Figure A.1-5

Sampling Locations in Reference Lake D, Doris Project, 2016

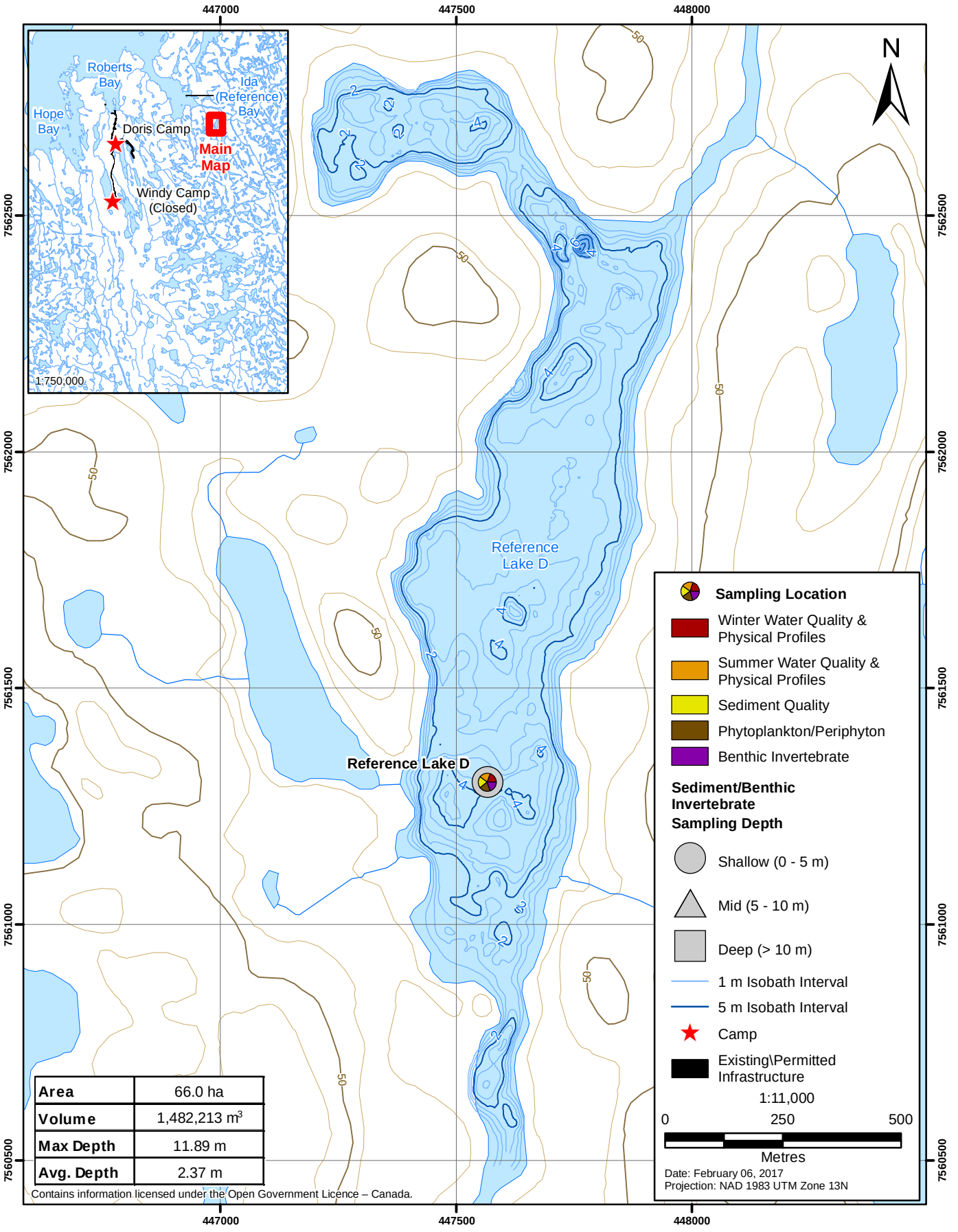


Figure A.1-6

Sampling Locations in Roberts Bay, Doris Project, 2016

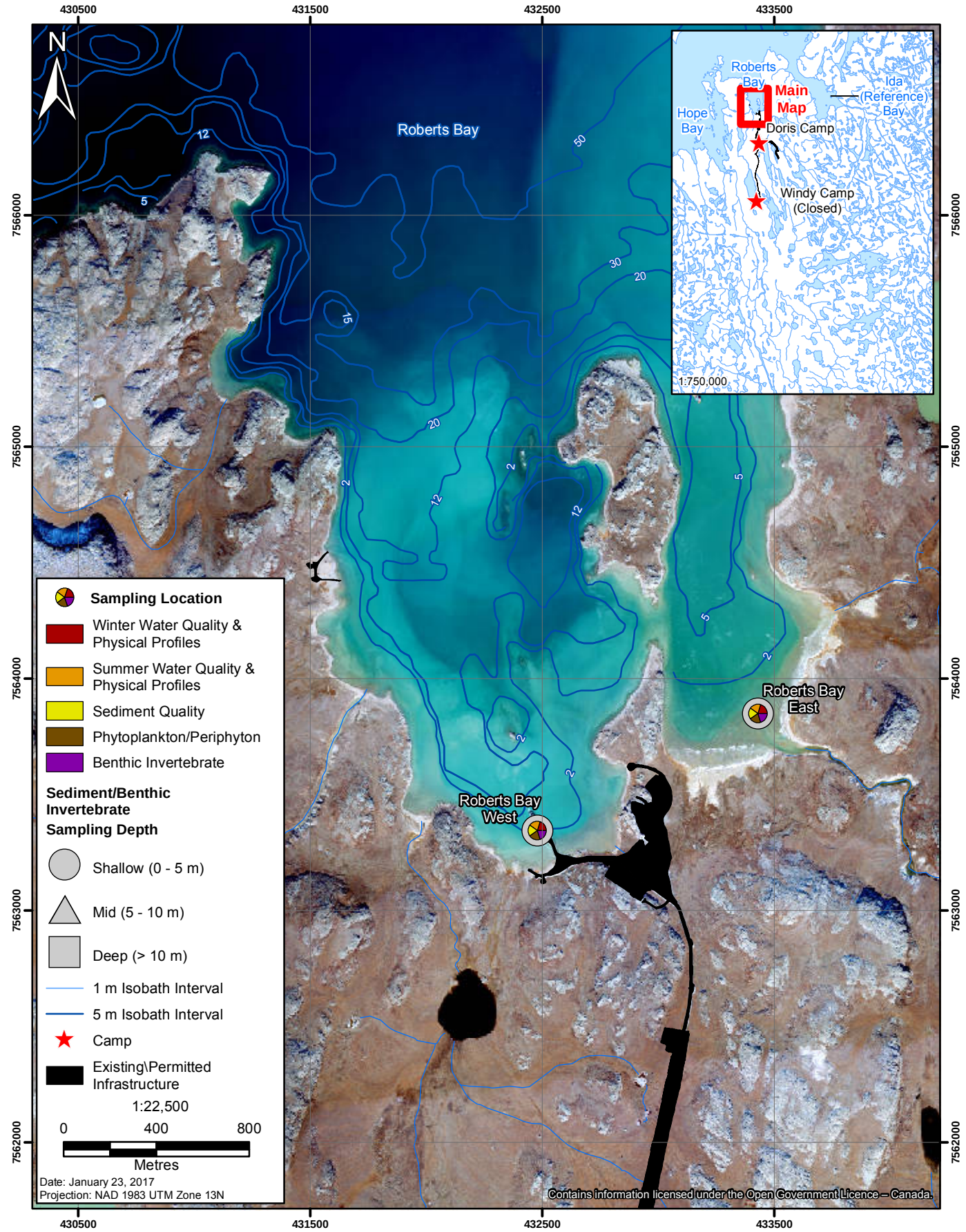
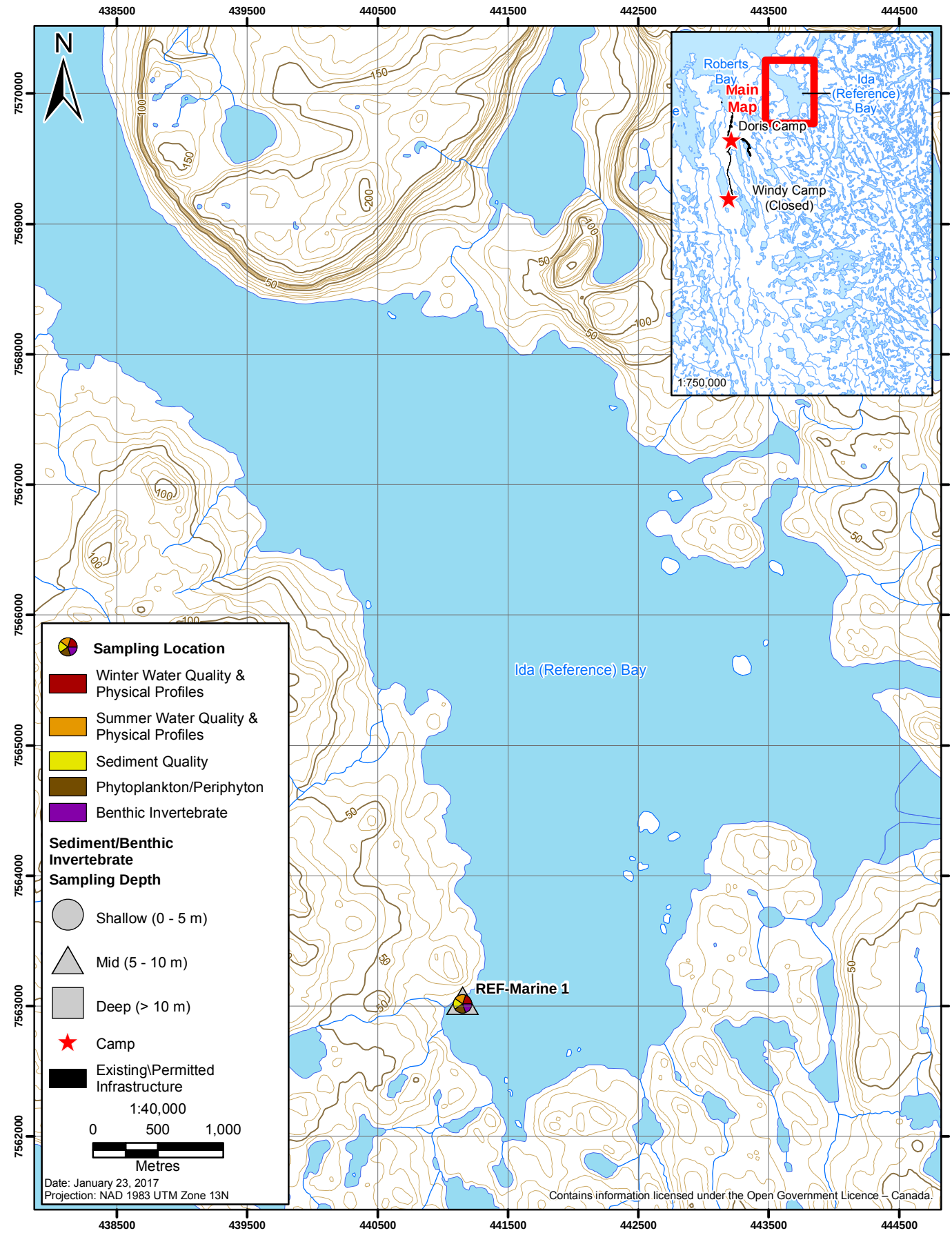


Figure A.1-7

Sampling Locations in Ida (Reference) Bay, Doris Project, 2016



A.1.2 Sampling Program Summary

Table A.1-1 presents a summary of the AEMP components and methods, including: the variables assessed, the within-year sampling frequency, sampling replication, sampling dates, and the sampling devices used.

Table A.1-1. Sampling Program Summary, Doris Project, 2016

Monitoring Variable	Sampling Frequency	Sample Replication and Depths	Sampling Dates / Timing	Sampling Device
Stream Water Quality				
Temperature, physical parameters, anions, nutrients, cyanides, organic carbon, total metals, radium-226	4×	n = 2/site	June, July, August, September	Water sampling bottles; temperature meter
Stream Periphyton				
Biomass (chlorophyll *a*)	3×	n = 3/site	June-July, July-August, August-September; coincident with stream water quality	Artificial samplers (Plexiglas plates) installed for ~1 month
Stream Benthos				
Density and taxonomy	1×	n = 5/site (3 composite subsamples/replicate	August; coincident with August stream survey	Hess sampler; 500 µm sieve
Stream Sediment Quality				
Physical, particle size, organic carbon, nutrients, metals	1×	n = 3/site	August; coincident with August stream survey	Plastic bowl and spoon
Lake Physical Limnology and Marine Oceanography				
Dissolved oxygen/temperature profile, Secchi depth, salinity profile (marine sites only)	4×	n = 1 profile/site throughout water column	April, July, August, September	Multi-parameter probe with optical dissolved oxygen sensor
Lake and Marine Water Quality				
Physical parameters, anions, nutrients, cyanides, organic carbon, total metals, radium-226	4×	Lakes: n = 1 sample/site @ 1 m below the surface and 2 m above water-sediment interface (large lakes only) + 20% replication; Marine: n = 2 samples/site @ 1 m	April, July, August, September	GO-FLO sampling bottle

(continued)

Table A.1-1. Sampling Program Summary, Doris Project, 2016 (completed)

Monitoring Variable	Sampling Frequency	Sample Replication and Depths	Sampling Dates / Timing	Sampling Device
Lake and Marine Phytoplankton				
Biomass (chlorophyll *a*)	4×	n = 3/site @ 1 m below the surface	April, July, August, September; coincident with lake and marine water quality	GO-FLO sampling bottle
Lake and Marine Benthos				
Density and taxonomy	1×	n = 5/site (3 composite subsamples/replicate)	August; coincident with August lake and marine survey	Ekman grab (lake); Petite Ponar grab (marine); 500 µm sieve
Lake and Marine Sediment Quality				
Physical, particle size, organic carbon, nutrients, metals	1×	n = 3/site	August; coincident with August lake and marine survey	Plastic bowl and spoon

A.1.3 Physical Limnology and Oceanography

A.1.3.1 Lakes

Under Ice

During winter (April), the underlying lake water at the sampling sites was accessed by drilling a 25 cm diameter hole through the ice using a motorized auger. The ice thickness was then recorded and the lake bottom depth measured using a depth sounder. Water column profiling and water quality sampling depths were calculated based on bottom depth.

In all lakes except for Little Roberts Lake, measurements of water column structure (including temperature and dissolved oxygen) were collected using a YSI ProDSS multiparameter probe equipped with an optical dissolved oxygen sensor. For ease of presentation, continuous data that were internally logged by the probe were post-processed by binning data into 0.2 m depth classes, and calculating the mean for each depth class. For Little Roberts Lake, a YSI ProODO metre equipped with an optical dissolved oxygen sensor was used to measure temperature and dissolved oxygen, and data were recorded manually at 0.5 m intervals as the probe was lowered into the water. The profiles extended from the surface to approximately 1 m above the sediment surface to reduce suspension of bottom sediments.

Open Water

Summer temperature and dissolved oxygen profiles were measured at the same sites as in winter, and were collected from aluminum boats. Profiles were collected using either a YSI ProODO probe (with data recorded manually at 0.5 m intervals) or a YSI EXO multiparameter probe equipped with an optical dissolved oxygen sensor (with internally logged data post-processed by binning data into 0.2 m depth classes). In addition, light attenuation was estimated in each lake using a Secchi disk. Light

attenuation measurements were collected at each site by lowering the 20 cm black and white Secchi disk on a metred line through the water column on the shaded side of the boat until it disappeared from sight. The depth of disappearance was recorded as the Secchi depth (D_s). The 1% euphotic zone depth ($Z_{1\%}$) was computed by first calculating the light extinction coefficient (k) from D_s, and then calculating the euphotic zone depth based on the appropriate light extinction coefficient. The 1% euphotic zone depth is the depth of the water column to which 1% of the surface irradiance reaches. It represents the depth at which the integrated gross water column photosynthetic production is equivalent to the integrated gross water column respiration; thus, there is net photosynthesis above this depth. The 1% euphotic zone depth is often referred to as the compensation depth, and is calculated as follows (Parsons, Takahashi, and Hargrave 1984):

Light extinction coefficient: $k\ (m^{-1}) = 1.7/D_s$

Euphotic Depth (1%): $Z_{1\%}\ (m) = 4.6/k$

A.1.3.2 Marine

Under Ice

Marine under-ice water was accessed by drilling a 25 cm diameter hole through the ice using a motorized auger. Ice thickness was recorded and the bottom depth measured using a depth sounder. Vertical profiles of temperature, salinity, conductivity, and dissolved oxygen concentration were collected using a YSI ProDSS multiparameter probe equipped with an optical dissolved oxygen sensor. The probe was lowered through the water column on a cable at approximately 0.5 m/s to within 1 m of the sea floor. Data from the downcast were used for physical profiles. As was done for lakes, continuous data were post-processed by binning data into 0.2 m depth classes, and calculating the mean for each depth class.

Open Water

Vertical profiles of temperature, salinity, conductivity, and dissolved oxygen concentration were collected over the side of an aluminum boat using a YSI EXO multiparameter probe equipped with an optical dissolved oxygen sensor. Profile data were processed as described for the under-ice season. Light penetration at each site was measured by lowering a 30 cm white Secchi disk over the shaded side of the boat until it disappeared from sight. This was recorded as the Secchi depth. The 1% euphotic zone depth was calculated from the Secchi depth as described above for lakes.

A.1.4 Water Quality

Water quality samples were collected at the lake and marine sites during the under-ice season in April, and the open-water season in July, August, and September 2016. Stream water quality samples were collected during the June freshet and the three open-water months listed above. Whenever possible, samples at a specific site were collected at least one month apart to conform to MMER/EEM recommendations. The sampling dates and depths for all sites are presented in Table A.1-2 and the analyzed variables are summarized in Table A.1-3. Sampling locations are presented in Figure A.1-1. The sampling procedures used for each aquatic habitat are described below.

Table A.1-2. Stream, Lake, and Marine Physical Limnology, Oceanography and Water Quality Sampling Dates and Depths, Doris Project, 2016

Habitat	Site	Sampling Date	Water Quality Sampling Depth(s) (m)	Physical Limnology and Oceanography Sampling Depths
Stream	Doris Outflow	12-Jun-16	Surface	Surface
		15-Jul-16	Surface	Surface
		14-Aug-16	Surface	Surface
		14-Sep-16	Surface	Surface
	Roberts Outflow	13-Jun-16	Surface	Surface
		16-Jul-16	Surface	Surface
		16-Aug-16	Surface	Surface
		14-Sep-16	Surface	Surface
	Little Roberts Outflow	13-Jun-16	Surface	Surface
		16-Jul-16	Surface	Surface
		19-Aug-16	Surface	Surface
		14-Sep-16	Surface	Surface
	Reference B Outflow	13-Jun-16	Surface	Surface
		17-Jul-16	Surface	Surface
		17-Aug-16	Surface	Surface
		19-Sep-16	Surface	Surface
	Reference D Outflow	13-Jun-16	Surface	Surface
		14-Jul-16	Surface	Surface
		18-Aug-16	Surface	Surface
		17-Sep-16	Surface	Surface
Lake	Doris Lake South	16-Apr-16	3.1, 9.0	Throughout water column
		16-Jul-16	1.0, 9.0	Throughout water column
		20-Aug-16	1.0, 9.0	Throughout water column
		19-Sep-16	1.0, 9.0	Throughout water column
	Doris Lake North	15-Apr-16	3.0, 11	Throughout water column
		17-Jul-16	1.0, 12.0	Throughout water column
		20-Aug-16	1.0, 12.0	Throughout water column
		19-Sep-16	1.0, 12.0	Throughout water column
	Little Roberts Lake	16-Apr-16	2.0	Throughout water column
		16-Jul-16	1.0	Throughout water column
		15-Aug-16	1.0	Throughout water column
		18-Sep-16	1.0	Throughout water column
	Reference Lake B	18-Apr-16	3.0, 10.0	Throughout water column
		18-Jul-16	1.0, 8.0	Throughout water column
		10-Aug-16	1.0, 8.0	Throughout water column
		19-Sep-16	1.0, 9.0	Throughout water column
	Reference Lake D	18-Apr-16	2.15	Throughout water column
		14-Jul-16	1.0	Throughout water column
		11-Aug-16	1.0	Throughout water column
		17-Sep-16	1.0	Throughout water column

(continued)

Table A.1-2. Stream, Lake, and Marine Physical Limnology, Oceanography and Water Quality Sampling Dates and Depths, Doris Project, 2016 (completed)

Habitat	Site	Sampling Date	Water Quality Sampling Depth(s) (m)	Physical Limnology and Oceanography Sampling Depths
Marine	RBE (Roberts Bay)	16-Apr-16	2.0	Throughout water column
		13-Jul-16	0	Throughout water column
		12-Aug-16	0	Throughout water column
		15-Sep-16	0.1	Throughout water column
	RBW (Roberts Bay)	16-Apr-16	3.0	Throughout water column
		13-Jul-16	1.0	Throughout water column
		12-Aug-16	1.0	Throughout water column
		15-Sep-16	1.0	Throughout water column
	REF-Marine 1 (Ida Bay)	18-Apr-16	2.7	Throughout water column
		13-Jul-16	1.0	Throughout water column
		13-Aug-16	1.0	Throughout water column
		18-Sep-16	1.0	Throughout water column

Note: April sample depths are recorded as depths below the water surface and are equal to approximately 0.25-1 m below the bottom of the ice.

A.1.4.1 Streams

During the open-water season, water quality samples were collected from three streams within the Doris and Roberts watersheds (Doris, Roberts, and Little Roberts outflows), and two reference streams far from Project activities (Reference B and Reference D outflows). Samples were collected on four occasions (June, July, August, and September) at each sampling site from June 12 to September 19, 2016. Stream sampling locations are presented in Figure A.1-1.

Stream water quality samples were collected at one midstream point in the cross section of the flow, with care being taken to prevent sampling artifacts associated with disturbing bottom sediments and collecting particulate material. Sampling personnel stood facing upstream to minimize sample contamination from re-suspended sediments. Samples were collected using appropriate verified-clean bottles provided by ALS Laboratory Group, Burnaby, BC (ALS). Samples were collected in duplicate and the appropriate preservatives provided by ALS were added in the field after sample collection.

All samples were kept cold and in the dark while in the field, and were refrigerated at Doris Camp prior to transport. Samples were transported in coolers with freezer packs to ALS in Burnaby, BC for analysis. The analyzed variables and their realized detection limits are presented in Table A.1-3.

A.1.4.2 Lakes and Marine

Lake water quality were collected from three sites in two lakes within the Doris and Roberts watersheds (Doris Lake South, Doris Lake North, and Little Roberts Lake), and from two reference lakes (Reference Lake B and Reference Lake D). Marine water quality samples were collected from two near-shore sites in Roberts Bay (RBE and RBW) and at one reference site in the adjacent inlet, Ida (Reference) Bay (REF-Marine 1). Lake and marine sampling sites are presented in Figure A.1-1.

Table A.1-3. Water Quality Variables and Realized Detection Limits, Doris Project, 2016

Variable	Units	Realized Detection Limits	
		Freshwater	Marine
Physical Tests			
pH	pH	0.1	0.1
Alkalinity, Total (as $CaCO_3$)	mg/L	1.0	1.0 to 2.0
Hardness (as $CaCO_3$)	mg/L	0.5	4.3
Conductivity	µS/cm	2.0	-
Total Suspended Solids	mg/L	1.0	2.0
Total Dissolved Solids	mg/L	10 to 20	20 to 80
Turbidity	NTU	0.1	0.1
Salinity		-	1.0
Anions			
Bromide (Br)	mg/L	0.05	0.25 to 5.0
Chloride (Cl)	mg/L	0.5	2.5 to 50
Fluoride (F)	mg/L	0.02	0.1 to 2.0
Sulphate (SO_4)	mg/L	0.3	1.5 to 30
Nutrients			
Ammonia (as N)	mg/L	0.005	0.005
Nitrate (as N)	mg/L	0.005	0.006
Nitrite (as N)	mg/L	0.001	0.002
Total Kjeldahl Nitrogen	mg/L	0.05	0.05
Orthophosphate-Dissolved (as P)	mg/L	0.001	0.001
Total Phosphorus	mg/L	0.002	0.01
Cyanides			
Cyanide Total	mg/L	0.001	0.001 to 0.005
Cyanide, Free	mg/L	0.001	0.001 to 0.005
Organic Carbon			
Dissolved Organic Carbon	mg/L	0.5	0.5
Total Organic Carbon	mg/L	0.5	0.5
Total Metals			
Aluminum (Al)	mg/L	0.003	0.005
Antimony (Sb)	mg/L	0.00003	0.0005
Arsenic (As)	mg/L	0.00005	0.0004
Barium (Ba)	mg/L	0.0001	0.001
Beryllium (Be)	mg/L	0.000005	0.0005
Bismuth (Bi)	mg/L	0.00005	0.0005
Boron (B)	mg/L	0.01	0.1
Cadmium (Cd)	mg/L	0.000005	0.00001
Calcium (Ca)	mg/L	0.05	0.5
Cesium (Cs)	mg/L	0.000005	0.0005
Chromium (Cr)	mg/L	0.0005	0.0005
Cobalt (Co)	mg/L	0.00005	0.0001
Copper (Cu)	mg/L	0.00005	0.0001
Gallium (Ga)	mg/L	0.00005	0.0005
Iron (Fe)	mg/L	0.03	0.01
Lead (Pb)	mg/L	0.00005	0.0001
Lithium (Li)	mg/L	0.0004	0.02
Magnesium (Mg)	mg/L	0.1	1.0
Manganese (Mn)	mg/L	0.0002	0.00005
Mercury (Hg)	µg/L	0.0005	0.0005

(continued)

Table A.1-3. Water Quality Variables and Realized Detection Limits, Doris Project, 2016 (completed)

Variable	Units	Realized Detection Limits		Variable	Units	Realized Detection Limits	
		Freshwater	Marine			Freshwater	Marine
Total Metals *(cont'd)*				**Total Metals *(cont'd)***			
Molybdenum (Mo)	mg/L	0.00005	0.002	Thallium (Tl)	mg/L	0.000005	0.00005
Nickel (Ni)	mg/L	0.0002	0.00005	Thorium (Th)	mg/L	0.000005	0.0005
Phosphorus (P)	mg/L	0.3	1.0	Tin (Sn)	mg/L	0.0002	0.001
Potassium (K)	mg/L	2.0	20	Titanium (Ti)	mg/L	0.0002	0.005
Rhenium (Re)	mg/L	0.000005	0.0005	Tungsten (W)	mg/L	0.00001	0.001
Rubidium (Rb)	mg/L	0.00002	0.005	Uranium (U)	mg/L	0.000002	0.00005
Selenium (Se)	mg/L	0.0002	0.0005	Vanadium (V)	mg/L	0.00005	0.0005
Silicon (Si)	mg/L	0.05	0.5	Yttrium (Y)	mg/L	0.000005	0.0005
Silver (Ag)	mg/L	0.000005	0.0001	Zinc (Zn)	mg/L	0.003	0.0008
Sodium (Na)	mg/L	2.0	20	Zirconium (Zr)	mg/L	0.00005	0.0005
Strontium (Sr)	mg/L	0.0002	0.05	**Radiochemistry**			
Tellurium (Te)	mg/L	0.00001	0.0005	Radium-226	Bq/L	0.0034 to 0.01	0.0039 to 0.01

Notes:
Dashes indicate variable was not measured.
Detection limits from Reference Lake D in August were excluded from the freshwater detection limits in this table because the sample was analyzed with marine detection limits.

Samples were collected once during the ice-covered season (April), and three times during the open-water season (July, August, September) from April 15 to September 19, 2016. Within each lake, samples were collected at approximately 1 m depth over the deepest part of the lake. At the deepest lake sites (Doris Lake North, Doris Lake South, and Reference Lake B), samples were collected both at approximately 1 m below the surface and 2 m above the sediment.

In April, the underlying water was accessed through a hole in the ice following the water column profiles. An adapted 2.5 L Niskin bottle was used to collect water during winter sampling. This bottle was designed to "trip" and collect discrete samples during freezing temperatures. To avoid metal contamination, the tripping mechanism used acid-cleaned silicone tubing within the interior of the bottle. A dual rope system was used to trigger the bottle to close and to ensure the collection of discrete samples.

During open-water season sampling, water samples were collected using an acid-washed, Teflon-lined 5 L GO-FLO sampling bottle. The GO-FLO was securely attached to a metred line and lowered to the appropriate sampling depth. It was then triggered to close using a Teflon-coated brass messenger and brought aboard the boat for distribution of the collected water into sample containers.

Samples for the various water quality components (e.g., physical variables/major ions, nutrients, and total metals) were drawn from the GO-FLO/Niskin bottles, with care being taken not to bring the bottle or cap into contact with the plastic spigot or other possible sources of contamination. The appropriate preservatives provided by ALS were added in the field after sample collection.

All samples were kept cold and in the dark while in the field and were refrigerated at Doris Camp prior to transport. Samples were transported in coolers with freezer packs to ALS, Burnaby for analysis as described for stream water quality samples. The variables analyzed and their realized detection limits are summarized in Table A.1-3. Realized detection limits were occasionally higher than the theoretical detection limits in freshwater samples due to interference from other variables. Marine samples were consistently diluted to reduce matrix effects from the high concentrations of cations (e.g., sodium).

A.1.4.3 Quality Assurance and Quality Control

The quality assurance and quality control (QA/QC) program for water quality sampling included the collection of replicates to account for within-site variability and the use of chain of custody forms to track samples. A set of travel, field, and equipment blanks (~20% of total samples) was also processed during each trip and submitted with the water samples as part of the QA/QC program. These blanks were used to identify potential sources of contamination to the field samples. Results for water quality QA/QC blanks are provided in Annex A.3-4.

A.1.5 Sediment Quality

Sediment quality samples were collected at stream, lake, and marine sites during the open-water season in August 2016. This sampling coincided with benthic invertebrate sampling. Sampling dates and depths for all sites are presented in Table A.1-4 and the analyzed variables are summarized in Table A.1-5. Sampling locations are presented in Figure A.1-1. Sampling procedures for each aquatic habitat are described below.

Table A.1-4. Stream, Lake, and Marine Sediment Quality and Benthic Invertebrate Sampling Dates and Depths, Doris Project, 2016

Habitat	Site	Sampling Date	Depth (m)
Stream	Doris Outflow	14-Aug-16	NA
	Roberts Outflow	16-Aug-16	NA
	Little Roberts Outflow	19-Aug-16	NA
	Reference B Outflow	17-Aug-16	NA
	Reference D Outflow	18-Aug-16	NA
Lake	Doris Lake North	20-Aug-16	14.0 to 15.0
	Doris Lake South	20-Aug-16	9.0 to 10.5
	Little Roberts Lake	15-Aug-16	2.0 to 2.6
	Reference Lake B	10-Aug-16	10.0 to 10.2
	Reference Lake D	11-Aug-16	2.0 to 2.3
Marine	RBE (Roberts Bay)	12-Aug-16	0.8 to 1.4
	RBW (Roberts Bay)	12-Aug-16	4.5 to 5.6
	REF-Marine 1 (Ida Bay)	13-Aug-16	3.5 to 6.5

Note:
NA = not applicable

A.1.5.1 Streams

Three replicate sediment samples were collected at each stream site. At each site, a replicate sample consisted of a 1 L composite of several (plastic) spoonsful of sediments, with replicates collected three times the channel width apart from each other whenever possible. The sediment was fully homogenized, slowly drained of excess water, and transferred into separate pre-labelled Whirl-Pak bags: one for particle size analysis, and one for sediment chemistry analysis. Each bag was then placed into another Whirl-Pak bag as a protective measure.

Samples were refrigerated (in darkness) until they were shipped to ALS, Burnaby. The sediment quality variables that were analyzed and their corresponding detection limits are presented in Table A.1-5.

A.1.5.2 Lakes

Lake sediments were obtained in the deepest section of the lake (except Doris Lake South) using an Ekman grab sampler with the replicates collected approximately 5 to 20 m apart. Sampling depths are provided in Table A.1-4. The Ekman was carefully set open, lowered gradually onto the sediment surface using a metred cable line, and triggered to close with a messenger. The sample was carefully raised and inspected to ensure the collection of an intact, undisturbed sample. Each sediment sample was carefully transferred onto a tray, and the top 2 to 3 cm of sediment was homogenized in a plastic bowl using a plastic spoon and placed into two Whirl-Pak bags: one for particle size, and one for sediment chemistry. Samples were refrigerated (in darkness) until they were shipped to ALS, Burnaby. The sediment quality variables that were analyzed and their corresponding detection limits are presented in Table A.1-5.

Table A.1-5. Sediment Quality Variables and Realized Detection Limits, Doris Project, August 2016

Variable	Units	Realized Detection Limit	
		Freshwater	Marine
Physical Tests			
Moisture	%	0.25	0.25
pH	pH	0.1	0.1
Particle Size			
% Gravel (>2 mm)	%	0.1	0.1
% Sand (2.0 - 0.063 mm)	%	0.1	0.1
% Silt (0.063 mm - 4 µm)	%	0.1	0.1
% Clay (<4 µm)	%	0.1	0.1
Organic Carbon			
Total Organic Carbon	%	0.05 to 0.075	0.05 to 0.075
Leachable Nutrients			
Total Nitrogen	%	0.02	0.02
Plant Available Nutrients			
Available Ammonium-N	mg/kg	1.0	1.0 or 1.6
Nitrate+Nitrite-N	mg/kg	2.0 or 4.0	2.0 or 4.0
Available Nitrate-N	mg/kg	2.0 or 4.0	2.0 or 4.0
Available Nitrite-N	mg/kg	0.4 or 0.8	0.4 or 0.8
Available Phosphate-P	mg/kg	2.0	2.0
Total Metals			
Aluminum (Al)	mg/kg	50	50
Antimony (Sb)	mg/kg	0.1	0.1
Arsenic (As)	mg/kg	0.1	0.1
Barium (Ba)	mg/kg	0.5	0.5
Beryllium (Be)	mg/kg	0.1	0.1
Bismuth (Bi)	mg/kg	0.2	0.2
Boron (B)	mg/kg	5.0	5.0
Cadmium (Cd)	mg/kg	0.05	0.05

Variable	Units	Realized Detection Limit	
		Freshwater	Marine
Total Metals *(cont'd)*			
Calcium (Ca)	mg/kg	50	50
Chromium (Cr)	mg/kg	0.5	0.5
Cobalt (Co)	mg/kg	0.1	0.1
Copper (Cu)	mg/kg	0.5	0.5
Iron (Fe)	mg/kg	50	50
Lead (Pb)	mg/kg	0.5	0.5
Lithium (Li)	mg/kg	2.0	2.0
Magnesium (Mg)	mg/kg	20	20
Manganese (Mn)	mg/kg	1.0	1.0
Mercury (Hg)	mg/kg	0.005	0.005
Molybdenum (Mo)	mg/kg	0.1	0.1
Nickel (Ni)	mg/kg	0.5	0.5
Phosphorus (P)	mg/kg	50	50
Potassium (K)	mg/kg	100	100
Selenium (Se)	mg/kg	0.2	0.2
Silver (Ag)	mg/kg	0.1	0.1
Sodium (Na)	mg/kg	50	50
Strontium (Sr)	mg/kg	0.5	0.5
Sulphur (S)	mg/kg	500	500
Thallium (Tl)	mg/kg	0.05	0.05
Tin (Sn)	mg/kg	2.0	2.0
Titanium (Ti)	mg/kg	1.0	1.0
Uranium (U)	mg/kg	0.05	0.05
Vanadium (V)	mg/kg	0.2	0.2
Zinc (Zn)	mg/kg	2	2

A.1.5.3 Marine

Marine sediment quality samples were collected in triplicate using a Petite Ponar grab sampler (surface sampling area of 0.023 m^2), with replicates spaced approximately 5 to 20 m apart. Sampling depths are provided in Table A.1-4. Each sediment sample was carefully transferred onto a tray, and the top 2 to 3 cm of sediment was homogenized in a plastic bowl using a plastic spoon and placed into two Whirl-Pak bags: one for particle size, and one for sediment chemistry. Samples were refrigerated (in darkness) until they were shipped to ALS, Burnaby. The sediment quality variables that were analyzed and their corresponding detection limits are presented in Table A.1-5.

A.1.5.4 Quality Assurance and Quality Control

The QA/QC program for sediment quality sampling included the collection of replicates to account for within-site variability and the use of chain of custody forms to track samples.

A.1.6 Primary Producers

Primary producer biomass (as chlorophyll *a*) samples were collected in streams, lakes, and the marine habitat to assess potential changes in their standing stocks due to eutrophication (i.e., excess nutrients) or toxicity (i.e., presence of deleterious substances). Periphyton biomass samples were collected in streams during the open-water season in July, August, and September. Phytoplankton biomass samples were collected in lakes and the marine environment both under-ice (April) and during the open-water season (July, August, and September).

A.1.6.1 Stream Periphyton

Stream periphyton samples were collected using artificial substrate samplers. The samplers were installed in each study stream for approximately one month before sample collection and processing (i.e., the plates collected in July, August, and September, were installed in June, July, and August, respectively). The complete installation and retrieval schedule is outlined in Table A.1-6.

The samplers were 10 cm × 10 cm Plexiglas® plates that were affixed to rocks with fishing line and placed in the stream such that they remained submerged until retrieval. Overall, six plates were submerged per site, but only three plates were processed. These extra plates were used to increase the likelihood that at least three plates were available to process after a month's time. The plates were installed a minimum distance of three times the channel width apart from each other whenever possible. Only a single plate was processed in Doris Outflow in July as high waters and flow washed plates away or made it unsafe to collect the remaining plates.

Upon collection, the sample plates were scraped using a razor blade, and rinsed into a 500 mL wide-mouth plastic jar. The samples were then filtered at Doris Camp onto 47 mm diameter, 0.45 µm pore-size membrane filters, folded carefully in half and placed into a black plastic tube to prevent light penetration. A label was then attached to the tube indicating sampling information. The filters were kept frozen and sent to ALS, Burnaby for analysis.

Table A.1-6. Periphyton Sampling Dates, Doris Project, 2016

Stream Site	Installation Date	Retrieval Date	# of Days Submerged
Doris Outflow	12-Jun-16	15-Jul-16	33
	15-Jul-16	14-Aug-16	30
	14-Aug-16	14-Sep-16	31
Roberts Outflow	13-Jun-16	16-Jul-16	33
	16-Jul-16	16-Aug-16	31
	16-Aug-16	14-Sep-16	29
Little Roberts Outflow	13-Jun-16	16-Jul-16	33
	16-Jul-16	19-Aug-16	35
	19-Aug-16	14-Sep-16	26
Reference B Outflow	13-Jun-16	17-Jul-16	34
	17-Jul-16	17-Aug-16	31
	17-Aug-16	19-Sep-16	33
Reference D Outflow	13-Jun-16	14-Jul-16	31
	14-Jul-15	18-Aug-16	35
	18-Aug-16	17-Sep-16	30

A.1.6.2 Lake and Marine Phytoplankton

Lake and marine phytoplankton biomass samples were collected in triplicate in clean 1 L bottles. In April, a 2.5 L Niskin bottle was used to collect a sample from approximately 1 m beneath the ice layer. Samples were collected at approximately 1 m depth using a 5 L GO-FLO water sampler in July, August, and September. For each phytoplankton sample, the water sampler was lowered to the appropriate depth using a metred cable line and triggered to close with a messenger. Once retrieved, a subsample was drawn for a chlorophyll *a* sample. The GO-FLO/Niskin was set, lowered, and triggered three times (i.e., once for each replicate).

The samples were kept cold and dark and transported to Doris Camp, where the samples were filtered using gentle vacuum filtration (hand pump). The samples were filtered onto 47-mm diameter, 0.45-µm pore size nitrocellulose membrane filters, folded carefully in half, and placed into a black plastic tube to prevent light penetration. A label was then attached to the tube indicating sampling information. The filters were kept frozen and sent to ALS, Burnaby for analysis.

A.1.6.3 Quality Assurance and Quality Control

The QA/QC program for phytoplankton and periphyton biomass sampling included the collection of replicates to account for within-site variability and the use of chain of custody forms to track samples.

A.1.7 Benthos

Benthic invertebrate (benthos) samples were collected at the stream, lake, and marine sites during the open-water season in August 2016. This coincided with the sediment quality sampling. Sampling dates and depths for all sites are presented in Table A.1-4 and sampling locations are indicated in Figure A.1-1.

All field sampling devices and methods for the AEMP benthos sampling were designed to comply with the *Metal Mining Technical Guidance for Environmental Effects Monitoring* document (Environment Canada 2012). Sampling procedures for each aquatic habitat are described below.

A.1.7.1 Streams

Benthos samples were collected at AEMP streams from August 14 to August 19, 2016. To comply with EEM requirements, three separate subsamples were collected and pooled for each replicate sample; five replicates were collected at each site. Samples were collected in riffle habitats using a Hess sampler (surface sampling area of 0.096 m^2) fitted with a 500 µm mesh net and terminal cod-end. Replicate samples were collected a minimum distance of three times the channel width apart from each other whenever possible.

For each subsample, the bottom of the Hess sampler was placed firmly on the sediment bottom making sure sediment contact was continuous along the bottom rim. The encircled sediment was then swept by hand and all rocks lifted and scrubbed to make sure the entire sediment surface was agitated. After sweeping, the collected debris was transferred from the cod-end into a 500 mL wide-mouthed plastic jar. Three subsamples were combined to make one sample and this was preserved with buffered formalin to a final concentration of 10%. Benthos samples were sent to Dr. Jack Zloty (Summerland, BC) for enumeration and identification.

Several community descriptors were calculated from the taxonomic results, including benthos density, family richness, Simpson's Diversity and Evenness indices, and the Bray-Curtis Index. Cladocerans and cyclopoid and calanoid copepods were not included in the community metrics as these groups are generally planktonic. Nematodes were also excluded from the community metrics as they are typically considered to be meiofauna (invertebrates ranging in size between 63 µm and 500 µm) and are not adequately sampled using a 500-µm sieve bucket. Immature or damaged organisms that were not identifiable to the family level were excluded from the community analysis. Organisms belonging to the groups Ostracoda and Microturbellaria were not identifiable to the family level but were included in the community metrics at the next lowest taxonomic category. Any terrestrial organisms that were identified in the benthos samples were excluded from the calculations of community descriptors.

Benthos counts were normalized to three times the surface area of the of the Hess sampler (i.e., 3 × 0.096 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of three pooled Hess samples).

Family richness was calculated as the total number of benthic invertebrate families present in each replicate sample.

The Simpson's Diversity Index (D) was calculated as:

$$\text{Simpson Diversity Index (D)} = 1 - \sum_{i=1}^{F} p_i^2$$

Simpson's Evenness Index (E) was calculated as:

$$\text{Simpson Evenness Index (E)} = 1/\sum_{i=1}^{F} p_i^2/F$$

where F was the number of families present (i.e., family richness), and p_i was the relative abundance of each family calculated as n_i/N, where n_i is the number of individuals in family i, and N was the total number of individuals.

A complete dissimilarity matrix was also generated that included pairwise comparisons of all samples using the Bray-Curtis Index. The Bray-Curtis Index compares the community composition within a benthos sample to the median reference community composition (Environment Canada 2012). This reference composition is generated from the median abundance of each represented family from all of the reference site replicates. Since the median reference composition is generated from the combined reference site replicates, the comparison of a single reference site replicate community to the median reference community composition will produce a dissimilarity value (although generally a much lower value than exposure sites). Because the Bray-Curtis Index measures the percent difference between sites, the greater the dissimilarity value between a site and the median reference community, the more dissimilar those benthos communities are. The Bray-Curtis Index ranges from 0 to 1, with 1 representing completely dissimilar communities, and 0 representing identical communities. This index is calculated as:

$$\text{Bray-Curtis Index (BC)} = \sum_{i=1}^{n} |y_{i1} - y_{i2}| \; / \; \sum_{i=1}^{n} (y_{i1} + y_{i2})$$

where BC is the Bray-Curtis distance between sites 1 and 2, n is the total number of families present at the two sites, y_{i1} is the count for family i at site 1, and y_{i2} is the count for family i at site 2. Replicate data from the two reference locations (Reference B and D outflows) were combined for the determination of the "median reference composition".

Standard summary statistics (minimum, maximum, median, mean, standard deviation, and standard error) were calculated for all 2016 benthic invertebrate endpoints described above.

A.1.7.2 Lakes

Lake benthos samples were collected during the open-water season from August 10 to August 20, 2016. Like in streams, lake benthos sampling was designed to meet EEM criteria (i.e., three subsamples/ replicate; five replicates/site). With the exception of Doris Lake South, lake benthos samples were obtained in the deepest section of the lake using an Ekman grab sampler (surface sampling area of 0.0225 m^2), with replicates collected approximately 5 to 20 m apart. The Ekman was carefully set open, lowered gradually onto soft sediment using a metred cable line, and triggered to close with a messenger. Sampling depths are provided in Table A.1-4.

At the surface, each sediment sample was transferred into a 500 µm sieve bucket and rinsed with site-specific water until free of sediments. The material retained within the sieve was then placed into a labelled plastic jar and preserved with buffered formalin to a final concentration of 10%. Benthos samples were sent to Dr. Jack Zloty (Summerland, BC) for enumeration and identification.

Benthos counts were normalized to three times the surface area of the Ekman sampler (i.e., 3 × 0.0225 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of three pooled Ekman samples). Community descriptors, Bray-Curtis dissimilarity distances, and summary statistics were calculated as described for stream benthos with the following exception: because lakes can have dramatically different physico-chemical and biological function based on their morphologies (Cole 1983), median reference compositions were created for each reference lake (large lake: Reference Lake B; small lake: Reference Lake D) for Bray-Curtis analysis. Bray-Curtis distances were then calculated by comparing the Reference Lake B median community to the large lake sites, Doris Lake North and Doris Lake South, and the Reference Lake D median community to Little Roberts Lake.

A.1.7.3 Marine

Benthos samples were collected at the two sites in Roberts Bay (RBW and RBE) and at the reference site in Ida Bay (REF-Marine 1) on August 12 and 13, 2016. Samples were collected with a Petite Ponar grab sampler (surface sampling area of 0.023 m^2). Five replicates were collected approximately 5 to 20 m apart at each site, with each replicate consisting of three pooled grab samples. Each sediment sample was transferred into a 500 µm sieve bucket and rinsed with site-specific water until free of sediments. The material retained within the sieve was then placed into a labelled plastic jar and preserved with buffered formalin to a final concentration of 10%. Benthos samples were sent to Columbia Science (Courtenay, BC) for enumeration and identification.

Benthos counts were normalized to three times the surface area of the of the Petite Ponar sampler (i.e., 3 × 0.023 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of three pooled Petite Ponar grab samples). Community descriptors and summary statistics were calculated as described for stream benthos. Nematodes were excluded from the calculations of density and community metrics as these organisms are typically considered to be meiofauna (invertebrates ranging in size between 63 µm and 500 µm) and are not adequately sampled using a 500 µm sieve bucket. Individuals that were not identifiable to the family level were excluded from the community analysis. Community descriptors, Bray-Curtis dissimilarity distances, and summary statistics were calculated as described for stream benthos, with the REF-Marine 1 median community composition compared to the RBW and RBE benthos communities in the Bray-Curtis analysis.

A.1.7.4 Quality Assurance and Quality Control

The QA/QC program for benthos sampling included the collection of replicates to account for within-site variability and the use of chain of custody forms to track samples.

A re-sorting of randomly selected sample residues was conducted by taxonomists on a minimum of 10% of the benthos samples to determine the level of sorting efficiency. The criterion for an acceptable sorting was that more than 95% of the total number of organisms was recovered during the initial sort. The number of organisms initially recovered from the sample was expressed as a percentage of the total number after the re-sort (total of initial and re-sort count). Any sample not meeting the 95% removal criterion was re-sorted a third time. The 95% minimum efficiency was always attained (see Section A.6).

A.2 2016 PHYSICAL PROFILES AND SECCHI DEPTHS

The following sections present the Secchi depth data and the physical profiles collected from April to September 2016 at stream, lake, and marine sites.

A.2.1 Stream Data

Stream water temperatures and dissolved oxygen concentrations measured between June 12 and September 19, 2016 are shown in Table A.2-1.

Table A.2-1. Stream Temperature and Dissolved Oxygen Concentration and Saturation, Doris Project, 2016

			Dissolved Oxygen	
Stream	Sampling Date	Temperature (°C)	Concentration (mg/L)	Saturation (%)
Doris Outflow	June 12, 2016	6.8	11.07	91.0
	July 15, 2016	11.3	10.93	99.8
	August 19, 2016	12.3	10.82	101.2
	September 14, 2016	5.27	12.48	98.5
Roberts Outflow	June 13, 2016	N/A	N/A	N/A
	July 16, 2016	9.3	11.49	100.1
	August 16, 2016	14.2	10.84	105.8
	September 14, 2016	4.67	12.41	96.4
Little Roberts Outflow	June 13, 2016	N/A	N/A	N/A
	July 15, 2016	12.6	10.70	100.6
	August 19, 2016	11.9	10.80	100.2
	September 14, 2016	3.10	12.95	96.5
Reference B Outflow	June 13, 2016	4.7	N/A	N/A
	July 17, 2016	12.6	10.66	100.3
	August 17, 2016	15.7	10.18	102.4
	September 19, 2016	3.3	13.08	97.8
Reference D Outflow	June 13, 2016	4.5	13.4	103.5
	July 14, 2016	18.9	9.49	102.1
	August 18, 2016	14.1	10.41	101.4
	September 17, 2016	2.92	13.54	100.3

Notes: N/A = Not available.

A.2.2 Lake Data

Lake Secchi depths and calculated euphotic zone depths (1% light level) are shown in Table A.2-2. Figures A.2-1 to A.2-5 show the temperature and dissolved oxygen profiles collected at lake sites from April to September 2016; Annex A.2-1 provides the profile data in tabular form.

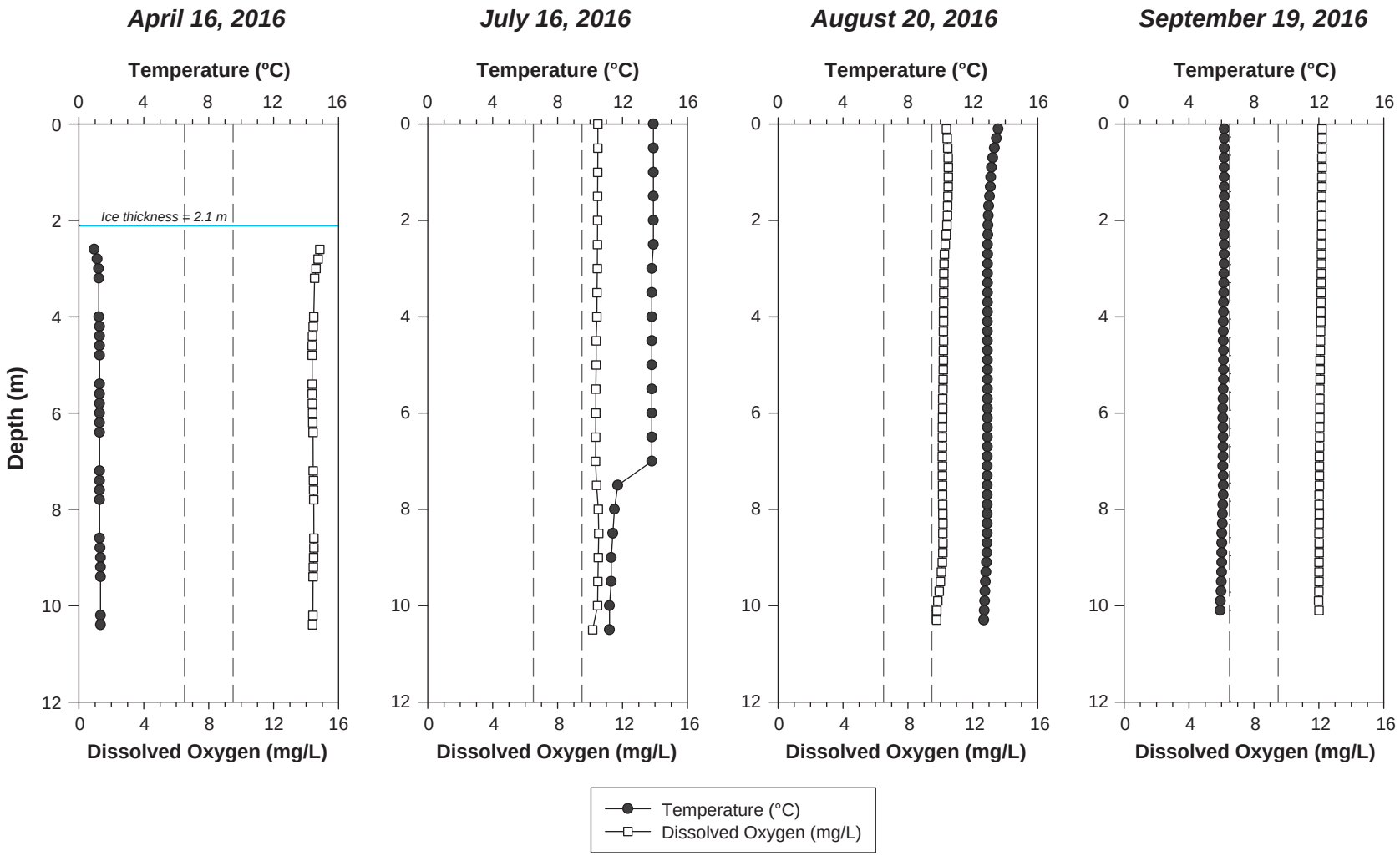
Table A.2-2. Lake Secchi Depths and Euphotic Zone Depths, Doris Project, 2016

Lake Site	Sampling Date	Secchi Depth (Ds) (m)	Euphotic Zone Depth 1% Light Level (m)
Large Lake Site			
Doris Lake South	July 16, 2016	1.2	3.25
	August 20, 2016	1.5	4.06
	September 19, 2016	1.2	3.25
Doris Lake North	July 17, 2016	1.3	3.52
	August 20, 2016	1.2	3.25
	September 19, 2016	1.2	3.25
Reference Lake B	July 18, 2016	5.2	14.1*
	August 10, 2016	7.0	18.9*
	September 19, 2016	8.0	21.6*
Small Lake Site			
Little Roberts Lake	July 16, 2016	Bottom (1.0)	-
	August 15, 2016	Bottom (2.6)	-
	September 18, 2016	Bottom (2.5)	-
Reference Lake D	July 14, 2016	Bottom (2.25)	-
	August 11, 2016	Bottom (2.7)	-
	September 17, 2016	Bottom (3.0)	-

*Notes: * indicates that the euphotic zone extended to the bottom of the water column.*
- indicates that the euphotic zone depth was not calculated because the Secchi depth extended to the bottom of the water column.

