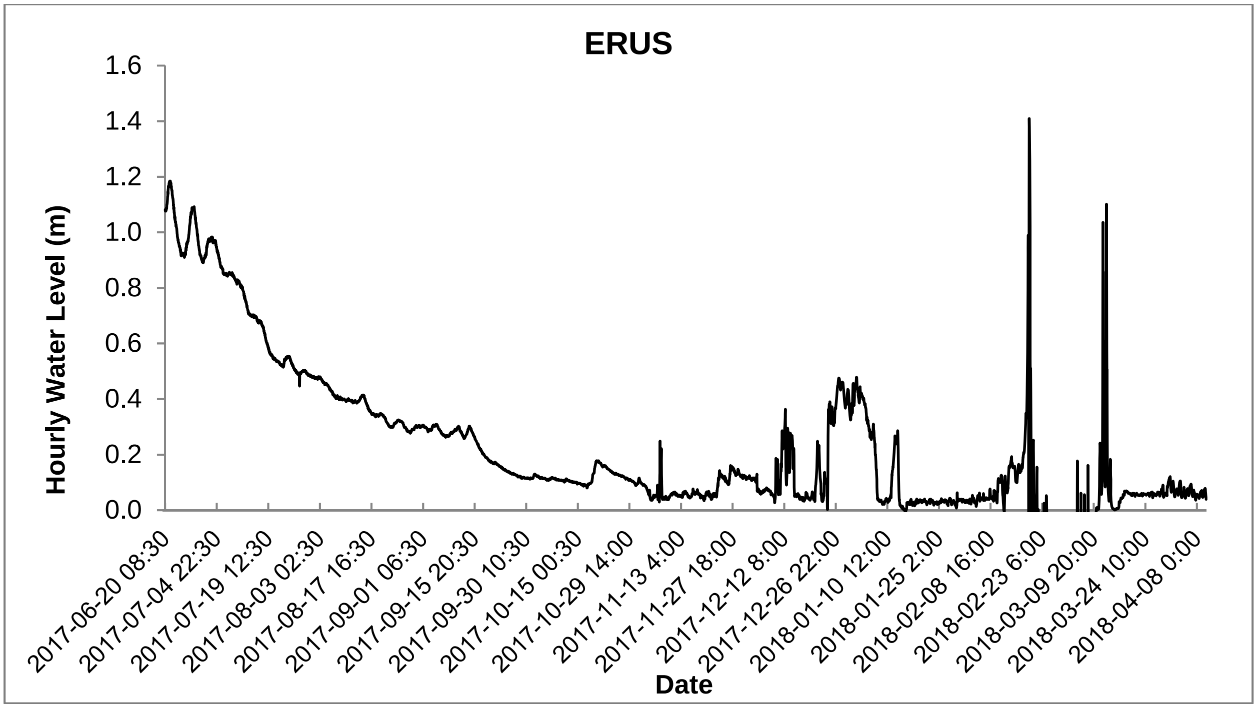


Figure A.13: Water Stage Record for ERUS

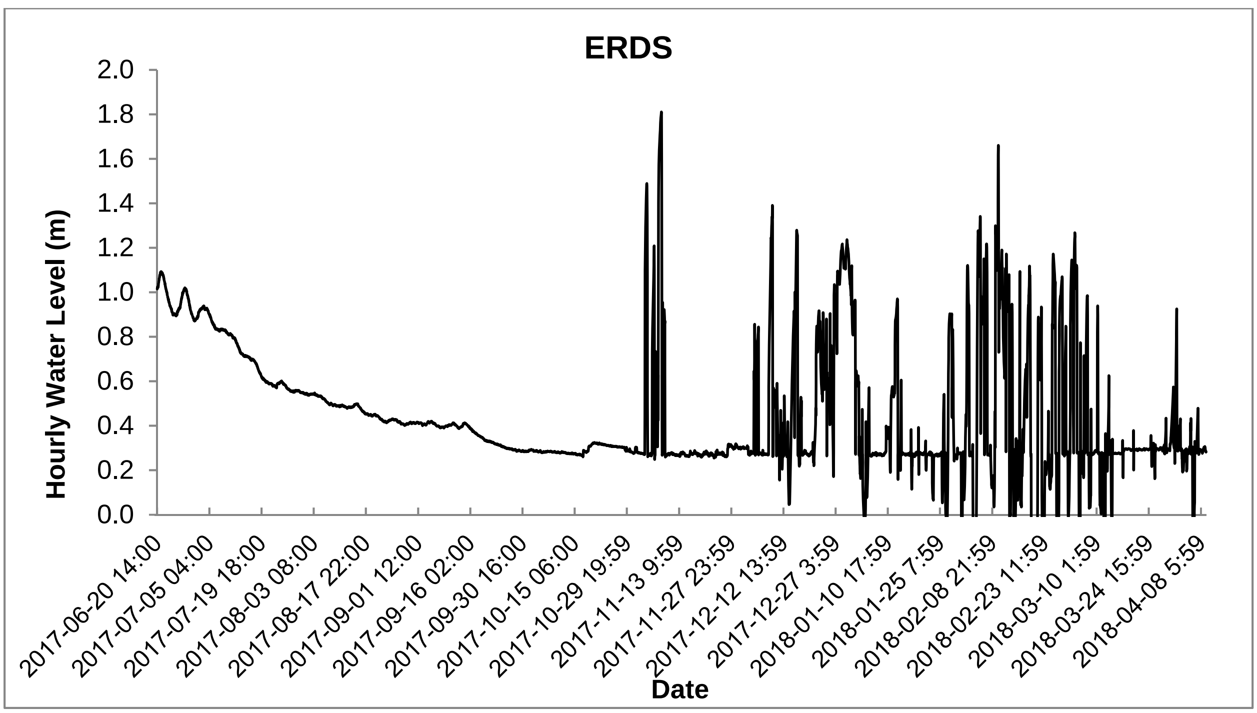


Figure A.14: Water Stage Record for ERDS

Attachment 2

Temporal Graphs of Cl in Surface Water
(Minnow and Lotic, 2018a)

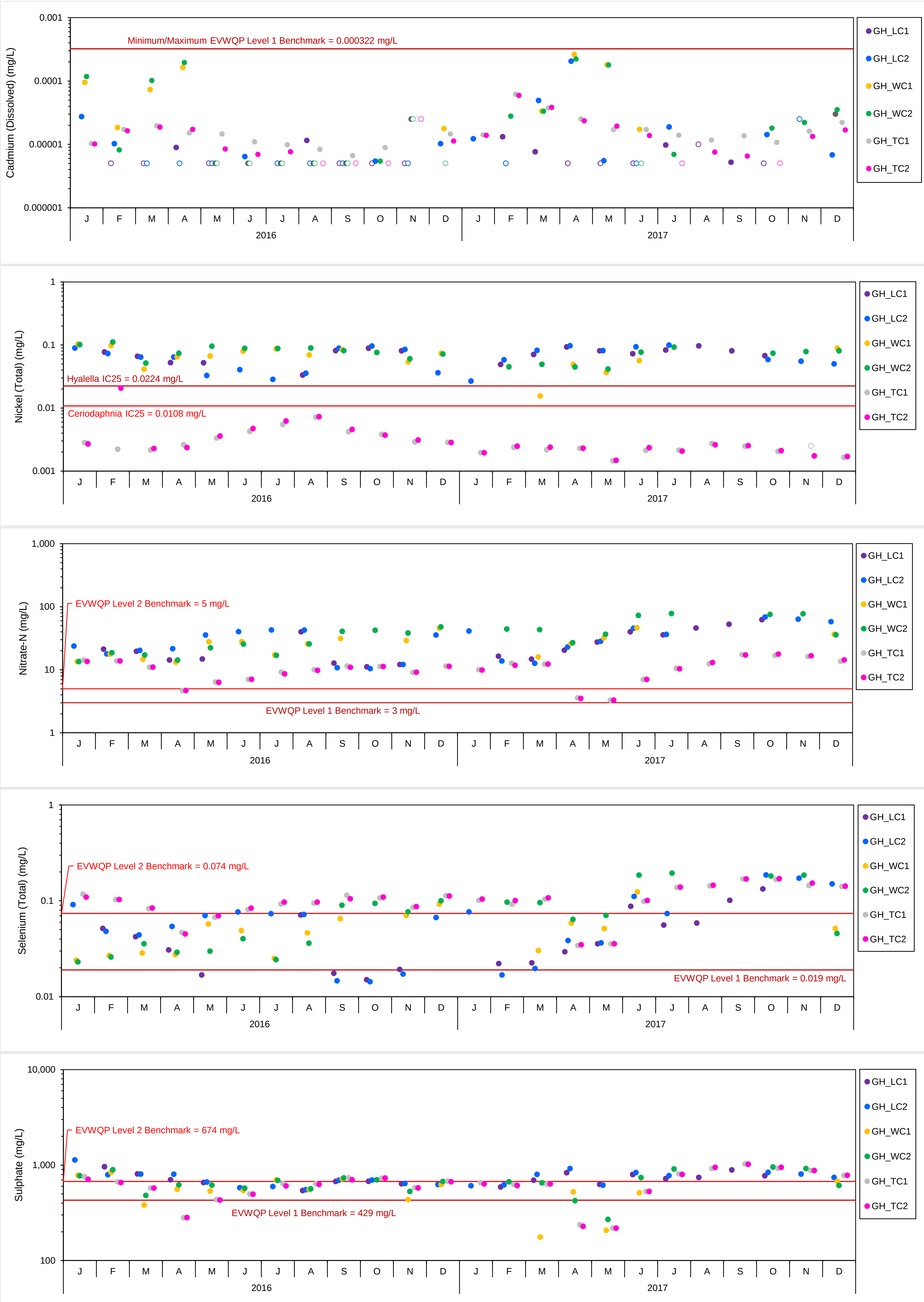


Figure 4.3: Water Quality Temporal Plots of Monthly Means for Order Constituents and Total Aqueous Nickel, Compared to EVWQP Benchmarks Preliminary IC_{25} Values for the West-side Tributaries Leask Creek (GH_LC1 and GH_LC2), Wolfram Creek (GH_WC1 and GH_WC2), and Thompson Creek (GH_TC1 and GH_TC2), 2016 to 2017

Note: open symbols indicate samples below the laboratory reporting limit (LRL), and were reported as 1×LRL. Data points are horizontally staggered within each month to allow overlapping points to be differentiated. For dissolved cadmium, minimum and maximum EVWQP benchmarks represent the range of benchmark values based on hardness for all monthly means.

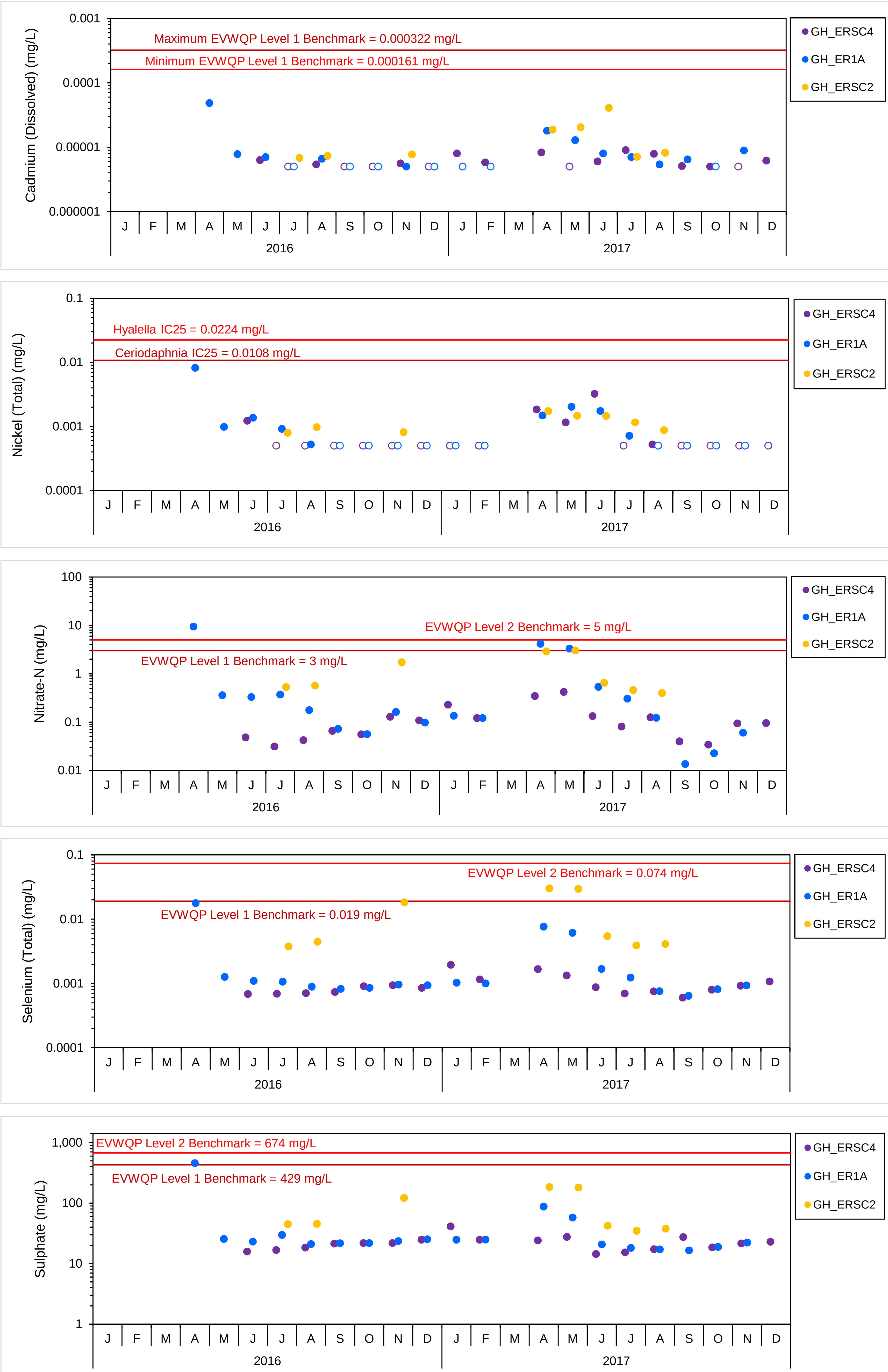


Figure 4.4: Water Quality Temporal Plots of Monthly Means for Order Constituents and Total Aqueous Nickel at Side Channel Monitoring Stations Compared to EVWQP Benchmarks and Preliminary IC_{25} Values, Elk River Side Channel, 2016 to 2017

Note: Open symbols indicate samples below the laboratory reporting limit (LRL), and were reported as 1×LRL. Minimum and maximum EVWQP benchmarks represent the range of benchmark values based on hardness for all monthly means. Data points are horizontally staggered within each month to allow overlapping points to be differentiated.

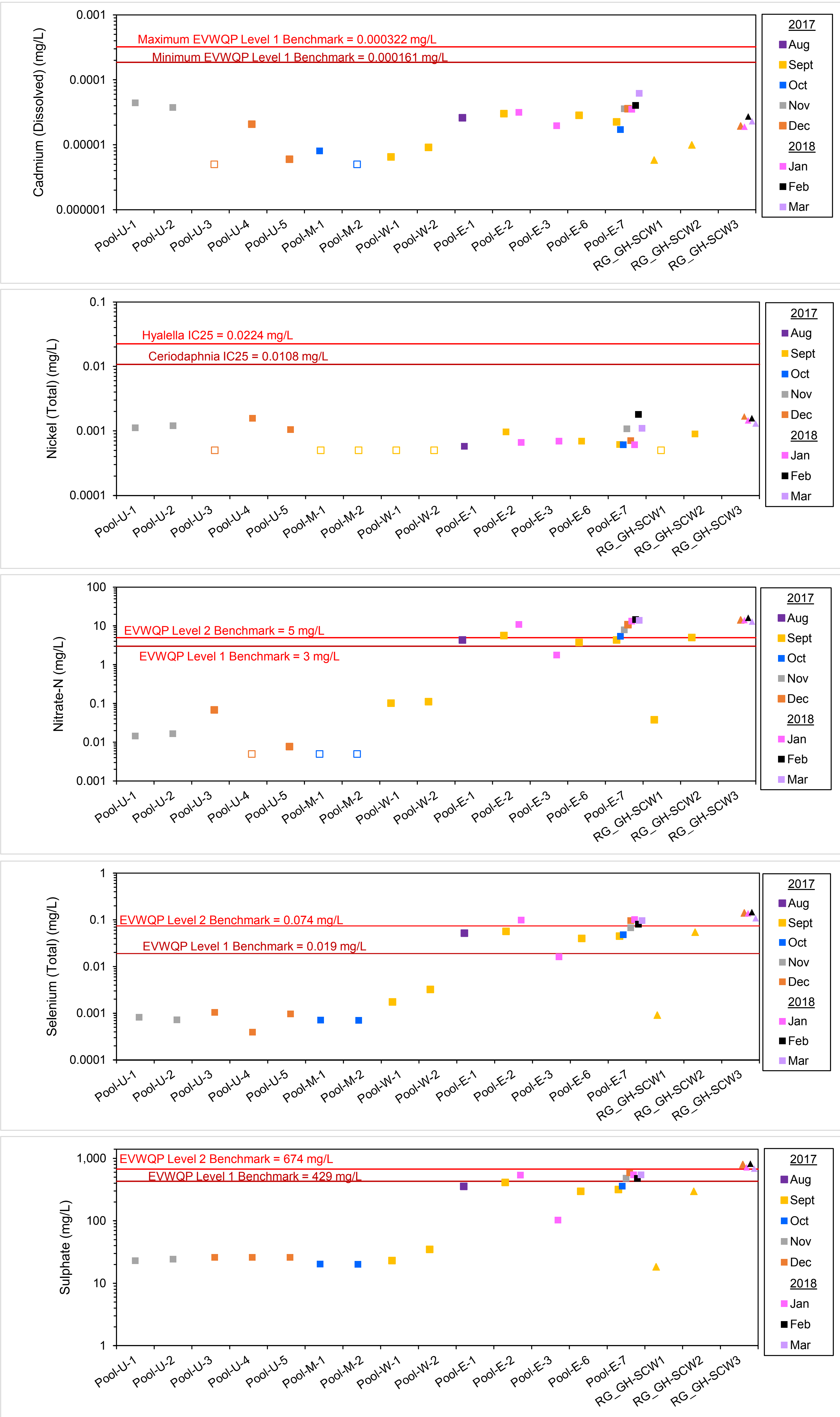


Figure 4.5: Water Quality Temporal Plots of Monthly Means for Order Constituents and Total Aqueous Nickel at Isolated Pool And Wetland Stations Compared to EVWQP Benchmarks and Preliminary IC_{25} Values, 2017 to 2018

Notes: Symbols differentiate station site locations, with squares (□) representing stations in pools and triangles (Δ) representing stations in wetlands. Open symbols indicate samples below the laboratory reporting limit (LRL), and were reported as 1×LRL. Minimum and maximum EVWQP benchmarks for cadmium represent the range of benchmark values based on hardness for all monthly means. Data points are horizontally staggered within each month to allow overlapping points to be differentiated.

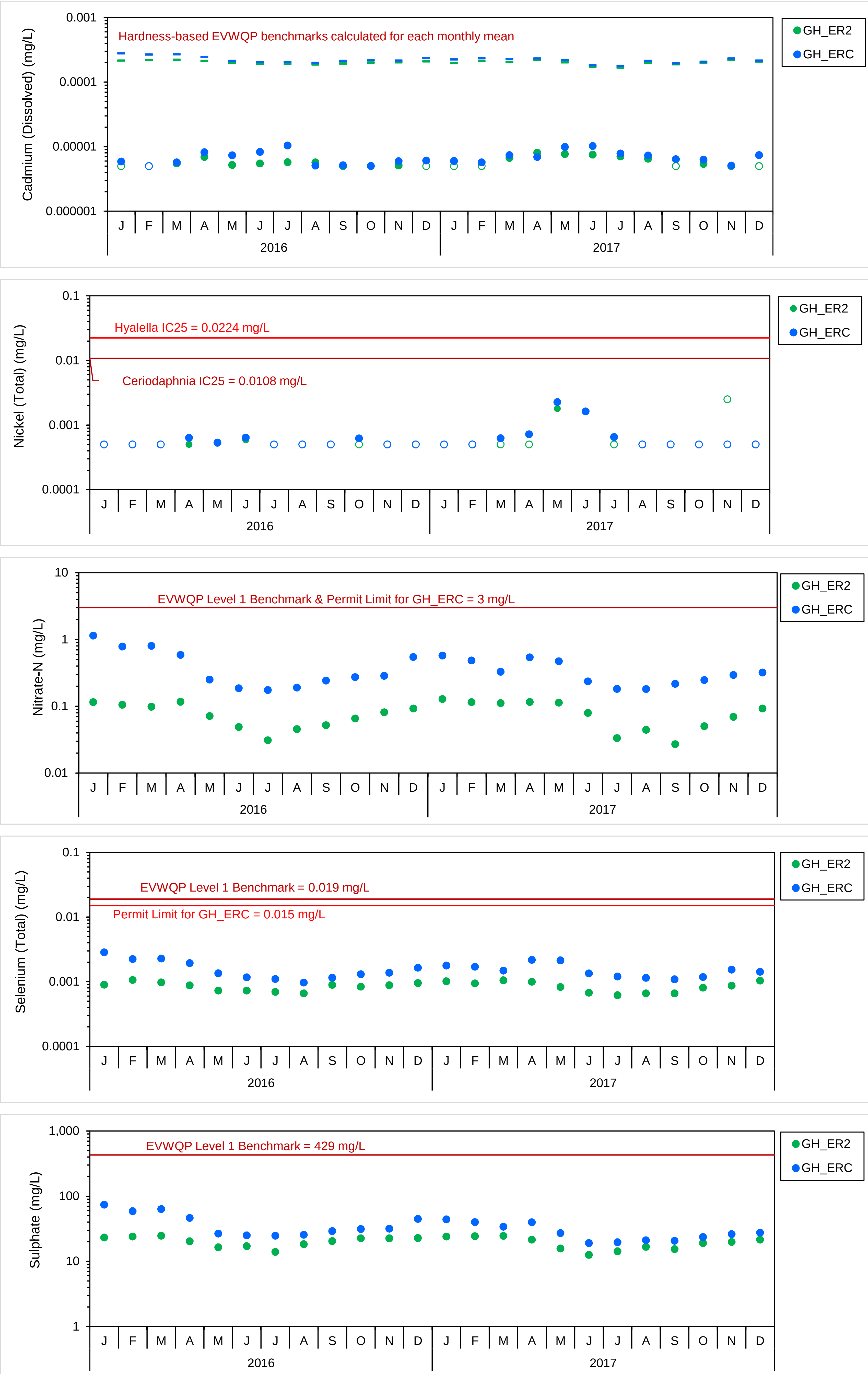


Figure 4.6: Water Quality Temporal Plots of Monthly Means for Order Constituents and Total Aqueous Nickel at Main Stem Elk River Areas Upstream (GH_ER2) and Downstream (GH_ERC) of Mine Activities Compared to EVWQP Benchmarks, Preliminary IC_{25} Values, and Permit Limits, 2016 to 2017

Note: open symbols indicate samples below the laboratory reporting limit (LRL), and were reported as 1×LRL. Dashes denote hardness-based EVWQP benchmarks calculated for each monthly mean.

APPENDIX E
BENTHIC INVERTEBRATE COMMUNITY COMPOSITION

Benthic Invertebrate Community Composition Data
Laboratory QA/QC

BENTHIC INVERTEBRATE COMMUNITY COMPOSITION

Benthic Invertebrate Community Composition Data

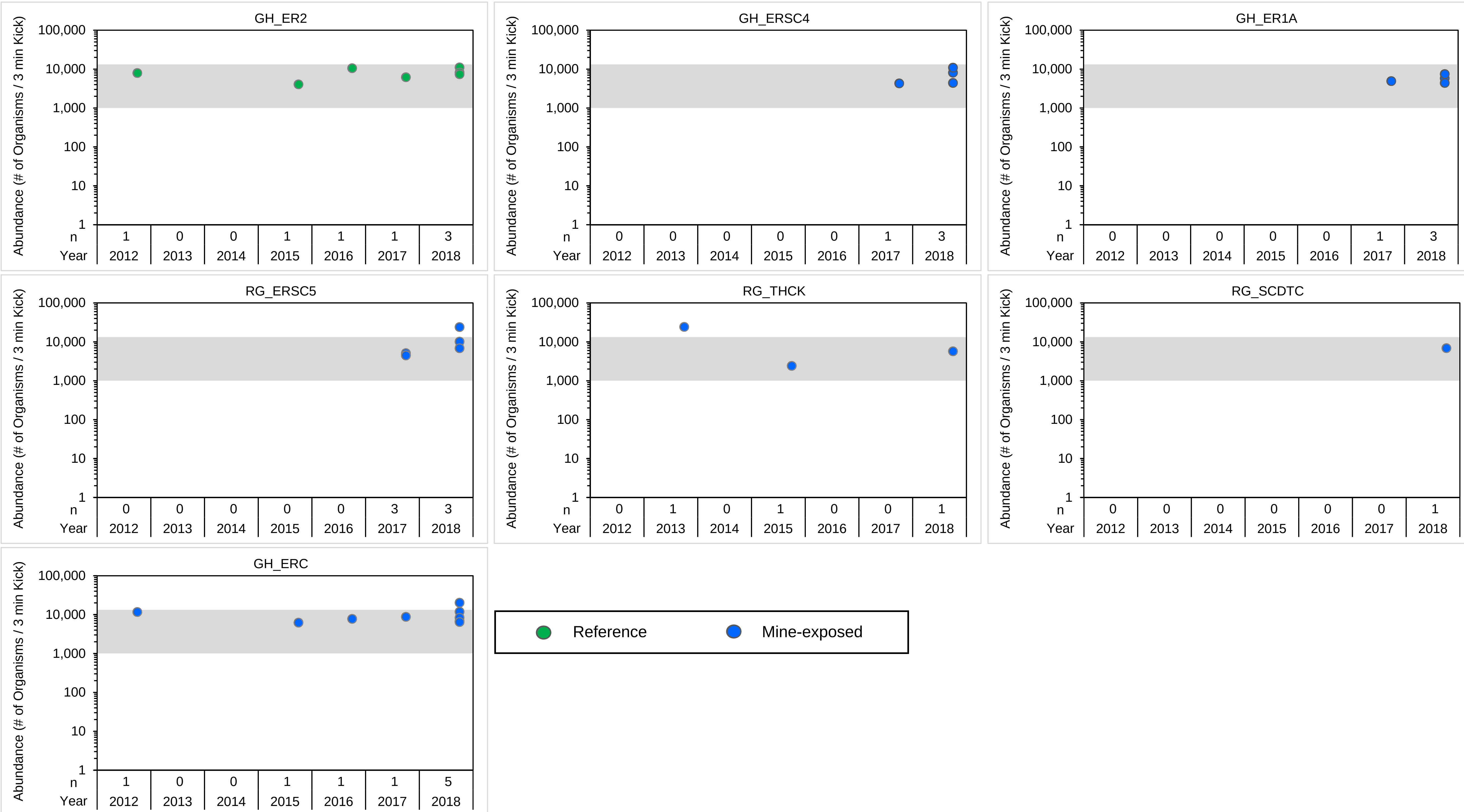


Figure E.1: Benthic Invertebrate Community Abundance, GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

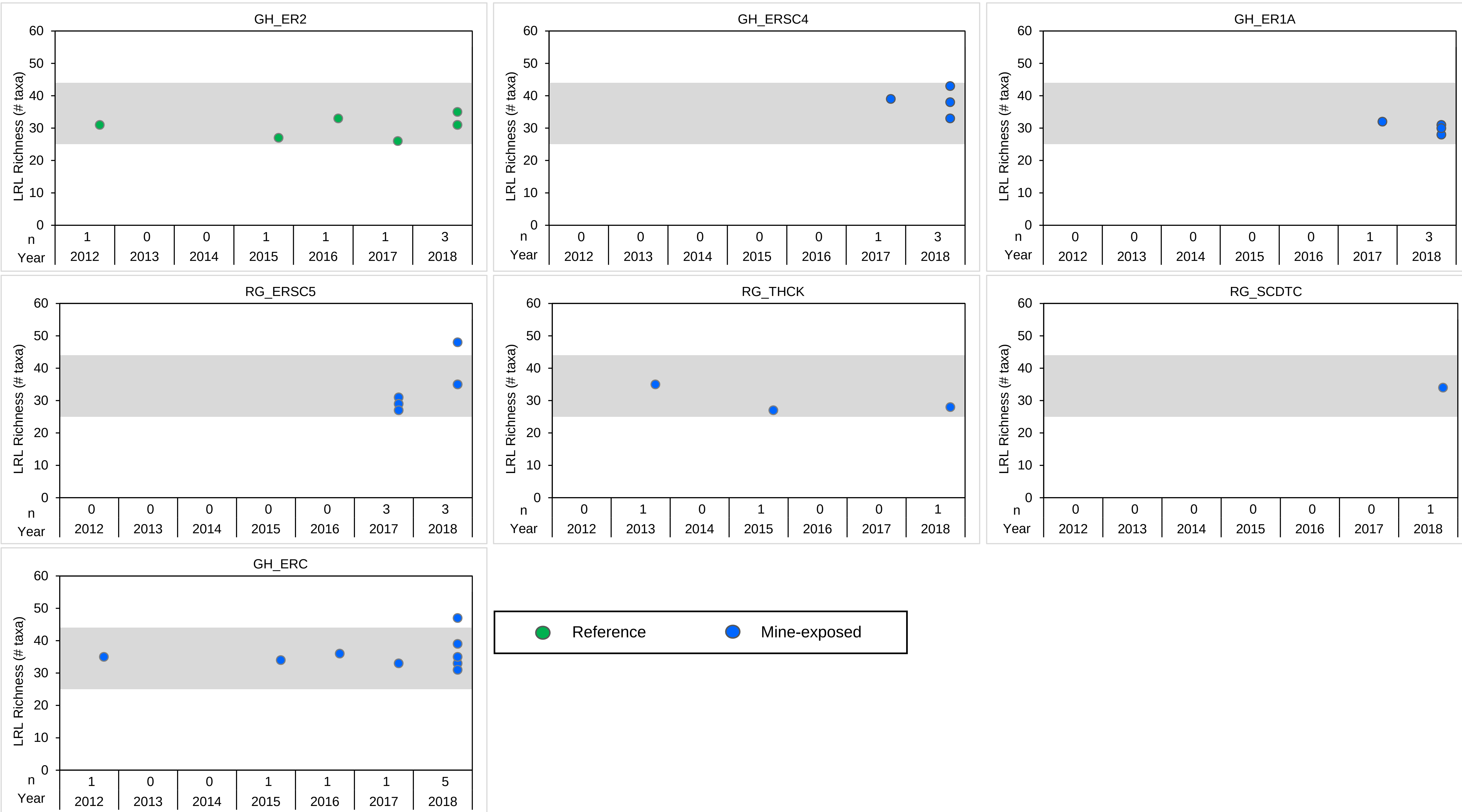


Figure E.2: Benthic Invertebrate LPL Richness, GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

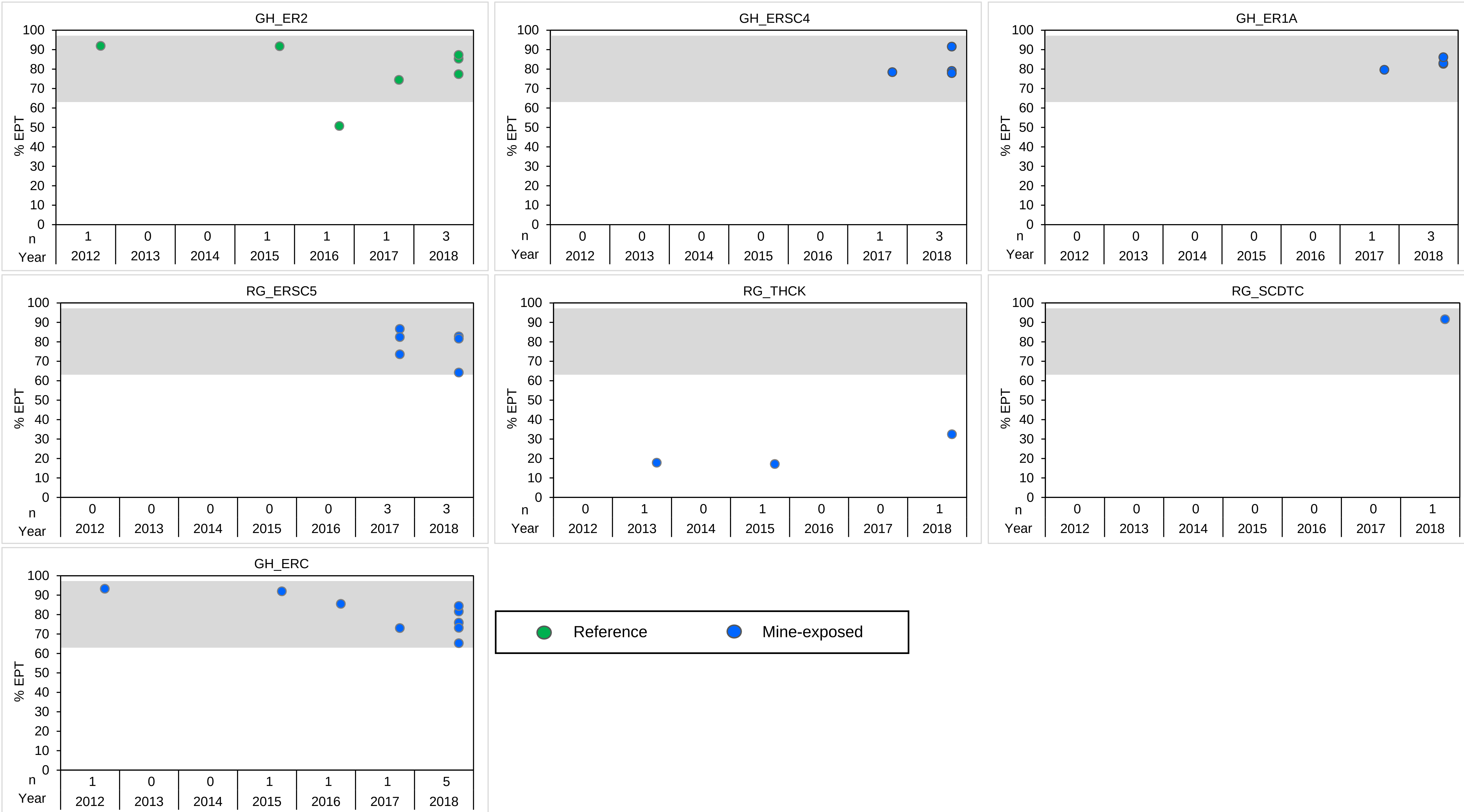


Figure E.3: Benthic Invertebrate % Ephemeroptera, Plecoptera Trichoptera (EPT), GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

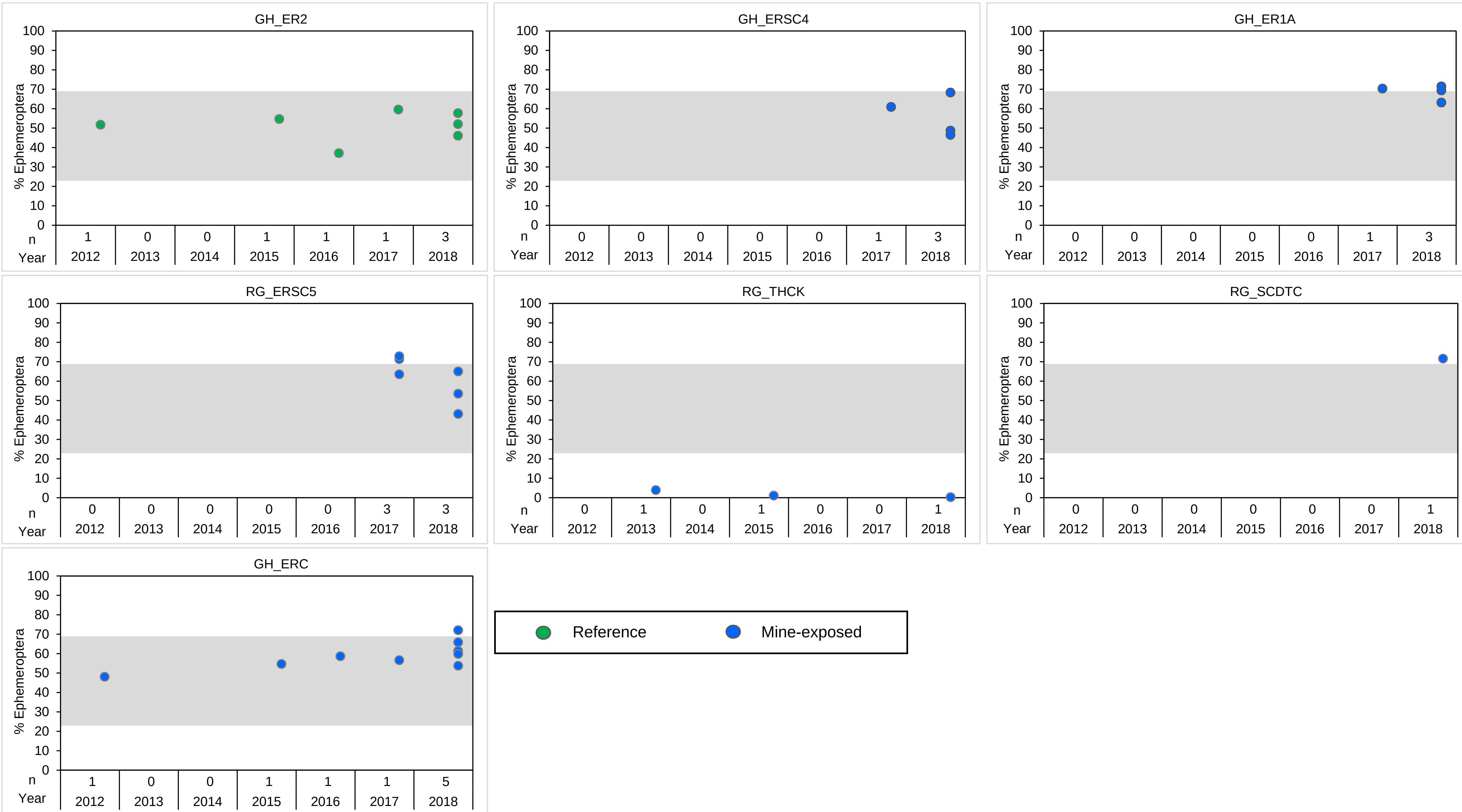


Figure E.4: Benthic Invertebrate % Ephemeroptera, GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

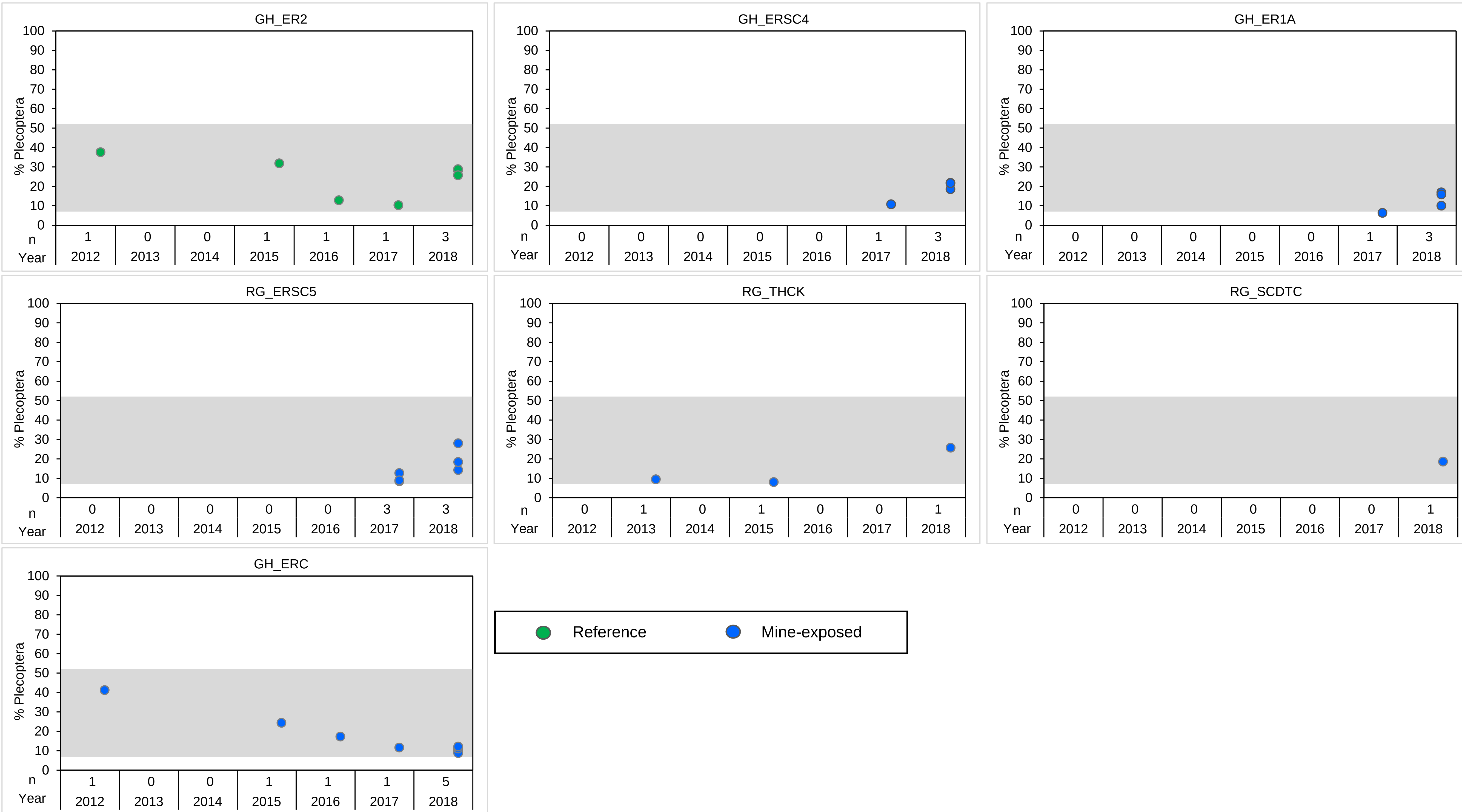


Figure E.5: Benthic Invertebrate % Plecoptera GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

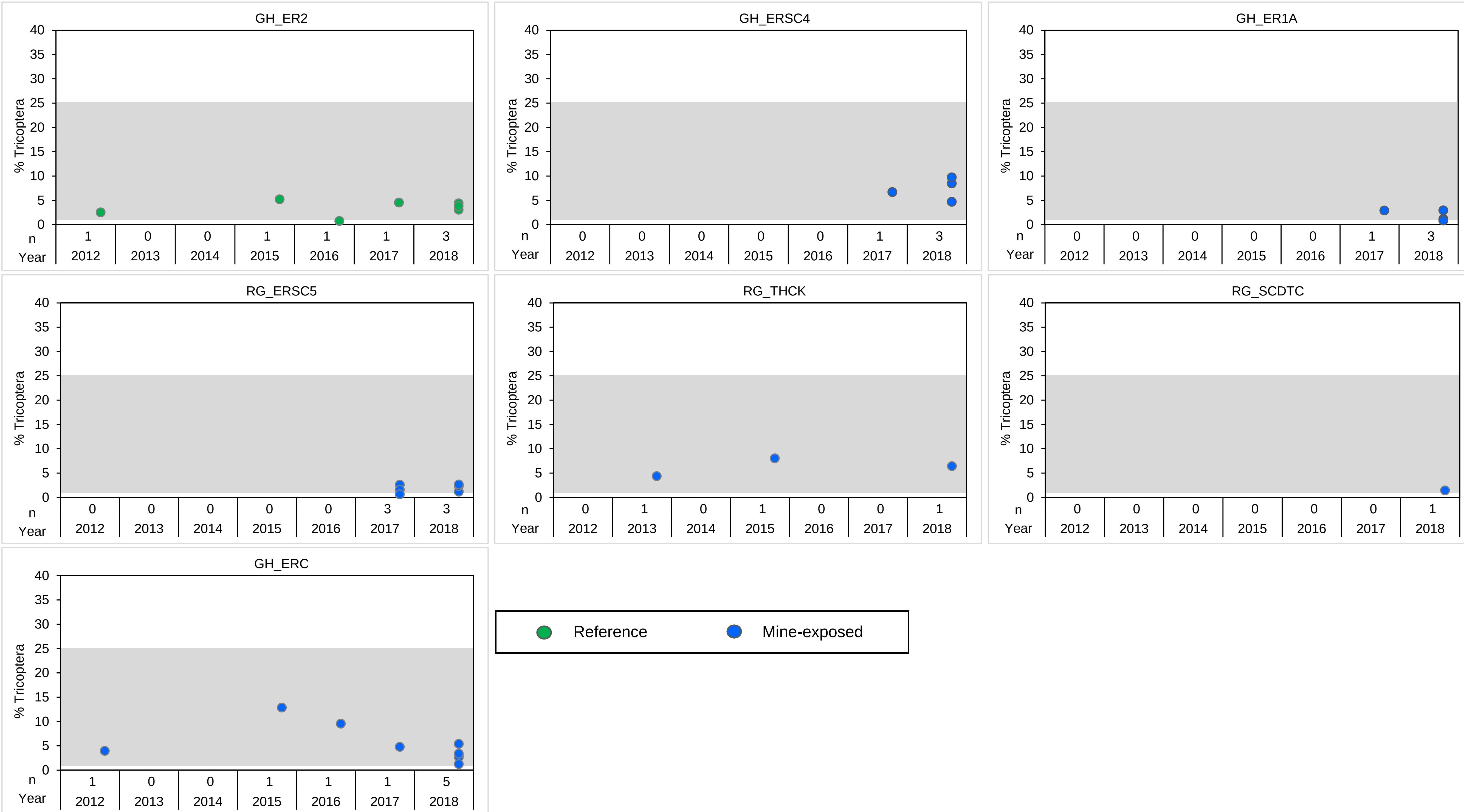


Figure E.6: Benthic Invertebrate % Trichoptera GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

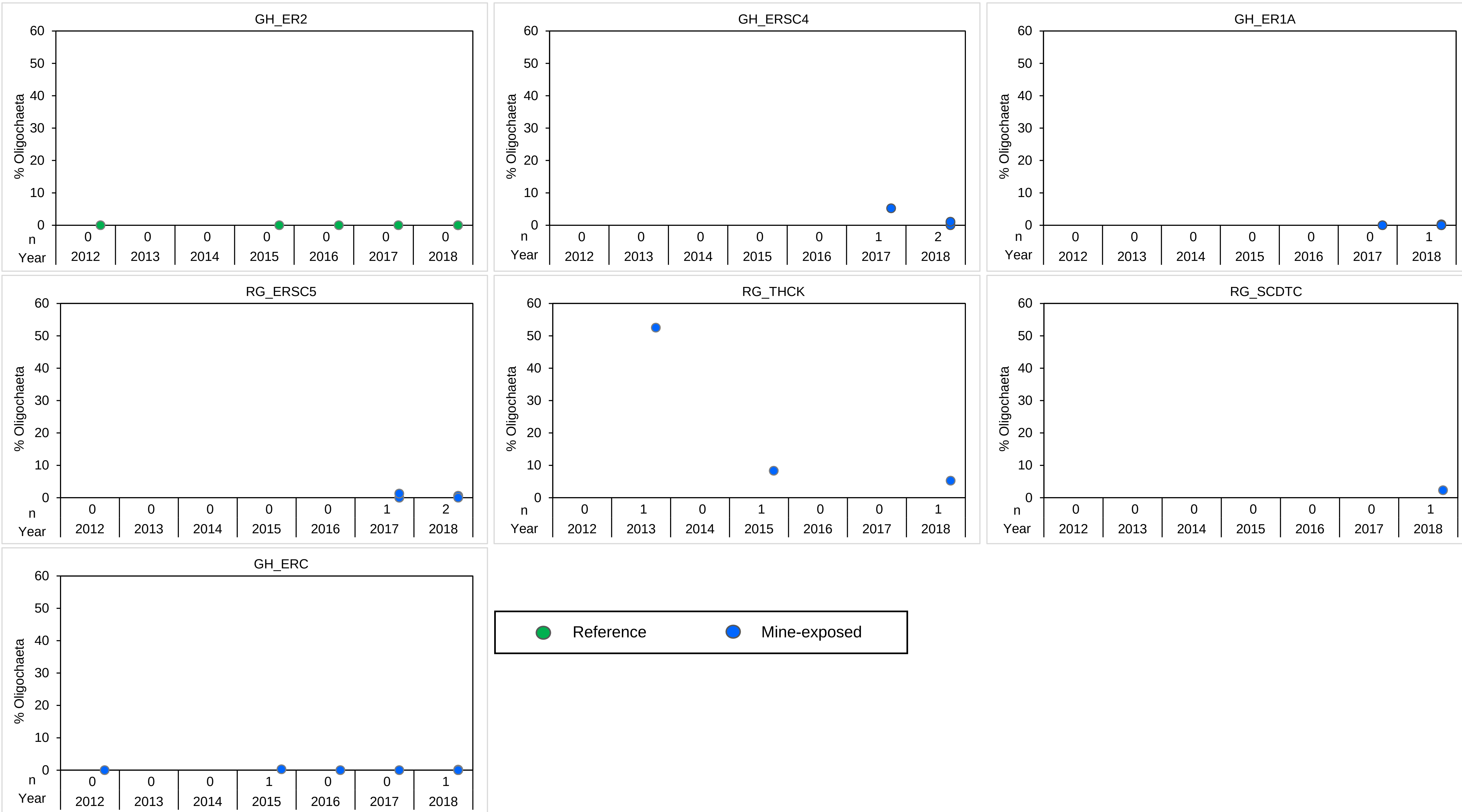


Figure E.7: Benthic Invertebrate % Oligochaeta GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

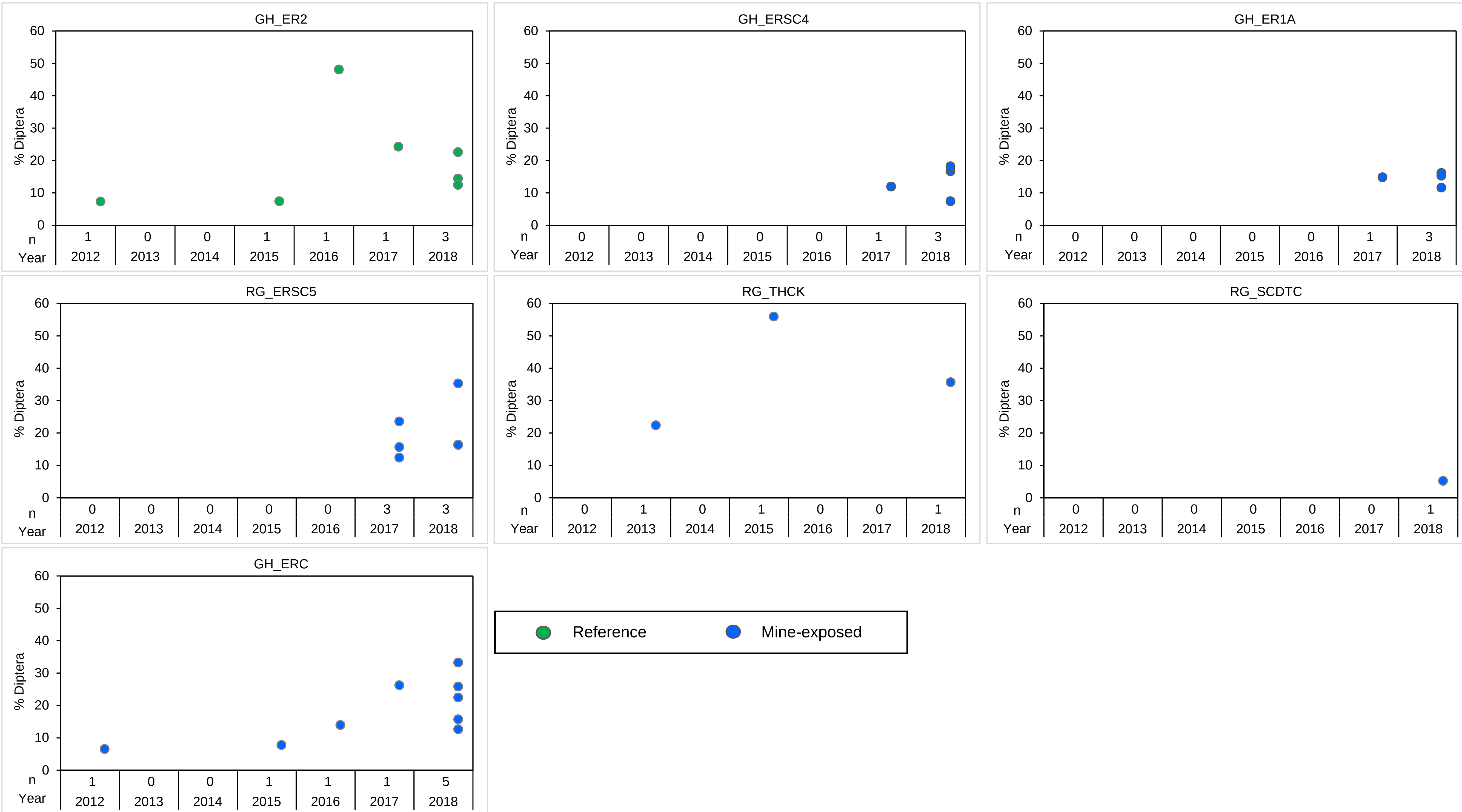


Figure E.8: Benthic Invertebrate % Diptera GHO LAEMP, 2012 to 2018

Note: Grey shading represents the normal range defined as the 2.5th and 97.5th percentiles of the 2012 and 2015 reference area data from the Regional Aquatic Environmental Monitoring Program (RAEMP).

