Mary River Project 2017
Core Receiving Environment Monitoring Program Report

Prepared for:
Baffinland Iron Mines Corporation
Oakville, Ontario

Prepared by:
Minnow Environmental Inc.
Georgetown, Ontario

March 2018

Mary River Project 2017

Core Receiving Environment

Monitoring Program Report

Paul LePage, M.Sc.
Project Manager

Pierre Stecko, M.Sc., R.P. Bio, EP
Senior Project Advisor

EXECUTIVE SUMMARY

The Mary River Project is an operating high-grade iron mine located in the Qikiqtani Region of northern Baffin Island, Nunavut. Owned and operated by Baffinland Iron Mines Corporation (Baffinland), the mine began commercial operation in 2015. Mining activities at the Mary River Project include open pit ore extraction, ore haulage, stockpiling, crushing, and screening, followed by transport by truck to Milne Port for subsequent seasonal loading onto bulk carrier ships for transfer to European markets. No milling or additional processing of the ore is conducted on-site and therefore no tailings are produced at the Mary River Project. Mine waste management facilities at the Mary River Project thus consist simply of a mine waste rock stockpile and surface runoff collection ponds currently situated near the mine waste rock stockpile and ore stockpile areas. In addition to periodic discharge of treated effluent from the mine waste rock stockpile area, other potential mine inputs to aquatic systems located adjacent to the mine include runoff and dust from ore (crusher) stockpiles, discharge of treated sewage effluent, runoff and explosives residue from quarry operations, deposition of fugitive dust generated by mine activities, and general mine site runoff.

Under terms and conditions of a Type A water licence issued by the Nunavut Water Board, Baffinland was required to develop and implement an Aquatic Effects Monitoring Plan (AEMP) at the Mary River Project. In order to meet the AEMP objectives for the Mary River Project, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to provide a basis for the evaluation of potential mine-related influences on water quality, sediment quality, and/or biota (including phytoplankton, benthic invertebrates, and fish). The primary receiving systems that serve as the focus for the CREMP include the Camp Lake system (i.e., Camp Lake tributaries 1 and 2, Camp Lake), the Sheardown Lake system (i.e., Sheardown Lake tributaries 1, 9, and 12; Sheardown Lake NW and Sheardown Lake SE), and the Mary River and Mary Lake system. The CREMP has implemented an effects-based approach using standard environmental effects monitoring techniques as the basis for the evaluation of potential mine-related effects within the mine primary receiving systems on an annual frequency since the commencement of commercial mine production/operation in 2015.

The results of the 2017 CREMP indicated some mine-related influences on water and sediment quality of a few of the mine primary receiver systems, but ecologically significant mine-related effects to biota were generally restricted to only a single tributary within the Sheardown Lake system. Within the Camp Lake system, mine-related effects on water quality were apparent as elevated concentrations of copper (CLT1 north branch only), iron, nitrate, and sulphate (CLT1 main stem only), and chloride, manganese, molybdenum, sodium, and uranium at Camp Lake Tributary 1 and Camp Lake based on comparison to reference conditions and to baseline data.

Arsenic and manganese concentrations were elevated within littoral sediment of Camp Lake compared to reference lake sediments and to Camp Lake baseline data. Active quarrying (QMR2 pit) in the watershed was likely a key source of these parameters to waterbodies of the Camp Lake system. Nevertheless, no adverse effects to phytoplankton, benthic invertebrates, or arctic charr (*Salvelinus alpinus*) were indicated at mine-exposed areas of the Camp Lake system in 2017, which was consistent with concentrations of most metals below applicable water and sediment quality guidelines (WQG and SQG, respectively) at these waterbodies.

Within the Sheardown Lake system, mine-related effects on water quality were apparent only at Sheardown Lake Tributary 1, where aqueous concentrations of nitrate, sodium, and sulphate were elevated compared to concentrations at reference areas and during applicable baseline studies. Sedimentation was evident as deposits of reddish-brown silt material characterized by iron concentrations above SQG at Sheardown Lake tributaries 1 and 12, but within lake environments, only manganese concentrations were elevated in sediment of Sheardown Lake SE compared to reference lake and baseline conditions. Sheardown Lake Tributary 12 was the only waterbody sampled under the CREMP at which differences in benthic invertebrate community structure could be definitively linked to a mine-related influence. At this tributary, changes in the benthic invertebrate community assemblage relative to reference conditions and baseline studies appeared to be related to potential flow reduction and/or sedimentation. No adverse effects to phytoplankton, benthic invertebrates, or arctic charr were indicated at mine-exposed areas of Sheardown Lake tributaries 1 and 9, Sheardown Lake NW, or Sheardown Lake SE in 2017, which was consistent with concentrations of most metals below applicable WQG and SQG at these waterbodies.

Within the Mary River/Mary Lake system, mine-related effects on water quality were apparent only as elevated concentrations of ammonia, nitrate, and sulphate at a tributary of Mary River (MRTF) that receives treated mine effluent, whereas mine-related effects on sediment quality only included slight elevation of manganese concentrations at Mary Lake. However, no adverse effects to phytoplankton, benthic invertebrates, or arctic charr were indicated at mine-exposed areas of MRTF, Mary River, or Mary Lake in 2017 which, similar to the other mine receiving systems, was consistent with concentrations of most metals below applicable WQG and SQG.

TABLE OF CONTENTS

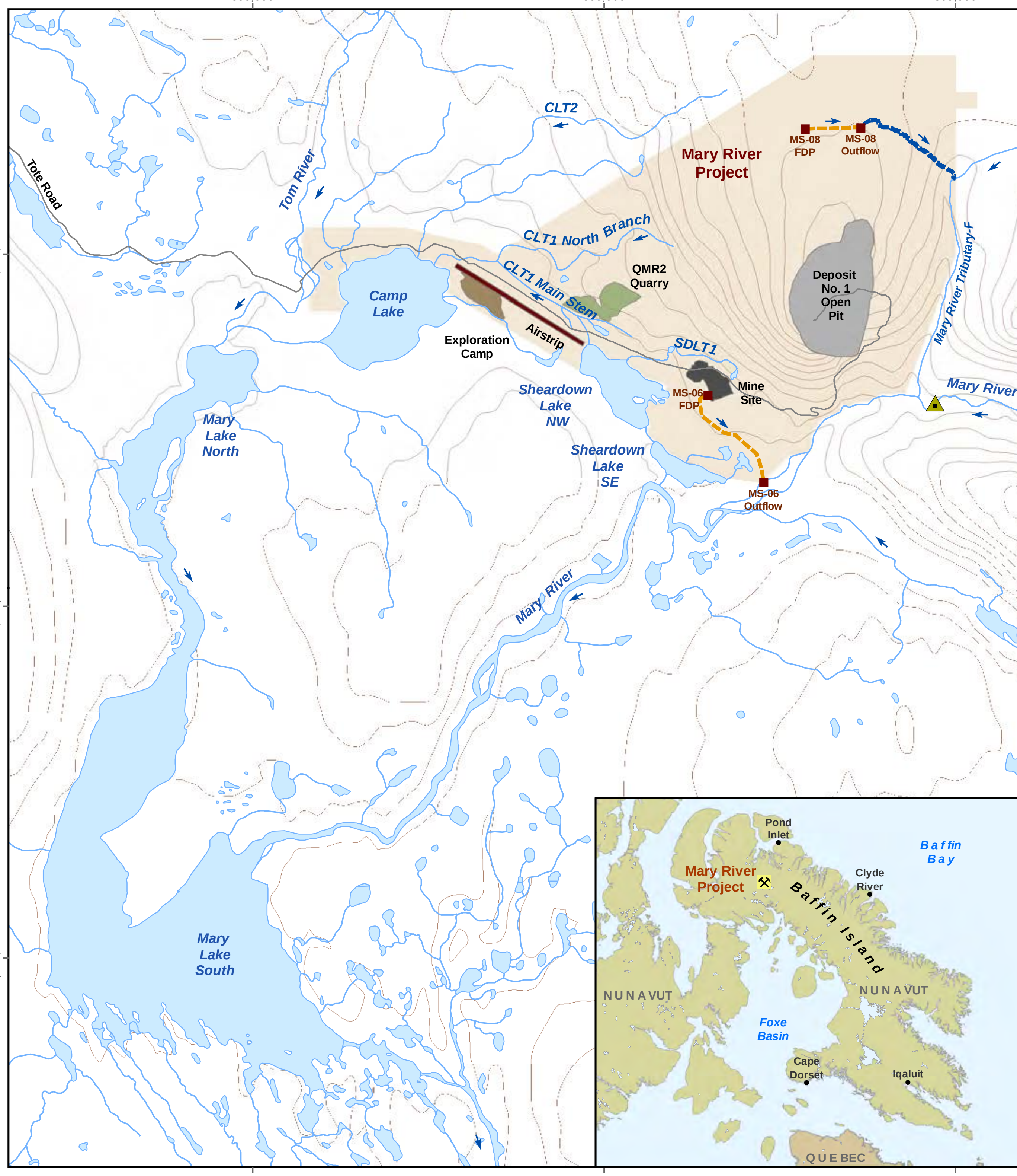
LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The Mary River Project, owned and operated by Baffinland Iron Mines Corporation (Baffinland), is a high-grade iron ore mining operation located in the Qikiqtani Region of northern Baffin Island, Nunavut (Figure 1.1). Open pit mining, including pit bench development, ore haulage and stockpiling, and the crushing and screening of high-grade iron ore, commenced at the Mary River Project in mid-September 2014. For the initial mining stages, as much as 4.2 million tonnes (Mt) of crushed/screened ore is transported annually by truck to Milne Port, which is located approximately 100 km north of the mine site. At Milne Port, the ore is stockpiled before being loaded onto bulk carrier ships for transport to European markets during the summer ice-free period. No milling or additional ore processing is conducted on-site, and thus no tailings are produced at the Mary River Project. The mine waste management facilities include a mine waste rock stockpile and surface runoff collection ponds currently situated near the mine waste rock stockpile and ore stockpile areas. In addition to periodic discharge of treated effluent from the mine waste rock disposal area to the Mary River system, other potential mine inputs to aquatic systems located adjacent to the mine include runoff and dust from ore (crusher) stockpiles located on the mine site within the Sheardown Lake catchment, treated mine camp sewage effluent discharge to Mary River, runoff and explosives residue from quarry operations to the Camp Lake catchment, deposition of fugitive dust generated by mine activities, and general mine site runoff.

Under terms and conditions of a Type A water licence issued by the Nunavut Water Board (No. 2AM-MRY1325 Amendment No. 1), Baffinland developed an Aquatic Effects Monitoring Plan (AEMP) for the Mary River Project. A key objective of the AEMP was to provide data and information to allow the evaluation of short- and long-term effects of the project on aquatic ecosystems. To meet this objective, Baffinland developed a Core Receiving Environment Monitoring Program (CREMP) to assess potential mine-related influences on water quality, sediment quality, and biota (including phytoplankton, benthic invertebrates, and fish) at aquatic environments located near the mine (Baffinland 2014; KP 2014a; NSC 2014). The primary receiving systems that serve as the focus for the CREMP include the Camp Lake system (Tributaries 1 and 2, Camp Lake), the Sheardown Lake system (Tributaries 1, 9, and 12; Sheardown Lake NW and Sheardown Lake SE), Mary River and Mary Lake (Figure 1.1). Over the initial two years of mine operation, the CREMP studies indicated some effects of Baffinland mine operations on water quality and sediment quality of receiving waterbodies, but these effects were confined to single tributaries feeding into each of Camp and Sheardown lakes, as well as near the immediate outlets of these tributaries to each respective lake (Minnow 2016a, 2017). No adverse mine-related effects to phytoplankton, benthic invertebrate, or fish were suggested at any of the Camp, Sheardown, or Mary lake systems in 2015 or 2016 based on comparisons to



LEGEND

- Final Discharge Point (FDP)
- Mary River Cascade Barrier
- Discharge Line
- Overland Effluent Channel
- QMR2 Quarry
- Airstrip
- Exploration Camp
- Mine Site
- Open Pit
- Mary River Project

Baffinland Iron Mines Corporation, Mary River Project Location

0 1.25 2.5 5 km

Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.

Date: March 2018
Project 177202.0033

minnow environmental inc.

Figure 1.1

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 1.1 Location.mxd representative reference waterbodies and to available pre-mine baseline data for each lake system (Minnow 2016a, 2017).

This report presents the methods and results of the 2017 CREMP, including an evaluation of potential Mary Lake Project-related influences on chemical and biological conditions at mine-exposed waterbodies through the third full year of mine operation. As in the two previous studies, the 2017 Mary River Project CREMP included water quality monitoring, sediment quality monitoring, phytoplankton monitoring, benthic invertebrate community assessment, and an arctic charr (*Salvelinus alpinus*) fish population assessment. The CREMP was designed as an iterative series of monitoring and interpretative phases, with the results of previous studies used to inform the direction of future monitoring. The 2017 CREMP was implemented in accordance with the original study design (Baffinland 2014) with the exception of the continued use of a reference creek benthic invertebrate community study area that was originally added to the program in 2016 (Minnow 2016a, 2017). Data and results of federal Environmental Effects Monitoring (EEM) conducted at the Mary River Project in 2017 have also been included in this CREMP report to consolidate all pertinent biological information and assist with the evaluation of potential mine-related effects.

2 METHODS

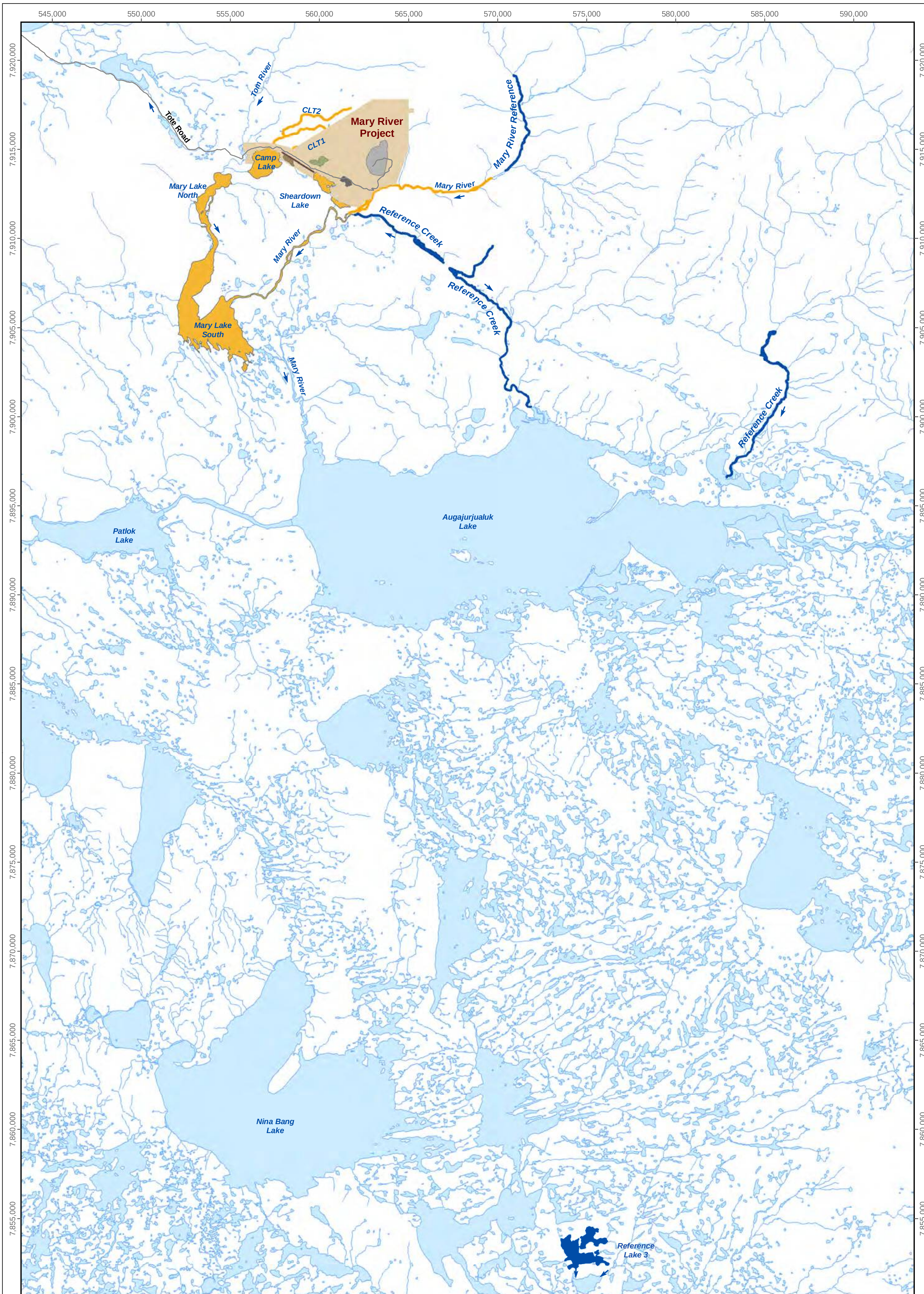
2.1 Overview

The Mary River Project CREMP includes water quality monitoring, sediment quality monitoring, phytoplankton (chlorophyll-a) monitoring, benthic invertebrate community assessment, and fish population assessment (Baffinland 2014). In 2017, water quality and phytoplankton monitoring was conducted by Baffinland environment department personnel over four separate sampling events, including an ice-cover event (April 11th - 17th) and open-water season events corresponding to Arctic spring (freshet), summer, and autumn (July 7th - 9th, July 21st - August 10th, and August 20th - September 2nd, respectively). Sediment quality, benthic invertebrate community, and fish population sampling was conducted by Minnow Environmental Inc. (Minnow) personnel with assistance from Baffinland environment department staff from August 16th - 30th 2017, the seasonal timing of which was consistent with monitoring conducted for previous baseline (2005 – 2013), mine construction (2014), and mine operational (2015, 2016) studies. Similar to previous CREMP studies, the 2017 study included field sampling and standard laboratory quality assurance/quality control (QA/QC) for individual water quality, sediment quality, and benthic invertebrate community study components to allow for an assessment of the overall quality of each respective data set (Appendix A).

The 2017 CREMP study areas included the same mine-exposed and reference waterbodies established in the original design documents (Baffinland 2014; KP 2014a; NSC 2014) and the same reference lake that was added to the program in 2015 (Figure 2.1). To simplify the discussion of results, the mine-exposed study areas were separated by lake catchment as follows:

- the Camp Lake system (Camp Lake Tributaries 1 and 2, and Camp Lake);
- the Sheardown Lake system (Sheardown Lake Tributaries 1, 9, and 12, Sheardown Lake Northwest [NW], and Sheardown Lake Southeast [SE]); and,
- the Mary River/Mary Lake system.

Reference Lake 3, which served as a reference waterbody for lentic (lake) environments beginning in the 2015 CREMP study, was again used as the reference lake for the 2017 study. Reference Lake 3 is located approximately 62 km south of the Mary River Project (Figure 2.1), and is well outside the area of any potential mine influence. Streams used as reference areas in the current and previous CREMP included an unnamed tributary to the Mary River and two unnamed tributaries to Angajurjuatuk Lake, all of which are located southeast of the mine (Figure 2.1). As in the previous CREMP studies, an area of Mary River located well upstream of



LEGEND

- Reference Stream/River System
- Mine Exposed Stream/River System
- Reference Lake
- Mine Exposed Lake
- QMR2 Quarry
- Airstrip
- Exploration Camp
- Mine Site
- Open Pit
- Mary River Project

Mary River Project CREMP Study Water Bodies

0 3.25 6.5 13
km

N
W E
S

Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from HerMajesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.

Date: March 2017
Project 177202.0033

minnow environmental inc.

Figure 2.1

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 2.1 Study Waterbodies.mxd current Baffinland mine activity (i.e., GO-09) served as a reference area for the mine-exposed portion of Mary River in the 2017 study (Figure 2.1).

2.2 Water Quality

2.2.1 General Design

Surface water quality monitoring was conducted by Baffinland environment department personnel at the sampling locations and frequencies stipulated in the Mary River Project CREMP design (Baffinland 2014; KP 2014a). The surface water sampling was conducted at as many as 57 stations per sampling period (Table 2.1; Figures 2.2 and 2.3), and included collection of *in situ* measurements and water chemistry data.

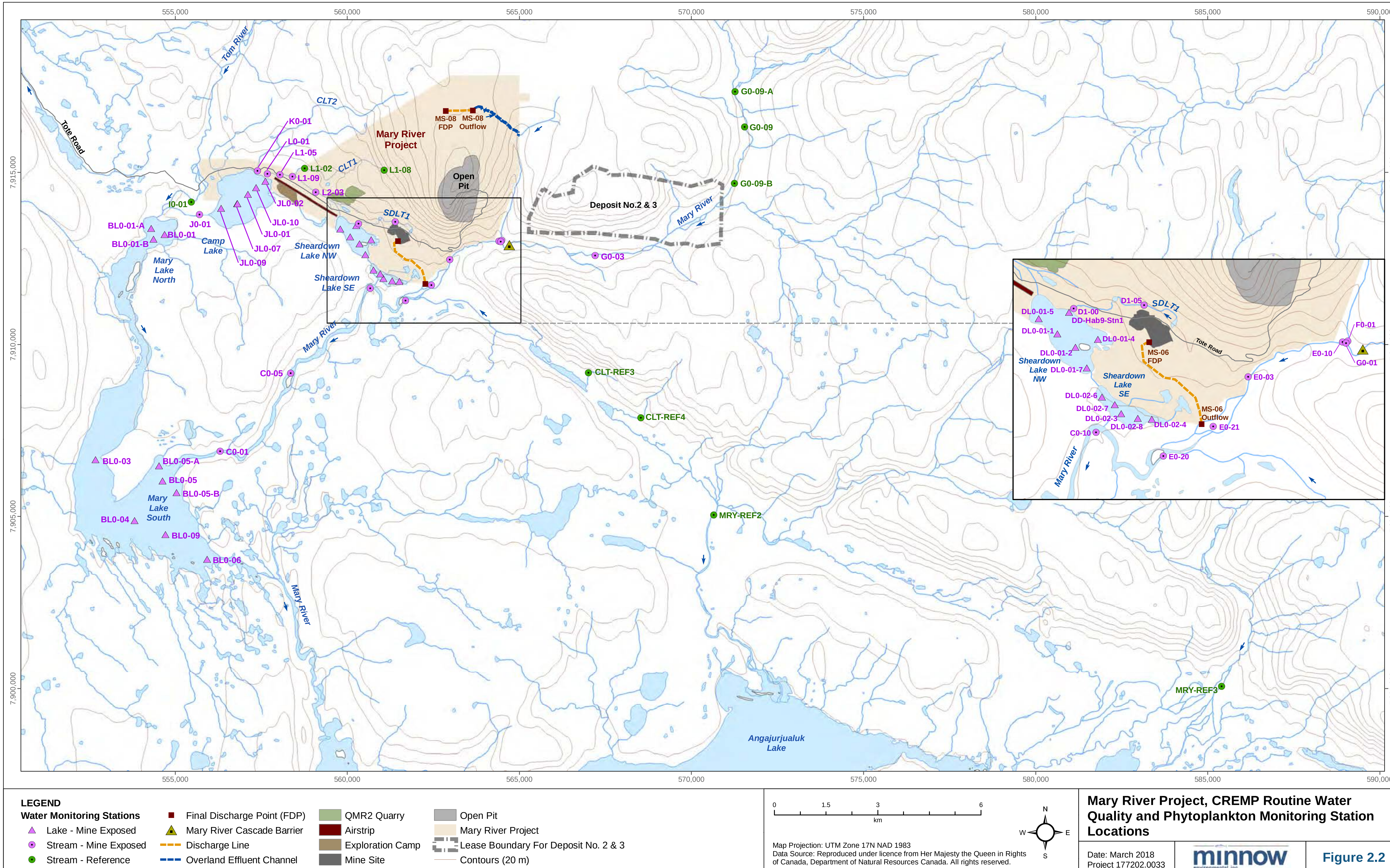
2.2.2 *In Situ* Water Quality Measurement Data Collection and Analysis

In situ measurements of water temperature, dissolved oxygen, pH, specific conductance (i.e., temperature standardized measurement of conductivity), and turbidity were taken at the bottom of the water column at all lotic (i.e., creek, river) stations and as a vertical profile at one metre intervals at each lentic (i.e., lake) water quality monitoring station during routine monitoring conducted by Baffinland. These *in situ* measurements were also collected at the surface and bottom (i.e., approximately 30 cm above the water-sediment interface) at all lake benthic invertebrate community (benthic) stations during the fall biological sampling completed by Minnow, with the exception of turbidity measurements. The *in situ* measurements were collected using a YSI ProDSS (Digital Sampling System) meter equipped with a 4-Port sensor and, for top-bottom measurements collected at lake benthic invertebrate community stations, a YSI 556 MDS (Multiparameter Display System) meter equipped with YSI 6820 sonde (YSI Inc., Yellow Springs, OH). Meter readings for pH, specific conductance, and turbidity were checked against standard solutions and calibrated as necessary on the day of field sampling. Dissolved oxygen concentration readings were checked and calibrated at greater frequency through each sampling day in response to changing sampling conditions (e.g., changes in elevation, barometric pressure, and/or ambient temperature). During the winter ice-cover sampling event, a gas-powered, 15 centimetre (6-inch) diameter ice auger was used to access the water column at all lake water quality monitoring stations. All ice shavings were removed from the auger hole prior to the collection of *in situ* measures. To avoid confounding influences associated with snow/ice melt in the auger hole, the *in situ* measurements were collected beginning just below the ice layer. Additional supporting observations of water colour and clarity were recorded at the time of water quality and biological sampling at all benthic stations, and Secchi depth was measured at all lake stations using the methods outlined in Wetzel and Likens (2000).

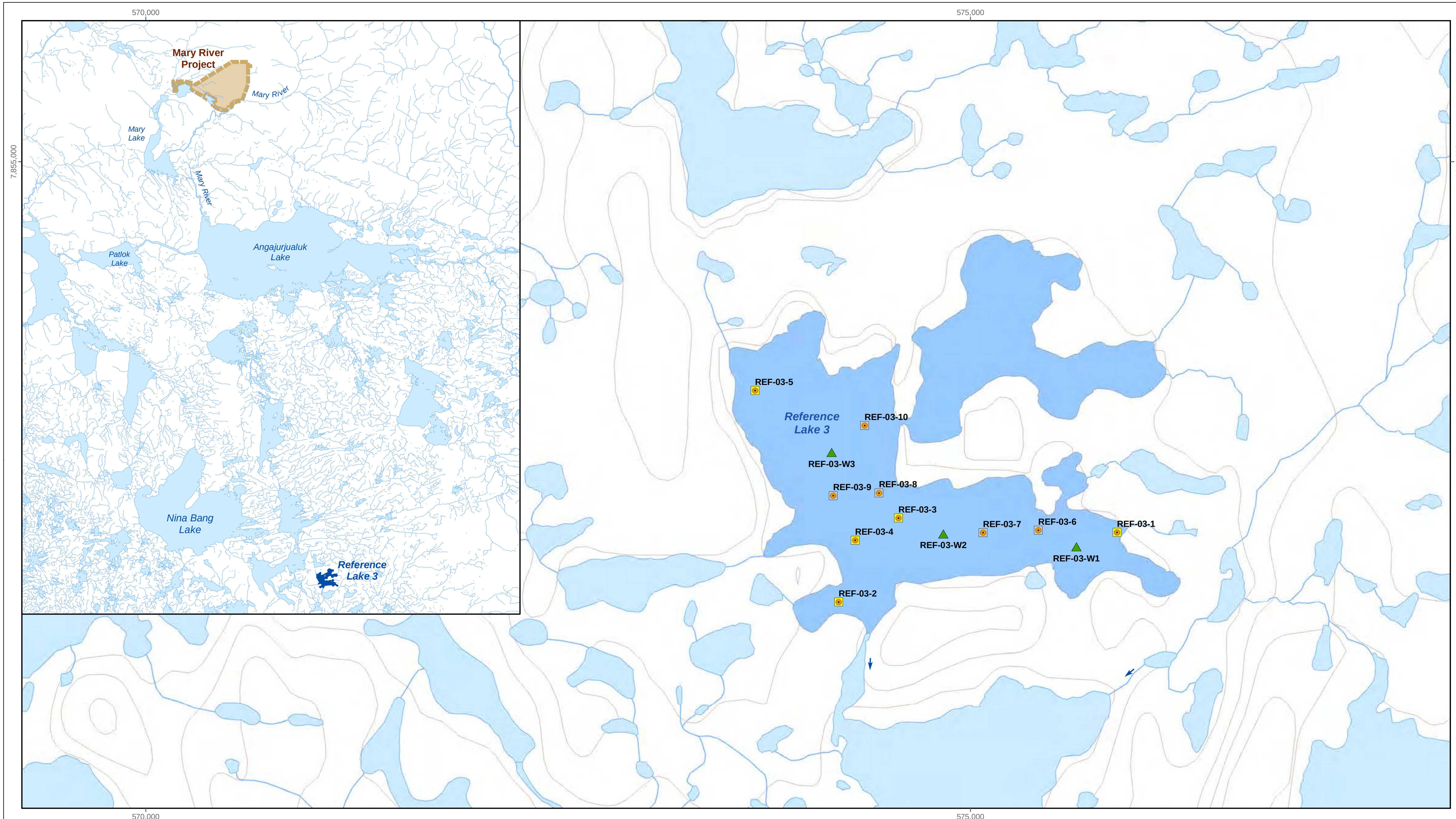
Table 2.1: Mary River Project CREMP Water Quality and Phytoplankton Monitoring Station Coordinates and Annual Sampling Schedule

Study System	Water Body	Station ID	UTM Zone 17N, NAD83		Ref. Data Set [a]	Sampling Season			
			Easting	Northing		Winter (Apr. - May)	Spring (June)	Summer (July)	Fall (Aug. - Sept.)
Reference Areas	Lotic Reference	CLT-REF3	567004	7909174	na	-	✓	✓	✓
		CLT-REF4	568533	7907874		-	✓	✓	✓
		MRY-REF3	585407	7900061		-	✓	✓	✓
		MRY-REF2	570650	7905045		-	✓	✓	✓
	Reference Lake 3	REF-03-W1	575642	7852666	na	-	-	✓	✓
		REF-03-W2	574836	7852744		-	-	✓	✓
		REF-03-W3	574158	7853237		-	-	✓	✓
	Mary River Reference	G0-09-A	571264	7917344	na	-	✓	✓	✓
		G0-09	571546	7916317		-	✓	✓	✓
		G0-09-B	571248	7914682		-	✓	✓	✓
Camp Lake System	Camp Lake Tributaries	I0-01	555470	7914139	a	-	✓	✓	✓
		J0-01	555701	7913773		-	✓	✓	✓
		K0-01	557390	7915030		-	✓	✓	✓
		L0-01	557681	7914959		-	✓	✓	✓
		L1-02	558765	7915121		-	✓	✓	✓
		L1-05	558040	7914935		-	✓	✓	✓
		L1-08	561076	7915068		-	✓	✓	✓
		L1-09	558407	7914885		-	✓	✓	✓
		L2-03	559081	7914425		-	✓	✓	✓
	Camp Lake	JL0-01	557108	7914369	b	✓	-	✓	✓
		JL0-02	557615	7914750		✓	-	✓	✓
		JL0-07	556800	7914094		✓	-	✓	✓
		JL0-09	556335	7913955		✓	-	✓	✓
		JL0-10	557346	7914562		✓	-	✓	✓
Sheardown Lake System	Sheardown Tributary 1	D1-00	560329	7913512	a	-	✓	✓	✓
		D1-05	561397	7913558		-	✓	✓	✓
	Sheardown Lake NW	DD-Hab9-Stn1	560259	7913455	b	✓	-	✓	✓
		DL0-01-1	560080	7913128		✓	-	✓	✓
		DL0-01-2	560353	7912924		✓	-	✓	✓
		DL0-01-4	560695	7913043		✓	-	✓	✓
		DL0-01-5	559798	7913356		✓	-	✓	✓
		DL0-01-7	560525	7912609		✓	-	✓	✓
	Sheardown Lake SE	DL0-02-3	561046	7911915	b	✓	-	✓	✓
		DL0-02-4	561511	7911832		✓	-	✓	✓
		DL0-02-6	560756	7912167		✓	-	✓	✓
		DL0-02-7	560952	7912054		✓	-	✓	✓
		DL0-02-8	561301	7911846		✓	-	✓	✓
Mary River and Mary Lake System	Mary River	G0-03	567204	7912587	c	-	✓	✓	✓
		G0-01	564459	7912984		-	✓	✓	✓
		F0-01	564483	7913015		-	✓	✓	✓
		E0-21	562444	7911724		-	✓	✓	✓
		E0-20	561688	7911272		-	✓	✓	✓
		E0-10	564405	7913004		-	✓	✓	✓
		E0-03	562974	7912472		-	✓	✓	✓
		C0-10	560669	7911633		-	✓	✓	✓
		C0-051	558352	7909170		-	✓	✓	✓
		C0-01	556305	7906894		-	✓	✓	✓
	Mary Lake (North Basin)	BL0-01	554691	7913194	b	✓	-	✓	✓
		BL0-01-A	554300	7913378		✓	-	✓	✓
		BL0-01-B	554369	7913058		✓	-	✓	✓
	Mary Lake (South Basin)	BL0-03	552680	7906651	b	✓	-	✓	✓
		BL0-04	553817	7904886		✓	-	✓	✓
		BL0-05	554632	7906031		✓	-	✓	✓
		BL0-06	555924	7903760		✓	-	✓	✓
		BL0-05-A	554530	7906478		✓	-	✓	✓
		BL0-05-B	555034	7905692		✓	-	✓	✓
		BL0-09	554715	7904479		✓	-	✓	✓

[a] Reference data applicable to indicated study area include a - lotic reference stations; b - lentic reference stations; and, c - Mary River upstream stations.



Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 2.2 Water Quality and Phyto.mxd



LEGEND

- Sediment and Benthic Monitoring Location
- Littoral Sampling Depth
- Profundal Sampling Depth
- Water Quality and Phytoplankton Monitoring Station
- Reference Lake

0 0.35 0.7 1.4 km

N W E S

Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.

Mary River Project CREMP Reference Lake 3 Monitoring Station Locations

Date: March 2018
Project 177202.0033

minnow environmental inc.

Figure 2.3

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 2.3 Reference Lake 3.mxd

In situ water quality data collected at the mine-exposed study streams, rivers, and lakes were compared to respective reference area data, to applicable water quality guidelines (WQG[1]; pH and dissolved oxygen concentrations only) and, for pH and conductivity, to baseline data. *In situ* water quality data were compared spatially within each system (i.e., from upstream- to downstream-most stations) using both qualitative and statistical approaches. For the statistical analysis, raw data and log-transformed data were assessed for normality and homogeneity of variance prior to conducting comparisons between (pair-wise) or among (multiple-group) applicable like-habitat mine-exposed and reference study area groups using Analysis-of-Variance (ANOVA). The selection of whether untransformed or log-transformed data were used for the ANOVA tests was determined based on which data best met the assumptions of ANOVA. In instances where normality could not be achieved through data transformation, non-parametric Mann-Whitney U-test and Kruskal-Wallis H-test statistics were applied using the raw data to validate the pair-wise and multiple-group ANOVA statistical results, respectively. Similarly, in instances in which variances of normal data could not be homogenized by transformation, Student's t-tests assuming unequal variance were applied using either raw or log-transformed data to validate the pair-wise ANOVA statistical results. In cases in which multiple-group comparisons were conducted, Tukey's Honestly Significant Difference (HSD) or Tamhane's pair-wise *post hoc* tests were implemented for homogenous and non-homogenous data, respectively All statistical comparisons were conducted using SPSS Version 12.0 software (SPSS Inc., Chicago, IL).

Vertical profiles of the *in situ* measurements taken from lake stations were plotted and visually assessed to evaluate potential thermal, dissolved oxygen, or chemical (i.e., pH and/or specific conductance) stratification and the corresponding depths associated with any distinct layering. The occurrence of a thermocline was conservatively assessed as a ≥0.5˚C change in temperature per 1 m incremental change in depth[2]. The vertical profile data collected at the mine-exposed study lakes were compared to that of the reference lake for each seasonal monitoring event using profile data averaged for each incremental depth below the water surface among lake stations by season. At each study lake, spatial and seasonal differences in the vertical profile plots were evaluated to provide a better understanding of natural conditions and/or mine-related influences on within-lake water quality. Additional evaluation of the *in situ* dissolved oxygen concentration and pH data included comparisons to WQG[1].

[1] Canadian Environmental Quality Guidelines for the protection of aquatic life (CCME 1999, 2017) were used as the primary source for WQG, including those for pH and dissolved oxygen concentrations.

[2] Wetzel (2001) defines the thermocline as a ≥1˚C change in temperature per 1 m incremental change in depth, and thus a ≥0.5˚C change in temperature per 1 m incremental change in depth was considered highly conservative.

2.2.3 Water Chemistry Sampling and Data Analysis

Surface water chemistry samples were collected from both lotic and lentic environments (Table 2.1). At lotic stations, the water chemistry samples were collected from approximately mid-water column by hand directly into pre-labeled sample bottles, which for those requiring preservation, were pre-dosed with required chemical preservatives. At lentic stations, two water chemistry samples were collected, one approximately 1 m below the surface (or just below the ice layer for the winter sampling event) and the other from approximately 1 m above the bottom, using a non-metallic, vertically-oriented 2.2 L TT Silicon Kemmerer bottle (Wildco Supply Co., Yulee, FL). During the winter sampling event, the water column was accessed at the same time and using the same methods as described above for the *in situ* measurements. Lake water collected using the beta-bottle was transferred directly into sample bottles that had been pre-dosed with required chemical preservatives, where appropriate, except those requiring field filtration. For samples that required filtration (e.g., for dissolved metals), filtration was conducted in the field using methods consistent with AEMP standard operating procedures (Baffinland 2014).

Following collection, the water chemistry samples were placed into coolers in the field and maintained at cool temperatures for shipment to the analytical laboratory. Field water chemistry sampling QA/QC included trip blanks, field blanks, and the collection of equipment blanks and field duplicates with replication conducted on as many as 10% of the total samples collected for each CREMP sampling event (Appendix A). The water chemistry samples were shipped on ice to ALS Canada Ltd. (ALS; Waterloo, ON) for analysis of pH, conductivity, hardness, total suspended solids (TSS), total dissolved solids (TDS), anions (alkalinity, bromide, chloride, sulphate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen [TKN], total phosphorus), dissolved and total organic carbon (DOC and TOC, respectively), mercury, total and dissolved metals, and phenols using standard laboratory methods.

Water chemistry data were compared: i) among mine-exposed and reference areas for each study lake catchment (Table 2.1); ii) spatially and seasonally at each mine-exposed waterbody; iii) to applicable WQG for the protection of aquatic life (Table 2.2); iv) to site specific water quality benchmarks developed for the Mary River Project AEMP (Intrinsik 2014); and, v) to baseline water quality data. For data screening, and to simplify discussion of results, the magnitude of elevation in parameter concentrations was calculated as the mine-exposed area mean concentration divided by the respective reference station/area mean concentration. Similarly, for temporal comparisons, the magnitude of elevation in parameter concentrations was calculated by dividing the individual mine-exposed station/area 2017 mean concentrations by the baseline (2005 - 2013) mean concentration for each parameter. The resulting magnitude of dissimilarity in parameter

Table 2.2: Water Quality Guidelines Used for the Mary River Project 2015 to 2017 CREMP Studies

Parameters		Units	Water Quality Guideline (WQG)[a]	Criteria Source[a]	Supporting Information and/or Calculations Used to Derive Hardness Dependent Criteria
Conventionals	pH (lab)	pH	6.5 - 9.0	CWQG	
Nutrients and Organics	Nitrate	mg/L	13	CWQG	
	Nitrite	mg/L	0.06	CWQG	
	Total Phosphorus	mg/L	0.020	PWQO	Total phosphorus objective is 0.030 mg/L for lotic (rivers, streams) environments, and 0.020 mg/L for lentic (lake) environments.
	Phenols	mg/L	0.001	PWQO	
Anions	Chloride (Cl)	mg/L	120	CWQG	
	Sulphate (SO_4)	mg/L	218	BCWQG	Sulphate guideline is hardness (mg/L $CaCO_3$) dependent as follows: 128 mg/L at 0 - 30 hardness, 218 mg/L at 31 - 75 hardness, 309 mg/L at 76 - 180 hardness, and 429 mg/L at 181 - 250 hardness. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
Total Metals	Aluminum (Al)	mg/L	0.100	CWQG	
	Antimony (Sb)	mg/L	0.020	PWQO	
	Arsenic (As)	mg/L	0.005	CWQG	
	Beryllium (Be)	mg/L	0.011	PWQO	
	Boron (B)	mg/L	1.5	CWQG	
	Cadmium (Cd)	mg/L	0.00012	CWQG	Cadmium guideline is hardness (mg/L $CaCO_3$) dependent. For hardness between 17 and 280 mg/L, the cadmium guideline is calculated using the equation Cd (ug/L) = $10^{(0.83[\log(hardness)] - 2.46)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Chromium (Cr)	mg/L	0.0089	CWQG	
	Cobalt (Co)	mg/L	0.001	PWQO	
	Copper (Cu)	mg/L	0.002	CWQG	Copper guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <82 mg/L and >180 mg/L, the copper guideline is 2 and 4 ug/L, respectively. For hardness ranging from 82 - 180 mg/L, the copper guideline (ug/L) = 0.2 * $e^{(0.8545[\ln(hardness)] - 1.463)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Iron (Fe)	mg/L	0.30	CWQG	
	Lead (Pb)	mg/L	0.002	CWQG	Lead guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <60 mg/L and >180 mg/L, the lead guideline is 1 and 7 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the lead guideline (ug/L) = $e^{(1.273[\ln(hardness)] - 4.705)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Manganese (Mn)	mg/L	0.935	BCWQG	Manganese guideline is hardness (mg/L $CaCO_3$) dependent, and calculated using the equation Mn (ug/L) = 0.0044 * (hardness) + 0.605. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with hardness of 75 mg/L.
	Mercury (Hg)	mg/L	0.000026	CWQG	
	Molybdenum (Mo)	mg/L	0.073	CWQG	
	Nickel (Ni)	mg/L	0.077	CWQG	Nickel guideline is hardness (mg/L $CaCO_3$) dependent. At hardness <60 mg/L and >180 mg/L, the nickel guideline is 25 and 150 ug/L, respectively. For hardness ranging from 60 - 180 mg/L, the nickel guideline (ug/L) = $e^{(0.76[\ln(hardness)] + 1.06)}$. Sample-specific (mean) hardness was used for screening purposes. Value presented applicable to water with 75 mg/L hardness.
	Selenium (Se)	mg/L	0.001	CWQG	
	Silver (Ag)	mg/L	0.00025	CWQG	
	Thallium (Tl)	mg/L	0.0008	CWQG	
	Tungsten	mg/L	0.030	PWQO	
	Uranium (U)	mg/L	0.015	CWQG	
	Vanadium (V)	mg/L	0.006	PWQO	
	Zinc (Zn)	mg/L	0.030	CWQG	

[a] Canadian Environment Water Quality Guideline for the protection of aquatic life (CCME1999, 2017) was selected where a CCME guideline exists. Where no CCME guideline exists, the selected criteria is the lowest of either the Ontario Provincial Water Quality Objective (PWQO; OMOE 1994) or the British Columbia Water Quality Guideline (BCWQG; BCMOE 2013), as available.

concentrations were qualitatively assigned as slightly, moderately, or highly elevated compared to reference and/or baseline conditions using the categorization described in Table 2.3.

Table 2.3: Magnitude of Elevation Categorizations for Water and Sediment Chemistry Comparisons

Categorization	Magnitude of Elevation Criterion
Slightly elevated	Concentration 3-fold to 5-fold higher at mine-exposed area versus the reference area or baseline data, as applicable.
Moderately elevated	Concentration 5-fold to 10-fold higher at mine-exposed area versus the reference area or baseline data, as applicable.
Highly elevated	Concentration ≥ 10-fold higher at mine-exposed area versus the reference area or baseline data, as applicable.

Applicable WQG included the Canadian Water Quality Guidelines for the protection of aquatic life (CWQG; CCME 1999, 2017) or, for parameters with no CWQG, the most conservative (i.e., lowest) criterion available from established Ontario Provincial Water Quality Objectives (PWQO; OMOEE 1994), or British Columbia Water Quality Guidelines (BCWQG; BCMOE 2006, 2017). The water quality guidelines are abbreviated simply as 'WQG' in this report, although it is recognized that in certain cases the values presented may be water quality 'objectives'. For those water quality guidelines that are hardness dependent, the hardness of the individual sample was used to calculate the water quality guideline for the specific parameter according to established formulae (Table 2.2). The water chemistry data were also compared to site specific water quality benchmarks developed for the Mary River Project AEMP (Intrinsik 2014). The Mary River Project AEMP water chemistry benchmarks were derived using an evaluation of background (i.e., baseline) water chemistry data together with existing generic water quality guidelines that consider aquatic toxicity thresholds. The AEMP benchmarks were developed to inform management decisions under the AEMP assessment approach and management response framework (Baffinland 2014). An elevation in parameter concentration above the respective AEMP benchmark may trigger various actions (e.g., sampling design modifications, additional statistical assessment, considerations for mitigation, etc.) to better understand and potentially mitigate effects resulting from elevated concentrations of the parameter of concern (Baffinland 2014). Water chemistry data for key parameters (i.e., parameters with concentrations that were notably higher at mine-exposed areas compared to reference areas, that were historically identified as site-specific parameters of concern, and/or that were above WQG and/or AEMP benchmarks) were plotted to evaluate changes in concentrations in 2017 compared to baseline (2005 – 2013) and previous mine construction (2014) and operational (2015, 2016) studies.

Correlation analysis was conducted to evaluate potential relationships between physical variables known to affect water quality (turbidity, TSS) and total metal concentrations. Spearman Rank correlation coefficients (r_s) were generated from untransformed water quality data collected at each waterbody of interest over the entire 2017 sampling season using SPSS Version 12.0 software. For correlations shown to be significant (i.e., p-value ≤ 0.05), the relative strength of the relationship was described according to definitions provided by Fowler et al. (1998). Particular emphasis was placed on correlations that were considered strong (absolute r_s ranging from 0.70 to 0.89) to very strong (absolute r_s ranging from 0.90 to 1.00) for identifying potential causal associations.

2.3 Sediment Quality

2.3.1 General Design

Sediment quality monitoring under the Mary River Project CREMP focuses primarily on assessing potential mine-related effects to the sediment of lake environments based on a gradient design (Baffinland 2014; KP 2014a, 2015). Sediment quality sampling was conducted at five to ten stations per study lake for physical and chemical characterization as outlined under the CREMP, with additional characterization of physical sediment properties conducted at four to six stations per study lake to support the benthic invertebrate community analysis (Table 2.4; Figure 2.4). The lake sediment stations were designated as littoral or profundal based on a sample collection cut-off depth of 12 m, which is the value that was used to define lake zonation during the baseline characterization studies (KP 2014a, 2015). Sediment quality sampling was also conducted at up to five stations from each of the eight stream and five river study areas used to assess mine-related effects to benthic invertebrate communities (Table 2.5; Figure 2.4). This level of effort exceeded the requirements for sampling at the Camp Lake tributaries (three stations), Sheardown Lake tributaries (six stations), and Mary River (four stations) outlined in the original CREMP design (KP 2014a). Notably, all stream and river study areas were previously observed to contain limited depositional habitat (KP 2015; Minnow 2016a,b, 2017) and a general absence of any substantial accumulation of fine sediments, and therefore sediment sampling for chemical characterization was generally restricted to shoreline and interstices of large, coarse substrate material (e.g., cobbles, boulders) within the applicable study areas.

2.3.2 Sample Collection and Laboratory Analysis

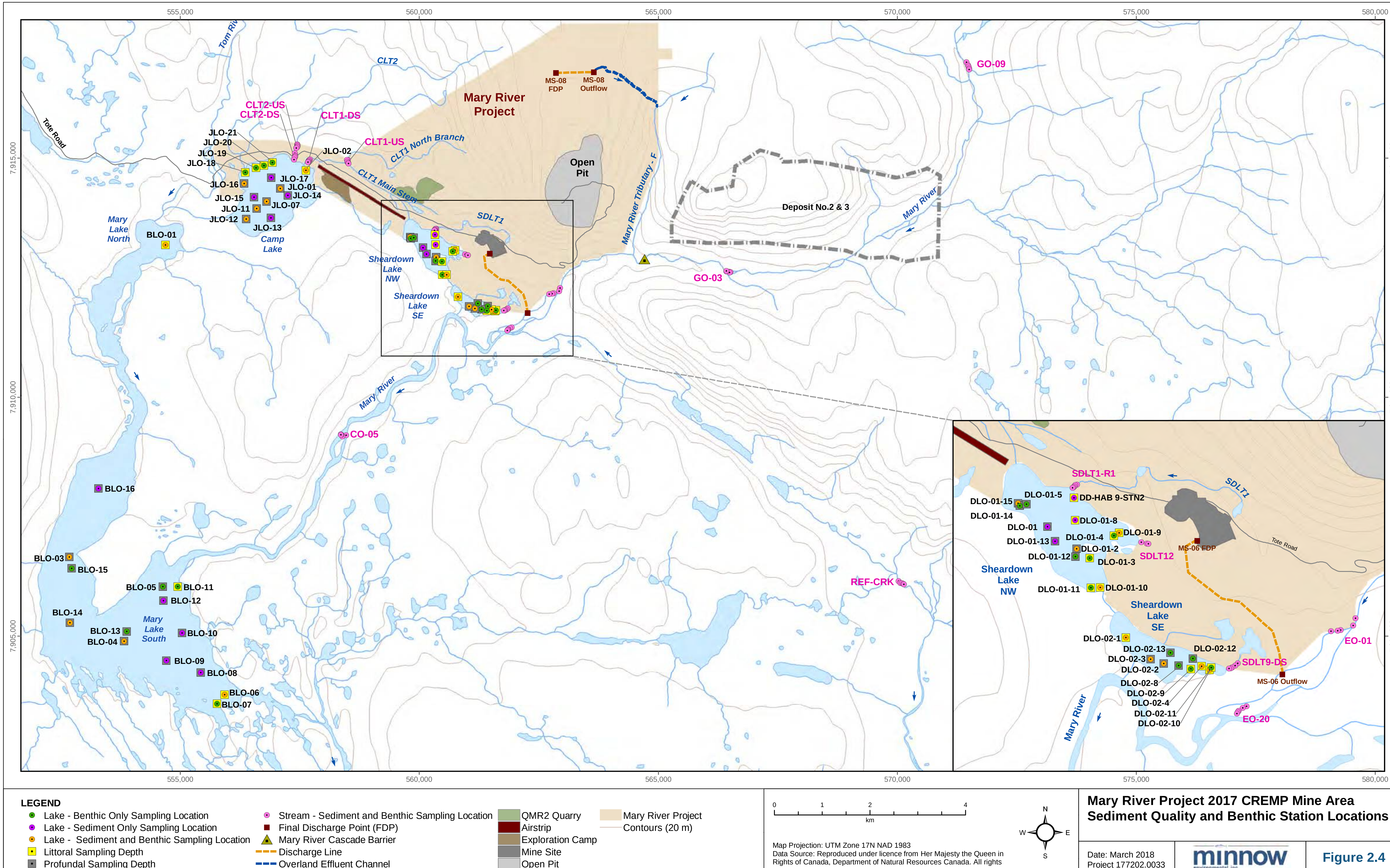
Sediment at study lakes was collected for physical and chemical characterization using a gravity corer (Hoskin Scientific Ltd., Model E-777-00) outfitted with a clean 5.1 cm inside-diameter polycarbonate tube. From each retrieved core sample containing an intact, representative sediment-water interface, the surficial two centimetres of sediment was manually extruded

Table 2.4: Lake Sediment Quality and Benthic Invertebrate Community Monitoring Station Coordinates Used for the Mary River Project CREMP 2017 Study

Waterbody	Station Code	UTM Zone 17W		Sampling Habitat	Sample Type		
		Easting	Northing		Sediment Core[a]	Sediment petite-Ponar[a]	Benthic Invertebrate
Reference Lake	REF-03-1	575992	7852992	littoral	✓	-	✓
	REF-03-2	574200	7852330	littoral	✓	-	✓
	REF-03-3	574564	7852840	littoral	✓	-	✓
	REF-03-4	574301	7852705	littoral	✓	-	✓
	REF-03-5	573694	7853613	littoral	✓	-	✓
	REF-03-6	575411	7852766	profundal	✓	-	✓
	REF-03-7	575076	7852750	profundal	✓	-	✓
	REF-03-8	574445	7852992	profundal	✓	-	✓
	REF-03-9	574168	7852975	profundal	✓	-	✓
	REF-03-10[b]	574358	7853400	profundal	✓	-	✓
Camp Lake	JLO-02	557627	7914748	littoral	✓	-	✓
	JLO-01[b]	557092	7914370	profundal	✓	-	✓
	JLO-14	557246	7914224	profundal	✓	-	-
	JLO-17	556900	7914594	profundal	✓	-	-
	JLO-21	556926	7914911	littoral	-	✓	✓
	JLO-20	556750	7914850	littoral	-	✓	✓
	JLO-19	556587	7914801	littoral	-	✓	✓
	JLO-07	556803	7914095	profundal	✓	-	✓
	JLO-18	556357	7914706	littoral	-	✓	✓
	JLO-16	556335	7914470	profundal	✓	-	✓
	JLO-15	556542	7914184	profundal	✓	-	-
	JLO-11	556594	7913946	profundal	✓	-	✓
	JLO-13	556896	7913751	profundal	✓	-	-
	JLO-12	556378	7913728	profundal	✓	-	✓
Sheardown Lake Northwest (NW)	DLO-01-5	559806	7913348	profundal	✓	-	✓
	DLO-01-14	559821	7913328	profundal	-	✓	✓
	DLO-01-15	559884	7913340	profundal	-	✓	✓
	DD-HAB 9-STN2	560325	7913400	littoral	✓	-	-
	DLO-01-8	560338	7913192	littoral	✓	-	-
	DLO-01	560079	7913132	profundal	✓	-	-
	DLO-01-13	560151	7912997	profundal	✓	-	-
	DLO-01-2[b]	560350	7912927	profundal	✓	-	✓
	DLO-01-12	560339	7912852	profundal	-	✓	✓
	DLO-01-9	560746	7913076	littoral	✓	-	✓
	DLO-01-4	560696	7913049	littoral	-	✓	✓
	DLO-01-3	560471	7912838	littoral	-	✓	✓
	DLO-01-11	560482	7912563	littoral	-	✓	✓
	DLO-01-10	560570	7912566	littoral	✓	-	✓
Sheardown Lake Southwest (SE)	DLO-02-1[b]	560807	7912099	littoral	✓	-	✓
	DLO-02-11	561585	7911799	littoral	✓	-	✓
	DLO-02-10	561602	7911821	littoral	-	✓	✓
	DLO-02-4	561512	7911833	littoral	✓	-	✓
	DLO-02-12	561433	7911905	profundal	-	✓	✓
	DLO-02-9	561414	7911806	littoral	-	✓	✓
	DLO-02-8	561300	7911839	profundal	-	✓	✓
	DLO-02-13	561222	7911958	profundal	-	✓	✓
	DLO-02-2	561161	7911858	profundal	✓	-	✓
	DLO-02-3	561039	7911898	profundal	✓	-	✓
Mary Lake	BLO-01	554690	7913186	littoral	✓	-	✓
	BLO-16	553289	7908092	profundal	✓	-	-
	BLO-03	552679	7906660	profundal	✓	-	✓
	BLO-15	552723	7906419	profundal	-	✓	✓
	BLO-14	552688	7905282	profundal	✓	-	✓
	BLO-05	554635	7906033	profundal	-	✓	✓
	BLO-11	554942	7906033	littoral	-	✓	✓
	BLO-12	554644	7905742	profundal	✓	-	-
	BLO-13	553879	7905094	profundal	-	✓	✓
	BLO-04[b]	553820	7904893	profundal	✓	-	✓
	BLO-10	555033	7905065	profundal	✓	-	-
	BLO-09	554707	7904486	profundal	✓	-	-
	BLO-08	555424	7904239	profundal	✓	-	-
	BLO-07	555767	7903583	littoral	-	✓	✓
	BLO-06	555925	7903771	littoral	✓	-	✓

[a] Sediment core samples analyzed for particle size, TOC and total metals. Petite-ponar sediment grab sample analyzed for particle size only.

[b] Duplicate sediment core sample collected for quality control/quality assurance (QA/QC).



Mary River Project 2017 CREMP Mine Area Sediment Quality and Benthic Station Locations

Figure 2.4

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 2.4 Sediment and Benthic.mxd

Table 2.5: Stream and River Benthic Invertebrate Community Monitoring Station Coordinates Used for the Mary River Project CREMP 2017 Study

Lake System	Waterbody	Station Code	Station Type	UTM Zone 17W, NAD83	
				Easting	Northing
Angajurjualuk Lake	Unnamed Tributary	REF-CRK-B1	Reference	570025	7906148
		REF-CRK-B2	Reference	570060	7906115
		REF-CRK-B3	Reference	570093	7906110
		REF-CRK-B4	Reference	570121	7906099
		REF-CRK-B5	Reference	570137	7906086
Camp Lake	Camp Lake Tributary 1	CLT1-US-B1	Reference	558502	7914967
		CLT1-US-B2	Reference	558488	7914963
		CLT1-US-B3	Reference	558494	7914930
		CLT1-US-B4	Reference	558509	7914903
		CLT1-US-B5	Reference	558517	7914890
		CLT1-DS-B1	Mine-Exposed	557710	7914978
		CLT1-DS-B2	Mine-Exposed	557693	7914957
		CLT1-DS-B3	Mine-Exposed	557686	7914944
		CLT1-DS-B4	Mine-Exposed	557678	7914932
		CLT1-DS-B5	Mine-Exposed	557672	7914917
	Camp Lake Tributary 2	CLT2-US-B1	Reference	557441	7915291
		CLT2-US-B2	Reference	557451	7915275
		CLT2-US-B3	Reference	557450	7915251
		CLT2-US-B4	Reference	557441	7915237
		CLT2-US-B5	Reference	557423	7915215
		CLT2-DS-B1	Mine-Exposed	557392	7915104
		CLT2-DS-B2	Mine-Exposed	557398	7915053
		CLT2-DS-B3	Mine-Exposed	557400	7915032
		CLT2-DS-B4	Mine-Exposed	557997	7915008
		CLT2-DS-B5	Mine-Exposed	557377	7914971
Sheardown Lake Northwest (NW)	Sheardown Lake Tributary 1 (Reach 1)	SDLT1-R1-B1	Mine-Exposed	560352	7913522
		SDLT1-R1-B2	Mine-Exposed	560338	7913520
		SDLT1-R1-B3	Mine-Exposed	560328	7913507
		SDLT1-R1-B4	Mine-Exposed	560320	7913497
		SDLT1-R1-B5	Mine-Exposed	560313	7913493
	Sheardown Lake Tributary 12	SDLT12-B1	Mine-Exposed	560953	7912988
		SDLT12-B2	Mine-Exposed	561003	7912975
		SDLT12-B3	Mine-Exposed	561016	7912971
Sheardown Lake Southwest (SE)	Sheardown Lake Tributary 9	SDLT9-DS-B1	Mine-Exposed	561848	7911860
		SDLT9-DS-B2	Mine-Exposed	561825	7911838
		SDLT9-DS-B3	Mine-Exposed	561798	7911824
		SDLT9-DS-B4	Mine-Exposed	561785	7911816
		SDLT9-DS-B5	Mine-Exposed	561767	7911812
Mary Lake	Mary River	GO-09-B1	Reference	571447	7917010
		GO-09-B2	Reference	571479	7916946
		GO-09-B3	Reference	571489	7916919
		GO-09-B4	Reference	571499	7916883
		GO-09-B5	Reference	571503	7916858
		GO-03-B1	Mine-Exposed	566489	7912626
		GO-03-B2	Mine-Exposed	566509	7912616
		GO-03-B3	Mine-Exposed	566491	7912605
		GO-03-B4	Mine-Exposed	566425	7912630
		GO-03-B5	Mine-Exposed	566425	7912642
		EO-01-B1	Mine-Exposed	562944	7912281
		EO-01-B2	Mine-Exposed	562922	7912214
		EO-01-B3	Mine-Exposed	562806	7912171
		EO-01-B4	Mine-Exposed	562778	7912165
		EO-01-B5	Mine-Exposed	562717	7912158
		EO-20-B1	Mine-Exposed	561930	7911460
		EO-20-B2	Mine-Exposed	561895	7911447
		EO-20-B3	Mine-Exposed	561858	7911420
		EO-20-B4	Mine-Exposed	561848	7911408
		EO-20-B5	Mine-Exposed	561841	7911393
		CO-05-B1	Mine-Exposed	558465	7909208
		CO-05-B2	Mine-Exposed	558387	7909183
		CO-05-B3	Mine-Exposed	558365	7909214
		CO-05-B4	Mine-Exposed	558355	7909224
		CO-05-B5	Mine-Exposed	558359	7909209

upwards into a graded core collar, sectioned with a stainless steel core knife, and placed into a pre-labeled plastic sample bag. Samples from three cores treated in this manner were composited to create a single sample at each station. Supporting measurements of total core sample length and depths of any visually-apparent redox boundaries/horizons, as well as notes regarding sediment texture and colour for each visible horizon, general sediment odour (e.g., hydrogen sulphide), and presence of algae or plants on or in the sediment, were recorded for each core sample. For QA/QC purposes, a field duplicate 'split' sample was collected at all study lakes using the same coring methods discussed above but twice the number of replicate core samples taken (Table 2.4; Appendix A). Sediment at stream/river habitats was collected for chemical characterization using a stainless steel scoop. At each station, sediment sampling focused on those locations containing the finest grain size available, including the channel margins and downstream of/underneath large boulders within the active channel. One sample, representing a composite of a variable number of scoopfuls, was collected directly into a pre-labelled 0.95 L plastic sealable bag at each station. Following collection, all sediment samples were placed into a cooler, transported to the mine and stored under cool conditions until shipment to the analytical laboratory.

Upon completion of the biological monitoring field program, sediment samples were shipped to ALS (Waterloo, ON). Physical characterization of samples included percent moisture and particle size analyses, and chemical characterization included analyses of total organic carbon (TOC) and total metals including mercury. Standard laboratory methods were used for all physical and chemical sediment analyses.

2.3.3 Data Analysis

Sediment quality data from the mine-exposed lakes were compared to reference lake data, to applicable sediment quality guidelines/AEMP benchmarks and, where applicable, to baseline sediment quality data. Deposited sediment quality data from mine-exposed stream/river study areas were compared only to applicable reference area data and SQG because no AEMP benchmarks or baseline data were available. Sediment physical characteristics (i.e., moisture, particle size) and TOC data were statistically summarized based on separate calculation of mean, standard deviation, standard error, minimum and maximum for littoral and profundal habitat at each study lake. These data were compared statistically between applicable mine-exposed and reference lakes using the same tests, transformations (with the exception that logit transformations were conducted for dependent proportional data rather than log transformations), assumptions, and software described previously for the statistical evaluation of *in situ* water quality (see Section 2.1.1).

Sediment chemistry data from the mine-exposed lakes were initially assessed to identify potential gradients in sediment metal concentrations with distance from known or suspected sources of mine-related deposits to the lake. For each sediment chemistry parameter, the data were separately averaged for littoral and profundal habitat at each lake and then compared between each respective mine-exposed and reference lake based on the magnitude of elevation in parameter concentrations. The magnitude of elevation in average parameter concentrations between the mine-exposed and reference lakes was calculated and compared as described previously (Section 2.1.2; Table 2.3). The same approach was applied to the stream/river sediment chemistry data using applicable mine-exposed and reference area sediment chemistry data.

Sediment chemistry data were compared to applicable Canadian Sediment Quality Guidelines (CSQG; CCME 1999, 2017) probable effect levels (PEL) or, for parameters with no CSQG, to Ontario Provincial Sediment Quality Guidelines (PSQG; OMOE 1993) severe effect levels (SEL). The sediment quality guidelines used for the 2017 CREMP were abbreviated simply as 'SQG', although it is recognized that the values presented may represent either national PEL or Ontario provincial SEL guidelines. The 2017 lake environment sediment chemistry data analyses also included comparisons to Mary River Project AEMP sediment quality benchmarks that were derived using baseline sediment chemistry data for each mine-exposed lake and existing generic CSQG interim or PSQG lowest effect level sediment quality guidelines (Intrinsik 2014, 2015). As indicated previously, the AEMP benchmarks were developed to inform management decisions under the AEMP assessment approach and management response framework (Baffinland 2014). An elevation in parameter concentration above the AEMP benchmark may trigger various actions to better understand and potentially mitigate effects resulting from elevated concentrations of the parameter of concern (Baffinland 2014).

Sediment chemistry data for key parameters (i.e., parameters with concentrations that were notably higher at mine-exposed areas compared to the reference area, that have been identified as site-specific parameters of concern in previous studies, and/or those with concentrations above SQG and/or AEMP benchmarks) were plotted to evaluate potential changes in parameter concentrations among 2017 data, baseline (2005 – 2013) data, and previous 2015 - 2016 mine operation period data. In addition, as described previously, the magnitude of elevation was calculated for all parameters between 2017 and baseline data for each individual study lake using the same calculation (and categorization description) as described previously (Section 2.1.2; Table 2.3).

Notably, the applicability of lotic sediment chemistry monitoring data to the interpretation of lotic benthic invertebrate community data was considered minimal given the fact that fine sediment composes much less than 5% of available substrate at the lotic environments (extrapolation of the data suggests that silt and clays compose less than 0.5% of available habitat) and that benthic invertebrates collected for the CREMP do not inhabit these fine sediments. By extension, because fish species inhabiting lotic environments of the area largely rely on benthic invertebrates as a food source, the applicability of sediment chemistry monitoring data to understanding effects on fish was also considered minimal. Because sufficient amounts of fine sediment were able to be collected at only 3 of 23 lotic stations during the baseline period (KP 2014a,b), no temporal comparison of the stream/river sediment chemistry data was conducted.

2.4 Biological Assessment

2.4.1 Phytoplankton

The Mary River Project CREMP uses measures of aqueous chlorophyll-a concentrations to assess potential mine-related influences to phytoplankton. Because chlorophyll-a is the primary pigment of phytoplankton (i.e., algae and other photosynthetic microbiota suspended in the water column), aqueous chlorophyll-a concentrations are often used as a surrogate for evaluating the abundance of photosynthetic microbiota in aquatic environments (Wetzel 2001). Chlorophyll-a samples were collected by Baffinland environmental department personnel at the same stations and same time as the collection of water chemistry samples (Table 2.1; Figures 2.2 and 2.3). In addition, the water samples for chlorophyll-a analyses were collected using the same methods and equipment as described for water chemistry samples (Section 2.1.2). The chlorophyll-a samples were collected into 1 L glass amber bottles and maintained in a cool and dark environment prior to submission to ALS (Mary River On-Site Laboratory, NU). On the same day of collection, the laboratory filtered the samples through a 0.45 micron cellulose acetate membrane filter assisted by vacuum pump. Following filtration, the membrane filter was wrapped in aluminum foil, inserted into a labelled envelope, and then frozen. At the completion of field collections for the seasonal sampling event, the filters were shipped frozen to ALS in Waterloo, ON for chlorophyll-a analysis using standard methods. The field QA/QC applied during chlorophyll-a sampling was similar to that described for water chemistry sampling (see Section 2.1.2).

The CREMP study design also stipulates the collection of phytoplankton community samples for archiving (NSC 2014, 2015a). In the event that water quality, chlorophyll-a, and/or other biological components indicate potential mine-related effects to primary productivity at a specific mine-exposed waterbody, the phytoplankton community samples may be processed to further investigate the nature of mine-related effects to phytoplankton biomass and community structure (i.e., taxonomic composition, richness, density). To date, none of the archived phytoplankton community samples have been processed (2006 - 2016). In 2017, phytoplankton community samples were collected using the same methods described in the CREMP (NSC 2014) and, as in the past, these samples were not processed, but were archived for potential future usage.

The analysis of aqueous chlorophyll-a concentrations closely mirrored the approach used to evaluate the water quality data. Briefly, chlorophyll-a concentrations were compared: i) between respective mine-exposed and reference areas; ii) spatially and seasonally at each mine-exposed waterbody; iii) to AEMP benchmarks; and, iv) to baseline data. Comparisons of chlorophyll-a concentrations between the mine-exposed and reference areas were based on both qualitative and statistical approaches, the latter of which used the same parametric and/or non-parametric statistics as described previously (Section 2.1). An AEMP benchmark chlorophyll-a concentration of 3.7 µg/L was established for the Mary River Project (NSC 2014), and therefore the 2017 chlorophyll-a concentration data were compared to this benchmark to assist with the determination of potential mine-related enrichment effects at waterbodies influenced by mine operations. A mine-related effect on the productivity of a waterbody of interest was assessed as a chlorophyll-a concentration above the AEMP benchmark, the representative reference area, and/or the respective waterbody baseline condition.

2.4.2 Benthic Invertebrate Community

2.4.2.1 General Design

The Mary River Project CREMP benthic invertebrate community (benthic) survey outlines a habitat-based approach for characterizing potential mine-related effects to benthic biota of lotic (stream/river) and lentic (lake) environments (NSC 2014). Lotic areas sampled for benthic invertebrates included Camp Lake Tributaries 1 and 2 at historically established areas located upstream and downstream of the Milne Inlet Tote Road (Tote Road), Sheardown Lake Tributaries 1, 9, and 12 near their respective outlets, and Mary River upstream (two areas) and downstream (three areas) of the mine site (Table 2.5; Figure 2.4). Benthic samples were also collected at a reference creek located within the same unnamed tributary to Angajurjualuk Lake that is used for reference water quality sampling (Stations CLT-REF4 and MRY-REF2) as part of the 2017 CREMP, augmenting the original study design (Table 2.5; Figure 2.4). This reference creek, referred to as Unnamed Reference Creek herein, was initially sampled as part of the benthic invertebrate community assessment in the 2016 CREMP (see Minnow 2017). Environmental Effects Monitoring (EEM) benthic invertebrate community data collected at an unnamed tributary to Mary River (referred to as Mary River Tributary-F [MRTF]) downstream (effluent-exposed) and upstream (reference) of the primary mine effluent discharge have also been included in this CREMP report to consolidate all available benthic information for the mine receiving environment (Appendix Table F.1; Figure 2.4). Consistent with the federal EEM program, five stations were sampled at each CREMP and EEM lotic study area with the exception of Sheardown Lake Tributary 12, where only three stations were sampled due to limited habitat available for sampling using conventional gear suitable for erosional habitat. As in 2015 and 2016, the level of replication used for lotic benthic sampling in 2017 was greater than specified under the original CREMP design in order to provide consistency with EEM standards (Minnow 2016a). To the extent possible, previously established lotic benthic stations were incorporated into the 2017 sampling program to provide comparability to historical baseline information.

At lentic environments, benthic sampling was conducted at the 40 previously established CREMP stations among the four mine-exposed study lakes (i.e., ten stations in each of Camp, Sheardown NW, Sheardown SE, and Mary lakes), as well as at ten stations established at Reference Lake 3 during the 2015 study (Table 2.5; Figures 2.3 and 2.4). Analysis of benthic data collected at Reference Lake 3 in both 2015 and 2016 indicated that, similar to temperate lakes (Ward 1992), depth-related differences in benthic invertebrate community structure (e.g., density and richness) occurs naturally in lakes of the Baffinland region (Minnow 2016a, 2017). Additional sampling conducted at Reference Lake 3 in 2017 confirmed the occurrence of natural depth-related differences in benthic invertebrate community structure in area lakes (Appendix B). Because of the occurrence of natural depth-related differences in benthic invertebrate communities, the benthic stations at each mine-exposed and reference lake were categorized as littoral (2-12 m depth) or profundal (>12 m depth) stations based on station depth (Table 2.5). To the extent possible, five littoral and five profundal stations were designated for each study lake based on the previously established suite of CREMP lentic benthic stations[3] in order to provide temporal continuity with the baseline studies and the original CREMP design (Table 2.4; Figure 2.4), as well as to allow data analysis in accordance with EEM standards. Furthermore, the sampling of five stations from each zone at each study area ensures provide adequate statistical power to detect ecologically meaningful differences in benthic metrics of ± two standard deviations at an α and β of 0.10 (Environment Canada 2012).

2.4.2.2 Sample Collection and Laboratory Analysis

Two types of sampling equipment and methods were employed during the 2017 CREMP benthic survey to reflect different habitat types as follows:

- at **lotic (stream/river) stations** (i.e., predominantly cobble and/or gravel substrate in flowing waters), benthic samples were collected using a Surber sampler (0.0929 m^2

[3] At Sheardown Lake SE, depths greater than 12 m deep are spatially limited, and thus the five deepest CREMP stations were designated as profundal despite one of the five being less than 12 m deep. At Mary Lake, six of the CREMP stations occurred at depths well greater than 12 m and thus were all designated as profundal, with the four remaining stations designated as littoral.

sampling area) outfitted with 500-µm mesh. At each erosional station, one sample representing a composite of three Surber sampler grabs (i.e., 0.279 m^2 area) was collected to ensure that each sample was representative of habitat conditions. A concerted effort was made to ensure that water velocity and substrate characteristics were comparable among respective lotic mine-exposed and reference study area stations to minimize natural influences on community variability. Once all three sub-samples were collected at each respective station, all material gathered in the Surber sampler net was transferred to a plastic sampling jar to which both external and internal station identification labels were affixed.

- at **lentic (lake) stations** (i.e., predominantly soft silt-sand, silt, and/or clay substrates with variable amounts of organics), benthic sampling was conducted using a Petite Ponar grab sampler (15.24 x 15.24 cm; 0.023 m^2 sampling area). A single sample, consisting of a composite of five grabs (i.e., 0.115 m^2 sampling area) was collected at each station with care taken to ensure that each grab was acceptable (i.e., that the grab captured sufficient surface material and was full to each edge). Any incomplete grabs were discarded. For each acceptable grab, the Petite Ponar was thoroughly rinsed and the material then field-sieved through 500 µm mesh. Following sieving of all five grabs, the retained material was carefully transferred into a plastic sampling jar to which both external and internal station identification labels were affixed.

Following collection, the benthic samples were preserved to a level of 10% buffered formalin in ambient water. Supporting measurements and information collected at each replicate grab location for lotic stations included sampling depth, water velocity, substrate size, an estimate of substrate embeddedness, and a description of macrophyte/algae presence. In addition, *in situ* water quality at the bottom of the water column and collection/recording of global positioning system (GPS) coordinates was conducted at each lotic benthic station. Supporting information recorded at each lake benthic station included substrate description, presence of aquatic macrophytes/ algae, sampling depth, *in situ* water quality measurements near the water column surface and bottom, and GPS coordinates. All GPS coordinates were collected in Universal Transverse Mercator (UTM) units using a hand-held portable Garmin GPS72 (Garmin International Inc., Olathe, KS) device based on 1983 North America Datum (NAD 83).

Benthic samples were submitted to and processed by Zeas Inc. (Nobleton, ON) using standard sorting methods. Upon arrival at the laboratory, a biological stain was added to each benthic sample to facilitate greater sorting accuracy. The samples were washed free of formalin in a 500 µm sieve and the remaining sample material was then examined under a stereomicroscope at a magnification of at least ten times by a technician. All benthic invertebrates were removed from the sample debris and placed into vials containing 70% ethanol according to major taxonomic groups (i.e., order or family levels). A senior taxonomist later enumerated and identified the benthic organisms to the lowest practical level (typically genus or species) utilizing up-to-date taxonomic keys. Quality assurance/quality control (QA/QC) conducted during the laboratory processing of benthic samples included organism recovery and sub-sampling checks on as many as 10% of the total samples collected for the 2017 CREMP (Appendix A).

2.4.2.3 Data Analysis

Benthic data were evaluated separately for lotic, lentic littoral and lentic profundal habitat data sets. Benthic invertebrate communities were evaluated using summary metrics of mean invertebrate abundance (or "density"; average number of organisms per m^2), mean taxonomic richness (number of taxa, as identified to lowest practical level), Simpson's Evenness Index (E), and the Bray-Curtis Index of Dissimilarity. Simpson's Evenness was calculated using the Krebs method (Smith and Wilson 1996), and Bray-Curtis Index was calculated using the formula presented in Environment Canada (2012). Additional comparisons were conducted using percent composition of dominant/indicator taxa, functional feeding groups, and habitat preference groups (calculated as the abundance of each respective group relative to the total number of organisms in the sample). Dominant/indicator taxonomic groups were defined as those groups representing, on average, greater than 5% of total organism abundance for a study area or any groups considered important indicators of environmental stress. Functional feeding groups (FFG) and habitat preference groups (HPG) were assigned based on Pennak (1989), Mandaville (2002), and/or Merritt et al. (2008) descriptions/designations for each taxon.

Statistical comparisons of all applicable benthic invertebrate community indices and community composition endpoints were conducted using the same tests described for the *in situ* water quality comparisons (see Section 2.2.2). Pair-wise differences between the mine-exposed and reference areas were preferentially tested using ANOVA and untransformed, normally distributed data. However, in the event that data were determined to be non-normal, a suite of transformations, including $\log_{10}$, square root, fourth root, and modified probit, was applied to the data and evaluated for normality[4]. The transformation that resulted in the highest p-value from a Shapiro-Wilks test of the residuals from t-tests was applied to the data for statistical testing using ANOVA and *post hoc* tests, as applicable. In instances where normality could not be achieved through data transformation, non-parametric Kruskal-Wallis H-test and Mann-Whitney U-tests were used to validate the statistical results from multiple group and pair-wise ANOVA tests, respectively. All

[4] Non-normal dependent proportional benthic data were subject to a modified probit transformation that better accounted for nil (or near-zero) values in the statistical analysis than the other indicated transformations.

statistical comparisons were conducted using R programming (R Foundation for Statistical Computing, Vienna, Austria).

An effect on benthic invertebrate communities was defined as a statistically significant difference between any paired mine-exposed and reference areas at a p-value of 0.10. For each endpoint showing a significant difference, the magnitude of difference was calculated between study area means. Because the benthic survey was designed to have sufficient power to detect a difference (effect size) of ± two standard deviations (SD), the magnitude of the difference was calculated to reflect the number of reference mean standard deviations (SD_{REF}) using equations provided by Environment Canada (2012). A Critical Effect Size for the benthic invertebrate community study (CES_{BIC}) of ± 2 SD_{REF} was used to define any ecologically relevant 'effects', which is analogous to differences beyond those expected to occur naturally between two areas that are uninfluenced by anthropogenic inputs (i.e., between pristine reference areas; see Munkittrick et al. 2009, Environment Canada 2012). The use of a CES_{BIC} of ± 2 SD_{REF} in defining ecologically significant differences or changes over time for the Mary River Project CREMP was further supported by temporal analysis of available site-specific reference creek and reference lake data (Appendix B).

Temporal comparisons included statistical evaluations among the baseline, 2015, 2016, and 2017 data for primary benthic metrics (i.e., density, richness, Simpson's Evenness), dominant invertebrate groups, and FFG using uni-variate tests (e.g., ANOVA) and pair-wise *post hoc* tests. The temporal statistical comparisons were conducted using the same tests, transformations, assumptions, and software described above for the *in situ* water quality comparisons (see Section 2.2.2). For study areas that contained data for multiple years (i.e., 3 or more), Tukey's HSD *post hoc* tests were used in instances in which normal data showed equal variance, and Tamhane's *post hoc* tests were used in instances in which normal data showed unequal variance. Similar to the 2017 within-year statistical analyses, the magnitude of difference was calculated for endpoints that differed significantly between years in the *post hoc* tests and compared to the benthic survey CES_{BIC} of within two standard deviations of the baseline year mean (abbreviated as ±2 $SD_{BL\text{-}year}$).

2.4.3 Fish Population

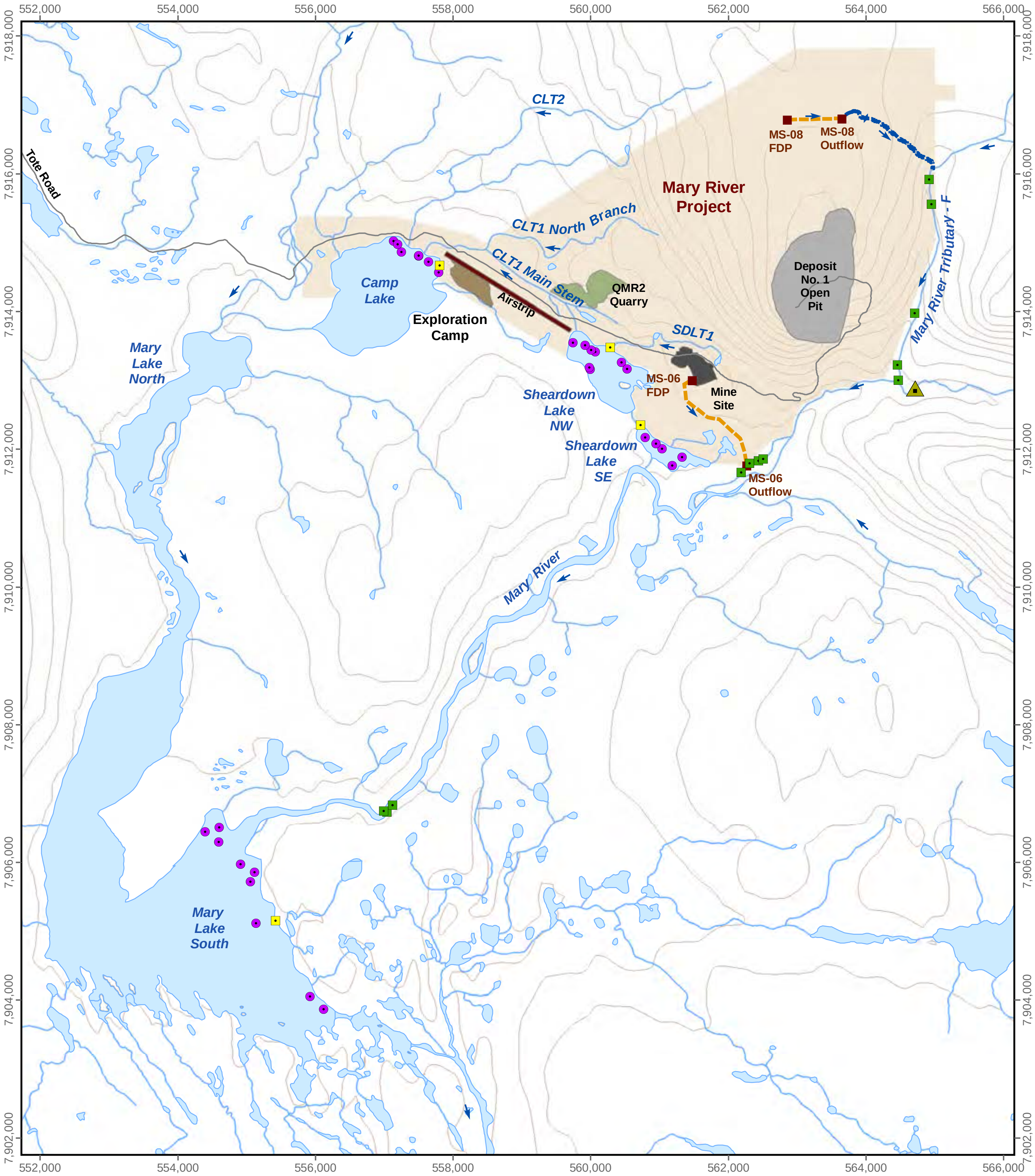
2.4.3.1 General Design

The Mary River Project CREMP fish population survey outlines a non-lethal sampling design to evaluate potential mine-related effects to the fish population (e.g., age structure, growth, condition) at the mine-exposed lakes (NSC 2014, 2015a). The fish population survey targeted arctic charr (*Salvelinus alpinus*) primarily because this species is the only abundant fish common to the mine's regional lakes, sufficient baseline catch and measurement data were available for this species to allow application of a before-after statistical evaluation, and because of this species importance as an Inuit subsistence food source. The approach employed for the CREMP fish population survey closely mirrored the recommended EEM approach for non-lethal sampling (Environment Canada 2012). Specifically, the fish population survey targeted the collection of approximately 100 arctic charr from nearshore lake habitat and 100 arctic charr from littoral/profundal lake habitat. The four mine-exposed study lakes used for the fish population survey were the same as those used to document baseline conditions, namely Camp, Sheardown NW, Sheardown SE, and Mary lakes (Figure 2.5). Although the 2017 study also targeted arctic charr from Reference Lake 3 as a basis for the evaluation of potential mine-related influences to the fish population, similar to the 2015 and 2016 CREMP studies, low numbers of arctic charr were captured from the littoral/profundal zone of the reference lake in 2017. Thus, the 2017 CREMP fish population survey focused on comparisons of fish collected at the nearshore of the mine-exposed and reference lakes, as well as on comparisons of fish captured at nearshore and littoral/profundal zones of individual mine-exposed lakes before-and-after the commencement of the Mary River Project commercial mine operations.

In addition to the CREMP data, EEM fish population survey data collected at MRTF and Mary River near- and far-field mine-exposed areas in 2017 have been included in this CREMP report to consolidate all available fish population information applicable to the mine receiving environment (Figure 2.5).

2.4.3.2 Sample Collection

Nearshore areas of the study lakes used for the CREMP study, and streams/rivers used for the EEM study, were sampled for arctic charr using a battery powered backpack electrofishing unit (Model LR-24, Smith-Root Inc., Vancouver, WA). An electrofishing team, consisting of the backpack electrofisher operator and a single netter, conducted a single fishing pass at one shoreline reach of each study lake and three to five reaches at each lotic study area. The number of passes conducted at each lake/lotic study area was dependent upon catch success, with more passes required in instances in which cumulative target numbers were not attained. All fish captured during each pass were retained in buckets of aerated water. At the conclusion of each pass, total fishing effort (i.e., electrofishing seconds) was recorded to allow calculation of time-standardized catch. All captured fish were identified to species and enumerated, with any non-target species subsequently released alive at the area of capture. All captured arctic charr were temporarily retained for processing using methods described below (Section 2.4.3.3). Additional supporting information collected for each electrofishing pass included recording the GPS coordinates at the points of commencement and completion of electrofishing activities, and a description of the sampled habitat.



LEGEND

- Lotic Electrofishing Station
- Lake Electrofishing Station
- Gill Net Station
- Final Discharge Point (FDP)
- Mary River Cascade Barrier
- Discharge Line
- Overland Effluent Channel

Mary River Project 2017 CREMP and EEM Mine Area Fish Survey Sampling Locations

0 1.25 2.5 5 km

N E S W

Map Projection: UTM Zone 17N NAD 1983
Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada.

Date: March 2018
Project 177202.0033

minnow environmental inc.

Figure 2.5

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig 2.5 Fish Survey Sampling Locations.mxd

Littoral/profundal areas of the study lakes were sampled for arctic charr using experimental (gang index) gill nets. Multiple-panel, 2 m high gill nets with total lengths ranging from 61 – 91 m (200' – 300') and bar mesh sizes ranging from 38 – 76 mm (1.5" – 3") were set on the bottom for short durations (approximately 0.8 – 3.3 hours per set; mean of 1.9 hours) during daylight hours only. Upon retrieval of each net, all captured fish were identified to species, enumerated, and processed (see below) separately for each individual gill net panel mesh size. For each gill net set, information including mesh size, duration of sampling, sampling depth range, GPS coordinates, and habitat descriptions were recorded.

2.4.3.3 Field and Laboratory Processing

Following completion of each electrofishing pass and retrieval of each individual gill net panel, all captured arctic charr were subject to processing in the field. For all live captures, the external condition of each individual was assessed visually for the presence of any deformities, erosions, lesions, and tumors (DELT) or evidence of external and/or internal parasites. All observations were recorded on field sheets, with supporting photographs taken as appropriate. Each fish was then subject to measurement of fork and total length to the nearest millimetre using a standard measuring board. Following length measurements, fish captured using the electrofishing unit were individually weighed to the nearest milligram using an Ohaus Model 123 Scout-Pro analytical balance (Ohaus Corp., Pine Brook, NJ) with a surrounding draft shield. For arctic charr captured in gill nets, individuals were weighed using Pesola™ spring scales (Pesola AG, Baar Switzerland) demarcated at intervals of 1-2% of the total scale range and providing accuracy of ± 0.3% of the fish mass. The Pesola™ spring scale for individual weight measurement of gill-net captured fish was selected so that the fish weight was near the top of the scale's range to ensure that measurements achieved a resolution near 1%. All live arctic charr captured by electrofishing and gill netting methods that were not selected for the collection of aging structures were released near the location of capture following these individual measurements of length and weight.

As specified for EEM non-lethal fish population surveys (see Environment Canada 2012), approximately 10% of the targeted number of arctic charr captured using electrofishing methods were sacrificed for collection of aging structures. Aging structures were also removed from all arctic charr that died incidentally during experimental gill net sampling, reflecting approximately 13% of the total catch numbers. Otoliths were removed from all sacrificed individuals and incidental mortalities for age determination. Upon removal, these aging structures were wrapped separately in wax paper, placed inside envelopes labelled with the fish identification, and then dried for storage. For all incidental mortalities from experimental gill netting, in addition to removal of aging structures, fish were dissected to determine sex and for removal of the liver and whole gonads for weight measurement. These organs were weighed to the nearest milligram using an

Ohaus Model 123 Scout-Pro balance outfitted with a surrounding draft shield. During processing, these fish were also inspected for internal abnormalities (e.g., parasites, lesions, tumours, etc.) and descriptions were recorded as appropriate.

Age structures (otoliths) were shipped to North Shore Environmental Services (NSES; Thunder Bay, ON; CREMP samples) or AAE Tech Services Inc. (LaSalle, MB; EEM samples) for age determination. At the laboratory, otoliths were prepared for aging using a "crack and burn" method (NSES) or read whole after polishing three to five seconds with an appropriately graded wet-dry sandpaper and a drop of clove oil to enhance translucency (AAE). The prepared otolith samples were mounted on a glass slide using a mounting medium and examined under a compound microscope using transmitted light to determine fish age. For each structure, the age and edge condition was recorded along with a confidence rating for the age determination.

2.4.3.4 Data Analysis

Fish community data from the mine-exposed and reference study areas were compared based on total catch and catch-per-unit-effort (CPUE) for each sampling method. Electrofishing CPUE was calculated as the number of fish captured per electrofishing minute for each lake nearshore or lotic study area, and gill netting CPUE was calculated as the number of fish captured per 100 metre·hours of net used for each study lake. Temporal comparison of fish community assemblage was conducted using electrofishing CPUE and gill netting CPUE to evaluate relative changes in fish catches at mine area lakes between mine baseline and the current year of mine operation.

Arctic charr population health was assessed separately for electrofishing and experimental gill netting data sets. Initial data analysis for the non-lethal survey included plotting length frequency distributions as described by Bonar (2002) and Gray et al. (2002), so that, together with appropriate aging data, YOY individuals could be distinguished from the older juvenile/adult life stages (electrofishing data set), or various size/age classes could be distinguished from one another (gill netting data set). Where sample sizes allowed, the YOY age class was assessed separately from the older juvenile/adult age classes for comparison of fish survey endpoints between the individual mine-exposed lakes and the reference lake (CREMP data) and lotic study areas (EEM data). Fish size endpoints of fork length and fresh body weight were summarized by separately reporting mean, median, minimum, maximum, standard deviation, standard error, and sample size by size class (if possible) for each study area. The recorded measurement endpoints were used as the basis for evaluating four response categories (survival, growth, reproduction, and energy storage; Table 2.6) according to the procedures outlined for EEM by Environment Canada (2012). Length-frequency distributions were compared between mine-exposed and reference lakes or between lotic study areas for data collected in 2017 (CREMP and EEM data),

Table 2.6: Fish Population Survey Endpoints Examined for the Mary River Project CREMP 2017 Study

Response Category	Endpoint	Statistical Procedure[c,d,e]	Critical Effect Size
Survival	Length-frequency distribution[a]	K-S Test	not applicable
	Age[a,f]	ANOVA	not applicable
Energy Use (size)	Size (fresh body weight)[b]	ANOVA	25%
	Size (fork length)[b]	ANOVA	25%
Energy Use (growth)	Size-at-age (body weight against age)[a,f]	ANCOVA	25%
	Size-at-age (fork length against age)[b,f]	ANCOVA	25%
Energy Use (reproduction)	Relative abundance of YOY (% composition)[b]	K-S Test	not applicable
Energy Storage	Condition (body weight against length)[a]	ANCOVA	10%

[a] Endpoints used for determining "effects" as designated by statistically significant difference between mine-exposed and reference areas (Environment Canada 2012).

[b] These analyses are for informational purposes and significant differences between exposure and reference areas are not necessarily used to designate an effect (Environment Canada 2012).

[c] ANOVA (Analysis of Variance) used except for non-normal data, where Mann Whitney U-test may have been used.

[d] ANCOVA (Analysis of Covariance). For the ANCOVA analyses, the first term in parentheses is the endpoint (dependent variable Y) that is analyzed for an effluent effect. The second term in parentheses is the covariate, X (age, weight, or length).

[e] K-S Test (Kolmogorov-Smirnov test).

[f] Endpoints which were applied to reduced data sets, including sacrificed fish and/or mortalities.

and for before-after analysis using data collected in 2017 and during the combined baseline period (CREMP data only), using a non-parametric two-sample Kolmogorov-Smirnov (KS) test. Potential differences in reproductive success between paired study areas were based on evaluation of the relative proportion of arctic charr YOY between the mine-exposed and reference areas, and by comparing the results of KS tests conducted with and without YOY individuals included in the data sets.

Mean fork length and body weight were compared between mine-exposed and reference study areas in 2017, and between 2017 and the mine baseline period, using ANOVA, with data evaluated for normality and homogeneity of variance before applying parametric statistical procedures. In cases where data did not meet the assumptions of ANOVA despite log-transformation, a non-parametric Mann-Whitney U-test was also performed to test for/validate significant differences between study areas or study periods indicated by the ANOVA tests, as appropriate. Body weight at fork length (condition) was compared using Analysis-of-Covariance (ANCOVA). Prior to conducting the ANCOVA tests, scatter plots of all variable and covariate combinations were examined to identify outliers, leverage values or other unusual data. The scatter plots were also examined to ensure there was adequate overlap between the 2017 mine-exposed and reference/mine-exposed baseline data sets, and that there was a linear relationship between the variable and the covariate. In order to verify the existence of a linear relationship, each relationship was tested using linear regression analysis by area and evaluated at an alpha level of 0.05. If it was determined that there was no significant linear regression relationship between the variable and covariate for the 2017 mine-exposed and/or reference/ mine-exposed baseline data sets, then the ANCOVA was not performed. Once it was determined that ANCOVA could be used for statistical analysis of the data, the first step in the ANCOVA analysis was to test whether the slopes of the regression lines for the 2017 mine-exposed and reference/baseline data sets were equal. This was accomplished by including an interaction term (dependent × covariate) in the ANCOVA model and evaluating if the interaction term was significantly different, in which case the regression slopes would not be equal between data sets and the resulting ANCOVA would provide spurious results. In such cases, two methodologies were employed to assess whether a full ANCOVA could proceed. In order of preference these were: 1) removal of influential points using Cook's distance and re-assessment of equality of slopes; and, 2) Coefficients of Determination that considered slopes equal regardless of an interaction effect (Environment Canada 2012). For the Coefficients of Determination, the full ANCOVA was completed to test for main effects, and if the r^2 value of both the parallel regression model (interaction term) and full regression model were greater than 0.8 and within 0.02 units in value, the full ANCOVA model was considered valid (Environment Canada 2012). If both methods proved unacceptable, the magnitude of effect was estimated at both the minimum and maximum overlap of covariate variables between areas (Environment Canada 2012). This results in a statistically significant interaction effect (slopes are not equal), but the calculation of the magnitude of difference at the minimum and maximum values of covariate overlap is not assigned statistical difference as it would for a full ANCOVA model. If the interaction term was not significant (i.e., homogeneous slopes between the two populations), then the full ANCOVA model was run without the interaction term to test for differences in adjusted means between the two data sets. The adjusted mean was then used as an estimate of the population mean based on the value of the covariate in the ANCOVA model.

For endpoints showing significant data set differences, the magnitude of difference between 2017 mine-exposed and reference data or the baseline data was calculated as described by Environment Canada (2012) using mean (ANOVA), adjusted mean (ANCOVA with no significant interaction), or predicted values (ANCOVA with significant interaction). The anti-log of the mean, adjusted mean, or predicted value was used in the equations for endpoints that were $\log_{10}$-transformed. In addition, the magnitude of difference for ANCOVA with a significant interaction was calculated for each of the minimum and maximum values of the covariate. If there was no significant difference indicated between data sets, the minimum detectable effect size was calculated as a percent difference from the reference mean/mine-exposed baseline mean for ANOVA or adjusted reference mean/mine-exposed baseline mean for ANCOVA at alpha = beta = 0.10 using the square root of the mean square error (generated during either the ANOVA or ANCOVA procedures) as a measure of variability in the sample population based on formula provided by Environment Canada (2012). Finally, if outliers or leverage values were observed in a data set (or sets) upon examination of scatter plots and residuals, then the values were removed and ANOVA or ANCOVA tests were repeated and presented only for the reduced data sets. Similar to the Critical Effect Sizes (CES) applied to the benthic invertebrate community survey, a fish population survey CES magnitude of difference of ± 25% was applied to general endpoints (CES_G) of survival, growth, reproduction and relative liver size, and a magnitude of difference of ± 10% was applied for condition (CES_C) to define any ecologically relevant differences, consistent with those recommended for EEM (Table 2.6; Munkittrick et al. 2009; Environment Canada 2012).

Finally, an *a priori* power analysis was completed to determine appropriate fish sample sizes for future surveys as recommended by Environment Canada (2012). These analyses were completed based on the mean square error values generated during the ANOVA or ANCOVA procedures and were calculated with alpha and beta set equally at 0.10 for the analysis. Two main assumptions served as the basis for the power analysis. The first assumption was that the fish caught in each of the effluent-exposed and reference areas were representative of the population at large (i.e., similar distribution and variance with respect to the parameters examined). The second assumption was that the characteristics of the populations as a whole would not change substantially prior to the next study. The power analysis results were reported as the minimum sample size (number of fish/area) required to detect a given magnitude of difference (effect size) between the mine-exposed and reference area/baseline populations for each endpoint. The magnitude of difference was presented as a percentage decrease or increase of the reference area/baseline mean for each endpoint as measured during the fish population study using the observed pooled standard deviation of the residuals from the t-test or parallel slope ANCOVA model.

3 CAMP LAKE SYSTEM

3.1 Camp Lake Tributary 1 (CLT1)

3.1.1 Water Quality

Camp Lake Tributary 1 (CLT1) dissolved oxygen (DO) was consistently at or above saturation at the north branch and main stem stations during all spring, summer, and fall monitoring events (Appendix Tables C.1 – C.3). Dissolved oxygen concentrations and percent saturation at the CLT1 north branch and lower main stem stations were comparable and similar to the reference creek at the time of biological sampling in August 2017 (Figure 3.1; Appendix Table C.13). Notably, DO concentrations were well above the WQG minimum limit for cold-water biota early life stages (i.e., 9.5 mg/L) at all CLT1 stations in 2017 (Appendix Figure C.1; Figure 3.1), suggesting that mine activity had not adversely affected DO concentrations. No consistent spatial patterns in pH were evident with progression downstream through the CLT1 north branch (Stations L1-08 to L1-02) and main branch (Stations L2-03 to L0-01) stations during all spring, summer, and fall monitoring events (Appendix Tables C.1 – C.3). Although pH was significantly higher at the CLT1 north branch compared to Unnamed Reference Creek, no significant differences in pH were indicated between the CLT1 north branch and lower main stem study areas in August 2017 suggesting no substantial influence of the Tote Road on pH (Figure 3.1; Appendix Table C.13). The pH at all CLT1 stations/study areas was also consistently within WQG limits, suggesting adverse effects on biota were unlikely as a result of the slight difference in pH between the CLT1 north branch and Unnamed Reference Creek.

Conductivity of CLT1 was consistently highest in the upper main stem (Station L2-03) and lowest in the north branch (Stations L1-02 and -08), with intermediate values observed at the lower main stem stations reflecting CLT1 system dilution influences and suggesting a mine-related source affecting water quality of the CLT1 upper main stem (Appendix Tables C.1 – C.3, C.14). Although specific conductance was significantly higher at the lower main stem than at the north branch of CLT1, specific conductance at both of these CLT1 study areas was significantly lower than at Unnamed Reference Creek during the August 2017 biological study (Figure 3.1). During spring and summer sampling events, conductivity was clearly elevated at the CLT1 upper and lower main stem stations compared to the CREMP lotic reference stations (Appendix Tables C.1, C.2 and C.14), suggesting that reference area conductivity can vary substantially among seasons.

Water chemistry of the CLT1 north branch was similar to the reference creek stations in 2017 with the exception of a slightly higher (i.e., 3- to 5-fold) total molybdenum and potassium concentrations during the spring sampling event (Table 3.1; Appendix Tables C.14 and C.15). In addition, parameter concentrations were below applicable WQG and watercourse-specific AEMP

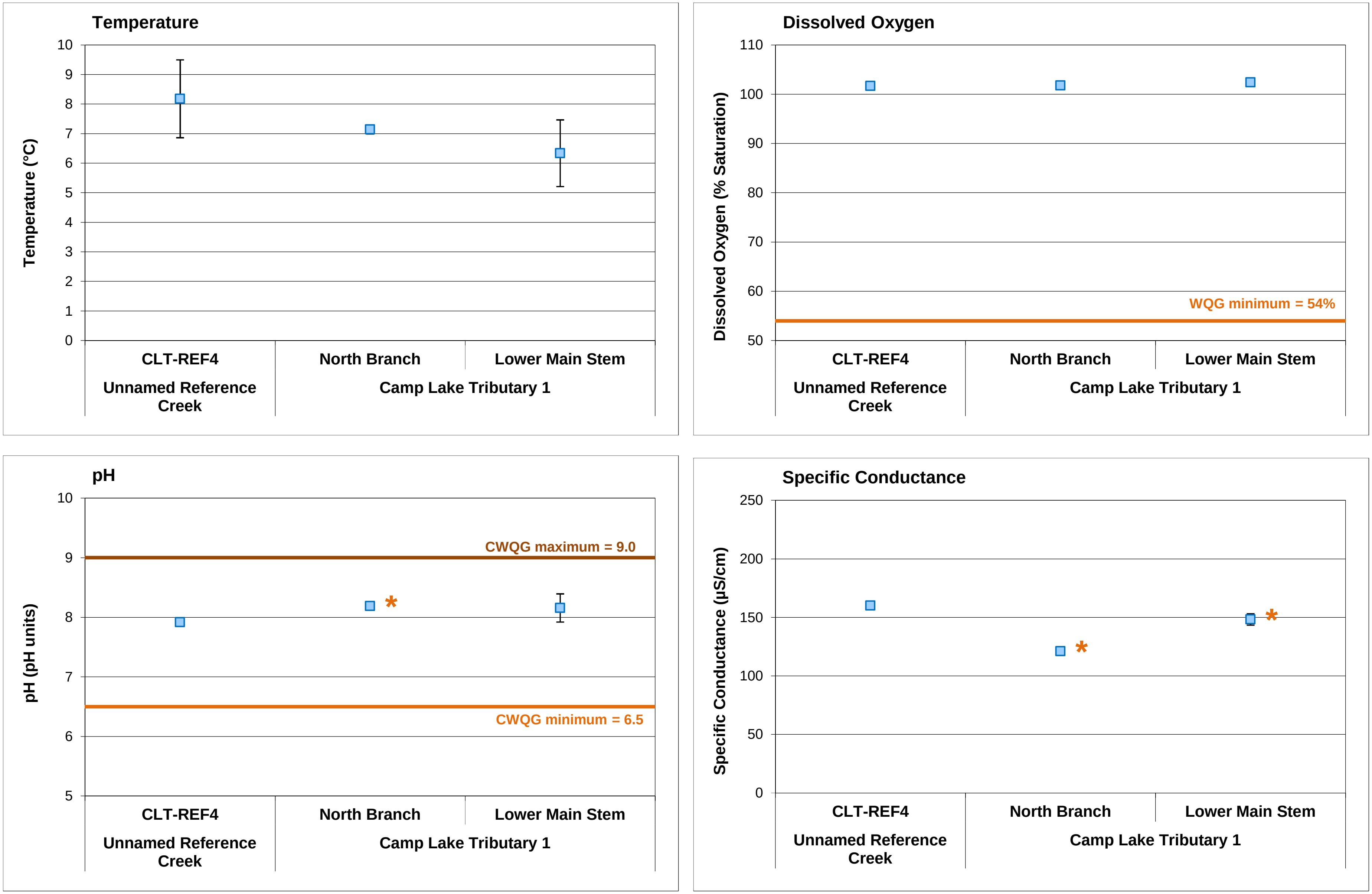


Figure 3.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 1 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

Table 3.1: Water Chemistry at Camp Lake Tributary (CLT) Monitoring Stations During Fall (August-September) Sampling, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n=4)	North Branch CLT1		Upper Main Stem	Lower Main Stem CLT1			CLT-2
						L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01
					Fall 2017	1-Sep-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	116	135	188	336	231	245	255	253
	pH (lab)	pH	6.5 - 9.0	-	7.90	8.03	8.13	8.18	8.14	8.18	8.09	8.20
	Hardness (as $CaCO_3$)	mg/L	-	-	55	65	94	153	114	117	124	129
	Total Suspended Solids (TSS)	mg/L	-	-	4.1	<2.0	<2.0	8.8	2.7	3.7	15.7	2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	73	96	169	90	114	152	134
	Turbidity	NTU	-	-	6.1	0.7	1.1	17.3	4.1	4.3	18.9	1.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	52	63	84	140	102	110	109	102
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.0265	<0.020	<0.020	0.032	<0.020	0.066	<0.020	<0.020
	Nitrate	mg/L	13	13	0.063	0.041	0.109	0.539	0.180	0.161	0.164	0.111
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	0.24	0.47	0.30	0.22	0.17	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.6	2.3	2.6	5.0	3.3	3.5	3.4	2.6
	Total Organic Carbon	mg/L	-	-	1.7	2.1	2.8	5.1	3.5	4.0	3.5	2.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0078	0.0072	0.0034	0.0096	0.0177	0.0060	0.0126	0.0044
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0015	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	2.0	2.6	19.9	8.6	9.8	10.9	3.1
	Sulphate (SO_4)	mg/L	218[β]	218	4.1	4.1	7.3	9.4	7.3	6.0	6.5	26.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.208***	0.022	0.032	***0.395***	0.100	0.179	***0.620***	0.063
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00012	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0076	0.0089	0.0112	0.0153	0.0132	0.0139	0.0175	0.0126
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	11.2	12.7	19.0	29.8	22.6	23.5	23.7	25.3
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00074	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00060	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.0040	0.00015	<0.00010	<0.00010	0.00034	0.00012	0.00016	0.00033	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0013	***0.0025***	0.0021	0.0016	0.0019	0.0020	0.0022	0.0011
	Iron (Fe)	mg/L	0.30	0.326	0.222	<0.030	<0.050	***0.705***	0.204	0.323	***0.821***	0.082
	Lead (Pb)	mg/L	0.001	0.001	0.00021	<0.000050	<0.000050	0.00060	0.00015	0.00022	0.00065	0.00006
	Lithium (Li)	mg/L	-	-	0.0014	<0.0010	<0.0010	0.0031	0.0021	0.0025	0.0030	0.0016
	Magnesium (Mg)	mg/L	-	-	6.5	7.9	11.4	19.9	13.7	14.6	15.0	16.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.0033	0.0006	0.0019	0.0456	0.0142	0.0184	0.0243	0.0029
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00034	0.00074	0.00070	0.00141	0.00087	0.00088	0.00071	0.00035
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	<0.00050	0.00067	0.00135	0.00092	0.00108	0.00144	0.00054
	Potassium (K)	mg/L	-	-	0.8	1.9	1.9	3.0	2.2	2.3	2.5	1.6
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.0010	<0.000050	0.000078	0.000055	<0.000050	0.000053	<0.000050
	Silicon (Si)	mg/L	-	-	1.3	0.8	1.0	1.8	1.2	1.4	2.0	1.1
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	1.8	0.5	1.4	9.9	3.6	3.9	4.1	2.0
	Strontium (Sr)	mg/L	-	-	0.0113	0.0075	0.0095	0.0256	0.0237	0.0277	0.0274	0.0146
	Thallium (Tl)	mg/L	0.0008	0.0008	0.00001	<0.00010	<0.000010	0.00001	<0.000010	<0.000010	0.00002	<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	-	-	0.0123	<0.010	<0.0020	0.0210	<0.0060	0.0103	0.0418	<0.0040
	Uranium (U)	mg/L	0.015	-	0.0021	0.0029	0.0021	0.0088	0.0033	0.0036	0.0035	0.0019
	Vanadium (V)	mg/L	0.006[α]	0.006	0.0007	<0.0010	<0.00050	0.0008	<0.00050	0.0006	0.0011	<0.00050
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0034	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake tributary system.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

benchmarks at the CLT1 north branch in 2017 except for copper, which was above both criteria at the upper-most station during the summer and fall sampling events (Table 3.1; Appendix Table C.14). Temporal comparisons indicated that parameter concentrations at the CLT1 north branch in fall 2017 were within the range of those measured during the mine baseline (2005 – 2013) period with the exception of higher total copper concentrations, which were consistently elevated in all years since commercial mine production commenced in 2015 (Figure 3.2; Appendix Figure C.2). Overall, only a minor influence on water quality, reflected mainly by a slight elevation in copper concentrations, was indicated at the CLT1 north branch following the commencement of commercial mine production.

Water chemistry at the CLT1 main stem indicated hardness and concentrations of total dissolved solids (TDS), nitrate, total Kjeldahl nitrogen (TKN), organic carbon, chloride, sulphate, and several metals including iron, manganese, molybdenum, potassium, sodium, strontium, and uranium, were slightly to highly elevated (i.e., 3-fold to ≥10-fold higher, respectively) at the upstream-most CLT1 main stem station (L2-03) compared to average reference creek station water chemistry in at least two of the three seasonal sampling events (Table 3.1; Appendix Tables C.14 and C.15). However, on average, only concentrations of chloride and total manganese were elevated at the CLT1 lower main stem (i.e., stations L1-09, L1-05 and L0-01) compared to respective reference creek station average concentrations (Appendix Table C.14), reflecting natural dilution of the CLT1 main stem from the north branch. Total aluminum and iron concentrations were above respective WQG and watercourse-specific AEMP benchmarks at the CLT1 upper main stem and downstream-most lower main stem station in 2017, but only during the fall sampling event. These metals also occurred at concentrations above WQG and AEMP benchmarks at the MRY-REF3 lotic reference station during the fall 2017 sampling event (Appendix Table B.2). Notably, abnormally high turbidity was evident at the CLT1 main stem and MRY-REF 3 lotic reference stations during the fall sampling event (Table 3.1), suggesting that elevations in total aluminum and iron concentrations during the fall sampling event were related to suspended particulate matter. Of the latter, only dissolved iron concentrations at the CLT1 main stem stations were elevated above average concentrations at the lotic reference area (Appendix Table C.17), suggesting that elevated iron concentrations in CLT1 reflected a mine-related source.

Temporal comparisons of CLT1 main stem water chemistry data indicated that, of the parameters shown to be elevated relative to the reference creek stations in 2017, hardness and concentrations of TDS, chloride, and total strontium were comparable to or only slightly higher than concentrations recorded during the baseline period (Figure 3.2; Appendix Figure C.2). However, nitrate, TKN, sulphate, and total iron, manganese, molybdenum, sodium, and uranium concentrations were consistently higher during the mine operational years, including 2017, compared to the mine baseline period at all four CLT1 main stem stations (Figure 3.2; Appendix

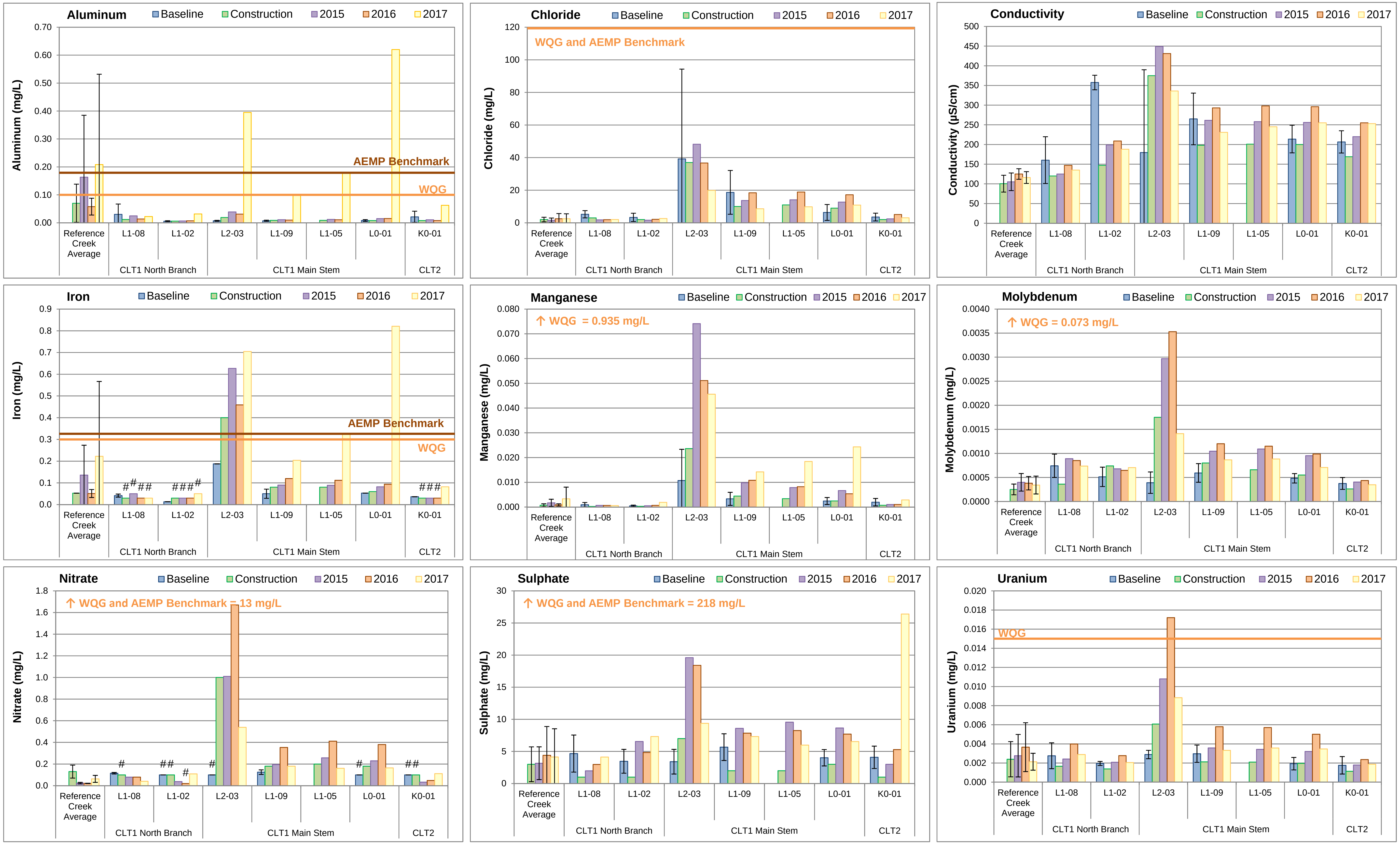


Figure 3.2: Temporal Comparison of Water Chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015 - 2017) Periods During Fall.

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

Figure C.2). Higher parameter concentrations at the CLT1 main stem stations following the initiation of commercial mine production potentially reflected blasting/excavating activity (including associated dust generation) at mine quarry QMR2[5], as well as fugitive dust generation from increased truck usage on the Tote Road, compared to the baseline period. Notably, total aluminum and iron concentrations were particularly elevated at the CLT1 main stem stations in fall 2017 compared to the baseline period and the two previous CREMP studies, but as discussed above, likely reflected elevated suspended particulate concentrations (i.e., turbidity) as similarly observed at the lotic reference stations. This was supported by the evaluation of dissolved metal fractions, which indicated no substantial difference in dissolved aluminum and iron concentrations between 2017 and the baseline period for all spring, summer, and fall sampling events (Appendix Table C.18), suggesting that these parameters were largely associated with suspended materials. Collectively, mine-related influences on water quality of the CLT1 main stem were primarily evidenced by elevated hardness and concentrations of nitrate, TKN, chloride, sulphate, and total metals including manganese, molybdenum, potassium, sodium, strontium, and uranium, at the upper main stem, though none were elevated above applicable WQG or AEMP benchmarks.

3.1.2 Sediment Quality

Deposited sediment at CLT1 upstream (north branch; CLT1-US) and downstream (lower main stem; CLT1-DS) study areas was visually characterized as predominantly coarse sand (Appendix Table D.7). In-stream substrate at both CLT1 study areas was composed mainly of cobble material (i.e., substrate diameter 6 – 25 cm), with sand constituting only a trace amount (i.e., <1%) of the material observed at the sediment surface (Appendix Table F.1). As a result, deposited sediment suitable for chemical characterization (i.e., sand and finer substrate sizes) was collected mainly from shoreline/streambank areas at the upstream north branch study area, and from underneath large cobble/boulders that were manually overturned at the downstream lower main stem study area (Appendix Table D.7). Sediment total organic carbon (TOC) content was low (i.e., <1%) at both CLT1 study areas, but nevertheless was slightly elevated (i.e., 3- to 5-fold higher) at the CLT1 upstream study area compared to average lotic reference conditions suggesting a more depositional environment at the former (Table 3.2; Appendix Table D.10).

Metal concentrations in deposited sediment at CLT1 upstream and downstream study areas were generally elevated compared to respective average lotic reference area metal concentrations (Table 3.2; Appendix Table D.10). Most notably, concentrations of aluminum, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, and potassium concentrations were highly elevated (i.e., ≥10-fold higher) in deposited sediment at one or both of the CLT1 study

[5] The QMR2 quarry is used to provide material for mine infrastructure projects (e.g., road construction).

Table 3.2: Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 1 (CLT1) and Lotic Reference Area Sediment Monitoring Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Lotic Reference Stations		Camp Lake Tributary 1	
			Unnamed Reference Creek (REFCRK; n = 5)	Mary River Reference (GO-09; n = 5)	Upstream CLT1-US (n = 5)	Downstream CLT1-DS (n = 9)
			Average ± SD	Average ± SD	Average ± SD	Average ± SD
TOC	%	10[α]	<0.10 ± 0.00	<0.10 ± 0.00	0.41 ± 0.18	0.23 ± 0.15
Aluminum (Al)	mg/kg	-	418 ± 126	763 ± 271	6,824 ± 2,489	4,426 ± 2,081
Antimony (Sb)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
Arsenic (As)	mg/kg	17	0.12 ± 0.02	0.16 ± 0.02	0.65 ± 0.14	0.61 ± 0.15
Barium (Ba)	mg/kg	-	2 ± 0.3	4 ± 1.2	16 ± 5.1	24 ± 11
Beryllium (Be)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	0.27 ± 0.11	0.17 ± 0.08
Bismuth (Bi)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0.01	0.26 ± 0.11
Boron (B)	mg/kg	-	<5.0 ± 0	<5.0 ± 0	9.5 ± 4.3	5.0 ± 0.0
Cadmium (Cd)	mg/kg	3.5	<0.020 ± 0	<0.020 ± 0	0.043 ± 0.013	0.061 ± 0.009
Calcium (Ca)	mg/kg	-	214 ± 44	842 ± 508	2,682 ± 560	2,384 ± 1,217
Chromium (Cr)	mg/kg	90	1.4 ± 0.4	3.4 ± 1.0	28.9 ± 6.9	18.4 ± 4.5
Cobalt (Co)	mg/kg	-	0.32 ± 0.09	0.67 ± 0.19	5.73 ± 1.68	4.10 ± 1.46
Copper (Cu)	mg/kg	110[α]	0.8 ± 0.5	1.3 ± 0.5	18 ± 3.7	13.5 ± 5.1
Iron (Fe)	mg/kg	40,000[α]	1,240 ± 475	2,826 ± 1,271	14,480 ± 2,663	23,240 ± 6,196
Lead (Pb)	mg/kg	91	0.7 ± 0.2	1.1 ± 0.1	3.9 ± 0.9	5.1 ± 2.1
Lithium (Li)	mg/kg	-	<2.0 ± 0.0	2.2 ± 0.5	12.6 ± 5.5	5.3 ± 2.1
Magnesium (Mg)	mg/kg	-	333 ± 116	826 ± 521	8,110 ± 2,920	5,054 ± 2,584
Manganese (Mn)	mg/kg	1,100[α,β]	10 ± 2.4	22 ± 7.1	134 ± 45	195 ± 80
Mercury (Hg)	mg/kg	0.486	0.0050 ± 0	<0.0050 ± 0	0.0067 ± 0.0016	0.0053 ± 0.0007
Molybdenum (Mo)	mg/kg	-	<0.10 ± 0.00	0.11 ± 0.01	0.15 ± 0.05	1.10 ± 0.50
Nickel (Ni)	mg/kg	75[α,β]	0.8 ± 0.2	1.9 ± 0.7	18.6 ± 5.7	14.3 ± 5.2
Phosphorus (P)	mg/kg	2,000[α]	61 ± 16	113 ± 49	227 ± 50	210 ± 72
Potassium (K)	mg/kg	-	106 ± 13	168 ± 77	1,310 ± 580	1,712 ± 784
Selenium (Se)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	0.20 ± 0	0.20 ± 0
Silver (Ag)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	0.10 ± 0	0.10 ± 0
Sodium (Na)	mg/kg	-	<50 ± 0	<50 ± 0	67 ± 17	59 ± 14
Strontium (Sr)	mg/kg	-	1.2 ± 0.2	1.9 ± 0.3	2.7 ± 0.4	2.8 ± 0.8
Sulphur (S)	mg/kg	-	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0
Thallium (Tl)	mg/kg	-	<0.050 ± 0.000	<0.050 ± 0	0.094 ± 0.033	0.093 ± 0.040
Tin (Sn)	mg/kg	-	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
Titanium (Ti)	mg/kg	-	36 ± 16	109 ± 26	396 ± 100	316 ± 122
Uranium (U)	mg/kg	-	0.2 ± 0.1	0.30 ± 0.0	0.8 ± 0.2	0.84 ± 0.4
Vanadium (V)	mg/kg	-	1.9 ± 0.7	5.0 ± 2.2	26.2 ± 4.6	17.4 ± 4.5
Zinc (Zn)	mg/kg	315	2.0 ± 0.0	3.7 ± 1.3	15 ± 5.1	21 ± 7.5
Zirconium (Zr)	mg/kg	-	1.1 ± 0.1	1.7 ± 0.3	1.9 ± 0.7	2.1 ± 0.4

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

areas compared to average lotic reference area concentrations (Appendix Table D.10). However, of these metals, only iron, manganese, and potassium, together with barium and zinc, occurred at concentrations ≥1.5 times greater at the downstream area than at the upstream area of CLT1 (Table 3.2), potentially reflecting an additional influence of the Tote Road and other mine sources on metal concentrations of deposited sediment at the lower main stem study area. Interestingly, the spatial pattern in metal concentrations of deposited sediment at CLT1 suggested that the primary source of metals was the north branch watershed, which differed from that shown for influences on water quality where the lower main stem watershed appeared to be the dominant source of metals (Section 3.1.1). Despite elevation in metal concentrations of deposited sediment at CLT1 compared to average lotic reference area conditions, concentrations of all metals were well below applicable Sediment Quality Guidelines (SQG) at all CLT1 upstream and downstream stations (Table 3.2; Appendix Tables D.8 and D.9). No baseline sediment metal concentration data were collected at the CLT1 study areas, and thus no evaluation of potential mine-related influences on sediment quality following commencement of commercial mine operations could be conducted.

3.1.3 Phytoplankton

Chlorophyll-a concentrations at the upper-most CLT1 north branch station (Station L1-08) were lower than the average concentration among reference creek stations for spring, summer, and fall sampling events in 2017 (Figure 3.3). However, chlorophyll-a concentrations further downstream at the CLT1 north branch, nearer to the mine (i.e., Station L1-02), were generally comparable to reference creek chlorophyll-a concentrations for each individual sampling event, suggesting no marked differences in phytoplankton productivity between the CLT1 north branch and the reference creek stations (Figure 3.3). Within the CLT1 main stem, chlorophyll-a concentrations were highest at upstream-most Station L2-03 during the spring and summer sampling events, but were comparable among the upper and lower main stem stations during the fall sampling event in 2017 (Figure 3.3). Chlorophyll-a concentrations were consistently significantly higher at the CLT1 main stem stations compared to the reference creek stations for each of the spring, summer, and fall sampling events in 2017 (Appendix Table E.2), potentially reflecting an outcome of higher nutrient (e.g., nitrate) concentrations at the CLT1 main stem stations compared to average reference conditions (Appendix Tables C.14 and C.15). Nevertheless, chlorophyll-a concentrations at all CLT1 north branch and main stem monitoring stations were well below the AEMP benchmark of 3.7 µg/L for all seasonal sampling events in 2017 (Figure 3.3). Similar to the reference creek stations, chlorophyll-a concentrations observed at all CLT1 stations in 2017 suggested low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al. (1998) trophic status classification for stream environments (i.e., chlorophyll-a < 10 µg/L). This trophic status classification was also consistent with an ‘ultra-oligotrophic’ to

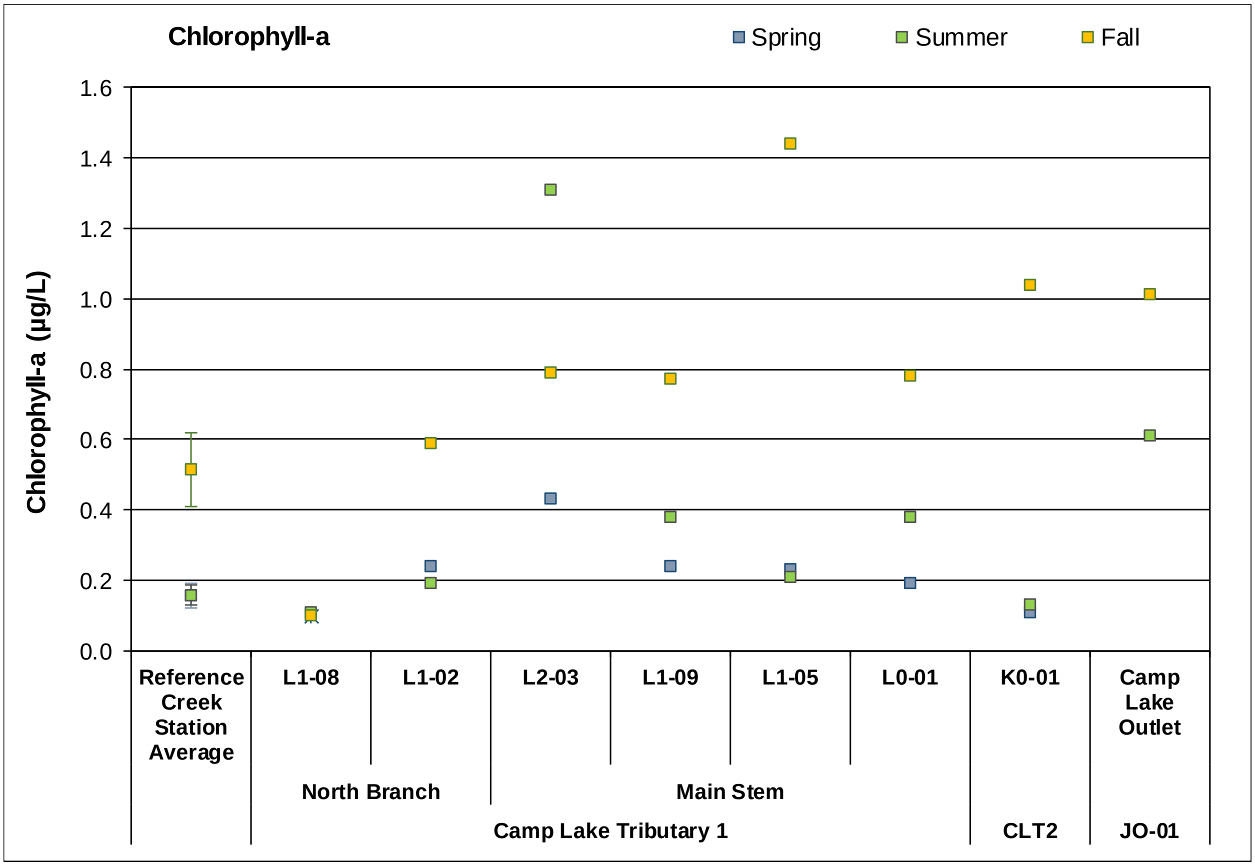


Figure 3.3: Chlorophyll-a Concentrations at Camp Lake Tributary 1 (CLT1) and Tributary 2 (CLT2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2017

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

'oligotrophic' WQG categorization (CCME 2017) for CLT1 based on aqueous total phosphorus concentrations typically less than 10 µg/L at each CLT1 north branch and main stem stations during all spring, summer, and fall sampling events in 2017 (Appendix Table C.14).

Temporal comparisons of the CLT1 chlorophyll-a data indicated that concentrations at the north branch in fall 2017 were similar to, or lower than, those observed in the fall during the baseline (2005 – 2013) period (Figure 3.4). At the CLT1 main stem, chlorophyll-a concentrations were generally higher in mine operational years from 2015 – 2017 than during the mine baseline period with the exception of at the CLT1 mouth (Station L0-01; Figure 3.4). The spatial and temporal analyses of chlorophyll-a concentrations suggested that mine operation may have contributed to slightly higher phytoplankton productivity at CLT1 main stem stations, but not at the north branch or at the mouth of the main stem. As indicated above, higher phytoplankton productivity within the CLT1 main stem was consistent with the occurrence of higher nutrient concentrations (e.g.,

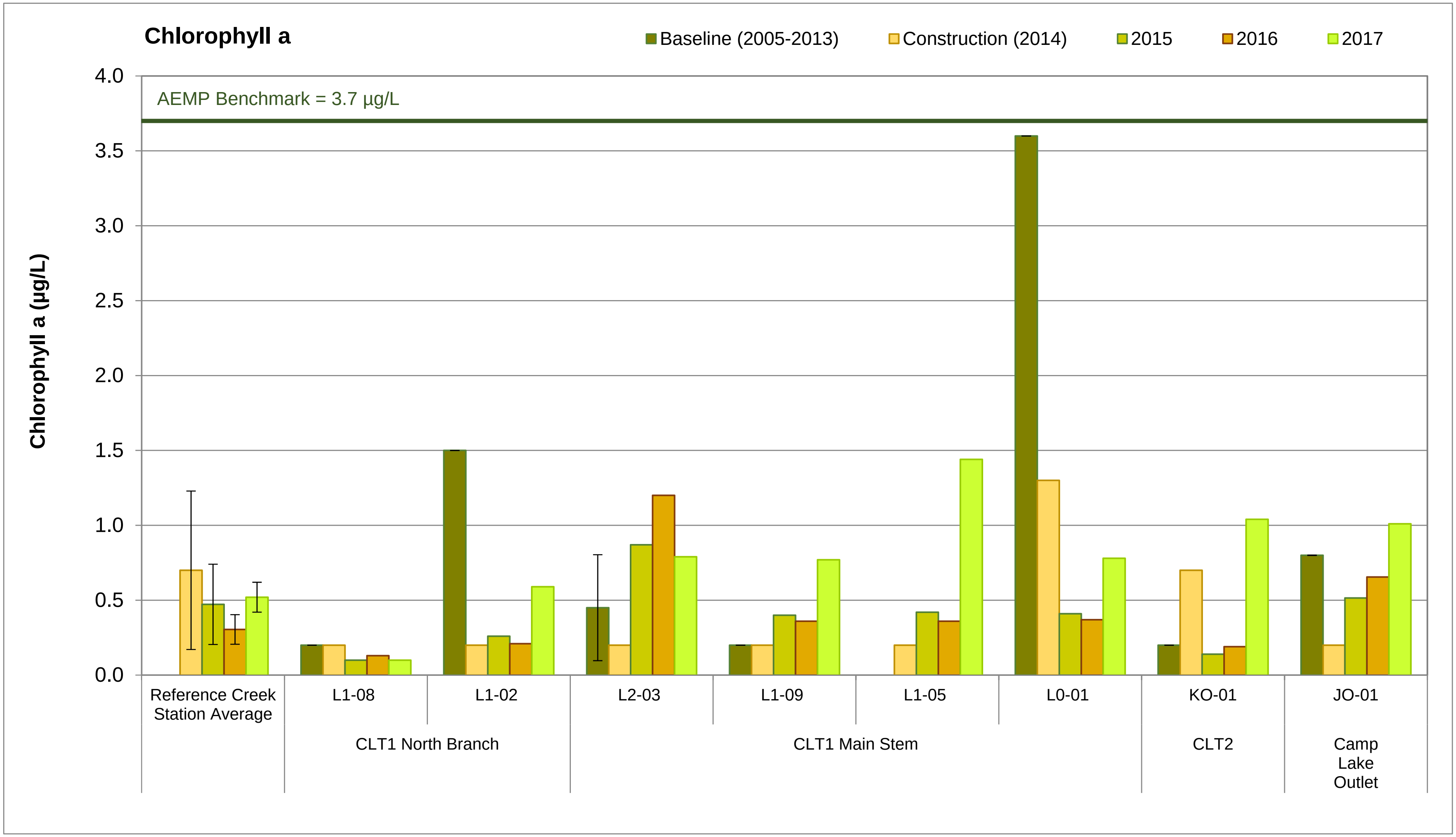


Figure 3.4: Temporal Comparison of Chlorophyll a Concentrations at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015, 2016, and 2017) Periods during Fall

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

nitrate) than at the reference creeks, although (see Section 3.1.1). This suggested that slightly greater phytoplankton productivity at the CLT1 main stem was the result of current mine operations and specifically, the introduction of nutrients to the system as a result of active quarrying at the QMR2 pit. Despite slightly greater phytoplankton productivity at CLT1 over time, the watercourse has remained 'oligotrophic' since the commencement of commercial mine operation.

3.1.4 Benthic Invertebrate Community

Upstream North Branch (CLT1 US)

Benthic invertebrate density, richness, and Simpson's Evenness did not differ significantly between the CLT1 upstream (north branch) and Unnamed Reference Creek study areas (Table 3.3). However, differences in community assemblage were suggested between these study areas based on significant differences in Bray-Curtis Index (Table 3.3). Ecologically significant lower relative abundance of Ephemeroptera (mayflies) and Simuliidae (blackflies), and conversely, higher relative abundance of Chironomidae (non-biting midges) and Tipulidae (crane flies), was indicated at the CLT1 north branch compared to the reference creek based on magnitudes of difference outside of the benthic invertebrate community critical effect size (CES_{BIC}) of ±2 reference area standard deviations (SD_{REF}; Table 3.3). Of these groups, only absolute densities of mayflies and crane flies showed significant, ecologically meaningful, differences between the CLT1 north branch and Unnamed Reference Creek (Appendix Table F.8). Notably, the relative abundance of metal-sensitive chironomids did not differ significantly between the CLT1 north branch and the reference creek, suggesting that the community composition differences between watercourses were unrelated to metal concentrations. Assessment of benthic invertebrate functional feeding groups (FFG) indicated significantly higher relative abundance of shredders at the CLT1 north branch, suggesting the presence of greater amounts of living and/or decomposing large leafy/woody vegetation, compared to Unnamed Reference Creek (Table 3.3). In addition, significantly lower proportions of FFG collector-gatherers and filterers were indicated at the CLT1 north branch compared to the reference creek (Table 3.3). The differences in FFG composition potentially reflected differences in in-stream vegetation types/abundance between watercourses, which included higher bryophyte (moss) and lower periphyton abundance at the CLT1 north branch compared to the reference creek (Appendix Table F.1). Specifically, a greater density of shredders (including *Tipula* crane flies) at the CLT1 north branch may have reflected greater abundance of bryophytes, which serve as a food source for shedders, compared to the reference creek where greater abundance of periphyton may have contributed to a greater relative abundance of collector-gatherer and filterer FFG (Table 3.3; Appendix Table F.1). Collectively, the data suggested that differences in benthic invertebrate

Table 3.3: Benthic Invertebrate Community Metric Statistical Comparison Results among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Data Transform-ation	Overall 3-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Study Area	Mean	Standard Deviation	Magnitude of Difference (SD)	Pairwise Comparison
Density (No. per m²)	log	NO	0.8399	Reference Creek	1,972	1,861	-	a
				CLT1 Upstream	1,242	143	-0.4	a
				CLT1 Downstream	1,465	735	-0.3	a
Richness (No. of Taxa)	log	YES	0.0224	Reference Creek	21.2	1.9	-	a
				CLT1 Upstream	19.2	2.6	-1.0	a,b
				CLT1 Downstream	16.8	1.9	-2.3	b
Simpson's Evenness	none	YES	0.0038	Reference Creek	0.935	0.017	-	a
				CLT1 Upstream	0.925	0.019	-0.5	a
				CLT1 Downstream	0.874	0.033	-3.6	b
Bray-Curtis Index	rank	YES	< 0.001	Reference Creek	0.305	0.205	-	a
				CLT1 Upstream	0.729	0.027	2.1	b
				CLT1 Downstream	0.777	0.029	2.3	c
Nemata (% of community)	none	NO	0.1301	Reference Creek	8.8	3.6	-	a
				CLT1 Upstream	4.1	2.1	-1.3	a
				CLT1 Downstream	4.6	5.0	-1.2	a
Oligochaeta (% of community)	fourth root	YES	0.0142	Reference Creek	1.0	1.4	-	a
				CLT1 Upstream	1.1	1.3	0.1	a,b
				CLT1 Downstream	5.0	2.7	2.9	b
Hydracarina (% of community)	square root	YES	0.0181	Reference Creek	4.8	2.3	-	a
				CLT1 Upstream	7.6	1.1	1.3	b
				CLT1 Downstream	4.0	1.4	-0.3	a
Ephemeroptera (% of community)	fourth root	YES	< 0.001	Reference Creek	13.8	6.0	-	a
				CLT1 Upstream	1.0	0.6	-2.1	b
				CLT1 Downstream	0.4	0.6	-2.2	c
Chironomidae (% of community)	none	YES	< 0.001	Reference Creek	37.9	11.2	-	a
				CLT1 Upstream	74.0	1.7	3.2	b
				CLT1 Downstream	80.9	4.5	3.9	b
Metal Sensitive Chironomids (% of community)	fourth root	YES	0.0785	Reference Creek	5.7	5.6	-	a,b
				CLT1 Upstream	7.2	5.2	0.3	a
				CLT1 Downstream	1.5	0.7	-0.7	b
Simuliidae (% of community)	fourth root	YES	< 0.001	Reference Creek	28.3	6.6	-	a
				CLT1 Upstream	1.2	1.3	-4.1	b
				CLT1 Downstream	0.3	0.5	-4.2	b
Tipulidae (% of community)	fourth root	YES	< 0.001	Reference Creek	0.7	0.5	-	a
				CLT1 Upstream	8.4	1.5	17.0	b
				CLT1 Downstream	3.9	3.1	7.1	c
Collector-Gatherer FFG (% of community)	none	YES	< 0.001	Reference Creek	58.8	7.2	-	a
				CLT1 Upstream	38.8	7.1	-2.8	b
				CLT1 Downstream	67.2	6.4	1.2	a
Filterer FFG (% of community)	fourth root	YES	< 0.001	Reference Creek	28.7	6.5	-	a
				CLT1 Upstream	1.3	1.5	-4.2	b
				CLT1 Downstream	0.3	0.5	-4.4	b
Shredder FFG (% of community)	none	YES	< 0.001	Reference Creek	6.7	5.5	-	a
				CLT1 Upstream	49.5	6.4	7.8	b
				CLT1 Downstream	27.6	4.9	3.8	c
Clinger HPG (% of community)	none	YES	0.0007	Reference Creek	40.1	7.8	-	a
				CLT1 Upstream	52.5	7.2	1.6	b
				CLT1 Downstream	28.9	5.7	-1.4	c
Sprawler HPG (% of community)	none	YES	0.0029	Reference Creek	49.0	9.2	-	a
				CLT1 Upstream	33.8	7.9	-1.7	b
				CLT1 Downstream	57.6	8.6	0.9	a
Burrower FFG (% of community)	none	NO	0.4433	Reference Creek	10.7	4.5	-	a
				CLT1 Upstream	13.7	2.1	0.7	a
				CLT1 Downstream	13.4	4.7	0.6	a

[grey] Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).
[blue] Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference between the mine-exposed area and reference area was ecologically meaningful.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

community assemblage between the CLT1 north branch and Unnamed Reference Creek were unrelated to metal concentrations, and likely reflected differences in the types and/or abundance of in-stream vegetation between these study areas.

Temporal comparisons of the CLT1 north branch benthic invertebrate community data indicated that density, richness, Simpson's Evenness, and relative abundance of key dominant groups and FFG did not show any consistent type and/or direction of significant differences in any years of mine operation, including 2017, compared to baseline data collected in both 2007 and 2011 (Figure 3.5; Appendix Table F.9). Notably, higher density, richness (2017 only) and Simpson's Evenness were indicated at the CLT1 north branch in years of mine operation than during years (2007 and 2011) in which baseline data were collected (Figure 3.5; Appendix Table F.9). Therefore, the temporal evaluation indicated no adverse mine-related influences on the benthic invertebrate community of the CLT1 north branch since the commencement of commercial mine operations in 2015.

Downstream Lower Main Stem (CLT1 DS)

The benthic invertebrate community at the lower main stem of Camp Lake Tributary (CLT1 DS), just downstream of the Tote Road, showed significantly lower richness and Simpson's Evenness compared to Unnamed Reference Creek in 2017 (Table 3.3). In addition, the benthic invertebrate community assemblage at the CLT1 lower main stem differed from the reference creek as suggested by significant differences in Bray-Curtis Index and composition of dominant invertebrate groups and FFG (Table 3.3). Because no significant difference in the relative abundance of metal-sensitive chironomids was indicated between the CLT1 lower main stem and reference area (Table 3.3), the community composition differences between these study areas appeared to be unrelated to differences in metal concentrations. The key differences in benthic invertebrate composition between the CLT1 lower main stem and reference study areas were very similar to those shown between the CLT1 north branch and reference creek, suggesting a similar mechanism for differences in benthic invertebrate community composition at the CLT1 north branch and lower main stem study areas compared to the reference creek. Specifically, the differences in benthic invertebrate community composition between the CLT1 lower main stem and reference area likely reflected higher and lower abundance of bryophytes and periphyton, respectively, at CLT1 (Appendix Table F.1). Notably, because substrate with significantly larger diameter and greater embeddedness was sampled at CLT1 compared to Unnamed Reference Creek (Appendix Tables F.3 and F.4), differences in habitat may have also contributed to the indicated differences in benthic invertebrate community compositional features between CLT1 and the reference creek.

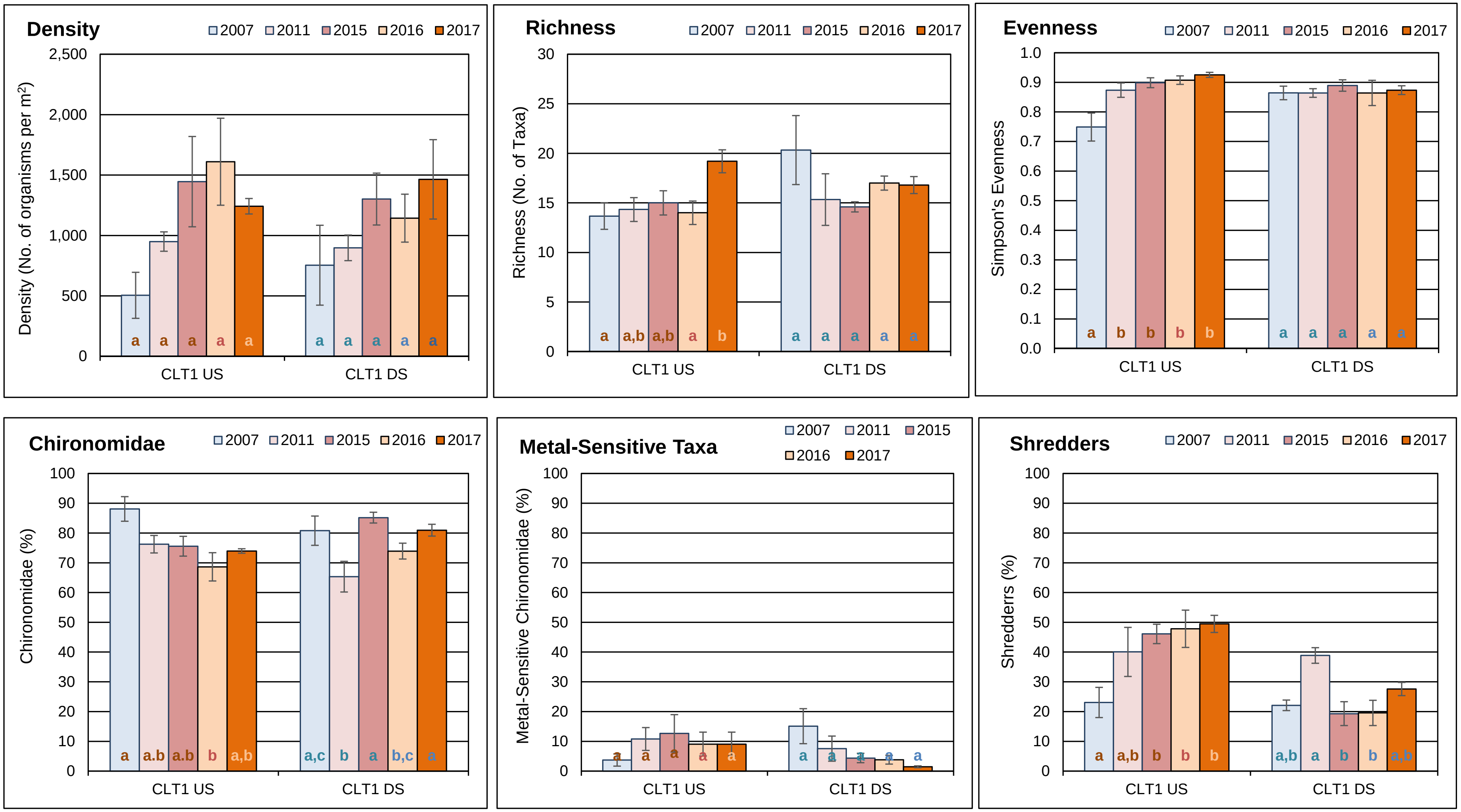


Figure 3.5: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 1 Study Areas among Mine Baseline (2007, 2011) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

Temporal comparison of the CLT1 lower main stem data indicated no significant differences in benthic invertebrate density, richness, Simpson's Evenness, or the proportion of metal-sensitive chironomids between individual years of mine operation (2015, 2016, 2017) and the mine baseline (2007, 2011 data) period (Figure 3.5; Appendix Table F.10). In addition, no consistent types and/or direction of differences in the relative abundance of dominant groups or FFG were indicated between 2017 and years in which baseline data were collected at the CLT1 lower main stem (Figure 3.5; Appendix Table F.10). Overall, these results suggested no substantial changes in benthic invertebrate community features between the mine operational and mine baseline periods at the CLT1 lower main stem.

3.1.5 Integrated Effects Evaluation

Upstream North Branch (CLT1 US)

Potential mine-related effects on water quality of the CLT1 north branch in 2017 included slightly elevated molybdenum and potassium concentrations compared to average reference creek data, but only during the spring sampling event. Although CLT1 north branch total copper concentrations were not particularly elevated compared to reference conditions, concentrations at the CLT1 north branch were above WQG and the CLT AEMP benchmark in summer and fall in 2017. In addition, total copper concentrations were consistently elevated compared to the 2005 - 2013 baseline data in each of the three years of commercial mine operation, indicating a mine-related source of copper to the CLT1 north branch. Deposited sediment at the CLT1 north branch contained elevated concentrations of several metals compared to Unnamed Reference Creek, but concentrations of all metals were well below SQG and deposited sediment material composed less than 1% of surficial bed material throughout CLT1. No substantial mine development has occurred in the CLT1 north branch watershed, and therefore hypothesized sources of metals to the watercourse potentially include fugitive dust from the mine and/or natural minerology of the bedrock/overburden in the region of the mine.

Despite copper concentrations above WQG, chlorophyll-a concentrations (a surrogate for phytoplankton abundance) at the CLT1 north branch were comparable to those of the reference creek stations in 2017, and to those during the baseline period, all of which were well below the AEMP benchmark and suggested oligotrophic conditions typical of Arctic watercourses. In addition, no ecologically significant differences in primary benthic invertebrate community endpoints (i.e., density, richness, and Simpson' Evenness) or in the relative abundance of metal-sensitive chironomids between the CLT1 north branch and reference creek in 2017, nor any consistent significant differences in benthic metric type or direction between mine operational (2015 – 2017) and baseline periods. In turn, this suggested that despite aqueous total copper concentrations above the applicable AEMP benchmark, concentrations did not adversely affect phytoplankton and benthic invertebrates of the CLT1 north branch. Overall, similar to the findings of the two previous CREMP studies, no adverse mine-related effects to biota of the CLT1 north branch were indicated in 2017.

Downstream Main Stem (CLT1 DS)

At the CLT1 main stem, mine-related influences on water quality were evident as elevated conductivity and concentrations of chloride, nitrate, sulphate, TDS, TKN, and several metals including iron, manganese, molybdenum, potassium, sodium, strontium, and uranium at the upstream-most station (Station L2-03) compared to reference creek station data in 2017. However, downstream of the confluence with the north branch, only chloride and total manganese concentrations were elevated at the CLT1 main stem stations (i.e., stations L1-01, L1-05, and L1-09) compared to average reference creek conditions in 2017. Nevertheless, concentrations of iron, manganese, molybdenum, nitrate, sodium, sulphate, TKN, and uranium were consistently elevated in 2015, 2016, and 2017 at the CLT1 main stem stations compared to the baseline period. As hypothesized in previous CREMP studies, quarrying activity at the QMR2 pit was likely a key source of the parameters shown to be elevated at CLT1 main stem stations.

Despite evidence of continued mine-related influence on water quality of the CLT1 upper main stem in 2017, parameter concentrations were below applicable WQG and site-specific AEMP benchmarks with the exception of aluminum and iron, which were above their respective benchmarks during the fall sampling event in 2017. Notably, total aluminum and iron concentrations were also elevated above AEMP benchmarks at one of the four lotic reference creek stations in fall 2017. High turbidity at the CLT1 main stem and reference creek in fall 2017 indicated a potential causal link to the high total concentrations of aluminum and iron, and evaluation of dissolved concentrations of these metals indicated that the source of iron was likely related to mine operations. Similar to the north branch, deposited sediment at the CLT1 main stem contained elevated concentrations of several metals compared to Unnamed Reference Creek, but concentrations of all metals were well below SQG and deposited sediment material composed a very small proportion of surficial bed material within the CLT1 main stem, limiting the exposure of sediment metal concentrations to in-stream biota.

Chlorophyll-a concentrations at the CLT1 main stem were generally highest at the upstream-most Station L2-03, were significantly higher than the reference creek average during all three seasonal sampling events in 2017, and were higher in 2015, 2016, and 2017 than during the mine baseline period. The occurrence of relatively high chlorophyll-a concentrations at the CLT1 main stem not only suggested that concentrations of aluminum, iron, uranium, and other metals were not highly bioavailable at the CLT1 upper main stem, but that elevated nitrate concentrations may have contributed to slight biological enrichment of the watercourse. Nevertheless, chlorophyll-a concentrations at the CLT1 main stem were well below the AEMP benchmark and were reflective of oligotrophic conditions typical of Arctic watercourses. Although benthic invertebrate community richness, Simpson's Evenness, and general composition differed significantly between the CLT1 lower main stem and Unnamed Reference Creek communities in 2017, the weight-of-evidence indicated that natural differences in in-stream bryophyte (moss) growth between watercourses accounted for these differences. This was supported by no ecologically significant differences in relative abundance of metal-sensitive chironomids between the CLT1 main stem and reference creek benthic invertebrate communities in 2017, and no consistent significant differences in benthic metric type or direction between the mine operational (2015 – 2017) and baseline (2007, 2011) studies. Thus, no adverse mine-related effects to phytoplankton and benthic invertebrate biota of the CLT1 lower main stem were indicated in 2017 based on comparison to reference creek conditions and to baseline data.

3.2 Camp Lake Tributary 2 (CLT2)

3.2.1 Water Quality

Camp Lake Tributary 2 (CLT2) dissolved oxygen saturation levels were consistently high at Station KO-01 in 2017, and were similar to mean DO saturation observed among the reference creek stations during all seasonal sampling events (Appendix Tables C.1 – C.3). *In situ* DO concentrations at the CLT2 upstream and downstream study areas did not differ significantly from those at Unnamed Reference Creek, nor from each other, at the time of biological sampling in August 2017 (Appendix Table C.19), and were all above the WQG minimum limit for protection of sensitive stages of cold-water biota (Figure 3.6). Aqueous pH at both CLT2 study areas was slightly higher (i.e., more alkaline) than the average among lotic reference stations, but was consistently well within WQG limits (Appendix Tables C.1 – C.3). No significant difference in pH was indicated between CLT2 study areas located upstream and downstream of the Tote Road (Figure 3.6). *In situ* specific conductance was significantly higher at CLT2 compared to Unnamed Reference Creek, but did not differ significantly upstream and downstream of the Tote Road during the August 2017 at the time of biological sampling (Figure 3.6).

Water chemistry at CLT2 (Station KO-01) was similar to the reference creek stations during spring, summer, and fall sampling events in 2017 with the exception of slightly to moderately higher (i.e., 5- to 10-fold) sulphate concentrations (Table 3.1; Appendix Table C.15). In addition, aqueous concentrations of all parameters, including sulphate, were consistently well below established WQG and AEMP benchmarks at the CLT2 monitoring station in 2017 (Table 3.1; Appendix Table C.14). Temporal comparisons of CLT2 water chemistry data indicated that parameter concentrations in fall 2017 were generally within the range of those measured during the mine baseline period (2005 – 2013; Appendix Tables C.15 and C.18) and were not unlike

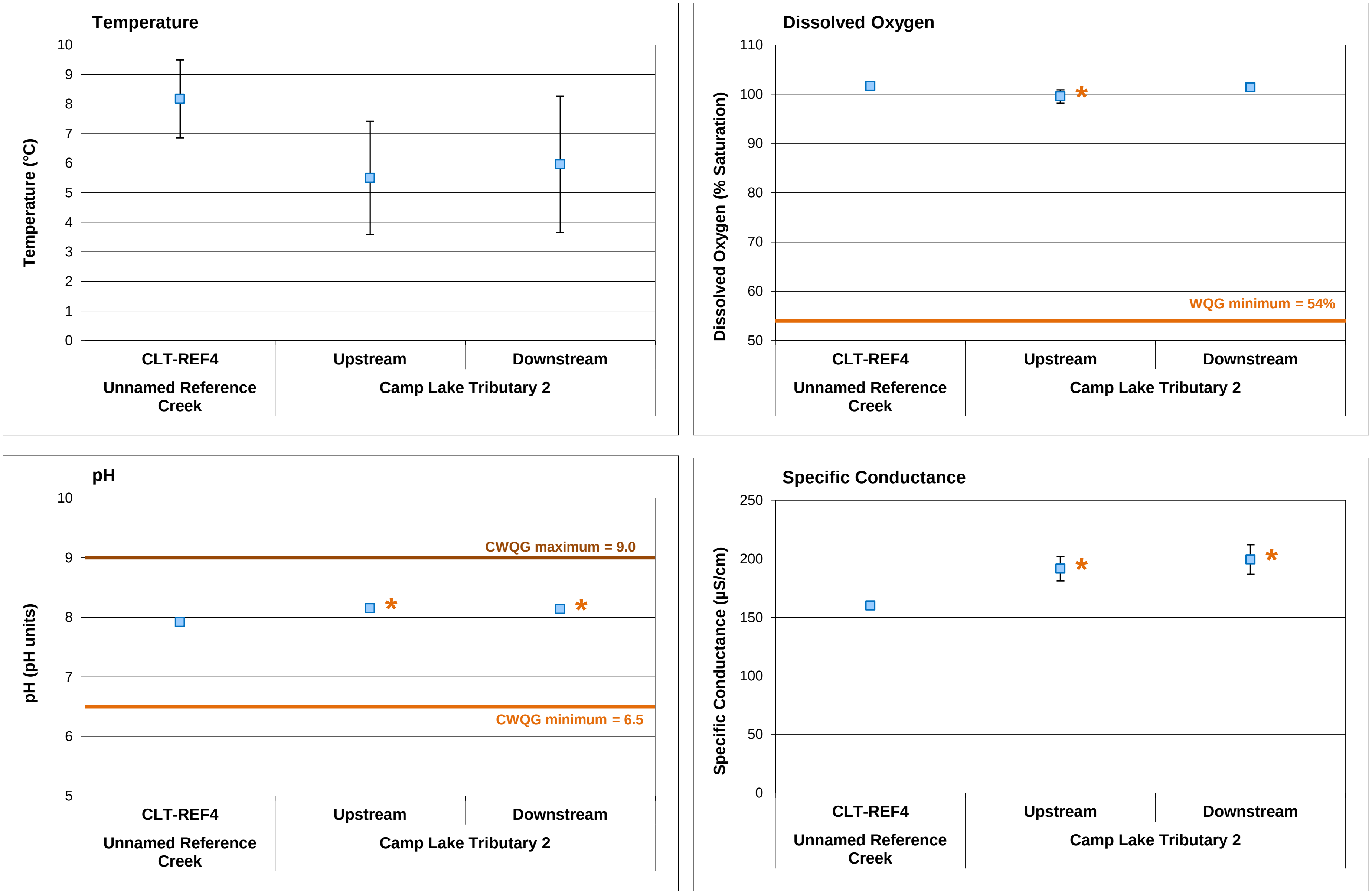


Figure 3.6: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake Tributary 2 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Unnamed Reference Creek mean.

those observed during the 2014 mine construction and 2015 – 2016 mine operation period (Figure 3.2; Appendix Figure C.2). Collectively, the 2017 water chemistry data suggested only minor mine-related influence on aqueous conductivity and sulphate concentrations within the CLT2 system compared to applicable reference and mine baseline conditions.

3.2.2 Sediment Quality

Deposited sediment at CLT2 upstream (CLT2-US) and downstream (CLT2-DS) study areas was visually characterized as coarse to very coarse sand (Appendix Table D.7). Similar to CLT1, the in-stream substrate at both CLT2 study areas was composed mainly of cobble material (i.e., substrate diameter 6 – 25 cm), with sand constituting only a trace amount (i.e., <1%) of the material observed at the sediment surface of the upstream area, and approximately 5% of material at the downstream area (Appendix Table F.1). Accordingly, deposited sediment was collected mainly from shoreline/streambank areas at the CLT2 study areas (Appendix Table D.7). Sediment TOC content was low (i.e., ~0.1%) at both CLT2 study areas, and comparable to average lotic reference area TOC content suggesting similar depositional characteristics among the CLT2 and lotic reference study areas (Table 3.4; Appendix Table D.10).

Deposited sediment at CLT2 showed slightly (i.e., 3- to 5-fold higher) to moderately (i.e., 5-fold to 10-fold higher) concentrations of aluminum, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, and vanadium compared to respective average concentrations at the reference creek (Table 3.4; Appendix Table D.10). Of these metals, only copper, iron, and vanadium, as well as zinc, occurred at concentrations ≥1.5 times higher at the downstream area at than at the upstream area of CLT2 (Table 3.4), potentially reflecting greater influence of the Tote Road on metal concentrations of deposited sediment within the lower CLT2 watercourse. However, concentrations of all metals were well below applicable SQG at all upstream and downstream stations at CLT2 (Table 3.4; Appendix Tables D.11 and D.12). Notably, metal concentrations in deposited sediment at the CLT2 upstream and downstream study areas were consistently lower than those at the CLT1 study areas, potentially indicating reduced influences with greater distance from the mine. No baseline sediment metal concentration data were collected at the CLT2 study areas, and thus no evaluation of potential mine-related influences on sediment quality following commencement of commercial mine operations could be conducted.

3.2.3 Phytoplankton

Chlorophyll-a concentrations at CLT2 (Station KO-01) were slightly lower than average concentrations observed at the reference creeks during spring and summer sampling events, but higher than concentrations at the reference creeks during the fall sampling event in 2017 (Figure 3.3). Nutrient concentrations, including ammonia, nitrate, and total phosphorus, showed

Table 3.4: Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 2 (CLT2) and Lotic Reference Area Sediment Monitoring Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Lotic Reference Stations		Camp Lake Tributary 2	
			Unnamed Reference Creek (REFCRK; n = 5)	Mary River Reference (GO-09; n = 5)	Upstream CLT2-US (n = 5)	Downstream CLT2-DS (n = 5)
			Average ± SD	Average ± SD	Average ± SD	Average ± SD
Total Organic Carbon	%	10[α]	<0.10 ± 0.00	<0.10 ± 0.00	0.11 ± 0.01	0.12 ± 0.03
Aluminum (Al)	mg/kg	-	418 ± 126	763 ± 271	1,664 ± 314	1,650 ± 509
Antimony (Sb)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
Arsenic (As)	mg/kg	17	0.12 ± 0.02	0.16 ± 0.02	0.35 ± 0.07	0.36 ± 0.12
Barium (Ba)	mg/kg	-	1.8 ± 0.3	3.7 ± 1.2	5.7 ± 1.1	5.5 ± 1
Beryllium (Be)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0.00
Bismuth (Bi)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0.00
Boron (B)	mg/kg	-	<5.0 ± 0	<5.0 ± 0	<5.0 ± 0	<5.0 ± 0.0
Cadmium (Cd)	mg/kg	3.5	<0.020 ± 0	<0.020 ± 0	<0.020 ± 0	0.021 ± 0.003
Calcium (Ca)	mg/kg	-	214 ± 44	842 ± 508	1,534 ± 511	1,536 ± 747
Chromium (Cr)	mg/kg	90	1.4 ± 0.4	3.4 ± 1.0	9.5 ± 2.1	12.3 ± 9.0
Cobalt (Co)	mg/kg	-	0.32 ± 0.09	0.67 ± 0.19	1.83 ± 0.37	1.96 ± 0.93
Copper (Cu)	mg/kg	110[α]	0.8 ± 0.5	1.3 ± 0.5	4.5 ± 0.7	6.5 ± 6.1
Iron (Fe)	mg/kg	40,000[α]	1,240 ± 475	2,826 ± 1,271	5,088 ± 1,784	8,254 ± 8,263
Lead (Pb)	mg/kg	91	0.7 ± 0.2	1.1 ± 0.1	1.5 ± 0.4	1.6 ± 0.5
Lithium (Li)	mg/kg	-	<2.0 ± 0.0	2.2 ± 0.5	3.1 ± 0.4	3.3 ± 0.9
Magnesium (Mg)	mg/kg	-	333 ± 116	826 ± 521	2,402 ± 552	2,408 ± 917
Manganese (Mn)	mg/kg	1,100[α,β]	10 ± 2.4	22 ± 7.1	58 ± 12	59 ± 21
Mercury (Hg)	mg/kg	0.486	<0.0050 ± 0	<0.0050 ± 0	<0.0050 ± 0	<0.0050 ± 0.0000
Molybdenum (Mo)	mg/kg	-	<0.10 ± 0.00	0.11 ± 0.01	<0.10 ± 0.00	<0.10 ± 0.00
Nickel (Ni)	mg/kg	75[α,β]	0.8 ± 0.2	1.9 ± 0.7	5.9 ± 1.1	6.4 ± 3.4
Phosphorus (P)	mg/kg	2,000[α]	61 ± 16	113 ± 49	117 ± 18	130 ± 58
Potassium (K)	mg/kg	-	106 ± 13	168 ± 77	392 ± 66	386 ± 110
Selenium (Se)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0
Silver (Ag)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
Sodium (Na)	mg/kg	-	<50 ± 0	<50 ± 0	<50 ± 0	<50 ± 0
Strontium (Sr)	mg/kg	-	1.2 ± 0.2	1.9 ± 0.3	1.8 ± 0.3	1.8 ± 0.4
Sulphur (S)	mg/kg	-	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0
Thallium (Tl)	mg/kg	-	<0.050 ± 0	<0.050 ± 0	<0.050 ± 0.000	<0.050 ± 0.000
Tin (Sn)	mg/kg	-	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
Titanium (Ti)	mg/kg	-	36 ± 16	109 ± 26	137 ± 36	146 ± 52
Uranium (U)	mg/kg	-	0.20 ± 0.08	0.30 ± 0.03	0.23 ± 0.05	0.27 ± 0.13
Vanadium (V)	mg/kg	-	1.9 ± 0.7	5.0 ± 2.2	8.4 ± 2.0	13.4 ± 11.4
Zinc (Zn)	mg/kg	315	2.0 ± 0.0	3.7 ± 1.3	4.2 ± 0.9	8.1 ± 4.1
Zirconium (Zr)	mg/kg	-	1.1 ± 0.1	1.7 ± 0.3	1.4 ± 0.2	1.5 ± 0.4

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

no marked differences between CLT2 and the reference creek stations during the fall sampling event in 2017 (Appendix Tables C.14 and C.15), and therefore the occurrence of higher chlorophyll-a concentrations within lower CLT2 in fall 2017 did not appear to be related to a nutrient enrichment influence. Notably, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L during each of the 2017 sampling events at CLT2. Low phytoplankton productivity, indicative of oligotrophic conditions, was also suggested at CLT2 based on comparison of chlorophyll-a concentrations to Dodds et al (1998) trophic status classification for creek environments. This productivity classification was supported by a WQG categorization of ultra-oligotrophic to oligotrophic based on mean aqueous phosphorus concentrations below 10 µg/L at CLT2 during all spring, summer, and fall sampling events (Table 3.1; Appendix Table C.14). Temporal comparisons indicated higher chlorophyll-a concentrations in 2017 compared to the mine baseline period and to the two previous years of mine operation at lower CLT2 during fall sampling (Figure 3.4). For the reasons indicated above, higher chlorophyll-a concentrations at CLT2 in fall 2017 did not appear to be associated with a mine-related change in nutrient concentrations over time, and thus may have simply reflected natural seasonal/temporal variation in chlorophyll-a concentrations.

3.2.4 Benthic Invertebrate Community

At Camp Lake Tributary 2 (CLT2), sampling was conducted upstream and downstream of the Tote Road (areas CLT2 US and CLT2 DS, respectively) to assess potential mine-related influences to the benthic invertebrate community. Benthic invertebrate density and richness were each significantly lower at both CLT2 study areas compared to Unnamed Reference Creek, although only the difference in richness was ecologically meaningful (Table 3.5). Differences in community composition were also indicated by a significantly higher Bray-Curtis Index at both CLT2 study areas compared to the Unnamed Reference Creek. Ecologically significant differences in the relative abundance of various dominant benthic invertebrate groups, including lower proportion of mayflies and blackflies, and higher proportion of chironomids (including metal-sensitive taxa), were indicated between CLT2 and the reference creek (Table 3.5). However, in terms of absolute densities, the only ecologically significant difference was a lower mayfly density at the CLT2 study areas compared to the Unnamed Reference Creek (Appendix Table F.14). Similarly, although the relative abundance of collector-gatherer and filterer FFG and clinger and sprawler habitat preference groups (HPG) differed significantly between CLT2 and reference creek study areas, absolute densities of all FFG and HPG did not differ significantly at magnitudes outside of CES_{BIC} (Table 3.5; Appendix Table F.14). The reason(s) for the variable differences in benthic invertebrate community relative abundances versus absolute densities between the CLT2 and reference creek study areas were unclear based on the available data. However, because metal-sensitive chironomids were present at CLT2 in significantly higher relative abundance and

Table 3.5: Benthic Invertebrate Community Metric Statistical Comparison Results among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Data Transform-ation	Overall 3-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Study Area	Mean	Standard Deviation	Magnitude of Difference (SD)	Pairwise Comparison
Density (No. per m²)	log	YES	0.0002	Reference Creek	1,972	1,861	-	a
				CLT2 Upstream	216	30	-0.9	b
				CLT2 Downstream	222	144	-0.9	b
Richness (No. of Taxa)	none	YES	0.0050	Reference Creek	21.2	1.9	-	a
				CLT2 Upstream	14.6	2.5	-3.4	b
				CLT2 Downstream	13.2	4.7	-4.2	b
Simpson's Evenness	none	NO	0.1803	Reference Creek	0.935	0.017	-	a
				CLT2 Upstream	0.955	0.013	1.2	a
				CLT2 Downstream	0.913	0.052	-1.2	a
Bray-Curtis Index	log	YES	< 0.001	Reference Creek	0.305	0.205	-	a
				CLT2 Upstream	0.782	0.019	2.3	b
				CLT2 Downstream	0.794	0.102	2.4	b
Nemata (% of community)	modified probit	YES	0.0142	Reference Creek	8.8	3.6	-	a
				CLT2 Upstream	1.0	1.4	-2.2	b
				CLT2 Downstream	3.2	4.4	-1.6	a,b
Oligochaeta (% of community)	modified probit	NO	0.2304	Reference Creek	1.0	1.4	-	a
				CLT2 Upstream	3.4	6.4	1.7	a
				CLT2 Downstream	4.8	6.9	2.8	a
Hydracarina (% of community)	none	NO	0.1479	Reference Creek	4.8	2.3	-	a
				CLT2 Upstream	8.0	4.2	1.4	a
				CLT2 Downstream	3.3	4.0	-0.6	a
Ephemeroptera (% of community)	none	YES	< 0.001	Reference Creek	13.8	6.0	-	a
				CLT2 Upstream	1.1	1.7	-2.1	b
				CLT2 Downstream	0.9	1.0	-2.2	b
Chironomidae (% of community)	none	YES	< 0.001	Reference Creek	37.9	11.2	-	a
				CLT2 Upstream	75.9	7.5	3.4	b
				CLT2 Downstream	81.8	8.4	3.9	b
Metal Sensitive Chironomids (% of community)	modified probit	YES	0.0031	Reference Creek	5.7	5.6	-	a
				CLT2 Upstream	22.0	3.1	2.9	b
				CLT2 Downstream	20.2	12.6	2.6	b
Simuliidae (% of community)	modified probit	YES	< 0.001	Reference Creek	28.3	6.6	-	a
				CLT2 Upstream	6.5	3.1	-3.3	b
				CLT2 Downstream	3.5	3.1	-3.8	b
Collector-Gatherer FFG (% of community)	none	YES	0.0045	Reference Creek	58.8	7.2	-	a
				CLT2 Upstream	75.6	3.9	2.3	b
				CLT2 Downstream	77.1	10.5	2.6	b
Filterer FFG (% of community)	modified probit	YES	< 0.001	Reference Creek	28.7	6.5	-	a
				CLT2 Upstream	6.5	3.1	-3.4	b
				CLT2 Downstream	3.5	3.1	-3.9	b
Shredder FFG (% of community)	none	NO	0.1833	Reference Creek	6.7	5.5	-	a
				CLT2 Upstream	7.4	5.9	0.1	a
				CLT2 Downstream	14.6	8.9	1.4	a
Clinger HPG (% of community)	modified probit	YES	0.0112	Reference Creek	40.1	7.8	-	a
				CLT2 Upstream	22.4	2.7	-2.3	b
				CLT2 Downstream	22.1	10.6	-2.3	b
Sprawler HPG (% of community)	none	YES	0.0008	Reference Creek	49.0	9.2	-	a
				CLT2 Upstream	70.9	5.3	2.4	b
				CLT2 Downstream	69.0	7.0	2.2	b
Burrower FFG (% of community)	none	NO	0.5877	Reference Creek	10.7	4.5	-	a
				CLT2 Upstream	6.7	5.0	-0.9	a
				CLT2 Downstream	8.9	8.2	-0.4	a

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference between the mine-exposed area and reference area was ecologically meaningful.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

similar density than at the Unnamed Reference Creek, no adverse metal-related influences to the benthic invertebrate community were indicated at the CLT2 study areas (Table 3.5). In turn, this suggested that the other differences in benthic invertebrate community structure between CLT2 and the reference creek likely reflected natural variability. Notably, no significant differences in density, richness, Simpson's Evenness, or the relative abundance of dominant invertebrate groups, FFG, or HPG were indicated between the CLT2 upstream and downstream study areas, indicating no adverse influences to the benthic invertebrate community of CLT2 associated with the Tote Road crossing (Table 3.5).

Temporal comparisons indicated no consistent ecologically significant differences in any benthic invertebrate community endpoints at the CLT2 upstream and downstream study areas over the three years of mine operation (2015, 2016, 2017) compared to 2007 baseline data with the exception of Simpson's Evenness (Figure 3.7; Appendix Tables F.15 and F.16). Because high Simpson's Evenness is normally associated with a diverse, healthy benthic invertebrate community, the occurrence of significantly higher Simpson's Evenness at the CLT2 upstream study area in 2015, 2016, and 2017 compared to 2007 was not consistent with an adverse influence related to recent mine operations. This suggested that differences in benthic invertebrate community endpoints between CLT2 and Unnamed Reference Creek in 2017 were most likely related to natural differences in habitat between watercourses, and that no appreciable changes to the benthic invertebrate community of CLT2 have occurred since commercial mine operations commenced in 2015.

3.2.5 Integrated Effects Evaluation

Potential mine-related effects on water quality of CLT2 in 2017 included slightly elevated conductivity and concentrations of sulphate compared to reference creek averages. However, because CLT2 water chemistry in 2017 was comparable to the 2005 - 2013 baseline data, natural regional variability in water chemistry among lotic environments likely accounted for seemingly elevated conductivity and sulphate at CLT2 in 2017 compared to the reference creek stations. Aqueous concentrations of all parameters were consistently well below applicable WQG and site-specific AEMP benchmarks at CLT2 during the 2015, 2016, and 2017 years of mine operation. Deposited sediment at CLT2 contained elevated concentrations of aluminum, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, and vanadium compared to the reference creek, but concentrations of all metals were well below SQG and deposited sediment material composed less than 5% of surficial bed material in CLT2.

Chlorophyll-a concentrations at CLT2 varied seasonally from those shown at reference creek stations in 2017, but were consistently well below the AEMP benchmark and reflective of oligotrophic conditions characteristic of Arctic watercourses. Although CLT2 chlorophyll-a

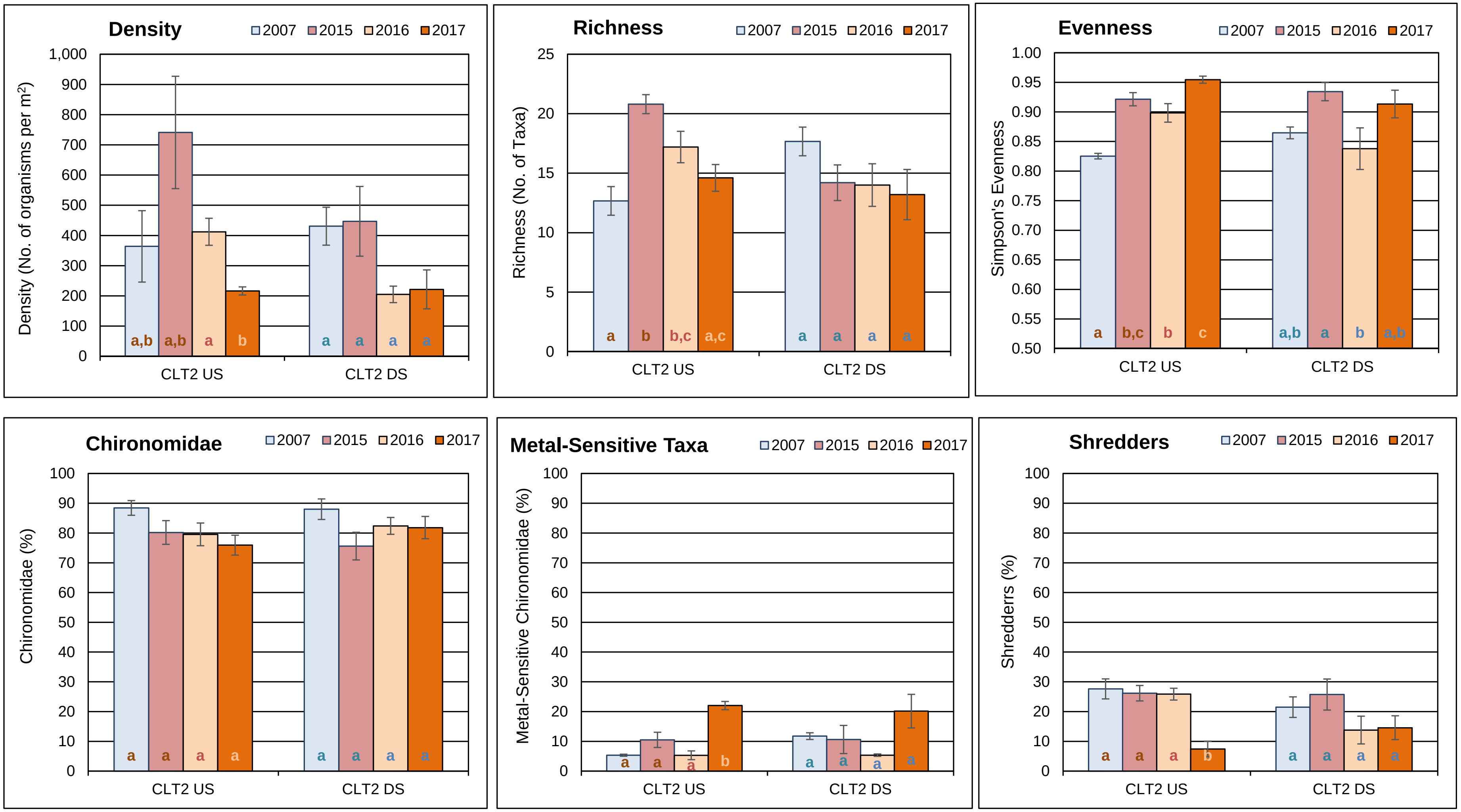


Figure 3.7: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Tributary 2 Study Areas among Mine Baseline (2007) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

concentrations were higher in 2017 than during the mine baseline period and the two previous CREMP studies, no change in nutrient concentrations was indicated at CLT2 in 2017 and therefore natural seasonal/temporal variation in chlorophyll-a concentrations potentially accounted for higher concentrations in 2017. The benthic invertebrate community of CLT2 exhibited significantly lower density and richness, and significantly different composition, than Unnamed Reference Creek in 2017, but these differences appeared to be related to natural habitat differences between watercourses. This was supported by the occurrence of significantly higher relative abundance of metal-sensitive chironomids at CLT2 than at the reference creek in 2017. In addition, no ecologically significant differences in benthic invertebrate community endpoints were consistently indicated at CLT2 between years of mine operation and the 2007 baseline study with the exception of higher Simpson's Evenness following commencement of commercial mine operation. Because high Simpson's Evenness is normally associated with a more diverse, healthy benthic invertebrate community, the occurrence of significantly higher Simpson's Evenness at the CLT2 upstream study area in years of mine operation compared to 2007 was not consistent with an adverse influence related to recent mine operations. Collectively, similar to the findings of the two previous CREMP studies, the chlorophyll-a and benthic invertebrate community data indicated no adverse mine-related effects to biota of CLT2 in 2017.

3.3 Camp Lake (JLO)

3.3.1 Hydraulic Retention Time

A hydraulic retention time of 416 ± 184 days was estimated for Camp Lake using mean annual watershed runoff (2007 – 2016 data) extrapolated from CLT1 and CLT2 flow monitoring stations (Stations H05 and H04, respectively) and a lake volume of 27.5 million cubic metres (from NSC 2015b).

3.3.2 Water Quality

In situ water quality profiles conducted at Camp Lake showed no substantial spatial differences in water temperature, dissolved oxygen, pH, or specific conductance with progression from the CLT1 inlet to the lake outlet during any of the winter, summer, or fall seasonal sampling events in 2017 (Appendix Figures C.3 - C.6). The 2017 Camp Lake water temperature profiles showed a slight increase in temperature with depth (i.e., <2˚C) during the winter sampling event, and a weakly stratified condition marked by a thermocline at the 20 – 23 m depth during fall sampling that mirrored the fall temperature profile pattern at Reference Lake 3 (Figure 3.8). On average, water temperature near the bottom of the water column at littoral and profundal stations of Camp Lake was cooler than at Reference Lake 3 (Figure 3.9; Appendix Tables C.24 – C.25). Although bottom water temperatures at Camp Lake littoral stations differed significantly from respective

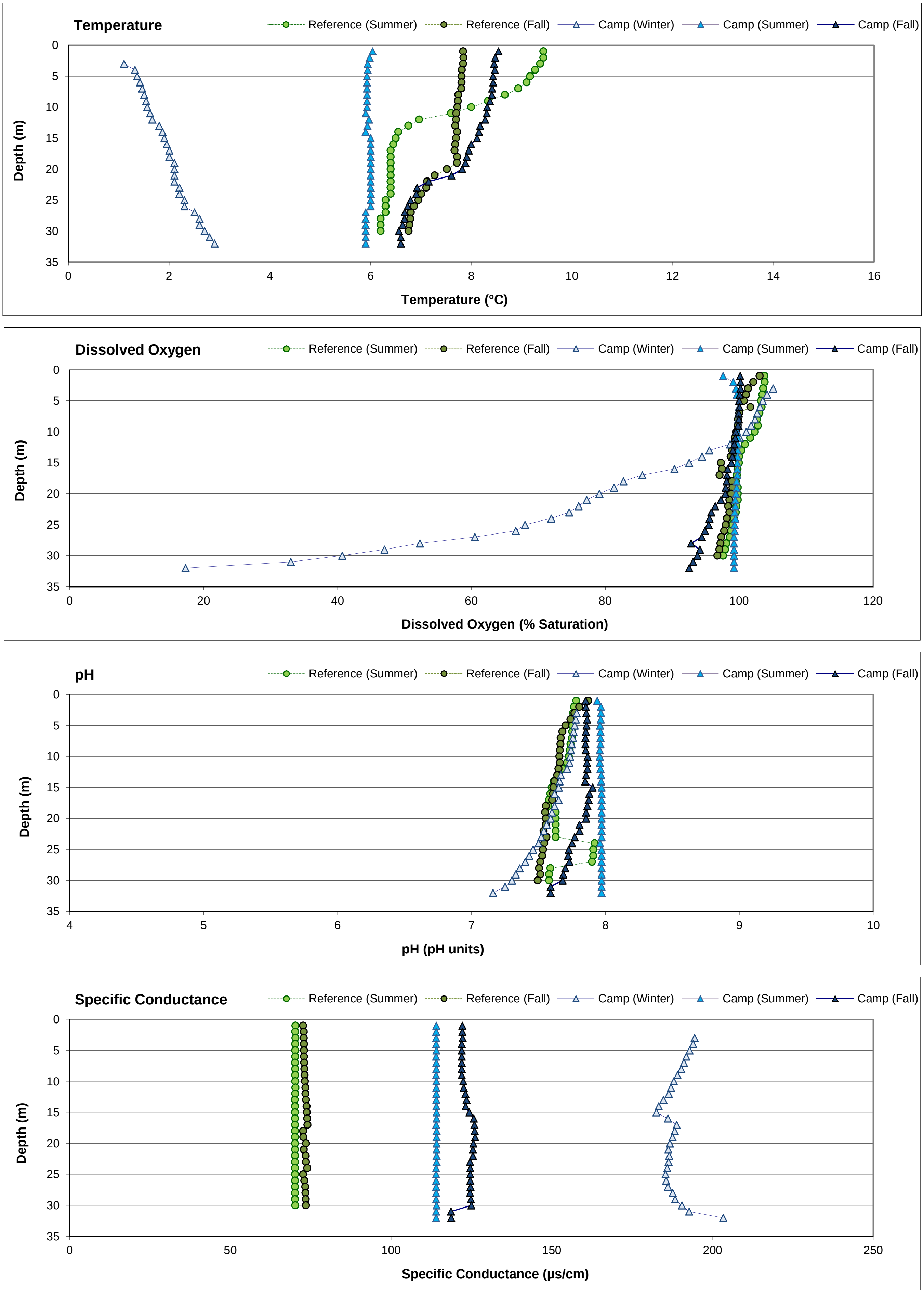


Figure 3.8: Average *In Situ* Water Quality with Depth from Surface at Camp Lake (JLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2017

stations at Reference Lake 3, the small incremental difference in water temperature (i.e., 0.4˚C) was unlikely to result in meaningful ecological differences between lakes.

Dissolved oxygen profiles conducted at Camp Lake in 2017 showed declining saturation levels with increased depth beginning at approximately 11 m below surface in the winter, but showed no appreciable changes from surface to bottom during summer or fall 2017, reflecting the dissolved oxygen profiles at Reference Lake 3 (Figure 3.8) and observations from Camp Lake in 2015 and 2016. Dissolved oxygen conditions near the bottom of the water column at littoral and profundal sampling depths of Camp Lake were generally fully saturated, and did not differ significantly from those at Reference Lake 3 during fall sampling in 2017 (Figure 3.9; Appendix Table C.25). In addition, dissolved oxygen concentrations/saturation levels at Camp Lake were well above the WQG minimum for the protection of sensitive stages of cold water biota (i.e., 9.5 mg/L or 54%, respectively) during all seasonal sampling events in 2017 except at water depths greater than approximately 30 m in winter (Figures 3.8 and 3.9). This suggested that dissolved oxygen concentrations were not likely to be limiting to biota at Camp Lake for the entire lake volume for the majority of the year.

In situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of the Camp Lake water column, indicating the absence of chemical stratification (Figure 3.8). Although the bottom pH at littoral and profundal stations of Camp Lake was significantly higher than at the reference lake during the fall sampling event (Appendix Table C.25), the mean incremental difference between lakes was very small (i.e., 0.5 pH units) and all pH values were consistently within WQG limits (Figure 3.9). Specific conductance was significantly higher at Camp Lake compared to the reference lake during fall sampling in 2017 (Figure 3.9). However, because mean specific conductance at Camp Lake was intermediate to that of the reference creek and river stations (i.e., range from 55 – 168 µS/cm), the occurrence of higher specific conductance at Camp Lake compared to the reference lake likely reflected natural phenomena. Secchi depth readings, which served as a proxy for water clarity, were significantly lower (i.e., shallower) at Camp Lake compared to Reference Lake 3 during the 2017 fall sampling event (Appendix Table C.25; Appendix Figure C.7). No spatial gradient in Secchi depth readings was apparent with progression from the CLT inlet to the lake outlet stations in fall 2017 at Camp Lake (Appendix Table C.23).

Water chemistry data collected at Camp Lake in 2017 showed no distinct spatial differences with progression from the CLT inlets to the lake outlet during any of the winter, summer, or fall sampling events (Table 3.6; Appendix Table C.26), suggesting that the lake waters were well mixed laterally. Slight elevation (i.e., 3- to 5-fold higher) in chloride and total manganese concentrations was evident at Camp Lake compared to the reference lake during the summer 2017 sampling

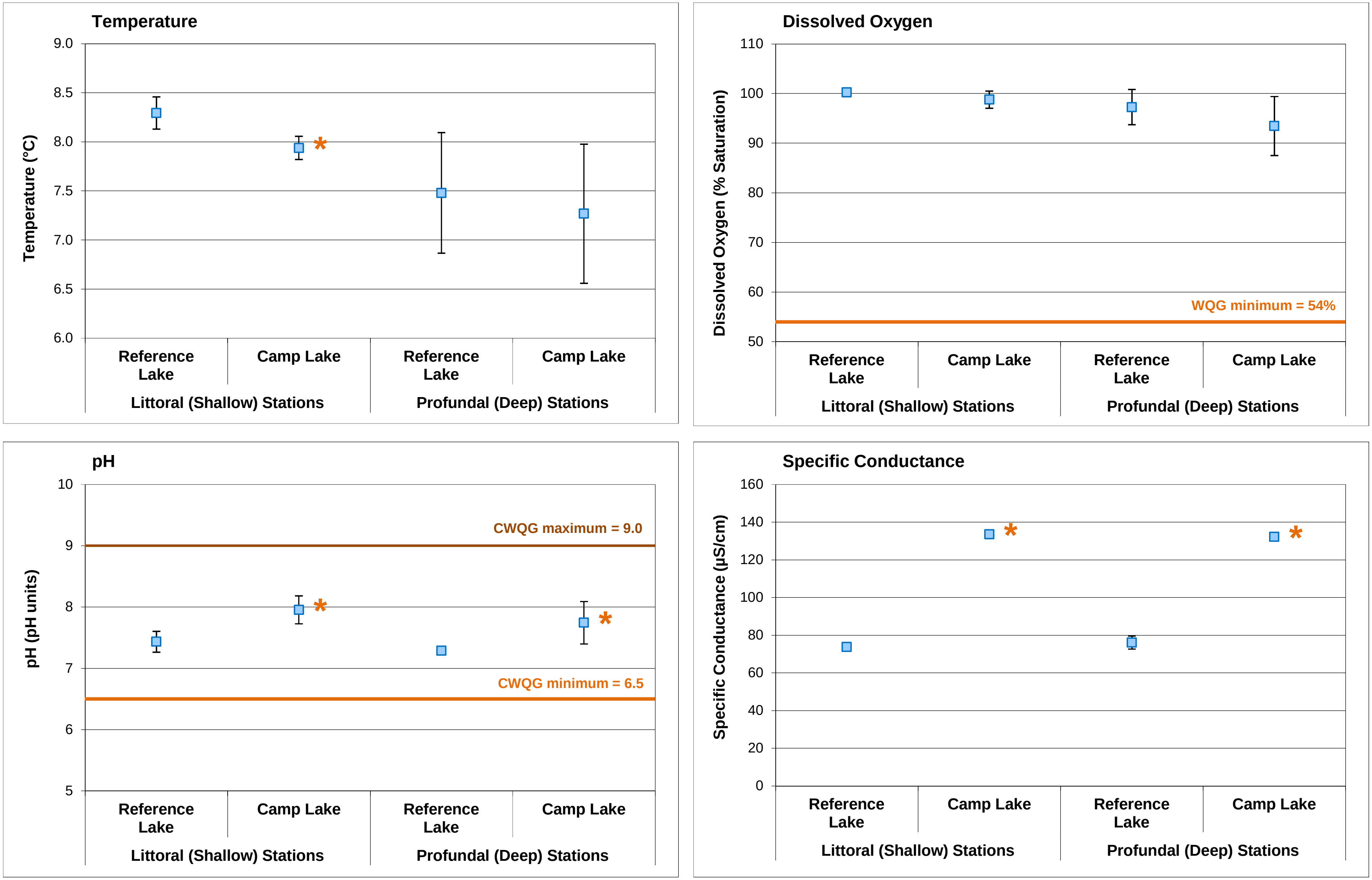


Figure 3.9: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Camp Lake (JLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

Table 3.6: Water Chemistry at Camp Lake (JLO) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2017

	Parameters	Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	Camp Lake Stations					
						JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	J0-01 Camp Lake Outlet
					Fall 2017	26-Aug-17	25-Aug-17	26-Aug-17	26-Aug-17	25-Aug-17	1-Sep-17
Conventionals	Conductivity (lab)	umho/cm	-	-	76	140	140	140	140	140	139
	pH (lab)	pH	6.5 - 9.0	-	7.76	8.05	8.06	8.06	7.97	8.02	8.02
	Hardness (as $CaCO_3$)	mg/L	-	-	35	68	66	67	66	66	66
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	33	61	59	64	62	59	69
	Turbidity	NTU	-	-	0.69	0.51	0.76	0.47	0.42	0.67	0.67
	Alkalinity (as $CaCO_3$)	mg/L	-	-	31	66	63	64	66	64	66
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.020	<0.020	<0.020	<0.020	0.026	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.8	1.8	1.8	1.7	1.7	1.7
	Total Organic Carbon	mg/L	-	-	2.8	1.8	1.8	1.7	1.7	1.8	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.0040	0.0052	<0.0030	0.0053	0.0058	<0.0030	0.0051
	Phenols	mg/L	0.004[α]	-	0.0020	0.0019	<0.0010	<0.0010	0.0013	0.0010	0.0019
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	3.6	3.6	3.2	3.7	3.5	3.7
	Sulphate (SO_4)	mg/L	218[β]	218	4.0	2.8	2.8	2.5	2.9	2.8	3.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0045	0.0055	0.0045	0.0053	0.0053	0.0050	0.0047
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0066	0.0063	0.0065	0.0064	0.0065	0.0065
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.9	13.6	13.4	13.3	13.3	13.2	13.2
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00079	0.00082	0.00082	0.00097	0.00081	0.00084	0.00083
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.057
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0015	0.0013	0.0014	0.0013	0.0013	0.0012
	Magnesium (Mg)	mg/L	-	-	4.4	8.5	8.4	8.4	8.3	8.2	8.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.00063	0.00171	0.00164	0.00166	0.00174	0.00172	0.00277
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00012	0.00029	0.00029	0.00029	0.00028	0.00029	0.00030
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00059	0.00057	0.00059	0.00059	0.00057	0.00075
	Potassium (K)	mg/L	-	-	0.9	1.1	1.1	1.1	1.1	1.1	1.1
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.41	0.32	0.32	0.33	0.36	0.32	0.34
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.8	1.4	1.4	1.4	1.4	1.4	1.4
	Strontium (Sr)	mg/L	-	-	0.0078	0.0102	0.0101	0.0100	0.0100	0.0100	0.0099
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<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
	Uranium (U)	mg/L	0.015	-	0.00025	0.00072	0.00070	0.00070	0.00069	0.00070	0.00077
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data (2006 - 2013) specific to Camp Lake.

(shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the applicable AEMP benchmark.

event, but no parameters were elevated at Camp Lake compared to the reference lake in fall 2017 (Table 3.6; Appendix Table C.27). However, evaluation of dissolved manganese indicated comparable concentrations between Camp Lake and the reference lake during the summer and fall sampling events in 2017. Concentrations of total manganese, together with total aluminum, showed a significant positive correlation with turbidity at Camp Lake using all 2017 data (r = 0.69 and 0.66, respectively; Appendix Table C.28), suggesting that these metals were associated with suspended particulate material in Camp Lake and thus were unlikely to be bioavailable. Notably, concentrations of all parameters were well below established WQG and AEMP benchmarks at Camp Lake during all sampling events in 2017 (Table 3.6; Appendix Table C.26), further indicating that parameter concentrations at Camp Lake were unlikely to adversely affect biota.

Temporal comparisons of Camp Lake water chemistry data indicated that, of the parameters shown to be elevated at CLT1 in 2017, only conductivity and total concentrations of chloride, molybdenum, sodium, and less so, strontium and uranium, showed continuous increases over the mine baseline, construction and operational periods (Figure 3.10; Appendix Figure C.8). Other parameters, including hardness, iron, manganese, nitrate, and sulphate, showed no consistent direction of change between the mine baseline and operational periods. Notably, all parameter concentrations were consistently well below WQG and AEMP benchmarks through all years of mine construction and operation at Camp Lake (e.g., Appendix Table C.26).

3.3.3 Sediment Quality

Surficial sediment (i.e., top 2 cm) collected at the Camp Lake coring stations in 2017 was composed mainly of sandy loam with low total organic carbon (TOC) content, except at Stations JLO-12 and JLO-16 where sand constituted the predominant substrate material (Figure 3.11). A surficial and/or sub-surface layer of oxidized material (likely iron hydroxide or oxy-hydroxides), visible as reddish-orange to orange-brown substrate, was commonly observed in sediments of Camp Lake (Appendix Table D.13). Similar substrate was observed at Reference Lake 3 (Appendix Table D.3), suggesting the natural occurrence of iron (oxy)hydroxides in the sediment of lakes within the mine local study area. Substrates of Camp Lake exhibited minor, sporadic blackening at sediment depths greater than 2 cm at some stations, suggesting occasional incidence of reducing conditions within substrates of the lake. However, no strongly defined redox boundaries were identified visually, and no noticeable sulphidic odours potentially associated with reducing sediment conditions were detected at Camp Lake littoral and profundal stations in 2017. Qualitative observations suggestive of reducing sediment conditions were similar between Camp Lake and Reference Lake 3 in 2017 (Appendix Tables D.3 and D.13), which indicated that factors leading to reduced sediment conditions were comparable between lakes.

Figure 3.10: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015 - 2017) Periods During Fall

Notes: Values represent mean (± SD) of surface and bottom measures. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake.

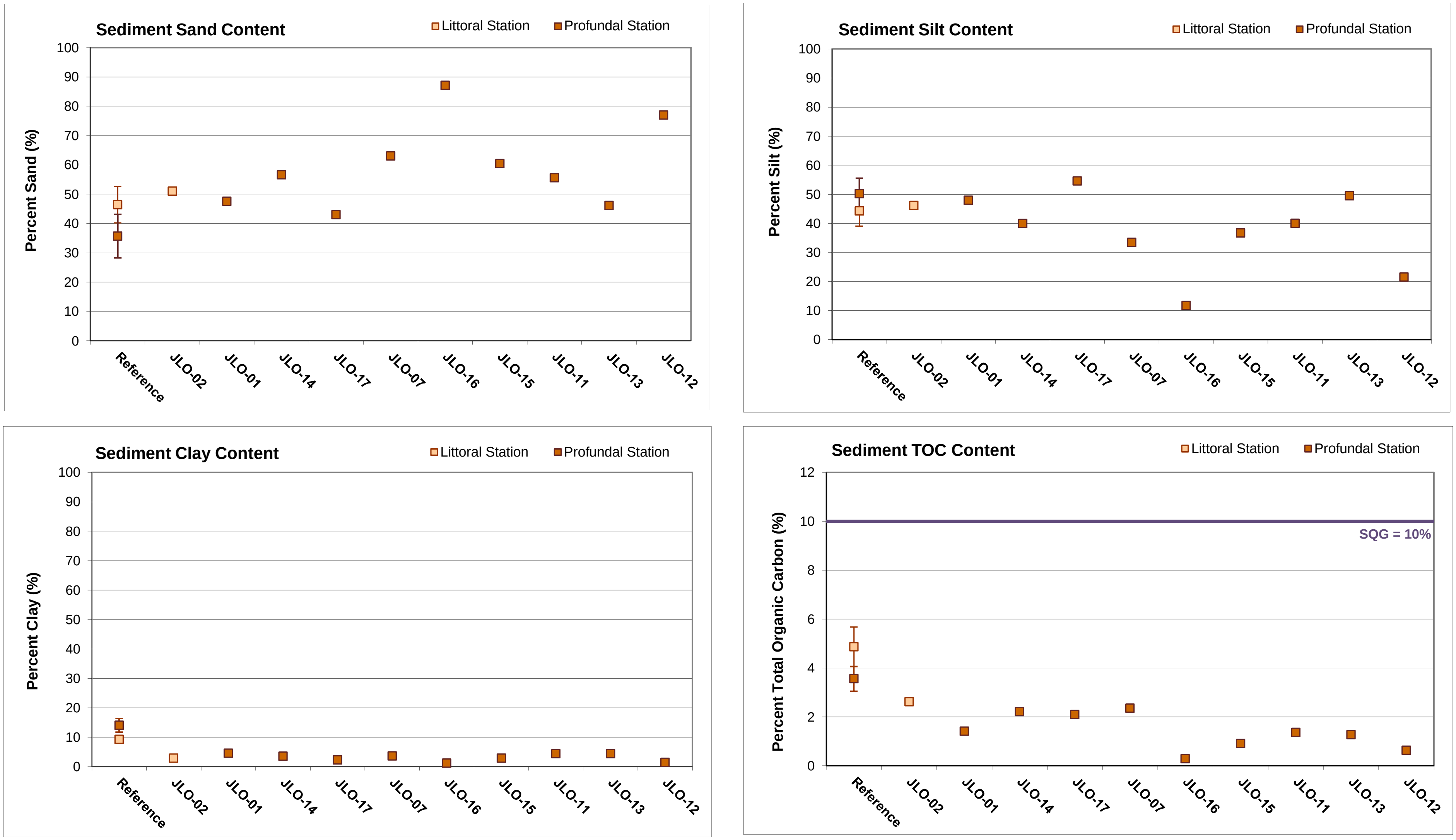


Figure 3.11: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Camp Lake (JLO) Sediment Monitoring Stations and to Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2017

No spatial gradients in sediment metal concentrations were evident with progression from stations located nearest to the CLT1 inlet to those located near the outlet of Camp Lake in 2017 (Appendix Table D.15). Arsenic and manganese concentrations were slightly elevated (i.e., 3- to 5-fold higher) at the single Camp Lake littoral station (i.e., Station JLO-02) compared to sediment at Reference Lake 3 littoral stations (Table 3.7; Appendix Table D.16). Manganese, iron, and nickel concentrations were above respective SQG, and arsenic, iron, nickel, and phosphorus were above respective AEMP benchmarks at the Camp Lake littoral station (Table 3.7). Of these metals, average iron concentrations were also above SQG in littoral sediment of Reference Lake 3 (Table 3.7). Because Camp Lake littoral station JLO-02 is located near the inlet from CLT1, this suggested that mine-influenced flow from this tributary potentially contributed to elevation of the metals indicated above in sediment at this location. Notably, metal concentrations were considerably higher in sediment of Camp Lake than in deposited sediment at either of the Camp Lake tributary study areas (Appendix Table D.18), reflecting the depositional nature of Camp Lake versus erosional characteristics of the tributaries. Metal concentrations in the profundal sediment of Camp Lake were comparable to those of the reference lake in 2017 (Table 3.7; Appendix Table D.16). Although mean iron and manganese concentrations were above respective SQG at Camp Lake profundal stations, mean concentrations of these metals in profundal sediment of Reference Lake 3 were also above SQG in 2017 (Table 3.7) indicating naturally high concentrations of iron and manganese in sediment of lakes in the mine local study area. On average, only arsenic concentrations were above applicable AEMP benchmarks in profundal sediment of Camp Lake in 2017 (Table 3.7).

Temporal comparisons indicated that average metal concentrations in sediment at Camp Lake littoral and profundal stations were comparable between 2017 and the baseline period for each respective station type, the only exception of which was slightly higher (i.e., 3- to 5-fold greater) arsenic concentrations in sediment at the single Camp Lake littoral station in 2017[6] (Figure 3.12; Appendix Table D.16). Average metal concentrations in sediment at Camp Lake littoral and profundal stations in 2017 were typically within the range of those observed from 2015 and 2016, with no consistently higher concentrations occurring that would suggest an increasing trend since the commencement of commercial mine operations (Figure 3.12; Appendix Table D.18). Notably, sediment metal concentrations at Camp Lake in 2017 were very similar to those measured in 2015, when the same station locations were sampled (Figure 3.12). Overall, with the exception of a step-increase in arsenic concentrations shown at the littoral station closest to the CLT1 inlet

[6] Reported sediment boron concentrations in 2015, 2016 and 2017 were considerably higher (i.e., 10- to 70-fold) than those reported during both the baseline and 2014 studies at all mine-exposed lakes. The lack of any distinct gradient in the magnitude of the elevation in boron concentrations among stations within each lake and among study lakes suggested that the stark contrast in boron concentrations between recent data and data collected prior to 2015 was likely due to laboratory-based analytical differences.

Table 3.7: Sediment Total Organic Carbon and Metal Concentrations at Camp Lake (JLO) and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2017

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations		Profundal Stations	
					Reference Lake (n = 5)	Camp Lake (n = 1)	Reference Lake (n = 5)	Camp Lake (n = 9)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Total Organic Carbon		%	10^{α}	-	4.87 ± 0.81	1.32 ± 0.52	3.60 ± 0.52	1.39 ± 0.24
Metals	Aluminum (Al)	mg/kg	-	-	14,720 ± 736	15,000 ± 0	22,140 ± 1,652	13,908 ± 1,501
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	0.13 ± 0.00	<0.10 ± 0.00	<0.10 ± 0
	Arsenic (As)	mg/kg	17	5.9	3.35 ± 0.64	***9.92*** ± 0.00	4.80 ± 0.20	***6.68*** ± 1.98
	Barium (Ba)	mg/kg	-	-	113 ± 10	163 ± 0	138 ± 7	90 ± 19
	Beryllium (Be)	mg/kg	-	-	0.57 ± 0.02	0.80 ± 0.00	0.85 ± 0.06	0.75 ± 0.08
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.28 ± 0.00	<0.20 ± 0.00	0.25 ± 0.02
	Boron (B)	mg/kg	-	-	12.1 ± 0.8	16.8 ± 0.0	16.6 ± 1.5	18.6 ± 1.9
	Cadmium (Cd)	mg/kg	3.5	1.5	0.182 ± 0.032	0.203 ± 0.000	0.179 ± 0.024	0.133 ± 0.018
	Calcium (Ca)	mg/kg	-	-	4,656 ± 362	4,560 ± 0	5,262 ± 377	5,101 ± 1,247
	Chromium (Cr)	mg/kg	90	98	51.1 ± 3.7	69.1 ± 0.0	70.2 ± 6.3	62.4 ± 5.5
	Cobalt (Co)	mg/kg	-	-	10.63 ± 0.79	21.30 ± 0.00	15.98 ± 1.14	15.97 ± 1.86
	Copper (Cu)	mg/kg	110^{α}	50	***64.7*** ± 5.3	44.5 ± 0.0	***88*** ± 8.5	37.5 ± 4.7
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	52,400	41,960 ± 8,713	***61,600*** ± 0	46,740 ± 3,447	42,100 ± 8,092
	Lead (Pb)	mg/kg	91	35	12.4 ± 0.6	17.5 ± 0.0	16.9 ± 1.0	16.3 ± 2.1
	Lithium (Li)	mg/kg	-	-	24.0 ± 0.9	26.2 ± 0.0	35.0 ± 2.1	25.1 ± 2.8
	Magnesium (Mg)	mg/kg	-	-	10,256 ± 714	13,800 ± 0	14,660 ± 1,126	12,373 ± 742
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	4,370	639 ± 115	1,960 ± 0	1,266 ± 70	1,465 ± 512
	Mercury (Hg)	mg/kg	0.486	0.17	0.0440 ± 0.0081	0.0483 ± 0.0000	0.0528 ± 0.0089	0.0327 ± 0.0064
	Molybdenum (Mo)	mg/kg	-	-	3.50 ± 0.97	2.29 ± 0.00	2.90 ± 0.20	1.35 ± 0.49
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	72	38.2 ± 2.4	***77.0*** ± 0.0	49.3 ± 3.0	57.6 ± 4.8
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	1,580	1,039 ± 246	***1,690*** ± 0	1,073 ± 54	1,377 ± 301
	Potassium (K)	mg/kg	-	-	3,754 ± 212	3,670 ± 0	5,694 ± 366	3,691 ± 402
	Selenium (Se)	mg/kg	-	-	0.61 ± 0.12	0.46 ± 0.00	0.59 ± 0.12	0.34 ± 0.05
	Silver (Ag)	mg/kg	-	-	0.13 ± 0.01	0.12 ± 0.00	0.20 ± 0.03	0.12 ± 0.01
	Sodium (Na)	mg/kg	-	-	284.2 ± 21	174 ± 0	410 ± 36	197 ± 32
	Strontium (Sr)	mg/kg	-	-	10.0 ± 0.5	8.1 ± 0.0	12.7 ± 0.8	10.8 ± 1.3
	Thallium (Tl)	mg/kg	-	-	0.346 ± 0.036	0.458 ± 0.000	0.657 ± 0.038	0.374 ± 0.047
	Tin (Sn)	mg/kg	-	-	2.1 ± 0.1	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
	Titanium (Ti)	mg/kg	-	-	997 ± 51	884 ± 0	1,288 ± 56	744 ± 62
	Uranium (U)	mg/kg	-	-	11.0 ± 1.0	5.43 ± 0.0	23.5 ± 2.3	4.31 ± 0.6
	Vanadium (V)	mg/kg	-	-	47.8 ± 2.0	57.0 ± 0.0	67.2 ± 3.9	50.4 ± 5.2
	Zinc (Zn)	mg/kg	315	135	67.32 ± 2.5	57.6 ± 0.0	91 ± 6.8	47.7 ± 5.1
	Zirconium (Zr)	mg/kg	-	-	3.9 ± 0.4	6.6 ± 0.0	3.4 ± 0.1	4.6 ± 0.5

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013). The indicated values are specific to Camp Lake.

(shaded) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

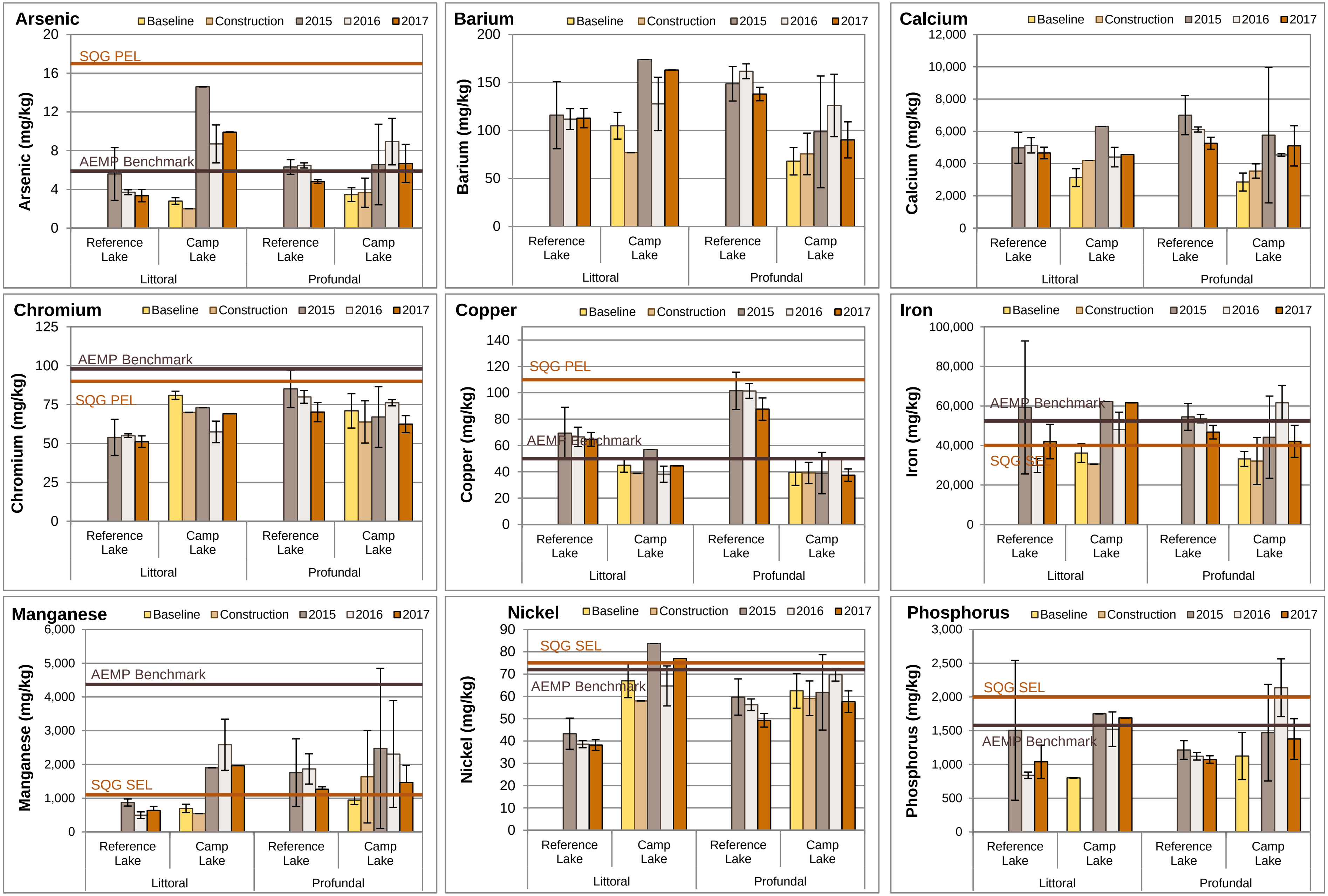


Figure 3.12: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Camp Lake and Reference Lake 3 for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015, 2016, and 2017) Periods, Mary River Project CREMP, 2017

to Camp Lake in 2015, and taking reference lake data into consideration, no substantial changes to sediment metal concentrations were indicated at Camp Lake littoral and profundal stations following the commencement of Baffinland commercial mine operations in 2015.

3.3.4 Phytoplankton

Camp Lake chlorophyll-a concentrations showed no clear spatial gradients with distance from the CLT1 inlet to the lake outlet stations during any of the winter, summer, or fall sampling events in 2017, although concentrations were somewhat lower at stations located nearer the lake outlet during the winter sampling event (Figure 3.13). Chlorophyll-a concentrations did not differ significantly between summer and fall sampling events, but concentrations during both of these sampling events were each significantly higher than during the winter sampling event at Camp Lake in 2017 (Appendix Table E.6). On average, chlorophyll-a concentrations at Camp Lake were significantly higher than at Reference Lake 3 during the summer and fall sampling events (Appendix Tables E.7 and E.8), suggesting greater phytoplankton density at Camp Lake. However, the Camp Lake chlorophyll-a concentrations were consistently well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events in 2017 (Figure 3.13). Camp Lake mean chlorophyll-a concentrations in 2017 suggested low phytoplankton productivity and an ‘oligotrophic’ trophic status based on comparison to Wetzel (2001) lake classification using chlorophyll-a concentrations. This trophic status classification was also consistent with an ultra-oligotrophic to oligotrophic CWQG categorization for Camp Lake based on mean aqueous total phosphorus concentrations below 10 µg/L during all 2017 lake sampling events (Table 3.4; Appendix Table C.26).

Temporal comparisons of the Camp Lake chlorophyll-a data did not indicate any consistent significant differences among the mine construction (2014) and operational (2015, 2016, 2017) years for seasonal data collected in winter, summer, and fall (Figure 3.14). In addition, annual average chlorophyll-a concentrations did not differ significantly among the most recent four years (Appendix Table E.9), suggesting no changes in the trophic status of Camp Lake since mine operations commenced. No chlorophyll-a baseline (2005 – 2013) data are available for Camp Lake, precluding comparisons to conditions prior to the mine construction period.

3.3.5 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal habitat of Camp Lake compared to like-habitat stations at Reference Lake 3 (Tables 3.8 and 3.9). For both habitat types, the magnitude of difference in density was ecologically meaningful based on a CES_{BIC} outside of ±2 SD_{REF}. Although no significant difference in richness was indicated between lakes at littoral stations, richness was significantly higher at Camp Lake profundal habitat compared to

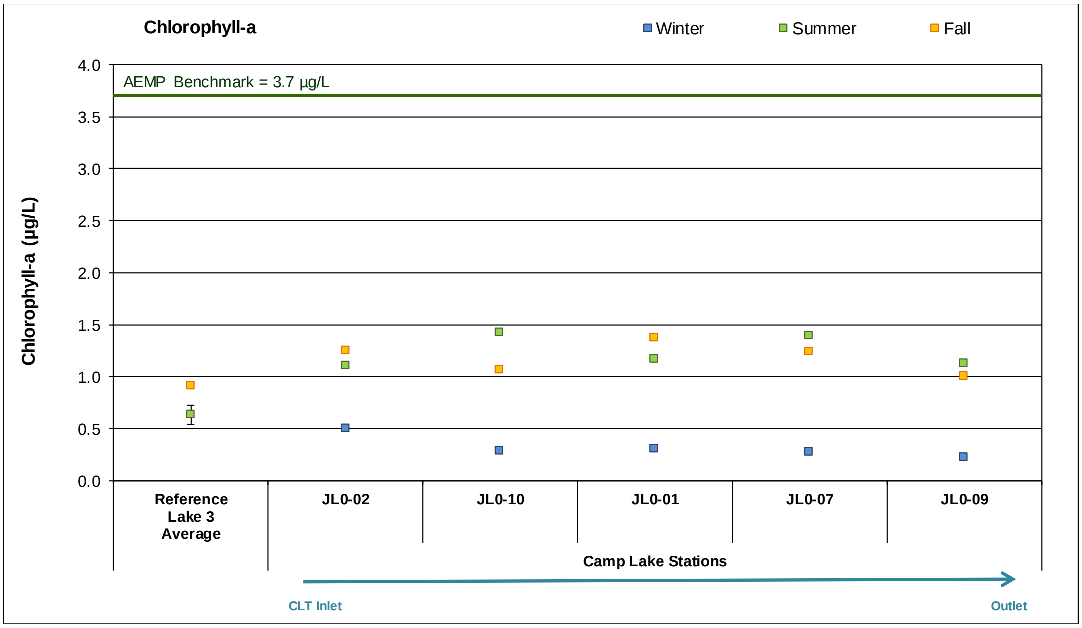


Figure 3.13: Chlorophyll-a Concentrations at Camp Lake (JLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2017

Notes: Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2017.

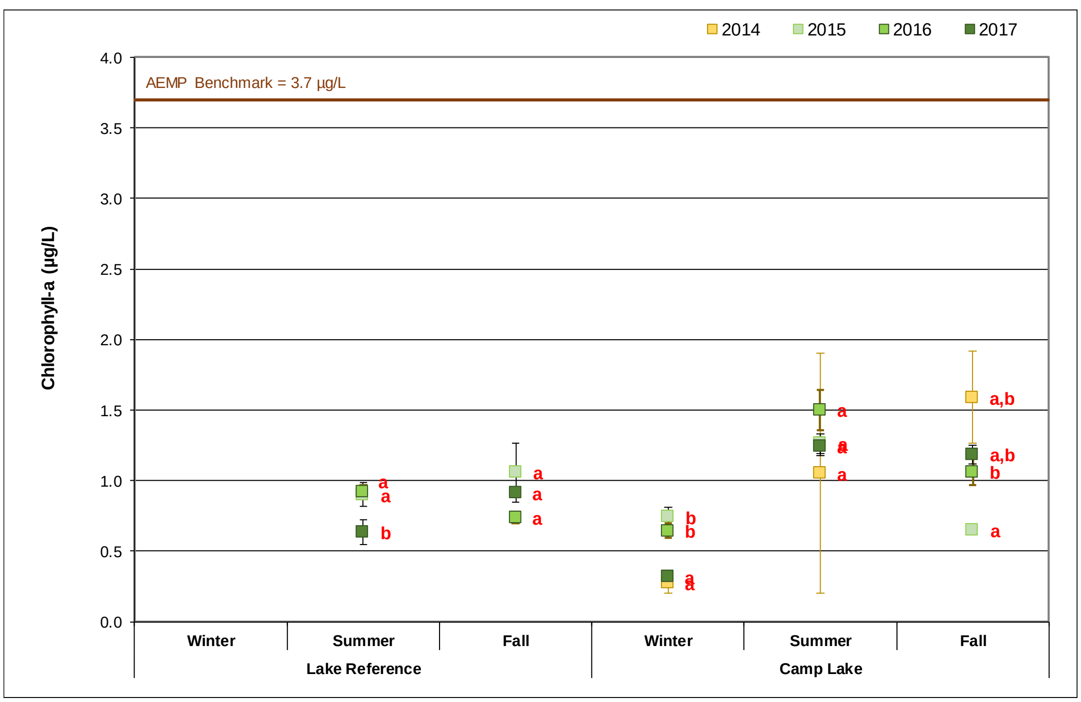


Figure 3.14: Chlorophyll-a Concentration Seasonal Comparison among 2014, 2015, 2016, and 2017 (mean ± SE) at Camp Lake Phytoplankton Monitoring Stations, Mary River Project CREMP

Notes: Data points with the same letter on the right do not differ significantly between years for the applicable season.

Table 3.8: Benthic Invertebrate Community Statistical Comparison Results between Camp Lake (JLO) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	square root	YES	0.018	ANOVA	2.5	Reference Lake 3	1,489	850	380	372	2,618
						Camp Lake Littoral	3,642	1,449	648	2,377	5,790
Richness (Number of Taxa)	log	NO	0.781	ANOVA	0.2	Reference Lake 3	12.4	2.5	1.1	10.0	15.0
						Camp Lake Littoral	12.8	2.3	1.0	10.0	15.0
Simpson's Evenness (E)	none	YES	< 0.001	ANOVA	0.3	Reference Lake 3	0.807	0.142	0.063	0.605	0.934
						Camp Lake Littoral	0.848	0.068	0.031	0.751	0.938
Bray-Curtis Index	none	YES	< 0.001	ANOVA	3.2	Reference Lake 3	0.384	0.120	0.054	0.203	0.536
						Camp Lake Littoral	0.763	0.060	0.027	0.690	0.821
Nemata (%)	square root	NO	0.866	ANOVA	0.1	Reference Lake 3	3.9	3.3	1.5	0.8	9.1
						Camp Lake Littoral	4.2	4.2	1.9	0.0	8.8
Hydracarina (%)	square root	NO	0.173	ANOVA	-0.9	Reference Lake 3	5.3	3.0	1.4	1.8	8.1
						Camp Lake Littoral	2.7	3.4	1.5	0.0	8.6
Ostracoda (%)	square root	YES	< 0.001	ANOVA	-2.1	Reference Lake 3	38.8	18.4	8.2	22.3	63.9
						Camp Lake Littoral	0.2	0.3	0.2	0.0	0.8
Chironomidae (%)	square root	YES	0.003	ANOVA	2.3	Reference Lake 3	51.8	17.9	8.0	29.5	67.9
						Camp Lake Littoral	92.2	6.5	2.9	82.8	98.6
Metal-Sensitive Chironomidae (%)	none	YES	0.049	ANOVA	1.7	Reference Lake 3	15.5	13.4	6.0	0.5	37.0
						Camp Lake Littoral	38.2	17.3	7.7	14.9	53.8
Collector-Gatherers (%)	log	YES	0.056	ANOVA	-1.4	Reference Lake 3	73.9	16.0	7.2	56.0	95.5
						Camp Lake Littoral	50.8	17.4	7.8	34.7	74.7
Filterers (%)	none	YES	0.049	ANOVA	1.7	Reference Lake 3	14.7	13.3	5.9	0.5	36.4
						Camp Lake Littoral	37.3	17.3	7.7	13.4	52.4
Shredders (%)	log(X+1)	NO	0.598	ANOVA	-0.4	Reference Lake 3	4.2	6.6	3.0	0.0	15.9
						Camp Lake Littoral	1.8	1.8	0.8	0.0	4.6
Clingers (%)	none	NO	0.128	ANOVA	1.3	Reference Lake 3	19.8	12.8	5.7	2.7	38.1
						Camp Lake Littoral	36.9	18.4	8.2	7.4	54.3
Sprawlers (%)	log	YES	0.033	ANOVA	-1.8	Reference Lake 3	72.6	13.9	6.2	55.7	92.9
						Camp Lake Littoral	48.1	18.5	8.3	33.4	79.2
Burrowers (%)	log	YES	0.082	ANOVA	2.5	Reference Lake 3	7.5	3.0	1.4	4.5	12.0
						Camp Lake Littoral	15.1	8.0	3.6	5.4	27.5

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value ≤ 0.10.

Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 3.9: Benthic Invertebrate Community Statistical Comparison Results between Camp Lake (JLO) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference[a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	log	YES	< 0.001	ANOVA	42.8	Reference Lake 3	149	32	14	113	190
						Camp Lake Profundal	1,510	844	377	509	2,549
Richness (Number of Taxa)	fourth root	YES	0.002	ANOVA	4.4	Reference Lake 3	4.2	1.5	0.7	2.0	6.0
						Camp Lake Profundal	10.8	3.3	1.5	8.0	16.0
Simpson's Evenness (E)	none	NO	0.791	ANOVA	-0.2	Reference Lake 3	0.704	0.105	0.047	0.597	0.843
						Camp Lake Profundal	0.681	0.154	0.069	0.520	0.861
Bray-Curtis Index	log	YES	< 0.001	ANOVA	5.4	Reference Lake 3	0.239	0.114	0.051	0.111	0.376
						Camp Lake Profundal	0.850	0.128	0.057	0.629	0.949
Nemata (%)	square root	YES	0.017	ANOVA	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0
						Camp Lake Profundal	7.1	6.2	2.8	0.0	12.2
Hydracarina (%)	none	YES	0.065	ANOVA	-1.0	Reference Lake 3	8.2	5.5	2.5	0.0	15.0
						Camp Lake Profundal	2.5	2.2	1.0	0.0	5.3
Ostracoda (%)	log(X+1)	NO	0.264	ANOVA	-0.6	Reference Lake 3	2.8	4.1	1.8	0.0	8.9
						Camp Lake Profundal	0.3	0.6	0.3	0.0	1.4
Chironomidae (%)	log	NO	0.816	ANOVA	0.1	Reference Lake 3	89.0	7.6	3.4	81.6	100.0
						Camp Lake Profundal	90.0	6.6	2.9	82.9	99.2
Metal-Sensitive Chironomidae (%)	square root	YES	0.097	ANOVA	2.4	Reference Lake 3	12.0	8.9	4.0	0.0	20.2
						Camp Lake Profundal	33.3	25.5	11.4	9.7	72.7
Collector-Gatherers (%)	none	NO	0.151	ANOVA	-4.9	Reference Lake 3	84.3	4.1	1.9	79.8	90.5
						Camp Lake Profundal	64.2	28.1	12.6	20.2	88.2
Filterers (%)	none	YES	0.079	ANOVA	2.7	Reference Lake 3	6.5	9.3	4.2	0.0	20.2
						Camp Lake Profundal	31.6	26.4	11.8	8.6	72.7
Clingers (%)	none	YES	0.028	ANOVA	3.7	Reference Lake 3	14.6	4.9	2.2	9.5	20.2
						Camp Lake Profundal	33.1	27.8	12.4	9.0	78.3
Sprawlers (%)	square root	YES	0.021	ANOVA	-4.6	Reference Lake 3	81.4	6.3	2.8	74.8	90.5
						Camp Lake Profundal	52.1	23.7	10.6	14.5	79.3
Burrowers (%)	square root	YES	0.063	t-test (unequal variance)	2.9	Reference Lake 3	3.9	3.7	1.7	0.0	8.0
						Camp Lake Profundal	14.9	8.3	3.7	7.2	28.9

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shaded values indicate statistically significant difference between study areas based on p-value ≤ 0.10.

Blue shaded values indicate significant difference (ANOVA p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

like-habitat at the reference lake by a magnitude outside of the CES_{BIC} of ±2 SD_{REF} (Tables 3.8 and 3.9). In addition to these differences, benthic invertebrate community structure differences were indicated between Camp Lake and Reference Lake 3 by significantly differing Bray-Curtis Index for both littoral and profundal habitat types (Tables 3.8 and 3.9). Higher benthic invertebrate density and richness at Camp Lake compared to the reference lake, which would contribute to the differences in Bray-Curtis Index, was not consistent with adverse influences typically associated with mine operations. This suggested that factors other than metal concentrations likely accounted for the differences in benthic invertebrate community structure between Camp Lake and Reference Lake 3. Notably, for the above general benthic invertebrate community metrics that differed significantly, a greater magnitude of difference was indicated between study lakes for profundal habitat than for littoral habitat (Tables 3.8 and 3.9). In turn, this suggested that habitat variables associated with greater depth likely contributed to more pronounced differences in benthic invertebrate community structure between lakes.

The key differences in benthic invertebrate community structure at magnitudes outside of CES_{BIC} included significantly lower and higher relative abundance of Ostracoda (seed shrimp) and Chironomidae (non-biting midges), respectively, at littoral habitat of Camp Lake compared to the reference lake (Tables 3.8 and 3.9). The relative abundance of metal-sensitive Chironomidae was also significantly higher at Camp Lake than at Reference Lake 3 for both habitat types (Tables 3.8 and 3.9), suggesting that the difference in benthic invertebrate community structure between lakes was unlikely associated with differences in metal concentrations. This was supported by water quality monitoring data that showed aqueous metal concentrations below WQG and AEMP benchmarks at Camp Lake (Appendix Table C.26), and by sediment quality monitoring data that showed sediment metal concentrations were generally below SQG at Camp Lake with the exception of iron and manganese, which were also above SQG at Reference Lake 3 (Table 3.7).

The differences in benthic invertebrate community structure between Camp Lake and Reference Lake 3 were consistent with differences in food resources between lakes. For instance, greater benthic invertebrate density and significantly higher relative abundance of the filterer FFG suggested higher phytoplankton productivity at Camp Lake than at Reference Lake 3, which was supported by observations of significantly lower Secchi depth and significantly higher summer and fall chlorophyll-a concentrations at Camp Lake in 2017 (Appendix Tables C.25, E.7 – E.8). Similarly, significantly lower relative abundance of Ostracoda and the collector-gatherer FFG at Camp Lake compared to the reference lake may have been related to significantly lower sediment TOC (Appendix Table F.21), which serves as a key food source for these groups. These observations suggested that benthic invertebrates of Camp Lake utilize autochthonous food sources (i.e., primary producers) to a greater extent than at Reference Lake 3, and that Camp Lake was naturally more productive than Reference Lake 3.

Temporal comparisons did not indicate any consistent ecologically significant differences in general community descriptors of density, richness, and Simpson's Evenness at littoral and profundal habitats of Camp Lake between the mine baseline (2007, 2013) period and individual years since the commencement of commercial mine operation (2015, 2016, 2017; Figure 3.15; Appendix Tables F.23 and F.24). Similarly, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were indicated between baseline and mine operational years at littoral habitat of Camp Lake (Figure 3.15; Appendix Table F.23). Despite a significantly differing relative abundance of metal-sensitive chironomids and FFG between mine operation year 2015 and the 2007 and 2013 baseline data at profundal habitat of Camp Lake, similar differences were not indicated between 2017 and either of the 2007 or 2013 baseline data (Appendix Table F.24). This indicated that the study-to-study differences in community features at profundal stations of Camp Lake were likely the result of sampling artifacts (e.g., differences in sampling station locations and/or replication among studies) or natural temporal variability among studies unrelated to potential influences from commercial mine operation. Overall, consistent with only minor changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Camp Lake following the commencement of commercial mine operation in 2015.

3.3.6 Fish Population

3.3.6.1 Camp Lake Fish Community

The Camp Lake fish community was represented by arctic charr (*Salvelinus alpinus*) and ninespine stickleback (*Pungitius pungitius*), reflecting the same fish species composition as that observed at Reference Lake 3 in 2017 (Table 3.10). A higher density of arctic charr was suggested at Camp Lake compared to Reference Lake 3 based on both greater electrofishing total catch-per-unit-effort (CPUE) from shallow rocky nearshore habitat, and on greater gill netting CPUE from deeper littoral/profundal habitat at Camp Lake in 2017 (Table 3.10). In turn, this suggested higher fish productivity at Camp Lake compared to Reference Lake 3, and was consistent with chlorophyll-a results which indicated higher phytoplankton productivity at Camp Lake. Ninespine stickleback, which were first recorded in Camp Lake in 2016 (Minnow 2017), appeared to exhibit similar abundance at rocky nearshore habitat of Camp Lake and Reference Lake 3 based on comparable electrofishing CPUE for this species in 2017 (Table 3.10). Camp Lake electrofishing and gill netting CPUE for arctic charr in 2017 were within the range of those observed during baseline (2005 - 2013) studies, as well as to those during the previous two years of mine operation, for each respective collection method (Figure 3.16). In turn, this suggested no

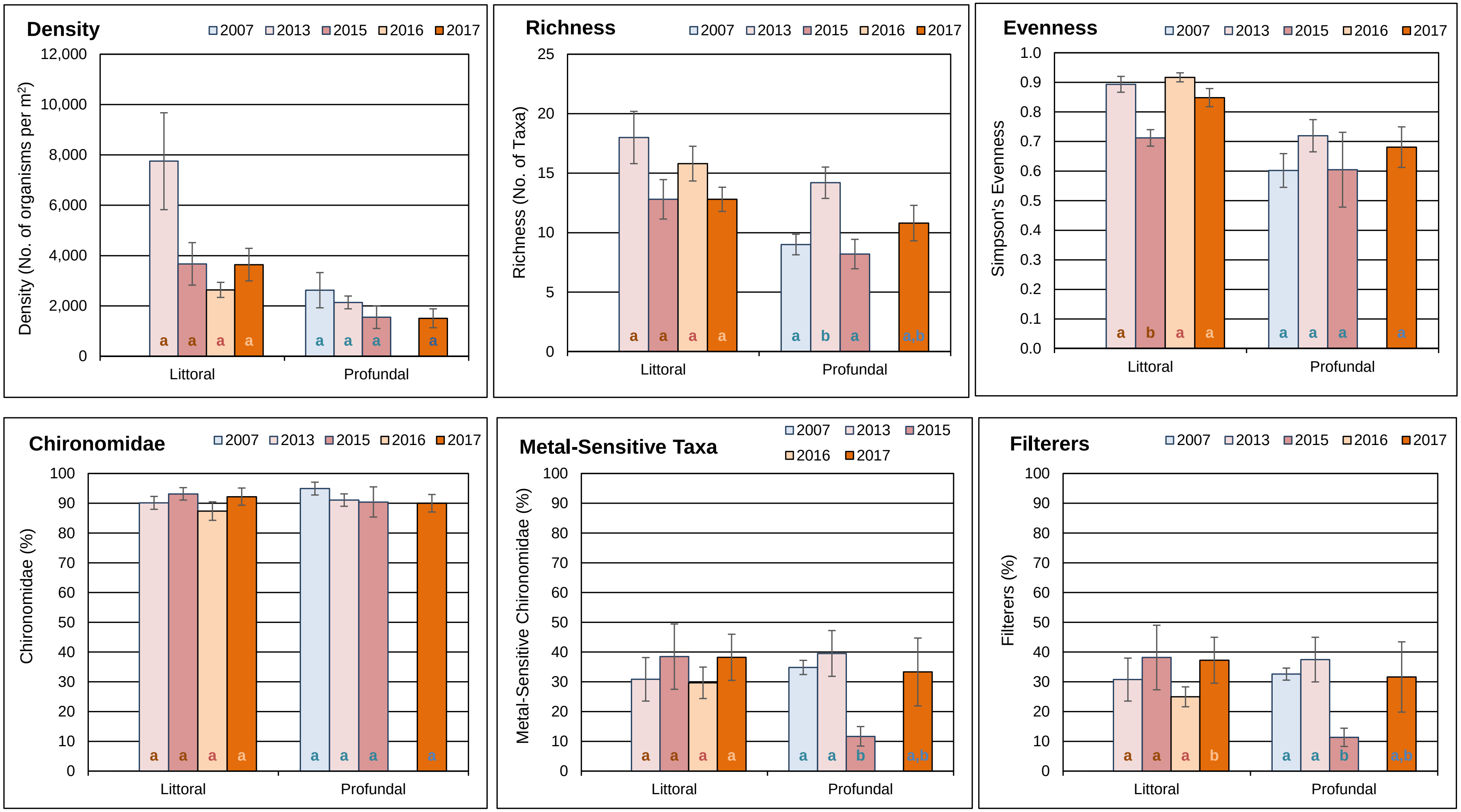


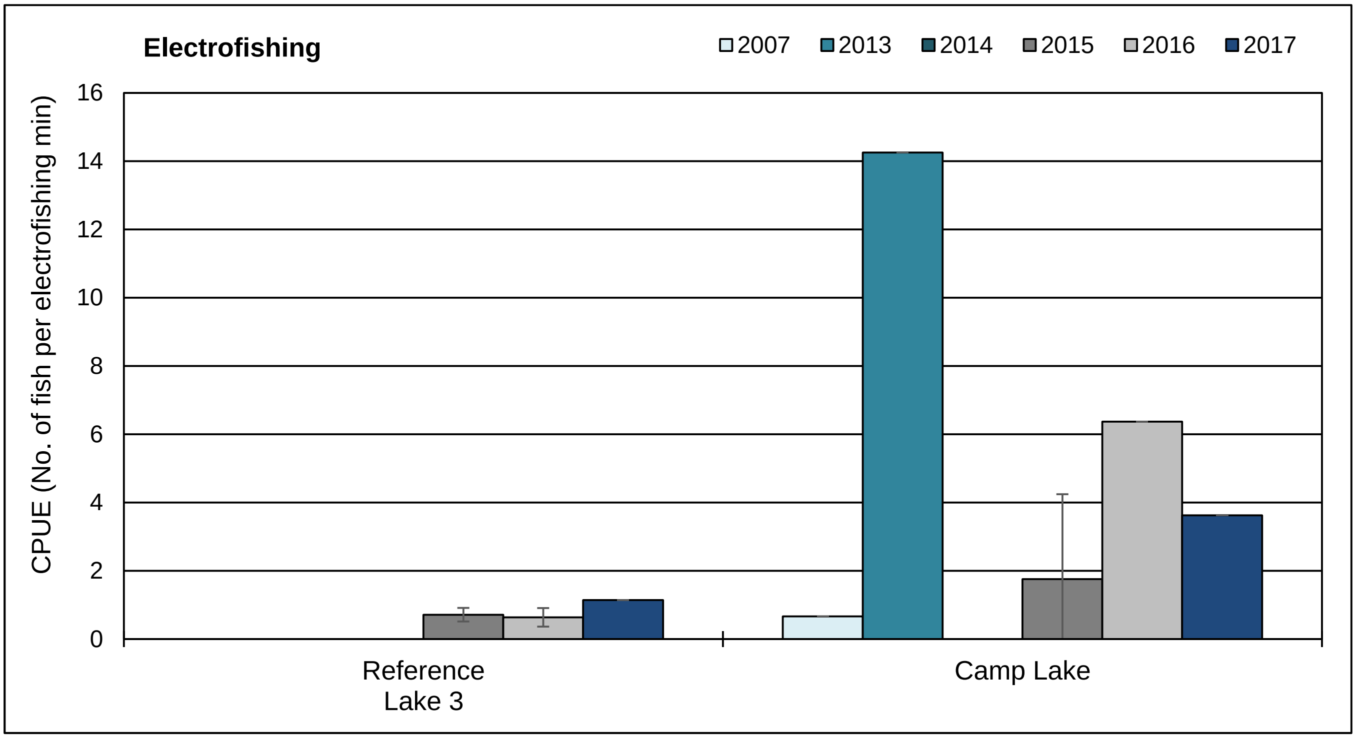
Figure 3.15: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Camp Lake Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

Table 3.10: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	100	11	111	2
		CPUE	1.03	0.11	1.14	
	Gill netting	No. Caught	1	0	1	
		CPUE	0.02	0	0.02	
Camp Lake	Electrofishing	No. Caught	97	4	101	2
		CPUE	3.48	0.14	3.62	
	Gill netting	No. Caught	96	0	96	
		CPUE	1.40	0	1.40	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net.



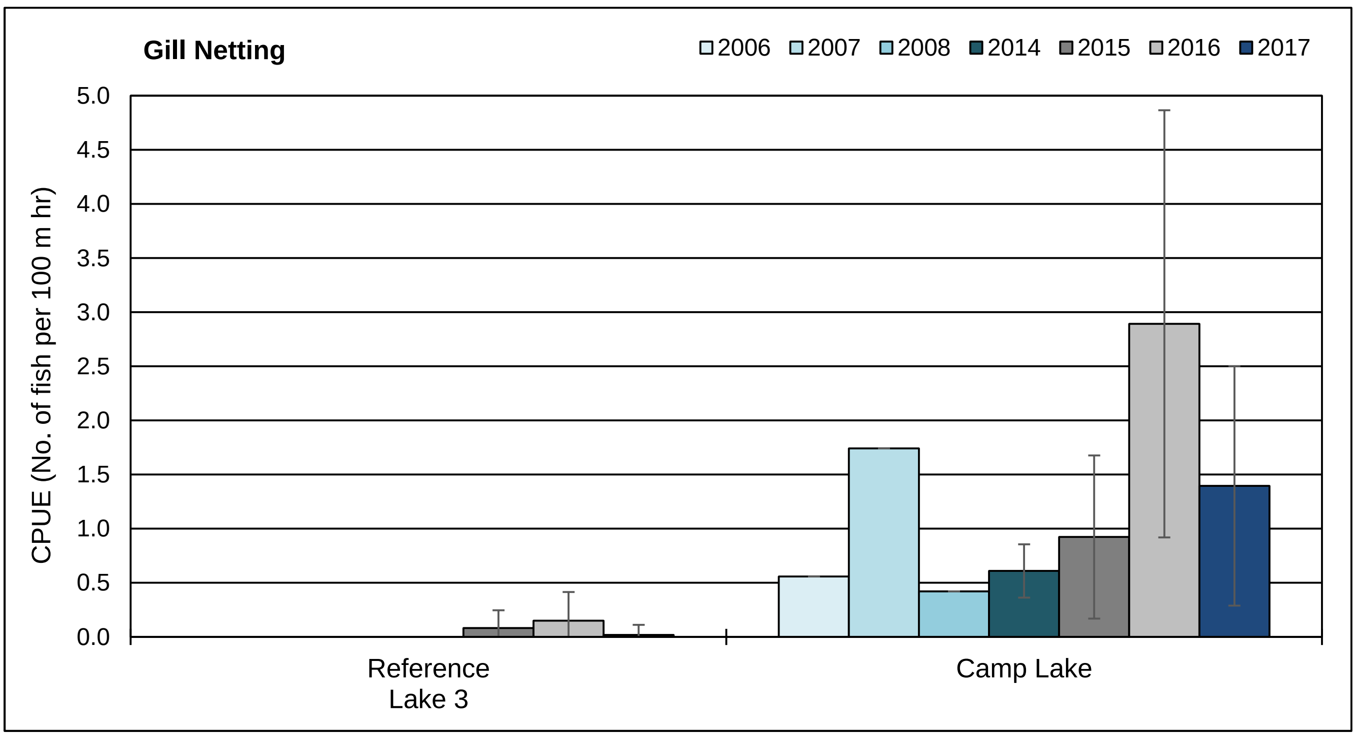


Figure 3.16: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, 2006 - 2017

Note: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015, 2016, 2017) mine phases.

substantial changes in the relative abundance of arctic charr at nearshore or littoral/profundal habitats of Camp Lake compared to the mine baseline period or since the commencement of commercial mine operations in 2015.

3.3.6.2 Camp Lake Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Camp Lake nearshore arctic charr population (i.e., fish captured by electrofishing) were assessed based on a control-impact analysis using 2017 data from Camp Lake and Reference Lake 3, as well as a before-after analysis using Camp Lake 2017 and baseline (2013) data. A total of 97 and 100 arctic charr were captured at nearshore habitat of Camp Lake and Reference Lake 3, respectively, in August 2017, for the control-impact analysis. Young-of-the-year (YOY) were distinguished from older (non-YOY) age classes at a fork length cut-off of 5.0 cm for the Camp Lake and Reference Lake 3 data sets based on the evaluation of length-frequency distributions coupled with supporting age determinations (Figure 3.17). Due to the low number of arctic charr YOY captured at Camp Lake (i.e., two), fish population comparisons were conducted using only non-YOY individuals, where applicable, to limit confounding influences of naturally differing weight-at-length relationships between YOY and non-YOY individuals on data interpretation.

The length-frequency distribution for the nearshore arctic charr differed significantly between Camp Lake and Reference Lake 3 (Table 3.11), reflecting the occurrence of very few YOY and greater numbers of larger individuals captured at Camp Lake (Figure 3.17). Non-YOY arctic charr captured at the Camp Lake nearshore were significantly longer (17%) and heavier (51%) than those captured at the reference lake nearshore (Table 3.11; Appendix Table G.6). However, condition (i.e., weight-at-length relationship) of non-YOY arctic charr did not differ significantly between Camp Lake and the reference lake (Table 3.11; Appendix Table G.6). Consequently, no substantial differences in the overall health of nearshore non-YOY arctic charr was suggested between the Camp Lake and Reference Lake 3 populations in 2017.

Temporal comparisons of the Camp Lake nearshore non-YOY arctic charr data indicated significantly different length-frequency distribution between the 2017 study and the 2013 baseline study (Table 3.11). In addition, non-YOY arctic charr captured at the nearshore of Camp Lake in 2017 were significantly shorter (-35%), lighter (-74%) and of lower condition (-10%) than those captured during the 2013 baseline study (Table 3.8; Appendix Table G.7). Similar differences in nearshore non-YOY arctic charr size and condition were demonstrated in 2015 and 2016 compared to the 2013 baseline data (Table 3.11). In each of the individual 2015, 2016, and 2017 studies, the magnitude of difference in non-YOY arctic charr condition compared to the 2013 baseline data was just within the Critical Effect Size (CES) of ±10% (referred to herein as CES_C;

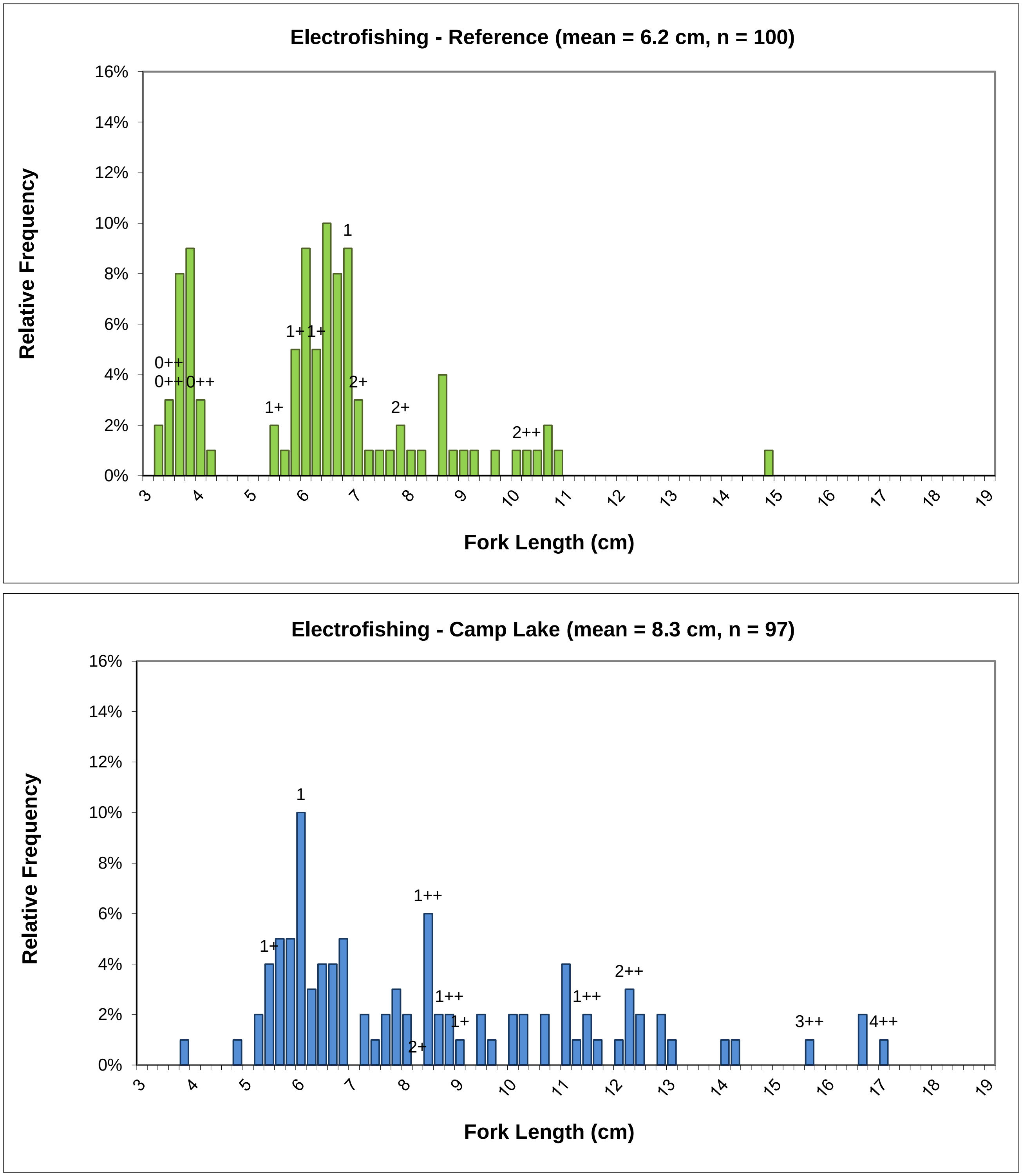


Figure 3.17: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing at Camp Lake (JLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Note: Fish ages are shown above the bars, where available.

Table 3.11: Summary of Statistical Results for Arctic Charr Population Comparisons between Camp Lake and Reference Lake 3 in 2015, 2016, and 2017, and between Camp Lake Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]					
			versus Reference Lake 3			versus Camp Lake baseline period data [b]		
			2015	2016	2017	2015	2016	2017
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	-	-	-
	Energy Use (non-YOY)	Size (mean weight)	**Yes (+176%)**	No	**Yes (+51%)**	**Yes (-42%)**	**Yes (-71%)**	**Yes (-74%)**
		Size (mean fork length)	**Yes (+41%)**	No	**Yes (+17%)**	**Yes (-15%)**	**Yes (-32%)**	**Yes (- 35%)**
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	No	**Yes (-6%)**	No	**Yes (-6%)**	**Yes (-10%)**	**Yes (-10%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**
		Age	-	-	-	**Yes (+48%)**	**Yes (+58%)**	**Yes (+ 46%)**
	Energy Use	Size (mean weight)	-	-	-	No	No	**Yes (+37%)**
		Size (mean fork length)	-	-	-	**Yes (+6%)**	No	**Yes (+12%)**
		Growth (weight-at-age)	-	-	-	No	**Yes (nc)**	No
		Growth (fork length-at-age)	-	-	-	No	**Yes (nc)**	No
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	No	**Yes (-3%)**	No

[a] Values in parentheses indicate direction and magnitude of any significant differences.
[b] Baseline period data included 2013 nearshore electrofishing data and 2006, 2008, and 2013 littoral/profundal gill netting data. nc = non-calculable magnitude.
[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

Table 3.11). This suggested that the differences in non-YOY arctic charr energy use in each year of mine operation compared to the baseline period was within the range of variability expected to occur naturally between years at waterbodies uninfluenced by human activity.

Littoral/Profundal Arctic Charr

Mine-related influences on the Camp Lake littoral/profundal arctic charr population (i.e., fish captured by gill netting) was assessed using a before-after analysis of Camp Lake 2017 versus baseline (combined 2006, 2007, 2008, and 2013) data. Similar to the two previous CREMP studies, despite a total of 96 arctic charr captured by gill netting at littoral/profundal areas of Camp Lake and application of similar fishing effort, the sample size of arctic charr from Reference Lake 3 was very small (i.e., 1) in August 2017, precluding a control-impact analysis for the determination of mine-related effects using the littoral/profundal catch data. Biological information collected from arctic charr mortalities encountered during the 2017 Camp Lake littoral/profundal sampling suggested that 23% of the population was represented by non-spawners of reproductive age (referred to simply as non-spawners herein; Appendix Table G.12). The average age, length, and weight of non-spawners was comparable to that of female spawners (Appendix Table G.12) indicating that, typical of high Arctic systems, individual arctic charr do not spawn yearly at Camp Lake. Liver somatic index (LSI) did not differ significantly between non-spawners and female spawners (ANOVA; $p = 0.22$), suggesting similar energy reserves available for gamete development between these groups. Internal body cavity parasites were present in all arctic charr incidental mortalities (Appendix Table G.12), which could contribute to biennial or longer frequency between spawning events for arctic charr in the mine local study area lakes as a result of lower energy applied towards gamete production stemming from infections with parasites. High incidence of internal parasites in arctic charr of the Mary River Project mine area lakes was noted in baseline studies (NSC 2014, 2015a) as well as in each of the two previous CREMP studies (Minnow 2016a, 2017).

Temporal comparisons of arctic charr data collected from Camp Lake littoral/profundal areas indicated significantly different length-frequency distribution of arctic charr in 2017 compared to the combined baseline data set (i.e., 2006, 2007, 2008, and 2013 studies; Table 3.11). The differences in length-frequency distributions were consistent with the analysis of significantly older arctic charr at Camp Lake in 2017 compared to the baseline period (Table 3.11; Appendix Table G.13). Fork length and fresh body weight were significantly larger in arctic charr captured at Camp Lake in 2017 compared to the baseline period. However, arctic charr of spawning size showed no significant differences in growth or condition between 2017 and the baseline period at Camp Lake (Table 3.11). These results were consistent with those of the two previous CREMP studies, which collectively indicated no ecologically meaningful differences in size, growth, or condition of spawning-sized arctic charr at Camp Lake between the mine operational years and the baseline period.

3.3.7 Integrated Effects Evaluation

Potential mine-related influences on water quality of Camp Lake in 2017 included slightly elevated chloride and manganese concentrations compared to the reference lake, as well as slightly higher conductivity and concentrations of chloride, molybdenum, sodium, and less so, strontium and uranium, compared to 2005 - 2013 baseline data. However, in all cases, parameter concentrations at Camp Lake were consistently well below WQG and AEMP benchmarks in 2015, 2016 and 2017. Sediment arsenic and manganese concentrations were elevated at the single Camp Lake littoral station compared to the reference lake in 2017 and, for arsenic, to concentrations observed during the baseline period. However, no metals were elevated in sediment at Camp Lake profundal stations compared to the reference lake in 2017, nor to concentrations shown in mine baseline studies. Although spatial analysis was limited by the collection of sediment chemistry from only a single littoral station at Camp Lake under the AEMP, elevated metal concentrations at this station suggested that mine-influenced flow from CLT1 was likely the source of these metals. Iron and manganese were observed at concentrations above SQG at the Camp Lake littoral station and on average at profundal stations, but average concentrations of these metals were also above SQG at the reference lake indicating natural elevation of these metals in sediments of regional lakes. Arsenic, iron, nickel, and phosphorus concentrations were above AEMP benchmarks at the littoral station, as was the average arsenic concentration at profundal stations at Camp Lake in 2017. Overall, recent mine operations appeared to contribute to higher chloride, molybdenum, manganese, and sodium concentrations in water, as well as to slightly higher arsenic, nickel, and phosphorus concentrations in sediment of Camp Lake. However, concentrations of these parameters remained below applicable guidelines with the exception of nickel, which was slightly above the SQG at the littoral station, suggesting a low potential for adverse effects to biota of Camp Lake.

Camp Lake chlorophyll-a concentrations were significantly higher than at the reference lake in 2017 suggesting greater primary production at Camp Lake. However, Camp Lake chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Camp Lake since mine operations commenced at the Mary River Project. Benthic invertebrate density, richness, Simpson's Evenness, and relative abundance of metal-sensitive chironomids was higher at Camp Lake than at the reference lake in 2017. In addition, no ecologically significant differences in primary benthic invertebrate community metrics, dominant taxonomic groups, or FFG were consistently indicated between the mine baseline (2007, 2013) period and individual years since the commencement of commercial mine operation (2015, 2016, 2017). Analysis of Camp Lake arctic charr populations suggested greater fish abundance compared to the reference lake in 2017, but similar numbers of arctic charr in 2017 relative to the Camp Lake baseline studies. No significant, ecologically meaningful, differences in arctic charr condition were indicated between Camp Lake and the reference lake in 2017, nor between Camp Lake arctic charr collected in 2017 compared to the baseline period, for nearshore and littoral/profundal arctic charr populations. Collectively, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Camp Lake since the commencement of commercial mine operation at the Mary River Project.