Figure A.2-1

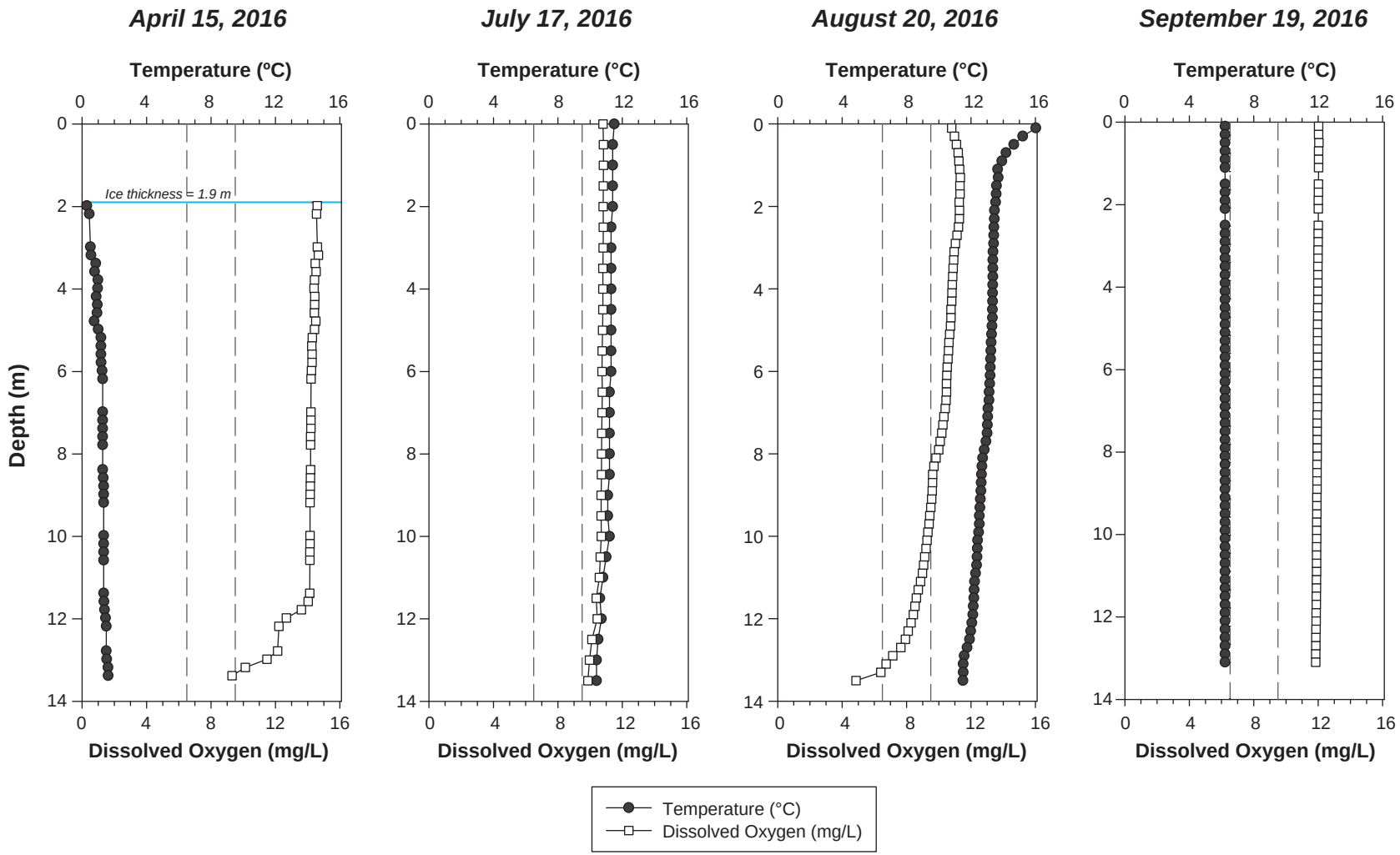
Temperature and Dissolved Oxygen Profiles in Doris Lake South, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-2

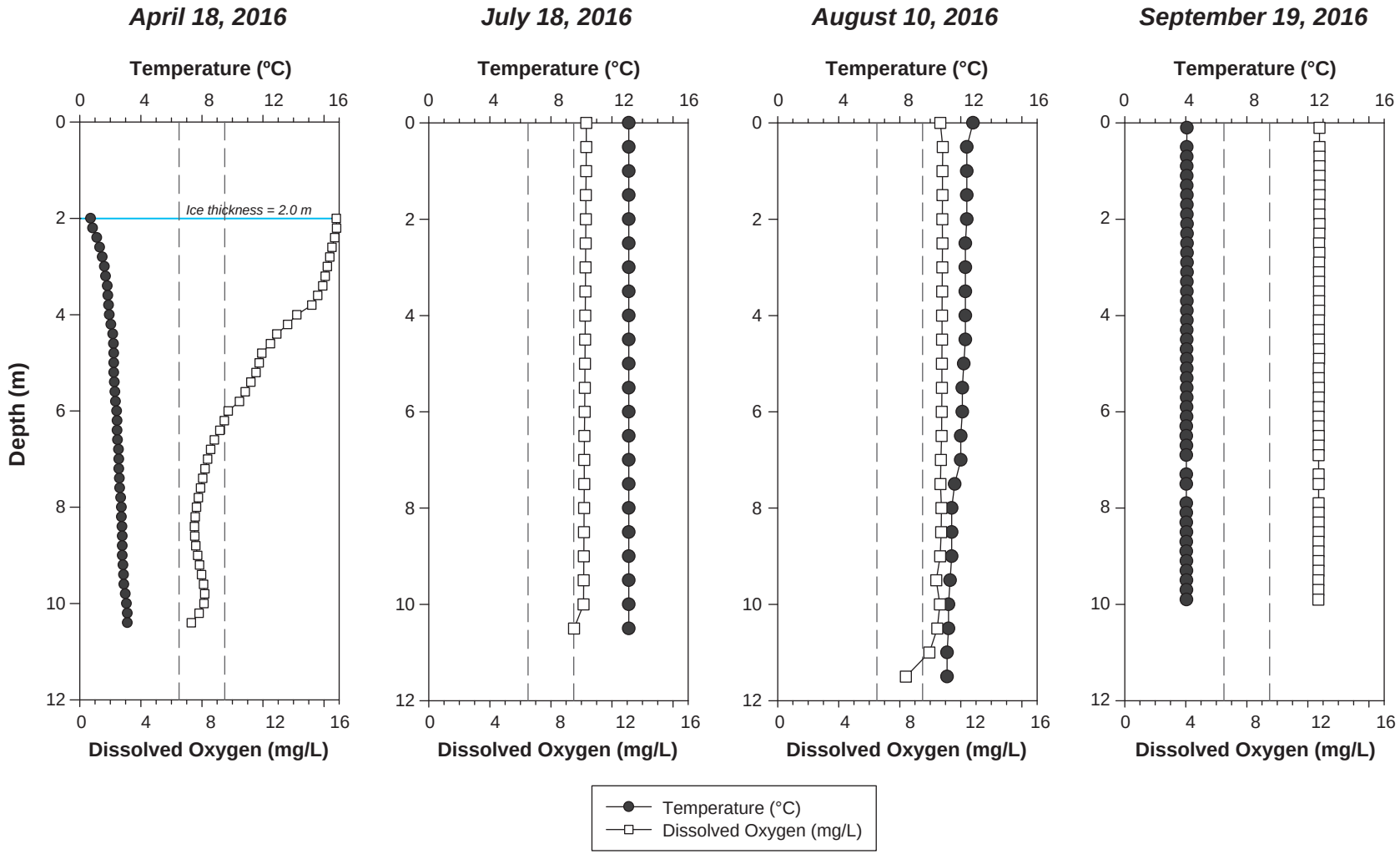
Temperature and Dissolved Oxygen Profiles in Doris Lake North, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-3

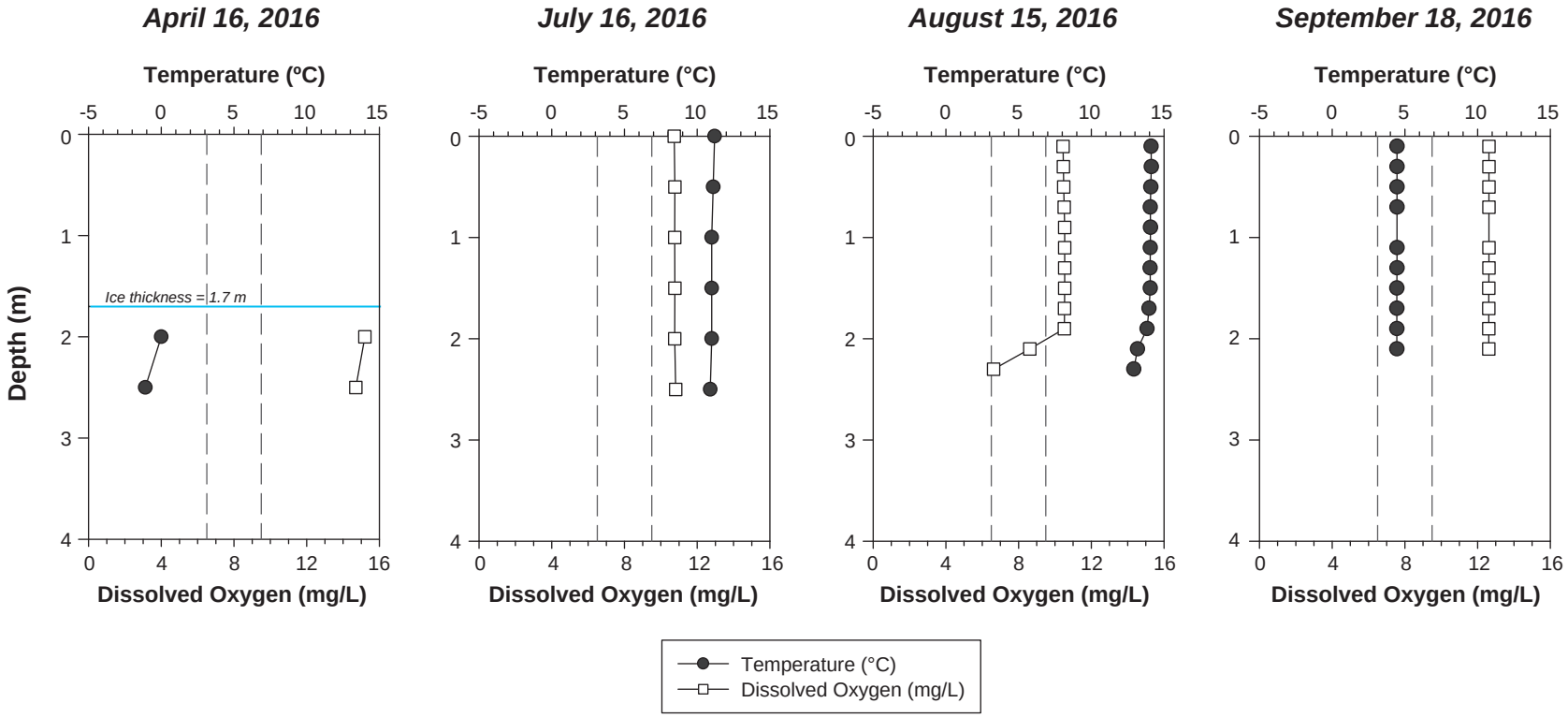
Temperature and Dissolved Oxygen Profiles in Reference Lake B, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-4

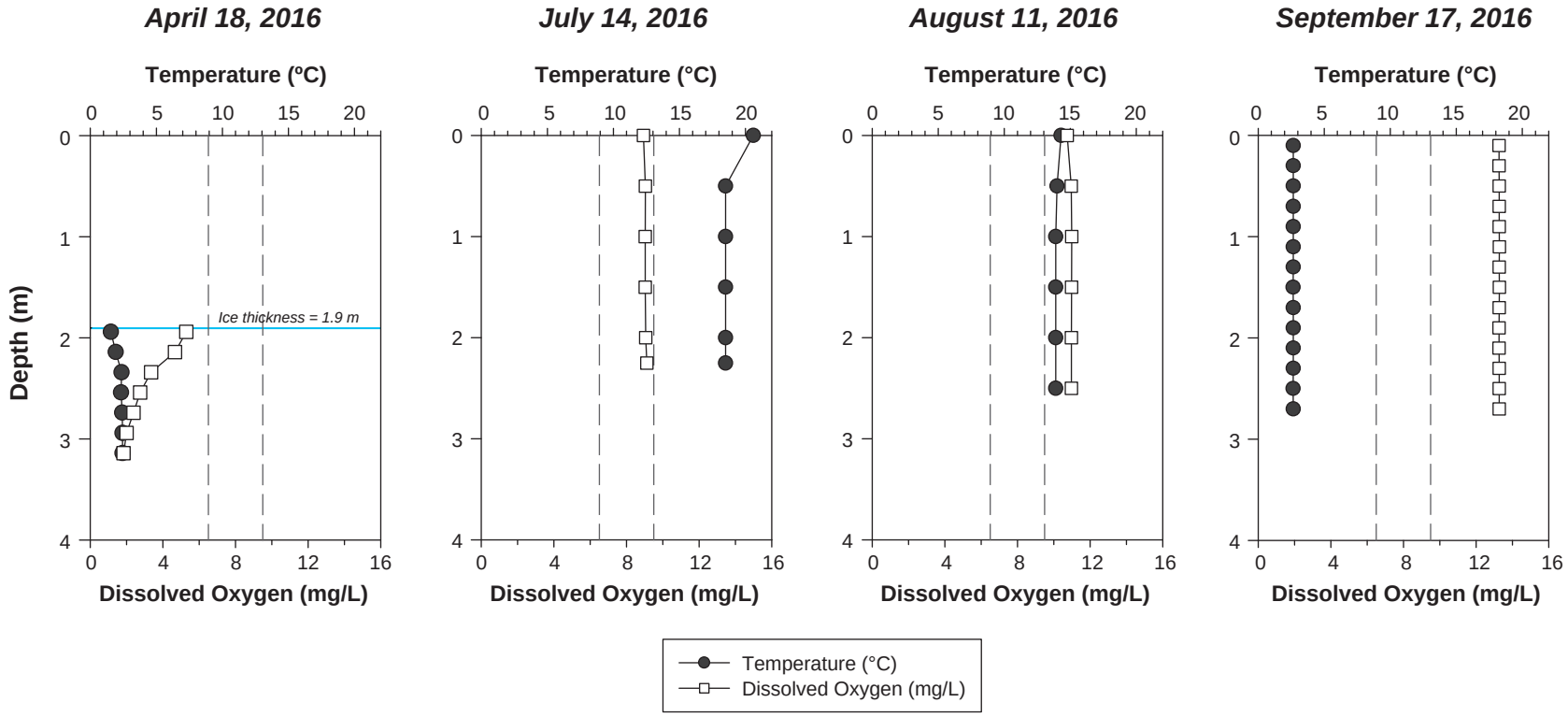
Temperature and Dissolved Oxygen Profiles in Little Roberts Lake, Doris Project, 2016



Notes: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-5

Temperature and Dissolved Oxygen Profiles in Reference Lake D, Doris Project, 2016



Notes: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Annex A.2-1. Temperature and Dissolved Oxygen Profiles, Lake Sites, Doris Project, 2016

Doris Lake South			
April 16, 2016			
Sonde used: YSI ProDSS			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.6	0.9	14.8	104
2.8	1.1	14.7	104
3.0	1.2	14.6	103
3.1	1.2	14.5	103
4.0	1.2	14.5	103
4.2	1.3	14.4	102
4.4	1.3	14.4	102
4.6	1.3	14.4	102
4.8	1.3	14.4	102
5.4	1.3	14.4	102
5.6	1.3	14.4	102
5.8	1.3	14.4	102
6.0	1.3	14.4	102
6.2	1.3	14.4	102
6.4	1.3	14.4	102
7.2	1.3	14.4	102
7.4	1.3	14.4	102
7.6	1.3	14.5	103
7.8	1.3	14.5	103
8.6	1.3	14.5	103
8.8	1.3	14.5	103
9.0	1.3	14.5	103
9.2	1.3	14.4	103
9.4	1.3	14.4	102
10.2	1.3	14.4	102
10.4	1.3	14.4	102

Doris Lake South			
July 16, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	13.9	10.5	101
0.5	13.9	10.5	101
1.0	13.9	10.5	101
1.5	13.9	10.5	101
2.0	13.9	10.5	101
2.5	13.9	10.5	101
3.0	13.8	10.4	101
3.5	13.8	10.4	101
4.0	13.8	10.4	101
4.5	13.8	10.4	100
5.0	13.8	10.4	100
5.5	13.8	10.4	100
6.0	13.8	10.4	100
6.5	13.8	10.3	100
7.0	13.8	10.3	100
7.5	11.7	10.4	96
8.0	11.5	10.5	96
8.5	11.4	10.5	96
9.0	11.3	10.5	96
9.5	11.3	10.5	96
10.0	11.2	10.5	95
10.5	11.2	10.2	93

Doris Lake South			
August 20, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	13.6	10.4	100
0.3	13.5	10.4	100
0.5	13.3	10.5	100
0.7	13.2	10.5	100
0.9	13.1	10.5	100
1.1	13.1	10.5	100
1.3	13.1	10.5	100
1.5	13.0	10.5	100
1.7	13.0	10.5	99
1.9	13.0	10.4	99
2.1	12.9	10.4	99
2.3	12.9	10.4	98
2.5	12.9	10.3	98
2.7	12.9	10.3	97
2.9	12.9	10.2	97
3.1	12.9	10.2	97
3.3	12.9	10.2	97
3.5	12.9	10.2	97
3.7	12.9	10.2	97
3.9	12.9	10.2	97
4.1	12.9	10.2	97
4.3	12.9	10.2	97
4.5	12.9	10.2	97
4.7	12.9	10.2	97
4.9	12.9	10.2	97
5.1	12.9	10.2	96
5.3	12.9	10.2	96
5.5	12.9	10.2	96
5.7	12.9	10.2	96
5.9	12.9	10.1	96
6.1	12.9	10.1	96
6.3	12.9	10.1	96
6.5	12.9	10.1	96
6.7	12.9	10.1	96
6.9	12.9	10.1	96
7.1	12.9	10.1	96
7.3	12.9	10.1	96
7.5	12.9	10.1	96
7.7	12.9	10.1	96
7.9	12.9	10.1	96
8.1	12.9	10.2	96
8.3	12.9	10.2	96
8.5	12.9	10.2	96
8.7	12.9	10.2	96
8.9	12.9	10.2	96
9.1	12.8	10.1	96
9.3	12.8	10.1	95
9.5	12.8	10.0	95
9.7	12.8	9.9	94
9.9	12.7	9.8	93
10.1	12.7	9.8	92
10.3	12.7	9.8	92

Doris Lake South			
September 19, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	6.2	12.2	99
0.3	6.2	12.2	99
0.5	6.2	12.2	99
0.7	6.2	12.2	99
0.9	6.2	12.2	99
1.1	6.2	12.2	99
1.3	6.2	12.2	98
1.5	6.2	12.2	98
1.7	6.2	12.2	98
1.9	6.2	12.2	98
2.1	6.2	12.2	98
2.3	6.2	12.2	98
2.5	6.2	12.2	98
2.7	6.2	12.2	98
2.9	6.2	12.2	98
3.1	6.2	12.2	98
3.3	6.2	12.2	98
3.5	6.2	12.1	98
3.7	6.1	12.1	98
3.9	6.1	12.1	98
4.1	6.1	12.1	98
4.3	6.1	12.1	98
4.5	6.1	12.1	98
4.7	6.1	12.1	98
4.9	6.1	12.1	98
5.1	6.1	12.1	98
5.3	6.1	12.1	97
5.5	6.1	12.1	97
5.7	6.1	12.1	97
5.9	6.1	12.1	97
6.1	6.1	12.1	97
6.3	6.1	12.1	97
6.5	6.1	12.1	97
6.7	6.1	12.0	97
6.9	6.1	12.0	97
7.1	6.1	12.0	97
7.3	6.1	12.0	97
7.5	6.1	12.0	97
7.7	6.1	12.0	97
7.9	6.1	12.0	97
8.1	6.1	12.0	97
8.3	6.1	12.0	97
8.5	6.0	12.0	97
8.7	6.0	12.0	97
8.9	6.0	12.0	97
9.1	6.0	12.0	97
9.3	6.0	12.0	97
9.5	6.0	12.0	97
9.7	6.0	12.0	97
9.9	5.9	12.0	96
10.1	5.9	12.0	96

Annex A.2-1. Temperature and Dissolved Oxygen Profiles, Lake Sites, Doris Project, 2016

Doris Lake North			
April 15, 2016			
Sonde used: YSI ProDSS			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.0	0.3	14.6	101
2.2	0.4	14.6	101
3.0	0.5	14.6	101
3.2	0.6	14.7	102
3.4	0.8	14.5	101
3.6	0.8	14.5	102
3.8	1.0	14.4	101
4.0	1.0	14.4	101
4.2	0.9	14.4	101
4.4	0.9	14.4	101
4.6	0.9	14.4	101
4.8	0.7	14.5	101
5.0	1.0	14.4	101
5.2	1.2	14.3	101
5.4	1.2	14.3	101
5.6	1.2	14.3	101
5.8	1.2	14.3	101
6.0	1.2	14.2	101
6.2	1.3	14.2	101
7.0	1.3	14.2	101
7.2	1.3	14.2	101
7.4	1.3	14.2	101
7.6	1.3	14.2	101
7.8	1.3	14.2	101
8.4	1.3	14.2	101
8.6	1.3	14.2	101
8.8	1.3	14.2	101
9.0	1.3	14.2	101
9.2	1.3	14.2	101
10.0	1.3	14.2	101
10.2	1.3	14.1	101
10.4	1.3	14.1	101
10.6	1.3	14.1	100
11.4	1.3	14.1	100
11.6	1.4	14.0	100
11.8	1.4	13.6	97
12.0	1.5	12.7	90
12.2	1.5	12.2	87
12.8	1.5	12.1	87
13.0	1.5	11.5	82
13.2	1.6	10.1	73
13.4	1.6	9.3	67

Doris Lake North			
July 17, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	11.5	10.8	99
0.5	11.4	10.8	99
1.0	11.4	10.8	99
1.5	11.4	10.8	99
2.0	11.4	10.8	99
2.5	11.3	10.8	99
3.0	11.3	10.8	99
3.5	11.3	10.8	99
4.0	11.3	10.8	99
4.5	11.3	10.8	99
5.0	11.3	10.8	98
5.5	11.3	10.8	98
6.0	11.3	10.7	98
6.5	11.2	10.8	98
7.0	11.2	10.7	98
7.5	11.2	10.7	98
8.0	11.2	10.7	98
8.5	11.2	10.7	98
9.0	11.1	10.7	97
9.5	11.1	10.7	97
10.0	11.2	10.7	97
10.5	11.0	10.6	96
11.0	10.8	10.6	96
11.5	10.6	10.4	93
12.0	10.7	10.4	94
12.5	10.5	10.1	91
13.0	10.4	10.0	89
13.5	10.4	9.9	88

Doris Lake North			
August 20, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	16.0	10.8	110
0.3	15.2	11.0	110
0.5	14.7	11.1	110
0.7	14.2	11.2	109
0.9	13.9	11.3	109
1.1	13.7	11.3	109
1.3	13.7	11.3	109
1.5	13.6	11.3	109
1.7	13.6	11.3	109
1.9	13.5	11.3	108
2.1	13.5	11.3	108
2.3	13.4	11.3	108
2.5	13.4	11.2	108
2.7	13.4	11.1	107
2.9	13.4	11.0	106
3.1	13.4	11.0	105
3.3	13.4	10.9	105
3.5	13.4	10.9	104
3.7	13.4	10.9	104
3.9	13.4	10.8	104
4.1	13.3	10.8	104
4.3	13.3	10.8	103
4.5	13.3	10.8	103
4.7	13.3	10.8	103
4.9	13.3	10.7	103
5.1	13.3	10.7	102
5.3	13.3	10.6	102
5.5	13.2	10.6	101
5.7	13.2	10.6	101
5.9	13.2	10.5	100
6.1	13.2	10.5	100
6.3	13.2	10.5	100
6.5	13.1	10.5	100
6.7	13.1	10.5	100
6.9	13.1	10.4	99
7.1	13.0	10.3	98
7.3	13.0	10.3	97
7.5	13.0	10.2	97
7.7	12.9	10.1	96
7.9	12.8	10.0	95
8.1	12.7	9.8	93
8.3	12.7	9.7	91
8.5	12.6	9.6	91
8.7	12.6	9.6	90
8.9	12.6	9.6	90
9.1	12.6	9.6	90
9.3	12.6	9.5	89
9.5	12.5	9.4	89
9.7	12.5	9.4	88
9.9	12.5	9.3	88
10.1	12.4	9.3	87
10.3	12.4	9.2	86
10.5	12.4	9.1	86
10.7	12.3	9.1	85
10.9	12.3	9.0	84
11.1	12.2	8.9	83
11.3	12.2	8.7	81
11.5	12.2	8.6	80
11.7	12.1	8.5	79
11.9	12.1	8.4	78
12.1	12.1	8.3	77
12.3	12.0	8.1	75
12.5	11.9	7.9	74
12.7	11.8	7.6	71
12.9	11.6	7.1	66
13.1	11.5	6.7	62
13.3	11.5	6.4	59
13.5	11.5	4.9	45

Doris Lake North			
September 19, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	6.2	12.0	97
0.3	6.2	12.0	97
0.5	6.2	12.0	97
0.7	6.2	12.0	97
0.9	6.2	12.0	97
1.1	6.2	12.0	97
1.5	6.2	12.0	97
1.7	6.2	12.0	97
1.9	6.2	12.0	97
2.1	6.2	12.0	97
2.5	6.2	12.0	97
2.7	6.2	12.0	97
2.9	6.2	12.0	97
3.1	6.2	12.0	97
3.3	6.2	12.0	97
3.5	6.2	12.0	97
3.7	6.2	12.0	97
3.9	6.2	12.0	97
4.1	6.2	12.0	97
4.3	6.2	12.0	97
4.5	6.2	12.0	97
4.7	6.2	12.0	97
4.9	6.2	12.0	97
5.1	6.2	12.0	97
5.3	6.2	12.0	97
5.5	6.2	12.0	97
5.7	6.2	12.0	97
5.9	6.2	12.0	97
6.1	6.2	12.0	97
6.3	6.2	12.0	97
6.5	6.2	12.0	97
6.7	6.2	12.0	97
6.9	6.2	12.0	97
7.1	6.2	11.9	97
7.3	6.2	11.9	97
7.5	6.2	11.9	97
7.7	6.2	11.9	97
7.9	6.2	11.9	97
8.1	6.2	11.9	97
8.3	6.2	11.9	97
8.5	6.2	11.9	96
8.7	6.2	11.9	96
8.9	6.2	11.9	96
9.1	6.2	11.9	96
9.3	6.2	11.9	96
9.5	6.2	11.9	96
9.7	6.2	11.9	96
9.9	6.2	11.9	96
10.1	6.2	11.9	96
10.3	6.2	11.9	96
10.5	6.2	11.9	96
10.7	6.2	11.9	96
10.9	6.2	11.9	96
11.1	6.2	11.9	96
11.3	6.2	11.9	96
11.5	6.2	11.9	96
11.7	6.2	11.9	96
11.9	6.2	11.9	96
12.1	6.2	11.9	96
12.3	6.2	11.9	96
12.5	6.2	11.9	96
12.7	6.2	11.9	96
12.9	6.2	11.9	96
13.1	6.2	11.8	96

Annex A.2-1. Temperature and Dissolved Oxygen Profiles, Lake Sites, Doris Project, 2016

Reference Lake B			
April 18, 2016			
Sonde used: YSI ProDSS			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.0	0.7	16.8	117
2.2	0.8	16.8	118
2.4	1.1	16.7	118
2.6	1.3	16.5	117
2.8	1.5	16.4	117
3.0	1.6	16.2	116
3.2	1.7	16.1	115
3.4	1.8	15.9	114
3.6	1.8	15.6	112
3.8	1.9	15.2	110
4.0	1.9	14.2	103
4.2	2.0	13.6	99
4.4	2.2	12.9	94
4.6	2.2	12.5	91
4.8	2.2	11.9	87
5.0	2.2	11.8	86
5.2	2.2	11.5	84
5.4	2.3	11.2	82
5.6	2.3	10.8	79
5.8	2.3	10.5	76
6.0	2.4	9.7	71
6.2	2.4	9.5	69
6.4	2.4	9.2	67
6.6	2.5	8.8	65
6.8	2.5	8.6	63
7.0	2.6	8.4	62
7.2	2.6	8.2	60
7.4	2.6	8.1	59
7.6	2.6	7.9	58
7.8	2.7	7.8	57
8.0	2.7	7.6	56
8.2	2.7	7.6	56
8.4	2.8	7.5	56
8.6	2.8	7.5	56
8.8	2.8	7.6	56
9.0	2.8	7.7	57
9.2	2.8	7.8	58
9.4	2.9	8.0	59
9.6	2.9	8.1	60
9.8	3.0	8.2	61
10.0	3.1	8.1	61
10.2	3.1	7.8	58
10.4	3.1	7.3	54

Reference Lake B			
July 18, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	13.1	10.3	98
0.5	13.1	10.3	98
1.0	13.1	10.3	98
1.5	13.1	10.3	98
2.0	13.1	10.3	98
2.5	13.1	10.3	98
3.0	13.1	10.3	98
3.5	13.1	10.3	98
4.0	13.1	10.3	98
4.5	13.1	10.2	97
5.0	13.1	10.2	97
5.5	13.1	10.2	97
6.0	13.1	10.2	97
6.5	13.1	10.2	97
7.0	13.1	10.2	97
7.5	13.1	10.2	97
8.0	13.1	10.2	97
8.5	13.1	10.2	97
9.0	13.1	10.2	97
9.5	13.1	10.2	97
10.0	13.1	10.1	96
10.5	13.1	9.5	91

Reference Lake B			
August 10, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	12.8	10.7	101
0.5	12.4	10.8	101
1.0	12.4	10.8	101
1.5	12.4	10.8	101
2.0	12.4	10.8	101
2.5	12.3	10.8	101
3.0	12.3	10.8	101
3.5	12.3	10.8	101
4.0	12.3	10.8	101
4.5	12.3	10.8	101
5.0	12.2	10.8	100
5.5	12.1	10.8	100
6.0	12.1	10.8	100
6.5	12.0	10.7	100
7.0	12.0	10.7	99
7.5	11.6	10.7	98
8.0	11.4	10.7	98
8.5	11.4	10.7	98
9.0	11.4	10.7	98
9.5	11.3	10.4	95
10.0	11.2	10.6	97
10.5	11.2	10.5	95
11.0	11.1	9.9	90
11.5	11.1	8.4	76

Reference Lake B			
September 19, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	4.1	12.8	98
0.5	4.1	12.8	98
0.7	4.1	12.8	98
0.9	4.1	12.8	98
1.1	4.1	12.8	98
1.3	4.1	12.8	98
1.5	4.1	12.8	98
1.7	4.1	12.8	98
1.9	4.1	12.8	98
2.1	4.1	12.8	98
2.3	4.1	12.8	98
2.5	4.1	12.7	97
2.7	4.1	12.8	98
2.9	4.1	12.7	97
3.1	4.1	12.7	97
3.3	4.1	12.7	97
3.5	4.1	12.7	97
3.7	4.1	12.7	97
3.9	4.1	12.7	97
4.1	4.1	12.7	97
4.3	4.1	12.7	97
4.5	4.1	12.7	97
4.7	4.1	12.7	97
4.9	4.1	12.7	97
5.1	4.1	12.7	97
5.3	4.1	12.7	97
5.5	4.1	12.7	97
5.7	4.1	12.7	97
5.9	4.1	12.7	97
6.1	4.1	12.7	97
6.3	4.0	12.7	97
6.5	4.0	12.7	97
6.7	4.0	12.7	97
6.9	4.0	12.7	97
7.3	4.0	12.7	97
7.5	4.0	12.7	97
7.9	4.0	12.7	97
8.1	4.0	12.7	97
8.3	4.0	12.7	97
8.5	4.0	12.7	97
8.7	4.0	12.7	97
8.9	4.0	12.7	97
9.1	4.0	12.7	97
9.3	4.0	12.7	97
9.5	4.0	12.7	97
9.7	4.0	12.7	97
9.9	4.0	12.7	97

Little Roberts Lake			
April 16, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.0	0.0	15.2	-
2.5	-1.1	14.7	-

Little Roberts Lake			
July 16, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	11.2	10.7	98
0.5	11.1	10.8	98
1.0	11.0	10.8	98
1.5	11.0	10.8	98
2.0	11.0	10.8	98
2.5	10.9	10.8	98

Little Roberts Lake			
August 15, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	14.1	10.4	102
0.3	14.1	10.5	102
0.5	14.1	10.5	102
0.7	14.1	10.5	102
0.9	14.1	10.5	103
1.1	14.1	10.5	103
1.3	14.0	10.5	102
1.5	14.1	10.5	102
1.7	14.0	10.5	102
1.9	13.8	10.5	102
2.1	13.2	8.6	82
2.3	12.9	6.6	63

Little Roberts Lake			
September 18, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	4.5	12.6	98
0.3	4.5	12.6	98
0.5	4.5	12.6	98
0.7	4.5	12.6	98
1.1	4.5	12.6	98
1.3	4.5	12.6	98
1.5	4.5	12.6	98
1.7	4.5	12.6	98
1.9	4.5	12.6	98
2.1	4.5	12.6	98

Annex A.2-1. Temperature and Dissolved Oxygen Profiles, Lake Sites, Doris Project, 2016

Reference Lake D			
April 18, 2016			
Sonde used: YSI ProDSS			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.9	1.6	5.3	38
2.1	1.9	4.7	34
2.3	2.4	3.3	24
2.5	2.3	2.7	20
2.7	2.4	2.4	17
2.9	2.4	2.0	15
3.1	2.4	1.8	13

Reference Lake D			
July 14, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	20.6	8.9	99
0.5	18.5	9.0	96
1.0	18.5	9.0	96
1.5	18.5	9.0	96
2.0	18.5	9.1	97
2.3	18.5	9.1	97

Reference Lake D			
August 11, 2016			
Sonde used: YSI ProODO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.0	14.3	10.7	105
0.5	14.0	11.0	106
1.0	13.9	11.0	106
1.5	13.9	11.0	106
2.0	13.9	11.0	106
2.5	13.9	11.0	106

Reference Lake D			
September 17, 2016			
Sonde used: YSI EXO			
Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	2.7	13.3	98
0.3	2.7	13.3	98
0.5	2.7	13.3	98
0.7	2.7	13.3	98
0.9	2.7	13.3	98
1.1	2.7	13.3	98
1.3	2.7	13.3	98
1.5	2.7	13.3	98
1.7	2.7	13.3	98
1.9	2.7	13.3	98
2.1	2.7	13.3	98
2.3	2.7	13.3	98
2.5	2.7	13.3	98
2.7	2.7	13.3	98

A.2.3 Marine Data

Marine Secchi depths and calculated euphotic zone depths (1% light level) are shown in Table A.2-3. Figures A.2-6 to A.2-8 show the temperature, dissolved oxygen, and salinity profiles collected at marine sites from April to September 2016; Annex A.2-2 provides the profile data in tabular form.

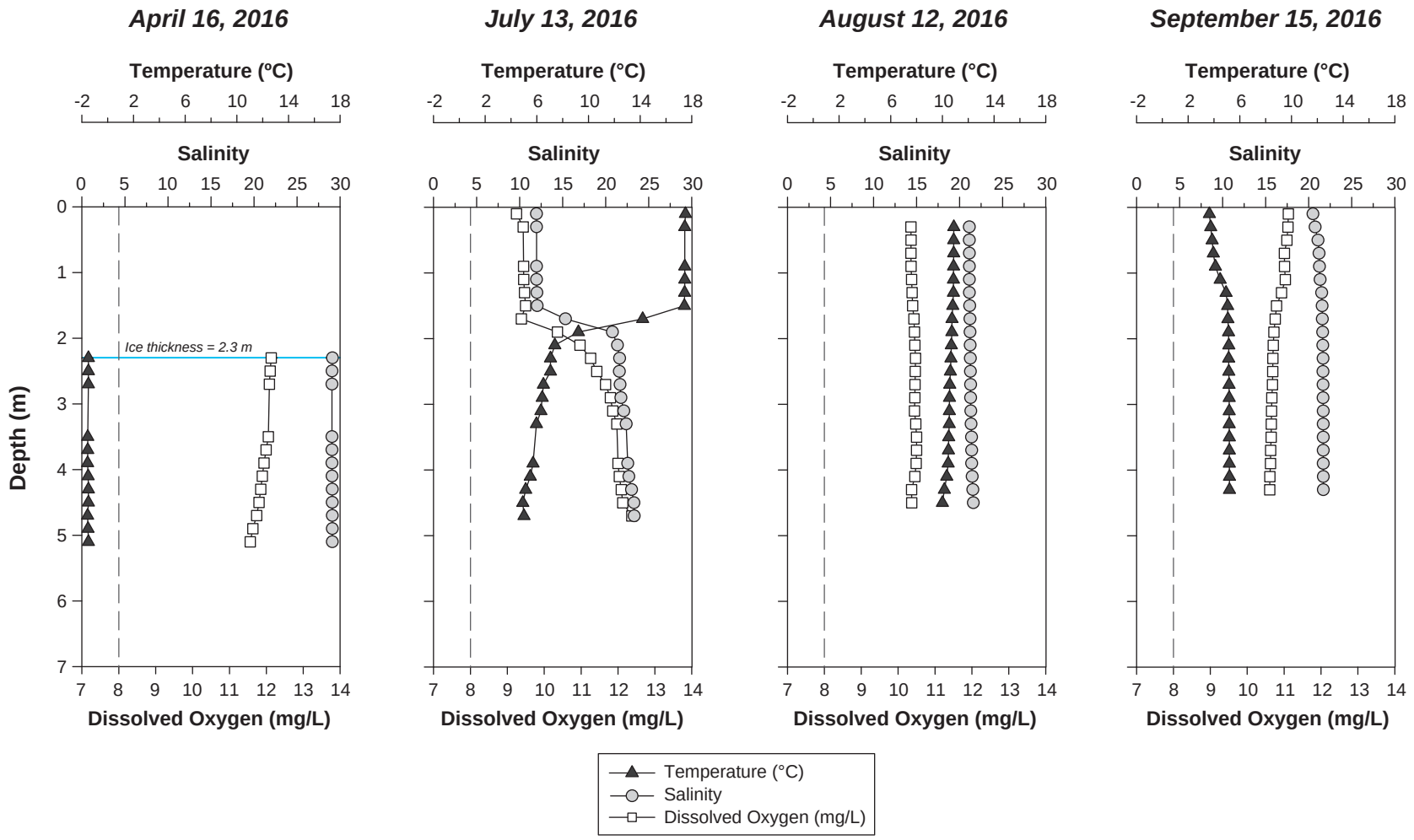
Table A.2-3. Marine Secchi Depths and Euphotic Zone Depths, Doris Project, 2016

Marine Site	Sampling Date	Secchi Depth (D_s) (m)	Euphotic Zone Depth 1% Light Level (m)
RBW	July 13, 2016	2.5	6.76*
	August 12, 2016	Bottom (5.0)	-
	September 15, 2016	Bottom (4.8)	-
RBE	July 13, 2016	Bottom (0.5)	-
	August 12, 2016	Bottom (0.8)	-
	September 15, 2016	Bottom (0.8)	-
REF-Marine 1	July 13, 2016	Bottom (4.0)	-
	August 13, 2016	Bottom (6.0)	-
	September 18, 2016	Bottom (7.0)	-

*Notes: * indicates that the euphotic zone extended to the bottom of the water column.*
- indicates that the euphotic zone depth was not calculated because the Secchi depth extended to the bottom of the water column.

Figure A.2-6

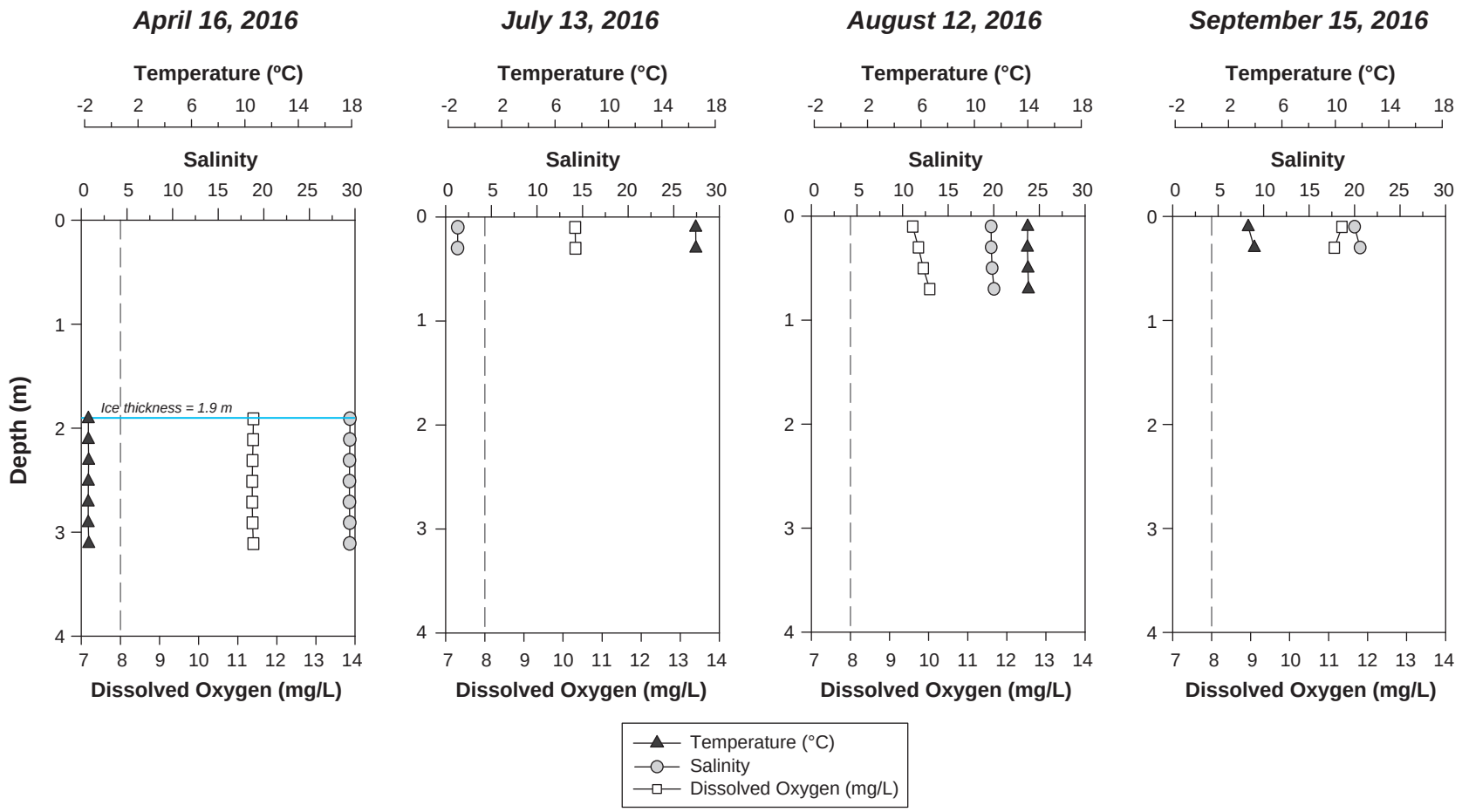
Temperature, Salinity, and Dissolved Oxygen Profiles at Marine Site RBW, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-7

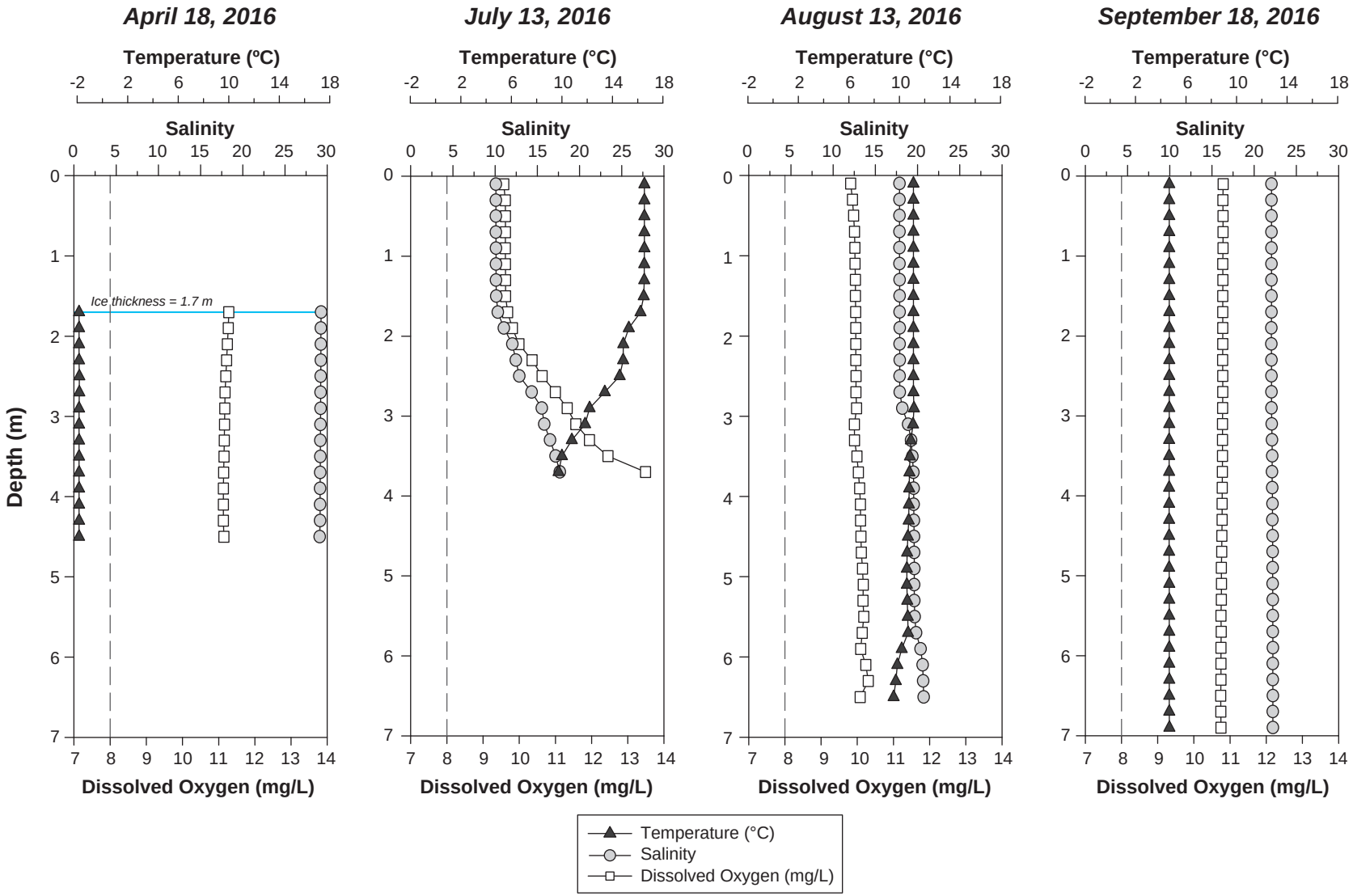
Temperature, Salinity, and Dissolved Oxygen Profiles at Marine Site RBE, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Figure A.2-8

Temperature, Salinity, and Dissolved Oxygen Profiles at Marine Site REF-Marine 1, Doris Project, 2016



Note: Vertical dashed lines represent CCME freshwater dissolved oxygen guidelines for the protection of aquatic life: 9.5 mg /L for early life stages; 6.5 mg/L for other life stages.

Annex A.2-2. Temperature, Salinity, and Dissolved Oxygen Profiles, Marine Sites, Doris Project, 2016

RBW				
April 16, 2016				
Sonde used: YSI ProDSS				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
2.3	-1.5	29.1	12.1	97.7
2.5	-1.5	29.1	12.1	97.5
2.7	-1.5	29.1	12.1	97.3
3.5	-1.5	29.1	12.1	97.0
3.7	-1.5	29.0	12.0	96.5
3.9	-1.6	29.1	11.9	96.0
4.1	-1.5	29.1	11.9	95.7
4.3	-1.5	29.1	11.8	95.4
4.5	-1.5	29.1	11.8	95.0
4.7	-1.6	29.1	11.7	94.5
4.9	-1.5	29.1	11.6	93.6
5.1	-1.5	29.1	11.6	93.1

RBW				
July 13, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	17.5	12.0	9.2	104
0.3	17.5	12.0	9.4	106
0.9	17.5	12.0	9.4	106
1.1	17.5	12.0	9.4	106
1.3	17.4	12.0	9.5	106
1.5	17.4	12.0	9.5	107
1.7	14.2	15.3	9.4	102
1.9	9.2	20.8	10.4	104
2.1	7.4	21.4	11.0	105
2.3	7.1	21.6	11.3	107
2.5	7.1	21.6	11.4	109
2.7	6.5	21.7	11.7	110
2.9	6.4	21.8	11.8	110
3.1	6.3	22.1	11.9	111
3.3	6.0	22.4	12.0	112
3.9	5.7	22.6	12.0	111
4.1	5.5	22.7	12.0	111
4.3	5.1	23.0	12.1	111
4.5	4.9	23.3	12.1	111
4.7	5.0	23.3	12.4	113

RBW				
August 12, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.3	10.9	21.1	10.3	107
0.5	10.9	21.1	10.4	107
0.7	10.9	21.1	10.3	107
0.9	10.9	21.1	10.4	107
1.1	10.9	21.1	10.4	107
1.3	10.9	21.1	10.4	107
1.5	10.8	21.2	10.4	107
1.7	10.7	21.2	10.4	108
1.9	10.7	21.2	10.4	108
2.1	10.7	21.2	10.5	108
2.3	10.7	21.3	10.5	108
2.5	10.6	21.3	10.5	108
2.7	10.6	21.3	10.5	108
2.9	10.6	21.3	10.5	107
3.1	10.5	21.3	10.4	107
3.3	10.5	21.3	10.5	108
3.5	10.5	21.4	10.5	108
3.7	10.5	21.4	10.5	108
3.9	10.5	21.4	10.5	108
4.1	10.3	21.5	10.5	107
4.3	10.1	21.5	10.4	106
4.5	10.0	21.6	10.4	105

RBW				
September 15, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	3.6	20.5	11.1	96.4
0.3	3.7	20.7	11.1	96.6
0.5	3.9	21.1	11.1	96.8
0.7	3.9	21.2	11.0	96.7
0.9	4.1	21.3	11.0	97.0
1.1	4.5	21.3	11.0	97.8
1.3	4.9	21.5	10.9	98.3
1.5	5.1	21.6	10.8	97.7
1.7	5.1	21.6	10.8	97.5
1.9	5.1	21.6	10.7	97.3
2.1	5.1	21.7	10.7	97.2
2.3	5.1	21.7	10.7	97.1
2.5	5.1	21.7	10.7	97.1
2.7	5.2	21.7	10.7	97.0
2.9	5.2	21.7	10.7	97.0
3.1	5.2	21.7	10.7	96.9
3.3	5.2	21.7	10.7	96.8
3.5	5.2	21.7	10.7	96.8
3.7	5.2	21.7	10.6	96.7
3.9	5.2	21.7	10.6	96.6
4.1	5.2	21.7	10.6	96.6
4.3	5.2	21.7	10.6	96.5

Annex A.2-2. Temperature, Salinity, and Dissolved Oxygen Profiles, Marine Sites, Doris Project, 2016

RBE				
April 16, 2016				
Sonde used: YSI ProDSS				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.9	-1.5	29.4	11.4	92.1
2.1	-1.5	29.4	11.4	92.0
2.3	-1.5	29.4	11.4	91.9
2.5	-1.5	29.4	11.4	91.8
2.7	-1.5	29.4	11.4	91.8
2.9	-1.5	29.4	11.4	91.9
3.1	-1.5	29.4	11.4	92.1

RBE				
July 13, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	16.3	1.3	10.3	106
0.3	16.3	1.3	10.3	106

RBE				
August 12, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	13.8	19.7	9.6	105
0.3	13.8	19.7	9.7	106
0.5	13.8	19.8	9.9	108
0.7	13.9	20.0	10.0	110

RBE				
September 15, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	3.5	20.0	11.3	97.0
0.3	4.0	20.6	11.1	97.5

REF-Marine 1				
April 18, 2016				
Sonde used: YSI ProDSS				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
1.7	-1.6	29.3	11.3	90.9
1.9	-1.6	29.2	11.3	90.7
2.1	-1.6	29.2	11.2	90.5
2.3	-1.6	29.2	11.2	90.4
2.5	-1.5	29.2	11.2	90.2
2.7	-1.5	29.2	11.2	90.0
2.9	-1.6	29.2	11.2	89.9
3.1	-1.6	29.2	11.2	89.8
3.3	-1.6	29.2	11.2	89.8
3.5	-1.6	29.2	11.1	89.7
3.7	-1.6	29.2	11.1	89.6
3.9	-1.6	29.2	11.1	89.5
4.1	-1.6	29.2	11.1	89.5
4.3	-1.6	29.2	11.1	89.5
4.5	-1.6	29.1	11.1	89.7

REF-Marine 1				
July 13, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	18.3	10.1	9.6	108
0.3	18.3	10.1	9.6	109
0.5	18.3	10.1	9.6	109
0.7	18.3	10.1	9.6	109
0.9	18.3	10.1	9.6	109
1.1	18.3	10.1	9.6	109
1.3	18.3	10.1	9.6	109
1.5	18.2	10.1	9.6	109
1.7	18.0	10.3	9.7	109
1.9	16.9	11.0	9.8	108
2.1	16.5	12.0	10.0	110
2.3	16.4	12.5	10.4	114
2.5	16.2	12.9	10.6	117
2.7	14.9	14.3	11.0	119
2.9	13.5	15.5	11.3	120
3.1	13.1	15.8	11.6	122
3.3	12.0	16.5	11.9	123
3.5	11.1	17.2	12.5	126
3.7	10.8	17.7	13.5	136

Annex A.2-2. Temperature, Salinity, and Dissolved Oxygen Profiles, Marine Sites, Doris Project, 2016

REF-Marine 1				
August 13, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	12.3	17.9	9.8	103
0.3	12.3	17.9	9.9	103
0.5	12.3	17.9	9.9	103
0.7	12.3	17.9	9.9	104
0.9	12.3	17.9	9.9	104
1.1	12.3	17.9	9.9	104
1.3	12.3	17.9	10.0	104
1.5	12.3	17.9	10.0	104
1.7	12.3	17.9	10.0	104
1.9	12.3	17.9	10.0	104
2.1	12.3	17.9	10.0	104
2.3	12.3	17.9	10.0	104
2.5	12.3	17.9	10.0	104
2.7	12.3	17.9	10.0	104
2.9	12.4	18.2	10.0	105
3.1	12.3	18.9	9.9	104
3.3	12.1	19.2	9.9	104
3.5	12.0	19.4	10.0	105
3.7	12.0	19.5	10.0	105
3.9	11.9	19.5	10.1	105
4.1	11.9	19.5	10.1	106
4.3	11.9	19.6	10.1	106
4.5	11.8	19.6	10.1	106
4.7	11.8	19.6	10.1	106
4.9	11.7	19.6	10.1	106
5.1	11.7	19.6	10.2	106
5.3	11.8	19.6	10.2	106
5.5	11.8	19.7	10.2	106
5.7	11.8	19.8	10.1	106
5.9	11.3	20.4	10.1	105
6.1	10.9	20.6	10.2	106
6.3	10.8	20.7	10.3	106
6.5	10.6	20.7	10.1	103

REF-Marine 1				
September 18, 2016				
Sonde used: YSI EXO				
Depth (m)	Temperature (°C)	Salinity	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
0.1	5.3	22.1	10.8	99
0.3	5.3	22.1	10.8	99
0.5	5.3	22.1	10.8	99
0.7	5.3	22.1	10.8	99
0.9	5.3	22.1	10.8	99
1.1	5.3	22.1	10.8	99
1.3	5.3	22.1	10.8	99
1.5	5.3	22.1	10.8	99
1.7	5.3	22.1	10.8	99
1.9	5.3	22.0	10.8	99
2.1	5.3	22.0	10.8	99
2.3	5.3	22.1	10.8	99
2.5	5.3	22.1	10.8	99
2.7	5.3	22.1	10.8	99
2.9	5.3	22.1	10.8	99
3.1	5.3	22.1	10.8	99
3.3	5.3	22.1	10.8	99
3.5	5.3	22.1	10.8	99
3.7	5.3	22.1	10.8	99
3.9	5.3	22.2	10.8	99
4.1	5.3	22.2	10.8	99
4.3	5.3	22.2	10.8	99
4.5	5.3	22.2	10.8	99
4.7	5.3	22.2	10.8	98
4.9	5.3	22.2	10.8	98
5.1	5.3	22.2	10.8	98
5.3	5.3	22.2	10.8	98
5.5	5.3	22.2	10.8	98
5.7	5.3	22.2	10.8	98
5.9	5.3	22.2	10.8	98
6.1	5.3	22.2	10.8	98
6.3	5.3	22.2	10.8	98
6.5	5.3	22.2	10.7	98
6.7	5.3	22.2	10.7	98
6.9	5.3	22.2	10.8	98

A.3 2016 WATER QUALITY

The following sections present the water quality data collected from April to September 2016 from stream, lake, and marine sites, as well as the QA/QC water quality data. Only the variables that were subjected to an evaluation of effects (see main body of the report) are shown graphically. All water quality variables were screened against CCME water quality guidelines for the protection of aquatic life (CCME 2016b). CCME guidelines are included in all graphs and annexes.

A.3.1 Stream Data

Stream water quality data were collected monthly from June to September 2016. Figures A.3-1 to A.3-9 show monthly trends of select water quality variables. Annex A.3-1 presents the full 2016 stream water quality dataset.

A.3.2 Lake Data

Lake water quality data were collected in April (under-ice sampling) and monthly from July to September 2016. Figures A.3-10 to A.3-18 show seasonal trends for select water quality variables. Annex A.3-2 presents the full 2016 lake water quality dataset.

Note that water quality samples collected from Reference Lake D in August were mistakenly analyzed as seawater samples using the parameter list and associated detection limits reserved for marine samples. As well, radium-226 was not analyzed in samples collected from Reference Lake D in September because of a sample preservation error.

A.3.3 Marine Data

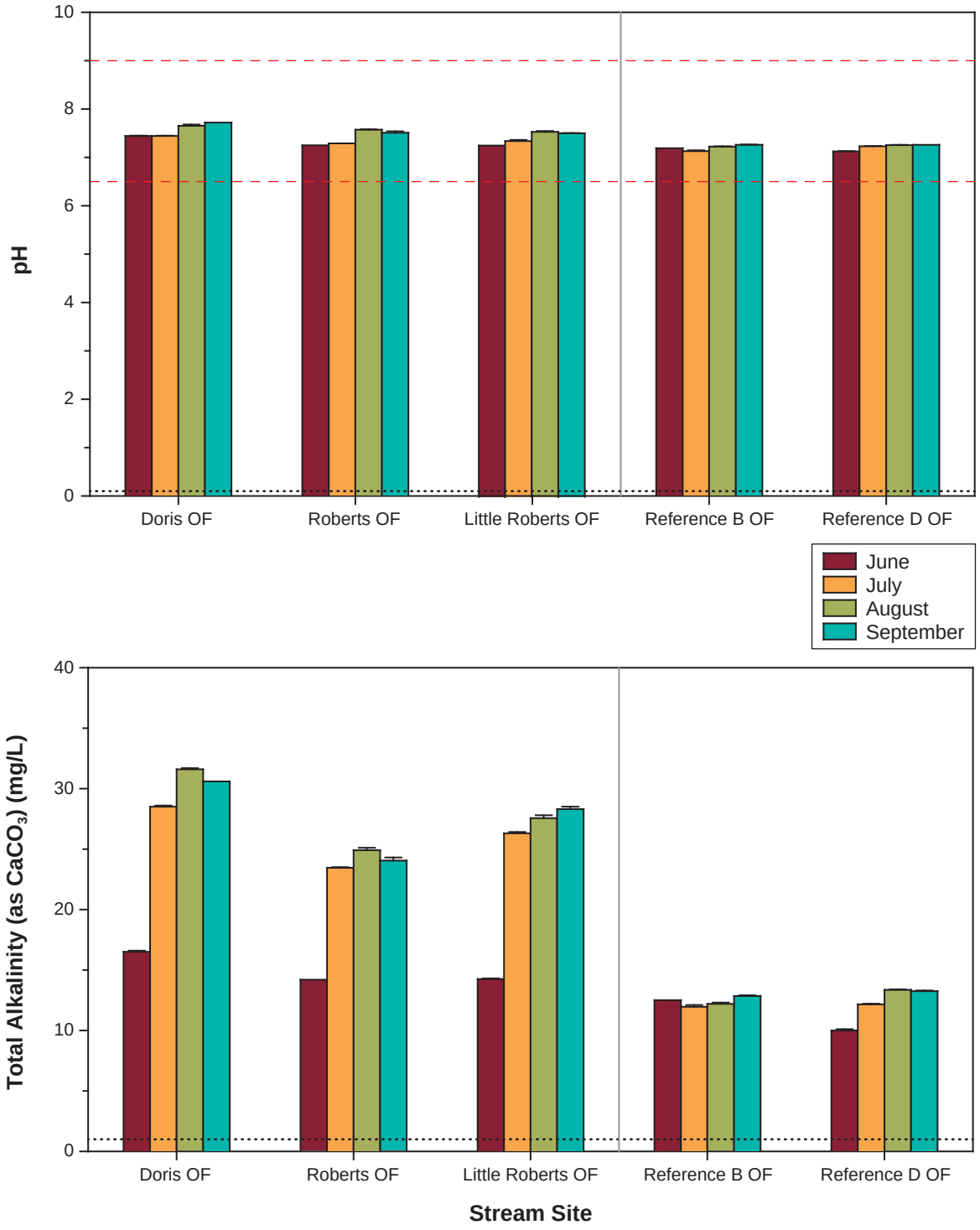
Marine water quality data were collected in April (under-ice sampling) and monthly from July to September 2016. Figures A.3-19 to A.3-27 show seasonal trends for select water quality variables. Annex A.3-3 presents the full 2016 marine water quality dataset.

A.3.4 Quality Assurance/Quality Control (QA/QC) Data

Annex A.3-4 presents the results of the QA/QC blank data (equipment, field, and travel blanks) collected to identify possible sources of contamination to water quality samples. A subset of blanks contained values above detection limits for select nutrients and metals; however, there was no obvious contamination of water quality samples that can be attributed to sampling equipment, sample collection, or sample transportation.

Figure A.3-1

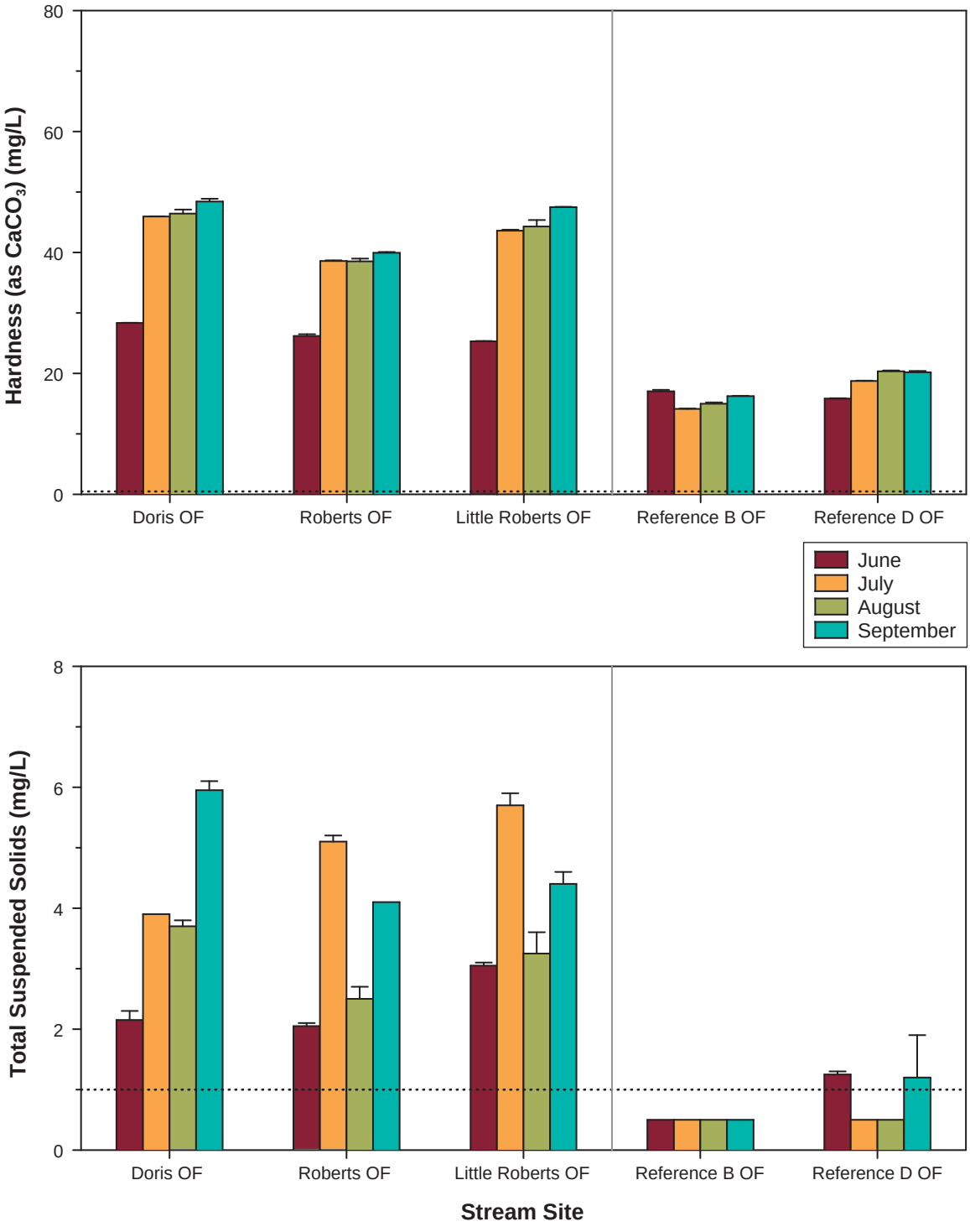
pH and Total Alkalinity in Stream Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits.
Red dashed lines represent the CCME freshwater guideline pH range (6.5–9.0).
pH is a required parameter for water quality monitoring as per Schedule 5, s. 7(1)(c) of the MMER.
Total alkalinity is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.