Table E.1: Benthic Invertebrate Community Data, GHO LAEMP, 2018

Area Type	Reference					Mine-exposed													
Station	GH_ER2 / EL20					GH_ERSC4			GH_ER1A			RG_ERSC5			RG_THCK	RG_SCDTC	GH_ERC / RG_ELUGH		
Sample ID	RG_EL20-1_BIC	RG_EL20-2_BIC	RG_EL20-3_BIC	RG_EL20-4_BIC	RG_EL20-5_BIC	RG_GH_ERSC4-1_BIC	RG_GH_ERSC4-2_BIC	RG_GH_ERSC4-3_BIC	RG_GH_ER1A-1_BIC	RG_GH_ER1A-2_BIC	RG_GH_ER1A-3_BIC	RG_ERSC5-1_BIC	RG_ERSC5-2_BIC	RG_ERSC5-3_BIC	RG_THCK_BIC	RG_SCDTC_BIC	RG_ELUGH1_BIC	RG_ELUGH2_BIC	RG_ELUGH3_BIC
Sample Date	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	09-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	09-Sep-18	06-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	1	2	4	0	25	0	0	33	0	63	0	0	0	0	260	2	0	1
| Family: Baetidae	56	40	203	47	32	300	560	700	250	1,980	188	1,200	540	2,300	0	520	8	0	0
Acentrella	0	0	1	3	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Baetis	132	76	191	100	89	150	480	520	233	700	350	700	880	1,060	0	600	21	25	44
Baetis rhodani group	5	0	12	4	5	63	200	300	183	80	75	1,040	440	880	0	400	7	4	8
Baetis bicaudatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
| Family: Ephemerellidae	36	20	27	30	16	200	320	180	117	80	100	100	140	460	1	160	12	16	5
Caudatella	0	0	1	1	1	0	0	0	0	0	0	40	0	120	0	0	0	0	0
Drunella	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Drunella coloradensis	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	20	0	0	0
Drunella doddsii	18	18	8	3	12	63	180	140	167	40	100	160	140	260	0	100	18	12	17
Drunella spinifera	4	15	19	6	1	0	0	20	0	0	0	0	0	20	0	0	0	0	0
Ephemerella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella excrucians complex	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serratella	0	0	0	0	0	0	20	0	0	0	0	40	20	60	0	20	0	0	0
| Family: Heptageniidae	123	70	70	51	29	1,188	3,040	2,240	2,583	1,400	1,675	1,540	1,380	4,100	0	2,780	164	111	104
Cinygmula	0	1	1	0	0	0	20	0	100	0	38	20	0	0	0	40	0	1	0
Epeorus	2	1	1	2	1	0	60	60	117	100	0	300	180	460	0	0	3	4	4
Rhithrogena	11	2	2	3	6	163	620	860	350	320	463	280	700	640	0	20	19	40	30
| Family: Leptophlebiidae	1	0	0	0	0	0	20	20	0	0	13	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0
| Family: Capniidae	7	6	6	7	0	0	20	20	0	0	63	0	40	80	0	20	3	0	1
| Family: Chloroperlidae	4	5	3	0	2	13	0	0	0	0	0	40	20	20	0	0	7	4	2
Haploperla	0	0	0	0	0	13	0	20	0	0	0	0	0	20	0	0	0	0	0
Sweltsa	0	3	0	1	2	13	120	160	67	0	63	40	40	160	0	0	13	8	0
| Family: Leuctridae	0	0	0	0	0	0	0	20	0	0	13	0	0	0	1	0	2	1	0
| Family: Nemouridae	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malenka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Zapada	7	0	9	8	1	288	340	500	100	100	75	220	40	400	7	120	8	9	18
Zapada oregonensis group	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	1	0	0
Zapada cinctipes	0	0	4	3	0	263	320	840	67	580	225	220	140	840	77	120	12	3	8
Zapada columbiana	0	0	0	0	0	13	0	60	0	0	0	0	0	0	1	0	0	0	0
| Family: Perlidae	6	2	40	10	7	38	120	100	17	220	63	120	20	40	0	40	3	6	5
Hesperoperla	3	0	3	2	8	38	260	160	133	140	25	0	20	80	0	0	1	0	3
| Family: Perlodidae	9	7	6	8	9	63	0	60	0	60	50	60	0	320	0	120	0	3	10
Isoperla	0	0	1	0	0	0	20	0	0	0	0	0	0	180	0	20	0	0	0
Kogotus	1	0	2	0	1	0	20	0	0	20	0	20	60	20	1	200	0	1	1
Megarcys	1	0	0	0	0	0	0	0	0	0	0	20	0	40	0	20	1	1	0
| Family: Pteronarcyidae	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteronarcella	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0
| Family: Taeniopterygidae	20	8	9	5	8	225	280	420	200	140	125	2,040	600	2,220	0	620	102	60	36
Taenionema	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	11
| Order: Trichoptera	1	2	0	0	1	0	0	20	17	20	0	0	0	140	2	0	1	1	1
| Family: Brachycentridae	5	3	15	5	0	0	0	0	0	0	0	0	0	40	0	0	9	3	5
Brachycentrus	0	0	0	0	0	100	100	340	17	80	0	60	20	220	0	20	0	0	0
Brachycentrus americanus	3	1	1	0	1	163	100	340	0	60	13	0	20	0	0	0	2	3	2
Micrasema	0	0	0	0	0	0	0	0	0	0	0	0	0	120	0	0	0	0	0
| Family: Glossosomatidae	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Glossosoma	1	0	1	3	0	0	20	0	0	20	0	0	0	20	0	0	0	0	1
| Family: Hydropsychidae	12	1	3	1	0	25	20	40	17	20	0	0	40	0	0	0	1	4	2
Arctopsyche	6	0	5	3	1	0	60	140	0	20	13	0	20	40	0	0	1	6	3
Parapsyche	0	0	0	0	0	0	0	0	0	0	0	0	0	20	6	0	0	0	0
| Family: Lepidostomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma	0	0	0	0	0	0	0	0	0	0	0	0	40	0	1	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	13	0	0	0	0	13	0	0	0	0	0	0	0	0
| Family: Rhyacophilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophila	0	0	2	0	1	25	0	120	17	0	0	60	20	20	8	40	1	0	0
Rhyacophila angelita group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
Rhyacophila betteni group	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Rhyacophila brunnea/vemna group	1	2	0	2	0	50	60	60	0	0	0	0	0	0	5	20	2	0	0

Table E.1: Benthic Invertebrate Community Data, GHO LAEMP, 2018

Area Type	**Reference**					**Mine-exposed**													
Station	**GH_ER2 / EL20**					**GH_ERSC4**			**GH_ER1A**			**RG_ERSC5**			**RG_THCK**	**RG_SCDTC**	**GH_ERC / RG_ELUGH**		
Sample ID	RG_EL20-1_BIC	RG_EL20-2_BIC	RG_EL20-3_BIC	RG_EL20-4_BIC	RG_EL20-5_BIC	RG_GH_ERSC4-1_BIC	RG_GH_ERSC4-2_BIC	RG_GH_ERSC4-3_BIC	RG_GH_ER1A-1_BIC	RG_GH_ER1A-2_BIC	RG_GH_ER1A-3_BIC	RG_ERSC5-1_BIC	RG_ERSC5-2_BIC	RG_ERSC5-3_BIC	RG_THCK_BIC	RG_SCDTC_BIC	RG_ELUGH1_BIC	RG_ELUGH2_BIC	RG_ELUGH3_BIC
Sample Date	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	09-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	09-Sep-18	06-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18
Rhyacophila atrata complex	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Elmidae	0	1	0	0	2	0	0	20	0	20	0	0	20	0	30	20	0	0	0
Heterlimnius	0	0	0	0	0	26	20	20	33	0	25	0	0	0	51	0	0	0	0
Order: Diptera	0	0	0	0	0	0	0	0	0	20	0	0	0	0	1	0	0	0	0
Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mallochohelea	0	1	0	1	2	0	0	20	0	0	0	0	0	0	0	0	6	0	0
Family: Chironomidae	6	2	32	11	9	0	20	140	33	100	38	20	20	20	8	0	5	0	3
Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	20	0	0	0	0	1	0	0	0	0
Stictochironomus	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Tanytarsini	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0
Cladotanytarsus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Constempellina sp. C	0	1	0	0	0	0	0	0	17	0	0	0	0	20	0	0	1	2	0
Micropsectra	4	3	5	6	0	0	40	200	33	20	38	40	40	160	4	0	6	5	0
Stempellinella	1	0	3	0	0	0	20	0	0	0	0	0	0	0	0	0	1	0	0
Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	9	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pagastia	1	2	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brillia	0	0	0	0	1	25	20	20	0	20	0	60	40	60	0	0	0	1	0
Corynoneura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	20	0	0	0
Eukiefferiella	22	1	91	26	5	13	0	80	0	40	0	20	0	180	0	0	1	0	5
Heleniella	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0
Limnophyes	0	0	1	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0
Orthocladius complex	18	10	132	31	34	0	0	0	0	40	0	20	0	60	2	20	0	2	7
Parametriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Parorthocladius	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus	3	0	8	5	0	0	0	100	33	0	50	120	60	220	0	40	2	0	2
Thienemanniella	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
Tvetenia	9	2	22	1	2	0	40	140	50	80	25	20	60	180	2	100	1	0	4
Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Thienemannimyia group	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Family: Dixidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dixa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Family: Empididae	3	2	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	1	0
Chelifera/ Metachela	0	0	0	0	0	38	20	20	83	40	13	20	40	40	0	0	0	0	0
Clinocera	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neoplasta	0	5	5	2	10	13	0	0	0	0	13	0	0	0	0	20	1	1	1
Oreogeton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roederiodes	0	0	0	0	0	0	0	0	0	20	0	0	0	20	0	0	0	0	0
Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	3	13	17	6	12	400	240	820	667	320	275	320	480	660	3	80	95	43	19
Family: Simuliidae	1	0	1	0	0	50	0	0	0	0	0	60	40	140	74	0	2	1	1
Helodon	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Prosimulium/Helodon	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Simulium	13	0	4	0	5	175	120	340	0	400	63	940	300	6,600	11	60	1	2	3
Family: Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Antocha	0	0	0	0	1	13	0	20	0	0	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	0	0	0	20	40	17	0	0	0	20	40	0	20	0	0	0
Hexatoma	0	1	0	0	0	0	0	20	0	0	0	0	0	0	0	0	3	1	0
Rhabdomastix	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Trombidiformes	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Aturidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aturus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Feltriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feltria	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E.1: Benthic Invertebrate Community Data, GHO LAEMP, 2018

Area Type	Reference					Mine-exposed													
Station	**GH_ER2 / EL20**					**GH_ERSC4**			**GH_ER1A**			**RG_ERSC5**			**RG_THCK**	**RG_SCDTC**	**GH_ERC / RG_ELUGH**		
Sample ID	RG_EL20-1_BIC	RG_EL20-2_BIC	RG_EL20-3_BIC	RG_EL20-4_BIC	RG_EL20-5_BIC	RG_GH_ERSC4-1_BIC	RG_GH_ERSC4-2_BIC	RG_GH_ERSC4-3_BIC	RG_GH_ER1A-1_BIC	RG_GH_ER1A-2_BIC	RG_GH_ER1A-3_BIC	RG_ERSC5-1_BIC	RG_ERSC5-2_BIC	RG_ERSC5-3_BIC	RG_THCK_BIC	RG_SCDTC_BIC	RG_ELUGH1_BIC	RG_ELUGH2_BIC	RG_ELUGH3_BIC
Sample Date	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	09-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	09-Sep-18	06-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18
Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia	15	7	10	7	1	88	20	140	0	100	75	20	60	60	0	40	0	1	1
Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	0	1	1	0	0	0	20	0	17	0	0	0	20	20	0	0	0	0	0
Family: Torrenticolidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Testudacarus	0	0	0	0	0	38	20	120	0	0	0	0	0	0	0	0	0	0	0
Order: Oribatida	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0
Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Basommatophora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Lymnaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fossaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Hirudinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Lumbriculidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0
Rhynchelmis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nais	0	0	0	0	0	0	0	0	0	0	0	20	0	0	6	0	0	0	0
Subfamily: Tubificinae without hair chaetae	0	0	0	0	0	38	0	120	17	0	0	40	40	0	0	160	0	0	0
Totals:	**592**	**340**	**1,008**	**414**	**321**	**4,425**	**8,080**	**10,880**	**5,785**	**7,440**	**4,421**	**10,120**	**6,860**	**24,020**	**342**	**6,900**	**553**	**409**	**369**
Taxa present but not included:																			
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	20	1	1	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Lumbricidae	0	0	0	0	0	0	0	0	0	0	0	20	0	0	9	0	0	0	0
Phylum: Nemata	1	1	1	0	1	13	20	20	17	20	13	20	20	20	1	0	1	1	1
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Turbellaria	0	0	0	0	0	13	0	0	0	0	0	0	0	0	1	0	1	1	0
Totals:	**1**	**1**	**1**	**0**	**1**	**26**	**20**	**20**	**17**	**20**	**13**	**40**	**20**	**20**	**12**	**20**	**3**	**3**	**1**

BENTHIC INVERTEBRATE COMMUNITY COMPOSITION

Laboratory Reports and QA/QC

Methods and QC Report 2018

Project ID: Teck Greenhills

Client: Minnow Environmental

Cordillera Consulting

Prepared by:
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Sample Reception

On September 20, 2018, Cordillera Consulting received 10 CABIN samples from Minnow Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.
See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Site Code	CC#	Date	Size	# of Jars
RG_SCDTC_BIC	CC191078	9/6/2018	400µM	1
RG_ERSC5-1_BIC	CC191079	9/8/2018	400µM	1
RG_ERSC5-2_BIC	CC191080	9/8/2018	400µM	1
RG_ERSC5-3_BIC	CC191081	9/8/2018	400µM	1
RG_GH_ERSC4-1_BIC	CC191082	9/9/2018	400µM	1
RG_GH_ERSC4-2_BIC	CC191083	9/9/2018	400µM	1
RG_GH_ERSC4-3_BIC	CC191084	9/9/2018	400µM	1
RG_GH_ER1A-1_BIC	CC191085	9/8/2018	400µM	1

RG_GH_ER1A-2_BIC	CC191086	9/9/2018	400µM	1
RG_GH_ER1A-3_BIC	CC191087	9/9/2018	400µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1
- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Sample	Date	CC#	400 micron fraction	
			% Sampled	# Invertebrates
RG_SCDTC_BIC	06-Sep-18	CC191078	5%	345
RG_ERSC5-1_BIC	08-Sep-18	CC191079	5%	506
RG_ERSC5-2_BIC	08-Sep-18	CC191080	5%	343
RG_ERSC5-3_BIC	08-Sep-18	CC191081	5%	1201
RG_GH_ERSC4-1_BIC	09-Sep-18	CC191082	8%	353
RG_GH_ERSC4-2_BIC	09-Sep-18	CC191083	5%	404
RG_GH_ERSC4-3_BIC	09-Sep-18	CC191084	5%	544
RG_GH_ER1A-1_BIC	08-Sep-18	CC191085	6%	347

RG_GH_ER1A-2_BIC	09-Sep-18	CC191086	5%	372
RG_GH_ER1A-3_BIC	09-Sep-18	CC191087	8%	353

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculated sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \%OM$$

Table 3: Summary of sorting efficiency

CC #	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CC191085	347	1	99%
		Average Recovery	99%

Sorting Quality Control - Sub-Sampling QC

Certain Provincial and Mining projects require additional sorting checks in the form of sub-sampling QC, (Environmental Effects Monitoring (EEM) protocol). This ensured that any fraction of the total sample that was examined was actually an accurate representation of the number of total organisms. Organisms from the additional sub-samples were not identified; rather total organism count only was compared.

Sub-Sampling efficiency was measured on 10% of the number of sub-sampled samples in the project. Ex. In a project where 50 of 100 total samples were processed through subsampling using a Marchant box, then 10% of 50; or 5 samples were used for sub sampling efficiency.

Sub-Sampling efficiency was performed by fractioning the entire sample into sub-sample percentages. On each sub-sampled portion, a total organism count was recorded and compared to the rest of the sub-samples. In order to pass, all fractions were required to be within 20% of total organism count.

Example: If 300 organisms are found in 10% of the sample, the sorter will continue to sample in 10% fractions until the entire sample is separated. They will then count the total number of organisms in each of the 10 fractions of 10% and compare the organism count.

When divergence is >20% the sorting manager examines for the source of the problem and takes steps to correct it. With the Marchant box, the problem typically rested with how the box is flipped back to the upright position. For this reason subsampling was performed by experienced employees only. Another common source of area would be the type of debris in the sample. Samples with algae or heavy with periphyton have a higher incident of failure due to clumping than clear samples.

Table 4: Summary of Sub Sample efficiency

Station ID		**Organisms in Subsample**																				Actual Total	Precision Error		Accuracy Error	
CC#	**Sample Name**																						Min (%)	Max (%)	Min (%)	Max (%)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
191078	RG_SCDTC_BIC	332	325	311	322	326	317	326	329	334	338	326	311	327	350	334	322	296	336	334	314	6510	0.00	15.43	0.15	9.06
																						0	#VALUE!	#VALUE!	2000.00	0.00

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.
- The Standard Taxonomic Effort lists compiled by the CABIN manual[1], SAFIT[2] , and PNAMP[3] were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomic QC

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae

Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

Taxonomic QC was performed in house by someone other than the original taxonomist.

- Quality control protocol involved complete, blind re-identification and re-enumeration of at least 10% of samples by a second SFS-certified taxonomist.
- Samples for taxonomic quality control were randomly selected and quality control procedures were conducted as the project progresses through the laboratories.

- The second (QC) taxonomist will calculate and record four types of errors:
    1. Misidentification error
    2. Enumeration error
    3. Questionable taxonomic resolution error
    4. Insufficient taxonomic resolution error

The QC coordinator then calculates the following estimates of taxonomic precision.

1. The percent total identification error rate is calculated as:

$$\frac{Sum\ of\ incorrect\ identifications}{total\ organisms\ counted\ in\ audit} * (100)$$

The average total identification error rate of audited samples did not exceed 5%. All samples that exceed a 5% error rate were re-evaluated to determine whether repeated errors or patterns in error contributed.

2. The percent difference in enumeration (PDE) to quantify the consistency of specimen counts.

$$PDE = \frac{|n_1 - n_2|}{n_1 + n_2} x100$$

3. The percent taxonomic disagreement (PTD) to quantify the shared precision between two sets of identifications.

$$PTD = \left(1 - \left[\frac{a}{N}\right]\right) x100$$

4. Bray Curtis dissimilarity Index to quantify the differences in identifications.

$$BC_{ij} = 1 - \frac{2C_{ij}}{S_j + S_i}$$

Error Summary

All samples report errors within the acceptable limits for CABIN Laboratory methods (less than 5% error).

Table 4: Summary of taxonomic error following QC

Site	Taxa Identified	% Error	PDE	PTD	Bray - Curtis Dissimilarity index
Site - CABIN, Sample - SLINE-BIC, CC# - CC171295,	363	0.00	0.14	0.83	0.01

There will always be disagreements between taxonomists regarding the degree of taxonomic resolution in immature specimens and when laboratories make use of different keys for certain groups (Mollusks is an especially disputed group). It is always possible that some taxa found by the original taxonomist were overlooked in QC.

All of the Taxonomic QC samples that were observed passed testing according to the CABIN misidentification protocols. See the tables below for results from taxonomic QC audit.

Error Rationale

Site - 2018, Sample - RG_ERSC5-1_BIC, CC# - CC191079, Percent sampled = 5%, Sieve size = 400	Laboratory Count	QC Audit Count	Agreement	Misidentification	Questionable Taxonomic Resolution	Enumeration	Insufficent Taxonomic Resolution	Comments
Baetidae	54	60	No			X		
Baetis	36	35	No			X		
Baetis rhodani group	57	52	No			X		
Brachycentrus	3	3						
Brillia	3	3						
Caudatella	2	2						
Chelifera/ Metachela	1	1						
Chironomidae	1	1						
Chloroperlidae	2	2						
Cinygmula	1	1						
Drunella doddsii	8	8						
Epeorus	15	15						
Ephemerellidae	5	5						

Eukiefferiella	1	1						
Heleniella	1	1						
Heptageniidae	75	77	No			X		
Kogotus	1	1						
Lebertia	1	1						
Megarcys	1	1						
Micropsectra	2	2						
Nais	1	1						
Orthocladius complex	1	1						
Pericoma/Telmatoscopus	16	16						
Perlidae	6	6						
Perlodidae	3	3						
Pteronarcella	2	2						
Rheocricotopus	6	6						
Rhithrogena	16	14	No			X		
Rhyacophila	3	3						
Serratella	2	2						
Simuliidae	3	3						
Simulium	47	47						
Sweltsa	2	2						
Taeniopterygidae	102	102						
Tubificinae without hair chaetae	2	2						
Tvetenia	1	1						
Zapada	11	11						
Zapada cinctipes	11	11						
Zapada oregonensis group	1	1						
Total:	**506**	**506**						
					0	**5**	**0**	
% Total Misidentification Rate =	misidentifications / total number			x100 =	0.00	**Pass**		

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[3] Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015).
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APPENDIX F
BENTHIC INVERTEBRATE TISSUE

Benthic Invertebrate Tissue Data
Laboratory Results and QA/QC

BENTHIC INVERTEBRATE TISSUE

Benthic Invertebrate Tissue Data

Table F.1: Metal Concentrations in Composite Benthic Invertebrate Tissue Samples, September 2018

Analyte		Units	Reference			Mine-exposed			Mine-exposed					
			GH_ER2			GH_ERSC4			GH_ER1A			RG_ERSC5		
			GH_ER2-1	GH_ER2-2	GH_ER2-3	GH_ERSC4-1	GH_ERSC4-2	GH_ERSC4-3	GH_ER1A-1	GH_ER1A-2	GH_ER1A-3	RG_ERSC5-1	RG_ERSC5-2	RG_ERSC5-3
			11-Sep-18	11-Sep-18	11-Sep-18	09-Sep-18	09-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18	08-Sep-18
Physical Tests	Moisture	%	86	82	79	81	79	81	82	93	79	76	77	77
Metals	Aluminum	µg/g dw	350	360	310	300	320	260	1,400	1,600	1,600	2,000	890	1,800
	Antimony	µg/g dw	<0.2	<1	<1	<1	<0.1	<0.1	<1	<1	<1	<1	<1	<1
	Arsenic	µg/g dw	1.3	0.80	0.80	<0.5	0.44	0.49	1.4	1.8	1.0	1.2	1.0	1.0
	Barium	µg/g dw	24	24	14	21	10	13	34	38	22	24	20	25
	Beryllium	µg/g dw	<0.02	<0.1	<0.1	<0.1	0.010	<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Boron	µg/g dw	<2	<10	<10	<10	<1	<1	<10	<10	<10	<10	<10	<10
	Cadmium	µg/g dw	3.2	2.3	1.9	1.4	1.4	1.4	6.0	7.9	4.9	10	5.1	4.2
	Chromium	µg/g dw	<1	<5	<5	<5	0.70	0.50	<5	<5	<5	<5	<5	<5
	Cobalt	µg/g dw	1.0	0.60	0.80	0.40	0.42	0.43	1.2	2.0	1.2	3.4	1.3	1.5
	Copper	µg/g dw	15	16	20	17	25	23	20	24	19	26	17	18
	Iron	µg/g dw	310	260	270	250	230	200	1,200	1,200	1,200	1,600	630	1,400
	Lead	µg/g dw	0.16	0.10	0.10	0.20	0.12	0.11	0.70	0.60	0.60	0.70	0.40	0.70
	Manganese	µg/g dw	140	100	74	130	55	69	240	240	110	150	180	160
	Mercury	µg/g dw	0.020	<0.05	<0.05	<0.05	0.044	0.045	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Molybdenum	µg/g dw	0.40	<1	<1	<1	0.20	0.30	<1	1.0	<1	<1	<1	<1
	Nickel	µg/g dw	1.9	1.5	1.3	1.1	1.0	1.2	2.9	4.0	2.5	3.2	2.4	3.5
	Selenium	µg/g dw	6.9	5.9	6.3	4.8	5.5	5.6	8.8	12	7.0	12	8.9	6.4
	Silver	µg/g dw	0.10	<0.1	0.20	0.20	0.24	0.24	0.10	<0.1	0.10	0.10	<0.1	0.10
	Strontium	µg/g dw	7.0	6.0	11	10	14	18	12	14	9.0	12	7.0	92
	Thallium	µg/g dw	<0.1	<0.5	<0.5	<0.5	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Tin	µg/g dw	<0.1	<0.5	<0.5	<0.5	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Titanium	µg/g dw	3.5	4.0	3.4	3.4	3.7	3.3	15	16	9.9	17	11	16
	Uranium	µg/g dw	0.050	0.050	<0.05	0.22	0.043	0.045	0.19	0.15	0.10	0.15	0.12	0.58
	Vanadium	µg/g dw	1.3	1.0	1.0	<1	1.0	0.80	6.0	6.0	4.0	7.0	3.0	6.0
	Zinc	µg/g dw	210	240	310	430	500	440	310	280	340	340	200	270

Value > upper limit of normal range of selenium (7.79 mg/kg dw; Minnow 2018).

Value > EVWQP level 1 benchmark of 11 mg/kg dw for dietary effects of selenium to fish (Teck 2014). (Level 1 benchmark for effects to invertebrates is 13 mg/kg dw.)

Notes: All summary stats calculated to 3 significant figures.

Table F.1: Metal Concentrations in Composite Benthic Invertebrate Tissue Samples, September 2018

Analyte		Units	Mine-exposed							Mine-exposed				
			GH_TC2	RG_GH_SCW3			RG_SCDTC			GH_ERC				
			GH_TC2-1	RG_GH_ SCW3-1	RG_GH_ SCW3-2	RG_GH_ SCW3-3	RG_ SCDTC-1	RG_ SCDTC-2	RG_ SCDTC-3	GH_ERC-1	GH_ERC-2	GH_ERC-3	GH_ERC-4	GH_ERC-5
			09-Sep-18	07-Sep-18	07-Sep-18	07-Sep-18	06-Sep-18	06-Sep-18	06-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18
Physical Tests	Moisture	%	86	84	81	80	79	81	82	78	81	74	81	80
Metals	Aluminum	µg/g dw	930	3,500	1,800	900	4,700	3,000	2,500	370	430	320	490	550
	Antimony	µg/g dw	<1	<1	<0.2	<0.2	<1	<1	<1	<1	<1	<2	<1	<1
	Arsenic	µg/g dw	1.1	1.4	1.2	0.60	1.9	1.6	1.5	1.3	0.80	<1	0.90	1.1
	Barium	µg/g dw	58	58	64	34	60	26	24	40	7.8	11	29	10
	Beryllium	µg/g dw	<0.1	0.10	0.070	0.040	0.20	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1
	Boron	µg/g dw	<10	10	12	4.0	10	<10	<10	<10	<10	<20	<10	<10
	Cadmium	µg/g dw	1.2	1.4	1.2	0.56	5.5	9.7	7.2	2.0	2.2	1.6	2.3	2.6
	Chromium	µg/g dw	<5	6.0	3.0	2.0	7.0	<5	<5	<5	<5	<10	<5	<5
	Cobalt	µg/g dw	0.80	1.7	1.8	0.86	2.7	2.7	2.2	1.0	1.1	0.80	1.1	1.0
	Copper	µg/g dw	36	22	21	17	20	25	20	13	17	25	16	14
	Iron	µg/g dw	500	2,300	1,200	720	2,900	1,700	1,600	290	330	260	330	390
	Lead	µg/g dw	0.40	1.5	1.1	0.71	1.9	0.90	0.80	0.10	0.20	<0.2	0.20	0.20
	Manganese	µg/g dw	99	280	280	260	180	87	88	120	46	48	60	48
	Mercury	µg/g dw	<0.05	<0.05	0.030	0.030	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
	Molybdenum	µg/g dw	<1	<1	0.80	0.80	<1	<1	<1	<1	<1	<2	<1	<1
	Nickel	µg/g dw	3.3	8.0	7.7	4.0	7.7	4.1	3.8	1.2	1.1	<1	1.3	1.3
	Selenium	µg/g dw	26	12	8.9	16	11	11	12	6.8	6.9	7.0	5.8	7.2
	Silver	µg/g dw	0.40	0.10	0.10	0.080	0.10	0.10	<0.1	<0.1	0.10	0.20	0.10	<0.1
	Strontium	µg/g dw	120	20	9.9	16	22	13	14	6.0	6.0	12	6.0	7.0
	Thallium	µg/g dw	<0.5	<0.5	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5
	Tin	µg/g dw	<0.5	<0.5	<0.1	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5
	Titanium	µg/g dw	13	43	24	8.7	36	37	30	3.4	4.2	4.0	4.5	4.8
	Uranium	µg/g dw	0.38	0.55	0.53	0.43	0.64	0.18	0.22	<0.05	0.050	<0.1	<0.05	0.050
	Vanadium	µg/g dw	3.0	11	5.9	3.0	14	9.0	7.0	1.0	2.0	<2	2.0	2.0
	Zinc	µg/g dw	160	370	400	360	340	240	200	180	190	320	200	170

Value > upper limit of normal range of selenium (7.79 mg/kg dw; Minnow 2018).

Value > EVWQP level 1 benchmark of 11 mg/kg dw for dietary effects of selenium to fish (Teck 2014). (Level 1 benchmark for effects to invertebrates is 13 mg/kg dw.)

Notes: All summary stats calculated to 3 significant figures.

BENTHIC INVERTEBRATE TISSUE

Laboratory Results and QA/QC

SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 F: 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Jennifer Ings

Date Samples Received: Sep-18-2018 Client P.O.: VPO00555477 Ref# 18-11

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

SASKATCHEWAN RESEARCH COUNCIL

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Jennifer Ings

Date Samples Received: Sep-18-2018

Client P.O.: VPO00555477 Ref# 18-11

37382 **09/05/2018 RG_ELUEL1_INV_20180905 *TISSUE***
37383 **09/05/2018 RG_ELUEL2_INV_20180905 *TISSUE***
37384 **09/05/2018 RG_ELUEL3_INV_20180905 *TISSUE***

Analyte	Units	37382	37383	37384
Lab Section 2 (ICP)				
Aluminum	ug/g	270	390	300
Antimony	ug/g	<0.2	<1	<1
Arsenic	ug/g	0.6	0.8	0.7
Barium	ug/g	7.6	11	5.7
Beryllium	ug/g	<0.02	<0.1	<0.1
Boron	ug/g	<2	<10	<10
Cadmium	ug/g	1.0	1.5	1.0
Chromium	ug/g	<1	<5	<5
Cobalt	ug/g	0.48	0.7	0.5
Copper	ug/g	31	22	17
Iron	ug/g	210	290	230
Lead	ug/g	0.22	0.2	0.1
Manganese	ug/g	31	54	52
Mercury	ug/g	0.04	<0.05	<0.05
Molybdenum	ug/g	<0.2	<1	<1
Nickel	ug/g	0.7	1.1	1.0
Selenium	ug/g	6.5	6.2	6.9
Silver	ug/g	0.31	0.2	0.1
Strontium	ug/g	14	12	5
Thallium	ug/g	<0.1	<0.5	<0.5
Tin	ug/g	<0.1	<0.5	<0.5
Titanium	ug/g	3.1	3.6	2.9
Uranium	ug/g	0.02	<0.05	<0.05
Vanadium	ug/g	0.9	1	<1
Zinc	ug/g	440	420	370
Lab Section 6 (SPTP)				
Moisture	%	72.29	75.58	73.80

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

SRC SASKATCHEWAN RESEARCH COUNCIL

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37385	**09/05/2018 RG_ELUEL4_INV_20180905 *TISSUE***
37386	**09/05/2018 RG_ELUEL5_INV_20180905 *TISSUE***
37387	**09/05/2018 RG_ELDFE_INV_20180905 *TISSUE***

Analyte	Units	37385	37386	37387
Lab Section 2 (ICP)				
Aluminum	ug/g	110	80	460
Antimony	ug/g	<0.2	<1	<1
Arsenic	ug/g	0.7	0.7	0.7
Barium	ug/g	7.6	8.7	16
Beryllium	ug/g	<0.02	<0.1	<0.1
Boron	ug/g	<2	<10	<10
Cadmium	ug/g	1.1	0.6	0.3
Chromium	ug/g	<1	<5	<5
Cobalt	ug/g	0.56	0.4	0.4
Copper	ug/g	26	27	23
Iron	ug/g	120	100	410
Lead	ug/g	0.06	<0.1	0.3
Manganese	ug/g	34	30	98
Mercury	ug/g	0.03	<0.05	<0.05
Molybdenum	ug/g	0.2	<1	<1
Nickel	ug/g	1.0	1.2	2.7
Selenium	ug/g	7.9	6.3	7.4
Silver	ug/g	0.24	0.2	0.1
Strontium	ug/g	13	19	14
Thallium	ug/g	<0.1	<0.5	<0.5
Tin	ug/g	<0.1	<0.5	<0.5
Titanium	ug/g	1.6	0.7	4.2
Uranium	ug/g	0.02	<0.05	0.15
Vanadium	ug/g	0.4	<1	3
Zinc	ug/g	390	350	350
Lab Section 6 (SPTP)				
Moisture	%	75.13	75.95	84.91

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37388	**09/06/2018 RG_GATE_INV_20180906 *TISSUE***
37389	**09/06/2018 RG_BOCK_INV_20180906 *TISSUE***
37390	**09/06/2018 RG_ERCK_INV_20180906 *TISSUE***

Analyte	Units	37388	37389	37390
Lab Section 2 (ICP)				
Aluminum	ug/g	70	2000	1300
Antimony	ug/g	<1	<2	<2
Arsenic	ug/g	1.1	<1	<1
Barium	ug/g	9.0	1770	28
Beryllium	ug/g	<0.1	<0.2	<0.2
Boron	ug/g	<10	<20	<20
Cadmium	ug/g	1.0	2.9	0.8
Chromium	ug/g	<5	<10	<10
Cobalt	ug/g	1.2	3.9	0.5
Copper	ug/g	6.9	19	16
Iron	ug/g	90	890	1100
Lead	ug/g	0.2	1.0	0.6
Manganese	ug/g	9	59	28
Mercury	ug/g	<0.05	<0.1	<0.1
Molybdenum	ug/g	<1	<2	<2
Nickel	ug/g	9.6	56	4
Selenium	ug/g	13	16	6
Silver	ug/g	<0.1	<0.2	<0.2
Strontium	ug/g	6	160	12
Thallium	ug/g	<0.5	<1	<1
Tin	ug/g	<0.5	<1	<1
Titanium	ug/g	0.5	15	11
Uranium	ug/g	0.06	1.5	0.3
Vanadium	ug/g	<1	7	5
Zinc	ug/g	120	240	290
Lab Section 6 (SPTP)				
Moisture	%	73.61	79.84	78.95

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Oct 24, 2018

Minnow Environmental Inc.

37391 **09/06/2018 RG_GHCKD_INV_20180906 *TISSUE***
37392 **09/06/2018 RG_ELH93-1_INV_20180906 *TISSUE***
37393 **09/06/2018 RG_ELH93-2_INV_20180906 *TISSUE***

Analyte	Units	37391	37392	37393
Lab Section 2 (ICP)				
Aluminum	ug/g	4300	3900	1200
Antimony	ug/g	<10	<10	<1
Arsenic	ug/g	<5	<5	1.9
Barium	ug/g	55	58	23
Beryllium	ug/g	<1	<1	<0.1
Boron	ug/g	<100	<100	<10
Cadmium	ug/g	1	3	2.8
Chromium	ug/g	<50	<50	<5
Cobalt	ug/g	5	2	1.4
Copper	ug/g	32	22	15
Iron	ug/g	2000	3200	1500
Lead	ug/g	2	2	0.6
Manganese	ug/g	170	160	140
Mercury	ug/g	<0.5	<0.5	<0.05
Molybdenum	ug/g	<10	<10	<1
Nickel	ug/g	53	7	4.4
Selenium	ug/g	21	11	7.8
Silver	ug/g	<1	<1	<0.1
Strontium	ug/g	20	20	15
Thallium	ug/g	<5	<5	<0.5
Tin	ug/g	<5	<5	<0.5
Titanium	ug/g	30	33	8.1
Uranium	ug/g	0.5	<0.5	0.17
Vanadium	ug/g	10	<10	2
Zinc	ug/g	270	150	140
Lab Section 6 (SPTP)				
Moisture	%	88.49	84.52	84.21

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37394 **09/06/2018 RG_ELH93-3_INV_20180906 *TISSUE***
37395 **09/07/2018 RG_ELELKO1_INV_20180907 *TISSUE***
37396 **09/07/2018 RG_ELELKO2_INV_20180907 *TISSUE***

Analyte	Units	37394	37395	37396
Lab Section 2 (ICP)				
Aluminum	ug/g	1600	550	240
Antimony	ug/g	<10	<1	<1
Arsenic	ug/g	<5	1.4	0.9
Barium	ug/g	39	18	10
Beryllium	ug/g	<1	<0.1	<0.1
Boron	ug/g	<100	<10	<10
Cadmium	ug/g	<1	1.4	0.8
Chromium	ug/g	<50	<5	<5
Cobalt	ug/g	1	0.8	0.5
Copper	ug/g	16	14	22
Iron	ug/g	1400	660	250
Lead	ug/g	1	0.4	0.1
Manganese	ug/g	160	140	57
Mercury	ug/g	<0.5	<0.05	<0.05
Molybdenum	ug/g	<10	<1	<1
Nickel	ug/g	<5	4.0	1.8
Selenium	ug/g	8.2	12	9.4
Silver	ug/g	<1	<0.1	0.2
Strontium	ug/g	20	9	10
Thallium	ug/g	<5	<0.5	<0.5
Tin	ug/g	<5	<0.5	<0.5
Titanium	ug/g	12	5.1	3.5
Uranium	ug/g	<0.5	0.08	<0.05
Vanadium	ug/g	<10	2	<1
Zinc	ug/g	120	160	400
Lab Section 6 (SPTP)				
Moisture	%	80.28	86.28	77.85

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Oct 24, 2018

Minnow Environmental Inc.

37397 **09/07/2018 RG_ELELKO3_INV_20180907 *TISSUE***
37398 **09/07/2018 RG_ELELKO4_INV_20180907 *TISSUE***
37399 **09/07/2018 RG_ELELKO5_INV_20180907 *TISSUE***

Analyte	Units	37397	37398	37399
Lab Section 2 (ICP)				
Aluminum	ug/g	430	1100	330
Antimony	ug/g	<0.2	<1	<0.2
Arsenic	ug/g	0.8	1.4	0.9
Barium	ug/g	16	34	13
Beryllium	ug/g	<0.02	<0.1	<0.02
Boron	ug/g	4	<10	5
Cadmium	ug/g	0.52	1.2	0.81
Chromium	ug/g	<1	<5	<1
Cobalt	ug/g	0.44	0.9	0.46
Copper	ug/g	23	15	28
Iron	ug/g	360	880	350
Lead	ug/g	0.26	0.6	0.17
Manganese	ug/g	71	160	69
Mercury	ug/g	0.03	<0.05	0.03
Molybdenum	ug/g	0.2	<1	<0.2
Nickel	ug/g	2.8	4.9	2.1
Selenium	ug/g	9.2	12	11
Silver	ug/g	0.18	<0.1	0.21
Strontium	ug/g	13	18	12
Thallium	ug/g	<0.1	<0.5	<0.1
Tin	ug/g	<0.1	<0.5	<0.1
Titanium	ug/g	19	9.0	13
Uranium	ug/g	0.05	0.12	0.03
Vanadium	ug/g	1.3	3	1.0
Zinc	ug/g	300	130	370
Lab Section 6 (SPTP)				
Moisture	%	82.96	86.08	80.72

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Minnow Environmental Inc.

37400 **09/07/2018 RG_MIDER_INV_20180907 *TISSUE***
37401 **09/07/2018 RG_MIDGA_INV_20180907 *TISSUE***
37402 **09/07/2018 RG_ALUSM1_INV_20180907 *TISSUE***

Analyte	Units	37400	37401	37402
Lab Section 2 (ICP)				
Aluminum	ug/g	1200	720	3000
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	0.7	0.8	1.7
Barium	ug/g	44	54	35
Beryllium	ug/g	<0.1	<0.1	0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	1.8	1.4	1.4
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	2.0	1.7	2.9
Copper	ug/g	12	12	18
Iron	ug/g	1000	490	2300
Lead	ug/g	0.5	0.4	1.5
Manganese	ug/g	140	90	130
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	6.0	35	3.8
Selenium	ug/g	10	10	9.4
Silver	ug/g	0.1	0.1	<0.1
Strontium	ug/g	9	20	10
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	15	3.8	16
Uranium	ug/g	0.09	0.30	0.15
Vanadium	ug/g	5	3	7
Zinc	ug/g	150	260	180
Lab Section 6 (SPTP)				
Moisture	%	87.31	80.22	76.92

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Minnow Environmental Inc.

37403 **09/07/2018 RG_ALUSM2_INV_20180907 *TISSUE***
37404 **09/07/2018 RG_ALUSM3_INV_20180907 *TISSUE***
37405 **09/07/2018 RG_UCWER1_INV_20180907 *TISSUE***

Analyte	Units	37403	37404	37405
Lab Section 2 (ICP)				
Aluminum	ug/g	3000	3800	130
Antimony	ug/g	<1	<2	<0.2
Arsenic	ug/g	1.9	2	0.9
Barium	ug/g	39	52	8.9
Beryllium	ug/g	0.1	<0.2	<0.02
Boron	ug/g	<10	<20	<2
Cadmium	ug/g	1.8	2.2	2.7
Chromium	ug/g	<5	<10	<1
Cobalt	ug/g	2.9	3.5	0.41
Copper	ug/g	19	20	12
Iron	ug/g	2500	3100	200
Lead	ug/g	1.7	2.1	0.09
Manganese	ug/g	150	160	43
Mercury	ug/g	<0.05	<0.1	0.02
Molybdenum	ug/g	<1	<2	0.4
Nickel	ug/g	4.4	5	2.0
Selenium	ug/g	9.7	11	7.4
Silver	ug/g	<0.1	<0.2	0.04
Strontium	ug/g	11	15	2.5
Thallium	ug/g	<0.5	<1	<0.1
Tin	ug/g	<0.5	<1	<0.1
Titanium	ug/g	17	22	1.4
Uranium	ug/g	0.15	0.2	0.14
Vanadium	ug/g	8	9	0.4
Zinc	ug/g	210	240	180
Lab Section 6 (SPTP)				
Moisture	%	83.16	82.40	85.39

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Minnow Environmental Inc.

37406 **09/07/2018 RG_UCWER2_INV_20180907 *TISSUE***
37407 **09/07/2018 RG_UCWER3_INV_20180907 *TISSUE***
37408 **09/08/2018 RG_FODGH1_INV_20180908 *TISSUE***

Analyte	Units	37406	37407	37408
Lab Section 2 (ICP)				
Aluminum	ug/g	380	470	910
Antimony	ug/g	<0.2	<0.2	<0.2
Arsenic	ug/g	1.1	1.4	0.7
Barium	ug/g	23	16	18
Beryllium	ug/g	<0.02	<0.02	0.03
Boron	ug/g	<2	<2	3
Cadmium	ug/g	2.3	3.0	4.1
Chromium	ug/g	2	3	1
Cobalt	ug/g	0.47	0.63	1.5
Copper	ug/g	13	13	15
Iron	ug/g	340	480	590
Lead	ug/g	0.18	0.23	0.30
Manganese	ug/g	110	56	65
Mercury	ug/g	0.02	0.02	0.02
Molybdenum	ug/g	0.4	0.5	0.3
Nickel	ug/g	2.2	2.2	3.8
Selenium	ug/g	7.9	10	9.2
Silver	ug/g	0.04	0.03	0.12
Strontium	ug/g	3.5	2.5	8.1
Thallium	ug/g	<0.1	<0.1	<0.1
Tin	ug/g	<0.1	<0.1	<0.1
Titanium	ug/g	3.6	5.0	7.9
Uranium	ug/g	0.27	0.13	0.08
Vanadium	ug/g	1.0	1.3	3.0
Zinc	ug/g	230	160	220
Lab Section 6 (SPTP)				
Moisture	%	83.04	85.85	86.10

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Minnow Environmental Inc.

37409 **09/08/2018 RG_FODGH2_INV_20180908 *TISSUE***
37410 **09/08/2018 RG_FODGH3_INV_20180908 *TISSUE***
37411 **09/08/2018 RG_FODGH4_INV_20180908 *TISSUE***

Analyte	Units	37409	37410	37411
Lab Section 2 (ICP)				
Aluminum	ug/g	980	2000	650
Antimony	ug/g	<1	<1	<0.2
Arsenic	ug/g	0.8	1.3	0.6
Barium	ug/g	17	32	18
Beryllium	ug/g	<0.1	<0.1	0.02
Boron	ug/g	<10	<10	3
Cadmium	ug/g	4.9	5.8	2.2
Chromium	ug/g	<5	<5	1
Cobalt	ug/g	2.1	2.2	0.94
Copper	ug/g	15	25	13
Iron	ug/g	910	1900	530
Lead	ug/g	0.4	0.8	0.26
Manganese	ug/g	78	150	100
Mercury	ug/g	<0.05	<0.05	0.01
Molybdenum	ug/g	<1	<1	0.3
Nickel	ug/g	5.3	7.8	3.5
Selenium	ug/g	9.6	17	10
Silver	ug/g	0.1	0.2	0.10
Strontium	ug/g	6	9	4.8
Thallium	ug/g	<0.5	<0.5	<0.1
Tin	ug/g	<0.5	<0.5	<0.1
Titanium	ug/g	9.7	18	10
Uranium	ug/g	0.08	0.16	0.11
Vanadium	ug/g	3	7	2.0
Zinc	ug/g	230	350	170
Lab Section 6 (SPTP)				
Moisture	%	87.03	87.05	83.56

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Minnow Environmental Inc.

37412 **09/08/2018 RG_FODGH5_INV_20180908 *TISSUE***
37413 **09/08/2018 RG_EL1-1_INV_20180908 *TISSUE***
37414 **09/08/2018 RG_EL1-2_INV_20180908 *TISSUE***

Analyte	Units	37412	37413	37414
Lab Section 2 (ICP)				
Aluminum	ug/g	420	590	530
Antimony	ug/g	<0.2	<0.2	<2
Arsenic	ug/g	0.4	0.8	<1
Barium	ug/g	11	20	32
Beryllium	ug/g	<0.02	0.02	<0.2
Boron	ug/g	8	3	<20
Cadmium	ug/g	2.5	1.8	0.9
Chromium	ug/g	<1	1	<10
Cobalt	ug/g	1.0	0.75	0.7
Copper	ug/g	17	17	17
Iron	ug/g	640	360	580
Lead	ug/g	0.15	0.22	0.3
Manganese	ug/g	41	100	88
Mercury	ug/g	<0.01	0.02	<0.1
Molybdenum	ug/g	0.2	0.3	<2
Nickel	ug/g	2.4	3.8	5
Selenium	ug/g	7.2	6.4	6
Silver	ug/g	0.15	0.11	<0.2
Strontium	ug/g	7.4	6.2	12
Thallium	ug/g	<0.1	<0.1	<1
Tin	ug/g	<0.1	<0.1	<1
Titanium	ug/g	4.3	5.6	5
Uranium	ug/g	0.05	0.05	<0.1
Vanadium	ug/g	1.4	1.7	2
Zinc	ug/g	310	230	310
Lab Section 6 (SPTP)				
Moisture	%	82.15	86.51	77.09

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Oct 24, 2018

Minnow Environmental Inc.

37415 09/08/2018 RG_EL1-3_INV_20180908 *TISSUE*
37416 09/08/2018 RG_EL1-4_INV_20180908 *TISSUE*
37417 09/08/2018 RG_EL1-5_INV_20180908 *TISSUE*

Analyte	Units	37415	37416	37417
Lab Section 2 (ICP)				
Aluminum	ug/g	1200	920	630
Antimony	ug/g	<0.2	<0.2	<0.2
Arsenic	ug/g	1.3	1.4	0.6
Barium	ug/g	47	31	20
Beryllium	ug/g	0.05	0.04	0.03
Boron	ug/g	6	6	3
Cadmium	ug/g	1.8	2.7	1.1
Chromium	ug/g	2	2	1
Cobalt	ug/g	1.5	1.7	0.77
Copper	ug/g	13	12	17
Iron	ug/g	1000	650	430
Lead	ug/g	0.48	0.39	0.27
Manganese	ug/g	130	160	93
Mercury	ug/g	0.02	0.02	0.02
Molybdenum	ug/g	0.3	0.4	0.2
Nickel	ug/g	5.8	6.8	2.9
Selenium	ug/g	7.0	7.0	7.0
Silver	ug/g	0.09	0.07	0.12
Strontium	ug/g	17	11	14
Thallium	ug/g	<0.1	<0.1	<0.1
Tin	ug/g	<0.1	<0.1	<0.1
Titanium	ug/g	10	8.5	7.5
Uranium	ug/g	0.17	0.12	0.06
Vanadium	ug/g	4.4	2.8	2.0
Zinc	ug/g	250	200	340
Lab Section 6 (SPTP)				
Moisture	%	84.10	85.03	75.83

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Minnow Environmental Inc.

37418 **09/08/2018 RG_CORCK1_INV_20180908 *TISSUE***
37419 **09/08/2018 RG_CORCK2_INV_20180908 *TISSUE***
37420 **09/08/2018 RG_CORCK3_INV_20180908 *TISSUE***

Analyte	Units	37418	37419	37420
Lab Section 2 (ICP)				
Aluminum	ug/g	960	880	400
Antimony	ug/g	<1	<2	<1
Arsenic	ug/g	0.6	<1	0.8
Barium	ug/g	46	53	17
Beryllium	ug/g	<0.1	<0.2	<0.1
Boron	ug/g	<10	<20	<10
Cadmium	ug/g	2.0	2.4	0.7
Chromium	ug/g	<5	<10	<5
Cobalt	ug/g	94	100	130
Copper	ug/g	9.4	9	10
Iron	ug/g	420	380	280
Lead	ug/g	0.3	0.3	0.2
Manganese	ug/g	720	780	470
Mercury	ug/g	<0.05	<0.1	<0.05
Molybdenum	ug/g	<1	<2	1
Nickel	ug/g	86	88	72
Selenium	ug/g	3.4	3	4.4
Silver	ug/g	<0.1	<0.2	<0.1
Strontium	ug/g	150	230	43
Thallium	ug/g	<0.5	<1	<0.5
Tin	ug/g	<0.5	<1	<0.5
Titanium	ug/g	10	8	3.3
Uranium	ug/g	1.0	1.7	0.39
Vanadium	ug/g	2	<2	1
Zinc	ug/g	350	400	210
Lab Section 6 (SPTP)				
Moisture	%	80.22	77.08	70.80

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Note for Sample # 37420
There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

Results are reported on a dry basis.

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37421 **09/08/2018 RG_MI2_INV_20180908 *TISSUE***
37422 **09/08/2018 RG_MIDAG1_INV_20180908 *TISSUE***
37423 **09/08/2018 RG_MIDAG2_INV_20180908 *TISSUE***

Analyte	Units	37421	37422	37423
Lab Section 2 (ICP)				
Aluminum	ug/g	2600	550	970
Antimony	ug/g	<2	<1	<1
Arsenic	ug/g	1	0.8	0.6
Barium	ug/g	42	24	12
Beryllium	ug/g	<0.2	<0.1	<0.1
Boron	ug/g	<20	<10	<10
Cadmium	ug/g	3.0	0.7	0.5
Chromium	ug/g	<10	<5	<5
Cobalt	ug/g	1.6	44	24
Copper	ug/g	12	13	17
Iron	ug/g	2000	430	890
Lead	ug/g	1.2	0.4	0.4
Manganese	ug/g	140	110	100
Mercury	ug/g	<0.1	<0.05	<0.05
Molybdenum	ug/g	<2	<1	<1
Nickel	ug/g	15	21	13
Selenium	ug/g	9	6.2	3.5
Silver	ug/g	<0.2	<0.1	0.1
Strontium	ug/g	17	18	18
Thallium	ug/g	<1	<0.5	<0.5
Tin	ug/g	<1	<0.5	<0.5
Titanium	ug/g	14	4.2	5.6
Uranium	ug/g	0.2	0.09	0.08
Vanadium	ug/g	9	1	2
Zinc	ug/g	160	160	190
Lab Section 6 (SPTP)				
Moisture	%	85.42	79.52	79.14

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37424 **09/08/2018 RG_AGCK1_INV_20180908 *TISSUE***
37425 **09/08/2018 RG_AGCK2_INV_20180908 *TISSUE***
37426 **09/09/2018 RG_AGCK3_INV_20180909 *TISSUE***

Analyte	Units	37424	37425	37426
Lab Section 2 (ICP)				
Aluminum	ug/g	270	180	220
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	1.9	1.4	1.0
Barium	ug/g	14	3.7	6.4
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	1.1	1.1	0.8
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	0.3	0.2	0.2
Copper	ug/g	9.2	9.0	9.2
Iron	ug/g	460	220	210
Lead	ug/g	0.2	0.1	0.1
Manganese	ug/g	22	20	28
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	4.2	3.6	3.3
Selenium	ug/g	8.0	8.6	6.2
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	18	5	6
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	2.4	1.8	2.0
Uranium	ug/g	0.14	0.22	0.08
Vanadium	ug/g	1	<1	<1
Zinc	ug/g	230	230	200
Lab Section 6 (SPTP)				
Moisture	%	86.81	89.09	79.10

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37427 09/09/2018 RG_HACKDS1_INV_20180909 *TISSUE*
37428 09/09/2018 RG_HACKDS2_INV_20180909 *TISSUE*
37429 09/09/2018 RG_HACKDS3_INV_20180909 *TISSUE*

Analyte	Units	37427	37428	37429
Lab Section 2 (ICP)				
Aluminum	ug/g	2000	1500	870
Antimony	ug/g	<2	<2	<0.2
Arsenic	ug/g	<1	<1	0.6
Barium	ug/g	33	32	20
Beryllium	ug/g	<0.2	<0.2	0.03
Boron	ug/g	<20	<20	<2
Cadmium	ug/g	1.4	1.3	1.1
Chromium	ug/g	<10	<10	1
Cobalt	ug/g	1.0	0.9	0.66
Copper	ug/g	13	12	12
Iron	ug/g	1600	1200	900
Lead	ug/g	0.9	0.6	0.50
Manganese	ug/g	580	460	310
Mercury	ug/g	<0.1	<0.1	0.02
Molybdenum	ug/g	<2	<2	0.4
Nickel	ug/g	5	4	3.1
Selenium	ug/g	16	18	19
Silver	ug/g	<0.2	<0.2	0.06
Strontium	ug/g	8	10	5.8
Thallium	ug/g	<1	<1	<0.1
Tin	ug/g	<1	<1	<0.1
Titanium	ug/g	12	9	7.0
Uranium	ug/g	0.1	0.1	0.09
Vanadium	ug/g	6	4	2.6
Zinc	ug/g	150	140	160
Lab Section 6 (SPTP)				
Moisture	%	83.51	83.10	85.41

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Oct 24, 2018

Minnow Environmental Inc.

37430 **09/09/2018 RG_HACKDS4_INV_20180909 *TISSUE***
37431 **09/09/2018 RG_HACKDS5_INV_20180909 *TISSUE***
37432 **09/09/2018 RG_HACKUS_INV_20180909 *TISSUE***

Analyte	Units	37430	37431	37432
Lab Section 2 (ICP)				
Aluminum	ug/g	1100	1300	2100
Antimony	ug/g	<2	<1	<2
Arsenic	ug/g	<1	<0.5	<1
Barium	ug/g	28	28	27
Beryllium	ug/g	<0.2	<0.1	<0.2
Boron	ug/g	<20	<10	<20
Cadmium	ug/g	1.0	1.1	1.4
Chromium	ug/g	<10	<5	<10
Cobalt	ug/g	0.7	0.9	0.5
Copper	ug/g	12	12	12
Iron	ug/g	750	880	990
Lead	ug/g	0.5	0.6	0.7
Manganese	ug/g	400	450	59
Mercury	ug/g	<0.1	<0.05	<0.1
Molybdenum	ug/g	<2	<1	<2
Nickel	ug/g	4	4.4	6
Selenium	ug/g	20	22	10
Silver	ug/g	<0.2	<0.1	<0.2
Strontium	ug/g	10	9	4
Thallium	ug/g	<1	<0.5	<1
Tin	ug/g	<1	<0.5	<1
Titanium	ug/g	8	8.3	10
Uranium	ug/g	0.1	0.12	0.2
Vanadium	ug/g	3	4	5
Zinc	ug/g	130	120	160
Lab Section 6 (SPTP)				
Moisture	%	81.46	80.17	84.48

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37433 **09/09/2018 RG_MIDAG3_INV_20180909 *TISSUE***
37434 **09/09/2018 RG_FO28-1_INV_20180909 *TISSUE***
37435 **09/09/2018 RG_FO28-2_INV_20180909 *TISSUE***

Analyte	Units	37433	37434	37435
Lab Section 2 (ICP)				
Aluminum	ug/g	1800	1700	1100
Antimony	ug/g	<1	<0.2	<2
Arsenic	ug/g	0.8	0.9	<1
Barium	ug/g	22	33	27
Beryllium	ug/g	<0.1	0.06	<0.2
Boron	ug/g	<10	5	<20
Cadmium	ug/g	0.5	3.4	2.2
Chromium	ug/g	<5	3	<10
Cobalt	ug/g	31	1.4	1.0
Copper	ug/g	14	47	14
Iron	ug/g	1300	1400	770
Lead	ug/g	0.6	0.68	0.4
Manganese	ug/g	100	110	130
Mercury	ug/g	<0.05	0.02	<0.1
Molybdenum	ug/g	<1	0.4	<2
Nickel	ug/g	10	5.2	4
Selenium	ug/g	3.8	9.4	9
Silver	ug/g	<0.1	0.09	<0.2
Strontium	ug/g	16	9.5	7
Thallium	ug/g	<0.5	<0.1	<1
Tin	ug/g	<0.5	<0.1	<1
Titanium	ug/g	8.6	11	6
Uranium	ug/g	0.06	0.15	0.1
Vanadium	ug/g	3	5.8	4
Zinc	ug/g	170	210	170
Lab Section 6 (SPTP)				
Moisture	%	70.28	84.35	83.72

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Oct 24, 2018

Minnow Environmental Inc.

37436	**09/09/2018 RG_FO28-3_INV_20180909 *TISSUE***
37437	**09/09/2018 RG_FO29-1_INV_20180909 *TISSUE***
37438	**09/09/2018 RG_FO29-2_INV_20180909 *TISSUE***

Analyte	Units	37436	37437	37438
Lab Section 2 (ICP)				
Aluminum	ug/g	860	670	1400
Antimony	ug/g	<0.2	<2	<0.2
Arsenic	ug/g	0.6	<1	1.0
Barium	ug/g	25	20	44
Beryllium	ug/g	0.03	<0.2	0.06
Boron	ug/g	4	<20	9
Cadmium	ug/g	2.6	1.9	2.9
Chromium	ug/g	1	<10	2
Cobalt	ug/g	0.87	0.9	1.2
Copper	ug/g	15	13	12
Iron	ug/g	680	500	1200
Lead	ug/g	0.41	0.2	0.54
Manganese	ug/g	120	110	100
Mercury	ug/g	0.02	<0.1	0.01
Molybdenum	ug/g	0.3	<2	0.3
Nickel	ug/g	3.8	3	4.5
Selenium	ug/g	8.7	8	9.7
Silver	ug/g	0.11	<0.2	0.09
Strontium	ug/g	4.5	6	18
Thallium	ug/g	<0.1	<1	<0.1
Tin	ug/g	<0.1	<1	<0.1
Titanium	ug/g	7.3	28	7.7
Uranium	ug/g	0.10	<0.1	0.19
Vanadium	ug/g	2.8	2	5.0
Zinc	ug/g	210	160	160
Lab Section 6 (SPTP)				
Moisture	%	81.29	82.34	83.90

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Oct 24, 2018

Minnow Environmental Inc.

37439 **09/09/2018 RG_FO29-3_INV_20180909 *TISSUE***
37441 **09/09/2018 RG_GRCK_INV_20180909 *TISSUE***
37442 **09/09/2018 RG_MIDCO1_INV_20180909 *TISSUE***

Analyte	Units	37439	37441	37442
Lab Section 2 (ICP)				
Aluminum	ug/g	910	550	3700
Antimony	ug/g	<0.2	<0.2	<1
Arsenic	ug/g	0.6	0.4	1.1
Barium	ug/g	24	16	39
Beryllium	ug/g	0.03	0.02	0.2
Boron	ug/g	8	<2	<10
Cadmium	ug/g	2.4	1.4	0.5
Chromium	ug/g	1	<1	<5
Cobalt	ug/g	0.99	0.46	70
Copper	ug/g	13	16	12
Iron	ug/g	690	420	2500
Lead	ug/g	0.38	0.20	1.2
Manganese	ug/g	95	75	350
Mercury	ug/g	0.01	0.02	<0.05
Molybdenum	ug/g	0.3	0.3	<1
Nickel	ug/g	3.2	1.5	43
Selenium	ug/g	8.8	6.9	3.8
Silver	ug/g	0.10	0.07	<0.1
Strontium	ug/g	6.9	9.1	61
Thallium	ug/g	<0.1	<0.1	<0.5
Tin	ug/g	<0.1	<0.1	<0.5
Titanium	ug/g	6.3	4.2	16
Uranium	ug/g	0.10	0.05	0.32
Vanadium	ug/g	3.0	1.4	8
Zinc	ug/g	170	280	140
Lab Section 6 (SPTP)				
Moisture	%	82.98	76.45	75.30

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37443 **09/09/2018 RG_MIDCO2_INV_20180909 *TISSUE***
37444 **09/09/2018 RG_MIDCO3_INV_20180909 *TISSUE***
37445 **09/09/2018 RG_MIDCO4_INV_20180909 *TISSUE***

Analyte	Units	37443	37444	37445
Lab Section 2 (ICP)				
Aluminum	ug/g	1700	1500	770
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	<0.5	0.6	0.6
Barium	ug/g	13	22	11
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	0.3	0.3	0.2
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	39	49	66
Copper	ug/g	13	14	8.9
Iron	ug/g	1000	940	480
Lead	ug/g	0.5	0.4	0.2
Manganese	ug/g	150	160	200
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	19	22	22
Selenium	ug/g	3.1	3.0	3.7
Silver	ug/g	<0.1	<0.1	<0.1
Strontium	ug/g	19	48	10
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	9.7	11	5.4
Uranium	ug/g	0.09	0.17	0.07
Vanadium	ug/g	4	3	2
Zinc	ug/g	130	130	130
Lab Section 6 (SPTP)				
Moisture	%	78.58	78.32	73.47

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37446 **09/09/2018 RG_MIDCO5_INV_20180909 *TISSUE***
37447 **09/09/2018 RG_THCK_INV_20180909 *TISSUE***
37448 **09/10/2018 RG_DCDS1_INV_20180910 *TISSUE***

Analyte	Units	37446	37447	37448
Lab Section 2 (ICP)				
Aluminum	ug/g	320	930	310
Antimony	ug/g	<1	<1	<0.2
Arsenic	ug/g	<0.5	1.1	0.5
Barium	ug/g	8.4	58	30
Beryllium	ug/g	<0.1	<0.1	<0.02
Boron	ug/g	<10	<10	<2
Cadmium	ug/g	0.2	1.2	2.6
Chromium	ug/g	<5	<5	<1
Cobalt	ug/g	60	0.8	3.5
Copper	ug/g	9.9	36	12
Iron	ug/g	210	500	170
Lead	ug/g	0.1	0.4	0.16
Manganese	ug/g	120	99	180
Mercury	ug/g	<0.05	<0.05	0.03
Molybdenum	ug/g	<1	<1	0.4
Nickel	ug/g	16	3.3	12
Selenium	ug/g	3.3	26	54
Silver	ug/g	<0.1	0.4	0.12
Strontium	ug/g	8	120	1.9
Thallium	ug/g	<0.5	<0.5	<0.1
Tin	ug/g	<0.5	<0.5	<0.1
Titanium	ug/g	3.3	13	4.6
Uranium	ug/g	0.06	0.38	0.08
Vanadium	ug/g	<1	3	1.6
Zinc	ug/g	130	160	180
Lab Section 6 (SPTP)				
Moisture	%	65.66	86.32	74.58

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Oct 24, 2018

Minnow Environmental Inc.