4 SHEARDOWN LAKE SYSTEM

4.1 Sheardown Lake Tributaries (SDLT1, SDLT12 and SDLT9)

4.1.1 Water Quality

Sheardown Lake Tributary 1 (SDLT1) dissolved oxygen (DO) concentrations were consistently near or slightly above saturation in spring, summer, and fall monitoring events in 2017 (Figure 4.1; Appendix Tables C.1 – C.3). Although DO saturation was significantly lower at Sheardown Lake Tributary 9 (SDLT9) than at Unnamed Reference Creek and the other Sheardown Lake tributaries during August 2017 sampling, DO saturation was well above the WQG minimum limit for cold-water biota (i.e., 54%) at all Sheardown Lake tributaries (Figure 4.1; Appendix Tables C.1 – C.3). *In situ* pH was significantly higher at Sheardown Lake Tributary 1 and 12 (SDLT1 and SDLT12, respectively) compared to Unnamed Reference Creek, whereas pH at SDLT9 did not differ significantly from reference conditions during the fall sampling event in 2017. Despite minor differences in pH among the Sheardown Lake tributaries, pH was consistently within WQG limits at each mine-exposed tributary and thus the slight dissimilarity in pH among areas was unlikely to be ecologically meaningful. Specific conductance at each of the Sheardown Lake tributaries was significantly higher than at Unnamed Reference Creek during August 2017 biological sampling (Figure 4.1; Appendix Table C.33). Because specific conductance often serves as an indication of mine-associated influences on water quality (e.g., Environment Canada 2012), these observations suggested a mine-related influence on water quality of the SDLT1, SDLT9, and SDLT12 watercourses.

Sheardown Lake Tributary 1 is the only tributary of the Sheardown Lake system at which routine water quality monitoring is conducted, with one monitoring station established in each of the upper and lower reaches of the tributary (i.e., Stations D1-05 and D1-00, respectively; Figure 2.2). Nitrate, sulphate, and molybdenum concentrations were moderately to highly elevated (i.e., 5- to 10-fold, and ≥10-fold, respectively) at both SDLT1 stations compared to reference creek station mean concentrations at the time of fall sampling (Table 4.1). In addition, slightly elevated (i.e., 3- to 5-fold higher) total concentrations of cadmium were observed at upper SDLT1, and slightly elevated hardness and concentrations of chloride and potassium were observed at lower SDLT1, compared to reference creek stations at the time of fall sampling in 2017 (Table 4.1). Along with the aforementioned parameters, hardness, alkalinity, TDS, and total concentrations of copper, sodium, strontium, and uranium were generally elevated (i.e., ≥3-fold higher) in spring and/or summer at one or both SDLT1 monitoring stations compared to reference creek station mean values during each seasonal sampling event (Appendix Table C.35). Average dissolved copper, manganese, molybdenum, and uranium concentrations were also elevated at SDLT1 compared

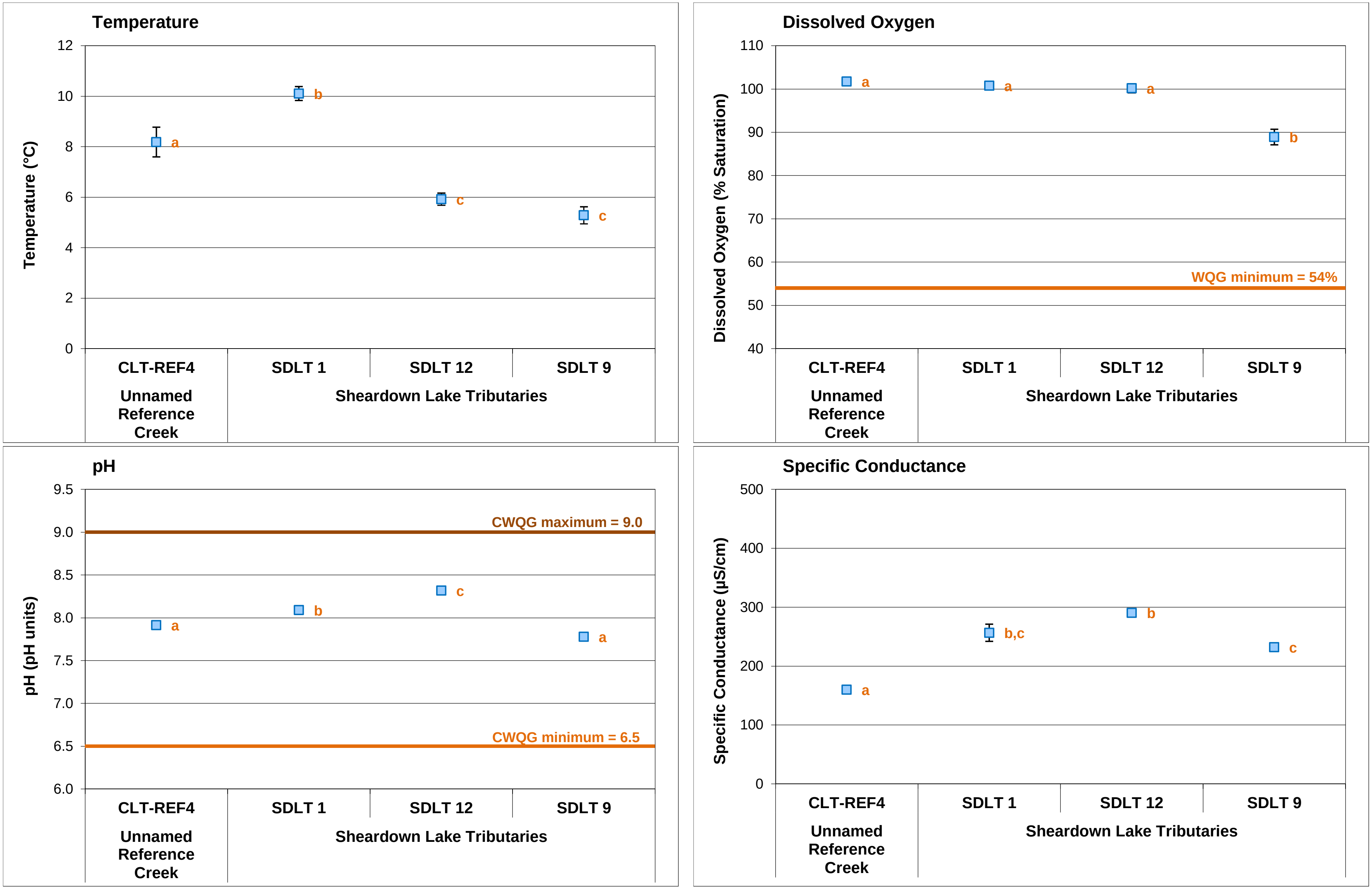


Figure 4.1: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Tributaries (SDLT) and Unnamed Reference Creek Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: The same letter(s) next to data points indicate study area values do not differ significantly.

Figure 4.2: Temporal Comparison of Water Chemistry at Sheardown Lake Tributaries (SDLT) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015, 2016, and 2017) Periods during Fall

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Sheardown Lake Tributaries.

Table 4.1: Water Chemistry at Sheardown Lake Tributary 1 (SDLT1) Monitoring Stations, Mary River Project CREMP, Fall 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n = 4) Fall 2017	Sheardown Lake Tributary 1			
						D1-05 (Upper) 28-Aug-2017	D1-00 (Lower) 28-Aug-2017	D1-05 (Upper) 1-Sep-2017	D1-00 (Lower) 1-Sep-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	116	215	396	200	306
	pH (lab)	pH	6.5 - 9.0	-	7.90	8.05	8.20	8.06	8.17
	Hardness (as $CaCO_3$)	mg/L	-	-	55	104	195	95	145
	Total Suspended Solids (TSS)	mg/L	-	-	4.1	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	80	241	111	159
	Turbidity	NTU	-	-	6.08	1.17	2.56	0.43	0.60
	Alkalinity (as $CaCO_3$)	mg/L	-	-	52	76	116	77	104
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.027	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.063	0.428	1.330	0.319	0.862
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	0.18	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.6	2.5	2.9	2.7	2.7
	Total Organic Carbon	mg/L	-	-	1.7	2.7	3.2	2.8	2.9
	Total Phosphorus	mg/L	0.030[α]	-	0.0078	0.0047	0.0031	0.0039	0.0046
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0016	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	4.2	10.9	4.7	8.1
	Sulphate (SO_4)	mg/L	218[β]	218	4.1	18.3	61.7	15.9	37.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	***0.208***	0.017	0.075	0.009	0.016
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00012	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0076	0.0101	0.0206	0.0091	0.0150
	Boron (B)	mg/L	1.5	-	<0.010	0.013	0.014	<0.010	0.011
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	0.000034	0.000010	0.000037	0.000015
	Chromium (Cr)	mg/L	0.0089	0.00856	0.00074	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00015	<0.00010	0.00015	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0013	***0.0032***	0.0021	***0.0031***	***0.0024***
	Iron (Fe)	mg/L	0.30	0.326	0.222	<0.050	0.154	<0.030	0.045
	Lead (Pb)	mg/L	0.001	0.001	0.00021	<0.000050	0.00011	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0014	0.0011	0.0016	0.0012	0.0018
	Manganese (Mn)	mg/L	0.935[β]	-	0.00332	<0.00050	0.00697	0.00027	0.00254
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00034	0.00403	0.00267	0.00343	0.00282
	Nickel (Ni)	mg/L	0.025	0.025	0.0007	0.0011	0.0016	0.0012	0.0013
	Potassium (K)	mg/L	-	-	0.82	2.26	2.73	2.13	2.34
	Selenium (Se)	mg/L	0.001	-	<0.000050	0.000111	0.00011	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	1.26	1.28	1.63	1.36	1.55
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.75	2.57	5.83	2.23	3.98
	Strontium (Sr)	mg/L	-	-	0.0113	0.0116	0.0216	0.0104	0.0165
	Thallium (Tl)	mg/L	0.0008	0.0008	0.00001	0.00001	0.00001	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.0123	0.0007	<0.0050	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00214	0.00616	0.00567	0.00554	0.00629
	Vanadium (V)	mg/L	0.006[α]	0.006	0.00075	<0.00050	<0.00050	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	0.0047	<0.0030	<0.0030

[a] Canadian Water Quality Guideline (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.3 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data adopted from the Camp Lake Tributaries.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

to average reference creek conditions during all seasonal sampling events in 2017, strongly suggesting a mine-related source for these parameters. Despite elevation of these parameters at the SDLT1 stations compared to reference conditions, copper was the only parameter present at concentrations greater than respective WQG or AEMP benchmarks at either of the SDLT1 monitoring stations in 2017 (Table 4.1; Appendix Table C.34).

Temporal comparisons of SDLT1 water chemistry data indicated that, of the parameters shown to be elevated above average reference conditions, nitrate, sodium, and sulphate concentrations were moderately to highly elevated (i.e., ≥5-fold higher) at upper and/or lower SDLT1 in 2017 compared to respective baseline period conditions in at least one sampling season (Figure 4.2; Appendix Table C.35 and Figure C.9). The SDLT1 concentrations of these parameters, and uranium, were elevated compared to baseline conditions in 2015 and 2016 as well, suggesting a mine-related source of these metals since the initiation of mine operations at the Mary River Project. Notably, total copper concentrations at SDLT1 in 2017 were comparable to those during the baseline period, suggesting naturally high concentrations of this metal within this tributary (Appendix Figure C.9).

4.1.2 Sediment Quality

Deposited sediment at SDLT1 and SDLT12 study areas was visually characterized as reddish brown silt, whereas deposited sediment at SDLT9 was described as medium to coarse sand (Appendix Table D.19). Although natural in-stream substrate at tributaries SDLT1 and SDLT12 is composed almost entirely of cobble and boulder material, fine reddish-brown silt occurred as a precipitate on the natural substrate and formed thicker deposits interstitially, in slow flowing areas, and along the shoreline, at both tributaries (Appendix Table F.1). In contrast, cobble composes the primary substrate type at SDLT9, but natural sand can constitute as much as 5 – 10% of the surficial bed material observed at this tributary to Sheardown Lake SE (Appendix Table F.1). No silt precipitate or deposits were observed at SDLT9 during the August 2017 sampling event. Deposited sediment was collected mainly from shoreline/streambank areas at SDLT1, and predominantly in-stream from between and behind boulders at SDLT12 and SDLT9 study areas (Appendix Table D.19). Sediment TOC content was low (i.e., <1%) at all of the Sheardown Lake Tributary study areas, but was slightly (i.e., 3- to 5-fold higher) to moderately (i.e., 5-fold to 10-fold higher) elevated compared to average lotic reference area TOC content (Table 4.2; Appendix Table D.21). This suggested a more depositional environment and/or greater suspended sediment loads at the three Sheardown Lake tributaries compared to reference conditions.

Metal concentrations in deposited sediment at both SDLT1 and SDLT12 were generally elevated compared to average lotic reference area metal concentrations (Table 4.2; Appendix Table D.21). In particular, concentrations of aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead,

Table 4.2: Sediment Total Organic Carbon and Metal Concentrations at Sheardown Lake Tributaries (SDLT1, 12, and 9) and Applicable Reference Creek and River Sediment Monitoring Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Lotic Reference Stations		Sheardown Lake Tributaries		
			Unnamed Reference Creek (REFCRK; n = 5)	Mary River Reference (GO-09; n = 5)	Sheardown Trib 1 SDLT1 (n = 5)	Sheardown Trib 12 SDLT12 (n = 3)	Sheardown Trib 9 SDLT9 (n = 5)
			Average ± SD	Average ± SD	Average ± SD	Average ± SD	Average ± SD
Total Organic Carbon	%	10[α]	<0.10 ± 0.00	<0.10 ± 0.00	0.64 ± 0.07	0.46 ± 0.15	0.63 ± 0.14
Aluminum (Al)	mg/kg	-	418 ± 126	763 ± 271	15,366 ± 4,088	9,450 ± 1,631	2,538 ± 722
Antimony (Sb)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	0.13 ± 0.03	0.19 ± 0.02	<0.10 ± 0
Arsenic (As)	mg/kg	17	0.12 ± 0.02	0.16 ± 0.02	2.74 ± 0.90	2.88 ± 0.90	0.64 ± 0.08
Barium (Ba)	mg/kg	-	2 ± 0.3	4 ± 1.2	81 ± 24.0	33 ± 7.7	11 ± 3
Beryllium (Be)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	0.70 ± 0.18	0.72 ± 0.14	0.12 ± 0.02
Bismuth (Bi)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	0.71 ± 0.23	0.55 ± 0.19	0.20 ± 0.00
Boron (B)	mg/kg	-	<5.0 ± 0	<5.0 ± 0	7.1 ± 0.8	5.2 ± 0.4	5.1 ± 0.2
Cadmium (Cd)	mg/kg	3.5	<0.020 ± 0	<0.020 ± 0	0.280 ± 0.051	0.095 ± 0.040	0.036 ± 0.010
Calcium (Ca)	mg/kg	-	214 ± 44	842 ± 508	4,254 ± 2,051	1,433 ± 425	1,660 ± 422
Chromium (Cr)	mg/kg	90	1.4 ± 0.4	3.4 ± 1.0	33.5 ± 5.6	33.2 ± 4.0	13.5 ± 0.6
Cobalt (Co)	mg/kg	-	0.32 ± 0.09	0.67 ± 0.19	13.79 ± 3.68	15.63 ± 1.50	2.36 ± 0.62
Copper (Cu)	mg/kg	110[α]	0.8 ± 0.5	1.3 ± 0.5	41 ± 8.2	36 ± 10.7	7.2 ± 2.2
Iron (Fe)	mg/kg	40,000[α]	1,240 ± 475	2,826 ± 1,271	155,000 ± 65,662	272,667 ± 69,759	15,000 ± 5,251
Lead (Pb)	mg/kg	91	0.7 ± 0.2	1.1 ± 0.1	23.6 ± 9.0	14.2 ± 5.6	3.6 ± 0.8
Lithium (Li)	mg/kg	-	<2.0 ± 0.0	2.2 ± 0.5	15.8 ± 3.3	10.2 ± 1.3	3.9 ± 0.7
Magnesium (Mg)	mg/kg	-	333 ± 116	826 ± 521	13,540 ± 2,415	7,237 ± 1,331	2,572 ± 895
Manganese (Mn)	mg/kg	1,100[α,β]	10 ± 2.4	22 ± 7.1	780 ± 160	1,056 ± 159	121 ± 52
Mercury (Hg)	mg/kg	0.486	0.0050 ± 0	<0.0050 ± 0	0.0104 ± 0.0019	0.0053 ± 0.0006	0.0103 ± 0.0087
Molybdenum (Mo)	mg/kg	-	<0.10 ± 0.00	0.11 ± 0.01	5.38 ± 2.04	5.28 ± 2.06	0.43 ± 0.27
Nickel (Ni)	mg/kg	75[α,β]	0.8 ± 0.2	1.9 ± 0.7	34.8 ± 5.6	34.9 ± 5.3	10.7 ± 2.4
Phosphorus (P)	mg/kg	2,000[α]	61 ± 16	113 ± 49	410 ± 73	388 ± 28	321 ± 83
Potassium (K)	mg/kg	-	106 ± 13	168 ± 77	5,808 ± 2,051	2,223 ± 297	582 ± 199
Selenium (Se)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	0.30 ± 0.04	0.24 ± 0.05	0.21 ± 0.03
Silver (Ag)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	0.26 ± 0.14	0.19 ± 0.08	<0.10 ± 0.00
Sodium (Na)	mg/kg	-	<50 ± 0	<50 ± 0	117 ± 32	50 ± 0	51 ± 3
Strontium (Sr)	mg/kg	-	1.2 ± 0.2	1.9 ± 0.3	3.9 ± 0.7	2.3 ± 0.4	2.6 ± 0.4
Sulphur (S)	mg/kg	-	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0
Thallium (Tl)	mg/kg	-	<0.050 ± 0.000	<0.050 ± 0	0.302 ± 0.074	0.136 ± 0.032	0.064 ± 0.009
Tin (Sn)	mg/kg	-	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
Titanium (Ti)	mg/kg	-	36 ± 16	109 ± 26	877 ± 258	382 ± 47	247 ± 38
Uranium (U)	mg/kg	-	0.2 ± 0.1	0.30 ± 0.0	3.2 ± 0.8	2.8 ± 0.2	0.60 ± 0.1
Vanadium (V)	mg/kg	-	1.9 ± 0.7	5.0 ± 2.2	28.5 ± 4.6	18.0 ± 2.5	12.9 ± 1.6
Zinc (Zn)	mg/kg	315	2.0 ± 0.0	3.7 ± 1.3	87 ± 18.3	44 ± 10.0	11 ± 2.9
Zirconium (Zr)	mg/kg	-	1.1 ± 0.1	1.7 ± 0.3	6.6 ± 1.7	3.9 ± 0.5	1.0 ± 0.0

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

(Grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

magnesium, manganese, molybdenum, nickel, uranium, and zinc were highly elevated (i.e., ≥10-fold higher) in deposited sediment at both of these tributaries compared to average lotic reference area concentrations (Appendix Table D.21). In part, elevated metal concentrations in the deposited sediment collected at SDLT1 and SDLT12 may reflect finer substrate size and more depositional features of these tributaries compared to average lotic reference area conditions. On average, metal concentrations in deposited sediment at SDLT1 and SDLT12 were below applicable SQG with the exception of iron, which occurred at mean concentrations approximately four-times and seven-times higher than the SQG, respectively, at these tributaries (Table 4.2; Appendix Tables D.20 and D.22). The concentration of manganese was also slightly above SQG in deposited sediment at one of the three SDLT12 replicate stations (Appendix Table D.22). Deposited sediment at SDLT9 showed slightly (i.e., 3- to 5-fold higher) to moderately (i.e., 5-fold to 10-fold higher) elevated concentrations of most of the metals indicated above compared to the lotic reference areas, but concentrations of all metals including iron were well below SQG (Table 4.2; Appendix Table D.21). Limited baseline sediment metal concentration data were collected at the Sheardown Lake tributaries, and thus no evaluation of potential mine-related influences on sediment quality following commencement of commercial mine operations could be conducted.

4.1.3 Phytoplankton

Phytoplankton (chlorophyll-a) monitoring is conducted only at SDLT1 within the Sheardown Lake system as part of the Mary River Project CREMP. Chlorophyll-a concentrations were lower at upper SDLT1 (Station D1-05) compared to near the creek mouth (Station D1- 00) during each of the spring, summer, and fall sampling events in 2017 (Figure 4.3). Higher chlorophyll-a concentrations observed near the mouth of SDLT1 may have reflected the occurrence of elevated nutrient concentrations and specifically, higher aqueous nitrate concentrations, compared to the upper SDLT1 station (Section 4.1.1). Chlorophyll-a concentrations at SDLT1 were higher than average reference creek concentrations in both spring and summer, but were substantially lower than the average reference creek concentration in the fall (Figure 4.3). For all sampling events in 2017, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L at both SDLT1 stations (Figure 4.3). Similar to the reference creek stations and Camp Lake tributary systems, chlorophyll-a concentrations at SDLT1 were suggestive of oligotrophic, low productivity conditions based on Dodds et al (1998) trophic status classification for stream environments (i.e., chlorophyll-a concentration <10 µg/L). Relatively low chlorophyll-a concentrations at SDLT1 stations in 2017 were also consistent with an oligotrophic WQG categorization based on aqueous phosphorus concentrations near or below 10 µg/L (Table 4.1; Appendix Table C.34).

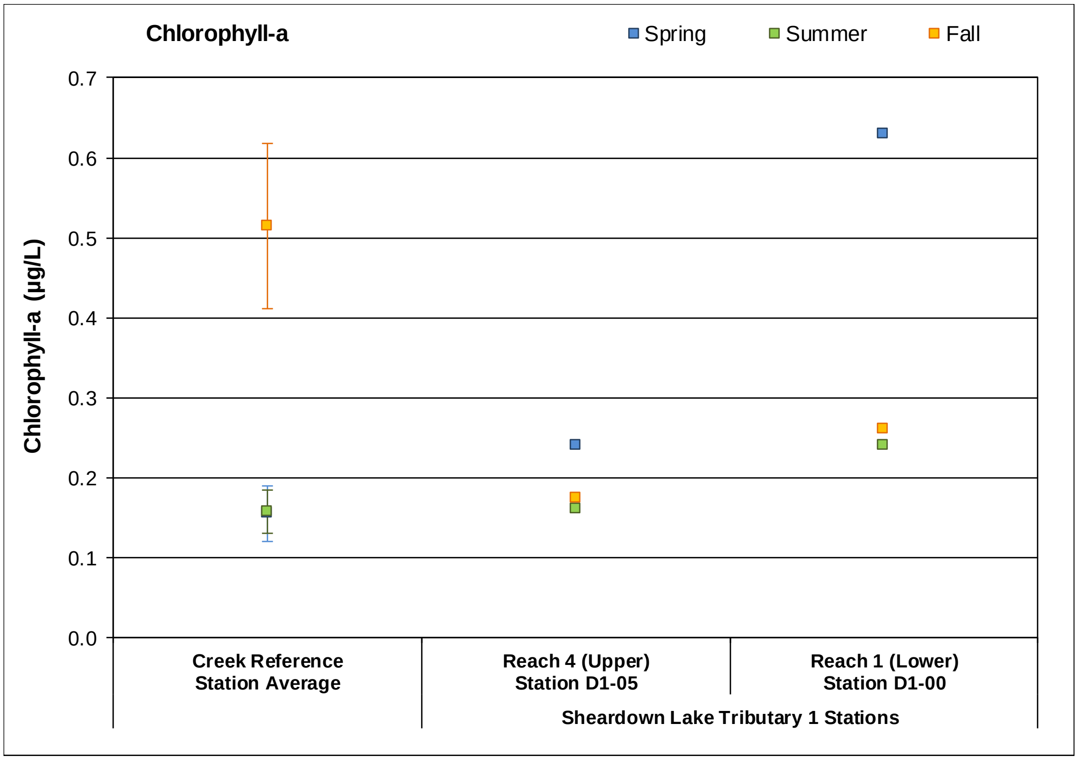


Figure 4.3: Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 Phytoplankton Monitoring Stations, Mary River Project CREMP, 2017

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

Temporal comparisons indicated chlorophyll-a concentrations at SDLT1 stations in 2017 were similar to those during the baseline period (Figure 4.4). In addition, no consistent directional changes in chlorophyll-a concentrations were shown at the SDLT1 stations over the mine baseline (2005 – 2013), construction (2014), and operational (2015, 2016, 2017) periods (Figure 4.4). These data suggested no adverse mine-related influences to phytoplankton productivity at SDLT1 over the initial three years of mine operation.

4.1.4 Benthic Invertebrate Community

Sheardown Lake Tributary 1 (SDLT1)

The benthic invertebrate community at the lower reach of SDLT1, near the outlet to Sheardown Lake NW, exhibited significantly lower richness and Simpson's Evenness, and significant differences in composition (as indicated by Bray-Curtis Index) compared to Unnnamed Reference Creek in 2017 (Figure 4.5; Appendix Table F.32). The key differences in relative abundance of dominant taxonomic groups included ecologically significant greater proportions of Oligochaeta (aquatic worms) and metal-sensitive Chironomidae (non-biting midges), and conversely, an absence of Ephemeroptera (mayflies) and significantly lower proportion of Simuliidae (blackflies)

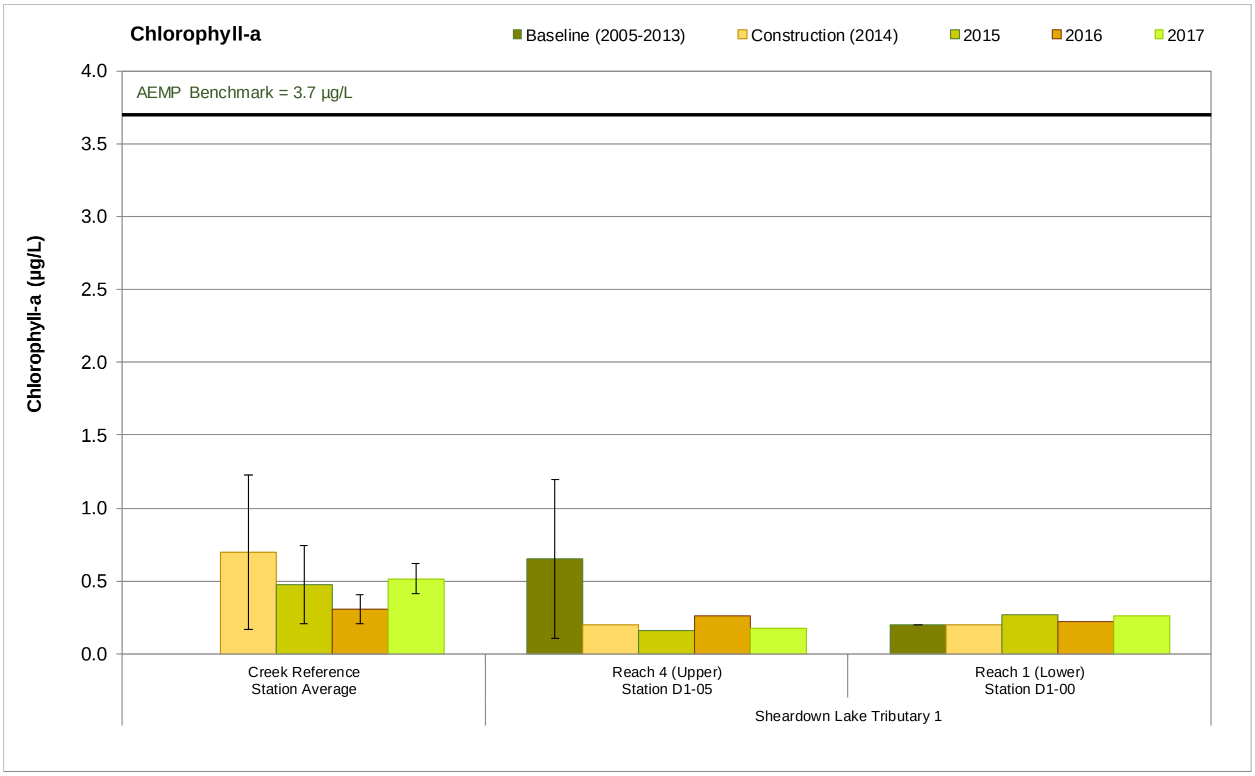


Figure 4.4: Temporal Comparison of Chlorophyll-a Concentrations at Sheardown Lake Tributary 1 for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015 - 2017) Periods in the Fall, Mary River Project CREMP

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

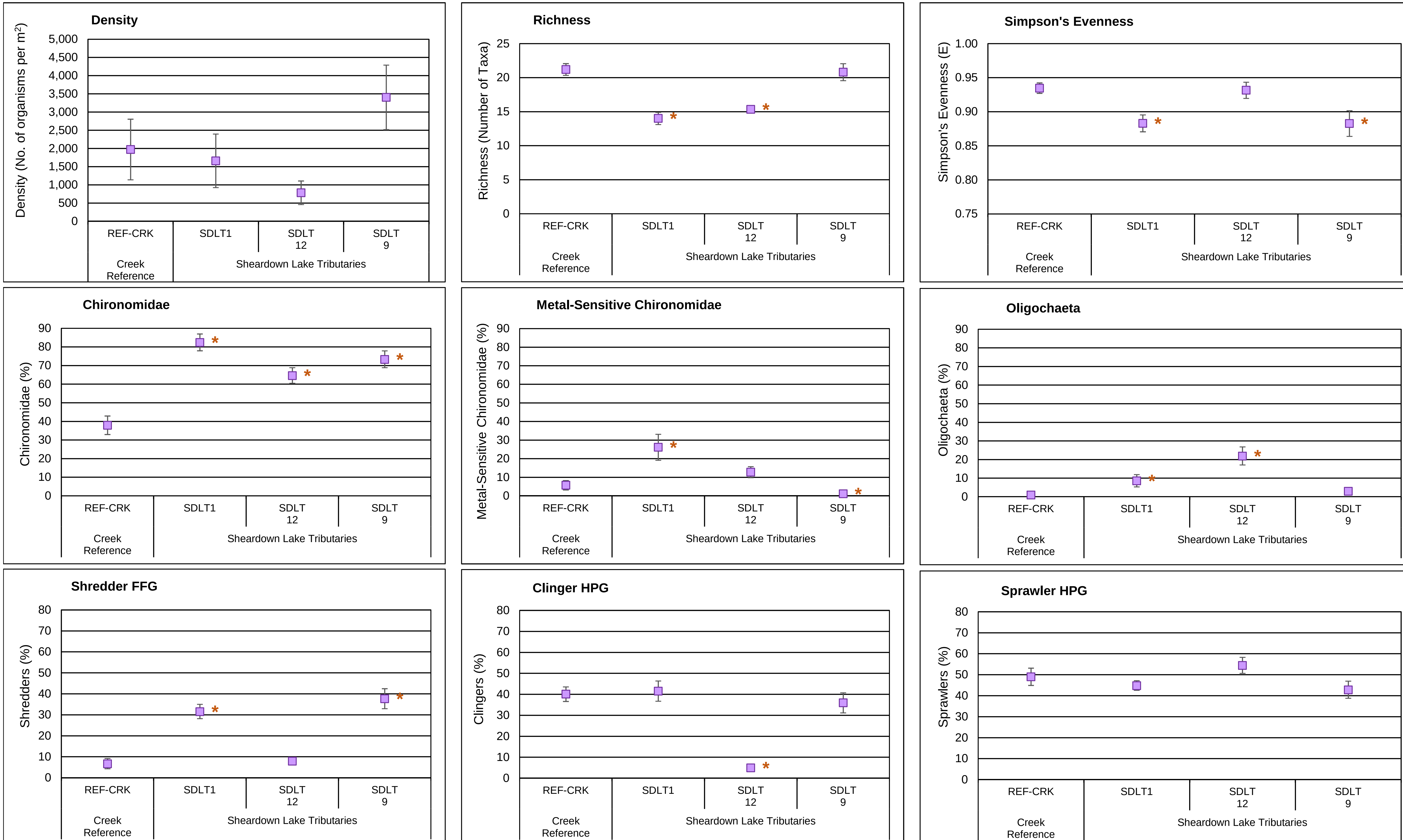


Figure 4.5: Comparison of Benthic Invertebrate Community Metrics between Sheardown Lake Tributary and Unnamed Reference Creek Study Areas (mean ± SE), Mary River Project CREMP, August 2017

Note: An asterisk (*) next to SDLT data point indicates that the metric value differs significantly than that at Unnamed Reference Creek.

at SDLT1 compared to Unnamed Reference Creek (Appendix Table F.32). However, of these, only absolute densities of mayflies differed significantly at magnitudes outside of CES_{BIC} between SDLT1 and the reference creek (Appendix Table F.33). A higher relative abundance of metal-sensitive chironomids at lower SDLT1 suggested that metal concentrations were not biologically available and/or did not account for differences in community composition compared to Unnamed Reference Creek, which was consistent with concentrations of all metals but copper and iron below WQG and SQG, respectively, at SDLT1 in 2017 (see Appendix Table C.34). A significantly higher relative abundance of FFG shredders (Appendix Table F.32), which rely upon plants as an important food source, was consistent with greater density of attached bryophytes (mosses) at SDLT1 compared to the reference creek (Appendix Table F.25). In turn, this suggested that differences in in-stream vegetation likely contributed to differing benthic invertebrate community composition between SDLT1 and Unnamed Reference Creek. Notably, no significant differences in relative abundance of HPG were indicated between SDLT1 and the reference creek (Appendix Table F.32), suggesting that physical habitat alteration from factors such as sedimentation had not substantially affected benthic invertebrate community composition at SDLT1 relative to reference conditions. Overall, no definitive mine-related influences on the benthic invertebrate community of SDLT1 were indicated by the 2017 data.

Temporal comparison of the lower SDLT1 benthic invertebrate community data did not indicate any consistent ecologically significant differences in density, richness, or Simpson’s Evenness for individual years of mine operation (2015, 2016, 2017) compared to baseline studies conducted in 2008 and 2013 (Figure 4.6; Appendix Table F.34). Similarly, no ecologically significant differences in the relative abundance of any dominant taxonomic groups or FFG were consistently indicated among years of mine operation and baseline studies at SDLT1 (Appendix Table F.34). The absence of any consistent, ecologically significant changes in benthic invertebrate community density, richness, Simpson’s Evenness, and composition at lower SDLT1 between the mine operational and baseline periods indicated no ecologically meaningful influences on benthic biota since the commencement of commercial mine operations in 2015.

Sheardown Lake Tributary 12 (SDLT12)

The benthic invertebrate community of Sheardown Lake Tributary 12 (SDLT12) did not differ significantly from Unnamed Reference Creek for primary endpoints of density and Simpson’s Evenness, but richness at SDLT12 was significantly lower at a magnitude outside of CES_{BIC}, in 2017 (Figure 4.5; Appendix Table F.32). In addition, marked differences in community composition were indicated between SDLT12 and the reference creek based on significant differences in Bray-Curtis Index and several dominant invertebrate, functional feeding, and habitat preference groups (Figure 4.5; Appendix Table F.32). Because the relative abundance of metal-

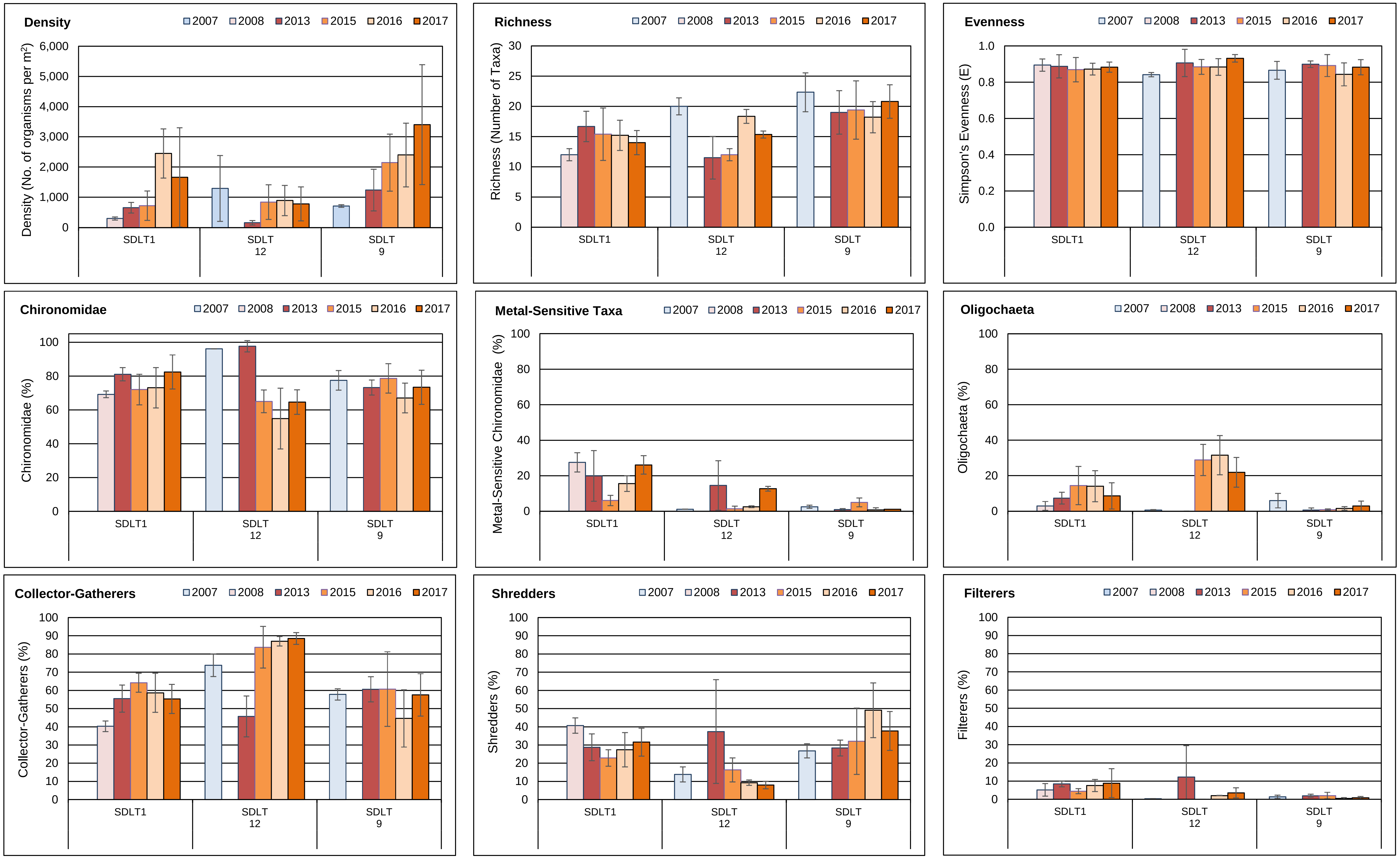


Figure 4.6: Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Sheardown Lake Tributaries 1, 12, and 9 among Operational (2015, 2016, 2017) and Baseline (2007, 2008, 2011, 2013) Studies for the Mary River Project CREMP

sensitive chironomids did not differ significantly between areas (Figure 4.5; Appendix Table F.32), the differences in community composition between SDLT12 and Unnamed Reference Creek were not likely directly related to metal concentrations. Rather, significantly higher relative abundance of the burrower HPG, which include Oligochaeta (aquatic worms) and Tipulidae (crane flies) taxonomic groups, as well as significantly greater relative abundance of FFG collector-gatherer deposit feeders, was consistent with the occurrence of significantly slower water velocity (i.e., more depositional habitat) at SDLT12 than at Unnamed Reference Creek (Appendix Tables F.28 and F.32). Therefore, differing habitat features between SDLT12 and Unnamed Reference Creek potentially accounted for the differences in benthic invertebrate community composition between watercourses.

Temporal comparison of the SDLT12 benthic invertebrate community data did not indicate any on-going significant differences in density, richness, or Simpson's Evenness between mine operational years and baseline data collected in 2007 (Figure 4.6; Appendix Table F.35). However, the consistent occurrence of significantly higher relative abundance of burrowing invertebrates, including aquatic worm and crane fly taxonomic groups, and the collector-gatherer FFG in 2015, 2016, and 2017 compared to the 2007 baseline data suggested changes in habitat conditions with the commencement of mine operations. Although such temporal changes potentially reflected slight differences in sampling location between the mine operational and baseline periods, field observations from the 2016 and 2017 studies documented the occurrence of silt deposits on in-stream substrate of SDLT12 suggesting sedimentation within this watercourse. Therefore, a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) may have accounted for temporal changes in the benthic invertebrate community between the mine operational and baseline periods that included a shift to higher abundance of deposit feeding, burrowing benthic invertebrates. Notably, the relative abundance of metal-sensitive chironomids was significantly higher, or showed no difference, between the mine operational and baseline period at SDLT12, suggesting that metals were largely biologically unavailable and/or did not account for the differences in benthic invertebrate community endpoints among these mine periods.

Sheardown Lake Tributary 9 (SDLT9)

The benthic invertebrate community of Sheardown Lake Tributary 9 (SDLT9) did not differ significantly from Unnamed Reference Creek for primary endpoints of density or richness in 2017 (Figure 4.5; Appendix Table F.32). However, significantly lower Simpson's Evenness was indicated at SDLT9 than at the reference creek. In addition, marked differences in community composition were indicated between SDLT9 and Unnamed Reference Creek based on significant differences in Bray-Curtis Index and several groups of dominant taxa and FFG (Figure 4.5;

Appendix Table F.32). However, the magnitude of difference in the relative abundance of metal-sensitive chironomids between SDLT9 and the reference creek was within the CES_{BIC} of ±2 SD_{REF} (Figure 4.5; Appendix Table F.32), suggesting that differences in community composition between watercourses were unlikely to be related to differing metal concentrations. A significantly higher relative abundance of the shredder FFG, which included taxa represented by Tipulidae (crane flies), was consistent with field observations of greater amounts of rooted in-stream vegetation at SDLT9 compared to the reference creek (Appendix Tables F.25 and F.32) given that plants serve as a food source for the shredder FFG. In turn, this suggested that differing amounts and/or types of in-stream vegetation accounted for the differences in benthic invertebrate community composition between SDLT9 and the reference creek. Notably, no significant differences in the relative abundance of HPG were indicated between SDLT9 and the reference creek (Appendix Table F.32), suggesting that a mine-related factor such as increased sedimentation had not substantially altered benthic invertebrate community composition at SDLT9 compared to reference conditions.

Temporal comparisons indicated no consistent, ecologically significant differences in benthic invertebrate density, richness, Simpson's Evenness, or any dominant taxonomic groups and FFG at SDLT9 between mine operational period data collected in 2015, 2016, and 2017 compared to baseline period data collected in 2007 and 2013 (Figure 4.6; Appendix Table F.36). In turn, this suggested that the differences in benthic invertebrate community composition between SDLT9 and Unnamed Reference Creek in 2017 likely reflected a natural difference in the amount of in-stream vegetation between watercourses and the associated influences of this vegetation on benthic invertebrate community composition.

4.1.5 Integrated Effects Evaluation

At Sheardown Lake Tributary 1 (SDLT1), aqueous concentrations of several parameters were elevated compared to average concentrations observed at the reference creek stations in 2017. However, similar to previous CREMP studies, only nitrate, sodium, and sulphate concentrations were elevated at SDLT1 in 2017 compared to the baseline period and, with the exception of copper, no parameters were present at concentrations above WQG or AEMP benchmarks in 2017. Mine-related sedimentation was evident at SDLT1 by the presence of reddish brown silt precipitate/deposits containing highly elevated concentrations of several metals compared to the reference creek. Although the accumulation of deposited sediment affected less than 1% of surficial bed material at SDLT1, iron concentrations of the deposited sediment were considerably higher than SQG. Chlorophyll-a concentrations at SDLT1 were higher in spring and summer, but lower in fall, compared to reference creek stations in 2017, suggesting that elevated nitrate concentrations may contribute variably to biological enrichment at SDLT1. However, similar chlorophyll-a concentrations between 2017 and the baseline period indicating no clear change to the trophic status of SDLT1 since commercial mine operation commenced. Significantly lower benthic invertebrate richness and Simpson's Evenness, as well as significant differences in community structure, were indicated at SDLT1 in 2017 compared to Unnamed Reference Creek. However, no significant difference in the relative abundance of metal-sensitive chironomids were indicated between SDLT1 and the reference creek in 2017. In addition, no consistent ecologically significant differences in any primary benthic invertebrate community metrics, dominant taxonomic groups or FFG were indicated for individual years of mine operation (2015, 2016, 2017) compared to baseline studies conducted in 2008 and 2013 at SDLT1. In turn, this suggested that metals in water and sediment at SDLT1 were not highly bio-available, and that differences in benthic invertebrate community composition between SDLT1 and the reference creek reflected natural differences in the amount and/or types of in-stream vegetation between watercourses. Overall, similar to the findings of the two previous CREMP studies, no adverse mine-related effects to biota of SDLT1 were indicated in 2017 based on the chlorophyll-a and benthic invertebrate community data analysis.

At Sheardown Lake Tributary 12 (SDLT12), mine-related sedimentation was evident as deposits of reddish brown silt which was shown to contain high concentrations of several metals compared to deposited sediment of the reference creek. Although the accumulation of deposited sediment affected less than 5% of surficial bed material at SDLT12, iron concentrations of the deposited sediment highly exceeded the applicable SQG. The SDLT12 benthic invertebrate community showed a significantly higher relative abundance of collector-gatherers and burrowers relative to Unnamed Reference Creek in 2017, and at SDLT12 between studies conducted in 2015, 2016, and 2017 relative to 2007 baseline data. The temporal changes in benthic invertebrate community composition at SDLT12 are hypothesized to reflect a mine-related reduction in flow and/or increased particle loadings (e.g., through dust and/or erosional deposition) over time at SDLT12, constituting a potential mine-related effect at this tributary.

At Sheardown Lake Tributary 9 (SLDT9), deposited sediment contained slight to moderate elevation in metal concentrations compared to the reference creek, but concentrations of all metals, including iron, were well below SQG in the SDLT9 deposited sediment. Significantly lower benthic invertebrate evenness, as well as significant differences in community structure, were indicated at SDLT9 in 2017 compared to the reference creek. However, no significant difference in the relative abundance of metal-sensitive chironomids were indicated between SDLT9 and the reference creek in 2017, and no consistent ecologically significant differences in any primary benthic invertebrate community metrics were indicated for years of mine operation (2015, 2016, 2017) compared to the baseline studies. Examination of FFG and HPG differences between SDLT9 and the reference creek indicated that naturally differing amounts and/or types of in-stream vegetation likely accounted for the differing benthic invertebrate community structure between these watercourses. Overall, no adverse mine-related effects to biota of SDLT9 were indicated in 2017 based on the benthic invertebrate community data analysis.

4.2 Sheardown Lake Northwest (DLO-1)

4.2.1 Hydraulic Retention Time

A hydraulic retention time of 511 ± 213 days was estimated for Sheardown Lake NW using mean annual watershed runoff (2007 – 2016 data) extrapolated from Baffinland flow monitoring stations installed in small watershed watercourses (i.e., ≤15 km^2) located on the mine property and a lake volume of 8.18 million cubic metres (from NSC 2015b).

4.2.2 Water Quality

Water quality profiles of *in situ* water temperature, dissolved oxygen, pH, and specific conductance conducted at Sheardown Lake NW in 2017 showed no substantial station-to-station differences during any of the winter, summer, or fall sampling events (Appendix Figures C.11 – C.14). No thermal stratification was indicated at Sheardown Lake NW during winter or summer, but a weak thermocline developed at depths extending from 14 m to lake bottom during the fall (Figure 4.7). Average water temperature at the bottom of the water column at Sheardown Lake NW littoral and profundal stations was slightly warmer than at Reference Lake 3 at the time of fall sampling in 2017, the difference of which was statistically significant only for the littoral stations (Figure 4.8). However, the incremental difference in average bottom water temperature between lakes at each respective depth was small (i.e., ≤0.5˚C) and thus was unlikely to be ecologically meaningful. Dissolved oxygen profiles at Sheardown Lake NW showed a slight oxycline at depths greater than approximately 14 m during the winter and fall, but no appreciable change in dissolved oxygen saturation from surface to bottom in the summer of 2017 (Figure 4.7; Appendix Figure C.12). No substantial oxycline was observed at Reference Lake 3 during the summer or fall sampling events in 2017 (Figure 4.7). Despite the slight difference in dissolved oxygen profiles between Sheardown Lake NW and Reference Lake 3 during the fall sampling event, dissolved oxygen saturation levels at the bottom of the water column did not differ significantly between these study lakes at littoral and profundal stations in 2017 (Figure 4.8; Appendix Table C.37). In addition, dissolved oxygen saturation levels were consistently well above the WQG of 54% at Sheardown Lake NW during all winter, summer, and fall sampling events in 2017 (Figures 4.7 and 4.8). This indicated that dissolved oxygen was not limiting for pelagic or bottom-dwelling biota within Sheardown Lake NW in 2017.

In situ profiles of pH and specific conductance showed no substantial change from the surface to bottom of the Sheardown Lake NW water column during any of the three sampling seasons in

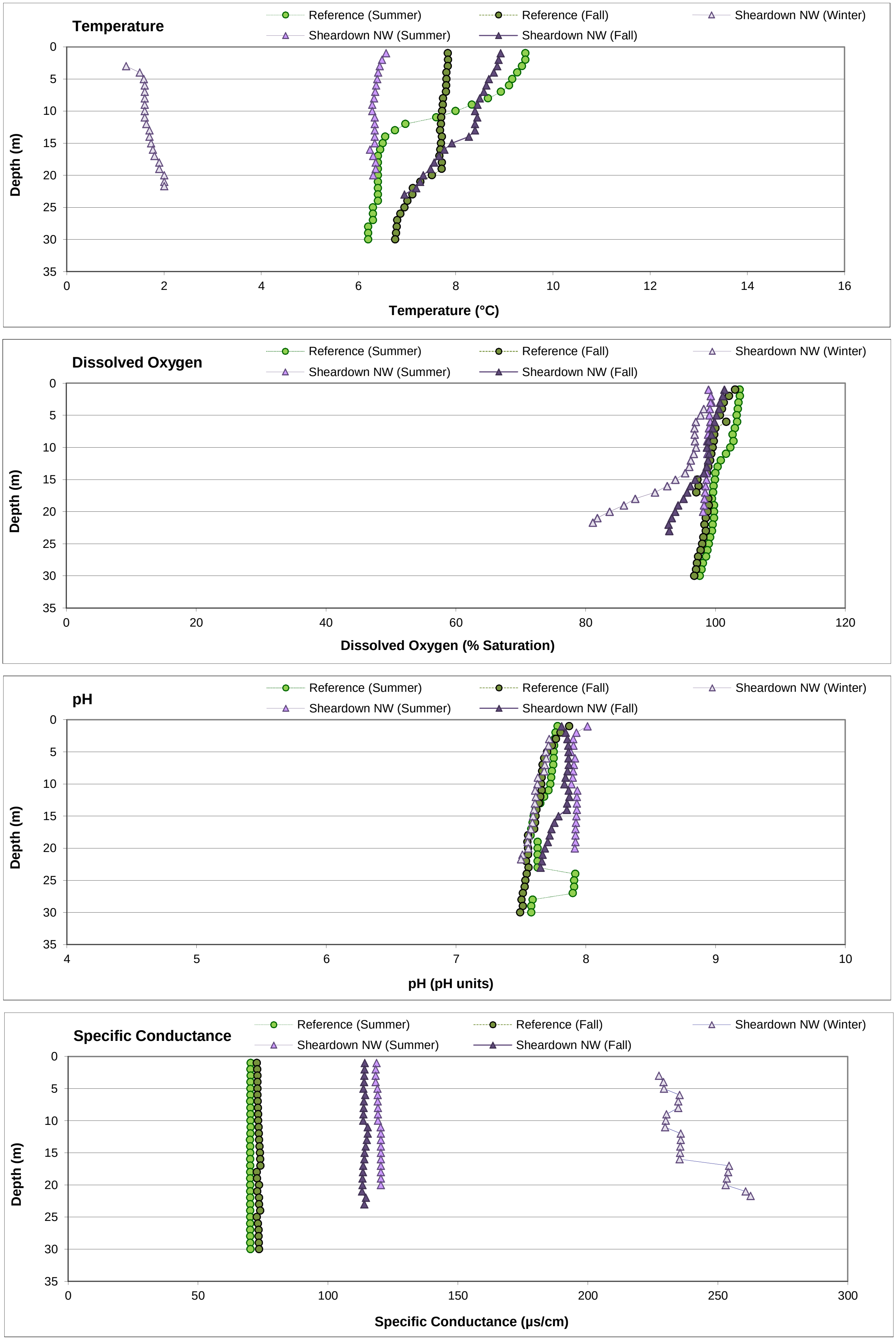


Figure 4.7: Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake NW (DLO-01) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2017

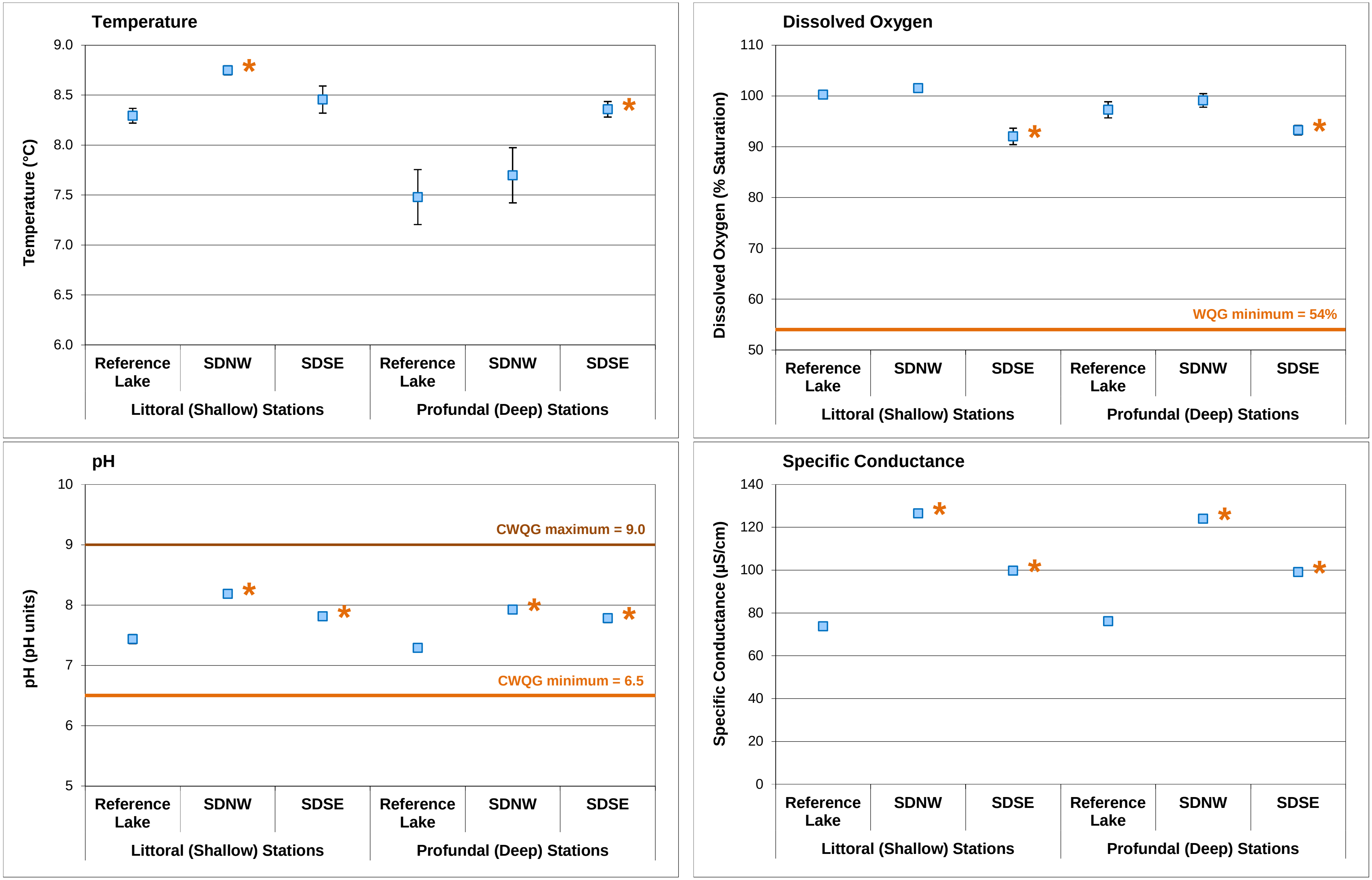


Figure 4.8: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Sheardown Lake Basins (SDNW and SDSE) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

2017, indicating no chemical stratification (Figure 4.7). Mean pH at the bottom of the water column at littoral and profundal stations of Sheardown Lake NW was significantly higher than at Reference Lake 3 during fall sampling in 2017 (Figure 4.8; Appendix Table C.37). However, pH values were consistently within WQG limits of 6.5 – 9.0 through the entire water column during all 2017 sampling events conducted at Sheardown Lake NW (Figures 4.7 and 4.8; Appendix Tables C.33 – C.36). Specific conductance was significantly higher at Sheardown Lake NW compared to the reference lake during fall sampling (Figure 4.8; Appendix Table C.42). However, similar to observations at Camp Lake (Section 4.2.1), specific conductance at Sheardown Lake NW was intermediate to that of reference creek and river stations in fall 2017 (i.e., range from 55 – 168 µS/cm). Therefore, it was unclear whether higher specific conductance at Sheardown Lake NW than at Reference Lake 3 was related to natural regional variability in surface waters or a mine-related influence. Water clarity, as determined through evaluation of Secchi depth, was significantly lower at Sheardown Lake NW than at Reference Lake 3 during the 2017 fall sampling event (Appendix Table C.42; Appendix Figure C.7). Secchi depth readings showed relatively low variability among stations at Sheardown Lake NW in the fall of 2017, suggesting no spatial differences in water clarity throughout the lake (Appendix Table C.40).

Water chemistry within Sheardown Lake NW showed no distinct spatial differences in parameter concentrations among the six sampling stations during any of the winter, summer, or fall sampling events in 2017 (Table 4.3; Appendix Table C.43), suggesting that the lake waters were continually well mixed both laterally and vertically. Turbidity and total concentrations of aluminum, manganese, molybdenum, tin, and uranium were slightly (3- to 5-fold higher) to moderately (5- to 10 fold higher) elevated at Sheardown Lake NW compared to Reference Lake 3 during the summer and/or fall sampling events (Table 4.3; Appendix Tables C.43 and C.44). Similar to the previous studies, total aluminum and manganese concentrations showed a strong positive correlation with turbidity at Sheardown Lake NW in 2017 (r_s = 0.79 and 0.85, respectively; Appendix Table C.47). This suggested that elevated total aluminum and manganese concentrations at Sheardown Lake NW reflected influences associated with surface runoff or backflow received from Mary River that contained naturally high concentrations of aluminum-based, manganese bearing, particulate minerals. This was supported through evaluation of dissolved metal concentrations, which indicated similar dissolved aluminum and manganese concentrations between Sheardown Lake NW and the reference lake (Appendix Table C.46), and the absence of a strong correlation between dissolved concentrations of these metals and turbidity. In addition, the ratio of dissolved to total concentrations of aluminum and manganese indicated that the majority (i.e., 76% and 89%, respectively) of these metals was in the total fraction at Sheardown Lake NW based on the 2017 data. Total and dissolved concentrations of molybdenum and uranium were each elevated at Sheardown Lake NW compared to the reference

Table 4.3: Water Chemistry at Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2017

	Parameters	Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	Sheardown Lake NW Station					
						DD-HAB9 STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7
					Fall 2017	21-Aug-2017	21-Aug-2017	26-Aug-2017	20-Aug-2017	20-Aug-2017	20-Aug-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	76	132	130	132	131	130	130
	pH (lab)	pH	6.5 - 9.0	-	7.76	8.06	7.86	7.99	8.01	8.04	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	35	62	61	61	62	62	62
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	2.85	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	33	54	52	70	49	63	53
	Turbidity	NTU	-	-	0.69	1.09	0.97	0.66	0.91	1.06	0.99
	Alkalinity (as $CaCO_3$)	mg/L	-	-	31	54	56	58	62	52	52
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.020	<0.020	<0.020	0.038	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	0.030	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.465	0.1725	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.6	1.6	1.5	1.7	1.5	1.6
	Total Organic Carbon	mg/L	-	-	2.8	1.7	1.6	1.6	1.7	1.6	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.004	0.005	0.004	0.005	0.004	0.006	0.005
	Phenols	mg/L	0.004[α]	-	0.002	<0.0010	<0.0010	0.002	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	0.1	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	2.8	3.0	3.0	3.0	2.9	3.0
	Sulphate (SO_4)	mg/L	218[β]	218	4.0	4.9	4.9	5.0	5.1	4.9	5.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[d]	0.005	0.012	0.011	0.010	0.013	0.011	0.013
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00642	0.00643	0.00609	0.00624	0.00623	0.00619	0.00616
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.9	12.0	11.7	12.3	12.1	11.7	12.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0008	0.0009	0.0008	0.0012	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0010	0.0012	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.4	7.9	7.7	7.9	7.7	7.5	7.5
	Manganese (Mn)	mg/L	0.935[β]	-	0.00063	0.00179	0.00173	0.00160	0.00175	0.00183	0.00178
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00012	0.00075	0.00075	0.00074	0.00075	0.00074	0.00075
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00064	0.00061	0.00058	0.00064	0.00062	0.00059
	Potassium (K)	mg/L	-	-	0.88	1.18	1.13	1.14	1.15	1.14	1.14
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.41	0.41	0.47	0.46	0.42	0.41	0.42
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.85	1.46	1.40	1.32	1.42	1.39	1.43
	Strontium (Sr)	mg/L	-	-	0.0078	0.0079	0.0078	0.0080	0.0079	0.0078	0.0079
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.00025	0.00084	0.00087	0.00080	0.00089	0.00088	0.00088
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake NW.

[d] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively (Intrinsik 2013).

(grey box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

lake, but concentrations of these metals at Sheardown Lake NW were not strongly correlated with turbidity, suggesting a potential mine-related source. Despite elevation of total aluminum, manganese, molybdenum, and uranium metals at Sheardown Lake NW compared to Reference Lake 3, concentrations of each of these metals, as well as all other parameters, were well below applicable WQG and AEMP benchmarks at Sheardown Lake NW during all sampling events in 2017 (Table 4.3; Appendix Table C.43).

Temporal comparisons of the Sheardown Lake NW water chemistry data suggested that 2017 seasonal average total and dissolved concentrations of most parameters were within each respective range of baseline concentrations (2005 – 2013; Figure 4.9; Appendix Figure C.19). However, a key exception was dissolved molybdenum, which showed slight elevation (i.e., 3- to 5-fold higher) in 2017 compared to the baseline data based on fall sampling results (Appendix Table C.44). In addition, turbidity and concentrations of molybdenum, sodium, and sulphate showed successively higher concentrations over years of mine-construction (2014) through mine operation (2015 – 2017; Figure 4.9; Appendix Figure C.19; Appendix Table C.44). Overall, the magnitude of these changes over time were relatively minor and unlikely to be ecologically meaningful given concentrations remained well below WQG, but nevertheless the sequential increases were consistent with greater mine-related influence on water quality over time at Sheardown Lake NW.

4.2.3 Sediment Quality

Surficial sediment at Sheardown Lake NW showed substrate properties varying from silt loam to sand at littoral areas, and substrate consistently represented by silt loam at profundal areas (Figure 4.10; Appendix Table D.25). Although no significant differences in sediment particle size were indicated between Sheardown Lake NW and the reference lake for littoral stations, sediment at profundal stations of Sheardown Lake NW was composed of significantly less sand and significantly more silt than at Reference Lake 3 (Figure 4.10; Appendix Table D.5). In addition, sediment at littoral and profundal stations of Sheardown Lake NW contained a significantly lower proportion of TOC than at the reference lake (Figure 4.10; Appendix Table D.5). Similar to observations at Reference Lake 3 and Camp Lake, reddish- to orange-brown oxidized material was commonly observed on the surface of Sheardown Lake NW littoral and profundal sediments (Appendix Table D.24). In Sheardown Lake NW, this material occasionally occurred as a thin, distinct layer that was likely composed principally of iron (oxy)hydroxide precipitate. Substrate of Sheardown Lake NW did not exhibit any substantial blackening (or unusually dark colouration) or noticeable sulphidic odour at the time of the August 2017 sampling event, suggesting the absence of strongly reducing conditions in the sediment (Appendix Table D.24).

Figure 4.9: Temporal Comparison of Water Chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015, 2016, 2017) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).

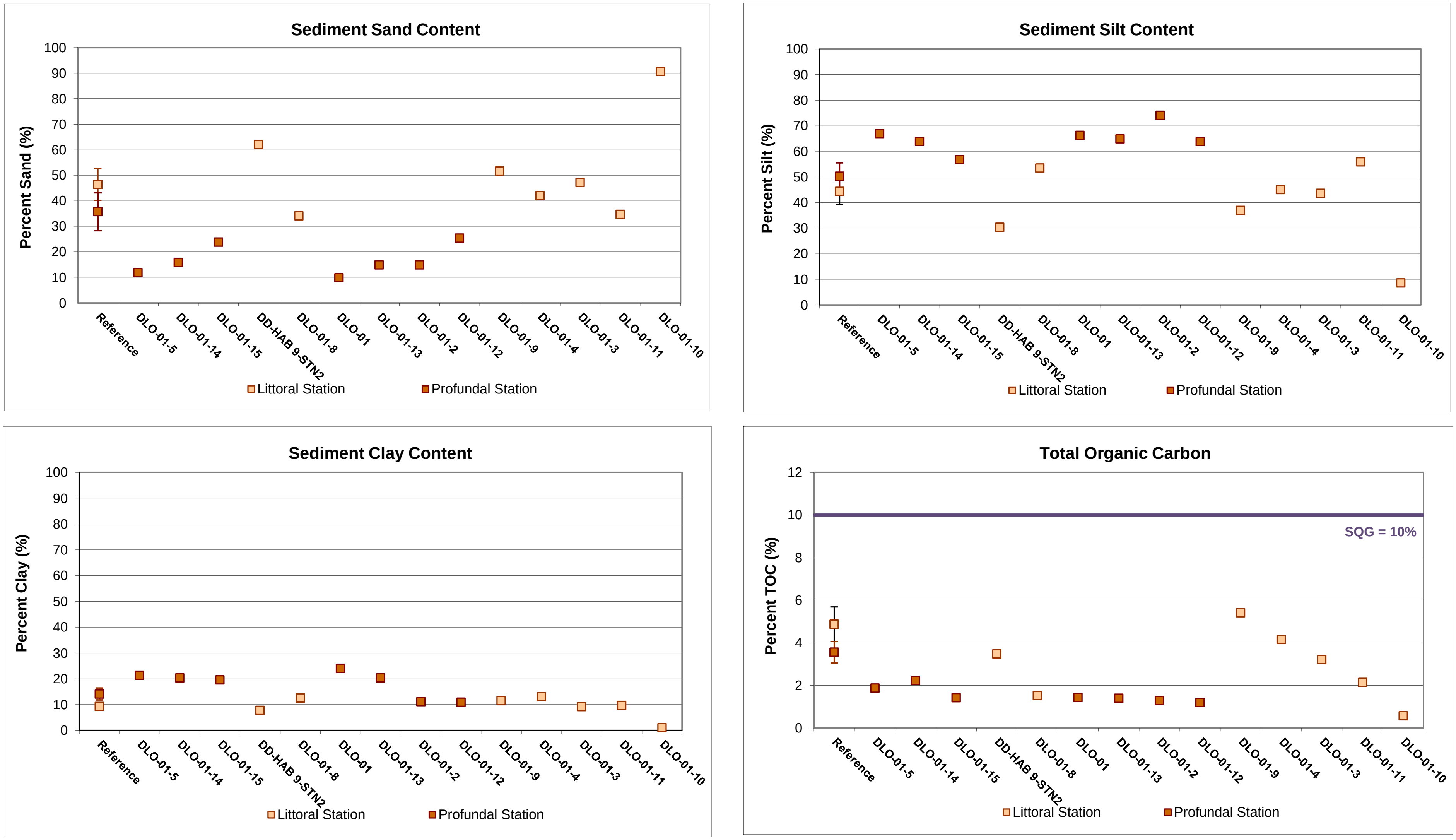


Figure 4.10: Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake NW (DLO-01) Sediment Monitoring Stations and Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2017

Sediment metal concentrations at Sheardown Lake NW showed no consistent spatial differences from stations located nearest to key tributary inlets (e.g., SDLT1 and SDLT12) to those located near the lake outlet in 2017 (Appendix Table D.26). However, sediment iron concentrations appeared to be highest at Sheardown Lake NW stations situated closest to the outlets of SDLT1 and SDLT12 (Stations DD-HAB 0-STN2 and DLO-01-9, respectively; Appendix Table D.26). Iron concentrations in deposited sediment at SDLT1 and SDLT12 were considerably higher than sediment of Sheardown Lake NW (Appendix Table D.29), indicating that these tributaries were a source of iron loadings to the lake. Concentrations of other metals were generally similar to or higher in sediment of Sheardown Lake NW compared to deposited sediment of SDLT1 and SDLT12 (Appendix Table D.29), reflecting the depositional nature of the lake versus erosional characteristics of the tributaries. Sediment metal concentrations at littoral and profundal stations of Sheardown Lake NW were very similar to averages observed for the same respective station types at Reference Lake 3 in 2017 (Table 4.4; Appendix Table D.27), suggesting no marked mine-related influences on sediment metal concentrations in Sheardown Lake NW. Although mean concentrations of iron were above SQG in sediment at littoral and profundal stations of Sheardown Lake NW, mean concentrations of iron were also above SQG at both station types of Reference Lake 3 in 2017 (Table 4.4). On average, manganese concentrations were above SQG in sediment at profundal stations, as were concentrations of manganese and nickel in sediment at individual littoral stations, of Sheardown Lake NW in 2017 (Table 4.4; Appendix Table D.26). However, iron and manganese concentrations were elevated above SQG in sediment at littoral and profundal stations of Reference Lake 3 (Table 4.4; Appendix Table D.6), indicating naturally elevated concentrations of these metals in sediment of local study area lakes. Although iron, manganese, and nickel concentrations were above AEMP benchmarks at individual littoral and profundal stations, on average, concentrations of these and all other metals were below their respective AEMP benchmarks at Sheardown Lake NW in 2017 (Table 4.4; Appendix Table D.26).

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Sheardown Lake NW in 2017 were comparable to those observed during the mine baseline (2005 – 2013) period (Figure 4.11; Appendix Table D.27). On average, metal concentrations in sediment at respective Sheardown Lake NW littoral and profundal stations in 2017 were typically within the range of those observed from 2015 and 2016, with no consistently higher concentrations occurring that would suggest an increasing trend over time (Figure 4.11; Appendix Table D.27). This contrasted with the results of the previous CREMP study, which suggested progressively higher concentrations of arsenic, barium, iron, manganese, and molybdenum at littoral stations of Sheardown Lake NW from baseline, to mine construction, to 2015 and 2016 mine operational years (Figure 4.11; Minnow 2017). Changes in station replication and location among studies likely contributed to the appearance of greater mean

Table 4.4: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2017

	Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b] (NW, SE)	Littoral			Profundal		
					Reference Lake (n = 5)	Sheardown Lake NW (n=4)	Sheardown Lake SE (n=3)	Reference Lake (n = 5)	Sheardown Lake NW (n=4)	Sheardown Lake SE (n=2)
					Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error	Average ± Std. Error
Non-metals	Sand	%	-	-	46 ± 6	60 ± 12	9 ± 2	36 ± 7	13 ± 1	15 ± 2
	Silt	%	-	-	44 ± 5	32 ± 9	76 ± 8	50 ± 5	68 ± 2	70 ± 2
	Clay	%	-	-	9 ± 1	8 ± 3	14 ± 7	14 ± 2	19 ± 3	15 ± 0.4
	Moisture	%	-	-	81 ± 5	57 ± 12	51 ± 4	76 ± 6	69 ± 1	46 ± 4
	Total Organic Carbon	%	10[α]	-	4.9 ± 0.8	2.7 ± 1.1	1.2 ± 0.1	3.6 ± 0.5	1.5 ± 0.13	1.1 ± 0.05
Metals	Aluminum (Al)	mg/kg	-	-	14,720 ± 736	15,683 ± 4,186	16,917 ± 705	22,140 ± 1,652	22,200 ± 883	18,450 ± 150
	Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	0.11 ± 0.005	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0.00	<0.10 ± 0
	Arsenic (As)	mg/kg	17	6.2, 5.9	3.35 ± 0.64	5.28 ± 1.87	4.83 ± 1.14	4.80 ± 0.20	4.88 ± 0.63	3.06 ± 0.61
	Barium (Ba)	mg/kg	-	-	113 ± 10	99 ± 31	110 ± 19	138 ± 7.0	113 ± 9	87 ± 6.6
	Beryllium (Be)	mg/kg	-	-	0.57 ± 0.02	0.77 ± 0.21	0.79 ± 0.043	0.85 ± 0.0573	1.09 ± 0.057	0.85 ± 0.000
	Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	0.30 ± 0.063	0.22 ± 0.009	<0.2 ± 0.0	0.25 ± 0.016	0.20 ± 0.0000
	Boron (B)	mg/kg	-	-	12.1 ± 0.80	26.4 ± 6.96	21.4 ± 1.41	16.6 ± 1.487	33.7 ± 2.58	27.3 ± 0.15
	Cadmium (Cd)	mg/kg	3.5	1.5, 1.5	0.182 ± 0.032	0.355 ± 0.114	0.122 ± 0.00753	0.179 ± 0.024	0.259 ± 0.008	0.119 ± 0.0005
	Calcium (Ca)	mg/kg	-	-	4,656 ± 362	4,223 ± 1,048	6,072 ± 95	5,262 ± 377	4,598 ± 126	6,225 ± 465
	Chromium (Cr)	mg/kg	90	97, 79	51.1 ± 3.7	61 ± 15	79 ± 4.3	70.2 ± 6.3	84 ± 1.9	78 ± 1.60
	Cobalt (Co)	mg/kg	-	-	10.6 ± 0.794	12.9 ± 3.49	14.0 ± 0.6	16.0 ± 1.1	17.4 ± 0.4	14.0 ± 0.450
	Copper (Cu)	mg/kg	110	58, 56	***64.7*** ± 5.27	43 ± 13	28 ± 1.3	***87.6*** ± 8.5	47 ± 1.8	29 ± 0.20
	Iron (Fe)	mg/kg	40,000[α]	52,200, 34,400	***41,960*** ± 8,713	46,323 ± 14,520	***44,867*** ± 4,734	***46,740*** ± 3,447	43,938 ± 2,530	***39,150*** ± 2,150
	Lead (Pb)	mg/kg	91.3	35	12.4 ± 0.6	16.2 ± 4.13	16.2 ± 1.04	16.9 ± 1.0	21.9 ± 0.8	15.9 ± 0.050
	Lithium (Li)	mg/kg	-	-	24.0 ± 0.9	25.5 ± 6.75	30.1 ± 1.41	35.0 ± 2.1	37.7 ± 1.6	31.8 ± 0.15
	Magnesium (Mg)	mg/kg	-	-	10,256 ± 714	10,503 ± 2,619	14,167 ± 338	14,660 ± 1,126	14,488 ± 315	14,650 ± 250.0
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530, 657	639 ± 115	664 ± 281	***1,506*** ± 588	***1,266*** ± 70	3,389 ± 2,141	***820*** ± 350.5
	Mercury (Hg)	mg/kg	0.486	0.17	0.0440 ± 0.0081	0.0355 ± 0.0118	0.0262 ± 0.00186	0.0528 ± 0.0089	0.0388 ± 0.00440	0.0299 ± 0.0008
	Molybdenum (Mo)	mg/kg	-	-	3.50 ± 0.97	4.40 ± 1.70	1.77 ± 0.469	2.90 ± 0.20	3.63 ± 1.69	1.10 ± 0.270
	Nickel (Ni)	mg/kg	75[α,β]	77, 66	38.2 ± 2.4	67.7 ± 19.2	62.4 ± 4.06	49.3 ± 3.0	70.3 ± 0.9	57.4 ± 2.050
	Phosphorus (P)	mg/kg	2,000[α]	1,958, 1,278	1,039 ± 246	908 ± 208	1,188 ± 122	1,073 ± 54	1,028 ± 111	1,050 ± 80.5
	Potassium (K)	mg/kg	-	-	3,754 ± 212	4,240 ± 1,142	4,315 ± 214	5,694 ± 366	5,896 ± 265	4,780 ± 30
	Selenium (Se)	mg/kg	-	-	0.61 ± 0.12	0.46 ± 0.12	0.20 ± 0.00	0.59 ± 0.120	0.33 ± 0.035	0.23 ± 0.0250
	Silver (Ag)	mg/kg	-	-	0.13 ± 0.01	0.15 ± 0.020	0.11 ± 0.000	0.20 ± 0.025	0.17 ± 0.011	0.12 ± 0.0100
	Sodium (Na)	mg/kg	-	-	284 ± 21	237 ± 60	274 ± 14	410 ± 36	323 ± 15	313 ± 6.5
	Strontium (Sr)	mg/kg	-	-	10.0 ± 0.461	9.5 ± 1.71	10.7 ± 0.450	12.7 ± 0.80	12.0 ± 0.34	11.8 ± 0.200
	Sulphur (S)	mg/kg	-	-	1,120 ± 96.9536	1,175 ± 175	<1,000 ± 0	1,140 ± 74.8	<1,000 ± 0	<1,000 ± 0
	Thallium (Tl)	mg/kg	-	-	0.35 ± 0.036	0.44 ± 0.13	0.38 ± 0.026	0.657 ± 0.038	0.57 ± 0.01	0.37 ± 0.0020
	Tin (Sn)	mg/kg	-	-	2.12 ± 0.12	<2.0 ± 0	<2.0 ± 0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0
	Titanium (Ti)	mg/kg	-	-	997 ± 51	984 ± 229	1,240 ± 15	1,288 ± 56	1,313 ± 35.0	1,455 ± 45.0
	Uranium (U)	mg/kg	-	-	11.0 ± 1.04	7.40 ± 2.69	4.71 ± 0.207	23.5 ± 2.26	7.64 ± 0.44	5.04 ± 0.015
	Vanadium (V)	mg/kg	-	-	47.8 ± 2.04	47.3 ± 12.0	51.1 ± 1.91	67.2 ± 3.86	63.8 ± 1.62	54.0 ± 1.050
	Zinc (Zn)	mg/kg	315	135	67.3 ± 2.51	55.5 ± 13.8	57.3 ± 2.08	91.1 ± 6.76	72.3 ± 1.68	59.6 ± 0.500
	Zirconium (Zr)	mg/kg	-	-	3.9 ± 0.4	10.0 ± 3.66	15.3 ± 0.89	3.38 ± 0.150	8.06 ± 0.69	19.9 ± 1.45

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to the Sheardown Lake basins.

(shaded) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

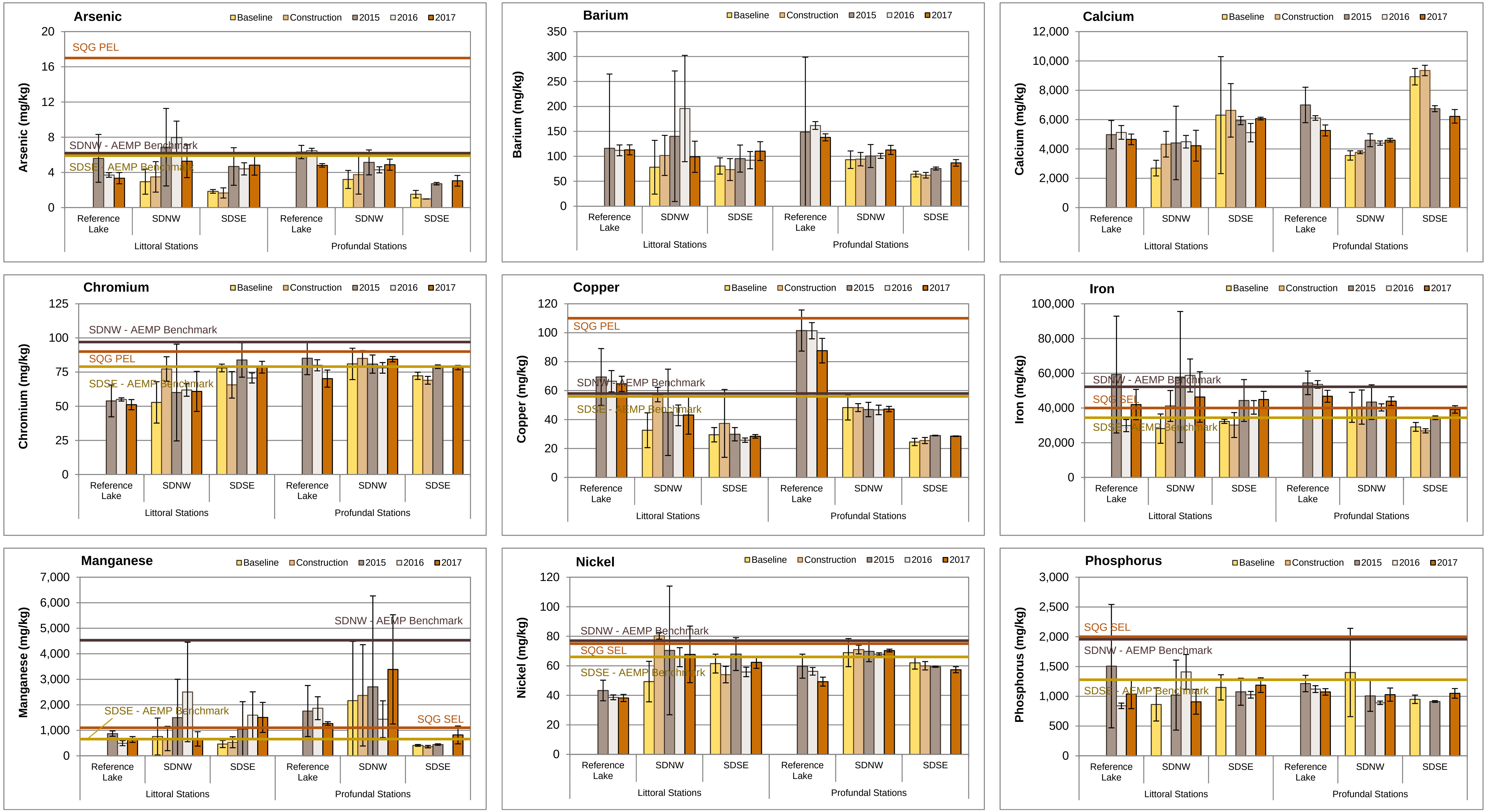


Figure 4.11: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Sheardown Lake NW (SDNW), Sheardown Lake SE (SDSE), and Reference Lake 3 for Mine Baseline (2005 - 2013), Construction (2014) and Individual Operational Year (2015, 2016, and 2017) Periods

concentrations of these parameters in sediment at the Sheardown Lake NW littoral stations leading into 2016. However, based on evaluation of data current to 2017, no substantial changes in sediment metal concentrations were indicated at Sheardown Lake NW littoral and profundal stations following the commencement of Baffinland commercial mine operations in 2015.

4.2.4 Phytoplankton

Chlorophyll-a concentrations at Sheardown Lake NW showed no consistent spatial gradients with progression towards the lake outlet among the winter, summer, and fall sampling events in 2017 (Figure 4.12). Chlorophyll-a concentrations differed significantly among seasons at Sheardown Lake NW in 2017, with highest and lowest concentrations observed in fall and winter, respectively (Appendix Table E.6), and reflecting similar seasonal differences in chlorophyll-a concentrations at the reference lake (Appendix Table B.8). Although chlorophyll-a concentrations were significantly higher at Sheardown Lake NW compared to Reference Lake 3 for both the summer and fall sampling events in 2017 (Appendix Tables E.7 – E.8), chlorophyll-a concentrations during each of the winter, summer, and fall sampling events were well below the AEMP benchmark of 3.7 µg/L (Figure 4.12). Chlorophyll-a concentrations at Sheardown Lake NW were suggestive of an 'oligotrophic' status using Wetzel (2001) lake trophic status classifications. This trophic status classification was consistent with a CWQG oligotrophic categorization for Sheardown Lake NW based on mean aqueous total phosphorus concentrations below 10 µg/L during all sampling events (Table 4.3; Appendix Table C.43).

Temporally, Sheardown Lake NW chlorophyll-a concentrations in 2017 did not differ significantly from concentrations during the mine construction (2014) and early operational (2015, 2016) periods in any consistent direction among the winter, summer, and fall seasons (Figure 4.13). In addition, annual average chlorophyll-a concentrations did not differ significantly among years from 2014 to 2017 (Appendix Table E.11), suggesting no ecologically meaningful changes in the trophic status of Sheardown Lake NW since the onset of mine operations at the Mary River Project. No chlorophyll-a data are available for the baseline (2005 – 2013) period for Sheardown Lake NW, precluding comparisons of chlorophyll-a data to the period prior to mine construction.

4.2.5 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral and profundal habitats of Sheardown Lake NW compared to like-habitat stations at Reference Lake 3 at magnitudes outside of the CES_{BIC} of ±2 SD_{REF} (Tables 4.5 and 4.6). Richness did not differ significantly between Sheardown Lake NW and the reference lake for littoral stations, but was significantly higher at Sheardown Lake NW compared to Reference Lake 3 for profundal stations (Table 4.5 and 4.6). In addition to these differences, benthic invertebrate community structure differences

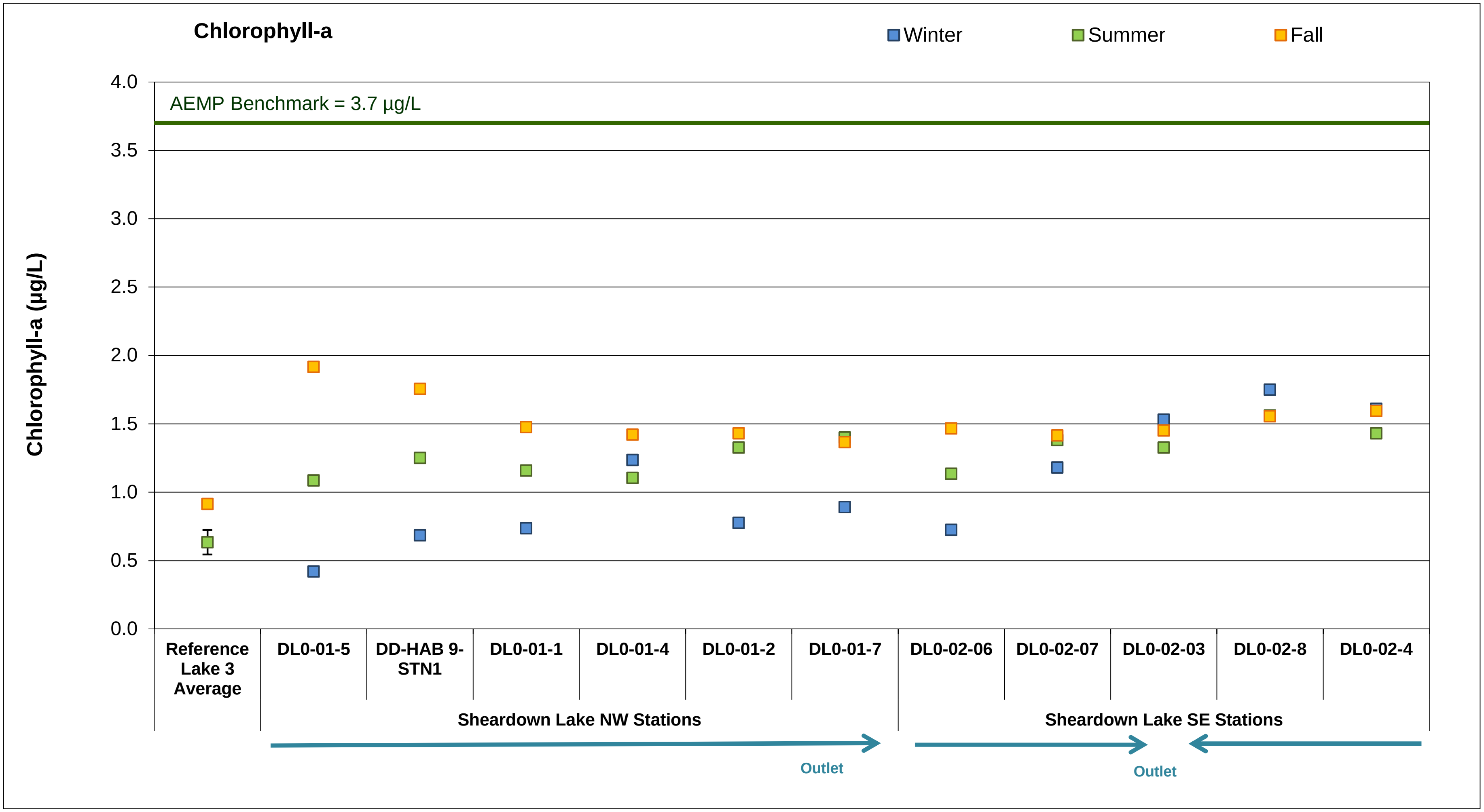


Figure 4.12: Chlorophyll-a Concentrations at Sheardown Lake NW (DLO-1) and Sheardown Lake SE (DLO-2) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2017

Notes: Values are averages of samples taken from the surface and the bottom of the water column at each station. Reference values are expressed as mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2017.

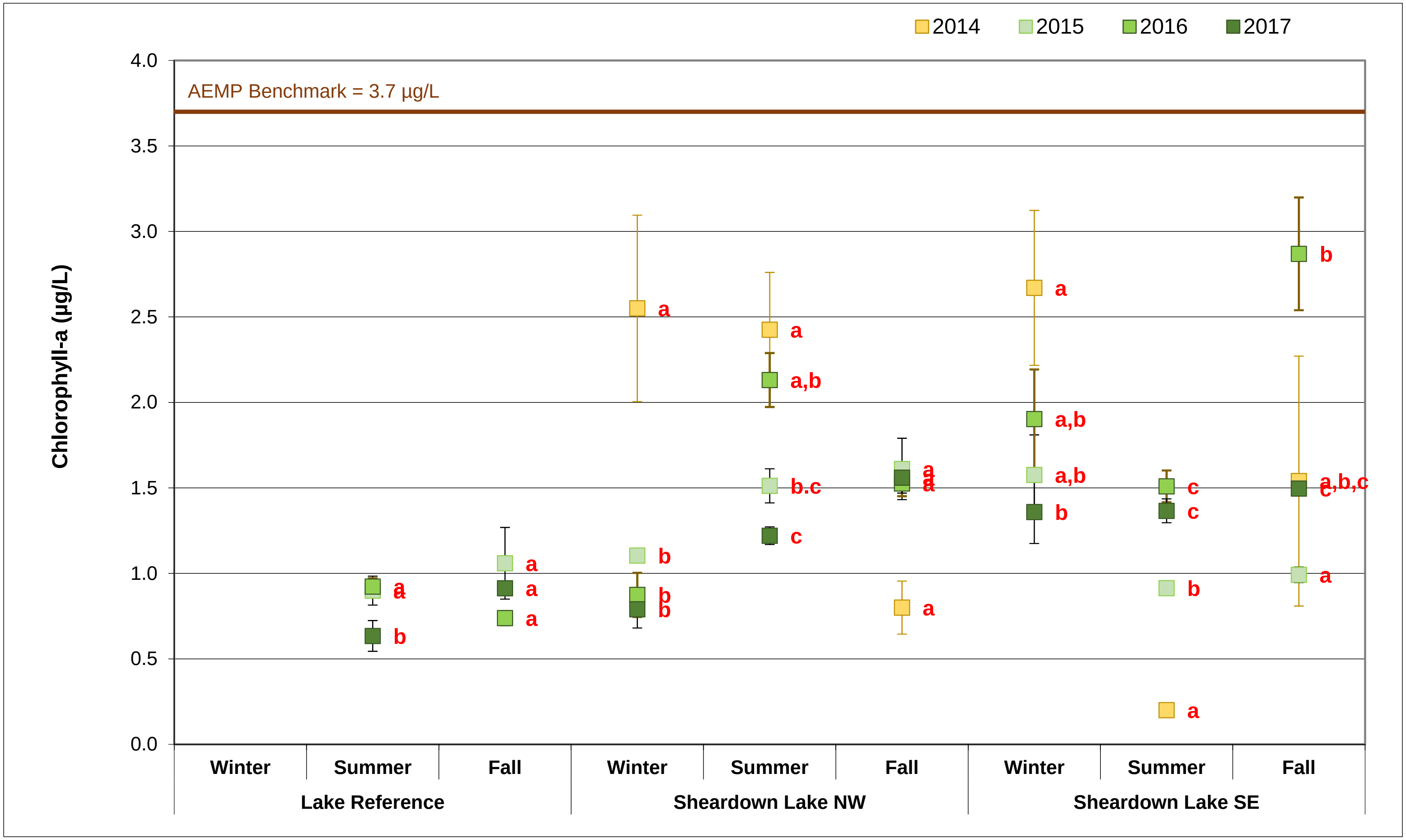


Figure 4.13: Chlorophyll-a Concentration Seasonal Comparison among 2014, 2015, 2016, and 2017 (mean ± SE) at Sheardown Lake Phytoplankton Monitoring Stations, Mary River Project CREMP

Note: Data points with the same letter on the right do not differ significantly between years for the applicable season.

Table 4.5: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	fourth root	YES	0.005	ANOVA	4.4	Reference Lake 3	1,489	850	380	372	2,618
						Sheardown NW Littoral	5,216	2,398	1,072	3,222	9,344
Richness (Number of Taxa)	square root	NO	0.398	ANOVA	0.6	Reference Lake 3	12.4	2.5	1.1	10.0	15.0
						Sheardown NW Littoral	14.0	3.2	1.4	11.0	19.0
Simpson's Evenness (E)	none	NO	0.696	ANOVA	0.2	Reference Lake 3	0.807	0.142	0.063	0.605	0.934
						Sheardown NW Littoral	0.842	0.048	0.022	0.790	0.911
Bray-Curtis Index	none	YES	< 0.001	ANOVA	3.2	Reference Lake 3	0.384	0.120	0.054	0.203	0.536
						Sheardown NW Littoral	0.762	0.066	0.030	0.695	0.859
Nemata (%)	none	NO	0.146	ANOVA	-0.8	Reference Lake 3	3.9	3.3	1.5	0.8	9.1
						Sheardown NW Littoral	1.3	1.5	0.7	0.0	3.4
Hydracarina (%)	fourth root	NO	0.192	ANOVA	-0.2	Reference Lake 3	5.3	3.0	1.4	1.8	8.1
						Sheardown NW Littoral	4.6	7.4	3.3	0.0	17.2
Ostracoda (%)	none	YES	0.078	ANOVA	-1.1	Reference Lake 3	38.8	18.4	8.2	22.3	63.9
						Sheardown NW Littoral	19.5	11.1	5.0	10.2	37.0
Chironomidae (%)	log	YES	0.065	ANOVA	1.2	Reference Lake 3	51.8	17.9	8.0	29.5	67.9
						Sheardown NW Littoral	73.5	11.2	5.0	58.9	85.8
Metal-Sensitive Chironomidae (%)	square root	NO	0.649	ANOVA	0.1	Reference Lake 3	15.5	13.4	6.0	0.5	37.0
						Sheardown NW Littoral	16.6	7.9	3.5	9.7	29.8
Collector-Gatherers (%)	none	NO	0.600	ANOVA	-0.3	Reference Lake 3	73.9	16.0	7.2	56.0	95.5
						Sheardown NW Littoral	69.4	9.2	4.1	59.4	80.8
Filterers (%)	square root	NO	0.576	ANOVA	0.1	Reference Lake 3	14.7	13.3	5.9	0.5	36.4
						Sheardown NW Littoral	16.5	8.0	3.6	9.7	29.8
Shredders (%)	fourth root	NO	0.263	ANOVA	-0.5	Reference Lake 3	4.2	6.6	3.0	0.0	15.9
						Sheardown NW Littoral	0.7	0.9	0.4	0.0	2.1
Clingers (%)	none	NO	0.906	ANOVA	-0.1	Reference Lake 3	19.8	12.8	5.7	2.7	38.1
						Sheardown NW Littoral	19.1	4.7	2.1	15.0	25.7
Sprawlers (%)	fourth root	YES	0.009	ANOVA	-2.3	Reference Lake 3	72.6	13.9	6.2	55.7	92.9
						Sheardown NW Littoral	41.0	14.0	6.2	22.9	59.4
Burrowers (%)	square root	YES	< 0.001	ANOVA	10.6	Reference Lake 3	7.5	3.0	1.4	4.5	12.0
						Sheardown NW Littoral	39.8	14.8	6.6	24.2	61.2

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value less than 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 4.6: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake NW (DLO-01) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	log	YES	< 0.001	ANOVA	22.4	Reference Lake 3	149	32	14	113	190
						Sheardown NW Profundal	861	391	175	465	1,457
Richness (Number of Taxa)	none	YES	0.019	ANOVA	3.4	Reference Lake 3	4.2	1.5	0.7	2.0	6.0
						Sheardown NW Profundal	9.2	3.5	1.6	5.0	13.0
Simpson's Evenness (E)	none	NO	0.856	ANOVA	0.1	Reference Lake 3	0.704	0.105	0.047	0.597	0.843
						Sheardown NW Profundal	0.717	0.113	0.051	0.618	0.899
Bray-Curtis Index	square root	YES	< 0.001	ANOVA	4.7	Reference Lake 3	0.239	0.114	0.051	0.111	0.376
						Sheardown NW Profundal	0.779	0.112	0.050	0.645	0.946
Hydracarina (%)	none	NO	0.656	ANOVA	-0.3	Reference Lake 3	8.2	5.5	2.5	0.0	15.0
						Sheardown NW Profundal	6.7	4.3	1.9	0.0	10.3
Ostracoda (%)	log(X+1)	NO	0.209	ANOVA	1.0	Reference Lake 3	2.8	4.1	1.8	0.0	8.9
						Sheardown NW Profundal	6.8	4.6	2.0	0.0	10.4
Chironomidae (%)	log	NO	0.455	ANOVA	-0.5	Reference Lake 3	89.0	7.6	3.4	81.6	100.0
						Sheardown NW Profundal	85.1	8.5	3.8	74.6	95.8
Metal-Sensitive Chironomidae (%)	none	NO	0.237	ANOVA	-0.6	Reference Lake 3	12.0	8.9	4.0	0.0	20.2
						Sheardown NW Profundal	6.3	4.4	2.0	2.8	13.7
Collector-Gatherers (%)	log	YES	0.044	ANOVA	-2.1	Reference Lake 3	84.3	4.1	1.9	79.8	90.5
						Sheardown NW Profundal	75.5	7.3	3.3	70.3	87.5
Filterers (%)	fourth root	NO	0.638	ANOVA	-0.4	Reference Lake 3	6.5	9.3	4.2	0.0	20.2
						Sheardown NW Profundal	2.9	2.5	1.1	0.0	6.0
Clingers (%)	none	NO	0.155	ANOVA	-1.1	Reference Lake 3	14.6	4.9	2.2	9.5	20.2
						Sheardown NW Profundal	9.4	5.6	2.5	0.0	15.2
Sprawlers (%)	none	NO	0.343	ANOVA	-2.1	Reference Lake 3	81.4	6.3	2.8	74.8	90.5
						Sheardown NW Profundal	68.2	28.6	12.8	28.0	97.2
Burrowers (%)	square root	NO	0.107	ANOVA	5.0	Reference Lake 3	3.9	3.7	1.7	0.0	8.0
						Sheardown NW Profundal	22.4	26.1	11.7	2.8	62.5

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates a statistically significant difference between study areas based on p-value less than 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

were indicated between Sheardown Lake NW and Reference Lake 3 by significantly differing Bray-Curtis Index for both littoral and profundal habitat types (Tables 4.5 and 4.6). However, because no ecologically significant differences (i.e., CES_{BIC} outside of ±2 SD_{REF}) in relative abundance of any dominant taxonomic groups was indicated between Sheardown NW Lake and the reference lake for either habitat type, the difference in Bray-Curtis Index between lakes mostly reflected substantially higher benthic invertebrate density at Sheardown Lake NW. The occurrence of higher benthic invertebrate density without an accompanying difference in Simpson's Evenness or compositional change in dominant taxonomic groups suggested that Sheardown Lake NW was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations in 2017. The latter point was supported by similar relative abundance of metal-sensitive chironomids between lakes, as well as the occurrence of a higher proportion of burrowing taxa (significantly so, for profundal stations) at Sheardown Lake NW compared to Reference Lake 3 (Tables 4.5 and 4.6), which collectively indicated no sediment metal-related influences on the benthic invertebrate community of Sheardown Lake NW. Benthic invertebrate FFG composition differed between lakes as indicated by the occurrence of significantly lower relative abundance of collector-gatherers at profundal stations of Sheardown Lake NW compared to Reference Lake 3 (Table 4.6), but this difference likely reflected naturally higher sediment TOC content, a key food source for the collector-gatherer FFG, at the reference lake (Appendix Table F.37). Overall, no adverse mine-related influences to the benthic invertebrate community of Sheardown Lake NW were indicated in 2017 based on comparisons to reference lake conditions.

Temporal comparisons did not indicate any consistent ecologically significant differences in general community descriptors of density, richness, and Simpson's Evenness at littoral and profundal habitats of Sheardown Lake NW between the mine baseline (2007, 2008, 2013) period and individual years since the commencement of commercial mine operation (2015, 2016, 2017; Figure 4.14; Appendix Tables F.39 and F.40). Although significantly lower density was indicated at profundal habitat of Sheardown Lake NW in both 2015 and 2017 compared to the 2013 baseline study, a significant difference in density was indicated between the 2007 and 2013 baseline studies, and no ecologically significant difference in density was indicated in either 2015 or 2017 during mine operation compared to the 2007 baseline study (Figure 4.14). This indicated that the differences in density between mine-operational and baseline studies at profundal stations of Sheardown Lake NW were likely the result of sampling artifacts (e.g., differences in sampling station locations and/or replication among studies) or natural temporal variability among studies unrelated to potential influences from commercial mine operation. Notably, no significant differences in benthic invertebrate dominant taxonomic groups or FFG were consistently indicated between baseline and mine operational years for littoral or profundal habitats of Sheardown Lake

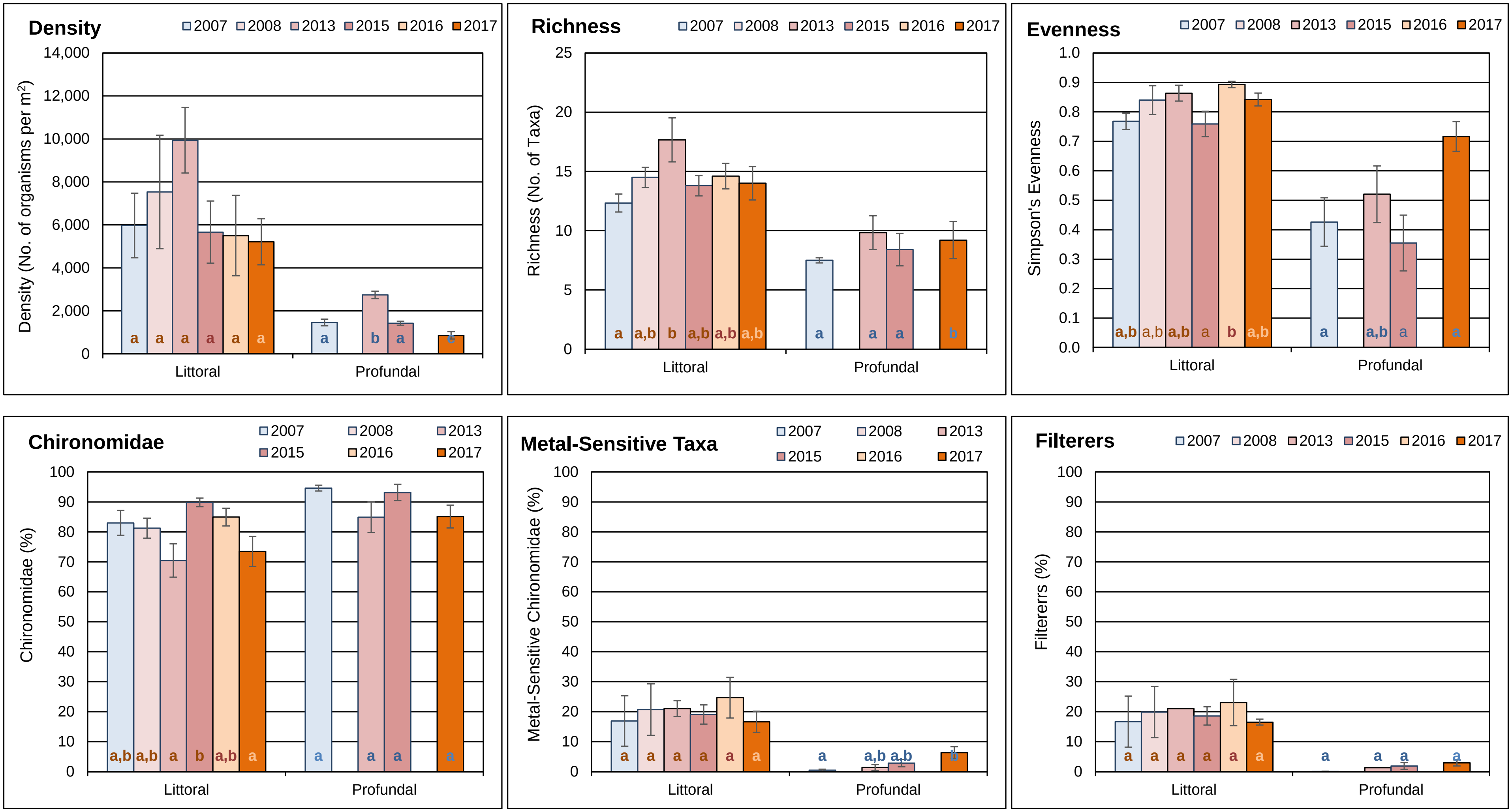


Figure 4.14: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake NW Littoral and Profundal Study Areas among Mine Baseline (2007, 2008, 2013) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

NW (Figure 4.14; Appendix Tables F.39 and F.40). Overall, consistent with no substantial changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Sheardown Lake NW following the commencement of commercial mine operation in 2015.

4.2.6 Fish Population

4.2.6.1 Sheardown Lake NW Fish Community

Arctic charr was the only fish species captured at the northwest basin of Sheardown Lake in 2017, which differed slightly from that of Reference Lake 3 where low numbers of ninespine stickleback were captured at nearshore rocky habitat in addition to arctic charr (Table 4.7). Total fish CPUE was much higher at Sheardown Lake NW than at the reference lake for nearshore electrofishing and for littoral/profundal gill net sampling (Table 4.7), suggesting higher densities and/or productivity of arctic charr at the Sheardown Lake northwest basin. Greater relative abundance of fish, together with higher chlorophyll-a concentrations and greater benthic invertebrate density, suggested that overall biological productivity was higher at Sheardown Lake NW than at Reference Lake 3.

Temporal comparison of the Sheardown Lake NW electrofishing catch data indicated that arctic charr CPUE in 2017 was within the range shown over the mine baseline period (2006-2013), and was also comparable to CPUE during mine construction (2014) and previous studies in the mine operation phase (2015, 2016), at nearshore rocky habitat of the lake (Figure 4.15). The 2017 gill netting CPUE for arctic charr was also within the range shown during the baseline period (Figure 4.15). These results suggested that the relative abundance of arctic charr at the nearshore and littoral/profundal habitats of Sheardown Lake NW in 2017 was similar to baseline studies, in turn suggesting no mine-related influences to arctic charr numbers in the lake.

4.2.6.2 Sheardown Lake NW Fish Population Assessment

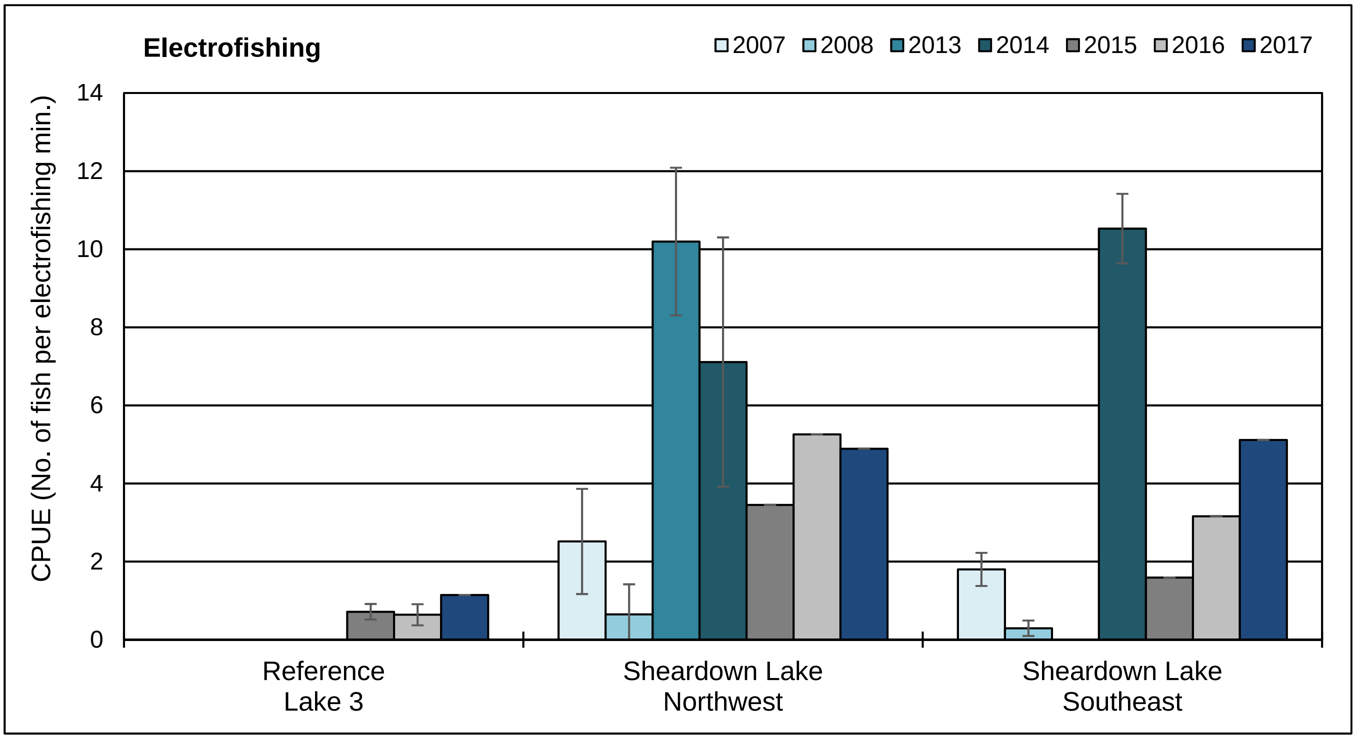
Nearshore Arctic Charr

Mine-related influences on the Sheardown Lake NW nearshore arctic charr population were assessed using a control-impact analysis using data collected from Sheardown Lake NW and Reference Lake 3 in 2017, as well as a before-after analysis using data collected from Sheardown Lake NW in 2017 and during 2013 baseline characterization. A total of 101 and 100 arctic charr were captured at nearshore habitat of Sheardown Lake NW and Reference Lake 3, respectively, in August 2017 for the control-impact analysis. Distinguishing arctic charr YOY from the older, non-YOY age class was possible using a fork length cut-off of 5.0 cm based on evaluation of length-frequency distributions coupled with supporting age determinations for the Sheardown Lake NW and Reference Lake 3 data sets (Figure 4.16). The nearshore arctic charr health

Table 4.7: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Sheardown Lake NW (DLO-01), Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	100	11	111	2
		CPUE	1.03	0.11	1.14	
	Gill netting	No. Caught	1	0	1	
		CPUE	0.02	0	0.02	
Sheardown Lake Northwest	Electrofishing	No. Caught	101	0	101	1
		CPUE	4.89	0	4.89	
	Gill netting	No. Caught	91	0	91	
		CPUE	2.81	0	2.81	
Sheardown Lake Southeast	Electrofishing	No. Caught	100	15	115	2
		CPUE	4.45	0.67	5.11	
	Gill netting	No. Caught	104	0	104	
		CPUE	5.88	0	5.88	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net.



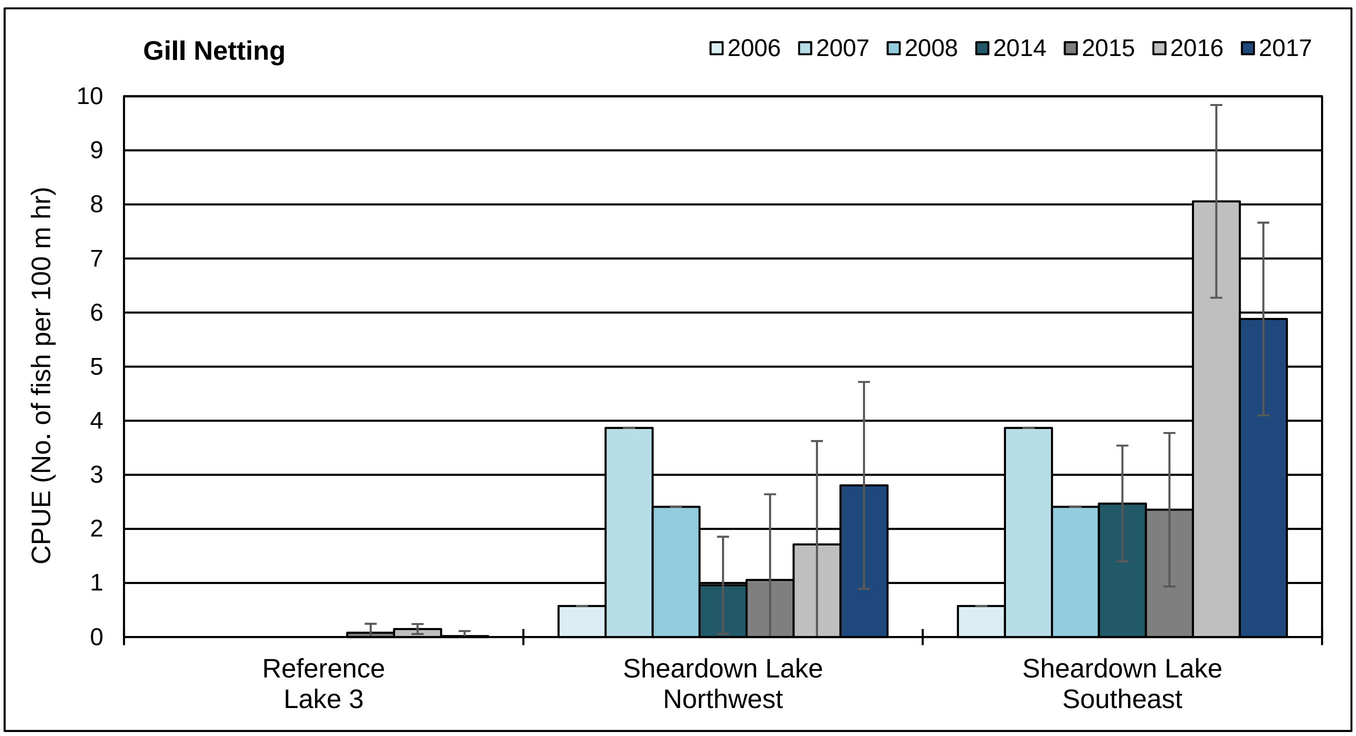


Figure 4.15: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Sheardown Lake NW (DLO-01) and Sheardown Lake SE (DLO-02), Mary River Project CREMP, 2006 - 2017

Notes: Data presented for fish sampling conducted in fall during baseline (2006, 2007, 2008, 2013), construction (2014) and operational (2015, 2016, 2017) mine phases. Lake basins (i.e., NW or SE) were not differentiated historically for baseline gill netting catches.

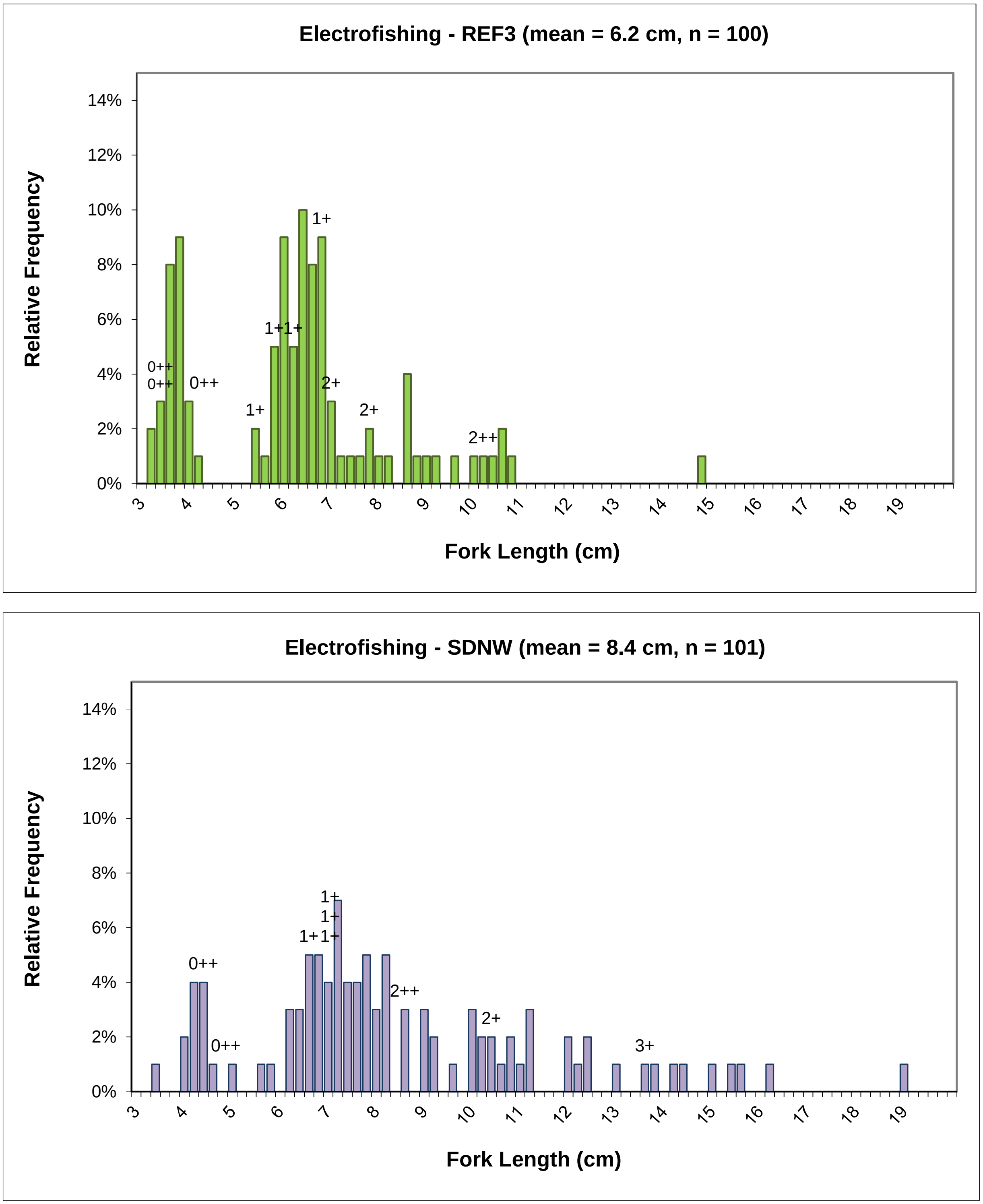


Figure 4.16: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing at Sheardown Lake NW (SDNW) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Note: Fish ages are shown above the bars, where available.

comparisons involved separate assessment of the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these life stages.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake NW and Reference Lake 3 (Table 4.8), potentially reflecting a lower proportion of YOY and larger mean size of individuals captured at Sheardown Lake NW. Arctic charr YOY and non-YOY were longer and heavier at the Sheardown Lake NW nearshore than at the reference lake nearshore, with only fresh body weight of non-YOY not differing significantly between lakes (Table 4.8; Appendix Table G.15). No significant differences in nearshore arctic charr YOY condition (i.e., weight-at-length relationship) were indicated between Sheardown Lake NW and Reference Lake 3, and although condition of non-YOY was significantly greater at Sheardown Lake NW, the magnitude of this difference was within the CES_C of ±10% suggesting that this difference was not ecologically meaningful (Table 4.8; Appendix Table G.15). Overall, these results indicated no substantial differences in the health of nearshore arctic charr between Sheardown Lake NW and reference lake conditions in 2017.

Temporal comparisons of the Sheardown Lake NW nearshore arctic charr data indicated a significantly different length-frequency distribution between 2017 and the combined 2007 and 2013 baseline data (Table 4.8; Appendix Table G.7). Lengths and weights of arctic charr non-YOY captured at the nearshore of Sheardown Lake NW in 2017 did not differ significantly from those fish captured during the mine baseline characterization (Table 4.8). However, as in the two previous CREMP studies, condition of arctic charr non-YOY was significantly lower in 2017 than during baseline studies conducted at Sheardown Lake NW (Table 4.8). Notably, whereas the magnitude of difference in non-YOY condition between 2017 and baseline (i.e., -9%) was just within the CES_C of ±10%, the magnitude of difference in both previous studies was just outside the CES_C compared to the baseline period (Table 4.8). This suggested on-going, lower condition of arctic charr non-YOY at Sheardown Lake NW nearshore habitat following the commencement of commercial mine operations.

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake NW littoral/profundal Arctic charr population were assessed using a before-after analysis between data collected in 2017 and the baseline characterization (combined 2006, 2007, 2008, and 2013) studies. Similar to the two previous CREMP studies, a small sample size from Reference Lake 3 (i.e., n = 1) precluded implementing a control-impact statistical analysis using data collected in 2017. Biological information collected from arctic charr mortalities indicated that non-spawners of reproductive age accounted for approximately 70% of the Sheardown Lake NW Arctic charr population at the time of sampling in August 2017 (Appendix Table G.19). No significant difference in LSI was indicated between

Table 4.8: Summary of Statistical Results for Arctic Charr Population Comparisons between Sheardown Lake NW and Reference Lake 3 in 2015, 2016, and 2017, and between Sheardown Lake NW Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]					
			versus Reference Lake 3			versus Sheardown Lake NW baseline period data [b]		
			2015	2016	2017	2015	2016	2017
Nearshore Electrofishing	Survival	Length-Frequency Distribution	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Nearshore Electrofishing	Survival	Age	No	No	No	No	-	-
Nearshore Electrofishing	Energy Use (non-YOY)	Size (mean weight)	**Yes (+121%)**	**Yes (+60%)**	No	No	**Yes (-29%)**	No
Nearshore Electrofishing	Energy Use (non-YOY)	Size (mean fork length)	**Yes (+29%)**	**Yes (+17%)**	**Yes (+20%)**	No	No	No
Nearshore Electrofishing	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+3%)**	No	**Yes (+7%)**	**Yes (-13%)**	**Yes (-12%)**	**Yes (-9%)**
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**
Littoral/Profundal Gill Netting [c]	Survival	Age	-	-	-	**Yes (-35%)**	**Yes (-28%)**	**Yes (-26%)**
Littoral/Profundal Gill Netting [c]	Energy Use	Size (mean weight)	-	-	-	**Yes (-47%)**	**Yes (-31%)**	**Yes (-9%)**
Littoral/Profundal Gill Netting [c]	Energy Use	Size (mean fork length)	-	-	-	**Yes (-21%)**	**Yes (-14%)**	**Yes (-6%)**
Littoral/Profundal Gill Netting [c]	Energy Use	Growth (weight-at-age)	-	-	-	No	No	**Yes (+24%)**
Littoral/Profundal Gill Netting [c]	Energy Use	Growth (fork length-at-age)	-	-	-	No	No	No
Littoral/Profundal Gill Netting [c]	Energy Storage	Condition (body weight-at-fork length)	-	-	-	**Yes (+8%)**	**Yes (+11%)**	**Yes (+6%)**

[a] Values in parentheses indicate direction and magnitude of any significant differences.
[b] Baseline period data included 2002, 2005, 2006, 2008, and 2013 nearshore electrofishing data and 2006, 2008 and 2013 littoral/profundal gill netting data.
[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

non-spawners and female spawners at Sheardown Lake NW (ANOVA; p = 0.12), suggesting similar energy reserves available for gamete development between these groups. The incidence of body cavity parasites was very high in arctic charr mortalities (i.e., 85%), with sparse to very abundant occurrence of encysted worms observed in affected individuals (Appendix Table G.19). High incidence of internal parasites in arctic charr were noted at Camp Lake in 2017, at all mine-exposed lakes in 2015 and 2016 (Minnow 2016a, 2017), and at the various Mary River Project mine area lakes in baseline studies (NSC 2014, 2015a).

The length-frequency distribution for arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2017 differed significantly from those captured during baseline monitoring (Table 4.8). The differences in length-frequency distribution may have reflected significantly younger and smaller individuals captured in 2017 compared to the baseline period (Table 4.8). No significant difference in length-related growth was indicated in arctic charr captured at Sheardown Lake NW between 2017 and the baseline period, and although arctic charr captured in 2017 showed significantly greater weight-related growth, the magnitude of this difference was within an ecologically meaningful growth CES of ±25% (referred to herein as CES_G; Table 4.6). Arctic charr captured at littoral/profundal areas of Sheardown Lake NW exhibited significantly greater condition in 2017 than during baseline monitoring, but at a magnitude of the difference within the ecologically relevant CES_C of ±10% (Table 4.8; Appendix Table G.20). Notably, the same type and direction of differences in length-frequency distribution, age, mean size, and condition for arctic charr captured at littoral/profundal areas of Sheardown Lake NW were consistently demonstrated from 2015 - 2017 relative to the mine baseline data (Table 4.8). The lack of significant, ecologically meaningful differences in growth combined with significantly greater condition of arctic charr captured at littoral/profundal areas of Sheardown Lake NW in 2017 versus the baseline period suggested no adverse mine-related influences on the adult Arctic charr population of the lake as a result of on-going mine operation.

4.2.7 Integrated Effects Evaluation

At Sheardown Lake NW, aqueous total concentrations of aluminum, manganese, molybdenum, and uranium were elevated compared to the reference lake in 2015, 2016, and 2017, but none of these metals, or any other parameters, showed substantial elevation from concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. As during the previous CREMP studies, total aluminum and manganese concentrations showed strong positive correlations with turbidity in 2017 that, in turn, suggested that these metals were largely bound to/contained in suspended particulate matter and were not likely biologically available. High turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Sediment metal concentrations at littoral and profundal stations of Sheardown Lake NW were very similar to averages observed for the same respective station types at Reference Lake 3 in 2017, suggesting no marked mine-related influences on sediment metal concentrations in Sheardown Lake NW. Mean concentrations of iron and manganese were above SQG in sediment of Sheardown Lake NW, but concentrations of these metals were also above SQG at the reference lake. Although iron, manganese, and nickel concentrations were above AEMP benchmarks at individual littoral and profundal stations, on average, concentrations of these and all other metals were below their respective AEMP benchmarks at Sheardown Lake NW in 2017. Temporal comparisons indicated that metal concentrations in sediment of Sheardown Lake NW in 2017 were within baseline ranges, indicating no substantial mine-related influences on sediment quality over time at the northwest lake basin.

Chlorophyll-a concentrations at Sheardown Lake NW were significantly higher than at the reference lake in 2017 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2017 at Sheardown Lake NW, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Sheardown Lake NW since commencement of commercial mine operations. The benthic invertebrate community of Sheardown Lake NW showed significantly higher density but no ecologically significant differences in Simpson's Evenness and relative abundance of dominant groups including metal-sensitive chironomids compared to the reference lake in 2017. The occurrence of higher benthic invertebrate density without an accompanying difference in Simpson's Evenness or compositional change in dominant taxonomic groups suggested that Sheardown Lake NW was simply more productive than Reference Lake 3, and was not adversely influenced by mine operations in 2017. No ecologically significant differences in primary benthic invertebrate community metrics, dominant taxonomic groups, or FFG were consistently indicated between the mine baseline (2007, 2013) period and individual years since the commencement of commercial mine operation (2015, 2016, 2017) at Sheardown Lake NW. Analysis of arctic charr populations suggested greater fish abundance at Sheardown Lake NW compared to the reference lake in 2017, but similar numbers of arctic charr in 2017 compared to Sheardown Lake baseline studies. Arctic charr captured at nearshore habitat of Sheardown Lake NW showed no ecologically significant differences in size and condition compared to those captured at the reference lake in 2017, and to those captured from the northwest basin during baseline studies. In addition, arctic charr captured at Sheardown Lake NW in 2017 showed slightly faster growth and greater condition compared to those captured during baseline studies, but the magnitude of these differences were not ecologically meaningful. Collectively, the chlorophyll-a, benthic invertebrate community and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake NW in the third year of mine operation at the Mary River Project.

4.3 Sheardown Lake Southeast (DLO-2)

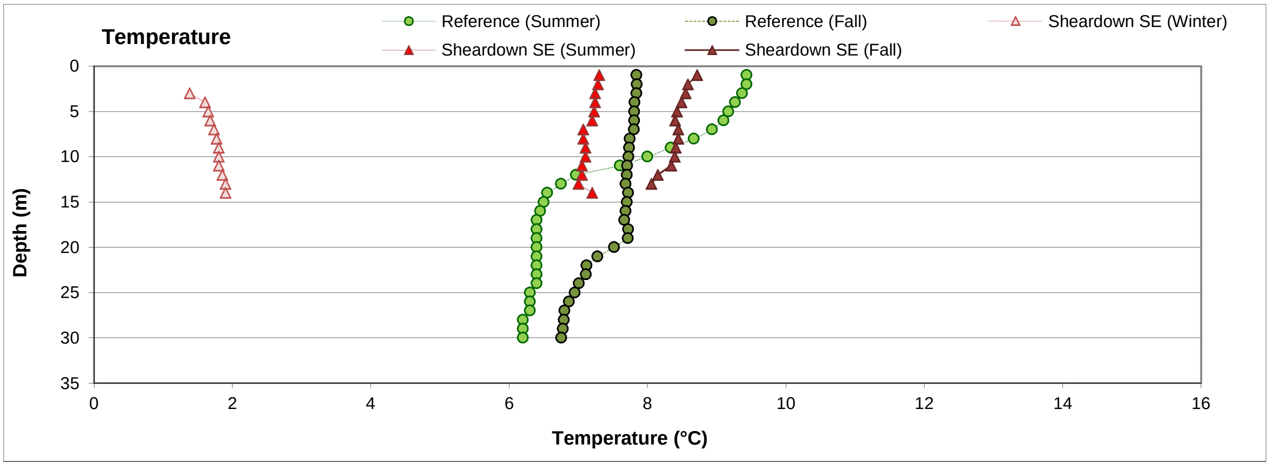
4.3.1 Hydraulic Retention Time

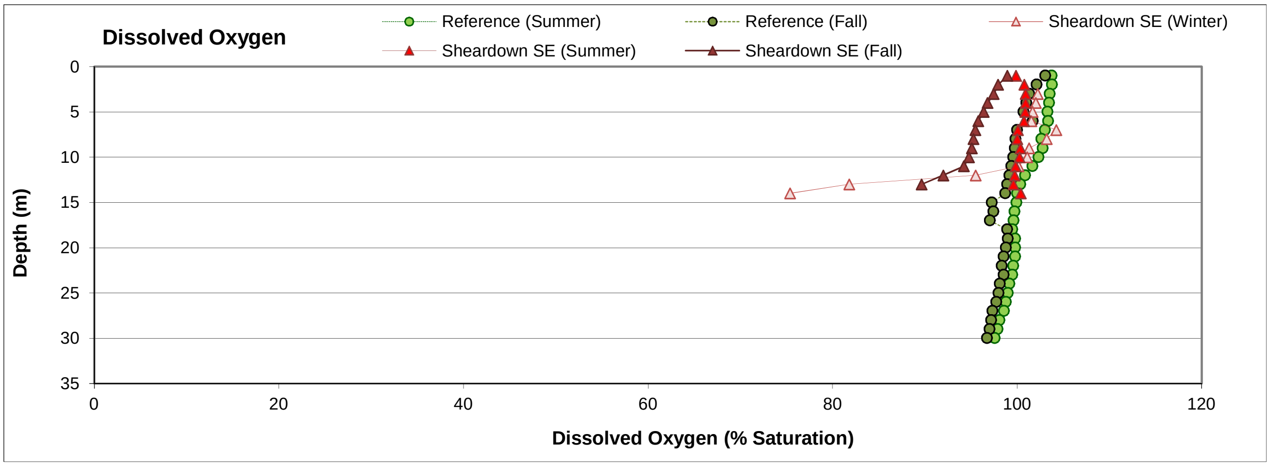
A hydraulic retention time of 83 ± 35 days was estimated for Sheardown Lake SE using mean annual watershed runoff (2007 – 2016 data) extrapolated from Baffinland flow monitoring stations installed in small watershed watercourses (i.e., ≤15 km^2) located on the mine property and a lake volume of 1.80 million cubic metres (from NSC 2015b).

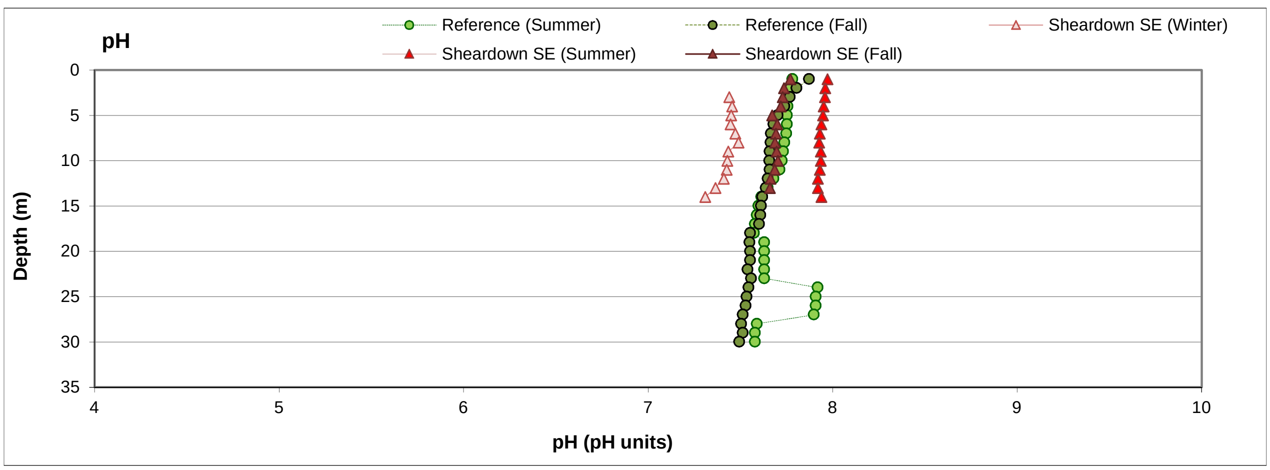
4.3.2 Water Quality

Vertical water quality profiles of *in situ* water temperature, dissolved oxygen, pH, and specific conductance conducted at Sheardown Lake SE showed no substantial station-to-station differences during any of the winter, summer, or fall sampling events in 2017 (Appendix Figures C.15 to C.18). No thermal stratification was evident at the Sheardown Lake SE basin during any of the winter, summer, or fall sampling events (Figure 4.17). The summer water temperature profile at Sheardown Lake SE did not show the gradual decrease in temperature with depth that was shown at the reference lake through the upper 14 m of the water column, but a similar profile structure was indicated between these lakes during the fall (Figure 4.17). Mean temperature near the bottom of the water column at littoral stations did not differ significantly between Sheardown Lake SE and Reference Lake 3 in fall 2017 (Figure 4.8; Appendix Table C.53). However, mean water temperature near the bottom at profundal stations was significantly warmer at Sheardown Lake SE than at the reference lake, reflecting significantly shallower profundal station depth at the former (Figure 4.8; Appendix Table C.53). Notably, Sheardown Lake SE is a much smaller and shallower waterbody than Reference Lake 3 (see Figure 2.1; Appendix Table B.1), and therefore heat distribution patterns (i.e., thermal profiles) may be expected to differ naturally between these lakes.

Dissolved oxygen profiles at Sheardown Lake SE in 2017 showed no substantial change in saturation with depth during summer, but oxycline development characterized by decreasing saturation levels with increasing depth occurring at depths greater than 11 m during the winter and fall sampling events (Figure 4.17). No oxycline had developed in summer or fall at Reference Lake 3 in 2017 (Figure 4.17). Dissolved oxygen saturation levels at the bottom of the water column at littoral and profundal stations of Sheardown Lake SE were significantly lower than at Reference Lake 3 during fall 2017 sampling (Figure 4.8; Appendix Table C.53). However, in all cases, dissolved oxygen saturation levels were well above WQG (54% saturation, or 9.5 mg/L) at Sheardown Lake SE at all depths during the winter, summer, and fall sampling events in 2017







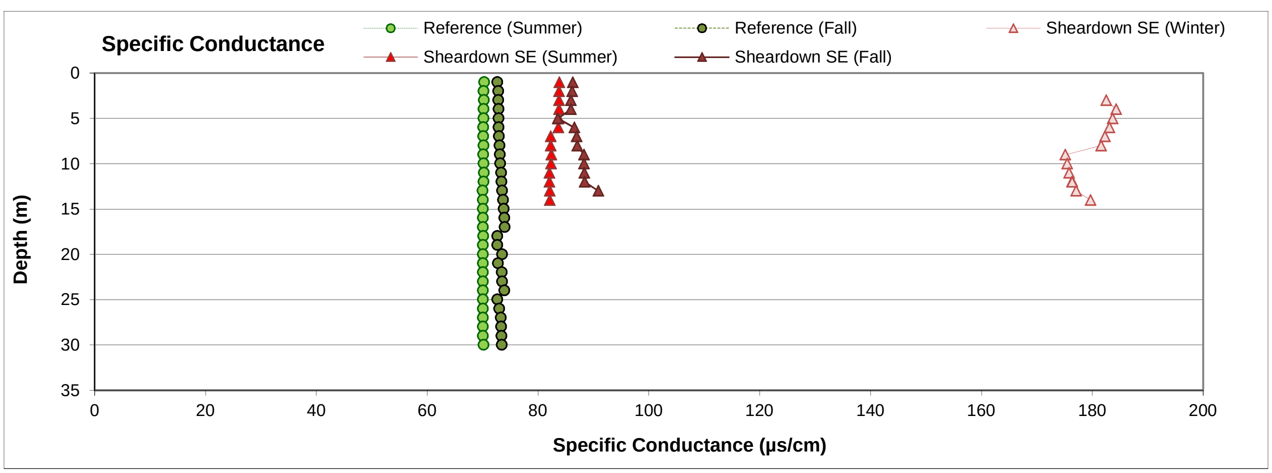


Figure 4.17: Average *In Situ* Water Quality with Depth from Surface at Sheardown Lake SE (DLO-02) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2017

(Figures 4.8 and 4.17), indicating that dissolved oxygen was not likely to be limiting to pelagic or bottom-dwelling biota within the lake.

In situ profiles of pH and specific conductance showed no substantial change from the surface to the bottom of the Sheardown Lake SE water column, indicating no chemical stratification (Figure 4.17). Similar to the northwest basin, pH was significantly higher (i.e., more alkaline) at the bottom of the water column at both littoral and profundal stations of Sheardown Lake SE compared to the reference lake during the 2017 fall sampling event, and was consistently within WQG limits in 2017 at Sheardown Lake SE (Figure 4.8; Appendix Table C.53; Figure 4.17). Specific conductance was significantly higher at Sheardown Lake SE compared to the reference lake during 2017 fall sampling (Figure 4.8). However, mean specific conductance at Sheardown Lake SE (i.e., 99 µS/cm) was intermediate to that of the reference creek and river areas (i.e., range from 55 – 168 µS/cm) in fall 2017. Therefore, similar to previous CREMP studies, the extent to which higher specific conductance at Sheardown Lake SE was related to natural regional variability or a mine-related influence was unclear. Water clarity at the southeast basin of Sheardown Lake was the lowest among the mine-exposed lakes (Appendix Figure C.7). Secchi depth readings from Sheardown Lake SE were significantly lower (shallower) than at Reference Lake 3 during the 2017 fall sampling event, but were relatively consistent among stations, suggesting no spatial differences in water clarity of the lake (Appendix Tables C.51 and C.53).

Water chemistry at Sheardown Lake SE showed no consistent spatial changes in parameter concentrations among the five lake sampling stations during any of the winter, summer, or fall sampling events in 2017 (Table 4.9; Appendix Table C.54), suggesting that the lake waters were generally well mixed both laterally and vertically. Total aluminum concentrations were highly elevated (i.e., ≥10-fold), turbidity and concentrations of total manganese and tin were moderately elevated (i.e., 5- to 10-fold), and concentrations of total molybdenum were slightly elevated (i.e., 3- to 5-fold), at Sheardown Lake SE compared to Reference Lake 3 during the 2017 summer and/or fall sampling events (Table 4.9; Appendix Tables C.44 and C.54). Dissolved aluminum and molybdenum concentrations were also slightly elevated at Sheardown Lake SE compared to the reference lake, but only during the fall sampling event (Appendix Table C.56). Similar to the northwest basin, total aluminum concentrations showed strong positive correlations with turbidity for the Sheardown Lake SE combined data set (i.e., winter, summer, and fall data; $r_s = 0.92$), suggesting that much of the aqueous aluminum was associated with suspended particles (Appendix Table C.57). This was corroborated by comparison of total and dissolved fractions of aluminum, which indicated that on average, most (i.e., 78%) was in particulate form at Sheardown Lake SE (compare Appendix Tables C.54 and C.55). Higher turbidity at Sheardown Lake SE, and lower water clarity (Secchi depth) associated with this turbidity, likely reflected backflow received from the Mary River, which directly affects water levels and chemistry of the southeast

Table 4.9: Water Chemistry at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3) Monitoring Stations[a], Mary River Project CREMP, August 2017

Parameters		Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	Sheardown Lake Southeast (SDSE) Station				
						DL0-02-6	DL0-02-7	DL0-02-4	DL0-02-8	DL0-02-3
					Fall 2017	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	76	104	102	102	102	102
	pH (lab)	pH	6.5 - 9.0	-	7.76	7.91	7.92	7.94	7.89	7.92
	Hardness (as $CaCO_3$)	mg/L	-	-	35	49	48	49	48	49
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2.1	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	33	54	46	46	38	45
	Turbidity	NTU	-	-	0.7	4.0	3.6	3.8	4.0	4.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	31	44	46	45	44	44
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.65	1.40	1.50	1.25	1.25	1.40
	Total Organic Carbon	mg/L	-	-	2.83	1.50	1.45	1.40	1.45	1.45
	Total Phosphorus	mg/L	0.020[α]	-	0.0040	0.0068	0.0059	0.0062	0.0070	0.0076
	Phenols	mg/L	0.004[α]	-	0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.28	2.17	2.11	2.11	2.11	2.10
	Sulphate (SO_4)	mg/L	218[β]	218	3.97	3.09	2.97	2.96	2.95	2.93
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[d]	0.005	0.086	0.089	0.083	0.076	0.080
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0061	0.0061	0.0061	0.0061	0.0061
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.93	9.60	9.19	9.47	9.43	9.57
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0008	0.0009	0.0008	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	0.067	0.065	0.065	0.065	0.060
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.0000925	0.000091	0.0000915	0.0000905	0.0000895
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.44	5.96	5.88	5.94	5.95	5.91
	Manganese (Mn)	mg/L	0.935[β]	-	0.00063	0.00392	0.00363	0.00373	0.00376	0.00342
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000124	0.0004435	0.000423	0.0004375	0.00043	0.000434
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.000605	0.00058	0.000595	0.0006	0.000565
	Potassium (K)	mg/L	-	-	0.88	0.94	0.92	0.92	0.92	0.91
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.408	0.595	0.625	0.610	0.615	0.600
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.85	1.11	1.11	1.10	1.09	1.07
	Strontium (Sr)	mg/L	-	-	0.0078	0.0068	0.0066	0.0068	0.0067	0.0067
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<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
	Uranium (U)	mg/L	0.015	-	0.00025	0.00063	0.00060	0.00061	0.00061	0.00060
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-	-	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake SE.

[d] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively (Intrinsik 2013).

(grey box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

basin during moderate to high flow periods. In contrast with aluminum, molybdenum concentrations at Sheardown Lake SE were not strongly correlated with turbidity, suggesting that slight elevation in molybdenum compared to Reference Lake 3 was related to mine operation and/or natural geochemical differences between these lakes. Despite elevation of the metals at Sheardown Lake SE, parameter concentrations were typically well below established WQG and AEMP benchmarks during the winter, summer, and fall sampling events in 2017 (Table 4.9; Appendix Table C.54).

Temporal comparisons of the Sheardown Lake SE water chemistry data indicated no appreciable changes in average parameter concentrations between the 2017 study and mine baseline (2005 – 2013) period, the only exception of which was a slightly elevated average dissolved aluminum concentration in fall 2017 (Figure 4.9; Appendix Figure C.19). As indicated above, because aluminum concentrations were strongly correlated with turbidity, higher dissolved aluminum concentrations in fall 2017 compared to baseline at Sheardown Lake SE likely reflected natural phenomena (e.g., surface runoff events). No parameters showed consistently higher concentrations annually over the mine construction (2014) and 2015 – 2017 mine operational stages with the exception of sulphate (Figure 4.9; Appendix Figure C.19), suggesting a potential mine-related source of this constituent. However, average sulphate concentrations at Sheardown Lake SE of approximately 3 mg/L in 2017 remained well below the WQG of 218 mg/L, indicating adverse effects associated with sulphate concentrations were highly unlikely.

4.3.3 Sediment Quality

Surficial sediment at Sheardown Lake SE was represented predominantly by silt loam material containing low TOC content at both littoral and profundal habitats (Figure 4.18; Appendix Table D.31). Substrate at littoral stations of Sheardown Lake SE contained significantly lower sand and TOC content, and significantly greater silt and clay content, than at Reference Lake 3 (Appendix Table D.5). The relatively high proportion of fines in substrate of Sheardown Lake SE potentially reflects the receipt of Mary River backflow during high flow periods, which can be expected to result in the deposition of high quantities of naturally suspended, fine-grained material. Similar to observations at the other mine-exposed lakes and the reference lake, iron (oxy)hydroxide material was visible in surficial and/or sub-surface substrate of Sheardown Lake SE, in some cases occurring as a thin, distinct layer or floc (Appendix Table D.30). Below the surficial layer, substrates at Sheardown Lake SE exhibited some sporadic blackening and, at one station, had a slight sulphidic odour, suggesting development of reducing conditions. However, no distinct redox boundary was observed in the littoral station sediments (Appendix Table D.30). Observations regarding reducing sediment conditions at Sheardown Lake SE were similar to

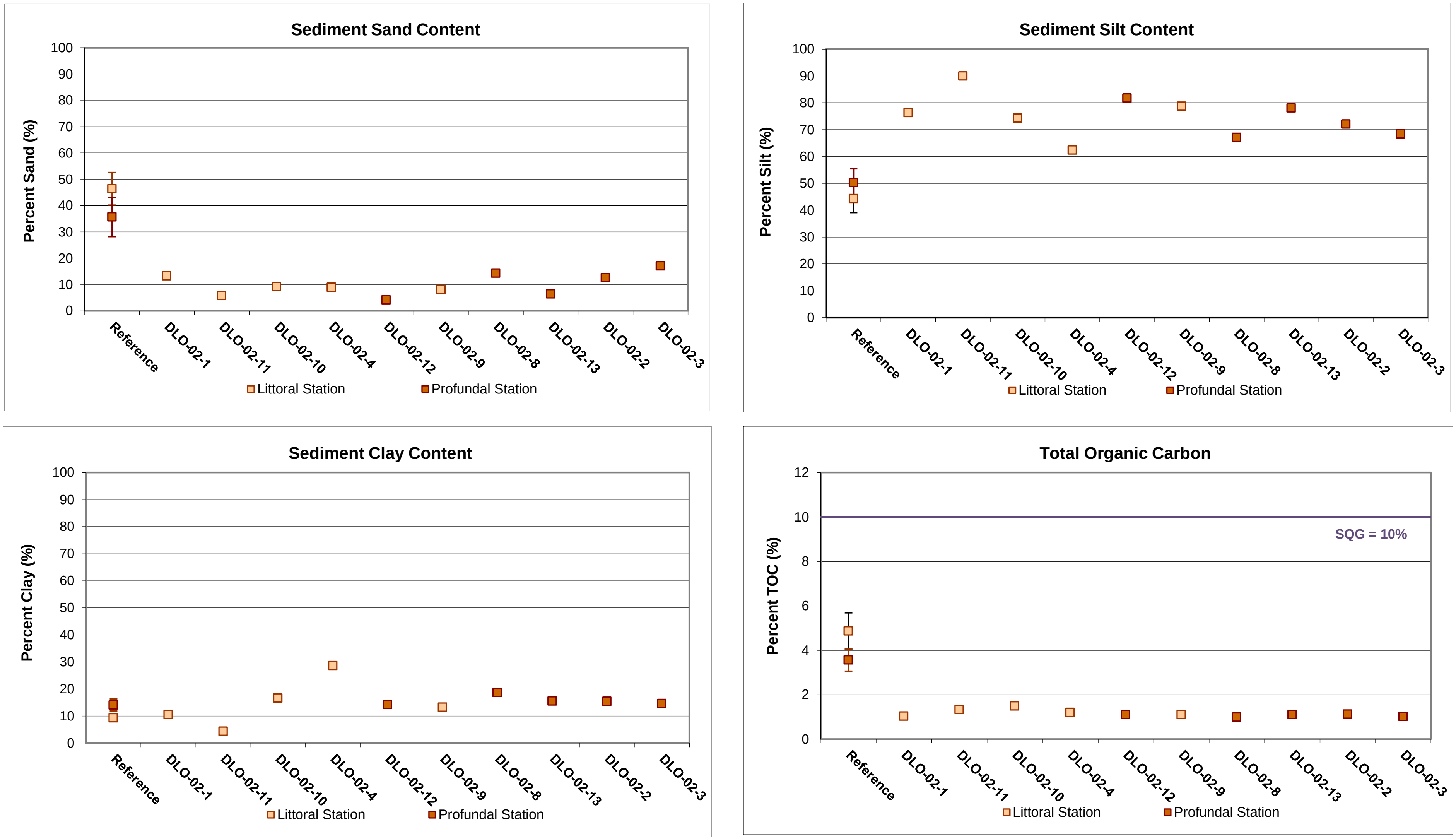


Figure 4.18: **Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Sheardown Lake SE (DLO-02) Sediment Monitoring Stations and Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2017**

those made at Reference Lake 3 (Appendix Tables D.3 and D.30), suggesting that factors leading to reduced sediment conditions were comparable between lakes.

Sediment metal concentrations at Sheardown Lake SE showed no clear spatial gradients with progression towards the lake outlet in 2017, suggesting no clear point sources of metals to the lake (Appendix Table D.32). Metal concentrations were considerably higher in sediment of Sheardown Lake SE than in deposited sediment at SDLT9 and Mary River (EO-20) lotic environments that are connected to the southeast basin (Appendix Table D.35), reflecting the depositional nature of lake habitat versus erosional characteristics of the lotic systems. With the exception of very slightly elevated manganese concentrations, sediment metal concentrations at littoral and profundal stations of Sheardown Lake SE were, on average, similar to those observed for the same respective station types at Reference Lake 3 in 2017 (Table 4.4; Appendix Table D.33) suggesting no marked mine-related influences on sediment metal concentrations at the southeast lake basin. Mean iron and manganese concentrations were above respective SQG and AEMP benchmarks at the Sheardown Lake SE littoral stations (Table 4.4; Appendix Table D.32). As indicated previously, average concentrations of iron and manganese were also above respective SQG at littoral and/or profundal stations of Reference Lake 3 (Table 4.4). In turn, this suggested that the elevation of iron and manganese concentrations in sediment of Sheardown Lake SE relative to SQG reflected natural lake conditions in the mine local study area. Arsenic, chromium, nickel, and phosphorus concentrations were above site-specific AEMP benchmarks at individual littoral and profundal stations of the southeast basin, but on average, concentrations of these metals were below their respective AEMP benchmarks at Sheardown Lake SE in 2017 (Table 4.4; Appendix Table D.32).

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Sheardown Lake SE in 2017 were comparable to those observed during the mine baseline (2005 – 2013) period. The only exception to this was slight elevation (i.e., 3- to 5-fold higher) in the average manganese concentration at littoral stations of the lake in 2017 (Figure 4.11; Appendix Table D.33). On average, metal concentrations in sediment at respective Sheardown Lake SE littoral and profundal stations in 2017 were also within the range of those observed from 2015 and 2016, with no consistently higher concentrations occurring that would suggest an increasing trend over time (Figure 4.11; Appendix Table D.34). This contrasted with the results of the previous CREMP study, which suggested progressively higher concentrations of arsenic and manganese at littoral stations of Sheardown Lake SE from baseline, to mine construction, to 2015 and 2016 mine operational years (Figure 4.11; Minnow 2017). Changes in station replication and location among studies likely contributed to the appearance of greater mean concentrations of these parameters in sediment at the Sheardown Lake SE littoral stations leading into 2016. However, based on evaluation of data current to 2017, perhaps with the exception of a step-increase in concentrations of manganese at littoral stations, no substantial changes in sediment metal concentrations were indicated at Sheardown Lake SE littoral and profundal stations following the commencement of Baffinland commercial mine operations in 2015.

4.3.4 Phytoplankton

Chlorophyll-a concentrations at Sheardown Lake SE showed no spatial gradients with closer proximity to the lake outlet during any of the winter, summer, or fall sampling events in 2017 (Figure 4.12). Chlorophyll-a concentrations did not differ significantly among the winter, summer, and fall sampling events in 2017, reflecting comparable concentrations among seasons (Appendix Table E.6). Similar to Camp Lake and Sheardown Lake NW, chlorophyll-a concentrations at the Sheardown Lake SE were significantly higher than at the reference lake for both the summer and fall sampling events in 2017 (Appendix Table E.7 and E.8), but concentrations were well below the AEMP benchmark of 3.7 µg/L at all stations and for all sampling events in 2017 (Figure 4.12). On average, chlorophyll-a concentrations at Sheardown Lake SE indicated an 'oligotrophic' trophic status as defined by Wetzel (2001). This trophic status classification was consistent with a CWQG oligotrophic categorization for Sheardown Lake SE based on mean total phosphorus concentrations below 10 µg/L during all sampling events (Table 4.8; Appendix Table C.54).

Temporal comparison of Sheardown Lake SE chlorophyll-a concentrations did not indicate any consistent direction of significant differences between the 2017 data and data from the mine construction (2014) period or previous years of mine operation (2015, 2016) among the winter, summer, or fall seasons (Figure 4.13). Annual average chlorophyll-a concentrations did not differ significantly among 2014, 2015, and 2017, but chlorophyll-a concentrations from each of these years were significantly lower than in 2016 (Appendix Table E.13). The variable differences in chlorophyll-a concentrations among years at Sheardown Lake SE may reflect the combination of mine-related influences (as suggested in 2016; Minnow 2017) and variable influence of Mary River on Sheardown Lake SE water levels, hydraulic retention time, and/or chemistry among years/seasons. Depending on flow conditions, Mary River discharges into (high flow periods) or drains (low flow periods) Sheardown Lake SE, respectively. No chlorophyll-a baseline (2005 – 2013) data are available for Sheardown Lake SE, precluding comparisons to conditions prior to the mine construction period.

4.3.5 Benthic Invertebrate Community

Benthic invertebrate density was significantly higher at littoral habitat of Sheardown Lake SE than at like-habitat stations of Reference Lake 3, the magnitude of which was outside of the CES_{BIC} of ±2 SD_{REF} (Table 4.10). However, no ecologically significant differences in richness or Simpson's

Evenness were indicated between study lakes at littoral sampling depths. Similar to the northwest basin, differences in littoral habitat benthic invertebrate community structure were indicated between Sheardown Lake SE and Reference Lake 3 based on significantly differing Bray-Curtis Index (Table 4.10). In addition to the substantial difference in density between lakes, the differences in Bray-Curtis Index likely reflected significantly lower and higher relative abundance of Ostracoda (seed shrimp) and Chironomidae (non-biting midges), respectively, at littoral habitat of Sheardown Lake SE compared to like-habitat stations at the reference lake (Table 4.10). The differences in littoral habitat benthic invertebrate community structure between Sheardown Lake SE and Reference Lake 3 almost certainly reflected marked differences in physical sediment properties between lakes, which included significantly lower TOC content and greater proportion of silt at Sheardown Lake SE littoral stations (Appendix Table F.41). Ostracoda are categorized within the collector-gatherer FFG, and because TOC serves as a key food source for this FFG, lower relative abundance of this taxonomic group was consistent with lower sediment TOC content at Sheardown Lake SE compared to the reference lake (Appendix Table F.41). Similarly, Ostracoda are categorized within the sprawler HPG, and because more compact sediments support fewer numbers of invertebrates exhibiting this mode of existence in lake environments, lower relative abundance of Ostracoda was consistent with the occurrence of finer-grained, compact sediment at Sheardown Lake SE compared to the reference lake (Appendix Table F.41). Therefore, the differences in littoral habitat benthic invertebrate community structure between Sheardown Lake SE and the reference lake likely reflected natural differences in substrate properties that included lower sediment TOC and greater compactness at Sheardown Lake SE. Notably, the relative abundance of metal-sensitive chironomids did not differ significantly between Sheardown Lake SE and Reference Lake 3 (Table 4.10), indicating no sediment metal-related influences on the benthic invertebrate community of Sheardown Lake SE. Overall, no adverse mine-related influence to the littoral benthic invertebrate community of Sheardown Lake SE was indicated in 2017 based on comparisons to reference lake conditions. In addition, as observed at the other mine-exposed lakes, higher benthic invertebrate density also suggested naturally higher secondary productivity at Sheardown Lake SE compared to reference lake conditions.

Marked, ecologically significant, differences in density, richness, Bray-Curtis Index, and relative abundance of collector-gatherer FFG and sprawler and burrower HPG were indicated between Sheardown Lake SE and Reference Lake 3 for profundal habitat (Table 4.11). However, the differences in benthic invertebrate community endpoints between lakes likely reflected significantly shallower 'profundal' sampling depths at Sheardown Lake SE compared to the reference lake, which on average differed by 8.1 m (Appendix Table F.41). Natural depth-related influences on benthic invertebrate community structure that include lower density and richness at greater depth in lake environments are well documented (Ward 1992; Armitage et al. 1995), and

Table 4.10: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	none	YES	0.003	ANOVA	3.4	Reference Lake 3	1,489	850	380	372	2,618
						Sheardown SE Littoral	4,417	1,317	589	2,259	5,671
Richness (Number of Taxa)	square root	YES	0.030	t-test (unequal variance)	-1.4	Reference Lake 3	12.4	2.5	1.1	10.0	15.0
						Sheardown SE Littoral	9.0	0.7	0.3	8.0	10.0
Simpson's Evenness (E)	none	NO	0.197	ANOVA	-0.7	Reference Lake 3	0.807	0.142	0.063	0.605	0.934
						Sheardown SE Littoral	0.712	0.055	0.024	0.634	0.771
Bray-Curtis Index	rank	YES	0.009	Mann-Whitney	4.4	Reference Lake 3	0.384	0.120	0.054	0.203	0.536
						Sheardown SE Littoral	0.916	0.006	0.003	0.908	0.924
Nemata (%)	log(X+1)	YES	0.017	ANOVA	-1.0	Reference Lake 3	3.9	3.3	1.5	0.8	9.1
						Sheardown SE Littoral	0.5	0.6	0.3	0.0	1.5
Hydracarina (%)	none	NO	0.182	ANOVA	-0.7	Reference Lake 3	5.3	3.0	1.4	1.8	8.1
						Sheardown SE Littoral	3.1	1.5	0.7	1.5	5.3
Ostracoda (%)	square root	YES	< 0.001	ANOVA	-2.1	Reference Lake 3	38.8	18.4	8.2	22.3	63.9
						Sheardown SE Littoral	0.8	0.8	0.4	0.2	2.1
Chironomidae (%)	none	YES	0.005	t-test (unequal variance)	2.4	Reference Lake 3	51.8	17.9	8.0	29.5	67.9
						Sheardown SE Littoral	95.6	1.8	0.8	92.8	97.3
Metal-Sensitive Chironomidae (%)	square root	NO	0.903	ANOVA	-0.3	Reference Lake 3	15.5	13.4	6.0	0.5	37.0
						Sheardown SE Littoral	12.1	4.2	1.9	6.2	16.2
Collector-Gatherers (%)	none	YES	0.050	ANOVA	-1.6	Reference Lake 3	73.9	16.0	7.2	56.0	95.5
						Sheardown SE Littoral	48.4	18.8	8.4	34.7	80.1
Filterers (%)	square root	NO	0.999	ANOVA	-0.2	Reference Lake 3	14.7	13.3	5.9	0.5	36.4
						Sheardown SE Littoral	12.1	4.2	1.9	6.2	16.2
Shredders (%)	rank	YES	0.037	Mann-Whitney	-0.6	Reference Lake 3	4.2	6.6	3.0	0.0	15.9
						Sheardown SE Littoral	0.0	0.0	0.0	0.0	0.0
Clingers (%)	none	NO	0.474	ANOVA	-0.4	Reference Lake 3	19.8	12.8	5.7	2.7	38.1
						Sheardown SE Littoral	15.2	5.6	2.5	7.7	21.5
Sprawlers (%)	none	YES	0.004	ANOVA	-2.5	Reference Lake 3	72.6	13.9	6.2	55.7	92.9
						Sheardown SE Littoral	37.7	14.2	6.4	14.2	51.5
Burrowers (%)	log	YES	< 0.001	ANOVA	13.0	Reference Lake 3	7.5	3.0	1.4	4.5	12.0
						Sheardown SE Littoral	47.1	18.2	8.1	34.3	78.2

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value less than 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 4.11: Benthic Invertebrate Community Statistical Comparison Results between Sheardown Lake SE (DLO-02) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	fourth root	YES	< 0.001	ANOVA	96.9	Reference Lake 3	149	32	14	113	190
						Sheardown SE Profundal	3,234	880	394	2,277	3,999
Richness (Number of Taxa)	square root	YES	0.002	ANOVA	3.1	Reference Lake 3	4.2	1.5	0.7	2.0	6.0
						Sheardown SE Profundal	8.8	1.6	0.7	7.0	11.0
Simpson's Evenness (E)	none	NO	0.409	ANOVA	-0.5	Reference Lake 3	0.704	0.105	0.047	0.597	0.843
						Sheardown SE Profundal	0.651	0.086	0.039	0.547	0.768
Bray-Curtis Index	none	YES	< 0.001	t-test (unequal variance)	6.4	Reference Lake 3	0.239	0.114	0.051	0.111	0.376
						Sheardown SE Profundal	0.975	0.008	0.004	0.964	0.983
Hydracarina (%)	none	YES	0.035	ANOVA	-1.1	Reference Lake 3	8.2	5.5	2.5	0.0	15.0
						Sheardown SE Profundal	1.9	0.7	0.3	0.7	2.6
Ostracoda (%)	fourth root	NO	0.779	ANOVA	-0.4	Reference Lake 3	2.8	4.1	1.8	0.0	8.9
						Sheardown SE Profundal	1.0	1.4	0.6	0.0	3.6
Chironomidae (%)	log	YES	0.046	ANOVA	1.1	Reference Lake 3	89.0	7.6	3.4	81.6	100.0
						Sheardown SE Profundal	97.1	1.6	0.7	94.5	98.9
Metal-Sensitive Chironomidae (%)	none	NO	0.960	ANOVA	0.0	Reference Lake 3	12.0	8.9	4.0	0.0	20.2
						Sheardown SE Profundal	12.3	9.5	4.2	3.0	28.0
Collector-Gatherers (%)	none	YES	0.001	ANOVA	-9.5	Reference Lake 3	84.3	4.1	1.9	79.8	90.5
						Sheardown SE Profundal	45.1	17.4	7.8	18.5	64.8
Filterers (%)	fourth root	YES	0.092	ANOVA	0.6	Reference Lake 3	6.5	9.3	4.2	0.0	20.2
						Sheardown SE Profundal	12.2	9.6	4.3	3.0	28.0
Clingers (%)	log	NO	0.642	ANOVA	-0.1	Reference Lake 3	14.6	4.9	2.2	9.5	20.2
						Sheardown SE Profundal	14.1	9.5	4.3	5.2	29.9
Sprawlers (%)	square root	YES	0.005	ANOVA	-6.1	Reference Lake 3	81.4	6.3	2.8	74.8	90.5
						Sheardown SE Profundal	42.8	20.1	9.0	24.6	70.7
Burrowers (%)	none	YES	0.001	ANOVA	10.5	Reference Lake 3	3.9	3.7	1.7	0.0	8.0
						Sheardown SE Profundal	43.1	17.0	7.6	17.5	62.5

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value less than 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

were consistently evident at Reference Lake 3 from 2015 to 2017 (Appendix B) indicating similar influences in pristine lakes of the Mary River Project region. Notably, the maximum depth of Sheardown Lake SE is approximately 14 m (Appendix Table B.1). Because littoral habitat for the Mary River Project CREMP is defined as depths ≤12 m, benthic invertebrate community data collected from profundal depths of Sheardown Lake SE are not directly comparable to those collected at the other mine-exposed lakes nor to Reference Lake 3, all of which attain maximum depths ranging from 30 – 40 m (Appendix Table B.1). Nevertheless, the relative abundance of metal-sensitive chironomids at 'profundal' depths of Sheardown Lake SE were comparable to those observed at littoral habitat as well as to those observed at Reference Lake 3 (Tables 4.10 and 4.11). In turn, this suggested no sediment metal-related influences on the profundal benthic invertebrate community of Sheardown Lake SE in 2017.

Temporal comparisons did not indicate any consistent ecologically significant differences in general community descriptors of richness and Simpson's Evenness at littoral and profundal habitats of Sheardown Lake SE between mine baseline studies (2007, 2013) and individual years since the commencement of commercial mine operation (2015, 2016, 2017; Figure 4.19; Appendix Tables F.43 and F.44). Although significantly lower density was indicated at littoral and profundal habitat of Sheardown Lake SE in at least one individual year of mine operation compared to the 2007 and/or 2013 baseline study data, the differences were not consistent among all years for both habitat types, nor for comparisons against both years of baseline studies (Appendix Tables F.43 and F.44). No significant differences in benthic invertebrate dominant taxonomic groups or FFG were indicated between the baseline and mine operational years for littoral or profundal habitats of Sheardown Lake SE (Figure 4.19; Appendix Tables F.43 and F.44). Because density was the only benthic invertebrate community metric that differed significantly between mine-operational and baseline studies at Sheardown Lake SE, natural temporal variability among studies most likely accounted for the indicated differences. Overall, consistent with no substantial changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Sheardown Lake SE following the commencement of commercial mine operation in 2015.

4.3.6 Fish Population

4.3.6.1 Sheardown Lake SE Fish Community

The Sheardown Lake SE fish community was composed of arctic charr and ninespine stickleback, reflecting the same fish species composition as the reference lake, in 2017 (Table 4.7). However, total fish CPUE was much higher at Sheardown Lake SE than at Reference Lake 3 for electrofishing and gill netting collection methods, suggesting higher densities and/or productivity

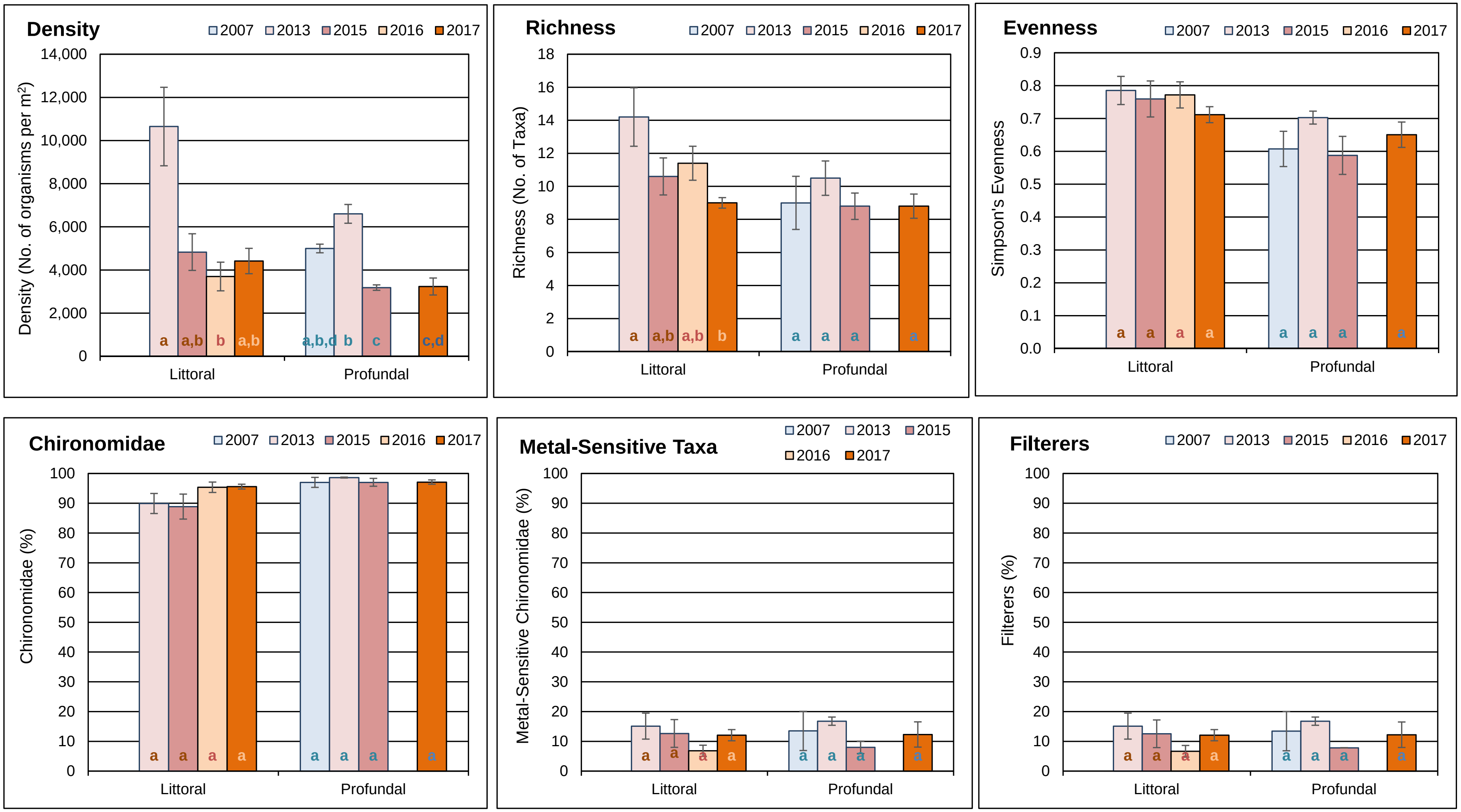


Figure 4.19: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Sheardown Lake SE Littoral and Profundal Study Areas among Mine Baseline (2007, 2013) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

of both arctic charr and ninespine stickleback at Sheardown Lake SE (Table 4.7). Consistent with the other mine lakes, greater numbers of arctic charr, together with greater density of benthic invertebrates, suggested that productivity was higher at Sheardown Lake SE than at Reference Lake 3.

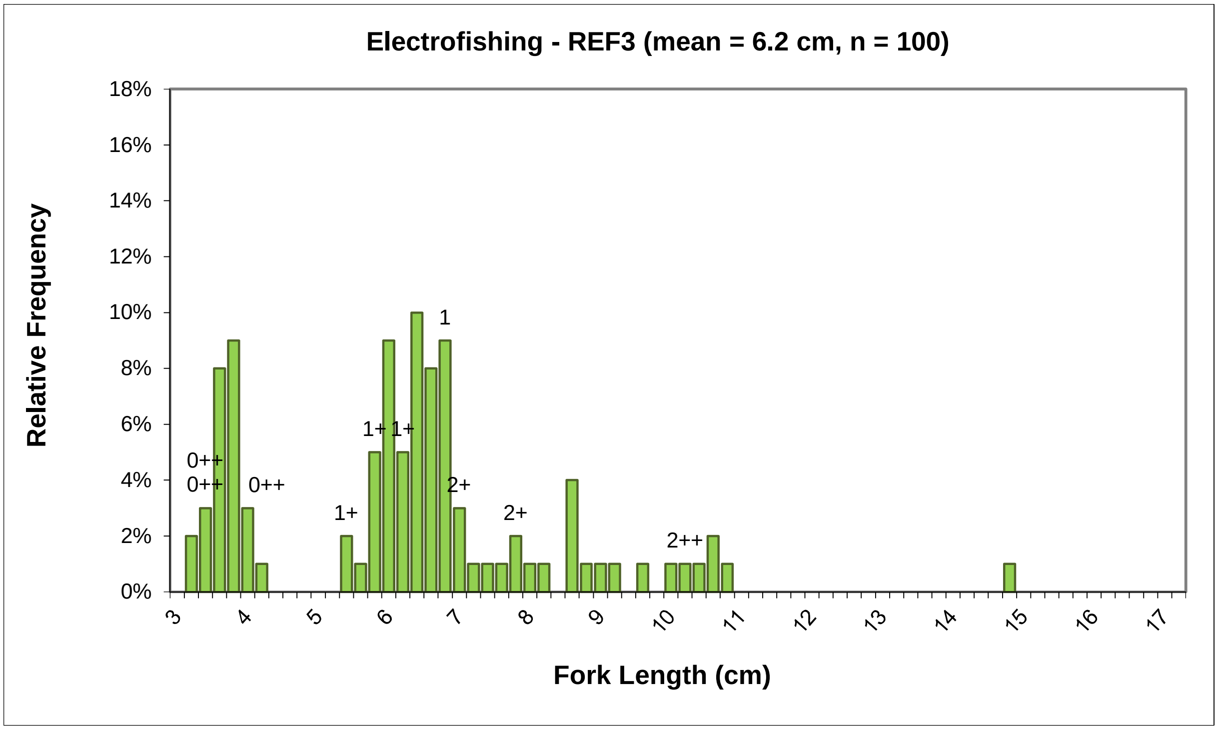
Temporal comparison of the Sheardown Lake SE electrofishing catch data indicated higher fish CPUE in 2017 and the two previous mine operational years compared to during mine baseline studies (2007, 2008; Figure 4.15). Gill netting CPUE for arctic charr was markedly higher in 2016 and 2017 compared to all previous baseline (2006 – 2008), mine construction (2014) and mine operational (2015) studies (Figure 4.15). In part, higher fish CPUE at Sheardown Lake SE during both the 2016 and 2017 studies potentially reflected improvements in sampling efficiency gained through experience from previous studies (see Minnow 2016b, 2017). Nevertheless, the CPUE data suggested that arctic charr abundance at nearshore and littoral/profundal habitats was likely comparable to, or greater than, the abundance of this species during the baseline period at Sheardown Lake SE, indicating no mine-related influences to arctic charr numbers in the lake following the commencement of commercial mine operation in 2015.

4.3.6.2 Sheardown Lake SE Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Sheardown Lake SE nearshore Arctic charr population were assessed with a control-impact analysis using data collected from Sheardown Lake SE and Reference Lake 3 in 2017. Although before-after analysis of data collected from Sheardown Lake SE in 2017 (mine operation) and 2007 (baseline) was conducted, poor accuracy in fresh body weight measures during baseline sampling precluded meaningful data interpretation, and therefore these results were not discussed further herein. A total of 100 arctic charr were captured at nearshore habitat of each of Sheardown Lake SE and Reference Lake 3 in August 2017 for the control-impact analysis. Distinguishing of arctic charr YOY from the older, non-YOY age category was possible using a fork length cut-off of 5.0 cm based on evaluation of length-frequency distributions coupled with supporting age determinations for the Sheardown Lake SE and Reference Lake 3 data sets, respectively (Figure 4.20). Nearshore arctic charr health comparisons were conducted separately for the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these age categories.

Length-frequency distributions for the nearshore arctic charr differed significantly between Sheardown Lake SE and Reference Lake 3 (Table 4.12), potentially reflecting the combination of greater prevalence of YOY and larger size of individuals within YOY and non-YOY age classes at Sheardown Lake SE (Figure 4.20). Arctic charr in YOY and non-YOY age classes were significantly longer and heavier at the Sheardown Lake SE nearshore than at the reference lake



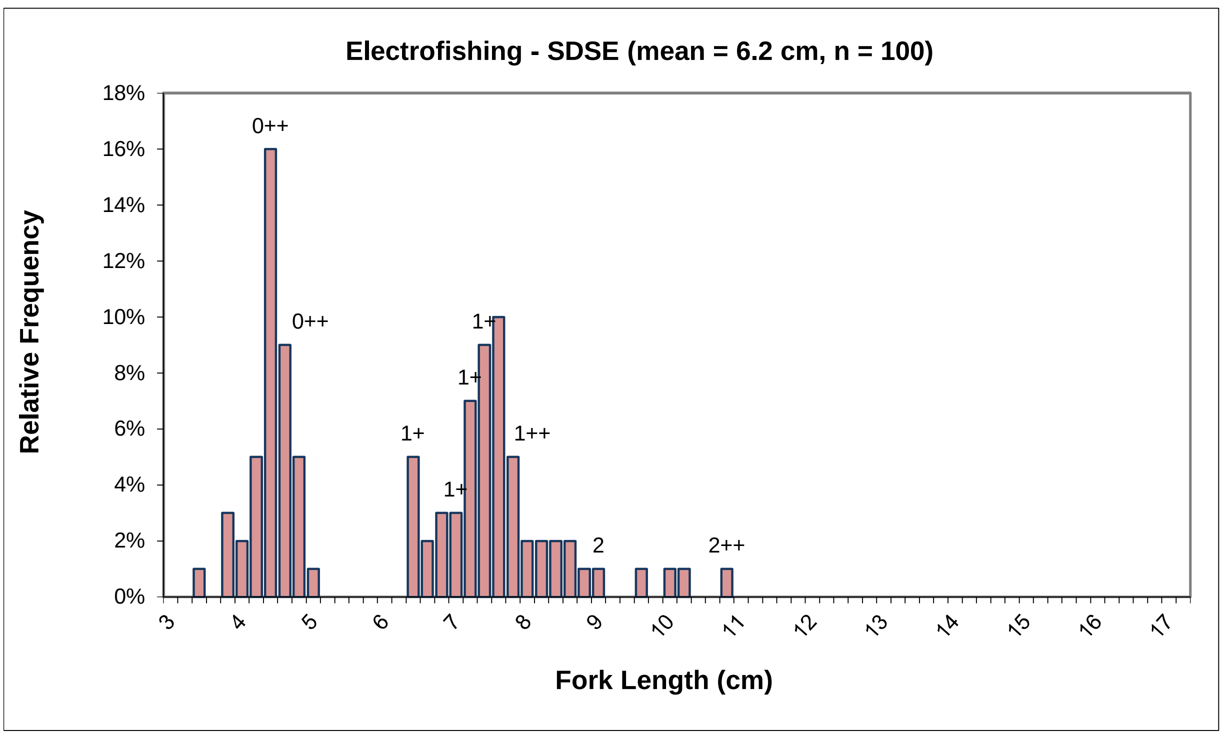


Figure 4.20: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing at Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Note: Fish ages are shown above the bars, where available.

nearshore (Table 4.12; Appendix Table G.22). The occurrence of significantly larger YOY suggested faster arctic charr growth at Sheardown Lake SE than at the reference lake in 2017. Although condition of nearshore arctic charr YOY did not differ significantly between Sheardown Lake SE and the reference lake, the condition of arctic charr non-YOY was significantly greater at Sheardown Lake SE in 2017 (Table 4.12; Appendix Table G.22). Notably, the magnitude of this difference was just within the CES_C of ±10% suggesting that this difference was not ecologically meaningful (Table 4.12). Similar differences in size and condition of arctic charr YOY were shown between Sheardown Lake SE and the reference lake in studies conducted in 2016 and 2017, but differences in arctic charr non-YOY size and condition were greater between Sheardown Lake SE and the reference lake in 2017 relative to either of the two previous CREMP studies (Table 4.12). Because the direction of difference was positive, the occurrence and/or larger magnitude of differences in size and condition of arctic charr non-YOY between Sheardown Lake SE and the reference lake in 2017 compared to the previous studies was not suggestive of an adverse response related to changes in mine operations over time.

Littoral/Profundal Arctic Charr

Mine-related influences on the Sheardown Lake SE littoral/profundal arctic charr population were assessed using a before-after analysis between data collected in 2017 and the baseline characterization (combined 2007/2008) studies. Similar to the two previous CREMP studies, a small sample size from Reference Lake 3 (i.e., n = 1) precluded implementation of a control-impact statistical analysis using data collected in 2017. Biological information collected from arctic charr mortalities indicated that non-spawners of reproductive age constituted approximately 60% of the Sheardown Lake SE arctic charr population during the August 2017 field study (Appendix Table G.26). No significant difference in LSI was indicated between non-spawners and female spawners at Sheardown Lake SE in 2017 (ANOVA; $p = 0.33$), suggesting similar energy reserves available for gamete development between these two groups. A high proportion of individuals (i.e., 90%) contained body cavity parasites (Appendix Table G.26), the incidence of which was comparable to that observed at other mine-exposed lakes in 2015, 2016, and 2017, as well as during baseline studies (NSC 2014, 2015a). An arctic charr that had been tagged and released previously at Sheardown Lake SE was re-captured in 2017, and showed a 2.1 mm/yr average increase in fork length over the past 11 years (Table 4.13). This growth rate was considerably lower than the incremental change in growth rate for recaptured tagged individuals from the lake in 2015 (Table 4.13), but was not unlike rates shown in resident populations at other arctic lakes that are available in published literature. The growth rate of tagged arctic charr captured at Sheardown Lake SE appeared to be lower than at those captured at the northwest basin of the lake (9.8 mm/yr; n = 1) and Mary Lake (24.4 mm/yr; n = 2) in 2015 and 2016 (Minnow 2017). The

Table 4.12: Summary of Statistical Results for Arctic Charr Population Comparisons between Sheardown Lake SE and Reference Lake 3 in 2015, 2016, and 2017, and between Sheardown Lake SE Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]					
			versus Reference Lake 3			versus Sheardown Lake SE baseline period data [b]		
			2015	2016	2017	2015	2016	2017
Nearshore Electrofishing	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
		Age	No	No	No	**Yes (+273%)**	-	-
	Energy Use (non-YOY)	Size (mean weight)	No	No	**Yes (+55%)**	No	**Yes (-43%)**	**Yes (+54%)**
		Size (mean fork length)	No	No	**Yes (+12%)**	**Yes (+7%)**	**Yes (-15%)**	**Yes (+19%)**
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+4%)**	No	**Yes (+9%)**	**Yes (-14%)**	**Yes (-16%)**	No
Littoral/Profundal Gill Netting [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**
		Age	-	-	-	**Yes (-13%)**	No	No
	Energy Use	Size (mean weight)	-	-	-	**Yes (-26%)**	**Yes (-20%)**	**Yes (-16%)**
		Size (mean fork length)	-	-	-	**Yes (-9%)**	**Yes (-7%)**	**Yes (-5%)**
		Growth (weight-at-age)	-	-	-	**Yes (+18%)**	**Yes (+24%)**	No
		Growth (fork length-at-age)	-	-	-	No	No	No
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	No	No	**Yes (-6%)**

[a] Values in parentheses indicate direction and magnitude of any significant differences.
[b] Baseline period data included 2007 nearshore electrofishing data and 2007 and 2008 littoral/profundal gill netting data.
[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

tagging information suggested that arctic charr can reside in the same lake for a prolonged period, and that faster growth rates in arctic charr may be associated with larger lake size.

Table 4.13: Fork Length and Weight Measurement Data for Tagged Arctic Charr Captured at Sheardown Lake SE in August 2015 and 2017, Mary River Project CREMP

Fish Tag Number	Capture Information			Re-Capture Information			Growth Rate
	Date of Capture	Length (mm)	Weight (g)	Date of Capture	Length (mm)	Weight (g)	Δ Length (mm/yr)
85944	03-Aug-2007	363	375	17-Aug-2015	407	500	5.5
89525	21-Aug-2014	368	500	17-Aug-2015	375	505	7.0
86480	03-Aug-2007	338	375	18-Aug-2017	361	430	2.1

Length-frequency distributions of arctic charr captured at littoral/profundal areas of Sheardown Lake SE in 2017 differed significantly than those captured during the baseline period (Table 4.12). In part, the differences in length-frequency distribution may have reflected significantly smaller size (i.e., weight and length) of individuals captured in 2017 compared to the baseline period (Table 4.12; Appendix Table G.27). No significant differences in length- or weight-related growth were indicated for arctic charr captured by gill netting at Sheardown Lake SE between 2017 and the baseline period (Table 4.12; Appendix Table G.27). Although condition of arctic charr from littoral/profundal areas of Sheardown Lake SE was significantly lower in 2017 compared to the baseline period, the magnitude of this difference was within the ecologically relevant CES_C of ±10% (Table 4.12). The arctic charr data collected from littoral/profundal areas of Sheardown Lake SE between 2017 and the baseline period showed slightly different types, direction, and/or magnitude of differences compared to those that were shown during the two previous CREMP studies (Table 4.12). However, the absence of any ecologically significant differences in growth and condition for arctic charr captured at littoral/profundal areas of Sheardown Lake SE in 2017 compared to the baseline period suggested no adverse influences on adult arctic charr following the initial three years of mine operation.

4.3.7 Integrated Effects Evaluation

At Sheardown Lake SE, aqueous total concentrations of aluminum, manganese, and molybdenum were elevated compared to the reference lake in 2015, 2016, and 2017, but none of these metals, or any other parameters, showed substantial elevation from concentrations observed during the baseline period, and none were above WQG or AEMP benchmarks. Similar to the northwest basin, total aluminum and manganese concentrations showed strong positive correlations with turbidity at Sheardown Lake SE in 2017 that, in turn, suggested that these metals were largely bound to/contained in suspended particulate matter and were not likely biologically available. High turbidity in Sheardown Lake is hypothesized to reflect natural sources of suspended particulates originating from Mary River, upstream of the mine. Sediment metal concentrations at littoral and profundal stations of Sheardown Lake SE were very similar to averages observed for the same respective station types at the reference lake in 2017, with the exception of slightly higher manganese at the southeast basin. Mean concentrations of iron and manganese were above SQG and AEMP benchmarks in sediment of Sheardown Lake SE, but concentrations of these metals were also above SQG and/or AEMP benchmarks at the reference lake. Although arsenic, chromium, nickel, and phosphorus concentrations were above AEMP benchmarks at individual littoral profundal stations, on average, concentrations of these and all other metals were below their respective AEMP benchmarks at Sheardown Lake SE in 2017. Temporal comparisons indicated that metal concentrations in sediment of Sheardown Lake SE in 2017 were within ranges shown during baseline studies, perhaps with the exception of slightly higher manganese concentrations in sediment of littoral habitat, generally indicating no substantial mine-related influences on sediment quality over time at Sheardown Lake SE.

Chlorophyll-a concentrations at Sheardown Lake SE were significantly higher than at the reference lake in 2017 suggesting greater primary production at Sheardown Lake. However, chlorophyll-a concentrations remained well below the AEMP benchmark during all seasonal sampling events in 2017 at Sheardown Lake SE, and suggested oligotrophic conditions typical of Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Sheardown Lake SE since commencement of commercial mine operations. Benthic invertebrate community differences between Sheardown Lake SE and the reference lake closely mirrored those shown for the northwest basin in 2017, indicating that differences in benthic invertebrate community features between Sheardown Lake SE and the reference lake were more consistent with natural physical substrate differences than any metal-related influences. In addition, no ecologically significant differences in primary benthic invertebrate community metrics, dominant taxonomic groups, or FFG were consistently indicated between the mine baseline period and individual years since the commencement of commercial mine operation (2015, 2016, 2017) at Sheardown Lake SE. Arctic charr population size was greater at Sheardown Lake SE compared to the reference lake in 2017, but similar numbers of arctic charr were present at the Sheardown Lake southeast basin in 2017 compared to the baseline period. Arctic charr captured at nearshore habitat of Sheardown Lake SE were significantly larger and had similar condition than those captured at the reference lake in 2017, but did not differ significantly in size and were of slightly lower condition in 2017 compared to those captured at Sheardown Lake SE during baseline studies. Arctic charr captured at Sheardown Lake SE littoral/profundal habitat in 2017 showed slightly faster growth and were of lower condition than those captured during baseline studies, but the magnitude of these differences were not ecologically meaningful. Collectively, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Sheardown Lake SE in the third year of mine operation at the Mary River Project.

5 MARY RIVER AND MARY LAKE SYSTEM

5.1 Mary River Tributary-F

5.1.1 Water Quality

Water quality monitoring was conducted at Station FO-01 of Mary River Tributary-F (MRTF) in spring, summer, and fall 2017 to meet CREMP requirements, as well as upstream and downstream of the MS-08 effluent discharge channel in fall 2017 to meet EEM requirements. Dissolved oxygen (DO) concentrations did not differ significantly between the MRTF effluent-exposed and reference study areas, and were well above the WQG lowest acceptable concentration for sensitive, early life stages of cold water biota (i.e., 9.5 mg/L) at both study areas (Figure 5.1). Although pH and specific conductance were each significantly higher at the effluent-exposed area than at the reference area of Mary River Tributary-F, the mean incremental difference between areas for each of these parameters was very small, and pH values were well within the WQG acceptable range for the protection of aquatic life (Figure 5.1). As a result, the small differences in pH and specific conductance between the MRTF effluent-exposed and reference areas was not likely to be ecologically meaningful.

Based on extrapolation of specific conductance measures, the proportion of MS-08 mine effluent at the MRTF effluent-exposed area immediately below the effluent channel confluence was estimated as 0.17% at the time of the August 2017 field study, with a maximum of 0.85% estimated for 2017 during periods of effluent discharge (Minnow 2018). Notably, a substantial step increase in specific conductance was observed approximately 1.9 km downstream of the MS-08 effluent channel confluence on MRTF at the time of the August 2017 field study (Appendix Figure C.20). Higher specific conductance at this location and farther downstream in Mary River Tributary-F was attributed to the receipt of surface runoff from areas at which chloride salts (e.g., $CaCl_2$) were used to assist with exploratory/operational drilling through material exhibiting subsurface permafrost, as well as potential natural variation in geological properties with progression through the MRTF system.

Water chemistry monitoring at MRTF indicated that, on average, only ammonia, nitrate, and/or sulphate concentrations were slightly elevated (i.e., three- to five-fold higher) at Mary River Tributary-F (Stations MRTF-1 and F0-01) compared to Mary River upstream reference conditions during periods of effluent discharge in 2017 (Appendix Table C.56). However, concentrations of these parameters were consistently well below applicable WQG at MRTF (Appendix Table C.56). Although total concentrations of aluminum and iron were occasionally above respective WQG at MRTF in 2017, similar or higher concentrations of these metals were observed at the Mary River upstream reference stations during any given sampling event (Appendix Table C.56), indicating

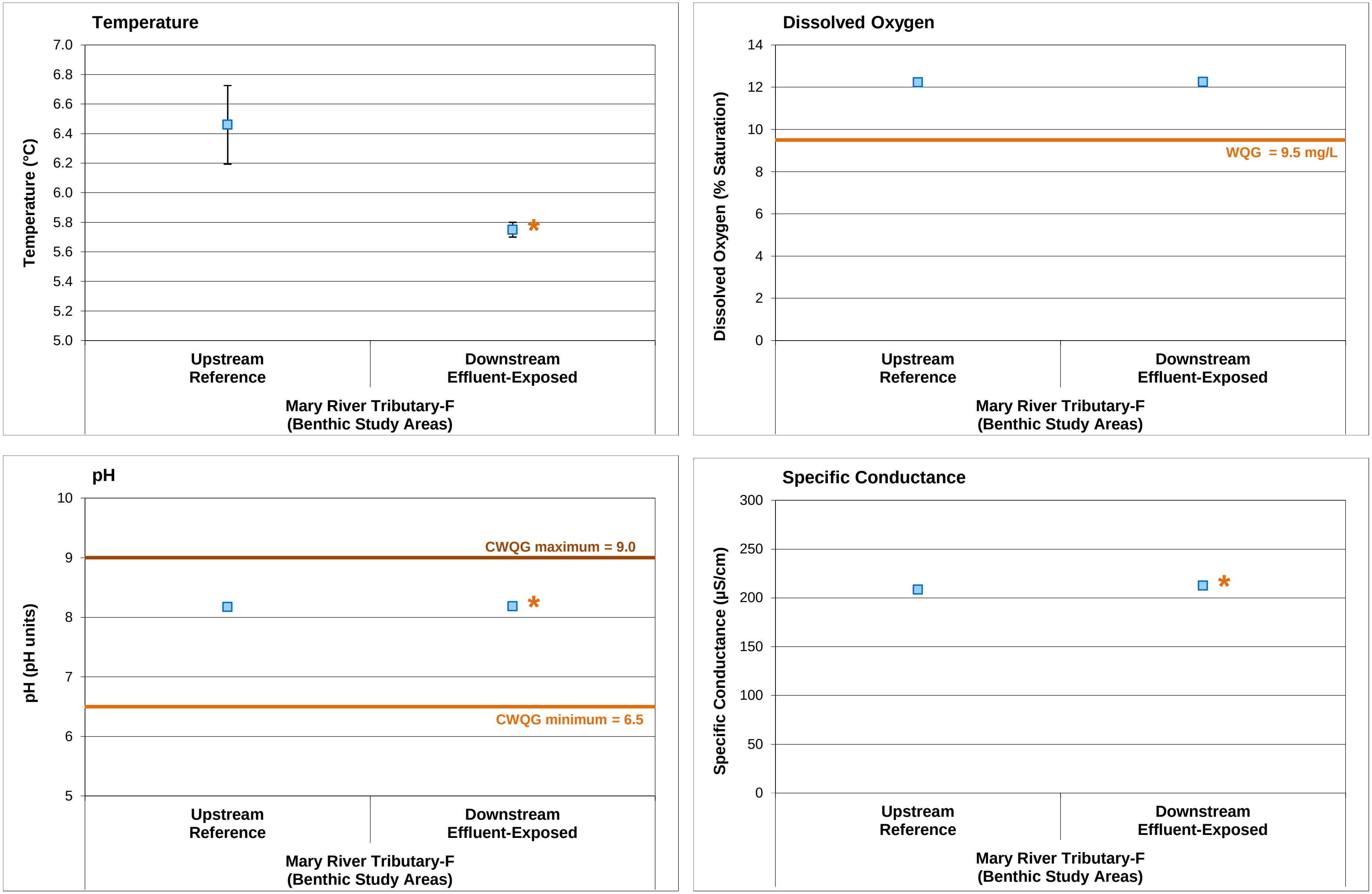


Figure 5.1: Comparison of *In Situ* Water Quality Variables (mean ± SE; n = 5) Measured at Mary River Tributary-F Benthic Stations During Mary River Project Phase 1 EEM, August 2017

Note: An asterisk (*) next to effluent-exposed area data point indicates that the mean value differed significantly from that of the applicable reference area.

natural elevation of total aluminum and iron concentrations in regional watercourses. Overall, the MS-08 effluent discharge resulted in only a marginal elevation in ammonia, nitrate, and/or sulphate concentrations at MRTF.

5.1.2 Phytoplankton

Chlorophyll-a concentrations at MRTF (Station FO-01) were lower than those observed among the reference stations during individual spring and summer sampling events in 2017 (Appendix Table E.14), and were well below the AEMP benchmark of 3.7 µg/L for each of these sampling events. Low phytoplankton productivity, indicative of oligotrophic conditions, was suggested at MRTF based on comparison of chlorophyll-a concentrations to Dodds et al (1998) trophic status classification for creek environments. This productivity classification was supported by a WQG categorization of ultra-oligotrophic to oligotrophic based on mean aqueous phosphorus concentrations near or below 10 µg/L at MRTF during all spring, summer, and fall sampling events (Table 3.1; Appendix Tables C.58 and C.62). Overall, no mine-related influences to MRTF phytoplankton density were suggested by the 2017 chlorophyll-a concentration data.

5.1.3 Benthic Invertebrate Community

Benthic invertebrate density, richness, Simpson's Evenness, and Bray-Curtis Index did not differ significantly between the MRTF effluent-exposed and reference study areas during the August 2017 EEM survey (Table 5.1)[7]. Direct comparison of dominant benthic invertebrate community groups indicated a subtle difference in community composition between the effluent-exposed and reference areas of MRTF that was driven entirely by significantly greater density of Simuliidae (blackflies) at the effluent-exposed study area (Table 5.1). Because blackflies exhibit a filter-feeding, clinging mode of existence in aquatic habitats (Merritt et al. 2008), differences in filterer FFG and clinger HPG densities between the MRTF effluent-exposed and reference study areas (Table 5.1) reflected the difference in blackfly densities shown between areas. No significant differences in any individual dominant taxonomic group, FFG or HPG were indicated between the MRTF effluent-exposed and reference study areas with the removal of Simuliidae from the data set metrics except for the proportion of collector-gatherer FFG (Minnow 2018).

Higher densities of blackflies generally occur at the outlets of tributaries and in larger-sized streams (Carlsson 1967; Grillet and Barrera 1997; Pramul and Wongpakum 2010), possibly due to greater inputs of suspended organic matter, the predominant food source for blackflies, at these habitats (Carlsson et al. 1977). Therefore, a greater density of blackflies downstream of the

[7] Under the MMER, metrics of richness, Simpson's Evenness, and Bray-Curtis Index are calculated using family-level taxonomy (as opposed to lowest-practical-level taxonomy), and thus the MRTF benthic invertebrate community results discussed herein evaluated metrics calculated using this same level of taxonomy. For all monitoring conducted for the Mary River Project CREMP, the above metrics were calculated using lowest-practical-level taxonomy.

Table 5.1: Benthic Invertebrate Community Statistical Comparison Results between Mary River Tributary-F Effluent-Exposed and Reference Study Areas, Calculated Using Family Level Taxonomy, for the Mary River Project EEM, August 2017

Metric	Two-Sample Comparison					Summary Statistics						
	Significant Difference Between Areas?	Trans-formation	Test	p-value	Magnitude of Difference [a] (No. of SD)	Area	Median	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	NO	fourth root	ANOVA	0.1238	~	Reference	474	533	334	149	188	1,058
						Effluent-Exposed	855	849	276	123	448	1,175
Richness (Number of Taxa)	NO	fourth root	ANOVA	0.9727	~	Reference	4.0	4.6	1.3	0.6	3.0	6.0
						Effluent-Exposed	5.0	4.6	1.1	0.5	3.0	6.0
Simpson's Evenness	NO	$\log_{10}$	ANOVA	0.7872	~	Reference	0.430	0.461	0.154	0.069	0.297	0.689
						Effluent-Exposed	0.379	0.430	0.120	0.054	0.338	0.637
Bray-Curtis Index	NO	none	ANOVA	0.1006	~	Reference	0.204	0.242	0.161	0.072	0.069	0.439
						Effluent-Exposed	0.423	0.398	0.096	0.043	0.291	0.491
Chironomidae (No. per m^2)	NO	none	ANOVA	0.8030	~	Reference	241	309	170	76	102	531
						Effluent-Exposed	284	283	139	62	133	426
Metal Sensitive Chironomidae	NO	none	ANOVA	0.8397	~	Reference	107	121	59	27	40	199
						Effluent-Exposed	112	114	34	15	70	155
Simuliidae (No. per m^2)	YES	none	ANOVA	0.0137	2.0	Reference	161	205	169	75	75	487
						Effluent-Exposed	552	540	169	75	297	706
Collector-gatherers (No. per m^2)	NO	none	ANOVA	0.7417	~	Reference	240	310	173	77	102	532
						Effluent-Exposed	277	277	132	59	133	416
Filterers (No. per m^2)	YES	none	ANOVA	0.0137	2.0	Reference	161	205	169	75	75	487
						Effluent-Exposed	552	540	169	75	297	706
Clingers (No. per m^2)	YES	none	ANOVA	0.0151	2.0	Reference	165	212	175	78	79	505
						Effluent-Exposed	563	558	179	80	308	763
Sprawlers (No. per m^2)	NO	none	ANOVA	0.7510	~	Reference	240	305	166	74	102	517
						Effluent-Exposed	277	274	130	58	133	412

[a] Magnitude calculated by comparing the difference between the reference area and effluent-exposed area means divided by the reference area standard deviation.

Highlighted values indicates significant difference between study areas based on a p-value less than 0.10.

effluent channel confluence on MRTF may have reflected increased food resources originating from the effluent-channel. Notably, blackfly larval densities do not appear to be strongly influenced by plankton abundance (Carlsson 1967), suggesting that non-living organic matter received from runoff potentially accounted for higher densities of blackflies at the effluent-exposed area. No significant differences in densities of metal-sensitive chironomids were indicated between the MRTF effluent-exposed and reference study areas, suggesting that between-area differences in metal concentrations did not affect the composition of the benthic invertebrate community at the effluent-exposed area. In addition, no significant differences in sample replicate water velocity, substrate size, or substrate embeddedness were indicated between the MRTF effluent-exposed and reference study areas (Minnow 2018), suggesting that the difference in blackfly density between these areas was unrelated to these variables.

Overall, statistical similarity in benthic invertebrate density, richness, Simpson's Evenness, and Bray-Curtis Index between effluent-exposed and reference areas of MRTF indicated no effluent-related effects on the benthic invertebrate community in the receiving environment downstream of the MS-08 effluent discharge

5.1.4 Fish Population

No fish were captured within MRTF either downstream or upstream of the MS-08 effluent discharge channel during the August 2017 fish population survey conducted for EEM (Table 5.2; Appendix Table G.28). Fish sampling was conducted at reaches extending from the MRTF outlet at Mary River to just of upstream of the effluent channel confluence approximately 3 km from Mary River (Figure 2.3), and therefore the lack of fish captures indicated that fish were naturally absent through the entire MRTF system in August 2017. The natural absence of fish from MRTF presumably reflects the combination of complete freezing overwinter and an inability of fish to colonize the tributary due to relatively high stream gradient and the presence of natural in-stream barriers. An average gradient of 12% was documented through the lower 750 m of MRTF during the fish population survey (Minnow 2018). In addition, an approximately 1.75 m high step-drop over large boulder habitat occurred on MRTF approximately 50 m upstream of the outlet to Mary River (Appendix Photo Plate G.1), representing an impassable barrier for upstream migration by fish under the flow conditions observed at the time of the fish population survey. The absence of fish precluded the implementation of a fish population survey to assess fish health at MRTF in 2017 as part of the EEM biological study (Minnow 2018).

5.1.5 Integrated Effects Evaluation

Potential mine-related effects on water quality of MRTF in 2017 included slightly elevated concentrations of ammonia, nitrate, and/or sulphate compared to reference conditions during

Table 5.2: Summary of Fish Catches at Mary River Project EEM Fish Population Survey Study Areas, August 2017

Study Area	Total Effort		Summary Statistic Endpoint	Fish Species			Catch Summary	
	Distance Sampled (m)	Electrofishing Seconds		Arctic Charr		Ninespine Stickleback	Totals	Total No. Species
				YOY [b]	Non-YOY [b]			
Mary River Tributary-F	678	4,157	Total No. Caught	0	0	0	**0**	**0**
			CPUE[a]	0.0	0.0	0.0	**0.0**	
Mary River Near-Field	388	4,587	Total No. Caught	0	100	0	**100**	**1**
			CPUE[a]	0	1.30	0	**1.30**	
Mary River Far-Field	708	8,340	Total No. Caught	2	103	3	**108**	**2**
			CPUE[a]	0.01	0.75	0.02	**0.78**	

[a] Electrofishing catch-per-unit-effort (CPUE) represents number of fish captured per minute of electrofishing.

[b] Young-of-the-year (YOY).

periods of effluent discharge in 2016 and 2017. However, concentrations of these parameters were consistently well below applicable WQG at MRTF. Despite slightly higher nutrient concentrations (e.g., nitrate) at MRTF, chlorophyll-a concentrations were lower than those observed at the reference stations in 2017 and were also well below the applicable AEMP benchmark. The benthic invertebrate community survey indicated no significant differences in primary endpoints of density, richness, Simpson's Evenness, and Bray-Curtis Index between effluent-exposed and reference areas of MRTF. Fish were determined to be naturally absent from MRTF as a result of the combination of complete freezing of the watercourse overwinter and an inability of fish to colonize the tributary due to relatively high stream gradient and the presence of natural in-stream barriers. Overall, no adverse influences to the phytoplankton and benthic invertebrate community of MRTF were indicated in 2017 as a result of the receiving of intermittent discharge of mine effluent to this watercourse.

5.2 Mary River

5.2.1 Water Quality

Dissolved oxygen (DO) levels at Mary River stations were consistently at or above saturation during all spring, summer, and fall monitoring events, and were comparable to DO saturation levels observed among the GO-09 series reference stations for each respective seasonal sampling event (Figure 5.2; Appendix Tables C.1 - C.3). Although DO saturation levels differed significantly among the Mary River benthic study areas, no gradient in DO saturation levels was shown from upstream to downstream of the mine at the time of biological sampling in August 2017. In addition, DO saturation was consistently well above the WQG minimum limit for cold-water biota (i.e., 54%) at all times (Figure 5.2; Appendix Figure C.21 and Table C.61). This suggested that slight differences in DO concentrations/saturation among Mary River study areas were not ecologically meaningful and were unrelated to potential mine influences.

In situ pH at all Mary River stations was similar to pH at the GO-09 series reference stations for each respective seasonal sampling event (Appendix Table C.1 – C.3 and Figure C.21). Although pH differed significantly among the Mary River benthic study areas, no gradient in pH was shown from upstream to downstream of the mine at the time of biological sampling in August 2017 and pH at all Mary River stations was consistently within WQG limits during all spring, summer and fall sampling events (Figure 5.2; Appendix Table C.61). Conductivity at Mary River stations showed no distinct spatial changes with progression from upstream to downstream of the mine that were consistent over the spring, summer, or fall sampling events, suggesting no mine-related influences on Mary River conductivity (Appendix Figure C.21). Notably, conductivity was consistently lowest in spring and highest in fall at all stations, reflecting natural seasonal differences related to proportion of flow from surface runoff (e.g., spring snowmelt) and baseflow/ groundwater sources. Although specific conductance differed significantly among Mary River benthic study areas during fall biological monitoring in 2017, specific conductance upstream of the mine at GO-03 did not differ significantly from the mine-exposed areas (Figure 5.2). Therefore, rather than being indicative of a potential mine-related influence, the differences in specific conductance among the Mary River study areas likely reflected differences in the natural proportion of flow contributed by various tributaries to the river, as well as differences in the geology of base material between Mary River and these tributaries.

Water chemistry within Mary River showed no distinct and/or consistent spatial differences with progression downstream from the GO-09 series river reference stations during any of the spring, summer, or fall sampling events in 2017 (Table 5.3; Appendix Table C.62). In general, parameter concentrations at Mary River stations located adjacent to or downstream of the mine (EO and CO series stations) were similar to, and often lower than, concentrations observed at the upstream reference stations (GO-09 series stations) during each respective sampling event (Table 5.3; Appendix Table C.62). The exception to the above statement related to total and dissolved concentrations of manganese, which were elevated at the EO and CO stations compared to the GO-09 reference stations during the summer and/or fall sampling events (Appendix Tables C.63 and C.65). Total concentrations of several other metals, including aluminum, chromium, cobalt, iron, lead, nickel, and phosphorus, were elevated at Station CO-05 compared to the GO-09 reference stations during the fall monitoring event (Table 5.3). However, relatively high total

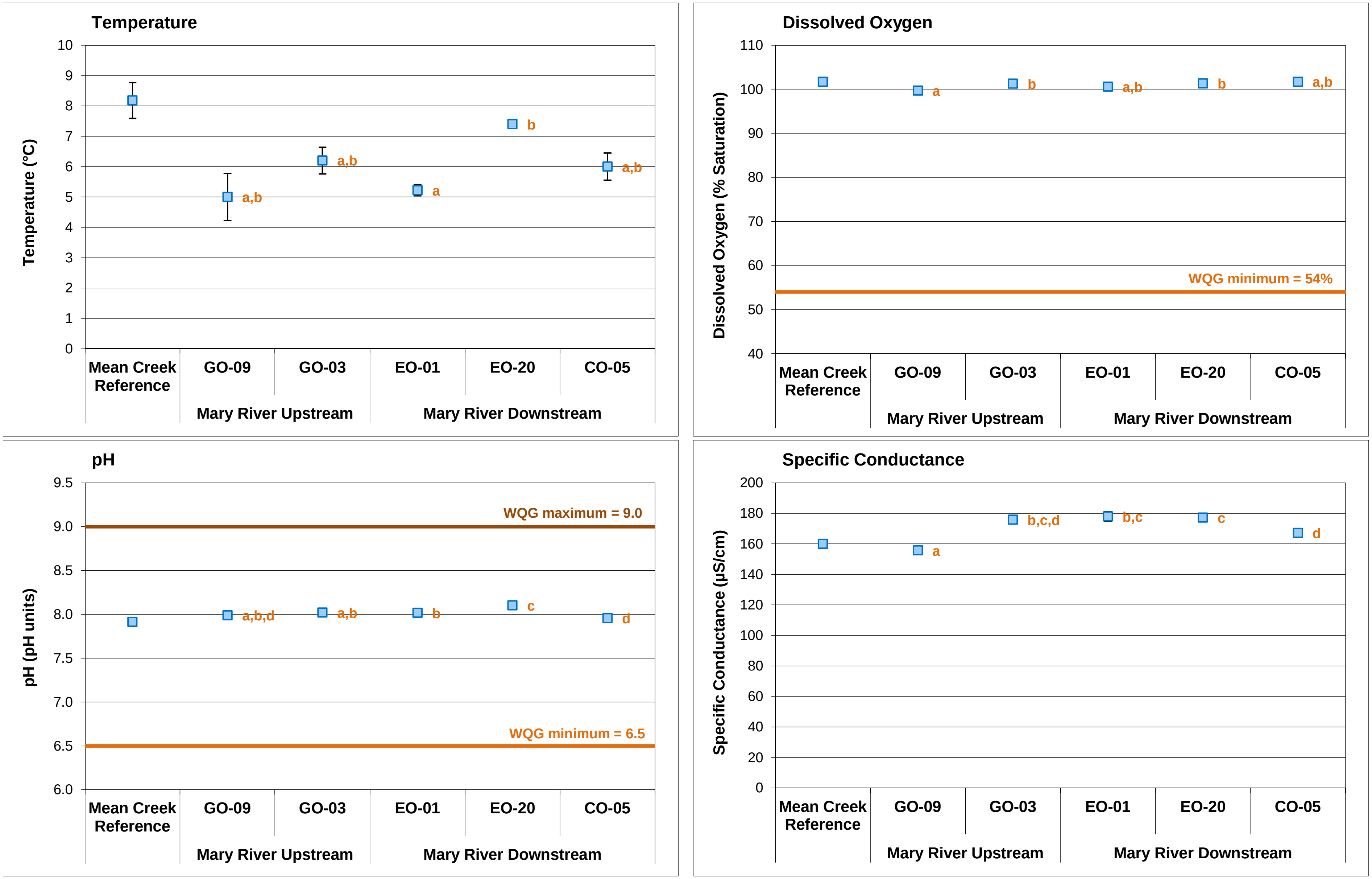


Figure 5.2: Comparison of *In Situ* Water Quality Variables (mean ± SD; n = 5) Measured at Mary River Mine-Exposed and Reference (GO-09) Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: The same letters next to Mary River study area data points indicates no significant difference between areas.

Table 5.3: Water Chemistry at Mary River Monitoring Stations, Mary River Project CREMP, August 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Reference Creek Average (n = 4)	Mary River Reference Station			Mary River Upstream		MRTF	Mary River Downstream of Mine						
						G0-09-A	G0-09	G0-09-B	G0-03	GO-01	F0-01	E0-10	EO-03	EO-21	EO-20	C0-10	C0-05	CO-01
					Fall 2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	29-Aug-2017	27-Aug-2017	27-Aug-2017
Conventionals	Conductivity (lab)	umho/cm	-	-	116	120	158	138	132	151	266	158	164	164	163	146	151	143
	pH (lab)	pH	6.5 - 9.0	-	7.90	7.93	8.09	8.01	7.99	8.08	8.22	8.10	8.06	8.04	7.99	7.98	8.01	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	55	52	76	62	61	70	134	74	77	78	80	66	71	72
	Total Suspended Solids (TSS)	mg/L	-	-	4.1	2.3	<2.0	<2.0	<2.0	<2.0	5.2	<2.0	<2.0	<2.0	9.5	<2.0	20.2	3.3
	Total Dissolved Solids (TDS)	mg/L	-	-	60	68	87	59	61	74	136	76	71	79	82	78	70	71
	Turbidity	NTU	-	-	6.1	8.3	2.8	5.8	5.3	1.8	6.3	1.9	2.3	2.2	4.5	7.4	45.3	7.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	52	48	77	58	59	66	107	69	73	69	69	62	63	63
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.027	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.063	0.057	<0.020	0.029	0.028	<0.020	0.134	0.035	0.062	0.058	0.057	0.053	0.076	0.070
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	<0.15	<0.15	<0.15	-	-	-	-	-	-	<0.15	0.22	0.15
	Dissolved Organic Carbon	mg/L	-	-	1.6	1.0	1.2	1.2	1.2	1.2	<1.0	1.1	1.0	1.1	1.3	1.3	1.8	1.2
	Total Organic Carbon	mg/L	-	-	1.7	<1.0	1.2	1.1	1.2	1.1	1.0	1.2	1.1	1.1	1.3	1.3	1.6	1.3
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0078	0.0097	0.0045	0.0053	0.0060	0.0036	0.0067	0.0046	0.0196	0.0037	0.0060	0.0078	0.0250	0.0066
	Phenols	mg/L	0.004$^{\alpha}$	-	<0.0010	0.0015	<0.0010	0.0012	<0.0010	<0.0010	0.0012	0.0013	0.0012	<0.0010	<0.0010	0.0023	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.5	5.2	2.9	4.6	4.1	4.6	5.4	4.7	4.7	4.7	4.2	3.9	5.2	4.1
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	4.1	3.2	2.5	2.8	2.7	2.9	25.3	4.3	7.5	7.5	6.7	5.5	4.8	3.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.208	0.186	0.087	0.168	0.167	0.059	0.187	0.071	0.108	0.070	0.072	0.178	***1.480***	0.219
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010
	Barium (Ba)	mg/L	-	-	0.0076	0.0090	0.0087	0.0090	0.0089	0.0090	0.0138	0.0093	0.0102	0.0097	0.0101	0.0095	0.0179	0.0101
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	11.2	10.9	16.2	13.3	12.6	13.7	26.5	14.9	15.2	15.7	15.1	14.0	14.8	13.9
	Chromium (Cr)	mg/L	0.0089	0.0089	0.00074	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00306	<0.00050
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00091	0.00013
	Copper (Cu)	mg/L	0.002	0.0024	0.0013	0.0014	0.0007	0.0009	0.0009	0.0008	0.0010	0.0008	0.0009	0.0009	0.0009	0.0009	***0.0025***	0.0011
	Iron (Fe)	mg/L	0.30	0.874	0.222	0.146	0.052	0.103	0.105	0.043	0.237	0.053	0.098	0.053	0.044	0.159	***2.120***	0.237
	Lead (Pb)	mg/L	0.001	0.001	0.00021	0.00020	0.00006	0.00012	0.00011	<0.000050	0.00025	0.00006	0.00010	0.00007	<0.000050	0.00016	0.00086	0.00018
	Lithium (Li)	mg/L	-	-	0.0014	0.0011	<0.0010	0.0011	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0023	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.5	6.1	9.0	7.6	7.2	8.0	16.4	8.9	9.3	8.9	9.6	8.3	9.2	8.2
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0033	0.0026	0.0007	0.0015	0.0013	0.0006	0.0068	0.0010	0.0068	0.0051	0.0033	0.0064	0.0360	0.0054
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00034	0.00029	0.00018	0.00024	0.00023	0.00027	0.00026	0.00026	0.00050	0.00056	0.00055	0.00034	0.00034	0.00032
	Nickel (Ni)	mg/L	0.025	0.025	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00068	<0.00050	<0.00050	0.00050	0.00061	0.00059	0.00290	0.00078
	Potassium (K)	mg/L	-	-	0.82	1.07	0.94	1.05	0.98	0.92	1.38	0.97	1.03	0.98	1.12	1.04	1.60	1.11
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.26	1.10	1.19	1.27	1.28	0.99	1.23	1.02	1.08	1.01	1.05	1.26	3.09	1.11
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	1.8	2.6	1.9	2.5	2.0	2.3	1.8	2.3	2.3	2.3	2.2	1.9	2.5	2.4
	Strontium (Sr)	mg/L	-	-	0.0113	0.0136	0.0131	0.0137	0.0123	0.0132	0.0191	0.0134	0.0157	0.0156	0.0144	0.0135	0.0138	0.0129
	Thallium (Tl)	mg/L	0.0008	0.0008	0.00001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00003	<0.000010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	0.073	0.011
	Uranium (U)	mg/L	0.015	-	0.0021	0.0026	0.0027	0.0027	0.0022	0.0028	0.0026	0.0028	0.0027	0.0027	0.0016	0.0021	0.0021	0.0021
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	0.0007	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00231	0.00055
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0038	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Mary River.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

concentrations of these metals at this station appeared to be associated with elevated turbidity at the time of the fall sampling event (Table 5.3). This was supported by no elevation in the corresponding dissolved concentrations for these metals between Station CO-05 and the reference stations, nor between the other mine-exposed stations and the reference stations, in each of the spring, summer, and fall sampling events (Appendix Table C.64).

Total aluminum concentrations were above WQG at a number of Mary River mine-exposed stations but were typically below the applicable AEMP benchmark, during the spring, summer, and fall monitoring events in 2017 (Table 5.3; Appendix Table C.62). However, total concentrations of aluminum were also elevated above applicable WQG at one or more of the Mary River GO series reference stations during the summer and fall monitoring events in 2017 (and during previous study years), suggesting naturally high concentrations of aluminum in the Mary River system. Although a number of other metals were also above WQG and/or AEMP benchmarks at Mary River Station CO-05 during fall monitoring in 2017, as discussed above, high concentrations appeared to be associated with elevated turbidity at the time of sampling (Appendix Table C.62). Notably, a high proportion (i.e., ≥65%) of aluminum, iron, and manganese were in the 'total' concentration form, suggesting that these metals were largely associated with suspended particulate matter and were unlikely to be bioavailable. Of these metals, total aluminum and iron concentrations showed a strong positive correlation with turbidity (i.e., r_s of 0.71 and 0.74, respectively; Appendix Table C.66). High turbidity was observed at the river reference (i.e., GO series) stations indicating that elevated turbidity in the Mary River was a natural phenomenon unrelated to the Mary River Project operations.

Temporal evaluation of Mary River water chemistry data indicated that parameter concentrations in 2017 were almost all within respective parameter concentration ranges measured at each station over the mine baseline period (2005-2013; Figure 5.3; Appendix Figure C.22). The only exception occurred at Station CO-05, where in fall 2017 higher total concentrations of several metals, including iron and manganese, was observed compared to baseline and previous years of commercial mine operation (Figure 5.3; Appendix Figure C.22). However, as discussed previously, higher total concentrations of these metals in fall 2017 reflected much greater amounts of material suspended in the water column than during the baseline period (e.g., on average, turbidity at Mary River Station CO-05 was 11.5 times higher in 2017 than during the baseline sampling in fall; Appendix Figure C.22). Concentrations of more conservative parameters commonly used as indicators of anthropogenic influences in aquatic environments (e.g., chloride, conductivity, nitrate, sulphate, hardness) indicated no substantial water quality changes between 2017 and the baseline period at the Mary River mine-exposed stations during all spring, summer, and fall sampling events (Figure 5.3; Appendix Figure C.22). Overall, no marked mine-related

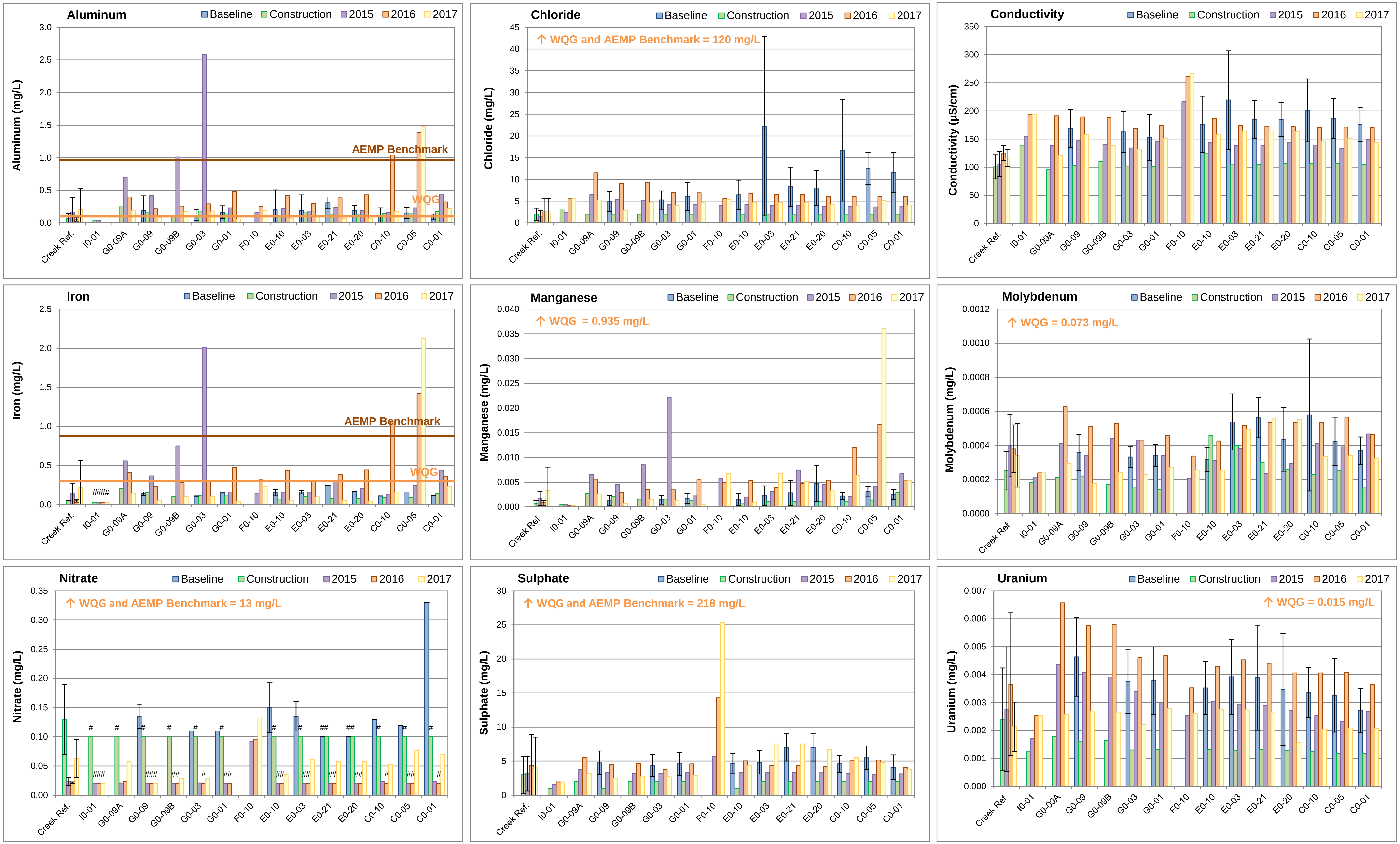


Figure 5.3: Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015 - 2017) Periods during Fall

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

influences to water quality of the Mary River were indicated in 2017 based on comparisons to reference conditions and to mine baseline data.

5.2.2 Sediment Quality

Deposited sediment at Mary River study areas was variable, visually characterized as ranging from predominantly medium sand (CO-05), medium to coarse sand (GO-03, EO-20), coarse sand (GO-09), and very coarse sand (EO-01) among the five study areas (Appendix Table D.36). Substrate among the Mary River study areas was largely composed of cobble and boulder material with minimal amounts of sand and finer material except at the downstream-most study area CO-05, where medium sand composed approximately 65% of the surficial in-stream substrate (Appendix Table F.1). Silt precipitate and/or deposits were generally absent at all Mary River study areas during the August 2017 sampling event. Deposited sediment for TOC and metal determination was collected mainly from shoreline/streambank areas at most of the Mary River study areas, although in-stream material was occasionally collected from depositional areas behind boulders or, for study area CO-05, directly from the channel (Appendix Table D.36). Sediment TOC content was low (i.e., <0.1%) at all of the Mary River study areas, and showed no detectable change between the mine-exposed and GO-09 upstream reference study areas which suggested similar depositional characteristics among the Mary River study areas (Table 5.2; Appendix Table D.39).

Metal concentrations in deposited sediment at Mary River study areas located upstream of the mine were highly comparable between the GO-09 and GO-03 study areas (Table 5.4; Appendix Table D.39). Downstream of the MRTF confluence with Mary River at the EO-01 mine-exposed area, deposited sediment contained slightly elevated (i.e., 3- to 5-fold higher) concentrations of arsenic, chromium, iron, and nickel compared to average concentrations at the upstream GO-09 reference area (Table 5.4). With the exception of arsenic, concentrations of these metals were moderately elevated (i.e., 5-fold to 10-fold higher), and concentrations of calcium, cobalt, copper, magnesium, manganese, and vanadium were slightly elevated, in deposited sediment further downstream at the EO-20 mine-exposed area compared to respective average concentrations at the GO-09 reference area (Table 5.4; Appendix Table D.39). However, deposited sediment collected downstream of the mine at the CO-05 mine-exposed area showed only slightly elevated concentrations of chromium and copper, and moderately elevated concentrations of nickel, compared to deposited sediment at the GO-09 reference area (Table 5.4), indicating that mine-related influences on deposited sediment metal concentrations were greatest adjacent to the mine. Notably, concentrations of metals were all well below applicable SQG in deposited sediment collected at each of the five Mary River study areas (Table 5.4; Appendix Tables D.37 – D.38 and D.40 – D.42). No baseline sediment metal concentration data were collected at Mary

Table 5.4: Sediment Total Organic Carbon and Metal Concentrations at Mary River Mine-Exposed and Reference (GO-09) Sediment Monitoring Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Mary River Reference (GO-09; n = 5)	Mary River Mine-Exposed Areas			
				Upstream GO-03 (n = 5)	Adjacent EO-01 (n = 5)	Adjacent EO-20 (n = 5)	Downstream CO-05 (n = 5)
			Average ± SD	Average ± SD	Average ± SD	Average ± SD	Average ± SD
Total Organic Carbon	%	10[α]	<0.10 ± 0.00	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
Aluminum (Al)	mg/kg	-	763 ± 271	790 ± 96	1,791 ± 875	2,034 ± 1,573	1,302 ± 719
Antimony (Sb)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0.00	<0.10 ± 0.00	<0.10 ± 0
Arsenic (As)	mg/kg	17	0.16 ± 0.02	0.15 ± 0.02	0.51 ± 0.51	0.46 ± 0.18	0.31 ± 0.08
Barium (Ba)	mg/kg	-	4 ± 1.2	4 ± 0.4	9 ± 4.8	9 ± 6.4	5 ± 2
Beryllium (Be)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	0.12 ± 0.04	<0.10 ± 0
Bismuth (Bi)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0
Boron (B)	mg/kg	-	<5.0 ± 0	<5.0 ± 0	<5.0 ± 0	5.2 ± 0.4	<5.0 ± 0
Cadmium (Cd)	mg/kg	3.5	<0.020 ± 0	<0.020 ± 0	<0.020 ± 0	0.023 ± 0.005	<0.020 ± 0
Calcium (Ca)	mg/kg	-	842 ± 508	619 ± 83	1,750 ± 924	3,094 ± 2,706	1,056 ± 593
Chromium (Cr)	mg/kg	90	3.4 ± 1.0	3.4 ± 1.3	13.1 ± 4.3	23.1 ± 9.9	13.7 ± 8.9
Cobalt (Co)	mg/kg	-	0.67 ± 0.19	0.69 ± 0.14	1.85 ± 0.69	2.89 ± 1.34	1.68 ± 0.80
Copper (Cu)	mg/kg	110[α]	1.3 ± 0.5	1.4 ± 0.4	3 ± 0.9	6 ± 6.1	3.9 ± 4.7
Iron (Fe)	mg/kg	40,000[α]	2,826 ± 1,271	2,916 ± 1,532	8,534 ± 3,433	15,518 ± 8,546	7,726 ± 8,774
Lead (Pb)	mg/kg	91	1.1 ± 0.1	1.2 ± 0.2	1.7 ± 0.5	2.3 ± 0.7	1.6 ± 0.6
Lithium (Li)	mg/kg	-	2.2 ± 0.5	<2.0 ± 0.0	3.5 ± 1.3	4.9 ± 4.0	3.5 ± 1.8
Magnesium (Mg)	mg/kg	-	826 ± 521	682 ± 94	2,252 ± 1,276	3,617 ± 3,678	1,894 ± 1,393
Manganese (Mn)	mg/kg	1,100[α,β]	22 ± 7.1	21 ± 3.3	59 ± 22	85 ± 48	49 ± 18
Mercury (Hg)	mg/kg	0.486	<0.0050 ± 0	<0.0050 ± 0	<0.0050 ± 0.0000	<0.0050 ± 0.0000	<0.0050 ± 0.0000
Molybdenum (Mo)	mg/kg	-	0.11 ± 0.01	<0.10 ± 0	0.12 ± 0.03	0.16 ± 0.08	<0.10 ± 0
Nickel (Ni)	mg/kg	75[α,β]	1.9 ± 0.7	1.8 ± 0.3	7.8 ± 3.8	15.3 ± 12.9	10.3 ± 6.1
Phosphorus (P)	mg/kg	2,000[α]	113 ± 49	121 ± 44	236 ± 94	316 ± 142	213 ± 110
Potassium (K)	mg/kg	-	168 ± 77	166 ± 13	480 ± 302	466 ± 407	236 ± 138
Selenium (Se)	mg/kg	-	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0	<0.20 ± 0
Silver (Ag)	mg/kg	-	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0	<0.10 ± 0
Sodium (Na)	mg/kg	-	<50 ± 0	<50 ± 0	<50 ± 0	59 ± 13	<50 ± 0
Strontium (Sr)	mg/kg	-	1.9 ± 0.3	1.9 ± 0.2	3.1 ± 1.2	3.6 ± 1.6	2.5 ± 0.6
Sulphur (S)	mg/kg	-	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0	<1,000 ± 0
Thallium (Tl)	mg/kg	-	<0.050 ± 0	<0.050 ± 0	0.051 ± 0.001	0.055 ± 0.012	<0.050 ± 0
Tin (Sn)	mg/kg	-	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0	<2.0 ± 0.0
Titanium (Ti)	mg/kg	-	109 ± 26	114 ± 21	201 ± 72	304 ± 171	194 ± 79
Uranium (U)	mg/kg	-	0.30 ± 0.0	0.31 ± 0.0	0.4 ± 0.1	0.8 ± 0.2	0.48 ± 0.2
Vanadium (V)	mg/kg	-	5.0 ± 2.2	5.2 ± 3.1	12.7 ± 4.7	25.0 ± 14.1	12.9 ± 14.7
Zinc (Zn)	mg/kg	315	3.7 ± 1.3	3.1 ± 0.6	6 ± 2.8	9 ± 6.8	5 ± 2.6
Zirconium (Zr)	mg/kg	-	1.7 ± 0.3	1.7 ± 0.2	2.2 ± 0.5	2.8 ± 1.2	2.0 ± 0.5

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

River study areas, and thus no evaluation of potential mine-related influences on sediment quality following commencement of commercial mine operations could be conducted.

5.2.3 Phytoplankton

Mary River chlorophyll-a concentrations at stations downstream of the mine were generally within the range of the GO series river reference stations and/or creek reference stations during the 2017 spring, summer, and/or fall sampling events (Figure 5.4). In addition, chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events at all Mary River sampling stations in 2017, and were suggestive of low (i.e., oligotrophic) phytoplankton productivity based on Dodds et al (1998) trophic status classification for stream environments. These results suggested no adverse mine-related influences on phytoplankton abundance at Mary River in 2017. Low to moderate phytoplankton productivity was predicted for Mary River reference and mine-exposed stations given 'oligotrophic' to 'mesotrophic' CWQG categorization based on total phosphorus concentrations of up to 25 µg/L in 2017 (Table 5.3; Appendix Table C.62).

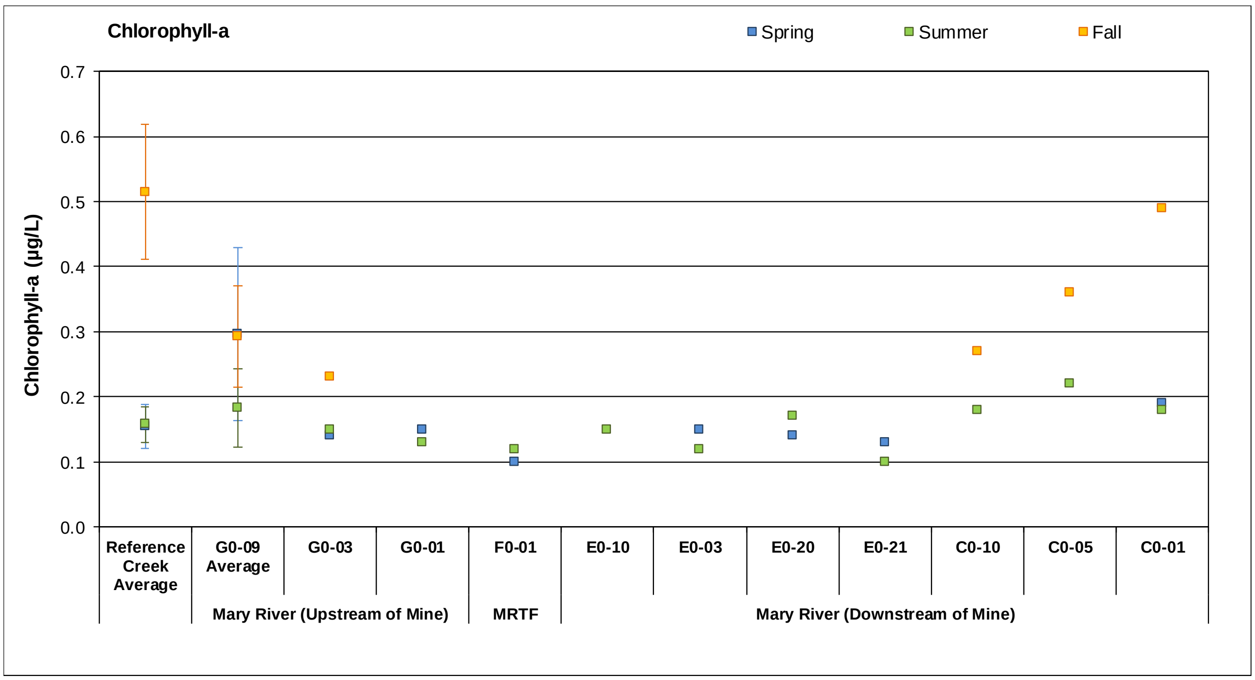


Figure 5.4: Chlorophyll-a Concentrations at Mary River Phytoplankton Monitoring Stations Located Upstream and Downstream of the Mine, Mary River Project CREMP, 2017

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

Temporal comparisons of the Mary River chlorophyll-a data suggested that concentrations were generally lower at stations located downstream of the mine sewage treatment plant outfall (i.e., EO-21, EO-20, and CO series stations) in 2017 and in each of the two previous years of mine operation (2015, 2016) than those observed during the baseline period (Figure 5.5). Notably, baseline period chlorophyll-a concentrations at these same stations were considerably higher than at the reference and mine-exposed stations located upstream for this same period (Figure 5.5). Some of the variability in chlorophyll-a concentrations at Mary River EO-21, EO-20 and CO series stations among baseline and commercial mine operation years may have reflected natural differences in turbidity affecting the amount of light energy available to phytoplankton as opposed to responses related to metals, nutrient enrichment or other potential mine-related influences on phytoplankton productivity (Minnow 2017). Changes in chlorophyll-a concentrations at Mary River stations located downstream of the mine among 2015, 2016, 2017, and the baseline period were consistent with effects associated with natural differences in turbidity (i.e., originating from sources upstream of the mine), but may also reflect influences from sources currently unidentifiable.

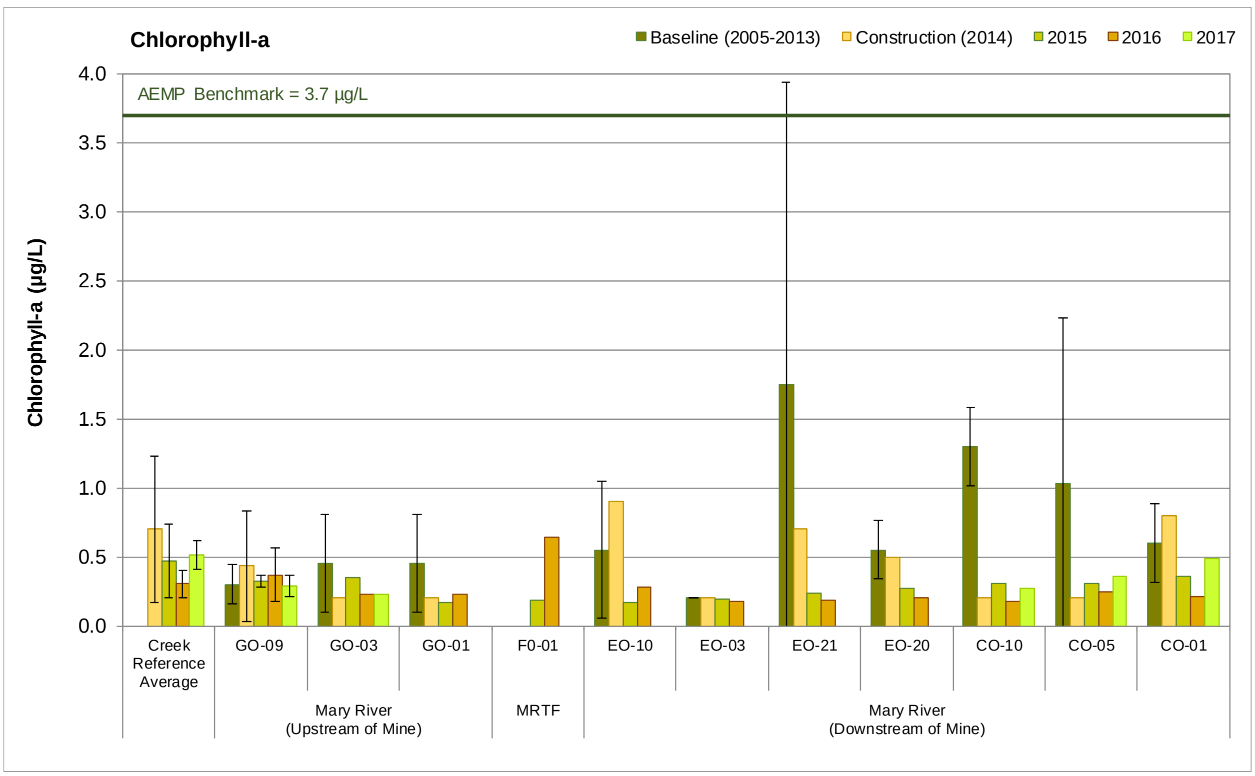


Figure 5.5: Temporal Comparison of Chlorophyll-a Concentrations at Mary River Stations for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015 - 2017) Periods during the Fall

Note: Reference creek data represented by average (± SD; n = 4) calculated from CLT-REF and MRY-REF stations.

5.2.4 Benthic Invertebrate Community

The Mary River benthic invertebrate community assessment included a spatial statistical analysis of key benthic endpoints among upstream reference areas (GO-09, GO-03), near-field mine-exposed areas located adjacent to the mine (EO-01, EO-20) and a far-field, cumulative effects mine-exposed area located downstream of the mine (CO-05; see Table 2.5, Figure 2.4). Benthic invertebrate density, richness, and Simpson's Evenness at Mary River near-field mine-exposed study areas EO-01 and EO-20 did not differ significantly from the GO-09 reference area in 2017 (Figure 5.6; Appendix Table F.58). Benthic invertebrate density and richness were significantly higher at the Mary River CO-05 far-field mine-exposed area compared to the GO-09 reference area (Figure 5.6), suggesting slight nutrient enrichment downstream of the mine. In addition to these differences, benthic invertebrate community structure at the near- and far-field mine-exposed areas of Mary River differed significantly from the upstream GO-09 reference area based on evaluation of Bray-Curtis Index (Appendix Table F.58).

Key differences in dominant benthic invertebrate taxonomic groups at Mary River near- and far-field mine-exposed areas compared to the upstream GO-09 reference area included the presence of Ephemeroptera (mayflies) at the mine-exposed areas, as well as a significantly lower relative abundance of metal-sensitive chironomids at near-field study area EO-01 (Figure 5.6; Appendix Table F.58). Because the relative abundance of metal-sensitive chironomids did not differ significantly between the near-field mine-exposed area EO-01 and the upstream reference area GO-03, and because mayflies, which are relatively metal-sensitive, were also present at near-field mine-exposed area EO-01, differences in benthic invertebrate community structure at EO-01 were not considered mine-related. No ecologically significant differences in the relative abundance of individual FFG were indicated between any of the Mary River mine-exposed areas compared to the GO-09 reference area (Figure 5.6; Appendix Table F.58), suggesting no mine-related influences to aquatic food resources available to benthic invertebrates. In addition, no ecologically significant differences in the relative abundance of individual HPG were indicated between any of the Mary River mine-exposed areas compared to the GO-09 reference area with the exception of at far-field mine-exposed area CO-05, where significantly higher proportion of burrowers was indicated compared to the reference area (Figure 5.6). A greater proportion of the burrower HPG at mine-exposed area CO-05 was consistent with significantly greater substrate embeddedness and greater proportion of sand substrate at this area compared to the GO-09 upstream reference area (Appendix Tables F.50 and F.53). Because the relative abundance of metal-sensitive taxa was similar between the mine-exposed and reference areas of Mary River, the differences in benthic invertebrate community structure suggested by differing Bray-Curtis Index between Mary River mine-exposed and reference areas in 2017 likely reflected natural differences in physical habitat features, including the amount of substrate embeddedness.

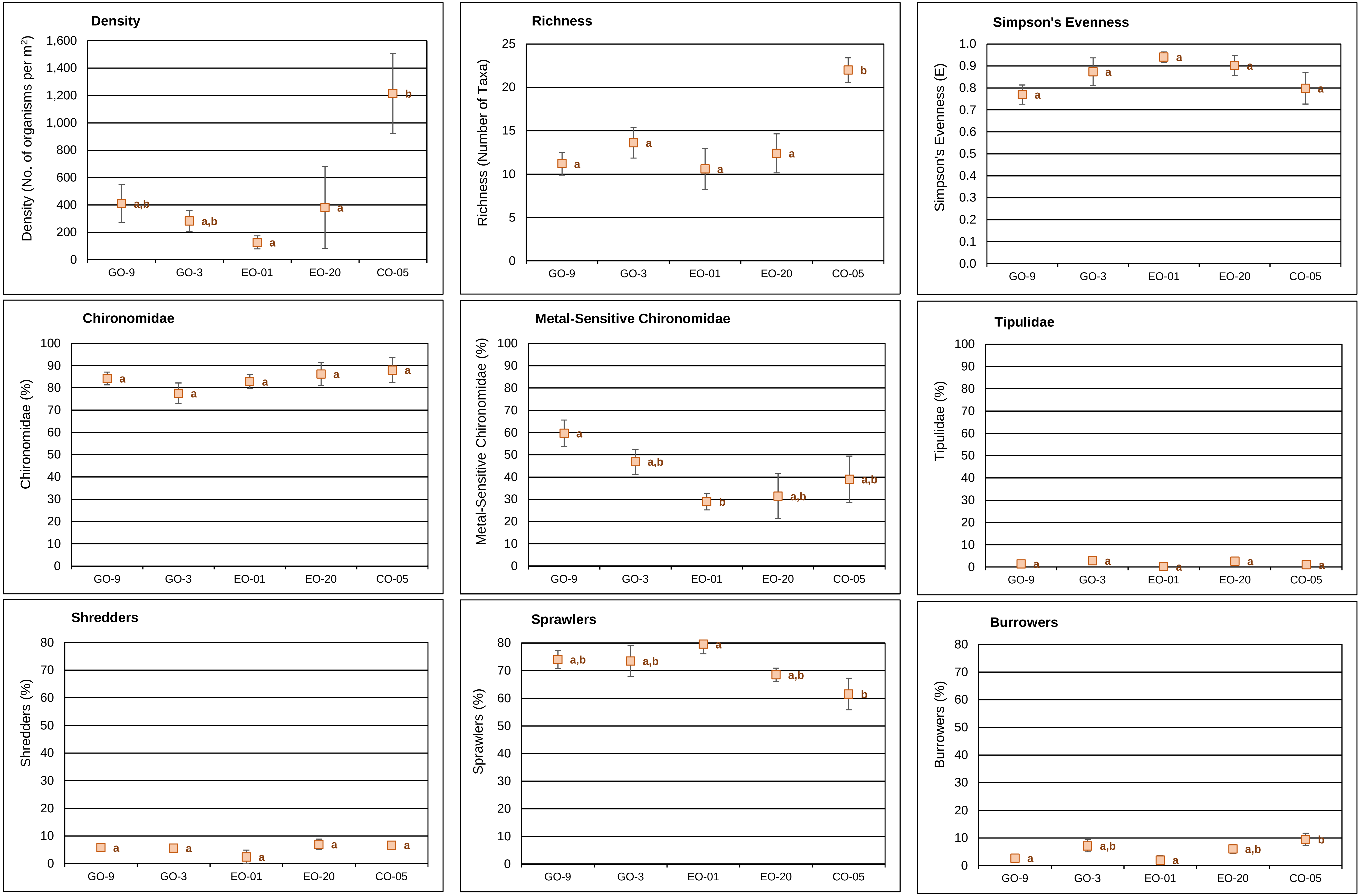


Figure 5.6: **Comparison of Benthic Invertebrate Community Metrics among Mary River Study Areas (mean ± SE), Mary River Project CREMP, August 2017**

Notes: The same letter(s) next to data points indicates no significant difference between/among study areas.

Temporal comparison of the Mary River benthic invertebrate community data indicated no ecologically significant differences in density between mine operational (2015, 2016, 2017) and baseline (2006 – 2011 data) periods at any of the mine-exposed study areas (i.e., EO-01, EO-20, or CO-05; Figure 5.7; Appendix Tables F.61 – F.63). Simpson's Evenness and chironomid relative abundance were often significantly higher and lower, respectively, at the Mary River mine-exposed areas during studies conducted at the time of mine operation compared to those conducted during mine baseline. However, these same benthic metrics showed the same direction of significant differences at Mary River upstream reference areas (Appendix Tables F.59 – F.63), suggesting that the differences in these metrics at all Mary River areas over time reflected natural temporal variability and/or represented sampling artifacts of the CREMP (e.g., changes in sampling location, personnel collecting samples, etc.). Although the relative abundance of the collector-gatherer FFG was significantly higher at near-field mine-exposed area EO-20 in each of 2015, 2016, and 2017 than during the 2011 baseline study, the proportion of collector-gatherers at this area became more similar to the reference condition in the mine operational years suggesting that the temporal changes were not mine-related (Appendix Tables F.59 and F.62). Notably, the types, direction, and magnitude of difference for endpoints that differed significantly between the mine operational and baseline periods at the Mary River mine-exposed areas were similar among the 2015 - 2017 CREMP studies (Figure 5.7), suggesting no cumulative temporal influences on benthic invertebrates of the Mary River since the commencement of commercial mine operations in 2015.

5.2.5 Fish Population

5.2.5.1 Mary River Fish Community

The fish community at the near-field area of Mary River, adjacent to the mine, was composed only of arctic charr, which differed slightly from that of the far-field area where low numbers of ninespine stickleback were captured in addition to arctic charr (Table 5.2; Appendix Table G.28). Arctic charr CPUE was substantially higher at the near-field area than further downstream near the mouth of the river at Mary Lake (Table 5.2), suggesting greater abundance of arctic charr closer to the mine. The between-area difference in arctic charr abundance may have reflected natural differences in the type of habitat sampled between the Mary River near- and far-field study areas. At the near-field study area, the predominant habitat consists of side and braided channels characterized by variable water velocity and large, loosely embedded cobble substrate, whereas at the far-field study area, habitat is dominated by a single main channel characterized by relatively deep, fast flowing water over highly embedded boulder substrate (Appendix Photo Plate G.2). These habitat features allowed fish sampling to be conducted throughout side-channels at the near-field study area, but limited the sampling to shoreline areas at the far-field

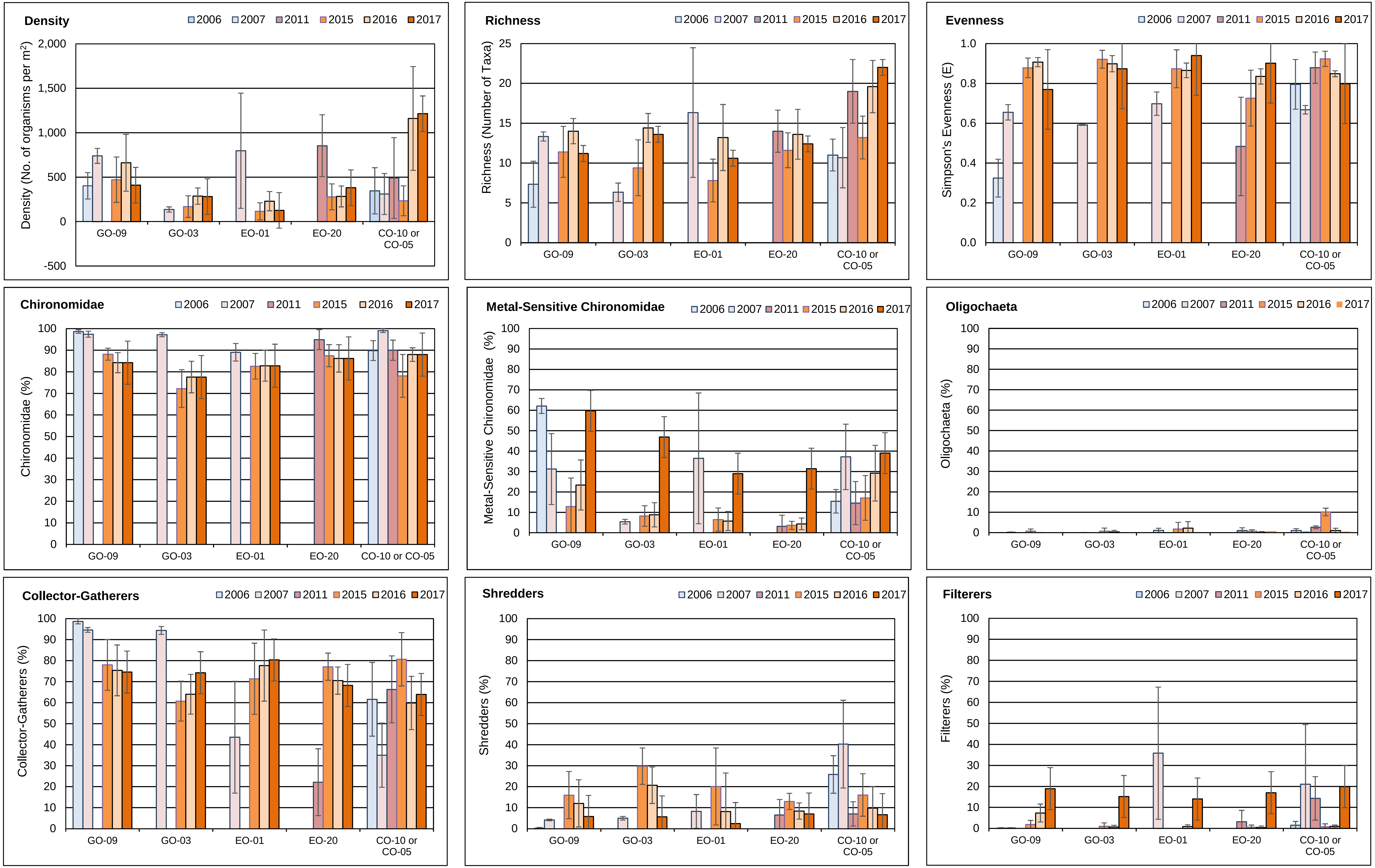


Figure 5.7: Comparison of Benthic Invertebrate Community Metrics (mean ± SD) at Mary River Study Areas among Baseline (2006, 2007, 2011) and Operational (2015, 2016, 2017) Years for the Mary River Project CREMP

study area. In addition, deeper, faster flowing water at the far-field study area likely reduced fish catch efficiency by limiting field study team mobility. Overall, the determination of mine-related influences on fish community composition and arctic charr abundance between Mary River near- and far-field study areas was partly confounded by differing habitat features and the commensurate influences on sampler efficiency.

5.2.5.2 Mary River Fish Population Assessment

Non-lethal measurements of length and weight were collected from 102 and 100 arctic charr at Mary River near- and far-field study areas, respectively, for the assessment of fish population endpoints (Appendix Tables G.29 and G.30). Arctic charr YOY were distinguishable from non-YOY individuals at a fork length of 5.0 cm based on evaluation of length-frequency distributions coupled with supporting age determinations (Figure 5.8). Based on this cut-off value, no YOY were captured at the near-field area, and only two YOY were captured at the far-field area (i.e., approximately 2% of arctic charr population). As a result, the Mary River arctic charr population assessment focused on non-YOY individuals.

Arctic charr length-frequency distributions did not differ significantly between the Mary River near- and far-field study areas, regardless of whether YOY were included or excluded from the data set (Table 5.5; Appendix Figure G.22). Because the inclusion of YOY did not change the outcome of the length-frequency distribution statistical comparison, no difference in the proportion of YOY was indicated between the Mary River study areas (Table 5.5). Among non-YOY arctic charr, no separation of age (i.e., cohorts) was possible at either study area using the length-frequency distribution and confirmatory aging results (Figure 5.8). Nevertheless, visual evaluation of the plotted data suggested a similar arctic charr length-at-age relationship between the Mary River near- and far-field areas (Figure 5.8). Fork length and body weight of non-YOY arctic charr captured at the near-field area did not differ significantly from those captured at the far-field area (Table 5.5). Although condition (i.e., weight-at-length relationship) of non-YOY individuals was significantly lower at the Mary River near-field area than at the far-field area, the magnitude of this difference was within applicable CES (i.e., ±10%; Table 5.5; Appendix Table G.31) suggesting that this difference was not ecologically meaningful. No externally visible abnormalities or parasitic infections were observed on any arctic charr captured at the Mary River study areas. Overall, no significant, ecologically meaningful differences in arctic charr non-YOY health endpoints were indicated between the near- and far-field study areas, suggesting limited influence of the mine on the health of arctic charr within Mary River in 2017.