Figure A.3-2

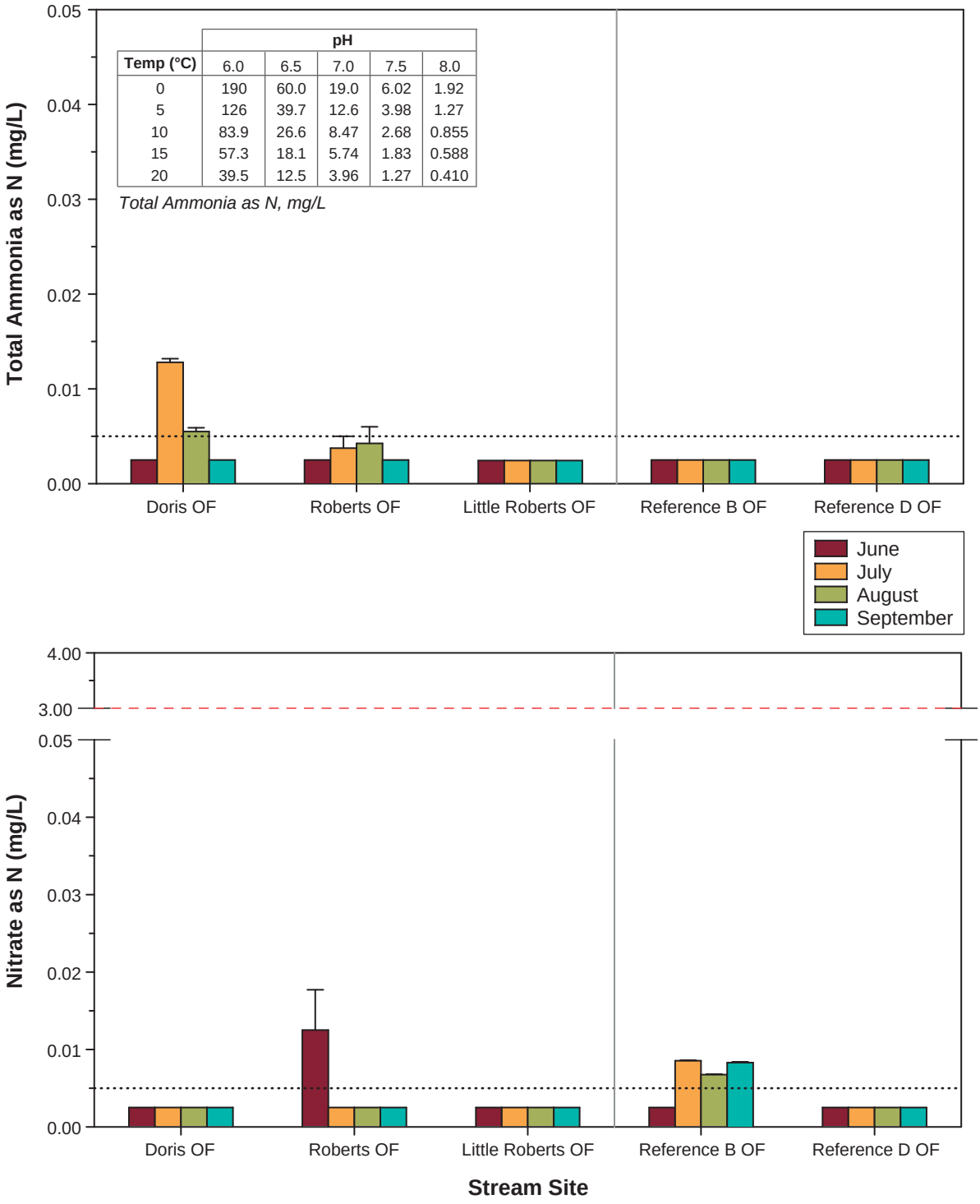
Hardness and Total Suspended Solids in Stream Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits.
The CCME freshwater guideline for total suspended solids is dependent upon background levels.
Hardness is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.
Total suspended solids are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Figure A.3-3

Total Ammonia and Nitrate Concentrations in Stream Sites, Doris Project, 2016

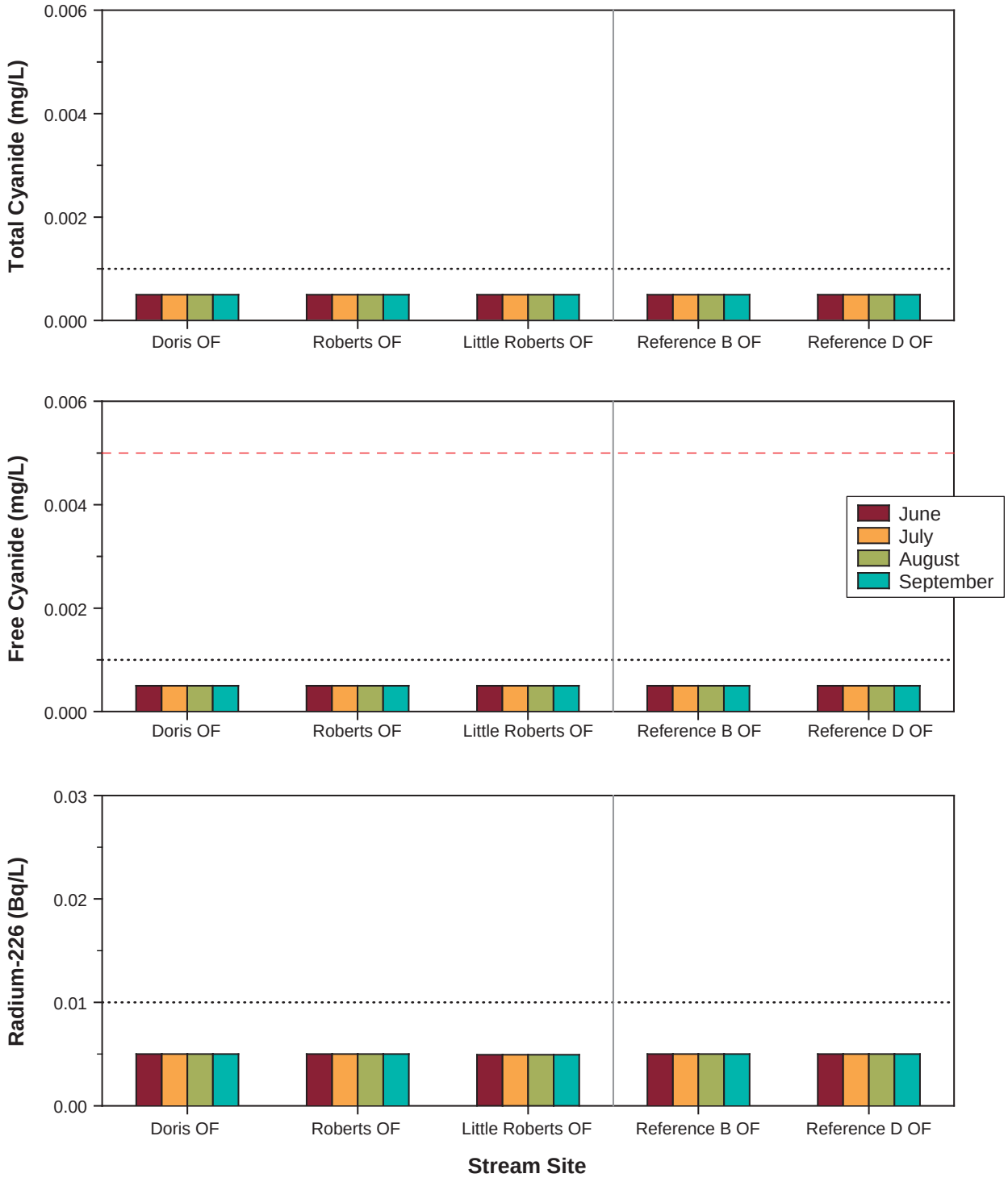


Temp (°C)	pH 6.0	6.5	7.0	7.5	8.0
0	190	60.0	19.0	6.02	1.92
5	126	39.7	12.6	3.98	1.27
10	83.9	26.6	8.47	2.68	0.855
15	57.3	18.1	5.74	1.83	0.588
20	39.5	12.5	3.96	1.27	0.410

Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Inset table shows the pH- and temperature-dependent CCME freshwater guideline for total ammonia.
Red dashed line represents the CCME freshwater guideline for nitrate as N (3.0 mg/L; long-term concentration).
Total ammonia and nitrate are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-4

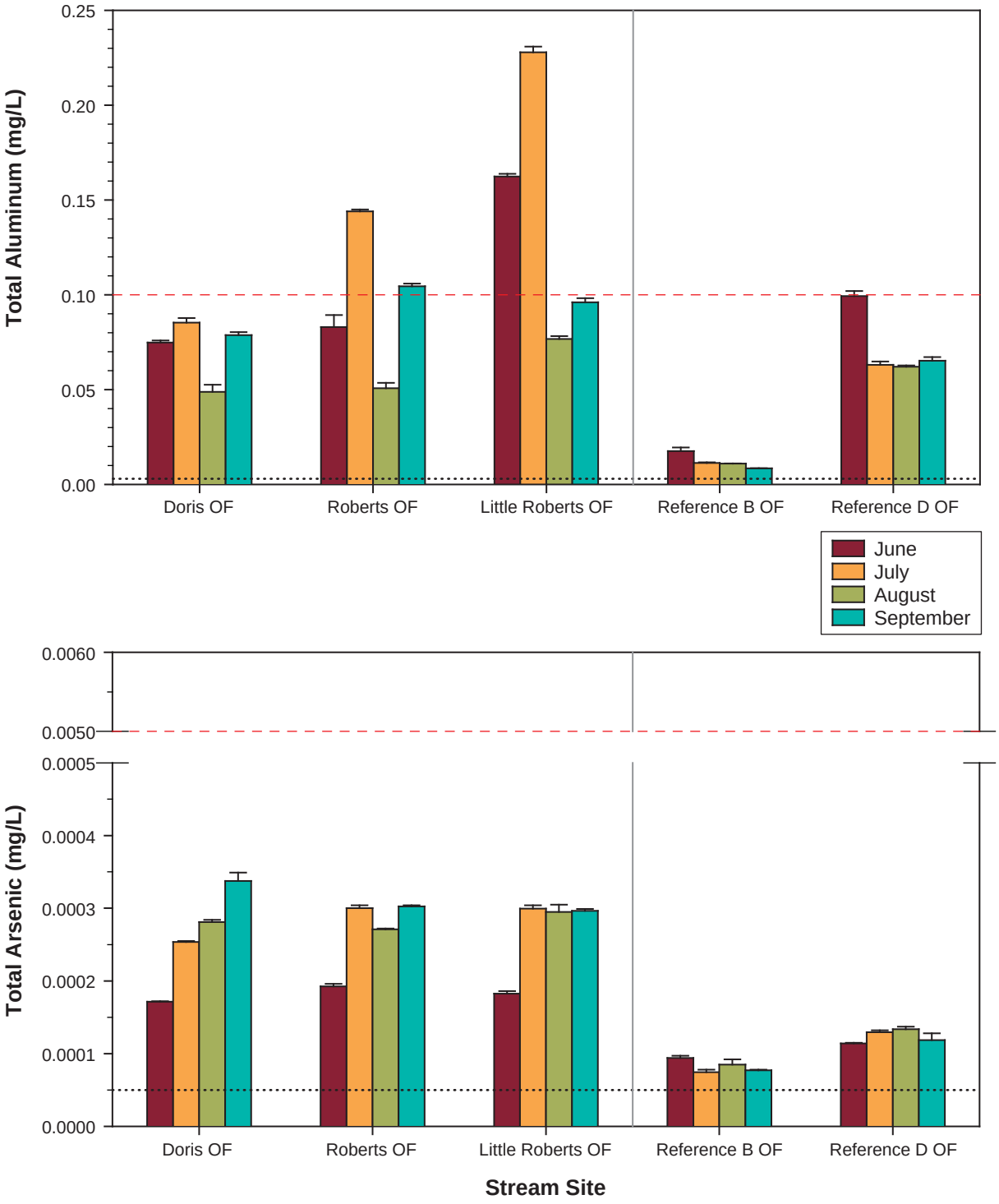
Total Cyanide, Free Cyanide, and Radium-226 Concentrations in Stream Sites, Doris Project, 2016



Notes: Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
All total cyanide, free cyanide, and radium-226 concentrations in stream samples were below the detection limit.
Red dashed line represents the CCME freshwater guideline for free cyanide (0.005 mg/L).
Total cyanide and radium-226 are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Figure A.3-5

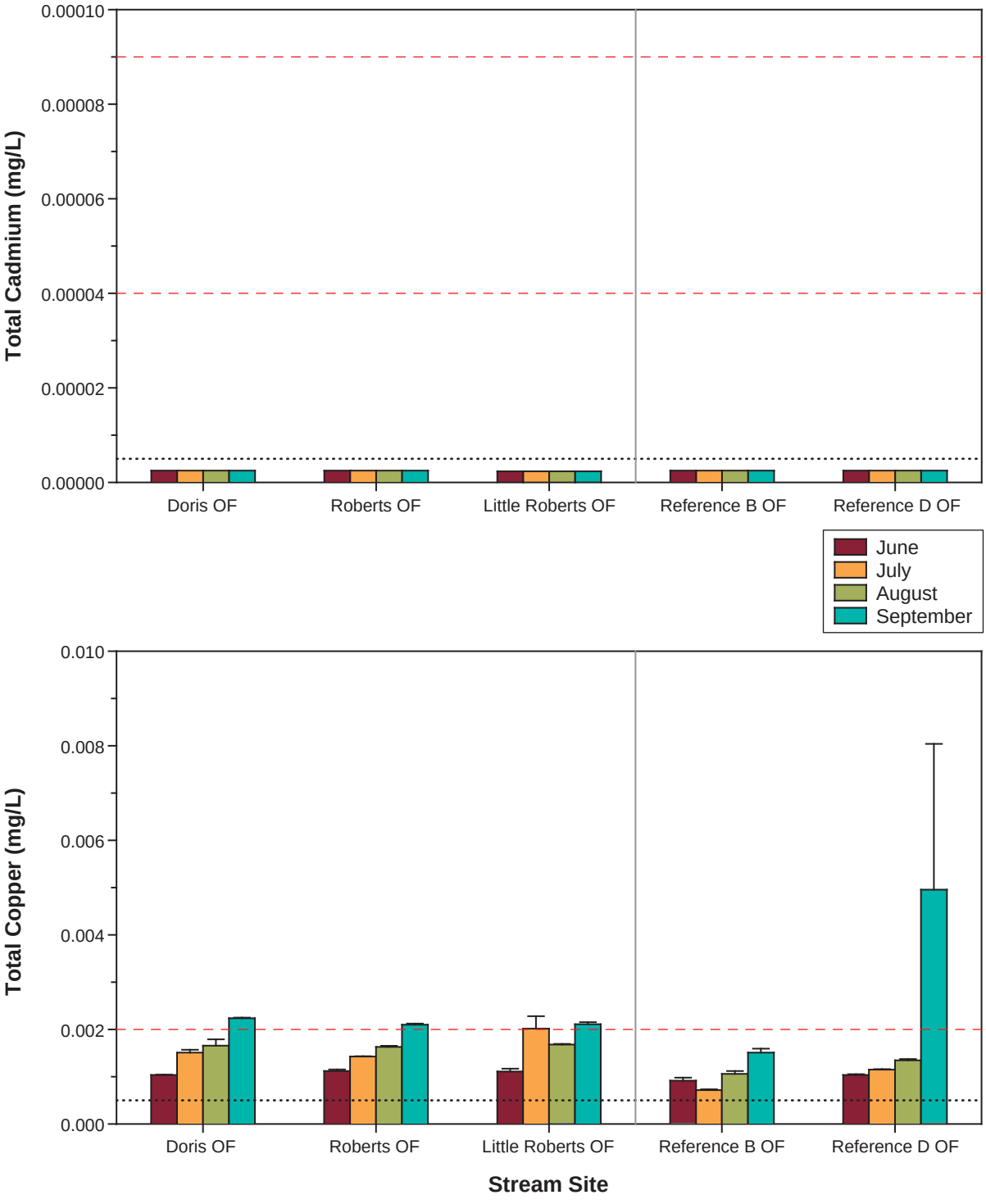
Total Aluminum and Total Arsenic Concentrations in Stream Sites, Doris Project, 2016



Notes: *Error bars represent the standard error of the mean of replicates.*
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed lines represent the pH-dependent CCME freshwater guideline for aluminum (0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5) and the CCME freshwater guideline for arsenic (0.005 mg/L).
pH was greater than 6.5 in all stream samples.
Total aluminum is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total arsenic is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-6

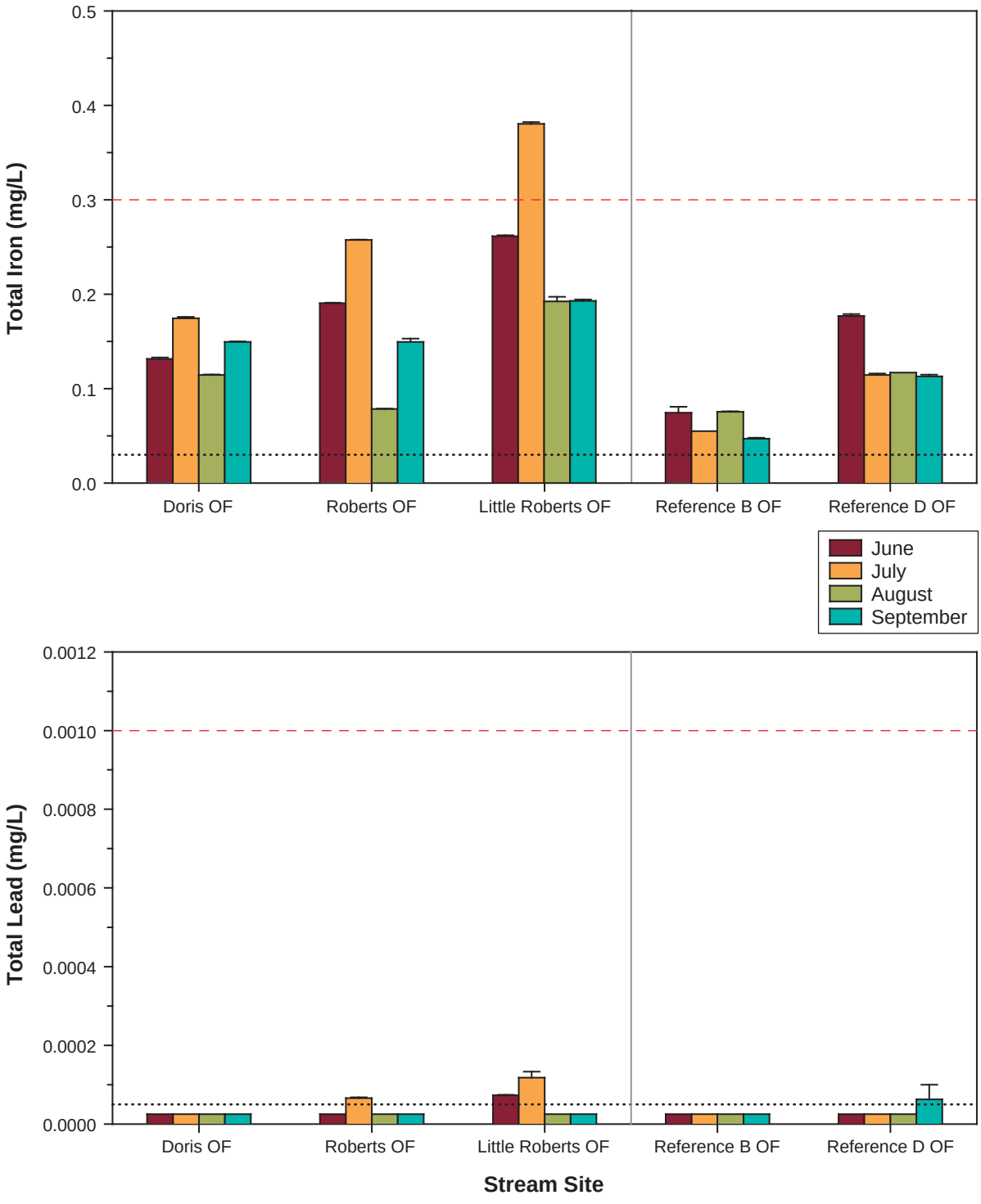
Total Cadmium and Total Copper Concentrations in Stream Sites, Doris Project, 2016



Notes: *Error bars represent the standard error of the mean of replicates.*
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
All total cadmium concentrations in stream samples were below the detection limit.
The CCME freshwater guidelines for cadmium and copper are hardness dependent.
Red dashed lines represent the minimum and maximum site-specific CCME freshwater guidelines for cadmium (0.00004 and 0.00009 mg/L) and for copper (0.002 mg/L) based on the hardness (as $CaCO_3$) range in streams of 14.1 to 48.9 mg/L.
Total cadmium is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total copper is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-7

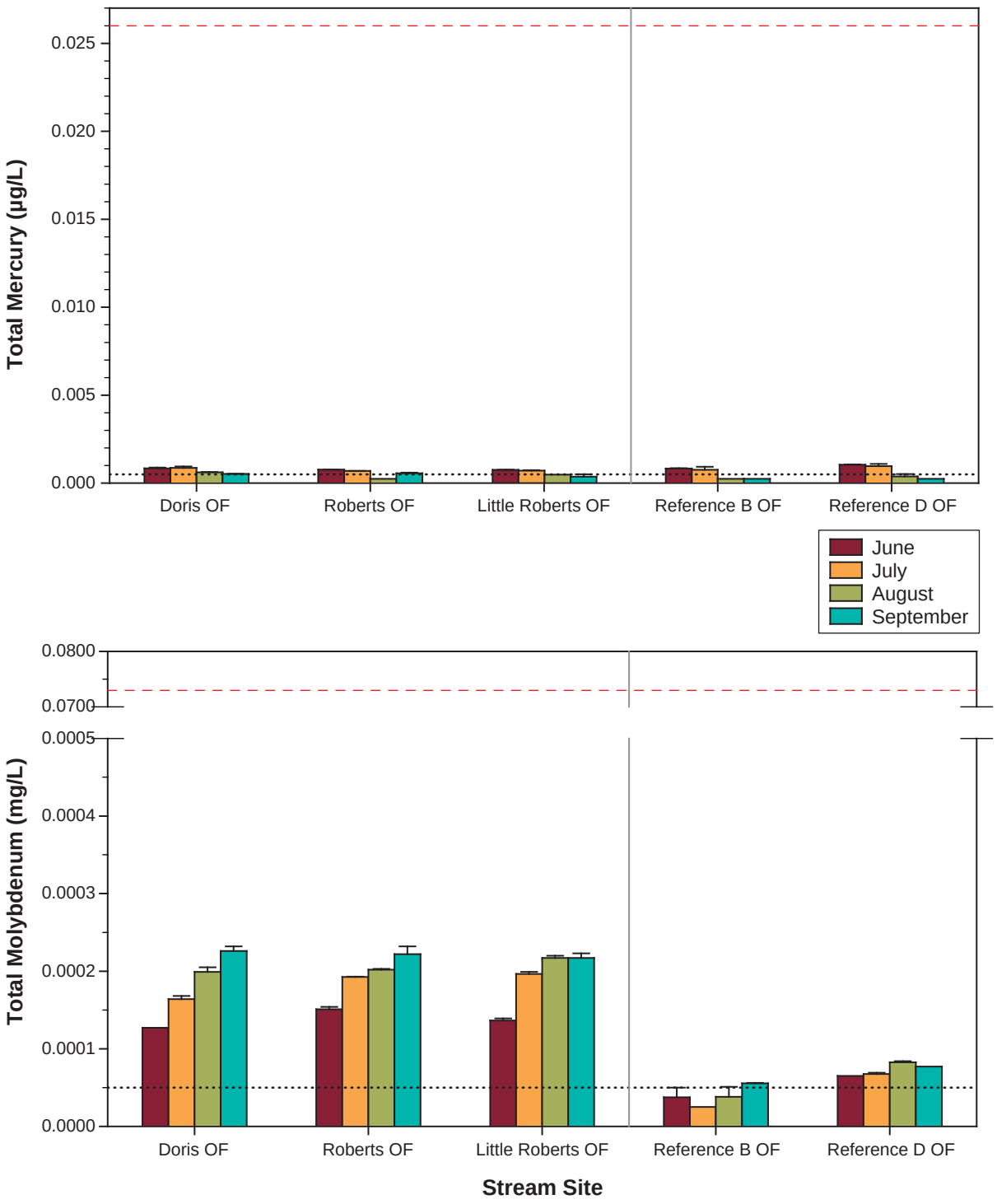
Total Iron and Total Lead Concentrations in Stream Sites, Doris Project, 2016



Notes: *Error bars represent the standard error of the mean of replicates.*
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
The CCME freshwater guideline for lead is hardness dependent.
Red dashed lines represent the CCME freshwater guideline for iron (0.3 mg/L) and the site-specific CCME freshwater guideline for lead (0.001 mg/L) based on the hardness (as $CaCO_3$) range in streams of 14.1 to 48.9 mg/L.
Total iron is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total lead is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-8

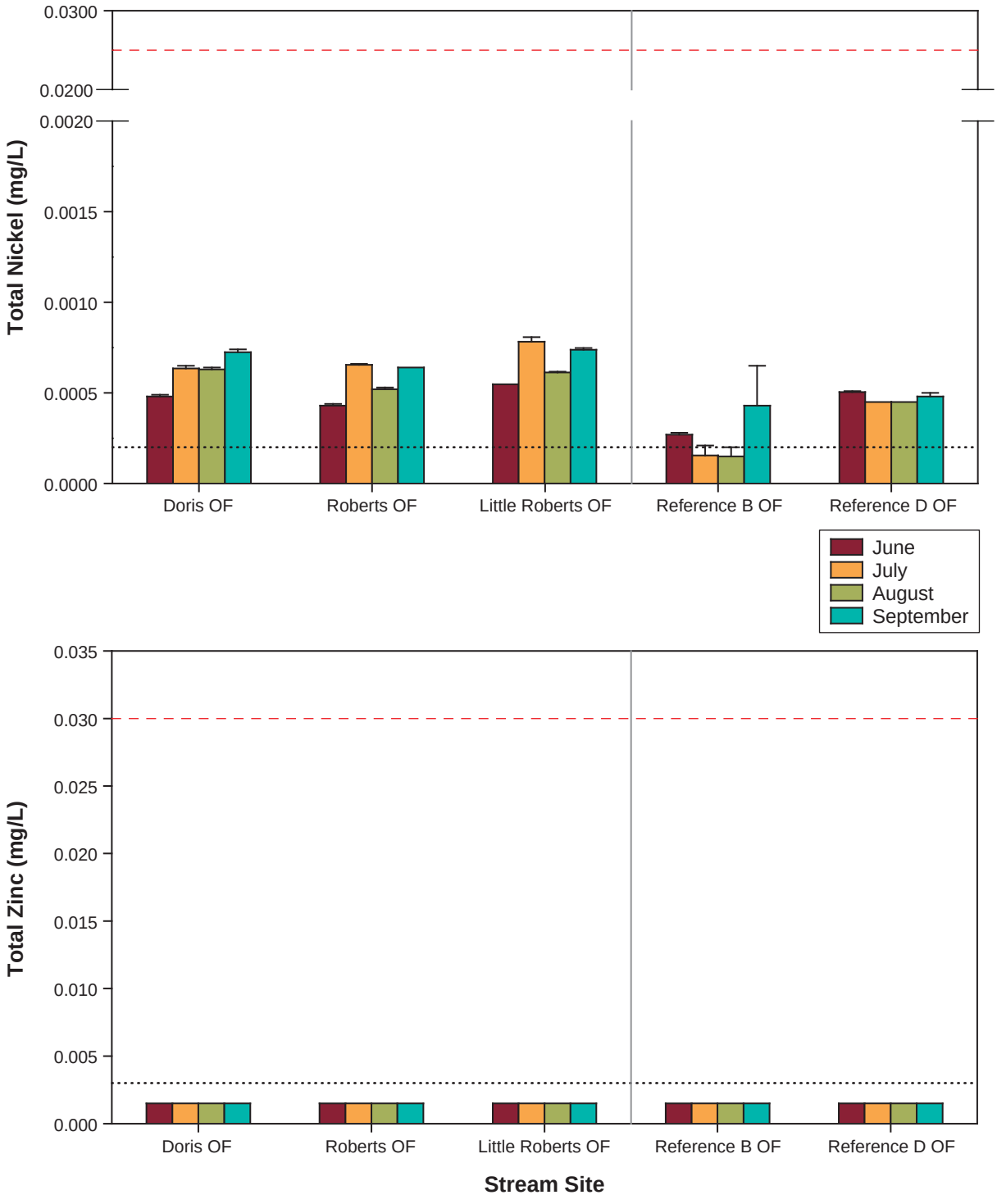
Total Mercury and Total Molybdenum Concentrations in Stream Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed lines represent the CCME freshwater guidelines for inorganic mercury (0.026 µg/L) and molybdenum (0.073 mg/L).
Total mercury and total molybdenum are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-9

Total Nickel and Total Zinc Concentrations in Stream Sites, Doris Project, 2016



Notes: *Error bars represent the standard error of the mean of replicates.*
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
All total zinc concentrations in stream samples were below the detection limit.
The CCME guideline for nickel is hardness dependent.
Red dashed lines represent the CCME freshwater guideline for zinc (0.03 mg/L) and the site-specific CCME guideline for nickel (0.025 mg/L) based on the hardness (as $CaCO_3$) range in streams of 14.1 to 48.9 mg/L.
Total nickel and total zinc are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Doris OF		Roberts OF		Little Roberts OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	12-Jun-2016	12-Jun-2016	13-Jun-2016	13-Jun-2016	13-Jun-2016	13-Jun-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1783343-1	L1783343-2	L1783343-3	L1783343-4	L1783343-5	L1783343-6
Physical Tests									
Conductivity	uS/cm		2.0	157	154	162	162	147	148
Hardness (as $CaCO_3$)	mg/L		0.50	28.4	28.3	25.9	26.5	25.5	25.4
pH	pH	6.5 to 9.0	0.10	7.45	7.44	7.25	7.25	7.28	7.28
Total Suspended Solids	mg/L	dependent on background levels	1.0	2.0	2.3	2.0	2.1	3.1	3.0
Total Dissolved Solids	mg/L		13	83	83	97	92	70	88
Turbidity	NTU	dependent on background levels	0.10	2.30	2.47	1.86	2.01	4.06	3.87
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	16.6	16.4	14.2	14.2	14.3	14.2
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.119	0.120	0.130	0.135	0.116	0.114
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	36.2	36.0	39.4	39.4	35.1	35.0
Fluoride (F)	mg/L	0.12[b]	0.020	0.037	0.037	0.033	0.034	0.034	0.033
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	0.0073	0.0177	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	0.0016	0.0031	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.292	0.319	0.274	0.249	0.243	0.255
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0011	0.0017	0.0020	0.0017	0.0016	0.0014
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0111	0.0134	0.0116	0.0248	0.0148	0.0132
Sulphate (SO_4)	mg/L		0.30	1.64	1.63	2.80	2.90	2.01	2.00
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	4.31	4.09	-	4.16	-	-
Total Organic Carbon	mg/L		0.50	3.91	3.91	3.89	3.88	3.66	3.66
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0737	0.0760	0.0766	0.0894	0.161	0.164
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000172	0.000171	0.000189	0.000196	0.000186	0.000179
Barium (Ba)	mg/L		0.00010	0.00264	0.00275	0.00261	0.00333	0.00379	0.00369
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.016	0.016	0.021	0.021	0.018	0.018
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	5.09	5.07	3.78	3.87	4.20	4.19
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	0.0000058	0.0000064	0.0000113	0.0000116
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000078	0.000084	0.000062	0.000061	0.000109	0.000109
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00104	0.00103	0.00109	0.00115	0.00117	0.00105
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000052	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.133	0.130	0.190	0.191	0.263	0.261
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000074	0.000072
Lithium (Li)	mg/L		0.00040	0.00211	0.00223	0.00168	0.00170	0.00193	0.00197
Magnesium (Mg)	mg/L		0.10	3.81	3.79	4.01	4.10	3.64	3.62
Manganese (Mn)	mg/L		0.00020	0.0217	0.0225	0.0152	0.0150	0.0169	0.0173
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00089	0.00080	0.00076	0.00077	0.00078	0.00075
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000127	0.000127	0.000148	0.000154	0.000139	0.000134
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00049	0.00047	0.00042	0.00044	0.00055	0.00055
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00085	0.00086	0.00090	0.00094	0.00105	0.00105
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.887	0.891	0.452	0.498	0.865	0.860
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	18.8	18.6	21.1	21.6	18.3	18.1
Strontium (Sr)	mg/L		0.00020	0.0216	0.0216	0.0224	0.0226	0.0211	0.0209
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000315	0.0000333	0.0000399	0.0000457	0.0000779	0.000083
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00225	0.00224	0.00255	0.00277	0.00738	0.00740
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000321	0.0000330	0.0000417	0.0000413	0.0000379	0.0000368
Vanadium (V)	mg/L		0.000050	0.000204	0.000197	0.000206	0.000229	0.000412	0.000452
Yttrium (Y)	mg/L		0.0000050	0.0000341	0.0000346	0.0000480	0.0000495	0.0000620	0.0000624
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000052	<0.000050	<0.000050	0.000060	0.000078	0.000076
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{[0.83(\log[hardness]) - 2.46]}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{[0.8545[\ln(hardness)]-1.465]}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{[1.273[\ln(hardness)]-4.705]}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{[0.76[\ln(hardness)]+1.06]}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Reference B OF		Reference D OF		Doris OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	13-Jun-2016	13-Jun-2016	13-Jun-2016	13-Jun-2016	15-Jul-2016	15-Jul-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1783343-7	L1783343-8	L1783343-9	L1783343-10	L1800754-12	L1800754-11
Physical Tests									
Conductivity	uS/cm		2.0	-	57.1	80.5	81.0	246	251
Hardness (as $CaCO_3$)	mg/L		0.50	17.3	16.8	15.8	15.9	45.9	46
pH	pH	6.5 to 9.0	0.10	-	7.19	7.13	7.12	7.45	7.44
Total Suspended Solids	mg/L	dependent on background levels	1.0	-	<1.0	1.3	1.2	3.9	3.9
Total Dissolved Solids	mg/L		13 or 20	-	47	47	53	156	156
Turbidity	NTU	dependent on background levels	0.10	-	0.62	1.80	2.02	4.83	4.86
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	-	12.5	9.9	10.1	28.6	28.4
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0132	0.0124
Bromide (Br)	mg/L		0.050	-	<0.050	0.053	0.053	0.192	0.191
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	-	8.11	17.0	17.0	57.4	57.5
Fluoride (F)	mg/L	0.12[b]	0.020	-	0.022	0.030	0.030	0.051	0.054
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.265	0.254	0.277	0.262	0.473	0.475
Orthophosphate-Dissolved (as P)	mg/L		0.0010	-	0.0015	0.0017	0.0015	<0.0010	0.001
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0070	0.0104	0.0110	0.0106	0.0160	0.0155
Sulphate (SO_4)	mg/L		0.30	-	1.77	1.53	1.53	2.40	2.42
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	3.55	3.78	4.52	4.21	6.71	6.53
Total Organic Carbon	mg/L		0.50	3.82	3.71	4.25	4.21	6.67	7.20
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0195	0.0158	0.097	0.102	0.0829	0.0878
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000097	0.000091	0.000115	0.000113	0.000252	0.000255
Barium (Ba)	mg/L		0.00010	0.00294	0.00279	0.00271	0.00283	0.00376	0.00381
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	<0.010	<0.010	0.012	0.014	0.027	0.024
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	4.31	4.12	2.52	2.54	8.20	8.20
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	0.0000051	0.0000063	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000069	0.000074	0.000057	0.000054	0.000066	0.000066
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00098	0.00085	0.00105	0.00102	0.00145	0.00157
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.081	0.068	0.175	0.179	0.173	0.176
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00052	0.00049	0.00117	0.00113	0.00334	0.00347
Magnesium (Mg)	mg/L		0.10	1.58	1.57	2.31	2.32	6.18	6.19
Manganese (Mn)	mg/L		0.00020	0.0130	0.0105	0.00735	0.00734	0.0202	0.0204
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00082	0.00085	0.00107	0.00102	0.00078	0.00095
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.00005	<0.000050	0.000065	0.000065	0.000160	0.000168
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00028	0.00026	0.00051	0.00050	0.00062	0.00065
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	2.2	2.2
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.000913	0.000890	0.00097	0.00099	0.00139	0.00141
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.152	0.144	0.320	0.333	1.62	1.62
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	4.4	4.3	9.2	9.2	30.0	29.9
Strontium (Sr)	mg/L		0.00020	0.0187	0.0181	0.0143	0.0142	0.0380	0.0366
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000170	0.0000146	0.0000580	0.0000590	0.0000392	0.0000423
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00059	0.00048	0.00325	0.00330	0.00231	0.00262
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000494	0.0000462	0.0000389	0.0000378	0.0000440	0.0000446
Vanadium (V)	mg/L		0.000050	0.000077	0.000068	0.000192	0.000207	0.000244	0.000250
Yttrium (Y)	mg/L		0.0000050	0.0000247	0.0000227	0.0000541	0.0000547	0.0000426	0.0000432
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	<0.000050	<0.000050	0.000064	0.000064	0.000086	0.000091
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Roberts OF		Little Roberts OF		Reference B OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	16-Jul-2016	16-Jul-2016	15-Jul-2016	15-Jul-2016	17-Jul-2016	17-Jul-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1800754-17	L1800754-18	L1800754-13	L1800754-14	L1800754-3	L1800754-4
Physical Tests									
Conductivity	uS/cm		2.0	232	235	244	246	51.6	49.4
Hardness (as $CaCO_3$)	mg/L		0.50	38.7	38.5	43.9	43.6	14.1	14.2
pH	pH	6.5 to 9.0	0.10	7.29	7.29	7.35	7.40	7.15	7.11
Total Suspended Solids	mg/L	dependent on background levels	1.0	5.0	5.2	5.9	5.5	<1.0	<1.0
Total Dissolved Solids	mg/L		10 or 20	136	139	148	152	41	41
Turbidity	NTU	dependent on background levels	0.10	4.82	4.97	7.88	7.60	0.58	0.44
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	23.5	23.4	26.2	26.4	12.1	11.8
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	0.005	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.194	0.193	0.195	0.195	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	56.2	56.2	57.7	57.6	6.48	6.48
Fluoride (F)	mg/L	0.12[b]	0.020	0.046	0.046	0.051	0.051	0.022	0.022
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0086	0.0085
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.335	0.346	0.395	0.376	0.217	0.192
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0012	0.0012	<0.0010	0.001	<0.0010	0.0012
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0134	0.0197	0.0147	0.0142	0.0048	0.0057
Sulphate (SO_4)	mg/L		0.30	3.97	3.97	3.10	3.09	1.51	1.51
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	5.66	5.72	6.20	6.18	3.39	3.24
Total Organic Carbon	mg/L		0.50	5.68	5.70	6.74	6.42	3.59	3.62
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.143	0.145	0.231	0.225	0.0110	0.0117
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000296	0.000304	0.000304	0.000295	0.000071	0.000078
Barium (Ba)	mg/L		0.00010	0.00404	0.00394	0.00522	0.00502	0.00160	0.00163
Beryllium (Be)	mg/L		0.0000050	0.0000060	0.0000063	0.0000105	0.0000097	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.034	0.033	0.027	0.028	<0.010	<0.010
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	5.68	5.68	7.27	7.23	3.47	3.48
Cesium (Cs)	mg/L		0.0000050	0.0000115	0.0000116	0.0000177	0.0000173	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	0.00063	0.00059	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000082	0.000087	0.000148	0.000140	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00143	0.00142	0.00175	0.00228	0.00070	0.00073
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	0.000082	0.000085	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.258	0.257	0.383	0.379	0.055	0.055
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	0.000064	0.000068	0.000103	0.000133	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00255	0.00257	0.00334	0.00319	0.00053	0.00052
Magnesium (Mg)	mg/L		0.10	5.95	5.91	6.25	6.20	1.33	1.34
Manganese (Mn)	mg/L		0.00020	0.01420	0.01410	0.0183	0.0179	0.00157	0.00153
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00069	0.00070	0.00069	0.00075	0.00059	0.00093
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000192	0.000193	0.000194	0.000199	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00066	0.00065	0.00081	0.00076	0.00021	<0.00020
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	2.1	2.1	2.2	2.2	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00149	0.00146	0.00179	0.00174	0.000780	0.000769
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.498	0.519	1.43	1.42	0.118	0.122
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	31.0	30.9	30.7	30.3	3.6	3.7
Strontium (Sr)	mg/L		0.00020	0.0307	0.0301	0.0366	0.0360	0.0145	0.0142
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000632	0.0000639	0.0000963	0.0000946	0.0000104	0.0000106
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00598	0.00578	0.01210	0.01230	0.00025	0.00027
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000598	0.0000582	0.0000608	0.0000594	0.0000465	0.0000464
Vanadium (V)	mg/L		0.000050	0.000377	0.000372	0.000694	0.000659	<0.000050	<0.000050
Yttrium (Y)	mg/L		0.0000050	0.0000713	0.0000718	0.0000927	0.0000886	0.0000163	0.0000163
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000090	0.000094	0.000136	0.000142	<0.000050	<0.000050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{[0.83(\log[hardness]) - 2.46]}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{[0.8545[\ln(hardness)]-1.465]}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{[1.273[\ln(hardness)]-4.705]}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{[0.76[\ln(hardness)]+1.06]}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Reference D OF		Doris OF		Roberts OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	14-Jul-2016	14-Jul-2016	14-Aug-2016	14-Aug-2016	16-Aug-2016	16-Aug-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1799162-3	L1799162-4	L1814657-5	L1814657-6	L1817820-7	L1817820-8
Physical Tests									
Conductivity	uS/cm		2.0	99.4	96.2	252	255	247	247
Hardness (as $CaCO_3$)	mg/L		0.50	18.7	18.8	45.8	47.1	38.1	39.0
pH	pH	6.5 to 9.0	0.10	7.24	7.22	7.68	7.63	7.57	7.58
Total Suspended Solids	mg/L	dependent on background levels	1.0	<1.0	<1.0	3.8	3.6	2.3	2.7
Total Dissolved Solids	mg/L		13 or 20	63	66	136	129	147	148
Turbidity	NTU	dependent on background levels	0.10	1.11	1.19	5.34	5.31	2.88	2.66
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	12.1	12.2	31.7	31.5	24.7	25.1
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	0.0059	0.0051	<0.0050	0.006
Bromide (Br)	mg/L		0.050	0.062	0.060	0.190	0.188	0.196	0.198
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	20.0	20.1	56.5	56.6	57.4	57.4
Fluoride (F)	mg/L	0.12[b]	0.020	0.036	0.036	0.054	0.054	0.049	0.049
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.265	0.306	0.503	0.542	0.433	0.420
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	0.0013
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0056	0.0065	0.0139	0.0175	0.0212	0.0197
Sulphate (SO_4)	mg/L		0.30	1.80	1.79	2.60	2.61	4.10	4.09
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	4.41	4.92	6.33	6.27	5.02	5.01
Total Organic Carbon	mg/L		0.50	4.66	4.72	6.61	6.55	5.68	5.16
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0614	0.0649	0.0452	0.0526	0.0536	0.0479
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000127	0.000132	0.000278	0.000284	0.000270	0.000272
Barium (Ba)	mg/L		0.00010	0.00215	0.00206	0.00315	0.00324	0.00267	0.00265
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	0.000006	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.015	0.012	0.025	0.025	0.027	0.027
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	2.95	2.96	8.13	8.42	5.62	5.77
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00114	0.00116	0.00179	0.00152	0.00165	0.00161
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.113	0.116	0.114	0.115	0.078	0.079
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00138	0.00143	0.00347	0.00351	0.00249	0.00242
Magnesium (Mg)	mg/L		0.10	2.74	2.77	6.20	6.34	5.83	5.98
Manganese (Mn)	mg/L		0.00020	0.00533	0.00560	0.0191	0.0187	0.00736	0.00720
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00084	0.00109	0.00063	0.00061	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000069	0.000066	0.000205	0.000193	0.000203	0.000201
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00045	0.00045	0.00064	0.00062	0.00053	0.00051
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	2.3	2.3	2.1	2.1
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00123	0.00119	0.00143	0.00146	0.00136	0.00134
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.276	0.283	1.46	1.57	0.306	0.289
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	11.8	12.1	31.1	31.3	31.7	32.8
Strontium (Sr)	mg/L		0.00020	0.0162	0.0170	0.0369	0.0395	0.0357	0.0373
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000383	0.0000417	0.0000213	0.0000252	0.0000313	0.0000295
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00152	0.00167	0.00102	0.00106	0.00106	0.00095
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000381	0.0000413	0.0000504	0.0000529	0.0000565	0.0000554
Vanadium (V)	mg/L		0.000050	0.000134	0.000134	0.000183	0.000193	0.000112	0.000115
Yttrium (Y)	mg/L		0.0000050	0.0000411	0.0000406	0.0000289	0.0000301	0.0000406	0.0000403
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000051	0.000061	0.000064	0.000060	<0.000050	<0.000050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{[0.83(\log[hardness]) - 2.46]}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{[0.8545[\ln(hardness)]-1.465]}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{[1.273[\ln(hardness)]-4.705]}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{[0.76[\ln(hardness)]+1.06]}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Little Roberts OF		Reference B OF		Reference D OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	19-Aug-2016	19-Aug-2016	17-Aug-2016	17-Aug-2016	18-Aug-2016	18-Aug-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1817820-3	L1817820-4	L1817820-1	L1817820-2	L1817820-5	L1817820-6
Physical Tests									
Conductivity	uS/cm		2.0	256	257	51.5	50.6	108	106
Hardness (as $CaCO_3$)	mg/L		0.50	43.4	45.5	14.8	15.2	20.2	20.5
pH	pH	6.5 to 9.0	0.10	7.58	7.55	7.23	7.22	7.26	7.25
Total Suspended Solids	mg/L	dependent on background levels	1.0	2.9	3.6	<1.0	<1.0	<1.0	<1.0
Total Dissolved Solids	mg/L		13 or 20	156	168	28	39	81	71
Turbidity	NTU	dependent on background levels	0.10	4.50	5.74	0.43	0.48	1.03	1.17
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	27.8	27.3	12.3	12.1	13.4	13.3
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.205	0.211	<0.050	<0.050	0.065	0.066
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	59.9	60.0	6.64	6.62	21.9	22.0
Fluoride (F)	mg/L	0.12[b]	0.020	0.053	0.053	0.022	0.022	0.039	0.039
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	0.0068	0.0067	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.475	0.451	0.214	0.217	0.244	0.274
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0015	0.0015	0.0014	0.0015	0.0016	0.0018
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0291	0.0194	0.0032	0.0028	0.0061	0.0054
Sulphate (SO_4)	mg/L		0.30	3.66	3.67	1.54	1.54	2.03	2.03
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	6.03	5.25	3.57	3.47	4.58	5.07
Total Organic Carbon	mg/L		0.50	6.76	6.02	3.67	3.78	4.99	4.69
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0754	0.0784	0.0111	0.0109	0.0628	0.0615
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000305	0.000285	0.000092	0.000078	0.000137	0.000130
Barium (Ba)	mg/L		0.00010	0.00311	0.00307	0.00150	0.00152	0.00204	0.00207
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.027	0.027	<0.010	<0.010	0.014	0.013
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	7.17	7.51	3.66	3.74	3.21	3.23
Cesium (Cs)	mg/L		0.0000050	0.0000055	0.0000057	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000058	0.000059	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00167	0.00169	0.00112	0.00100	0.00132	0.00137
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.188	0.198	0.076	0.075	0.117	0.117
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00326	0.00318	<0.00040	<0.00040	0.00144	0.00141
Magnesium (Mg)	mg/L		0.10	6.19	6.49	1.38	1.41	2.97	3.01
Manganese (Mn)	mg/L		0.00020	0.0208	0.0208	0.00339	0.00337	0.00782	0.00781
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00050	0.00050	<0.00050	<0.00050	<0.00050	0.00052
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000220	0.000214	0.000051	<0.000050	0.000084	0.000081
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00062	0.00061	0.00020	<0.00020	0.00045	0.00045
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	2.2	2.3	<2.0	<2.0	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00148	0.00147	0.000831	0.000830	0.00111	0.00110
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.981	1.04	0.135	0.139	0.359	0.364
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	31.4	33.3	3.8	4.0	12.6	13.0
Strontium (Sr)	mg/L		0.00020	0.0415	0.0416	0.0166	0.0169	0.0202	0.0186
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000358	0.0000365	0.0000107	0.0000105	0.0000437	0.0000441
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00190	0.00190	<0.00020	<0.00020	0.00113	0.00114
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000539	0.0000527	0.0000551	0.0000530	0.0000646	0.0000664
Vanadium (V)	mg/L		0.000050	0.000201	0.000204	0.000050	<0.000050	0.000119	0.000112
Yttrium (Y)	mg/L		0.0000050	0.0000457	0.0000438	0.0000209	0.0000208	0.0000476	0.0000461
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000056	0.000077	<0.000050	<0.000050	0.000054	0.000053
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Doris OF		Roberts OF		Little Roberts OF	
Replicate:				1	2	1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	14-Sep-2016	14-Sep-2016	14-Sep-2016	14-Sep-2016	14-Sep-2016	14-Sep-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1830186-1	L1830186-2	L1830186-3	L1830186-4	L1830186-5	L1830186-6
Physical Tests									
Conductivity	uS/cm		2.0	253	255	247	250	266	265
Hardness (as $CaCO_3$)	mg/L		0.50	48.9	48.0	40.1	39.8	47.6	47.7
pH	pH	6.5 to 9.0	0.10	7.72	7.72	7.54	7.48	7.53	7.54
Total Suspended Solids	mg/L	dependent on background levels	1.0	6.1	5.8	4.1	4.1	4.2	4.6
Total Dissolved Solids	mg/L		20	145	140	135	130	147	148
Turbidity	NTU	dependent on background levels	0.10	7.37	8.05	5.41	5.50	5.82	6.28
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	30.6	30.6	24.3	23.8	28.5	28.1
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.195	0.193	0.196	0.197	0.202	0.200
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	58.3	58.4	58.9	59.0	61.3	61.4
Fluoride (F)	mg/L	0.12[b]	0.020	0.055	0.055	0.046	0.046	0.051	0.052
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.616	0.602	0.453	0.428	0.556	0.507
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0245	0.0238	0.0133	0.0170	0.0174	0.0206
Sulphate (SO_4)	mg/L		0.30	2.95	2.93	4.30	4.32	4.43	4.43
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	5.96	6.29	5.43	5.64	6.23	6.07
Total Organic Carbon	mg/L		0.50	6.57	7.26	5.88	5.85	6.80	6.34
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0804	0.0772	0.106	0.103	0.098	0.094
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000349	0.000326	0.000301	0.000304	0.000299	0.000294
Barium (Ba)	mg/L		0.00010	0.00324	0.00320	0.00336	0.00307	0.00354	0.00357
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.025	0.025	0.028	0.027	0.026	0.025
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	8.83	8.67	5.79	5.76	7.98	8.02
Cesium (Cs)	mg/L		0.0000050	0.0000063	0.0000067	0.0000089	0.0000088	0.0000070	0.0000074
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000074	0.000073	0.000058	0.000053	0.000064	0.000070
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00222	0.00225	0.00208	0.00212	0.00215	0.00207
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.150	0.149	0.153	0.146	0.192	0.195
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00386	0.00390	0.00264	0.00276	0.00343	0.00348
Magnesium (Mg)	mg/L		0.10	6.51	6.39	6.22	6.18	6.72	6.73
Manganese (Mn)	mg/L		0.00020	0.0249	0.0262	0.00796	0.00830	0.0120	0.0120
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00054	0.00051	0.0006	0.00052	<0.00050	0.00052
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000232	0.000220	0.000232	0.000212	0.000223	0.000211
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00071	0.00074	0.00064	0.00064	0.00073	0.00075
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	2.5	2.4	2.3	2.3	2.4	2.4
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00155	0.00160	0.00149	0.00151	0.00152	0.00150
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	1.68	1.67	0.639	0.609	1.42	1.45
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	31.6	32.9	33.7	35.7	35.7	35.1
Strontium (Sr)	mg/L		0.00020	0.0423	0.0410	0.0352	0.0363	0.0434	0.0412
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000264	0.0000248	0.0000413	0.0000419	0.0000401	0.0000436
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00291	0.00323	0.00366	0.00351	0.00286	0.00271
Tungsten (W)	mg/L		0.000010	0.000014	0.000013	<0.000010	<0.000010	0.000011	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000541	0.0000544	0.0000611	0.0000635	0.0000530	0.0000578
Vanadium (V)	mg/L		0.000050	0.000254	0.000240	0.000221	0.000219	0.000222	0.000227
Yttrium (Y)	mg/L		0.0000050	0.0000343	0.0000383	0.0000572	0.0000535	0.0000538	0.0000539
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000068	0.000071	0.000091	0.000086	0.000243	0.000104
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-1. Stream Water Quality Data, Doris Project, 2016

Site ID:				Reference B OF		Reference D OF	
Replicate:				1	2	1	2
Date Sampled:		CCME Guideline for the	Realized Detection	19-Sep-2016	19-Sep-2016	17-Sep-2016	17-Sep-2016
ALS Sample ID:	Units	Protection of Aquatic life[a]	Limit	L1831856-16	L1831856-17	L1831856-4	L1831856-5
Physical Tests							
Conductivity	uS/cm		2.0	55.7	55.5	110	114
Hardness (as $CaCO_3$)	mg/L		0.50	16.2	16.3	20.0	20.4
pH	pH	6.5 to 9.0	0.10	7.25	7.27	7.26	7.26
Total Suspended Solids	mg/L	dependent on background levels	1.0	<1.0	<1.0	1.9	<1.0
Total Dissolved Solids	mg/L		13 or 20	45	38	126	79
Turbidity	NTU	dependent on background levels	0.10	0.50	0.60	1.53	1.47
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	12.8	12.9	13.2	13.3
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	<0.050	<0.050	0.065	0.066
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	7.70	7.68	23.7	23.7
Fluoride (F)	mg/L	0.12[b]	0.020	0.021	0.021	0.037	0.034
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	0.0082	0.0084	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.253	0.236	0.283	0.291
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0042	0.0042	0.0058	0.0055
Sulphate (SO_4)	mg/L		0.30	2.08	2.07	2.37	2.32
Cyanides							
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon							
Dissolved Organic Carbon	mg/L		0.50	3.56	3.85	4.94	4.94
Total Organic Carbon	mg/L		0.50	3.79	3.89	4.96	4.66
Total Metals							
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0084	0.0086	0.0672	0.0633
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000076	0.000078	0.000109	0.000128
Barium (Ba)	mg/L		0.00010	0.00178	0.00184	0.00213	0.00200
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	<0.010	<0.010	0.012	0.012
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	4.07	4.08	3.11	3.18
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00143	0.00159	0.00187	0.00804
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.046	0.048	0.111	0.115
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	0.000100
Lithium (Li)	mg/L		0.00040	0.00057	0.00057	0.00153	0.00154
Magnesium (Mg)	mg/L		0.10	1.47	1.48	2.97	3.03
Manganese (Mn)	mg/L		0.00020	0.00148	0.00165	0.00350	0.00350
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000055	0.000056	0.000077	0.000077
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00021	0.00065	0.00046	0.00050
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.000797	0.000787	0.00107	0.00104
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.185	0.193	0.446	0.445
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	4.0	4.1	13.2	13.4
Strontium (Sr)	mg/L		0.00020	0.0177	0.0173	0.0197	0.0188
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000093	0.0000098	0.0000425	0.0000411
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	<0.00020	<0.00020	0.00163	0.00156
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	0.000013
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000787	0.0000816	0.0000631	0.0000641
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000124	0.000123
Yttrium (Y)	mg/L		0.0000050	0.0000189	0.0000198	0.0000504	0.0000450
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	<0.000050	<0.000050	0.000067	0.000065
Radiological Parameters							
Ra-226	Bq/L		0.010	<0.0100	<0.0100	-	<0.0100

Notes:

Dashes indicate the parameter was not analyzed.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

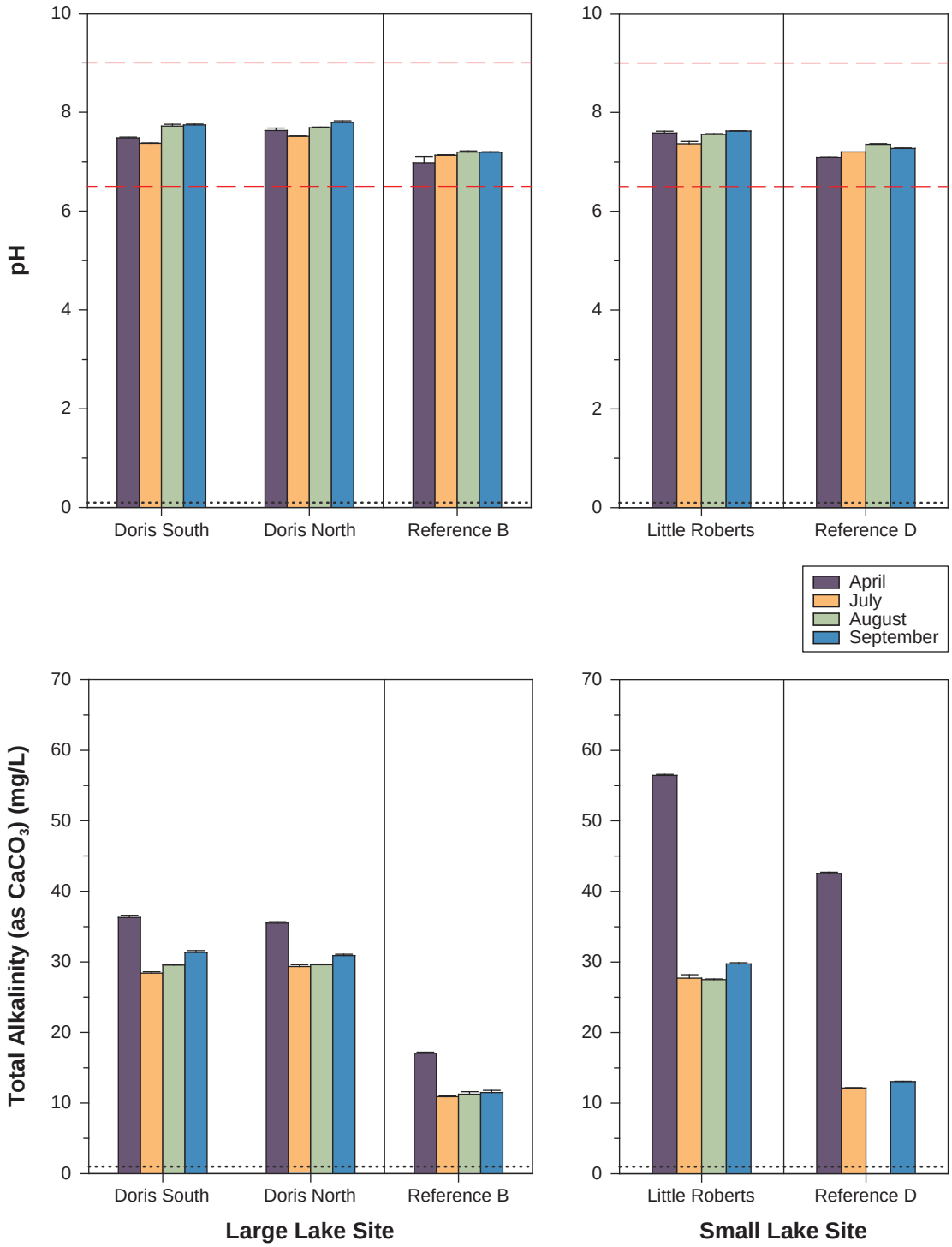
[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Figure A.3-10

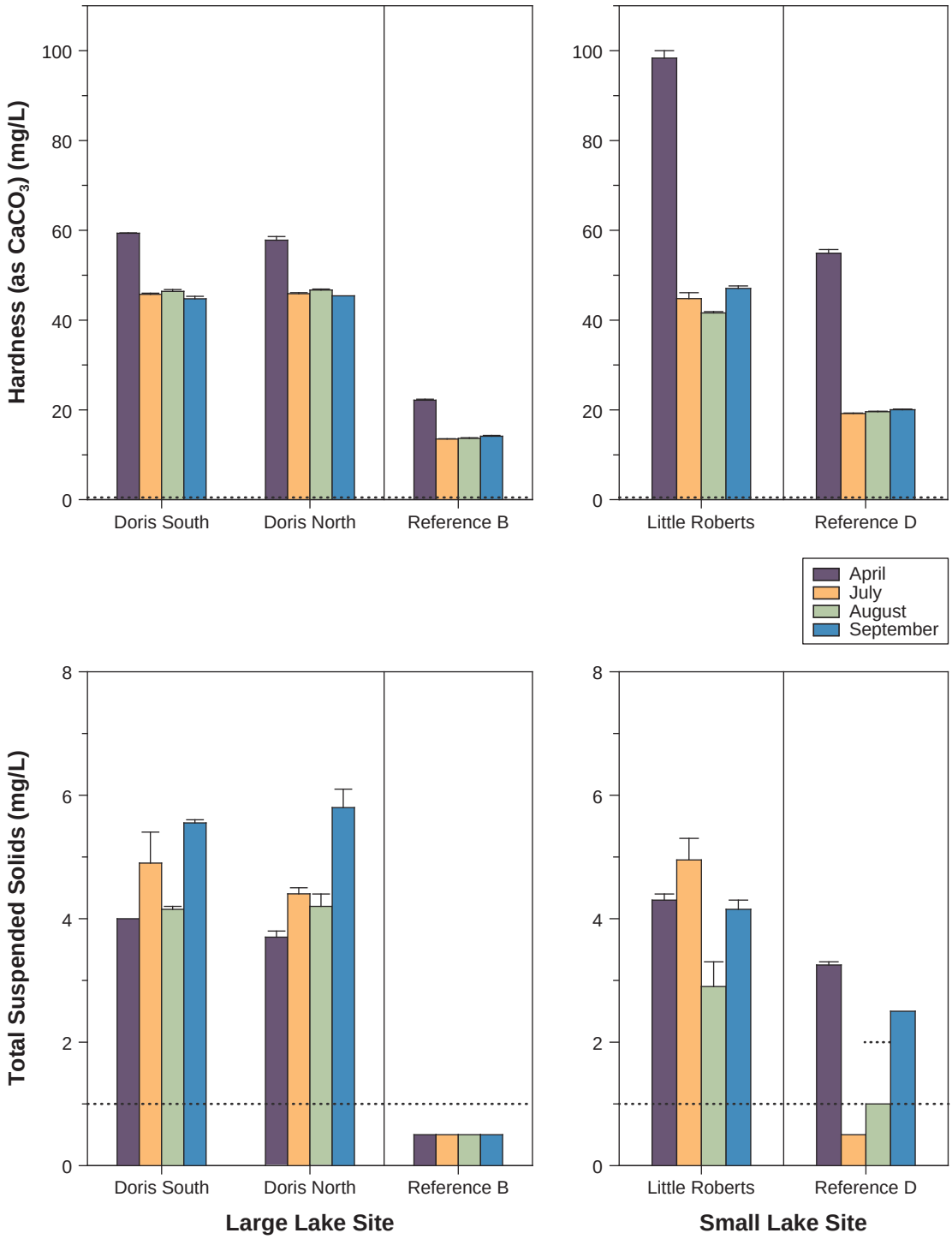
pH and Total Alkalinity in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits.
Red dashed lines represent the CCME freshwater guideline pH range (6.5–9.0).
pH is a required parameter for water quality monitoring as per Schedule 5, s. 7(1)(c) of the MMER.
Total alkalinity is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.

Figure A.3-11

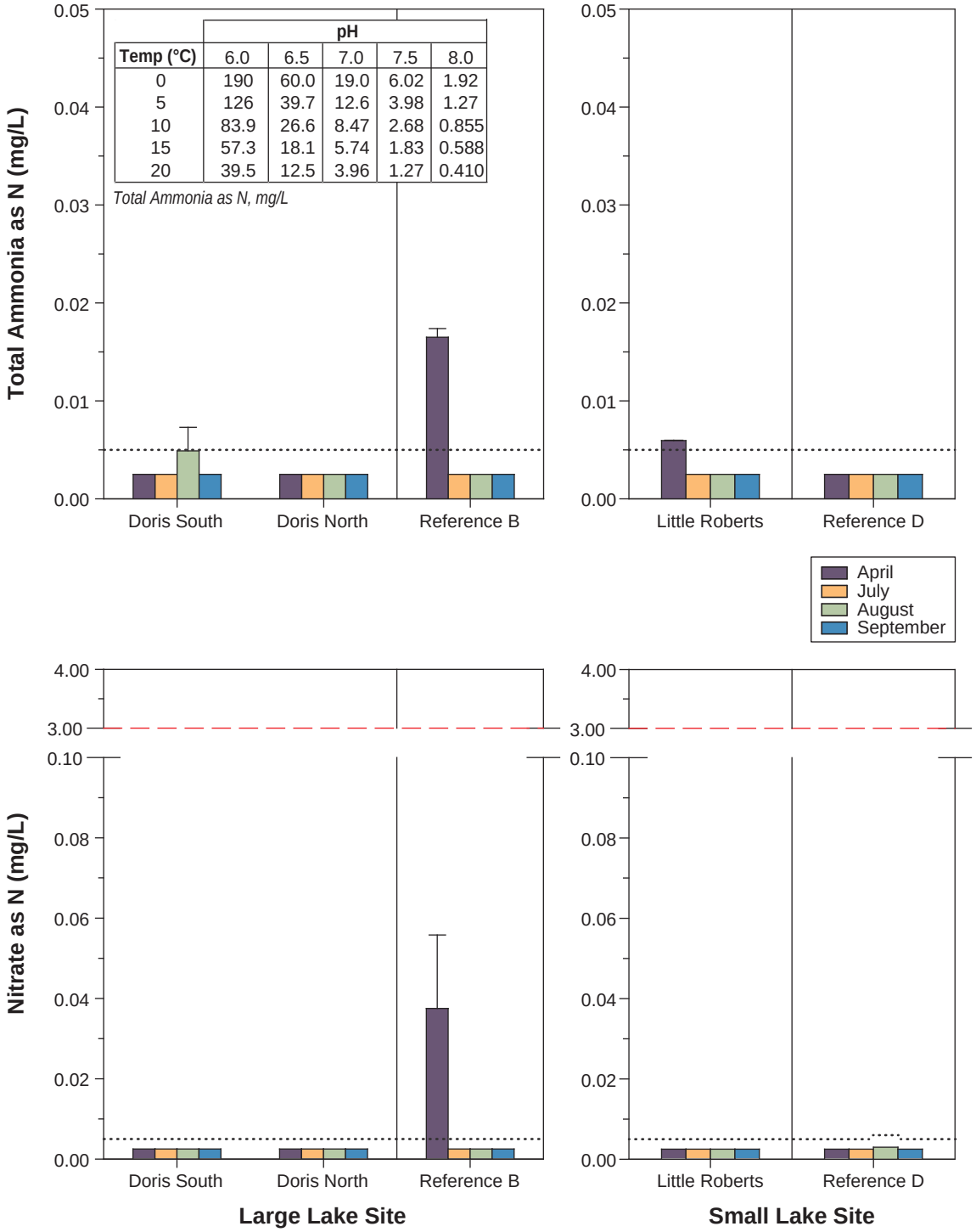
Hardness and Total Suspended Solids in Lake Sites, Doris Project, 2016



Notes: The CCME freshwater guideline for total suspended solids is dependent upon background levels.
Hardness is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.
Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.