37449 **09/10/2018 RG_DCDS2_INV_20180910 *TISSUE***
37450 **09/10/2018 RG_DCDS3_INV_20180910 *TISSUE***
37451 **09/10/2018 RG_DC1-1_INV_20180910 *TISSUE***

Analyte	Units	37449	37450	37451
Lab Section 2 (ICP)				
Aluminum	ug/g	670	240	330
Antimony	ug/g	<2	<1	<2
Arsenic	ug/g	<1	<0.5	<1
Barium	ug/g	52	28	37
Beryllium	ug/g	<0.2	<0.1	<0.2
Boron	ug/g	<20	<10	<20
Cadmium	ug/g	1.9	1.4	1.6
Chromium	ug/g	<10	<5	<10
Cobalt	ug/g	3.4	2.3	0.8
Copper	ug/g	13	12	11
Iron	ug/g	2000	140	400
Lead	ug/g	0.4	0.1	<0.2
Manganese	ug/g	240	180	82
Mercury	ug/g	<0.1	<0.05	<0.1
Molybdenum	ug/g	<2	<1	<2
Nickel	ug/g	17	12	4
Selenium	ug/g	69	85	11
Silver	ug/g	<0.2	<0.1	<0.2
Strontium	ug/g	8	2	2
Thallium	ug/g	<1	<0.5	<1
Tin	ug/g	<1	<0.5	<1
Titanium	ug/g	6	3.1	4
Uranium	ug/g	0.3	0.06	<0.1
Vanadium	ug/g	5	2	<2
Zinc	ug/g	160	140	150
Lab Section 6 (SPTP)				
Moisture	%	84.16	75.54	79.70

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Oct 24, 2018

Minnow Environmental Inc.

37452 **09/10/2018 RG_DC1-2_INV_20180910 *TISSUE***
37453 **09/10/2018 RG_DC1-3_INV_20180910 *TISSUE***
37454 **09/10/2018 RG_MIUCO1_INV_20180910 *TISSUE***

Analyte	Units	37452	37453	37454
Lab Section 2 (ICP)				
Aluminum	ug/g	790	1200	940
Antimony	ug/g	<2	<1	<0.2
Arsenic	ug/g	<1	0.6	0.6
Barium	ug/g	57	62	16
Beryllium	ug/g	<0.2	<0.1	0.03
Boron	ug/g	<20	<10	2
Cadmium	ug/g	2.0	1.7	1.4
Chromium	ug/g	<10	<5	1
Cobalt	ug/g	0.9	0.9	0.66
Copper	ug/g	13	11	28
Iron	ug/g	590	1000	670
Lead	ug/g	0.3	0.4	0.32
Manganese	ug/g	100	96	100
Mercury	ug/g	<0.1	<0.05	0.03
Molybdenum	ug/g	<2	<1	0.4
Nickel	ug/g	5	5.8	1.4
Selenium	ug/g	12	10	3.2
Silver	ug/g	<0.2	<0.1	0.10
Strontium	ug/g	5	7	5.7
Thallium	ug/g	<1	<0.5	<0.1
Tin	ug/g	<1	<0.5	<0.1
Titanium	ug/g	6	9.6	8.7
Uranium	ug/g	<0.1	0.12	0.03
Vanadium	ug/g	4	6	2.0
Zinc	ug/g	160	140	130
Lab Section 6 (SPTP)				
Moisture	%	83.65	80.62	82.26

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37455 **09/10/2018 RG_MIUCO2_INV_20180910 *TISSUE***
37456 **09/10/2018 RG_MIUCO3_INV_20180910 *TISSUE***
37457 **09/10/2018 RG_MI25-1_INV_20180910 *TISSUE***

Analyte	Units	37455	37456	37457
Lab Section 2 (ICP)				
Aluminum	ug/g	5200	1300	3000
Antimony	ug/g	<0.2	<1	<0.2
Arsenic	ug/g	1.8	0.9	1.4
Barium	ug/g	34	18	31
Beryllium	ug/g	0.19	<0.1	0.11
Boron	ug/g	12	<10	9
Cadmium	ug/g	2.7	1.7	2.0
Chromium	ug/g	6	<5	4
Cobalt	ug/g	2.8	1.2	1.0
Copper	ug/g	17	18	16
Iron	ug/g	3600	930	1800
Lead	ug/g	1.5	0.4	1.6
Manganese	ug/g	190	140	94
Mercury	ug/g	0.03	<0.05	0.03
Molybdenum	ug/g	0.6	<1	0.7
Nickel	ug/g	4.5	2.2	3.8
Selenium	ug/g	6.7	5.5	3.8
Silver	ug/g	0.05	<0.1	0.05
Strontium	ug/g	10	5	8.7
Thallium	ug/g	0.1	<0.5	0.1
Tin	ug/g	<0.1	<0.5	<0.1
Titanium	ug/g	28	9.7	19
Uranium	ug/g	0.10	<0.05	0.10
Vanadium	ug/g	10	3	7.2
Zinc	ug/g	130	120	140
Lab Section 6 (SPTP)				
Moisture	%	86.38	87.43	83.90

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37458 **09/10/2018 RG_MI25-2_INV_20180910 *TISSUE***
37459 **09/10/2018 RG_MI25-3_INV_20180910 *TISSUE***
37460 **09/11/2018 RG_MI5-1_INV_20180911 *TISSUE***

Analyte	Units	37458	37459	37460
Lab Section 2 (ICP)				
Aluminum	ug/g	2100	1500	880
Antimony	ug/g	<0.2	<2	<2
Arsenic	ug/g	1.3	1	<1
Barium	ug/g	25	28	25
Beryllium	ug/g	0.08	<0.2	<0.2
Boron	ug/g	6	<20	<20
Cadmium	ug/g	3.0	2.8	1.8
Chromium	ug/g	3	<10	<10
Cobalt	ug/g	0.98	1.3	5.0
Copper	ug/g	18	16	14
Iron	ug/g	1800	1000	760
Lead	ug/g	1.6	1.2	0.4
Manganese	ug/g	94	130	77
Mercury	ug/g	0.03	<0.1	<0.1
Molybdenum	ug/g	0.6	<2	<2
Nickel	ug/g	3.3	3	9
Selenium	ug/g	4.5	5	5
Silver	ug/g	0.05	<0.2	<0.2
Strontium	ug/g	5.9	5	10
Thallium	ug/g	0.1	<1	<1
Tin	ug/g	<0.1	<1	<1
Titanium	ug/g	16	10	5
Uranium	ug/g	0.08	<0.1	0.1
Vanadium	ug/g	4.9	4	4
Zinc	ug/g	150	150	160
Lab Section 6 (SPTP)				
Moisture	%	84.92	85.52	81.87

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37461 **09/11/2018 RG_MI5-2_INV_20180911 *TISSUE***
37462 **09/11/2018 RG_MI5-3_INV_20180911 *TISSUE***
37463 **09/11/2018 RG_MIULE1_INV_20180911 *TISSUE***

Analyte	Units	37461	37462	37463
Lab Section 2 (ICP)				
Aluminum	ug/g	1500	6200	960
Antimony	ug/g	<1	<0.2	<1
Arsenic	ug/g	1.4	2.0	0.7
Barium	ug/g	45	72	26
Beryllium	ug/g	<0.1	0.20	<0.1
Boron	ug/g	<10	10	<10
Cadmium	ug/g	4.3	2.5	1.3
Chromium	ug/g	<5	8	<5
Cobalt	ug/g	11	5.2	14
Copper	ug/g	11	12	11
Iron	ug/g	1400	4400	620
Lead	ug/g	0.9	2.1	0.4
Manganese	ug/g	83	140	80
Mercury	ug/g	<0.05	0.04	<0.05
Molybdenum	ug/g	<1	0.6	<1
Nickel	ug/g	12	14	9.2
Selenium	ug/g	8.1	6.6	9.0
Silver	ug/g	<0.1	0.11	<0.1
Strontium	ug/g	16	30	19
Thallium	ug/g	<0.5	0.2	<0.5
Tin	ug/g	<0.5	<0.1	<0.5
Titanium	ug/g	10	32	9.2
Uranium	ug/g	0.20	0.32	0.08
Vanadium	ug/g	8	22	3
Zinc	ug/g	160	160	170
Lab Section 6 (SPTP)				
Moisture	%	86.84	86.56	83.72

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37464 **09/11/2018 RG_MIULE2_INV_20180911 *TISSUE***
37465 **09/11/2018 RG_MIULE3_INV_20180911 *TISSUE***
37466 **09/11/2018 RG_EL20-1_INV_20180911 *TISSUE***

Analyte	Units	37464	37465	37466
Lab Section 2 (ICP)				
Aluminum	ug/g	890	2300	370
Antimony	ug/g	<0.2	<0.2	<1
Arsenic	ug/g	0.6	1.2	1.3
Barium	ug/g	20	30	40
Beryllium	ug/g	0.03	0.10	<0.1
Boron	ug/g	2	4	<10
Cadmium	ug/g	1.4	2.1	2.0
Chromium	ug/g	1	3	<5
Cobalt	ug/g	12	24	1.0
Copper	ug/g	12	13	13
Iron	ug/g	560	2000	290
Lead	ug/g	0.35	0.83	0.1
Manganese	ug/g	56	69	120
Mercury	ug/g	0.02	0.02	<0.05
Molybdenum	ug/g	0.3	0.4	<1
Nickel	ug/g	5.6	13	1.2
Selenium	ug/g	6.8	11	6.8
Silver	ug/g	0.08	0.07	<0.1
Strontium	ug/g	14	18	6
Thallium	ug/g	<0.1	<0.1	<0.5
Tin	ug/g	<0.1	<0.1	<0.5
Titanium	ug/g	8.4	17	3.4
Uranium	ug/g	0.06	0.12	<0.05
Vanadium	ug/g	2.7	7.2	1
Zinc	ug/g	190	200	180
Lab Section 6 (SPTP)				
Moisture	%	75.03	82.42	77.60

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37467 **09/11/2018 RG_EL20-2_INV_20180911 *TISSUE***
37468 **09/11/2018 RG_EL20-3_INV_20180911 *TISSUE***
37469 **09/11/2018 RG_ELUGH1_INV_20180911 *TISSUE***

Analyte	Units	37467	37468	37469
Lab Section 2 (ICP)				
Aluminum	ug/g	430	320	350
Antimony	ug/g	<1	<2	<0.2
Arsenic	ug/g	0.8	<1	1.3
Barium	ug/g	7.8	11	24
Beryllium	ug/g	<0.1	<0.2	<0.02
Boron	ug/g	<10	<20	<2
Cadmium	ug/g	2.2	1.6	3.2
Chromium	ug/g	<5	<10	<1
Cobalt	ug/g	1.1	0.8	1.0
Copper	ug/g	17	25	15
Iron	ug/g	330	260	310
Lead	ug/g	0.2	<0.2	0.16
Manganese	ug/g	46	48	140
Mercury	ug/g	<0.05	<0.1	0.02
Molybdenum	ug/g	<1	<2	0.4
Nickel	ug/g	1.1	<1	1.9
Selenium	ug/g	6.9	7	6.9
Silver	ug/g	0.1	0.2	0.10
Strontium	ug/g	6	12	7.0
Thallium	ug/g	<0.5	<1	<0.1
Tin	ug/g	<0.5	<1	<0.1
Titanium	ug/g	4.2	4	3.5
Uranium	ug/g	0.05	<0.1	0.05
Vanadium	ug/g	2	<2	1.3
Zinc	ug/g	190	320	210
Lab Section 6 (SPTP)				
Moisture	%	80.62	74.31	86.05

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Oct 24, 2018

Minnow Environmental Inc.

37470 **09/11/2018 RG_ELUGH2_INV_20180911 *TISSUE***
37471 **09/11/2018 RG_ELUGH3_INV_20180911 *TISSUE***
37472 **09/12/2018 RG_MIDBO_INV_20180912 *TISSUE***

Analyte	Units	37470	37471	37472
Lab Section 2 (ICP)				
Aluminum	ug/g	360	310	290
Antimony	ug/g	<1	<1	<0.2
Arsenic	ug/g	0.8	0.8	0.5
Barium	ug/g	24	14	33
Beryllium	ug/g	<0.1	<0.1	<0.02
Boron	ug/g	<10	<10	<2
Cadmium	ug/g	2.3	1.9	1.1
Chromium	ug/g	<5	<5	<1
Cobalt	ug/g	0.6	0.8	1.2
Copper	ug/g	16	20	12
Iron	ug/g	260	270	280
Lead	ug/g	0.1	0.1	0.20
Manganese	ug/g	100	74	68
Mercury	ug/g	<0.05	<0.05	0.03
Molybdenum	ug/g	<1	<1	0.3
Nickel	ug/g	1.5	1.3	21
Selenium	ug/g	5.9	6.3	7.8
Silver	ug/g	<0.1	0.2	0.10
Strontium	ug/g	6	11	6.2
Thallium	ug/g	<0.5	<0.5	<0.1
Tin	ug/g	<0.5	<0.5	<0.1
Titanium	ug/g	4.0	3.4	3.2
Uranium	ug/g	0.05	<0.05	0.08
Vanadium	ug/g	1	1	1.3
Zinc	ug/g	240	310	150
Lab Section 6 (SPTP)				
Moisture	%	81.76	79.32	82.84

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Oct 24, 2018

Minnow Environmental Inc.

37473 **09/12/2018 RG_MICOMP1_INV_20180912 *TISSUE***
37474 **09/12/2018 RG_MICOMP2_INV_20180912 *TISSUE***
37475 **09/12/2018 RG_MICOMP3_INV_20180912 *TISSUE***

Analyte	Units	37473	37474	37475
Lab Section 2 (ICP)				
Aluminum	ug/g	260	930	640
Antimony	ug/g	<0.2	<2	<2
Arsenic	ug/g	0.7	<1	<1
Barium	ug/g	20	24	30
Beryllium	ug/g	<0.02	<0.2	<0.2
Boron	ug/g	<2	<20	<20
Cadmium	ug/g	1.8	1.9	1.6
Chromium	ug/g	<1	<10	<10
Cobalt	ug/g	1.1	1.8	1.5
Copper	ug/g	13	14	13
Iron	ug/g	300	670	440
Lead	ug/g	0.28	0.4	0.3
Manganese	ug/g	54	67	58
Mercury	ug/g	0.03	<0.1	<0.1
Molybdenum	ug/g	0.3	<2	<2
Nickel	ug/g	14	12	9
Selenium	ug/g	8.8	10	8
Silver	ug/g	0.13	<0.2	<0.2
Strontium	ug/g	6.5	7	8
Thallium	ug/g	<0.1	<1	<1
Tin	ug/g	<0.1	<1	<1
Titanium	ug/g	2.5	10	6
Uranium	ug/g	0.06	<0.1	<0.1
Vanadium	ug/g	1.0	4	2
Zinc	ug/g	160	260	390
Lab Section 6 (SPTP)				
Moisture	%	85.65	84.02	76.21

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Oct 24, 2018

Minnow Environmental Inc.

37476 **09/12/2018 RG_MICOMP4_INV_20180912 *TISSUE***
37477 **09/12/2018 RG_MICOMP5_INV_20180912 *TISSUE***
37478 **09/12/2018 RG_BACK_INV_20180912 *TISSUE***

Analyte	Units	37476	37477	37478
Lab Section 2 (ICP)				
Aluminum	ug/g	760	350	2300
Antimony	ug/g	<0.2	<2	<0.2
Arsenic	ug/g	0.9	<1	0.7
Barium	ug/g	34	25	68
Beryllium	ug/g	0.03	<0.2	0.08
Boron	ug/g	3	<20	10
Cadmium	ug/g	2.8	1.5	2.2
Chromium	ug/g	1	<10	3
Cobalt	ug/g	1.8	0.8	1.4
Copper	ug/g	11	12	14
Iron	ug/g	660	270	1400
Lead	ug/g	0.38	0.2	0.99
Manganese	ug/g	87	70	120
Mercury	ug/g	0.04	<0.1	0.08
Molybdenum	ug/g	0.4	<2	0.7
Nickel	ug/g	20	8	4.1
Selenium	ug/g	10	7	9.6
Silver	ug/g	0.09	<0.2	0.13
Strontium	ug/g	12	11	10
Thallium	ug/g	<0.1	<1	<0.1
Tin	ug/g	<0.1	<1	<0.1
Titanium	ug/g	8.0	3	21
Uranium	ug/g	0.14	<0.1	0.18
Vanadium	ug/g	3.2	<2	6.2
Zinc	ug/g	190	170	140
Lab Section 6 (SPTP)				
Moisture	%	88.26	80.41	84.73

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Minnow Environmental Inc.

37479 **09/12/2018 RG_SMCK_INV_20180912 *TISSUE***
37480 **09/12/2018 RG_GRDS_INV_20180912 *TISSUE***
37481 **09/12/2018 RG_EL19-1_INV_20180912 *TISSUE***

Analyte	Units	37479	37480	37481
Lab Section 2 (ICP)				
Aluminum	ug/g	1400	560	380
Antimony	ug/g	<1	<0.2	<1
Arsenic	ug/g	2.7	0.5	1.4
Barium	ug/g	280	23	10
Beryllium	ug/g	<0.1	<0.02	<0.1
Boron	ug/g	<10	<2	<10
Cadmium	ug/g	0.5	1.3	1.8
Chromium	ug/g	<5	<1	<5
Cobalt	ug/g	0.6	0.51	1.0
Copper	ug/g	62	13	19
Iron	ug/g	610	420	270
Lead	ug/g	0.4	0.29	0.2
Manganese	ug/g	27	99	79
Mercury	ug/g	0.05	0.02	<0.05
Molybdenum	ug/g	<1	0.3	<1
Nickel	ug/g	1.6	2.4	3.9
Selenium	ug/g	6.2	15	8.0
Silver	ug/g	0.7	0.05	0.2
Strontium	ug/g	1450	5.4	8
Thallium	ug/g	<0.5	<0.1	<0.5
Tin	ug/g	<0.5	<0.1	<0.5
Titanium	ug/g	13	5.2	3.8
Uranium	ug/g	<0.05	0.09	<0.05
Vanadium	ug/g	3	1.4	1
Zinc	ug/g	64	140	350
Lab Section 6 (SPTP)				
Moisture	%	85.12	82.16	80.42

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37482 **09/12/2018 RG_EL19-2_INV_20180912 *TISSUE***
37483 **09/12/2018 RG_EL19-3_INV_20180912 *TISSUE***
37484 **09/12/2018 RG_EL19-4_INV_20180912 *TISSUE***

Analyte	Units	37482	37483	37484
Lab Section 2 (ICP)				
Aluminum	ug/g	480	110	770
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	0.9	<0.5	1.1
Barium	ug/g	11	4.9	11
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	1.7	0.5	2.2
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	0.7	0.4	1.3
Copper	ug/g	15	19	12
Iron	ug/g	340	90	760
Lead	ug/g	0.2	<0.1	0.3
Manganese	ug/g	61	27	62
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	2.8	0.9	5.6
Selenium	ug/g	5.5	4.3	5.0
Silver	ug/g	0.2	0.2	0.1
Strontium	ug/g	14	8	8
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	3.8	1.1	6.4
Uranium	ug/g	0.05	<0.05	0.07
Vanadium	ug/g	2	<1	3
Zinc	ug/g	320	310	260
Lab Section 6 (SPTP)				
Moisture	%	84.47	78.22	81.84

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37485	**09/12/2018 RG_EL19-5_INV_20180912 *TISSUE***
37486	**09/12/2018 RG_KICK_INV_20180912 *TISSUE***
37487	**09/12/2018 RG_CLODE_INV_20180912 *TISSUE***

Analyte	Units	37485	37486	37487
Lab Section 2 (ICP)				
Aluminum	ug/g	740	1800	7100
Antimony	ug/g	<1	<1	<0.2
Arsenic	ug/g	0.8	0.9	2.2
Barium	ug/g	16	36	182
Beryllium	ug/g	<0.1	<0.1	0.29
Boron	ug/g	<10	30	11
Cadmium	ug/g	1.6	2.8	4.4
Chromium	ug/g	<5	<5	11
Cobalt	ug/g	0.7	1.2	3.6
Copper	ug/g	16	22	15
Iron	ug/g	500	1100	5700
Lead	ug/g	0.3	1.1	2.8
Manganese	ug/g	99	45	150
Mercury	ug/g	<0.05	<0.05	0.04
Molybdenum	ug/g	<1	<1	2.2
Nickel	ug/g	2.3	5.2	39
Selenium	ug/g	5.2	6.6	13
Silver	ug/g	0.2	<0.1	0.10
Strontium	ug/g	8	12	82
Thallium	ug/g	<0.5	<0.5	0.3
Tin	ug/g	<0.5	<0.5	<0.1
Titanium	ug/g	6.8	12	25
Uranium	ug/g	0.07	0.56	0.99
Vanadium	ug/g	2	6	26
Zinc	ug/g	340	120	240
Lab Section 6 (SPTP)				
Moisture	%	81.05	91.74	75.75

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Minnow Environmental Inc.

37488 **09/12/2018 RG_FC1_INV_20180912 *TISSUE***
37489 **09/13/2018 RG_WWRL1_INV_20190913 *TISSUE***
37490 **09/13/2018 RG_WWRL2_INV_20190913 *TISSUE***

Analyte	Units	37488	37489	37490
Lab Section 2 (ICP)				
Aluminum	ug/g	2100	530	530
Antimony	ug/g	<0.2	<1	<1
Arsenic	ug/g	1.0	3.8	3.1
Barium	ug/g	34	36	24
Beryllium	ug/g	0.09	<0.1	<0.1
Boron	ug/g	4	<10	<10
Cadmium	ug/g	1.2	0.8	0.8
Chromium	ug/g	3	<5	<5
Cobalt	ug/g	0.90	0.5	0.7
Copper	ug/g	11	11	10
Iron	ug/g	1700	540	440
Lead	ug/g	0.82	0.2	0.2
Manganese	ug/g	61	53	51
Mercury	ug/g	0.02	<0.05	<0.05
Molybdenum	ug/g	0.3	<1	<1
Nickel	ug/g	3.2	1.1	0.9
Selenium	ug/g	4.8	8.0	6.9
Silver	ug/g	0.08	<0.1	<0.1
Strontium	ug/g	7.4	2	2
Thallium	ug/g	<0.1	<0.5	<0.5
Tin	ug/g	<0.1	<0.5	<0.5
Titanium	ug/g	9.7	4.6	3.3
Uranium	ug/g	0.15	0.05	0.05
Vanadium	ug/g	7.2	1	2
Zinc	ug/g	95	130	200
Lab Section 6 (SPTP)				
Moisture	%	84.70	82.75	81.55

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37491	**09/13/2018 RG_WWRL3_INV_20190913 *TISSUE***
37492	**09/13/2018 RG_LE1_INV_20180913 *TISSUE***
37910	**RG_EL20-4_INV_20180911 *TISSUE***

Analyte	Units	37491	37492	37910
Lab Section 2 (ICP)				
Aluminum	ug/g	210	450	490
Antimony	ug/g	<0.2	<1	<1
Arsenic	ug/g	1.8	<0.5	0.9
Barium	ug/g	8.3	18	29
Beryllium	ug/g	<0.02	<0.1	<0.1
Boron	ug/g	7	<10	<10
Cadmium	ug/g	0.82	3.1	2.3
Chromium	ug/g	<1	<5	<5
Cobalt	ug/g	0.46	0.3	1.1
Copper	ug/g	9.1	19	16
Iron	ug/g	240	540	330
Lead	ug/g	0.13	0.2	0.2
Manganese	ug/g	36	34	60
Mercury	ug/g	0.01	<0.05	<0.05
Molybdenum	ug/g	0.3	<1	<1
Nickel	ug/g	0.6	1.5	1.3
Selenium	ug/g	5.6	3.2	5.8
Silver	ug/g	0.03	0.2	0.1
Strontium	ug/g	3.8	4	6
Thallium	ug/g	<0.1	<0.5	<0.5
Tin	ug/g	<0.1	<0.5	<0.5
Titanium	ug/g	2.1	4.2	4.5
Uranium	ug/g	0.03	<0.05	<0.05
Vanadium	ug/g	0.6	2	2
Zinc	ug/g	130	120	200
Lab Section 6 (SPTP)				
Moisture	%	82.95	80.07	81.43

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SRC Group # 2018-11596

Oct 24, 2018

Minnow Environmental Inc.

37911 **RG_EL20-5_INV_20180911 *TISSUE***

Analyte	Units	37911
Lab Section 2 (ICP)		
Aluminum	ug/g	550
Antimony	ug/g	<1
Arsenic	ug/g	1.1
Barium	ug/g	10
Beryllium	ug/g	<0.1
Boron	ug/g	<10
Cadmium	ug/g	2.6
Chromium	ug/g	<5
Cobalt	ug/g	1.0
Copper	ug/g	14
Iron	ug/g	390
Lead	ug/g	0.2
Manganese	ug/g	48
Mercury	ug/g	<0.05
Molybdenum	ug/g	<1
Nickel	ug/g	1.3
Selenium	ug/g	7.2
Silver	ug/g	<0.1
Strontium	ug/g	7
Thallium	ug/g	<0.5
Tin	ug/g	<0.5
Titanium	ug/g	4.8
Uranium	ug/g	0.05
Vanadium	ug/g	2
Zinc	ug/g	170
Lab Section 6 (SPTP)		
Moisture	%	79.56

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Oct 24, 2018

This report was generated for samples included in SRC Group # 2018-11596

Quality Control Report

Jennifer Ings
Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9

Reference Materials and Standards:

A reference material of known concentration is used whenever possible as either a control sample or control standard and analyzed with each batch of samples. These "QC" results are used to assess the performance of the method and must be within clearly defined limits; otherwise corrective action is required.

QC Analysis	Units	Target Value	Obtained Value
Aluminum	ug/g	1280	1400
Aluminum	ug/g	1280	1410
Aluminum	ug/g	1280	1450
Aluminum	ug/g	1280	1400
Aluminum	ug/g	1280	1300
Aluminum	ug/g	1280	1240
Aluminum	ug/g	1280	1120
Arsenic	ug/g	6.87	7.16
Arsenic	ug/g	6.87	7.19
Arsenic	ug/g	6.87	6.80
Arsenic	ug/g	6.87	6.52
Arsenic	ug/g	6.87	5.74
Cadmium	ug/g	0.299	0.310
Cadmium	ug/g	0.299	0.314
Cadmium	ug/g	0.299	0.319
Cadmium	ug/g	0.299	0.298
Cadmium	ug/g	0.299	0.268
Chromium	ug/g	1.57	1.80
Chromium	ug/g	1.57	1.79
Chromium	ug/g	1.57	1.74
Chromium	ug/g	1.57	1.94
Chromium	ug/g	1.57	1.53
Copper	ug/g	13.8	14.4
Copper	ug/g	13.8	14.6
Copper	ug/g	13.8	14.8
Copper	ug/g	13.8	13.8
Copper	ug/g	13.8	12.5
Iron	ug/g	312	336
Iron	ug/g	312	342
Iron	ug/g	312	332
Iron	ug/g	312	298
Iron	ug/g	312	297

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QC Analysis	Units	Target Value	Obtained Value
Iron	ug/g	312	288
Iron	ug/g	312	242
Lead	ug/g	0.404	0.414
Lead	ug/g	0.404	0.413
Lead	ug/g	0.404	0.438
Lead	ug/g	0.404	0.394
Lead	ug/g	0.404	0.354
Manganese	ug/g	2.70	3.06
Manganese	ug/g	2.70	3.05
Manganese	ug/g	2.70	2.88
Manganese	ug/g	2.70	2.83
Manganese	ug/g	2.70	2.16
Mercury	ug/g	0.364	0.344
Mercury	ug/g	0.364	0.411
Mercury	ug/g	0.364	0.383
Mercury	ug/g	0.364	0.364
Mercury	ug/g	0.364	0.313
Nickel	ug/g	1.20	1.21
Nickel	ug/g	1.20	1.26
Nickel	ug/g	1.20	1.27
Nickel	ug/g	1.20	1.20
Nickel	ug/g	1.20	1.12
Selenium	ug/g	3.74	3.72
Selenium	ug/g	3.74	3.80
Selenium	ug/g	3.74	3.66
Selenium	ug/g	3.74	3.41
Selenium	ug/g	3.74	3.65
Selenium	ug/g	3.74	3.03
Silver	ug/g	0.0215	0.0217
Silver	ug/g	0.0215	0.0203
Silver	ug/g	0.0215	0.0222
Silver	ug/g	0.0215	0.0199
Silver	ug/g	0.0215	0.0173
Zinc	ug/g	47.8	47.2
Zinc	ug/g	47.8	47.3
Zinc	ug/g	47.8	48.7
Zinc	ug/g	47.8	42.8
Zinc	ug/g	47.8	38.8

Duplicates:

Duplicates are used to assess problems with precision and help ensure that samples within a given batch were processed appropriately. The difference between duplicates must be within strict limits, otherwise corrective action is required. Please note, the duplicate(s) in this report are duplicates analyzed within a given batch of test samples and may not be from this specific group of samples.

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This report was generated for samples included in SRC Group # 2018-11596

Duplicate Analysis	Units	Sample ID	First Result	Second Result	
Silver	ug/g	37420	<0.1	<0.1	
Aluminum	ug/g	37420	2400	400	*(1)
Arsenic	ug/g	37420	1.7	0.8	
Boron	ug/g	37420	<10	<10	
Barium	ug/g	37420	43	17	*(2)
Beryllium	ug/g	37420	0.1	<0.1	
Cadmium	ug/g	37420	1.4	0.7	*(3)
Cobalt	ug/g	37420	140	135	
Chromium	ug/g	37420	<5	<5	
Copper	ug/g	37420	10	10	
Iron	ug/g	37420	2100	280	*(4)
Mercury	ug/g	37420	<0.05	<0.05	
Manganese	ug/g	37420	640	470	*(5)
Molybdenum	ug/g	37420	1	1	
Moisture	%	37382	72.29	75.43	
Moisture	%	37400	87.31	84.49	
Moisture	%	37402	76.92	84.37	
Moisture	%	37413	86.51	82.47	
Moisture	%	37462	86.56	82.12	
Moisture	%	37471	79.32	83.33	
Moisture	%	37483	78.22	78.56	
Nickel	ug/g	37420	92	72	*(6)
Lead	ug/g	37420	0.9	0.2	*(7)
Antimony	ug/g	37420	<1	<1	
Selenium	ug/g	37420	3.9	4.4	
Tin	ug/g	37420	<0.5	<0.5	
Strontium	ug/g	37420	99	43	*(8)
Titanium	ug/g	37420	14	3.3	*(9)
Thallium	ug/g	37420	<0.5	<0.5	
Uranium	ug/g	37420	0.82	0.39	*(10)
Vanadium	ug/g	37420	8	1	*(11)
Zinc	ug/g	37420	260	210	

*(1) - (11) The duplicate results for Aluminum, Barium, Cadmium, Iron, Manganese, Nickel, Lead, Strontium, Titanium, Uranium and Vanadium were outside the laboratory's specified limits. The data was reviewed. There was no sample remaining to repeat analysis, however the second results compared to other samples in the group. All other quality control measures in the batch were within limits.
Overall, there were no other indications of problems with the analysis and the results were considered acceptable.

Roxane Ortmann - Quality Assurance Supervisor

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Jess Tester

Date Samples Received: Sep-18-2018 Client P.O.: VPO00555477 Ref# 18-18

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Sections 1 and 2 have been authorized by Keith Gipman, Supervisor
Results from Lab Section 3 have been authorized by Pat Moser, Supervisor
Results from Lab Sections 4 and 5 have been authorized by Vicky Snook, Supervisor
Results from Lab Section 6 have been authorized by Marion McConnell, Supervisor

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* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

This is a final report.

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.

2 Lamb Street
Georgetown, ON L7G 3M9
Attn: Jess Tester

Date Samples Received: Sep-18-2018 Client P.O.: VPO00555477 Ref# 18-18

37077 **09/07/2018 RG_GH_SCW3-1_INV_20180907 *TISSUE***
37078 **09/07/2018 RG_GH_SCW3-2_INV_20180907 *TISSUE***
37079 **09/07/2018 RG_GH_SCW3-3_INV_20180907 *TISSUE***

Analyte	Units	37077	37078	37079
Lab Section 2 (ICP)				
Aluminum	ug/g	3500	1800	900
Antimony	ug/g	<1	<0.2	<0.2
Arsenic	ug/g	1.4	1.2	0.6
Barium	ug/g	58	64	34
Beryllium	ug/g	0.1	0.07	0.04
Boron	ug/g	10	12	4
Cadmium	ug/g	1.4	1.2	0.56
Chromium	ug/g	6	3	2
Cobalt	ug/g	1.7	1.8	0.86
Copper	ug/g	22	21	17
Iron	ug/g	2300	1200	720
Lead	ug/g	1.5	1.1	0.71
Manganese	ug/g	280	280	260
Mercury	ug/g	<0.05	0.03	0.03
Molybdenum	ug/g	<1	0.8	0.8
Nickel	ug/g	8.0	7.7	4.0
Selenium	ug/g	12	8.9	16
Silver	ug/g	0.1	0.10	0.08
Strontium	ug/g	20	9.9	16
Thallium	ug/g	<0.5	<0.1	<0.1
Tin	ug/g	<0.5	<0.1	<0.1
Titanium	ug/g	43	24	8.7
Uranium	ug/g	0.55	0.53	0.43
Vanadium	ug/g	11	5.9	3.0
Zinc	ug/g	370	400	360
Lab Section 6 (SPTP)				
Moisture	%	83.58	81.04	80.04

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Results are reported on a dry basis.
There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.

37080 **09/06/2018 RG_SCDTC-1_INV_20180906 *TISSUE***
37081 **09/06/2018 RG_SCDTC-2_INV_20180906 *TISSUE***
37082 **09/06/2018 RG_SCDTC-3_INV_20180906 *TISSUE***

Analyte	Units	37080	37081	37082
Lab Section 2 (ICP)				
Aluminum	ug/g	4700	3000	2500
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	1.9	1.6	1.5
Barium	ug/g	60	26	24
Beryllium	ug/g	0.2	<0.1	<0.1
Boron	ug/g	10	<10	<10
Cadmium	ug/g	5.5	9.7	7.2
Chromium	ug/g	7	<5	<5
Cobalt	ug/g	2.7	2.7	2.2
Copper	ug/g	20	25	20
Iron	ug/g	2900	1700	1600
Lead	ug/g	1.9	0.9	0.8
Manganese	ug/g	180	87	88
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	7.7	4.1	3.8
Selenium	ug/g	11	11	12
Silver	ug/g	0.1	0.1	<0.1
Strontium	ug/g	22	13	14
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	36	37	30
Uranium	ug/g	0.64	0.18	0.22
Vanadium	ug/g	14	9	7
Zinc	ug/g	340	240	200
Lab Section 6 (SPTP)				
Moisture	%	79.35	81.08	81.62

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.

37083 **09/08/2018 RG_ERSC5-1_INV_20180908 *TISSUE***
37084 **09/08/2018 RG_ERSC5-2_INV_20180908 *TISSUE***
37085 **09/08/2018 RG_ERSC5-3_INV_20180908 *TISSUE***

Analyte	Units	37083	37084	37085
Lab Section 2 (ICP)				
Aluminum	ug/g	2000	890	1800
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	1.2	1.0	1.0
Barium	ug/g	24	20	25
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	10	5.1	4.2
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	3.4	1.3	1.5
Copper	ug/g	26	17	18
Iron	ug/g	1600	630	1400
Lead	ug/g	0.7	0.4	0.7
Manganese	ug/g	150	180	160
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	<1	<1
Nickel	ug/g	3.2	2.4	3.5
Selenium	ug/g	12	8.9	6.4
Silver	ug/g	0.1	<0.1	0.1
Strontium	ug/g	12	7	92
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	17	11	16
Uranium	ug/g	0.15	0.12	0.58
Vanadium	ug/g	7	3	6
Zinc	ug/g	340	200	270
Lab Section 6 (SPTP)				
Moisture	%	75.63	76.80	76.90

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.

37086 **09/08/2018 RG_GH_ER1A-1_INV_20180908 *TISSUE***
37087 **09/09/2018 RG_GH_ER1A-2_INV_20180909 *TISSUE***
37088 **09/09/2018 RG_GH_ER1A-3_INV_20180909 *TISSUE***

Analyte	Units	37086	37087	37088
Lab Section 2 (ICP)				
Aluminum	ug/g	1400	1600	1600
Antimony	ug/g	<1	<1	<1
Arsenic	ug/g	1.4	1.8	1.0
Barium	ug/g	34	38	22
Beryllium	ug/g	<0.1	<0.1	<0.1
Boron	ug/g	<10	<10	<10
Cadmium	ug/g	6.0	7.9	4.9
Chromium	ug/g	<5	<5	<5
Cobalt	ug/g	1.2	2.0	1.2
Copper	ug/g	20	24	19
Iron	ug/g	1200	1200	1200
Lead	ug/g	0.7	0.6	0.6
Manganese	ug/g	240	240	110
Mercury	ug/g	<0.05	<0.05	<0.05
Molybdenum	ug/g	<1	1	<1
Nickel	ug/g	2.9	4.0	2.5
Selenium	ug/g	8.8	12	7.0
Silver	ug/g	0.1	<0.1	0.1
Strontium	ug/g	12	14	9
Thallium	ug/g	<0.5	<0.5	<0.5
Tin	ug/g	<0.5	<0.5	<0.5
Titanium	ug/g	15	16	9.9
Uranium	ug/g	0.19	0.15	0.10
Vanadium	ug/g	6	6	4
Zinc	ug/g	310	280	340
Lab Section 6 (SPTP)				
Moisture	%	81.70	92.93	79.14

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SRC Group # 2018-11604

Oct 02, 2018

Minnow Environmental Inc.

37089 **09/09/2018 RG_GH_ERSC4-1_INV_20180909 *TISSUE***
37090 **09/09/2018 RG_GH_ERSC4-2_INV_20180909 *TISSUE***
37091 **09/09/2018 RG_GH_ERSC4-3_INV_20180909 *TISSUE***

Analyte	Units	37089	37090	37091
Lab Section 2 (ICP)				
Aluminum	ug/g	300	320	260
Antimony	ug/g	<1	<0.1	<0.1
Arsenic	ug/g	<0.5	0.44	0.49
Barium	ug/g	21	10	13
Beryllium	ug/g	<0.1	0.01	<0.01
Boron	ug/g	<10	<1	<1
Cadmium	ug/g	1.4	1.4	1.4
Chromium	ug/g	<5	0.7	0.5
Cobalt	ug/g	0.4	0.42	0.43
Copper	ug/g	17	25	23
Iron	ug/g	250	230	200
Lead	ug/g	0.2	0.12	0.11
Manganese	ug/g	130	55	69
Mercury	ug/g	<0.05	0.044	0.045
Molybdenum	ug/g	<1	0.2	0.3
Nickel	ug/g	1.1	1.0	1.2
Selenium	ug/g	4.8	5.5	5.6
Silver	ug/g	0.2	0.24	0.24
Strontium	ug/g	10	14	18
Thallium	ug/g	<0.5	<0.05	<0.05
Tin	ug/g	<0.5	<0.05	<0.05
Titanium	ug/g	3.4	3.7	3.3
Uranium	ug/g	0.22	0.043	0.045
Vanadium	ug/g	<1	1.0	0.8
Zinc	ug/g	430	500	440
Lab Section 6 (SPTP)				
Moisture	%	80.54	78.78	81.17

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.

Results are reported on a dry basis.
There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

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Oct 02, 2018

This report was generated for samples included in SRC Group # 2018-11604

Quality Control Report

Jess Tester
Minnow Environmental Inc.
2 Lamb Street
Georgetown, ON L7G 3M9

Reference Materials and Standards:

A reference material of known concentration is used whenever possible as either a control sample or control standard and analyzed with each batch of samples. These "QC" results are used to assess the performance of the method and must be within clearly defined limits; otherwise corrective action is required.

QC Analysis	Units	Target Value	Obtained Value
Aluminum	ug/g	1280	1430
Arsenic	ug/g	6.87	8.34
Cadmium	ug/g	0.299	0.320
Chromium	ug/g	1.57	1.82
Copper	ug/g	13.8	14.6
Iron	ug/g	312	345
Lead	ug/g	0.404	0.426
Manganese	ug/g	2.70	2.83
Mercury	ug/g	0.364	0.357
Nickel	ug/g	1.20	1.33
Selenium	ug/g	3.74	4.27
Silver	ug/g	0.0215	0.0210
Zinc	ug/g	47.8	48.2

Duplicates:

Duplicates are used to assess problems with precision and help ensure that samples within a given batch were processed appropriately. The difference between duplicates must be within strict limits, otherwise corrective action is required. Please note, the duplicate(s) in this report are duplicates analyzed within a given batch of test samples and may not be from this specific group of samples.

Duplicate Analysis	Units	Sample ID	First Result	Second Result
Moisture	%	37079	79.91	80.04

Please note, duplicates could not be analyzed due to insufficient sample available.

All quality control results were within the specified limits and considered acceptable.

Roxane Ortmann - Quality Assurance Supervisor

APPENDIX G

DATA COLLECTED CONCURRENT WITH SEPTEMBER BIOLOGICAL SAMPLES

Supporting Data

Laboratory Results and QA/QC

DATA COLLECTED CONCURRENT WITH SEPTEMBER BIOLOGICAL SAMPLES

Supporting Data

Table G.1: Chemistry of Water Samples Collected Concurrent with Biological Samples, September 2018

Analyte		Units	BC Water Quality Guidelines		Reference	Mine-exposed						
					GH_ER2	GH_ERSC4	GH_ER1A	RG_ERSC5	GH_TC2	RG_GH_SCW3	RG_SCDTC	GH_ERC
			30-Day Average	Short-term Maximum	11-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	09-Sep-18	07-Sep-18	06-Sep-18	11-Sep-18
Physical Tests	Conductivity (@ 25°C)	µS/cm	-	-	290	303	304	301	1,960	589	577	322
	Temperature	°C			8.6	8.9	9.9	9.1	14	12.1	11.8	7.5
	Hardness (as $CaCO_3$)	mg/L	-	-	148	166	158	163	1,220	297	301	164
	pH	pH	6.5 - 9.0		7.9	8.4	8.4	8.4	8.4	8.4	8.4	7.9
	ORP	mV	-	-	405	444	318	366	362	397	417	411
	Total Suspended Solids	mg/L	-	-	1.9	2.2	<1.0	4.1	3.5	4.2	<1.0	<1.0
	Total Dissolved Solids	mg/L	-	-	179	158	197	189	1,660	426	374	193
	Turbidity	NTU	-	-	1.8	0.63	0.55	1.6	1.2	1.3	2.0	0.49
Anions and Nutrients	Acidity (as $CaCO_3$)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	-	-	143	139	143	141	148	149	145	155
	Alkalinity, Carbonate (as $CaCO_3$)	mg/L	-	-	<1.0	2.2	3.0	3.8	4.8	3.2	3.4	<1.0
	Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as $CaCO_3$)	mg/L	10-20 minimum		143	142	146	145	153	152	148	155
	Ammonia as N	mg/L	2.4 - 8.3	0.46 - 1.6	0.0068	<0.0050	0.0069	<0.0050	0.0092	0.0059	0.0090	<0.0050
	Bromide (Br)	mg/L	-	-	<0.050	<0.050	<0.050	<0.050	<0.25	<0.050	<0.050	<0.050
	Chloride (Cl)	mg/L	150	600	<0.50	<0.50	<0.50	<0.50	14	2.1	2.1	<0.50
	Fluoride (F)	mg/L	-	1.5 - 1.9[a]	0.17	0.18	0.18	0.17	<0.10	0.16	0.16	0.17
	Ion Balance	%	-	-	92	103	96	100	95	92	97	92
	Nitrate (as N)	mg/L	3.0	32.8	0.033	0.037	0.031	0.024	19	2.6	2.5	0.34
	Nitrite (as N)	mg/L	0.02 - 0.2	0.06 - 0.6	<0.0010	<0.0010	<0.0010	<0.0010	0.015	0.0021	0.0055	<0.0010
	Total Kjeldahl Nitrogen	mg/L	-	-	0.12	<0.050	<0.050	<0.050	<0.050	0.092	0.056	0.092
	Orthophosphate-Dissolved (as P)	mg/L	-	-	0.0045	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0049
	Phosphorus (P)-Total	mg/L	0.005 - 0.015[a]		0.0066	0.0060	0.0038	0.0050	0.0070	0.0084	0.0044	0.0061
	Sulphate (SO_4)	mg/L	309 - 429[a]	-	18	19	19	19	1,030	158	151	24
	Anion Sum	meq/L	-	-	3.2	3.2	3.3	3.3	26	6.6	6.3	3.6
	Cation Sum	meq/L	-	-	3.0	3.4	3.2	3.3	25	6.1	6.1	3.3
	Cation - Anion Balance	%	-	-	-4.1	1.7	-2.0	0	-2.9	-4.1	-1.7	-4.4
Organic / Inorganic Carbon	Dissolved Organic Carbon	mg/L	-	-	0.89	0.93	0.89	0.92	2.7	1.4	1.5	0.64
	Total Organic Carbon	mg/L	-	-	0.75	0.97	0.85	0.90	2.7	1.3	1.3	0.63
Total Metals	Aluminum (Al)	mg/L	-	-	0.0048	0.012	0.0077	0.014	0.012	0.025	0.029	0.0047
	Antimony (Sb)	mg/L	0.009	-	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	-	0.005	<0.00010	0.00015	0.00015	0.00015	0.00022	0.00017	0.00016	0.00011
	Barium (Ba)	mg/L	1	-	0.048	0.047	0.047	0.048	0.079	0.052	0.052	0.058
	Beryllium (Be)	µg/L	0.13	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	1.2	-	<0.010	<0.010	<0.010	<0.010	0.023	<0.010	<0.010	<0.010
	Cadmium (Cd)	µg/L	-	-	0.0070	0.012	0.0091	0.012	0.018	0.015	0.016	0.0079
	Calcium (Ca)	mg/L	-	-	51	48	46	48	234	77	74	51
	Chromium (Cr)	mg/L	-	-	0.00023	0.00026	0.00026	0.00024	<0.00030	0.00024	0.00025	0.00023
	Cobalt (Co)	µg/L	4.0	110	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)	mg/L	0.006 - 0.01[a]	0.016 - 0.04[a]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	-	1.0	<0.010	0.016	0.011	0.017	0.017	0.033	0.036	<0.010
	Lead (Pb)	mg/L	0.009 - 0.02[a]	0.13 - 0.42[a]	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0019	0.0017	0.0017	0.0017	0.023	0.0048	0.0046	0.0026
	Magnesium (Mg)	mg/L	-	-	11	11	11	11	149	30	28	13
	Manganese (Mn)	mg/L	1.3 - 2.6[a]	2.2 - 3.4[a]	0.0017	0.0027	0.0013	0.0014	0.0014	0.0020	0.0018	0.0012
	Mercury (Hg)	µg/L	-	-	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	0.00051	0.00070	<0.00050
	Molybdenum (Mo)	mg/L	0.073	-	0.00098	0.0010	0.0010	0.0010	0.0014	0.0011	0.0011	0.0010

Table G.1: Chemistry of Water Samples Collected Concurrent with Biological Samples, September 2018

Analyte		Units	BC Water Quality Guidelines		Reference	Mine-exposed						
					GH_ER2	GH_ERSC4	GH_ER1A	RG_ERSC5	GH_TC2	RG_GH_SCW3	RG_SCDTC	GH_ERC
			30-Day Average	Short-term Maximum	11-Sep-18	09-Sep-18	08-Sep-18	08-Sep-18	09-Sep-18	07-Sep-18	06-Sep-18	11-Sep-18
Total Metals	Nickel (Ni)	mg/L	0.13 - 0.15[a]	-	<0.00050	<0.00050	<0.00050	<0.00050	0.0013	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.34	0.36	0.36	0.37	1.9	0.56	0.54	0.40
	Selenium (Se)	µg/L	-	2.0	0.77	0.70	0.70	0.73	162	22	24	1.6
	Silicon (Si)	mg/L	-	-	1.9	1.8	1.7	1.7	1.8	1.8	1.9	2.1
	Silver (Ag)	mg/L	0.0015	0.003	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.68	0.67	0.66	0.67	11	2.1	1.9	0.84
	Strontium (Sr)	mg/L	-	-	0.21	0.22	0.22	0.22	0.60	0.28	0.27	0.21
	Thallium (Tl)	mg/L	0.0008	-	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.0085	-	0.00065	0.00065	0.00063	0.00065	0.0059	0.0014	0.0015	0.00070
	Vanadium (V)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	0.05 - 0.19[a]	0.08 - 0.34[a]	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.05	0.10	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	-	-	<0.00010	0.00010	<0.00010	<0.00010	0.00020	0.00011	0.00013	0.00010
	Barium (Ba)	mg/L	-	-	0.044	0.053	0.054	0.051	0.085	0.059	0.055	0.053
	Beryllium (Be)	µg/L	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	0.023	<0.010	<0.010	<0.010
	Cadmium (Cd)	µg/L	0.28 - 0.46[a]	0.9 - 2.8[a]	0.0057	0.0061	0.0067	0.0071	0.014	0.0097	0.0096	<0.0050
	Calcium (Ca)	mg/L	-	-	43	47	46	47	242	71	71	46
	Chromium (Cr)	mg/L	-	-	0.00020	0.00023	0.00025	0.00025	<0.00010	0.00016	0.00017	0.00022
	Cobalt (Co)	µg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Copper (Cu)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)	mg/L	-	0.35	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0018	0.0019	0.0019	0.0019	0.023	0.0050	0.0049	0.0026
	Magnesium (Mg)	mg/L	-	-	10	12	11	12	149	29	30	12
	Manganese (Mn)	mg/L	-	-	0.00065	0.0010	0.00054	0.00016	0.00020	0.00049	0.00032	0.00032
	Mercury (Hg)	mg/L	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)	mg/L	-	-	0.00099	0.0011	0.0011	0.0011	0.0016	0.0011	0.0012	0.0010
	Nickel (Ni)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	0.0011	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.35	0.40	0.42	0.39	1.9	0.63	0.56	0.41
	Selenium (Se)	µg/L	-	-	0.79	0.74	0.75	0.83	188	22	24	1.3
	Silicon (Si)	mg/L	-	-	1.7	1.8	1.7	1.8	1.8	1.8	1.7	1.9
	Silver (Ag)	mg/L	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.67	0.68	0.73	0.67	10	2.2	2.1	0.85
	Strontium (Sr)	mg/L	-	-	0.21	0.20	0.21	0.19	0.66	0.26	0.27	0.21
	Thallium (Tl)	mg/L	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	-	-	0.00073	0.00072	0.00075	0.00068	0.0056	0.0015	0.0014	0.00076
	Vanadium (V)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

[a] Guideline based on hardness value of water sample.

Value > 30-day average chronic guideline.

Value > short-term maximum guideline.

Table G.2: ***In Situ*** **Water Quality at Biological Monitoring Areas, GHO LAEMP, September 2018**

Field Parameters		Date	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Specific Conductivity (µS/cm)	Conductivity (µS/cm)	pH
Reference	GH_ER2 / ELUGH	11-Sep-18	Station 1	8.6	10.24	104.0	279.3	191.3	7.80
			Station 2	8.8	10.30	104.8	280.0	193.5	7.80
			Station 3	8.9	10.11	102.9	279.6	193.7	7.80
Mine-exposed	GH_ERSC4	9-Sep-18	Station 1	8.9	9.92	100.3	292.4	202.7	7.29
			Station 2	9.5	9.81	100.8	205.8	291.9	7.30
			Station 3	10.1	9.63	100.3	291.8	208.8	7.30
	GH_ER1A	9-Sep-18	Station 1	9.9	9.99	103.7	292.0	207.8	7.31
			Station 2	8.6	8.78	87.8	293.0	201.3	7.31
			Station 3	8.6	10.4	100.4	292.6	200.6	7.31
	RG_ERSC5	8-Sep-18	Station 1	9.1	9.83	99.6	291.9	203.3	7.30
			Station 2	9.3	9.66	97.0	295.1	206.4	7.29
			Station 3	9.3	9.81	99.7	292.3	204.6	7.32
	GH_TC2 / THCK	9-Sep-18	Station 1	13.6	8.41	95.9	1,869.0	1,463.0	8.56
	RG_GH-SCW3	7-Sep-18	Station 1	12.1	9.75	106.0	560.3	422.8	7.39
	RG_SCDTC	6-Sep-18	Station 1	11.8	8.57	92.8	611.4	457.4	7.29
	GH_ERC / EL20	11-Sep-18	Station 1	7.5	9.90	96.5	308.7	205.4	7.56
			Station 2	7.7	9.60	94.3	308.6	206.7	7.54
			Station 3	7.8	9.49	93.7	309.0	207.3	7.51
			Station 4	8.0	9.26	92.2	310.3	208.6	7.51
			Station 5	8.1	9.61	95.2	309.4	205.9	7.50

Table G.3: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2018

	Analyte	Units	BC Sediment Quality Guidelines		Reference							
					RG_GH-ER2							
			Lower SQG	Upper SQG	GH_ER2-1	GH_ER2-2	GH_ER2-3	Minimum	Median	Maximum	Mean	Standard Deviation
					11-Sep-18	11-Sep-18	11-Sep-18					
Physical Tests	Moisture	%	-	-	37	60	38	37.2	37.5	59.8	44.8	13.0
	pH(1:2 Soil:Water)	pH	-	-	8.0	7.6	8.0	7.61	7.96	7.96	7.84	0.202
Particle Size	% Gravel (>2 mm)	%	-	-	<1.0	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00	-
	% Sand (2.00 mm - 1.00 mm)	%	-	-	<1.0	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00	-
	% Sand (1.00 mm - 0.50 mm)	%	-	-	1.4	<1.0	2.7	<1.00	1.40	2.70	1.70	0.867
	% Sand (0.50 mm - 0.25 mm)	%	-	-	26	9.0	13	9.00	12.6	26.2	15.9	9.07
	% Sand (0.25 mm - 0.125 mm)	%	-	-	28	11	33	11.0	27.7	32.6	23.8	11.3
	% Sand (0.125 mm - 0.063 mm)	%	-	-	18	15	26	15.3	18.1	25.6	19.7	5.33
	% Silt (0.063 mm - 0.0312 mm)	%	-	-	12	27	14	12.4	13.6	27.2	17.7	8.22
	% Silt (0.0312 mm - 0.004 mm)	%	-	-	12	32	11	10.8	12.2	31.7	18.2	11.7
	% Clay (<4 µm)	%	-	-	2.2	5.0	1.9	1.90	2.20	5.00	3.03	1.71
	Texture	-	-	-	Loamy sand	Silt loam	Loamy sand	-	-	-	-	-
	Total Organic Carbon	%	-	-	2.2	5.9	2.2	2.15	2.18	5.93	3.42	2.17
Metals	Aluminum (Al)	mg/kg	-	-	6,420	7,540	5,470	5,470	6,420	7,540	6,480	1,040
	Antimony (Sb)	mg/kg	-	-	0.47	0.57	0.45	0.450	0.470	0.570	0.497	0.0643
	Arsenic (As)	mg/kg	5.9	17	5.0	5.5	4.6	4.60	5.00	5.48	5.03	0.441
	Barium (Ba)	mg/kg	-	-	109	136	109	109	109	136	118	15.6
	Beryllium (Be)	mg/kg	-	-	0.51	0.59	0.47	0.470	0.510	0.590	0.523	0.0611
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.200	<0.200	<0.200	<0.200	-
	Boron (B)	mg/kg	-	-	10	14	8.1	8.10	10.2	13.5	10.6	2.72
	Cadmium (Cd)	mg/kg	0.60	3.5	0.59	0.93	0.57	0.572	0.589	0.934	0.698	0.204
	Calcium (Ca)	mg/kg	-	-	81,000	68,600	63,600	63,600	68,600	81,000	71,100	8,960
	Chromium (Cr)	mg/kg	37	90	16	19	14	13.8	15.8	19.1	16.2	2.68
	Cobalt (Co)	mg/kg	-	-	3.6	4.6	3.6	3.58	3.61	4.55	3.91	0.552
	Copper (Cu)	mg/kg	36	197	7.6	11	7.6	7.61	7.62	11.4	8.88	2.19
	Iron (Fe)	mg/kg	21,200	43,766	11,000	12,500	10,300	10,300	11,000	12,500	11,300	1,120
	Lead (Pb)	mg/kg	35	91	5.7	6.8	5.6	5.58	5.69	6.80	6.02	0.675
	Lithium (Li)	mg/kg	-	-	9.6	12	8.6	8.60	9.60	12.2	10.1	1.86
	Magnesium (Mg)	mg/kg	-	-	14,100	13,700	12,700	12,700	13,700	14,100	13,500	721
	Manganese (Mn)	mg/kg	460	1,100	342	520	322	322	342	520	395	109
	Mercury (Hg)	mg/kg	0.17	0.49	0.022	0.036	0.023	0.0222	0.0226	0.0364	0.0271	0.00809
	Molybdenum (Mo)	mg/kg	-	-	1.2	1.5	1.1	1.14	1.20	1.46	1.27	0.170
	Nickel (Ni)	mg/kg	16	75	14	19	14	14.0	14.3	19.3	15.9	2.98
	Phosphorus (P)	mg/kg	-	-	1,290	1,260	1,260	1,260	1,260	1,290	1,270	17.3
	Potassium (K)	mg/kg	-	-	1,880	2,190	1,560	1,560	1,880	2,190	1,880	315
	Selenium (Se)	mg/kg	2.0	-	0.58	1.2	0.56	0.560	0.580	1.17	0.770	0.347
	Silver (Ag)	mg/kg	0.50	-	0.11	0.18	0.11	0.110	0.110	0.180	0.133	0.0404
	Sodium (Na)	mg/kg	-	-	95	90	83	83.0	90.0	95.0	89.3	6.03
	Strontium (Sr)	mg/kg	-	-	109	106	94	94.2	106	109	103	7.82
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
	Thallium (Tl)	mg/kg	-	-	0.18	0.23	0.17	0.171	0.180	0.232	0.194	0.0329
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.00	<2.00	<2.00	<2.00	-
	Titanium (Ti)	mg/kg	-	-	15	21	17	15.4	16.7	20.6	17.6	2.71
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.500	<0.500	<0.500	<0.500	-
	Uranium (U)	mg/kg	-	-	1.1	1.2	0.99	0.987	1.07	1.17	1.08	0.0916
	Vanadium (V)	mg/kg	-	-	32	36	28	28.0	32.0	35.5	31.8	3.75
	Zinc (Zn)	mg/kg	123	315	68	85	65	64.6	67.9	85.0	72.5	11.0
	Zirconium (Zr)	mg/kg	-	-	<1.0	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00	-
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0067	0.089	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acenaphthylene	mg/kg	0.0059	0.13	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acridine	mg/kg	-	-	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Anthracene	mg/kg	0.047	0.25	<0.0040	<0.0040	<0.0040	<0.00400	<0.00400	<0.00400	<0.00400	-
	Benz(a)anthracene	mg/kg	0.032	0.39	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(a)pyrene	mg/kg	0.032	0.78	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(b&j)fluoranthene	mg/kg	-	-	<0.010	0.014	<0.010	<0.0100	<0.0100	0.0140	0.0113	-
	Benzo(e)pyrene	mg/kg	-	-	<0.010	<0.010	<0.010	<0.0100	<0.0100	0.0130	0.0110	-
	Benzo(g,h,i)perylene	mg/kg	0.17	3.2	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(k)fluoranthene	mg/kg	0.24	13	<0.010	0.013	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Chrysene	mg/kg	0.057	0.86	0.010	0.029	0.011	0.0100	0.0110	0.0290	0.0167	0.0107
	Dibenz(a,h)anthracene	mg/kg	0.0062	0.14	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Fluoranthene	mg/kg	0.11	2.4	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Fluorene	mg/kg	0.021	0.14	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.20	3.2	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	1-Methylnaphthalene	mg/kg	-	-	0.014	0.054	0.015	0.0140	0.0150	0.0540	0.0277	0.0228
	2-Methylnaphthalene	mg/kg	0.020	0.20	0.020	0.071	0.020	0.0200	0.0200	0.0710	0.0370	0.0294
	Naphthalene	mg/kg	0.035	0.39	<0.010	0.027	<0.010	<0.0100	<0.0100	0.0270	0.0157	-
	Perylene	mg/kg	-	-	<0.010	0.018	<0.010	<0.0100	<0.0100	0.0180	0.0127	-
	Phenanthrene	mg/kg	0.042	0.52	0.024	0.084	0.026	0.0240	0.0260	0.0840	0.0447	0.0341
	Pyrene	mg/kg	0.053	0.88	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Quinoline	mg/kg	-	-	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	d10-Acenaphthene	%	-	-	80	68	76	67.8	76.4	79.6	74.6	6.10
	d12-Chrysene	%	-	-	100	97	98	97.3	98.0	99.8	98.4	1.29
	d8-Naphthalene	%	-	-	80	68	76	67.9	76.4	79.8	74.7	6.13
	d10-Phenanthrene	%	-	-	87	86	86	86.0	86.3	87.1	86.5	0.569
	B(a)P Total Potency Equivalent	mg/kg	-	-	<0.020	<0.020	<0.020	<0.0200	<0.0200	<0.0200	<0.0200	-
	IACR (CCME)	mg/kg	-	-	<0.15	0.18	<0.15	<0.150	<0.150	0.180	0.160	-

Value > Lower SQG.

Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table G.3: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2018

Analyte		Units	BC Sediment Quality Guidelines		Mine-exposed									
					RG_GH-SCW3									
			Lower SQG	Upper SQG	RG_GH-SCW3-1	RG_GH-SCW3-2	RG_GH-SCW3-3	RG_GH-SCW3-4	RG_GH-SCW3-5	Minimum	Median	Maximum	Mean	Standard Deviation
					07-Sep-18	07-Sep-18	08-Sep-18	09-Sep-18	07-Sep-18					
Physical Tests	Moisture	%	-	-	43	53	47	49	47	42.7	47.4	52.8	47.8	3.67
	pH(1:2 Soil:Water)	pH	-	-	8.0	7.8	7.8	8.0	7.9	7.81	7.86	7.99	7.88	0.0823
Particle Size	% Gravel (>2 mm)	%	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00	-
	% Sand (2.00 mm - 1.00 mm)	%	-	-	1.5	<1.0	1.1	<1.0	<1.0	<1.00	<1.00	1.50	1.12	0.226
	% Sand (1.00 mm - 0.50 mm)	%	-	-	3.5	<1.0	3.9	1.6	3.4	<1.00	3.40	3.90	2.68	1.15
	% Sand (0.50 mm - 0.25 mm)	%	-	-	4.4	<1.0	5.5	4.9	7.0	<1.00	4.90	7.00	4.56	1.12
	% Sand (0.25 mm - 0.125 mm)	%	-	-	16	12	14	10	12	10.4	12.4	15.6	12.8	1.90
	% Sand (0.125 mm - 0.063 mm)	%	-	-	15	17	15	9.3	12	9.30	15.2	16.6	13.6	3.07
	% Silt (0.063 mm - 0.0312 mm)	%	-	-	24	30	27	30	27	24.3	27.1	30.3	27.7	2.41
	% Silt (0.0312 mm - 0.004 mm)	%	-	-	29	35	29	37	33	29.1	32.5	37.3	32.6	3.52
	% Clay (<4 µm)	%	-	-	6.2	5.8	4.3	6.0	5.3	4.30	5.80	6.20	5.52	0.760
	Texture	-	-	-	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	-	-	-	-	-
	Total Organic Carbon	%	-	-	6.2	5.8	5.8	5.1	8.1	5.10	5.79	8.07	6.19	1.13
Metals	Aluminum (Al)	mg/kg	-	-	7,420	7,300	8,010	6,570	6,900	6,570	7,300	8,010	7,240	546
	Antimony (Sb)	mg/kg	-	-	0.48	0.54	0.58	0.50	0.57	0.480	0.540	0.580	0.534	0.0434
	Arsenic (As)	mg/kg	5.9	17	5.3	5.5	5.9	5.8	5.1	5.12	5.45	5.86	5.50	0.324
	Barium (Ba)	mg/kg	-	-	131	125	139	114	132	114	131	139	128	9.36
	Beryllium (Be)	mg/kg	-	-	0.54	0.61	0.65	0.55	0.61	0.540	0.610	0.650	0.592	0.0460
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.200	<0.200	<0.200	<0.200	-
	Boron (B)	mg/kg	-	-	9.0	11	10	7.9	10	7.90	10.0	10.8	9.62	1.17
	Cadmium (Cd)	mg/kg	0.60	3.5	0.83	0.91	0.83	0.85	0.76	0.758	0.832	0.911	0.836	0.0549
	Calcium (Ca)	mg/kg	-	-	46,500	56,700	45,500	51,900	52,500	45,500	51,900	56,700	50,600	4,620
	Chromium (Cr)	mg/kg	37	90	16	18	17	17	16	16.3	16.6	18.3	16.9	0.832
	Cobalt (Co)	mg/kg	-	-	4.9	4.8	5.3	4.9	4.9	4.83	4.85	5.27	4.93	0.190
	Copper (Cu)	mg/kg	36	197	12	12	13	12	12	11.6	12.0	12.9	12.1	0.513
	Iron (Fe)	mg/kg	21,200	43,766	12,400	12,400	14,400	12,500	12,300	12,300	12,400	14,400	12,800	897
	Lead (Pb)	mg/kg	35	91	7.4	7.8	9.2	7.5	8.6	7.40	7.76	9.19	8.09	0.763
	Lithium (Li)	mg/kg	-	-	10	12	13	10	12	10.4	11.5	12.9	11.4	1.04
	Magnesium (Mg)	mg/kg	-	-	12,500	14,000	11,400	13,400	12,300	11,400	12,500	14,000	12,700	1,010
	Manganese (Mn)	mg/kg	460	1,100	275	300	285	326	283	275	285	326	294	20.1
	Mercury (Hg)	mg/kg	0.17	0.49	0.036	0.039	0.035	0.037	0.037	0.0351	0.0369	0.0390	0.0368	0.00152
	Molybdenum (Mo)	mg/kg	-	-	1.2	1.3	1.5	1.3	1.4	1.20	1.30	1.48	1.32	0.111
	Nickel (Ni)	mg/kg	16	75	18	20	19	19	18	18.3	19.1	19.9	19.0	0.653
	Phosphorus (P)	mg/kg	-	-	1,200	1,280	1,310	1,340	1,300	1,200	1,300	1,340	1,290	52.7
	Potassium (K)	mg/kg	-	-	1,770	1,790	1,840	1,510	1,650	1,510	1,770	1,840	1,710	133
	Selenium (Se)	mg/kg	2.0	-	1.6	1.9	1.4	1.7	1.8	1.40	1.66	1.89	1.65	0.187
	Silver (Ag)	mg/kg	0.50	-	0.17	0.20	0.19	0.18	0.19	0.170	0.190	0.200	0.186	0.0114
	Sodium (Na)	mg/kg	-	-	102	103	98	99	95	95.0	99.0	103	99.4	3.21
	Strontium (Sr)	mg/kg	-	-	73	87	76	76	90	73.3	76.3	89.6	80.4	7.31
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
	Thallium (Tl)	mg/kg	-	-	0.19	0.22	0.22	0.19	0.20	0.187	0.204	0.216	0.203	0.0134
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.00	<2.00	<2.00	<2.00	-
	Titanium (Ti)	mg/kg	-	-	20	21	21	17	19	16.6	19.5	21.0	19.3	1.78
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500	<0.500	<0.500	<0.500	-
	Uranium (U)	mg/kg	-	-	1.0	1.3	1.1	1.1	1.1	1.00	1.10	1.26	1.11	0.0963
	Vanadium (V)	mg/kg	-	-	32	33	33	30	30	29.9	31.7	33.0	31.5	1.39
	Zinc (Zn)	mg/kg	123	315	82	83	87	87	82	82.0	83.2	87.3	84.3	2.47
	Zirconium (Zr)	mg/kg	-	-	1.1	1.3	1.1	<1.0	1.2	<1.00	1.10	1.30	1.14	0.0924
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0067	0.089	<0.023	<0.0070	<0.010	<0.0090	<0.024	<0.00700	<0.0100	<0.0240	<0.00700	-
	Acenaphthylene	mg/kg	0.0059	0.13	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acridine	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Anthracene	mg/kg	0.047	0.25	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.00400	<0.00400	<0.00400	<0.00400	-
	Benz(a)anthracene	mg/kg	0.032	0.39	0.012	<0.010	<0.010	<0.010	0.012	<0.0100	<0.0100	0.0120	0.0108	-
	Benzo(a)pyrene	mg/kg	0.032	0.78	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(b&j)fluoranthene	mg/kg	-	-	0.028	0.012	0.014	0.015	0.027	0.0120	0.0150	0.0280	0.0192	0.00766
	Benzo(e)pyrene	mg/kg	-	-	0.011	<0.010	<0.010	<0.010	<0.010	0.0110	0.0140	0.0270	0.0182	0.00766
	Benzo(g,h,i)perylene	mg/kg	0.17	3.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	0.0110	0.0102	-
	Benzo(k)fluoranthene	mg/kg	0.24	13	0.027	0.011	0.013	0.014	0.026	<0.0100	<0.0100	<0.0100	<0.0100	-
	Chrysene	mg/kg	0.057	0.86	0.069	0.029	0.034	0.035	0.067	0.0290	0.0350	0.0690	0.0468	0.0195
	Dibenz(a,h)anthracene	mg/kg	0.0062	0.14	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Fluoranthene	mg/kg	0.11	2.4	0.011	<0.010	<0.010	<0.010	0.011	<0.0100	<0.0100	0.0110	0.0104	-
	Fluorene	mg/kg	0.021	0.14	0.021	<0.010	<0.010	0.011	0.027	<0.0100	0.0110	0.0270	0.0158	0.00814
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.20	3.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	1-Methylnaphthalene	mg/kg	-	-	0.34	0.11	0.17	0.14	0.38	0.112	0.172	0.382	0.231	0.123
	2-Methylnaphthalene	mg/kg	0.020	0.20	0.57	0.18	0.29	0.24	0.65	0.178	0.292	0.650	0.385	0.212
	Naphthalene	mg/kg	0.035	0.39	0.15	0.054	0.078	0.069	0.18	0.0540	0.0780	0.180	0.107	0.0562
	Perylene	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Phenanthrene	mg/kg	0.042	0.52	0.24	0.090	0.12	0.11	0.24	0.0900	0.118	0.243	0.160	0.0756
	Pyrene	mg/kg	0.053	0.88	0.017	<0.010	<0.010	<0.010	0.018	<0.0100	<0.0100	0.0180	0.0130	0.000566
	Quinoline	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	d10-Acenaphthene	%	-	-	82	75	76	80	80	74.6	79.7	82.4	78.6	3.21
	d12-Chrysene	%	-	-	102	95	96	100	99	95.1	98.9	102	98.2	2.90
	d8-Naphthalene	%	-	-	84	74	76	81	79	74.4	79.1	84.2	78.9	3.88
	d10-Phenanthrene	%	-	-	91	82	87	86	86	81.5	85.9	90.5	86.1	3.21
	B(a)P Total Potency Equivalent	mg/kg	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.0200	<0.0200	<0.0200	<0.0200	-
	IACR (CCME)	mg/kg	-	-	0.30	0.16	0.18	0.18	0.30	0.160	0.180	0.300	0.224	0.0699

Value > Lower SQG.

Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table G.3: Chemistry of Sediment Samples Collected Concurrent with Biological Samples, September 2018

	Analyte	Units	BC Sediment Quality Guidelines		Mine-exposed									
					GH_ERC									
			Lower SQG	Upper SQG	GH_ERC-1	GH_ERC-2	GH_ERC-3	GH_ERC-4	GH_ERC-5	Minimum	Median	Maximum	Mean	Standard Deviation
					11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18	11-Sep-18					
Physical Tests	Moisture	%	-	-	39	39	59	56	53	38.7	52.9	59.2	49.2	9.70
	pH(1:2 Soil:Water)	pH	-	-	7.9	8.1	7.6	7.7	7.7	7.58	7.69	8.06	7.78	0.188
Particle Size	% Gravel (>2 mm)	%	-	-	6.8	1.1	<1.0	19	3.1	<1.00	3.10	18.6	6.12	7.58
	% Sand (2.00 mm - 1.00 mm)	%	-	-	3.4	<1.0	<1.0	3.4	1.0	<1.00	1.00	3.40	1.96	1.44
	% Sand (1.00 mm - 0.50 mm)	%	-	-	5.1	1.5	<1.0	2.8	1.7	<1.00	1.70	5.10	2.42	1.59
	% Sand (0.50 mm - 0.25 mm)	%	-	-	12	8.1	<1.0	2.9	5.1	<1.00	5.10	12.0	5.82	4.01
	% Sand (0.25 mm - 0.125 mm)	%	-	-	16	23	5.9	10	18	5.90	16.4	23.4	14.9	6.86
	% Sand (0.125 mm - 0.063 mm)	%	-	-	16	19	23	17	21	16.4	19.3	23.3	19.4	2.88
	% Silt (0.063 mm - 0.0312 mm)	%	-	-	17	19	32	20	21	17.2	19.7	31.9	21.9	5.78
	% Silt (0.0312 mm - 0.004 mm)	%	-	-	20	22	33	21	24	19.5	22.1	33.4	24.1	5.47
	% Clay (<4 µm)	%	-	-	3.3	4.5	4.9	3.9	4.0	3.30	4.00	4.90	4.12	0.610
	Texture	-	-	-	Sandy loam	Sandy loam	Silt loam	Sandy loam	Sandy loam	-	-	-	-	-
	Total Organic Carbon	%	-	-	2.9	3.3	7.6	4.5	4.2	2.91	4.22	7.64	4.53	1.86
Metals	Aluminum (Al)	mg/kg	-	-	6,170	8,150	5,890	6,140	6,020	5,890	6,140	8,150	6,470	943
	Antimony (Sb)	mg/kg	-	-	0.37	0.44	0.45	0.48	0.42	0.370	0.440	0.480	0.432	0.0409
	Arsenic (As)	mg/kg	5.9	17	4.4	5.2	4.8	5.2	4.7	4.40	4.77	5.22	4.85	0.356
	Barium (Ba)	mg/kg	-	-	108	123	115	119	111	108	115	123	115	6.02
	Beryllium (Be)	mg/kg	-	-	0.42	0.59	0.49	0.51	0.48	0.420	0.490	0.590	0.498	0.0614
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.200	<0.200	<0.200	<0.200	-
	Boron (B)	mg/kg	-	-	9.8	11	9.0	8.8	8.9	8.80	9.00	11.2	9.54	1.01
	Cadmium (Cd)	mg/kg	0.60	3.5	0.63	0.67	0.89	0.79	0.66	0.625	0.666	0.888	0.726	0.110
	Calcium (Ca)	mg/kg	-	-	86,100	52,400	49,500	57,300	64,600	49,500	57,300	86,100	62,000	14,600
	Chromium (Cr)	mg/kg	37	90	15	20	16	16	15	15.3	15.7	19.9	16.5	1.95
	Cobalt (Co)	mg/kg	-	-	3.3	4.0	3.9	4.2	3.8	3.26	3.92	4.23	3.84	0.365
	Copper (Cu)	mg/kg	36	197	7.0	10	11	10	8.4	7.01	10.3	10.8	9.38	1.62
	Iron (Fe)	mg/kg	21,200	43,766	9,940	12,200	10,600	11,400	10,400	9,940	10,600	12,200	10,900	895
	Lead (Pb)	mg/kg	35	91	4.8	6.1	6.0	6.3	5.8	4.75	6.04	6.26	5.78	0.602
	Lithium (Li)	mg/kg	-	-	8.8	11	9.1	10	9.3	8.80	9.30	11.1	9.68	0.928
	Magnesium (Mg)	mg/kg	-	-	14,000	15,300	12,500	13,700	12,500	12,500	13,700	15,300	13,600	1,170
	Manganese (Mn)	mg/kg	460	1,100	351	324	358	452	437	324	358	452	384	56.6
	Mercury (Hg)	mg/kg	0.17	0.49	0.020	0.026	0.036	0.033	0.023	0.0197	0.0261	0.0360	0.0276	0.00671
	Molybdenum (Mo)	mg/kg	-	-	1.1	1.2	1.1	1.3	1.2	1.11	1.16	1.34	1.18	0.0913
	Nickel (Ni)	mg/kg	16	75	13	17	17	17	15	13.4	16.7	17.1	15.8	1.67
	Phosphorus (P)	mg/kg	-	-	1,230	1,240	1,030	1,140	1,080	1,030	1,140	1,240	1,140	91.8
	Potassium (K)	mg/kg	-	-	1,850	2,300	1,650	1,650	1,670	1,650	1,670	2,300	1,820	279
	Selenium (Se)	mg/kg	2.0	-	0.81	0.65	1.2	0.98	0.63	0.630	0.810	1.15	0.844	0.222
	Silver (Ag)	mg/kg	0.50	-	0.11	0.14	0.17	0.15	0.12	0.110	0.140	0.170	0.138	0.0239
	Sodium (Na)	mg/kg	-	-	104	93	75	79	81	75.0	81.0	104	86.4	11.9
	Strontium (Sr)	mg/kg	-	-	108	73	78	82	85	72.9	81.9	108	85.1	13.5
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	-
	Thallium (Tl)	mg/kg	-	-	0.18	0.22	0.21	0.20	0.20	0.176	0.203	0.224	0.201	0.0174
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.00	<2.00	<2.00	<2.00	-
	Titanium (Ti)	mg/kg	-	-	21	24	22	22	19	19.0	21.7	24.4	21.7	1.94
	Tungsten (W)	mg/kg	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.500	<0.500	<0.500	<0.500	-
	Uranium (U)	mg/kg	-	-	1.1	0.96	1.1	1.0	0.96	0.959	1.00	1.09	1.01	0.0583
	Vanadium (V)	mg/kg	-	-	29	37	29	29	28	27.7	29.0	36.7	30.2	3.67
	Zinc (Zn)	mg/kg	123	315	58	74	71	72	63	58.3	71.2	73.5	67.5	6.51
	Zirconium (Zr)	mg/kg	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00	-
Polycyclic Aromatic Hydrocarbons	Acenaphthene	mg/kg	0.0067	0.089	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acenaphthylene	mg/kg	0.0059	0.13	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Acridine	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Anthracene	mg/kg	0.047	0.25	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.00400	<0.00400	<0.00400	<0.00400	-
	Benz(a)anthracene	mg/kg	0.032	0.39	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(a)pyrene	mg/kg	0.032	0.78	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(b&j)fluoranthene	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(e)pyrene	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(g,h,i)perylene	mg/kg	0.17	3.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Benzo(k)fluoranthene	mg/kg	0.24	13	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Chrysene	mg/kg	0.057	0.86	0.016	0.010	0.020	0.022	0.020	0.0100	0.0200	0.0220	0.0176	0.00477
	Dibenz(a,h)anthracene	mg/kg	0.0062	0.14	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.00500	<0.00500	<0.00500	<0.00500	-
	Fluoranthene	mg/kg	0.11	2.4	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Fluorene	mg/kg	0.021	0.14	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.20	3.2	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	1-Methylnaphthalene	mg/kg	-	-	0.045	0.038	0.045	0.060	0.061	0.0380	0.0450	0.0610	0.0498	0.0102
	2-Methylnaphthalene	mg/kg	0.020	0.20	0.071	0.050	0.056	0.085	0.092	0.0500	0.0710	0.0920	0.0708	0.0180
	Naphthalene	mg/kg	0.035	0.39	0.022	0.025	0.024	0.028	0.030	0.0220	0.0250	0.0300	0.0258	0.00319
	Perylene	mg/kg	-	-	<0.010	<0.010	0.017	0.011	<0.010	<0.0100	<0.0100	0.0170	0.0116	0.00339
	Phenanthrene	mg/kg	0.042	0.52	0.047	0.038	0.056	0.065	0.060	0.0380	0.0560	0.0650	0.0532	0.0108
	Pyrene	mg/kg	0.053	0.88	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	Quinoline	mg/kg	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0100	<0.0100	<0.0100	<0.0100	-
	d10-Acenaphthene	%	-	-	80	81	84	80	85	79.8	81.4	84.6	81.9	2.11
	d12-Chrysene	%	-	-	90	92	97	96	95	90.2	94.6	97.0	93.9	2.70
	d8-Naphthalene	%	-	-	82	84	85	80	88	80.4	84.3	88.3	84.0	3.04
	d10-Phenanthrene	%	-	-	87	88	93	90	92	87.1	90.0	93.0	89.9	2.59
	B(a)P Total Potency Equivalent	mg/kg	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.0200	<0.0200	<0.0200	<0.0200	-
	IACR (CCME)	mg/kg	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.150	<0.150	<0.150	<0.150	-

Value > Lower SQG.

Value > Upper SQG.

Notes: All summary stats calculated to 3 significant figures.

Table G.4: Field Duplicate (Split Sample) Results for Sediment Chemistry Samples Results Summary (ALS Lab Work Order #L2163882)

Client Sample ID	Lowest Reporting Limit	Units	RG_ELUGH1_SE_ 20180911-1410	RG_DUP_SE_ 20180911-1410	RPD (%)	RG_EL20-1_SE_ 20180911-0930	RG_DUP_SE_ 20180911-0930	RPD (%)
Date Sampled			11-Sep-2018	11-Sep-2018		11-Sep-2018	11-Sep-2018	
Time Sampled			14:10	14:10		9:30	9:30	
ALS Sample ID			L2163882-1	L2163882-4		L2163882-8	L2163882-13	
Parameter			Soil	Soil		Soil	Soil	
Physical Tests (Soil)								
Moisture	0.25	%	37.2	38.5	3	39.1	34.9	11
pH (1:2 soil:water)	0.10	pH	7.96	7.93	0	7.86	7.78	1
Particle Size (Soil)								
% Gravel (>2mm)	1.0	%	<1.0	<1.0	0	6.8	5.3	25
% Sand (2.00mm - 1.00mm)	1.0	%	<1.0	<1.0	0	3.4	3.4	0
% Sand (1.00mm - 0.50mm)	1.0	%	1.4	1.6	13	5.1	6.1	18
% Sand (0.50mm - 0.25mm)	1.0	%	26.2	28.3	8	12.0	12.6	5
% Sand (0.25mm - 0.125mm)	1.0	%	27.7	28.9	4	16.4	17.6	7
% Sand (0.125mm - 0.063mm)	1.0	%	18.1	16.5	9	16.4	14.3	14
% Silt (0.063mm - 0.0312mm)	1.0	%	12.4	11.8	5	17.2	17.2	0
% Silt (0.0312mm - 0.004mm)	1.0	%	12.2	10.7	13	19.5	20.0	3
% Clay (<4um)	1.0	%	2.2	2.1	5	3.3	3.6	9
Texture		-	Loamy sand	Loamy sand		Sandy loam	Sandy loam	
Organic / Inorganic Carbon (Soil)								
Total Organic Carbon	0.050	%	2.15	2.1		2.91	2.99	
Metals (Soil)								
Aluminum (Al)	50	mg/kg	6420	5000	25	6170	5470	12
Antimony (Sb)	0.10	mg/kg	0.47	0.46	2	0.37	0.38	3
Arsenic (As)	0.10	mg/kg	5.00	4.76	5	4.40	4.44	1
Barium (Ba)	0.50	mg/kg	109	106	3	108	103	5
Beryllium (Be)	0.10	mg/kg	0.51	0.44	15	0.42	0.44	5
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	0	<0.20	<0.20	0
Boron (B)	5.0	mg/kg	10.2	7.0	37	9.8	8.8	11
Cadmium (Cd)	0.020	mg/kg	0.589	0.584	1	0.625	0.582	7
Calcium (Ca)	50	mg/kg	81000	74000	9	86100	74800	14
Chromium (Cr)	0.50	mg/kg	15.8	13.1	19	15.3	14.1	8
Cobalt (Co)	0.10	mg/kg	3.58	3.49	3	3.26	3.41	4
Copper (Cu)	0.50	mg/kg	7.62	7.49	2	7.01	7.30	4
Iron (Fe)	50	mg/kg	11000	10500	5	9940	9720	2
Lead (Pb)	0.50	mg/kg	5.69	5.26	8	4.75	5.16	8
Lithium (Li)	2.0	mg/kg	9.6	8.4	13	8.8	8.7	1
Magnesium (Mg)	20	mg/kg	14100	13300	6	14000	13700	2
Manganese (Mn)	1.0	mg/kg	342	336	2	351	366	4
Mercury (Hg)	0.0050	mg/kg	0.0222	0.0231	4	0.0197	0.0183	7
Molybdenum (Mo)	0.10	mg/kg	1.20	1.15	4	1.11	1.13	2
Nickel (Ni)	0.50	mg/kg	14.3	13.7	4	13.4	13.8	3
Phosphorus (P)	50	mg/kg	1290	1180	9	1230	1140	8
Potassium (K)	100	mg/kg	1880	1390	30	1850	1560	17
Selenium (Se)	0.20	mg/kg	0.58	0.60	3	0.81	0.84	4
Silver (Ag)	0.10	mg/kg	0.11	0.11	0	0.11	0.11	0
Sodium (Na)	50	mg/kg	95	89	7	104	85	20
Strontium (Sr)	0.50	mg/kg	109	100	9	108	94.7	13
Sulfur (S)	1000	mg/kg	<1000	<1000	0	<1000	<1000	0
Thallium (Tl)	0.050	mg/kg	0.180	0.151	18	0.176	0.173	2
Tin (Sn)	2.0	mg/kg	<2.0	<2.0	0	<2.0	<2.0	0
Titanium (Ti)	1.0	mg/kg	15.4	16.7	8	21.3	19.0	11
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	0	<0.50	<0.50	0
Uranium (U)	0.050	mg/kg	1.07	0.965	10	1.06	0.961	10
Vanadium (V)	0.20	mg/kg	32.0	26.7	18	29.0	26.1	11
Zinc (Zn)	2.0	mg/kg	67.9	66.3	2	58.3	59.5	2
Zirconium (Zr)	1.0	mg/kg	<1.0	<1.0	0	<1.0	<1.0	0
Polycyclic Aromatic Hydrocarbons (Soil)								
Acenaphthene	0.0050	mg/kg	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Acenaphthylene	0.0050	mg/kg	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Acridine	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Anthracene	0.0040	mg/kg	<0.0040	<0.0040	0	<0.0040	<0.0040	0
Benz(a)anthracene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Benzo(a)pyrene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Benzo(b&j)fluoranthene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Benzo(e)pyrene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Benzo(g,h,i)perylene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Benzo(k)fluoranthene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Chrysene	0.010	mg/kg	0.010	0.013	26	0.016	0.023	36
Dibenz(a,h)anthracene	0.0050	mg/kg	<0.0050	<0.0050	0	<0.0050	<0.0050	0
Fluoranthene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Fluorene	0.010	mg/kg	<0.010	<0.010	0	<0.010	0.010	0
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
1-Methylnaphthalene	0.010	mg/kg	0.014	0.020	35	0.045	0.065	36
2-Methylnaphthalene	0.010	mg/kg	0.020	0.024	18	0.071	0.103	37
Naphthalene	0.010	mg/kg	<0.010	0.010	0	0.022	0.035	46
Perylene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Phenanthrene	0.010	mg/kg	0.024	0.028	15	0.047	0.066	34
Pyrene	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
Quinoline	0.010	mg/kg	<0.010	<0.010	0	<0.010	<0.010	0
d10-Acenaphthene	-	%	79.6	77.6	3	80.2	82.4	3
d12-Chrysene	-	%	99.8	99.1	1	90.2	94	4
d8-Naphthalene	-	%	79.8	78.5	2	82	84.3	3
d10-Phenanthrene	-	%	87.1	86.2	1	87.1	90.1	3
B(a)P Total Potency Equivalent	0.020	mg/kg	<0.020	<0.020	0	<0.020	<0.020	0
IACR (CCME)	0.15	mg/kg	<0.15	<0.15	0	<0.15	<0.15	0

Relative Percent Difference (RDP) greater than 40%.

Note: For calculation of the RPD, method detection limit (MDL) values were used in cases where the reported value was below the MDL.

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

GH_ER2 / ELUGH (1)					GH_ER2 / ELUGH (2)					GH_ER2 / ELUGH (3)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	14.4	-	1	0	0	10.6	-	1	0	0	8.4	-
2	0	0	12.0	-	2	0	0	11.2	-	2	0	0	7.2	-
3	0	0	15.2	-	3	0	0	7.0	-	3	0	0	9.6	-
4	0	0	9.8	-	4	0	0	13.3	-	4	0	0	14.1	-
5	0	0	10.3	-	5	0	0	10.6	-	5	0	0	17.2	-
6	0	0	13.4	-	6	0	0	5.9	-	6	0	0	7.0	-
7	0	0	12.9	-	7	0	0	7.4	-	7	0	0	5.6	-
8	0	0	7.3	-	8	0	0	11.7	-	8	0	0	4.3	-
9	0	0	10.5	-	9	0	0	13.4	-	9	0	0	5.6	-
10	0	0	11.2	0.5	10	0	0	6.1	0	10	0	0	8.4	0.25
11	0	0	8.8	-	11	0	0	9.4	-	11	0	0	7.0	-
12	0	0	9.9	-	12	0	0	7.2	-	12	0	0	13.1	-
13	0	0	7.8	-	13	0	0	14.7	-	13	0	0	12.0	-
14	0	0	10.2	-	14	0	0	9.9	-	14	0	0	6.3	-
15	0	0	14.4	-	15	0	0	15.8	-	15	0	0	5.7	-
16	0	0	12.4	-	16	0	0	13.6	-	16	0	0	3.7	-
17	0	0	10.7	-	17	0	0	4.6	-	17	0	0	7.1	-
18	0	0	9.8	-	18	0	0	4.2	-	18	0	0	8.6	-
19	0	0	12.2	-	19	0	0	12.6	-	19	0	0	8.4	-
20	0	0	15.0	0.25	20	0	0	21.3	0.5	20	0	0	7.5	0
21	0	0	9.4	-	21	0	0	4.7	-	21	0	0	7.2	-
22	0	0	10.2	-	22	0	0	18.1	-	22	0	0	6.6	-
23	0	0	11.7	-	23	0	0	9.9	-	23	0	0	5.9	-
24	0	0	12.3	-	24	0	0	10.8	-	24	0	0	6.6	-
25	0	0	15.1	-	25	0	0	8.8	-	25	0	0	5.0	-
26	0	0	16.1	-	26	0	0	2.5	-	26	0	0	5.1	-
27	0	0	13.4	-	27	0	0	12.9	-	27	0	0	6.2	-
28	0	0	9.2	-	28	0	0	8.8	-	28	0	0	7.4	-
29	0	0	13.1	-	29	0	0	13.1	-	29	0	0	5.5	-
30	0	0	10.7	0	30	0	0	8.9	0	30	0	0	17.6	0
31	0	0	18.0	-	31	0	0	5.4	-	31	0	0	5.4	-
32	0	0	10.9	-	32	0	0	2.9	-	32	0	0	6.6	-
33	0	0	7.8	-	33	0	0	15.6	-	33	0	0	8.6	-
34	0	0	11.8	-	34	0	0	7.1	-	34	0	0	9.8	-
35	0	0	7.8	-	35	0	0	10.3	-	35	0	0	7.2	-
36	0	0	14.0	-	36	0	0	17.1	-	36	0	0	18.3	-
37	0	0	5.0	-	37	0	0	5.3	-	37	0	0	13.1	-
38	0	0	21.0	-	38	0	0	10.4	-	38	0	0	7.3	-
39	0	0	4.9	-	39	0	0	9.4	-	39	0	0	4.8	-
40	0	0	14.3	0.25	40	0	0	7.9	0.25	40	0	0	6.0	0
41	0	0	14.8	-	41	0	0	15.8	-	41	0	0	5.5	-
42	0	0	5.0	-	42	0	0	15.2	-	42	0	0	7.5	-
43	0	0	7.8	-	43	0	0	5.6	-	43	0	0	9.5	-
44	0	0	8.1	-	44	0	0	8.6	-	44	0	0	7.6	-
45	0	0	5.3	-	45	0	0	10.8	-	45	0	0	4.8	-
46	0	0	6.5	-	46	0	0	13.1	-	46	0	0	9.6	-
47	0	0	8.4	-	47	0	0	11.7	-	47	0	0	8.0	-
48	0	0	9.6	-	48	0	0	13.8	-	48	0	0	16.2	-
49	0	0	9.3	-	49	0	0	10.6	-	49	0	0	6.0	-
50	0	0	5.4	0	50	0	0	5.0	0	50	0	0	5.1	0
51	0	0	3.3	-	51	0	0	8.9	-	51	0	0	5.4	-
52	0	0	8.2	-	52	0	0	14.6	-	52	0	0	3.7	-
53	0	0	8.8	-	53	0	0	11.7	-	53	0	0	4.0	-
54	0	0	18.7	-	54	0	0	4.3	-	54	0	0	7.0	-
55	0	0	15.9	-	55	0	0	6.6	-	55	0	0	2.8	-
56	0	0	12.8	-	56	0	0	5.2	-	56	0	0	6.0	-
57	0	0	10.7	-	57	0	0	4.8	-	57	0	0	7.5	-
58	0	0	18.7	-	58	0	0	3.2	-	58	0	0	7.0	-
59	0	0	11.8	-	59	0	0	11.5	-	59	0	0	7.0	-
60	0	0	13.4	0.5	60	0	0	10.1	0.5	60	0	0	8.1	0
61	0	0	12.2	-	61	0	0	10.4	-	61	0	0	10.9	-
62	0	0	2.7	-	62	0	0	11.9	-	62	0	0	5.0	-
63	0	0	8.6	-	63	0	0	5.6	-	63	0	0	3.1	-
64	0	0	9.6	-	64	0	0	13.2	-	64	0	0	4.8	-
65	0	0	11.3	-	65	0	0	15.8	-	65	0	0	8.6	-
66	0	0	14.3	-	66	0	0	9.8	-	66	0	0	3.3	-
67	0	0	13.1	-	67	0	0	12.2	-	67	0	0	15.6	-
68	0	0	9.4	-	68	0	0	9.6	-	68	0	0	10.2	-
69	0	0	12.6	-	69	0	0	9.8	-	69	0	0	6.4	-
70	0	0	18.9	0.25	70	0	0	5.2	0.5	70	0	0	4.6	0
71	0	0	11.4	-	71	0	0	10.2	-	71	0	0	4.6	-
72	0	0	16.6	-	72	0	0	12.4	-	72	0	0	4.5	-
73	0	0	7.4	-	73	0	0	10.5	-	73	0	0	9.5	-
74	0	0	6.9	-	74	0	0	12.6	-	74	0	0	5.0	-
75	0	0	17.2	-	75	0	0	10.1	-	75	0	0	8.0	-
76	0	0	12.0	-	76	0	0	7.7	-	76	0	0	2.6	-
77	0	0	11.1	-	77	0	0	9.2	-	77	0	0	6.0	-
78	0	0	12.6	-	78	0	0	14.3	-	78	0	0	12.2	-
79	0	0	4.3	-	79	0	0	8.7	-	79	0	0	13.6	-
80	0	0	8.4	0	80	0	0	9.2	0.75	80	0	0	4.0	0
81	0	0	9.0	-	81	0	0	6.2	-	81	0	0	8.5	-
82	0	0	9.0	-	82	0	0	5.2	-	82	0	0	3.5	-
83	0	0	7.6	-	83	0	0	7.2	-	83	0	0	5.6	-
84	0	0	11.6	-	84	0	0	9.1	-	84	0	0	5.4	-
85	0	0	10.2	-	85	0	0	9.1	-	85	0	0	7.8	-
86	0	0	12.0	-	86	0	0	13.7	-	86	0	0	5.4	-
87	0	0	13.0	-	87	0	0	12.2	-	87	0	0	4.6	-
88	0	0	7.6	-	88	0	0	13.0	-	88	0	0	4.4	-
89	0	0	10.3	-	89	0	0	14.1	-	89	0	0	4.4	-
90	0	0	11.8	0	90	0	0	8.1	0.5	90	0	0	3.1	0
91	0	0	6.8	-	91	0	0	18.1	-	91	0	0	10.4	-
92	0	0	11.9	-	92	0	0	8.4	-	92	0	0	9.1	-
93	0	0	7.8	-	93	0	0	8.6	-	93	0	0	4.6	-
94	0	0	12.8	-	94	0	0	11.8	-	94	0	0	10.4	-
95	0	0	5.8	-	95	0	0	13.2	-	95	0	0	7.7	-
96	0	0	9.0	-	96	0	0	9.0	-	96	0	0	5.9	-
97	0	0	12.9	-	97	0	0	9.3	-	97	0	0	7.6	-
98	0	0	14.7	-	98	0	0	10.9	-	98	0	0	4.2	-
99	0	0	7.1	-	99	0	0	8.5	-	99	0	0	4.0	-
100	0	0	8.2	0.25	100	0	0	9.4	0	100	0	0	7.4	0
Minimum	**0.0**	**0.0**	**2.7**	**0**	**Minimum**	**0.0**	**0.0**	**2.5**	**0**	**Minimum**	**0.0**	**0.0**	**2.6**	**0**
Maximum	**0.0**	**0.0**	**21.0**	**0.5**	**Maximum**	**0.0**	**0.0**	**21.3**	**0.75**	**Maximum**	**0.0**	**0.0**	**18.3**	**0.25**
Mean	**0.0**	**0.0**	**10.9**	**0.2**	**Mean**	**0.0**	**0.0**	**10.1**	**0.3**	**Mean**	**0.0**	**0.0**	**7.3**	**0.0**
Standard dev.	**0.0**	**0.0**	**3.6**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**3.7**	**0.3**	**Standard dev.**	**0.0**	**0.0**	**3.3**	**0.1**
Geometric mean	**-**	**-**	**10.2**	**-**	**Geometric mean**	**-**	**-**	**9.3**	**-**	**Geometric mean**	**-**	**-**	**6.7**	**-**
Median	**0.0**	**0.0**	**10.7**	**0**	**Median**	**0.0**	**0.0**	**9.9**	**0**	**Median**	**0.0**	**0.0**	**6.8**	**0**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

ERSC4 (1)					ERSC4 (2)					ERSC4 (3)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	2.5	-	1	0	0	1.5	-	1	0	0	8.5	-
2	0	0	2.6	-	2	0	0	4.6	-	2	0	0	5.4	-
3	0	0	3.4	-	3	0	0	2.7	-	3	0	0	3.6	-
4	0	0	3.4	-	4	0	0	1.9	-	4	0	0	2.0	-
5	0	0	3.6	-	5	0	0	2.2	-	5	0	0	3.3	-
6	0	0	2.9	-	6	0	0	2.3	-	6	0	0	3.2	-
7	0	0	sand	-	7	0	0	2.6	-	7	0	0	5.2	-
8	0	0	sand	-	8	0	0	2.6	-	8	0	0	3.8	-
9	0	0	2.1	-	9	0	0	5.8	-	9	0	0	2.9	-
10	0	0	1.9	0.5	10	0	0	4.4	0.5	10	0	0	4.5	0.25
11	0	0	1.5	-	11	0	0	3.7	-	11	0	0	8.5	-
12	0	0	2.1	-	12	0	0	3.8	-	12	0	0	3.1	-
13	0	0	2.4	-	13	0	0	2.9	-	13	0	0	3.5	-
14	0	0	2.1	-	14	0	0	4.9	-	14	0	0	3.0	-
15	0	0	2.9	-	15	0	0	3.5	-	15	0	0	6.0	-
16	0	0	2.4	-	16	0	0	4.5	-	16	0	0	3.5	-
17	0	0	2.1	-	17	0	0	4.5	-	17	0	0	1.5	-
18	0	0	3.1	-	18	0	0	2.6	-	18	0	0	3.1	-
19	0	0	1.8	-	19	0	0	4.8	-	19	0	0	7.7	-
20	0	0	sand		20	0	0	2.3	0.5	20	0	0	6.8	0.25
21	0	0	1.5	0.5	21	0	0	3.5	-	21	0	0	6.1	-
22	0	0	sand	-	22	0	0	4.4	-	22	0	0	3.5	-
23	0	0	2.8	-	23	0	0	3.2	-	23	0	0	4.4	-
24	0	0	1.7	-	24	0	0	2.9	-	24	0	0	3.8	-
25	0	0	2.2	-	25	0	0	5.3	-	25	0	0	3.9	-
26	0	0	1.8	-	26	0	0	2.8	-	26	0	0	6.4	-
27	0	0	1.7	-	27	0	0	3.4	-	27	0	0	2.2	-
28	0	0	sand	-	28	0	0	4.0	-	28	0	0	4.2	-
29	0	0	2.2	-	29	0	0	2.8	-	29	0	0	2.4	-
30	0	0	sand		30	0	0	7.7	0.5	30	0	0	4.6	0.25
31	0	0	2.2	0.25	31	0	0	3.5	-	31	0	0	5.3	-
32	0	0	3.4	-	32	0	0	4.1	-	32	0	0	1.9	-
33	0	0	1.5	-	33	0	0	3.2	-	33	0	0	3.9	-
34	0	0	3.6	-	34	0	0	3.8	-	34	0	0	4.3	-
35	0	0	3.6	-	35	0	0	1.5	-	35	0	0	3.2	-
36	0	0	2.9	-	36	0	0	4.6	-	36	0	0	2.1	-
37	0	0	2.8	-	37	0	0	3.4	-	37	0	0	4.4	-
38	0	0	2.4	-	38	0	0	2.7	-	38	0	0	7.9	-
39	0	0	3.6	-	39	0	0	4.6	-	39	0	0	6.2	-
40	0	0	3.2	0.5	40	0	0	3.4	0.5	40	0	0	4.2	0.5
41	0	0	1.9	-	41	0	0	3.9	-	41	0	0	4.6	-
42	0	0	3.8	-	42	0	0	4.3	-	42	0	0	3.4	-
43	0	0	2.8	-	43	0	0	5.2	-	43	0	0	5.8	-
44	0	0	2.5	-	44	0	0	4.6	-	44	0	0	6.3	-
45	0	0	2.4	-	45	0	0	6.2	-	45	0	0	3.5	-
46	0	0	2.4	-	46	0	0	4.8	-	46	0	0	gravel	-
47	0	0	2.1	-	47	0	0	sand/grave	-	47	0	0	1.9	-
48	0	0	3.5	-	48	0	0	5.4	-	48	0	0	5.6	-
49	0	0	3.8	-	49	0	0	5.2	-	49	0	0	2.4	-
50	0	0	2.7	0.25	50	0	0	2.5	0.25	50	0	0	4.5	0.25
51	0	0	2.8	-	51	0	0	2.8	-	51	0	0	2.2	-
52	0	0	2.7	-	52	0	0	sand/grave	-	52	0	0	4.5	-
53	0	0	2.3	-	53	0	0	2.9	-	53	0	0	3.1	-
54	0	0	1.4	-	54	0	0	8.3	-	54	0	0	1.6	-
55	0	0	2.1	-	55	0	0	4.8	-	55	0	0	4.8	-
56	0	0	sand	-	56	0	0	2.6	-	56	0	0	1.9	-
57	0	0	1.6	-	57	0	0	3.1	-	57	0	0	3.7	-
58	0	0	1.7	-	58	0	0	2.8	-	58	0	0	2.8	-
59	0	0	2.5	-	59	0	0	5.4	-	59	0	0	2.8	-
60	0	0	2.3	0.25	60	0	0	3.0	0.5	60	0	0	2.9	0.5
61	0	0	sand	-	61	0	0	4.2	-	61	0	0	4.3	-
62	0	0	1.7	-	62	0	0	4.4	-	62	0	0	5.7	-
63	0	0	2.8	-	63	0	0	4.3	-	63	0	0	3.5	-
64	0	0	2.6	-	64	0	0	5.1	-	64	0	0	6.4	-
65	0	0	1.0	-	65	0	0	3.1	-	65	0	0	7.4	-
66	0	0	2.5	-	66	0	0	6.3	-	66	0	0	6.5	-
67	0	0	sand	-	67	0	0	5.5	-	67	0	0	3.8	-
68	0	0	sand	-	68	0	0	5.5	-	68	0	0	3.7	-
69	0	0	3.4	-	69	0	0	3.2	-	69	0	0	6.2	-
70	0	0	1.7	0.25	70	0	0	4.7	0.5	70	0	0	3.7	0.5
71	0	0	2.4	-	71	0	0	3.5	-	71	0	0	5.0	-
72	0	0	sand	-	72	0	0	2.1	-	72	0	0	4.9	-
73	0	0	2.8	-	73	0	0	4.4	-	73	0	0	sand	-
74	0	0	1.7	-	74	0	0	4.1	-	74	0	0	4.1	-
75	0	0	1.6	-	75	0	0	4.7	-	75	0	0	2.8	-
76	0	0	3.2	-	76	0	0	4.7	-	76	0	0	5.9	-
77	0	0	sand	-	77	0	0	3.5	-	77	0	0	14.0	-
78	0	0	1.6	-	78	0	0	1.9	-	78	0	0	8.9	-
79	0	0	1.6	-	79	0	0	5.6	-	79	0	0	4.8	-
80	0	0	sand		80	0	0	2.1	0.5	80	0	0	3.4	0.5
81	0	0	1.3	0.25	81	0	0	5.6	-	81	0	0	3.1	-
82	0	0	1.2	-	82	0	0	2.8	-	82	0	0	gravel	-
83	0	0	sand	-	83	0	0	3.2	-	83	0	0	3.7	-
84	0	0	1.7	-	84	0	0	4.1	-	84	0	0	3.2	-
85	0	0	1.8	-	85	0	0	3.4	-	85	0	0	4.6	-
86	0	0	2.2	-	86	0	0	3.5	-	86	0	0	4.1	-
87	0	0	3.2	-	87	0	0	2.8	-	87	0	0	4.5	-
88	0	0	2.7	-	88	0	0	3.4	-	88	0	0	16.0	-
89	0	0	sand	-	89	0	0	4.1	-	89	0	0	1.6	-
90	0	0	sand	0	90	0	0	4.1	0.25	90	0	0	6.3	0.5
91	0	0	2.6	-	91	0	0	2.8	-	91	0	0	3.5	-
92	0	0	2.4	-	92	0	0	2.8	-	92	0	0	4.3	-
93	0	0	sand	-	93	0	0	3.2	-	93	0	0	7.5	-
94	0	0	2.9	-	94	0	0	5.0	-	94	0	0	4.5	-
95	0	0	2.3	-	95	0	0	5.5	-	95	0	0	sand	-
96	0	0	2.5	-	96	0	0	4.1	-	96	0	0	sand	-
97	0	0	1.8	-	97	0	0	3.0	-	97	0	0	6.1	-
98	0	0	1.5	-	98	0	0	3.1	-	98	0	0	8.5	-
99	0	0	2.2	-	99	0	0	3.5	-	99	0	0	4.5	-
100	0	0	sand	0	100	0	0	3.4	0.25	100	0	0	4.1	0.5
Minimum	**0.0**	**0.0**	**1.0**	**0**	**Minimum**	**0.0**	**0.0**	**1.5**	**0.25**	**Minimum**	**0.0**	**0.0**	**1.5**	**0.25**
Maximum	**0.0**	**0.0**	**3.8**	**0.5**	**Maximum**	**0.0**	**0.0**	**8.3**	**0.5**	**Maximum**	**0.0**	**0.0**	**16.0**	**0.5**
Mean	**0.0**	**0.0**	**2.4**	**0.3**	**Mean**	**0.0**	**0.0**	**3.8**	**0.4**	**Mean**	**0.0**	**0.0**	**4.6**	**0.4**
Standard dev.	**0.0**	**0.0**	**0.7**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**1.2**	**0.1**	**Standard dev.**	**0.0**	**0.0**	**2.3**	**0.1**
Geometric mean	**-**	**-**	**2.3**	**-**	**Geometric mean**	**-**	**-**	**3.7**	**-**	**Geometric mean**	**-**	**-**	**4.2**	**-**
Median	**0.0**	**0.0**	**2.4**	**0**	**Median**	**0.0**	**0.0**	**3.5**	**1**	**Median**	**0.0**	**0.0**	**4.2**	**1**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

ER1A (1)					ER1A (2)					ER1A (3)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	3.1	-	1	0	0	6.8	-	1	0	0	12.0	-
2	0	0	4.6	-	2	0	0	6.2	-	2	0	0	9.9	-
3	0	0	4.5	-	3	0	0	6.4	-	3	0	0	6.4	-
4	0	0	5.3	-	4	0	0	5.8	-	4	0	0	9.1	-
5	0	0	6.2	-	5	0	0	4.7	-	5	0	0	7.2	-
6	0	0	7.0	-	6	0	0	10.4	-	6	0	0	7.0	-
7	0	0	3.0	-	7	0	0	6.5	-	7	0	0	3.4	-
8	0	0	3.0	-	8	0	0	5.2	-	8	0	0	4.8	-
9	0	0	5.5	-	9	0	0	13.0	-	9	0	0	6.8	-
10	0	0	5.8	0.25	10	0	0	11.3	0.25	10	0	0	7.9	0.25
11	0	0	5.8	-	11	0	0	5.5	-	11	0	0	4.4	-
12	0	0	5.0	-	12	0	0	4.2	-	12	0	0	6.8	-
13	0	0	sand	-	13	0	0	3.4	-	13	0	0	4.6	-
14	0	0	3.7	-	14	0	0	6.4	-	14	0	0	3.4	-
15	0	0	5.5	-	15	0	0	10.6	-	15	0	0	9.2	-
16	0	0	4.1	-	16	0	0	5.6	-	16	0	0	5.3	-
17	0	0	6.2	-	17	0	0	6.4	-	17	0	0	3.8	-
18	0	0	4.6	-	18	0	0	5.8	-	18	0	0	7.6	-
19	0	0	3.3	-	19	0	0	5.7	-	19	0	0	10.6	-
20	0	0	3.1	0.5	20	0	0	5.4	0.25	20	0	0	6.4	0.25
21	0	0	8.4	-	21	0	0	4.6	-	21	0	0	4.1	-
22	0	0	4.0	-	22	0	0	7.3	-	22	0	0	7.8	-
23	0	0	6.2	-	23	0	0	14.5	-	23	0	0	6.2	-
24	0	0	5.3	-	24	0	0	7.0	-	24	0	0	5.5	-
25	0	0	8.1	-	25	0	0	8.5	-	25	0	0	7.4	-
26	0	0	5.4	-	26	0	0	4.2	-	26	0	0	10.6	-
27	0	0	2.5	-	27	0	0	5.7	-	27	0	0	7.6	-
28	0	0	6.6	-	28	0	0	9.1	-	28	0	0	5.4	-
29	0	0	5.5	-	29	0	0	5.6	-	29	0	0	4.3	-
30	0	0	9.3	0.25	30	0	0	5.5	0.25	30	0	0	3.4	0.25
31	0	0	5.4	-	31	0	0	12.5	-	31	0	0	7.8	-
32	0	0	6.5	-	32	0	0	10.6	-	32	0	0	5.6	-
33	0	0	5.9	-	33	0	0	14.4	-	33	0	0	7.0	-
34	0	0	6.5	-	34	0	0	5.3	-	34	0	0	9.0	-
35	0	0	7.4	-	35	0	0	8.0	-	35	0	0	8.2	-
36	0	0	3.8	-	36	0	0	6.4	-	36	0	0	4.6	-
37	0	0	4.8	-	37	0	0	11.0	-	37	0	0	4.3	-
38	0	0	5.1	-	38	0	0	5.5	-	38	0	0	6.3	-
39	0	0	5.2	-	39	0	0	5.1	-	39	0	0	7.5	-
40	0	0	8.4	0.5	40	0	0	6.3	0.25	40	0	0	3.7	0.25
41	0	0	9.8	-	41	0	0	5.4	-	41	0	0	5.3	-
42	0	0	4.5	-	42	0	0	3.3	-	42	0	0	3.5	-
43	0	0	9.2	-	43	0	0	8.9	-	43	0	0	5.9	-
44	0	0	7.0	-	44	0	0	7.2	-	44	0	0	8.2	-
45	0	0	5.1	-	45	0	0	6.5	-	45	0	0	5.3	-
46	0	0	5.4	-	46	0	0	4.4	-	46	0	0	4.7	-
47	0	0	4.6	-	47	0	0	5.5	-	47	0	0	4.4	-
48	0	0	5.1	-	48	0	0	8.2	-	48	0	0	2.3	-
49	0	0	4.0	-	49	0	0	9.1	-	49	0	0	4.5	-
50	0	0	4.4	0.25	50	0	0	5.4	0.5	50	0	0	8.4	0.25
51	0	0	5.9	-	51	0	0	6.2	-	51	0	0	4.1	-
52	0	0	9.9	-	52	0	0	4.9	-	52	0	0	9.3	-
53	0	0	5.4	-	53	0	0	7.0	-	53	0	0	6.2	-
54	0	0	4.1	-	54	0	0	4.3	-	54	0	0	7.3	-
55	0	0	3.2	-	55	0	0	5.8	-	55	0	0	3.5	-
56	0	0	6.6	-	56	0	0	5.4	-	56	0	0	8.6	-
57	0	0	2.4	-	57	0	0	6.2	-	57	0	0	sand	-
58	0	0	3.4	-	58	0	0	2.8	-	58	0	0	6.6	-
59	0	0	3.8	-	59	0	0	12.0	-	59	0	0	10.9	-
60	0	0	6.1	0.5	60	0	0	4.5	0.5	60	0	0	12.8	0.25
61	0	0	6.0	-	61	0	0	6.3	-	61	0	0	3.6	-
62	0	0	3.0	-	62	0	0	4.3	-	62	0	0	5.3	-
63	0	0	8.1	-	63	0	0	6.3	-	63	0	0	5.5	-
64	0	0	4.6	-	64	0	0	3.5	-	64	0	0	4.9	-
65	0	0	3.5	-	65	0	0	4.5	-	65	0	0	5.3	-
66	0	0	4.8	-	66	0	0	4.8	-	66	0	0	13.5	-
67	0	0	4.5	-	67	0	0	8.0	-	67	0	0	5.3	-
68	0	0	5.5	-	68	0	0	12.1	-	68	0	0	12.4	-
69	0	0	4.5	-	69	0	0	5.7	-	69	0	0	11.6	-
70	0	0	5.8	0.25	70	0	0	8.4	0.25	70	0	0	sand	
71	0	0	5.4	-	71	0	0	7.3	-	71	0	0	9.3	0.25
72	0	0	4.8	-	72	0	0	4.7	-	72	0	0	4.8	-
73	0	0	5.6	-	73	0	0	6.2	-	73	0	0	1.9	-
74	0	0	4.4	-	74	0	0	8.5	-	74	0	0	5.6	-
75	0	0	3.9	-	75	0	0	9.7	-	75	0	0	4.5	-
76	0	0	6.4	-	76	0	0	10.2	-	76	0	0	4.6	-
77	0	0	5.4	-	77	0	0	9.3	-	77	0	0	7.7	-
78	0	0	6.1	-	78	0	0	7.4	-	78	0	0	3.7	-
79	0	0	5.5	-	79	0	0	8.6	-	79	0	0	3.1	-
80	0	0	6.0	0.25	80	0	0	3.1	0.75	80	0	0	7.9	0.25
81	0	0	4.4	-	81	0	0	8.1	-	81	0	0	6.1	-
82	0	0	7.5	-	82	0	0	7.3	-	82	0	0	7.2	-
83	0	0	sand	-	83	0	0	8.1	-	83	0	0	2.6	-
84	0	0	4.3	-	84	0	0	5.5	-	84	0	0	6.4	-
85	0	0	11.0	-	85	0	0	4.6	-	85	0	0	9.3	-
86	0	0	6.5	-	86	0	0	5.1	-	86	0	0	2.9	-
87	0	0	7.8	-	87	0	0	7.6	-	87	0	0	2.9	-
88	0	0	6.8	-	88	0	0	5.7	-	88	0	0	sand	-
89	0	0	8.7	-	89	0	0	9.1	-	89	0	0	5.3	-
90	0	0	4.6	0.25	90	0	0	5.9	0.75	90	0	0	5.5	0.5
91	0	0	5.3	-	91	0	0	7.4	-	91	0	0	9.4	-
92	0	0	7.5	-	92	0	0	3.5	-	92	0	0	6.5	-
93	0	0	4.5	-	93	0	0	3.4	-	93	0	0	4.0	-
94	0	0	sand	-	94	0	0	3.8	-	94	0	0	4.4	-
95	0	0	3.5	-	95	0	0	6.4	-	95	0	0	6.1	-
96	0	0	3.1	-	96	0	0	4.9	-	96	0	0	6.8	-
97	0	0	6.2	-	97	0	0	6.6	-	97	0	0	5.5	-
98	0	0	6.3	-	98	0	0	7.4	-	98	0	0	6.3	-
99	0	0	3.5	-	99	0	0	12.5	-	99	0	0	1.9	-
100	0	0	6.5	0.25	100	0	0	9.8	0.25	100	0	0	4.9	0.25
Minimum	**0.0**	**0.0**	**2.4**	**0.25**	**Minimum**	**0.0**	**0.0**	**2.8**	**0.25**	**Minimum**	**0.0**	**0.0**	**1.9**	**0.25**
Maximum	**0.0**	**0.0**	**11.0**	**0.5**	**Maximum**	**0.0**	**0.0**	**14.5**	**0.75**	**Maximum**	**0.0**	**0.0**	**13.5**	**0.5**
Mean	**0.0**	**0.0**	**5.5**	**0.3**	**Mean**	**0.0**	**0.0**	**6.9**	**0.4**	**Mean**	**0.0**	**0.0**	**6.3**	**0.3**
Standard dev.	**0.0**	**0.0**	**1.7**	**0.1**	**Standard dev.**	**0.0**	**0.0**	**2.5**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**2.5**	**0.1**
Geometric mean	**-**	**-**	**5.2**	**-**	**Geometric mean**	**-**	**-**	**6.4**	**-**	**Geometric mean**	**-**	**-**	**5.8**	**-**
Median	**0.0**	**0.0**	**5.4**	**0**	**Median**	**0.0**	**0.0**	**6.3**	**0**	**Median**	**0.0**	**0.0**	**5.9**	**0**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