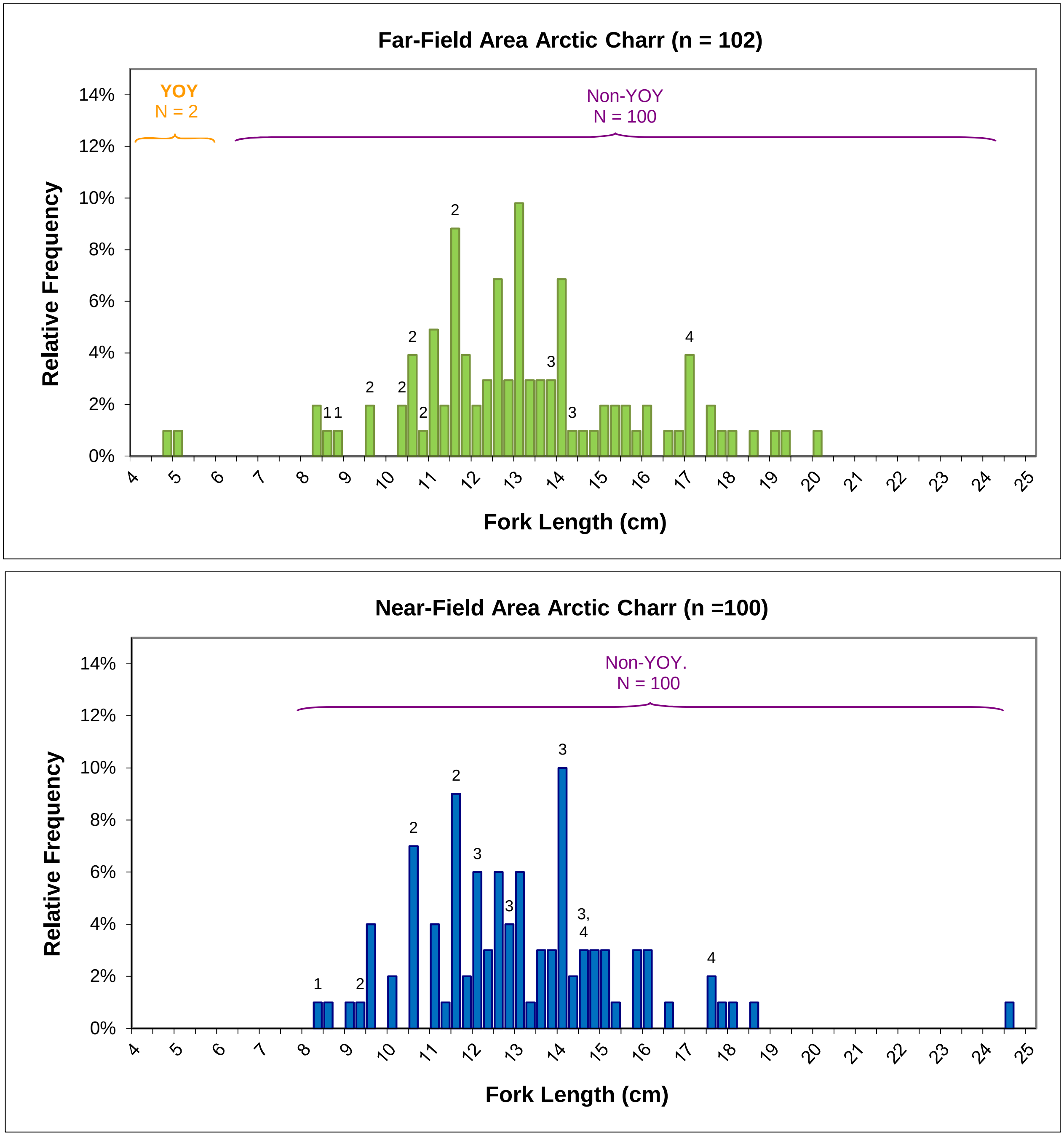


Figure 5.8: Length-frequency Distributions for Arctic Charr Collected at Mary River Project Phase 1 EEM Effluent-Exposed and Reference Study Areas, August 2017

Note: Numbers above bars represent individual fish ages, where available.

Table 5.5: Summary of Arctic Charr Population Statistical Comparison Results between Near-Field and Far-Field Areas of Mary River, August 2017

Endpoint		Significant Difference		Magnitude of Difference (%)
		Yes/No	p-value	
Survival – Length Frequency Distribution	All Fish	No	0.936	-
	Non-YOY only	No	0.906	-
Growth	Non-YOY length	No	0.523	-
	Non-YOY weight	No	0.200	-
Energy Storage	Non-YOY condition	Yes	<0.001	-4.5
Reproduction	YOY Proportion	No		

5.2.6 Integrated Effects Evaluation

Mine-related influences on water quality of Mary River in 2017 were limited to slight elevation of manganese concentrations at mine-exposed areas compared to the upstream reference area in summer and fall sampling events. Although total concentrations of a number of metals, including aluminum, chromium, cobalt, iron, lead, nickel, and phosphorus, were elevated at one or more mine-exposed areas of the Mary River in 2017 compared to reference and baseline data, naturally high turbidity in 2017 likely accounted for these spatial and temporal differences. This was supported by the occurrence of similar dissolved metal concentrations at Mary River mine-exposed areas in 2017 compared to Mary River reference and baseline data, by significant positive correlations between total concentrations of key metals (e.g., aluminum, manganese) and turbidity, and by observations of high ratios of total to dissolved metal concentrations for the Mary River water quality data. Notably, turbidity within Mary River was often highest upstream of the mine (i.e., the GO series stations) during all mine baseline (2005 – 2013) and operational (2015, 2016, 2017) periods, indicating that the dominant source of turbidity at mine-exposed areas of the Mary River reflected natural (runoff) inputs unrelated to the mine operation. Although total aluminum concentrations were above WQG and/or AEMP benchmarks at one or more Mary River mine-exposed stations in 2017, as discussed above, the elevation in these metals compared to water quality criteria appeared to be associated with naturally high turbidity. Deposited sediment at Mary River mine-exposed areas most frequently contained elevated concentrations of chromium, copper, iron, and nickel compared to the reference area, and were generally highest adjacent to the mine. However, concentrations of all metals were well below SQG and deposited sediment material composed less than 1% of surficial bed material at all but the downstream-most station of Mary River.

Chlorophyll-a concentrations were similar among the ten Mary River phytoplankton monitoring stations, with no significant differences in annual chlorophyll-a concentrations indicated between the Mary River mine-exposed and reference stations. Although lower chlorophyll-a concentrations were indicated at individual Mary River stations in 2017 compared to the baseline period, these differences likely reflected natural differences in turbidity among years, which would be expected to affect phytoplankton productivity by affecting the amount of light available for photosynthesis. No adverse or ecologically meaningful significant differences in benthic invertebrate density, richness, or relative abundance of metal-sensitive taxa were shown between Mary River mine-exposed areas compared to the upstream reference area (i.e., GO- 09) in 2017. Although some differences in community composition were indicated between the Mary River mine-exposed and reference areas in 2017, these differences appeared to be related to naturally greater substrate embeddedness at the mine-exposed areas rather than a mine-related influence. Temporal comparisons indicated significantly higher Simpson's Evenness and significantly lower relative abundance of chironomid midges at Mary River mine-exposed areas compared to the reference area between the 2017 and baseline studies. However, because the direction of these responses was opposite to those typically related to adverse mine-related effects, natural temporal variability and/or sampling artifacts of the CREMP likely accounted for the temporal differences in these endpoints. No ecologically significant differences in arctic charr size and condition were indicated between Mary River near- and far-field study areas in 2017, suggesting no mine-related influences on fish populations of Mary River with closer proximity to the mine. Overall, the chlorophyll-a, benthic invertebrate community, and arctic charr fish population data suggested no adverse mine-related influences to Mary River biota since the commencement of commercial mine operations.

5.3 Mary Lake

5.3.1 Hydraulic Retention Time

A hydraulic retention time of 75 ± 29 days was estimated for Mary Lake using mean annual watershed runoff (2007 – 2016 data) extrapolated from Baffinland flow monitoring stations installed in the primary tributaries of Mary Lake (Tom and Mary rivers) and at small watercourses (i.e., watershed ≤15 km^2) located on the mine property. The volume of Mary Lake used for the calculation of hydraulic retention time was 156.35 million cubic metres.

5.3.2 Water Quality

Water quality profiles taken at Mary Lake in 2017 showed similar *in situ* water temperature, dissolved oxygen saturation and pH values, but consistently higher specific conductance, at the north basin compared to the south basin throughout the year (Figures 5.9 and 5.10). Water

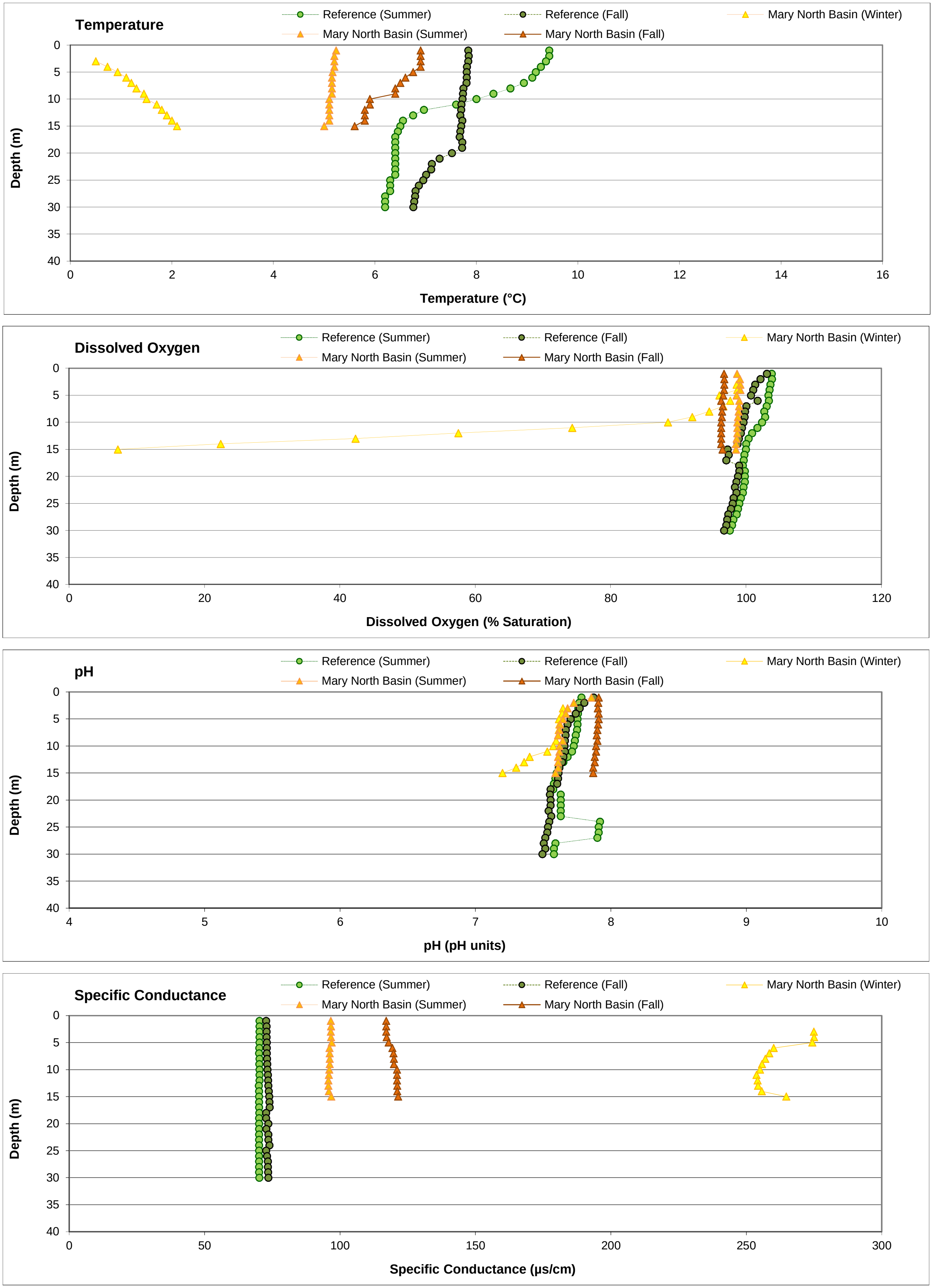


Figure 5.9: Average *In Situ* Water Quality with Depth from Surface at the Mary Lake North Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2017

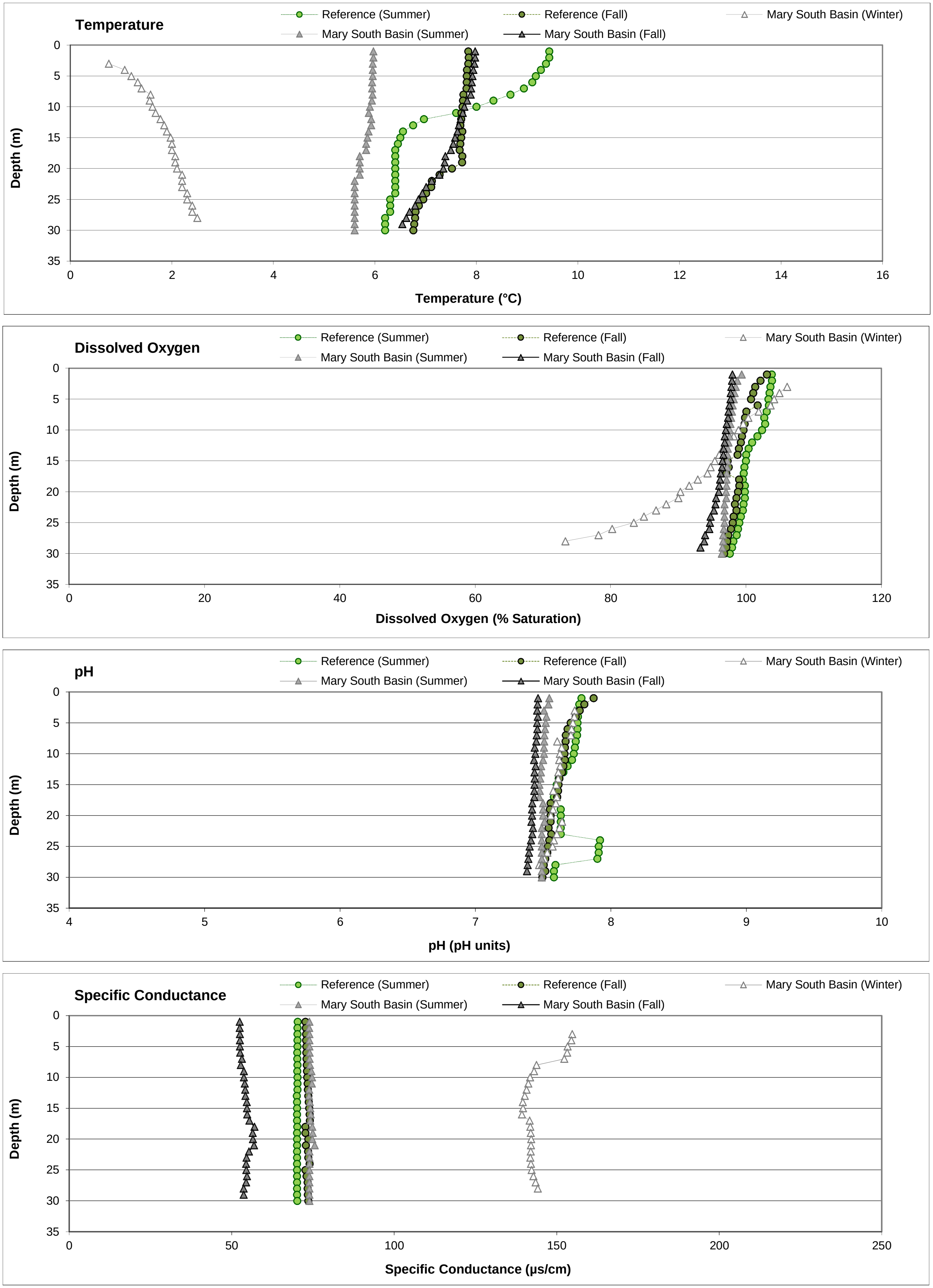


Figure 5.10: Average *In Situ* Water Quality with Depth from Surface at the Mary Lake South Basin (BLO) Compared to Reference Lake 3 during Winter, Summer, and Fall Sampling Events, Mary River Project CREMP, 2017

temperatures showed a gradient from surface to bottom during the winter and fall at the Mary Lake north and south basins. However, the temperature profile did not suggest any establshied thermal layers at either basin during the winter and fall sampling events in 2017 (Figures 5.9 and 5.10). The Mary Lake temperature profiles contrasted with those of the reference lake, where weak thermal stratification occurred during the summer and fall sampling events (Figures 5.9 and 5.10). Nevertheless, mean water temperature at the bottom of water column at Mary Lake littoral and profundal stations did not differ significantly from the reference lake at comparable station depths in fall 2017 (Figure 5.11; Appendix Table C.72).

Dissolved oxygen profiles conducted at Mary Lake in 2017 indicated the development of a strong oxycline at the north basin in winter beginning at a depth of approximately 7 m, and a weak oxycline at the south basin in winter through the entire water column (Figures 5.9 and 5.10). However, similar to Reference Lake 3, no oxycline development was apparent in the summer or fall of 2017 at either Mary Lake basin. Dissolved oxygen saturation levels at Mary Lake remained above WQG (i.e., 54%) through the entire water column at the south basin in all seasons, and at the north basin in summer and fall seasons (Figures 5.9 and 5.10). However, dissolved oxygen saturation levels below the WQG of 54% occurred at depths greater than approximately 12.5 m at the Mary Lake north basin in the winter (Figure 5.9). During the 2017 fall sampling event, dissolved oxygen saturation levels at Mary Lake littoral and profundal stations were well above the applicable WQG at the bottom of the water column, but were significantly lower than those at Reference Lake 3 (Figure 5.11; Appendix Table C.72).

In situ profiles of pH showed no substantial change from the surface to bottom of the water column at either the north or south basins of Mary Lake during winter, summer, or fall sampling in 2017, and were also comparable to pH profiles at Reference Lake 3 (Figures 5.9 and 5.10). No significant differences in bottom pH were indicated between Mary Lake and Reference Lake 3 at littoral stations sampled in fall 2017, but significantly lower pH was indicated at profundal stations of Mary Lake compared to the reference lake (Figure 5.11; Appendix Table F.72). However, pH values at Mary Lake water quality and benthic littoral stations were consistently within WQG limits (Figure 5.10). Specific conductance was substantially higher at the north basin compared to the south basin of Mary Lake (Figures 5.9 and 5.10; Appendix Figure C.27). The differences in specific conductance between lake basins likely reflected natural differences in dominant inflow sources to Mary Lake (i.e., Tom River inflow to the north basin, and the Mary River inflow to the south basin) and natural differences in geochemistry associated with these inflows. Specific conductance profiles showed no substantial change from the surface to bottom of the water column at either the north or south basins of Mary Lake during winter, summer, or fall sampling in 2017, reflecting similar profile structure at Reference Lake 3 (Figures 5.9 and 5.10). Although specific conductance at the bottom of the water column of littoral and profundal stations was

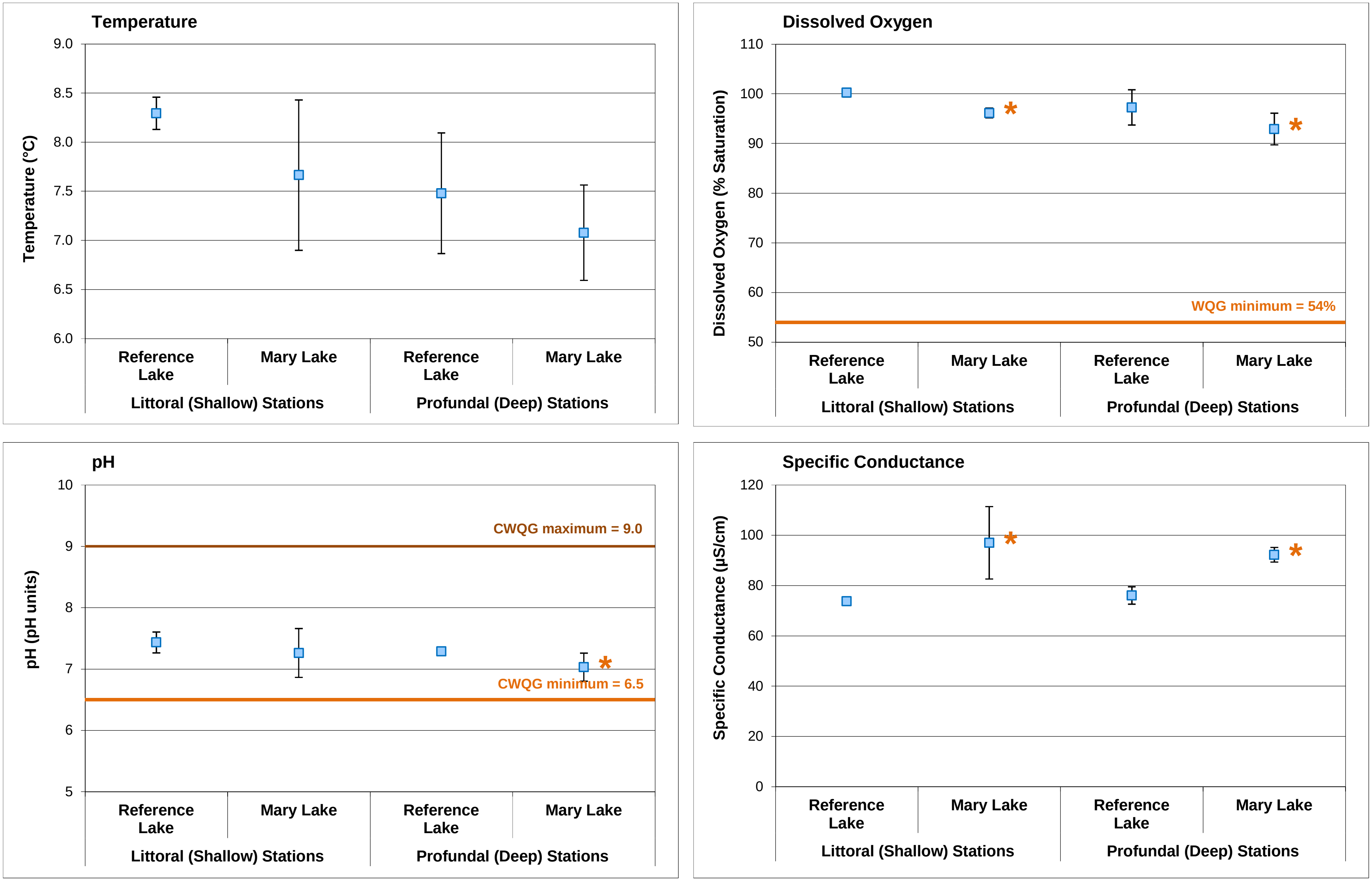


Figure 5.11: Comparison of *In Situ* Water Quality Variables (mean ± SD) Measured at Mary Lake (BLO) and Reference Lake 3 (REF3) Littoral and Profundal Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Note: An asterisk (*) next to data point indicates mean value differs significantly from the Reference Lake 3 mean for the respective littoral or profundal station type.

significantly higher at Mary Lake than at the reference lake, mean values of 97 and 92 µS/cm at littoral and profundal stations, respectively, of Mary Lake were intermediate to that of the reference creek and river areas (i.e., range from 55 – 168 µS/cm) in fall 2017. Similar to the other mine-exposed lakes, the extent to which higher specific conductance at Mary Lake was related to natural regional variability or a mine-related influence was unclear.

Water clarity, as determined using Secchi depth readings, was significantly lower at Mary Lake compared to Reference Lake 3 in fall 2017 (Appendix Table C.72; Appendix Figure C.7). In general, Secchi depth readings were similar among the Mary Lake stations, suggesting no spatial differences in water clarity throughout the lake (Appendix Table C.70).

Water chemistry of the Mary Lake north basin showed moderately (i.e., 5- to 10-fold higher) to highly elevated (i.e., ≥10-fold higher) turbidity and concentrations of total aluminum, manganese, silver, and/or uranium compared to Reference Lake 3 during summer and/or fall sampling in 2017 (Table 5.6; Appendix Tables C.73 and C.74). However, no parameters were above WQG and, with the exception of total silver concentrations during the summer sampling event, concentrations of all parameters were below AEMP benchmarks at the Mary Lake north basin during the winter, summer, and fall monitoring events in 2017 (Table 5.6; Appendix Table C.73). Total silver concentrations were below laboratory reportable detection limits (RDL) at the Mary Lake north basin during winter and fall sampling events (Appendix Table C.73), as well as further upstream closer to the mine at Camp Lake during all winter, summer, and fall sampling events (Appendix Table C.26). In turn, this suggested that elevated total silver concentrations at the Mary Lake north basin in summer 2017 were likely a laboratory analysis anomaly. As in previous studies and other mine-exposed areas, aluminum concentrations showed a strong positive correlation with turbidity at the Mary Lake north basin stations in 2017, suggesting that much of the aqueous aluminum was associated with suspended particles (e.g., aluminosilicates; Appendix Table C.77). Temporal evaluation of the data indicated that parameter concentrations in 2017 were mostly within respective parameter concentration ranges measured over the mine baseline period (2005-2013; Appendix Table C.74), although annual concentrations of some parameters, including chloride, sodium, and sulphate, showed consistently higher concentrations since the onset of commercial mine operations in 2015 (Figure 5.12; Appendix Figure C.28).

Water chemistry at the Mary Lake south basin showed no consistent spatial differences in parameter concentrations with progression from the Mary River inlet to the lake outlet during any of the winter, summer, or fall sampling events in 2017 (Table 5.6; Appendix Table C.78), suggesting that the south basin waters were generally well mixed both laterally and vertically. On average, turbidity and total aluminum concentrations were highly elevated, total manganese concentrations moderately elevated, and total iron and lead concentrations slightly elevated (i.e.,

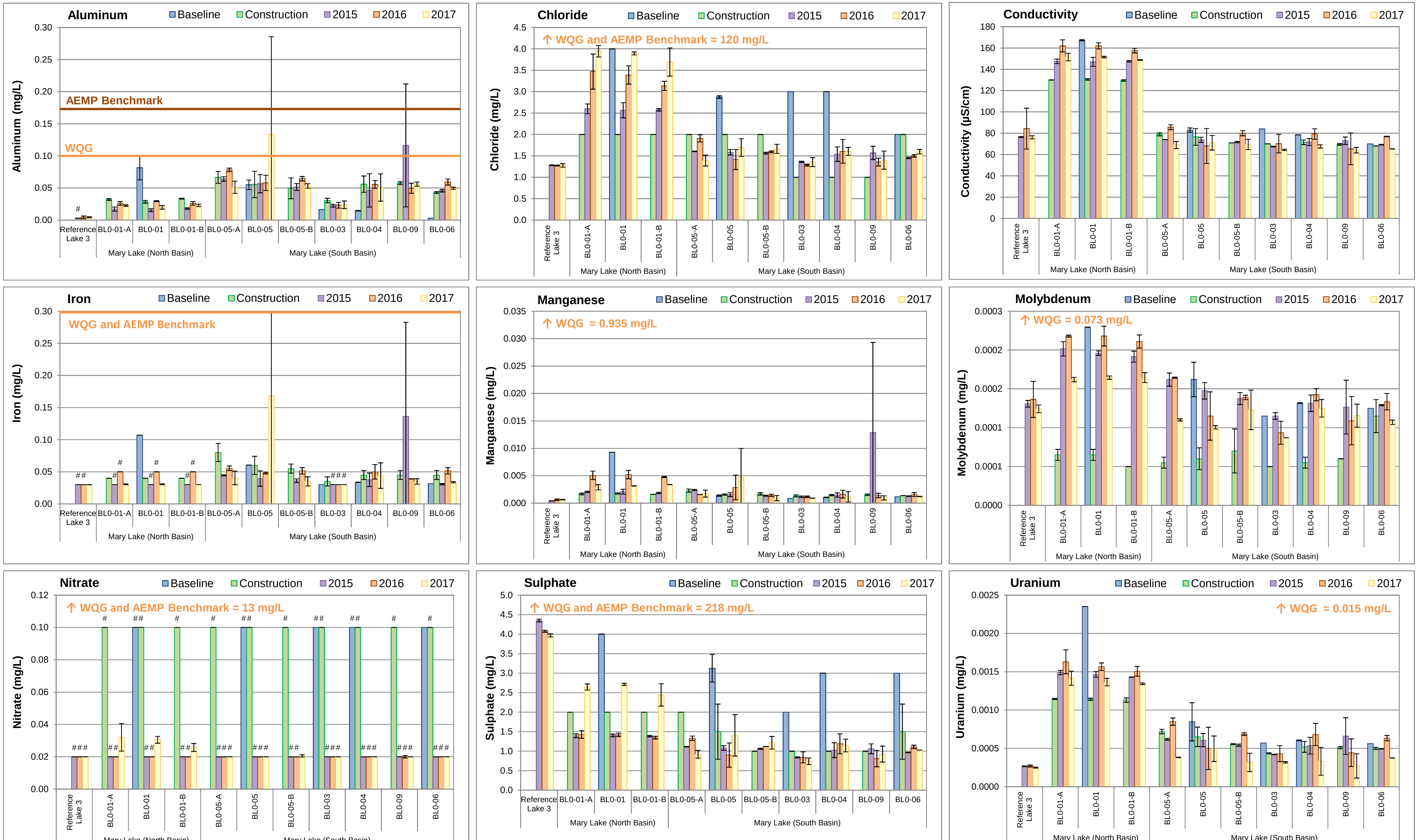


Figure 5.12: Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015-2017) Periods during Fall

Note: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.3 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Mary Lake.

Table 5.6: Water Chemistry at Mary Lake North Basin (BLO-01) and South Basin (BLO) Monitoring Stations[a], Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[b]	AEMP Benchmark[c]	Reference Lake 3 Average (n = 3)	North Basin (Mine-exposed)			South Basin (Mine-exposed)						
						BL0-01-A	BL0-01	BL0-01-B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06
					Fall 2017	30-Aug-2017	30-Aug-2017	30-Aug-2017	28-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017
Conventionals	Conductivity (lab)	umho/cm	-	-	76	152	152	149	69	71	70	64	68	64	65
	pH (lab)	pH	6.5 - 9.0	-	7.76	8.05	8.05	8.06	7.55	7.75	7.74	7.71	7.65	7.67	7.72
	Hardness (as $CaCO_3$)	mg/L	-	-	35	74	74	72	31	32	31	30	31	30	30
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	4.5	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	33	75	89	70	34	38	35	36	36	39	28
	Turbidity	NTU	-	-	0.7	0.9	0.9	0.9	1.9	6.5	1.6	0.7	1.7	2.1	1.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	31	71	66	66	31	33	28	29	31	25	28
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	0.020	<0.020	0.024	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	0.032	0.0305	0.02575	<0.020	<0.020	0.0205	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	0.17	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.7	1.5	1.7	1.6	1.1	1.2	1.2	1.2	1.2	1.2	1.3
	Total Organic Carbon	mg/L	-	-	2.8	1.7	1.8	1.7	1.2	1.3	1.2	1.3	1.2	1.2	1.2
	Total Phosphorus	mg/L	0.020[α]	-	0.004	0.014	0.004	0.004	0.011	0.008	0.003	0.003	0.005	0.004	0.004
	Phenols	mg/L	0.004[α]	-	0.002	<0.0010	<0.0010	0.001	0.004	<0.0010	<0.0010	0.001	0.001	0.001	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.28	3.95	3.90	3.69	1.39	1.70	1.67	1.36	1.61	1.40	1.60
	Sulphate (SO_4)	mg/L	218[β]	218	3.97	2.65	2.71	2.44	0.92	1.41	1.22	0.74	1.15	0.93	1.03
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.005	0.023	0.020	0.023	0.051	***0.134***	0.053	0.024	0.051	0.056	0.050
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0064	0.0073	0.0073	0.0073	0.0041	0.0055	0.0046	0.0036	0.0045	0.0043	0.0041
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	6.9	15.0	14.5	14.5	6.3	6.6	6.1	6.1	6.2	5.9	6.1
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.00079	0.00084	0.00082	0.00085	0.00060	0.00074	0.00054	0.00051	0.00056	0.00053	0.00056
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.031	0.031	<0.030	0.041	0.168	0.035	<0.030	0.044	0.035	0.034
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000143	<0.000050	<0.000050	0.000055	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.4	8.9	8.9	8.6	3.8	4.2	4.1	3.7	4.1	3.9	3.7
	Manganese (Mn)	mg/L	0.935[β]	-	0.00063	0.00289	0.00313	0.00338	0.00173	0.00478	0.00090	0.00091	0.00115	0.00095	0.00122
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.00012	0.00016	0.00016	0.00016	0.00011	0.00010	0.00012	0.00009	0.00013	0.00012	0.00011
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00057	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.88	0.82	0.81	0.82	0.55	0.63	0.58	0.48	0.58	0.57	0.53
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.41	0.80	0.80	0.75	0.51	0.60	0.52	0.43	0.53	0.56	0.50
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.85	1.98	2.02	2.01	0.85	0.90	0.91	0.78	0.90	0.87	0.83
	Strontium (Sr)	mg/L	-	-	0.0078	0.0097	0.0096	0.0098	0.0050	0.0056	0.0051	0.0046	0.0051	0.0049	0.0050
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<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	0.0135	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.00025	0.00142	0.00137	0.00134	0.00038	0.00050	0.00032	0.00032	0.00033	0.00027	0.00037
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Values presented are averages from samples taken from the surface and the bottom of the water column at each station.

[b] Canadian Water Quality Guideline (CCME 1999, 2017) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2017). See Table 2.2 for information regarding WQG criteria.

[c] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data (2006 - 2013) specific to Mary Lake.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

3- to 5-fold higher) at the Mary Lake south basin compared to Reference Lake 3 during the 2017 summer and/or fall sampling events (Table 5.6; Appendix Tables C.74 and C.78). Of the metals indicated above, total aluminum, manganese, and iron concentrations showed a very strong positive correlation with turbidity for the Mary Lake south basin combined data set (i.e., winter, summer and fall data; $r_s \geq 0.90$; Appendix Table C.80), suggesting that these metals were associated with suspended particles (e.g., aluminosilicates). Indeed, evaluation of the ratios of dissolved to total concentrations of aluminum, manganese, and iron indicated that on average, 85%, 56%, and 73% of these metals were associated with the total fraction, respectively, during summer and fall sampling events. As indicated previously, high turbidity in the Mary River originates from natural sources upstream of the mine which, in turn, contributes to high turbidity and elevated concentrations of metals such as aluminum, iron, and manganese at Mary Lake. Aluminum concentrations were occasionally above applicable WQG and/or AEMP benchmarks, and copper, iron, and mercury concentrations were above respective WQG on a single occasion, at the south basin of Mary Lake over the course of the 2017 winter, summer, and fall sampling events (Table 5.6; Appendix Table C.78).

Temporal comparisons of the Mary Lake south basin water chemistry data suggested no changes in average concentrations of mine-related parameters in 2017 compared to the baseline (2005 – 2013) period except for slightly higher turbidity during the summer 2017 sampling event (Figure 5.12; Appendix Figure C.28). Highest turbidity was observed at stations most distant to the inlets of the Tom and Mary rivers to Mary Lake during the summer 2017 sampling event, and therefore the source of turbidity to the Mary Lake south basin was unclear, but did not appear to be related to discharge from the Tom or Mary rivers. Parameter concentrations at the Mary River south basin in fall 2017 did not show any consistent increase compared to the year of mine construction (2014) and the two previous years of mine operation (2015 and 2016; Figure 5.12; Appendix Figure C.28). The absence of any temporal changes in water quality suggested no adverse mine-related influences on water chemistry of the Mary Lake south basin since the onset of commercial mine operations.

5.3.3 Sediment Quality

Surficial sediment of the Mary Lake north basin (BLO-01) was composed of silt loam material with low TOC content (Figure 5.13). At the Mary Lake south basin littoral stations, surficial sediment varied from loamy sand to silty clay loam (Figure 5.13; Appendix Table D.45), whereas at the south basin profundal stations, surficial sediment was predominantly silt and clay loams except at two stations where sand was more prevalent (Figure 5.13). Sediment TOC content was significantly lower at littoral and profundal stations of Mary Lake compared to respective habitat types at the reference lake (Appendix Table D.5). Substrate containing visible iron (oxy)hydroxide

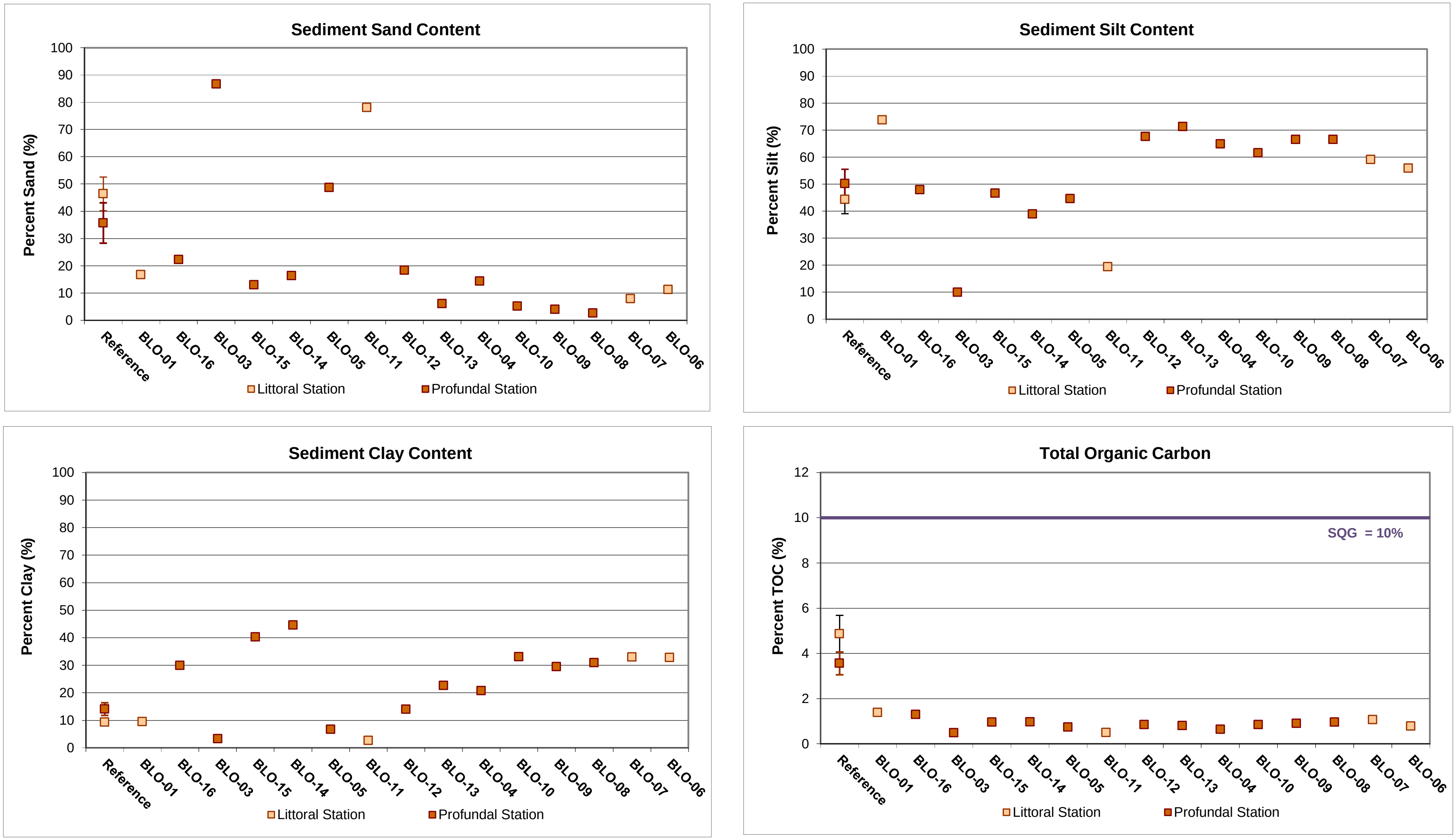


Figure 5.13: **Sediment Particle Size and Total Organic Carbon (TOC) Content Comparisons among Mary Lake (BLO) North and South Basin Sediment Monitoring Stations and to Reference Lake 3 Averages (mean ± SE), Mary River Project CREMP, August 2017**

material was not observed at the Mary Lake north basin, but was present at some south basin stations in 2017 (Appendix Table D.43), mirroring similar observations at Reference Lake 3 and the other mine-exposed lakes where such material was commonly visible as a thin, distinct layer or floc on or within surficial sediment. Substrate of Mary Lake occasionally contained sub-surface blackening/dark colouration which appeared as bands/layers indicating the presence of reduced sediment demarcated by distinct redox boundaries in some cases (Appendix Table D.43). Similar sub-surface reducing conditions were observed in sediment of the reference lake, though no distinct redox boundaries were visible (Appendix Table D.3).

Sediment metal concentrations at littoral stations of the Mary Lake north and south basins were comparable to those observed at littoral stations of Reference Lake 3 (Table 5.7; Appendix Table D.46). Sediment metal concentrations at the Mary Lake south basin showed no spatial gradients with progression from the Mary River inlet to the lake outlet among the profundal stations, suggesting that the Mary River was not contributing disproportionate concentrations of metals (Appendix Table D.45). In addition, sediment metal concentrations at the Mary Lake south basin profundal stations were similar to average metal concentrations at like-depth stations of the reference lake (Table 5.7; Appendix Table D.46). Although manganese concentrations were above SQG at the Mary Lake north basin littoral station, and chromium, iron, and manganese concentrations were above respective SQG at some individual profundal stations of the Mary Lake south basin, average concentrations of these metals were below the applicable guidelines at Mary Lake (Table 5.7; Appendix Table D.45). As indicated previously, concentrations of iron and manganese were elevated above SQG in sediment at Reference Lake 3 littoral and/or profundal stations, suggesting that concentrations of these metals above SQG at Mary Lake may reflect natural conditions un-related to mine activity. On average, no metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of the Mary Lake north or south basins (Table 5.7; Appendix Table D.45).

Temporal comparisons indicated that metal concentrations in sediment at littoral and profundal stations of Mary Lake in 2017 closely mirrored those observed during the mine baseline (2005 – 2013) period (Figure 5.14; Appendix Table D.46). On average, metal concentrations in sediment at Mary Lake littoral and profundal stations in 2017 were also within the range of those observed from 2015 and 2016, with no consistently higher concentrations indicated that would suggest an increasing trend over time (Figure 5.14; Appendix Table D.47). Accordingly, evaluation of data current to 2017 indicated no substantial changes in sediment metal concentrations at Mary Lake littoral and profundal stations following the commencement of Baffinland commercial mine operations in 2015.

Table 5.7: Sediment Total Organic Carbon and Metal Concentrations at Mary Lake north basin (BLO-01) and south basin (BLO), and Reference Lake 3 (REF3) Sediment Monitoring Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral			Profundal	
				Reference Lake (n = 5)	Mary Lake (North Basin) (n = 1)	Mary Lake (South Basin) (n = 1)	Reference Lake (n = 5)	Mary Lake (South Basin) (n = 8)
				Average ± Std. Error			Average ± Std. Error	Average ± Std. Error
Total Organic Carbon	%	10$^{\alpha}$	-	4.87 ± 0.81	1.38	0.78	3.60 ± 0.52	0.86 ± 0.06
Metals: Aluminum (Al)	mg/kg	-	-	14,720 ± 736	14,900	21,200	22,140 ± 1,652	21,334 ± 2,557
Antimony (Sb)	mg/kg	-	-	<0.10 ± 0	<0.10	<0.10	<0.10 ± 0.00	<0.10 ± 0.00
Arsenic (As)	mg/kg	17	5.9	3.35 ± 0.64	4.48	2.77	4.80 ± 0.20	3.26 ± 0.47
Barium (Ba)	mg/kg	-	-	113 ± 10	85	88	138 ± 7	91 ± 11
Beryllium (Be)	mg/kg	-	-	0.57 ± 0.02	0.77	1.01	0.85 ± 0.06	0.99 ± 0.12
Bismuth (Bi)	mg/kg	-	-	<0.20 ± 0	<0.20	<0.20	0.20 ± 0.000	0.23 ± 0.01
Boron (B)	mg/kg	-	-	12.1 ± 0.8	19.4	27.9	16.6 ± 1.5	30.6 ± 3.5
Cadmium (Cd)	mg/kg	3.5	1.5	0.182 ± 0.032	0.112	0.098	0.179 ± 0.024	0.142 ± 0.017
Calcium (Ca)	mg/kg	-	-	4,656 ± 362	8,550	3,850	5,262 ± 377	3,987 ± 428
Chromium (Cr)	mg/kg	90	98	51.1 ± 3.7	65.4	74.8	70.2 ± 6.3	78.4 ± 9.1
Cobalt (Co)	mg/kg	-	-	10.63 ± 0.79	14.20	14.50	15.98 ± 1.14	14.92 ± 1.65
Copper (Cu)	mg/kg	110	50	***64.7*** ± 5.3	29.1	28.2	***87.6*** ± 8.5	29.8 ± 3.6
Iron (Fe)	mg/kg	40,000$^{\alpha}$	52,400	41,960 ± 8,713	34,800	35,400	46,740 ± 3,447	37,400 ± 3,801
Lead (Pb)	mg/kg	91.3	35	12.4 ± 0.6	14.6	18.3	16.9 ± 1.0	19.6 ± 2.4
Lithium (Li)	mg/kg	-	-	24.0 ± 0.9	29.2	37.9	35.0 ± 2.1	37.9 ± 4.5
Magnesium (Mg)	mg/kg	-	-	10,256 ± 714	15,000	13,700	14,660 ± 1,126	14,580 ± 1,687
Manganese (Mn)	mg/kg	1,100$^{\alpha,\beta}$	4,370	639 ± 115	1,270	554	1,266 ± 70	996 ± 171
Mercury (Hg)	mg/kg	0.486	0.17	0.0440 ± 0.0081	0.0328	0.0218	0.0528 ± 0.0089	0.0541 ± 0.0070
Molybdenum (Mo)	mg/kg	-	-	3.50 ± 0.97	0.71	0.55	2.90 ± 0.20	0.78 ± 0.10
Nickel (Ni)	mg/kg	75$^{\alpha,\beta}$	72	38.2 ± 2.4	54.5	49.8	49.3 ± 3.0	54.8 ± 6.3
Phosphorus (P)	mg/kg	2,000$^{\alpha}$	1,580	1,039 ± 246	1,060	679	1,073 ± 54	808 ± 86
Potassium (K)	mg/kg	-	-	3,754 ± 212	3,640	5,530	5,694 ± 366	5,632 ± 678
Selenium (Se)	mg/kg	-	-	0.61 ± 0.12	<0.20	0.20	0.59 ± 0.12	0.24 ± 0.02
Silver (Ag)	mg/kg	-	-	0.13 ± 0.01	<0.10	0.10	0.20 ± 0.03	0.14 ± 0.01
Sodium (Na)	mg/kg	-	-	284.2 ± 21	258	323	410 ± 36	360 ± 43
Strontium (Sr)	mg/kg	-	-	10.0 ± 0.5	11.5	11.9	12.7 ± 0.8	13.2 ± 1.5
Thallium (Tl)	mg/kg	-	-	0.346 ± 0.036	0.325	0.470	0.657 ± 0.038	0.459 ± 0.054
Uranium (U)	mg/kg	-	-	11.0 ± 1.04	3.9	5.10	23.5 ± 2.26	7.27 ± 0.80
Vanadium (V)	mg/kg	-	-	47.8 ± 2.0	50.1	60.2	67.2 ± 3.9	60.2 ± 6.8
Zinc (Zn)	mg/kg	315	135	67.3 ± 2.5	52.1	66.4	91 ± 6.8	68.0 ± 7.8

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013). The indicated values are specific to Mary Lake.

(shaded box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

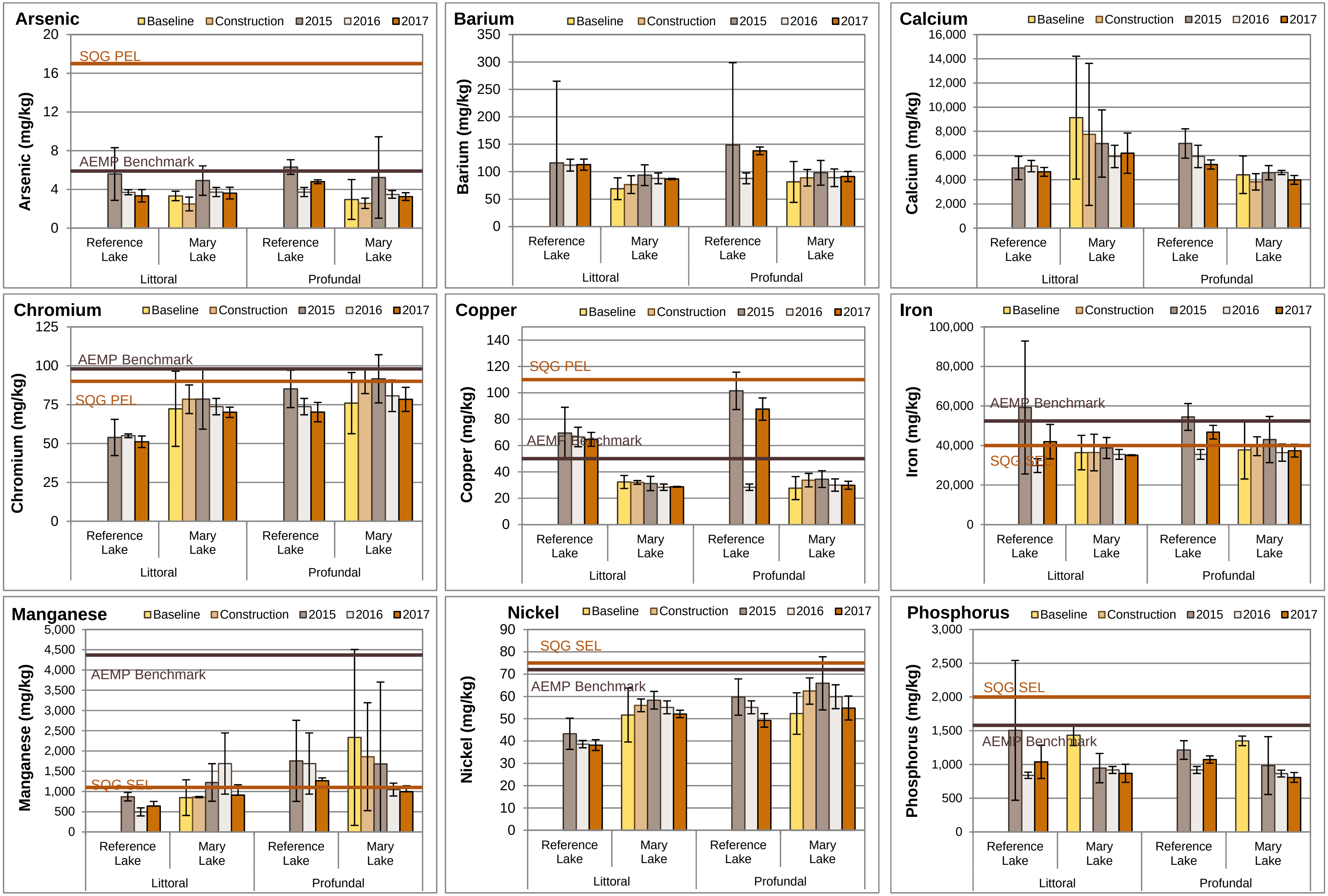


Figure 5.14: Temporal Comparison of Sediment Metal Concentrations (mean ± SD) at Littoral and Profundal Stations of Mary Lake and Reference Lake 3 for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015, 2016, and 2017) Periods, Mary River Project CREMP, 2017

5.3.4 Phytoplankton

Chlorophyll-a concentrations at Mary Lake showed no spatial gradients with distance from either the Tom River inlet or the Mary River inlet towards the lake outlet during any of the winter, summer, or fall sampling events in 2017 (Figure 5.15). Chlorophyll-a concentrations were consistently lowest in winter and highest in fall at both the north and south basins of Mary Lake in 2017 (Appendix Table E.6), and mirrored similar relative differences in chlorophyll-a concentrations between summer and fall sampling events at the reference lake (Appendix Table B.8). Similar to the other mine-exposed lakes, chlorophyll-a concentrations were significantly higher at the Mary Lake north and south basins than at the reference lake in summer, as well as at the south basin during the fall sampling event (Appendix Tables E.7 and E.8). However, Mary Lake chlorophyll-a concentrations were well below the AEMP benchmark of 3.7 µg/L during all winter, summer, and fall sampling events in 2017 (Figure 5.15). Chlorophyll-a concentrations at Mary Lake reflected an 'oligotrophic' primary productivity categorization (sensu Wetzel 2001), which agreed closely with an 'oligotrophic' CWQG categorization based on mean aqueous total phosphorus concentrations generally between 4 – 10 µg/L during the 2017 Mary Lake winter, summer, and fall sampling events (Table 5.6; Appendix Tables C.73 and C.78).

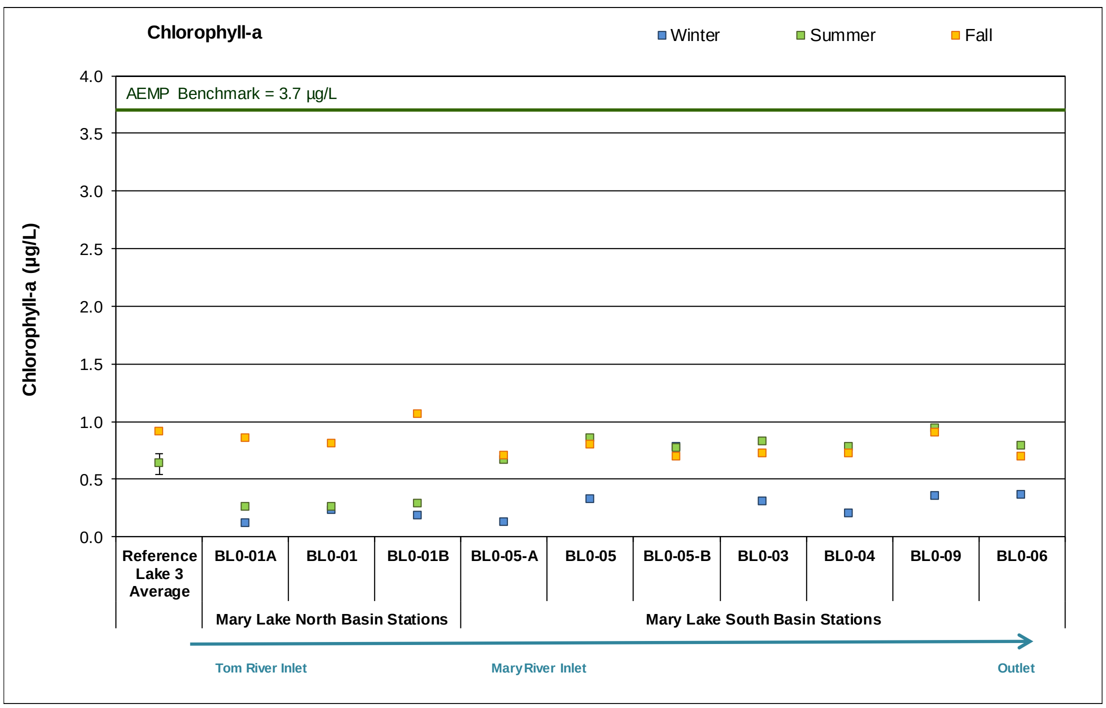


Figure 5.15: Chlorophyll-a Concentrations at Mary Lake (BLO) Phytoplankton Monitoring Stations, Mary River Project CREMP, 2017

Notes: Values presented are averages of samples taken from the surface and the bottom of the water column at each station. Reference values represent mean ± standard deviation (n = 3). Reference Lake 3 was not sampled in winter 2017.

Temporal comparison of Mary Lake chlorophyll-a concentrations, conducted separately for the north and south basins, did not indicate any consistent direction of significant differences between the 2017 data and data from the mine construction (2014) period or previous years of mine operation (2015, 2016) among the winter, summer, or fall sampling events (Figure 5.16; Appendix Tables E.16 and E.17). In addition, annual average chlorophyll-a concentrations did not differ significantly among years from 2014 – 2017 at either basin of Mary Lake (Appendix Tables E.16 and E.17), suggesting no substantial changes in the trophic status since mine operations commenced at the Mary River Project. No chlorophyll-a baseline (2005 – 2013) data are available for Mary Lake, precluding comparisons to conditions prior to the mine construction period.

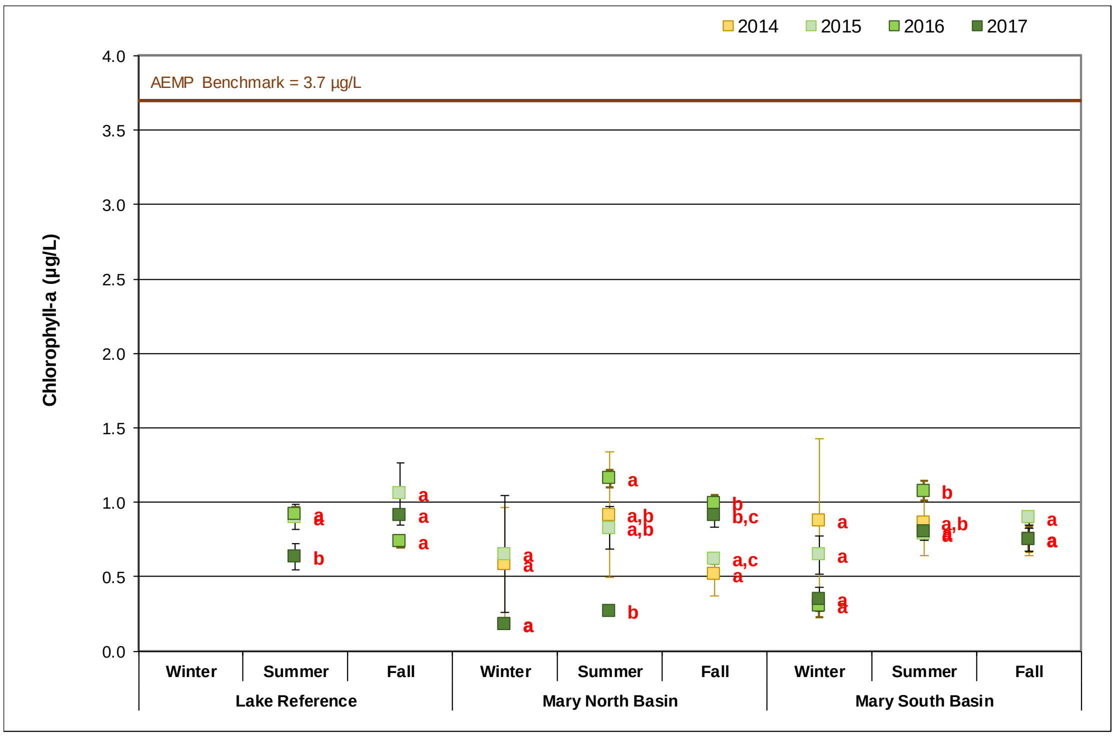


Figure 5.16: Chlorophyll-a Concentration Seasonal Comparison among 2014, 2015, 2016, and 2017 years (mean ± SE) at Mary Lake Phytoplankton Monitoring Stations, Mary River Project CREMP

Notes: Data points with the same letter on the right do not differ significantly between years for the applicable season.

5.3.5 Benthic Invertebrate Community

Benthic invertebrate density, richness, and Simpson's Evenness did not differ significantly between Mary Lake and Reference Lake 3 at littoral stations, but at profundal stations, both density and richness were significantly higher at Mary Lake in 2017 (Tables 5.8 and 5.9). Benthic invertebrate community structure differed between Mary Lake and Reference Lake 3 based on significant differences in Bray-Curtis Index for both littoral and profundal habitat types (Tables 5.8

Table 5.8: Benthic Invertebrate Community Statistical Comparison Results between Mary Lake (BLO) and Reference Lake 3 for Littoral Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Littoral Habitat	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	none	NO	0.745	t-test (unequal variance)	0.4	Reference Lake 3	1,489	850	380	372	2,618
						Mary Lake Littoral	1,839	1,853	926	216	3,911
Richness (Number of Taxa)	log	NO	0.102	ANOVA	-1.2	Reference Lake 3	12.4	2.5	1.1	10.0	15.0
						Mary Lake Littoral	9.5	2.1	1.0	7.0	12.0
Simpson's Evenness (E)	none	NO	0.905	ANOVA	0.1	Reference Lake 3	0.807	0.142	0.063	0.605	0.934
						Mary Lake Littoral	0.818	0.110	0.055	0.717	0.934
Bray-Curtis Index	none	YES	< 0.001	ANOVA	3.7	Reference Lake 3	0.384	0.120	0.054	0.203	0.536
						Mary Lake Littoral	0.828	0.040	0.020	0.768	0.853
Nemata (%)	fourth root	NO	0.219	ANOVA	-0.1	Reference Lake 3	3.9	3.3	1.5	0.8	9.1
						Mary Lake Littoral	3.5	6.2	3.1	0.0	12.8
Hydracarina (%)	none	NO	0.509	ANOVA	0.8	Reference Lake 3	5.3	3.0	1.4	1.8	8.1
						Mary Lake Littoral	7.8	7.2	3.6	0.0	15.5
Ostracoda (%)	log(X+1)	YES	< 0.001	ANOVA	-2.0	Reference Lake 3	38.8	18.4	8.2	22.3	63.9
						Mary Lake Littoral	2.1	2.2	1.1	0.0	5.1
Chironomidae (%)	log	YES	0.033	ANOVA	1.9	Reference Lake 3	51.8	17.9	8.0	29.5	67.9
						Mary Lake Littoral	85.7	13.1	6.6	66.6	94.3
Metal-Sensitive Chironomidae (%)	square root	NO	0.361	ANOVA	0.4	Reference Lake 3	15.5	13.4	6.0	0.5	37.0
						Mary Lake Littoral	21.3	7.7	3.8	15.5	32.2
Collector-Gatherers (%)	none	NO	0.143	ANOVA	-1.4	Reference Lake 3	73.9	16.0	7.2	56.0	95.5
						Mary Lake Littoral	52.2	23.6	11.8	20.7	74.3
Filterers (%)	fourth root	NO	0.415	t-test (unequal variance)	-0.1	Reference Lake 3	14.7	13.3	5.9	0.5	36.4
						Mary Lake Littoral	13.3	16.0	8.0	0.0	32.2
Shredders (%)	fourth root	NO	0.197	ANOVA	-0.6	Reference Lake 3	4.2	6.6	3.0	0.0	15.9
						Mary Lake Littoral	0.4	0.6	0.3	0.0	1.2
Clingers (%)	square root	NO	0.636	ANOVA	0.3	Reference Lake 3	19.8	12.8	5.7	2.7	38.1
						Mary Lake Littoral	23.5	13.3	6.6	12.0	41.7
Sprawlers (%)	none	NO	0.231	ANOVA	-1.5	Reference Lake 3	72.6	13.9	6.2	55.7	92.9
						Mary Lake Littoral	52.3	31.4	15.7	5.9	71.8
Burrowers (%)	log	YES	0.019	ANOVA	5.5	Reference Lake 3	7.5	3.0	1.4	4.5	12.0
						Mary Lake Littoral	24.2	18.8	9.4	12.8	52.4

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value ≤ 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

Table 5.9: Benthic Invertebrate Community Statistical Comparison Results between Mary Lake (BLO) and Reference Lake 3 for Profundal Habitat Stations, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Areas?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Study Lake Profundal Habitat	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	log	YES	0.020	ANOVA	12.2	Reference Lake 3	149	32	14	113	190
						Mary Lake Profundal	536	497	203	156	1,515
Richness (Number of Taxa)	fourth root	YES	0.017	ANOVA	1.9	Reference Lake 3	4.2	1.5	0.7	2.0	6.0
						Mary Lake Profundal	7.0	1.5	0.6	5.0	9.0
Simpson's Evenness (E)	none	NO	0.245	t-test (unequal variance)	-1.0	Reference Lake 3	0.704	0.105	0.047	0.597	0.843
						Mary Lake Profundal	0.604	0.236	0.096	0.394	0.962
Bray-Curtis Index	log	YES	0.001	ANOVA	3.7	Reference Lake 3	0.239	0.114	0.051	0.111	0.376
						Mary Lake Profundal	0.665	0.165	0.067	0.471	0.958
Nemata (%)	rank	YES	0.022	Mann-Whitney	nc	Reference Lake 3	0.0	0.0	0.0	0.0	0.0
						Mary Lake Profundal	2.4	1.9	0.8	0.0	5.8
Hydracarina (%)	log(X+1)	NO	0.860	ANOVA	0.2	Reference Lake 3	8.2	5.5	2.5	0.0	15.0
						Mary Lake Profundal	9.5	11.8	4.8	2.2	33.3
Ostracoda (%)	rank	NO	0.855	Mann-Whitney	0.1	Reference Lake 3	2.8	4.1	1.8	0.0	8.9
						Mary Lake Profundal	3.2	6.2	2.5	0.0	15.4
Chironomidae (%)	none	NO	0.568	ANOVA	-0.5	Reference Lake 3	89.0	7.6	3.4	81.6	100.0
						Mary Lake Profundal	84.9	13.8	5.7	60.9	96.3
Metal-Sensitive Chironomidae (%)	none	NO	0.131	ANOVA	-0.7	Reference Lake 3	12.0	8.9	4.0	0.0	20.2
						Mary Lake Profundal	5.6	3.2	1.3	1.8	10.7
Collector-Gatherers (%)	rank	NO	0.584	Mann-Whitney	-0.9	Reference Lake 3	84.3	4.1	1.9	79.8	90.5
						Mary Lake Profundal	80.7	18.2	7.4	44.2	92.0
Filterers (%)	fourth root	NO	0.471	ANOVA	-0.3	Reference Lake 3	6.5	9.3	4.2	0.0	20.2
						Mary Lake Profundal	3.8	2.7	1.1	0.0	6.8
Clingers (%)	fourth root	NO	0.870	ANOVA	0.4	Reference Lake 3	14.6	4.9	2.2	9.5	20.2
						Mary Lake Profundal	16.7	14.3	5.8	3.7	39.1
Sprawlers (%)	rank	NO	0.855	Mann-Whitney	-1.9	Reference Lake 3	81.4	6.3	2.8	74.8	90.5
						Mary Lake Profundal	69.1	34.4	14.1	4.5	91.4
Burrowers (%)	fourth root	NO	0.188	ANOVA	2.8	Reference Lake 3	3.9	3.7	1.7	0.0	8.0
						Mary Lake Profundal	14.2	25.5	10.4	1.8	66.0

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between study areas based on p-value ≤ 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD_{REF}, indicating that the difference was ecologically meaningful.

and 5.9). However, Ostracoda (seed shrimp) was the only dominant taxonomic group that differed significantly in relative abundance between Mary Lake and the reference lake at a magnitude outside of the CES_{BIC} of ±2 SD_{REF}, but only at the littoral sampling depth. As indicated previously, because TOC serves as a key food source for Ostracoda, lower relative abundance of this taxonomic group at Mary Lake littoral habitat was consistent with significantly lower sediment TOC at Mary Lake compared to the reference lake (Appendix Table F.64). No significant difference in the relative abundance of metal-sensitive chironomids was indicated between Mary Lake and Reference Lake 3 for either littoral or profundal habitat stations (Tables 5.7 and 5.8), suggesting no sediment metal-related influences on the benthic invertebrate community of Mary Lake. In addition, Mary Lake profundal stations exhibited no significant differences in the relative abundance of dominant taxonomic groups, FFG, or HPG compared to like-habitat at Reference Lake 3 (Table 5.8). Overall, no adverse mine-related influence to the littoral or profundal benthic invertebrate community of Mary Lake was indicated relative to reference lake conditions in 2017.

Temporal comparisons did not indicate any consistent ecologically significant differences in benthic invertebrate community density, richness, or Simpson's Evenness at littoral and profundal habitats of Mary Lake between the mine 2007 baseline study and individual years since the commencement of commercial mine operation (2015, 2016, 2017; Figure 5.17; Appendix Tables F.66 and F.67). In addition, no significant differences in the relative abundance of dominant taxonomic groups and FFG were indicated between baseline and mine operational years at Mary Lake with the exception of consistently lower relative abundance of Chironomidae (non-biting midges) at profundal stations in 2015 and 2017 compared to the 2007 baseline study (Appendix Table F.67). Adverse responses of benthic invertebrate communities to anthropogenic industrial inputs normally result in increased relative abundance of chironomids (Taylor and Bailey 1997; Barbour et al. 1999). Therefore, a lower relative abundance of this group at Mary Lake profundal stations in 2015 and 2017 was not consistent with a biological response typical of exposure to mine-related inputs to aquatic systems. Moreover, no significant differences in the relative abundance of metal-sensitive chironomids were indicated between the mine baseline and mine operational years at Mary Lake (Figure 5.17). Overall, consistent with no substantial changes in water and sediment quality since the mine baseline period, no significant changes in benthic invertebrate community features were indicated at littoral and profundal habitat of Mary Lake following the commencement of commercial mine operation in 2015.

5.3.6 Fish Population

5.3.6.1 Mary Lake (South) Fish Community

Arctic charr and ninespine stickleback composed the fish community of Mary Lake in 2017, reflecting the same fish species composition as Reference Lake 3 (Table 5.10). Similar to the

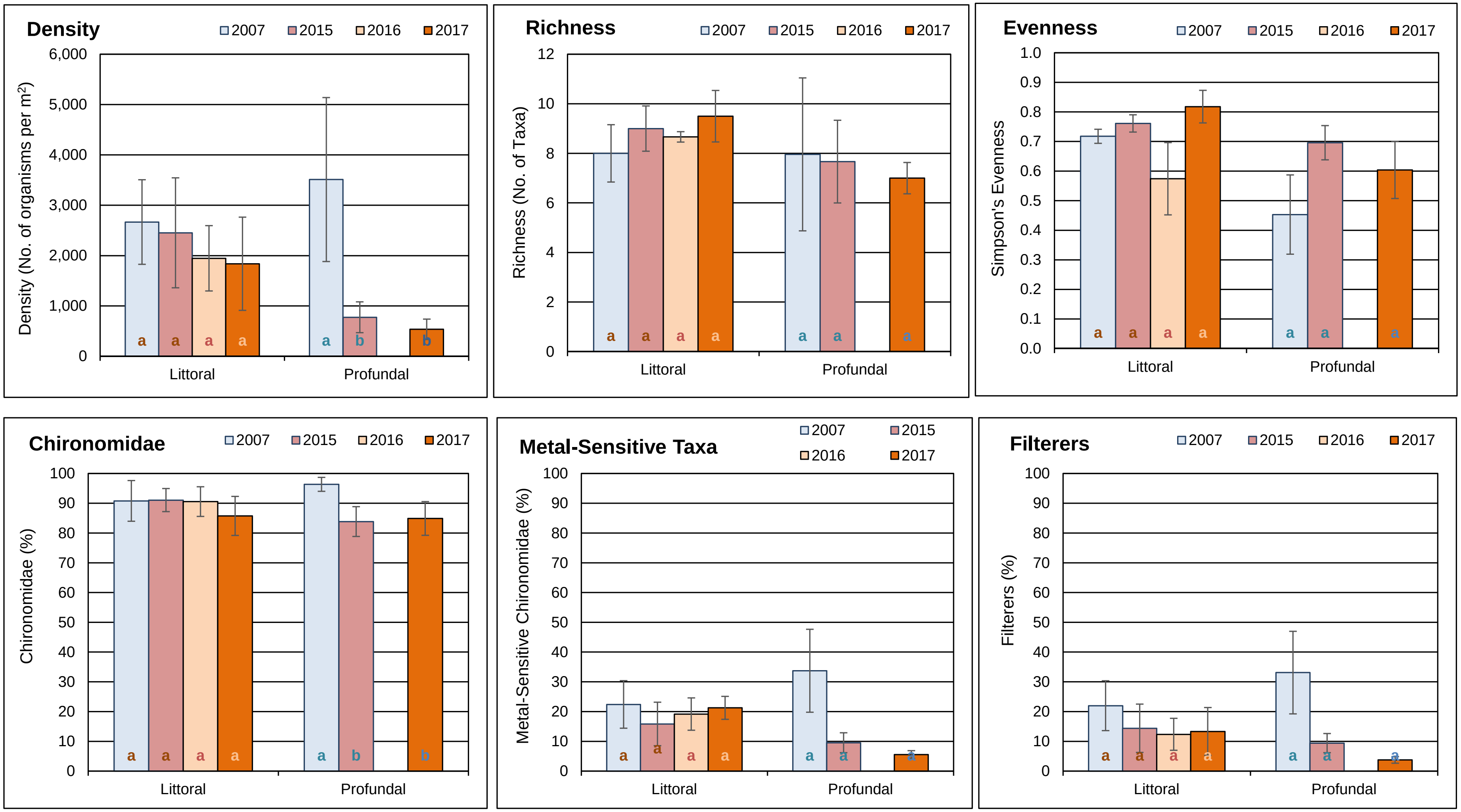


Figure 5.17: Comparison of Key Benthic Invertebrate Community Metrics (mean ± SE) at Mary Lake Littoral and Profundal Study Areas among Mine Baseline (2007) and Operational (2015, 2016, 2017) Periods

Note: The same like-coloured letter inside bars indicates no significant difference between/among study years for respective community endpoint.

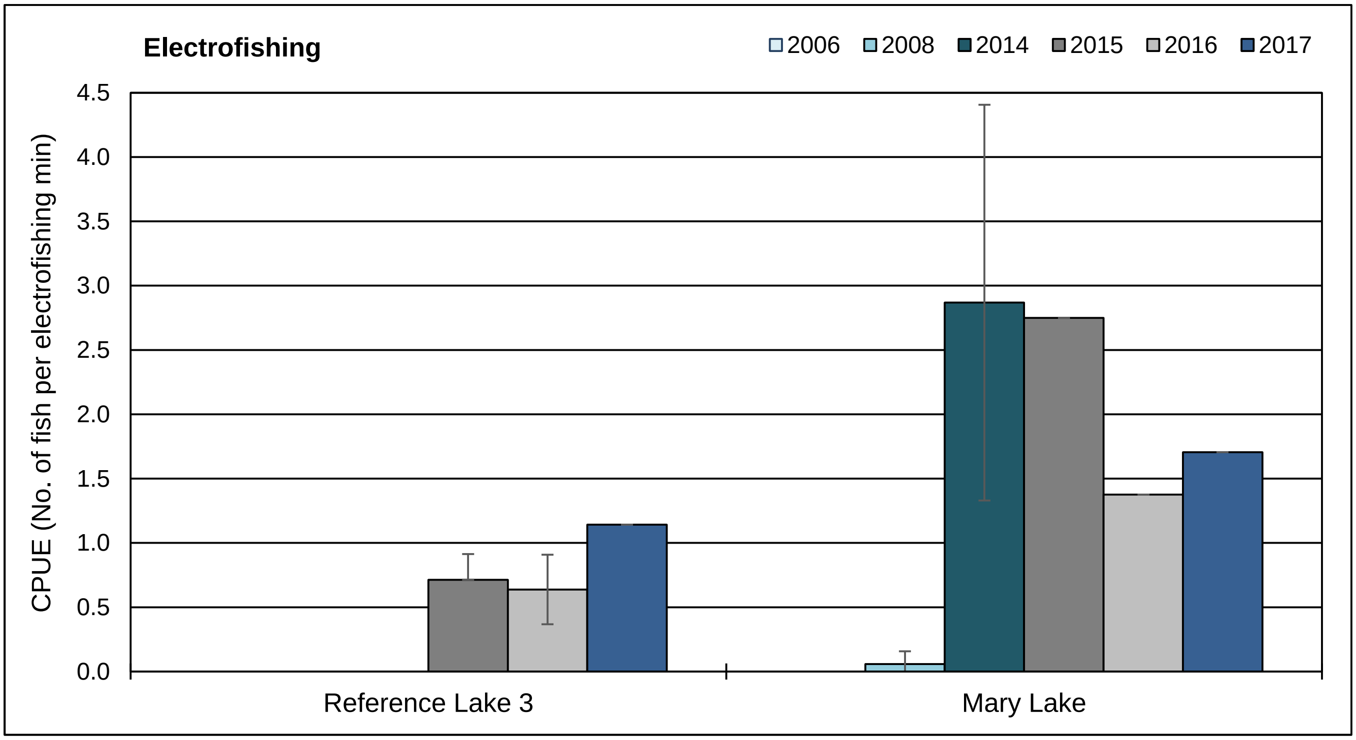
Table 5.10: Fish Catch and Community Summary from Backpack Electrofishing and Gill Netting Conducted at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Lake	Method [a]		Arctic Charr	Nine-spine Stickleback	Total by Method	Total No. of Species
Reference Lake 3	Electrofishing	No. Caught	100	11	111	2
		CPUE	1.03	0.11	1.14	
	Gill netting	No. Caught	1	0	1	
		CPUE	0.02	0	0.02	
Mary Lake	Electrofishing	No. Caught	98	20	118	2
		CPUE	1.42	0.29	1.71	
	Gill netting	No. Caught	93	0	93	
		CPUE	3.41	0	3.41	

[a] Catch-per-unit-effort (CPUE) for electrofishing represents the number of fish captured per electrofishing minute, and for gill netting represents the number of fish captured per 100 m hours of net.

other mine-exposed lakes, arctic charr CPUE was much higher at Mary Lake than at the reference lake for electrofishing and gill netting collection methods in 2017, suggesting higher densities and/or productivity of arctic charr at Mary Lake. Also consistent with the other mine-exposed lakes, greater numbers of arctic charr together with greater density of benthic invertebrates suggested that productivity was higher at Mary Lake than at Reference Lake 3.

Temporal comparison of the Mary Lake electrofishing catch data indicated substantially higher arctic charr CPUE in 2017, as well as in other mine construction/operation years, than during baseline monitoring conducted in 2008 (Figure 5.18). Similar to other mine-exposed lakes, gill netting CPUE for arctic charr was higher in 2016 and 2017 compared to all previous baseline (2007 – 2008), mine construction (2014) and mine operational (2015) studies (Figure 5.18), likely reflecting greater sampling efficiencies in 2016 and 2017 relative to the previous studies. Nevertheless, the CPUE data suggested that arctic charr abundance at nearshore and littoral/profundal habitats was likely comparable to, or greater than, the abundance of this species during the baseline period at Mary Lake, indicating no mine-related influences to arctic charr numbers in the lake following commercial mine operation start-up in 2015.



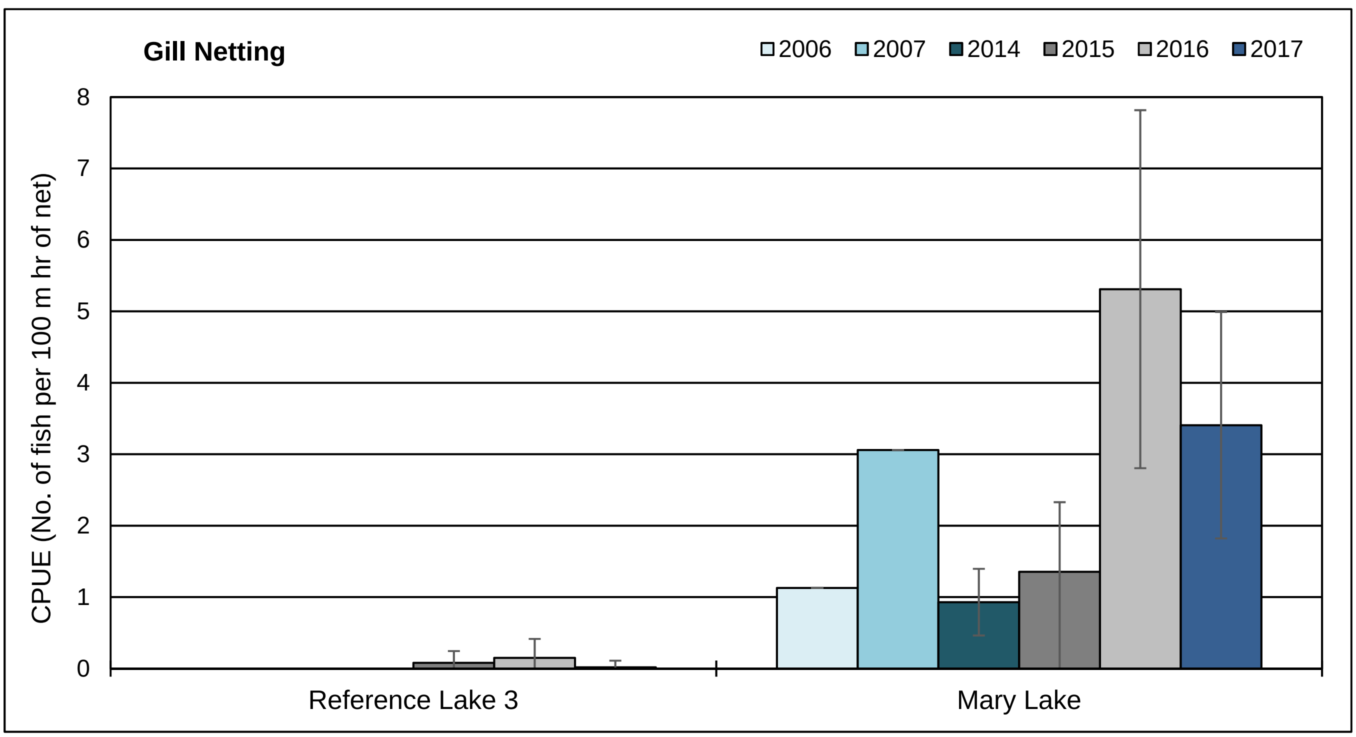


Figure 5.18: Catch-per-unit-effort (CPUE; mean ± SD) of Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Mary Lake (BLO), Mary River Project CREMP, 2006 - 2017

5.3.6.2 Mary Lake (South) Fish Population Assessment

Nearshore Arctic Charr

Mine-related influences on the Mary Lake nearshore arctic charr population were assessed with a control-impact analysis using data collected from Mary Lake and Reference Lake 3 in 2017. No nearshore arctic charr baseline data were collected at Mary Lake, precluding data analysis using a before-after design. A total of 98 and 100 arctic charr were captured at nearshore habitat of Mary Lake and Reference Lake 3, respectively, in August 2017, for the control-impact analysis. Arctic charr YOY were distinguished from the older, non-YOY age class using a fork length cut-off of 5.0 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations for the Mary Lake and Reference Lake 3 data sets (Figure 5.19). Nearshore arctic charr health comparisons were conducted separately for the YOY and non-YOY data sets to account for naturally differing weight-at-length relationships that occur between these age categories.

Nearshore arctic charr length-frequency distributions differed significantly between Mary Lake and Reference Lake 3, reflecting the occurrence of larger YOY and greater numbers of larger non-YOY individuals at Mary Lake (Table 5.11; Figure 5.19; Appendix Table G.34). Arctic charr in YOY and non-YOY age classes were significantly longer and heavier at Mary Lake than at the reference lake (Table 5.11; Appendix Table G.34). The occurrence of significantly larger YOY suggested faster arctic charr growth at Mary Lake than at the reference lake in 2017. Although condition of nearshore arctic charr YOY was significantly lower at Mary Lake than at the reference lake, the condition of arctic charr non-YOY did not differ significantly between lakes in 2017 (Table 5.11; Appendix Table G.34). Notably, the magnitude of difference in YOY condition between lakes was within the CES_C of ±10% suggesting that this difference was not ecologically meaningful (Table 5.11). Arctic charr non-YOY at Mary Lake showed no substantial, ecologically meaningful, changes in condition relative to those at Reference Lake 3 over the past three years of mine operation (Table 5.11), indicating no adverse response to fish at Mary Lake nearshore areas since the commencement of commercial mine operations.

Littoral/Profundal Arctic Charr

Mine-related influences on the Mary Lake littoral/profundal arctic charr population were assessed with a before-after analysis using data collected from Mary Lake in 2017 and during 2006-2007 baseline monitoring. Similar to the two previous CREMP studies, a small sample size from Reference Lake 3 (i.e., n = 1) precluded conducting a control-impact statistical analysis using the 2017 data for arctic charr of spawning size. Biological information collected from arctic charr mortalities indicated that non-spawners of reproductive age constituted approximately 62% of the Mary Lake sampled arctic charr population during the August 2017 field study (Appendix

Table 5.11: Summary of Statistical Results for Arctic Charr Population Comparisons between Mary Lake and Reference Lake 3 in 2015, 2016, and 2017, and between Mary Lake Mine Operational and Baseline Period Data, for Fish Captured by Electrofishing and Gill Netting Methods, Mary River Project CREMP

Data Set by Sampling Method	Response Category	Endpoint	Statistically Significant Differences Observed? [a]					
			versus Reference Lake 3			versus Mary Lake baseline period data [b]		
			2015	2016	2017	2015	2016	2017
Electrofishing Samples	Survival	Length-Frequency Distribution	No	**Yes**	**Yes**	-	-	-
		Age	**Yes (-43%)**	No	No	-	-	-
	Energy Use (non-YOY)	Size (mean weight)	No	No	**Yes (+51%)**	-	-	-
		Size (mean fork length)	No	No	**Yes (+17%)**	-	-	-
	Energy Storage (non-YOY)	Condition (body weight-at-fork length)	**Yes (+3%)**	No	No	-	-	-
Gill Netting Samples [c]	Survival	Length Frequency Distribution	-	-	-	**Yes**	**Yes**	**Yes**
		Age	-	-	-	No	**Yes (-14%)**	No
	Energy Use	Size (mean weight)	-	-	-	**Yes (+19%)**	No	**Yes (-9%)**
		Size (mean fork length)	-	-	-	**Yes (+6%)**	No	**Yes (-5%)**
		Growth (weight-at-age)	-	-	-	No	**Yes (nc)**	No
		Growth (fork length-at-age)	-	-	-	No	**Yes (nc)**	No
	Energy Storage	Condition (body weight-at-fork length)	-	-	-	No	**Yes (+3%)**	**Yes (+5%)**

[a] Values in parentheses indicate direction and magnitude of any signficant differences.
[b] No baseline period data collected for nearshore electrofishing; baseline period littoral/profundal gill netting data included combined 2006 and 2007 information.
[c] Due to low catches of arctic charr in gill nets at Reference Lake 3 in 2015, 2016, and 2017, no comparison of fish health was conducted for gill netted fish.

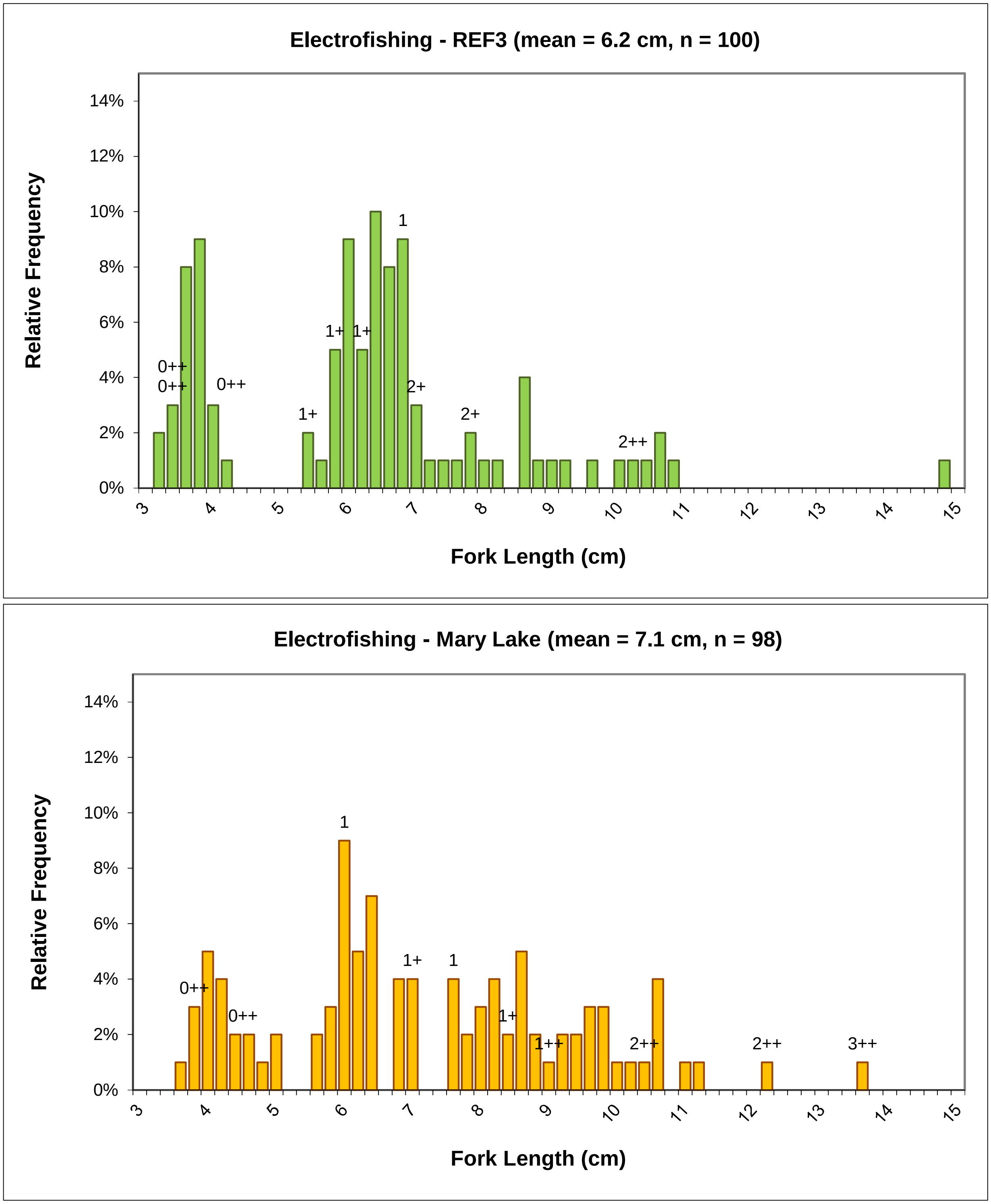


Figure 5.19: Length-Frequency Distributions for Arctic Charr Captured by Backpack Electrofishing at Mary Lake (BLO) and Reference Lake 3 (REF3), Mary River Project CREMP, August 2017

Note: Fish ages are shown above bars, where available.

Table G.38). On average, arctic charr non-spawners exhibited age, size (length and weight), and LSI that were similar to male and female individuals with developing gonads (Appendix Table G.38). All captured arctic charr of spawning size contained body cavity parasites (Appendix Table G.38), the incidence rate of which was comparable to that observed previously at Mary Lake, at other mine-exposed lakes, and during historical studies at mine local study area lakes (NSC 2014, 2015a).

The length-frequency distribution of arctic charr captured at littoral/profundal areas of Mary Lake in 2017 differed significantly from that of fish captured during the baseline period (Table 5.11; Appendix Table G.39). On average, arctic charr captured at littoral/profundal areas of Mary Lake in 2017 were significantly shorter and lighter than those captured during the baseline period, but no significant differences in growth were shown between these periods (Table 5.11). Although condition of adult arctic charr captured at Mary Lake differed significantly between 2017 and the baseline period, the magnitude of this difference was within the CES_C of ±10% (Table 5.11) suggesting that this difference was not ecologically meaningful. No consistent differences in adult arctic charr health endpoints of size, growth, or condition were indicated at Mary Lake for individual years of mine operation from 2015 to 2017 compared to baseline data (Table 5.11). In turn, this suggested that natural and/or sampling variability accounted for slight differences in the arctic charr health endpoints shown during years of mine operation relative to baseline conditions at Mary Lake.

5.3.7 Integrated Effects Evaluation

At Mary Lake, turbidity and aqueous concentrations of total aluminum, iron, manganese, and uranium were elevated compared to the reference lake in 2017, but none of these metals, or any other parameters, were consistently elevated compared to concentrations observed during the baseline period, and none were consistently above WQG or AEMP benchmarks. Similar to Sheardown Lake, turbidity at Mary Lake was naturally higher than the reference lake as a result of receiving flow from relatively large river systems (i.e., Tom River and Mary River inflows to the Mary Lake north and south basins, respectively). Aluminum, iron, and manganese were generally shown to be associated with turbidity at all mine lakes, including Mary Lake, which suggested that these metals were largely bound to/comprised the suspended particulate matter and were thus unlikely to be biologically available. Sediment metal concentrations at Mary Lake littoral and profundal stations were similar to those at the reference lake in 2017 and, with the exception of slightly elevated sediment manganese concentrations at littoral stations, were similar to concentrations observed during the baseline period. Although sediment chromium, iron, and manganese concentrations were above SQG at Mary Lake in 2017, with the exception of chromium, these metals were also above SQG at the reference lake suggesting low potential for any adverse effects to biota associated with these metals. No metals were observed at concentrations above the sediment AEMP benchmarks at littoral and profundal stations of Mary Lake in 2017.

Mary Lake chlorophyll-a concentrations were significantly higher than at the reference lake in 2017, suggesting greater primary production at Mary Lake. However, Mary Lake chlorophyll-a concentrations were continuously well below the AEMP benchmark during all seasonal sampling events in 2017, and were indicative of oligotrophic conditions normally encountered in Arctic waterbodies. Temporal evaluation of the chlorophyll-a data indicated no changes to the trophic status of Mary Lake since commencement of commercial mine operations. Benthic invertebrate community data collected at Mary Lake in 2017 indicated no significant differences in primary community endpoints at littoral habitat, but significantly higher density and richness at profundal habitat, compared to the reference lake. Similar to Sheardown Lake, the differences in community composition appeared to reflect naturally differing sediment TOC and/or particle size between Mary Lake and the reference lake in 2017. No ecologically significant differences in primary benthic invertebrate community metrics, dominant taxonomic groups, or FFG were consistently indicated between the mine baseline period and individual years since the commencement of commercial mine operation (2015, 2016, 2017) at Mary Lake that could be linked to an adverse response to mine operations. Analysis of Mary Lake arctic charr populations suggested greater fish abundance compared to the reference lake in 2017, but no definitive changes in numbers of arctic charr in 2017 relative to baseline data. No significant or ecologically meaningful differences in growth and condition of nearshore captured arctic charr occurred between Mary Lake and the reference lake in 2017, nor between arctic charr collected in 2017 compared to the baseline period for nearshore and littoral/profundal arctic charr populations at Mary Lake. Collectively, the chlorophyll-a, benthic invertebrate community and arctic charr fish population data all suggested no adverse mine-related influences to the biota of Mary Lake in the third year of mine operation at the Mary River Project.

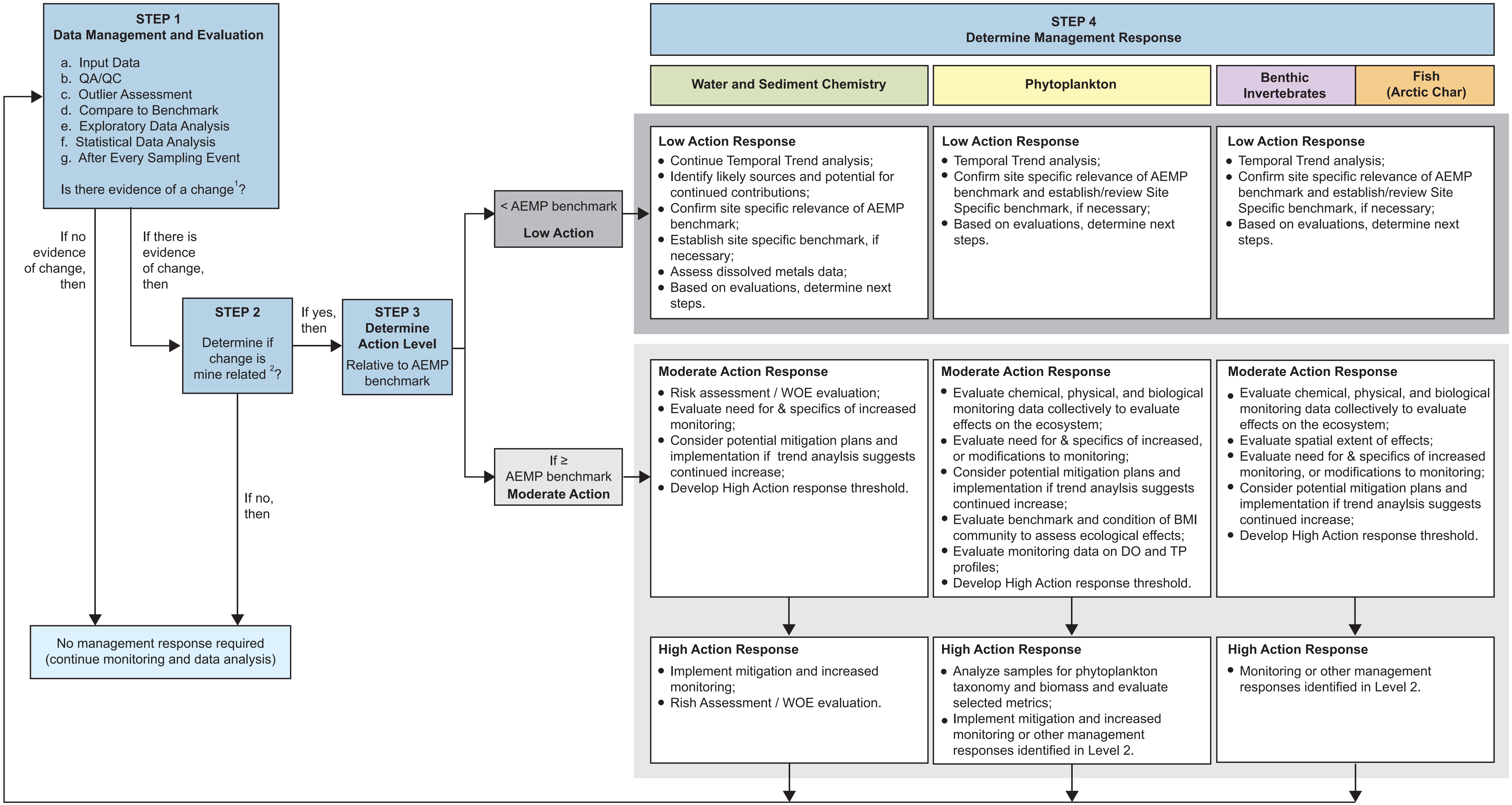
6 EFFECTS DETERMINATION AND RECOMMENDATIONS

6.1 Contextual Overview

The objective of the 2017 Mary River Project CREMP was to evaluate potential mine-related influences on chemical and biological conditions at aquatic environments located near the mine following the third full year of mine operation. The 2017 CREMP utilized an effects-based approach that included standard environmental effects monitoring techniques to provide rigorous analysis of potential mine-related effects at key receiving waterbodies. Under this approach, water quality and sediment quality data were used to support the interpretation of phytoplankton, benthic invertebrate community, and fish population survey data collected at mine-exposed areas of the Camp Lake, Sheardown Lake, Mary River, and Mary Lake systems. The evaluation of potential mine-related effects within these systems was based on comparisons of the 2017 data to applicable reference data, to available baseline data, and to guidelines that included site-specific AEMP benchmarks. The latter were developed to guide management response decisions within a four-step Assessment Approach and Management Response Framework as outlined in the Mary River Project AEMP (Figure 6.1; Baffinland 2014). This effects assessment summarizes instances in which the Mary River Project AEMP benchmarks for water and sediment quality were exceeded at waterbodies examined under the CREMP, as well as relevant reference area information and evidence of biological effects at these waterbodies to provide additional perspective and assist Baffinland with decisions regarding appropriate management actions.

6.2 Camp Lake System

Within the Camp Lake system, AEMP benchmarks for water quality were exceeded only at the north branch and main stem channels of Camp Lake Tributary 1 (CLT1), and AEMP benchmarks for sediment quality were exceeded at Camp Lake (Table 6.1). At the CLT1 north branch, aqueous copper concentrations were elevated compared to the average concentration from comparable reference creek stations in 2017, as well as to concentrations observed at the north branch during baseline studies (2005 – 2013 data; Appendix Figure C.2). In turn, this suggested a mine-related source of copper to the CLT1 north branch. Biological monitoring conducted at the CLT1 north branch in 2017 indicated no adverse effects to phytoplankton (chlorophyll-a) or benthic invertebrates, potentially reflecting copper concentrations at, or just marginally above, the WQG. Because no adverse effects to biota were associated with copper concentrations above the AEMP benchmark at the CLT1 north branch, a low action response to identify the likely source(s) of copper to the system is recommended to meet obligations under the AEMP Management Response Framework.



Notes:
1. Statistical or qualitative change when compared to:
   a) benchmark,
   b) baseline values,
   c) temporal or spatial trents
2. Mine related changes are a result of the mine and associated facilities including but not limited to effects from effluent discharges and dust deposition that are distinguished from natural causes or variation.

Baffinland Mary River Project AEMP Data Assessment Approach and Response Framework

Date: March 2018
Project 177202.0033

Figure 6.1

Table 6.1: Summary of AEMP Benchmark Exceedances for the 2017 Mary River Project CREMP and Supporting Reference Area and Biological Effects Summary Information

Waterbody	AEMP Benchmark Exceedance	Reference Area Information	Evidence of Biological Effects
Camp Lake Tributary 1 (North Branch)	Aqueous copper concentration greater than 0.0022 mg/L benchmark in summer (mean = 0.022 mg/L; max = 0.0024 mg/L) & fall (mean = 0.0023; max = 0.0025 mg/L)	Mean copper concentration (summer) = 0.0009 mg/L (max = 0.0012 mg/L) Mean copper concentration (fall) = 0.0013 mg/L (max = 0.0019 mg/L)	No adverse effects on phytoplankton or benthic invertebrate community endpoints.
Camp Lake Tributary 1 (Main Stem)	Aqueous aluminum concentration greater than 0.179 mg/L benchmark in fall at upper main stem (0.395 mg/L) and lower main stem (mean = 0.300 mg/L; max = 0.620 mg/L) Aqueous iron concentration greater than 0.326 mg/L benchmark in fall at upper main stem (0.705 mg/L) and lower main stem (mean = 0.449 mg/L; max = 0.821 mg/L)	Mean aluminum concentration (fall) = 0.208 mg/L (max = 0.693 mg/L) Mean iron concentration (fall) = 0.222 mg/L (max = 0.739 mg/L)	No adverse, metal related effects on phytoplankton or benthic invertebrate community endpoints.
Camp Lake	Sediment arsenic concentration > 5.9 mg/kg benchmark at single littoral monitoring station (9.9 mg/kg). Sediment iron concentration > 52,400 mg/kg benchmark at single littoral monitoring station (61,600 mg/kg). Sediment nickel concentration > 72 mg/kg benchmark at single littoral monitoring station (77 mg/kg). Sediment phosphorus concentration > 1,580 mg/kg benchmark at single littoral monitoring station (1,690 mg/kg). Sediment arsenic concentration > 5.9 mg/kg benchmark, on average, at profundal stations (mean = 6.68 mg/kg; max = 17.5 mg/kg).	Reference lake littoral sediment mean arsenic concentration = 3.35 mg/kg (max = 5.67 mg/kg) Reference lake littoral sediment mean iron concentration = 41,960 mg/kg (max = 73,400 mg/kg). Reference lake littoral sediment mean nickel concentration = 38 mg/kg (max = 58 mg/kg). Reference lake littoral sediment mean phosphorus concentration = 1,039 mg/kg (max = 2,020 mg/kg). Reference lake profundal sediment mean arsenic concentration = 4.78 mg/kg (max = 5.50 mg/kg).	No adverse, ecologically significant difference in phytoplankton, benthic invertebrate community or fish population endpoints compared to reference and baseline conditions.
Sheardown Lake Tributary 1	Aqueous copper concentration greater than 0.0022 mg/L benchmark in spring, summer and fall (annual mean = 0.0027 mg/L; max = 0.0034 mg/L)	Mean copper concentration (annual) = 0.0009 mg/L (max = 0.0012 mg/L)	No adverse, metal related effects on phytoplankton or benthic invertebrate community endpoints.
Sheardown Lake SE	Littoral sediment iron concentration > 34,400 mg/kg benchmark (mean = 44,867 mg/kg; max = 51,500 mg/kg). Littoral sediment manganese concentration > 657 mg/kg benchmark (mean = 1,506 mg/kg; max = 2,560 mg/kg). Profundal sediment iron concentration > 34,400 mg/kg benchmark (mean = 39,150 mg/kg; max = 41,300 mg/kg). Profundal sediment manganese concentration > 657 mg/kg benchmark (mean = 820 mg/kg; max = 1,170 mg/kg).	Reference lake littoral sediment mean iron concentration = 41,960 mg/kg (max = 73,800 mg/kg) Reference lake littoral sediment mean manganese concentration = 639 mg/kg (max = 1,010 mg/kg). Reference lake profundal sediment mean iron concentration = 46,740 mg/kg (max = 55,400 mg/kg). Reference lake profundal sediment mean manganese concentration = 1,266 mg/kg (max = 1,500 mg/kg).	No adverse, ecologically significant difference in phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference and baseline conditions.
Mary River	Aqueous aluminum concentration greater than 0.966 mg/L benchmark in fall at Station CO-05 (1.48 mg/L) Aqueous copper concentration greater than 0.024 mg/L benchmark in fall at Station CO-05 (0.025 mg/L) Aqueous iron concentration greater than 0.874 mg/L benchmark in fall at Station CO-05 (2.12 mg/L)	Mean aluminum concentration (fall) = 0.147 mg/L (max = 0.186 mg/L) Mean copper concentration (fall) = 0.0010 mg/L (max = 0.0014 mg/L) Mean iron concentration (fall) = 0.100 mg/L (max = 0.146 mg/L)	No adverse, metal related effects on phytoplankton or benthic invertebrate community endpoints.
Mary Lake	Aqueous silver concentration > 0.00010 mg/L benchmark at north basin in summer (mean = 0.000103 mg/L; max = 0.00017 mg/L).	Mean silver concentration (summer) = < 0.00001 mg/L	No adverse, ecologically significant difference in phytoplankton, benthic invertebrate community, or fish population endpoints compared to reference and baseline conditions.

At the CLT1 main stem, aqueous concentrations of aluminum and iron were elevated above their respective AEMP benchmarks during the fall sampling event in 2017 (Table 6.1). However, similar concentrations of these metals were also indicated at one of the four reference creek stations (Station MRY-REF-3) in fall 2017 (Table 6.1; Appendix Table B.2). At CLT1 main stem stations L2-03 and L1-09, and reference creek station MRY-REF-3, total aluminum and iron concentrations were elevated above AEMP benchmarks, and turbidity was also considerably elevated compared to other CLT1 main stem or reference creek stations on the same collection date (i.e., 4.3 times and 14 times higher, respectively, on average; see Appendix Tables B.2 and C.14). Because similar turbidity was not observed among all CLT1 main stem and reference creek stations on the collection date, higher turbidity in these samples, and aluminum and iron metal concentrations associated with this turbidity, most likely reflected compromised samples at the time of collection[8]. The occurrence of aluminum and iron concentrations above AEMP benchmarks at the CLT1 main stem therefore was unlikely related to mine activity, and thus a low action response is recommended to meet obligations under the AEMP Management Response Framework. In this case, it is recommended that in future sampling, all personnel conducting water sampling should be made aware of, and adhere to, Standard Operating Procedures (SOP) developed by Baffinland (2014) for AEMP field water sample collection to ensure that samples do not become compromised.

At Camp Lake, AEMP benchmarks for water quality were consistently met in 2017, but benchmarks for sediment quality were exceeded for four metals (Table 6.1). Arsenic, iron, nickel, and phosphorus concentrations were elevated above AEMP benchmarks in sediment at the single Camp Lake littoral sediment chemistry monitoring station, and the average arsenic concentration from profundal stations was also above the respective AEMP benchmark. Because the lone littoral sediment chemistry monitoring station is located near the inlet from CLT1, mine-influenced flow from this tributary likely contributed to elevation of the metals indicated above in sediment at this location. Notably, iron concentrations in sediment of Reference Lake 3 were above SQG, indicating natural elevation within the region of the mine (Appendix Table D.6). Sediment arsenic concentrations at the Camp Lake littoral sediment chemistry station in 2017 were slightly elevated compared to concentrations at the reference lake, and to Camp Lake average littoral station concentrations recorded in the mine baseline period. However, iron, nickel, and phosphorus concentrations in sediment at Camp Lake did not show similar elevation compared to reference lake conditions or Camp Lake baseline conditions for littoral or profundal stations. In addition, no

[8] Within the CLT1 main stem, no gradient in turbidity was indicated with progression downstream from any of the four sampling stations that suggested a definitive point source of suspended material (e.g., the Tote Road), indicating that elevated turbidity in the water samples most likely reflected sampler error on August 27th, 2017 (see Appendix Table C.14).

adverse effects to biota in direct contact with sediment (i.e., benthic invertebrates) were indicated at Camp Lake relative to reference conditions and Camp Lake baseline conditions for both littoral and profundal habitats[9]. Because no adverse effects to biota were associated with concentrations of metals above the AEMP benchmarks for sediment quality at Camp Lake, a moderate action response is recommended to meet obligations under the AEMP Management Response Framework. Notably, sediment metal concentrations were elevated above AEMP benchmarks at Reference Lake 3, sediment quality monitoring is conducted only at a single littoral station within Camp Lake, and sediment chemistry data is not always collected at the same locations as benthic invertebrate community samples, under the CREMP. Therefore, as per recommendations 14 - 17 provided by Minnow (2016b) following the 2015 CREMP, the following changes to the existing CREMP lake sediment quality and benthic invertebrate community survey study component designs (including Camp Lake) are recommended:

- Consider updating the AEMP sediment quality benchmarks to reflect not only baseline data, but also reference lake data; and,
- Harmonize the lake sediment quality and benthic invertebrate monitoring stations, focusing only on littoral habitat, to improve the ability of the program to evaluate mine-related effects to biota and potentially allow linkages to be assessed between sediment metal concentrations and benthic endpoints.

6.3 Sheardown Lake System

Within the Sheardown Lake system, AEMP benchmarks for water quality were exceeded only at Sheardown Lake Tributary 1 (SDLT1), and AEMP benchmarks for sediment quality were exceeded only at Sheardown Lake SE (Table 6.1). Sheardown Lake NW was the only waterbody at which no water or sediment quality AEMP benchmarks were exceeded during sampling completed in 2017. At SDLT1, aqueous copper concentrations were elevated compared to the average concentration from reference creek stations in 2017, but not to concentrations observed at SDLT1 during baseline studies (2005 – 2013 data; Appendix Table C.35). Given close proximity to mine operations and evidence of sedimentation, a mine-related source of copper to SDLT1 seems likely, but because no elevation in copper concentrations was indicated at SDLT1 in 2017 compared to baseline conditions, copper concentrations at SDLT1 may naturally be similar to the AEMP benchmark. Biological monitoring conducted at SDLT1 in 2017 indicated no adverse effects to phytoplankton or benthic invertebrates, potentially reflecting copper concentrations at, or just marginally above, the WQG. Because no adverse effects to biota were

[9] Notably, in addition to benthic biota, no adverse effects to biota typically associated with pelagic habitat (i.e., phytoplankton or arctic charr population and health) were indicated at Camp Lake in the 2017 CREMP.

associated with copper concentrations above the AEMP benchmark at SDLT1, a low action response to identify the likely source(s) of copper to the system is recommended to meet obligations under the AEMP Management Response Framework.

At Sheardown Lake SE, AEMP benchmarks for water quality were consistently met, but AEMP benchmarks for sediment quality were exceeded for iron and manganese for both littoral and profundal habitat stations in 2017 (Table 6.1). Sediment iron concentrations at Sheardown Lake SE in 2017 were similar to concentrations at the reference lake, as well as to concentrations documented at Sheardown Lake SE in baseline studies. However, sediment manganese concentrations were slightly greater at Sheardown Lake SE than at the reference lake and compared to baseline studies (littoral habitat only) at the southeast basin. Although mean concentrations of iron and manganese were above AEMP benchmarks in sediment of Sheardown Lake SE, concentrations of these metals were also well above these AEMP benchmarks at the reference lake (Appendix Table D.6). Notably, AEMP benchmarks established for sediment quality at Sheardown Lake SE tend to be lower than SQG, and are generally lower than AEMP benchmarks established for the other mine-exposed lakes. No adverse effects to benthic invertebrates and other biota were indicated at Sheardown Lake SE in 2017 based on comparisons to reference conditions and to Sheardown Lake SE baseline conditions. Because no adverse effects to biota were associated with sediment iron and manganese concentrations above AEMP benchmarks at Sheardown Lake SE, a low action response is recommended to meet obligations under the AEMP Management Response Framework. Specifically, it is recommended that the relevance of site-specific sediment quality AEMP benchmarks for Sheardown Lake SE be assessed and, if necessary, determined anew taking into consideration data from the reference lake and applicable SQG.

6.4 Mary River and Mary Lake System

Within the Mary River and Mary Lake systems, AEMP benchmarks for water quality were exceeded at only one of five Mary River water quality monitoring stations, and at the Mary Lake north basin in 2017 (Table 6.1). Notably, no AEMP benchmarks for sediment quality were exceeded at any of the Mary Lake north or south basin stations. AEMP benchmarks for aqueous concentrations of aluminum, copper, and iron were exceeded at Mary River far-field mine-exposed Station CO-05 in 2017, but only during the fall sampling event (Table 6.1). Similar to observations at the CLT1 main stem, very high turbidity in the Station CO-05 water sample relative to samples collected at other Mary River stations during the fall sampling event suggested that elevated concentrations of aluminum, copper and iron in the August 2017 CO-05 sample reflected a compromised sample rather than a mine-related influence on Mary River water quality. Therefore, a low action response requiring that all personnel conducting water sampling be made aware of, and adhere to, Baffinland (2014) SOP for AEMP field water sample collection is recommended to ensure that water samples do not become compromised in the future.

At Mary Lake, aqueous silver concentrations greater than the applicable AEMP benchmark were indicated at the north basin during the summer sampling event in 2017 (Table 6.1; Appendix Table C.73). Silver concentrations were consistently below laboratory reportable detection limits (RDL) at all other CREMP stream and lake water quality monitoring stations in 2017, including those stations located in Camp Lake and Tom River upstream of the Mary Lake north basin, for all winter, spring, summer, and fall sampling events (Appendix Table C.26). In addition, silver concentrations had consistently been below laboratory RDL during all winter, spring, summer, and fall sampling events in both previous years at all CREMP stations, including those at the Mary Lake north basin (see Minnow 2016a, 2017). The absence of any spatial gradient in silver concentrations with distance from the mine, and the extremely rare occurrence of silver concentrations above laboratory RDL, suggested that concentrations of silver greater than the applicable AEMP benchmark at the Mary Lake north basin in summer 2017 likely reflected a laboratory related anomaly and was unlikely mine-related. Therefore, a low action response that includes on-going monitoring to re-evaluate silver concentrations above laboratory RDL at this study area, and more detailed scrutiny of laboratory data to ensure accuracy, is recommended in future CREMP to meet obligations under the AEMP Management Response Framework.

7 REFERENCES

Armitage, P.D., L.C. Pindar and P. Cranston (Eds). 1995. The Chironomidae: The Biology and Ecology of Non-Biting Midges. Chapman and Hall, London, UK. 572 pp.

Baffinland (Baffinland Iron Mines Corporation). 2014. Mary River Project Aquatic Effects Monitoring Plan. Document No. BAF-PH1-830-P16-0039. Rev 0. June 27, 2014.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

BCMOE (British Columbia Ministry of the Environment). 2006. A Compendium of Working Water Quality Guidelines for British Columbia. Environmental Protection Division, Victoria, British Columbia.

BCMOE. 2017. British Columbia Approved Water Quality Guidelines. http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines Accessed December 2017.

Bonar, S.A. 2002. Relative Length Frequency: A Simple, Visual Technique to Evaluate Size Structure in Fish Populations. North American Journal of Fisheries Management 22: 1086-1094.

Carlsson, G. 1967. Environmental factors influencing blackfly populations. Bulletin of the World Health Organization. 37. 139-50

Carlsson, M., L. M. Nilsson, B.J. Svensson, S. Ulfstrand and R. S. Wotton. 1977. Lacustrine seston and other factors influencing the blackflies (Diptera: Simuliidae) inhabiting lake outlets in Swedish Lapland. Oikos 29 :229-238.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg, MB. With Updates to 2017.

CCME. 2017. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg. http://www.ccme.ca/publications/ceqg_rcqe.html Accessed December 2017.

Dodds, W.K., J.R. Jones and E.B. Welch. 1998. Suggested classification of stream trophic state: distributions of temperate stream types by chlorophyll, total nitrogen, and phosphorus. Water Resources 12 : 1455 – 1462.

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

Fowler, J., L. Cohen and P. Jarvis. 1998. Practical Statistics for Field Biology. Second Edition. John Wiley and Sons Ltd., West Sussex, UK. 259 pp.

Gray, M.A., A.R. Curry and K. Munkittrick. 2002. Non-Lethal Sampling Methods for Assessing Environmental Impacts Using a Small-Bodied Sentinel Fish Species. Water Quality Research Journal of Canada. 37(1): 195-211.

Grillet, M.E. and R. Barrera. 1997. Spatial and temporal abundance, substrate partitioning and species co-occurrence in a guild of Neotropical blackflies (Diptera: Simuliidae). Hydrobiologia 345 : 197 – 208.

Intrinsik (Intrinsik Environmental Sciences Inc.) 2014. Development of Water and Sediment Quality Benchmarks for Application in Aquatic Effects Monitoring at the Mary River Project. Report Prepared for Baffinland Iron Ore. June 26 2014.

Intrinsik (Intrinsik Environmental Sciences Inc.) 2015. Establishment of Final Sediment Quality Aquatic Effects Monitoring Program Benchmarks. Report Prepared for Baffinland Iron Ore. March 2015.

KP (Knight Piesold Ltd.) 2014a. Baffinland Iron Mines Corporation – Mary River Project – Water and Sediment Quality Review and CREMP Monitoring Report. KP Ref. No. NB102-181/33-1. June 25, 2014.

KP 2014b. Baffinland Iron Mines Corporation – Mary River Project – Detailed Review of Baseline Stream Water Quality. KP Ref. No. NB102-181/33-1C. May 30, 2014.

KP 2015. Baffinland Iron Mines Corporation – Mary River Project – 2014 Water and Sediment CREMP Monitoring Report. KP Ref. No. NB102-181/34-6. March 19, 2015.

Mandaville, S.M. 2002. Benthic Macroinvertebrates in Freshwaters – Taxa Tolerance Values, Metrics and Protocols. Project H-1. Soil and Water Conservation Society of Metro Halifax.

Merritt, R.L., K.M. Cummins and M.B. Berg. 2008. An Introduction to the Aquatic Insects of North America. 4th Ed. Kendall/Hunt Publishing, Dubuque. 1214 pp.

Minnow (Minnow Environmental Inc.). 2016a. Mary River Project 2015 Core Receiving Environment Monitoring Program Report. Prepared for Baffinland Iron Mines Corp. March 2016.

Minnow. 2016b. Mary River Project CREMP Recommendations for Future Monitoring. Letter report to Jim Millard, Baffinland Iron Mines Corp. March 17, 2016.

Minnow. 2017. Mary River Project 2016 Core Receiving Environment Monitoring Program Report. Prepared for Baffinland Iron Mines Corp. March 2017.

Minnow. 2018. Mary River Project Phase 1 Environmental Effects Monitoring (2017) Interpretive Report. Prepared for Baffinland Iron Mines Corp. January 2018.

Munkittrick, K.R., C.J. Arens, R.B. Lowell and G.P. Kaminski. 2009. A review of potential methods of determining critical effect size for designing environmental monitoring programs. Environmental Toxicology and Chemistry 8: 1361 – 1371.

NSC (North/South Consultants Inc.). 2014. Mary River Project – Core Receiving Environment Monitoring Program: Freshwater Biota. Report prepared for Baffinland Iron Mines Corporation. June 2014.

NSC. 2015a. Mary River Project - Description of Biological Sampling Completed in the Mine Area: 2014. Report prepared for Baffinland Iron Mines Corporation. March 2015.

NSC. 2015b. Mary River Project – Candidate Reference Lakes: Results of the 2014 Field Program. Report prepared for Baffinland Iron Mines Corporation. March 2015.

OMOE (Ontario Ministry of Environment). 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. August 1993, Reprinted October, 1996.

OMOEE (Ontario Ministry of Environment and Energy). 1994. Water Management: Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. July, 1994. Reprinted February 1999.

Pennak, R.W. 1989. Freshwater invertebrates of the United States. Third edition. John Wiley and Sons, Inc., New. York. 628 pp.

Pramual, P. and K. Wongpakam. 2010. Seasonal variation of black fly (Diptera: Simuliidae) species diversity and community structure in tropical streams of Thailand. Entomological Science 13 : 17-28.

Smith, B. and J.B. Wilson. 1996. A consumer's guide to evenness indices. Oikos 76: 70 – 82.

Taylor, B.R. and R.C. Bailey. 1997. Aquatic Effects Technology Evaluation (AETE) Program: Technical Evaluation on Methods for Benthic Invertebrate Data Analysis and Interpretation. AETE Project 2.1.1. 93 p.

Ward, J.V. 1992. Aquatic Insect Ecology, Part 1, Biology and Habitat. John Wiley and Sons, Inc. New York. 456 pp.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Third Edition. Academic Press. San Diego, CA, USA. 1006 pp.

Wetzel, R.G. and G. E. Likens 2000. Limnological Analysis. Third Edition. Springer Science + Business Media Inc. New York, NY, USA. 429 pp.

APPENDIX A

DATA QUALITY REVIEW

APPENDIX A DATA QUALITY REVIEW

A1 INTRODUCTION

Data Quality Review (DQR) was conducted on data collected as part of the Mary River Project 2017 CREMP to define the overall quality of the data collected for the program, and by extension, the confidence with which the data can be used to derive conclusions. A variety of factors can influence the physical, chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on the magnitude of these influences, inaccuracy or imprecision have the potential to affect the reliability of conclusions drawn from the available data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

The Mary River Project 2017 CREMP DQR involved comparison of field performance to generic environmental study data quality objectives (DQO) for the evaluation of sample blanks, data precision and data accuracy. DQO were established *a priori* to reflect reasonable and achievable performance expectations. Overall, the intent of comparing data to DQO was not to reject any measurement that did not meet the DQO, but rather to evaluate whether, based on the available data and using a weight-of-evidence approach, whether the field and/or analytical sample data adequately reflected actual conditions and thus could be used with confidence to derive study conclusions. Using this approach, questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project. Quality Control (QC) samples assessed for the Mary River Project CREMP included water sample trip blanks, field blanks, equipment blanks and field duplicates, sediment sample field duplicates and the verification of the accuracy of sub-sampling and organism recovery for the benthic invertebrate component, defined as follows:

- Blanks (water quality samples) are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples reflect any contamination that occurred from the equipment (in the case of equipment blanks), in the field (in the case of trip or field blanks), or in the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable, although a data quality objective of five times the laboratory reportable detection limit (RDL) allows for slight “noise” around the detection limit.

- Trip blanks are meant to detect any widespread contamination resulting from the container (including caps) and preservative during transport and storage. A trip blank is a bottle set full of de-ionized water that is prepared prior to the field sample collections, is transported with the regular sample bottles in the field, and remains unopened throughout the trip.

- Field blanks mimic the sampling and preservative process but do not come in contact with ambient water. Field blanks are exposed to the sampling environment at the sample site. Consequently, they provide information on contamination resulting from the handling technique and through exposure to the atmosphere. They are processed in the same manner as the associated field samples (i.e., they are exposed to all the same potential sources of contamination as the field sample), including handling and, in some cases, filtration and/or preservation.

- Equipment blanks are samples of de-ionized water collected from the sampling equipment following decontamination (i.e., rinsing of the sampling device using de-ionized water) in the field between sampling stations and/or events. These blanks are useful in identifying cross contamination of samples in the field as a result of the sampling device.

- Field Duplicates (water quality and sediment quality samples) are sub-sample pairs collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field duplicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.

- Sub-Sampling Checks (benthic invertebrate community samples) are used when excessive sample volume and/or organism density results in only a fraction of the original sample being analyzed. By comparing the numbers of benthic invertebrates recovered between at least two sub-samples, this measure provides an evaluation of how effective the sub-sampling method was in evenly dividing the original sample. Therefore, sub-sampling error provides a measure of analytical precision. The processing of entire samples in representative sample fractions also allows an evaluation of sub-sampling accuracy.

- Organism Recovery Checks (benthic invertebrate community samples) involve the re-processing of previously sorted material from a randomly selected sample to determine the number of invertebrates that were not recovered during the original sample processing. The reprocessing is conducted by an analyst not involved during the original processing to reduce any bias. This check allows the determination of accuracy through assessment of recovery efficiency.

A2 RESULTS

A2.1 Water Quality

A2.1.1 Sample Blanks

Trip blank samples were taken on field sampling campaigns a total of six times during the 2017 CREMP, including two during the winter lake monitoring event (April-May), two during the summer lake/stream monitoring event (July), and two during the fall lake/stream monitoring event (August). Of the 512 total number of analyses conducted on the trip blank samples, 36 (7.0%) resulted in analyte detection above the trip blank DQO of less than five-times the laboratory RDL (Appendix Table A.1). Aluminum, barium, calcium, silicon, sodium, and strontium were the parameters most often detected in trip blanks at concentrations that were above the DQO. Bottle contamination or contaminated deionized source water were the most likely sources of contamination.

Field blank samples were assessed a total of seven times during the 2017 CREMP, including three during the winter lake monitoring event, one during the spring stream monitoring event, one during the summer lake monitoring event, and two during the fall lake/stream monitoring event. Of the 604 determinations made, 38 (6.3%) resulted in analyte detections above the DQO of less than five-times the laboratory RDL (Appendix Table A.2). Similar to the trip blanks, aluminum, barium, calcium, silicon, sodium, and strontium were the parameters most often detected at concentrations above DQO in the 2017 field blank samples. A similar frequency of detected concentrations over respective RDL occurred between the trip and field blanks, which suggested that a similar source of contamination was common to both QC sample types.

Equipment blank samples were collected a total of six times during the 2017 CREMP, including two during the winter lake monitoring event, three during the summer lake monitoring event, and one during the fall lake monitoring event. Of the 504 determinations conducted, 10 (2.0%) resulted in analyte detection above the DQO of less than five-times the laboratory RDL (Appendix Table A.3). Tin was most frequently detected at concentrations above RDL in the equipment blank samples, suggesting that the sampling device may have been a source of this metal. In addition to tin, total barium, total phosphorus, dissolved aluminum, and phenols were each detected at concentrations above the RDL at a magnitude greater than the DQO in a single equipment blank sample. Notably, a lower frequency of analyte detection above the DQO was observed in the equipment blank samples compared to the trip and field blank samples.

A2.1.2 Precision – Field Duplicates

A total of 18 field duplicates were collected over the course of the 2017 Mary River Project CREMP water sampling, including two during the winter lake monitoring event, one during the spring stream monitoring event, seven during the summer stream/lake monitoring event, and eight during the fall stream/lake monitoring event. In general, close agreement in parameter concentrations was observed between duplicate samples, with 97% of field duplicate analyte pairs meeting the water quality field duplicate DQO of ≤25% Relative Percent Difference (RPD) in parameter concentrations of the 1,521 duplicate analyses conducted (Table A.4). Total dissolved solids, total phosphorus, phenols and turbidity were the key parameters which most frequently did not meet the DQO between the duplicate samples (Table A.4). In some cases in which DQO were not met, measured concentrations in one or both duplicate samples were close to the RDL (i.e., two- to three-times the RDL) such that small differences in concentrations between duplicate samples resulted in relatively high RPD. In other cases, the relatively high RPD between duplicate samples likely reflected variability in actual concentrations in the field or field sampling related influences. Because metals can be associated with materials reflected by turbidity (e.g., suspended inorganic minerals), the relatively high frequency in which turbidity differed between replicate samples may often have accounted for various metals not meeting the field duplicate DQO between replicated samples. Nevertheless, in the majority of cases, and for key parameters of concern, the RPD in analyte concentrations was sufficiently low as to not affect interpretation of the data.

A2.2 Sediment Quality

Field duplicate sediment samples were collected at each of Reference Lake 3 (REF03-10), Camp Lake (Station JLO-01), Sheardown Lake NW (Station DLO-01-2), Sheardown Lake SE (Station DLO-02-4), and Mary Lake (BLO-04), which represented 12% of the total number of sediment quality monitoring stations sampled for the 2017 CREMP. Excellent agreement in parameter concentrations were observed between duplicate samples, with none of the duplicate samples exhibiting greater than 40% RPD in parameter concentrations between split samples collected in the field (Table A.5). Therefore, data precision was very high and considered acceptable for providing reliable interpretation of the sediment quality data.

A2.3 Benthic Invertebrate Community Samples

A2.3.1 Subsampling Accuracy

Sub-sampling of benthic invertebrate community samples was conducted on 15 of 63 stream samples (24%) and 20 of 50 lake samples (40%; total of 32%) with the sorted fraction for these samples ranging between 12.5% (1/8) to 50% (1/2) of the sample material (average of 40%;

Table A.8). Sub-sampling error estimates indicated that, on average, precision and accuracy of the sub-sampled benthic invertebrate community samples met the DQO of ≤ 20% (Table A.6). Only two of the six paired sub-sample comparisons resulted in precision or accuracy outside of the DQO for the quartered sample (Table A.6), but on average for this sample, and all others, precision and accuracy achieved the DQO of ≤ 20%. Overall, this indicated that precision and accuracy for sub-sampling of the benthic invertebrate community samples was acceptable.

A2.3.2 Organism Recovery

Sorting efficiency (i.e., percent recovery) of benthic invertebrate samples was high, averaging 97% for eight lotic samples evaluated and 98% for the five lentic samples evaluated (Table A.7a,b). Sorting efficiency for these samples achieved the DQO of ≥ 90% recovery, and therefore the benthic invertebrate community sample recovery was considered acceptable.

A3 DATA QUALITY STATEMENT

The DQR results generally indicated that water, sediment and benthic invertebrate community data were of acceptable quality. Few water quality and sediment quality parameters did not meet acceptable DQO. In general, most parameters that did not meet respective DQO typically showed very low margins of error relative to respective criteria and/or were observed at low concentrations often near RDL which led to relatively small incremental differences in concentrations between replicates resulting in failure to meet DQO. However, key exceptions to this occurred for total and/or dissolved aluminum, barium, calcium, silicon, sodium, and strontium concentrations in water, which routinely did not meet DQO in trip, field and equipment blank analyses suggesting that the results for these parameters should be interpreted with caution. In field equipment blanks, tin was the parameter that most often did not achieve DQO. Although it was unclear as to the source of these metals in the various blank samples, because the parameters that did not meet DQO in trip and field blanks differed slightly from those that did not meet field equipment blanks, the water bottles/water bottle caps themselves were most likely sources of contamination in the blank samples. Notably, the deionized water used to create blanks was suggested as the most likely source of blank contamination in previous CREMP (KP 2015). The trip, field and equipment blank analyses indicated that aluminum, barium, calcium, silicon, sodium, strontium, and tin results for water samples should be interpreted with caution, but otherwise analyses of these blanks suggested limited sample contamination for the majority of parameters. The benthic invertebrate community data quality was also acceptable, meeting most precision, accuracy and percent recovery benchmarks. Overall, the data associated with the 2017 CREMP were considered defensible and acceptable for interpretation and derivation of conclusions with a reasonable level of confidence.

Table A.1: Trip Blank Results Indicating, in Highlight, Parameters Not Meeting the Data Quality Objective of ≤ Five-Times the Laboratory Reportable Detection Limit (RDL)

	Client Sample ID		Lowest RDL[1]	BL0-01-B	DL0-01-4	GO-03	BL0-05-A	BLO-01-B	G0-03
	Date Sampled			12-Apr-2017	16-Apr-2017	8-Jul-2017	1-Aug-2017	30-Aug-2017	29-Aug-2017
	ALS Sample ID			L1913377-4	L1914228-7	L1790501-30	L1969603-8	L1985596-6	L1984383-6
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.8
Physical Tests	Hardness (as $CaCO_3$)	mg/L	10	<10	<10	<10	<10	<10	<10
Physical Tests	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	5.5	<2.0	<2.0	<2.0
Physical Tests	Total Dissolved Solids	mg/L	10	<10	<10	11	<20	<10	<10
Physical Tests	Turbidity	NTU	0.10	<0.10	<0.10	1.76	1.66	<0.10	0.72
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	mg/L	10	<10	<10	<10	<10	<10	<10
Anions and Nutrients	Ammonia, Total (as N)	mg/L	0.020	<0.020	0.02	<0.020	<0.020	<0.020	<0.020
Anions and Nutrients	Bromide (Br)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients	Chloride (Cl)	mg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Anions and Nutrients	Nitrate and Nitrite as N	mg/L	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Anions and Nutrients	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Anions and Nutrients	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anions and Nutrients	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Anions and Nutrients	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Anions and Nutrients	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbon	Dissolved Organic Carbon	mg/L	0.5	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0
Carbon	Total Organic Carbon	mg/L	0.5	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0
Total Metals	Aluminum (Al)	mg/L	0.0030	<0.0030	<0.0030	0.0394	0.0377	<0.0030	0.036
Total Metals	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Barium (Ba)	mg/L	0.000050	0.00037	0.000361	0.000532	0.0005	<0.000050	0.000608
Total Metals	Beryllium (Be)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00050
Total Metals	Bismuth (Bi)	mg/L	0.000050	<0.00050	<0.00050	<0.00050	<0.000050	<0.00050	<0.00050
Total Metals	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total Metals	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Calcium (Ca)	mg/L	0.050	0.153	0.142	0.472	<0.50	<0.050	0.584
Total Metals	Chromium (Cr)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Cobalt (Co)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	0.00064
Total Metals	Iron (Fe)	mg/L	0.030	<0.030	<0.030	<0.030	<0.050	<0.030	<0.030
Total Metals	Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Total Metals	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Metals	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Total Metals	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.000070	<0.00050	<0.000070	<0.000070
Total Metals	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Total Metals	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Metals	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.050	<0.20	<0.20
Total Metals	Selenium (Se)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010
Total Metals	Silicon (Si)	mg/L	0.050	0.17	0.17	2.31	2.26	<0.10	2.72
Total Metals	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010
Total Metals	Sodium (Na)	mg/L	0.050	0.068	0.087	0.537	0.520	0.054	0.736
Total Metals	Strontium (Sr)	mg/L	0.00010	<0.00010	0.00011	0.00061	<0.0010	<0.00010	0.00086
Total Metals	Thallium (Tl)	mg/L	0.000010	<0.00010	<0.00010	<0.00010	<0.000010	<0.00010	<0.00010
Total Metals	Tin (Sn)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Metals	Titanium (Ti)	mg/L	0.00030	<0.010	<0.010	<0.010	<0.00030	<0.010	<0.010
Total Metals	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Metals	Vanadium (V)	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010
Total Metals	Zinc (Zn)	mg/L	0.0030	<0.0030	0.0042	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.00300	<0.0030	<0.0030	0.0403	0.039	<0.0030	0.0339
Dissolved Metals	Antimony (Sb)	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Metals	Arsenic (As)	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Metals	Barium (Ba)	mg/L	0.000050	0.001010	0.000329	0.000499	0.000546	<0.000050	0.000609
Dissolved Metals	Beryllium (Be)	mg/L	0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Bismuth (Bi)	mg/L	0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Boron (B)	mg/L	0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dissolved Metals	Cadmium (Cd)	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Metals	Calcium (Ca)	mg/L	0.050	0.173	0.133	0.464	0.466	<0.050	0.582
Dissolved Metals	Chromium (Cr)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Cobalt (Co)	mg/L	0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Metals	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Iron (Fe)	mg/L	0.0010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Dissolved Metals	Lead (Pb)	mg/L	0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Metals	Lithium (Li)	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Metals	Magnesium (Mg)	mg/L	0.0050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Metals	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070
Dissolved Metals	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Metals	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Metals	Nickel (Ni)	mg/L	0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Dissolved Metals	Selenium (Se)	mg/L	0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Metals	Silicon (Si)	mg/L	0.100	<0.10	0.17	2.28	2.26	<0.10	2.67
Dissolved Metals	Silver (Ag)	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Metals	Sodium (Na)	mg/L	0.020 - 0.50	0.054	0.094	0.577	0.548	0.053	0.71
Dissolved Metals	Strontium (Sr)	mg/L	0.000100	<0.00010	0.0001	0.00064	0.00068	<0.00010	0.00085
Dissolved Metals	Thallium (Tl)	mg/L	0.0001000	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Metals	Tin (Sn)	mg/L	0.000030	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Metals	Titanium (Ti)	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dissolved Metals	Uranium (U)	mg/L	0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Metals	Vanadium (V)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Metals	Zinc (Zn)	mg/L	0.00300	0.0071	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Zirconium (Zr)	mg/L	0.00010						
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	0.0022	<0.0010	<0.0010	<0.0010
Other	Chlorophyll a	µg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Other	Phaeophytin a	µg/L	0.10	0.13	0.10	0.14	0.14	0.12	0.14

[1] For some analytes, a range of RDLs were achieved in different laboratory reports. Each blank is compared to the RDL applicable to that sample.

Table A.2: Field Blank Results Indicating, in Highlight, Parameters Not Meeting the Data Quality Objective of ≤ Five-Times the Laboratory Reportable Detection Limit (RDL)

	Client Sample ID		Lowest RDL[1]	JL0-02	DL0-02-3	BL0-05-B	G0-01	BL0-06	BL0-05-A-B	D1-05
	Date Sampled			11-Apr-2017	13-Apr-2017	15-Apr-2017	8-Jul-2017	1-Aug-2017	28-Aug-2017	28-Aug-2017
	ALS Sample ID			L1913378-1	L1913376-7	L1914231-5	L1957899-19	L1969603-17	L1984366-2	L1984351-17
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Hardness (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10
	pH	pH units	-	8.69	6.72	6.24	6.07	5.74	6.17	5.87
	Total Suspended Solids	mg/L	2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	10	<10	<10	<10	<10	20	<10	<10
	Turbidity	NTU	0.10	0.70	<0.10	<0.10	4.07	1.7	0.18	0.16
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Bromide (Br)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrate and Nitrite as N	mg/L	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbon	Dissolved Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<0.50	<1.0	<1.0	<1.0
Total Metals	Aluminum (Al)	mg/L	0.0030	0.0265	<0.0030	<0.0030	0.0447	0.0374	<0.0030	<0.0050
	Antimony (Sb)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.000050	0.000322	<0.000050	<0.000050	0.000567	0.000500	<0.000050	<0.00020
	Beryllium (Be)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00010
	Bismuth (Bi)	mg/L	0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.00050	<0.000050
	Boron (B)	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.050	0.265	<0.050	<0.050	0.459	<0.50	<0.050	<0.50
	Chromium (Cr)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.0010
	Iron (Fe)	mg/L	0.030	<0.030	<0.030	<0.030	<0.030	<0.050	<0.030	<0.050
	Lead (Pb)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	0.00008	<0.000070	<0.000070	<0.000070	<0.00050	<0.000070	<0.00050
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.050	<0.20	<0.050
	Selenium (Se)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.0010	<0.000050
	Silicon (Si)	mg/L	0.050	1.53	<0.10	<0.10	2.3	2.25	<0.10	<0.10
	Silver (Ag)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000050
	Sodium (Na)	mg/L	0.050	0.457	<0.050	0.05	0.608	0.52	<0.050	<0.50
	Strontium (Sr)	mg/L	0.00010	0.00037	<0.00010	<0.00010	0.0006	<0.0010	<0.00010	<0.0010
	Thallium (Tl)	mg/L	0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.00010	<0.000010
	Tin (Sn)	mg/L	0.00010	0.00406	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.00030	<0.010	<0.00030
	Uranium (U)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.0010	<0.00050
	Zinc (Zn)	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)	mg/L	0.00060	0.02570	<0.0030	<0.0030	0.0399	0.0395	<0.0030	<0.0050
	Antimony (Sb)	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00003 - 0.00005	0.000281	0.000229	0.000511	0.000563	0.000565	<0.000050	<0.00010
	Beryllium (Be)	mg/L	0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010
	Bismuth (Bi)	mg/L	0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050
	Boron (B)	mg/L	0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	0.020 - 0.050	0.261	<0.050	<0.050	0.465	0.479	<0.050	<0.050
	Chromium (Cr)	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00050	0.00076	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00020
	Iron (Fe)	mg/L	0.0010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010
	Lead (Pb)	mg/L	0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	0.0050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)	mg/L	0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.000070	<0.00050
	Mercury (Hg)	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)	mg/L	0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)	mg/L	0.050							
	Potassium (K)	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.050
	Selenium (Se)	mg/L	0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050
	Silicon (Si)	mg/L	0.050	1.53	<0.10	<0.10	2.28	2.31	<0.10	<0.050
	Silver (Ag)	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050
	Sodium (Na)	mg/L	0.020	0.458	0.068	0.063	0.556	0.556	<0.050	<0.50
	Strontium (Sr)	mg/L	0.000050	0.00037	<0.00010	<0.00010	0.00063	0.0007	<0.00010	<0.0010
	Thallium (Tl)	mg/L	0.0000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010
	Tin (Sn)	mg/L	0.000030	0.00448	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00030
	Uranium (U)	mg/L	0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050
	Zinc (Zn)	mg/L	0.00050	<0.0030	0.174	0.0295	<0.0030	<0.0030	<0.0030	<0.0010
	Zirconium (Zr)	mg/L	0.00010							<0.00030
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	0.0024	<0.0010	<0.0010	<0.0010
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Phaeophytin a	ug/L	0.10	<0.10	<0.10	<0.10	0.23	0.21	0.17	0.14

Table A.3: Equipment Blank Results Indicating, in Highlight, Parameters Not Meeting the Data Quality Objective of ≤ Five-Times the Laboratory Reportable Detection Limit (RDL)

	Client Sample ID		Lowest RDL[1]	BL0-01	DL0-01-5	JL0-09	REF3-01	REF3-03	REF3-02-S
	Date Sampled			12-Apr-2017	17-Apr-2017	24-Jul-2017	12-Aug-2017	12-Aug-2017	2-Sep-2017
	ALS Sample ID			L1913377-1	L1914230-7	L1964421-7	L1974112-10	L1974112-9	L1987563-8
Physical Tests	Conductivity	umhos/cm	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Hardness (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10
	Total Suspended Solids	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids	mg/L	10	<10	<10	<10	<10	<10	<10
	Turbidity	NTU	0.10	<0.10	<0.10	0.33	0.21	0.18	0.33
Anions and Nutrients	Alkalinity, Total (as CaCO3)	mg/L	10	<10	<10	<10	<10	<10	<10
	Ammonia, Total (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.028
	Bromide (Br)	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrate and Nitrite as N	mg/L	0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Nitrate (as N)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen	mg/L	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Phosphorus, Total	mg/L	0.0030	<0.0030	<0.0030	0.361	<0.0030	<0.0030	<0.0030
	Sulfate (SO4)	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Carbon	Dissolved Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Total Organic Carbon	mg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Metals	Aluminum (Al)-Total	mg/L	0.0030	<0.0030	<0.0030	0.0045	<0.0030	<0.0030	0.0032
	Antimony (Sb)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)-Total	mg/L	0.000050	0.000434	<0.000050	0.000082	<0.000050	<0.000050	0.000054
	Beryllium (Be)-Total	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Total	mg/L	0.050	0.16	<0.050	0.067	<0.050	<0.050	<0.050
	Chromium (Cr)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total	mg/L	0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Total	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)-Total	mg/L	0.000070	<0.000070	<0.000070	0.000106	0.000077	<0.000070	<0.000070
	Mercury (Hg)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Total	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)-Total	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Total	mg/L	0.050	0.16	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total	mg/L	0.050	0.078	<0.050	<0.050	<0.050	<0.050	<0.050
	Strontium (Sr)-Total	mg/L	0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)-Total	mg/L	0.000010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total	mg/L	0.00010	0.0026	0.00062	<0.00010	0.00091	<0.00010	<0.00010
	Titanium (Ti)-Total	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)-Total	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total	mg/L	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Aluminum (Al)-Dissolved	mg/L	0.00060	<0.0030	0.0089	<0.0030	<0.0030	<0.0030	<0.0030
	Antimony (Sb)-Dissolved	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved	mg/L	0.000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)-Dissolved	mg/L	0.00003 - 0.00005	0.000119	0.000165	<0.000050	0.000121	0.000094	0.000099
	Beryllium (Be)-Dissolved	mg/L	0.000010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved	mg/L	0.0000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved	mg/L	0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Dissolved	mg/L	0.020 - 0.050	0.052	<0.050	<0.050	<0.050	<0.050	<0.050
	Chromium (Cr)-Dissolved	mg/L	0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved	mg/L	0.0000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved	mg/L	0.0010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved	mg/L	0.0000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved	mg/L	0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved	mg/L	0.0050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Manganese (Mn)-Dissolved	mg/L	0.000070	<0.000070	0.000213	<0.000070	0.000137	<0.000070	<0.000070
	Mercury (Hg)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Nickel (Ni)-Dissolved	mg/L	0.000090	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)-Dissolved	mg/L	0.050	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Selenium (Se)-Dissolved	mg/L	0.000040	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Dissolved	mg/L	0.050	0.16	<0.10	<0.10	<0.10	<0.10	<0.10
	Silver (Ag)-Dissolved	mg/L	0.0000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved	mg/L	0.020 - 0.050	0.07	<0.050	<0.050	0.069	0.06	<0.050
	Strontium (Sr)-Dissolved	mg/L	0.000050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Thallium (Tl)-Dissolved	mg/L	0.0000020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved	mg/L	0.00003 - 0.0001	0.00363	0.00178	<0.00010	0.00214	<0.00010	<0.00010
	Titanium (Ti)-Dissolved	mg/L	0.00030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved	mg/L	0.0000070	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Vanadium (V)-Dissolved	mg/L	0.000050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved	mg/L	0.00050 - 0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Other	Phenols (4AAP)	mg/L	0.0010	<0.0010	<0.0010	0.0061	<0.0010	<0.0010	<0.0010
	Chlorophyll a	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10
	Phaeophytin a	ug/L	0.10	0.11	<0.10	0.12	0.11	<0.20	0.12

[1] For some analytes, a range of RDLs were achieved in different laboratory reports. Each blank is compared to the RDL applicable to that sample.

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest Detection Limit	D1-00	D1-0001	RPD	E0-10	E0-1001	RPD	EO-10	EO-1001	RPD
	Date Sampled		28-Jul-17	28-Jul-17		10-Aug-17	10-Aug-17		1-Sep-17	1-Sep-17	
	ALS Sample ID		L1967373-5	L1967373-6		L1973877-17	L1973877-8		L1987577-5	L1987577-6	
Physical	Conductivity	3.0	304.0	306.0	0.7	100.0	118.0	17	157.0	158.0	0.6
	pH	10	8.06	8.04	0.2	7.94	7.94	0	8.1	8.09	0.1
	Total Suspended Solids	2.0	3.1	2.1	38	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	172	180	4.5	54	43	23	75	77	**2.6**
	Turbidity	0.10	1.72	1.37	23	6.10	6.10	0	1.87	2.00	6.7
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	101	97.000	4.0	42	40	4.9	67	71	5.8
	Ammonia, Total (as N)	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	7.61	7.7	1.2	2.25	2.15	4.5	4.62	4.68	1.3
	Nitrate and Nitrite as N	0.021	0.591	0.594	0.5	<0.021	<0.021	0	0.03	0.04	29
	Nitrate (as N)	1.0	0.6	0.6	0.5	<0.020	<0.020	0	0.03	0.04	29
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	0.2100	0.1700	21	<0.15	<0.15	0	IP	IP	
	Phosphorus, Total	0.0010	0.0037	0.0549	175	0.005	0.0054	7.7	<0.0030	0.0046	42
	Sulfate (SO4)	0.10	43.4	44.1	1.6	3.59	3.4	5.4	4.32	4.36	0.9
	Dissolved Organic Carbon	0.30	2.70	2.70	0	<1.0	1.20	18	1.00	1.10	9.5
	Total Organic Carbon	0.0030	2.9000	2.7000	7.1	<1.0	<1.0	**0**	1.2	1.1	8.7
Total Metals	Aluminum (Al)	0.00010	0.0454	0.0601	28	0.0844	0.0822	2.6	0.0599	0.0818	31
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.0157	0.0162	3.1	0.00685	0.00681	0.6	0.00925	0.00944	2.0
	Beryllium (Be)	0.010	<0.00010	<0.00010	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000010	<0.000050	<0.000050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.050	0.01	0.01	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	0.00	0.00	6.9	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	27	25.9	4.2	9.28	9.19	1.0	15.00000	14.8	1.3
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	0.00011	0.00012	8.7	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	0.0028	0.0024	15	0.000850	0.000770	9.9	0.00081	0.00081	0
	Iron (Fe)	0.0010	0.12	0.136	13	0.081	0.076	6.4	0.046	0.059	25
	Lead (Pb)	0.050	0.00	0.00	33	0.00	0.00	0	0.00	0.00	5.3
	Lithium (Li)	0.000070	0.001200	0.001100	8.7	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.000010	18.9	18.3	3.2	5.41	5.49	1.5	8.81	8.93	1.4
	Manganese (Mn)	0.000050	0.00453	0.00519	14	0.001170	0.001060	9.9	0.000940	0.001030	9.1
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00286	0.00278	2.8	0.000176	0.000173	1.7	0.000268	0.000242	10
	Nickel (Ni)	0.050	0.00	0.00	33	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000050	2.37	2.36	0.4	0.76	0.76	0	0.96	0.97	1.0
	Selenium (Se)	0.000010	0.000076	0.000072	5.4	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	1.290	1.340	3.8	0.800	0.790	1.3	1.000	1.040	3.9
	Silver (Ag)	0.00010	<0.000050	<0.000050	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	4.14000	4.12000	0.5	1.34000	1.35000	0.7	2.25000	2.31000	2.6
	Strontium (Sr)	0.00020	0.01770	0.01740	1.7	0.00872	0.00897	2.8	0.01360	0.01320	3.0
	Thallium (Tl)	0.00010	0.000011	0.000012	8.7	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.000010	0.002830	0.003620	24	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0030	0.0052	0.00515	1.0	0.00103	0.00102	1.0	0.00273	0.00279	2.2
	Vanadium (V)	0.00030	<0.00050	<0.00050	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	0.0032	< 0.0038	17	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.000020	<0.00030	<0.00030	0						
Dissolved Metals	Aluminum (Al)	0.000030	0.00530	0.00510	3.8	0.01140	0.00960	17	0.00550	0.00560	1.8
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.0159	0.0163	2.5	0.00607	0.00601	1.0	0.00912	0.00899	1.4
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	0.011	0.011	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	< 0.000015	0.0000	**0**	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	26.5	25.90000	2.3	9.55	9.25	3.2	15.2	15.6	2.6
	Chromium (Cr)	0.0010	<0.00050	<0.00050	**0**	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00209	0.00208	0.5	0.00093	0.00061	42	0.00076	0.00078	2.6
	Iron (Fe)	0.0050	0.04	0.04	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	**0**	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	0.0015	0.0013	14	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.00005	18.500000	18.500000	0	5.540000	5.490000	0.9	8.480000	8.660000	2.1
	Manganese (Mn)	0.00009	< 0.00339	0.00352	3.8	0.000133	0.000126	5.4	0.000221	0.000212	4.2
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.003	0.003	1.1	0.00	0.00	2.8	0.00	0.00	35
	Nickel (Ni)	0.00020	0.00133	0.00125	6.2	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000040	2.41	2.42	0.4	0.75	0.74	1.3	0.93	0.94	1.1
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	1.25	1.23	1.6	0.660	0.660	0	0.890	0.900	1.1
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	4.01	3.97	1.0	1.38000	1.37000	0.7	2.24000	2.29000	2.2
	Strontium (Sr)	0.00020	0.0172	0.0165	4.2	0.00874	0.00853	2.4	0.01390	0.01370	1.4
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.0003	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.00481	0.00477	0.8	0.000964	0.000965	0.1	0.00278	0.00274	1.4
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Other	Phenols (4AAP)	0.00100	<0.0010	0.0011	9.5	<0.0010	<0.0010	0	<0.0010	0.0013	26
	Chlorophyll a	0.01000	0.23	0.25	8.3	0.16	0.13	21	IP	IP	
	Phaeophytin a	0.01000	0.3	0.44	38	<1.0	0.23	125	IP	IP	

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest Detection Limit	G0-09	G0-0901	RPD	I0-01	I0-0101	RPD	K0-01	K0-0101	RPD
	Date Sampled		29-Aug-17	29-Aug-17		27-Aug-17	27-Aug-17		7-Jul-17	7-Jul-17	
	ALS Sample ID		L1984383-2	L1984383-3		L1984351-7	L1984351-16		L1957862-2	L1957862-3	
Physical	Conductivity	3.0	159.0	157.0	1.3	184	185	0.5	98	98	0.1
	pH	10	8.09	8.09	0	8.15	8.16	0.1	7.84	7.84	0
	Total Suspended Solids	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	86	87	1.2	98	108	9.7	48	50	4.1
	Turbidity	0.10	2.58	3.08	18	1.55	1.32	16	0.69	0.32	73
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	77	77	0	88	83.000	5.8	36	38.000	5.4
	Ammonia, Total (as N)	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	2.93	2.96	1.0	5.84	5.56	4.9	1.28	1.27	0.8
	Nitrate and Nitrite as N	0.021	<0.021	<0.021	0	0.063	0.056	12	0.046	0.055	18
	Nitrate (as N)	1.0	<0.020	<0.020	0	0.063	0.056	12	0.046	0.055	18
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	<0.15	<0.15	0	0.1700	<0.15	13	<0.15	<0.15	0
	Phosphorus, Total	0.0010	0.0042	0.0047	11	0.0031	<0.0030	3.3	0.0062	0.0033	61
	Sulfate (SO4)	0.10	2.51	2.5	0.4	2.69	2.62	2.6	6.82	6.81	0.1
	Dissolved Organic Carbon	0.30	1.30	1.10	17	1.70	1.80	5.7	0.91	0.83	9.2
	Total Organic Carbon	0.0030	1.2000	1.2000	0	1.8000	1.9	5.4	1.2200	0.8600	35
Total Metals	Aluminum (Al)	0.00010	0.0884	0.0847	4.3	0.0388	0.039	0.5	0.0106	0.0128	19
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00855	0.00883	3.2	0.00864	0.00858	0.7	0.00525	0.00521	0.8
	Beryllium (Be)	0.010	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000010	<0.00050	<0.00050	0	<0.000050	<0.000050	0	<0.00050	<0.00050	0
	Boron (B)	0.050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	16	16.3	1.9	17	18	5.7	8.6	8.63000	0.3
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	0.00073	0.00074	1.4	<0.0010	<0.0010	0	0.00069	0.0007	1.4
	Iron (Fe)	0.0010	0.051	0.053	3.8	<0.050	<0.050	0	<0.030	<0.030	0
	Lead (Pb)	0.050	0.00	0.00	9.0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.000070	<0.0010	<0.0010	0	<0.0010	0.001100	9.5	<0.0010	<0.0010	0
	Magnesium (Mg)	0.000010	8.92	9.06	1.6	10.8	10.5	2.8	5.7	5.82	2.1
	Manganese (Mn)	0.000050	0.000637	0.000701	9.6	0.001610	0.001450	10	0.000725	0.000674	7.3
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.000182	0.000171	6.2	0.00021	0.00025	17	0.00017	0.00017	0.6
	Nickel (Ni)	0.050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000050	0.92	0.95	3.2	0.965	0.977	1.2	0.78	0.8	2.5
	Selenium (Se)	0.000010	<0.0010	<0.0010	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	1.200	1.170	2.5	0.89	0.93	4.4	0.43	0.44	2.3
	Silver (Ag)	0.00010	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	1.83000	1.91000	4.3	3.1400	3.2000	1.9	0.99400	1.05000	5.5
	Strontium (Sr)	0.00020	0.01290	0.01330	3.1	0.0122	0.0125	2.4	0.00525	0.00515	1.9
	Thallium (Tl)	0.00010	<0.00010	<0.00010	0	<0.000010	<0.000010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.000010	<0.010	<0.010	0	0.001870	0.002000	6.7	<0.010	<0.010	0
	Uranium (U)	0.0030	0.00268	0.00271	1.1	0.00202	0.00211	4.4	0.000296	0.000286	3.4
	Vanadium (V)	0.00030	<0.0010	<0.0010	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	0.0037	0.0041	10
	Zirconium (Zr)	0.000020				<0.00030	<0.00030	0			
Dissolved Metals	Aluminum (Al)	0.000030	0.00650	0.00560	15	<0.0050	<0.0050	0	0.00630	0.00340	60
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.00804	0.00807	0.4	0.00892	0.00858	3.9	0.00518	0.00525	1.3
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.000050	<0.000050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	15.9	16	0.6	17.80000	17.8	0	8.43	8.91	5.5
	Chromium (Cr)	0.0010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00066	0.00063	4.7	0.0008	0.0011	31	0.0008	0.0007	13
	Iron (Fe)	0.0050	<0.030	<0.030	0	<0.010	<0.010	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	0	<0.000050	<0.000050	**0**	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	<0.0010	<0.0010	0	0.0015	0.0015	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.00005	8.700000	8.700000	0	11.000000	10.700000	2.8	5.720000	5.580000	2.5
	Manganese (Mn)	0.00009	0.000078	0.000096	21	0.0008	0.00072	**13**	0.00039	0.00032	19
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00	0.00	15	0.00	0.00	35	0.00	0.00	1.1
	Nickel (Ni)	0.00020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000040	0.91	0.9	1.1	0.959	0.957	0.2	0.79	0.78	1.3
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	0.980	0.960	2.1	0.82	0.84	2.2	0.43	0.41	4.8
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	1.83000	1.81000	1.1	3.1100	3.1200	0.3	1.03000	0.99200	3.8
	Strontium (Sr)	0.00020	0.01270	0.01290	1.6	0.0116	0.0118	1.7	0.00510	0.00522	2.3
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.000010	<0.000010	**0**	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.0003	<0.010	<0.010	0	<0.00030	<0.00030	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.00258	0.00249	3.6	0.00194	0.00195	0.5	0.000288	0.000278	3.5
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0010	<0.0010	0	0.0039	0.0037	5.3
Other	Phenols (4AAP)	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0026	0.0015	54
	Chlorophyll a	0.01000	0.25	0.21	17	0.86	1.01	16	0.11	0.11	0
	Phaeophytin a	0.01000	0.31	0.24	25	0.43	0.49	13	0.19	0.22	15

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest	BL0-01-B	BL0-01-B01		BLO-01-B-B	BLO-01-B-B01		BL0-03-S	BL0-03-S01	
	Date Sampled	Detection	30-Jul-17	30-Jul-17	RPD	30-Aug-17	30-Aug-17	RPD	1-Aug-17	1-Aug-17	RPD
	ALS Sample ID	Limit	L1969320-1	L1969320-2		L1985596-4	L1985596-5		L1969603-2	L1969603-3	
Physical	Conductivity	3.0	73.7	73.3	0.5	149.0	148.0	0.7	58	59	0.2
	pH	10	7.76	7.77	0.1	8.06	8.06	0	7.54	7.56	0.3
	Total Suspended Solids	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	51	47	8.2	51	67	27	43	30	36
	Turbidity	0.10	1.74	2.28	27	0.83	0.85	2.4	1.31	1.39	5.9
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	33	35	5.9	67	66	1.5	26	25	3.9
	Ammonia, Total (as N)	0.020	<0.020	<0.020	0	<0.020	<0.020	0	0.024	<0.020	18
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	1.12	1.25	11	3.96	3.89	1.8	1.31	1.31	0
	Nitrate and Nitrite as N	0.021	<0.021	<0.021	0	0.028	0.027	3.6	<0.021	<0.021	0
	Nitrate (as N)	1.0	<0.020	<0.020	0	0.028	0.027	3.6	<0.020	<0.020	0
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
	Phosphorus, Total	0.0010	0.0059	0.0061	3.3	<0.0030	0.0035	15	0.0056	0.0056	0
	Sulfate (SO4)	0.10	0.57	0.59	3.4	2.64	2.65	0.4	0.48	0.43	11
	Dissolved Organic Carbon	0.30	<1.0	<1.0	0	1.60	1.60	0	1.30	1.20	8.0
	Total Organic Carbon	0.0030	1.3000	1.2000	8.0	1.7000	1.8000	5.7	1.3000	1.4000	7.4
Total Metals	Aluminum (Al)	0.00010	0.0501	0.0454	9.8	0.0193	0.0238	21	0.031	0.034	9.2
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00357	0.00357	0	0.00725	0.00714	1.5	0.00317	0.00312	1.6
	Beryllium (Be)	0.010	<0.00010	<0.00010	0	<0.00050	<0.00050	0	<0.00010	<0.00010	0
	Bismuth (Bi)	0.000010	<0.000050	<0.000050	0	<0.00050	<0.00050	0	<0.000050	<0.000050	0
	Boron (B)	0.050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	7	6.77	3.3	13.9	14.7	5.6	5.38	5.3	1.5
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	<0.0010	<0.0010	0	0.000840	0.000830	1.2	<0.0010	<0.0010	0
	Iron (Fe)	0.0010	<0.050	<0.050	0	<0.030	<0.030	0	<0.050	<0.050	0
	Lead (Pb)	0.050	0.00	0.00	1.7	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.000070	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.000010	4.11	4.13	0.5	8.61	8.85	2.7	3.21	3.22	0.3
	Manganese (Mn)	0.000050	0.001400	0.001170	18	0.0034	0.0034	0	0.001980	0.001880	5.2
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.000076	0.00008	5.1	0.000156	0.000164	5.0	0.00009	0.00008	7.3
	Nickel (Ni)	0.050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000050	0.42	0.405	3.6	0.81	0.82	1.2	0.443	0.432	2.5
	Selenium (Se)	0.000010	0.000052	<0.000050	3.9	<0.0010	<0.0010	0	<0.000050	<0.000050	0
	Silicon (Si)	0.050	0.60	0.58	3.4	0.750	0.760	1.3	0.41	0.44	7.1
	Silver (Ag)	0.00010	0.00017	0.00017	5.3	<0.000010	<0.000010	0	<0.000050	<0.000050	0
	Sodium (Na)	0.50	0.76000	0.73000	4.0	1.99000	2.00000	0.5	0.75000	0.74000	1.3
	Strontium (Sr)	0.00020	0.00460	0.00450	2.2	0.00952	0.00975	2.4	0.00400	0.00390	2.5
	Thallium (Tl)	0.00010	<0.000010	<0.000010	0	<0.00010	<0.00010	0	<0.000010	<0.000010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.000010	0.002240	0.001870	18	<0.010	<0.010	0	0.001360	0.001440	5.7
	Uranium (U)	0.0030	0.000396	0.00041	3.5	0.00132	0.00135	2.2	0.000314	0.000315	0.3
	Vanadium (V)	0.00030	<0.00050	<0.00050	0	<0.0010	<0.0010	0	<0.00050	<0.00050	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.000020	<0.00030	<0.00030	0				<0.00030	<0.00030	0
Dissolved Metals	Aluminum (Al)	0.000030	0.00660	0.00590	11	0.00490	0.00450	8.5	0.00610	0.00580	5.0
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.00359	0.00356	0.8	0.00721	0.00714	1.0	0.00298	0.0031	3.9
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	7.15	6.85	4.3	14.4	14.4	0	5.51	5.5	0.2
	Chromium (Cr)	0.0010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00051	0.00051	0	0.00082	0.00082	0	<0.00050	0.00055	9.5
	Iron (Fe)	0.0050	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	<0.0010	<0.0010	0	<0.0010	0.001	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.00005	4.240000	4.240000	0	8.69	8.75	0.7	3.180000	3.290000	3.4
	Manganese (Mn)	0.00009	0.00043	0.000421	2.6	0.00202	0.00206	2.0	0.00063	0.00068	7.5
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00	0.00	5.8	0.000	0.000	1.8	0.00	0.00	5.1
	Nickel (Ni)	0.00020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000040	0.43	0.42	2.4	0.82	0.81	1.2	0.43	0.44	2.3
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	0.49	0.49	0	0.74	0.74	0	0.37	0.37	0
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	0.74300	0.73400	1.2	2.04	2.05	0.5	0.74600	0.76000	1.9
	Strontium (Sr)	0.00020	0.00467	0.00449	3.9	0.00962	0.00968	0.6	0.00393	0.00391	0.5
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.0003	<0.010	<0.010	**0**	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.000379	0.000382	0.8	0.00133	0.00138	3.7	0.00029	0.000294	1.4
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Other	Phenols (4AAP)	0.00100	<0.0010	<0.0010	0	<0.0010	0.0018	57	<0.0010	<0.0010	0
	Chlorophyll a	0.01000	0.25	0.24	4.1	1.05	1.11	5.6	0.84	0.67	23
	Phaeophytin a	0.01000	0.37	0.33	11	0.53	0.57	7.3	1.2	<1.0	18

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest	BL0-06-S	BL0-06-S01		DL0-01-1-S	DL0-01-1-S01		DL0-01-1-S	DL0-01-1-S01	
	Date Sampled	Detection	29-Aug-17	29-Aug-17	RPD	22-Jul-17	22-Jul-17	RPD	26-Aug-17	26-Aug-17	RPD
	ALS Sample ID	Limit	L1984252-10	L1984252-13		L1963242-4	L1963242-5		L1984374-6	L1984374-7	
Physical	Conductivity	3.0	65.3	65.5	0.3	131.0	133.0	1.5	132.0	132.0	0
	pH	10	7.72	7.73	0.1	7.87	7.83	0.5	8	8	0
	Total Suspended Solids	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	22	34	43	67	63	6.2	72	57	23
	Turbidity	0.10	1.30	1.28	1.6	1.33	1.28	**3.8**	0.74	0.20	115
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	28	27.000	3.6	56	56	0	60	61	1.7
	Ammonia, Total (as N)	0.020	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	0.055	93
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	1.53	1.74	13	3.19	3.1	2.9	2.99	3.02	1.0
	Nitrate and Nitrite as N	0.021	<0.021	<0.021	0	0.032	0.032	0	0.025	0.024	4.1
	Nitrate (as N)	1.0	<0.020	<0.020	0	0.032	0.032	0	0.025	0.024	4.1
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	<0.15	<0.15	0	<0.15	<0.15	0	0.1700	0.2200	26
	Phosphorus, Total	0.0010	0.0035	0.0040	13	0.0088	0.0042	71	0.0051	0.0032	46
	Sulfate (SO4)	0.10	1.03	1.03	0	4.53	4.51	0.4	5.1	5.15	1.0
	Dissolved Organic Carbon	0.30	1.20	1.20	0	1.70	1.70	0	1.60	1.70	6.1
	Total Organic Carbon	0.0030	1.200	1.300	8.0	1.7000	1.7000	**0**	1.600	1.600	0
Total Metals	Aluminum (Al)	0.00010	0.0467	0.0503	7.4	0.0148	0.0145	2.0	0.0092	0.0087	5.6
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00416	0.00398	4.4	0.00629	0.00618	1.8	0.0064	0.00629	1.7
	Beryllium (Be)	0.010	<0.00050	<0.00050	0	<0.00010	<0.00010	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000010	<0.00050	<0.00050	0	<0.000050	<0.000050	0	<0.00050	<0.00050	0
	Boron (B)	0.050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	6.16	6.08	1.3	11.9	11.9	0	12.4	12.4	0
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	0.000600	0.000530	12	0.0018	<0.0010	57	0.000790	0.000820	3.7
	Iron (Fe)	0.0010	0.036	0.033	8.7	<0.050	<0.050	0	<0.030	<0.030	0
	Lead (Pb)	0.050	<0.000050	<0.000050	0	0.00	0.00	16	<0.000050	<0.000050	0
	Lithium (Li)	0.000070	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.00120	0.00130	8.0
	Magnesium (Mg)	0.000010	3.8	3.67	3.5	7.28	7.32	0.5	7.95	8.04	1.1
	Manganese (Mn)	0.000050	0.001170	0.001210	3.4	0.004450	0.004460	0.2	0.001510	0.001570	3.9
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	0.000022	<0.000010	75	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00012	0.00010	13	0.000775	0.000779	0.5	0.000744	0.000751	0.9
	Nickel (Ni)	0.050	<0.00050	<0.00050	0	0.00	0.00	22	0.00	0.00	0
	Potassium (K)	0.000050	0.53	0.53	0	1.09	1.08	0.9	1.14	1.14	0
	Selenium (Se)	0.000010	<0.0010	<0.0010	0	<0.000050	<0.000050	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.500	0.490	2.0	0.550	0.540	1.8	0.430	0.420	2.4
	Silver (Ag)	0.00010	<0.000010	<0.000010	0	<0.000050	<0.000050	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	0.83900	0.82700	1.4	1.34000	1.38000	2.9	1.33000	1.33000	0
	Strontium (Sr)	0.00020	0.00502	0.00498	0.8	0.00820	0.00830	1.2	0.00808	0.00809	0.1
	Thallium (Tl)	0.00010	<0.00010	<0.00010	0	<0.000010	<0.000010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	0.0009	0.001	11	<0.00010	<0.00010	0
	Titanium (Ti)	0.000010	<0.010	<0.010	0	0.000650	0.000750	14	<0.010	<0.010	0
	Uranium (U)	0.0030	0.000377	0.000372	1.3	0.000921	0.000895	2.9	0.000829	0.000812	2.1
	Vanadium (V)	0.00030	<0.0010	<0.0010	0	<0.00050	<0.00050	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.000020				<0.00030	<0.00030	0			
Dissolved Metals	Aluminum (Al)	0.000030	0.00840	0.00880	4.7	0.00350	0.00320	9.0	<0.0030	<0.0030	0
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.00376	0.00374	0.5	0.006	0.00619	3.1	0.00637	0.00632	0.8
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	6.07	5.96	1.8	12.2	12.2	0	12	12	0
	Chromium (Cr)	0.0010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	<0.00050	0.00051	2.0	0.00077	0.00076	1.3	0.00075	0.00078	3.9
	Iron (Fe)	0.0050	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0011	0.0011	0
	Magnesium (Mg)	0.00005	3.650000	3.690000	1.1	7.840000	7.680000	2.1	7.600000	7.890000	3.7
	Manganese (Mn)	0.00009	0.000249	0.000271	8.5	0.000202	0.000215	6.2	0.000106	0.000099	6.8
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00	0.00	8.9	0.00	0.00	3.0	0.00	0.00	0.4
	Nickel (Ni)	0.00020	<0.00050	<0.00050	0	0.00	0.00	4.6	0.00	0.00	5.5
	Potassium (K)	0.000040	0.5	0.51	2.0	1.16	1.12	3.5	1.14	1.15	0.9
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	0.390	0.400	2.5	0.530	0.510	3.8	0.390	0.380	2.6
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	0.81400	0.82700	1.6	1.48000	1.41000	4.8	1.30000	1.31000	0.8
	Strontium (Sr)	0.00020	0.00491	0.00483	1.6	0.00799	0.00799	0	0.00790	0.00784	0.8
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	0.00069	0.00022	103	<0.00010	<0.00010	0
	Titanium (Ti)	0.0003	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.000357	0.0004	0.8	0.000866	0.000865	0.1	0.000831	0.000836	0.6
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0030	<0.0030	0	0.0075	<0.0030	86
Other	Phenols (4AAP)	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0017	0.0029	52
	Chlorophyll a	0.01000	0.75	0.6200	19	0.99	1.2	19	1.42	1.58	11
	Phaeophytin a	0.01000	0.72	0.6400	12	0.77	0.87	12	0.6	0.67	11

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest Detection Limit	REF3-02-B	REF3-02-B01	RPD	DL0-02-4-S	DL0-02-401	RPD	JL0-01-B	JL0-0101	RPD
	Date Sampled		12-Aug-17	12-Aug-17		13-Apr-17	13-Apr-17		14-Apr-17	14-Apr-17	
	ALS Sample ID		L1974112-2	L1974112-3		L1913376-1	L1913376-2		L1914229-9	L1914229-10	
Physical	Conductivity	3.0	76	76	0	160	159	0.6	153	156	1.9
	pH	10	7.66	7.71	0.7	7.57	7.59	0.3	7.71	7.69	0.3
	Total Suspended Solids	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	42	32	27	74	71	4.1	84	84	0
	Turbidity	0.10	0.39	0.43	9.8	0.24	0.30	22	0.12	0.13	8.0
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	35.000	35.000	0	76	76	0	68	72.000	5.7
	Ammonia, Total (as N)	0.020	0.049	0.077	44	<0.020	<0.020	0	<0.020	<0.020	0
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	1.26	1.25	0.8	3.32	3.32	0	4.21	4.21	0
	Nitrate and Nitrite as N	0.021	<0.021	<0.021	0	<0.021	<0.021	0	0.023	0.023	0
	Nitrate (as N)	1.0	<0.020	<0.020	0	<0.020	<0.020	0	0.023	0.023	0
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	<0.15	<0.15	0	0.3000	0.16	61	<0.15	<0.15	0
	Phosphorus, Total	0.0010	0.0046	0.0034	30	0.0040	0.0034	16	0.0030	0.0030	0
	Sulfate (SO4)	0.10	3.93	3.87	1.5	3.6	3.62	0.6	2.5	2.5	0
	Dissolved Organic Carbon	0.30	3.10	3.00	3.3	1.70	1.90	11	1.90	1.90	0
	Total Organic Carbon	0.0030	3.0000	2.9000	3.4	1.9000	1.9000	0	1.800	1.800	0
Total Metals	Aluminum (Al)	0.00010	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.00648	0.00602	7.4	0.00778	0.00805	3.4	0.00778	0.0074	5.0
	Beryllium (Be)	0.010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	6.99	6.86	1.9	16.2	15.7	3.1	15.9	15.8	0.6
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	0.0009	0.00082	9.3	0.00086	0.00093	7.8	0.00096	0.00097	1.0
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.000070	<0.0010	<0.0010	0	0.00100	<0.0010	**0**	0.00110	0.00110	0
	Magnesium (Mg)	0.000010	4.33	4.26	1.6	9.94	10.4	4.5	9.79	9.32	4.9
	Manganese (Mn)	0.000050	0.000613	0.000565	8.1	0.001500	0.001460	2.7	0.000457	0.000474	3.7
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00014	0.00014	2.9	0.00064	0.00063	1.7	0.000321	0.000309	3.8
	Nickel (Ni)	0.050	<0.00050	<0.00050	0	0.00	0.00	5.6	0.001	0.001	2.8
	Potassium (K)	0.000050	0.91	0.85	6.8	1.32	1.32	0	1.34	1.33	0.7
	Selenium (Se)	0.000010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.43	0.42	2.4	0.63	0.64	1.6	0.47	0.46	2.2
	Silver (Ag)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	0.89300	0.81900	8.6	1.74000	1.78000	2.3	1.85	1.80	2.7
	Strontium (Sr)	0.00020	0.00798	0.00786	1.5	0.01110	0.01070	3.7	0.0125	0.0118	5.8
	Thallium (Tl)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	0.00029	0.00045	43	0.00018	<0.00010	57
	Titanium (Ti)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0030	0.000258	0.000257	0.4	0.00097	0.000967	0.3	0.0009	0.000897	4.9
	Vanadium (V)	0.00030	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.000020									
Dissolved Metals	Aluminum (Al)	0.000030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.00642	0.00644	0.3	0.0079	0.00793	0.4	0.00727	0.00744	2.3
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	6.9	7.06	2.3	15.7	15.2	3.2	15.5	15	3.3
	Chromium (Cr)	0.0010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.0008	0.0009	11	0.0009	0.0008	11	0.00084	0.00085	1.2
	Iron (Fe)	0.0050	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0012	0.0013	8.0
	Magnesium (Mg)	0.00005	4.340000	4.480000	3.2	9.640000	9.710000	0.7	9.680000	9.580000	1.0
	Manganese (Mn)	0.00009	0.00015	0.00012	20	0.00048	0.00047	2.7	0.000205	0.000179	14
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00	0.00	0.7	0.00	0.00	1.6	0.00	0.00	1.6
	Nickel (Ni)	0.00020	<0.00050	<0.00050	0	0.00	0.00	1.4	0.00	0.00	2.9
	Potassium (K)	0.000040	0.92	0.92	0	1.24	1.29	4.0	1.3	1.31	0.8
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	0.42	0.43	2.4	0.61	0.63	3.2	0.47	0.48	2.1
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	0.88800	0.89400	0.7	1.68000	1.71000	1.8	1.80000	1.77000	1.7
	Strontium (Sr)	0.00020	0.00788	0.00802	1.8	0.01030	0.01080	4.7	0.01180	0.01170	0.9
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	0.00158	0.00114	32	<0.00010	0.00132	172
	Titanium (Ti)	0.0003	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.000257	0.000257	0	0.00097	0.000992	2.2	0.000891	0.000914	2.5
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Other	Phenols (4AAP)	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0012	0.001	18
	Chlorophyll a	0.01000	0.88	0.88	0	1.12	1.04	7.4	0.16	0.14	13
	Phaeophytin a	0.01000	0.64	0.6	6.5	0.85	0.64	28	0.17	0.21	21

Figure A.4: Water Sample Field Duplicate Results Indicating, in Highlight, Parameter Values Not Meeting the DQO of ≤ 25% RPD.

	Sample ID	Lowest	JL0-01-B	JL0-01-B01		REF3-01-S	REF3-01-S01		REF3-01-S	REF3-01-S01	
	Date Sampled	Detection	26-Aug-17	26-Aug-17	RPD	12-Aug-17	12-Aug-17	RPD	2-Sep-17	2-Sep-17	RPD
	ALS Sample ID	Limit	L1984374-10	L1984374-11		L1974112-4	L1974112-5		L1987563-1	L1987563-7	
Physical	Conductivity	3.0	140	140	0	76	76	0	76.3	76.6	0.4
	pH	10	8.05	8.05	0	7.84	7.75	1.2	7.81	7.75	0.8
	Total Suspended Solids	2.0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
	Total Dissolved Solids	10	59	69	16	27	46	52	39	29	29
	Turbidity	0.10	0.6	0.5	20	0.4	0.3	41	0.36	2.07	141
Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	0.020	66	66	0	34	32	6.1	29	29	0
	Ammonia, Total (as N)	0.020	<0.020	<0.020	0	<0.020	0.055	93	<0.020	<0.020	0
	Bromide (Br)	0.0050	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
	Chloride (Cl)	0.15	3.04	3.59	17	1.25	1.22	2.4	1.28	1.3	1.6
	Nitrate and Nitrite as N	0.021	<0.021	<0.021	0	<0.021	<0.021	0	<0.021	<0.021	0
	Nitrate (as N)	1.0	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0
	Nitrite (as N)	1.0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0
	Total Kjeldahl Nitrogen	0.0030	<0.15	<0.15	0	<0.15	<0.15	0	<0.15	<0.15	0
	Phosphorus, Total	0.0010	0.0094	0.0048	65	0.0051	0.0224	126	0.0036	<0.0030	18
	Sulfate (SO4)	0.10	2.29	2.84	21	3.9	3.74	4.2	3.97	4	0.8
	Dissolved Organic Carbon	0.30	1.70	1.90	11	3.20	3.00	6.5	2.60	2.70	3.8
	Total Organic Carbon	0.0030	1.700	1.700	0	3.100	3.000	3.3	2.8000	2.8000	0
Total Metals	Aluminum (Al)	0.00010	0.00470	0.00470	0	0.00330	<0.0030	9.5	0.0048	<0.0030	46
	Antimony (Sb)	0.000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.00010	<0.00010	<0.00010	0	0.00012	<0.00010	18	<0.00010	<0.00010	0
	Barium (Ba)	0.000050	0.0064	0.00656	2.5	0.00642	0.00626	2.5	0.00636	0.00632	0.6
	Beryllium (Be)	0.010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.000010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.050	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.000010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.00050	13.30000	13.40000	0.7	7.13000	7.04000	1.3	6.88	6.97	1.3
	Chromium (Cr)	0.00050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.000050	0.00086	0.00083	3.6	0.00099	0.00081	20	0.000860	0.00073	16
	Iron (Fe)	0.0010	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.050	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.000070	0.00130	0.00140	7.4	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.000010	8.48	8.35	1.5	4.47	4.39	1.8	4.43	4.28	3.4
	Manganese (Mn)	0.000050	0.001590	0.001570	1.3	0.000599	0.000641	6.8	0.000739	0.000593	22
	Mercury (Hg)	0.00050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.000305	0.000292	4.4	0.000147	0.000145	1.4	0.000129	0.000117	9.8
	Nickel (Ni)	0.050	0.00	0.00	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000050	1.11	1.12	0.9	0.94	0.92	2.2	0.9	0.84	6.9
	Selenium (Se)	0.000010	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.050	0.32	0.32	0	0.40	0.40	0	0.41	0.40	2.5
	Silver (Ag)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	1.38	1.40	1.4	0.92	0.86	6.3	0.86800	0.85700	1.3
	Strontium (Sr)	0.00020	0.0101	0.0101	0	0.00806	0.00796	1.2	0.00768	0.00795	3.5
	Thallium (Tl)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0030	0.000694	0.000696	0.3	0.000267	0.000272	1.9	0.000255	0.00025	2.0
	Vanadium (V)	0.00030	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.00050	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Zirconium (Zr)	0.000020									
Dissolved Metals	Aluminum (Al)	0.000030	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
	Antimony (Sb)	0.000010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Arsenic (As)	0.0000050	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Barium (Ba)	0.0050	0.00636	0.00653	2.6	0.00642	0.00633	1.4	0.00651	0.00625	4.1
	Beryllium (Be)	0.0000050	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Bismuth (Bi)	0.020	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Boron (B)	0.000010	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Cadmium (Cd)	0.00010	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Calcium (Ca)	0.0000050	13.2	13.3	0.8	7.06	7.01	0.7	6.89	6.87	0.3
	Chromium (Cr)	0.0010	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Cobalt (Co)	0.0000090	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Copper (Cu)	0.00050	0.00076	0.00078	2.6	0.00079	0.0008	1.3	0.00089	0.00081	9.4
	Iron (Fe)	0.0050	<0.030	<0.030	0	<0.030	<0.030	0	<0.030	<0.030	0
	Lead (Pb)	0.00007	<0.000050	<0.000050	0	<0.000050	<0.000050	0	<0.000050	<0.000050	0
	Lithium (Li)	0.00001	0.0013	0.0013	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Magnesium (Mg)	0.00005	8.220000	8.290000	0.8	4.390000	4.390000	0	4.200000	4.230000	0.7
	Manganese (Mn)	0.00009	0.000169	0.000158	6.7	0.000258	0.000245	5.2	0.000269	0.000207	26
	Mercury (Hg)	0.00001	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Molybdenum (Mo)	0.050	0.00	0.00	4.1	0.00	0.00	2.8	0.00	0.00	5.4
	Nickel (Ni)	0.00020	0.00	0.00	14	<0.00050	<0.00050	0	<0.00050	<0.00050	0
	Potassium (K)	0.000040	1.11	1.11	0	0.93	0.93	0	0.86	0.85	1.2
	Selenium (Se)	0.0000050	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Silicon (Si)	0.020	0.32	0.31	3.2	0.40	0.40	0	0.40	0.40	0
	Silver (Ag)	0.000050	<0.000010	<0.000010	0	<0.000010	<0.000010	0	<0.000010	<0.000010	0
	Sodium (Na)	0.50	1.3800	1.3900	0.7	0.8890	0.8890	0	0.88000	0.86900	1.3
	Strontium (Sr)	0.00020	0.0099	0.0100	1.0	0.0079	0.0080	0.1	0.00786	0.00781	0.6
	Thallium (Tl)	0.000030	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Tin (Sn)	0.00010	<0.00010	<0.00010	0	<0.00010	<0.00010	0	<0.00010	<0.00010	0
	Titanium (Ti)	0.0003	<0.010	<0.010	0	<0.010	<0.010	0	<0.010	<0.010	0
	Uranium (U)	0.0005	0.000705	0.000706	0.1	0.000262	0.000273	4.1	0.000255	0.00025	2.0
	Vanadium (V)	0.0005	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0
	Zinc (Zn)	0.003	<0.0030	<0.0030	0	<0.0030	<0.0030	0	<0.0030	<0.0030	0
Other	Phenols (4AAP)	0.00100	<0.0010	<0.0010	0	<0.0010	<0.0010	0	0.0024	0.0017	34
	Chlorophyll a	0.01000	1.4	1.49	6.2	0.61	0.54	12	0.93	0.89	4.4
	Phaeophytin a	0.01000	0.66	0.64	3.1	0.52	0.47	10	0.44	0.7	46

Figure A.5: **Sediment Sample Field Duplicate Comparisons Indicating, in Highlight, Values Mot Meeting the DQO of ≤ 40% Relative Percent Difference (RPD)**

Parameter	Lowest Detection Limit	Units	REF-03-10	REF-03-DUP	% RPD	JLO-01	JLO-DUP	% RPD	DLO-01-02	DLO-01-DUP	% RPD	BLO-04	BLO-DUP	% RPD
			24-Aug-2017	24-Aug-2017		20-Aug-2017	20-Aug-2017		25-Aug-2017	25-Aug-2017		26-Aug-2017	26-Aug-2017	
Total Organic Carbon	0.10	%	4.20	4.39	4	1.28	1.41	10	1.23	1.29	4	0.67	0.64	5
Aluminum (Al)	50	µg/g	21,900	22,450	2	16,400	17,100	4	19,000	19,600	3	18,400	18,800	2
Antimony (Sb)	0.10	µg/g	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0
Arsenic (As)	0.10	µg/g	4.56	4.69	3	4.6	4.8	5	3.95	4.25	7	2.47	2.50	1
Barium (Ba)	0.50	µg/g	137	140	2	72.0	75	5	127.0	139.0	9	78.3	79.5	1
Beryllium (Be)	0.10	µg/g	0.86	0.87	1	0.89	0.93	4	0.91	0.94	3	0.85	0.87	2
Bismuth (Bi)	0.20	µg/g	<0.20	<0.20	0	0.24	0.26	6	0.21	0.22	2	<0.20	<0.20	0
Boron (B)	5.0	µg/g	17.1	17.8	4	21.7	22.1	2	24.6	26.2	6	23.8	25.2	6
Cadmium (Cd)	0.020	µg/g	0.165	0.161	3	0.141	0.155	9	0.247	0.261	6	0.108	0.114	5
Calcium (Ca)	50	µg/g	5,470	5,555	2	3,820	4,005	5	4,880	4,950	1	4,130	4,165	1
Chromium (Cr)	0.50	µg/g	70.6	72.2	2	69.4	73.0	5	77.4	78.9	2	70.0	71.2	2
Cobalt (Co)	0.10	µg/g	16.0	16.2	1	17.7	18.3	3	15.9	16.6	4	13.0	13.2	1
Copper (Cu)	0.50	µg/g	88.7	89.5	1	44.1	45.5	3	41.0	42.4	3	25.3	25.7	2
Iron (Fe)	50	µg/g	46,600	47,100	1	31,900	33,200	4	39,300	41,950	7	32,300	33,000	2
Lead (Pb)	0.50	µg/g	16.9	17.3	2	19.4	20.1	3	19.2	19.6	2	16.7	16.9	1
Lithium (Li)	2.0	µg/g	34.5	35.4	2	29.8	30.9	4	32.4	33.3	3	32.9	33.8	3
Magnesium (Mg)	20	µg/g	14,700	14,900	1	12,700	13,350	5	13,300	13,550	2	12,900	13,200	2
Manganese (Mn)	1.0	µg/g	1,130	1,130	0	928	984	6	10,200	9,805	4	603	559	8
Mercury (Hg)	0.0050	µg/g	0.0562	0.0599	6	0.0302	0.0326	7	0.0319	0.0342	7	0.0362	0.0347	4
Molybdenum (Mo)	0.10	µg/g	2.37	2.41	1	0.73	0.78	6	7.53	8.67	14	0.63	0.62	2
Nickel (Ni)	0.50	µg/g	48.5	49.3	2	62.2	66	6	67.3	69.3	3	47.2	47.7	1
Phosphorus (P)	50	µg/g	1,020	1,060	4	944	972	3	873	934	7	746	759	2
Potassium (K)	100	µg/g	5,640	5,750	2	4,490	4,630	3	4,890	5,105	4	4,890	4,995	2
Selenium (Se)	0.20	µg/g	0.66	0.71	7	0.23	0.27	14	0.28	0.34	19	<0.20	<0.20	0
Silver (Ag)	0.10	µg/g	0.21	0.22	5	0.11	0.12	4	0.14	0.14	0	0.12	0.12	0
Sodium (Na)	50	µg/g	415	431	4	188	198	5	276	287	4	319	332	4
Strontium (Sr)	0.50	µg/g	12.6	13.1	4	11.1	11.2	1	10.8	11.1	3	11.4	11.7	2
Sulfur (S)	5000	µg/g	1000	1050	0	<1000	<1,000	0	<1000	<1,000	0	<1000	<1,000	0
Thallium (Tl)	0.050	µg/g	0.665	0.676	2	0.462	0.490	6	0.553	0.581	5	0.406	0.412	1
Tin (Sn)	2.0	µg/g	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0
Titanium (Ti)	1.0	µg/g	1,220	1,265	4	829	868	5	1,170	1,220	4	1,390	1,405	1
Uranium (U)	0.050	µg/g	24.3	24.1	1	4.51	4.77	5	6.30	6.50	3	6.49	6.50	0
Vanadium (V)	0.20	µg/g	65.9	67.2	2	59.5	61.8	4	56.9	59.0	4	54.4	55.0	1
Zinc (Zn)	2.0	µg/g	90.6	92.1	2	54.3	56.4	4	65.9	67.6	3	60.7	61.4	1
Zirconium (Zr)	1.0	µg/g	3.2	3.2	2	4.9	5.0	2	7.0	6.8	4	19.8	20.1	1

Table A.6: Subsampling Error for Benthic Invertebrate Community Samples, 2017 CREMP

a) Lotic (creek and river) samples

Station	Whole Organisms	No. of Organisms in Fraction 1	No. of Organisms in Fraction 2	No. of Organisms in Fraction 3	No. of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
CLT1-US-B2	22	151	178	-	-	329	15.2	-	8.2	-
CLT1-US-B5	11	165	178	-	-	343	7.3	-	3.8	-
SDLT9-B1	-	174	204	-	-	378	14.7	-	7.9	-

b) Lentic (lake) samples

Station	Whole Organisms	Number of Organisms in Fraction 1	Number of Organisms in Fraction 2	Number of Organisms in Fraction 3	Number of Organisms in Fraction 4	Actual Density*	Precision		Accuracy	
							% range		min	max
DLO-02-9	-	111	111	140	142	504	0.0	21.8	11.9	12.7
DL0-02-12	-	215	249			464	13.7	-	7.3	-
DL0-02-03	-	91	93	102	134	420	2.2	32.1	2.9	27.6

* whole large organisms excluded in calculations.
min = minimum absolute % error. max = maximum absolute % error.

Table A.7: Percent Recovery from Benthic Invertebrate Samples, Mary River Project CREMP, 2017

(a) Lotic (creek and river) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
CLT2-US-B4	67	70	95.7%
CLT2-DS-B2	114	122	93.4%
REF-CRK-B5	263	274	96.0%
SDLT9-B3	405	418	96.9%
SDLT12-B1	196	197	99.5%
CO-05-B1	96	100	96.0%
EO-01-B4	33	33	100.0%
GO-03-B3	115	116	99.1%
		Average % Recovery	**97.1%**

b) Lentic (lake) samples

Station	Number of Organisms Recovered (initial sort)	Number of Organisms in Re-sort	Percent Recovery
REF-03-2	149	152	98.0%
BLO-11	84	84	100.0%
DLO-01-14	168	169	99.4%
DLO-02-10	328	329	99.7%
JLO-16	70	74	94.6%
		Average % Recovery	**98.3%**

Table A.8: Proportion of Benthic Invertebrates Samples Sorted for the 2017 CREMP

(a) Lotic (creek and river) samples / b) Lentic (lake) samples

Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)	Station	Fraction Sorted (500 um)
CLT1-US-B3	1/2	SDLT1-B1	1/8	SDLT12-B1	1/2	DLO-01-9	1/ 4	DLO-02-13	1/ 2
CLT1-US-B4	1/2	SDLT1-B3	1/2	REF-03-2	1/2	DLO-01-10	1/ 2	JLO-2	1/ 4
CLT1-DS-B2	1/4	SDLT1-B4	1/2	BLO-1	1/2	DLO-01-11	1/ 2	JLO-11	1/ 2
CLT1-DS-B3	1/2	SDLT9-B2	1/4	BLO-5	1/4	DLO-02-2	1/ 2	JLO-16	1/ 4
CLT1-DS-B5	1/4	SDLT9-B3	1/4	BLO-11	1/4	DLO-02-4	1/ 2	JLO-18	1/ 4
REF-CRK-B2	1/4	SDLT9-B4	1/2	DLO-01-3	1/4	DLO-02-10	1/ 2	JLO-20	1/ 4
REF-CRK-B3	1/2	SDLT9-B5	1/2	DLO-01-4	1/4	DLO-02-11	1/ 2	JLO-21	1/ 2

Notes: Any samples not listed were sorted in their entirety (total of 68 lotic samples and 50 lenthc samples for the program)

QA/QC Notes: Pupae were not counted toward total number of taxa unless they were the sole representative of their taxa group. Immatures were not counted toward total number of taxa unless they were the sole representative of their taxa group.

APPENDIX B

REFERENCE AREA DESCRIPTIVE OVERVIEW

APPENDIX B OVERVIEW OF REFERENCE CONDITIONS

B1 INTRODUCTION

The initial review of background (reference) data collected from lotic (i.e., creeks and rivers) and lentic (i.e., lakes) study areas as part of the 2015 Mary River Project CREMP revealed naturally elevated metal concentrations above guidelines and significant differences in benthic community endpoints between reference lake littoral and profundal stations (Minnow 2016a). Therefore, this overview of reference conditions is included to provide context and perspective regarding water quality, sediment quality, phytoplankton (chlorophyll-a), benthic invertebrate community, and fish population characteristics at the CREMP reference study areas. Key implications of reference area features towards the evaluation of potential mine-related effects at mine-exposed water bodies as part of the CREMP are also identified as part of this reference area overview.

B2 HABITAT

B2.1 Creek/Tributary Environments

Four reference creek/tributary (reference creek) stations were established among two unnamed tributaries to Angajurjualuk Lake (Stations CLT-REF4, MRY-REF2 and MRY-REF3) and one unnamed tributary to the Mary River (Station CLT-REF3) during the Mary River Project CREMP in 2014 (see Figure 2.2). These stations were intended to provide reference information for the creek water quality and phytoplankton monitoring components of the CREMP, and have been used as such in the three studies conducted since commercial mine operations commenced at the Mary River Project (i.e., 2015, 2016, and 2017; see Table 2.1). In 2016 and 2017, habitat conditions at the western tributary to Angajurjualuk Lake that is used for Baffinland CREMP water quality monitoring (Stations CLT-REF4 and MRY-REF) were deemed comparable to habitat conditions at the Camp Lake and Sheardown Lake tributaries. Therefore, this tributary served as a benthic reference creek (REF-CRK) for comparisons involving the various mine-exposed tributaries as part of the 2016 and 2017 CREMP (see Figure 2.4), and herein has been referred to as Unnamed Reference Creek.

The reference creeks/tributaries are moderate gradient lotic systems characterized predominantly by riffle-run and riffle-rapid stream morphology, with pools occurring rarely as dictated by localized topography and associated gradient. The wetted width and depth of the benthic reference tributary averaged 11.1 m and 0.09 m, respectively, during the August survey in 2017 (Appendix Table F.1). The corresponding water velocities across a representative riffle area of the benthic reference tributary ranged from 0.02 – 0.52 m/s in August 2017 (average of 0.28 m/s; Appendix Table F.1). As for most small lotic systems in the region, surface flow at all of the CREMP reference tributaries is limited to months in which average ambient air temperatures are near or above freezing (i.e., June – September). The substrate at the reference tributaries is composed mainly of cobble and large pebble (i.e., 50 – 256 mm diameter), with surficial areas of sand generally limited to less than 10% of stream area (Appendix Table F.1). In-stream vegetation at the reference tributaries is sparse, and generally includes a relatively thin layer of algae/periphyton attached surficially to relatively stable substrate.

B2.2 River Environments

The area of Mary River located upstream of the mine lease property is only minimally influenced by Mary River Project mining activity (i.e., low amounts of dust deposition; see Baffinland 2014). Therefore, this area has been considered representative of background (reference) conditions for the mine-exposed stations/study areas situated farther downstream on the Mary River under the CREMP (Baffinland 2014; KP 2014a,b, 2015; NSC 2014). Water quality, phytoplankton productivity and benthic invertebrate community (benthic) data collected at the Mary River reference area, referred to as GO-09 (including water quality stations GO-09A, GO-09 and GO-09B), has been used for comparison to data from areas of the Mary River that are potentially influenced by mine activity. Although area GO-03 can also currently serve as a reference area, potential advancement of the Mary River Project to include the Deposit 2 ore body would result in this area becoming a near-field mine-exposed area in the future.

The Mary River reference area is a moderate gradient erosional environment characterized mainly by riffle and run stream morphology (Appendix Table F.50). Depending on flow conditions, average wetted width and average depth of the Mary River reference area has ranged from 30 – 55 m and 0.20 - 0.36 m, respectively, in studies conducted by Minnow during the month of August. On average, the corresponding water velocities across representative riffle areas of the GO-09 benthic study area has ranged from 0.20 – 0.47 m/s during these studies. The substrate at the GO-09 reference area is composed mainly of boulder and cobble, with roughly equal proportion of pebble, gravel, and sand composing the surficial substrate at much of the remaining area (Appendix Table F.50). In-stream vegetation at the Mary River GO-09 reference area is sparse, and generally includes a relatively thin layer of periphyton and/or scarce bryophytes (moss) growth on the upper surface of physically stable substrate.

B2.3 Lake Environments

A geographically expansive reconnaissance survey of local study area (LSA) lakes was conducted in 2014 to identify a waterbody that could potentially serve as a suitable reference area for the mine-exposed lakes (i.e., Camp, Sheardown NW, Sheardown SE, and Mary lakes; NSC 2015b). The key criteria for the selection of the suitable reference lake included a waterbody with similar surface area, maximum water depth, substrate features, and fish species composition as the mine-exposed lakes, in addition to also being uninfluenced by current or past mining activity. Based on the results of this survey, Reference Lake 3 was selected to represent reference conditions for the mine-exposed lakes as part of the 2015 and 2016 Mary River Project CREMP studies (Appendix Table B.1).

Reference Lake 3 is an unnamed lake located approximately 62 km south of the Mary Lake Project (see Figures 2.1 and 2.3), well outside the area of mine influence. Reference Lake 3 is a headwater lake that is characterized by a relatively complex morphology that includes three basins and connection to a separate lake by a short, shallow channel (see Figure 2.3). The three basins reach approximately 15 m, 30 m and 36 m in depth with progression from east to west, and the average depth of Reference Lake 3 is approximately 11.8 m (Appendix Table B.1). The outlet of Reference Lake 3, located off the south-central portion of the lake,

Table B.1: Physical Characteristics for Mine-Exposed Lakes and Reference Lake 3

Lake Feature	Mine-Exposed Lakes				Reference Lake
	Camp	Sheardown NW	Sheardown SE	Mary	Reference Lake 3
Drainage Basin Area (km^2)	26.5	6.6	8.9	663.4	23.2
Lake Area (km^2)	2.21	0.68	0.25	13.6	2.05
Drainage Basin: Lake Area Ratio	11.98	9.66	35.6	48.8	11.32
Mean Depth (m)	13.0	12.1	7.4	-	11.8
Maximum Depth (m)	35.1	30.1	14.8	40.0	38.3
Volume (1,000,000 m^3)	27.5	8.18	1.8	156.4	22.6
Hydraulic Retention Time (days)	416 ± 184	511 ± 213	83 ± 35	75 ± 29	-

drains into a large boulder field through which flow can occur largely as sub-surface drainage. Substrate along the shoreline and shallow littoral areas of Reference Lake 3 is composed mainly of large boulder and cobble that is commonly interrupted by areas of bedrock. Substrate of the deeper littoral and profundal areas of Reference Lake 3 is almost exclusively represented by silt loam containing approximately 15 - 35% fine sand (by dry weight) and a moderate organic carbon content of approximately 5%. No substantial aquatic plant beds have been observed at Reference Lake 3, with fish cover provided predominantly by rocky substrates along the shoreline and shallow littoral zone of the lake.

B3 WATER QUALITY

B3.1 Creek/Tributary Environments

Water chemistry at the reference creek stations met all applicable WQG and AEMP benchmarks for lotic environments in 2017 with the exceptions of total phosphorus and metals including aluminum and iron (Appendix Table B.2). Concentrations of these parameters were particularly elevated at reference creek station MRY-REF-3 in fall 2017, but appeared to be associated with very high turbidity (Appendix Table B.2). Because similar turbidity was not observed among all reference creek stations on the same collection date in August 2017, higher turbidity in these samples, and total aluminum, iron, and phosphorus concentrations associated with this turbidity, likely reflected compromised samples at the time of collection (see Section 6.2).

Water chemistry at the reference creek stations showed distinct seasonal changes in concentrations for some parameters (Appendix Figure B.1; Appendix Table B.2). In general, conventional parameters, ions and total metals were observed at lowest concentrations in spring, with intermediate concentrations in the summer and highest concentrations observed during the fall sampling event in 2017 (Appendix Figure B.1). This pattern almost certainly reflected dilution from snow melt- and precipitation-related sources, with the lowest parameter concentrations typically associated with the spring freshet conditions, and highest parameter concentrations generally associated with low precipitation/streamflow conditions later in the open water season. Previous baseline, 2015, and 2016 water quality monitoring conducted at reference creek stations showed similar seasonal patterns (KP 2014b; Minnow 2016a, 2017). Temporal comparison of mean water chemistry for the reference creek stations showed no substantial changes in water quality from 2014 to 2017, suggesting that water chemistry at the reference creek stations was relatively consistent year-to-year taking seasonal sampling timing into account (Figure 3.2; Appendix Figure C.2). Therefore, the reference creek stations were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at mine-exposed creek/tributary receiving environments taking seasonality into consideration.

B3.2 River Environments

Water chemistry at the Mary River reference stations (GO-09 series) often showed elevated concentrations of total aluminum, and on a single occasion, total chromium, copper, and iron concentrations, compared to WQG and/or applicable AEMP benchmarks in 2017 (Appendix Table B.3). Mary River GO-09 reference station total aluminum and iron concentrations showed strong positive correlations with turbidity in 2017 (r_s of 0.71 and 0.94, respectively).

Table B.2: Water Chemistry at Reference Creek Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event				Summer Sampling Event				Fall Sampling Event			
					CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2
					8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	34.0	42.2	25.9	44.6	83.0	77.6	69.0	93.9	124	102	105	133
	pH (lab)	pH	6.5 - 9.0	-	7.44	7.53	7.04	7.51	7.90	7.78	7.44	7.90	8.00	7.89	7.69	8.02
	Hardness (as $CaCO_3$)	mg/L	-	-	16	20	<10	20	40	36	26	45	65	51	39	65
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	3.5	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	10.4	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	16	22	16	23	39	51	35	31	61	44	67	68
	Turbidity	NTU	-	-	1.5	1.0	3.8	1.2	1.2	0.8	5.1	1.1	2.2	1.0	20.1	1.1
	Alkalinity (as $CaCO_3$)	mg/L	-	-	15	19	<10	19	42	41	21	41	64	50	28	67
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.046	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.033	0.095	0.086	0.037
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	0.033	0.095	0.086	0.037
	Dissolved Organic Carbon	mg/L	-	-	1.29	0.7	1.04	1.3	<1.0	1.5	1	1.5	1.6	1.6	1.4	1.9
	Total Organic Carbon	mg/L	-	-	1.21	1.3	1.2	1.3	<1.0	1.5	<1.0	1.7	1.7	1.7	1.6	1.9
	Total Phosphorus	mg/L	0.020[α]	-	0.0074	0.0042	0.0064	0.0044	0.0040	0.0033	0.0051	<0.0030	0.0044	0.0036	0.0203	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0014	0.0019	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	<0.50	<0.50	1.79	0.67	<0.50	<0.50	4.18	1.83	0.57	0.74	6.96	1.78
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	0.50	2.21	0.41	0.84	1.40	6.75	1.64	1.45	2.27	10.7	2.14
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0434	0.0233	0.1070	0.0186	0.0286	0.0309	0.096	0.0424	0.0688	0.0345	***0.6930***	0.037
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010
	Barium (Ba)	mg/L	-	-	0.00192	0.00273	0.00329	0.00242	0.00348	0.00468	0.00696	0.00574	0.00529	0.00555	0.0129	0.00659
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	3.36	4.03	1.99	4.24	8.14	7.30	5.56	9.16	12.9	10.5	8.78	12.5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00146	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00031	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0006	0.00076	0.00067	<0.00050	<0.00050	0.00110	0.00124	0.00063	<0.0010	0.00120	0.00190	<0.0010
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.084	<0.030	<0.030	0.030	0.080	<0.030	<0.050	<0.050	***0.739***	<0.050
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000063	0.000094	<0.000050	<0.000050	0.000094	0.000134	<0.000050	0.000066	0.000132	0.000582	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	0.0011
	Magnesium (Mg)	mg/L	-	-	1.86	2.44	1.050	2.53	4.61	4.56	2.99	5.43	7.63	6.19	4.67	7.63
	Manganese (Mn)	mg/L	0.935[β]	-	0.000487	0.000410	0.00142	0.000513	0.000185	0.00065	0.00096	0.000589	0.000740	0.00126	0.010400	0.00086
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	0.000181	0.000091	0.000059	0.000147	0.000442	0.000311	0.000161	0.000189	0.000574	0.000407	0.000194
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00058	<0.00050	<0.00050	<0.00050	0.00071	0.00101	<0.00050
	Potassium (K)	mg/L	-	-	0.29	0.36	0.36	0.35	0.45	0.54	0.74	0.64	0.63	0.66	1.17	0.811
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.42	0.56	0.55	0.39	0.69	0.83	0.95	0.73	0.94	1.00	2.17	0.930
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.261	0.337	0.888	0.487	0.655	0.632	2.31	1.24	0.96	0.860	3.78	1.41
	Strontium (Sr)	mg/L	-	-	0.00253	0.00256	0.00429	0.00311	0.00630	0.00494	0.0124	0.00808	0.0091	0.00660	0.0196	0.0098
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010	0.000018	<0.000010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.00211	0.00061	0.0444	<0.0020
	Tungsten (W)	mg/L	0.030[α]	-									<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)	mg/L	0.015	-	0.000159	0.000229	0.000245	0.000224	0.00179	0.001040	0.000564	0.000947	0.00341	0.00167	0.00143	0.00203
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	0.00148	<0.00050
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)	mg/L	-	-									<0.00030	<0.00030	0.00083	<0.00030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

(grey shading) Indicates parameter concentration above applicable Water Qquality Guideline.

BOLD Indicates parameter concentration above AEMP benchmark applicable to the mine lotic receiving environments.

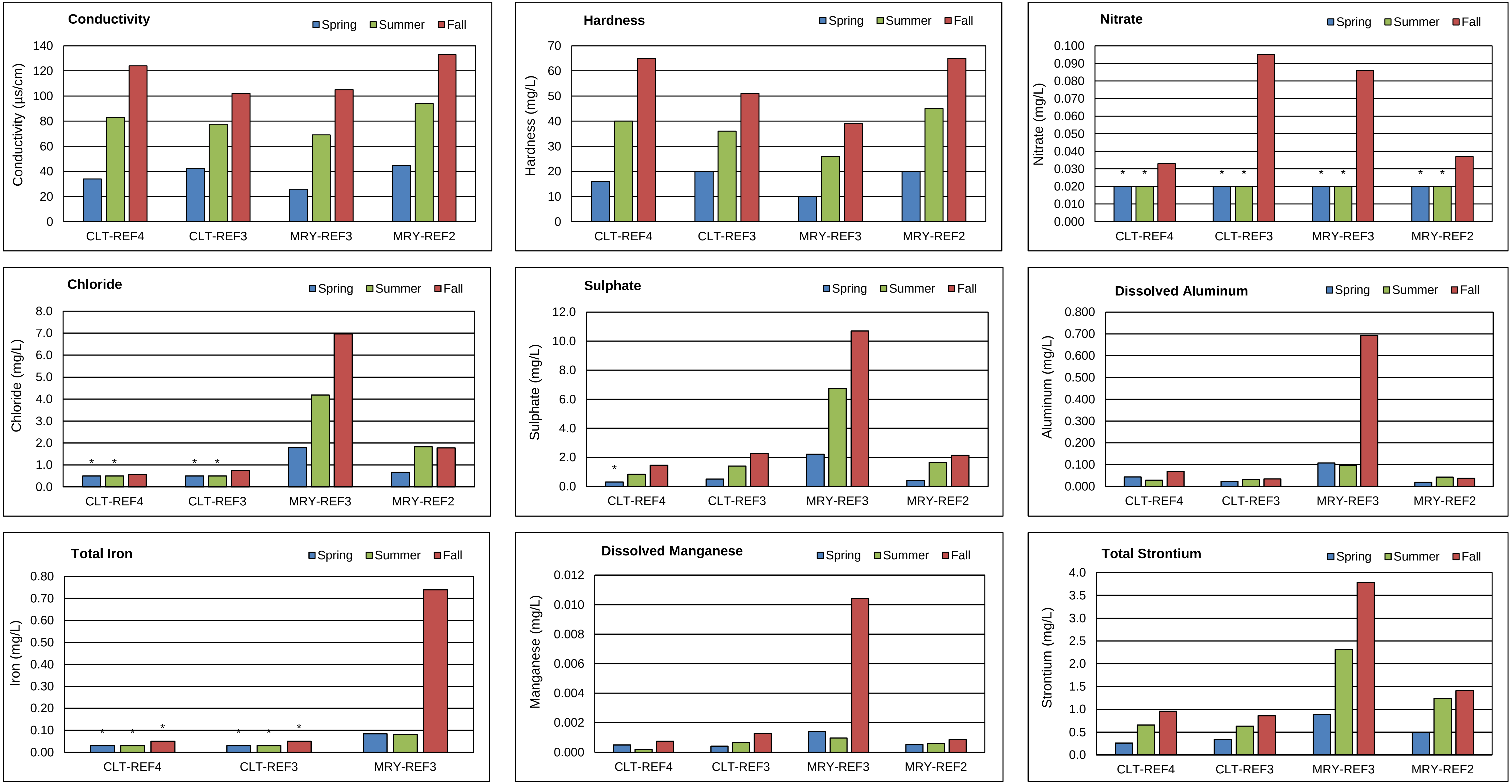


Figure B.1: Seasonal Variation in Water Chemistry at Stream/Tributary Reference Stations, Mary River Project CREMP, 2017.

Note: Asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

Table B.3: Water Chemistry at Mary River GO-09 Series Reference Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark	Spring Sampling Event			Summer Sampling Event			Fall Sampling Event		
					G0-09-A 8-Jul-2017	G0-09 8-Jul-2017	G0-09-B 8-Jul-2017	G0-09-A 10-Aug-2017	G0-09 10-Aug-2017	G0-09-B 10-Aug-2017	G0-09-A 29-Aug-2017	G0-09 29-Aug-2017	G0-09-B 29-Aug-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	32	29.4	29.2	74.3	77.6	84.6	120	158	138
	pH (lab)	pH	6.5 - 9.0	-	7.41	7.37	7.33	7.81	7.83	7.92	7.93	8.09	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	15	14	13	33	33	37	52	75.5	62
	Total Suspended Solids (TSS)	mg/L	-	-	4.2	2.5	<2.0	<2.0	<2.0	<2.0	2.3	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	19	14	<10	39	28	40	68	86.5	59
	Turbidity	NTU	-	-	1.74	2.05	3.42	12.5	10.5	8.94	8.29	2.83	5.81
	Alkalinity (as $CaCO_3$)	mg/L	-	-	13	<10	12	34	36	38	48	77	58
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.057	<0.020	0.029
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	0.83	1.41	1.41	<1.0	<1.0	<1.0	1	1.2	1.2
	Total Organic Carbon	mg/L	-	-	1.75	1.35	1.61	<1.0	<1.0	<1.0	<1.0	1.2	1.1
	Total Phosphorus	mg/L	0.020[α]	-	0.0113	0.0092	0.0093	0.0085	0.0082	0.0078	0.0097	0.00445	0.0053
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.51	<0.50	0.55	2.37	2.35	2.49	5.23	2.945	4.6
	Sulphate (SO_4)	mg/L	218[β]	218	<0.30	<0.30	<0.30	1.4	1.3	1.4	3.22	2.505	2.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.0368	0.0412	0.0838	0.1470	0.163	0.120	***0.186***	0.08655	0.168
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0027	0.00223	0.00287	0.0061	0.0065	0.0065	0.00899	0.00869	0.00901
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	3.1	2.96	2.86	7	7	8	10.9	16.15	13.3
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	***0.0209***	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	<0.00050	<0.00050	***0.00673***	0.0009	0.0009	0.0008	0.00142	0.000735	0.00091
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	***2.16***	0.151	0.153	0.110	0.146	0.052	0.103
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.00008	0.00025	0.00020	0.00016	0.000199	0.0000555	0.000119
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	0.0011
	Magnesium (Mg)	mg/L	-	-	1.75	1.55	1.58	4.02	4.06	4.43	6.08	8.99	7.63
	Manganese (Mn)	mg/L	0.935[β]	-	0.00137	0.0017	0.0172	0.00205	0.00192	0.00155	0.0026	0.0007	0.0015
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	<0.000050	<0.000050	0.00369	0.00013	0.00014	0.00014	0.00029	0.00018	0.00024
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00245	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.34	0.28	0.35	0.75	0.75	0.75	1.07	0.935	1.05
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.42	0.35	0.53	0.78	0.89	0.79	1.1	1.185	1.27
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.334	0.269	0.364	1.530	1.490	1.560	2.61	1.87	2.46
	Strontium (Sr)	mg/L	-	-	0.00262	0.00214	0.00261	0.008	0.008	0.009	0.0136	0.0131	0.0137
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<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	<0.010
	Uranium (U)	mg/L	0.015	-	0.000106	0.000085	0.00013	0.0011	0.0011	0.0011	0.00258	0.002695	0.00266
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above AEMP benchmark applicable to the mine lotic receiving environments.

This suggested that total aluminum and iron concentrations were largely associated with suspended particulate matter and that elevation of total aluminum concentrations above WQG reflected naturally turbid conditions. Comparison of the ratio between dissolved and total concentrations of aluminum also indicated a high proportion of these metals was in the total (particulate) fraction in 2017 (i.e., 87%, on average; compare Appendix Tables B.3 and C.64), which can be expected for metals contained in particulate matter.

Water chemistry at the Mary River reference stations showed distinct seasonal changes in concentrations of some parameters (Appendix Figure B.2; Appendix Table B.3). These seasonal changes in parameter concentrations were consistent with those observed at the reference creek stations in 2017, and in previous baseline (2005 – 2013), 2015 and 2016 water quality monitoring data collected at the Mary River GO-09 series reference stations (KP 2014b; Minnow 2016a, 2017). The seasonal changes in the Mary River reference station parameter concentrations likely reflected greater dilution during the spring snowmelt period, and consecutively lower precipitation/groundwater inputs during the summer and fall periods. Temporal comparison of the Mary River GO-09 series reference station water chemistry indicated that on average, parameter concentrations in 2017 were within respective ranges observed between the baseline period and previous operating mine conditions based on fall monitoring data (Figure 5.3; Appendix Figure C.22). Therefore, the Mary River reference stations were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on water chemistry at the Mary River mine-exposed study areas.

B3.3 Lake Environments (Reference Lake 3)

In situ water temperature profiles conducted at Reference Lake 3 indicated a weakly thermally stratified water column in the summer, but no stratification in the fall of 2017 (Appendix Figure B.3). The thermocline was present between depths of approximately 9 and 13 m in the summer (Appendix Figure B.3). Despite the occurrence of thermal stratification in 2017, no marked changes in dissolved oxygen concentration occurred with increased depth at any of the Reference Lake 3 basins, and dissolved oxygen saturation remained high (i.e., ≥ 95%) throughout the entire water column in both the summer and fall profiles (Appendix Figure B.3). The 2017 water quality profiles also showed only minor changes in pH and specific conductance among stations and with depth during each of the summer and fall sampling events (Appendix Figure B.3). Overall, the *in situ* water quality profiles suggested relatively thorough lateral mixing within Reference Lake 3 and that, despite development of thermal stratification in summer 2017, no substantial influences on dissolved oxygen, pH or conductivity were associated with the changes in temperature with depth.

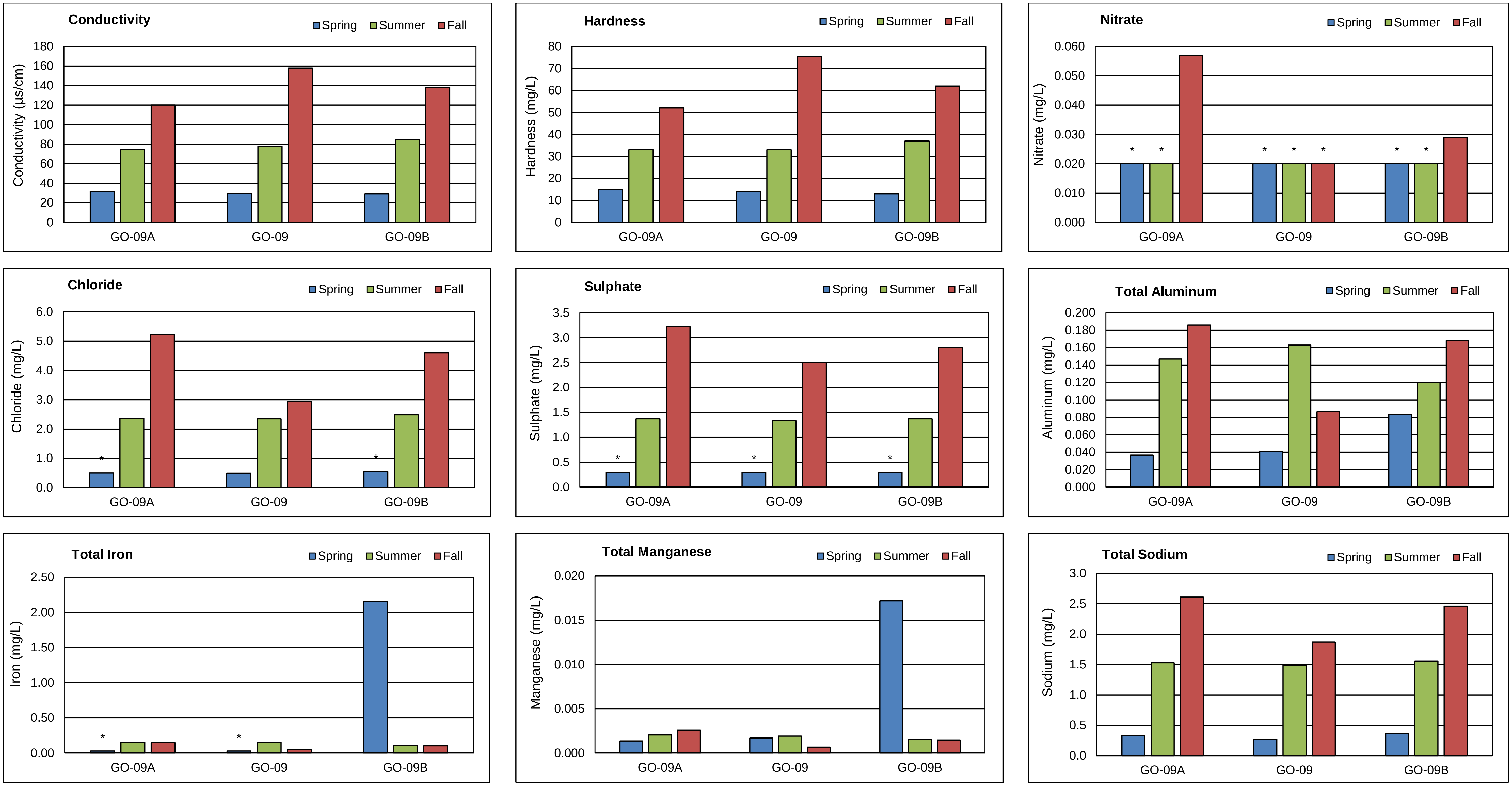


Figure B.2: Seasonal Variation in Water Chemistry at Mary River GO-09 Reference Stations, Mary River Project CREMP, 2017.

Note: Asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

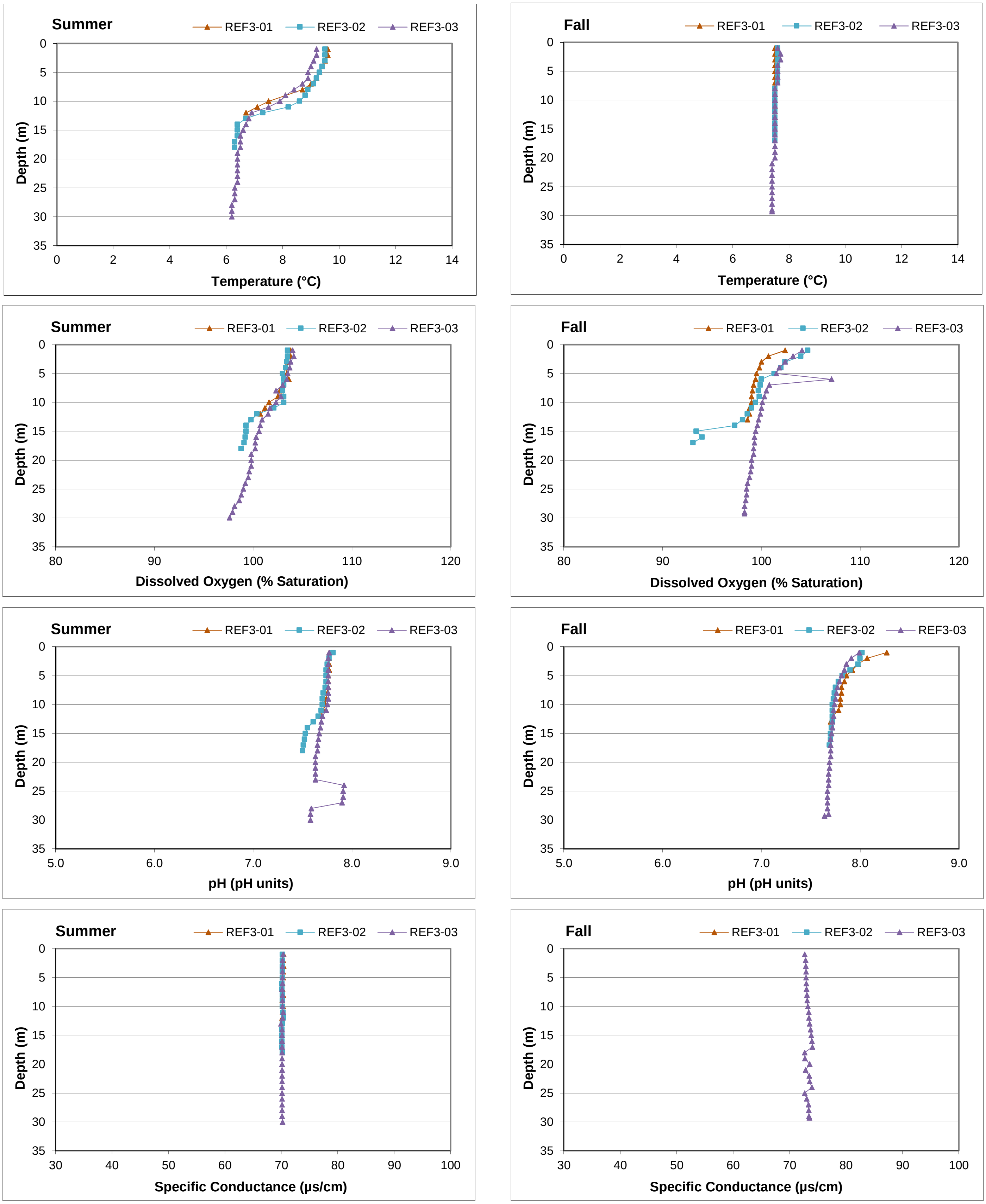


Figure B.3: ***In situ* Water Quality with Depth from Surface at Reference Lake 3 during Summer and Fall Sampling Events, Mary River Project CREMP, 2017**

The evaluation of water chemistry at Reference Lake 3 indicated that only phenol was elevated above WQG on a single sampling occasion in 2017 (Appendix Table B.4). In addition, no parameters were observed at concentrations above lentic AEMP benchmarks at Reference Lake 3 (Appendix Table B.4), suggesting that these water quality benchmarks were relevant to the mine LSA lakes. No substantial differences in water chemistry were observed between the summer and fall at Reference Lake 3 in 2017, which was similar to observations among winter, summer and fall at LSA lakes during the mine baseline period and in summer and fall at Reference Lake 3 in 2015 and 2016 (KP 2014a,c; Minnow 2016a, 2017).

Water chemistry data collected at Reference Lake 3 showed no consistent differences in parameter concentrations between the surface and the bottom of the water column at each individual station in 2017 (Appendix Figure B.4; Appendix Table B.4). The lack of any appreciable depth-related differences in parameter concentrations at each station likely reflected only minor differences in dissolved oxygen saturation, pH and/or specific conductance with increased depth from the surface. Because anoxic conditions do not appear to develop in the summer or fall at Reference Lake 3, reducing conditions conducive to metal mobilization from sediment to the overlying water are less likely to occur near the lake bottom, resulting in relative uniform water chemistry between surface and bottom waters of Reference Lake 3. Accordingly, metal concentrations can naturally be expected to be similar between surface and bottom of LSA lakes provided no substantial gradients in dissolved oxygen saturation, pH and/or specific conductance occur within the water column.

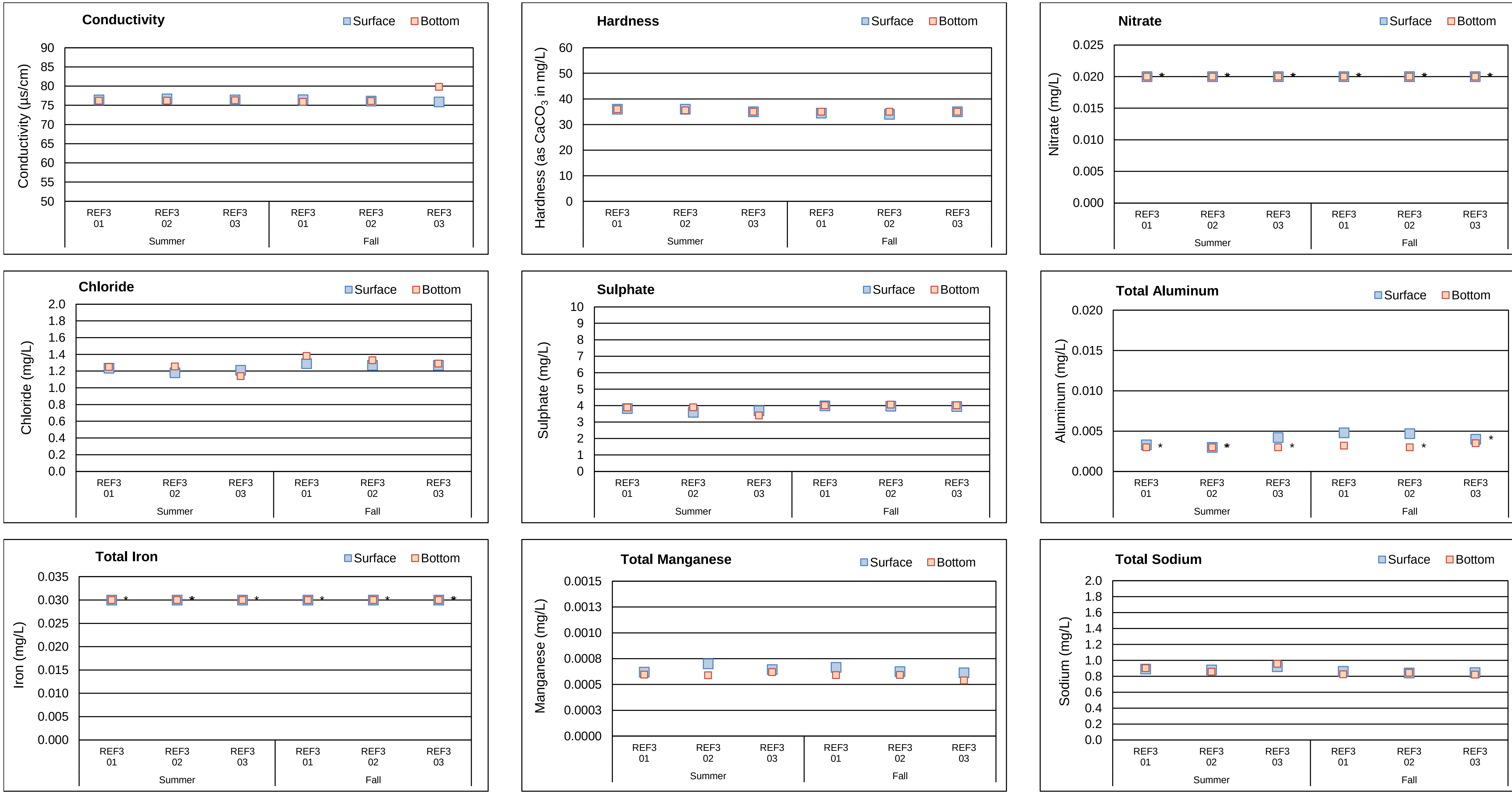


Figure B.4: Water Chemistry Comparison Between the Surface and the Bottom of the Water Column at Reference Lake 3 Routine Monitoring Stations during Summer and Fall, Mary River Project CREMP, 2017

Note: An asterisk (*) indicates that the parameter concentration was below the laboratory reportable detection limit.

Table B.4: Water Chemistry at Reference Lake 3, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event						Fall Sampling Event					
					REF3-01 bottom 12-Aug-2017	REF3-01 surface 12-Aug-2017	REF3-02 bottom 12-Aug-2017	REF3-02 surface 12-Aug-2017	REF3-03 bottom 12-Aug-2017	REF3-03 surface 12-Aug-2017	REF3-01 bottom 2-Sep-2017	REF3-01 surface 2-Sep-2017	REF3-02 bottom 2-Sep-2017	REF3-02 surface 2-Sep-2017	REF3-03 bottom 2-Sep-2017	REF3-03 surface 2-Sep-2017
Conventionals[b]	Conductivity (lab)	umho/cm	-	-	76.2	76.4	76.2	76.7	76.3	76.4	75.9	76.5	76.1	76.1	79.8	75.9
	pH (lab)	pH	6.5 - 9.0	-	7.78	7.80	7.69	7.67	7.69	7.79	7.75	7.78	7.74	7.75	7.57	7.75
	Hardness (as $CaCO_3$)	mg/L	-	-	36	36	35.5	36	35	35	35	34.5	35	34	35	35
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	48	37	37	36	36	27	32	34	42	30	42	35
	Turbidity	NTU	-	-	0.38	0.37	0.41	0.43	0.34	0.36	0.24	1.22	0.23	0.45	0.36	0.41
	Alkalinity (as $CaCO_3$)	mg/L	-	-	28	33	35	36	31	27	35	29	31	35	35	30
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	0.055	0.063	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.20	<0.15	<0.15	<0.15	0.26	0.19	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	2.9	3.1	3.1	2.8	3.1	3.0	2.7	2.7	2.7	2.6	2.7	2.7
	Total Organic Carbon	mg/L	-	-	3.0	3.1	3.0	3.2	3.0	3.3	2.8	2.8	2.8	2.9	2.7	2.8
	Total Phosphorus	mg/L	0.030[α]	-	0.0116	0.0138	0.0040	0.0034	0.0042	0.0047	0.0048	0.0036	0.0044	0.0053	<0.0030	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	0.0021	**0.0054**	0.0028	0.0022	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.25	1.24	1.26	1.18	1.14	1.21	1.38	1.29	1.33	1.27	1.29	1.27
	Sulphate (SO_4)	mg/L	218[β]	218	3.89	3.82	3.90	3.60	3.40	3.69	4.02	3.99	4.06	3.97	4.02	3.95
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	<0.0030	0.0033	<0.0030	<0.0030	<0.0030	0.0042	0.0032	0.0048	<0.0030	0.0047	0.0035	0.004
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	0.00012	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.00646	0.00634	0.00625	0.00664	0.00646	0.00650	0.00626	0.00634	0.00632	0.00651	0.00629	0.00642
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	-	7.01	7.09	6.93	7.05	6.91	6.83	6.73	6.93	6.97	7.02	6.82	6.84
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.00078	0.00090	0.00086	0.00086	0.00085	0.00081	0.00086	0.00080	0.00086	0.00081	0.00080	0.00075
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.41	4.43	4.30	4.38	4.48	4.47	4.39	4.36	4.51	4.47	4.31	4.49
	Manganese (Mn)	mg/L	0.935[β]	-	0.000596	0.000620	0.000589	0.000700	0.000620	0.000645	0.000591	0.000666	0.000592	0.000625	0.000540	0.000613
	Mercury (Hg)	mg/L	0.000026	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	-	0.000138	0.000146	0.000139	0.000147	0.000138	0.000139	0.000121	0.000123	0.000127	0.000129	0.000115	0.000121
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.91	0.93	0.88	0.91	0.94	0.92	0.86	0.87	0.88	0.88	0.85	0.89
	Selenium (Se)	mg/L	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	-	-	0.40	0.40	0.43	0.42	0.43	0.41	0.40	0.41	0.40	0.41	0.40	0.41
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.901	0.891	0.856	0.880	0.956	0.920	0.824	0.863	0.843	0.842	0.819	0.845
	Strontium (Sr)	mg/L	-	-	0.00803	0.00801	0.00792	0.00808	0.00778	0.00763	0.00755	0.00782	0.00779	0.00785	0.00757	0.00759
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.000265	0.000270	0.000258	0.000258	0.000258	0.000264	0.000239	0.000253	0.000258	0.000252	0.000248	0.000244
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using background water quality data. The values are specific to the Camp Lake system.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

B4 SEDIMENT QUALITY

B4.1 Creek/Tributary Environments

Deposited sediment at Unnamed Reference Creek (CLT-REF) was visually characterized as predominantly medium-sized sand (Appendix Table D.1). In-stream substrate of the reference creek was composed mainly of cobble and pebble material (i.e., substrate diameter 6 – 25 cm, and 2 – 6 cm, respectively), with sand constituting only a small amount (i.e., ~7%) of the material observed at the sediment surface (Appendix Table F.1). Deposited sediment suitable for chemical characterization (i.e., sand and finer substrate sizes) was collected mainly from shoreline/streambank areas (Appendix Table D.1). Sediment total organic carbon (TOC) content was very low (i.e., <0.1%) at the reference creek suggesting very limited deposition of fine organic materials (Appendix Table D.2). Metal concentrations in deposited sediment at the reference creek were well below SQG (Appendix Table D.2), and therefore the Unnamed Reference Creek data were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on chemistry of deposited sediment at the mine-exposed creeks.

B4.2 River Environment

Deposited sediment at the Mary River (GO-09) upstream reference area was visually characterized as predominantly coarse sand (Appendix Table D.36). In-stream substrate of the reference creek was composed mainly of boulder and cobble material (i.e., substrate diameter >25 cm, and 6 – 25 cm, respectively), with sand constituting only a minor amount (i.e., ~10%) of the material observed at the sediment surface (Appendix Table F.50). Deposited sediment suitable for chemical characterization (i.e., sand and finer substrate sizes) was collected in-stream from quiescent zones immediately downstream of large boulders (Appendix Table D.36). Sediment total organic carbon (TOC) content was very low (i.e., <0.1%) at the GO-09 reference area, suggesting very limited deposition of fine organic materials (Appendix Table D.37). Metal concentrations in deposited sediment at the reference creek were well below SQG (Appendix Table D.37), and therefore the GO-09 data were deemed to provide a meaningful benchmark for the evaluation of potential mine-related influences on chemistry of deposited sediment at the Mary River mine-exposed study areas.

B4.3 Lake Environments (Reference Lake 3)

Sediment sampling was conducted at littoral and profundal (i.e., <12 m and >12 m depths, respectively) areas of Reference Lake 3 in 2015, 2016, and 2017 for the analysis of particle size, total organic carbon (TOC) content, and total metal concentrations (see Figure 2.3).

Surficial sediment at Reference Lake 3 littoral and profundal areas was composed of silty to sandy loam material with moderate TOC content. Unlike previous CREMP studies, substrate particle size did not differ significantly between the Reference Lake 3 littoral and profundal habitats in 2017 (Appendix Table F.17), whereas previous studies showed a significantly higher and lower proportion of sand- and clay-sized material, respectively, present at littoral stations compared to profundal stations (Minnow 2016a, 2017). No significant differences in sediment TOC content occurred between the littoral and profundal habitats of the reference lake in 2017 (Appendix Table F.17). A surficial and/or sub-surface layer of oxidized material (likely iron hydroxide or oxy-hydroxides), visible as an orange-brown floc or distinct layer, was commonly observed in the surficial sediment of Reference Lake 3 (Appendix Tables D.3 and D.4). In addition, sub-surface sediment of Reference Lake 3 occasionally contained blackened/dark colouration, which suggested the occurrence of reducing (i.e., anoxic) sediment conditions (Appendix Tables D.3 and D.4). The physical properties of sediment observed at Reference Lake 3 in 2017 were consistent with those of the 2015 and 2016 studies (Minnow 2016a, 2017).

Metal concentrations in sediment at Reference Lake 3 were generally lower at the littoral stations than at the profundal stations, although less than a two-fold difference in concentrations was typically shown for most parameters between the littoral and profundal station depths (Appendix Table B.5; Appendix Figure B.5). The differences in sediment metal concentrations between the littoral and profundal station depths likely reflected a naturally higher proportion of fine silt- and clay-sized particles at the latter, which is consistent with expected depositional patterns in lakes. Among metals with established SQG, mean concentrations of iron were elevated above SQG at littoral and profundal stations, and mean concentrations of manganese were elevated above SQG at profundal stations of Reference Lake 3 in 2017 (Appendix Table B.5). Sediment phosphorus concentrations were also elevated above SQG at a single littoral station of Reference Lake 3 (Appendix Table B.5). Therefore, compared to SQG, high concentrations of iron and manganese, and phosphorus to a lesser extent, appear to occur naturally in sediments of Mary River Project LSA lakes. Mean copper and iron concentrations at littoral stations, and mean copper, iron, and manganese concentrations at profundal stations, were above the most stringent (i.e., lowest) AEMP sediment quality benchmarks at Reference Lake 3 (Appendix Table B.5). This suggested that the AEMP sediment benchmarks for these metals were conservative.

Table B.5: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Reference Lake 3 (REF-03) Sediment Stations, Mary River Project CREMP, August 2017

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Littoral Stations							Profundal Stations						
					REF-03-1	REF-03-2	REF-03-3	REF-03-4	REF-03-5	Mean	Standard Error	REF-03-6	REF-03-7	REF-03-8	REF-03-9	REF-03-10	Mean	Standard Error
Non-metals	Sand	%	-	-	46.5	58.0	25.6	59.9	42.0	46.4	6.2	45.3	15.6	39.2	22.4	55.95	35.7	5.23
	Silt	%	-	-	43.7	32.8	62.2	35.4	47.4	44.3	5.20	42.5	62.4	49.6	61.4	35.3	50.2	3.73
	Clay	%	-	-	9.80	9.2	12.20	4.70	10.60	9.3	1.26	12.2	22.0	11.2	16.2	8.8	14.1	1.63
	Moisture	%	-	-	89.1	91.3	68.0	70.7	88.2	81.5	4.99	86.1	54.4	76.6	77.5	85.3	76.0	4.05
	Total Organic Carbon	%	10[α]	-	6.06	7.23	3.59	2.74	4.71	4.87	0.81	4.43	1.81	3.03	4.13	4.39	3.56	0.358
Metals	Aluminum (Al)	mg/kg	-	-	14,400	14,200	16,500	12,400	16,100	14,720	736	26,000	16,400	21,000	24,300	22,450	22,030	1,160
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0
	Arsenic (As)	mg/kg	17	5.9 - 6.2[c]	2.34	3.01	3.65	2.08	5.67	3.35	0.64	5.50	4.41	4.41	4.87	4.69	4.78	0.142
	Barium (Ba)	mg/kg	-	-	120	133	105.0	77.4	129.0	113	10	158	115	133	142	140	138	4.93
	Beryllium (Be)	mg/kg	-	-	0.54	0.58	0.65	0.50	0.58	0.57	0.02	1.00	0.66	0.80	0.91	0.87	0.85	0.040
	Bismuth (Bi)	mg/kg	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.00	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.0000
	Boron (B)	mg/kg	-	-	10.8	13.8	13.3	9.7	13.1	12.1	0.8	18.8	11.0	16.0	18.7	17.8	16.5	1.03
	Cadmium (Cd)	mg/kg	3.5	1.5	0.152	0.298	0.180	0.105	0.173	0.182	0.032	0.181	0.269	0.131	0.158	0.161	0.180	0.017
	Calcium (Ca)	mg/kg	-	-	5,570	5,260	4,430	3,490	4,530	4,656	362	6,050	3,970	4,880	5,770	5,555	5,245	263.6
	Chromium (Cr)	mg/kg	90	79 - 98[c]	56.5	48.0	53.9	38.2	59.1	51.1	3.7	***84.3***	48.5	65.4	***79.1***	72.2	69.9	4.40
	Cobalt (Co)	mg/kg	-	-	9.03	10.00	12.1	9.1	12.9	10.6	0.8	19.0	12.2	15.1	17.3	16.2	16.0	0.81
	Copper (Cu)	mg/kg	197	50 - 58[c]	***60***	***84***	***62***	***53***	***65***	***65***	5	**107**	57	**87**	**97**	**90**	**87**	5.99
	Iron (Fe)	mg/kg	40,000[α]	34,400 - 52,400[c]	23,900	***45,800***	***35,200***	31,100	***73,800***	***41,960***	8,713	***55,400***	***34,600***	***45,700***	***50,400***	***47,100***	***46,640***	2,434
	Lead (Pb)	mg/kg	91.3	35	12.5	11.9	13.4	10.6	13.7	12.4	0.6	19.7	13.6	15.8	18.0	17.3	16.9	0.73
	Lithium (Li)	mg/kg	-	-	23.3	23.7	26.5	21.2	25.2	24.0	0.9	39.8	27.7	33.5	37.8	35.4	34.8	1.47
	Magnesium (Mg)	mg/kg	-	-	11,600	9,450	11,000	7,830	11,400	10,256	714	17,500	11,000	13,500	16,200	14,900	14,620	794
	Manganese (Mn)	mg/kg	1,100[α,β]	657 - 4,370	306	***718***	***1,010***	609	554	639	115	***1,340***	***1,500***	***1,220***	***1,140***	***1,130***	***1,266***	49.2
	Mercury (Hg)	mg/kg	0.486	0.17	0.0613	0.0528	0.0325	0.0182	0.0554	0.0440	0.0081	0.0661	0.0238	0.0407	0.0701	0.0599	0.0521	0.00615
	Molybdenum (Mo)	mg/kg	-	-	1.04	4.08	2.84	2.68	6.85	3.50	0.97	3.08	3.52	2.92	2.53	2.41	2.89	0.141
	Nickel (Ni)	mg/kg	75[α,β]	66 - 77[c]	41.3	38.3	40.9	28.8	41.6	38.2	2.4	57.9	41.0	44.2	53.1	49.3	49.1	2.14
	Phosphorus (P)	mg/kg	2,000[α]	1,278 - 1,958[c]	726	830	859	760	***2,020***	1,039	246	1,200	897	1,010	1,160	1,060	1,065	38.3
	Potassium (K)	mg/kg	-	-	3,380	3,750	4,360	3,210	4,070	3,754	212	6,580	4,470	5,360	6,200	5,750	5,672	257.5
	Selenium (Se)	mg/kg	-	-	0.58	0.92	0.44	0.26	0.86	0.61	0.12	0.79	<0.20	0.41	0.79	0.71	0.58	0.083
	Silver (Ag)	mg/kg	-	-	0.13	0.15	<0.10	<0.10	0.15	0.13	0.01	0.24	0.12	0.16	0.25	0.22	0.20	0.018
	Sodium (Na)	mg/kg	-	-	262	301	300	218	340	284	21	473	290	366	472	431	406	24.8
	Strontium (Sr)	mg/kg	-	-	9.9	10.9	10.2	8.3	10.6	10.0	0.5	14.3	9.9	12.0	13.8	13.1	12.6	0.55
	Sulphur (S)	mg/kg	-	-	1100	1500	<1000	<1000	1000	1,120	97	1400	<1000	<1000	1200	1050	1,130	54
	Thallium (Tl)	mg/kg	-	-	0.334	0.333	0.422	0.226	0.415	0.346	0.036	0.762	0.561	0.579	0.695	0.676	0.655	0.0265
	Tin (Sn)	mg/kg	-	-	2.6	<2.0	<2.0	<2.0	<2.0	2.1	0.1	2.0	<2.0	<2.0	<2.0	<2.0	2.0	0.000
	Titanium (Ti)	mg/kg	-	-	936	903	1,060	917	1,170	997	51	1,380	1,110	1,220	1,420	1,265	1,279	39.5
	Uranium (U)	mg/kg	-	-	9.20	12.1	12.2	8.02	13.6	11.0	1.0	27.1	15.0	27.6	23.8	24.1	23.5	1.60
	Vanadium (V)	mg/kg	-	-	47.1	45.4	52.0	41.8	52.6	47.8	2.0	77.7	54.7	63.9	71.5	67.2	67.0	2.72
	Zinc (Zn)	mg/kg	315	123 - 135[c]	66.9	68.5	69.7	58.2	73.3	67.3	0.5	107	66.8	89.3	99.0	92.1	90.8	4.8
	Zirconium (Zr)	mg/kg	-	-	5.5	3.9	3.1	3.1	3.8	3.8	0.1	3.6	3.8	3.0	3.4	3.2	3.4	0.1

[a] Canadian Sediment Quality Guideline, probable effects level (PEL; CCME 2017) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2017)).

[b] Baffinland Mary River Project Aquatic Effects Monitoring Program (AEMP) sediment quality benckmarks (Baffinland 2014, 2016; Intrinsik 2014, 2015).

[c] The AEMP benchmarks were derived for individual mine-exposed lakes, and therefore a range of values is presented to reflect the AEMP benchmark variation among the mine-exposed lakes. Reference Lake 3 sediment chemistry was screened against the lowest AEMP benchmark for applicable parameters.

(grey box) Indicates paramter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

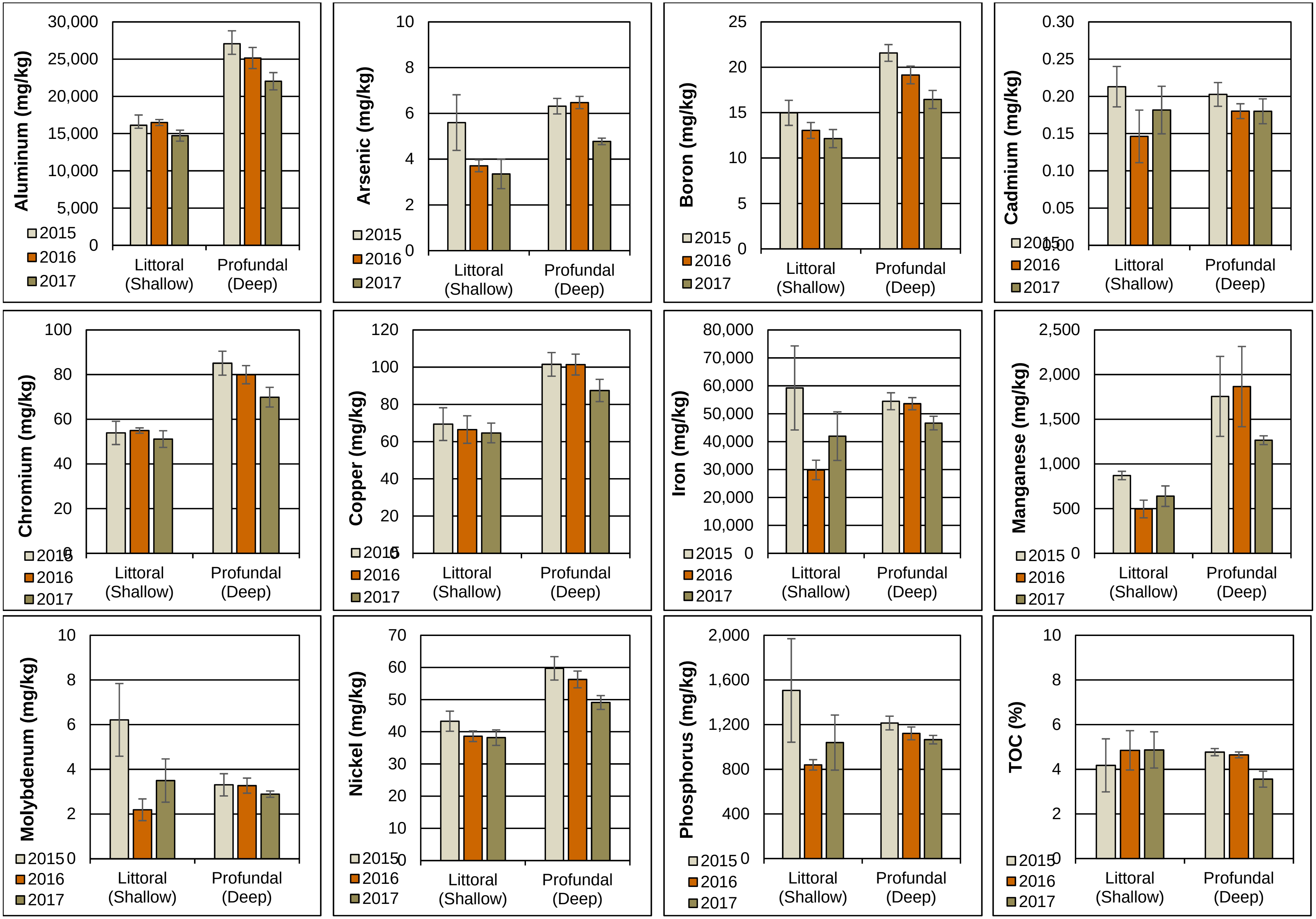


Figure B.5: **Sediment Metal Concentrations (mean ± SE) at Littoral (<12m depth) and Profundal (>12m depth) Monitoring Stations of Reference Lake 3 (REF03), Mary River Project CREMP, 2015 - 2017**

B5 PHYTOPLANKTON (CHLOROPHYLL-A)

B5.1 Lotic Environments

Chlorophyll-a concentrations, which were used as a surrogate for phytoplankton abundance, ranged from approximately 0.11 – 0.63 µg/L at the reference creek and river stations among spring, summer, and fall sampling events in 2017 (Appendix Table B.6). Therefore, lotic reference station chlorophyll-a concentrations were consistently well below the AEMP benchmark of 3.7 µg/L, and reflected low (i.e., oligotrophic) phytoplankton productivity according to Dodds et al (1998) trophic status classification for stream environments. This trophic status classification was consistent with an 'oligotrophic' CWQG categorization for the stream and river reference stations based on mean aqueous total phosphorus concentrations generally ranging between 4 – 10 µg/L during each respective spring, summer, and fall sampling event in 2017 (Appendix Tables B.2 and B.3). Seasonally, chlorophyll-a concentrations were significantly higher in the fall than during either the spring and summer at the reference creek stations, but no differences in chlorophyll-a concentrations were indicated among seasons at Mary River GO-09 series reference stations in 2017 (Appendix Table B.7).

Comparisons among 2015, 2016, and 2017 for like-season chlorophyll-a concentrations did not indicate any consistent significant differences among years over the spring, summer, and fall sampling events at either the reference creek or the Mary River reference area stations (Appendix Figure B.6). The variability in response shown among seasons and years at the lotic reference areas indicated that significant differences in chlorophyll-a concentrations occurs naturally among years and seasons in watercourses within the Mary River Project mine LSA.

B5.2 Lentic Environments (Reference Lake 3)

Chlorophyll-a concentrations at Reference Lake 3 showed no consistent differences between the surface and the bottom of the water column at each individual station during both the summer and fall sampling events in 2017 (Appendix Figure B.7). Chlorophyll-a concentrations did not differ significantly between the surface and the bottom of the water column among Reference Lake 3 stations for either the summer or fall sampling events, suggesting similar phytoplankton abundance near the surface and bottom of the lake stations regardless of differences in depth.

Reference Lake 3 chlorophyll-a concentrations averaged 0.63 µg/L in summer and 0.91 µg/L in fall 2017, and were consistently well below the AEMP benchmark of 3.7 µg/L (Appendix Table E.3; Appendix Figure B.7). Similar to the lotic reference stations, mean chlorophyll-a

Table B.6: Phytoplankton Monitoring Data Collected at Lotic Reference Stations, Mary River Project CREMP 2017

	Station	Reference Creek Stations				Mary River Reference Stations		
		CLT-REF3	CLT-REF4	MRY-REF2	MRY-REF3	G0-09-A	G0-09	G0-09-B
Sample Collection Date	Spring	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17
	Summer	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17
	Fall	27-Aug-17	27-Aug-17	27-Aug-17	27-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17
Chlorophyll a (µg/L)	Spring	0.15	0.17	0.19	0.11	0.45	0.23	0.21
	Summer	0.17	0.19	0.14	0.13	0.19	0.24	0.12
	Fall	0.39	0.63	0.48	0.56	0.23	0.38	0.27
	Average	0.24	0.33	0.27	0.27	0.29	0.28	0.20
	Standard Deviation	0.13	0.26	0.18	0.25	0.14	0.08	0.08
	Standard Error	0.08	0.15	0.11	0.15	0.08	0.05	0.04
Phaeophytin a (µg/L)	Spring	0.18	0.18	0.28	0.13	0.38	0.17	0.19
	Summer	0.32	0.25	0.38	<1.0	0.23	0.28	0.16
	Fall	0.34	0.32	0.31	0.52	0.28	0.35	0.29
	Average	0.28	0.25	0.32	0.55	0.30	0.27	0.21
	Standard Deviation	0.09	0.07	0.05	0.44	0.08	0.09	0.07
	Standard Error	0.05	0.04	0.03	0.25	0.04	0.05	0.04

Table B.7: Statistical Comparisons of Chlorophyll-a Concentrations among Winter, Spring, Summer, and/or Fall Sampling Events at Reference Lotic and Lentic Study Areas, Mary River Project CREMP, 2017

Study Lake	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	p-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	p-value	Statistical Test
Stream Reference Stations	YES	0.00003	ANOVA[c]	Spring	Summer	NO	0.9993	Tamhane's
				Spring	Fall	YES	0.0112	
				Summer	Fall	YES	0.0133	
Mary River GO-09 Reference Stations	NO	0.32438	ANOVA[c]	Spring	Summer	NO	0.3755	Tukey's
				Spring	Fall	NO	0.9990	
				Summer	Fall	NO	0.3943	
Reference Lake 3	-	-	-	Winter	Summer	not applicable	-	ANOVA[c]
				Winter	Fall	not applicable	-	
				Summer	Fall	YES	0.0062	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.
[b] Statistical tests include Analysis of Variance (ANOVA) and Kruskal Wallis H-test (KW H-test).
[c] Untransformed data normally distributed.
[d] Logged data non-normally distributed.
[e] Kruskal-Wallis H-test used to validate results of ANOVA three-group comparison.
[f] Mann-Whitney U-test used to validate results of post-hoc tests for all pair-wise comparisons.