Figure A.3-12

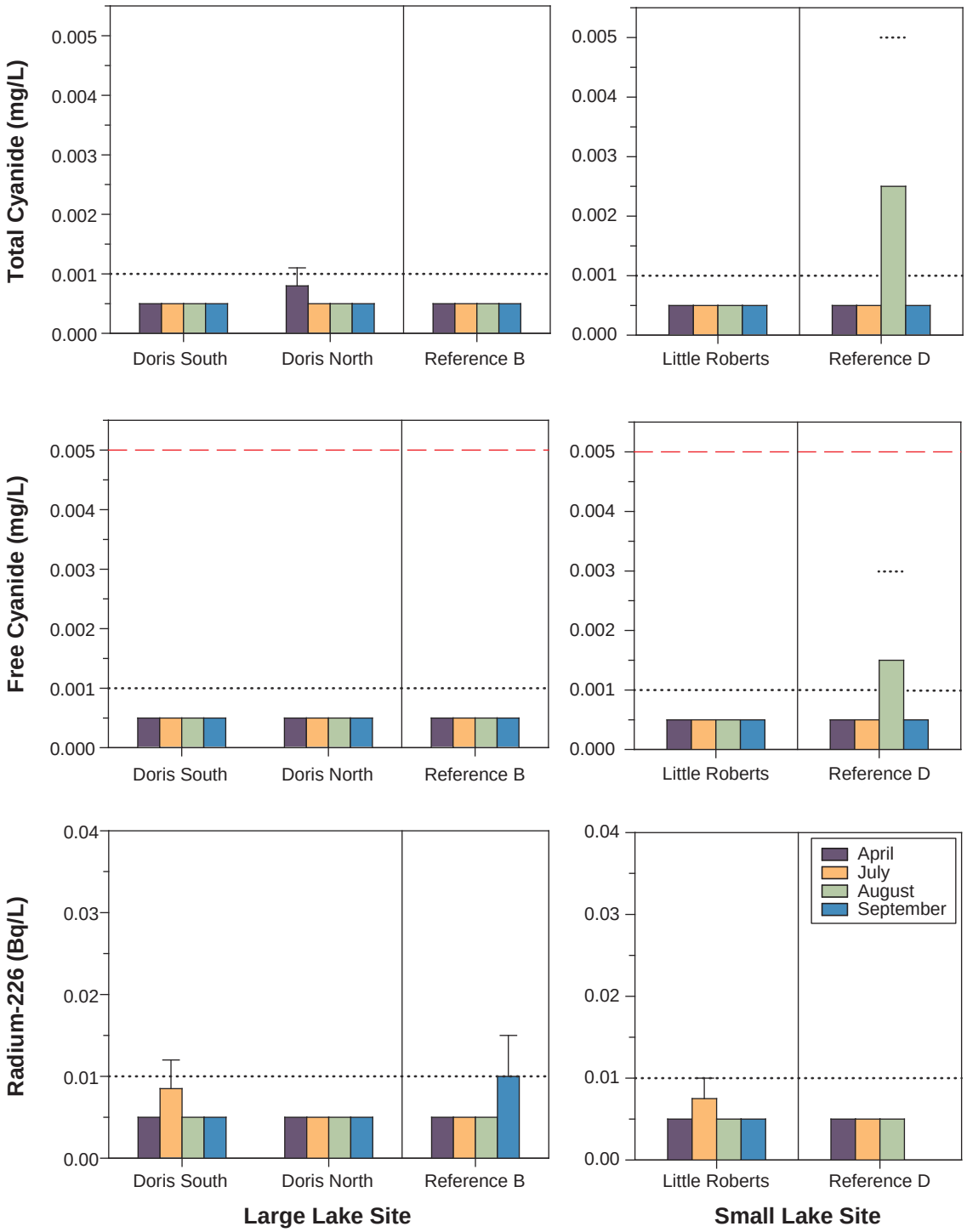
Total Ammonia and Nitrate Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Inset table shows the pH- and temperature-dependent CCME freshwater guideline for total ammonia.
Red dashed line represents the CCME freshwater guideline for nitrate as N (3.0 mg/L; long-term concentration).
Total ammonia and nitrate are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-13

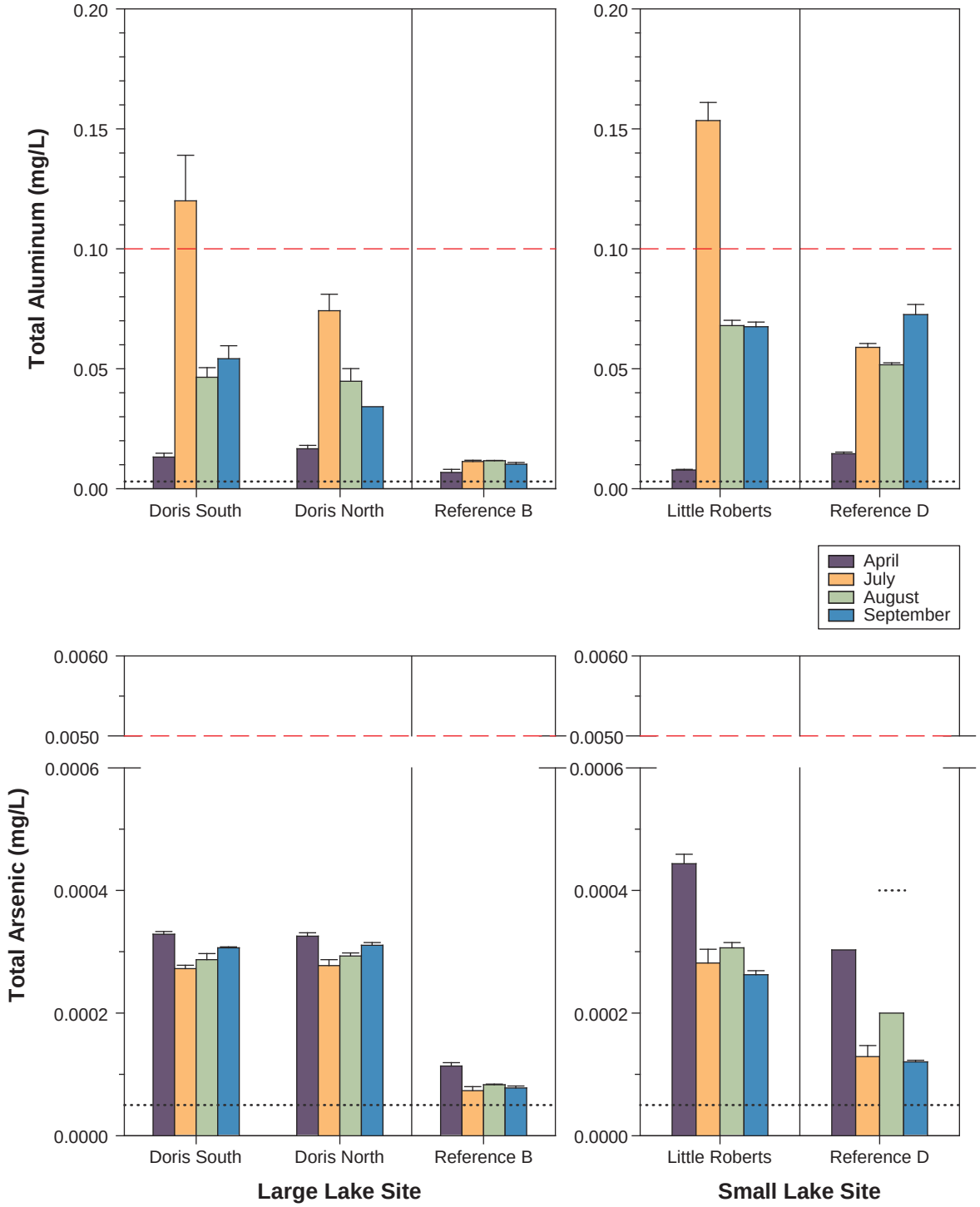
Total Cyanide, Free Cyanide, and Radium-226 Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
All total cyanide concentrations in lake samples were below the detection limit except for one sample collected at Doris Lake North in April 2016.
All free cyanide concentrations in lake samples were below the detection limit.
Red dashed line represents the CCME freshwater guideline for free cyanide (0.005 mg/L).
Total cyanide and radium-226 are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Figure A.3-14

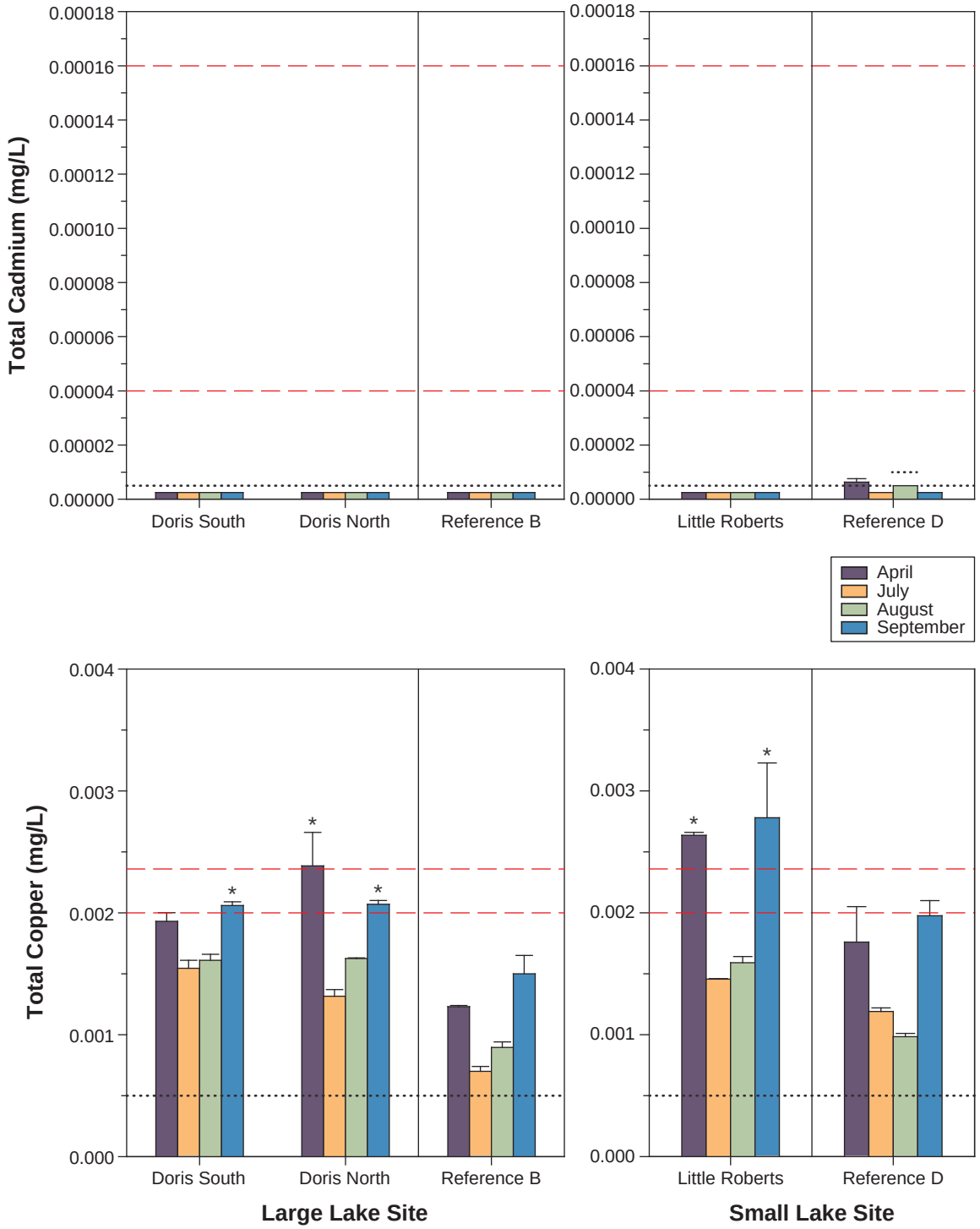
Total Aluminum and Total Arsenic Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed lines represent the pH-dependent CCME freshwater guideline for aluminum (0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5) and the CCME freshwater guideline for arsenic (0.005 mg/L).
pH was greater than 6.5 in all lake samples.
Total aluminum is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total arsenic is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-15

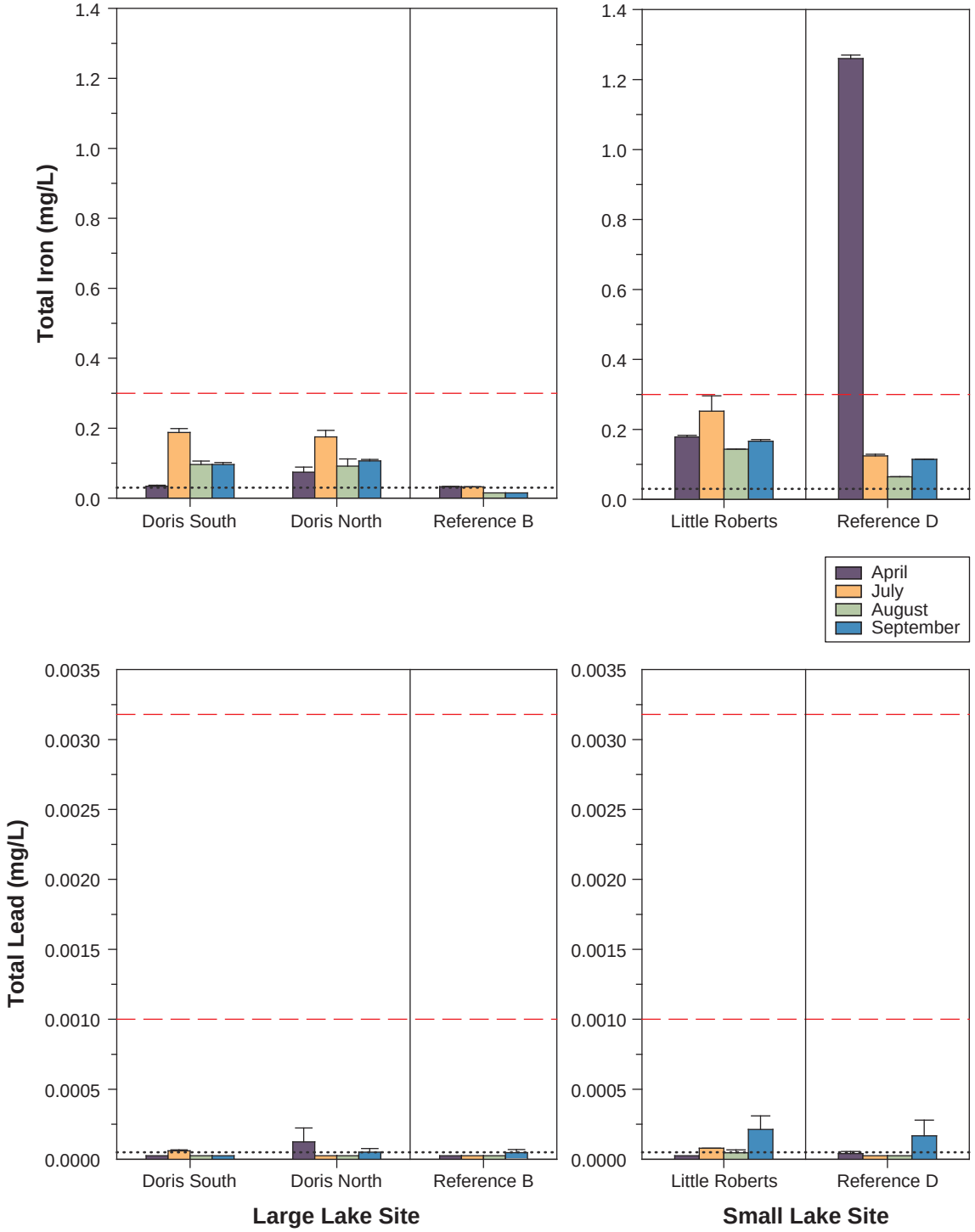
Total Cadmium and Total Copper Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
The CCME freshwater guidelines for cadmium and copper are hardness dependent.
Red dashed lines represent the minimum and maximum site-specific CCME freshwater guidelines for cadmium (0.00004 and 0.00016 mg/L) and for copper (0.00200 to 0.00236 mg/L) based on the hardness (as CaCO3) range in lakes of 13.4 to 100 mg/L.
** Indicates that mean concentration is higher than the applicable CCME guideline.*
Total cadmium is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total copper is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-16

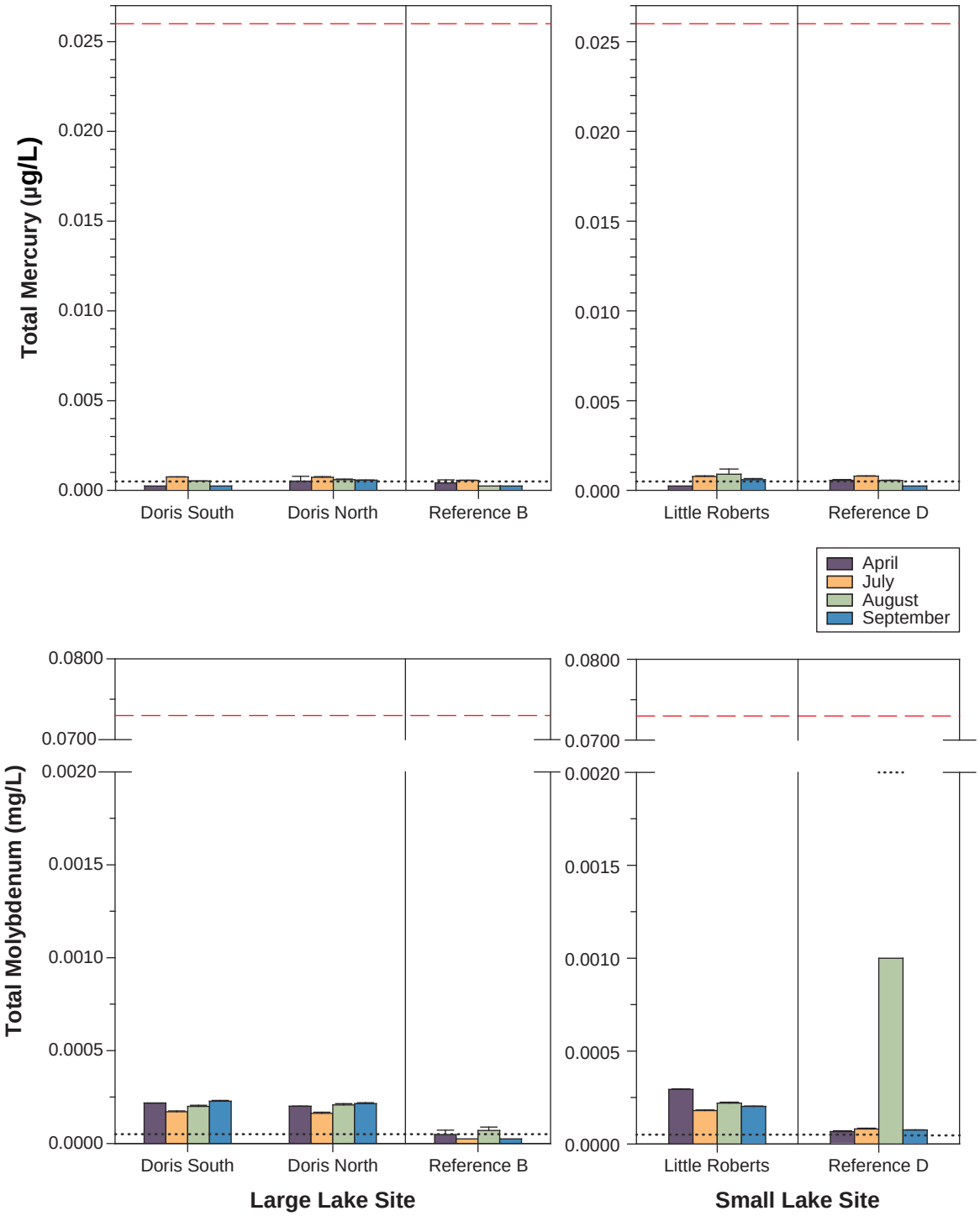
Total Iron and Total Lead Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
The CCME freshwater guideline for lead is hardness dependent.
Red dashed lines represent the CCME freshwater guideline for iron (0.3 mg/L) and the minimum and maximum site-specific CCME freshwater guideline for lead (0.001 and 0.00318 mg/L) based on the hardness (as CaCO3) range in lakes of 13.4 to 100 mg/L.
Total iron is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total lead is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-17

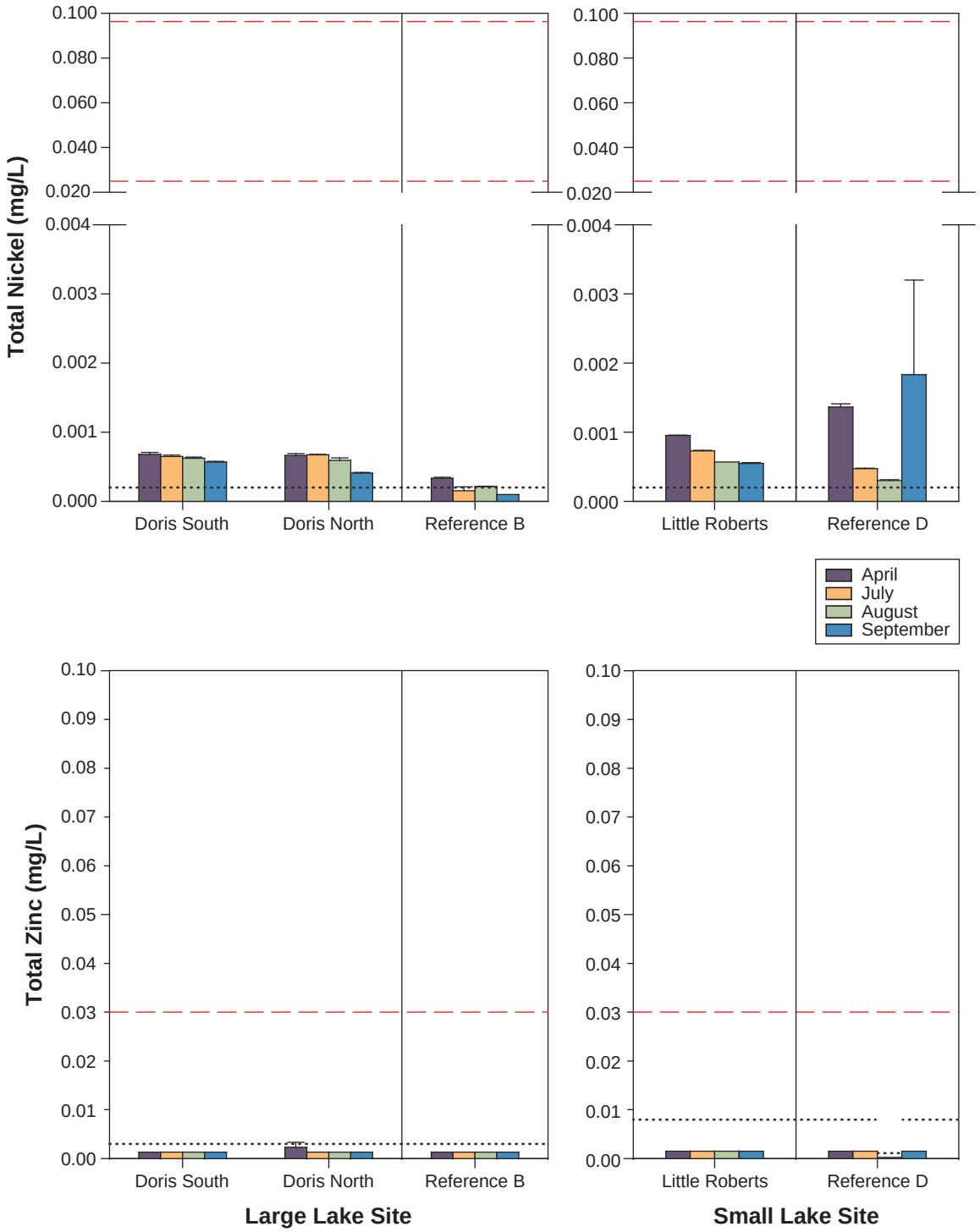
Total Mercury and Total Molybdenum Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed lines represent the CCME freshwater guidelines for inorganic mercury (0.026 mg/L) and molybdenum (0.073 mg/L).
Total mercury and total molybdenum are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-18

Total Nickel and Total Zinc Concentrations in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
The CCME guideline for nickel is hardness dependent.
Red dashed lines represent the CCME freshwater guideline for zinc (0.03 mg/L) and the minimum and maximum site-specific CCME guideline for nickel (0.025 and 0.096 mg/L) based on the hardness (as CaCO3) range in lakes of 13.4 to 100 mg/L.

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Doris South		Doris North		Little Roberts	
Replicate:				1	1	1	1	1	2
Depth Sampled (m):				3.1	9	3	11	2	2
Date Sampled:		CCME Guideline for the Protection	Realized Detection	16-Apr-2016	16-Apr-2016	15-Apr-2016	15-Apr-2016	16-Apr-2016	16-Apr-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1757772-6	L1757772-7	L1757772-1	L1757772-2	L1757772-8	L1757772-9
Physical Tests									
Conductivity	uS/cm		2.0	336	336	336	334	616	621
Hardness (as $CaCO_3$)	mg/L		0.50	59.3	59.4	57	58.6	96.7	100
pH	pH	6.5 to 9.0	0.10	7.46	7.50	7.68	7.58	7.62	7.55
Total Suspended Solids	mg/L	dependent on background levels	1.0	4.0	4.0	3.8	3.6	4.4	4.2
Total Dissolved Solids	mg/L		20	188	190	183	186	335	333
Turbidity	NTU	dependent on background levels	0.10	4.71	4.95	5.05	5.01	2.75	2.78
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	36.0	36.6	35.3	35.7	56.6	56.3
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0060	0.0059
Bromide (Br)	mg/L		0.050	0.246	0.245	0.245	0.242	0.486	0.480
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	75.4	76.1	74.4	74.7	144	145
Fluoride (F)	mg/L	0.12[b]	0.020	0.064	0.064	0.063	0.063	0.092	0.092
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.598	0.646	0.586	0.614	0.711	0.699
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0216	0.0254	0.0244	0.0269	<0.0010	0.0380
Sulphate (SO_4)	mg/L		0.30	3.28	3.30	3.25	3.24	8.40	8.41
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	7.66	7.86	7.59	7.76	11.00	11.00
Total Organic Carbon	mg/L		0.50	8.62	8.57	8.44	8.52	11.80	11.10
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0148	0.0116	0.0181	0.0153	0.0081	0.0076
Antimony (Sb)	mg/L		0.000030	0.000060	0.000043	0.000065	0.000045	0.000054	0.000048
Arsenic (As)	mg/L	0.005	0.000050	0.000324	0.000333	0.000331	0.000320	0.000428	0.000459
Barium (Ba)	mg/L		0.00010	0.00303	0.00318	0.00331	0.00330	0.00592	0.00599
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.031	0.035	0.029	0.033	0.061	0.065
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	9.98	9.95	10.1	9.86	14.2	14.9
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000052
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	0.000068
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00200	0.00186	0.00266	0.00211	0.00261	0.00266
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.0370	0.0320	0.0600	0.0890	0.174	0.183
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	0.000223	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00469	0.00459	0.00451	0.00449	0.00636	0.00658
Magnesium (Mg)	mg/L		0.10	8.35	8.38	7.68	8.26	14.9	15.3
Manganese (Mn)	mg/L		0.00020	0.00464	0.00499	0.00406	0.0113	0.0521	0.0533
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	<0.00050	<0.00050	0.00079	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000218	0.000217	0.000200	0.000201	0.000291	0.000296
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00071	0.00065	0.00069	0.00064	0.00095	0.00096
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	3.3	3.3	2.8	3.4	5.6	5.7
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00185	0.00200	0.00181	0.00192	0.00317	0.00315
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	1.97	1.95	1.87	2.03	1.70	1.74
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	44.3	43.4	40.9	41.6	75.9	77.8
Strontium (Sr)	mg/L		0.00020	0.0509	0.0521	0.0495	0.0512	0.0831	0.0880
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000111	0.0000120	0.0000096	0.0000103	0.0000145	0.0000154
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00031	0.00030	0.00078	0.00026	<0.00020	0.00020
Tungsten (W)	mg/L		0.000010	0.000013	<0.000010	<0.000010	0.000011	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000477	0.0000494	0.0000449	0.0000431	0.0000618	0.0000657
Vanadium (V)	mg/L		0.000050	0.000113	0.0000980	0.000124	0.0000990	0.000111	0.000106
Yttrium (Y)	mg/L		0.0000050	0.0000262	0.0000272	0.0000255	0.0000256	0.0000374	0.0000383
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	0.0033	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000057	0.000061	0.000059	0.000053	0.000069	0.000069
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Reference B		Reference D		Doris South	
Replicate:				1	1	1	2	1	1
Depth Sampled (m):				3	10	2.15	2.15	1	9
Date Sampled:		CCME Guideline for the Protection	Realized Detection	18-Apr-2016	18-Apr-2016	18-Apr-2016	18-Apr-2016	16-Jul-2016	16-Jul-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1757772-10	L1757772-11	L1757772-12	L1757772-13	L1800754-10	L1800754-9
Physical Tests									
Conductivity	uS/cm		2.0	82.2	77.5	277	278	249	248
Hardness (as $CaCO_3$)	mg/L		0.50	22.4	21.9	55.7	54.1	45.5	46.0
pH	pH	6.5 to 9.0	0.10	7.11	6.85	7.09	7.10	7.38	7.36
Total Suspended Solids	mg/L	dependent on background levels	1.0	<1.0	<1.0	3.2	3.3	5.4	4.4
Total Dissolved Solids	mg/L		13 or 20	50	45	158	155	162	144
Turbidity	NTU	dependent on background levels	0.10	0.25	0.24	1.77	1.73	6.04	6.08
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	17.2	16.9	42.7	42.4	28.2	28.6
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0174	0.0156	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	<0.050	<0.050	0.192	0.188	0.194	0.198
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	10.8	10.0	53.7	53.4	57.0	57.3
Fluoride (F)	mg/L	0.12[b]	0.020	0.029	0.025	0.067	0.067	0.055	0.054
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	0.0192	0.0558	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.259	0.244	0.541	0.509	0.443	0.442
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0030	0.0025	0.0156	0.0141	0.0122	0.0153
Sulphate (SO_4)	mg/L		0.30	2.75	2.68	3.54	3.53	2.38	2.40
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	4.07	3.75	8.70	9.14	6.59	6.40
Total Organic Carbon	mg/L		0.50	4.16	4.26	9.00	9.39	6.75	6.62
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0055	0.0081	0.0153	0.0139	0.139	0.101
Antimony (Sb)	mg/L		0.000030	0.000035	0.000039	0.000074	0.000047	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000119	0.000108	0.000303	0.000303	0.000267	0.000278
Barium (Ba)	mg/L		0.00010	0.00285	0.00296	0.00778	0.00796	0.00474	0.00422
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000054	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	<0.010	<0.010	0.029	0.027	0.025	0.025
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	0.0000076	0.0000051	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	5.25	5.16	9.05	8.80	8.03	8.15
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000074	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	0.000338	0.000335	0.000075	0.000058
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00122	0.00124	0.00147	0.00205	0.00161	0.00148
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.034	0.032	1.25	1.27	0.199	0.177
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	0.000055	0.000067	0.000053
Lithium (Li)	mg/L		0.00040	0.00091	0.00086	0.00348	0.00336	0.00365	0.00345
Magnesium (Mg)	mg/L		0.10	2.27	2.19	8.04	7.80	6.18	6.22
Manganese (Mn)	mg/L		0.00020	0.00203	0.00466	0.328	0.315	0.0138	0.0185
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00059	<0.00050	0.00061	0.00052	0.00076	0.00074
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000072	<0.000050	0.000062	0.000071	0.000175	0.000166
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00032	0.00035	0.00132	0.00141	0.00067	0.00063
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	3.4	3.4	2.2	2.2
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00129	0.00116	0.00282	0.00282	0.00155	0.00145
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.171	0.508	1.12	1.09	1.71	1.69
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000054	0.0000086
Sodium (Na)	mg/L		2.0	6.80	6.40	33.4	31.2	29.6	29.9
Strontium (Sr)	mg/L		0.00020	0.0244	0.0251	0.0557	0.0534	0.0374	0.0370
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000084	0.0000053	0.0000341	0.0000353	0.0000562	0.0000400
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00025	<0.00020	0.00035	0.00033	0.00557	0.00310
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000573	0.0000360	0.0000452	0.0000444	0.0000505	0.0000467
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000170	0.000166	0.000372	0.000268
Yttrium (Y)	mg/L		0.0000050	0.0000173	0.0000200	0.0000746	0.0000756	0.0000555	0.0000455
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	<0.000050	<0.000050	0.000071	0.00007	0.000111	0.000096
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.012

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Doris North		Little Roberts		Reference B	
Replicate:				1	1	1	2	1	1
Depth Sampled (m):				1	12	1	1	1	8
Date Sampled:		CCME Guideline for the Protection	Realized Detection	17-Jul-2016	17-Jul-2016	16-Jul-2016	16-Jul-2016	18-Jul-2016	18-Jul-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1800754-6	L1800754-5	L1800754-15	L1800754-16	L1800754-1	L1800754-2
Physical Tests									
Conductivity	uS/cm		2.0	252	253	246	242	48.5	47.0
Hardness (as $CaCO_3$)	mg/L		0.50	46.1	45.7	43.5	46.1	13.4	13.6
pH	pH	6.5 to 9.0	0.10	7.52	7.51	7.32	7.41	7.14	7.12
Total Suspended Solids	mg/L	dependent on background levels	1.0	4.3	4.5	4.6	5.3	<1.0	<1.0
Total Dissolved Solids	mg/L		10 or 20	152	155	150	158	35	42
Turbidity	NTU	dependent on background levels	0.10	5.22	6.00	6.26	5.99	0.47	0.40
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	29.6	29.1	27.2	28.2	11.0	10.8
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.193	0.190	0.202	0.188	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	57.2	57.3	57.7	57.0	6.23	6.18
Fluoride (F)	mg/L	0.12[b]	0.020	0.053	0.054	0.051	0.055	<0.020	0.020
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.457	0.482	0.395	0.438	0.189	0.205
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	0.0013	0.0011	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0183	0.0177	0.0142	0.0114	0.0036	0.0033
Sulphate (SO_4)	mg/L		0.30	2.40	2.41	3.06	2.38	1.52	1.50
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	6.55	6.38	6.36	6.79	4.16	3.20
Total Organic Carbon	mg/L		0.50	6.76	6.51	6.60	6.71	3.50	3.28
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0673	0.0811	0.161	0.146	0.0119	0.0108
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000268	0.000287	0.000304	0.000259	0.000067	0.000080
Barium (Ba)	mg/L		0.00010	0.00380	0.00397	0.00455	0.00448	0.00183	0.00197
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	0.0000082	0.0000071	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.031	0.030	0.031	0.028	<0.010	<0.010
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	8.19	8.11	7.25	8.12	3.33	3.33
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	0.0000133	0.0000088	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.00005	0.000054	0.000102	0.000075	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00137	0.00126	0.00146	0.00145	0.00066	0.00074
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	0.000054	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.156	0.194	0.296	0.208	0.032	0.033
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	0.000079	0.000078	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00373	0.00365	0.00327	0.00373	0.00051	0.00051
Magnesium (Mg)	mg/L		0.10	6.24	6.19	6.16	6.28	1.24	1.29
Manganese (Mn)	mg/L		0.00020	0.0180	0.0257	0.01540	0.01330	0.00163	0.00163
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00077	0.00069	0.00075	0.00081	0.00056	0.00057
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000168	0.000157	0.000177	0.000183	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00067	0.00068	0.00072	0.00074	0.00021	<0.00020
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	2.2	2.2	2.2	2.2	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00140	0.00141	0.001610	0.001590	0.00069	0.00071
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	1.63	1.68	1.300	1.730	0.104	0.104
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	30.1	29.9	30.4	30.2	3.4	3.5
Strontium (Sr)	mg/L		0.00020	0.0335	0.0336	0.0334	0.0333	0.0130	0.0136
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000344	0.0000345	0.0000697	0.0000566	0.0000084	0.0000101
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00160	0.00194	0.00694	0.0051	0.00024	0.00022
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000462	0.0000456	0.0000546	0.0000498	0.0000445	0.0000470
Vanadium (V)	mg/L		0.000050	0.000214	0.000232	0.000467	0.000361	<0.000050	<0.000050
Yttrium (Y)	mg/L		0.0000050	0.0000419	0.0000451	0.0000732	0.0000592	0.0000180	0.0000173
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000092	0.00009	0.000109	0.000117	<0.000050	<0.000050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	0.01	<0.0100	<0.0100	<0.0100

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Reference D		Doris South		Doris North	
Replicate:				1	2	1	1	1	1
Depth Sampled (m):				1	1	1	9	1	12
Date Sampled:		CCME Guideline for the Protection	Realized Detection	14-Jul-2016	14-Jul-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016	20-Aug-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1799162-1	L1799162-2	L1817820-9	L1817820-10	L1817820-11	L1817820-12
Physical Tests									
Conductivity	uS/cm		2.0	97.7	99.5	251	244	249	243
Hardness (as $CaCO_3$)	mg/L		0.50	19.1	19.3	46.0	46.8	46.5	46.9
pH	pH	6.5 to 9.0	0.10	7.20	7.20	7.76	7.68	7.70	7.68
Total Suspended Solids	mg/L	dependent on background levels	1.0	<1.0	<1.0	4.2	4.1	4.0	4.4
Total Dissolved Solids	mg/L		13 or 20	66	69	157	157	153	153
Turbidity	NTU	dependent on background levels	0.10	1.26	1.27	5.49	6.43	4.81	7.38
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	12.1	12.2	29.5	29.6	29.5	29.7
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	0.0073	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.061	0.062	0.197	0.197	0.197	0.197
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	20.0	20.1	57.8	57.8	57.9	57.8
Fluoride (F)	mg/L	0.12[b]	0.020	0.036	0.037	0.058	0.057	0.057	0.057
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.248	0.275	0.533	0.604	0.567	0.607
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	0.0019	0.0014	0.0012	0.0013
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0055	0.0044	0.0229	0.0241	0.0220	0.0176
Sulphate (SO_4)	mg/L		0.30	1.80	1.81	2.53	2.52	2.54	2.52
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	4.34	4.53	5.61	6.04	5.75	5.56
Total Organic Carbon	mg/L		0.50	4.49	4.76	6.07	6.08	6.07	6.73
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0573	0.0606	0.0425	0.0505	0.0395	0.0501
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000111	0.000147	0.000297	0.000277	0.000288	0.000298
Barium (Ba)	mg/L		0.00010	0.00235	0.00242	0.00306	0.00306	0.00308	0.00321
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.014	0.013	0.024	0.024	0.025	0.025
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	3.03	3.06	8.23	8.43	8.36	8.41
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00116	0.00122	0.00166	0.00156	0.00163	0.00162
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.129	0.120	0.087	0.106	0.071	0.112
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040	0.00141	0.00150	0.00355	0.00350	0.00348	0.00370
Magnesium (Mg)	mg/L		0.10	2.81	2.82	6.17	6.25	6.23	6.29
Manganese (Mn)	mg/L		0.00020	0.00605	0.00610	0.0211	0.0261	0.0149	0.0276
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00078	0.00081	0.00052	0.00053	0.00063	0.00057
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000085	0.000076	0.000193	0.000206	0.000200	0.000214
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00048	0.00047	0.00061	0.00064	0.00056	0.00063
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	2.3	2.3	2.3	2.3
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00115	0.00121	0.00145	0.00144	0.00148	0.00147
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.293	0.294	1.50	1.54	1.49	1.53
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	12.1	11.9	31.3	31.8	31.8	32.7
Strontium (Sr)	mg/L		0.00020	0.0166	0.0174	0.0420	0.0405	0.0400	0.0403
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000339	0.0000368	0.0000200	0.0000251	0.0000191	0.0000232
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00150	0.00152	0.00074	0.00095	0.00083	0.00112
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	0.00001	<0.000010	0.000011
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000380	0.0000387	0.0000504	0.0000507	0.0000501	0.0000524
Vanadium (V)	mg/L		0.000050	0.000122	0.000127	0.000181	0.000187	0.000167	0.000195
Yttrium (Y)	mg/L		0.0000050	0.0000383	0.0000395	0.0000265	0.0000289	0.0000252	0.0000297
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000051	0.000056	<0.000050	0.000051	<0.000050	0.000053
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L)= 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Little Roberts		Reference B		Reference D	
Replicate:				1	2	1	1	1	2
Depth Sampled (m):				1	1	1	8	1	1
Date Sampled:		CCME Guideline for the Protection	Realized Detection	15-Aug-2016	15-Aug-2016	10-Aug-2016	10-Aug-2016	11-Aug-2016	11-Aug-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1814657-7	L1814657-8	L1814657-1	L1814657-2	L1813293-12	L1813293-13
Physical Tests									
Conductivity	uS/cm		2.0	254	251	48.0	48.9	121	111
Hardness (as $CaCO_3$)	mg/L		0.5 or 4.3	41.3	41.9	13.5	13.8	19.5	19.7
pH	pH	6.5 to 9.0	0.10	7.57	7.54	7.17	7.22	7.37	7.34
Total Suspended Solids	mg/L	dependent on background levels	1.0 or 2.0	3.3	2.5	<1.0	<1.0	<2.0	<2.0
Total Dissolved Solids	mg/L		10 or 20	143	135	37	36	-	-
Turbidity	NTU	dependent on background levels	0.10	4.73	4.49	0.35	0.37	1.18	1.02
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	27.6	27.4	10.9	11.6	-	-
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.195	0.198	<0.050	<0.050	-	-
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	57.8	58.1	6.25	6.24	-	-
Fluoride (F)	mg/L	0.12[b]	0.020	0.048	0.049	0.020	<0.020	-	-
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050 or 0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060	<0.0060
Nitrite (as N)	mg/L	0.06	0.0010 or 0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L		0.050	0.447	0.465	0.250	0.193	-	-
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0338	0.0149	0.0021	0.0022	<0.010	<0.010
Sulphate (SO_4)	mg/L		0.30	3.80	3.80	1.57	1.57	-	-
Cyanides									
Cyanide, Total	mg/L		0.0010 or 0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050
Cyanide, Free	mg/L	0.005	0.0010 or 0.0030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0030	<0.0030
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	5.86	5.95	3.21	3.18	-	-
Total Organic Carbon	mg/L		0.50	6.35	6.21	3.33	3.13	-	-
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030 or 0.0050	0.0702	0.0659	0.0116	0.0118	0.0509	0.0525
Antimony (Sb)	mg/L		0.000030 or 0.00050	<0.000030	<0.000030	<0.000030	<0.000030	<0.00050	<0.00050
Arsenic (As)	mg/L	0.005	0.000050 or 0.00040	0.000298	0.000315	0.000084	0.000082	<0.00040	<0.00040
Barium (Ba)	mg/L		0.00010 or 0.0010	0.00314	0.00308	0.00165	0.00149	0.00190	0.00170
Beryllium (Be)	mg/L		0.0000050 or 0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Bismuth (Bi)	mg/L		0.000050 or 0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010 or 0.10	0.026	0.028	<0.010	<0.010	<0.10	<0.10
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050 or 0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.050 or 0.50	6.42	6.48	3.26	3.35	3.05	3.10
Cesium (Cs)	mg/L		0.0000050 or 0.00050	0.0000051	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.000050 or 0.00050	0.00164	0.00154	0.00085	0.00094	0.00101	0.000958
Gallium (Ga)	mg/L		0.000050 or 0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.3	0.030 or 0.010	0.143	0.144	<0.030	<0.030	0.064	0.065
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	0.000067	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.00040 or 0.020	0.00283	0.00278	0.00041	<0.00040	<0.020	<0.020
Magnesium (Mg)	mg/L		0.10 or 1.0	6.15	6.25	1.30	1.32	2.90	2.90
Manganese (Mn)	mg/L		0.000050 or 0.00020	0.01730	0.0180	0.00164	0.00160	0.00327	0.00326
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	0.00119	0.00062	<0.00050	<0.00050	0.00057	0.00053
Molybdenum (Mo)	mg/L	0.073[b]	0.000050 or 0.0020	0.000225	0.000215	0.000088	0.000052	<0.0020	<0.0020
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020 or 0.000050	0.00057	0.00057	0.00021	0.00022	0.000313	0.000294
Phosphorus (P)	mg/L		0.30 or 1.0	<0.30	<0.30	<0.30	<0.30	<1.0	<1.0
Potassium (K)	mg/L		2.0 or 20	2.1	2.1	<2.0	<2.0	<20	<20
Rhenium (Re)	mg/L		0.0000050 or 0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Rubidium (Rb)	mg/L		0.000020 or 0.0050	0.00140	0.00140	0.000812	0.000746	<0.0050	<0.0050
Selenium (Se)	mg/L	0.001	0.00020 or 0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050
Silicon (Si)	mg/L		0.050 or 0.50	0.733	0.742	0.106	0.112	<0.50	<0.50
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050 or 0.00010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00010	<0.00010
Sodium (Na)	mg/L		2.0 or 20	32.4	33.0	3.7	3.7	<20	<20
Strontium (Sr)	mg/L		0.00020 or 0.050	0.0383	0.0386	0.0164	0.0160	<0.050	<0.050
Tellurium (Te)	mg/L		0.000010 or 0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.00050
Thallium (Tl)	mg/L	0.0008	0.0000050 or 0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000050
Thorium (Th)	mg/L		0.0000050 or 0.00050	0.0000328	0.0000331	0.0000112	0.0000103	<0.00050	<0.00050
Tin (Sn)	mg/L		0.00020 or 0.0010	<0.00020	<0.00020	<0.00020	<0.00020	<0.0010	<0.0010
Titanium (Ti)	mg/L		0.00020 or 0.0050	0.00136	0.00129	<0.00020	<0.00020	<0.0050	<0.0050
Tungsten (W)	mg/L		0.000010 or 0.0010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0010	<0.0010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020 or 0.000050	0.0000549	0.0000544	0.0000592	0.0000536	<0.000050	<0.000050
Vanadium (V)	mg/L		0.000050 or 0.00050	0.000164	0.000163	<0.000050	<0.000050	<0.00050	<0.00050
Yttrium (Y)	mg/L		0.0000050 or 0.00050	0.0000402	0.0000407	0.0000160	0.0000151	<0.00050	<0.00050
Zinc (Zn)	mg/L	0.03	0.0030 or 0.00080	<0.0030	<0.0030	<0.0030	<0.0030	<0.00080	<0.00080
Zirconium (Zr)	mg/L		0.000050 or 0.00050	0.000058	0.000060	<0.000050	<0.000050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Doris South		Doris North		Little Roberts	
Replicate:				1	1	1	1	1	2
Depth Sampled (m):				1	9	1	12	1	1
Date Sampled:		CCME Guideline for the Protection	Realized Detection	19-Sep-2016	19-Sep-2016	19-Sep-2016	19-Sep-2016	18-Sep-2016	18-Sep-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1831856-12	L1831856-13	L1831856-10	L1831856-11	L1831856-6	L1831856-7
Physical Tests									
Conductivity	uS/cm		2.0	247	251	254	251	261	259
Hardness (as $CaCO_3$)	mg/L		0.50	45.3	44.2	45.4	45.4	46.5	47.6
pH	pH	6.5 to 9.0	0.10	7.76	7.73	7.83	7.76	7.62	7.63
Total Suspended Solids	mg/L	dependent on background levels	1.0	5.5	5.6	6.1	5.5	4.3	4
Total Dissolved Solids	mg/L		20	163	159	159	164	150	169
Turbidity	NTU	dependent on background levels	0.10	7.89	7.18	8.49	6.47	6.34	7.41
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	31.6	31.1	31.1	30.7	29.6	29.9
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	0.200	0.202	0.201	0.198	0.202	0.210
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	59.3	59.6	59.4	59.4	62.5	62.5
Fluoride (F)	mg/L	0.12[b]	0.020	0.052	0.053	0.052	0.052	0.048	0.051
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.725	0.687	0.719	0.719	0.524	0.529
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	0.0021	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0129	0.0113	0.0121	0.0168	0.0112	0.0157
Sulphate (SO_4)	mg/L		0.30	2.62	2.63	2.61	2.61	4.36	4.35
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	6.14	6.49	6.41	6.27	6.63	7.06
Total Organic Carbon	mg/L		0.50	6.61	6.69	6.89	6.55	6.59	6.26
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0488	0.0596	0.0342	0.0342	0.0695	0.0656
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000308	0.000305	0.000306	0.000315	0.000269	0.000256
Barium (Ba)	mg/L		0.00010	0.00316	0.00331	0.00297	0.00312	0.00348	0.00347
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	0.025	0.026	0.024	0.026	0.025	0.029
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	8.22	8.06	8.29	8.27	8.07	8.31
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055	0.000054
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00209	0.00203	0.00210	0.00204	0.00233	0.00323
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	0.102	0.091	0.102	0.111	0.162	0.171
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	<0.000050	<0.000050	0.000077	<0.000050	0.000310	0.000117
Lithium (Li)	mg/L		0.00040	0.00367	0.00368	0.00362	0.00366	0.00333	0.00342
Magnesium (Mg)	mg/L		0.10	6.02	5.84	5.99	6.02	6.39	6.52
Manganese (Mn)	mg/L		0.00020	0.0185	0.0195	0.0196	0.0208	0.0119	0.0119
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	<0.00050	<0.00050	0.00056	0.00058	0.00053	0.00066
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	0.000232	0.000223	0.000208	0.000220	0.000200	0.000204
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	0.00056	0.00058	0.00040	0.00042	0.00054	0.00056
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	2.2	2.1	2.2	2.2	2.2	2.2
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.00139	0.00148	0.00141	0.00148	0.00138	0.00135
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	1.62	1.49	1.58	1.64	1.37	1.44
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	30.4	29.1	30.2	30.6	32.2	32.6
Strontium (Sr)	mg/L		0.00020	0.0377	0.0390	0.0381	0.0395	0.0411	0.0409
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000169	0.0000202	0.0000080	0.0000087	0.0000274	0.0000250
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	0.00127	0.00155	0.00116	0.00128	0.00207	0.00205
Tungsten (W)	mg/L		0.000010	0.000013	0.000012	0.00001	0.000011	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000473	0.0000506	0.0000457	0.0000466	0.0000474	0.0000469
Vanadium (V)	mg/L		0.000050	0.000179	0.000195	0.000182	0.000174	0.00018	0.000179
Yttrium (Y)	mg/L		0.0000050	0.0000274	0.0000286	0.0000258	0.0000276	0.0000463	0.0000467
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	0.000056	0.000059	<0.000050	<0.000050	0.000068	0.000065
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: CWQG (mg/L) = $0.001*10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: CWQG (mg/L) = $0.0002 * e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: CWQG (mg/L)= $0.001*e^{\{1.273[\ln(\text{hardness})]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: CWQG (mg/L) = $0.001*e^{\{0.76[\ln(\text{hardness})]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Annex A.3-2. Lake Water Quality Data, Doris Project, 2016

Site ID:				Reference B		Reference D	
Replicate:				1	1	1	2
Depth Sampled (m):				1	9	1	1
Date Sampled:		CCME Guideline for the Protection	Realized Detection	19-Sep-2016	19-Sep-2016	17-Sep-2016	17-Sep-2016
ALS Sample ID:	Units	of Aquatic life[a]	Limit	L1831856-8	L1831856-9	L1831856-2	L1831856-3
Physical Tests							
Conductivity	uS/cm		2.0	50.0	49.1	103	106
Hardness (as $CaCO_3$)	mg/L		0.50	14.3	14.0	19.9	20.2
pH	pH	6.5 to 9.0	0.10	7.20	7.18	7.26	7.28
Total Suspended Solids	mg/L	dependent on background levels	1.0	<1.0	<1.0	2.5	2.5
Total Dissolved Solids	mg/L		13 or 20	43	40	118	136
Turbidity	NTU	dependent on background levels	0.10	0.65	0.66	1.75	1.69
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	11.8	11.2	13.0	13.1
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.050	<0.050	<0.050	0.069	0.066
Chloride (Cl)	mg/L	short-term: 640; long-term: 120	0.50	7.11	6.81	22.9	22.8
Fluoride (F)	mg/L	0.12[b]	0.020	0.020	0.022	0.032	0.032
Nitrate (as N)	mg/L	short-term: 124; long-term: 3.0	0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	0.222	0.223	0.285	0.269
Orthophosphate-Dissolved (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	0.0035
Phosphorus (P)-Total	mg/L	Trigger ranges from guidance framework[c]	0.0020	0.0052	0.0058	0.0060	0.0061
Sulphate (SO_4)	mg/L		0.30	1.65	1.64	2.20	2.18
Cyanides							
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon							
Dissolved Organic Carbon	mg/L		0.50	3.17	3.01	4.95	4.96
Total Organic Carbon	mg/L		0.50	3.11	3.15	4.66	4.81
Total Metals							
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0110	0.0094	0.0768	0.0685
Antimony (Sb)	mg/L		0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	0.005	0.000050	0.000081	0.000075	0.000123	0.000118
Barium (Ba)	mg/L		0.00010	0.00160	0.00162	0.00233	0.00221
Beryllium (Be)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.010	<0.010	<0.010	0.012	0.012
Cadmium (Cd)	mg/L	long-term: 0.00004-0.00037[d]	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L		0.050	3.48	3.44	3.12	3.16
Cesium (Cs)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	Cr(VI): 0.001; Cr(III): 0.0089[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	0.002-0.004[e]	0.00050	0.00165	0.00135	0.00210	0.00185
Gallium (Ga)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	0.3	0.030	<0.030	<0.030	0.115	0.114
Lead (Pb)	mg/L	0.001-0.007[f]	0.000050	0.000069	<0.000050	0.000280	0.000055
Lithium (Li)	mg/L		0.00040	0.00055	0.00052	0.00152	0.00146
Magnesium (Mg)	mg/L		0.10	1.36	1.33	2.95	3.00
Manganese (Mn)	mg/L		0.00020	0.00145	0.00135	0.00398	0.00371
Mercury (Hg)	µg/L	Inorganic Hg: 0.026	0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	0.073[b]	0.000050	<0.000050	<0.000050	0.000075	0.000076
Nickel (Ni)	mg/L	0.025-0.150[g]	0.00020	<0.00020	<0.00020	0.00320	0.00047
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0
Rhenium (Re)	mg/L		0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L		0.000020	0.000767	0.00079	0.00111	0.00107
Selenium (Se)	mg/L	0.001	0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L		0.050	0.167	0.163	0.452	0.453
Silver (Ag)	mg/L	long-term : 0.00025	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium (Na)	mg/L		2.0	4.1	3.9	13.1	13.1
Strontium (Sr)	mg/L		0.00020	0.0169	0.0170	0.0189	0.0187
Tellurium (Te)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	0.0008	0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L		0.0000050	0.0000072	0.0000057	0.0000399	0.0000398
Tin (Sn)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L		0.00020	<0.00020	<0.00020	0.00196	0.00208
Tungsten (W)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.0000020	0.0000546	0.0000531	0.0000619	0.0000638
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000138	0.000131
Yttrium (Y)	mg/L		0.0000050	0.0000131	0.0000143	0.0000457	0.0000457
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L		0.000050	<0.000050	<0.000050	0.000072	0.000066
Radiological Parameters							
Ra-226	Bq/L		0.010	<0.0100	0.015	-	-

Notes:

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

Realized detection limts are reported as ranges when necessary, Reference D in August was analyzed as seawater and therefore had much higher detection limits

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

[a] *Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

[c] *Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultra-oligotrophic; 0.004–0.01 = Oligotrophic; 0.01–0.02 = Mesotrophic; 0.02–0.035 = Meso-eutrophic; 0.035–0.1 = Eutrophic; >0.1 = Hyper-eutrophic.*

[d] *Cadmium guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <17 mg/L, the CWQG is 0.00004 mg/L. At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*10^{\{0.83(\log[hardness]) - 2.46\}}$. At hardness > 280 mg/L, the CWQG is 0.00037 mg/L.*

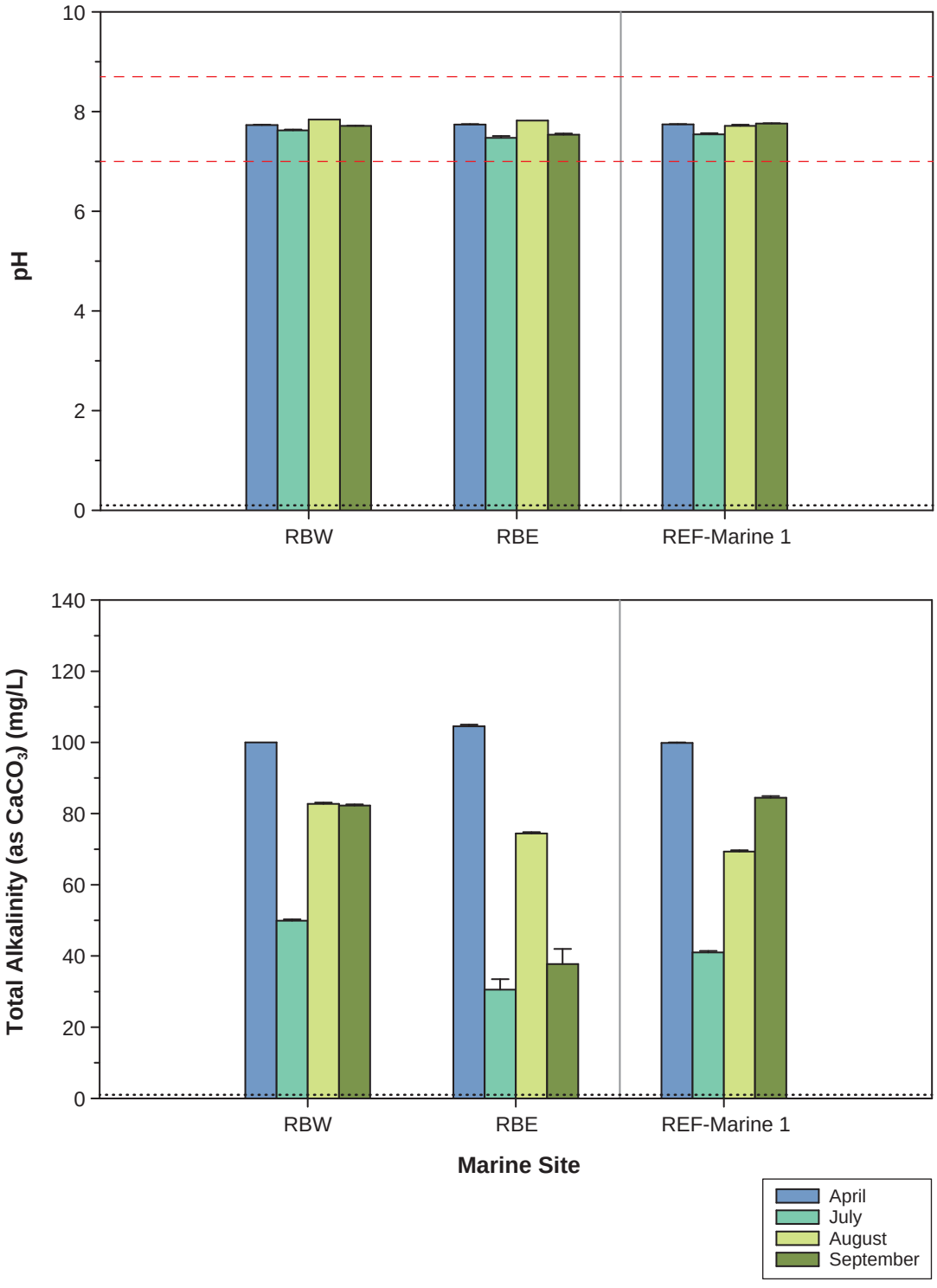
[e] *Copper guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is <82 mg/L, the CWQG is 0.002 mg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.0002 * e^{\{0.8545[\ln(hardness)]-1.465\}}$. At hardness >180 mg/L, the CWQG is 0.004 mg/L. If the hardness is unknown, the CWQG is 0.002 mg/L.*

[f] *Lead guideline is hardness dependent (hardness as $CaCO_3$). When the hardness is 0 to ≤ 60 mg/L, the CWQG is 0.001 mg/L. At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{1.273[\ln(hardness)]-4.705\}}$. At hardness >180 mg/L, the CWQG is 0.007 mg/L. If the hardness is unknown, the CWQG is 0.001 mg/L.*

[g] *Nickel guideline is hardness dependent (hardness as $CaCO_3$). When the water hardness is 0 to ≤ 60 mg/L, the CWQG is 0.025 mg/L. At hardness > 60 to ≤ 180 mg/L the CWQG is calculated using this equation: $CWQG\ (mg/L) = 0.001*e^{\{0.76[\ln(hardness)]+1.06\}}$. At hardness >180 mg/L, the CWQG is 0.150 mg/L. If the hardness is unknown, the CWQG is 0.025 mg/L.*

Figure A.3-19

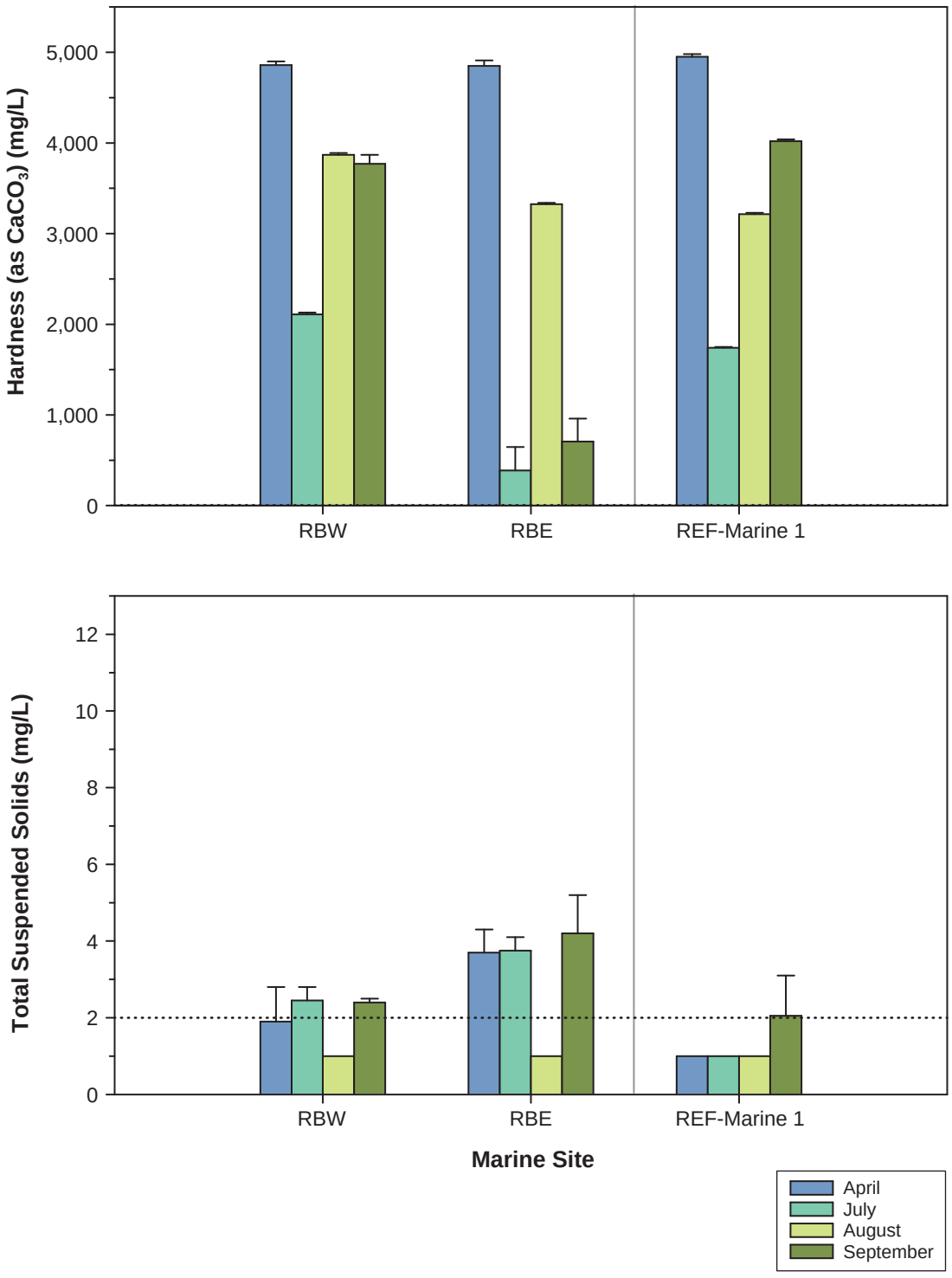
pH and Total Alkalinity in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits.
Red dashed lines represent the CCME marine and estuarine guideline pH range (7.0–8.7).
pH is a required parameter for water quality monitoring as per Schedule 5, s. 7(1)(c) of the MMER.
Total alkalinity is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.