ERSC5 (1)					ERSC5 (2)					ERSC5 (3)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	3.5	-	1	0	0	7.9	-	1	0	0	5.3	-
2	0	0	3.4	-	2	0	0	4.1	-	2	0	0	5.6	-
3	0	0	5.2	-	3	0	0	8.0	-	3	0	0	4.4	-
4	0	0	5.3	-	4	0	0	3.3	-	4	0	0	3.6	-
5	0	0	3.4	-	5	0	0	9.1	-	5	0	0	3.6	-
6	0	0	5.2	-	6	0	0	5.0	-	6	0	0	9.5	-
7	0	0	6.1	-	7	0	0	5.0	-	7	0	0	5.0	-
8	0	0	3.9	-	8	0	0	6.4	-	8	0	0	4.5	-
9	0	0	2.6	-	9	0	0	8.3	-	9	0	0	4.8	-
10	0	0	4.1	0.25	10	0	0	2.6	0	10	0	0	4.7	0.25
11	0	0	7.2	-	11	0	0	4.5	-	11	0	0	5.6	-
12	0	0	8.8	-	12	0	0	6.4	-	12	0	0	8.2	-
13	0	0	7.1	-	13	0	0	3.1	-	13	0	0	4.4	-
14	0	0	3.2	-	14	0	0	6.8	-	14	0	0	5.9	-
15	0	0	4.4	-	15	0	0	4.4	-	15	0	0	6.4	-
16	0	0	5.3	-	16	0	0	4.6	-	16	0	0	3.2	-
17	0	0	3.8	-	17	0	0	5.3	-	17	0	0	7.5	-
18	0	0	3.7	-	18	0	0	3.8	-	18	0	0	9.8	-
19	0	0	5.9	-	19	0	0	3.5	-	19	0	0	9.7	-
20	0	0	5.4	0.25	20	0	0	6.6	0.25	20	0	0	5.1	0.75
21	0	0	5.4	-	21	0	0	6.3	-	21	0	0	6.6	-
22	0	0	6.5	-	22	0	0	4.7	-	22	0	0	14.0	-
23	0	0	4.3	-	23	0	0	5.9	-	23	0	0	5.7	-
24	0	0	4.6	-	24	0	0	4.2	-	24	0	0	4.8	-
25	0	0	5.0	-	25	0	0	12.5	-	25	0	0	5.5	-
26	0	0	6.3	-	26	0	0	5.1	-	26	0	0	5.4	-
27	0	0	3.9	-	27	0	0	6.2	-	27	0	0	7.7	-
28	0	0	2.2	-	28	0	0	9.4	-	28	0	0	5.0	-
29	0	0	3.9	-	29	0	0	3.6	-	29	0	0	7.4	-
30	0	0	3.5	0.5	30	0	0	6.6	0.25	30	0	0	8.1	0.5
31	0	0	4.6	-	31	0	0	4.6	-	31	0	0	8.1	-
32	0	0	3.9	-	32	0	0	5.3	-	32	0	0	sand/grave	-
33	0	0	2.7	-	33	0	0	4.6	-	33	0	0	7.1	-
34	0	0	4.0	-	34	0	0	6.9	-	34	0	0	4.8	-
35	0	0	8.0	-	35	0	0	9.0	-	35	0	0	5.5	-
36	0	0	3.1	-	36	0	0	3.8	-	36	0	0	2.4	-
37	0	0	4.0	-	37	0	0	3.2	-	37	0	0	9.2	-
38	0	0	3.5	-	38	0	0	4.1	-	38	0	0	5.7	-
39	0	0	2.5	-	39	0	0	4.0	-	39	0	0	5.7	-
40	0	0	5.1	0.5	40	0	0	6.6	0.25	40	0	0	5.6	0.25
41	0	0	2.4	-	41	0	0	2.1	-	41	0	0	9.1	-
42	0	0	2.5	-	42	0	0	4.4	-	42	0	0	4.9	-
43	0	0	3.8	-	43	0	0	4.3	-	43	0	0	5.6	-
44	0	0	4.8	-	44	0	0	5.2	-	44	0	0	6.8	-
45	0	0	3.9	-	45	0	0	3.1	-	45	0	0	6.4	-
46	0	0	5.3	-	46	0	0	4.3	-	46	0	0	4.5	-
47	0	0	3.3	-	47	0	0	5.5	-	47	0	0	8.2	-
48	0	0	4.2	-	48	0	0	7.1	-	48	0	0	6.8	-
49	0	0	10.1	-	49	0	0	3.3	-	49	0	0	5.5	-
50	0	0	10.6	0.75	50	0	0	8.1	0.75	50	0	0	5.1	0.75
51	0	0	2.7	-	51	0	0	5.5	-	51	0	0	4.3	-
52	0	0	4.7	-	52	0	0	6.2	-	52	0	0	8.2	-
53	0	0	5.4	-	53	0	0	9.5	-	53	0	0	6.3	-
54	0	0	2.7	-	54	0	0	4.4	-	54	0	0	3.3	-
55	0	0	2.6	-	55	0	0	3.0	-	55	0	0	5.2	-
56	0	0	4.4	-	56	0	0	6.2	-	56	0	0	3.2	-
57	0	0	4.4	-	57	0	0	6.6	-	57	0	0	4.4	-
58	0	0	3.2	-	58	0	0	6.4	-	58	0	0	5.6	-
59	0	0	3.3	-	59	0	0	5.3	-	59	0	0	4.6	-
60	0	0	3.6	0.5	60	0	0	6.7	0.25	60	0	0	4.5	0.5
61	0	0	4.5	-	61	0	0	5.0	-	61	0	0	1.5	-
62	0	0	5.0	-	62	0	0	2.2	-	62	0	0	3.3	-
63	0	0	3.4	-	63	0	0	5.1	-	63	0	0	9.2	-
64	0	0	2.4	-	64	0	0	4.4	-	64	0	0	7.6	-
65	0	0	12.5	-	65	0	0	4.8	-	65	0	0	5.5	-
66	0	0	11.3	-	66	0	0	4.8	-	66	0	0	3.5	-
67	0	0	2.4	-	67	0	0	3.7	-	67	0	0	4.1	-
68	0	0	5.0	-	68	0	0	5.9	-	68	0	0	5.5	-
69	0	0	3.1	-	69	0	0	6.5	-	69	0	0	3.0	-
70	0	0	3.9	0.25	70	0	0	6.5	0.25	70	0	0	4.0	0.75
71	0	0	8.0	-	71	0	0	6.0	-	71	0	0	8.6	-
72	0	0	10.9	-	72	0	0	8.5	-	72	0	0	8.5	-
73	0	0	10.9	-	73	0	0	7.1	-	73	0	0	9.5	-
74	0	0	3.6	-	74	0	0	5.2	-	74	0	0	2.6	-
75	0	0	13.4	-	75	0	0	6.0	-	75	0	0	4.8	-
76	0	0	2.3	-	76	0	0	5.5	-	76	0	0	3.9	-
77	0	0	4.4	-	77	0	0	6.8	-	77	0	0	11.0	-
78	0	0	3.4	-	78	0	0	6.0	-	78	0	0	5.2	-
79	0	0	3.5	-	79	0	0	5.5	-	79	0	0	7.9	-
80	0	0	4.3	0.25	80	0	0	2.8	0.25	80	0	0	4.3	0.25
81	0	0	1.8	-	81	0	0	2.5	-	81	0	0	4.2	-
82	0	0	3.4	-	82	0	0	3.4	-	82	0	0	5.0	-
83	0	0	2.8	-	83	0	0	8.5	-	83	0	0	6.1	-
84	0	0	4.2	-	84	0	0	3.5	-	84	0	0	6.4	-
85	0	0	4.9	-	85	0	0	3.2	-	85	0	0	4.2	-
86	0	0	2.5	-	86	0	0	4.1	-	86	0	0	3.8	-
87	0	0	4.2	-	87	0	0	5.6	-	87	0	0	5.5	-
88	0	0	3.7	-	88	0	0	4.3	-	88	0	0	6.8	-
89	0	0	4.8	-	89	0	0	5.4	-	89	0	0	5.1	-
90	0	0	4.5	0.5	90	0	0	6.9	0.25	90	0	0	3.7	0.25
91	0	0	4.8	-	91	0	0	5.3	-	91	0	0	7.1	-
92	0	0	5.3	-	92	0	0	5.8	-	92	0	0	6.5	-
93	0	0	3.5	-	93	0	0	3.2	-	93	0	0	3.3	-
94	0	0	5.6	-	94	0	0	7.7	-	94	0	0	9.3	-
95	0	0	2.7	-	95	0	0	4.7	-	95	0	0	5.4	-
96	0	0	4.7	-	96	0	0	8.9	-	96	0	0	3.5	-
97	0	0	1.8	-	97	0	0	5.2	-	97	0	0	4.3	-
98	0	0	3.3	-	98	0	0	3.9	-	98	0	0	7.5	-
99	0	0	5.4	-	99	0	0	5.0	-	99	0	0	4.4	-
100	0	0	5.3	0.25	100	0	0	8.7	0.25	100	0	0	8.5	0.5
Minimum	**0.0**	**0.0**	**1.8**	**0.25**	**Minimum**	**0.0**	**0.0**	**2.1**	**0**	**Minimum**	**0.0**	**0.0**	**1.5**	**0.25**
Maximum	**0.0**	**0.0**	**13.4**	**0.75**	**Maximum**	**0.0**	**0.0**	**12.5**	**0.75**	**Maximum**	**0.0**	**0.0**	**14.0**	**0.75**
Mean	**0.0**	**0.0**	**4.7**	**0.4**	**Mean**	**0.0**	**0.0**	**5.5**	**0.3**	**Mean**	**0.0**	**0.0**	**5.8**	**0.5**
Standard dev.	**0.0**	**0.0**	**2.3**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**1.9**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**2.1**	**0.2**
Geometric mean	**-**	**-**	**4.3**	**-**	**Geometric mean**	**-**	**-**	**5.2**	**-**	**Geometric mean**	**-**	**-**	**5.5**	**-**
Median	**0.0**	**0.0**	**4.2**	**0**	**Median**	**0.0**	**0.0**	**5.3**	**0**	**Median**	**0.0**	**0.0**	**5.5**	**1**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

GH_TC2 / THCK (1)					RG_SCDTC (1)					GH_ERC / EL20 (1)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	1	10.5	-	1	0	0	6.0	-	1	0	0	8.3	-
2	0	1	12.0	-	2	0	0	5.8	-	2	0	0	5.5	-
3	0	1	8.3	-	3	0	0	5.6	-	3	0	0	9.5	-
4	0	1	6.8	-	4	0	0	4.7	-	4	0	0	12.2	-
5	0	1	6.2	-	5	0	0	8.2	-	5	0	0	8.6	-
6	0	1	6.3	-	6	0	0	6.1	-	6	0	0	7.5	-
7	0	1	11.2	-	7	0	0	3.0	-	7	0	0	9.1	-
8	0	1	9.1	-	8	0	0	4.2	-	8	0	0	17.2	-
9	0	1	6.8	-	9	0	0	2.6	-	9	0	0	7.4	-
10	0	0	3.2	0	10	0	0	2.2	0.25	10	0	0	8.2	0
11	0	1	5.6	-	11	0	0	4.8	-	11	0	0	6.6	-
12	0	1	10.8	-	12	0	0	4.1	-	12	0	0	7.2	-
13	0	1	12.6	-	13	0	0	2.1	-	13	0	0	13.2	-
14	0	1	6.3	-	14	0	0	3.2	-	14	0	0	8.5	-
15	0	1	9.6	-	15	0	0	4.6	-	15	0	0	8.0	-
16	0	0	3.3	-	16	0	0	3.1	-	16	0	0	22.7	-
17	0	1	9.2	-	17	0	0	4.0	-	17	0	0	10.1	-
18	0	1	8.4	-	18	0	0	3.8	-	18	0	0	6.2	-
19	0	1	6.8	-	19	0	0	6.3	-	19	0	0	4.1	-
20	0	gravel	gravel	0.25	20	0	0	7.1	0.25	20	0	0	9.1	0
21	0	1	6.0	-	21	0	0	3.8	-	21	0	0	8.9	-
22	0	1	6.9	-	22	0	0	4.4	-	22	0	0	14.6	-
23	0	0	3.5	-	23	0	0	4.3	-	23	0	0	6.9	-
24	0	1	10.5	-	24	0	0	4.9	-	24	0	0	7.7	-
25	0	1	8.5	-	25	0	0	4.8	-	25	0	0	6.4	-
26	0	1	15.0	-	26	0	0	5.5	-	26	0	0	4.5	-
27	0	1	4.7	-	27	0	0	3.5	-	27	0	0	12.3	-
28	0	1	8.5	-	28	0	0	6.0	-	28	0	0	7.2	-
29	0	1	8.1	-	29	0	0	2.8	-	29	0	0	9.1	-
30	0	1	6.9	0.75	30	0	0	5.3	0.25	30	0	0	7.1	0
31	0	1	6.4	-	31	0	0	6.5	-	31	0	0	8.3	-
32	0	1	16.0	-	32	0	0	4.5	-	32	0	0	19.0	-
33	0	gravel	gravel	-	33	0	0	2.5	-	33	0	0	9.8	-
34	0	1	7.5	-	34	0	0	7.4	-	34	0	0	2.6	-
35	0	0	2.4	-	35	0	0	3.0	-	35	0	0	8.1	-
36	0	gravel	gravel	-	36	0	0	4.4	-	36	0	0	15.7	-
37	0	1	4.7	-	37	0	0	6.2	-	37	0	0	7.4	-
38	0	1	5.0	-	38	0	0	4.2	-	38	0	0	17.0	-
39	0	1	4.9	-	39	0	0	4.0	-	39	0	0	5.7	-
40	0	1	4.5	0.25	40	0	0	5.0	0.5	40	0	0	7.3	0
41	0	1	3.9	-	41	0	0	3.5	-	41	0	0	13.9	-
42	0	1	4.8	-	42	0	0	5.3	-	42	0	0	16.2	-
43	0	1	8.2	-	43	0	0	8.2	-	43	0	0	6.7	-
44	0	0	3.0	-	44	0	0	3.4	-	44	0	0	9.6	-
45	0	1	8.1	-	45	0	0	8.4	-	45	0	0	11.9	-
46	0	gravel	gravel	-	46	0	0	6.5	-	46	0	0	9.4	-
47	0	1	12.5	-	47	0	0	5.1	-	47	0	0	6.7	-
48	0	1	20.0	-	48	0	0	6.2	-	48	0	0	9.0	-
49	0	1	4.5	-	49	0	0	5.0	-	49	0	0	8.0	-
50	0	1	5.2		50	0	0	3.0	0.25	50	0	0	6.7	0
51	0	gravel	gravel	-	51	0	0	sand/grave	-	51	0	0	6.0	-
52	0	1	4.1	0.25	52	0	0	5.4	-	52	0	0	7.6	-
53	0	0	2.5	-	53	0	0	6.5	-	53	0	0	17.9	-
54	0	0	5.4	-	54	0	0	5.3	-	54	0	0	5.4	-
55	0	1	8.5	-	55	0	0	3.6	-	55	0	0	10.4	-
56	0	1	5.6	-	56	0	0	3.5	-	56	0	0	5.7	-
57	0	1	3.9	-	57	0	0	10.7	-	57	0	0	13.4	-
58	0	1	15.0	-	58	0	0	5.1	-	58	0	0	6.1	-
59	0	1	5.7	-	59	0	0	4.1	-	59	0	0	11.4	-
60	0	1	6.5	0.25	60	0	0	4.1	0.25	60	0	0	11.4	0.75
61	0	1	7.9	-	61	0	0	3.7	-	61	0	0	6.0	-
62	0	gravel	gravel	-	62	0	0	5.7	-	62	0	0	6.4	-
63	0	1	5.5	-	63	0	0	5.9	-	63	0	0	15.2	-
64	0	1	6.4	-	64	0	0	8.2	-	64	0	0	5.9	-
65	0	gravel	gravel	-	65	0	0	3.5	-	65	0	0	9.3	-
66	0	1	5.4	-	66	0	0	1.7	-	66	0	0	6.3	-
67	0	1	9.2	-	67	0	0	4.0	-	67	0	0	10.6	-
68	0	1	4.4	-	68	0	0	5.3	-	68	0	0	6.7	-
69	0	1	9.4	-	69	0	0	1.8	-	69	0	0	6.9	-
70	0	1	9.1	0.5	70	0	0	3.6	0.25	70	0	0	12.0	0.5
71	0	gravel	gravel	-	71	0	0	5.1	-	71	0	0	8.9	-
72	0	1	3.8	-	72	0	0	6.9	-	72	0	0	6.6	-
73	0	1	4.6	-	73	0	0	10.2	-	73	0	0	4.1	-
74	0	1	3.5	-	74	0	0	5.1	-	74	0	0	3.2	-
75	0	gravel	gravel	-	75	0	0	4.4	-	75	0	0	14.5	-
76	0	1	4.4	-	76	0	0	5.1	-	76	0	0	16.2	-
77	0	1	5.8	-	77	0	0	3.2	-	77	0	0	5.2	-
78	0	1	7.6	-	78	0	0	6.7	-	78	0	0	6.2	-
79	0	1	7.9	-	79	0	0	5.4	-	79	0	0	6.9	-
80	0	1	12.8	0.5	80	0	0	5.4	0.25	80	0	0	11.0	0.5
81	0	1	16.0	-	81	0	0	4.2	-	81	0	0	13.3	-
82	0	1	6.6	-	82	0	0	5.2	-	82	0	0	4.0	-
83	0	1	6.0	-	83	0	0	4.1	-	83	0	1	16.3	-
84	0	1	4.0	-	84	0	0	4.9	-	84	0	0	10.4	-
85	0	0	5.2	-	85	0	0	6.8	-	85	0	1	6.9	-
86	0	1	3.5	-	86	0	0	4.3	-	86	0	0	8.2	-
87	0	0	2.4	-	87	0	0	7.3	-	87	0	0	9.8	-
88	0	1	4.7	-	88	0	0	7.8	-	88	0	0	11.6	-
89	0	1	4.7	-	89	0	0	7.2	-	89	0	0	3.7	-
90	0	1	4.8	0	90	0	0	10.3	0.75	90	0	0	7.0	0
91	0	0	3.6	-	91	0	0	7.4	-	91	0	0	7.0	-
92	0	1	5.0	-	92	0	0	6.2	-	92	0	0	6.7	-
93	0	1	6.4	-	93	0	0	6.0	-	93	0	0	9.4	-
94	0	1	5.5	-	94	0	0	5.3	-	94	0	0	12.2	-
95	0	gravel	gravel	-	95	0	0	8.5	-	95	0	1	8.1	-
96	0	1	6.2	-	96	0	0	6.4	-	96	0	0	6.3	-
97	0	1	4.8	-	97	0	0	7.1	-	97	0	1	16.1	-
98	0	1	8.0	-	98	0	0	7.2	-	98	0	0	9.0	-
99	0	1	4.3	-	99	0	0	4.8	-	99	0	0	6.5	-
100	0	1	4.5	0.25	100	0	0	10.3	0.5	100	0	0	8.2	0.25
Minimum	**0.0**	**0.0**	**2.4**	**0**	**Minimum**	**0.0**	**0.0**	**1.7**	**0.25**	**Minimum**	**0.0**	**0.0**	**2.6**	**0**
Maximum	**0.0**	**1.0**	**20.0**	**0.75**	**Maximum**	**0.0**	**0.0**	**10.7**	**0.75**	**Maximum**	**0.0**	**1.0**	**22.7**	**0.75**
Mean	**0.0**	**0.9**	**6.9**	**0.3**	**Mean**	**0.0**	**0.0**	**5.2**	**0.4**	**Mean**	**0.0**	**0.0**	**9.2**	**0.2**
Standard dev.	**0.0**	**0.3**	**3.4**	**0.2**	**Standard dev.**	**0.0**	**0.0**	**1.9**	**0.2**	**Standard dev.**	**0.0**	**0.2**	**3.8**	**0.3**
Geometric mean	**-**	**-**	**6.3**	**-**	**Geometric mean**	**-**	**-**	**4.9**	**-**	**Geometric mean**	**-**	**-**	**8.5**	**-**
Median	**0.0**	**1.0**	**6.2**	**0**	**Median**	**0.0**	**0.0**	**5.1**	**0**	**Median**	**0.0**	**0.0**	**8.2**	**0**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

GH_ERC / EL20 (2)					GH_ERC / EL20 (3)					GH_ERC / EL20 (4)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness	Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	12.3	-	1	0	0	10.4	-	1	0	0	9.4	-
2	0	0	12.0	-	2	0	0	11.7	-	2	0	0	11.9	-
3	0	0	11.0	-	3	0	0	6.9	-	3	0	0	11.2	-
4	0	0	8.4	-	4	0	0	10.8	-	4	0	0	15.7	-
5	0	0	7.9	-	5	0	0	7.1	-	5	0	0	11.3	-
6	0	0	8.0	-	6	0	0	11.4	-	6	0	0	13.2	-
7	0	0	7.1	-	7	0	0	7.6	-	7	0	0	13.5	-
8	0	0	11.4	-	8	0	0	4.3	-	8	0	0	11.3	-
9	0	0	8.7	-	9	0	0	11.2	-	9	0	0	12.6	-
10	0	0	10.9	0	10	0	0	9.1	0.25	10	0	0	7.3	0.25
11	0	0	12.0	-	11	0	0	11.6	-	11	0	0	13.5	-
12	0	0	11.7	-	12	0	0	10.4	-	12	0	0	11.4	-
13	0	0	10.3	-	13	0	0	9.4	-	13	0	0	8.9	-
14	0	0	8.4	-	14	0	0	4.9	-	14	0	0	8.6	-
15	0	0	10.4	-	15	0	0	5.6	-	15	0	0	17.3	-
16	0	0	6.6	-	16	0	0	8.7	-	16	0	0	15.3	-
17	0	0	6.9	-	17	0	0	19.3	-	17	0	0	7.9	-
18	0	0	9.1	-	18	0	0	11.7	-	18	0	0	12.2	-
19	0	0	10.1	-	19	0	0	22.4	-	19	0	0	10.1	-
20	0	0	9.3	0.25	20	0	0	9.7	0	20	0	0	15.6	0
21	0	0	6.2	-	21	0	0	12.7	-	21	0	0	12.9	-
22	0	0	11.3	-	22	0	0	8.4	-	22	0	0	10.4	-
23	0	0	9.6	-	23	0	0	3.9	-	23	0	0	5.6	-
24	0	0	11.4	-	24	0	0	7.1	-	24	0	0	7.3	-
25	0	0	19.1	-	25	0	0	6.8	-	25	0	0	9.2	-
26	0	0	10.5	-	26	0	0	7.2	-	26	0	0	14.2	-
27	0	0	8.2	-	27	0	0	15.9	-	27	0	0	8.1	-
28	0	0	6.1	-	28	0	0	18.8	-	28	0	0	8.8	-
29	0	0	10.9	-	29	0	0	14.6	-	29	0	0	10.8	-
30	0	0	8.9	0	30	0	0	9.8	0	30	0	0	11.8	0
31	0	0	8.1	-	31	0	0	12.9	-	31	0	0	12.9	-
32	0	0	14.9	-	32	0	0	10.1	-	32	0	0	6.3	-
33	0	0	11.7	-	33	0	0	20.4	-	33	0	0	19.0	-
34	0	0	12.1	-	34	0	0	15.3	-	34	0	0	4.1	-
35	0	0	11.9	-	35	0	0	13.6	-	35	0	0	3.2	-
36	0	0	10.0	-	36	0	0	10.6	-	36	0	0	7.9	-
37	0	0	10.7	-	37	0	0	7.7	-	37	0	0	11.3	-
38	0	0	10.9	-	38	0	0	12.9	-	38	0	0	9.7	-
39	0	0	11.3	-	39	0	0	11.5	-	39	0	0	5.9	-
40	0	0	11.7	0	40	0	0	11.2	0	40	0	0	9.4	0.5
41	0	0	11.6	-	41	0	0	5.3	-	41	0	0	12.8	-
42	0	0	9.4	-	42	0	0	8.3	-	42	0	0	7.7	-
43	0	0	8.9	-	43	0	0	11.4	-	43	0	0	9.2	-
44	0	0	6.4	-	44	0	0	12.8	-	44	0	0	14.5	-
45	0	0	10.7	-	45	0	0	11.8	-	45	0	0	15.9	-
46	0	0	7.5	-	46	0	0	12.5	-	46	0	0	16.0	-
47	0	0	13.4	-	47	0	1	9.3	-	47	0	0	10.9	-
48	0	0	14.1	-	48	0	0	14.4	-	48	0	1	11.7	-
49	0	0	10.9	-	49	0	0	8.8	-	49	0	0	9.5	-
50	0	0	15.2	0	50	0	0	9.4	0	50	0	0	12.2	0.25
51	0	0	16.6	-	51	0	0	9.8	-	51	0	0	14.2	-
52	0	0	16.3	-	52	0	0	7.2	-	52	0	0	10.9	-
53	0	0	17.2	-	53	0	0	19.0	-	53	0	0	12.8	-
54	0	0	6.7	-	54	0	0	10.3	-	54	0	0	16.8	-
55	0	0	6.9	-	55	0	0	11.8	-	55	0	0	13.9	-
56	0	0	11.4	-	56	0	0	10.7	-	56	0	0	7.3	-
57	0	0	8.1	-	57	0	0	10.9	-	57	0	0	6.1	-
58	0	0	7.4	-	58	0	0	10.6	-	58	0	0	21.3	-
59	0	0	5.5	-	59	0	0	11.9	-	59	0	0	11.8	-
60	0	0	13.5	0.25	60	0	0	9.4	0.25	60	0	0	13.4	0.25
61	0	0	8.9	-	61	0	0	12.4	-	61	0	0	9.7	-
62	0	0	13.8	-	62	0	0	10.8	-	62	0	0	5.4	-
63	0	0	15.2	-	63	0	0	12.9	-	63	0	0	13.8	-
64	0	0	8.2	-	64	0	0	5.3	-	64	0	0	12.2	-
65	0	0	16.3	-	65	0	0	15.8	-	65	0	0	8.9	-
66	0	0	12.9	-	66	0	0	17.6	-	66	0	0	11.7	-
67	0	0	11.7	-	67	0	0	11.4	-	67	0	0	17.6	-
68	0	0	12.4	-	68	0	0	9.7	-	68	0	0	18.7	-
69	0	0	11.6	-	69	0	0	12.8	-	69	0	0	8.0	-
70	0	0	10.6	0	70	0	0	11.2	0.25	70	0	0	13.6	0.5
71	0	0	12.8	-	71	0	0	7.0	-	71	0	0	20.3	-
72	0	0	8.8	-	72	0	0	9.2	-	72	0	0	12.0	-
73	0	0	8.4	-	73	0	0	11.8	-	73	0	0	14.8	-
74	0	0	13.2	-	74	0	0	9.3	-	74	0	0	8.8	-
75	0	0	5.9	-	75	0	0	7.5	-	75	0	0	8.2	-
76	0	0	8.9	-	76	0	0	17.3	-	76	0	0	11.5	-
77	0	0	10.1	-	77	0	0	8.7	-	77	0	0	9.4	-
78	0	0	10.7	-	78	0	0	16.2	-	78	0	0	12.8	-
79	0	0	7.3	-	79	0	0	11.9	-	79	0	0	11.2	-
80	0	0	7.3	0	80	0	0	6.8	0	80	0	0	13.1	0
81	0	0	6.2	-	81	0	0	12.4	-	81	0	0	11.0	-
82	0	0	8.0	-	82	0	0	14.2	-	82	0	0	11.3	-
83	0	0	5.2	-	83	0	0	9.4	-	83	0	0	13.3	-
84	0	0	10.2	-	84	0	0	7.7	-	84	0	0	10.1	-
85	0	0	10.4	-	85	0	0	6.1	-	85	0	0	12.8	-
86	0	0	23.0	-	86	0	0	8.3	-	86	0	0	14.7	-
87	0	0	11.1	-	87	0	0	9.4	-	87	0	0	11.0	-
88	0	0	12.5	-	88	0	0	11.7	-	88	0	0	18.6	-
89	0	0	13.5	-	89	0	0	13.2	-	89	0	0	24.3	-
90	0	0	7.0	0	90	0	0	6.9	0	90	0	0	16.3	0
91	0	0	9.4	-	91	0	0	6.5	-	91	0	0	14.9	-
92	0	0	14.6	-	92	0	0	5.9	-	92	0	0	11.9	-
93	0	0	10.3	-	93	0	1	13.9	-	93	0	0	16.8	-
94	0	0	15.4	-	94	0	0	11.4	-	94	0	0	9.3	-
95	0	0	10.6	-	95	0	0	9.3	-	95	0	0	11.4	-
96	0	0	11.6	-	96	0	0	7.7	-	96	0	0	15.3	-
97	0	0	7.2	-	97	0	0	15.2	-	97	0	0	13.1	-
98	0	0	7.3	-	98	0	0	12.2	-	98	0	0	14.4	-
99	0	0	10.2	-	99	0	0	14.4	-	99	0	0	9.1	-
100	0	0	7.4	0.5	100	0	0	16.8	0.25	100	0	0	9.8	0.25
Minimum	**0.0**	**0.0**	**5.2**	**0**	**Minimum**	**0.0**	**0.0**	**3.9**	**0**	**Minimum**	**0.0**	**0.0**	**3.2**	**0**
Maximum	**0.0**	**0.0**	**23.0**	**0.5**	**Maximum**	**0.0**	**1.0**	**22.4**	**0.25**	**Maximum**	**0.0**	**1.0**	**24.3**	**0.5**
Mean	**0.0**	**0.0**	**10.5**	**0.1**	**Mean**	**0.0**	**0.0**	**10.9**	**0.1**	**Mean**	**0.0**	**0.0**	**11.9**	**0.2**
Standard dev.	**0.0**	**0.0**	**3.1**	**0.2**	**Standard dev.**	**0.0**	**0.1**	**3.6**	**0.1**	**Standard dev.**	**0.0**	**0.1**	**3.7**	**0.2**
Geometric mean	**-**	**-**	**10.1**	**-**	**Geometric mean**	**-**	**-**	**10.3**	**-**	**Geometric mean**	**-**	**-**	**11.3**	**-**
Median	**0.0**	**0.0**	**10.5**	**0**	**Median**	**0.0**	**0.0**	**10.8**	**0**	**Median**	**0.0**	**0.0**	**11.7**	**0**

Table G.5: Pebble and Calcite Count for the GHO LAEMP, September 2018

GH_ERC / EL20 (5)				
Rock	Concreted Status	Calcite Presence	Intermediate Axis (cm)	Embedd -edness
1	0	0	14.0	-
2	0	0	10.8	-
3	0	0	13.7	-
4	0	0	8.0	-
5	0	0	15.0	-
6	0	0	11.4	-
7	0	0	15.5	-
8	0	0	9.1	-
9	0	0	6.7	-
10	0	0	12.7	0.25
11	0	0	11.9	-
12	0	0	7.1	-
13	0	0	12.4	-
14	0	0	12.4	-
15	0	0	12.3	-
16	0	0	9.9	-
17	0	0	7.8	-
18	0	0	5.3	-
19	0	0	6.6	-
20	0	0	7.2	0
21	0	0	7.5	-
22	0	0	11.6	-
23	0	0	12.5	-
24	0	0	13.2	-
25	0	0	12.9	-
26	0	0	11.7	-
27	0	0	17.6	-
28	0	0	3.3	-
29	0	0	15.4	-
30	0	0	6.7	0.25
31	0	0	12.0	-
32	0	0	8.0	-
33	0	0	12.4	-
34	0	0	10.0	-
35	0	0	13.9	-
36	0	0	14.0	-
37	0	0	11.7	-
38	0	0	12.1	-
39	0	0	11.3	-
40	0	0	12.3	0
41	0	0	14.0	-
42	0	0	17.9	-
43	0	0	11.0	-
44	0	0	3.9	-
45	0	0	4.1	-
46	0	0	11.6	-
47	0	0	5.5	-
48	0	0	7.3	-
49	0	0	8.8	-
50	0	0	15.4	
51	0	0	12.0	-
52	0	0	15.4	-
53	0	0	9.9	-
54	0	0	8.7	-
55	0	0	9.4	-
56	0	0	8.4	-
57	0	0	10.1	-
58	0	0	7.6	-
59	0	0	4.2	-
60	0	0	6.3	0
61	0	0	10.9	-
62	0	0	11.4	-
63	0	0	3.7	-
64	0	0	8.7	-
65	0	0	14.4	-
66	0	0	7.7	-
67	0	0	6.6	-
68	0	0	15.1	-
69	0	0	3.1	-
70	0	0	8.6	0
71	0	0	8.5	-
72	0	0	15.1	-
73	0	0	24.1	-
74	0	0	10.2	-
75	0	0	13.7	-
76	0	0	9.5	-
77	0	0	10.6	-
78	0	0	11.2	-
79	0	0	15.2	-
80	0	0	7.2	0.5
81	0	0	13.0	-
82	0	0	15.8	-
83	0	0	19.1	-
84	0	0	14.1	-
85	0	0	17.3	-
86	0	0	18.8	-
87	0	0	11.9	-
88	0	0	8.7	-
89	0	0	17.4	-
90	0	0	6.4	0
91	0	0	6.2	-
92	0	0	8.7	-
93	0	0	7.0	-
94	0	0	17.4	-
95	0	0	7.1	-
96	0	0	20.4	-
97	0	0	14.1	-
98	0	0	8.7	-
99	0	0	8.0	-
100	0	0	7.0	0.25
Minimum	**0.0**	**0.0**	**3.1**	**0**
Maximum	**0.0**	**0.0**	**24.1**	**0.5**
Mean	**0.0**	**0.0**	**10.9**	**0.1**
Standard dev.	**0.0**	**0.0**	**4.1**	**0.2**
Geometric mean	**-**	**-**	**10.1**	**-**
Median	**0.0**	**0.0**	**11.1**	**0**

Table G.6: Channel Depth and Velocity Data, GHO LAEMP, September 2018

		Replicate		1	2	3	4	5	Mean
Reference	GH_ER2 / ELUGH								
	1	Depth (cm)		23	27	20	25	28	24.6
		Velocity (m/s)		0.738	0.276	0.207	0.474	0.839	0.507
	2	Depth (cm)		23	23	30	21	33	26
		Velocity (m/s)		0.582	0.612	0.421	0.752	0.512	0.576
	3	Depth (cm)		17	22	20	25	28	22.4
		Velocity (m/s)		0.548	0.833	1.03	0.807	0.661	0.776
Mine-exposed	GH_ERSC4								
	1	Depth (cm)		22	25	37	23	26	26.6
		Velocity (m/s)		0.825	0.705	0.325	0.214	0.306	0.475
	2	Depth (cm)		13	17	15	10	19	14.8
		Velocity (m/s)		0.627	0.675	0.494	0.163	0.248	0.441
	3	Depth (cm)		10	13	20	30	17	18
		Velocity (m/s)		0.653	0.518	0.301	0.318	0.48	0.454
	GH_ER1A								
	1	Depth (cm)		19	11	14	12	15	14.2
		Velocity (m/s)		0.315	0.784	0.511	0.323	0.308	0.448
	2	Depth (cm)		14	17	16	14	20	16.2
		Velocity (m/s)		0.274	0.322	0.441	0.530	0.477	0.409
	3	Depth (cm)		14	26	23	17	14	18.8
		Velocity (m/s)		0.616	0.540	0.654	0.292	0.112	0.443
	RG_ERSC5								
	1	Depth (cm)		10	14	9	14	12	11.8
		Velocity (m/s)		0.095	0.499	0.263	0.268	0.525	0.330
	2	Depth (cm)		22	12	12	12	13	14.2
		Velocity (m/s)		0.372	0.06	0.061	0.304	0.348	0.229
	3	Depth (cm)		7	12	10	15	10	10.8
		Velocity (m/s)		0.573	0.918	0.205	0.219	0.126	0.408
	GH_TC2 / THCK								
	1	Depth (cm)		11	11	9	10	10	10.2
		Velocity (m/s)		0.233	0.148	0.255	0.264	0.259	0.232
	RG_SCDTC								
	1	Depth (cm)		7	7	10	8	10	8.4
		Velocity (m/s)		0.02	0.238	0.252	0.056	0.188	0.151
	GH_ERC / EL20								
	1	Depth (cm)		27	24	24	28	26	25.8
		Velocity (m/s)		0.752	0.716	0.452	0.410	0.946	0.655
	2	Depth (cm)		27	34	34	34	40	33.8
		Velocity (m/s)		0.269	0.469	0.553	0.459	0.186	0.387
	3	Depth (cm)		22	14	20	17	15	17.6
		Velocity (m/s)		0.551	0.581	0.065	0.360	1.114	0.534
	4	Depth (cm)		31	34	44	35	34.5	35.7
		Velocity (m/s)		0.212	0.470	0.432	0.324	0.101	0.308
	5	Depth (cm)		15.5	20	34	33.5	25.5	25.7
		Velocity (m/s)		0.116	0.420	0.542	0.439	0.282	0.360

Notes: Velocity measurements were taken at five randomly chosen locations throughout the kick sample area. Velocity was measured at the bottom of the water column.

Table G.7: Habitat Information Associated with Mine-exposed and Reference Areas Sampled during the Benthic Invertebrate Survey, GHO LAEMP, September 2018

Station ID		Reference	Mine-exposed						
		GH_ER2 / ELUGH	GH_ERSC4	GH_ER1A	RG_ERSC5	GH_TC2 / THCK	RG_GH-SCW3	RG_SCDTC	GH_ERC / EL20
Waterbody		Elk River Mainstem	Elk River Side Channel	Elk River Side Channel	Elk River Side Channel	Thompson Creek	Elk River Side Channel	Elk River Side Channel downstream from Thompson Creek	Elk River Mainstream
Date Sampled		11-Sep-18	9-Sep-18	08-Sep-18 and 09-Sep-18	8-Sep-18	9-Sep-18	7-Sep-18	6-Sep-18	11-Sep-18
Zone 11 UTMs - E		646556	648091	648381	648274	648595	648331	648226	649145
Zone 11 UTMs - N		5557495	5552561	5551535	5550609	5550238	5550167	5549603	5548515
Elevation (m)		1,341	1,312	1,304	1,300	1,302	1,291	1,291	-
Habitat Characteristics									
Site Access Description		take Round Prairie Road North, eft at Branch F Creek	Round Prairie Road close to site, take small logging road, walk ~40m to side channel	beside Round Prairie Road	beside Round Prairie Road	Thompson Creek is crossed by Round Prairie Road	hike in along Thompson Creek	go through the cut block at Thompson Creek and hike downstream	from logging road North of Elkford
Surrounding Land Use		Forest	Forest, Livestock, Logging, Mining	Forest, Livestock	Forest, Livestock, Logging, Mining	Forest, Livestock, Logging, Mining	Forest, Livestock, Logging, Mining	Forest, Livestock, Logging, Mining	Forest, Livestock, Logging, Mining
Anthropogenic Influences		likely logging and livestock although neither were observed	extensive logging and cattle use	extensive logging and cattle use in the area	cattle using area, clear cutting very close to side channel		massive devastation from logging	devastation from logging	
Length of Reach Assessed (m)		100	100	75	100	30	100	50	100
Substrate	% Bedrock	0	0	0	0	0	0	0	0
	% Boulder	0	0	0	0	0	0	0	0
	% Cobble	70	50	90	70	60	5	50	70
	% Pebble	0	0	0	0	0	0	0	0
	% Gravel	20	20	5	25	25	5	25	20
	% Sand/Finer	10	30	5	5	15	90	25	10
Bank Stability		stable, no erosion	moderate	unstable, substantial erosion	unstable, substantial erosion	moderate	unstable, substantial erosion	unstable, substantial erosion	unstable, substantial erosion
Water Colour & Clarity		colourless, clear	colourless, clear	colourless, clear	colourless, clear	colourless, clear	colourless, silty/clear	colourless, clear	colourless, clear
Channel Measurements									
Bankfull Width (m)		200	12	5.1	6.3	3	30	3	56
Wetted Width (m)		20	4.6	3.2	2.53	1.5	5.2	1	31
Bankfull-Wetted Depth (cm)		2	1	1.9	1.8	0.6	1.5	2	15

DATA COLLECTED CONCURRENT WITH SEPTEMBER BIOLOGICAL SAMPLES

Laboratory Results and QA/QC

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 11-SEP-18
Report Date: 18-SEP-18 17:36 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2162166

Project P.O. #: VPO00563597
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers:
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2162166-1	L2162166-2	L2162166-3	L2162166-4	L2162166-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18
	Sampled Time	15:00	15:00	15:00	15:00	15:00
	Client ID	RG_GH_SCW3-1_SE_20180907-1500	RG_GH_SCW3-2_SE_20180907-1510	RG_GH_SCW3-3_SE_20180907-1520	RG_GH_SCW3-4_SE_20180907-1530	RG_GH_SCW3-5_SE_20180907-1540
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	42.7	52.8	46.9	49.2	47.4
	pH (1:2 soil:water) (pH)	7.95	7.81	7.81	7.99	7.86
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm) (%)	1.5	<1.0	1.1	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	3.5	<1.0	3.9	1.6	3.4
	% Sand (0.50mm - 0.25mm) (%)	4.4	<1.0	5.5	4.9	7.0
	% Sand (0.25mm - 0.125mm) (%)	15.6	12.3	13.5	10.4	12.4
	% Sand (0.125mm - 0.063mm) (%)	15.2	16.6	15.4	9.3	11.5
	% Silt (0.063mm - 0.0312mm) (%)	24.3	29.7	26.9	30.3	27.1
	% Silt (0.0312mm - 0.004mm) (%)	29.3	34.7	29.1	37.3	32.5
	% Clay (<4um) (%)	6.2	5.8	4.3	6.0	5.3
	Texture	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	6.24	5.79	5.75	5.10	8.07
Metals	Aluminum (Al) (mg/kg)	7420	7300	8010	6570	6900
	Antimony (Sb) (mg/kg)	0.48	0.54	0.58	0.50	0.57
	Arsenic (As) (mg/kg)	5.28	5.45	5.86	5.81	5.12
	Barium (Ba) (mg/kg)	131	125	139	114	132
	Beryllium (Be) (mg/kg)	0.54	0.61	0.65	0.55	0.61
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	9.0	10.8	10.4	7.9	10.0
	Cadmium (Cd) (mg/kg)	0.832	0.911	0.828	0.852	0.758
	Calcium (Ca) (mg/kg)	46500	56700	45500	51900	52500
	Chromium (Cr) (mg/kg)	16.3	18.3	16.6	16.9	16.3
	Cobalt (Co) (mg/kg)	4.85	4.83	5.27	4.85	4.85
	Copper (Cu) (mg/kg)	12.1	12.0	12.9	11.7	11.6
	Iron (Fe) (mg/kg)	12400	12400	14400	12500	12300
	Lead (Pb) (mg/kg)	7.40	7.76	9.19	7.53	8.56
	Lithium (Li) (mg/kg)	10.4	11.5	12.9	10.4	11.6
	Magnesium (Mg) (mg/kg)	12500	14000	11400	13400	12300
	Manganese (Mn) (mg/kg)	275	300	285	326	283
	Mercury (Hg) (mg/kg)	0.0357	0.0390	0.0351	0.0369	0.0373
	Molybdenum (Mo) (mg/kg)	1.20	1.25	1.48	1.30	1.38
	Nickel (Ni) (mg/kg)	18.3	19.9	19.1	19.2	18.4
	Phosphorus (P) (mg/kg)	1200	1280	1310	1340	1300
	Potassium (K) (mg/kg)	1770	1790	1840	1510	1650
	Selenium (Se) (mg/kg)	1.55	1.89	1.40	1.66	1.75
	Silver (Ag) (mg/kg)	0.17	0.20	0.19	0.18	0.19

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2162166-1	L2162166-2	L2162166-3	L2162166-4	L2162166-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18
	Sampled Time	15:00	15:00	15:00	15:00	15:00
	Client ID	RG_GH_SCW3-1_SE_20180907-1500	RG_GH_SCW3-2_SE_20180907-1510	RG_GH_SCW3-3_SE_20180907-1520	RG_GH_SCW3-4_SE_20180907-1530	RG_GH_SCW3-5_SE_20180907-1540
Grouping	**Analyte**					
SOIL						
Metals	Sodium (Na) (mg/kg)	102	103	98	99	95
	Strontium (Sr) (mg/kg)	73.3	86.9	76.0	76.3	89.6
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.187	0.215	0.216	0.191	0.204
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	19.5	21.0	20.7	16.6	18.6
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.00	1.26	1.07	1.10	1.14
	Vanadium (V) (mg/kg)	31.7	33.0	32.7	29.9	30.3
	Zinc (Zn) (mg/kg)	82.4	83.2	87.3	86.6	82.0
	Zirconium (Zr) (mg/kg)	1.1	1.3	1.1	<1.0	1.2
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	DLQ <0.023	DLQ <0.0070	DLQ <0.010	DLQ <0.0090	DLQ <0.024
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	0.012	<0.010	<0.010	<0.010	0.012
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	0.028	0.012	0.014	0.015	0.027
	Benzo(e)pyrene (mg/kg)	0.027	0.011	0.013	0.014	0.026
	Benzo(g,h,i)perylene (mg/kg)	0.011	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	0.069	0.029	0.034	0.035	0.067
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	0.011	<0.010	<0.010	<0.010	0.011
	Fluorene (mg/kg)	0.021	<0.010	<0.010	0.011	0.027
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	0.344	0.112	0.172	0.143	0.382
	2-Methylnaphthalene (mg/kg)	0.572	0.178	0.292	0.235	0.650
	Naphthalene (mg/kg)	0.154	0.054	0.078	0.069	0.180
	Perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene (mg/kg)	0.242	0.090	0.118	0.109	0.243
	Pyrene (mg/kg)	0.017	<0.010	<0.010	<0.010	0.018
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	82.4	74.6	76.0	80.3	79.7
	Surrogate: d12-Chrysene (%)	101.9	95.1	95.5	99.8	98.9
	Surrogate: d8-Naphthalene (%)	84.2	74.4	76.1	80.9	79.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2162166-1	L2162166-2	L2162166-3	L2162166-4	L2162166-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18	07-SEP-18
	Sampled Time	15:00	15:00	15:00	15:00	15:00
	Client ID	RG_GH_SCW3-1_SE_20180907-1500	RG_GH_SCW3-2_SE_20180907-1510	RG_GH_SCW3-3_SE_20180907-1520	RG_GH_SCW3-4_SE_20180907-1530	RG_GH_SCW3-5_SE_20180907-1540
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d10-Phenanthrene (%)	90.5	81.5	86.9	85.9	85.8
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	0.30	0.16	0.18	0.18	0.30

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLQ	Detection Limit raised due to co-eluting interference. GCMS qualifier ion ratio did not meet acceptance criteria.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAA-CL	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-CL	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

MOISTURE-CL	Soil	% Moisture	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C

PAH-TMB-D/A-MS-CL	Soil	PAH by Tumbler Extraction (DCM/Acetone)	EPA 3570/8270

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of DCM and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-CL	Soil	pH in soil (1:2 Soil:Water Extraction)	CSSS Ch. 16

Soil and de-ionized water (by volume) are mixed in a defined ratio. The slurry is allowed to stand, shaken, and then allowed to stand again prior to taking measurements. After equilibration, the pH of the liquid portion of the extract is measured by a pH meter. Field Measurement is recommended where accurate pH measurements are required, due to the 15 minute recommended hold time.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Reference Information

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2162166 Report Date: 18-SEP-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4217725								
WG2874944-2 LCS								
Inorganic Carbon			97.6		%		80-120	17-SEP-18
WG2874944-3 MB								
Inorganic Carbon			<0.050		%		0.05	17-SEP-18
C-TOT-LECO-SK	**Soil**							
Batch R4217020								
WG2874631-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			93.6		%		80-120	15-SEP-18
WG2874631-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			99.5		%		90-110	15-SEP-18
WG2874631-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	15-SEP-18
HG-200.2-CVAA-CL	**Soil**							
Batch R4215161								
WG2875453-4 CRM		**TILL-1**						
Mercury (Hg)			117.2		%		70-130	13-SEP-18
WG2875453-3 LCS								
Mercury (Hg)			96.0		%		80-120	13-SEP-18
WG2875453-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	13-SEP-18
MET-200.2-CCMS-CL	**Soil**							
Batch R4215484								
WG2875453-4 CRM		**TILL-1**						
Aluminum (Al)			96.1		%		70-130	13-SEP-18
Antimony (Sb)			114.5		%		70-130	13-SEP-18
Arsenic (As)			101.4		%		70-130	13-SEP-18
Barium (Ba)			96.2		%		70-130	13-SEP-18
Beryllium (Be)			105.8		%		70-130	13-SEP-18
Bismuth (Bi)			110.6		%		70-130	13-SEP-18
Boron (B)			3.2		mg/kg		0-8.2	13-SEP-18
Cadmium (Cd)			94.2		%		70-130	13-SEP-18
Calcium (Ca)			105.3		%		70-130	13-SEP-18
Chromium (Cr)			103.3		%		70-130	13-SEP-18
Cobalt (Co)			103.9		%		70-130	13-SEP-18
Copper (Cu)			102.5		%		70-130	13-SEP-18
Iron (Fe)			99.6		%		70-130	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4215484								
WG2875453-4 CRM		**TILL-1**						
Lead (Pb)			110.9		%		70-130	13-SEP-18
Lithium (Li)			109.4		%		70-130	13-SEP-18
Magnesium (Mg)			96.0		%		70-130	13-SEP-18
Manganese (Mn)			97.0		%		70-130	13-SEP-18
Molybdenum (Mo)			108.7		%		70-130	13-SEP-18
Nickel (Ni)			101.4		%		70-130	13-SEP-18
Phosphorus (P)			101.3		%		70-130	13-SEP-18
Potassium (K)			105.1		%		70-130	13-SEP-18
Selenium (Se)			0.28		mg/kg		0.11-0.51	13-SEP-18
Silver (Ag)			0.24		mg/kg		0.13-0.33	13-SEP-18
Sodium (Na)			106.8		%		70-130	13-SEP-18
Strontium (Sr)			104.0		%		70-130	13-SEP-18
Thallium (Tl)			0.144		mg/kg		0.077-0.18	13-SEP-18
Tin (Sn)			1.0		mg/kg		0-3.1	13-SEP-18
Titanium (Ti)			103.8		%		70-130	13-SEP-18
Tungsten (W)			0.18		mg/kg		0-0.66	13-SEP-18
Uranium (U)			113.2		%		70-130	13-SEP-18
Vanadium (V)			101.2		%		70-130	13-SEP-18
Zinc (Zn)			98.1		%		70-130	13-SEP-18
Zirconium (Zr)			1.2		mg/kg		0-1.8	13-SEP-18
WG2875453-3 LCS								
Aluminum (Al)			105.0		%		80-120	13-SEP-18
Antimony (Sb)			106.4		%		80-120	13-SEP-18
Arsenic (As)			100.1		%		80-120	13-SEP-18
Barium (Ba)			109.3		%		80-120	13-SEP-18
Beryllium (Be)			101.4		%		80-120	13-SEP-18
Bismuth (Bi)			100.7		%		80-120	13-SEP-18
Boron (B)			99.9		%		80-120	13-SEP-18
Cadmium (Cd)			95.9		%		80-120	13-SEP-18
Calcium (Ca)			99.4		%		80-120	13-SEP-18
Chromium (Cr)			103.8		%		80-120	13-SEP-18
Cobalt (Co)			106.3		%		80-120	13-SEP-18
Copper (Cu)			102.7		%		80-120	13-SEP-18
Iron (Fe)			104.4		%		80-120	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4215484								
WG2875453-3 LCS								
Lead (Pb)			100.5		%		80-120	13-SEP-18
Lithium (Li)			93.4		%		80-120	13-SEP-18
Magnesium (Mg)			100.6		%		80-120	13-SEP-18
Manganese (Mn)			103.2		%		80-120	13-SEP-18
Molybdenum (Mo)			101.8		%		80-120	13-SEP-18
Nickel (Ni)			103.4		%		80-120	13-SEP-18
Potassium (K)			102.6		%		80-120	13-SEP-18
Selenium (Se)			96.3		%		80-120	13-SEP-18
Silver (Ag)			109.5		%		80-120	13-SEP-18
Sodium (Na)			104.6		%		80-120	13-SEP-18
Strontium (Sr)			106.5		%		80-120	13-SEP-18
Sulfur (S)			115.6		%		80-120	13-SEP-18
Thallium (Tl)			101.9		%		80-120	13-SEP-18
Tin (Sn)			98.7		%		80-120	13-SEP-18
Titanium (Ti)			100.9		%		80-120	13-SEP-18
Tungsten (W)			111.6		%		80-120	13-SEP-18
Uranium (U)			110.5		%		80-120	13-SEP-18
Vanadium (V)			104.4		%		80-120	13-SEP-18
Zinc (Zn)			99.0		%		80-120	13-SEP-18
Zirconium (Zr)			101.4		%		80-120	13-SEP-18
WG2875453-1 MB								
Aluminum (Al)			<50		mg/kg		50	13-SEP-18
Antimony (Sb)			<0.10		mg/kg		0.1	13-SEP-18
Arsenic (As)			<0.10		mg/kg		0.1	13-SEP-18
Barium (Ba)			<0.50		mg/kg		0.5	13-SEP-18
Beryllium (Be)			<0.10		mg/kg		0.1	13-SEP-18
Bismuth (Bi)			<0.20		mg/kg		0.2	13-SEP-18
Boron (B)			<5.0		mg/kg		5	13-SEP-18
Cadmium (Cd)			<0.020		mg/kg		0.02	13-SEP-18
Calcium (Ca)			<50		mg/kg		50	13-SEP-18
Chromium (Cr)			<0.50		mg/kg		0.5	13-SEP-18
Cobalt (Co)			<0.10		mg/kg		0.1	13-SEP-18
Copper (Cu)			<0.50		mg/kg		0.5	13-SEP-18
Iron (Fe)			<50		mg/kg		50	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4215484								
WG2875453-1 MB								
Lead (Pb)			<0.50		mg/kg		0.5	13-SEP-18
Lithium (Li)			<2.0		mg/kg		2	13-SEP-18
Magnesium (Mg)			<20		mg/kg		20	13-SEP-18
Manganese (Mn)			<1.0		mg/kg		1	13-SEP-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	13-SEP-18
Nickel (Ni)			<0.50		mg/kg		0.5	13-SEP-18
Phosphorus (P)			<50		mg/kg		50	13-SEP-18
Potassium (K)			<100		mg/kg		100	13-SEP-18
Selenium (Se)			<0.20		mg/kg		0.2	13-SEP-18
Silver (Ag)			<0.10		mg/kg		0.1	13-SEP-18
Sodium (Na)			<50		mg/kg		50	13-SEP-18
Strontium (Sr)			<0.50		mg/kg		0.5	13-SEP-18
Sulfur (S)			<1000		mg/kg		1000	13-SEP-18
Thallium (Tl)			<0.050		mg/kg		0.05	13-SEP-18
Tin (Sn)			<2.0		mg/kg		2	13-SEP-18
Titanium (Ti)			<1.0		mg/kg		1	13-SEP-18
Tungsten (W)			<0.50		mg/kg		0.5	13-SEP-18
Uranium (U)			<0.050		mg/kg		0.05	13-SEP-18
Vanadium (V)			<0.20		mg/kg		0.2	13-SEP-18
Zinc (Zn)			<2.0		mg/kg		2	13-SEP-18
Zirconium (Zr)			<1.0		mg/kg		1	13-SEP-18
MOISTURE-CL	**Soil**							
Batch R4215560								
WG2874830-3 DUP		**L2162166-2**						
Moisture		52.8	52.8		%	0.1	20	13-SEP-18
WG2874830-2 LCS								
Moisture			103.3		%		90-110	13-SEP-18
WG2874830-1 MB								
Moisture			<0.25		%		0.25	13-SEP-18
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-7 DUP		**L2162166-2**						
Acenaphthene		<0.0070	<0.0070	RPD-NA	mg/kg	N/A	50	15-SEP-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	15-SEP-18
Acridine		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-7 DUP		**L2162166-2**						
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	15-SEP-18
Benz(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Benzo(b&j)fluoranthene		0.012	0.012		mg/kg	0.8	50	15-SEP-18
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Benzo(e)pyrene		0.011	0.011		mg/kg	0.9	50	15-SEP-18
Chrysene		0.029	0.027		mg/kg	5.0	50	15-SEP-18
Dibenz(a,h)anthracene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	50	15-SEP-18
Fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Indeno(1,2,3-c,d)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
1-Methylnaphthalene		0.112	0.110		mg/kg	1.7	50	15-SEP-18
2-Methylnaphthalene		0.178	0.180		mg/kg	0.9	50	15-SEP-18
Naphthalene		0.054	0.053		mg/kg	1.1	50	15-SEP-18
Perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Phenanthrene		0.090	0.091		mg/kg	1.7	50	15-SEP-18
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
Quinoline		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	15-SEP-18
WG2877672-1 LCS								
Acenaphthene			82.6		%		60-130	14-SEP-18
Acenaphthylene			79.4		%		60-130	14-SEP-18
Acridine			88.3		%		60-130	14-SEP-18
Anthracene			79.1		%		60-130	14-SEP-18
Benz(a)anthracene			80.2		%		60-130	14-SEP-18
Benzo(a)pyrene			77.7		%		60-130	14-SEP-18
Benzo(b&j)fluoranthene			80.2		%		60-130	14-SEP-18
Benzo(g,h,i)perylene			84.0		%		60-130	14-SEP-18
Benzo(k)fluoranthene			83.6		%		60-130	14-SEP-18
Benzo(e)pyrene			88.5		%		60-130	14-SEP-18
Chrysene			82.5		%		60-130	14-SEP-18
Dibenz(a,h)anthracene			83.2		%		60-130	14-SEP-18
Fluoranthene			78.8		%		60-130	14-SEP-18
Fluorene			80.2		%		60-130	14-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-1 LCS								
Indeno(1,2,3-c,d)pyrene			78.9		%		60-130	14-SEP-18
1-Methylnaphthalene			87.6		%		60-130	14-SEP-18
2-Methylnaphthalene			83.1		%		60-130	14-SEP-18
Naphthalene			84.5		%		50-130	14-SEP-18
Perylene			88.9		%		60-130	14-SEP-18
Phenanthrene			81.5		%		60-130	14-SEP-18
Pyrene			79.5		%		60-130	14-SEP-18
Quinoline			86.8		%		60-130	14-SEP-18
WG2877672-5 LCS								
Acenaphthene			81.8		%		60-130	15-SEP-18
Acenaphthylene			81.4		%		60-130	15-SEP-18
Acridine			88.1		%		60-130	15-SEP-18
Anthracene			77.6		%		60-130	15-SEP-18
Benz(a)anthracene			90.9		%		60-130	15-SEP-18
Benzo(a)pyrene			89.5		%		60-130	15-SEP-18
Benzo(b&j)fluoranthene			91.2		%		60-130	15-SEP-18
Benzo(g,h,i)perylene			94.2		%		60-130	15-SEP-18
Benzo(k)fluoranthene			94.9		%		60-130	15-SEP-18
Benzo(e)pyrene			100.7		%		60-130	15-SEP-18
Chrysene			96.2		%		60-130	15-SEP-18
Dibenz(a,h)anthracene			92.7		%		60-130	15-SEP-18
Fluoranthene			81.8		%		60-130	15-SEP-18
Fluorene			77.7		%		60-130	15-SEP-18
Indeno(1,2,3-c,d)pyrene			94.0		%		60-130	15-SEP-18
1-Methylnaphthalene			88.2		%		60-130	15-SEP-18
2-Methylnaphthalene			82.1		%		60-130	15-SEP-18
Naphthalene			83.5		%		50-130	15-SEP-18
Perylene			100.1		%		60-130	15-SEP-18
Phenanthrene			77.9		%		60-130	15-SEP-18
Pyrene			83.4		%		60-130	15-SEP-18
Quinoline			83.5		%		60-130	15-SEP-18
WG2877672-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	14-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	14-SEP-18
Acridine			<0.010		mg/kg		0.01	14-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-2 MB								
Anthracene			<0.0040		mg/kg		0.004	14-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	14-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	14-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	14-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	14-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	14-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	14-SEP-18
Chrysene			<0.010		mg/kg		0.01	14-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	14-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	14-SEP-18
Fluorene			<0.010		mg/kg		0.01	14-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	14-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	14-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	14-SEP-18
Naphthalene			<0.010		mg/kg		0.01	14-SEP-18
Perylene			<0.010		mg/kg		0.01	14-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	14-SEP-18
Pyrene			<0.010		mg/kg		0.01	14-SEP-18
Quinoline			<0.010		mg/kg		0.01	14-SEP-18
Surrogate: d8-Naphthalene			72.6		%		50-130	14-SEP-18
Surrogate: d10-Acenaphthene			71.0		%		60-130	14-SEP-18
Surrogate: d10-Phenanthrene			72.7		%		60-130	14-SEP-18
Surrogate: d12-Chrysene			87.1		%		60-130	14-SEP-18
WG2877672-6 MB								
Acenaphthene			<0.0050		mg/kg		0.005	15-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	15-SEP-18
Acridine			<0.010		mg/kg		0.01	15-SEP-18
Anthracene			<0.0040		mg/kg		0.004	15-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	15-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-6 MB								
Chrysene			<0.010		mg/kg		0.01	15-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	15-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Fluorene			<0.010		mg/kg		0.01	15-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	15-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	15-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	15-SEP-18
Naphthalene			<0.010		mg/kg		0.01	15-SEP-18
Perylene			<0.010		mg/kg		0.01	15-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	15-SEP-18
Pyrene			<0.010		mg/kg		0.01	15-SEP-18
Quinoline			<0.010		mg/kg		0.01	15-SEP-18
Surrogate: d8-Naphthalene			75.3		%		50-130	15-SEP-18
Surrogate: d10-Acenaphthene			71.6		%		60-130	15-SEP-18
Surrogate: d10-Phenanthrene			77.1		%		60-130	15-SEP-18
Surrogate: d12-Chrysene			102.1		%		60-130	15-SEP-18
WG2877672-8 MS		**L2162166-5**						
Acenaphthene			77.5		%		50-150	15-SEP-18
Acenaphthylene			74.8		%		50-150	15-SEP-18
Acridine			97.4		%		50-150	15-SEP-18
Anthracene			82.3		%		50-150	15-SEP-18
Benz(a)anthracene			96.7		%		50-150	15-SEP-18
Benzo(a)pyrene			95.2		%		50-150	15-SEP-18
Benzo(b&j)fluoranthene			96.3		%		50-150	15-SEP-18
Benzo(g,h,i)perylene			93.4		%		50-150	15-SEP-18
Benzo(k)fluoranthene			95.4		%		50-150	15-SEP-18
Benzo(e)pyrene			102.9		%		50-150	15-SEP-18
Chrysene			97.4		%		50-150	15-SEP-18
Dibenz(a,h)anthracene			94.6		%		50-150	15-SEP-18
Fluoranthene			92.8		%		50-150	15-SEP-18
Fluorene			83.7		%		50-150	15-SEP-18
Indeno(1,2,3-c,d)pyrene			92.7		%		50-150	15-SEP-18
1-Methylnaphthalene			75.8		%		50-150	15-SEP-18
2-Methylnaphthalene			72.5		%		50-150	15-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217027								
WG2877672-8 MS		**L2162166-5**						
Naphthalene			74.4		%		50-150	15-SEP-18
Perylene			105.2		%		50-150	15-SEP-18
Phenanthrene			83.2		%		50-150	15-SEP-18
Pyrene			93.5		%		50-150	15-SEP-18
Quinoline			77.2		%		50-150	15-SEP-18
PH-1:2-CL	**Soil**							
Batch R4220808								
WG2879943-6 DUP		**L2162166-1**						
pH (1:2 soil:water)		7.95	7.93	J	pH	0.02	0.2	18-SEP-18
WG2879943-5 IRM		**SAL-STD9**						
pH (1:2 soil:water)			7.94		pH		7.7-8.3	18-SEP-18
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4218024								
WG2874932-1 DUP		**L2162166-3**						
% Gravel (>2mm)		<1.0	<1.0	RPD-NA	%	N/A	25	17-SEP-18
% Sand (2.00mm - 1.00mm)		1.1	<1.0	RPD-NA	%	N/A	5	17-SEP-18
% Sand (1.00mm - 0.50mm)		3.9	3.9	J	%	0.1	5	17-SEP-18
% Sand (0.50mm - 0.25mm)		5.5	5.7	J	%	0.2	5	17-SEP-18
% Sand (0.25mm - 0.125mm)		13.5	13.5	J	%	0.0	5	17-SEP-18
% Sand (0.125mm - 0.063mm)		15.4	16.0	J	%	0.7	5	17-SEP-18
% Silt (0.063mm - 0.0312mm)		26.9	25.7	J	%	1.1	5	17-SEP-18
% Silt (0.0312mm - 0.004mm)		29.1	29.5	J	%	0.4	5	17-SEP-18
% Clay (<4um)		4.3	4.6	J	%	0.3	5	17-SEP-18
WG2874932-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			2.6		%		0-7.6	17-SEP-18
% Sand (1.00mm - 0.50mm)			3.6		%		0-8.9	17-SEP-18
% Sand (0.50mm - 0.25mm)			10.2		%		5.3-15.3	17-SEP-18
% Sand (0.25mm - 0.125mm)			15.2		%		10-20	17-SEP-18
% Sand (0.125mm - 0.063mm)			13.5		%		7.3-17.3	17-SEP-18
% Silt (0.063mm - 0.0312mm)			14.4		%		9.9-19.9	17-SEP-18
% Silt (0.0312mm - 0.004mm)			22.6		%		17.6-27.6	17-SEP-18
% Clay (<4um)			17.9		%		13.4-23.4	17-SEP-18