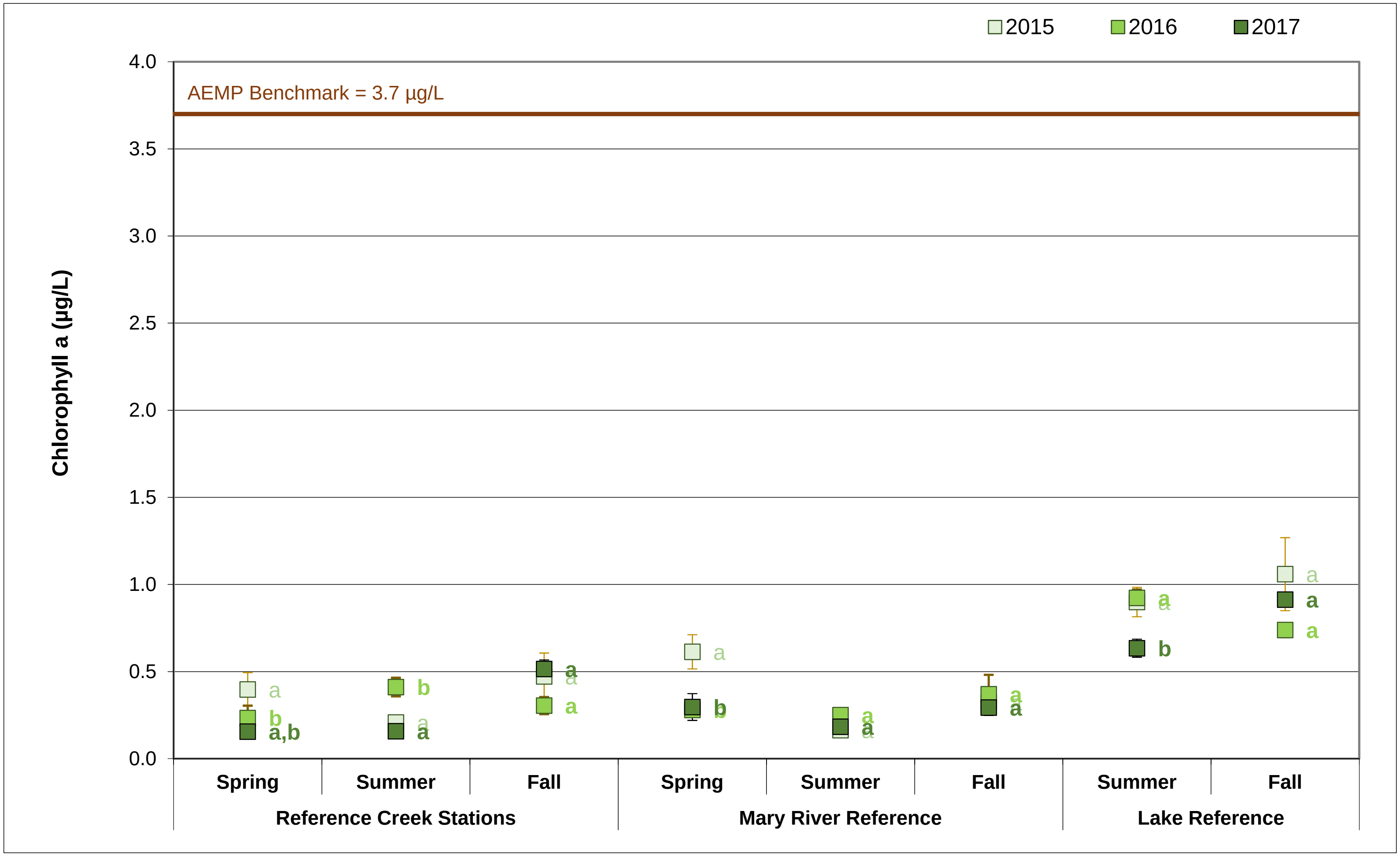


Figure B.6: Chlorophyll-a Concentration Seasonal Comparison between 2015, 2016, and 2017 at Creek, River and Lake Reference Phytoplankton Monitoring Stations, Mary River Project CREMP

The same letters next to data points associated with each individual season/reference area indicates no significant difference between points .

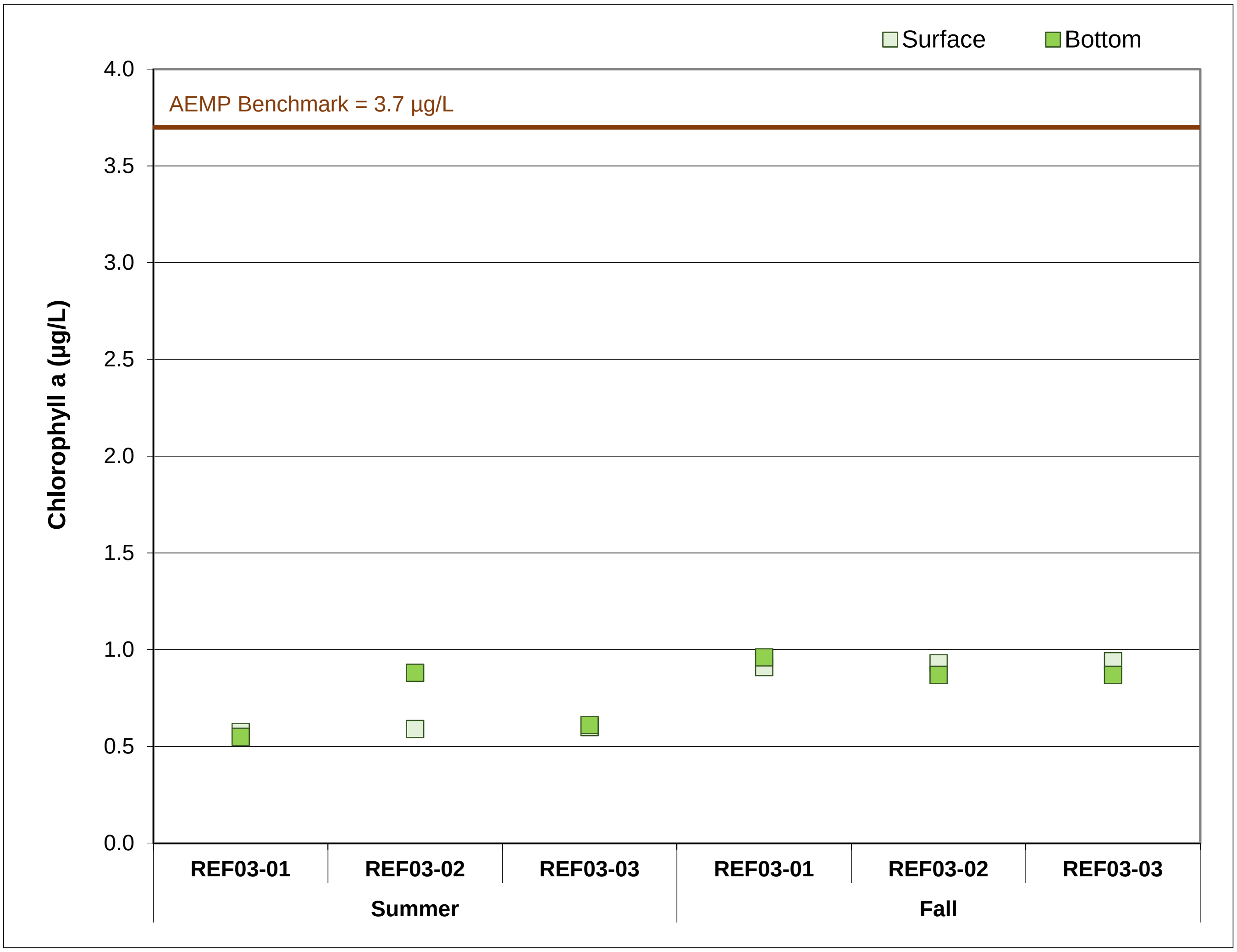


Figure B.7: Chlorophyll-a Concentrations at the Surface and Bottom of the Water Column at Reference Lake 3 Phytoplankton Monitoring Stations during Summer and Fall Sampling Events, Mary River Project CREMP, 2017

concentrations observed at Reference Lake 3 in 2017 indicated low (i.e., oligotrophic) phytoplankton productivity based on the lake trophic status classification presented in Wetzel (2001). This trophic status classification was also consistent with an 'oligotrophic' CWQG categorization for Reference Lake 3 based on mean aqueous total phosphorus concentrations typically ranging between 4 and 10 µg/L during the summer and fall sampling events in 2017 (Appendix Table B.4). Chlorophyll-a concentrations were significantly lower in the summer than in the fall at Reference Lake 3 in 2017 (Appendix Table B.7), which differed from results of the 2015 study when chlorophyll-a concentrations did not differ between seasons, and from the results of the 2016 study when chlorophyll-a concentrations were significantly higher in the summer. Although chlorophyll-a concentrations were generally comparable among the 2015, 2016, and 2017 studies for like-seasons at Reference Lake 3, the relative seasonal changes in chlorophyll-a concentrations among years suggested naturally variable temporal patterns in phytoplankton abundance can expected at Mary River Project mine LSA lakes.

B6 BENTHIC INVERTEBRATE COMMUNITY

B6.1 Creek/Tributary Environments

The original Mary River Project CREMP design had not included/identified a reference creek from which to evaluate potential mine-related effects on benthic invertebrate communities of creek/tributary environments, instead relying solely on a before-after approach to identify potential mine influences on benthic invertebrates over time (see NSC 2014). Stemming from recommendations from the 2015 CREMP (Minnow 2016b), a reference creek was incorporated into the 2016 and 2017 CREMP benthic invertebrate community studies to provide a stronger basis for evaluating potential within-year mine-related effects to biota residing in mine-exposed tributaries of Camp and Sheardown lakes. The benthic invertebrate community (benthic) study area selected for the CREMP was located within at the same unnamed tributary to Angajurjualuk Lake that is used for reference water quality sampling (Stations CLT-REF4 and MRY-REF2; Table 2.5; Figure 2.4). Criteria used for the selection of this creek as a reference area for the CREMP, which is herein referred to as Unnamed Reference Creek, included a watercourse exhibiting similar habitat characteristics (e.g., width, water velocity, substrate size) as the mine-exposed tributaries (see Appendix Tables F.1 and F.25) that is not/has not been influenced by mining or adverse anthropogenic disturbances. The acceptance of Unnamed Reference Creek as a reference area for the evaluation of mine-related influences on tributary water chemistry under the original CREMP (KP 2014a) was also considered an important criterion in the selection of this watercourse as a suitable reference area for the benthic invertebrate community survey.

Benthic invertebrate density at Unnamed Reference Creek ranged from 817 – 5,229 individuals/m^2 in 2017 (mean of 1,972 individuals/m^2) , which is considered moderate to high for Arctic streams (Craig and McCart 1975). Unnamed Reference Creek showed relatively high richness and Simpson's Evenness in 2017, which was unlike the low production that can naturally be expected in Arctic streams as a result of constraints associated with low nutrients and seasonal temperatures, as well as food limitation (Huryn and Wallace 2000). Chironomidae (non-biting midges) and Simuliidae (blackflies) were the dominant taxomonic groups observed at Unnamed Reference Creek benthic stations, collectively accounting for approximately 66% of the community (Appendix Table B.8). Collector-gatherers were the dominant benthic invertebrate functional feeding group (FFG) present at Unnamed Reference Creek (Appendix Table B.8), suggesting greatest reliance upon deposited fine particulate organic matter as a food source for benthic invertebrates. Shredders constituted a low proportion of the Unnamed Reference Creek benthic invertebrate community (Appendix Table B.9), suggesting that live and/or decomposing leaf material was a less important food source.

Table B.8: Benthic Invertebrate Community Summary Statistics for Unnamed Reference Creek and Mary River (GO-09) Reference Areas, Mary River Project CREMP, August 2017

Metric	Area	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	5	1,972	1,861	832	-339	4,282	817	5,229
	Mary River GO-09 Reference	5	410	313	140	21	799	179	958
Richness (Number of Taxa)	Unnamed Reference Creek	5	21.2	1.9	0.9	18.8	23.6	19.0	24.0
	Mary River GO-09 Reference	5	11.2	2.9	1.3	7.5	14.9	6.0	13.0
Simpson's Evenness	Unnamed Reference Creek	5	0.935	0.017	0.008	0.913	0.956	0.909	0.951
	Mary River GO-09 Reference	5	0.770	0.097	0.044	0.649	0.891	0.678	0.892
Bray-Curtis Index	Unnamed Reference Creek	5	0.305	0.205	0.092	0.050	0.560	0.173	0.664
	Mary River GO-09 Reference	5	0.240	0.215	0.096	-0.027	0.507	0.050	0.536
Simuliidae (% of community)	Unnamed Reference Creek	5	28.3%	6.6%	3.0%	20.1%	36.5%	23.0%	39.3%
	Mary River GO-09 Reference	5	18.9%	5.2%	2.3%	12.5%	25.4%	13.1%	25.7%
Hydracarina (% of community)	Unnamed Reference Creek	5	4.8%	2.3%	1.0%	2.0%	7.6%	2.2%	7.7%
	Mary River GO-09 Reference	5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chironomidae (% of community)	Unnamed Reference Creek	5	37.9%	11.1%	5.0%	24.1%	51.7%	25.3%	55.7%
	Mary River GO-09 Reference	5	79.0%	6.4%	2.9%	71.1%	87.0%	69.8%	86.9%
Metal Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5	5.7%	5.7%	2.5%	-1.3%	12.7%	1.7%	15.7%
	Mary River GO-09 Reference	5	59.7%	13.2%	5.9%	43.2%	76.1%	38.5%	73.9%
Tipulidae (% of community)	Unnamed Reference Creek	5	0.7%	0.4%	0.2%	0.1%	1.2%	0.3%	1.4%
	Mary River GO-09 Reference	5	1.5%	1.3%	0.6%	-0.1%	3.1%	0.0%	3.3%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	5	58.8%	7.2%	3.2%	49.9%	67.6%	51.8%	69.3%
	Mary River GO-09 Reference	5	74.6%	6.6%	2.9%	66.4%	82.8%	65.4%	82.9%
Filterer FFG (% of community)	Unnamed Reference Creek	5	28.6%	6.5%	2.9%	20.6%	36.7%	23.0%	39.3%
	Mary River GO-09 Reference	5	18.9%	5.2%	2.3%	12.5%	25.4%	13.1%	25.7%
Shredder FFG (% of community)	Unnamed Reference Creek	5	6.7%	5.5%	2.4%	-0.1%	13.5%	2.7%	16.3%
	Mary River GO-09 Reference	5	5.8%	2.2%	1.0%	3.1%	8.6%	4.1%	8.9%
Clinger HPG (% of community)	Unnamed Reference Creek	5	40.1%	7.8%	3.5%	30.4%	49.7%	28.8%	47.8%
	Mary River GO-09 Reference	5	23.3%	6.1%	2.7%	15.6%	30.9%	17.1%	32.4%
Sprawler HPG (% of community)	Unnamed Reference Creek	5	49.0%	9.2%	4.1%	37.6%	60.5%	37.0%	58.8%
	Mary River GO-09 Reference	5	74.0%	7.5%	3.3%	64.8%	83.3%	63.1%	82.9%
Burrower HPG (% of community)	Unnamed Reference Creek	5	10.7%	4.5%	2.0%	5.2%	16.3%	4.0%	15.1%
	Mary River GO-09 Reference	5	2.7%	1.7%	0.7%	0.7%	4.8%	0.0%	4.5%

In terms of benthic invertebrate habitat preference groups (HPG), clingers and sprawlers were co-dominant groups at Unnamed Reference Creek (Appendix Table B.8) suggesting that most invertebrates were associated with substrate surfaces and were not deeply embedded in the substrate (i.e., non-burrowers).

B6.2 River Environments

The area of Mary River located upstream of the mine lease property has been considered representative of reference conditions for the mine-exposed stations/study areas situated farther downstream on the Mary River under the CREMP (Baffinland 2014; KP 2014a,b, 2015; NSC 2014). As in previous CREMP studies, the GO-09 area of Mary River (including water quality stations GO-09A, GO-09 and GO-09B) was used as the benthic reference area for mine-exposed areas of Mary River as part of the 2017 CREMP (see Table 2.5; Figure 2.4).

Benthic invertebrate density at the Mary River reference area in 2017 ranged from 179 – 958 individuals/m^2, which is considered low to moderate for Arctic lotic systems (Craig and McCart 1975). Moderate richness and Simpson's Evenness also characterized the benthic invertebrate community of the Mary River reference area, and reflected naturally low Arctic stream environment productivity as a result of low ambient temperatures and nutrient levels (Huryn and Wallace 2000). Midges of the family Chironomidae were the dominant taxonomic group observed at the Mary River reference area, with the relative abundance of this group ranging from 70 – 86% of individuals (mean of 79%) and taxa considered metal-sensitive constituting 39 – 74% of the community (Appendix Table B.8). Similar to the reference creek, collector-gatherers were the dominant FFG present at the Mary River reference area (Appendix Table B.8), suggesting that fine particulate organic matter was the predominant food source for benthic invertebrates at this area. Sprawlers composed the dominant HPG at the Mary River reference area (Appendix Table B.8), which suggested that most benthic invertebrates were associated with the surface of rocky substrates.

Comparison of the Mary River reference area benthic invertebrate communities among baseline (2006, 2007) and mine-operational (2015, 2016, 2017) studies for key metrics indicated no consistent significant differences in density, richness, and relative abundance of metal-sensitive chironomids between the baseline and mine-operational periods (Figure 5.7; Appendix Table F.59). Although Simpson's Evenness was significantly higher, and relative abundance of chironomids and FFG collector-gatherers significantly lower, for the mine-operational studies compared to the baseline studies, the direction of these differences was not consistent with an adverse change but rather suggested greater diversity and/or more even distribution of invertebrate groups and FFG for the mine-operational period (Figure 5.6; Appendix Table F.59). These changes in benthic invertebrate community metrics between the mine baseline and operational studies at the Mary River reference area were thus attributable to natural variability in community traits among years and/or to artifacts associated with CREMP sampling among studies.

B6.3 Lentic Environments (Reference Lake 3)

The benthic invertebrate community of Reference Lake 3 differed dramatically between littoral (<12 m depth) and profundal (>12 m depth) stations in 2017. As in the previous 2015 and 2016 studies, significantly higher benthic invertebrate density, richness, and Simpson's Evenness was observed at littoral stations compared to profundal stations in 2017, most at Critical Effect Sizes outside of ± 2 SD (Appendix Table B.9). In addition, differences in benthic invertebrate community structure occurred between sampling depths as indicated by significantly differing Bray-Curtis Index and supported by higher and lower relative abundance of Ostracoda (seed shrimp) and Chironomidae (non-biting midges), respectively, at littoral stations compared to profundal stations (Appendix Table B.9). However, no significant differences in relative abundance of FFG or HPG were indicated between littoral and profundal habitats of Reference Lake 3. The difference in benthic invertebrate community metrics and assemblage features between the littoral and profundal stations observed at Reference Lake 3 in 2015, 2016, and 2017 validated proposed changes to the CREMP benthic invertebrate community survey by Minnow (2016b). Specifically, benthic invertebrate community surveys can focus only on littoral habitat to reflect the fact that natural habitat factors that affect community assemblage at profundal areas limit the ability to interpret potential mine-related biological effects at profundal depths of the LSA lakes.

Littoral habitat of Reference Lake 3 was largely dominated by Ostracoda (seed shrimp) and Chironomid non-biting midge larvae that exhibit collector-gathering feeding habits and inhabit the sediment surface (i.e., sprawler mode of existence) in 2015, 2016, and 2017. Comparison of littoral habitat benthic invertebrate communities at Reference Lake 3 among the 2015, 2016 and 2017 studies for key metrics indicated no significant differences in density, richness, Simpson's Evenness, Bray-Curtis Index, relative abundance of dominant FFG, and the relative abundance of all dominant taxonomic groups except Ostracoda (Appendix Table B.10). Although the relative abundance of Ostracoda differed between studies, the magnitude of difference was within scientifically established Critical Effect Sizes (CES), suggesting that this difference was not ecologically meaningful. Overall, this suggested that littoral habitat benthic invertebrate community features at Reference Lake 3 were relatively consistent among the 2015, 2016, and 2017 studies.

Table B.9: Benthic Invertebrate Community Statistical Comparison Results between Littoral and Profundal Stations at Reference Lake 3, Mary River Project CREMP, August 2017

Metric	Statistical Test Results					Summary Statistics					
	Data Transform-ation	Significant Difference Between Habitats?	p-value	Statistical Analysis[a]	Magnitude of Difference [a] (No. of SD)	Habitat	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Density (Individuals/m^2)	log	YES	< 0.001	ANOVA	-1.6	Lake Littoral	1,489	850	380	372	2,618
						Lake Profundal	149	32	14	113	190
Richness (Number of Taxa)	fourth root	YES	< 0.001	ANOVA	-3.3	Lake Littoral	12.4	2.5	1.1	10.0	15.0
						Lake Profundal	4.2	1.5	0.7	2.0	6.0
Simpson's Evenness (E)	log	YES	0.097	ANOVA	-0.7	Lake Littoral	0.807	0.142	0.063	0.605	0.934
						Lake Profundal	0.704	0.105	0.047	0.597	0.843
Bray-Curtis Index	none	YES	0.086	ANOVA	-1.2	Lake Littoral	0.384	0.120	0.054	0.203	0.536
						Lake Profundal	0.239	0.114	0.051	0.111	0.376
Nemata (%)	fourth root	YES	< 0.001	t-test unequal variance	-1.2	Lake Littoral	3.9	3.3	1.5	0.8	9.1
						Lake Profundal	0.0	0.0	0.0	0.0	0.0
Hydracarina (%)	none	NO	0.340	ANOVA	0.9	Lake Littoral	5.3	3.0	1.4	1.8	8.1
						Lake Profundal	8.2	5.5	2.5	0.0	15.0
Ostracoda (%)	none	YES	0.003	ANOVA	-2.0	Lake Littoral	38.8	18.4	8.2	22.3	63.9
						Lake Profundal	2.8	4.1	1.8	0.0	8.9
Chironomidae (%)	square root	YES	0.005	ANOVA	2.1	Lake Littoral	51.8	17.9	8.0	29.5	67.9
						Lake Profundal	89.0	7.6	3.4	81.6	100.0
Metal-Sensitive Chironomidae (%)	none	NO	0.636	ANOVA	-0.3	Lake Littoral	15.5	13.4	6.0	0.5	37.0
						Lake Profundal	12.0	8.9	4.0	0.0	20.2
Collector-Gatherers (%)	log	NO	0.172	ANOVA	0.7	Lake Littoral	73.9	16.0	7.2	56.0	95.5
						Lake Profundal	84.3	4.1	1.9	79.8	90.5
Filterers (%)	log(X+1)	NO	0.204	ANOVA	-0.6	Lake Littoral	14.7	13.3	5.9	0.5	36.4
						Lake Profundal	6.5	9.3	4.2	0.0	20.2
Shredders (%)	fourth root	NO	0.114	ANOVA	-0.5	Lake Littoral	4.2	6.6	3.0	0.0	15.9
						Lake Profundal	1.0	2.3	1.0	0.0	5.2
Clingers (%)	none	NO	0.419	ANOVA	-0.4	Lake Littoral	19.8	12.8	5.7	2.7	38.1
						Lake Profundal	14.6	4.9	2.2	9.5	20.2
Sprawlers (%)	square root	NO	0.217	ANOVA	0.6	Lake Littoral	72.6	13.9	6.2	55.7	92.9
						Lake Profundal	81.4	6.3	2.8	74.8	90.5
Burrowers (%)	log(X+1)	NO	0.125	ANOVA	-1.2	Lake Littoral	7.5	3.0	1.4	4.5	12.0
						Lake Profundal	3.9	3.7	1.7	0.0	8.0

[a] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Gray shading indicates statistically significant difference between habitat types based on p-value ≤ 0.10.

Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD, indicating that the difference was ecologically meaningful.

Table B.10: Benthic Invertebrate Community Metric Statistical Comparison Results among 2015, 2016, and 2017 Studies for Reference Lake 3 Littoral Station Data

Metric	Data Transform-ation	Overall 3-Year Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Yearss?	P-value	Study Year	Mean	Standard Deviation	Magnitude of Difference (SD)	Pairwise Comparison
Density (No. per m^2)	log	NO	0.3332	2015	1,278	888	-	a
				2016	2,390	1,396	1.3	a
				2017	1,489	850	0.2	a
Richness (No. of Taxa)	none	NO	0.9757	2015	12.6	4.1	-	a
				2016	12.2	1.1	-0.1	a
				2017	12.4	2.5	0.0	a
Simpson's Evenness	log	NO	0.4931	2015	0.865	0.052	-	a
				2016	0.758	0.189	-2.0	a
				2017	0.807	0.142	-1.1	a
Nemata (% of community)	modified probit	NO	0.7212	2015	8.1%	7.4%	-	a
				2016	4.0%	5.6%	-0.6	a
				2017	3.9%	3.3%	-0.6	a
Hydracarina (% of community)	none	NO	0.5870	2015	4.2%	2.7%	-	a
				2016	3.6%	2.0%	-0.2	a
				2017	5.3%	3.0%	0.4	a
Ostracoda (% of community)	modified probit	YES	0.0587	2015	20.9%	18.5%	-	a
				2016	46.9%	17.5%	1.4	b
				2017	38.8%	18.4%	1.0	a,b
Chironomidae (% of community)	none	NO	0.2208	2015	66.5%	18.9%	-	a
				2016	45.4%	18.8%	-1.1	a
				2017	51.8%	17.9%	-0.8	a
Metal Sensitive Chironomids (% of community)	none	NO	0.5767	2015	11.4%	12.6%	-	a
				2016	19.3%	8.3%	0.6	a
				2017	15.5%	13.4%	0.3	a
Collector-Gatherer FFG (% of community)	none	NO	0.7031	2015	81.4%	17.1%	-	a
				2016	75.0%	11.4%	-0.4	a
				2017	73.9%	16.0%	-0.4	a
Filterer FFG (% of community)	none	NO	0.8070	2015	11.4%	12.6%	-	a
				2016	16.1%	8.4%	0.4	a
				2017	14.7%	13.3%	0.3	a

(grey box) Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

(blue box) Blue shaded values indicate significant difference (p-value ≤ 0.10) that was also outside of a Critical Effect Size of ±2 SD from 2015 mean data, indicating that the difference relative to 2015 was ecologically meaningful.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

B7 FISH POPULATION

B7.1 Lotic Environments

Fish population sampling of lotic habitats is not required as part of the Mary River Project CREMP (see NSC 2014). In part, this reflects the fact that fish can only inhabit LSA creeks/rivers for a short period each year (i.e., July – September) as a result of complete freezing/desiccation of these lotic habitats over much of the year, and because sampling of juvenile arctic charr within a representative lotic habitat is conducted for the federal Environmental Effects Monitoring (EEM) program to meet Metal Mining Effluent Regulation requirements (Baffinland 2014; Minnow 2018).

B7.2 Lentic Environments (Reference Lake 3)

The Reference Lake 3 fish community was composed of arctic charr and ninespine stickleback. As in 2015 and 2016, the relative abundance of both species appeared to be low at Reference Lake 3 based on low electrofishing and gill netting catches and catch-per-unit-effort (CPUE) for each species in 2017 (Appendix Tables G.1 and G.2). Suitable numbers of arctic charr were captured at nearshore habitat of Reference Lake 3 (i.e., 100 individuals) to allow evaluation of mine-related effects on survival, growth and condition of fish collected at the mine-exposed lake shorelines. For these fish, young-of-the-year (YOY) individuals were generally distinguishable from the 1+ to 5+ age classes at a fork length of 5.0 cm based on the evaluation of length-frequency distributions coupled with supporting age determinations (Appendix Figure B.8). In 2015, YOY arctic charr captured at nearshore habitat were not able to be distinguished from older age classes at Reference Lake 3 (Appendix Figure B.8). However, population comparisons of nearshore arctic charr captured between the mine-exposed and reference lakes in 2016 and 2017 were completed separately for YOY and non-YOY data sets. Temporal comparisons of the 2015, 2016, and 2017 nearshore arctic charr data did indicated significantly larger sized fish were sampled in 2016 compared to both 2015 and 2017 at the reference lake, but the differences in endpoints of fork length and fresh body weight were not outside of accepted CES_G of ±25% (Appendix Table B.11). Similarly, although condition of nearshore arctic charr differed significantly among the 2015, 2016, and 2017 studies at Reference Lake 3, a high degree of overlap in data points suggested that the differences between individual years were not ecologically meaningful (Appendix Figure B.9). This indicated that some year-to-year differences in fish population endpoints can be expected naturally, but because the differences between years were within established CES, the fish population survey CES were relevant to, and can be suitably applied, to the Mary River Project CREMP.

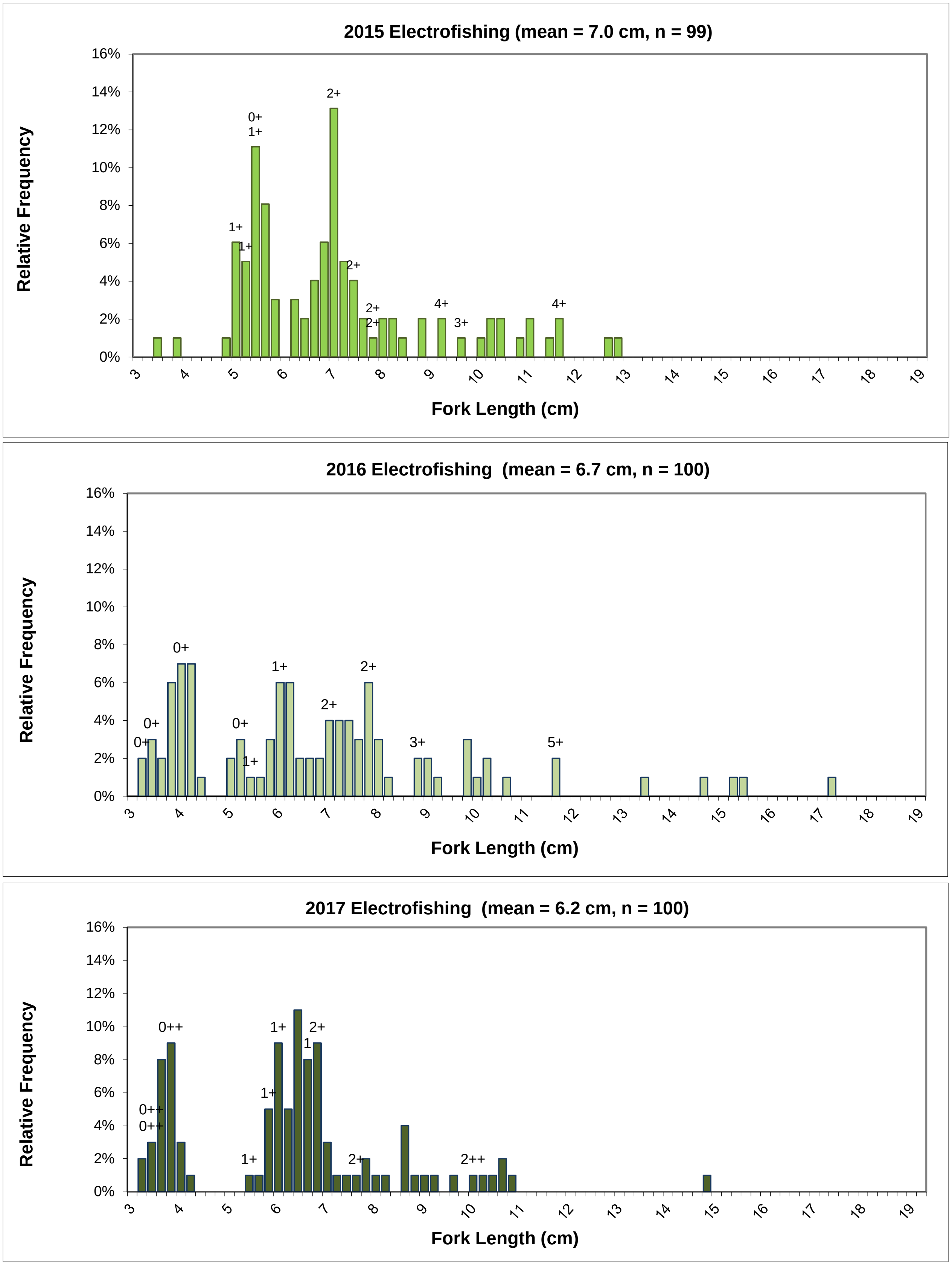


Figure B.8: Length-frequency Distributions for Arctic Charr Captured by Backpack Electrofishing and Gill Netting at Reference Lake 3 (REF3) in August 2015, 2016, and 2017, Mary River Project CREMP

Note: Fish ages are shown above the bars, where available.

Table B.11: Statistical Comparisons For Length, Weight and Condition Endpoints For Arctic Charr, Mary River Project CREMP

Endpoint	Variables		Sample Size			Test	Model Statistics			Summary Statistics[b]				Test P-value (Year)	Post-hoc Contrasts P-value and Magnitude of Difference (%)[c]					
							Interaction Model	Parallel Slope Model							2016 (vs 2015)		2017 (vs 2016)		2017 (vs 2015)	
	Response	Covariate	2015	2016	2017		Interaction P-value	Covariate P-value	Covariate Value for Comparisons[a]	Statistic	2015	2016	2017		P-value	MOD (%)	P-value	MOD (%)	P-value	MOD (%)
Length	Fork Length (cm)	-	97	68	74	K-W	-	-	-	Median	6.80	7.30	6.60	0.018	0.006	7.4	0.038	-10	0.564	-2.9
Weight	Weight (g)	-	97	68	74	K-W	-	-	-	Median	2.68	3.34	2.49	0.023	0.007	25	0.051	-26	0.522	-7.3
Condition	log[Weight (g)]	log[Fork Length (cm)]	97	68	74	ANCOVA	0.029	<0.001	-	-	-	-	-	-	-	-	-	-	-	-
			97	67[d]	73[d]	ANCOVA	0.035	<0.001	5.30	Predicted Mean	1.26	1.26	1.29	0.065	-	-0.089	-	2.3	-	2.2
									12.6		17.2	18.3	10.4			6.3		-43		-40

[Shaded] Area P-value < 0.1 or Interaction P-value < 0.05

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

[b] The median and adjusted mean are reported for Kruskal-Wallis and ANCOVA, respectively, and the predicted means of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., different slopes) occurs.

[c] The magnitude of difference calculated as: [(year mean - earlier year mean) /earlier year mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(year predicted mean - earlier year predicted mean) / earlier year predicted mean] x 100.

[d] Two fish (REF316-ACJ-58 & REF317-ACJ-56) were identified as statiscal outliers (studentized residuals = -4.06 [2016] & 4.12 [2017]) and were removed from the analysis

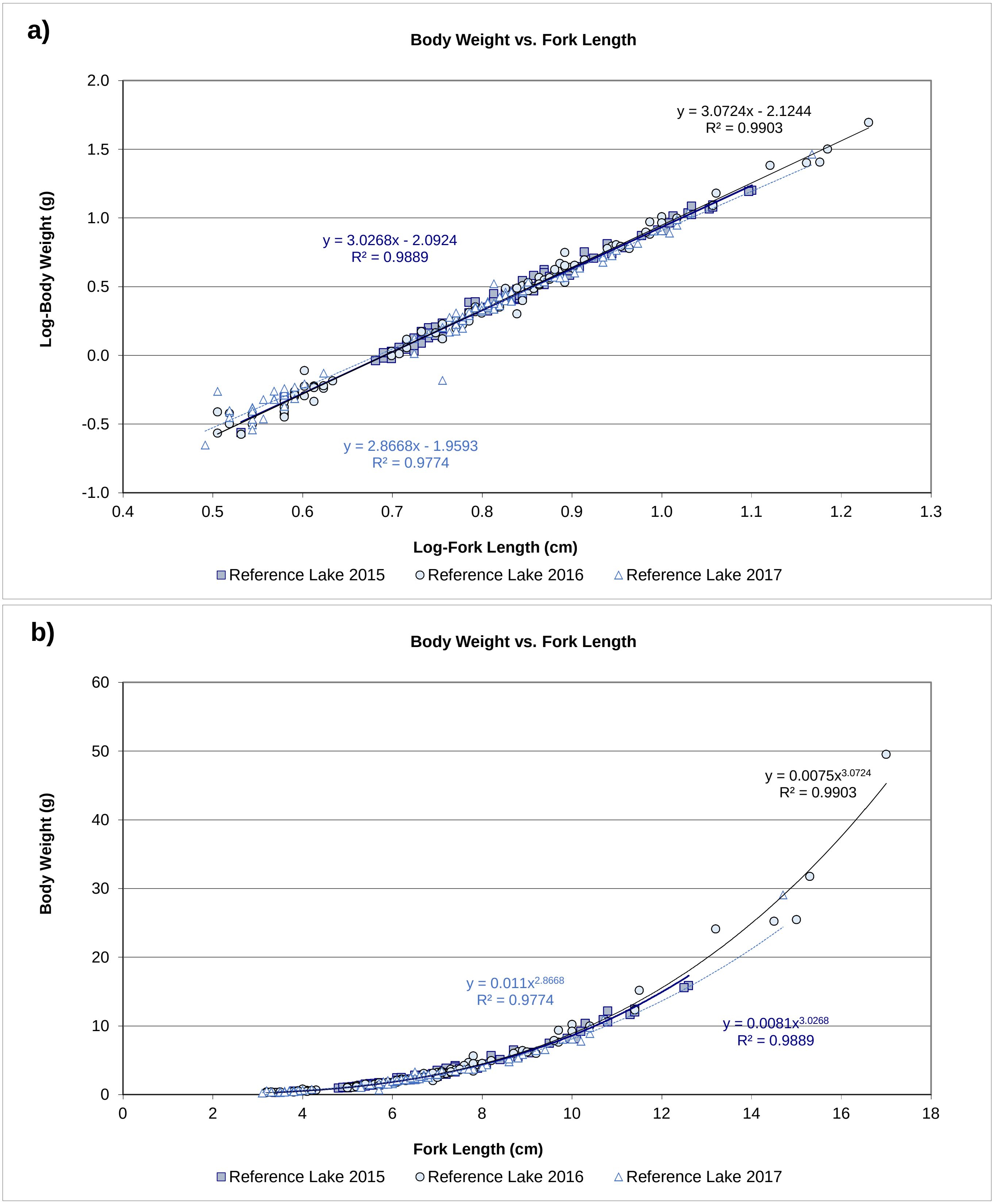


Figure B.9: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Reference Lake 3 in August 2015, 2016, and 2017 using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP

Very low numbers of arctic charr were captured at littoral/profundal areas of Reference Lake 3 in 2017 (i.e., 1 individual) despite application of similar fishing effort to that used at the mine-exposed study lakes (Appendix Table G.2). Due to the small sample size, no meaningful evaluation of mine-related effects on the population of reproductive-aged arctic charr was possible using data from the mine-exposed lakes and Reference Lake 3 in 2017. Because arctic charr can show differential growth rates between the sexes (females grow faster; Jonsson et al. 1999; Skulason et al. 1996; Gulseth and Nilssen 2001), natural differences in sex ratios between study areas could potentially result in falsely attributing differences in growth and/or condition between mine-exposed and reference areas to mine-related influences. Thus, the inability to definitively determine arctic charr sex using external characteristics when applying a non-lethal sampling approach could confound data interpretation. To determine whether differences in sex ratios could potentially confound the interpretation of the CREMP arctic charr health assessment, growth and condition were compared between male and female Arctic charr collected at Camp, Sheardown and Mary lakes during the baseline period as part of the 2015 CREMP (Minnow 2016a). No significant differences in growth and condition were indicated between males and females based on this analysis, suggesting that a non-lethal study approach is unlikely to bias the evaluation of mine-related effects on fish health as part of the CREMP. Contrary to the published literature, the absence of any differences in arctic charr growth and condition between males and females at Mary River Project LSA lakes may be explained by naturally slow growth rates and low spawning frequency (i.e., once every 2 – 4 years) at high Arctic areas, and also by low gonadosomatic index (GSI) at the time that sampling is normally conducted for the Mary River Project CREMP (i.e., August).

B8 CREMP IMPLICATIONS

This overview of reference conditions was included in the 2016 and 2017 CREMP to provide context and perspective regarding key chemical, physical and biological features of the CREMP reference study areas. Key implications of reference area features affecting the CREMP the evaluation of potential mine-related effects at mine-exposed waterbodies that were identified through this reference area overview in 2016 and/or 2017 include the following:

- Federal Water Quality Guidelines (WQG) not applicable for aqueous phenol concentrations. Aqueous concentrations of phenols were routinely elevated above WQG at the CREMP creek, river and lake reference stations in 2015 and 2016. Correlation analysis indicated a significant, positive relationship between phenol and both nitrate and DOC concentrations in the 2015 and 2016 CREMP, suggesting that high phenol concentrations in waterbodies near the Mary River Project mine were associated with influences from natural organic composition. Therefore, phenol concentration comparisons against applicable WQG did not serve as a focus for discussion as part of the 2016 and 2017 CREMP.

- Greater reliance on the use of dissolved metals concentrations for assessing mine-related influences on aqueous metal concentrations at waterbodies used for the CREMP. Total aluminum concentrations were routinely elevated, and other metals including (total) iron and manganese periodically elevated, above WQG at creek, river and/or lake reference areas used for the CREMP in 2015, 2016, 2017, and historically in baseline studies. Significant positive correlations between total concentrations of these metals and turbidity were identified using the 2015, 2016, and 2017 data sets which suggested that these metals were likely bound to and/or composed suspended particulate materials in water samples. This was supported by a low ratio of dissolved to total metal concentrations for the reference water samples in 2015, 2016 and 2017. Accordingly, greater emphasis was placed on comparison of dissolved metal concentrations for assessing potential mine-related influences on water quality for the 2016 and 2017 CREMP studies.

- Use of fall sampling event water quality data to allow the most conservative evaluation of potential mine-related influences on water chemistry. Water chemistry at lotic reference stations showed distinct seasonal changes in parameter concentrations during the baseline, 2015, 2016, and 2017 studies. In general, conventional parameters, ions and total metals were observed at lowest concentrations in spring, with intermediate concentrations in the summer and highest concentrations observed during the fall in each year. Therefore, although water chemistry data from winter, spring and summer sampling events were examined, the fall water chemistry data generally served as the focus for the evaluation of potential mine-related influences on water quality at the mine-exposed lakes in 2016 and 2017.

- Use of average water chemistry and chlorophyll-a data for lake water quality/phytoplankton monitoring stations. No consistent differences in water chemistry or chlorophyll-a concentrations were observed between the surface and bottom of the water column at Reference Lake 3 stations in 2015, 2016, or 2017. Therefore, the evaluation of water chemistry and phytoplankton productivity among stations and study areas for the 2016 and 2017 Mary River Project CREMP was based on average water chemistry and chlorophyll-a values, respectively, from the water column surface and bottom for each lake station.

- Consider updating of the AEMP sediment quality benchmarks. Arsenic, chromium, copper, iron, manganese, and phosphorus in have been observed at concentrations above the AEMP sediment quality benchmarks in sediment at Reference Lake 3 in the 2015, 2016, and/or 2017 CREMP studies. This suggested that the AEMP benchmarks for these metals may be overly conservative and therefore, to improve the applicability of the AEMP benchmarks for these metals, consideration should be given to incorporating reference lake data into derivation of updated sediment benchmarks.

- Focus lake benthic invertebrate community survey on littoral zone. Benthic invertebrate community data collected at Reference Lake 3 in 2015, 2016, and 2017 indicated that, similar to most lakes, benthic invertebrate community features can be expected to naturally change with depth. In general, as depth increases, lower benthic invertebrate density and richness typically occurs. The occurrence of naturally low density and/or richness can, in turn, limit the ability to distinguish adverse effects associated with a project. Therefore, in order to maximize the confidence in the benthic invertebrate community analysis results, the littoral zone should serve as the focus for the lake benthic invertebrate community survey analysis for the CREMP.

- Adopting of standard CES for benthic invertebrate community and fish population endpoints into the CREMP. Year-to-year evaluation of reference creek and lake habitat used for the CREMP has indicated that benthic invertebrate and fish populations differences between years can be expected to vary within the CES set out for use under the federal EEM program (Munkittrick et al. 2009). Therefore, the use of established CES for defining effects appears to be applicable to the Mary River Project CREMP.

B9 REFERENCES

Baffinland (Baffinland Iron Mines Corporation). 2014. Mary River Project Aquatic Effects Monitoring Plan. Document No. BAF-PH1-830-P16-0039. Rev 0. June 27, 2014.

BCMOE. 2017. British Columbia Approved Water Quality Guidelines. http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines Accessed December 2017.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg, MB. With Updates to 2017.

CCME. 2017. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg. http://www.ccme.ca/publications/ceqg_rcqe.html Accessed December 2017.

Craig, P.C. and P.J. McCart. 1975. Classification of stream types in Beaufort Sea drainages between Prudhoe Bay, Alaska, and the McKenzie Delta, N.W.T., Canada. Arctic and Alpine Research. 7 : 183 – 198.

Dodds, W.K., J.R. Jones and E.B. Welch. 1998. Suggested classification of stream trophic state: distributions of temperate stream types by chlorophyll, total nitrogen, and phosphorus. Water Resources 12 : 1455 – 1462.

Gulseth, O.A. and K.J. Nilssen. 2001. Life-History Traits of Charr, *Salvelinus alpines*, from a High Arctic Watercourse on Svalbard. Arctic 54:1-11.

Huryn, A.D. and J.B. Wallace. 2000. Life history and production of stream insects. Annual Review of Entomology 45: 83 – 110.

Jonsson, B., S. Skulason, S.S. Snorrason, O.T. Sandlund, H.J. Malmquist, P.M. Jonasson, R. Gydemo and T. Lindem. 1988. Life History Variation of Polymorphic Arctic Charr (*Salvelinus alpinus*) in Thingvallavatn, Iceland. Can. J. Fish Aquat. Sci. 45:1537-1547.

KP (Knight Piesold Ltd.) 2014a. Baffinland Iron Mines Corporation – Mary River Project – Water and Sediment Quality Review and CREMP Monitoring Report. KP Ref. No. NB102-181/33-1. June 25, 2014.

KP 2014b. Baffinland Iron Mines Corporation – Mary River Project – Detailed Review of Baseline Stream Water Quality. KP Ref. No. NB102-181/33-1C. May 30, 2014.

KP 2015. Baffinland Iron Mines Corporation – Mary River Project – 2014 Water and Sediment CREMP Monitoring Report. KP Ref. No. NB102-181/34-6. March 19, 2015.

Minnow (Minnow Environmental Inc.). 2016a. Mary River Project 2015 Core Receiving Environment Monitoring Program Report. Prepared for Baffinland Iron Mines Corp. March 2016.

Minnow. 2016b. Mary River Project CREMP Recommendations for Future Monitoring. Letter report to Jim Millard, Baffinland Iron Mines Corp. March 17, 2016.

Minnow. 2017. Mary River Project 2016 Core Receiving Environment Monitoring Program Report. Prepared for Baffinland Iron Mines Corp. March 2017.

Minnow. 2018. Mary River Project Phase 1 Environmental Effects Monitoring (2017) Interpretive Report. Prepared for Baffinland Iron Mines Corp. January 2018.

Munkittrick, K.R., C.J. Arens, R.B. Lowell and G.P. Kaminski. 2009. A review of potential methods of determining critical effect size for designing environmental monitoring programs. Environmental Toxicology and Chemistry 8: 1361 – 1371.

NSC (North/South Consultants Inc.). 2014. Mary River Project – Core Receiving Environment Monitoring Program: Freshwater Biota. Report prepared for Baffinland Iron Mines Corporation. June 2014.

OMOE (Ontario Ministry of Environment). 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. August 1993, Reprinted October, 1996.

OMOEE (Ontario Ministry of Environment and Energy). 1994. Water Management: Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. July, 1994. Reprinted February 1999.

Skulason, S., S.S. Snorrason, D.L.G. Noakes and M.M. Ferguson. 1996. Genetic Basis of Life History Variations Among Sympatric Morphs of Arctic Char, *Salvelinus alpines*. Can. J. Fish Aquat. Sci. 53:1807-1813

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Third Edition. Academic Press. San Diego, CA, USA. 1006 pp.

APPENDIX C

WATER QUALITY DATA

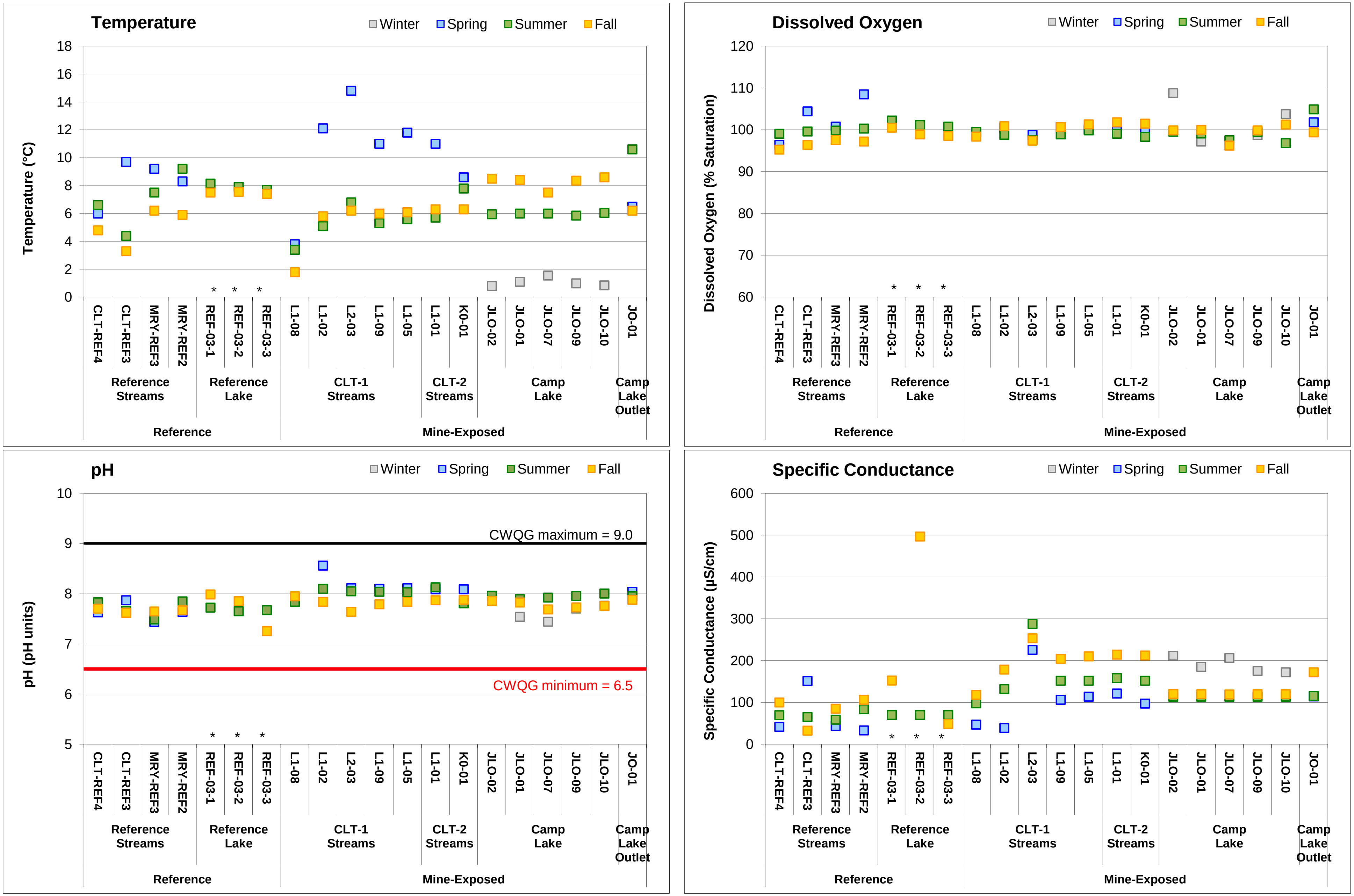


Figure C.1: Comparison of *In Situ* Water Quality Variables Measured at Camp Lake System Water Quality Monitoring Stations in Winter, Spring, Summer, and Fall 2017, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom *in situ* water quality measurements. Streams were not sampled in winter. Lakes were not sampled in spring.
* Reference Lake 3 (REF-03) was not sampled in winter.

Figure C.2: Temporal Comparison of Water Chemistry at Camp Lake Tributary 1 (CLT-1) and Tributary 2 (CLT-2) for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015 - 2017) Periods During Fall

Notes: Values represent mean ± SD. Lotic reference stations include the CLT-REF and MRY-REF series (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Camp Lake Tributaries.

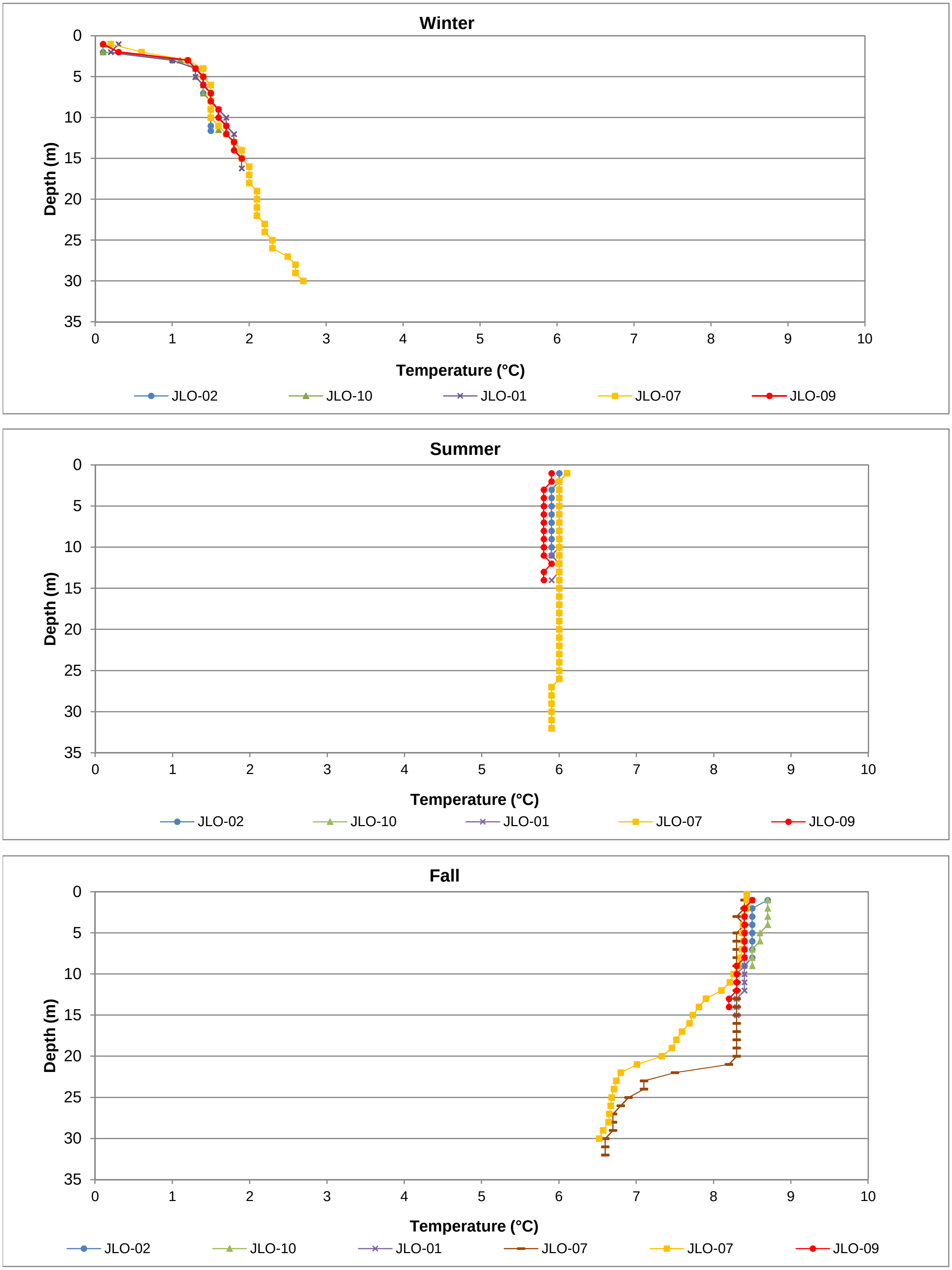


Figure C.3: Vertical Profiles of Temperature Measured at Camp Lake in Winter, Summer, and Fall, 2017

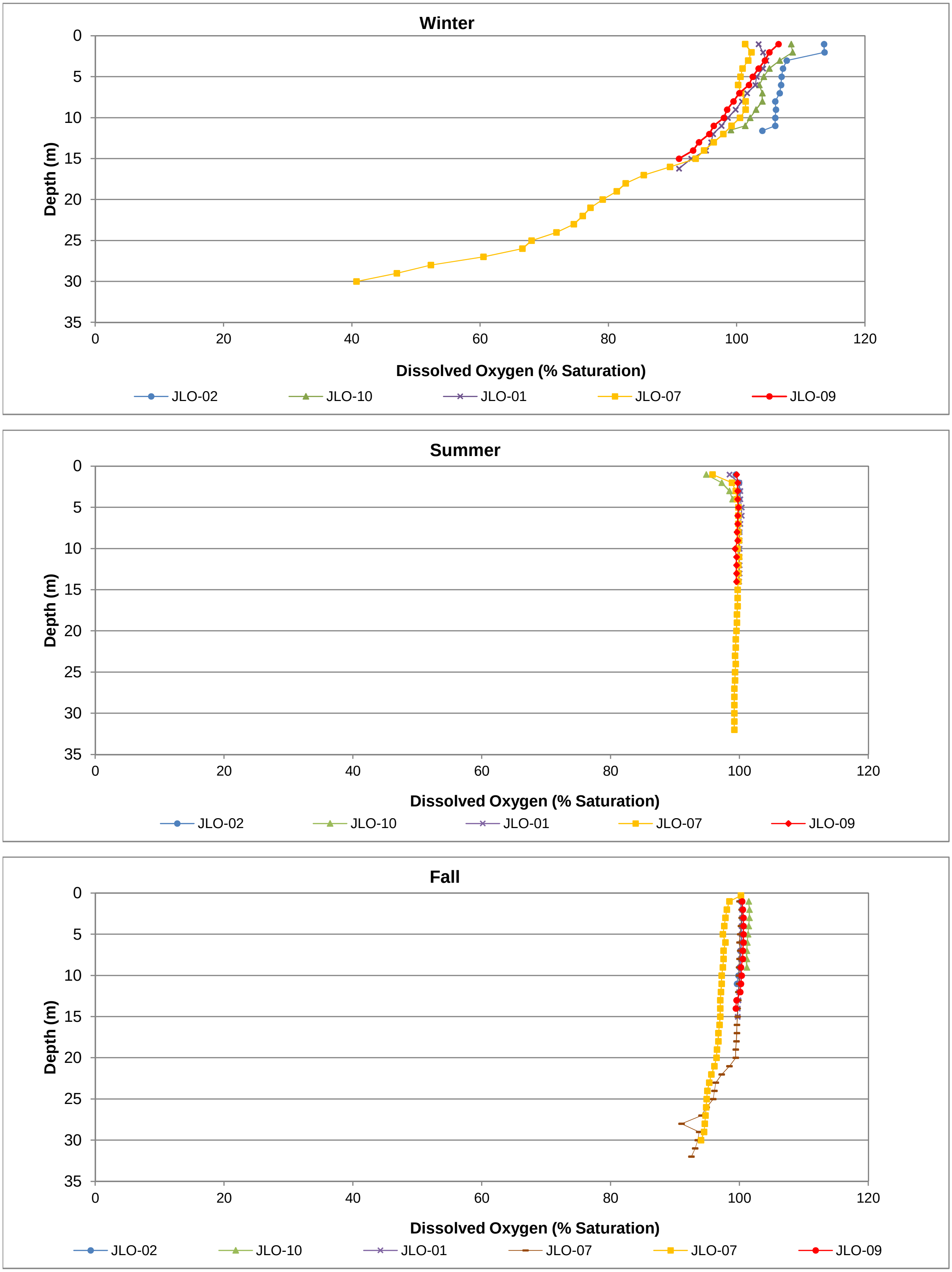


Figure C.4: Vertical Profiles of Dissolved Oxygen Measured at Camp Lake in Winter, Summer, and Fall, 2017

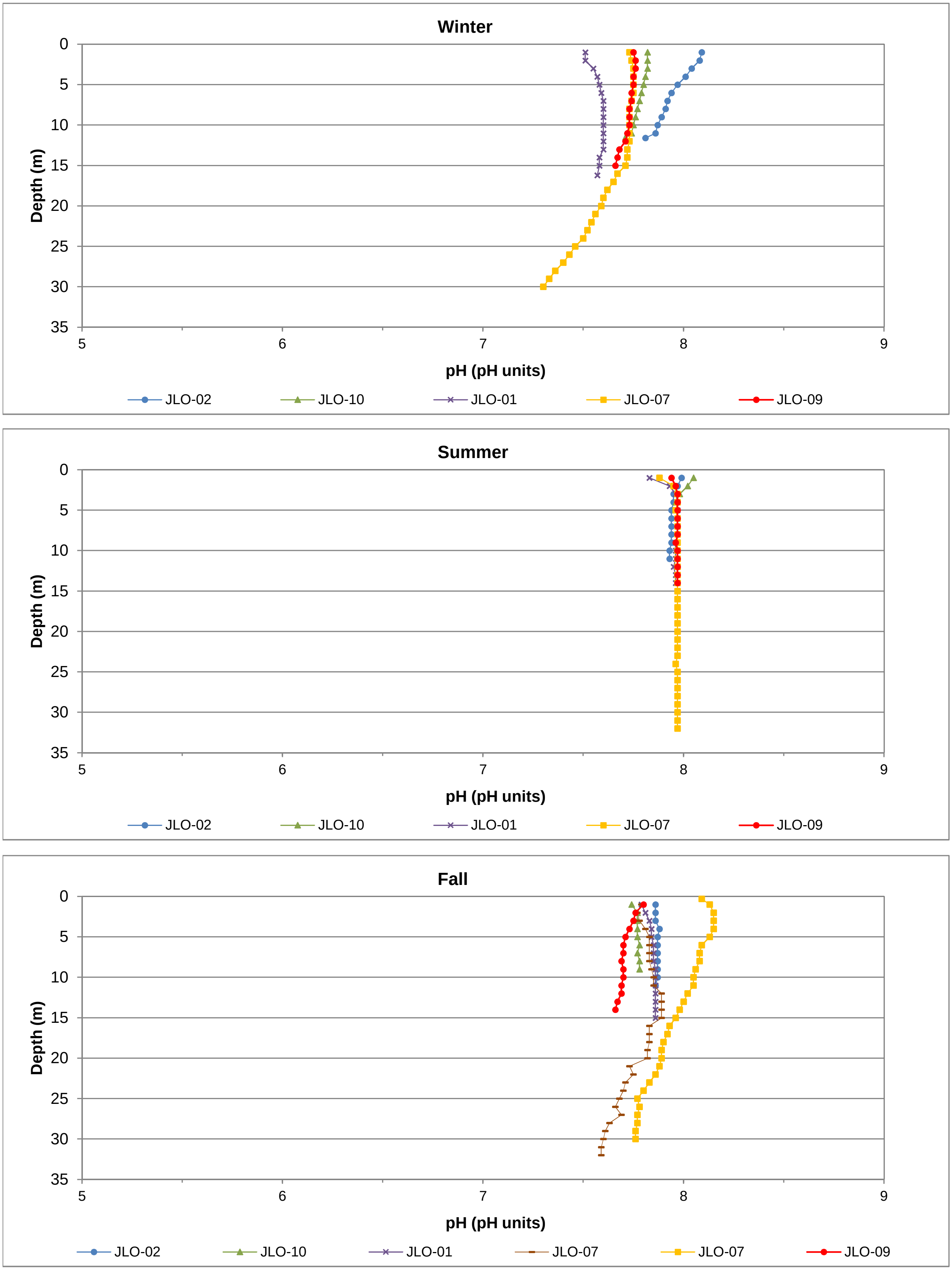


Figure C.5: Vertical Profiles of pH Measured at Camp Lake in Winter, Summer, and Fall, 2017

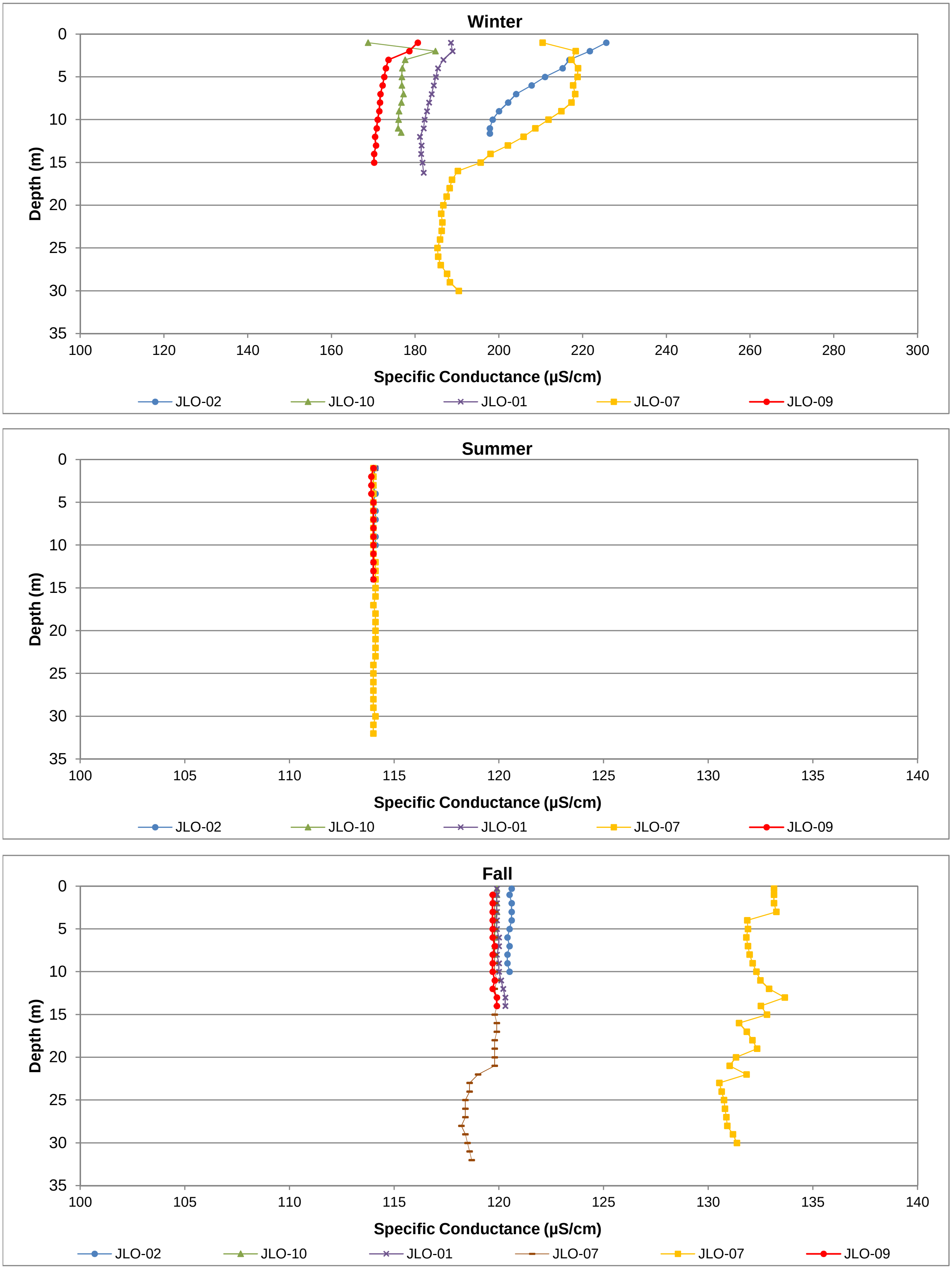


Figure C.6: Vertical Profiles of Specific Conductance Measured at Camp Lake in Winter, Summer, and Fall, 2017

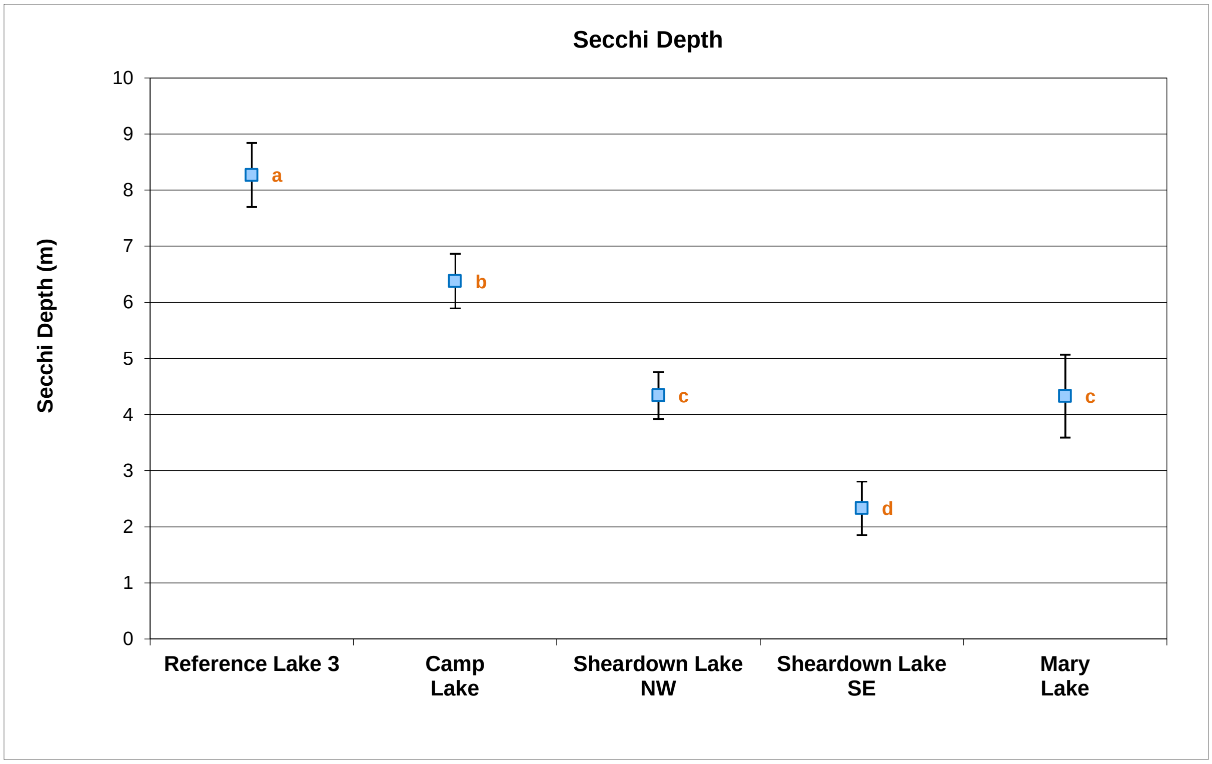


Figure C.7: Comparison of Secchi Depth (mean ± SD) Measured at the Mary River Project Lake Benthic Invertebrate Community Stations (n = 10 for each lake), August 2017

Note: The same letter(s) next to study area data points indicate no significant difference between study areas.

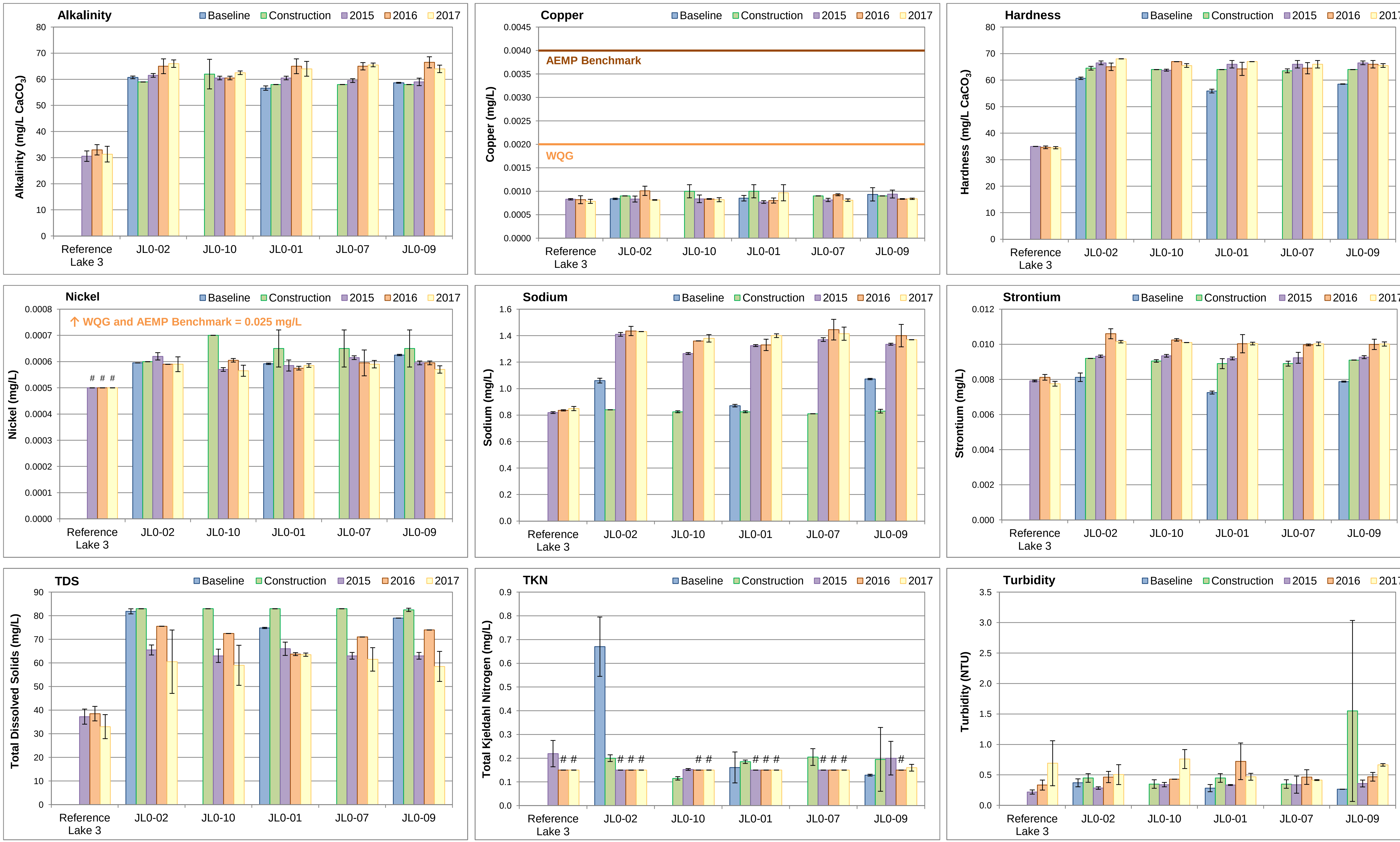


Figure C.8: Temporal Comparison of Water Chemistry at Camp Lake (JLO) for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015, 2016) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Camp Lake.

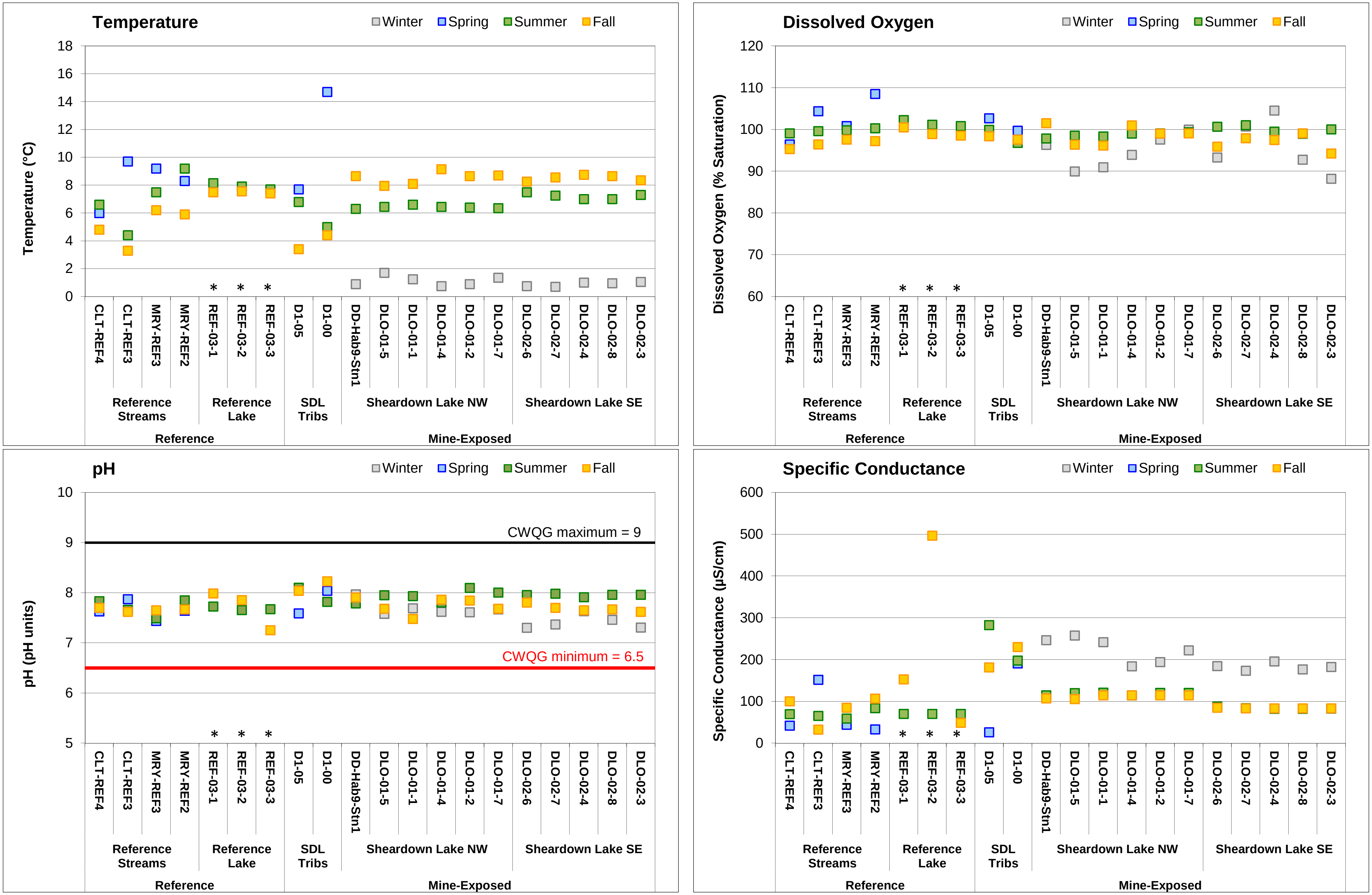


Figure C.9: Comparison of *In Situ* Water Quality Variables Measured at Sheardown Lake System Water Quality Monitoring Stations in Winter, Spring, Summer, and Fall 2017, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom *in situ* water quality measurements. Streams were not sampled in winter. Lakes were not sampled in spring.

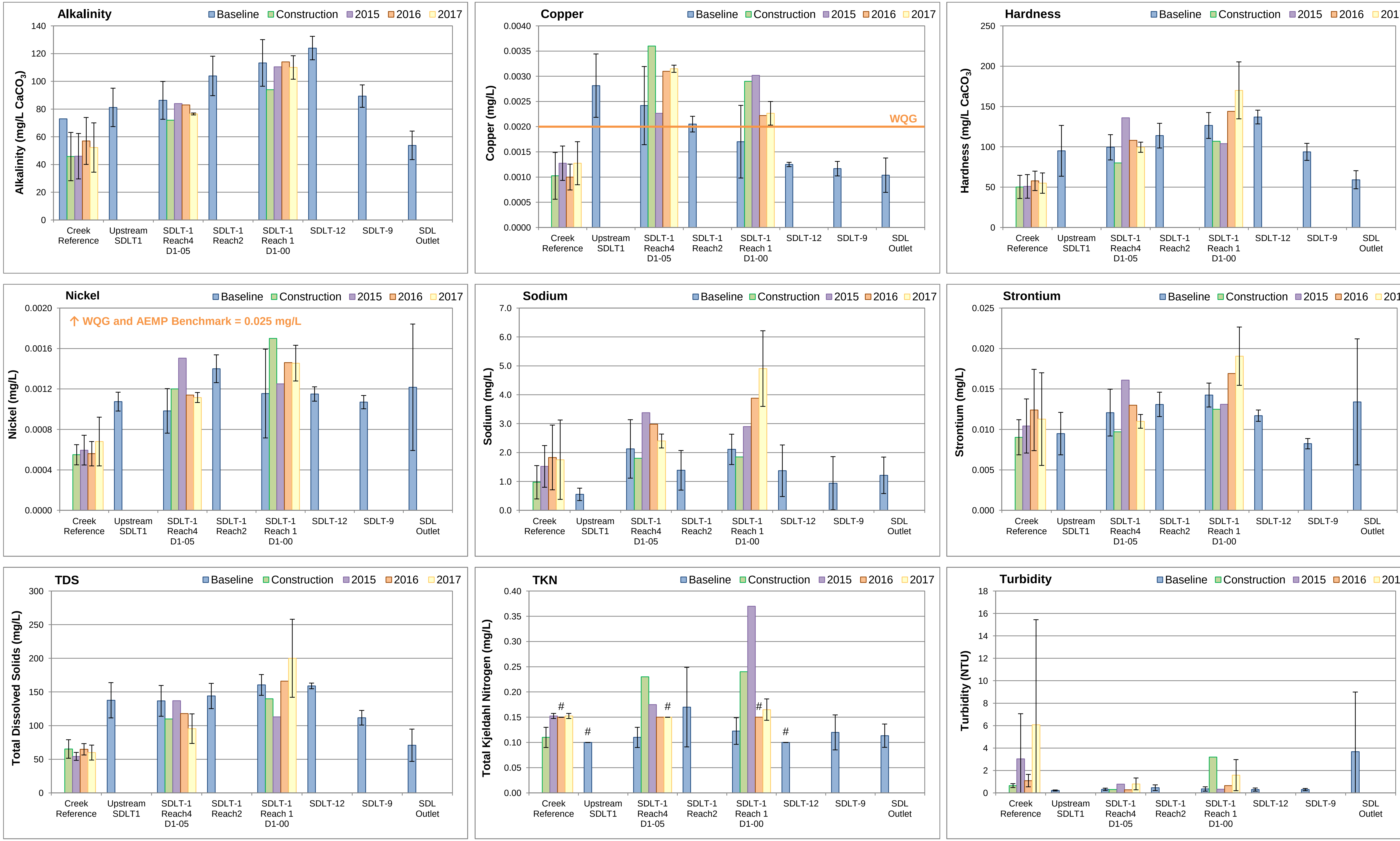


Figure C.10: Temporal Comparison of Water Chemistry at Sheardown Lake Tributaries (SDLT) for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015, 2016, and 2017) Periods during Fall

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to the Sheardown Lake Tributaries.

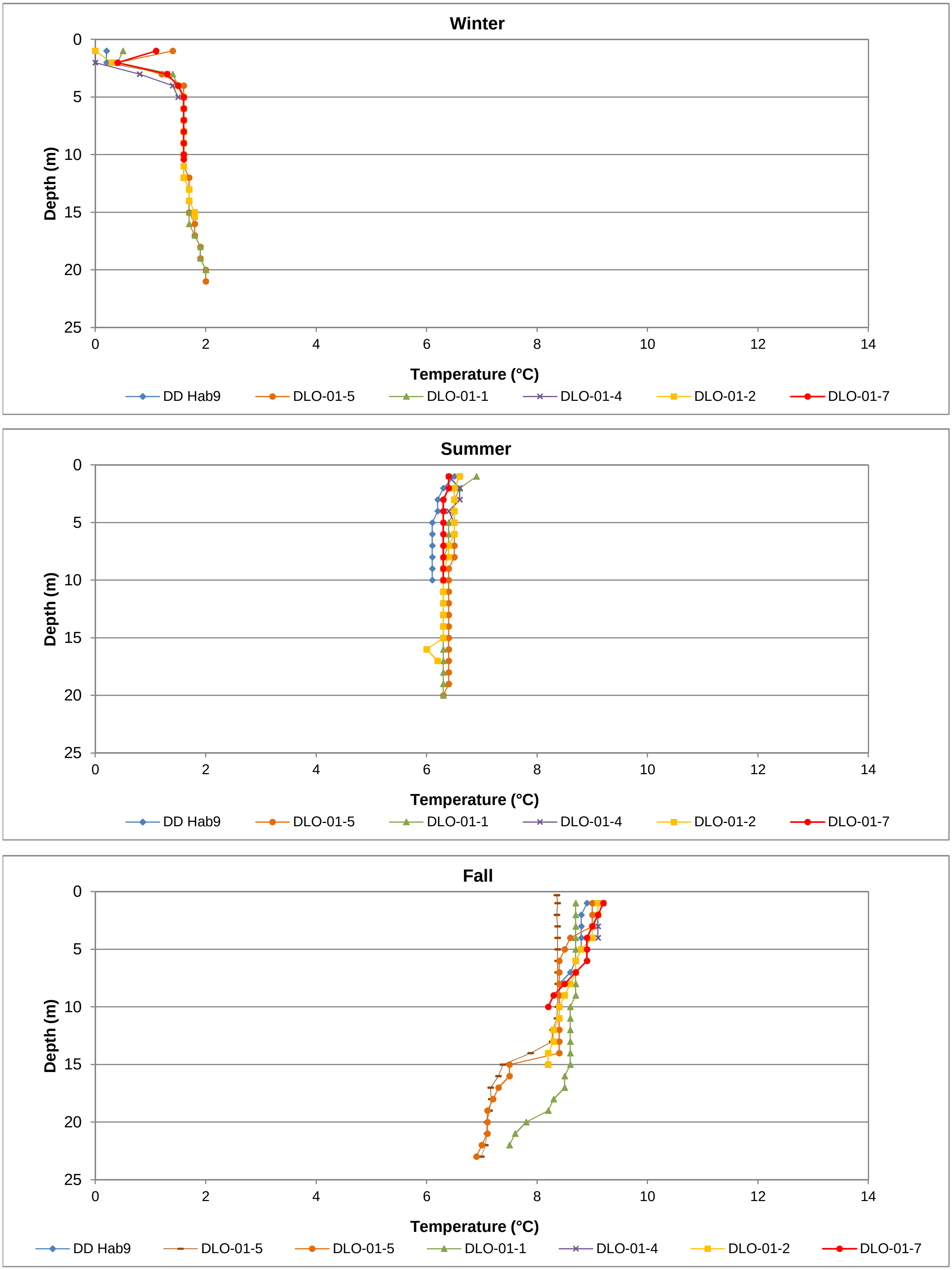


Figure C.11: Vertical Profiles of Temperature Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2017

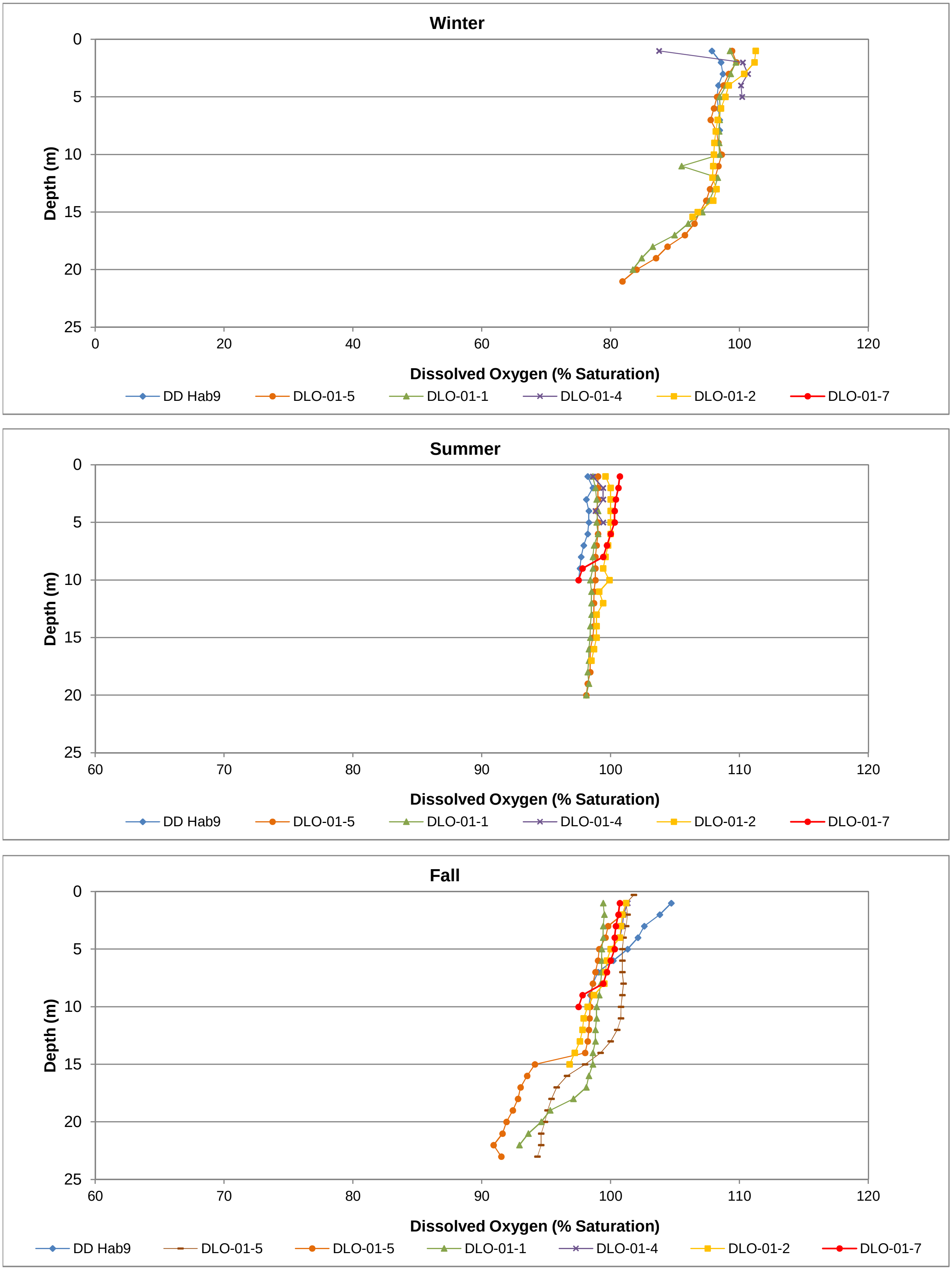


Figure C.12: Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2017

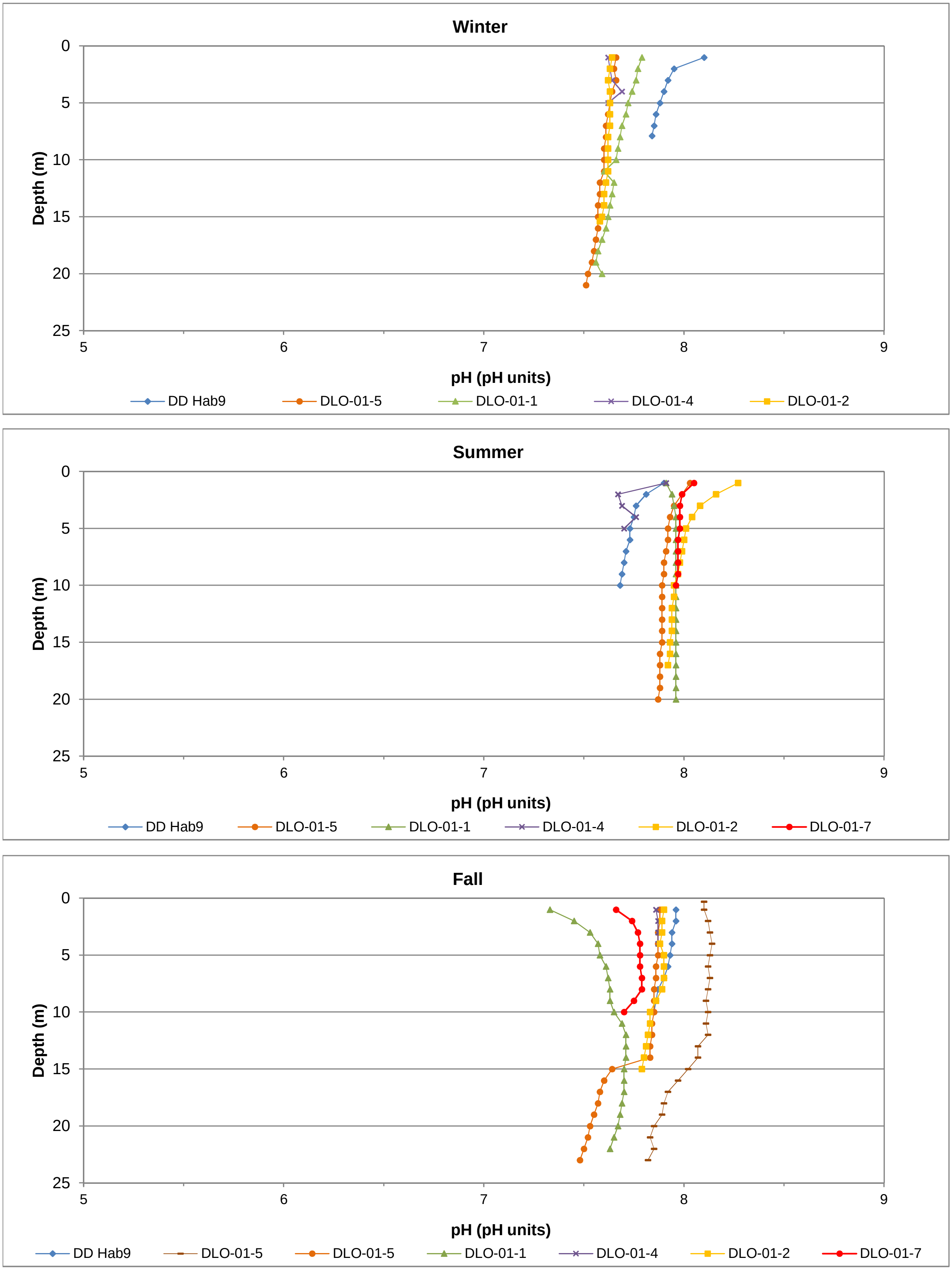


Figure C.13: Vertical Profiles of pH Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2017

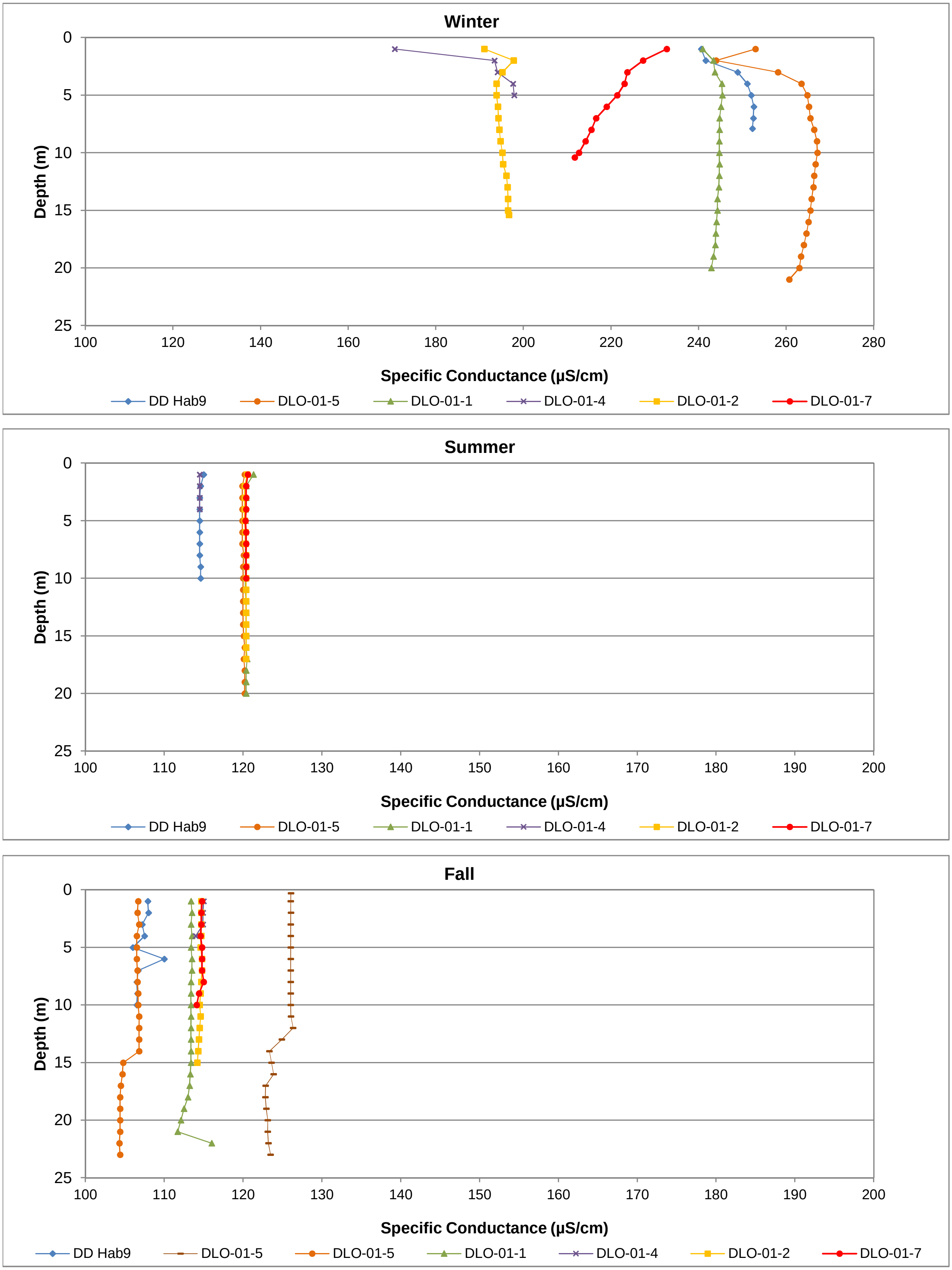
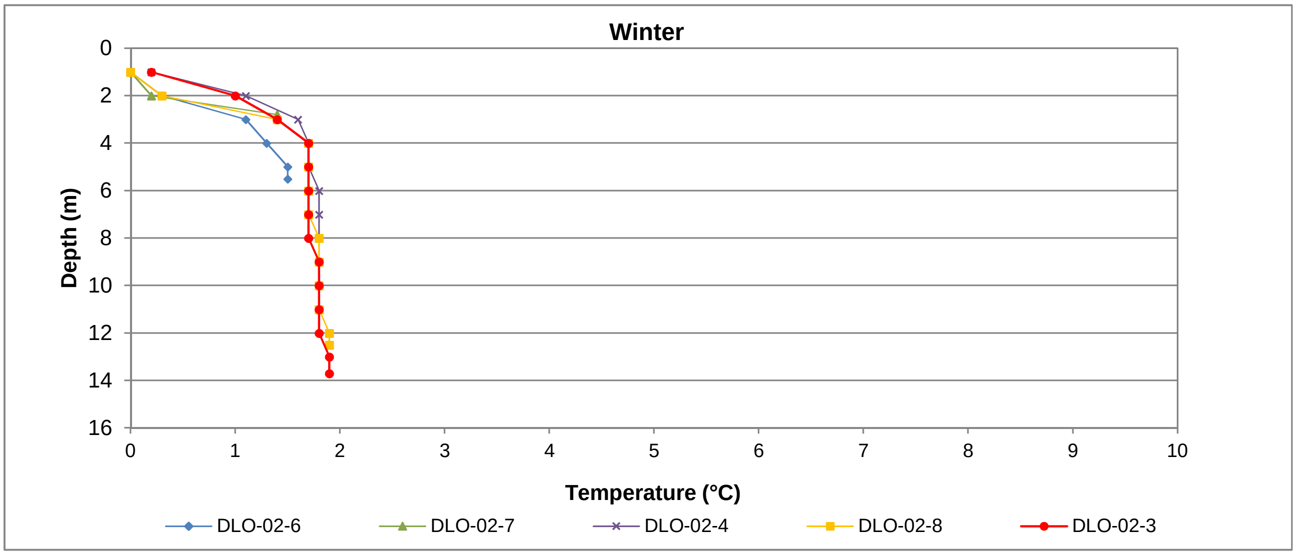
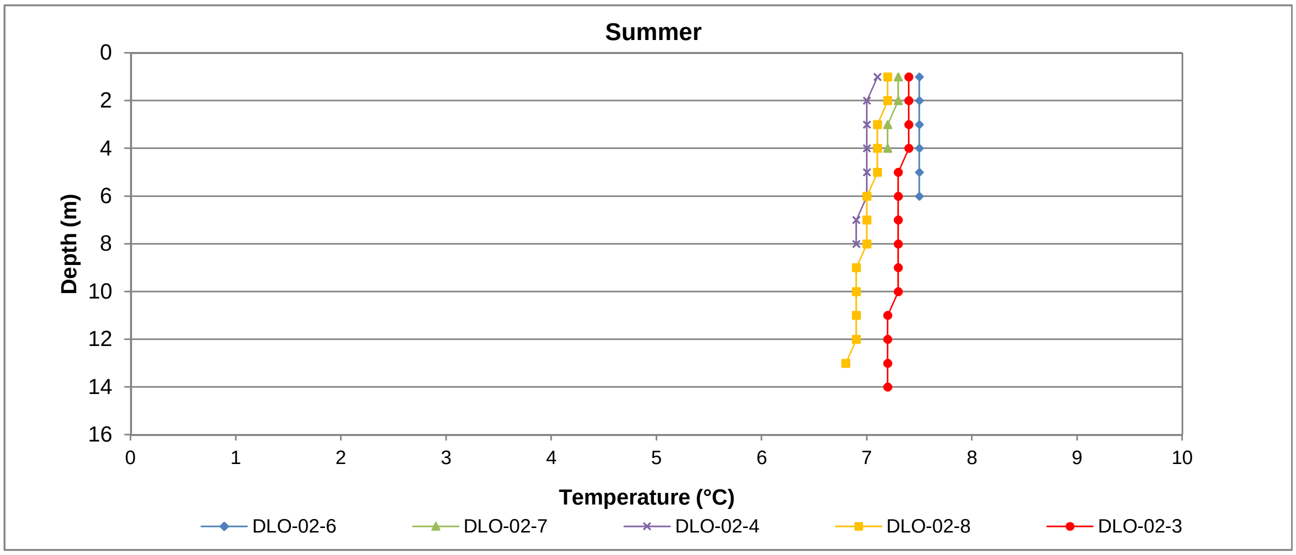


Figure C.14: Vertical Profiles of Specific Conductance Measured at Sheardown Lake NW in Winter, Summer, and Fall, 2017





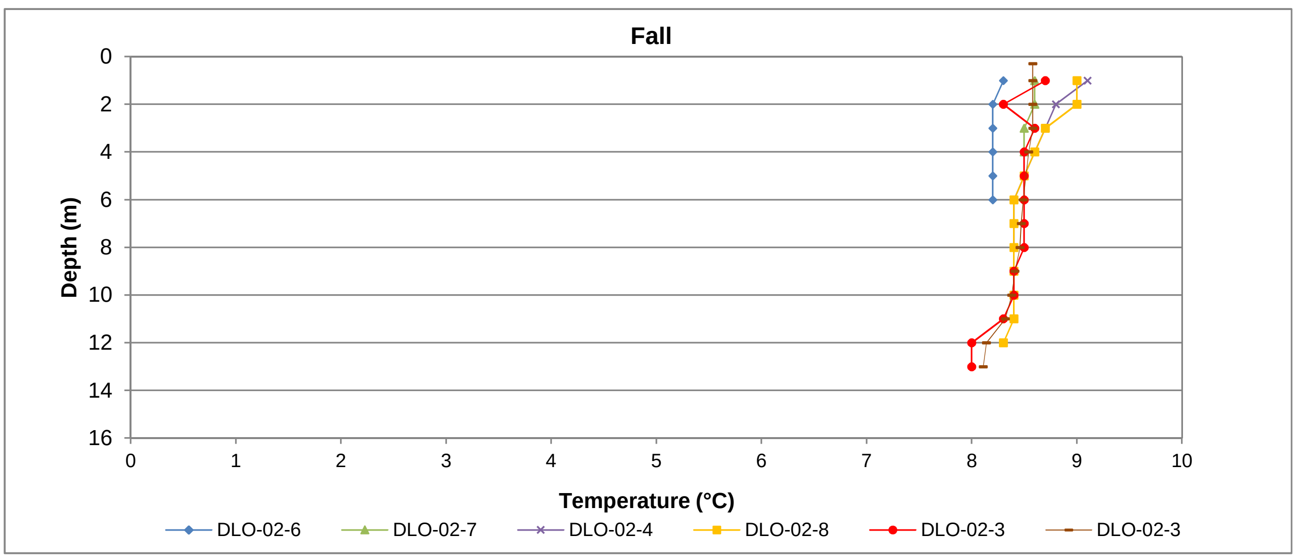


Figure C.15: Vertical Profiles of Temperature Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2017

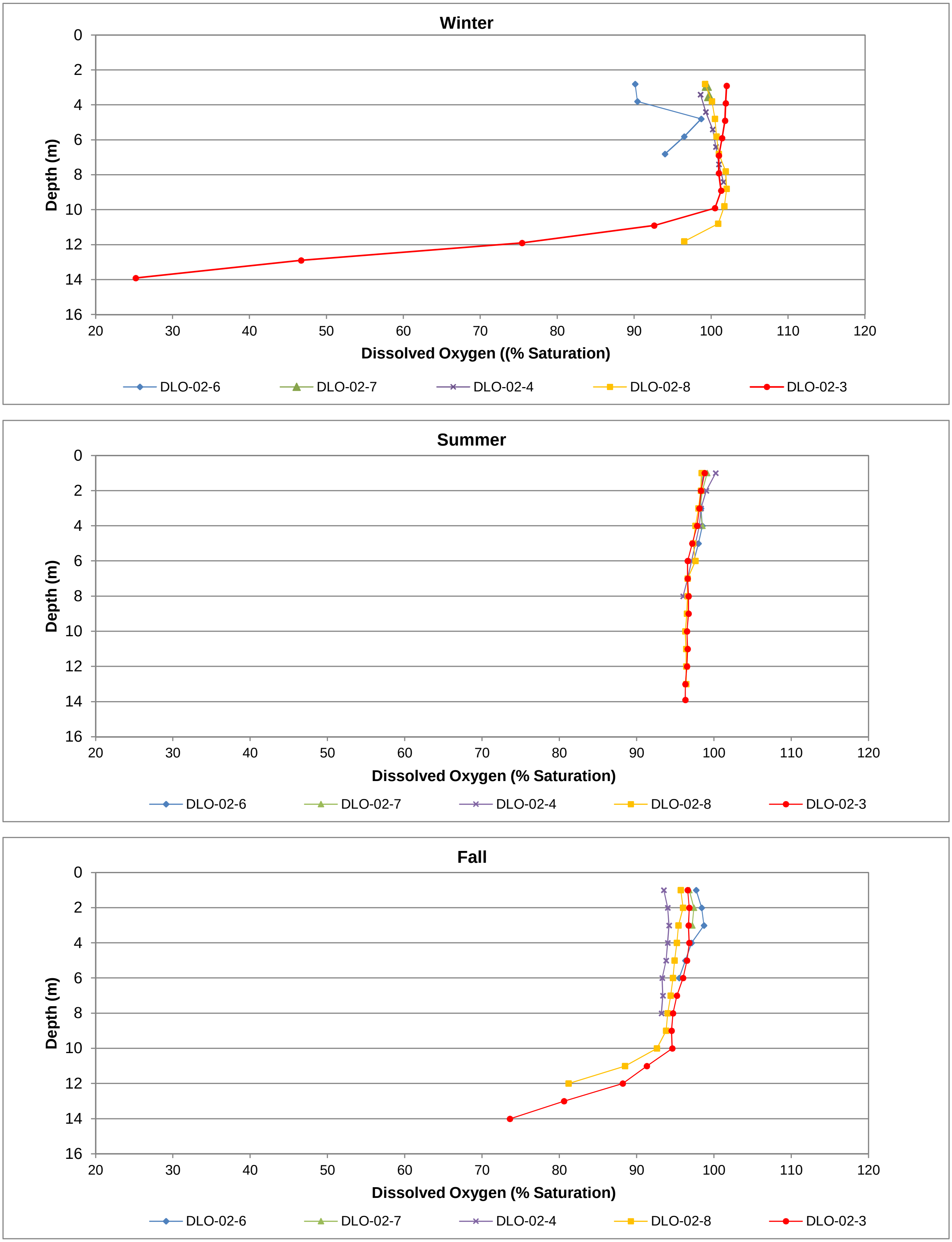


Figure C.16: Vertical Profiles of Dissolved Oxygen Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2017

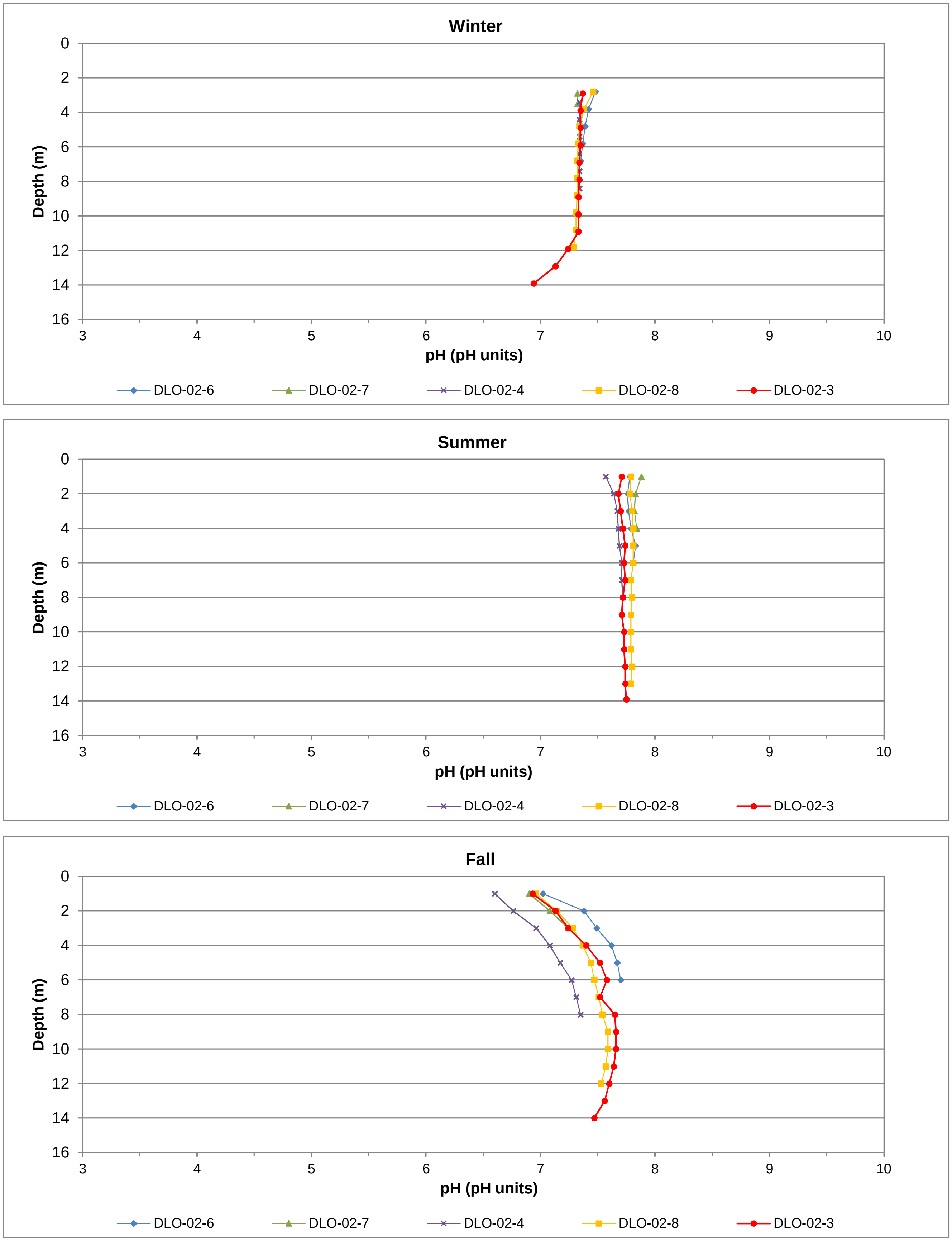


Figure C.17: Vertical Profiles of pH Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2017

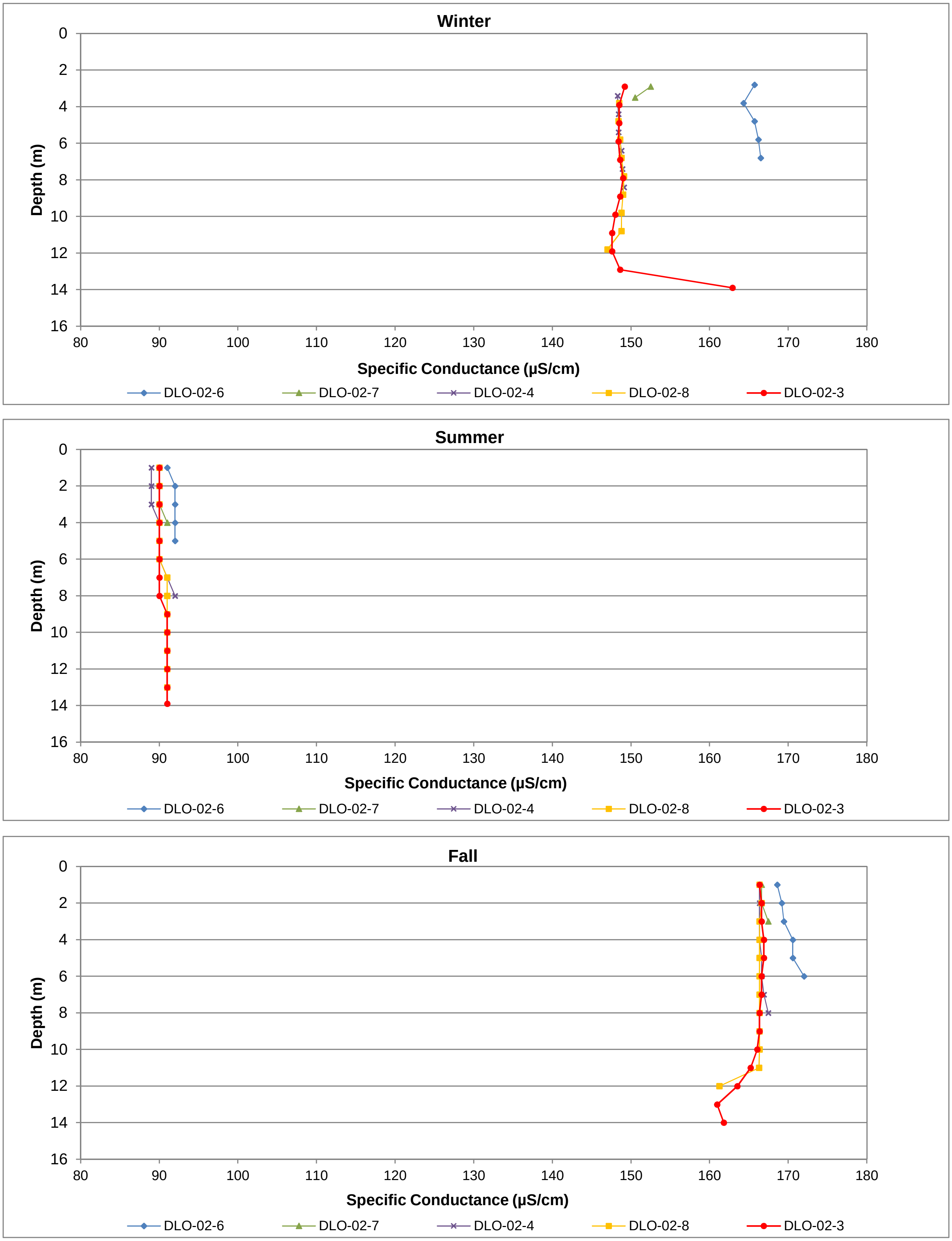


Figure C.18: Vertical Profiles of Conductivity Measured at Sheardown Lake SE in Winter, Summer, and Fall, 2017

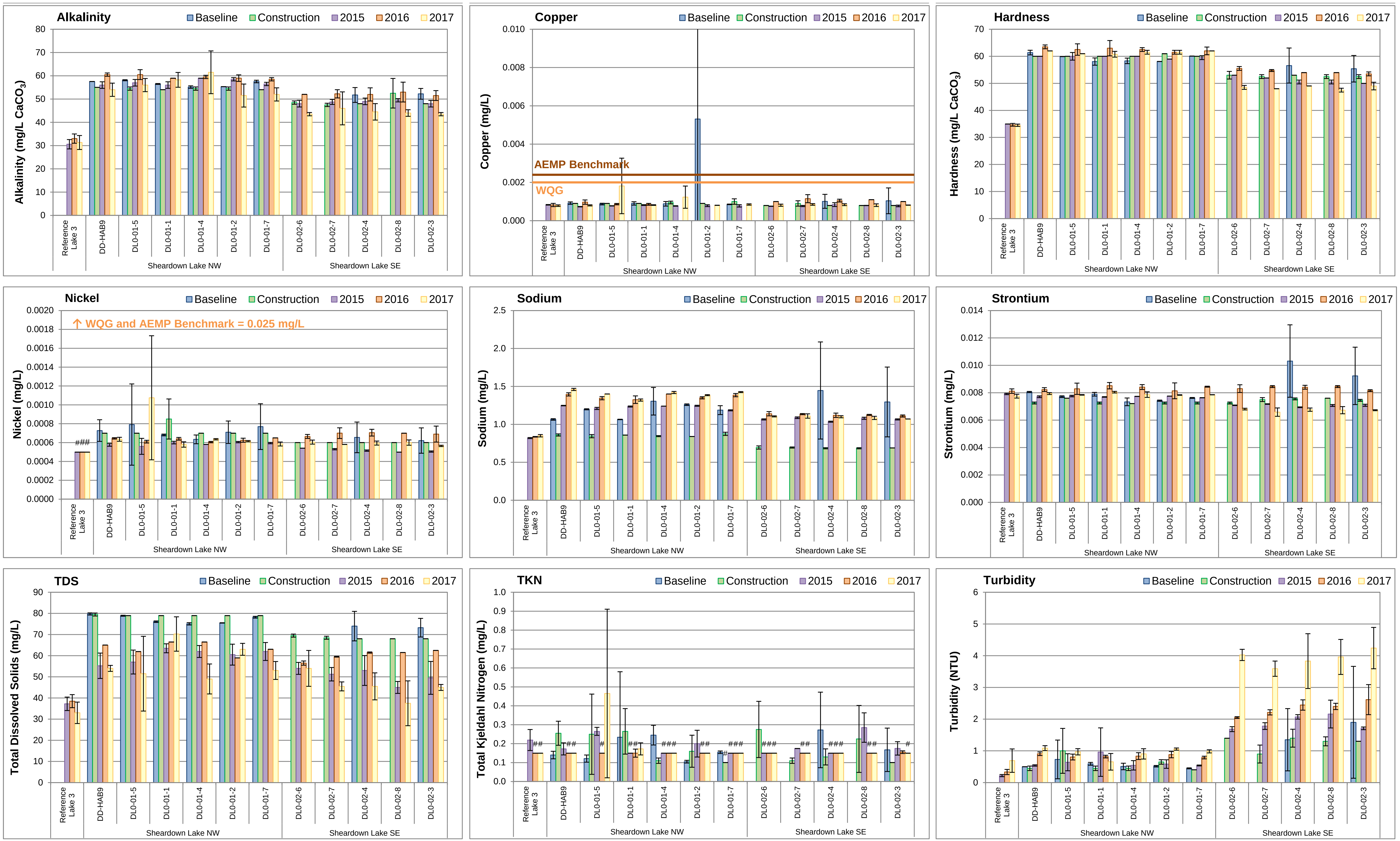
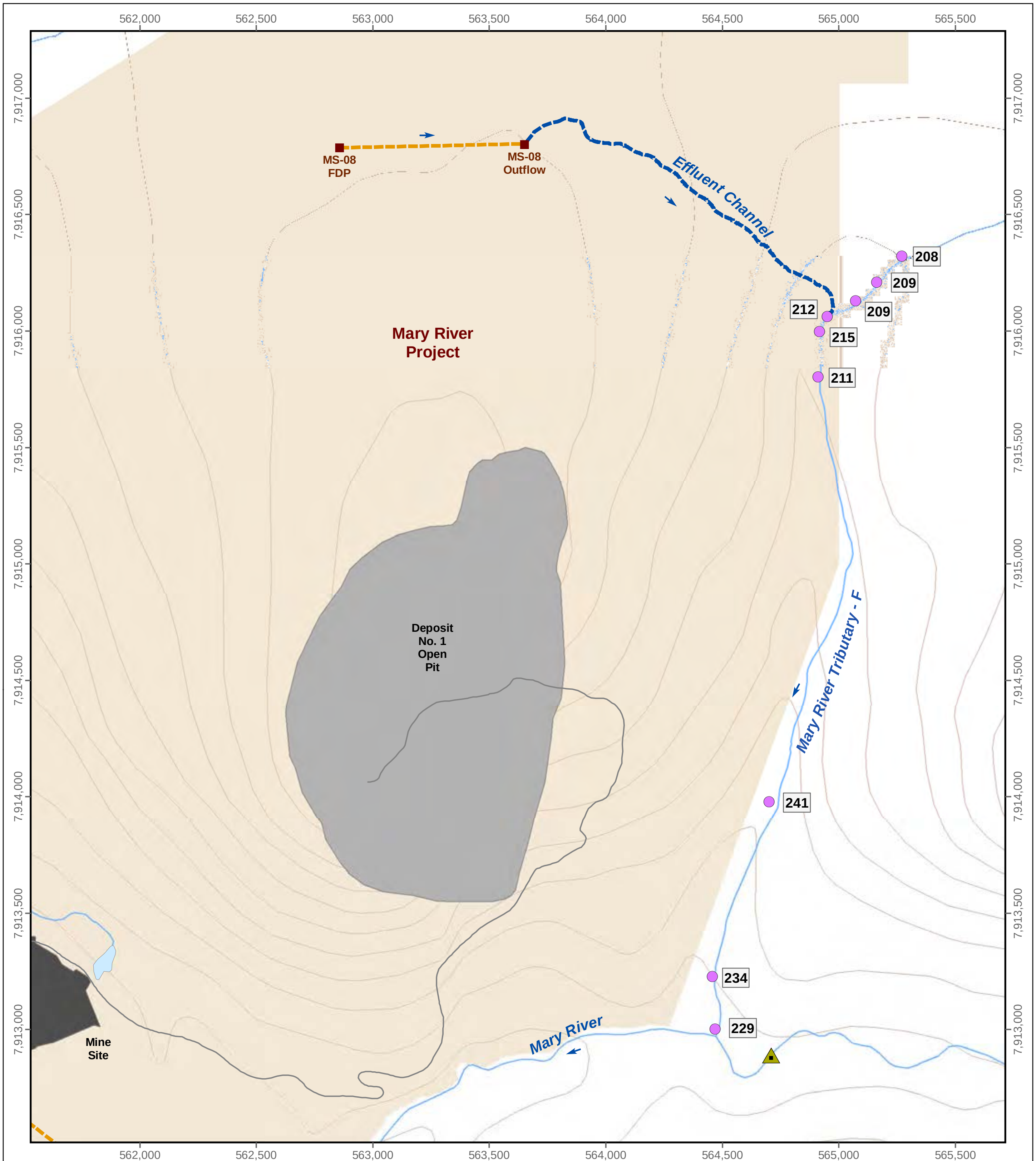


Figure C.19: Temporal Comparison of Water Chemistry at Sheardown Lake Northwest (DLO-01) and Sheardown Lake Southeast (DLO-02) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015, 2016, and 2017) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Sheardown Lake (northwest and southeast).



LEGEND

- Sampling Location
- Final Discharge Point (FDP)
- Mary River Cascade Barrier
- Discharge Line
- Overland Effluent Channel
- 229 Specific Conductance (uS/cm)

Specific Conductance Data for Mary River Tributary-F During the 2017 EEM Field Study

0 0.25 0.5 1 km

Map Projection: UTM Zone 17N NAD 1983

Data Source: Reproduced under licence from Her Majesty the Queen in Rights of Canada, Department of Natural Resources Canada. All rights reserved.

N E S W

Date: March 2018

Project 177202.0033

minnow environmental inc.

Figure C.20

Document Path: S:\Projects\177202\177202.0033 - Baffinland 2017\2 - Mapping\CREMP Maps\17-33 Fig C.20 Specific Conductance Data.mxd

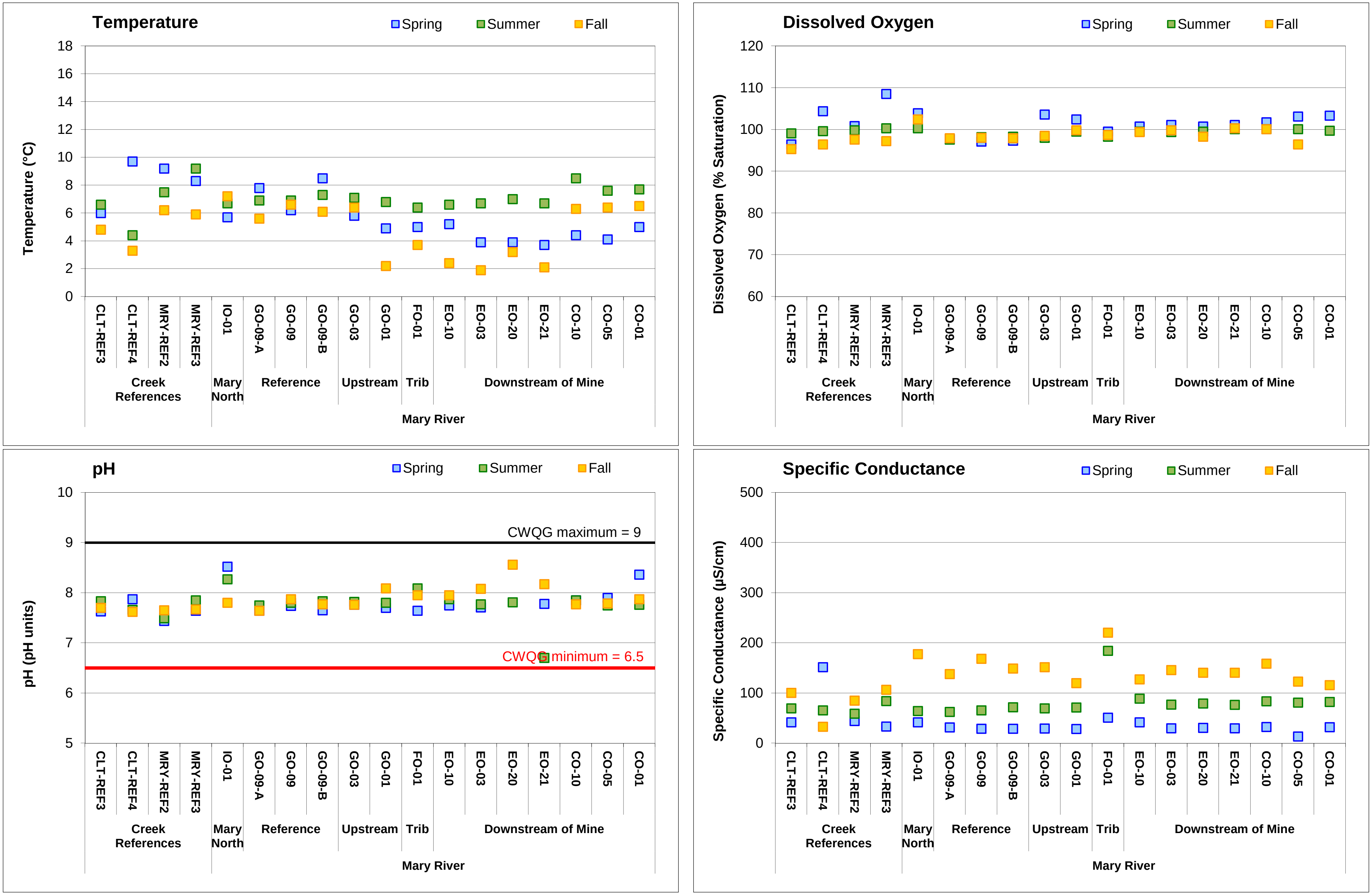


Figure C.21: Comparison of *in situ* Water Quality Variables Measured at Mary River Water Quality Monitoring Stations in Spring, Summer, and Fall 2017, Mary River Project CREMP

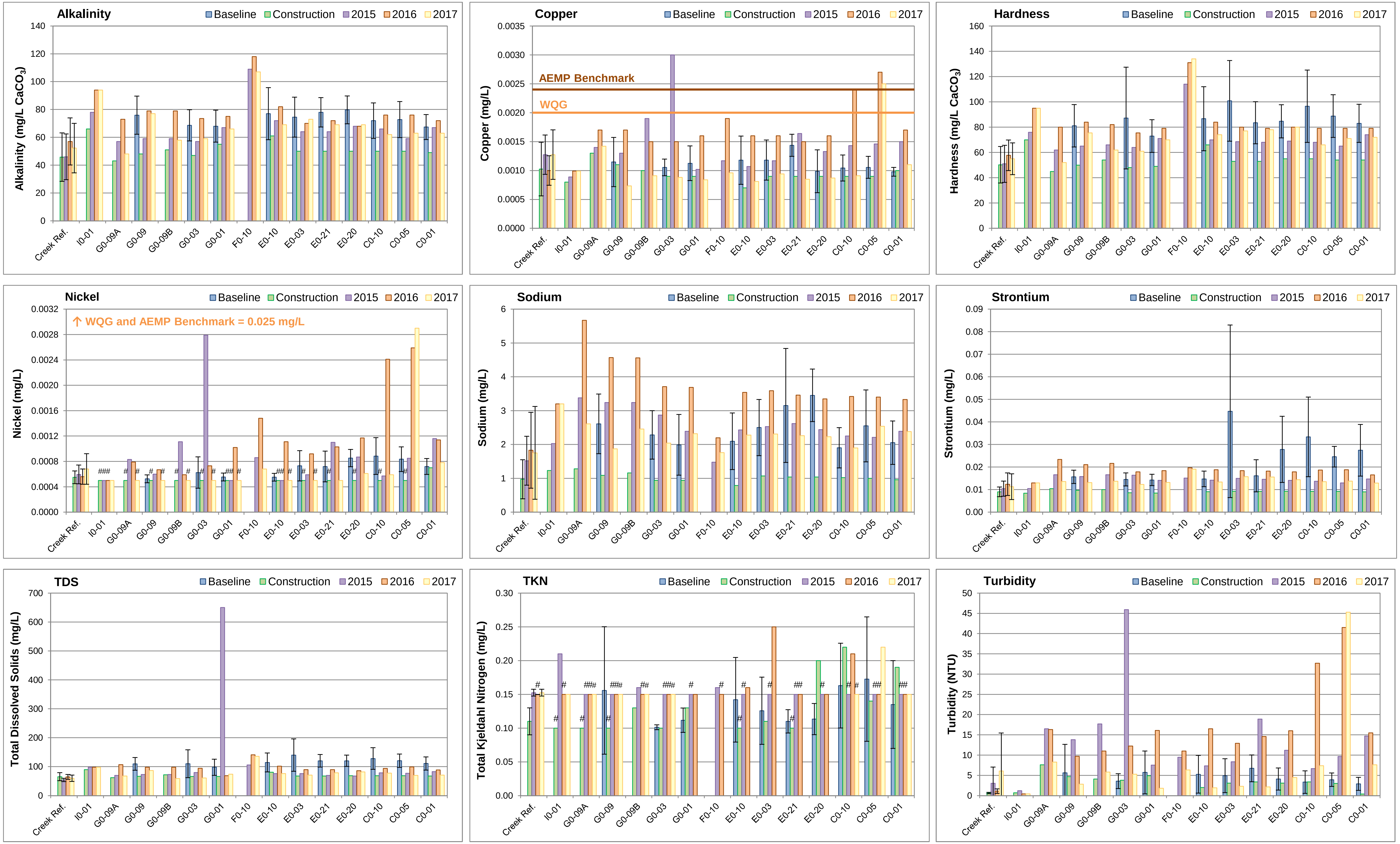


Figure C.22: Temporal Comparison of Water Chemistry at Mary River Stations for Mine Baseline (2005 - 2013), Construction (2014) and Operational (2015 - 2017) Periods in the Fall

Notes: Values represent mean ± SD. Creek reference includes the CLT-REF and MRY-REF series stations (mean ± SD; n = 4). Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guidelines (WQG) AEMP Benchmarks are specific to Mary River.

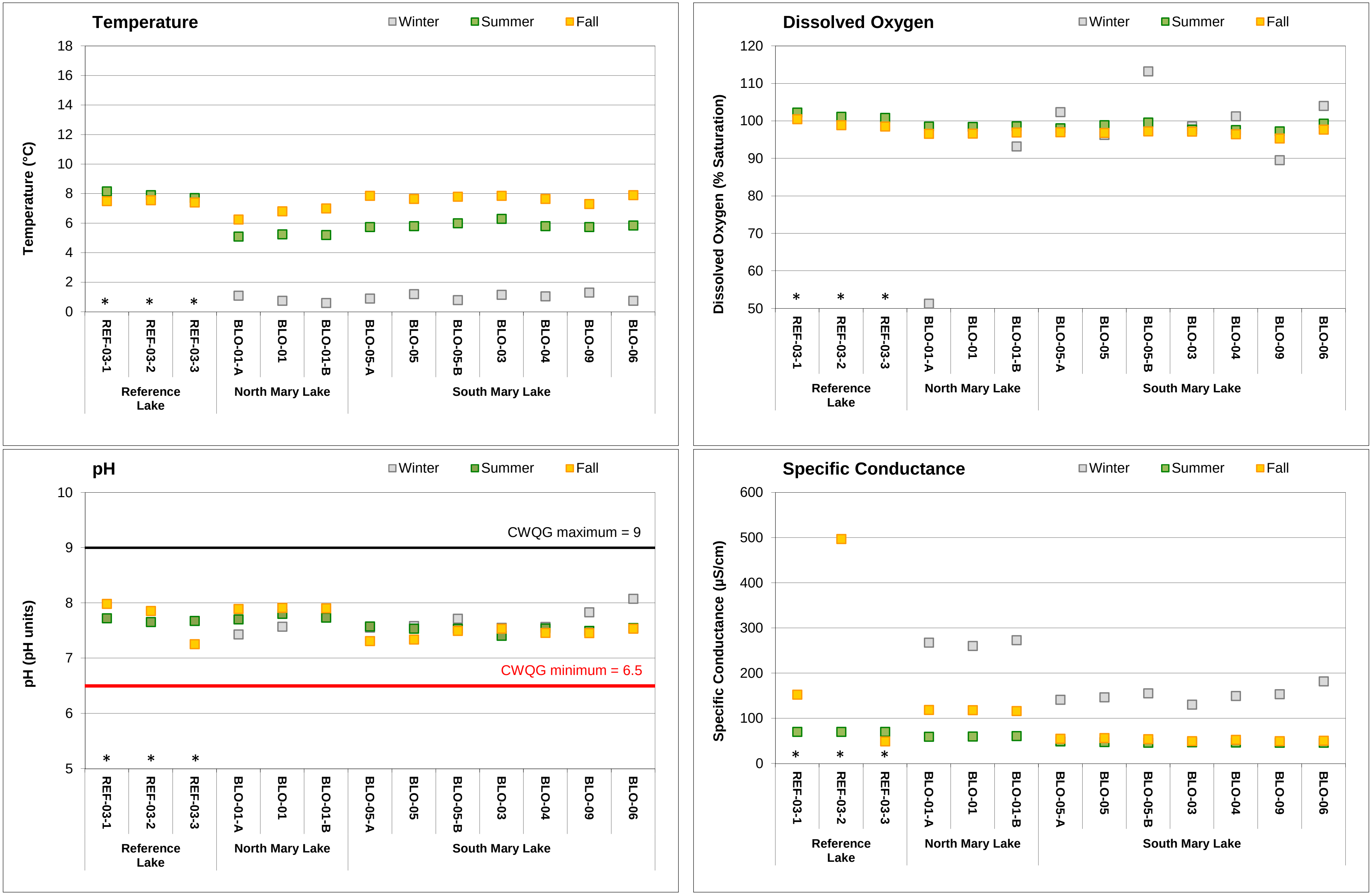
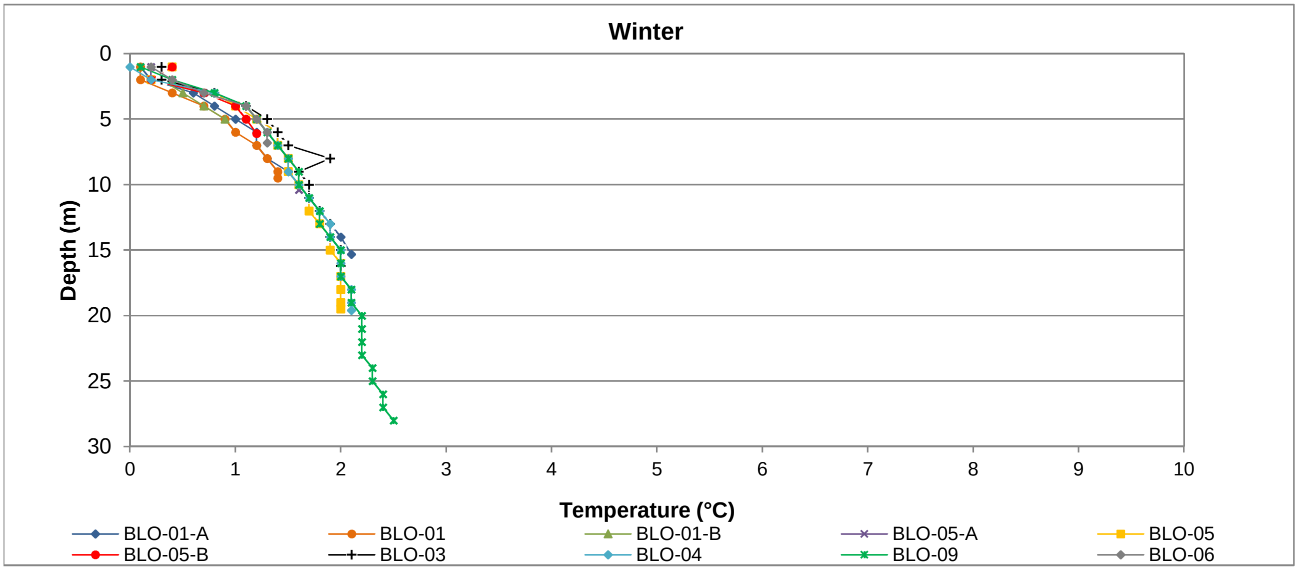
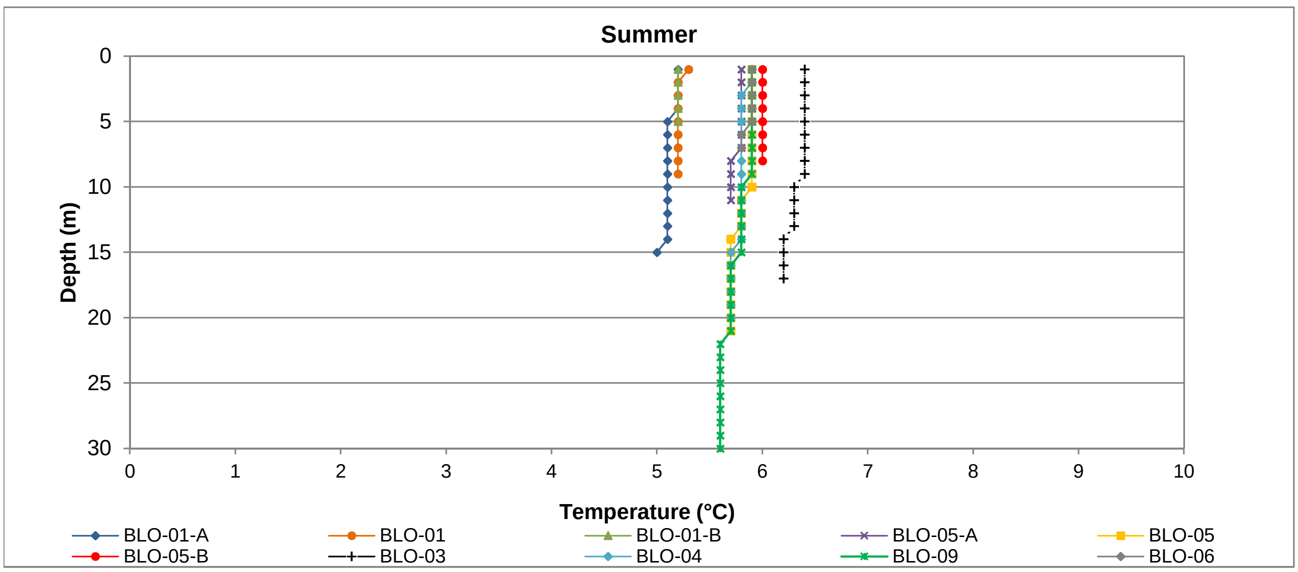


Figure C.23: Comparison of *in situ* Water Quality Variables Measured at Mary Lake Water Quality Monitoring Stations in Winter, Summer, and Fall 2017, Mary River Project CREMP

Notes: Lake values represent mean of surface and bottom in situ water quality measurements. * Reference Lake 3 (REF-03) was not sampled in winter.





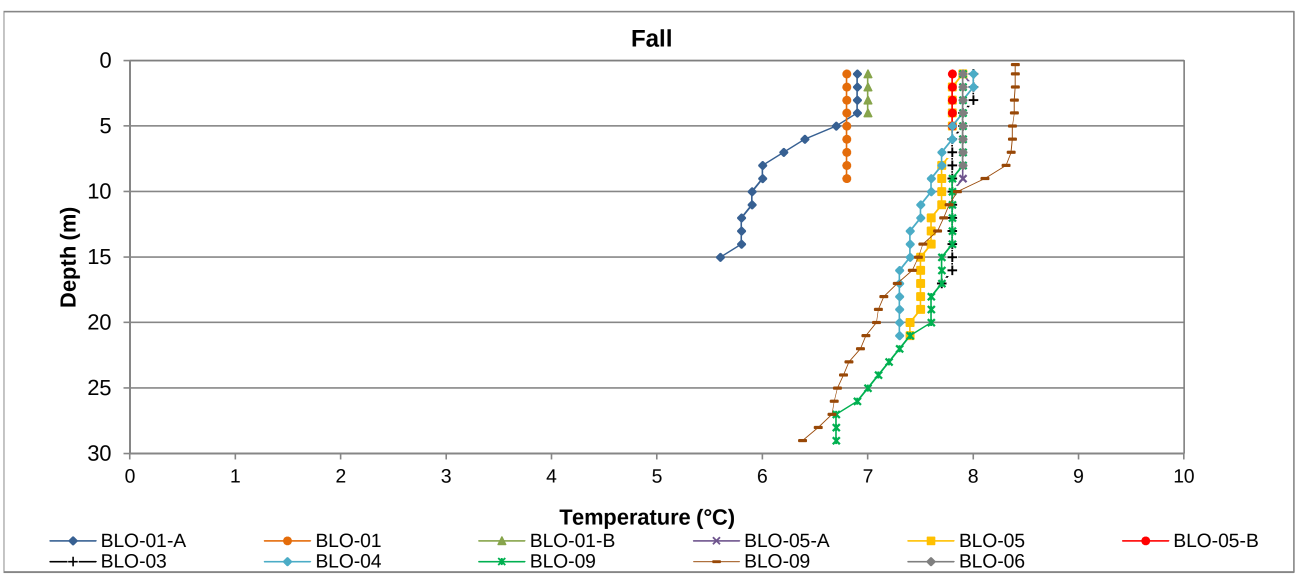


Figure C.24: Vertical Profiles of Temperature Measured at Mary Lake in Winter, Summer, and Fall, 2017

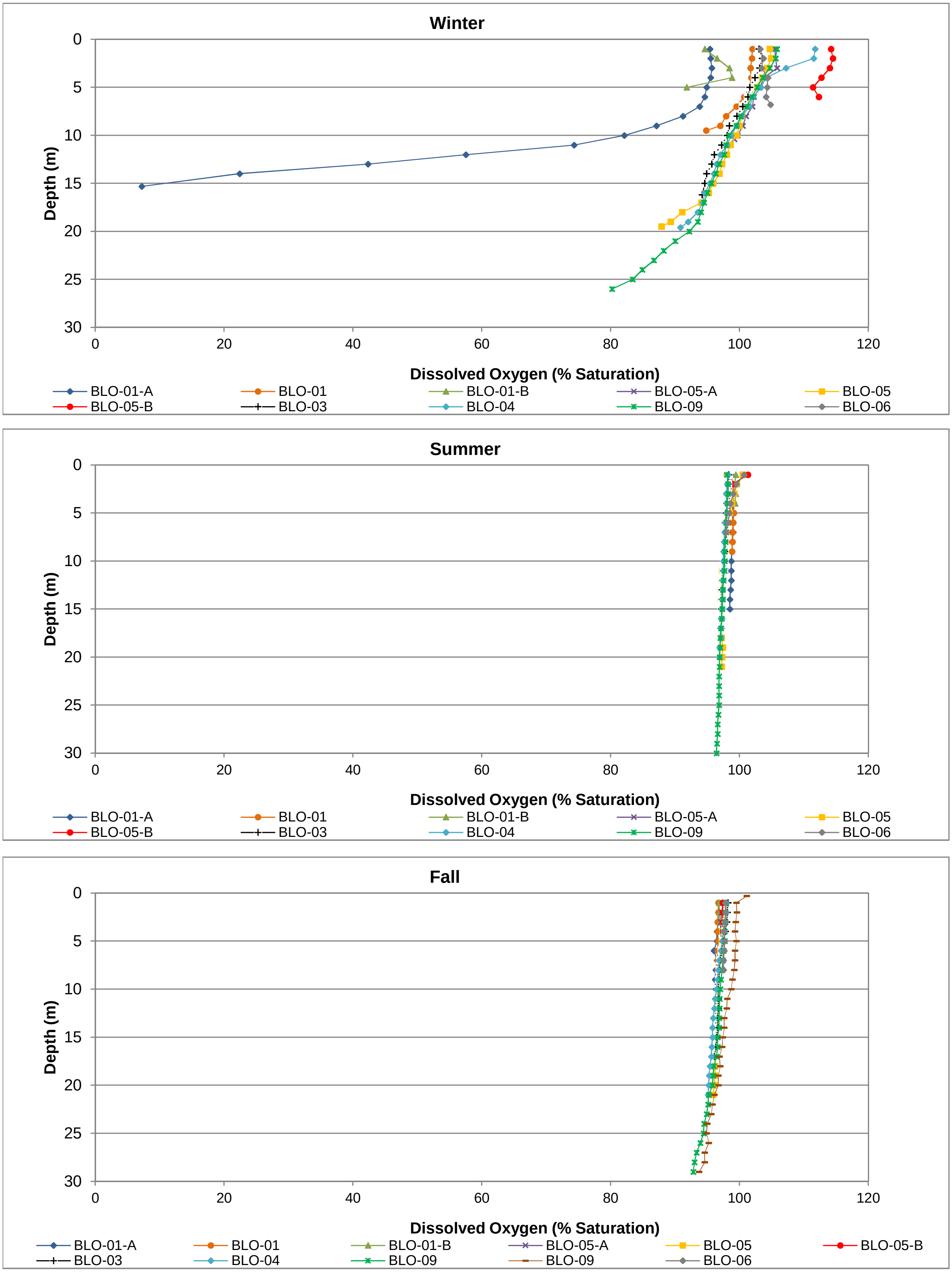


Figure C.25: Vertical Profiles of Dissolved Oxygen Measured at Mary Lake in Winter, Summer, and Fall, 2017

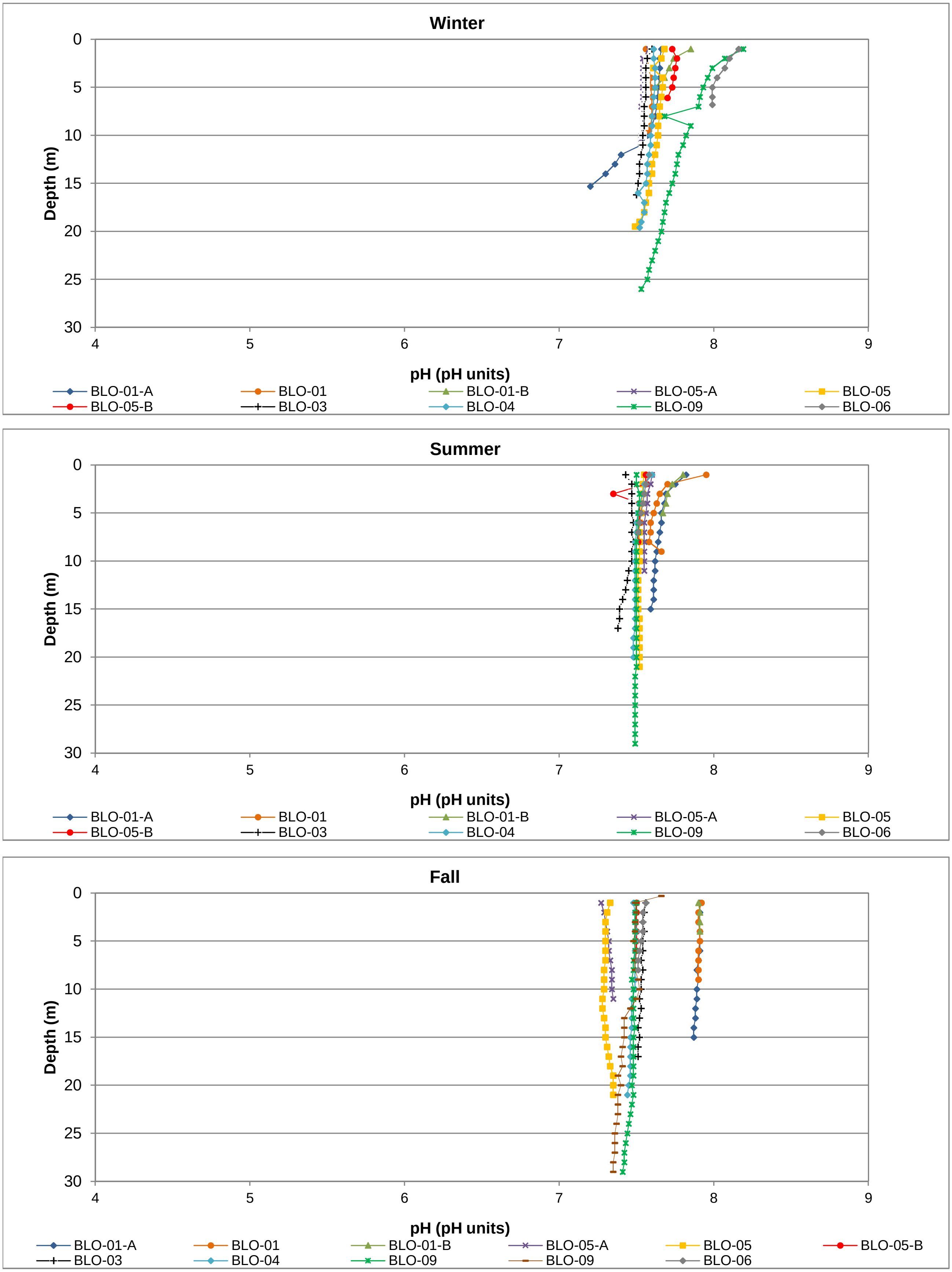


Figure C.26: Vertical Profiles of pH Measured at Mary Lake in Winter, Summer, and Fall, 2017

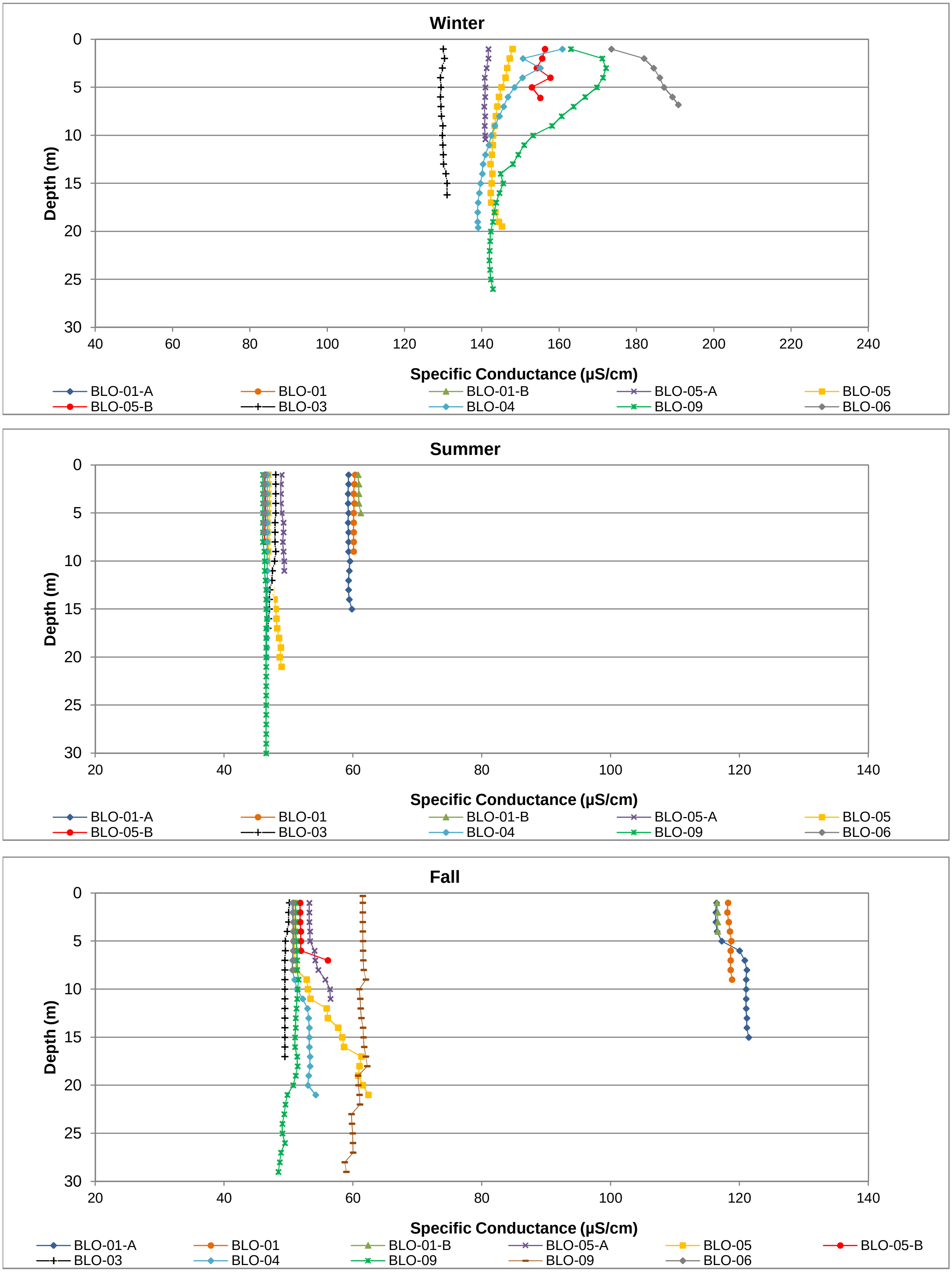


Figure C.27: Vertical Profiles of Specific Conductance Measured at Mary Lake in Winter, Summer, and Fall, 2017

Figure C.28: Temporal Comparison of Water Chemistry at Mary Lake (BLO) for Mine Baseline (2005 - 2013), Construction (2014), and Operational (2015-2017) Periods during Fall

Notes: Values represent mean ± SD. Pound symbol (#) indicates parameter concentration is below the laboratory method detection limit. See Table 2.2 for information regarding Water Quality Guideline (WQG) criteria. AEMP Benchmarks are specific to Mary Lake.

Table C.1: *In Situ* Water Quality Data Collected from Lotic Environments for the Mary River Project CREMP, Spring 2017

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (°C)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	08-07-2017	6.0	96.4	7.63	41.8	0.90
		CLT-REF3	09-07-2017	9.7	104.4	7.87	151.6	0.10
		MRY-REF3	08-07-2017	9.2	100.8	7.44	44.2	0.90
		MRY-REF2	08-07-2017	8.3	108.5	7.64	33.3	1.90
	CLT-1	L1-08	09-07-2017	3.8	99.4	7.91	47.4	0.40
		L1-02	09-07-2017	12.1	100.4	8.56	39.2	-0.10
		L2-03	07-07-2017	14.8	98.8	8.11	225.8	3.30
		L1-09	07-07-2017	11.0	100.7	8.10	106.8	1.70
		L1-05	07-07-2017	11.8	100.1	8.11	114.2	1.00
		L0-01	07-07-2017	11.0	99.7	8.09	121.5	1.20
	CLT-2	K0-01	07-07-2017	8.6	99.5	8.09	97.4	1.00
	Camp Lake	J0-01	09-07-2017	6.5	101.8	8.04	114.8	0.00
Sheardown Lake System	SDL Tribs	D1-05	09-07-2017	14.7	99.7	8.04	191.1	0.80
		D1-00	08-07-2017	7.7	102.7	7.59	26.1	3.00
Mary River/Lake System	Tom River	I0-01	07-07-2017	5.7	103.9	8.52	41.5	1.60
	Mary River	G0-09-A	08-07-2017	7.8	97.8	7.64	31.7	1.40
		G0-09	08-07-2017	6.2	97.1	7.74	29.0	2.30
		G0-09-B	08-07-2017	8.5	97.3	7.65	28.8	2.90
		G0-03	08-07-2017	5.8	103.6	7.76	29.2	3.10
		G0-01	08-07-2017	4.9	102.4	7.70	28.6	3.00
		F0-01	08-07-2017	5.0	99.5	7.64	51.1	7.80
		E0-10	08-07-2017	5.2	100.7	7.75	41.7	4.50
		E0-03	08-07-2017	3.9	101.1	7.71	29.7	3.10
		E0-20	08-07-2017	3.9	100.7	-	30.7	3.40
		E0-21	08-07-2017	3.7	101.1	7.78	29.8	3.30
		C0-10	08-07-2017	4.4	101.7	7.85	32.3	3.40
		C0-05	08-07-2017	4.1	103.1	7.90	13.5	4.00
		C0-01	08-07-2017	5.0	103.3	8.36	32.1	4.10

Table C.2: ***In Situ*** **Water Quality Data Collected from Lotic Environments for the Mary River Project CREMP, Summer 2017**

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (°C)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	10-Aug-17	6.60	99.1	7.83	69.6	0.2
		CLT-REF3	10-Aug-17	4.40	99.6	7.66	65.3	0
		MRY-REF3	10-Aug-17	7.50	99.8	7.49	58.9	4.2
		MRY-REF2	10-Aug-17	9.20	100.3	7.85	83.9	-0.2
	CLT-1	L1-08	10-Aug-17	3.40	99.5	7.84	98.1	-0.7
		L1-02	28-07-2017	5.10	98.8	8.10	132.5	0.5
		L2-03	28-07-2017	6.80	97.6	8.05	288.1	1.9
		L1-09	28-07-2017	5.30	98.9	8.04	151.9	1.3
		L1-05	28-07-2017	5.60	99.9	8.03	152.3	0.1
		L0-01	28-07-2017	5.70	99.1	8.13	158.6	0.2
	CLT-2	K0-01	27-07-2017	7.80	98.3	7.81	152.2	-0.4
	Camp Lake	J0-01	10-Aug-17	10.60	104.9	7.95	115.7	-0.6
Sheardown Lake System	SDL Tribs	D1-05	28-07-2017	5.00	96.8	7.82	197.6	0.8
		D1-00	28-07-2017	6.80	99.9	8.1	282.5	0.8
Mary River/Lake System	Tom River	I0-01	27-07-2017	6.70	100.3	8.27	64.1	0.3
	Mary River	G0-09-A	10-Aug-17	6.90	97.6	7.75	62.5	10.7
		G0-09	10-Aug-17	6.90	98.2	7.8	65.4	10.3
		G0-09-B	10-Aug-17	7.30	98.3	7.83	71.5	8.2
		G0-03	10-Aug-17	7.10	98.0	7.82	69.5	5.4
		G0-01	10-Aug-17	6.80	99.5	7.8	71.4	5.7
		F0-01	10-Aug-17	6.40	98.3	8.09	184.4	1.1
		E0-10	10-Aug-17	6.60	99.5	7.87	88.9	5.2
		E0-03	10-Aug-17	6.70	99.4	7.77	76.9	4.5
		E0-20	10-Aug-17	7.00	99.5	7.81	79.4	4.9
		E0-21	10-Aug-17	6.70	100.1	6.7	76.7	5.2
		C0-10	10-Aug-17	8.50	100.1	7.85	83.7	4.1
		C0-05	10-Aug-17	7.60	100.1	7.75	80.8	4.7
		C0-01	10-Aug-17	7.70	99.7	7.76	82.3	6.3

Table C.3: *In Situ* Water Quality Data Collected From Lotic Environments for the Mary River Project CREMP, Fall 2017

Study Area		Station	Sampling Date	*In Situ* Water Quality Parameter				
				Temperature (^{o}C)	Dissolved Oxygen (% saturation)	pH	Conductivity (µS/cm)	Turbidity (NTU)
Camp Lake System	Reference Creek Stations	CLT-REF4	27-Aug-17	4.8	95.3	7.70	100.3	-2.5
		CLT-REF3	27-Aug-17	3.3	96.4	7.62	32.7	-4.6
		MRY-REF3	27-Aug-17	6.2	97.6	7.65	85.1	17.3
		MRY-REF2	27-Aug-17	5.9	97.2	7.67	106.8	-4.9
	CLT-1	L1-08	1-Sep-17	1.8	98.4	7.95	118.5	-1.4
		L1-02	27-Aug-17	5.8	100.9	7.84	178.8	-1.9
		L2-03	27-Aug-17	6.2	97.4	7.64	253.4	17.7
		L1-09	27-Aug-17	6.0	100.7	7.79	204.7	0.6
		L1-05	27-Aug-17	6.1	101.3	7.84	210.3	2.3
		L0-01	27-Aug-17	6.3	101.8	7.87	214.8	22.1
	CLT-2	K0-01	27-Aug-17	6.3	101.5	7.88	212.5	-1.2
	Camp Lake	J0-01	1-Sep-17	6.2	99.4	7.88	172.4	-1.4
Sheardown Lake System	SDL Tribs	D1-05	3-Sep-17	3.4	98.4	8.04	181.3	-1.4
		D1-00	3-Sep-17	4.4	97.6	8.23	230.2	-0.5
Mary River/Lake System	Tom River	I0-01	27-Aug-17	7.2	102.4	7.80	177.6	-1.3
	Mary River	G0-09-A	29-Aug-17	5.6	97.9	7.64	138.1	7.7
		G0-09	29-Aug-17	6.6	98.0	7.87	168.4	-4.0
		G0-09-B	29-Aug-17	6.1	97.9	7.77	148.8	2.5
		G0-03	29-Aug-17	6.4	98.5	7.76	151.5	0.4
		G0-01	1-Sep-17	2.2	99.8	8.09	119.9	-0.7
		F0-01	1-Sep-17	3.7	98.7	7.95	220.4	1.9
		E0-10	1-Sep-17	2.4	99.4	7.95	127.3	-0.5
		E0-03	1-Sep-17	1.9	99.8	8.08	145.7	-0.4
		E0-20	1-Sep-17	3.2	98.3	8.56	140.4	-0.7
		E0-21	1-Sep-17	2.1	100.3	8.17	140.7	-0.3
		C0-10	29-Aug-17	6.3	100.1	7.77	158.6	5.8
		C0-05	27-Aug-17	6.4	96.4	7.79	122.8	60.0
		C0-01	27-Aug-17	6.5	11.9	7.87	115.8	4.7

Table C.4: Dissolved Metal Concentrations at Reference Creek Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Spring Sampling Event				Summer Sampling Event				Fall Sampling Event			
			CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2	CLT-REF4	CLT-REF3	MRY-REF3	MRY-REF2
			8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017	27-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.0095	0.0092	0.0172	0.0051	0.0086	0.0082	0.0314	0.0087	0.0059	0.0071	0.0194	0.0062
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00173	0.00274	0.00266	0.00233	0.00329	0.00454	0.00630	0.00558	0.00496	0.00548	0.00818	0.00656
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	3.32	4.12	1.97	4.21	8.07	7.34	5.66	9.07	13.5	10.1	8.48	13.0
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	0.00078	0.00052	<0.00050	<0.00050	0.00106	0.00092	0.00059	0.00047	0.00112	0.00100	0.00061
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	0.013	0.011	<0.010
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	0.0011
	Magnesium (Mg)	mg/L	1.83	2.44	0.993	2.42	4.71	4.36	2.95	5.47	7.51	6.16	4.39	7.90
	Manganese (Mn)	mg/L	0.000091	0.000238	0.00040	0.0003	<0.000070	0.000359	0.000124	0.000255	<0.00050	0.00074	0.000570	0.000530
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	<0.000050	0.000185	0.000096	0.000055	0.000158	0.000445	0.000350	0.000159	0.000162	0.000501	0.000414	0.000181
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00051	<0.00050	<0.00050	<0.00050	0.00061	<0.00050	<0.00050
	Potassium (K)	mg/L	0.270	0.360	0.330	0.340	0.450	0.53	0.72	0.63	0.61	0.64	0.92	0.79
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	0.340	0.520	0.350	0.350	0.64	0.76	0.85	0.67	0.79	0.93	0.90	0.84
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	0.274	0.359	0.85	0.488	0.686	0.601	2.23	1.26	0.95	0.860	3.56	1.44
	Strontium (Sr)	mg/L	0.0025	0.0027	0.0042	0.0031	0.00636	0.00502	0.0127	0.00797	0.0090	0.00630	0.0180	0.0097
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<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	<0.00030	<0.00030	0.00037	<0.00030
	Uranium (U)	mg/L	0.000146	0.000221	0.000191	0.000222	0.001790	0.001020	0.000470	0.000910	0.00310	0.00155	0.00105	0.00190
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)	mg/L									<0.00030	<0.00030	<0.00030	<0.00030

Table C.5: ***In Situ*** **Water Quality Profile Data Collected at Reference Lake 3 Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)			Dissolved Oxygen (mg/L)			Dissolved Oxygen (% Saturation)			pH (pH units)			Specific Conductance (µS/cm)		
	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03	REF3-01	REF3-02	REF3-03
Date Collected	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17	12-Aug-17
1.0	9.6	9.5	9.2	11.8	11.8	12.0	103.8	103.5	104.0	7.77	7.81	7.77	70	70	70
2.0	9.6	9.5	9.2	11.8	11.8	12.0	103.8	103.5	104.1	7.77	7.77	7.76	70	70	70
3.0	9.5	9.5	9.1	11.8	11.8	12.0	103.5	103.4	103.8	7.77	7.75	7.76	70	70	70
4.0	9.4	9.4	9.0	11.9	11.8	12.0	103.4	103.3	103.7	7.77	7.74	7.76	70	70	70
5.0	9.3	9.3	8.9	11.9	11.8	12.0	103.4	103.0	103.5	7.76	7.74	7.76	70	70	70
6.0	9.2	9.2	8.9	11.9	11.9	12.0	103.6	103.1	103.4	7.76	7.74	7.76	70	70	70
7.0	9.0	9.1	8.7	11.9	11.9	12.0	103.0	103.1	103.0	7.76	7.73	7.76	70	70	70
8.0	8.7	8.9	8.4	12.0	11.9	12.1	102.7	103.0	102.3	7.75	7.71	7.76	70	70	70
9.0	8.1	8.8	8.1	12.2	12.0	12.2	102.5	103.1	102.8	7.74	7.70	7.76	70	70	70
10.0	7.5	8.6	7.9	12.3	12.0	12.2	101.6	103.1	102.3	7.73	7.70	7.75	70	70	70
11.0	7.1	8.2	7.5	12.3	12.1	12.3	101.2	102.1	101.7	7.71	7.69	7.74	70	70	70
12.0	6.7	7.3	6.9	12.3	12.2	12.4	100.7	100.4	101.5	7.68	7.66	7.70	70	70	70
13.0		6.7	6.8		12.3	12.3		99.8	100.9		7.61	7.69		70	70
14.0		6.4	6.7		12.2	12.3		99.3	100.7		7.55	7.68		70	70
15.0		6.4	6.6		12.2	12.3		99.3	100.6		7.53	7.67		70	70
16.0		6.4	6.5		12.2	12.3		99.2	100.3		7.52	7.66		70	70
17.0		6.3	6.5		12.2	12.3		99.1	100.2		7.51	7.65		70	70
18.0		6.3	6.5		12.2	12.3		98.8	100.2		7.50	7.65		70	70
19.0			6.4			12.3			99.8			7.63			70
20.0			6.4			12.3			99.8			7.63			70
21.0			6.4			12.3			99.8			7.63			70
22.0			6.4			12.3			99.6			7.63			70
23.0			6.4			12.3			99.5			7.63			70
24.0			6.4			12.2			99.2			7.92			70
25.0			6.3			12.2			99.0			7.91			70
26.0			6.3			12.2			98.8			7.91			70
27.0			6.3			12.2			98.6			7.90			70
28.0			6.2			12.1			98.1			7.59			70
29.0			6.2			12.1			97.9			7.58			70
30.0			6.2			12.1			97.6			7.58			70

Notes:

Total depth at stations REF3-01, REF3-02, and REF3-03 was 12.75, 18.5, and 30.5 m, respectively, at the time of summer sampling.

Table C.6: ***In Situ*** **Water Quality Profile Data Collected at Reference Lake 3 Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)				Dissolved Oxygen (mg/L)				Dissolved Oxygen (% Saturation)				pH (pH units)				Specific Conductance (µS/cm)			
	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03	REF3-01	REF3-02	REF3-03	REF3-03
Date Collected	2-Sep-17	2-Sep-17	2-Sep-17	21-Aug-17	2-Sep-17	2-Sep-17	2-Sep-17	21-Aug-17	2-Sep-17	2-Sep-17	2-Sep-17	21-Aug-17	2-Sep-17	2-Sep-17	2-Sep-17	21-Aug-17	2-Sep-17	2-Sep-17	2-Sep-17	21-Aug-17
surface				8.70				11.85				101.90				7.16				74
1.0	7.50	7.60	7.60	8.66	12.24	12.46	12.41	11.76	102.4	104.7	104.1	101.00	8.27	8.02	7.99	7.21	151	494	492	73
2.0	7.50	7.60	7.70	8.58	12.05	12.30	12.29	11.75	100.7	104.0	103.2	100.60	8.07	8.00	7.91	7.24	153	499	196	73
3.0	7.50	7.60	7.70	8.56	11.98	12.24	12.20	11.74	100.0	102.4	102.4	100.50	7.98	7.98	7.86	7.26	155	501	200	73
4.0	7.50	7.60	7.60	8.55	11.95	12.15	12.14	11.74	99.8	102.0	101.8	100.50	7.92	7.90	7.84	7.30	155	508	504	73
5.0	7.50	7.60	7.60	8.54	11.93	12.08	12.11	11.75	99.5	101.3	101.5	100.50	7.86	7.82	7.81	7.32	156	508	505	73
6.0	7.50	7.60	7.60	8.53	11.91	11.95	12.08	11.73	99.4	100.0	107.1	100.30	7.84	7.78	7.79	7.31	156	512	507	73
7.0	7.50	7.60	7.60	8.51	11.89	11.94	12.06	11.72	99.2	99.9	100.8	100.20	7.81	7.75	7.77	7.34	157	514	507	73
8.0	7.50	7.50	7.50	8.47	11.88	11.91	12.03	11.71	99.1	99.7	100.5	100.00	7.81	7.74	7.76	7.35	155	515	507	73
9.0	7.50	7.50	7.50	8.44	11.88	11.89	12.01	11.71	99.0	99.8	100.3	100.00	7.80	7.73	7.75	7.36	155	515	507	73
10.0	7.50	7.50	7.50	8.40	11.88	11.89	12.00	11.71	99.0	99.4	100.1	99.90	7.80	7.72	7.74	7.37	155	515	506	73
11.0	7.50	7.50	7.50	8.32	11.86	11.81	11.97	11.71	98.8	99.0	100.0	99.70	7.78	7.72	7.73	7.41	154	515	506	73
12.0	7.50	7.50	7.50	8.30	11.85	11.74	11.96	11.70	98.8	98.6	99.9	99.50	7.72	7.72	7.73	7.43	154	515	505	73
13.0	7.50	7.50	7.50	8.23	11.84	11.54	11.94	11.69	98.6	98.1	99.7	99.30	7.70	7.72	7.72	7.42	154	515	504	74
14.0		7.50	7.50	8.16		11.49	11.93	11.71		97.3	99.6	99.30		7.71	7.72	7.43		515	502	74
15.0		7.50	7.50	8.10		11.41	11.91	11.71		93.4	99.4	99.00		7.70	7.71	7.43		515	500	74
16.0		7.50	7.50	8.05		11.30	11.90	11.71		94.0	99.3	99.00		7.70	7.70	7.43		500	496	74
17.0		7.50	7.50	8.00		11.24	11.89	11.71		93.1	99.3	98.80		7.69	7.70	7.42		500	494	74
18.0			7.50	7.94			11.89	11.68			99.2	98.70			7.70	7.41			492	73
19.0			7.50	7.93			11.88	11.73			99.2	98.80			7.70	7.40			490	73
20.0			7.50	7.53			11.87	11.81			99.0	98.60			7.69	7.42			488	74
21.0			7.40	7.15			11.86	11.86			99.0	98.10			7.69	7.42			486	73
22.0			7.40	6.84			11.85	11.92			98.9	97.80			7.68	7.40			482	73
23.0			7.40	6.82			11.84	11.99			98.8	98.30			7.68	7.44			479	74
24.0			7.40	6.62			11.85	11.97			98.6	97.70			7.68	7.41			151	74
25.0			7.40	6.50			11.84	11.99			98.5	97.50			7.67	7.40			151	73
26.0			7.40	6.33			11.83	11.97			98.5	97.00			7.67	7.39			150	73
27.0			7.40	6.20			11.82	11.92			98.4	96.30			7.67	7.36			150	73
28.0			7.40	6.18			11.82	11.91			98.3	96.10			7.67	7.34			147	73
29.0			7.40	6.15			11.81	11.88			98.3	95.80			7.68	7.35			145	73
30.0			7.40	6.11			11.81	11.81			98.3	95.20			7.64	7.35			144	74

Notes:
2-Sep-17 sampling was conducted by Baffinland. 21-Aug-17 sampling was conducted by Minnow.
Total depths at stations REF3-01, REF3-02, and REF3-03 were 14.1, 17.8, and 30.1 m, respectively, at the time of fall sampling.

Table C.7: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Reference Lake 3 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Replicate ID	Date Sampled	Station Depth (m)	Secchi Depth (m)	Colour/ Clarity	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (pH units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
REF 03-1	21-Aug-17	8.5	8.5	-	surface	9.10	11.80	102	7.76	73.2
					bottom	8.42	11.69	100	7.72	74.6
REF 03-2	21-Aug-17	9.4	9.4	-	surface	9.54	11.92	105	7.87	73.8
					bottom	8.42	11.83	101	7.32	73.2
REF 03-3	21-Aug-17	10.3	8.1	clear	surface	9.18	11.84	103	7.91	73.1
					bottom	8.20	11.86	101	7.36	73.6
REF 03-4	21-Aug-17	9.3	7.8	clear	surface	9.25	11.80	103	7.86	72.9
					bottom	8.05	11.76	99	7.46	73.9
REF 03-5	21-Aug-17	11.2	7.5	clear	surface	8.98	12.06	104	7.92	73.5
					bottom	8.38	11.82	101	7.31	73.3
REF 03-6	21-Aug-17	19.5	9.0	clear	surface	9.38	11.70	102	7.62	74.1
					bottom	7.42	11.90	99	7.23	73.8
REF 03-7	21-Aug-17	24.2	8.2	clear	surface	9.39	11.74	103	7.91	74.1
					bottom	6.47	11.50	94	7.23	78.9
REF 03-8	21-Aug-17	18.5	8.0	clear	surface	9.30	11.81	103	7.23	72.8
					bottom	7.70	10.70	93	7.31	80.6
REF 03-9	21-Aug-17	20.1	7.9	clear	surface	9.24	11.87	103	7.80	73.0
					bottom	7.71	12.01	101	7.37	73.2
REF 03-10	21-Aug-17	20.5	8.3	clear	surface	9.15	11.93	104	7.82	73.1
					bottom	8.10	11.78	100	7.30	73.8

Table C.8: Statistical Comparison of Bottom *In Situ* Water Quality Between Littoral and Profundal Stations of Reference Lake 3, Mary River Project CREMP, August 2017

Lake	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Station Type	n	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Reference Lake 3	Secchi Depth (m)	NO	0.960	α	Littoral	5	8.3	0.7	0.3	7.5	9.4
					Profundal	5	8.3	0.4	0.2	7.9	9.0
	Temperature (˚C)	YES	0.021	α	Littoral	5	8.3	0.2	0.1	8.1	8.4
					Profundal	5	7.5	0.6	0.3	6.5	8.1
	Dissolved Oxygen (mg/L)	NO	0.394	α,δ	Littoral	5	11.8	0.1	0.0	11.7	11.9
					Profundal	5	11.6	0.5	0.2	10.7	12.0
	Dissolved Oxygen (% saturation)	NO	0.107	α,δ	Littoral	5	100.3	0.9	0.4	99.0	101.0
					Profundal	5	97.3	3.6	1.6	93.0	100.7
	pH (units)	NO	0.108	α	Littoral	5	7.43	0.17	0.08	7.31	7.72
					Profundal	5	7.29	0.06	0.03	7.23	7.37
	Specific Conductance (umho/cm)	NO	0.174	α,δ	Littoral	5	73.7	0.6	0.3	73.2	74.6
					Profundal	5	76.1	3.5	1.5	73.2	80.6

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results validated using Mann-Whitney U-test; and, δ - single-factor ANOVA test results validated using t-test assuming unequal variance.

Table C.9: Dissolved Metal Concentrations at Reference Lake 3 Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Summer Sampling Event						Fall Sampling Event					
			REF3-01 bottom 12-Aug-2017	REF3-01 surface 12-Aug-2017	REF3-02 bottom 12-Aug-2017	REF3-02 surface 12-Aug-2017	REF3-03 bottom 12-Aug-2017	REF3-03 surface 12-Aug-2017	REF3-01 bottom 2-Sep-2017	REF3-01 surface 2-Sep-2017	REF3-02 bottom 2-Sep-2017	REF3-02 surface 2-Sep-2017	REF3-03 bottom 2-Sep-2017	REF3-03 surface 2-Sep-2017
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00679	0.00638	0.00643	0.00651	0.00643	0.00647	0.00623	0.00638	0.00633	0.00643	0.00637	0.00624
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	6.98	7.04	6.98	6.98	6.94	6.92	6.83	6.88	6.81	6.79	6.95	6.95
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00081	0.00080	0.00088	0.00084	0.00079	0.00085	0.00085	0.00085	0.0009	0.00077	0.0008	0.00076
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	4.50	4.39	4.41	4.53	4.34	4.36	4.25	4.215	4.3	4.25	4.22	4.19
	Manganese (Mn)	mg/L	0.000415	0.000252	0.000138	0.000232	0.000149	0.000241	0.000153	0.000238	0.000168	0.000196	0.00015	0.000189
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000140	0.000144	0.000145	0.000136	0.000140	0.000138	0.000107	0.000112	0.00011	0.000111	0.000108	0.000113
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.95	0.93	0.92	0.92	0.92	0.91	0.85	0.855	0.86	0.84	0.84	0.85
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.41	0.40	0.43	0.41	0.42	0.41	0.39	0.4	0.4	0.4	0.41	0.39
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.901	0.889	0.891	0.901	0.888	0.900	0.877	0.8745	0.884	0.889	0.854	0.883
	Strontium (Sr)	mg/L	0.00792	0.00795	0.00795	0.00790	0.00782	0.00779	0.00783	0.007835	0.00778	0.00783	0.00791	0.0079
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000272	0.000268	0.000257	0.000273	0.000261	0.000266	0.000259	0.0002525	0.000251	0.000256	0.000255	0.000252
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.10: Average Relative Percent Difference (RPD) Values between Water Chemistry Samples Taken at the Top and Bottom of the Water Column at Lake Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Reference Lake		Camp Lake			Sheardown Lake Northwest			Sheardown Lake Southeast			Mary Lake North Basin			Mary Lake South Basin		
		Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall	Winter	Summer	Fall
Conventionals[b]	Conductivity (lab)	0.3	1.9	3.9	0	0.3	4	1	0	3.2	0.3	0	1.5	0.2	1.4	7.2	1.7	5.9
	pH (lab)	0.6	1.0	1.7	0.7	0.4	0.9	0.3	1.2	1.5	0.6	0.4	2.9	0.1	0.3	1.2	0.8	1.1
	Hardness (as $CaCO_3$)	0.5	1.4	8.1	0.9	1.2	3.6	1.3	1.0	4.9	0.6	1.6	2.8	1.0	2.3	8.4	2.1	5.1
	Total Suspended Solids (TSS)	0	0	3.6	5.2	0	9.5	0	9.9	21	5.6	1.0	0	25	0	0.7	33	16
	Total Dissolved Solids (TDS)	20	19	6.0	13	16	13	7.6	18	3.0	17	19	6.5	4.9	24	11	48	11
	Turbidity	4.8	71	27	13	20	24	22	20	72	11	18	82	23	6.9	51	31	44
	Alkalinity (as $CaCO_3$)	11	15	6.8	3.3	3.1	5.7	15	11	4.3	3.6	8.4	3.7	4.2	3.2	10	2.7	7.6
Nutrients and Organics	Total Ammonia	66	0	4.7	2.8	8.6	22	0	15	29	0	0	54	0	11	0	0	0
	Nitrate	0	0	25	0	0	31	11	6.7	34	0	0	27	0	20	23	0.7	0.7
	Nitrite	0	0	0	0	0	0	0	0	0	0	0	6.1	0	0	0	0	0
	Total Kjeldahl Nitrogen (TKN)	20	0	0	0	2.5	3.0	1.1	27	19	0	0	32	0	0	0	0	1.7
	Dissolved Organic Carbon	6.2	1.9	7.1	1.1	7.1	17	5.1	13	13	3.3	11	7.5	3.2	6.5	12	13	8.7
	Total Organic Carbon	6.4	2.4	6.2	2.2	1.1	6.1	4.9	2.0	9.6	5.2	4.1	7.5	7.2	4.9	10	3.6	5.2
	Total Phosphorus	15	16	22	25	32	17	23	29	37	10	24	48	18	70	23	27	42
	Phenols	0	45	1.9	0	27	11	0	13	44	0	0	0	24	19	2.7	0	30
Anions	Bromide (Br)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chloride (Cl)	4.4	4.3	6.7	0.8	5.0	3.4	1.1	4.2	11	1.3	0.9	3.9	4.0	6.2	7.5	2.5	12
	Sulphate (SO_4)	6.0	1.6	5.6	1.2	7.7	3.7	0.7	6.7	6.3	1.0	1.7	15	10	7.4	9.5	15	22
Total Metals	Aluminum (Al)	14	32	8.3	26	18	0	23	26	40	8.7	13	8.7	12	13	48	44	43
	Antimony (Sb)	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0
	Arsenic (As)	9.2	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0
	Barium (Ba)	2.8	2.1	5.6	2.5	0.9	3.2	2.8	2.3	4.1	1.5	2.7	4.0	0.9	2.3	6.0	10	13
	Beryllium (Be)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bismuth (Bi)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Boron (B)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cadmium (Cd)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Calcium (Ca)	1.3	1.3	6.5	2.3	0.5	3.7	2.6	2.8	1.3	3.3	4.3	2.4	0.6	1.8	8.9	2.6	6.2
	Chromium (Cr)	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0
	Cobalt (Co)	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0	6.4	9.5
	Copper (Cu)	6.4	6.8	5.4	4.9	8.2	5.5	30	32	9.5	13	7.8	23	0	2.2	7.3	9.2	12
	Iron (Fe)	0	0	0	0	0	0	6.9	30	0	0	13	51	0	2.2	0	41	45
	Lead (Pb)	0	0	0	0	0	0	12	0	0	9.7	11	0	9.5	0	0	39	21
	Lithium (Li)	0	0	15	0	3.7	0	0	0.7	2.4	0	0	5.3	0	3.2	0	0	0
	Magnesium (Mg)	0.9	1.9	6.7	1.8	1.3	4.7	2.6	3.5	5.8	2.7	2.3	2.7	3.3	2.4	7.7	2.9	6.3
	Manganese (Mn)	8.4	10	48	2.7	5.0	45	5.2	30	62	4.9	9.6	89	10	8.4	58	31	66
	Mercury (Hg)	0	0	48	39	0	26	24	0	16	40	0	3.2	0	0	34	0	0
	Molybdenum (Mo)	4.0	2.8	11	2.7	2.5	4.9	2.5	2.5	9.6	5.1	3.2	9.1	3.3	3.3	11	8.7	9.8
	Nickel (Ni)	0	0	7.4	4.1	4.1	3.8	11	18	7.5	9.0	3.7	11	0	0	0	12	3.5
	Potassium (K)	2.6	1.9	6.2	0.4	1.5	3.4	2.0	1.3	6.4	2.9	0.9	2.7	1.8	0.6	9.9	5.1	10
	Selenium (Se)	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0	0	0	0
	Silicon (Si)	2.0	2.1	16	1.6	8.1	10	3.8	11	15	3.5	4.3	20	5.0	3.6	11	14	15
	Silver (Ag)	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0
	Sodium (Na)	2.6	2.6	8.2	1.8	1.9	4.1	3.6	1.0	6.8	2.5	1.8	4.6	2.4	1.8	7.1	1.8	6.6
	Strontium (Sr)	1.4	1.5	4.3	3.2	1.1	2.9	1.1	1.1	4.4	3.7	3.3	3.4	1.1	2.6	10	4.1	6.5
	Thallium (Tl)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tin (Sn)	0	0	46	25	0	39	61	0	53	42	0	37	0	0	40	0	0
	Titanium (Ti)	0	0	0	0	0	0	27	0	0	15	0	0	11	0	0	47	7.4
	Uranium (U)	1.4	3.2	9.8	2.0	3.2	5.0	1.1	5.1	3.8	1.1	1.8	12	3.1	5.1	14	5.1	38
	Vanadium (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Zinc (Zn)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Shaded values indicate RDP >30%

Table C.11: *In Situ* Water Quality Measurements Collected at Camp Lake Tributary 1 and Tributary 2 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Study Area	Station	Temperature (^{o}C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Conductivity (µS/cm)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	9.7	11.55	101.7	7.93	112	157
	REF-CRK-B2	9.2	11.80	102.7	7.92	111	159
	REF-CRK-B3	8.2	11.98	101.8	7.93	109	161
	REF-CRK-B4	7.3	12.20	101.5	7.91	108	163
	REF-CRK-B5	6.5	12.39	100.7	7.88	104	160
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	6.9	12.39	101.7	8.22	183	120
	CLT-1-US B2	7.3	12.23	101.5	8.22	184	122
	CLT-1-US-B3	7.2	12.23	101.3	8.22	183	121
	CLT-1-US-B4	7.2	12.30	101.8	8.18	183	121
	CLT-1-US-B5	7.1	12.43	102.6	8.10	184	121
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	7.7	12.24	102.8	8.31	229	154
	CLT-1-DS-B2	7.1	12.39	102.5	8.29	229	151
	CLT-1-DS-B3	6.3	12.68	102.7	8.23	231	148
	CLT-1-DS-B4	5.8	12.78	102.2	8.21	232	147
	CLT-1-DS-B5	4.8	13.06	101.8	7.74	229	141
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	7.8	11.94	100.4	8.21	138	206
	CLT-2-US-B2	7.0	12.21	100.6	8.18	126	190
	CLT-2-US-B3	5.3	12.56	98.9	8.16	146	188
	CLT-2-US-B4	4.3	12.72	97.5	8.11	107	178
	CLT-2-US-B5	3.1	13.47	100.4	8.10	114	196
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	8.7	11.85	101.7	8.18	137	201
	CLT-2-DS-B2	7.4	12.23	101.8	8.19	124	187
	CLT-2-DS-B3	6.2	12.54	101.4	8.15	135	210
	CLT-2-DS-B4	4.7	13.02	101.0	8.10	114	186
	CLT-2-DS-B5	2.8	13.69	101.1	8.05	123	213

Table C.12: *In Situ* Water Quality Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2017

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	8.2	1.3	0.6	6.5	9.8	6.5	9.7
	CLT1-US North Branch	7.1	0.2	0.1	7.0	7.3	6.9	7.3
	CLT1-DS Lower Main Stem	6.3	1.1	0.5	4.9	7.7	4.8	7.7
	CLT2-US Upstream	5.5	1.9	0.9	3.1	7.9	3.1	7.8
	CLT2-DS Downstream	6.0	2.3	1.0	3.1	8.8	2.8	8.7
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	11.98	0.33	0.15	11.58	12.39	11.55	12.39
	CLT1-US North Branch	12.32	0.09	0.04	12.20	12.43	12.23	12.43
	CLT1-DS Lower Main Stem	12.63	0.32	0.14	12.23	13.03	12.24	13.06
	CLT2-US Upstream	12.58	0.58	0.26	11.86	13.30	11.94	13.47
	CLT2-DS Downstream	12.67	0.72	0.32	11.78	13.55	11.85	13.69
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	101.7	0.7	0.3	100.8	102.6	100.7	102.7
	CLT1-US North Branch	101.8	0.5	0.2	101.2	102.4	101.3	102.6
	CLT1-DS Lower Main Stem	102.4	0.4	0.2	101.9	102.9	101.8	102.8
	CLT2-US Upstream	99.6	1.3	0.6	97.9	101.2	97.5	100.6
	CLT2-DS Downstream	101.4	0.4	0.2	101.0	101.8	101.0	101.8
pH (units)	Unnamed Reference Creek	7.91	0.02	0.01	7.89	7.94	7.88	7.93
	CLT1-US North Branch	8.19	0.05	0.02	8.12	8.25	8.10	8.22
	CLT1-DS Lower Main Stem	8.16	0.24	0.11	7.86	8.45	7.74	8.31
	CLT2-US Upstream	8.15	0.05	0.02	8.09	8.21	8.10	8.21
	CLT2-DS Downstream	8.13	0.06	0.03	8.06	8.21	8.05	8.19
Specific Conductance (µS/cm)	Unnamed Reference Creek	160	2.2	1.0	157	163	157	163
	CLT1-US North Branch	121	0.7	0.3	120	122	120	122
	CLT1-DS Lower Main Stem	148	4.9	2.2	142	154	141	154
	CLT2-US Upstream	192	10.3	4.6	179	204	178	206
	CLT2-DS Downstream	199	12.6	5.6	184	215	186	213

Table C.13: ***In Situ*** **Water Quality Statistical Comparisons among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017**

Metric	Overall 3-group Comparison[a]			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	0.0412	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.3916	Tamhane's
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1314	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.4661	
Dissolved Oxygen (mg/L)	YES	0.0094	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.1724	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0071	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.2028	
Dissolved Oxygen (% saturation)	NO	0.1264	α	Unnamed Reference Creek	CLT1 North Branch	NO	0.9564	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1424	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.2221	
pH (units)	YES	0.0181	α,γ	Unnamed Reference Creek	CLT1 North Branch	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Lower Main Stem	NO	0.1508	
				CLT1 North Branch	CLT1 Lower Main Stem	NO	0.4206	
Specific Conductance (µS/cm)	YES	0.0000	α	Unnamed Reference Creek	CLT1 North Branch	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT1 Lower Main Stem	YES	0.0002	
				CLT1 North Branch	CLT1 Lower Main Stem	YES	0.0000	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results validated using Kraskal Wallis H-test or Mann-Whitney U-test, as appropriate.

Table C.14: Water Chemistry at Lotic Camp Lake Tributary (CLT) Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event							Summer Sampling Event							Fall Sampling Event						
					L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	LI-08	L1-02	L2-03	L1-09	L0-05	L0-01	K0-01
					09/Jul/17	09/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	10/Aug/17	28/Jul/17	28/Jul/17	28/Jul/17	28/Jul/17	28/Jul/17	27/Jul/17	01/Sep/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	54	89	225	107	114	122	98	116	140	308	165	160	171	164	135	188	336	231	245	255	253
	pH (lab)	pH	6.5 - 9.0	-	7.64	7.87	8.06	7.92	7.94	7.95	7.84	7.95	7.96	8.01	7.98	8.05	8.01	8.06	8.03	8.13	8.18	8.14	8.18	8.09	8.20
	Hardness (as $CaCO_3$)	mg/L	-	-	25	41	93	50	52	59	45	55	68	123	78	77	84	79	65	94	153	114	117	124	129
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	3.4	<2.0	<2.0	<2.0	2.5	<2.0	<2.0	<2.0	8.8	2.7	3.7	15.7	2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	27	48	66	54	59	66	49	56	64	163	100	77	115	83	73	96	169	90	114	152	134
	Turbidity	NTU	-	-	0.6	0.6	3.2	1.1	0.9	0.6	0.5	0.5	0.5	2.9	0.6	1.2	1.3	0.7	0.7	1.1	17.3	4.1	4.3	18.9	1.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	25	40	75	44	46	51	37	54	70	107	74	72	74	72	63	84	140	102	110	109	102
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.032	<0.020	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.031	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.032	<0.020	0.066	<0.020	<0.020
	Nitrate	mg/L	13	13	0.081	<0.020	0.352	0.024	0.033	0.033	0.051	0.061	0.023	0.688	0.065	0.074	0.073	0.023	0.041	0.109	0.539	0.180	0.161	0.164	0.111
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.30	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.37	<0.15	0.16	<0.15	<0.15	<0.15	0.24	0.47	0.30	0.22	0.17	<0.15
	Dissolved Organic Carbon	mg/L	-	-	0.9	1.0	3.0	1.4	1.4	1.4	0.9	1.9	2.0	3.9	2.1	2.2	2.1	1.5	2.3	2.6	5.0	3.3	3.5	3.4	2.6
	Total Organic Carbon	mg/L	-	-	0.9	1.2	3.0	1.6	1.5	1.5	1.0	2.0	2.3	4.1	2.2	2.2	2.3	1.6	2.1	2.8	5.1	3.5	4.0	3.5	2.8
	Total Phosphorus	mg/L	0.030[α]	-	0.0065	<0.0030	0.0130	0.0053	<0.0030	0.0035	0.0048	0.0045	<0.0030	0.0057	<0.0030	0.0037	0.0055	0.0108	0.0072	0.0034	0.0096	0.0177	0.0060	0.0126	0.0044
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.7	0.8	16.6	2.6	3.9	4.1	1.3	1.3	1.6	26.0	4.3	4.7	5.3	1.9	2.0	2.6	19.9	8.6	9.8	10.9	3.1
	Sulphate (SO_4)	mg/L	218[β]	218	1.0	3.3	9.1	3.8	3.9	4.2	6.8	2.7	5.4	10.4	5.0	5.9	6.4	11.8	4.1	7.3	9.4	7.3	6.0	6.5	26.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.020	0.009	0.062	0.014	0.021	0.044	0.012	0.018	0.008	0.053	0.012	0.017	0.031	0.008	0.022	0.032	***0.395***	0.100	0.179	***0.620***	0.063
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0043	0.0060	0.0105	0.0066	0.0069	0.0074	0.0052	0.0086	0.0086	0.0124	0.0094	0.0091	0.0093	0.0088	0.0089	0.0112	0.0153	0.0132	0.0139	0.0175	0.0126
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00005	<0.00050	<0.00005	<0.00005	<0.00050	<0.00050	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	0.015	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	5	8	19	10	11	12	9	11	13	24	15	15	17	16	13	19	30	23	24	24	25
	Chromium (Cr)	mg/L	0.0089	0.000856	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00034	0.00012	0.00016	0.00033	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	0.0016	0.0013	0.0012	0.0013	0.0016	0.0012	0.0007	***0.0024***	0.0019	0.0011	0.0017	0.0017	0.0017	0.0008	***0.0025***	0.0021	0.0016	0.0019	0.0020	0.0022	0.0011
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	0.217	<0.030	0.041	0.063	<0.030	<0.030	<0.030	0.287	0.044	<0.050	0.063	<0.030	<0.030	<0.050	***0.705***	0.204	0.323	***0.821***	0.082
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000137	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000104	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000604	0.000147	0.000217	0.000651	0.000058
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0025	<0.0010	0.0010	0.0011	<0.0010	<0.0010	<0.0010	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0031	0.0021	0.0025	0.0030	0.0016
	Magnesium (Mg)	mg/L	-	-	3.1	5.3	11.2	5.9	6.4	6.8	5.8	6.7	8.2	14.8	9.4	9.4	9.6	9.91	7.9	11.4	19.9	13.7	14.6	15.0	16.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.0007	0.0003	0.0243	0.0018	0.0034	0.0038	0.0007	0.0006	0.0004	0.0300	0.0038	0.0032	0.0029	0.0006	0.0006	0.0019	0.0456	0.0142	0.0184	0.0243	0.0029
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00029	0.00178	0.00037	0.00038	0.00037	0.00017	0.00080	0.00042	0.00267	0.00063	0.00064	0.00067	0.00027	0.00074	0.00070	0.00141	0.00087	0.00088	0.00071	0.00035
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00092	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00110	0.00056	0.00073	0.00078	<0.00050	<0.00050	0.00067	0.00135	0.00092	0.00108	0.00144	0.00054
	Potassium (K)	mg/L	-	-	0.95	1.11	2.49	1.20	1.23	1.29	0.79	1.79	1.40	2.82	1.60	1.51	1.55	1.19	1.91	1.94	2.96	2.17	2.25	2.53	1.59
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	0.000088	<0.001000	<0.000050	<0.000050	<0.001000	<0.001000	<0.000050	0.000078	0.000055	<0.000050	0.000053	<0.000050
	Silicon (Si)	mg/L	-	-	0.47	0.47	0.59	0.48	0.51	0.58	0.44	0.72	0.72	0.67	0.77	0.75	0.79	0.64	0.83	1.01	1.76	1.22	1.42	2.02	1.08
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000050	<0.000050	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.2	0.6	7.9	1.2	1.3	1.4	1.0	0.5	0.7	11.6	1.9	1.8	2.1	1.4	0.5	1.4	9.9	3.6	3.9	4.1	2.0
	Strontium (Sr)	mg/L	-	-	0.003	0.004	0.023	0.009	0.011	0.012	0.005	0.006	0.007	0.026	0.012	0.012	0.014	0.009	0.008	0.010	0.026	0.024	0.028	0.027	0.015
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00001	<0.00010	<0.00001	<0.00001	<0.00010	<0.00010	<0.00001	0.00001	<0.00001	<0.00001	0.00002	<0.00001
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0025	<0.0100	0.0007	0.0019	<0.0100	<0.0100	<0.0020	0.0210	<0.0060	0.0103	0.0418	<0.0040
	Uranium (U)	mg/L	0.015	-	0.0002	0.0003	0.0052	0.0007	0.0008	0.0008	0.0003	0.0020	0.0010	0.0091	0.0018	0.0018	0.0019	0.0009	0.0029	0.0021	0.0088	0.0033	0.0036	0.0035	0.0019
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0010	<0.0005	<0.0005	<0.0010	<0.0010	<0.0005	0.0008	<0.0005	0.0006	0.0011	<0.0005
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0039	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0034	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake Tributaries.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.15: **Magnitude of Elevation in Seasonal Average Water Chemistry (Total Metal Concentration Data Provided) Between the Camp Lake Tributaries and Average Reference Creek Stations, Mary River Project CREMP, 2017**

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Conductivity (lab)	1.9	6.1	3.1	2.7	1.6	3.8	2.0	2.0	1.4	2.9	2.1	2.2
Hardness (as $CaCO_3$)	2.0	5.6	3.3	2.7	1.7	3.3	2.2	2.1	1.4	2.8	2.2	2.3
Total Suspended Solids (TSS)	0.8	0.8	0.8	0.8	1.4	1.0	1.1	1.0	0.5	2.1	1.8	0.5
Total Dissolved Solids (TDS)	1.9	3.4	3.1	2.5	1.5	4.2	2.5	2.1	1.4	2.8	2.0	2.2
Turbidity	0.3	1.7	0.5	0.3	0.3	1.4	0.5	0.3	0.1	2.8	1.5	0.3
Alkalinity (as $CaCO_3$)	2.1	4.8	3.0	2.3	1.7	3.0	2.0	2.0	1.4	2.7	2.0	2.0
Total Ammonia	1.3	1.1	1.0	1.0	1.0	1.6	1.0	1.0	0.8	1.2	1.3	0.8
Nitrate	2.5	18	1.5	2.5	2.1	34	3.5	1.2	1.2	8.6	2.7	1.8
Nitrite	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	2.0	1.0	1.0	1.0	2.5	1.0	1.0	1.3	3.1	1.5	1.0
Dissolved Organic Carbon	0.9	2.7	1.3	0.8	1.6	3.1	1.7	1.2	1.5	3.1	2.1	1.6
Total Organic Carbon	0.9	2.4	1.2	0.8	1.7	3.2	1.7	1.2	1.4	3.0	2.1	1.6
Total Phosphorus	0.8	2.3	0.7	0.8	1.0	1.5	1.1	2.8	0.7	1.2	1.5	0.6
Phenols	0.7	0.7	0.7	1.3	1.0	1.0	1.0	1.0	1.3	1.0	1.2	1.0
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	0.9	19	4.1	1.5	0.8	15	2.7	1.1	0.9	7.9	3.9	1.2
Sulphate (SO_4)	2.5	11	4.6	8.0	1.5	3.9	2.2	4.4	1.4	2.3	1.6	6.4
Aluminum (Al)	0.3	1.3	0.5	0.2	0.3	1.1	0.4	0.2	0.1	1.9	1.4	0.3
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.2	0.9	0.9
Barium (Ba)	2.0	4.1	2.7	2.0	1.6	2.4	1.8	1.7	1.3	2.0	2.0	1.7
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	0.2	0.5	1.0	1.0	1.0	1.0	1.0
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	0.1	0.4	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.5	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.3	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	1.9	5.6	3.1	2.5	1.6	3.2	2.1	2.2	1.4	2.7	2.1	2.3
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.7	0.7	0.7	0.7
Cobalt (Co)	1.0	1.2	1.0	1.0	1.0	1.5	1.0	1.0	0.7	2.2	1.3	0.7
Copper (Cu)	2.3	1.8	2.2	1.1	2.5	1.3	1.9	1.0	1.8	1.3	1.6	0.9
Iron (Fe)	0.7	5.0	1.0	0.7	0.7	6.8	1.2	0.7	0.2	3.2	2.0	0.4
Lead (Pb)	0.8	2.1	0.8	0.8	0.6	1.3	0.6	0.6	0.2	2.9	1.6	0.3
Lithium (Li)	1.0	2.5	1.0	1.0	1.0	2.2	1.0	1.0	0.7	2.3	1.9	1.2
Magnesium (Mg)	2.1	5.7	3.2	2.9	1.7	3.4	2.1	2.3	1.5	3.0	2.2	2.5
Manganese (Mn)	0.7	34	4.3	1.0	0.8	50	5.5	0.9	0.4	14	5.7	0.9
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	3.0	19	3.9	1.8	2.3	10	2.4	1.0	2.1	4.1	2.4	1.0
Nickel (Ni)	1.0	1.8	1.0	1.0	1.0	2.1	1.3	1.0	0.9	2.0	1.7	0.8
Potassium (K)	3.0	7.3	3.6	2.3	2.7	4.8	2.6	2.0	2.4	3.6	2.8	1.9
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	0.1	0.4	1.0	1.0	1.6	1.1	1.0
Silicon (Si)	1.0	1.2	1.1	0.9	0.9	0.8	1.0	0.8	0.7	1.4	1.2	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0	1.0	1.0
Sodium (Na)	0.8	16	2.6	2.1	0.5	9.6	1.6	1.1	0.6	5.6	2.2	1.1
Strontium (Sr)	1.1	7.2	3.4	1.7	0.9	3.3	1.6	1.2	0.8	2.3	2.3	1.3
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	0.1	0.4	1.0	0.8	1.0	1.1	0.8
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	0.2	0.4	1.0	0.5	1.7	1.6	0.3
Uranium (U)	1.2	24	3.6	1.4	1.4	8.4	1.7	0.8	1.2	4.1	1.6	0.9
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	0.5	0.7	1.0	1.0	1.0	1.0	0.7
Zinc (Zn)	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).
Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Table C.16: Dissolved Metal Concentrations at Camp Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Spring Sampling Event							Summer Sampling Event							Fall Sampling Event						
			L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	LI-08	L1-02	L2-03	L1-09	L0-05	L0-01	K0-01
			09/Jul/17	09/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	07/Jul/17	10/Aug/17	28/Jul/17	28/Jul/17	28/Jul/17	28/Jul/17	28/Jul/17	27/Jul/17	01/Sep/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17	27/Aug/17
Dissolved Metals	Aluminum (Al)	mg/L	0.0052	0.0042	0.0100	0.0049	0.0054	0.0135	0.0049	0.0060	0.0052	0.0076	0.0055	0.0055	0.0046	0.0202	0.0062	<0.0050	0.0075	0.0052	0.0058	0.0054	<0.0050
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0041	0.0060	0.0099	0.0066	0.0067	0.0074	0.0052	0.0088	0.0089	0.0129	0.0094	0.0093	0.0096	0.0087	0.0090	0.0114	0.0124	0.0121	0.0124	0.0121	0.0123
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	<0.010	<0.010	0.015	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	4.89	8.10	18.7	9.95	10.80	12.40	8.67	10.70	13.50	23.80	15.70	15.10	16.80	15.90	13.00	18.40	29.60	23.60	23.40	24.90	25.50
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00124	0.00118	0.00113	0.00126	0.00141	0.00118	0.00075	0.00253	0.00219	0.00088	0.00167	0.00156	0.00149	0.00087	0.00247	0.00194	0.00093	0.00170	0.00161	0.00156	0.00099
	Iron (Fe)	mg/L	<0.030	<0.030	0.068	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.115	<0.030	<0.030	<0.030	<0.030	<0.030	0.012	0.113	0.040	0.043	0.033	<0.010
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	0.0023	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0026	0.0011	<0.0010	0.0013	<0.0010	<0.0010	0.0017	0.0035	0.0029	0.0031	0.0032	0.0021
	Magnesium (Mg)	mg/L	3.05	4.99	11.20	6.00	6.18	6.77	5.65	6.82	8.42	15.50	9.47	9.45	10.10	9.56	7.80	11.60	19.10	13.40	14.10	15.00	15.90
	Manganese (Mn)	mg/L	0.00025	0.00019	0.02020	0.00104	0.00241	0.00234	0.00035	0.00033	0.00026	0.02850	0.00279	0.00223	0.00142	0.00035	0.00019	0.00094	0.02980	0.00885	0.00855	0.00663	0.00069
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00029	0.00027	0.00180	0.00038	0.00037	0.00039	0.00018	0.00078	0.00041	0.00249	0.00063	0.00060	0.00063	0.00028	0.00057	0.00065	0.00156	0.00085	0.00084	0.00084	0.00034
	Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00079	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00098	0.00057	0.00055	0.00062	<0.00050	<0.00050	0.00061	0.00085	0.00076	0.00079	0.00084	<0.00050
	Potassium (K)	mg/L	0.960	1.070	2.440	1.200	1.210	1.280	0.785	1.810	1.430	2.950	1.630	1.570	1.630	1.200	1.900	1.900	2.720	2.090	2.110	2.200	1.540
	Selenium (Se)	mg/L	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00005	0.00012	0.00006	0.00005	0.00006	0.00006
	Silicon (Si)	mg/L	0.44	0.44	0.43	0.46	0.48	0.52	0.42	0.71	0.74	0.59	0.74	0.75	0.75	0.61	0.81	0.93	1.20	1.06	1.10	1.10	0.96
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	0.24	0.52	7.80	1.19	1.22	1.34	1.01	0.49	0.74	11.70	1.97	1.91	1.98	1.36	0.55	1.46	9.57	3.36	3.84	4.12	2.01
	Strontium (Sr)	mg/L	0.0027	0.0042	0.0223	0.0086	0.0112	0.0126	0.0052	0.0063	0.0068	0.0252	0.0123	0.0123	0.0138	0.0095	0.0077	0.0093	0.0234	0.0236	0.0276	0.0301	0.0142
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Uranium (U)	mg/L	0.00023	0.00029	0.00526	0.00071	0.00078	0.00080	0.00028	0.00197	0.00101	0.00829	0.00175	0.00168	0.00169	0.00089	0.00283	0.00194	0.00811	0.00311	0.00330	0.00316	0.00180
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0033	<0.0030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0020

Table C.17: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between the Camp Lake Tributaries and Average Reference Creek Stations, Mary River Project CREMP, 2017

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Aluminum (Al)	0.5	0.7	1.0	0.5	0.4	0.5	0.3	1.4	0.6	0.8	0.6	0.5
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	2.1	2.0	3.0	2.2	1.8	2.6	1.9	1.8	1.6	2.0	1.9	2.0
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	1.0	1.0
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.5	1.0	1.0	1.0
Boron (B)	1.0	1.5	1.0	1.0	1.0	1.7	1.0	1.0	1.0	1.2	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	1.9	2.5	3.4	2.5	1.6	3.2	2.2	2.1	1.4	2.6	2.2	2.3
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.5	1.0	1.0
Copper (Cu)	2.1	1.5	2.1	1.3	3.1	1.1	2.0	1.1	2.8	1.2	2.0	1.2
Iron (Fe)	1.0	2.3	1.0	1.0	1.0	3.8	1.0	1.0	1.9	10	3.3	0.9
Lead (Pb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lithium (Li)	1.0	2.3	1.1	1.0	1.0	2.6	1.2	1.0	1.3	3.3	3.0	2.0
Magnesium (Mg)	2.1	2.6	3.4	2.9	1.7	3.5	2.3	2.2	1.5	2.9	2.2	2.4
Manganese (Mn)	0.9	100	8.4	1.4	1.5	141	8.8	1.7	1.0	51	13	1.2
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	2.9	6.5	4.0	1.8	2.1	9.0	2.2	1.0	1.9	5.0	2.7	1.1
Nickel (Ni)	1.0	1.6	1.0	1.0	1.0	2.0	1.2	1.0	1.1	1.6	1.6	0.9
Potassium (K)	3.1	4.2	3.9	2.4	2.8	5.1	2.8	2.1	2.6	3.7	2.9	2.1
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	11	2.4	1.1	1.2
Silicon (Si)	1.1	0.6	1.3	1.1	1.0	0.8	1.0	0.8	1.0	1.4	1.3	1.1
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0	1.0	1.0
Sodium (Na)	0.8	6.5	2.6	2.1	0.5	9.8	1.6	1.1	0.6	5.6	2.3	1.2
Strontium (Sr)	1.1	2.8	3.7	1.6	0.8	3.1	1.7	1.2	0.8	2.2	2.7	1.3
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.5	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	16	0.9	0.9	0.9
Uranium (U)	1.3	5.0	4.0	1.5	1.4	7.9	1.6	0.8	1.3	4.3	1.7	0.9
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.1	2.0	1.0	1.0	2.0

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).

Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Table C.18: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations at the Camp Lake Tributaries between 2017 and Mine Baseline (2005-2013) Periods

Variable	Spring				Summer				Fall			
	CLT1			CLT2	CLT1			CLT2	CLT1			CLT2
	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01	North Branch	Upper Main Stem L2-03	Lower Main Stem	Station KO-01
Aluminum (Al)	0.6	3.2	1.1	0.9	1.1	1.1	1.2	4.1	1.4	2.8	2.1	1.4
Antimony (Sb)	0.5	1.0	1.0	0.6	0.7	1.0	1.0	0.6	0.7	1.0	1.0	0.6
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.6	2.2	1.8	1.0	1.3	1.4	1.1	1.0	1.0	0.7	0.9	1.2
Beryllium (Be)	0.3	RDL	RDL	0.4	0.5	2.1	2.1	0.4	0.3	0.4	0.4	0.1
Bismuth (Bi)	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.1	0.6	0.1	0.1	0.1
Boron (B)	0.5	1.5	1.0	0.6	0.6	1.7	1.0	1.0	1.0	1.2	1.0	1.0
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Calcium (Ca)	1.5	1.6	1.6	1.2	1.2	1.1	1.1	1.1	1.0	0.7	0.9	1.2
Chromium (Cr)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL
Cobalt (Co)	0.6	1.0	1.0	0.6	0.8	1.2	1.0	0.6	0.8	1.5	1.0	0.6
Copper (Cu)	1.3	1.9	1.3	1.0	1.4	1.0	1.0	0.9	1.3	1.3	1.0	0.4
Iron (Fe)	1.2	1.9	1.2	1.1	1.6	0.6	1.0	1.4	1.2	1.1	0.9	0.5
Lead (Pb)	0.5	1.0	1.0	0.6	0.7	1.0	1.0	0.6	0.7	1.0	1.0	0.6
Lithium (Li)	0.7	2.3	2.0	0.5	0.4	0.8	0.5	0.4	0.6	0.5	0.8	0.7
Magnesium (Mg)	1.5	1.7	1.6	1.3	1.2	1.3	1.2	1.2	1.0	0.9	1.0	1.2
Manganese (Mn)	0.2	7.1	0.7	0.1	1.0	2.3	1.0	0.5	1.4	2.1	1.8	0.6
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0
Molybdenum (Mo)	1.5	12	2.6	1.2	1.5	12	1.4	1.0	0.9	5.9	1.4	0.8
Nickel (Ni)	0.8	1.0	0.7	0.2	0.9	0.9	1.0	0.2	0.9	0.7	0.9	0.3
Potassium (K)	1.7	3.1	1.8	1.3	1.3	3.0	1.2	1.2	1.1	1.8	1.2	1.1
Selenium (Se)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	1.2	0.6	0.0
Silicon (Si)	1.2	0.7	1.2	0.9	1.3	0.7	1.1	1.0	1.1	0.9	1.0	1.5
Silver (Ag)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL
Sodium (Na)	1.1	7.7	2.1	2.6	1.0	6.6	1.8	1.2	1.0	2.8	1.7	1.1
Strontium (Sr)	1.6	1.7	1.9	1.5	1.3	0.8	1.0	1.2	1.0	0.2	0.5	1.2
Thallium (Tl)	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL	RDL
Titanium (Ti)	1.3	1.0	1.0	1.2	1.1	1.0	1.0	1.2	0.6	0.0	0.0	0.0
Uranium (U)	1.6	24	4.3	1.9	2.5	15	2.3	1.3	0.9	4.9	1.2	1.0
Vanadium (V)	1.0	1.0	1.0	1.0	0.8	1.0	1.0	0.9	0.7	0.5	0.5	0.3
Zinc (Zn)	2.1	2.1	1.5	2.4	2.2	1.7	1.2	1.4	1.5	0.5	0.7	1.6

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference value).

Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference value).

Note: RDL = Laboratory Reportable Detection Limit

Table C.19: *In Situ* Water Quality Statistical Comparisons among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Overall 3-group Comparison[a]			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	0.0958	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.1044	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.1939	
				CLT2 Upstream	CLT2 Downstream	NO	0.9223	
Dissolved Oxygen (mg/L)	NO	0.1584	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.2574	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.1791	
				CLT2 Upstream	CLT2 Downstream	NO	0.9687	
Dissolved Oxygen (% saturation)	YES	0.0057	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0589	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	NO	0.8455	
				CLT2 Upstream	CLT2 Downstream	NO	0.1012	
pH (units)	YES	0.0000	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0000	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0000	
				CLT2 Upstream	CLT2 Downstream	NO	0.8042	
Specific Conductance (µS/cm)	YES	0.0001	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0056	Tamhane's
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0055	
				CLT2 Upstream	CLT2 Downstream	NO	0.6806	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results validated using Kraskal Wallis H-test or Mann-Whitney U-test, as appropriate.

Table C.20: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09
Date Collected	11/Apr/17	11/Apr/17	14/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	14/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	14/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	14/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	11/Apr/17	14/Apr/17	11/Apr/17	11/Apr/17
1.0	0.1	0.1	0.3	0.2	0.1	16.6	15.8	15.0	14.7	15.5	113.6	108.5	103.4	101.3	106.5	8.09	7.82	7.51	7.73	7.75	226	169	189	210	181
2.0	0.1	0.1	0.2	0.6	0.3	16.4	15.8	15.1	14.8	15.2	113.7	108.7	104.1	102.3	105.1	8.08	7.82	7.51	7.74	7.76	222	185	189	218	179
3.0	1.0	1.1	1.0	1.2	1.2	15.2	15.1	14.9	14.4	14.8	107.8	106.7	104.6	101.8	104.4	8.04	7.82	7.55	7.75	7.76	217	178	187	217	174
4.0	1.3	1.3	1.3	1.4	1.3	15.1	14.8	14.7	14.2	14.6	107.2	105.1	104.1	100.9	103.4	8.01	7.81	7.57	7.75	7.75	215	177	185	219	173
5.0	1.4	1.3	1.3	1.4	1.4	15.0	14.6	14.5	14.1	14.4	107.0	104.2	103.1	100.6	102.5	7.97	7.80	7.58	7.75	7.75	211	177	185	219	173
6.0	1.4	1.4	1.4	1.5	1.4	15.0	14.6	14.5	14.1	14.3	106.9	103.5	102.9	100.2	101.9	7.94	7.79	7.59	7.75	7.74	208	177	184	218	172
7.0	1.4	1.4	1.5	1.5	1.5	15.0	14.6	14.2	14.1	14.1	106.7	104.0	101.6	100.7	100.4	7.92	7.78	7.60	7.74	7.74	204	177	184	218	172
8.0	1.5	1.5	1.5	1.5	1.5	14.9	14.6	14.1	14.2	13.9	106.0	104.0	100.8	101.4	99.5	7.91	7.77	7.60	7.73	7.73	202	177	183	217	172
9.0	1.5	1.5	1.6	1.5	1.6	14.9	14.4	13.9	14.2	13.8	106.1	103.0	99.8	101.4	98.5	7.89	7.76	7.60	7.73	7.73	200	176	183	215	171
10.0	1.5	1.5	1.7	1.5	1.6	14.9	14.3	15.8	14.1	13.7	106.0	102.1	98.6	100.5	98.0	7.87	7.75	7.60	7.73	7.73	199	176	182	212	171
11.0	1.5	1.6	1.7	1.6	1.7	14.9	14.1	15.6	13.8	13.5	106.0	101.3	97.6	99.2	96.4	7.86	7.74	7.60	7.73	7.72	198	176	182	209	171
12.0	1.5	1.6	1.8	1.7	1.7	14.6	13.9	13.4	13.6	13.3	104.0	99.1	96.3	97.9	95.7	7.81	7.71	7.60	7.73	7.71	198	177	181	206	170
13.0			1.8	1.8	1.8			13.3	13.4	13.1			96.0	96.4	94.1			7.60	7.72	7.68			182	202	171
14.0			1.9	1.9	1.8			13.2	13.2	12.9			95.2	94.9	93.2			7.58	7.72	7.67			181	198	170
15.0			1.9	1.9	1.9			12.9	13.0	12.6			92.9	93.6	91.0			7.58	7.71	7.66			182	196	170
16.0			1.9	2.0				12.6	12.4				91.0	89.6				7.57	7.67				182	190	
17.0				2.0					11.8					85.5					7.65					189	
18.0				2.0					11.4					82.7					7.62					188	
19.0				2.1					11.2					81.3					7.60					188	
20.0				2.1					10.9					79.1					7.59					187	
21.0				2.1					10.6					77.2					7.56					186	
22.0				2.1					10.5					76.0					7.54					187	
23.0				2.2					10.3					74.6					7.52					186	
24.0				2.2					9.9					71.9					7.50					186	
25.0				2.3					9.3					68.0					7.46					185	
26.0				2.3					9.1					66.6					7.43					186	
27.0				2.5					8.2					60.5					7.40					186	
28.0				2.6					7.1					52.3					7.36					188	
29.0				2.6					6.3					47.0					7.33					188	
30.0				2.7					5.5					40.7					7.30					190	
31.0				2.8					4.5					33.0					7.25					193	
32.0				2.9					2.3					17.3					7.16					203	

Notes:
Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.6, 12.7, 16.2, 33.2, and 16.1 m, respectively, at the time of winter sampling.
Ice thickness at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 1.90, 1.91, 1.80, 1.69, and 1.50 m, respectively, at the time of winter sampling.
Deepest measurement at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.6, 11.5, 16.2, 32, and 15 m, respectively, at the time of winter sampling.

Table C.21: *In Situ* Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-09
Date Collected	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17
1.0	6.0	6.1	6.1	6.1	5.9	12.38	11.85	12.00	12.03	12.44	99.4	94.8	98.4	95.8	99.5	7.99	8.05	7.83	7.88	7.94	114	114	114	114	114
2.0	6.0	6.0	6.0	6.0	5.9	12.44	12.18	28.00	12.03	12.45	99.9	97.2	99.9	98.8	99.7	7.97	8.02	7.93	7.95	7.96	114	114	114	114	114
3.0	5.9	6.0	6.0	6.0	5.8	12.45	12.24	12.44	12.37	12.46	99.9	98.4	100.1	99.4	99.7	7.95	7.98	7.96	7.97	7.97	114	114	114	114	114
4.0	5.9	6.0	6.0	6.0	5.8	12.45	12.30	12.45	12.39	12.46	99.9	98.9	100.1	99.6	99.7	7.95	7.96	7.97	7.97	7.97	114	114	114	114	114
5.0	5.9		6.0	6.0	5.8	12.45		12.46	12.41	12.46	99.9		100.3	99.8	99.8	7.94		7.97	7.96	7.97	114		114	114	114
6.0	5.9		6.0	6.0	5.8	12.46		12.48	12.41	12.46	99.9		100.3	99.8	99.7	7.94		7.97	7.97	7.97	114		114	114	114
7.0	5.9		6.0	6.0	5.8	12.45		12.48	12.41	12.46	99.8		100.1	99.8	99.7	7.94		7.97	7.97	7.97	114		114	114	114
8.0	5.9		6.0	6.0	5.8	12.46		12.47	12.41	12.45	99.9		100.0	99.8	99.6	7.94		7.97	7.97	7.97	114		114	114	114
9.0	5.9		6.0	6.0	5.8	12.46		12.46	12.42	12.46	99.9		100.0	99.9	99.7	7.94		7.96	7.97	7.96	114		114	114	114
10.0	5.9		6.0	6.0	5.8	12.45		12.46	12.40	12.42	99.8		100.0	99.7	99.3	7.93		7.96	7.97	7.97	114		114	114	114
11.0	5.9		5.9	6.0	5.8	12.44		12.46	12.42	12.43	99.7		100.0	99.9	99.5	7.93		7.96	7.97	7.97	114		114	114	114
12.0			6.0	6.0	5.9			12.45	12.41	12.43			100.0	99.8	99.5			7.95	7.97	7.97			114	114	114
13.0			6.0	6.0	5.8			12.46	12.40	12.43			100.0	99.8	99.5			7.96	7.97	7.97			114	114	114
14.0			5.9	6.0	5.8			12.45	12.40	12.43			99.9	99.8	99.5			7.96	7.97	7.97			114	114	114
15.0				6.0					12.40					99.7					7.97					114	
16.0				6.0					12.40					99.7					7.97					114	
17.0				6.0					12.39					99.7					7.97					114	
18.0				6.0					12.39					99.6					7.97					114	
19.0				6.0					12.38					99.6					7.97					114	
20.0				6.0					12.38					99.5					7.97					114	
21.0				6.0					12.38					99.4					7.97					114	
22.0				6.0					12.37					99.4					7.97					114	
23.0				6.0					12.37					99.3					7.97					114	
24.0				6.0					12.37					99.4					7.96					114	
25.0				6.0					12.37					99.3					7.97					114	
26.0				6.0					12.37					99.3					7.97					114	
27.0				5.9					12.37					99.2					7.97					114	
28.0				5.9					12.36					99.2					7.97					114	
29.0				5.9					12.37					99.2					7.97					114	
30.0				5.9					12.36					99.2					7.97					114	
31.0				5.9					12.37					99.2					7.97					114	
32.0				5.9					12.36					99.2					7.97					114	

Note:
Total depth at stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 12.26, 5.9, 15.9, 32.45, and 15.64 m, respectively, at the time of summer sampling.

Table C.22: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)					
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09
Date Collected	26/Aug/17	25/Aug/17	26/Aug/17	26/Aug/17	19/Aug/17	25/Aug/17	26/Aug/17	25/Aug/17	26/Aug/17	26/Aug/17	19/Aug/17	25/Aug/17	26/Aug/17	25/Aug/17	26/Aug/17	26/Aug/17	19/Aug/17	25/Aug/17
surface					8.4						11.69						100.2	
1.0	8.7	8.7	8.5	8.4	8.4	8.5	11.72	11.81	11.76	11.79	11.53	11.8	100.2	101.4	100.3	100.0	98.4	100.4
2.0	8.5	8.7	8.4	8.4	8.4	8.4	11.74	11.82	11.77	11.78	11.48	11.8	100.4	101.5	100.4	100.3	98.0	100.5
3.0	8.5	8.7	8.4	8.3	8.4	8.4	11.73	11.82	11.76	11.77	11.47	11.8	100.4	101.5	100.4	100.3	97.8	100.6
4.0	8.5	8.7	8.4	8.4	8.4	8.4	11.73	11.81	11.76	11.76	11.44	11.8	100.3	101.4	100.3	100.2	97.6	100.6
5.0	8.5	8.6	8.4	8.3	8.4	8.4	11.73	11.81	11.76	11.75	11.43	11.8	100.3	101.3	100.3	100.1	97.4	100.6
6.0	8.5	8.6	8.4	8.3	8.4	8.4	11.73	11.81	11.75	11.74	11.46	11.8	100.3	101.2	100.3	100.0	97.8	100.6
7.0	8.5	8.5	8.4	8.3	8.4	8.4	11.73	11.82	11.75	11.75	11.44	11.8	100.1	101.1	100.2	100.1	97.5	100.5
8.0	8.5	8.5	8.4	8.3	8.4	8.4	11.73	11.83	11.74	11.74	11.45	11.8	100.2	101.1	100.2	100.0	97.5	100.5
9.0	8.4	8.5	8.4	8.3	8.3	8.3	11.73	11.83	11.74	11.74	11.45	11.8	100.0	101.1	100.1	99.9	97.4	100.2
10.0	8.3		8.4	8.3	8.3	8.3	11.73		11.74	11.73	11.44	11.8	99.8		100.1	99.9	97.2	100.3
11.0	8.3		8.4	8.3	8.2	8.3	11.71		11.73	11.73	11.44	11.8	99.6		100.0	99.9	97.2	100.2
12.0			8.4	8.3	8.1	8.3			11.73	11.72	11.47	11.8			99.9	99.8	97.1	100.1
13.0			8.3	8.3	7.9	8.2			11.72	11.72	11.52	11.7			99.8	99.8	97.0	99.5
14.0			8.3	8.3	7.8	8.2			11.71	11.71	11.54	11.7			99.7	99.7	97.0	99.4
15.0			8.3	8.3	7.7				11.71	11.71	11.55				99.7	99.7	97.0	
16.0				8.3	7.7					11.70	11.56					99.6	96.9	
17.0				8.3	7.6					11.70	11.57					99.6	96.7	
18.0				8.3	7.5					77.69	11.58					99.5	96.7	
19.0				8.3	7.5					11.69	11.59					99.4	96.5	
20.0				8.3	7.3					11.68	11.63					99.4	96.4	
21.0				8.2	7.0					11.63	11.68					98.4	96.1	
22.0				7.5	6.8					11.64	11.67					97.2	95.6	
23.0				7.1	6.7					11.65	11.65					96.3	95.3	
24.0				7.1	6.7					11.63	11.61					96.1	95.0	
25.0				6.9	6.7					11.61	11.61					95.9	94.9	
26.0				6.8	6.7					11.57	11.61					94.9	94.8	
27.0				6.7	6.7					11.57	11.59					94.1	94.7	
28.0				6.7	6.6					11.50	11.58					91.0	94.6	
29.0				6.7	6.6					11.47	11.58					93.7	94.5	
30.0				6.6	6.5					11.45	11.55					93.5	94.0	
31.0				6.6						11.40						93.1		
32.0				6.6						11.33						92.5		

Notes:
25-Aug-17 and 26-Aug-17 sampling was conducted by Baffinland. 19-Aug-17 sampling was conducted by Minnow.
Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.5, 9.85, 16.2, 32.5, 15.05 m, respectively, at the time of fall sampling.

Table C.22: ***In Situ*** **Water Quality Profile Data Collected at Camp Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	pH (pH units)						Specific Conductance (µS/cm)					
	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09	JLO-02	JLO-10	JLO-01	JLO-07	JLO-07	JLO-09
Date Collected	26/Aug/17	25/Aug/17	26/Aug/17	26/Aug/17	19/Aug/17	25/Aug/17	26/Aug/17	25/Aug/17	26/Aug/17	26/Aug/17	19/Aug/17	25/Aug/17
surface					8.09						133	
1.0	7.86	7.74	7.79	7.79	8.13	7.80	121	120	120	120	133	120
2.0	7.86	7.77	7.81	7.77	8.15	7.76	121	120	120	120	133	120
3.0	7.86	7.77	7.83	7.78	8.15	7.75	121	120	120	120	133	120
4.0	7.88	7.77	7.84	7.81	8.15	7.73	121	120	120	120	132	120
5.0	7.87	7.77	7.84	7.83	8.13	7.71	121	120	120	120	132	120
6.0	7.87	7.78	7.85	7.83	8.09	7.70	121	120	120	120	132	120
7.0	7.87	7.77	7.85	7.83	8.08	7.70	120	120	120	120	132	120
8.0	7.87	7.78	7.85	7.83	8.08	7.69	121	120	120	120	132	120
9.0	7.87	7.78	7.86	7.84	8.06	7.70	120	120	120	120	132	120
10.0	7.87		7.86	7.85	8.05	7.70	120		120	120	132	120
11.0	7.86		7.86	7.85	8.05	7.69	121		120	120	132	120
12.0			7.86	7.89	8.02	7.69			120	120	133	120
13.0			7.86	7.89	8.00	7.67			120	120	134	120
14.0			7.86	7.89	7.98	7.66			120	120	133	120
15.0			7.86	7.89	7.96				120	120	133	
16.0				7.83	7.93					120	131	
17.0				7.83	7.92					120	132	
18.0				7.83	7.90					120	132	
19.0				7.82	7.89					120	132	
20.0				7.82	7.89					120	131	
21.0				7.73	7.88					120	131	
22.0				7.75	7.86					119	132	
23.0				7.71	7.83					119	131	
24.0				7.70	7.80					119	131	
25.0				7.68	7.77					118	131	
26.0				7.66	7.78					118	131	
27.0				7.69	7.77					118	131	
28.0				7.63	7.77					118	131	
29.0				7.61	7.76					118	131	
30.0				7.60	7.76					119	131	
31.0				7.59						119		
32.0				7.59						119		

Notes:
25-Aug-17 and 26-Aug-17 sampling was conducted by Baffinland. 19-Aug-17 sampling was conducted by Minnow.
Total depth at Stations JLO-02, JLO-10, JLO-01, JLO-07, and JLO-09 was 11.5, 9.85, 16.2, 32.5, 15.05 m, respectively, at the time of fall sampling.

Table C.23: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Camp Lake Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	JLO-02	18-Aug-17	12.4	6.0	surface	8.19	11.86	100.9	8.03	133
					bottom	7.82	12.04	101.7	7.75	134
	JLO-21	19-Aug-17	9.9	6.8	surface	8.20	11.71	99.6	8.17	133
					bottom	7.82	11.58	97.5	8.17	134
	JLO-20	18-Aug-17	6.3	5.8	surface	8.23	12.03	102.7	8.22	132
					bottom	8.04	11.68	98.9	7.78	133
	JLO-19	19-Aug-17	7.0	7.0	surface	8.34	11.68	99.7	8.18	132
					bottom	8.07	11.62	98.3	8.23	133
	JLO-18	19-Aug-17	11.5	6.4	surface	8.20	11.60	98.5	8.01	133
					bottom	7.94	11.56	97.5	7.84	134
Profundal (Deep) Stations	JLO-01	18-Aug-17	16.5	6.8	surface	8.83	11.47	98.0	8.23	130
					bottom	7.81	11.57	97.4	7.70	133
	JLO-07	19-Aug-17	35.1	6.2	surface	8.43	11.69	100.2	8.09	133
					bottom	6.52	11.55	94.0	7.76	131
	JLO-16	19-Aug-17	16.5	5.7	surface	8.27	11.70	99.5	8.14	132
					bottom	7.62	11.42	95.6	8.02	133
	JLO-11	18-Aug-17	33.0	7.0	surface	8.39	11.43	97.4	7.98	132
					bottom	6.48	10.25	83.1	7.19	132
	JLO-12	19-Aug-17	16.2	6.2	surface	8.58	11.58	99.4	8.26	133
					bottom	7.91	11.54	97.2	8.05	132

Table C.24: Statistical Comparison of Bottom *In Situ* Water Quality Between Camp Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2017

Habitat Variable	Statistical Test Results			Summary Statistics					
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Mean (n = 5)	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	1.000	α	Littoral	6.38	0.51	0.23	5.80	7.00
				Profundal	6.38	0.52	0.23	5.70	7.00
Temperature (˚C)	NO	0.102	δ	Littoral	7.94	0.12	0.05	7.82	8.07
				Profundal	7.27	0.71	0.32	6.48	7.91
Dissolved Oxygen (mg/L)	YES	0.016	γ	Littoral	11.7	0.2	0.1	11.6	12.0
				Profundal	11.3	0.6	0.3	10.3	11.6
Dissolved Oxygen (% saturation)	YES	0.008	γ	Littoral	98.8	1.7	0.8	97.5	101.7
				Profundal	93.5	6.0	2.7	83.1	97.4
pH (units)	NO	0.290	α	Littoral	7.95	0.23	0.10	7.75	8.23
				Profundal	7.74	0.35	0.15	7.19	8.05
Specific Conductance (umho/cm)	YES	0.009	α	Littoral	133.5	0.4	0.2	133.0	134.0
				Profundal	132.2	0.8	0.3	131.4	133.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.25: Statistical Comparison of Bottom *In Situ* Water Quality Between Camp Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	Station Depth (m)	NO	0.810	α , η	Reference	5	9.74	1.04	0.46	8.50	11.20
					Camp	5	9.42	2.69	1.20	6.30	12.40
	Secchi Depth (m)	YES	0.002	α	Reference	5	8.26	0.74	0.33	7.50	9.40
					Camp	5	6.38	0.51	0.23	5.80	7.00
	Temperature (˚C)	YES	0.004	α	Reference	5	8.29	0.16	0.07	8.05	8.42
					Camp	5	7.94	0.12	0.05	7.82	8.07
	Dissolved Oxygen (mg/L)	NO	0.326	β , ζ	Reference	5	11.8	0.1	0.0	11.7	11.9
					Camp	5	11.7	0.2	0.1	11.6	12.0
	Dissolved Oxygen (% saturation)	NO	0.128	α	Reference	5	100.3	0.9	0.4	99.0	101.0
					Camp	5	98.8	1.7	0.8	97.5	101.7
	pH (units)	YES	0.004	α	Reference	5	7.43	0.17	0.08	7.31	7.72
					Camp	5	7.95	0.23	0.10	7.75	8.23
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	5	73.7	0.6	0.3	73.2	74.6
					Camp	5	133.5	0.4	0.2	133.0	134.0
Profundal (Deep) Stations	Station Depth (m)	NO	0.714	β , ζ	Reference	5	20.56	2.17	0.97	18.50	24.20
					Camp	5	23.46	9.70	4.34	16.20	35.10
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.28	0.43	0.19	7.90	9.00
					Camp	5	6.38	0.52	0.23	5.70	7.00
	Temperature (˚C)	NO	0.627	α	Reference	5	7.48	0.61	0.27	6.47	8.10
					Camp	5	7.27	0.71	0.32	6.48	7.91
	Dissolved Oxygen (mg/L)	NO	0.405	β , ζ	Reference	5	11.6	0.5	0.2	10.7	12.0
					Camp	5	11.3	0.6	0.3	10.3	11.6
	Dissolved Oxygen (% saturation)	NO	0.259	β , ζ	Reference	5	97.3	3.6	1.6	93.0	100.7
					Camp	5	93.5	6.0	2.7	83.1	97.4
	pH (units)	YES	0.020	α	Reference	5	7.29	0.06	0.03	7.23	7.37
					Camp	5	7.74	0.35	0.15	7.19	8.05
	Specific Conductance (umho/cm)	YES	< 0.001	α , η	Reference	5	76.1	3.5	1.5	73.2	80.6
					Camp	5	132.2	0.8	0.3	131.4	133.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											Summer Sampling Event					
					JL0-02 bottom 11-Apr-17	JL0-02 surface 11-Apr-17	JL0-10 bottom 11-Apr-17	JL0-10 surface 11-Apr-17	JL0-01 bottom 14-Apr-17	JL0-01 surface 14-Apr-17	JL0-07 bottom 11-Apr-17	JL0-07 surface 11-Apr-17	JL0-09 bottom 11-Apr-17	JL0-09 surface 11-Apr-17	J0-01 outlet 9-Jul-17	JL0-02 bottom 24-Jul-17	JL0-02 surface 24-Jul-17	JL0-10 bottom 24-Jul-17	JL0-10 surface 24-Jul-17	JL0-01 bottom 24-Jul-17	JL0-01 surface 24-Jul-17
Conventionals	Conductivity (lab)	umho/cm	-	-	163	167	160	166	155	168	153	158	174	170	130	137	137	137	137	137	137
	pH (lab)	pH	6.5 - 9.0	-	7.89	7.86	7.77	7.85	7.70	7.86	7.51	7.86	7.78	7.80	7.91	7.85	7.89	7.86	7.90	7.80	7.87
	Hardness (as $CaCO_3$)	mg/L	-	-	82	82	78	86	78	87	78	82	74	86	61	66	65	66	66	66	67
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.6	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	72	77	70	75	84	94	72	72	81	77	68	78	82	79	60	79	77
	Turbidity	NTU	-	-	0.1	0.2	0.2	0.2	0.1	0.2	0.3	0.3	0.1	0.2	0.5	0.8	0.6	0.9	0.8	0.6	0.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	75	80	74	77	70	78	74	79	85	80	57	64	62	64	62	59	58
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.022	0.020	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.023
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	0.023	<0.020	0.068	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	0.023	<0.021	0.068	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	1.9	2.1	1.9	2.0	1.9	2.1	1.8	1.9	1.9	2.0	1.5	1.8	1.8	1.7	1.8	1.8	1.8
	Total Organic Carbon	mg/L	-	-	2.0	2.1	2.0	2.0	1.8	1.9	1.8	1.9	1.8	2.1	1.7	1.7	1.8	1.8	1.8	1.9	1.8
	Total Phosphorus	mg/L	0.020[α]	-	0.0050	0.0034	<0.0030	0.0033	0.0030	0.0039	0.0033	<0.0030	0.0040	<0.0030	0.0040	0.0038	0.0067	0.0031	0.0041	0.0054	0.0058
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	4.5	4.7	4.4	4.7	4.2	4.6	4.9	4.4	4.9	4.7	3.6	3.7	3.7	3.7	3.7	3.7	3.6
	Sulphate (SO_4)	mg/L	218[β]	218	2.7	2.8	2.6	2.8	2.5	2.8	2.5	2.6	2.9	2.8	2.6	2.7	2.8	2.7	2.7	2.7	2.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	0.005	0.003	<0.003	<0.003	0.010	0.011	0.018	0.008	0.007	0.007	0.009
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0075	0.0078	0.0077	0.0078	0.0076	0.0080	0.0076	0.0082	0.0072	0.0080	0.0060	0.0065	0.0063	0.0064	0.0065	0.0063	0.0064
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.0001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	16	17	16	17	16	17	16	17	15	16	12	13	13	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.0010	0.0010	0.0010	0.0010	0.0010	0.0011	0.0010	0.0010	0.0009	0.0010	0.0008	0.0008	0.0009	0.0009	0.0009	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0013	0.0010	0.0011	0.0011	0.0010	<0.0010	0.0012	0.0011	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.7	10.4	9.8	9.8	9.6	10.5	9.5	10.0	9.1	10.3	7.3	8.0	8.1	8.1	8.2	8.2	8.0
	Manganese (Mn)	mg/L	0.935[β]	-	0.0005	0.0004	0.0004	0.0003	0.0005	0.0004	0.0016	0.0004	0.0006	0.0003	0.0030	0.0028	0.0030	0.0029	0.0029	0.0027	0.0029
	Mercury (Hg)	mg/L	0.000026	-	0.00004	0.00002	<0.00001	0.00002	<0.00001	0.00001	0.00002	<0.00001	0.00002	0.00003	<0.00001	0.00004	0.00001	<0.00001	<0.00001	0.00003	0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00033	0.00036	0.00032	0.00035	0.00032	0.00035	0.00029	0.00035	0.00031	0.00034	0.00027	0.00030	0.00028	0.00027	0.00028	0.00028	0.00027
	Nickel (Ni)	mg/L	0.025	0.025	0.00072	0.00077	0.00069	0.00071	0.00071	0.00081	0.00071	0.00069	0.00067	0.00075	0.00057	0.00062	0.00062	0.00060	0.00063	0.00065	0.00060
	Potassium (K)	mg/L	-	-	1.28	1.32	1.26	1.29	1.34	1.46	1.23	1.30	1.21	1.35	1.02	1.09	1.09	1.09	1.09	1.08	1.07
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.43	0.45	0.44	0.43	0.47	0.45	0.94	0.45	0.45	0.45	0.39	0.39	0.39	0.38	0.39	0.38	0.36
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.9	1.8	1.8	1.8	1.8	2.0	2.2	1.9	1.7	1.9	1.4	1.5	1.5	1.6	1.5	1.5	1.6
	Strontium (Sr)	mg/L	-	-	0.012	0.013	0.012	0.013	0.012	0.013	0.012	0.012	0.012	0.012	0.009	0.010	0.010	0.010	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	0.00082	0.00036	0.00088	0.00033	0.00018	0.00018	0.00235	0.00252	0.00113	0.00064	<0.00010	0.00051	0.00073	<0.00010	<0.00010	0.00064	0.00024
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0009	0.0010	0.0009	0.0009	0.0009	0.0010	0.0008	0.0009	0.0008	0.0009	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake system.

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.26: Water Chemistry at Camp Lake (JLO) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event					Fall Sampling Event										
					JL0-07 bottom 24-Jul-17	JL0-07 surface 24-Jul-17	JL0-09 bottom 24-Jul-17	JL0-09 surface 24-Jul-17	J0-01 outlet 10-Aug-17	JL0-02 bottom 26-Aug-17	JL0-02 surface 26-Aug-17	JL0-10 bottom 25-Aug-17	JL0-10 surface 25-Aug-17	JL0-01 bottom 26-Aug-17	JL0-01 surface 26-Aug-17	JL0-07 bottom 26-Aug-17	JL0-07 surface 26-Aug-17	JL0-09 bottom 25-Aug-17	JL0-09 surface 25-Aug-17	J0-01 outlet 1-Sep-17
Conventionals	Conductivity (lab)	umho/cm	-	-	137	137	137	137	138	140	140	140	140	140	140	139	141	140	140	139
	pH (lab)	pH	6.5 - 9.0	-	7.89	7.83	7.87	7.80	8.07	8.04	8.05	8.05	8.06	8.05	8.06	8.01	7.92	8.00	8.04	8.02
	Hardness (as $CaCO_3$)	mg/L	-	-	67	66	66	66	64	68	68	65	66	67	67	65	67	66	65	66
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	69	54	78	73	69	70	51	65	53	64	63	65	58	63	54	69
	Turbidity	NTU	-	-	0.7	0.6	0.6	0.7	0.5	0.4	0.6	0.7	0.9	0.5	0.4	0.4	0.4	0.7	0.7	0.7
	Alkalinity (as $CaCO_3$)	mg/L	-	-	63	60	59	61	65	65	67	63	62	66	62	66	65	63	65	66
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.031	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	0.17	<0.15
	Nitrate and Nitrite (as N)	mg/L	-	-	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Dissolved Organic Carbon	mg/L	-	-	1.8	1.8	1.8	1.8	1.9	1.8	1.7	1.7	1.8	1.8	1.8	1.5	1.8	1.6	1.7	1.7
	Total Organic Carbon	mg/L	-	-	1.8	1.8	1.8	1.8	1.9	1.8	1.8	1.7	1.8	1.7	1.7	1.7	1.7	1.8	1.8	1.7
	Total Phosphorus	mg/L	0.020^{α}	-	0.0052	0.0051	0.0045	0.0033	0.0039	0.0048	0.0055	<0.0030	<0.0030	0.0071	0.0035	0.0081	0.0035	<0.0030	<0.0030	0.0051
	Phenols	mg/L	0.001^{α}	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0028	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	0.0010	<0.0010	0.0019
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.7	3.7	3.7	3.7	3.5	3.4	3.7	3.5	3.7	3.3	3.2	3.6	3.7	3.4	3.6	3.7
	Sulphate (SO_4)	mg/L	218^{β}	218	2.7	2.7	2.7	2.7	2.9	2.6	3.0	2.7	2.9	2.6	2.4	2.8	2.9	2.7	2.9	3.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.1	0.008	0.010	0.010	0.008	0.004	0.006	0.005	0.004	0.005	0.005	0.006	0.006	0.005	0.005	0.005	0.005
	Antimony (Sb)	mg/L	0.020^{α}	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0062	0.0063	0.0065	0.0063	0.0064	0.0067	0.0066	0.0063	0.0064	0.0065	0.0065	0.0064	0.0065	0.0064	0.0065	0.0065
	Beryllium (Be)	mg/L	0.011^{α}	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.0001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	13	13	13	13	13	14	14	13	13	13	13	13	13	13	13	13
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009^{α}	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.004	0.0008	0.0008	0.0011	0.0010	0.0009	0.0008	0.0008	0.0009	0.0008	0.0008	0.0011	0.0008	0.0008	0.0009	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.057
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	0.0015	0.0013	0.0013	0.0014	0.0014	0.0013	0.0013	0.0012	0.0013	0.0012
	Magnesium (Mg)	mg/L	-	-	8.1	8.1	7.9	8.1	7.9	8.4	8.6	8.5	8.3	8.4	8.4	8.3	8.3	8.2	8.1	8.2
	Manganese (Mn)	mg/L	0.935^{β}	-	0.0028	0.0028	0.0028	0.0028	0.0024	0.0017	0.0017	0.0016	0.0017	0.0016	0.0017	0.0018	0.0017	0.0017	0.0017	0.0028
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00028	0.00028	0.00029	0.00028	0.00030	0.00030	0.00029	0.00029	0.00029	0.00030	0.00029	0.00028	0.00029	0.00028	0.00029	0.00030
	Nickel (Ni)	mg/L	0.025	0.025	0.00060	0.00061	0.00065	0.00069	0.00059	0.00061	0.00057	0.00058	0.00055	0.00059	0.00058	0.00060	0.00058	0.00058	0.00056	0.00075
	Potassium (K)	mg/L	-	-	1.09	1.09	1.08	1.09	1.06	1.14	1.13	1.11	1.09	1.12	1.13	1.12	1.10	1.10	1.08	1.06
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.39	0.39	0.38	0.38	0.35	0.32	0.32	0.32	0.31	0.32	0.33	0.41	0.31	0.31	0.33	0.34
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.5	1.5	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.4	1.4	1.4	1.4
	Strontium (Sr)	mg/L	-	-	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0007	0.0007	0.0007	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0008
	Vanadium (V)	mg/L	0.006^{α}	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Camp Lake system.