Figure A.3-20

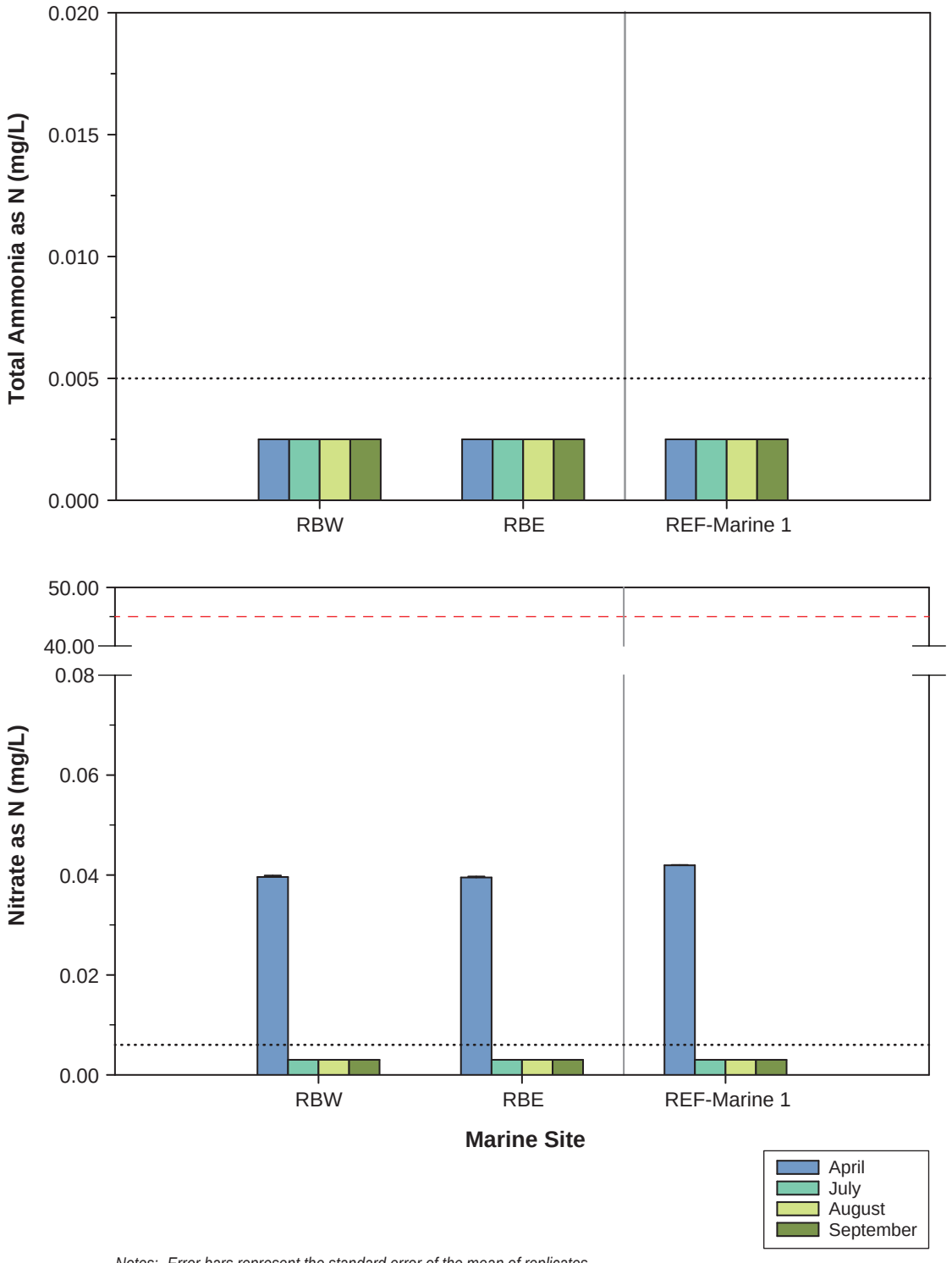
Hardness and Total Suspended Solids in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
The CCME marine guideline for total suspended solids is dependent upon background levels.
Hardness is a required parameter for effluent characterization and water quality monitoring as per Schedule 5, s. 4(1) and s. 7(1)(c) of the MMER.
Total suspended solids are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Figure A.3-21

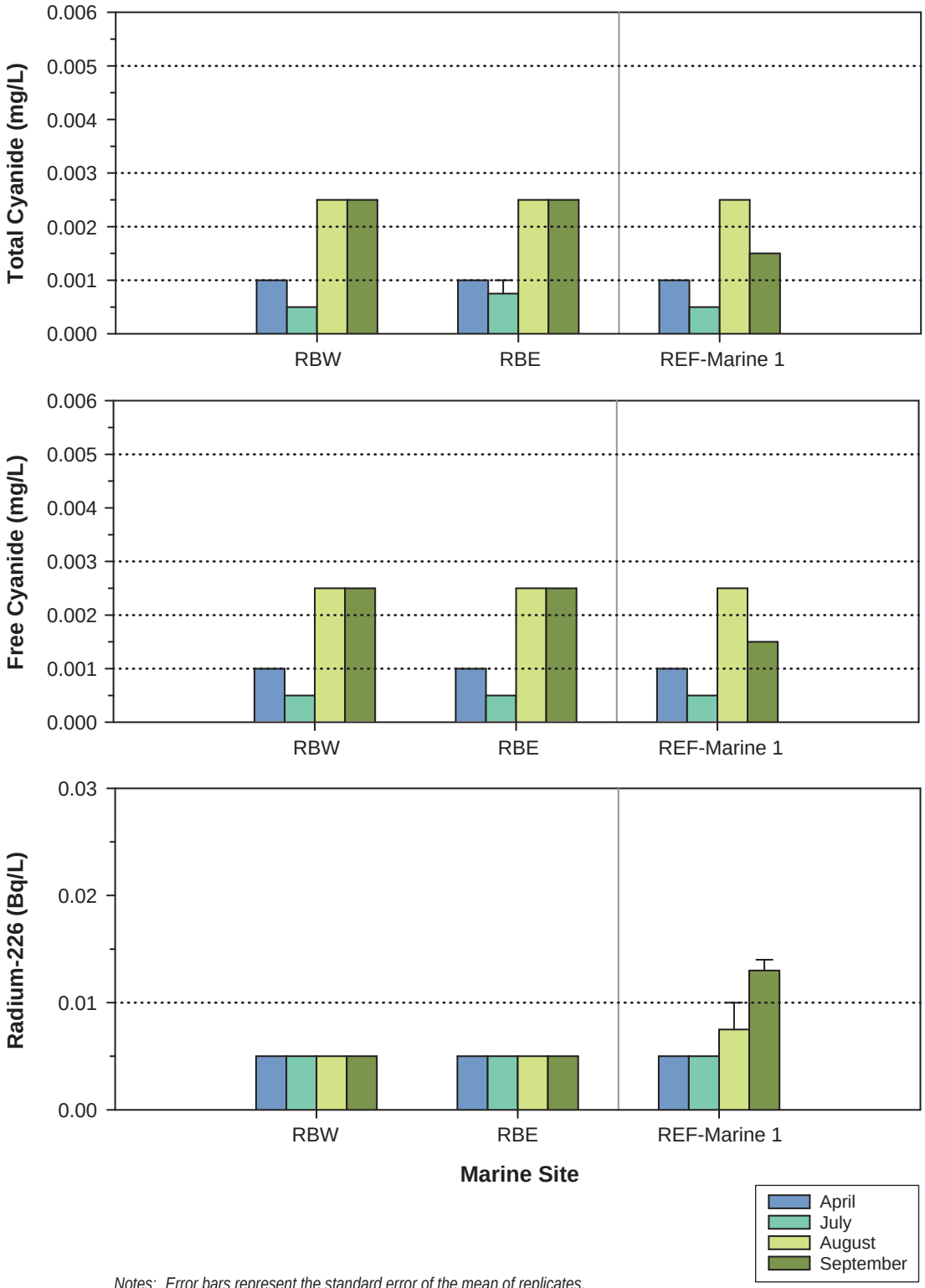
Total Ammonia and Nitrate Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed line represents the CCME marine guideline for nitrate as N (45 mg/L; long-term concentration).
Total ammonia and nitrate are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-22

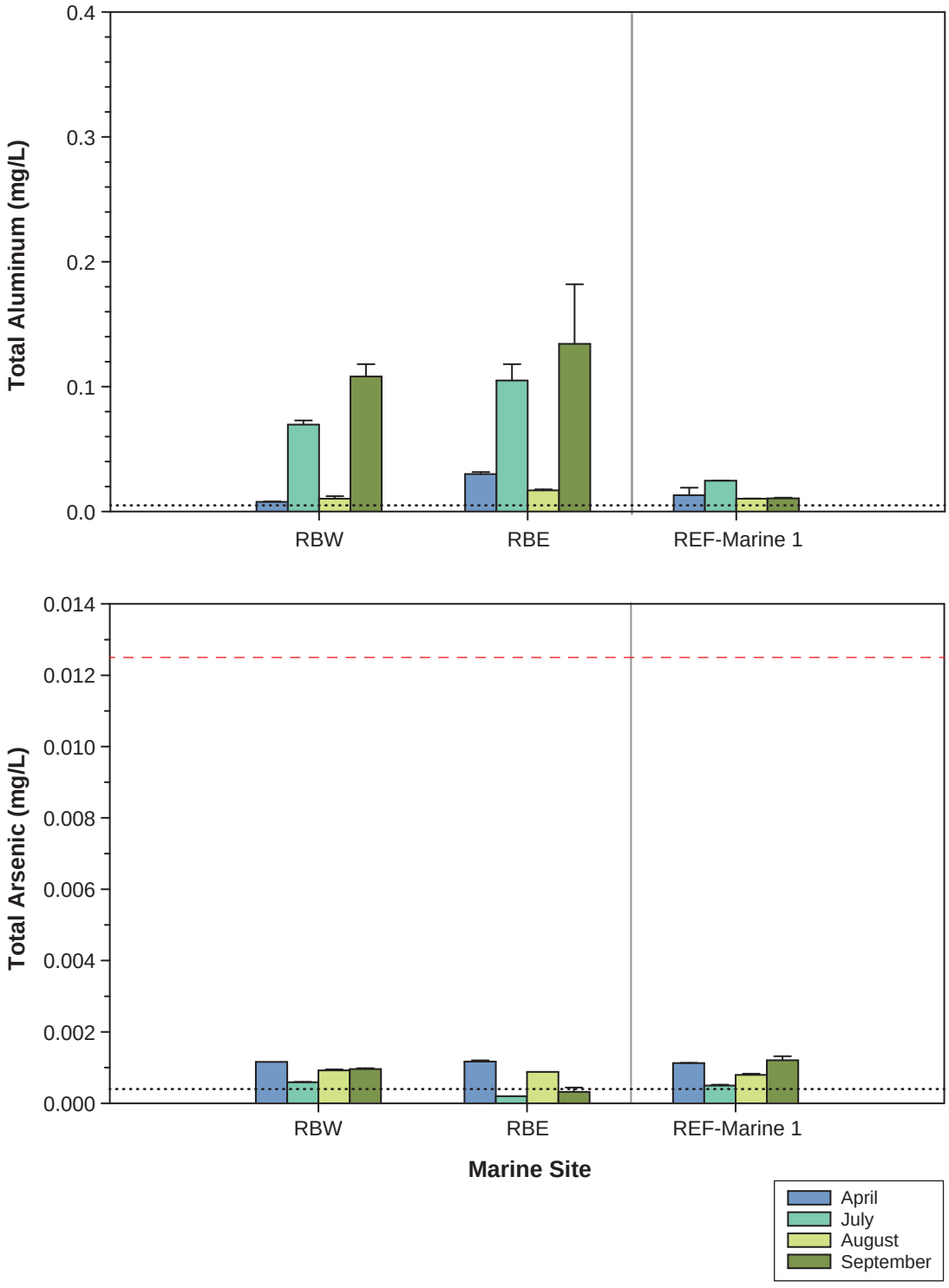
Total Cyanide, Free Cyanide, and Radium-226 Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Only one marine sample contained a detectable concentration of total cyanide (total cyanide of 0.001 mg/L in one of two duplicates collected at RBE on July 13, 2016).
All free cyanide concentrations in marine samples were below the detection limit.
Total cyanide and radium-226 are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Figure A.3-23

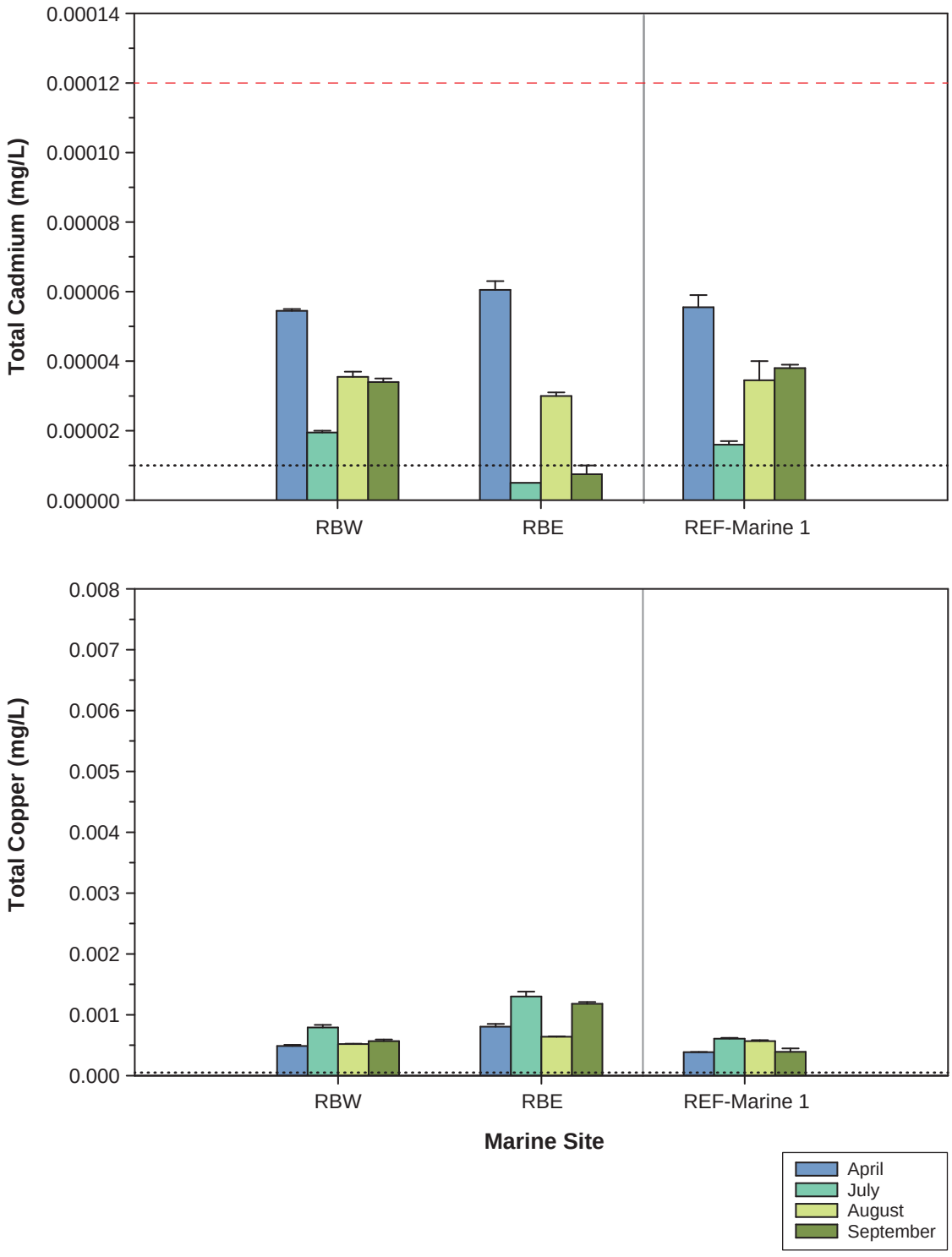
Total Aluminum and Total Arsenic Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed line represents the interim CCME marine guideline for arsenic (0.0125 mg/L).
Total aluminum is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total arsenic is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-24

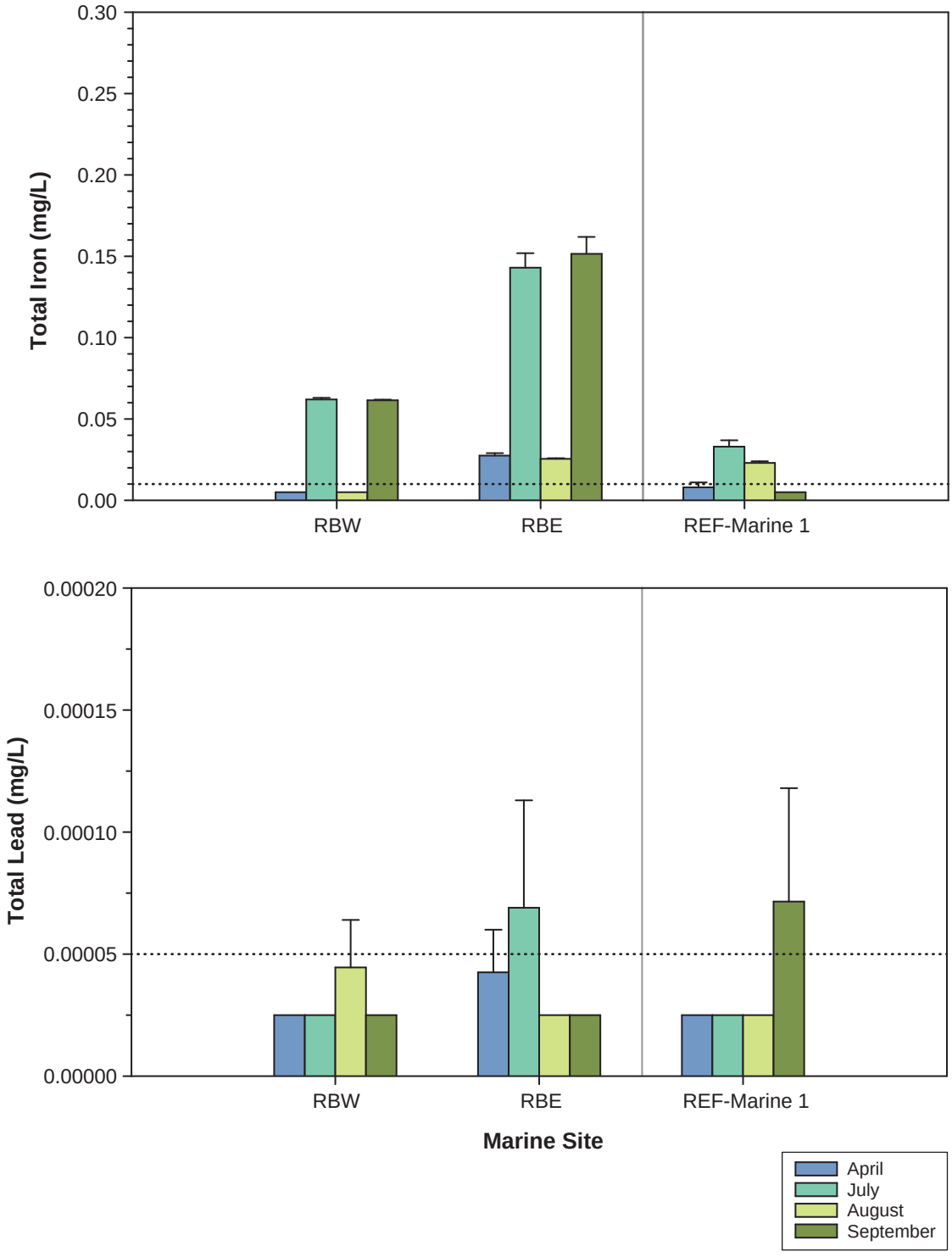
Total Cadmium and Total Copper Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed line represents the CCME marine guideline for cadmium (0.00012 mg/L).
Total cadmium is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total copper is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-25

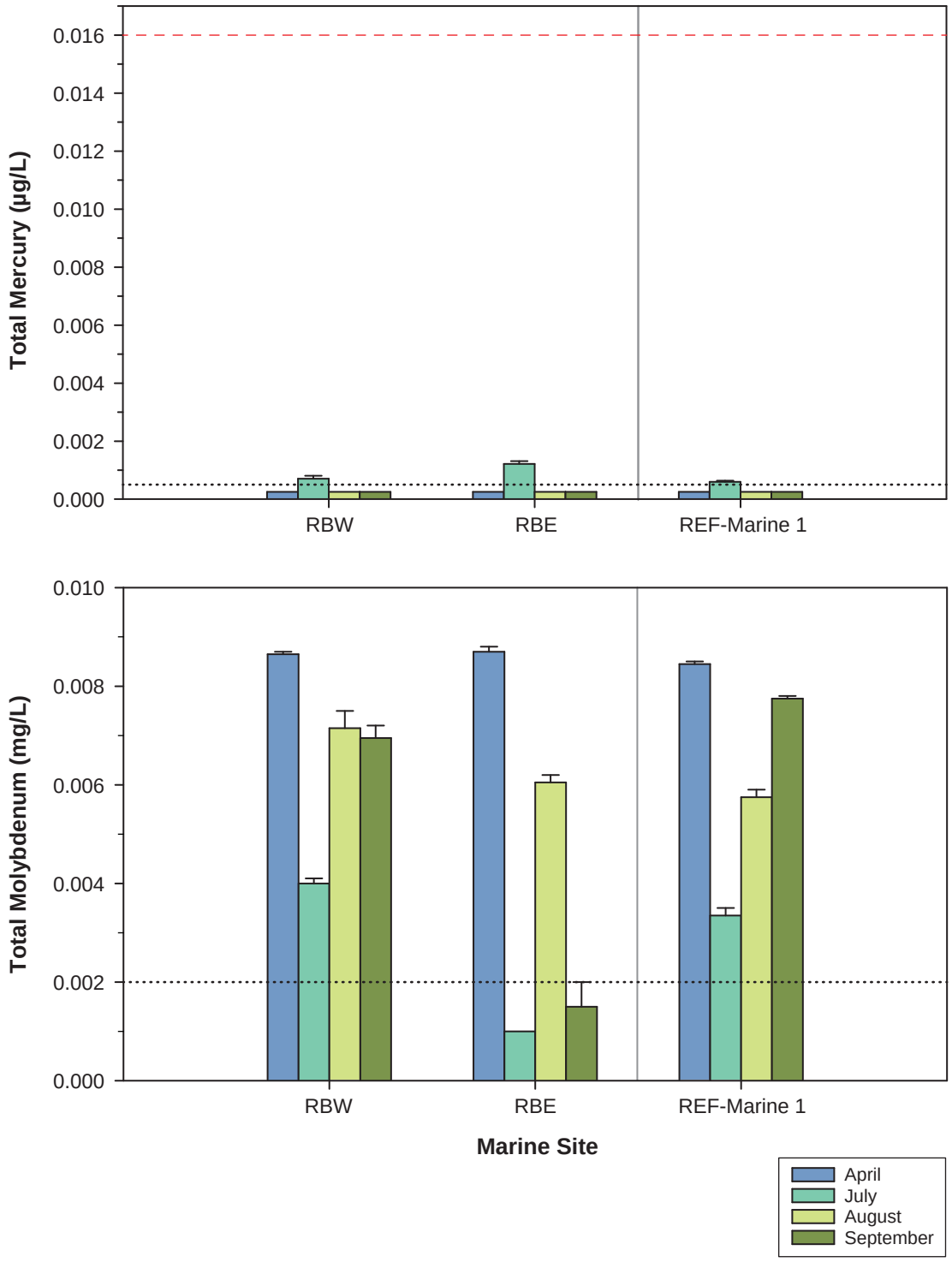
Total Iron and Total Lead Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Total iron is a required parameter for effluent characterization as per Schedule 5, s. 4(1) of the MMER.
Total lead is regulated as a deleterious substance in effluents as per Schedule 4 of the MMER.

Figure A.3-26

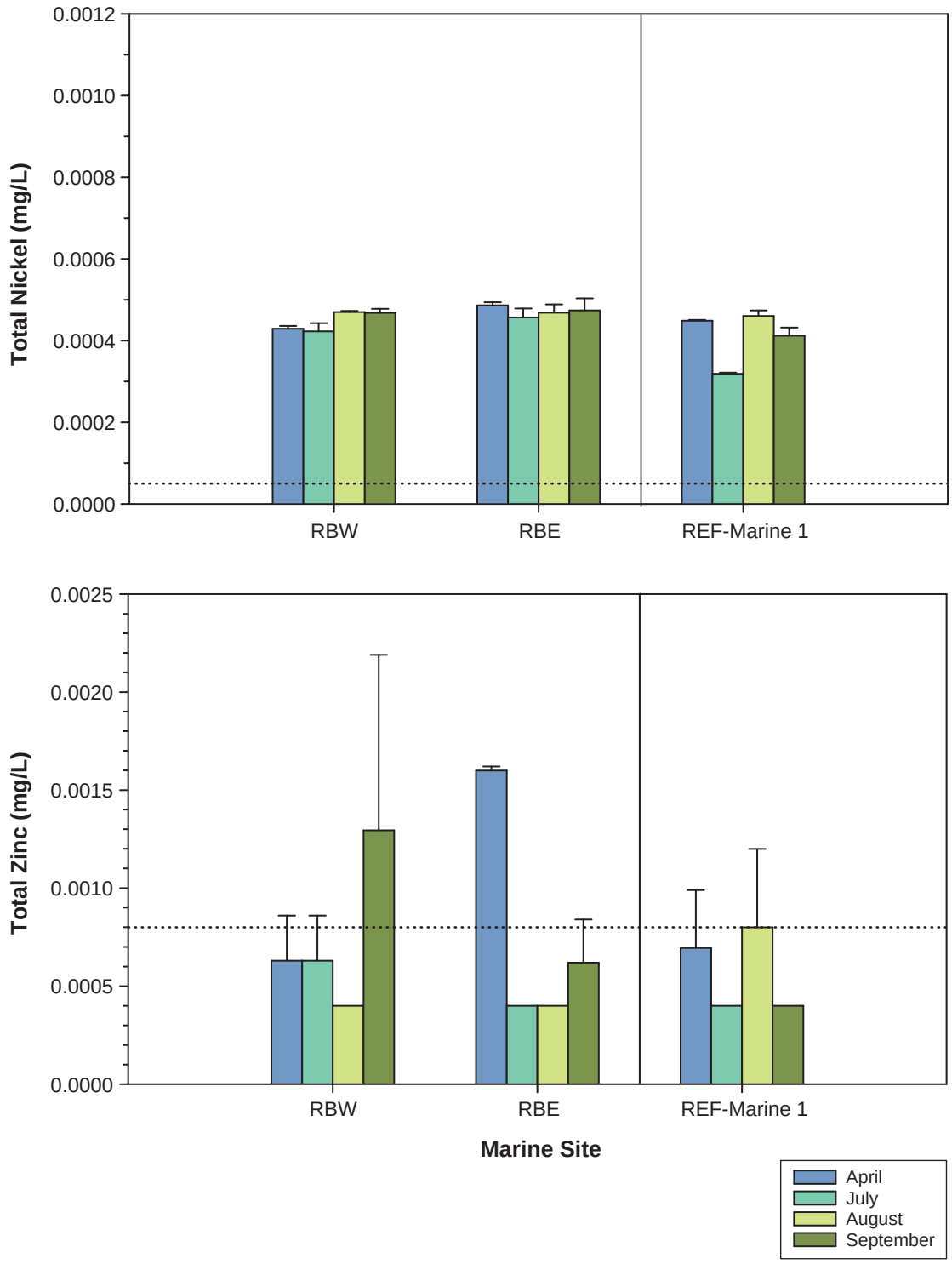
Total Mercury and Total Molybdenum Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Red dashed line represents the interim CCME marine guideline for inorganic mercury (0.016 µg/L).
Total mercury and total molybdenum are required parameters for effluent characterization as per Schedule 5, s. 4(1) of the MMER.

Figure A.3-27

Total Nickel and Total Zinc Concentrations in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean of replicates.
Black dotted lines represent the analytical detection limits; values below the detection limit are plotted at half the applicable detection limit.
Total nickel and total zinc are regulated as deleterious substances in effluents as per Schedule 4 of the MMER.

Annex A.3-3. Marine Water Quality Data, Doris Project, 2016

Site ID:				RBW		RBE		REF-Marine 1	
Replicate:				1	2	1	2	1	2
Depth Sampled (m):				3	3	2	2	2.7	2.7
Date Sampled:		CCME Guideline for the Protection	Realized	16-Apr-16	16-Apr-16	16-Apr-16	16-Apr-16	18-Apr-16	18-Apr-16
ALS Sample ID:	Units	of Aquatic Life[a]	Detection Limit	L1757779-4	L1757779-5	L1757779-2	L1757779-3	L1757779-7	L1757779-8
Physical Tests									
Hardness (as $CaCO_3$)	mg/L		4.3	4820	4900	4790	4910	4920	4980
pH	pH	7.0 to 8.7	0.10	7.72	7.74	7.75	7.73	7.74	7.75
Salinity	psu	dependent on background levels[b]	1.0	27.5	27.6	27.5	27.5	27.5	27.3
Total Suspended Solids	mg/L	dependent on background levels	2.0	<2.0	2.8	4.3	3.1	<2.0	<2.0
Total Dissolved Solids	mg/L		80	29900	29900	28900	21600	29600	30700
Turbidity	NTU	dependent on background levels	0.10	0.18	0.17	0.28	0.26	0.16	0.19
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	100	100	104	105	100	99.7
Ammonia, Total (as N)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		5.0	52.4	55.1	53.7	54.1	52.8	54.7
Chloride (Cl)	mg/L		50	15800	16500	15900	16100	15900	16500
Fluoride (F)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrate and Nitrite (as N)	mg/L		0.0060	0.0393	0.0399	0.0393	0.0397	0.0419	0.0420
Nitrate (as N)	mg/L	short-term: 339; long-term: 45	0.0060	0.0393	0.0399	0.0393	0.0397	0.0419	0.0420
Nitrite (as N)	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L		0.050	0.086	0.083	0.075	0.079	0.075	0.076
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0388	0.0388	0.0384	0.0382	0.0380	0.0381
Phosphorus (P)-Total	mg/L		0.010	0.033	0.031	0.035	0.033	0.038	0.037
Sulphate (SO_4)	mg/L		30	2240	2340	2250	2290	2250	2330
Cyanides									
Cyanide, Total	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Cyanide, Free	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	1.35	1.28	1.31	1.08	1.26	1.80
Total Organic Carbon	mg/L		0.50	1.23	1.19	1.14	1.30	1.18	1.32
Total Metals									
Aluminum (Al)	mg/L		0.0050	0.0075	0.0080	0.0284	0.0316	0.0191	0.0072
Antimony (Sb)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)	mg/L	0.0125[b]	0.00040	0.00116	0.00116	0.00114	0.00120	0.00113	0.00112
Barium (Ba)	mg/L		0.0010	0.0109	0.0112	0.0110	0.0113	0.0108	0.0109
Beryllium (Be)	mg/L		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		0.10	3.70	3.73	3.66	3.80	3.67	3.79
Cadmium (Cd)	mg/L	long-term: 0.00012	0.000020	0.000055	0.000054	0.000058	0.000063	0.000059	0.000052
Calcium (Ca)	mg/L		0.50	326	328	326	328	329	333
Cesium (Cs)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)	mg/L	Cr(VI): 0.0015; Cr(III): 0.056[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L		0.000050	0.000505	0.000471	0.000849	0.000760	0.000387	0.000383
Gallium (Ga)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L		0.010	<0.010	<0.010	0.026	0.029	0.011	<0.010
Lead (Pb)	mg/L		0.00005 or 0.0003	<0.000050	<0.000050	<0.000050	0.00006	<0.000050	<0.000050
Lithium (Li)	mg/L		0.020	0.151	0.150	0.148	0.148	0.149	0.148
Magnesium (Mg)	mg/L		1.0	974	991	965	992	995	1010
Manganese (Mn)	mg/L		0.000050	0.00192	0.00187	0.00221	0.00219	0.00212	0.00199
Mercury (Hg)	µg/L	Inorganic Hg: 0.016[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L		0.0020	0.0086	0.0087	0.0086	0.0088	0.0084	0.0085
Nickel (Ni)	mg/L		0.000050	0.000423	0.000436	0.000494	0.000479	0.000451	0.000447
Phosphorus (P)	mg/L		1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)	mg/L		20	268	274	263	269	272	273
Rhenium (Re)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L		0.0050	0.102	0.100	0.100	0.101	0.0986	0.101
Selenium (Se)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)	mg/L		0.50	0.60	0.59	0.61	0.67	0.59	0.60
Silver (Ag)	mg/L	short-term: 0.0075	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)	mg/L		20	8930	9100	8730	8950	9030	9080
Strontium (Sr)	mg/L		0.050	5.66	5.78	5.57	5.70	5.74	5.78
Tellurium (Te)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thorium (Th)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)	mg/L		0.000050	0.00264	0.00273	0.00271	0.00275	0.00254	0.00271
Vanadium (V)	mg/L		0.00050	0.00076	0.00082	0.00090	0.00084	0.00074	0.00076
Yttrium (Y)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L		0.00080	0.00086	<0.00080	0.00158	0.00162	0.00099	<0.00080
Zirconium (Zr)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

All sample parameters were below CCME guidelines for the protection of marine life.

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

[a] *Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

Annex A.3-3. Marine Water Quality Data, Doris Project, 2016

Site ID:				RBW		RBE		REF-Marine 1	
Replicate:				1	2	1	2	1	2
Depth Sampled (m):				1	1	surface	surface	1	1
Date Sampled:		CCME Guideline for the Protection	Realized	13-Jul-2016	13-Jul-2016	13-Jul-2016	13-Jul-2016	13-Jul-2016	13-Jul-2016
ALS Sample ID:	Units	of Aquatic Life[a]	Detection Limit	L1799212-2	L1799212-1	L1799212-4	L1799212-5	L1799212-8	L1799212-9
Physical Tests									
Hardness (as $CaCO_3$)	mg/L		4.3	2090	2130	128	646	1730	1750
pH	pH	7.0 to 8.7	0.10	7.64	7.61	7.44	7.51	7.52	7.57
Salinity	psu	dependent on background levels[b]	1.0	11.9	11.9	<1.0	3.6	9.8	10.0
Total Suspended Solids	mg/L	dependent on background levels	2.0	2.1	2.8	3.4	4.1	<2.0	<2.0
Total Dissolved Solids	mg/L		20 or 40	12200	12400	598	3730	10600	10300
Turbidity	NTU	dependent on background levels	0.10	2.04	1.72	4.86	4.11	0.67	0.65
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	50.3	49.5	27.6	33.5	41.4	40.6
Ammonia, Total (as N)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		0.25 or 5.0	22.3	22.3	1.01	6.1	16.8	20.4
Chloride (Cl)	mg/L		2.5 or 25 or 50	6550	6670	302	1840	4990	5560
Fluoride (F)	mg/L		0.10 or 1.0 or 2.0	<2.0	<2.0	<0.10	<1.0	<2.0	<2.0
Nitrate and Nitrite (as N)	mg/L		0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	short-term: 339; long-term: 45	0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L		0.050	0.149	0.154	0.393	<0.050	0.161	0.159
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0075	0.0067	<0.0010	<0.0010	0.0067	0.0071
Phosphorus (P)-Total	mg/L		0.010	0.018	0.022	0.021	0.024	0.019	0.030
Sulphate (SO_4)	mg/L		1.5 or 30	897	915	36	242	681	760
Cyanides									
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	0.001	<0.0010	<0.0010
Cyanide, Free	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	3.09	3.15	6.20	5.29	2.92	2.91
Total Organic Carbon	mg/L		0.50	2.41	2.60	6.19	5.32	2.90	2.85
Total Metals									
Aluminum (Al)	mg/L		0.0050	0.0730	0.0664	0.118	0.0920	0.0246	0.0249
Antimony (Sb)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)	mg/L	0.0125[b]	0.00040	0.00058	0.00060	<0.00040	<0.00040	0.00047	0.00052
Barium (Ba)	mg/L		0.0010	0.0061	0.0062	0.0036	0.0045	0.0049	0.0051
Beryllium (Be)	mg/L		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		0.10	1.94	1.58	<0.10	0.55	1.57	1.70
Cadmium (Cd)	mg/L	long-term: 0.00012	0.000020	0.000020	0.000019	<0.000010	<0.000010	0.000015	0.000017
Calcium (Ca)	mg/L		0.50	134	136	12.8	45.4	111	112
Cesium (Cs)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)	mg/L	Cr(VI): 0.0015; Cr(III): 0.056[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000054	0.000057	0.000055	0.000055	<0.000050	<0.000050
Copper (Cu)	mg/L		0.000050	0.000748	0.000833	0.00138	0.00122	0.000620	0.000592
Gallium (Ga)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L		0.010	0.061	0.063	0.152	0.134	0.037	0.029
Lead (Pb)	mg/L		0.00005 or 0.0003	<0.000050	<0.000050	0.000113	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.020	0.067	0.063	<0.020	0.020	0.054	0.053
Magnesium (Mg)	mg/L		1.0	427	435	23.3	129	353	357
Manganese (Mn)	mg/L		0.000050	0.00481	0.00468	0.0154	0.0147	0.00202	0.00195
Mercury (Hg)	µg/L	Inorganic Hg: 0.016[b]	0.00050	0.00081	0.0006	0.00131	0.00112	0.00064	0.00056
Molybdenum (Mo)	mg/L		0.0020	0.0039	0.0041	<0.0020	<0.0020	0.0032	0.0035
Nickel (Ni)	mg/L		0.000050	0.000403	0.000443	0.000479	0.000435	0.000322	0.000316
Phosphorus (P)	mg/L		1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)	mg/L		20	129	130	<20	40	106	108
Rhenium (Re)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L		0.0050	0.038	0.0385	<0.0050	0.0124	0.0317	0.0331
Selenium (Se)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)	mg/L		0.50	0.50	0.55	1.27	1.00	<0.50	<0.50
Silver (Ag)	mg/L	short-term: 0.0075	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)	mg/L		20	3560	3580	179	1090	2980	3020
Strontium (Sr)	mg/L		0.050	2.55	2.57	0.147	0.803	2.14	2.17
Tellurium (Te)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thorium (Th)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)	mg/L		0.000050	0.00112	0.00115	0.000106	0.000400	0.000951	0.000951
Vanadium (V)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Yttrium (Y)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L		0.00080	0.00086	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080
Zirconium (Zr)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100

Notes:

All sample parameters were below CCME guidelines for the protection of marine life.

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

[a] *Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

Annex A.3-3. Marine Water Quality Data, Doris Project, 2016

Site ID:				RBW		RBE		REF-Marine 1	
Replicate:				1	2	1	2	1	2
Depth Sampled (m):				1	1	surface	surface	1	1
Date Sampled:		CCME Guideline for the Protection	Realized	12-Aug-2016	12-Aug-2016	12-Aug-2016	12-Aug-2016	13-Aug-2016	13-Aug-2016
ALS Sample ID:	Units	of Aquatic Life[a]	Detection Limit	L1814606-3	L1814606-4	L1814606-5	L1814606-6	L1814606-1	L1814606-2
Physical Tests									
Hardness (as $CaCO_3$)	mg/L		4.3	3890	3850	3340	3310	3200	3230
pH	pH	7.0 to 8.7	0.10	7.84	7.84	7.82	7.82	7.69	7.74
Salinity	psu	dependent on background levels[b]	1.0	21.5	21.3	18.7	18.3	17.7	17.9
Total Suspended Solids	mg/L	dependent on background levels	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L		80	24200	24000	20700	20300	20200	20200
Turbidity	NTU	dependent on background levels	0.10	0.25	0.25	0.66	0.74	0.35	0.29
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	83.1	82.3	74.8	74.0	68.9	69.7
Ammonia, Total (as N)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		5.0	39.5	44.9	38.9	31.4	33.5	30.5
Chloride (Cl)	mg/L		50	11400	12900	11100	9100	9670	8780
Fluoride (F)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrate and Nitrite (as N)	mg/L		0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	short-term: 339; long-term: 45	0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L		0.050	0.108	0.108	0.148	0.153	0.132	0.132
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0144	0.0158	0.0092	0.0075	0.0138	0.0138
Phosphorus (P)-Total	mg/L		0.010	0.020	0.021	0.021	0.017	0.017	0.013
Sulphate (SO_4)	mg/L		30	1580	1800	1550	1240	1340	1200
Cyanides									
Cyanide, Total	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cyanide, Free	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	1.18	1.33	1.91	1.95	1.70	1.92
Total Organic Carbon	mg/L		0.50	1.47	1.39	1.97	2.06	2.01	1.90
Total Metals									
Aluminum (Al)	mg/L		0.0050	0.0084	0.0123	0.0178	0.0162	0.0105	0.0101
Antimony (Sb)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)	mg/L	0.0125[b]	0.00040	0.00095	0.00089	0.00088	0.00088	0.00076	0.00083
Barium (Ba)	mg/L		0.0010	0.0054	0.0054	0.0052	0.0051	0.0056	0.0055
Beryllium (Be)	mg/L		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		0.10	2.79	2.74	2.36	2.37	2.26	2.30
Cadmium (Cd)	mg/L	long-term: 0.00012	0.000020	0.000037	0.000034	0.000029	0.000031	0.000040	0.000029
Calcium (Ca)	mg/L		0.50	245	242	210	208	199	203
Cesium (Cs)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)	mg/L	Cr(VI): 0.0015; Cr(III): 0.056[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L		0.000050	0.000512	0.000523	0.000631	0.000645	0.000583	0.000549
Gallium (Ga)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L		0.010	<0.010	<0.010	0.025	0.026	0.024	0.022
Lead (Pb)	mg/L		0.00005 or 0.0003	0.000064	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.020	0.117	0.122	0.102	0.101	0.096	0.095
Magnesium (Mg)	mg/L		1.0	795	788	683	679	655	662
Manganese (Mn)	mg/L		0.000050	0.00188	0.00186	0.0033	0.0036	0.00200	0.00189
Mercury (Hg)	µg/L	Inorganic Hg: 0.016[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L		0.0020	0.0068	0.0075	0.0062	0.0059	0.0059	0.0056
Nickel (Ni)	mg/L		0.000050	0.000467	0.000473	0.000448	0.000489	0.000474	0.000447
Phosphorus (P)	mg/L		1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)	mg/L		20	241	238	205	202	192	196
Rhenium (Re)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L		0.0050	0.0707	0.0724	0.0612	0.0593	0.0611	0.0584
Selenium (Se)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)	mg/L		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver (Ag)	mg/L	short-term: 0.0075	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)	mg/L		20	6770	6760	5700	5610	5330	5430
Strontium (Sr)	mg/L		0.050	4.63	4.63	4.01	3.96	3.75	3.81
Tellurium (Te)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thorium (Th)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten (W)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)	mg/L		0.000050	0.00218	0.00210	0.00190	0.00192	0.00177	0.00173
Vanadium (V)	mg/L		0.00050	0.00057	0.00079	0.00058	0.00059	0.00056	0.00052
Yttrium (Y)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L		0.00080	<0.00080	<0.00080	<0.00080	<0.00080	<0.00080	0.0012
Zirconium (Zr)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	0.01

Notes:

All sample parameters were below CCME guidelines for the protection of marine life.

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

[a] *Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

Annex A.3-3. Marine Water Quality Data, Doris Project, 2016

Site ID:				RBW		RBE		REF-Marine 1	
Replicate:				1	2	1	2	1	2
Depth Sampled (m):				1	1	surface	surface	1	1
Date Sampled:		CCME Guideline for the Protection	Realized	15-Sep-2016	15-Sep-2016	15-Sep-2016	15-Sep-2016	18-Sep-2016	18-Sep-2016
ALS Sample ID:	Units	of Aquatic Life[a]	Detection Limit	L1830320-1	L1830320-2	L1830320-3	L1830320-4	L1831897-1	L1831897-2
Physical Tests									
Hardness (as $CaCO_3$)	mg/L		4.3	3670	3870	959	456	4040	4000
pH	pH	7.0 to 8.7	0.10	7.71	7.72	7.56	7.52	7.77	7.75
Salinity	psu	dependent on background levels[b]	1.0	20.8	20.9	5.7	2.4	22.1	22.0
Total Suspended Solids	mg/L	dependent on background levels	2.0	2.3	2.5	5.2	3.2	3.1	<2.0
Total Dissolved Solids	mg/L		20 or 40 or 80	22600	22800	5920	2580	23800	24400
Turbidity	NTU	dependent on background levels	0.10	1.87	1.97	7.36	5.97	0.42	0.44
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0	82.6	81.9	42.0	33.5	84.0	84.9
Ammonia, Total (as N)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L		1.0 or 2.5 or 5.0	48.2	46.9	11.2	4.6	46.7	49.1
Chloride (Cl)	mg/L		10 or 25 or 50	13700	13400	3190	1310	13300	14300
Fluoride (F)	mg/L		0.40 or 1.0 or 2.0	<2.0	<2.0	<1.0	<0.40	<2.0	<2.0
Nitrate and Nitrite (as N)	mg/L		0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	short-term: 339; long-term: 45	0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L		0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L		0.050	0.117	0.111	0.394	0.468	0.089	0.090
Orthophosphate-Dissolved (as P)	mg/L		0.0010	0.0133	0.0151	<0.0010	<0.0010	0.0177	0.0174
Phosphorus (P)-Total	mg/L		0.010	0.017	0.015	0.020	0.019	0.027	0.026
Sulphate (SO_4)	mg/L		6 or 15 or 30	1920	1880	428	175	1860	1990
Cyanides									
Cyanide, Total	mg/L		0.0030 or 0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0030	<0.0030
Cyanide, Free	mg/L		0.0030 or 0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0030	<0.0030
Organic Carbon									
Dissolved Organic Carbon	mg/L		0.50	1.56	1.52	5.16	5.93	1.46	1.29
Total Organic Carbon	mg/L		0.50	1.59	1.64	5.44	6.60	1.36	1.43
Total Metals									
Aluminum (Al)	mg/L		0.0050	0.118	0.098	0.182	0.0866	0.0111	0.0102
Antimony (Sb)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)	mg/L	0.0125[b]	0.00040	0.00094	0.00098	0.00044	<0.00040	0.00109	0.00132
Barium (Ba)	mg/L		0.0010	0.0059	0.0058	0.0050	0.0036	0.0081	0.0071
Beryllium (Be)	mg/L		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		0.10	2.79	2.64	0.67	0.32	2.99	2.85
Cadmium (Cd)	mg/L	long-term: 0.00012	0.000020	0.000033	0.000035	0.000010	<0.000010	0.000039	0.000037
Calcium (Ca)	mg/L		0.50	219	236	64.7	33.3	251	254
Cesium (Cs)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (Cr)	mg/L	Cr(VI): 0.0015; Cr(III): 0.056[b]	0.00050	<0.00050	<0.00050	0.00114	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L		0.000050	0.000058	0.000059	0.000081	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L		0.000050	0.00059	0.00054	0.00115	0.00121	0.000448	0.000334
Gallium (Ga)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L		0.010	0.061	0.062	0.162	0.141	<0.010	<0.010
Lead (Pb)	mg/L		0.00005 or 0.0003	<0.000050	<0.000050	<0.000050	<0.000050	0.000118	<0.000050
Lithium (Li)	mg/L		0.020	0.118	0.112	0.031	<0.020	0.117	0.115
Magnesium (Mg)	mg/L		1.0	758	796	194	90	829	818
Manganese (Mn)	mg/L		0.000050	0.00299	0.00310	0.00956	0.01030	0.00183	0.00166
Mercury (Hg)	µg/L	Inorganic Hg: 0.016[b]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L		0.0020	0.0072	0.0067	0.0020	<0.0020	0.0078	0.0077
Nickel (Ni)	mg/L		0.000050	0.00048	0.000458	0.000504	0.000444	0.000432	0.000392
Phosphorus (P)	mg/L		1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Potassium (K)	mg/L		20	216	237	62	29	234	238
Rhenium (Re)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L		0.0050	0.076	0.077	0.021	0.010	0.079	0.080
Selenium (Se)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silicon (Si)	mg/L		0.50	<0.50	<0.50	1.39	1.36	<0.50	<0.50
Silver (Ag)	mg/L	short-term: 0.0075	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)	mg/L		20	6070	6070	1650	749	7240	7300
Strontium (Sr)	mg/L		0.050	4.24	4.62	1.17	0.548	4.94	4.94
Tellurium (Te)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Thallium (Tl)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thorium (Th)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tin (Sn)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)	mg/L		0.0050	0.0062	0.0063	0.0106	<0.0050	<0.0050	<0.0050
Tungsten (W)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Uranium (U)	mg/L		0.000050	0.00212	0.00221	0.000625	0.000315	0.00225	0.00225
Vanadium (V)	mg/L		0.00050	0.00073	0.00079	0.00057	<0.00050	0.00056	0.00065
Yttrium (Y)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L		0.00080	0.00219	<0.00080	0.00084	<0.00080	<0.00080	<0.00080
Zirconium (Zr)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L		0.010	<0.0100	<0.0100	<0.0100	<0.0100	0.014	0.012

Notes:

All sample parameters were below CCME guidelines for the protection of marine life.

April sampling depths are depths below the water surface and are equal to approximately 0.25-1 m below ice.

[a] *Canadian water quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *Interim guideline.*

Annex A.3-4. QA/QC Blank Data for Water Quality Sampling, Doris Project, 2016

Blank Type:		Field Blank (Marine)	Travel Blank (Marine)	Travel Blank (Freshwater)	Field Blank (Freshwater)	Equipment Blank (Freshwater)	Field Blank (Freshwater)	Travel Blank (Freshwater)	Equipment Blank (Marine)
Date Sampled:		**16-Apr-16**	**16-Apr-16**	**15-Apr-2016**	**16-Apr-2016**	**16-Apr-2016**	**13-Jun-2016**	**13-Jun-2016**	**12-Jul-2016**
ALS Sample ID:	**Units**	**L1757779-1**	**L1757779-6**	**L1757772-3**	**L1757772-4**	**L1757772-5**	**L1783343-11**	**L1783343-12**	**L1799212-3**
Physical Tests									
Conductivity	uS/cm	-	-	<2.0	<2.0	<2.0	<2.0	<2.0	-
Hardness (as $CaCO_3$)	mg/L	<4.3	<4.3	<0.50	<0.50	<0.50	<0.50	<0.50	<4.3
pH	pH	5.64	5.67	5.40	5.52	5.43	5.44	5.40	5.30
Salinity	psu	<1.0	<1.0	-	-	-	-	-	<1.0
Total Suspended Solids	mg/L	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
Total Dissolved Solids	mg/L	<10	<10	<10	<10	<10	<10	<10	<10
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.0082	<0.0050	0.0108	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate and Nitrite (as N)	mg/L	<0.0060	<0.0060	-	-	-	-	-	<0.0060
Nitrate (as N)	mg/L	<0.0060	<0.0060	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0060
Nitrite (as N)	mg/L	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulfate (SO_4)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Cyanides									
Cyanide, Total	mg/L	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon									
Dissolved Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals									
Aluminum (Al)	mg/L	<0.0050	<0.0050	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	**0.0130**
Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.00050
Arsenic (As)	mg/L	<0.00040	<0.00040	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00040
Barium (Ba)	mg/L	<0.0010	<0.0010	<0.00010	<0.00010	**0.00027**	<0.00010	<0.00010	<0.0010
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050
Boron (B)	mg/L	<0.10	<0.10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.10
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010
Calcium (Ca)	mg/L	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.50
Cesium (Cs)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050
Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050
Gallium (Ga)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050
Iron (Fe)	mg/L	<0.010	<0.010	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.020	<0.020	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.020
Magnesium (Mg)	mg/L	<1.0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<1.0
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.000061
Mercury (Hg)	ug/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	<0.0020	<0.0020	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.0020
Nickel (Ni)	mg/L	<0.000050	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050
Phosphorus (P)	mg/L	<1.0	<1.0	<0.30	<0.30	<0.30	<0.30	<0.30	<1.0
Potassium (K)	mg/L	<20	<20	<2.0	<2.0	<2.0	<2.0	<2.0	<20
Rhenium (Re)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050
Rubidium (Rb)	mg/L	<0.0050	<0.0050	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.0050
Selenium (Se)	mg/L	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050
Silicon (Si)	mg/L	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.50
Silver (Ag)	mg/L	<0.00010	<0.00010	<0.0000050	<0.0000050	**0.0000115**	<0.0000050	<0.0000050	<0.00010
Sodium (Na)	mg/L	<20	<20	<2.0	<2.0	<2.0	<2.0	<2.0	<20
Strontium (Sr)	mg/L	<0.050	<0.050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.050
Tellurium (Te)	mg/L	<0.00050	<0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050
Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050
Thorium (Th)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050
Tin (Sn)	mg/L	<0.0010	<0.0010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0010
Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0050
Tungsten (W)	mg/L	<0.0010	<0.0010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0010
Uranium (U)	mg/L	<0.000050	<0.000050	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.000050
Vanadium (V)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050
Yttrium (Y)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050
Zinc (Zn)	mg/L	<0.00080	<0.00080	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.00080
Zirconium (Zr)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050
Radiological Parameters									
Ra-226	Bq/L	-	-	-	-	<0.0100	<0.0100	<0.0100	<0.0100

Note:
Bold values represent concentrations that are higher than analytical detection limits.

Annex A.3-4. QA/QC Blank Data for Water Quality Sampling, Doris Project, 2016

Blank Type:		Field Blank (Marine)	Travel Blank (Marine)	Equipment Blank (Freshwater)	Field Blank (Freshwater)	Travel Blank (Freshwater)	Equipment Blank (Freshwater)	Equipment Blank (Marine)	Field Blank (Marine)
Date Sampled:		**13-Jul-2016**	**13-Jul-2016**	**14-Jul-2016**	**17-Jul-2016**	**17-Jul-2016**	**9-Aug-2016**	**9-Aug-2016**	**13-Aug-2016**
ALS Sample ID:	**Units**	**L1799212-7**	**L1799212-6**	**L1799162-5**	**L1800754-8**	**L1800754-7**	**L1814657-9**	**L1814606-9**	**L1814606-8**
Physical Tests									
Conductivity	uS/cm	-	-	<2.0	<2.0	<2.0	<2.0	-	-
Hardness (as $CaCO_3$)	mg/L	<4.3	<4.3	<0.50	<0.50	<0.50	<0.50	<4.3	<4.3
pH	pH	5.51	5.37	5.45	5.39	5.36	5.26	5.30	5.31
Salinity	psu	<1.0	<1.0	-	-	-	-	<1.0	<1.0
Total Suspended Solids	mg/L	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0
Total Dissolved Solids	mg/L	<10	<10	<10	<10	<10	<10	<10	<10
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate and Nitrite (as N)	mg/L	<0.0060	<0.0060	-	-	-	-	<0.0060	<0.0060
Nitrate (as N)	mg/L	<0.0060	<0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060	<0.0060
Nitrite (as N)	mg/L	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulfate (SO_4)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Cyanides									
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050
Cyanide, Free	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050
Organic / Inorganic Carbon									
Dissolved Organic Carbon	mg/L	<0.50	<0.50	<0.50	-	-	<0.50	<0.50	<0.50
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals									
Aluminum (Al)	mg/L	<0.0050	<0.0050	<0.0030	<0.0030	<0.0030	**0.0034**	<0.0050	<0.0050
Antimony (Sb)	mg/L	<0.00050	<0.00050	<0.000030	<0.000030	<0.000030	<0.000030	<0.00050	<0.00050
Arsenic (As)	mg/L	<0.00040	<0.00040	<0.000050	<0.000050	<0.000050	<0.000050	<0.00040	<0.00040
Barium (Ba)	mg/L	<0.0010	<0.0010	**0.00027**	<0.00010	<0.00010	<0.00010	<0.0010	<0.0010
Beryllium (Be)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Boron (B)	mg/L	<0.10	<0.10	<0.010	<0.010	<0.010	<0.010	<0.10	<0.10
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010
Calcium (Ca)	mg/L	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.50	<0.50
Cesium (Cs)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050
Gallium (Ga)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.010	<0.010	<0.030	<0.030	<0.030	<0.030	<0.010	<0.010
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.020	<0.020	<0.00040	<0.00040	<0.00040	<0.00040	<0.020	<0.020
Magnesium (Mg)	mg/L	<1.0	<1.0	<0.10	<0.10	<0.10	<0.10	<1.0	<1.0
Manganese (Mn)	mg/L	<0.000050	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050	<0.000050
Mercury (Hg)	ug/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	<0.0020	<0.0020	<0.000050	<0.000050	<0.000050	<0.000050	<0.0020	<0.0020
Nickel (Ni)	mg/L	<0.000050	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050	<0.000050
Phosphorus (P)	mg/L	<1.0	<1.0	<0.30	<0.30	<0.30	<0.30	<1.0	<1.0
Potassium (K)	mg/L	<20	<20	<2.0	<2.0	<2.0	<2.0	<20	<20
Rhenium (Re)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Rubidium (Rb)	mg/L	<0.0050	<0.0050	<0.000020	<0.000020	<0.000020	<0.000020	<0.0050	<0.0050
Selenium (Se)	mg/L	<0.00050	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050
Silicon (Si)	mg/L	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.50	<0.50
Silver (Ag)	mg/L	<0.00010	<0.00010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00010	<0.00010
Sodium (Na)	mg/L	<20	<20	<2.0	<2.0	<2.0	<2.0	<20	<20
Strontium (Sr)	mg/L	<0.050	<0.050	<0.00020	<0.00020	<0.00020	<0.00020	<0.050	<0.050
Tellurium (Te)	mg/L	<0.00050	<0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.00050
Thallium (Tl)	mg/L	<0.000050	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000050
Thorium (Th)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Tin (Sn)	mg/L	<0.0010	<0.0010	**0.00076**	<0.00020	<0.00020	<0.00020	<0.0010	<0.0010
Titanium (Ti)	mg/L	<0.0050	<0.0050	<0.00020	<0.00020	<0.00020	<0.00020	<0.0050	<0.0050
Tungsten (W)	mg/L	<0.0010	<0.0010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0010	<0.0010
Uranium (U)	mg/L	<0.000050	<0.000050	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.000050	<0.000050
Vanadium (V)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Yttrium (Y)	mg/L	<0.00050	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050
Zinc (Zn)	mg/L	<0.00080	<0.00080	<0.0030	<0.0030	<0.0030	<0.0030	**<0.00080**	<0.00080
Zirconium (Zr)	mg/L	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L	<0.0100	-	<0.0100	<0.0100	-	<0.0100	<0.0100	<0.0100

Note:
Bold values represent concentrations that are higher than analytical detection limits.