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	Regional Effects Program	TURNAROUND TIME:	Regular

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program/RAEMP/GHO LAEMP
Project Manager	Cait Good
Email	cait.good@teck.com
Address	421 Pine Avenue
City	Sparwood, Province BC
Postal Code	V0B 2G0, Country Canada
Phone Number	250-425-8202

LABORATORY

Lab Name	ALS Calgary
Lab Contact	Lyuda Shvets
Email	Lyudmyla.Shvets@ALSGlobal.com
Address	2559 29 Street NE
City	Calgary, Province AB
Postal Code	T1Y 7B5, Country Canada
Phone Number	403-407-1800

OTHER INFO

Report Format / Distribution		Excel	PDF	EDD
Email 1:	cait.good@teck.com	x	x	x
Email 2:	carla.fraser@teck.com	x	x	x
Email 3:	colleen.mooney@teck.com	x	x	x
Email 4:	teckcoal@equisonline.com			x
Email 5:	jtester@minnow.ca	x	x	x
PO number	VPO00563597			

L2162166-COFC

SAMPLE DETAILS / **ANALYSIS REQUESTED** (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	C-TOC-SK	MET-CCME+FULL-CL	MOISTURE-CL - % Moisture	PSA-PIPET-DETAIL-SK Particle Size	PAH-TMB-D/A-MS-CL-PAHs
FILTER								N	N	N	N	N
PRESERV.								NONE	NONE	NONE	NONE	NONE
RG_GH_SCW3-1_SE_20180907-1500	RG_GH_SCW3	SE	No	07-Sep-18	3:00:00 PM	G	2	x	x	x	x	x
RG_GH_SCW3-2_SE_20180907-1510	RG_GH_SCW3	SE	No	07-Sep-18	3:10:00 PM	G	2	x	x	x	x	x
RG_GH_SCW3-3_SE_20180907-1520	RG_GH_SCW3	SE	No	07-Sep-18	3:20:00 PM	G	2	x	x	x	x	x
RG_GH_SCW3-4_SE_20180907-1530	RG_GH_SCW3	SE	No	07-Sep-18	3:30:00 PM	G	2	x	x	x	x	x
RG_GH_SCW3-5_SE_20180907-1540	RG_GH_SCW3	SE	No	07-Sep-18	3:40:00 PM	G	2	x	x	x	x	x

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00563597	Shari Weech/Minnow	Sep 10/18; 16:00		9/10
				9/11

SERVICE REQUEST (rush - subject to availability)

Regular (default)	X
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Shari Weech	Mobile #	250-893-3322
Sampler's Signature	Shari Weech	Date/Time	September 10, 2018

6.0°C

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 13-SEP-18
Report Date: 20-SEP-18 17:03 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2163882

Project P.O. #: VPO00563597

Job Reference: Regional Effects Program

C of C Numbers:

Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-1	L2163882-2	L2163882-3	L2163882-4	L2163882-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:40	15:30	14:10	12:43
	Client ID	RG_ELUGH1_SE_20180911-1410	RG_ELUGH2_SE_20180911-1440	RG_ELUGH3_SE_20180911-1530	RG_DUP_SE_20180911-1410	RG_SLINE1_SE_20180911-1243
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	37.2	59.8	37.5	38.5	78.9
	pH (1:9) (pH)					7.36
	pH (1:2 soil:water) (pH)	7.96	7.61	7.96	7.93	
Particle Size	% Gravel (>2mm) (%)	<1.0	<1.0	<1.0	<1.0	22.8
	% Sand (2.00mm - 1.00mm) (%)	<1.0	<1.0	<1.0	<1.0	12.8
	% Sand (1.00mm - 0.50mm) (%)	1.4	<1.0	2.7	1.6	3.9
	% Sand (0.50mm - 0.25mm) (%)	26.2	9.0	12.6	28.3	1.6
	% Sand (0.25mm - 0.125mm) (%)	27.7	11.0	32.6	28.9	1.9
	% Sand (0.125mm - 0.063mm) (%)	18.1	15.3	25.6	16.5	4.4
	% Silt (0.063mm - 0.0312mm) (%)	12.4	27.2	13.6	11.8	22.4
	% Silt (0.0312mm - 0.004mm) (%)	12.2	31.7	10.8	10.7	25.7
	% Clay (<4um) (%)	2.2	5.0	1.9	2.1	4.6
	Texture	Loamy sand	Silt loam	Loamy sand	Loamy sand	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.15	5.93	2.18	2.10	9.97
Metals	Aluminum (Al) (mg/kg)	6420	7540	5470	5000	6570
	Antimony (Sb) (mg/kg)	0.47	0.57	0.45	0.46	0.33
	Arsenic (As) (mg/kg)	5.00	5.48	4.60	4.76	4.22
	Barium (Ba) (mg/kg)	109	136	109	106	108
	Beryllium (Be) (mg/kg)	0.51	0.59	0.47	0.44	0.31
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	10.2	13.5	8.1	7.0	10.9
	Cadmium (Cd) (mg/kg)	0.589	0.934	0.572	0.584	1.73
	Calcium (Ca) (mg/kg)	81000	68600	63600	74000	61500
	Chromium (Cr) (mg/kg)	15.8	19.1	13.8	13.1	16.9
	Cobalt (Co) (mg/kg)	3.58	4.55	3.61	3.49	3.47
	Copper (Cu) (mg/kg)	7.62	11.4	7.61	7.49	9.29
	Iron (Fe) (mg/kg)	11000	12500	10300	10500	9210
	Lead (Pb) (mg/kg)	5.69	6.80	5.58	5.26	4.97
	Lithium (Li) (mg/kg)	9.6	12.2	8.6	8.4	9.7
	Magnesium (Mg) (mg/kg)	14100	13700	12700	13300	21700
	Manganese (Mn) (mg/kg)	342	520	322	336	306
	Mercury (Hg) (mg/kg)	0.0222	0.0364	0.0226	0.0231	0.0584
	Molybdenum (Mo) (mg/kg)	1.20	1.46	1.14	1.15	1.34
	Nickel (Ni) (mg/kg)	14.3	19.3	14.0	13.7	22.2
	Phosphorus (P) (mg/kg)	1290	1260	1260	1180	1050
	Potassium (K) (mg/kg)	1880	2190	1560	1390	1980
	Selenium (Se) (mg/kg)	0.58	1.17	0.56	0.60	2.96

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-6	L2163882-7	L2163882-8	L2163882-9	L2163882-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	13:04	15:13	09:30	10:15	10:45
	Client ID	RG_SLINE2_SE_20180911-1304	RG_SLINE3_SE_20180911-1513	RG_EL20-1_SE_20180911-0930	RG_EL20-2_SE_20180911-1015	RG_EL20-3_SE_20180911-1045
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	74.6	73.6	39.1	38.7	59.2
	pH (1:9) (pH)					
	pH (1:2 soil:water) (pH)	7.51	7.44	7.86	8.06	7.58
Particle Size	% Gravel (>2mm) (%)	8.1	<1.0	6.8	1.1	<1.0
	% Sand (2.00mm - 1.00mm) (%)	6.3	1.1	3.4	<1.0	<1.0
	% Sand (1.00mm - 0.50mm) (%)	9.7	<1.0	5.1	1.5	<1.0
	% Sand (0.50mm - 0.25mm) (%)	11.7	1.9	12.0	8.1	<1.0
	% Sand (0.25mm - 0.125mm) (%)	8.6	13.9	16.4	23.4	5.9
	% Sand (0.125mm - 0.063mm) (%)	10.1	23.6	16.4	19.3	23.3
	% Silt (0.063mm - 0.0312mm) (%)	19.2	27.6	17.2	19.4	31.9
	% Silt (0.0312mm - 0.004mm) (%)	22.2	26.7	19.5	22.1	33.4
	% Clay (<4um) (%)	4.2	3.5	3.3	4.5	4.9
	Texture	Sandy loam	Silt loam	Sandy loam	Sandy loam	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	6.41	5.44	2.91	3.34	7.64
Metals	Aluminum (Al) (mg/kg)	7190	6580	6170	8150	5890
	Antimony (Sb) (mg/kg)	0.39	0.36	0.37	0.44	0.45
	Arsenic (As) (mg/kg)	4.46	4.22	4.40	5.21	4.77
	Barium (Ba) (mg/kg)	114	117	108	123	115
	Beryllium (Be) (mg/kg)	0.46	0.44	0.42	0.59	0.49
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	13.8	12.2	9.8	11.2	9.0
	Cadmium (Cd) (mg/kg)	1.55	1.17	0.625	0.666	0.888
	Calcium (Ca) (mg/kg)	85500	93900	86100	52400	49500
	Chromium (Cr) (mg/kg)	16.3	14.2	15.3	19.9	15.7
	Cobalt (Co) (mg/kg)	3.95	3.59	3.26	4.02	3.92
	Copper (Cu) (mg/kg)	9.29	7.90	7.01	10.3	10.8
	Iron (Fe) (mg/kg)	10100	9790	9940	12200	10600
	Lead (Pb) (mg/kg)	6.70	6.06	4.75	6.08	6.04
	Lithium (Li) (mg/kg)	12.9	11.3	8.8	11.1	9.1
	Magnesium (Mg) (mg/kg)	22100	22600	14000	15300	12500
	Manganese (Mn) (mg/kg)	308	290	351	324	358
	Mercury (Hg) (mg/kg)	0.0463	0.0365	0.0197	0.0261	0.0360
	Molybdenum (Mo) (mg/kg)	1.52	1.33	1.11	1.16	1.13
	Nickel (Ni) (mg/kg)	21.5	17.7	13.4	17.1	16.7
	Phosphorus (P) (mg/kg)	1060	930	1230	1240	1030
	Potassium (K) (mg/kg)	2060	1870	1850	2300	1650
	Selenium (Se) (mg/kg)	2.23	1.38	0.81	0.65	1.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2163882-11	L2163882-12	L2163882-13		
	Description	SE	SE	SE		
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18		
	Sampled Time	11:30	12:00	09:30		
	Client ID	RG_EL20-4_SE_20180911-1130	RG_EL20-5_SE_20180911-1200	RG_DUP_SE_20180911-0930		
SOIL						
Physical Tests	Moisture (%)	56.3	52.9	34.9		
	pH (1:9) (pH)					
	pH (1:2 soil:water) (pH)	7.69	7.69	7.78		
Particle Size	% Gravel (>2mm) (%)	18.6	3.1	5.3		
	% Sand (2.00mm - 1.00mm) (%)	3.4	1.0	3.4		
	% Sand (1.00mm - 0.50mm) (%)	2.8	1.7	6.1		
	% Sand (0.50mm - 0.25mm) (%)	2.9	5.1	12.6		
	% Sand (0.25mm - 0.125mm) (%)	10.3	18.3	17.6		
	% Sand (0.125mm - 0.063mm) (%)	17.0	21.2	14.3		
	% Silt (0.063mm - 0.0312mm) (%)	19.7	21.3	17.2		
	% Silt (0.0312mm - 0.004mm) (%)	21.3	24.2	20.0		
	% Clay (<4um) (%)	3.9	4.0	3.6		
	Texture	Sandy loam	Sandy loam	Sandy loam		
Organic / Inorganic Carbon	Total Organic Carbon (%)	4.54	4.22	2.99		
Metals	Aluminum (Al) (mg/kg)	6140	6020	5470		
	Antimony (Sb) (mg/kg)	0.48	0.42	0.38		
	Arsenic (As) (mg/kg)	5.22	4.67	4.44		
	Barium (Ba) (mg/kg)	119	111	103		
	Beryllium (Be) (mg/kg)	0.51	0.48	0.44		
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20		
	Boron (B) (mg/kg)	8.8	8.9	8.8		
	Cadmium (Cd) (mg/kg)	0.791	0.659	0.582		
	Calcium (Ca) (mg/kg)	57300	64600	74800		
	Chromium (Cr) (mg/kg)	16.1	15.3	14.1		
	Cobalt (Co) (mg/kg)	4.23	3.76	3.41		
	Copper (Cu) (mg/kg)	10.4	8.39	7.30		
	Iron (Fe) (mg/kg)	11400	10400	9720		
	Lead (Pb) (mg/kg)	6.26	5.76	5.16		
	Lithium (Li) (mg/kg)	10.1	9.3	8.7		
	Magnesium (Mg) (mg/kg)	13700	12500	13700		
	Manganese (Mn) (mg/kg)	452	437	366		
	Mercury (Hg) (mg/kg)	0.0328	0.0234	0.0183		
	Molybdenum (Mo) (mg/kg)	1.34	1.18	1.13		
	Nickel (Ni) (mg/kg)	17.1	14.7	13.8		
	Phosphorus (P) (mg/kg)	1140	1080	1140		
	Potassium (K) (mg/kg)	1650	1670	1560		
	Selenium (Se) (mg/kg)	0.98	0.63	0.84		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-1	L2163882-2	L2163882-3	L2163882-4	L2163882-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:40	15:30	14:10	12:43
	Client ID	RG_ELUGH1_SE_20180911-1410	RG_ELUGH2_SE_20180911-1440	RG_ELUGH3_SE_20180911-1530	RG_DUP_SE_20180911-1410	RG_SLINE1_SE_20180911-1243
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	0.11	0.18	0.11	0.11	0.13
	Sodium (Na) (mg/kg)	95	90	83	89	129
	Strontium (Sr) (mg/kg)	109	106	94.2	100	63.3
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.180	0.232	0.171	0.151	0.248
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	15.4	20.6	16.7	16.7	30.2
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.07	1.17	0.987	0.965	1.71
	Vanadium (V) (mg/kg)	32.0	35.5	28.0	26.7	20.1
	Zinc (Zn) (mg/kg)	67.9	85.0	64.6	66.3	194
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	DLQ <0.017
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	DLHM <0.012
	Acridine (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLCI <0.031
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040	<0.0040	DLHM <0.0092
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	0.014	<0.010	<0.010	DLHM 0.031
	Benzo(e)pyrene (mg/kg)	<0.010	0.013	<0.010	<0.010	DLHM 0.032
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Chrysene (mg/kg)	0.010	0.029	0.011	0.013	DLHM 0.053
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050	<0.0050	DLHM <0.012
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Fluorene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM 0.035
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	1-Methylnaphthalene (mg/kg)	0.014	0.054	0.015	0.020	DLHM 0.197
	2-Methylnaphthalene (mg/kg)	0.020	0.071	0.020	0.024	DLHM 0.305
	Naphthalene (mg/kg)	<0.010	0.027	<0.010	0.010	DLHM 0.092
	Perylene (mg/kg)	<0.010	0.018	<0.010	<0.010	DLHM 0.059
	Phenanthrene (mg/kg)	0.024	0.084	0.026	0.028	DLHM 0.210
	Pyrene (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Quinoline (mg/kg)	<0.010	<0.010	<0.010	<0.010	DLHM <0.023
	Surrogate: d10-Acenaphthene (%)	79.6	67.8	76.4	77.6	84.5
	Surrogate: d12-Chrysene (%)	99.8	97.3	98.0	99.1	105.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-6	L2163882-7	L2163882-8	L2163882-9	L2163882-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	13:04	15:13	09:30	10:15	10:45
	Client ID	RG_SLINE2_SE_20180911-1304	RG_SLINE3_SE_20180911-1513	RG_EL20-1_SE_20180911-0930	RG_EL20-2_SE_20180911-1015	RG_EL20-3_SE_20180911-1045
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	0.15	0.13	0.11	0.14	0.17
	Sodium (Na) (mg/kg)	135	126	104	93	75
	Strontium (Sr) (mg/kg)	83.1	85.3	108	72.9	78.2
	Sulfur (S) (mg/kg)	<1000	<1000	<1000	<1000	<1000
	Thallium (Tl) (mg/kg)	0.315	0.269	0.176	0.224	0.206
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	29.9	35.7	21.3	24.4	22.2
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U) (mg/kg)	1.80	1.16	1.06	0.959	1.09
	Vanadium (V) (mg/kg)	21.4	20.4	29.0	36.7	28.6
	Zinc (Zn) (mg/kg)	174	135	58.3	73.5	71.2
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	DLHM <0.010	DLHM <0.0085	<0.0050	<0.0050	<0.0050
	Acenaphthylene (mg/kg)	DLHM <0.010	DLHM <0.0085	<0.0050	<0.0050	<0.0050
	Acridine (mg/kg)	DLHM 0.024	DLHM <0.017	<0.010	<0.010	<0.010
	Anthracene (mg/kg)	DLHM <0.0080	DLHM <0.0068	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Benzo(a)pyrene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene (mg/kg)	DLHM 0.025	DLHM 0.017	<0.010	<0.010	<0.010
	Benzo(e)pyrene (mg/kg)	DLHM 0.023	DLHM <0.017	<0.010	<0.010	<0.010
	Benzo(g,h,i)perylene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Chrysene (mg/kg)	DLHM 0.046	DLHM 0.036	0.016	0.010	0.020
	Dibenz(a,h)anthracene (mg/kg)	DLHM <0.010	DLHM <0.0085	<0.0050	<0.0050	<0.0050
	Fluoranthene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Fluorene (mg/kg)	DLHM 0.025	DLHM 0.019	<0.010	<0.010	<0.010
	Indeno(1,2,3-c,d)pyrene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	1-Methylnaphthalene (mg/kg)	DLHM 0.133	DLHM 0.099	0.045	0.038	0.045
	2-Methylnaphthalene (mg/kg)	DLHM 0.202	DLHM 0.152	0.071	0.050	0.056
	Naphthalene (mg/kg)	DLHM 0.060	DLHM 0.046	0.022	0.025	0.024
	Perylene (mg/kg)	DLHM 0.027	DLHM <0.010	<0.010	<0.010	0.017
	Phenanthrene (mg/kg)	DLHM 0.155	DLHM 0.109	0.047	0.038	0.056
	Pyrene (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Quinoline (mg/kg)	DLHM <0.020	DLHM <0.017	<0.010	<0.010	<0.010
	Surrogate: d10-Acenaphthene (%)	73.7	82.9	80.2	81.4	83.6
	Surrogate: d12-Chrysene (%)	99.6	96.0	90.2	92.2	97.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-11	L2163882-12	L2163882-13		
	Description	SE	SE	SE		
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18		
	Sampled Time	11:30	12:00	09:30		
	Client ID	RG_EL20-4_SE_20180911-1130	RG_EL20-5_SE_20180911-1200	RG_DUP_SE_20180911-0930		
Grouping	**Analyte**					
SOIL						
Metals	Silver (Ag) (mg/kg)	0.15	0.12	0.11		
	Sodium (Na) (mg/kg)	79	81	85		
	Strontium (Sr) (mg/kg)	81.9	84.6	94.7		
	Sulfur (S) (mg/kg)	<1000	<1000	<1000		
	Thallium (Tl) (mg/kg)	0.203	0.196	0.173		
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0		
	Titanium (Ti) (mg/kg)	21.7	19.0	19.0		
	Tungsten (W) (mg/kg)	<0.50	<0.50	<0.50		
	Uranium (U) (mg/kg)	1.00	0.964	0.961		
	Vanadium (V) (mg/kg)	29.0	27.7	26.1		
	Zinc (Zn) (mg/kg)	71.5	63.1	59.5		
	Zirconium (Zr) (mg/kg)	<1.0	<1.0	<1.0		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Acenaphthylene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Acridine (mg/kg)	<0.010	<0.010	<0.010		
	Anthracene (mg/kg)	<0.0040	<0.0040	<0.0040		
	Benz(a)anthracene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(a)pyrene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(b&j)fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(e)pyrene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(g,h,i)perylene (mg/kg)	<0.010	<0.010	<0.010		
	Benzo(k)fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Chrysene (mg/kg)	0.022	0.020	0.023		
	Dibenz(a,h)anthracene (mg/kg)	<0.0050	<0.0050	<0.0050		
	Fluoranthene (mg/kg)	<0.010	<0.010	<0.010		
	Fluorene (mg/kg)	<0.010	<0.010	0.010		
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010	<0.010	<0.010		
	1-Methylnaphthalene (mg/kg)	0.060	0.061	0.065		
	2-Methylnaphthalene (mg/kg)	0.085	0.092	0.103		
	Naphthalene (mg/kg)	0.028	0.030	0.035		
	Perylene (mg/kg)	0.011	<0.010	<0.010		
	Phenanthrene (mg/kg)	0.065	0.060	0.066		
	Pyrene (mg/kg)	<0.010	<0.010	<0.010		
	Quinoline (mg/kg)	<0.010	<0.010	<0.010		
	Surrogate: d10-Acenaphthene (%)	79.8	84.6	82.4		
	Surrogate: d12-Chrysene (%)	95.5	94.6	94.0		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-1	L2163882-2	L2163882-3	L2163882-4	L2163882-5
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:40	15:30	14:10	12:43
	Client ID	RG_ELUGH1_SE_20180911-1410	RG_ELUGH2_SE_20180911-1440	RG_ELUGH3_SE_20180911-1530	RG_DUP_SE_20180911-1410	RG_SLINE1_SE_20180911-1243
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	79.8	67.9	76.4	78.5	79.7
	Surrogate: d10-Phenanthrene (%)	87.1	86.3	86.0	86.2	97.7
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020	<0.020	0.024
	IACR (CCME) (mg/kg)	<0.15	0.18	<0.15	<0.15	0.39

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-6	L2163882-7	L2163882-8	L2163882-9	L2163882-10
	Description	SE	SE	SE	SE	SE
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	13:04	15:13	09:30	10:15	10:45
	Client ID	RG_SLINE2_SE_20180911-1304	RG_SLINE3_SE_20180911-1513	RG_EL20-1_SE_20180911-0930	RG_EL20-2_SE_20180911-1015	RG_EL20-3_SE_20180911-1045
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	70.3	83.3	82.0	84.3	85.2
	Surrogate: d10-Phenanthrene (%)	91.2	89.0	87.1	87.5	93.0
	B(a)P Total Potency Equivalent (mg/kg)	0.021	<0.020	<0.020	<0.020	<0.020
	IACR (CCME) (mg/kg)	0.32	0.25	<0.15	<0.15	<0.15

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163882-11	L2163882-12	L2163882-13		
	Description	SE	SE	SE		
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18		
	Sampled Time	11:30	12:00	09:30		
	Client ID	RG_EL20-4_SE_20180911-1130	RG_EL20-5_SE_20180911-1200	RG_DUP_SE_20180911-0930		
Grouping	**Analyte**					
SOIL						
Polycyclic Aromatic Hydrocarbons	Surrogate: d8-Naphthalene (%)	80.4	88.3	84.3		
	Surrogate: d10-Phenanthrene (%)	90.0	91.8	90.1		
	B(a)P Total Potency Equivalent (mg/kg)	<0.020	<0.020	<0.020		
	IACR (CCME) (mg/kg)	<0.15	<0.15	<0.15		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2163882-11	RG_EL20-4_SE_20180911-1	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2163882-5	RG_SLINE1_SE_20180911-1	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2163882-6	RG_SLINE2_SE_20180911-1	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.
L2163882-7	RG_SLINE3_SE_20180911-1	PSAL	Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Benz(a)anthracene	DUP-H	L2163882-1, -2, -3, -4, -5, -6
Duplicate	Fluoranthene	DUP-H	L2163882-1, -2, -3, -4, -5, -6
Duplicate	Phenanthrene	DUP-H	L2163882-1, -2, -3, -4, -5, -6
Duplicate	Pyrene	DUP-H	L2163882-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic Interference due to co-elution.
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
DLQ	Detection Limit raised due to co-eluting interference. GCMS qualifier ion ratio did not meet acceptance criteria.
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-200.2-CVAA-CL	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-CL	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

MOISTURE-CL	Soil	% Moisture	CWS for PHC in Soil - Tier 1

This analysis is carried out gravimetrically by drying the sample at 105 C

PAH-TMB-D/A-MS-CL	Soil	PAH by Tumbler Extraction (DCM/Acetone)	EPA 3570/8270

Polycyclic Aromatic Hydrocarbons in Sediment/Soil
This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of DCM and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-1:2-CL	Soil	pH in soil (1:2 Soil:Water Extraction)	CSSS Ch. 16

Soil and de-ionized water (by volume) are mixed in a defined ratio. The slurry is allowed to stand, shaken, and then allowed to stand again prior to taking measurements. After equilibration, the pH of the liquid portion of the extract is measured by a pH meter. Field Measurement is recommended where accurate pH measurements are required, due to the 15 minute recommended hold time.

Reference Information

PH-1:9-CL	Soil	pH (1:9 H2O)	CSSS Ch. 16

Soil and de-ionized water (by volume) are mixed in a defined ratio. The slurry is allowed to stand, shaken, and then allowed to stand again prior to taking measurements. After equilibration, the pH of the liquid portion of the extract is measured by a pH meter. Field Measurement is recommended where accurate pH measurements are required, due to the 15 minute recommended hold time.

PSA-PIPET-DETAIL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4223354								
WG2879430-2 LCS								
Inorganic Carbon			98.9		%		80-120	19-SEP-18
WG2879430-3 MB								
Inorganic Carbon			<0.050		%		0.05	19-SEP-18
Batch R4223388								
WG2877286-1 DUP		**L2163882-2**						
Inorganic Carbon		1.78	1.76		%	0.6	20	19-SEP-18
WG2877286-2 LCS								
Inorganic Carbon			97.5		%		80-120	19-SEP-18
WG2877286-3 MB								
Inorganic Carbon			<0.050		%		0.05	19-SEP-18
C-TOT-LECO-SK	**Soil**							
Batch R4222600								
WG2876130-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			99.8		%		80-120	17-SEP-18
WG2876130-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			98.9		%		90-110	17-SEP-18
WG2876130-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	17-SEP-18
Batch R4222612								
WG2877228-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			104.3		%		80-120	18-SEP-18
WG2877228-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			100.4		%		90-110	18-SEP-18
WG2877228-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	18-SEP-18
HG-200.2-CVAA-CL	**Soil**							
Batch R4217968								
WG2878733-4 CRM		**TILL-1**						
Mercury (Hg)			92.3		%		70-130	17-SEP-18
WG2878733-9 CRM		**TILL-1**						
Mercury (Hg)			96.6		%		70-130	18-SEP-18
WG2878733-3 LCS								
Mercury (Hg)			95.8		%		80-120	17-SEP-18
WG2878733-8 LCS								
Mercury (Hg)			90.1		%		80-120	18-SEP-18
WG2878733-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	17-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-200.2-CVAA-CL	**Soil**							
Batch R4217968								
WG2878733-6 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	18-SEP-18
MET-200.2-CCMS-CL	**Soil**							
Batch R4217560								
WG2878733-4 CRM		**TILL-1**						
Aluminum (Al)			100.2		%		70-130	17-SEP-18
Antimony (Sb)			109.5		%		70-130	17-SEP-18
Arsenic (As)			101.1		%		70-130	17-SEP-18
Barium (Ba)			102.3		%		70-130	17-SEP-18
Beryllium (Be)			90.4		%		70-130	17-SEP-18
Bismuth (Bi)			105.5		%		70-130	17-SEP-18
Boron (B)			3.1		mg/kg		0-8.2	17-SEP-18
Cadmium (Cd)			109.3		%		70-130	17-SEP-18
Calcium (Ca)			114.8		%		70-130	17-SEP-18
Chromium (Cr)			100.0		%		70-130	17-SEP-18
Cobalt (Co)			98.3		%		70-130	17-SEP-18
Copper (Cu)			95.3		%		70-130	17-SEP-18
Iron (Fe)			99.7		%		70-130	17-SEP-18
Lead (Pb)			112.8		%		70-130	17-SEP-18
Lithium (Li)			85.0		%		70-130	17-SEP-18
Magnesium (Mg)			96.5		%		70-130	17-SEP-18
Manganese (Mn)			92.5		%		70-130	17-SEP-18
Molybdenum (Mo)			108.0		%		70-130	17-SEP-18
Nickel (Ni)			97.8		%		70-130	17-SEP-18
Phosphorus (P)			97.7		%		70-130	17-SEP-18
Potassium (K)			113.9		%		70-130	17-SEP-18
Selenium (Se)			0.32		mg/kg		0.11-0.51	17-SEP-18
Silver (Ag)			0.22		mg/kg		0.13-0.33	17-SEP-18
Sodium (Na)			113.5		%		70-130	17-SEP-18
Strontium (Sr)			118.1		%		70-130	17-SEP-18
Thallium (Tl)			0.139		mg/kg		0.077-0.18	17-SEP-18
Tin (Sn)			1.1		mg/kg		0-3.1	17-SEP-18
Titanium (Ti)			120.1		%		70-130	17-SEP-18
Tungsten (W)			0.17		mg/kg		0-0.66	17-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4217560								
WG2878733-4 CRM		**TILL-1**						
Uranium (U)			110.3		%		70-130	17-SEP-18
Vanadium (V)			98.8		%		70-130	17-SEP-18
Zinc (Zn)			99.9		%		70-130	17-SEP-18
Zirconium (Zr)			0.8		mg/kg		0-1.8	17-SEP-18
WG2878733-3 LCS								
Aluminum (Al)			103.6		%		80-120	17-SEP-18
Antimony (Sb)			106.8		%		80-120	17-SEP-18
Arsenic (As)			103.2		%		80-120	17-SEP-18
Barium (Ba)			113.6		%		80-120	17-SEP-18
Beryllium (Be)			101.4		%		80-120	17-SEP-18
Bismuth (Bi)			102.7		%		80-120	17-SEP-18
Boron (B)			102.7		%		80-120	17-SEP-18
Cadmium (Cd)			104.4		%		80-120	17-SEP-18
Calcium (Ca)			103.8		%		80-120	17-SEP-18
Chromium (Cr)			103.8		%		80-120	17-SEP-18
Cobalt (Co)			104.8		%		80-120	17-SEP-18
Copper (Cu)			102.5		%		80-120	17-SEP-18
Iron (Fe)			102.0		%		80-120	17-SEP-18
Lead (Pb)			104.7		%		80-120	17-SEP-18
Lithium (Li)			95.4		%		80-120	17-SEP-18
Magnesium (Mg)			103.1		%		80-120	17-SEP-18
Manganese (Mn)			103.9		%		80-120	17-SEP-18
Molybdenum (Mo)			111.1		%		80-120	17-SEP-18
Nickel (Ni)			103.0		%		80-120	17-SEP-18
Potassium (K)			104.7		%		80-120	17-SEP-18
Selenium (Se)			106.4		%		80-120	17-SEP-18
Silver (Ag)			99.7		%		80-120	17-SEP-18
Sodium (Na)			102.1		%		80-120	17-SEP-18
Strontium (Sr)			107.8		%		80-120	17-SEP-18
Sulfur (S)			103.6		%		80-120	17-SEP-18
Thallium (Tl)			98.4		%		80-120	17-SEP-18
Tin (Sn)			102.7		%		80-120	17-SEP-18
Titanium (Ti)			101.4		%		80-120	17-SEP-18
Tungsten (W)			109.5		%		80-120	17-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4217560								
WG2878733-3 LCS								
Uranium (U)			110.7		%		80-120	17-SEP-18
Vanadium (V)			103.6		%		80-120	17-SEP-18
Zinc (Zn)			104.8		%		80-120	17-SEP-18
Zirconium (Zr)			104.9		%		80-120	17-SEP-18
WG2878733-1 MB								
Aluminum (Al)			<50		mg/kg		50	17-SEP-18
Antimony (Sb)			<0.10		mg/kg		0.1	17-SEP-18
Arsenic (As)			<0.10		mg/kg		0.1	17-SEP-18
Barium (Ba)			<0.50		mg/kg		0.5	17-SEP-18
Beryllium (Be)			<0.10		mg/kg		0.1	17-SEP-18
Bismuth (Bi)			<0.20		mg/kg		0.2	17-SEP-18
Boron (B)			<5.0		mg/kg		5	17-SEP-18
Cadmium (Cd)			<0.020		mg/kg		0.02	17-SEP-18
Calcium (Ca)			<50		mg/kg		50	17-SEP-18
Chromium (Cr)			<0.50		mg/kg		0.5	17-SEP-18
Cobalt (Co)			<0.10		mg/kg		0.1	17-SEP-18
Copper (Cu)			<0.50		mg/kg		0.5	17-SEP-18
Iron (Fe)			<50		mg/kg		50	17-SEP-18
Lead (Pb)			<0.50		mg/kg		0.5	17-SEP-18
Lithium (Li)			<2.0		mg/kg		2	17-SEP-18
Magnesium (Mg)			<20		mg/kg		20	17-SEP-18
Manganese (Mn)			<1.0		mg/kg		1	17-SEP-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	17-SEP-18
Nickel (Ni)			<0.50		mg/kg		0.5	17-SEP-18
Phosphorus (P)			<50		mg/kg		50	17-SEP-18
Potassium (K)			<100		mg/kg		100	17-SEP-18
Selenium (Se)			<0.20		mg/kg		0.2	17-SEP-18
Silver (Ag)			<0.10		mg/kg		0.1	17-SEP-18
Sodium (Na)			<50		mg/kg		50	17-SEP-18
Strontium (Sr)			<0.50		mg/kg		0.5	17-SEP-18
Sulfur (S)			<1000		mg/kg		1000	17-SEP-18
Thallium (Tl)			<0.050		mg/kg		0.05	17-SEP-18
Tin (Sn)			<2.0		mg/kg		2	17-SEP-18
Titanium (Ti)			<1.0		mg/kg		1	17-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4217560								
WG2878733-1 MB								
Tungsten (W)			<0.50		mg/kg		0.5	17-SEP-18
Uranium (U)			<0.050		mg/kg		0.05	17-SEP-18
Vanadium (V)			<0.20		mg/kg		0.2	17-SEP-18
Zinc (Zn)			<2.0		mg/kg		2	17-SEP-18
Zirconium (Zr)			<1.0		mg/kg		1	17-SEP-18
Batch R4219319								
WG2878733-6 MB								
Aluminum (Al)			<50		mg/kg		50	17-SEP-18
Antimony (Sb)			<0.10		mg/kg		0.1	17-SEP-18
Arsenic (As)			<0.10		mg/kg		0.1	17-SEP-18
Barium (Ba)			<0.50		mg/kg		0.5	17-SEP-18
Beryllium (Be)			<0.10		mg/kg		0.1	17-SEP-18
Bismuth (Bi)			<0.20		mg/kg		0.2	17-SEP-18
Boron (B)			<5.0		mg/kg		5	17-SEP-18
Cadmium (Cd)			<0.020		mg/kg		0.02	17-SEP-18
Calcium (Ca)			<50		mg/kg		50	17-SEP-18
Chromium (Cr)			<0.50		mg/kg		0.5	17-SEP-18
Cobalt (Co)			<0.10		mg/kg		0.1	17-SEP-18
Copper (Cu)			<0.50		mg/kg		0.5	17-SEP-18
Iron (Fe)			<50		mg/kg		50	17-SEP-18
Lead (Pb)			<0.50		mg/kg		0.5	17-SEP-18
Lithium (Li)			<2.0		mg/kg		2	17-SEP-18
Magnesium (Mg)			<20		mg/kg		20	17-SEP-18
Manganese (Mn)			<1.0		mg/kg		1	17-SEP-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	17-SEP-18
Nickel (Ni)			<0.50		mg/kg		0.5	17-SEP-18
Phosphorus (P)			<50		mg/kg		50	17-SEP-18
Potassium (K)			<100		mg/kg		100	17-SEP-18
Selenium (Se)			<0.20		mg/kg		0.2	17-SEP-18
Silver (Ag)			<0.10		mg/kg		0.1	17-SEP-18
Sodium (Na)			<50		mg/kg		50	17-SEP-18
Strontium (Sr)			<0.50		mg/kg		0.5	17-SEP-18
Sulfur (S)			<1000		mg/kg		1000	17-SEP-18
Thallium (Tl)			<0.050		mg/kg		0.05	17-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-CL	**Soil**							
Batch R4219319								
WG2878733-6 MB								
Tin (Sn)			<2.0		mg/kg		2	17-SEP-18
Titanium (Ti)			<1.0		mg/kg		1	17-SEP-18
Tungsten (W)			<0.50		mg/kg		0.5	17-SEP-18
Uranium (U)			<0.050		mg/kg		0.05	17-SEP-18
Vanadium (V)			<0.20		mg/kg		0.2	17-SEP-18
Zinc (Zn)			<2.0		mg/kg		2	17-SEP-18
Zirconium (Zr)			<1.0		mg/kg		1	17-SEP-18
MOISTURE-CL	**Soil**							
Batch R4217138								
WG2877126-2 LCS								
Moisture			104.6		%		90-110	14-SEP-18
WG2877126-1 MB								
Moisture			<0.25		%		0.25	14-SEP-18
Batch R4218451								
WG2878350-3 DUP		**L2163882-7**						
Moisture		73.6	74.4		%	1.0	20	18-SEP-18
WG2878350-2 LCS								
Moisture			104.6		%		90-110	18-SEP-18
WG2878350-1 MB								
Moisture			<0.25		%		0.25	18-SEP-18
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217232								
WG2878044-1 LCS								
Acenaphthene			72.1		%		60-130	15-SEP-18
Acenaphthylene			71.3		%		60-130	15-SEP-18
Acridine			88.5		%		60-130	15-SEP-18
Anthracene			72.8		%		60-130	15-SEP-18
Benz(a)anthracene			92.2		%		60-130	15-SEP-18
Benzo(a)pyrene			90.3		%		60-130	15-SEP-18
Benzo(b&j)fluoranthene			91.5		%		60-130	15-SEP-18
Benzo(g,h,i)perylene			92.8		%		60-130	15-SEP-18
Benzo(k)fluoranthene			95.4		%		60-130	15-SEP-18
Benzo(e)pyrene			101.6		%		60-130	15-SEP-18
Chrysene			99.9		%		60-130	15-SEP-18
Dibenz(a,h)anthracene			91.7		%		60-130	15-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217232								
WG2878044-1 LCS								
Fluoranthene			81.7		%		60-130	15-SEP-18
Fluorene			73.2		%		60-130	15-SEP-18
Indeno(1,2,3-c,d)pyrene			88.9		%		60-130	15-SEP-18
1-Methylnaphthalene			78.1		%		60-130	15-SEP-18
2-Methylnaphthalene			72.8		%		60-130	15-SEP-18
Naphthalene			72.2		%		50-130	15-SEP-18
Perylene			101.7		%		60-130	15-SEP-18
Phenanthrene			73.2		%		60-130	15-SEP-18
Pyrene			83.2		%		60-130	15-SEP-18
Quinoline			85.5		%		60-130	15-SEP-18
WG2878044-6 LCS								
Acenaphthene			74.0		%		60-130	15-SEP-18
Acenaphthylene			71.0		%		60-130	15-SEP-18
Acridine			92.4		%		60-130	15-SEP-18
Anthracene			80.2		%		60-130	15-SEP-18
Benz(a)anthracene			98.4		%		60-130	15-SEP-18
Benzo(a)pyrene			100.4		%		60-130	15-SEP-18
Benzo(b&j)fluoranthene			103.7		%		60-130	15-SEP-18
Benzo(g,h,i)perylene			93.5		%		60-130	15-SEP-18
Benzo(k)fluoranthene			102.6		%		60-130	15-SEP-18
Benzo(e)pyrene			112.7		%		60-130	15-SEP-18
Chrysene			101.2		%		60-130	15-SEP-18
Dibenz(a,h)anthracene			94.3		%		60-130	15-SEP-18
Fluoranthene			88.9		%		60-130	15-SEP-18
Fluorene			79.2		%		60-130	15-SEP-18
Indeno(1,2,3-c,d)pyrene			86.9		%		60-130	15-SEP-18
1-Methylnaphthalene			80.6		%		60-130	15-SEP-18
2-Methylnaphthalene			74.4		%		60-130	15-SEP-18
Naphthalene			76.4		%		50-130	15-SEP-18
Perylene			113.4		%		60-130	15-SEP-18
Phenanthrene			80.6		%		60-130	15-SEP-18
Pyrene			91.2		%		60-130	15-SEP-18
Quinoline			84.1		%		60-130	15-SEP-18
WG2878044-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	16-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217232								
WG2878044-2 MB								
Acenaphthylene			<0.0050		mg/kg		0.005	16-SEP-18
Acridine			<0.010		mg/kg		0.01	16-SEP-18
Anthracene			<0.0040		mg/kg		0.004	16-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	16-SEP-18
Chrysene			<0.010		mg/kg		0.01	16-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	16-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Fluorene			<0.010		mg/kg		0.01	16-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	16-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	16-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	16-SEP-18
Naphthalene			<0.010		mg/kg		0.01	16-SEP-18
Perylene			<0.010		mg/kg		0.01	16-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	16-SEP-18
Pyrene			<0.010		mg/kg		0.01	16-SEP-18
Quinoline			<0.010		mg/kg		0.01	16-SEP-18
Surrogate: d8-Naphthalene			80.7		%		50-130	16-SEP-18
Surrogate: d10-Acenaphthene			76.6		%		60-130	16-SEP-18
Surrogate: d10-Phenanthrene			79.6		%		60-130	16-SEP-18
Surrogate: d12-Chrysene			95.3		%		60-130	16-SEP-18
WG2878044-5 MB								
Acenaphthene			<0.0050		mg/kg		0.005	15-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	15-SEP-18
Acridine			<0.010		mg/kg		0.01	15-SEP-18
Anthracene			<0.0040		mg/kg		0.004	15-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	15-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217232								
WG2878044-5 MB								
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	15-SEP-18
Chrysene			<0.010		mg/kg		0.01	15-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	15-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	15-SEP-18
Fluorene			<0.010		mg/kg		0.01	15-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	15-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	15-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	15-SEP-18
Naphthalene			<0.010		mg/kg		0.01	15-SEP-18
Perylene			<0.010		mg/kg		0.01	15-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	15-SEP-18
Pyrene			<0.010		mg/kg		0.01	15-SEP-18
Quinoline			<0.010		mg/kg		0.01	15-SEP-18
Surrogate: d8-Naphthalene			72.9		%		50-130	15-SEP-18
Surrogate: d10-Acenaphthene			71.1		%		60-130	15-SEP-18
Surrogate: d10-Phenanthrene			78.0		%		60-130	15-SEP-18
Surrogate: d12-Chrysene			99.3		%		60-130	15-SEP-18
WG2878044-7 MB								
Acenaphthene			<0.0050		mg/kg		0.005	16-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	16-SEP-18
Acridine			<0.010		mg/kg		0.01	16-SEP-18
Anthracene			<0.0040		mg/kg		0.004	16-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	16-SEP-18
Chrysene			<0.010		mg/kg		0.01	16-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	16-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	16-SEP-18
Fluorene			<0.010		mg/kg		0.01	16-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	16-SEP-18

Environmental

Quality Control Report

Workorder: L2163882 Report Date: 20-SEP-18

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4217232								
WG2878044-7 MB								
1-Methylnaphthalene			<0.010		mg/kg		0.01	16-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	16-SEP-18
Naphthalene			<0.010		mg/kg		0.01	16-SEP-18
Perylene			<0.010		mg/kg		0.01	16-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	16-SEP-18
Pyrene			<0.010		mg/kg		0.01	16-SEP-18
Quinoline			<0.010		mg/kg		0.01	16-SEP-18
Surrogate: d8-Naphthalene			85.7		%		50-130	16-SEP-18
Surrogate: d10-Acenaphthene			82.2		%		60-130	16-SEP-18
Surrogate: d10-Phenanthrene			86.6		%		60-130	16-SEP-18
Surrogate: d12-Chrysene			99.5		%		60-130	16-SEP-18
Batch R4228128								
WG2881028-3 DUP		**L2163882-7**						
Acenaphthene		<0.0085	<0.0085	RPD-NA	mg/kg	N/A	50	18-SEP-18
Acenaphthylene		<0.0085	<0.0085	RPD-NA	mg/kg	N/A	50	18-SEP-18
Acridine		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Anthracene		<0.0068	<0.0068	RPD-NA	mg/kg	N/A	50	18-SEP-18
Benz(a)anthracene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Benzo(a)pyrene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Benzo(b&j)fluoranthene		0.017	0.019		mg/kg	8.2	50	18-SEP-18
Benzo(g,h,i)perylene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Benzo(k)fluoranthene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Benzo(e)pyrene		<0.017	0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Chrysene		0.036	0.040		mg/kg	8.6	50	18-SEP-18
Dibenz(a,h)anthracene		<0.0085	<0.0085	RPD-NA	mg/kg	N/A	50	18-SEP-18
Fluoranthene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Fluorene		0.019	0.019		mg/kg	4.7	50	18-SEP-18
Indeno(1,2,3-c,d)pyrene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
1-Methylnaphthalene		0.099	0.103		mg/kg	3.9	50	18-SEP-18
2-Methylnaphthalene		0.152	0.154		mg/kg	0.9	50	18-SEP-18
Naphthalene		0.046	0.043		mg/kg	5.2	50	18-SEP-18
Perylene		<0.010	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
Phenanthrene		0.109	0.115		mg/kg	5.3	50	18-SEP-18
Pyrene		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-3 DUP		**L2163882-7**						
Quinoline		<0.017	<0.017	RPD-NA	mg/kg	N/A	50	18-SEP-18
WG2881028-1 LCS								
Acenaphthene			74.0		%		60-130	18-SEP-18
Acenaphthylene			70.7		%		60-130	18-SEP-18
Acridine			86.5		%		60-130	18-SEP-18
Anthracene			75.5		%		60-130	18-SEP-18
Benz(a)anthracene			86.5		%		60-130	18-SEP-18
Benzo(a)pyrene			84.2		%		60-130	18-SEP-18
Benzo(b&j)fluoranthene			84.1		%		60-130	18-SEP-18
Benzo(g,h,i)perylene			90.4		%		60-130	18-SEP-18
Benzo(k)fluoranthene			92.1		%		60-130	18-SEP-18
Benzo(e)pyrene			95.2		%		60-130	18-SEP-18
Chrysene			92.9		%		60-130	18-SEP-18
Dibenz(a,h)anthracene			92.4		%		60-130	18-SEP-18
Fluoranthene			80.4		%		60-130	18-SEP-18
Fluorene			75.3		%		60-130	18-SEP-18
Indeno(1,2,3-c,d)pyrene			84.9		%		60-130	18-SEP-18
1-Methylnaphthalene			81.9		%		60-130	18-SEP-18
2-Methylnaphthalene			74.7		%		60-130	18-SEP-18
Naphthalene			74.0		%		50-130	18-SEP-18
Perylene			94.9		%		60-130	18-SEP-18
Phenanthrene			76.8		%		60-130	18-SEP-18
Pyrene			81.5		%		60-130	18-SEP-18
Quinoline			74.5		%		60-130	18-SEP-18
WG2881028-11 LCS								
Acenaphthene			79.7		%		60-130	20-SEP-18
Acenaphthylene			77.5		%		60-130	20-SEP-18
Acridine			91.9		%		60-130	20-SEP-18
Anthracene			81.6		%		60-130	20-SEP-18
Benz(a)anthracene			88.2		%		60-130	20-SEP-18
Benzo(a)pyrene			93.6		%		60-130	20-SEP-18
Benzo(b&j)fluoranthene			92.9		%		60-130	20-SEP-18
Benzo(g,h,i)perylene			85.2		%		60-130	20-SEP-18
Benzo(k)fluoranthene			96.2		%		60-130	20-SEP-18
Benzo(e)pyrene			103.9		%		60-130	20-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-11 LCS								
Chrysene			89.0		%		60-130	20-SEP-18
Dibenz(a,h)anthracene			85.7		%		60-130	20-SEP-18
Fluoranthene			83.8		%		60-130	20-SEP-18
Fluorene			83.5		%		60-130	20-SEP-18
Indeno(1,2,3-c,d)pyrene			80.7		%		60-130	20-SEP-18
1-Methylnaphthalene			88.6		%		60-130	20-SEP-18
2-Methylnaphthalene			83.7		%		60-130	20-SEP-18
Naphthalene			81.5		%		50-130	20-SEP-18
Perylene			104.9		%		60-130	20-SEP-18
Phenanthrene			82.9		%		60-130	20-SEP-18
Pyrene			85.4		%		60-130	20-SEP-18
Quinoline			95.3		%		60-130	20-SEP-18
WG2881028-8 LCS								
Acenaphthene			75.6		%		60-130	19-SEP-18
Acenaphthylene			73.2		%		60-130	19-SEP-18
Acridine			88.4		%		60-130	19-SEP-18
Anthracene			76.3		%		60-130	19-SEP-18
Benz(a)anthracene			84.4		%		60-130	19-SEP-18
Benzo(a)pyrene			87.9		%		60-130	19-SEP-18
Benzo(b&j)fluoranthene			87.4		%		60-130	19-SEP-18
Benzo(g,h,i)perylene			80.1		%		60-130	19-SEP-18
Benzo(k)fluoranthene			92.4		%		60-130	19-SEP-18
Benzo(e)pyrene			98.0		%		60-130	19-SEP-18
Chrysene			85.3		%		60-130	19-SEP-18
Dibenz(a,h)anthracene			80.0		%		60-130	19-SEP-18
Fluoranthene			78.3		%		60-130	19-SEP-18
Fluorene			78.9		%		60-130	19-SEP-18
Indeno(1,2,3-c,d)pyrene			75.8		%		60-130	19-SEP-18
1-Methylnaphthalene			84.6		%		60-130	19-SEP-18
2-Methylnaphthalene			78.7		%		60-130	19-SEP-18
Naphthalene			77.4		%		50-130	19-SEP-18
Perylene			99.9		%		60-130	19-SEP-18
Phenanthrene			78.4		%		60-130	19-SEP-18
Pyrene			81.0		%		60-130	19-SEP-18