(grey box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.27: **Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Camp Lake and Reference Lake 3 in 2017, and Between Camp Lake 2017 and Baseline (2005 - 2013), Mary River Project CREMP**

Parameter	Camp Lake vs Reference Lake 3 in 2017		Camp Lake 2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.8	1.8	1.3	1.2	1.2
Hardness (as $CaCO_3$)	1.9	1.9	1.3	1.1	1.1
Total Suspended Solids (TSS)	1.0	1.0	1.0	1.0	1.0
Total Dissolved Solids (TDS)	2.0	1.7	0.9	1.0	0.8
Turbidity	1.8	1.2	1.0	1.3	1.8
Alkalinity (as $CaCO_3$)	1.9	2.0	1.2	1.1	1.1
Total Ammonia	0.6	1.1	0.4	0.3	0.8
Nitrate	1.0	1.0	0.3	0.2	0.2
Nitrite	1.0	1.0	1.9	0.2	1.0
Total Kjeldahl Nitrogen (TKN)	0.8	1.0	0.8	0.7	0.5
Dissolved Organic Carbon	0.6	0.6	1.0	1.0	1.0
Total Organic Carbon	0.6	0.6	1.0	0.9	1.0
Total Phosphorus	0.7	1.1	0.6	1.0	0.9
Phenols	1.0	0.5	1.0	0.8	1.2
Bromide (Br)	1.0	1.0	1.1	0.4	0.4
Chloride (Cl)	3.0	2.7	3.3	1.9	1.6
Sulphate (SO_4)	0.7	0.7	1.9	1.9	1.0
Aluminum (Al)	2.9	1.3	2.0	0.7	0.8
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.0	1.0	1.3	1.2	1.1
Beryllium (Be)	1.0	1.0	1.1	1.3	2.8
Cadmium (Cd)	1.0	1.0	0.6	0.8	0.9
Calcium (Ca)	1.9	1.9	1.3	1.1	1.1
Chromium (Cr)	1.0	1.0	RDL	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.0	1.0	0.9	0.3	1.0
Iron (Fe)	1.0	1.0	1.1	1.1	1.7
Lead (Pb)	1.0	1.0	0.7	0.6	1.0
Lithium (Li)	1.0	1.3	0.2	0.2	
Magnesium (Mg)	1.8	1.9	1.3	1.1	1.2
Manganese (Mn)	4.5	2.8	0.6	1.4	1.1
Mercury (Hg)	1.6	1.0	1.8	1.5	1.0
Molybdenum (Mo)	2.0	2.4	1.6	1.4	1.4
Nickel (Ni)	1.3	1.2	1.1	0.9	1.0
Potassium (K)	1.2	1.3		1.3	1.3
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.9	0.8	1.0	0.9	0.8
Silver (Ag)	1.0	1.0	1.1	1.6	2.7
Sodium (Na)	1.7	1.7		1.7	1.4
Strontium (Sr)	1.3	1.3	1.7	1.4	1.3
Thallium (Tl)	1.0	1.0	1.1	1.3	RDL
Tin (Sn)	2.7	1.0	0.8	0.6	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.7	2.8	2.0	1.6	1.4
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	2.4	1.3	1.3

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.28: Spearman's Rank Correlation Coefficients for Camp Lake (JLO) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Conventional Parameters							Total Metals														
	Total Dissolved Solids	Turbidity	Alkalinity	Ammonia (total)	Phosphorus (total)	Cloride	Sulphate	Aluminum	Barium	Calcium	Copper	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Uranium
Total Dissolved Solids	1	-0.341	0.227	0.085	-0.004	0.494	-0.149	-0.066	0.269	0.185	0.505	-0.505	0.130	-0.097	0.602	0.250	0.674	0.245	0.605	0.708	0.397	0.518
Turbidity	-0.341	1	-0.675	-0.227	0.080	-0.460	0.185	0.661	-0.660	-0.706	-0.451	-0.055	-0.693	0.694	-0.354	-0.663	-0.510	-0.734	-0.601	-0.550	-0.681	-0.506
Alkalinity	0.227	-0.675	1	0.113	-0.265	0.667	0.163	-0.820	0.814	0.855	0.443	0.235	0.819	-0.831	0.335	0.859	0.538	0.789	0.524	0.533	0.759	0.653
Ammonia (total)	0.085	-0.227	0.113	1	0.123	0.096	0.089	0.032	0.103	0.051	-0.001	-0.136	0.091	-0.042	0.256	-0.117	0.129	0.123	0.275	0.289	-0.054	-0.157
Phosphorus (total)	-0.004	0.080	-0.265	0.123	1	-0.181	0.119	0.421	-0.346	-0.408	-0.340	-0.067	-0.332	0.450	0.094	-0.321	-0.058	-0.330	-0.115	-0.098	-0.386	-0.277
Chloride	0.494	-0.460	0.667	0.096	-0.181	1	0.147	-0.467	0.609	0.556	0.508	-0.318	0.559	-0.463	0.534	0.530	0.746	0.555	0.776	0.799	0.590	0.832
Sulphate	-0.149	0.185	0.163	0.089	0.119	0.147	1	-0.160	-0.064	-0.053	-0.363	0.185	-0.054	-0.024	0.074	0.055	-0.116	-0.195	-0.220	-0.176	-0.054	0.016
Aluminum (total)	-0.066	0.661	-0.820	0.032	0.421	-0.467	-0.160	1	-0.681	-0.818	-0.400	-0.278	-0.827	0.908	-0.175	-0.817	-0.386	-0.717	-0.310	-0.350	-0.772	-0.602
Barium (total)	0.269	-0.660	0.814	0.103	-0.346	0.609	-0.064	-0.681	1	0.854	0.552	0.157	0.776	-0.768	0.360	0.829	0.568	0.770	0.510	0.616	0.793	0.676
Calcium (total)	0.185	-0.706	0.855	0.051	-0.408	0.556	-0.053	-0.818	0.854	1	0.565	0.348	0.908	-0.914	0.226	0.875	0.493	0.889	0.426	0.500	0.883	0.625
Copper (total)	0.505	-0.451	0.443	-0.001	-0.340	0.508	-0.363	-0.400	0.552	0.565	1	-0.245	0.505	-0.450	0.317	0.499	0.643	0.585	0.582	0.687	0.594	0.597
Lithium (total)	-0.505	-0.055	0.235	-0.136	-0.067	-0.318	0.185	-0.278	0.157	0.348	-0.245	1	0.341	-0.358	-0.360	0.228	-0.398	0.243	-0.477	-0.512	0.091	-0.300
Magnesium (total)	0.130	-0.693	0.819	0.091	-0.332	0.559	-0.054	-0.827	0.776	0.908	0.505	0.341	1	-0.904	0.294	0.771	0.517	0.928	0.450	0.481	0.750	0.560
Manganese (total)	-0.097	0.694	-0.831	-0.042	0.450	-0.463	-0.024	0.908	-0.768	-0.914	-0.450	-0.358	-0.904	1	-0.264	-0.861	-0.409	-0.833	-0.342	-0.394	-0.828	-0.540
Mercury (total)	0.602	-0.354	0.335	0.256	0.094	0.534	0.074	-0.175	0.360	0.226	0.317	-0.360	0.294	-0.264	1	0.358	0.552	0.306	0.512	0.587	0.417	0.473
Molybdenum (total)	0.250	-0.663	0.859	-0.117	-0.321	0.530	0.055	-0.817	0.829	0.875	0.499	0.228	0.771	-0.861	0.358	1	0.541	0.728	0.419	0.467	0.870	0.713
Nickel (total)	0.674	-0.510	0.538	0.129	-0.058	0.746	-0.116	-0.386	0.568	0.493	0.643	-0.398	0.517	-0.409	0.552	0.541	1	0.509	0.759	0.832	0.538	0.781
Potassium (total)	0.245	-0.734	0.789	0.123	-0.330	0.555	-0.195	-0.717	0.770	0.889	0.585	0.243	0.928	-0.833	0.306	0.728	0.509	1	0.534	0.572	0.756	0.543
Silicon (total)	0.605	-0.601	0.524	0.275	-0.115	0.776	-0.220	-0.310	0.510	0.426	0.582	-0.477	0.450	-0.342	0.512	0.419	0.759	0.534	1	0.862	0.465	0.676
Sodium (total)	0.708	-0.550	0.533	0.289	-0.098	0.799	-0.176	-0.350	0.616	0.500	0.687	-0.512	0.481	-0.394	0.587	0.467	0.832	0.572	0.862	1	0.580	0.744
Strontium (total)	0.397	-0.681	0.759	-0.054	-0.386	0.590	-0.054	-0.772	0.793	0.883	0.594	0.091	0.750	-0.828	0.417	0.870	0.538	0.756	0.465	0.580	1	0.776
Uranium (total)	0.518	-0.506	0.653	-0.157	-0.277	0.832	0.016	-0.602	0.676	0.625	0.597	-0.300	0.560	-0.540	0.473	0.713	0.781	0.543	0.676	0.744	0.776	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 33.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.29: Dissolved Metal Concentrations at Camp Lake Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Winter Sampling Event											Summer Sampling Event					
			JL0-02 bottom 11-Apr-17	JL0-02 surface 11-Apr-17	JL0-10 bottom 11-Apr-17	JL0-10 surface 11-Apr-17	JL0-01 bottom 14-Apr-17	JL0-01 surface 14-Apr-17	JL0-07 bottom 11-Apr-17	JL0-07 surface 11-Apr-17	JL0-09 bottom 11-Apr-17	JL0-09 surface 11-Apr-17	J0-01 outlet 9-Jul-17	JL0-02 bottom 24-Jul-17	JL0-02 surface 24-Jul-17	JL0-10 bottom 24-Jul-17	JL0-10 surface 24-Jul-17	JL0-01 bottom 24-Jul-17	JL0-01 surface 24-Jul-17
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00752	0.00798	0.00734	0.00794	0.00736	0.00810	0.00736	0.00761	0.00712	0.00803	0.00594	0.00620	0.00613	0.00626	0.00634	0.00619	0.00645
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	16.3	16.6	15.8	17.1	15.3	17.0	15.8	16.4	14.5	17.3	12.2	13.2	12.8	13.1	13.1	13.1	13.3
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00095	0.00100	0.00092	0.00096	0.00085	0.00096	0.00088	0.00094	0.00088	0.00121	0.00081	0.00074	0.00080	0.00096	0.00085	0.00082	0.00081
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0012	0.0011	0.0011	0.0013	0.00125	0.0013	0.0014	0.0011	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	10.10	9.98	9.40	10.50	9.63	10.70	9.27	9.95	9.14	10.30	7.42	7.99	7.99	8.09	8.15	8.12	8.16
	Manganese (Mn)	mg/L	0.00014	0.00025	0.000183	0.000176	0.000192	0.000171	0.000315	0.000150	0.000138	0.000121	0.001770	0.000461	0.00040	0.000435	0.000400	0.000431	0.000481
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	0.00001	0.000016	<0.000010	<0.000010	0.000021	0.000013
	Molybdenum (Mo)	mg/L	0.000344	0.000344	0.000335	0.000348	0.000312	0.000354	0.000307	0.000347	0.000298	0.000364	0.000279	0.000282	0.000284	0.000271	0.000283	0.000282	0.000290
	Nickel (Ni)	mg/L	0.00073	0.00073	0.00069	0.00073	0.00070	0.00077	0.00069	0.00070	0.00067	0.00074	0.00052	0.00060	0.00065	0.00061	0.00059	0.00062	0.00057
	Potassium (K)	mg/L	1.27	1.35	1.24	1.34	1.31	1.49	1.22	1.31	1.18	1.35	1.02	1.08	1.07	1.10	1.09	1.08	1.09
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.41	0.45	0.43	0.44	0.48	0.46	0.87	0.43	0.44	0.45	0.37	0.38	0.37	0.38	0.38	0.37	0.37
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.85	1.91	1.72	1.83	1.79	2.01	2.15	1.86	1.66	1.88	1.41	1.47	1.53	1.53	1.54	1.57	1.53
	Strontium (Sr)	mg/L	0.0119	0.0126	0.0121	0.0127	0.0118	0.0130	0.0119	0.0113	0.0106	0.0128	0.0091	0.00971	0.01000	0.00945	0.00983	0.01010	0.01040
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00125	0.00042	0.00252	0.00077	0.00132	0.00065	0.00337	0.00154	0.00147	0.00271	<0.00010	0.00064	0.00108	<0.00010	<0.00010	0.00113	0.00092
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000932	0.000977	0.000923	0.000981	0.000903	0.001030	0.000773	0.000921	0.000834	0.000996	0.000697	0.000737	0.000731	0.000735	0.000723	0.000715	0.000725
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	0.0069	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.29: Dissolved Metal Concentrations at Camp Lake Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Summer Sampling Event					Fall Sampling Event										
			JL0-07	JL0-07	JL0-09	JL0-09	J0-01	JL0-02	JL0-02	JL0-10	JL0-10	JL0-01	JL0-01	JL0-07	JL0-07	JL0-09	JL0-09	J0-01
			bottom	surface	bottom	surface	outlet	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	outlet
			24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	10-Aug-17	26-Aug-17	26-Aug-17	25-Aug-17	25-Aug-17	26-Aug-17	26-Aug-17	26-Aug-17	26-Aug-17	25-Aug-17	25-Aug-17	1-Sep-17
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00634	0.00630	0.00628	0.00628	0.00633	0.00661	0.00661	0.00639	0.00642	0.00645	0.00652	0.00638	0.00641	0.00660	0.00650	0.00639
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	13.0	13.3	13.1	12.9	12.6	13.4	13.4	12.9	12.9	13.3	13.3	12.9	13.1	13.0	13.0	13.4
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00080	0.00077	0.00105	0.00076	0.00079	0.00077	0.00087	0.00081	0.00114	0.00077	0.00082	0.00077	0.00142	0.00086	0.00079	0.00077
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.059
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0014	0.0012	0.0011	0.0013	0.0013	0.0012	0.0012	0.0011	0.0012	<0.0010
	Magnesium (Mg)	mg/L	8.31	7.92	8.05	8.15	7.92	8.35	8.39	7.84	8.12	8.26	8.31	8.05	8.36	8.22	7.93	7.95
	Manganese (Mn)	mg/L	0.000470	0.000406	0.000449	0.000378	0.00089	0.000196	0.000268	0.000332	0.000332	0.000164	0.000271	0.000116	0.000190	0.000183	0.000221	0.00179
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000280	0.000280	0.000277	0.000285	0.000294	0.000289	0.000279	0.000300	0.000299	0.000292	0.000295	0.000280	0.000282	0.000282	0.000284	0.000292
	Nickel (Ni)	mg/L	0.00057	0.00057	0.00062	0.00059	0.00059	0.00055	0.00059	0.00055	0.00053	0.00057	0.00052	0.00056	0.00059	0.00053	0.00058	0.00071
	Potassium (K)	mg/L	1.10	1.09	1.10	1.08	1.07	1.11	1.13	1.06	1.08	1.11	1.12	1.10	1.12	1.10	1.09	1.05
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.37	0.38	0.38	0.38	0.35	0.32	0.32	0.30	0.30	0.32	0.31	0.41	0.31	0.32	0.31	0.34
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.58	1.58	1.57	1.54	1.48	1.39	1.42	1.33	1.34	1.39	1.41	1.41	1.39	1.36	1.36	1.46
	Strontium (Sr)	mg/L	0.0099	0.00969	0.00974	0.00989	0.00995	0.01000	0.0101	0.0098	0.0099	0.0100	0.00994	0.0098	0.00987	0.0100	0.0099	0.0098
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000716	0.000726	0.000706	0.000724	0.000797	0.000709	0.000711	0.000733	0.000686	0.000706	0.000701	0.000672	0.000698	0.000710	0.000695	0.000768
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.30: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Camp Lake and Reference Lake 3 in 2017, and Between Camp Lake 2017 and Baseline (2005 - 2013), Mary River Project CREMP

Parameter	Camp Lake vs Reference Lake 3 in 2017		Camp Lake 2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.0	1.0	0.0	0.7	1.0
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	1.0	1.0	0.0	1.2	1.1
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.9	1.9	1.2	1.2	1.1
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.0	1.1	0.8	0.6	1.1
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.0	1.2	0.3	0.0	0.5
Magnesium (Mg)	1.8	1.9	1.2	1.2	1.2
Manganese (Mn)	1.8	1.2	0.6	0.0	0.3
Mercury (Hg)	1.2	1.0	1.0	1.2	1.0
Molybdenum (Mo)	2.0	2.6	1.4	0.0	1.4
Nickel (Ni)	1.2	1.1	1.0	0.6	1.0
Potassium (K)	1.2	1.3	0.8	1.0	0.9
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.9	0.8	1.0	0.9	0.8
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.7	1.6	1.1	1.2	1.1
Strontium (Sr)	1.2	1.3	1.5	1.4	1.3
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	4.4	1.0	0.9	0.8	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	2.7	2.8	1.8	1.6	1.4
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.7	1.0	1.9

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).
Note: RDL = Reportable Detection Limit

Table C.31: *In Situ* Water Quality Measurements Collected at Sheardown Lake Tributary 1, Tributary 12, and Tributary 9 Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Unnamed Reference Creek	REF-CRK-B1	9.7	11.55	101.7	7.93	157
	REF-CRK-B2	9.2	11.80	102.7	7.92	159
	REF-CRK-B3	8.2	11.98	101.8	7.93	161
	REF-CRK-B4	7.3	12.20	101.5	7.91	163
	REF-CRK-B5	6.5	12.39	100.7	7.88	160
Sheardown Lake Tributary 1 Reach 1	SDLT-1-R1 B1	10.8	11.14	100.6	8.14	277
	SDLT-1-R1-B2	9.8	11.53	101.8	8.15	303
	SDLT-1-R1-B3	10.3	11.15	99.0	8.15	225
	SDLT-1-R1-B4	10.4	11.28	100.8	7.90	237
	SDLT-1-R1-B5	9.2	11.66	101.4	8.11	241
Sheardown Lake Tributary 12 Downstream	SDLT-12-DS-B1	5.4	12.38	98.1	8.23	294
	SDLT-12-DS-B2	6.2	12.57	101.6	8.36	290
	SDLT-12-DS-B3	6.1	12.48	100.7	8.36	287
Sheardown Lake Tributary 9 Upstream	SDLT-9-DS-B1	6.6	11.08	90.5	7.95	216
	SDLT-9-DS-B2	4.9	10.56	82.4	7.68	235
	SDLT-9-DS-B3	4.8	11.29	88.1	7.73	235
	SDLT-9-DS-B4	4.9	11.57	90.3	7.75	236
	SDLT-9-DS-B5	5.2	11.82	93.1	7.78	239

Table C.32: *In Situ* Water Quality Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2017

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Temperature (°C)	Unnamed Reference Creek	8.2	1.3	0.6	6.5	9.8	6.5	9.7
	Sheardown Lake Tributary 1 (SDLT1)	10.1	0.6	0.3	9.3	10.9	9.2	10.8
	Sheardown Lake Tributary 12 (SDLT12)	5.9	0.4	0.2	4.9	7.0	5.4	6.2
	Sheardown Lake Tributary 9 (SDLT9)	5.3	0.8	0.3	4.3	6.2	4.8	6.6
Dissolved Oxygen (mg/L)	Unnamed Reference Creek	11.98	0.33	0.15	11.58	12.39	11.55	12.39
	Sheardown Lake Tributary 1 (SDLT1)	11.35	0.23	0.10	11.06	11.64	11.14	11.66
	Sheardown Lake Tributary 12 (SDLT12)	12.48	0.10	0.05	12.24	12.71	12.38	12.57
	Sheardown Lake Tributary 9 (SDLT9)	11.26	0.48	0.22	10.66	11.86	10.56	11.82
Dissolved Oxygen (% Saturation)	Unnamed Reference Creek	101.7	0.7	0.3	100.8	102.6	100.7	102.7
	Sheardown Lake Tributary 1 (SDLT1)	100.7	1.1	0.5	99.4	102.1	99.0	101.8
	Sheardown Lake Tributary 12 (SDLT12)	100.1	1.8	1.0	95.6	104.6	98.1	101.6
	Sheardown Lake Tributary 9 (SDLT9)	88.9	4.0	1.8	83.9	93.9	82.4	93.1
pH (units)	Unnamed Reference Creek	7.91	0.02	0.01	7.89	7.94	7.88	7.93
	Sheardown Lake Tributary 1 (SDLT1)	8.09	0.11	0.05	7.96	8.22	7.90	8.15
	Sheardown Lake Tributary 12 (SDLT12)	8.32	0.08	0.04	8.13	8.50	8.23	8.36
	Sheardown Lake Tributary 9 (SDLT9)	7.78	0.10	0.05	7.65	7.91	7.68	7.95
Specific Conductance (μS/cm)	Unnamed Reference Creek	160	2.3	1.0	157.2	162.9	157.4	163.4
	Sheardown Lake Tributary 1 (SDLT1)	257	33	15	216	297	225	303
	Sheardown Lake Tributary 12 (SDLT12)	290	4	2	282	299	287	294
	Sheardown Lake Tributary 9 (SDLT9)	232	9	4	221	243	216	239

Note: Five stations were sampled at each study area except Tributary 9, where three stations were sampled.

Table C.33: *In Situ* Water Quality Statistical Comparisons Among the Sheardown Lake Tributaries and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Overall 4-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test
Water Temperature (°C)	YES	< 0.001	α,γ	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0523	Tukey's HSD
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0145	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0003	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0002	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 12	Sheardown Tributary 9	NO	0.5415	
Dissolved Oxygen (% saturation)	YES	< 0.001	α	Unnamed Reference Creek	Sheardown Tributary 1	NO	0.9167	Tukey's HSD
				Unnamed Reference Creek	Sheardown Tributary 12	NO	0.8073	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 1	Sheardown Tributary 12	NO	0.9859	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0001	
pH (units)	YES	< 0.001	α,γ	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0952	Mann-Whitney U-test
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0357	
				Unnamed Reference Creek	Sheardown Tributary 9	NO	0.1508	
				Sheardown Tributary 1	Sheardown Tributary 12	YES	0.0357	
				Sheardown Tributary 1	Sheardown Tributary 9	YES	0.0159	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0357	
Specific Conductance (µS/cm)	YES	< 0.001	α,γ	Unnamed Reference Creek	Sheardown Tributary 1	YES	0.0060	Tamhane's
				Unnamed Reference Creek	Sheardown Tributary 12	YES	0.0000	
				Unnamed Reference Creek	Sheardown Tributary 9	YES	0.0000	
				Sheardown Tributary 1	Sheardown Tributary 12	NO	0.3871	
				Sheardown Tributary 1	Sheardown Tributary 9	NO	0.6665	
				Sheardown Tributary 12	Sheardown Tributary 9	YES	0.0004	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results validated using Kruskal Wallis H-test or Mann-Whitney U-test, as appropriate.

Table C.34: Water Chemistry at Sheardown Lake Tributary 1 (SDLT1) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event			
					D1-05	D1-00	D1-05	D1-00	D1-05	D1-00	DI-05	DI-00
					09/Jul/17	09/Jul/17	28/Jul/17	28/Jul/17	28/Aug/17	28/Aug/17	01/Sep/17	01/Sep/17
Conventionals	Conductivity (lab)	umho/cm	-	-	170	220	212	305	215	396	200	306
	pH (lab)	pH	6.5 - 9.0	-	7.87	8.11	7.95	8.05	8.05	8.20	8.06	8.17
	Hardness (as $CaCO_3$)	mg/L	-	-	78	102	99	142	104	195	95	145
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	2.2	<2.0	2.6	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	92	129	103	176	80	241	111	159
	Turbidity	NTU	-	-	0.66	2.03	1.00	1.55	1.17	2.56	0.43	0.60
	Alkalinity (as $CaCO_3$)	mg/L	-	-	57	84	80	99	76	116	77	104
Nutrients and Organics	Total Ammonia	mg/L	variable	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.241	0.220	0.312	0.593	0.428	1.330	0.319	0.862
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.16	0.19	0.19	<0.15	0.18	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.1	2.3	2.5	2.7	2.5	2.9	2.7	2.7
	Total Organic Carbon	mg/L	-	-	2.0	2.7	2.6	2.8	2.7	3.2	2.8	2.9
	Total Phosphorus	mg/L	0.030[α]	-	0.0044	0.0119	0.0033	0.0293	0.0047	0.0031	0.0039	0.0046
	Phenols	mg/L	0.004[α]	-	0.0016	0.0012	<0.0010	0.0011	0.0016	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.8	5.3	3.9	7.7	4.2	10.9	4.7	8.1
	Sulphate (SO_4)	mg/L	218[β]	218	19.8	21.3	24.2	43.8	18.3	61.7	15.9	37.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.179	0.008	0.043	0.017	0.053	0.017	0.075	0.009	0.016
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0088	0.0126	0.0097	0.0160	0.0101	0.0206	0.0091	0.0150
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	0.011	0.013	0.010	0.011	0.013	0.014	<0.010	0.011
	Cadmium (Cd)	mg/L	0.00012	0.00008	0.00003	0.00001	0.00004	0.00001	0.00003	0.00001	0.00004	0.00002
	Calcium (Ca)	mg/L	-	-	14	20	18	26	18	36	17	27
	Chromium (Cr)	mg/L	0.0089	0.00856	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	0.00015	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0022	***0.0027***	***0.0023***	***0.0034***	***0.0026***	***0.0032***	0.0021	***0.0031***	***0.0024***
	Iron (Fe)	mg/L	0.30	0.326	<0.030	0.118	<0.050	0.128	<0.050	0.154	<0.030	0.045
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	0.000098	0.000072	0.000094	<0.000050	0.000106	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0016	<0.0010	0.0012	0.0011	0.0016	0.0012	0.0018
	Magnesium (Mg)	mg/L	-	-	10.6	13.5	12.8	18.6	12.8	24.3	12.6	19.3
	Manganese (Mn)	mg/L	0.935[β]	-	0.0003	0.0055	<0.0005	0.0049	<0.0005	0.0070	0.0003	0.0025
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00243	0.00219	0.00335	0.00282	0.00403	0.00267	0.00343	0.00282
	Nickel (Ni)	mg/L	0.025	0.025	0.00107	0.00122	0.00124	0.00189	0.00108	0.00158	0.00115	0.00133
	Potassium (K)	mg/L	-	-	1.90	2.32	2.06	2.37	2.26	2.73	2.13	2.34
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	0.000078	0.000074	0.000111	0.000110	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	1.00	1.02	1.10	1.32	1.28	1.63	1.36	1.55
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.7	2.8	2.2	4.1	2.6	5.8	2.2	4.0
	Strontium (Sr)	mg/L	-	-	0.009	0.014	0.012	0.018	0.012	0.022	0.010	0.017
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	0.00001	0.00001	0.00001	0.00001	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0006	0.0032	0.0007	<0.0050	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0026	0.0028	0.0053	0.0052	0.0062	0.0057	0.0055	0.0063
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	0.0035	<0.0030	0.0047	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for WQG information.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data and adopted from the Camp Lake Tributaries.

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.35: Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between SDLT1 and Reference Creek Stations in 2016, and at SDLT1 Between 2016 and the Baseline Period, Mary River Project CREMP

Parameter	SDLT1 Station D1-05 (Reach 4)						SDLT1 Station D1-00 (Reach 1)					
	2017 vs Reference Creek			2017 vs Baseline			2017 vs Reference Creek			2017 vs Baseline		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Conductivity (lab)	4.6	2.6	1.8	2.5	1.5	1.0	6.0	3.8	3.0	2.7	1.6	1.4
Hardness (as $CaCO_3$)	4.7	2.7	1.8	2.3	1.4	1.0	6.2	3.9	3.1	2.4	1.4	1.3
Total Suspended Solids (TSS)	0.8	1.0	0.5	1.0	1.0	1.0	0.9	1.3	0.5	1.1	1.3	1.0
Total Dissolved Solids (TDS)	4.8	2.6	1.6	2.1	1.1	0.7	6.7	4.5	3.3	2.4	1.4	1.2
Turbidity	0.4	0.5	0.1	0.9	2.8	2.5	1.1	0.7	0.3	0.5	2.3	4.5
Alkalinity (as $CaCO_3$)	3.6	2.2	1.5	1.9	1.2	0.9	5.3	2.7	2.1	2.2	1.1	1.0
Total Ammonia	1.0	1.0	0.8	0.1	0.2	0.3	1.0	1.0	0.8	0.1	0.4	0.7
Nitrate	12	16	6.0	2.8	3.3	2.6	11	30	17	2.2	5.9	10
Nitrite	1.0	1.0	1.0	1.0		0.7	1.0	1.0	1.0	1.0		0.8
Total Kjeldahl Nitrogen (TKN)	1.0	1.3	1.0	1.1	1.6	1.4	1.1	1.3	1.1	0.7	1.0	1.3
Dissolved Organic Carbon	2.0	2.0	1.6	0.6	1.0	1.1	2.1	2.2	1.7	0.5	0.9	1.1
Total Organic Carbon	1.6	2.0	1.6	0.6	1.0	1.2	2.2	2.2	1.8	0.6	0.9	1.2
Total Phosphorus	0.8	0.9	0.5	0.4	0.7	1.4	2.1	7.6	0.5	1.1	6.4	0.6
Phenols	1.0	1.0	1.3				0.8	1.1	1.0			
Bromide (Br)	1.0	1.0	1.0	0.4			1.0	1.0	1.0	0.4		
Chloride (Cl)	3.2	2.2	1.8	0.6	1.2	0.5	6.2	4.4	3.8		1.6	1.3
Sulphate (SO_4)	23	9.1	4.1	25	5.3	1.8	25	16	12	43	8.0	5.7
Aluminum (Al)	0.2	0.3	0.1	0.2	1.1	1.2	0.9	1.1	0.2	0.3	2.5	4.1
Antimony (Sb)	1.0	1.0	1.0	0.5	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0
Barium (Ba)	3.4	1.9	1.3	2.1	1.3	1.0	4.9	3.1	2.3	2.3	1.4	1.4
Boron (B)	1.1	1.0	1.2	1.1	0.6	0.7	1.3	1.1	1.3	1.2	0.6	0.9
Cadmium (Cd)	3.4	3.8	3.6	1.1	1.1	1.0	1.3	1.5	1.3	0.9	0.8	0.9
Calcium (Ca)	4.1	2.4	1.6	2.1	1.3	0.9	5.9	3.5	2.8	2.5	1.4	1.3
Chromium (Cr)	1.0	1.0	0.7	RDL	2.4	RDL	1.0	1.0	0.7	1.0	1.7	RDL
Cobalt (Co)	1.0	1.0	0.7	0.6	0.8	0.8	1.0	1.2	0.8	0.8	1.2	1.3
Copper (Cu)	4.3	3.9	2.5	0.9	1.1	1.3	3.7	3.0	1.8	0.8	1.1	1.3
Iron (Fe)	0.7	1.2	0.2	0.5	1.9	1.6	2.7	3.0	0.4	0.7	1.2	1.9
Lead (Pb)	0.8	0.9	0.2	0.2	0.7	0.6	1.5	1.1	0.4	0.3	1.7	1.5
Lithium (Li)	1.0	1.0	0.9	2.0	1.1	1.3	1.6	1.2	1.3	3.2	0.9	1.5
Magnesium (Mg)	5.4	2.9	1.9	2.4	1.4	1.0	6.9	4.2	3.3	2.6	1.5	1.6
Manganese (Mn)	0.5	0.8	0.1	0.4	0.7	0.8	7.7	8.2	1.4	1.3	1.8	3.2
Mercury (Hg)	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
Molybdenum (Mo)	26	13	11	2.7	1.4	1.3	23	11	8.0	1.7	1.4	1.4
Nickel (Ni)	2.1	2.4	1.6	0.7	1.1	1.1	2.4	3.6	2.1	0.6	1.4	1.3
Potassium (K)	5.6	3.5	2.7	2.1	1.3	1.2	6.8	4.0	3.1	2.4	1.4	1.5
Silicon (Si)	2.1	1.4	1.0	1.2	0.9	1.1	2.1	1.6	1.3	0.9	1.0	1.2
Silver (Ag)	1.0	RDL	0.6	0.9			1.0	RDL	0.6			
Sodium (Na)	3.5	1.8	1.4	5.9	2.3	1.1	5.7	3.4	2.8	5.5	3.3	2.3
Strontium (Sr)	2.9	1.5	1.0	2.7	1.6	0.9	4.5	2.2	1.7	2.8	1.5	1.3
Thallium (Tl)	1.0	0.1	0.9	RDL	1.0	4.0	1.0	0.1	0.8	RDL	1.0	5.5
Titanium (Ti)	1.0	0.1	0.4	1.0			1.0	0.3	0.6	1.0		
Uranium (U)	12	4.9	2.7	4.1	2.1	0.8	13	4.8	2.8	4.5	2.1	1.4
Vanadium (V)	1.0	0.5	1.0	1.0			1.0	0.5	1.0	1.0		
Zinc (Zn)	1.0	1.0	1.0	2.2	1.2	1.4	1.0	1.2	1.3	3.0	0.8	1.4

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).
Note: RDL = Reportable Detection Limit

Table C.36: Dissolved Metal Concentrations at Sheardown Lake Tributary Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Spring Sampling Event		Summer Sampling Event		Fall Sampling Event			
			D1-05 9/Jul/17	D1-00 9/Jul/17	D1-05 28/Jul/17	D1-00 28/Jul/17	D1-05 28/Aug/17	D1-00 28/Aug/17	DI-05 1/Sep/17	DI-00 1/Sep/17
Dissolved Metals	Aluminum (Al)	mg/L	0.0053	0.0109	0.0044	0.0052	0.0055	<0.0050	0.0041	0.0030
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0088	0.0129	0.0102	0.0161	0.0099	0.0206	0.0093	0.0147
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00005	<0.00005	<0.00050	<0.00050
	Boron (B)	mg/L	0.011	0.013	0.010	0.011	0.013	0.013	<0.010	0.011
	Cadmium (Cd)	mg/L	0.000031	0.000013	0.000034	0.000015	0.000033	0.000012	0.000032	0.000015
	Calcium (Ca)	mg/L	14.4	19.3	17.7	26.2	19.4	36.3	17.9	27.2
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00262	0.00225	0.00296	0.00209	0.00292	0.00183	0.00296	0.00233
	Iron (Fe)	mg/L	<0.030	0.062	<0.030	0.038	<0.010	0.049	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	0.0016	0.0010	0.0014	0.0020	0.0028	0.0010	0.0014
	Magnesium (Mg)	mg/L	10.2	13.0	13.3	18.5	13.5	25.4	12.3	18.6
	Manganese (Mn)	mg/L	0.00031	0.00427	0.00027	0.00346	<0.00050	0.00490	0.00020	0.00214
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00242	0.00220	0.00310	0.00263	0.00387	0.00258	0.00289	0.00236
	Nickel (Ni)	mg/L	0.00094	0.00117	0.00105	0.00129	0.00103	0.00144	0.00107	0.00133
	Potassium (K)	mg/L	1.86	2.30	2.15	2.42	2.24	2.68	2.06	2.28
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0001	0.0001	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.97	0.97	1.10	1.24	1.26	1.46	1.35	1.52
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.68	2.71	2.28	3.99	2.63	5.98	2.12	3.96
	Strontium (Sr)	mg/L	0.0093	0.0135	0.0118	0.0169	0.0119	0.0212	0.0109	0.0161
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00001	<0.000010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	<0.01000	<0.01000	<0.01000	<0.01000	0.00031	<0.00060	<0.01000	<0.01000
	Uranium (U)	mg/L	0.0026	0.0027	0.0050	0.0048	0.0058	0.0055	0.0058	0.0065
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0010	0.0034	<0.0030	<0.0030

Table C.37: *In Situ* Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2017

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	17/Apr/17	17/Apr/17	17/Apr/17	16/Apr/17	16/Apr/17	16/Apr/17	17/Apr/17	17/Apr/17	17/Apr/17	16/Apr/17	16/Apr/17	16/Apr/17	17/Apr/17	17/Apr/17	17/Apr/17	16/Apr/17	16/Apr/17	16/Apr/17	17/Apr/17	17/Apr/17	17/Apr/17	16/Apr/17	16/Apr/17	16/Apr/17	17/Apr/17	17/Apr/17	17/Apr/17	16/Apr/17	16/Apr/17	16/Apr/17
1.0	0.2	1.4	0.5	0.0	0.0	1.1	14.0	14.0	14.2	12.8	15.0	14.5	95.7	98.8	98.5	87.5	102.5	102.1	8.10	7.66	7.79	7.62	7.64	7.73	241	253	241	171	191	233
2.0	0.2	0.4	0.4	0.0	0.3	0.4	13.8	14.4	14.4	14.8	14.9	14.7	97.1	99.5	99.4	100.5	102.3	101.6	7.95	7.65	7.77	7.63	7.63	7.70	242	244	243	193	198	227
3.0	1.3	1.2	1.4	0.8	1.3	1.3	13.7	13.8	13.9	14.4	14.1	14.1	97.4	98.3	98.6	101.3	100.7	100.2	7.92	7.66	7.76	7.64	7.62	7.70	249	258	244	194	195	224
4.0	1.5	1.6	1.5	1.4	1.5	1.5	13.6	13.6	13.7	14.1	13.8	13.8	96.7	97.5	97.9	100.2	98.3	98.5	7.90	7.64	7.74	7.69	7.63	7.67	251	264	245	198	194	223
5.0	1.6	1.6	1.6	1.5	1.6	1.6	13.5	13.5	13.6	14.1	13.7	13.7	96.5	96.5	96.9	100.4	97.8	98.2	7.88	7.63	7.72	7.62	7.63	7.66	252	265	245	198	194	221
6.0	1.6	1.6	1.6		1.6	1.6	13.5	13.4	13.6		13.6	13.7	96.7	96.0	97.0		97.1	98.0	7.86	7.62	7.71		7.63	7.65	253	265	245		194	219
7.0	1.6	1.6	1.6		1.6	1.6	13.5	13.3	13.6		13.5	13.7	96.9	95.5	96.9		96.6	97.9	7.85	7.61	7.69		7.63	7.64	253	266	245		194	217
8.0	1.6	1.6	1.6		1.6	1.6	13.5	13.5	13.5		13.5	13.7	96.9	96.4	96.8		96.3	97.6	7.84	7.61	7.68		7.62	7.64	252	266	245		195	216
9.0		1.6	1.6		1.6	1.6		13.5	13.5		13.4	13.7		96.7	96.8		96.1	97.8		7.60	7.67		7.62	7.63		267	245		195	214
10.0		1.6	1.6		1.6	1.6		13.6	13.5		13.4	13.7		97.2	96.9		96.0	98.0		7.60	7.66		7.62	7.62		267	245		195	213
11.0		1.6	1.6		1.6	1.6		13.5	13.6		13.4	13.7		96.7	96.1		95.9	97.9		7.60	7.60		7.62	7.61		267	245		195	212
12.0		1.7	1.6		1.6			13.4	13.5		13.4			96.2	96.6		95.8			7.58	7.65		7.61			266	245		196	
13.0		1.7	1.7		1.7			13.3	13.4		13.4			95.4	96.1		96.4			7.58	7.64		7.60			266	245		196	
14.0		1.7	1.7		1.7			13.2	13.3		13.4			94.8	95.3		95.9			7.57	7.63		7.60			266	244		197	
15.0		1.7	1.7		1.8			13.0	13.1		13.0			93.8	94.2		93.5			7.57	7.62		7.59			266	244		197	
16.0		1.8	1.7		1.8			12.9	12.7		12.9			93.0	92.0		92.7			7.57	7.61		7.58			265	244		197	
17.0		1.8	1.8					12.7	12.5					91.5	89.9					7.56	7.59					265	244			
18.0		1.9	1.9					12.3	12.0					88.8	86.5					7.55	7.57					264	244			
19.0		1.9	1.9					12.0	11.8					87.0	84.8					7.54	7.56					263	243			
20.0		2.0	2.0					11.6	11.5					84.0	83.4					7.52	7.59					263	243			
21.0		2.0						11.3						81.8						7.51						261				
21.7		2.0						11.2						81.1						7.50						263				

Notes:
Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 8.9, 22.7, 20.9, 6.4, and 11.4 m, respectively, at the time of winter sampling.
Ice thickness at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 2.1, 1.7, 1.8, 2.0, and 1.9 m, respectively, at the time of winter sampling.
Deepest measurement at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 7.9, 21.7, 20, 5.0, 15.4, and 10.4 m, respectively, at the time of winter sampling.

Table C.38: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)						pH (pH units)						Specific Conductance (µS/cm)					
	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	21/Jul/17	22/Jul/17	22/Jul/17	21/Jul/17	23-Jul-17	23-Jul-17	21/Jul/17	22/Jul/17	22/Jul/17	21/Jul/17	23-Jul-17	23-Jul-17	21/Jul/17	22/Jul/17	22/Jul/17	21/Jul/17	23-Jul-17	23-Jul-17	21/Jul/17	22/Jul/17	22/Jul/17	21/Jul/17	23-Jul-17	23-Jul-17	21/Jul/17	22/Jul/17	22/Jul/17	21/Jul/17	23-Jul-17	23-Jul-17
1.0	6.5	6.6	6.9	6.4	6.6	6.4	12.13	12.15	12.08	12.18	12.24	12.27	98.2	99.0	98.6	98.6	99.6	99.5	7.90	8.03	7.91	7.91	8.27	8.05	115	120	121	115	121	121
2.0	6.3	6.5	6.6	6.6	6.5	6.4	12.20	12.17	12.14	12.19	12.30	12.32	98.6	99.0	98.8	99.4	100.0	99.9	7.81	7.99	7.94	7.67	8.16	7.99	115	120	120	115	120	120
3.0	6.2	6.5	6.5	6.6	6.5	6.3	12.17	12.17	12.18	12.19	12.30	12.24	98.1	99.0	98.9	99.4	100.0	100.0	7.76	7.95	7.95	7.69	8.08	7.98	115	120	120	115	120	120
4.0	6.2	6.5	6.5	6.4	6.5	6.3	12.17	12.16	12.19	12.17	12.30	12.32	98.3	98.9	99.0	98.8	100.0	99.9	7.75	7.93	7.96	7.76	8.04	7.98	115	120	120	115	120	120
5.0	6.1	6.5	6.4	6.5	6.5	6.3	12.19	12.17	12.19		12.30	12.23	98.3	99.0	98.9	99.4	100.0	98.9	7.73	7.92	7.96	7.70	8.01	7.98	115	120	120		120	120
6.0	6.1	6.5	6.4		6.5	6.3	12.18	12.17	12.20		12.30	12.32	98.2	99.0	99.0		100.0	99.9	7.73	7.92	7.96		8.00	7.97	115	120	120		120	120
7.0	6.1	6.5	6.4		6.4	6.3	12.15	12.16	12.16		12.28	12.32	97.9	98.9	98.7		99.8	99.7	7.71	7.91	7.96		7.99	7.97	115	120	120		120	120
8.0	6.1	6.5	6.3		6.4	6.3	12.14	12.15	12.17		12.28	12.31	97.7	98.8	98.6		99.6	99.6	7.70	7.90	7.96		7.98	7.97	115	120	120		120	120
9.0	6.1	6.4	6.3		6.3	6.3	12.13	12.16	12.16		12.26	12.28	97.6	98.8	98.6		99.4	99.3	7.69	7.90	7.96		7.97	7.97	115	120	120		120	120
10.0	6.1	6.4	6.3		6.3	6.3	12.12	12.15	12.14		12.25	12.26	97.5	98.8	98.4		99.9	99.2	7.68	7.89	7.96		7.95	7.96	115	120	120		120	120
11.0		6.4	6.3		6.3			12.15	12.16		12.25			98.7	98.5		99.1			7.89	7.96		7.95			120	120		120	
12.0		6.4	6.3		6.3			12.15	12.15		12.25			98.7	98.5		99.4			7.89	7.96		7.94			120	120		120	
13.0		6.4	6.3		6.3			12.15	12.15		12.23			98.7	98.5		98.9			7.89	7.96		7.94			120	120		120	
14.0		6.4	6.3		6.3			12.15	12.14		12.22			98.7	98.4		98.9			7.89	7.96		7.94			120	120		120	
15.0		6.4	6.3		6.3			12.14	12.14		12.21			98.6	98.4		98.9			7.89	7.96		7.93			120	120		120	
16.0		6.4	6.3		6.0			12.12	12.13		12.20			98.4	98.3		98.7			7.88	7.96		7.93			120	120		120	
17.0		6.4	6.3		6.2			12.12	12.13		12.19			98.4	98.3		98.5			7.88	7.96		7.92			120	121		120	
18.0		6.4	6.3					12.12	12.12					98.4	98.2					7.88	7.96					120	120			
19.0		6.4	6.3					12.11	12.12					98.2	98.3					7.88	7.96					120	120			
20.0		6.3	6.3					12.10	12.10					98.1	98.1					7.87	7.96					120	120			

Note:
Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 10.3, 24.1, 20.3, 6, 18.7, and 10.9 m, respectively, at the time of summer sampling.

Table C.39: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)							Dissolved Oxygen (mg/L)							Dissolved Oxygen (% Saturation)						
	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	21/Aug/17	23/Aug/17	21/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	21/Aug/17	23/Aug/17	21/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	21/Aug/17	23/Aug/17	21/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17
surface		8.4							12.0							101.8					
1.0	8.9	8.4	9.0	8.7	9.2	9.1	9.2	12.1	11.9	11.7	11.6	11.7	11.7	11.6	104.7	101.2	101.2	99.4	101.3	101.2	100.7
2.0	8.8	8.4	9.0	8.7	9.1	9.1	9.1	12.1	11.9	11.7	11.6	11.7	11.7	11.6	103.8	101.3	100.9	99.5	101.0	100.9	100.6
3.0	8.8	8.4	9.0	8.7	9.1	9.0	9.0	11.9	11.9	11.7	11.6	11.6	11.6	11.6	102.6	101.2	99.8	99.4	100.9	100.8	100.4
4.0	8.8	8.4	8.6	8.7	9.1	9.0	8.9	11.9	11.9	11.6	11.6	11.6	11.6	11.6	102.1	101.0	99.6	99.4	100.7	100.7	100.3
5.0	8.8	8.4	8.5	8.7		8.8	8.9	11.8	11.8	11.6	11.6		11.6	11.6	101.3	100.9	99.1	99.3		100.0	100.3
6.0	8.7	8.4	8.4	8.7		8.7	8.9	11.7	11.8	11.6	11.6		11.6	11.6	100.2	100.9	99.0	99.3		99.7	100.0
7.0	8.6	8.4	8.4	8.7		8.7	8.7	11.6	11.8	11.6	11.6		11.6	11.6	99.0	100.9	98.8	99.3		99.6	99.7
8.0	8.4	8.4	8.4	8.7		8.6	8.5	11.6	11.9	11.6	11.6		11.6	11.6	98.6	101.0	98.6	99.2		99.5	99.4
9.0	8.4	8.4	8.4	8.7		8.5	8.3	11.6	11.8	11.6	11.5		11.6	11.5	98.4	100.9	98.5	99.1		98.7	97.8
10.0	8.4	8.4	8.4	8.6		8.4	8.2	11.5	11.8	11.5	11.5		11.5	11.5	98.3	100.8	98.4	98.9		98.2	97.5
11.0		8.4	8.4	8.6		8.4			11.8	11.5	11.5		11.5			100.8	98.4	98.9		97.9	
12.0		8.3	8.4	8.6		8.3			11.8	11.5	11.5		11.5			100.5	98.3	98.8		97.8	
13.0		8.3	8.4	8.6		8.3			11.8	11.5	11.5		11.5			100.0	98.2	98.8		97.6	
14.0		7.9	8.4	8.6		8.2			11.8	11.5	11.5		11.4			99.2	98.0	98.6		97.2	
15.0		7.4	7.5	8.6		8.2			11.8	11.3	11.5		11.4			98.0	94.1	98.6		96.8	
16.0		7.3	7.5	8.5					11.6	11.2	11.5					96.6	93.5	98.3			
17.0		7.2	7.3	8.5					11.6	11.2	11.5					95.8	93.0	98.1			
18.0		7.2	7.2	8.3					11.5	11.2	11.4					95.4	92.8	97.1			
19.0		7.1	7.1	8.2					11.5	11.2	11.4					95.1	92.4	95.3			
20.0		7.1	7.1	7.8					11.5	11.1	11.3					94.9	91.9	94.6			
21.0		7.1	7.1	7.6					11.5	11.1	11.2					94.6	91.6	93.6			
22.0		7.1	7.0	7.5					11.5	11.0	11.1					94.6	90.9	92.9			
23.0		7.0	6.9						11.5	11.0						94.3	91.5				

Notes:

21-Aug-17 sampling was conducted by Minnow. Sheardown Lake NW water profile sampling on all other dates was conducted by Baffinland.

Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 10.2, 23.15, 22.6, 4.41, 15.35, and 10.9 m, respectively, at the time of fall sampling.

Table C.39: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake NW Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	pH (pH units)							Specific Conductance (µS/cm)						
	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7	DD Hab9	DLO-01-5	DLO-01-5	DLO-01-1	DLO-01-4	DLO-01-2	DLO-01-7
Date Collected	21/Aug/17	23/Aug/17	21/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	21/Aug/17	23/Aug/17	21/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17
surface		8.10							126					
1.0	7.96	8.10	7.88	7.33	7.86	7.90	7.66	108	126	107	113	115	115	115
2.0	7.96	8.12	7.88	7.45	7.87	7.89	7.74	108	126	107	114	115	115	115
3.0	7.94	8.13	7.87	7.53	7.87	7.89	7.77	107	126	107	113	115	115	115
4.0	7.94	8.14	7.87	7.57	7.87	7.88	7.78	108	126	107	114	114	115	115
5.0	7.93	8.13	7.87	7.58		7.90	7.78	106	126	107	113		115	115
6.0	7.92	8.12	7.86	7.61		7.90	7.78	110	126	107	114		115	115
7.0	7.90	8.13	7.86	7.62		7.90	7.79	107	126	107	114		115	115
8.0	7.87	8.12	7.85	7.63		7.89	7.79	107	126	107	113		115	115
9.0	7.86	8.11	7.85	7.63		7.86	7.75	107	126	107	113		115	114
10.0	7.85	8.12	7.85	7.65		7.83	7.70	107	126	107	113		115	114
11.0		8.11	7.84	7.69		7.83			126	107	113		115	
12.0		8.12	7.84	7.71		7.82			126	107	113		115	
13.0		8.07	7.83	7.71		7.81			125	107	113		114	
14.0		8.07	7.83	7.71		7.80			123	107	113		114	
15.0		8.02	7.64	7.70		7.79			124	105	113		114	
16.0		7.97	7.60	7.70					124	105	113			
17.0		7.92	7.58	7.70					123	105	113			
18.0		7.90	7.57	7.69					123	104	113			
19.0		7.89	7.55	7.68					123	104	113			
20.0		7.85	7.53	7.67					123	104	112			
21.0		7.83	7.52	7.65					123	104	112			
22.0		7.85	7.50	7.63					123	104	116			
23.0		7.82	7.48						123	104				

Notes:

21-Aug-17 sampling was conducted by Minnow. Sheardown Lake NW water profile sampling on all other dates was conducted by Baffinland.

Total depth at stations DD Hab9, DLO-01-5, DLO-01-1, DLO-01-4, DLO-01-2, and DLO-01-7 was 10.2, 23.15, 22.6, 4.41, 15.35, and 10.9 m, respectively, at the time of fall sampling.

Table C.40: Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Sheardown Lake NW Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-01-9	23-Aug-2017	7.8	3.8	surface	8.80	11.85	102.4	8.31	127
					bottom	8.79	11.57	99.7	8.29	127
	DLO-01-4	23-Aug-2017	7.8	3.9	surface	8.77	11.73	100.9	8.33	128
					bottom	8.78	11.69	100.5	8.33	127
	DLO-01-3	23-Aug-2017	8.5	4.1	surface	8.62	11.89	102.0	8.33	127
					bottom	8.57	11.84	101.4	8.25	125
	DLO-01-11	23-Aug-2017	8.6	5.1	surface	8.93	12.03	103.9	8.13	127
					bottom	8.80	11.95	103.0	8.08	126
	DLO-01-10	23-Aug-2017	8.3	4.5	surface	9.07	11.97	103.6	8.20	126
					bottom	8.80	11.97	103.1	7.97	126
Profundal (Deep) Stations	DLO-01-5	23-Aug-2017	24.0	4.0	surface	8.36	11.95	101.8	8.10	126
					bottom	6.99	11.48	94.3	7.82	123
	DLO-01-14	23-Aug-2017	24.2	4.4	surface	8.52	12.12	103.7	7.89	126
					bottom	7.33	12.08	100.3	7.83	124
	DLO-01-15	23-Aug-2017	22.5	4.2	surface	8.57	12.05	103.2	8.14	125
					bottom	7.61	11.94	98.8	7.95	124
	DLO-01-2	23-Aug-2017	20.0	4.8	surface	8.62	11.98	102.7	8.17	127
					bottom	7.96	12.02	99.8	7.97	122
	DLO-01-12	23-Aug-2017	15.0	4.6	surface	8.70	11.98	102.9	8.24	126
					bottom	8.60	11.96	102.4	8.04	127

Table C.41: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake NW Littoral and Profundal Stations, Mary River Project CREMP, August 2017

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.676	α	Littoral	5	4.28	0.53	0.24	3.80	5.10
				Profundal	5	4.40	0.32	0.14	4.00	4.80
Temperature (˚C)	YES	0.007	β , ζ	Littoral	5	8.75	0.10	0.04	8.57	8.80
				Profundal	5	7.70	0.62	0.28	6.99	8.60
Dissolved Oxygen (mg/L)	NO	0.512	β , ζ	Littoral	5	11.8	0.2	0.1	11.6	12.0
				Profundal	5	11.9	0.2	0.1	11.5	12.1
Dissolved Oxygen (% saturation)	NO	0.145	α	Littoral	5	101.5	1.5	0.7	99.7	103.1
				Profundal	5	99.1	3.0	1.3	94.3	102.4
pH (units)	YES	0.012	α	Littoral	5	8.18	0.15	0.07	7.97	8.33
				Profundal	5	7.92	0.09	0.04	7.82	8.04
Specific Conductance (umho/cm)	YES	0.028	α	Littoral	5	126.5	1.0	0.4	125.3	127.5
				Profundal	5	124.0	1.8	0.8	121.6	126.7

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.42: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake NW and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	YES	0.014	α	Reference	5	9.74	1.04	0.46	8.50	11.20
					Sheardown NW	5	8.20	0.38	0.17	7.80	8.60
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.26	0.74	0.33	7.50	9.40
					Sheardown NW	5	4.28	0.53	0.24	3.80	5.10
	Temperature (˚C)	YES	0.001	β , ζ	Reference	5	8.29	0.16	0.07	8.05	8.42
					Sheardown NW	5	8.75	0.10	0.04	8.57	8.80
	Dissolved Oxygen (mg/L)	NO	0.888	α , η	Reference	5	11.8	0.1	0.0	11.7	11.9
					Sheardown NW	5	11.8	0.2	0.1	11.6	12.0
	Dissolved Oxygen (% saturation)	NO	0.138	α	Reference	5	100.3	0.9	0.4	99.0	101.0
					Sheardown NW	5	101.5	1.5	0.7	99.7	103.1
	pH (units)	YES	< 0.001	α	Reference	5	7.43	0.17	0.08	7.31	7.72
					Sheardown NW	5	8.18	0.15	0.07	7.97	8.33
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	5	73.7	0.6	0.3	73.2	74.6
					Sheardown NW	5	126.5	1.0	0.4	125.3	127.5
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.775	α	Reference	5	20.56	2.17	0.97	18.50	24.20
					Sheardown NW	5	21.14	3.82	1.71	15.00	24.20
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.28	0.43	0.19	7.90	9.00
					Sheardown NW	5	4.40	0.32	0.14	4.00	4.80
	Temperature (˚C)	NO	0.591	α	Reference	5	7.48	0.61	0.27	6.47	8.10
					Sheardown NW	5	7.70	0.62	0.28	6.99	8.60
	Dissolved Oxygen (mg/L)	NO	0.256	β , ζ	Reference	5	11.6	0.5	0.2	10.7	12.0
					Sheardown NW	5	11.9	0.2	0.1	11.5	12.1
	Dissolved Oxygen (% saturation)	NO	0.402	α	Reference	5	97.3	3.6	1.6	93.0	100.7
					Sheardown NW	5	99.1	3.0	1.3	94.3	102.4
	pH (units)	YES	< 0.001	α	Reference	5	7.29	0.06	0.03	7.23	7.37
					Sheardown NW	5	7.92	0.09	0.04	7.82	8.04
	Specific Conductance (umho/cm)	YES	< 0.001	α , η	Reference	5	76.1	3.5	1.5	73.2	80.6
					Sheardown NW	5	124.0	1.8	0.8	121.6	126.7

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.43: Water chemistry at Sheardown Lake NW (DLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event											
					DD-HAB9-STN-1	DD-HAB9-STN-1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017
Conventionals	Conductivity (lab)	umho/cm	-	-	155	160	150	157	154	160	158	166	155	161	155	159
	pH (lab)	pH	6.5 - 9.0	-	7.64	7.63	7.46	7.67	7.50	7.65	7.70	7.72	7.60	7.60	7.69	7.70
	Hardness (as $CaCO_3$)	mg/L	-	-	78	77	77	81	77	80	81	83	76	80	76	73
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	3.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	77	79	67	111	77	74	72	78	69	74	74	67
	Turbidity	NTU	-	-	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2
	Alkalinity (as $CaCO_3$)	mg/L	-	-	70	72	68	59	70	73	66	70	69	74	70	70
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.020	<0.020	0.022	<0.020	<0.020	<0.020	0.046	<0.020	0.032
	Nitrate	mg/L	13	13	0.061	0.052	0.101	0.054	0.094	0.053	0.056	0.051	0.066	0.049	0.051	0.058
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.18
	Dissolved Organic Carbon	mg/L	-	-	1.7	1.8	1.6	1.7	1.6	1.9	1.7	1.9	1.7	1.8	<1.0	1.8
	Total Organic Carbon	mg/L	-	-	2.0	1.9	1.7	2.0	1.8	1.9	2.0	2.0	2.0	2.1	1.9	2.0
	Total Phosphorus	mg/L	0.020[α]	-	0.0036	0.0038	0.0032	0.0036	0.0049	0.0036	0.0047	0.0031	0.0040	0.0041	0.0033	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0012	<0.0010	<0.0010	0.0011	<0.0010	0.0015	0.0011	<0.0010	0.0011	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.8	3.8	3.7	3.8	3.8	3.9	3.8	4.1	3.8	3.9	3.8	3.9
	Sulphate (SO_4)	mg/L	218[β]	218	5.0	5.1	4.9	5.1	5.0	5.3	5.2	5.4	5.0	5.2	5.0	5.2
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0074	0.0076	0.0075	0.0076	0.0075	0.0075	0.0077	0.0080	0.0075	0.0081	0.0076	0.0073
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	15	15	15	15	15	16	16	16	15	16	16	15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0009	0.0009	0.0010	0.0009	0.0009	0.0009	0.0010	0.0009	0.0010	0.0009	0.0009
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	9.6	9.9	9.4	10.2	9.7	10.0	10.1	10.4	9.6	10.4	10.2	9.8
	Manganese (Mn)	mg/L	0.935[β]	-	0.0009	0.0008	0.0014	0.0006	0.0014	0.0007	0.0008	0.0007	0.0011	0.0007	0.0013	0.0007
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002
	Molybdenum (Mo)	mg/L	0.073	-	0.00092	0.00092	0.00086	0.00094	0.00085	0.00092	0.00091	0.00097	0.00091	0.00092	0.00091	0.00087
	Nickel (Ni)	mg/L	0.025	0.025	0.00079	0.00080	0.00076	0.00078	0.00076	0.00079	0.00077	0.00082	0.00079	0.00083	0.00080	0.00083
	Potassium (K)	mg/L	-	-	1.38	1.43	1.36	1.44	1.39	1.41	1.44	1.49	1.39	1.48	1.41	1.41
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.64	0.66	0.87	0.65	0.79	0.64	0.63	0.65	0.70	0.66	0.63	0.63
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.9	1.9	1.8	1.9	1.9	1.9	1.9	2.0	1.8	1.9	1.9	1.8
	Strontium (Sr)	mg/L	-	-	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.010	0.011	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	0.00084	0.00085	0.00087	0.00058	0.00072	0.00239	0.00048	0.00072	0.00058	0.00065	0.00057	0.00078
	Titanium (Ti)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0012	0.0012	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0012	0.0013	0.0012	0.0012
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.43: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event											
					DD-HAB9-STN-1 bottom 21-Jul-2017	DD-HAB9-STN-1 surface 21-Jul-2017	DL0-01-5 bottom 22-Jul-2017	DL0-01-5 surface 22-Jul-2017	DL0-01-1 bottom 22-Jul-2017	DL0-01-1 surface 22-Jul-2017	DL0-01-4 bottom 21-Jul-2017	DL0-01-4 surface 21-Jul-2017	DL0-01-2 bottom 23-Jul-2017	DL0-01-2 surface 23-Jul-2017	DL0-01-7 bottom 23-Jul-2017	DL0-01-7 surface 23-Jul-2017
Conventionals	Conductivity (lab)	umho/cm	-	-	131	133	131	131	132	132	132	131	131	131	131	132
	pH (lab)	pH	6.5 - 9.0	-	7.84	7.81	7.84	7.84	7.84	7.85	7.83	7.85	7.91	7.95	7.88	7.82
	Hardness (as $CaCO_3$)	mg/L	-	-	62	63	62	62	62	63	60	62	63	62	64	63
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	77	67	69	70	71	65	70	73	71	67	72	80
	Turbidity	NTU	-	-	1.0	1.1	1.1	1.5	1.1	1.3	1.2	1.2	1.5	1.2	0.9	1.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	56	55	59	58	60	56	56	57	55	31	46	56
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.031	0.034	0.032	0.031	0.022	0.032	0.029	0.028	0.031	0.035	0.033	0.032
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.6	1.6	1.7	1.7	1.7	1.7	1.5	1.8	1.7	1.6	1.7	1.6
	Total Organic Carbon	mg/L	-	-	1.7	1.7	1.6	1.7	1.8	1.7	1.6	1.8	1.6	1.7	1.7	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.0045	0.0054	0.0049	0.0041	0.0045	0.0065	0.0047	0.0068	0.0036	0.0031	0.0043	0.0038
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.1	3.1	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
	Sulphate (SO_4)	mg/L	218[β]	218	4.5	4.6	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.016	0.015	0.013	0.013	0.016	0.015	0.016	0.017	0.017	0.012	0.039	0.015
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0063	0.0060	0.0061	0.0060	0.0061	0.0062	0.0061	0.0063	0.0061	0.0060	0.0061	0.0062
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	12	12	12	12	12	12	12	12	12	13	12	12
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	<0.0010	<0.0010	0.0022	<0.0010	0.0011	0.0018	0.0010	<0.0010	0.0014	0.0011	0.0014	<0.0010
	Iron (Fe)	mg/L	0.30	0.300	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.076	<0.050
	Lead (Pb)	mg/L	0.001	0.001	0.000051	0.000058	<0.000050	<0.000050	0.000055	0.000058	0.000054	<0.000050	0.000057	<0.000050	0.000070	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.6	7.4	7.7	7.7	7.9	7.3	7.6	7.5	7.9	7.6	7.6	7.6
	Manganese (Mn)	mg/L	0.935[β]	-	0.0048	0.0046	0.0045	0.0045	0.0047	0.0045	0.0046	0.0045	0.0045	0.0044	0.0052	0.0044
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	0.00001	0.00001	<0.00001	0.00003	0.00002	0.00002	0.00002	0.00001	0.00002	0.00002	0.00002
	Molybdenum (Mo)	mg/L	0.073	-	0.00077	0.00080	0.00078	0.00079	0.00079	0.00078	0.00080	0.00078	0.00077	0.00081	0.00081	0.00079
	Nickel (Ni)	mg/L	0.025	0.025	0.00075	0.00079	0.00091	0.00075	0.00079	0.00083	0.00075	0.00078	0.00084	0.00079	0.00108	0.00083
	Potassium (K)	mg/L	-	-	1.12	1.09	1.10	1.11	1.12	1.09	1.09	1.11	1.12	1.09	1.11	1.12
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.55	0.54	0.54	0.56	0.57	0.55	0.55	0.54	0.56	0.54	0.58	0.54
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	1.4	1.4	1.4	1.4	1.5	1.4	1.4	1.4	1.5	1.4	1.5	1.4
	Strontium (Sr)	mg/L	-	-	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Tin (Sn)	mg/L	-	-	0.00063	0.00122	0.00017	0.00040	0.00042	0.00095	0.00030	0.00021	0.00049	0.00022	0.00058	0.00042
	Titanium (Ti)	mg/L	-	-	0.0007	0.0008	0.0007	0.0007	0.0008	0.0007	0.0008	0.0008	0.0009	0.0006	0.0027	0.0009
	Uranium (U)	mg/L	0.015	-	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.43: Water chemistry at Sheardown Lake NW (DLO-01) water quality monitoring stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event											
					DD-HAB9-STN-1	DD-HAB9-STN-1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
					bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
					21/Aug/17	21/Aug/17	21/Aug/17	21/Aug/17	26/Aug/17	26/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17	20/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	132	131	129	130	131	132	131	131	130	130	130	130
	pH (lab)	pH	6.5 - 9.0	-	8.08	8.03	7.67	8.05	7.98	8.00	8.02	8.00	8.00	8.07	8.02	8.00
	Hardness (as $CaCO_3$)	mg/L	-	-	62	62	61	61	60	62	62	61	61	62	62	62
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.7	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	53	55	64	39	76	65	54	44	61	65	50	56
	Turbidity	NTU	-	-	1.0	1.1	1.0	0.9	0.8	0.5	0.8	1.0	1.0	1.1	1.0	1.0
	Alkalinity (as $CaCO_3$)	mg/L	-	-	56	52	54	58	56	61	55	68	55	48	54	50
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	0.021	0.055	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	0.021	<0.020	0.035	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	0.78	<0.15	0.20	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.7	1.6	1.6	1.4	1.7	1.9	1.5	1.5	1.4	1.4	1.7
	Total Organic Carbon	mg/L	-	-	1.6	1.7	1.6	1.6	1.6	1.6	1.7	1.6	1.6	1.6	1.7	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.0051	0.0042	0.0036	0.0036	0.0061	0.0042	0.0044	0.0033	0.0061	0.0053	0.0064	<0.0030
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.6	3.0	3.0	3.0	3.0	3.0	3.0	2.9	3.0	2.9	3.0	3.0
	Sulphate (SO_4)	mg/L	218[β]	218	4.4	5.4	4.7	5.1	4.9	5.1	5.2	5.0	5.1	4.8	5.1	5.1
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.015	0.008	0.013	0.010	0.012	0.009	0.015	0.011	0.010	0.011	0.012	0.013
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0062	0.0067	0.0061	0.0061	0.0061	0.0063	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	12	12	12	12	12	12	12	12	12	12	12	12
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	***0.0216****	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0008	0.0008	***0.00284****	0.0008	0.0008	0.0008	0.0008	0.0016	0.0008	0.0008	0.0009	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	***0.534****	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	0.0010	<0.0010	0.0012	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	7.7	8.2	7.6	7.7	7.8	8.0	7.6	7.7	7.3	7.7	7.6	7.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0018	0.0018	***0.0124****	0.0016	0.0017	0.0015	0.0018	0.0017	0.0019	0.0017	0.0018	0.0018
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00077	0.00074	0.00078	0.00074	0.00074	0.00075	0.00074	0.00077	0.00074	0.00074	0.00076	0.00075
	Nickel (Ni)	mg/L	0.025	0.025	0.00062	0.00065	***0.00154****	0.00061	0.00056	0.00060	0.00063	0.00064	0.00062	0.00061	0.00060	0.00057
	Potassium (K)	mg/L	-	-	1.15	1.21	1.13	1.13	1.13	1.14	1.14	1.15	1.13	1.14	1.14	1.14
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.41	0.41	0.56	0.38	0.49	0.43	0.43	0.41	0.42	0.39	0.42	0.41
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.5	1.5	1.4	1.4	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4
	Strontium (Sr)	mg/L	-	-	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.015	-	0.0009	0.0008	0.0009	0.0009	0.0008	0.0008	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.44: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between the Sheardown Lake Basins and Reference Lake 3 in 2017, and at the Sheardown Lake Basins Between 2017 and the Baseline Period

Variable	Sheardown Lake NW					Sheardown Lake SE				
	2017 vs Reference Lake 3		2017 vs Baseline			2017 vs Reference Lake 3		2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.7	1.7	1.1	1.1	1.1	1.2	1.3	1.0	0.9	0.9
Hardness (as $CaCO_3$)	1.7	1.8	1.2	1.1	1.0	1.2	1.4	1.0	0.9	0.9
Total Suspended Solids (TSS)	1.0	1.1	1.1	0.5	0.8	1.1	1.0	1.1	0.8	0.8
Total Dissolved Solids (TDS)	1.9	1.6	0.8	0.9	0.7	1.4	1.3	0.8	0.8	0.6
Turbidity	3.2	1.9	0.8	1.6	1.8	4.0	8.1	1.1	0.9	2.2
Alkalinity (as $CaCO_3$)	1.7	1.7	1.0	1.0	1.0	1.3	1.4	1.0	0.9	0.9
Total Ammonia	0.6	1.2	0.1	0.4	0.5	0.6	1.0	0.2	0.8	0.7
Nitrate	1.5	1.1	0.6	0.3	0.2	1.0	1.0	0.3	0.2	0.2
Nitrite	1.0	1.0	1.3	0.1	1.1	1.0	1.0	1.4	0.4	1.1
Total Kjeldahl Nitrogen (TKN)	0.8	1.4	0.7	0.9	1.3	0.8	1.0	0.9	1.0	0.7
Dissolved Organic Carbon	0.6	0.6	0.9	0.9	0.9	0.5	0.5	1.0	1.0	0.9
Total Organic Carbon	0.5	0.6	1.1	0.9	0.9	0.5	0.5	1.0	0.9	0.9
Total Phosphorus	0.7	1.1	1.0	0.7	0.9	0.9	1.7	1.2	0.9	1.2
Phenols	1.0	0.4	1.1	1.0	1.1	1.0	0.4	1.4	1.0	1.0
Bromide (Br)	1.0	1.0	0.6	0.4	0.4	1.0	1.0	0.7	0.4	0.4
Chloride (Cl)	2.6	2.3	1.2	1.3	1.1	1.7	1.6	1.0	0.8	0.7
Sulphate (SO_4)	1.2	1.2	1.6	1.7	1.6	0.7	0.7	1.2	1.1	1.2
Aluminum (Al)	5.2	3.0	1.0	1.2	0.6	10	21	0.6	0.4	1.2
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	0.9	1.0	1.3	1.2	1.2	0.7	1.0	1.2	0.8	1.0
Beryllium (Be)	0.2	1.0	2.0	0.3	1.5	0.2	1.0	1.5	0.2	1.3
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.9	1.0	1.0	0.8	0.8	0.8
Calcium (Ca)	1.7	1.7	1.1	1.0	1.0	1.2	1.4	1.0	0.9	0.8
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	2.1
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	0.9	0.9
Copper (Cu)	1.5	1.0	0.9	1.2	0.7	1.3	1.0	0.8	0.9	0.8
Iron (Fe)	1.7	1.0	1.2	1.8	0.8	1.7	2.1	0.6	0.5	0.8
Lead (Pb)	1.1	1.0	0.9	1.0	0.1	1.1	1.8	0.5	0.5	1.1
Lithium (Li)	1.0	1.0	0.4	0.3	0.0	1.0	1.0	0.3	0.2	0.3
Magnesium (Mg)	1.7	1.7	1.1	1.1	1.1	1.2	1.3	1.1	1.0	0.9
Manganese (Mn)	7.3	2.8	1.4	2.6	0.8	7.4	6.1	0.3	0.8	1.1
Mercury (Hg)	1.6	1.0	1.2	1.4	0.3	1.4	1.0	1.1	1.6	1.0
Molybdenum (Mo)	5.6	6.1	1.1	1.2	1.1	3.0	3.5	1.2	1.2	1.0
Nickel (Ni)	1.6	1.2	1.0	1.3	0.9	1.2	1.2	0.9	0.9	0.9
Potassium (K)	1.2	1.3	1.4	1.4	1.3	0.9	1.1	1.3	1.2	1.2
Selenium (Se)	0.1	1.0	RDL	0.6	RDL	0.1	1.0	RDL	0.6	RDL
Silicon (Si)	1.3	1.1	0.9	0.9	0.7	1.0	1.5	0.8	0.6	0.8
Silver (Ag)	RDL	1.0	2.5	RDL	1.3	RDL	1.0	1.6	RDL	1.4
Sodium (Na)	1.6	1.7	1.3	1.3	1.2	1.1	1.3	1.3	1.5	1.2
Strontium (Sr)	1.0	1.0	1.1	1.1	1.0	0.8	0.9	0.9	0.8	0.7
Thallium (Tl)	0.1	1.0	2.3	0.2	0.4	0.1	1.0	1.6	0.1	1.3
Tin (Sn)	5.0	1.0	1.4	0.9	0.2	6.9	1.0	0.8	0.5	0.1
Titanium (Ti)	0.1	1.0	1.0	0.1	1.0	0.2	1.0	1.0	0.1	0.9
Uranium (U)	3.5	3.5	1.3	1.2	1.0	2.1	2.5	1.1	1.0	0.8
Vanadium (V)	0.5	1.0	1.0	0.5	1.0	0.5	1.0	1.0	0.5	1.0
Zinc (Zn)	1.0	1.0	1.2	1.5	1.2	1.0	1.0	1.0	1.8	1.9

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.45: Dissolved Metal Concentrations at Sheardown Lake NW Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Winter Sampling Event												Summer Sampling Event					
			DD-HAB9-STN-1	DD-HAB9-STN-1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7	DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-5	DL0-01-5	DL0-01-1	DL0-01-1
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	17-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	16-Apr-2017	21-Jul-2017	21-Jul-2017	22-Jul-2017	22-Jul-2017	22-Jul-2017	22-Jul-2017
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.00335
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00740	0.00744	0.00756	0.00794	0.00731	0.00765	0.00758	0.00780	0.00724	0.00757	0.00750	0.00718	0.00610	0.00634	0.00609	0.00607	0.00620	0.00610
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	15.5	14.6	14.7	15.9	14.7	15.8	15.4	16.4	14.9	15.8	14.6	14.2	12.2	12.3	12.2	12.0	12.0	12.2
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00097	0.00087	0.00086	0.00101	0.00086	0.00093	0.00094	0.00095	0.00082	0.00090	0.00087	0.00085	0.00075	0.00078	0.00090	0.00077	0.00094	0.00077
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00110	<0.0010	0.0012	0.0011	<0.0010	0.0011	0.0011	0.0014	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	9.62	9.94	9.88	9.92	9.80	9.87	10.20	10.20	9.27	9.91	9.52	9.19	7.59	7.90	7.65	7.74	7.78	7.76
	Manganese (Mn)	mg/L	0.000161	0.000272	0.000122	0.0002	0.00010	0.000087	0.000127	0.000271	0.000075	0.000102	0.000081	<0.000070	0.000161	0.000208	0.000183	0.000211	0.000246	0.000209
	Mercury (Hg)	mg/L	<0.000010	0.000014	<0.000010	0.000014	<0.000010	0.000012	0.000011	<0.000010	<0.000010	0.000013	<0.000010	0.000017	0.00001	0.000011	<0.000010	<0.000010	0.000027	<0.000010
	Molybdenum (Mo)	mg/L	0.000921	0.000888	0.000892	0.000950	0.000844	0.000930	0.000872	0.000973	0.000872	0.000913	0.000869	0.000816	0.000772	0.000771	0.000754	0.000746	0.000744	0.000761
	Nickel (Ni)	mg/L	0.000840	0.000750	0.00074	0.00081	0.00074	0.00078	0.00080	0.00079	0.00076	0.00079	0.000740	0.000730	0.00061	0.00066	0.00066	0.00060	0.00063	0.00066
	Potassium (K)	mg/L	1.40	1.42	1.38	1.46	1.39	1.43	1.43	1.50	1.35	1.44	1.39	1.34	1.11	1.13	1.12	1.13	1.14	1.14
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.650	0.640	0.87	0.65	0.80	0.62	0.64	0.65	0.69	0.64	0.610	0.590	0.51	0.52	0.51	0.52	0.53	0.52
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.94	1.82	1.80	1.90	1.79	1.85	1.84	1.91	1.76	1.82	1.82	1.69	1.41	1.47	1.44	1.44	1.48	1.45
	Strontium (Sr)	mg/L	0.01040	0.01000	0.01030	0.01080	0.0097	0.01050	0.01010	0.01120	0.00967	0.01070	0.00977	0.00959	0.00804	0.00802	0.00784	0.00784	0.00785	0.00799
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00085	0.00164	0.00128	0.00134	0.00097	0.00369	0.00077	0.00116	0.00094	0.00104	0.00069	0.00138	0.00041	0.00044	0.00069	0.00018	0.00165	0.000455
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00120	0.00120	0.00111	0.001250	0.00111	0.00128	0.00121	0.00131	0.00119	0.00127	0.00122	0.00116	0.000850	0.000892	0.000863	0.000879	0.000873	0.000866
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.00360	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.45: Dissolved Metal Concentrations at Sheardown Lake NW Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Summer Sampling Event						Fall Sampling Event											
			DL0-01-04	DL0-01-04	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7	DD-HAB9-STN1	DD-HAB9-STN1	DL0-01-1	DL0-01-1	DL0-01-5	DL0-01-5	DL0-01-4	DL0-01-4	DL0-01-2	DL0-01-2	DL0-01-7	DL0-01-7
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			21-Jul-2017	21-Jul-2017	23-Jul-2017	23-Jul-2017	23-Jul-2017	23-Jul-2017	21-Aug-2017	21-Aug-2017	26-Aug-2017	26-Aug-2017	21-Aug-2017	21-Aug-2017	20-Aug-2017	20-Aug-2017	20-Aug-2017	20-Aug-2017	20-Aug-2017	20-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.0032	0.0038	<0.0030	<0.0030	0.0033	<0.0030	0.0036	0.0037	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0032	<0.0030	<0.0030	<0.0030	0.0031
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00630	0.00589	0.00612	0.00619	0.00625	0.00609	0.00617	0.00632	0.00633	0.00635	0.00600	0.00601	0.00601	0.00614	0.00612	0.00617	0.00609	0.00619
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	11.7	12.2	12.6	12.2	12.5	12.2	11.8	12.1	11.8	12.0	12.0	11.8	11.9	12.0	11.9	12.1	12.1	12.0
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00082	0.00096	0.00076	0.00075	0.00101	0.00080	0.00079	0.00078	0.00074	0.00077	0.00080	0.00079	0.00080	0.0008	0.00078	0.0007	0.00084	0.0008
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	7.58	7.74	7.74	7.71	7.77	7.94	7.81	7.76	7.51	7.75	7.66	7.72	7.80	7.60	7.72	7.61	7.70	7.67
	Manganese (Mn)	mg/L	0.000233	0.000330	0.000153	0.000137	0.000117	0.000208	0.000299	0.000218	<0.000070	0.000103	0.000121	0.000181	0.000190	0.000206	0.000231	0.000180	0.000093	0.000208
	Mercury (Hg)	mg/L	0.000023	0.000015	<0.000010	<0.000010	0.0000135	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000728	0.000765	0.000774	0.000775	0.000766	0.000756	0.000786	0.000797	0.000721	0.000744	0.000759	0.000771	0.000779	0.000750	0.000798	0.000774	0.000757	0.000762
	Nickel (Ni)	mg/L	0.00060	0.00064	0.00069	0.00060	0.00060	0.00066	0.00069	0.00058	0.00054	0.00055	0.00058	0.00060	0.00058	0.00057	0.00057	0.00056	0.00058	0.00056
	Potassium (K)	mg/L	1.11	1.11	1.13	1.14	1.13	1.14	1.17	1.16	1.12	1.15	1.15	1.15	1.15	1.14	1.15	1.13	1.13	1.13
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.51	0.50	0.52	0.52	0.53	0.52	0.39	0.41	0.47	0.39	0.52	0.39	0.39	0.39	0.38	0.38	0.42	0.39
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.45	1.48	1.49	1.51	1.43	1.45	1.50	1.45	1.29	1.31	1.41	1.41	1.44	1.43	1.42	1.40	1.38	1.41
	Strontium (Sr)	mg/L	0.00784	0.00804	0.00810	0.00798	0.00798	0.00813	0.00773	0.00793	0.00785	0.00787	0.00779	0.00786	0.00808	0.00788	0.00795	0.00792	0.00780	0.00788
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00051	0.00023	0.00038	0.00137	0.001035	0.00156	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000868	0.000867	0.000882	0.000876	0.000882	0.000891	0.00094	0.00091	0.000787	0.000834	0.000859	0.000920	0.00091	0.00088	0.00090	0.000908	0.000881	0.00092
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0075	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.46: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Sheardown Lake Northwest and Reference Lake 3 in 2017, and at Sheardown Lake Northwest Between 2017 and the Baseline Period

Dissolved Metal	Sheardown Lake NW				
	2017 vs Reference Lake 3		2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.0	1.0	0.0	0.7	1.0
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	0.9	1.0	0.0	1.2	1.1
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.7	1.7	1.2	1.1	1.0
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.0	1.0	0.8	0.6	1.0
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.0	1.0	0.3	0.0	0.4
Magnesium (Mg)	1.8	1.8	1.2	1.2	1.1
Manganese (Mn)	0.8	1.0	0.2	0.0	0.3
Mercury (Hg)	1.4	1.0	1.2	1.4	1.0
Molybdenum (Mo)	5.4	7.0	3.9	0.0	3.8
Nickel (Ni)	1.3	1.2	1.1	0.7	1.0
Potassium (K)	1.2	1.3	0.9	1.0	1.0
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.3	1.0	1.4	1.3	1.0
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.6	1.6	1.1	1.1	1.1
Strontium (Sr)	1.0	1.0	1.3	1.1	1.0
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	7.4	1.0	0.9	1.3	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	3.3	3.5	2.5	1.9	1.8
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.1	1.5	1.0	2.1

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).
Note: RDL = Reportable Detection Limit

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Conventional Parameters										Total Metals											
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Nitrate	Total Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	1	0.799	0.607	-0.607	0.796	0.784	0.446	-0.260	0.837	0.350	-0.572	0.708	0.117	-0.625	0.823	0.527	0.608	0.759	0.745	0.841	0.761	0.847
Hardness	0.799	1	0.608	-0.581	0.558	0.772	0.518	-0.310	0.851	0.359	-0.543	0.671	0.137	-0.568	0.806	0.608	0.616	0.775	0.834	0.788	0.784	0.816
Total Dissolved Solids	0.607	0.608	1	-0.273	0.473	0.693	0.289	-0.091	0.691	-0.028	-0.218	0.437	0.340	-0.234	0.681	0.503	0.254	0.696	0.540	0.720	0.614	0.579
Turbidity	-0.607	-0.581	-0.273	1	-0.651	-0.551	-0.274	0.396	-0.546	-0.700	0.788	-0.726	0.379	0.847	-0.526	-0.028	-0.855	-0.520	-0.619	-0.520	-0.340	-0.582
Alkalinity	0.796	0.558	0.473	-0.651	1	0.631	0.357	-0.294	0.689	0.396	-0.669	0.696	0.020	-0.691	0.666	0.318	0.644	0.658	0.642	0.709	0.549	0.696
Nitrate	0.784	0.772	0.693	-0.551	0.631	1	0.300	-0.291	1	0.173	-0.560	0.530	0.189	-0.523	0.838	0.542	0.418	0.875	0.621	0.878	0.807	0.705
Total Organic Carbon	0.446	0.518	0.289	-0.274	0.357	0.300	1	-0.245	0.570	0	-0.135	0.357	0.187	-0.241	0.396	0.479	0.268	0.428	0.426	0.356	0.423	0.439
Total Phosphorus	-0.260	-0.310	-0.091	0.396	-0.294	-0.291	-0.245	1	-0.338	-0.295	0	-0.235	-0.004	0.464	-0.424	-0.236	-0.410	-0.309	-0.450	-0.416	-0.198	-0.261
Chloride	0.837	0.851	0.691	-0.546	0.689	0.855	0.570	-0.338	1	0.329	-0.519	1	0.319	-0.502	0.856	0.734	0.468	0.845	0.752	0.900	0.844	0.832
Sulphate	0.350	0.359	-0.028	-0.700	0.396	0.173	0.411	-0.295	0.329	1	-0.741	0.632	0	-0.750	0.168	-0.106	0.743	0.139	0.350	0.140	0.054	0.248
Aluminum (total)	-0.572	-0.543	-0.218	0.788	-0.669	-0.560	-0.135	0.423	-0.519	-0.741	1	-0.757	0.400	1	-0.501	-0.017	-0.851	-0.467	-0.562	-0.529	-0.298	-0.463
Barium (total)	0.708	0.671	0.437	-0.726	0.696	0.530	0.357	-0.235	0.623	0.632	-0.757	1	-0.198	-0.780	1	0.176	0.846	0.556	0.645	0.611	0.426	0.629
Copper (total)	0.117	0.137	0.340	0.379	0.020	0.189	0.187	-0.004	0.319	-0.466	0.400	-0.198	1	0.438	0.345	1	-0.427	0.285	0.107	0.334	0.371	0.169
Manganese (total)	-0.625	-0.568	-0.234	0.847	-0.691	-0.523	-0.241	0.464	-0.502	-0.750	0.926	-0.780	0.438	1	-0.501	-0.002	-1	-0.422	-0.576	-0.491	-0.243	-0.518
Molybdenum (total)	0.823	0.806	0.681	-0.526	0.666	0.838	0.396	-0.424	0.856	0.168	-0.501	0.521	0.345	-0.501	1	0.646	0.468	1	0.779	0.906	0.782	0.816
Nickel (total)	0.527	0.608	0.503	-0.028	0.318	0.542	0.479	-0.236	0.734	-0.106	-0.017	0.176	0.674	-0.002	0.646	1	0.008	0.601	0	0.628	0.682	0.567
Potassium (total)	0.608	0.616	0.254	-0.855	0.644	0.418	0.268	-0.410	0.468	0.743	-0.851	0.846	-0.427	-0.909	0.468	0.008	1	0.458	0.730	0	0.229	0.565
Silicon (total)	0.759	0.775	0.696	-0.520	0.658	0.875	0.428	-0.309	0.845	0.139	-0.467	0.556	0.285	-0.422	0.876	0.601	0.458	1	0.748	0.875	1	0.785
Sodium (total)	0.745	0.834	0.540	-0.619	0.642	0.621	0.426	-0.450	0.752	0.350	-0.562	0.645	0.107	-0.576	0.779	0.475	0.730	0.748	1	0.786	0.591	1
Strontium (total)	0.841	0.788	0.720	-0.520	0.709	0.878	0.356	-0.416	0.900	0.140	-0.529	0.611	0.334	-0.491	0.906	0.628	0.476	0.875	0.786	1	0.779	0.790
Tin (total)	0.761	0.784	0.614	-0.340	0.549	0.807	0.423	-0.198	0.844	0.054	-0.298	0.426	0.371	-0.243	0.782	0.682	0.229	0.799	0.591	0.779	1	0.776
Uranium (total)	0.847	0.816	0.579	-0.582	0.696	0.705	0.439	-0.261	0.832	0.248	-0.463	0.629	0.169	-0.518	0.816	0.567	0.565	0.785	0.793	0.790	0.776	1
Aluminum (dissolved)	-0.214	-0.271	-0.306	0.350	-0.311	-0.388	0.006	0.225	-0.327	-0.249	0.412	-0.118	0.125	0.363	-0.278	-0.092	-0.269	-0.360	-0.212	-0.285	-0.216	-0.272
Barium (dissolved)	0.671	0.711	0.347	-0.675	0.533	0.611	0.241	-0.497	0.676	0.469	-0.689	0.573	-0.076	-0.651	0.756	0.324	0.686	0.658	0.766	0.667	0.576	0.702
Copper (dissolved)	0.605	0.599	0.537	-0.577	0.569	0.522	0.445	-0.090	0.584	0.293	-0.336	0.500	0.168	-0.397	0.648	0.385	0.462	0.571	0.638	0.590	0.407	0.578
Manganese (dissolved)	-0.070	-0.222	-0.025	0.451	-0.168	-0.401	0.123	0.299	-0.263	-0.235	0.405	-0.151	0.111	0.409	-0.228	-0.114	-0.290	-0.321	-0.197	-0.239	-0.158	-0.111
Molybdenum (dissolved)	0.702	0.795	0.422	-0.706	0.502	0.624	0.382	-0.287	0.660	0.559	-0.701	0.781	-0.270	-0.716	0.573	0.252	0.763	0.583	0.698	0.619	0.537	0.745
Nickel (dissolved)	0.907	0.874	0.680	-0.514	0.720	0.820	0.437	-0.198	0.854	0.210	-0.499	0.656	0.204	-0.540	0.829	0.601	0.541	0.792	0.782	0.857	0.767	0.879
Potassium (dissolved)	0.750	0.679	0.338	-0.793	0.672	0.574	0.311	-0.345	0.586	0.679	-0.835	0.758	-0.348	-0.874	0.549	0.142	0.852	0.524	0.674	0.560	0.396	0.652
Silicon (dissolved)	0.803	0.828	0.722	-0.521	0.637	0.936	0.373	-0.303	0.855	0.153	-0.502	0.529	0.269	-0.471	0.876	0.580	0.456	0.942	0.762	0.902	0.816	0.760
Sodium (dissolved)	0.880	0.833	0.597	-0.507	0.663	0.756	0.456	-0.331	0.794	0.282	-0.529	0.632	0.162	-0.556	0.825	0.551	0.574	0.746	0.804	0.820	0.696	0.872
Strontium (dissolved)	0.729	0.875	0.600	-0.597	0.567	0.714	0.509	-0.410	0.821	0.470	-0.581	0.761	0.086	-0.592	0.718	0.519	0.618	0.722	0.700	0.731	0.726	0.795
Tin (dissolved)	0.735	0.713	0.681	-0.317	0.527	0.758	0.440	-0.349	0.818	0.051	-0.307	0.352	0.415	-0.275	0.834	0.732	0.253	0.772	0.644	0.814	0.775	0.726
Uranium (dissolved)	0.752	0.781	0.337	-0.732	0.577	0.525	0.363	-0.385	0.582	0.615	-0.730	0.779	-0.310	-0.795	0.602	0.198	0.852	0.523	0.752	0.582	0.440	0.684

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.47: Spearman's Rank Correlation Coefficients for Sheardown Lake NW (DLO-1) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Dissolved Metals											
	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	-0.214	0.671	0.605	-0.070	0.702	0.907	0.750	0.803	0.880	0.729	0.735	0.752
Hardness	-0.271	0.711	0.599	-0.222	0.795	0.874	0.679	0.828	0.833	0.875	0.713	0.781
Total Dissolved Solids	-0.306	0.347	0.537	-0.025	0.422	0.680	0.338	0.722	0.597	0.600	0.681	0.337
Turbidity	0.350	-0.675	-0.577	0.451	-0.706	-0.514	-0.793	-0.521	-0.507	-0.597	-0.317	-0.732
Alkalinity	-0.311	0.533	0.569	-0.168	0.502	0.720	0.672	0.637	0.663	0.567	0.527	0.577
Nitrate	-0.388	0.611	0.522	-0.401	0.624	0.820	0.574	0.936	0.756	0.714	0.758	0.525
Total Organic Carbon	0.006	0.241	0.445	0.123	0.382	0.437	0.311	0.373	0.456	0.509	0.440	0.363
Total Phosphorus	0.225	-0.497	-0.090	0.299	-0.287	-0.198	-0.345	-0.303	-0.331	-0.410	-0.349	-0.385
Chloride	-0.327	0.676	0.584	-0.263	0.660	0.854	0.586	0.855	0.794	0.821	0.818	0.582
Sulphate	-0.249	0.469	0.293	-0.235	0.559	0.210	0.679	0.153	0.282	0.470	0.051	0.615
Aluminum (total)	0.412	-0.689	-0.336	0.405	-0.701	-0.499	-0.835	-0.502	-0.529	-0.581	-0.307	-0.730
Barium (total)	-0.118	0.573	0.500	-0.151	0.781	0.656	0.758	0.529	0.632	0.761	0.352	0.779
Copper (total)	0.125	-0.076	0.168	0.111	-0.270	0.204	-0.348	0.269	0.162	0.086	0.415	-0.310
Manganese (total)	0.363	-0.651	-0.397	0.409	-0.716	-0.540	-0.874	-0.471	-0.556	-0.592	-0.275	-0.795
Molybdenum (total)	-0.278	0.756	0.648	-0.228	0.573	0.829	0.549	0.876	0.825	0.718	0.834	0.602
Nickel (total)	-0.092	0.324	0.385	-0.114	0.252	0.601	0.142	0.580	0.551	0.519	0.732	0.198
Potassium (total)	-0.269	0.686	0.462	-0.290	0.763	0.541	0.852	0.456	0.574	0.618	0.253	0.852
Silicon (total)	-0.360	0.658	0.571	-0.321	0.583	0.792	0.524	0.942	0.746	0.722	0.772	0.523
Sodium (total)	0	1	1	0	1	1	1	1	1	1	1	0.752
Strontium (total)	-0.285	0.667	0.590	-0.239	0.619	0.857	0.560	0.902	0.820	0.731	0.814	0.582
Tin (total)	-0.216	0.576	0.407	-0.158	0.537	0.767	0.396	0.816	0.696	0.726	0.775	0.440
Uranium (total)	-0.272	0.702	0.578	-0.111	0.745	0.879	0.652	0.760	0.872	0.795	0.726	0.684
Aluminum (dissolved)	1	-0.235	0.010	0.456	-0.259	-0.264	-0.300	-0.336	-0.153	-0.306	-0.293	-0.203
Barium (dissolved)	-0.235	1	0.447	-0.319	0.662	0.614	0.690	0.664	0.696	0.683	0.563	0.695
Copper (dissolved)	0.010	0.447	1	-0.018	0.438	0.625	0.473	0.612	0.623	0.485	0.569	0.519
Manganese (dissolved)	0.456	-0.319	-0.018	1	-0.164	-0.101	-0.191	-0.305	-0.010	-0.222	-0.129	-0.122
Molybdenum (dissolved)	-0.259	0.662	0.438	-0.164	1	0.738	0.823	0.601	0.782	0.824	0.451	0.877
Nickel (dissolved)	-0.264	0.614	0.625	-0.101	0.738	1	0.667	0.842	0.921	0.761	0.720	0.698
Potassium (dissolved)	-0.300	0.690	0.473	-0.191	0.823	0.667	1	0.594	0.729	0.676	0.430	0.839
Silicon (dissolved)	-0.336	0.664	0.612	-0.305	0.601	0.842	0.594	1	0.807	0.719	0.809	0.547
Sodium (dissolved)	-0.153	0.696	0.623	-0.010	0.782	0.921	0.729	0.807	1	0.781	0.729	0.753
Strontium (dissolved)	-0.306	0.683	0.485	-0.222	0.824	0.761	0.676	0.719	0.781	1	0.640	0.732
Tin (dissolved)	-0.293	0.563	0.569	-0.129	0.451	0.720	0.430	0.809	0.729	0.640	1	0.426
Uranium (dissolved)	-0.203	0.695	0.519	-0.122	0.877	0.698	0.839	0.547	0.753	0.732	0.426	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.48: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3
Date Collected	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17	13/Apr/17
1.0	0.0	0.0	0.2	0.0	0.2	13.59	14.64	15.17	15.54	14.69	93.0	100.2	104.3	106.5	101.0	7.30	7.36	7.69	7.54	7.30	186	176	197	179	185
2.0	0.3	0.2	1.1	0.3	1.0	13.42	14.55	15.11	15.57	14.68	92.6	100.1	107.1	107.5	103.1	7.30	7.36	7.65	7.53	7.33	186	174	205	177	184
3.0	1.1	1.4	1.6	1.4	1.4	13.28	14.21	14.78	14.97	14.57	93.7	101.2	105.9	106.5	103.8	7.30	7.38	7.63	7.54	7.35	184	171	204	171	182
4.0	1.3		1.7	1.7	1.7	13.22		14.66	14.69	14.44	93.8		105.3	105.5	103.5	7.30		7.62	7.53	7.37	184		203	170	180
5.0	1.5		1.7	1.7	1.7	13.13		14.61	14.61	14.39	93.6		105.0	104.9	103.2	7.30		7.61	7.52	7.37	183		201	170	180
6.0	1.5		1.8	1.7	1.7	13.11		14.58	14.57	14.37	93.6		104.8	104.6	103.2	7.30		7.60	7.52	7.37	183		199	170	180
7.0			1.8	1.7	1.7			14.57	14.51	14.45			104.7	104.3	103.7			7.53	7.51	7.38			197	171	180
8.0			1.8	1.8	1.7			14.57	14.06	14.43			104.8	101.1	103.7			7.58	7.50	7.39			195	171	179
9.0				1.8	1.8				13.87	14.30				99.8	102.8				7.48	7.39				171	179
10.0				1.8	1.8				13.76	14.33				99.1	103.1				7.47	7.39				172	179
11.0				1.8	1.8				13.47	14.33				97.1	103.2				7.46	7.39				173	179
12.0				1.9	1.8				12.18	14.30				88.0	103.0				7.43	7.39				174	179
13.0				1.9	1.9				12.91	11.72				79.0	84.6				7.38	7.35				175	179
14.0					1.9					10.42					75.4					7.31					180

Notes:
Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.5, 3.9, 8.3, 13.5, and 14.7 m, respectively, at the time of winter sampling.
Ice thickness at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 1.6, 1.8, 1.75, 1.75, and 1.8 m, respectively, at the time of winter sampling.
Deepest measurement at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 5.5, 2.8, 8.0, 12.5, and 13.7 m, respectively, at the time of winter sampling.

Table C.49: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017

Depth (m)	Temperature (°C)					Dissolved Oxygen (mg/L)					Dissolved Oxygen (% Saturation)					pH (pH units)					Specific Conductance (µS/cm)				
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3
Date Collected	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17	23/Jul/17
1.0	7.5	7.3	7.1	7.2	7.4	11.93	12.19	12.11	11.95	12.03	99.4	101.1	99.9	99.2	99.7	7.94	8.00	7.92	8.02	7.98	88	84	82	82	83
2.0	7.5	7.3	7.0	7.2	7.4	12.17	12.18	12.13	12.13	12.17	101.4	101.1	100.0	100.2	101.2	7.95	7.98	7.90	8.00	7.97	87	84	82	82	83
3.0	7.5	7.2	7.0	7.1	7.4	12.20	12.18	12.13	12.17	12.19	101.7	101.0	100.0	100.6	101.3	7.97	7.97	7.91	7.98	7.96	87	84	82	82	83
4.0	7.5	7.2	7.0	7.1	7.4	12.21	12.18	12.13	12.17	12.20	101.8	101.0	99.9	100.5	101.4	7.97	7.96	7.91	7.96	7.96	88	84	82	82	83
5.0	7.5		7.0	7.1	7.3	12.22		12.13	12.15	12.20	101.8		99.9	100.4	101.4	7.97		7.91	7.95	7.96	88		82	82	83
6.0	7.5		7.0	7.0	7.3	12.23		12.10	12.14	12.19	101.9		99.7	100.1	101.3	7.97		7.91	7.93	7.95	88		82	82	83
7.0			6.9	7.0	7.3			12.10	12.14	12.19			99.0	100.1	101.2			7.91	7.93	7.95			82	82	83
8.0			6.9	7.0	7.3			12.07	12.12	12.19			99.1	99.8	101.1			7.90	7.93	7.95			82	82	83
9.0				6.9	7.3				12.10	12.19				99.5	101.2				7.92	7.95				82	83
10.0				6.9	7.3				12.08	12.18				99.4	101.1				7.92	7.95				82	83
11.0				6.9	7.2				12.07	12.14				99.2	100.5				7.91	7.95				82	82
12.0				6.9	7.2				12.05	12.15				99.0	100.5				7.90	7.94				82	82
13.0				6.8	7.2				12.03	12.15				98.7	100.5				7.90	7.94				82	82
14.0					7.2					12.14					100.4					7.94					82

Note:
Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 7.1, 5.0, 9.3, 13.8, and 14.9 m, respectively, at the time of summer sampling.

Table C.50: ***In Situ*** **Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)						Dissolved Oxygen (mg/L)						Dissolved Oxygen (% Saturation)					
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-3
Date Collected	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	22-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	22-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	22-Aug-17
surface						8.6						11.21						96.0
1.0	8.3	8.6	9.1	9.0	8.7	8.6	11.3	11.5	11.6	12.0	11.6	11.13	96.2	98.6	100.3	103.7	99.5	95.3
2.0	8.2	8.6	8.8	9.0	8.3	8.6	11.3	11.4	11.5	11.8	11.5	11.11	96.0	98.1	98.6	101.4	98.4	95.2
3.0	8.2	8.5	8.7	8.7	8.6	8.6	11.3	11.4	11.4	11.7	11.4	11.09	95.9	97.7	98.1	100.0	98.0	95.0
4.0	8.2	8.5	8.6	8.6	8.5	8.5	11.3	11.4	11.3	11.5	11.4	11.07	96.0	97.2	97.0	98.6	97.1	94.9
5.0	8.2		8.5	8.5	8.5	-	11.3		11.3	11.3	11.3	-	95.5		96.2	96.9	96.9	-
6.0	8.2		8.4	8.4	8.5	8.5	11.3		11.2	11.3	11.3	11.08	95.6		95.7	96.2	96.7	94.7
7.0			8.4	8.4	8.5	8.5			11.2	11.3	11.3	11.04			95.4	96.0	96.2	94.3
8.0			8.4	8.4	8.5	8.5			11.1	11.2	11.2	11.06			94.7	95.8	96.0	94.5
9.0				8.4	8.4	8.4				11.2	11.2	11.02				95.4	95.9	94.0
10.0				8.4	8.4	8.4				11.2	11.1	11.05				95.3	94.8	94.2
11.0				8.4	8.3	8.3				11.1	11.1	11.02				94.9	94.1	93.7
12.0				8.3	8.0	8.1				11.1	10.6	10.81				94.4	89.7	91.9
13.0					8.0	8.1					10.6	10.65					89.0	90.3

Notes:
21-Aug-17 sampling was conducted by Baffinland. 22-Aug-17 sampling was conducted by Minnow.
Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.85, 4.3, 8.4, 12.6, and 13.85 m, respectively, at the time of fall sampling.

Table C.50: *In Situ* Water Quality Profile Data Collected at Sheardown Lake SE Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017

Depth (m)	pH (pH units)						Specific Conductance (µS/cm)					
	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-3	DLO-02-6	DLO-02-7	DLO-02-4	DLO-02-8	DLO-02-3	DLO-02-3
Date Collected	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	22-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	22-Aug-17
surface						7.81						99
1.0	7.91	7.72	7.70	7.74	7.72	7.84	85	83	84	84	84	99
2.0	7.80	7.70	7.68	7.72	7.70	7.82	85	83	83	83	83	99
3.0	7.76	7.69	7.68	7.70	7.69	7.86	85	83	83	83	83	98
4.0	7.73	7.68	7.67	7.68	7.68	7.87	85	83	83	83	83	98
5.0	7.71		7.65	7.66	7.67	-	85		83	83	83	-
6.0	7.70		7.64	7.64	7.67	7.85	85		83	83	83	98
7.0			7.62	7.63	7.66	7.86			83	83	83	98
8.0			7.60	7.63	7.66	7.86			84	83	83	98
9.0				7.62	7.65	7.82				83	84	98
10.0				7.61	7.64	7.86				83	83	98
11.0				7.60	7.61	7.85				83	83	98
12.0				7.60	7.55	7.84				83	83	99
13.0					7.52	7.80					83	99

Notes:
21-Aug-17 sampling was conducted by Baffinland. 22-Aug-17 sampling was conducted by Minnow.
Total depth at stations DLO-02-6, DLO-02-7, DLO-02-4, DLO-02-8, and DLO-02-3 was 6.85, 4.3, 8.4, 12.6, and 13.85 m, respectively, at the time of fall sampling.

Table C.51: **Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Sheardown Lake SE Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017**

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	DLO-02-1	22-Aug-17	11.5	2.8	surface	8.20	11.23	95.3	8.00	100
					bottom	7.94	10.99	93.0	7.93	102
	DLO-02-11	22-Aug-17	8.0	1.7	surface	8.69	11.13	95.6	7.88	99
					bottom	8.68	11.05	94.9	7.82	99
	DLO-02-10	22-Aug-17	7.5	1.7	surface	8.69	11.25	96.9	8.08	99
					bottom	8.68	10.92	93.5	7.72	99
	DLO-02-4	22-Aug-17	8.8	2.6	surface	8.54	11.08	94.8	8.09	99
					bottom	8.51	9.99	85.7	7.88	99
	DLO-02-9	22-Aug-17	9.7	2.8	surface	8.56	11.44	97.9	7.98	98
					bottom	8.47	10.89	93.1	7.70	99
Profundal (Deep) Stations	DLO-02-12	22-Aug-17	10.5	1.9	surface	8.60	11.26	96.5	8.08	99
					bottom	8.54	11.10	95.0	7.80	99
	DLO-02-8	22-Aug-17	12.5	2.1	surface	8.56	11.25	96.3	8.08	99
					bottom	8.47	11.11	94.9	7.84	99
	DLO-02-13	22-Aug-17	13.2	2.2	surface	8.55	11.22	96.0	8.05	99
					bottom	8.26	10.78	91.8	7.52	100
	DLO-02-2	22-Aug-17	12.5	2.5	surface	8.55	11.14	95.4	8.04	99
					bottom	8.41	11.07	94.4	7.95	98
	DLO-02-3	22-Aug-17	13.5	3.0	surface	8.58	11.21	96.0	7.81	99
					bottom	8.11	10.65	90.3	7.80	99

Table C.52: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake SE Littoral and Profundal Stations, Mary River Project CREMP, August 2017

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.879	β , ζ	Littoral	5	2.32	0.57	0.26	1.70	2.80
				Profundal	5	2.34	0.43	0.19	1.90	3.00
Temperature (°C)	NO	0.548	α	Littoral	5	8.46	0.30	0.14	7.94	8.68
				Profundal	5	8.36	0.17	0.08	8.11	8.54
Dissolved Oxygen (mg/L)	NO	0.446	β , ζ	Littoral	5	10.8	0.4	0.2	10.0	11.1
				Profundal	5	10.9	0.2	0.1	10.7	11.1
Dissolved Oxygen (% saturation)	NO	0.524	β , ζ	Littoral	5	92.0	3.6	1.6	85.7	94.9
				Profundal	5	93.3	2.1	0.9	90.3	95.0
pH (units)	NO	0.747	α	Littoral	5	7.81	0.10	0.04	7.70	7.93
				Profundal	5	7.78	0.16	0.07	7.52	7.95
Specific Conductance (umho/cm)	NO	0.428	β , ζ	Littoral	5	99.7	1.5	0.7	98.8	102.4
				Profundal	5	99.1	0.7	0.3	98.1	100.0

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.53: Statistical Comparison of Bottom *In Situ* Water Quality Between Sheardown Lake SE and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.470	α	Reference	5	9.74	1.04	0.46	8.50	11.20
					Sheardown SE	5	9.10	1.58	0.71	7.50	11.50
	Secchi Depth (m)	YES	< 0.001	β , ζ	Reference	5	8.26	0.74	0.33	7.50	9.40
					Sheardown SE	5	2.32	0.57	0.26	1.70	2.80
	Temperature (˚C)	NO	0.325	α	Reference	5	8.29	0.16	0.07	8.05	8.42
					Sheardown SE	5	8.46	0.30	0.14	7.94	8.68
	Dissolved Oxygen (mg/L)	YES	0.001	β , ζ	Reference	5	11.8	0.1	0.0	11.7	11.9
					Sheardown SE	5	10.8	0.4	0.2	10.0	11.1
	Dissolved Oxygen (% saturation)	YES	0.002	β , ζ	Reference	5	100.3	0.9	0.4	99.0	101.0
					Sheardown SE	5	92.0	3.6	1.6	85.7	94.9
	pH (units)	YES	0.003	α	Reference	5	7.43	0.17	0.08	7.31	7.72
					Sheardown SE	5	7.81	0.10	0.04	7.70	7.93
	Specific Conductance (umho/cm)	YES	< 0.001	β , ζ	Reference	5	73.7	0.6	0.3	73.2	74.6
					Sheardown SE	5	99.7	1.5	0.7	98.8	102.4
Profundal (Deep) Stations	**Station Depth (m)**	YES	< 0.001	α	Reference	5	20.56	2.17	0.97	18.50	24.20
					Sheardown SE	5	12.44	1.17	0.52	10.50	13.50
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.28	0.43	0.19	7.90	9.00
					Sheardown SE	5	2.34	0.43	0.19	1.90	3.00
	Temperature (˚C)	YES	0.015	α	Reference	5	7.48	0.61	0.27	6.47	8.10
					Sheardown SE	5	8.36	0.17	0.08	8.11	8.54
	Dissolved Oxygen (mg/L)	YES	0.037	α	Reference	5	11.6	0.5	0.2	10.7	12.0
					Sheardown SE	5	10.9	0.2	0.1	10.7	11.1
	Dissolved Oxygen (% saturation)	YES	0.063	α , η	Reference	5	97.3	3.6	1.6	93.0	100.7
					Sheardown SE	5	93.3	2.1	0.9	90.3	95.0
	pH (units)	YES	< 0.001	α	Reference	5	7.29	0.06	0.03	7.23	7.37
					Sheardown SE	5	7.78	0.16	0.07	7.52	7.95
	Specific Conductance (umho/cm)	YES	< 0.001	α , η	Reference	5	76.1	3.5	1.5	73.2	80.6
					Sheardown SE	5	99.1	0.7	0.3	98.1	100.0

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.54: Water chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event								
					DL0-02-6 bottom 13-Apr-17	DL0-02-6 surface 13-Apr-17	DL0-02-7 surface 13-Apr-17	DL0-02-4 bottom 13-Apr-17	DL0-02-4 surface 13-Apr-17	DL0-02-8 bottom 13-Apr-17	DL0-02-8 surface 13-Apr-17	DL0-02-3 bottom 13-Apr-17	DL0-02-3 surface 13-Apr-17
Conventionals	Conductivity (lab)	umho/cm	-	-	172	178	160	153	160	154	161	156	157
	pH (lab)	pH	6.5 - 9.0	-	7.42	7.43	7.53	7.60	7.58	7.40	7.59	7.40	7.63
	Hardness (as $CaCO_3$)	mg/L	-	-	87	90	77	75	79	75	81	75	78
	Total Suspended Solids (TSS)	mg/L	-	-	2.5	<2.0	<2.0	<2.0	<2.0	3.6	3.2	2.0	3.4
	Total Dissolved Solids (TDS)	mg/L	-	-	91	91	80	69	73	73	73	67	72
	Turbidity	NTU	-	-	0.3	0.6	0.4	1.0	0.3	0.7	0.3	0.4	0.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	79	81	77	75	76	70	79	72	73
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	0.052	<0.020	<0.020	<0.020	<0.020	0.026
	Nitrate	mg/L	13	13	0.051	0.050	0.023	<0.020	<0.020	0.037	0.024	0.055	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	0.49	0.23	0.17	0.18	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.0	2.0	1.9	2.1	1.8	1.6	2.0	1.7	2.0
	Total Organic Carbon	mg/L	-	-	2.0	1.9	1.9	1.8	1.9	1.8	2.0	1.6	1.9
	Total Phosphorus	mg/L	0.020[α]	-	0.0070	0.0054	0.0051	0.0067	0.0037	0.0054	0.0087	0.0039	0.0046
	Phenols	mg/L	0.004[α]	-	<0.0010	0.0015	0.0014	0.0038	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	3.6	3.7	2.7	3.2	3.3	3.2	3.3	3.3	4.7
	Sulphate (SO_4)	mg/L	218[β]	218	3.9	3.9	2.7	3.4	3.6	3.3	3.6	3.1	2.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	<0.003	<0.003	0.004	0.005	<0.003	0.006	<0.003	0.004	<0.003
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0087	0.0089	0.0081	0.0076	0.0079	0.0075	0.0081	0.0076	0.0078
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	17	18	17	16	16	16	16	16	16
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0008	0.0009	0.0008	0.0009	0.0008	0.0010	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	0.0011	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	10.9	10.8	9.5	9.1	10.2	9.4	10.1	9.4	9.8
	Manganese (Mn)	mg/L	0.935[β]	-	0.0032	0.0037	0.0025	0.0032	0.0015	0.0038	0.0017	0.0038	0.0015
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002
	Molybdenum (Mo)	mg/L	0.073	-	0.00065	0.00066	0.00063	0.00060	0.00063	0.00056	0.00065	0.00054	0.00063
	Nickel (Ni)	mg/L	0.025	0.025	0.00076	0.00079	0.00067	0.00065	0.00071	0.00065	0.00075	0.00064	0.00066
	Potassium (K)	mg/L	-	-	1.40	1.46	1.28	1.24	1.32	1.22	1.34	1.20	1.27
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.81	0.83	0.65	0.61	0.64	0.76	0.64	0.87	0.61
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.8	1.9	1.7	1.6	1.8	1.7	1.8	1.6	1.7
	Strontium (Sr)	mg/L	-	-	0.011	0.012	0.011	0.010	0.011	0.010	0.011	0.010	0.011
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	0.00051	0.00119	0.00057	0.00098	0.00037	0.00123	0.00083	0.00077	0.00074
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0010	0.0010	0.0009	0.0009	0.0010	0.0009	0.0010	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(grey box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.54: Water chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event								
					DL0-02-6 bottom 23-Jul-17	DL0-02-6 surface 23-Jul-17	DL0-02-7 surface 23-Jul-17	DL0-02-4 bottom 23-Jul-17	DL0-02-4 surface 23-Jul-17	DL0-02-8 bottom 23-Jul-17	DL0-02-8 surface 23-Jul-17	DL0-02-3 bottom 23-Jul-17	DL0-02-3 surface 23-Jul-17
Conventionals	Conductivity (lab)	umho/cm	-	-	96	96	93	90	90	90	90	90	91
	pH (lab)	pH	6.5 - 9.0	-	7.76	7.85	7.86	7.74	7.78	7.67	7.71	7.78	7.77
	Hardness (as $CaCO_3$)	mg/L	-	-	46	46	43	42	43	43	43	43	43
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	2.4	2.3	<2.0	2.4	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	54	50	43	46	55	48	50	67	46
	Turbidity	NTU	-	-	1.5	1.7	1.1	1.6	1.8	1.5	1.5	1.3	1.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	44	45	41	43	42	40	41	43	40
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.5	1.5	1.5	1.5	1.6	1.4	1.5	1.5	1.5
	Total Organic Carbon	mg/L	-	-	1.5	1.4	1.5	1.4	1.4	1.4	1.5	1.4	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0045	0.0045	0.0104	0.0063	0.0062	0.0047	0.0064	0.0049	0.0054
	Phenols	mg/L	0.001[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.1	2.1	2.0	2.0	2.0	2.0	2.0	1.9	2.0
	Sulphate (SO_4)	mg/L	218[β]	218	2.7	2.7	2.5	2.4	2.4	2.4	2.4	2.4	2.4
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.028	0.024	0.033	0.038	0.038	0.040	0.035	0.036	0.034
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0048	0.0047	0.0046	0.0046	0.0046	0.0046	0.0047	0.0045	0.0046
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	9	9	9	8	8	8	8	8	8
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0013	<0.0010
	Iron (Fe)	mg/L	0.30	0.300	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
	Lead (Pb)	mg/L	0.001	0.001	0.000053	<0.000050	0.000055	0.000056	<0.000050	0.000050	0.000059	0.000055	0.000058
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	5.6	5.5	5.5	5.0	5.0	5.1	5.2	5.1	5.4
	Manganese (Mn)	mg/L	0.935[β]	-	0.0042	0.0041	0.0045	0.0052	0.0048	0.0052	0.0047	0.0046	0.0046
	Mercury (Hg)	mg/L	0.000026	-	0.00002	0.00001	0.00002	<0.00001	<0.00001	0.00001	0.00002	0.00003	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00046	0.00047	0.00044	0.00041	0.00040	0.00041	0.00039	0.00039	0.00043
	Nickel (Ni)	mg/L	0.025	0.025	0.00059	0.00058	0.00062	0.00057	0.00054	0.00066	0.00057	0.00059	0.00068
	Potassium (K)	mg/L	-	-	0.82	0.78	0.79	0.78	0.74	0.78	0.78	0.76	0.78
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.43	0.41	0.43	0.43	0.43	0.45	0.43	0.44	0.42
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Strontium (Sr)	mg/L	-	-	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Tin (Sn)	mg/L	-	-	0.00042	0.00019	0.00061	0.00068	0.00083	0.00038	0.00057	0.00077	0.00105
	Titanium (Ti)	mg/L	-	-	0.0014	0.0012	0.0016	0.0018	0.0017	0.0018	0.0017	0.0020	0.0015
	Uranium (U)	mg/L	0.015	-	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.54: Water chemistry at Sheardown Lake SE (DLO-02) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event									
					DL0-02-6 bottom 21-Aug-17	DL0-02-6 surface 21-Aug-17	DL0-02-7 bottom 21-Aug-17	DL0-02-7 surface 21-Aug-17	DL0-02-4 bottom 21-Aug-17	DL0-02-4 surface 21-Aug-17	DL0-02-8 bottom 21-Aug-17	DL0-02-8 surface 21-Aug-17	DL0-02-3 bottom 21-Aug-17	DL0-02-3 surface 21-Aug-17
Conventionals	Conductivity (lab)	umho/cm	-	-	104	104	102	102	102	102	102	102	102	102
	pH (lab)	pH	6.5 - 9.0	-	7.90	7.91	7.90	7.93	7.94	7.94	7.90	7.88	7.88	7.96
	Hardness (as $CaCO_3$)	mg/L	-	-	48	49	48	48	49	49	48	47	48	50
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	60	48	47	44	41	50	45	30	44	46
	Turbidity	NTU	-	-	4.2	3.9	3.8	3.4	4.4	3.2	4.4	3.6	4.7	3.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	43	44	41	51	47	42	43	45	44	43
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.4	1.4	1.3	1.7	1.3	1.2	1.3	1.2	1.3	1.5
	Total Organic Carbon	mg/L	-	-	1.5	1.5	1.4	1.5	1.4	1.4	1.4	1.5	1.4	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0060	0.0076	0.0042	0.0076	0.0068	0.0055	0.0072	0.0067	0.0080	0.0072
	Phenols	mg/L	0.001[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
	Sulphate (SO_4)	mg/L	218[β]	218	3.1	3.1	3.0	3.0	3.0	3.0	2.9	3.0	2.9	3.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.179, 0.173[c]	0.091	0.081	0.090	0.088	0.087	0.078	0.085	0.067	0.074	0.087
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0061	0.0060	0.0063	0.0060	0.0061	0.0061	0.0062	0.0060	0.0060	0.0061
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00009	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	10	10	9	10	9	9	10	9	10	9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0008	0.0009	0.0008	0.0008	0.0009	0.0009	0.0008	0.0008	0.0008
	Iron (Fe)	mg/L	0.30	0.300	0.064	0.069	0.068	0.062	0.069	0.060	0.073	0.057	0.057	0.063
	Lead (Pb)	mg/L	0.001	0.001	0.000094	0.000091	0.000087	0.000095	0.000100	0.000083	0.000099	0.000082	0.000086	0.000093
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.0	5.9	5.8	6.0	6.0	5.8	5.9	6.0	6.0	5.9
	Manganese (Mn)	mg/L	0.935[β]	-	0.0040	0.0038	0.0036	0.0037	0.0041	0.0034	0.0042	0.0034	0.0034	0.0034
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00043	0.00045	0.00042	0.00043	0.00043	0.00045	0.00044	0.00042	0.00043	0.00044
	Nickel (Ni)	mg/L	0.025	0.025	0.00062	0.00059	0.00058	0.00058	0.00061	0.00058	0.00062	0.00058	0.00056	0.00057
	Potassium (K)	mg/L	-	-	0.94	0.93	0.92	0.92	0.91	0.92	0.93	0.91	0.91	0.91
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.60	0.59	0.62	0.63	0.60	0.62	0.64	0.59	0.58	0.62
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
	Strontium (Sr)	mg/L	-	-	0.007	0.007	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to Sheardown Lake.

[c] Benchmark is 0.179 mg/L and 0.173 mg/L for shallow and deep stations, respectively.

(shaded box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Winter Sampling Event									Summer Sampling Event				
			DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-4	DL0-02-4	DL0-02-8	DL0-02-8	DL0-02-3	DL0-02-3	DL0-02-6	DL0-02-6	DL0-02-7	DL0-02-4	DL0-02-4
			bottom	surface	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	surface	bottom	surface
			13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0049	0.0046	0.0054	0.005	0.0053
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00872	0.00885	0.00775	0.00762	0.00792	0.00733	0.00816	0.00735	0.00763	0.00482	0.0046	0.00454	0.00451	0.00442
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	17.7	18.0	15.7	14.6	15.5	14.7	16.2	14.8	15.4	9.08	8.91	8.52	8.36	8.23
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00084	0.00084	0.00082	0.00080	0.00089	0.00079	0.00085	0.00074	0.00080	0.00063	0.00066	0.00082	0.00057	0.00087
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.00130	0.00100	<0.0010	<0.0010	<0.0010	<0.0010	0.00110	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	10.40	10.8	9.28	9.42	9.68	9.31	9.96	9.29	9.67	5.55	5.67	5.33	5.2	5.34
	Manganese (Mn)	mg/L	0.00035	0.000626	0.000486	0.000160	0.000476	0.000326	0.000305	0.000317	0.00016	0.000358	0.000378	0.000301	0.000247	0.000323
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000021	0.000012	<0.000010
	Molybdenum (Mo)	mg/L	0.000667	0.000661	0.000617	0.000589	0.000632	0.000554	0.000651	0.000540	0.000615	0.000442	0.000437	0.0004	0.000386	0.000387
	Nickel (Ni)	mg/L	0.000740	0.000770	0.000680	0.000660	0.000695	0.000600	0.000700	0.000610	0.000650	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.39	1.44	1.28	1.24	1.27	1.20	1.32	1.19	1.26	0.82	0.84	0.8	0.78	0.78
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.770	0.810	0.640	0.590	0.620	0.760	0.650	0.840	0.590	0.36	0.38	0.36	0.37	0.36
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.80	1.81	1.67	1.66	1.70	1.62	1.79	1.59	1.68	1.1	1.07	1.08	1.03	1.01
	Strontium (Sr)	mg/L	0.0119	0.0120	0.0108	0.00985	0.01055	0.00991	0.01100	0.01030	0.01040	0.0061	0.00599	0.00589	0.00579	0.00573
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00127	0.00082	0.00072	0.00127	0.00136	0.00245	0.00199	0.00169	0.00122	0.00104	0.00059	0.00108	0.00084	0.0008
	Titanium (Ti)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.001030	0.001060	0.000973	0.000940	0.000981	0.000914	0.001020	0.000912	0.000960	0.000551	0.000556	0.000521	0.000498	0.000495
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.55: Dissolved Metal Concentrations at Sheardown Lake SE Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Summer Sampling Event				Fall Sampling Event									
			DL0-02-8 bottom 23-Jul-17	DL0-02-8 surface 23-Jul-17	DL0-02-3 bottom 23-Jul-17	DL0-02-3 surface 23-Jul-17	DL0-02-6 bottom 21-Aug-17	DL0-02-6 surface 21-Aug-17	DL0-02-7 bottom 21-Aug-17	DL0-02-7 surface 21-Aug-17	DL0-02-4 bottom 21-Aug-17	DL0-02-4 surface 21-Aug-17	DL0-02-8 bottom 21-Aug-17	DL0-02-8 surface 21-Aug-17	DL0-02-3 bottom 21-Aug-17	DL0-02-3 surface 21-Aug-17
Dissolved Metals	Aluminum (Al)	mg/L	0.0057	0.005	0.0061	0.0047	0.0081	0.0087	0.0092	0.0081	0.0073	0.0113	0.0087	0.0105	0.0124	0.0093
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00462	0.00447	0.00453	0.00455	0.00548	0.00548	0.00542	0.00531	0.00538	0.00542	0.00536	0.00546	0.00543	0.00547
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	8.38	8.81	8.48	8.43	9.4	9.8	9.3	9.5	9.7	9.8	9.4	9.3	9.5	10.0
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00085	0.001	0.00098	0.00093	0.00069	0.00070	0.00077	0.00072	0.00076	0.00070	0.00078	0.00071	0.00068	0.00073
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.26	5.1	5.29	5.35	6.04	5.99	6.06	5.85	6.00	5.98	5.95	5.88	5.81	5.99
	Manganese (Mn)	mg/L	0.000277	0.000312	0.000355	0.000326	0.000262	0.00025	0.000248	0.00027	0.000489	0.000352	0.000193	0.000282	0.000488	0.000304
	Mercury (Hg)	mg/L	0.000011	<0.000010	0.000027	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.00038	0.00039	0.0004	0.000398	0.000478	0.000452	0.000469	0.000467	0.000478	0.000473	0.000479	0.000465	0.000459	0.000460
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.78	0.78	0.79	0.79	0.89	0.90	0.91	0.90	0.90	0.89	0.89	0.90	0.89	0.90
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.36	0.36	0.37	0.36	0.45	0.45	0.45	0.44	0.46	0.46	0.45	0.46	0.50	0.45
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.03	1.04	1.04	1.06	1.11	1.09	1.08	1.09	1.11	1.10	1.11	1.11	1.07	1.11
	Strontium (Sr)	mg/L	0.00573	0.00578	0.00584	0.00572	0.00665	0.00687	0.00671	0.00672	0.00670	0.00656	0.00661	0.00657	0.00657	0.00654
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00055	0.00011	0.00229	0.00038	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000498	0.000503	0.000501	0.000499	0.000603	0.000611	0.000596	0.000590	0.000578	0.000587	0.000603	0.000592	0.000587	0.000603
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.56: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Sheardown Lake Southeast and Reference Lake 3 in 2017, and at Sheardown Lake Southeast Between 2017 and the Baseline Period

Dissolved Metal	Sheardown Lake SE				
	2017 vs Reference Lake 3		2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	1.7	3.1	0.0	1.1	3.1
Antimony (Sb)	1.0	1.0	0.0	0.0	1.0
Arsenic (As)	1.0	1.0	1.0	0.8	1.0
Barium (Ba)	0.7	0.9	0.0	0.9	0.9
Beryllium (Be)	1.0	1.0	1.2	1.2	2.1
Cadmium (Cd)	1.0	1.0	0.4	0.0	0.8
Calcium (Ca)	1.2	1.4	1.2	0.8	0.8
Chromium (Cr)	1.0	1.0	RDL	RDL	RDL
Cobalt (Co)	1.0	1.0	1.0	1.0	0.9
Copper (Cu)	1.0	0.9	0.7	0.5	0.9
Iron (Fe)	1.0	1.0	1.2	1.2	1.7
Lead (Pb)	1.0	1.0	0.6	1.0	1.0
Lithium (Li)	1.0	1.0	0.2	0.0	0.4
Magnesium (Mg)	1.2	1.4	1.2	0.8	0.8
Manganese (Mn)	1.3	1.7	0.6	0.0	0.5
Mercury (Hg)	1.3	1.0	1.0	1.3	1.0
Molybdenum (Mo)	2.9	4.2	2.7	0.0	2.3
Nickel (Ni)	1.0	1.0	1.0	0.5	0.9
Potassium (K)	0.9	1.1	0.8	0.7	0.7
Selenium (Se)	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	0.9	1.1	1.4	0.9	1.1
Silver (Ag)	1.0	1.0	1.2	1.8	2.7
Sodium (Na)	1.2	1.3	1.0	0.8	0.8
Strontium (Sr)	0.7	0.8	1.4	0.8	0.9
Thallium (Tl)	1.0	1.0	1.2	1.3	2.6
Tin (Sn)	8.5	1.0	0.9	1.5	0.1
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0
Uranium (U)	1.9	2.3	2.0	1.1	1.2
Vanadium (V)	1.0	1.0	1.0	1.0	1.0
Zinc (Zn)	1.0	1.0	1.5	1.0	1.9

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.57: Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Conventional Parameters									Total Metals													
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Lead	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	1	0.957	0.602	-0.438	0.851	0.516	-0.008	0.925	0.862	-0.468	0.942	-0.606	-0.431	-0.294	-0.809	0.867	0.639	0.980	0.834	0.971	0.959	0.110	0.977
Hardness	0.957	1	0.613	-0.440	0.828	0.526	-0.018	0.883	0.836	-0.467	0.944	-0.584	-0.427	-0.304	-0.824	0.857	0.599	0.938	0.850	0.947	0.943	0.097	0.938
Total Dissolved Solids	0.602	0.613	1	-0.766	0.595	0.739	-0.411	0.624	0.414	-0.732	0.596	0.060	-0.774	-0.745	-0.389	0.651	0.608	0.598	0.492	0.599	0.533	0.588	0.583
Turbidity	-0.438	-0.440	-0.766	1	-0.523	-0.815	0.383	-0.514	-0.203	0.921	-0.430	-0.181	0.937	0.855	0.344	-0.606	-0.684	-0.445	-0.333	-0.461	-0.436	-0.714	-0.441
Alkalinity	0.851	0.828	0.595	-0.523	1	0.663	-0.018	0.865	0.681	-0.612	0.771	-0.510	-0.573	-0.444	-0.701	0.809	0.528	0.808	0.658	0.789	0.846	0.236	0.860
Dissolved Organic Carbon	0.516	0.526	0.739	-0.815	0.663	1	-0.122	0.572	0.302	-0.785	0.471	0.003	-0.835	-0.718	-0.364	0.635	0.557	0.513	0.383	0.475	0.525	0.698	0.526
Total Phosphorus	-0.008	-0.018	-0.411	0.383	-0.018	-0.122	1	-0.160	0.102	0.304	-0.064	-0.236	0.350	0.450	-0.012	-0.078	-0.204	0.006	-0.017	-0.064	0.056	-0.228	0.049
Chloride	0.925	0.883	0.624	-0.514	0.865	0.572	-0.160	1	0.798	-0.568	0.867	-0.536	-0.508	-0.414	-0.742	0.898	0.609	0.902	0.667	0.893	0.881	0.169	0.915
Sulphate	0.862	0.836	0.414	-0.203	0.681	0.302	0.102	0.798	1	-0.231	0.811	-0.633	-0.202	-0.084	-0.701	0.708	0.486	0.857	0.758	0.852	0.792	-0.041	0.859
Aluminum (total)	-0.468	-0.467	-0.732	0.921	-0.612	-0.785	0.304	-0.568	-0.231	1	-0.445	-0.111	0.945	0.878	0.348	-0.682	-0.647	-0.452	-0.263	-0.453	-0.473	-0.729	-0.480
Barium (total)	0.942	0.944	0.596	-0.430	0.771	0.471	-0.064	0.867	0.811	-0.445	1	-0.519	-0.418	-0.290	-0.794	0.807	0.587	0.956	0.872	0.954	0.917	0.072	0.916
Copper (total)	-0.606	-0.584	0.060	-0.181	-0.510	0.003	-0.236	-0.536	-0.633	-0.111	-0.519	1	-0.096	-0.193	0.528	-0.355	-0.085	-0.543	-0.561	-0.537	-0.608	0.252	-0.597
Iron (total)	-0.431	-0.427	-0.774	0.937	-0.573	-0.835	0.350	-0.508	-0.202	0.945	-0.418	-0.096	1	0.922	0.324	-0.584	-0.605	-0.414	-0.294	-0.413	-0.417	-0.799	-0.430
Lead (total)	-0.294	-0.304	-0.745	0.855	-0.444	-0.718	0.450	-0.414	-0.084	0.878	-0.290	-0.193	0.922	1	0.207	-0.505	-0.516	-0.268	-0.160	-0.288	-0.263	-0.737	-0.275
Manganese (total)	-0.809	-0.824	-0.389	0.344	-0.701	-0.364	-0.012	-0.742	-0.701	0.348	-0.794	0.528	0.324	0.207	1	-0.691	-0.356	-0.788	-0.630	-0.792	-0.740	0.123	-0.803
Molybdenum (total)	0.867	0.857	0.651	-0.606	0.809	0.635	-0.078	0.898	0.708	-0.682	0.807	-0.355	-0.584	-0.505	-0.691	1	0.682	0.862	0.632	0.850	0.873	0.258	0.861
Nickel (total)	0.639	0.599	0.608	-0.684	0.528	0.557	-0.204	0.609	0.486	-0.647	0.587	-0.085	-0.605	-0.516	-0.356	0.682	1	0.655	0.511	0.645	0.681	0.458	0.639
Potassium (total)	0.980	0.938	0.598	-0.445	0.808	0.513	0.006	0.902	0.857	-0.452	0.956	-0.543	-0.414	-0.268	-0.788	0.862	0.655	1	0.848	0.982	0.957	0.095	0.977
Silicon (total)	0.834	0.850	0.492	-0.333	0.658	0.383	-0.017	0.667	0.758	-0.263	0.872	-0.561	-0.294	-0.160	-0.630	0.632	0.511	0.848	1	0.864	0.839	0.043	0.815
Sodium (total)	0.971	0.947	0.599	-0.461	0.789	0.475	-0.064	0.893	0.852	-0.453	0.954	-0.537	-0.413	-0.288	-0.792	0.850	0.645	0.982	0.864	1	0.934	0.098	0.951
Strontium (total)	0.959	0.943	0.533	-0.436	0.846	0.525	0.056	0.881	0.792	-0.473	0.917	-0.608	-0.417	-0.263	-0.740	0.873	0.681	0.957	0.839	0.934	1	0.097	0.961
Tin (total)	0.110	0.097	0.588	-0.714	0.236	0.698	-0.228	0.169	-0.041	-0.729	0.072	0.252	-0.799	-0.737	0.123	0.258	0.458	0.095	0.043	0.098	0.097	1	0.108
Uranium (total)	0.977	0.938	0.583	-0.441	0.860	0.526	0.049	0.915	0.859	-0.480	0.916	-0.597	-0.430	-0.275	-0.803	0.861	0.639	0.977	0.815	0.951	0.961	0.108	1
Aluminum (dissolved)	-0.463	-0.448	-0.770	0.878	-0.605	-0.867	0.372	-0.589	-0.226	0.896	-0.444	-0.100	0.904	0.827	0.215	-0.636	-0.694	-0.464	-0.296	-0.448	-0.485	-0.775	-0.465
Barium (dissolved)	0.973	0.953	0.602	-0.440	0.807	0.477	-0.038	0.900	0.870	-0.466	0.934	-0.608	-0.442	-0.325	-0.834	0.836	0.651	0.948	0.804	0.940	0.925	0.085	0.946
Copper (dissolved)	-0.008	0.080	0.390	-0.521	-0.008	0.427	-0.101	-0.089	-0.092	-0.425	0.052	0.387	-0.455	-0.413	0.042	-0.012	0.467	0.014	0.095	0.017	0.039	0.549	0.029
Manganese (dissolved)	0.109	0.178	0.234	-0.135	0.265	0.053	-0.210	0.078	0.037	-0.285	0.072	0.075	-0.235	-0.217	-0.065	0.198	0.124	0.016	0.056	0.051	0.123	0.106	0.077
Molybdenum (dissolved)	0.951	0.944	0.595	-0.441	0.827	0.496	-0.036	0.871	0.825	-0.453	0.960	-0.520	-0.415	-0.262	-0.798	0.823	0.647	0.959	0.862	0.954	0.938	0.102	0.947
Nickel (dissolved)	0.829	0.824	0.755	-0.767	0.860	0.846	-0.110	0.793	0.636	-0.748	0.800	-0.293	-0.772	-0.622	-0.660	0.806	0.725	0.833	0.735	0.818	0.830	0.475	0.840
Potassium (dissolved)	0.960	0.956	0.552	-0.454	0.853	0.534	-0.025	0.893	0.843	-0.462	0.934	-0.603	-0.432	-0.299	-0.850	0.822	0.606	0.939	0.835	0.951	0.922	0.107	0.938
Silicon (dissolved)	0.919	0.911	0.549	-0.397	0.828	0.419	-0.047	0.823	0.803	-0.461	0.902	-0.669	-0.459	-0.322	-0.766	0.743	0.515	0.881	0.852	0.901	0.876	0.143	0.894
Sodium (dissolved)	0.939	0.932	0.573	-0.493	0.836	0.524	-0.013	0.907	0.829	-0.517	0.933	-0.535	-0.457	-0.297	-0.777	0.869	0.684	0.935	0.804	0.917	0.944	0.139	0.936
Strontium (dissolved)	0.969	0.937	0.582	-0.443	0.875	0.530	-0.009	0.900	0.827	-0.446	0.930	-0.590	-0.412	-0.276	-0.784	0.818	0.599	0.964	0.852	0.967	0.942	0.085	0.960
Tin (dissolved)	0.266	0.253	0.688	-0.864	0.435	0.726	-0.318	0.355	0.131	-0.830	0.226	0.224	-0.864	-0.811	-0.107	0.446	0.515	0.250	0.187	0.280	0.247	0.805	0.260
Uranium (dissolved)	0.972	0.952	0.607	-0.444	0.818	0.525	0.010	0.903	0.867	-0.466	0.954	-0.561	-0.416	-0.281	-0.815	0.852	0.621	0.974	0.839	0.955	0.942	0.088	0.971

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 28.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.57: Spearman's Rank Correlation Coefficients for Sheardown Lake SE (DLO-2) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Dissolved Metals											
	Aluminum	Barium	Copper	Manganese	Molybdenum	Nickel	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	-0.463	0.973	-0.008	0.109	0.951	0.829	0.960	0.919	0.939	0.969	0.266	0.972
Hardness	-0.448	0.953	0.080	0.178	0.944	0.824	0.956	0.911	0.932	0.937	0.253	0.952
Total Dissolved Solids	-0.770	0.602	0.390	0.234	0.595	0.755	0.552	0.549	0.573	0.582	0.688	0.607
Turbidity	0.878	-0.440	-0.521	-0.135	-0.441	-0.767	-0.454	-0.397	-0.493	-0.443	-0.864	-0.444
Alkalinity	-0.605	0.807	-0.008	0.265	0.827	0.860	0.853	0.828	0.836	0.875	0.435	0.818
Dissolved Organic Carbon	-0.867	0.477	0.427	0.053	0.496	0.846	0.534	0.419	0.524	0.530	0.726	0.525
Total Phosphorus	0.372	-0.038	-0.101	-0.210	-0.036	-0.110	-0.025	-0.047	-0.013	-0.009	-0.318	0.010
Chloride	-0.589	0.900	-0.089	0.078	0.871	0.793	0.893	0.823	0.907	0.900	0.355	0.903
Sulphate	-0.226	0.870	-0.092	0.037	0.825	0.636	0.843	0.803	0.829	0.827	0.131	0.867
Aluminum (total)	0.896	-0.466	-0.425	-0.285	-0.453	-0.748	-0.462	-0.461	-0.517	-0.446	-0.830	-0.466
Barium (total)	-0.444	0.934	0.052	0.072	0.960	0.800	0.934	0.902	0.933	0.930	0.226	0.954
Copper (total)	-0.100	-0.608	0.387	0.075	-0.520	-0.293	-0.603	-0.669	-0.535	-0.590	0.224	-0.561
Iron (total)	0.904	-0.442	-0.455	-0.235	-0.415	-0.772	-0.432	-0.459	-0.457	-0.412	-0.864	-0.416
Lead (total)	0.827	-0.325	-0.413	-0.217	-0.262	-0.622	-0.299	-0.322	-0.297	-0.276	-0.811	-0.281
Manganese (total)	0.215	-0.834	0.042	-0.065	-0.798	-0.660	-0.850	-0.766	-0.777	-0.784	-0.107	-0.815
Molybdenum (total)	-0.636	0.836	-0.012	0.198	0.823	0.806	0.822	0.743	0.869	0.818	0.446	0.852
Nickel (total)	-0.694	0.651	0.467	0.124	0.647	0.725	0.606	0.515	0.684	0.599	0.515	0.621
Potassium (total)	-0.464	0.948	0.014	0.016	0.959	0.833	0.939	0.881	0.935	0.964	0.250	0.974
Silicon (total)	-0.296	0.804	0.095	0.056	0.862	0.735	0.835	0.852	0.804	0.852	0.187	0.839
Sodium (total)	-0.448	0.940	0.017	0.051	0.954	0.818	0.951	0.901	0.917	0.967	0.280	0.955
Strontium (total)	-0.485	0.925	0.039	0.123	0.938	0.830	0.922	0.876	0.944	0.942	0.247	0.942
Tin (total)	-0.775	0.085	0.549	0.106	0.102	0.475	0.107	0.143	0.139	0.085	0.805	0.088
Uranium (total)	-0.465	0.946	0.029	0.077	0.947	0.840	0.938	0.894	0.936	0.960	0.260	0.971
Aluminum (dissolved)	1	-0.427	-0.427	-0.177	-0.463	-0.768	-0.454	-0.413	-0.503	-0.464	-0.816	-0.449
Barium (dissolved)	-0.427	1	0.027	0.099	0.914	0.802	0.944	0.907	0.926	0.926	0.245	0.963
Copper (dissolved)	-0.427	0.027	1	0.132	0.093	0.341	0.073	-0.010	0.074	0.021	0.435	0.063
Manganese (dissolved)	-0.177	0.099	0.132	1	0.137	0.154	0.115	0.208	0.121	0.089	0.143	0.031
Molybdenum (dissolved)	-0.463	0.914	0.093	0.137	1	0.825	0.943	0.902	0.959	0.944	0.275	0.943
Nickel (dissolved)	-0.768	0.802	0.341	0.154	0.825	1	0.842	0.778	0.812	0.847	0.586	0.820
Potassium (dissolved)	-0.454	0.944	0.073	0.115	0.943	0.842	1	0.902	0.926	0.966	0.262	0.957
Silicon (dissolved)	-0.413	0.907	-0.010	0.208	0.902	0.778	0.902	1	0.860	0.900	0.297	0.883
Sodium (dissolved)	-0.503	0.926	0.074	0.121	0.959	0.812	0.926	0.860	1	0.905	0.312	0.941
Strontium (dissolved)	-0.464	0.926	0.021	0.089	0.944	0.847	0.966	0.900	0.905	1	0.278	0.955
Tin (dissolved)	-0.816	0.245	0.435	0.143	0.275	0.586	0.262	0.297	0.312	0.278	1	0.256
Uranium (dissolved)	-0.449	0.963	0.063	0.031	0.943	0.820	0.957	0.883	0.941	0.955	0.256	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 28.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.58: Water Chemistry at Mary River Tributary-F and Mary River CREMP and EEM Stations during Periods of Effluent Discharge in 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	Mary River Tributary-F			Mary River Upstream				Mary River Downstream						
				MRTF-1	FO-01	FO-01	MS-08-US	MS-08-US	GO-01	G0-01	E0-10	MS-08-DS	MS-08-DS	EO-21	E0-21	CO-01	CO-01
				24/Aug/17	8/Jul/17	1/Sep/17	21/Jul/17	24/Aug/17	8/Jul/17	1/Sep/17	1/Sep/17	21/Jul/17	24/Aug/17	8/Jul/17	1/Sep/17	8/Jul/17	27/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	196	51	266	50	136	30	151	158	53	141	30	164	32	143
	pH (lab)	pH	6.5 - 9.0	8.12	7.57	8.22	7.62	8.06	7.22	8.08	8.10	7.63	8.04	7.32	8.04	7.44	8.01
	Hardness (as $CaCO_3$)	mg/L	-	96	27	134	22	61	13	70	74	24	63	13	78	14	72
	Total Suspended Solids (TSS)	mg/L	-	<2.0	7.3	5.2	3.4	<2.0	3.9	<2.0	<2.0	3.6	<2.0	<2.0	<2.0	3.4	3.3
	Total Dissolved Solids (TDS)	mg/L	-	106	35	136	-	76	19	74	76	-	43	17	79	25	71
	Alkalinity (as $CaCO_3$)	mg/L	-	97	22	107	24	58	11	66	69	24	61	10	69	14	63
Nutrients and Anions	Total Ammonia	mg/L	variable[c]	0.177	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	0.116	<0.020	0.134	<0.020	<0.020	<0.020	<0.020	0.035	0.075	<0.020	<0.020	0.058	<0.020	0.070
	Total Organic Carbon	mg/L	-	<1.0	1.0	1.0	<1.0	1.4	1.3	1.1	1.2	<1.0	1.5	1.5	1.1	1.2	1.3
	Total Phosphorus	mg/L	0.020^{α}	<0.0030	0.0112	0.0067	0.0065	0.0046	0.0078	0.0036	0.0038	0.0110	0.0053	0.0088	0.0037	0.0103	0.0066
	Chloride (Cl)	mg/L	120	1.3	<0.5	5.4	1.1	3.9	0.7	4.6	4.7	1.5	3.9	0.8	4.7	0.7	4.1
	Sulphate (SO_4)	mg/L	218^{β}	2.8	1.2	25.3	0.6	2.4	0.3	2.9	4.3	0.7	3.0	0.4	7.5	0.6	3.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.057	**0.133**	**0.187**	0.091	**0.154**	0.099	0.059	0.071	0.095	**0.150**	**0.101**	0.070	**0.123**	**0.219**
	Antimony (Sb)	mg/L	0.020^{α}	0.00043	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	0.0076	0.0036	0.0138	0.0039	0.0091	0.0030	0.0090	0.0093	0.0037	0.0095	0.0028	0.0097	0.0030	0.0101
	Beryllium (Be)	mg/L	0.011^{α}	<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00010
	Bismuth (Bi)	mg/L	-	<0.00005	<0.00050	<0.00050	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00005
	Boron (B)	mg/L	1.5	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	21	5	27	5	13	3	14	15	5	13	3	16	3	14
	Chromium (Cr)	mg/L	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009^{α}	<0.00010	0.00011	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013
	Copper (Cu)	mg/L	0.002	<0.0010	0.0006	0.0010	<0.0010	0.0010	0.0005	0.0008	0.0008	<0.0010	<0.0010	0.0005	0.0009	0.0005	0.0011
	Iron (Fe)	mg/L	0.30	<0.050	0.189	0.237	0.090	0.114	0.071	0.043	0.053	0.102	0.091	0.083	0.053	0.090	0.237
	Lead (Pb)	mg/L	0.001	0.000051	0.000225	0.000253	0.000112	0.000103	0.000087	<0.000050	0.000057	0.000095	0.000089	0.000087	0.000073	0.000109	0.000175
	Lithium (Li)	mg/L	-	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	11.5	3.2	16.4	2.7	6.9	1.6	8.0	8.9	3.0	7.3	1.7	8.9	1.8	8.2
	Manganese (Mn)	mg/L	0.935^{β}	0.0005	0.0033	0.0068	0.0016	0.0019	0.0018	0.0006	0.0010	0.0016	0.0011	0.0017	0.0051	0.0021	0.0054
	Mercury (Hg)	mg/L	0.000026	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	0.00019	<0.00005	0.00026	0.00009	0.00031	<0.00005	0.00027	0.00026	0.00009	0.00032	0.00005	0.00056	0.00005	0.00032
	Nickel (Ni)	mg/L	0.025	<0.00050	0.00051	0.00068	0.00060	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00050	<0.00050	0.00050	<0.00050	0.00078
	Potassium (K)	mg/L	-	0.90	0.37	1.38	0.47	1.04	0.35	0.92	0.97	0.46	1.06	0.35	0.98	0.37	1.11
	Selenium (Se)	mg/L	0.001	<0.000050	<0.001000	<0.001000	<0.000050	<0.000050	<0.001000	<0.001000	<0.001000	<0.000050	<0.000050	<0.001000	<0.001000	<0.001000	<0.000050
	Silicon (Si)	mg/L	-	0.88	0.50	1.23	0.64	0.99	0.50	0.99	1.02	0.64	1.02	0.57	1.01	0.56	1.11
	Silver (Ag)	mg/L	0.00025	<0.000050	<0.000010	<0.000010	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000050
	Sodium (Na)	mg/L	-	0.9	0.3	1.8	0.7	2.2	0.5	2.3	2.3	0.6	2.1	0.4	2.3	0.5	2.4
	Strontium (Sr)	mg/L	-	0.011	0.003	0.019	0.005	0.013	0.003	0.013	0.013	0.004	0.013	0.003	0.016	0.003	0.013
	Thallium (Tl)	mg/L	0.0008	<0.00001	<0.00010	<0.00010	<0.00001	<0.00001	<0.00010	<0.00010	<0.00010	<0.00001	<0.00001	<0.00010	<0.00010	<0.00010	<0.00001
	Tin (Sn)	mg/L	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	<0.0003	<0.0100	0.0140	0.0050	0.0057	<0.0100	<0.0100	<0.0100	0.0054	0.0050	<0.0100	<0.0100	<0.0100	0.0113
	Uranium (U)	mg/L	0.015	0.0025	0.0002	0.0026	0.0003	0.0023	0.0001	0.0028	0.0028	0.0003	0.0024	0.0001	0.0027	0.0002	0.0021
	Vanadium (V)	mg/L	0.006^{α}	<0.0005	<0.0010	<0.0010	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	0.0006
	Zinc (Zn)	mg/L	0.030	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013).

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

Table C.59: *In Situ* Water Quality Measurements Collected at Mary River Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017

Study Area	Station	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (µS/cm)
Mary River Upstream (GO-09)	GO-09 B1	7.3	12.00	99.6	8.00	163
	GO-09 B2	6.2	12.35	99.8	7.97	155
	GO-09 B3	4.6	12.84	99.6	7.95	153
	GO-09 B4	3.9	13.11	99.7	7.96	148
	GO-09 B5	3.0	13.45	99.8	8.06	160
Mary River Upstream (GO-03)	GO-03 B1	7.5	12.22	101.6	8.07	178
	GO-03 B2	6.3	12.59	101.8	8.05	175
	GO-03 B3	5.5	12.80	101.6	8.01	175
	GO-03 B4	6.7	12.95	100.6	7.98	175
	GO-03 B5	5.0	12.88	100.8	7.98	177
Mary River Downstream (EO-01)	EO-01 B1	5.6	12.75	101.4	8.07	176
	EO-01 B2	5.7	12.61	100.4	8.02	173
	EO-01 B3	5.1	12.84	100.9	8.01	190
	EO-01 B4	4.9	12.88	100.5	8.00	174
	EO-01 B5	4.8	12.50	99.8	7.98	177
Mary River Downstream (EO-20)	EO-20 B1	7.7	12.05	101.1	8.11	178
	EO-20 B2	7.6	12.11	101.4	8.11	178
	EO-20 B3	7.4	12.16	101.2	8.10	178
	EO-20 B4	7.2	12.23	101.3	8.10	177
	EO-20 B5	7.1	12.29	101.6	8.09	176
Mary River Downstream (CO-05)	CO-05 B1	7.0	13.60	103.9	7.98	174
	CO-05 B2	7.1	12.50	102.7	7.95	162
	CO-05 B3	5.7	12.80	102.1	7.97	167
	CO-05 B4	5.3	12.71	100.4	7.94	171
	CO-05 B5	4.9	12.72	99.4	7.94	162

Table C.60: *In Situ* Water Quality Summary for Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2017

Metric	Station	Sample Size	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
						Lower Bound	Upper Bound		
Temperature (˚C)	GO-09	5	5.00	1.74	0.78	2.84	7.16	3.00	7.30
	GO-03	5	6.20	0.98	0.44	4.98	7.42	5.00	7.50
	EO-01	5	5.22	0.41	0.18	4.71	5.73	4.80	5.70
	EO-20	5	7.40	0.25	0.11	7.08	7.72	7.10	7.70
	CO-05	5	6.00	1.00	0.45	4.76	7.24	4.90	7.10
Dissolved Oxygen (mg/L)	GO-09	5	12.8	0.6	0.3	12.0	13.5	12.0	13.5
	GO-03	5	12.7	0.3	0.1	12.3	13.1	12.2	13.0
	EO-01	5	12.7	0.2	0.1	12.5	12.9	12.5	12.9
	EO-20	5	12.2	0.1	0.0	12.1	12.3	12.1	12.3
	CO-05	5	12.9	0.4	0.2	12.3	13.4	12.5	13.6
Dissolved Oxygen (% saturation)	GO-09	5	99.7	0.1	0.0	99.6	99.8	99.6	99.8
	GO-03	5	101.3	0.5	0.2	100.6	102.0	100.6	101.8
	EO-01	5	100.6	0.6	0.3	99.9	101.3	99.8	101.4
	EO-20	5	101.3	0.2	0.1	101.1	101.6	101.1	101.6
	CO-05	5	101.7	1.8	0.8	99.5	103.9	99.4	103.9
pH (pH units)	GO-09	5	7.99	0.04	0.02	7.93	8.04	7.95	8.06
	GO-03	5	8.02	0.04	0.02	7.97	8.07	7.98	8.07
	EO-01	5	8.02	0.03	0.02	7.97	8.06	7.98	8.07
	EO-20	5	8.10	0.01	0.00	8.09	8.11	8.09	8.11
	CO-05	5	7.96	0.02	0.01	7.93	7.98	7.94	7.98
Specific Conductance (µS/cm)	GO-09	5	155.7	6.1	2.7	148.2	163.2	147.7	163.0
	GO-03	5	175.8	1.5	0.7	174.0	177.6	174.5	178.0
	EO-01	5	178.0	6.8	3.0	169.5	186.4	173.3	189.9
	EO-20	5	177.2	0.9	0.4	176.1	178.3	175.9	178.2
	CO-05	5	167.1	5.6	2.5	160.2	174.1	161.6	173.9

Table C.61: **Statistical Comparison of *In Situ* Water Quality Variables Among Mary River Benthic Invertebrate Community Study Areas, Mary River Project CREMP, August 2017**

In Situ Variable	Overall 5-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test[b]	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test
Temperature (˚C)	YES	0.0113	α	GO-09	GO-03	NO	0.922	Tamhane's
				GO-09	EO-01	NO	1.000	
				GO-09	EO-20	NO	0.306	
				GO-09	CO-05	NO	0.974	
				GO-03	EO-01	NO	0.617	
				GO-03	EO-20	NO	0.407	
				GO-03	CO-05	NO	1.000	
				EO-01	EO-20	YES	0.000	
				EO-01	CO-05	NO	0.833	
				EO-20	CO-05	NO	0.285	
Dissolved Oxygen (% Saturation)	YES	0.0160	α	GO-09	GO-03	YES	0.024	Tamhane's
				GO-09	EO-01	NO	0.238	
				GO-09	EO-20	YES	< 0.001	
				GO-09	CO-05	NO	0.505	
				GO-03	EO-01	NO	0.634	
				GO-03	EO-20	NO	1.000	
				GO-03	CO-05	NO	1.000	
				EO-01	EO-20	NO	0.412	
				EO-01	CO-05	NO	0.946	
				EO-20	CO-05	NO	1.000	
pH (pH units)	YES	< 0.001	α	GO-09	GO-03	NO	0.557	Tukey's HSD
				GO-09	EO-01	NO	0.641	
				GO-09	EO-20	YES	< 0.001	
				GO-09	CO-05	NO	0.539	
				GO-03	EO-01	NO	1.000	
				GO-03	EO-20	YES	0.004	
				GO-03	CO-05	YES	0.041	
				EO-01	EO-20	YES	0.003	
				EO-01	CO-05	YES	0.055	
				EO-20	CO-05	YES	< 0.001	
Specific Conductance (umho/cm)	YES	< 0.001	δ	GO-09	GO-03	YES	0.008	Mann-Whitney U-test
				GO-09	EO-01	YES	0.008	
				GO-09	EO-20	YES	0.008	
				GO-09	CO-05	YES	0.032	
				GO-03	EO-01	NO	1.000	
				GO-03	EO-20	NO	0.151	
				GO-03	CO-05	NO	0.310	
				EO-01	EO-20	NO	0.310	
				EO-01	CO-05	YES	0.016	
				EO-20	CO-05	YES	0.008	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

b Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results validated using Kruskal Wallis H-test or Mann-Whitney U-test, as appropriate; δ - data log-transformed, Kruskal Wallis test conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.62: Water chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Spring Sampling Event									
					G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-03	E0-21	E0-20	C0-01
					08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17	08/Jul/17
Conventionals	Conductivity (lab)	umho/cm	-	-	32	29	29	29	30	51	30	30	31	32
	pH (lab)	pH	6.5 - 9.0	-	7.41	7.37	7.33	7.34	7.22	7.57	7.30	7.32	7.33	7.44
	Hardness (as $CaCO_3$)	mg/L	-	-	15	14	13	13	13	27	13	13	14	14
	Total Suspended Solids (TSS)	mg/L	-	-	4.2	2.5	<2.0	<2.0	3.9	7.3	2.1	<2.0	2.5	3.4
	Total Dissolved Solids (TDS)	mg/L	-	-	19	14	<10	16	19	35	16	17	20	25
	Turbidity	NTU	-	-	1.7	2.1	3.4	3.1	5.0	11.3	4.3	4.6	5.9	6.8
	Alkalinity (as $CaCO_3$)	mg/L	-	-	13	<10	12	12	11	22	11	10	15	14
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	0.8	1.4	1.4	1.2	1.3	0.8	1.2	1.2	1.2	1.2
	Total Organic Carbon	mg/L	-	-	1.8	1.4	1.6	1.2	1.3	1.0	1.3	1.5	1.2	1.2
	Total Phosphorus	mg/L	0.030[α]	-	0.0113	0.0092	0.0093	0.0083	0.0078	0.0112	0.0070	0.0088	0.0071	0.0103
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	0.0013	0.0015	<0.0010	0.0014	<0.0010	0.0015	0.0013	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	0.5	<0.5	0.6	0.7	0.7	<0.5	0.7	0.8	0.8	0.7
	Sulphate (SO_4)	mg/L	218[β]	218	<0.3	<0.3	<0.3	0.3	0.3	1.2	0.4	0.4	0.4	0.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.037	0.041	0.084	0.107	0.099	0.133	0.118	0.101	0.117	0.123
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0027	0.0022	0.0029	0.0029	0.0030	0.0036	0.0029	0.0028	0.0030	0.0030
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	3	3	3	3	3	5	3	3	3	3
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	***0.0209***	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00021	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	<0.0005	<0.0005	***0.0067***	0.0005	0.0005	0.0006	0.0005	0.0005	<0.0005	0.0005
	Iron (Fe)	mg/L	0.30	0.874	<0.030	<0.030	***2.160***	0.073	0.071	0.189	0.086	0.083	0.084	0.09
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000080	0.000079	0.000087	0.000225	0.000083	0.000087	0.000084	0.000109
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	1.8	1.6	1.6	1.6	1.6	3.2	1.7	1.7	1.7	1.8
	Manganese (Mn)	mg/L	0.935[β]	-	0.0014	0.0017	0.0172	0.0017	0.0018	0.0033	0.0017	0.0017	0.0015	0.0021
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	<0.00005	<0.00005	0.00369	<0.00005	<0.00005	<0.00005	<0.00005	0.00005	0.00006	0.00005
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00245	<0.00050	<0.00050	0.00051	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.34	0.28	0.35	0.36	0.35	0.37	0.35	0.35	0.36	0.37
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.42	0.35	0.53	0.52	0.50	0.50	0.54	0.57	0.55	0.56
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.3	0.3	0.4	0.4	0.5	0.3	0.4	0.4	0.4	0.455000
	Strontium (Sr)	mg/L	-	-	0.0026	0.0021	0.0026	0.0025	0.0026	0.0029	0.0025	0.0026	0.0027	0.0027
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG crite

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.62: Water chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event												
					G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-21	E0-20	C0-10	C0-05	C0-01
					10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17	10/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	74	78	85	83	85	218	109	91	91	94	94	95	98
	pH (lab)	pH	6.5 - 9.0	-	7.81	7.83	7.92	7.91	7.85	8.16	7.94	7.90	7.88	7.89	7.87	7.88	7.77
	Hardness (as $CaCO_3$)	mg/L	-	-	33	33	37	36	38	103	47	41	41	43	43	43	44
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	39	28	40	27	31	85	49	42	52	43	44	42	39
	Turbidity	NTU	-	-	12.5	10.5	8.9	6.8	6.5	2.1	6.1	6.4	6.5	6.0	6.2	3.9	4.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	36	38	37	37	85	41	38	39	39	38	41	45
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	0.125	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	1.0	1.1
	Total Organic Carbon	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.2
	Total Phosphorus	mg/L	0.020[α]	-	0.0085	0.0082	0.0078	0.0048	0.0040	0.0041	0.0052	0.0044	0.0056	0.0042	0.0047	0.0062	0.0049
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.4	2.4	2.5	2.2	2.2	2.9	2.2	2.1	2.1	2.0	2.0	2.1	2.1
	Sulphate (SO_4)	mg/L	218[β]	218	1.4	1.3	1.4	1.4	1.4	21.0	3.5	2.9	2.9	2.8	2.8	2.7	3.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.147	0.163	0.120	0.106	0.098	0.049	0.083	0.108	0.097	0.055	0.057	0.066	0.081
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0061	0.0065	0.0065	0.0062	0.0063	0.0116	0.0068	0.0068	0.0066	0.0066	0.0068	0.0069	0.0067
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	7	7	8	8	8	21	9	8	9	9	9	9	9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	0.0008
	Iron (Fe)	mg/L	0.30	0.874	0.151	0.153	0.110	0.092	0.084	0.046	0.079	0.091	0.091	0.065	0.069	0.073	0.075
	Lead (Pb)	mg/L	0.001	0.001	0.000248	0.000200	0.000163	0.000127	0.000120	0.000056	0.000116	0.000127	0.000130	0.000108	0.000112	0.000109	0.000098
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	4.0	4.1	4.4	4.5	4.5	12.7	5.5	5.1	5.0	5.1	5.2	5.2	5.3
	Manganese (Mn)	mg/L	0.935[β]	-	0.0021	0.0019	0.0016	0.0013	0.0011	0.0015	0.0011	0.0025	0.0022	0.0019	0.0018	0.0022	0.0020
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00013	0.00014	0.00014	0.00014	0.00015	0.00029	0.00017	0.00022	0.00023	0.00022	0.00023	0.00022	0.00024
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.75	0.75	0.75	0.72	0.71	1.21	0.76	0.75	0.74	0.74	0.75	0.75	0.76
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.78	0.89	0.79	0.79	0.77	0.92	0.80	0.83	0.82	0.73	0.72	0.77	0.81
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.5	1.5	1.6	1.4	1.4	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.4
	Strontium (Sr)	mg/L	-	-	0.0081	0.0084	0.0086	0.0079	0.0082	0.015	0.0088	0.0090	0.0093	0.0089	0.0092	0.0091	0.0090
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0011	0.0011	0.0011	0.0009	0.0009	0.0021	0.0010	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

[grey box] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.62: Water chemistry at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event												
					G0-09-A	G0-09	G0-09-B	G0-03	GO-01	F0-01	E0-10	EO-03	EO-21	EO-20	C0-10	C0-05	CO-01
					29/Aug/17	29/Aug/17	29/Aug/17	29/Aug/17	01/Sep/17	01/Sep/17	01/Sep/17	01/Sep/17	01/Sep/17	01/Sep/17	29/Aug/17	27/Aug/17	27/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	120	158	138	132	151	266	158	164	164	163	146	151	143
	pH (lab)	pH	6.5 - 9.0	-	7.93	8.09	8.01	7.99	8.08	8.22	8.10	8.06	8.04	7.99	7.98	8.01	8.01
	Hardness (as $CaCO_3$)	mg/L	-	-	52	76	62	61	70	134	74	77	78	80	66	71	72
	Total Suspended Solids (TSS)	mg/L	-	-	2.3	<2.0	<2.0	<2.0	<2.0	5.2	<2.0	<2.0	<2.0	9.5	<2.0	20.2	3.3
	Total Dissolved Solids (TDS)	mg/L	-	-	68	87	59	61	74	136	76	71	79	82	78	70	71
	Turbidity	NTU	-	-	8.3	2.8	5.8	5.3	1.8	6.3	1.9	2.3	2.2	4.5	7.4	45.3	7.6
	Alkalinity (as $CaCO_3$)	mg/L	-	-	48	77	58	59	66	107	69	73	69	69	62	63	63
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.057	<0.020	0.029	0.028	<0.020	0.134	0.035	0.062	0.058	0.057	0.053	0.076	0.070
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15							<0.15	0.22	0.15
	Dissolved Organic Carbon	mg/L	-	-	1.0	1.2	1.2	1.2	1.2	<1.0	1.1	1.0	1.1	1.3	1.3	1.8	1.2
	Total Organic Carbon	mg/L	-	-	<1.0	1.2	1.1	1.2	1.1	1.0	1.2	1.1	1.1	1.3	1.3	1.6	1.3
	Total Phosphorus	mg/L	0.020[α]	-	0.0097	0.0045	0.0053	0.0060	0.0036	0.0067	0.0046	0.0196	0.0037	0.0060	0.0078	0.0250	0.0066
	Phenols	mg/L	0.004[α]	-	0.0015	<0.0010	0.0012	<0.0010	<0.0010	0.0012	0.0013	0.0012	<0.0010	<0.0010	0.0023	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	5.2	2.9	4.6	4.1	4.6	5.4	4.7	4.7	4.7	4.2	3.9	5.2	4.1
	Sulphate (SO_4)	mg/L	218[β]	218	3.2	2.5	2.8	2.7	2.9	25.3	4.3	7.5	7.5	6.7	5.5	4.8	3.8
Total Metals	Aluminum (Al)	mg/L	0.100	0.966	0.186	0.087	0.168	0.167	0.059	0.187	0.071	0.108	0.070	0.072	0.178	***1.480***	0.219
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010
	Barium (Ba)	mg/L	-	-	0.0090	0.0087	0.0090	0.0089	0.0090	0.0138	0.0093	0.0102	0.0097	0.0101	0.0095	0.0179	0.0101
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	11	16	13	13	14	27	15	15	16	15	14	15	14
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0031	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00091	0.00013
	Copper (Cu)	mg/L	0.002	0.0024	0.0014	0.0007	0.0009	0.0009	0.0008	0.0010	0.0008	0.0009	0.0009	0.0009	0.0009	***0.0025***	0.0011
	Iron (Fe)	mg/L	0.30	0.874	0.146	0.052	0.103	0.105	0.043	0.237	0.053	0.098	0.053	0.044	0.159	***2.120***	0.237
	Lead (Pb)	mg/L	0.001	0.001	0.000199	0.000056	0.000119	0.000105	<0.000050	0.000253	0.000057	0.000099	0.000073	<0.000050	0.000155	0.000862	0.000175
	Lithium (Li)	mg/L	-	-	0.0011	<0.0010	0.0011	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0023	<0.0010
	Magnesium (Mg)	mg/L	-	-	6.1	9.0	7.6	7.2	8.0	16.4	8.9	9.3	8.9	9.6	8.3	9.2	8.2
	Manganese (Mn)	mg/L	0.935[β]	-	0.0026	0.0007	0.0015	0.0013	0.0006	0.0068	0.0010	0.0068	0.0051	0.0033	0.0064	0.0360	0.0054
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00029	0.00018	0.00024	0.00023	0.00027	0.00026	0.00026	0.00050	0.00056	0.00055	0.00034	0.00034	0.00032
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00068	<0.00050	<0.00050	0.00050	0.00061	0.00059	0.00290	0.00078
	Potassium (K)	mg/L	-	-	1.07	0.94	1.05	0.98	0.92	1.38	0.97	1.03	0.98	1.12	1.04	1.60	1.11
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.0010	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	1.10	1.19	1.27	1.28	0.99	1.23	1.02	1.08	1.01	1.05	1.26	3.09	1.11
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	2.6	1.9	2.5	2.0	2.3	1.8	2.3	2.3	2.3	2.2	1.9	2.5	2.4
	Strontium (Sr)	mg/L	-	-	0.0136	0.0131	0.0137	0.0123	0.0132	0.019	0.0134	0.016	0.016	0.014	0.0135	0.0138	0.0129
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00003	<0.00001
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0140	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0731	0.0113
	Uranium (U)	mg/L	0.015	-	0.0026	0.0027	0.0027	0.0022	0.0028	0.0026	0.0028	0.0027	0.0027	0.0016	0.0021	0.0021	0.0021
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	0.0006
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0038	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intrinsik (2013) using baseline water quality data specific to the Mary River system.

[shaded] Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.63: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentration Data Provided) Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2017

Variable	Spring						Summer									Fall								
	G0-03	G0-01	E0-03	E0-21	E0-20	CO-01	G0-03	G0-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01	G0-03	G0-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Conductivity (lab)	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.4	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.1	1.1	1.2	1.2	1.2	1.1	1.1	1.0
Hardness (as $CaCO_3$)	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.4	1.2	1.2	1.3	1.3	1.3	1.3	1.0	1.1	1.2	1.2	1.2	1.3	1.0	1.1	1.1
Total Suspended Solids (TSS)	0.7	1.3	0.7	0.7	0.9	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.5	1.0	9.6	1.6
Total Dissolved Solids (TDS)	1.1	1.3	1.1	1.2	1.4	1.7	0.8	0.9	1.4	1.2	1.5	1.2	1.2	1.2	1.1	0.9	1.0	1.1	1.0	1.1	1.2	1.1	1.0	1.0
Turbidity	1.3	2.1	1.8	1.9	2.5	2.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.9	0.3	0.3	0.4	0.4	0.8	1.3	8.0	1.3
Alkalinity (as $CaCO_3$)	1.0	0.9	0.9	0.9	1.3	1.2	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.3	1.0	1.1	1.1	1.2	1.1	1.1	1.0	1.0	1.0
Total Ammonia	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nitrate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.6	1.0	1.8	1.6	1.6	1.5	2.2	2.0
Nitrite	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Kjeldahl Nitrogen (TKN)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.5	1.0
Dissolved Organic Carbon	1.0	1.1	1.0	0.9	0.9	1.0	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	0.9	0.9	1.0	1.1	1.1	1.6	1.1
Total Organic Carbon	0.8	0.8	0.8	0.9	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.2	1.1	1.0	1.0	1.0	1.0	1.2	1.2	1.5	1.2
Total Phosphorus	0.8	0.8	0.7	0.9	0.7	1.0	0.6	0.5	0.6	0.5	0.7	0.5	0.6	0.8	0.6	0.9	0.6	0.7	3.0	0.6	0.9	1.2	3.9	1.0
Phenols	1.4	0.9	0.9	1.4	1.2	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0	0.8	0.8	1.1	1.0	0.8	0.8	1.9	0.8	0.8
Bromide (Br)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride (Cl)	1.3	1.4	1.4	1.4	1.5	1.4	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.1	1.1	1.0	0.9	1.2	1.0
Sulphate (SO_4)	1.1	1.1	1.3	1.3	1.4	2.0	1.0	1.0	2.6	2.1	2.2	2.1	2.0	2.0	2.2	0.9	1.0	1.5	2.6	2.6	2.3	1.9	1.7	1.3
Aluminum (Al)	2.0	1.8	2.2	1.9	2.2	2.3	0.7	0.7	0.6	0.8	0.7	0.4	0.4	0.5	0.6	1.1	0.4	0.5	0.7	0.5	0.5	1.2	10	1.5
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	1.0
Barium (Ba)	1.1	1.2	1.1	1.1	1.1	1.2	1.0	1.0	1.1	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	2.0	1.1
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.2	0.2
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Calcium (Ca)	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.3	1.2	1.2	1.2	1.2	1.3	1.2	0.9	1.0	1.1	1.1	1.2	1.1	1.0	1.1	1.0
Chromium (Cr)	0.1	0.1	0.1	0.1	0.1	0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.1	1.0
Cobalt (Co)	0.7	0.7	0.7	0.7	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	9.1	1.3
Copper (Cu)	0.2	0.2	0.2	0.2	0.2	0.2	0.9	0.9	0.9	1.0	0.9	0.9	0.9	1.0	0.9	0.9	0.8	0.8	0.9	0.8	0.9	0.9	2.4	1.1
Iron (Fe)	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.6	0.6	0.7	0.7	0.5	0.5	0.5	0.5	1.0	0.4	0.5	1.0	0.5	0.4	1.6	21	2.4
Lead (Pb)	1.3	1.5	1.4	1.5	1.4	1.8	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.8	0.4	0.5	0.8	0.6	0.4	1.2	6.9	1.4
Lithium (Li)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	1.0	2.2	0.9
Magnesium (Mg)	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.3	1.2	1.2	1.2	1.3	1.2	1.3	1.0	1.1	1.2	1.2	1.2	1.3	1.1	1.2	1.1
Manganese (Mn)	0.2	0.3	0.2	0.3	0.2	0.3	0.7	0.6	0.6	1.3	1.2	1.0	1.0	1.2	1.1	0.8	0.4	0.6	4.3	3.2	2.1	4.0	23	3.4
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.1	1.3	1.6	1.6	1.6	1.6	1.6	1.7	1.0	1.1	1.1	2.1	2.4	2.3	1.4	1.4	1.4
Nickel (Ni)	0.4	0.4	0.4	0.4	0.4	0.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	5.8	1.6
Potassium (K)	1.1	1.1	1.1	1.1	1.1	1.1	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	1.0	1.0	1.1	1.0	1.6	1.1
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	0.1
Silicon (Si)	1.2	1.2	1.2	1.3	1.3	1.3	1.0	0.9	1.0	1.0	1.0	0.9	0.9	0.9	1.0	1.1	0.8	0.9	0.9	0.9	0.9	1.1	2.6	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	5.0
Sodium (Na)	1.3	1.4	1.3	1.3	1.3	1.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	0.8	1.1	1.0
Strontium (Sr)	1.0	1.1	1.0	1.1	1.1	1.1	0.9	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9	1.0	1.0	1.2	1.2	1.1	1.0	1.0	1.0
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3	0.1
Tin (Sn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.3	1.1
Uranium (U)	1.3	1.3	1.3	1.3	1.4	1.4	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	1.1	1.0	1.0	1.0	0.6	0.8	0.8	0.8
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.3	0.6
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean concentration≥ 10 times higher than respective mean reference or baseline period value).

Table C.64: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Spring Sampling Event										Summer Sampling Event									
			G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-03	E0-21	E0-20	C0-01	G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-21	E0-20
			8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	8-Jul-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017	10-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.0088	0.0071	0.0138	0.0131	0.0127	0.0053	0.0132	0.0139	0.0127	0.0115	0.0188	0.0133	0.0130	0.0156	0.0108	0.0057	0.0105	0.0186	0.0153	0.0105
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00242	0.00187	0.00230	0.00216	0.00221	0.00221	0.00215	0.00228	0.00221	0.00226	0.00463	0.00484	0.00530	0.00562	0.00546	0.01080	0.00604	0.00583	0.00577	0.00595
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	3.00	2.87	2.70	2.72	2.59	6.04	2.70	2.79	2.90	2.85	6.6	6.86	7.72	7.27	7.79	20.60	9.40	8.30	8.3	8.69
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00062	0.00057	0.00065	0.00082	0.00062	0.00095	0.00077	0.00065	0.00061	0.00084
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000066	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	1.720	1.56	1.51	1.57	1.49	2.96	1.58	1.53	1.64	1.660	3.95	3.97	4.32	4.38	4.59	12.40	5.52	4.98	4.89	5.23
	Manganese (Mn)	mg/L	0.00081	0.00094	0.00072	0.00051	0.00049	0.00044	0.00050	0.00045	0.00064	0.00059	0.00014	0.00014	0.00014	0.001360	0.000127	0.000812	0.000130	0.001360	0.001110	0.000985
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000059	0.000056	0.000052	0.000233	0.000214	0.000216	0.000194	0.000194	0.000297	0.000214	0.000271	0.000282	0.000284
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.320	0.270	0.310	0.330	0.310	0.290	0.320	0.310	0.310	0.320	0.69	0.670	0.690	0.70	0.69	1.18	0.75	0.72	0.70	0.73
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.360	0.300	0.370	0.350	0.320	0.260	0.340	0.330	0.320	0.320	0.57	0.570	0.630	0.61	0.63	0.82	0.66	0.66	0.65	0.67
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.347	0.276	0.368	0.441	0.445	0.266	0.44	0.415	0.456	0.456	1.5	1.45	1.57	1.400	1.380	1.360	1.375	1.370	1.370	1.380
	Strontium (Sr)	mg/L	0.0026	0.0021	0.0024	0.0025	0.0024	0.0034	0.0025	0.0025	0.0026	0.0026	0.0080	0.0080	0.0085	0.00757	0.00801	0.01530	0.00864	0.00894	0.00892	0.00883
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000097	0.000074	0.000108	0.000111	0.000114	0.000116	0.000109	0.000112	0.000117	0.000116	0.000971	0.000971	0.001060	0.000834	0.000856	0.001990	0.000965	0.000878	0.00085	0.000811
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0051	<0.0030	<0.0030	<0.0030	<0.0030

Table C.64: Dissolved Metal Concentrations at Mary River Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Summer Sampling Event			Fall Sampling Event												
			C0-10	C0-05	C0-01	G0-09-A	G0-09	G0-09-B	G0-03	GO-01	FO-01	EO-10	EO-03	EO-21	EO-20	C0-10	C0-05	CO-01
			10-Aug-2017	10-Aug-2017	10-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017	29-Aug-2017	27-Aug-2017	27-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.0099	0.0110	0.011	0.0143	0.0061	0.0090	0.0113	0.0068	0.0037	0.0056	0.0050	0.0149	0.0114	0.0100	0.0093	0.0184
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00601	0.00597	0.00608	0.00710	0.00806	0.00776	0.0076	0.0087	0.0118	0.0091	0.0092	0.0094	0.0098	0.0079	0.0087	0.0091
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011
	Calcium (Ca)	mg/L	8.61	8.77	8.9	10.70	15.95	12.90	12.5	14.6	27.3	15.4	15.8	16.1	16.0	13.2	14.6	15.3
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00067	0.00078	0.0007	0.0008	0.00065	0.00071	0.00072	0.00076	0.00069	0.00077	0.00079	0.00082	0.00071	0.00072	0.00086	0.00144
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.014	0.019
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000082
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	0.0014
	Magnesium (Mg)	mg/L	5.25	5.15	5.32	6.22	8.70	7.29	7.12	8.11	16.00	8.57	9.14	9.2	9.80	7.97	8.39	8.14
	Manganese (Mn)	mg/L	0.000959	0.001290	0.00091	0.000152	0.000087	0.000102	0.000118	0.000102	0.001370	0.00022	0.004980	0.004480	0.003670	0.003600	0.002380	0.002280
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000268	0.000261	0.000277	0.000336	0.000169	0.000262	0.000238	0.000291	0.000310	0.000257	0.000553	0.000576	0.000522	0.000347	0.000309	0.000379
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	<0.00050	<0.00050	0.00082
	Potassium (K)	mg/L	0.74	0.76	0.73	1.01	0.91	0.97	0.92	0.90	1.29	0.94	0.97	0.97	1.03	0.96	1.11	1.15
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.000050	<0.000050
	Silicon (Si)	mg/L	0.66	0.67	0.68	0.83	0.97	0.91	0.94	0.89	0.97	0.90	0.88	0.88	0.96	0.92	0.92	0.79
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000050
	Sodium (Na)	mg/L	1.400	1.350	1.36	2.640	1.820	2.360	2.01	2.29	1.80	2.27	2.35	2.27	2.19	1.89	2.61	2.51
	Strontium (Sr)	mg/L	0.00875	0.00875	0.0090	0.01330	0.01280	0.01310	0.0120	0.0134	0.0197	0.0138	0.0163	0.0157	0.0147	0.0126	0.0142	0.0141
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000010	<0.000010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00030	<0.00050
	Uranium (U)	mg/L	0.000787	0.000836	0.000889	0.002410	0.002535	0.002550	0.00215	0.00279	0.00256	0.002760	0.00270	0.00271	0.00186	0.00180	0.00158	0.00192
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0010	0.0039

Table C.65: Summary of the Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary River Mine-Exposed and Reference (GO-09) Stations in 2017

Variable	Spring						Summer									Fall								
	G0-03	G0-01	E0-03	E0-21	E0-20	CO-01	G0-03	G0-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01	G0-03	G0-01	E0-10	E0-03	E0-21	E0-20	C0-10	CO-05	CO-01
Aluminum (Al)	1.3	1.3	1.3	1.4	1.3	1.2	1.0	0.7	0.7	1.2	1.0	0.7	0.7	0.7	0.7	1.2	0.7	0.6	0.5	1.5	1.2	1.0	1.0	1.9
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Barium (Ba)	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	1.1	1.2	1.2	1.2	1.3	1.0	1.1	1.2
Beryllium (Be)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.2	0.2
Cadmium (Cd)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Calcium (Ca)	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.3	1.2	1.2	1.2	1.2	1.2	1.3	0.9	1.1	1.2	1.2	1.2	1.2	1.0	1.1	1.2
Chromium (Cr)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cobalt (Co)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Copper (Cu)	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.3	1.1	1.0	1.4	1.1	1.3	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0	1.2	2.0
Iron (Fe)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.6
Lead (Pb)	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6
Lithium (Li)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.4
Magnesium (Mg)	1.0	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.4	1.2	1.2	1.3	1.3	1.3	1.3	1.0	1.1	1.2	1.2	1.2	1.3	1.1	1.1	1.1
Manganese (Mn)	0.6	0.6	0.6	0.5	0.8	0.7	9.8	0.9	0.9	9.8	8.0	7.1	6.9	9.3	6.5	1.0	0.9	1.9	44	39	32	32	21	20
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Molybdenum (Mo)	1.0	1.0	1.0	1.2	1.1	1.0	0.9	0.9	1.0	1.2	1.3	1.3	1.2	1.2	1.3	0.9	1.1	1.0	2.2	2.3	2.0	1.4	1.2	1.5
Nickel (Ni)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.6
Potassium (K)	1.1	1.0	1.1	1.0	1.0	1.1	1.0	1.0	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.0	0.9	1.0	1.0	1.0	1.1	1.0	1.2	1.2
Selenium (Se)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	0.1
Silicon (Si)	1.0	0.9	1.0	1.0	0.9	0.9	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	0.9
Silver (Ag)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	RDL	RDL
Sodium (Na)	1.3	1.3	1.3	1.3	1.4	1.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	0.8	1.1	1.1
Strontium (Sr)	1.1	1.0	1.0	1.1	1.1	1.1	0.9	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9	1.0	1.1	1.2	1.2	1.1	1.0	1.1	1.1
Thallium (Tl)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.1	0.1
Tin (Sn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.1
Uranium (U)	1.2	1.2	1.2	1.2	1.3	1.2	0.8	0.9	1.0	0.9	0.8	0.8	0.8	0.8	0.9	0.9	1.1	1.1	1.1	1.1	0.7	0.7	0.6	0.8
Vanadium (V)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5
Zinc (Zn)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3	1.3

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference or baseline period value).

Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).

Denotes highly elevated concentration (mean concentration ≥ 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.66: Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer and Fall 2017[a]

Parameters	Conventional Parameters										Total Metals											
	Conduct-ivity	Hardness	Total Suspended Solids	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Lead	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	1	0.992	-0.096	0.969	-0.102	0.986	-0.056	-0.430	0.867	0.928	0.043	0.957	0.523	-0.038	0.050	0.132	0.764	0.921	0.854	0.804	0.963	0.882
Hardness	0.992	1	-0.071	0.967	-0.108	0.985	-0.039	-0.429	0.854	0.922	0.021	0.952	0.527	-0.053	0.036	0.137	0.773	0.923	0.843	0.795	0.958	0.864
Total Suspended Solids	-0.096	-0.071	1	-0.072	0.174	-0.121	0.188	0.510	-0.093	-0.092	0.258	-0.030	-0.115	0.100	0.074	0.327	-0.138	-0.021	-0.135	-0.111	-0.078	-0.213
Total Dissolved Solids	0.969	0.967	-0.072	1	-0.030	0.967	-0.044	-0.424	0.847	0.902	0.086	0.936	0.498	-0.019	0.091	0.136	0.724	0.908	0.847	0.785	0.949	0.870
Turbidity	-0.102	-0.108	0.174	-0.030	1	-0.108	-0.171	0.258	0.109	0.049	0.714	0.052	0.357	0.744	0.919	0.353	-0.070	0.145	0.164	0.140	-0.011	0.030
Alkalinity	0.986	0.985	-0.121	0.967	-0.108	1	-0.044	-0.429	0.861	0.906	0.058	0.950	0.534	-0.010	0.043	0.120	0.777	0.920	0.859	0.802	0.956	0.888
Dissolved Organic Carbon	-0.056	-0.039	0.188	-0.044	-0.171	-0.044	1	0.127	0.009	-0.086	0.106	0.015	0.044	-0.031	-0.313	0.052	0.170	0.043	0.114	0.072	-0.082	-0.033
Total Phosphorus	-0.430	-0.429	0.510	-0.424	0.258	-0.429	0.127	1	-0.261	-0.389	0.426	-0.326	0.061	0.443	0.239	0.451	-0.244	-0.255	-0.259	-0.247	-0.336	-0.352
Chloride	0.867	0.854	-0.093	0.847	0.109	0.861	0.009	-0.261	1	0.816	0.343	0.889	0.704	0.209	0.247	0.139	0.728	0.909	0.918	0.952	0.889	0.948
Sulphate	0.928	0.922	-0.092	0.902	0.049	0.906	-0.086	-0.389	0.816	1	0.095	0.941	0.551	0.068	0.201	0.307	0.783	0.898	0.792	0.734	0.927	0.773
Aluminum (total)	0.043	0.021	0.258	0.086	0.714	0.058	0.106	0.426	0.343	0.095	1	0.215	0.476	0.857	0.735	0.368	0.070	0.319	0.427	0.364	0.139	0.267
Barium (total)	0.957	0.952	-0.030	0.936	0.052	0.950	0.015	-0.326	0.889	0.941	0.215	1	0.644	0.138	0.208	0.279	0.810	0.968	0.890	0.853	0.968	0.858
Copper (total)	0.523	0.527	-0.115	0.498	0.357	0.534	0.044	0.061	0.704	0.551	0.476	0.644	1	0.622	0.504	0.544	0.769	0.694	0.697	0.725	0.624	0.605
Iron (total)	-0.038	-0.053	0.100	-0.019	0.744	-0.010	-0.031	0.443	0.209	0.068	0.857	0.138	0.622	1	0.818	0.540	0.199	0.216	0.297	0.209	0.080	0.136
Lead (total)	0.050	0.036	0.074	0.091	0.919	0.043	-0.313	0.239	0.247	0.201	0.735	0.208	0.504	0.818	1	0.426	0.047	0.269	0.286	0.244	0.153	0.167
Manganese (total)	0.132	0.137	0.327	0.136	0.353	0.120	0.052	0.451	0.139	0.307	0.368	0.279	0.544	0.540	0.426	1	0.444	0.258	0.161	0.130	0.265	-0.012
Molybdenum (total)	0.764	0.773	-0.138	0.724	-0.070	0.777	0.170	-0.244	0.728	0.783	0.070	0.810	0.769	0.199	0.047	0.444	1	0.781	0.735	0.714	0.825	0.672
Potassium (total)	0.921	0.923	-0.021	0.908	0.145	0.920	0.043	-0.255	0.909	0.898	0.319	0.968	0.694	0.216	0.269	0.258	0.781	1	0.922	0.877	0.937	0.869
Silicon (total)	0.854	0.843	-0.135	0.847	0.164	0.859	0.114	-0.259	0.918	0.792	0.427	0.890	0.697	0.297	0.286	0.161	0.735	0.922	1	0.905	0.874	0.899
Sodium (total)	0.804	0.795	-0.111	0.785	0.140	0.802	0.072	-0.247	0.952	0.734	0.364	0.853	0.725	0.209	0.244	0.130	0.714	0.877	0.905	1	0.835	0.920
Strontium (total)	0.963	0.958	-0.078	0.949	-0.011	0.956	-0.082	-0.336	0.889	0.927	0.139	0.968	0.624	0.080	0.153	0.265	0.825	0.937	0.874	0.835	1	0.869
Uranium (total)	0.882	0.864	-0.213	0.870	0.030	0.888	-0.033	-0.352	0.948	0.773	0.267	0.858	0.605	0.136	0.167	-0.012	0.672	0.869	0.899	0.920	0.869	1
Aluminum (dissolved)	-0.414	-0.413	-0.152	-0.364	0.363	-0.400	0.020	0.027	-0.146	-0.253	0.239	-0.308	0.119	0.279	0.237	0.179	-0.111	-0.247	-0.148	-0.087	-0.332	-0.272
Barium (dissolved)	0.978	0.979	-0.110	0.941	-0.115	0.970	-0.013	-0.419	0.869	0.923	0.032	0.954	0.601	-0.006	0.039	0.179	0.835	0.925	0.855	0.809	0.956	0.853
Copper (dissolved)	0.786	0.788	-0.207	0.723	0.049	0.774	-0.091	-0.411	0.737	0.803	0.019	0.814	0.569	0.039	0.180	0.127	0.694	0.781	0.694	0.737	0.758	0.692
Manganese (dissolved)	0.248	0.268	0.242	0.202	-0.010	0.221	0.002	0.090	0.103	0.415	-0.063	0.318	0.227	0.059	0.057	0.690	0.406	0.211	0.105	0.047	0.300	-0.060
Molybdenum (dissolved)	0.845	0.843	-0.107	0.825	0.103	0.821	-0.091	-0.316	0.805	0.923	0.128	0.882	0.656	0.111	0.226	0.427	0.818	0.852	0.773	0.783	0.895	0.723
Potassium (dissolved)	0.935	0.940	-0.055	0.909	-0.004	0.930	0.012	-0.346	0.883	0.908	0.176	0.964	0.638	0.082	0.154	0.210	0.794	0.959	0.880	0.846	0.939	0.825
Silicon (dissolved)	0.916	0.916	-0.162	0.901	-0.098	0.925	0.105	-0.402	0.857	0.814	0.120	0.895	0.615	0.029	0.042	0.098	0.780	0.892	0.910	0.834	0.903	0.847
Sodium (dissolved)	0.771	0.770	-0.111	0.769	0.203	0.770	0.071	-0.237	0.937	0.716	0.375	0.817	0.721	0.231	0.283	0.123	0.698	0.844	0.884	0.968	0.811	0.902
Strontium (dissolved)	0.972	0.970	-0.067	0.948	-0.034	0.967	-0.095	-0.363	0.890	0.941	0.128	0.965	0.598	0.054	0.126	0.245	0.804	0.939	0.869	0.840	0.978	0.876
Uranium (dissolved)	0.897	0.883	-0.215	0.888	-0.014	0.905	-0.043	-0.389	0.947	0.805	0.227	0.874	0.598	0.093	0.128	0.016	0.695	0.882	0.887	0.913	0.890	0.987

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.66: Spearman's Rank Correlation Coefficients for Mary River Water Quality Data Collected in Spring, Summer and Fall 2017[a]

Parameters	Dissolved Metals									
	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Uranium
Conductivity	-0.414	0.978	0.786	0.248	0.845	0.935	0.916	0.771	0.972	0.897
Hardness	-0.413	0.979	0.788	0.268	0.843	0.940	0.916	0.770	0.970	0.883
Total Suspended Solids	-0.152	-0.110	-0.207	0.242	-0.107	-0.055	-0.162	-0.111	-0.067	-0.215
Total Dissolved Solids	-0.364	0.941	0.723	0.202	0.825	0.909	0.901	0.769	0.948	0.888
Turbidity	0.363	-0.115	0.049	-0.010	0.103	-0.004	-0.098	0.203	-0.034	-0.014
Alkalinity	-0.400	0.970	0.774	0.221	0.821	0.930	0.925	0.770	0.967	0.905
Dissolved Organic Carbon	0.020	-0.013	-0.091	0.002	-0.091	0.012	0.105	0.071	-0.095	-0.043
Total Phosphorus	0.027	-0.419	-0.411	0.090	-0.316	-0.346	-0.402	-0.237	-0.363	-0.389
Chloride	-0.146	0.869	0.737	0.103	0.805	0.883	0.857	0.937	0.890	0.947
Sulphate	-0.253	0.923	0.803	0.415	0.923	0.908	0.814	0.716	0.941	0.805
Aluminum (total)	0.239	0.032	0.019	-0.063	0.128	0.176	0.120	0.375	0.128	0.227
Barium (total)	-0.308	0.954	0.814	0.318	0.882	0.964	0.895	0.817	0.965	0.874
Copper (total)	0.119	0.601	0.569	0.227	0.656	0.638	0.615	0.721	0.598	0.598
Iron (total)	0.279	-0.006	0.039	0.059	0.111	0.082	0.029	0.231	0.054	0.093
Lead (total)	0.237	0.039	0.180	0.057	0.226	0.154	0.042	0.283	0.126	0.128
Manganese (total)	0.179	0.179	0.127	0.690	0.427	0.210	0.098	0.123	0.245	0.016
Molybdenum (total)	-0.111	0.835	0.694	0.406	0.818	0.794	0.780	0.698	0.804	0.695
Potassium (total)	-0.247	0.925	0.781	0.211	0.852	0.959	0.892	0.844	0.939	0.882
Silicon (total)	-0.148	0.855	0.694	0.105	0.773	0.880	0.910	0.884	0.869	0.887
Sodium (total)	-0.087	0.809	0.737	0.047	0.783	0.846	0.834	0.968	0.840	0.913
Strontium (total)	-0.332	0.956	0.758	0.300	0.895	0.939	0.903	0.811	0.978	0.890
Uranium (total)	-0.272	0.853	0.692	-0.060	0.723	0.825	0.847	0.902	0.876	0.987
Aluminum (dissolved)	1	-0.330	-0.116	0.072	-0.063	-0.247	-0.329	-0.060	-0.304	-0.252
Barium (dissolved)	-0.330	1	0.808	0.302	0.867	0.955	0.924	0.783	0.969	0.873
Copper (dissolved)	-0.116	0.808	1	0.328	0.799	0.843	0.716	0.729	0.786	0.691
Manganese (dissolved)	0.072	0.302	0.328	1	0.494	0.300	0.160	0.067	0.309	-0.027
Molybdenum (dissolved)	-0.063	0.867	0.799	0.494	1	0.870	0.776	0.777	0.907	0.761
Potassium (dissolved)	-0.247	0.955	0.843	0.300	0.870	1	0.916	0.821	0.947	0.840
Silicon (dissolved)	-0.329	0.924	0.716	0.160	0.776	0.916	1	0.810	0.898	0.852
Sodium (dissolved)	-0.060	0.783	0.729	0.067	0.777	0.821	0.810	1	0.811	0.881
Strontium (dissolved)	-0.304	0.969	0.786	0.309	0.907	0.947	0.898	0.811	1	0.900
Uranium (dissolved)	-0.252	0.873	0.691	-0.027	0.761	0.840	0.852	0.881	0.900	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 36.

Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.67: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2017

Depth (m)	Temperature (°C)										Dissolved Oxygen (mg/L)										Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05
Date Collected	12-Apr-17	12-Apr-17	12-Apr-17	15-Apr-17	15-Apr-17	15-Apr-17	14-Apr-17	14-Apr-17	14-Apr-17	15-Apr-17	12-Apr-17	########	12-Apr-17	15-Apr-17	########	15-Apr-17	########	########	########	########	12-Apr-17	########	12-Apr-17	15-Apr-17	########
1.0	0.1	0.1	0.3	0.2	0.4	0.4	0.3	0.0	0.1	0.2	13.9	14.9	13.7	15.3	15.1	16.5	14.9	16.3	15.4	15.0	95.4	102.0	94.6	105.5	104.7
2.0	0.2	0.1	0.3	0.2	0.2	0.2	0.3	0.2	0.4	0.4	13.9	14.8	14.0	15.3	15.2	16.7	15.0	16.2	15.3	15.3	95.5	101.9	96.5	105.6	104.9
3.0	0.6	0.4	0.5	0.7	0.8	0.7	0.8	0.8	0.8	0.7	13.8	14.7	14.2	15.0	14.9	16.3	14.8	15.3	15.0	15.1	95.7	101.7	98.4	105.8	104.3
4.0	0.8	0.7	0.7	1.1	1.0	1.0	1.1	1.1	1.1	1.1	13.6	14.6	14.2	14.7	14.7	16.0	14.5	14.8	14.7	14.8	95.5	101.8	98.8	103.8	103.4
5.0	1.0	0.9	0.9	1.2	1.2	1.1	1.3	1.2	1.2	1.2	13.5	14.5	13.1	14.6	14.5	15.7	14.3	14.6	14.5	14.7	94.9	101.5	91.8	103.1	102.5
6.0	1.2	1.0		1.4	1.4	1.2	1.4	1.3	1.3	1.3	13.4	14.3		14.4	14.3	15.9	14.2	14.4	14.3	14.7	94.6	100.7		102.2	101.5
7.0	1.2	1.2		1.4	1.4		1.5	1.4	1.4	1.3	13.2	14.1		14.3	14.2		14.1	14.3	14.2	14.8	93.8	99.5		102.0	101.2
8.0	1.3	1.3		1.5	1.5		1.9	1.5	1.5		12.8	13.8		14.2	14.1		16.0	14.2	14.0		91.2	97.9		101.0	100.4
9.0	1.5	1.4		1.6	1.5		1.6	1.5	1.6		12.2	13.6		14.1	14.0		13.7	13.9	13.9		87.1	97.0		100.5	100.0
10.0	1.6	1.4		1.6	1.6		1.7	1.6	1.6		11.5	13.3		13.9	13.9		13.7	13.8	13.7		82.1	94.8		99.7	99.5
11.0	1.7			1.6	1.7		1.7	1.7	1.7		10.3			13.9	13.8		13.5	13.7	13.6		74.3			99.2	98.6
12.0	1.8				1.7		1.8	1.8	1.8		6.6				13.6		13.4	19.5	13.6		57.5				98.0
13.0	1.9				1.8		1.9	1.9	1.8		5.8				13.5		13.3	13.4	13.4		42.3				97.3
14.0	2.0				1.9		1.9	1.9	1.9		3.1				13.4		13.2	13.3	13.4		22.4				96.9
15.0	2.1				1.9		2.0	2.0	2.0		1.0				13.3		13.1	13.2	13.2		7.2				95.9
16.0					2.0		2.0	2.0	2.0						13.2		13.0	13.1	13.1						95.2
17.0					2.0			2.0	2.0						13.0			13.0	13.1						94.1
18.0					2.0			2.1	2.1						12.6			12.9	13.0						91.1
19.0					2.0			2.1	2.1						12.3			12.7	12.9						89.3
20.0					2.0			2.1	2.2						12.2			12.5	12.7						87.9
21.0									2.2										12.4						
22.0									2.2										12.1						
23.0									2.2										11.9						
24.0									2.3										11.6						
25.0									2.3										11.4						
26.0									2.4										11.0						
27.0									2.4										10.7						
28.0									2.5										10.0						
29.0																									
30.0																									

Note:
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 16.3, 10.6, 6.0, 11.4, 20.5, 7.1, 17.2, 20.6, 29.1, and 7.8 m, respectively, at the time of winter sampling.
Ice thickness at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 1.5, 1.74, 1.52, 1.5, 1.8, 1.7, 1.3, 2.3, 1.2, and 1.7 m, respectively, at the time of winter sampling.
Deepest measurement at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.3, 9.5, 5.0, 10.4, 19.5, 6.1, 16.2, 19.6, 28, and 6.8 m, respectively, at the time of winter sampling.

Table C.67: ***In Situ*** **Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Winter, Mary River Project CREMP, 2017**

Depth (m)	Dissolved Oxygen (% Saturation)					pH (pH units)										Specific Conductance (µS/cm)									
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06
Date Collected	15-Apr-17	########	########	########	########	12-Apr-17	########	12-Apr-17	15-Apr-17	########	15-Apr-17	########	########	########	########	12-Apr-17	########	12-Apr-17	15-Apr-17	########	15-Apr-17	########	########	########	########
1.0	114.2	103.0	111.7	105.8	103.2	7.66	7.56	7.85	7.58	7.68	7.73	7.60	7.61	8.19	8.16	270	266	246	142	148	156	130	161	163	174
2.0	114.5	103.5	111.5	105.6	103.7	7.65	7.57	7.74	7.54	7.66	7.76	7.57	7.61	8.07	8.10	271	262	288	142	147	156	130	151	171	182
3.0	114.0	103.1	107.2	104.7	103.4	7.65	7.58	7.71	7.54	7.60	7.75	7.56	7.62	7.99	8.07	269	261	295	141	147	154	130	155	172	184
4.0	112.7	102.4	104.1	103.6	104.4	7.65	7.59	7.68	7.54	7.67	7.74	7.56	7.62	7.96	8.02	267	261	298	141	146	158	129	151	171	186
5.0	111.4	101.6	103.3	102.7	104.3	7.64	7.59	7.62	7.54	7.67	7.73	7.56	7.62	7.93	7.99	264	259	301	141	145	153	129	148	170	187
6.0	112.3	101.3	102.1	101.9	104.1	7.64	7.60		7.54	7.66	7.70	7.56	7.61	7.91	7.99	262	258		141	144	155	129	147	167	189
7.0		100.5	101.5	101.1	104.8	7.63	7.60		7.53	7.65		7.55	7.61	7.90	7.99	261	256		141	144		129	146	164	191
8.0		99.6	100.4	100.2		7.62	7.60		7.54	7.65		7.55	7.60	7.68		259	255		141	144		130	145	161	
9.0		98.4	99.5	99.5		7.60	7.59		7.54	7.64		7.55	7.60	7.85		257	255		141	143		130	143	158	
10.0		98.1	98.7	98.3		7.57	7.58		7.53	7.64		7.54	7.59	7.82		255	255		141	143		130	142	153	
11.0		97.2	98.0	97.9		7.53			7.53	7.63		7.54	7.59	7.80		254			141	143		130	142	151	
12.0		96.1	97.0	97.6		7.40				7.62		7.53	7.58	7.77		254				143		130	141	149	
13.0		95.7	96.4	96.8		7.36				7.60		7.52	7.57	7.76		254				142		130	140	148	
14.0		94.9	96.0	96.3		7.30				7.60		7.52	7.57	7.75		256				143		131	140	145	
15.0		94.6	95.4	95.6		7.20				7.58		7.51	7.56	7.73		265				143		131	140	146	
16.0		94.2	94.6	95.0						7.58		7.50	7.51	7.71						142		131	139	145	
17.0			94.3	94.5						7.56			7.55	7.69						142			139	144	
18.0			93.5	94.0						7.55			7.55	7.68						144			139	143	
19.0			92.0	93.5						7.52			7.53	7.67						144			139	143	
20.0			90.8	92.2						7.49			7.52	7.66						145			139	142	
21.0				90.0										7.64										142	
22.0				88.2										7.62										142	
23.0				86.7										7.60										142	
24.0				84.9										7.58										142	
25.0				83.4										7.57										142	
26.0				80.2										7.53										143	
27.0				78.2										7.51										144	
28.0				73.3										7.47										144	
29.0																									
30.0																									

Note:
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 16.3, 10.6, 6.0, 11.4, 20.5, 7.1, 17.2, 20.6, 29.1, and 7.8 m, respectively, at the time of winter sampling.
Ice thickness at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 1.5, 1.74, 1.52, 1.5, 1.8, 1.7, 1.3, 2.3, 1.2, and 1.7 m, respectively, at the time of winter sampling.
Deepest measurement at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.3, 9.5, 5.0, 10.4, 19.5, 6.1, 16.2, 19.6, 28, and 6.8 m, respectively, at the time of winter sampling.

Table C.68: ***In Situ*** **Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017**

Depth (m)	Temperature (°C)										Dissolved Oxygen (mg/L)										Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05
Date Collected	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17
1.0	5.2	5.3	5.2	5.8	5.9	6.0	6.4	5.9	5.9	5.9	12.6	12.5	12.6	12.3	12.5	12.6	12.1	12.3	12.2	12.5	98.6	98.0	99.4	98.3	100.5
2.0	5.2	5.2	5.2	5.8	5.9	6.0	6.4	5.9	5.9	5.9	12.6	12.6	12.6	12.3	12.4	12.3	12.1	12.3	12.2	12.4	99.0	99.0	99.3	98.3	99.6
3.0	5.2	5.2	5.2	5.8	5.9	6.0	6.4	5.8	5.9	5.9	12.6	12.6	12.6	12.3	12.4	12.3	12.1	12.3	12.2	12.4	99.0	99.0	99.4	98.2	99.2
4.0	5.2	5.2	5.2	5.8	5.9	6.0	6.4	5.8	5.9	5.9	12.6	12.6	12.6	12.3	12.3	12.3	12.1	12.3	12.2	12.3	99.0	99.1	99.3	98.1	98.8
5.0	5.1	5.2	5.2	5.8	5.9	6.0	6.4	5.8	5.9	5.9	12.6	12.6	12.4	12.3	12.3	12.2	12.1	12.3	12.2	12.3	98.9	99.1	97.8	98.0	98.5
6.0	5.1	5.2		5.8	5.9	6.0	6.4	5.8	5.9	5.8	12.6	12.6		12.3	12.3	12.2	12.1	12.2	12.2	12.3	99.0	99.0		97.9	98.2
7.0	5.1	5.2		5.8	5.9	6.0	6.4	5.8	5.9	5.8	12.6	12.6		12.3	12.2	12.2	12.1	12.2	12.2	12.2	99.0	98.9		97.9	98.1
8.0	5.1	5.2		5.7	5.9	6.0	6.4	5.8	5.9		12.6	12.6		12.3	12.2	12.2	12.1	12.2	12.2		98.9	98.9		97.9	97.8
9.0	5.1	5.2		5.7	5.9		6.4	5.8	5.9		12.6	12.6		12.3	12.2		12.1	12.2	12.2		98.8	98.8		97.8	97.7
10.0	5.1			5.7	5.9		6.3	5.8	5.8		12.6			12.3	12.2		12.0	12.2	12.2		98.7			97.7	97.5
11.0	5.1			5.7	5.8		6.3	5.8	5.8		12.6			12.3	12.2		12.0	12.2	12.2		98.7			97.8	97.3
12.0	5.1				5.8		6.3	5.8	5.8		12.6				12.2		12.0	12.2	12.2		98.7				97.2
13.0	5.1				5.8		6.3	5.8	5.8		12.6				12.2		12.0	12.2	12.2		98.6				97.1
14.0	5.1				5.7		6.2	5.8	5.8		12.6				12.2		12.0	12.2	12.2		98.5				97.1
15.0	5.0				5.7		6.2	5.7	5.8		12.6				12.2		12.0	12.2	12.2		98.5				97.1
16.0					5.7		6.2	5.7	5.7						12.2		12.0	12.2	12.2						97.2
17.0					5.7		6.2	5.7	5.7						12.2		12.0	12.2	12.2						97.2
18.0					5.7			5.7	5.7						12.2			12.2	12.2						97.2
19.0					5.7			5.7	5.7						12.2			12.2	12.2						97.4
20.0					5.7			5.7	5.7						12.2			12.2	12.2						97.3
21.0					5.7				5.7						12.2*				12.2						97.2
22.0									5.6										12.2						
23.0									5.6										12.2						
24.0									5.6										12.2						
25.0									5.6										12.2						
26.0									5.6										12.2						
27.0									5.6										12.1						
28.0									5.6										12.1						
29.0									5.6										12.1						
30.0									5.6										12.1						

Note:
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 16.09, 9.95, 5.14, 11.0, 21.7, 8.5, 19.9, 20.99, 30.5, and 8.2 m, respectively, at the time of summer sampling.

Table C.68: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Summer, Mary River Project CREMP, 2017

Depth (m)	Dissolved Oxygen (% Saturation)					pH (pH units)										Specific Conductance (µS/cm)									
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-06
Date Collected	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17
1.0	101.3	98.3	98.2	98.0	100.7	7.82	7.95	7.80	7.60	7.55	7.56	7.43	7.60	7.50	7.58	95	97	98	77	74	73	74	74	72	73
2.0	98.9	98.2	98.1	98.2	99.5	7.75	7.70	7.73	7.59	7.54	7.56	7.47	7.55	7.50	7.56	95	97	98	77	74	73	74	74	72	73
3.0	98.5	98.2	97.9	98.2	99.0	7.69	7.65	7.70	7.57	7.54	7.35	7.47	7.54	7.52	7.55	95	97	98	77	74	73	74	74	72	73
4.0	98.4	98.0	98.0	98.1	98.6	7.68	7.63	7.69	7.57	7.53	7.52	7.47	7.52	7.52	7.54	95	97	98	77	74	73	74	74	72	73
5.0	98.3	97.9	98.0	98.1	98.4	7.66	7.61	7.67	7.56	7.53	7.52	7.47	7.51	7.51	7.53	96	97	98	77	74	73	74	74	72	73
6.0	98.2	97.8	97.8	97.9	98.2	7.66	7.59		7.55	7.52	7.52	7.48	7.50	7.51	7.52	95	97		78	74	73	74	74	72	73
7.0	98.1	97.8	97.7	97.9	97.9	7.65	7.59		7.55	7.52	7.51	7.47	7.50	7.51	7.51	96	97		78	74	73	74	74	72	73
8.0	97.9	97.7	97.6	97.8		7.64	7.58		7.55	7.52	7.51	7.48	7.49	7.50		96	97		78	74	73	74	74	72	
9.0		97.7	97.5	97.7		7.63	7.66		7.55	7.52		7.47	7.49	7.50		96	97		78	74		74	74	73	
10.0		97.6	97.5	97.7		7.62			7.55	7.52		7.47	7.49	7.50		96			78	74		74	74	73	
11.0		97.5	97.5	97.6		7.62			7.55	7.51		7.45	7.49	7.50		96			78	74		74	74	73	
12.0		97.4	97.4	97.5		7.61				7.51		7.44	7.49	7.50		96				75		74	74	73	
13.0		97.3	97.4	97.4		7.61				7.51		7.43	7.49	7.50		96				75		73	74	73	
14.0		97.3	97.3	97.4		7.61				7.51		7.41	7.49	7.50		96				76		73	74	73	
15.0		97.2	97.3	97.3		7.59				7.51		7.39	7.49	7.50		97				76		73	74	73	
16.0		97.2	97.2	97.2						7.52		7.39	7.49	7.50						76		73	74	74	
17.0		97.1	97.1	97.1						7.52		7.38	7.49	7.50						76		73	74	74	
18.0			97.1	97.0						7.52			7.48	7.50						77			74	74	
19.0			96.9	97.0						7.52			7.48	7.50						77			74	74	
20.0			96.9	96.9						7.52			7.48	7.50						77			74	74	
21.0				96.9						7.52				7.50						77				74	
22.0				96.8										7.49										74	
23.0				96.8										7.49										74	
24.0				96.8										7.49										74	
25.0				96.8										7.49										74	
26.0				96.7										7.49										74	
27.0				96.6										7.49										74	
28.0				96.6										7.49										74	
29.0				96.5										7.49										74	
30.0				96.4										7.49										74	

Note:
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 were 16.09, 9.95, 5.14, 11.0, 21.7, 8.5, 19.9, 20.99, 30.5, and 8.2 m, respectively, at the time of summer sampling.

Table C.69: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017

Depth (m)	Temperature (°C)											Dissolved Oxygen (mg/L)											Dissolved Oxygen (% Saturation)				
	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05
Date Collected	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	26-Aug-18	29-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	26-Aug-18	29-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17
surface										8.4											11.73						
1.0	6.9	6.8	7.0	7.9	7.9	7.8	8.0	8.0	7.9	8.4	7.9	11.76	11.80	11.75	11.55	11.61	11.61	11.63	11.59	11.62	11.68	11.62	96.7	96.7	96.8	97.4	97.7
2.0	6.9	6.8	7.0	8.0	7.8	7.8	8.0	8.0	7.9	8.4	7.9	11.75	11.78	11.76	11.52	11.60	11.60	11.62	11.60	11.60	11.68	11.62	96.7	96.7	96.9	97.2	97.6
3.0	6.9	6.8	7.0	8.0	7.8	7.8	8.0	7.9	7.9	8.4	7.9	11.75	11.78	11.77	11.51	11.59	11.60	11.60	11.59	11.61	11.66	11.61	96.7	96.6	97.0	97.1	97.5
4.0	6.9	6.8	7.0	7.9	7.8	7.8	7.9	7.9	7.9	8.4	7.9	11.76	11.79	11.77	11.52	11.58	11.60	11.60	11.58	11.60	11.65	11.60	96.5	96.6	97.1	97.1	97.3
5.0	6.7	6.8		7.9	7.8	7.8	7.9	7.8	7.9	8.4	7.9	11.81	11.81		11.52	11.56	11.59	11.58	11.57	11.59	11.68	11.60	96.5	96.7		97.2	97.2
6.0	6.4	6.8		7.9	7.8	7.8	7.8	7.8	7.9	8.4	7.9	11.92	11.80		11.52	11.56	11.59	11.55	11.56	11.58	11.65	11.60	96.0	96.6		97.1	97.1
7.0	6.2	6.8		7.9	7.8	7.8	7.8	7.7	7.9	8.4	7.9	11.97	11.80		11.51	11.55	11.57	11.54	11.55	11.57	11.66	11.59	96.5	96.6		97.0	97.0
8.0	6.0	6.8		7.9	7.7		7.8	7.7	7.9	8.3	7.9	11.98	11.80		11.50	11.50		11.52	11.54	11.56	11.68	11.58	96.3	96.6		96.8	96.9
9.0	6.0	6.8		7.9	7.7		7.8	7.6	7.8	8.1		11.99	11.79		11.48	11.54		11.52	11.54	11.55	11.70		96.2	96.6		96.6	96.7
10.0	5.9			7.8	7.7		7.8	7.6	7.8	7.9		12.01			11.48	11.54		11.51	11.53	11.55	11.73		96.3			96.6	96.6
11.0	5.9			7.8	7.7		7.8	7.5	7.8	7.8		12.02			11.48	11.52		11.50	11.54	11.54	11.68		96.3			96.6	96.5
12.0	5.8				7.6		7.8	7.5	7.8	7.7		12.04				11.52		11.51	11.53	11.54	11.69		96.3				96.4
13.0	5.8				7.6		7.8	7.4	7.8	7.7		12.05				11.54		11.50	11.53	11.53	11.68		96.3				96.4
14.0	5.8				7.6		7.8	7.4	7.8	7.5		12.05				11.53		11.49	11.53	11.53	11.69		96.3				96.4
15.0	5.6				7.5		7.8	7.4	7.7	7.5		12.13				11.54		11.49	11.52	11.51	11.68		96.5				96.3
16.0					7.5		7.8	7.3	7.7	7.4						11.54		11.47	11.51	11.51	11.68						96.3
17.0					7.5		7.7	7.3	7.7	7.3						11.54		11.46	11.50	11.50	11.73						96.2
18.0					7.5			7.3	7.6	7.2						11.54			11.49	11.48	11.73						96.2
19.0					7.5			7.3	7.6	7.1						11.54			11.48	11.47	11.70						96.2
20.0					7.4			7.3	7.6	7.1						11.53			11.47	11.46	11.71						96.1
21.0					7.4			7.3	7.4	7.0						11.53			11.47	11.46	11.68						95.9
22.0									7.3	6.9										11.46	11.66						
23.0									7.2	6.8										11.46	11.67						
24.0									7.1	6.8										11.45	11.61						
25.0									7.0	6.7										11.45	11.62						
26.0									6.9	6.7										11.43	11.64						
27.0									6.7	6.7										11.39	11.58						
28.0									6.7	6.5										11.37	11.62						
29.0									6.7	6.4										11.36	11.55						

Notes:
28-Aug-17 to 30-Aug-17 sampling was conducted by Baffinland. 26-Aug-17 sampling was conducted by Minnow.
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 was 15.4, 9.8, 4.8, 11.95, 21.3, 7.95, 17.6, 21.21, 29.05, and 9.0 m, respectively, at the time of fall sampling.

Table C.69: *In Situ* Water Quality Profile Data Collected at Mary Lake Water Quality Monitoring Stations in Fall, Mary River Project CREMP, 2017

Depth (m)	Dissolved Oxygen (% Saturation)						pH (pH units)											Specific Conductance (µS/cm)										
	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06	BLO-01-A	BLO-01	BLO-01-B	BLO-05-A	BLO-05	BLO-05-B	BLO-03	BLO-04	BLO-09	BLO-09	BLO-06
Date Collected	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	26-Aug-18	29-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	26-Aug-18	29-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	26-Aug-18	29-Aug-17
surface					101.1											7.66											61	
1.0	97.4	98.2	97.8	97.9	99.5	97.9	7.91	7.92	7.90	7.27	7.33	7.50	7.56	7.48	7.50	7.49	7.56	116	118	117	53	51	52	50	51	51	61	51
2.0	97.4	98.1	97.9	97.8	99.6	97.8	7.91	7.90	7.91	7.29	7.31	7.50	7.55	7.49	7.49	7.50	7.54	116	118	117	53	51	52	50	51	51	61	51
3.0	97.4	98.0	97.6	97.8	99.4	97.8	7.90	7.90	7.91	7.30	7.30	7.50	7.54	7.49	7.49	7.49	7.54	116	118	117	53	51	52	50	51	51	62	51
4.0	97.4	97.8	97.5	97.7	99.3	97.6	7.91	7.91	7.91	7.31	7.30	7.50	7.55	7.50	7.49	7.49	7.54	117	119	117	53	51	52	50	51	51	62	51
5.0	97.4	97.5	97.3	97.7	99.5	97.7	7.91	7.91		7.32	7.30	7.50	7.54	7.49	7.49	7.48	7.53	117	119		53	51	52	50	51	51	62	51
6.0	97.3	97.2	97.1	97.5	99.3	97.6	7.91	7.90		7.32	7.30	7.50	7.54	7.49	7.49	7.50	7.52	120	119		54	51	52	50	51	51	62	51
7.0	97.1	97.0	96.8	97.4	99.3	97.5	7.90	7.90		7.33	7.30	7.49	7.53	7.49	7.48	7.49	7.51	121	119		54	51	56	49	51	51	62	51
8.0		96.9	96.7	97.3	99.2	97.5	7.89	7.90		7.34	7.29		7.54	7.49	7.48	7.49	7.51	121	119		55	51		49	51	51	62	51
9.0		96.8	96.6	97.1	98.9		7.90	7.90		7.34	7.29		7.53	7.49	7.47	7.51		121	119		56	53		49	51	52	62	
10.0		96.7	96.4	97.0	98.7		7.89			7.34	7.29		7.53	7.49	7.48	7.52		121			56	53		49	51	51	61	
11.0		96.7	96.2	96.9	98.1		7.89			7.35	7.28		7.52	7.47	7.48	7.50		121			57	53		49	52	51	61	
12.0		96.7	96.1	96.9	98.0		7.88				7.28		7.53	7.47	7.48	7.46		121				56		49	53	51	61	
13.0		96.6	95.9	96.8	97.6		7.88				7.29		7.52	7.47	7.48	7.42		121				56		49	53	51	61	
14.0		96.6	95.8	96.8	97.6		7.87				7.30		7.51	7.47	7.49	7.42		121				58		49	53	51	62	
15.0		96.5	95.8	96.6	97.4		7.87				7.30		7.52	7.46	7.48	7.42		121				58		49	53	51	62	
16.0		96.3	95.7	96.6	97.3						7.31		7.51	7.46	7.48	7.41						59		49	53	51	62	
17.0		96.1	95.6	96.4	96.9						7.32		7.51	7.46	7.48	7.40						61		49	53	51	62	
18.0			95.4	96.0	97.0						7.33			7.46	7.48	7.41						61			53	51	62	
19.0			95.3	95.9	96.7						7.35			7.46	7.48	7.38						61			53	51	61	
20.0			95.2	95.8	96.7						7.35			7.45	7.47	7.40						62			53	51	61	
21.0			95.1	95.2	96.1						7.35			7.44	7.48	7.38						62			54	50	61	
22.0				95.1	95.8										7.47	7.38										50	61	
23.0				94.9	95.6										7.46	7.38										49	60	
24.0				94.5	95.0										7.45	7.37										49	60	
25.0				94.4	94.9										7.44	7.36										49	60	
26.0				93.9	95.2										7.43	7.36										49	60	
27.0				93.3	94.6										7.42	7.36										49	60	
28.0				93.0	94.6										7.42	7.35										49	59	
29.0				92.8	93.7										7.41	7.35										48	59	

Notes:
28-Aug-17 to 30-Aug-17 sampling was conducted by Baffinland. 26-Aug-17 sampling was conducted by Minnow.
Total depth at stations BLO-01-A, BLO-01, BLO-01-B, BLO-05-A, BLO-05, BLO-05-B, BLO-03, BLO-04, BLO-09, and BLO-06 were 15.4, 9.8, 4.8, 11.95, 21.3, 7.95, 17.6, 21.21, 29.05, and 9.0 m, respectively, at the time of fall sampling.

Table C.70: **Sampling Depth, Water Clarity Measures, and Surface and Bottom *In Situ* Water Quality Measures Collected at Mary Lake Benthic Invertebrate Community Stations, Mary River Project CREMP, August 2017**

Categorization & Replicate ID		Date Sampled	Station Depth (m)	Secchi Depth (m)	Depth sampled	Temperature (°C)	Dissolved Oxygen		pH (units)	Specific Conductance (µS/cm)
							(mg/L)	(% sat.)		
Littoral (Shallow) Stations	BLO-01	30-Aug-17	9.8	4.5	surface	7.00	11.72	96.5	7.67	117
					bottom	6.70	11.76	96.1	7.78	118
	BLO-11	20-Aug-17	9.1	3.4	surface	8.24	11.55	97.9	7.67	94
					bottom	7.75	11.46	96.1	7.36	92
	BLO-07	20-Aug-17	12.0	4.0	surface	8.92	11.49	99.1	7.67	87
					bottom	7.64	11.23	95.0	6.89	90
	BLO-06	20-Aug-17	6.6	4.0	surface	8.80	11.40	98.2	7.47	87
					bottom	8.57	11.37	97.4	7.02	87
Profundal (Deep) Stations	BLO-03	20-Aug-17	15.0	4.3	surface	9.21	11.67	101.0	7.54	87
					bottom	7.97	11.59	97.6	7.22	89
	BLO-15	20-Aug-17	29.0	4.9	surface	9.45	11.45	100.2	7.08	87
					bottom	6.58	10.99	87.8	6.84	89
	BLO-14	20-Aug-17	20.0	6.0	surface	9.36	11.42	99.7	7.48	87
					bottom	7.20	11.11	91.7	6.87	91
	BLO-05	20-Aug-17	21.5	3.5	surface	8.16	11.48	97.2	7.60	90
					bottom	6.82	11.34	93.0	7.40	93
	BLO-13	20-Aug-17	22.0	4.3	surface	9.07	11.55	100.0	7.66	88
					bottom	7.05	11.35	93.7	6.98	96
	BLO-04	20-Aug-17	22.0	4.4	surface	8.79	11.50	98.9	7.24	88
					bottom	6.85	11.35	93.7	6.87	95

Table C.71: Statistical Comparison of Bottom *In Situ* Water Quality Between Mary Lake Littoral and Profundal Stations, Mary River Project CREMP, August 2017

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Lake Zone	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Secchi Depth (m)	NO	0.235	α	Littoral	4	3.98	0.45	0.23	3.40	4.50
				Profundal	6	4.57	0.83	0.34	3.50	6.00
Temperature (˚C)	NO	0.172	α	Littoral	4	7.67	0.77	0.38	6.70	8.57
				Profundal	6	7.08	0.49	0.20	6.58	7.97
Dissolved Oxygen (mg/L)	NO	0.266	α	Littoral	4	11.5	0.2	0.1	11.2	11.8
				Profundal	6	11.3	0.2	0.1	11.0	11.6
Dissolved Oxygen (% saturation)	YES	0.089	α	Littoral	4	96.2	1.0	0.5	95.0	97.4
				Profundal	6	92.9	3.2	1.3	87.8	97.6
pH (units)	NO	0.270	α	Littoral	4	7.26	0.40	0.20	6.89	7.78
				Profundal	6	7.03	0.23	0.09	6.84	7.40
Specific Conductance (umho/cm)	NO	0.475	α , η	Littoral	4	97.0	14.4	7.2	87.4	118.4
				Profundal	6	92.3	2.9	1.2	88.9	95.9

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.72: Statistical Comparison of Bottom *In Situ* Water Quality Between Mary Lake and Reference Lake 3 Stations Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.752	α	Reference	5	9.74	1.04	0.46	8.50	11.20
					Mary Lake	4	9.38	2.22	1.11	6.60	12.00
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.26	0.74	0.33	7.50	9.40
					Mary Lake	4	3.98	0.45	0.23	3.40	4.50
	Temperature (˚C)	NO	0.112	α	Reference	5	8.29	0.16	0.07	8.05	8.42
					Mary Lake	4	7.67	0.77	0.38	6.70	8.57
	Dissolved Oxygen (mg/L)	YES	0.014	α	Reference	5	11.8	0.1	0.0	11.7	11.9
					Mary Lake	4	11.5	0.2	0.1	11.2	11.8
	Dissolved Oxygen (% saturation)	YES	< 0.001	α	Reference	5	100.3	0.9	0.4	99.0	101.0
					Mary Lake	4	96.2	1.0	0.5	95.0	97.4
	pH (units)	NO	0.408	α	Reference	5	7.43	0.17	0.08	7.31	7.72
					Mary Lake	4	7.26	0.40	0.20	6.89	7.78
	Specific Conductance (umho/cm)	YES	0.003	β , η	Reference	5	73.7	0.6	0.3	73.2	74.6
					Mary Lake	4	97.0	14.4	7.2	87.4	118.4
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.655	α	Reference	5	20.56	2.17	0.97	18.50	24.20
					Mary Lake	6	21.58	4.50	1.84	15.00	29.00
	Secchi Depth (m)	YES	< 0.001	α	Reference	5	8.28	0.43	0.19	7.90	9.00
					Mary Lake	6	4.57	0.83	0.34	3.50	6.00
	Temperature (˚C)	NO	0.256	α	Reference	5	7.48	0.61	0.27	6.47	8.10
					Mary Lake	6	7.08	0.49	0.20	6.58	7.97
	Dissolved Oxygen (mg/L)	NO	0.245	α	Reference	5	11.6	0.5	0.2	10.7	12.0
					Mary Lake	6	11.3	0.2	0.1	11.0	11.6
	Dissolved Oxygen (% saturation)	YES	0.060	α	Reference	5	97.3	3.6	1.6	93.0	100.7
					Mary Lake	6	92.9	3.2	1.3	87.8	97.6
	pH (units)	YES	0.038	α , η	Reference	5	7.29	0.06	0.03	7.23	7.37
					Mary Lake	6	7.03	0.23	0.09	6.84	7.40
	Specific Conductance (umho/cm)	YES	< 0.001	α	Reference	5	76.1	3.5	1.5	73.2	80.6
					Mary Lake	6	92.3	2.9	1.2	88.9	95.9

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table C.73: Water Chemistry at Mary Lake North Basin (BLO-01) Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event						er Sampling Event						Fall Sampling Event					
					BL0-01-A bottom 12/Apr/17	BL0-01-A surface 12/Apr/17	BL0-01 bottom 12/Apr/17	BL0-01 surface 12/Apr/17	BL0-01-B bottom 12/Apr/17	BL0-01-B surface 12/Apr/17	BL0-01-A bottom 30/Jul/17	BL0-01-A surface 30/Jul/17	BL0-01 bottom 30/Jul/17	BL0-01 surface 30/Jul/17	BL0-01-B bottom 30/Jul/17	BL0-01-B surface 30/Jul/17	BLO-01-A bottom 30/Aug/17	BLO-01-A surface 30/Aug/17	BLO-01 bottom 30/Aug/17	BLO-01 surface 30/Aug/17	BLO-01-B bottom 30/Aug/17	BLO-01-B surface 30/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	262	263	259	269	267	266	73	73	74	74	74	75	154	149	152	151	149	149
	pH (lab)	pH	6.5 - 9.0	-	7.28	7.77	7.76	7.87	7.77	7.82	7.79	7.79	7.77	7.79	7.80	7.80	8.06	8.04	8.07	8.02	8.06	8.05
	Hardness (as $CaCO_3$)	mg/L	-	-	131	132	127	134	136	133	35	34	35	35	36	36	75	72	74	73	72	71
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.2	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	123	122	120	125	121	140	49	44	49	51	46	46	82	68	99	79	59	80
	Turbidity	NTU	-	-	2.1	0.1	0.2	0.1	0.2	0.2	2.6	2.5	2.0	3.0	2.7	2.1	0.9	0.9	0.9	0.8	0.8	0.9
	Alkalinity (as $CaCO_3$)	mg/L	-	-	130	127	122	132	130	131	31	33	34	34	31	33	72	70	68	64	67	66
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	0.192	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.028	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.045	0.091	0.078	0.084	0.072	0.077	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.038	0.026	0.032	0.029	0.028	0.024
	Nitrite	mg/L	0.06	0.06	0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	0.42	0.17	0.16	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	2.3	2.1	2.1	2.3	2.3	2.2	1.0	<1.0	<1.0	<1.0	1.1	<1.0	1.4	1.6	1.7	1.6	1.6	1.6
	Total Organic Carbon	mg/L	-	-	2.3	2.3	2.4	2.3	2.5	3.0	1.2	1.1	1.3	1.1	1.1	1.1	1.6	1.7	1.8	1.7	1.8	1.7
	Total Phosphorus	mg/L	0.020[α]	-	0.0109	0.0044	0.0030	0.0034	0.0065	0.0041	0.0046	0.0051	0.0060	0.0075	0.0054	0.0044	0.0244	0.0039	0.0054	<0.0030	0.0035	0.0038
	Phenols	mg/L	0.004[α]	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0019	0.0013	<0.0010	0.0012	0.0016	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	0.0018	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	10.8	11.5	11.1	11.6	11.2	11.1	1.2	1.2	1.2	1.2	1.2	1.3	4.0	3.9	3.9	3.9	3.9	3.5
	Sulphate (SO_4)	mg/L	218[β]	218	2.5	3.7	3.6	3.8	3.6	3.6	0.7	0.6	0.6	0.6	0.5	0.6	2.7	2.6	2.7	2.7	2.6	2.2
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	<0.003	<0.003	<0.003	<0.003	<0.003	0.004	0.040	0.048	0.048	0.048	0.055	0.046	0.022	0.023	0.018	0.022	0.022	0.024
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0139	0.0128	0.0127	0.0132	0.0132	0.0132	0.0036	0.0036	0.0036	0.0035	0.0037	0.0036	0.0075	0.0072	0.0073	0.0074	0.0072	0.0073
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	26	26	25	27	26	26	7	7	7	7	7	7	15	15	15	15	14	15
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0007	0.0011	0.0011	0.0011	0.0011	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0009	0.0008	0.0008	0.0008	0.0008	0.0009
	Iron (Fe)	mg/L	0.30	0.326	0.221	<0.030	<0.030	<0.030	<0.030	<0.030	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.030	0.031	0.031	0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	0.000061	0.000053	0.000054	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	0.0012	0.0012	0.0012	0.0013	0.0013	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0010
	Magnesium (Mg)	mg/L	-	-	15.6	15.7	15.5	16.5	16.6	16.4	4.2	4.2	4.1	4.2	4.5	4.2	9.1	8.7	8.9	9.0	8.7	8.6
	Manganese (Mn)	mg/L	0.935[β]	-	0.0036	0.0012	0.0020	0.0015	0.0028	0.0019	0.0011	0.0012	0.0013	0.0012	0.0013	0.0012	0.0026	0.0032	0.0031	0.0032	0.0034	0.0034
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00027	0.00034	0.00033	0.00034	0.00034	0.00036	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00016	0.00016	0.00017	0.00016	0.00016	0.00017
	Nickel (Ni)	mg/L	0.025	0.025	0.00083	0.00068	0.00063	0.00070	0.00069	0.00070	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	1.31	1.32	1.30	1.40	1.40	1.40	0.42	0.43	0.41	0.42	0.42	0.41	0.81	0.82	0.81	0.81	0.82	0.82
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.000050	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	2.25	1.25	1.27	1.30	1.32	1.32	0.56	0.62	0.59	0.58	0.63	0.61	0.83	0.76	0.80	0.79	0.76	0.75
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	***0.000101***	0.000088	***0.000170***	***0.000130***	0.000069	0.000061	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	4.6	4.8	4.8	4.9	4.8	5.0	0.8	0.8	0.7	0.8	0.8	0.7	2.0	1.9	2.0	2.0	2.0	2.0
	Strontium (Sr)	mg/L	-	-	0.018	0.017	0.017	0.017	0.018	0.018	0.005	0.005	0.005	0.005	0.005	0.005	0.010	0.009	0.010	0.010	0.010	0.010
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	0.00080	0.00056	0.00062	0.00113	0.00099	0.00118	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.0018	0.0022	0.0021	0.0020	0.0023	<0.0020	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0025	0.0033	0.0033	0.0035	0.0034	0.0034	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0015	0.0014	0.0013	0.0014	0.0013	0.0014
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

(grey box) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.74: Summary of the Magnitude of Elevation in Seasonal Average Parameter Concentrations (Total Metal Concentrations Provided) Between Mary Lake and Reference Lake 3 in 2017, and at Mary Lake Between 2017 and the Baseline Period

Parameter	Mary Lake North Basin					Mary Lake South Basin				
	2017 vs Reference Lake 3		2017 vs Baseline			2017 vs Reference Lake 3		2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Conductivity (lab)	1.0	2.0	1.1	0.7	0.9	0.8	0.9	1.0	0.9	0.8
Hardness (as $CaCO_3$)	1.0	2.1	1.1	0.6	0.9	0.7	0.9	1.0	0.8	0.8
Total Suspended Solids (TSS)	1.2	1.0	1.0	1.2	1.0	2.1	1.2	1.0	1.3	1.2
Total Dissolved Solids (TDS)	1.3	2.2	0.8	0.7	0.7	1.6	1.0	0.8	1.4	0.7
Turbidity	6.6	1.8	2.3	0.9	1.0	16	4.6	0.4	3.5	1.9
Alkalinity (as $CaCO_3$)	1.0	2.1	1.1	0.6	0.8	1.0	0.9	1.0	1.0	0.8
Total Ammonia	0.6	1.1	0.5	0.2	0.2	0.6	1.0	0.2	0.3	0.3
Nitrate	1.0	1.5	0.7	0.2	0.3	1.0	1.0	0.4	0.2	0.2
Nitrite	1.0	1.0	1.2	1.2	0.8	1.0	1.0	1.6	0.3	1.1
Total Kjeldahl Nitrogen (TKN)	0.8	1.0	1.0	0.5	0.6	0.8	1.0	1.1	0.9	0.9
Dissolved Organic Carbon	0.3	0.6	1.1	0.7	0.9	0.4	0.4	0.9	0.9	0.8
Total Organic Carbon	0.4	0.6	1.2	0.7	1.0	0.5	0.4	0.9	0.9	0.8
Total Phosphorus	0.8	1.8	0.8	0.7	1.0	1.4	1.4	1.2	1.7	0.9
Phenols	1.5	0.4	1.0	1.5	1.1	1.0	0.6	1.0	1.0	1.5
Bromide (Br)	1.0	1.0	0.5	0.5	0.7	1.0	1.0	0.9	0.4	0.4
Chloride (Cl)	1.0	2.9	1.3	0.7	1.0	1.1	1.2	0.7	0.6	0.5
Sulphate (SO_4)	0.2	0.6	0.6	0.3	0.6	0.2	0.3	0.7	0.3	0.4
Aluminum (Al)	15	5.6	0.6	0.6	0.3	33	15	0.5	1.6	1.8
Antimony (Sb)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Arsenic (As)	1.0	1.0	1.1	1.0	0.5	1.0	1.0	1.0	1.0	0.9
Barium (Ba)	0.6	1.1	1.1	0.5	0.8	0.6	0.7	1.0	0.9	0.9
Beryllium (Be)	0.2	1.0	1.5	0.3	1.0	0.2	1.0	1.1	0.3	2.0
Bismuth (Bi)	0.1	1.0	1.0	0.1	1.0	0.1	1.0	1.0	0.1	1.0
Boron (B)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	0.8	0.9	0.7	1.0	1.0	0.2	0.9	0.8
Calcium (Ca)	1.0	2.1	1.1	0.6	0.8	0.8	0.9	1.0	0.8	0.8
Chromium (Cr)	1.0	1.0	1.4	0.9	0.7	1.0	1.0	1.2	1.1	1.1
Cobalt (Co)	1.0	1.0	1.3	0.8	0.7	1.0	1.1	1.0	1.0	0.9
Copper (Cu)	1.2	1.0	0.9	1.1	0.3	1.3	0.7	0.9	1.4	0.7
Iron (Fe)	1.7	1.0	2.3	0.5	0.3	4.2	1.8	1.0	1.7	1.2
Lead (Pb)	1.1	1.0	0.9	0.8	0.7	3.1	1.3	0.9	1.9	1.1
Lithium (Li)	1.0	1.0	0.4	0.3	0.2	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.0	2.0	1.1	0.7	0.9	0.7	0.9	1.1	0.8	0.9
Manganese (Mn)	1.9	5.2	0.4	0.3	0.3	6.0	2.7	0.6	1.8	1.4
Mercury (Hg)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0
Molybdenum (Mo)	0.6	1.3	1.1	0.6	0.7	0.7	0.9	1.2	0.9	0.8
Nickel (Ni)	1.0	1.0	0.9	0.9	0.8	1.1	1.0	1.0	1.1	1.0
Potassium (K)	0.5	0.9	1.1	0.7	1.0	0.5	0.6	1.1	1.0	1.1
Selenium (Se)	0.1	1.0	2.8	0.1	1.8	0.1	1.0	1.2	0.1	1.9
Silicon (Si)	1.4	1.9	1.1	0.9	0.9	1.4	1.3	1.1	1.1	1.2
Silver (Ag)	10	1.0	1.6	19	1.8	RDL	1.0	1.2	RDL	2.3
Sodium (Na)	0.8	2.4	1.1	0.9	1.0	0.9	1.0	1.1	1.0	0.8
Strontium (Sr)	0.6	1.3	1.1	0.7	0.8	0.6	0.7	0.8	0.7	0.7
Thallium (Tl)	0.1	1.0	1.6	0.1	1.0	0.1	1.0	1.1	0.2	2.1
Tin (Sn)	1.0	1.0	1.0	0.0	0.0	1.0	1.0	1.4	0.1	0.1
Titanium (Ti)	0.2	1.0	1.0	0.2	1.0	0.6	1.1	1.0	0.6	1.1
Uranium (U)	1.6	5.5	1.1	0.5	0.6	1.4	1.4	1.1	0.8	0.5
Vanadium (V)	0.5	1.0	1.0	0.5	0.5	0.5	1.0	1.0	0.5	1.0
Zinc (Zn)	1.0	1.0	1.6	1.6	RDL	1.0	1.0	1.7	1.4	1.4

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference ot baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration greater than 10 times higher than respective mean reference or baseline period value).

Note: RDL = Reportable Detection Limit

Table C.75: Dissolved metal concentrations at Mary Lake north basin water quality monitoring stations, Mary River Project CREMP, 2017

	Parameters	Units	Winter Sampling Event						Summer Sampling Event						Fall Sampling Event					
			BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B	BL0-01-A	BL0-01-A	BL0-01	BL0-01	BL0-01-B	BL0-01-B	BLO-01-A	BLO-01-A	BLO-01	BLO-01	BLO-01-B	BLO-01-B
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			12-Apr-2017	12-Apr-2017	12-Apr-2017	12-Apr-2017	12-Apr-2017	12-Apr-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	30-Jul-2017	30-Aug-2017	30-Aug-2017	30-Aug-2017	30-Aug-2017	30-Aug-2017	30-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	0.011	<0.0030	0.0059	0.0064	0.0063	0.0058	0.0059	0.0051	0.0041	0.0051	0.0049	0.0043	0.0047	0.0047
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.0133	0.01250	0.0125	0.0133	0.0130	0.013	0.00358	0.00348	0.00358	0.00345	0.00356	0.00352	0.00713	0.00725	0.00722	0.00708	0.00718	0.00721
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	26.4	26.6	25.3	26.8	27.4	26.7	6.92	6.84	7.00	7.08	7.10	7.30	15.1	14.4	14.9	14.8	14.4	14.2
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.00022	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00059	0.00106	0.00107	0.00112	0.00114	0.0012	0.00063	0.00051	0.00051	0.00053	0.00052	0.00052	0.00079	0.00082	0.00078	0.00080	0.00082	0.00083
	Iron (Fe)	mg/L	0.071	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	0.0012	0.0013	<0.0010	0.00140	0.0015	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0011	0.0011	0.0010	<0.0010
	Magnesium (Mg)	mg/L	15.8	15.9	15.5	16.3	16.3	16.1	4.32	4.19	4.24	4.17	4.35	4.26	9.16	8.83	8.99	8.79	8.72	8.70
	Manganese (Mn)	mg/L	0.003170	0.000288	0.00052	0.00056	0.00154	0.000971	0.000480	0.00046	0.00043	0.00045	0.00039	0.00042	0.00150	0.00202	0.00195	0.00187	0.00204	0.00218
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000048	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000267	0.000307	0.000308	0.000349	0.000253	0.000334	0.000071	0.000073	0.000069	0.000070	0.000070	0.000072	0.000152	0.000173	0.000166	0.000165	0.000168	0.000171
	Nickel (Ni)	mg/L	0.00078	0.00065	0.000610	0.000710	0.00070	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	1.28	1.33	1.30	1.39	1.39	1.4	0.43	0.42	0.43	0.42	0.43	0.42	0.80	0.81	0.81	0.80	0.82	0.82
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	2.23	1.25	1.25	1.25	1.28	1.32	0.49	0.49	0.49	0.48	0.50	0.50	0.78	0.75	0.78	0.76	0.74	0.73
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	4.51	4.75	4.54	4.86	4.85	4.84	0.730	0.732	0.739	0.738	0.748	0.737	1.94	2.01	1.98	2.00	2.05	2.03
	Strontium (Sr)	mg/L	0.0165	0.0177	0.0172	0.0185	0.0179	0.0172	0.00450	0.00448	0.00458	0.00464	0.00462	0.00474	0.0099	0.0096	0.0099	0.0098	0.0097	0.0096
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00113	0.00101	0.00125	0.00136	0.00241	0.00356	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.00250	0.00327	0.00338	0.00348	0.00345	0.0034	0.000355	0.000354	0.000381	0.000388	0.000379	0.000384	0.00151	0.00138	0.00137	0.00141	0.00136	0.00138
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.76: Magnitude of Elevation in Seasonal Average Dissolved Metal Concentrations Between Mary Lake and Reference Lake 3 in 2017, and at Mary Lake Between 2017 and the Baseline Period

Dissolved Metal	Mary Lake North Basin					Mary Lake South Basin				
	2017 vs Reference Lake 3		2017 vs Baseline			2017 vs Reference Lake 3		2017 vs Baseline		
	Summer	Fall	Winter	Summer	Fall	Summer	Fall	Winter	Summer	Fall
Aluminum (Al)	2.0	1.5	0.4	0.5	1.0	3.9	2.6	0.4	1.0	1.6
Antimony (Sb)	1.0	1.0	0.8	0.8	1.0	1.0	1.0	0.8	0.8	1.0
Arsenic (As)	1.0	1.0	0.8	0.9	1.0	1.0	1.0	0.8	0.9	1.0
Barium (Ba)	0.5	1.1	1.4	0.4	1.6	0.5	0.6	0.6	0.4	0.8
Beryllium (Be)	1.0	1.0	1.0	1.4	2.1	1.0	1.0	1.0	1.4	2.1
Bismuth (Bi)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Boron (B)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	1.0	1.0	0.8	0.5	1.0	1.0	1.0	0.8	0.5	1.0
Calcium (Ca)	1.0	2.1	1.5	0.4	1.0	0.8	0.9	0.5	0.3	0.4
Chromium (Cr)	1.0	1.0	1.3	1.7	2.1	1.0	1.0	1.9	1.7	2.1
Cobalt (Co)	1.0	1.0	0.9	0.8	1.0	1.0	1.0	0.8	0.8	1.0
Copper (Cu)	0.6	1.0	0.7	0.4	1.1	0.7	0.6	0.5	0.4	0.7
Iron (Fe)	1.0	1.0	1.1	1.0	1.8	1.0	1.0	0.9	1.0	1.8
Lead (Pb)	1.0	1.0	1.0	0.8	1.0	1.0	1.0	1.0	0.8	1.0
Lithium (Li)	1.0	1.1	0.3	0.3	0.5	1.0	1.0	0.2	0.3	0.4
Magnesium (Mg)	1.0	2.1	1.6	0.4	1.0	0.7	0.9	0.6	0.3	0.4
Manganese (Mn)	1.8	11	0.9	0.3	0.4	4.2	1.9	0.4	0.7	0.1
Mercury (Hg)	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.2	1.0	1.0
Molybdenum (Mo)	0.5	1.5	1.2	0.3	0.9	0.7	0.9	0.7	0.4	0.6
Nickel (Ni)	1.0	1.0	1.1	0.7	0.9	1.0	1.0	1.0	0.7	0.9
Potassium (K)	0.5	1.0	1.6	0.5	1.1	0.5	0.6	0.9	0.5	0.7
Selenium (Se)	1.0	1.0	RDL	RDL	RDL	1.0	1.0	RDL	RDL	RDL
Silicon (Si)	1.2	1.9	1.6	0.5	0.8	1.0	1.0	0.6	0.5	0.5
Silver (Ag)	1.0	1.0	0.2	1.8	2.5	1.0	1.0	0.2	1.8	2.5
Sodium (Na)	0.8	2.3	2.8	0.3	0.9	0.9	0.9	0.9	0.4	0.4
Strontium (Sr)	0.6	1.2	1.6	0.4	1.0	0.5	0.6	0.7	0.4	0.5
Thallium (Tl)	1.0	1.0	1.0	1.4	2.5	1.0	1.0	1.0	1.4	2.5
Tin (Sn)	1.0	1.0	0.5	0.2	0.4	1.0	1.0	0.3	0.2	0.4
Titanium (Ti)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Uranium (U)	1.4	5.5	1.6	0.2	0.9	1.1	1.3	0.4	0.1	0.2
Vanadium (V)	1.0	1.0	0.8	0.9	1.0	1.0	1.0	0.8	0.9	1.0
Zinc (Zn)	1.0	1.0	1.6	1.3	1.2	1.0	1.0	1.7	1.3	1.2

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference ot baseline period value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference or baseline period value).
Denotes highly elevated concentration (mean concentration≥ 10 times higher than respective mean reference or baseline period value).
Note: RDL = Reportable Detection Limit

Table C.77: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Conventional Parameters										Total Metals										
	Conduct-ivity	Hardness	Total Dissolved Solids	Turbidity	Alkalinity	Nitrate	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Silicon	Silver	Sodium	Strontium	Uranium
Conductivity	1	0.989	0.941	-0.836	0.940	0.944	0.933	-0.160	0.950	0.885	-0.900	0.941	0.287	0.431	0.914	0.887	0.943	-0.820	0.917	0.932	0.970
Hardness	0.989	1	0.927	-0.845	0.927	0.946	0.938	-0.148	0.963	0.894	-0.921	0.947	0.279	0.442	0.916	0.889	0.947	-0.821	0.906	0.936	0.956
Total Dissolved Solids	0.941	0.927	1	-0.777	0.948	0.928	0.920	-0.131	0.912	0.875	-0.905	0.916	0.238	0.432	0.904	0.882	0.900	-0.768	0.927	0.914	0.913
Turbidity	-0.836	-0.845	-0.777	1	-0.793	-0.888	-0.775	0.453	-0.869	-0.941	0.837	-0.754	-0.352	-0.354	-0.815	-0.792	-0.743	0.767	-0.834	-0.748	-0.834
Alkalinity	0.940	0.927	0.948	-0.793	1	1	0.910	-0.117	0.914	0.861	-0.892	0.883	0.262	0.463	0.871	0.902	0.921	-0.774	0.879	0.897	0.931
Nitrate	0.944	0.946	0.928	-0.888	1	1	0.899	-0.255	0.967	0.944	-0.943	0.906	0.293	0.376	0.893	0.882	0.910	-0.811	0.925	0.894	0.929
Dissolved Organic Carbon	0.933	0.938	0.920	-0.775	0.910	0.899	1	-0.217	0.896	0.810	-0.921	0.938	0.181	0.570	0.948	0.935	0.944	-0.823	0.930	0.933	0.908
Total Phosphorus	-0.160	-0.148	-0.131	0.453	-0.117	-0.255	-0.217	1	-0.246	-0.368	0.248	-0.157	-0.123	-0.189	-0.311	-0.303	-0.086	0.378	-0.298	-0.149	-0.233
Chloride	0.950	0.963	0.912	-0.869	0.914	0.967	0.896	-0.246	1	0.936	-0.954	0.906	0.307	0.374	0.879	0.880	0.880	-0.813	0.882	0.894	0.929
Sulphate	0.885	0.894	0.875	-0.941	0.861	0.944	0.810	-0.368	0.936	1	-0.899	0.801	0.326	0.310	0.844	0.813	0.789	-0.785	0.855	0.795	0.856
Aluminum (total)	-0.900	-0.921	-0.905	0.837	-0.892	-0.943	-0.921	0.248	-0.954	-0.899	1	-0.895	-0.178	-0.460	-0.866	-0.859	-0.883	0.799	-0.856	-0.875	-0.860
Barium (total)	0.941	0.947	0.916	-0.754	0.883	0.906	0.938	-0.157	0.906	0.801	-0.895	1	0.171	0.525	0.920	0.901	0.959	-0.831	0.922	0.978	0.920
Copper (total)	0.287	0.279	0.238	-0.352	0.262	0.293	0.181	-0.123	0.307	0.326	-0.178	0.171	1	-0.568	0.327	0.314	0.149	0.135	0.329	0.225	0.327
Manganese (total)	0.431	0.442	0.432	-0.354	0.463	0.376	0.570	-0.189	0.374	0.310	-0.460	0.525	-0.568	1	0.462	0.485	0.549	-0.756	0.435	0.531	0.439
Molybdenum (total)	0.914	0.916	0.904	-0.815	0.871	0.893	0.948	-0.311	0.879	0.844	-0.866	0.920	0.327	0.462	1	0.966	0.896	-0.822	0.967	0.934	0.902
Potassium (total)	0.887	0.889	0.882	-0.792	0.902	0.882	0.935	-0.303	0.880	0.813	-0.859	0.901	0.314	0.485	0.966	1	0.886	-0.814	0.945	0.912	0.911
Silicon (total)	0.943	0.947	0.900	-0.743	0.921	0.910	0.944	-0.086	0.880	0.789	-0.883	0.959	0.149	0.549	0.896	0.886	1	-0.823	0.897	0.958	0.914
Silver (total)	-0.820	-0.821	-0.768	0.767	-0.774	-0.811	-0.823	0.378	-0.813	-0.785	0.799	-0.831	0.135	-0.756	-0.822	-0.814	-0.823	1	-0.802	-0.834	-0.805
Sodium (total)	0.917	0.906	0.927	-0.834	0.879	0.925	0.930	-0.298	0.882	0.855	-0.856	0.922	0.329	0.435	0.967	0.945	0.897	-0.802	1	0.926	0.924
Strontium (total)	0.932	0.936	0.914	-0.748	0.897	0.894	0.933	-0.149	0.894	0.795	-0.875	0.978	0.225	0.531	0.934	0.912	0.958	-0.834	0.926	1	0.904
Uranium (total)	0.970	0.956	0.913	-0.834	0.931	0.929	0.908	-0.233	0.929	0.856	-0.860	0.920	0.327	0.439	0.902	0.911	0.914	-0.805	0.924	0.904	1
Aluminum (dissolved)	-0.670	-0.636	-0.738	0.568	-0.666	-0.751	-0.613	0.394	-0.710	-0.680	0.677	-0.697	-0.011	-0.357	-0.599	-0.590	-0.645	0.680	-0.681	-0.684	-0.669
Barium (dissolved)	0.892	0.902	0.919	-0.747	0.919	0.877	0.958	-0.217	0.881	0.816	-0.915	0.913	0.184	0.545	0.928	0.925	0.900	-0.792	0.880	0.914	0.862
Copper (dissolved)	0.807	0.816	0.797	-0.847	0.783	0.811	0.784	-0.484	0.845	0.865	-0.775	0.754	0.406	0.379	0.885	0.881	0.702	-0.776	0.857	0.779	0.854
Manganese (dissolved)	0.314	0.322	0.392	-0.214	0.399	0.252	0.466	-0.139	0.286	0.248	-0.391	0.425	-0.584	0.893	0.383	0.429	0.420	-0.645	0.341	0.436	0.308
Molybdenum (dissolved)	0.869	0.856	0.872	-0.797	0.895	0.896	0.907	-0.446	0.883	0.842	-0.880	0.866	0.292	0.452	0.933	0.956	0.861	-0.824	0.911	0.886	0.875
Potassium (dissolved)	0.892	0.905	0.910	-0.834	0.889	0.891	0.939	-0.322	0.896	0.853	-0.883	0.899	0.346	0.487	0.969	0.959	0.864	-0.796	0.947	0.922	0.898
Sodium (dissolved)	0.912	0.911	0.880	-0.851	0.908	0.889	0.942	-0.341	0.895	0.827	-0.869	0.874	0.330	0.519	0.920	0.937	0.871	-0.793	0.920	0.884	0.942
Strontium (dissolved)	0.982	0.981	0.925	-0.869	0.927	0.962	0.925	-0.205	0.975	0.920	-0.939	0.903	0.292	0.403	0.888	0.866	0.912	-0.810	0.895	0.893	0.950
Uranium (dissolved)	0.971	0.953	0.933	-0.836	0.943	0.929	0.897	-0.234	0.935	0.882	-0.887	0.906	0.321	0.419	0.889	0.885	0.899	-0.791	0.900	0.893	0.985

[a] Correlation matrix included only those parameters with ≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

(green) Indicates strong positive correlation (i.e., Spearman's rho ≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho ≤ -0.7) between parameter pairings.