Annex A.3-4. QA/QC Blank Data for Water Quality Sampling, Doris Project, 2016

Blank Type:		Travel Blank (Marine)	Field Blank (Freshwater)	Travel Blank (Freshwater)	Field Blank (Freshwater)	Travel Blank (Freshwater)	Equipment Blank (Marine)	Field Blank (Marine)	Travel Blank (Marine)
Date Sampled:		**13-Aug-2016**	**19-Aug-2016**	**19-Aug-2016**	**20-Aug-2016**	**20-Aug-2016**	**14-Sep-2016**	**15-Sep-2016**	**15-Sep-2016**
ALS Sample ID:	**Units**	**L1814606-7**	**L1817820-16**	**L1817820-15**	**L1817820-14**	**L1817820-13**	**L1830320-7**	**L1830320-6**	**L1830320-5**
Physical Tests									
Conductivity	uS/cm	-	<2.0	<2.0	<2.0	<2.0	-	-	-
Hardness (as $CaCO_3$)	mg/L	<4.3	<0.50	<0.50	<0.50	<0.50	<4.3	<4.3	<4.3
pH	pH	5.27	5.40	5.44	5.32	5.35	5.34	5.37	5.36
Salinity	psu	<1.0	-	-	-	-	<1.0	<1.0	<1.0
Total Suspended Solids	mg/L	<2.0	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Total Dissolved Solids	mg/L	<10	<10	<10	<10	<10	<10	<10	<10
Turbidity	NTU	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Anions and Nutrients									
Alkalinity, Total (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	<0.0050	<0.0050	**0.0076**	<0.0050	**0.0057**	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate and Nitrite (as N)	mg/L	<0.0060	-	-	-	-	<0.0060	<0.0060	<0.0060
Nitrate (as N)	mg/L	<0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060	<0.0060	<0.0060
Nitrite (as N)	mg/L	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulfate (SO_4)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Cyanides									
Cyanide, Total	mg/L	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon									
Dissolved Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals									
Aluminum (Al)	mg/L	<0.0050	<0.0030	<0.0030	<0.0030	<0.0030	<0.0050	<0.0050	<0.0050
Antimony (Sb)	mg/L	<0.00050	<0.000030	<0.000030	<0.000030	<0.000030	<0.00050	<0.00050	<0.00050
Arsenic (As)	mg/L	<0.00040	<0.000050	<0.000050	<0.000050	<0.000050	<0.00040	<0.00040	<0.00040
Barium (Ba)	mg/L	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0010	<0.0010	<0.0010
Beryllium (Be)	mg/L	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050
Bismuth (Bi)	mg/L	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	<0.10	<0.010	<0.010	<0.010	<0.010	<0.10	<0.10	<0.10
Cadmium (Cd)	mg/L	<0.000010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	<0.50	<0.050	<0.050	<0.050	<0.050	<0.50	<0.50	<0.50
Cesium (Cs)	mg/L	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050
Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	<0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050
Gallium (Ga)	mg/L	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	<0.010	<0.030	<0.030	<0.030	<0.030	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.020	<0.00040	<0.00040	<0.00040	<0.00040	<0.020	<0.020	<0.020
Magnesium (Mg)	mg/L	<1.0	<0.10	<0.10	<0.10	<0.10	<1.0	<1.0	<1.0
Manganese (Mn)	mg/L	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050	<0.000050	<0.000050
Mercury (Hg)	ug/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	<0.0020	<0.000050	<0.000050	<0.000050	<0.000050	<0.0020	<0.0020	<0.0020
Nickel (Ni)	mg/L	<0.000050	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050	<0.000050	<0.000050
Phosphorus (P)	mg/L	<1.0	<0.30	<0.30	<0.30	<0.30	<1.0	<1.0	<1.0
Potassium (K)	mg/L	<20	<2.0	<2.0	<2.0	<2.0	<20	<20	<20
Rhenium (Re)	mg/L	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050
Rubidium (Rb)	mg/L	<0.0050	<0.000020	<0.000020	<0.000020	<0.000020	<0.0050	<0.0050	<0.0050
Selenium (Se)	mg/L	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050	<0.00050
Silicon (Si)	mg/L	<0.50	<0.050	<0.050	<0.050	<0.050	<0.50	<0.50	<0.50
Silver (Ag)	mg/L	<0.00010	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00010	<0.00010	<0.00010
Sodium (Na)	mg/L	<20	<2.0	<2.0	<2.0	<2.0	<20	<20	<20
Strontium (Sr)	mg/L	<0.050	<0.00020	<0.00020	<0.00020	<0.00020	<0.050	<0.050	<0.050
Tellurium (Te)	mg/L	<0.00050	<0.000010	<0.000010	<0.000010	<0.000010	<0.00050	<0.00050	<0.00050
Thallium (Tl)	mg/L	<0.000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.000050	<0.000050	<0.000050
Thorium (Th)	mg/L	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050
Tin (Sn)	mg/L	<0.0010	<0.00020	<0.00020	<0.00020	<0.00020	<0.0010	<0.0010	<0.0010
Titanium (Ti)	mg/L	<0.0050	<0.00020	<0.00020	<0.00020	<0.00020	<0.0050	<0.0050	<0.0050
Tungsten (W)	mg/L	<0.0010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0010	<0.0010	<0.0010
Uranium (U)	mg/L	<0.000050	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.000050	<0.000050	<0.000050
Vanadium (V)	mg/L	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050
Yttrium (Y)	mg/L	<0.00050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L	<0.00080	<0.0030	<0.0030	<0.0030	<0.0030	<0.00080	<0.00080	<0.00080
Zirconium (Zr)	mg/L	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00050	<0.00050	<0.00050
Radiological Parameters									
Ra-226	Bq/L	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	-	-

Note:
Bold values represent concentrations that are higher than analytical detection limits.

Annex A.3-4. QA/QC Blank Data for Water Quality Sampling, Doris Project, 2016

Blank Type:		**Equipment Blank (Freshwater)**	**Field Blank (Freshwater)**	**Travel Blank (Freshwater)**
Date Sampled:		**16-Sep-2016**	**19-Sep-2016**	**19-Sep-2016**
ALS Sample ID:	**Units**	**L1831856-1**	**L1831856-14**	**L1831856-15**
Physical Tests				
Conductivity	uS/cm	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50
pH	pH	5.27	5.27	5.32
Salinity	psu	-	-	-
Total Suspended Solids	mg/L	<1.0	<1.0	<1.0
Total Dissolved Solids	mg/L	52	<10	<10
Turbidity	NTU	<0.10	<0.10	<0.10
Anions and Nutrients				
Alkalinity, Total (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	<0.0050	<0.0050	<0.0050
Bromide (Br)	mg/L	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	<0.020	<0.020	<0.020
Nitrate and Nitrite (as N)	mg/L	-	-	-
Nitrate (as N)	mg/L	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	<0.050	<0.050	<0.050
Orthophosphate-Dissolved (as P)	mg/L	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	mg/L	<0.0020	<0.0020	<0.0020
Sulfate (SO_4)	mg/L	<0.30	<0.30	<0.30
Cyanides				
Cyanide, Total	mg/L	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon				
Dissolved Organic Carbon	mg/L	<0.50	<0.50	-
Total Organic Carbon	mg/L	<0.50	<0.50	<0.50
Total Metals				
Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L	<0.000030	<0.000030	<0.000030
Arsenic (As)	mg/L	<0.000050	<0.000050	<0.000050
Barium (Ba)	mg/L	<0.00010	<0.00010	<0.00010
Beryllium (Be)	mg/L	<0.0000050	<0.0000050	<0.0000050
Bismuth (Bi)	mg/L	<0.000050	<0.000050	<0.000050
Boron (B)	mg/L	<0.010	<0.010	<0.010
Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)	mg/L	<0.050	<0.050	<0.050
Cesium (Cs)	mg/L	<0.0000050	<0.0000050	<0.0000050
Chromium (Cr)	mg/L	<0.00050	<0.00050	<0.00050
Cobalt (Co)	mg/L	<0.000050	<0.000050	<0.000050
Copper (Cu)	mg/L	<0.00050	<0.00050	<0.00050
Gallium (Ga)	mg/L	<0.000050	<0.000050	<0.000050
Iron (Fe)	mg/L	<0.030	<0.030	<0.030
Lead (Pb)	mg/L	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	<0.00040	<0.00040	<0.00040
Magnesium (Mg)	mg/L	<0.10	<0.10	<0.10
Manganese (Mn)	mg/L	<0.00020	<0.00020	<0.00020
Mercury (Hg)	ug/L	<0.00050	<0.00050	<0.00050
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	<0.00020	<0.00020	<0.00020
Phosphorus (P)	mg/L	<0.30	<0.30	<0.30
Potassium (K)	mg/L	<2.0	<2.0	<2.0
Rhenium (Re)	mg/L	<0.0000050	<0.0000050	<0.0000050
Rubidium (Rb)	mg/L	<0.000020	<0.000020	<0.000020
Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020
Silicon (Si)	mg/L	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	<0.0000050	0.000005	<0.0000050
Sodium (Na)	mg/L	<2.0	<2.0	<2.0
Strontium (Sr)	mg/L	<0.00020	<0.00020	<0.00020
Tellurium (Te)	mg/L	<0.000010	<0.000010	<0.000010
Thallium (Tl)	mg/L	<0.0000050	<0.0000050	<0.0000050
Thorium (Th)	mg/L	<0.0000050	<0.0000050	<0.0000050
Tin (Sn)	mg/L	<0.00020	<0.00020	<0.00020
Titanium (Ti)	mg/L	<0.00020	<0.00020	<0.00020
Tungsten (W)	mg/L	<0.000010	<0.000010	<0.000010
Uranium (U)	mg/L	<0.0000020	<0.0000020	<0.0000020
Vanadium (V)	mg/L	<0.000050	<0.000050	<0.000050
Yttrium (Y)	mg/L	<0.0000050	<0.0000050	<0.0000050
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030
Zirconium (Zr)	mg/L	<0.000050	<0.000050	<0.000050
Radiological Parameters				
Ra-226	Bq/L	-	<0.0100	-

Note:
Bold values represent concentrations that are higher than analytical detection limits.

A.4 2016 SEDIMENT QUALITY

The following sections present the sediment quality data collected in August 2016 from stream, lake, and marine sites. Only the variables that were subjected to an evaluation of effects (see main body of report) are shown graphically. All sediment quality variables were screened against CCME sediment quality guidelines for the protection of aquatic life (CCME 2016a). CCME guidelines for sediments include interim sediment quality guidelines (ISQGs) and probable effects levels (PELs). The more conservative ISQGs are levels below which adverse biological effects are rarely observed. The higher PELs correspond to concentrations above which negative effects would be expected. CCME guidelines are included in all graphs and annexes.

A.4.1 Stream Data

Figures A.4-1 to A.4-5 show select sediment quality variable concentrations in the AEMP streams. Annex A.4-1 presents the full stream sediment quality dataset.

A.4.2 Lake Data

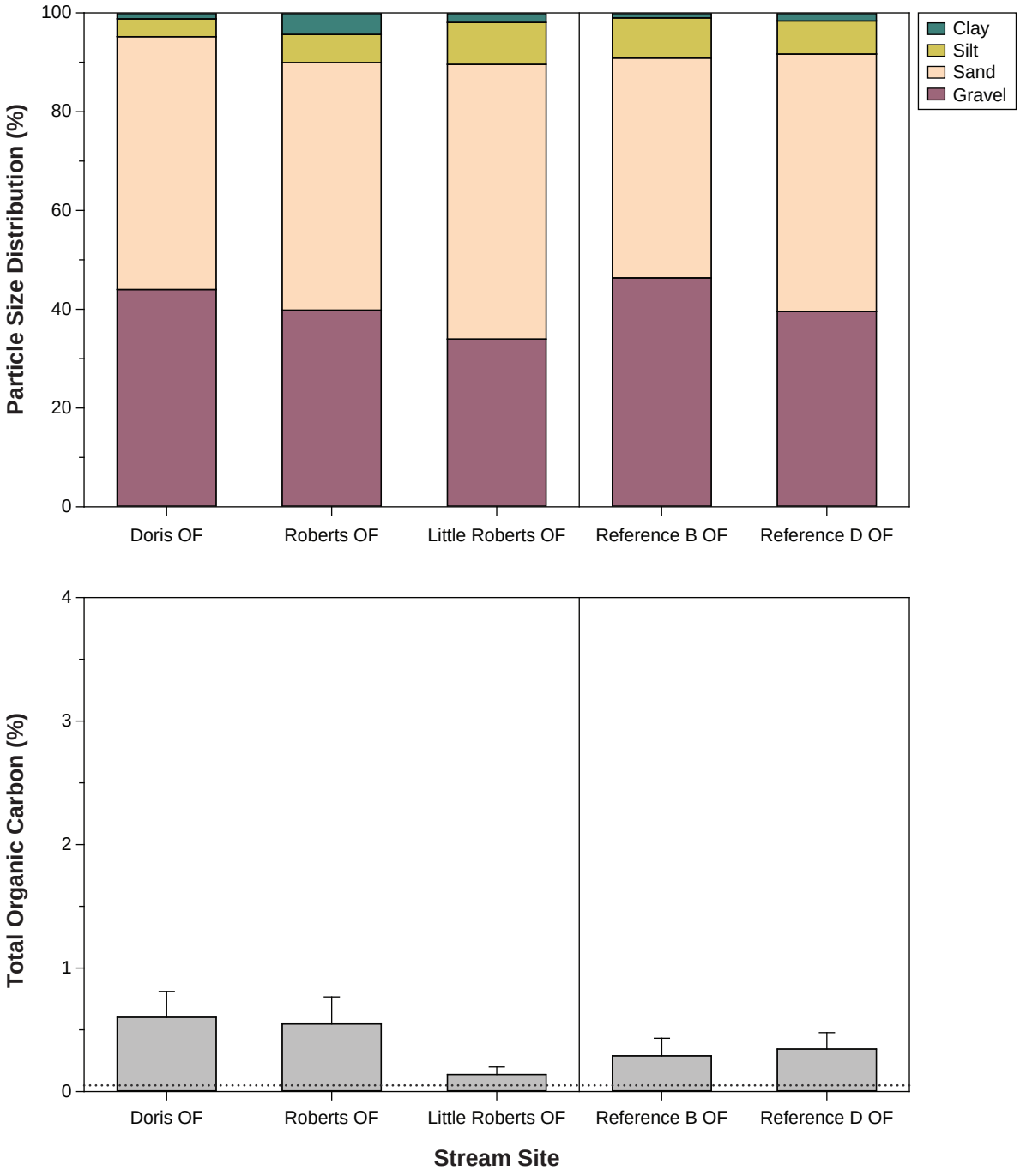
Figures A.4-6 to A.4-10 show select sediment quality variable concentrations in the AEMP lakes. Annex A.4-2 presents the full lake sediment quality dataset.

A.4.3 Marine Data

Figures A.4-11 to A.4-15 show select sediment quality variable concentrations at the AEMP marine sites. Annex A.4-3 presents the full marine sediment quality dataset.

Figure A.4-1

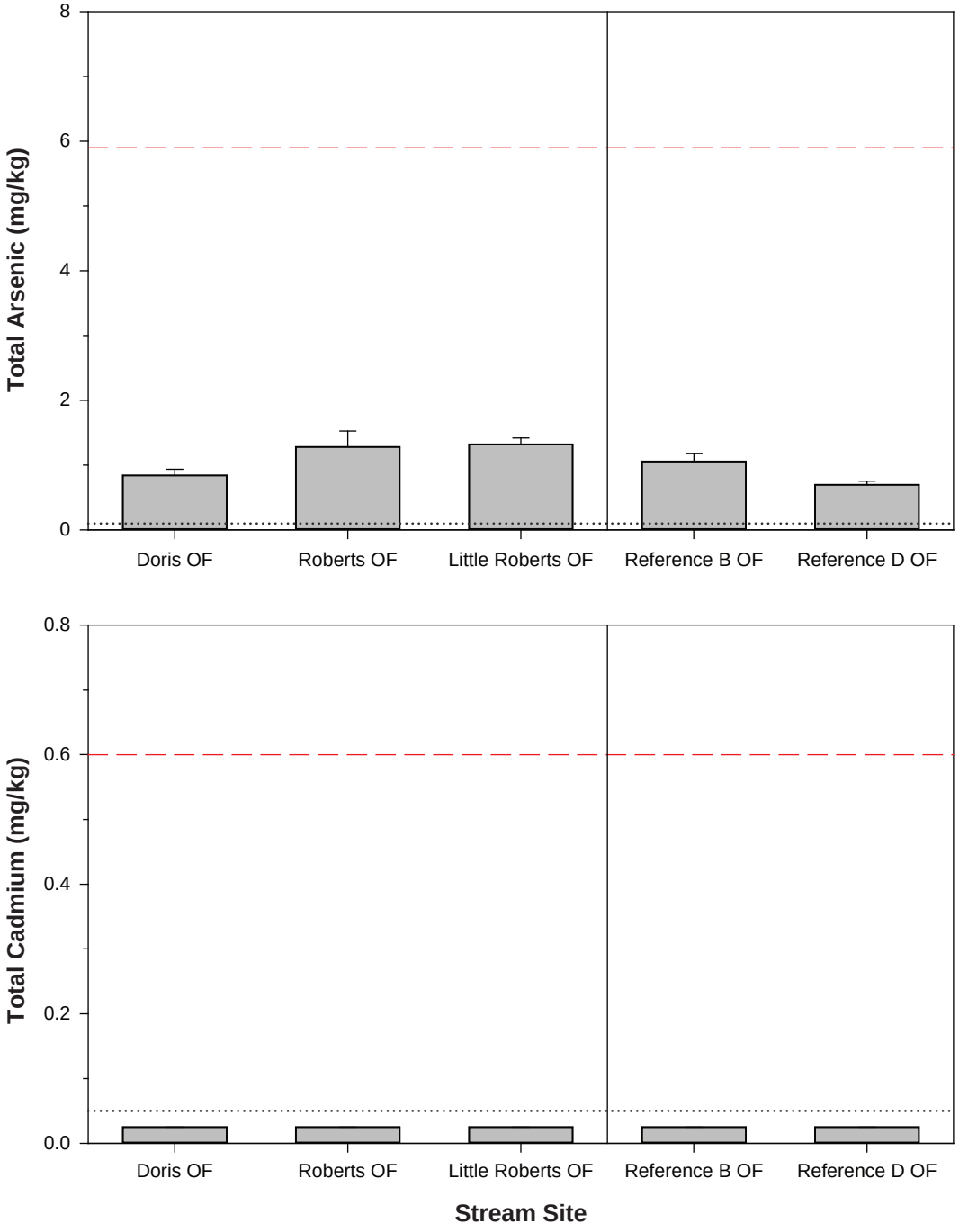
Particle Size Distribution and Total Organic Carbon Concentration in Stream Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Stacked bars represent the mean of replicate samples.
Dotted line represents the analytical detection limit; values below the detection limit are plotted at half the detection limit.
Particle size distribution and total organic carbon content of sediments are required parameters as part of benthic invertebrate surveys as per Schedule 5, s.16a (iii) of the MMER.

Figure A.4-2

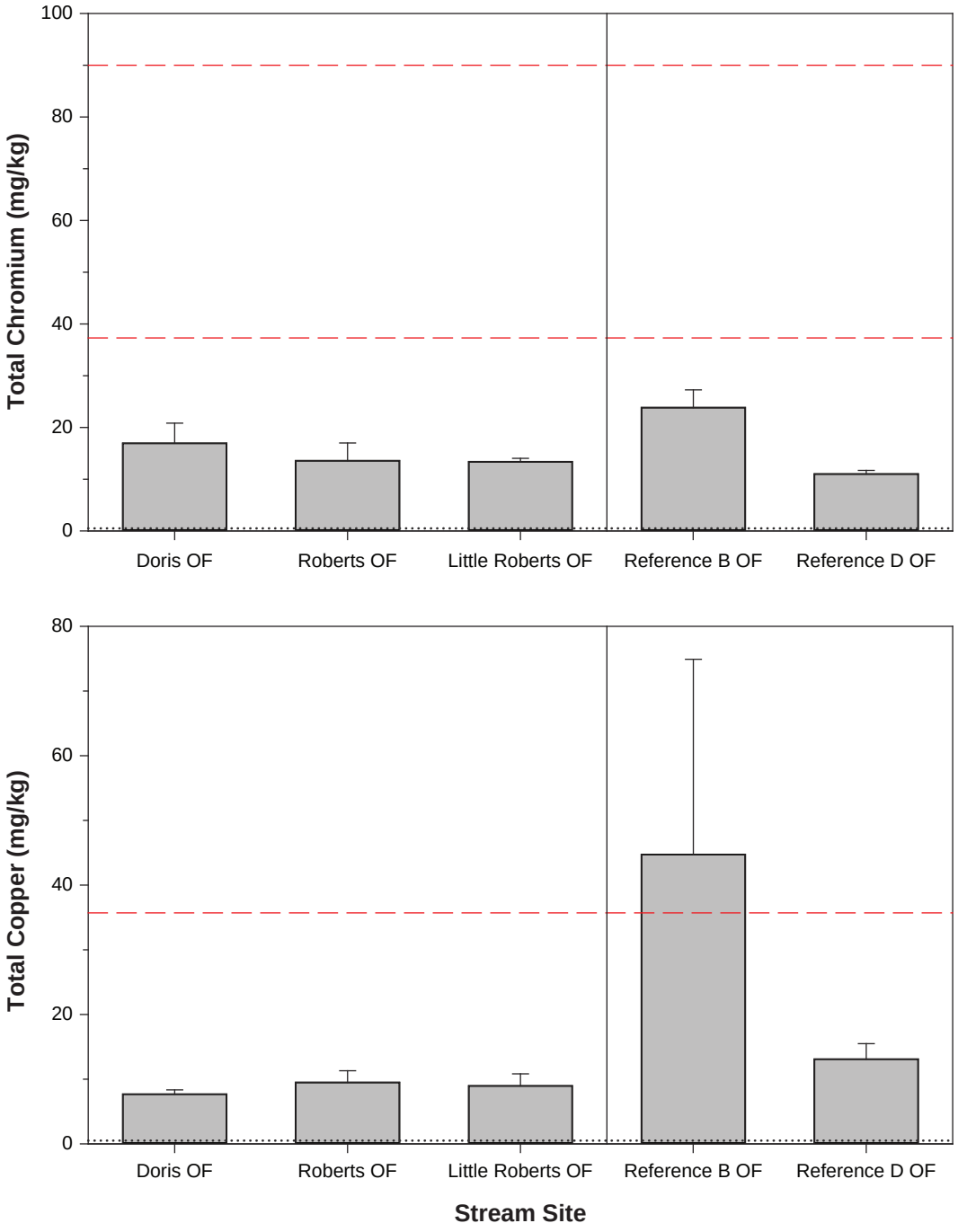
Total Arsenic and Total Cadmium Concentrations in Stream Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for arsenic (5.9 mg/kg) and cadmium (0.6 mg/kg); probable effects levels (PELs) for arsenic (17 mg/kg) and cadmium (3.5 mg/kg) are not shown.

Figure A.4-3

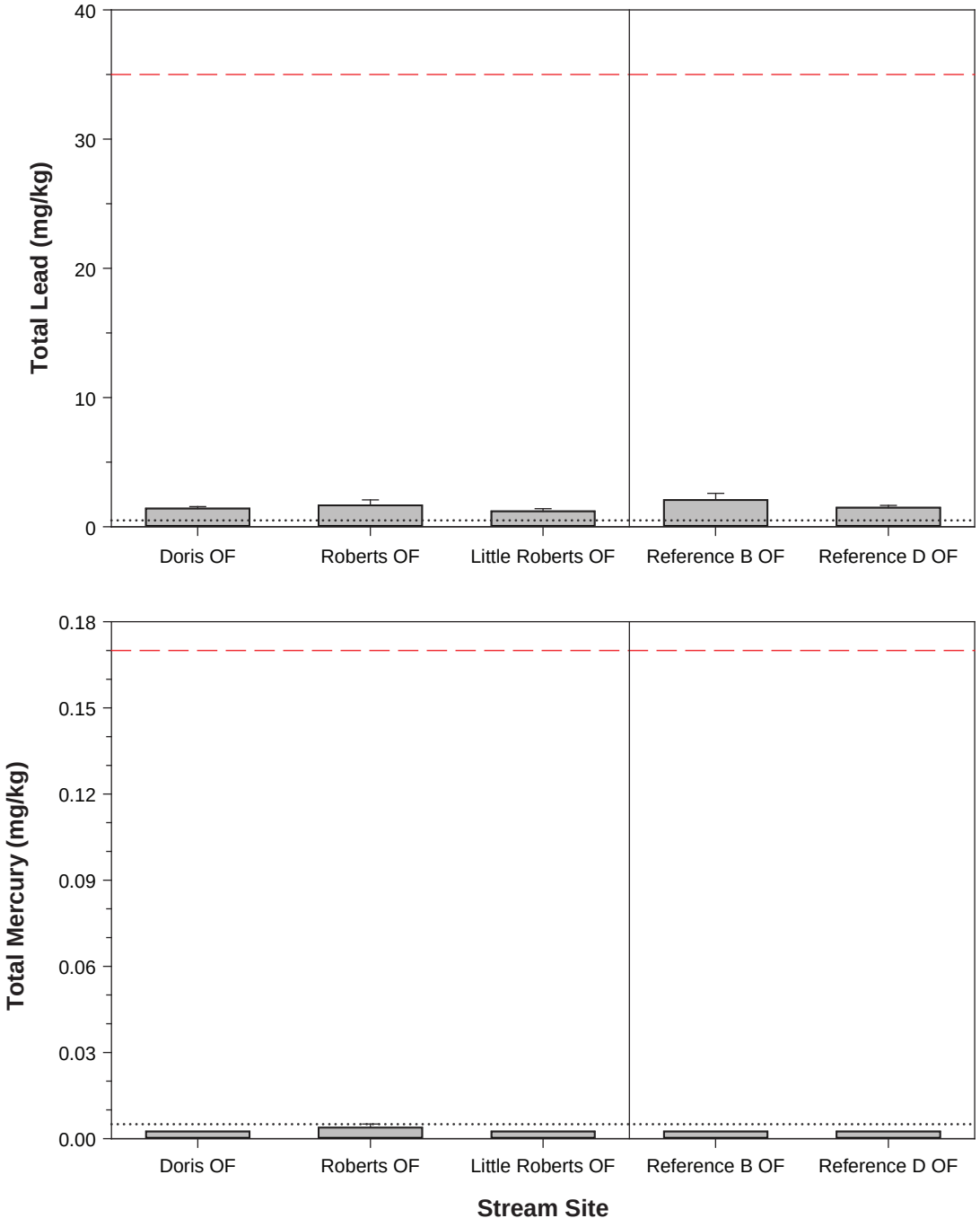
Total Chromium and Total Copper Concentrations in Stream Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for chromium (37.3 mg/kg) and copper (35.7 mg/kg) and the probable effects level (PEL) for chromium (90 mg/kg); the PEL for copper (197 mg/kg) is not shown.

Figure A.4-4

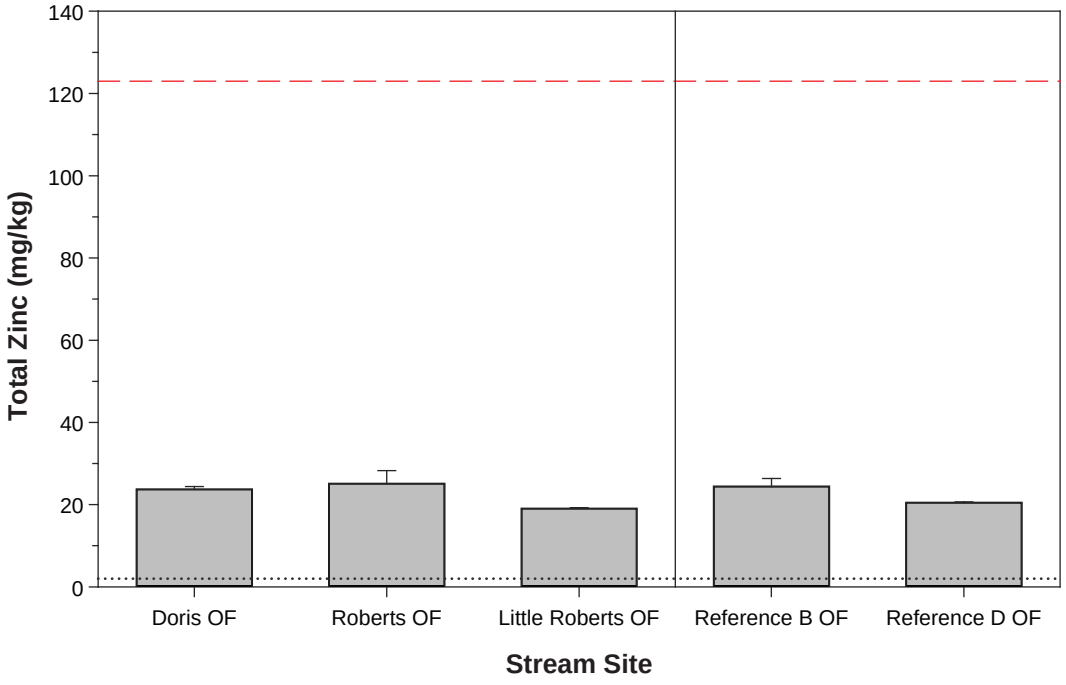
Total Lead and Total Mercury Concentrations in Stream Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for lead (35 mg/kg) and mercury (0.17 mg/kg); probable effects levels (PELs) for lead (91.3 mg/kg) and mercury (0.486 mg/kg) are not shown.

Figure A.4-5

Total Zinc Concentrations in Stream Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted line represents the analytical detection limit; values below the detection limit are plotted at half the detection limit.
Dashed line represents the CCME freshwater interim sediment quality guideline (ISQG) for zinc (123 mg/kg);
the probable effects level (PEL) for zinc (315 mg/kg) is not shown.

Annex A.4-1. Stream Sediment Quality Data, Doris Project, 2016

Site ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realized Detection Limit	Doris OF			Roberts OF			Little Roberts OF			Reference B OF			Reference D OF		
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					14-Aug-16	14-Aug-16	14-Aug-16	16-Aug-16	16-Aug-16	16-Aug-16	19-Aug-16	19-Aug-16	19-Aug-16	17-Aug-16	17-Aug-16	17-Aug-16	18-Aug-16	18-Aug-16	18-Aug-16
ALS Sample ID:	Unit	ISQG[b]	PEL[c]		L1817834-4	L1817834-5	L1817834-6	L1817834-10	L1817834-11	L1817834-12	L1817834-19	L1817834-20	L1817834-21	L1817834-13	L1817834-14	L1817834-15	L1817834-16	L1817834-17	L1817834-18
Physical Tests																			
Moisture	%			0.25	24.9	19.7	15.4	26.7	23.9	16.4	20.1	13.0	17.6	16.5	12.7	11.9	17.8	15.6	17.4
pH	pH			0.10	7.03	6.32	7.20	5.92	6.64	7.31	7.06	7.14	7.02	6.81	6.91	7.15	6.58	6.72	6.65
Particle Size																			
% Gravel (>2 mm)	%			0.10	46.4	36.8	48.9	0.23	58.9	60.4	51.9	22.8	27.2	59.4	15.8	63.9	22.0	55.5	41.2
% Sand (2.0 mm - 0.063 mm)	%			0.10	48.5	55.7	49.4	75.0	36.9	38.4	41.0	66.2	59.6	37.4	64.5	31.6	65.1	38.9	52.3
% Silt (0.063 mm - 4 µm)	%			0.10	3.74	5.87	1.20	14.1	2.34	0.65	5.68	9.03	10.8	2.66	17.7	4.09	11.0	4.0	5.15
% Clay (<4 µm)	%			0.10	1.37	1.62	0.49	10.6	1.92	0.57	1.49	1.96	2.46	0.53	2.05	0.40	1.91	1.56	1.38
Texture	-			-	Sand	Sand	Sand	Sandy loam	Sand	Sand	Loamy sand	Sand	Loamy sand	Sand	Loamy sand	Sand	Loamy sand	Sand	Sand
Anions & Nutrients																			
Total Nitrogen	%			0.020	0.039	0.060	<0.020	0.070	0.062	0.023	0.026	<0.020	<0.020	0.049	<0.020	<0.020	0.023	0.049	<0.020
Organic Carbon																			
Total Organic Carbon	%			0.050 or 0.075	0.572	0.976	0.256	0.901	0.594	0.148	0.257	0.105	0.051	0.568	0.194	0.105	0.193	0.610	0.226
Plant Available Nutrients																			
Available Ammonium-N	mg/kg			1.0	4.0	5.1	1.9	17.4	4.2	2.7	2.2	1.4	1.3	2.3	1.3	1.1	2.6	2.9	1.4
Nitrate+Nitrite-N	mg/kg			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
Available Nitrate-N	mg/kg			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
Available Nitrite-N	mg/kg			0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate-P	mg/kg			2.0	6.1	4.3	2.9	3.9	6.0	3.9	3.3	3.0	2.8	2.1	<2.0	2.7	3.5	3.8	3.2
Metals																			
Aluminum (Al)	mg/kg			50	8280	6790	7010	7910	6270	5320	5480	5880	5710	8680	6060	7210	6320	6650	6170
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	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.10	0.87	0.99	0.66	1.74	1.20	0.90	1.49	1.33	1.14	1.31	0.94	0.92	0.63	0.81	0.65
Barium (Ba)	mg/kg			0.50	19.6	22.1	12.6	40.8	22.2	16.4	19.8	17.2	16.2	22.5	16.9	17.9	17.0	22.9	19.6
Beryllium (Be)	mg/kg			0.10	0.14	0.14	0.10	0.22	0.15	0.10	0.13	0.10	0.12	0.17	0.12	0.12	0.15	0.17	0.13
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	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	mg/kg			5.00	<5.0	<5.0	<5.0	5.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Calcium (Ca)	mg/kg			50	2030	1890	1800	2240	1790	1660	1880	1770	2130	2520	1880	2330	2330	2430	1920
Chromium (Cr)	mg/kg	37.3	90	0.50	24.6	14.6	11.6	19.4	13.8	7.52	12.3	13.2	14.6	28.8	17.2	25.5	10.6	12.4	10.0
Cobalt (Co)	mg/kg			0.10	6.31	4.66	5.36	5.49	4.67	4.21	4.19	4.85	4.42	7.55	5.05	8.50	4.24	4.26	4.97
Copper (Cu)	mg/kg	35.7	197	0.50	8.18	8.47	6.39	11.9	10.6	5.94	6.02	12.4	8.44	17.8	11.3	105	9.83	11.6	17.8
Iron (Fe)	mg/kg			50	14700	11900	13300	13300	11500	9760	10200	11600	9840	15300	10600	14100	11000	11200	10200
Lead (Pb)	mg/kg	35	91.3	0.50	1.50	1.62	1.14	2.50	1.37	1.10	1.52	0.83	1.26	3.06	1.87	1.27	1.30	1.84	1.31
Lithium (Li)	mg/kg			2.0	12.2	11.2	11.0	15.9	11.8	12.1	11.4	12.0	11.3	18.4	11.1	13.7	14.8	14.6	14.6
Magnesium (Mg)	mg/kg			20	5280	4430	4690	5590	4810	4470	4180	4760	4470	6150	4460	5920	4510	4380	4640
Manganese (Mn)	mg/kg			1.0	179	137	168	163	159	218	167	188	142	373	152	332	131	128	148
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	<0.0050	<0.0050	<0.0050	0.0064	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg			0.10	0.15	0.27	0.11	0.35	0.14	0.14	0.17	0.22	0.18	0.37	0.19	0.26	0.15	0.21	0.19
Nickel (Ni)	mg/kg			0.50	14.3	10.1	8.95	11.8	9.44	7.18	8.13	9.89	9.02	16.3	10.3	14.5	8.39	8.76	8.55
Phosphorus (P)	mg/kg			50	295	317	327	400	366	325	310	281	289	389	316	436	322	338	352
Potassium (K)	mg/kg			100	970	1080	660	1760	1010	730	850	750	780	930	590	580	770	980	920
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			50	218	211	121	353	246	116	173	114	205	107	99	107	231	284	209
Strontium (Sr)	mg/kg			0.50	10.9	8.97	8.22	12.6	8.05	8.16	8.53	7.12	9.39	12.8	8.52	9.36	13.4	13.0	10.2
Sulphur (S)	mg/kg			500	700	600	<500	600	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium (Tl)	mg/kg			0.050	<0.050	<0.050	<0.050	0.074	<0.050	<0.050	0.053	<0.050	<0.050	0.084	<0.050	0.050	<0.050	<0.050	<0.050
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	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	443	410	328	511	358	273	371	357	400	682	519	527	441	491	454
Uranium (U)	mg/kg			0.050	0.409	0.456	0.271	0.619	0.376	0.280	0.405	0.274	0.324	0.756	0.526	0.471	0.549	1.37	0.630
Vanadium (V)	mg/kg			0.20	29.4	25.6	25.4	25.8	25.2	18.4	20.8	26.4	22.9	29.9	22.6	28.6	28.0	28.5	24.1
Zinc (Zn)	mg/kg	123	315	2.0	25.0	22.5	23.5	30.7	24.9	19.7	18.7	19.0	19.4	28.1	21.5	23.6	20.8	20.1	20.5

Notes:

Shaded cells indicate values that exceed CCME guidelines (light grey ISQG, dark grey PEL).

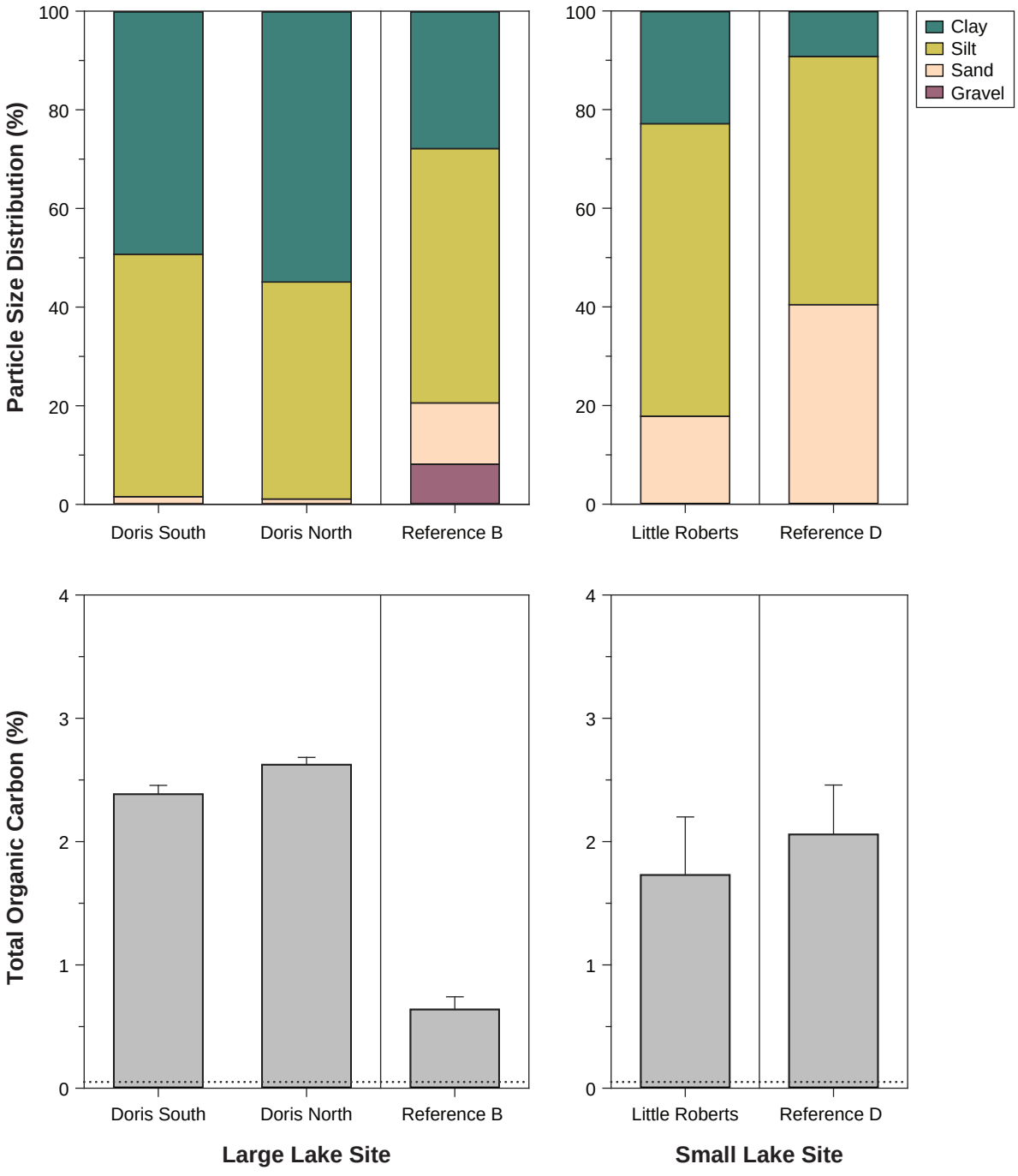
[a] *Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *ISQG = Interim Sediment Quality Guideline*

[c] *PEL = Probable Effects Level*

Figure A.4-6

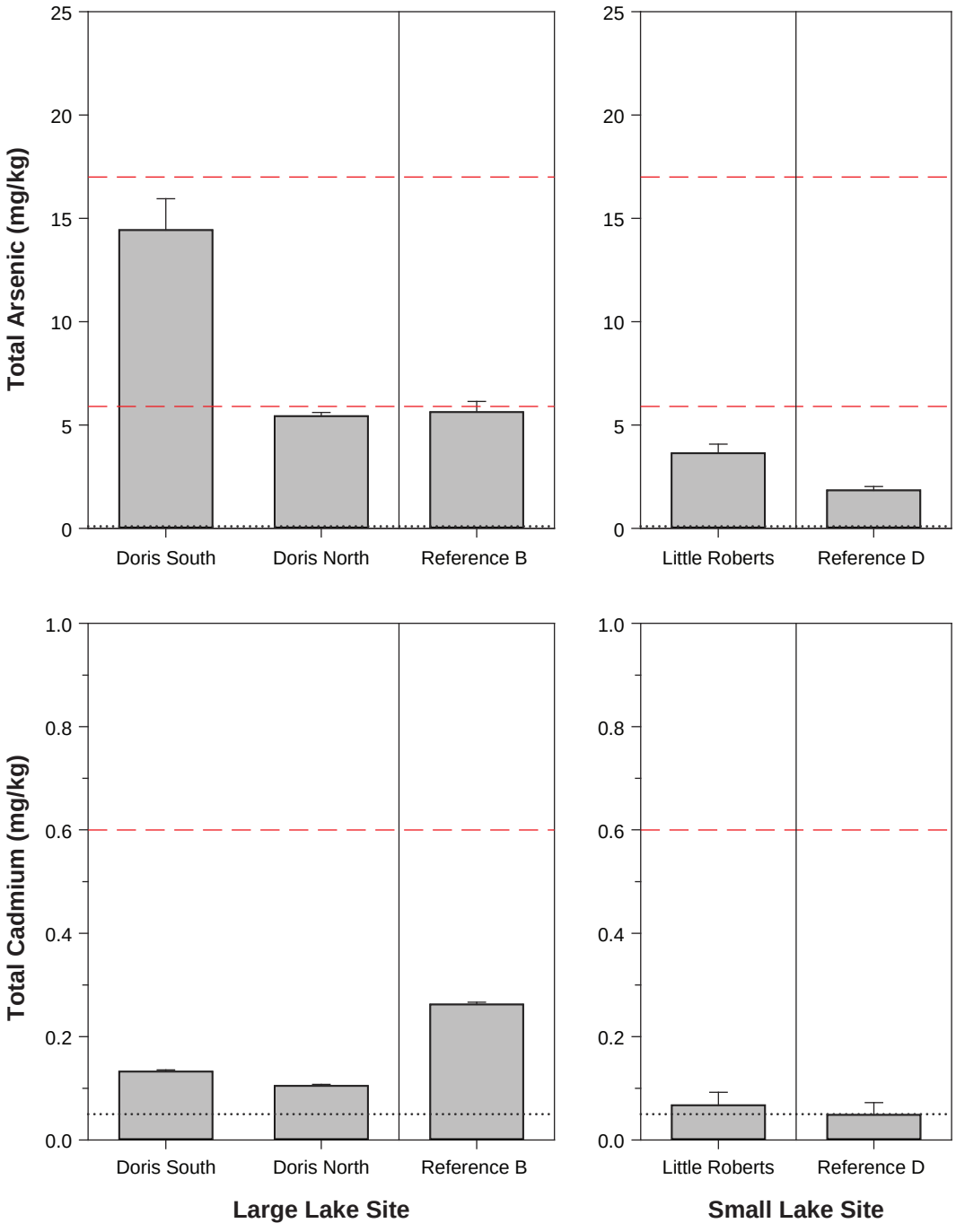
Particle Size Distribution and Total Organic Carbon Concentration in Lake Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Stacked bars represent the mean of replicate samples.
Dotted line represents the analytical detection limit; values below the detection limit are plotted at half the detection limit.
Particle size distribution and total organic carbon content of sediments are required parameters as part of benthic invertebrate surveys as per Schedule 5, s.16a (iii) of the MMER.

Figure A.4-7

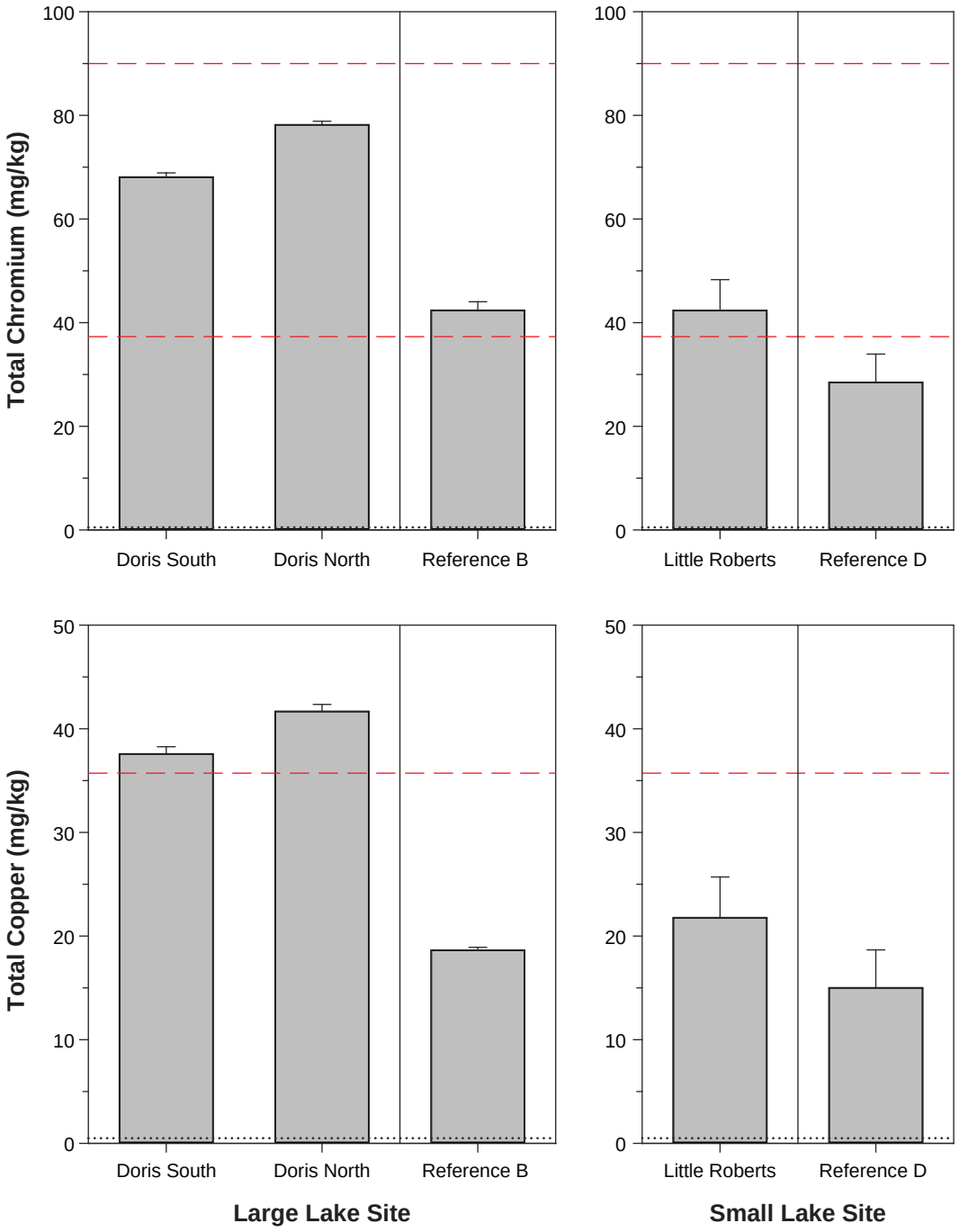
Total Arsenic and Total Cadmium Concentrations in Lake Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for arsenic (5.9 mg/kg) and cadmium (0.6 mg/kg) and the probable effects level (PEL) for arsenic (17 mg/kg); the PEL for cadmium (3.5 mg/kg) is not shown.

Figure A.4-8

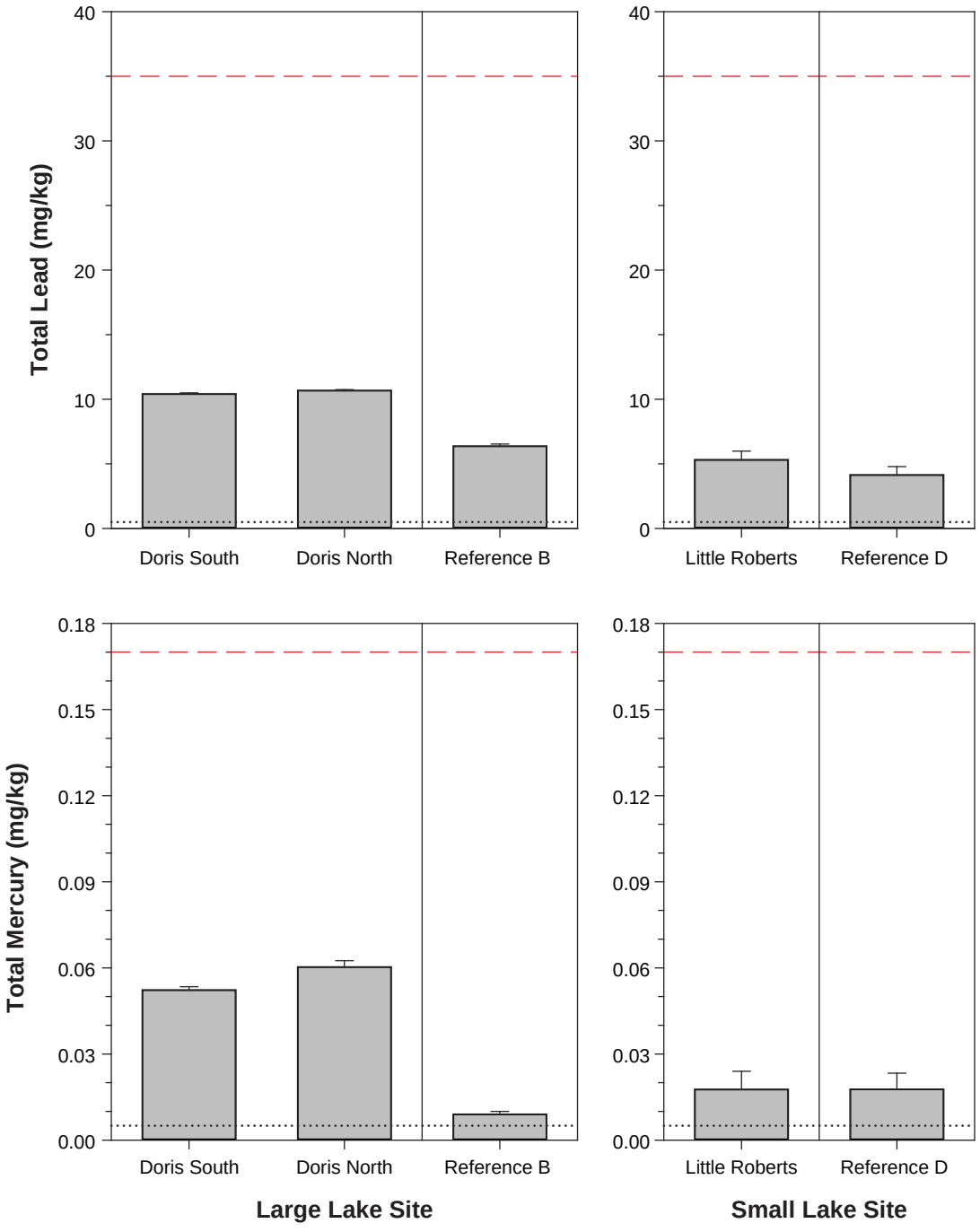
Total Chromium and Total Copper Concentrations in Lake Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for chromium (37.3 mg/kg) and copper (35.7 mg/kg) and the probable effects level (PEL) for chromium (90 mg/kg); the PEL for copper (197 mg/kg) is not shown.

Figure A.4-9

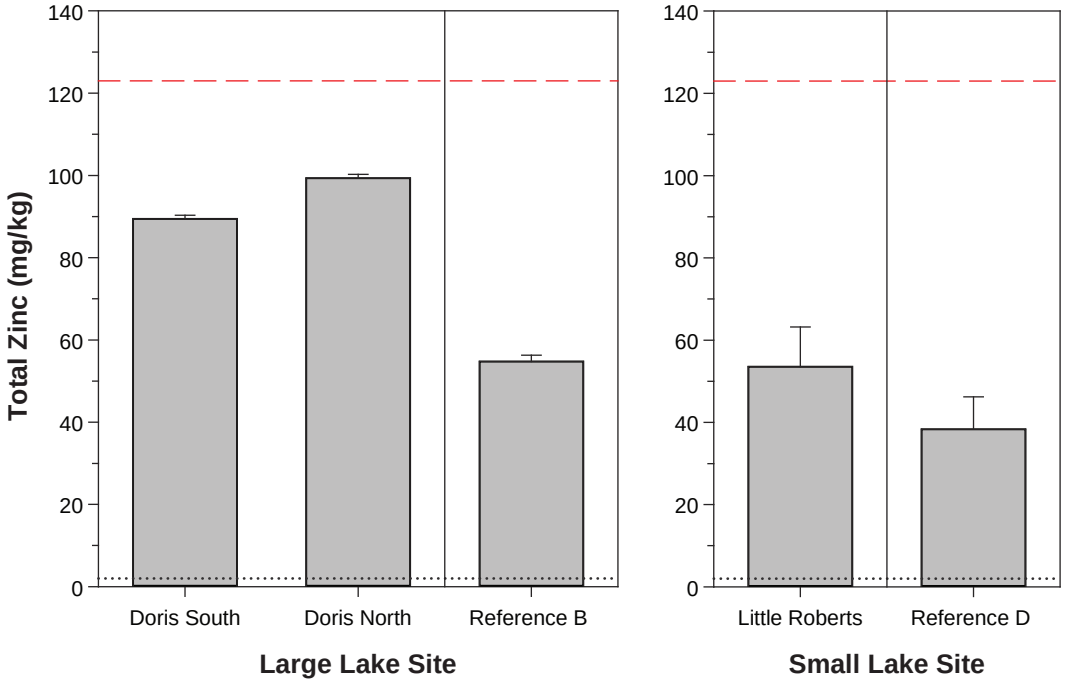
Total Lead and Total Mercury Concentrations in Lake Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME freshwater interim sediment quality guidelines (ISQGs) for lead (35 mg/kg) and mercury (0.17 mg/kg); probable effects levels (PELs) for lead (91.3 mg/kg) and mercury (0.486 mg/kg) are not shown.

Figure A.4-10

Total Zinc Concentrations in Lake Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted line represents the analytical detection limit; values below the detection limit are plotted at half the detection limit.
Dashed line represents the CCME freshwater interim sediment quality guideline (ISQG) for zinc (123 mg/kg);
the probable effects level (PEL) for zinc (315 mg/kg) is not shown.

Annex A.4-2. Lake Sediment Quality Data, Doris Project, 2016

Site ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realized Detection Limit	Doris South			Doris North			Reference B			Little Roberts			Reference D		
Date Sampled:					20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	20-Aug-16	21-Aug-16	10-Aug-16	10-Aug-16	10-Aug-16	15-Aug-16	15-Aug-16	15-Aug-16	11-Aug-16	11-Aug-16	11-Aug-16
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Depth Sampled (m):					10.5	10.0	9.0	14.0	14.0	14.0	10.2	10.0	10.0	2.0	2.0	2.5	2.0	2.0	2.0
ALS Sample ID:	Unit	ISQG[b]	PEL[c]		L1817834-37	L1817834-38	L1817834-39	L1817834-22	L1817834-23	L1817834-24	L1817834-25	L1817834-26	L1817834-27	L1817834-7	L1817834-8	L1817834-9	L1817834-28	L1817834-29	L1817834-30
Physical Tests																			
Moisture	%			0.25	75.4	72.2	73.6	72.4	71.8	72.6	47.1	45.1	45.7	55.3	36.6	69.8	62.5	53.4	49.9
pH	pH			0.10	6.00	5.81	6.19	5.67	5.81	5.73	5.42	5.67	5.71	6.04	6.04	5.68	6.11	6.07	6.21
Particle Size																			
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	24.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0 mm - 0.063 mm)	%			0.10	1.28	1.29	2.04	1.12	1.01	1.10	15.9	12.0	9.33	20.1	31.8	1.53	8.45	53.2	59.6
% Silt (0.063 mm - 4 µm)	%			0.10	48.0	46.3	53.2	44.0	42.5	45.4	56.9	56.2	41.6	59.7	52.3	65.9	77.7	39.0	34.2
% Clay (<4 µm)	%			0.10	50.7	52.4	44.8	54.9	56.5	53.6	27.2	31.8	24.7	20.2	15.9	32.5	13.9	7.78	6.16
Texture	-			-	Silty clay	Silty clay	Silt Clay loam/Silty clay	Silty clay	Silty clay	Silty clay	Silt loam	Silty clay loam	Silty clay loam	Silt loam	Silt loam	Silt loam	Silt	Sandy loam	Sandy loam
Anions and Nutrients																			
Total Nitrogen	%			0.020	0.305	0.271	0.293	0.337	0.331	0.327	0.084	0.070	0.057	0.181	0.089	0.284	0.261	0.155	0.147
Organic Carbon																			
Total Organic Carbon	%			0.050	2.47	2.24	2.44	2.58	2.74	2.55	0.83	0.599	0.485	1.65	0.955	2.58	2.86	1.67	1.64
Plant Available Nutrients																			
Available Ammonium-N	mg/kg			1.6	32.2	33.8	23.6	34.1	32.8	36.7	4.6	5.5	5.2	12.3	9.2	40.6	12.8	8.4	7.5
Nitrate+Nitrite-N	mg/kg			4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<4.0	<4.0	<4.0	<4.0
Available Nitrate-N	mg/kg			4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<4.0	<4.0	<4.0	<4.0
Available Nitrite-N	mg/kg			0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.40	<0.40	<0.80	<0.80	<0.80	<0.80
Available Phosphate-P	mg/kg			2.0	2.9	2.1	<2.0	<2.0	2.4	2.3	<2.0	2.2	2.1	3.8	2.9	2	9.7	4.3	3.6
Metals																			
Aluminum (Al)	mg/kg			50	25400	26200	25100	28300	29000	29200	14900	16800	17600	14800	11500	19000	15300	10400	9050
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.18	0.19	0.22	<0.10	<0.10	0.11	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.10	16.1	11.4	15.8	5.78	5.17	5.35	4.62	5.90	6.36	3.08	3.31	4.51	2.22	1.67	1.64
Barium (Ba)	mg/kg			0.50	194	190	190	169	169	171	80.7	91.5	96.6	86.7	63.6	117	81.0	51.7	46.0
Beryllium (Be)	mg/kg			0.10	0.9	0.91	0.87	0.98	0.97	0.93	0.47	0.53	0.55	0.45	0.34	0.59	0.45	0.3	0.27
Bismuth (Bi)	mg/kg			0.20	0.24	0.24	0.24	0.25	0.24	0.25	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	mg/kg			5.0	18.6	19.4	17.9	20.4	20.0	17.5	11.7	13.9	14.9	10.8	8.3	13.3	11.9	8.5	7.3
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	0.138	0.132	0.127	0.100	0.110	0.104	0.270	0.255	0.262	0.066	<0.050	0.111	0.096	<0.050	<0.050
Calcium (Ca)	mg/kg			50	5870	6030	6060	6560	6570	6170	3720	4210	4390	4730	3980	5900	5050	3730	3370
Chromium (Cr)	mg/kg	37.3	90	0.50	67.7	69.7	66.8	77.1	77.9	79.5	39.1	43.3	44.7	41.2	32.6	53.2	39.3	24.6	21.5
Cobalt (Co)	mg/kg			0.10	15.7	15.9	15.4	15.6	15.7	17.3	14.0	16.4	16.3	9.28	7.78	12.4	8.67	5.61	4.93
Copper (Cu)	mg/kg	35.7	197	0.50	38.0	38.5	36.2	40.3	42.6	42.1	18.1	18.8	19.0	20.2	15.9	29.2	22.3	11.8	10.9
Iron (Fe)	mg/kg			50	55600	50000	53400	43400	42200	42900	26200	25500	28800	22200	19400	30000	18100	13000	11900
Lead (Pb)	mg/kg	35	91.3	0.50	10.5	10.5	10.2	10.8	10.7	10.5	6.00	6.49	6.59	5.15	4.21	6.56	5.43	3.62	3.36
Lithium (Li)	mg/kg			2.0	44.1	45.5	43.5	51.4	52.7	51.5	23.3	26.3	27.3	26.1	20.5	33.5	24.4	16.9	15.1
Magnesium (Mg)	mg/kg			20	14700	15100	14500	16600	17200	17600	7260	8250	8510	9760	7550	12600	8050	5600	4960
Manganese (Mn)	mg/kg			1.0	2340	1630	2490	579	511	545	204	236	244	302	284	401	239	150	134
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	0.0542	0.0524	0.0501	0.0640	0.0604	0.0564	0.0108	0.0088	0.0073	0.0169	0.0070	0.0290	0.0289	0.0121	0.0121
Molybdenum (Mo)	mg/kg			0.10	2.48	2.09	3.00	1.49	1.49	1.87	1.64	1.91	2.20	0.91	0.67	1.40	0.83	0.62	0.52
Nickel (Ni)	mg/kg			0.50	45.8	47.0	44.6	47.4	48.6	50.1	23.0	25.9	26.4	22.0	17.6	30.4	22.0	14.1	12.2
Phosphorus (P)	mg/kg			50	1280	1140	1250	1040	1010	1010	607	634	656	712	625	843	646	556	459
Potassium (K)	mg/kg			100	6280	6460	6160	7030	7130	7140	3670	4310	4540	3870	2860	4990	3660	2420	1980
Selenium (Se)	mg/kg			0.20	0.37	0.33	0.37	0.33	0.30	0.28	0.36	0.38	0.37	<0.20	<0.20	0.26	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	0.14	0.13	0.12	0.25	0.25	0.24	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			50	1460	1530	1420	1520	1480	1420	528	641	604	808	600	1030	755	505	430
Strontium (Sr)	mg/kg			0.50	39.9	40.6	41.4	42.2	42.1	38.6	26.8	30.9	32.8	25.5	21.2	31.1	30.3	21.5	19.6
Sulphur (S)	mg/kg			500	1300	1600	1200	1300	1400	1400	1500	2600	2000	1000	600	2100	1100	900	800
Thallium (Tl)	mg/kg			0.050	0.279	0.287	0.281	0.306	0.311	0.307	0.257	0.277	0.287	0.173	0.119	0.218	0.162	0.099	0.085
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	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	1410	1480	1380	1600	1650	1590	938	1090	1140	1090	898	1250	1090	808	699
Uranium (U)	mg/kg			0.050	2.45	2.45	2.42	2.28	2.22	2.21	1.79	1.89	1.96	1.27	1.05	1.70	2.07	1.39	1.09
Vanadium (V)	mg/kg			0.20	82.6	83.2	80.9	85.3	85.3	86.9	46.5	50.8	52.9	51.4	43.1	64.2	47.0	33.0	30.7
Zinc (Zn)	mg/kg	123	315	2.0	90.1	90.5	87.7	97.7	99.3	101	51.9	55.3	57.1	51.9	37.8	71.0	54.0	32.1	28.9

Notes:

Shaded cells indicate values that exceed CCME guidelines (light grey ISQG, dark grey PEL).