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Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-8 LCS								
Quinoline			90.9		%		60-130	19-SEP-18
WG2881028-2 MB								
Acenaphthene			<0.0050		mg/kg		0.005	18-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	18-SEP-18
Acridine			<0.010		mg/kg		0.01	18-SEP-18
Anthracene			<0.0040		mg/kg		0.004	18-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	18-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	18-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	18-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	18-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	18-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	18-SEP-18
Chrysene			<0.010		mg/kg		0.01	18-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	18-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	18-SEP-18
Fluorene			<0.010		mg/kg		0.01	18-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	18-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	18-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	18-SEP-18
Naphthalene			<0.010		mg/kg		0.01	18-SEP-18
Perylene			<0.010		mg/kg		0.01	18-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	18-SEP-18
Pyrene			<0.010		mg/kg		0.01	18-SEP-18
Quinoline			<0.010		mg/kg		0.01	18-SEP-18
Surrogate: d8-Naphthalene			81.7		%		50-130	18-SEP-18
Surrogate: d10-Acenaphthene			77.9		%		60-130	18-SEP-18
Surrogate: d10-Phenanthrene			78.0		%		60-130	18-SEP-18
Surrogate: d12-Chrysene			93.6		%		60-130	18-SEP-18
WG2881028-5 MB								
Acenaphthene			<0.0050		mg/kg		0.005	19-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	19-SEP-18
Acridine			<0.010		mg/kg		0.01	19-SEP-18
Anthracene			<0.0040		mg/kg		0.004	19-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	19-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-5 MB								
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	19-SEP-18
Chrysene			<0.010		mg/kg		0.01	19-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	19-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	19-SEP-18
Fluorene			<0.010		mg/kg		0.01	19-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	19-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	19-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	19-SEP-18
Naphthalene			<0.010		mg/kg		0.01	19-SEP-18
Perylene			<0.010		mg/kg		0.01	19-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	19-SEP-18
Pyrene			<0.010		mg/kg		0.01	19-SEP-18
Quinoline			<0.010		mg/kg		0.01	19-SEP-18
Surrogate: d8-Naphthalene			84.8		%		50-130	19-SEP-18
Surrogate: d10-Acenaphthene			80.2		%		60-130	19-SEP-18
Surrogate: d10-Phenanthrene			78.6		%		60-130	19-SEP-18
Surrogate: d12-Chrysene			82.0		%		60-130	19-SEP-18
WG2881028-9 MB								
Acenaphthene			<0.0050		mg/kg		0.005	19-SEP-18
Acenaphthylene			<0.0050		mg/kg		0.005	19-SEP-18
Acridine			<0.010		mg/kg		0.01	19-SEP-18
Anthracene			<0.0040		mg/kg		0.004	19-SEP-18
Benz(a)anthracene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(a)pyrene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	19-SEP-18
Benzo(e)pyrene			<0.010		mg/kg		0.01	19-SEP-18
Chrysene			<0.010		mg/kg		0.01	19-SEP-18
Dibenz(a,h)anthracene			<0.0050		mg/kg		0.005	19-SEP-18
Fluoranthene			<0.010		mg/kg		0.01	19-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-9 MB								
Fluorene			<0.010		mg/kg		0.01	19-SEP-18
Indeno(1,2,3-c,d)pyrene			<0.010		mg/kg		0.01	19-SEP-18
1-Methylnaphthalene			<0.010		mg/kg		0.01	19-SEP-18
2-Methylnaphthalene			<0.010		mg/kg		0.01	19-SEP-18
Naphthalene			<0.010		mg/kg		0.01	19-SEP-18
Perylene			<0.010		mg/kg		0.01	19-SEP-18
Phenanthrene			<0.010		mg/kg		0.01	19-SEP-18
Pyrene			<0.010		mg/kg		0.01	19-SEP-18
Quinoline			<0.010		mg/kg		0.01	19-SEP-18
Surrogate: d8-Naphthalene			77.5		%		50-130	19-SEP-18
Surrogate: d10-Acenaphthene			76.8		%		60-130	19-SEP-18
Surrogate: d10-Phenanthrene			78.2		%		60-130	19-SEP-18
Surrogate: d12-Chrysene			86.8		%		60-130	19-SEP-18
WG2881028-4 MS		**L2163882-11**						
Acenaphthene			76.8		%		50-150	18-SEP-18
Acenaphthylene			74.7		%		50-150	18-SEP-18
Acridine			98.6		%		50-150	18-SEP-18
Anthracene			85.7		%		50-150	18-SEP-18
Benz(a)anthracene			97.9		%		50-150	18-SEP-18
Benzo(a)pyrene			95.7		%		50-150	18-SEP-18
Benzo(b&j)fluoranthene			97.0		%		50-150	18-SEP-18
Benzo(g,h,i)perylene			89.7		%		50-150	18-SEP-18
Benzo(k)fluoranthene			97.3		%		50-150	18-SEP-18
Benzo(e)pyrene			103.7		%		50-150	18-SEP-18
Chrysene			97.3		%		50-150	18-SEP-18
Dibenz(a,h)anthracene			94.6		%		50-150	18-SEP-18
Fluoranthene			91.1		%		50-150	18-SEP-18
Fluorene			82.0		%		50-150	18-SEP-18
Indeno(1,2,3-c,d)pyrene			98.1		%		50-150	18-SEP-18
1-Methylnaphthalene			81.6		%		50-150	18-SEP-18
2-Methylnaphthalene			80.2		%		50-150	18-SEP-18
Naphthalene			76.1		%		50-150	18-SEP-18
Perylene			107.0		%		50-150	18-SEP-18
Phenanthrene			86.8		%		50-150	18-SEP-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TMB-D/A-MS-CL	**Soil**							
Batch R4228128								
WG2881028-4 MS		**L2163882-11**						
Pyrene			94.0		%		50-150	18-SEP-18
Quinoline			92.2		%		50-150	18-SEP-18
PH-1:2-CL	**Soil**							
Batch R4220808								
WG2879943-10 DUP		**L2163882-13**						
pH (1:2 soil:water)		7.78	7.75	J	pH	0.03	0.2	18-SEP-18
WG2879943-7 IRM		**SAL-STD9**						
pH (1:2 soil:water)			8.01		pH		7.7-8.3	18-SEP-18
WG2879943-9 IRM		**SAL-STD9**						
pH (1:2 soil:water)			7.88		pH		7.7-8.3	18-SEP-18
PH-1:9-CL	**Soil**							
Batch R4218034								
WG2878928-1 IRM		**SAL-STD9**						
pH (1:9)			8.50		pH		8.36-8.96	17-SEP-18
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4224513								
WG2879455-1 DUP		**L2163882-13**						
% Gravel (>2mm)		5.3	5.3		%	0.0	25	19-SEP-18
% Sand (2.00mm - 1.00mm)		3.4	3.2	J	%	0.2	5	19-SEP-18
% Sand (1.00mm - 0.50mm)		6.1	5.9	J	%	0.2	5	19-SEP-18
% Sand (0.50mm - 0.25mm)		12.6	12.3	J	%	0.3	5	19-SEP-18
% Sand (0.25mm - 0.125mm)		17.6	16.8	J	%	0.8	5	19-SEP-18
% Sand (0.125mm - 0.063mm)		14.3	13.9	J	%	0.4	5	19-SEP-18
% Silt (0.063mm - 0.0312mm)		17.2	17.9	J	%	0.7	5	19-SEP-18
% Silt (0.0312mm - 0.004mm)		20.0	21.1	J	%	1.1	5	19-SEP-18
% Clay (<4um)		3.6	3.6	J	%	0.1	5	19-SEP-18
WG2879455-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			3.7		%		0-7.6	19-SEP-18
% Sand (1.00mm - 0.50mm)			3.5		%		0-8.9	19-SEP-18
% Sand (0.50mm - 0.25mm)			10.5		%		5.3-15.3	19-SEP-18
% Sand (0.25mm - 0.125mm)			16.0		%		10-20	19-SEP-18
% Sand (0.125mm - 0.063mm)			12.8		%		7.3-17.3	19-SEP-18
% Silt (0.063mm - 0.0312mm)			13.8		%		9.9-19.9	19-SEP-18
% Silt (0.0312mm - 0.004mm)			22.5		%		17.6-27.6	19-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-PIPET-DETAIL-SK	**Soil**							
Batch R4224513								
WG2879455-2 IRM		**2017-PSA**						
% Clay (<4um)			17.1		%		13.4-23.4	19-SEP-18
Batch R4224653								
WG2878509-2 IRM		**2017-PSA**						
% Sand (2.00mm - 1.00mm)			2.8		%		0-7.6	19-SEP-18
% Sand (1.00mm - 0.50mm)			3.6		%		0-8.9	19-SEP-18
% Sand (0.50mm - 0.25mm)			10.0		%		5.3-15.3	19-SEP-18
% Sand (0.25mm - 0.125mm)			14.9		%		10-20	19-SEP-18
% Sand (0.125mm - 0.063mm)			13.9		%		7.3-17.3	19-SEP-18
% Silt (0.063mm - 0.0312mm)			15.1		%		9.9-19.9	19-SEP-18
% Silt (0.0312mm - 0.004mm)			21.7		%		17.6-27.6	19-SEP-18
% Clay (<4um)			18.2		%		13.4-23.4	19-SEP-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	Regional Effects Program	TURNAROUND TIME:	Regular

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program/RAEMP		
Project Manager	Cait Good		
Email	cait.good@teck.com		
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Phone Number	250-425-8202		

LABORATORY

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Email 3:	colleen.mooney@teck.com	x	x	x
Email 4:	teckcoal@equisonline.com			x
Email 5:	jlnga@minnow.ca	x	x	x
PO number	VPO00563597			

L2163882-COFC

SAMPLE DETAILS / **ANALYSIS REQUESTED** (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	C-TOC-SK	MET-CCME+FULL-CL	MOISTURE-CL - % Moisture	PSA-PIPET-DETAIL-SK Particle Size	PAH-TMB-D/A-MS-CL-PAHs
							Filtered	N	N	N	N	N
							Preservative	NONE	NONE	NONE	NONE	NONE
RG_ELUGH1_SE_20180911-1410	RG_ELUGH	SE	No	11-Sep-18	2:10:00 PM	G	2	x	x	x	x	x
RG_ELUGH2_SE_20180911-1440	RG_ELUGH	SE	No	11-Sep-18	2:40:00 PM	G	2	x	x	x	x	x
RG_ELUGH3_SE_20180911-1530	RG_ELUGH	SE	No	11-Sep-18	3:30:00 PM	G	2	x	x	x	x	x
RG_DUP_SE_20180911-1410	RG_DUP	SE	No	11-Sep-18	2:10:00 PM	G	2	x	x	x	x	x
RG_SLINE1_SE_20180911-1243	RG_SLINE	SE	No	11-Sep-18	12:43:00 PM	G	2	x	x	x	x	x
RG_SLINE2_SE_20180911-1304	RG_SLINE	SE	No	11-Sep-18	1:04:00 PM	G	2	x	x	x	x	x
RG_SLINE3_SE_20180911-1513	RG_SLINE	SE	No	11-Sep-18	3:13:00 PM	G	2	x	x	x	x	x
RG_EL20-1_SE_20180911-0930	RG_EL20	SE	No	11-Sep-18	9:30:00 AM	G	2	x	x	x	x	x
RG_EL20-2_SE_20180911-1015	RG_EL20	SE	No	11-Sep-18	10:15:00 AM	G	2	x	x	x	x	x
RG_EL20-3_SE_20180911-1045	RG_EL20	SE	No	11-Sep-18	10:45:00 AM	G	2	x	x	x	x	x

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00563597	Shari Weech/Minnow	Sep 12/18; 16:00	[signature]	9/13 9:50

SERVICE REQUEST (rush - subject to availability)

Regular (default)	X
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Shari Weech	Mobile #	250-893-3322
Sampler's Signature	Shari Weech	Date/Time	September 12, 2018

3

Teck

COC ID:	Regional Effects Program	TURNAROUND TIME:	Regular

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program/RAEMP		
Project Manager	Cait Good		
Email	cait.good@teck.com		
Address	421 Pine Avenue		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

LABORATORY

Lab Name	ALS Calgary		
Lab Contact	Lyuda Shvets		
Email	Lyudmyla.Shvets@ALSGlobal.com		
Address	2559 29 Street NE		
City	Calgary	Province	AB
Postal Code	T1Y 7B5	Country	Canada
Phone Number	403-407-1800		

OTHER INFO

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Email 3:	colleen.mooney@teck.com	x	x	x
Email 4:	teckcoal@equisonline.com			x
Email 5:	jings@minnow.ca	x	x	x
PO number	VPO00563597			

L2163882-COFC

SAMPLE DETAILS / **ANALYSIS REQUESTED** Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	C-TOC-SK	MET-CCME+FULL-CL	MOISTURE-CL - % Moisture	PSA-PIPET-DETAIL-SK Particle Size	PAH-TMB-D/A-MS-CL-PAHs
FILTER								N	N	N	N	N
PRESERVATIVE								NONE	NONE	NONE	NONE	NONE
RG_EL20-4_SE_20180911-1130	RG_EL20	SE	No	11-Sep-18	11:30:00 AM	G	2	x	x	x	x	x
RG_EL20-5_SE_20180911-1200	RG_EL20	SE	No	11-Sep-18	12:00:00 PM	G	2	x	x	x	x	x
RG_DUP_SE_20180911-0930	RG_DUP	SE	No	11-Sep-18	9:30:00 AM	G	2	x	x	x	x	x

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00563597	Shari Weech/Minnow	Sep 12/18; 16:00		

SERVICE REQUEST (rush - subject to availability)

Regular (default)	X
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Shari Weech	Mobile #	250-893-3322
Sampler's Signature	Shari Weech	Date/Time	September 12, 2018

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 08-SEP-18
Report Date: 21-SEP-18 21:06 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2160853
Project P.O. #: VPO00552656
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: REGIONAL EFFECTS PRO
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2160853-1	L2160853-2			
	Description	WS	WS			
	Sampled Date	06-SEP-18	06-SEP-18			
	Sampled Time	15:00	15:00			
	Client ID	RG_SCDTC_WS_20180906-1500	RG_SCDTC_WS_20180906-1500_FB-HG			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	577				
	Hardness (as CaCO3) (mg/L)	301				
	pH (pH)	8.43				
	ORP (mV)	417				
	Total Suspended Solids (mg/L)	<1.0				
	Total Dissolved Solids (mg/L)	DLHC 374				
	Turbidity (NTU)	2.03				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	145				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	3.4				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	148				
	Ammonia as N (mg/L)	0.0090				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	2.13				
	Fluoride (F) (mg/L)	0.164				
	Ion Balance (%)	96.6				
	Nitrate (as N) (mg/L)	HTD 2.46				
	Nitrite (as N) (mg/L)	HTD 0.0055				
	Total Kjeldahl Nitrogen (mg/L)	TKNI 0.056				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	0.0044				
	Sulfate (SO4) (mg/L)	151				
	Anion Sum (meq/L)	6.34				
	Cation Sum (meq/L)	6.12				
	Cation - Anion Balance (%)	-1.7				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.53				
	Total Organic Carbon (mg/L)	1.29				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0288				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00016				
	Barium (Ba)-Total (mg/L)	0.0521				
	Beryllium (Be)-Total (ug/L)	<0.020				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (ug/L)	0.0160				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2160853-1	L2160853-2			
	Description	WS	WS			
	Sampled Date	06-SEP-18	06-SEP-18			
	Sampled Time	15:00	15:00			
	Client ID	RG_SCDTC_WS_20180906-1500	RG_SCDTC_WS_20180906-1500_FB-HG			
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	74.3				
	Chromium (Cr)-Total (mg/L)	0.00025				
	Cobalt (Co)-Total (ug/L)	<0.10				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	0.036				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0046				
	Magnesium (Mg)-Total (mg/L)	27.7				
	Manganese (Mn)-Total (mg/L)	0.00183				
	Mercury (Hg)-Total (ug/L)	0.00070	<0.00050			
	Molybdenum (Mo)-Total (mg/L)	0.00114				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Potassium (K)-Total (mg/L)	0.540				
	Selenium (Se)-Total (ug/L)	23.8				
	Silicon (Si)-Total (mg/L)	1.88				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	1.85				
	Strontium (Sr)-Total (mg/L)	0.271				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	0.00146				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Mercury Filtration Location	LAB				
	Dissolved Metals Filtration Location	LAB				
	Aluminum (Al)-Dissolved (mg/L)	<0.0030				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00013				
	Barium (Ba)-Dissolved (mg/L)	0.0547				
	Beryllium (Be)-Dissolved (ug/L)	<0.020				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	<0.010				
	Cadmium (Cd)-Dissolved (ug/L)	0.0096				
	Calcium (Ca)-Dissolved (mg/L)	71.4				
	Chromium (Cr)-Dissolved (mg/L)	0.00017				
	Cobalt (Co)-Dissolved (ug/L)	<0.10				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2160853-1	L2160853-2			
	Description	WS	WS			
	Sampled Date	06-SEP-18	06-SEP-18			
	Sampled Time	15:00	15:00			
	Client ID	RG_SCDTC_WS_20180906-1500	RG_SCDTC_WS_20180906-1500_FB-HG			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0049				
	Magnesium (Mg)-Dissolved (mg/L)	29.9				
	Manganese (Mn)-Dissolved (mg/L)	0.00032				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00116				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Potassium (K)-Dissolved (mg/L)	0.562				
	Selenium (Se)-Dissolved (ug/L)	23.8				
	Silicon (Si)-Dissolved (mg/L)	1.73				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	2.07				
	Strontium (Sr)-Dissolved (mg/L)	0.266				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	0.00140				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - DOC and dissolved metals to be filtered and preserved in lab; filter code added

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity (@ 25C)	MB-LOR	L2160853-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

ALS Test Code	Matrix	Test Description	Method Reference**
C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

ALS Test Code	Matrix	Test Description	Method Reference**
CL-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
EC-L-PCT-CL	Water	Electrical Conductivity (EC)	APHA 2510B

Reference Information

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL	Water	Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Reference Information

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

REGIONAL EFFECTS
PRO

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2160853 Report Date: 21-SEP-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0

Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R4214174								
WG2872035-11 LCS								
Acidity (as CaCO3)			109.7		%		85-115	09-SEP-18
WG2872035-10 MB								
Acidity (as CaCO3)			1.5		mg/L		2	09-SEP-18
ALK-MAN-CL	**Water**							
Batch R4216390								
WG2876549-29 LCS								
Alkalinity, Total (as CaCO3)			102.4		%		85-115	13-SEP-18
WG2876549-28 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	13-SEP-18
BE-D-L-CCMS-VA	**Water**							
Batch R4214602								
WG2874163-2 LCS								
Beryllium (Be)-Dissolved			91.8		%		80-120	12-SEP-18
WG2874163-1 MB		**LF**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	12-SEP-18
BE-T-L-CCMS-VA	**Water**							
Batch R4215703								
WG2874049-2 LCS								
Beryllium (Be)-Total			91.0		%		80-120	12-SEP-18
WG2874049-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	12-SEP-18
BR-L-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Bromide (Br)			96.7		%		85-115	10-SEP-18
WG2873367-5 MB								
Bromide (Br)			<0.050		mg/L		0.05	10-SEP-18
C-DIS-ORG-LOW-CL	**Water**							
Batch R4217134								
WG2877966-6 LCS								
Dissolved Organic Carbon			98.7		%		80-120	15-SEP-18
WG2877966-5 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	15-SEP-18
C-TOT-ORG-LOW-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TOT-ORG-LOW-CL	**Water**							
Batch R4217134								
WG2877966-6 LCS								
Total Organic Carbon			111.7		%		80-120	15-SEP-18
WG2877966-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	15-SEP-18
CL-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Chloride (Cl)			102.8		%		90-110	10-SEP-18
WG2873367-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	10-SEP-18
EC-L-PCT-CL	**Water**							
Batch R4216390								
WG2876549-29 LCS								
Conductivity (@ 25C)			108.2		%		90-110	13-SEP-18
WG2876549-28 MB								
Conductivity (@ 25C)			2.9	MB-LOR	uS/cm		2	13-SEP-18
F-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Fluoride (F)			106.1		%		90-110	10-SEP-18
WG2873367-5 MB								
Fluoride (F)			<0.020		mg/L		0.02	10-SEP-18
HG-D-CVAA-VA	**Water**							
Batch R4214861								
WG2874772-2 LCS								
Mercury (Hg)-Dissolved			100.5		%		80-120	13-SEP-18
WG2874772-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	13-SEP-18
HG-T-U-CVAF-VA	**Water**							
Batch R4215539								
WG2875690-2 LCS								
Mercury (Hg)-Total			93.6		%		80-120	13-SEP-18
WG2875690-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	13-SEP-18
MET-D-CCMS-VA	**Water**							

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4214602								
WG2874163-2 LCS								
Aluminum (Al)-Dissolved			96.6		%		80-120	12-SEP-18
Antimony (Sb)-Dissolved			97.2		%		80-120	12-SEP-18
Arsenic (As)-Dissolved			95.9		%		80-120	12-SEP-18
Barium (Ba)-Dissolved			94.8		%		80-120	12-SEP-18
Bismuth (Bi)-Dissolved			90.4		%		80-120	12-SEP-18
Boron (B)-Dissolved			89.5		%		80-120	12-SEP-18
Cadmium (Cd)-Dissolved			92.7		%		80-120	12-SEP-18
Calcium (Ca)-Dissolved			94.7		%		80-120	12-SEP-18
Chromium (Cr)-Dissolved			94.6		%		80-120	12-SEP-18
Cobalt (Co)-Dissolved			92.3		%		80-120	12-SEP-18
Copper (Cu)-Dissolved			91.6		%		80-120	12-SEP-18
Iron (Fe)-Dissolved			98.4		%		80-120	12-SEP-18
Lead (Pb)-Dissolved			89.5		%		80-120	12-SEP-18
Lithium (Li)-Dissolved			91.7		%		80-120	12-SEP-18
Magnesium (Mg)-Dissolved			94.7		%		80-120	12-SEP-18
Manganese (Mn)-Dissolved			95.5		%		80-120	12-SEP-18
Molybdenum (Mo)-Dissolved			98.5		%		80-120	12-SEP-18
Nickel (Ni)-Dissolved			93.3		%		80-120	12-SEP-18
Potassium (K)-Dissolved			92.1		%		80-120	12-SEP-18
Selenium (Se)-Dissolved			93.6		%		80-120	12-SEP-18
Silicon (Si)-Dissolved			92.7		%		60-140	12-SEP-18
Silver (Ag)-Dissolved			92.3		%		80-120	12-SEP-18
Sodium (Na)-Dissolved			105.7		%		80-120	12-SEP-18
Strontium (Sr)-Dissolved			92.6		%		80-120	12-SEP-18
Thallium (Tl)-Dissolved			91.6		%		80-120	12-SEP-18
Tin (Sn)-Dissolved			94.8		%		80-120	12-SEP-18
Titanium (Ti)-Dissolved			92.2		%		80-120	12-SEP-18
Uranium (U)-Dissolved			88.8		%		80-120	12-SEP-18
Vanadium (V)-Dissolved			93.4		%		80-120	12-SEP-18
Zinc (Zn)-Dissolved			96.6		%		80-120	12-SEP-18
WG2874163-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	12-SEP-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4214602								
WG2874163-1 MB		**LF**						
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	12-SEP-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	12-SEP-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	12-SEP-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	12-SEP-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	12-SEP-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-18
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	12-SEP-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	12-SEP-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	12-SEP-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	12-SEP-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	12-SEP-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	12-SEP-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	12-SEP-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	12-SEP-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	12-SEP-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	12-SEP-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	12-SEP-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	12-SEP-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	12-SEP-18
MET-T-CCMS-VA	**Water**							
Batch R4215703								
WG2874049-2 LCS								
Aluminum (Al)-Total			96.9		%		80-120	12-SEP-18
Antimony (Sb)-Total			99.5		%		80-120	12-SEP-18
Arsenic (As)-Total			94.1		%		80-120	12-SEP-18
Barium (Ba)-Total			89.6		%		80-120	12-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4215703								
WG2874049-2 LCS								
Bismuth (Bi)-Total			96.7		%		80-120	12-SEP-18
Boron (B)-Total			89.2		%		80-120	12-SEP-18
Cadmium (Cd)-Total			93.2		%		80-120	12-SEP-18
Calcium (Ca)-Total			89.7		%		80-120	12-SEP-18
Chromium (Cr)-Total			90.3		%		80-120	12-SEP-18
Cobalt (Co)-Total			91.4		%		80-120	12-SEP-18
Copper (Cu)-Total			89.2		%		80-120	12-SEP-18
Iron (Fe)-Total			90.4		%		80-120	12-SEP-18
Lead (Pb)-Total			97.5		%		80-120	12-SEP-18
Lithium (Li)-Total			89.1		%		80-120	12-SEP-18
Magnesium (Mg)-Total			92.8		%		80-120	12-SEP-18
Manganese (Mn)-Total			92.1		%		80-120	12-SEP-18
Molybdenum (Mo)-Total			91.6		%		80-120	12-SEP-18
Nickel (Ni)-Total			90.4		%		80-120	12-SEP-18
Potassium (K)-Total			97.3		%		80-120	12-SEP-18
Selenium (Se)-Total			92.5		%		80-120	12-SEP-18
Silicon (Si)-Total			97.2		%		80-120	12-SEP-18
Silver (Ag)-Total			86.2		%		80-120	12-SEP-18
Sodium (Na)-Total			88.0		%		80-120	12-SEP-18
Strontium (Sr)-Total			89.8		%		80-120	12-SEP-18
Thallium (Tl)-Total			99.2		%		80-120	12-SEP-18
Tin (Sn)-Total			93.6		%		80-120	12-SEP-18
Titanium (Ti)-Total			93.7		%		80-120	12-SEP-18
Uranium (U)-Total			93.3		%		80-120	12-SEP-18
Vanadium (V)-Total			92.5		%		80-120	12-SEP-18
Zinc (Zn)-Total			90.0		%		80-120	12-SEP-18
WG2874049-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	12-SEP-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	12-SEP-18
Boron (B)-Total			<0.010		mg/L		0.01	12-SEP-18
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	12-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4215703								
WG2874049-1 MB								
Calcium (Ca)-Total			<0.050		mg/L		0.05	12-SEP-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Copper (Cu)-Total			<0.00050		mg/L		0.0005	12-SEP-18
Iron (Fe)-Total			<0.010		mg/L		0.01	12-SEP-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	12-SEP-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	12-SEP-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	12-SEP-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	12-SEP-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	12-SEP-18
Potassium (K)-Total			<0.050		mg/L		0.05	12-SEP-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	12-SEP-18
Silicon (Si)-Total			<0.10		mg/L		0.1	12-SEP-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	12-SEP-18
Sodium (Na)-Total			<0.050		mg/L		0.05	12-SEP-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	12-SEP-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	12-SEP-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	12-SEP-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	12-SEP-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	12-SEP-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	12-SEP-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	12-SEP-18
NH3-L-F-CL	**Water**							
Batch R4223131								
WG2880771-2 LCS								
Ammonia as N			103.3		%		85-115	19-SEP-18
WG2880771-1 MB								
Ammonia as N			<0.0050		mg/L		0.005	19-SEP-18
NO2-L-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Nitrite (as N)			106.7		%		90-110	10-SEP-18
WG2873367-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	10-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Nitrate (as N)			103.6		%		90-110	10-SEP-18
WG2873367-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	10-SEP-18
ORP-CL	**Water**							
Batch R4214475								
WG2873749-7 CRM		**CL-ORP**						
ORP			226		mV		210-230	11-SEP-18
P-T-L-COL-CL	**Water**							
Batch R4228308								
WG2881771-82 LCS								
Phosphorus (P)-Total			104.9		%		80-120	20-SEP-18
WG2881771-81 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	20-SEP-18
PH-CL	**Water**							
Batch R4216390								
WG2876549-29 LCS								
pH			7.01		pH		6.9-7.1	13-SEP-18
PO4-DO-L-COL-CL	**Water**							
Batch R4207327								
WG2871821-14 LCS								
Orthophosphate-Dissolved (as P)			103.9		%		80-120	09-SEP-18
WG2871821-13 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	09-SEP-18
SO4-IC-N-CL	**Water**							
Batch R4210942								
WG2873367-6 LCS								
Sulfate (SO4)			103.5		%		90-110	10-SEP-18
WG2873367-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	10-SEP-18
SOLIDS-TDS-CL	**Water**							
Batch R4215421								
WG2874239-11 LCS								
Total Dissolved Solids			96.1		%		85-115	12-SEP-18
WG2874239-10 MB								

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TDS-CL	**Water**							
Batch R4215421								
WG2874239-10 MB								
Total Dissolved Solids			<10		mg/L		10	12-SEP-18
TKN-L-F-CL	**Water**							
Batch R4217558								
WG2876260-6 LCS								
Total Kjeldahl Nitrogen			108.8		%		75-125	17-SEP-18
WG2876260-5 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-18
TSS-LOW-VA	**Water**							
Batch R4216054								
WG2876318-2 LCS								
Total Suspended Solids			104.5		%		85-115	13-SEP-18
WG2876318-1 MB								
Total Suspended Solids			<1.0		mg/L		1	13-SEP-18
TURBIDITY-CL	**Water**							
Batch R4205681								
WG2871530-15 DUP		**L2160853-1**						
Turbidity		2.03	2.09		NTU	2.9	15	08-SEP-18
WG2871530-14 LCS								
Turbidity			98.0		%		85-115	08-SEP-18
WG2871530-13 MB								
Turbidity			<0.10		NTU		0.1	08-SEP-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	06-SEP-18 15:00	11-SEP-18 15:50	0.25	121	hours	EHTR-FM
pH							
	1	06-SEP-18 15:00	13-SEP-18 17:00	0.25	170	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Water by IC (Low Level)							
	1	06-SEP-18 15:00	10-SEP-18 09:34	3	4	days	EHT
Nitrite in Water by IC (Low Level)							
	1	06-SEP-18 15:00	10-SEP-18 09:34	3	4	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2160853 were received on 08-SEP-18 09:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

Page 1 of

COC ID:	Regional Effects Program	TURNAROUND

L2160853-COFC

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program/Upper Greenhills Calcite		
Project Manager	Cait Good		
Email	cait.good@teck.com		
Address	421 Pine Avenue		
City	Sparwood	Province	BC
Postal Code	V0B 2G0	Country	Canada
Phone Number	250-425-8202		

Lab Name	A		
Lab Contact	Lyuda Shvets		
Email	Lyudmyla.Shvets@ALSGlobal.com		
Address	2559 29 Street NE		
City	Calgary	Province	AB
Postal Code	T1Y 7B5	Country	Canada
Phone Number	403-407-1800		

R INFO

		Excel	PDF	EDD
	k.com	x	x	x
	k.com	x	x	x
Email 3:	colle...y@teck.com	x	x	x
Email 4:	teckcoal@equisonline.com			x
Email 5:	sweech@minnow.ca	x	x	x
PO number	VPO00552656			

SAMPLE DETAILS / ANALYSIS REQUESTED

Filtered - F: Field, L: Lab, FL: Field & Lab, N: None

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	HG-T-U-CVAF-VA	ALS_Package-DOC	ALS_Package-TKN/TOC	HG-D-CVAF-VA	TECKCOAL-MET-D-VA	TECKCOAL-MET-T-VA	TECKCOAL-ROUTINE-VA
FILTERED								N	N	N	N	N	N	N
PRESERV.								NONE	NONE	H2SO4	NONE	NONE	HNO3	NONE
RG_SCDTC_WS_20180906-1500	RG_SCDTC	WS	No	06-Sep-18	3:00:00 PM	G	7	1	1	1	1	1	1	1
RG_SCDTC_WS_20180906-1500_FB-HG	RG_SCDTC	WS	No	06-Sep-18	3:00:00 PM	G	1	1						

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00552656	Shari Weech/Minnow	Sep 7/18; 17:00		09/08 9:50

SERVICE REQUEST (rush - subject to availability)				
Regular (default) X	Sampler's Name	Shari Weech	Mobile #	250-893-3322
Priority (2-3 business days) - 50% surcharge				
Emergency (1 Business Day) - 100% surcharge	Sampler's Signature	Shari Weech	Date/Time	September 7, 2018
For Emergency <1 Day, ASAP or Weekend - Contact ALS				

5

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 11-SEP-18
Report Date: 25-SEP-18 09:29 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2161891
Project P.O. #: VPO00552656
Job Reference: Regional Effects Program
C of C Numbers: Regional Effects Pr
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2161891-1	L2161891-2	L2161891-3	L2161891-4	L2161891-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	09-SEP-18	09-SEP-18	07-SEP-18	07-SEP-18	08-SEP-18
	Sampled Time	11:45	11:45	15:00	15:00	12:23
	Client ID	GH_ERSC4_WS_20180909-1145	GH_ERSC4_WS_20180909-1145_FB-HG	RG_GH_SCW3_WS_20180907-1500	RG_GH_SCW3_WS_20180907-1500_FB-HG	GH_ER1A_WS_20180908-1223
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	303		589		304
	Hardness (as CaCO3) (mg/L)	166		297		158
	pH (pH)	8.35		8.39		8.41
	ORP (mV)	444		397		318
	Total Suspended Solids (mg/L)	2.2		4.2		<1.0
	Total Dissolved Solids (mg/L)	158 DLHC		426 DLHC		197 DLHC
	Turbidity (NTU)	0.63		1.30		0.55
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0		<1.0		<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	139		149		143
	Alkalinity, Carbonate (as CaCO3) (mg/L)	2.2		3.2		3.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0		<1.0		<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	142		152		146
	Ammonia as N (mg/L)	<0.0050		0.0059		0.0069
	Bromide (Br) (mg/L)	<0.050		<0.050		<0.050
	Chloride (Cl) (mg/L)	<0.50		2.13		<0.50
	Fluoride (F) (mg/L)	0.175		0.162		0.176
	Ion Balance (%)	103		92.0		96.1
	Nitrate (as N) (mg/L)	0.0366		2.57		0.0309
	Nitrite (as N) (mg/L)	<0.0010		0.0021		<0.0010
	Total Kjeldahl Nitrogen (mg/L)	<0.050		0.092 TKNI		<0.050
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010		<0.0010		<0.0010
	Phosphorus (P)-Total (mg/L)	0.0060		0.0084		0.0038
	Sulfate (SO4) (mg/L)	19.2		158		19.2
	Anion Sum (meq/L)	3.24		6.58		3.34
	Cation Sum (meq/L)	3.35		6.06		3.21
	Cation - Anion Balance (%)	1.7		-4.1		-2.0
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	0.93		1.40		0.89
	Total Organic Carbon (mg/L)	0.97		1.31		0.85
Total Metals	Aluminum (Al)-Total (mg/L)	0.0119		0.0247		0.0077
	Antimony (Sb)-Total (mg/L)	<0.00010		<0.00010		<0.00010
	Arsenic (As)-Total (mg/L)	0.00015		0.00017		0.00015
	Barium (Ba)-Total (mg/L)	0.0473		0.0518		0.0472
	Beryllium (Be)-Total (ug/L)	<0.020		<0.020		<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050		<0.000050		<0.000050
	Boron (B)-Total (mg/L)	<0.010		<0.010		<0.010
	Cadmium (Cd)-Total (ug/L)	0.0119		0.0148		0.0091

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161891-6	L2161891-7	L2161891-8		
	Description	WS	WS	WS		
	Sampled Date	08-SEP-18	08-SEP-18	08-SEP-18		
	Sampled Time	12:23	08:45	08:45		
	Client ID	GH_ER1A_WS_20180908-1223_FB-HG	RG_ERSC5_WS_20180908-0845	RG_ERSC5_WS_20180908-0845_FB-HG		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)		301			
	Hardness (as CaCO3) (mg/L)		163			
	pH (pH)		8.43			
	ORP (mV)		366			
	Total Suspended Solids (mg/L)		4.1			
	Total Dissolved Solids (mg/L)		189 DLHC			
	Turbidity (NTU)		1.58			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)		<1.0			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		141			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		3.8			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)		145			
	Ammonia as N (mg/L)		<0.0050			
	Bromide (Br) (mg/L)		<0.050			
	Chloride (Cl) (mg/L)		<0.50			
	Fluoride (F) (mg/L)		0.174			
	Ion Balance (%)		100			
	Nitrate (as N) (mg/L)		0.0236			
	Nitrite (as N) (mg/L)		<0.0010			
	Total Kjeldahl Nitrogen (mg/L)		<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)		<0.0010			
	Phosphorus (P)-Total (mg/L)		0.0050			
	Sulfate (SO4) (mg/L)		19.2			
	Anion Sum (meq/L)		3.30			
	Cation Sum (meq/L)		3.30			
	Cation - Anion Balance (%)		0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		0.92			
	Total Organic Carbon (mg/L)		0.90			
Total Metals	Aluminum (Al)-Total (mg/L)		0.0140			
	Antimony (Sb)-Total (mg/L)		<0.00010			
	Arsenic (As)-Total (mg/L)		0.00015			
	Barium (Ba)-Total (mg/L)		0.0479			
	Beryllium (Be)-Total (ug/L)		<0.020			
	Bismuth (Bi)-Total (mg/L)		<0.000050			
	Boron (B)-Total (mg/L)		<0.010			
	Cadmium (Cd)-Total (ug/L)		0.0121			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161891-1	L2161891-2	L2161891-3	L2161891-4	L2161891-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	09-SEP-18	09-SEP-18	07-SEP-18	07-SEP-18	08-SEP-18
	Sampled Time	11:45	11:45	15:00	15:00	12:23
	Client ID	GH_ERSC4_WS_20180909-1145	GH_ERSC4_WS_20180909-1145_FB-HG	RG_GH_SCW3_WS_20180907-1500	RG_GH_SCW3_WS_20180907-1500_FB-HG	GH_ER1A_WS_20180908-1223
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	47.5		76.5		46.3
	Chromium (Cr)-Total (mg/L)	0.00026		0.00024		0.00026
	Cobalt (Co)-Total (ug/L)	<0.10		<0.10		<0.10
	Copper (Cu)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Iron (Fe)-Total (mg/L)	0.016		0.033		0.011
	Lead (Pb)-Total (mg/L)	<0.000050		<0.000050		<0.000050
	Lithium (Li)-Total (mg/L)	0.0017		0.0048		0.0017
	Magnesium (Mg)-Total (mg/L)	11.0		30.4		11.1
	Manganese (Mn)-Total (mg/L)	0.00269		0.00196		0.00127
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	0.00051	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.00102		0.00113		0.00104
	Nickel (Ni)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Potassium (K)-Total (mg/L)	0.357		0.559		0.356
	Selenium (Se)-Total (ug/L)	0.702		22.3		0.700
	Silicon (Si)-Total (mg/L)	1.76		1.78		1.71
	Silver (Ag)-Total (mg/L)	<0.000010		<0.000010		<0.000010
	Sodium (Na)-Total (mg/L)	0.672		2.12		0.661
	Strontium (Sr)-Total (mg/L)	0.215		0.283		0.216
	Thallium (Tl)-Total (mg/L)	<0.000010		<0.000010		<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010		<0.00010		<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010		<0.010		<0.010
	Uranium (U)-Total (mg/L)	0.000653		0.00139		0.000633
	Vanadium (V)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030		<0.0030		<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	LAB		LAB		LAB
	Dissolved Metals Filtration Location	LAB		LAB		LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0030		<0.0030		<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010		<0.00010		<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00010		0.00011		<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0531		0.0592		0.0540
	Beryllium (Be)-Dissolved (ug/L)	<0.020		<0.020		<0.020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050		<0.000050		<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Cadmium (Cd)-Dissolved (ug/L)	0.0061		0.0097		0.0067
	Calcium (Ca)-Dissolved (mg/L)	47.2		71.2		45.8
	Chromium (Cr)-Dissolved (mg/L)	0.00023		0.00016		0.00025
	Cobalt (Co)-Dissolved (ug/L)	<0.10		<0.10		<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161891-6	L2161891-7	L2161891-8		
	Description	WS	WS	WS		
	Sampled Date	08-SEP-18	08-SEP-18	08-SEP-18		
	Sampled Time	12:23	08:45	08:45		
	Client ID	GH_ER1A_WS_20180908-1223_FB-HG	RG_ERSC5_WS_20180908-0845	RG_ERSC5_WS_20180908-0845_FB-HG		
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)		47.5			
	Chromium (Cr)-Total (mg/L)		0.00024			
	Cobalt (Co)-Total (ug/L)		<0.10			
	Copper (Cu)-Total (mg/L)		<0.00050			
	Iron (Fe)-Total (mg/L)		0.017			
	Lead (Pb)-Total (mg/L)		<0.000050			
	Lithium (Li)-Total (mg/L)		0.0017			
	Magnesium (Mg)-Total (mg/L)		11.1			
	Manganese (Mn)-Total (mg/L)		0.00141			
	Mercury (Hg)-Total (ug/L)	<0.00050	0.00052	<0.00050		
	Molybdenum (Mo)-Total (mg/L)		0.00103			
	Nickel (Ni)-Total (mg/L)		<0.00050			
	Potassium (K)-Total (mg/L)		0.369			
	Selenium (Se)-Total (ug/L)		0.730			
	Silicon (Si)-Total (mg/L)		1.74			
	Silver (Ag)-Total (mg/L)		<0.000010			
	Sodium (Na)-Total (mg/L)		0.665			
	Strontium (Sr)-Total (mg/L)		0.217			
	Thallium (Tl)-Total (mg/L)		<0.000010			
	Tin (Sn)-Total (mg/L)		<0.00010			
	Titanium (Ti)-Total (mg/L)		<0.010			
	Uranium (U)-Total (mg/L)		0.000648			
	Vanadium (V)-Total (mg/L)		<0.00050			
	Zinc (Zn)-Total (mg/L)		<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location		LAB			
	Dissolved Metals Filtration Location		LAB			
	Aluminum (Al)-Dissolved (mg/L)		<0.0030			
	Antimony (Sb)-Dissolved (mg/L)		<0.00010			
	Arsenic (As)-Dissolved (mg/L)		<0.00010			
	Barium (Ba)-Dissolved (mg/L)		0.0513			
	Beryllium (Be)-Dissolved (ug/L)		<0.020			
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050			
	Boron (B)-Dissolved (mg/L)		<0.010			
	Cadmium (Cd)-Dissolved (ug/L)		0.0071			
	Calcium (Ca)-Dissolved (mg/L)		46.5			
	Chromium (Cr)-Dissolved (mg/L)		0.00025			
	Cobalt (Co)-Dissolved (ug/L)		<0.10			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID		L2161891-1	L2161891-2	L2161891-3	L2161891-4	L2161891-5
Description		WS	WS	WS	WS	WS
Sampled Date		09-SEP-18	09-SEP-18	07-SEP-18	07-SEP-18	08-SEP-18
Sampled Time		11:45	11:45	15:00	15:00	12:23
Client ID		GH_ERSC4_WS_20180909-1145	GH_ERSC4_WS_20180909-1145_FB-HG	RG_GH_SCW3_WS_20180907-1500	RG_GH_SCW3_WS_20180907-1500_FB-HG	GH_ER1A_WS_20180908-1223
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050		<0.000050		<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0019		0.0050		0.0019
	Magnesium (Mg)-Dissolved (mg/L)	11.6		29.0		10.7
	Manganese (Mn)-Dissolved (mg/L)	0.00104		0.00049		0.00054
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050		<0.0000050		<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00110		0.00114		0.00114
	Nickel (Ni)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Potassium (K)-Dissolved (mg/L)	0.396		0.626		0.415
	Selenium (Se)-Dissolved (ug/L)	0.736		22.2		0.749
	Silicon (Si)-Dissolved (mg/L)	1.80		1.75		1.72
	Silver (Ag)-Dissolved (mg/L)	<0.000010		<0.000010		<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.682		2.20		0.733
	Strontium (Sr)-Dissolved (mg/L)	0.198		0.264		0.208
	Thallium (Tl)-Dissolved (mg/L)	<0.000010		<0.000010		<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010		<0.00010		<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Uranium (U)-Dissolved (mg/L)	0.000724		0.00149		0.000747
	Vanadium (V)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010		<0.0010		<0.0010

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2161891-6	L2161891-7	L2161891-8		
	Description	WS	WS	WS		
	Sampled Date	08-SEP-18	08-SEP-18	08-SEP-18		
	Sampled Time	12:23	08:45	08:45		
	Client ID	GH_ER1A_WS_20180908-1223_FB-HG	RG_ERSC5_WS_20180908-0845	RG_ERSC5_WS_20180908-0845_FB-HG		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)		<0.00050			
	Iron (Fe)-Dissolved (mg/L)		<0.010			
	Lead (Pb)-Dissolved (mg/L)		<0.000050			
	Lithium (Li)-Dissolved (mg/L)		0.0019			
	Magnesium (Mg)-Dissolved (mg/L)		11.5			
	Manganese (Mn)-Dissolved (mg/L)		0.00016			
	Mercury (Hg)-Dissolved (mg/L)		<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)		0.00107			
	Nickel (Ni)-Dissolved (mg/L)		<0.00050			
	Potassium (K)-Dissolved (mg/L)		0.394			
	Selenium (Se)-Dissolved (ug/L)		0.833			
	Silicon (Si)-Dissolved (mg/L)		1.80			
	Silver (Ag)-Dissolved (mg/L)		<0.000010			
	Sodium (Na)-Dissolved (mg/L)		0.668			
	Strontium (Sr)-Dissolved (mg/L)		0.191			
	Thallium (Tl)-Dissolved (mg/L)		<0.000010			
	Tin (Sn)-Dissolved (mg/L)		<0.00010			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)		0.000676			
	Vanadium (V)-Dissolved (mg/L)		<0.00050			
	Zinc (Zn)-Dissolved (mg/L)		<0.0010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - Lab to filter, preserve for DOC, Dissolved Metals

Qualifiers for Individual Samples Listed:

Sample Numbe	Client Sample ID	Qualifier	Description
L2161891-3	RG_GH_SCW3_WS_201809	EHR	Exceeded Recommended Holding Time prior to receipt at the lab. - NO2,NO3 EXPIRED UPON ARRIVAL AT LABORATORY

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2161891-1, -3, -5, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2161891-1, -3, -5, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
TKNI	TKN result may be biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

ALS Test Code	Matrix	Test Description	Method Reference**
BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by

Reference Information

subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL Water Total Organic Carbon APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-IC-N-CL Water Chloride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL Water Electrical Conductivity (EC) APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA Water Total Mercury in Water by CVAFS (Ultra) EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL Water Ion Balance Calculation APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL Water Ammonia, Total (as N) J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Regional Effects Pr

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2161891   Report Date: 25-SEP-18

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0
Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R4218013								
WG2878906-3 DUP		**L2161891-7**						
Acidity (as CaCO3)		<1.0	<1.0	RPD-NA	mg/L	N/A	20	17-SEP-18
WG2878906-2 LCS								
Acidity (as CaCO3)			103.0		%		85-115	17-SEP-18
WG2878906-1 MB								
Acidity (as CaCO3)			1.6		mg/L		2	17-SEP-18
ALK-MAN-CL	**Water**							
Batch R4228181								
WG2880416-6 DUP		**L2161891-5**						
Alkalinity, Total (as CaCO3)		146	146		mg/L	0.3	20	18-SEP-18
WG2880416-2 LCS								
Alkalinity, Total (as CaCO3)			102.7		%		85-115	18-SEP-18
WG2880416-5 LCS								
Alkalinity, Total (as CaCO3)			100.3		%		85-115	18-SEP-18
WG2880416-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-SEP-18
WG2880416-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-SEP-18
BE-D-L-CCMS-VA	**Water**							
Batch R4215743								
WG2875357-2 LCS								
Beryllium (Be)-Dissolved			94.8		%		80-120	13-SEP-18
WG2875357-1 MB		**LF**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	13-SEP-18
BE-T-L-CCMS-VA	**Water**							
Batch R4215759								
WG2875134-2 LCS								
Beryllium (Be)-Total			93.9		%		80-120	13-SEP-18
WG2875134-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	13-SEP-18
BR-L-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Bromide (Br)			103.9		%		85-115	11-SEP-18
WG2875491-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	11-SEP-18
C-DIS-ORG-LOW-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-LOW-CL	**Water**							
Batch R4217072								
WG2877852-6 LCS								
Dissolved Organic Carbon			101.2		%		80-120	15-SEP-18
WG2877852-5 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	15-SEP-18
C-TOT-ORG-LOW-CL	**Water**							
Batch R4217072								
WG2877852-6 LCS								
Total Organic Carbon			100.3		%		80-120	15-SEP-18
WG2877852-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	15-SEP-18
CL-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Chloride (Cl)			102.4		%		90-110	11-SEP-18
WG2875491-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	11-SEP-18
EC-L-PCT-CL	**Water**							
Batch R4228181								
WG2880416-6 DUP		**L2161891-5**						
Conductivity (@ 25C)		304	302		uS/cm	0.7	10	18-SEP-18
WG2880416-2 LCS								
Conductivity (@ 25C)			103.8		%		90-110	18-SEP-18
WG2880416-5 LCS								
Conductivity (@ 25C)			103.5		%		90-110	18-SEP-18
WG2880416-1 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	18-SEP-18
WG2880416-4 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	18-SEP-18
F-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Fluoride (F)			109.0		%		90-110	11-SEP-18
WG2875491-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	11-SEP-18
HG-D-CVAA-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-D-CVAA-VA	**Water**							
Batch R4214861								
WG2875246-2 LCS								
Mercury (Hg)-Dissolved			101.6		%		80-120	13-SEP-18
WG2875246-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	13-SEP-18
WG2875246-4 MS		**L2161891-7**						
Mercury (Hg)-Dissolved			83.7		%		70-130	13-SEP-18
HG-T-U-CVAF-VA	**Water**							
Batch R4216438								
WG2876833-2 LCS								
Mercury (Hg)-Total			95.4		%		80-120	14-SEP-18
WG2876833-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	14-SEP-18
WG2876833-4 MS		**L2161891-4**						
Mercury (Hg)-Total			88.0		%		70-130	14-SEP-18
MET-D-CCMS-VA	**Water**							
Batch R4215743								
WG2875357-2 LCS								
Aluminum (Al)-Dissolved			104.4		%		80-120	13-SEP-18
Antimony (Sb)-Dissolved			94.0		%		80-120	13-SEP-18
Arsenic (As)-Dissolved			102.9		%		80-120	13-SEP-18
Barium (Ba)-Dissolved			104.5		%		80-120	13-SEP-18
Bismuth (Bi)-Dissolved			88.8		%		80-120	13-SEP-18
Boron (B)-Dissolved			92.9		%		80-120	13-SEP-18
Cadmium (Cd)-Dissolved			102.0		%		80-120	13-SEP-18
Calcium (Ca)-Dissolved			99.0		%		80-120	13-SEP-18
Chromium (Cr)-Dissolved			102.1		%		80-120	13-SEP-18
Cobalt (Co)-Dissolved			100.8		%		80-120	13-SEP-18
Copper (Cu)-Dissolved			101.8		%		80-120	13-SEP-18
Iron (Fe)-Dissolved			103.5		%		80-120	13-SEP-18
Lead (Pb)-Dissolved			97.5		%		80-120	13-SEP-18
Lithium (Li)-Dissolved			97.4		%		80-120	13-SEP-18
Magnesium (Mg)-Dissolved			108.0		%		80-120	13-SEP-18
Manganese (Mn)-Dissolved			97.6		%		80-120	13-SEP-18
Molybdenum (Mo)-Dissolved			103.4		%		80-120	13-SEP-18
Nickel (Ni)-Dissolved			102.3		%		80-120	13-SEP-18
Potassium (K)-Dissolved			104.6		%		80-120	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4215743								
WG2875357-2 LCS								
Selenium (Se)-Dissolved			99.2		%		80-120	13-SEP-18
Silicon (Si)-Dissolved			97.0		%		60-140	13-SEP-18
Silver (Ag)-Dissolved			98.5		%		80-120	13-SEP-18
Sodium (Na)-Dissolved			103.6		%		80-120	13-SEP-18
Strontium (Sr)-Dissolved			96.8		%		80-120	13-SEP-18
Thallium (Tl)-Dissolved			91.2		%		80-120	13-SEP-18
Tin (Sn)-Dissolved			100.7		%		80-120	13-SEP-18
Titanium (Ti)-Dissolved			97.3		%		80-120	13-SEP-18
Uranium (U)-Dissolved			94.6		%		80-120	13-SEP-18
Vanadium (V)-Dissolved			103.8		%		80-120	13-SEP-18
Zinc (Zn)-Dissolved			104.1		%		80-120	13-SEP-18
WG2875357-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	13-SEP-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	13-SEP-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	13-SEP-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	13-SEP-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	13-SEP-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	13-SEP-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	13-SEP-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	13-SEP-18
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	13-SEP-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	13-SEP-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	13-SEP-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	13-SEP-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	13-SEP-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	13-SEP-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	13-SEP-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	13-SEP-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4215743								
WG2875357-1 MB		**LF**						
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	13-SEP-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	13-SEP-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	13-SEP-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	13-SEP-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	13-SEP-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	13-SEP-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	13-SEP-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	13-SEP-18
MET-T-CCMS-VA	**Water**							
Batch R4215759								
WG2875134-2 LCS								
Aluminum (Al)-Total			94.7		%		80-120	13-SEP-18
Antimony (Sb)-Total			103.6		%		80-120	13-SEP-18
Arsenic (As)-Total			96.2		%		80-120	13-SEP-18
Barium (Ba)-Total			97.2		%		80-120	13-SEP-18
Bismuth (Bi)-Total			103.6		%		80-120	13-SEP-18
Boron (B)-Total			90.2		%		80-120	13-SEP-18
Cadmium (Cd)-Total			93.7		%		80-120	13-SEP-18
Calcium (Ca)-Total			95.9		%		80-120	13-SEP-18
Chromium (Cr)-Total			95.0		%		80-120	13-SEP-18
Cobalt (Co)-Total			93.4		%		80-120	13-SEP-18
Copper (Cu)-Total			92.3		%		80-120	13-SEP-18
Iron (Fe)-Total			89.9		%		80-120	13-SEP-18
Lead (Pb)-Total			99.0		%		80-120	13-SEP-18
Lithium (Li)-Total			92.5		%		80-120	13-SEP-18
Magnesium (Mg)-Total			98.4		%		80-120	13-SEP-18
Manganese (Mn)-Total			94.9		%		80-120	13-SEP-18
Molybdenum (Mo)-Total			94.5		%		80-120	13-SEP-18
Nickel (Ni)-Total			94.6		%		80-120	13-SEP-18
Potassium (K)-Total			97.2		%		80-120	13-SEP-18
Selenium (Se)-Total			93.3		%		80-120	13-SEP-18
Silicon (Si)-Total			95.9		%		80-120	13-SEP-18
Silver (Ag)-Total			94.0		%		80-120	13-SEP-18
Sodium (Na)-Total			105.1		%		80-120	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4215759								
WG2875134-2 LCS								
Strontium (Sr)-Total			96.8		%		80-120	13-SEP-18
Thallium (Tl)-Total			104.5		%		80-120	13-SEP-18
Tin (Sn)-Total			94.6		%		80-120	13-SEP-18
Titanium (Ti)-Total			89.0		%		80-120	13-SEP-18
Uranium (U)-Total			87.9		%		80-120	13-SEP-18
Vanadium (V)-Total			96.1		%		80-120	13-SEP-18
Zinc (Zn)-Total			96.7		%		80-120	13-SEP-18
WG2875134-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	13-SEP-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Barium (Ba)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	13-SEP-18
Boron (B)-Total			<0.010		mg/L		0.01	13-SEP-18
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	13-SEP-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	13-SEP-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Copper (Cu)-Total			<0.00050		mg/L		0.0005	13-SEP-18
Iron (Fe)-Total			<0.010		mg/L		0.01	13-SEP-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	13-SEP-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	13-SEP-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	13-SEP-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	13-SEP-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	13-SEP-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	13-SEP-18
Potassium (K)-Total			<0.050		mg/L		0.05	13-SEP-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	13-SEP-18
Silicon (Si)-Total			<0.10		mg/L		0.1	13-SEP-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	13-SEP-18
Sodium (Na)-Total			<0.050		mg/L		0.05	13-SEP-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	13-SEP-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	13-SEP-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	13-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4215759								
WG2875134-1 MB								
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	13-SEP-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	13-SEP-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	13-SEP-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	13-SEP-18
NH3-L-F-CL	**Water**							
Batch R4228353								
WG2882292-2 LCS								
Ammonia as N			103.7		%		85-115	20-SEP-18
WG2882292-1 MB								
Ammonia as N			<0.0050		mg/L		0.005	20-SEP-18
NO2-L-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Nitrite (as N)			107.6		%		90-110	11-SEP-18
WG2875491-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	11-SEP-18
NO3-L-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Nitrate (as N)			102.6		%		90-110	11-SEP-18
WG2875491-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	11-SEP-18
ORP-CL	**Water**							
Batch R4218827								
WG2878689-6 CRM		**CL-ORP**						
ORP			218		mV		210-230	17-SEP-18
P-T-L-COL-CL	**Water**							
Batch R4236892								
WG2884824-58 LCS								
Phosphorus (P)-Total			96.0		%		80-120	24-SEP-18
WG2884824-57 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	24-SEP-18
PH-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-CL	**Water**							
Batch R4228181								
WG2880416-6 DUP		**L2161891-5**						
pH		8.41	8.41	J	pH	0.00	0.2	18-SEP-18
WG2880416-2 LCS								
pH			7.00		pH		6.9-7.1	18-SEP-18
WG2880416-5 LCS								
pH			7.00		pH		6.9-7.1	18-SEP-18
PO4-DO-L-COL-CL	**Water**							
Batch R4214104								
WG2874399-2 LCS								
Orthophosphate-Dissolved (as P)			103.6		%		80-120	11-SEP-18
WG2874399-1 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	11-SEP-18
SO4-IC-N-CL	**Water**							
Batch R4214977								
WG2875491-2 LCS								
Sulfate (SO4)			104.9		%		90-110	11-SEP-18
WG2875491-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	11-SEP-18
SOLIDS-TDS-CL	**Water**							
Batch R4216327								
WG2875458-11 LCS								
Total Dissolved Solids			98.3		%		85-115	13-SEP-18
WG2875458-10 MB								
Total Dissolved Solids			<10		mg/L		10	13-SEP-18
Batch R4217699								
WG2877042-5 LCS								
Total Dissolved Solids			97.4		%		85-115	14-SEP-18
WG2877042-4 MB								
Total Dissolved Solids			<10		mg/L		10	14-SEP-18
TKN-L-F-CL	**Water**							
Batch R4217558								
WG2876260-14 LCS								
Total Kjeldahl Nitrogen			113.2		%		75-125	17-SEP-18
WG2876260-18 LCS								
Total Kjeldahl Nitrogen			111.4		%		75-125	17-SEP-18
WG2876260-13 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-18
WG2876260-17								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-L-F-CL	**Water**							
Batch R4217558								
WG2876260-17 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	17-SEP-18
TSS-L-CL	**Water**							
Batch R4217696								
WG2876644-5 LCS								
Total Suspended Solids			101.3		%		85-115	14-SEP-18
WG2876644-4 MB								
Total Suspended Solids			<1.0		mg/L		1	14-SEP-18
TURBIDITY-CL	**Water**							
Batch R4212527								
WG2873221-6 DUP		**L2161891-7**						
Turbidity		1.58	1.60		NTU	1.3	15	11-SEP-18
WG2873221-5 LCS								
Turbidity			99.0		%		85-115	11-SEP-18
WG2873221-4 MB								
Turbidity			<0.10		NTU		0.1	11-SEP-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	09-SEP-18 11:45	17-SEP-18 13:38	0.25	194	hours	EHTR-FM
	3	07-SEP-18 15:00	17-SEP-18 13:38	0.25	239	hours	EHTR-FM
	5	08-SEP-18 12:23	17-SEP-18 13:38	0.25	217	hours	EHTR-FM
	7	08-SEP-18 08:45	17-SEP-18 13:38	0.25	221	hours	EHTR-FM
Turbidity							
	3	07-SEP-18 15:00	11-SEP-18 15:15	3	4	days	EHTR
pH							
	1	09-SEP-18 11:45	18-SEP-18 16:00	0.25	220	hours	EHTR-FM
	3	07-SEP-18 15:00	18-SEP-18 16:00	0.25	265	hours	EHTR-FM
	5	08-SEP-18 12:23	18-SEP-18 16:00	0.25	244	hours	EHTR-FM
	7	08-SEP-18 08:45	18-SEP-18 16:00	0.25	247	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Water by IC (Low Level)							
	3	07-SEP-18 15:00	11-SEP-18 09:18	3	4	days	EHTR
Nitrite in Water by IC (Low Level)							
	3	07-SEP-18 15:00	11-SEP-18 09:18	3	4	days	EHTR
Orthophosphate-Dissolved (as P)							
	3	07-SEP-18 15:00	11-SEP-18 19:03	3	4	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2161891 were received on 11-SEP-18 09:10.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