Table C.77: Spearman's Rank Correlation Coefficients for Mary Lake North Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Dissolved Metals								
	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Sodium	Strontium	Uranium
Conductivity	-0.670	0.892	0.807	0.314	0.869	0.892	0.912	0.982	0.971
Hardness	-0.636	0.902	0.816	0.322	0.856	0.905	0.911	0.981	0.953
Total Dissolved Solids	-0.738	0.919	0.797	0.392	0.872	0.910	0.880	0.925	0.933
Turbidity	0.568	-0.747	-0.847	-0.214	-0.797	-0.834	-0.851	-0.869	-0.836
Alkalinity	-0.666	0.919	0.783	0.399	0.895	0.889	0.908	0.927	0.943
Nitrate	-0.751	0.877	0.811	0.252	0.896	0.891	0.889	0.962	0.929
Dissolved Organic Carbon	-0.613	0.958	0.784	0.466	0.907	0.939	0.942	0.925	0.897
Total Phosphorus	0.394	-0.217	-0.484	-0.139	-0.446	-0.322	-0.341	-0.205	-0.234
Chloride	-0.710	0.881	0.845	0.286	0.883	0.896	0.895	0.975	0.935
Sulphate	-0.680	0.816	0.865	0.248	0.842	0.853	0.827	0.920	0.882
Aluminum (total)	0.677	-0.915	-0.775	-0.391	-0.880	-0.883	-0.869	-0.939	-0.887
Barium (total)	-0.697	0.913	0.754	0.425	0.866	0.899	0.874	0.903	0.906
Copper (total)	-0.011	0.184	0.406	-0.584	0.292	0.346	0.330	0.292	0.321
Manganese (total)	-0.357	0.545	0.379	0.893	0.452	0.487	0.519	0.403	0.419
Molybdenum (total)	-0.599	0.928	0.885	0.383	0.933	0.969	0.920	0.888	0.889
Potassium (total)	-0.590	0.925	0.881	0.429	0.956	0.959	0.937	0.866	0.885
Silicon (total)	-0.645	0.900	0.702	0.420	0.861	0.864	0.871	0.912	0.899
Silver (total)	0.680	-0.792	-0.776	-0.645	-0.824	-0.796	-0.793	-0.810	-0.791
Sodium (total)	-0.681	0.880	0.857	0.341	0.911	0.947	0.920	0.895	0.900
Strontium (total)	-0.684	0.914	0.779	0.436	0.886	0.922	0.884	0.893	0.893
Uranium (total)	-0.669	0.862	0.854	0.308	0.875	0.898	0.942	0.950	0.985
Aluminum (dissolved)	1	-0.628	-0.544	-0.260	-0.718	-0.617	-0.612	-0.670	-0.675
Barium (dissolved)	-0.628	1	0.783	0.483	0.915	0.944	0.905	0.875	0.871
Copper (dissolved)	-0.544	0.783	1	0.352	0.854	0.905	0.869	0.816	0.857
Manganese (dissolved)	-0.260	0.483	0.352	1	0.399	0.398	0.366	0.284	0.329
Molybdenum (dissolved)	-0.718	0.915	0.854	0.399	1	0.922	0.906	0.865	0.873
Potassium (dissolved)	-0.617	0.944	0.905	0.398	0.922	1	0.959	0.882	0.886
Sodium (dissolved)	-0.612	0.905	0.869	0.366	0.906	0.959	1	0.912	0.919
Strontium (dissolved)	-0.670	0.875	0.816	0.284	0.865	0.882	0.912	1	0.958
Uranium (dissolved)	-0.675	0.871	0.857	0.329	0.873	0.886	0.919	0.958	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 18.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.78: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Winter Sampling Event													
					BL0-05-A bottom 15/Apr/17	BL0-05-A surface 15/Apr/17	BL0-05 bottom 15/Apr/17	BL0-05 surface 15/Apr/17	BL0-05-B bottom 15/Apr/17	BL0-05-B surface 15/Apr/17	BL0-03 bottom 14/Apr/17	BL0-03 surface 14/Apr/17	BL0-04 bottom 14/Apr/17	BL0-04 surface 14/Apr/17	BL0-09 bottom 14/Apr/17	BL0-09 surface 14/Apr/17	BL0-06 bottom 15/Apr/17	BL0-06 surface 15/Apr/17
Conventionals	Conductivity (lab)	umho/cm	-	-	89	94	87	93	100	100	82	91	83	100	85	93	96	96
	pH (lab)	pH	6.5 - 9.0	-	7.68	7.64	7.64	7.63	7.60	7.64	7.63	7.64	7.51	7.62	7.30	7.65	7.54	7.62
	Hardness (as $CaCO_3$)	mg/L	-	-	44	47	44	46	50	51	41	45	42	52	43	49	48	49
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	41	43	42	42	62	61	51	54	49	57	68	53	43	57
	Turbidity	NTU	-	-	0.2	0.2	0.3	0.1	0.2	0.2	0.1	0.1	0.3	0.1	0.4	0.1	0.2	0.1
	Alkalinity (as $CaCO_3$)	mg/L	-	-	44	45	45	47	48	49	39	46	43	52	33	42	46	45
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	0.035	0.028	0.036	0.034	0.024	0.029	0.028	0.031	0.042	0.036	0.069	0.033	0.035	0.043
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.3	1.2	<1.0	1.4	1.4	1.3	1.6	1.3	1.6	1.1	1.0	1.3	1.5
	Total Organic Carbon	mg/L	-	-	1.2	1.3	1.2	1.3	1.6	1.6	1.4	1.4	1.3	1.5	1.4	<1.0	1.4	1.5
	Total Phosphorus	mg/L	0.020[α]	-	0.0076	0.0037	0.0042	0.0046	0.0046	0.0055	<0.0030	0.0032	<0.0030	0.0031	0.0050	0.0049	<0.0030	0.0051
	Phenols	mg/L	0.004[α]	-	0.0011	<0.0010	0.0011	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	2.1	1.9	2.0	2.2	2.4	2.4	1.9	2.1	2.0	2.5	2.3	2.3	2.3	2.3
	Sulphate (SO_4)	mg/L	218[β]	218	1.2	1.0	1.1	1.3	1.4	1.4	1.0	1.1	1.1	1.3	1.1	1.3	1.3	1.3
Total Metals	Aluminum (Al)	mg/L	0.100	0.130	0.005	0.006	0.010	0.005		0.005	0.005	0.004	0.009	0.004	0.011	0.004	0.006	0.005
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0053	0.0055	0.0052	0.0054		0.0056	0.0047	0.0052	0.0051	0.0060	0.0055	0.0055	0.0057	0.0056
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	9	10	9	10		10	8	9	8	10	9	10	10	9
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0007	0.0007	0.0008	0.0007		0.0007	0.0006	0.0007	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007
	Iron (Fe)	mg/L	0.30	0.326	<0.030	<0.030	<0.030	<0.030		<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	5.5	5.8	5.4	6.0		5.8	5.3	5.5	5.2	6.2	5.4	5.8	6.0	5.9
	Manganese (Mn)	mg/L	0.935[β]	-	0.0005	0.0004	0.0018	0.0003		0.0006	0.0005	0.0004	0.0005	0.0003	0.0009	0.0004	0.0006	0.0004
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	0.00001	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00014	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00017	0.00019	0.00017	0.00018		0.00017	0.00014	0.00016	0.00015	0.00018	0.00016	0.00019	0.00019	0.00018
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.71	0.77	0.69	0.76		0.76	0.65	0.72	0.67	0.79	0.67	0.76	0.75	0.77
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000		<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.52	0.53	0.58	0.53		0.54	0.50	0.52	0.59	0.54	0.79	0.52	0.54	0.54
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	1.5	1.5	1.4	1.5		1.5	1.3	1.5	1.4	1.7	1.5	1.5	1.6	1.6
	Strontium (Sr)	mg/L	-	-	0.00733	0.00774	0.00702	0.00757		0.00813	0.00655	0.00720	0.00677	0.00791	0.00684	0.0079	0.00822	0.00747
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	0.00054	0.00055	0.00058	0.00082		0.00058	0.00078	0.00124	0.00069	<0.00010	0.00152	0.00159	0.00084	0.00089
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	<0.0100	<0.0100		<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0009	0.0009	0.0008	0.0009		0.0009	0.0007	0.0008	0.0008	0.0010	0.0007	0.0009	0.0009	0.0009
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030		<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

(grey shading) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.78: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2017

	Parameters	Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Summer Sampling Event													
					BL0-05-A bottom 1/Aug/17	BL0-05-A surface 1/Aug/17	BL0-05 bottom 1/Aug/17	BL0-05 surface 1/Aug/17	BL0-05-B bottom 1/Aug/17	BL0-05-B surface 1/Aug/17	BL0-03 bottom 1/Aug/17	BL0-03 surface 1/Aug/17	BL0-04 bottom 1/Aug/17	BL0-04 surface 1/Aug/17	BL0-09 bottom 1/Aug/17	BL0-09 surface 1/Aug/17	BL0-06 bottom 1/Aug/17	BL0-06 surface 1/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	60	59	59	57	57	59	57	58	57	57	57	56	56	56
	pH (lab)	pH	6.5 - 9.0	-	7.44	7.37	7.45	7.42	7.49	7.51	7.50	7.55	7.53	7.43	7.52	7.51	7.41	7.54
	Hardness (as $CaCO_3$)	mg/L	-	-	28	27	27	27	26	27	26	27	26	26	27	26	26	26
	Total Suspended Solids (TSS)	mg/L	-	-	3.6	2.8	4.4	2.4	3.2	2.8	<2.0	<2.0	9.2	6.4	7.2	2.8	5.6	5.2
	Total Dissolved Solids (TDS)	mg/L	-	-	33	40	44	33	30	57	35	37	270	25	50	65	52	70
	Turbidity	NTU	-	-	5.7	5.2	6.6	4.0	4.0	3.6	3.5	1.4	10.1	6.3	11.1	11.5	7.4	6.7
	Alkalinity (as $CaCO_3$)	mg/L	-	-	32	33	29	30	32	32	27	26	28	29	32	32	32	33
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	1.3	1.6	1.2	1.4	1.3	1.2	1.6	1.3	1.2	1.4	1.3	1.2	1.2	1.2
	Total Organic Carbon	mg/L	-	-	1.3	1.4	1.4	1.4	1.6	1.5	1.4	1.4	1.4	1.3	1.4	1.4	1.3	1.3
	Total Phosphorus	mg/L	0.020$^{\alpha}$	-	0.0079	0.0084	0.0092	0.0090	0.0092	0.0069	0.0078	0.0056	0.0132	0.0098	0.0126	0.0078	0.0154	0.0099
	Phenols	mg/L	0.004$^{\alpha}$	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.3	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.3	1.4	1.3	1.4	1.3	1.4
	Sulphate (SO_4)	mg/L	218$^{\beta}$	218	0.7	0.6	0.8	0.6	0.6	0.5	0.7	0.5	0.6	0.6	0.6	0.6	0.6	0.6
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.099	***0.146***	***0.153***	0.085	0.080	0.068	0.074	0.033	***0.189***	0.114	***0.162***	0.080	0.114	0.114
	Antimony (Sb)	mg/L	0.020$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0042	0.0042	0.0045	0.0038	0.0036	0.0037	0.0034	0.0031	0.0052	0.0042	0.0047	0.0038	0.0041	0.0041
	Beryllium (Be)	mg/L	0.011$^{\alpha}$	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	5	5	6	5	5	5	5	5	5	5	5	5	5	5
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009$^{\alpha}$	0.004	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	<0.0010	<0.0010	0.0012	0.0021	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe)	mg/L	0.30	0.326	0.110	0.147	0.171	0.099	0.103	0.083	0.091	<0.050	0.228	0.139	0.195	0.089	0.141	0.136
	Lead (Pb)	mg/L	0.001	0.001	0.000137	0.000156	0.000190	0.000124	0.000119	0.000102	0.000107	<0.000050	0.000274	0.000183	0.000272	0.000108	0.000189	0.000178
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	3.2	3.3	3.3	3.0	3.1	3.0	3.1	3.2	3.1	3.1	3.1	3.1	3.0	3.1
	Manganese (Mn)	mg/L	0.935$^{\beta}$	-	0.0032	0.0037	0.0049	0.0032	0.0031	0.0027	0.0032	0.0019	0.0058	0.0041	0.0059	0.0031	0.0042	0.0042
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00011	0.00011	0.00011	0.00010	0.00009	0.00011	0.00009	0.00008	0.00008	0.00008	0.00008	0.00009	0.00008	0.00008
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	0.00056	0.00062	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00069	0.00058	0.00070	<0.00050	<0.00050	0.00052
	Potassium (K)	mg/L	-	-	0.51	0.52	0.54	0.49	0.48	0.48	0.47	0.44	0.53	0.50	0.53	0.49	0.50	0.50
	Selenium (Se)	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)	mg/L	-	-	0.64	0.71	0.75	0.57	0.53	0.52	0.48	0.43	0.74	0.63	0.66	0.51	0.61	0.58
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)	mg/L	-	-	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8
	Strontium (Sr)	mg/L	-	-	0.00460	0.00460	0.00480	0.00430	0.00430	0.00430	0.00410	0.00395	0.00450	0.00430	0.00440	0.00420	0.00440	0.00420
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	0.0054	0.0074	0.0091	0.0048	0.0048	0.0039	0.0040	0.0014	0.0109	0.0068	0.0090	0.0042	0.0066	0.0065
	Uranium (U)	mg/L	0.015	-	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
	Vanadium (V)	mg/L	0.006$^{\alpha}$	0.006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.78: Water chemistry at Mary Lake south basin (BLO) water quality monitoring stations, Mary River Project CREMP, 2017

Parameters		Units	Water Quality Guideline (WQG)[a]	AEMP Benchmark[b]	Fall Sampling Event													
					BL0-05-A bottom 28/Aug/17	BL0-05-A surface 28/Aug/17	BL0-05 bottom 29/Aug/17	BL0-05 surface 29/Aug/17	BL0-05-B bottom 29/Aug/17	BL0-05-B surface 29/Aug/17	BL0-03 bottom 29/Aug/17	BL0-03 surface 29/Aug/17	BL0-04 bottom 29/Aug/17	BL0-04 surface 29/Aug/17	BL0-09 bottom 29/Aug/17	BL0-09 surface 29/Aug/17	BL0-06 bottom 29/Aug/17	BL0-06 surface 29/Aug/17
Conventionals	Conductivity (lab)	umho/cm	-	-	67	71	76	66	73	66	64	65	69	67	62	66	65	65
	pH (lab)	pH	6.5 - 9.0	-	7.67	7.43	7.81	7.69	7.74	7.73	7.70	7.72	7.71	7.59	7.64	7.69	7.71	7.73
	Hardness (as $CaCO_3$)	mg/L	-	-	30	31	34	30	31	30	29	30	32	30	29	30	29	30
	Total Suspended Solids (TSS)	mg/L	-	-	<2.0	<2.0	7.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Total Dissolved Solids (TDS)	mg/L	-	-	28	39	36	40	34	36	35	37	34	37	37	40	27	28
	Turbidity	NTU	-	-	1.8	2.0	11.4	1.6	1.9	1.4	0.7	0.7	2.0	1.3	2.8	1.4	1.4	1.3
	Alkalinity (as $CaCO_3$)	mg/L	-	-	34	27	32	33	29	26	30	28	31	30	24	25	28	28
Nutrients and Organics	Total Ammonia	mg/L	variable[c]	0.855	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	13	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrite	mg/L	0.06	0.06	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	<0.15	0.15	<0.15	<0.15	0.16	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	Dissolved Organic Carbon	mg/L	-	-	<1.0	1.2	1.1	1.2	1.1	1.2	1.2	1.2	1.1	1.2	1.1	1.2	1.3	1.2
	Total Organic Carbon	mg/L	-	-	1.2	1.2	1.4	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.1	1.2	1.2	1.3
	Total Phosphorus	mg/L	0.020[α]	-	<0.0030	0.0183	0.0116	0.0043	0.0034	0.0033	<0.0030	0.0038	0.0053	0.0047	0.0038	0.0041	0.0041	0.0038
	Phenols	mg/L	0.004[α]	-	0.0014	0.0069	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	0.0014	<0.0010	0.0010	<0.0010	<0.0010
Anions	Bromide (Br)	mg/L	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chloride (Cl)	mg/L	120	120	1.5	1.3	1.8	1.6	1.7	1.6	1.4	1.3	1.7	1.5	1.3	1.6	1.6	1.6
	Sulphate (SO_4)	mg/L	218[β]	218	1.0	0.9	1.8	1.0	1.3	1.1	0.8	0.7	1.3	1.0	0.8	1.1	1.0	1.0
Total Metals	Aluminum (Al)	mg/L	0.100	0.13	0.058	0.044	***0.241***	0.026	0.051	0.056	0.020	0.028	0.066	0.036	0.058	0.054	0.051	0.049
	Antimony (Sb)	mg/L	0.020[α]	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	-	-	0.0042	0.0041	0.0071	0.0039	0.0049	0.0042	0.0036	0.0036	0.0045	0.0044	0.0046	0.0041	0.0041	0.0041
	Beryllium (Be)	mg/L	0.011[α]	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	1.5	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	0.00012	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Calcium (Ca)	mg/L	-	-	6	6	7	6	6	6	6	6	6	6	6	6	6	6
	Chromium (Cr)	mg/L	0.0089	0.0089	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Cobalt (Co)	mg/L	0.0009[α]	0.004	<0.00010	<0.00010	0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	0.0024	0.0006	0.0006	0.0008	0.0007	<0.0005	0.0006	<0.0005	0.0005	0.0006	<0.0005	<0.0005	0.0006	0.0006	0.0006
	Iron (Fe)	mg/L	0.30	0.326	0.048	0.033	0.306	<0.030	<0.030	0.040	<0.030	<0.030	0.058	<0.030	0.032	0.038	0.033	0.035
	Lead (Pb)	mg/L	0.001	0.001	<0.000050	<0.000050	0.000235	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000060	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	-	-	3.8	3.8	4.6	3.9	4.4	3.8	3.6	3.7	4.0	4.2	3.9	3.8	3.7	3.7
	Manganese (Mn)	mg/L	0.935[β]	-	0.0022	0.0013	0.0085	0.0011	0.0006	0.0012	0.0009	0.0009	0.0018	0.0005	0.0007	0.0012	0.0012	0.0012
	Mercury (Hg)	mg/L	0.000026	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	0.073	-	0.00011	0.00011	0.00010	0.00010	0.00014	0.00011	0.00009	0.00009	0.00012	0.00013	0.00013	0.00011	0.00011	0.00011
	Nickel (Ni)	mg/L	0.025	0.025	<0.00050	<0.00050	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	-	-	0.55	0.54	0.73	0.52	0.63	0.53	0.47	0.48	0.56	0.60	0.60	0.54	0.53	0.53
	Selenium (Se)	mg/L	0.001	-	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000	<0.001000
	Silicon (Si)	mg/L	-	-	0.53	0.48	0.78	0.42	0.51	0.52	0.42	0.43	0.56	0.49	0.59	0.52	0.51	0.50
	Silver (Ag)	mg/L	0.00025	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	-	0.9	0.8	1.0	0.8	1.0	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.8
	Strontium (Sr)	mg/L	-	-	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	Thallium (Tl)	mg/L	0.0008	0.0008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)	mg/L	-	-	<0.0100	<0.0100	0.0170	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
	Uranium (U)	mg/L	0.015	-	0.0004	0.0004	0.0006	0.0004	0.0002	0.0004	0.0003	0.0003	0.0005	0.0002	0.0002	0.0004	0.0004	0.0004
	Vanadium (V)	mg/L	0.006[α]	0.006	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

[a] Canadian Water Quality Guideline for the protection of aquatic life (CCME 1987, 1999) except those indicated by α (Ontario Provincial Water Quality Objective [PWQO]; OMOE 1994) and β (British Columbia Water Quality Guideline [BCWQG]; BCMOE 2013). See Table 2.2 for information regarding WQG criteria.

[b] AEMP Water Quality Benchmarks developed by Intinsik (2013) using baseline water quality data specific to Mary Lake.

(shaded) Indicates parameter concentration above applicable Water Quality Guideline.

BOLD Indicates parameter concentration above the AEMP benchmark.

Table C.79: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2017

Parameters		Units	Winter Sampling Event														Summer Sampling Event						
			BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06	BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03
			bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom
			15-Apr-2017	15-Apr-2017	15-Apr-2017	15-Apr-2017	15-Apr-2017	15-Apr-2017	14-Apr-2017	14-Apr-2017	14-Apr-2017	14-Apr-2017	14-Apr-2017	14-Apr-2017	15-Apr-2017	15-Apr-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.00390	0.00430	0.00410	<0.0030	0.00370	0.00540	0.0034	0.0035	0.0038	0.0045	0.0061	0.0039	0.0031	0.0039	0.0134	0.0136	0.0139	0.0099	0.0128	0.0127	0.0071
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00491	0.00551	0.00502	0.00486	0.00574	0.00605	0.00461	0.00502	0.00485	0.00601	0.00530	0.00574	0.00551	0.00546	0.00332	0.00348	0.00347	0.00330	0.00310	0.00327	0.00309
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	8.78	9.53	8.86	9.49	9.83	10.40	8.01	8.99	8.7	10.50	8.48	9.9	9.73	9.92	5.58	5.62	5.52	5.35	5.26	5.31	5.23
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.00181	<0.00050	<0.00050	<0.00050	<0.00050	0.00258	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00068	0.00071	0.00064	0.00066	0.00077	0.00079	0.00056	0.00061	0.00205	0.00071	0.00060	0.00070	0.00071	0.00069	0.00067	0.00052	0.00056	0.0005	0.00052	0.00073	0.00057
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	5.28	5.64	5.41	5.41	6.18	6.00	5.09	5.59	5.07	6.24	5.29	6.03	5.85	5.97	3.36	3.27	3.33	3.34	3.10	3.23	3.19
	Manganese (Mn)	mg/L	0.000306	0.000323	0.001340	0.000262	0.000670	0.000412	0.000315	0.000296	0.00030	0.000456	0.000759	0.00030	0.000528	0.000271	0.000885	0.000838	0.001690	0.000839	0.001920	0.001080	0.000770
	Mercury (Hg)	mg/L	<0.000010	0.00002	0.000012	0.000012	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000167	0.000180	0.000159	0.000189	0.000210	0.000200	0.000139	0.000161	0.000149	0.000226	0.000160	0.000193	0.000187	0.000189	0.000122	0.000117	0.000126	0.000105	0.000090	0.000106	0.000092
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.001450	0.000510	<0.00050	<0.00050	<0.00050	0.00142	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.680	0.760	0.690	0.710	0.800	0.820	0.64	0.73	0.66	0.83	0.68	0.80	0.76	0.76	0.50	0.48	0.49	0.48	0.47	0.47	0.46
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.500	0.530	0.560	0.520	0.530	0.540	0.50	0.53	0.55	0.56	0.83	0.56	0.54	0.52	0.47	0.46	0.46	0.40	0.40	0.41	0.36
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	1.40	1.47	1.44	1.45	1.62	1.62	1.30	1.46	1.36	1.66	1.50	1.64	1.56	1.52	0.796	0.780	0.803	0.822	0.805	0.803	0.803
	Strontium (Sr)	mg/L	0.00694	0.00736	0.00709	0.00753	0.00804	0.00878	0.00651	0.00717	0.00687	0.00881	0.00693	0.0084	0.00777	0.00813	0.00443	0.00442	0.00444	0.00421	0.00416	0.00421	0.00395
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	0.00117	0.00151	0.0011	0.00094	0.00107	0.00086	0.00036	0.0002	0.00050	0.00034	0.00095	0.00046	0.00112	0.00143	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000840	0.000920	0.000805	0.000940	0.000965	0.000979	0.000697	0.000798	0.000743	0.000920	0.000636	0.000923	0.000874	0.000931	0.000296	0.000299	0.000314	0.000306	0.000311	0.000308	0.000304
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0053	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.79: Dissolved Metal Concentrations at Mary Lake South Basin Water Quality Monitoring Stations, Mary River Project CREMP, 2017

	Parameters	Units	Summer Sampling Event							Fall Sampling Event													
			BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06	BL0-05-A	BL0-05-A	BL0-05	BL0-05	BL0-05-B	BL0-05-B	BL0-03	BL0-03	BL0-04	BL0-04	BL0-09	BL0-09	BL0-06	BL0-06
			surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface	bottom	surface
			1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	1-Aug-2017	28-Aug-2017	28-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017	29-Aug-2017
Dissolved Metals	Aluminum (Al)	mg/L	0.0060	0.0164	0.0109	0.0134	0.0094	0.0114	0.0124	0.0080	0.0073	0.0070	0.0078	0.0082	0.0076	0.0060	0.0062	0.0092	0.0077	0.0084	0.0082	0.0080	0.0086
	Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Barium (Ba)	mg/L	0.00304	0.00325	0.00314	0.00330	0.00321	0.00321	0.00333	0.00387	0.00386	0.00423	0.00372	0.00374	0.00375	0.00343	0.00350	0.00403	0.00366	0.00366	0.00370	0.00362	0.00375
	Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	5.51	5.26	5.21	5.29	5.26	5.19	5.12	5.93	6.15	6.84	5.84	6.19	6.13	5.90	6.00	6.3	6.02	5.70	6.07	6.03	6.02
	Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.00055	0.00065	0.00065	0.00054	<0.00050	0.00054	<0.00050	<0.00050	0.00059	0.00056	<0.00050	0.00052	<0.00050	<0.00050	<0.00050	0.00062	0.0005	0.00053	0.0005	<0.00050	0.0005
	Iron (Fe)	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)	mg/L	3.24	3.18	3.14	3.23	3.07	3.14	3.12	3.77	3.80	4.17	3.71	3.76	3.61	3.50	3.64	3.86	3.71	3.54	3.67	3.42	3.67
	Manganese (Mn)	mg/L	0.000657	0.000903	0.00076	0.000977	0.000791	0.000920	0.000961	0.00086	0.00039	0.00100	0.00022	0.00028	0.00025	0.00013	0.00020	0.00028	0.00023	0.00017	0.00024	0.00022	0.00026
	Mercury (Hg)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.000079	0.000110	0.000099	0.000106	0.000100	0.000105	0.000103	0.000121	0.000112	0.000116	0.000123	0.000121	0.000094	0.000077	0.000076	0.000104	0.000098	0.000091	0.000101	0.000097	0.000102
	Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Potassium (K)	mg/L	0.44	0.48	0.48	0.49	0.48	0.48	0.47	0.55	0.52	0.57	0.53	0.50	0.49	0.46	0.46	0.54	0.50	0.51	0.51	0.49	0.51
	Selenium (Se)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)	mg/L	0.37	0.41	0.40	0.42	0.39	0.41	0.41	0.42	0.40	0.45	0.41	0.41	0.40	0.38	0.38	0.44	0.39	0.43	0.40	0.40	0.40
	Silver (Ag)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	0.753	0.794	0.807	0.806	0.809	0.810	0.799	0.87	0.84	0.92	0.846	0.83	0.81	0.754	0.759	0.88	0.81	0.807	0.833	0.80	0.82
	Strontium (Sr)	mg/L	0.00392	0.00422	0.00409	0.00416	0.00411	0.00404	0.00407	0.00472	0.00488	0.00588	0.00474	0.00501	0.00499	0.00449	0.00449	0.0052	0.00481	0.00464	0.00490	0.00490	0.00487
	Thallium (Tl)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)	mg/L	0.000292	0.000295	0.000301	0.000291	0.000304	0.000303	0.000301	0.000227	0.000356	0.000465	0.000207	0.000400	0.000373	0.000298	0.000309	0.000414	0.000336	0.000303	0.000352	0.000340	0.000356
	Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Table C.80: **Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2017[a]**

Parameters	Conventional Parameters										Total Metals											
	Conduct-ivity	Hardness	Total Suspended Solids	Total Dissolved Solids	Turbidity	Alkalinity	Dissolved Organic Carbon	Total Phosphorus	Chloride	Sulphate	Aluminum	Barium	Copper	Iron	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	1	0.986	-0.643	0.246	-0.839	0.642	0.053	-0.550	0.836	0.886	-0.822	0.741	-0.539	-0.777	-0.797	0.889	0.893	-0.075	0.908	0.954	0.723	0.735
Hardness	0.986	1	-0.620	0.276	-0.843	0.646	0.027	-0.543	0.840	0.877	-0.832	0.739	-0.540	-0.782	-0.804	0.870	0.890	-0.071	0.913	0.952	0.729	0.745
Total Suspended Solids	-0.643	-0.620	1	0.119	0.757	-0.120	0.000	0.749	-0.465	-0.545	0.758	-0.087	0.748	0.812	0.755	-0.552	-0.381	0.575	-0.571	-0.514	-0.348	-0.185
Total Dissolved Solids	0.246	0.276	0.119	1	-0.216	0.526	0.086	0.094	0.347	0.127	-0.259	0.447	0.163	-0.172	-0.191	0.263	0.350	0.252	0.341	0.256	0.482	0.452
Turbidity	-0.839	-0.843	0.757	-0.216	1	-1	-0.175	0.694	-0.746	-0.642	0.968	-0.434	0.559	0.897	0.921	-0.766	-0.640	0.357	-0.759	-0.765	-0.729	-0.567
Alkalinity	0.642	0.646	-0.120	0.526	-1	1	0.271	-0.229	0.712	0.495	-0.548	0.640	-0.129	-0.443	-0.457	0.623	0.626	0.231	0.636	0.627	0.702	0.695
Dissolved Organic Carbon	0.053	0.027	0.000	0.086	-0.175	0.271	1	0.046	0.076	-0.083	-0.096	-0.024	0.327	0.022	-0.038	0.002	-0.056	0.030	-0.080	-0.031	0.098	0.138
Total Phosphorus	-0.550	-0.543	0.749	0.094	0.694	-0.229	0.046	1	-0.478	-0.467	0.661	-0.180	0.671	0.733	0.723	-0.527	-0.379	0.398	-0.518	-0.524	-0.352	-0.189
Chloride	0.836	0.840	-0.465	0.347	-0.746	0.712	0.076	-0.478	1	0.840	-0.737	0.700	-0.406	-0.666	-0.685	0.727	0.785	-0.027	0.856	0.844	0.732	0.761
Sulphate	0.886	0.877	-0.545	0.127	-0.642	0.495	-0.083	-0.467	0.840	1	-0.621	0.718	-0.571	-0.625	-0.630	0.738	0.835	-0.004	0.856	0.887	0.538	0.631
Aluminum (total)	-0.822	-0.832	0.758	-0.259	0.968	-0.548	-0.096	0.661	-0.737	-0.621	1	-0.401	0.566	0.937	0.933	-0.751	-0.618	0.427	-0.765	-0.731	-0.741	-0.539
Barium (total)	0.741	0.739	-0.087	0.447	-0.434	0.640	-0.024	-0.180	0.700	0.718	-0.401	1	-0.154	-0.343	-0.425	0.712	0.912	0.502	0.767	0.818	0.651	0.782
Copper (total)	-0.539	-0.540	0.748	0.163	0.559	-0.129	0.327	0.671	-0.406	-0.571	0.566	-0.154	1	0.713	0.625	-0.367	-0.314	0.496	-0.507	-0.489	-0.275	-0.174
Iron (total)	-0.777	-0.782	0.812	-0.172	0.897	-0.443	0.022	0.733	-0.666	-0.625	0.937	-0.343	0.713	1	0.930	-0.714	-0.565	0.461	-0.739	-0.674	-0.641	-0.364
Manganese (total)	-0.797	-0.804	0.755	-0.191	0.921	-0.457	-0.038	0.723	-0.685	-0.630	0.933	-0.425	0.625	0.930	1	-0.784	-0.658	0.399	-0.785	-0.725	-0.644	-0.445
Molybdenum (total)	0.889	0.870	-0.552	0.263	-0.766	0.623	0.002	-0.527	0.727	0.738	-0.751	0.712	-0.367	-0.714	-0.784	1	0.865	0.023	0.869	0.880	0.737	0.645
Potassium (total)	0.893	0.890	-0.381	0.350	-0.640	0.626	-0.056	-0.379	0.785	0.835	-0.618	0.912	-0.314	-0.565	-0.658	0.865	1	0.223	0.917	0.934	0.695	0.797
Silicon (total)	-0.075	-0.071	0.575	0.252	0.357	0.231	0.030	0.398	-0.027	-0.004	0.427	0.502	0.496	0.461	0.399	0.023	0.223	1	-0.016	0.084	0.098	0.282
Sodium (total)	0.908	0.913	-0.571	0.341	-0.759	0.636	-0.080	-0.518	0.856	0.856	-0.765	0.767	-0.507	-0.739	-0.785	0.869	0.917	-0.016	1	0.907	0.731	0.714
Strontium (total)	0.954	0.952	-0.514	0.256	-0.765	0.627	-0.031	-0.524	0.844	0.887	-0.731	0.818	-0.489	-0.674	-0.725	0.880	0.934	0.084	0.907	1	0.730	0.821
Tin (total)	0.723	0.729	-0.348	0.482	-0.729	0.702	0.098	-0.352	0.732	0.538	-0.741	0.651	-0.275	-0.641	-0.644	0.737	0.695	0.098	0.731	0.730	1	0.719
Uranium (total)	0.735	0.745	-0.185	0.452	-0.567	0.695	0.138	-0.189	0.761	0.631	-0.539	0.782	-0.174	-0.364	-0.445	0.645	0.797	0.282	0.714	0.821	0.719	1
Aluminum (dissolved)	-0.818	-0.814	0.693	-0.226	0.872	-0.545	-0.115	0.594	-0.742	-0.672	0.888	-0.461	0.532	0.816	0.794	-0.655	-0.629	0.336	-0.760	-0.711	-0.759	-0.586
Barium (dissolved)	0.961	0.970	-0.553	0.334	-0.780	0.676	-0.007	-0.518	0.844	0.876	-0.755	0.791	-0.515	-0.712	-0.734	0.874	0.924	0.050	0.928	0.969	0.729	0.788
Copper (dissolved)	0.570	0.550	-0.059	0.444	-0.423	0.561	0.285	0.000	0.482	0.397	-0.394	0.627	0.060	-0.246	-0.345	0.588	0.562	0.333	0.459	0.531	0.592	0.630
Manganese (dissolved)	-0.362	-0.374	0.705	0.213	0.530	0.168	0.137	0.610	-0.233	-0.383	0.539	0.031	0.768	0.642	0.666	-0.257	-0.207	0.573	-0.329	-0.321	-0.124	0.011
Molybdenum (dissolved)	0.768	0.758	-0.158	0.540	-0.551	0.837	0.166	-0.176	0.704	0.628	-0.543	0.802	-0.152	-0.431	-0.478	0.773	0.804	0.308	0.692	0.782	0.725	0.814
Potassium (dissolved)	0.909	0.915	-0.430	0.350	-0.690	0.710	0.040	-0.398	0.818	0.821	-0.680	0.841	-0.328	-0.603	-0.667	0.866	0.950	0.168	0.891	0.939	0.727	0.831
Silicon (dissolved)	0.709	0.716	-0.113	0.518	-0.505	0.797	0.088	-0.224	0.647	0.593	-0.461	0.854	-0.132	-0.376	-0.422	0.754	0.800	0.528	0.691	0.772	0.744	0.772
Sodium (dissolved)	0.851	0.866	-0.414	0.368	-0.669	0.715	0.042	-0.348	0.871	0.788	-0.681	0.757	-0.328	-0.603	-0.645	0.807	0.868	0.099	0.889	0.859	0.734	0.803
Strontium (dissolved)	0.968	0.973	-0.560	0.290	-0.810	0.633	0.018	-0.534	0.867	0.900	-0.779	0.785	-0.521	-0.736	-0.780	0.886	0.921	0.006	0.921	0.983	0.726	0.780
Tin (dissolved)	0.803	0.801	-0.415	0.494	-0.775	0.784	0.246	-0.358	0.794	0.610	-0.768	0.721	-0.237	-0.676	-0.689	0.801	0.770	0.122	0.794	0.794	0.914	0.793
Uranium (dissolved)	0.844	0.854	-0.454	0.332	-0.734	0.576	0.113	-0.340	0.833	0.801	-0.704	0.690	-0.296	-0.621	-0.698	0.820	0.822	0.009	0.868	0.853	0.737	0.732

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

Table C.80: Spearman's Rank Correlation Coefficients for Mary Lake South Basin (BLO) Water Quality Data Collected in Winter, Summer and Fall 2017[a]

Parameters	Dissolved Metals										
	Aluminum	Barium	Copper	Manganese	Molybdenum	Potassium	Silicon	Sodium	Strontium	Tin	Uranium
Conductivity	-0.818	0.961	0.570	-0.362	0.768	0.909	0.709	0.851	0.968	0.803	0.844
Hardness	-0.814	0.970	0.550	-0.374	0.758	0.915	0.716	0.866	0.973	0.801	0.854
Total Suspended Solids	0.693	-0.553	-0.059	0.705	-0.158	-0.430	-0.113	-0.414	-0.560	-0.415	-0.454
Total Dissolved Solids	-0.226	0.334	0.444	0.213	0.540	0.350	0.518	0.368	0.290	0.494	0.332
Turbidity	0.872	-0.780	-0.423	0.530	-0.551	-0.690	-0.505	-0.669	-0.810	-0.775	-0.734
Alkalinity	-0.545	0.676	0.561	0.168	0.837	0.710	0.797	0.715	0.633	0.784	0.576
Dissolved Organic Carbon	-0.115	-0.007	0.285	0.137	0.166	0.040	0.088	0.042	0.018	0.246	0.113
Total Phosphorus	0.594	-0.518	0.000	0.610	-0.176	-0.398	-0.224	-0.348	-0.534	-0.358	-0.340
Chloride	-0.742	0.844	0.482	-0.233	0.704	0.818	0.647	0.871	0.867	0.794	0.833
Sulphate	-0.672	0.876	0.397	-0.383	0.628	0.821	0.593	0.788	0.900	0.610	0.801
Aluminum (total)	0.888	-0.755	-0.394	0.539	-0.543	-0.680	-0.461	-0.681	-0.779	-0.768	-0.704
Barium (total)	-0.461	0.791	0.627	0.031	0.802	0.841	0.854	0.757	0.785	0.721	0.690
Copper (total)	0.532	-0.515	0.060	0.768	-0.152	-0.328	-0.132	-0.328	-0.521	-0.237	-0.296
Iron (total)	0.816	-0.712	-0.246	0.642	-0.431	-0.603	-0.376	-0.603	-0.736	-0.676	-0.621
Manganese (total)	0.794	-0.734	-0.345	0.666	-0.478	-0.667	-0.422	-0.645	-0.780	-0.689	-0.698
Molybdenum (total)	-0.655	0.874	0.588	-0.257	0.773	0.866	0.754	0.807	0.886	0.801	0.820
Potassium (total)	-0.629	0.924	0.562	-0.207	0.804	0.950	0.800	0.868	0.921	0.770	0.822
Silicon (total)	0.336	0.050	0.333	0.573	0.308	0.168	0.528	0.099	0.006	0.122	0.009
Sodium (total)	-0.760	0.928	0.459	-0.329	0.692	0.891	0.691	0.889	0.921	0.794	0.868
Strontium (total)	-0.711	0.969	0.531	-0.321	0.782	0.939	0.772	0.859	0.983	0.794	0.853
Tin (total)	-0.759	0.729	0.592	-0.124	0.725	0.727	0.744	0.734	0.726	0.914	0.737
Uranium (total)	-0.586	0.788	0.630	0.011	0.814	0.831	0.772	0.803	0.780	0.793	0.732
Aluminum (dissolved)	1	-0.738	-0.425	0.421	-0.516	-0.665	-0.466	-0.690	-0.752	-0.781	-0.727
Barium (dissolved)	-0.738	1	0.513	-0.308	0.791	0.943	0.779	0.885	0.971	0.798	0.837
Copper (dissolved)	-0.425	0.513	1	0.188	0.700	0.605	0.700	0.569	0.540	0.692	0.610
Manganese (dissolved)	0.421	-0.308	0.188	1	0.119	-0.194	0.149	-0.131	-0.371	-0.084	-0.214
Molybdenum (dissolved)	-0.516	0.791	0.700	0.119	1	0.860	0.891	0.811	0.764	0.795	0.671
Potassium (dissolved)	-0.665	0.943	0.605	-0.194	0.860	1	0.832	0.938	0.925	0.796	0.789
Silicon (dissolved)	-0.466	0.779	0.700	0.149	0.891	1	1	0.747	0.743	0.788	0.640
Sodium (dissolved)	-0.690	0.885	0.569	-0.131	0.811	0.938	0.747	1	0.861	0.792	0.816
Strontium (dissolved)	-0.752	0.971	0.540	-0.371	0.764	0.925	0.743	0.861	1	0.794	0.884
Tin (dissolved)	-0.781	0.798	0.692	-0.084	0.795	0.796	0.788	0.792	0.794	1	0.805
Uranium (dissolved)	-0.727	0.837	0.610	-0.214	0.671	0.789	0.640	0.816	0.884	0.805	1

[a] Correlation matrix included only those parameters with≥75% of values above laboratory reportable detection limits (RDL). Sample size (n) totalled 42.

(green) Indicates strong positive correlation (i.e., Spearman's rho≥ 0.7) between parameter pairings.

(blue) Indicates strong negative correlation (i.e., Spearman's rho≤ -0.7) between parameter pairings.

APPENDIX D

SEDIMENT QUALITY DATA

Table D.1: Deposited Sediment Field Observations and Collection Details at Unnamed Reference Creek Benthic Stations[a], Mary River Project CREMP, August 2017

Station	Visually Assessed Texture Observations	Location of Sampling	Presence of Silt Precipitate
REF-CRK-1	medium (sized) sand	in-stream channel	none observed
REF-CRK-2	medium (sized) sand	in-stream channel	none observed
REF-CRK-3	medium (sized) sand	in-stream channel	none observed
REF-CRK-4	medium (sized) sand	in-stream channel	none observed
REF-CRK-5	medium (sized) sand	in-stream channel	none observed

[a] Deposited sediment samples were collected using a stainless steel spoon.

Table D.2: Deposited Sediment Total Organic Carbon and Metal Concentrations at Unnamed Reference Creek (REF-CRK) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Unnamed Reference Creek Station					Study Area Summary Statistics		
			REF-CRK-B1	REF-CRK-B2	REF-CRK-B3	REF-CRK-B4	REF-CRK-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	medium sand	medium sand	medium sand	medium sand	medium sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Aluminum (Al)	mg/kg	-	602	310	302	481	395	418	126	56
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.00	0.00
Arsenic (As)	mg/kg	17	0.13	<0.10	<0.10	0.14	0.12	0.12	0.02	0.01
Barium (Ba)	mg/kg	-	2	1	1	2	2	2	0.3	0.2
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	0
Calcium (Ca)	mg/kg	-	224	216	147	212	269	214	44	20
Chromium (Cr)	mg/kg	90	1.5	1.0	1.1	1.5	1.9	1.4	0.4	0.2
Cobalt (Co)	mg/kg	-	0.41	0.2	0.22	0.3	0.4	0.3	0.09	0.04
Copper (Cu)	mg/kg	197	0.7	<0.50	<0.50	2	0.6	0.8	0.5	0.2
Iron (Fe)	mg/kg	40,000[α]	1,310	978	897	976	2,040	1,240	475	212
Lead (Pb)	mg/kg	91.3	0.9	0.6	0.6	0.7	0.9	0.7	0.16	0.07
Lithium (Li)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Magnesium (Mg)	mg/kg	-	490	232	219	409	313	333	116	52
Manganese (Mn)	mg/kg	1,100[α,β]	13	7	7	11	10	10	2.4	1.1
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Nickel (Ni)	mg/kg	75[α,β]	1.0	0.6	0.5	1.0	0.9	0.8	0.21	0.10
Phosphorus (P)	mg/kg	2,000[α]	54	53	<50	60	89	61	16.0	7.1
Potassium (K)	mg/kg	-	130	<100	<100	<100	<100	106	13	6
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	1.3	1.0	1.0	1.3	1.4	1.2	0.16	0.07
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	54	16	31	30	49	36	16	7
Uranium (U)	mg/kg	-	0.30	0.1	0.1	0.2	0.3	0.2	0.08	0.04
Vanadium (V)	mg/kg	-	1.9	1.4	1.6	1.4	3.0	1.9	0.7	0.3
Zinc (Zn)	mg/kg	315	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Zirconium (Zr)	mg/kg	-	1.2	<1.0	<1.0	1.1	<1.0	1.1	0.1	0.0

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.3: Field Observations of Sediment Properties at Reference Lake 3 (REF-03) Benthic Stations [a], Mary River Project CREMP, August 2017

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
REF-03-1	8.5	gray-brown silt with some fine sand; no precipitate layer observed	none detected	sparse moss growth
REF-03-2	9.4	thin orange-brown precipitate layer over brown-gray silt	none detected	sparse moss growth
REF-03-3	10.3	thin orange-brown precipitate layer over medium red-brown sandy-silt	none detected	none observed
REF-03-4	9.3	medium brown coloured silt over gray-brown silt; no precipitate layer	none detected	none observed
REF-03-5	11.2	thin iron oxide precipitate layer over gray-brown silt	none detected	sparse moss growth
REF-03-6	19.5	medium orange-brown coloured silt; no precipitate layer observed	none detected	none observed
REF-03-7	24.2	medium orange-brown coloured silt; no precipitate layer observed	none detected	none observed
REF-03-8	18.5	orange-brown coloured silt with some fine sand, no precipitate layer observed	none detected	none observed
REF-03-9	20.1	thin orange-brown precipitate layer over medium brown silt	none detected	none observed
REF-03-10	20.5	red-brown silt; no precipitate layer observed	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.4: Observations from Sediment Cores Collected at Reference Lake 3 (REF-03), Mary River Project CREMP, August 2017

Sample Station	Station Depth (m)	Station Type	Core #	Core Length (cm)	Surficial Substrate (top 2 cm) Texture Description
REF-03-1	8.0	Littoral	1	22.0	Loam
			2	24.0	
			3	20.0	
REF-03-6	20.0	Profundal	1	17.0	Loam
			2	10.0	
			3	12.0	
REF-03-2	9.4	Littoral	1	-	Sandy loam
			2	-	
			3	-	
REF-03-7	24.0	Profundal	1	7.0	Silt loam
			2	6.0	
			3	6.0	
REF-03-3	10.2	Littoral	1	11.0	Silt loam
			2	15.0	
			3	17.0	
REF-03-8	18.5	Profundal	1	-	Silt loam / Loam
			2	-	
			3	-	
REF-03-4	9.3	Littoral	1	-	Sandy loam
			2	-	
			3	-	
REF-03-9	20.1	Profundal	1	-	Silt loam
			2	-	
			3	-	
REF-03-5	11.1	Littoral	1	21.0	Loam
			2	19.0	
			3	14.0	
REF-03-10	19.5	Profundal	1	18.0	Sandy loam
			2	21.0	
			3	17.0	
Ref-03-DUP (duplicate of REF-03-10)	19.5	Profundal	1	17.0	Sandy loam
			2	21.0	
			3	6.0	

Table D.5: Statistical Comparison of Substrate Physical Properties between Littoral and Profundal Sediment Stations of Individual Study Lakes, Mary River Project CREMP, August 2015

Lake	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Station Type	N	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Camp Lake	Sand (% by weight)	NO	0.528	β	Littoral	5	58.3	18.1	8.1	41.8	85.4
					Profundal	9	52.9	22.0	7.3	33.8	92.0
	Silt (% by weight)	NO	0.876	α	Littoral	5	39.1	16.5	7.4	14.1	54.4
					Profundal	9	40.7	18.8	6.3	7.1	60.0
	Clay (% by weight)	YES	0.077	α	Littoral	5	2.6	1.6	0.7	0.5	4.6
					Profundal	9	6.4	4.1	1.4	0.4	13.0
	TOC (%)	-	-	-	Littoral	1	3.4	.	.	3.4	3.4
					Profundal	9	1.3	0.6	0.2	0.2	2.1
Sheardown Lake NW	Sand (% by weight)	NO	0.165	γ	Littoral	7	44.2	15.4	5.8	32.2	76.9
					Profundal	7	36.7	27.5	10.4	16.7	96.2
	Silt (% by weight)	NO	0.318	γ	Littoral	7	46.2	12.7	4.8	20.5	57.1
					Profundal	7	48.0	20.2	7.6	3.7	62.4
	Clay (% by weight)	NO	0.137	α	Littoral	7	9.6	3.6	1.4	2.6	13.2
					Profundal	7	15.3	8.7	3.3	0.1	26.4
	TOC (%)	NO	0.343	β	Littoral	4	2.5	2.0	1.0	0.2	5.1
					Profundal	4	1.5	0.2	0.1	1.4	1.8
Sheardown Lake SE	Sand (% by weight)	NO	0.221	α	Littoral	5	13.6	4.0	1.8	8.8	19.3
					Profundal	5	17.6	5.5	2.4	12.0	24.6
	Silt (% by weight)	NO	0.512	δ	Littoral	5	68.2	2.6	1.2	64.5	70.3
					Profundal	5	66.3	5.5	2.5	59.7	72.7
	Clay (% by weight)	NO	0.458	δ	Littoral	5	18.2	5.8	2.6	10.8	25.0
					Profundal	5	16.1	0.6	0.3	15.3	16.6
	TOC (%)	-	-	-	Littoral	3	1.2	0.4	0.2	0.9	1.7
					Profundal	2	0.9	0.0	0.0	0.9	0.9
Mary Lake	Sand (% by weight)	NO	0.897	β	Littoral	4	31.6	39.5	19.8	7.0	90.4
					Profundal	11	26.8	24.4	7.4	7.5	90.9
	Silt (% by weight)	NO	0.939	δ	Littoral	4	46.1	26.4	13.2	8.5	69.8
					Profundal	11	47.0	16.6	5.0	6.6	64.8
	Clay (% by weight)	NO	0.657	δ	Littoral	4	22.3	18.8	9.4	1.1	38.9
					Profundal	11	26.3	13.5	4.1	2.6	43.3
	TOC (%)	-	-	-	Littoral	2	1.1	0.2	0.2	0.9	1.3
					Profundal	8	0.8	0.2	0.1	0.6	1.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - single factor ANOVA test results confirmed using Mann-Whitney U-test; and, δ - single-factor ANOVA test results confirmed using t-test assuming unequal variance.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table D.6: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Reference Lake 3 (REF-03) Sediment Stations, Mary River Project CREMP, August 2017

Parameter		Units	Sediment Quality Guideline (SQG)[a]	Reference Lake 3 Station										Study Area Summary Statistics		
				REF-03-1 (littoral)	REF-03-6 (profundal)	REF-03-2 (littoral)	REF-03-7 (profundal)	REF-03-3 (littoral)	REF-03-8 (profundal)	REF-03-4 (littoral)	REF-03-9 (profundal)	REF-03-5 (littoral)	REF-03-10 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	46.5	45.3	58.0	15.6	25.6	39.2	59.9	22.4	42.0	56.0	41.0	15.5	4.89
	Silt	%	-	43.7	42.5	32.8	62.4	62.2	49.6	35.4	61.4	47.4	35.3	47.3	11.48	3.63
	Clay	%	-	9.80	12.2	9.2	22.0	12.20	11.2	4.70	16.2	10.60	8.8	11.7	4.66	1.47
	Moisture	%	-	89.1	86.1	91.3	54.4	68.0	76.6	70.7	77.5	88.2	85.3	79	11.69	3.70
	Total Organic Carbon	%	10^{α}	6.06	4.43	7.23	1.81	3.59	3.03	2.74	4.13	4.71	4.39	4.21	1.58	0.501
Metals	Aluminum (Al)	mg/kg	-	14,400	26,000	14,200	16,400	16,500	21,000	12,400	24,300	16,100	22,450	18,375	4,694	1,484
	Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	2.34	5.50	3.01	4.41	3.65	4.41	2.08	4.87	5.67	4.69	4.06	1.25	0.396
	Barium (Ba)	mg/kg	-	120	158	133	115	105.0	133	77.4	142	129.0	140	125	22.4	7.09
	Beryllium (Be)	mg/kg	-	0.54	1.00	0.58	0.66	0.65	0.80	0.50	0.91	0.58	0.87	0.71	0.17	0.055
	Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.0000	0.0000
	Boron (B)	mg/kg	-	10.8	18.8	13.8	11.0	13.3	16.0	9.7	18.7	13.1	17.8	14.3	3.36	1.06
	Cadmium (Cd)	mg/kg	3.5	0.152	0.181	0.298	0.269	0.180	0.131	0.105	0.158	0.173	0.161	0.18	0.059	0.019
	Calcium (Ca)	mg/kg	-	5,570	6,050	5,260	3,970	4,430	4,880	3,490	5,770	4,530	5,555	4,951	835	264.0
	Chromium (Cr)	mg/kg	90	56.5	84.3	48.0	48.5	53.9	65.4	38.2	79.1	59.1	72.2	60.5	14.6	4.63
	Cobalt (Co)	mg/kg	-	9.03	19.0	10.00	12.2	12.1	15.1	9.1	17.3	12.9	16.2	13.3	3.49	1.10
	Copper (Cu)	mg/kg	197	59.6	107.0	84.2	57	61.9	87	52.8	97.2	64.8	89.5	76.1	19.1	6.04
	Iron (Fe)	mg/kg	$40,000^{\alpha}$	23,900	55,400	45,800	34,600	35,200	45,700	31,100	50,400	73,800	47,100	44,300	14,181	4,485
	Lead (Pb)	mg/kg	91.3	12.5	19.7	11.9	13.6	13.4	15.8	10.6	18.0	13.7	17.3	14.6	2.92	0.92
	Lithium (Li)	mg/kg	-	23.3	39.8	23.7	27.7	26.5	33.5	21.2	37.8	25.2	35.4	29.4	6.64	2.10
	Magnesium (Mg)	mg/kg	-	11,600	17,500	9,450	11,000	11,000	13,500	7,830	16,200	11,400	14,900	12,438	3,038	961
	Manganese (Mn)	mg/kg	$1,100^{\alpha,\beta}$	306	1,340	718	1,500	1,010	1,220	609	1,140	554	1,130	953	386.0	122.1
	Mercury (Hg)	mg/kg	0.486	0.0613	0.0661	0.0528	0.0238	0.0325	0.0407	0.0182	0.0701	0.0554	0.0599	0.0481	0.0182	0.00575
	Molybdenum (Mo)	mg/kg	-	1.04	3.08	4.08	3.52	2.84	2.92	2.68	2.53	6.85	2.41	3.19	1.51	0.477
	Nickel (Ni)	mg/kg	$75^{\alpha,\beta}$	41.3	57.9	38.3	41.0	40.9	44.2	28.8	53.1	41.6	49.3	43.6	8.15	2.58
	Phosphorus (P)	mg/kg	$2,000^{\alpha}$	726	1,200	830	897	859	1,010	760	1,160	2,020	1,060	1,052	376.3	119.0
	Potassium (K)	mg/kg	-	3,380	6,580	3,750	4,470	4,360	5,360	3,210	6,200	4,070	5,750	4,713	1,190	376.4
	Selenium (Se)	mg/kg	-	0.58	0.79	0.92	<0.20	0.44	0.41	0.26	0.79	0.86	0.71	0.60	0.26	0.081
	Silver (Ag)	mg/kg	-	0.13	0.24	0.15	0.12	<0.10	0.16	<0.10	0.25	0.15	0.22	0.16	0.056	0.018
	Sodium (Na)	mg/kg	-	262	473	301	290	300	366	218	472	340	431	345	88	28.0
	Strontium (Sr)	mg/kg	-	9.9	14.3	10.9	9.9	10.2	12.0	8.3	13.8	10.6	13.1	11.3	1.94	0.61
	Sulphur (S)	mg/kg	-	1100	1400	1500	<1000	<1000	<1000	<1000	1200	1000	1050	1,125.0	184.5	58.3
	Thallium (Tl)	mg/kg	-	0.334	0.762	0.333	0.561	0.422	0.579	0.226	0.695	0.415	0.676	0.500	0.180	0.0569
	Tin (Sn)	mg/kg	-	2.6	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	0.19	0.060
	Titanium (Ti)	mg/kg	-	936	1,380	903	1,110	1,060	1,220	917	1,420	1,170	1,265	1,138	187	59.0
	Uranium (U)	mg/kg	-	9.20	27.1	12.1	15.0	12.2	27.6	8.02	23.8	13.6	24.1	17.3	7.55	2.39
	Vanadium (V)	mg/kg	-	47.1	77.7	45.4	54.7	52.0	63.9	41.8	71.5	52.6	67.2	57.4	12.0	3.80
	Zinc (Zn)	mg/kg	315	66.9	107	68.5	67	69.7	89	58.2	99.0	73.3	92	79	16.4	5.18
	Zirconium (Zr)	mg/kg	-	5.5	3.6	3.9	3.8	3.1	3.0	3.1	3.4	3.8	3.2	3.6	0.7	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.7: Deposited Sediment Field Sampling Observations at the Camp Lake Tributary 1 and 2 Benthic Stations[a], Mary River Project CREMP, August 2017

Study Area	Station	Texture of Collected Sediment	Predominant Collection Location	Silt Presence[b]
Camp Lake Tributary 1 Upstream (North Branch; CLT1 US)	CLT1 US-1	coarse sand	shoreline/bank	none observed
	CLT1 US-2	coarse sand	shoreline/bank	none observed
	CLT1 US-3	coarse sand	shoreline/bank	none observed
	CLT1 US-4	coarse sand (some fine sand)	shoreline/bank	none observed
	CLT1 US-5	coarse sand	shoreline/bank	none observed
Camp Lake Tributary 1 Downstream (Lower Main Stem; CLT1 DS)	CLT1 DS-1	coarse to fine sand	in-stream under large cobble/boulders	present (thin film)
	CLT1 DS-2	coarse sand	in-stream under large cobble/boulders	present (thin film)
	CLT1 DS-3	coarse sand	in-stream under large cobble/boulders	present (thin film)
	CLT1 DS-4	coarse sand	in-stream under large cobble/boulders	present (thin film)
	CLT1 DS-5	coarse sand-gravel mix	in-stream under large cobble/boulders	present (thin film)
Camp Lake Tributary 2 Upstream (CLT2 US)	CLT2 US-1	very coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 US-2	coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 US-3	coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 US-4	coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 US-5	coarse sand	shoreline/bank and in-stream under rocks	present (thin film)
Camp Lake Tributary 2 Downstream (CLT2 DS)	CLT2 DS-1	coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 DS-2	very coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 DS-3	coarse sand	in-stream under large cobble/boulders	none observed
	CLT2 DS-4	coarse sand	shoreline/bank and in-stream under rocks	none observed
	CLT2 DS-5	coarse sand	shoreline/bank and in-stream under rocks	none observed

[a] Sediment samples collected using a stainless steel scoop directly from the streambed or shoreline, as available.
[b] Evidence of silt precipitate included fine material present on the surface of in-stream substrate and/or as interstitial deposits not otherwise expected to occur at such habitat.

Table D.8: Deposited Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 1 Upstream (CLT1-US) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Camp Lake Tributary 1 Upstream Station					Study Area Summary Statistics		
			CLT1-US-1	CLT1-US-2	CLT1-US-3	CLT1-US-4	CLT1-US-5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	coarse sand	coarse sand	coarse sand	fine-coarse sand	coarse sand	-	-	-
Total Organic Carbon	%	10[α]	0.40	0.32	0.27	0.34	0.73	0.41	0.18	0.082
Aluminum (Al)	mg/kg	-	8,080	4,630	3,960	7,510	9,940	6,824	2,489	1,113
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.80	0.63	0.44	0.61	0.77	0.65	0.14	0.06
Barium (Ba)	mg/kg	-	18	12	9	17	22	16	5.1	2.3
Beryllium (Be)	mg/kg	-	0.32	0.18	0.16	0.28	0.42	0.27	0.11	0.05
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	0.22	0.20	0.0089	0.0040
Boron (B)	mg/kg	-	9.8	6.9	5.1	9.4	16.5	9.5	4.34	1.94
Cadmium (Cd)	mg/kg	3.5	0.042	0.040	0.026	0.046	0.063	0.04	0.013	0.006
Calcium (Ca)	mg/kg	-	2,730	1,760	3,130	2,660	3,130	2,682	560	250
Chromium (Cr)	mg/kg	90	33.0	21.1	21.8	33.9	34.9	28.9	6.9	3.1
Cobalt (Co)	mg/kg	-	6.71	4.4	3.67	6.1	7.8	5.7	1.68	0.75
Copper (Cu)	mg/kg	197	16.0	13.0	21.5	17	21.5	17.7	3.7	1.7
Iron (Fe)	mg/kg	40,000[α]	16,700	12,200	11,700	14,100	17,700	14,480	2,663	1,191
Lead (Pb)	mg/kg	91.3	4.5	3.0	2.9	4.1	5.0	3.9	0.92	0.41
Lithium (Li)	mg/kg	-	14.0	8.0	7.0	13.2	20.8	12.6	5.52	2.47
Magnesium (Mg)	mg/kg	-	9,150	5,100	5,470	8,630	12,200	8,110	2,920	1,306
Manganese (Mn)	mg/kg	1,100[α,β]	151	92	90	140	199	134	45.4	20.3
Mercury (Hg)	mg/kg	0.486	0.0065	0.0057	0.0063	0.0054	0.0095	0.0067	0.0016	0.0007
Molybdenum (Mo)	mg/kg	-	0.19	0.11	<0.10	0.13	0.21	0.15	0.05	0.02
Nickel (Ni)	mg/kg	75[α,β]	22.0	13.4	12.0	20.2	25.4	18.6	5.72	2.56
Phosphorus (P)	mg/kg	2,000[α]	262	235	140	243	257	227	50.0	22.4
Potassium (K)	mg/kg	-	1,480	890	690	1,310	2,180	1,310	580	259
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	71	54	<50	67	94	67	17	8
Strontium (Sr)	mg/kg	-	3.2	2.4	2.2	2.8	3.0	2.7	0.40	0.18
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.113	0.067	0.055	0.100	0.134	0.094	0.033	0.015
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	526	317	283	457	399	396	100	45
Uranium (U)	mg/kg	-	0.81	0.6	0.5	0.8	1.1	0.8	0.23	0.10
Vanadium (V)	mg/kg	-	28.9	22.5	20.5	27.7	31.6	26.2	4.6	2.1
Zinc (Zn)	mg/kg	315	18.2	11	9.5	17	21.5	15	5.1	2.3
Zirconium (Zr)	mg/kg	-	2.3	1.2	1.2	1.8	2.9	1.9	0.7	0.3

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.9: Deposited Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 1 Downstream (CLT1-DS) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Camp Lake Tributary 1 Downstream Station					Study Area Summary Statistics		
			CLT1-DS-1	CLT1-DS-2	CLT1-DS-3	CLT1-DS-4	CLT1-DS-5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	fine-coarse sand	coarse sand	coarse sand	coarse sand	very coarse sand	-	-	-
Total Organic Carbon	%	10[α]	0.36	0.41	0.17	<0.10	<0.10	0.23	0.15	0.066
Aluminum (Al)	mg/kg	-	6,540	6,370	4,560	2,700	1,960	4,426	2,081	931
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.76	0.74	0.54	0.41	0.59	0.61	0.15	0.07
Barium (Ba)	mg/kg	-	36	32	27	15	10	24	11.0	4.9
Beryllium (Be)	mg/kg	-	0.24	0.26	0.15	<0.10	<0.10	0.17	0.08	0.03
Bismuth (Bi)	mg/kg	-	0.24	0.45	0.2	<0.20	<0.20	0.26	0.1087	0.0486
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	0.00	0.00
Cadmium (Cd)	mg/kg	3.5	0.074	0.054	0.064	0.064	0.050	0.06	0.009	0.004
Calcium (Ca)	mg/kg	-	3,130	4,080	2,150	1,240	1,320	2,384	1,217	544
Chromium (Cr)	mg/kg	90	20.1	22.8	16.8	11.4	21.1	18.4	4.5	2.0
Cobalt (Co)	mg/kg	-	5.53	5.5	4.15	2.3	2.9	4.1	1.46	0.65
Copper (Cu)	mg/kg	197	16.3	12.5	18.1	16	5.2	13.5	5.1	2.3
Iron (Fe)	mg/kg	40,000[α]	30,600	21,800	24,000	13,800	26,000	23,240	6,196	2,771
Lead (Pb)	mg/kg	91.3	7.9	4.4	6.1	2.4	4.5	5.1	2.08	0.93
Lithium (Li)	mg/kg	-	7.4	7.2	5.6	3.3	3.0	5.3	2.09	0.93
Magnesium (Mg)	mg/kg	-	7,080	8,230	4,810	2,860	2,290	5,054	2,584	1,156
Manganese (Mn)	mg/kg	1,100[α,β]	276	273	196	106	126	195	79.6	35.6
Mercury (Hg)	mg/kg	0.486	<0.0050	0.0066	<0.0050	<0.0050	<0.0050	0.0053	0.0007	0.0003
Molybdenum (Mo)	mg/kg	-	1.04	0.69	0.72	1.93	1.13	1.10	0.50	0.22
Nickel (Ni)	mg/kg	75[α,β]	16.5	21.9	13.6	8.2	11.4	14.3	5.22	2.33
Phosphorus (P)	mg/kg	2,000[α]	260	274	240	101	175	210	71.8	32.1
Potassium (K)	mg/kg	-	2,590	2,210	1,930	1,160	670	1,712	784	350
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.00	0.00
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.000	0.000
Sodium (Na)	mg/kg	-	54	57	83	<50	<50	59	14	6
Strontium (Sr)	mg/kg	-	3.2	3.9	2.7	1.9	2.2	2.8	0.83	0.37
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.131	0.134	0.095	0.054	<0.050	0.093	0.040	0.018
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	438	422	341	203	175	316	122	54
Uranium (U)	mg/kg	-	1.2	1.2	0.7	0.5	0.6	0.8	0.4	0.2
Vanadium (V)	mg/kg	-	21.3	19.3	16.1	10.1	20.4	17.4	4.5	2.0
Zinc (Zn)	mg/kg	315	29.4	28.2	20.8	13.8	13.8	21.2	7.5	3.4
Zirconium (Zr)	mg/kg	-	2.6	2.4	2.2	1.8	1.7	2.1	0.4	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.10: Magnitude of Elevation in Deposited Sediment Metal Concentrations between Camp Lake Tributary Study Areas and Average Lotic Reference Area Data, Mary River Project CREMP, August 2017

Parameter	Units	Reference Area Data		Camp Lake Tributary 1		Camp Lake Tributary 2	
		Reference Creek (REF-CRK)	Mary River Reference (GO-09)	CLT1-US Magnitude of Difference	CLT1-DS Magnitude of Difference	CLT2-US Magnitude of Difference	CLT2-DS Magnitude of Difference
Total Organic Carbon	%	<0.10	<0.10	4.1	2.3	1.1	1.2
Aluminum (Al)	mg/kg	418	763	12.6	8.2	3.1	3.1
Antimony (Sb)	mg/kg	<0.10	<0.10	1.0	1.0	1.0	1.0
Arsenic (As)	mg/kg	0.12	0.16	4.8	4.5	2.6	2.7
Barium (Ba)	mg/kg	2	4	6.6	10.0	2.4	2.3
Beryllium (Be)	mg/kg	<0.10	<0.10	2.7	1.7	1.0	1.0
Bismuth (Bi)	mg/kg	<0.20	<0.20	1.0	1.3	1.0	1.0
Boron (B)	mg/kg	<5.0	<5.0	1.9	1.0	1.0	1.0
Cadmium (Cd)	mg/kg	<0.020	<0.020	2.2	3.1	1.0	1.1
Calcium (Ca)	mg/kg	214	842	7.9	7.0	4.5	4.5
Chromium (Cr)	mg/kg	1.4	3.4	14.5	9.3	4.8	6.1
Cobalt (Co)	mg/kg	0.3	0.7	13.3	9.5	4.3	4.6
Copper (Cu)	mg/kg	0.8	1.3	17.9	13.7	4.5	6.6
Iron (Fe)	mg/kg	1,240	2,826	8.4	13.5	3.0	4.8
Lead (Pb)	mg/kg	0.7	1.1	4.4	5.7	1.7	1.8
Lithium (Li)	mg/kg	<2.0	2.2	6.0	2.5	1.5	1.6
Magnesium (Mg)	mg/kg	333	826	17.1	10.7	5.1	5.1
Manganese (Mn)	mg/kg	10	22	10.1	14.6	4.4	4.4
Mercury (Hg)	mg/kg	<0.0050	<0.0050	1.3	1.1	1.0	1.0
Molybdenum (Mo)	mg/kg	<0.10	0.11	1.4	10.6	1.0	1.0
Nickel (Ni)	mg/kg	0.8	1.9	17.0	13.1	5.4	5.9
Phosphorus (P)	mg/kg	61	113	2.9	2.6	1.5	1.6
Potassium (K)	mg/kg	106	168	10.1	13.2	3.0	3.0
Selenium (Se)	mg/kg	<0.20	<0.20	1.0	1.0	1.0	1.0
Silver (Ag)	mg/kg	<0.10	<0.10	1.0	1.0	1.0	1.0
Sodium (Na)	mg/kg	<50	<50	1.3	1.2	1.0	1.0
Strontium (Sr)	mg/kg	1.2	1.9	1.9	1.9	1.2	1.2
Sulphur (S)	mg/kg	<1,000	<1,000	1.0	1.0	1.0	1.0
Thallium (Tl)	mg/kg	<0.050	<0.050	1.9	1.9	1.0	1.0
Tin (Sn)	mg/kg	<2.0	<2.0	1.0	1.0	1.0	1.0
Titanium (Ti)	mg/kg	36	109	7.4	5.9	2.5	2.7
Uranium (U)	mg/kg	0.2	0.3	3.1	3.4	0.9	1.1
Vanadium (V)	mg/kg	1.9	5.0	9.6	6.4	3.1	4.9
Zinc (Zn)	mg/kg	<2.0	4	5.9	8.1	1.6	3.1
Zirconium (Zr)	mg/kg	1.1	1.7	1.5	1.7	1.1	1.2

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference creek value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference creek value).
Denotes highly elevated (mean concentration greater than 10 times higher than respective mean reference creek value).

Table D.11: Deposited Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 2 Upstream (CLT2-US) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Camp Lake Tributary 2 Upstream Station					Study Area Summary Statistics		
			CLT2-US-B1	CLT2-US-B2	CLT2-US-B3	CLT2-US-B4	CLT2-US-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	very coarse sand	coarse sand	coarse sand	coarse sand	coarse sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	0.13	0.10	0.11	0.01	0.006
Aluminum (Al)	mg/kg	-	1,400	1,710	1,440	2,180	1,590	1,664	314	140
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.28	0.29	0.38	0.45	0.33	0.35	0.07	0.03
Barium (Ba)	mg/kg	-	5	6	5	8	6	6	1.1	0.5
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.00	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.02	0	0
Calcium (Ca)	mg/kg	-	1,110	1,310	1,390	2,420	1,440	1,534	511	229
Chromium (Cr)	mg/kg	90	8.8	9.1	8.7	13.1	7.8	9.5	2.1	0.9
Cobalt (Co)	mg/kg	-	1.67	1.8	1.57	2.5	1.7	1.8	0.37	0.17
Copper (Cu)	mg/kg	197	3.6	4.8	4.1	4	5.5	4.5	0.7	0.3
Iron (Fe)	mg/kg	40,000[α]	4,700	4,590	3,980	8,220	3,950	5,088	1,784	798
Lead (Pb)	mg/kg	91.3	1.3	1.4	1.3	2.2	1.4	1.5	0.38	0.17
Lithium (Li)	mg/kg	-	2.9	3.1	2.8	3.8	2.9	3.1	0.41	0.18
Magnesium (Mg)	mg/kg	-	1,930	2,330	2,130	3,350	2,270	2,402	552	247
Manganese (Mn)	mg/kg	1,100[α,β]	52	54	48	80	58	58	12.4	5.6
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	<0.10	<0.10	<0.10	0.10	<0.10	0.10	0.00	0.00
Nickel (Ni)	mg/kg	75[α,β]	5.2	5.6	5.8	7.9	5.2	5.9	1.13	0.51
Phosphorus (P)	mg/kg	2,000[α]	111	100	113	148	112	117	18.2	8.1
Potassium (K)	mg/kg	-	330	400	350	500	380	392	66	30
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	1.5	1.7	1.7	2.2	1.7	1.8	0.28	0.12
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.05	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	110	127	115	199	135	137	36	16
Uranium (U)	mg/kg	-	0.19	0.2	0.2	0.3	0.2	0.2	0.05	0.02
Vanadium (V)	mg/kg	-	7.5	8.4	6.9	11.8	7.6	8.4	2.0	0.9
Zinc (Zn)	mg/kg	315	3.9	4	3.3	6	3.8	4	0.9	0.4
Zirconium (Zr)	mg/kg	-	1.2	1.4	1.4	1.7	1.3	1.4	0.2	0.1

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.12: Deposited Sediment Total Organic Carbon and Metal Concentrations at Camp Lake Tributary 2 Downstream (CLT2-DS) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Camp Lake Tributary 2 Downstream Station					Study Area Summary Statistics		
			CLT2-DS-1	CLT2-DS-2	CLT2-DS-3	CLT2-DS-4	CLT2-DS-5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	coarse sand	very coarse sand	coarse sand	coarse sand	coarse sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	0.14	<0.10	0.17	<0.10	0.12	0.03	0.014
Aluminum (Al)	mg/kg	-	1,540	1,890	1,070	2,390	1,360	1,650	509	228
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.40	0.32	0.29	0.55	0.26	0.36	0.12	0.05
Barium (Ba)	mg/kg	-	5.3	5.8	4.0	7.6	4.9	5.5	1.4	0.6
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	0.026	<0.020	0.02	0.003	0.001
Calcium (Ca)	mg/kg	-	1,250	1,410	870	2,820	1,330	1,536	747	334
Chromium (Cr)	mg/kg	90	8.9	10.3	7.3	28.1	6.8	12.3	9.0	4.0
Cobalt (Co)	mg/kg	-	1.6	2.0	1.2	3.6	1.5	2.0	0.9	0.4
Copper (Cu)	mg/kg	197	4.3	3.6	2.4	5	17.3	6.5	6.1	2.7
Iron (Fe)	mg/kg	40,000[α]	4,590	5,330	3,720	23,000	4,630	8,254	8,263	3,695
Lead (Pb)	mg/kg	91.3	1.4	1.4	1.3	2.5	1.2	1.6	0.5	0.2
Lithium (Li)	mg/kg	-	3.3	3.8	2.2	4.6	2.7	3.3	0.9	0.4
Magnesium (Mg)	mg/kg	-	2,120	2,720	1,410	3,820	1,970	2,408	917	410
Manganese (Mn)	mg/kg	1,100[α,β]	52	58	39	94	51	59	21	9
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	<0.10	<0.10	<0.10	0.11	<0.10	0.10	0.004	0.002
Nickel (Ni)	mg/kg	75[α,β]	4.9	6.3	3.9	12.3	4.8	6.4	3.39	1.52
Phosphorus (P)	mg/kg	2,000[α]	90	123	67	214	157	130	57.9	25.9
Potassium (K)	mg/kg	-	390	430	250	540	320	386	110	49
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	1.9	1.7	1.4	2.5	1.6	1.8	0.42	0.19
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	117	149	121	235	108	146	52	23
Uranium (U)	mg/kg	-	0.22	0.23	0.15	0.49	0.25	0.27	0.13	0.06
Vanadium (V)	mg/kg	-	7.9	9.9	7.7	33.8	7.7	13.4	11.4	5.1
Zinc (Zn)	mg/kg	315	5.8	8	4.8	15	7.1	8	4.1	1.8
Zirconium (Zr)	mg/kg	-	1.3	1.4	1.0	2.1	1.7	1.5	0.4	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.13: **Field Observations of Sediment Properties at Camp Lake (JLO) Benthic Stations[a], Mary River Project CREMP, August 2017**

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
JLO-02	12.4	gray-brown silt, fine sand; some reddish-brown material at sediment surface	none detected	none observed
JLO-01	16.5	brown-red silt	none detected	globular algae (sparse)
JLO-21	9.9	thin reddish layer over gray-brown silty loam with some fine sand	none detected	globular algae (common)
JLO-20	6.3	thin layer of reddish material over gray-brown material; mainly fine sand with silt, but some coarse sand present	none detected	globular algae (common)
JLO-19	7.0	reddish-brown layer (0.5 cm thick) at surface transitioning to gray-brown fine sand with embedded organics	none detected	none observed
JLO-07	35.1	brown-gray sandy-silt	none detected	none observed
JLO-18	11.5	reddish-brown layer (0.5 cm thick) at surface transitioning to grey-brown fine sand with embedded organics	none detected	none observed
JLO-16	16.5	medium brown-gray fine sand-silt	none detected	none observed
JLO-11	33.0	medium brown silt with some fine sand	none detected	none observed
JLO-12	16.2	brown-red at surface with dark reddish/brown ferricrete-like layer at 2 cm depth, overlying medium gray-brown fine-medium grained sand	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.14: Observations from Sediment Cores Collected at Camp Lake (JLO), Mary River Project CREMP, August 2017

Sample Station	Station Depth (m)	Station Type	Core #	Core Length (cm)	Surface (Top 2 cm) Description
JLO-02	11.3	Littoral	1	18	Sandy loam
			2	17	
			3	18	
JLO-01	16.5	Profundal	1	12	Silt loam / Sandy loam
			2	10	
			3	16	
JLO-14	26.1	Profundal	1	20	Sandy loam
			2	16	
			3	16	
JLO-17	14.4	Profundal	1	20	Silt loam
			2	22	
			3	16	
JLO-07	32.8	Profundal	1	11	Sandy loam
			2	20	
			3	10	
JLO-16	16.1	Profundal	1	8	Sand
			2	10	
			3	11	
JLO-15	17.3	Profundal	1	15	Sandy loam
			2	9	
			3	10	
JLO-11	28.8	Profundal	1	12	Sandy loam
			2	17	
			3	19	
JLO-13	16.6	Profundal	1	19	Silt loam / Sandy loam
			2	21	
			3	15	
JLO-12	16.2	Profundal	1	5	Loamy sand
			2	5	
			3	6	
JLO-DUP (duplicate of JLO-01)	16.4	Profundal	1	14	Sandy loam
			2	10	
			3	10	

Table D.15: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Camp Lake (JLO) Sediment Stations, Mary River Project CREMP, August 2017

	Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Camp Lake Stations										Study Area Summary Statistics		
					JLO-02 (littoral)	JLO-01 (profundal)	JLO-14 (profundal)	JLO-17 (profundal)	JLO-07 (profundal)	JLO-16 (profundal)	JLO-15 (profundal)	JLO-11 (profundal)	JLO-13 (profundal)	JLO-12 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	51	48	57	43	63	87	60	56	46	77	59	14	4.4
	Silt	%	-	-	46	48	40	55	33	12	37	40	50	22	38	13	4.2
	Clay	%	-	-	2.9	4.6	4	2.3	4	1.2	2.9	4.4	4.4	1.4	3.1	1.2	0.4
	Moisture	%	-	-	72	65	77	73	80	23	44	62	68	44	61	18	5.70
	Total Organic Carbon	%	10[α]	-	2.62	1.41	2.21	2.09	2.35	0.29	0.91	1.36	1.27	0.63	1.51	0.78	0.247
Metals	Aluminum (Al)	mg/kg	-	-	15,000	17,100	17,200	16,100	18,300	4,830	12,700	14,500	15,900	8,540	14,017	4,258	1,347
	Antimony (Sb)	mg/kg	-	-	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.103	0.009	0.003
	Arsenic (As)	mg/kg	17	5.9	***9.9***	4.8	***16.0***	***17.5***	3.8	0.8	3.3	***6.4***	5.0	2.6	***7.0***	5.7	1.8
	Barium (Ba)	mg/kg	-	-	163	75	111	217	80.1	22.4	52.6	122.0	82	49.8	98	58.0	18.4
	Beryllium (Be)	mg/kg	-	-	0.80	0.93	0.94	0.84	0.95	0.23	0.69	0.78	0.91	0.45	0.75	0.24	0.075
	Bismuth (Bi)	mg/kg	-	-	0.28	0.26	0.29	0.25	0.41	<0.20	<0.20	0.21	0.23	<0.20	0.25	0.065	0.020
	Boron (B)	mg/kg	-	-	16.8	22.1	21.5	20.9	24.4	7.6	19.1	17.8	23.0	10.7	18.4	5.43	1.72
	Cadmium (Cd)	mg/kg	3.5	1.5	0.203	0.155	0.186	0.219	0.157	0.044	0.109	0.136	0.128	0.066	0.14	0.056	0.018
	Calcium (Ca)	mg/kg	-	-	4,560	4,005	4,520	4,600	4,390	14,900	3,230	3,990	3,890	2,380	5,047	3,531	1,116.5
	Chromium (Cr)	mg/kg	90	98	69.1	73	76	72.0	80.6	32.6	57.8	63.5	67.1	39.8	63.1	15.6	4.93
	Cobalt (Co)	mg/kg	-	-	21.3	18.3	22.2	21.9	15.8	5.49	13.8	18.9	18.0	9.37	16.5	5.54	1.75
	Copper (Cu)	mg/kg	197	50	44.5	45	***50***	46.3	***54.0***	11.7	33.2	36.3	40.2	20.1	38.2	13.4	4.23
	Iron (Fe)	mg/kg	40,000[α]	52,400	***61,600***	33,200	***93,300***	***62,100***	38,300	11,700	26,100	52,300	36,700	25,200	44,050	23,703	7,495
	Lead (Pb)	mg/kg	91.3	35	17.5	20.1	21.8	20.0	23.5	4.87	13.5	15.7	18.3	8.82	16.4	5.87	1.86
	Lithium (Li)	mg/kg	-	-	26.2	30.9	32.1	29.2	33.0	8.6	22.5	26.2	28.8	14.8	25.2	7.91	2.50
	Magnesium (Mg)	mg/kg	-	-	13,800	13,350	13,800	13,300	14,700	14,200	11,100	11,600	11,900	7,410	12,516	2,148	679
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	1,960	984	741	4,350	360	147	741		2,930	1,470	1,520	1,365.9	455.3
	Mercury (Hg)	mg/kg	0.486	0.17	0.0483	0.0326	0.0585	0.0447	0.0613	<0.0050	0.0186	0.0269	0.0328	0.0139	0.0343	0.0189	0.00596
	Molybdenum (Mo)	mg/kg	-	-	2.29	0.78	1.76	5.09	0.72	0.24	0.55	1.39	1.10	0.50	1.44	1.43	0.451
	Nickel (Ni)	mg/kg	75[α,β]	72	***77.0***	66.1	70.4	***74***	66.5	33.2	51.4	60.1	61	36.4	59.6	15.0	4.73
	Phosphorus (P)	mg/kg	2,000[α]	1,580	***1,690***	972	***3,260***	***2,440***	1,220	469	781	1,430	1,010	811	1,408	856	271
	Potassium (K)	mg/kg	-	-	3,670	4,630	4,420	4,220	4,940	1,400	3,190	3,650	4,550	2,220	3,689	1,138	360
	Selenium (Se)	mg/kg	-	-	0.46	0.27	0.66	0.45	0.48	<0.20	<0.20	0.34	0.24	<0.20	0.35	0.16	0.050
	Silver (Ag)	mg/kg	-	-	0.12	0.12	0.15	0.12	0.18	<0.10	<0.10	<0.10	0.10	<0.10	0.12	0.027	0.009
	Sodium (Na)	mg/kg	-	-	174	198	255	199	410	80	148	201	184	97	195	92	29
	Strontium (Sr)	mg/kg	-	-	8.1	11.2	13.2	9.8	19.5	8.1	8.4	9.7	11.2	6.01	10.5	3.75	1.19
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.458	0.49	0.45	0.529	0.427	0.100	0.316	0.393	0.448	0.212	0.382	0.135	0.0426
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	884	868	818	838	944	369	732	796	829	506	758	181	57.2
	Uranium (U)	mg/kg	-	-	5.4	4.8	7.0	5.21	6.29	0.99	3.73	4.44	4.28	2.12	4.43	1.81	0.572
	Vanadium (V)	mg/kg	-	-	57.0	61.8	63.4	60.1	62.2	18.9	47.1	51.6	57.2	31.5	51.1	14.8	4.69
	Zinc (Zn)	mg/kg	315	135	57.6	56.4	61.9	56.1	64.3	17.7	43.4	48.5	52.0	29.2	48.7	14.9	4.70
	Zirconium (Zr)	mg/kg	-	-	6.6	5.0	4.7	4.2	7.9	4.9	3.6	4.8	4.0	2.4	4.8	1.5	0.48

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Camp Lake.

(shaded) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.16: Magnitude of Elevation in Sediment Metal Concentrations between Camp Lake and Reference Lake 3 2017 Data, and between Camp Lake 2017 and Baseline Data, Mary River Project CREMP, 2017

Parameter	Camp Lake 2017 versus Reference Lake 3 2017				Camp Lake 2017 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Elevation	Camp Lake Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	14,720	1.0	22,140	0.6	18,267	0.8	15,175	0.9
Antimony (Sb)	<0.10	1.3	0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	3.4	3.0	4.8	1.4	2.8	3.5	3.5	1.9
Barium (Ba)	113	1.4	138	0.7	105	1.6	68	1.3
Beryllium (Be)	0.6	1.4	0.9	0.9	1.0	0.8	1.0	0.7
Bismuth (Bi)	<0.20	1.4	0.20	1.2	-	-	-	-
Boron (B)	12.1	1.4	16.6	1.1	1	22.9	2	10.1
Cadmium (Cd)	0.2	1.1	0.2	0.7	0.5	0.4	0.5	0.3
Calcium (Ca)	4,656	1.0	5,262	1.0	3,130	1.5	2,857	1.8
Chromium (Cr)	51	1.4	70	0.9	81	0.9	71	0.9
Cobalt (Co)	11	2.0	16	1.0	18	1.2	17	1.0
Copper (Cu)	65	0.7	88	0.4	45	1.0	40	0.9
Iron (Fe)	41,960	1.5	46,740	0.9	36,133	1.7	33,206	1.3
Lead (Pb)	12	1.4	17	1.0	18	1.0	19	0.9
Lithium (Li)	24	1.1	35	0.7	-	-	-	-
Magnesium (Mg)	10,256	1.3	14,660	0.8	13,967	1.0	10,113	1.2
Manganese (Mn)	639	3.1	1,266	1.2	699	2.8	942	1.6
Mercury (Hg)	0.0440	1.1	0.0528	0.6	0.100	0.5	0.100	0.3
Molybdenum (Mo)	3.498	0.7	2.898	0.5	1.0	2.3	1.0	1.3
Nickel (Ni)	38	2.0	49	1.2	67	1.1	63	0.9
Phosphorus (P)	1,039	1.6	1,073	1.3	800	2.1	1,125	1.2
Potassium (K)	3,754	1.0	5,694	0.6	3,450	1.1	3,771	1.0
Selenium (Se)	0.6	0.8	0.6	0.6	1.0	0.5	1.0	0.3
Silver (Ag)	0.1	1.0	0.2	0.6	0.3	0.4	0.3	0.3
Sodium (Na)	284	0.6	410	0.5	279	0.6	254	0.8
Strontium (Sr)	10	0.8	13	0.8	9.3	0.9	12.0	0.9
Sulphur (S)	1,120	0.9	1,140	0.9	-	-	-	-
Thallium (Tl)	0.346	1.3	0.657	0.6	1.0	0.5	1.0	0.4
Tin (Sn)	2	0.9	2	1.0	-	-	-	-
Titanium (Ti)	997	0.9	1,288	0.6	-	-	-	-
Uranium (U)	11	0.5	23	0.2	-	-	-	-
Vanadium (V)	48	1.2	67	0.7	69	0.8	57	0.9
Zinc (Zn)	67	0.9	91	0.5	67	0.9	57	0.8
Zirconium (Zr)	3.9	1.7	3.4	1.4	-	-	-	-

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).

Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).

Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.17: Magnitude of Elevation in Sediment Metal Concentrations between Camp Lake 2015 and 2017 Data, and between Camp Lake 2016 and 2017 Data

Parameter	Camp Lake 2017 versus Initial Year of Mine Operation (2015)				Camp Lake 2017 versus Second Year of Mine Operation (2016)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Camp Lake 2015 Concentration (mg/kg)	Magnitude of Elevation	Camp Lake 2015 Concentration (mg/kg)	Magnitude of Elevation	Camp Lake 2016 Concentration (mg/kg)	Magnitude of Elevation	Camp Lake 2016 Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	15,900	0.9	15,430	0.9	13,460	1.1	18,900	0.7
Antimony (Sb)	0.1	1.3	0.1	1.0	0.1	1.2	0.1	1.0
Arsenic (As)	14.6	0.7	6.6	1.0	8.7	1.1	8.9	0.7
Barium (Ba)	174	0.9	99	0.9	128	1.3	126	0.7
Beryllium (Be)	0.8	1.0	0.9	0.9	0.8	1.0	1.0	0.7
Bismuth (Bi)	0.3	0.9	0.3	0.9	0.3	0.9	0.3	0.8
Boron (B)	24	0.7	23	0.8	21	0.8	28	0.7
Cadmium (Cd)	0.4	0.6	0.2	0.9	0.2	1.0	0.2	0.8
Calcium (Ca)	6,310	0.7	5,759	0.9	4,404	1.0	4,540	1.1
Chromium (Cr)	73	0.9	67	0.9	57	1.2	76	0.8
Cobalt (Co)	22	1.0	17	0.9	17	1.3	20	0.8
Copper (Cu)	57	0.8	39	1.0	38	1.2	50	0.8
Iron (Fe)	62,300	1.0	44,161	1.0	48,150	1.3	61,633	0.7
Lead (Pb)	21	0.8	20	0.8	20	0.9	24	0.7
Lithium (Li)	28.1	0.9	28.4	0.9	26	1.0	35	0.7
Magnesium (Mg)	13,600	1.0	12,638	1.0	10,792	1.3	13,567	0.9
Manganese (Mn)	1,900	1.0	2,476	0.6	2,583	0.8	2,307	0.6
Mercury (Hg)	0.058	0.8	0.036	0.9	0.0	1.3	0.1	0.6
Molybdenum (Mo)	2.6	0.9	1.8	0.7	2.6	0.9	1.8	0.8
Nickel (Ni)	84	0.9	62	0.9	65	1.2	70	0.8
Phosphorus (P)	1750.0	1.0	1,471	0.9	1,521	1.1	2,137	0.6
Potassium (K)	4,090	0.9	4,010	0.9	3,383	1.1	4,773	0.8
Selenium (Se)	0.6	0.8	0.4	0.9	0.4	1.2	0.5	0.6
Silver (Ag)	0.2	0.8	0.1	0.9	0.1	1.1	0.2	0.8
Sodium (Na)	184	0.9	193	1.0	152	1.1	274	0.7
Strontium (Sr)	11.1	0.7	13.4	0.8	8.9	0.9	15	0.7
Sulphur (S)	5000	0.2	5000	0.2	5,000	0.2	5,000	0.2
Thallium (Tl)	0.7	0.7	0.5	0.8	0.5	1.0	0.5	0.7
Tin (Sn)	2.0	1.0	2.0	1.0	5.7	0.4	3.3	0.6
Titanium (Ti)	893	1.0	760	1.0	733	1.2	877	0.8
Uranium (U)	9.7	0.6	5.7	0.8	5.0	1.1	7.2	0.6
Vanadium (V)	61	0.9	53	0.9	48	1.2	63	0.8
Zinc (Zn)	61	0.9	52	0.9	47	1.2	62	0.8
Zirconium (Zr)	8	0.8	5	0.9	4.1	1.6	5.2	0.9

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.18: **Magnitude of Elevation in Sediment Metal Concentrations between Camp Lake and Camp Lake Tributary 1, and between Camp Lake and Camp Lake Tributary 2, Using Data Collected in 2017**

Parameter	Camp Lake 2017 versus Camp Lake Tributary 1 Upstream (CLT1-US)			Camp Lake 2017 versus Camp Lake Tributary 1 Downstream (CLT1-DS)			Camp Lake 2017 versus Camp Lake Tributary 2 Upstream (CLT2-US)			Camp Lake 2017 versus Camp Lake Tributary 2 Downstream (CLT2-DS)		
	CLT1-US Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations	CLT1-DS Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations	CLT2-US Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations	CLT2-DS Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations
Aluminum (Al)	6,824	2.2	2.0	4,426	3.4	3.1	1,664	9.0	8.4	1,650	9.1	8.4
Antimony (Sb)	<0.10	1.3	1.0	<0.10	1.3	1.0	<0.10	1.3	1.0	<0.10	1.3	1.0
Arsenic (As)	0.7	15.3	10.3	0.6	16.3	11.0	0.3	28.7	19.3	0.4	27.3	18.3
Barium (Ba)	16	10.4	5.8	24	6.8	3.8	6	28.4	15.7	5	29.7	16.4
Beryllium (Be)	0.3	2.9	2.7	0.2	4.7	4.4	0.1	8.0	7.5	0.1	7.8	7.3
Bismuth (Bi)	0.2	1.4	1.2	0.3	1.1	1.0	0.2	1.4	1.2	0.2	1.4	1.2
Boron (B)	10	1.8	1.9	5	3.4	3.7	5	3.4	3.7	5	3.4	3.7
Cadmium (Cd)	0.0	4.7	3.1	0.1	3.3	2.2	0.0	10.2	6.7	0.0	9.6	6.3
Calcium (Ca)	2,682	1.7	1.9	2,384	1.9	2.1	1,534	3.0	3.3	1,536	3.0	3.3
Chromium (Cr)	29	2.4	2.2	18	3.7	3.4	9	7.3	6.6	12	5.6	5.1
Cobalt (Co)	6	3.7	2.8	4	5.2	3.9	2	11.7	8.7	2	10.8	8.1
Copper (Cu)	18	2.5	2.1	14	3.3	2.8	4	10.0	8.4	7	6.8	5.7
Iron (Fe)	14,480	4.3	2.9	23,240	2.7	1.8	5,088	12.1	8.3	8,254	7.5	5.1
Lead (Pb)	4	4.5	4.2	5	3.5	3.2	2	11.6	10.8	2	11.1	10.3
Lithium (Li)	12.6	2.1	2.0	5	4.9	4.7	3.1	8.5	8.1	3	7.9	7.6
Magnesium (Mg)	8,110	1.7	1.5	5,054	2.7	2.4	2,402	5.7	5.2	2,408	5.7	5.1
Manganese (Mn)	134	14.6	10.9	195	10.0	7.5	58	33.6	25.1	59	33.4	24.9
Mercury (Hg)	0.007	7.2	4.9	0.0	9.1	6.1	0.005	9.7	6.5	0.0	9.7	6.5
Molybdenum (Mo)	0.1	15.5	9.1	1.1	2.1	1.2	0.1	22.9	13.5	0.1	22.5	13.2
Nickel (Ni)	19	4.1	3.1	14	5.4	4.0	6	13.0	9.7	6	12.0	9.0
Phosphorus (P)	227.4	7.4	6.1	210	8.0	6.6	116.8	14.5	11.8	130	13.0	10.6
Potassium (K)	1,310	2.8	2.8	1,712	2.1	2.2	392	9.4	9.4	386	9.5	9.6
Selenium (Se)	0.2	2.3	1.7	0.2	2.3	1.7	0.2	2.3	1.7	0.2	2.3	1.7
Silver (Ag)	0.1	1.2	1.2	0.1	1.2	1.2	0.1	1.2	1.2	0.1	1.2	1.2
Sodium (Na)	67	2.6	2.9	59	3.0	3.3	50	3.5	3.9	50	3.5	3.9
Strontium (Sr)	2.7	3.0	4.0	2.8	2.9	3.9	1.8	4.6	6.1	1.8	4.5	6.0
Sulphur (S)	<1000	1.0	1.0	<1000	1.0	1.0	<1000	1.0	1.0	<1000	1.0	1.0
Thallium (Tl)	0.1	4.9	4.0	0.1	4.9	4.0	0.1	9.2	7.5	0.1	9.2	7.5
Tin (Sn)	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0
Titanium (Ti)	396	2.2	1.9	316	2.8	2.4	137	6.4	5.4	146	6.1	5.1
Uranium (U)	0.8	7.2	5.7	0.8	6.5	5.2	0.2	24.1	19.1	0.3	20.4	16.2
Vanadium (V)	26	2.2	1.9	17	3.3	2.9	8	6.8	6.0	13	4.2	3.8
Zinc (Zn)	15	3.7	3.1	21	2.7	2.3	4	13.7	11.4	8	7.1	5.9
Zirconium (Zr)	2	3.5	2.5	2.1	3.1	2.2	1	4.7	3.3	1.5	4.4	3.1

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
Denotes high elevation (mean parameter concentration is ≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.19: **Deposited Sediment Field Sampling Observations at Sheardown Lake Tributary 1 and 12 Benthic Stations[a], Mary River Project CREMP, August 2017**

Study Area	Station	Texture of Collected Sediment	Predominant Collection Location	Silt Presence[b]
Sheardown Lake Tributary 1 (SDLT1)	SDLT1-1	red-brown silt	shoreline/bank	precipitate and deposits
	SDLT1-2	red-brown silt	shoreline/bank, in-stream between rocks	precipitate and deposits
	SDLT1-3	red-brown silt	shoreline/bank, in-stream between rocks	precipitate and deposits
	SDLT1-4	red-brown silt	shoreline/bank	precipitate and deposits
	SDLT1-5	red-brown silt	in-stream under large cobble/boulders	precipitate and deposits
Sheardown Lake Tributary 12 (SDLT12)	SDLT12-1	red-brown silt	in-stream between and under rocks	precipitate and deposits
	SDLT1-2	red-brown silt	in-stream between and under rocks	precipitate and deposits
	SDLT1-3	red-brown silt	in-stream between and under rocks	precipitate and deposits

[a] Sediment samples collected using a stainless steel scoop directly from the streambed or shoreline, as available.

[b] Evidence of silt precipitate included fine material present on the surface of in-stream substrate and/or as interstitial deposits not otherwise expected to occur at such habitat.

Table D.20: Deposited Sediment Total Organic Carbon and Metal Concentrations at Sheardown Lake Tributary 1 (SDLT1) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Sheardown Lake Tributary 1 Station					Study Area Summary Statistics		
			SDLT1-B1	SDLT1-B2	SDLT1-B3	SDLT1-B4	SDLT1-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	red-brown silt	red-brown silt	red-brown silt	red-brown silt	red-brown silt	-	-	-
Total Organic Carbon	%	10[α]	0.63	0.61	0.75	0.56	0.65	0.64	0.07	0.031
Aluminum (Al)	mg/kg	-	15,000	19,100	18,300	15,700	8,730	15,366	4,088	1,828
Antimony (Sb)	mg/kg	-	0.14	<0.10	0.13	0.18	<0.10	0.13	0.03	0.01
Arsenic (As)	mg/kg	17	2.83	2.50	2.71	4.09	1.58	2.74	0.90	0.40
Barium (Ba)	mg/kg	-	88	105	100	66	48	81	24.0	10.7
Beryllium (Be)	mg/kg	-	0.66	0.74	0.76	0.92	0.43	0.70	0.18	0.08
Bismuth (Bi)	mg/kg	-	0.7	0.8	0.95	0.75	0.34	0.71	0.2260	0.1011
Boron (B)	mg/kg	-	5.9	7.8	7.7	6.7	7.5	7.1	0.81	0.36
Cadmium (Cd)	mg/kg	3.5	0.262	0.272	0.342	0.210	0.314	0.28	0.051	0.023
Calcium (Ca)	mg/kg	-	3,110	4,020	4,160	2,310	7,670	4,254	2,051	917
Chromium (Cr)	mg/kg	90	31.1	38.0	36.4	37.4	24.8	33.5	5.6	2.5
Cobalt (Co)	mg/kg	-	14.00	14.2	14.60	18.2	8.0	13.8	3.68	1.65
Copper (Cu)	mg/kg	197	44.7	44.4	48.3	41	27.1	41.0	8.2	3.7
Iron (Fe)	mg/kg	40,000[α]	203,000	137,000	150,000	227,000	58,000	155,000	65,662	29,365
Lead (Pb)	mg/kg	91.3	23.8	26.3	35.4	21.9	10.4	23.6	9.00	4.02
Lithium (Li)	mg/kg	-	15.9	18.6	18.0	16.5	10.2	15.8	3.34	1.49
Magnesium (Mg)	mg/kg	-	12,000	16,500	15,800	12,100	11,300	13,540	2,415	1,080
Manganese (Mn)	mg/kg	1,100[α,β]	820	766	829	960	524	780	159.8	71.5
Mercury (Hg)	mg/kg	0.486	0.0077	0.0091	0.0125	0.0113	0.0113	0.0104	0.0019	0.0009
Molybdenum (Mo)	mg/kg	-	5.83	6.50	5.44	7.19	1.92	5.38	2.04	0.91
Nickel (Ni)	mg/kg	75[α,β]	32.4	34.7	36.7	42.8	27.5	34.8	5.63	2.52
Phosphorus (P)	mg/kg	2,000[α]	416	486	449	408	291	410	73.3	32.8
Potassium (K)	mg/kg	-	6,270	7,930	7,300	4,660	2,880	5,808	2,051	917
Selenium (Se)	mg/kg	-	0.26	0.27	0.34	0.32	0.33	0.30	0.04	0.02
Silver (Ag)	mg/kg	-	0.23	0.27	0.49	0.20	0.11	0.26	0.141	0.063
Sodium (Na)	mg/kg	-	104	156	147	93	86	117	32	14
Strontium (Sr)	mg/kg	-	3.3	3.9	4.1	3.2	4.8	3.9	0.68	0.30
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.319	0.380	0.357	0.249	0.205	0.302	0.074	0.033
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.0	0.0
Titanium (Ti)	mg/kg	-	943	1,140	1,070	715	518	877	258	115
Uranium (U)	mg/kg	-	2.79	3.6	3.8	3.8	2.0	3.2	0.77	0.34
Vanadium (V)	mg/kg	-	26.3	34.2	32.5	25.4	23.9	28.5	4.6	2.1
Zinc (Zn)	mg/kg	315	78.8	100	113.0	76	69.6	87	18.3	8.2
Zirconium (Zr)	mg/kg	-	6.0	8.2	8.1	6.6	4.1	6.6	1.69	0.76

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.21: Magnitude of Elevation in Deposited Sediment Metal Concentrations at the Sheardown Lake Tributaries Compared to Average Lotic Reference Area Data, Mary River Project CREMP, August 2017

Parameter	Units	Reference Area Data		Sheardown Lake Tributary 1 (SDLT1) Magnitude of Elevation	Sheardown Lake Tributary 12 (SDLT12) Magnitude of Elevation	Sheardown Lake Tributary 9 (SDLT9) Magnitude of Elevation
		Reference Creek (REF-CRK)	Mary River Reference (GO-09)			
Total Organic Carbon	%	<0.10	<0.10	6.4	4.6	6.3
Aluminum (Al)	mg/kg	418	763	28.4	17.5	4.7
Antimony (Sb)	mg/kg	<0.10	<0.10	1.3	1.9	1.0
Arsenic (As)	mg/kg	0.12	0.16	20.4	21.4	4.7
Barium (Ba)	mg/kg	2	4	34.0	13.6	4.6
Beryllium (Be)	mg/kg	<0.10	<0.10	7.0	7.2	1.2
Bismuth (Bi)	mg/kg	<0.20	<0.20	3.5	2.8	1.0
Boron (B)	mg/kg	<5.0	<5.0	1.4	1.0	1.0
Cadmium (Cd)	mg/kg	<0.020	<0.020	14.0	4.7	1.8
Calcium (Ca)	mg/kg	214	842	12.5	4.2	4.9
Chromium (Cr)	mg/kg	1.4	3.4	16.8	16.6	6.8
Cobalt (Co)	mg/kg	0.3	0.7	32.1	36.4	5.5
Copper (Cu)	mg/kg	0.8	1.3	41.6	36.9	7.3
Iron (Fe)	mg/kg	1,240	2,826	89.9	158.2	8.7
Lead (Pb)	mg/kg	0.7	1.1	26.7	16.1	4.1
Lithium (Li)	mg/kg	<2.0	2.2	7.5	4.9	1.8
Magnesium (Mg)	mg/kg	333	826	28.6	15.3	5.4
Manganese (Mn)	mg/kg	10	22	58.4	79.1	9.0
Mercury (Hg)	mg/kg	<0.0050	<0.0050	2.1	1.1	2.1
Molybdenum (Mo)	mg/kg	<0.10	0.11	51.8	50.8	4.1
Nickel (Ni)	mg/kg	0.8	1.9	31.9	31.9	9.8
Phosphorus (P)	mg/kg	61	113	5.2	4.9	4.0
Potassium (K)	mg/kg	106	168	44.7	17.1	4.5
Selenium (Se)	mg/kg	<0.20	<0.20	1.5	1.2	1.1
Silver (Ag)	mg/kg	<0.10	<0.10	2.6	1.9	1.0
Sodium (Na)	mg/kg	<50	<50	2.3	1.0	1.0
Strontium (Sr)	mg/kg	1.2	1.9	2.6	1.5	1.8
Sulphur (S)	mg/kg	<1,000	<1,000	1.0	1.0	1.0
Thallium (Tl)	mg/kg	<0.050	<0.050	6.0	2.7	1.3
Tin (Sn)	mg/kg	<2.0	<2.0	1.0	1.0	1.0
Titanium (Ti)	mg/kg	36	109	16.3	7.1	4.6
Uranium (U)	mg/kg	0.2	0.3	13.1	11.6	2.4
Vanadium (V)	mg/kg	1.9	5.0	10.4	6.6	4.7
Zinc (Zn)	mg/kg	<2.0	4	33.6	16.7	4.3
Zirconium (Zr)	mg/kg	1.1	1.7	5.1	3.0	0.8

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference creek value).
Denotes moderate elevation (mean concentration 5 to 10 times higher than respective mean reference creek value).
Denotes highly elevated (mean concentration ≥10 times higher than respective mean reference creek value).

Table D.22: Deposited Sediment Total Organic Carbon and Metal Concentrations at Sheardown Lake Tributary 12 (SDLT12) Benthic Stations, Mary River Project CREMP, August 2017

Parameter	Units	Sediment Quality Guideline (SQG)[a]	Sheardown Lake Tributary 12 Station			Study Area Summary Statistics		
			SDLT12-B1	SDLT12-B2	SDLT12-B3	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	red-brown silt	red-brown silt	red-brown silt	-	-	-
Total Organic Carbon	%	10[α]	0.60	0.47	0.31	0.46	0.15	0.065
Aluminum (Al)	mg/kg	-	11,300	8,830	8,220	9,450	1,631	729
Antimony (Sb)	mg/kg	-	0.2	0.17	0.19	0.19	0.02	0.01
Arsenic (As)	mg/kg	17	3.71	3.00	1.93	2.88	0.90	0.40
Barium (Ba)	mg/kg	-	40	34	25	33	7.7	3.4
Beryllium (Be)	mg/kg	-	0.85	0.74	0.58	0.72	0.14	0.06
Bismuth (Bi)	mg/kg	-	0.62	0.69	0.34	0.55	0.1852	0.0828
Boron (B)	mg/kg	-	5.7	<5.0	<5.0	5.2	0.40	0.18
Cadmium (Cd)	mg/kg	3.5	0.113	0.122	0.049	0.09	0.040	0.018
Calcium (Ca)	mg/kg	-	1,870	1,020	1,410	1,433	425	190
Chromium (Cr)	mg/kg	90	37.5	29.6	32.4	33.2	4.0	1.8
Cobalt (Co)	mg/kg	-	17.30	15.2	14.40	15.6	1.50	0.67
Copper (Cu)	mg/kg	197	46.6	37.4	25.3	36.4	10.7	4.8
Iron (Fe)	mg/kg	40,000[α]	330,000	293,000	195,000	272,667	69,759	31,197
Lead (Pb)	mg/kg	91.3	18.0	16.9	7.8	14.2	5.62	2.51
Lithium (Li)	mg/kg	-	11.3	8.8	10.6	10.2	1.29	0.58
Magnesium (Mg)	mg/kg	-	8,710	6,120	6,880	7,237	1,331	595
Manganese (Mn)	mg/kg	1,100[α,β]	1,020	918	1,230	1,056	159.1	71.1
Mercury (Hg)	mg/kg	0.486	0.0060	<0.0050	<0.0050	0.0053	0.0006	0.0003
Molybdenum (Mo)	mg/kg	-	7.27	5.42	3.15	5.28	2.06	0.92
Nickel (Ni)	mg/kg	75[α,β]	40.6	33.9	30.1	34.9	5.32	2.38
Phosphorus (P)	mg/kg	2,000[α]	418	363	382	388	27.9	12.5
Potassium (K)	mg/kg	-	2,550	2,150	1,970	2,223	297	133
Selenium (Se)	mg/kg	-	0.29	0.21	0.21	0.24	0.05	0.02
Silver (Ag)	mg/kg	-	0.23	0.25	<0.10	0.19	0.081	0.036
Sodium (Na)	mg/kg	-	50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	2.5	1.8	2.4	2.3	0.36	0.16
Sulphur (S)	mg/kg	-	<1000	<1000	<1000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.165	0.140	0.102	0.136	0.032	0.014
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	436	351	360	382	47	21
Uranium (U)	mg/kg	-	2.95	2.6	2.9	2.8	0.19	0.09
Vanadium (V)	mg/kg	-	20.1	15.2	18.6	18.0	2.5	1.1
Zinc (Zn)	mg/kg	315	51.9	46	32.4	44	10.0	4.5
Zirconium (Zr)	mg/kg	-	4.4	3.5	3.8	3.9	0.5	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.23: Deposited Sediment Total Organic Carbon and Metal Concentrations at Sheardown Lake Tributary 9 (SDLT9) Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Sheardown Lake Tributary 9 Station					Study Area Summary Statistics		
			SDLT9-B1	SDLT9-B2	SDLT9-B3	SDLT9-B4	SDLT9-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	sand	sand	sand	sand	sand	-	-	-
Total Organic Carbon	%	10[α]	0.62	0.52	0.52	0.60	0.87	0.63	0.14	0.064
Aluminum (Al)	mg/kg	-	2,020	1,570	2,740	3,270	3,090	2,538	722	323
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.62	0.50	0.69	0.71	0.66	0.64	0.08	0.04
Barium (Ba)	mg/kg	-	9	7	11	14	14	11	3.1	1.4
Beryllium (Be)	mg/kg	-	0.11	<0.10	0.13	0.14	0.13	0.12	0.02	0.01
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	5.4	<5.0	<5.0	<5.0	<5.0	5.1	0.18	0.08
Cadmium (Cd)	mg/kg	3.5	0.041	<0.020	0.034	0.039	0.047	0.04	0.010	0.005
Calcium (Ca)	mg/kg	-	2,100	1,070	1,440	2,010	1,680	1,660	422	189
Chromium (Cr)	mg/kg	90	13.7	12.6	13.6	14.1	13.6	13.5	0.6	0.2
Cobalt (Co)	mg/kg	-	1.73	1.7	2.54	3.0	2.9	2.4	0.62	0.28
Copper (Cu)	mg/kg	197	9.7	3.8	7.1	8	8.1	7.2	2.2	1.0
Iron (Fe)	mg/kg	40,000[α]	11,800	10,100	13,200	23,400	16,500	15,000	5,251	2,348
Lead (Pb)	mg/kg	91.3	4.3	2.3	3.4	4.0	4.1	3.6	0.80	0.36
Lithium (Li)	mg/kg	-	3.6	2.7	4.1	4.5	4.4	3.9	0.74	0.33
Magnesium (Mg)	mg/kg	-	1,780	1,530	2,750	3,610	3,190	2,572	895	400
Manganese (Mn)	mg/kg	1,100[α,β]	63	68	137	174	161	121	52.2	23.3
Mercury (Hg)	mg/kg	0.486	0.0257	<0.0050	0.0077	0.0060	0.0072	0.0103	0.0087	0.0039
Molybdenum (Mo)	mg/kg	-	0.24	0.12	0.38	0.75	0.64	0.43	0.27	0.12
Nickel (Ni)	mg/kg	75[α,β]	10.1	7.1	11.2	12.0	13.3	10.7	2.35	1.05
Phosphorus (P)	mg/kg	2,000[α]	463	277	326	284	255	321	83.4	37.3
Potassium (K)	mg/kg	-	480	300	600	790	740	582	199	89
Selenium (Se)	mg/kg	-	0.26	<0.20	<0.20	<0.20	<0.20	0.21	0.03	0.01
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	56	<50	51	3	1
Strontium (Sr)	mg/kg	-	3.2	2.3	2.6	2.6	2.4	2.6	0.38	0.17
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.060	<0.050	0.069	0.066	0.074	0.064	0.009	0.004
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	214	199	265	271	286	247	38	17
Uranium (U)	mg/kg	-	0.81	0.4	0.5	0.6	0.6	0.6	0.14	0.06
Vanadium (V)	mg/kg	-	14.9	14.3	11.7	12.4	11.3	12.9	1.6	0.7
Zinc (Zn)	mg/kg	315	9.2	8	11.2	14	14.4	11	2.9	1.3
Zirconium (Zr)	mg/kg	-	1.1	<1.0	<1.0	<1.0	<1.0	1.0	0.04	0.02

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.24: Field Observations of Sediment Properties at Sheardown Lake Northwest (DLO-01) Benthic Stations[a], Mary River Project CREMP, August 2017

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-01-9	7.8	~ 1 mm layer of iron oxide precipitate over medium brown silt	none detected	decaying macrophytes (*Chara* sp. or moss), globular algae (common)
DLO-01-4	7.8	some iron oxide particulate over medium brown-gray silt	none detected	aquatic moss (sparse), globular algae (common)
DLO-01-3	8.3	medium dark brown-gray silt; no iron oxide precipitate	none detected	*Chara* sp. present (common)
DLO-01-11	8.6	thin iron oxide precipitate over brown silt	none detected	*Chara* sp. and aquatic moss (sparse), globular algae (sparse)
DLO-01-10	8.3	thin layer of reddish-brown iron oxide precipitate over sand-silt	none detected	aquatic moss (common), globular algae (sparse)
DLO-01-5	24.0	some iron oxide speckling at surface overlying gray-brown silt	none detected	globular algae (common)
DLO-01-14	24.2	thin reddish-brown layer over gray-brown silt with some intermixed sand; ferricrete-like layer present	none detected	globular algae (sparse)
DLO-01-15	22.5	reddish-brown silt with some (minor) sand	none detected	none observed
DLO-01-2	20.0	reddish-brown silt with some (minor) sand	none detected	globular algae (sparse)
DLO-01-12	15.0	reddish-brown, compact sand	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.25: Observations from Sediment Cores Collected at Sheardown Lake NW (DLO-01), Mary River Project CREMP, August 2017

Sample Station	Station Depth (m)	Station Type	Core #	Core Length (cm)	Surface (Top 2 cm) Description
DLO-01-05	23.2	Profundal	1	15.0	Silt loam
			2	16.0	
			3	20.0	
DD-HAB 9-STN2	10.5	Littoral	1	18.0	Sandy loam
			2	12.0	
			3	20.0	
DLO-01-08	12.1	Littoral	1	8.0	Silt loam
			2	10.0	
			3	15.0	
DLO-01-01	22.0	Profundal	1	10.0	Silt loam
			2	8.0	
			3	7.0	
DLO-01-13	17.8	Profundal	1	12.0	Silt loam
			2	16.0	
			3	10.0	
DLO-01-2	16.8	Profundal	1	18.0	Silt loam
			2	21.0	
			3	18.0	
DLO-01-9	7.7	Littoral	1	14.0	Loam
			2	16.0	
			3	15.0	
DLO-01-10	7.8	Littoral	1	-	Sand
			2	-	
			3	-	
DLO-01-DUP (duplicate of DLO-01-2)	16.8	Profundal	1	10.0	Silt loam
			2	11.0	
			3	16.0	

Table D.26: Sediment Particle Size, Total Organic Carbon, Metal Concentrations at Sheardown Lake Northwest (DLO-01) Sediment Stations, Mary River Project CREMP, August 2017

	Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Northwest Stations														Study Area Summary Statistics		
					DLO-01-5 (profundal)	DLO-01-14 (profundal)	DLO-01-15 (profundal)	DD-HAB 9-STN2 (littoral)	DLO-01-8 (littoral)	DLO-01 (profundal)	DLO-01-13 (profundal)	DLO-01-2 (profundal)	DLO-01-12 (profundal)	DLO-01-9 (littoral)	DLO-01-4 (littoral)	DLO-01-3 (littoral)	DLO-01-11 (littoral)	DLO-01-10 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	12	16	24	62	34	10	15	15	25	52	42	47	35	91	36	29	10.4
	Silt	%	-	-	67	64	57	30	53	66	65	74	64	37	45	44	56	9	50	23	8.1
	Clay	%	-	-	21	20	20	8	13	24	20	11	11	12	13	9	10	<1.0	14	7.7	2.7
	Moisture	%	-	-	67	75	69	67	62	70	69	69	61	76	81	72	71	21	63	17	6.1
	Total Organic Carbon	%	10[α]	-	1.87	2.23	1.41	3.47	1.52	1.42	1.39	1.29	1.19	5.40	4.16	3.2	2.13	0.56	2.11	1.57	0.554
Metals	Aluminum (Al)	mg/kg	-	-	22,600			17,700	21,200	23,200	23,400	19,600		20,500				3,330	18,941	6,597	2,332
	Antimony (Sb)	mg/kg	-	-	<0.10			<0.10	<0.10	<0.10	<0.10	<0.10		0.12				<0.10	0.10	0.0071	0.0025
	Arsenic (As)	mg/kg	17	6.2	***6.77***			***8.65***	3.92	4.34	4.17	4.25		***7.91***				0.62	5.08	2.59	0.92
	Barium (Ba)	mg/kg	-	-	111.0			162	98	101.0	100.0	139		122				14.00	106	43.2	15.3
	Beryllium (Be)	mg/kg	-	-	1.07			0.89	1.03	1.19	1.16	0.94		1.01				0.16	0.931	0.328	0.116
	Bismuth (Bi)	mg/kg	-	-	0.29			0.30	0.48	0.26	0.24	0.22		0.23				<0.20	0.28	0.089	0.031
	Boron (B)	mg/kg	-	-	35.9			29.8	35.7	35.3	37.6	26.2		34.1				5.8	30.0	10.49	3.71
	Cadmium (Cd)	mg/kg	3.5	1.5	0.238			0.465	0.391	0.263	0.275	0.261		0.539				0.026	0.307	0.158	0.0558
	Calcium (Ca)	mg/kg	-	-	4,370			5,010	4,160	4,480	4,590	4,950		6,340				1,380	4,410	1,397	493.9
	Chromium (Cr)	mg/kg	90	97	87.6			70.2	78.8	85.2	86.1	78.9		77.1				17.30	72.6	23.1	8.16
	Cobalt (Co)	mg/kg	-	-	18.4			14.3	16.8	17.2	17.3	16.6		17.8				2.65	15.1	5.19	1.83
	Copper (Cu)	mg/kg	197	58	46.8			54.5	45.2	51.1	48.6	42.4		***67.3***				5.69	45.2	17.70	6.26
	Iron (Fe)	mg/kg	40,000[α]	52,200	51,500			***71,700***	38,400	41,400	40,900	41,950		***66,500***				8,690	45,130	19,340	6,838
	Lead (Pb)	mg/kg	91.3	35	23.2			20.8	19.9	22.7	22.0	19.6		20.2				3.78	19.0	6.30	2.23
	Lithium (Li)	mg/kg	-	-	38.1			28.3	35.1	40.3	39.2	33.3		32.9				5.7	31.6	11.2	3.95
	Magnesium (Mg)	mg/kg	-	-	14,900			12,200	13,300	14,700	14,800	13,550		13,800				2,710	12,495	4,058	1,435
	Manganese (Mn)	mg/kg	1,100[α,β]	4,530	1,520			662	1,430	1,130	1,100	***9,805***		469				94	2,026	3,180	1,124
	Mercury (Hg)	mg/kg	0.486	0.17	0.0520			0.0508	0.0292	0.0347	0.0343	0.0342		0.057				0.005	0.0372	0.0166	0.00586
	Molybdenum (Mo)	mg/kg	-	-	2.42			6.14	2.9	1.71	1.70	8.67		8.09				0.43	4.01	3.16	1.12
	Nickel (Ni)	mg/kg	75[α,β]	77	73.0			74	***79.2***	68.9	70.1	69		***104***				13.70	69.0	25.2	8.89
	Phosphorus (P)	mg/kg	2,000[α]	1,958	1,360			1,400	866	902	917	934		978				387	968	315	112
	Potassium (K)	mg/kg	-	-	6,110			4,780	5,710	6,150	6,220	5,105		5,600				870	5,068	1,772	627
	Selenium (Se)	mg/kg	-	-	0.42			0.60	0.32	0.26	0.29	0.34		0.70				<0.20	0.39	0.17	0.061
	Silver (Ag)	mg/kg	-	-	0.18			0.17	0.14	0.19	0.17	0.14		0.19				<0.10	0.16	0.031	0.011
	Sodium (Na)	mg/kg	-	-	361			276	277	315	328	287		333				63	280	92.6	32.7
	Strontium (Sr)	mg/kg	-	-	12.7			10.6	10.9	12.0	12.3	11.1		12.1				4.47	10.8	2.65	0.94
	Sulphur (S)	mg/kg	-	-	<1,000			<1,000	<1,000	<1,000	<1,000	<1,000		1700				<1,000	1,087.5	247.5	78.3
	Thallium (Tl)	mg/kg	-	-	0.549			0.489	0.558	0.575	0.578	0.581		0.652				0.069	0.506	0.182	0.0645
	Tin (Sn)	mg/kg	-	-	<2.0			<2.0	<2.0	<2.0	<2.0	<2.0		<2.0				<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,380			1,120	1,230	1,300	1,350	1,220		1,280				304	1,148	351	124
	Uranium (U)	mg/kg	-	-	7.6			9.1	5.53	8.60	7.88	6.50		13.8				1.130	7.52	3.57	1.26
	Vanadium (V)	mg/kg	-	-	64.8			54.4	60.1	65.6	65.7	59.0		63.0				11.80	55.5	18.1	6.40
	Zinc (Zn)	mg/kg	315	123	72.1			66.5	67.9	74.3	75.1	67.6		73.2				14.2	63.9	20.3	7.19
	Zirconium (Zr)	mg/kg	-	-	10.0			11.0	5.8	7.8	7.7	6.8		19.8				3.2	9.0	4.98	1.76

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Northwest.

(grey shading) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD5 Indicates parameter concentration above the AEMP Benchmark.

Table D.27: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake NW and Reference Lake 3 2017 Data, and between Sheardown Lake NW 2017 and Baseline Data, Mary River Project CREMP, 2017

Parameter	Sheardown Lake NW versus Reference Lake 3 in 2017				Sheardown Lake NW 2017 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	14,720	1.1	22,140	1.0	11,792	1.3	17,745	1.3
Antimony (Sb)	<0.10	1.1	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	3.4	1.6	4.8	1.0	3.0	1.8	3.2	1.5
Barium (Ba)	113	0.9	138	0.8	78	1.3	93	1.2
Beryllium (Be)	0.6	1.4	0.9	1.3	1.0	0.8	1.0	1.1
Bismuth (Bi)	<0.20	1.5	0.20	1.3	-	-	-	-
Boron (B)	12.1	2.2	16.6	2.0	3	9.2	3	10.9
Cadmium (Cd)	0.2	2.0	0.2	1.4	0.5	0.7	0.5	0.5
Calcium (Ca)	4,656	0.9	5,262	0.9	2,697	1.6	3,558	1.3
Chromium (Cr)	51	1.2	70	1.2	53	1.2	81	1.0
Cobalt (Co)	11	1.2	16	1.1	10	1.2	15	1.1
Copper (Cu)	65	0.7	88	0.5	33	1.3	48	1.0
Iron (Fe)	41,960	1.1	46,740	0.9	28,120	1.6	40,382	1.1
Lead (Pb)	12	1.3	17	1.3	13	1.3	20	1.1
Lithium (Li)	24	1.1	35	1.1	-	-	-	-
Magnesium (Mg)	10,256	1.0	14,660	1.0	7,448	1.4	11,498	1.3
Manganese (Mn)	639	1.0	1,266	2.7	756	0.9	2,164	1.6
Mercury (Hg)	0.0440	0.8	0.0528	0.7	0.100	0.4	0.100	0.4
Molybdenum (Mo)	3.498	1.3	2.898	1.3	3.4	1.3	3.5	1.0
Nickel (Ni)	38	1.8	49	1.4	49	1.4	69	1.0
Phosphorus (P)	1,039	0.9	1,073	1.0	863	1.1	1,400	0.7
Potassium (K)	3,754	1.1	5,694	1.0	2,681	1.6	4,612	1.3
Selenium (Se)	0.6	0.7	0.6	0.6	1.0	0.5	1.0	0.3
Silver (Ag)	0.1	1.2	0.2	0.9	0.3	0.6	0.3	0.6
Sodium (Na)	284	0.8	410	0.8	249	1.0	342	0.9
Strontium (Sr)	10.0	1.0	12.7	0.9	7.2	1.3	11.4	1.1
Sulphur (S)	1,120	1.0	1,140	0.9	-	-	-	-
Thallium (Tl)	0.346	1.3	0.657	0.9	1.0	0.4	1.0	0.6
Tin (Sn)	<2	0.9	<2	1.0	-	-	-	-
Titanium (Ti)	997	1.0	1,288	1.0	-	-	-	-
Uranium (U)	11	0.7	23	0.3	-	-	-	-
Vanadium (V)	48	1.0	67	0.9	37	1.3	58	1.1
Zinc (Zn)	67	0.8	91	0.8	51	1.1	76	1.0
Zirconium (Zr)	3.9	2.6	3.4	2.4	-	-	-	-

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).

Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).

Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.28: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake NW 2015 and 2017 Data, and between Sheardown Lake NW 2016 and 2017 Data

Parameter	Sheardown Lake NW 2017 versus Initial Year of Mine Operation (2015)				Sheardown Lake NW 2017 versus Second Year of Mine Operation (2016)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Sheardown Lake NW 2015 Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW 2015 Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW 2016 Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW 2016 Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	15,205	1.0	21,000	1.1	15,620	1.0	21,217	1.0
Antimony (Sb)	0.1	1.1	0.1	1.0	0.1	1.1	0.1	1.0
Arsenic (As)	6.9	0.8	5.1	0.9	8.0	0.7	4.3	1.1
Barium (Ba)	140	0.7	100	1.1	196	0.5	101	1.1
Beryllium (Be)	0.8	0.9	1.1	1.0	0.8	0.9	1.1	1.0
Bismuth (Bi)	0.3	1.1	0.3	0.8	0.2	1.3	0.3	0.9
Boron (B)	25	1.0	32	1.1	24	1.1	31	1.1
Cadmium (Cd)	0.4	1.0	0.3	1.0	0.3	1.3	0.3	1.0
Calcium (Ca)	4,411	1.0	4,595	1.0	4,494	0.9	4,402	1.0
Chromium (Cr)	60	1.0	81	1.0	62	1.0	78	1.1
Cobalt (Co)	14	0.9	17	1.0	13	1.0	16	1.1
Copper (Cu)	45	1.0	47	1.0	43	1.0	47	1.0
Iron (Fe)	57,810	0.8	43,375	1.0	58,740	0.8	40,333	1.1
Lead (Pb)	19	0.9	24	0.9	20	0.8	31	0.7
Lithium (Li)	26.6	1.0	36.2	1.0	28	0.9	39	1.0
Magnesium (Mg)	10,250	1.0	13,750	1.1	10,896	1.0	13,517	1.1
Manganese (Mn)	1,496	0.4	2,707	1.3	2,503	0.3	1,435	2.4
Mercury (Hg)	0.039	0.9	0.041	1.0	0.0	0.9	0.0	0.9
Molybdenum (Mo)	9.6	0.5	3.8	1.0	8.8	0.5	3.0	1.2
Nickel (Ni)	70	1.0	70	1.0	66	1.0	68	1.0
Phosphorus (P)	1,020	0.9	1,007	1.0	1,410	0.6	891	1.2
Potassium (K)	3,889	1.1	5,458	1.1	3,806	1.1	5,255	1.1
Selenium (Se)	0.5	0.9	0.4	0.8	0.4	1.1	0.4	0.8
Silver (Ag)	0.2	0.9	0.2	0.9	0.1	1.2	0.2	0.9
Sodium (Na)	233	1.0	306	1.1	231	1.0	301	1.1
Strontium (Sr)	10.7	0.9	13.0	0.9	10	1.0	12	1.0
Sulphur (S)	5,000	0.2	5,000	0.2	5,000	0.2	5,000	0.2
Thallium (Tl)	0.5	0.8	0.7	0.9	0.4	1.0	0.6	1.0
Tin (Sn)	2.0	1.0	2.0	1.0	4.6	0.4	13	0.2
Titanium (Ti)	889	1.1	1,235	1.1	968	1.0	1,257	1.0
Uranium (U)	8.9	0.8	9.2	0.8	8.2	0.9	8.3	0.9
Vanadium (V)	47	1.0	61	1.0	47	1.0	60	1.1
Zinc (Zn)	59	0.9	76	1.0	57	1.0	73	1.0
Zirconium (Zr)	11	0.9	10	0.8	10	1.0	9.4	0.9

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.29: **Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake NW and Sheardown Lake Tributaries 1 and 12 Using Data Collected in 2017**

Parameter	Sheardown Lake NW 2017 versus Sheardown Lake Tributary 1 (SDLT1)			Sheardown Lake NW 2017 versus Sheardown Lake Tributary 12 (SDLT12)		
	SDLT1 Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations	SDLT12 Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations
Aluminum (Al)	15,366	1.0	1.4	9,450	1.7	2.3
Antimony (Sb)	0.13	0.8	0.8	0.19	0.6	0.5
Arsenic (As)	2.7	1.9	1.8	2.9	1.8	1.7
Barium (Ba)	81	1.2	1.4	33	3.0	3.5
Beryllium (Be)	0.7	1.1	1.6	0.7	1.1	1.5
Bismuth (Bi)	0.7	0.4	0.4	0.6	0.6	0.5
Boron (B)	7	3.7	4.7	5	5.0	6.4
Cadmium (Cd)	0.3	1.3	0.9	0.1	3.8	2.7
Calcium (Ca)	4,254	1.0	1.1	1,433	2.9	3.2
Chromium (Cr)	34	1.8	2.5	33	1.8	2.5
Cobalt (Co)	14	0.9	1.3	16	0.8	1.1
Copper (Cu)	41	1.1	1.2	36	1.2	1.3
Iron (Fe)	155,000	0.3	0.3	272,667	0.2	0.2
Lead (Pb)	24	0.7	0.9	14	1.1	1.5
Lithium (Li)	15.8	1.6	2.4	10	2.5	3.7
Magnesium (Mg)	13,540	0.8	1.1	7,237	1.5	2.0
Manganese (Mn)	780	0.9	4.3	1,056	0.6	3.2
Mercury (Hg)	0.010	3.4	3.7	0.005	6.7	7.3
Molybdenum (Mo)	5.4	0.8	0.7	5.3	0.8	0.7
Nickel (Ni)	35	1.9	2.0	35	1.9	2.0
Phosphorus (P)	410.0	2.2	2.5	388	2.3	2.7
Potassium (K)	5,808	0.7	1.0	2,223	1.9	2.7
Selenium (Se)	0.3	1.5	1.1	0.2	1.9	1.4
Silver (Ag)	0.3	0.6	0.7	0.2	0.8	0.9
Sodium (Na)	117	2.0	2.8	50	4.7	6.5
Strontium (Sr)	3.9	2.5	3.1	2.3	4.2	5.3
Sulphur (S)	<1000	1.2	1.0	<1000	1.2	1.0
Thallium (Tl)	0.3	1.5	1.9	0.1	3.3	4.2
Tin (Sn)	2.0	1.0	1.0	2.0	1.0	1.0
Titanium (Ti)	877	1.1	1.5	382	2.6	3.4
Uranium (U)	3.2	2.3	2.4	2.8	2.6	2.7
Vanadium (V)	28	1.7	2.2	18	2.6	3.5
Zinc (Zn)	87	0.6	0.8	44	1.3	1.7
Zirconium (Zr)	7	1.5	1.2	3.9	2.6	2.1

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than at respective tributary).

Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than at respective tributary).

Denotes high elevation (mean parameter concentration is ≥ 10 times higher than at respective tributary).

Table D.30: Field Observations of Sediment Properties at Sheardown Lake Southeast (DLO-02) Benthic Stations[a], Mary River Project CREMP, August 2017

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
DLO-02-11	8.0	reddish iron oxide and/or black oxidized layer (<0.5 cm thick) at surface overlying gray-brown silt	black oxidized layer (possibly due to decaying vegetation)	*Chara* sp. (common), globular algae (sparse)
DLO-02-10	7.5	gray-brown silt	none detected	*Chara* sp. (common), globular algae (sparse)
DLO-02-4	8.8	reddish-brown silt layer (~1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-9	9.7	reddish-brown layer (~ 1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-1	11.5	dark brown, compact silt	none detected	globular algae (sparse)
DLO-02-12	10.5	reddish layer (~1 cm thick) over medium brown silt	none detected	globular algae (sparse)
DLO-02-8	12.5	reddish-brown layer (~ 1 cm) over medium brown silt	none detected	globular algae (sparse)
DLO-02-13	13.2	thin red-brown layer (~1 cm) over dark brown silt	none detected	globular algae (sparse)
DLO-02-2	12.5	dark brown silt	none detected	none observed
DLO-02-3	13.5	dark brown silt	none detected	globular algae (sparse)

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.

[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.31: Observations from Sediment Cores Collected at Sheardown Lake SE (DLO-02), Mary River Project CREMP, August 2017

Sample Station	Station Depth (m)	Station Type	Core #	Core Length (cm)	Surface (Top 2 cm) Description
DLO-02-1	11.5	Littoral	1	6.0	Silt loam
			2	7.0	
			3	5.0	
DLO-02-11	7.8	Littoral	1	7.0	Silt
			2	10.0	
			3	12.0	
DLO-02-4	8.5	Littoral	1	10.0	Silty clay loam
			2	11.0	
			3	14.0	
DLO-02-2	13.4	Profundal	1	6.0	Silt loam
			2	7.0	
			3	7.0	
DLO-02-3	13.0	Profundal	1	7.0	Silt loam
			2	10.0	
			3	8.0	
DLO-02-DUP (duplicate of DLO-02-1)	11.5	Littoral	1	7.0	Silt loam
			2	8.0	
			3	8.0	

Table D.32: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Sheardown Lake Southeast (DLO-02) Sediment Stations, Mary River Project CREMP, August 2017

	Parameter	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Sheardown Lake Southeast Basin Station										Study Area Summary Statistics		
					DLO-02-1 (littoral)	DLO-02-11 (littoral)	DLO-02-10 (littoral)	DLO-02-4 (littoral)	DLO-02-12 (profundal)	DLO-02-9 (littoral)	DLO-02-8 (profundal)	DLO-02-13 (profundal)	DLO-02-2 (profundal)	DLO-02-3 (profundal)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	13	6	9	9	4	8	14	6	13	17	12	4.3	1.9
	Silt	%	-	-	76	90	74	62	82	79	67	78	72	68	74	10.3	4.6
	Clay	%	-	-	11	4	17	29	14	13	19	16	15	15	15	8.9	4.0
	Moisture	%	-	-	44	55	67	55	64	63	58	65	50	42	49	6.1	2.7
	Total Organic Carbon	%	10[α]	-	1.03	1.33	1.48	1.20	1.1	1.09	0.98	1.1	1.12	1.02	1.14	0.13	0.058
Metals	Aluminum (Al)	mg/kg	-	-	15,550	17,900		17,300					18,300	18,600	17,530	1,209	541
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10		<0.10					<0.10	<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	2.57	***6.18***		5.75					2.45	3.66	4.12	1.75	0.785
	Barium (Ba)	mg/kg	-	-	76.0	141.0		114					80.2	93.3	100.9	26.9	12.01
	Beryllium (Be)	mg/kg	-	-	0.71	0.85		0.82					0.85	0.85	0.82	0.06	0.027
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.22		0.23					<0.20	<0.20	0.21	0.0141	0.0063
	Boron (B)	mg/kg	-	-	18.6	22.4		23.1					27.1	27.4	23.7	3.67	1.64
	Cadmium (Cd)	mg/kg	3.5	1.5	0.108	0.133		0.125					0.118	0.119	0.121	0.0094	0.00421
	Calcium (Ca)	mg/kg	-	-	6,115	5,890		6,210					6,690	5,760	6,133	359	160.4
	Chromium (Cr)	mg/kg	90	79	70.1	***82.0***		***83.7***					76.7	***79.9***	78.5	5.4	2.41
	Cobalt (Co)	mg/kg	-	-	12.9	15.1		14.0					13.5	14.4	14.0	0.86	0.383
	Copper (Cu)	mg/kg	110	56	26.0	30.1		29.1					28.7	28.3	28.4	1.54	0.69
	Iron (Fe)	mg/kg	40,000[α]	34,400	***35,700***	***51,500***		***47,400***					***37,000***	***41,300***	***42,580***	6,762	3,024
	Lead (Pb)	mg/kg	91.3	35	14.2	17.6		16.9					15.9	15.8	16.1	1.29	0.58
	Lithium (Li)	mg/kg	-	-	27.4	32.1		30.7					31.6	31.9	30.7	1.96	0.88
	Magnesium (Mg)	mg/kg	-	-	13,500	14,400		14,600					14,900	14,400	14,360	522	234
	Manganese (Mn)	mg/kg	1,100[α,β]	657	527	***2,560***		***1,430***					469	***1,170***	***1,231***	849	380
	Mercury (Hg)	mg/kg	0.486	0.17	0.0258	0.0296		0.0232					0.0307	0.0291	0.0277	0.00311	0.001390
	Molybdenum (Mo)	mg/kg	-	-	0.98	2.60		1.73					0.8	1.37	1.50	0.71	0.317
	Nickel (Ni)	mg/kg	75[α,β]	66	54.3	***66.8***		66					55.3	59.4	60.4	5.86	2.62
	Phosphorus (P)	mg/kg	2,000[α]	1,278	944	***1,300***		***1,320***					969	1,130	1,133	177	79.3
	Potassium (K)	mg/kg	-	-	3,895	4,600		4,450					4,750	4,810	4,501	366	163.9
	Selenium (Se)	mg/kg	-	-	<0.20	0.21		<0.20					0.20	0.25	0.21	0.022	0.0097
	Silver (Ag)	mg/kg	-	-	0.11	0.11		0.11					0.13	0.11	0.11	0.009	0.0040
	Sodium (Na)	mg/kg	-	-	246	292		285					306	319	290	27.7	12.4
	Strontium (Sr)	mg/kg	-	-	9.8	11.1		11.1					11.6	12.0	11.1	0.849	0.380
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000		<1,000					<1,000	<1,000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.333	0.417		0.405					0.370	0.374	0.380	0.0331	0.0148
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0		<2.0					<2.0	<2.0	<2.0	0	0
	Titanium (Ti)	mg/kg	-	-	1,210	1,250		1,260					1,410	1,500	1,326	123	55.2
	Uranium (U)	mg/kg	-	-	4.60	5.11		4.42					5.0	5.05	4.84	0.310	0.138
	Vanadium (V)	mg/kg	-	-	47.3	53.5		52.4					52.9	55.0	52.2	2.92	1.31
	Zinc (Zn)	mg/kg	315	135	53.6	60.8		57.5					59.1	60.1	58.2	2.86	1.28
	Zirconium (Zr)	mg/kg	-	-	17.1	14.3		14.5					21.3	18.4	17.1	2.91	1.30

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Sheardown Lake Southeast.

(grey box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.33: **Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake SE and Reference Lake 3 2017 Data, and between Sheardown Lake SE 2017 and Baseline Data, Mary River Project CREMP, 2017**

Parameter	Sheardown Lake SE versus Reference Lake 3 in 2017				Sheardown Lake SE 2017 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake SE Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	14,720	1.1	22,140	0.8	14,950	1.1	13,133	1.4
Antimony (Sb)	<0.10	1.0	<0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	3.4	1.4	4.8	0.6	1.9	2.6	1.5	2.0
Barium (Ba)	113	1.0	138	0.6	81	1.4	64	1.4
Beryllium (Be)	0.6	1.4	0.9	1.0	1.0	0.8	1.0	0.9
Bismuth (Bi)	<0.20	1.1	0.20	1.0	-	-	-	-
Boron (B)	12.1	1.8	16.6	1.6	2.5	8.5	1.4	20.2
Cadmium (Cd)	0.2	0.7	0.2	0.7	0.5	0.2	0.6	0.2
Calcium (Ca)	4,656	1.3	5,262	1.2	6,310	1.0	8,925	0.7
Chromium (Cr)	51	1.5	70	1.1	78	1.0	72	1.1
Cobalt (Co)	11	1.3	16	0.9	13	1.1	12	1.2
Copper (Cu)	65	0.4	88	0.3	30	1.0	25	1.2
Iron (Fe)	41,960	1.1	46,740	0.8	32,284	1.4	29,117	1.3
Lead (Pb)	12	1.3	17	0.9	17	1.0	14	1.2
Lithium (Li)	24	1.3	35	0.9	-	-	-	-
Magnesium (Mg)	10,256	1.4	14,660	1.0	12,634	1.1	13,742	1.1
Manganese (Mn)	639	2.4	1,266	0.6	462	3.3	410	2.0
Mercury (Hg)	0.0440	0.6	0.0528	0.6	0.100	0.3	0.100	0.3
Molybdenum (Mo)	3.498	0.5	2.898	0.4	1.5	1.2	1.0	1.1
Nickel (Ni)	38	1.6	49	1.2	62	1.0	62	0.9
Phosphorus (P)	1,039	1.1	1,073	1.0	1,150	1.0	950	1.1
Potassium (K)	3,754	1.1	5,694	0.8	3,947	1.1	3,317	1.4
Selenium (Se)	0.6	0.3	0.6	0.4	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	0.9	0.2	0.6	0.4	0.3	0.3	0.4
Sodium (Na)	284	1.0	410	0.8	353	0.8	330	0.9
Strontium (Sr)	10.0	1.1	12.7	0.9	16.0	0.7	11.0	1.1
Sulphur (S)	1,120	0.9	1,140	0.9	-	-	-	-
Thallium (Tl)	0.346	1.1	0.657	0.6	1.0	0.4	1.0	0.4
Tin (Sn)	<2	0.9	<2	1.0	-	-	-	-
Titanium (Ti)	997	1.2	1,288	1.1	-	-	-	-
Uranium (U)	11	0.4	23	0.2	-	-	-	-
Vanadium (V)	48	1.1	67	0.8	52	1.0	44	1.2
Zinc (Zn)	67	0.9	91	0.7	51	1.1	51	1.2

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.34: **Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake SE 2015 and 2017 Data, and between Sheardown Lake SE 2016 and 2017 Data**

Parameter	Sheardown Lake SE 2017 versus Initial Year of Mine Operation (2015)				Sheardown Lake NW 2017 versus Second Year of Mine Operation (2016)	
	Littoral Stations		Profundal Stations		Littoral Stations	
	Sheardown Lake SE 2015 Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake SE 2015 Concentration (mg/kg)	Magnitude of Elevation	Sheardown Lake NW 2016 Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	18,467	0.9	18,600	1.0	15,933	1.1
Antimony (Sb)	0.1	1.0	0.1	1.0	0.1	1.0
Arsenic (As)	4.7	1.0	2.7	1.1	4.2	1.2
Barium (Ba)	95	1.2	75	1.2	81	1.4
Beryllium (Be)	0.9	0.9	0.9	1.0	0.7	1.1
Bismuth (Bi)	0.3	0.9	0.2	0.9	0.3	0.6
Boron (B)	27	0.8	27	1.0	20	1.0
Cadmium (Cd)	0.1	1.1	0.1	1.2	0.1	1.2
Calcium (Ca)	5,933	1.0	6,745	0.9	5,350	1.1
Chromium (Cr)	84	0.9	79	1.0	72	1.1
Cobalt (Co)	15	0.9	14	1.0	13	1.1
Copper (Cu)	30	1.0	29	1.0	26	1.1
Iron (Fe)	44,300	1.0	34,350	1.1	40,233	1.1
Lead (Pb)	19	0.8	19	0.8	23	0.7
Lithium (Li)	32.7	0.9	32.3	1.0	30	1.0
Magnesium (Mg)	14,233	1.0	14,425	1.0	12,800	1.1
Manganese (Mn)	1,048	1.4	444	1.8	931	1.6
Mercury (Hg)	0.025	1.1	0.026	1.2	0.0	1.1
Molybdenum (Mo)	1.7	1.0	0.9	1.3	1.5	1.2
Nickel (Ni)	68	0.9	59	1.0	57	1.1
Phosphorus (P)	1,076	1.1	912	1.2	998	1.2
Potassium (K)	4,647	0.9	4,503	1.1	3,787	1.1
Selenium (Se)	0.2	0.9	0.2	1.0	0.2	1.0
Silver (Ag)	0.1	0.8	0.1	0.8	0.1	1.0
Sodium (Na)	299	0.9	293	1.1	257	1.1
Strontium (Sr)	13.1	0.8	13.5	0.9	10	1.1
Sulphur (S)	5,000	0.2	5,000	0.2	5,000	0.2
Thallium (Tl)	0.5	0.8	0.4	0.8	0.4	1.0
Tin (Sn)	2.0	1.0	2.0	1.0	13.4	0.1
Titanium (Ti)	1,380	0.9	1,418	1.0	1,167	1.1
Uranium (U)	6.3	0.7	6.4	0.8	5.0	0.9
Vanadium (V)	55	0.9	54	1.0	47	1.1
Zinc (Zn)	62	0.9	62	1.0	51	1.1
Zirconium (Zr)	22	0.7	23	0.9	16	1.0

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective previous study year).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective previous study year).
Denotes high elevation (mean parameter concentration is ≥ 10 times higher than respective previous study year).

Table D.35: Magnitude of Elevation in Sediment Metal Concentrations between Sheardown Lake SE and Sheardown Lake Tributary 9 and Mary River Using Data Collected in 2017

Parameter	Sheardown Lake SE 2017 versus Sheardown Lake Tributary 9 (SDLT9)			Sheardown Lake NW 2017 versus Mary River (EO-20)		
	SDLT9 Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations	EO-20 Concentration (mg/kg)	Magnitude of Elevation for Littoral Station	Magnitude of Elevation for Profundal Stations
Aluminum (Al)	2,538	6.7	7.3	2,034	8.3	9.1
Antimony (Sb)	<0.10	1.0	1.0	<0.10	1.0	1.0
Arsenic (As)	0.6	7.6	4.8	0.5	10.5	6.7
Barium (Ba)	11	10.0	7.9	9	12.5	9.8
Beryllium (Be)	0.1	6.5	7.0	0.1	6.4	6.9
Bismuth (Bi)	0.2	1.1	1.0	<0.2	1.1	1.0
Boron (B)	5	4.2	5.4	5	4.1	5.2
Cadmium (Cd)	0.036	3.4	3.3	0.023	5.4	5.2
Calcium (Ca)	1,660	3.7	3.8	3,094	2.0	2.0
Chromium (Cr)	14	5.8	5.8	23	3.4	3.4
Cobalt (Co)	2	5.9	5.9	3	4.8	4.8
Copper (Cu)	7	3.9	3.9	6	4.9	4.9
Iron (Fe)	15,000	3.0	2.6	15,518	2.9	2.5
Lead (Pb)	4	4.5	4.4	2	7.0	6.8
Lithium (Li)	3.9	7.8	8.2	5	6.2	6.5
Magnesium (Mg)	2,572	5.5	5.7	3,617	3.9	4.0
Manganese (Mn)	121	12.5	6.8	85	17.7	9.6
Mercury (Hg)	0.010	2.5	2.9	<0.005	5.2	6.0
Molybdenum (Mo)	0.4	4.2	2.6	0.2	10.9	6.8
Nickel (Ni)	11	5.8	5.3	15	4.1	3.7
Phosphorus (P)	321	3.7	3.3	316	3.8	3.3
Potassium (K)	582	7.4	8.2	466	9.3	10.3
Selenium (Se)	0.2	0.9	1.1	0.2	1.0	1.1
Silver (Ag)	0.1	1.1	1.2	0.1	1.1	1.2
Sodium (Na)	51	5.4	6.1	59	4.7	5.3
Strontium (Sr)	2.6	4.1	4.5	3.6	2.9	3.3
Sulphur (S)	<1000	1.0	1.0	<1000	1.0	1.0
Thallium (Tl)	0.1	6.0	5.8	0.1	7.0	6.7
Tin (Sn)	2.0	1.0	1.0	<2.0	1.0	1.0
Titanium (Ti)	247	5.0	5.9	304	4.1	4.8
Uranium (U)	0.6	7.9	8.4	0.8	5.9	6.3
Vanadium (V)	13	4.0	4.2	25	2.0	2.2
Zinc (Zn)	11	5.1	5.3	9	6.3	6.5
Zirconium (Zr)	1	15.0	19.5	2.8	5.5	7.1

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than average at respective tributary/river area).

Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than average at respective tributary/river area).

Denotes high elevation (mean parameter concentration is ≥ 10 times higher than average at respective tributary/river area).

Table D.36: Deposited Sediment Field Sampling Observations at Mary River Study Area Benthic Stations[a], Mary River Project CREMP, August 2017

Study Area	Station	Texture of Collected Sediment	Predominant Collection Location	Silt Presence[b]
GO-09 Upstream Reference	GO-09-1	coarse sand	in-stream behind boulders	none observed
	GO-09-2	coarse sand	in-stream behind boulders	none observed
	GO-09-3	coarse sand	in-stream behind boulders	none observed
	GO-09-4	coarse sand	in-stream behind boulders	none observed
	GO-09-5	coarse sand	in-stream behind boulders	none observed
GO-03 Upstream	GO-03-1	medium to coarse sand	shoreline/bank	precipitate
	GO-03-2	medium to coarse sand	shoreline/bank	precipitate
	GO-03-3	very coarse sand	shoreline/bank	none observed
	GO-03-4	medium (sized) sand	in-stream pool habitat	none observed
	GO-03-5	coarse sand	shoreline/bank	none observed
EO-01 Upper Mine-Exposed	EO-01-1	very coarse sand	shoreline/bank	none observed
	EO-01-2	very coarse sand	shoreline/bank	none observed
	EO-01-3	very coarse sand	shoreline/bank	none observed
	EO-01-4	very coarse sand	in-stream behind boulders	none observed
	EO-01-5	very coarse sand	in-stream behind boulders	none observed
EO-20 Middle Mine-Exposed	EO-20-1	medium to coarse sand	shoreline/bank	none observed
	EO-20-2	medium to coarse sand	shoreline/bank	none observed
	EO-20-3	coarse sand	shoreline/bank; some behind boulders	none observed
	EO-20-4	very coarse sand	in-stream behind boulders	none observed
	EO-20-5	medium to coarse sand	shoreline/bank; some behind boulders	none observed
CO-05 Lower Mine-Exposed	CO-05-1	medium (sized) sand	in-stream bed material	none observed
	CO-05-2	medium (sized) sand	in-stream bed material	none observed
	CO-05-3	medium (sized) sand	in-stream bed material	none observed
	CO-05-4	medium (sized) sand	in-stream bed material	none observed
	CO-05-5	medium (sized) sand	in-stream bed material	none observed

[a] Sediment samples collected using a stainless steel scoop directly from the streambed or shoreline, as available.
[b] Silt observations described as fine material present on the surface of in-stream substrate and/or as interstitial deposits, occurring unusually.

Table D.37: Deposited Sediment Total Organic Carbon and Metal Concentrations at Mary River GO-09 Reference Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Mary River GO-09 Reference Station					Study Area Summary Statistics		
			GO-09-B1	GO-09-B2	GO-09-B3	GO-09-B4	GO-09-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	coarse sand	coarse sand	coarse sand	coarse sand	coarse sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Aluminum (Al)	mg/kg	-	799	571	637	1,220	589	763	271	121
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.00	0.00
Arsenic (As)	mg/kg	17	0.17	0.13	0.13	0.18	0.17	0.16	0.02	0.01
Barium (Ba)	mg/kg	-	4	3	3	6	2.9	4	1.2	0.5
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	0
Calcium (Ca)	mg/kg	-	713	739	547	1,730	481	842	508	227
Chromium (Cr)	mg/kg	90	3.8	4.2	2.0	4.2	3.0	3.4	1.0	0.4
Cobalt (Co)	mg/kg	-	0.76	0.7	0.48	0.9	0.5	0.7	0.19	0.08
Copper (Cu)	mg/kg	197	1.6	1.0	1.0	2	0.8	1.3	0.5	0.2
Iron (Fe)	mg/kg	40,000[α]	3,230	4,680	1,290	2,810	2,120	2,826	1,271	568
Lead (Pb)	mg/kg	91.3	1.3	1.1	1.0	1.2	1.0	1.1	0.13	0.06
Lithium (Li)	mg/kg	-	<2.0	<2.0	<2.0	3.1	<2.0	2.2	0.49	0.22
Magnesium (Mg)	mg/kg	-	694	531	617	1,750	536	826	521	233
Manganese (Mn)	mg/kg	1,100[α,β]	24	19	17	33	16	22	7.1	3.2
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	0.13	0.11	<0.10	<0.10	<0.10	0.11	0.01	0.01
Nickel (Ni)	mg/kg	75[α,β]	1.9	1.6	1.3	3.1	1.4	1.9	0.71	0.32
Phosphorus (P)	mg/kg	2,000[α]	132	170	56	138	67	113	49.0	21.9
Potassium (K)	mg/kg	-	170	120	140	300	110	168	77	35
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.00	0.00
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.000	0.000
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	1.9	2.1	1.6	2.3	1.7	1.9	0.31	0.14
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	115	100	112	145	74	109	26	12
Uranium (U)	mg/kg	-	0.30	0.3	0.3	0.4	0.3	0.3	0.03	0.01
Vanadium (V)	mg/kg	-	6.1	8.2	2.3	4.8	3.8	5.0	2.2	1.0
Zinc (Zn)	mg/kg	315	4.9	3	2.8	5	2.5	4	1.3	0.6
Zirconium (Zr)	mg/kg	-	2.0	1.5	1.5	1.9	1.4	1.7	0.3	0.1

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.38: Deposited Sediment Total Organic Carbon and Metal Concentrations at Mary River GO-03 Upstream Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Mary River CO-03 Upstream Station					Study Area Summary Statistics		
			GO-03-B1	GO-03-B2	GO-03-B3	GO-03-B4	GO-03-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	med-coarse sand	med-coarse sand	very coarse sand	medium sand	coarse sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Aluminum (Al)	mg/kg	-	696	786	783	736	948	790	96	43
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.12	0.17	0.16	0.16	0.16	0.15	0.02	0.01
Barium (Ba)	mg/kg	-	3	4	4	3	4.3	4	0.4	0.2
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.000	0.000
Calcium (Ca)	mg/kg	-	513	661	549	705	665	619	83	37
Chromium (Cr)	mg/kg	90	2.0	2.4	4.4	5.1	3.4	3.4	1.3	0.6
Cobalt (Co)	mg/kg	-	0.49	0.6	0.76	0.8	0.8	0.7	0.14	0.06
Copper (Cu)	mg/kg	197	1.2	1.0	1.4	2	1.2	1.4	0.4	0.2
Iron (Fe)	mg/kg	40,000[α]	1,290	1,870	4,090	4,920	2,410	2,916	1,532	685
Lead (Pb)	mg/kg	91.3	0.8	1.2	1.2	1.5	1.3	1.2	0.23	0.10
Lithium (Li)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Magnesium (Mg)	mg/kg	-	627	668	676	597	840	682	94	42
Manganese (Mn)	mg/kg	1,100[α,β]	16	19	21	23	24	21	3.3	1.5
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.00	0.00
Nickel (Ni)	mg/kg	75[α,β]	1.3	1.7	2.0	1.8	2.0	1.8	0.29	0.13
Phosphorus (P)	mg/kg	2,000[α]	69	141	105	185	107	121	43.7	19.6
Potassium (K)	mg/kg	-	160	160	160	160	190	166	13	6
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	1.8	2.1	1.8	2.1	2.0	1.9	0.18	0.08
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	87	102	111	136	135	114	21	10
Uranium (U)	mg/kg	-	0.27	0.3	0.3	0.4	0.3	0.3	0.03	0.01
Vanadium (V)	mg/kg	-	2.2	3.2	6.9	9.7	4.1	5.2	3.1	1.4
Zinc (Zn)	mg/kg	315	2.0	3	3.3	3	3.7	3	0.6	0.3
Zirconium (Zr)	mg/kg	-	1.4	1.7	1.7	1.8	1.9	1.7	0.2	0.1

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.39: Magnitude of Elevation in Deposited Sediment Metal Concentrations at Mary River Upper and Mine-Exposed Study Areas Compared to Reference Area Data, Mary River Project CREMP, August 2017

Parameter	Units	Mary River Reference (GO-09)	Upstream (GO-03)	Upper Mine-Exposed (EO-01)	Middle Mine-Exposed (EO-20)	Lower Mine-Exposed (CO-05)
Total Organic Carbon	%	<0.10	1.0	1.0	1.0	1.0
Aluminum (Al)	mg/kg	763	1.0	2.3	2.7	1.7
Antimony (Sb)	mg/kg	<0.10	1.0	1.0	1.0	1.0
Arsenic (As)	mg/kg	0.16	1.0	3.2	2.9	2.0
Barium (Ba)	mg/kg	4	1.0	2.4	2.4	1.4
Beryllium (Be)	mg/kg	<0.10	1.0	1.0	1.2	1.0
Bismuth (Bi)	mg/kg	<0.20	1.0	1.0	1.0	1.0
Boron (B)	mg/kg	<5.0	1.0	1.0	1.0	1.0
Cadmium (Cd)	mg/kg	<0.020	1.0	1.0	1.1	1.0
Calcium (Ca)	mg/kg	842	0.7	2.1	3.7	1.3
Chromium (Cr)	mg/kg	3.4	1.0	3.8	6.7	4.0
Cobalt (Co)	mg/kg	0.7	1.0	2.8	4.3	2.5
Copper (Cu)	mg/kg	1.3	1.1	2.0	4.5	3.1
Iron (Fe)	mg/kg	2,826	1.0	3.0	5.5	2.7
Lead (Pb)	mg/kg	1.1	1.1	1.5	2.1	1.5
Lithium (Li)	mg/kg	2.2	0.9	1.6	2.2	1.6
Magnesium (Mg)	mg/kg	826	0.8	2.7	4.4	2.3
Manganese (Mn)	mg/kg	22	0.9	2.7	3.9	2.3
Mercury (Hg)	mg/kg	<0.0050	1.0	1.0	1.0	1.0
Molybdenum (Mo)	mg/kg	0.11	0.9	1.1	1.5	0.9
Nickel (Ni)	mg/kg	1.9	0.9	4.2	8.3	5.5
Phosphorus (P)	mg/kg	113	1.1	2.1	2.8	1.9
Potassium (K)	mg/kg	168	1.0	2.9	2.8	1.4
Selenium (Se)	mg/kg	<0.20	1.0	1.0	1.0	1.0
Silver (Ag)	mg/kg	<0.10	1.0	1.0	1.0	1.0
Sodium (Na)	mg/kg	<50	1.0	1.0	1.2	1.0
Strontium (Sr)	mg/kg	1.9	1.0	1.6	1.9	1.3
Sulphur (S)	mg/kg	<1,000	1.0	1.0	1.0	1.0
Thallium (Tl)	mg/kg	<0.050	1.0	1.0	1.1	1.0
Tin (Sn)	mg/kg	<2.0	1.0	1.0	1.0	1.0
Titanium (Ti)	mg/kg	109	1.0	1.8	2.8	1.8
Uranium (U)	mg/kg	0.3	1.0	1.5	2.7	1.6
Vanadium (V)	mg/kg	5.0	1.0	2.5	5.0	2.6
Zinc (Zn)	mg/kg	4	0.8	1.7	2.5	1.5
Zirconium (Zr)	mg/kg	1.7	1.0	1.3	1.7	1.2

Denotes slight elevation (mean concentration 3 to 5 times higher than respective mean reference area value).
Denotes moderate elevation (concentration 5 to 10 times higher than respective mean reference area value).
Denotes highly elevated (mean concentration ≥10 times higher than respective mean reference area value).

Table D.40: Deposited Sediment Total Organic Carbon and Metal Concentrations at Mary River EO-01 Mine-Exposed Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Mary River Mine-Exposed Area Station					Study Area Summary Statistics		
			EO-01-B1	EO-01-B2	EO-01-B3	EO-01-B4	EO-01-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	very coarse sand	very coarse sand	very coarse sand	very coarse sand	very coarse sand	-	-	-
Total Organic Carbon	%	10[α]	0.11	<0.10	<0.10	<0.10	<0.10	0.10	0.00	0.002
Aluminum (Al)	mg/kg	-	2,710	2,470	745	1,010	2,020	1,791	875	391
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.37	0.34	0.22	0.20	1.40	0.51	0.51	0.23
Barium (Ba)	mg/kg	-	14	13	3	5	8.2	9	4.8	2.1
Beryllium (Be)	mg/kg	-	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	0	0
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	0
Calcium (Ca)	mg/kg	-	2,700	2,030	685	864	2,470	1,750	924	413
Chromium (Cr)	mg/kg	90	16.1	10.1	11.0	9.1	19.0	13.1	4.3	1.9
Cobalt (Co)	mg/kg	-	2.69	2.1	1.18	1.1	2.2	1.9	0.69	0.31
Copper (Cu)	mg/kg	197	3.3	2.8	1.1	2	3.1	2.5	0.9	0.4
Iron (Fe)	mg/kg	40,000[α]	14,400	6,740	8,490	5,680	7,360	8,534	3,433	1,535
Lead (Pb)	mg/kg	91.3	2.4	2.0	1.1	1.3	1.6	1.7	0.51	0.23
Lithium (Li)	mg/kg	-	4.4	4.4	<2.0	2.3	4.6	3.5	1.28	0.57
Magnesium (Mg)	mg/kg	-	3,270	2,840	691	1,070	3,390	2,252	1,276	571
Manganese (Mn)	mg/kg	1,100[α,β]	87	68	37	35	68	59	22.4	10.0
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	0.18	0.11	<0.10	<0.10	<0.10	0.12	0.03	0.02
Nickel (Ni)	mg/kg	75[α,β]	9.2	8.5	4.1	4.3	13.2	7.8	3.79	1.70
Phosphorus (P)	mg/kg	2,000[α]	380	269	180	136	216	236	94.0	42.0
Potassium (K)	mg/kg	-	840	730	150	230	450	480	302	135
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.00	0.00
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.000	0.000
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	3.3	3.1	2.1	2.2	5.0	3.1	1.16	0.52
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	0.053	0.052	<0.050	<0.050	<0.050	0.051	0.001	0.001
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	276	249	130	117	232	201	72	32
Uranium (U)	mg/kg	-	0.65	0.5	0.3	0.3	0.4	0.4	0.15	0.07
Vanadium (V)	mg/kg	-	20.0	9.1	14.4	8.8	11.1	12.7	4.7	2.1
Zinc (Zn)	mg/kg	315	9.0	8.0	2.9	3.6	7.9	6.3	2.8	1.3
Zirconium (Zr)	mg/kg	-	2.6	2.7	1.6	1.8	2.3	2.2	0.5	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.41: Deposited Sediment Total Organic Carbon and Metal Concentrations at Mary River EO-20 Mine-Exposed Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Mary River Mine-Exposed Area Station					Study Area Summary Statistics		
			EO-20-B1	EO-20-B2	EO-20-B3	EO-20-B4	EO-20-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	med-coarse sand	med-coarse sand	coarse sand	very coarse sand	med-coarse sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Aluminum (Al)	mg/kg	-	1,120	884	4,380	847	2,940	2,034	1,573	703
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.36	0.34	0.71	0.29	0.59	0.46	0.18	0.08
Barium (Ba)	mg/kg	-	5	4	19	4	12.0	9	6.4	2.9
Beryllium (Be)	mg/kg	-	<0.10	<0.10	0.19	<0.10	0.13	0.12	0.04	0.02
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	6.0	<5.0	<5.0	5.2	0.45	0.20
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	0.031	<0.020	0.022	0.02	0.005	0.002
Calcium (Ca)	mg/kg	-	1,900	1,070	7,040	739	4,720	3,094	2,706	1,210
Chromium (Cr)	mg/kg	90	26.0	21.8	36.0	8.4	23.5	23.1	9.9	4.4
Cobalt (Co)	mg/kg	-	2.69	2.4	4.82	1.2	3.4	2.9	1.34	0.60
Copper (Cu)	mg/kg	197	2.3	16.4	4.8	1	4.1	5.8	6.1	2.7
Iron (Fe)	mg/kg	40,000[α]	28,400	19,000	12,800	6,090	11,300	15,518	8,546	3,822
Lead (Pb)	mg/kg	91.3	2.2	2.2	3.3	1.5	2.4	2.3	0.66	0.29
Lithium (Li)	mg/kg	-	2.4	<2.0	10.7	<2.0	7.3	4.9	3.95	1.77
Magnesium (Mg)	mg/kg	-	1,370	922	9,080	925	5,790	3,617	3,678	1,645
Manganese (Mn)	mg/kg	1,100[α,β]	68	56	146	31	125	85	48.4	21.7
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	0.11	<0.10	0.25	<0.10	0.25	0.16	0.08	0.04
Nickel (Ni)	mg/kg	75[α,β]	6.6	8.3	35.4	5.2	21.2	15.3	12.89	5.77
Phosphorus (P)	mg/kg	2,000[α]	356	308	517	124	276	316	141.9	63.5
Potassium (K)	mg/kg	-	250	180	1,110	160	630	466	407	182
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.00	0.00
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.000	0.000
Sodium (Na)	mg/kg	-	<50	<50	80	<50	63	59	13	6
Strontium (Sr)	mg/kg	-	2.9	2.5	6.0	2.3	4.6	3.6	1.59	0.71
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	0.076	<0.050	<0.050	0.055	0.012	0.005
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	204	200	507	139	471	304	171	77
Uranium (U)	mg/kg	-	0.68	0.6	1.1	0.9	0.7	0.8	0.22	0.10
Vanadium (V)	mg/kg	-	44.4	34.6	18.4	10.1	17.4	25.0	14.1	6.3
Zinc (Zn)	mg/kg	315	5.6	5	18.8	3	13.6	9	6.8	3.0
Zirconium (Zr)	mg/kg	-	2.2	1.9	4.5	1.8	3.5	2.8	1.2	0.5

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.42: Deposited Sediment Total Organic Carbon and Metal Concentrations at Mary River Downstream (CO-05) Benthic Stations, Mary River Project CREMP, August 2017

Analyte	Units	Sediment Quality Guideline (SQG)[a]	Mary River Downstream Mine-Exposed Area Station					Study Area Summary Statistics		
			CO-05-B1	CO-05-B2	CO-05-B3	CO-05-B4	CO-05-B5	Mean	Standard Deviation	Standard Error
Substrate Description	-	-	medium sand	medium sand	medium sand	medium sand	medium sand	-	-	-
Total Organic Carbon	%	10[α]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Aluminum (Al)	mg/kg	-	672	599	1,140	1,920	2,180	1,302	719	322
Antimony (Sb)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Arsenic (As)	mg/kg	17	0.39	0.19	0.27	0.38	0.33	0.31	0.08	0.04
Barium (Ba)	mg/kg	-	4	3	5	7	7.5	5	2.2	1.0
Beryllium (Be)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	0.11	0.10	0.004	0.002
Bismuth (Bi)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Boron (B)	mg/kg	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0	0
Cadmium (Cd)	mg/kg	3.5	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	0
Calcium (Ca)	mg/kg	-	818	314	818	1,660	1,670	1,056	593	265
Chromium (Cr)	mg/kg	90	25.2	2.8	6.9	15.3	18.0	13.7	8.9	4.0
Cobalt (Co)	mg/kg	-	2.04	0.5	1.25	2.2	2.4	1.7	0.80	0.36
Copper (Cu)	mg/kg	197	12.2	0.9	1.7	2	2.6	3.9	4.7	2.1
Iron (Fe)	mg/kg	40,000[α]	23,100	1,390	3,060	5,290	5,790	7,726	8,774	3,924
Lead (Pb)	mg/kg	91.3	2.1	0.8	1.4	2.2	1.8	1.6	0.58	0.26
Lithium (Li)	mg/kg	-	<2.0	<2.0	2.7	5.0	6.0	3.5	1.85	0.83
Magnesium (Mg)	mg/kg	-	591	550	1,660	3,170	3,500	1,894	1,393	623
Manganese (Mn)	mg/kg	1,100[α,β]	47	26	40	60	73	49	18.0	8.0
Mercury (Hg)	mg/kg	0.486	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0	0
Molybdenum (Mo)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Nickel (Ni)	mg/kg	75[α,β]	6.7	3.1	8.3	16.2	17.0	10.3	6.09	2.72
Phosphorus (P)	mg/kg	2,000[α]	260	<50	155	325	277	213	110.4	49.4
Potassium (K)	mg/kg	-	120	100	200	350	410	236	138	62
Selenium (Se)	mg/kg	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0	0
Silver (Ag)	mg/kg	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0	0
Sodium (Na)	mg/kg	-	<50	<50	<50	<50	<50	<50	0	0
Strontium (Sr)	mg/kg	-	2.5	1.6	2.3	3.1	3.1	2.5	0.64	0.29
Sulphur (S)	mg/kg	-	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	0	0
Thallium (Tl)	mg/kg	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	0
Tin (Sn)	mg/kg	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0	0
Titanium (Ti)	mg/kg	-	196	79	162	250	281	194	79	35
Uranium (U)	mg/kg	-	0.59	0.2	0.4	0.6	0.6	0.5	0.19	0.08
Vanadium (V)	mg/kg	-	38.6	2.3	4.8	9.2	9.9	12.9	14.7	6.6
Zinc (Zn)	mg/kg	315	4.4	2	4.2	8	8.4	5	2.6	1.2
Zirconium (Zr)	mg/kg	-	2.0	1.3	1.6	2.4	2.6	2.0	0.5	0.2

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

(grey box) Indicates parameter concentration above Sediment Quality Guideline (SQG).

Table D.43: Field Observations of Sediment Properties at Mary Lake (BLO) Benthic Stations[a], Mary River Project CREMP, August 2017

Station	Station Depth (m)	Colour and Texture Observations	Evidence of Anoxia[b]	Plant or Algal Presence
BLO-01	9.8	medium brown silt over gray-brown compact silt	none detected	none observed
BLO-11	9.1	medium gray-brown silty sand	none detected	aquatic moss (common)
BLO-7	12.0	iron oxide over medium brown silt	none detected	none observed
BLO-6	6.6	medium brown silt with some fine sand; no precipitate layer observed	none detected	none observed
BLO-3	15.0	sand; no precipitate layer observed	none detected	none observed
BLO-15	29.0	orangish brown silt; black streaking at 1 cm depth in sediment	black streaking at 1 cm depth in sediment	aquatic moss (sparse)
BLO-14	20.0	orangish brown silt; some minor black streaking in sediment	minor black streaking in sediment	none observed
BLO-13	22.0	medium brown silt	none detected	none observed
BLO-4	22.0	medium brown silt	none detected	none observed
BLO-5	21.5	medium brown silt with some sand	none detected	none observed

[a] Sediment particle size and benthic invertebrate community samples were collected by Petite-Ponar.
[b] Evidence of anoxic sediments assessed visually as the presence of blackened substrate, and by smell based on presence/strength of hydrogen sulphide odour.

Table D.44: Observations from Sediment Cores Collected at Mary Lake (BLO), Mary River Project CREMP, August 2017

Sample Station	Station Depth (m)	Station Type	Core #	Core Length (cm)	Surface (Top 2 cm) Description
BLO-01	9.8	Littoral	1	14.0	Silt loam
			2	16.0	
			3	21.0	
BLO-16	30.5	Profundal	1	22.0	Clay loam
			2	24.0	
			3	18.0	
BLO-03	16.0	Profundal	1	12.0	Loamy sand
			2	10.0	
			3	13.0	
BLO-14	20.0	Profundal	1	10.0	Silty clay / Clay
			2	15.0	
			3	12.0	
BLO-12	20.0	Profundal	1	10.0	Silt loam
			2	12.0	
			3	10.0	
BLO-04	19.5	Profundal	1	13.0	Silt loam
			2	14.0	
			3	12.0	
BLO-10	9.8	Profundal	1	14.0	Silty clay loam
			2	16.0	
			3	21.0	
BLO-09	30.0	Profundal	1	12.0	Silty clay loam
			2	16.0	
			3	10.0	
BLO-08	25.8	Profundal	1	12.0	Silty clay loam
			2	8.0	
			3	10.0	
BLO-06	5.5	Littoral	1	8.0	Silty clay loam
			2	7.0	
			3	9.0	
BLO-DUP (duplicate of BLO-04)	19.5	Profundal	1	11.0	Silty clay loam
			2	18.0	
			3	15.0	

Table D.45: Sediment Particle Size, Total Organic Carbon, and Metal Concentrations at Mary Lake (BLO) Sediment Stations, Mary River Project CREMP, August 2017

	Analyte	Units	Sediment Quality Guideline (SQG)[a]	AEMP Benchmark[b]	Mary Lake Stations															Study Area Summary Statistics		
					BLO-01 (littoral)	BLO-16 (profundal)	BLO-03 (profundal)	BLO-15 (profundal)	BLO-14 (profundal)	BLO-05 (profundal)	BLO-11 (littoral)	BLO-12 (profundal)	BLO-13 (profundal)	BLO-04 (profundal)	BLO-10 (profundal)	BLO-09 (profundal)	BLO-08 (profundal)	BLO-07 (littoral)	BLO-06 (littoral)	Mean	Standard Deviation	Standard Error
Non-metals	Sand	%	-	-	17	22	87	13	16	49	78	18	6	14	5	4.0	2.6	7.9	11.3	20	24	7.7
	Silt	%	-	-	74	48	10.0	47	39	45	19	68	71	65	62	67	67	59	56	55	19	6.0
	Clay	%	-	-	10	30	3.3	40	45	7	3	14	23	21	33	30	31	33	33	25	13	4.0
	Moisture	%	-	-	48	56	19	65	57	29	21	46	56	47	48	56	51	70	48	47	10.7	3.4
	Total Organic Carbon	%	10[α]	-	1.38	1.30	0.48	0.96	0.97	0.74	0.50	0.85	0.8	0.64	0.85	0.90	0.96	1.07	0.78	0.91	0.27	0.086
Metals	Aluminum (Al)	mg/kg	-	-	14,900	24,700	5,570		27,400			18,300		18,800	24,200	24,300	27,400		21,200	20,677	6,693	2,117
	Antimony (Sb)	mg/kg	-	-	<0.10	<0.10	<0.10		<0.10			<0.10		<0.10	<0.10	<0.10	<0.10		<0.10	<0.10	0	0
	Arsenic (As)	mg/kg	17	5.9	4.48	5.74	1.19		3.80			2.55		2.50	3.17	3.29	3.86		2.77	3.33	1.24	0.39
	Barium (Ba)	mg/kg	-	-	85	117	26		111			73.6		79.5	104	112	107		88	90.3	27.3	8.62
	Beryllium (Be)	mg/kg	-	-	0.77	1.16	0.25		1.30			0.86		0.87	1.13	1.11	1.26		1.01	0.97	0.308	0.0975
	Bismuth (Bi)	mg/kg	-	-	<0.20	0.23	<0.20		0.23			<0.20		<0.20	0.22	0.26	0.27		<0.20	0.22	0.026	0.008
	Boron (B)	mg/kg	-	-	19.4	36.8	10.9		39.8			26.0		25.2	31.2	34.9	40.1		27.9	29.2	9.34	2.95
	Cadmium (Cd)	mg/kg	3.5	1.5	0.112	0.190	0.043		0.167			0.1190		0.114	0.148	0.181	0.174		0.098	0.135	0.0459	0.01450
	Calcium (Ca)	mg/kg	-	-	8,550	3,720	1,150		4,350			4,360		4,165	4,420	4,640	5,090		3,850	4,430	1,799	569.0
	Chromium (Cr)	mg/kg	90	98	65.4	87.3	20.5		88.6			74.3		71.2	87.1	93	***105***		74.8	76.8	23.0	7.28
	Cobalt (Co)	mg/kg	-	-	14.2	16.7	4.6		17.8			13.6		13.2	16.8	17.5	19.2		14.5	14.8	4.12	1.302
	Copper (Cu)	mg/kg	110	50	29.1	36	7.8		36.6			26.1		25.7	33.4	34.6	38.2		28.2	29.6	8.91	2.82
	Iron (Fe)	mg/kg	40,000[α]	52,400	34,800	48,400	14,400		43,900			33,200		33,000	40,900	40,300	45,100		35,400	36,940	9,533	3,014
	Lead (Pb)	mg/kg	91.3	35	14.6	23.9	5.3		24.9			15.9		16.9	22.2	22.2	25.3		18.3	19.0	6.15	1.94
	Lithium (Li)	mg/kg	-	-	29.2	44.0	10.0		48.8			32.6		33.8	43.5	43.3	47.5		37.9	37.1	11.6	3.65
	Magnesium (Mg)	mg/kg	-	-	15,000	16,300	3,740		17,400			13,600		13,200	16,700	16,800	18,900		13,700	14,534	4,220	1,335
	Manganese (Mn)	mg/kg	1,100[α,β]	4,370	1,270	624	1,120		760			1,360		559	677		1,870		554	977	456	152
	Mercury (Hg)	mg/kg	0.486	0.17	0.0328	0.0752	0.0197		0.0667			0.0420		0.0347	0.0568	0.0691	0.0686		0.0218	0.0487	0.0210	0.00664
	Molybdenum (Mo)	mg/kg	-	-	0.71	0.95	0.37		0.65			0.76		0.62	0.68	1.28	0.94		0.55	0.75	0.25	0.08
	Nickel (Ni)	mg/kg	75[α,β]	72	54.5	61.7	15.3		59.1			53.9		47.7	59.3	68	***73.8***		49.8	54.3	15.8	5.00
	Phosphorus (P)	mg/kg	2,000[α]	1,580	1,060	1,200	323		788			860		759	777	827	931		679	820	233	74
	Potassium (K)	mg/kg	-	-	3,640	6,520	1,490		7,190			4,690		4,995	6,440	6,410	7,320		5,530	5,423	1,805	571
	Selenium (Se)	mg/kg	-	-	<0.20	0.28	<0.20		0.33			<0.20		<0.20	0.22	0.24	0.26		<0.20	0.23	0.045	0.014
	Silver (Ag)	mg/kg	-	-	<0.10	0.15	<0.10		0.15			0.11		0.12	0.15	0.15	0.17		<0.10	0.13	0.027	0.008
	Sodium (Na)	mg/kg	-	-	258	432	91		425			314		332	398	428	464		323	346	111.3	35.2
	Strontium (Sr)	mg/kg	-	-	11.5	17.6	4.3		15.7			11.3		11.7	13.5	15.0	16.7		11.9	12.9	3.80	1.202
	Sulphur (S)	mg/kg	-	-	<1,000	<1,000	<1,000		<1,000			<1,000		<1,000	<1,000	<1,000	<1,000		<1,000	<1,000	0	0
	Thallium (Tl)	mg/kg	-	-	0.325	0.51	0.128		0.588			0.382		0.412	0.533	0.541	0.578		0.470	0.447	0.141	0.0447
	Tin (Sn)	mg/kg	-	-	<2.0	<2.0	<2.0		<2.0			<2.0		<2.0	<2.0	<2.0	<2.0		<2.0	<2.0	0.000	0.000
	Titanium (Ti)	mg/kg	-	-	985	1,420	371		1,620			1,340		1,405	1,640	1,580	1,780		1,410	1,355	408	129
	Uranium (U)	mg/kg	-	-	3.85	8.71	2.25		9.0			6.30		6.50	8.5	8.35	8.7		5.1	6.71	2.34	0.742
	Vanadium (V)	mg/kg	-	-	50.1	70.8	17.0		74.2			53.0		55.0	68.5	67.4	75.5		60.2	59.2	17.3	5.48
	Zinc (Zn)	mg/kg	315	135	52	77	18.7		85.3			59.7		61.4	78.5	77.4	86		66.4	66.2	20.2	6.38
	Zirconium (Zr)	mg/kg	-	-	9.7	22.7	4.3		24.7			17.1		20.1	25.2	20.1	25.3		15.3	18.4	7.02	2.22

[a] Canadian Sediment Quality Guideline for the protection of aquatic life, probable effects level (PEL; CCME 2015) except those indicated by α (Ontario Provincial Sediment Quality Objective [PSQO], severe effect level (SEL); OMOE 1993) and β (British Columbia Working Sediment Quality Guideline [BCSQG], probable effects level (PEL; BCMOE 2015)).

[b] AEMP Sediment Quality Benchmarks developed by Intrinsik (2013) using sediment quality guidelines, background sediment quality data, and method detection limits. The indicated values are specific to Mary Lake.

(shaded) Indicates parameter concentration above Sediment Quality Guideline (SQG).

BOLD Indicates parameter concentration above the AEMP Benchmark.

Table D.46: **Magnitude of Elevation in Sediment Metal Concentrations between Mary Lake and Reference Lake 3 2017 Data, and between Mary Lake 2017 and Baseline Data, Mary River Project CREMP, 2017**

Parameter	Mary Lake versus Reference Lake 3 in 2017				Mary Lake 2017 versus Baseline Period			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Reference Lake Concentration (mg/kg)	Magnitude of Elevation	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Elevation	Mary Lake Baseline Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	14,720	1.2	22,140	1.0	18,267	1.0	17,000	1.3
Antimony (Sb)	<0.10	1.0	0.10	1.0	1.0	0.1	1.0	0.1
Arsenic (As)	3.4	1.1	4.8	0.7	2.8	1.3	3.7	0.9
Barium (Ba)	113	0.8	138	0.7	105	0.8	76	1.2
Beryllium (Be)	0.6	1.6	0.9	1.2	1.0	0.9	1.0	1.0
Bismuth (Bi)	<0.20	1.0	0.20	1.1	-	-	-	-
Boron (B)	12.1	1.9	16.6	1.8	1	32.3	2	14.7
Cadmium (Cd)	0.2	0.6	0.2	0.8	0.5	0.2	0.5	0.3
Calcium (Ca)	4,656	1.3	5,262	0.8	3,130	2.0	2,934	1.4
Chromium (Cr)	51	1.4	70	1.1	81	0.9	76	1.0
Cobalt (Co)	11	1.4	16	0.9	18	0.8	18	0.8
Copper (Cu)	65	0.4	88	0.3	45	0.6	44	0.7
Iron (Fe)	41,960	0.8	46,740	0.8	36,133	1.0	35,654	1.0
Lead (Pb)	12	1.3	17	1.2	18	0.9	21	0.9
Lithium (Li)	24	1.4	35	1.1	-	-	-	-
Magnesium (Mg)	10,256	1.4	14,660	1.0	13,967	1.0	10,903	1.3
Manganese (Mn)	639	1.4	1,266	0.8	699	1.3	991	1.0
Mercury (Hg)	0.0440	0.6	0.0528	1.0	0.100	0.3	0.100	0.5
Molybdenum (Mo)	3.498	0.2	2.898	0.3	1.0	0.6	1.0	0.8
Nickel (Ni)	38	1.4	49	1.1	67	0.8	65	0.8
Phosphorus (P)	1,039	0.8	1,073	0.8	800	1.1	1,325	0.6
Potassium (K)	3,754	1.2	5,694	1.0	3,450	1.3	4,287	1.3
Selenium (Se)	0.6	0.3	0.6	0.4	1.0	0.2	1.0	0.2
Silver (Ag)	0.1	0.8	0.2	0.7	0.3	0.4	0.4	0.4
Sodium (Na)	284	1.0	410	0.9	279	1.0	284	1.3
Strontium (Sr)	10.0	1.2	12.7	1.0	9.3	1.3	13.3	1.0
Sulphur (S)	1,120	0.9	1,140	0.9	-	-	-	-
Thallium (Tl)	0.346	1.1	0.657	0.7	1.0	0.4	1.0	0.5
Tin (Sn)	2	0.9	2	1.0	-	-	-	-
Titanium (Ti)	997	1.2	1,288	1.1	-	-	-	-
Uranium (U)	11	0.4	23	0.3	-	-	-	-
Vanadium (V)	48	1.2	67	0.9	69	0.8	63	1.0
Zinc (Zn)	67	0.9	91	0.7	67	0.9	64	1.1

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective mean reference lake value or baseline period, as applicable).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective mean reference area value or baseline period value, as applicable).
Denotes high levitation (mean parameter concentration is≥ 10 times higher than respective mean reference area value or baseline period value, as applicable).

Table D.47: Magnitude of Elevation in Sediment Metal Concentrations between Mary Lake 2015 and 2017 Data, and between Mary Lake 2016 and 2017 Data, Mary River Project CREMP

Parameter	Mary Lake 2017 versus Initial Year of Mine Operation (2015)				Mary Lake 2017 versus Second Year of Mine Operation (2016)			
	Littoral Stations		Profundal Stations		Littoral Stations		Profundal Stations	
	Mary Lake 2015 Concentration (mg/kg)	Magnitude of Elevation	Mary Lake 2015 Concentration (mg/kg)	Magnitude of Elevation	Mary Lake 2016 Concentration (mg/kg)	Magnitude of Elevation	Mary Lake 2016 Concentration (mg/kg)	Magnitude of Elevation
Aluminum (Al)	21,300	0.8	24,913	0.9	19,333	0.9	21,533	1.0
Antimony (Sb)	0.1	1.0	0.1	1.0	0.1	1.0	0.1	1.0
Arsenic (As)	4.9	0.7	5.2	0.6	3.7	1.0	3.5	0.9
Barium (Ba)	94	0.9	98	0.9	88	1.0	89	1.0
Beryllium (Be)	1.1	0.8	1.2	0.8	1.0	0.9	1.1	0.9
Bismuth (Bi)	0.2	0.8	0.3	0.8	0.2	0.9	0.2	0.9
Boron (B)	33	0.7	36	0.8	27	0.9	30	1.0
Cadmium (Cd)	0.1	0.9	0.1	1.0	0.1	0.9	0.1	1.1
Calcium (Ca)	6,995	0.9	4,583	0.9	5,930	1.0	4,603	0.9
Chromium (Cr)	79	0.9	92	0.9	74	1.0	81	1.0
Cobalt (Co)	16	0.9	18	0.8	15	1.0	15	1.0
Copper (Cu)	31	0.9	34	0.9	28	1.0	30	1.0
Iron (Fe)	38,750	0.9	43,019	0.9	35,525	1.0	36,400	1.0
Lead (Pb)	22	0.7	25	0.8	22	0.7	25	0.8
Lithium (Li)	42.3	0.8	47.0	0.8	38	0.9	40	1.0
Magnesium (Mg)	15,750	0.9	16,063	0.9	14,517	1.0	14,633	1.0
Manganese (Mn)	1,222	0.7	1,681	0.6	1,690	0.5	1,047	1.0
Mercury (Hg)	0.035	0.8	0.050	1.1	0.0	0.7	0.1	1.0
Molybdenum (Mo)	0.8	0.8	1.0	0.8	0.8	0.8	0.9	0.8
Nickel (Ni)	58	0.9	66	0.8	55	0.9	60	0.9
Phosphorus (P)	947	0.9	984	0.8	919	0.9	865	0.9
Potassium (K)	5,400	0.8	6,237	0.9	4,668	1.0	5,210	1.1
Selenium (Se)	0.2	0.9	0.2	1.0	0.2	1.0	0.2	1.1
Silver (Ag)	0.1	0.7	0.2	0.8	0.1	0.9	0.1	1.0
Sodium (Na)	331	0.9	382	0.9	298	1.0	331	1.1
Strontium (Sr)	15.3	0.8	16.4	0.8	13	0.9	14	1.0
Sulphur (S)	5,000	0.2	5,000	0.2	5,000	0.2	5,000	0.2
Thallium (Tl)	0.5	0.7	0.6	0.7	0.5	0.9	0.5	0.9
Tin (Sn)	2.0	1.0	2.0	1.0	6.5	0.3	8.3	0.2
Titanium (Ti)	1,401	0.9	1,565	0.9	1,339	0.9	1,407	1.0
Uranium (U)	7.4	0.6	9.7	0.8	7.0	0.6	8.6	0.8
Vanadium (V)	61	0.9	68	0.9	55	1.0	59	1.0
Zinc (Zn)	71	0.8	82	0.8	65	0.9	70	1.0

Denotes slight elevation (mean parameter concentration is 3 to 5 times higher than respective average value from previous study).
Denotes moderate elevation (mean parameter concentration 5 to 10 times higher than respective average value from previous study).
Denotes high elevation (mean parameter concentration is≥ 10 times higher than respective average value from previous study).

APPENDIX E

PHYTOPLANKTON DATA

Table E.1: Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Lotic Reference Stations, the Camp Lake Tributaries, Sheardown Lake Tributary 1 and the Tom River, Mary River Project CREMP, 2017

	Station	Reference Creek Stations				Camp Lake Tributary 1 (CLT1)						Camp Lake Tributary 2	Camp Lake Outlet	Sheardown Lake Tributary 1 (SDLT1)		Tom River
						North Branch		Main Stem								
		CLT-REF3	CLT-REF4	MRY-REF2	MRY-REF3	L1-08	L1-02	L2-03	L1-09	L1-05	L0-01	K0-01	J0-01	D1-05	D1-00	I0-01
Sample Collection Date	Spring	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	9-Jul-17	9-Jul-17	7-Jul-17	7-Jul-17	7-Jul-17	7-Jul-17	7-Jul-17	9-Jul-17	9-Jul-17	9-Jul-17	7-Jul-17
	Summer	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	28-Jul-17	28-Jul-17	28-Jul-17	28-Jul-17	28-Jul-17	27-Jul-17	10-Aug-17	28-Jul-17	28-Jul-17	27-Jul-17
	Fall	27-Aug-17	27-Aug-17	27-Aug-17	27-Aug-17	1-Sep-17	27-Aug-17	27-Aug-17	27-Aug-17	27-Aug-17	27-Aug-17	27-Aug-17	1-Sep-17	28-Aug and 1-Sep, 2017	28-Aug and 1-Sep, 2017	27-Aug-17
Chlorophyll a (µg/L)	Spring	0.15	0.17	0.19	0.11	<0.10	0.24	0.43	0.24	0.23	0.19	0.11	-	0.24	0.63	0.13
	Summer	0.17	0.19	0.14	0.13	0.11	0.19	1.31	0.38	0.21	0.38	0.13	0.61	0.16	0.24	0.12
	Fall	0.39	0.63	0.48	0.56	<0.10	0.59	0.79	0.77	1.44	0.78	1.04	1.01	0.18	0.26	0.94
	Average	0.24	0.33	0.27	0.27	0.10	0.34	0.84	0.46	0.63	0.45	0.43	0.81	0.19	0.38	0.40
	Standard Deviation	0.13	0.26	0.18	0.25	0.01	0.22	0.44	0.27	0.70	0.30	0.53	0.28	0.04	0.22	0.47
	Standard Error	0.08	0.15	0.11	0.15	0.00	0.13	0.26	0.16	0.41	0.17	0.31	0.16	0.02	0.13	0.27
Phaeophytin a (µg/L)	Spring	0.18	0.18	0.28	0.13	0.17	0.25	0.37	0.27	0.24	0.27	0.21	-	0.30	0.38	0.19
	Summer	0.32	0.25	0.38	1.00	0.24	0.40	0.93	0.38	0.39	0.66	0.26	0.55	0.32	0.37	0.31
	Fall	0.34	0.32	0.31	0.52	0.18	0.41	0.40	0.43	0.67	0.38	0.42	0.46	0.17	0.26	0.46
	Average	0.28	0.25	0.32	0.55	0.20	0.35	0.57	0.36	0.43	0.44	0.30	0.51	0.26	0.34	0.32
	Standard Deviation	0.09	0.07	0.05	0.44	0.04	0.09	0.32	0.08	0.22	0.20	0.11	0.06	0.08	0.07	0.14
	Standard Error	0.05	0.04	0.03	0.25	0.02	0.05	0.18	0.05	0.13	0.12	0.06	0.04	0.05	0.04	0.08

Table E.2: Chlorophyll a Concentration (mg/L) Data Summary and Statistical Comparison Results between Camp Lake Tributary 1 Main Stem Stations and Lotic Reference Creek Stations for Spring, Summer and Fall Sampling Events in 2017

Season	Two-Sample Comparison			Study Area	Mean (n = 4)	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test					Lower Bound	Upper Bound		
Spring	YES	0.0455	β	Reference	0.155	0.034	0.017	0.101	0.209	0.110	0.190
				CLT1 Main Stem	0.273	0.107	0.054	0.102	0.443	0.190	0.430
Summer	YES	0.0371	β	Reference	0.158	0.028	0.014	0.114	0.201	0.130	0.190
				CLT1 Main Stem	0.570	0.500	0.250	-0.225	1.365	0.210	1.310
Fall	YES	0.0197	β , ζ	Reference	0.515	0.103	0.052	0.350	0.680	0.390	0.630
				CLT1 Main Stem	0.945	0.330	0.165	0.420	1.470	0.770	1.440

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance.

Table E.3: Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Reference Lake 3 (REF-03), Mary River Project CREMP, 2017

	Analyte	Chlorophyll a (µg/L)						Phaeophytin a (µg/L)					
	Station	**REF3-01**	**REF3-02**	**REF3-03**	**Average**	**Standard Deviation**	**Standard Error**	**REF3-01**	**REF3-02**	**REF3-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Summer	12-Aug-17	12-Aug-17	12-Aug-17	-	-	-	12-Aug-17	12-Aug-17	12-Aug-17	-	-	-
	Fall	2-Sep-17	2-Sep-17	2-Sep-17	-	-	-	2-Sep-17	2-Sep-17	2-Sep-17	-	-	-
Summer	Surface	0.58	0.59	0.6	0.59	0.01	0.01	0.495	0.46	0.46	0.47	0.02	0.01
	Bottom	0.55	0.88	0.61	0.68	0.18	0.10	0.44	0.62	0.56	0.54	0.09	0.05
	Average	0.56	0.74	0.61	0.63	0.09	0.05	0.47	0.54	0.51	0.51	0.04	0.02
Fall	Surface	0.91	0.93	0.94	0.93	0.02	0.01	0.57	0.50	0.44	0.50	0.07	0.04
	Bottom	0.96	0.87	0.87	0.90	0.05	0.03	0.5	0.59	0.51	0.53	0.05	0.03
	Average	0.94	0.90	0.91	0.91	0.02	0.01	0.54	0.55	0.48	0.52	0.04	0.02

Table E.4: Statistical Comparisons of Chlorophyll a Concentrations Among Years at Reference Lake 3, Mary River Project CREMP

Season	Overall 3-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test
Summer	YES	0.03355	α	2015	0.90	2015	2016	NO	0.9640	Tukey's
				2016	0.92	2015	2017	YES	0.0588	
				2017	0.63	2016	2017	YES	0.0428	
Fall	NO	0.26054	α	2015	1.06	2015	2016	NO	0.5996	Tamhane's
				2016	0.74	2015	2017	NO	0.9138	
				2017	0.91	2016	2017	NO	0.1224	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.5: **Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Camp Lake (JLO), Mary River Project CREMP, 2017**

	Analyte	Chlorophyll a (µg/L)							
	Station	JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	11-Apr-17	11-Apr-17	14-Apr-17	11-Apr-17	11-Apr-17	-	-	-
	Summer	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	-	-	-
	Fall	26-Aug-17	25-Aug-17	26-Aug-17	26-Aug-17	25-Aug-17	-	-	-
Winter	Surface	0.58	0.36	0.46	0.32	0.34	0.41	0.11	0.05
	Bottom	0.42	0.21	0.15	0.22	<0.10	0.22	0.12	0.05
	Average	0.50	0.29	0.31	0.27	0.22	0.32	0.11	0.05
Summer	Surface	1.14	1.33	1.26	1.40	1.18	1.26	0.11	0.05
	Bottom	1.07	1.52	1.07	1.39	1.07	1.22	0.22	0.10
	Average	1.11	1.43	1.17	1.40	1.13	1.24	0.15	0.07
Fall	Surface	1.27	0.96	1.31	1.18	0.82	1.11	0.21	0.09
	Bottom	1.22	1.18	1.45	1.29	1.19	1.27	0.11	0.05
	Average	1.25	1.07	1.38	1.24	1.01	1.19	0.15	0.07

	Analyte	Phaeophytin a (µg/L)							
	Station	JL0-02	JL0-10	JL0-01	JL0-07	JL0-09	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	11-Apr-17	11-Apr-17	14-Apr-17	11-Apr-17	11-Apr-17	-	-	-
	Summer	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	24-Jul-17	-	-	-
	Fall	26-Aug-17	25-Aug-17	26-Aug-17	26-Aug-17	25-Aug-17	-	-	-
Winter	Surface	0.60	0.32	0.34	0.27	0.33	0.37	0.13	0.06
	Bottom	0.39	0.23	0.19	0.19	0.18	0.24	0.09	0.04
	Average	0.50	0.28	0.27	0.23	0.26	0.30	0.11	0.05
Summer	Surface	0.80	0.83	0.69	0.84	1.02	0.84	0.12	0.05
	Bottom	0.80	0.86	0.86	0.88	0.86	0.85	0.03	0.01
	Average	0.80	0.85	0.78	0.86	0.94	0.84	0.06	0.03
Fall	Surface	0.66	0.41	0.60	0.61	0.35	0.53	0.14	0.06
	Bottom	0.56	0.54	0.65	0.74	0.45	0.59	0.11	0.05
	Average	0.61	0.48	0.63	0.68	0.40	0.56	0.11	0.05

Table E.6: Statistical Comparisons of Chlorophyll a Concentrations Among Winter, Spring, Summer and/or Fall Sampling Events at Mine-Exposed and Reference Creek and Lake Study Areas, Mary River Project CREMP, 2017

Study Area	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Seasons?	p-value	Statistical Test[b]	(I) Season	(J) Season	Significant Difference Between 2 Seasons?	p-value	Statistical Test
Reference Creek Stations	YES	0.00003	ANOVA[a]	Spring	Summer	NO	0.9993	Tamhane's[a]
				Spring	Fall	YES	0.0112	
				Summer	Fall	YES	0.0133	
Mary River GO-09 Reference Stations	NO	0.32438	ANOVA[a]	Spring	Summer	NO	0.3755	Tukey's[a]
				Spring	Fall	NO	0.9990	
				Summer	Fall	NO	0.3943	
Reference Lake 3	-	-	-	Winter	Summer	not applicable		ANOVA[a]
				Winter	Fall	not applicable		
				Summer	Fall	YES	0.0062	
Camp Lake	YES	0.00000	ANOVA[a]	Winter	Summer	YES	0.0000	Tukey's[a]
				Winter	Fall	YES	0.0000	
				Summer	Fall	NO	0.7987	
Sheardown Lake NW	YES	0.00007	ANOVA[a]	Winter	Summer	YES	0.0087	Tukey's[a]
				Winter	Fall	YES	0.0000	
				Summer	Fall	YES	0.0372	
Sheardown Lake SE	NO	0.64976	ANOVA[a]	Winter	Summer	NO	1.0000	Tamhane's[a]
				Winter	Fall	NO	0.8771	
				Summer	Fall	NO	0.3770	
Mary Lake North Basin	YES	0.00009	ANOVA[a]	Winter	Summer	NO	0.2734	Tamhane's[a]
				Winter	Fall	YES	0.0159	
				Summer	Fall	YES	0.0407	
Mary Lake South Basin	YES	0.00039	ANOVA[b]	Winter	Summer	YES	0.0014	Tukey's[b]
				Winter	Fall	YES	0.0006	
				Summer	Fall	NO	0.9670	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Statistical tests include Analysis of Variance (ANOVA) and Kruskal Wallis H-test (KW H-test).

[c] Untransformed data, normally distributed, used for the analysis

[d] Log-transformed data, normally distributed, used for the analysis.

[e] Kruskal-Wallis H-test used to validate results of ANOVA three-group comparison.

[f] Mann-Whitney U-test used to validate results of post-hoc tests for all pair-wise comparisons.

Table E.7: **Summary Data and Statistical Results for Chlorophyll a Concentration (mg/L) Comparisons between Individual Mine-Exposed Lakes and Reference Lake 3 for Summer Sampling, Mary River Project CREMP, 2017**

Study Lake	Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.63	0.09	0.05	0.41	0.86	0.56	0.74
Camp Lake	YES	0.0009	α	6.8	5	1.24	0.15	0.07	1.05	1.43	1.11	1.43
Sheardown Lake NW	YES	0.0002	α	6.5	6	1.22	0.13	0.05	1.09	1.35	1.09	1.40
Sheardown Lake SE	YES	0.0003	α	8.1	5	1.37	0.16	0.07	1.17	1.56	1.14	1.56
Mary Lake North	YES	0.0022	α	-4.1	3	0.27	0.02	0.01	0.22	0.31	0.26	0.29
Mary Lake South	YES	0.0203	α	-2.9	7	0.80	0.08	0.03	0.73	0.88	0.67	0.94

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test;
δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

[b] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.8: **Summary Data and Statistical Results for Chlorophyll a Concentration (mg/L) Comparisons between Individual Mine-Exposed Lakes and Reference Lake 3 for Fall Sampling, Mary River Project CREMP, 2017**

Study Lake	Comparison to Reference				Number of Stations (n)	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test	Magnitude of Difference					Lower Bound	Upper Bound		
Reference Lake 03	-	-	-	-	3	0.91	0.02	0.01	0.87	0.96	0.90	0.94
Camp Lake	YES	0.0221	α , δ	14.4	5	1.19	0.15	0.07	1.00	1.37	1.01	1.38
Sheardown Lake NW	YES	0.0018	α , δ	34.2	6	1.56	0.22	0.09	1.33	1.79	1.37	1.92
Sheardown Lake SE	YES	0.0000	α , δ	30.8	5	1.50	0.08	0.03	1.40	1.59	1.42	1.60
Mary Lake North	NO	0.9214	α , δ	-	3	0.91	0.14	0.08	0.57	1.24	0.81	1.06
Mary Lake South	YES	0.0333	α , γ	-2.9	7	0.75	0.08	0.03	0.68	0.82	0.70	0.91

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Mann-Whitney U-test;
δ - data exhibit unequal variance; test results validated using t-test assuming unequal variance

[b] Magnitude calculated by comparing the difference between the reference area and mine-exposed area means divided by the reference area standard deviation.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.9: Statistical Comparisons of Chlorophyll a Concentrations Among Years at Camp Lake, Mary River Project CREMP

Season	Overall 4-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test[b]
Winter	YES	0.0001	β , γ	2014	0.275	2014	2015	YES	0.001	Tukey's (β , γ)
						2014	2016	YES	0.002	
				2015	0.742	2014	2017	NO	0.791	
				2016	0.646	2015	2016	NO	0.891	
						2015	2017	YES	0.002	
				2017	0.316	2016	2017	YES	0.008	
Summer	NO	0.2144	β , γ	2014	1.050	2014	2015	NO	0.998	Tamhane's (β , γ)
						2014	2016	NO	0.994	
				2015	1.262	2014	2017	NO	0.998	
				2016	1.503	2015	2016	NO	0.698	
						2015	2017	NO	1.000	
				2017	1.243	2016	2017	NO	0.624	
Fall	YES	0.0124	α	2014	1.590	2014	2015	NO	0.237	Tamhane's (α)
						2014	2016	NO	0.704	
				2015	0.651	2014	2017	NO	0.867	
				2016	1.063	2015	2016	YES	0.059	
						2015	2017	YES	0.003	
				2017	1.187	2016	2017	NO	0.903	
Annual	NO	0.4212	β , γ	2014	1.014	2014	2015	NO	0.976	Tamhane's (β , γ)
						2014	2016	NO	0.798	
				2015	0.885	2014	2017	NO	0.999	
				2016	1.070	2015	2016	NO	0.785	
						2015	2017	NO	0.998	
				2017	0.915	2016	2017	NO	0.771	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.10: Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Sheardown Lake Northwest (DLO-01), Mary River Project CREMP, 2017

	Analyte	Chlorophyll a (µg/L)								
	Station	DD-HAB 9-STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	17-Apr-17	17-Apr-17	17-Apr-17	16-Apr-17	16-Apr-17	16-Apr-17	-	-	-
	Summer	21-Jul-17	22-Jul-17	22-Jul-17	21-Jul-17	23-Jul-17	23-Jul-17	-	-	-
	Fall	21-Aug-17	21-Aug-17	26-Aug-17	20-Aug-17	20-Aug-17	20-Aug-17	-	-	-
Winter	Surface	0.74	0.69	1.25	0.83	1.16	0.91	0.93	0.23	0.09
	Bottom	0.63	0.15	0.22	1.64	0.39	0.87	0.65	0.55	0.23
	Average	0.69	0.42	0.74	1.24	0.78	0.89	0.79	0.27	0.11
Summer	Surface	1.23	1.12	1.10	1.18	1.44	1.49	1.26	0.17	0.07
	Bottom	1.27	1.05	1.22	1.03	1.21	1.31	1.18	0.12	0.05
	Average	1.25	1.09	1.16	1.11	1.33	1.40	1.22	0.13	0.05
Fall	Surface	1.83	1.67	1.50	1.33	1.58	1.10	1.50	0.26	0.11
	Bottom	1.68	2.16	1.45	1.51	1.28	1.63	1.62	0.30	0.12
	Average	1.76	1.92	1.48	1.42	1.43	1.37	1.56	0.22	0.09

	Analyte	Phaeophytin a (µg/L)								
	Station	DD-HAB 9-STN1	DL0-01-5	DL0-01-1	DL0-01-4	DL0-01-2	DL0-01-7	Average	Standard Deviation	Standard Error
Sample Collection Date	Winter	17-Apr-17	17-Apr-17	17-Apr-17	16-Apr-17	16-Apr-17	16-Apr-17	-	-	-
	Summer	21-Jul-17	22-Jul-17	22-Jul-17	21-Jul-17	23-Jul-17	23-Jul-17	-	-	-
	Fall	21-Aug-17	21-Aug-17	26-Aug-17	20-Aug-17	20-Aug-17	20-Aug-17	-	-	-
Winter	Surface	0.53	0.37	0.59	0.59	0.39	0.51	0.50	0.10	0.04
	Bottom	0.43	0.22	0.26	0.98	0.32	0.46	0.45	0.28	0.11
	Average	0.48	0.30	0.43	0.79	0.36	0.49	0.47	0.17	0.07
Summer	Surface	0.66	1.05	0.82	0.89	1.05	0.83	0.88	0.15	0.06
	Bottom	0.78	0.83	0.93	0.89	0.94	0.88	0.87	0.06	0.02
	Average	0.72	0.94	0.88	0.89	1.00	0.85	0.88	0.09	0.04
Fall	Surface	0.57	0.61	0.64	0.88	0.76	0.63	0.68	0.12	0.05
	Bottom	1.13	0.86	0.76	0.84	0.72	0.74	0.84	0.15	0.06
	Average	0.85	0.74	0.70	0.86	0.74	0.69	0.76	0.08	0.03

Table E.11: Statistical Comparisons of Chlorophyll a Concentrations Among Years at Sheardown Lake NW, Mary River Project CREMP

Season	Overall 4-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test[b]
Winter	YES	0.0049	β	2014	2.550	2014	2015	NO	0.113	Tukey's (β)
						2014	2016	YES	0.014	
				2015	1.104	2014	2017	YES	0.006	
						2015	2016	NO	0.736	
				2016	0.874	2015	2017	NO	0.500	
				2017	0.790	2016	2017	NO	0.978	
Summer	YES	0.0010	α	2014	2.425	2014	2015	YES	0.016	Tukey's (α)
						2014	2016	NO	0.709	
				2015	1.512	2014	2017	YES	0.001	
						2015	2016	NO	0.142	
				2016	2.131	2015	2017	NO	0.714	
				2017	1.220	2016	2017	YES	0.016	
Fall	YES	0.0018	β	2014	0.800	2014	2015	NO	0.159	Tamhane's (β)
						2014	2016	NO	0.186	
				2015	1.611	2014	2017	NO	0.171	
						2015	2016	NO	1.000	
				2016	1.526	2015	2017	NO	1.000	
				2017	1.560	2016	2017	NO	1.000	
Annual	NO	0.3985	β	2014	1.925	2014	2015	NO	0.999	Tamhane's (β)
						2014	2016	NO	1.000	
				2015	1.409	2014	2017	NO	0.731	
						2015	2016	NO	1.000	
				2016	1.510	2015	2017	NO	0.315	
				2017	1.190	2016	2017	NO	0.571	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.12: Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Sheardown Lake SE (DLO-02), Mary River Project CREMP, 2017

	Analyte	Chlorophyll a (µg/L)							
	Station	**DL0-02-06**	**DL0-02-07**	**DL0-02-4**	**DL0-02-8**	**DL0-02-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	-	-	-
	Summer	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17	-	-	-
	Fall	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	-	-	-
Winter	Surface	0.90	1.18	1.08	2.45	2.34	1.59	0.74	0.33
	Bottom	0.55	-	2.14	1.05	0.72	1.12	0.71	0.36
	Average	0.73	1.18	1.61	1.75	1.53	1.36	0.41	0.18
Summer	Surface	1.25	1.38	1.44	1.58	1.14	1.36	0.17	0.08
	Bottom	1.02	-	1.42	1.54	1.51	1.37	0.24	0.12
	Average	1.14	1.38	1.43	1.56	1.33	1.37	0.16	0.07
Fall	Surface	1.69	1.54	1.64	1.60	1.51	1.60	0.07	0.03
	Bottom	1.24	1.29	1.55	1.51	1.39	1.40	0.13	0.06
	Average	1.47	1.42	1.60	1.56	1.45	1.50	0.08	0.03

	Analyte	Phaeophytin a (µg/L)							
	Station	**DL0-02-06**	**DL0-02-07**	**DL0-02-4**	**DL0-02-8**	**DL0-02-03**	**Average**	**Standard Deviation**	**Standard Error**
Sample Collection Date	Winter	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	13-Apr-17	-	-	-
	Summer	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17	23-Jul-17	-	-	-
	Fall	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	21-Aug-17	-	-	-
Winter	Surface	0.57	0.66	0.75	1.15	1.17	0.86	0.28	0.13
	Bottom	0.37	-	1.06	0.73	0.48	0.66	0.31	0.15
	Average	0.47	0.66	0.90	0.94	0.83	0.76	0.19	0.09
Summer	Surface	0.87	0.73	1.01	1.02	0.76	0.88	0.14	0.06
	Bottom	0.83	-	0.96	0.97	0.76	0.88	0.10	0.05
	Average	0.85	0.73	0.99	1.00	0.76	0.86	0.12	0.06
Fall	Surface	0.81	0.65	0.64	1.13	0.75	0.80	0.20	0.09
	Bottom	0.64	0.58	0.66	0.75	0.68	0.66	0.06	0.03
	Average	0.73	0.62	0.65	0.94	0.72	0.73	0.13	0.06

Table E.13: Statistical Comparisons of Chlorophyll a Concentrations Among Years at Sheardown Lake SE, Mary River Project CREMP

Season	Overall 4-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test[b]
Winter	YES	0.0534	β	2014	2.670	2014	2015	NO	0.156	Tukey's (β)
						2014	2016	NO	0.510	
				2015	1.576	2014	2017	YES	0.044	
						2015	2016	NO	0.842	
				2016	1.903	2015	2017	NO	0.901	
				2017	1.359	2016	2017	NO	0.454	
Summer	YES	0.0000	α	2014	0.203	2014	2015	YES	0.000	Tamhane's (α)
						2014	2016	YES	0.001	
				2015	0.914	2014	2017	YES	0.000	
						2015	2016	YES	0.011	
				2016	1.509	2015	2017	YES	0.008	
				2017	1.366	2016	2017	NO	0.830	
Fall	YES	0.0269	α	2014	1.540	2014	2015	NO	0.984	Tamhane's (α)
						2014	2016	NO	0.629	
				2015	0.922	2014	2017	NO	1.000	
						2015	2016	YES	0.026	
				2016	2.869	2015	2017	YES	0.000	
				2017	1.496	2016	2017	YES	0.080	
Annual	YES	0.0034	γ	2014	1.471	2014	2015	NO	0.683	Mann-Whitney (γ)
						2014	2016	NO	0.126	
				2015	1.160	2014	2017	NO	0.461	
						2015	2016	YES	0.000	
				2016	2.094	2015	2017	YES	0.010	
				2017	1.407	2016	2017	YES	0.009	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.14: **Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at the Mary River, Mary River Project CREMP, 2017**

	Station	Upstream Reference			Upstream Mine-Exposed							Downstream Mine-Exposed		
		G0-09-A	G0-09	G0-09-B	G0-03	G0-01	F0-01	E0-10	E0-03	E0-20	E0-21	C0-10	C0-05	C0-01
Sample Collection Date	Spring	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	8-Jul-17	-	8-Jul-17	8-Jul-17	8-Jul-17	-	-	8-Jul-17
	Summer	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17	10-Aug-17
	Fall	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	1-Sep-17	1-Sep-17	1-Sep-17	1-Sep-17	1-Sep-17	1-Sep-17	29-Aug-17	27-Aug-17	27-Aug-17
Chlorophyll a (µg/L)	Spring	0.23	0.45	0.21	0.14	0.15	<0.10	-	0.15	0.14	0.13	-	-	0.19
	Summer	0.24	0.19	0.12	0.15	0.13	0.12	0.15	0.12	0.17	0.10	0.18	0.22	0.18
	Fall	0.38	0.23	0.27	0.23	-	-	-	-	-	-	0.27	0.36	0.49
	Average	0.28	0.29	0.20	0.17	0.14	0.11	0.15	0.14	0.16	0.12	0.23	0.29	0.29
	Standard Deviation	0.08	0.14	0.08	0.05	0.01	0.01	-	0.02	0.02	0.02	0.06	0.10	0.18
	Standard Error	0.05	0.08	0.04	0.03	0.010	0.01	-	0.02	0.02	0.02	0.05	0.07	0.10
Phaeophytin a (µg/L)	Spring	0.17	0.38	0.19	0.25	0.24	0.17	-	0.17	0.23	0.25	-	-	0.30
	Summer	0.28	0.23	0.16	0.52	0.30	0.25	0.62	0.31	<1.00	0.42	0.52	0.30	0.26
	Fall	0.35	0.28	0.29	0.29	-	-	-	-	-	-	0.28	0.33	0.40
	Average	0.27	0.30	0.21	0.35	0.27	0.21	0.62	0.24	0.62	0.34	0.40	0.32	0.32
	Standard Deviation	0.09	0.08	0.07	0.15	0.04	0.06	-	0.10	0.54	0.12	0.17	0.02	0.07
	Standard Error	0.05	0.04	0.04	0.08	0.03	0.04	-	0.070	0.39	0.09	0.12	0.02	0.04

Table E.15: Phytoplankton Monitoring Data (i.e., chlorophyll a and phaeophytin a concentrations) Collected at Mary Lake (north and south basins; BLO), Mary River Project CREMP, 2017

	Analyte	Chlorophyll a (µg/L)												
	Station	Mary Lake North			Mary Lake South							Average	Standard Deviation	Standard Error
		BL0-01A	BL0-01	BL0-01B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06			
Sample Collection Date	Winter	12-Apr-17	12-Apr-17	12-Apr-17	15-Apr-17	15-Apr-17	15-Apr-17	14-Apr-17	14-Apr-17	14-Apr-17	15-Apr-17	-	-	-
	Summer	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	-	-	-
	Fall	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	-	-	-
Winter	Surface	0.14	0.36	0.20	0.15	0.55	0.89	0.51	0.30	0.61	0.54	0.43	0.24	0.08
	Bottom	<0.10	<0.10	0.17	<0.10	<0.10	0.67	<0.10	<0.10	<0.10	0.19	0.17	0.18	0.06
	Average	0.12	0.23	0.19	0.13	0.33	0.78	0.31	0.20	0.36	0.37	0.30	0.19	0.06
Summer	Surface	0.23	0.27	0.27	0.58	0.95	0.71	0.76	0.87	1.08	0.78	0.65	0.30	0.10
	Bottom	0.28	0.25	0.30	0.76	0.75	0.83	0.89	0.69	0.80	0.79	0.63	0.25	0.08
	Average	0.26	0.26	0.29	0.67	0.85	0.77	0.82	0.78	0.94	0.79	0.64	0.27	0.08
Fall	Surface	1.06	0.73	1.04	0.70	0.76	0.71	0.68	0.71	0.73	0.69	0.78	0.14	0.05
	Bottom	0.64	0.88	1.08	0.71	0.84	0.68	0.77	0.73	1.08	0.71	0.81	0.16	0.05
	Average	0.85	0.81	1.06	0.71	0.80	0.70	0.73	0.72	0.91	0.70	0.80	0.12	0.04

	Analyte	Phaeophytin a (µg/L)												
	Station	Mary Lake North			Mary Lake South							Average	Standard Deviation	Standard Error
		BL0-01-A	BL0-01	BL0-01-B	BL0-05-A	BL0-05	BL0-05-B	BL0-03	BL0-04	BL0-09	BL0-06			
Sample Collection Date	Winter	12-Apr-17	12-Apr-17	12-Apr-17	15-Apr-17	15-Apr-17	15-Apr-17	14-Apr-17	14-Apr-17	14-Apr-17	15-Apr-17	-	-	-
	Summer	30-Jul-17	30-Jul-17	30-Jul-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	1-Aug-17	-	-	-
	Fall	30-Aug-17	30-Aug-17	30-Aug-17	28-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17	-	-	-
Winter	Surface	0.19	<0.10	0.24	0.19	0.42	0.74	0.37	0.27	0.48	0.39	0.34	0.18	0.06
	Bottom	0.16	0.17	0.22	0.19	0.21	0.51	0.16	0.15	0.15	0.22	0.21	0.11	0.03
	Average	0.18	0.14	0.23	0.19	0.32	0.63	0.27	0.21	0.32	0.31	0.28	0.14	0.04
Summer	Surface	0.47	<1.00	<1.00	1.22	0.79	0.57	1.20	1.23	0.93	0.54	0.90	0.29	0.09
	Bottom	0.45	0.35	<1.00	<1.00	0.62	0.71	<1.00	<1.00	0.58	0.16	0.69	0.31	0.10
	Average	0.46	0.68	1.00	1.11	0.71	0.64	1.10	1.12	0.76	0.35	0.79	0.28	0.09
Fall	Surface	0.55	0.43	0.55	0.56	0.55	0.63	0.67	0.62	0.64	0.68	0.59	0.08	0.02
	Bottom	0.34	0.48	0.55	0.56	0.57	0.56	0.68	0.69	1.01	0.60	0.60	0.17	0.05
	Average	0.45	0.46	0.55	0.56	0.56	0.60	0.68	0.66	0.83	0.64	0.60	0.11	0.04

Table E.16: **Statistical Comparisons of Chlorophyll a Concentrations Among Years at Mary Lake North, Mary River Project CREMP**

Season	Overall 4-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test[b]
Winter	NO	0.4281	β , γ	2014	0.585	2014	2015	NO	1.000	Tamhane's (β , γ)
						2014	2016	NO	0.932	
				2015	0.6525	2014	2017	NO	0.914	
						2015	2016	NO	0.821	
				2016	0.183	2015	2017	NO	0.787	
				2017	0.178	2016	2017	NO	1.000	
Summer	YES	0.1032	α	2014	0.917	2014	2015	NO	0.991	Tukey's (α)
						2014	2016	NO	0.866	
				2015	0.827	2014	2017	NO	0.243	
						2015	2016	NO	0.724	
				2016	1.159	2015	2017	NO	0.348	
				2017	0.266	2016	2017	YES	0.084	
Fall	YES	0.0154	α	2014	0.517	2014	2015	NO	0.831	Tukey's (α)
						2014	2016	YES	0.022	
				2015	0.623	2014	2017	YES	0.059	
						2015	2016	YES	0.070	
				2016	0.997	2015	2017	NO	0.193	
				2017	0.905	2016	2017	NO	0.883	
Annual	NO	0.2695	β , γ	2014	0.673	2014	2015	NO	0.931	Tukey's (β , γ)
						2014	2016	NO	0.803	
				2015	0.701	2014	2017	NO	0.757	
						2015	2016	NO	0.988	
				2016	0.854	2015	2017	NO	0.399	
				2017	0.450	2016	2017	NO	0.265	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table E.17: Statistical Comparisons of Chlorophyll a Concentrations Among Years at Mary Lake South, Mary River Project CREMP

Season	Overall 4-group Comparison			Summary		Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Years?	p-value	Statistical Treatment[b]	Year	Mean Concentration (mg/L)	(I) Year	(J) Year	Significant Difference Between 2 Years?	p-value	Statistical Test[b]
Winter	NO	0.3108	β , γ	2014	0.879	2014	2015	NO	0.816	Tukey's (β , γ)
						2014	2016	NO	0.786	
				2015	0.646	2014	2017	NO	0.935	
				2016	0.306	2015	2016	NO	0.292	
						2015	2017	NO	0.473	
				2017	0.351	2016	2017	NO	0.985	
Summer	NO	0.3211	α	2014	0.864	2014	2015	NO	1.000	Tamhane's (α)
						2014	2016	NO	0.951	
				2015	0.789	2014	2017	NO	1.000	
				2016	1.076	2015	2016	NO	0.023	
						2015	2017	NO	1.000	
				2017	0.803	2016	2017	YES	0.027	
Fall	NO	0.4617	β , γ	2014	0.750	2014	2015	NO	0.801	Tamhane's (β , γ)
						2014	2016	NO	1.000	
				2015	0.895	2014	2017	NO	0.999	
				2016	0.752	2015	2016	NO	0.661	
						2015	2017	NO	0.143	
				2017	0.750	2016	2017	NO	1.000	
Annual	NO	0.6227	β , γ	2014	0.831	2014	2015	NO	1.000	Tamhane's (β , γ)
						2014	2016	NO	0.994	
				2015	0.777	2014	2017	NO	0.912	
				2016	0.711	2015	2016	NO	0.985	
						2015	2017	NO	0.311	
				2017	0.634	2016	2017	NO	0.968	

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons.

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log transformed, single factor ANOVA test conducted; γ - data non-normal, test results validated using Kruskal-Wallis H-test (multiple group comparison) or Mann-Whitney U-test (pair-wise comparison), as appropriate.

Shaded values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

APPENDIX F

BENTHIC INVERTEBRATE COMMUNITY DATA

Table F.1: Summary of Habitat Features at Camp Lake Tributary and Unnamed Reference Creek Study Areas Evaluated for the 2017 Mary River Project CREMP Benthic Invertebrate Community Assessment

Habitat Characteristic		Reference Creek	Camp Lake Tributary 1		Camp Lake Tributary 2	
		REF-CRK	CLT-1-US	CLT-1-DS	CLT-2-US	CLT-2-DS
Mean Width (m)	**Wetted**	11.1	4.5	6.6	9.0	5.0
Mean Depth (m)	**Average**	0.09	0.09	0.10	0.12	0.10
Mean Velocity (m/s)	**Average**	0.28	0.36	0.44	0.32	0.26
Stream Morphology	**% Pool**	8	5	0	3	0
	% Rapid	0	5	0	50	0
	% Riffle	83	85	100	45	90
	% Run	10	5	0	3	10
Substrate (% areal coverage)		3% boulder 32% cobble 48% pebble 10% gravel 7% sand	8% boulder 78% cobble 10 % pebble 5% gravel	5% boulder 77% cobble 17% pebble	35% boulder 60% cobble 5% pebble trace % gravel	0% boulder 75% cobble 10% pebble 10% gravel 5% sand
Mean Substrate Size (mm)		47	86	86	132	56
Aquatic Vegetation (% areal coverage)	**Bryophyte Coverage**	trace	trace (<5%)	trace (<5%)	trace	none observed
	Periphyton Coverage	28%	<5%	<5%	trace	none observed
	Periphyton Description	Rock noticeably slippery, green algae present (1-5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)
Functional Instream Cover (% areal coverage)		5% deep pool	trace boulder trace undercut banks	trace boulder	5% boulder 5% deep pool	trace undercut banks

Table F.2: Replicate Grab Data for Benthic Invertebrate Community Samples Collected at the Unnamed Reference Creek and Camp Lake Tributaries, Mary River Project CREMP, August 2017

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (mm)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Unnamed Reference Creek	REF-CRK-B1	8	6	9	0.39	0.44	0.44	56.9	42.0	62.3	25%	13%	25%	scarce	scarce	scarce	scarce	scarce	scarce
	REF-CRK-B2	8	8	6	0.47	0.47	0.46	70.8	60.8	58.6	25%	25%	38%	common	scarce	common	common	scarce	common
	REF-CRK-B3	10	10	9	0.49	0.59	0.57	67.8	50.0	48.0	25%	13%	38%	scarce	scarce	none	scarce	scarce	scarce
	REF-CRK-B4	11	11	9	0.51	0.38	0.39	64.1	50.0	51.6	13%	13%	25%	none	none	none	scarce	scarce	common
	REF-CRK-B5	7	7	8	0.42	0.41	0.53	69.6	56.8	46.5	37%	25%	25%	none	none	none	common	common	common
Camp Lake Tributary 1 Upstream	CLT-1-US-B1	8	7	7	0.44	0.49	0.46	66.5	85.2	81.4	50%	75%	50%	scarce	common	common	scarce	scarce	scarce
	CLT-1-US-B2	7	8	8	0.44	0.38	0.53	85.2	97.7	86.6	50%	68%	75%	scarce	scarce	scarce	scarce	scarce	scarce
	CLT-1-US-B3	8	9	10	0.54	0.47	0.45	59.5	88.6	89.5	50%	68%	75%	none	none	none	common	common	common
	CLT-1-US-B4	10	9	8	0.41	0.44	0.43	72.1	56.4	60.4	50%	75%	50%	scarce	scarce	scarce	common	common	common
	CLT-1-US-B5	9	5	7	0.50	0.54	0.36	94.8	51.6	77.6	75%	50%	68%	scarce	scarce	scarce	common	common	common
Camp Lake Tributary 1 Downstream	CLT-1-DS-B1	11	9	8	0.58	0.48	0.49	49.8	55.0	78.0	25%	38%	50%	none	scarce	none	scarce	scarce	scarce
	CLT-1-DS-B2	9	10	8	0.53	0.47	0.41	71.3	83.2	66.4	25%	38%	38%	scarce	scarce	scarce	scarce	scarce	scarce
	CLT-1-DS-B3	12	8	10	0.56	0.55	0.36	92.8	91.5	93.3	38%	25%	38%	scarce	scarce	scarce	scarce	scarce	scarce
	CLT-1-DS-B4	14	12	11	0.48	0.58	0.54	65.8	73.6	61.6	50%	38%	38%	scarce	scarce	scarce	scarce	scarce	scarce
	CLT-1-DS-B5	14	14	15	0.43	0.44	0.36	65.0	64.7	80.6	50%	25%	38%	scarce	none	none	scarce	scarce	scarce
Camp Lake Tributary 2 Upstream	CLT-2-US-B1	7	12	14	0.55	0.55	0.41	82.8	64.8	65.0	25%	25%	25%	none	none	none	scarce	scarce	scarce
	CLT-2-US-B2	8	19	4	0.58	0.56	0.38	55.1	74.3	49.3	50%	75%	38%	none	none	none	scarce	none	common
	CLT-2-US-B3	9	10	9	0.51	0.56	0.59	52.6	74.6	62.4	50%	50%	75%	none	none	none	scarce	scarce	scarce
	CLT-2-US-B4	8	7	7	0.49	0.49	0.42	73.0	55.0	53.3	75%	25%	50%	scarce	none	none	scarce	scarce	scarce
	CLT-2-US-B5	8	6	8	0.50	0.42	0.42	58.4	55.9	59.1	68%	50%	68%	none	none	none	scarce	scarce	scarce
Camp Lake Tributary 2 Downstream	CLT-2-DS-B1	7	10	8	0.39	0.49	0.39	68.5	66.5	67.0	38%	75%	75%	none	scarce	none	scarce	scarce	scarce
	CLT-2-DS-B2	8	12	8	0.56	0.42	0.39	49.4	50.0	55.6	75%	75%	50%	none	none	scarce	none	none	none
	CLT-2-DS-B3	9	12	8	0.47	0.46	0.46	58.9	57.1	68.4	50%	38%	50%	none	none	none	none	none	none
	CLT-2-DS-B4	8	7	7	0.42	0.51	0.42	54.1	67.3	62.9	50%	68%	50%	none	none	none	none	none	none
	CLT-2-DS-B5	8	10	8	0.52	0.40	0.44	49.1	63.4	68.7	68%	50%	50%	none	none	none	none	none	none

[a] Substrate measurements taken from the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 4 - 9 per replicate grab, with a mean of 7.1 for the CLT stations in 2017

Table F.3: Replicate Station Habitat Feature Summary Statistics for the Camp Lake Tributary Benthic Stations, Mary River Project CREMP, August 2017

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	8.5	1.4	0.6	6.7	10.2	7.3	10.3
	CLT1-US North Branch	8.0	0.9	0.4	6.8	9.2	7.0	9.0
	CLT1-DS Lower Main Stem	11.0	2.3	1.0	8.2	13.8	9.0	14.3
	CLT2-US Upstream	9.1	1.7	0.8	7.0	11.2	7.3	11.0
	CLT2-DS Downstream	8.7	0.9	0.4	7.5	9.8	7.3	9.7
Water Velocity (cm/s)	Unnamed Reference Creek	46.4	5.1	2.3	40.0	52.8	42.3	55.0
	CLT1-US North Branch	45.9	2.2	1.0	43.1	48.6	42.7	48.7
	CLT1-DS Lower Main Stem	48.4	4.8	2.1	42.4	54.4	41.0	53.3
	CLT2-US Upstream	49.5	4.1	1.8	44.4	54.6	44.7	55.3
	CLT2-DS Downstream	44.9	1.5	0.7	43.0	46.8	42.3	46.3
Substrate Size (mm diameter)	Unnamed Reference Creek	57.0	3.8	1.7	52.3	61.8	53.7	63.4
	CLT1-US North Branch	76.9	9.6	4.3	64.9	88.8	63.0	89.8
	CLT1-DS Lower Main Stem	72.8	12.0	5.3	58.0	87.7	60.9	92.5
	CLT2-US Upstream	62.4	5.1	2.3	56.0	68.7	57.8	70.8
	CLT2-DS Downstream	60.5	5.6	2.5	53.5	67.4	51.7	67.3
Substrate Embeddedness (%)	Unnamed Reference Creek	24	5	2	17	31	17	29
	CLT1-US North Branch	62	3	1	58	66	58	64
	CLT1-DS Lower Main Stem	37	3	2	33	41	34	42
	CLT2-US Upstream	50	15	7	32	68	25	62
	CLT2-DS Downstream	57	8	4	48	67	46	67

Note: Five stations were sampled at each study area.

Table F.4: Benthic Station Habitat Feature Statistical Comparisons among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Depth (cm)	YES	0.0289	α	Unnamed Reference Creek	CLT1 Upstream	NO	0.9154	Tamhane's
				Unnamed Reference Creek	CLT1 Downstream	NO	0.2067	
				CLT1 Upstream	CLT1 Downstream	NO	0.1118	
Water Velocity (cm/s)	NO	0.6231	α	Unnamed Reference Creek	CLT1 Upstream	NO	0.9786	Tukey's HSD
				Unnamed Reference Creek	CLT1 Downstream	NO	0.7435	
				CLT1 Upstream	CLT1 Downstream	NO	0.6260	
Substrate Size (mm diameter)	YES	0.0118	α	Unnamed Reference Creek	CLT1 Upstream	YES	0.0128	Tukey's HSD
				Unnamed Reference Creek	CLT1 Downstream	YES	0.0446	
				CLT1 Upstream	CLT1 Downstream	NO	0.7690	
Substrate Embeddedness (%)	YES	0.0018	γ	Unnamed Reference Creek	CLT1 Upstream	YES	0.0079	Mann-Whitney U-test
				Unnamed Reference Creek	CLT1 Downstream	YES	0.0079	
				CLT1 Upstream	CLT1 Downstream	YES	0.0079	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Kruskal-Wallis H-test (multiple group) or Mann-Whitney U-test (pair-wise) conducted on non-normal data; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance.

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Unnamed Reference Creek Study Area, August 2017

Taxa (Study Area / Replicate Station)	Unnamed Reference Creek B1	B2	B3	B4	B5
ROUNDWORMS					
P. Nemata	90	488	230	25	100
ANNELIDS					
P. Annelida					
WORMS					
Cl. Oligochaeta					
F. Enchytraeidae	-	-	36	-	29
ARTHROPODS					
P. Arthropoda					
MITES					
Cl. Arachnida					
O. Acarina	-	**43**	-	-	**4**
F. Sperchonidae					
Sperchon	79	258	50	43	18
HARPACTICOIDS					
O. Harpacticoida	-	-	-	-	-
SEED SHRIMPS					
Cl. Ostracoda	36	43	22	50	61
SPRINGTAILS					
Cl. Entognatha					
O. Collembola	7	-	-	-	-
INSECTS					
Cl. Insecta					
MAYFLIES					
O. Ephemeroptera					
F. Baetidae					
Acentrella feropagus	158	187	287	158	147
STONEFLIES					
O. Plecoptera					
F. Capniidae					
immature	7	-	-	-	-
TRUE FLIES					
O. Diptera					
BITING-MIDGE					
F. Ceratopogonidae					
Culicoides	-	-	-	4	-
MIDGES					
F. Chironomidae					
chironomid pupae	**72**	**258**	**86**	**54**	**32**
S.F. Chironominae					
Micropsectra	-	-	-	-	-
Rheotanytarsus	-	29	-	7	-
S.F. Diamesinae					
Diamesa	14	-	14	-	29
Pseudokiefferiella	14	718	50	4	-
S.F. Orthocladiinae					
Cardiocladius	-	-	-	-	-
Chaetocladius	-	-	7	-	-
Corynoneura	-	-	-	-	-
Cricotopus	18	560	65	11	7
Cricotopus/Orthocladius	7	187	14	4	18
Eukiefferiella	32	187	72	86	54
Hydrobaenus	-	57	7	-	4
Hydrosmittia	-	29	14	-	-
Krenosmittia	-	-	-	-	-
Limnophyes	43	129	57	43	133
Metriocnemus	-	43	-	-	-
Orthocladius (Euorthocladius)	25	129	-	18	22

Table F.5: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for the Unnamed Reference Creek Study Area, August 2017

Taxa	Study Area / Replicate Station	Unnamed Reference Creek B1	B2	B3	B4	B5
Parakiefferiella		-	-	-	-	-
Parametriocnemus		-	-	-	-	-
Paraphaenocladius		-	14	-	-	18
Thienemanniella		-	273	14	25	7
Tokunagaia		-	29	14	-	-
Tvetenia		111	230	43	47	50
indeterminate		-	**43**	-	-	-
S.F. Tanypodinae						
Thienemannimyia complex		7	-	-	-	4
F. Empididae						
Clinocera		11	29	7	4	7
pupae		-	**29**	-	-	-
F. Muscidae		-	4	-	-	-
F. Simuliidae						
Gymnopais		14	14	7	7	4
Metacnephia		230	703	258	90	144
Prosimulium		32	502	445	133	79
indeterminate		**7**	-	-	-	-
F. Tipulidae						
Tipula		7	14	7	4	14
Number of Organisms (No. organisms per m^2)		1,021	5,229	1,806	817	985
Richness (total number of taxa)[a]		20	24	22	19	21
Simpson's Evenness (E)		0.927	0.951	0.909	0.938	0.949
Bray-Curtis Index		0.173	0.664	0.287	0.190	0.210
Percent Composition						
% Nemata		8.8%	9.3%	12.7%	3.1%	10.2%
% Oligochaeta		0.0%	0.0%	2.0%	0.0%	2.9%
% Hydracarina		7.7%	5.8%	2.8%	5.3%	2.2%
% Ostracods		3.5%	0.8%	1.2%	6.1%	6.2%
% Ephemeroptera		15.5%	3.6%	15.9%	19.3%	14.9%
% Chironomids		33.6%	55.7%	25.3%	36.6%	38.4%
% Metal Sensitive Chironmids		3.5%	15.7%	4.4%	1.7%	3.2%
% Simuliidae		27.7%	23.3%	39.3%	28.2%	23.0%
% Tipulidae		0.7%	0.3%	0.4%	0.5%	1.4%
Functional Feeding Group Composition						
% Collector - Gatherers		58.1%	52.8%	51.8%	61.8%	69.3%
% Filterers		27.7%	23.9%	39.3%	29.3%	23.0%
% Shredders		4.5%	16.3%	5.8%	2.7%	4.3%
Habitat Preference Group Composition						
% Clingers		39.7%	46.8%	47.8%	37.2%	28.8%
% Sprawlers		50.1%	42.6%	37.0%	58.8%	56.6%
% Burrowers		9.5%	10.5%	15.1%	4.0%	14.5%

[a] Bold entries excluded from taxa count

Table F.6: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2017

Taxa	Study Area / Replicate Station	North Branch Upstream (CLT1-US) B1	B2	B3	B4	B5	Lower Main Stem (CLT1-DS) B1	B2	B3	B4	B5
ROUNDWORMS											
P. Nemata		57	25	57	86	25	4	100	179	7	86
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		4	43	7	7	7	18	172	43	29	172
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina		22	14	-	14	14	-	-	-	-	-
F. Sperchonidae											
Sperchon		50	68	100	108	86	39	115	50	25	57
HARPACTICOIDS											
O. Harpacticoida		-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS											
Cl. Ostracoda		-	-	-	-	-	-	-	-	-	-
SPRINGTAILS											
Cl. Entognatha											
O. Collembola		-	-	-	-	-	-	-	-	-	-
INSECTS											
Cl. Insecta											
MAYFLIES											
O. Ephemeroptera											
F. Baetidae											
Acentrella feropagus		7	25	14	7	11	4	-	-	11	-
STONEFLIES											
O. Plecoptera											
F. Capniidae											
immature		-	-	-	-	-	-	-	-	-	-
TRUE FLIES											
O. Diptera											
BITING-MIDGE											
F. Ceratopogonidae											
Culicoides		-	-	-	-	-	-	-	-	-	-
MIDGES											
F. Chironomidae											
chironomid pupae		68	54	57	65	83	68	158	144	39	144
S.F. Chironominae											
Micropsectra		-	-	7	-	-	-	-	-	-	-
Rheotanytarsus		-	-	-	-	-	-	-	-	-	-
S.F. Diamesinae											
Diamesa		14	32	43	-	7	7	-	-	-	14
Pseudokiefferiella		68	39	144	7	61	7	29	14	14	-
S.F. Orthocladiinae											
Cardiocladius		-	-	-	-	7	-	-	-	-	-
Chaetocladius		-	-	-	-	-	-	-	-	-	-
Corynoneura		-	-	-	-	-	-	-	-	-	-
Cricotopus		104	187	179	309	194	111	402	201	104	287
Cricotopus/Orthocladius		248	287	280	301	269	11	258	93	29	187
Eukiefferiella		-	7	-	-	7	4	-	7	-	-
Hydrobaenus		-	32	29	-	14	11	57	-	65	29
Hydrosmittia		54	32	86	86	97	122	804	488	294	660
Krenosmittia		43	14	29	36	39	68	72	14	72	43
Limnophyes		36	14	14	29	7	32	43	22	29	100
Metriocnemus		-	-	-	-	-	-	-	-	-	-
Orthocladius (Euorthocladius)		36	115	50	43	54	22	-	22	22	86

Table F.6: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 1 Study Areas, August 2017

Taxa (Study Area / Replicate Station)	North Branch Upstream (CLT1-US)					Lower Main Stem (CLT1-DS)				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Parakiefferiella	-	-	-	-	-	-	29	14	7	29
Parametriocnemus	-	-	-	-	-	-	43	-	-	-
Paraphaenocladius	-	-	-	-	-	-	-	-	-	-
Thienemanniella	43	61	72	14	54	25	29	14	104	14
Tokunagaia	7	7	29	-	-	-	-	14	-	-
Tvetenia	36	32	36	29	32	7	43	14	-	43
indeterminate	-	7	-	7	-	-	-	-	-	-
S.F. Tanypodinae										
Thienemannimyia complex	-	7	-	-	-	-	-	-	-	-
F. Empididae										
Clinocera	14	22	29	36	61	14	-	-	7	29
pupae	-	-	-	-	-	-	-	-	-	-
F. Muscidae	-	-	-	-	-	-	-	-	-	-
F. Simuliidae										
Gymnopais	-	-	-	-	11	-	-	-	-	-
Metacnephia	-	-	-	7	7	4	-	-	-	-
Prosimulium	-	7	43	-	7	4	-	-	4	-
indeterminate	-	-	-	-	-	-	-	-	-	-
F. Tipulidae										
Tipula	93	126	86	97	115	57	11	54	29	61
Number of Organisms (No. organisms per m^2)	1,004	1,257	1,391	1,288	1,269	639	2,365	1,387	891	2,041
Richness (total number of taxa)[a]	17	21	20	16	22	20	15	16	17	16
Simpson's Evenness (E)	0.933	0.925	0.948	0.895	0.926	0.920	0.860	0.829	0.882	0.878
Bray-Curtis Index	0.691	0.746	0.716	0.735	0.759	0.748	0.808	0.755	0.806	0.766
Percent Composition										
% Nemata	5.7%	2.0%	4.1%	6.7%	2.0%	0.6%	4.2%	12.9%	0.8%	4.2%
% Oligochaeta	0.4%	3.4%	0.5%	0.5%	0.6%	2.8%	7.3%	3.1%	3.3%	8.4%
% Hydracarina	7.2%	6.5%	7.2%	9.5%	7.9%	6.1%	4.9%	3.6%	2.8%	2.8%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.7%	2.0%	1.0%	0.5%	0.9%	0.6%	0.0%	0.0%	1.2%	0.0%
% Chironomids	75.4%	73.7%	75.8%	71.9%	72.9%	77.5%	83.2%	76.5%	87.4%	80.2%
% Metal Sensitive Chironmids	9.0%	6.0%	14.7%	0.6%	5.9%	2.5%	1.4%	1.2%	1.7%	0.7%
% Simuliidae	0.0%	0.6%	3.1%	0.5%	2.0%	1.3%	0.0%	0.0%	0.4%	0.0%
% Tipulidae	9.3%	10.0%	6.2%	7.5%	9.1%	8.9%	0.5%	3.9%	3.3%	3.0%
Functional Feeding Group Composition										
% Collector - Gatherers	43.7%	40.0%	46.2%	28.3%	35.6%	59.3%	64.4%	67.9%	76.9%	67.3%
% Filterers	0.0%	0.6%	3.6%	0.5%	2.0%	1.3%	0.0%	0.0%	0.4%	0.0%
% Shredders	47.7%	50.6%	41.0%	58.9%	49.1%	31.1%	30.8%	28.5%	19.1%	28.5%
Habitat Preference Group Composition										
% Clingers	47.0%	49.4%	47.2%	64.2%	54.7%	31.8%	35.2%	28.2%	19.9%	29.7%
% Sprawlers	37.6%	35.2%	42.1%	21.0%	33.1%	55.9%	52.9%	51.9%	72.8%	54.7%
% Burrowers	15.3%	15.4%	10.8%	14.8%	12.2%	12.4%	12.0%	19.9%	7.3%	15.6%

[a] Bold entries excluded from taxa count

Table F.7: Benthic Invertebrate Community Summary Statistics for Camp Lake Tributary 1 Study Areas, Mary River Project CREMP, August 2017

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	1,972	1,861	832	-339	4,282	817	5,229
	CLT1 Upstream	1,242	143	64	1,064	1,419	1,004	1,391
	CLT1 Downstream	1,465	735	329	552	2,377	639	2,365
Richness (Number of Taxa)	Unnamed Reference Creek	21.2	1.9	0.9	18.8	23.6	19.0	24.0
	CLT1 Upstream	19.2	2.6	1.2	16.0	22.4	16.0	22.0
	CLT1 Downstream	16.8	1.9	0.9	14.4	19.2	15.0	20.0
Simpson's Evenness	Unnamed Reference Creek	0.935	0.017	0.008	0.913	0.956	0.909	0.951
	CLT1 Upstream	0.925	0.019	0.009	0.901	0.949	0.895	0.948
	CLT1 Downstream	0.874	0.033	0.015	0.833	0.915	0.829	0.920
Bray-Curtis Index	Unnamed Reference Creek	0.305	0.205	0.092	0.050	0.560	0.173	0.664
	CLT1 Upstream	0.729	0.027	0.012	0.696	0.762	0.691	0.759
	CLT1 Downstream	0.777	0.029	0.013	0.741	0.812	0.748	0.808
Nemata (% of community)	Unnamed Reference Creek	8.8%	3.5%	1.6%	4.4%	13.2%	3.1%	12.7%
	CLT1 Upstream	4.1%	2.1%	1.0%	1.5%	6.7%	2.0%	6.7%
	CLT1 Downstream	4.5%	5.0%	2.2%	-1.7%	10.7%	0.6%	12.9%
Oligochaeta (% of community)	Unnamed Reference Creek	1.0%	1.4%	0.6%	-0.7%	2.7%	0.0%	2.9%
	CLT1 Upstream	1.1%	1.3%	0.6%	-0.5%	2.7%	0.4%	3.4%
	CLT1 Downstream	5.0%	2.7%	1.2%	1.7%	8.3%	2.8%	8.4%
Hydracarina (% of community)	Unnamed Reference Creek	4.8%	2.3%	1.0%	2.0%	7.6%	2.2%	7.7%
	CLT1 Upstream	7.7%	1.1%	0.5%	6.2%	9.1%	6.5%	9.5%
	CLT1 Downstream	4.0%	1.4%	0.6%	2.3%	5.8%	2.8%	6.1%
Ostracoda (% of community)	Unnamed Reference Creek	3.6%	2.6%	1.2%	0.4%	6.8%	0.8%	6.2%
	CLT1 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ephemeroptera (% of community)	Unnamed Reference Creek	13.8%	6.0%	2.7%	6.4%	21.3%	3.6%	19.3%
	CLT1 Upstream	1.0%	0.6%	0.3%	0.3%	1.7%	0.5%	2.0%
	CLT1 Downstream	0.4%	0.5%	0.2%	-0.3%	1.0%	0.0%	1.2%
Chironomidae (% of community)	Unnamed Reference Creek	37.9%	11.1%	5.0%	24.1%	51.7%	25.3%	55.7%
	CLT1 Upstream	73.9%	1.7%	0.7%	71.9%	76.0%	71.9%	75.8%
	CLT1 Downstream	81.0%	4.4%	2.0%	75.4%	86.5%	76.5%	87.4%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5.7%	5.7%	2.5%	-1.3%	12.7%	1.7%	15.7%
	CLT1 Upstream	7.2%	5.2%	2.3%	0.8%	13.6%	0.6%	14.7%
	CLT1 Downstream	1.5%	0.7%	0.3%	0.7%	2.3%	0.7%	2.5%
Simuliidae (% of community)	Unnamed Reference Creek	28.3%	6.6%	3.0%	20.1%	36.5%	23.0%	39.3%
	CLT1 Upstream	1.2%	1.3%	0.6%	-0.3%	2.8%	0.0%	3.1%
	CLT1 Downstream	0.3%	0.6%	0.3%	-0.4%	1.0%	0.0%	1.3%
Tipulidae (% of community)	Unnamed Reference Creek	0.7%	0.4%	0.2%	0.1%	1.2%	0.3%	1.4%
	CLT1 Upstream	8.4%	1.5%	0.7%	6.5%	10.3%	6.2%	10.0%
	CLT1 Downstream	3.9%	3.1%	1.4%	0.1%	7.7%	0.5%	8.9%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	58.8%	7.2%	3.2%	49.9%	67.6%	51.8%	69.3%
	CLT1 Upstream	38.8%	7.1%	3.2%	30.0%	47.6%	28.3%	46.2%
	CLT1 Downstream	67.2%	6.4%	2.9%	59.2%	75.1%	59.3%	76.9%
Filterer FFG (% of community)	Unnamed Reference Creek	28.6%	6.5%	2.9%	20.6%	36.7%	23.0%	39.3%
	CLT1 Upstream	1.3%	1.5%	0.7%	-0.5%	3.2%	0.0%	3.6%
	CLT1 Downstream	0.3%	0.6%	0.3%	-0.4%	1.0%	0.0%	1.3%
Shredder FFG (% of community)	Unnamed Reference Creek	6.7%	5.5%	2.4%	-0.1%	13.5%	2.7%	16.3%
	CLT1 Upstream	49.5%	6.4%	2.9%	41.5%	57.4%	41.0%	58.9%
	CLT1 Downstream	27.6%	4.9%	2.2%	21.5%	33.7%	19.1%	31.1%
Clinger HPG (% of community)	Unnamed Reference Creek	40.1%	7.8%	3.5%	30.4%	49.7%	28.8%	47.8%
	CLT1 Upstream	52.5%	7.2%	3.2%	43.5%	61.5%	47.0%	64.2%
	CLT1 Downstream	29.0%	5.7%	2.6%	21.9%	36.0%	19.9%	35.2%
Sprawler HPG (% of community)	Unnamed Reference Creek	49.0%	9.2%	4.1%	37.6%	60.5%	37.0%	58.8%
	CLT1 Upstream	33.8%	7.9%	3.5%	24.0%	43.6%	21.0%	42.1%
	CLT1 Downstream	57.6%	8.6%	3.9%	46.9%	68.3%	51.9%	72.8%
Burrower HPG (% of community)	Unnamed Reference Creek	10.7%	4.5%	2.0%	5.2%	16.3%	4.0%	15.1%
	CLT1 Upstream	13.7%	2.1%	0.9%	11.1%	16.3%	10.8%	15.4%
	CLT1 Downstream	13.4%	4.7%	2.1%	7.6%	19.2%	7.3%	19.9%

Table F.8: Benthic Invertebrate Community Absolute Density Statistical Comparison Results among Camp Lake Tributary 1 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Data Transfor-mation	Overall 3-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Study Area	Mean	Standard Deviation	Magnitude of Difference (SD)	Pairwise Comparison
Nemata (No. per m^2)	square root	NO	0.1887	Reference Creek	187	184	-	a
				CLT1 Upstream	50	26	-0.7	a
				CLT1 Downstream	75	73	-0.6	a
Oligochaeta (No. per m^2)	none	YES	0.0461	Reference Creek	13	18	-	a
				CLT1 Upstream	14	16	0.0	a
				CLT1 Downstream	87	78	4.1	b
Hydracarina (No. per m^2)	log	NO	0.3552	Reference Creek	99	115	-	a
				CLT1 Upstream	95	19	0.0	a
				CLT1 Downstream	57	34	-0.4	a
Ephemeroptera (No. per m^2)	log(X+1)	YES	< 0.001	Reference Creek	187	58	-	a
				CLT1 Upstream	13	7	-3.0	b
				CLT1 Downstream	3	5	-3.2	c
Chironomidae (No. per m^2)	log	NO	0.2780	Reference Creek	878	1140	-	a
				CLT1 Upstream	918	106	0.0	a
				CLT1 Downstream	1188	606	0.3	a
Metal Sensitive Chironomidae (No. per m^2)	log	NO	0.1850	Reference Creek	196	349	-	a
				CLT1 Upstream	91	71	-0.3	a
				CLT1 Downstream	19	7	-0.5	a
Simuliidae (No. per m^2)	fourth root	YES	< 0.001	Reference Creek	534	433	-	a
				CLT1 Upstream	16	18	-1.2	b
				CLT1 Downstream	2	4	-1.2	b
Tipulidae (No. per m^2)	none	YES	< 0.001	Reference Creek	9	5	-	a
				CLT1 Upstream	103	17	20.7	b
				CLT1 Downstream	42	22	7.3	c
Collector-Gatherer FFG (No. per m^2)	log	NO	0.1383	Reference Creek	1096	945	-	a
				CLT1 Upstream	480	103	-0.7	a
				CLT1 Downstream	980	474	-0.1	a
Filterer FFG (No. per m^2)	log(X+1)	YES	< 0.001	Reference Creek	542	444	-	a
				CLT1 Upstream	18	20	-1.2	b
				CLT1 Downstream	2	4	-1.2	b
Shredder FFG (No. per m^2)	log	YES	0.0120	Reference Creek	213	359	-	a
				CLT1 Upstream	613	102	1.1	b
				CLT1 Downstream	415	241	0.6	b
Clinger HPG (No. per m^2)	log	NO	0.3952	Reference Creek	861	918	-	a
				CLT1 Upstream	654	128	-0.2	a
				CLT1 Downstream	442	278	-0.5	a
Sprawler HPG (No. per m^2)	log	NO	0.1308	Reference Creek	890	753	-	a
				CLT1 Upstream	419	114	-0.6	a
				CLT1 Downstream	818	363	-0.1	a
Burrower HPG (No. per m^2)	fourth root	NO	0.9876	Reference Creek	219	205	-	a
				CLT1 Upstream	169	21	-0.2	a
				CLT1 Downstream	204	122	-0.1	a

(grey) Indicates a statisitically significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of reference mean, suggesting an ecologically meaningful difference in endpoint value between study areas.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.9: Statistical Comparison of Benthic Metrics at Camp Lake Tributary 1 North Branch (CLT1 US) Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transformation	Overall 5-Year Comparison: Significant Difference Among Years?	Overall 5-Year Comparison: P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.1536	2007	3	505	330	-	-3.2	a	Tamhane's
				2011	3	949	139	1.3	-	a	
				2015	5	1,446	836	2.9	3.6	a	
				2016	5	1,610	806	3.4	4.8	a	
				2017	5	1,242	143	2.2	2.1	a	
Richness (No. of Taxa)	none	YES	0.0268	2007	3	13.7	2.3	-	-0.3	a	Tukey's HSD
				2011	3	14.3	2.1	0.3	-	a,b	
				2015	5	15.0	2.7	0.6	0.3	a,b	
				2016	5	14.0	2.6	0.1	-0.2	a	
				2017	5	19.2	2.6	2.4	2.3	b	
Simpson's Evenness	none	YES	0.0004	2007	3	0.749	0.082	-	-3.0	a	Tukey's HSD
				2011	3	0.874	0.042	1.5	-	b	
				2015	5	0.899	0.037	1.8	0.6	b	
				2016	5	0.908	0.032	1.9	0.8	b	
				2017	5	0.925	0.019	2.1	1.2	b	
Nemata (% of community)	none	YES	0.0020	2007	3	0.1	0.3	-	-0.7	a	Tamhane's
				2011	3	0.7	0.8	2.1	-	a,b	
				2015	5	1.7	0.7	6.0	1.3	b	
				2016	5	1.3	0.5	4.5	0.8	b	
				2017	5	4.1	2.1	15.4	4.4	a,b	
Oligochaeta (% of community)	none	NO	0.9122	2007	3	1.5	2.1	-	1.4	a	Tamhane's
				2011	3	0.7	0.5	-0.3	-	a	
				2015	5	1.4	1.3	0.0	1.3	a	
				2016	5	1.5	0.6	0.0	1.5	a	
				2017	5	1.1	1.3	-0.2	0.7	a	
Hydracarina (% of community)	none	YES	0.0001	2007	3	0.8	1.0	-	-2.0	a	Tamhane's
				2011	3	14.4	6.7	13.3	-	a,b	
				2015	5	2.3	1.7	1.5	-1.8	a	
				2016	5	9.8	3.2	8.8	-0.7	b	
				2017	5	7.6	1.1	6.7	-1.0	b	
Chironomidae (% of community)	none	YES	0.0323	2007	3	88.1	7.1	-	2.3	a	Tukey's HSD
				2011	3	76.3	5.1	-1.7	-	a,b	
				2015	5	75.6	7.5	-1.8	-0.1	a,b	
				2016	5	68.6	10.6	-2.7	-1.5	b	
				2017	5	74.0	1.7	-2.0	-0.5	a,b	
Metal Sensitive Taxa (% of community)	none	NO	0.7141	2007	3	3.7	3.6	-	-1.1	a	Tukey's HSD
				2011	3	10.8	6.6	2.0	-	a	
				2015	5	12.7	14.0	2.5	0.3	a	
				2016	5	9.1	9.0	1.5	-0.3	a	
				2017	5	7.2	5.2	1.0	-0.5	a	
Tipulidae (% of community)	none	NO	0.1009	2007	3	8.9	4.1	-	0.9	a	Tukey's HSD
				2011	3	6.9	2.1	-0.5	-	a	
				2015	5	16.8	4.7	2.0	4.6	a	
				2016	5	16.9	11.8	2.0	4.7	a	
				2017	5	8.4	1.5	-0.1	0.7	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0022	2007	3	72.6	11.0	-	2.2	a	Tukey's HSD
				2011	3	41.4	14.1	-2.8	-	b	
				2015	5	50.2	7.3	-2.0	0.6	b	
				2016	5	40.8	11.4	-2.9	0.0	b	
				2017	5	38.8	7.1	-3.1	-0.2	b	
Filterer FFG (% of community)	none	NO	0.1128	2007	3	0.3	0.3	-	nc	a	Tamhane's
				2011	3	0.0	0.0	-1.2	-	a	
				2015	5	0.0	0.0	-1.2	nc	a	
				2016	5	0.5	0.6	0.9	nc	a	
				2017	5	1.3	1.5	3.9	nc	a	
Shredder FFG (% of community)	none	YES	0.0258	2007	3	23.1	8.8	-	-1.2	a	Tukey's HSD
				2011	3	40.1	14.3	1.9	-	a,b	
				2015	5	46.1	7.3	2.6	0.4	b	
				2016	5	47.8	14.0	2.8	0.5	b	
				2017	5	49.5	6.4	3.0	0.7	b	

(Grey shading) Indicates a statistically significant difference for respective comparison (p-value ≤ 0.1).

(Blue shading) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.10: Statistical Comparison of Benthic Metrics at Camp Lake Tributary 1 Lower Main Stem (CLT1 DS) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-Year Comparison: Significant Difference Among Years?	Overall 5-Year Comparison: P-value	Pair-wise, post-hoc comparisons[a]: Year	Sample Size (n)	Mean	Standard Deviation	Effect Size: vs. Baseline Year 2007	Effect Size: vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.3886	2007	3	754	573	-	-0.8	a	Tukey's HSD
				2011	3	898	183	0.3	-	a	
				2015	5	1,301	479	1.0	2.2	a	
				2016	5	1,143	443	0.7	1.3	a	
				2017	5	1,465	735	1.2	3.1	a	
Richness (No. of Taxa)	none	NO	0.1619	2007	3	20.3	6.0	-	1.1	a	Tukey's HSD
				2011	3	15.3	4.5	-0.8	-	a	
				2015	5	14.6	1.1	-1.0	-0.2	a	
				2016	5	17.0	1.6	-0.6	0.4	a	
				2017	5	16.8	1.9	-0.6	0.3	a	
Simpson's Evenness	none	NO	0.9523	2007	3	0.864	0.040	-	0.0	a	Tukey's HSD
				2011	3	0.864	0.026	0.0	-	a	
				2015	5	0.889	0.043	0.6	1.0	a	
				2016	5	0.864	0.095	0.0	0.0	a	
				2017	5	0.874	0.033	0.2	0.4	a	
Nemata (% of community)	logit	YES	0.0943	2007	3	1.0	1.3	-	1.7	a	Tamhane's
				2011	3	0.4	0.4	-0.5	-	a	
				2015	5	3.2	2.6	1.6	7.7	a	
				2016	5	4.5	4.1	2.6	11.3	a	
				2017	5	4.6	5.0	2.6	11.5	a	
Oligochaeta (% of community)	logit	NO	0.1043	2007	3	7.3	6.2	-	3.9	a	Tamhane's
				2011	3	1.1	1.6	-1.0	-	a	
				2015	5	5.6	3.1	-0.3	2.9	a	
				2016	5	9.7	3.7	0.4	5.5	a	
				2017	5	5.0	2.7	-0.4	2.5	a	
Hydracarina (% of community)	logit	YES	0.0265	2007	3	2.9	1.4	-	-3.4	a	Tamhane's
				2011	3	24.7	6.4	15.4	-	b	
				2015	5	1.7	1.6	-0.8	-3.6	a,b,c	
				2016	5	4.6	0.8	1.2	-3.1	c	
				2017	5	4.0	1.4	0.8	-3.2	c	
Chironomidae (% of community)	logit	YES	0.0064	2007	3	80.8	8.5	-	1.7	a,c	Tukey's HSD
				2011	3	65.3	9.0	-1.8	-	b	
				2015	5	85.2	4.0	0.5	2.2	a	
				2016	5	73.9	5.9	-0.8	1.0	b,c	
				2017	5	80.9	4.5	0.0	1.7	a	
Metal Sensitive Taxa (% of community)	logit	NO	0.4584	2007	3	15.1	10.2	-	1.0	a	Tamhane's
				2011	3	7.6	7.3	-0.7	-	a	
				2015	5	4.4	3.5	-1.1	-0.4	a	
				2016	5	3.8	3.3	-1.1	-0.5	a	
				2017	5	1.5	0.7	-1.3	-0.8	a	
Tipulidae (% of community)	logit	NO	0.1594	2007	3	6.4	2.6	-	-0.6	a	Tukey's HSD
				2011	3	8.4	3.2	0.7	-	a	
				2015	5	3.1	1.0	-1.3	-1.6	a	
				2016	5	6.1	3.4	-0.1	-0.7	a	
				2017	5	3.9	3.1	-1.0	-1.4	a	
Collector-Gatherer FFG (% of community)	logit	YES	0.0018	2007	3	51.7	24.3	-	1.5	a,c	Tukey's HSD
				2011	3	35.6	10.5	-0.7	-	a	
				2015	5	78.4	9.5	1.1	4.1	b,c	
				2016	5	73.8	9.9	0.9	3.7	c	
				2017	5	67.2	6.4	0.6	3.0	c	
Filterer FFG (% of community)	logit	NO	0.3384	2007	3	10.2	13.1	-	37.4	a	Tukey's HSD
				2011	3	0.3	0.3	-0.8	-	a	
				2015	5	0.2	0.5	-0.8	-0.3	a	
				2016	5	1.3	1.5	-0.7	3.8	a	
				2017	5	0.3	0.5	-0.8	0.2	a	
Shredder FFG (% of community)	logit	YES	0.0275	2007	3	22.1	3.1	-	-3.7	a,b	Tukey's HSD
				2011	3	38.9	4.5	5.5	-	a	
				2015	5	19.3	9.0	-0.9	-4.3	b	
				2016	5	19.6	9.5	-0.8	-4.2	b	
				2017	5	27.6	4.9	1.8	-2.5	a,b	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).
(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.
[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.11: Benthic Station Habitat Feature Statistical Comparisons among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Overall 3-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between 2 Areas?	P-value	Statistical Test
Water Depth (cm)	NO	0.7868	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.7754	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.9716	
				CLT2 Upstream	CLT2 Downstream	NO	0.8918	
Water Velocity (cm/s)	NO	0.2048	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.4374	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.8256	
				CLT2 Upstream	CLT2 Downstream	NO	0.1911	
Substrate Size (mm diameter)	NO	0.2623	α	Unnamed Reference Creek	CLT2 Upstream	NO	0.2420	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	NO	0.5331	
				CLT2 Upstream	CLT2 Downstream	NO	0.8173	
Substrate Embeddedness (%)	YES	0.0005	α	Unnamed Reference Creek	CLT2 Upstream	YES	0.0043	Tukey's HSD
				Unnamed Reference Creek	CLT2 Downstream	YES	0.0006	
				CLT2 Upstream	CLT2 Downstream	NO	0.4861	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Kruskal-Wallis H-test (multiple group) or Mann-Whitney U-test (pair-wise) conducted on non-normal data; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance.