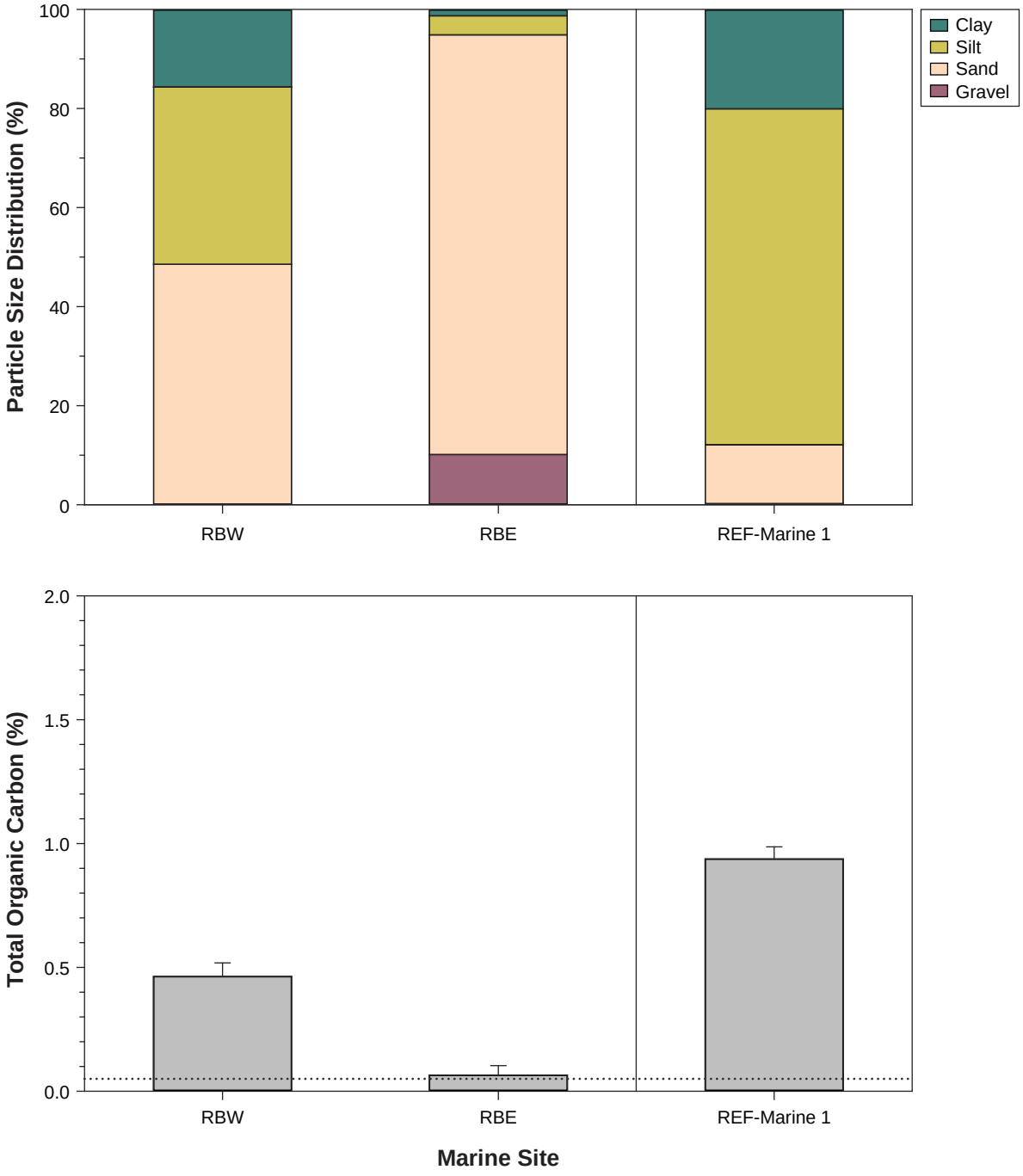
[a] *Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *ISQG = Interim Sediment Quality Guideline*

[c] *PEL = Probable Effects Level*

Figure A.4-11

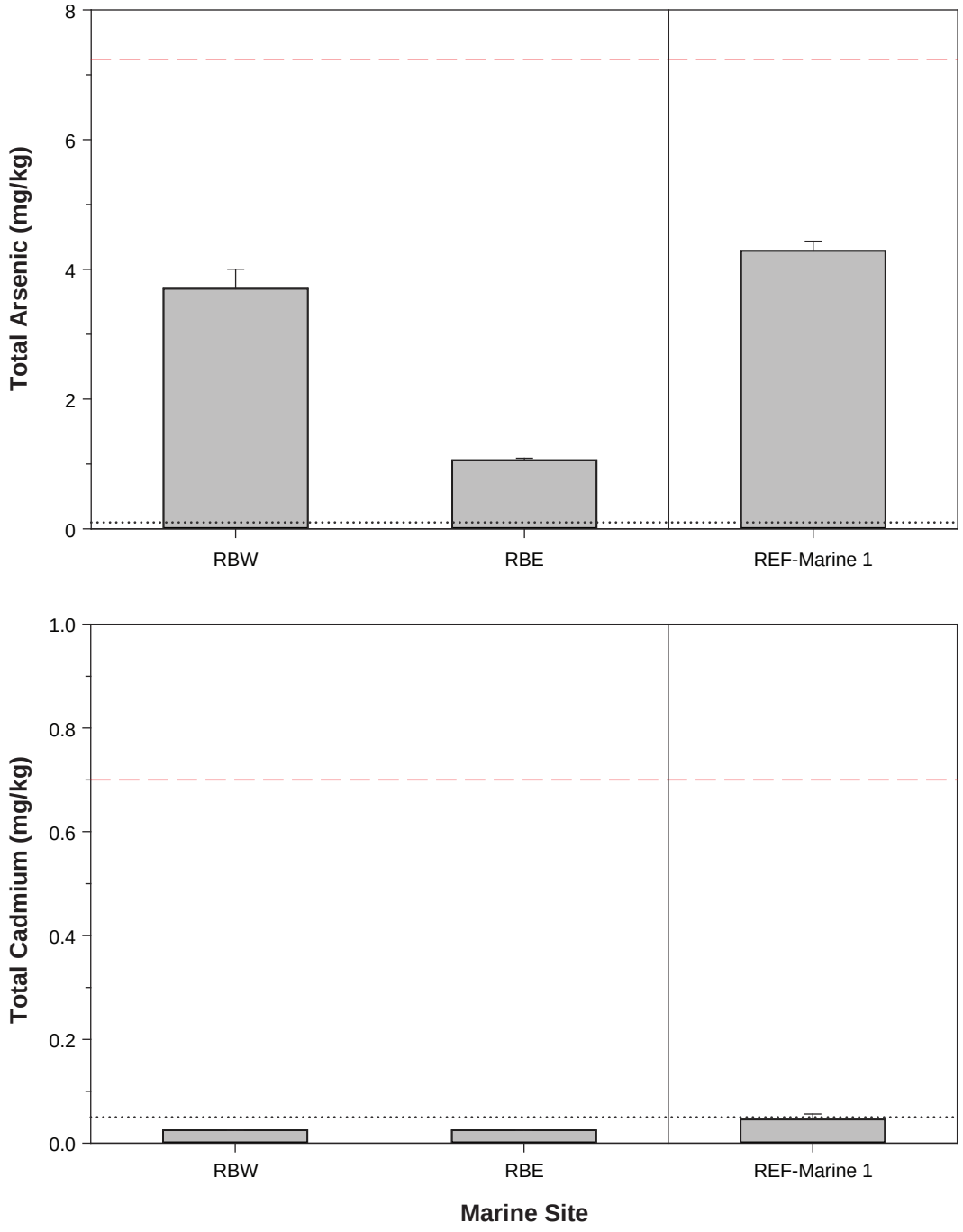
Particle Size Distribution and Total Organic Carbon Concentration in Marine Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Stacked bars represent the mean of replicate samples.
Dotted line represents the analytical detection limit; values below the detection limit are plotted at half the detection limit.
Particle size distribution and total organic carbon content of sediments are required parameters as part of benthic invertebrate surveys as per Schedule 5, s.16a (iii) of the MMER.

Figure A.4-12

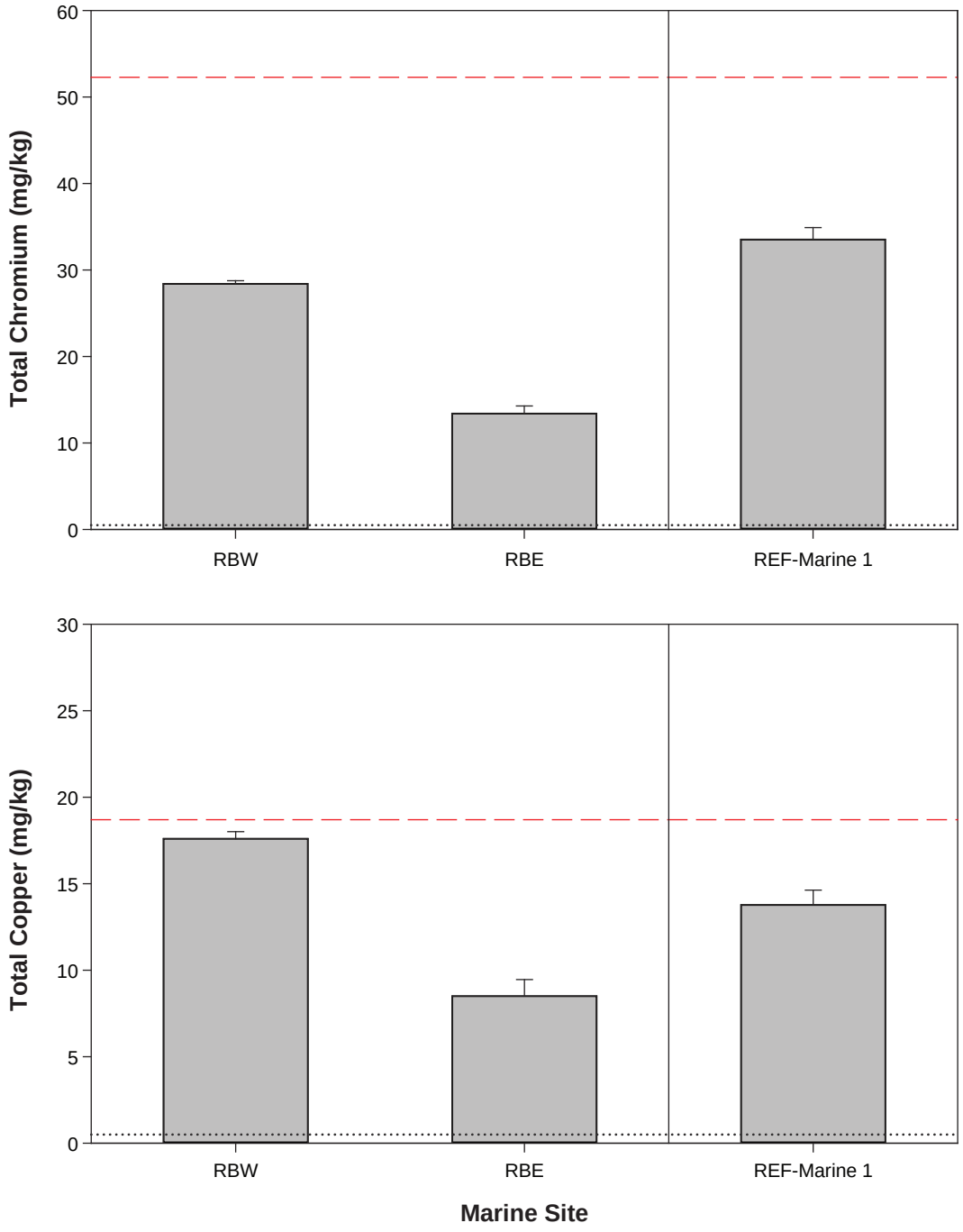
Total Arsenic and Total Cadmium Concentrations in Marine Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME marine and estuarine interim sediment quality guidelines (ISQGs) for arsenic (7.24 mg/kg) and cadmium (0.7 mg/kg); probable effects levels (PELs) for arsenic (41.6 mg/kg) and cadmium (4.2 mg/kg) are not shown.

Figure A.4-13

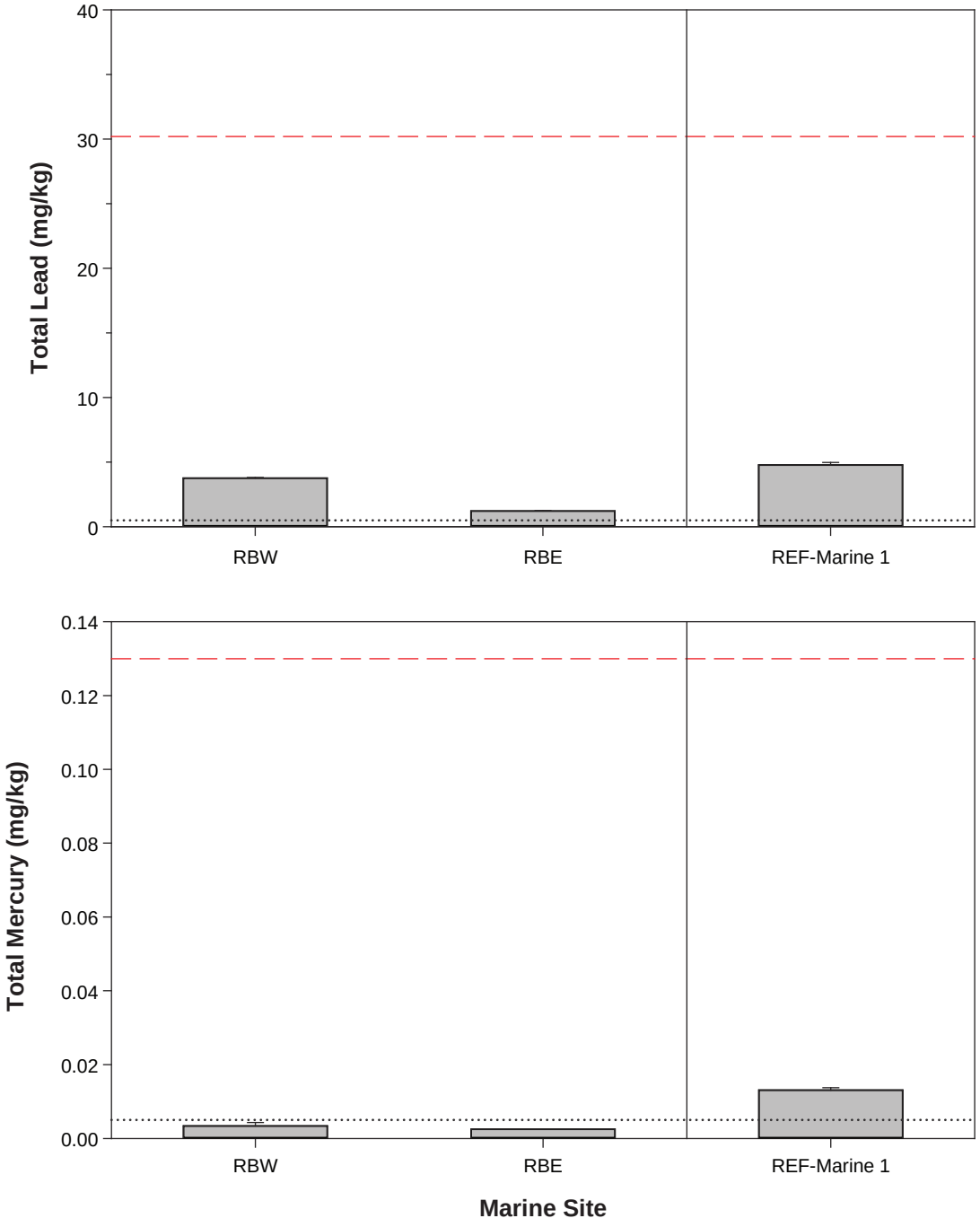
Total Chromium and Total Copper Concentrations in Marine Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME marine and estuarine interim sediment quality guidelines (ISQGs) for chromium (52.3 mg/kg) and copper (18.7 mg/kg); probable effects levels (PELs) for chromium (160 mg/kg) and copper (108 mg/kg) are not shown.

Figure A.4-14

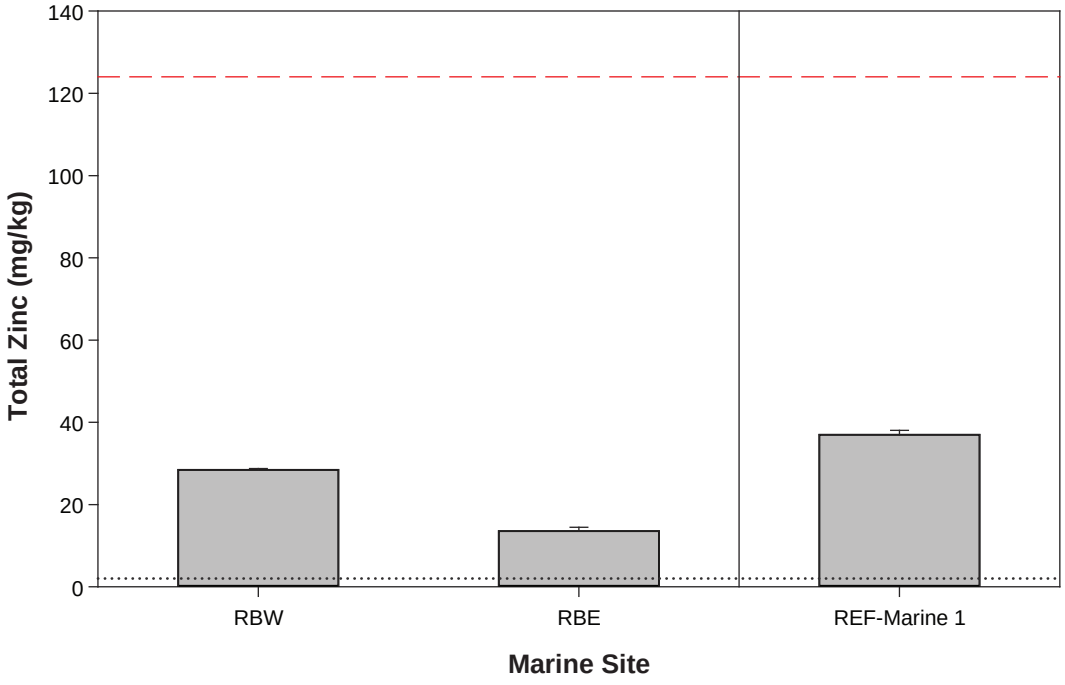
Total Lead and Total Mercury Concentrations in Marine Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME marine and estuarine interim sediment quality guidelines (ISQGs) for lead (30.2 mg/kg) and mercury (0.13 mg/kg); probable effects levels (PELs) for lead (112 mg/kg) and mercury (0.7 mg/kg) are not shown.

Figure A.4-15

Total Zinc Concentration in Marine Sediments, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Dotted lines represent analytical detection limits; values below the detection limit are plotted at half the detection limit.
Dashed line represents the CCME marine and estuarine interim sediment quality guideline (ISQG) for zinc (124 mg/kg); the probable effects level (PEL) for zinc (271 mg/kg) is not shown.

Annex A.4-3. Marine Sediment Quality Data, Doris Project, 2016

Site ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realized Detection Limit	RBW			RBE			REF- Marine 1		
Date Sampled:					12-Aug-16	12-Aug-16	12-Aug-16	12-Aug-16	12-Aug-16	12-Aug-16	13-Aug-16	13-Aug-16	13-Aug-16
Replicate:					1	2	3	1	2	3	1	2	3
Depth Sampled (m):					5.0	4.5	5.5	0.8	1.2	1.4	6.2	6.5	6.0
ALS Sample ID:	Unit	ISQG[b]	PEL[c]		L1817834-34	L1817834-35	L1817834-36	L1817834-31	L1817834-32	L1817834-33	L1817834-1	L1817834-2	L1817834-3
Physical Tests													
Moisture	%			0.25	32.0	34.8	32.0	16.8	13.7	19.7	46.5	46.6	45.2
pH	pH			0.10	7.97	7.68	7.93	7.01	7.11	7.56	7.58	7.68	7.51
Particle Size													
% Gravel (>2 mm)	%			0.10	0.45	<0.10	<0.10	13.8	15.8	0.88	<0.10	0.64	<0.10
% Sand (2.0 mm - 0.063 mm)	%			0.10	49.6	46.4	49.1	79.4	80.5	94.3	16.6	11.6	7.6
% Silt (0.063 mm - 4 µm)	%			0.10	33.3	38.6	35.5	5.54	2.70	3.21	62.2	68.9	72.3
% Clay (<4 µm)	%			0.10	16.6	15.1	15.4	1.30	1.03	1.58	21.1	18.9	20.2
Texture	-			-	Sandy loam	Sandy loam	Sandy loam	Sand	Sand	Sand	Silt loam	Silt loam	Silt loam
Anions and Nutrients													
Total Nitrogen	%			0.020	0.05	0.06	0.04	<0.020	<0.020	<0.020	0.100	0.118	0.116
Organic Carbon													
Total Organic Carbon	%			0.050	0.439	0.567	0.382	<0.050	<0.050	0.142	0.843	0.958	1.01
Plant Available Nutrients													
Available Ammonium-N	mg/kg			1.0	9.8	18.0	7.6	<1.0	<1.0	1.4	3.9	11.0	8.6
Nitrate+Nitrite-N	mg/kg			4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Available Nitrate-N	mg/kg			4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Available Nitrite-N	mg/kg			0.80	<0.80	<0.80	<0.80	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate-P	mg/kg			2.0	13.6	12.0	13.2	2.8	4.4	6.3	12.6	29.0	14.7
Metals													
Aluminum (Al)	mg/kg			50	10200	9840	9980	4330	4880	4410	13700	12100	13500
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	0.13	0.14
Arsenic (As)	mg/kg	7.24	41.6	0.10	4.25	3.65	3.21	1.11	1.01	1.06	4.33	4.01	4.52
Barium (Ba)	mg/kg			0.50	44.1	44.6	43.1	9.81	10.9	9.59	67.5	69.0	62.7
Beryllium (Be)	mg/kg			0.10	0.27	0.27	0.27	<0.10	<0.10	<0.10	0.39	0.33	0.37
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	mg/kg			5.0	14.1	14.4	14.0	<5.0	<5.0	<5.0	26.3	25.7	28.1
Cadmium (Cd)	mg/kg	0.7	4.2	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.054	<0.050	0.058
Calcium (Ca)	mg/kg			50	4050	4070	4030	1870	1810	1910	5290	5080	5290
Chromium (Cr)	mg/kg	52.3	160	0.50	29.1	27.9	28.2	13.0	15.1	12.1	35.1	30.8	34.7
Cobalt (Co)	mg/kg			0.10	6.77	6.37	6.45	4.32	4.26	4.12	6.77	6.13	6.75
Copper (Cu)	mg/kg	18.7	108	0.50	18.4	17.1	17.3	6.71	8.81	9.98	13.4	12.5	15.4
Iron (Fe)	mg/kg			50	16000	15600	15700	10400	10200	9730	18100	16400	18000
Lead (Pb)	mg/kg	30.2	112	0.50	3.88	3.66	3.74	1.31	1.17	1.18	4.96	4.38	5.00
Lithium (Li)	mg/kg			2.0	16.4	16.4	16.4	7.9	8.8	7.5	23.3	20.9	23.3
Magnesium (Mg)	mg/kg			20	7180	6840	6930	3250	4050	3250	9040	8200	8990
Manganese (Mn)	mg/kg			1.0	165	159	162	86.1	104	85.3	194	178	192
Mercury (Hg)	mg/kg	0.13	0.7	0.0050	0.0052	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0130	0.0120	0.0143
Molybdenum (Mo)	mg/kg			0.10	0.54	0.57	0.61	0.14	0.12	0.12	1.23	0.73	1.30
Nickel (Ni)	mg/kg			0.50	15.1	14.8	14.8	7.47	8.90	7.79	16.8	15.1	16.9
Phosphorus (P)	mg/kg			50	525	535	490	241	253	242	774	933	745
Potassium (K)	mg/kg			100	2860	2850	2780	630	630	660	4470	3980	4310
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.28	0.29	0.25
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			50	3860	4150	3770	1140	1190	1310	7280	7140	7310
Strontium (Sr)	mg/kg			0.50	22.5	23.9	22.9	8.60	8.47	9.92	36.3	38.9	37.2
Sulphur (S)	mg/kg			500	1100	1000	1100	700	<500	600	1500	1500	2300
Thallium (Tl)	mg/kg			0.050	0.107	0.106	0.110	<0.050	<0.050	<0.050	0.164	0.136	0.149
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	796	796	822	347	345	402	1040	930	1020
Uranium (U)	mg/kg			0.050	0.77	0.753	0.751	0.382	0.316	0.456	1.33	1.16	1.40
Vanadium (V)	mg/kg			0.20	38.9	37.3	38.2	27.0	22.8	25.4	49.1	44.1	48.2
Zinc (Zn)	mg/kg	124	271	2.0	29.1	27.9	28.3	13.0	15.4	12.3	38.0	34.8	38.1

Notes:

Shaded cells indicate values that exceed CCME guidelines (light grey ISQG, dark grey PEL).

[a] *Canadian sediment quality guidelines for the protection of marine aquatic life, Canadian Council of Ministers of the Environment, Accessed 2016.*

[b] *ISQG = Interim Sediment Quality Guideline*

[c] *PEL = Probable Effects Level*

A.5 2016 PRIMARY PRODUCERS

The following sections present the periphyton and phytoplankton biomass (as chlorophyll *a*) data collected from April to September 2016 at stream, lake, and marine sites.

A.5.1 Stream Data

Stream periphyton sampling plates were installed three times in AEMP streams in 2016 (in June, July, and August), and were retrieved after approximately one month (in July, August, and September, respectively). Figure A.5-1 shows the average periphyton biomass measured in streams. Annex A.5-1 presents the full periphyton biomass dataset.

Note that only one periphyton plate could be retrieved in July from Doris Outflow out of the five plates that were installed in June. This was due to high water levels and high flow conditions, which hindered the safe retrieval of plates.

A.5.2 Lake Data

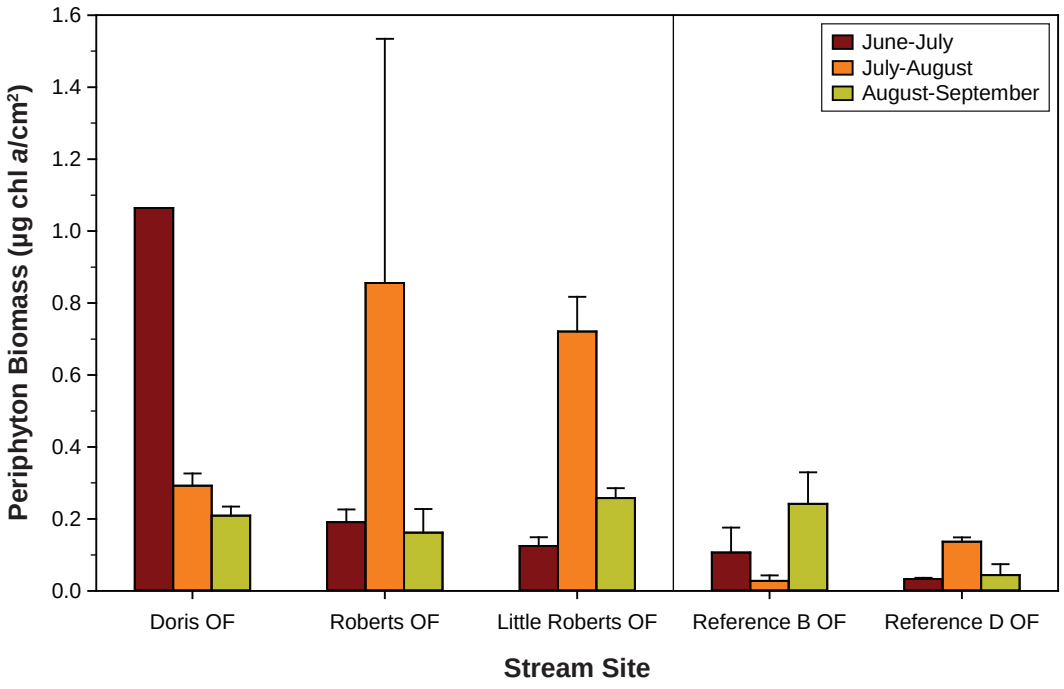
Lake phytoplankton samples were collected in April (under-ice sampling) and monthly from July to September 2016. Figure A.5-2 shows the average phytoplankton biomass measured in lakes. Annex A.5-2 presents the full phytoplankton biomass dataset.

A.5.3 Marine Data

Marine phytoplankton samples were collected in April (under-ice sampling) and monthly from July to September 2016. Figure A.5-3 shows the average phytoplankton biomass measured at marine sites. Annex A.5-3 presents the full phytoplankton biomass dataset.

Figure A.5-1

Periphyton Biomass (as Chlorophyll *a*) in Stream Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean.
The analytical detection limit for chlorophyll a was 0.01, 0.1, or 1 µg; all chlorophyll a concentrations were higher than detection limits.

Annex A.5-1. Stream Periphyton Biomass Data, Doris Project, 2016

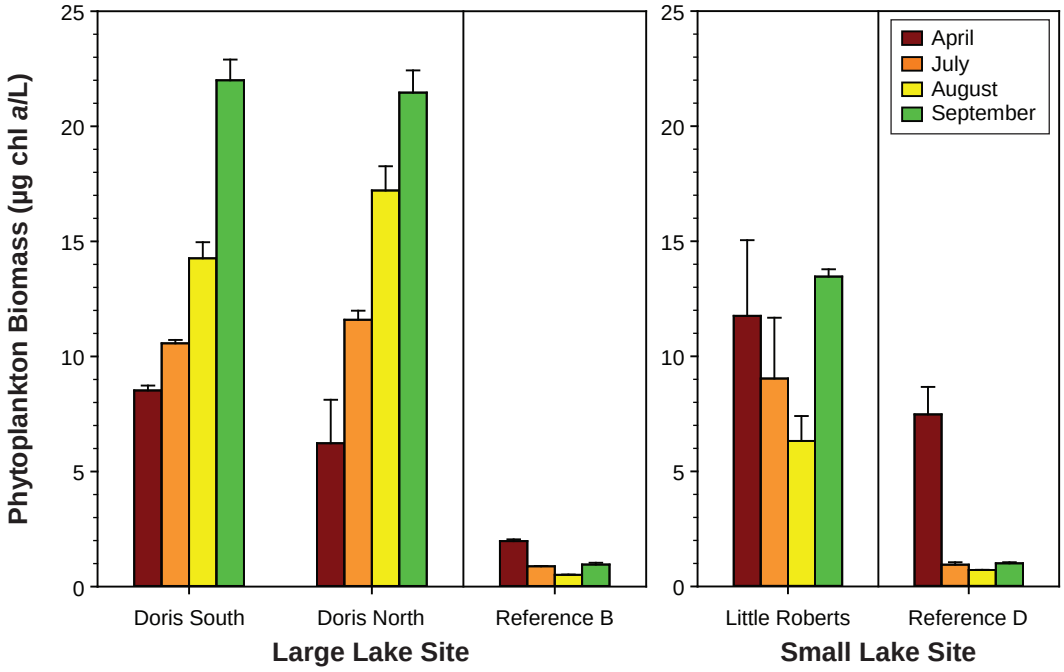
Stream Site	Replicate #	Date Sampler Installed	Date Sampler Retrieved	Number of Days Immersed	Area Sampled (cm^2)	ALS Sample ID	Periphyton Biomass (µg chl *a*/cm^2)	Mean	SE
Doris OF[†]	1	12-Jun-16	15-Jul-16	33	100	L1802569-31	1.06	1.06	-
Doris OF	1	15-Jul-16	14-Aug-16	30	100	L1817823-22	0.225	0.292	0.0340
Doris OF	2	15-Jul-16	14-Aug-16	30	100	L1817823-23	0.336		
Doris OF	3	15-Jul-16	14-Aug-16	30	100	L1817823-24	0.315		
Doris OF	1	14-Aug-16	14-Sep-16	31	100	L1832221-1	0.180	0.209	0.0251
Doris OF	2	14-Aug-16	14-Sep-16	31	100	L1832221-2	0.188		
Doris OF	3	14-Aug-16	14-Sep-16	31	100	L1832221-3	0.259		
Roberts OF	1	13-Jun-16	16-Jul-16	33	100	L1802569-32	0.191	0.191	0.0353
Roberts OF	2	13-Jun-16	16-Jul-16	33	100	L1802569-33	0.252		
Roberts OF	3	13-Jun-16	16-Jul-16	33	100	L1802569-34	0.130		
Roberts OF	1	16-Jul-16	16-Aug-16	31	100	L1817823-28	0.246	0.856	0.678
Roberts OF	2	16-Jul-16	16-Aug-16	31	100	L1817823-29	0.112		
Roberts OF	3	16-Jul-16	16-Aug-16	31	100	L1817823-30	2.21		
Roberts OF	1	16-Aug-16	14-Sep-16	29	100	L1832221-4	0.190	0.162	0.0658
Roberts OF	2	16-Aug-16	14-Sep-16	29	100	L1832221-5	0.259		
Roberts OF	3	16-Aug-16	14-Sep-16	29	100	L1832221-6	0.0365		
Little Roberts OF	1	13-Jun-16	16-Jul-16	33	100	L1802569-19	0.151	0.125	0.0243
Little Roberts OF	2	13-Jun-16	16-Jul-16	33	100	L1802569-20	0.146		
Little Roberts OF	3	13-Jun-16	16-Jul-16	33	100	L1802569-21	0.0759		
Little Roberts OF	1	15-Jul-16	19-Aug-16	35	100	L1817823-7	0.912	0.721	0.0963
Little Roberts OF	2	15-Jul-16	19-Aug-16	35	100	L1817823-8	0.647		
Little Roberts OF	3	15-Jul-16	19-Aug-16	35	100	L1817823-9	0.604		
Little Roberts OF	1	19-Aug-16	14-Sep-16	26	100	L1832221-7	0.313	0.258	0.0275
Little Roberts OF	2	19-Aug-16	14-Sep-16	26	100	L1832221-8	0.233		
Little Roberts OF	3	19-Aug-16	14-Sep-16	26	100	L1832221-9	0.228		
Reference B OF	1	13-Jun-16	17-Jul-16	34	100	L1802569-22	0.0371	0.107	0.0692
Reference B OF	2	13-Jun-16	17-Jul-16	34	100	L1802569-23	0.245		
Reference B OF	3	13-Jun-16	17-Jul-16	34	100	L1802569-24	0.0378		
Reference B OF	1	17-Jul-16	17-Aug-16	31	100	L1817823-1	0.0174	0.028	0.0150
Reference B OF	2	17-Jul-16	17-Aug-16	31	100	L1817823-2	0.00884		
Reference B OF	3	17-Jul-16	17-Aug-16	31	100	L1817823-3	0.0575		
Reference B OF	1	17-Aug-16	19-Sep-16	33	100	L1832221-31	0.296	0.242	0.0874
Reference B OF	2	17-Aug-16	19-Sep-16	33	100	L1832221-32	0.359		
Reference B OF	3	17-Aug-16	19-Sep-16	33	100	L1832221-33	0.0710		
Reference D OF	1	13-Jun-16	14-Jul-16	31	100	L1802569-13	0.0274	0.0330	0.00335
Reference D OF	2	13-Jun-16	14-Jul-16	31	100	L1802569-14	0.0390		
Reference D OF	3	13-Jun-16	14-Jul-16	31	100	L1802569-15	0.0326		
Reference D OF	1	14-Jul-16	18-Aug-16	35	100	L1817823-4	0.114	0.137	0.0119
Reference D OF	2	14-Jul-16	18-Aug-16	35	100	L1817823-5	0.154		
Reference D OF	3	14-Jul-16	18-Aug-16	35	100	L1817823-6	0.142		
Reference D OF	1	18-Aug-16	17-Sep-16	30	100	L1832221-19	0.104	0.0436	0.0305
Reference D OF	2	18-Aug-16	17-Sep-16	30	100	L1832221-20	0.0209		
Reference D OF	3	18-Aug-16	17-Sep-16	30	100	L1832221-21	0.00595		

SE = standard error of the mean

[†] *Only a single replicate was retrieved in Doris OF in July, as high waters and flow made it unsafe to collect the remaining plates.*

Figure A.5-2

Phytoplankton Biomass (as Chlorophyll *a*) in Lake Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean.
The analytical detection limit for chlorophyll a was 0.01 or 0.1 µg; all chlorophyll a concentrations were higher than detection limits.

Annex A.5-2. Lake Phytoplankton Biomass Data, Doris Project, 2016

Lake Site	Replicate #	Date Sampled	Depth Sampled (m)	ALS Sample ID	Phytoplankton Biomass (µg chl *a*/L)	Mean	SE
Doris South	1	16-Apr-16	3.1	L1757854-4	8.84	8.53	0.213
Doris South	2	16-Apr-16	3.1	L1757854-5	8.62		
Doris South	3	16-Apr-16	3.1	L1757854-6	8.12		
Doris South	1	16-Jul-16	1	L1802569-7	10.3	10.6	0.145
Doris South	2	16-Jul-16	1	L1802569-8	10.5		
Doris South	3	16-Jul-16	1	L1802569-9	10.8		
Doris South	1	20-Aug-16	1	L1817823-19	13.3	14.3	0.701
Doris South	2	20-Aug-16	1	L1817823-20	13.8		
Doris South	3	20-Aug-16	1	L1817823-21	15.6		
Doris South	1	19-Sep-16	1	L1832221-34	23.8	22.0	0.902
Doris South	2	19-Sep-16	1	L1832221-35	21.2		
Doris South	3	19-Sep-16	1	L1832221-36	21.0		
Doris North	1	15-Apr-16	3	L1757854-1	2.48	6.23	1.90
Doris North	2	15-Apr-16	3	L1757854-2	7.60		
Doris North	3	15-Apr-16	3	L1757854-3	8.60		
Doris North	1	17-Jul-16	1	L1802569-4	11.5	11.6	0.393
Doris North	2	17-Jul-16	1	L1802569-5	12.3		
Doris North	3	17-Jul-16	1	L1802569-6	11.0		
Doris North	1	20-Aug-16	1	L1817823-10	15.7	17.2	1.05
Doris North	2	20-Aug-16	1	L1817823-11	19.2		
Doris North	3	20-Aug-16	1	L1817823-12	16.7		
Doris North	1	19-Sep-16	1	L1832221-37	23.4	21.5	0.968
Doris North	2	19-Sep-16	1	L1832221-38	20.6		
Doris North	3	19-Sep-16	1	L1832221-39	20.4		
Little Roberts	1	16-Apr-16	2	L1757854-7	17.9	11.8	3.29
Little Roberts	2	16-Apr-16	2	L1757854-8	6.68		
Little Roberts	3	16-Apr-16	2	L1757854-9	10.7		
Little Roberts[†]	2	16-Jul-16	1	L1802569-11	6.40	9.04	2.64
Little Roberts[†]	3	16-Jul-16	1	L1802569-12	11.7		
Little Roberts	1	15-Aug-16	1	L1817823-25	4.16	6.32	1.09
Little Roberts	2	15-Aug-16	1	L1817823-26	7.64		
Little Roberts	3	15-Aug-16	1	L1817823-27	7.16		
Little Roberts	1	18-Sep-16	1	L1832221-25	12.8	13.5	0.317
Little Roberts	2	18-Sep-16	1	L1832221-26	13.9		
Little Roberts	3	18-Sep-16	1	L1832221-27	13.7		
Reference B	1	18-Apr-16	3	L1757854-10	1.87	1.97	0.0751
Reference B	2	18-Apr-16	3	L1757854-11	1.93		
Reference B	3	18-Apr-16	3	L1757854-12	2.12		
Reference B	1	18-Jul-16	1	L1802569-16	0.858	0.879	0.0134
Reference B	2	18-Jul-16	1	L1802569-17	0.876		
Reference B	3	18-Jul-16	1	L1802569-18	0.904		
Reference B	1	10-Aug-16	1	L1817823-13	0.496	0.509	0.00971
Reference B	2	10-Aug-16	1	L1817823-14	0.528		
Reference B	3	10-Aug-16	1	L1817823-15	0.503		
Reference B	1	19-Sep-16	1	L1832221-28	1.09	0.958	0.0718
Reference B	2	19-Sep-16	1	L1832221-29	0.850		
Reference B	3	19-Sep-16	1	L1832221-30	0.930		
Reference D	1	18-Apr-16	2.15	L1757854-13	9.72	7.48	1.19
Reference D	2	18-Apr-16	2.15	L1757854-14	7.08		
Reference D	3	18-Apr-16	2.15	L1757854-15	5.64		
Reference D	1	14-Jul-16	1	L1802569-28	0.84	0.943	0.107
Reference D	2	14-Jul-16	1	L1802569-29	1.158		
Reference D	3	14-Jul-16	1	L1802569-30	0.832		
Reference D	1	11-Aug-16	1	L1817823-16	0.708	0.713	0.00961
Reference D	2	11-Aug-16	1	L1817823-17	0.70		
Reference D	3	11-Aug-16	1	L1817823-18	0.732		
Reference D	1	17-Sep-16	1	L1832221-16	0.946	1.00	0.0495
Reference D	2	17-Sep-16	1	L1832221-17	0.962		
Reference D	3	17-Sep-16	1	L1832221-18	1.102		

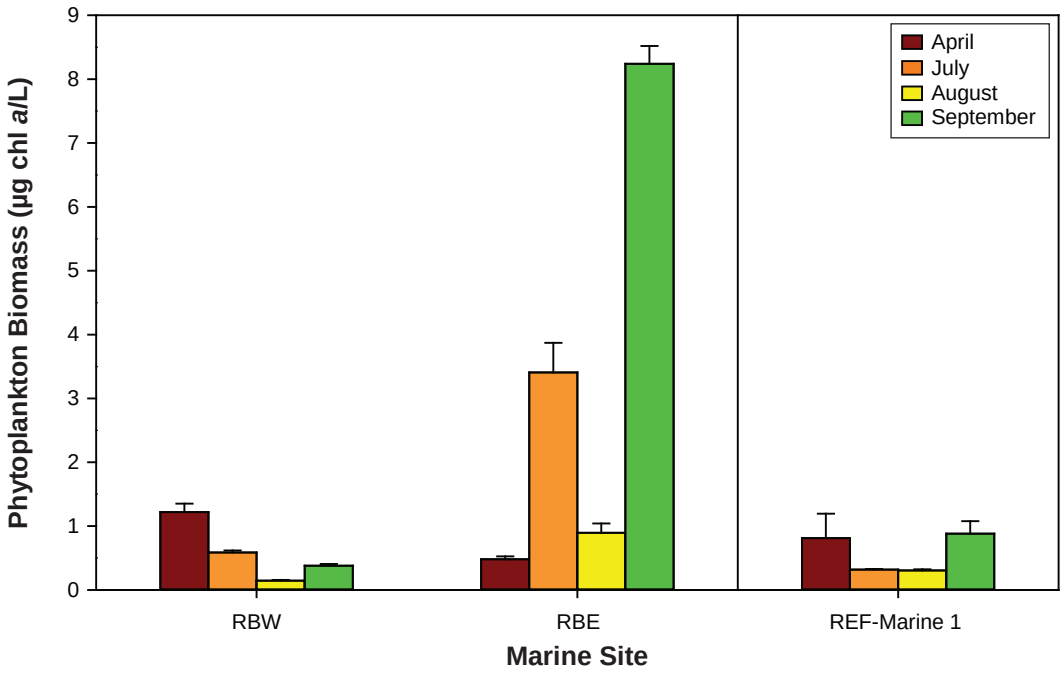
SE = standard error of the mean

[†] *One replicate was lost from Little Roberts Lake in July.*

April depths are recorded as depth from water surface and equal approximately 0.25 to 1 m below ice.

Figure A.5-3

Phytoplankton Biomass (as Chlorophyll *a*) in Marine Sites, Doris Project, 2016



Notes: Error bars represent the standard error of the mean.
The analytical detection limit for chlorophyll a was 0.01 or 0.1 µg; all chlorophyll a concentrations were higher than detection limits.

Annex A.5-3. Marine Phytoplankton Biomass Data, Doris Project, 2016

Marine Site	Replicate #	Date Sampled	Depth Sampled (m)	ALS Sample ID	Phytoplankton Biomass (µg chl *a*/L)	Mean	SE
RBW	1	16-Apr-16	3	L1757868-4	1.004	1.22	0.132
RBW	2	16-Apr-16	3	L1757868-5	1.190		
RBW	3	16-Apr-16	3	L1757868-6	1.460		
RBW	1	13-Jul-16	1	L1802569-35	0.652	0.585	0.033
RBW	2	13-Jul-16	1	L1802569-36	0.549		
RBW	3	13-Jul-16	1	L1802569-37	0.555		
RBW	1	12-Aug-16	1	L1817823-37	0.124	0.146	0.011
RBW	2	12-Aug-16	1	L1817823-38	0.159		
RBW	3	12-Aug-16	1	L1817823-39	0.154		
RBW	1	15-Sep-16	1	L1832221-10	0.334	0.379	0.027
RBW	2	15-Sep-16	1	L1832221-11	0.374		
RBW	3	15-Sep-16	1	L1832221-12	0.428		
RBE	1	16-Apr-16	2	L1757868-1	0.566	0.481	0.045
RBE	2	16-Apr-16	2	L1757868-2	0.412		
RBE	3	16-Apr-16	2	L1757868-3	0.466		
RBE	1	13-Jul-16	surface	L1802569-25	4.300	3.41	0.464
RBE	2	13-Jul-16	surface	L1802569-26	2.740		
RBE	3	13-Jul-16	surface	L1802569-27	3.180		
RBE	1	12-Aug-16	surface	L1817823-34	0.908	0.894	0.147
RBE	2	12-Aug-16	surface	L1817823-35	1.142		
RBE	3	12-Aug-16	surface	L1817823-36	0.632		
RBE	1	15-Sep-16	surface	L1832221-13	7.680	8.240	0.280
RBE	2	15-Sep-16	surface	L1832221-14	8.540		
RBE	3	15-Sep-16	surface	L1832221-15	8.500		
REF-Marine 1	1	18-Apr-16	2.7	L1757868-7	0.272	0.811	0.382
REF-Marine 1	2	18-Apr-16	2.7	L1757868-8	1.550		
REF-Marine 1	3	18-Apr-16	2.7	L1757868-9	0.612		
REF-Marine 1	1	13-Jul-16	1	L1802569-1	0.334	0.318	0.009
REF-Marine 1	2	13-Jul-16	1	L1802569-2	0.304		
REF-Marine 1	3	13-Jul-16	1	L1802569-3	0.316		
REF-Marine 1	1	13-Aug-16	1	L1817823-31	0.315	0.306	0.018
REF-Marine 1	2	13-Aug-16	1	L1817823-32	0.331		
REF-Marine 1	3	13-Aug-16	1	L1817823-33	0.271		
REF-Marine 1	1	18-Sep-16	1	L1832221-22	1.257	0.880	0.196
REF-Marine 1	2	18-Sep-16	1	L1832221-23	0.788		
REF-Marine 1	3	18-Sep-16	1	L1832221-24	0.596		

SE = standard error of the mean

RBE site was too shallow for sampling at 1 m depth in July, August, and September.

April depths are recorded as depth from water surface and equal approximately 0.25 to 1 m below ice.

A.6 2016 BENTHIC INVERTEBRATES

The following sections present the benthic invertebrate taxonomy data collected in August 2016 from stream, lake, and marine sites. Benthos data were used to calculate several community descriptors including: total density, taxa richness, evenness, diversity, and the Bray-Curtis Index. Details of these calculations are provided in Section A.1-7.

A.6.1 Stream Data

Figure A.6-1 presents the average density and taxonomic composition of benthos community at stream sites. Figure A.6-2 presents the average family richness, Simpson's Evenness Index, and Simpson's Diversity Index. Figure A.6-3 presents the average Bray-Curtis Index. Annex A.6-1 provides the full stream benthos taxonomy dataset, and Annex A.6-2 presents the summary statistics calculated for the community descriptors.

A.6.2 Lake Data

Figure A.6-4 presents the average density and taxonomic composition of the lake benthos community at lake sites. Figure A.6-5 presents the average family richness, Simpson's Evenness Index, and Simpson's Diversity Index. Figure A.6-6 presents the average Bray-Curtis Index. Annex A.6-3 provides the full lake benthos taxonomy dataset, and Annex A.6-4 presents the summary statistics calculated for the community descriptors.

A.6.3 Marine Data

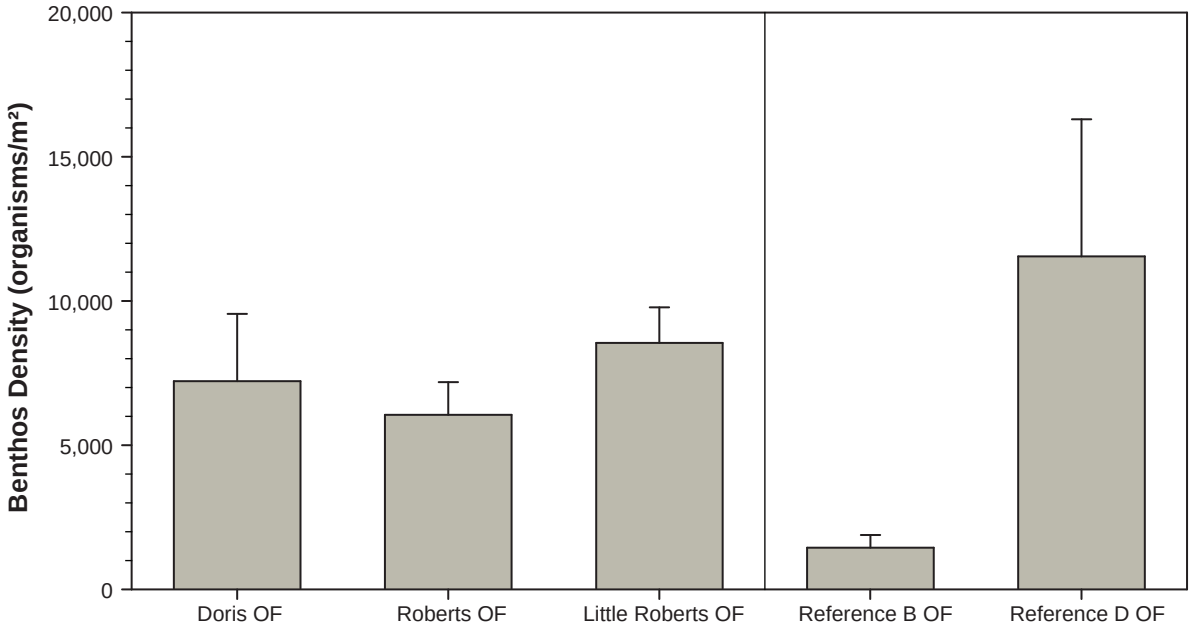
Figure A.6-7 presents the average density and taxonomic composition of the benthos community at marine sites. Figure A.6-8 presents the average family richness, Simpson's Evenness Index, and Simpson's Diversity Index. Figure A.6-9 presents the average Bray-Curtis Index. Annex A.6-5 provides the full marine benthos taxonomy dataset, and Annex A.6-6 presents the summary statistics calculated for the community descriptors.

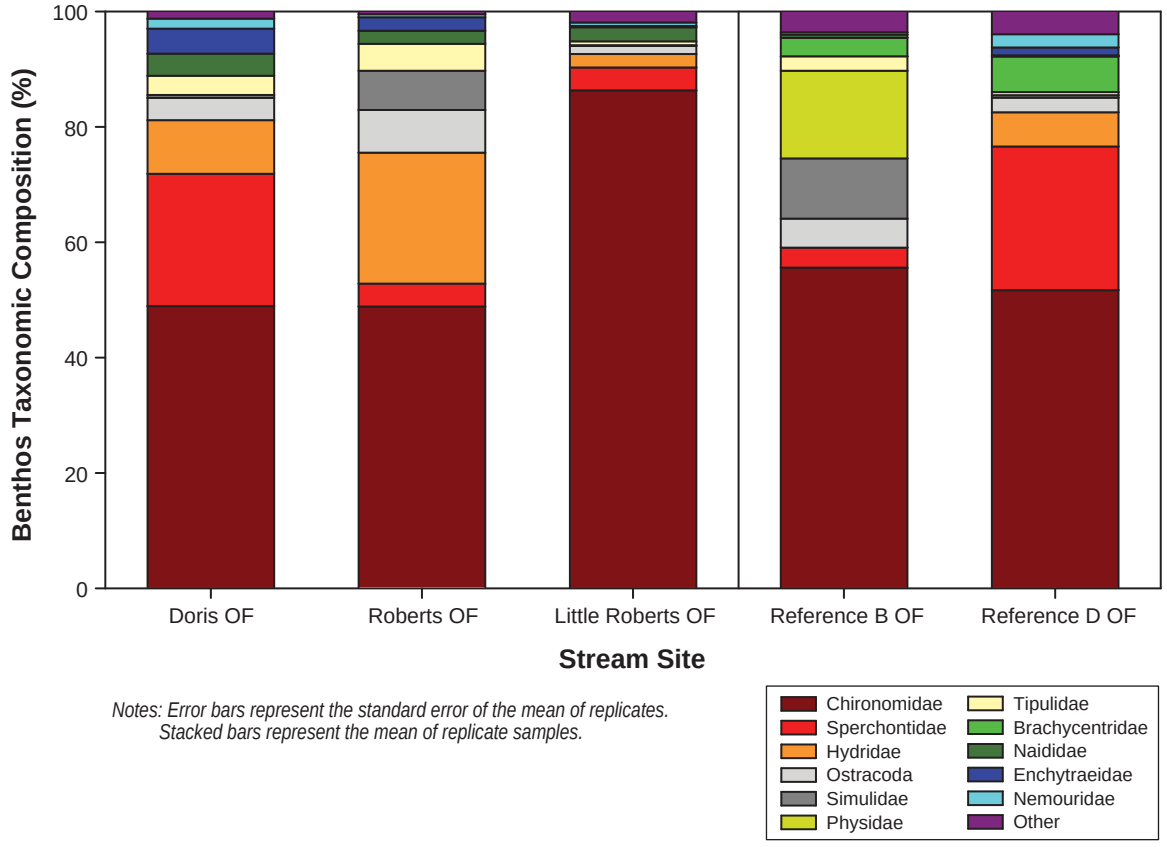
A.6.4 Quality Assurance/Quality Control (QA/QC) Data

A re-sorting of randomly selected sample residues was conducted by taxonomists on a minimum of 10% of the benthos samples to determine the level of sorting efficiency. Results of this QA/QC procedure are provided in Annex A.6-7.

Figure A.6-1

Benthos Density and Taxonomic Composition in Stream Sites, Doris Project, August 2016

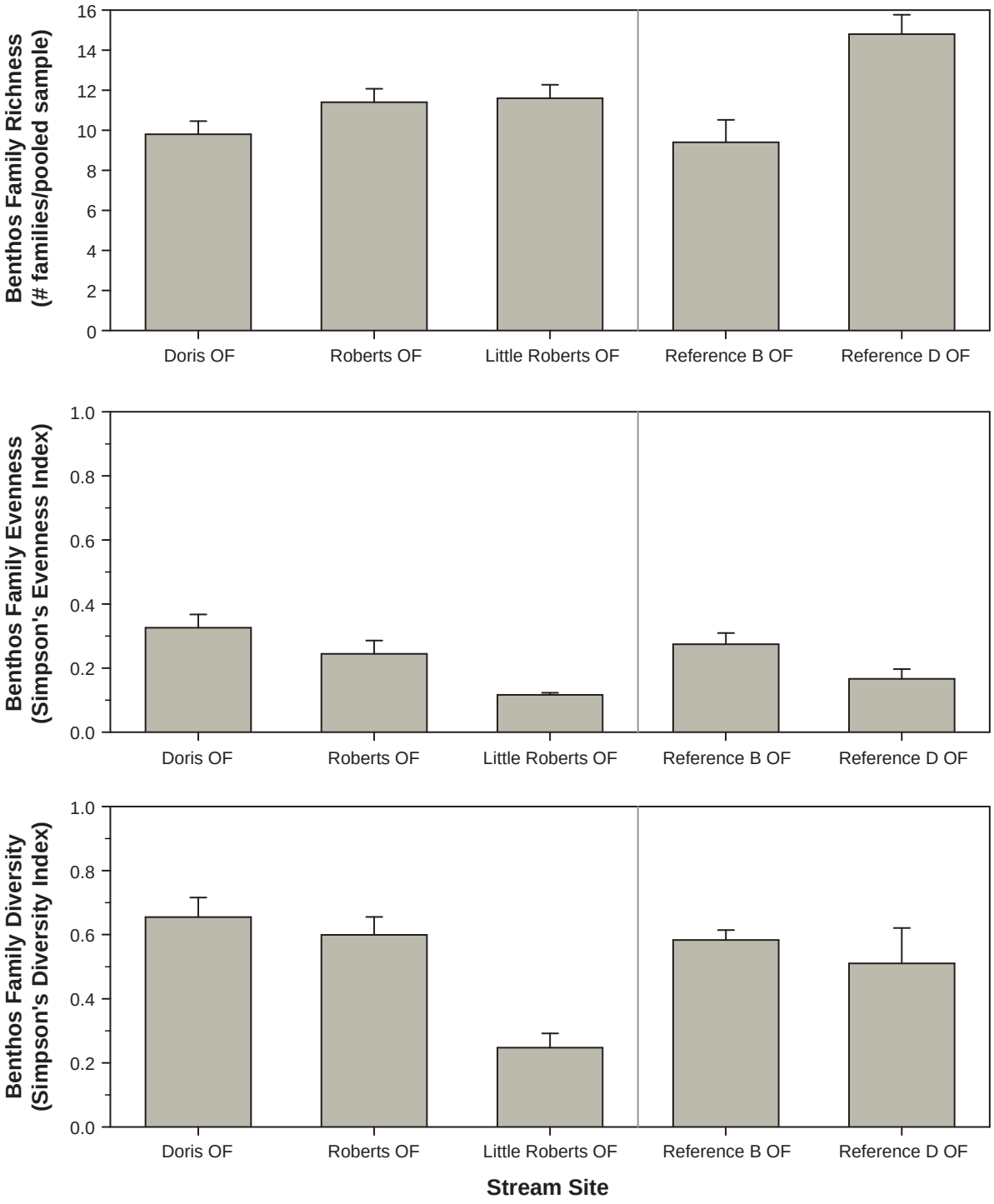




Notes: Error bars represent the standard error of the mean of replicates.
Stacked bars represent the mean of replicate samples.

Figure A.6-2

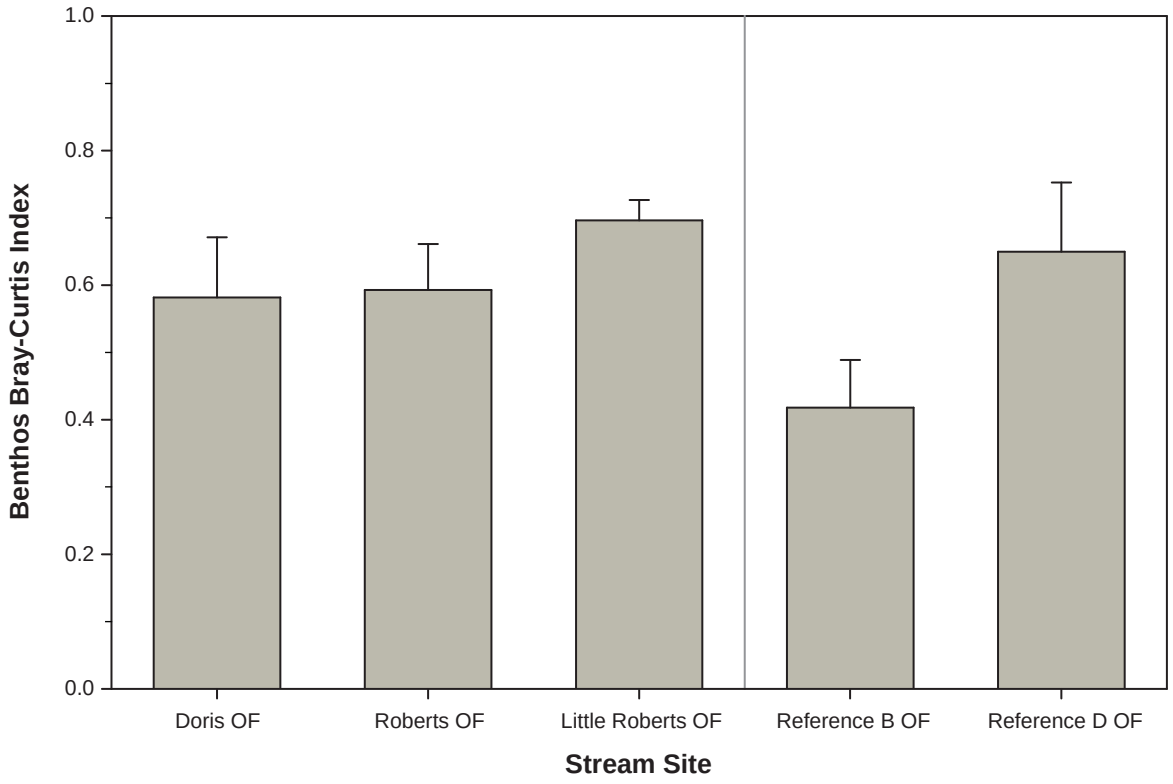
Benthos Richness, Evenness, and Diversity in Stream Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Figure A.6-3

Benthos Bray-Curtis Index for Stream Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Annex A.6-1. Stream Benthos Taxonomy Data, Doris Project, 2016

					Doris Outflow 14-Aug-16					Roberts Outflow 16-Aug-16					Little Roberts Outflow 19-Aug-16					Reference B Outflow 17-Aug-16					Reference D Outflow 18-Aug-16				
Major Group	**Family**	**Subfamily**	**Tribe**	**Genus**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**
Coelenterata	Hydridae	-	-	*Hydra*	48	20	228	16	616	750	1,100	72	136	21		32	104	24	96						200	128	40	48	24
Microturbellaria	-	-	-	-																10		8								
Nematoda*	-	-	-	-	104	58	280	126	136	51	14	25	23	22	25	25	72	44	146	10		8			16	48	40	16	9
Hirudinea	Piscicolidae	-	-	*Piscicola milneri*							1	1																	
Oligochaeta - cocoon*	-	-	-				8																						
Oligochaeta	Enchytraeidae	-	-	-	96	58	88	40	88	60		40	16	42	8	8	8									8		24	65
	Lumbriculidae	-	-	-		1		4	2	21	6	1	1	2	21	25	7	13	42					1	6	11	4		1
	Naididae	Naidinae	-	-						30	10	16	8			8	8		8	10	1				8	4			
	Naididae	Tubificinae	-	-		60	60	72	24	24	53	16		2	16	90	29	4	111										
Gastropoda	Physidae	-	-	*Physa*																24	75	26	28	72					
	Valvatidae	-	-	*Valvata sincera*																					8	5	56	14	8
Acari - Hydracarina*	-	-	-	(i/d)*	4	4	8																						
Acari - Hydracarina	Hygrobatidae	-	-	*Hygrobates*		4									5	1	2								42	32	4	34	9
	Lebertiidae	-	-	*Lebertia*		4									6	7	23	10	47						9	16	80	10	1
	Sperchontidae	-	-	*Sperchon*	972	278	574	120	448	85	72	33	89	35	90	69	105	89	102	12		8	36	11	104	240	708	1,331	424
Copepoda – Calanoida*	-	-	-	-					8					20															
Copepoda – Cyclopoida*	-	-	-	-								8						8			10								
Ostracoda	-	-	-	-	8	50	128	40	48	250	70	112	56	40	24	64	16	9	48	40	50			8	88	64		32	
Cladocera*	Chydoridae*	-	-	*Eurycercus**											1				1										
	Holopedidae*	-	-	*Holopedium gibberum**					8																				
Isopoda	Chaetiliidae	-	-	*Saduria entomon*							3		1																
Collembola	Sminthuridae	-	-	-																1									
Ephemeroptera	Baetidae	-	-	*Baetis*	29	8	41		22				2										3	4	1			11	3
	Ephemerellidae	-	-	*Ephemerella*									1	1							1		2		13	17	8	6	9
	Heptageniidae	-	-	*Heptagenia*																						8		8	
Plecoptera	Perlodidae	-	-	*Isoperla*																								1	3
	Nemouridae	-	-	*Nemoura*	14	82	22			20		8	8	2	14	12	7	40	7	3	1	1		1	16	16	132	43	66
Trichoptera	Apataniidae	-	-	*Apatania*															1										
	Brachycentridae	-	-	*Brachycentrus*												1				1		10	53	7	8		8	315	174
	Hydroptilidae	-	-	*Agraylea*																5	2	1		4	1				1
	Limnephilidae	-	-	(i/d)						1			1						1	10									
		-	-	*Grensia praeterita*												5			1										

Notes:

i/d = immature or damaged

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Calanoid and cyclopoid copepods and cladocerans were excluded because they are generally planktonic.