COC ID:	Regional Effects Program	TURNAROUND TIME:	Regular

PROJECT/CLIENT INFO

Facility Name / Job#	Regional Effects Program/GHO LAEMP
Project Manager	Cait Good
Email	cait.good@teck.com
Address	421 Pine Avenue
City	Sparwood — Province: BC
Postal Code	V0B 2G0 — Country: Canada
Phone Number	250-425-8202

LABORATORY

Lab Name	ALS Calgary
Lab Contact	Lyuda Shvets
Email	Lyudmyla.Shvets@ALSGlobal.com
Address	2559 29 Street NE
City	Calgary — Province: AB
Postal Code	T1Y 7B5 — Country: Canada
Phone Number	403-407-1800

OTHER INFO

Report Format / Distribution		Excel	PDF	EDD
Email 1:	cait.good@teck.com	x	x	x
Email 2:	carla.fraser@teck.com	x	x	x
Email 3:	colleen.mooney@teck.com	x	x	x
Email 4:	teckcoal@equisonline.com			x
Email 5:	jtester@minnow.ca	x	x	x
PO number	VPO00552656			

SAMPLE DETAILS / **ANALYSIS REQUESTED** (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

L2161891-COFC

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont	HG-T-U-CVAF-VA (N, NONE)	ALS_Package-DOC (N, NONE)	ALS_Package-TKN/TOC (N, H2SO4)	HG-D-CVAF-VA (N, NONE)	TECKCOAL-MET-D-VA (N, NONE)	TECKCOAL-MET-T-VA (N, HNO3)	TECKCOAL-ROUTINE-VA (N, NONE)
GH_ERSC4_WS_20180909-1145	GH_ERSC4	WS	No	09-Sep-18	11:45:00 AM	G	7	1	1	1	1	1	1	1
GH_ERSC4_WS_20180909-1145_FB-HG	GH_ERSC4	WS	No	09-Sep-18	11:45:00 AM	G	1	1						
RG_GH_SCW3_WS_20180907-1500	RG_GH_SCW3	WS	No	07-Sep-18	3:00:00 PM	G	7	1	1	1	1	1	1	1
RG_GH_SCW3_WS_20180907-1500_FB-HG	RG_GH_SCW3	WS	No	07-Sep-18	3:00:00 PM	G	1	1						
GH_ER1A_WS_20180908-1223	GH_ER1A	WS	No	08-Sep-18	12:23:00 PM	G	7	1	1	1	1	1	1	1
GH_ER1A_WS_20180908-1223_FB-HG	GH_ER1A	WS	No	08-Sep-18	12:23:00 PM	G	1	1						
RG_ERSC5_WS_20180908-0845	RG_ERSC5	WS	No	08-Sep-18	8:45:00 AM	G	7	1	1	1	1	1	1	1
RG_ERSC5_WS_20180908-0845_FB-HG	RG_ERSC5	WS	No	08-Sep-18	8:45:00 AM	G	1	1						

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00552656	Shari Weech/Minnow	Sep 10/18; 16:00		9/10
				9/11

SERVICE REQUEST (rush - subject to availability)

Regular (default)	X
Priority (2-3 business days) - 50% surcharge	
Emergency (1 Business Day) - 100% surcharge	
For Emergency <1 Day, ASAP or Weekend - Contact ALS	

Sampler's Name	Shari Weech	Mobile #	250-893-3322
Sampler's Signature	Shari Weech	Date/Time	September 10, 2018

6°C

Teck Coal Ltd.
ATTN: Cait Good
421 Pine Avenue
Sparwood BC V0B 2G0

Date Received: 13-SEP-18
Report Date: 26-SEP-18 18:59 (MT)
Version: FINAL

Client Phone: 250-425-8202

Certificate of Analysis

Lab Work Order #: L2163865
Project P.O. #: VPO00552656
Job Reference: REGIONAL EFFECTS PROGRAM
C of C Numbers: REGIONAL EFFECTS PRO
Legal Site Desc:

Lyudmyla Shvets, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2163865-1	L2163865-2	L2163865-3	L2163865-4	L2163865-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:10	09:00	09:00	09:00
	Client ID	RG_ELUGH_WS_20180911-1410	RG_ELUGH_WS_20180911-1410_FB-HG	RG_EL20_WS_20180911-0900	RG_EL20_WS_20180911-0900_FB-HG	RG_DUP_WS_20180911-0900
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)	290		322		322
	Hardness (as CaCO3) (mg/L)	148		164		168
	pH (pH)	7.88		7.91		7.85
	ORP (mV)	405		411		383
	Total Suspended Solids (mg/L)	1.9		<1.0		<1.0
	Total Dissolved Solids (mg/L)	179 DLHC		193 DLHC		196 DLHC
	Turbidity (NTU)	1.76		0.49		0.47
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0		<1.0		<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	143		155		152
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0		<1.0		<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0		<1.0		<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	143		155		152
	Ammonia as N (mg/L)	0.0068		<0.0050		0.0061
	Bromide (Br) (mg/L)	<0.050		<0.050		<0.050
	Chloride (Cl) (mg/L)	<0.50		<0.50		<0.50
	Fluoride (F) (mg/L)	0.169		0.168		0.163
	Ion Balance (%)	92.2		91.5		95.2
	Nitrate (as N) (mg/L)	0.0327		0.337		0.334
	Nitrite (as N) (mg/L)	<0.0010		<0.0010		<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.115		0.092		0.085
	Orthophosphate-Dissolved (as P) (mg/L)	0.0045		0.0049		<0.0010
	Phosphorus (P)-Total (mg/L)	0.0066		0.0061		0.0027
	Sulfate (SO4) (mg/L)	18.0		24.0		23.8
	Anion Sum (meq/L)	3.24		3.62		3.57
	Cation Sum (meq/L)	2.99		3.32		3.40
	Cation - Anion Balance (%)	-4.1		-4.4		-2.4
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	0.89		0.64		0.52
	Total Organic Carbon (mg/L)	0.75		0.63		0.70
Total Metals	Aluminum (Al)-Total (mg/L)	0.0048		0.0047		0.0046
	Antimony (Sb)-Total (mg/L)	<0.00010		<0.00010		<0.00010
	Arsenic (As)-Total (mg/L)	<0.00010		0.00011		0.00012
	Barium (Ba)-Total (mg/L)	0.0475		0.0583		0.0564
	Beryllium (Be)-Total (ug/L)	<0.020		<0.020		<0.020
	Bismuth (Bi)-Total (mg/L)	<0.000050		<0.000050		<0.000050
	Boron (B)-Total (mg/L)	<0.010		<0.010		<0.010
	Cadmium (Cd)-Total (ug/L)	0.0070		0.0079		0.0098

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163865-6	L2163865-7			
	Description	WS	WS			
	Sampled Date	11-SEP-18	11-SEP-18			
	Sampled Time	09:00	17:00			
	Client ID	RG_DUP_WS_20180911-0900_FB-HG	RG_TB_WS_20180911-1700			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (@ 25C) (uS/cm)		<2.0			
	Hardness (as CaCO3) (mg/L)		<0.50			
	pH (pH)		5.31			
	ORP (mV)		427			
	Total Suspended Solids (mg/L)		<1.0			
	Total Dissolved Solids (mg/L)		<10			
	Turbidity (NTU)		0.19			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)		1.9			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)		<1.0			
	Ammonia as N (mg/L)		0.0055 RRV			
	Bromide (Br) (mg/L)		<0.050			
	Chloride (Cl) (mg/L)		<0.50			
	Fluoride (F) (mg/L)		<0.020			
	Ion Balance (%)		0.0			
	Nitrate (as N) (mg/L)		<0.0050			
	Nitrite (as N) (mg/L)		<0.0010			
	Total Kjeldahl Nitrogen (mg/L)		<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)		<0.0010			
	Phosphorus (P)-Total (mg/L)		<0.0020			
	Sulfate (SO4) (mg/L)		<0.30			
	Anion Sum (meq/L)		<0.10			
	Cation Sum (meq/L)		<0.10			
	Cation - Anion Balance (%)		0.0			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)		<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)		<0.0030			
	Antimony (Sb)-Total (mg/L)		<0.00010			
	Arsenic (As)-Total (mg/L)		<0.00010			
	Barium (Ba)-Total (mg/L)		<0.00010			
	Beryllium (Be)-Total (ug/L)		<0.020			
	Bismuth (Bi)-Total (mg/L)		<0.000050			
	Boron (B)-Total (mg/L)		<0.010			
	Cadmium (Cd)-Total (ug/L)		<0.0050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163865-1	L2163865-2	L2163865-3	L2163865-4	L2163865-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:10	09:00	09:00	09:00
	Client ID	RG_ELUGH_WS_20180911-1410	RG_ELUGH_WS_20180911-1410_FB-HG	RG_EL20_WS_20180911-0900	RG_EL20_WS_20180911-0900_FB-HG	RG_DUP_WS_20180911-0900
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)	50.6		50.9		51.9
	Chromium (Cr)-Total (mg/L)	0.00023		0.00023		0.00024
	Cobalt (Co)-Total (ug/L)	<0.10		<0.10		<0.10
	Copper (Cu)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Iron (Fe)-Total (mg/L)	<0.010		<0.010		<0.010
	Lead (Pb)-Total (mg/L)	<0.000050		<0.000050		<0.000050
	Lithium (Li)-Total (mg/L)	0.0019		0.0026		0.0026
	Magnesium (Mg)-Total (mg/L)	11.4		13.0		12.6
	Manganese (Mn)-Total (mg/L)	0.00165		0.00122		0.00119
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Molybdenum (Mo)-Total (mg/L)	0.000983		0.00103		0.00104
	Nickel (Ni)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Potassium (K)-Total (mg/L)	0.336		0.395		0.385
	Selenium (Se)-Total (ug/L)	0.766		1.59		1.51
	Silicon (Si)-Total (mg/L)	1.89		2.09		2.08
	Silver (Ag)-Total (mg/L)	<0.000010		<0.000010		<0.000010
	Sodium (Na)-Total (mg/L)	0.679		0.835		0.821
	Strontium (Sr)-Total (mg/L)	0.212		0.205		0.206
	Thallium (Tl)-Total (mg/L)	<0.000010		<0.000010		<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010		<0.00010		<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010		<0.010		<0.010
	Uranium (U)-Total (mg/L)	0.000652		0.000697		0.000706
	Vanadium (V)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030		<0.0030		<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	LAB		LAB		LAB
	Dissolved Metals Filtration Location	LAB		LAB		LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.0030		<0.0030		<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010		<0.00010		<0.00010
	Arsenic (As)-Dissolved (mg/L)	<0.00010		0.00010		<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.0440		0.0525		0.0515
	Beryllium (Be)-Dissolved (ug/L)	<0.020		<0.020		<0.020
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050		<0.000050		<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Cadmium (Cd)-Dissolved (ug/L)	0.0057		<0.0050		0.0090
	Calcium (Ca)-Dissolved (mg/L)	42.5		46.2		48.3
	Chromium (Cr)-Dissolved (mg/L)	0.00020		0.00022		0.00019
	Cobalt (Co)-Dissolved (ug/L)	<0.10		<0.10		<0.10

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163865-6	L2163865-7			
	Description	WS	WS			
	Sampled Date	11-SEP-18	11-SEP-18			
	Sampled Time	09:00	17:00			
	Client ID	RG_DUP_WS_20180911-0900_FB-HG	RG_TB_WS_20180911-1700			
Grouping	**Analyte**					
WATER						
Total Metals	Calcium (Ca)-Total (mg/L)		<0.050			
	Chromium (Cr)-Total (mg/L)		<0.00010			
	Cobalt (Co)-Total (ug/L)		<0.10			
	Copper (Cu)-Total (mg/L)		<0.00050			
	Iron (Fe)-Total (mg/L)		<0.010			
	Lead (Pb)-Total (mg/L)		<0.000050			
	Lithium (Li)-Total (mg/L)		<0.0010			
	Magnesium (Mg)-Total (mg/L)		<0.10			
	Manganese (Mn)-Total (mg/L)		<0.00010			
	Mercury (Hg)-Total (ug/L)	<0.00050	<0.00050			
	Molybdenum (Mo)-Total (mg/L)		<0.000050			
	Nickel (Ni)-Total (mg/L)		<0.00050			
	Potassium (K)-Total (mg/L)		<0.050			
	Selenium (Se)-Total (ug/L)		<0.050			
	Silicon (Si)-Total (mg/L)		<0.10			
	Silver (Ag)-Total (mg/L)		<0.000010			
	Sodium (Na)-Total (mg/L)		<0.050			
	Strontium (Sr)-Total (mg/L)		<0.00020			
	Thallium (Tl)-Total (mg/L)		<0.000010			
	Tin (Sn)-Total (mg/L)		<0.00010			
	Titanium (Ti)-Total (mg/L)		<0.010			
	Uranium (U)-Total (mg/L)		<0.000010			
	Vanadium (V)-Total (mg/L)		<0.00050			
	Zinc (Zn)-Total (mg/L)		<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location		LAB			
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (ug/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (ug/L)					
	Calcium (Ca)-Dissolved (mg/L)		<0.050			
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (ug/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163865-1	L2163865-2	L2163865-3	L2163865-4	L2163865-5
	Description	WS	WS	WS	WS	WS
	Sampled Date	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18	11-SEP-18
	Sampled Time	14:10	14:10	09:00	09:00	09:00
	Client ID	RG_ELUGH_WS_20180911-1410	RG_ELUGH_WS_20180911-1410_FB-HG	RG_EL20_WS_20180911-0900	RG_EL20_WS_20180911-0900_FB-HG	RG_DUP_WS_20180911-0900
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050		<0.000050		<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0018		0.0026		0.0027
	Magnesium (Mg)-Dissolved (mg/L)	10.1		11.7		11.5
	Manganese (Mn)-Dissolved (mg/L)	0.00065		0.00032		0.00035
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050		<0.0000050		<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.000994		0.00103		0.00113
	Nickel (Ni)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Potassium (K)-Dissolved (mg/L)	0.346		0.406		0.409
	Selenium (Se)-Dissolved (ug/L)	0.787		1.31		1.37
	Silicon (Si)-Dissolved (mg/L)	1.69		1.85		1.84
	Silver (Ag)-Dissolved (mg/L)	<0.000010		<0.000010		<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.674		0.851		0.845
	Strontium (Sr)-Dissolved (mg/L)	0.211		0.205		0.210
	Thallium (Tl)-Dissolved (mg/L)	<0.000010		<0.000010		<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010		<0.00010		<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010		<0.010		<0.010
	Uranium (U)-Dissolved (mg/L)	0.000732		0.000755		0.000793
	Vanadium (V)-Dissolved (mg/L)	<0.00050		<0.00050		<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010		<0.0010		<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2163865-6	L2163865-7			
	Description	WS	WS			
	Sampled Date	11-SEP-18	11-SEP-18			
	Sampled Time	09:00	17:00			
	Client ID	RG_DUP_WS_20180911-0900_FB-HG	RG_TB_WS_20180911-1700			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)		<0.0050			
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)		<0.050			
	Selenium (Se)-Dissolved (ug/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)		<0.050			
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - DOC and dissolved metals to be filtered and preserved in lab; filter code added

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2163865-1, -3, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2163865-1, -3, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2163865-1, -3, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2163865-1, -3, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2163865-1, -3, -5, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2163865-1, -3, -5, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2163865-1, -3, -5, -7
Matrix Spike	Manganese (Mn)-Total	MS-B	L2163865-1, -3, -5, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2163865-1, -3, -5, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2163865-1, -3, -5, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACIDITY-PCT-CL	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-CL	Water	Alkalinity (Species) by Manual Titration	APHA 2320 ALKALINITY

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BE-D-L-CCMS-VA	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

BE-T-L-CCMS-VA	Water	Total Be (Low) in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

BR-L-IC-N-CL	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

C-DIS-ORG-LOW-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This method is applicable to the analysis of ground water, wastewater, and surface water samples. The form detected depends upon sample pretreatment: Unfiltered sample = TC, 0.45um filtered = TDC. Samples are injected into a combustion tube containing an oxidation catalyst. The carrier gas containing the combustion product from the combustion tube flows through an inorganic carbon reactor vessel and is then sent through a halogen scrubber into a sample cell set in a non-dispersive infrared gas analyzer (NDIR) where carbon dioxide is detected. For total inorganic carbon and dissolved inorganic carbon, the sample is injected into an IC reactor vessel where only the IC component is decomposed to become carbon

Reference Information

dioxide.

The peak area generated by the NDIR indicates the TC/TDC or TIC/DIC as applicable. The total organic carbon content of the sample is calculated by subtracting the TIC from the TC.
TOC = TC-TIC, DOC = TDC-DIC, Particulate = Total - Dissolved.

CL-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-L-PCT-CL	Water	Electrical Conductivity (EC)	APHA 2510B

Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25C.

F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-U-CVAF-VA	Water	Total Mercury in Water by CVAFS (Ultra)	EPA 1631 REV. E

This analysis is carried out using procedures adapted from Method 1631 Rev. E. by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to a purge and trap concentration step and final reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry.

IONBALANCE-BC-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-L-F-CL	Water	Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

ORP-CL	Water	Oxidation redution potential by elect.	ASTM D1498

This analysis is carried out in accordance with the procedure described in the "ASTM" method D1498 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM). Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

It is recommended that this analysis be conducted in the field.

P-T-L-COL-CL	Water	Phosphorus (P)-Total	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-CL	Water	pH	APHA 4500 H-Electrode

pH is determined in the laboratory using a pH electrode. All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)

PO4-DO-L-COL-CL	Water	Orthophosphate-Dissolved (as P)	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-CL	Water	Total Dissolved Solids	APHA 2540 C

A well-mixed sample is filtered through a glass fibre filter paper. The filtrate is then evaporated to dryness in a pre-weighed vial and dried at 180 – 2 °C. The increase in vial weight represents the total dissolved solids (TDS).

TECKCOAL-IONBAL-CL	Water	Ion Balance Calculation	APHA 1030E

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

TKN-L-F-CL	Water	Total Kjeldahl Nitrogen	APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, and by drying the filter at 104 deg. C.

TSS-LOW-VA	Water	Total Suspended Solids by Grav. (1 mg/L)	APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

REGIONAL EFFECTS
PRO

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: Teck Coal Ltd.
421 Pine Avenue
Sparwood BC V0B 2G0

Contact: Cait Good

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACIDITY-PCT-CL	**Water**							
Batch R4227995								
WG2882050-14 LCS								
Acidity (as CaCO3)			112.0		%		85-115	19-SEP-18
WG2882050-17 LCS								
Acidity (as CaCO3)			103.6		%		85-115	19-SEP-18
WG2882050-13 MB								
Acidity (as CaCO3)			2.0		mg/L		2	19-SEP-18
WG2882050-16 MB								
Acidity (as CaCO3)			1.9		mg/L		2	19-SEP-18
ALK-MAN-CL	**Water**							
Batch R4218058								
WG2878956-11 LCS								
Alkalinity, Total (as CaCO3)			102.5		%		85-115	17-SEP-18
WG2878956-10 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	17-SEP-18
BE-D-L-CCMS-VA	**Water**							
Batch R4219107								
WG2878997-2 LCS								
Beryllium (Be)-Dissolved			100.7		%		80-120	17-SEP-18
WG2878997-1 MB		**LF**						
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	17-SEP-18
BE-T-L-CCMS-VA	**Water**							
Batch R4222621								
WG2879146-2 LCS								
Beryllium (Be)-Total			98.8		%		80-120	18-SEP-18
WG2879146-1 MB								
Beryllium (Be)-Total			<0.000020		mg/L		0.00002	18-SEP-18
BR-L-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Bromide (Br)			91.5		%		85-115	14-SEP-18
WG2878750-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Bromide (Br)			96.4		%		75-125	14-SEP-18
C-DIS-ORG-LOW-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-LOW-CL	**Water**							
Batch R4224387								
WG2881096-10 LCS								
Dissolved Organic Carbon			101.6		%		80-120	18-SEP-18
Batch R4230683								
WG2883155-2 LCS								
Dissolved Organic Carbon			102.2		%		80-120	20-SEP-18
WG2883155-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	20-SEP-18
C-TOT-ORG-LOW-CL	**Water**							
Batch R4224387								
WG2881096-10 LCS								
Total Organic Carbon			95.2		%		80-120	18-SEP-18
Batch R4233388								
WG2883965-3 DUP		**L2163865-3**						
Total Organic Carbon		0.63	<0.50	RPD-NA	mg/L	N/A	20	21-SEP-18
WG2883965-2 LCS								
Total Organic Carbon			103.5		%		80-120	21-SEP-18
WG2883965-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	21-SEP-18
WG2883965-4 MS		**L2163865-3**						
Total Organic Carbon			81.7		%		70-130	21-SEP-18
CL-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Chloride (Cl)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Chloride (Cl)			102.4		%		90-110	14-SEP-18
WG2878750-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Chloride (Cl)			106.6		%		75-125	14-SEP-18
EC-L-PCT-CL	**Water**							
Batch R4218058								
WG2878956-11 LCS								
Conductivity (@ 25C)			103.1		%		90-110	17-SEP-18
WG2878956-10 MB								
Conductivity (@ 25C)			<2.0		uS/cm		2	17-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Fluoride (F)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Fluoride (F)			106.1		%		90-110	14-SEP-18
WG2878750-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Fluoride (F)			112.7		%		75-125	14-SEP-18
HG-D-CVAA-VA	**Water**							
Batch R4218256								
WG2879060-2 LCS								
Mercury (Hg)-Dissolved			99.9		%		80-120	18-SEP-18
WG2879060-1 MB		**LF**						
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	18-SEP-18
HG-T-U-CVAF-VA	**Water**							
Batch R4224727								
WG2880696-2 LCS								
Mercury (Hg)-Total			90.3		%		80-120	19-SEP-18
WG2880696-1 MB								
Mercury (Hg)-Total			<0.00050		ug/L		0.0005	19-SEP-18
MET-D-CCMS-CL	**Water**							
Batch R4222814								
WG2880464-2 LCS		**TMRM**						
Calcium (Ca)-Dissolved			98.1		%		80-120	18-SEP-18
Magnesium (Mg)-Dissolved			108.7		%		80-120	18-SEP-18
Potassium (K)-Dissolved			94.4		%		80-120	18-SEP-18
Sodium (Na)-Dissolved			97.4		%		80-120	18-SEP-18
WG2880464-6 LCS		**TMRM**						
Calcium (Ca)-Dissolved			102.4		%		80-120	18-SEP-18
Magnesium (Mg)-Dissolved			112.6		%		80-120	18-SEP-18
Potassium (K)-Dissolved			99.3		%		80-120	18-SEP-18
Sodium (Na)-Dissolved			103.0		%		80-120	18-SEP-18
WG2880464-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	18-SEP-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	18-SEP-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	18-SEP-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	18-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL	**Water**							
Batch R4222814								
WG2880464-5 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	18-SEP-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	18-SEP-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	18-SEP-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	18-SEP-18
MET-D-CCMS-VA	**Water**							
Batch R4219107								
WG2878997-2 LCS								
Aluminum (Al)-Dissolved			101.6		%		80-120	17-SEP-18
Antimony (Sb)-Dissolved			98.8		%		80-120	17-SEP-18
Arsenic (As)-Dissolved			95.9		%		80-120	17-SEP-18
Barium (Ba)-Dissolved			94.0		%		80-120	17-SEP-18
Bismuth (Bi)-Dissolved			95.5		%		80-120	17-SEP-18
Boron (B)-Dissolved			97.5		%		80-120	17-SEP-18
Cadmium (Cd)-Dissolved			96.0		%		80-120	17-SEP-18
Calcium (Ca)-Dissolved			100.7		%		80-120	17-SEP-18
Chromium (Cr)-Dissolved			98.5		%		80-120	17-SEP-18
Cobalt (Co)-Dissolved			96.2		%		80-120	17-SEP-18
Copper (Cu)-Dissolved			94.7		%		80-120	17-SEP-18
Iron (Fe)-Dissolved			98.4		%		80-120	17-SEP-18
Lead (Pb)-Dissolved			95.8		%		80-120	17-SEP-18
Lithium (Li)-Dissolved			101.3		%		80-120	17-SEP-18
Magnesium (Mg)-Dissolved			96.1		%		80-120	17-SEP-18
Manganese (Mn)-Dissolved			95.0		%		80-120	17-SEP-18
Molybdenum (Mo)-Dissolved			99.9		%		80-120	17-SEP-18
Nickel (Ni)-Dissolved			95.0		%		80-120	17-SEP-18
Potassium (K)-Dissolved			102.9		%		80-120	17-SEP-18
Selenium (Se)-Dissolved			91.9		%		80-120	17-SEP-18
Silicon (Si)-Dissolved			96.2		%		60-140	17-SEP-18
Silver (Ag)-Dissolved			99.8		%		80-120	17-SEP-18
Sodium (Na)-Dissolved			98.9		%		80-120	17-SEP-18
Strontium (Sr)-Dissolved			104.1		%		80-120	17-SEP-18
Thallium (Tl)-Dissolved			92.9		%		80-120	17-SEP-18
Tin (Sn)-Dissolved			94.5		%		80-120	17-SEP-18
Titanium (Ti)-Dissolved			100.4		%		80-120	17-SEP-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4219107								
WG2878997-2 LCS								
Uranium (U)-Dissolved			97.4		%		80-120	17-SEP-18
Vanadium (V)-Dissolved			97.8		%		80-120	17-SEP-18
Zinc (Zn)-Dissolved			93.0		%		80-120	17-SEP-18
WG2878997-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	17-SEP-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-SEP-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	17-SEP-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-SEP-18
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	17-SEP-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	17-SEP-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-18
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	17-SEP-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	17-SEP-18
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	17-SEP-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	17-SEP-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	17-SEP-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-SEP-18
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	17-SEP-18
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	17-SEP-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	17-SEP-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	17-SEP-18
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	17-SEP-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	17-SEP-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	17-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4222621								
WG2879146-2 LCS								
Aluminum (Al)-Total			103.6		%		80-120	18-SEP-18
Antimony (Sb)-Total			101.5		%		80-120	18-SEP-18
Arsenic (As)-Total			101.1		%		80-120	18-SEP-18
Barium (Ba)-Total			106.5		%		80-120	18-SEP-18
Bismuth (Bi)-Total			93.3		%		80-120	18-SEP-18
Boron (B)-Total			94.0		%		80-120	18-SEP-18
Cadmium (Cd)-Total			101.8		%		80-120	18-SEP-18
Calcium (Ca)-Total			99.6		%		80-120	18-SEP-18
Chromium (Cr)-Total			101.4		%		80-120	18-SEP-18
Cobalt (Co)-Total			100.6		%		80-120	18-SEP-18
Copper (Cu)-Total			100.2		%		80-120	18-SEP-18
Iron (Fe)-Total			93.1		%		80-120	18-SEP-18
Lead (Pb)-Total			95.2		%		80-120	18-SEP-18
Lithium (Li)-Total			97.0		%		80-120	18-SEP-18
Magnesium (Mg)-Total			101.2		%		80-120	18-SEP-18
Manganese (Mn)-Total			108.0		%		80-120	18-SEP-18
Molybdenum (Mo)-Total			96.5		%		80-120	18-SEP-18
Nickel (Ni)-Total			100.2		%		80-120	18-SEP-18
Potassium (K)-Total			98.4		%		80-120	18-SEP-18
Selenium (Se)-Total			96.2		%		80-120	18-SEP-18
Silicon (Si)-Total			100.2		%		80-120	18-SEP-18
Silver (Ag)-Total			92.1		%		80-120	18-SEP-18
Sodium (Na)-Total			104.0		%		80-120	18-SEP-18
Strontium (Sr)-Total			94.9		%		80-120	18-SEP-18
Thallium (Tl)-Total			94.1		%		80-120	18-SEP-18
Tin (Sn)-Total			97.2		%		80-120	18-SEP-18
Titanium (Ti)-Total			98.8		%		80-120	18-SEP-18
Uranium (U)-Total			92.0		%		80-120	18-SEP-18
Vanadium (V)-Total			101.7		%		80-120	18-SEP-18
Zinc (Zn)-Total			102.4		%		80-120	18-SEP-18
WG2879146-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	18-SEP-18
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Arsenic (As)-Total			<0.00010		mg/L		0.0001	18-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4222621								
WG2879146-1 MB								
Barium (Ba)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	18-SEP-18
Boron (B)-Total			<0.010		mg/L		0.01	18-SEP-18
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	18-SEP-18
Calcium (Ca)-Total			<0.050		mg/L		0.05	18-SEP-18
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Copper (Cu)-Total			<0.00050		mg/L		0.0005	18-SEP-18
Iron (Fe)-Total			<0.010		mg/L		0.01	18-SEP-18
Lead (Pb)-Total			<0.000050		mg/L		0.00005	18-SEP-18
Lithium (Li)-Total			<0.0010		mg/L		0.001	18-SEP-18
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	18-SEP-18
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	18-SEP-18
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	18-SEP-18
Potassium (K)-Total			<0.050		mg/L		0.05	18-SEP-18
Selenium (Se)-Total			<0.000050		mg/L		0.00005	18-SEP-18
Silicon (Si)-Total			<0.10		mg/L		0.1	18-SEP-18
Silver (Ag)-Total			<0.000010		mg/L		0.00001	18-SEP-18
Sodium (Na)-Total			<0.050		mg/L		0.05	18-SEP-18
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	18-SEP-18
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	18-SEP-18
Tin (Sn)-Total			<0.00010		mg/L		0.0001	18-SEP-18
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	18-SEP-18
Uranium (U)-Total			<0.000010		mg/L		0.00001	18-SEP-18
Vanadium (V)-Total			<0.00050		mg/L		0.0005	18-SEP-18
Zinc (Zn)-Total			<0.0030		mg/L		0.003	18-SEP-18
NH3-L-F-CL	**Water**							
Batch R4233494								
WG2884064-10 LCS								
Ammonia as N			104.4		%		85-115	22-SEP-18
WG2884064-14 LCS								
Ammonia as N			102.7		%		85-115	22-SEP-18
WG2884064-13 MB								
Ammonia as N			<0.0050		mg/L		0.005	22-SEP-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-L-F-CL	**Water**							
Batch R4233494								
WG2884064-9 MB								
Ammonia as N			<0.0050		mg/L		0.005	22-SEP-18
NO2-L-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Nitrite (as N)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Nitrite (as N)			106.4		%		90-110	14-SEP-18
WG2878750-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Nitrite (as N)			111.4		%		75-125	14-SEP-18
NO3-L-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Nitrate (as N)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Nitrate (as N)			101.5		%		90-110	14-SEP-18
WG2878750-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Nitrate (as N)			105.8		%		75-125	14-SEP-18
ORP-CL	**Water**							
Batch R4218827								
WG2878689-6 CRM		**CL-ORP**						
ORP			218		mV		210-230	17-SEP-18
P-T-L-COL-CL	**Water**							
Batch R4236892								
WG2884824-90 LCS								
Phosphorus (P)-Total			104.7		%		80-120	24-SEP-18
WG2884824-89 MB								
Phosphorus (P)-Total			<0.0020		mg/L		0.002	24-SEP-18
PH-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-CL	**Water**							
Batch R4218058								
WG2878956-11 LCS								
pH			7.00		pH		6.9-7.1	17-SEP-18
PO4-DO-L-COL-CL	**Water**							
Batch R4216282								
WG2875974-15 DUP		**L2163865-5**						
Orthophosphate-Dissolved (as P)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-SEP-18
WG2875974-14 LCS								
Orthophosphate-Dissolved (as P)			101.4		%		80-120	13-SEP-18
WG2875974-13 MB								
Orthophosphate-Dissolved (as P)			<0.0010		mg/L		0.001	13-SEP-18
WG2875974-16 MS		**L2163865-5**						
Orthophosphate-Dissolved (as P)			108.2		%		70-130	13-SEP-18
SO4-IC-N-CL	**Water**							
Batch R4217844								
WG2878750-3 DUP		**L2163865-7**						
Sulfate (SO4)		<0.30	<0.30	RPD-NA	mg/L	N/A	20	14-SEP-18
WG2878750-2 LCS								
Sulfate (SO4)			102.8		%		90-110	14-SEP-18
WG2878750-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	14-SEP-18
WG2878750-4 MS		**L2163865-7**						
Sulfate (SO4)			107.1		%		75-125	14-SEP-18
SOLIDS-TDS-CL	**Water**							
Batch R4226709								
WG2879364-8 LCS								
Total Dissolved Solids			97.8		%		85-115	18-SEP-18
WG2879364-7 MB								
Total Dissolved Solids			<10		mg/L		10	18-SEP-18
TKN-L-F-CL	**Water**							
Batch R4220587								
WG2879029-10 LCS								
Total Kjeldahl Nitrogen			99.4		%		75-125	19-SEP-18
WG2879029-9 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	19-SEP-18
TSS-L-CL	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TSS-L-CL	**Water**							
Batch R4220316								
WG2878899-8 LCS								
Total Suspended Solids			106.9		%		85-115	17-SEP-18
WG2878899-7 MB								
Total Suspended Solids			<1.0		mg/L		1	17-SEP-18
TSS-LOW-VA	**Water**							
Batch R4222712								
WG2879095-4 LCS								
Total Suspended Solids			108.1		%		85-115	18-SEP-18
WG2879095-3 MB								
Total Suspended Solids			<1.0		mg/L		1	18-SEP-18
TURBIDITY-CL	**Water**							
Batch R4217079								
WG2876766-14 LCS								
Turbidity			97.5		%		85-115	14-SEP-18
WG2876766-15 MB								
Turbidity			<0.10		NTU		0.1	14-SEP-18

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Oxidation redution potential by elect.							
	1	11-SEP-18 14:10	17-SEP-18 08:20	0.25	138	hours	EHTR-FM
	3	11-SEP-18 09:00	17-SEP-18 08:20	0.25	143	hours	EHTR-FM
	5	11-SEP-18 09:00	17-SEP-18 08:20	0.25	143	hours	EHTR-FM
	7	11-SEP-18 17:00	17-SEP-18 08:20	0.25	135	hours	EHTR-FM
pH							
	1	11-SEP-18 14:10	17-SEP-18 15:00	0.25	145	hours	EHTR-FM
	3	11-SEP-18 09:00	17-SEP-18 15:00	0.25	150	hours	EHTR-FM
	5	11-SEP-18 09:00	17-SEP-18 15:00	0.25	150	hours	EHTR-FM
	7	11-SEP-18 17:00	17-SEP-18 15:00	0.25	142	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2163865 were received on 13-SEP-18 09:50.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Teck

Page

L2163865-COFC

COC ID:	Regional Effects Program	TURNA[illegible]

PROJECT/CLIENT INFO									OTHER INFO			
Facility Name / Job#	Regional Effects Program/GHO LAEMP			Lab					[illegible]stribution	Excel	PDF	EDD
Project Manager	Cait Good			Lab Co					[illegible]	cait.good@teck.com	x	x	x
Email	cait.good@teck.com			Email	Lyudmyla.Shvets@ALSGlobal.com				Email 2:	carla.fraser@teck.com	x	x	x
Address	421 Pine Avenue			Address	2559 29 Street NE				Email 3:	colleen.mooney@teck.com	x	x	x
									Email 4:	teckcoal@equisonline.com			x
City	Sparwood	Province	BC	City	Calgary	Province	AB		Email 5:	jtester@minnow.ca	x	x	x
Postal Code	V0B 2G0	Country	Canada	Postal Code	T1Y 7B5	Country	Canada						
Phone Number	250-425-8202			Phone Number	403-407-1800				PO number	VPO00552656			

SAMPLE DETAILS / ANALYSIS REQUESTED (Filtered - F: Field, L: Lab, FL: Field & Lab, N: None)

Sample ID	Sample Location (sys_loc_code)	Field Matrix	Hazardous Material (Yes/No)	Date	Time (24hr)	G=Grab C=Comp	# Of Cont.	HG-T-U-CVAF-VA (N, NONE)	ALS_Package-DOC (N, NONE)	ALS_Package-TKN/TOC (N, H2SO4)	HG-D-CVAF-VA (N, NONE)	TECKCOAL-MET-D-VA (N, NONE)	TECKCOAL-MET-T-VA (N, HNO3)	TECKCOAL-ROUTINE-VA (N, NONE)
RG_ELUGH_WS_20180911-1410	GH_ELUGH	WS	No	11-Sep-18	2:10:00 PM	G	7	1	1	1	1	1	1	1
RG_ELUGH_WS_20180911-1410_FB-HG	GH_ELUGH	WS	No	11-Sep-18	2:10:00 PM	G	1	1						
RG_EL20_WS_20180911-0900	RG_EL20	WS	No	11-Sep-18	9:00:00 AM	G	7	1	1	1	1	1	1	1
RG_EL20_WS_20180911-0900_FB-HG	RG_EL20	WS	No	11-Sep-18	9:00:00 AM	G	1	1						
RG_DUP_WS_20180911-0900	RG_DUP	WS	No	11-Sep-18	9:00:00 AM	G	7	1	1	1	1	1	1	1
RG_DUP_WS_20180911-0900_FB-HG	RG_DUP	WS	No	11-Sep-18	9:00:00 AM	G	1	1						
RG_TB_WS_20180911-1700	RG_TRIP	WS	No	11-Sep-18	5:00:00 PM	G	5	1	X	1	X	X	1	1

[illegible] 09/13

ADDITIONAL COMMENTS/SPECIAL INSTRUCTIONS	RELINQUISHED BY/AFFILIATION	DATE/TIME	ACCEPTED BY/AFFILIATION	DATE/TIME
RAEMP - VPO00552656	Shari Weech/Minnow	Sep 12/18; 16:00	[illegible]	9/13 950

SERVICE REQUEST (rush - subject to availability)

Regular (default)	X	Sampler's Name	Shari Weech	Mobile #	250-893-3322
Priority (2-3 business days) - 50% surcharge					
Emergency (1 Business Day) - 100% surcharge		Sampler's Signature	Shari Weech	Date/Time	September 12, 2018
For Emergency <1 Day, ASAP or Weekend - Contact ALS					

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APPENDIX H

DATA COLLECTED FOR THE LENTIC AREA SUPPORTING STUDY

Table H.1: Habitat Conditions, Lentic Area Supporting Study, 2018

Management Unit		**MU3**		
Exposure Type		**Mine-exposed**		
Lentic Area ID		**RG_GHSCW**		
UTMs (Zone 11, NAD83)	Easting	648345		
	Northing	5550229		
	Date of Habitat Assessment	10-May-18	19-Jun-18	30-Jul-18
	Aquatic Habitat Type	Lotic	Semi-lotic side channel	
	Area Description	Greenhills side-channel wetland		
	Approximate Wetted Area (m^2)	5,748		
	Connected to Adjacent Aquatic Environment(s)?	Yes		
	Dominant Influence in Water Levels	-	Surface inflows/ outflows	
In Situ Water Quality [b]	Date(s) Sampled	-	19-Jun-18	30-Jul-18
	Temperature (°C)	-	10	9.79 - 18 (5)
	DO (mg/L)	-	11	7.60 - 11 (5)
	DO (% Saturation)	-	99	76 - 101 (5)
	pH	-	8.70	6.62 - 8.26 (5)
	Specific Conductance (µS/cm)	-	1,370	279 - 1,817 (5) [a]
Aquatic Vegetation	Cattails	-	Not observed	
	Chara	-	Not observed	
	Bur Reed	-	Not observed	
	Duckweed	-	Not observed	
	Filamentous/ Blue-green Algae	-	Not observed	
	Grasses	-	Sparse	Common
	Mares Tail	-	Not observed	
	Pond/Water Lily	-	Not observed	
	Pondweed	-	Not observed	
	Rushes	-	Not observed	
	Sedges	-	Not observed	Abundant
	Water Milfoil	-	Not observed	
Adjacent Vegetation	Ferns/Grass	-	Common	
	Shrubs	-	Abundant	Common
	Deciduous Trees	-	Sparse	Abundant
	Coniferous Trees	-	Abundant	
Adjacent Land Use	Crop	-	Absent	
	Commercial	-	Absent	
	Forest	-	Present	
	Livestock	-	Present	
	Logging	-	Present	
	Mining	-	Absent	
	Residential	-	Absent	
Substrate Composition	Organic (%)	-	5	10
	Sand/Silt/Clay (%)	-	90	70
	Gravel (%)	-	5	0
	Cobble (%)	-	0	20
	Boulder (%)	-	0	0
	Bedrock (%)	-	0	0
Substrate Notes		-	-	Some cobble bars present.
Cover and Accessibility for Amphibians and Fish	Cover - Woody Debris	-	Present	
	Cover - Turbidity	-	Absent	
	Cover - Unstable Banks/ Ledges	-	Present	Absent
	Accessible to Amphibians	-	Yes	
	Accessible to Fish	-	Yes	
General Habitat Notes		Lotic; no detailed assessment completed.	Still some flow in channel. Impacted by logging. Little aquatic vegetation.	

Notes: ID = identifier; UTM = Universal Transverse Mercator; NAD = North American Datum; FRO = Fording River Operation; GHO = Greenhills Operation; m^2 = square metres; °C = degrees Celsius; DO = dissolved oxygen; mg/L = milligrams per litre; % = percent; µS/cm = microSiemens per centimetre; - = no data/not recorded; m = metres.

[a] Measurements of specific conductance were much lower (i.e., 279 to 304 µS/cm [n = 3]) upstream of the Thompson Creek mouth than downstream.

Table H.2: Catch-per-unit-effort (CPUE) for Minnow Traps Set during the Lentic Area Supporting Study, August 2018

Management Unit	Lentic Area ID	Station ID	UTM Coordinates (Zone 11, NAD83)		Set Date	Lift Date	Set Time	Lift Time	No. of Traps	Effort (fishing days)	Longnose Sucker			Mountain Whitefish			Total Catch	Total CPUE [a]
			Easting	Northing							Catch	Mortalities/ Sacrificed	CPUE [a]	Catch	Mortalities/ Sacrificed	CPUE [a]		
MU3	RG_GHSCW	GHSCW-MT-1	648371	5550219	07-Aug-18	08-Aug-18	14:45	8:40	3	2.24	4	0	1.79	2	0	0.893	14	1.26
		GHSCW-MT-2	648324	5550233	07-Aug-18	08-Aug-18	14:50	8:30	3	2.21	-	-	-	3	3	1.36		
		GHSCW-MT-3	648325	5550229	07-Aug-18	08-Aug-18	14:45	8:25	3	2.21	-	-	-	3	3	1.36		
		GHSCW-MT-4	648333	5550229	07-Aug-18	08-Aug-18	14:50	8:35	3	2.22	-	-	-	-	-	-		
		GHSCW-MT-5	648333	5550225	07-Aug-18	08-Aug-18	15:00	8:40	3	2.21	-	-	-	2	0	0.906		
								Total	15	11	4	0	0.361	10	6	0.902		

Notes: ID = identifier; UTM = Universal Transverse Mercator; NAD = North American Datum; No. = number; CPUE = catch-per-unit-effort; MU = Management Unit; - = no fish captured/no data.

[a] CPUE = total number of fish/fishing day.

Table H.3: Catch-per-unit-effort (CPUE) for Hoop Nets Set during the Lentic Area Supporting Study, August 2018

Management Unit	Exposure Type	Lentic Area ID	Station ID	Hoop Net Size	UTM Coordinates (Zone 11, NAD83)		Set Date	Lift Date	Set Time	Lift Time	Trap Hours (hrs)	Mountain Whitefish		
					Easting	Northing						Catch	Mortalities/ Sacrificed	CPUE [a]
MU3	Mine-exposed	RG_GHSCW	GHSCW-HN-1	Mini	648345	5550226	03-Aug-18	04-Aug-18	16:35	8:20	15.75	1	0	0.0635

Notes: ID = identifier; UTM = Universal Transverse Mercator; NAD = North American Datum; hrs = hours; CPUE = catch-per-unit-effort; MU = Management Unit; - = no fish captured/no data.
[a] CPUE = total number of fish /trap*hour.

Table H.4: Effort Data for Avian Survey, Lentic Area Supporting Study, June 2018 [a]

Management Unit	Exposure Type	Lentic Area ID	UTM Coordinates (Zone 11, NAD83)		Effort Data for Individual Surveys															
					First Survey								Second Survey							
									Weather								Weather			
			Easting	Northing	Date	Start Time	End Time	Survey Duration	Air Temperature (°C)	Precipitation	Cloud Cover (%)	Notes	Date	Start Time	End Time	Survey Duration	Air Temperature (°C)	Precipitation	Cloud Cover (%)	Notes
MU3	Mine-exposed	RG_GHSCW	648345	5550229	19-Jun-18	9:31	10:22	0:51	11	None	76 to 100	-	25-Jun-18	8:06	8:31	0:25	14	None	26 to 50	-

Notes: UTM = Universal Transverse Mercator; NAD = North American Datum; °C = degrees Celsius; % = percent; MU = Management Unit; - = not applicable/not recorded; ≤ = less than or equal to.

[a] Surveys focused on aquatic and aquatic-dependent bird species.

Table H.5: Aquatic and Aquatic-dependent Bird Species Observed, Lentic Area Supporting Study, June 2018

Species	Total Number of Visual and Auditory Observations	
	Management Unit 3	
	Mine-exposed	
	RG_GHSCW	
	19-Jun-18	25-Jun-18
Total Number of Species	**5**	**3**
Total Number of Observations	**24**	**5**
American bittern	1	-
Bank swallow	8	-
Belted kingfisher	-	1
Canada goose	8	-
Common yellowthroat	2	1
Northern waterthrush	5	3

Notes: - = not observed/not applicable.

Table H.6: Sediment Quality Collected for the Lentic Area Supporting Study and GHO LAEMP at the Mine-exposed Reach 2 of the Side Channel, July and September 2018

Analyte		Units	Mine-exposed									
			RG_GHSCW					RG_GH-SCW3				
			30-Jul-18					7-Sep-18				
Physical Tests	% Moisture	%	46	51	40	49	38	43	53	47	49	47
	pH (1:2 soil:water)	pH units	8.01	***8.14***	***8.12***	8.03	8.09	7.95	7.81	7.81	7.99	7.86
	pH (1:9)	pH units	-	-	-	-	-	-	-	-	-	-
Particle Size	% Gravel (>2mm)	%	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	% Sand (2.00mm - 1.00mm)	%	<1.0	1.20	<1.0	<1.0	<1.0	1.5	<1.0	1.1	<1.0	<1.0
	% Sand (1.00mm - 0.50mm)	%	<1.0	<1.0	2.10	<1.0	<1.0	3.5	<1.0	3.90	1.6	3.4
	% Sand (0.50mm - 0.25mm)	%	<1.0	<1.0	4.10	4.10	5.30	4.4	<1.0	5.50	4.90	7.00
	% Sand (0.25mm - 0.125mm)	%	7.90	3.40	10	18	23	16	12	14	10	12
	% Sand (0.125mm - 0.063mm)	%	23	25	28	25	24	15	17	15	9.3	12
	% Silt (0.063mm - 0.0312mm)	%	29	31	25	22	20	24	30	27	30	27
	% Silt (0.0312mm - 0.004mm)	%	33	33	25	25	21	29	35	29	37	33
	% Clay (<4μm)	%	5.90	4.80	5.20	6.20	5.70	6.20	5.80	4.30	6.00	5.30
	Texture	-	Silt loam	Silt loam	Sandy loam	Sandy loam	Sandy loam	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam
Organic Carbon	Total Organic Carbon	%	5.01	3.66	3.72	4.70	3.14	6.24	5.79	5.75	5.10	8.07
Metals	Aluminum (Al)	mg/kg	6,240	6,290	<50	8,470	7,610	7,420	7,300	8010.00	6,570	6,900
	Antimony (Sb)	mg/kg	0.450	0.430	<0.10	0.640	0.590	0.480	0.540	0.58	0.500	0.570
	Arsenic (As)	mg/kg	5.22	5.10	<0.11	***6.51***	***6.48***	5.28	5.45	5.86	5.81	5.12
	Barium (Ba)	mg/kg	119	122	<0.50	153	140	131	125	139.00	114	132
	Beryllium (Be)	mg/kg	0.460	0.450	<0.10	0.700	0.610	0.540	0.610	0.65	0.550	0.610
	Bismuth (Bi)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)	mg/kg	7.90	8.10	<5.0	11	8.40	9.00	10.80	10.40	8	10.00
	Cadmium (Cd)	mg/kg	0.761	0.681	<0.020	0.986	0.837	0.832	0.911	0.828	0.852	0.758
	Calcium (Ca)	mg/kg	48,300	53,200	<50	69,100	66,400	46,500	56,700	45,500	51,900	52,500
	Chromium (Cr)	mg/kg	16	15	<0.50	20	19	16	18	16.6	17	16
	Cobalt (Co)	mg/kg	4.17	3.99	<0.10	5.19	5.06	4.85	4.83	5.27	4.85	4.85
	Copper (Cu)	mg/kg	10	9.55	<0.50	13	11	12	12.00	12.9	12	12
	Iron (Fe)	mg/kg	11,000	10,700	<50	14,000	13,900	12,400	12,400	14400	12,500	12,300
	Lead (Pb)	mg/kg	6.12	5.90	<0.50	8.38	7.70	7.40	7.76	9.19	7.53	8.56
	Lithium (Li)	mg/kg	10	10	<2.0	14	12	10	12	12.9	10	12
	Magnesium (Mg)	mg/kg	13,500	14,200	<20	14,700	14,500	12,500	14,000	11,400	13,400	12,300
	Manganese (Mn)	mg/kg	307	345	<1.0	***437***	***447***	275	300	285	326	283
	Mercury (Hg)	mg/kg	0.0369	0.0366	0.0517	0.0564	0.0474	0.0357	0.0390	0.0351	0.0369	0.0373
	Molybdenum (Mo)	mg/kg	1.18	1.22	<0.10	1.70	1.49	1.20	1.25	1.48	1.30	1.38
	Nickel (Ni)	mg/kg	18	17	<0.50	22	21	18	20	19.1	19	18
	Phosphorus (P)	mg/kg	1,290	1,290	<50	1,530	1,550	1,200	1,280	1,310	1,340	1,300
	Potassium (K)	mg/kg	1,560	1,590	<100	1,980	1,690	1,770	1,790	1,840	1,510	1,650
	Selenium (Se)	mg/kg	2.86	2.28	<0.20	1.66	1.17	1.55	1.89	1.4	1.66	1.75
	Silver (Ag)	mg/kg	0.150	0.140	<0.10	0.210	0.180	0.170	0.200	0.19	0.180	0.190
	Sodium (Na)	mg/kg	94	96	<50	103	103	102	103	98	99	95
	Strontium (Sr)	mg/kg	75	77	<0.50	110	100	73	87	76.00	76	90
	Sulphur (S)	mg/kg	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
	Thallium (Tl)	mg/kg	0.197	0.193	<0.050	0.266	0.227	0.187	0.215	0.22	0.191	0.204
	Tin (Sn)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti)	mg/kg	15	15	<1.0	16	19	20	21	20.70	17	19
	Tungsten (W)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Uranium (U)	mg/kg	1.02	1.06	<0.050	1.36	1.18	1.00	1.26	1.07	1.10	1.14
	Vanadium (V)	mg/kg	28	27	<0.20	36	33	32	33	32.70	30	30
	Zinc (Zn)	mg/kg	75	71	<2.0	94	88	82	83	87.3	87	82
	Zirconium (Zr)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.3	1.1	<1.0	1.2
Hydrocarbons	Acenaphthene	mg/kg	<0.0090	<0.011	<0.0050	<0.0090	<0.0060	<0.023	<0.0070	<0.010	<0.0090	<0.024
	Acenaphthylene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Acridine	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Anthracene	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Benz(a)anthracene	mg/kg	<0.010	0.0190	<0.010	0.0100	<0.010	0.012	<0.010	<0.010	<0.010	0.012
	Benzo(a)pyrene	mg/kg	<0.010	0.0150	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b&j)fluoranthene	mg/kg	0.0210	0.0340	0.0170	0.0250	0.0220	0.0280	0.0120	0.0140	0.0150	0.0270
	Benzo(e)pyrene	mg/kg	0.0200	0.0280	0.0160	0.0230	0.0200	0.0110	<0.010	<0.010	<0.010	<0.010
	Benzo(g,h,i)perylene	mg/kg	<0.010	0.0140	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(k)fluoranthene	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.027	0.011	0.013	0.014	0.026
	Chrysene	mg/kg	0.0520	0.0620	0.0420	0.0580	0.0500	0.0690	0.0290	0.0340	0.0350	0.0670
	Dibenz(a,h)anthracene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Fluoranthene	mg/kg	0.0130	0.0240	<0.010	0.0120	0.0100	0.0110	<0.010	<0.010	<0.010	0.0110
	Fluorene	mg/kg	0.0160	0.0160	<0.010	0.0140	<0.010	0.0210	<0.010	<0.010	0.0110	0.027
	Indeno(1,2,3-c,d)pyrene	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	1-Methylnaphthalene	mg/kg	0.154	0.145	0.0940	0.134	0.0950	0.344	0.112	0.1720	0.143	0.3820
	2-Methylnaphthalene	mg/kg	0.215	0.201	0.116	0.182	0.122	0.572	0.178	0.292	0.235	0.650
	Naphthalene	mg/kg	0.0820	0.0590	0.0540	0.0720	0.0550	0.1540	0.0540	0.0780	0.0690	0.1800
	Perylene	mg/kg	0.0130	0.0200	0.0120	0.0130	0.0140	<0.010	<0.010	<0.010	<0.010	<0.010
	Phenanthrene	mg/kg	0.197	0.188	0.129	0.193	0.143	0.242	0.090	0.118	0.109	0.243
	Pyrene	mg/kg	0.0170	0.0340	0.0110	0.0150	0.0120	0.0170	<0.010	<0.010	<0.010	0.0180
	Quinoline	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Acenaphthene d10	%	72	80	71	75	76	82	75	76	80	80
	Chrysene d12	%	75	103	85	96	105	102	95	96	100	99
	Naphthalene d8	%	66	64	61	61	64	84	74	76	81	79
	Phenanthrene d10	%	77	110	72	84	84	91	82	87	86	86
	B(a)P Total Potency Equivalent	mg/kg	<0.020	0.0250	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	IACR (CCME)	mg/kg	0.230	0.380	0.200	0.270	0.230	0.300	0.160	0.180	0.180	0.300

= Concentration exceeds lower SQG.

= Concentration exceeds upper SQG.

= Concentrations were < lowest reporting limit (LRL) and LRL exceeds SQGs.

Italics = Concentrations are outside the reference area normal range (2.5th and 97.5th percentiles) from the RAEMP (Minnow 2018).

Notes: - = no data/not applicable; CCME = Canadian Council of Ministers of the Environment; SQG = sediment quality guideline.

Table H.7: Chemistry Data for Benthic Invertebrate Tissues Collected for the Lentic Area Supporting Study and GHO LAEMP from the Mine-Exposed Reach 2 of the Side Channel, July and September 2018

Analyte	Units	Mine-exposed							
		RG_GHSCW				RG_GH_SCW3			
		30-Jul-18			Mean (n = 3)	07-Sep-18			Mean (n = 3)
% Moisture	%	76	82	80	80	84	81	80	81.6
Aluminum (Al)	µg/g dw	5,300	9,600	4,600	6,500	3,500	1,800	900	2,070
Antimony (Sb)	µg/g dw	<0.2	<1	<1	<0.2	<1	<0.2	<0.2	<0.200
Arsenic (As)	µg/g dw	2.60	3.20	2.00	2.60	1.40	1.20	0.60	1.07
Barium (Ba)	µg/g dw	72	130	78	93	58	64	34	52
Beryllium (Be)	µg/g dw	0.200	0.300	0.200	0.233	0.100	0.070	0.040	0.07
Boron (B)	µg/g dw	11	20	<10	14	10	12	4.00	8.67
Cadmium (Cd)	µg/g dw	8.10	7.20	4.50	6.60	1.40	1.20	0.56	1.05
Chromium (Cr)	µg/g dw	9.00	16	8.00	11	6.00	3	2.00	3.67
Cobalt (Co)	µg/g dw	3.30	2.20	2.20	2.57	1.70	1.80	0.86	1.45
Copper (Cu)	µg/g dw	30	20	31	27	22	21	17	20
Iron (Fe)	µg/g dw	3,400	6,300	3,100	4,270	2,300	1,200	720	1,410
Lead (Pb)	µg/g dw	2.00	3.40	1.80	2.40	1.50	1.10	0.71	1.1
Manganese (Mn)	µg/g dw	320	190	210	240	280	280	260	273
Mercury (Hg)	µg/g dw	0.0500	0.0600	<0.05	0.0533	<0.05	0.0300	0.0300	0.03
Molybdenum (Mo)	µg/g dw	1.00	<1	<1	1.00	<1	0.800	0.800	0.8
Nickel (Ni)	µg/g dw	7.00	9.40	6.60	7.67	8.00	7.70	4.00	6.57
Selenium (Se)	µg/g dw	***8.20***	***9.20***	***9.50***	***8.97***	***12.00***	***8.90***	***16.00***	***12.3***
Silver (Ag)	µg/g dw	0.190	0.400	0.300	0.297	0.100	0.100	0.080	0.0933
Strontium (Sr)	µg/g dw	67	150	110	109	20	10	16	15.3
Thallium (Tl)	µg/g dw	0.200	<0.5	<0.5	0.200	<0.5	<0.1	<0.1	<0.100
Tin (Sn)	µg/g dw	0.100	<0.5	<0.5	0.100	<0.5	<0.1	<0.1	<0.100
Titanium (Ti)	µg/g dw	38	58	39	45	43	24	9	25.2
Uranium (U)	µg/g dw	0.470	0.810	0.500	0.593	0.550	0.530	0.430	0.503
Vanadium (V)	µg/g dw	17	30	15	21	11	6	3	6.63
Zinc (Zn)	µg/g dw	200	120	150	157	370	400	360	377

= Selenium concentration exceeds 15 µg/g dw EVWQP Level 1 Benchmark for dietary effects to birds.

= Selenium concentration exceeds 13 µg/g dw EVWQP Level 1 Benchmark for growth, reproduction, and survival of benthic invertebrates.

= Selenium concentration exceeds 11 µg/g dw EVWQP Level 1 Benchmark for dietary effects to juvenile fish.

Italics = Selenium concentrations are outside the reference normal range (2.5th [1.41 µg/g dw] and 97.5th percentiles [7.79 µg/g dw]) from the RAEMP (Minnow 2018).

Notes: EVWQP = Elk Valley Water Quality Plan; RAEMP = Regional Aquatic Effects Monitoring Program.