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2017

Taxa — Study Area / Replicate Station	Upstream (CLT2-US)					Downstream (CLT2-DS)				
	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	-	-	-	7	4	7	47	-	4	-
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	29	4	-	-	-	-	14	-	22	7
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina	-	-	-	-	-	-	-	-	-	4
F. Sperchonidae										
Sperchon	25	7	25	25	7	25	7	-	-	7
HARPACTICOIDS										
O. Harpacticoida	-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS										
Cl. Ostracoda	-	-	-	-	-	-	-	-	-	-
SPRINGTAILS										
Cl. Entognatha										
O. Collembola	-	-	-	-	-	-	-	-	-	-
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	4	7	-	-	-	4	4	-	-	4
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	-	-	-	-	-	-	-	-	-	-
TRUE FLIES										
O. Diptera										
BITING-MIDGE										
F. Ceratopogonidae										
Culicoides	-	4	-	-	-	-	-	-	-	-
MIDGES										
F. Chironomidae										
chironomid pupae	**18**	**61**	**39**	**18**	**32**	**32**	**47**	**14**	**22**	**54**
S.F. Chironominae										
Micropsectra	-	-	-	-	-	-	-	-	-	-
Rheotanytarsus	-	-	-	-	-	-	-	-	-	-
S.F. Diamesinae										
Diamesa	22	25	39	39	25	18	61	25	22	-
Pseudokiefferiella	11	7	-	7	11	4	32	-	-	7
S.F. Orthocladiinae										
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Chaetocladius	-	-	-	-	-	-	-	-	-	4
Corynoneura	-	4	-	-	-	-	-	-	-	-
Cricotopus	-	7	4	14	4	25	14	7	-	4
Cricotopus/Orthocladius	-	4	-	-	14	36	47	4	-	7
Eukiefferiella	-	4	-	-	-	-	18	-	4	-
Hydrobaenus	-	-	-	4	-	-	4	-	-	-
Hydrosmittia	4	4	-	4	-	7	14	-	4	-
Krenosmittia	22	11	25	43	7	4	7	-	4	4
Limnophyes	-	-	-	7	11	-	32	-	4	-
Metriocnemus	-	-	-	4	-	-	-	-	-	-
Orthocladius (Euorthocladius)	7	11	4	7	-	14	7	-	4	4

Table F.12: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake Tributary 2 Study Areas, August 2017

Taxa	Study Area	Upstream (CLT2-US)					Downstream (CLT2-DS)				
	Replicate Station	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Parakiefferiella		-	-	-	-	-	-	-	-	-	-
Parametriocnemus		-	-	-	-	-	-	-	-	-	-
Paraphaenocladius		-	-	-	-	-	-	-	-	-	-
Thienemanniella		14	-	18	4	18	54	4	-	4	-
Tokunagaia		-	-	29	7	7	4	29	14	4	4
Tvetenia		25	18	39	36	25	43	32	11	22	47
indeterminate		-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae											
Thienemannimyia complex		-	-	-	-	-	-	-	-	-	-
F. Empididae											
Clinocera		4	4	-	7	-	4	-	4	-	-
pupae		**4**	-	4	-	-	**4**	-	-	-	-
F. Muscidae		-	-	-	-	-	-	-	-	-	-
F. Simuliidae											
Gymnopais		-	-	11	11	11	7	11	-	7	-
Metacnephia		-	4	-	-	4	-	-	-	-	-
Prosimulium		7	7	7	-	7	-	7	-	4	4
indeterminate		-	-	-	-	-	-	-	-	-	-
F. Tipulidae											
Tipula		-	-	4	7	7	-	-	-	-	7
Number of Organisms (No. organisms per m^2)		196	193	248	251	194	292	438	79	131	168
Richness (total number of taxa)[a]		12	17	12	17	15	15	19	6	13	13
Simpson's Evenness (E)		0.969	0.954	0.942	0.941	0.967	0.941	0.962	0.910	0.927	0.827
Bray-Curtis Index		0.802	0.797	0.789	0.762	0.762	0.717	0.669	0.915	0.864	0.807
Percent Composition											
% Nemata		0.0%	0.0%	0.0%	2.8%	2.1%	2.4%	10.7%	0.0%	3.1%	0.0%
% Oligochaeta		14.8%	2.1%	0.0%	0.0%	0.0%	0.0%	3.2%	0.0%	16.8%	4.2%
% Hydracarina		12.8%	3.6%	10.1%	10.0%	3.6%	8.6%	1.6%	0.0%	0.0%	6.5%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		2.0%	3.6%	0.0%	0.0%	0.0%	1.4%	0.9%	0.0%	0.0%	2.4%
% Chironomids		62.8%	80.8%	79.4%	77.3%	79.4%	82.5%	79.5%	94.9%	71.8%	80.4%
% Metal Sensitive Chironmids		19.9%	26.9%	19.8%	20.3%	23.2%	8.9%	24.7%	38.0%	22.1%	7.1%
% Simuliidae		3.6%	5.7%	7.3%	4.4%	11.3%	2.4%	4.1%	0.0%	8.4%	2.4%
% Tipulidae		0.0%	0.0%	1.6%	2.8%	3.6%	0.0%	0.0%	0.0%	0.0%	4.2%
Functional Feeding Group Composition											
% Collector - Gatherers		79.6%	77.2%	77.4%	74.1%	69.6%	62.0%	78.3%	77.2%	91.6%	76.2%
% Filterers		3.6%	5.7%	7.3%	4.4%	11.3%	2.4%	4.1%	0.0%	8.4%	2.4%
% Shredders		0.0%	9.3%	3.6%	8.8%	15.5%	24.3%	16.0%	17.7%	0.0%	14.9%
Habitat Preference Group Composition											
% Clingers		20.4%	20.7%	21.0%	23.1%	26.8%	38.0%	21.7%	22.8%	8.4%	19.6%
% Sprawlers		64.8%	75.1%	77.4%	69.7%	67.5%	59.6%	64.4%	77.2%	71.8%	72.0%
% Burrowers		14.8%	4.1%	1.6%	7.2%	5.7%	2.4%	13.9%	0.0%	19.8%	8.3%

[a] Bold entries excluded from taxa count

Table F.13: Benthic Invertebrate Community Summary Statistics for Camp Lake Tributary 2 Study Areas, Mary River Project CREMP, August 2017

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	1,972	1,861	832	-339	4,282	817	5,229
	CLT1 Upstream	216	30	14	179	254	193	251
	CLT1 Downstream	222	144	64	43	401	79	438
Richness (Number of Taxa)	Unnamed Reference Creek	21.2	1.9	0.9	18.8	23.6	19.0	24.0
	CLT1 Upstream	14.6	2.5	1.1	11.5	17.7	12.0	17.0
	CLT1 Downstream	13.2	4.7	2.1	7.3	19.1	6.0	19.0
Simpson's Evenness	Unnamed Reference Creek	0.935	0.017	0.008	0.913	0.956	0.909	0.951
	CLT1 Upstream	0.955	0.013	0.006	0.938	0.971	0.941	0.969
	CLT1 Downstream	0.913	0.052	0.023	0.849	0.978	0.827	0.962
Bray-Curtis Index	Unnamed Reference Creek	0.305	0.205	0.092	0.050	0.560	0.173	0.664
	CLT1 Upstream	0.782	0.019	0.009	0.759	0.806	0.762	0.802
	CLT1 Downstream	0.794	0.102	0.046	0.668	0.921	0.669	0.915
Nemata (% of community)	Unnamed Reference Creek	8.8%	3.5%	1.6%	4.4%	13.2%	3.1%	12.7%
	CLT1 Upstream	1.0%	1.4%	0.6%	-0.7%	2.7%	0.0%	2.8%
	CLT1 Downstream	3.2%	4.4%	2.0%	-2.2%	8.7%	0.0%	10.7%
Oligochaeta (% of community)	Unnamed Reference Creek	1.0%	1.4%	0.6%	-0.7%	2.7%	0.0%	2.9%
	CLT1 Upstream	3.4%	6.4%	2.9%	-4.6%	11.4%	0.0%	14.8%
	CLT1 Downstream	4.8%	6.9%	3.1%	-3.8%	13.5%	0.0%	16.8%
Hydracarina (% of community)	Unnamed Reference Creek	4.8%	2.3%	1.0%	2.0%	7.6%	2.2%	7.7%
	CLT1 Upstream	8.0%	4.2%	1.9%	2.8%	13.2%	3.6%	12.8%
	CLT1 Downstream	3.3%	4.0%	1.8%	-1.6%	8.3%	0.0%	8.6%
Ostracoda (% of community)	Unnamed Reference Creek	3.6%	2.6%	1.2%	0.4%	6.8%	0.8%	6.2%
	CLT1 Upstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	CLT1 Downstream	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ephemeroptera (% of community)	Unnamed Reference Creek	13.8%	6.0%	2.7%	6.4%	21.3%	3.6%	19.3%
	CLT1 Upstream	1.1%	1.6%	0.7%	-0.9%	3.1%	0.0%	3.6%
	CLT1 Downstream	0.9%	1.0%	0.5%	-0.3%	2.2%	0.0%	2.4%
Chironomidae (% of community)	Unnamed Reference Creek	37.9%	11.1%	5.0%	24.1%	51.7%	25.3%	55.7%
	CLT1 Upstream	75.9%	7.5%	3.3%	66.7%	85.2%	62.8%	80.8%
	CLT1 Downstream	81.8%	8.4%	3.7%	71.4%	92.2%	71.8%	94.9%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5.7%	5.7%	2.5%	-1.3%	12.7%	1.7%	15.7%
	CLT1 Upstream	22.0%	3.1%	1.4%	18.2%	25.8%	19.8%	26.9%
	CLT1 Downstream	20.2%	12.6%	5.7%	4.5%	35.9%	7.1%	38.0%
Simuliidae (% of community)	Unnamed Reference Creek	28.3%	6.6%	3.0%	20.1%	36.5%	23.0%	39.3%
	CLT1 Upstream	6.5%	3.0%	1.4%	2.7%	10.2%	3.6%	11.3%
	CLT1 Downstream	3.5%	3.1%	1.4%	-0.4%	7.3%	0.0%	8.4%
Tipulidae (% of community)	Unnamed Reference Creek	0.7%	0.4%	0.2%	0.1%	1.2%	0.3%	1.4%
	CLT1 Upstream	1.6%	1.6%	0.7%	-0.4%	3.6%	0.0%	3.6%
	CLT1 Downstream	0.8%	1.9%	0.8%	-1.5%	3.2%	0.0%	4.2%
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	58.8%	7.2%	3.2%	49.9%	67.6%	51.8%	69.3%
	CLT1 Upstream	75.6%	3.9%	1.7%	70.8%	80.4%	69.6%	79.6%
	CLT1 Downstream	77.1%	10.5%	4.7%	64.0%	90.1%	62.0%	91.6%
Filterer FFG (% of community)	Unnamed Reference Creek	28.6%	6.5%	2.9%	20.6%	36.7%	23.0%	39.3%
	CLT1 Upstream	6.5%	3.0%	1.4%	2.7%	10.2%	3.6%	11.3%
	CLT1 Downstream	3.5%	3.1%	1.4%	-0.4%	7.3%	0.0%	8.4%
Shredder FFG (% of community)	Unnamed Reference Creek	6.7%	5.5%	2.4%	-0.1%	13.5%	2.7%	16.3%
	CLT1 Upstream	7.4%	5.9%	2.6%	0.1%	14.8%	0.0%	15.5%
	CLT1 Downstream	14.6%	8.9%	4.0%	3.5%	25.7%	0.0%	24.3%
Clinger HPG (% of community)	Unnamed Reference Creek	40.1%	7.8%	3.5%	30.4%	49.7%	28.8%	47.8%
	CLT1 Upstream	22.4%	2.7%	1.2%	19.1%	25.7%	20.4%	26.8%
	CLT1 Downstream	22.1%	10.6%	4.7%	9.0%	35.2%	8.4%	38.0%
Sprawler HPG (% of community)	Unnamed Reference Creek	49.0%	9.2%	4.1%	37.6%	60.5%	37.0%	58.8%
	CLT1 Upstream	70.9%	5.2%	2.3%	64.4%	77.4%	64.8%	77.4%
	CLT1 Downstream	69.0%	7.0%	3.1%	60.4%	77.6%	59.6%	77.2%
Burrower HPG (% of community)	Unnamed Reference Creek	10.7%	4.5%	2.0%	5.2%	16.3%	4.0%	15.1%
	CLT1 Upstream	6.7%	5.0%	2.2%	0.5%	12.9%	1.6%	14.8%
	CLT1 Downstream	8.9%	8.1%	3.6%	-1.2%	19.0%	0.0%	19.8%

Table F.14: Benthic Invertebrate Community Absolute Density Statistical Comparison Results among Camp Lake Tributary 2 and Unnamed Reference Creek Study Areas, Mary River Project CREMP, August 2017

Metric	Data Transformation	Overall 3-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Study Area	Mean	Standard Deviation	Magnitude of Difference (SD)	Pairwise Comparison
Nemata (No. per m^2)	none (MW)	YES	0.0094	Reference Creek	187	184	-	a
				CLT2 Upstream	2	3	-1.0	b
				CLT2 Downstream	12	20	-1.0	b
Oligochaeta (No. per m^2)	none (MW)	NO	0.8681	Reference Creek	13	18	-	a
				CLT2 Upstream	7	13	-0.4	a
				CLT2 Downstream	9	9	-0.2	a
Hydracarina (No. per m^2)	none (MW)	YES	0.0202	Reference Creek	99	115	-	a
				CLT2 Upstream	18	10	-0.7	b
				CLT2 Downstream	9	10	-0.8	b
Ephemeroptera (No. per m^2)	none (MW)	YES	0.0069	Reference Creek	187	58	-	a
				CLT2 Upstream	2	3	-3.2	b
				CLT2 Downstream	2	2	-3.2	b
Chironomidae (No. per m^2)	none (MW)	YES	0.0189	Reference Creek	878	1140	-	a
				CLT2 Upstream	165	31	-0.6	b
				CLT2 Downstream	179	114	-0.6	b
Metal Sensitive Taxa (No. per m^2)	none (MW)	NO	0.2491	Reference Creek	196	349	-	a
				CLT2 Upstream	47	5	-0.4	a
				CLT2 Downstream	41	38	-0.4	a
Simuliidae (No. per m^2)	none (MW)	YES	0.0057	Reference Creek	534	433	-	a
				CLT2 Upstream	14	6	-1.2	b
				CLT2 Downstream	8	7	-1.2	b
Collector-Gatherer FFG (No. per m^2)	none (MW)	YES	0.0075	Reference Creek	1096	945	-	a
				CLT2 Upstream	164	24	-1.0	b
				CLT2 Downstream	167	107	-1.0	b
Filterer FFG (No. per m^2)	none (MW)	YES	0.0057	Reference Creek	542	444	-	a
				CLT2 Upstream	14	6	-1.2	b
				CLT2 Downstream	8	7	-1.2	b
Shredder FFG (No. per m^2)	none (MW)	YES	0.0816	Reference Creek	213	359	-	a
				CLT2 Upstream	16	12	-0.6	b
				CLT2 Downstream	36	33	-0.5	a,b
Clinger HPG (No. per m^2)	none (MW)	YES	0.0085	Reference Creek	861	918	-	a
				CLT2 Upstream	48	8	-0.9	b
				CLT2 Downstream	54	46	-0.9	b
Sprawler HPG (No. per m^2)	none (MW)	YES	0.0075	Reference Creek	890	753	-	a
				CLT2 Upstream	154	28	-1.0	b
				CLT2 Downstream	146	86	-1.0	b
Burrower HPG (No. per m^2)	none (MW)	YES	0.0132	Reference Creek	219	205	-	a
				CLT2 Upstream	14	10	-1.0	b
				CLT2 Downstream	22	24	-1.0	b

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of reference mean, suggesting an ecologically meaningful difference in endpoint value relative to the reference area.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.15: Statistical Comparison of Benthic Metrics at Camp Lake Tributary 2 Upstream (CLT2 US) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0273	2007	3	364	205	-	a,b	Tamhane's
				2015	5	741	416	1.8	a,b	
				2016	5	412	100	0.2	a	
				2017	5	216	30	-0.7	b	
Richness (No. of Taxa)	none	YES	0.0015	2007	3	12.7	2.1	-	a	Tukey's HSD
				2015	5	20.8	1.8	3.9	b	
				2016	5	17.2	2.9	2.2	b,c	
				2017	5	14.6	2.5	0.9	a,c	
Simpson's Evenness	none	YES	0.0000	2007	3	0.825	0.008	-	a	Tukey's HSD
				2015	5	0.922	0.025	11.8	b,c	
				2016	5	0.898	0.035	9.0	b	
				2017	5	0.955	0.013	15.8	c	
Nemata (% of community)	none	NO	0.9868	2007	3	1.1	0.6	-	a	Tukey's HSD
				2015	5	0.9	0.9	-0.5	a	
				2016	5	1.0	0.8	-0.3	a	
				2017	5	1.0	1.4	-0.3	a	
Oligochaeta (% of community)	none	NO	0.7807	2007	3	2.1	0.8	-	a	Tukey's HSD
				2015	5	2.7	2.8	0.7	a	
				2016	5	4.9	3.5	3.5	a	
				2017	5	3.4	6.4	1.6	a	
Hydracarina (% of community)	none	YES	0.0074	2007	3	2.9	2.1	-	a,b	Tamhane's
				2015	5	0.9	0.7	-1.0	a	
				2016	5	5.5	2.6	1.2	b	
				2017	5	8.0	4.2	2.4	a,b	
Chironomidae (% of community)	none	NO	0.2377	2007	3	88.4	4.3	-	a	Tukey's HSD
				2015	5	80.2	8.9	-1.9	a	
				2016	5	79.5	8.5	-2.1	a	
				2017	5	75.9	7.5	-2.9	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0000	2007	3	5.3	0.6	-	a	Tukey's HSD
				2015	5	10.5	5.7	8.8	a	
				2016	5	5.3	3.3	0.0	a	
				2017	5	22.0	3.1	28.3	b	
Tipulidae (% of community)	none	NO	0.1946	2007	3	5.2	2.0	-	a	Tukey's HSD
				2015	5	4.1	3.5	-0.5	a	
				2016	5	4.0	1.8	-0.6	a	
				2017	5	1.6	1.6	-1.8	a	
Collector-Gatherer FFG (% of community)	none	NO	0.1010	2007	3	68.5	6.5	-	a	Tamhane's
				2015	5	63.8	10.3	-0.7	a	
				2016	5	66.6	5.8	-0.3	a	
				2017	5	75.6	3.9	1.1	a	
Filterer FFG (% of community)	none	YES	0.0002	2007	3	0.2	0.4	-	a	Tamhane's
				2015	5	1.0	1.1	1.7	a	
				2016	5	0.2	0.4	-0.2	a	
				2017	5	6.5	3.1	14.3	b	
Shredder FFG (% of community)	none	YES	0.0001	2007	3	27.6	5.8	-	a	Tukey's HSD
				2015	5	26.2	5.8	-0.3	a	
				2016	5	25.9	4.4	-0.3	a	
				2017	5	7.4	5.9	-3.5	b	

Indicates a significant difference for respective comparison (p-value ≤ 0.1).

Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.16: Statistical Comparison of Benthic Metrics at Camp Lake Tributary 2 Downstream (CLT2 DS) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0798	2007	3	431	109	-	a	Tukey's HSD
				2015	5	447	258	0.1	a	
				2016	5	205	61	-2.1	a	
				2017	5	222	144	-1.9	a	
Richness (No. of Taxa)	none	NO	0.4616	2007	3	17.7	2.1	-	a	Tukey's HSD
				2015	5	14.2	3.3	-1.7	a	
				2016	5	14.0	4.0	-1.8	a	
				2017	5	13.2	4.7	-2.1	a	
Simpson's Evenness	none	YES	0.0563	2007	3	0.865	0.017	-	a,b	Tukey's HSD
				2015	5	0.934	0.034	4.0	a	
				2016	5	0.838	0.079	-1.5	b	
				2017	5	0.913	0.052	2.8	a,b	
Nemata (% of community)	none	NO	0.4989	2007	3	1.1	1.2	-	a	Tukey's HSD
				2015	5	4.2	2.4	2.6	a	
				2016	5	2.0	2.4	0.8	a	
				2017	5	3.2	4.4	1.8	a	
Oligochaeta (% of community)	none	NO	0.5555	2007	3	2.6	0.6	-	a	Tukey's HSD
				2015	5	8.8	12.8	10.1	a	
				2016	5	1.9	3.2	-1.1	a	
				2017	5	4.8	6.9	3.6	a	
Hydracarina (% of community)	none	YES	0.0765	2007	3	1.8	1.2	-	a,b	Tamhane's
				2015	5	0.3	0.6	-1.2	a	
				2016	5	4.5	1.9	2.2	b	
				2017	5	3.3	4.0	1.3	a,b	
Chironomidae (% of community)	none	NO	0.2573	2007	3	88.0	6.0	-	a	Tukey's HSD
				2015	5	75.6	10.4	-2.1	a	
				2016	5	82.4	6.3	-0.9	a	
				2017	5	81.8	8.4	-1.0	a	
Metal Sensitive Taxa (% of community)	none	NO	0.1120	2007	3	11.8	2.0	-	a	Tukey's HSD
				2015	5	10.6	10.6	-0.6	a	
				2016	5	5.4	0.9	-3.3	a	
				2017	5	20.2	12.6	4.3	a	
Tipulidae (% of community)	none	NO	0.1441	2007	3	6.4	6.6	-	a	Tamhane's
				2015	5	5.8	5.1	-0.1	a	
				2016	5	2.2	1.6	-0.6	a	
				2017	5	0.8	1.9	-0.9	a	
Collector-Gatherer FFG (% of community)	none	NO	0.3981	2007	3	66.4	11.0	-	a	Tukey's HSD
				2015	5	69.3	10.9	0.3	a	
				2016	5	77.6	11.6	1.0	a	
				2017	5	77.1	10.5	1.0	a	
Filterer FFG (% of community)	none	NO	0.1446	2007	3	2.7	1.9	-	a	Tukey's HSD
				2015	5	0.8	0.9	-1.0	a	
				2016	5	1.1	1.0	-0.9	a	
				2017	5	3.5	3.1	0.4	a	
Shredder FFG (% of community)	none	NO	0.2288	2007	3	21.5	5.9	-	a	Tukey's HSD
				2015	5	25.7	11.6	0.7	a	
				2016	5	13.8	10.4	-1.3	a	
				2017	5	14.6	8.9	-1.2	a	

Indicates a significant difference for respective comparison (p-value ≤ 0.1).

Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.17: Statistical Comparison of Physical Sediment Quality Between Littoral and Profundal Stations of Reference Lake 3, Mary River Project CREMP, August 2017

Habitat Variable	Statistical Test Results			Summary Statistics						
	Significant Difference Between Habitats?	P-value	Statistical Analysis[a]	Station Type	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Sand-Sized Particles (% by weight)	NO	0.300	α	Littoral	5	46.4	13.9	6.2	25.6	59.9
				Profundal	5	35.7	16.5	7.4	15.6	56.0
Silt-Sized Particles (% by weight)	NO	0.436	β	Littoral	5	44.3	11.6	5.2	32.8	62.2
				Profundal	5	50.2	11.8	5.3	35.3	62.4
Clay-Sized Particles (% by weight)	NO	0.106	ζ	Littoral	5	9.3	2.8	1.3	4.7	12.2
				Profundal	5	14.1	5.2	2.3	8.8	22.0
Total Organic Carbon (%)	NO	0.209	α	Littoral	5	4.9	1.8	0.8	2.7	7.2
				Profundal	5	3.6	1.1	0.5	1.8	4.4

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; ζ - data fourth root transformed, single factor ANOVA test conducted; Ŧ - data square root transformed, single factor ANOVA test conducted; η - single factor ANOVA test validated using t-test assuming unequal variance; γ - data non-normal, Mann-Whitney U-test conducted.

Table F.18: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2017

Taxa (Study Area / Replicate Station)	Reference Lake 03 - Littoral Stations 2017					Reference Lake 03 - Profundal Stations 2017				
	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
ROUNDWORMS										
P. Nemata	9	103	34	86	17	-	-	-	-	-
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	-	-	-	-	-	-	-	-	-	-
F. Lumbriculidae										
Lumbriculus	9	-	-	-	-	-	-	-	-	-
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
immature	-	-	-	-	-	-	-	-	-	**9**
F. Acalyptonotidae										
Acalyptonotus	78	34	9	9	17	9	-	17	17	9
F. Hygrobatidae										
Hygrobates	-	17	9	17	-	-	-	-	-	-
F. Lebertiidae										
Lebertia	9	138	9	17	9	-	-	-	-	-
HARPACTICOIDS										
O. Harpacticoida	-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS										
Cl. Ostracoda	241	1,379	95	1,233	431	-	-	9	-	17
FAIRY SHRIMP										
O. Notostraca										
Lepidurus arcticus	-	-	-	-	-	-	-	-	-	-
INSECTS										
Cl. Insecta										
CADDISFLIES										
O. Trichoptera										
F. Apataniidae										
Apatania	-	-	-	-	-	-	-	-	-	-
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	-	-	**9**	**17**	**34**	-	-	-	-	-
S.F. Chironominae										
Chironomus	-	-	-	-	-	-	-	-	-	-
Micropsectra	86	190	52	9	422	17	26	-	-	-
Paratanytarsus	-	17	-	-	-	-	-	-	-	-
Sergentia	-	-	-	-	-	-	-	-	-	-
Stictochironomus	112	34	-	-	69	-	-	-	-	-
Tanytarsus	52	34	-	-	86	-	-	-	-	-
S.F. Diamesinae	-	-	-	-	-	-	-	-	-	-
Protanypus	-	17	-	-	-	9	-	9	9	-
Pseudodiamesa	26	17	-	-	9	-	-	-	9	-
S.F. Orthocladiinae										
Abiskomyia	164	483	60	388	293	26	-	69	-	17
Chaetocladius	-	-	-	-	-	-	-	-	-	-
Corynoneura	-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius	-	-	-	-	-	-	-	-	-	-
Heterotrissocladius	34	69	26	78	9	78	103	60	78	138
Mesocricotopus	-	-	-	-	-	-	-	-	-	-
Paracladius	9	34	60	43	34	-	-	-	-	-
Parakiefferiella	-	-	-	-	-	-	-	-	-	-
Psectrocladius	-	-	-	-	-	-	-	-	-	-

Table F.18: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Reference Lake 3, August 2017

Taxa — Study Area / Replicate Station	Reference Lake 03 - Littoral Stations 2017					Reference Lake 03 - Profundal Stations 2017				
	REF-01	REF-02	REF-03	REF-04	REF-05	REF-06	REF-07	REF-08	REF-09	REF-10
Zalutschia	172	52	-	34	17	-	-	9	-	-
Genus "Greenland"	-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Arctopelopia	9	-	9	-	-	-	-	-	-	-
Procladius	69	-	-	-	-	-	-	-	-	-
F. Tipulidae										
Tipula	-	-	-	-	-	-	-	-	-	-
Density (No. organisms per m^2)	1,079	2,618	372	1,931	1,447	139	129	173	113	190
Richness (total number of taxa)[a]	15	15	10	10	12	5	2	6	4	4
Simpson's Evenness (E)	0.933	0.725	0.934	0.605	0.838	0.783	0.644	0.843	0.651	0.597
Bray-Curtis Index	0.367	0.420	0.536	0.394	0.203	0.131	0.376	0.299	0.111	0.280
Percent Composition										
% Nemata	0.8%	3.9%	9.1%	4.5%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	8.1%	7.2%	7.3%	2.2%	1.8%	6.5%	0.0%	9.8%	15.0%	9.5%
% Ostracods	22.3%	52.7%	25.5%	63.9%	29.8%	0.0%	0.0%	5.2%	0.0%	8.9%
% Chironomids	67.9%	36.2%	58.1%	29.5%	67.2%	93.5%	100.0%	85.0%	85.0%	81.6%
% Metal Sensitive Chironmids	15.2%	10.5%	14.5%	0.5%	37.0%	18.7%	20.2%	5.2%	15.9%	0.0%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition										
% Collector - Gatherers	56.0%	81.6%	75.8%	95.5%	60.6%	81.3%	79.8%	85.0%	85.0%	90.5%
% Filterers	12.8%	0.09	0.15	0.00	0.36	0.12	0.20	0.00	0.00	0.00
% Shredders	15.9%	2.0%	0.0%	1.8%	1.2%	0.0%	0.0%	5.2%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	20.9%	15.8%	21.8%	2.7%	38.1%	18.7%	20.2%	9.8%	15.0%	9.5%
% Sprawlers	67.1%	78.3%	69.1%	92.9%	55.7%	74.8%	79.8%	85.0%	77.0%	90.5%
% Burrowers	12.0%	5.9%	9.1%	4.5%	6.2%	6.5%	0.0%	5.2%	8.0%	0.0%

[a] Bold entries excluded from taxa count

Table F.19: Statistical Comparison of Benthic Metrics at Reference Lake 3 Littoral (Shallow) Stations Among Years of Mine Operation (2015, 2016, 2017) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 3-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Mean	Standard Deviation	Effect Size vs. Year 2015	Effect Size vs. Year 2016	Pairwise Comparison	Statistical Test
Density (No. per m²)	log	NO	0.3332	2015	1,278	888	-	-0.8	a	Tukey's HSD
				2016	2,390	1,396	1.3	-	a	
				2017	1,489	850	0.2	-0.6	a	
Richness (No. of Taxa)	none	NO	0.9757	2015	12.6	4.1	-	0.4	a	Tamhane's
				2016	12.2	1.1	-0.1	-	a	
				2017	12.4	2.5	0.0	0.2	a	
Simpson's Evenness	log	NO	0.4931	2015	0.865	0.052	-	0.6	a	Tukey's HSD
				2016	0.758	0.189	-2.0	-	a	
				2017	0.807	0.142	-1.1	0.3	a	
Nemata (% of community)	modified probit	NO	0.7212	2015	8.1%	7.4%	-	0.7	a	Tukey's HSD
				2016	4.0%	5.6%	-0.6	-	a	
				2017	3.9%	3.3%	-0.6	0.0	a	
Hydracarina (% of community)	none	NO	0.5870	2015	4.2%	2.7%	-	0.3	a	Tukey's HSD
				2016	3.6%	2.0%	-0.2	-	a	
				2017	5.3%	3.0%	0.4	0.9	a	
Ostracoda (% of community)	modified probit	YES	0.0587	2015	20.9%	18.5%	-	-1.5	a	Tukey's HSD
				2016	46.9%	17.5%	1.4	-	b	
				2017	38.8%	18.4%	1.0	-0.5	a,b	
Chironomidae (% of community)	none	NO	0.2208	2015	66.5%	18.9%	-	1.1	a	Tukey's HSD
				2016	45.4%	18.8%	-1.1	-	a	
				2017	51.8%	17.9%	-0.8	0.3	a	
Metal Sensitive Taxa (% of community)	none	NO	0.5767	2015	11.4%	12.6%	-	-0.9	a	Tukey's HSD
				2016	19.3%	8.3%	0.6	-	a	
				2017	15.5%	13.4%	0.3	-0.4	a	
Collector-Gatherer FFG (% of community)	none	NO	0.7031	2015	81.4%	17.1%	-	0.6	a	Tukey's HSD
				2016	75.0%	11.4%	-0.4	-	a	
				2017	73.9%	16.0%	-0.4	-0.1	a	
Filterer FFG (% of community)	none	NO	0.8070	2015	11.4%	12.6%	-	-0.6	a	Tukey's HSD
				2016	16.1%	8.4%	0.4	-	a	
				2017	14.7%	13.3%	0.3	-0.2	a	

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of initial year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.20: Statistical Comparison of Benthic Metrics at Reference Lake 3 Profundal (Deep) Stations Among Years of Mine Operation (2015, 2016, 2017) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 3-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Mean	Standard Deviation	Effect Size vs. Year 2015	Effect Size vs. Year 2016	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	< 0.001	2015	180	39	-	-5.0	a	Tukey's HSD
				2016	452	55	6.9	-	b	
				2017	149	32	-0.8	-5.5	a	
Richness (No. of Taxa)	none	NO	0.1888	2015	2.8	0.8	-	-0.9	a	Tukey's HSD
				2016	4.2	1.5	1.7	-	a	
				2017	4.2	1.5	1.7	0.0	a	
Simpson's Evenness	none	YES	0.0017	2015	0.397	0.232	-	3.2	a,b	Tamhane's
				2016	0.267	0.041	-0.6	-	a	
				2017	0.704	0.105	1.3	10.6	b	
Nemata (% of community)	modified probit	YES	0.0248	2015	1.0%	2.2%	-	nc	a	Tamhane's
				2016	0.0%	0.0%	-0.4	-	b	
				2017	0.0%	0.0%	-0.4	nc	b	
Hydracarina (% of community)	modified probit	NO	0.1011	2015	1.5%	3.3%	-	-0.3	a	Tukey's HSD
				2016	2.1%	2.1%	0.2	-	a	
				2017	8.2%	5.5%	2.0	2.8	a	
Ostracoda (% of community)	modified probit	NO	0.3837	2015	9.7%	13.1%	-	2.2	a	Tukey's HSD
				2016	5.7%	1.8%	-0.3	-	a	
				2017	2.8%	4.1%	-0.5	-1.5	a	
Chironomidae (% of community)	none	NO	0.6684	2015	87.4%	12.8%	-	-1.5	a	Tukey's HSD
				2016	92.2%	3.2%	0.4	-	a	
				2017	88.8%	7.2%	0.1	-1.1	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0208	2015	2.8%	2.6%	-	0.6	a	Tamhane's
				2016	1.7%	1.7%	-0.4	-	a	
				2017	12.0%	8.9%	3.6	6.0	a	
Collector-Gatherer FFG (% of community)	none	YES	< 0.001	2015	96.2%	2.8%	-	-0.3	a	Tukey's HSD
				2016	96.9%	2.1%	0.2	-	a	
				2017	84.3%	4.1%	-4.2	-6.0	b	
Filterer FFG (% of community)	modified probit	YES	0.0469	2015	1.9%	2.7%	-	nc	a	Tamhane's
				2016	0.0%	0.0%	-0.7	-	a	
				2017	6.5%	9.3%	1.7	nc	a	

(Grey shading) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(Blue shading) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of initial year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.21: Statistical Comparison of Physical Sediment Quality Between Camp Lake and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	Station Depth (m)	NO	0.810	α	Reference	5	9.74	1.04	0.46	8.50	11.20
					Camp	5	9.42	2.69	1.20	6.30	12.40
	Sand-Sized Particles (% by weight)	YES	0.072	α	Reference	5	46.4	13.9	6.2	25.6	59.9
					Camp	5	66.2	16.3	7.3	50.2	89.4
	Silt-Sized Particles (% by weight)	NO	0.176	α	Reference	5	44.3	11.6	5.2	32.8	62.2
					Camp	5	31.5	15.4	6.9	9.7	46.4
	Clay-Sized Particles (% by weight)	YES	<0.001	Ŧ	Reference	5	9.3	2.8	1.3	4.7	12.2
					Camp	5	2.2	1.0	0.4	1.0	3.4
	Total Organic Carbon (%)	YES	0.004	α	Reference	5	4.9	1.8	0.8	2.7	7.2
					Camp	5	1.3	0.7	0.3	0.9	2.6
Profundal (Deep) Stations	Station Depth (m)	NO	0.714	β	Reference	5	20.56	2.17	0.97	18.50	24.20
					Camp	5	23.46	9.70	4.34	16.20	35.10
	Sand-Sized Particles (% by weight)	YES	0.028	β	Reference	5	35.7	16.5	7.4	15.6	56.0
					Camp	5	66.1	16.0	7.1	47.6	87.1
	Silt-Sized Particles (% by weight)	YES	0.056	Ŧ	Reference	5	50.2	11.8	5.3	35.3	62.4
					Camp	5	30.9	14.4	6.5	11.7	47.9
	Clay-Sized Particles (% by weight)	YES	<0.001	Ŧ	Reference	5	14.1	5.2	2.3	8.8	22.0
					Camp	5	3.0	1.6	0.7	1.2	4.6
	Total Organic Carbon (%)	YES	0.005	α	Reference	5	3.6	1.1	0.5	1.8	4.4
					Camp	5	1.2	0.8	0.4	0.3	2.4

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted; Ŧ data square root transformed, t-test conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.22: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2017

Taxa	Study Area / Replicate Station	Camp Lake - Littoral Stations 2017					Camp Lake - Profundal Stations 2017				
		JLO-02	JLO-21	JLO-20	JLO-19	JLO-18	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
ROUNDWORMS											
P. Nemata		-	34	172	216	276	310	60	9	-	241
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		-	-	-	-	-	-	-	-	-	-
F. Lumbriculidae											
Lumbriculus		-	-	-	-	-	-	-	-	-	-
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina											
immature		-	-	**69**	-	**103**	-	**9**	-	**17**	-
F. Acalyptonotidae											
Acalyptonotus		-	17	34	52	69	34	9	-	-	9
F. Hygrobatidae											
Hygrobates		-	17	-	9	103	-	-	-	-	9
F. Lebertiidae											
Lebertia		-	-	-	-	-	-	9	-	34	17
HARPACTICOIDS											
O. Harpacticoida		-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS											
Cl. Ostracoda		-	34	-	-	-	-	-	-	17	-
FAIRY SHRIMP											
O. Notostraca											
Lepidurus arcticus		-	-	-	-	-	-	-	-	-	-
INSECTS											
Cl. Insecta											
CADDISFLIES											
O. Trichoptera											
F. Apataniidae											
Apatania		34	34	69	-	-	-	-	-	-	9
TRUE FLIES											
O. Diptera											
MIDGES											
F. Chironomidae											
chironomid pupae		**69**	**34**	**138**	**26**	**34**	**69**	-	**9**	**17**	-
S.F. Chironominae											
Chironomus		-	-	-	-	-	345	-	-	-	-
Micropsectra		103	1,259	2,379	1,017	690	34	103	397	862	129
Paratanytarsus		207	284	-	121	-	34	-	60	-	34
Sergentia		-	-	-	-	-	-	-	17	17	-
Stictochironomus		276	1,103	103	78	241	69	-	103	86	-
Tanytarsus		-	379	517	129	103	276	-	-	-	26
S.F. Diamesinae		-	-	-	-	-	-	-	-	-	-
Protanypus		34	60	34	17	-	-	17	9	-	17
Pseudodiamesa		-	-	-	17	-	34	9	-	-	9
S.F. Orthocladiinae											
Abiskomyia		172	474	1,000	216	379	931	17	-	103	121
Chaetocladius		-	-	-	-	-	-	-	-	-	-
Corynoneura		-	-	-	-	-	34	-	-	-	-
Cricotopus/Orthocladius		34	-	-	-	-	-	-	-	-	-
Heterotrissocladius		1,241	224	448	172	724	345	276	431	17	1,552
Mesocricotopus		-	-	-	-	-	-	-	-	-	-
Paracladius		-	-	207	172	379	34	-	-	-	-
Parakiefferiella		-	-	-	-	-	-	-	-	-	9
Psectrocladius		-	-	-	-	-	-	-	-	-	-

Table F.22: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Camp Lake, August 2017

Taxa — Study Area / Replicate Station	Camp Lake - Littoral Stations 2017					Camp Lake - Profundal Stations 2017				
	JLO-02	JLO-21	JLO-20	JLO-19	JLO-18	JLO-16	JLO-01	JLO-07	JLO-11	JLO-12
Zalutschia	-	-	34	112	69	-	-	9	-	9
Genus "Greenland"	-	34	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Arctopelopia	138	345	241	34	-	-	-	9	-	9
Procladius	69	60	345	60	34	-	-	26	34	9
F. Tipulidae										
Tipula	-	-	-	-	-	-	-	-	-	-
Density (No. organisms per m^2)	2,377	4,392	5,790	2,448	3,204	2,549	509	1,079	1,204	2,209
Richness (total number of taxa)[a]	10	15	13	15	11	12	8	10	8	16
Simpson's Evenness (E)	0.751	0.878	0.831	0.844	0.938	0.861	0.740	0.763	0.521	0.520
Bray-Curtis Index	0.807	0.785	0.821	0.690	0.709	0.916	0.629	0.855	0.949	0.903
Percent Composition										
% Nemata	0.0%	0.8%	3.0%	8.8%	8.6%	12.2%	11.8%	0.8%	0.0%	10.9%
% Hydracarina	0.0%	0.8%	1.8%	2.5%	8.6%	1.3%	5.3%	0.0%	4.2%	1.6%
% Ostracods	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	0.0%
% Chironomids	98.6%	96.9%	94.1%	88.7%	82.8%	86.5%	82.9%	99.2%	94.4%	87.1%
% Metal Sensitive Chironmids	14.9%	45.5%	51.9%	53.8%	25.1%	15.3%	25.3%	43.6%	72.7%	9.7%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition										
% Collector - Gatherers	74.7%	45.1%	34.7%	36.6%	63.1%	84.7%	74.5%	53.2%	20.2%	88.2%
% Filterers	13.4%	0.44	0.51	0.52	0.25	0.14	0.20	0.43	0.73	0.09
% Shredders	1.5%	0.0%	0.6%	4.6%	2.2%	0.0%	0.0%	0.8%	0.0%	0.4%
Habitat Preference Group Composition										
% Clingers	7.4%	39.1%	54.3%	49.9%	33.6%	13.9%	25.5%	38.6%	78.3%	9.0%
% Sprawlers	79.2%	33.4%	40.3%	37.4%	50.1%	57.2%	59.3%	50.0%	14.5%	79.3%
% Burrowers	13.4%	27.5%	5.4%	12.7%	16.2%	28.9%	15.1%	11.3%	7.2%	11.7%

[a] Bold entries excluded from taxa coun

Table F.23: Statistical Comparison of Benthic Metrics at Camp Lake Littoral (Shallow) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0159	2013	4	7,752	3,849	-	a	Tamhane's
				2015	5	3,671	1,891	-1.1	a	
				2016	5	2,639	668	-1.3	a	
				2017	5	3,642	1,449	-1.1	a	
Richness (No. of Taxa)	none	NO	0.1056	2013	4	18.0	4.4	-	a	Tukey's HSD
				2015	5	12.8	3.7	-1.2	a	
				2016	5	15.8	3.3	-0.5	a	
				2017	5	12.8	2.3	-1.2	a	
Simpson's Evenness	none	YES	0.0002	2013	4	0.893	0.054	-	a	Tamhane's
				2015	5	0.712	0.063	-3.4	b	
				2016	5	0.917	0.034	0.4	a	
				2017	5	0.848	0.068	-0.8	a	
Nemata (% of community)	modified probit	NO	0.7231	2013	4	5.6%	3.6%	-	a	Tukey's HSD
				2015	5	4.7%	4.6%	-0.2	a	
				2016	5	4.4%	4.8%	-0.3	a	
				2017	5	4.2%	4.2%	-0.4	a	
Ostracoda (% of community)	modified probit	NO	0.1229	2013	4	0.7%	0.5%	-	a	Tukey's HSD
				2015	5	0.2%	0.3%	-1.0	a	
				2016	5	1.8%	1.1%	2.5	a	
				2017	5	0.2%	0.3%	-1.1	a	
Chironomidae (% of community)	modified probit	NO	0.4153	2013	4	90.1%	4.4%	-	a	Tukey's HSD
				2015	5	93.1%	4.7%	0.7	a	
				2016	5	87.4%	7.0%	-0.6	a	
				2017	5	92.2%	6.5%	0.5	a	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.9345	2013	4	30.8%	14.6%	-	a	Tukey's HSD
				2015	5	38.5%	24.5%	0.5	a	
				2016	5	29.7%	11.8%	-0.1	a	
				2017	5	38.2%	17.3%	0.5	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.3175	2013	4	55.9%	12.4%	-	a	Tukey's HSD
				2015	5	51.1%	14.7%	-0.4	a	
				2016	5	65.7%	7.8%	0.8	a	
				2017	5	50.8%	17.4%	-0.4	a	
Filterer FFG (% of community)	modified probit	NO	0.8432	2013	4	30.8%	14.5%	-	a	Tukey's HSD
				2015	5	38.2%	24.3%	0.5	a	
				2016	5	25.0%	7.5%	-0.4	a	
				2017	5	37.3%	17.3%	0.4	a	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.24: Statistical Comparison of Benthic Metrics at Camp Lake Profundal (Deep) Stations Among Years of Mine Operation (2015, 2017) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.3007	2007	4	2,627	1,403	-	0.9	a	Tukey's HSD
				2013	5	2,140	567	-0.3	-	a	
				2015	5	1,552	1,005	-0.8	-1.0	a	
				2017	5	1,510	844	-0.8	-1.1	a	
Richness (No. of Taxa)	none	YES	0.0214	2007	4	9.0	1.7	-	-1.8	a	Tukey's HSD
				2013	5	14.2	2.9	3.0	-	b	
				2015	5	8.2	2.8	-0.5	-2.0	a	
				2017	5	10.8	3.3	1.0	-1.2	a,b	
Simpson's Evenness	none	NO	0.7081	2007	4	0.602	0.114	-	-1.0	a	Tukey's HSD
				2013	5	0.720	0.122	1.0	-	a	
				2015	5	0.604	0.283	0.0	-0.9	a	
				2017	5	0.681	0.154	0.7	-0.3	a	
Nemata (% of community)	modified probit	NO	0.8652	2007	4	3.5%	3.1%	-	-0.3	a	Tukey's HSD
				2013	5	4.4%	3.2%	0.3	-	a	
				2015	5	6.7%	10.4%	1.0	0.7	a	
				2017	5	7.1%	6.2%	1.2	0.9	a	
Ostracoda (% of community)	modified probit	NO	0.5498	2007	4	0.0%	0.1%	-	-0.8	a	Tukey's HSD
				2013	5	0.4%	0.4%	4.9	-	a	
				2015	5	0.3%	0.7%	3.6	-0.2	a	
				2017	5	0.3%	0.6%	3.3	-0.3	a	
Chironomidae (% of community)	modified probit	NO	0.7007	2007	4	94.9%	4.3%	-	0.8	a	Tukey's HSD
				2013	5	91.1%	4.7%	-0.9	-	a	
				2015	5	90.4%	11.3%	-1.1	-0.1	a	
				2017	5	90.0%	6.6%	-1.1	-0.2	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0241	2007	4	34.8%	4.8%	-	-0.3	a	Tukey's HSD
				2013	5	39.5%	17.2%	1.0	-	a	
				2015	5	11.7%	7.3%	-4.9	-1.6	b	
				2017	5	33.3%	25.5%	-0.3	-0.4	a,b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0810	2007	4	64.6%	6.1%	-	0.4	a,b	Tukey's HSD
				2013	5	57.0%	19.9%	-1.3	-	a	
				2015	5	84.7%	7.3%	3.3	1.4	b	
				2017	5	64.2%	28.1%	-0.1	0.4	a,b	
Filterer FFG (% of community)	modified probit	YES	0.0371	2007	4	32.6%	4.0%	-	-0.3	a	Tamhane's
				2013	5	37.5%	16.8%	1.2	-	a	
				2015	5	11.4%	6.8%	-5.3	-1.6	b	
				2017	5	31.6%	26.4%	-0.2	-0.3	a,b	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.25: Summary of Habitat Features at Sheardown Lake Tributary and Unnamed Reference Creek Study Areas Evaluated for the 2017 Mary River Project CREMP Benthic Invertebrate Community Assessment

Habitat Characteristic		Reference Creek	Sheardown Lake Tributaries		
		REF-CRK	SDLT1	SDLT12	SDLT9
Mean Width (m)	Wetted	11.1	5.3	1.5	0.8
Mean Depth (m)	Average	0.09	0.08	0.10	0.03
Mean Velocity (m/s)	Average	0.28	0.40	0.06	0.13
Stream Morphology	% Pool	8	0	20	0
	% Rapid	0	5	20	0
	% Riffle	83	85	40	50
	% Run	10	10	20	50
Substrate (% areal coverage)		3% boulder 32% cobble 48% pebble 10% gravel 7% sand	10% boulder 87% cobble 3% pebble	70% boulder 25% cobble 5% pebble trace silt	5% boulder 40% cobble 20% pebble 20% gravel 15% sand
Mean Substrate Size (mm)		47	100	219	73
Aquatic Vegetation (% areal coverage)	Bryophyte Coverage	trace	8%	none observed	3%
	Periphyton Coverage	28%	none observed	80%	70%
	Periphyton Description	Rock noticeably slippery, green algae present (1-5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks noticeably slippery, patches of thicker green to brown algae (1-5 mm thick)	Rock noticeably slippery, green algae present (1-5 mm thick)
Functional Instream Cover (% areal coverage)		5% deep pool	2.5% boulder	1 % boulder	trace boulder 5% macrophytes

Table F.26: Replicate Grab Habitat Data for Benthic Invertebrate Community Samples Collected at the Sheardown Lake Tributaries, Mary River Project CREMP, August 2017

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Unnamed Reference Creek	REF-CRK-B1	8	6	9	0.39	0.44	0.44	56.9	43.3	62.3	25%	13%	25%	scarce	scarce	scarce	scarce	scarce	scarce
	REF-CRK-B2	8	8	6	0.47	0.47	0.46	85.8	58.3	58.6	25%	25%	38%	common	scarce	common	common	scarce	common
	REF-CRK-B3	10	10	9	0.49	0.59	0.57	67.8	50.0	48.0	25%	13%	38%	scarce	scarce	none	scarce	scarce	scarce
	REF-CRK-B4	11	11	9	0.51	0.38	0.39	64.1	50.0	51.6	13%	13%	25%	none	none	none	scarce	scarce	common
	REF-CRK-B5	7	7	8	0.42	0.41	0.53	69.6	56.8	46.5	25%	25%	25%	none	none	none	common	common	common
Sheardown Tributary 1 Reach 1	SDLT1 - B1	9	9	8	0.33	0.43	0.45	72.1	80.5	73.8	0%	0%	13%	common	common	common	scarce	scarce	scarce
	SDLT1 - B2	11	9	7	-	-	-	72.0	64.3	56.3	13%	25%	13%	common	scarce	scarce	common	common	common
	SDLT1 - B3	14	10	8	-	-	-	79.1	82.2	72.3	25%	25%	13%	scarce	common	scarce	common	scarce	common
	SDLT1 - B4	10	8	8	0.53	0.44	0.50	83.9	84.0	80.8	13%	25%	50%	scarce	common	scarce	scarce	scarce	scarce
	SDLT1 - B5	13	11	9	0.58	0.39	0.45	65.9	70.0	54.1	25%	25%	25%	common	scarce	scarce	none	none	none
Sheardown Tributary 9	SDLT9 - B1	2	2	2	0.22	0.17	0.18	4.4	8.3	5.8	50%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT9 - B2	2	4	4	0.18	0.31	0.20	6.6	5.7	5.4	-	-	-	scarce	scarce	scarce	common	common	common
	SDLT9 - B3	2	4	6	0.34	0.22	0.24	4.4	4.7	4.3	50%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT9 - B4	4	6	4	0.18	0.17	0.16	4.4	5.9	6.4	50%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT9 - B5	4	2	5	0.29	0.12	0.31	5.2	6.5	5.2	50%	50%	50%	scarce	scarce	scarce	common	common	common
Sheardown Tributary 12	SDLT12 - B1	2	6	2	0.17	0.18	0.16	6.2	5.6	5.0	25%	-	25%	scarce	scarce	scarce	common	common	common
	SDLT12 - B2	4	4	4	0.12	0.14	0.11	4.0	7.2	7.9	25%	50%	50%	scarce	scarce	scarce	common	common	common
	SDLT12 - B3	4	2	2	0.12	0.14	0.11	6.3	5.9	6.5	50%	50%	50%	scarce	scarce	scarce	common	common	common

[a] Substrate measurements taken from the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 6 - 11 per replicate grab, with a mean of 8 for the SDLT stations in 2017.

Table F.27: Replicate Station Habitat Feature Summary Statistics for the Sheardown Lake Tributary Benthic Stations, Mary River Project CREMP, August 2017

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	Unnamed Reference Creek	8.5	1.4	0.6	6.7	10.2	7.3	10.3
	Sheardown Tributary 1 (SDLT1)	9.6	1.1	0.5	8.2	11.0	8.7	11.0
	Sheardown Tributary 12 (SDLT12)	3.3	0.7	0.4	1.7	5.0	2.7	4.0
	Sheardown Tributary 9 (SDLT9)	3.5	1.0	0.4	2.3	4.8	2.0	4.7
Water Velocity (cm/s)	Unnamed Reference Creek	46.4	5.1	2.3	40.0	52.8	42.3	55.0
	Sheardown Tributary 1 (SDLT1)	45.6	4.6	2.7	34.1	57.0	40.3	49.0
	Sheardown Tributary 12 (SDLT12)	13.9	2.7	1.6	7.2	20.6	12.3	17.0
	Sheardown Tributary 9 (SDLT9)	21.9	3.9	1.7	17.1	26.8	17.0	26.7
Substrate Size (mm diameter)	Unnamed Reference Creek	58.0	5.5	2.5	51.1	64.8	54.1	67.6
	Sheardown Tributary 1 (SDLT1)	72.7	8.6	3.9	62.0	83.5	63.3	82.9
	Sheardown Tributary 12 (SDLT12)	60.6	4.0	2.3	50.6	70.6	56.0	63.6
	Sheardown Tributary 9 (SDLT9)	55.5	6.6	3.0	47.2	63.7	44.4	61.7
Substrate Embeddedness (%)	Unnamed Reference Creek	23	5	2	17	29	17	29
	Sheardown Tributary 1 (SDLT1)	19	10	4	7	31	4	29
	Sheardown Tributary 12 (SDLT12)	39	13	7	7	71	25	50
	Sheardown Tributary 9 (SDLT9)	48	4	2	44	53	42	50

Note: Five stations were sampled at SDLT1 and SDLT9, and three stations were sampled at SDLT12.

Table F.28: Benthic Station Habitat Feature Statistical Comparisons Between Individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2017

Metric	Pair-wise comparisons[a]				
	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test[b]
Water Depth (cm)	Unnamed Reference Creek	SDLT1	NO	0.4111	α , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0001	
	Unnamed Reference Creek	SDLT9	YES	0.0000	
Water Velocity (cm/s)	Unnamed Reference Creek	SDLT1	NO	0.9930	α , ζ
	Unnamed Reference Creek	SDLT12	YES	0.0000	
	Unnamed Reference Creek	SDLT9	YES	0.0000	
Substrate Size (mm diameter)	Unnamed Reference Creek	SDLT1	YES	0.0166	β , ζ
	Unnamed Reference Creek	SDLT12	NO	0.9442	
	Unnamed Reference Creek	SDLT9	NO	0.9370	
Substrate Embeddedness (%)	Unnamed Reference Creek	SDLT1	NO	0.5476	γ
	Unnamed Reference Creek	SDLT12	NO	0.1429	
	Unnamed Reference Creek	SDLT9	YES	0.0079	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; ζ - Tukey's HSD post-hoc test used; η - Tamhane's post-hoc test used; γ - non-parametric Kruskal Wallis (multiple group) and Mann-Whitney U-tests (pair-wise) used on untransformed data

Table F.29: **Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2017**

Taxa — Study Area / Replicate Station	Sheardown Lake Tributary 1 (SDLT1) - Lower Reach B1	B2	B3	B4	B5	Sheardown Lake Tributary 12 (SDLT12) B1	B2	B3
ROUNDWORMS								
P. Nemata	172	32	14	7	7	57	18	65
ANNELIDS								
P. Annelida								
WORMS								
Cl. Oligochaeta								
F. Enchytraeidae	86	50	115	57	90	445	108	54
F. Lumbriculidae								
Lumbriculus	-	-	7	-	4	-	-	-
ARTHROPODS								
P. Arthropoda								
MITES								
Cl. Arachnida								
O. Acarina	-	-	-	-	-	-	-	-
F. Sperchonidae								
Sperchon	86	25	115	29	18	-	-	-
HARPACTICOIDS								
O. Harpacticoida	-	-	-	-	-	-	-	-
SEED SHRIMPS								
Cl. Ostracoda	-	-	-	-	-	-	-	-
SPRINGTAILS								
Cl. Entognatha								
O. Collembola	-	-	-	-	-	-	7	7
INSECTS								
Cl. Insecta								
MAYFLIES								
O. Ephemeroptera								
F. Baetidae								
Acentrella feropagus	-	-	-	-	-	-	-	-
STONEFLIES								
O. Plecoptera								
F. Capniidae								
immature	-	-	-	-	-	-	-	-
CADDISFLIES								
O. Trichoptera								
F. Limnephilidae								
immature	-	-	-	-	-	-	-	-
TRUE FLIES								
O. Diptera								
BITING-MIDGE								
F. Ceratopogonidae								
indeterminate	-	-	-	-	-	-	-	-
Culicoides	-	-	-	-	-	-	-	-
MIDGES								
F. Chironomidae								
chironomid pupae	**86**	**32**	**22**	**43**	**29**	7	**-**	**-**
S.F. Chironominae								
Micropsectra	-	-	-	-	-	-	-	-
Paratanytarsus	-	-	-	-	-	22	14	22
Rheotanytarsus	832	36	50	144	4	-	-	-
S.F. Diamesinae								
Diamesa	-	-	-	-	-	108	100	11
Pseudokiefferiella	660	72	244	309	50	-	-	-
S.F. Orthocladiinae								
Cardiocladius	-	-	-	-	-	-	-	-
Chaetocladius	-	-	-	-	-	29	43	4
Corynoneura	-	-	-	-	-	-	-	-
Cricotopus	1206	280	481	172	72	-	4	7
Cricotopus/Orthocladius	201	25	36	-	7	29	29	11
Diplocladius	-	-	-	-	-	158	100	14
Eukiefferiella	-	4	22	-	-	14	-	7
Hydrobaenus	-	-	-	-	-	-	-	-
Hydrosmittia	832	183	309	86	83	7	-	-

Table F.29: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributaries 1 and 12, August 2017

Taxa	Study Area	Sheardown Lake Tributary 1 (SDLT1) - Lower Reach					Sheardown Lake Tributary 12 (SDLT12)		
	Replicate Station	B1	B2	B3	B4	B5	B1	B2	B3
Krenosmittia		-	-	-	-	4	29	4	-
Limnophyes		-	-	-	-	-	57	-	36
Metriocnemus		-	-	-	-	-	50	29	18
Nanocladius		-	-	57	-	-	-	-	-
Orthocladius (Euorthocladius)		86	4	-	7	4	-	-	-
Parakiefferiella		57	4	7	-	-	-	-	-
Parametriocnemus		-	-	-	-	-	-	-	-
Paraphaenocladius		-	-	-	-	-	122	47	43
Rheocricotopus		-	-	-	-	4	-	-	-
Thienemanniella		144	14	86	65	29	-	-	-
Tokunagaia		-	7	-	-	-	93	36	11
Tvetenia		-	11	-	14	-	-	-	-
indeterminate		**-**	**-**	-	-	-	129	36	**14**
S.F. Podonominae									
Trichotanypus		-	-	-	-	-	-	4	-
S.F. Tanypodinae									
Thienemannimyia complex		29	-	7	-	4	-	-	-
F. Empididae									
Clinocera		-	-	-	-	-	-	-	-
pupae		-	-	-	-	-	-	-	-
F. Muscidae		-	-	-	-	-	-	-	-
F. Simuliidae									
Gymnopais		-	-	-	-	-	-	-	-
Metacnephia		-	-	-	-	-	-	-	-
Prosimulium		-	-	7	-	-	-	-	-
Simulium baffinense		-	-	-	-	-	-	-	-
pupae		-	-	-	-	-	-	-	-
F. Tipulidae									
Ormosia		-	-	-	-	-	-	7	-
Tipula		22	11	32	25	29	54	25	4
indeterminate		-	-	-	-	4	-	-	-
Number of Organisms (No. organisms per m^2)		4,499	790	1,611	958	442	1,410	611	328
Richness (total number of taxa)[a]		13	15	16	11	15	15	16	15
Simpson's Evenness (E)		0.894	0.838	0.885	0.884	0.914	0.908	0.940	0.946
Bray-Curtis Index		0.908	0.832	0.870	0.879	0.866	0.851	0.924	0.791
Percent Composition									
% Nemata		3.8%	4.1%	0.9%	0.7%	1.6%	4.0%	2.9%	19.8%
% Oligochaeta		1.9%	6.3%	7.6%	5.9%	21.3%	31.6%	17.7%	16.5%
% Hydracarina		1.9%	3.2%	7.1%	3.0%	4.1%	0.0%	0.0%	0.0%
% Ostracods		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Chironomids		91.9%	85.1%	82.0%	87.7%	65.6%	60.6%	73.0%	60.4%
% Metal Sensitive Chironmids		33.9%	14.4%	18.6%	49.9%	13.8%	9.4%	18.7%	10.1%
% Simuliidae		0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
% Tipulidae		0.5%	1.4%	2.0%	2.6%	7.5%	3.8%	5.2%	1.2%
Functional Feeding Group Composition									
% Collector - Gatherers		46.1%	50.1%	54.1%	59.6%	66.5%	92.1%	87.4%	86.0%
% Filterers		18.9%	4.8%	3.6%	15.9%	1.1%	1.6%	2.3%	6.7%
% Shredders		32.4%	41.9%	34.7%	21.5%	27.4%	6.3%	10.3%	7.3%
Habitat Preference Group Composition									
% Clingers		52.7%	48.5%	43.5%	37.8%	25.1%	2.5%	6.2%	6.1%
% Sprawlers		41.0%	39.7%	46.1%	52.9%	44.6%	53.8%	61.4%	48.2%
% Burrowers		6.2%	11.8%	10.4%	9.3%	30.3%	43.8%	31.3%	43.6%

[a] Bold entries excluded from taxa count

Table F.30: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2017

Taxa	Study Area / Replicate Station	Sheardown Lake Tributary 9 (SDLT9) B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		65	474	1,521	108	158
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		93	57	273	57	-
F. Lumbriculidae						
Lumbriculus		-	-	-	-	-
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina		-	-	-	-	-
F. Sperchonidae						
Sperchon		54	57	72	151	86
HARPACTICOIDS						
O. Harpacticoida		-	-	14	-	-
SEED SHRIMPS						
Cl. Ostracoda		61	14	14	36	22
SPRINGTAILS						
Cl. Entognatha						
O. Collembola		11	14	-	-	36
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		7	14	115	7	7
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
CADDISFLIES						
O. Trichoptera						
F. Limnephilidae						
immature		-	-	-	-	14
TRUE FLIES						
O. Diptera						
BITING-MIDGE						
F. Ceratopogonidae						
indeterminate		7	57	-	-	-
Culicoides		-	-	-	-	-
MIDGES						
F. Chironomidae						
chironomid pupae		**22**	**129**	**172**	**287**	**136**
S.F. Chironominae						
Micropsectra		-	57	-	-	-
Paratanytarsus		-	-	-	-	-
Rheotanytarsus		-	-	-	-	-
S.F. Diamesinae						
Diamesa		-	-	72	61	-
Pseudokiefferiella		-	-	-	11	-
S.F. Orthocladiinae						
Cardiocladius		-	-	-	-	-
Chaetocladius		22	-	14	11	43
Corynoneura		29	43	201	-	-
Cricotopus		136	775	72	359	703
Cricotopus/Orthocladius		187	459	976	75	72
Diplocladius		118	-	-	61	-
Eukiefferiella		-	-	172	-	-
Hydrobaenus		-	-	-	-	-
Hydrosmittia		-	43	43	61	14

Table F.30: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake Tributary 9, August 2017

Taxa — Study Area / Replicate Station	Sheardown Lake Tributary 9 (SDLT9) B1	B2	B3	B4	B5
Krenosmittia	50	474	402	147	172
Limnophyes	-	43	29	14	-
Metriocnemus	36	43	57	-	-
Nanocladius	-	-	-	-	-
Orthocladius (Euorthocladius)	-	-	-	-	-
Parakiefferiella	-	-	-	-	-
Parametriocnemus	-	-	-	-	-
Paraphaenocladius	4	-	-	-	-
Rheocricotopus	-	-	-	-	-
Thienemanniella	14	29	57	25	43
Tokunagaia	47	359	861	739	402
Tvetenia	7	43	115	50	-
indeterminate	**151**	**1636**	459	136	57
S.F. Podonominae					
Trichotanypus	11	86	72	-	14
S.F. Tanypodinae					
Thienemannimyia complex	-	-	-	-	-
F. Empididae					
Clinocera	-	14	-	14	7
pupae	4	29	-	-	-
F. Muscidae	-	-	-	-	-
F. Simuliidae					
Gymnopais	-	-	-	7	-
Metacnephia	-	-	-	-	-
Prosimulium	4	14	-	7	-
Simulium baffinense	18	-	29	-	-
pupae	-	-	-	-	-
F. Tipulidae					
Ormosia	-	-	-	-	-
Tipula	197	97	111	222	50
indeterminate	-	-	-	-	-
Number of Organisms (No. organisms per m^2)	1,355	5,060	5,923	2,646	2,036
Richness (total number of taxa)[a]	23	22	22	21	16
Simpson's Evenness (E)	0.943	0.888	0.890	0.864	0.828
Bray-Curtis Index	0.798	0.873	0.845	0.795	0.839
Percent Composition					
% Nemata	4.8%	9.4%	25.7%	4.1%	7.8%
% Oligochaeta	6.9%	1.1%	4.6%	2.2%	0.0%
% Hydracarina	4.0%	1.1%	1.2%	5.7%	4.2%
% Ostracods	4.5%	0.3%	0.2%	1.4%	1.1%
% Ephemeroptera	0.5%	0.3%	1.9%	0.3%	0.3%
% Chironomids	61.5%	83.4%	63.7%	77.0%	81.3%
% Metal Sensitive Chironmids	0.0%	1.2%	1.3%	3.2%	0.0%
% Simuliidae	1.6%	0.3%	0.5%	0.5%	0.0%
% Tipulidae	14.5%	1.9%	1.9%	8.4%	2.5%
Functional Feeding Group Composition					
% Collector - Gatherers	48.9%	50.6%	75.0%	64.0%	49.1%
% Filterers	1.6%	1.4%	0.5%	0.5%	0.0%
% Shredders	44.7%	44.9%	23.2%	29.3%	46.3%
Habitat Preference Group Composition					
% Clingers	36.1%	45.2%	23.1%	27.6%	47.7%
% Sprawlers	33.1%	39.5%	43.6%	57.7%	40.3%
% Burrowers	30.0%	15.0%	33.3%	14.6%	10.2%

[a] Bold entries excluded from taxa count

Table F.31: Benthic Invertebrate Community Summary Statistics for the Sheardown Lake Tributaries, Mary River Project CREMP, August 2017

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	Unnamed Reference Creek	1,972	1,861	832	-339	4,282	817	5,229
	Sheardown Tributary 1 (SDLT1)	1,660	1,643	735	-380	3,700	442	4,499
	Sheardown Tributary 12 (SDLT12)	783	561	324	-611	2,177	328	1,410
	Sheardown Tributary 9 (SDLT9)	3,404	1,983	887	942	5,866	1,355	5,923
Richness (Number of Taxa)	Unnamed Reference Creek	21.2	1.9	0.9	18.8	23.6	19.0	24.0
	Sheardown Tributary 1 (SDLT1)	14.0	2.0	0.9	11.5	16.5	11.0	16.0
	Sheardown Tributary 12 (SDLT12)	15.3	0.6	0.3	13.9	16.8	15.0	16.0
	Sheardown Tributary 9 (SDLT9)	20.8	2.8	1.2	17.4	24.2	16.0	23.0
Simpson's Evenness	Unnamed Reference Creek	0.935	0.017	0.008	0.913	0.956	0.909	0.951
	Sheardown Tributary 1 (SDLT1)	0.883	0.028	0.012	0.848	0.917	0.838	0.914
	Sheardown Tributary 12 (SDLT12)	0.931	0.021	0.012	0.881	0.982	0.908	0.946
	Sheardown Tributary 9 (SDLT9)	0.883	0.042	0.019	0.830	0.935	0.828	0.943
Bray-Curtis Index	Unnamed Reference Creek	0.305	0.205	0.092	0.050	0.560	0.173	0.664
	Sheardown Tributary 1 (SDLT1)	0.871	0.027	0.012	0.837	0.905	0.832	0.908
	Sheardown Tributary 12 (SDLT12)	0.855	0.067	0.039	0.689	1.021	0.791	0.924
	Sheardown Tributary 9 (SDLT9)	0.830	0.033	0.015	0.789	0.871	0.795	0.873
Nemata (% of community)	Unnamed Reference Creek	8.8%	3.5%	1.6%	4.4%	13.2%	3.1%	12.7%
	Sheardown Tributary 1 (SDLT1)	2.2%	1.6%	0.7%	0.2%	4.2%	0.7%	4.1%
	Sheardown Tributary 12 (SDLT12)	8.9%	9.5%	5.5%	-14.6%	32.4%	2.9%	19.8%
	Sheardown Tributary 9 (SDLT9)	10.4%	8.8%	4.0%	-0.6%	21.3%	4.1%	25.7%
Oligochaeta (% of community)	Unnamed Reference Creek	1.0%	1.4%	0.6%	-0.7%	2.7%	0.0%	2.9%
	Sheardown Tributary 1 (SDLT1)	8.6%	7.4%	3.3%	-0.6%	17.8%	1.9%	21.3%
	Sheardown Tributary 12 (SDLT12)	21.9%	8.4%	4.8%	1.1%	42.8%	16.5%	31.6%
	Sheardown Tributary 9 (SDLT9)	3.0%	2.8%	1.2%	-0.5%	6.4%	0.0%	6.9%
Hydracarina (% of community)	Unnamed Reference Creek	4.8%	2.3%	1.0%	2.0%	7.6%	2.2%	7.7%
	Sheardown Tributary 1 (SDLT1)	3.9%	2.0%	0.9%	1.4%	6.3%	1.9%	7.1%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	3.2%	2.0%	0.9%	0.7%	5.7%	1.1%	5.7%
Ostracoda (% of community)	Unnamed Reference Creek	3.6%	2.6%	1.2%	0.4%	6.8%	0.8%	6.2%
	Sheardown Tributary 1 (SDLT1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	1.5%	1.8%	0.8%	-0.7%	3.7%	0.2%	4.5%
Ephemeroptera (% of community)	Unnamed Reference Creek	13.8%	6.0%	2.7%	6.4%	21.3%	3.6%	19.3%
	Sheardown Tributary 1 (SDLT1)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	0.7%	0.7%	0.3%	-0.2%	1.5%	0.3%	1.9%
Chironomidae (% of community)	Unnamed Reference Creek	37.9%	11.1%	5.0%	24.1%	51.7%	25.3%	55.7%
	Sheardown Tributary 1 (SDLT1)	82.5%	10.1%	4.5%	69.9%	95.0%	65.6%	91.9%
	Sheardown Tributary 12 (SDLT12)	64.7%	7.2%	4.2%	46.7%	82.6%	60.4%	73.0%
	Sheardown Tributary 9 (SDLT9)	73.4%	10.1%	4.5%	60.8%	86.0%	61.5%	83.4%
Metal-Sensitive Chironomidae (% of community)	Unnamed Reference Creek	5.7%	5.7%	2.5%	-1.3%	12.7%	1.7%	15.7%
	Sheardown Tributary 1 (SDLT1)	26.1%	15.6%	7.0%	6.8%	45.5%	13.8%	49.9%
	Sheardown Tributary 12 (SDLT12)	12.7%	5.2%	3.0%	-0.1%	25.6%	9.4%	18.7%
	Sheardown Tributary 9 (SDLT9)	1.1%	1.3%	0.6%	-0.5%	2.8%	0.0%	3.2%
Simuliidae (% of community)	Unnamed Reference Creek	28.3%	6.6%	3.0%	20.1%	36.5%	23.0%	39.3%
	Sheardown Tributary 1 (SDLT1)	0.1%	0.2%	0.1%	-0.1%	0.3%	0.0%	0.4%
	Sheardown Tributary 12 (SDLT12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sheardown Tributary 9 (SDLT9)	0.6%	0.6%	0.3%	-0.2%	1.3%	0.0%	1.6%
Tipulidae (% of community)	Unnamed Reference Creek	0.7%	0.4%	0.2%	0.1%	1.2%	0.3%	1.4%
	Sheardown Tributary 1 (SDLT1)	2.8%	2.7%	1.2%	-0.6%	6.2%	0.5%	7.5%
	Sheardown Tributary 12 (SDLT12)	3.4%	2.0%	1.2%	-1.6%	8.4%	1.2%	5.2%
	Sheardown Tributary 9 (SDLT9)	5.8%	5.6%	2.5%	-1.1%	12.7%	1.9%	14.5%

Table F.31: Benthic Invertebrate Community Summary Statistics for the Sheardown Lake Tributaries, Mary River Project CREMP, August 2017

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Collector-Gatherer FFG (% of community)	Unnamed Reference Creek	58.8%	7.2%	3.2%	49.9%	67.6%	51.8%	69.3%
	Sheardown Tributary 1 (SDLT1)	55.3%	8.0%	3.6%	45.3%	65.2%	46.1%	66.5%
	Sheardown Tributary 12 (SDLT12)	88.5%	3.2%	1.8%	80.6%	96.4%	86.0%	92.1%
	Sheardown Tributary 9 (SDLT9)	57.5%	11.6%	5.2%	43.1%	72.0%	48.9%	75.0%
Filterer FFG (% of community)	Unnamed Reference Creek	28.6%	6.5%	2.9%	20.6%	36.7%	23.0%	39.3%
	Sheardown Tributary 1 (SDLT1)	8.9%	8.0%	3.6%	-1.0%	18.8%	1.1%	18.9%
	Sheardown Tributary 12 (SDLT12)	3.5%	2.8%	1.6%	-3.3%	10.4%	1.6%	6.7%
	Sheardown Tributary 9 (SDLT9)	0.8%	0.7%	0.3%	0.0%	1.6%	0.0%	1.6%
Shredder FFG (% of community)	Unnamed Reference Creek	6.7%	5.5%	2.4%	-0.1%	13.5%	2.7%	16.3%
	Sheardown Tributary 1 (SDLT1)	31.6%	7.7%	3.4%	22.0%	41.1%	21.5%	41.9%
	Sheardown Tributary 12 (SDLT12)	8.0%	2.1%	1.2%	2.8%	13.1%	6.3%	10.3%
	Sheardown Tributary 9 (SDLT9)	37.7%	10.7%	4.8%	24.4%	50.9%	23.2%	46.3%
Clinger HPG (% of community)	Unnamed Reference Creek	40.1%	7.8%	3.5%	30.4%	49.7%	28.8%	47.8%
	Sheardown Tributary 1 (SDLT1)	41.5%	10.7%	4.8%	28.2%	54.9%	25.1%	52.7%
	Sheardown Tributary 12 (SDLT12)	4.9%	2.1%	1.2%	-0.3%	10.2%	2.5%	6.2%
	Sheardown Tributary 9 (SDLT9)	35.9%	10.7%	4.8%	22.6%	49.2%	23.1%	47.7%
Sprawler HPG (% of community)	Unnamed Reference Creek	49.0%	9.2%	4.1%	37.6%	60.5%	37.0%	58.8%
	Sheardown Tributary 1 (SDLT1)	44.9%	5.2%	2.3%	38.4%	51.3%	39.7%	52.9%
	Sheardown Tributary 12 (SDLT12)	54.5%	6.6%	3.8%	38.0%	70.9%	48.2%	61.4%
	Sheardown Tributary 9 (SDLT9)	42.8%	9.1%	4.1%	31.5%	54.2%	33.1%	57.7%
Burrower HPG (% of community)	Unnamed Reference Creek	10.7%	4.5%	2.0%	5.2%	16.3%	4.0%	15.1%
	Sheardown Tributary 1 (SDLT1)	13.6%	9.6%	4.3%	1.7%	25.5%	6.2%	30.3%
	Sheardown Tributary 12 (SDLT12)	39.6%	7.2%	4.1%	21.8%	57.4%	31.3%	43.8%
	Sheardown Tributary 9 (SDLT9)	20.6%	10.3%	4.6%	7.8%	33.4%	10.2%	33.3%

Note: Sample size equals five for SDLT1 and SDLT9, and three for SDLT12.

Table F.32: Benthic Invertebrate Community Metric Statistical Comparisons between Individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2017

Metric	Data Transform-ation	Overall 4-Area Comparison[a]		Pair-wise, post-hoc comparisons[a]					
		Significant Difference Among Areas?	P-value	Area	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Reference	Pairwise Comparison
Density (No. per m^2)	log	YES	0.0870	Reference	5	1,972	1,861	-	a,b
				SDLT1	5	1,660	1,643	-0.2	a,b
				SDLT12	3	783	561	-0.6	b
				SDLT9	5	3,404	1,983	0.8	a
Richness (No. of Taxa)	none	YES	< 0.001	Reference	5	21.2	1.9	-	a
				SDLT1	5	14.0	2.0	-3.7	b
				SDLT12	3	15.3	0.6	-3.0	b
				SDLT9	5	20.8	2.8	-0.2	a
Simpson's Evenness	none	YES	0.0010	Reference	5	0.935	0.017	-	a
				SDLT1	5	0.883	0.028	-3.0	b
				SDLT12	3	0.931	0.021	-0.2	a,b
				SDLT9	5	0.883	0.042	-3.0	b
Bray Curtis Index	rank	YES	0.0011	Reference	5	0.305	0.205	-	a
				SDLT1	5	0.871	0.027	2.8	b
				SDLT12	3	0.855	0.067	2.7	b
				SDLT9	5	0.830	0.033	2.6	b
Nemata (% of community)	fourth root	YES	0.0353	Reference	5	8.8%	3.5%	-	a
				SDLT1	5	2.2%	1.6%	-1.9	b
				SDLT12	3	8.9%	9.5%	0.0	a.b
				SDLT9	5	10.4%	8.8%	0.4	a
Oligochaeta (% of community)	fourth root	YES	0.0041	Reference	5	1.0%	1.4%	-	a
				SDLT1	5	8.6%	7.4%	5.5	b,c
				SDLT12	3	21.9%	8.4%	15.2	b
				SDLT9	5	3.0%	2.8%	1.4	a,c
Hydracarina (% of community)	fourth root	YES	< 0.001	Reference	5	4.8%	2.3%	-	a
				SDLT1	5	3.9%	2.0%	-0.4	a
				SDLT12	3	0.0%	0.0%	-2.1	b
				SDLT9	5	3.2%	2.0%	-0.7	a
Ephemeroptera (% of community)	rank	YES	< 0.001	Reference	5	13.8%	6.0%	-	a
				SDLT1	5	0.0%	0.0%	-2.3	b
				SDLT12	3	0.0%	0.0%	-2.3	b
				SDLT9	5	0.7%	0.7%	-2.2	c
Chironomidae (% of community)	none	YES	< 0.001	Reference	5	37.9%	11.1%	-	a
				SDLT1	5	82.5%	10.1%	4.0	b
				SDLT12	3	64.7%	7.2%	2.4	b
				SDLT9	5	73.4%	10.1%	3.2	b
Metal Sensitive Taxa (% of community)	fourth root	YES	< 0.001	Reference	5	5.7%	5.7%	-	a
				SDLT1	5	26.1%	15.6%	3.6	b
				SDLT12	3	12.7%	5.2%	1.2	a,b
				SDLT9	5	1.1%	1.3%	-0.8	c
Simuliidae (% of community)	fourth root	YES	0.0010	Reference	5	28.3%	6.6%	-	a
				SDLT1	5	0.1%	0.2%	-4.3	b
				SDLT12	3	0.0%	0.0%	-4.3	b
				SDLT9	5	0.6%	0.6%	-4.2	c
Tipulidae (% of community)	log	YES	0.0144	Reference	5	0.7%	0.4%	-	a
				SDLT1	5	2.8%	2.7%	4.9	a,b
				SDLT12	3	3.4%	2.0%	6.2	b
				SDLT9	5	5.8%	5.6%	11.8	b
Collector-Gatherer FFG (% of community)	log	YES	0.0022	Reference	5	58.8%	7.2%	-	a
				SDLT1	5	55.3%	8.0%	-0.5	a
				SDLT12	3	88.5%	3.2%	4.2	b
				SDLT9	5	57.5%	11.6%	-0.2	a
Filterer FFG (% of community)	square root	YES	< 0.001	Reference	5	28.6%	6.5%	-	a
				SDLT1	5	8.9%	8.0%	-3.0	b
				SDLT12	3	3.5%	2.8%	-3.9	b,c
				SDLT9	5	0.8%	0.7%	-4.3	c
Shredder FFG (% of community)	square root	YES	< 0.001	Reference	5	6.7%	5.5%	-	a
				SDLT1	5	31.6%	7.7%	4.5	b
				SDLT12	3	8.0%	2.1%	0.2	a
				SDLT9	5	37.7%	10.7%	5.7	b
Clinger HPG (% of community)	none	YES	< 0.001	Reference	5	40.1%	7.8%	-	a
				SDLT1	5	41.5%	10.7%	0.2	a
				SDLT12	3	4.9%	2.1%	-4.5	b
				SDLT9	5	35.9%	10.7%	-0.5	a
Sprawler HPG (% of community)	log	NO	0.2373	Reference	5	49.0%	9.2%	-	a
				SDLT1	5	44.9%	5.2%	-0.5	a
				SDLT12	3	54.5%	6.6%	0.6	a
				SDLT9	5	42.8%	9.1%	-0.7	a
Burrower HPG (% of community)	log	YES	0.0109	Reference	5	10.7%	4.5%	-	a
				SDLT1	5	13.6%	9.6%	0.6	a
				SDLT12	3	39.6%	7.2%	6.4	b
				SDLT9	5	20.6%	10.3%	2.2	a,b

(Grey) Indicates a statisitically significant difference for respective comparison (p-value ≤ 0.1).

(Blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of reference mean, suggesting an ecologically meaningful difference in endpoint value relative to reference conditions.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.33: Benthic Invertebrate Community Absolute Density Statistical Comparison Results between Individual Sheardown Lake Tributaries and Unnamed Reference Creek, Mary River Project CREMP, August 2017

Metric	Data Transform-ation	Overall 4-Area Comparison[a]		Pair-wise, post-hoc comparisons[a]					
		Significant Difference Among Areas?	P-value	Area	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Reference	Pairwise Comparison
Nemata (No. per m2)	log	YES	0.0270	Reference	5	187	184	-	a,b
				SDLT1	5	46	71	-0.8	b
				SDLT12	3	47	25	-0.8	a,b
				SDLT9	5	465	612	1.5	a
Oligochaeta (No. per m2)	square root	YES	0.0351	Reference	5	13	18	-	a
				SDLT1	5	82	29	3.8	a,b
				SDLT12	3	202	212	10.5	b
				SDLT9	5	96	104	4.6	a,b
Hydracarina (No. per m2)	log(X+1)	YES	< 0.001	Reference	5	99	115	-	a
				SDLT1	5	55	43	-0.4	a
				SDLT12	3	0	0	-0.9	b
				SDLT9	5	84	40	-0.1	a
Ephemeroptera (No. per m2)	rank	YES	< 0.001	Reference	5	187	58	-	a
				SDLT1	5	0	0	-3.3	b
				SDLT12	3	0	0	-3.3	b
				SDLT9	5	30	48	-2.7	c
Chironomidae (No. per m2)	log	YES	0.0627	Reference	5	878	1140	-	a,b
				SDLT1	5	1451	1544	0.5	a,b
				SDLT12	3	499	331	-0.3	a
				SDLT9	5	2504	1439	1.4	b
Metal Sensitive Taxa (No. per m2)	fourth root	YES	0.0769	Reference	5	196	349	-	a,b
				SDLT1	5	495	598	0.9	a
				SDLT12	3	93	53	-0.3	a,b
				SDLT9	5	44	41	-0.4	a
Simuliidae (No. per m2)	fourth root	YES	< 0.001	Reference	5	534	433	-	a
				SDLT1	5	1	3	-1.2	b
				SDLT12	3	0	0	-1.2	b
				SDLT9	5	16	11	-1.2	c
Tipulidae (No. per m2)	square root	YES	< 0.001	Reference	5	9	5	-	a
				SDLT1	5	25	9	3.4	a
				SDLT12	3	30	25	4.6	a
				SDLT9	5	135	72	27.7	b
Collector-Gatherer FFG (No. per m2)	log	NO	0.1889	Reference	5	1096	945	-	a
				SDLT1	5	842	724	-0.3	a
				SDLT12	3	705	530	-0.4	a
				SDLT9	5	2072	1512	1.0	a
Filterer FFG (No. per m2)	fourth root	YES	0.0073	Reference	5	542	444	-	a
				SDLT1	5	221	356	-0.7	a,b
				SDLT12	3	19	5	-1.2	b
				SDLT9	5	28	28	-1.2	b
Shredder FFG (No. per m2)	log	YES	0.0019	Reference	5	213	359	-	a,b
				SDLT1	5	535	542	0.9	b,c
				SDLT12	3	59	33	-0.4	a
				SDLT9	5	1194	667	2.7	c
Clinger HPG (No. per m2)	log	YES	< 0.001	Reference	5	861	918	-	a
				SDLT1	5	786	912	-0.1	a
				SDLT12	3	31	10	-0.9	b
				SDLT9	5	1170	705	0.3	a
Sprawler HPG (No. per m2)	log	NO	0.1581	Reference	5	890	753	-	a
				SDLT1	5	721	662	-0.2	a
				SDLT12	3	430	304	-0.6	a
				SDLT9	5	1475	864	0.8	a
Burrower HPG (No. per m2)	log	YES	0.0680	Reference	5	219	205	-	a
				SDLT1	5	153	78	-0.3	a
				SDLT12	3	317	261	0.5	a,b
				SDLT9	5	747	714	2.6	b

Indicates a significant difference for respective comparison (p-value ≤ 0.1).

Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of reference mean, suggesting an ecologically meaningful difference relative to reference conditions.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.34: Statistical Comparison of Benthic Metrics at Sheardown Lake Tributary 1 (SDLT1) Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2008, 2013) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2008	vs. Baseline Year 2013		
Density (No. per m^2)	none	YES	0.0268	2008	3	300	52	-	-2.0	a	Tukey's HSD
				2013	3	657	176	6.8	-	a,b	
				2015	5	722	485	8.1	0.4	a	
				2016	5	2,453	814	41.1	10.2	b	
				2017	5	1,660	1,643	25.9	5.7	a,b	
Richness (No. of Taxa)	none	NO	0.3439	2008	3	12.0	1.0	-	-1.9	a	Tukey's HSD
				2013	3	16.7	2.5	4.7	-	a	
				2015	5	15.4	4.3	3.4	-0.5	a	
				2016	5	15.2	2.5	3.2	-0.6	a	
				2017	5	14.0	2.0	2.0	-1.1	a	
Simpson's Evenness	none	YES	0.0000	2008	3	0.894	0.034	-	0.1	a	Tukey's HSD
				2013	3	0.887	0.064	-0.2	-	a	
				2015	5	0.869	0.067	-0.7	-0.3	a	
				2016	5	0.872	0.032	-0.6	-0.2	a	
				2017	5	0.406	0.067	-14.4	-7.5	b	
Oligochaeta (% of community)	modified probit	NO	0.8401	2008	3	3.0%	2.5%	-	-1.3	a	Tukey's HSD
				2013	3	7.3%	3.3%	1.7	-	a	
				2015	5	14.4%	10.8%	4.6	2.1	a	
				2016	5	14.1%	8.8%	4.5	2.0	a	
				2017	5	8.6%	7.4%	2.3	0.4	a	
Hydracarina (% of community)	modified probit	YES	0.0163	2008	3	12.1%	4.7%	-	2.6	a	Tukey's HSD
				2013	3	4.6%	2.9%	-1.6	-	b	
				2015	5	4.6%	1.6%	-1.6	0.0	b	
				2016	5	5.3%	1.3%	-1.4	0.2	b	
				2017	5	3.9%	2.0%	-1.7	-0.2	b	
Chironomidae (% of community)	modified probit	NO	0.2646	2008	3	69.2%	2.0%	-	-3.0	a	Tukey's HSD
				2013	3	81.1%	3.9%	6.0	-	a	
				2015	5	72.0%	9.0%	1.4	-2.3	a	
				2016	5	73.1%	11.9%	2.0	-2.0	b	
				2017	5	82.4%	10.1%	6.7	0.3	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0054	2008	3	27.5%	5.4%	-	0.5	a	Tamhane's
				2013	3	19.9%	14.3%	-1.4	-	a,b	
				2015	5	6.1%	2.9%	-3.9	-1.0	b	
				2016	5	15.6%	4.4%	-2.2	-0.3	a	
				2017	5	26.1%	15.6%	-0.3	0.4	a	
Tipulidae (% of community)	modified probit	YES	0.0419	2008	3	14.7%	2.7%	-	22.8	a	Tukey's HSD
				2013	3	3.8%	0.5%	-4.0	-	a,b	
				2015	5	2.1%	1.3%	-4.7	-3.7	b	
				2016	5	3.5%	1.9%	-4.1	-0.6	a,b	
				2017	5	2.8%	2.7%	-4.4	-2.1	b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0127	2008	3	40.3%	2.9%	-	-2.0	a	Tukey's HSD
				2013	3	55.5%	7.5%	5.2	-	a,b	
				2015	5	64.2%	5.2%	8.2	1.2	b	
				2016	5	58.6%	10.7%	6.3	0.4	b	
				2017	5	55.3%	8.0%	5.2	0.0	a,b	
Filterer FFG (% of community)	modified probit	NO	0.6403	2008	3	5.2%	3.5%	-	-2.0	a	Tamhane's
				2013	3	8.5%	1.6%	0.9	-	a	
				2015	5	4.5%	1.4%	-0.2	-2.4	a	
				2016	5	7.6%	3.3%	0.7	-0.5	a	
				2017	5	8.9%	8.0%	1.1	0.2	a	
Shredder FFG (% of community)	modified probit	YES	0.0475	2008	3	40.6%	4.2%	-	1.6	a	Tukey's HSD
				2013	3	28.7%	7.4%	-2.8	-	a,b	
				2015	5	22.9%	4.5%	-4.2	-0.8	b	
				2016	5	27.4%	9.4%	-3.1	-0.2	a,b	
				2017	5	31.6%	7.7%	-2.1	0.4	a,b	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.35: Statistical Comparison of Benthic Metrics at Sheardown Lake Tributary 12 (SDLT12) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transform-ation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.9523	2007	5	1,016	669	-	a	Tukey's HSD
				2015	3	841	575	-0.3	a	
				2016	3	894	502	-0.2	a	
				2017	3	783	561	-0.3	a	
Richness (No. of Taxa)	none	YES	0.0002	2007	5	19.0	1.9	-	a	Tukey's HSD
				2015	3	12.0	1.0	-3.7	b	
				2016	3	18.3	1.2	-0.4	a	
				2017	3	15.3	0.6	-2.0	c	
Simpson's Evenness	none	YES	0.0483	2007	5	0.854	0.020	-	a	Tukey's HSD
				2015	3	0.884	0.041	1.5	a,b	
				2016	3	0.884	0.046	1.5	a,b	
				2017	3	0.931	0.021	3.9	b	
Oligochaeta (% of community)	modified probit	YES	0.0000	2007	5	0.7%	0.6%	-	a	Tukey's HSD
				2015	3	28.8%	8.8%	48.8	b	
				2016	3	31.6%	11.1%	53.6	b	
				2017	3	21.9%	8.4%	36.8	b	
Hydracarina (% of community)	modified probit	NO	0.1121	2007	5	3.0%	2.9%	-	a	Tukey's HSD
				2015	3	0.0%	0.0%	-1.0	a	
				2016	3	0.4%	0.4%	-0.9	a	
				2017	3	0.0%	0.0%	-1.0	a	
Chironomidae (% of community)	modified probit	YES	0.0098	2007	5	88.0%	10.2%	-	a	Tukey's HSD
				2015	3	65.1%	6.7%	-2.3	b	
				2016	3	54.9%	18.0%	-3.2	b	
				2017	3	64.6%	7.2%	-2.3	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0500	2007	5	3.2%	2.0%	-	a	Tamhane's
				2015	3	1.4%	1.5%	-0.9	a,b	
				2016	3	2.6%	0.5%	-0.3	a	
				2017	3	12.7%	5.2%	4.7	b	
Tipulidae (% of community)	modified probit	YES	0.0049	2007	5	0.3%	0.5%	-	a	Tukey's HSD
				2015	3	3.4%	1.3%	6.3	b	
				2016	3	3.8%	3.1%	7.2	b	
				2017	3	3.4%	2.0%	6.5	b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0057	2007	5	57.8%	15.8%	-	a	Tukey's HSD
				2015	3	83.7%	11.4%	1.6	b	
				2016	3	87.0%	2.6%	1.8	b	
				2017	3	88.5%	3.2%	1.9	b	
Filterer FFG (% of community)	modified probit	YES	0.0174	2007	5	6.8%	9.2%	-	a	Tamhane's
				2015	3	0.0%	0.0%	-0.7	b	
				2016	3	2.1%	0.1%	-0.5	a	
				2017	3	3.5%	2.8%	-0.4	a	
Shredder FFG (% of community)	modified probit	YES	0.0448	2007	5	22.5%	8.9%	-	a	Tukey's HSD
				2015	3	16.3%	11.4%	-0.7	a,b	
				2016	3	9.3%	1.5%	-1.5	a,b	
				2017	3	8.0%	2.1%	-1.6	b	

[grey box] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue box] Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.36: Statistical Comparison of Benthic Metrics at Sheardown Lake Tributary 9 (SDLT9) Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007, 2013) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2007	vs. Baseline Year 2013		
Density (No. per m^2)	none	YES	0.0660	2007	3	712	42	-	-0.8	a	Tamhane's
				2013	3	1,240	690	12.6	-	a	
				2015	5	2,147	942	34.2	1.3	a	
				2016	5	2,401	1,054	40.3	1.7	a	
				2017	5	3,404	1,983	64.2	3.1	a	
Richness (No. of Taxa)	none	NO	0.5394	2007	3	22.3	3.2	-	0.9	a	Tukey's HSD
				2013	3	19.0	3.6	-1.0	-	a	
				2015	5	19.4	4.8	-0.9	0.1	a	
				2016	5	18.2	2.6	-1.3	-0.2	a	
				2017	5	20.8	2.8	-0.5	0.5	a	
Simpson's Evenness	none	NO	0.5415	2007	3	0.865	0.049	-	-1.9	a	Tukey's HSD
				2013	3	0.899	0.018	0.7	-	a	
				2015	5	0.892	0.060	0.5	-0.4	a	
				2016	5	0.843	0.063	-0.4	-3.1	a	
				2017	5	0.883	0.042	0.4	-0.9	a	
Oligochaeta (% of community)	modified probit	NO	0.1086	2007	3	5.9%	4.1%	-	4.7	a	Tukey's HSD
				2013	3	0.7%	1.1%	-1.3	-	a	
				2015	5	0.8%	0.4%	-1.3	0.2	a	
				2016	5	1.5%	1.0%	-1.1	0.8	a	
				2017	5	3.0%	2.8%	-0.7	2.0	a	
Hydracarina (% of community)	modified probit	NO	0.3466	2007	3	3.3%	2.0%	-	-1.3	a	Tukey's HSD
				2013	3	9.0%	4.2%	2.8	-	a	
				2015	5	4.2%	4.1%	0.4	-1.1	a	
				2016	5	4.6%	3.2%	0.6	-1.0	a	
				2017	5	3.3%	2.0%	0.0	-1.4	a	
Chironomidae (% of community)	modified probit	NO	0.2687	2007	3	77.5%	5.8%	-	1.0	a	Tukey's HSD
				2013	3	73.3%	4.4%	-0.7	-	a	
				2015	5	78.7%	8.7%	0.2	1.2	a	
				2016	5	67.1%	8.8%	-1.8	-1.4	a	
				2017	5	73.4%	10.1%	-0.7	0.0	a	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0355	2007	3	2.6%	0.9%	-	2.9	a	Tamhane's
				2013	3	1.0%	0.5%	-1.8	-	a	
				2015	5	5.0%	2.5%	2.8	7.4	a	
				2016	5	0.8%	1.2%	-2.1	-0.4	a	
				2017	5	1.1%	1.3%	-1.7	0.2	a	
Tipulidae (% of community)	modified probit	NO	0.3930	2007	3	4.6%	1.9%	-	0.1	a	Tukey's HSD
				2013	3	4.4%	2.1%	-0.1	-	a	
				2015	5	3.9%	3.4%	-0.4	-0.2	a	
				2016	5	8.0%	3.3%	1.8	1.7	a	
				2017	5	5.8%	5.6%	0.7	0.7	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.4084	2007	3	57.8%	3.1%	-	-0.4	a	Tamhane's
				2013	3	60.6%	6.9%	0.9	-	a	
				2015	5	60.7%	20.5%	0.9	0.0	a	
				2016	5	44.6%	15.7%	-4.3	-2.3	a	
				2017	5	57.5%	11.7%	-0.1	-0.4	a	
Filterer FFG (% of community)	modified probit	NO	0.5132	2007	3	1.3%	0.9%	-	-0.7	a	Tamhane's
				2013	3	1.9%	0.9%	0.6	-	a	
				2015	5	2.0%	1.8%	0.7	0.1	a	
				2016	5	0.5%	0.4%	-0.9	-1.6	a	
				2017	5	0.8%	0.7%	-0.6	-1.3	a	
Shredder FFG (% of community)	modified probit	NO	0.1403	2007	3	26.8%	3.9%	-	-0.4	a	Tukey's HSD
				2013	3	28.3%	4.4%	0.4	-	a	
				2015	5	32.0%	18.2%	1.3	0.8	a	
				2016	5	49.1%	15.0%	5.7	4.7	a	
				2017	5	37.7%	10.7%	2.8	2.1	a	

Indicates a significant difference for respective comparison (p-value ≤ 0.1).

Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.37: Statistical Comparison of Physical Sediment Quality Between Sheardown Lake NW and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	YES	0.011	β	Reference	5	9.74	1.04	0.46	8.50	11.20
					Sheardown NW	5	8.20	0.38	0.17	7.80	8.60
	Sand-Sized Particles (% by weight)	NO	0.597	β	Reference	5	46.4	13.9	6.2	25.6	59.9
					Sheardown NW	5	53.2	21.8	9.8	34.6	90.6
	Silt-Sized Particles (% by weight)	NO	0.526	α	Reference	5	44.3	11.6	5.2	32.8	62.2
					Sheardown NW	5	38.0	17.8	8.0	8.5	55.9
	Clay-Sized Particles (% by weight)	NO	0.856	α	Reference	5	9.3	2.8	1.3	4.7	12.2
					Sheardown NW	4	10.8	1.8	0.9	9.2	13.0
	Total Organic Carbon (%)	NO	0.166	Ŧ	Reference	5	4.9	1.8	0.8	2.7	7.2
					Sheardown NW	5	3.1	1.9	0.8	0.6	5.4
Profundal (Deep) Stations	**Station Depth (m)**	NO	0.775	α	Reference	5	20.56	2.17	0.97	18.50	24.20
					Sheardown NW	5	21.14	3.82	1.71	15.00	24.20
	Sand-Sized Particles (% by weight)	YES	0.057	α	Reference	5	35.7	16.5	7.4	15.6	56.0
					Sheardown NW	5	18.2	6.0	2.7	11.8	25.3
	Silt-Sized Particles (% by weight)	YES	0.045	β	Reference	5	50.2	11.8	5.3	35.3	62.4
					Sheardown NW	5	65.1	6.4	2.9	56.7	74.4
	Clay-Sized Particles (% by weight)	NO	0.455	α	Reference	5	14.1	5.2	2.3	8.8	22.0
					Sheardown NW	5	16.7	5.2	2.3	10.9	21.4
	Total Organic Carbon (%)	YES	0.006	β	Reference	5	3.6	1.1	0.5	1.8	4.4
					Sheardown NW	5	1.6	0.4	0.2	1.2	2.2

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted; Ŧ data square root transformed, t-test conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.38: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2017

Taxa	Study Area	Sheardown Lake NW - Littoral Stations 2017					Sheardown Lake NW - Profundal Stations 2017				
	Replicate Station	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
ROUNDWORMS											
P. Nemata		103	172	-	-	17	-	-	-	-	69
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		-	-	-	-	-	-	-	-	-	-
F. Lumbriculidae											
Lumbriculus		-	34	-	-	-	-	-	-	-	-
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina											
immature		-	-	-	-	-	-	-	-	-	-
F. Acalyptonotidae											
Acalyptonotus		-	-	-	86	121	17	60	26	-	60
F. Hygrobatidae											
Hygrobates		-	-	34	466	34	34	9	17	-	26
F. Lebertiidae											
Lebertia		-	-	-	155	17	26	-	-	-	9
HARPACTICOIDS											
O. Harpacticoida		-	-	414	-	-	-	-	-	-	-
SEED SHRIMPS											
Cl. Ostracoda		517	1,862	2,207	603	328	78	147	-	26	95
FAIRY SHRIMP											
O. Notostraca											
Lepidurus arcticus		-	-	-	-	17	-	-	-	-	-
INSECTS											
Cl. Insecta											
CADDISFLIES											
O. Trichoptera											
F. Apataniidae											
Apatania		-	-	-	17	-	-	-	-	-	-
TRUE FLIES											
O. Diptera											
MIDGES											
F. Chironomidae											
chironomid pupae		**34**	-	**69**	**17**	-	**17**	17	-	-	-
S.F. Chironominae											
Chironomus		414	241	69	-	-	207	845	-	-	-
Micropsectra		276	172	552	241	190	9	-	9	-	17
Paratanytarsus		138	345	1,655	103	86	-	17	-	-	-
Sergentia		69	759	379	34	17	-	-	-	-	-
Stictochironomus		2,138	966	2,172	1,621	1,448	43	43	-	-	-
Tanytarsus		345	172	552	52	103	26	69	-	-	-
S.F. Diamesinae		-	-	-	-	-	-	-	-	-	-
Protanypus		-	-	-	-	17	9	9	17	17	9
Pseudodiamesa		-	-	-	-	-	-	103	-	-	9
S.F. Orthocladiinae											
Abiskomyia		34	34	103	69	34	52	112	-	-	-
Chaetocladius		-	-	-	-	-	-	-	-	-	-
Corynoneura		-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius		-	34	-	-	-	-	-	-	-	-
Heterotrissocladius		-	-	172	190	172	181	-	310	397	534
Mesocricotopus		-	-	-	-	-	-	-	-	-	-
Paracladius		-	-	-	-	121	-	-	-	-	-
Parakiefferiella		-	-	-	-	-	-	-	-	-	-
Psectrocladius		34	-	-	-	52	-	-	-	-	-

Table F.38: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake NW, August 2017

Taxa — Study Area / Replicate Station	Sheardown Lake NW - Littoral Stations 2017					Sheardown Lake NW - Profundal Stations 2017				
	DLO-1-9	DLO-1-4	DLO-1-3	DLO-1-11	DLO-1-10	DLO-1-5	DLO-1-14	DLO-1-15	DLO-1-2	DLO-1-12
Zalutschia	-	-	-	86	17	9	-	-	-	9
Genus "Greenland"	-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Arctopelopia	276	207	966	190	17	-	-	-	9	-
Procladius	-	34	-	172	414	43	26	86	164	181
F. Tipulidae										
Tipula	-	-	-	-	-	-	-	-	-	-
Density (No. organisms per m^2)	4,378	5,032	9,344	4,102	3,222	751	1,457	465	613	1,018
Richness (total number of taxa)[a]	11	13	12	15	19	13	11	6	5	11
Simpson's Evenness (E)	0.790	0.857	0.911	0.851	0.802	0.899	0.690	0.618	0.633	0.743
Bray-Curtis Index	0.760	0.786	0.859	0.707	0.695	0.722	0.946	0.645	0.763	0.817
Percent Composition										
% Nemata	2.4%	3.4%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	6.8%
% Hydracarina	0.0%	0.0%	0.4%	17.2%	5.3%	10.3%	4.7%	9.2%	0.0%	9.3%
% Ostracods	11.8%	37.0%	23.6%	14.7%	10.2%	10.4%	10.1%	0.0%	4.2%	9.3%
% Chironomids	85.8%	58.9%	71.6%	67.6%	83.4%	79.4%	85.2%	90.8%	95.8%	74.6%
% Metal Sensitive Chironmids	17.5%	13.7%	29.8%	9.7%	12.3%	6.1%	13.7%	5.6%	2.8%	3.4%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition										
% Collector - Gatherers	76.1%	80.8%	59.4%	61.6%	69.0%	77.6%	87.5%	70.3%	71.8%	70.3%
% Filterers	17.5%	0.14	0.30	0.10	0.12	0.05	0.06	0.02	0.00	0.02
% Shredders	0.0%	0.7%	0.0%	2.1%	0.5%	1.3%	0.0%	0.0%	0.0%	0.9%
Habitat Preference Group Composition										
% Clingers	15.9%	22.6%	16.4%	25.7%	15.0%	15.2%	9.5%	11.2%	0.0%	11.0%
% Sprawlers	22.9%	49.3%	59.4%	34.6%	39.0%	49.4%	28.0%	85.2%	97.2%	81.3%
% Burrowers	61.2%	28.1%	24.2%	39.8%	46.0%	35.4%	62.5%	3.7%	2.8%	7.7%

[a] Bold entries excluded from taxa coun

Table F.39: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Littoral (Shallow) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007, 2008, 2013) for the Mary River Project CREMP

Metric	Data Transformation	Overall 6-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]								
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2008	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	NO	0.5559	2007	4	5,974	3,000	-	-0.3	-1.5	a	Tukey's HSD
				2008	4	7,536	5,273	0.5	-	-0.9	a	
				2013	3	9,940	2,634	1.3	0.5	-	a	
				2015	5	5,665	3,230	-0.1	-0.4	-1.6	a	
				2016	5	5,503	4,184	-0.2	-0.4	-1.7	a	
				2017	5	5,216	2,398	-0.3	-0.4	-1.8	a	
Richness (No. of Taxa)	log	NO	0.1822	2007	4	12.3	1.5	-	-1.3	-1.7	a	Tukey's HSD
				2008	4	14.5	1.7	1.4	-	-1.0	a,b	
				2013	3	17.7	3.2	3.5	1.9	-	b	
				2015	5	13.8	1.9	1.0	-0.4	-1.2	a,b	
				2016	5	14.6	2.4	1.5	0.1	-1.0	a,b	
				2017	5	14.0	3.2	1.1	-0.3	-1.1	a,b	
Simpson's Evenness	none	YES	0.0419	2007	4	0.768	0.055	-	-0.7	-2.0	a,b	Tukey's HSD
				2008	4	0.840	0.098	1.3	-	-0.5	a,b	
				2013	3	0.863	0.047	1.7	0.2	-	a,b	
				2015	5	0.759	0.096	-0.2	-0.8	-2.2	a	
				2016	5	0.893	0.024	2.3	0.5	0.6	b	
				2017	5	0.842	0.048	1.3	0.0	-0.5	a,b	
Nemata (% of community)	modified probit	NO	0.9172	2007	4	1.5%	1.6%	-	0.4	1.1	a	Tukey's HSD
				2008	4	1.1%	1.0%	-0.3	-	0.6	a	
				2013	3	0.6%	0.8%	-0.6	-0.5	-	a	
				2015	5	0.9%	1.1%	-0.4	-0.2	0.3	a	
				2016	5	1.1%	0.7%	-0.2	0.1	0.6	a	
				2017	5	1.3%	1.5%	-0.2	0.2	0.8	a	
Ostracoda (% of community)	modified probit	NO	0.1703	2007	4	11.9%	12.8%	-	0.1	-1.4	a	Tamhane's
				2008	4	10.8%	8.7%	-0.1	-	-1.5	a	
				2013	3	23.4%	8.1%	0.9	1.4	-	a	
				2015	5	7.8%	3.7%	-0.3	-0.3	-1.9	a	
				2016	5	9.2%	6.1%	-0.2	-0.2	-1.7	a	
				2017	5	19.5%	11.1%	0.6	1.0	-0.5	a	
Chironomidae (% of community)	modified probit	YES	0.0186	2007	4	83.0%	8.3%	-	0.3	1.3	a,b	Tukey's HSD
				2008	4	81.2%	6.7%	-0.2	-	1.1	a,b	
				2013	3	70.5%	9.6%	-1.5	-1.6	-	a	
				2015	5	89.8%	3.2%	0.8	1.3	2.0	b	
				2016	5	85.0%	6.6%	0.2	0.6	1.5	a,b	
				2017	5	73.5%	11.2%	-1.1	-1.2	0.3	a	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.8454	2007	4	16.9%	16.8%	-	-0.2	-0.9	a	Tamhane's
				2008	4	20.7%	17.2%	0.2	-	-0.1	a	
				2013	3	21.0%	4.6%	0.2	0.0	-	a	
				2015	5	19.1%	7.2%	0.1	-0.1	-0.4	a	
				2016	5	24.6%	15.2%	0.5	0.2	0.8	a	
				2017	5	16.6%	7.9%	0.0	-0.2	-0.9	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.3349	2007	4	71.6%	13.5%	-	0.7	0.7	a	Tukey's HSD
				2008	4	61.1%	15.0%	-0.8	-	-0.5	a	
				2013	3	65.3%	9.0%	-0.5	0.3	-	a	
				2015	5	68.9%	8.0%	-0.2	0.5	0.4	a	
				2016	5	56.8%	7.7%	-1.1	-0.3	-1.0	a	
				2017	5	69.4%	9.2%	-0.2	0.6	0.5	a	
Filterer FFG (% of community)	modified probit	NO	0.9164	2007	4	16.7%	17.1%	-	-0.2	-0.9	a	Tamhane's
				2008	4	19.9%	17.1%	0.2	-	-0.2	a	
				2013	3	21.0%	4.7%	0.3	0.1	-	a	
				2015	5	18.6%	6.8%	0.1	-0.1	-0.5	a	
				2016	5	23.0%	17.3%	0.4	0.2	0.4	a	
				2017	5	16.5%	8.0%	0.0	-0.2	-1.0	a	

Indicates a significant difference for respective comparison (p-value ≤ 0.1).
Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.40: Statistical Comparison of Benthic Metrics at Sheardown Lake NW Profundal (Deep) Stations Among Years of Mine Operation (2015, 2017) and Baseline (2007,2013) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0000	2007	4	1,461	308	-	-4.3	a	Tukey's HSD
				2013	3	2,744	302	4.2	-	b	
				2015	5	1,425	210	-0.1	-4.4	a	
				2017	5	861	391	-1.9	-6.2	c	
Richness (No. of Taxa)	none	NO	0.6912	2007	4	7.5	0.4	-	-0.9	a	Tamhane's
				2013	3	9.8	2.5	5.4	-	a	
				2015	5	8.4	3.0	2.1	-0.6	a	
				2017	5	9.2	3.5	4.0	-0.3	a	
Simpson's Evenness	none	YES	0.0265	2007	4	0.426	0.165	-	-0.6	a	Tukey's HSD
				2013	3	0.521	0.167	0.6	-	a,b	
				2015	5	0.355	0.212	-0.4	-1.0	a	
				2017	5	0.717	0.113	1.8	1.2	b	
Nemata (% of community)	none	NO	0.2085	2007	4	0.6%	0.5%	-	-1.2	a	Tukey's HSD
				2013	3	3.6%	2.6%	5.8	-	a	
				2015	5	0.5%	0.3%	-0.2	-1.2	a	
				2017	5	1.4%	3.0%	1.4	-0.9	a	
Ostracoda (% of community)	none	NO	0.2094	2007	4	0.3%	0.4%	-	-0.7	a	Tamhane's
				2013	3	6.2%	8.7%	16.4	-	a	
				2015	5	2.8%	3.7%	7.0	-0.4	a	
				2017	5	6.8%	4.6%	18.2	0.1	a	
Chironomidae (% of community)	none	NO	0.1171	2007	4	94.6%	1.9%	-	1.1	a	Tukey's HSD
				2013	3	84.9%	8.8%	-5.0	-	a	
				2015	5	93.2%	6.0%	-0.7	0.9	a	
				2017	5	85.1%	8.5%	-4.9	0.0	a	
Metal Sensitive Taxa (% of community)	none	YES	0.0510	2007	4	0.5%	0.6%	-	-0.5	a	Tukey's HSD
				2013	3	1.4%	1.7%	1.4	-	a,b	
				2015	5	2.8%	2.8%	3.7	0.9	a,b	
				2017	5	6.3%	4.4%	9.2	2.9	b	
Collector-Gatherer FFG (% of community)	none	YES	0.0253	2007	4	83.6%	8.4%	-	-0.6	a	Tukey's HSD
				2013	3	86.4%	4.8%	0.3	-	a	
				2015	5	90.5%	5.3%	0.8	0.9	a	
				2017	5	75.5%	7.3%	-1.0	-2.3	a	
Filterer FFG (% of community)	none	NO	0.2780	2007	4	0.1%	0.1%	-	-0.8	a,b	Tamhane's
				2013	3	1.3%	1.6%	11.6	-	a,b	
				2015	5	1.9%	2.6%	16.7	0.3	a	
				2017	5	2.9%	2.5%	26.2	1.0	b	

(grey box) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue box) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.41: Statistical Comparison of Physical Sediment Quality Between Sheardown Lake SE and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	**Station Depth (m)**	NO	0.423	β	Reference	5	9.74	1.04	0.46	8.50	11.20
					Sheardown SE	5	9.10	1.58	0.71	7.50	11.50
	Sand-Sized Particles (% by weight)	YES	<0.001	β	Reference	5	46.4	13.9	6.2	25.6	59.9
					Sheardown SE	5	8.9	2.4	1.1	5.8	12.5
	Silt-Sized Particles (% by weight)	YES	0.002	β	Reference	5	44.3	11.6	5.2	32.8	62.2
					Sheardown SE	5	76.4	9.8	4.4	62.4	89.9
	Clay-Sized Particles (% by weight)	NO	0.280	Ŧ	Reference	5	9.3	2.8	1.3	4.7	12.2
					Sheardown SE	5	14.7	9.0	4.0	4.3	28.6
	Total Organic Carbon (%)	YES	<0.001	β	Reference	5	4.9	1.8	0.8	2.7	7.2
					Sheardown SE	5	1.2	0.2	0.1	1.0	1.5
Profundal (Deep) Stations	**Station Depth (m)**	YES	<0.001	β	Reference	5	20.56	2.17	0.97	18.50	24.20
					Sheardown SE	5	12.44	1.17	0.52	10.50	13.50
	Sand-Sized Particles (% by weight)	YES	0.013	α	Reference	5	35.7	16.5	7.4	15.6	56.0
					Sheardown SE	5	10.9	5.4	2.4	4.1	17.0
	Silt-Sized Particles (% by weight)	YES	0.007	Ŧ	Reference	5	50.2	11.8	5.3	35.3	62.4
					Sheardown SE	5	73.4	6.3	2.8	67.1	81.7
	Clay-Sized Particles (% by weight)	NO	0.381	β	Reference	5	14.1	5.2	2.3	8.8	22.0
					Sheardown SE	5	15.7	1.7	0.8	14.2	18.6
	Total Organic Carbon (%)	YES	0.001	α	Reference	5	3.6	1.1	0.5	1.8	4.4
					Sheardown SE	5	1.1	0.1	0.0	1.0	1.1

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted; Ŧ data square root transformed, t-test conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.42: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2017

Taxa	Study Area / Replicate Station	Sheardown Lake SE - Littoral Stations 2017					Sheardown Lake SE - Profundal Stations 2017				
		DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
ROUNDWORMS											
P. Nemata		34	-	69	9	-	-	-	-	-	-
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		-	-	-	-	-	-	-	-	-	-
F. Lumbriculidae											
Lumbriculus		-	-	-	-	-	-	-	-	-	-
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina											
immature		-	-	-	-	-	-	-	-	-	-
F. Acalyptonotidae											
Acalyptonotus		34	69	138	60	17	17	26	52	52	26
F. Hygrobatidae											
Hygrobates		138	34	86	43	-	-	9	-	34	9
F. Lebertiidae											
Lebertia		34	34	17	-	17	9	9	-	17	34
HARPACTICOIDS											
O. Harpacticoida		-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS											
Cl. Ostracoda		17	121	17	9	26	17	9	17	-	129
FAIRY SHRIMP											
O. Notostraca											
Lepidurus arcticus		-	-	-	-	-	-	-	-	-	-
INSECTS											
Cl. Insecta											
CADDISFLIES											
O. Trichoptera											
F. Apataniidae											
Apatania		-	-	-	-	-	-	-	-	-	-
TRUE FLIES											
O. Diptera											
MIDGES											
F. Chironomidae											
chironomid pupae		-	-	-	**9**	**9**	-	-	-	-	17
S.F. Chironominae											
Chironomus		-	-	-	-	1,431	-	-	-	-	17
Micropsectra		457	483	328	233	-	267	129	34	276	862
Paratanytarsus		-	34	-	-	-	-	-	-	-	-
Sergentia		-	34	-	-	-	-	-	-	-	-
Stictochironomus		1,974	2,741	1,500	1,569	328	698	1,414	862	2,086	1,621
Tanytarsus		353	207	414	190	138	181	26	34	207	147
S.F. Diamesinae		-	-	-	-	-	-	-	-	-	-
Protanypus		-	-	-	-	-	-	9	-	-	-
Pseudodiamesa		-	-	-	-	-	-	-	-	-	-
S.F. Orthocladiinae											
Abiskomyia		-	-	-	34	17	26	43	-	17	34
Chaetocladius		-	-	-	-	-	-	-	-	-	-
Corynoneura		-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius		-	-	-	-	-	-	-	-	-	-
Heterotrissocladius		-	-	-	-	-	-	-	17	-	17
Mesocricotopus		-	-	-	-	-	-	-	-	-	-
Paracladius		-	-	-	-	-	-	-	-	-	-
Parakiefferiella		-	-	-	-	-	-	-	-	-	-
Psectrocladius		-	-	-	-	-	-	-	-	-	-

Table F.42: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Sheardown Lake SE, August 2017

Taxa — Study Area / Replicate Station	Sheardown Lake SE - Littoral Stations 2017					Sheardown Lake SE - Profundal Stations 2017				
	DLO-2-11	DLO-2-10	DLO-2-4	DLO-2-9	DLO-2-1	DLO-2-12	DLO-2-8	DLO-2-13	DLO-2-2	DLO-2-3
Zalutschia	-	-	-	-	-	-	-	-	-	-
Genus "Greenland"	-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Arctopelopia	-	-	-	-	-	-	-	-	-	-
Procladius	2,198	1,914	2,000	2,190	276	2,784	603	1,276	1,293	707
F. Tipulidae										
Tipula	-	-	-	-	-	-	-	-	-	-
Density (No. organisms per m^2)	5,239	5,671	4,569	4,346	2,259	3,999	2,277	2,292	3,982	3,620
Richness (total number of taxa)[a]	9	10	9	9	8	8	10	7	8	11
Simpson's Evenness (E)	0.753	0.715	0.771	0.685	0.634	0.547	0.600	0.639	0.700	0.768
Bray-Curtis Index	0.924	0.908	0.915	0.914	0.918	0.983	0.964	0.972	0.983	0.973
Percent Composition										
% Nemata	0.6%	0.0%	1.5%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	3.9%	2.4%	5.3%	2.4%	1.5%	0.7%	1.9%	2.3%	2.6%	1.9%
% Ostracods	0.3%	2.1%	0.4%	0.2%	1.2%	0.4%	0.4%	0.7%	0.0%	3.6%
% Chironomids	95.1%	95.5%	92.8%	97.2%	97.3%	98.9%	97.7%	97.0%	97.4%	94.5%
% Metal Sensitive Chironmids	15.5%	12.8%	16.2%	9.8%	6.2%	11.2%	7.2%	3.0%	12.1%	28.0%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition										
% Collector - Gatherers	38.7%	51.1%	34.7%	37.4%	80.1%	18.5%	64.8%	39.1%	52.8%	50.4%
% Filterers	15.5%	0.13	0.16	0.10	0.06	0.11	0.07	0.03	0.12	0.28
% Shredders	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composition										
% Clingers	19.4%	15.2%	21.5%	12.1%	7.7%	11.9%	8.7%	5.2%	14.7%	29.9%
% Sprawlers	42.3%	36.5%	44.1%	51.5%	14.2%	70.7%	28.8%	57.2%	32.9%	24.6%
% Burrowers	38.3%	48.3%	34.3%	36.4%	78.2%	17.5%	62.5%	37.6%	52.4%	45.5%

[a] Bold entries excluded from taxa count

Table F.43: Statistical Comparison of Benthic Metrics at Sheardown Lake SE Littoral (Shallow) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2013) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0013	2013	5	10,649	4,062	-	a	Tamhane's
				2015	5	4,829	1,898	-1.4	a,b	
				2016	5	3,700	1,485	-1.7	b	
				2017	5	4,417	1,317	-1.5	a,b	
Richness (No. of Taxa)	none	YES	0.0434	2013	5	14.2	4.0	-	a	Tukey's HSD
				2015	5	10.6	2.5	-0.9	a,b	
				2016	5	11.4	2.3	-0.7	a,b	
				2017	5	9.0	0.7	-1.3	b	
Simpson's Evenness	none	NO	0.6327	2013	5	0.785	0.096	-	a	Tukey's HSD
				2015	5	0.759	0.123	-0.3	a	
				2016	5	0.772	0.089	-0.1	a	
				2017	5	0.712	0.055	-0.8	a	
Nemata (% of community)	modified probit	NO	0.9486	2013	5	0.2%	0.2%	-	a	Tukey's HSD
				2015	5	1.5%	2.9%	7.0	a	
				2016	5	1.1%	1.3%	4.4	a	
				2017	5	0.5%	0.6%	1.4	a	
Ostracoda (% of community)	modified probit	NO	0.9082	2013	5	5.9%	8.8%	-	a	Tamhane's
				2015	5	5.5%	10.0%	0.0	a	
				2016	5	1.7%	2.5%	-0.5	a	
				2017	5	0.8%	0.8%	-0.6	b	
Chironomidae (% of community)	modified probit	NO	0.1173	2013	5	89.9%	7.5%	-	a	Tukey's HSD
				2015	5	88.9%	9.4%	-0.1	a	
				2016	5	95.4%	3.9%	0.7	a	
				2017	5	95.6%	1.8%	0.8	b	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.3976	2013	5	15.1%	9.8%	-	a	Tukey's HSD
				2015	5	12.7%	10.4%	-0.2	b	
				2016	5	6.8%	4.2%	-0.8	b	
				2017	5	12.1%	4.2%	-0.3	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.3443	2013	5	44.6%	8.2%	-	a	Tukey's HSD
				2015	5	59.1%	10.6%	1.8	a	
				2016	5	56.5%	12.8%	1.5	a	
				2017	5	48.4%	18.8%	0.5	a	
Filterer FFG (% of community)	modified probit	NO	0.3395	2013	5	15.1%	9.8%	-	a	Tukey's HSD
				2015	5	12.5%	10.4%	-0.3	a	
				2016	5	6.7%	4.4%	-0.9	a	
				2017	5	12.1%	4.2%	-0.3	b	

[grey] Indicates a significant difference for respective comparison (p-value ≤ 0.1).

[blue] Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.44: Statistical Comparison of Benthic Metrics at Sheardown Lake SE Profundal (Deep) Stations Among Years of Mine Operation (2015, 2017) and Baseline (2007,2013) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Effect Size vs. Baseline Year 2013	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0001	2007	3	4,998	348	-	-1.8	a,c	Tamhane's
				2013	4	6,602	874	4.6	-	a	
				2015	5	3,185	281	-5.2	-3.9	b	
				2017	5	3,234	880	-5.1	-3.9	b,c	
Richness (No. of Taxa)	log	NO	0.6225	2007	3	9.0	2.8	-	-0.7	a	Tukey's HSD
				2013	4	10.5	2.1	0.5	-	a	
				2015	5	8.8	1.8	-0.1	-0.8	a	
				2017	5	8.8	1.6	-0.1	-0.8	a	
Simpson's Evenness	log	NO	0.3865	2007	3	0.607	0.093	-	-2.4	a	Tukey's HSD
				2013	4	0.703	0.039	1.0	-	a	
				2015	5	0.588	0.130	-0.2	-2.9	a	
				2017	5	0.651	0.086	0.5	-1.3	a	
Nemata (% of community)	modified probit	NO	0.3304	2007	3	0.0%	0.1%	-	-0.9	a	Tamhane's
				2013	4	0.1%	0.1%	1.6	-	a	
				2015	5	0.6%	1.1%	11.4	5.4	a	
				2017	5	0.0%	0.0%	-0.6	-1.2	a	
Ostracoda (% of community)	modified probit	NO	0.5460	2007	3	1.1%	1.5%	-	5.1	a	Tukey's HSD
				2013	4	0.2%	0.2%	-0.7	-	a	
				2015	5	0.5%	0.4%	-0.4	1.8	a	
				2017	5	1.0%	1.4%	-0.1	4.5	a	
Chironomidae (% of community)	modified probit	NO	0.6852	2007	3	97.0%	2.9%	-	-5.6	a	Tukey's HSD
				2013	4	98.6%	0.3%	0.6	-	a	
				2015	5	97.0%	2.9%	0.0	-5.5	a	
				2017	5	97.1%	1.6%	0.0	-5.3	a	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.3087	2007	3	13.5%	11.4%	-	-1.2	a	Tukey's HSD
				2013	4	16.8%	2.8%	0.3	-	a	
				2015	5	8.0%	4.7%	-0.5	-3.2	a	
				2017	5	12.3%	9.5%	-0.1	-1.6	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.1801	2007	3	74.1%	15.7%	-	1.2	a	Tukey's HSD
				2013	4	64.9%	7.5%	-0.6	-	a	
				2015	5	60.2%	23.0%	-0.9	-0.6	a	
				2017	5	45.1%	17.4%	-1.8	-2.6	a	
Filterer FFG (% of community)	modified probit	NO	0.2931	2007	3	13.4%	11.5%	-	-1.2	a	Tukey's HSD
				2013	4	16.8%	2.8%	0.3	-	a	
				2015	5	7.8%	4.7%	-0.5	-3.2	a	
				2017	5	12.2%	9.6%	-0.1	-1.6	a	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.45: Coordinates of Mary River Tributary-F Benthic Invertebrate Community Sampling Stations Used for the Mary River Project EEM, August 2017

Study Area	Station	Date Sampled	UTM Zone 17, NAD 83	
			Easting	Northing
Mary River Tributary-F Reference	MRTF-REF1	25-Aug-17	565271	7916323
	MRTF-REF2	25-Aug-17	565220	7916261
	MRTF-REF3	25-Aug-17	565163	7916211
	MRTF-REF4	25-Aug-17	565124	7916167
	MRTF-REF5	25-Aug-17	565074	7916129
Mary River Tributary-F Effluent-Exposed	MRTF-EXP1	25-Aug-17	564950	7916062
	MRTF-EXP2	25-Aug-17	564933	7916037
	MRTF-EXP3	25-Aug-17	564918	7915998
	MRTF-EXP4	25-Aug-17	564915	7915909
	MRTF-EXP5	25-Aug-17	564911	7915804

Table F.46: Replicate Habitat Measurements Collected at Mary River Tributary-F Benthic Invertebrate Community Stations Used for the Mary River Project EEM, August 2017

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Mary River Tributary-F Reference	MRTF-REF1	6	7	6	0.27	0.25	0.26	6.6	6.4	6.8	0%	38%	13%
	MRTF-REF2	4	4	4	0.28	0.14	0.18	6.6	6.1	6.8	25%	13%	38%
	MRTF-REF3	3	3	3	0.19	0.14	0.15	6.7	6.1	4.9	13%	0%	13%
	MRTF-REF4	4	5	6	0.12	0.19	0.15	6.7	4.1	8.0	0%	25%	25%
	MRTF-REF5	4	4	4	0.13	0.11	0.29	6.2	5.5	5.0	25%	25%	38%
Mary River Tributary-F Effluent-Exposed	MRTF-EXP1	4	4	4	0.11	0.18	0.26	5.6	6.1	4.7	13%	25%	13%
	MRTF-EXP2	6	6	6	0.17	0.23	0.22	5.2	5.7	6.5	0%	25%	50%
	MRTF-EXP3	6	7	7	0.29	0.17	0.13	7.0	6.9	7.0	13%	13%	13%
	MRTF-EXP4	7	7	6	0.30	0.14	0.19	7.8	6.4	6.8	13%	38%	0%
	MRTF-EXP5	8	9	6	0.29	0.23	0.17	6.7	5.9	7.2	13%	25%	25%

[a] Substrate measurements taken on the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 6 - 8 measurements per replicate grab, with a mean of 6.2 for the entire 2017 MRTF creek sampling program.

Table F.47: Replicate Station Habitat Feature Summary and Statistical Comparison Results between Mary River Tributary-F Effluent-Exposed and Reference Study Areas Used for the Mary River Project EEM, August 2017

Channel Feature	Two-Area Comparison			Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval for Mean		Minimum	Maximum
	Significant Difference between Areas?	p-value	Statistical Test					Lower Bound	Upper Bound		
Water Depth (cm)	YES	0.0706	α	Reference	4.5	1.3	0.6	2.9	6.0	3.0	6.3
				Effluent-Exposed	6.2	1.4	0.6	4.5	7.9	4.0	7.7
Water Velocity (cm/s)	NO	0.4811	α	Reference	19.0	4.3	1.9	13.7	24.3	15.3	26.0
				Effluent-Exposed	20.5	1.7	0.8	18.4	22.7	18.3	23.0
Substrate Size (cm)	NO	0.6103	α	Reference	6.2	0.4	0.2	5.6	6.7	5.6	6.6
				Effluent-Exposed	6.4	0.7	0.3	5.5	7.2	5.5	7.0
Substrate Embeddedness (%)	NO	0.8480	α	Reference	19.2	8.1	3.6	9.1	29.3	8.3	29.2
				Effluent-Exposed	18.3	4.8	2.1	12.4	24.2	12.5	25.0

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.1.

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance.

Table F.48: Benthic Invertebrate Community Data (Densities Expressed in Number of Organisms per Square Metre) for Mary River Tributary-F Study Areas, August 2017

Taxa	Reference Area					Effluent-Exposed Area				
	1	2	3	4	5	1	2	3	4	5
ROUNDWORMS										
P. Nemata	7	-	-	-	-	-	-	4	-	-
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	4	-	-	4	-	-	-	-	7	4
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Sperchonidae										
Sperchon	-	7	-	7	4	7	-	4	18	-
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
immature	-	-	-	4	-	-	-	-	-	-
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	18	4	-	14	14	-	4	4	4	-
S.F. Diamesinae										
Diamesa	75	29	22	86	36	22	50	100	133	97
Pseudokiefferiella	57	-	11	68	36	14	4	-	7	11
S.F. Orthocladiinae										
Chaetocladius	14	-	-	14	-	7	-	4	-	-
Corynoneura	-	-	7	-	-	-	-	-	-	-
Cricotopus/Orthocladius	-	4	-	7	-	-	7	7	32	-
Diplocladius	11	-	4	4	-	7	4	4	7	-
Eukiefferiella	208	104	47	280	100	39	168	247	222	43
Krenosmittia	14	75	7	39	29	32	39	39	14	4
Limnophyes	18	7	-	4	-	4	-	-	-	-
Metriocnemus	-	-	-	7	-	-	-	-	-	-
Parakiefferiella	-	11	-	-	-	-	-	-	-	-
Paraphaenocladius	4	-	-	-	-	-	-	-	-	-
Tokunagaia	11	7	4	-	25	4	4	14	7	-
Tvetenia	-	-	-	-	-	-	4	-	-	-
Vivacricotopus	-	-	-	4	-	-	-	-	-	-
indeterminate	-	-	-	4	-	4	-	-	-	-
F. Empididae										
Clinocera	-	-	-	-	-	4	-	-	7	-
pupae	4	-	-	-	-	-	-	-	-	-
F. Simuliidae										
Gymnopais	161	219	82	480	75	297	462	552	706	685
Prosimulium/Helodon	-	-	-	7	-	-	-	-	-	-
F. Tipulidae										
Tipula	7	7	4	25	11	7	4	36	11	11
Density (No. organisms per m^2)	613	474	188	1,058	330	448	750	1,015	1,175	855
Richness[a]	6	4	3	6	4	5	3	5	6	4
Simpson's Evenness (E)[a]	0.297	0.529	0.689	0.359	0.430	0.379	0.637	0.428	0.338	0.370
Bray-Curtis Index[a]	0.204	0.069	0.378	0.439	0.121	0.291	0.302	0.423	0.481	0.491

[a] Metrics calculated using Family Level (FL) taxonomy.

Table F.49: Supporting Benthic Invertebrate Community Metrics for Mary River Tributary-F Effluent-Exposed and Reference Study Area Replicate Stations Used for the Mary River Project EEM, August 2017

Supporting Metric	Reference Area					Effluent-Exposed Area				
	1	2	3	4	5	1	2	3	4	5
Family Level Taxonomy										
Simpson's Diversity (FL) [a]	0.439	0.528	0.516	0.536	0.418	0.472	0.477	0.533	0.507	0.324
Shannon-Wiener Diversity (FL)[a]	1.108	1.191	1.121	1.251	1.061	1.162	1.001	1.239	1.216	0.818
Lowest Practical Level Taxonomy										
Richness (LPL) [b]	14	10	9	16	8	12	10	11	12	7
Simpson's Evenness (LPL)[b]	0.319	0.339	0.406	0.211	0.626	0.182	0.228	0.246	0.202	0.217
Bray-Curtis Index (LPL) [b]	0.249	0.200	0.385	0.460	0.160	0.312	0.387	0.493	0.557	0.580
Simpson's Diversity (LPL) [b]	0.776	0.705	0.726	0.704	0.800	0.542	0.561	0.631	0.588	0.342
Shannon-Wiener Diversity (LPL)[b]	2.655	2.213	2.332	2.322	2.581	1.918	1.667	1.919	1.849	1.063
Dominant Taxa Groups										
% Chironomidae	70.1%	50.8%	54.3%	50.2%	72.7%	29.7%	37.9%	41.3%	36.3%	18.1%
% Metal Sensitive Chironomidae	24.8%	22.2%	21.3%	18.8%	32.4%	15.6%	12.5%	13.8%	13.2%	13.1%
% Simuliidae	26.3%	46.2%	43.6%	46.0%	22.7%	66.3%	61.6%	54.4%	60.1%	80.1%
% Tipulidae	1.1%	1.5%	2.1%	2.4%	3.3%	1.6%	0.5%	3.5%	0.9%	1.3%
Functional Feeding Groups										
% Collector Gatherers	71.9%	50.0%	54.3%	50.3%	72.7%	29.7%	36.9%	41.0%	34.1%	18.6%
% Filterers	26.3%	46.2%	43.6%	46.0%	22.7%	66.3%	61.6%	54.4%	60.1%	80.1%
% Shredders	1.1%	2.3%	2.1%	3.0%	3.3%	1.6%	1.5%	4.2%	3.7%	1.3%
Habitat Preference Groups										
% Clingers	26.9%	48.5%	43.6%	47.7%	23.9%	68.8%	62.5%	55.5%	64.9%	80.1%
% Sprawlers	70.1%	50.0%	54.3%	48.9%	72.7%	29.7%	36.9%	40.6%	33.5%	18.1%
% Burrowers	2.9%	1.5%	2.1%	3.4%	3.3%	1.6%	0.5%	3.9%	1.5%	1.8%
Dominant Taxa Groups										
Density Chironomidae	430	241	102	531	240	133	284	419	426	155
Density Metal Sensitive Chironomidae	152	105	40	199	107	70	94	140	155	112
Density Simuliidae	161	219	82	487	75	297	462	552	706	685
Density Tipulidae	7	7	4	25	11	7	4	36	11	11
Functional Feeding Groups										
Density Collector Gatherers	441	237	102	532	240	133	277	416	401	159
Density Filterers	161	219	82	487	75	297	462	552	706	685
Density Shredders	7	11	4	32	11	7	11	43	43	11
Habitat Preference Groups										
Density Clingers	165	230	82	505	79	308	469	563	763	685
Density Sprawlers	430	237	102	517	240	133	277	412	394	155
Density Burrowers	18	7	4	36	11	7	4	40	18	15

[a] Metrics calculated using Family Level (FL) taxonomy.

[b] Metrics calculated using Lowest Practical Level (LPL) taxonomy.

Table F.50: Summary of Habitat Features at Mary River Study Areas Evaluated for the 2017 Mary River Project CREMP Benthic Invertebrate Community Assessment

Habitat Characteristic		Mary River Upstream		Mary River Downstream		
		GO-09	GO-03	EO-01	EO-20	CO-05
Mean Width (m)	**Wetted**	30.3	37.5	20.3	12.3	73
Mean Depth (m)	**Average**	0.20	0.25	0.34	0.27	0.22
Mean Velocity (m/s)	**Average**	not measured	0.28	not measured	not measured	0.16
Stream Morphology	**% Pool**	0	0	0	0	0
	% Rapid	0	0	30	10	0
	% Riffle	100	95	63	90	20
	% Run	0	5	7	0	80
Substrate (% areal coverage)		45% boulder 35% cobble 5% pebble 5% gravel 10% sand	35% boulder 50% cobble 10% pebble 5% gravel	48% boulder 48% cobble 2% pebble 2% gravel	5% boulder 88% cobble 7% pebble trace sand	10% boulder 10% cobble 5% pebble 10% gravel 65% sand
Mean Substrate Size (mm)		191	177	201	119	38
Aquatic Vegetation (% areal coverage)	**Bryophyte Coverage**	15%	trace	trace	none observed	none observed
	Periphyton Coverage	<5%	trace	trace	trace	trace
	Periphyton Description	Rocks slightly slippery, yellow-green (0.5-1.0 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)	Rocks not slippery, no obvious colour (<0.5 mm thick)
Functional Instream Cover (% areal coverage)		8% boulder	15% boulder	22% deep pool/ boulder mix	no significant cover	25% deep pool

Table F.51: Replicate Grab Data for Benthic Invertebrate Community Samples Collected at the Mary River, Mary River Project CREMP,

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness			In-Stream Vegetation			Algae Presence		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Mary River Upstream Reference (GO-09)	GO-09 B1	10	10	18	-	-	-	74.9	52.8	64.8	75%	50%	50%	none	none	none	scarce	scarce	scarce
	GO-09 B2	10	20	20	-	-	-	65.6	65.3	69.8	50%	50%	50%	none	none	none	none	none	scarce
	GO-09 B3	20	18	15	-	-	-	66.5	56.4	55.0	50%	-	-	scarce	none	none	none	scarce	scarce
	GO-09 B4	18	19	18	-	-	-	50.0	45.6	46.8	25%	25%	25%	none	none	none	none	none	none
	GO-09 B5	16	15	15	-	-	0.45	37.4	54.1	69.1	50%	50%	50%	none	none	scarce	none	none	common
Mary River Upstream (GO-03)	GO-03 B1	12	12	14	0.27	0.45	0.45	72.0	85.2	80.7	25%	25%	0%	scarce	scarce	none	common	scarce	common
	GO-03 B2	12	11	14	0.22	0.31	0.24	-	58.3	69.8	25%	25%	0%	none	none	none	scarce	scarce	scarce
	GO-03 B3	14	10	12	0.34	0.26	0.27	85.5	84.1	76.1	0%	25%	25%	none	none	none	scarce	scarce	scarce
	GO-03 B4	16	12	12	0.26	0.31	0.44	60.1	57.6	71.5	0%	25%	0%	none	none	none	none	scarce	scarce
	GO-03 B5	14	6	18	0.25	0.31	0.26	65.4	75.4	92.6	25%	0%	0%	none	none	none	none	none	none
Mary River Upper Mine-Exposed (EO-01)	EO-01 B1	20	19	25	-	-	-	64.3	69.4	53.8	0%	25%	25%	none	none	none	none	scarce	none
	EO-01 B2	15	22	20	-	-	-	56.4	79.0	59.8	0%	50%	25%	none	none	none	scarce	none	none
	EO-01 B3	20	12	10	-	-	-	71.3	64.7	71.4	25%	25%	25%	none	scarce	none	none	none	none
	EO-01 B4	15	18	23	-	-	-	62.4	60.3	92.6	25%	-	50%	none	none	none	none	scarce	none
	EO-01 B5	20	14	17	-	-	-	86.9	56.9	77.6	-	50%	25%	scarce	none	none	none	scarce	scarce
Mary River Middle Mine-Exposed (EO-20)	EO-20 B1	22	22	15	-	-	-	97.7	63.8	79.3	75%	50%	50%	none	none	none	scarce	scarce	scarce
	EO-20 B2	14	15	19	-	-	-	81.0	48.8	63.6	50%	0%	25%	common	scarce	none	common	scarce	scarce
	EO-20 B3	18	19	16	-	-	-	-	62.5	66.5	75%	50%	50%	none	none	none	none	none	none
	EO-20 B4	20	16	21	-	-	-	74.2	57.6	55.8	75%	25%	50%	none	none	none	none	none	none
	EO-20 B5	17	15	18	-	-	-	86.4	87.8	58.6	0%	0%	50%	none	none	none	none	none	none
Mary River Lower Mine-Exposed (CO-05)	CO-05 B1	18	15	14	0.33	0.43	0.34	50.3	53.5	55.1	75%	75%	75%	none	none	none	scarce	scarce	scarce
	CO-05 B2	10	8	10	0.45	0.38	0.44	64.8	77.3	62.5	75%	50%	75%	scarce	common	scarce	none	none	none
	CO-05 B3	12	8	14	0.36	0.38	0.34	64.0	52.1	71.6	50%	75%	75%	scarce	common	scarce	none	none	none
	CO-05 B4	8	9	5	0.40	0.30	0.56	80.8	76.3	89.3	75%	75%	75%	scarce	scarce	scarce	none	none	none
	CO-05 B5	10	9	8	0.54	0.46	0.40	95.3	96.4	79.0	75%	50%	75%	common	none	common	scarce	scarce	scarce

[a] Substrate measurements taken from the intermediate axis of each individual particle observed within the Surber sampler area as viewed from the surface prior to sampling. Sample size ranged from 5 - 8 measurements per replicate grab, with a mean of 7.3 for Mary River sampling stations in 2017.

Table F.52: **Replicate Station Habitat Feature Summary Statistics for Mary River Benthic Stations, Mary River Project CREMP, August 2017**

Metric	Study Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Water Depth (cm)	GO-09 Reference Area	16.1	2.2	1.0	13.3	18.9	12.7	18.3
	GO-03 Upstream Area	12.6	0.5	0.2	12.0	13.2	12.0	13.3
	EO-01 Upper Mine-Exposed Area	18.0	2.7	1.2	14.6	21.4	14.0	21.3
	EO-20 Middle Mine-Exposed Area	17.8	1.5	0.7	15.9	19.7	16.0	19.7
	CO-05 Lower Mine-Exposed Area	10.5	3.2	1.4	6.6	14.5	7.3	15.7
Water Velocity (cm/s)	GO-09 Reference Area	-	-	-	-	-	-	-
	GO-03 Upstream Area	30.9	5.4	2.4	24.2	37.6	25.7	39.0
	EO-01 Upper Mine-Exposed Area	-	-	-	-	-	-	-
	EO-20 Middle Mine-Exposed Area	-	-	-	-	-	-	-
	CO-05 Lower Mine-Exposed Area	40.7	4.4	2.0	35.2	46.2	36.0	46.7
Substrate Size (mm diameter)	GO-09 Reference Area	58.3	7.9	3.5	48.5	68.0	47.5	66.9
	GO-03 Upstream Area	73.2	9.0	4.0	62.1	84.3	63.1	81.9
	EO-01 Upper Mine-Exposed Area	68.4	4.7	2.1	62.6	74.2	62.5	73.8
	EO-20 Middle Mine-Exposed Area	69.9	8.4	3.7	59.5	80.2	62.5	80.2
	CO-05 Lower Mine-Exposed Area	71.2	15.0	6.7	52.6	89.8	53.0	90.2
Substrate Embeddedness (%)	GO-09 Reference Area	47	13	6	31	62	25	58
	GO-03 Upstream Area	13	5	2	8	19	8	17
	EO-01 Upper Mine-Exposed Area	28	9	4	17	40	17	38
	EO-20 Middle Mine-Exposed Area	42	19	9	17	66	17	58
	CO-05 Lower Mine-Exposed Area	70	5	2	64	76	66	75

Note: Five stations were sampled at each study area.

Table F.53: Benthic Station Habitat Feature Statistical Comparisons Among Mary River Reference and Mine-Exposed Study Areas, Mary River Project CREMP, August 2017

Metric	Overall 5-group Comparison			Pair-wise, post-hoc comparisons[a]				
	Significant Difference Among Areas?	P-value	Statistical Test [b]	(I) Area	(J) Area	Significant Difference Between Areas?	P-value	Statistical Test
Water Depth (cm)	YES	0.0001	α	GO-09	GO-03	NO	0.1342	Tukey's HSD
				GO-09	EO-01	NO	0.6870	
				GO-09	EO-20	NO	0.7668	
				GO-09	CO-05	YES	0.0065	
				GO-03	EO-01	YES	0.0089	
				GO-03	EO-20	YES	0.0121	
				GO-03	CO-05	NO	0.6026	
				EO-01	EO-20	NO	0.9999	
				EO-01	CO-05	YES	0.0003	
				EO-20	CO-05	YES	0.0005	
Substrate Size (mm diameter)	NO	0.1582	α	GO-09	GO-03	NO	0.2110	Tamhane's
				GO-09	EO-01	NO	0.3655	
				GO-09	EO-20	NO	0.4250	
				GO-09	CO-05	NO	0.7715	
				GO-03	EO-01	NO	0.9818	
				GO-03	EO-20	NO	0.9997	
				GO-03	CO-05	NO	1.0000	
				EO-01	EO-20	NO	1.0000	
				EO-01	CO-05	NO	1.0000	
				EO-20	CO-05	NO	1.0000	
Substrate Embeddedness (%)	YES	0.0008	ζ	GO-09	GO-03	YES	0.0079	Mann-Whitney U-test
				GO-09	EO-01	YES	0.0556	
				GO-09	EO-20	NO	1.0000	
				GO-09	CO-05	YES	0.0079	
				GO-03	EO-01	YES	0.0159	
				GO-03	EO-20	YES	0.0159	
				GO-03	CO-05	YES	0.0079	
				EO-01	EO-20	NO	0.3095	
				EO-01	CO-05	YES	0.0079	
				EO-20	CO-05	YES	0.0079	

Note: Shading indicates a significant difference for respective comparison (p-value ≤ 0.1).

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

[b] Data analysis included: α - data untransformed, single factor ANOVA test conducted; ζ - data untransformed, Kruskal-Wallis H-test conducted; η - data log transformed, single factor ANOVA test conducted; β - data logit transformed, single factor ANOVA test conducted.

Table F.54: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River GO-09 and GO-03 Study Areas, August 2017

Taxa (Study Area / Replicate Station)	GO-09 Reference Area B1	B2	B3	B4	B5	GO-03 Upstream of Mine B1	B2	B3	B4	B5
ROUNDWORMS										
P. Nemata	-	4	-	-	4	11	4	11	-	-
ANNELIDS										
P. Annelida										
WORMS										
Cl. Oligochaeta										
F. Enchytraeidae	-	-	-	-	-	-	-	-	-	-
ARTHROPODS										
P. Arthropoda										
MITES										
Cl. Arachnida										
O. Acarina										
F. Sperchonidae										
Sperchon	-	-	-	-	-	22	7	11	-	-
SEED SHRIMPS										
Cl. Ostracoda	-	-	-	-	-	-	-	-	-	-
INSECTS										
Cl. Insecta										
MAYFLIES										
O. Ephemeroptera										
F. Baetidae										
Acentrella feropagus	-	-	-	-	-	29	11	18	-	-
STONEFLIES										
O. Plecoptera										
F. Capniidae										
immature	-	-	-	-	-	-	-	-	4	-
TRUE FLIES										
O. Diptera										
MIDGES										
F. Chironomidae										
chironomid pupae	**72**	**47**	**57**	**65**	**72**	**36**	**57**	**65**	**39**	**7**
S.F. Chironominae										
Stictochironomus	-	-	-	-	-	-	-	-	-	-
S.F. Diamesinae										
Diamesa	136	36	154	108	276	115	47	104	72	14
Pseudokiefferiella	11	7	22	18	237	43	32	39	4	18
S.F. Orthocladiinae										
Chaetocladius	-	-	4	-	-	-	-	-	-	-
Cardiocladius	4	-	-	-	14	11	7	29	-	-
Corynoneura	-	4	-	-	-	-	-	-	-	-
Cricotopus	-	4	-	-	-	7	-	4	-	-
Cricotopus/Orthocladius	7	4	11	7	32	14	4	11	-	-
Diplocladius	-	-	-	-	-	-	7	-	4	4
Eukiefferiella	7	11	7	4	39	11	-	-	-	-
Hydrobaenus	-	-	-	-	-	-	11	-	-	-
Hydrosmittia	-	-	-	-	-	-	-	4	4	-
Krenosmittia	7	4	4	-	-	11	7	22	7	7
Limnophyes	-	-	-	-	-	-	-	-	-	-
Orthocladius (Euorthocladius)	18	4	7	-	-	18	11	4	-	-
Parakiefferiella	-	-	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-

Table F.54: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River GO-09 and GO-03 Study Areas, August 2017

Taxa / Study Area / Replicate Station	GO-09 Reference Area B1	B2	B3	B4	B5	GO-03 Upstream of Mine B1	B2	B3	B4	B5
Paraphaenocladius	-	-	-	-	-	-	-	-	-	-
Thienemanniella	-	-	-	-	7	-	-	-	-	-
Tokunagaia	7	4	7	11	47	32	14	25	4	7
Tvetenia	-	-	-	-	7	-	-	4	4	7
indeterminate	-	-	-	-	-	-	-	-	-	-
S.F. Podonominae										
Trichotanypus	-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Thienemannimyia complex	-	-	-	-	-	-	-	-	-	-
F. Empididae										
Hemerodromia	-	-	-	-	-	-	-	-	-	-
F. Simuliidae										
Gymnopais	32	39	32	32	47	25	7	29	4	14
Metacnephia	11	-	7	-	18	25	7	4	4	-
Prosimulium	18	7	11	-	151	61	22	29	4	-
pupae	-	-	-	-	-	-	-	-	-	-
F. Tipulidae										
Tipula	4	4	11	-	7	18	11	7	-	4
Number of Organisms (No. organisms per m²)	334	179	334	245	958	489	266	420	154	82
Richness (total number of taxa)[a]	12	13	12	6	13	16	16	17	11	8
Simpson's Evenness (E)	0.729	0.892	0.694	0.678	0.854	0.938	0.939	0.909	0.621	0.960
Bray-Curtis Index	0.082	0.400	0.050	0.133	0.536	0.387	0.488	0.351	0.437	0.653
Percent Composition										
% Nemata	0.0%	2.2%	0.0%	0.0%	0.4%	2.2%	1.5%	2.6%	0.0%	0.0%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Hydracarina	0.0%	0.0%	0.0%	0.0%	0.0%	4.5%	2.6%	2.6%	0.0%	0.0%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%	0.0%	0.0%	0.0%	5.9%	4.1%	4.3%	0.0%	0.0%
% Chironomids	80.5%	69.8%	81.7%	86.9%	76.3%	60.9%	74.1%	74.0%	89.6%	78.0%
% Metal Sensitive Chironmids	59.9%	38.5%	66.8%	73.9%	59.3%	36.8%	41.7%	43.1%	68.8%	43.9%
% Simuliidae	18.3%	25.7%	15.0%	13.1%	22.5%	22.7%	13.5%	14.8%	7.8%	17.1%
% Tipulidae	1.2%	2.2%	3.3%	0.0%	0.7%	3.7%	4.1%	1.7%	0.0%	4.9%
Functional Feeding Group Composition										
% Collector - Gatherers	75.7%	65.4%	77.5%	82.9%	71.3%	61.8%	74.1%	67.6%	89.6%	78.0%
% Filterers	18.3%	25.7%	15.0%	13.1%	22.5%	22.7%	13.5%	14.8%	7.8%	17.1%
% Shredders	4.2%	8.9%	7.5%	4.1%	4.5%	8.6%	6.0%	6.2%	2.6%	4.9%
Habitat Preference Group Composition										
% Clingers	21.3%	32.4%	19.2%	17.1%	26.3%	32.1%	18.0%	21.9%	7.8%	17.1%
% Sprawlers	75.7%	63.1%	77.5%	82.9%	70.9%	59.5%	72.6%	65.0%	92.2%	78.0%
% Burrowers	3.0%	4.5%	3.3%	0.0%	2.8%	8.4%	9.4%	13.1%	0.0%	4.9%

[a] Bold entries excluded from taxa count

Table F.55: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River EO-01 and EO-20 Study Areas, August 2017

Taxa	Study Area	EO-01 Mine-Exposed Area					EO-20 Mine-Exposed Area				
	Replicate Station	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
ROUNDWORMS											
P. Nemata		-	-	4	-	-	-	50	-	-	-
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		-	-	-	-	-	4	18	-	-	-
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina											
F. Sperchonidae											
Sperchon		-	4	-	4	11	7	54	4	-	4
SEED SHRIMPS											
Cl. Ostracoda		-	-	-	-	-	-	-	-	-	-
INSECTS											
Cl. Insecta											
MAYFLIES											
O. Ephemeroptera											
F. Baetidae											
Acentrella feropagus		-	-	14	4	18	11	14	7	-	-
STONEFLIES											
O. Plecoptera											
F. Capniidae											
immature		-	-	-	-	-	-	-	-	-	-
TRUE FLIES											
O. Diptera											
MIDGES											
F. Chironomidae											
chironomid pupae		**-**	**18**	**18**	**11**	**29**	**18**	**43**	**7**	**4**	**7**
S.F. Chironominae											
Stictochironomus		-	-	-	-	-	-	-	-	-	-
S.F. Diamesinae											
Diamesa		4	7	22	22	54	22	179	7	-	18
Pseudokiefferiella		-	4	-	14	36	11	804	4	4	-
S.F. Orthocladiinae											
Chaetocladius		-	-	-	4	-	-	-	4	-	-
Cardiocladius		-	-	4	-	-	-	54	4	-	-
Corynoneura		-	-	-	-	-	-	-	-	-	-
Cricotopus		-	-	-	-	18	-	126	-	-	-
Cricotopus/Orthocladius		-	-	-	-	11	4	-	-	4	-
Diplocladius		-	-	-	4	-	-	-	-	-	-
Eukiefferiella		-	-	7	11	39	7	18	-	-	4
Hydrobaenus		-	4	-	4	-	4	-	-	-	-
Hydrosmittia		-	-	-	4	-	-	7	-	-	-
Krenosmittia		-	32	7	18	4	4	-	11	14	7

Table F.55: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River EO-01 and EO-20 Study Areas, August 2017

Taxa — Study Area	EO-01 Mine-Exposed Area					EO-20 Mine-Exposed Area				
Replicate Station	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Limnophyes	-	4	-	-	-	-	-	-	-	-
Orthocladius (Euorthocladius)	-	4	4	-	25	7	11	4	4	-
Parakiefferiella	-	-	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	4	-	-	-	-	-
Paraphaenocladius	-	-	-	-	-	-	-	-	-	-
Thienemanniella	4	-	-	-	4	14	-	-	4	-
Tokunagaia	-	-	7	4	18	7	7	4	4	-
Tvetenia	-	7	4	4	7	4	18	-	-	-
indeterminate	-	-	4	-	-	-	-	-	-	-
S.F. Podonominae										
Trichotanypus	-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae										
Thienemannimyia complex	-	-	-	-	-	-	-	-	4	-
F. Empididae										
Hemerodromia	-	-	-	-	-	-	4	-	-	-
F. Simuliidae										
Gymnopais	4	11	7	4	7	14	65	11	-	4
Metacnephia	-	-	-	-	4	4	43	4	-	4
Prosimulium	-	-	-	11	7	11	25	7	7	-
pupae	-	-	-	-	-	-	7	-	-	-
F. Tipulidae										
Tipula	-	-	-	-	4	7	22	-	-	4
Number of Organisms (No. organisms per m^2)	12	95	102	123	300	160	1,569	78	49	52
Richness (total number of taxa)[a]	3	9	10	14	17	17	18	12	8	7
Simpson's Evenness (E)	1.000	0.855	0.945	0.955	0.947	0.977	0.731	0.983	0.932	0.884
Bray-Curtis Index	0.949	0.825	0.675	0.653	0.510	0.543	0.694	0.738	0.836	0.753
Percent Composition										
% Nemata	0.0%	0.0%	3.9%	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%	0.0%
% Oligochaeta	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%	1.1%	0.0%	0.0%	0.0%
% Hydracarina	0.0%	4.2%	0.0%	3.3%	3.7%	4.4%	3.4%	5.1%	0.0%	7.7%
% Ostracods	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Ephemeroptera	0.0%	0.0%	13.7%	3.3%	6.0%	6.9%	0.9%	9.0%	0.0%	0.0%
% Chironomids	66.7%	84.2%	75.5%	81.3%	83.0%	63.8%	80.8%	57.7%	85.7%	69.2%
% Metal Sensitive Chironmids	33.3%	14.7%	29.4%	33.3%	34.0%	25.0%	64.8%	16.7%	8.2%	42.3%
% Simuliidae	33.3%	11.6%	6.9%	12.2%	6.0%	18.1%	8.9%	28.2%	14.3%	15.4%
% Tipulidae	0.0%	0.0%	0.0%	0.0%	1.3%	4.4%	1.4%	0.0%	0.0%	7.7%
Functional Feeding Group Composition										
% Collector - Gatherers	66.7%	84.2%	88.2%	84.6%	78.0%	70.0%	74.1%	60.3%	67.3%	69.2%
% Filterers	33.3%	11.6%	6.9%	12.2%	6.0%	18.1%	8.9%	28.2%	14.3%	15.4%
% Shredders	0.0%	0.0%	0.0%	0.0%	12.3%	7.5%	9.7%	0.0%	10.2%	7.7%
Habitat Preference Group Composition										
% Clingers	33.3%	15.8%	6.9%	15.4%	20.7%	25.6%	20.9%	33.3%	24.5%	23.1%
% Sprawlers	66.7%	84.2%	84.3%	84.6%	78.0%	67.5%	69.8%	60.3%	75.5%	69.2%
% Burrowers	0.0%	0.0%	8.8%	0.0%	1.3%	6.9%	9.3%	6.4%	0.0%	7.7%

[a] Bold entries excluded from taxa count

Table F.56: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River Study Area CO-05, August 2017

Taxa	Study Area / Replicate Station	CO-05 Downstream Mine-Exposed Area				
		B1	B2	B3	B4	B5
ROUNDWORMS						
P. Nemata		4	22	79	14	22
ANNELIDS						
P. Annelida						
WORMS						
Cl. Oligochaeta						
F. Enchytraeidae		-	7	14	-	22
ARTHROPODS						
P. Arthropoda						
MITES						
Cl. Arachnida						
O. Acarina						
F. Sperchonidae						
Sperchon		43	47	22	4	36
SEED SHRIMPS						
Cl. Ostracoda		4	-	11	-	-
INSECTS						
Cl. Insecta						
MAYFLIES						
O. Ephemeroptera						
F. Baetidae						
Acentrella feropagus		72	57	147	47	72
STONEFLIES						
O. Plecoptera						
F. Capniidae						
immature		-	-	-	-	-
TRUE FLIES						
O. Diptera						
MIDGES						
F. Chironomidae						
chironomid pupae		**43**	**72**	**43**	**25**	**32**
S.F. Chironominae						
Stictochironomus		-	4	-	-	11
S.F. Diamesinae						
Diamesa		-	14	22	14	-
Pseudokiefferiella		14	341	653	334	1,396
S.F. Orthocladiinae						
Chaetocladius		-	4	-	-	-
Cardiocladius		32	93	22	43	14
Corynoneura		-	-	-	-	-
Cricotopus		4	18	83	22	11
Cricotopus/Orthocladius		4	29	83	22	65
Diplocladius		-	-	-	-	11
Eukiefferiella		-	7	22	-	-
Hydrobaenus		11	4	25	-	4
Hydrosmittia		4	4	54	7	7
Krenosmittia		7	4	-	7	7

Table F.56: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary River Study Area CO-05, August 2017

Taxa — Study Area / Replicate Station	CO-05 Downstream Mine-Exposed Area				
	B1	B2	B3	B4	B5
Limnophyes	-	-	4	7	4
Orthocladius (Euorthocladius)	18	4	-	7	14
Parakiefferiella	-	-	11	-	4
Parametriocnemus	-	7	-	-	-
Paraphaenocladius	-	7	4	-	7
Thienemanniella	7	18	22	7	22
Tokunagaia	7	7	-	14	-
Tvetenia	22	18	50	36	36
indeterminate	-	4	11	-	-
S.F. Podonominae					
Trichotanypus	4	-	-	-	-
S.F. Tanypodinae					
Thienemannimyia complex	-	11	-	-	7
F. Empididae					
Hemerodromia	-	-	-	-	-
F. Simuliidae					
Gymnopais	11	25	18	11	32
Metacnephia	14	118	39	72	54
Prosimulium	22	283	147	140	147
pupae	-	-	-	-	-
F. Tipulidae					
Tipula	14	7	11	-	7
Number of Organisms (No. organisms per m^2)	361	1,236	1,597	833	2,044
Richness (total number of taxa)[a]	20	26	22	18	24
Simpson's Evenness (E)	0.954	0.862	0.826	0.822	0.527
Bray-Curtis Index	0.765	0.840	0.886	0.824	0.914
Percent Composition					
% Nemata	1.1%	1.8%	4.9%	1.7%	1.1%
% Oligochaeta	0.0%	0.6%	0.9%	0.0%	1.1%
% Hydracarina	11.9%	3.8%	1.4%	0.5%	1.8%
% Ostracods	1.1%	0.0%	0.7%	0.0%	0.0%
% Ephemeroptera	19.9%	4.6%	9.2%	5.6%	3.5%
% Chironomids	49.0%	54.2%	69.4%	65.4%	80.8%
% Metal Sensitive Chironmids	5.3%	32.2%	44.0%	43.8%	69.7%
% Simuliidae	13.0%	34.5%	12.8%	26.8%	11.4%
% Tipulidae	3.9%	0.6%	0.7%	0.0%	0.3%
Functional Feeding Group Composition					
% Collector - Gatherers	56.5%	47.1%	72.4%	61.8%	81.7%
% Filterers	13.0%	34.9%	12.8%	26.8%	11.9%
% Shredders	6.9%	4.9%	12.0%	5.5%	4.2%
Habitat Preference Group Composition					
% Clingers	28.0%	42.6%	25.4%	32.8%	17.0%
% Sprawlers	55.4%	45.7%	66.6%	60.1%	79.8%
% Burrowers	16.6%	12.1%	8.0%	7.1%	3.7%

[a] Bold entries excluded from taxa count

Table F.57: Benthic Invertebrate Community Summary Statistics for Mary River, Mary River Project CREMP, August 2017

Metric	Area	Mean	Standard Deviation	Standard Error	95% Confidence Interval		Minimum	Maximum
					Lower Bound	Upper Bound		
Density (no. organisms / m^2)	GO-09 Reference Area	410	313	140	21	799	179	958
	GO-03 Upstream Area	282	172	77	68	496	82	489
	EO-01 Upper Mine-Exposed Area	126	106	47	-5	258	12	300
	EO-20 Middle Mine-Exposed Area	382	665	298	-444	1,208	49	1,569
	CO-05 Lower Mine-Exposed Area	1,214	654	292	403	2,026	361	2,044
Richness (Number of Taxa)	GO-09 Reference Area	11.2	2.9	1.3	7.5	14.9	6.0	13.0
	GO-03 Upstream Area	13.6	3.9	1.7	8.7	18.5	8.0	17.0
	EO-01 Upper Mine-Exposed Area	10.6	5.3	2.4	4.0	17.2	3.0	17.0
	EO-20 Middle Mine-Exposed Area	12.4	5.0	2.2	6.2	18.6	7.0	18.0
	CO-05 Lower Mine-Exposed Area	22.0	3.2	1.4	18.1	25.9	18.0	26.0
Simpson's Evenness	GO-09 Reference Area	0.770	0.097	0.044	0.649	0.891	0.678	0.892
	GO-03 Upstream Area	0.873	0.142	0.064	0.697	1.050	0.621	0.960
	EO-01 Upper Mine-Exposed Area	0.940	0.053	0.023	0.875	1.006	0.855	1.000
	EO-20 Middle Mine-Exposed Area	0.902	0.103	0.046	0.774	1.030	0.731	0.983
	CO-05 Lower Mine-Exposed Area	0.798	0.161	0.072	0.599	0.998	0.527	0.954
Bray-Curtis Index	GO-09 Reference Area	0.240	0.215	0.096	-0.027	0.507	0.050	0.536
	GO-03 Upstream Area	0.463	0.118	0.053	0.317	0.610	0.351	0.653
	EO-01 Upper Mine-Exposed Area	0.722	0.169	0.076	0.513	0.932	0.510	0.949
	EO-20 Middle Mine-Exposed Area	0.713	0.108	0.048	0.579	0.847	0.543	0.836
	CO-05 Lower Mine-Exposed Area	0.846	0.058	0.026	0.775	0.918	0.765	0.914
Ephemeroptera (% of community)	GO-09 Reference Area	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	GO-03 Upstream Area	2.9%	2.7%	1.2%	-0.5%	6.2%	0.0%	5.9%
	EO-01 Upper Mine-Exposed Area	4.6%	5.7%	2.5%	-2.4%	11.6%	0.0%	13.7%
	EO-20 Middle Mine-Exposed Area	3.4%	4.3%	1.9%	-1.9%	8.7%	0.0%	9.0%
	CO-05 Lower Mine-Exposed Area	8.6%	6.7%	3.0%	0.3%	16.9%	3.5%	19.9%
Chironomidae (% of community)	GO-09 Reference Area	79.0%	6.4%	2.9%	71.1%	87.0%	69.8%	86.9%
	GO-03 Upstream Area	75.3%	10.3%	4.6%	62.6%	88.1%	60.9%	89.6%
	EO-01 Upper Mine-Exposed Area	78.1%	7.2%	3.2%	69.2%	87.1%	66.7%	84.2%
	EO-20 Middle Mine-Exposed Area	71.4%	11.7%	5.2%	57.0%	85.9%	57.7%	85.7%
	CO-05 Lower Mine-Exposed Area	63.8%	12.6%	5.6%	48.1%	79.4%	49.0%	80.8%
Metal-Sensitive Chironomidae (% of community)	GO-09 Reference Area	59.7%	13.2%	5.9%	43.2%	76.1%	38.5%	73.9%
	GO-03 Upstream Area	46.9%	12.6%	5.6%	31.3%	62.5%	36.8%	68.8%
	EO-01 Upper Mine-Exposed Area	28.9%	8.2%	3.7%	18.8%	39.1%	14.7%	34.0%
	EO-20 Middle Mine-Exposed Area	31.4%	22.5%	10.1%	3.4%	59.4%	8.2%	64.8%
	CO-05 Lower Mine-Exposed Area	39.0%	23.3%	10.4%	10.1%	67.9%	5.3%	69.7%
Simuliidae (% of community)	GO-09 Reference Area	18.9%	5.2%	2.3%	12.5%	25.4%	13.1%	25.7%
	GO-03 Upstream Area	15.2%	5.4%	2.4%	8.4%	21.9%	7.8%	22.7%
	EO-01 Upper Mine-Exposed Area	14.0%	11.1%	5.0%	0.2%	27.8%	6.0%	33.3%
	EO-20 Middle Mine-Exposed Area	17.0%	7.1%	3.2%	8.2%	25.8%	8.9%	28.2%
	CO-05 Lower Mine-Exposed Area	19.7%	10.4%	4.6%	6.8%	32.6%	11.4%	34.5%
Collector-Gatherer FFG (% of community)	GO-09 Reference Area	74.6%	6.6%	2.9%	66.4%	82.8%	65.4%	82.9%
	GO-03 Upstream Area	74.2%	10.6%	4.7%	61.1%	87.4%	61.8%	89.6%
	EO-01 Upper Mine-Exposed Area	80.3%	8.5%	3.8%	69.8%	90.8%	66.7%	88.2%
	EO-20 Middle Mine-Exposed Area	68.2%	5.1%	2.3%	61.9%	74.5%	60.3%	74.1%
	CO-05 Lower Mine-Exposed Area	63.9%	13.5%	6.0%	47.1%	80.7%	47.1%	81.7%
Filterer FFG (% of community)	GO-09 Reference Area	18.9%	5.2%	2.3%	12.5%	25.4%	13.1%	25.7%
	GO-03 Upstream Area	15.2%	5.4%	2.4%	8.4%	21.9%	7.8%	22.7%
	EO-01 Upper Mine-Exposed Area	14.0%	11.1%	5.0%	0.2%	27.8%	6.0%	33.3%
	EO-20 Middle Mine-Exposed Area	17.0%	7.1%	3.2%	8.2%	25.8%	8.9%	28.2%
	CO-05 Lower Mine-Exposed Area	19.9%	10.4%	4.7%	6.9%	32.8%	11.9%	34.9%
Shredder FFG (% of community)	GO-09 Reference Area	5.8%	2.2%	1.0%	3.1%	8.6%	4.1%	8.9%
	GO-03 Upstream Area	5.7%	2.2%	1.0%	3.0%	8.4%	2.6%	8.6%
	EO-01 Upper Mine-Exposed Area	2.5%	5.5%	2.5%	-4.4%	9.3%	0.0%	12.3%
	EO-20 Middle Mine-Exposed Area	7.0%	4.1%	1.8%	1.9%	12.1%	0.0%	10.2%
	CO-05 Lower Mine-Exposed Area	6.7%	3.1%	1.4%	2.8%	10.6%	4.2%	12.0%
Clinger HPG (% of community)	GO-09 Reference Area	23.3%	6.1%	2.7%	15.6%	30.9%	17.1%	32.4%
	GO-03 Upstream Area	19.4%	8.8%	3.9%	8.5%	30.3%	7.8%	32.1%
	EO-01 Upper Mine-Exposed Area	18.4%	9.7%	4.3%	6.4%	30.4%	6.9%	33.3%
	EO-20 Middle Mine-Exposed Area	25.5%	4.7%	2.1%	19.6%	31.3%	20.9%	33.3%
	CO-05 Lower Mine-Exposed Area	29.2%	9.5%	4.2%	17.4%	40.9%	17.0%	42.6%
Sprawler HPG (% of community)	GO-09 Reference Area	74.0%	7.5%	3.3%	64.8%	83.3%	63.1%	82.9%
	GO-03 Upstream Area	73.5%	12.6%	5.7%	57.8%	89.2%	59.5%	92.2%
	EO-01 Upper Mine-Exposed Area	79.6%	7.7%	3.4%	70.0%	89.1%	66.7%	84.6%
	EO-20 Middle Mine-Exposed Area	68.5%	5.5%	2.4%	61.7%	75.2%	60.3%	75.5%
	CO-05 Lower Mine-Exposed Area	61.5%	12.7%	5.7%	45.7%	77.3%	45.7%	79.8%
Burrower HPG (% of community)	GO-09 Reference Area	2.7%	1.7%	0.7%	0.7%	4.8%	0.0%	4.5%
	GO-03 Upstream Area	7.2%	5.0%	2.2%	1.0%	13.3%	0.0%	13.1%
	EO-01 Upper Mine-Exposed Area	2.0%	3.8%	1.7%	-2.7%	6.8%	0.0%	8.8%
	EO-20 Middle Mine-Exposed Area	6.1%	3.6%	1.6%	1.6%	10.5%	0.0%	9.3%
	CO-05 Lower Mine-Exposed Area	9.5%	5.0%	2.2%	3.3%	15.7%	3.7%	16.6%

Table F.58: Benthic Invertebrate Community Metric Statistical Comparison Results among Mary River Reference (GO-09), Upstream (GO-03) and Mine-Exposed (EO-01, EO-20, CO-05) Study Areas, Mary River Project CREMP, August 2017

Metric	Data Transform-ation	Overall 5-Area Comparison		Pair-wise, post-hoc comparisons[a]				
		Significant Difference Among Areas?	P-value	Area	Mean	Standard Deviation	Effect Size vs. GO-09 Reference	Pairwise Comparison
Density (No. per m²)	log	YES	0.0077	GO-09 Ref	410	313	-	a,b
				GO-03	282	172	-0.4	a,b
				EO-01	126	106	-0.9	a
				EO-20	382	665	-0.1	a
				CO-05	1,214	654	2.6	b
Richness (No. of Taxa)	none	YES	0.0022	GO-09 Ref	11.2	2.9	-	a
				GO-03	13.6	3.9	0.8	a
				EO-01	10.6	5.3	-0.2	a
				EO-20	12.4	5.0	0.4	a
				CO-05	22.0	3.2	3.7	b
Simpson's Evenness	log	NO	0.2131	GO-09 Ref	0.770	0.097	-	a
				GO-03	0.873	0.142	1.1	a
				EO-01	0.940	0.053	1.8	a
				EO-20	0.902	0.103	1.4	a
				CO-05	0.798	0.161	0.3	a
Bray-Curtis Index	none	YES	< 0.001	GO-09 Ref	0.240	0.215	-	a
				GO-03	0.463	0.118	1.0	a
				EO-01	0.722	0.169	2.2	b
				EO-20	0.713	0.108	2.2	b
				CO-05	0.846	0.058	2.8	b
Ephemeroptera (% of community)	square root	YES	0.0272	GO-09 Ref	0.0	0.0	-	a
				GO-03	2.9	2.7	nc	a,b
				EO-01	4.6	5.7	nc	a,b
				EO-20	3.4	4.3	nc	a,b
				CO-05	8.6	6.7	nc	b
Chironomidae (% of community)	log	NO	0.1168	GO-09 Ref	79.0	6.4	-	a
				GO-03	75.3	10.3	-0.6	a
				EO-01	78.1	7.2	-0.1	a
				EO-20	71.4	11.7	-1.2	a
				CO-05	63.8	12.6	-2.4	a
Metal Sensitive Chironomidae (% of community)	none	YES	0.0608	GO-09 Ref	59.7	13.2	-	a
				GO-03	46.9	12.6	-1.0	a,b
				EO-01	28.9	8.2	-2.3	b
				EO-20	31.4	22.5	-2.1	a,b
				CO-05	39.0	23.3	-1.6	a,b
Simuliidae (% of community)	log	NO	0.5293	GO-09 Ref	18.9	5.2	-	a
				GO-03	15.2	5.4	-0.7	a
				EO-01	14.0	11.1	-0.9	a
				EO-20	17.0	7.1	-0.4	a
				CO-05	19.7	10.4	0.1	a
Tipulidae (% of community)	log (X+1)	NO	0.2086	GO-09 Ref	1.5	1.3	-	a
				GO-03	2.9	2.0	1.1	a
				EO-01	0.3	0.6	-0.9	a
				EO-20	2.7	3.3	0.9	a
				CO-05	1.1	1.6	-0.3	a
Collector-Gatherer FFG (% of community)	square root	YES	0.0925	GO-09 Ref	74.6	6.6	-	a,b
				GO-03	74.2	10.6	-0.1	a,b
				EO-01	80.3	8.5	0.9	a
				EO-20	68.2	5.1	-1.0	a,b
				CO-05	63.9	13.5	-1.6	b
Filterer FFG (% of community)	log	NO	0.5154	GO-09 Ref	18.9	5.2	-	a
				GO-03	15.2	5.4	-0.7	a
				EO-01	14.0	11.1	-0.9	a
				EO-20	17.0	7.1	-0.4	a
				CO-05	19.9	10.4	0.2	a
Shredder FFG (% of community)	none	NO	0.3312	GO-09 Ref	5.8	2.2	-	a
				GO-03	5.7	2.2	-0.1	a
				EO-01	2.5	5.5	-1.5	a
				EO-20	7.0	4.1	0.5	a
				CO-05	6.7	3.1	0.4	a
Clinger HPG (% of community)	square root	NO	0.2122	GO-09 Ref	23.3	6.1	-	a
				GO-03	19.4	8.8	-0.6	a
				EO-01	18.4	9.7	-0.8	a
				EO-20	25.5	4.7	0.4	a
				CO-05	29.2	9.5	1.0	a
Sprawler HPG (% of community)	log	YES	0.0692	GO-09 Ref	74.0	7.5	-	a,b
				GO-03	73.5	12.6	-0.1	a,b
				EO-01	79.6	7.7	0.7	a
				EO-20	68.5	5.5	-0.7	a,b
				CO-05	61.5	12.7	-1.7	b
Burrower HPG (% of community)	none	YES	0.0411	GO-09 Ref	2.7	1.7	-	a
				GO-03	7.2	5.0	2.7	a,b
				EO-01	2.0	3.8	-0.4	a
				EO-20	6.1	3.6	2.0	a,b
				CO-05	9.5	5.0	4.1	b

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoin

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.59: Statistical Comparison of Benthic Metrics at Mary River Reference Area Stations (GO-09) Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2006, 2007) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 5-Year Comparison		Pair-wise, post-hoc comparisons[a]							
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size		Pairwise Comparison	Statistical Test
								vs. Baseline Year 2006	vs. Baseline Year 2007		
Density (No. per m^2)	log	NO	0.2340	2006	3	403	149	-	-4.0	a	Tukey's HSD
				2007	3	739	84	2.3	-	a	
				2015	5	472	255	0.5	-3.2	a	
				2016	5	662	320	1.7	-0.9	a	
				2017	5	410	313	0.0	-3.9	a	
Richness (No. of Taxa)	log	YES	0.0342	2006	3	7.3	2.9	-	-10.4	a	Tukey's HSD
				2007	3	13.3	0.6	2.1	-	b	
				2015	5	11.4	3.2	1.4	-3.3	a,b	
				2016	5	14.0	1.6	2.3	1.2	b	
				2017	5	11.2	2.9	1.3	-3.7	a,b	
Simpson's Evenness	none	YES	0.0000	2006	3	0.324	0.095	-	-8.5	a	Tamhane's
				2007	3	0.655	0.039	3.5	-	a,c	
				2015	5	0.878	0.049	5.8	5.7	b	
				2016	5	0.907	0.023	6.1	6.5	b	
				2017	5	0.770	0.097	4.7	3.0	b,c	
Nemata (% of community)	modified probit	NO	0.5292	2006	3	0.6%	0.5%	-	1.4	a	Tukey's HSD
				2007	3	0.4%	0.1%	-0.3	-	a	
				2015	5	0.3%	0.4%	-0.6	-1.2	a	
				2016	5	1.7%	1.2%	2.0	10.6	a	
				2017	5	0.5%	1.0%	-0.1	0.8	a	
Oligochaeta (% of community)	modified probit	YES	0.0648	2006	3	0.0%	0.0%	-	-0.6	a	Tamhane's
				2007	3	0.1%	0.2%	nc	-	a	
				2015	5	0.8%	1.0%	nc	3.7	a	
				2016	5	0.0%	0.0%	nc	-0.6	a	
				2017	5	0.0%	0.0%	nc	-0.6	a	
Hydracarina (% of community)	modified probit	YES	0.0000	2006	3	0.5%	0.9%	-	0.2	a,b	Tamhane's
				2007	3	0.4%	0.4%	-0.1	-	a,b	
				2015	5	4.1%	3.0%	4.2	9.4	a	
				2016	5	4.8%	2.1%	5.0	11.1	a	
				2017	5	0.0%	0.0%	-0.6	-1.1	b	
Chironomidae (% of community)	modified probit	YES	0.0000	2006	3	98.7%	0.8%	-	0.9	a	Tukey's HSD
				2007	3	97.4%	1.4%	-1.5	-	a	
				2015	5	88.1%	2.8%	-13.0	-6.7	b	
				2016	5	84.2%	4.6%	-17.9	-9.5	b	
				2017	5	79.1%	6.4%	-24.3	-13.2	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0002	2006	3	62.1%	3.7%	-	1.8	a	Tukey's HSD
				2007	3	31.2%	17.4%	-8.4	-	a,b	
				2015	5	12.8%	14.0%	-13.4	-1.1	b	
				2016	5	23.4%	12.3%	-10.6	-0.5	b	
				2017	5	59.7%	13.2%	-0.7	1.6	a	
Tipulidae (% of community)	modified probit	NO	0.1209	2006	3	0.2%	0.4%	-	-0.7	a	Tukey's HSD
				2007	3	1.5%	1.8%	3.1	-	a	
				2015	5	4.6%	2.9%	10.5	1.7	a	
				2016	5	1.9%	1.6%	4.1	0.2	a	
				2017	5	1.5%	1.3%	3.1	0.0	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0000	2006	3	98.7%	1.2%	-	3.6	a	Tukey's HSD
				2007	3	94.6%	1.1%	-3.4	-	a	
				2015	5	78.0%	12.1%	-17.4	-14.7	b	
				2016	5	75.4%	9.1%	-19.6	-17.1	b	
				2017	5	74.6%	6.6%	-20.3	-17.8	b	
Filterer FFG (% of community)	modified probit	NO	0.1210	2006	3	0.1%	0.2%	-	-0.3	a	Tamhane's
				2007	3	0.2%	0.1%	0.2	-	a	
				2015	5	1.9%	1.9%	8.6	11.7	a	
				2016	5	7.3%	4.3%	35.1	48.6	a	
				2017	5	18.9%	5.2%	91.4	127.3	a	
Shredder FFG (% of community)	modified probit	YES	0.0001	2006	3	0.2%	0.4%	-	-10.8	a	Tukey's HSD
				2007	3	4.2%	0.4%	9.6	-	b	
				2015	5	16.0%	11.2%	38.3	32.4	b	
				2016	5	12.0%	3.7%	28.7	21.5	b	
				2017	5	5.8%	2.2%	13.6	4.5	b	

(grey box) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue box) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.60: Statistical Comparison of Benthic Metrics at Mary River Upstream Study Area (GO-03) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	NO	0.2293	2007	3	136	29	-	a	Tamhane's
				2015	5	169	122	1.1	a	
				2016	5	287	92	5.1	a	
				2017	5	282	172	5.0	a	
Richness (No. of Taxa)	log	YES	0.0105	2007	3	6.3	1.2	-	a	Tukey's HSD
				2015	5	9.4	3.5	2.7	a,b	
				2016	5	14.4	1.8	7.0	b	
				2017	5	13.6	3.9	6.3	b	
Simpson's Evenness	none	YES	0.0004	2007	3	0.591	0.003	-	a	Tukey's HSD
				2015	5	0.921	0.045	126.1	b	
				2016	5	0.899	0.041	117.5	b	
				2017	5	0.873	0.142	107.8	b	
Nemata (% of community)	modified probit	YES	0.0008	2007	3	0.0%	0.0%	-	a	Tukey's HSD
				2015	5	0.0%	0.0%	nc	a	
				2016	5	2.6%	0.7%	nc	b	
				2017	5	1.3%	1.2%	nc	a,b	
Hydracarina (% of community)	modified probit	YES	0.0011	2007	3	0.6%	1.1%	-	a,b	Tamhane's
				2015	5	7.0%	2.5%	5.7	a,b	
				2016	5	9.8%	4.6%	8.2	a	
				2017	5	1.9%	1.9%	1.2	b	
Chironomidae (% of community)	modified probit	YES	0.0000	2007	3	97.2%	0.9%	-	a	Tukey's HSD
				2015	5	72.2%	8.8%	-27.2	b	
				2016	5	77.6%	7.3%	-21.4	b	
				2017	5	75.3%	10.3%	-23.8	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0005	2007	3	5.4%	1.1%	-	a	Tukey's HSD
				2015	5	8.2%	5.0%	2.4	a	
				2016	5	8.8%	5.9%	3.0	a	
				2017	5	46.9%	12.6%	36.1	b	
Tipulidae (% of community)	modified probit	YES	0.0092	2007	3	2.2%	1.9%	-	a	Tukey's HSD
				2015	5	19.0%	6.2%	8.6	b	
				2016	5	8.5%	7.0%	3.2	a,b	
				2017	5	2.9%	2.0%	0.4	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0000	2007	3	94.4%	1.9%	-	a	Tamhane's
				2015	5	60.7%	9.5%	-17.7	b	
				2016	5	64.0%	6.1%	-16.0	b	
				2017	5	74.2%	10.6%	-10.6	b	
Filterer FFG (% of community)	modified probit	YES	0.0001	2007	3	0.0%	0.0%	-	a	Tamhane's
				2015	5	1.0%	1.6%	nc	a	
				2016	5	0.6%	0.9%	nc	a	
				2017	5	15.2%	5.4%	nc	b	
Shredder FFG (% of community)	modified probit	YES	0.0000	2007	3	5.0%	0.9%	-	a	Tukey's HSD
				2015	5	29.8%	8.7%	28.9	b	
				2016	5	20.7%	5.5%	18.3	b	
				2017	5	5.7%	2.2%	0.8	a	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.61: Statistical Comparison of Benthic Metrics at Mary River Upper Mine-Exposed Area (EO-01) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0133	2007	3	797	648	-	a	Tamhane's
				2015	5	116	97	-1.1	a	
				2016	5	230	109	-0.9	a	
				2017	5	126	106	-1.0	a	
Richness (No. of Taxa)	none	NO	0.1418	2007	3	16.3	8.1	-	a	Tukey's HSD
				2015	5	7.8	2.7	-1.0	a	
				2016	5	13.2	4.1	-0.4	a	
				2017	5	10.6	5.3	-0.7	a	
Simpson's Evenness	none	YES	0.0016	2007	3	0.698	0.059	-	a	Tukey's HSD
				2015	5	0.873	0.095	3.0	b	
				2016	5	0.865	0.037	2.8	b	
				2017	5	0.940	0.053	4.1	b	
Nemata (% of community)	modified probit	NO	0.7456	2007	3	2.8%	3.2%	-	a	Tukey's HSD
				2015	5	1.3%	2.8%	-0.5	a	
				2016	5	2.0%	1.4%	-0.3	a	
				2017	5	0.8%	1.8%	-0.6	a	
Hydracarina (% of community)	modified probit	YES	0.0982	2007	3	1.9%	3.3%	-	a	Tukey's HSD
				2015	5	2.1%	3.0%	0.1	a,b	
				2016	5	7.2%	4.6%	1.6	b	
				2017	5	2.2%	2.1%	0.1	a,b	
Chironomidae (% of community)	modified probit	NO	0.1649	2007	3	89.1%	4.1%	-	a	Tukey's HSD
				2015	5	82.6%	6.0%	-1.6	b	
				2016	5	82.8%	7.2%	-1.5	b	
				2017	5	78.1%	7.2%	-2.7	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0862	2007	3	36.4%	32.0%	-	a,b	Tamhane's
				2015	5	6.5%	5.7%	-0.9	a	
				2016	5	5.7%	4.7%	-1.0	a,b	
				2017	5	29.0%	8.2%	-0.2	b	
Tipulidae (% of community)	modified probit	YES	0.0417	2007	3	3.4%	4.6%	-	a,b	Tukey's HSD
				2015	5	7.9%	5.5%	1.0	a	
				2016	5	3.2%	2.2%	0.0	a,b	
				2017	5	0.3%	0.6%	-0.7	b	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0229	2007	3	43.6%	26.6%	-	a	Tukey's HSD
				2015	5	71.4%	16.9%	1.0	b	
				2016	5	77.6%	6.8%	1.3	b	
				2017	5	80.3%	8.5%	1.4	b	
Filterer FFG (% of community)	modified probit	YES	0.0025	2007	3	35.8%	31.5%	-	a,b	Tamhane's
				2015	5	0.0%	0.0%	-1.1	a	
				2016	5	0.9%	0.8%	-1.1	a	
				2017	5	14.0%	11.2%	-0.7	b	
Shredder FFG (% of community)	modified probit	YES	0.0248	2007	3	8.2%	8.0%	-	a,b	Tukey's HSD
				2015	5	20.1%	18.3%	1.5	a	
				2016	5	8.2%	6.9%	0.0	a,b	
				2017	5	2.5%	5.5%	-0.7	b	

(grey box) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue box) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.62: Statistical Comparison of Benthic Metrics at Mary River Middle Mine-Exposed Area (EO-20) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2011) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0957	2011	3	854	348	-	a	Tukey's HSD
				2015	5	278	146	-1.7	a,b	
				2016	5	283	118	-1.6	a,b	
				2017	5	382	665	-1.4	b	
Richness (No. of Taxa)	log	NO	0.7012	2011	3	14.0	2.6	-	a	Tukey's HSD
				2015	5	11.6	2.2	-0.9	a	
				2016	5	13.6	3.1	-0.2	a	
				2017	5	12.4	5.0	-0.6	a	
Simpson's Evenness	none	YES	0.0047	2011	3	0.483	0.247	-	a	Tukey's HSD
				2015	5	0.726	0.140	1.0	a,b	
				2016	5	0.835	0.038	1.4	b	
				2017	5	0.902	0.103	1.7	b	
Nemata (% of community)	modified probit	NO	0.1835	2011	3	0.7%	0.6%	-	a	Tukey's HSD
				2015	5	0.2%	0.4%	-0.9	a	
				2016	5	1.4%	0.9%	1.1	a	
				2017	5	0.6%	1.4%	-0.1	a	
Hydracarina (% of community)	modified probit	YES	0.0073	2011	3	0.9%	0.7%	-	a	Tukey's HSD
				2015	5	3.8%	1.4%	4.1	b	
				2016	5	6.4%	3.0%	8.0	b	
				2017	5	4.1%	2.8%	4.6	b	
Chironomidae (% of community)	modified probit	YES	0.0029	2011	3	94.9%	4.6%	-	a	Tukey's HSD
				2015	5	87.4%	5.1%	-1.6	b	
				2016	5	86.2%	6.3%	-1.9	b	
				2017	5	71.4%	11.7%	-5.1	b	
Metal Sensitive Taxa (% of community)	modified probit	YES	0.0025	2011	3	3.1%	5.4%	-	a,b	Tamhane's
				2015	5	3.6%	2.0%	0.1	a	
				2016	5	4.3%	2.9%	0.2	a	
				2017	5	31.4%	22.5%	5.2	b	
Tipulidae (% of community)	modified probit	NO	0.5951	2011	3	1.9%	1.7%	-	a	Tukey's HSD
				2015	5	4.6%	2.4%	1.6	a	
				2016	5	4.3%	4.8%	1.4	a	
				2017	5	2.7%	3.3%	0.5	a	
Collector-Gatherer FFG (% of community)	none	YES	0.0000	2011	3	22.1%	15.9%	-	a	Tukey's HSD
				2015	5	77.1%	6.5%	3.5	b	
				2016	5	70.5%	7.5%	3.0	b	
				2017	5	68.2%	5.1%	2.9	b	
Filterer FFG (% of community)	modified probit	YES	0.0011	2011	3	3.1%	5.4%	-	a,b	Tamhane's
				2015	5	0.6%	1.0%	-0.5	a	
				2016	5	0.4%	0.8%	-0.5	a	
				2017	5	17.0%	7.1%	2.5	b	
Shredder FFG (% of community)	modified probit	NO	0.2972	2011	3	6.5%	7.4%	-	a	Tukey's HSD
				2015	5	13.0%	3.9%	0.9	a	
				2016	5	8.4%	5.3%	0.3	a	
				2017	5	7.0%	4.1%	0.1	a	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.63: Statistical Comparison of Benthic Metrics at Mary River Lower Mine-Exposed Area (CO-05) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007, 2011) for the Mary River Project CREMP

Metric	Data Transformation	Overall 5-Year Comparison: Significant Difference Among Years?	Overall 5-Year Comparison: P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size: vs. Baseline Year 2007	Effect Size: vs. Baseline Year 2011	Pairwise Comparison	Statistical Test
Density (No. per m^2)	none	YES	0.0144	2007	3	311	230	-	-0.4	a,b	Tukey's HSD
				2011	3	491	455	0.8	-	a,b	
				2015	5	234	168	-0.3	-0.6	a	
				2016	5	1,161	584	3.7	1.5	b	
				2017	5	1,214	654	3.9	1.6	b	
Richness (No. of Taxa)	none	YES	0.0008	2007	3	10.7	3.8	-	-2.1	a	Tukey's HSD
				2011	3	19.0	4.0	2.2	-	b,c	
				2015	5	13.2	2.7	0.7	-1.5	a,b	
				2016	5	19.6	3.3	2.4	0.2	c	
				2017	5	22.0	3.2	3.0	0.8	c	
Simpson's Evenness	none	YES	0.0136	2007	3	0.668	0.022	-	-2.7	a	Tukey's HSD
				2011	3	0.879	0.079	9.8	-	b	
				2015	5	0.923	0.038	11.8	0.6	b	
				2016	5	0.848	0.015	8.4	-0.4	b	
				2017	5	0.798	0.161	6.0	-1.0	a,b	
Nemata (% of community)	modified probit	YES	0.0313	2007	3	0.2%	0.4%	-	-1.9	a	Tukey's HSD
				2011	3	3.5%	1.7%	7.8	-	b	
				2015	5	3.2%	2.2%	7.1	-0.2	b	
				2016	5	1.5%	0.9%	3.1	-1.2	a,b	
				2017	5	2.1%	1.6%	4.5	-0.8	b	
Oligochaeta (% of community)	modified probit	YES	0.0002	2007	3	0.1%	0.2%	-	-3.6	a	Tamhane's
				2011	3	2.6%	0.7%	12.0	-	a	
				2015	5	10.1%	1.9%	48.0	10.7	b	
				2016	5	1.0%	1.1%	4.4	-2.3	a	
				2017	5	0.5%	0.5%	1.8	-3.0	a	
Hydracarina (% of community)	modified probit	YES	0.0526	2007	3	0.5%	0.4%	-	-0.4	a,b	Tukey's HSD
				2011	3	0.7%	0.5%	0.5	-	a	
				2015	5	2.3%	3.1%	4.4	3.3	a,b	
				2016	5	6.5%	2.5%	14.4	11.7	b	
				2017	5	3.9%	4.7%	8.2	6.4	a,b	
Chironomidae (% of community)	modified probit	YES	0.0000	2007	3	99.0%	0.8%	-	1.9	a	Tukey's HSD
				2011	3	90.0%	4.7%	-10.9	-	b	
				2015	5	78.1%	9.9%	-25.2	-2.5	c,d	
				2016	5	88.0%	3.2%	-13.4	-0.4	b,d	
				2017	5	63.8%	12.6%	-42.5	-5.6	c	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.2558	2007	3	37.2%	16.0%	-	2.1	a	Tukey's HSD
				2011	3	14.5%	10.5%	-1.4	-	a	
				2015	5	17.1%	11.0%	-1.3	0.2	a	
				2016	5	29.2%	13.6%	-0.5	1.4	a	
				2017	5	39.0%	23.3%	0.1	2.3	a	
Tipulidae (% of community)	modified probit	NO	0.2684	2007	3	0.0%	0.0%	-	-0.9	a	Tukey's HSD
				2011	3	2.1%	2.4%	nc	-	a	
				2015	5	5.1%	8.1%	nc	1.3	a	
				2016	5	1.9%	0.9%	nc	-0.1	a	
				2017	5	1.1%	1.6%	nc	-0.4	a	
Collector-Gatherer FFG (% of community)	modified probit	YES	0.0074	2007	3	35.0%	15.3%	-	-2.0	a	Tukey's HSD
				2011	3	66.3%	16.0%	2.0	-	a,b	
				2015	5	80.6%	12.7%	3.0	0.9	b	
				2016	5	59.9%	10.4%	1.6	-0.4	a	
				2017	5	63.9%	13.5%	1.9	-0.2	a,b	
Filterer FFG (% of community)	modified probit	YES	0.0009	2007	3	21.0%	28.3%	-	0.6	a	Tukey's HSD
				2011	3	14.3%	10.4%	-0.2	-	a	
				2015	5	0.8%	1.4%	-0.7	-1.3	b	
				2016	5	0.9%	0.7%	-0.7	-1.3	b	
				2017	5	19.9%	10.4%	0.0	0.5	a	
Shredder FFG (% of community)	modified probit	YES	0.0126	2007	3	40.2%	20.9%	-	5.7	a	Tukey's HSD
				2011	3	7.0%	5.8%	-1.6	-	b	
				2015	5	16.0%	10.1%	-1.2	1.6	a,b	
				2016	5	9.8%	5.4%	-1.5	0.5	b	
				2017	5	6.7%	3.1%	-1.6	-0.1	b	

(grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.64: Statistical Comparison of Physical Sediment Quality Between Mary Lake and Reference Lake 3 for Samples Collected at Littoral and Profundal Depths, Mary River Project CREMP, August 2017

Lake Zone	Habitat Variable	Statistical Test Results			Summary Statistics						
		Significant Difference Between Areas?	P-value	Statistical Analysis[a]	Study Lake	Sample Size (n)	Mean	Standard Deviation	Standard Error	Minimum	Maximum
Littoral (Shallow) Stations	Station Depth (m)	NO	0.752	α	Reference	5	9.74	1.04	0.46	8.50	11.20
					Mary Lake	4	9.38	2.22	1.11	6.60	12.00
	Sand-Sized Particles (% by weight)	NO	0.107	β	Reference	5	46.4	13.9	6.2	25.6	59.9
					Mary Lake	4	28.5	33.2	16.6	7.9	78.0
	Silt-Sized Particles (% by weight)	NO	0.530	α	Reference	5	44.3	11.6	5.2	32.8	62.2
					Mary Lake	4	52.1	23.1	11.6	19.4	73.8
	Clay-Sized Particles (% by weight)	NO	0.191	α , η	Reference	5	9.3	2.8	1.3	4.7	12.2
					Mary Lake	4	19.5	15.7	7.9	2.7	33.0
	Total Organic Carbon (%)	YES	0.004	α , η	Reference	5	4.9	1.8	0.8	2.7	7.2
					Mary Lake	4	0.9	0.4	0.2	0.5	1.4
Profundal (Deep) Stations	Station Depth (m)	NO	0.748	β	Reference	5	20.56	2.17	0.97	18.50	24.20
					Mary Lake	6	21.58	4.50	1.84	15.00	29.00
	Sand-Sized Particles (% by weight)	NO	0.387	β	Reference	5	35.7	16.5	7.4	15.6	56.0
					Mary Lake	6	30.9	31.1	12.7	6.1	86.7
	Silt-Sized Particles (% by weight)	NO	0.709	α	Reference	5	50.2	11.8	5.3	35.3	62.4
					Mary Lake	6	46.1	21.7	8.8	10.0	71.3
	Clay-Sized Particles (% by weight)	NO	0.436	Ŧ	Reference	5	14.1	5.2	2.3	8.8	22.0
					Mary Lake	6	23.0	16.9	6.9	3.3	44.6
	Total Organic Carbon (%)	YES	<0.001	Ŧ	Reference	5	3.6	1.1	0.5	1.8	4.4
					Mary Lake	6	0.8	0.2	0.1	0.5	1.0

[a] Data analysis included: α - data untransformed, single factor ANOVA test conducted; β - data log-transformed, single factor ANOVA test conducted; γ - data log-transformed, Mann-Whitney U-test conducted; ζ - single factor ANOVA test validated using Mann-Whitney U-test; η - single factor ANOVA test validated using t-test assuming unequal variance; δ - data untransformed, t-test assuming unequal variance conducted; Ŧ data square root transformed, t-test conducted.

Highlighted values indicate significant difference between study areas based on ANOVA p-value less than 0.10.

Table F.65: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2017

Taxa	Study Area / Replicate Station	Mary Lake - Littoral Stations 2017 BLO-1	BLO-11	BLO-7	BLO-6	Mary Lake - Profundal Stations 2017 BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
ROUNDWORMS											
P. Nemata		-	34	-	43	9	9	-	9	9	34
ANNELIDS											
P. Annelida											
WORMS											
Cl. Oligochaeta											
F. Enchytraeidae		-	34	-	-	-	-	-	-	-	-
F. Lumbriculidae											
Lumbriculus		-	34	-	-	-	-	-	-	-	-
ARTHROPODS											
P. Arthropoda											
MITES											
Cl. Arachnida											
O. Acarina											
immature		-	-	-	-	**26**	-	-	-	-	34
F. Acalyptonotidae											
Acalyptonotus		103	-	17	34	9	17	9	9	17	-
F. Hygrobatidae											
Hygrobates		-	-	-	9	-	-	-	-	-	-
F. Lebertiidae											
Lebertia		34	-	9	9	17	9	-	9	17	-
HARPACTICOIDS											
O. Harpacticoida		-	-	-	-	-	-	-	-	-	-
SEED SHRIMPS											
Cl. Ostracoda		86	34	-	17	-	-	-	52	17	-
FAIRY SHRIMP											
O. Notostraca											
Lepidurus arcticus		-	-	-	-	-	-	-	-	-	-
INSECTS											
Cl. Insecta											
CADDISFLIES											
O. Trichoptera											
F. Apataniidae											
Apatania		-	-	-	-	-	-	-	-	-	-
TRUE FLIES											
O. Diptera											
MIDGES											
F. Chironomidae											
chironomid pupae		-	-	-	-	-	-	-	**9**	-	-
S.F. Chironominae											
Chironomus		-	34	-	-	-	-	-	-	-	414
Micropsectra		724	931	-	-	9	9	-	9	26	34
Paratanytarsus		-	-	-	-	-	-	-	-	-	-
Sergentia		-	276	-	-	-	-	-	-	-	310
Stictochironomus		603	1,345	26	-	-	-	-	-	-	552
Tanytarsus		103	-	-	-	-	-	-	-	-	69
S.F. Diamesinae		-	-	-	-	-	-	-	-	-	-
Protanypus		-	-	9	-	-	-	17	-	-	-
Pseudodiamesa		-	-	26	52	-	-	9	-	-	-
S.F. Orthocladiinae											
Abiskomyia		86	69	-	-	34	-	-	-	-	-
Chaetocladius		-	-	-	-	-	-	-	-	-	34

Table F.65: Benthic Invertebrate Community Data, Expressed in Number of Organisms per Square Metre, for Mary Lake, August 2017

Taxa	Study Area	Mary Lake - Littoral Stations 2017				Mary Lake - Profundal Stations 2017					
	Replicate Station	BLO-1	BLO-11	BLO-7	BLO-6	BLO-3	BLO-15	BLO-14	BLO-13	BLO-4	BLO-5
Corynoneura		-	-	-	-	-	-	-	-	-	-
Cricotopus/Orthocladius		-	-	-	-	-	-	-	-	-	-
Heterotrissocladius		34	34	43	103	26	414	190	241	353	34
Mesocricotopus		-	-	-	-	-	-	-	-	9	-
Paracladius		-	-	-	34	-	-	-	-	-	-
Parakiefferiella		-	-	-	-	-	-	-	-	-	-
Psectrocladius		-	-	-	-	-	-	-	-	-	-
Zalutschia		17	-	-	-	-	-	-	-	-	-
Genus "Greenland"		-	-	-	-	-	-	-	-	-	-
S.F. Tanypodinae											
Arctopelopia		-	-	-	-	9	-	-	-	-	-
Procladius		2,121	34	86	34	17	52	17	-	9	-
F. Tipulidae											
Tipula		-	34	-	-	-	-	-	-	-	-
Density (No. organisms per m^2)		3,911	2,893	216	335	156	510	242	338	457	1,515
Richness (total number of taxa)[a]		10	12	7	9	8	6	5	6	8	9
Simpson's Evenness (E)		0.717	0.730	0.890	0.934	0.962	0.394	0.464	0.512	0.451	0.839
Bray-Curtis Index		0.838	0.853	0.852	0.768	0.567	0.699	0.471	0.621	0.671	0.958
Percent Composition											
% Nemata		0.0%	1.2%	0.0%	12.8%	5.8%	1.8%	0.0%	2.7%	2.0%	2.2%
% Hydracarina		3.5%	0.0%	12.0%	15.5%	33.3%	5.1%	3.7%	5.3%	7.4%	2.2%
% Ostracods		2.2%	1.2%	0.0%	5.1%	0.0%	0.0%	0.0%	15.4%	3.7%	0.0%
% Chironomids		94.3%	94.1%	88.0%	66.6%	60.9%	93.1%	96.3%	76.6%	86.9%	95.5%
% Metal Sensitive Chironmids		21.1%	32.2%	16.2%	15.5%	5.8%	1.8%	10.7%	2.7%	5.7%	6.8%
% Tipulidae		0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Functional Feeding Group Composition											
% Collector - Gatherers		20.7%	65.5%	48.1%	74.3%	44.2%	82.9%	89.3%	92.0%	84.9%	91.0%
% Filterers		21.1%	0.32	0.00	0.00	0.06	0.02	0.00	0.03	0.06	0.07
% Shredders		0.4%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Habitat Preference Group Composition											
% Clingers		24.6%	41.7%	12.0%	15.5%	39.1%	6.9%	3.7%	8.0%	13.1%	29.5%
% Sprawlers		59.9%	5.9%	71.8%	71.6%	55.1%	91.4%	89.3%	89.3%	84.9%	4.5%
% Burrowers		15.4%	52.4%	16.2%	12.8%	5.8%	1.8%	7.0%	2.7%	2.0%	66.0%

[a] Bold entries excluded from taxa coun

Table F.66: Statistical Comparison of Benthic Metrics at Mary Lake Littoral (Shallow) Stations Among Years of Mine Operation (2015, 2016, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transformation	Overall 4-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m²)	none	NO	0.9028	2007	3	2,667	1,454	-	a	Tukey's HSD
				2015	4	2,453	2,186	-0.1	a	
				2016	6	1,947	1,591	-0.5	a	
				2017	4	1,839	1,853	-0.6	a	
Richness (No. of Taxa)	log	NO	0.6596	2007	3	8.0	2.0	-	a	Tukey's HSD
				2015	4	9.0	1.8	0.5	a	
				2016	6	8.7	0.5	0.3	a	
				2017	4	9.5	2.1	0.8	a	
Simpson's Evenness	none	NO	0.2738	2007	3	0.718	0.041	-	a	Tamhane's
				2015	4	0.761	0.058	1.1	a	
				2016	6	0.574	0.299	-3.5	a	
				2017	4	0.818	0.110	2.4	a	
Nemata (% of community)	modified probit	NO	0.6950	2007	3	7.3%	11.2%	-	a	Tukey's HSD
				2015	4	5.6%	6.3%	-0.1	a	
				2016	6	3.6%	7.5%	-0.3	a	
				2017	4	3.5%	6.2%	-0.3	a	
Ostracoda (% of community)	modified probit	NO	0.4702	2007	3	0.2%	0.4%	-	a	Tukey's HSD
				2015	4	1.9%	2.2%	4.3	a	
				2016	6	2.3%	2.2%	5.5	a	
				2017	4	2.1%	2.2%	5.0	a	
Chironomidae (% of community)	modified probit	NO	0.7784	2007	3	90.8%	11.8%	-	a	Tukey's HSD
				2015	4	91.1%	7.7%	0.0	a	
				2016	6	90.6%	12.2%	0.0	a	
				2017	4	85.7%	13.1%	-0.4	a	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.7548	2007	3	22.4%	13.8%	-	a	Tukey's HSD
				2015	4	15.8%	14.6%	-0.5	a	
				2016	6	19.2%	13.3%	-0.2	a	
				2017	4	21.3%	7.7%	-0.1	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.5006	2007	3	66.0%	26.7%	-	a	Tukey's HSD
				2015	4	72.8%	23.1%	0.3	a	
				2016	6	73.5%	24.7%	0.3	a	
				2017	4	52.2%	23.6%	-0.5	a	
Filterer FFG (% of community)	modified probit	NO	0.7065	2007	3	22.0%	14.5%	-	a	Tukey's HSD
				2015	4	14.4%	16.2%	-0.5	a	
				2016	6	12.4%	13.2%	-0.7	a	
				2017	4	13.3%	16.0%	-0.6	a	

Indicates a significant difference for respective comparison (p-value ≤ 0.1).

Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

Table F.67: Statistical Comparison of Benthic Metrics at Mary Lake Profundal (Deep) Stations Among Years of Mine Operation (2015, 2017) and Baseline (2007) for the Mary River Project CREMP

Metric	Data Transfor-mation	Overall 3-Year Comparison[a]		Pair-wise, post-hoc comparisons[a]						
		Significant Difference Among Years?	P-value	Year	Sample Size (n)	Mean	Standard Deviation	Effect Size vs. Baseline Year 2007	Pairwise Comparison	Statistical Test
Density (No. per m^2)	log	YES	0.0361	2007	4	3,512	3,257	-	a	Tukey's HSD
				2015	6	775	748	-0.8	b	
				2017	6	536	497	-0.9	b	
Richness (No. of Taxa)	log	NO	0.9103	2007	4	8.0	6.2	-	a	Tukey's HSD
				2015	6	7.7	4.1	0.0	a	
				2017	6	7.0	1.5	-0.2	a	
Simpson's Evenness	log	NO	0.2061	2007	4	0.453	0.268	-	a	Tamhane's
				2015	6	0.696	0.142	0.9	a	
				2017	6	0.604	0.236	0.6	a	
Nemata (% of community)	modified probit	NO	0.4109	2007	4	1.3%	1.8%	-	a	Tamhane's
				2015	6	2.0%	2.6%	0.4	a	
				2017	6	2.4%	1.9%	0.6	a	
Ostracoda (% of community)	modified probit	NO	0.4085	2007	4	1.6%	2.2%	-	a	Tukey's HSD
				2015	6	11.1%	10.9%	4.4	a	
				2017	6	3.2%	6.2%	0.7	a	
Chironomidae (% of community)	modified probit	YES	0.0516	2007	4	96.4%	4.7%	-	a	Tukey's HSD
				2015	6	83.8%	12.2%	-2.7	b	
				2017	6	84.9%	13.8%	-2.5	b	
Metal Sensitive Taxa (% of community)	modified probit	NO	0.7473	2007	4	33.7%	27.9%	-	a	Tamhane's
				2015	6	9.5%	8.2%	-0.9	a	
				2017	6	5.6%	3.2%	-1.0	a	
Collector-Gatherer FFG (% of community)	modified probit	NO	0.9753	2007	4	64.4%	27.7%	-	a	Tamhane's
				2015	6	82.7%	5.9%	0.7	a	
				2017	6	80.7%	18.2%	0.6	a	
Filterer FFG (% of community)	modified probit	NO	0.5026	2007	4	33.1%	27.8%	-	a	Tukey's HSD
				2015	6	9.4%	7.9%	-0.9	a	
				2017	6	3.8%	2.7%	-1.1	a	

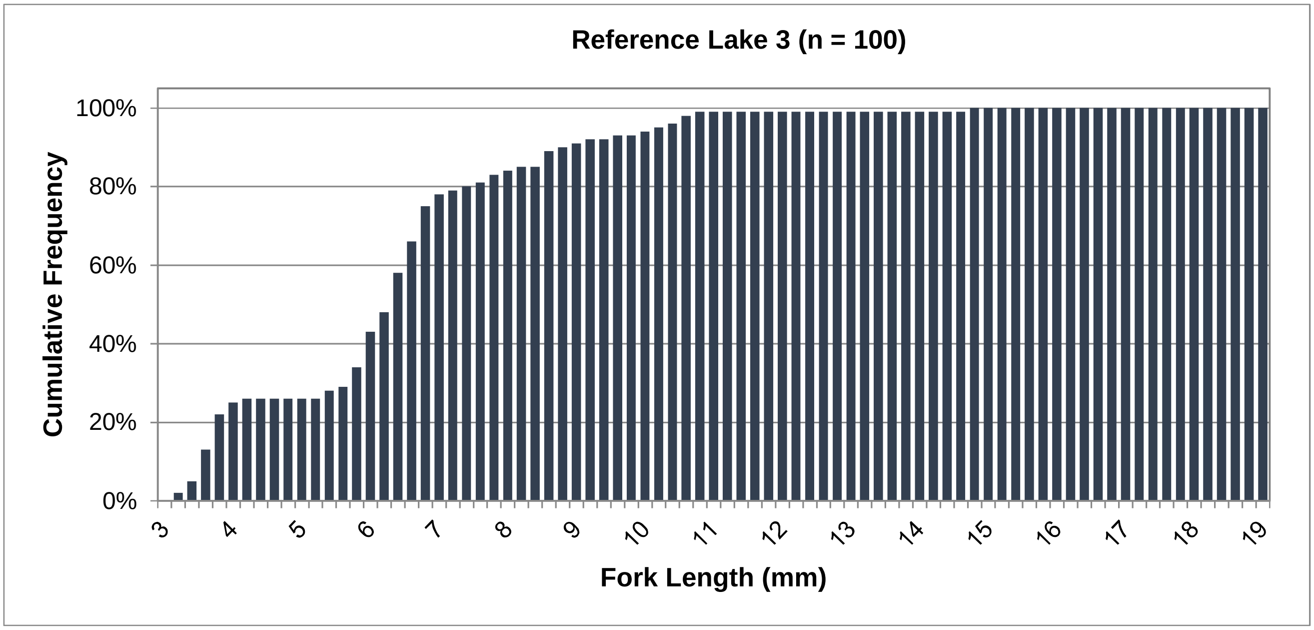
(Grey) Indicates a significant difference for respective comparison (p-value ≤ 0.1).

(Blue) Indicates magnitude of difference outside of the Critical Effect Size of ± 2 SD of respective baseline year mean, suggesting an ecologically meaningful difference in endpoint value between study years.

[a] Post-hoc analysis of 1-way ANOVA among all areas protected for multiple comparisons

APPENDIX G

FISH POPULATION SURVEY DATA



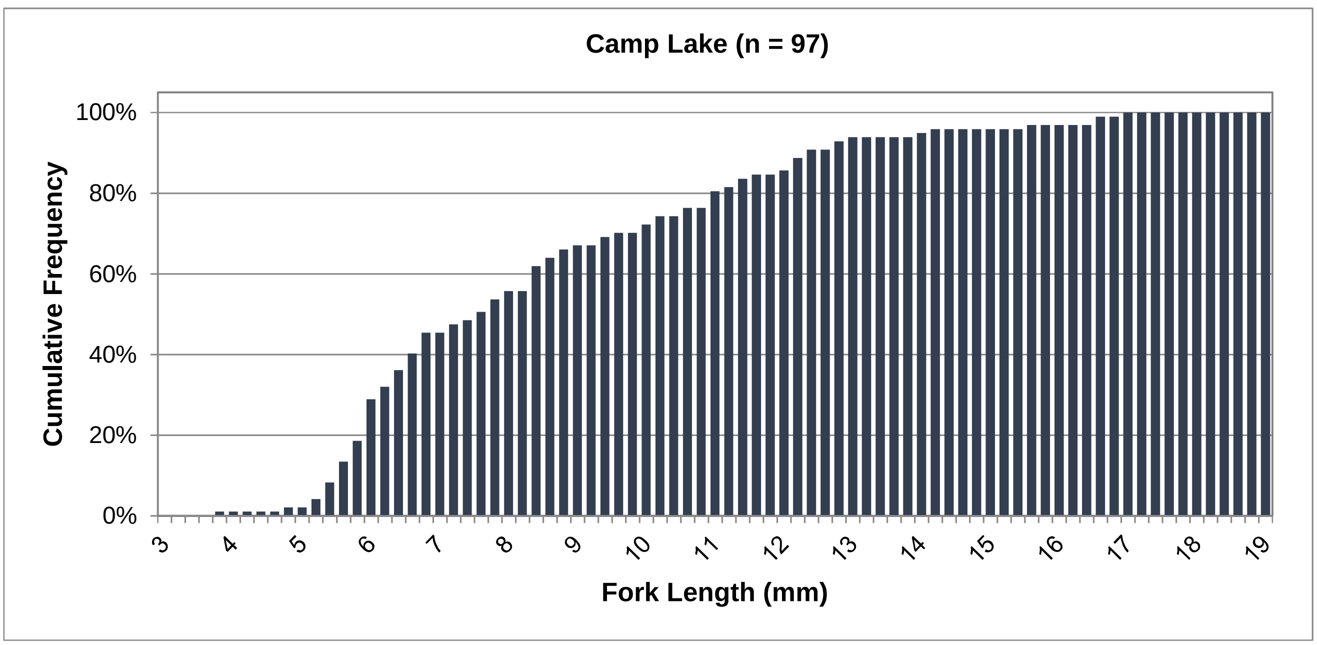
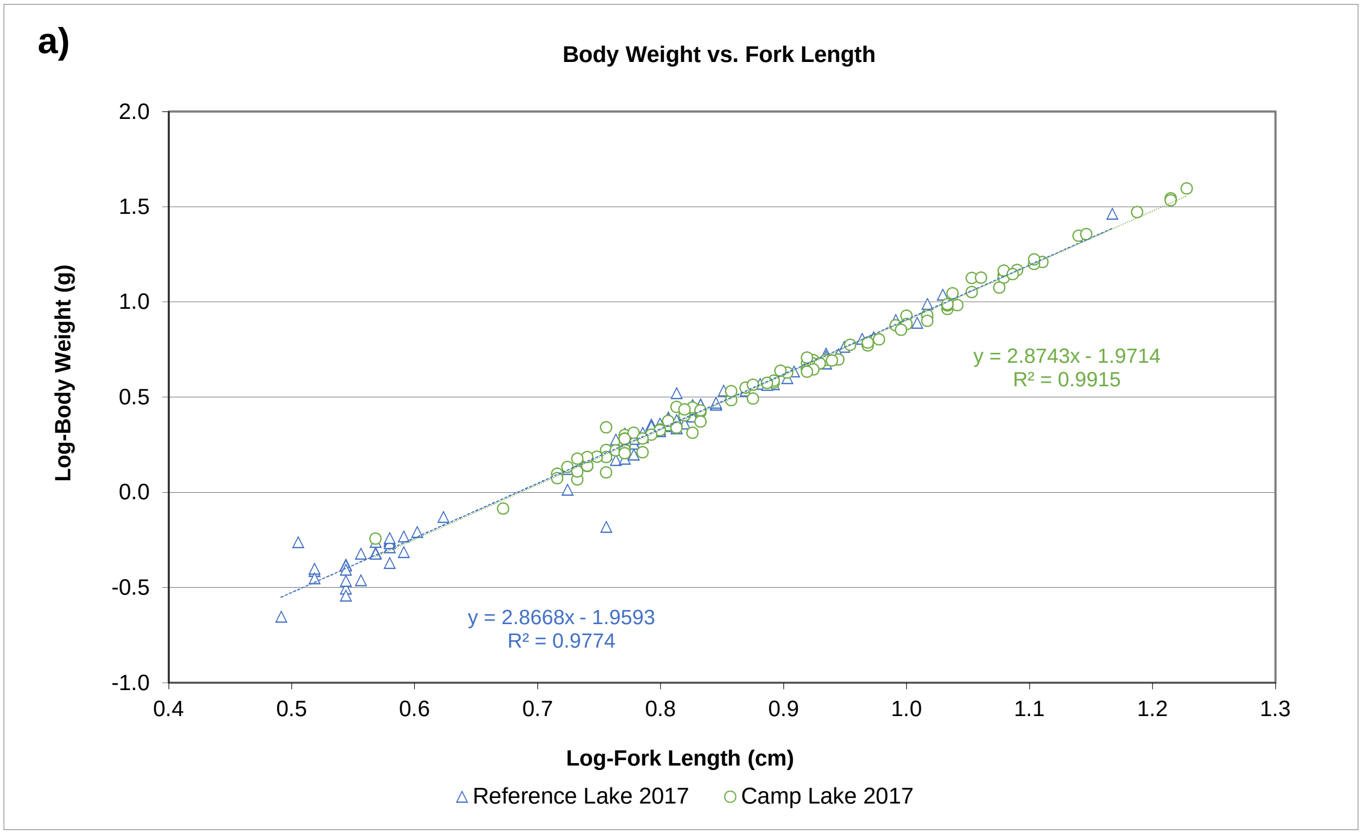


Figure G.1: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2017



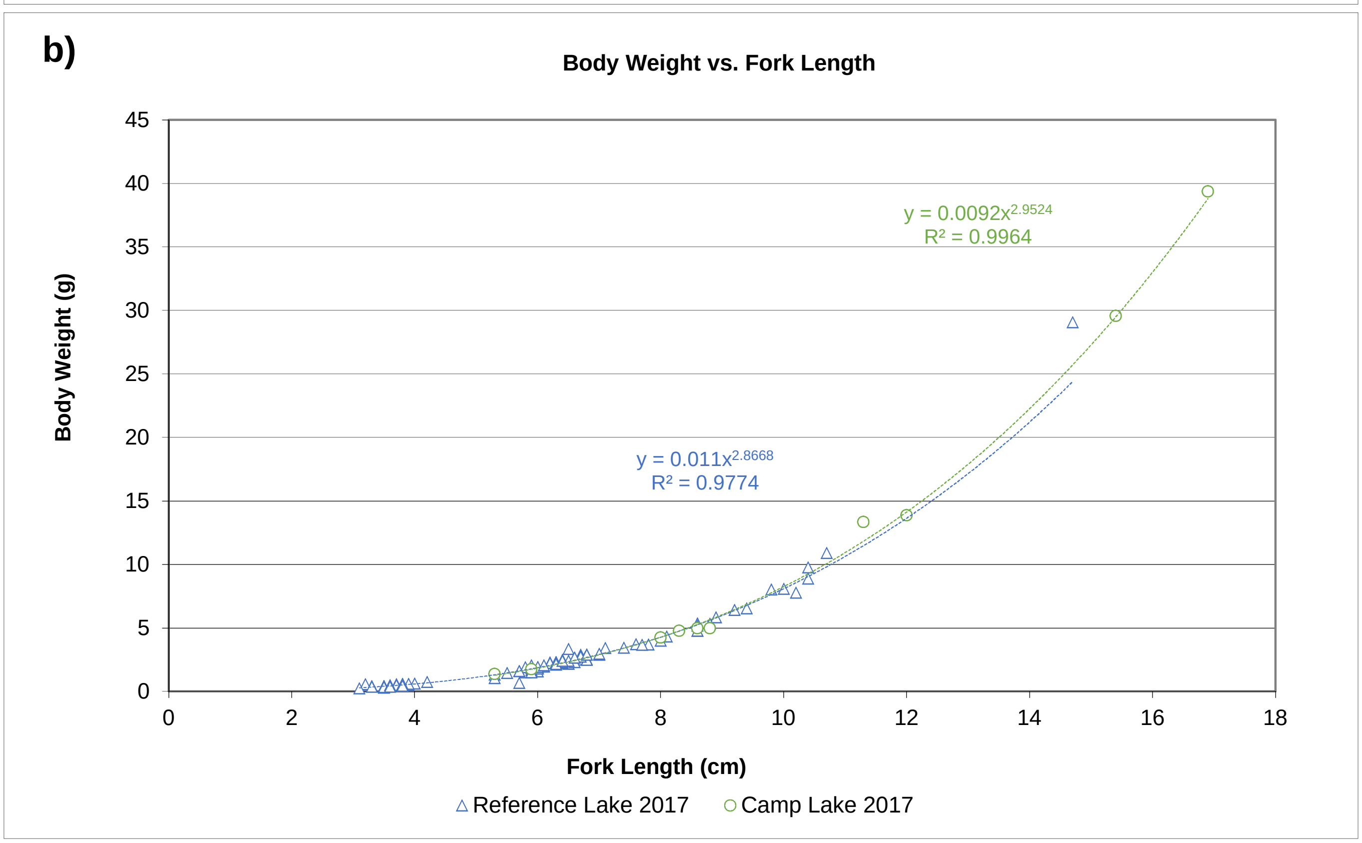
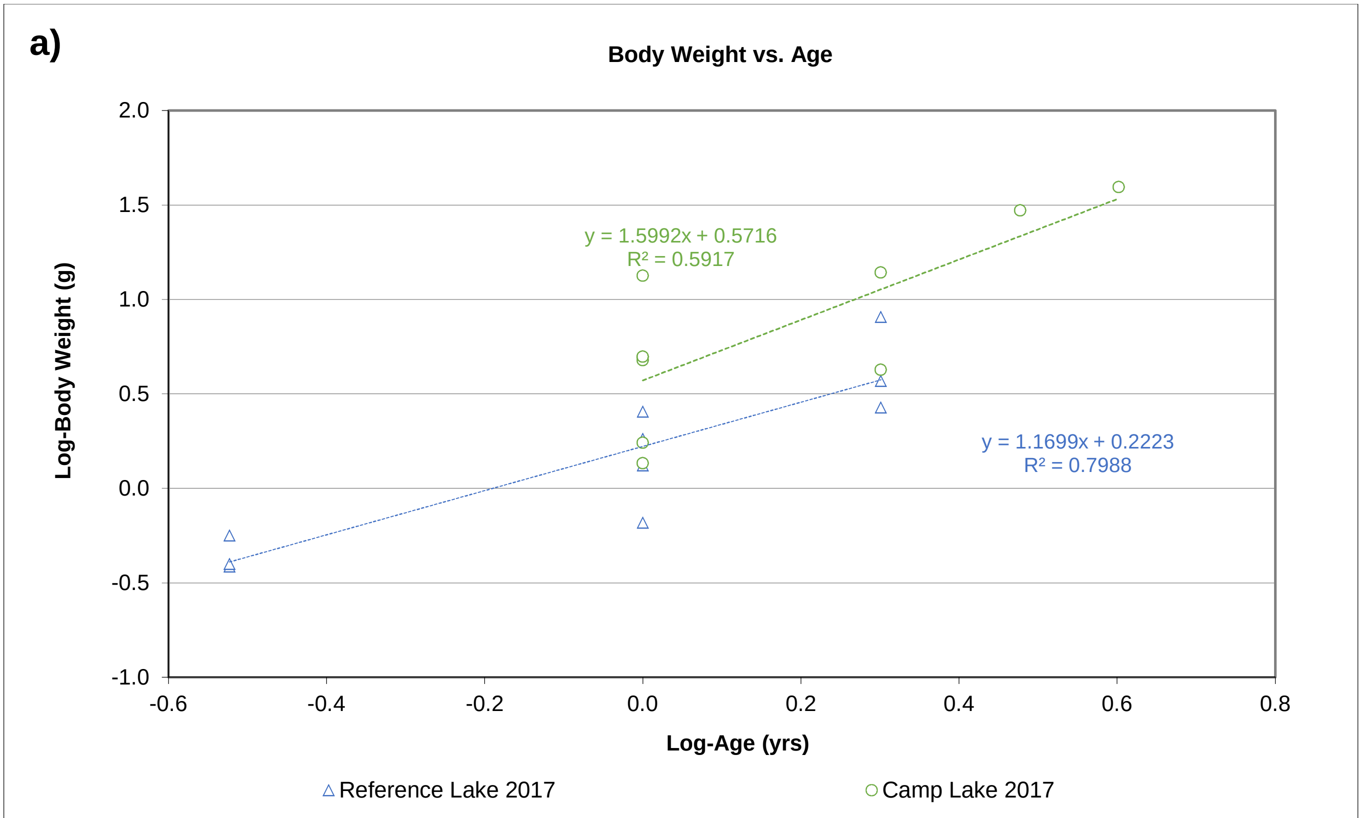


Figure G.2: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Camp Lake and Reference Lake 3 in August 2017 using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP, 2017



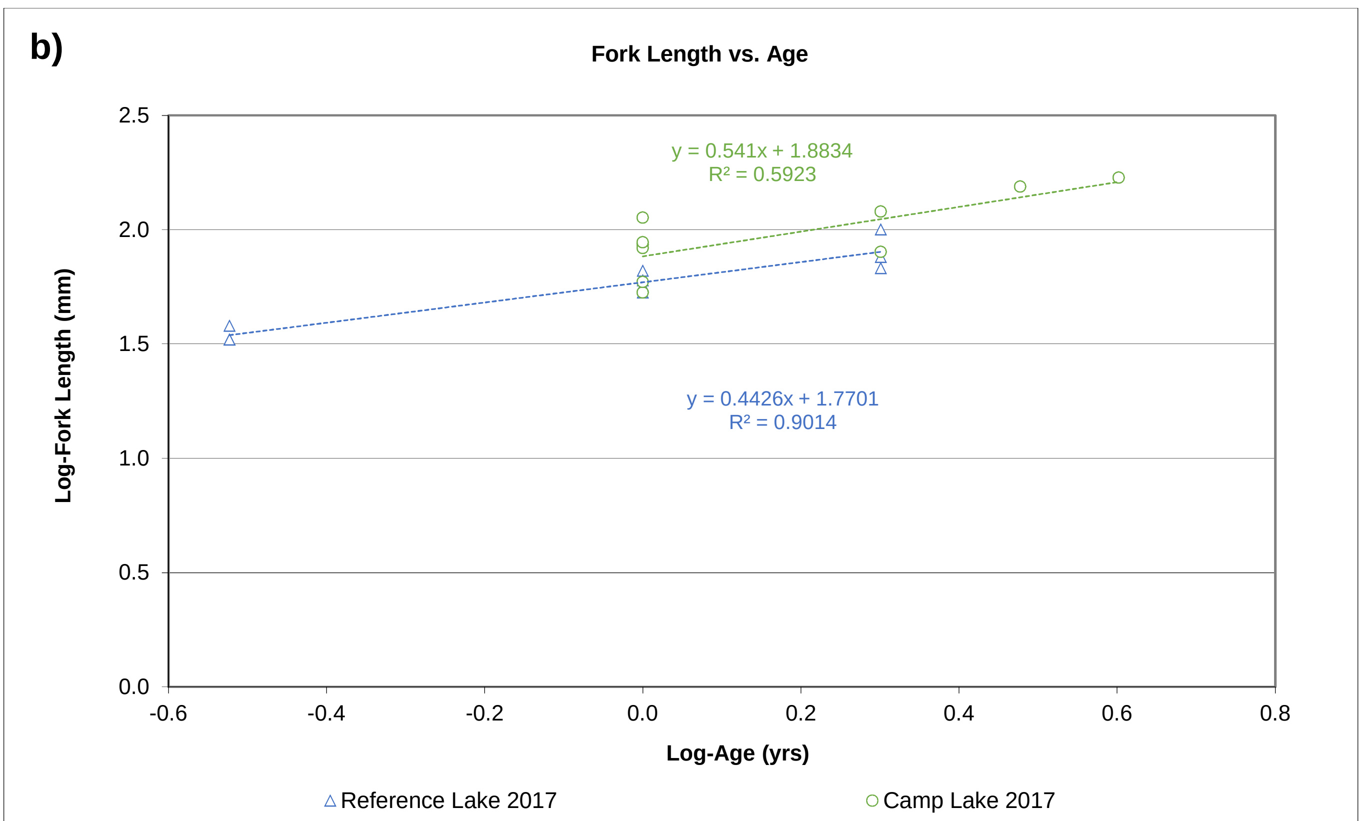
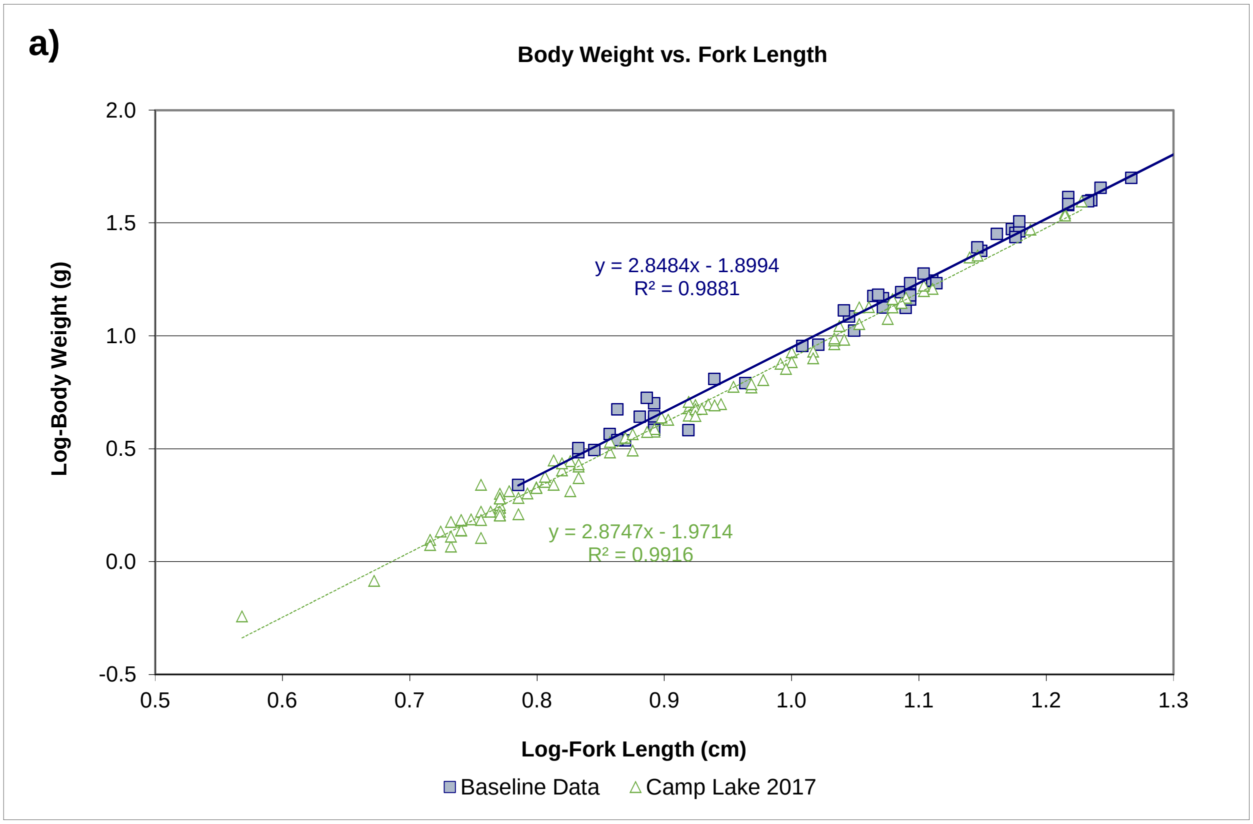


Figure G.3: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected at the Nearshore Area of Camp Lake and Reference Lake 3, Mary River Project CREMP, August 2017



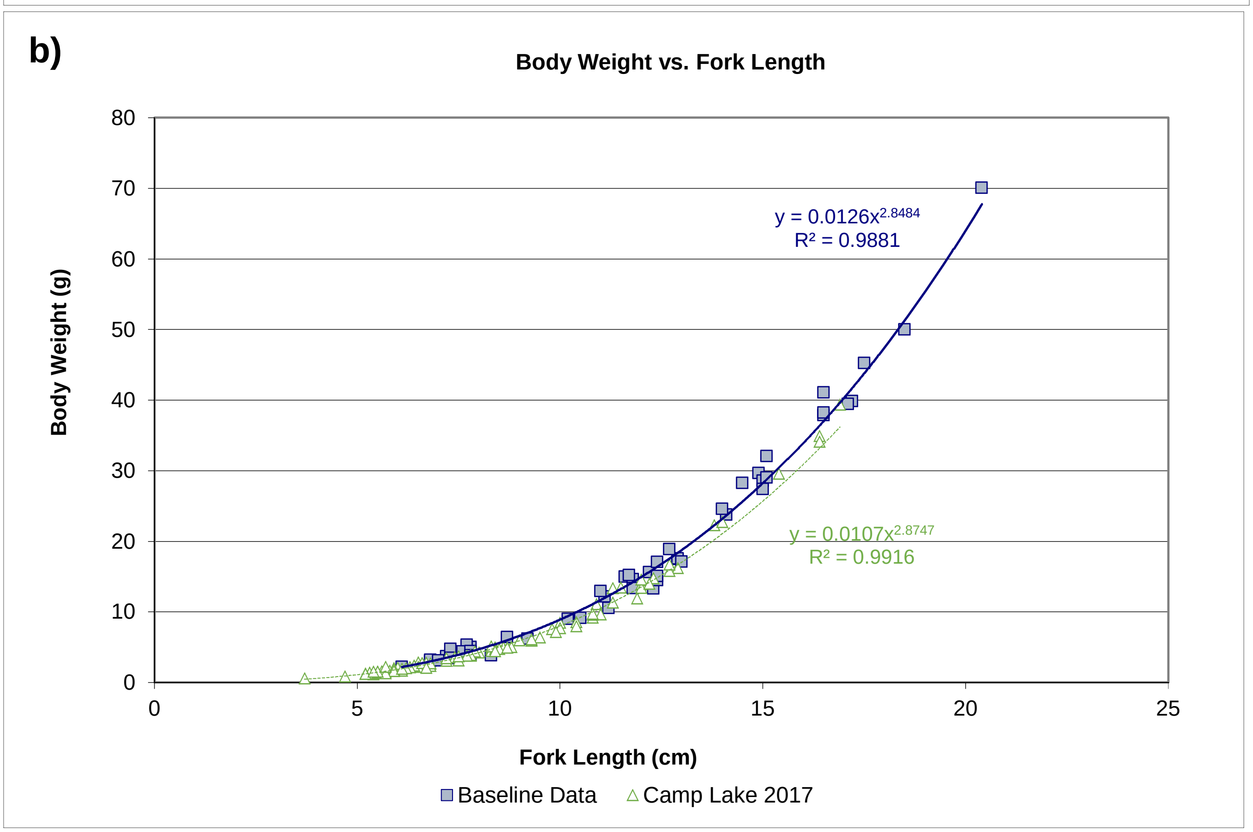
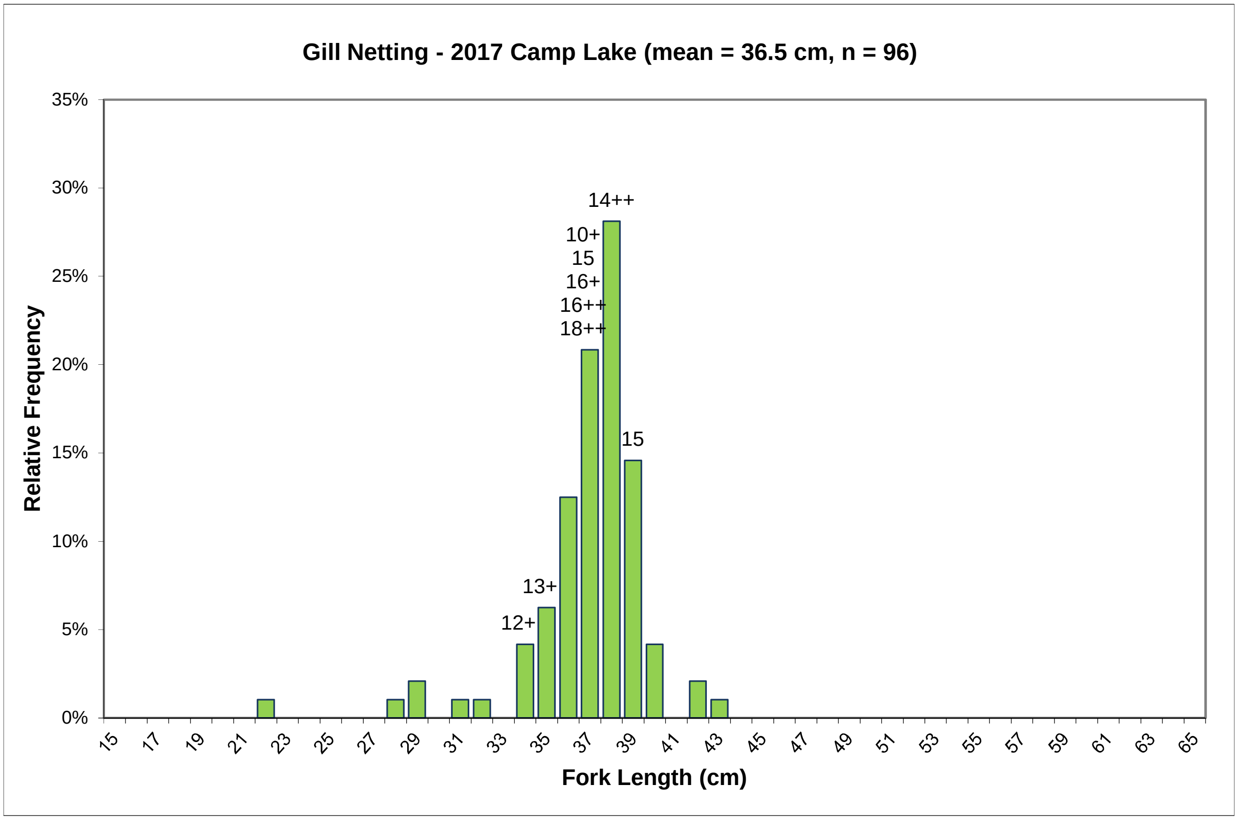


Figure G.4: Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Nearshore Areas in 2017 and during the Mine Baseline Period (2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



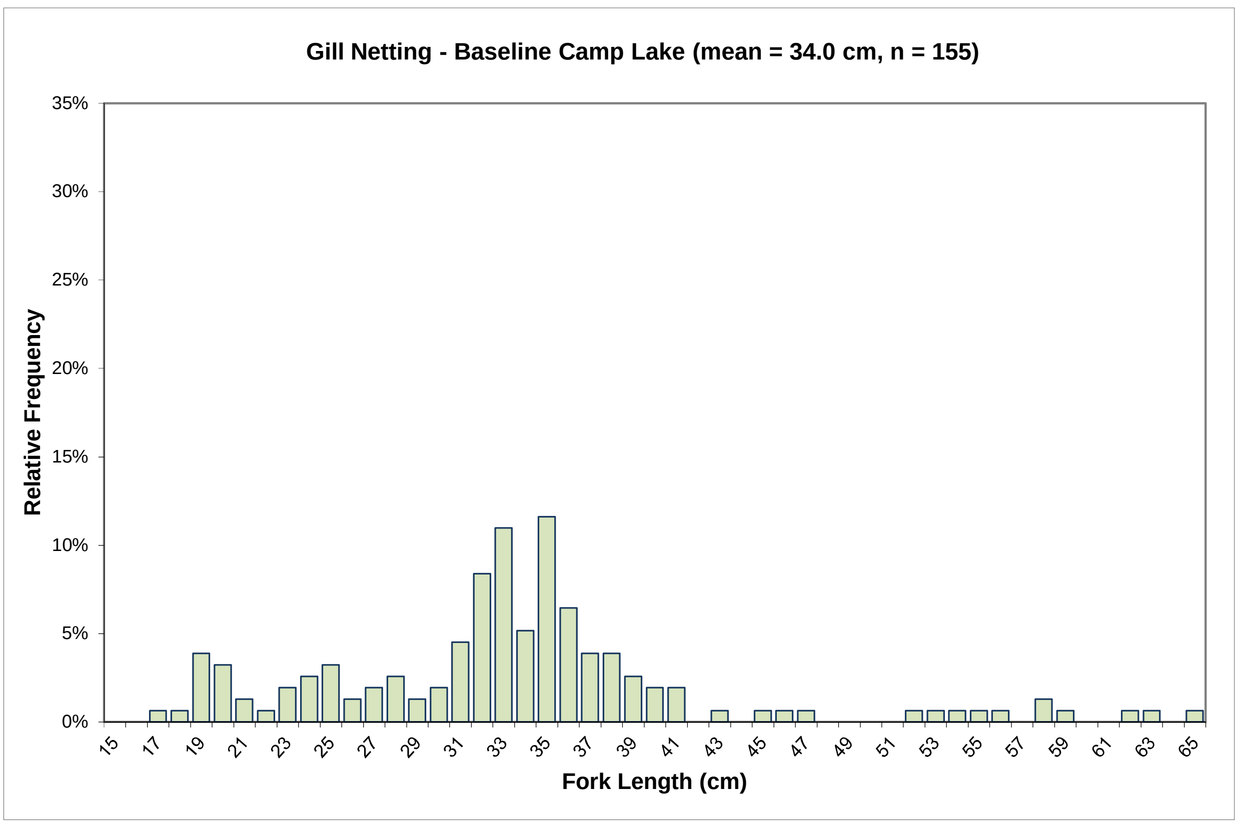


Figure G.5: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Camp Lake (JLO) in 2017 and Baseline Studies Conducted in Fall, Mary River Project CREMP

Note: Fish ages are shown above the bars, where available.

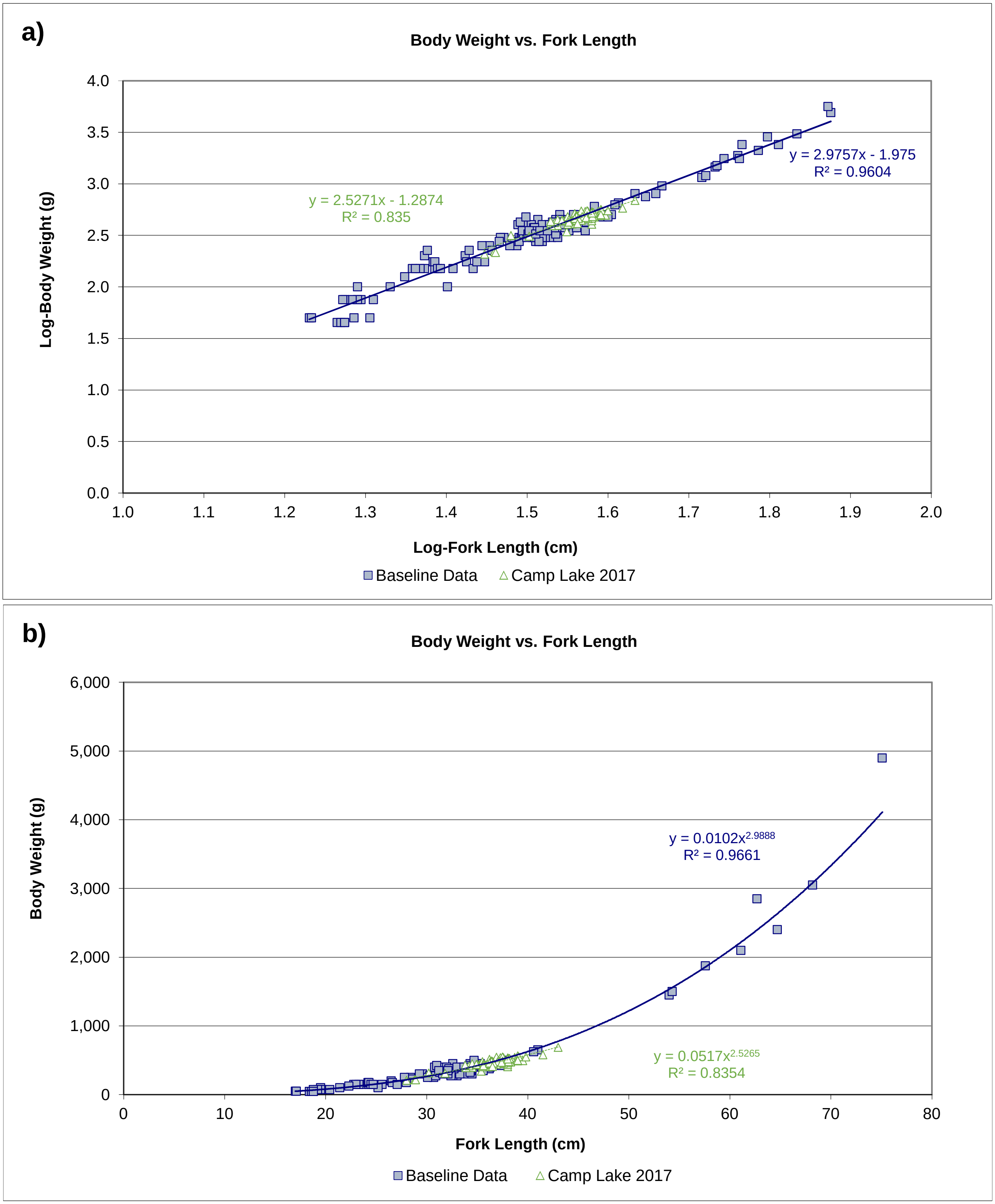


Figure G.6: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Camp Lake Littoral/Profundal Areas in 2017 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP

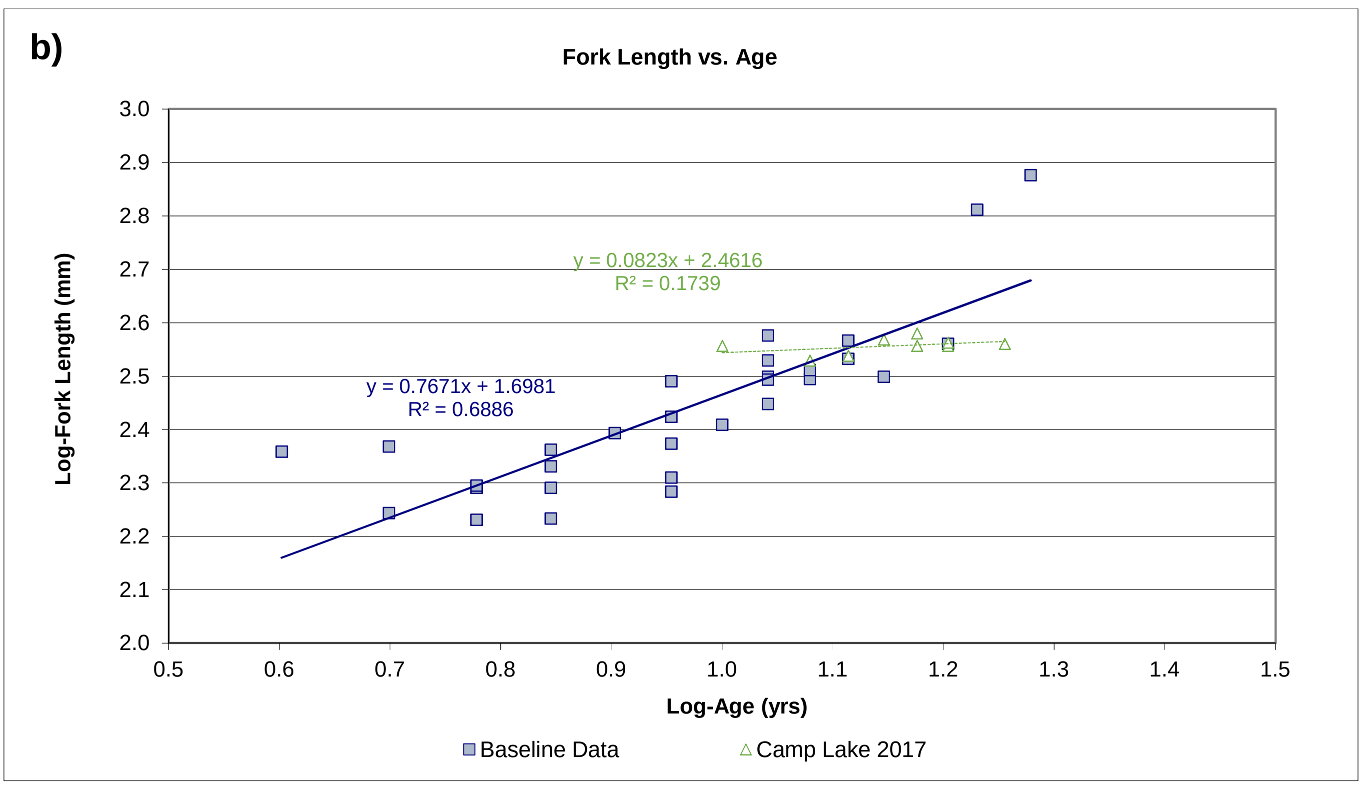
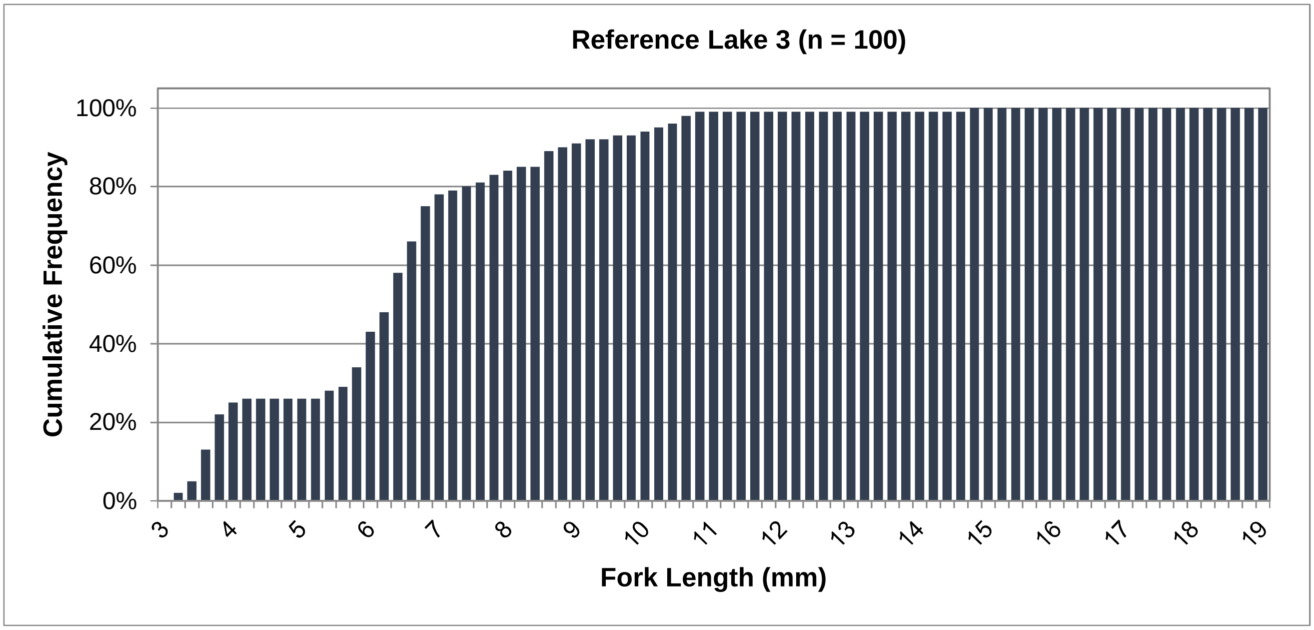


Figure G.7: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected in Fall (August-September) at Camp Lake Littoral and Profundal Areas in 2017 and during the Baseline Period (2006, 2007, 2013), Mary River Project CREMP



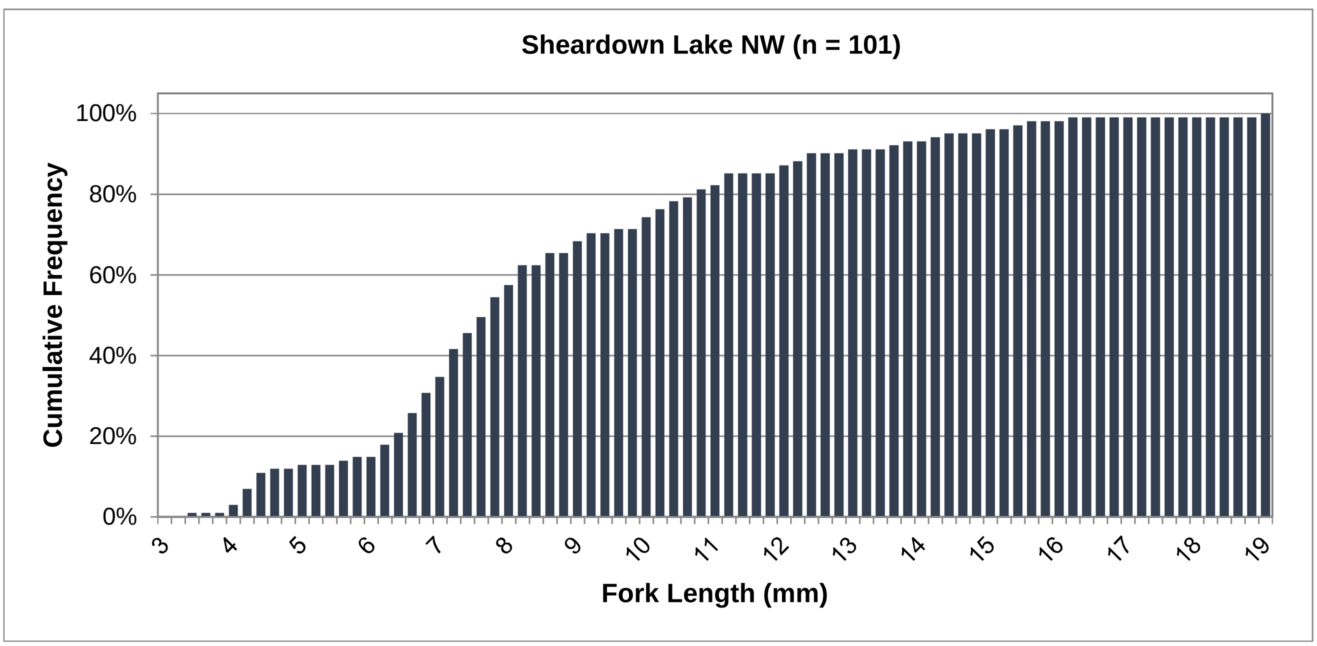
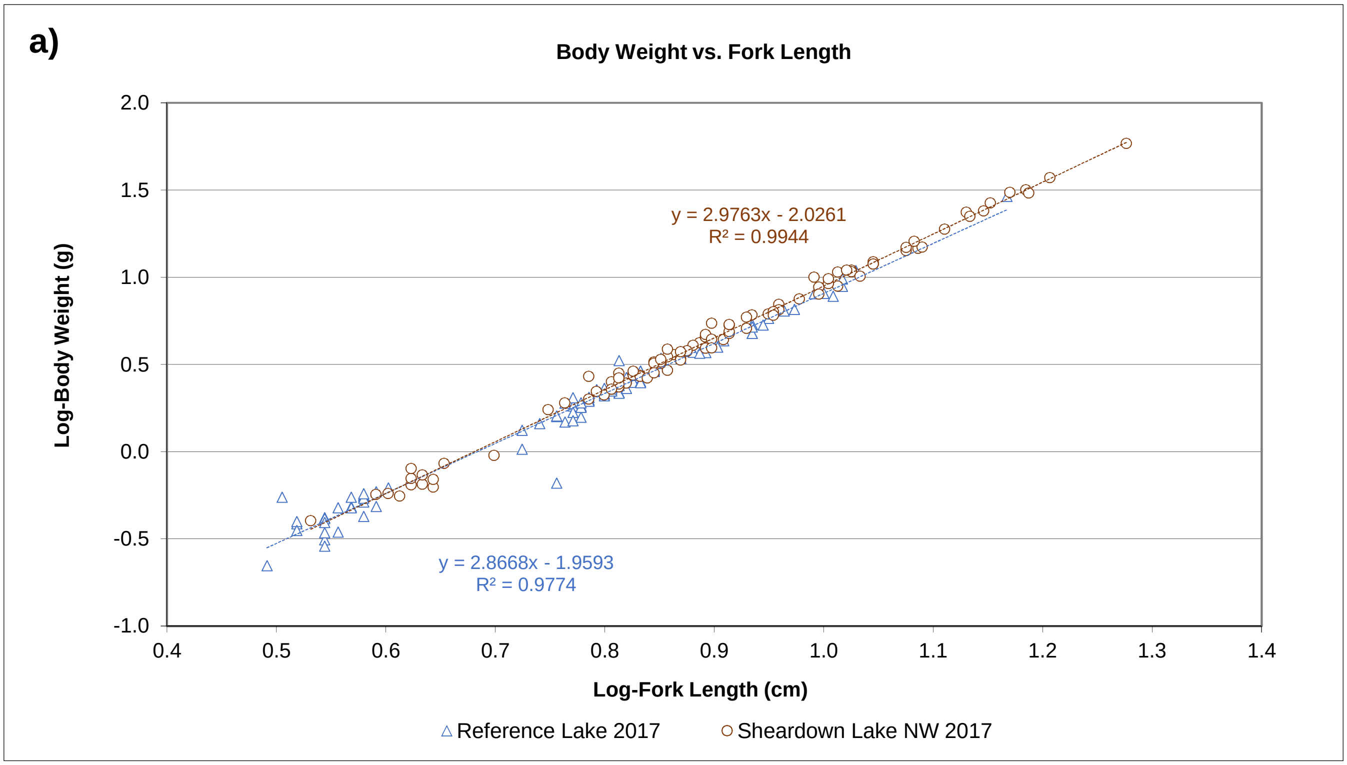


Figure G.8: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2017



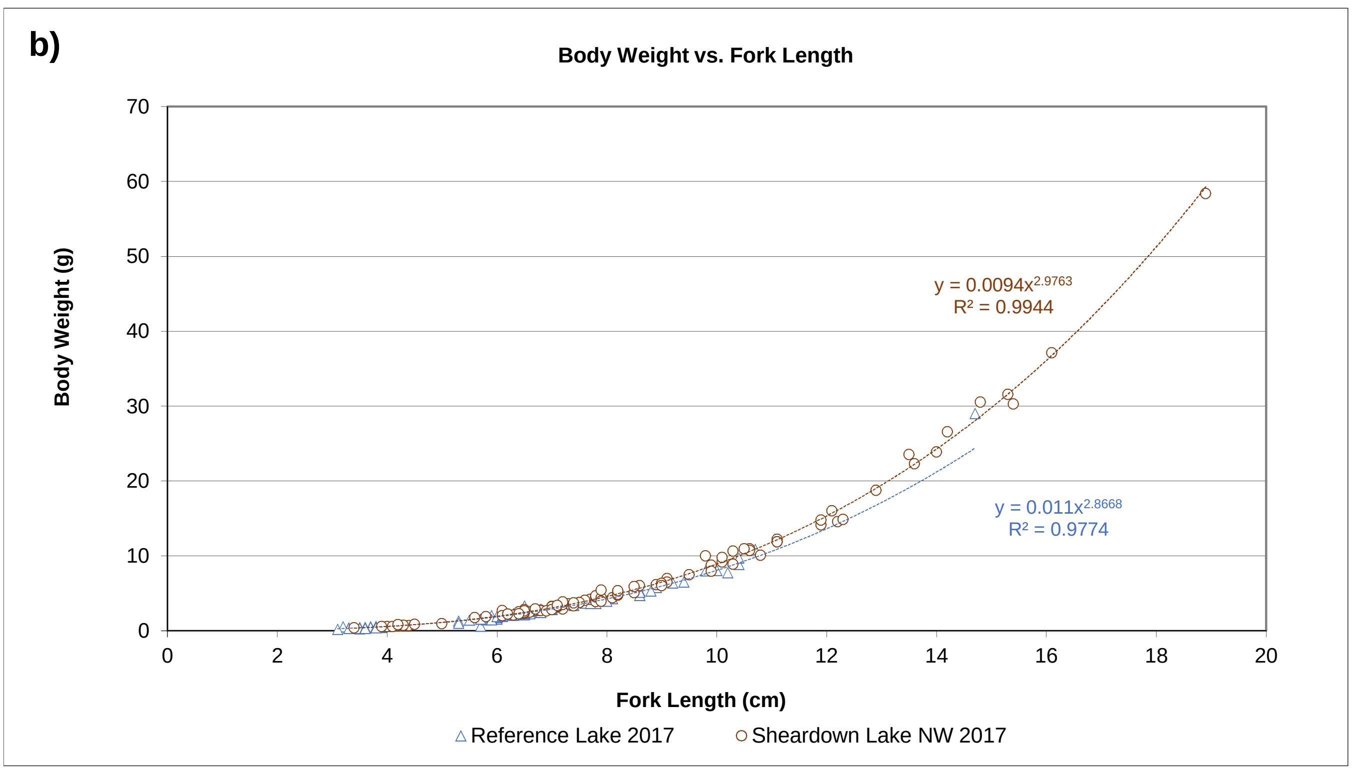


Figure G.9: Comparison of Condition (Weight-at-fork-length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake NW and Reference Lake 3 in August 2017 using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP, 2017

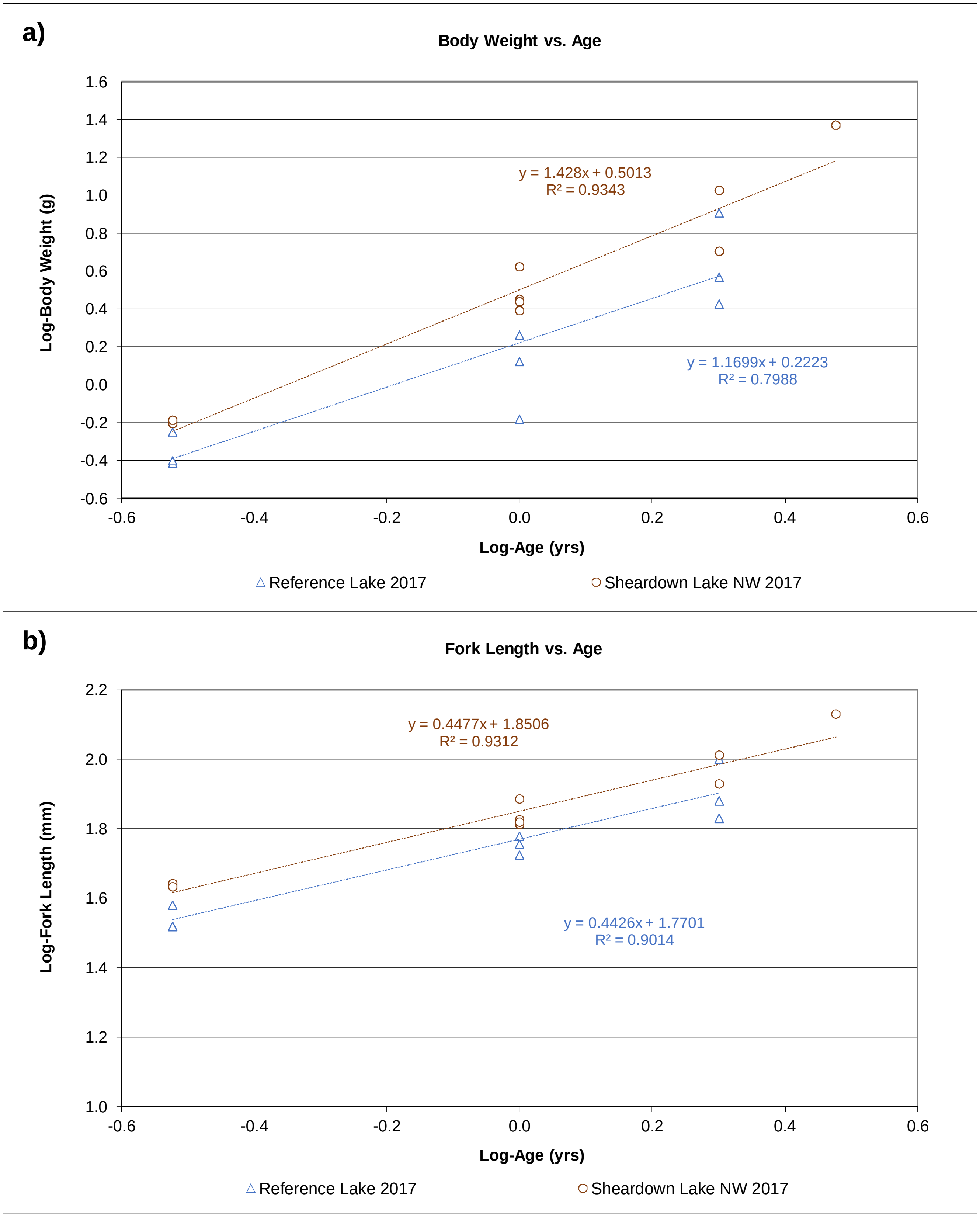


Figure G.10: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected at the Nearshore Area of Sheardown Lake NW and Reference Lake 3, Mary River Project CREMP, August 2017

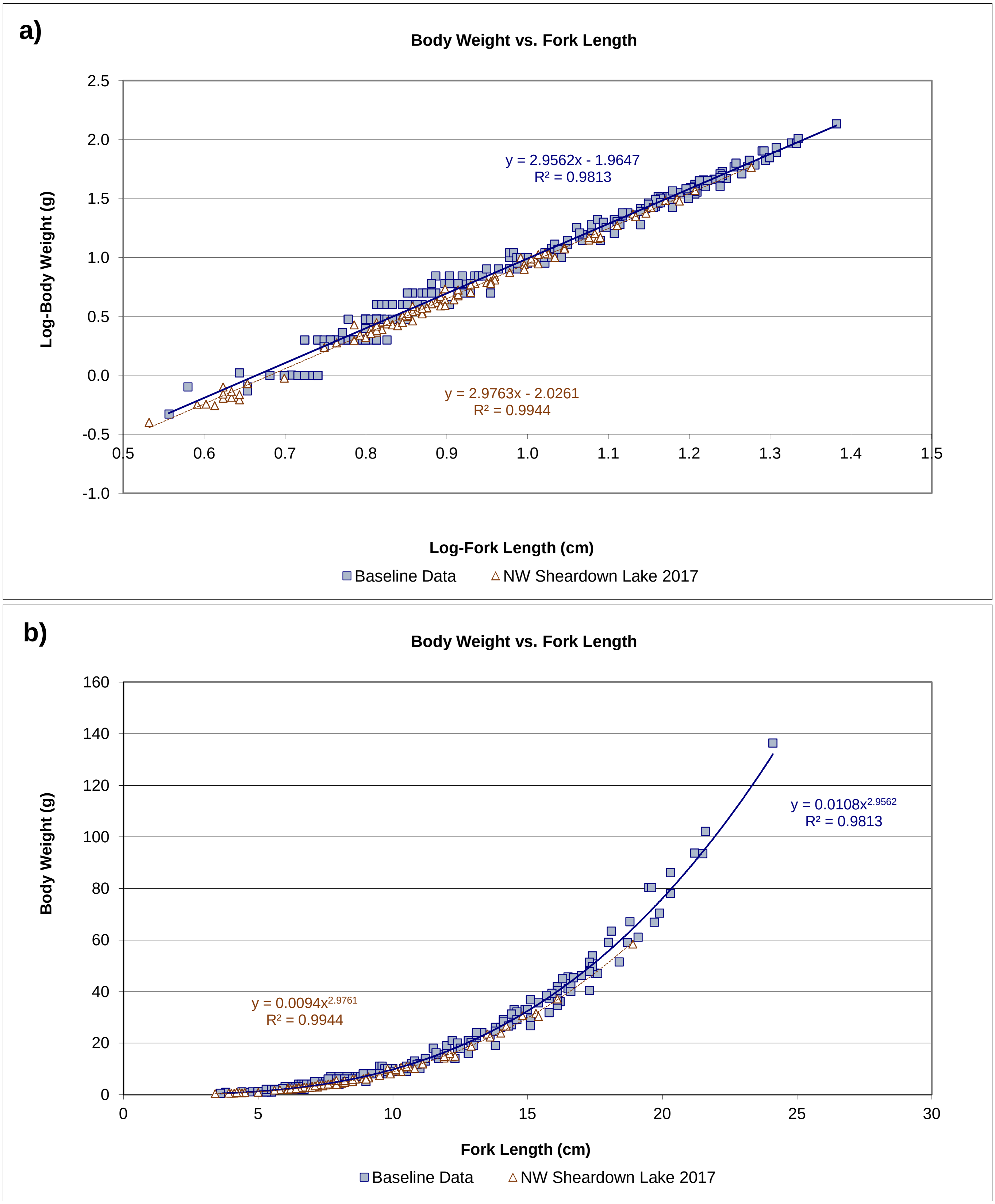
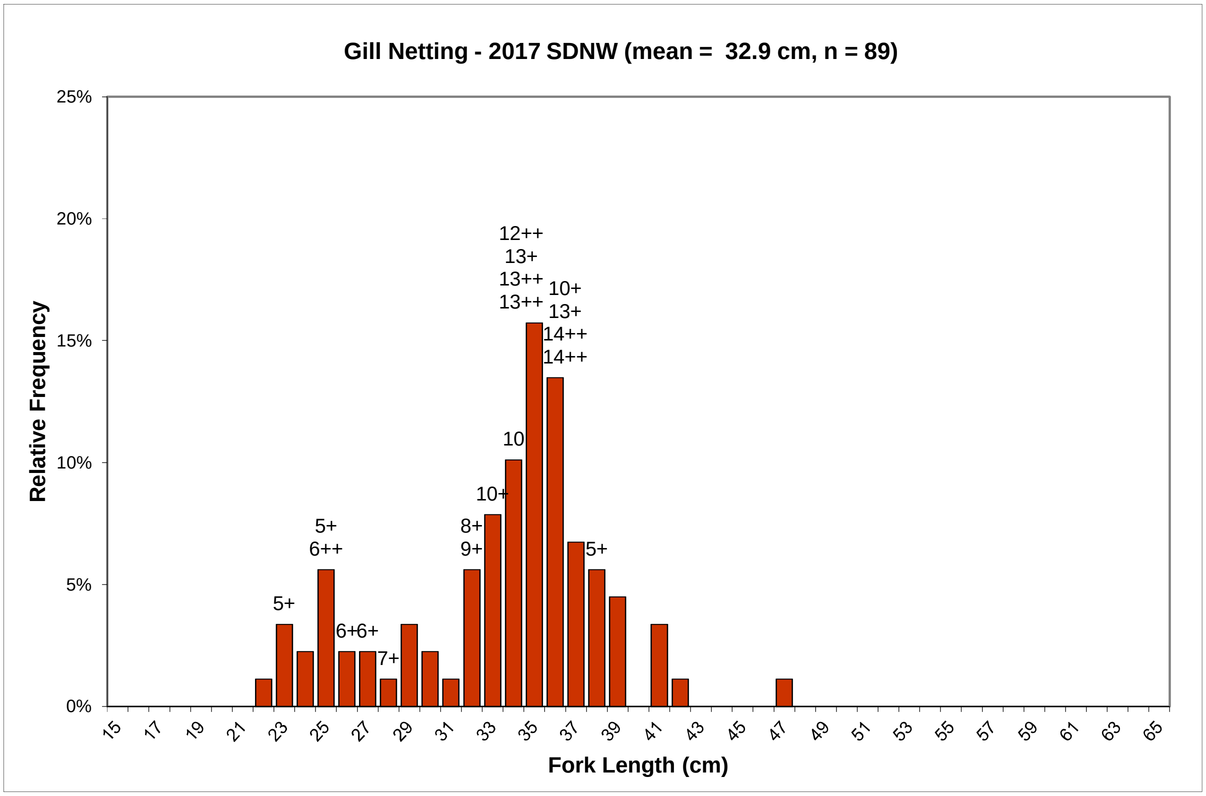


Figure G.11: Comparison of Condition (Weight-at-fork length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2017 and During the Mine Baseline Period (2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



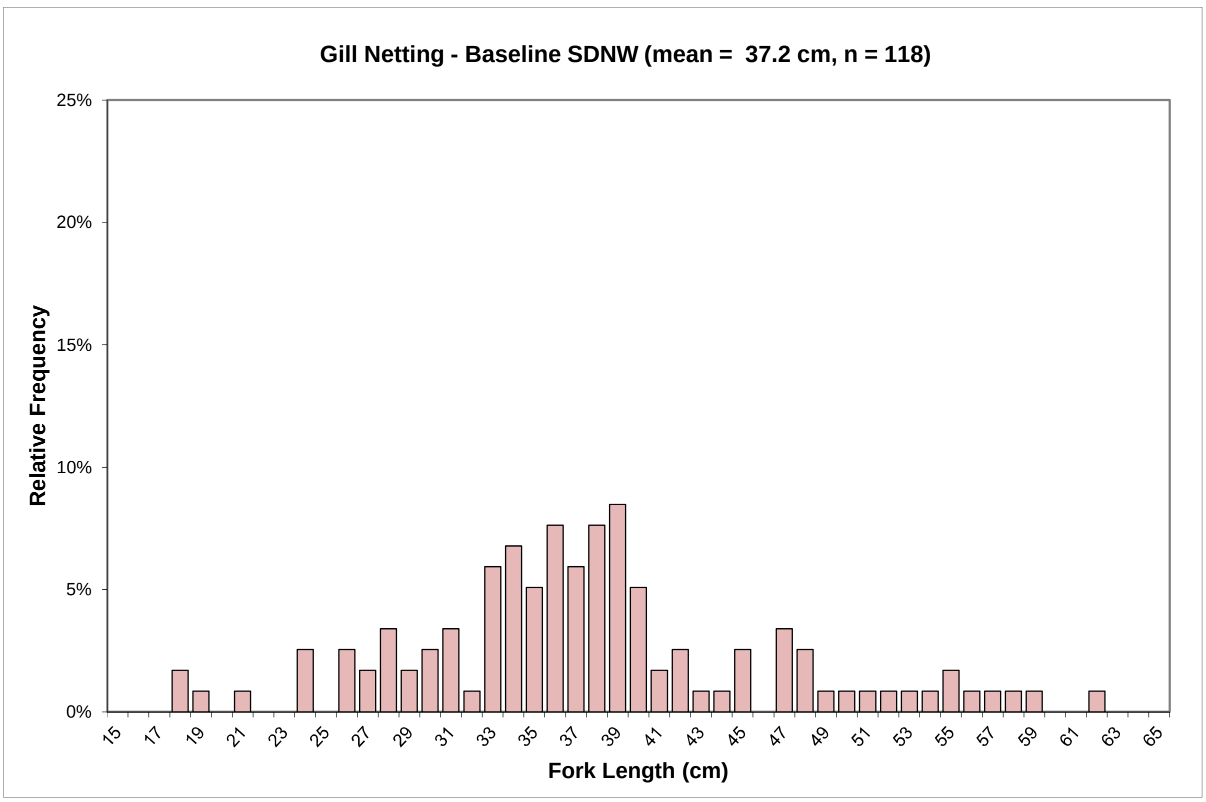
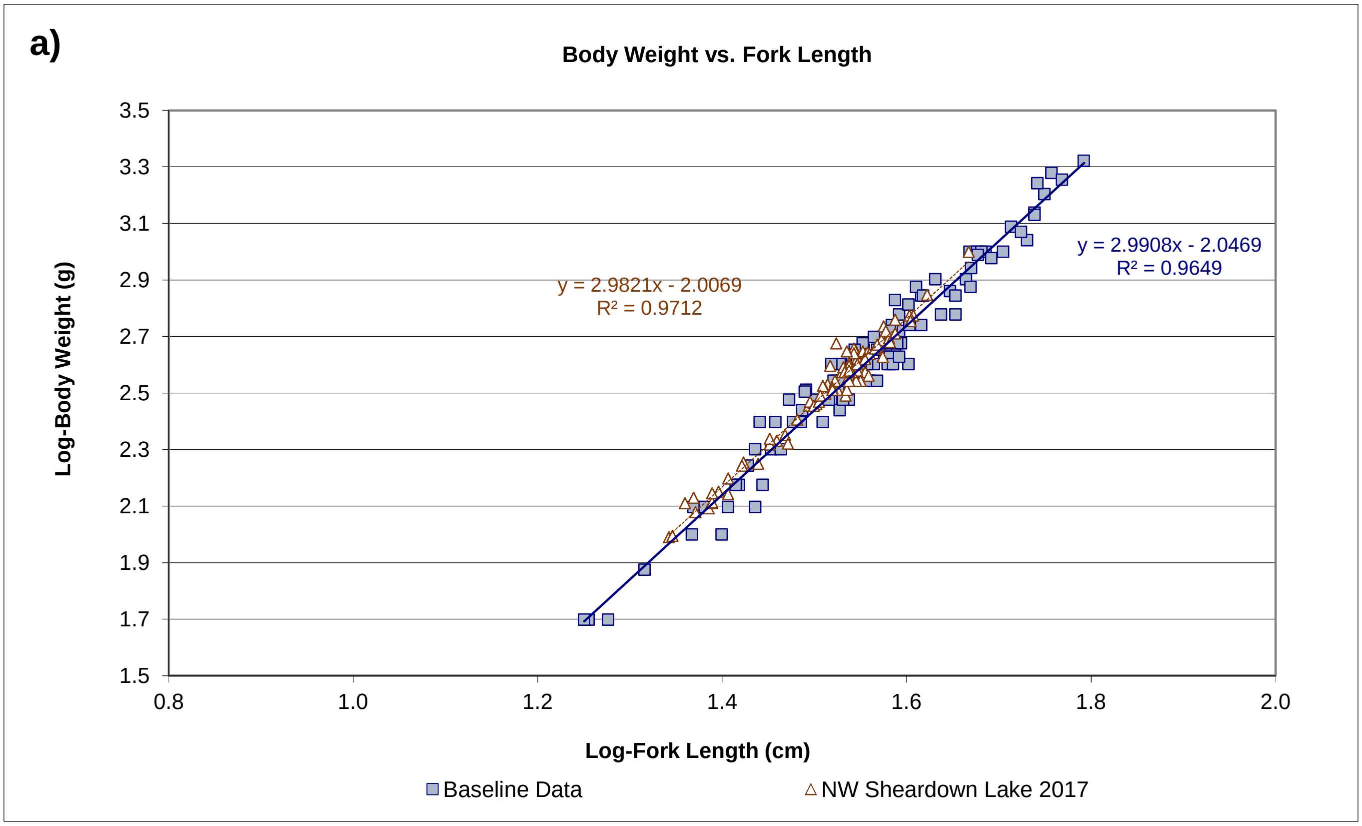


Figure G.12: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake NW (DLO-01) in 2017 and Baseline Studies Conducted in Fall, Mary River Project CREMP

Note: Fish ages are shown above the bars, where available.



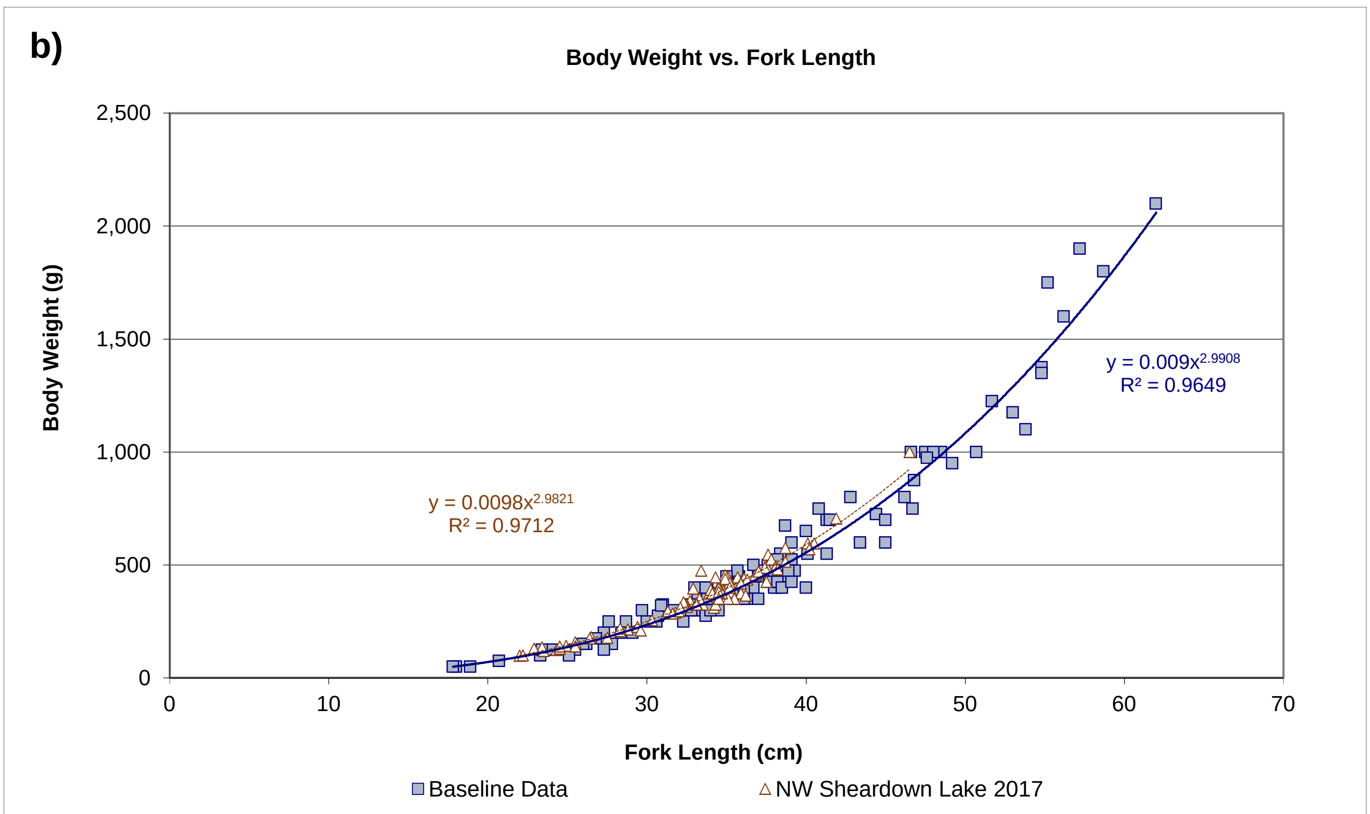


Figure G.13: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Nearshore Areas in 2017 and during the Mine Baseline Period (2006, 2007, 2008, 2013) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP

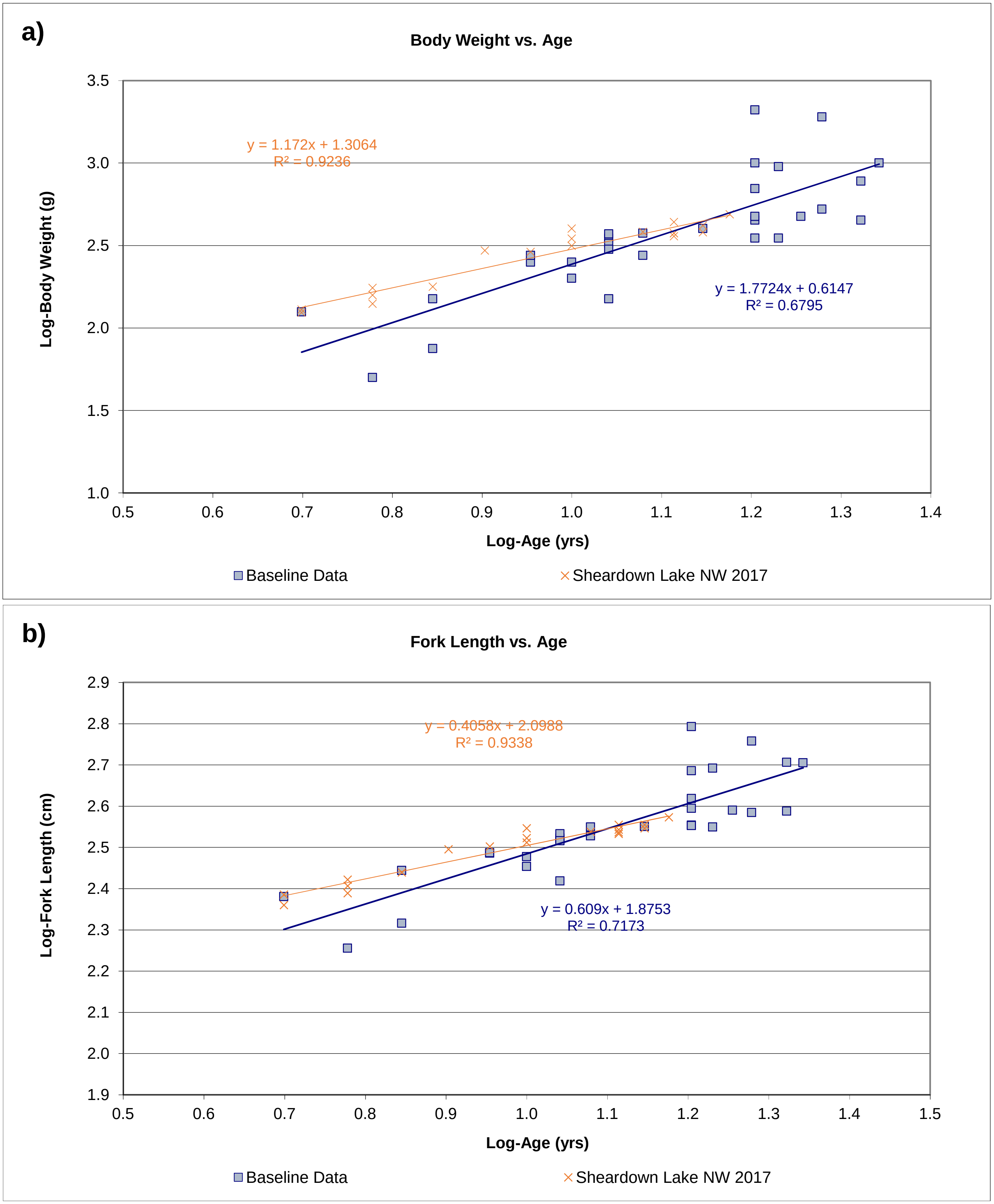
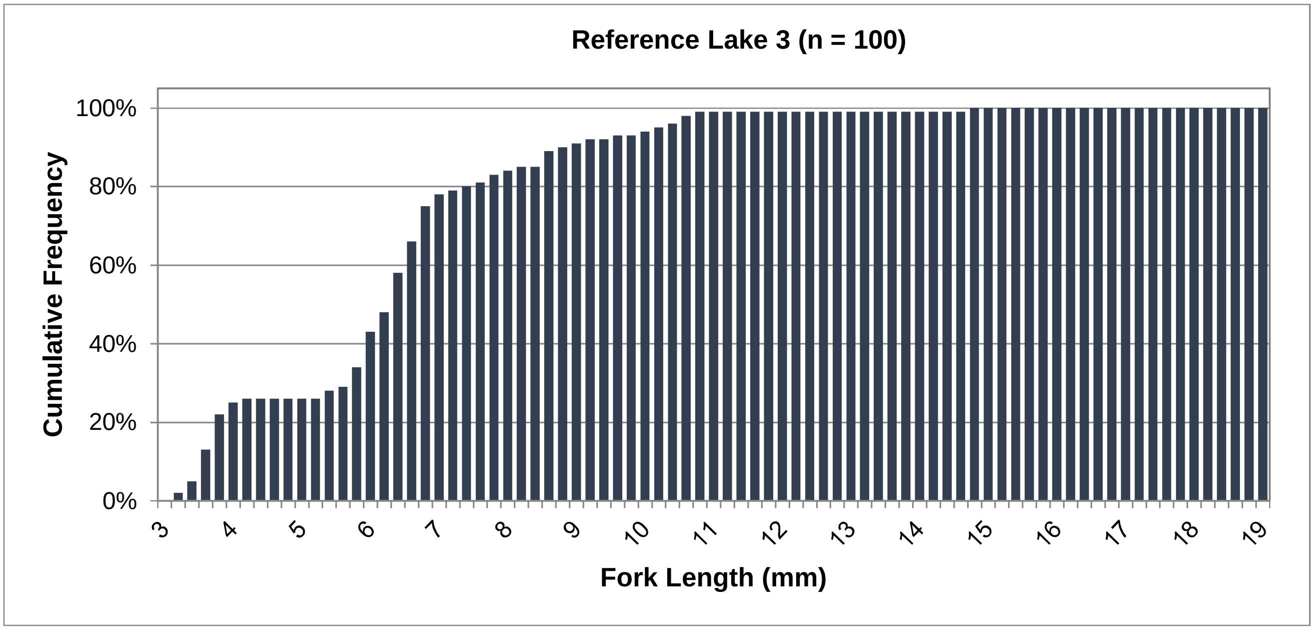


Figure G.14: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected in Fall (August-September) at Sheardown Lake NW Littoral/Profundal Areas in 2017 and During the Baseline Period (2006, 2007, 2013), Mary River Project CREMP



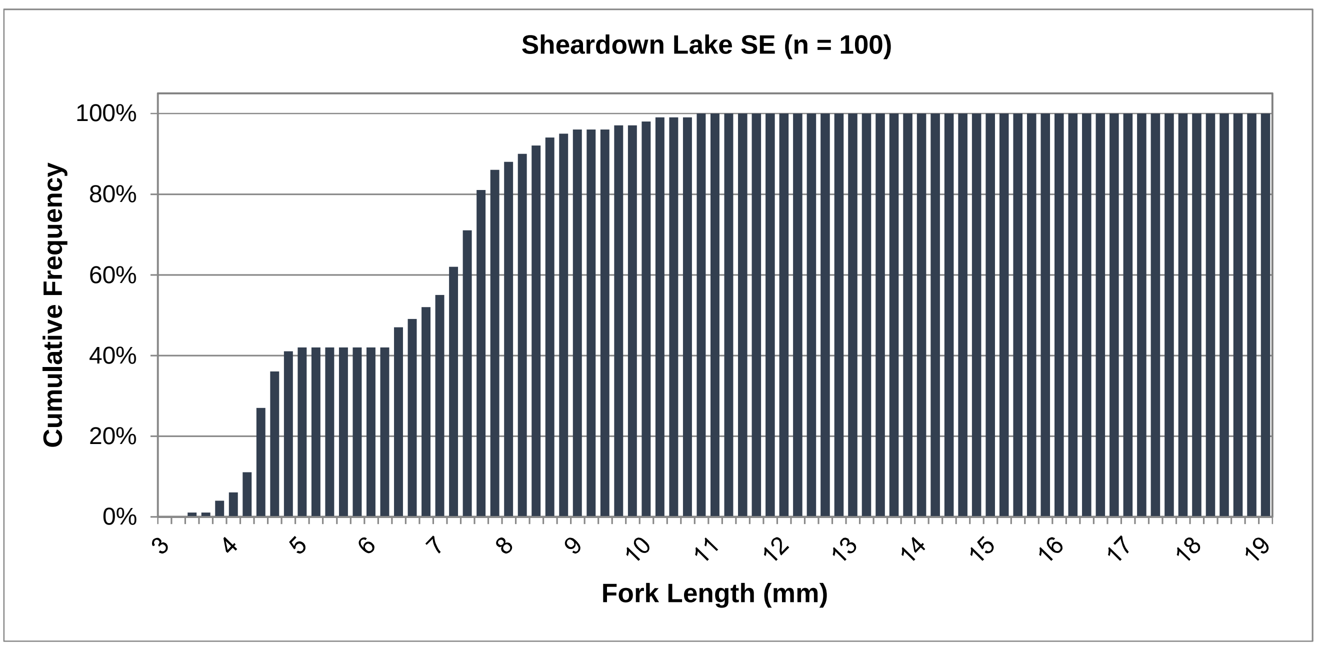


Figure G.15: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2017

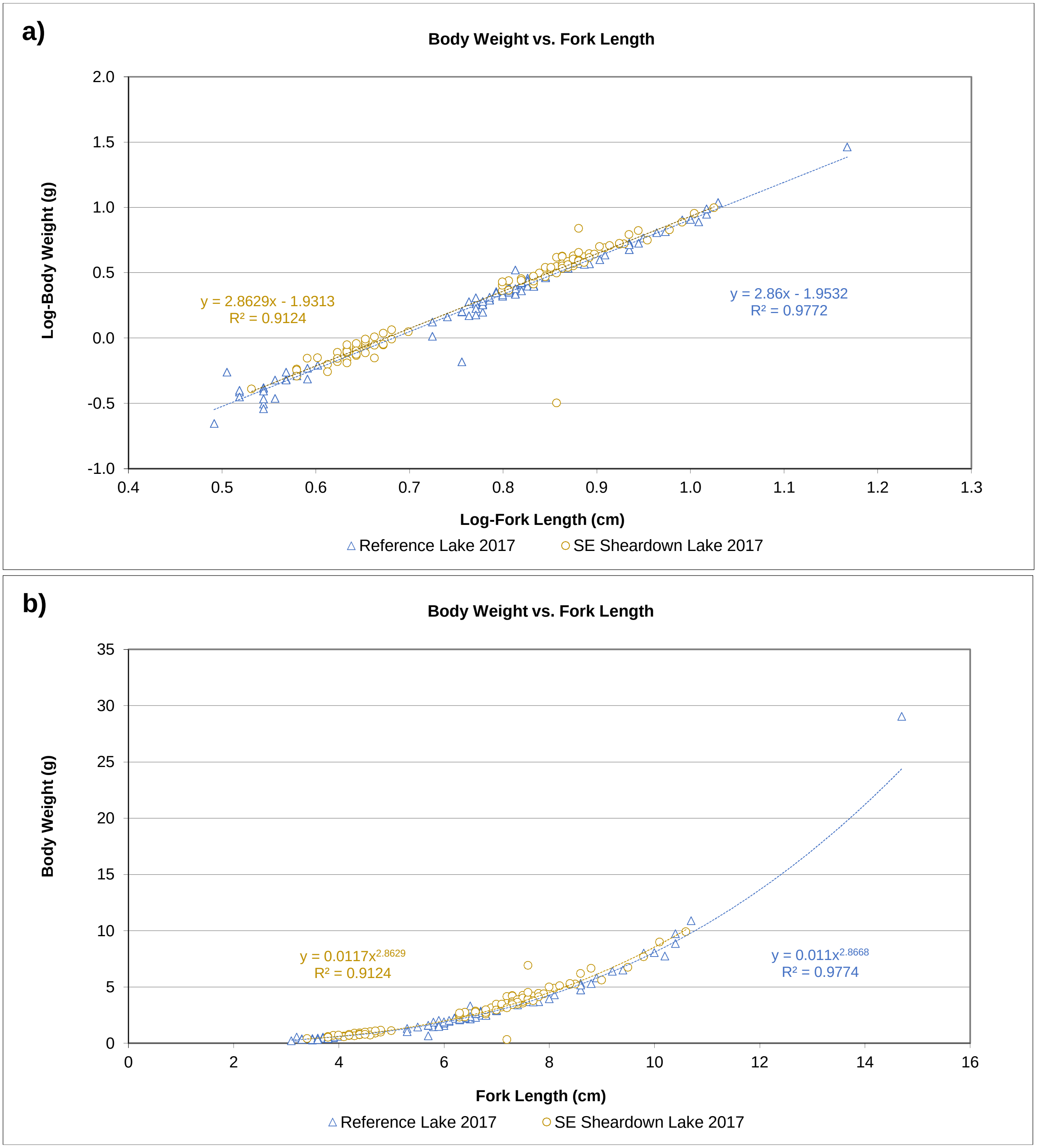
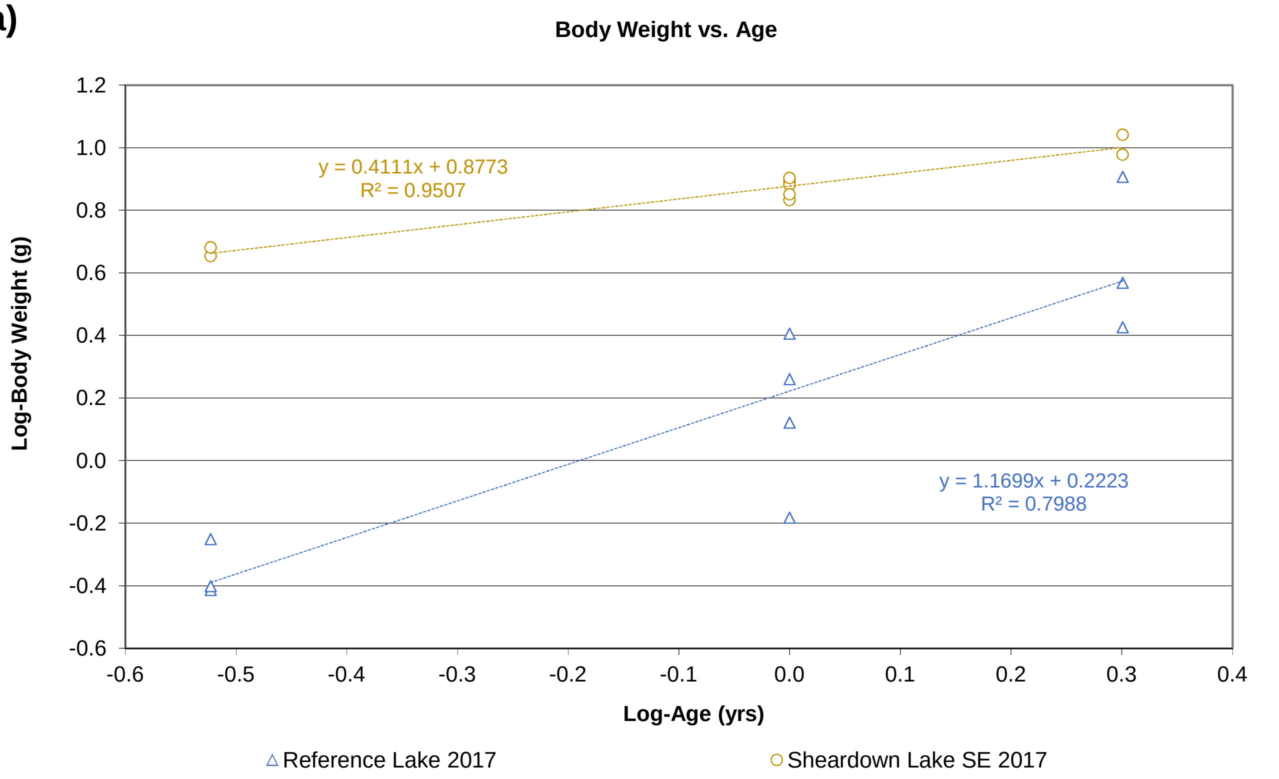


Figure G.16: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected at the Nearshore Area of Sheardown Lake SE and Reference Lake 3 in August 2017 using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP, 2017

a)



b)

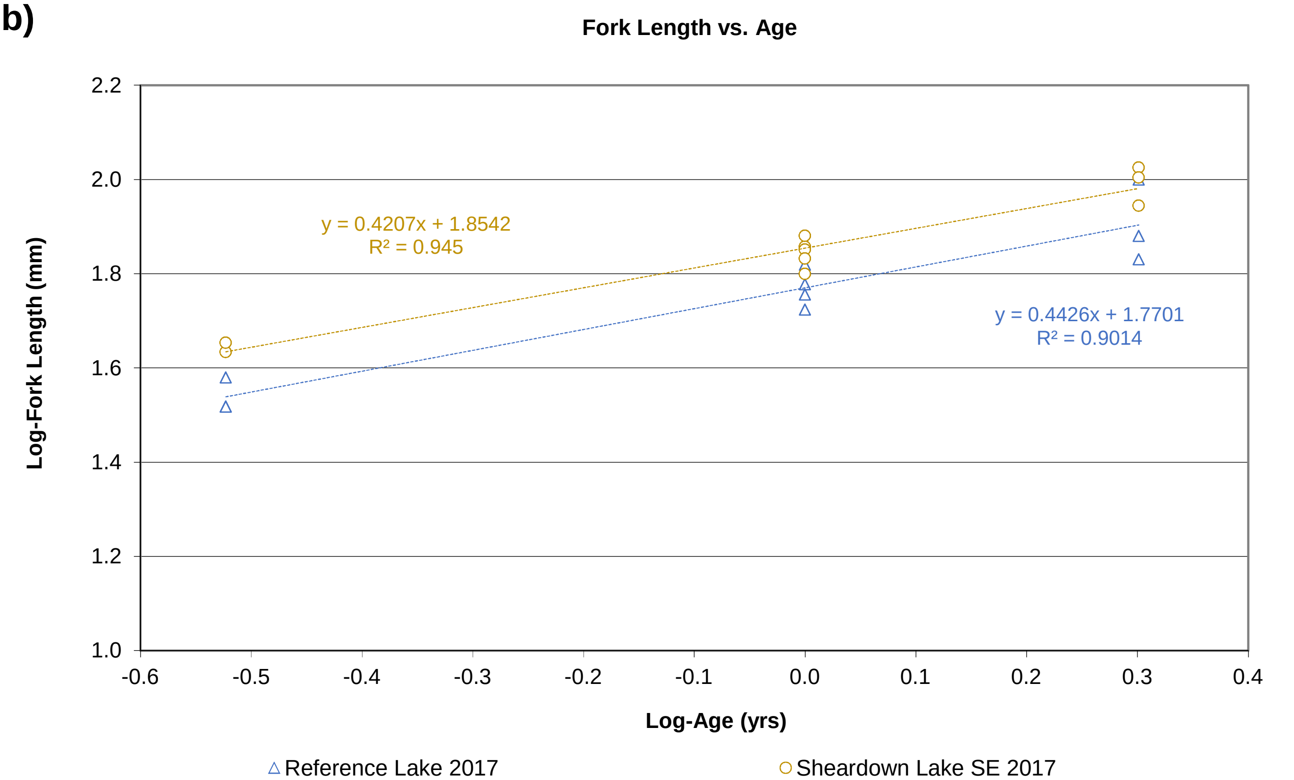
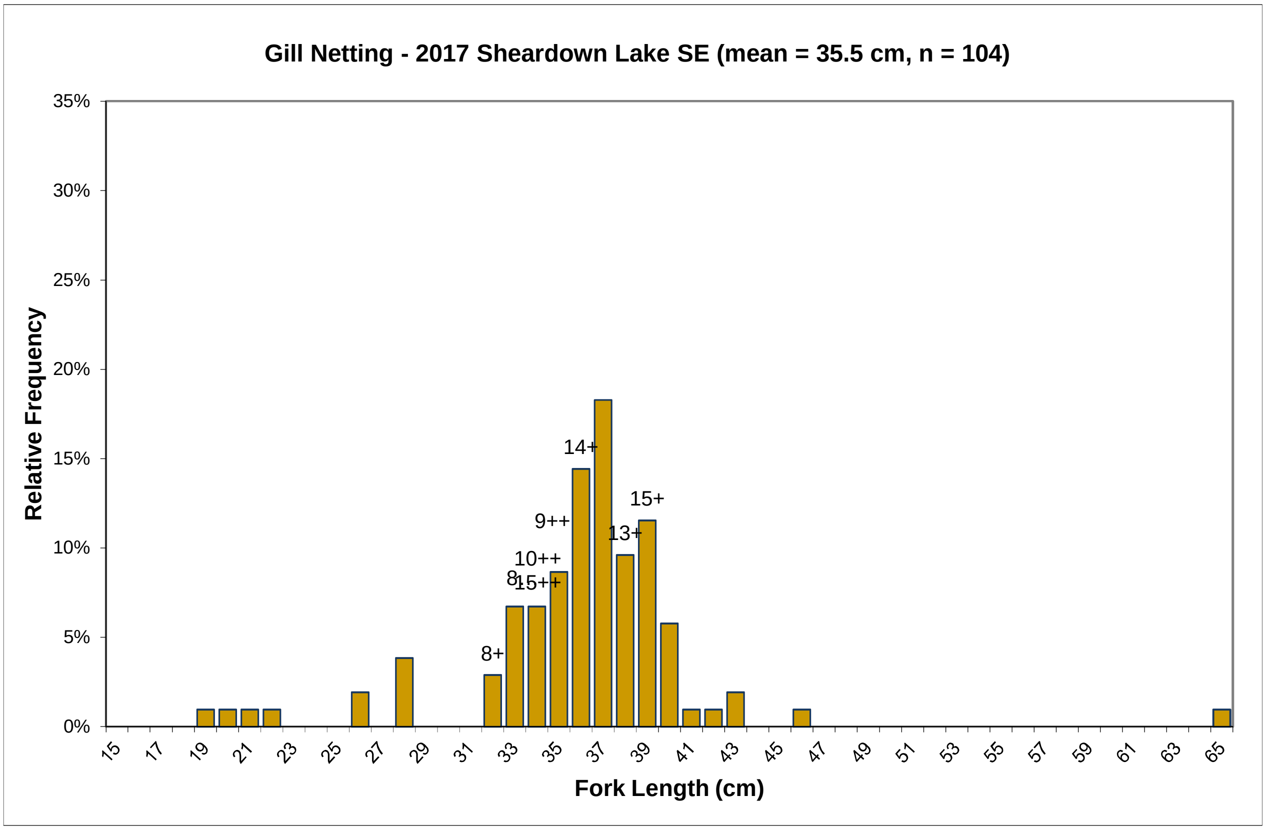


Figure G.17: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected at the Nearshore Area of Sheardown Lake SE and Reference Lake 3, Mary River Project CREMP, August 2017

Figure G.18: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2017 and During the Mine Baseline Period (2007) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



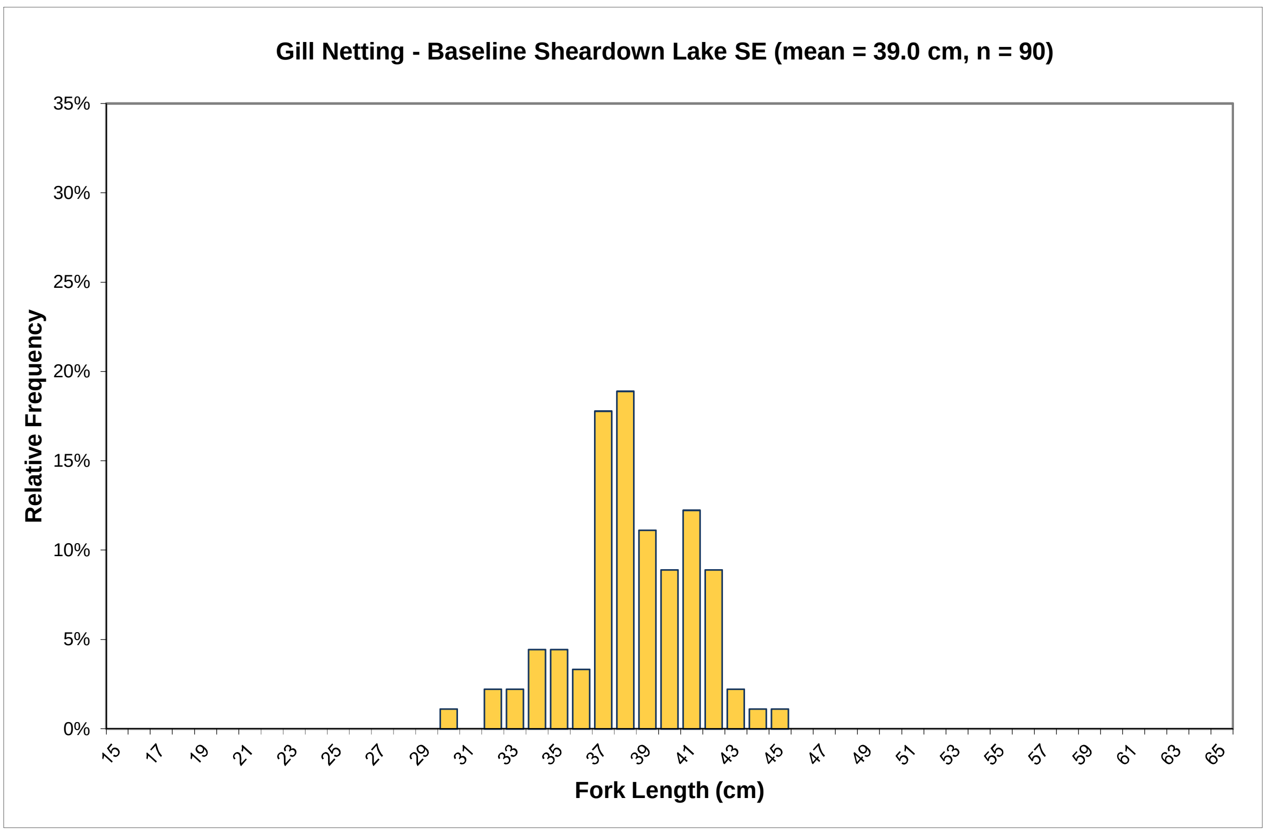
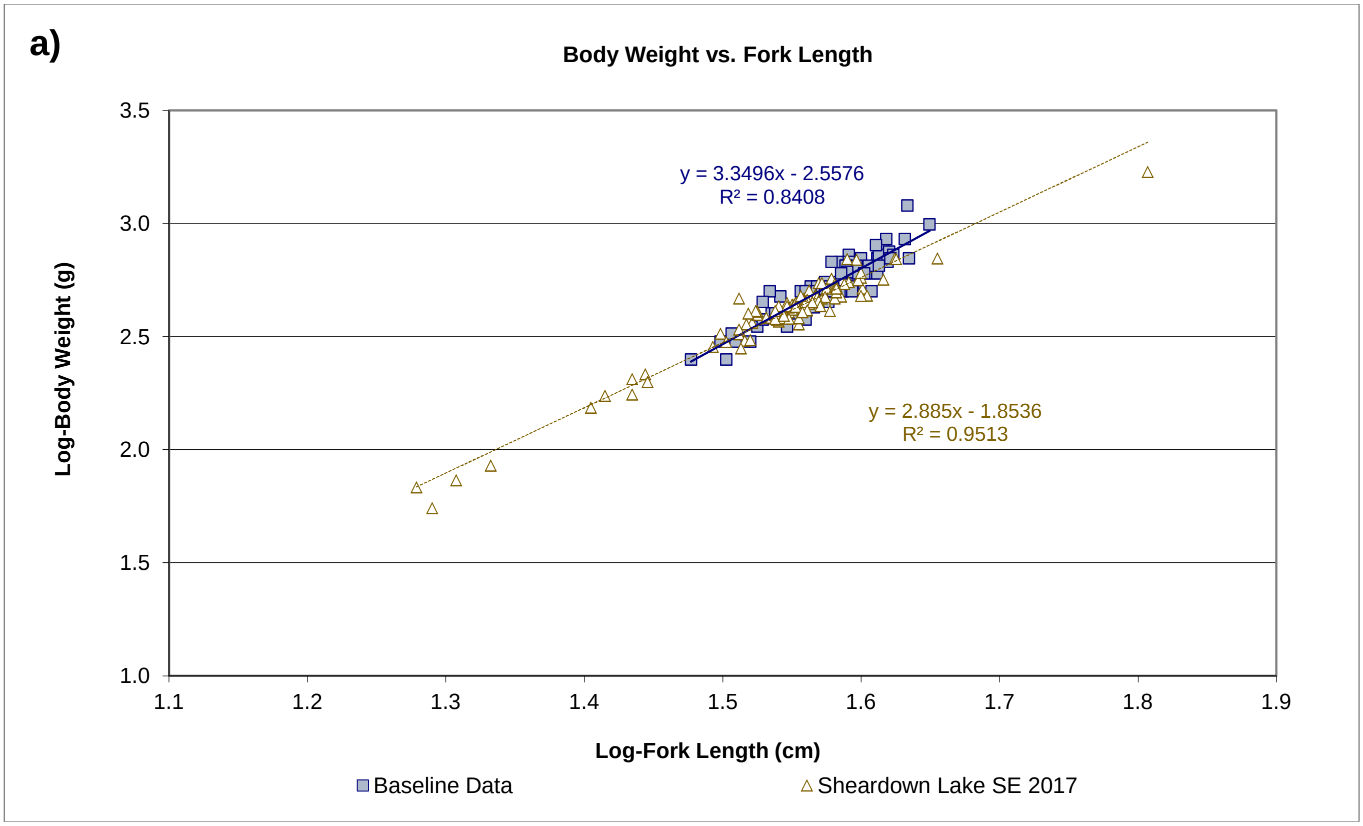


Figure G.19: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Sheardown Lake SE (DLO-02) in 2017 and Baseline Studies Conducted in Fall, Mary River Project CREMP

Note: Fish ages are shown above the bars, where available.



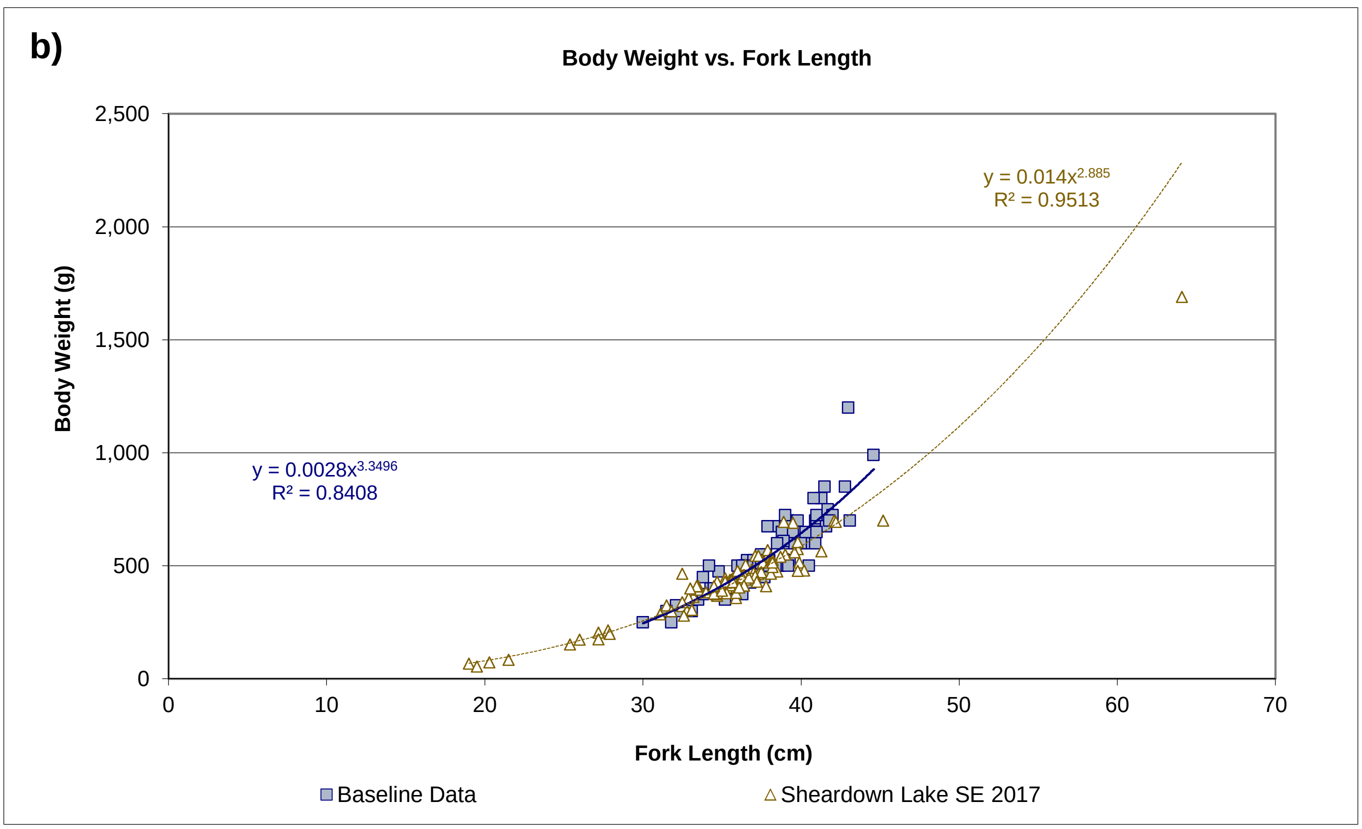


Figure G.20: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr collected in Fall (August-September) at Sheardown Lake SE Nearshore Areas in 2017 and During the Mine Baseline Period (2007, 2008) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP

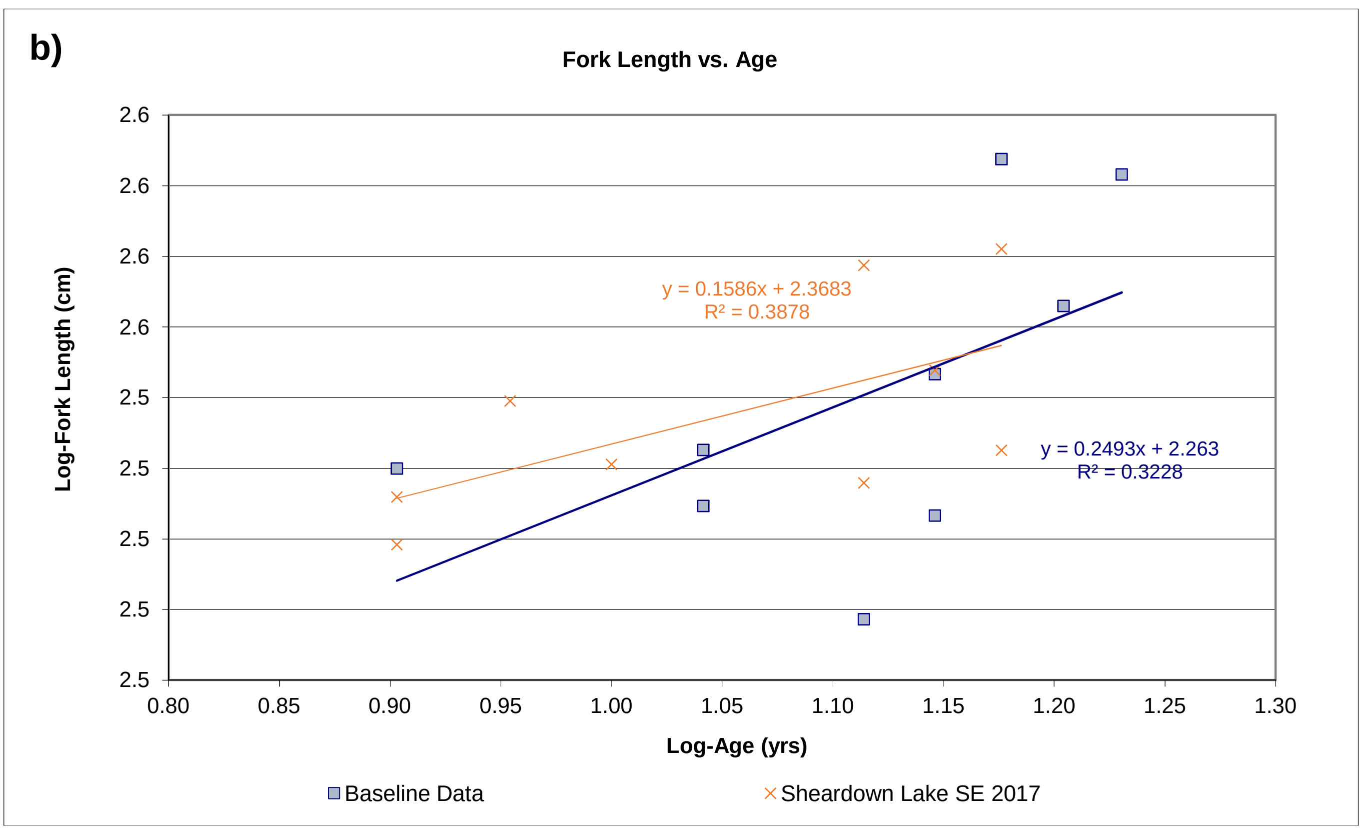


Figure G.21: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected in Fall (August-September) at Sheardown Lake SE Littoral/Profundal Areas in 2017 and During the Baseline Period (2007), Mary River Project CREMP

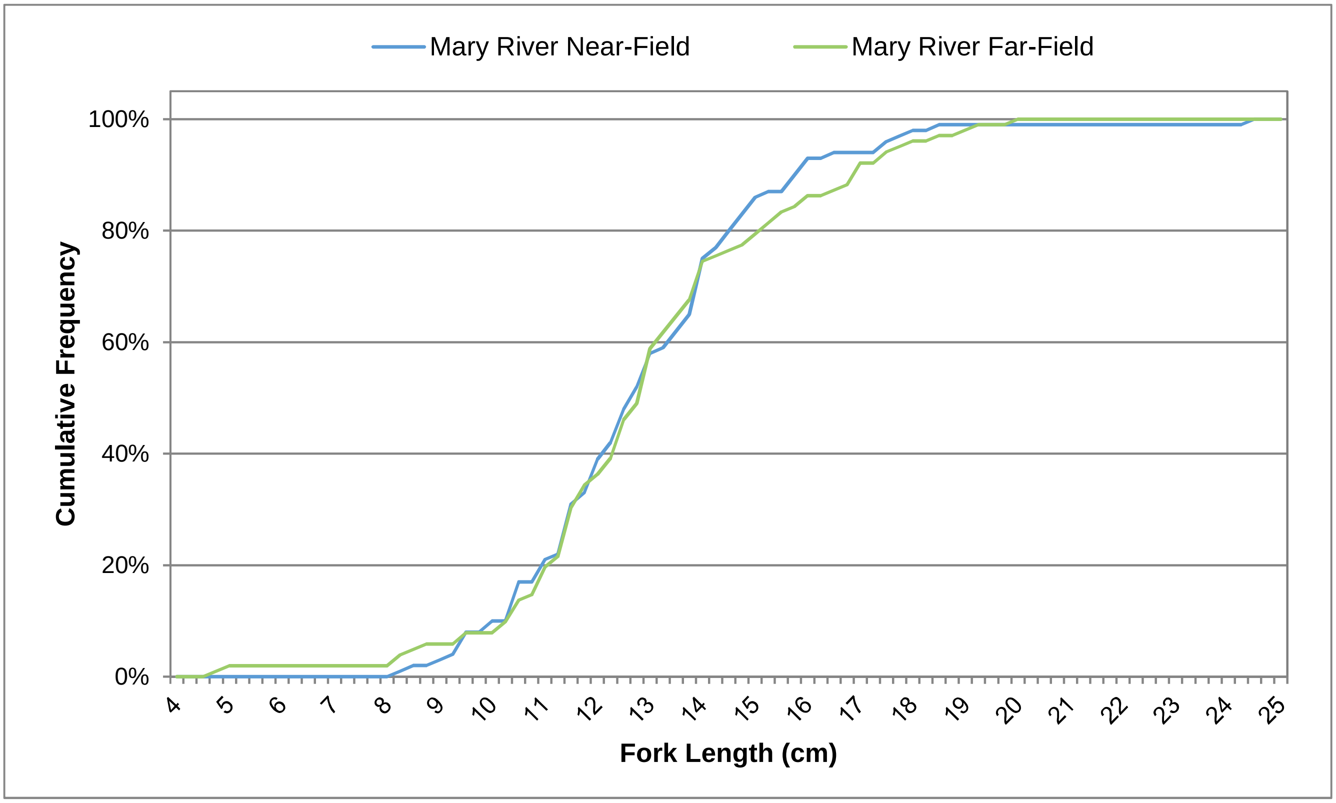


Figure G.22: Cumulative Length-frequency Distributions for Arctic Charr Captured at Mary River Near- and Far-Field Study Areas as Part of the Mary River Project EEM Study, August 2017

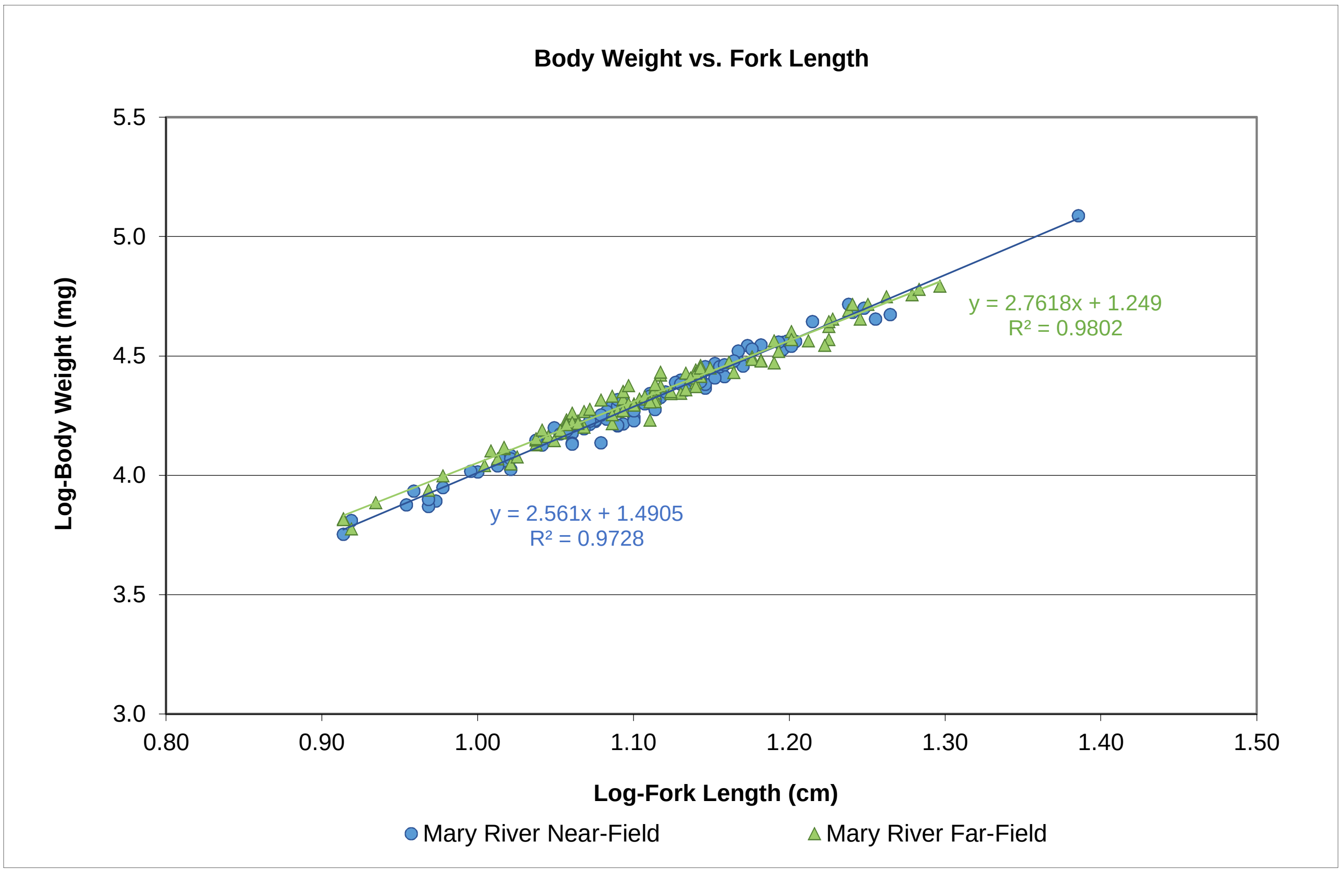
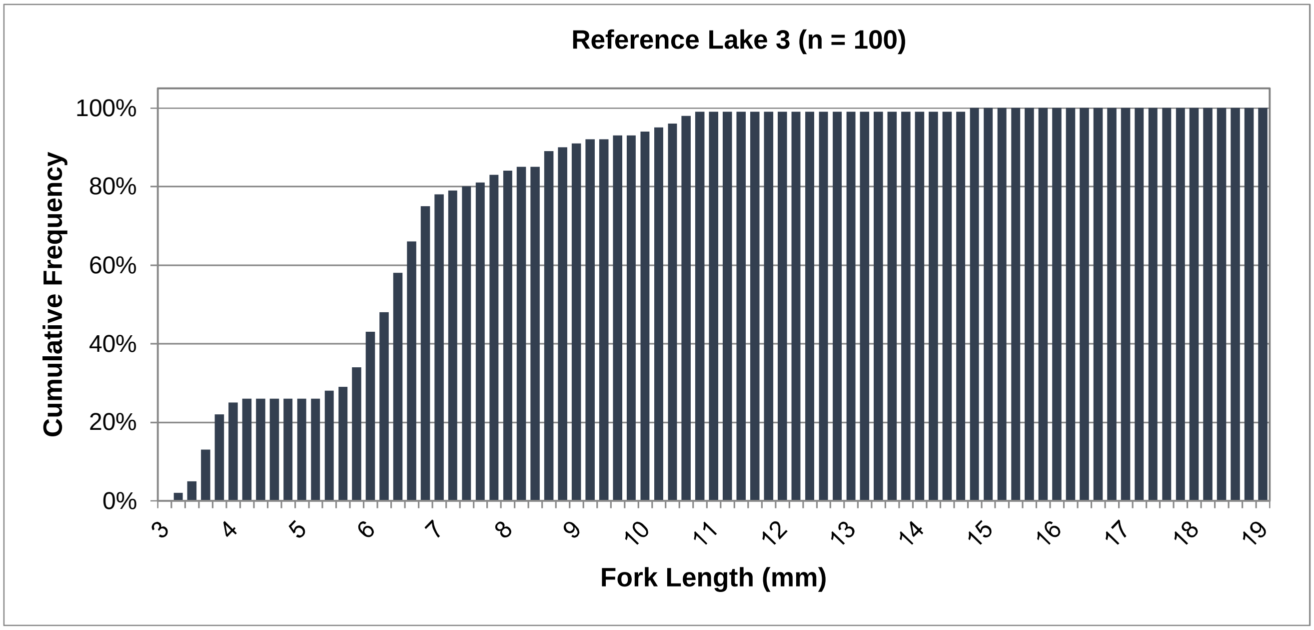


Figure G.23: **Comparison of Condition (Weight-at-Fork Length Relationship) for Arctic Charr Non-Young-of-the-Year (Non-YOY) Collected at Mary River Near- and Far-Field Areas as Part of the Mary River Project EEM Study, August 2017**



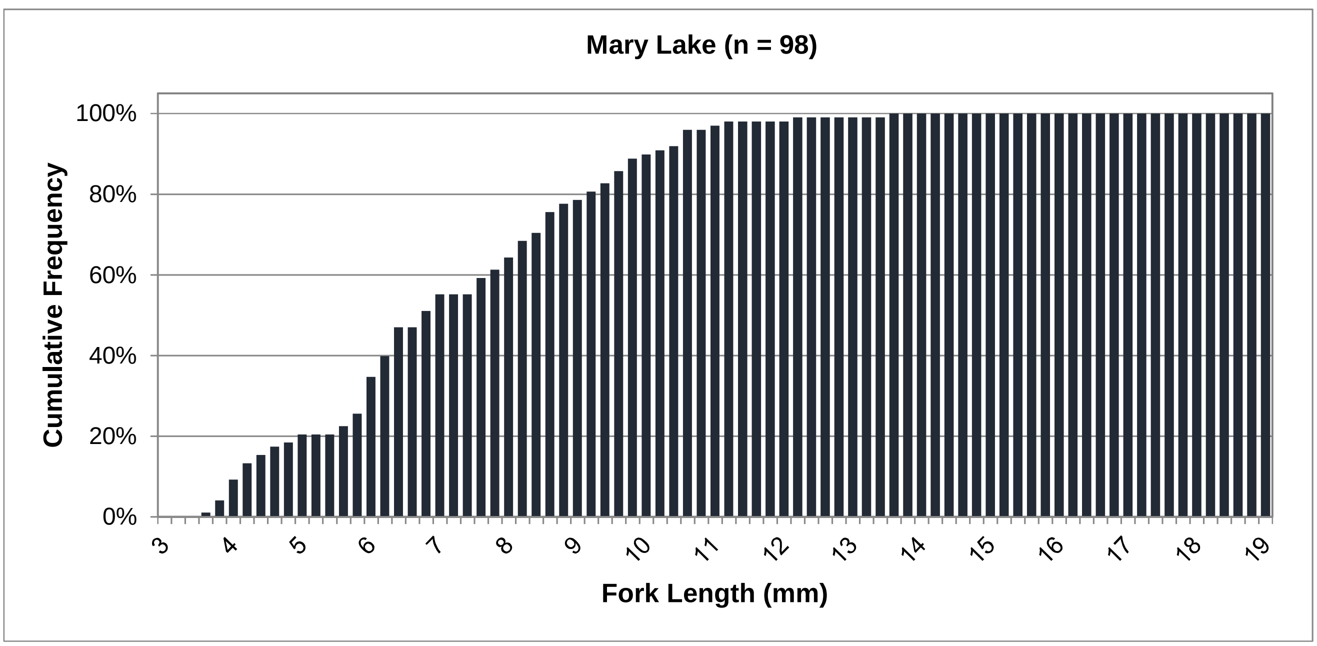
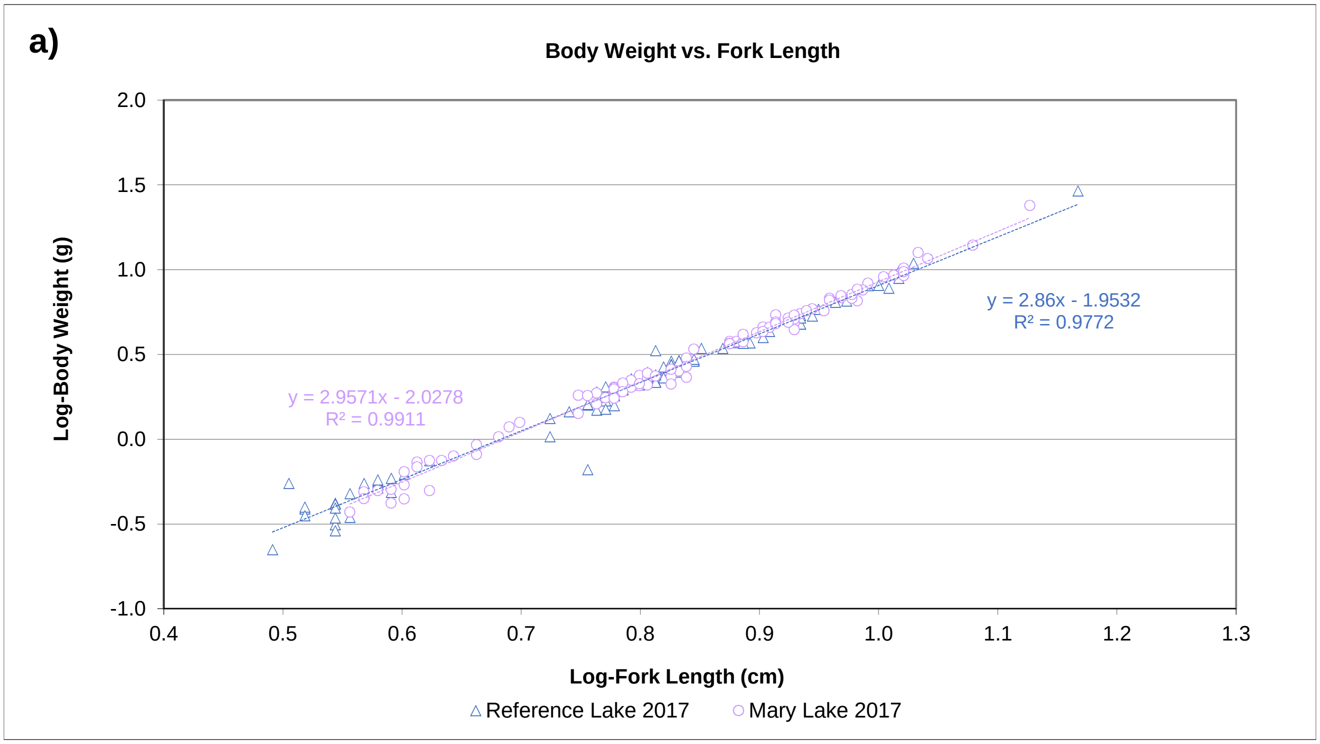


Figure G.24: Cumulative Length-frequency Distributions for Juvenile Arctic Charr Captured by Electrofishing at Nearshore Areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2017



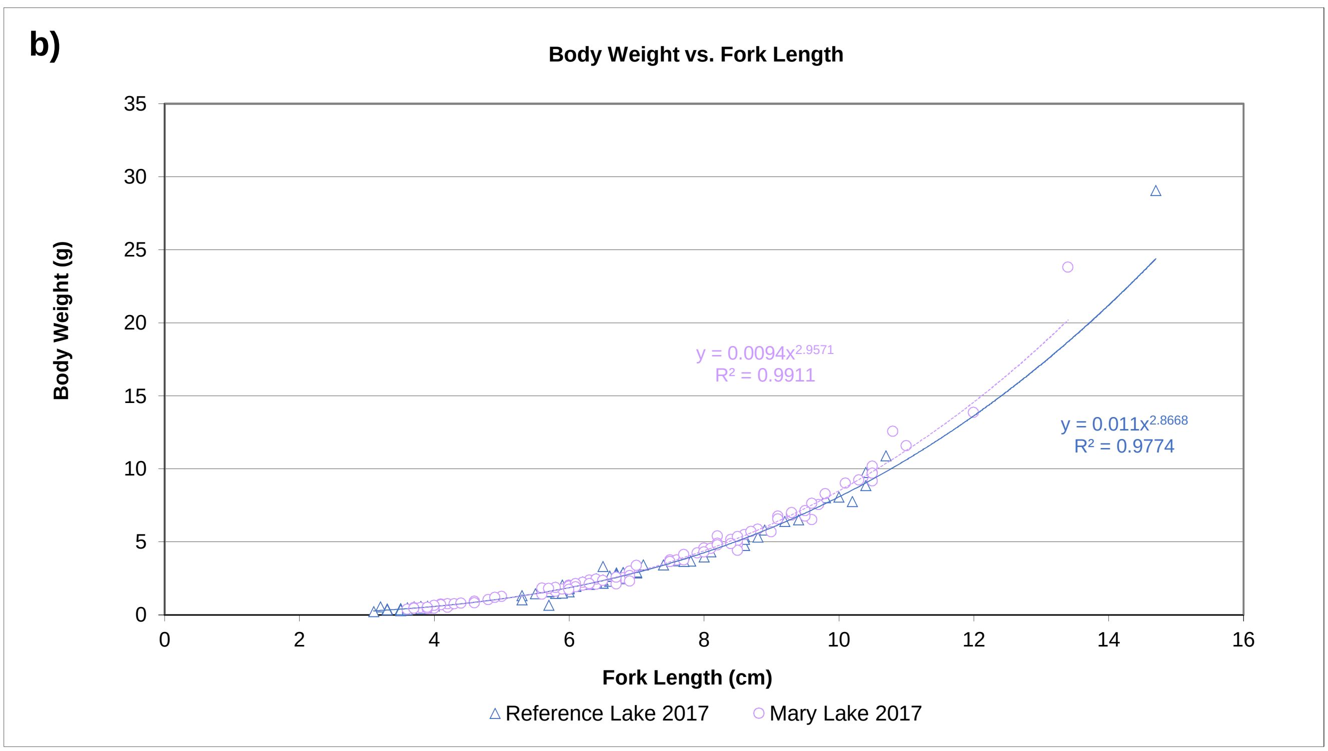


Figure G.25: Comparison of Condition (Weight-at-fork-Length Relationship) for Arctic Charr Collected at the Nearshore Area of Mary Lake and Reference Lake 3 in August 2017 using Log-Transformed (a) and Untransformed (b) Data, Mary River Project CREMP, 2017

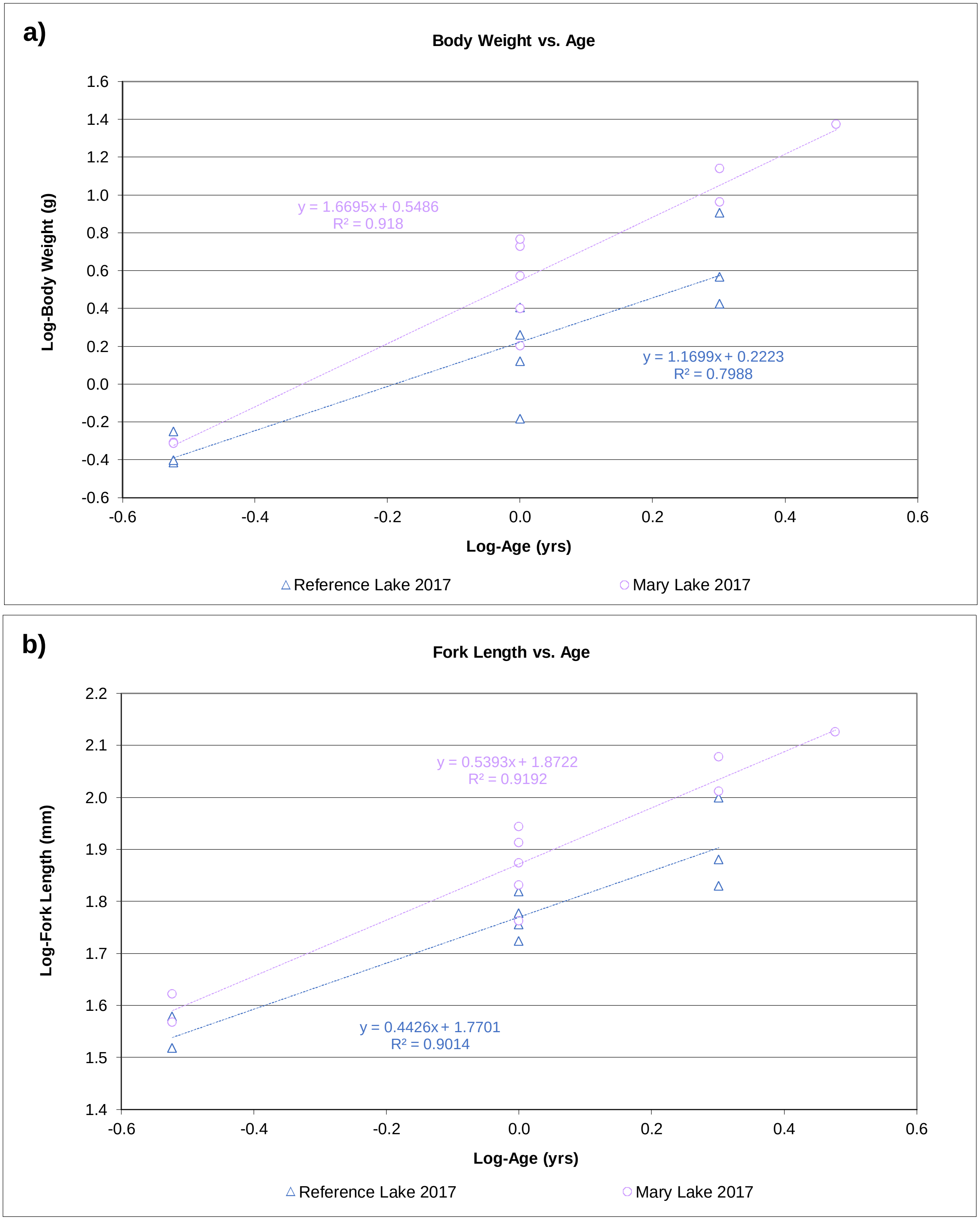
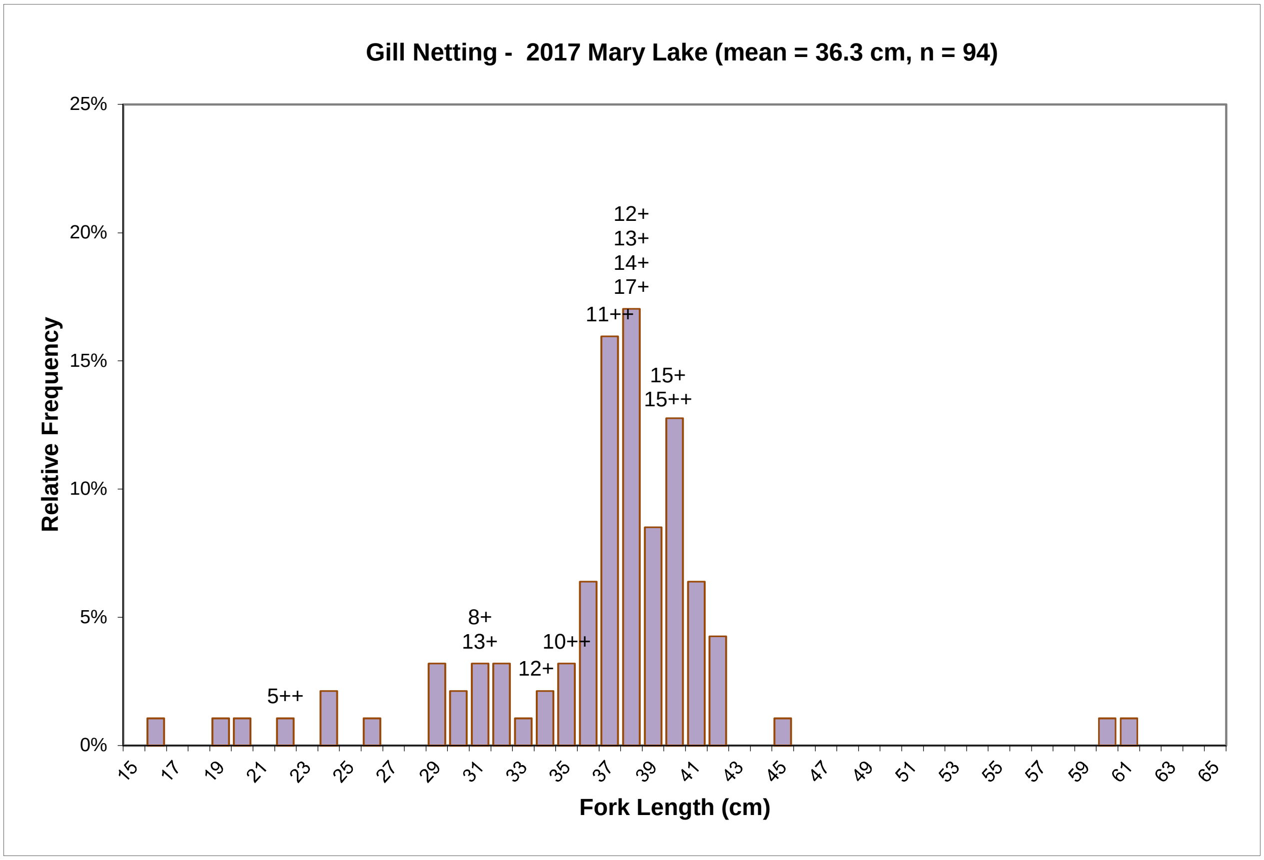


Figure G.26: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected at the Nearshore Areas of Mary Lake and Reference Lake 3, Mary River Project CREMP, August 2017



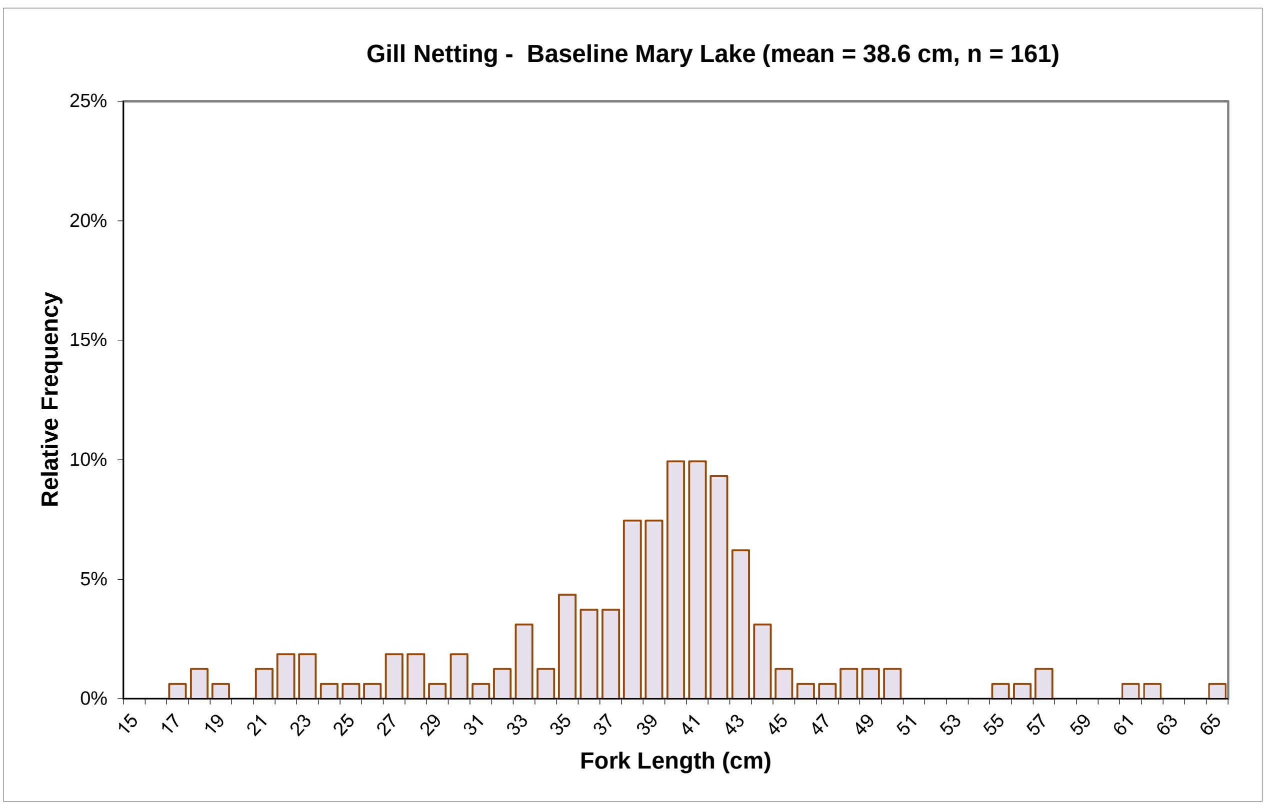
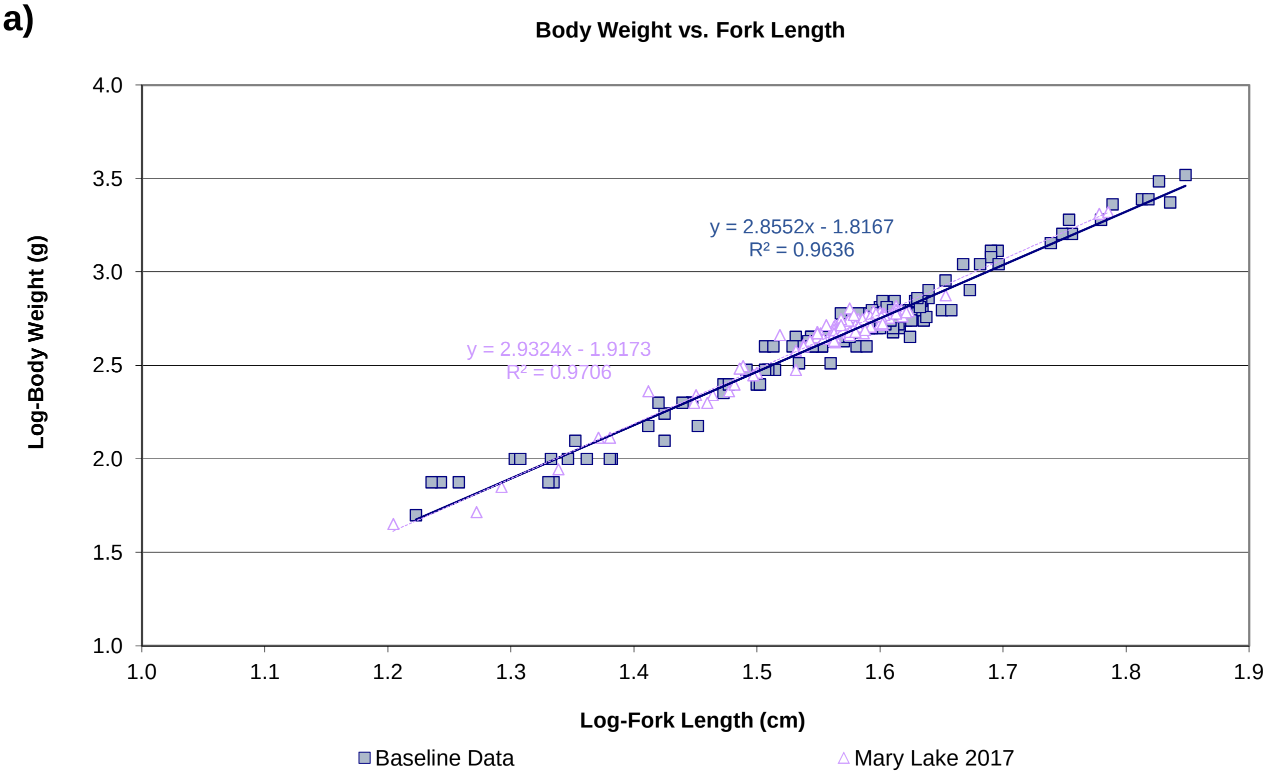


Figure G.27: Length-Frequency Distributions for Arctic Charr Captured by Gill Netting at Mary Lake (BLO) in 2017 and Baseline Studies Conducted in Fall, Mary River Project

Note: Fish ages are shown above the bars, where available.

a)



b)

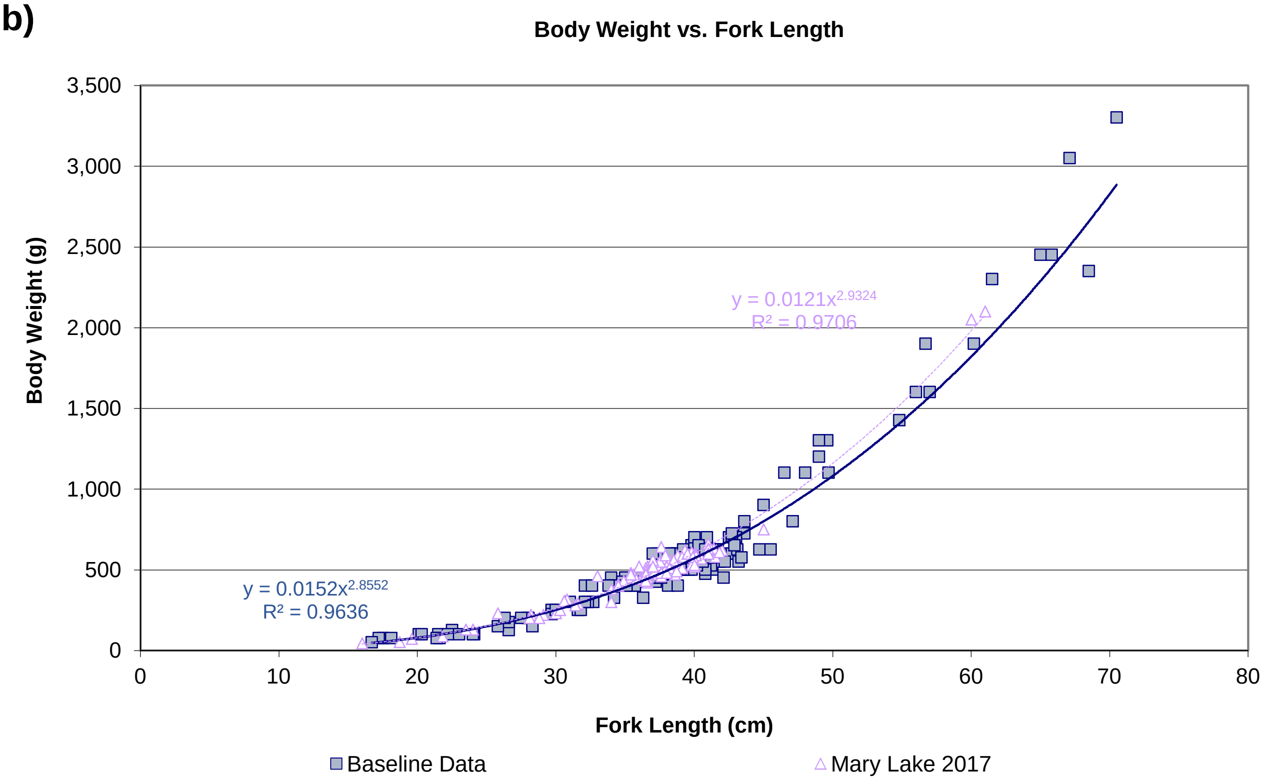
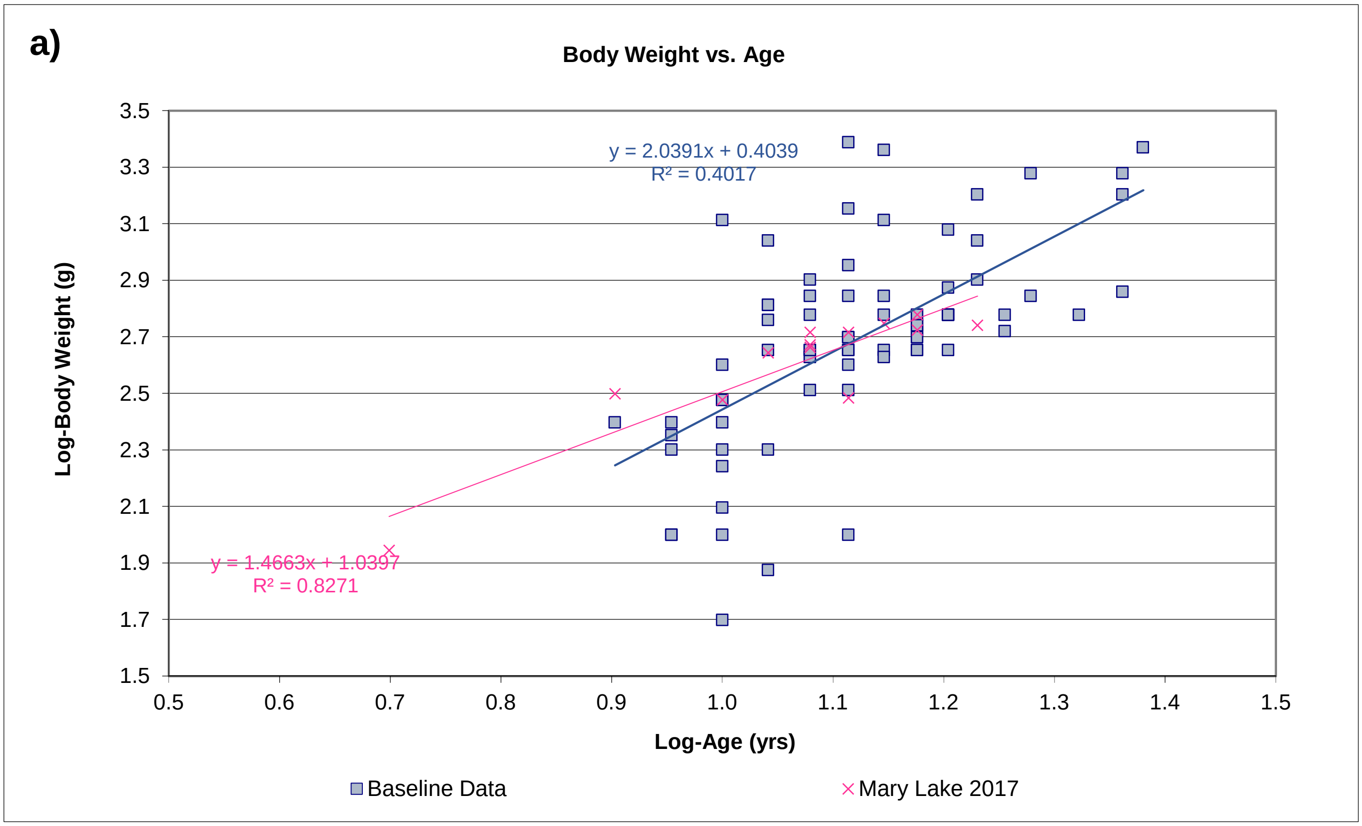


Figure G.28: Comparison of Condition (Weight-at-fork Length Relationship) for Arctic Charr Collected in Fall (August-September) at Mary Lake Nearshore Areas in 2017 and During the Mine Baseline Period (2006, 2007) using Log-transformed (a) and Untransformed (b) Data, Mary River Project CREMP



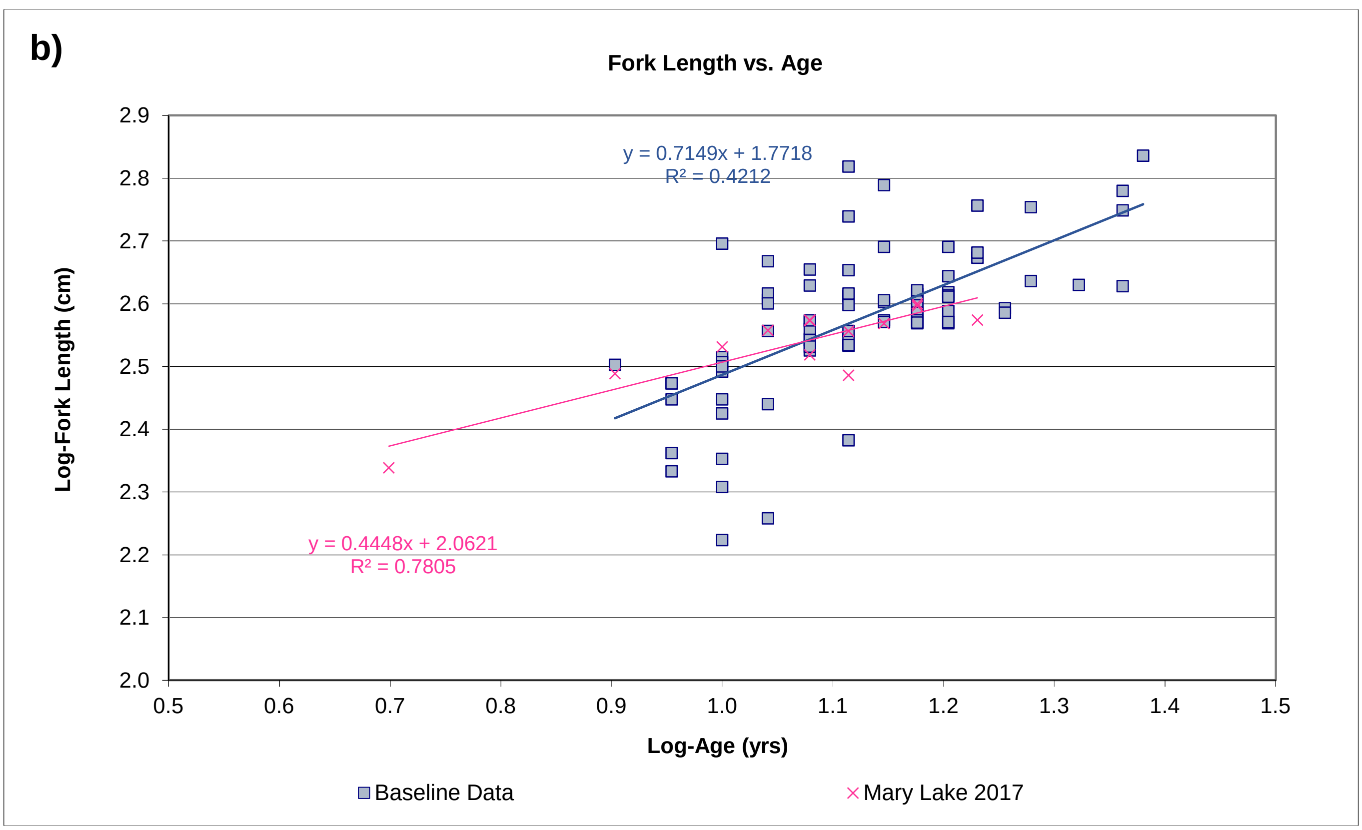


Figure G.29: Weight-at-age (a) and Length-at-age (b) Growth Relationships for Arctic Charr Collected in Fall (August-September) at Mary Lake Littoral and Profundal Areas in 2017 and During the Baseline Period (2006, 2007), Mary River Project CREMP

1) Mary River Tributary-F Benthic Reference Area.

2) Mary River Tributary-F Benthic Effluent-Exposed Area.

3) Mary River Tributary-F step-drop cascade barrier.

4) Mary River downstream of Mary River Tributary-F confluence.

Photo Plate G.1: Photographs of Mary River Tributary-F and Mary River at Gorge Area, August 2017

1) Mary River Fish Population Near-Field Study Area

2) Mary River Fish Population Near-Field Study Area Substrate

3) Mary River Fish Population Far-Field Study Area

4) Mary River Fish Population Far-Field Study Area Substrate

Photo Plate G.2: Photographs of Mary River Fish Population Survey Near- and Far-Field Study Areas, August 2017

Table G.1: Electrofishing Catch Records, Mary River Project CREMP, August 2017

Waterbody	Sample Station Identifier	Location (NAD83, UTM Zone 17W)				Fishing Date	Electrofisher Settings			Effort (seconds)	Fish Species				Total (all species)	
		Start		Finish							Arctic Charr		Nine-spine Stickleback			
		Easting	Northing	Easting	Northing		Output Voltage (volts)	Cycle Freq. (Hz)	Duty Cycle (%)		No. Captured	CPUE	No. Captured	CPUE	Total Catch	CPUE
Reference Lake 3	REF317-EF-1	575164	7853094	574878	7853051	21-Aug-17	450	30	10	5,833	100	1.03	11	0.11	111	1.14
Camp Lake	CL17-EF-1	557805	7914668	557804	7914619	16-Aug-17	400	30	10	1,672	97	3.48	4	0.14	101	3.62
Sheardown Lake NW	SDNW17-EF-1	560280	7913482	560212	7913481	19-Aug-17	450	30	10	1,239	101	4.89	0	0.00	101	4.89
Sheardown Lake SE	SDSE17-EF-1	560725	7912351	560853	7912244	19-Aug-17	450	30	10	1,349	100	4.45	15	0.67	115	5.11
Mary Lake	ML17-EF-1	555419	7905153	555501	7905001	18-Aug-17	450	30	10	4,152	98	1.42	20	0.29	118	1.71

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per electrofishing minute.

Table G.2: Gill Netting Catch Records for Reference Lake 3, Mary River Project CREMP, August 2017

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
REF317-GN-1	575881	7852703	91.4	29-Aug-17	29-Aug-17	10:00	12:25	2.42	2.21	0	0	0	0	0
				29-Aug-17	29-Aug-17	12:30	14:45	2.25	2.06	0	0	0	0	0
				29-Aug-17	29-Aug-17	14:45	16:30	1.75	1.60	0	0	0	0	0
REF317-GN-2	575750	7852542	91.4	29-Aug-17	29-Aug-17	10:23	12:35	2.20	2.01	0	0	0	0	0
				29-Aug-17	29-Aug-17	12:40	14:55	2.25	2.06	0	0	0	0	0
				29-Aug-17	29-Aug-17	14:55	16:35	1.67	1.52	0	0	0	0	0
REF317-GN-3	574253	7852451	91.4	29-Aug-17	29-Aug-17	10:45	13:00	2.25	2.06	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:05	15:10	2.08	1.90	0	0	0	0	0
				29-Aug-17	29-Aug-17	15:10	16:50	1.67	1.52	0	0	0	0	0
REF317-GN-4	573945	7852906	91.4	29-Aug-17	29-Aug-17	11:00	13:10	2.17	1.98	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:10	15:25	2.25	2.06	0	0	0	0	0
				29-Aug-17	29-Aug-17	15:25	17:00	1.58	1.45	0	0	0	0	0
REF317-GN-5	574499	7853078	91.4	29-Aug-17	29-Aug-17	11:15	13:15	2.00	1.83	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:15	15:40	2.42	2.21	0	1	0	1	0.45
				29-Aug-17	29-Aug-17	15:40	17:00	1.33	1.22	0	0	0	0	0
REF317-GN-6	574510	7853512	91.4	29-Aug-17	29-Aug-17	11:25	13:25	2.00	1.83	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:25	15:46	2.35	2.15	0	0	0	0	0
				29-Aug-17	29-Aug-17	15:46	17:15	1.48	1.36	0	0	0	0	0
REF317-GN-7	574014	7853834	91.4	29-Aug-17	29-Aug-17	11:40	13:40	2.00	1.83	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:40	16:00	2.33	2.13	0	0	0	0	0
				29-Aug-17	29-Aug-17	16:00	17:25	1.42	1.30	0	0	0	0	0
REF317-GN-8	573715	7853285	91.4	29-Aug-17	29-Aug-17	11:50	13:50	2.00	1.83	0	0	0	0	0
				29-Aug-17	29-Aug-17	13:50	16:10	2.33	2.13	0	0	0	0	0
				29-Aug-17	29-Aug-17	16:10	17:30	1.33	1.22	0	0	0	0	0
								Total	**43.46**	**0**	**1**	**0**	**1**	**0.02**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.3: Summary of Arctic Charr Gill Net Catches by Mesh Size, Mary River Project CREMP, August 2017

Waterbody	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE	Mortalities
		1½"	2"	3"			
Reference Lake 3	43.46	0	1	0	1	0.02	0
Camp Lake	66.37	0	42	35	96	1.40	10
Sheardown Lake NW	33.92	17	52	22	91	2.81	18
Sheardown Lake SE	17.62	19	42	44	105	5.96	10
Mary Lake	28.12	21	32	40	93	3.41	13
Total	**189.49**	**57**	**169**	**141**	**386**	**2.72**	**51**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.4: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF317-ACJ-1	6.6	7.0	2.548	1	0.886
REF317-ACJ-2	7.6	8.1	3.706	2+	0.844
REF317-ACJ-3	3.3	3.5	0.386	0++	1.074
REF317-ACJ-4	10.0	10.1	8.073	2++	0.807
REF317-ACJ-5	6.0	6.4	1.823	1+	0.844
REF317-ACJ-6	3.8	4.0	0.562	0++	1.024
REF317-ACJ-7	5.3	5.6	1.323	1+	0.889
REF317-ACJ-8	3.3	3.5	0.397	0++	1.105
REF317-ACJ-9	6.8	7.1	2.672	2+	0.861
REF317-ACJ-10	5.7	6.1	0.658	1+	0.355
REF317-ACJ-11	14.7	15.8	29.049	-	0.914
REF317-ACJ-12	6.0	6.3	1.575	-	0.729
REF317-ACJ-13	7.1	7.7	3.416	-	0.954
REF317-ACJ-14	6.5	6.9	2.178	-	0.793
REF317-ACJ-15	5.8	6.2	1.479	-	0.758
REF317-ACJ-16	6.4	6.9	2.247	-	0.857
REF317-ACJ-17	9.8	10.5	8.024	-	0.853
REF317-ACJ-18	8.6	9.3	5.347	-	0.841
REF317-ACJ-19	6.8	7.1	2.896	-	0.921
REF317-ACJ-20	3.5	3.7	0.312	-	0.728
REF317-ACJ-21	6.0	6.5	1.796	-	0.831
REF317-ACJ-22	6.7	7.1	2.496	-	0.830
REF317-ACJ-23	5.9	6.3	1.823	-	0.888
REF317-ACJ-24	5.3	5.6	1.032	-	0.693
REF317-ACJ-25	3.2	3.5	0.547	-	1.669
REF317-ACJ-26	3.5	3.7	0.417	-	0.973
REF317-ACJ-27	3.7	3.9	0.482	-	0.952
REF317-ACJ-28	4.0	4.2	0.619	-	0.967
REF317-ACJ-29	3.9	4.1	0.485	-	0.818
REF317-ACJ-30	3.5	3.7	0.412	-	0.961
REF317-ACJ-31	6.2	6.6	2.265	-	0.950
REF317-ACJ-32	7.8	8.2	3.693	-	0.778
REF317-ACJ-33	6.0	6.3	1.797	-	0.832
REF317-ACJ-34	6.5	6.8	2.164	-	0.788
REF317-ACJ-35	6.3	6.7	2.089	-	0.835
REF317-ACJ-36	6.8	7.1	2.512	-	0.799
REF317-ACJ-37	6.6	7.0	2.298	-	0.799
REF317-ACJ-38	5.9	6.3	1.678	-	0.817
REF317-ACJ-39	5.9	6.3	2.036	-	0.991
REF317-ACJ-40	6.7	7.1	2.878	-	0.957
REF317-ACJ-41	3.3	3.5	0.353	-	0.982
REF317-ACJ-42	3.5	3.7	0.392	-	0.914
REF317-ACJ-43	3.8	4.0	0.514	-	0.937
REF317-ACJ-44	8.6	9.2	4.758	-	0.748
REF317-ACJ-45	8.6	8.9	4.754	-	0.747
REF317-ACJ-46	6.1	6.5	1.975	-	0.870
REF317-ACJ-47	5.5	5.8	1.448	-	0.870
REF317-ACJ-48	6.7	7.1	2.754	-	0.916
REF317-ACJ-49	6.6	7.1	2.637	-	0.917
REF317-ACJ-50	3.7	3.9	0.548	-	1.082
REF317-ACJ-51	6.1	6.5	1.947	-	0.858
REF317-ACJ-52	6.8	7.3	2.478	-	0.788
REF317-ACJ-53	7.0	7.4	2.904	-	0.847
REF317-ACJ-54	6.4	6.7	2.331	-	0.889
REF317-ACJ-55	3.5	3.7	0.287	-	0.669
REF317-ACJ-56	6.5	6.9	3.319	-	1.209
REF317-ACJ-57	7.0	7.5	2.882	-	0.840
REF317-ACJ-58	6.4	6.8	2.467	-	0.941

Table G.4: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF317-ACJ-59		6.3	6.6	2.291	-	0.916
REF317-ACJ-60		5.7	6.0	1.585	-	0.856
REF317-ACJ-61		6.4	6.7	2.227	-	0.850
REF317-ACJ-62		10.2	10.9	7.756	-	0.731
REF317-ACJ-63		8.1	8.7	4.312	-	0.811
REF317-ACJ-64		6.2	6.5	2.217	-	0.930
REF317-ACJ-65		6.3	6.6	2.297	-	0.919
REF317-ACJ-66		8.6	9.3	5.179	-	0.814
REF317-ACJ-67		3.7	3.9	0.476	-	0.940
REF317-ACJ-68		6.7	7.1	2.731	-	0.908
REF317-ACJ-69		6.5	6.9	2.391	-	0.871
REF317-ACJ-70		8.9	9.5	5.812	-	0.824
REF317-ACJ-71		5.8	6.1	1.893	-	0.970
REF317-ACJ-72		5.9	6.2	1.502	-	0.731
REF317-ACJ-73		8.8	9.4	5.318	-	0.780
REF317-ACJ-74		6.0	6.5	1.906	-	0.882
REF317-ACJ-75		3.8	4.0	0.552	-	1.006
REF317-ACJ-76		10.7	11.4	10.896	-	0.889
REF317-ACJ-77		10.4	10.9	8.862	-	0.788
REF317-ACJ-78		10.4	11.3	9.746	-	0.866
REF317-ACJ-79		7.7	8.2	3.667	-	0.803
REF317-ACJ-80		6.8	7.2	2.885	-	0.918
REF317-ACJ-81		7.4	7.8	3.423	-	0.845
REF317-ACJ-82		6.1	6.5	2.048	-	0.902
REF317-ACJ-83		6.6	7.1	2.658	-	0.925
REF317-ACJ-84		6.4	6.7	2.285	-	0.872
REF317-ACJ-85		3.8	4.0	0.541	-	0.986
REF317-ACJ-86		8.0	8.5	3.972	-	0.776
REF317-ACJ-87		9.2	9.8	6.408	-	0.823
REF317-ACJ-88		5.7	6.0	1.598	-	0.863
REF317-ACJ-89		3.5	3.7	0.342	-	0.798
REF317-ACJ-90		9.4	10.1	6.519	-	0.785
REF317-ACJ-91		3.9	4.1	0.587	-	0.990
REF317-ACJ-92		3.6	3.8	0.476	-	1.020
REF317-ACJ-93		6.3	6.6	2.142	-	0.857
REF317-ACJ-94		7.0	7.4	2.947	-	0.859
REF317-ACJ-95		4.2	4.4	0.743	-	1.003
REF317-ACJ-96		3.8	4.0	0.574	-	1.046
REF317-ACJ-97		6.4	6.8	2.407	-	0.918
REF317-ACJ-98		3.1	3.3	0.222	-	0.745
REF317-ACJ-99		3.8	4.0	0.425	-	0.775
REF317-ACJ-100		3.6	3.8	0.345	-	0.739
Overall Catch Summary	Sample Size (N)	100	100	100	10	100
	Average	6.2	6.6	2.781	1.0	0.877
	Median	6.3	6.6	2.198	1.0	0.862
	Standard Deviation	2.1	2.2	3.430	0.82	0.134
	Standard Error	0.2	0.2	0.343	0.26	0.013
	Minimum	3.1	3.3	0.222	0	0.355
	Maximum	14.7	15.8	29.049	2	1.669
Young-of-the-Year Catch Summary	proportion of YOY			**26%**		
	Sample Size (N)	26	26	26	3	26
	Average	3.6	3.8	0.461	0	0.958
	Median	3.7	3.9	0.476	0	0.970
	Standard Deviation	0.3	0.3	0.118	0	0.189
	Standard Error	0.1	0.0	0.023	0	0.037
	Minimum	3.1	3.3	0.222	0	0.669
	Maximum	4.2	4.4	0.743	0	1.669

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL17-ACJ-1	11.3	12.4	13.345	1++	0.925
CL17-ACJ-2	5.3	5.7	1.357	1+	0.911
CL17-ACJ-3	12.0	12.9	13.862	2++	0.802
CL17-ACJ-4	16.9	18.5	39.359	4++	0.815
CL17-ACJ-5	15.4	16.7	29.552	3++	0.809
CL17-ACJ-6	8.0	8.6	4.242	2+	0.829
CL17-ACJ-7	8.6	9.3	4.960	1++	0.780
CL17-ACJ-8	8.3	8.8	4.774	1++	0.835
CL17-ACJ-9	8.8	9.4	4.977	1+	0.730
CL17-ACJ-10	5.9	6.2	1.740	1	0.847
CL17-ACJ-11	5.5	5.9	1.370	-	0.823
CL17-ACJ-12	10.9	11.9	11.060	-	0.854
CL17-ACJ-13	5.9	6.4	1.727	-	0.841
CL17-ACJ-14	6.3	6.6	2.132	-	0.853
CL17-ACJ-15	5.9	6.2	1.610	-	0.784
CL17-ACJ-16	6.4	6.7	2.252	-	0.859
CL17-ACJ-17	12.9	13.8	16.177	-	0.754
CL17-ACJ-18	9.0	9.6	5.946	-	0.816
CL17-ACJ-19	6.1	6.4	1.622	-	0.715
CL17-ACJ-20	4.7	4.9	0.821	-	0.791
CL17-ACJ-21	7.9	8.4	4.351	-	0.882
CL17-ACJ-22	7.2	7.6	3.042	-	0.815
CL17-ACJ-23	5.5	5.9	1.517	-	0.912
CL17-ACJ-24	10.0	10.7	8.451	-	0.845
CL17-ACJ-25	12.3	13.2	14.724	-	0.791
CL17-ACJ-26	16.4	17.6	34.887	-	0.791
CL17-ACJ-27	6.5	7.0	2.806	-	1.022
CL17-ACJ-28	7.8	8.2	3.762	-	0.793
CL17-ACJ-29	6.6	7.1	2.533	-	0.881
CL17-ACJ-30	8.4	9.1	4.937	-	0.833
CL17-ACJ-31	6.7	7.3	2.785	-	0.926
CL17-ACJ-32	8.3	8.9	4.435	-	0.776
CL17-ACJ-33	6.5	6.9	2.187	-	0.796
CL17-ACJ-34	5.4	5.7	1.165	-	0.740
CL17-ACJ-35	6.4	6.7	2.372	-	0.905
CL17-ACJ-36	6.6	7.2	2.726	-	0.948
CL17-ACJ-37	9.3	9.9	5.907	-	0.734
CL17-ACJ-38	13.8	14.9	22.236	-	0.846
CL17-ACJ-39	16.4	17.8	34.102	-	0.773
CL17-ACJ-40	11.3	12.2	11.275	-	0.781
CL17-ACJ-41	10.4	11.3	8.513	-	0.757
CL17-ACJ-42	7.8	8.4	3.857	-	0.813
CL17-ACJ-43	5.7	6.2	1.662	-	0.897
CL17-ACJ-44	6.8	7.3	2.635	-	0.838
CL17-ACJ-45	5.7	6.1	1.527	-	0.825
CL17-ACJ-46	5.9	6.4	1.995	-	0.971
CL17-ACJ-47	5.9	6.4	1.781	-	0.867
CL17-ACJ-48	5.2	5.5	1.249	-	0.888
CL17-ACJ-49	5.4	5.6	1.287	-	0.817
CL17-ACJ-50	11.5	12.5	13.410	-	0.882
CL17-ACJ-51	14.0	15.1	22.704	-	0.827
CL17-ACJ-52	10.8	11.7	9.180	-	0.729
CL17-ACJ-53	12.7	13.5	15.790	-	0.771
CL17-ACJ-54	12.0	13.1	13.382	-	0.774
CL17-ACJ-55	9.5	10.1	6.360	-	0.742
CL17-ACJ-56	8.4	8.9	4.726	-	0.797

Table G.5: Arctic Charr Measurements from Fish Captured at Camp Lake by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL17-ACJ-57		5.8	6.1	1.661	-	0.851
CL17-ACJ-58		7.4	7.9	3.534	-	0.872
CL17-ACJ-59		7.7	8.1	3.754	-	0.822
CL17-ACJ-60		7.2	7.6	3.392	-	0.909
CL17-ACJ-61		6.8	7.2	2.345	-	0.746
CL17-ACJ-62		5.9	6.3	1.664	-	0.810
CL17-ACJ-63		7.5	7.9	3.105	-	0.736
CL17-ACJ-64		5.9	6.3	1.915	-	0.932
CL17-ACJ-65		3.7	3.9	0.571	-	1.127
CL17-ACJ-66		6.0	6.6	2.051	-	0.950
CL17-ACJ-67		11.0	11.8	9.595	-	0.721
CL17-ACJ-68		12.7	13.7	16.695	-	0.815
CL17-ACJ-69		10.0	10.7	7.655	-	0.766
CL17-ACJ-70		9.3	9.9	6.104	-	0.759
CL17-ACJ-71		8.3	8.9	5.093	-	0.891
CL17-ACJ-72		11.9	13.0	11.890	-	0.706
CL17-ACJ-73		8.5	9.1	4.745	-	0.773
CL17-ACJ-74		6.8	7.2	2.695	-	0.857
CL17-ACJ-75		7.5	7.8	3.667	-	0.869
CL17-ACJ-76		6.7	6.9	2.051	-	0.682
CL17-ACJ-77		5.5	5.8	1.375	-	0.826
CL17-ACJ-78		6.3	6.6	2.120	-	0.848
CL17-ACJ-79		9.8	10.5	7.527	-	0.800
CL17-ACJ-80		5.6	6.0	1.538	-	0.876
CL17-ACJ-81		10.4	11.2	7.938	-	0.706
CL17-ACJ-82		5.9	6.3	1.903	-	0.927
CL17-ACJ-83		5.9	6.3	1.601	-	0.780
CL17-ACJ-84		5.7	6.0	1.272	-	0.687
CL17-ACJ-85		5.5	5.8	1.529	-	0.919
CL17-ACJ-86		12.0	12.9	14.565	-	0.843
CL17-ACJ-87		9.9	10.7	7.132	-	0.735
CL17-ACJ-88		10.8	11.6	9.551	-	0.758
CL17-ACJ-89		8.7	9.4	4.925	-	0.748
CL17-ACJ-90		8.4	8.9	4.415	-	0.745
CL17-ACJ-91		5.2	5.4	1.185	-	0.843
CL17-ACJ-92		6.2	6.6	2.001	-	0.840
CL17-ACJ-93		5.4	5.7	1.500	-	0.953
CL17-ACJ-94		5.7	6.1	2.191	-	1.183
CL17-ACJ-95		12.2	13.1	13.987	-	0.770
CL17-ACJ-96		6.1	6.4	1.914	-	0.843
CL17-ACJ-97		10.8	11.6	9.722	-	0.772
Overall Catch Summary	Sample Size (N)	97	97	97	10	97
	Average	8.3	8.9	6.569	1.7	0.828
	Median	7.5	7.9	3.667	1	0.822
	Standard Deviation	2.9	3.2	7.616	1.1	0.083
	Standard Error	0.3	0.3	0.773	0.3	0.008
	Minimum	3.7	3.9	0.571	1	0.682
	Maximum	16.9	18.5	39.359	4	1.183
Young-of-the-Year Catch Summary	proportion of YOY			**2%**		
	Sample Size (N)	2	2	2	-	2
	Average	4.2	4.4	0.696	-	0.959
	Median	4.2	4.4	0.696	-	0.959
	Standard Deviation	0.7	0.7	0.177	-	0.238
	Standard Error	0.5	0.5	0.125	-	0.168
	Minimum	3.7	3.9	0.571	-	0.791
	Maximum	4.7	4.9	0.821	-	1.127

Table G.6: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Camp Lake (JLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2017

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
								Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
			Response	Covariate	REF	JLO		Interaction P-value	Covariate P-value		Statistic	REF	JLO		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	97	K-S	-	-	-	-	-	-	<0.001	34
YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	26	2	-	-	-	-	Geometric Mean	3.6	3.6	-	0
		Body Weight	log[Body Weight (g)]	-	26	2	-	-	-	-	Geometric Mean	0.446	0.684	-	53
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	26	2	-	-	-	-	-	-	-	-	-
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	74	95	K-S	-	-	-	-	-	-	0.004	27
	Body Size	Fork Length	Fork Length (cm)	-	74	95	M-W	-	-	-	Median	6.6	7.7	0.031	17
		Body Weight	Body Weight (g)	-	74	95	M-W	-	-	-	Median	2.49	3.75	0.014	51
	Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	74	95	ANCOVA	0.652	<0.001	7.54	Adjusted Mean	3.63	3.55	0.101	-2.2

[shaded] P-value < 0.1

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.7: Results of Nearshore Arctic Charr Non-Young-of-the-Year (Non-YOY) Health Endpoint Statistical Comparisons between Samples Collected in 2017 and the Baseline Period at Individual Mine-Exposed Lakes, Mary River Project CREMP, 2017

Lake	Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
				Response	Covariate	Baseline	2017		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	Baseline	2017		
Camp (JLO)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	51	95	K-S	-	-	-	-	-	-	<0.001	-43
		Body Size	Fork Length	Fork Length (cm)	-	51	95	M-W	-	-	-	Median	11.8	7.7	<0.001	-35
			Body Weight	Body Weight (g)	-	51	95	M-W	-	-	-	Median	14.6	3.75	<0.001	-74
		Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	51	95	ANCOVA	0.445	<0.001	9.00	Adjusted Mean	6.56	5.91	<0.001	-9.9
Sheardown NW (DLO-01)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	247	89	K-S	-	-	-	-	-	-	0.021	19
		Body Size	Fork Length	Fork Length (cm)	-	247	89	M-W	-	-	-	Median	8.2	7.9	0.947	-3.7
			Body Weight	Body Weight (g)	-	247	89	M-W	-	-	-	Median	6.00	4.52	0.188	-25
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	247	89	ANCOVA	0.974	<0.001	9.00	Adjusted Mean	7.18	6.54	<0.001	-9.0
Sheardown SE (DLO-02)	Non-YOY	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	16	59	K-S	-	-	-	-	-	-	<0.001	65
		Body Size	Fork Length	log[Fork Length (cm)]	-	16	59	t-test	-	-	-	Geometric Mean	6.32	7.49	<0.001	19
			Body Weight	Body Weight (g)	-	16	59	M-W	-	-	-	Median	2.50	3.84	<0.001	54
		Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	16	59	ANCOVA	<0.001	<0.001	5.5	Predicted Mean	1.27	1.66	-	31
											7.2		4.34	3.49		-20
						16	58	ANCOVA	<0.001	<0.001	5.5	Predicted Mean	1.27	1.65	-	30
											7.2		4.34	3.46		-20

(Shaded cell) Indicates p-value < 0.1

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2017 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2017 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2017 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Sample SDSE17-ACJ-36 was detected as a statistical outlier (Studentized residual = 4.94) from the 2017 data set. The analysis is presented with both the inclusion and exclusion of this individual.

Table G.8: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Camp Lake Using 2017 Data Relative to Reference Lake 3 (2017) Data or Camp Lake Baseline (2006 - 2013) Data with α=β=0.1, Mary River Project CREMP, 2017

Comparison	Group	Indicator	Endpoint	Variables		Test	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5%	10%	20%	25%	30%	33%	40%	50%	100%
										-5%	-9%	-17%	-20%	-23%	-25%	-29%	-33%	-50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing Data) versus Reference Lake 3, 2017 Data	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	33.94	Response	916	231	60	39	27	22	17	11	4
			Body Weight	Body Weight (g)	-	M-W	-	172.4	Response	23,568	5,893	1,475	945	657	532	370	238	61
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03661	-	log(Response)	53	16	6	5	4	4	4	3	3
Nearshore Arctic Charr (Electrofishing Data) 2017 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	28.39	Response	641	161	42	27	20	17	12	9	4
			Body Weight	Body Weight (g)	-	M-W	-	87.66	Response	6,094	1,525	382	246	171	139	97	63	17
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03943	-	log(Response)	62	18	7	5	5	4	4	4	3
Littoral/Profundal Arctic Charr (Gill Netting Data) 2017 versus Baseline	All fish	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	25.01	Response	498	125	33	21	16	13	10	7	4
			Body Weight	Body Weight (g)	-	M-W	-	111.3	Response	9,825	2,458	616	395	275	223	156	100	26
		Growth	Weight-at-age	log[Adjusted Body Weight (g)]	log[Age (years)]	ANCOVA	0.26375	-	log(Response)	2,656	698	192	129	94	79	58	41	15
			Length-at-age	log[Fork Length (cm)]	log[Age (years)]	ANCOVA	0.08081	-	log(Response)	251	67	20	14	11	9	8	6	4
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.06395	-	log(Response)	158	43	13	10	8	7	6	5	4

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

Table G.9: Arctic Charr Measurements from Fish Captured at Reference Lake 3 by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
REF316-AC-01	2	36.5	40.0	435	-	0.895

Table G.10: Gill Netting Catch Records for Camp Lake, Mary River Project CREMP, August 2017

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
CL17-GN-1	557640	7914728	91.4	19-Aug-17	19-Aug-17	11:50	14:00	2.17	1.98	1	2	2	5	2.52
				19-Aug-17	19-Aug-17	14:10	15:20	1.17	1.07	0	2	0	2	1.87
				20-Aug-17	20-Aug-17	8:50	10:30	1.67	1.52	0	5	1	6	3.94
				20-Aug-17	20-Aug-17	10:55	12:50	1.92	1.75	2	2	1	5	2.85
				20-Aug-17	20-Aug-17	13:05	15:10	2.08	1.90	0	3	2	5	2.62
				20-Aug-17	20-Aug-17	15:30	16:40	1.17	1.07	1	0	0	1	0.94
				22-Aug-17	22-Aug-17	7:55	9:25	1.50	1.37	0	2	2	4	2.92
				22-Aug-17	22-Aug-17	9:36	10:25	0.82	0.75	2	0	1	3	4.02
				22-Aug-17	22-Aug-17	10:35	12:00	1.42	1.30	0	1	0	1	0.8
				22-Aug-17	22-Aug-17	12:10	13:05	0.92	0.84	0	0	1	1	1.19
CL17-GN-2	557498	7914807	91.4	19-Aug-17	19-Aug-17	11:55	14:15	2.33	2.13	1	1	1	3	1.41
				19-Aug-17	19-Aug-17	14:30	15:30	1.00	0.91	0	1	1	2	2.19
				20-Aug-17	20-Aug-17	8:55	11:00	2.08	1.90	1	2	1	4	2.10
				20-Aug-17	20-Aug-17	11:10	13:10	2.00	1.83	0	1	1	2	1.09
				20-Aug-17	20-Aug-17	13:15	15:35	2.33	2.13	0	0	3	3	1.41
				20-Aug-17	20-Aug-17	15:40	16:50	1.17	1.07	1	1	0	2	1.87
				22-Aug-17	22-Aug-17	8:00	9:36	1.60	1.46	0	0	1	1	0.68
				22-Aug-17	22-Aug-17	9:45	10:35	0.83	0.76	0	1	0	1	1.31
				22-Aug-17	22-Aug-17	10:46	12:10	1.40	1.28	0	1	0	1	0.8
				22-Aug-17	22-Aug-17	12:18	13:10	0.87	0.79	0	0	0	0	0.00
CL17-GN-3	557495	7914816	91.4	19-Aug-17	19-Aug-17	12:00	14:30	2.50	2.29	0	0	2	2	0.87
				20-Aug-17	20-Aug-17	9:00	11:10	2.17	1.98	0	0	0	0	0.00
				20-Aug-17	20-Aug-17	11:15	13:20	2.08	1.90	0	0	0	0	0.00
				22-Aug-17	22-Aug-17	8:05	9:40	1.58	1.45	0	1	1	2	1.38
				22-Aug-17	22-Aug-17	9:55	10:55	1.00	0.91	0	0	0	0	0.00
				22-Aug-17	22-Aug-17	10:55	12:20	1.42	1.30	1	0	1	2	1.54
				22-Aug-17	22-Aug-17	12:25	13:20	0.92	0.84	0	0	0	0	0.00
CL17-GN-4	557245	7914869	91.4	19-Aug-17	19-Aug-17	12:10	14:55	2.75	2.51	1	5	2	8	3.18
				20-Aug-17	20-Aug-17	9:05	11:20	2.25	2.06	1	1	2	4	1.94
				20-Aug-17	20-Aug-17	11:35	13:25	1.83	1.68	1	1	0	2	1.19
				20-Aug-17	20-Aug-17	13:35	15:40	2.08	1.91	0	3	0	3	1.57
				22-Aug-17	22-Aug-17	8:10	9:56	1.77	1.62	0	0	0	0	0.00
				22-Aug-17	22-Aug-17	10:05	11:00	0.92	0.84	0	0	0	0	0.00
CL17-GN-5	557135	7915023	91.4	19-Aug-17	19-Aug-17	12:15	15:05	2.83	2.59	0	0	2	2	0.77
				22-Aug-17	22-Aug-17	10:20	12:55	2.58	2.36	1	3	1	5	2.12
				22-Aug-17	22-Aug-17	12:45	13:35	0.83	0.76	0	0	0	0	0.00
CL17-GN-6	557191	7914974	91.4	20-Aug-17	20-Aug-17	9:10	11:40	2.50	2.29	2	0	0	2	0.87
				20-Aug-17	20-Aug-17	11:45	13:40	1.92	1.75	0	2	4	6	3.42
				20-Aug-17	20-Aug-17	13:55	15:43	1.80	1.65	0	1	0	1	0.61
				22-Aug-17	22-Aug-17	11:05	12:50	1.75	1.60	2	0	0	2	1.25
CL17-GN-7	557789	7914572	91.4	20-Aug-17	20-Aug-17	13:20	16:05	2.75	2.51	0	0	2	2	0.8
				22-Aug-17	22-Aug-17	8:15	10:10	1.92	1.75	1	0	0	1	0.57
								Total	**66.4**	**0**	**42**	**35**	**96**	**1.40**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL17-AC-01	3	37.6	41.0	500	-	0.941
CL17-AC-02	3	34.5	37.0	395	-	0.962
CL17-AC-03	2	38.0	40.9	493	15	0.898
CL17-AC-04	2	37.6	41.5	515	-	0.969
CL17-AC-05	1½	38.2	41.2	495	-	0.888
CL17-AC-06	3	36.5	39.7	485	-	0.997
CL17-AC-07	2	33.8	36.8	408	12+	1.057
CL17-AC-08	1½	38.1	41.5	510	-	0.922
CL17-AC-09	3	43.0	47.2	690	-	0.868
CL17-AC-10	3	37.5	40.5	508	-	0.963
CL17-AC-11	3	35.2	37.3	435	-	0.997
CL17-AC-12	3	34.5	37.8	435	-	1.059
CL17-AC-13	2	36.4	39.8	445	-	0.923
CL17-AC-14	2	38.0	41.9	405	-	0.738
CL17-AC-15	2	36.6	40.0	475	-	0.969
CL17-AC-16	2	37.5	40.9	455	-	0.863
CL17-AC-17	2	35.9	38.5	406	-	0.877
CL17-AC-18	1½	38.0	41.2	438	-	0.798
CL17-AC-19	3	35.8	38.7	433	-	0.944
CL17-AC-20	3	37.4	40.6	515	-	0.984
CL17-AC-21	2	31.8	34.4	310	-	0.964
CL17-AC-22	2	41.5	45.4	580	-	0.811
CL17-AC-23	3	38.3	41.5	475	-	0.845
CL17-AC-24	2	35.3	38.6	445	-	1.012
CL17-AC-25	3	37.5	40.7	540	-	1.024
CL17-AC-26	2	38.0	41.5	535	-	0.975
CL17-AC-27	2	37.3	40.7	540	-	1.041
CL17-AC-28	2	36.0	39.2	408	16++	0.874
CL17-AC-29	2	38.0	41.1	463	-	0.844
CL17-AC-30	2	33.9	36.8	393	-	1.009
CL17-AC-31	3	37.1	40.2	465	-	0.911
CL17-AC-32	2	28.8	31.0	220	-	0.921
CL17-AC-33	2	37.0	40.1	480	-	0.948
CL17-AC-34	3	36.3	39.2	458	-	0.958
CL17-AC-35	2	36.0	39.1	433	15	0.928
CL17-AC-36	1½	37.6	41.0	498	-	0.937
CL17-AC-37	1½	38.2	40.7	518	-	0.929
CL17-AC-38	1½	36.2	39.3	435	-	0.917
CL17-AC-39	1½	38.1	41.5	515	-	0.931
CL17-AC-40	3	39.1	42.7	502	-	0.840
CL17-AC-41	2	38.1	41.2	528	-	0.955
CL17-AC-42	2	37.6	41.0	458	-	0.862
CL17-AC-43	1½	37.4	30.4	495	-	0.946
CL17-AC-44	1½	38.7	42.4	543	-	0.937
CL17-AC-45	3	36.2	39.2	514	-	1.084
CL17-AC-46	2	36.0	38.6	443	10+	0.950
CL17-AC-47	2	37.0	39.9	485	14++	0.957
CL17-AC-48	1½	35.4	38.0	343	-	0.773
CL17-AC-49	3	36.3	39.4	483	-	1.010
CL17-AC-50	3	38.2	41.6	525	-	0.942
CL17-AC-51	3	39.0	42.3	565	-	0.952
CL17-AC-52	3	39.5	42.6	495	-	0.803
CL17-AC-53	2	36.3	39.2	458	18++	0.958
CL17-AC-54	2	39.1	42.5	552	-	0.923
CL17-AC-55	3	37.6	40.2	538	-	1.012
CL17-AC-56	3	34.2	37.1	420	-	1.050

Table G.11: Arctic Charr Measurements from Fish Captured at Camp Lake by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
CL17-AC-57	2	28.9	31.2	215	-	0.891
CL17-AC-58	2	28.0	30.2	208	-	0.948
CL17-AC-59	2	35.0	38.0	445	-	1.038
CL17-AC-60	3	36.9	40.4	443	-	0.882
CL17-AC-61	3	36.9	40.2	545	-	1.085
CL17-AC-62	3	39.8	42.5	548	-	0.869
CL17-AC-63	2	36.5	40.2	462	16+	0.950
CL17-AC-64	2	37.5	40.8	548	-	1.039
CL17-AC-65	2	35.5	38.2	405	-	0.905
CL17-AC-66	2	34.5	37.7	450	13+	1.096
CL17-AC-67	3	39.0	42.5	490	-	0.826
CL17-AC-68	3	37.5	41.1	489	-	0.927
CL17-AC-69	1½	37.2	40.0	485	-	0.942
CL17-AC-70	2	38.2	41.7	525	-	0.942
CL17-AC-71	3	36.4	39.8	490	-	1.016
CL17-AC-72	3	37.0	40.2	480	-	0.948
CL17-AC-73	2	30.2	32.7	315	-	1.144
CL17-AC-74	2	36.4	39.5	480	-	0.995
CL17-AC-75	3	39.0	42.5	500	-	0.843
CL17-AC-76	3	37.9	41.6	500	-	0.918
CL17-AC-77	2	37.5	40.5	480	-	0.910
CL17-AC-78	1½	37.4	41.0	470	-	0.898
CL17-AC-79	3	35.5	39.0	480	-	1.073
CL17-AC-80	1½	35.6	38.9	450	-	0.997
CL17-AC-81	1½	33.8	37.0	430	-	1.114
CL17-AC-82	2	36.6	39.4	460	-	0.938
CL17-AC-83	2	35.6	39.0	425	-	0.942
CL17-AC-84	2	36.2	39.3	460	-	0.970
CL17-AC-85	3	38.1	40.9	480	-	0.868
CL17-AC-86	1½	38.0	42.2	520	-	0.948
CL17-AC-87	3	36.5	39.5	410	-	0.843
CL17-AC-88	2	34.9	38.0	440	-	1.035
CL17-AC-89	2	38.1	41.4	560	-	1.013
CL17-AC-90	2	37.8	41.5	500	-	0.926
CL17-AC-91	1½	21.8	23.2	80	-	0.772
CL17-AC-92	1½	41.6	43.0	640	-	0.889
CL17-AC-93	1½	37.5	41.1	500	-	0.948
CL17-AC-94	3	37.0	40.1	490	-	0.967
CL17-AC-95	1½	37.6	40.3	510	-	0.959
CL17-AC-96	3	33.6	36.7	403	-	1.062
Overall Catch Summary	Sample Size (N)	96	96	96	9	96
	Average	36.5	39.6	466	14.3	0.944
	Median	37.1	40.2	480	15	0.945
	Standard Deviation	2.8	3.2	84	2.4	0.078
	Standard Error	0.3	0.3	9	0.8	0.008
	Minimum	21.8	23.2	80	10	0.738
	Maximum	43.0	47.2	690	18	1.144

Table G.12: Additional Meristics Collected From Adult Arctic Charr Incidental Mortalities at Camp Lake, Mary River Project CREMP, August 2017

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
CL17-AC-03		15	38.0	40.9	493	488	0.90	i	5.346	1.10	-	-	2	iw (VA)
CL17-AC-46		10+	36.0	38.6	443	439	0.95	i	3.593	0.82	-	-	2	iw (C)
CL17-AC-47		14++	37.0	39.9	485	480	0.96	i	4.860	1.01	-	-	2	iw (A)
CL17-AC-07		12+	33.8	36.8	408	402	1.06	F	3.904	0.97	2.451	0.610	2	iw (VA)
CL17-AC-17		-	35.9	38.5	406	397	0.88	F	5.471	1.38	3.442	0.867	2	iw (VA), tw (S)
CL17-AC-28		16++	36.0	39.2	408	399	0.87	F	6.898	1.73	1.639	0.410	2	iw (C)
CL17-AC-35		15	36.0	39.1	433	425	0.93	F	4.632	1.09	3.476	0.818	2	iw (C)
CL17-AC-53		18++	36.3	39.2	458	449	0.96	F	5.699	1.27	2.873	0.639	2	iw (A)
CL17-AC-63		16+	36.5	40.2	462	455	0.95	F	3.702	0.81	3.791	0.834	2	iw (VA)
CL17-AC-66		13+	34.5	37.7	450	441	1.10	F	5.711	1.29	3.124	0.708	2	iw (S)
Adult Non-Spawner Statistics	Average	13	37.0	39.8	473.7	469.1	0.9	-	4.6	1.0	-	-	-	-
	Standard deviation	2.6	1.0	1.2	26.9	26.0	0.0	-	0.9	0.1	-	-	-	-
	Minimum	10	36.0	38.6	443.0	439.4	0.9	-	3.6	0.8	-	-	-	-
	Maximum	15	38.0	40.9	493.0	487.7	1.0	-	5.3	1.1	-	-	-	-
	Sample Size (N)	3	3	3	3	3	3	3	3	3	-	-	-	-
Females Statistics	Average	15	35.6	38.7	432	424	0.96	-	5.145	1.22	2.97	0.70	-	-
	Standard deviation	2.2	1.0	1.1	25	25	0.08	-	1.132	0.30	0.73	0.16	-	-
	Minimum	12	33.8	36.8	406	397	0.87	-	3.702	0.81	1.64	0.41	-	-
	Maximum	18	36.5	40.2	462	455	1.10	-	6.898	1.73	3.79	0.87	-	-
	Sample Size (N)	6	7	7	7	7	7	7	7	7	7	7	-	-

[a] - Abnormalities include internal worms (iw) and tapeworms (tw) in body cavity; letter in parentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.
Sex - Female (F), Indeterminate (i)

Table G.13: Results of Adult (Littoral/Profundal) Arctic Charr Health Endpoint Statistical Comparisons for Camp Lake (JLO) between 2017 and the Mine Baseline (2006 - 2013) Period, Mary River Project CREMP, 2017

Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
							Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
		Response	Covariate	Baseline	2017		Interaction P-value	Covariate P-value		Statistic	Baseline	2017		
Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	155	96	K-S	-	-	-	-	-	-	<0.001	53
Body Size	Fork Length	Fork Length (cm)	-	155	96	M-W	-	-	-	Median	33	37	<0.001	12
	Body Weight	Body Weight (g)	-	155	96	M-W	-	-	-	Median	350	480	<0.001	37
Growth	Length-at-age	log[Fork Length (cm)]	log[Age]	30	9	ANCOVA	0.073	<0.001	10.12	Adjusted Mean	293	282	0.624	-3.9
	Weight-at-age	log[Body Weight (g)]	log[Age]	29	9	ANCOVA	0.095	<0.001	10.31	Adjusted Mean	268	235	0.613	-13
Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	155	96	ANCOVA	0.498	<0.001	33.97	Adjusted Mean	381	370	0.123	-3.0

(grey shading) Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2017 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2017 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2017 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.

Table G.14: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW17-ACJ-01	13.5	14.6	23.509	3+	0.956
SDNW17-ACJ-02	7.7	8.3	4.194	1+	0.919
SDNW17-ACJ-03	10.3	11.1	10.651	2+	0.975
SDNW17-ACJ-04	8.5	9.0	5.075	2++	0.826
SDNW17-ACJ-05	6.5	6.8	2.809	1+	1.023
SDNW17-ACJ-06	6.7	7.1	2.823	1+	0.939
SDNW17-ACJ-07	6.7	7.1	2.739	1+	0.911
SDNW17-ACJ-08	6.6	7.0	2.459	1+	0.855
SDNW17-ACJ-09	4.4	4.6	0.623	0++	0.731
SDNW17-ACJ-10	4.3	4.5	0.649	0++	0.816
SDNW17-ACJ-11	6.8	7.2	2.723	-	0.866
SDNW17-ACJ-12	7.8	8.3	3.901	-	0.822
SDNW17-ACJ-13	8.1	8.6	4.382	-	0.825
SDNW17-ACJ-14	7.8	8.3	4.521	-	0.953
SDNW17-ACJ-15	4.2	4.4	0.643	-	0.868
SDNW17-ACJ-16	5.0	5.2	0.949	-	0.759
SDNW17-ACJ-17	6.1	6.5	2.689	-	1.185
SDNW17-ACJ-18	4.2	4.4	0.698	-	0.942
SDNW17-ACJ-19	9.1	9.8	6.950	-	0.922
SDNW17-ACJ-20	4.0	4.2	0.574	-	0.897
SDNW17-ACJ-21	10.3	11.0	8.868	-	0.812
SDNW17-ACJ-22	14.0	15.0	23.875	-	0.870
SDNW17-ACJ-23	4.1	4.3	0.555	-	0.805
SDNW17-ACJ-24	8.2	8.6	4.730	-	0.858
SDNW17-ACJ-25	7.5	8.0	3.741	-	0.887
SDNW17-ACJ-26	7.1	7.5	3.200	-	0.894
SDNW17-ACJ-27	8.9	9.4	6.143	-	0.871
SDNW17-ACJ-28	7.0	7.4	3.258	-	0.950
SDNW17-ACJ-29	7.8	8.2	4.518	-	0.952
SDNW17-ACJ-30	3.4	3.6	0.401	-	1.020
SDNW17-ACJ-31	7.8	8.3	4.671	-	0.984
SDNW17-ACJ-32	9.5	10.2	7.489	-	0.873
SDNW17-ACJ-33	8.2	8.7	5.289	-	0.959
SDNW17-ACJ-34	14.2	15.4	26.562	-	0.928
SDNW17-ACJ-35	7.9	8.5	4.385	-	0.889
SDNW17-ACJ-36	9.9	10.5	8.746	-	0.901
SDNW17-ACJ-37	3.9	4.1	0.565	-	0.952
SDNW17-ACJ-38	7.2	3.6	2.914	-	0.781
SDNW17-ACJ-39	7.1	7.6	3.179	-	0.888
SDNW17-ACJ-40	4.4	4.6	0.689	-	0.809
SDNW17-ACJ-41	6.5	7.0	2.338	-	0.851
SDNW17-ACJ-42	15.3	16.5	31.568	-	0.881
SDNW17-ACJ-43	4.5	4.7	0.851	-	0.934
SDNW17-ACJ-44	6.4	6.8	2.502	-	0.954
SDNW17-ACJ-45	6.8	7.1	2.695	-	0.857
SDNW17-ACJ-46	12.2	13.1	14.570	-	0.802
SDNW17-ACJ-47	9.1	9.9	6.479	-	0.860
SDNW17-ACJ-48	11.9	12.9	14.127	-	0.838
SDNW17-ACJ-49	10.6	11.4	10.923	-	0.917
SDNW17-ACJ-50	14.8	16.0	30.549	-	0.942
SDNW17-ACJ-51	10.6	11.3	10.729	-	0.901
SDNW17-ACJ-52	12.3	13.2	14.849	-	0.798
SDNW17-ACJ-53	12.9	13.9	18.744	-	0.873
SDNW17-ACJ-54	7.1	7.7	3.248	-	0.907
SDNW17-ACJ-55	7.0	7.5	3.198	-	0.932
SDNW17-ACJ-56	7.3	7.7	3.591	-	0.923
SDNW17-ACJ-57	6.7	7.1	2.884	-	0.959
SDNW17-ACJ-58	6.5	6.9	2.429	-	0.884
SDNW17-ACJ-59	7.6	8.2	4.058	-	0.924

Table G.14: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW17-ACJ-60		10.1	11.0	9.168	-	0.890
SDNW17-ACJ-61		4.3	4.5	0.731	-	0.919
SDNW17-ACJ-62		6.3	6.6	2.108	-	0.843
SDNW17-ACJ-63		11.1	12.0	12.195	-	0.892
SDNW17-ACJ-64		11.1	12.0	11.857	-	0.867
SDNW17-ACJ-65		12.1	13.2	16.003	-	0.903
SDNW17-ACJ-66		10.1	11.0	9.760	-	0.947
SDNW17-ACJ-67		8.6	9.4	6.042	-	0.950
SDNW17-ACJ-68		6.9	7.3	2.638	-	0.803
SDNW17-ACJ-69		6.1	6.3	1.989	-	0.876
SDNW17-ACJ-70		7.4	7.8	3.429	-	0.846
SDNW17-ACJ-71		4.2	4.5	0.798	-	1.077
SDNW17-ACJ-72		18.9	20.5	58.382	-	0.865
SDNW17-ACJ-73		15.4	16.5	30.268	-	0.829
SDNW17-ACJ-74		13.6	14.8	22.287	-	0.886
SDNW17-ACJ-75		10.8	11.5	10.083	-	0.800
SDNW17-ACJ-76		7.2	7.8	3.484	-	0.933
SDNW17-ACJ-77		9.9	10.5	7.963	-	0.821
SDNW17-ACJ-78		7.0	7.5	2.823	-	0.823
SDNW17-ACJ-79		7.9	8.4	3.912	-	0.793
SDNW17-ACJ-80		11.9	12.8	14.759	-	0.876
SDNW17-ACJ-81		16.1	17.6	37.098	-	0.889
SDNW17-ACJ-82		7.5	8.0	3.778	-	0.896
SDNW17-ACJ-83		8.5	9.1	5.886	-	0.958
SDNW17-ACJ-84		5.8	6.1	1.891	-	0.969
SDNW17-ACJ-85		9.0	9.5	6.324	-	0.867
SDNW17-ACJ-86		7.4	7.8	3.342	-	0.825
SDNW17-ACJ-87		6.5	7.0	2.632	-	0.958
SDNW17-ACJ-88		5.6	5.9	1.732	-	0.986
SDNW17-ACJ-89		10.5	11.1	10.919	-	0.943
SDNW17-ACJ-90		7.4	7.9	3.728	-	0.920
SDNW17-ACJ-91		6.2	6.6	2.206	-	0.926
SDNW17-ACJ-92		8.2	8.7	4.858	-	0.881
SDNW17-ACJ-93		7.9	8.5	5.432	-	1.102
SDNW17-ACJ-94		6.4	6.8	2.275	-	0.868
SDNW17-ACJ-95		9.8	10.6	9.986	-	1.061
SDNW17-ACJ-96		11.1	12.0	11.858	-	0.867
SDNW17-ACJ-97		9.0	9.7	6.023	-	0.826
SDNW17-ACJ-98		8.2	8.7	5.343	-	0.969
SDNW17-ACJ-99		7.2	7.6	3.858	-	1.034
SDNW17-ACJ-100		7.1	7.5	3.360		0.939
SDNW17-ACJ-101		7.6	8.1	4.124	-	0.939
Overall Catch Summary	Sample Size (N)	101	101	101	10	101
	Average	8.4	8.9	7.475	1.2	0.900
	Median	7.7	8.2	4.058	1	0.892
	Standard Deviation	3.0	3.3	9.080	0.9	0.073
	Standard Error	0.3	0.3	0.903	0.3	0.007
	Minimum	3.4	3.6	0.401	0	0.731
	Maximum	18.9	20.5	58.382	3	1.185
Young-of-the-Year Catch Summary	proportion of YOY			**13%**		
	Sample Size (N)	13	13	13	2	13
	Average	4.2	4.4	0.671	0	0.887
	Median	4.2	4.5	0.649	0	0.897
	Standard Deviation	0.4	0.4	0.142	0	0.101
	Standard Error	0.1	0.1	0.039	0	0.028
	Minimum	3.4	3.6	0.401	0	0.731
	Maximum	5.0	5.2	0.949	0	1.077

Table G.15: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Sheardown Lake NW (DLO-01) and Reference Lake 3 (REF), Mary River Project CREMP, August 2017

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
								Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
			Response	Covariate	REF	DLO-01		Interaction P-value	Covariate P-value		Statistic	REF	DLO-01		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	101	K-S	-	-	-	-	-	-	<0.001	44
YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	26	12	t-test	-	-	-	Geometric Mean	3.6	4.2	<0.001	15
		Body Weight	log[Body Weight (g)]	-	26	12	t-test	-	-	-	Geometric Mean	447	631	<0.001	41
	Energy Storage	Condition [e]	log[Body Weight (g)]	log[Fork Length (cm)]	26	12	ANCOVA	0.537	<0.001	3.79	Adjusted Mean	500	498	0.95	-0.48
			log[Body Weight (g)]	log[Fork Length (cm)]	25	12	ANCOVA	0.097	<0.001	3.79	Adjusted Mean	504	487	0.591	-3.4
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	74	89	K-S	-	-	-	-	-	-	<0.001	45
	Body Size	Fork Length	Fork Length (cm)	-	74	89	M-W	-	-	-	Median	6.6	7.9	<0.001	20
		Body Weight	Body Weight (g)	-	74	89	M-W	-	-	-	Median	2	5	0.211	82.4
	Energy Storage	Condition [f]	log[Body Weight (g)]	log[Fork Length (cm)]	74	89	ANCOVA	0.434	<0.001	7.82	Adjusted Mean	4.1	4.3	<0.001	6.5
			log[Body Weight (g)]	log[Fork Length (cm)]	73	89	ANCOVA	0.507	<0.001	7.83	Adjusted Mean	4.1	4.3	<0.001	6.9

(Shaded) Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted values of the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction (i.e., different slopes) occurs.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) /reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted value - reference area predicted value) / reference area predicted value] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Sample REF317-ACJ-25 was detected as a statistical outlier (studentized residual = 4.21) from the 2017 Reference Lake 3 data set. The analysis is presented with both the inclusion and exclusion of this individual.

[f] Sample REF317-ACJ-56 was detected as a statistical outlier (studentized residual = 4.65) from the 2017 Reference Lake 3 data set. The analysis is presented with both the inclusion and exclusion of this individual.

Table G.16: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Sheardown Lake NW Using 2017 Data Relative to Reference Lake 3 (2017) Data or Sheardown Lake NW Baseline (2006 - 2013) Data with α=β=0.1, Mary River Project CREMP, 2017

Comparison	Group	Indicator	Endpoint	Variables		Test	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5% -5%	10% -9%	20% -17%	25% -20%	30% -23%	33% -25%	40% -29%	50% -33%	100% -50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing Data) versus Reference Lake 3, 2017 Data	YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	t-test	0.03082	-	log(Response)	37	11	4	3	3	3	3	2	2
			Body Weight	log[Adjusted Body Weight (g)]	-	t-test	0.10931	-	log(Response)	457	121	34	23	17	14	11	8	4
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.07046	-	log(Response)	192	52	16	11	9	8	6	5	4
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.05797	-	log(Response)	130	36	11	8	7	6	5	4	3
	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	33.06	Response	869	218	56	36	26	21	16	11	4
			Body Weight	Body Weight (g)	-	M-W	-	202.6	Response	32,558	8,141	2,036	1,304	907	734	511	327	84
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03439	-	log(Response)	47	14	6	5	4	4	4	3	3
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03236	-	log(Response)	42	13	5	4	4	4	4	3	3
Nearshore Arctic Charr (Electrofishing Data) 2017 versus Baseline	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	40.70	Response	1,315	330	84	55	39	32	22	16	5
			Body Weight	Body Weight (g)	-	M-W	-	117.6	Response	10,976	2,746	688	440	307	249	173	112	29
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.06710	-	log(Response)	174	47	15	10	8	7	6	5	4
Littoral/Profundal Arctic Charr (Gill Netting Data) 2017 versus Baseline	All fish	Body Size	Fork Length	Fork Length (mm)	-	M-W	-	19.57	Response	306	78	21	14	11	9	6	5	3
			Body Weight	Body Weight (g)	-	M-W	-	59.30	Response	2,791	700	176	114	79	64	46	29	9
		Growth	Weight-at-age	log[Adjusted Body Weight (g)]	log[Age (years)]	ANCOVA	0.17325	-	log(Response)	1,147	302	84	57	42	35	26	19	8
			Weight-at-age	log[Adjusted Body Weight (g)]	log[Age (years)]	ANCOVA	0.14984	-	log(Response)	859	227	64	43	32	27	20	15	7
			Length-at-age	log[Fork Length (mm)]	log[Age (years)]	ANCOVA	0.05285	-	log(Response)	109	30	10	7	6	5	5	4	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (mm)]	ANCOVA	0.05032	-	log(Response)	99	28	9	7	6	5	5	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

Table G.17: Gill Netting Catch Records for Sheardown Lake NW, Mary River Project CREMP, August 2017

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
SDNW17-GN-1	560441	7913260	91.4	17-Aug-17	17-Aug-17	9:00	10:30	1.50	1.37	0	7	3	10	7.29
				17-Aug-17	17-Aug-17	11:15	13:20	2.08	1.90	1	4	1	6	3.15
				17-Aug-17	17-Aug-17	13:40	15:10	1.50	1.37	1	4	1	6	4.37
				18-Aug-17	18-Aug-17	8:35	10:20	1.75	1.60	1	8	2	11	6.87
				18-Aug-17	18-Aug-17	10:45	11:50	1.08	0.99	0	3	0	3	3.03
SDNW17-GN-2	560522	7913165	91.4	17-Aug-17	17-Aug-17	9:10	11:15	2.08	1.90	0	2	2	4	2.10
				17-Aug-17	17-Aug-17	11:50	13:30	1.67	1.52	0	0	0	0	0
				18-Aug-17	18-Aug-17	8:30	10:00	1.50	1.37	0	2	1	3	2.19
				18-Aug-17	18-Aug-17	10:15	12:00	1.75	1.60	0	1	1	2	1.25
SDNW17-GN-3	560062	7913418	91.4	17-Aug-17	17-Aug-17	9:30	11:50	2.33	2.13	1	1	1	3	1.41
				17-Aug-17	17-Aug-17	12:10	13:49	1.65	1.51	0	0	0	0	0
				18-Aug-17	18-Aug-17	8:40	10:50	2.17	1.98	2	2	1	5	2.52
SDNW17-GN-4	560007	7913447	91.4	17-Aug-17	17-Aug-17	9:45	12:10	2.42	2.21	1	2	1	4	1.81
				17-Aug-17	17-Aug-17	12:35	14:00	1.42	1.30	1	2	1	4	3.09
SDNW17-GN-5	559918	7913511	91.4	17-Aug-17	17-Aug-17	10:00	12:35	2.58	2.36	0	3	2	5	2.12
				17-Aug-17	17-Aug-17	12:50	14:30	1.67	1.52	0	3	2	5	3.28
SDNW17-GN-6	559738	7913545	91.4	17-Aug-17	17-Aug-17	14:00	15:30	1.50	1.37	2	0	0	2	1.46
SDNW17-GN-7	559987	7913162	91.4	17-Aug-17	17-Aug-17	14:25	15:42	1.28	1.17	2	3	1	6	5.11
				18-Aug-17	18-Aug-17	8:45	11:00	2.25	2.06	3	1	1	5	2.43
SDNW17-GN-8	559975	7913189	91.4	17-Aug-17	17-Aug-17	8:50	11:45	2.92	2.67	2	4	1	7	2.62
								Total	**33.92**	**17**	**52**	**22**	**91**	**2.81**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.18: **Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Gill Netting, Mary River Project CREMP, August 2017**

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW17-AC-01	3	36.0	38.8	435	-	0.932
SDNW17-AC-02	3	32.3	35.0	318	-	0.944
SDNW17-AC-03	3	37.5	40.2	495	-	0.939
SDNW17-AC-04	2	35.3	38.4	389	-	0.884
SDNW17-AC-05	2	46.5	50.0	1,000	-	0.995
SDNW17-AC-06	2	30.3	33.2	255	-	0.917
SDNW17-AC-07	2	34.8	37.9	385	-	0.914
SDNW17-AC-08	2	35.9	38.9	375	13+	0.810
SDNW17-AC-09	2	24.9	26.8	142	-	0.920
SDNW17-AC-10	2	26.5	28.7	180	-	0.967
SDNW17-AC-11	3	35.1	37.9	445	-	1.029
SDNW17-AC-12	3	41.9	45.4	705	-	0.958
SDNW17-AC-13	2	31.2	33.6	185	-	0.609
SDNW17-AC-14	2	25.5	27.7	158	6+	0.953
SDNW17-AC-15 *	3	38.7	41.7	315	-	0.543
SDNW17-AC-16	2	27.5	30.0	178	7+	0.856
SDNW17-AC-17	1½	34.5	37.5	405	-	0.986
SDNW17-AC-18	1½	22.0	23.9	98	-	0.920
SDNW17-AC-19	2	33.9	37.3	375	-	0.963
SDNW17-AC-20	2	37.4	40.5	488	5+	0.933
SDNW17-AC-21	3	33.5	36.0	325	-	0.864
SDNW17-AC-22	3	38.1	42.0	495	-	0.895
SDNW17-AC-23	3	35.7	38.3	445	-	0.978
SDNW17-AC-24	2	34.5	37.2	383	12++	0.933
SDNW17-AC-25	3	34.5	37.3	395	-	0.962
SDNW17-AC-26	2	32.7	35.7	340	-	0.972
SDNW17-AC-27	2	35.2	37.9	380	14++	0.871
SDNW17-AC-28	2	34.4	37.1	359	13++	0.882
SDNW17-AC-29	2	31.8	34.2	289	9+	0.899
SDNW17-AC-30	1½	36.9	39.6	460	-	0.916
SDNW17-AC-31	3	37.6	41.1	545	-	1.025
SDNW17-AC-32	2	28.8	31.0	215	-	0.900
SDNW17-AC-33	2	29.4	31.5	225	-	0.885
SDNW17-AC-34	1½	24.3	26.4	124	5+	0.864
SDNW17-AC-35	3	40.5	43.5	595	-	0.896
SDNW17-AC-36	3	37.8	41.0	525	-	0.972
SDNW17-AC-37	2	34.0	36.7	390	-	0.992
SDNW17-AC-38	2	34.9	37.9	455	-	1.070
SDNW17-AC-39	2	31.3	33.8	295	8+	0.962
SDNW17-AC-40	3	31.6	34.4	285	-	0.903
SDNW17-AC-41	2	24.5	36.4	129	-	0.877
SDNW17-AC-42	2	28.3	30.7	208	-	0.918
SDNW17-AC-43	2	33.3	36.0	348	10	0.942
SDNW17-AC-44	2	24.5	26.6	130	-	0.884
SDNW17-AC-45	1½	22.2	24.0	99	-	0.905
SDNW17-AC-46	1½	36.1	39.3	440	-	0.935
SDNW17-AC-47	3	33.3	36.0	350	-	0.948
SDNW17-AC-48	2	32.5	35.3	325	-	0.947
SDNW17-AC-49	2	35.2	38.4	420	-	0.963
SDNW17-AC-50	1½	35.5	38.3	350	-	0.782
SDNW17-AC-51	2	25.5	27.7	139	-	0.838
SDNW17-AC-52	1½	32.5	35.3	315	10+	0.918
SDNW17-AC-53	3	35.9	39.7	420	-	0.908

Table G.18: Arctic Charr Measurements from Fish Captured at Sheardown Lake NW by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDNW17-AC-54	2	23.5	25.4	120	-	0.925
SDNW17-AC-55	2	34.1	36.3	375	13+	0.946
SDNW17-AC-56	3	38.2	41.3	480	-	0.861
SDNW17-AC-57	3	36.3	39.8	435	-	0.909
SDNW17-AC-58	2	32.3	35.0	335	-	0.994
SDNW17-AC-59	2	34.2	37.2	310	-	0.775
SDNW17-AC-60	2	35.1	38.1	350	-	0.809
SDNW17-AC-61	2	32.0	34.8	295	-	0.900
SDNW17-AC-62	2	33.1	36.1	325	-	0.896
SDNW17-AC-63	2	34.7	37.7	375	-	0.898
SDNW17-AC-64	2	34.3	37.1	325	-	0.805
SDNW17-AC-65	1½	32.9	36.8	395	-	1.109
SDNW17-AC-66	2	40.1	43.4	595	-	0.923
SDNW17-AC-67	2	29.6	31.9	210	-	0.810
SDNW17-AC-68 *	1½	22.5	25.2	300	-	2.634
SDNW17-AC-69	1½	33.4	36.2	475	-	1.275
SDNW17-AC-70	1½	34.9	38.0	438	13++	1.030
SDNW17-AC-71	2	32.1	34.9	310	-	0.937
SDNW17-AC-72	2	23.4	25.4	135	-	1.054
SDNW17-AC-73	3	38.7	41.6	575	-	0.992
SDNW17-AC-74	3	36.8	39.9	455	-	0.913
SDNW17-AC-75	2	22.9	25.9	129	5+	1.074
SDNW17-AC-76	1½	34.5	37.3	380	-	0.925
SDNW17-AC-77	1½	24.5	26.7	140	6++	0.952
SDNW17-AC-78	1½	34.3	37.1	445	-	1.103
SDNW17-AC-79	3	37.0	40.1	470	-	0.928
SDNW17-AC-80	2	36.2	39.3	365	-	0.769
SDNW17-AC-81	2	35.9	38.0	418	14++	0.903
SDNW17-AC-82	2	28.3	30.9	218	-	0.962
SDNW17-AC-83	1½	34.5	37.2	350	-	0.852
SDNW17-AC-84	1½	26.4	28.8	175	6+	0.951
SDNW17-AC-85	3	33.1	35.6	330	-	0.910
SDNW17-AC-86	2	35.2	38.1	400	10+	0.917
SDNW17-AC-87	2	37.5	40.1	425	-	0.806
SDNW17-AC-88	2	40.2	43.6	570	-	0.877
SDNW17-AC-89	2	33.1	35.9	325	-	0.896
Overall Catch Summary	Sample Size (N)	89	89	89	19	89
	Average	32.9	35.8	351	9.4	0.939
	Median	34.2	37.1	350	10	0.920
	tandard Deviation	4.9	5.2	147	3.4	0.204
	Standard Error	0.5	0.6	15.6	0.8	0.022
	Minimum	22.0	23.9	98	5	0.543
	Maximum	46.5	50.0	1,000	14	2.634

* Initial screening indicated sample was an outlier, and therefore the sample was removed from all subsequent statistical analysis data sets.

Table G.19: Additional Meristics Collected from Adult Arctic Charr Incidental Mortalities at Sheardown Lake NW, Mary River Project CREMP, August 2017

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
SDNW17-AC-08		13+	35.9	38.9	375	372	0.81	i	3.462	0.93	-	-	2	iw (C)
SDNW17-AC-14		6+	25.5	27.7	158	156	0.95	i	1.603	1.02	-	-	2	iw (S)
SDNW17-AC-20		5+	37.4	40.5	488	487	0.93	i	1.193	0.25	-	-	2	-
SDNW17-AC-27		14++	35.2	37.9	380	376	0.87	i	4.401	1.17	-	-	2	iw (A)
SDNW17-AC-28		13++	34.4	37.1	359	355	0.88	i	3.847	1.08	-	-	2	iw (A)
SDNW17-AC-39		8+	31.3	33.8	295	292	0.96	i	2.599	0.89	-	-	2	iw (C)
SDNW17-AC-43		10	33.3	36.0	348	344	0.94	i	4.301	1.25	-	-	2	iw (S)
SDNW17-AC-52		10+	32.5	35.3	315	312	0.92	i	3.178	1.02	-	-	1½	iw (S)
SDNW17-AC-55		13+	34.1	36.3	375	370	0.95	i	4.958	1.34	-	-	2	iw (A)
SDNW17-AC-70		13++	34.9	38.0	438	433	1.03	i	4.851	1.12	-	-	1½	-
SDNW17-AC-75		5+	22.9	25.9	129	126	1.07	i	2.592	2.05	-	-	2	iw (S)
SDNW17-AC-77		6++	24.5	36.7	140	139	0.95	i	1.012	0.73	-	-	1½	iw (S)
SDNW17-AC-84		6+	26.4	28.8	175	173	0.95	i	1.950	1.13	-	-	1½	iw (S)
SDNW17-AC-86		10+	35.2	38.1	400	397	0.92	i	2.591	0.65	-	-	2	iw (S)
SDNW17-AC-16		7+	27.5	30.0	178	177	0.86	F	0.583	0.33	0.583	0.330	2	iw (S)
SDNW17-AC-24		12++	34.5	37.2	383	348	0.93	F	7.525	2.17	27.937	8.039	2	iw (VA)
SDNW17-AC-29		9+	31.8	34.2	289	283	0.90	F	4.816	1.70	1.584	0.561	2	iw (A)
SDNW17-AC-34		5+	24.3	26.4	124	122	0.86	F	1.474	1.21	0.434	0.355	1½	iw (C)
SDNW17-AC-37		-	34.0	36.7	390	383	0.99	F	4.024	1.05	2.635	0.687	2	-
SDNW17-AC-81		14++	35.9	38.0	418	365	0.90	F	8.181	2.24	45.136	12.377	2	iw (C)
Adult Non-Spawner Statistics	Average	9.4	31.7	35.1	313	309	0.94	-	3.038	1.05	#DIV/0!	#DIV/0!	-	-
	Standard deviation	3.4	4.8	4.5	117	116	0.06	-	1.319	0.40	#DIV/0!	#DIV/0!	-	-
	Minimum	5	22.9	25.9	129	126	0.81	-	1.012	0.25	0.000	0.000	-	-
	Maximum	14	37.4	40.5	488	487	1.07	-	4.958	2.05	0.000	0.000	-	-
	Sample Size (N)	14	14	14	14	14	14	14	14	14	0.000	0.000	-	-
Females Statistics	Average	9.4	31.3	33.8	297	280	0.91	-	4.434	1.45	13.05	3.72	-	-
	Standard deviation	3.6	4.5	4.6	122	108	0.05	-	3.082	0.73	19.00	5.21	-	-
	Minimum	5	24.3	26.4	124	122	0.86	-	0.583	0.33	0.43	0.33	-	-
	Maximum	14	35.9	38	418	383	0.99	-	8.181	2.24	45.14	12.38	-	-
	Sample Size (N)	5	6	6	6	6	6	6	6	6	6	6	-	-

[a] Abnormalities include internal worms (iw) in body cavity; letter in parentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.

Note: Sex - Female (F), Indeterminate (i).

Table G.20: Results of Adult (Littoral/Profundal) Arctic Charr Health Endpoint Statistical Comparisons for Sheardown Lake NW (DLO-01) between 2017 and the Mine Baseline (2006 - 2013) Period, Mary River Project CREMP, 2017

Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
		Response	Covariate	Baseline	2017		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	Baseline	2017		
Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	118	88	K-S	-	-	-	-	-	-	<0.001	-34
Body Size	Fork Length	log[Fork Length (cm)]	-	118	88	M-W	-	-	-	Median	36.5	34.3	<0.001	-6.2
	Body Weight	log[Body Weight (g)]	-	118	88	M-W	-	-	-	Median	400	362	0.003	-9.5
Growth	Weight-at-age	log[Body Weight (g)]	log[Age (years)]	30	19	ANCOVA	0.056	<0.001	11.3	Adjusted Mean	308	371	0.150	20
				29[e]	19	ANCOVA	0.053	<0.001	11.2	Adjusted Mean	293	363	0.053	24
	Length-at-age	log[Fork Length (cm)]	log[Age (years)]	30	19	ANCOVA	0.040	<0.001	5	Predicted Mean	200	241	-	21
									15		390	377		-3.5
				29[e]	19	ANCOVA	0.035	<0.001	5	Predicted Mean	201	241	-	20
									15		383	377		-1.7
Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	118	88	ANCOVA	0.924	<0.001	34.6	Adjusted Mean	361	384	<0.001	6.4

[shaded box] Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2017 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2017 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2017 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Sample SLNW13-04 was detected as a statistical outlier (Studentized residual = 4.04 [weight-at-age] and 4.15 [length-at-age]) from the 2017 Sheardown Lake NW data set. The analysis is presented with both the inclusion and exclusion of this individual.

Table G.21: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE17-ACJ-01	7.2	7.8	4.128	1+	1.106
SDSE17-ACJ-02	10.6	11.4	9.894	2++	0.831
SDSE17-ACJ-03	10.1	11.0	8.992	2++	0.873
SDSE17-ACJ-04	6.3	6.8	2.292	1+	0.917
SDSE17-ACJ-05	7.1	7.6	3.202	1+	0.895
SDSE17-ACJ-06	4.3	4.5	0.676	0++	0.850
SDSE17-ACJ-07	4.5	4.8	0.867	0++	0.951
SDSE17-ACJ-08	7.6	8.0	4.094	1++	0.933
SDSE17-ACJ-09	8.8	9.5	6.638	2	0.974
SDSE17-ACJ-10	6.8	7.1	2.581	1+	0.821
SDSE17-ACJ-11	7.5	8.0	3.552	-	0.842
SDSE17-ACJ-12	4.3	4.5	0.768	-	0.966
SDSE17-ACJ-13	8.1	8.6	4.887	-	0.920
SDSE17-ACJ-14	7.7	8.1	3.994	-	0.875
SDSE17-ACJ-15	8.4	8.9	5.199	-	0.877
SDSE17-ACJ-16	7.2	7.7	3.518	-	0.943
SDSE17-ACJ-17	4.5	4.7	0.868	-	0.953
SDSE17-ACJ-18	4.7	4.9	0.881	-	0.849
SDSE17-ACJ-19	4.3	4.5	0.797	-	1.002
SDSE17-ACJ-20	4.5	4.7	0.904	-	0.992
SDSE17-ACJ-21	4.5	4.7	0.939	-	1.030
SDSE17-ACJ-22	7.2	7.6	3.318	-	0.889
SDSE17-ACJ-23	4.6	4.8	0.876	-	0.900
SDSE17-ACJ-24	4.1	4.3	0.626	-	0.908
SDSE17-ACJ-25	4.4	4.6	0.732	-	0.859
SDSE17-ACJ-26	4.3	4.5	0.808	-	1.016
SDSE17-ACJ-27	4.3	4.5	0.772	-	0.971
SDSE17-ACJ-28	3.8	4.0	0.576	-	1.050
SDSE17-ACJ-29	4.7	4.9	0.894	-	0.861
SDSE17-ACJ-30	4.4	4.6	0.807	-	0.947
SDSE17-ACJ-31	9.5	10.2	6.723	-	0.784
SDSE17-ACJ-32	7.7	8.1	4.178	-	0.915
SDSE17-ACJ-33	4.4	4.6	0.820	-	0.963
SDSE17-ACJ-34	4.4	4.6	0.827	-	0.971
SDSE17-ACJ-35	8.5	9.1	5.248	-	0.855
SDSE17-ACJ-36	7.6	8.1	6.903	-	1.573
SDSE17-ACJ-37	7.8	8.3	4.419	-	0.931
SDSE17-ACJ-38	7.5	7.9	3.707	-	0.879
SDSE17-ACJ-39	6.6	7.0	2.843	-	0.989
SDSE17-ACJ-40	4.2	4.4	0.658	-	0.888
SDSE17-ACJ-41	6.9	7.3	3.132	-	0.953
SDSE17-ACJ-42	4.4	4.6	0.841	-	0.987
SDSE17-ACJ-43	7.0	7.4	3.464	-	1.010
SDSE17-ACJ-44	9.0	9.7	5.604	-	0.769
SDSE17-ACJ-45	8.0	8.6	4.998	-	0.976
SDSE17-ACJ-46	7.4	7.7	3.586	-	0.885
SDSE17-ACJ-47	7.3	7.8	4.218	-	1.084
SDSE17-ACJ-48	4.6	4.9	1.019	-	1.047
SDSE17-ACJ-49	6.4	6.7	2.318	-	0.884
SDSE17-ACJ-50	7.5	8.0	3.960	-	0.939
SDSE17-ACJ-51	7.3	7.7	4.184	-	1.076
SDSE17-ACJ-52	7.4	7.9	3.468	-	0.856
SDSE17-ACJ-53	7.3	7.7	3.684	-	0.947
SDSE17-ACJ-54	3.9	4.1	0.698	-	1.177
SDSE17-ACJ-55	7.0	7.4	2.941	-	0.857
SDSE17-ACJ-56	4.3	4.5	0.786	-	0.989
SDSE17-ACJ-57	4.8	5.6	0.980	-	0.886
SDSE17-ACJ-58	6.4	6.8	2.739	-	1.045
SDSE17-ACJ-59	6.8	7.3	2.715	-	0.863

Table G.21: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE17-ACJ-60		7.4	7.9	3.844	-	0.949
SDSE17-ACJ-61		7.5	8.0	4.251	-	1.008
SDSE17-ACJ-62		7.5	7.9	4.009	-	0.950
SDSE17-ACJ-63		4.3	4.5	0.886	-	1.114
SDSE17-ACJ-64		7.3	7.7	3.549	-	0.912
SDSE17-ACJ-65		6.8	7.2	2.968	-	0.944
SDSE17-ACJ-66		6.3	6.6	2.521	-	1.008
SDSE17-ACJ-67		7.9	8.4	4.376	-	0.888
SDSE17-ACJ-68		8.6	9.2	6.179	-	0.971
SDSE17-ACJ-69		4.6	4.7	0.702	-	0.721
SDSE17-ACJ-70		4.3	4.5	0.644	-	0.810
SDSE17-ACJ-71		4.1	4.3	0.549	-	0.797
SDSE17-ACJ-72		7.1	7.5	3.356	-	0.938
SDSE17-ACJ-73		7.6	8.0	3.948	-	0.899
SDSE17-ACJ-74		7.4	7.9	3.638	-	0.898
SDSE17-ACJ-75		6.3	6.6	2.682	-	1.073
SDSE17-ACJ-76		4.0	4.2	0.704	-	1.100
SDSE17-ACJ-77		3.8	4.0	0.568	-	1.035
SDSE17-ACJ-78		7.8	8.2	4.125	-	0.869
SDSE17-ACJ-79		9.8	10.5	7.675	-	0.815
SDSE17-ACJ-80		7.6	8.2	3.874	-	0.883
SDSE17-ACJ-81		4.2	4.4	0.773	-	1.043
SDSE17-ACJ-82		4.2	4.4	0.696	-	0.939
SDSE17-ACJ-83		4.4	4.6	0.903	-	1.060
SDSE17-ACJ-84		4.8	5.1	1.153	-	1.043
SDSE17-ACJ-85		7.6	8.2	4.506	-	1.026
SDSE17-ACJ-86		6.6	7.0	2.754	-	0.958
SDSE17-ACJ-87		7.1	7.5	3.462	-	0.967
SDSE17-ACJ-88		8.2	8.8	5.088	-	0.923
SDSE17-ACJ-89		7.3	7.8	3.406	-	0.876
SDSE17-ACJ-90		4.5	4.7	0.978	-	1.073
SDSE17-ACJ-91		4.4	4.6	0.795	-	0.933
SDSE17-ACJ-92		3.8	4.0	0.508	-	0.926
SDSE17-ACJ-93		3.4	3.6	0.406	-	1.033
SDSE17-ACJ-94		5.0	5.2	1.112	-	0.890
SDSE17-ACJ-95		4.7	4.9	1.084	-	1.044
SDSE17-ACJ-96		4.4	4.6	0.749	-	0.879
SDSE17-ACJ-97		4.5	4.7	0.768	-	0.843
SDSE17-ACJ-98		7.7	8.1	3.774	-	0.827
SDSE17-ACJ-99		8.4	9.0	5.289	-	0.892
SDSE17-ACJ-100		7.2	7.6	3.128	-	0.838
Overall Catch Summary	Sample Size (N)	100	100	100	10	100
	Average	6.2	6.6	2.771	1.1	0.944
	Median	6.8	7.2	2.799	1	0.935
	Standard Deviation	1.8	1.9	2.056	1	0.106
	Standard Error	0.2	0.2	0.206	0.2	0.011
	Minimum	3.4	3.6	0.406	0	0.721
	Maximum	10.6	11.4	9.894	2	1.573
Young-of-the-Year Catch Summary	proportion of YOY			**42%**		
	Sample Size (N)	42	42	42	2	42
	Average	4.3	4.6	0.795	0	0.959
	Median	4.4	4.6	0.796	0	0.964
	Standard Deviation	0.3	0.3	0.160	0	0.095
	Standard Error	0.0	0.1	0.025	0	0.015
	Minimum	3.4	3.6	0.406	0	0.721
	Maximum	5.0	5.6	1.153	0	1.177

Table G.22: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Sheardown Lake SE (DLO-02) and Reference Lake 3 (REF), Mary River Project CREMP, August 2017

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	DLO-02		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF	DLO-02		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	100	K-S	-	-	-	-	-	-	0.010	23
YOY	Body Size	Fork Length	Fork Length (cm)	-	26	41	M-W	-	-	-	Median	3.65	4.4	<0.001	21
		Body Weight	Body Weight (g)	-	26	41	M-W	-	-	-	Median	0.476	0.795	<0.001	67
	Energy Storage	Condition[e]	log[Body Weight (g)]	log[Fork Length (cm)]	26	41	ANCOVA	0.680	<0.001	4.03	Adjusted Mean	0.597	0.642	0.189	7.5
			log[Body Weight (g)]	log[Fork Length (cm)]	25	41	ANCOVA	0.064	<0.001	4.05	Adjusted Mean	0.604	0.639	0.240	5.8
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	74	59	K-S	-	-	-	-	-	-	<0.001	47
	Body Size	Fork Length	Fork Length (cm)	-	74	59	M-W	-	-	-	Median	6.6	7.4	<0.001	12
		Body Weight	Body Weight (g)	-	74	59	M-W	-	-	-	Median	2.49	3.84	<0.001	55
	Energy Storage	Condition[f]	log[Body Weight (g)]	log[Fork Length (cm)]	74	59	ANCOVA	0.189	<0.001	7.20	Adjusted Mean	3.18	3.48	<0.001	9.5
			log[Body Weight (g)]	log[Fork Length (cm)]	73	58	ANCOVA	0.068	<0.001	7.21	Adjusted Mean	3.17	3.45	<0.001	9.0

[shaded] Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Sample REF317-ACJ-25 was detected as a statistical outlier (Studentized residual = 5.13) from the 2017 Reference Lake 3 data set. The analysis is presented with both the inclusion and exclusion of this individual.

[f] Samples REF317-ACJ-56 and SDSE17-ACJ-36 were detected as a statistical outliers (Studentized residual = 4.57 [REF] and 6.67 [SDSE]) from the 2017 Reference Lake 3 and Sheardown Lake SE data sets, respectively. The analysis is presented with both the inclusion and exclusion of these individuals.

Table G.23: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Sheardown Lake SE Using 2017 Data Relative to Reference Lake 3 (2017) Data or Sheardown Lake SE Baseline (2006 - 2013) Data with α=β=0.1, Mary River Project CREMP, 2017

Comparison	Group	Indicator	Endpoint	Variables		Test	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5% -5%	10% -9%	20% -17%	25% -20%	30% -23%	33% -25%	40% -29%	50% -33%	100% -50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing Data) versus Reference Lake 3, 2017 Data	YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	7.650	Response	48	13	5	4	4	4	3	3	3
			Body Weight	Body Weight (g)	-	M-W	-	31.95	Response	811	204	53	34	25	20	14	10	4
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.05925	-	log(Response)	136	37	12	9	7	6	5	4	3
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.05137	-	log(Response)	103	29	9	7	6	5	5	4	3
	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	19.48	Response	303	77	20	14	11	9	6	5	3
			Body Weight	Body Weight (g)	-	M-W	-	100.5	Response	8,007	2,003	502	322	224	182	127	82	22
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.04030	-	log(Response)	64	18	7	5	5	4	4	4	3
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03247	-	log(Response)	42	13	5	4	4	4	4	3	3
Nearshore Arctic Charr (Electrofishing Data) 2017 versus Baseline	Non-YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	t-test	0.05098	-	log(Response)	100	27	8	6	5	4	4	3	2
			Body Weight	Body Weight (g)	-	M-W	-	60.96	Response	2,948	739	186	120	84	68	48	32	10
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.05446	-	log(Response)	115	32	10	8	6	6	5	4	3
Littoral/Profundal Arctic Charr (Gill Netting Data) 2017 versus Baseline	All fish	Body Size	Fork Length	Fork Length (mm)	-	M-W	-	11.43	Response	106	28	9	6	5	5	4	4	3
			Body Weight	Body Weight (g)	-	M-W	-	31.40	Response	784	197	50	33	24	19	14	10	4
		Growth	Weight-at-age	log[Adjusted Body Weight (g)]	log[Age (years)]	ANCOVA	0.07911	-	log(Response)	241	65	19	14	11	9	7	6	4
			Length-at-age	log[Fork Length (mm)]	log[Age (years)]	ANCOVA	0.03191	-	log(Response)	41	12	5	4	4	4	4	3	3
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (mm)]	ANCOVA	0.04787	-	log(Response)	90	25	9	7	5	5	4	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

Table G.24: Gill Netting Catch Records for Sheardown Lake SE, Mary River Project CREMP, August 2017

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch Per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
SDSE17-GN-1	561034	7912010	91.4	18-Aug-17	18-Aug-17	12:45	14:20	1.58	1.45	1	2	4	7	4.83
				18-Aug-17	18-Aug-17	14:35	16:40	2.08	1.90	3	0	7	10	5.25
SDSE17-GN-2	560788	7912169	91.4	18-Aug-17	18-Aug-17	13:00	14:40	1.67	1.52	2	6	7	15	9.84
				18-Aug-17	18-Aug-17	15:08	17:00	1.87	1.71	0	4	4	8	4.69
				19-Aug-17	19-Aug-17	8:20	9:45	1.42	1.30	1	4	3	8	6.18
SDSE17-GN-3	560945	7912083	91.4	18-Aug-17	18-Aug-17	13:05	15:20	2.25	2.06	3	5	4	12	5.83
				19-Aug-17	19-Aug-17	8:25	10:00	1.58	1.45	2	5	0	7	4.83
SDSE17-GN-4	561183	7911763	91.4	18-Aug-17	18-Aug-17	13:11	15:30	2.32	2.12	3	2	3	8	3.78
SDSE17-GN-5	561325	7911887	91.4	18-Aug-17	18-Aug-17	13:15	16:00	2.75	2.51	4	8	8	20	7.95
				19-Aug-17	19-Aug-17	8:30	10:15	1.75	1.60	0	5	4	9	5.62
								Total	**17.62**	**19**	**41**	**44**	**104**	**5.88**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.25: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE17-AC-01	3	42.1	45.2	700	-	0.938
SDSE17-AC-02	3	37.8	40.2	539	-	0.998
SDSE17-AC-03	3	37.9	40.6	379	-	0.696
SDSE17-AC-04	3	36.3	39.3	455	-	0.951
SDSE17-AC-05	2	27.8	30.4	215	-	1.001
SDSE17-AC-06	2	35.3	38.5	405	-	0.921
SDSE17-AC-07	1½	19.0	20.2	68	-	0.991
SDSE17-AC-08	3	38.2	41.1	525	-	0.942
SDSE17-AC-09	3	39.0	40.8	550	-	0.927
SDSE17-AC-10	3	36.5	39.4	440	-	0.905
SDSE17-AC-11	3	38.1	41.0	540	-	0.976
SDSE17-AC-12	3	41.3	44.2	565	-	0.802
SDSE17-AC-13	3	35.9	38.8	420	-	0.908
SDSE17-AC-14	3	37.6	40.1	515	-	0.969
SDSE17-AC-15	2	36.2	39.2	465	-	0.980
SDSE17-AC-16	2	31.5	34.4	325	8+	1.040
SDSE17-AC-17	2	32.5	35.3	323	8+	0.941
SDSE17-AC-18	2	39.8	42.7	575	-	0.912
SDSE17-AC-19	2	26.0	28.0	173	-	0.984
SDSE17-AC-20	2	32.8	35.2	303	13+	0.859
SDSE17-AC-21	1½	34.7	37.5	368	-	0.881
SDSE17-AC-22	1½	19.5	20.9	55	-	0.742
SDSE17-AC-23	3	36.9	40.2	485	-	0.965
SDSE17-AC-24	3	42.2	45.0	695	-	0.925
SDSE17-AC-25	3	34.6	37.9	400	-	0.966
SDSE17-AC-26	3	35.2	38.0	445	-	1.020
SDSE17-AC-27	2	35.5	38.5	425	-	0.950
SDSE17-AC-28	2	34.6	37.7	375	9++	0.905
SDSE17-AC-29	2	35.9	38.6	358	-	0.774
SDSE17-AC-30	2	37.8	40.1	410	13+	0.759
SDSE17-AC-31	2	33.2	35.9	363	10++	0.992
SDSE17-AC-32	1½	31.1	33.6	285	-	0.947
SDSE17-AC-33	1½	38.7	41.8	540	-	0.932
SDSE17-AC-34	1½	34.8	37.7	398	-	0.944
SDSE17-AC-35	3	39.9	43.4	515	-	0.811
SDSE17-AC-36	3	37.1	40.0	545	-	1.067
SDSE17-AC-37	3	34.7	37.5	430	-	1.029
SDSE17-AC-38	2	39.6	42.9	560	-	0.902
SDSE17-AC-39	2	32.9	35.6	358	-	1.005
SDSE17-AC-40	1½	36.8	40.0	465	-	0.933
SDSE17-AC-41	1½	20.3	22.0	73	-	0.873
SDSE17-AC-42	1½	27.9	30.0	199	-	0.916
SDSE17-AC-43	3	37.3	40.5	465	-	0.896
SDSE17-AC-44	3	39.5	42.2	690	-	1.120
SDSE17-AC-45	3	36.1	39.0	408	-	0.867
SDSE17-AC-46	3	36.4	39.4	475	-	0.985
SDSE17-AC-47	3	33.5	36.7	395	-	1.051
SDSE17-AC-48	3	38.9	41.9	695	-	1.181
SDSE17-AC-49	3	38.1	40.8	523	-	0.946
SDSE17-AC-50	3	36.1	39.6	430	-	0.914
SDSE17-AC-51	2	33.5	36.3	410	-	1.091
SDSE17-AC-52	2	34.9	37.2	380	-	0.894
SDSE17-AC-53	2	35.5	38.2	415	-	0.928
SDSE17-AC-54	2	35.5	38.5	438	-	0.979
SDSE17-AC-55	2	33.5	36.5	408	15++	1.085
SDSE17-AC-56	2	35.3	38.2	425	-	0.966

Table G.25: Arctic Charr Measurements from Fish Captured at Sheardown Lake SE by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
SDSE17-AC-57	2	38.2	41.5	475	15+	0.852
SDSE17-AC-58	1½	40.2	43.5	480	-	0.739
SDSE17-AC-59	1½	21.5	23.0	85	-	0.855
SDSE17-AC-60	1½	25.4	28.0	153	-	0.934
SDSE17-AC-61	1½	33.4	36.0	410	-	1.100
SDSE17-AC-62	3	36.5	39.5	485	-	0.997
SDSE17-AC-63	3	37.3	40.0	545	-	1.050
SDSE17-AC-64	3	36.5	39.4	505	-	1.039
SDSE17-AC-65	3	35.6	38.5	438	-	0.971
SDSE17-AC-66	3	35.7	38.9	445	-	0.978
SDSE17-AC-67	3	36.9	40.5	480	-	0.955
SDSE17-AC-68	3	37.5	40.8	473	-	0.897
SDSE17-AC-69	1½	32.5	35.1	465	-	1.355
SDSE17-AC-70	1½	35.2	38.7	430	-	0.986
SDSE17-AC-71	1½	33.0	35.9	400	-	1.113
SDSE17-AC-72	3	39.8	43.5	605	-	0.960
SDSE17-AC-73	3	35.7	39.0	428	-	0.941
SDSE17-AC-74	3	38.5	42.1	475	-	0.832
SDSE17-AC-75	3	37.0	40.1	450	-	0.888
SDSE17-AC-76	2	27.2	29.5	205	-	1.019
SDSE17-AC-77	2	45.2	48.8	700	-	0.758
SDSE17-AC-78	2	36.4	39.6	460	-	0.954
SDSE17-AC-79	2	34.0	36.6	383	-	0.974
SDSE17-AC-80	3	39.8	42.7	478	-	0.758
SDSE17-AC-81	3	37.0	40.0	470	-	0.928
SDSE17-AC-82	3	34.5	37.6	378	-	0.921
SDSE17-AC-83	2	35.3	38.0	379	14+	0.862
SDSE17-AC-84	2	27.2	29.1	175	-	0.870
SDSE17-AC-85	2	37.1	40.1	455	-	0.891
SDSE17-AC-86	2	36.3	40.1	450	-	0.941
SDSE17-AC-87	1½	37.2	40.0	430	-	0.835
SDSE17-AC-88	2	33.1	35.9	305	-	0.841
SDSE17-AC-89	2	36.4	39.3	413	-	0.856
SDSE17-AC-90	2	35.0	38.0	390	-	0.910
SDSE17-AC-91	2	34.5	37.3	410	-	0.998
SDSE17-AC-92	2	31.8	34.6	299	-	0.930
SDSE17-AC-93	1.5	38.1	41.8	465	-	0.841
SDSE17-AC-94	1.5	64.1	67.5	1,690	-	0.642
SDSE17-AC-95	3	36.7	39.4	448	-	0.906
SDSE17-AC-96	3	36.0	38.7	478	-	1.025
SDSE17-AC-97	3	38.2	41.5	495	-	0.888
SDSE17-AC-98	3	38.2	41.3	528	-	0.947
SDSE17-AC-99	2	36.4	39.7	413	-	0.856
SDSE17-AC-100	2	38.2	41.8	515	-	0.924
SDSE17-AC-101	2	32.5	35.3	339	-	0.988
SDSE17-AC-102	2	35.9	38.9	380	-	0.821
SDSE17-AC-103	2	36.1	39.3	405	-	0.861
SDSE17-AC-104	2	32.6	34.8	280	-	0.808
Overall Catch Summary	Sample Size (N)	104	104	104	9	104
	Average	35.5	38.3	435	11.7	0.932
	Median	36.1	39.1	430	13	0.933
	Standard Deviation	5.3	5.6	177	2.9	0.101
	Standard Error	0.5	0.5	17.40	1.0	0.010
	Minimum	19.0	20.2	55	8	0.642
	Maximum	64.1	67.5	1,690	15	1.355

Table G.26: Additional Meristics Collected from Adult Arctic Charr Incidental Mortalities at Sheardown Lake SE, Mary River Project CREMP, August 2017

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
SDSE17-AC-16		8+	31.5	34.4	325	321	1.040	i	4.342	1.35	-	-	2	iw (S)
SDSE17-AC-17		8+	32.5	35.3	323	320	0.941	i	2.791	0.87	-	-	2	iw (S)
SDSE17-AC-28		9++	34.6	37.7	375	371	0.905	i	3.670	0.99	-	-	2	iw (C)
SDSE17-AC-30		13+	37.8	40.1	410	406	0.759	i	4.055	1.00	-	-	2	iw (VA)
SDSE17-AC-39		-	32.9	35.6	358	354	1.005	i	3.857	1.09	-	-	2	-
SDSE17-AC-57		15+	38.2	41.5	475	470	0.852	i	4.608	0.98	-	-	2	iw (S)
SDSE17-AC-20		13+	32.8	35.2	303	298	0.859	F	2.303	0.77	2.206	0.739	2	iw (A)
SDSE17-AC-31		10++	33.2	35.9	363	356	0.992	F	4.308	1.21	2.881	0.810	2	iw (A)
SDSE17-AC-55		15++	33.5	36.5	408	361	1.085	F	7.588	2.10	39.698	11.005	2	iw (S)
SDSE17-AC-83		14+	35.3	38.0	379	371	0.862	F	4.085	1.10	3.435	0.925	2	iw (A)
Adult Non-Spawner Statistics	Average	10.6	34.6	37.4	378	374	0.92	-	3.887	1.05	-	-	-	-
	Standard deviation	3.2	2.8	2.9	58	57	0.10	-	0.633	0.17	-	-	-	-
	Minimum	8	31.5	34.4	323	320	0.76	-	2.791	0.87	-	-	-	-
	Maximum	15	38.2	41.5	475	470	1.04	-	4.608	1.35	-	-	-	-
	Sample Size (N)	5	6	6	6	6	6	6	6	6	-	-	-	-
Females Statistics	Average	13.0	33.7	36.4	363	347	0.95	-	4.571	1.30	12.055	3.370	-	-
	Standard deviation	2.2	1.1	1.2	44	33	0.11	-	2.202	0.57	18.436	5.091	-	-
	Minimum	10	32.8	35.2	303	298	0.86	-	2.303	0.77	2.206	0.739	-	-
	Maximum	15	35.3	38.0	408	371	1.09	-	7.588	2.10	39.698	11.005	-	-
	Sample Size (N)	4	4	4	4	4	4	4	4	4	4	4	-	-

[a] - Abnormalities include internal worms (iw) in body cavity; letter in parentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.
Sex - Female (F), Indeterminate (i).

Table G.27: Results of Adult (Littoral/Profundal) Arctic Charr Health Endpoint Statistical Comparisons for Sheardown Lake SE (DLO-02) between 2017 and the Mine Baseline (2006 - 2013) Period, Mary River Project CREMP, 2017

Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test *P*-value	Magnitude of Difference (%)[c,d]
							Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
		Response	Covariate	Baseline	2017		Interaction *p*-value	Covariate *p*-value		Statistic	Baseline	2017		
Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	90	104	K-S	-	-	-	-	-	-	<0.001	-34
Body Size	Fork Length	Fork Length (cm)	-	90	104	M-W	-	-	-	Median	37.9	36.1	<0.001	-4.6
	Body Weight	Body Weight (g)	-	90	104	M-W	-	-	-	Median	518	434	<0.001	-16
Growth	Length-at-age	log[Fork Length (cm)]	log[Age]	9	9	ANCOVA	0.560	0.017	12.1	Adjusted Mean	342	348	0.673	1.6
	Weight-at-age	log[Body Weight (g)]	log[Age]	9	9	ANCOVA	0.254	0.012	12.1	Adjusted Mean	352	383	0.365	8.7
Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	90	104	ANCOVA	0.005[e]	<0.001	36.3	Adjusted Mean	474	446	0.007	-5.9

(Shaded cell) Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2017 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2017 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2017 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] The R^2 of the interaction model was 0.934 and the R^2 of the parallel slope model was 0.931 (difference of 0.03%) so the ANCOVA proceeded under the assumption that the slopes are practically parallel.

Table G.28: Catch Record for Electrofishing Conducted Within the Mary River System as Part of the Mary River Project EEM, August 2017

Watercourse	Station ID	Date	Location			Effort (seconds)	Fish Species				Total (all species)	
			Coordinates		Station Length (m)		Arctic Charr		Ninespine Stickleback			
			Easting	Northing			Catch	CPUE	Catch	CPUE	Total Catch	CPUE
Mary River Tributary-F	MRTF-EXP-F1	26-Aug-17	564945	7915557	167	1,254	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F2	26-Aug-17	564913	7915917	193	730	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F3	26-Aug-17	564470	7913003	55	355	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F4	26-Aug-17	564457	7913229	125	866	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F5	26-Aug-17	564702	7913980	138	952	0	0.00	0	0.00	0	0.00
					Total	**4,157**	**0**	**0.00**	**0**	**0.00**	**0**	**0.00**
Mary River Near-field	MR-EXP-F1	27-Aug-17	562188	7911661	129	2,086	40	1.15	0	0.00	40	1.15
	MR-EXP-F2	27-Aug-17	562309	7911796	55	481	7	0.87	0	0.00	7	0.87
	MR-EXP-F3	27-Aug-17	562436	7911831	133	1,093	26	1.43	0	0.00	26	1.43
	MR-EXP-F4	27-Aug-17	562501	7911860	71	927	27	1.75	0	0.00	27	1.75
					Total	**4,587**	**100**	**1.30**	**0**	**0.00**	**100**	**1.30**
Mary River Far-Field	MR-REF-F1	28-Aug-17	557037	7906734	159	1,754	27	0.92	0	0.00	27	0.92
	MR-REF-F2	28-Aug-17	557118	7906835	331	2,794	22	0.47	2	0.04	24	0.52
	MR-REF-F3	28-Aug-17	556991	7906745	218	3,792	56	0.89	1	0.02	57	0.90
					Total	**8,340**	**105**	**0.76**	**3**	**0.02**	**108**	**0.78**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per electrofishing minute.

Table G.29: Arctic Charr Measurements from Fish Captured at the Mary River Near-Field Area by Electrofishing as Part of the Mary River Project EEM, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
MR-NF-AC-01	12.6	13.7	19.174	-	0.959
MR-NF-AC-02	12.4	13.4	16.362	-	0.858
MR-NF-AC-03	14.4	15.5	25.868	-	0.866
MR-NF-AC-04	13.0	13.9	18.810	-	0.856
MR-NF-AC-05	10.9	11.7	13.933	-	1.076
MR-NF-AC-06	11.9	12.7	16.775	-	0.995
MR-NF-AC-07	11.3	12.3	15.096	-	1.046
MR-NF-AC-08	10.5	11.5	10.572	-	0.913
MR-NF-AC-09	15.7	17.2	35.921	-	0.928
MR-NF-AC-10	10.0	10.8	10.311	-	1.031
MR-NF-AC-11	10.4	11.1	11.483	-	1.021
MR-NF-AC-12	12.6	13.9	17.439	-	0.872
MR-NF-AC-13	11.0	11.9	14.160	-	1.064
MR-NF-AC-14	13.1	14.3	21.184	-	0.942
MR-NF-AC-15	11.4	12.3	15.075	-	1.018
MR-NF-AC-16	15.7	17.0	33.560	-	0.867
MR-NF-AC-17	13.7	14.8	23.778	-	0.925
MR-NF-AC-18	11.5	12.5	14.966	-	0.984
MR-NF-AC-19	12.3	13.2	16.097	-	0.865
MR-NF-AC-20	14.7	15.9	30.004	-	0.945
MR-NF-AC-21	13.8	14.6	24.608	-	0.936
MR-NF-AC-22	9.9	10.6	10.375	-	1.069
MR-NF-AC-23	13.8	15.1	25.628	-	0.975
MR-NF-AC-24	14.9	16.2	34.875	-	1.054
MR-NF-AC-25	14.0	15.2	23.108	-	0.842
MR-NF-AC-26	17.7	19.2	50	-	0.902
MR-NF-AC-27	18.0	19.5	45	-	0.772
MR-NF-AC-28	12.2	13.2	19.444	-	1.071
MR-NF-AC-29	13.8	14.9	24.217	-	0.921
MR-NF-AC-30	13.0	14.0	20.587	-	0.937
MR-NF-AC-31	11.8	12.9	16.323	-	0.993
MR-NF-AC-32	12.3	13.3	19.558	-	1.051
MR-NF-AC-33	11.5	12.5	13.621	-	0.896
MR-NF-AC-34	8.3	8.9	6.450	-	1.128
MR-NF-AC-35	12.3	13.3	16.185	-	0.870
MR-NF-AC-36	16.4	17.9	44	-	0.998
MR-NF-AC-37	11.0	11.9	13.349	-	1.003
MR-NF-AC-38	11.7	12.5	15.999	-	0.999
MR-NF-AC-39	10.9	11.8	14.006	-	1.082
MR-NF-AC-40	9.4	10.1	7.783	-	0.937
MR-NF-AC-41	15.2	16.5	35.126	-	1.000
MR-NF-AC-42	13.5	14.6	25.016	-	1.017
MR-NF-AC-43	12.3	13.5	20.696	-	1.112
MR-NF-AC-44	14.8	16.0	28.649	-	0.884
MR-NF-AC-45	14.0	15.2	24.043	-	0.876
MR-NF-AC-46	10.5	11.3	11.822	-	1.021
MR-NF-AC-47	10.3	11.1	10.947	-	1.002
MR-NF-AC-48	13.8	14.9	22.302	-	0.849
MR-NF-AC-49	14.0	15.4	28.457	-	1.037
MR-NF-AC-50	16.0	17.4	36.283	-	0.886
MR-NF-AC-51	14.7	15.9	33.098	-	1.042
MR-NF-AC-52	15.8	17.2	36.468	-	0.925
MR-NF-AC-53	9.3	9.8	7.393	-	0.919
MR-NF-AC-54	13.9	14.7	26.469	-	0.986
MR-NF-AC-55	15.0	16.3	33.729	-	0.999
MR-NF-AC-56	11.2	12.1	15.798	-	1.124
MR-NF-AC-57	12.9	14.1	21.952	-	1.023
MR-NF-AC-58	12.1	13.1	18.452	-	1.042
MR-NF-AC-59	11.5	12.3	13.467	-	0.885

Table G.29: Arctic Charr Measurements from Fish Captured at the Mary River Near-Field Area by Electrofishing as Part of the Mary River Project EEM, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
MR-NF-AC-60		18.4	19.9	47	-	0.754
MR-NF-AC-61		8.2	8.7	5.649	1	1.025
MR-NF-AC-62		13.4	14.4	24.484	-	1.018
MR-NF-AC-63		13.7	15.0	23.966	-	0.932
MR-NF-AC-64		15.9	16.9	34.709	-	0.863
MR-NF-AC-65		11.7	12.7	15.638	-	0.976
MR-NF-AC-66		9.0	9.5	7.509	-	1.030
MR-NF-AC-67		9.3	10.0	7.918	-	0.984
MR-NF-AC-68		14.2	15.3	25.522	-	0.891
MR-NF-AC-69		24.3	26.2	122	-	0.850
MR-NF-AC-70		10.4	11.2	12.021	-	1.069
MR-NF-AC-71		11.3	12.5	14.909	-	1.033
MR-NF-AC-72		12.6	13.3	16.920	-	0.846
MR-NF-AC-73		12.6	13.6	18.579	3	0.929
MR-NF-AC-74		14.2	15.5	29.376	-	1.026
MR-NF-AC-75		9.5	10.3	8.864	-	1.034
MR-NF-AC-76		13.6	14.5	22.717	-	0.903
MR-NF-AC-77		12.8	13.9	20.361	-	0.971
MR-NF-AC-78		11.9	12.9	16.975	-	1.007
MR-NF-AC-79		11.5	12.6	16.252	-	1.069
MR-NF-AC-80		12.9	14.0	21.412	-	0.997
MR-NF-AC-81		13.9	15.0	25.734	-	0.958
MR-NF-AC-82		14.6	15.8	30.065	-	0.966
MR-NF-AC-83		12.1	13.0	17.180	-	0.970
MR-NF-AC-84		17.4	18.9	48	-	0.911
MR-NF-AC-85		12.8	13.8	19.908	-	0.949
MR-NF-AC-86		13.5	14.6	24.067	-	0.978
MR-NF-AC-87		10.5	11.3	12.084	-	1.044
MR-NF-AC-88		15.6	16.9	36.058	-	0.950
MR-NF-AC-89		12.0	13.1	17.858	-	1.033
MR-NF-AC-90		12.0	12.8	13.647	3	0.790
MR-NF-AC-91		10.5	11.2	11.712	2	1.012
MR-NF-AC-92		9.1	10.0	8.578	2	1.138
MR-NF-AC-93		11.4	21.3	15.316	2	1.034
MR-NF-AC-94		17.3	18.7	52	4	1.004
MR-NF-AC-95		14.3	15.4	28.430	3	0.972
MR-NF-AC-96		13.9	15.0	24.611	3	0.916
MR-NF-AC-97		14.4	15.6	28.965	4	0.970
MR-NF-AC-98		11.5	12.5	16.483	-	1.084
MR-NF-AC-99		11.8	12.7	16.841	-	1.025
MR-NF-AC-100		12.4	13.4	20.578	-	1.079
Overall Catch Summary	**total number**	**100**	**100**	**100**	**10**	**100**
	average	**12.9**	**14.0**	**22.567**	**2.7**	**0.971**
	median	**12.6**	**13.8**	**19.501**	**3.0**	**0.981**
	standard deviation	**2.4**	**2.8**	**14.264**	**0.9**	**0.081**
	standard error	**0.2**	**0.3**	**1.426**	**0.3**	**0.008**
	minimum	**8.2**	**8.7**	**5.649**	**1**	**0.754**
	maximum	**24.3**	**26.2**	**122.000**	**4**	**1.138**

Table G.30: Arctic Charr Measurements from Fish Captured at the Mary River Far-Field Area by Electrofishing as Part of the Mary River Project EEM, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
MR-FF-AC-01	14.5	15.7	29.707	-	0.974
MR-FF-AC-02	12.4	13.4	20.865	-	1.094
MR-FF-AC-03	15.9	17.3	40	-	0.995
MR-FF-AC-04	12.9	14.0	17.009	-	0.792
MR-FF-AC-05	19.8	21.5	62	-	0.799
MR-FF-AC-06	15.9	17.2	37	-	0.920
MR-FF-AC-07	12.5	13.6	19.920	-	1.020
MR-FF-AC-08	12.7	13.7	20.811	-	1.016
MR-FF-AC-09	13.1	14.2	26.242	-	1.167
MR-FF-AC-10	13.6	14.6	26.714	-	1.062
MR-FF-AC-11	13.8	14.9	24.405	-	0.929
MR-FF-AC-12	10.3	11.0	11.707	-	1.071
MR-FF-AC-13	13.9	15.0	25.934	-	0.966
MR-FF-AC-14	12.4	13.4	22.428	-	1.176
MR-FF-AC-15	11.5	12.4	16.697	-	1.098
MR-FF-AC-16	15.0	16.2	31.273	-	0.927
MR-FF-AC-17	12.8	14.0	21.380	-	1.019
MR-FF-AC-18	10.5	11.3	11.128	-	0.961
MR-FF-AC-19	9.3	10.0	8.654	-	1.076
MR-FF-AC-20	10.9	11.7	13.423	-	1.037
MR-FF-AC-21	11.4	12.3	17.076	-	1.153
MR-FF-AC-22	13.5	14.6	22.042	-	0.896
MR-FF-AC-23	11.7	12.7	18.479	-	1.154
MR-FF-AC-24	12.2	13.2	16.414	-	0.904
MR-FF-AC-25	11.5	12.6	17.321	-	1.139
MR-FF-AC-26	10.9	11.6	13.475	-	1.041
MR-FF-AC-27	11.3	12.2	15.022	-	1.041
MR-FF-AC-28	13.1	14.1	23.621	-	1.051
MR-FF-AC-29	12.9	14.0	20.777	-	0.968
MR-FF-AC-30	19.0	20.6	57	-	0.831
MR-FF-AC-31	11.1	12.0	14.529	-	1.062
MR-FF-AC-32	15.2	16.5	30.388	-	0.865
MR-FF-AC-33	16.9	18.4	45	-	0.932
MR-FF-AC-34	19.2	20.8	60	-	0.848
MR-FF-AC-35	11.7	12.8	15.888	-	0.992
MR-FF-AC-36	13.0	14.2	23.379	-	1.064
MR-FF-AC-37	13.8	14.8	27.605	-	1.050
MR-FF-AC-38	13.8	14.9	26.785	-	1.019
MR-FF-AC-39	14.6	15.7	26.954	-	0.866
MR-FF-AC-40	11.8	12.7	18.854	-	1.148
MR-FF-AC-41	10.4	11.2	12.919	2	1.148
MR-FF-AC-42	11.6	12.5	16.920	-	1.084
MR-FF-AC-43	12.3	13.2	18.558	-	0.997
MR-FF-AC-44	11.5	12.6	18.175	-	1.195
MR-FF-AC-45	11.4	12.4	16.587	-	1.120
MR-FF-AC-46	13.9	15.0	28.827	-	1.073
MR-FF-AC-47	11.2	12.0	13.942	-	0.992
MR-FF-AC-48	8.2	8.8	6.579	-	1.193
MR-FF-AC-49	13.0	14.0	22.087	-	1.005
MR-FF-AC-50	11.5	12.3	16.566	-	1.089
MR-FF-AC-51	12.2	13.2	17.889	-	0.985
MR-FF-AC-52	13.9	15.0	28.129	-	1.047
MR-FF-AC-53	10.9	11.9	14.052	-	1.085
MR-FF-AC-54	15.5	16.8	29.487	-	0.792
MR-FF-AC-55	15.5	16.9	36.551	-	0.982
MR-FF-AC-56	12.2	13.1	21.402	-	1.179
MR-FF-AC-57	12.6	13.6	19.925	-	0.996
MR-FF-AC-58	13.0	14.0	22.926	-	1.044
MR-FF-AC-59	15.0	16.5	30.585	-	0.906

Table G.30: Arctic Charr Measurements from Fish Captured at the Mary River Far-Field Area by Electrofishing as Part of the Mary River Project EEM, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
MR-FF-AC-60		11.3	12.1	15.386	-	1.066
MR-FF-AC-61		12.4	13.4	22.403	-	1.175
MR-FF-AC-62		15.6	16.9	32.972	-	0.869
MR-FF-AC-63		13.0	13.9	20.955	-	0.954
MR-FF-AC-64		12.5	13.5	23.753	-	1.216
MR-FF-AC-65		13.1	14.1	27.020	-	1.202
MR-FF-AC-66		11.6	12.5	16.457	-	1.054
MR-FF-AC-67		18.3	19.8	56	-	0.914
MR-FF-AC-68		8.2	8.8	6.518	-	1.182
MR-FF-AC-69		16.3	17.7	36.480	-	0.842
MR-FF-AC-70		13.0	14.0	20.302	-	0.924
MR-FF-AC-71		10.2	11.0	12.626	-	1.190
MR-FF-AC-72		13.0	14.1	23.922	-	1.089
MR-FF-AC-73		13.7	14.8	25.515	-	0.992
MR-FF-AC-74		17.3	18.6	49	-	0.946
MR-FF-AC-75		12.4	13.3	18.645	-	0.978
MR-FF-AC-76		13.3	14.3	21.957	-	0.933
MR-FF-AC-77		13.3	14.4	22.383	-	0.951
MR-FF-AC-78		12.9	13.9	20.245	-	0.943
MR-FF-AC-79		10.4	11.2	13.070	-	1.162
MR-FF-AC-80		17.8	19.4	52	-	0.922
MR-FF-AC-81		12.0	13.0	20.633	-	1.194
MR-FF-AC-82		12.6	13.6	19.636	-	0.982
MR-FF-AC-83		17.6	19.0	45	-	0.825
MR-FF-AC-84		16.8	18.0	37	-	0.780
MR-FF-AC-85		17.4	18.9	52	-	0.987
MR-FF-AC-86		15.2	16.5	30.117	-	0.858
MR-FF-AC-87		16.7	18.1	35	-	0.751
MR-FF-AC-88		13.8	14.8	23.499	-	0.894
MR-FF-AC-89		16.8	18.5	42	-	0.886
MR-FF-AC-90		10.9	11.6	14.225	-	1.098
MR-FF-AC-91		11.0	11.8	15.461	-	1.162
MR-FF-AC-92		11.4	12.2	16.260	2	1.098
MR-FF-AC-93		10.1	10.8	10.986	2	1.066
MR-FF-AC-94		8.6	9.2	7.659	1	1.204
MR-FF-AC-95		9.5	10.2	9.949	2	1.160
MR-FF-AC-96		16.8	18.3	44	4	0.928
MR-FF-AC-97		14.1	15.3	28.108	3	1.003
MR-FF-AC-98		13.6	14.6	22.804	3	0.907
MR-FF-AC-99		10.6	11.3	11.906	2	1.000
MR-FF-AC-100		8.3	8.7	5.963	1	1.043
Overall Catch Summary	**total number**	**100**	**100**	**100**	**10**	**100**
	average	**13.1**	**14.2**	**24.198**	**2.2**	**1.014**
	median	**12.9**	**14.0**	**21.391**	**2.0**	**1.011**
	standard deviation	**2.5**	**2.7**	**12.116**	**0.9**	**0.114**
	standard error	**0.2**	**0.3**	**1.212**	**0.3**	**0.011**
	minimum	**8.2**	**8.7**	**5.963**	**1**	**0.751**
	maximum	**19.8**	**21.5**	**62.000**	**4**	**1.216**

Table G.31: **Non-Lethal Endpoint Statistical Comparison Results for Arctic Charr Collected from Mary River Near- and Far-Field Study Areas as Part of the Mary River Project EEM, August 2017**

Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Statistics			Summary Statistics			Test *P*-value (Area)	Magnitude of Difference (%)[a]	Estimated Minimum Detectable Difference (% Relative to Reference) with α=β=0.1	
		Response	Covariate	Far-Field Area	Near-Field Area		Interaction Model / Interaction P-value	Parallel Slope Model / Covariate P-value	Covariate Value for Comparisons	Statistic	Far-Field Area	Near-Field Area			Decrease	Increase
Survival/ Recruitment	Length Frequency Distribution All Fish	Fork Length (cm)	n/a	102	100	K-S	-	-	-	-	-	-	0.936	-	-	-
Survival/ Recruitment	Length Frequency Distribution Non-YOY only	Fork Length (cm)	n/a	100	100	K-S	-	-	-	-	-	-	0.906	-	-	-
Body Size	Fork Length (Non-YOY)	$\log_{10}$[Fork Length (cm)]	n/a	100	100	t-test	-	-	-	Geometric Mean	12.9	12.7	0.523	-1.6	-7.4	8.0
Body Size	Body Weight (Non-YOY)	$\log_{10}$[Body Weight (g)]	n/a	100	100	t-test	-	-	-	Geometric Mean	21.6	19.7	0.200	-8.7	-19	23
Energy Storage	Condition (Non-YOY)	$\log_{10}$[Body Weight (g)]	$\log_{10}$[Fork Length (cm)]	100	100	ANCOVA	0.001[b]	<0.001	12.8	Adjusted Mean	21.1	20.1	<0.001	-4.5	-2.3	2.3

[shaded] = P-value < 0.05 for ANCOVA interaction and covariate terms and P-value < 0.1 for overall test for area

[a] For ANCOVA: Calculated as the difference in adjusted mean between areas (effluent-exposed minus reference), expressed as a percentage of the reference area mean

[b] The R^2 of the interaction model was 0.9766 and the R^2 of the parallel slope model was 0.9753 (difference of 0.13%) so the ANCOVA proceeded under the assumption that the slopes are practically parallel, as per Environment Canada (2012) guidance.

Table G.32: **Estimated Minimum Sample Sizes to Detect Various Effect Sizes for Arctic Charr Health Endpoints between Mary River Near- and Far-Field Areas Based on the Observed Variability in the EEM Study, 2017**

Indicator	Endpoint	Variables		Sample Size		Model	S[a]	Minimum Sample Size to Detect an Effect Size (% Increase [i] or Decrease [d] Relative to Reference) with α=β=0.1							
		Response	Covariate	Far-Field	Near-Field			i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
								d=5%	d=9%	d=17%	d=20%	d=23%	d=29%	d=33%	d=50%
Body Size	Fork Length	$\log_{10}$[Fork Length (cm)]	n/a	100	100	t-test	0.0803	247	66	19	13	10	6	5	3
Body Size	Body Weight	$\log_{10}$[Body Weight (g)]	n/a	100	100	t-test	0.2161	1,782	468	129	86	63	39	27	10
Energy Storage	Condition	$\log_{10}$[Body Weight (g)]	$\log_{10}$[Fork Length (cm)]	100	100	ANCOVA	0.0342	46	13	5	4	3	3	2	2

[a] Pooled standard deviation of the residuals.

Table G.33: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID	Fork Length (cm)	Total Length (cm)	Total Length (mm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML17-ACJ-01	13.4	14.3	143	23.802	3++	0.989
ML17-ACJ-02	10.3	11.0	110	9.218	2++	0.844
ML17-ACJ-03	7.5	7.9	79	3.745	1	0.888
ML17-ACJ-04	12.0	12.8	128	13.849	2++	0.801
ML17-ACJ-05	8.2	8.8	88	5.380	1+	0.976
ML17-ACJ-06	8.8	9.4	94	5.843	1++	0.857
ML17-ACJ-07	6.8	7.1	71	2.517	1+	0.800
ML17-ACJ-08	5.8	6.1	61	1.605	1	0.823
ML17-ACJ-09	4.2	4.4	44	0.495	0++	0.668
ML17-ACJ-10	3.7	3.9	39	0.487	0++	0.961
ML17-ACJ-11	3.6	3.8	38	0.370	-	0.793
ML17-ACJ-12	9.6	10.3	103	6.516	-	0.736
ML17-ACJ-13	9.5	10.1	101	7.052	-	0.823
ML17-ACJ-14	9.3	9.9	99	6.910	-	0.859
ML17-ACJ-15	7.5	8.1	81	3.649	-	0.865
ML17-ACJ-16	8.4	9.0	90	5.154	-	0.870
ML17-ACJ-17	6.3	6.6	66	2.212	-	0.885
ML17-ACJ-18	8.0	8.6	86	4.565	-	0.892
ML17-ACJ-19	6.0	6.5	65	2.011	-	0.931
ML17-ACJ-20	6.3	6.6	66	2.062	-	0.825
ML17-ACJ-21	6.0	6.5	65	1.871	-	0.866
ML17-ACJ-22	10.1	10.9	109	9.004	-	0.874
ML17-ACJ-23	9.8	10.5	105	8.284	-	0.880
ML17-ACJ-24	8.2	8.9	89	4.880	-	0.885
ML17-ACJ-25	9.1	9.8	98	6.747	-	0.895
ML17-ACJ-26	6.9	7.4	74	2.987	-	0.909
ML17-ACJ-27	6.3	6.6	66	2.364	-	0.945
ML17-ACJ-28	6.2	6.6	66	2.123	-	0.891
ML17-ACJ-29	9.3	10.2	102	6.804	-	0.846
ML17-ACJ-30	7.0	7.5	75	3.378	-	0.985
ML17-ACJ-31	6.0	6.4	64	1.998	-	0.925
ML17-ACJ-32	10.5	11.6	116	9.707	-	0.839
ML17-ACJ-33	10.5	11.3	113	9.169	-	0.792
ML17-ACJ-34	11.0	11.7	117	11.569	-	0.869
ML17-ACJ-35	4.1	4.3	43	0.728	-	1.056
ML17-ACJ-36	4.2	4.4	44	0.745	-	1.006
ML17-ACJ-37	4.3	4.5	45	0.744	-	0.936
ML17-ACJ-38	6.0	6.4	64	1.919	-	0.888
ML17-ACJ-39	6.7	7.1	71	2.324	-	0.773
ML17-ACJ-40	6.7	7.1	71	2.105	-	0.700
ML17-ACJ-41	6.0	6.5	65	1.836	-	0.850
ML17-ACJ-42	10.8	11.6	116	12.558	-	0.997
ML17-ACJ-43	6.2	6.6	66	2.015	-	0.845
ML17-ACJ-44	6.2	6.6	66	2.213	-	0.929
ML17-ACJ-45	7.6	8.1	81	3.746	-	0.853
ML17-ACJ-46	9.5	10.2	102	6.755	-	0.788
ML17-ACJ-47	5.9	6.3	63	1.745	-	0.850
ML17-ACJ-48	4.6	4.8	48	0.923	-	0.948
ML17-ACJ-49	4.1	4.3	43	0.684	-	0.992
ML17-ACJ-50	9.0	9.6	96	5.681	-	0.779
ML17-ACJ-51	6.4	6.8	68	2.269	-	0.866
ML17-ACJ-52	8.6	9.3	93	5.476	-	0.861
ML17-ACJ-53	4.8	5.1	51	1.028	-	0.930
ML17-ACJ-54	5.6	5.9	59	1.409	-	0.802
ML17-ACJ-55	6.0	6.4	64	1.940	-	0.898
ML17-ACJ-56	4.4	4.6	46	0.790	-	0.927
ML17-ACJ-57	4.0	4.2	42	0.536	-	0.838

Table G.33: Arctic Charr Measurements from Fish Captured at Mary Lake by Electrofishing, Mary River Project CREMP, August 2017

Specimen ID		Fork Length (cm)	Total Length (cm)	Total Length (mm)	Body Weight (g)	Age (years)	Fulton's Condition Factor (K)
ML17-ACJ-58		6.4	6.8	68	2.081	-	0.794
ML17-ACJ-59		6.4	6.9	69	2.436	-	0.929
ML17-ACJ-60		6.0	6.5	65	1.959	-	0.907
ML17-ACJ-61		6.1	6.5	65	2.128	-	0.938
ML17-ACJ-62		7.9	8.4	84	4.226	-	0.857
ML17-ACJ-63		5.6	6.0	60	1.810	-	1.031
ML17-ACJ-64		3.8	4.0	40	0.494	-	0.900
ML17-ACJ-65		4.6	4.9	49	0.809	-	0.831
ML17-ACJ-66		8.1	8.6	86	4.534	-	0.853
ML17-ACJ-67		10.5	11.3	113	10.168	-	0.878
ML17-ACJ-68		10.5	11.2	112	9.684	-	0.837
ML17-ACJ-69		9.5	10.2	102	7.114	-	0.830
ML17-ACJ-70		8.2	8.8	88	4.779	-	0.867
ML17-ACJ-71		5.8	6.2	62	1.862	-	0.954
ML17-ACJ-72		6.9	7.3	73	2.669	-	0.812
ML17-ACJ-73		5.0	5.3	53	1.248	-	0.998
ML17-ACJ-74		8.7	9.3	93	5.704	-	0.866
ML17-ACJ-75		8.5	9.1	91	4.818	-	0.785
ML17-ACJ-76		6.7	7.1	71	2.569	-	0.854
ML17-ACJ-77		9.7	10.4	104	7.542	-	0.826
ML17-ACJ-78		8.5	9.1	91	5.076	-	0.827
ML17-ACJ-79		7.7	8.2	82	3.741	-	0.819
ML17-ACJ-80		8.5	9.0	90	4.396	-	0.716
ML17-ACJ-81		7.5	8.0	80	3.632	-	0.861
ML17-ACJ-82		6.9	7.3	73	2.310	-	0.703
ML17-ACJ-83		6.1	6.4	64	1.898	-	0.836
ML17-ACJ-84		4.0	4.2	42	0.442	-	0.691
ML17-ACJ-85		3.9	4.1	41	0.418	-	0.705
ML17-ACJ-86		9.1	9.7	97	6.556	-	0.870
ML17-ACJ-87		7.7	8.2	82	4.118	-	0.902
ML17-ACJ-88		8.4	9.0	90	4.875	-	0.823
ML17-ACJ-89		8.0	8.5	85	4.288	-	0.838
ML17-ACJ-90		9.6	10.2	102	7.620	-	0.861
ML17-ACJ-91		8.5	8.9	89	5.348	-	0.871
ML17-ACJ-92		5.7	6.0	60	1.796	-	0.970
ML17-ACJ-93		6.3	6.6	66	2.116	-	0.846
ML17-ACJ-94		6.0	6.3	63	1.741	-	0.806
ML17-ACJ-95		4.0	4.2	42	0.639	-	0.998
ML17-ACJ-96		4.9	5.1	51	1.176	-	1.000
ML17-ACJ-97		3.7	3.9	39	0.444	-	0.877
ML17-ACJ-98		3.9	4.1	41	0.504	-	0.850
Overall Catch Summary	Sample Size (N)	98	98	98	98	10	98
	Average	7.1	7.6	75.9	3.982	1.2	0.867
	Median	6.8	7.1	71.0	2.477	1	0.863
	Standard Deviation	2.2	2.3	23.5	3.627	0.9	0.077
	Standard Error	0.2	0.2	2.4	0.366	0.3	0.008
	Minimum	3.6	3.8	38.0	0.370	0	0.668
	Maximum	13.4	14.3	143.0	23.802	3	1.056
Young-of-the-Year Catch Summary	proportion of YOY	20%					
	Sample Size (N)	20	20	20	20	2	20
	Average	4.2	4.4	44.1	0.685	0.0	0.895
	Median	4.1	4.3	43.0	0.662	0	0.928
	Standard Deviation	0.4	0.4	4.3	0.254	0	0.113
	Standard Error	0.1	0.1	1.0	0.057	0	0.025
	Minimum	3.6	3.8	38.0	0.370	0	0.668
	Maximum	5.0	5.3	53.0	1.248	0	1.056

Table G.34: Results of Nearshore Arctic Charr Young-of-the-Year (YOY) and Non-YOY Health Endpoint Statistical Comparisons between Mary Lake (BLO) and Reference Lake 3 (REF), Mary River Project CREMP, August 2017

Group	Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
			Response	Covariate	REF	Mary Lake		Interaction Model: Interaction P-value	Parallel Slope Model: Covariate P-value	Covariate Value for Comparisons[a]	Statistic	REF	Mary Lake		
All Fish	Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	100	98	K-S	-	-	-	-	-	-	0.004	25
YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	26	19	t-test	-	-	-	Geometric Mean	3.62	4.13	<0.001	14
		Body Weight	log[Body Weight (g)]	-	26	19	t-test	-	-	-	Geometric Mean	0.446	0.622	<0.001	40
	Energy Storage	Condition [e]	log[Body Weight (g)]	log[Fork Length (cm)]	26	19	ANCOVA	0.350	<0.001	3.83	Adjusted Mean	0.531	0.490	0.224	-7.7
			log[Body Weight (g)]	log[Fork Length (cm)]	25	19	ANCOVA	0.985	<0.001	3.84	Adjusted Mean	0.534	0.486	0.087	-9.0
Non-YOY	Survival	Length Frequency Distribution	Fork Length (cm)	-	74	79	K-S	-	-	-	-	-	-	0.004	29
	Body Size	Fork Length	Fork Length (cm)	-	74	79	M-W	-	-	-	Median	6.60	7.70	0.014	17
		Body Weight	Body Weight (g)	-	74	79	M-W	-	-	-	Median	2.48	3.75	0.012	51
	Energy Storage	Condition [f]	log[Body Weight (g)]	log[Fork Length (cm)]	74	79	ANCOVA	0.680	<0.001	7.32	Adjusted Mean	3.33	3.38	0.277	1.4
			log[Body Weight (g)]	log[Fork Length (cm)]	73	79	ANCOVA	0.772	<0.001	7.32	Adjusted Mean	3.32	3.39	0.133	1.9

(Shaded) Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(exposed area mean - reference area mean) / reference area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(exposed area predicted mean - reference area predicted mean) / reference area predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between areas. A negative difference implies that the exposed area has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that the exposed area has fewer fish less than the length where the maximum difference in CFRDs was observed.

[e] Sample REF317-ACJ-25 was determined to be a statistical outlier (Studentized residual = 4.33) from the 2017 Reference Lake 3 data set. The analysis was conducted with both the inclusion and exclusion of this individual.

[f] Sample REF317-ACJ-56 was determined to be a statistical outlier (Studentized residual = 4.64) from the 2017 Reference Lake 3 data set. The analysis is presented with both the inclusion and exclusion of this individual.

Table G.35: Arctic Charr Estimated Sample Sizes to Detect Various Effect Sizes as a Percentage Change in Respective Fish Health Endpoints at Mary Lake Using 2017 Data Relative to Reference Lake 3 (2017) Data or Mary Lake Baseline (2006 - 2013) Data with α=β=0.1, Mary River Project CREMP, 2017

Comparison	Group	Indicator	Endpoint	Variables		Test	S[a]	COV (%)[b]	Minimum Sample Size to Detect an Effect Size (% Increase/Decrease Relative to Reference) with α=β=0.1									
				Response	Covariate				log(Response)	5% -5%	10% -9%	20% -17%	25% -20%	30% -23%	33% -25%	40% -29%	50% -33%	100% -50%
									Response	±5%	±10%	±20%	±25%	±30%	±33%	±40%	±50%	±100%
Nearshore Arctic Charr (Electrofishing Data) versus Reference Lake 3, 2017 Data	YOY	Body Size	Fork Length	log[Fork Length (cm)]	-	t-test	0.03321	-	log(Response)	43	12	4	4	3	3	3	2	2
			Body Weight	log[Adjusted Body Weight (g)]	-	t-test	0.12408	-	log(Response)	588	155	43	29	22	18	14	10	4
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.07194	-	log(Response)	200	54	16	12	9	8	7	5	4
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.05961	-	log(Response)	138	38	12	9	7	6	5	4	3
	Non-YOY	Body Size	Fork Length	Fork Length (cm)	-	M-W	-	23.77	Response	450	114	29	20	14	12	9	6	4
			Body Weight	Body Weight (g)	-	M-W	-	100.7	Response	8,035	2,010	504	323	225	182	128	83	22
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03450	-	log(Response)	48	14	6	5	4	4	4	3	3
				log[Adjusted Body Weight (g)]	log[Fork Length (cm)]	ANCOVA	0.03236	-	log(Response)	42	13	5	4	4	4	4	3	3
Littoral/Profundal Arctic Charr (Gill Netting Data) 2017 versus Baseline	All fish	Body Size	Fork Length	Fork Length (mm)	-	M-W	-	21.81	Response	379	97	26	17	12	11	7	6	4
			Body Weight	Body Weight (g)	-	M-W	-	72.00	Response	4,113	1,029	259	166	116	94	66	43	12
		Growth	Weight-at-age	log[Adjusted Body Weight (g)]	log[Age (years)]	ANCOVA	0.25191	-	log(Response)	2,423	637	176	118	86	72	53	37	14
			Length-at-age	log[Fork Length (mm)]	log[Age (years)]	ANCOVA	0.08535	-	log(Response)	280	75	22	16	12	10	8	6	4
		Energy Storage	Condition	log[Adjusted Body Weight (g)]	log[Fork Length (mm)]	ANCOVA	0.05584	-	log(Response)	121	33	11	8	6	6	5	4	3

[a] Pooled standard deviation of the regression residuals

[b] Coefficient of variation (pooled standard deviation/reference mean)×100%

Table G.36: Gill Netting Catch Records for Mary Lake, Mary River Project CREMP, August 2017

Gill Net Set ID	Location (NAD83, UTM Zone 17W)		Length (m)	Set Date	Lift Date	Set Time	Lift Time	Fishing Hours	Effort (m*hrs/100 m)	Arctic Charr Catch per Mesh Size			Total Catch	CPUE
	Easting	Northing								1½"	2"	3"		
ML17-GN-1	555112	7905861	91.4	17-Aug-17	17-Aug-17	10:55	12:15	1.33	1.22	0	3	4	7	5.74
				17-Aug-17	17-Aug-17	12:25	14:35	2.17	1.98	1	2	2	5	2.52
				17-Aug-17	17-Aug-17	15:00	16:25	1.42	1.30	0	0	2	2	1.54
				18-Aug-17	18-Aug-17	9:45	11:10	1.42	1.30	0	1	3	4	3.09
ML17-GN-2	555054	7905720	91.4	17-Aug-17	17-Aug-17	11:05	12:40	1.58	1.45	1	2	4	7	4.83
				17-Aug-17	17-Aug-17	12:50	15:15	2.42	2.21	3	1	1	5	2.26
ML17-GN-3	555134	7905118	91.4	17-Aug-17	17-Aug-17	11:15	13:00	1.75	1.60	1	2	4	7	4.37
ML17-GN-4	555921	7904056	91.4	17-Aug-17	17-Aug-17	11:30	13:30	2.00	1.83	1	1	1	3	1.64
ML17-GN-5	556119	7903866	91.4	17-Aug-17	17-Aug-17	11:45	13:45	2.00	1.83	3	3	2	8	4.37
ML17-GN-6	554909	7905977	91.4	17-Aug-17	17-Aug-17	14:20	16:15	1.92	1.75	1	1	1	3	1.71
ML17-GN-7	554592	7906297	91.4	17-Aug-17	17-Aug-17	15:30	18:50	3.33	3.05	2	7	3	12	3.94
				18-Aug-17	18-Aug-17	9:30	10:55	1.42	1.30	2	4	1	7	5.40
ML17-GN-8	554601	7906508	91.4	17-Aug-17	17-Aug-17	15:45	19:05	3.33	3.05	6	0	3	9	2.95
				18-Aug-17	18-Aug-17	9:20	10:25	1.08	0.99	0	1	5	6	6.06
ML17-GN-8	554396	7906450	91.4	17-Aug-17	17-Aug-17	16:35	19:15	2.67	2.44	0	4	3	7	2.87
				18-Aug-17	18-Aug-17	9:05	10:00	0.92	0.84	0	0	1	1	1.19
								Total	**28.12**	**21**	**32**	**40**	**93**	**3.41**

Note: Catch-per-unit-effort (CPUE) represents the number of fish captured per 100 m·hours of net.

Table G.37: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor
ML17-AC-01	2	39.3	42.8	620	-	1.021
ML17-AC-02	2	37.4	40.5	470	12+	0.898
ML17-AC-03	2	38.9	41.6	540	-	0.917
ML17-AC-04	3	37.2	40.2	510	-	0.991
ML17-AC-05	3	37.0	39.9	540	-	1.066
ML17-AC-06	3	41.5	45.0	580	-	0.811
ML17-AC-07	3	42.0	45.4	620	-	0.837
ML17-AC-08	3	37.6	40.6	520	-	0.978
ML17-AC-09	3	37.4	40.6	540	-	1.032
ML17-AC-10	3	37.5	40.8	520	-	0.986
ML17-AC-11	3	38.4	41.3	480	-	0.848
ML17-AC-12	2	38.6	41.4	470	-	0.817
ML17-AC-13	2	34.0	36.8	380	-	0.967
ML17-AC-14	1½	40.0	43.4	600	-	0.938
ML17-AC-15	3	45.0	49.0	750	-	0.823
ML17-AC-16	3	36.5	39.6	460	-	0.946
ML17-AC-17	3	40.0	43.2	570	-	0.891
ML17-AC-18	3	39.5	43.5	590	-	0.957
ML17-AC-19	2	39.8	42.5	610	-	0.968
ML17-AC-20	2	38.8	41.5	590	-	1.010
ML17-AC-21	1½	40.0	44.0	520	-	0.813
ML17-AC-22	2	39.1	42.5	580	-	0.970
ML17-AC-23	3	39.5	42.7	600	15++	0.974
ML17-AC-24	1½	21.8	23.6	88	5++	0.849
ML17-AC-25	1½	60.0	63.6	2,050	-	0.949
ML17-AC-26	1½	36.5	39.7	500	-	1.028
ML17-AC-27	1½	36.1	39.1	440	11++	0.935
ML17-AC-28	2	61.0	64.4	2,100	-	0.925
ML17-AC-29	2	41.4	44.9	630	-	0.888
ML17-AC-30	2	38.2	41.4	560	-	1.005
ML17-AC-31	3	36.6	39.6	520	-	1.061
ML17-AC-32	3	37.5	40.2	490	-	0.929
ML17-AC-33	1½	37.6	40.8	460	-	0.865
ML17-AC-34	2	37.5	40.5	500	-	0.948
ML17-AC-35	2	30.0	32.4	230	-	0.852
ML17-AC-36	3	41.0	44.1	660	-	0.958
ML17-AC-37	3	37.5	40.1	520	12+	0.986
ML17-AC-38	1½	25.8	30.9	230	-	1.339
ML17-AC-39	1½	29.1	31.5	220	-	0.893
ML17-AC-40	1½	41.8	44.2	610	-	0.835
ML17-AC-41	2	40.5	43.9	570	-	0.858
ML17-AC-42	3	36.5	39.0	510	-	1.049
ML17-AC-43	3	34.5	37.5	410	-	0.998
ML17-AC-44	2	38.5	42.2	560	-	0.981
ML17-AC-45	1½	35.6	38.5	470	-	1.042
ML17-AC-46	3	41.0	44.3	630	-	0.914
ML17-AC-47	3	36.5	38.5	490	-	1.008
ML17-AC-48	3	38.0	41.1	520	-	0.948
ML17-AC-49	3	37.6	41.2	640	-	1.204
ML17-AC-50	3	39.8	43.2	530	15+	0.841
ML17-AC-51	2	30.3	32.8	250	-	0.899
ML17-AC-52	2	40.1	43.2	600	-	0.931
ML17-AC-53	2	33.0	35.6	460	12+	1.280
ML17-AC-54	2	24.0	25.6	130	-	0.940

Table G.37: Arctic Charr Measurements from Fish Captured at Mary Lake by Gill Netting, Mary River Project CREMP, August 2017

Specimen ID	Net Mesh Size (inches)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Age (years)	Fulton's Condition Factor
ML17-AC-55	2	30.8	33.0	315	8+	1.078
ML17-AC-56	2	37.5	40.0	550	17+	1.043
ML17-AC-57	2	31.6	34.2	290	-	0.919
ML17-AC-58	1½	16.0	17.0	45	-	1.099
ML17-AC-59	1½	37.9	40.6	590	-	1.084
ML17-AC-60	1½	36.0	38.9	520	13+	1.115
ML17-AC-61	1½	31.4	33.0	280	-	0.904
ML17-AC-62	1½	37.0	39.9	560	14+	1.106
ML17-AC-63	1½	28.2	30.5	220	-	0.981
ML17-AC-64	1½	28.1	30.4	200	-	0.901
ML17-AC-65	1½	30.6	33.6	305	13+	1.064
ML17-AC-66	3	36.6	37.2	450	-	0.918
ML17-AC-67	3	40.1	43.5	590	-	0.915
ML17-AC-68	3	36.6	39.6	420	-	0.857
ML17-AC-69	3	35.4	38.5	450	-	1.014
ML17-AC-70	3	34.9	37.9	430	-	1.012
ML17-AC-71	3	38.2	41.3	510	-	0.915
ML17-AC-72	3	39.9	44.9	580	-	0.913
ML17-AC-73	2	23.5	25.7	130	-	1.002
ML17-AC-74	2	31.4	34.0	280	-	0.904
ML17-AC-75	2	36.8	39.4	500	-	1.003
ML17-AC-76	2	28.8	30.9	200	-	0.837
ML17-AC-77	3	35.4	38.2	480	-	1.082
ML17-AC-78	2	35.8	38.2	440	-	0.959
ML17-AC-79	3	39.1	42.2	510	-	0.853
ML17-AC-80	3	40.0	43.7	530	-	0.828
ML17-AC-81	3	38.7	42.3	490	-	0.845
ML17-AC-82	3	37.0	40.1	500	-	0.987
ML17-AC-83	3	36.5	39.6	470	-	0.967
ML17-AC-84	3	37.1	40.7	490	-	0.960
ML17-AC-85	2	37.6	40.5	480	-	0.903
ML17-AC-86	2	34.0	36.4	300	10++	0.763
ML17-AC-87	2	38.0	41.2	480	-	0.875
ML17-AC-88	2	36.5	39.8	430	-	0.884
ML17-AC-89	1½	19.6	21.1	71	-	0.943
ML17-AC-90	1½	18.7	19.9	52	-	0.795
ML17-AC-91	2	37.0	40.2	520	-	1.027
ML17-AC-92	3	35.4	38.5	470	-	1.059
ML17-AC-93	3	41.0	44.0	600	-	0.871
ML17-AC-94	3	34.5	37.5	400	-	0.974
Overall Catch Summary	Sample Size (N)	94	94	94	13	94
	Average	36.3	39.2	493	12.1	0.9
	Median	37.3	40.2	500	12	0.9
	andard Deviation	6.4	6.8	278	3.1	0.1
	Standard Error	0.7	0.7	28.7	0.9	0.0
	Minimum	16.0	17.0	45	5	0.6
	Maximum	61.0	64.4	2,100	17	1.3

Table G.38: Additional Meristics Collected from Arctic Charr Incidental Mortalities at Mary Lake, Mary River Project CREMP, August 2017

Specimen ID		Age (years)	Fork Length (cm)	Total Length (cm)	Body Weight (g)	Adjusted Body Weight (g)	Fulton's Condition Factor (K)	Sex	Liver Weight (g)	Liver Somatic Index (LSI)	Gonad Weight (g)	Gonad Somatic Index (GSI)	Gill Net Mesh Size (inches)	Abnormalities[a]
ML17-AC-50		15+	39.8	43.2	530	525	0.841	M	4.262	0.81	0.775	0.148	3	iw (S)
ML17-AC-23		15++	39.5	42.7	600	594	-0.151	i	6.459	1.09	-	-	3	iw (C)
ML17-AC-24		5++	21.8	23.6	88	87	0.849	i	0.943	1.08	-	-	1½	iw (S)
ML17-AC-37		12+	37.5	40.1	520	514	0.986	i	6.100	1.19			3	iw (C)
ML17-AC-55		8+	30.8	33.0	315	313	1.078	i	2.450	0.78			2	iw (C), tw (C)
ML17-AC-56		17+	37.5	40.0	550	543	1.043	i	6.787	1.25	-	-	2	iw (A)
ML17-AC-60		13+	36.0	38.9	520	515	1.115	i	4.716	0.92	-	-	1½	iw (C)
ML17-AC-86		10++	34.0	36.4	300	296	0.763	i	3.734	1.26	-	-	2	iw (S)
ML17-AC-65		13+	30.6	33.6	305	302	1.064	i	3.276	1.09			1½	iw (VA)
ML17-AC-02		12+	37.4	40.5	470	463	0.898	F	4.806	1.04	2.226	0.481	2	iw (C)
ML17-AC-27		11++	36.1	39.1	440	388	0.935	F	9.506	2.45	42.699	11.011	1½	iw (C)
ML17-AC-53		12+	33.0	35.6	460	454	1.280	F	4.750	1.05	1.704	0.376	2	iw (S)
ML17-AC-62		14+	37.0	39.9	560	549	1.106	F	6.927	1.26	3.870	0.705	1½	iw (VA)
Adult Non-Spawner Statistics	Average	11.6	33.5	36.0	399.8	395.4	0.8	-	4.3	1.1	-	-	-	-
	Standard deviation	3.9	5.7	6.0	175.2	173.2	0.4	-	2.1	0.2	-	-	-	-
	Minimum	5	21.8	23.6	88.0	87.1	-0.2	-	0.9	0.8	-	-	-	-
	Maximum	17	39.5	42.7	600.0	593.5	1.1	-	6.8	1.3	-	-	-	-
	Sample Size (N)	8	8	8	8	8	8	8	8	8	-	-	-	-
Females Statistics	Average	12.3	35.9	38.8	482.5	463.4	1.1	-	6.5	1.4	12.6	3.1	-	-
	Standard deviation	1.3	2.0	2.2	53.2	66.3	0.2	-	2.2	0.7	20.1	5.2	-	-
	Minimum	11	33.0	35.6	440.0	387.8	0.9	-	4.8	1.0	1.7	0.4	-	-
	Maximum	14	37.4	40.5	560.0	549.2	1.3	-	9.5	2.5	42.7	11.0	-	-
	Sample Size (N)	4	4	4	4	4	4	4	4	4	4	4	-	-

[a] Abnormalities include internal worms (iw) and tapeworms (tw) in body cavity; letter in parentheses indicates Scarce (1-5), Common (6-15), Abundant (16-50) and Very Abundant (>50) observation.
Sex - Female (F), Male (M), Indeterminate (i).

Table G.39: Results of Adult (Littoral/Profundal) Arctic Charr Health Endpoint Statistical Comparisons for Mary Lake (BLO) between 2017 and the Mine Baseline (2006 - 2013) Period, Mary River Project CREMP, 2017

Indicator	Endpoint	Variables		Sample Size		Test	ANCOVA Model Statistics			Summary Statistics[b]			Test P-value	Magnitude of Difference (%)[c,d]
							Interaction Model	Parallel Slope Model	Covariate Value for Comparisons[a]					
		Response	Covariate	Baseline	2017		Interaction P-value	Covariate P-value		Statistic	Baseline	2017		
Recruitment/ Survival	Length Frequency Distribution	Fork Length (cm)	-	161	94	K-S	-	-	-	-	-	-	<0.001	-29
Body Size	Fork Length	Fork Length (cm)	-	161	94	M-W	-	-	-	Median	39.2	37.3	0.002	-4.8
	Body Weight	Body Weight (g)	-	161	94	M-W	-	-	-	Median	550	500	0.057	-9.1
Growth	Length-at-age	log[Fork Length (cm)]	log[Age (years)]	79	13	ANCOVA	0.178	<0.001	13.0	Adjusted Mean	371	371	0.984	-0.12
	Weight-at-age	log[Body Weight (g)]	log[Age (years)]	79	13	ANCOVA	0.335	<0.001	13.0	Adjusted Mean	477	499	0.804	4.5
Energy Storage	Condition	log[Body Weight (g)]	log[Fork Length (cm)]	161	94	ANCOVA	0.332	<0.001	36.8	Adjusted Mean	449	470	0.008	4.6

(grey box) Indicates P-value < 0.1 (i.e., significant difference between data sets)

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

[b] The median, mean (geometric mean for log_{10}-transformed variables), and adjusted mean are reported for Mann-Whitney, t-test and ANCOVA, respectively, and the predicted mean values from the regression line equations for minimum and maximum values of the covariate (where the data sets overlap) for ANCOVAs where a significant interaction was detected.

[c] The magnitude of difference calculated as: [(2017 mean - baseline mean) / baseline area mean] x 100. When there is a significant interaction in the ANCOVA, the magnitude of difference is calculated at the minimum and maximum values of overlap in covariate values as : [(2017 predicted mean - baseline predicted mean) / baseline predicted mean] x 100.

[d] Calculated as the maximum difference in the cumulative relative frequency distributions (CRFD) between groups. A negative difference implies that 2017 has more fish less than the length where the maximum difference in CFRDs was observed. A positive difference implies that 2017 has fewer fish less than the length where the maximum difference in CFRDs was observed.