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Terrestrial organisms were excluded because they are not aquatic invertebrates.

Immature (e.g., oligochaete cocoons) or damaged organisms that were not identiable to the family level were excluded from analyses.

Individuals within the major groups Ostracoda and Microturbellaria were not identifiable to family, so they are included at the next lowest taxonomic category (class).

The total number of individuals was divided by 3 times the surface are of the Hess sampler (i.e., 3 x 0.096 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Hess samples).

Annex A.6-1. Stream Benthos Taxonomy Data, Doris Project, 2016

Major Group	Family	Subfamily	Tribe	Genus	Doris Outflow 14-Aug-16					Roberts Outflow 16-Aug-16					Little Roberts Outflow 19-Aug-16					Reference B Outflow 17-Aug-16					Reference D Outflow 18-Aug-16				
					Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Diptera	Chironomidae	-	-	(pupa)	160	68	40	4	92	23	27	26	37	26	66	30	17	45	35			1	32	16		32	84	8	8
		Tanypodinae	Pentaneurini	(i/d)																				8					
				Thienemannimyia group	45	198	84	108	80	32	116	59	222	82	63	169	75	93	100	66	79	40	8	8	26	116	40	50	41
			Procladiini	*Procladius*					28	1																			
		Diamesinae	Diamesini	*Pagastia*											1														
				Potthastia longimana group											1			1	1							4			
				Pseudokiefferiella parva	1,116		28		146	6	46	5	238	708	40	25	20	73	42	1	1	9	74	9	193	2,793	5,192	27	49
		Orthocladiinae	Orthocladiini	(i/d)	88	20							16	3										9	8			8
				Abyskomyia						10																			
				Cricotopus / Orthocladius	180	20	24	16	54	235	162	112	540	608	136	228	104	506	171	10	23			8	64	96	80	24	24
				Doncricotopus														1											
				Eukiefferiella	1,157	32	100	60	272	10			1									8	137	16		8	160		48
				Euryhapsis		16	17	12								1		1	9				1		22	21	80	37	51
				Nanocladius																						8			
				Parakiefferiella	8	10													24										
				Psectrocladius	4											8			17	40	32	8							
				Synorthocladius semivirens																10						16			
				Tvetenia	585	136	240	100	206	16	5	1	26	50	63	8	15	51	20	20			3	8	25	230	676		4
		Chironominae	Chironomini	*Chironomus*						12								1											
				Cryptochironomus				8		1																			
				Dicrotendipes														1	3	78	114	10		8	2				
				Polypedilum						1																16			8
				Sergenta						10								1	1						1				
				Stictochironomus		19	5	80		15		8				10	3	2	5										
			Tanytarsini	(i/d)										1															
				Cladotanytarsus				8									8												
				Corynocera								8																	
				Micropsectra				4		20				1															
				Paratanytarsus												1		4		20				8	16				
				Rheotanytarsus											1,287	1,536	1,306	2,815	1,478				67		33	169	888	91	114
				Tanytarsus				12	8	672	20	56		40	8	8		8		20	41	8		24	16				
		Simulidae	-	-	*adult*			4					3	3		2		2	2							4	4	6	2
		Simulidae	-	-	*pupa*	24		7		4	3	9	3	112	546					1			307	3	3	8	68	3	
			-	-	*Helodon*																		119						
			-	-	*Metacnephia*	1																							
			-	-	*Simulium*	48		4				2		3	19	8				1			16	1	1		12	2	
		Tipulidae	-	-	*Tipula*	4	59	77	49	12	228	53	53	41	7	6	15	15	18	26	19	2	8		4	6	14		10	14
Terrestrial*	-	-	-	-	4	8			20		1				10	3		9											
Total					4,587	1,143	1,771	753	2,150	2,536	1,755	630	1,558	2,239	1,863	2,363	1,872	3,812	2,398	402	422	146	886	229	921	4,088	8,328	2,135	1,159

Notes:

i/d = immature or damaged

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Calanoid and cyclopoid copepods and cladocerans were excluded because they are generally planktonic.

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Terrestrial organisms were excluded because they are not aquatic invertebrates.

Immature (e.g., oligochaete cocoons) or damaged organisms that were not identiable to the family level were excluded from analyses.

Individuals within the major groups Ostracoda and Microturbellaria were not identifiable to family, so they are included at the next lowest taxonomic category (class).

The total number of individuals was divided by 3 times the surface are of the Hess sampler (i.e., 3 x 0.096 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Hess samples).

Annex A.6-2. Stream Benthos Summary Statistics, Doris Project, 2016

	Doris OF					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	2,615	15,927	6,149	7,225	5,215	2,332
Family Richness	8	12	10	9.8	1.5	0.7
Simpson's Diversity Index	0.42	0.77	0.70	0.65	0.14	0.06
Simpson's Evenness Index	0.19	0.44	0.34	0.33	0.09	0.04
Bray-Curtis Index	0.31	0.84	0.62	0.58	0.20	0.09

	Little Roberts OF					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	6,469	13,236	8,205	8,547	2,769	1,238
Family Richness	10	14	11	11.6	1.5	0.7
Simpson's Diversity Index	0.11	0.36	0.26	0.25	0.10	0.04
Simpson's Evenness Index	0.10	0.13	0.11	0.12	0.01	0.01
Bray-Curtis Index	0.64	0.80	0.70	0.70	0.07	0.03

	Roberts OF					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	2,188	8,806	6,094	6,054	2,544	1,138
Family Richness	10	14	11	11.4	1.5	0.7
Simpson's Diversity Index	0.47	0.75	0.56	0.60	0.13	0.06
Simpson's Evenness Index	0.14	0.36	0.23	0.24	0.09	0.04
Bray-Curtis Index	0.34	0.71	0.62	0.59	0.15	0.07

	Reference B OF					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	507	3,076	1,396	1,448	996	445
Family Richness	7	13	8	9.4	2.51	1.12
Simpson's Diversity Index	0.48	0.65	0.61	0.58	0.07	0.03
Simpson's Evenness Index	0.17	0.37	0.26	0.27	0.08	0.03
Bray-Curtis Index	0.25	0.60	0.45	0.42	0.16	0.07

	Reference D OF					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	3,198	28,917	7,413	11,549	10,631	4,754
Family Richness	11	16	16	14.8	2.2	1.0
Simpson's Diversity Index	0.24	0.74	0.58	0.51	0.25	0.11
Simpson's Evenness Index	0.09	0.24	0.15	0.17	0.07	0.03
Bray-Curtis Index	0.35	0.90	0.71	0.65	0.23	0.10

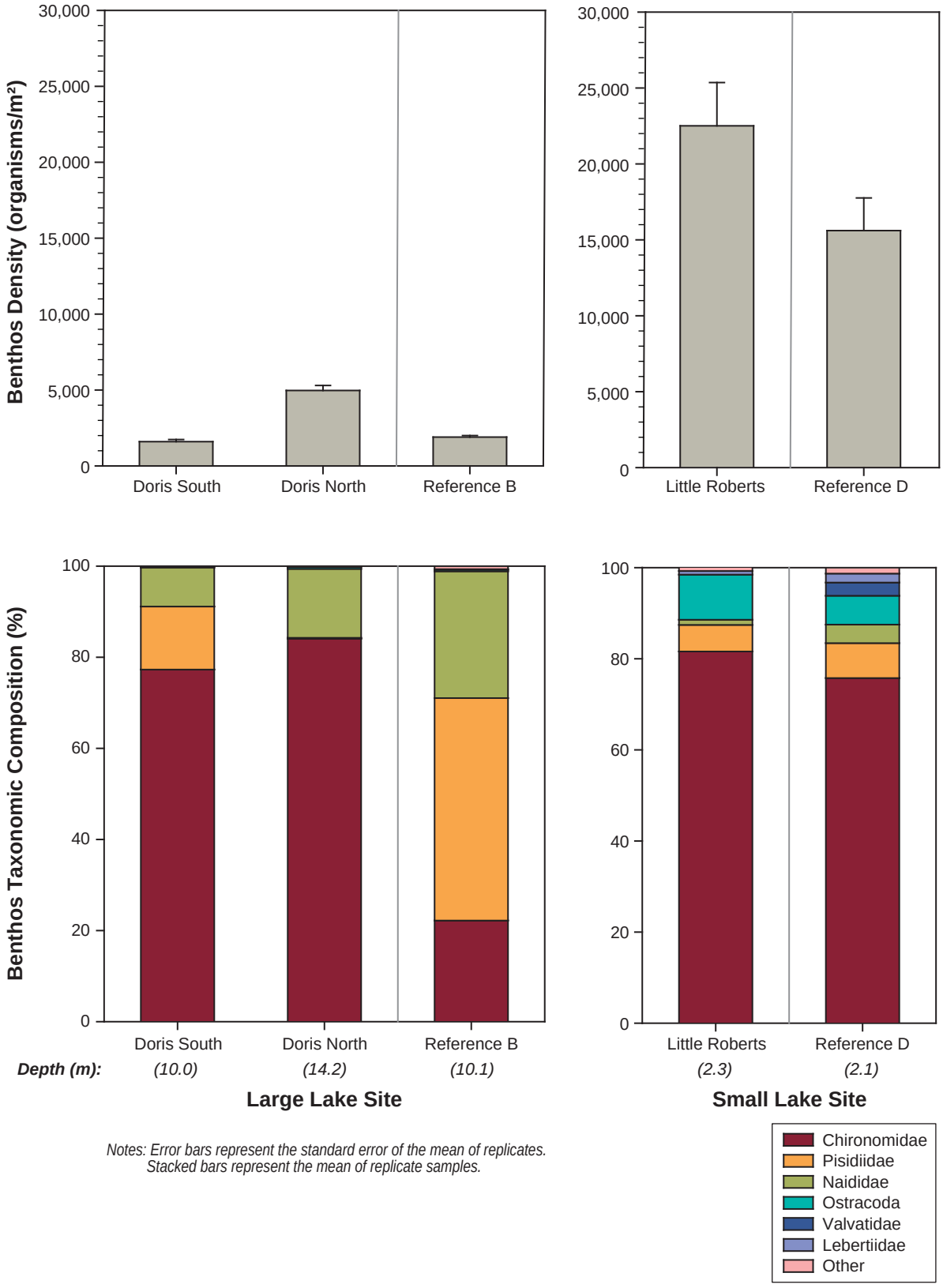
Notes:

SD - Standard deviation of the mean

SE - Standard error of the mean

Figure A.6-4

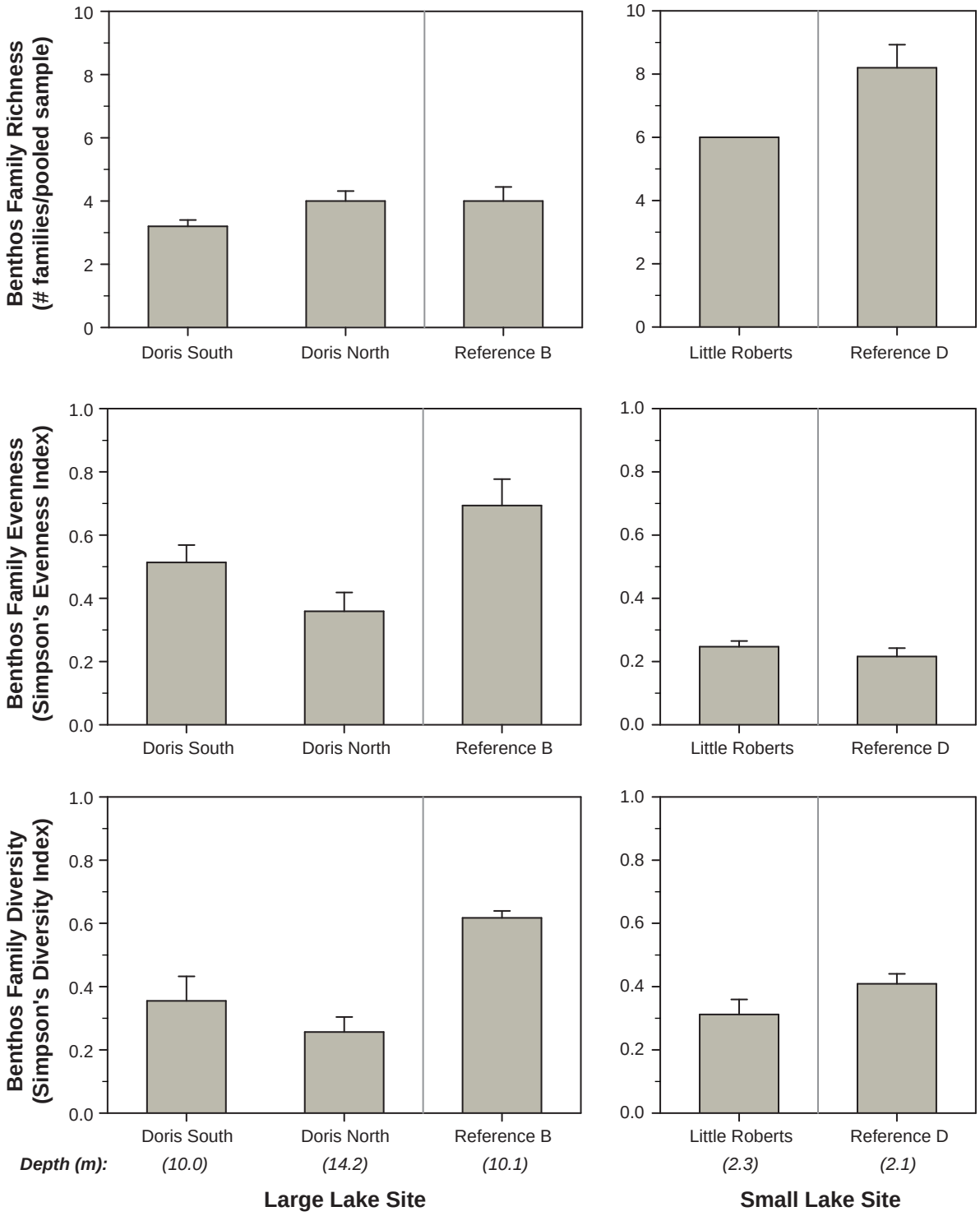
Benthos Density and Taxonomic Composition in Lake Sites, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Stacked bars represent the mean of replicate samples.

Figure A.6-5

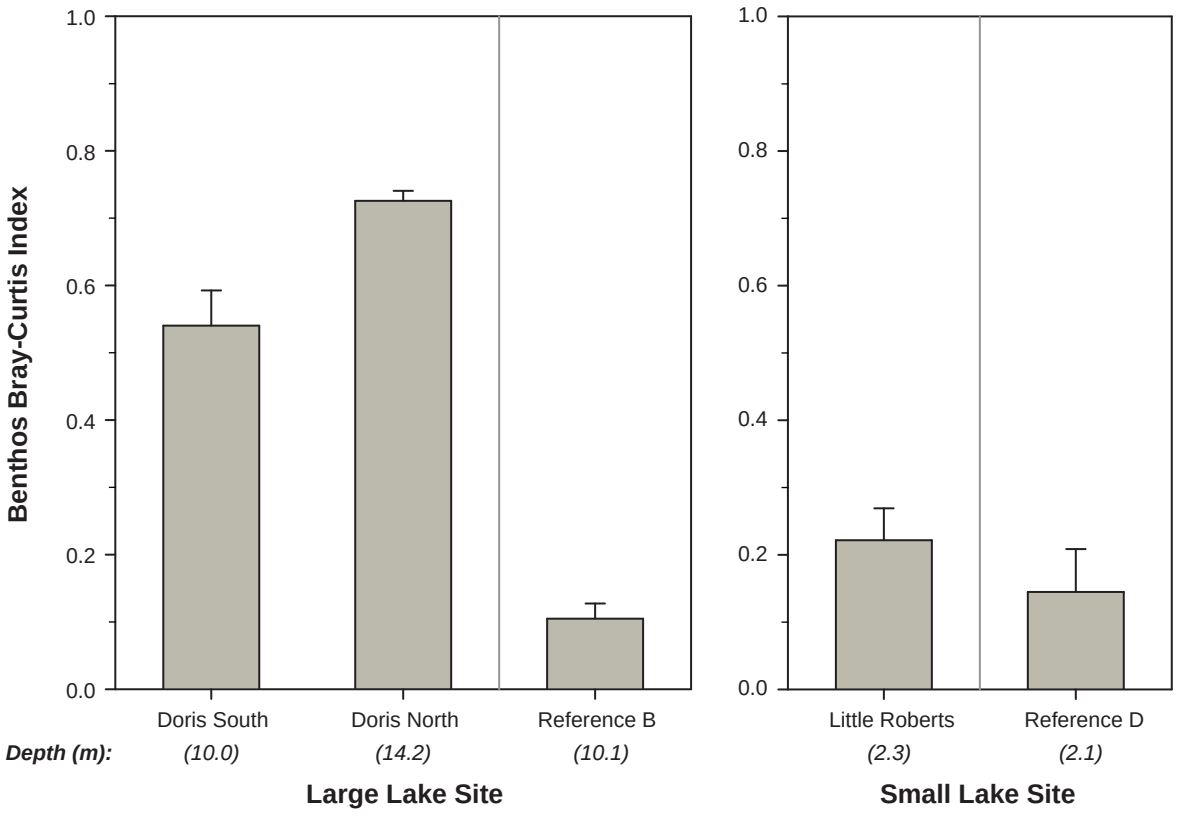
Benthos Richness, Evenness, and Diversity in Lake Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Figure A.6-6

Benthos Bray-Curtis Index for Lake Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Annex A.6-3. Lake Benthos Taxonomy Data, Doris Project, 2016

				Sampling Date:	Doris Lake South 20-Aug-16					Doris Lake North 20-Aug-16					Reference Lake B 10-Aug-16					Little Roberts Lake 15-Aug-16					Reference Lake D 11-Aug-16				
				Sampling Depth:	10.5 m	10 m	9 m	10 m	10.5 m	14 m	14 m	14 m	14 m	15 m	10.2 m	10 m	10 m	10 m	10 m	2 m	2 m	2.5 m	2.3 m	2.6 m	2 m	2 m	2 m	2.3 m	2 m
Major Group	**Family**	**Subfamily**	**Tribe**	**Genus**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**
Nematoda*	-	-	-	-	1						1				58	34	66	100	104	1	10		32	12	94	67	38	43	28
Hirudinea	Piscicolidae	-	-	*Piscicola milneri*																								1	
Oligochaeta - cocoon*	-	-	-		5	2				12	10	7	17	4	1										10				
Oligochaeta	Lumbriculidae	-	-	-													1	3		1				2		3	10		1
	Naididae	Tubificinae	-	-	17	6	1	16	7	36	29	53	89	36	28	42	54	34	22	31	16	20	10		64	13	15	63	61
Gastropoda	Valvatidae	-	-	*Valvata sincera*																					67	43	5	18	22
Pelecypoda	Pisidiidae	-	-	(i/d)	11		2	2				1			27	14	10	16	20	40	40	24		80				1	56
		-	-	*Sphaerium*											2	1		4							13	21	3	4	18
		-	-	*Pisidium*	20	9	4	15	15				1	1	25	65	33	42	54	48	18	8	29	93	72	116		86	68
Acari - Hydracarina*	-	-	-	(i/d)*																								10	
Acari - Hydracarina	Hygrobatidae	-	-	*Hygrobates*																									1
	Lebertiidae	-	-	*Lebertia*													1			10	11	20	10	10	34	6	12	36	7
	Oxidae	-	-	*Oxus*						1	1										40								
	Sperchontidae	-	-	*Sperchon*																			1			30			16
	Unionicolidae	-	-	*Neumania*																		20							
Copepoda – Calanoida*	-	-	-	-	3	2		1		1	10	1	2	3		1	1												
Copepoda – Cyclopoida*	-	-	-	-											1		1		1	50	40	10		60		20	10		8
Ostracoda	-	-	-	-	2					1	3	2		1				1	1	170	90	174	171	90	30	80	40	110	72
Cladocera*	Bosminidae*	-	-	*Bosmina**															1										
Isopoda	Chaetiliidae	-	-	*Saduria entomon*										1										2					
Trichoptera	Limnephilidae	-	-	(i/d)																								2	

Notes:

i/d = immature or damaged

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Calanoid and cyclopoid copepods and cladocerans were excluded because they are generally planktonic.

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Terrestrial organisms were excluded because they are not aquatic invertebrates.

Immature (e.g., oligochaete cocoons) or damaged organisms that were not identiable to the family level were excluded from analyses.

Individuals within the major groups Ostracoda were not identifiable to family, so they are included at the next lowest taxonomic category (class).

The total number of individuals was divided by 3 times the surface are of the Ekman sampler (i.e., 3 x 0.0225 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Ekman grabs).

Annex A.6-3. Lake Benthos Taxonomy Data, Doris Project, 2016

				Sampling Date:	Doris Lake South 20-Aug-16					Doris Lake North 20-Aug-16					Reference Lake B 10-Aug-16					Little Roberts Lake 15-Aug-16					Reference Lake D 11-Aug-16				
				Sampling Depth:	10.5 m	10 m	9 m	10 m	10.5 m	14 m	14 m	14 m	14 m	15 m	10.2 m	10 m	10 m	10 m	10 m	2 m	2 m	2.5 m	2.3 m	2.6 m	2 m	2 m	2 m	2.3 m	2 m
Major Group	**Family**	**Subfamily**	**Tribe**	**Genus**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**	**Rep-1**	**Rep-2**	**Rep-3**	**Rep-4**	**Rep-5**
Diptera	Chironomidae	-	-	(pupa)												2	1		3	1					10		2	
		Tanypodinae	Pentaneurini	*Thienemannimyia* group																	1							
			Procladiini	*Procladius*	1	5	19	6	3				1		5		1	1	1	32	78	39	106	49	66	21	28	9	54
		Diamesinae	Protanypini	*Protanypus*											1		1	1	3										
		Prodiamesinae		*Monodiamesa*	10	10	4	5	8								1	1			1						1		
		Orthocladiinae	Orthocladiini	(i/d)														1											
				Abyskomyia											4	1	1	1											
				Cricotopus / Orthocladius																1						12			9
				Heterotanytarsus											1			1											
				Heterotrissocladius													2		1										
				Psectrocladius											3	2	3	1	2	10						46	12	1	20
				Zalutschia											4	3		13	2										
		Chironominae	Chironomini	(i/d)								66																	
				Chironomus	3			1		347	300	260	190	253	1					234	148	848	619	385	10			13	3
				Cladopelma																						10			1
				Cryptochironomus																					16	2	4		
				Dicrotendipes																					8				
				Microtendipes																					16				9
				Sergenta		1														249	28	422	15	66	57	309	21	519	136
				Stictochironomus	69	84	57	43	82	5	1										33		1	1			1		
			Tanytarsini	(i/d)															2	8									
				Cladotanytarsus																						10			
				Corynocera																					66	8	239	43	137
				Paratanytarsus											3	1	2		1	21		74	1	2	278	484	60	268	485
				Tanytarsus	3			2						1	13	24	17	5	7	191	1,579	172	478	434	158	17	74	43	143
	Empididae	-	-	*Chelifera/Metachela*																						1		1	
	Tipulidae	-	-	*Tipula*																									1
Terrestrial*	-	-	-	-			1																						
Total					136	115	87	90	115	390	334	382	281	293	117	155	128	125	117	1,039	2,083	1,821	1,441	1,216	963	1,242	525	1,220	1,320

Notes:

i/d = immature or damaged

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Calanoid and cyclopoid copepods and cladocerans were excluded because they are generally planktonic.

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Terrestrial organisms were excluded because they are not aquatic invertebrates.

Immature (e.g., oligochaete cocoons) or damaged organisms that were not identiable to the family level were excluded from analyses.

Individuals within the major groups Ostracoda were not identifiable to family, so they are included at the next lowest taxonomic category (class).

The total number of individuals was divided by 3 times the surface are of the Ekman sampler (i.e., 3 x 0.0225 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Ekman grabs).

Annex A.6-4. Lake Benthos Summary Statistics, Doris Project, 2016

	Doris Lake South					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	1,289	2,015	1,704	1,609	300	134
Family Richness	3	4	3	3.2	0.4	0.2
Simpson's Diversity Index	0.15	0.53	0.33	0.35	0.17	0.08
Simpson's Evenness Index	0.39	0.71	0.49	0.51	0.12	0.06
Bray-Curtis Index	0.41	0.66	0.58	0.54	0.12	0.05

	Doris Lake North					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	4,163	5,778	4,948	4,978	737	330
Family Richness	3	5	4	4.0	0.7	0.3
Simpson's Diversity Index	0.18	0.44	0.23	0.26	0.11	0.05
Simpson's Evenness Index	0.26	0.59	0.30	0.36	0.13	0.06
Bray-Curtis Index	0.68	0.76	0.75	0.73	0.03	0.02

	Little Roberts Lake					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	15,393	30,859	21,348	22,519	6,362	2,845
Family Richness	6	6	6	6.0	0.0	0.0
Simpson's Diversity Index	0.19	0.46	0.27	0.31	0.11	0.05
Simpson's Evenness Index	0.21	0.31	0.23	0.25	0.04	0.02
Bray-Curtis Index	0.10	0.35	0.22	0.22	0.11	0.05

	Reference Lake B					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	1,733	2,296	1,852	1,902	232	104
Family Richness	3	5	4	4.0	1.0	0.4
Simpson's Diversity Index	0.54	0.66	0.64	0.62	0.05	0.02
Simpson's Evenness Index	0.54	0.93	0.58	0.69	0.19	0.08
Bray-Curtis Index	0.032	0.16	0.11	0.10	0.05	0.02

	Reference Lake D					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	7,778	19,556	18,074	15,615	4,811	2,151
Family Richness	6	10	9	8.2	1.6	0.7
Simpson's Diversity Index	0.29	0.48	0.42	0.41	0.07	0.03
Simpson's Evenness Index	0.17	0.32	0.20	0.22	0.06	0.03
Bray-Curtis Index	0.03	0.39	0.08	0.14	0.14	0.06

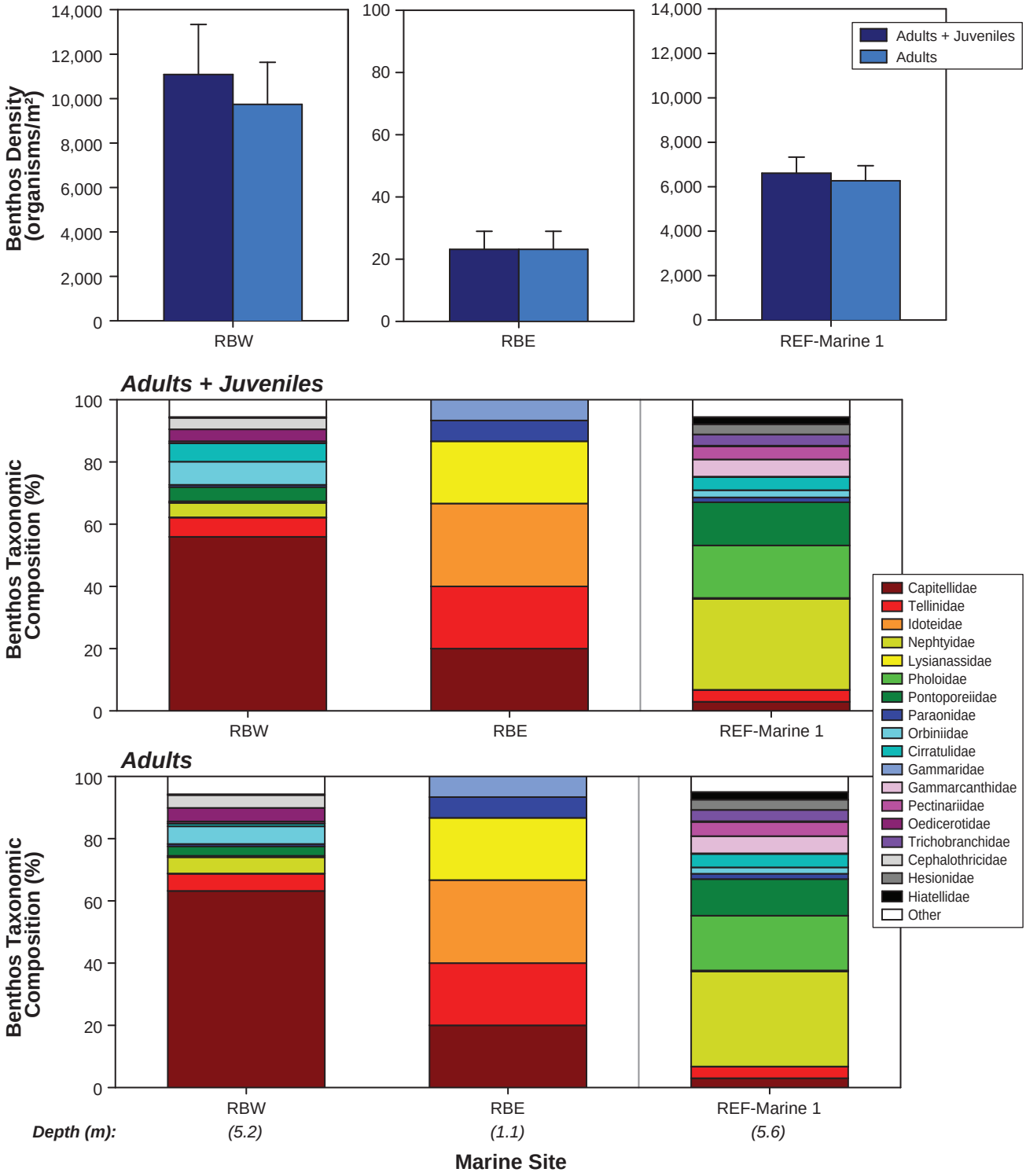
Notes:

SD - Standard deviation of the mean

SE - Standard error of the mean

Figure A.6-7

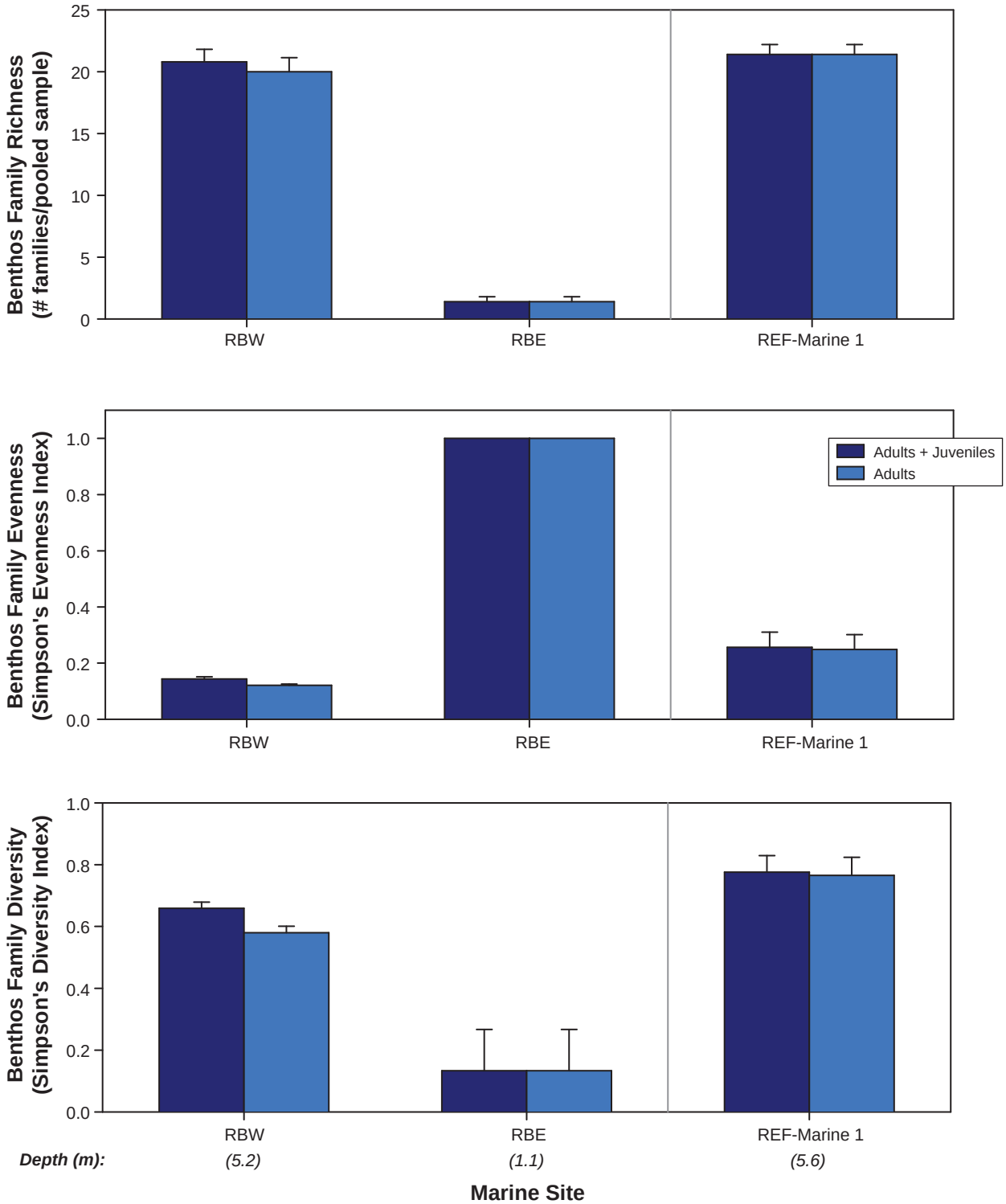
Benthos Density and Taxonomic Composition in Marine Sites, Doris Project, August 2016



Notes: Error bars represent the standard error of the mean of replicates.
Benthos density y-axis scale differs for RBE plot because of relatively low density at this site.
Stacked bars represent the mean of replicate samples.

Figure A.6-8

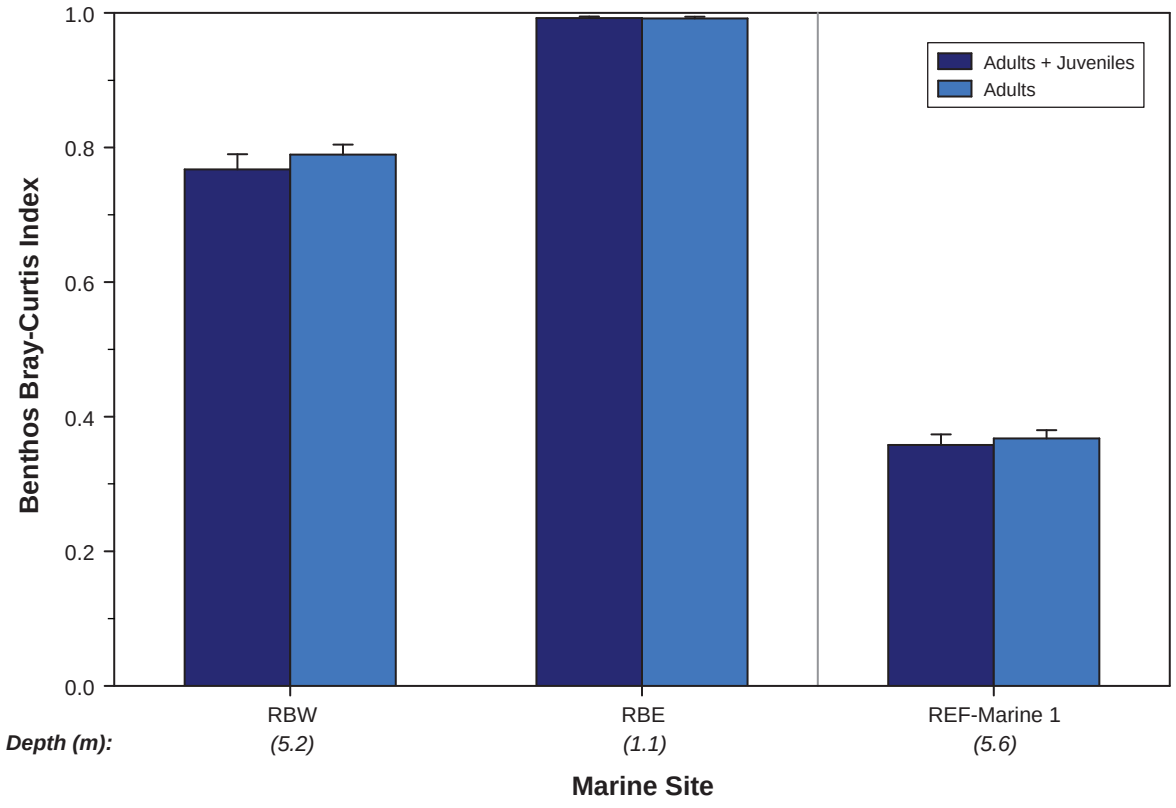
Benthos Richness, Evenness, and Diversity in Marine Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Figure A.6-9

Benthos Bray-Curtis Index for Marine Sites, Doris Project, August 2016



Note: Error bars represent the standard error of the mean of replicates.

Annex A.6-5. Marine Benthos Taxonomy Data, Doris Project, 2016

	Station ID:	REF-Marine 1										RBE									
	Sampling Date:	13-Aug-16										12-Aug-16									
	Replicate:	1		2		3		4		5		1		2		3		4		5	
	Sampling Depth:	6.2 m		6.5 m		6.0 m		3.5 m		6.0 m		0.8 m		1.2 m		1.4 m		not reported		not reported	
	Adult (A)/Juvenile (J):	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J
TAXA	Family																				
FORAMINIFERA																					
Cornuspira sp.	Cornuspiridae							4		1											
NEMATODA																					
Nematoda indet*														1							
NEMERTEA																					
Cephalothrix nr *linearis*	Cephalothricidae																				
Cerebratulus sp	Lineidae	2																			
Lineidae indet	Lineidae																				
Nemertea sp indet*	Phylum																				
ANNELIDA																					
Polychaeta Errantia																					
Bipalponephtys neotena	Nephtyidae	74		14		235	1	304	1	68	1										
Eteone barbata	Phyllodocidae																				
Eteone longa	Phyllodocidae	1		2																	
Harmothoe imbricata Cmplx	Polynoidae	1		2		1		2		2											
Lumbrineris sp	Lumbrineridae																				
Nereimya nr *aphroditoides*	Hesionidae	15	1	33		1		7		6											
Pholoe inornata	Pholoidae	145		89		18		62		32											
Pholoe nr *longa*	Pholoidae	10		2		9		7		3											
Phyllodoce groenlandica	Phyllodocidae																				
Polychaeta Sedentaria																					
Aphelochaeta nr *marioni*	Cirratulidae	15		53		6		1													
Aricidea nolani	Paraonidae	3				7				25		1									
Capitella capitata Cmplx	Capitellidae									11											
Chaetozone sp	Cirratulidae																				
Chone duneri	Sabellidae	4																			
Cirratulidae indet	Cirratulidae																				
Cistenides granulata	Pectinariidae	3		5		3		19		4											
Cistenides hyperborea	Pectinariidae	5		9						47											
Clymenura polaris	Maldanidae	1		2		3				2											
Leitoscoloplos sp	Orbiniidae	11	3	1		30	6	1		27											
Mediomastus sp	Capitellidae	34		4		14	1	2										2			
Polycirrus sp	Terebellidae			1																	
Prionospio sp	Spionidae																				
Pygospio elegans	Spionidae																				
Spio cirrifera	Spionidae																				
Terebellides sp	Trichobranchidae	21	3	23		13		18													

	Station ID:	RBW									
	Sampling Date:	12-Aug-16									
	Replicate:	1		2		3		4		5	
	Sampling Depth:	5.0 m		4.5 m		5.5 m		5.2 m		5.6 m	
	Adult (A)/Juvenile (J):	A	J	A	J	A	J	A	J	A	J
TAXA	Family										
FORAMINIFERA											
Cornuspira sp.	Cornuspiridae										
NEMATODA											
Nematoda indet*											
NEMERTEA											
Cephalothrix nr *linearis*	Cephalothricidae	21		47		22		6		46	
Cerebratulus sp	Lineidae		1	2			1				1
Lineidae indet	Lineidae									1	
Nemertea sp indet*	Phylum	1		1		3		1		2	
ANNELIDA											
Polychaeta Errantia											
Bipalponephtys neotena	Nephtyidae	59	2	59	1	40		9		19	
Eteone barbata	Phyllodocidae							1			
Eteone longa	Phyllodocidae	3		1		4		2		3	
Harmothoe imbricata Cmplx	Polynoidae										
Lumbrineris sp	Lumbrineridae										1
Nereimya nr *aphroditoides*	Hesionidae										
Pholoe inornata	Pholoidae							1		1	
Pholoe nr *longa*	Pholoidae	5	4	4		3					
Phyllodoce groenlandica	Phyllodocidae								1		
Polychaeta Sedentaria											
Aphelochaeta nr *marioni*	Cirratulidae	6	61	12	88	3	19	1	16	7	29
Aricidea nolani	Paraonidae	6		1		4		2	1	9	
Capitella capitata Cmplx	Capitellidae	3		1		1		2		1	
Chaetozone sp	Cirratulidae	1								1	
Chone duneri	Sabellidae										
Cirratulidae indet	Cirratulidae							1			
Cistenides granulata	Pectinariidae	1		13		4		2		2	
Cistenides hyperborea	Pectinariidae	2									
Clymenura polaris	Maldanidae	1						2			
Leitoscoloplos sp	Orbiniidae	54	26	82	55	29	20	15	3	25	7
Mediomastus sp	Capitellidae	433		646		393		231		368	
Polycirrus sp	Terebellidae										
Prionospio sp	Spionidae			1						1	
Pygospio elegans	Spionidae	1									
Spio cirrifera	Spionidae			1				1			
Terebellides sp	Trichobranchidae										

Notes:

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Individuals that were not identifiable to the family level were excluded from analyses.

The total number of individuals was divided by 3 times the surface are of the Petite Ponar (i.e., 3 x 0.023 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Petite Ponar grabs).

Annex A.6-5. Marine Benthos Taxonomy Data, Doris Project, 2016

	Station ID:	REF-Marine 1										RBE										RBW									
	Sampling Date:	13-Aug-16										12-Aug-16										12-Aug-16									
	Replicate:	1		2		3		4		5		1		2		3		4		5		1		2		3		4		5	
	Sampling Depth:	6.2 m		6.5 m		6.0 m		3.5 m		6.0 m		0.8 m		1.2 m		1.4 m		not reported		not reported		5.0 m		4.5 m		5.5 m		5.2 m		5.6 m	
	Adult (A)/Juvenile (J):	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J	A	J
TAXA	Family																														
ARTHROPODA																															
Amphipoda																															
Apherusa glacialis	Calliopiidae	16		2																											
Deflexilodes nr *uncinatus*	Oedicerotidae					1		1																							
Gammaracanthus loricatus	Gammarcanthidae	3		1		11	3	42	5	67	2													3							
Lagunogammarus setosus	Gammaridae					1		2		1		1																			
Onisimus affinis	Lysianassidae																	1													
Onisimus sp	Lysianassidae							1		2																1	1				
Orchomenella minuta	Lysianassidae	4								1																					
Paroediceros lynceus	Oedicerotidae	1								1																					
Pontogeneia inermis	Pontogeneiidae							2		4																					
Pontoporeia femorata	Pontoporeiidae	115	10	44	6	21	1	47	19	32	27											18	8	2	3	12	20	29	15	14	7
Rostroculodes nr *vibei*	Oedicerotidae	1																				21		7		23		29		34	
Ostracoda																															
Cytheridae indet	Cytheridae									1												4		6		2				1	
Cumacea																															
Brachydiastylis resima	Diastylidae	2		1		1		4		3												1								1	
Diastylis goodsiri	Diastylidae																													1	
Diastylis rathkei	Diastylidae	1		1		4		1	1																						
Diastylis sp	Diastylidae									1																				3	
Isopoda																															
Saduria entomon	Idoteidae					1						1				1								1	1					1	
MOLLUSCA																															
Gastropoda																															
Admete sp	Cancellariidae																							2							
Cylichna occulta	Cylichnidae									7												17		103	7	13		11		7	
Retusa obtusa	Retusidae			1																				10		1		2		1	
Bivalvia																															
Astarte borealis	Astartidae			1						1												2	1	3		2					
Astarte montagui	Astartidae																							1		1					
Axinopsida serricata	Thyasiridae																							1							
Hiatella arctica	Hiatellidae	4		13	1	2		5		24												2		6		1		1		1	
Macoma balthica	Tellinidae	5	1	4		14		38	4	24	3			1								49	9	125	16	20	16	9	5	13	6
Macoma calcarea	Tellinidae																					1		3		4		2			
Musculus discors	Mytilidae	2		1				1		5																					
Mytilus trossulus	Mytilidae	3		3	1			2	1	4	15																1			1	1
Serripes groenlandicus	Cardiidae			1																				1				1			
Total		502	18	313	8	396	12	573	31	406	48	3	0	1	0	1	0	1	0	2	0	711	112	1144	171	583	78	360	41	562	52

Notes:

** Taxa marked with an asterisk were excluded from total counts and from all benthos analyses.*

Nematodes were excluded because they are meiofauna and are not adequately sampled using a 500 um sieve bucket.

Individuals that were not identifiable to the family level were excluded from analyses.

The total number of individuals was divided by 3 times the surface are of the Petite Ponar (i.e., 3 x 0.023 m^2) to determine the benthos density in units of organisms/m^2 (because each replicate consisted of 3 pooled Petite Ponar grabs).

Annex A.6-6. Marine Benthos Summary Statistics, Doris Project, 2016

	Roberts Bay West (RBW) - Adults and Juveniles					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	5,812	19,203	9,580	11,084	5,037	2,252
Family Richness	18	24	20	21	2.3	1.0
Simpson's Diversity Index	0.62	0.72	0.64	0.66	0.04	0.02
Simpson's Evenness Index	0.12	0.16	0.15	0.14	0.02	0.01
Bray-Curtis Index	0.71	0.84	0.74	0.77	0.05	0.02

	Roberts Bay West (RBW) - Adults					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	5,217	16,580	8,449	9,739	4,236	1,894
Family Richness	18	24	19	20	2.5	1.1
Simpson's Diversity Index	0.53	0.65	0.56	0.58	0.05	0.02
Simpson's Evenness Index	0.11	0.13	0.12	0.12	0.01	0.004
Bray-Curtis Index	0.75	0.83	0.78	0.79	0.03	0.01

	Roberts Bay East (RBE) - Adults and Juveniles					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	14	43	14	23	13	5.8
Family Richness	1	3	1	1.4	0.9	0.4
Simpson's Diversity Index	0.00	0.67	0.00	0.13	0.30	0.13
Simpson's Evenness Index	1.00	1.00	1.00	1.00	0.00	0.00
Bray-Curtis Index	0.99	1.00	0.99	0.99	0.005	0.002

	Roberts Bay East (RBE) - Adults					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	14	43	14	23	13	5.8
Family Richness	1	3	1	1.4	0.9	0.4
Simpson's Diversity Index	0.00	0.67	0.00	0.13	0.30	0.13
Simpson's Evenness Index	1.00	1.00	1.00	1.00	0.00	0.00
Bray-Curtis Index	0.99	1.00	0.99	0.99	0.006	0.003

	Ida Bay (REF-Marine 1) - Adults and Juveniles					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	4,652	8,754	6,580	6,609	1,618	724
Family Richness	19	23	22	21	1.8	0.8
Simpson's Diversity Index	0.60	0.90	0.82	0.78	0.12	0.05
Simpson's Evenness Index	0.13	0.44	0.24	0.26	0.12	0.05
Bray-Curtis Index	0.31	0.41	0.36	0.36	0.04	0.02

	Ida Bay (REF-Marine 1) - Adults					
	Min	**Max**	**Median**	**Mean**	**SD**	**SE**
Density (#/m^2)	4,536	8,304	5,884	6,270	1,513	677
Family Richness	19	23	22	21	1.8	0.8
Simpson's Diversity Index	0.58	0.90	0.82	0.77	0.13	0.06
Simpson's Evenness Index	0.13	0.43	0.24	0.25	0.12	0.05
Bray-Curtis Index	0.33	0.40	0.37	0.37	0.03	0.01

Notes:

SD - Standard deviation of the mean

SE - Standard error of the mean

Annex A.6-7. Results of Benthos QA/QC Sorting Efficiencies, Doris Project, 2016

Sample ID	# from First Sort	1st QAQC Re-sort # Found	Initial Sort Efficiency (%)	Re-sort Required?	2nd QAQC Re-sort # Found	Final Efficiency (%)
Freshwater						
Roberts Outflow, rep 3	663	18	97.4	N	-	97.4
Little Roberts Outflow, rep 5	2,545	54	97.9	N	-	97.9
Reference D Outflow, rep 4	2,151	31	99.0	N	-	99.0
Doris Lake North, rep 3	390	8	98.0	N	-	98.0
Doris Lake South, rep 1	145	4	97.3	N	-	97.3
Marine						
REF-Marine 1, rep 1	520	0	100	N	-	100
REF-Marine 1, rep 2	321	0	100	N	-	100
REF-Marine 1, rep 3	409	0	100	N	-	100
REF-Marine 1, rep 4	286	0	100	N	-	100
REF-Marine 1, rep 5	454	0	100	N	-	100
RBE, rep 1	3	0	100	N	-	100
RBE, rep 2	2	0	100	N	-	100
RBE, rep 3	1	0	100	N	-	100
RBE, rep 4	1	0	100	N	-	100
RBE, rep 5	2	0	100	N	-	100
RBW, rep 1	824	0	100	N	-	100
RBW, rep 2	1,316	0	100	N	-	100
RBW, rep 3	664	0	100	N	-	100
RBW, rep 4	402	0	100	N	-	100
RBW, rep 5	616	0	100	N	-	100

Notes:

If the efficiency is 95% or better nothing further is done and the QA/QC invertebrates are not added to the data.

If the efficiency is less than 95%, the QA/QC invertebrates are added to the sample, it is re-sorted, and a second 20% QA/QC is performed.

*Freshwater data: % Sorting Efficiency = [1- {# in QA/QC re-sort/(# sorted originally + # in QA/QC re-sort)}]*100*

*Marine data (20% of sample is re-sorted): % Sorting Efficiency = [1- {(5 x # in QA/QC re-sort)/(# sorted originally + (5 x # in QA/QC re-sort))}]*100*

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Appendix B

2016 Evaluation of Effects Supporting Information

APPENDIX B. 2016 EVALUATION OF EFFECTS SUPPORTING INFORMATION

B.1 BASELINE DATA SELECTION RATIONALE FOR EVALUATION OF EFFECTS

The tables presented in this section present a summary of the baseline water quality, sediment quality, and primary producer biomass data collected at the AEMP sites, as well as the rationale for the inclusion or exclusion of certain baseline data from the 2016 evaluation of effects.

B.1.1 Water Quality Data

Table B.1-1 presents a summary of the baseline water quality data collected at AEMP stream, lake, and marine sites, and the rationale for the inclusion or exclusion of certain baseline data from the 2016 evaluation of effects. The selection of historical data to include in the water quality evaluation of effects was mainly based on similarity of baseline sampling locations to 2016 sampling locations, methodology, and sampling depth.

B.1.2 Sediment Quality Data

Table B.1-2 presents a summary of the baseline sediment quality data collected at AEMP stream, lake, and marine sites, and the rationale for the inclusion or exclusion of certain baseline data from the 2016 evaluation of effects. The selection of historical data to include in the sediment quality evaluation of effects was mainly based on the comparability of the depth strata sampled between baseline and 2016 samples, the proximity of baseline sampling sites to the 2016 sites, and the similarity of sampling techniques.

B.1.3 Phytoplankton and Periphyton Biomass Data

Table B.1-3 presents a summary of the baseline phytoplankton and periphyton biomass data collected at AEMP stream, lake, and marine sites, and the rationale for the inclusion or exclusion of certain baseline data from the 2016 evaluation of effects. The main criteria for the selection of historical phytoplankton and periphyton biomass data for inclusion in the evaluation of effect were the proximity of baseline sampling sites to 2016 AEMP sampling sites, and the comparability of sampling methodologies.

Table B.1-1. Baseline Data Selection Rationale for Water Quality, Doris Project, 2016

Sampling Sites	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Streams					
Doris OF	1996	June, August	All	None	
	1997	June July, August	All	None	
	2000	June, September	All	None	
	2003	July, August, September	All	None	
	2004	June, July, August, September	All	None	
	2005	June, July, August, September	All	None	
	2006	June, July, August, September	All	None	
	2007	June, July, August, September	All	None	
	2008	June, July, August, September	All	None	
	2009	June, August, September	All	None	
Roberts OF	2004	June, July, August, September	All	None	
	2005	June, July, August, September	All	None	
	2006	June, July, August, September	All	None	
	2007	June, July, August, September	All	None	
	2008	June, July, August, September	All	None	
Little Roberts OF	1996	June, August	None	All	1996-1997 sampling site was further downstream than the 2003-2016 sampling site.
	1997	June, July, August	None	All	1996-1997 sampling site was further downstream than the 2003-2016 sampling site.
	2003	July, August, September	All	None	
	2004	June, July, August, September	All	None	
	2005	June, July, August, September	All	None	
	2006	June, July, August, September	All	None	
	2007	June, July, August, September	All	None	
	2008	June, July, August, September	All	None	
	2009	June, August, September	All	None	
Reference B OF	2009	June, August, September	All	None	
Reference D OF	no pre-2010 baseline data available				

Table B.1-1. Baseline Data Selection Rationale for Water Quality, Doris Project, 2016

Sampling Sites	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Lakes					
Doris South	1995	May, June, July, August	Included May and June under-ice samples and August samples collected from boat at site SW4	Excluded shoreline grabs from July and August	Shoreline grabs from July and August were from a near-shore site that is not comparable to the 2016 Doris South site.
	1996	April, August	All	None	
	1997	April, July, August	All	None	
	1998	April	All	None	
	2000	July, August	All	None	
	2009	April, August	All	None	
Doris North	1995	May, June, July, August	Included May and June under-ice samples and August samples collected from boat a site SW3	Excluded shoreline grabs from July and August	Shoreline grabs from July and August are from a shallow, near-shore site that is not comparable to the 2016 Doris North site.
	2003	July, August, September	All	None	
	2004	June, July, August, September	All	None	
	2005	July, August, September	All	None	
	2006	May, July, August, September	All	None	
	2007	May, July, August, September	All	None	
	2008	May, July, August, September	All	None	
	2009	April, August	All	None	
Little Roberts	1995	May, June, July, August	Included May and June under-ice samples	Excluded shoreline grabs from July and August	Shoreline grabs from July and August are from a near-shore site that is not comparable to the 2016 Little Roberts Lake site.
	1996	August	All	None	
	1997	July	All	None	
	2003	July, August, September	All	None	
	2004	July, August, September	All	None	
	2005	July, August, September	All	None	
	2006	May, July, August, September	All	None	
	2007	May, July, August, September	All	None	
	2008	May, July, August, September	All	None	
	2009	April, August	All	None	
Reference B	2009	April, August	All	None	
Reference D	no pre-2010 baseline data available				

Table B.1-1. Baseline Data Selection Rationale for Water Quality, Doris Project, 2016

Sampling Sites	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Marine Sites					
RBW	1996	August	None	All	1996-1998 sampling sites were >1 km away from 2016 RBW site.
	1997	August	None	All	1996-1998 sampling sites were >1 km away from 2016 RBW site.
	1998	July	None	All	1996-1998 sampling sites were >1 km away from 2016 RBW site.
	2009	April, August	Included surface samples from sites WT1 and ST2	Exluded samples from sites: WT2, WT4, WT6, ST1, ST3, ST4, ST5, ST6, and deep sample from site ST2	Excluded sites that were >1 km away from 2016 RBW site, and excluded deep samples because only surface samples were collected in 2016.
RBE	1996	August	Included single site that was in the eastern basin	None	
	1997	August	None	All	1997-1998 sampling site in eastern basin was closer to the mouth of Little Roberts Outflow than the 2016 RBE site (greater freshwater influence).
	1998	July	None	All	1997-1998 sampling site in eastern basin was closer to the mouth of Little Roberts Outflow than the 2016 RBE site (greater freshwater influence).
	2004	July, August, September	All	None	
	2005	July, August, September	All	None	
	2006	May, July, August, September	All	None	
	2007	May, July, August, September	All	None	
	2008	July, August, September	All	None	
	2009	April, August	All	None	
REF-Marine 1	2009	April, August	Included surface samples from site RP3	Excluded samples from sites: REF-W and REF-4, and deep samples from site RP3	Excluded sites that were >1 km away from 2016 REF-Marine 1 site, and excluded deep samples because only surface samples were collected in 2016.

Table B.1-2. Baseline Data Selection Rationale for Sediment Quality, Doris Project, 2016

Sampling sites	Years Sampled	Month Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Streams					
Doris OF	2009	August	All	None	
Roberts OF	no pre-2010 baseline data available				
Little Roberts OF	2009	August	All	None	
Reference B OF	2009	August	All	None	
Reference D OF	no pre-2010 baseline data available				
Lakes					
Doris South (deep)	1996	August	None	All	Sediment sample was separated into layers (0-1 cm and 1-3 cm).
	1997	July	All	None	
	2009	August	Included deep site	Excluded shallow site	Shallow site not comparable with deep site.
Doris North (deep)	2009	August	Included deep site		Shallow site not comparable with deep site.
Little Roberts (shallow)	1996	August	None	All	Sediment sample was separated into layers (0-1 cm and 1-3 cm).
	1997	July	All	None	
	2009	August	All	None	
Reference B (deep)	2009	August	None	All	Shallow/mid depth sites and located at opposite end of lake relative to 2016 site.
Reference D (shallow)	no pre-2010 baseline data available				
Marine Sites					
RBW (shallow to mid-depth)	1997	August	None	All	Mid-depth/deep sites and located >1 km from 2016 RBW site.
	2002	August	Included sites RB3 and RB4	Excluded sites RB1, RB2	Average sampling depth at RBW in 2016 was 5.1 m, so used data from both RB3 (7.9 m depth) and RB4 (4.6 m depth) since RBW depth was between these two depths. RB1 and RB2 were excluded as they were >1 km from 2016 RBW site.
	2009	August	None	All	Excluded sites were all ~0.4 km or more away from 2016 RBW site.
RBE (shallow)	1997	August	None	All	Sampling site in eastern basin was closer to the mouth of Little Roberts Outflow than the 2016 RBE site (greater freshwater influence, and depositional zone).
REF-Marine 1 (shallow to mid-depth)	2009	August	Included sites RP1 and RP2	Excluded deep site RP3	Average sampling depth at REF-Marine 1 in 2016 was 6.2 m, so used data from both RP1 (5 m depth) and RP2 (9 m depth) since REF-Marine 1 depth was between these two depths. Data from RP3 (14 m depth) were excluded because of deep sampling depth.

Table B.1-3. Baseline Data Selection Rationale for Primary Producer Biomass (as Chlorophyl *a*), Doris Project, 2016

Sampling Sites	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Streams (Periphyton)					
Doris OF	1996	August	None	All	An instantaneous sample was collected, and chlorophyll *a* concentrations were not measured (only abundance and taxonomy data).
	1997	June-July, July-August	All	None	
	2000	July-August	All	None	
	2009	July-August	All	None	
Roberts OF	no pre-2010 baseline data available				
Little Roberts OF	1996	August	None	All	1996 sampling site was further downstream than 2009-2016 sampling site, an instantaneous sample was collected, and chlorophyll a concentrations were not measured (only abundance and taxonomy data).
	1997	June-July, July-August	None	All	1997 sampling site was further downstream than 2009-2016 sampling site.
	2009	July-August	All	None	
Reference B OF	2009	July-August	All	None	
Reference D OF	no pre-2010 baseline data available				
Lakes (Phytoplankton)					
Doris South	1996	August	None	All	Chlorophyll *a* concentrations were not measured (only abundance and taxonomy data).
	1997	July	All	None	
	2000	July	All	None	
	2009	April, August	All	None	
Doris North	2003	July, August, September	None	All	Each sample consisted of a composite of 5 subsamples collected throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2006	September	None	All	Phytoplankton biomass sampling method not described in report.
	2007	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2008	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2009	April, August	All	None	

Table B.1-3. Baseline Data Selection Rationale for Primary Producer Biomass (as Chlorophyl *a*), Doris Project, 2016

Sampling Sites	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Lakes (Phytoplankton*; cont'd)*					
Little Roberts	1996	August	None	All	Chlorophyll *a* concentrations were not measured (only abundance and taxonomy data).
	1997	July	All	None	
	2003	July, August, September	None	All	Each sample consisted of a composite of 5 subsamples collected throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2006	September	None	All	Phytoplankton biomass sampling method not described in report.
	2007	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2008	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2009	April, August	All	None	
Reference B	2009	August	All	None	
Reference D	no pre-2010 baseline data available				
Marine Sites (Phytoplankton)					
RBW	2009	August	Included surface samples from site ST2	Exluded samples from sites ST1, ST3, ST4, ST5, ST6, and deep samples from site ST2	Excluded sites that were >1 km away from 2016 RBW site, and excluded deep samples because only surface samples were collected in 2016.
RBE	2006	September	None	All	Phytoplankton biomass sampling method not described in report.
	2007	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2008	July, August, September	None	All	Phytoplankton biomass samples were collected using an integrated tube sampler deployed throughout the euphotic zone (not comparable to discrete surface samples collected in 2016).
	2009	August	All	None	
REF-Marine 1	2009	August	Included surface samples from site RP3	Excluded samples from site REF-4, and deep samples from site RP3	Excluded sites that were >1 km away from 2016 REF-Marine 1 site, and excluded deep samples because only surface samples were collected in 2016.

APPENDIX B. 2016 EVALUATION OF EFFECTS SUPPORTING INFORMATION

B.2 STATISTICAL METHODOLOGY AND RESULTS FOR EVALUATION OF EFFECTS

The following reports present the statistical methodology and results, including lists of outliers and statistical outputs, for the evaluation of effects on Secchi depth, water quality, sediment quality, phytoplankton and periphyton biomass, and benthic invertebrates:

- Appendix B.2.1. Statistical Methodology and Results for Secchi Depth Evaluation of Effects, Doris Project, 2016
- Appendix B.2.2. Statistical Methodology and Results for Water Quality Evaluation of Effects, Doris Project, 2016
- Appendix B.2.3. Statistical Methodology and Results for Sediment Quality Evaluation of Effects, Doris Project, 2016
- Appendix B.2.4. Statistical Methodology and Results for Phytoplankton and Periphyton Evaluation of Effects, Doris Project, 2016
- Appendix B.2.5. Statistical Methodology and Results for Benthos Evaluation of Effects, Doris Project, 2016

Appendix B.2.1. Statistical Methodology and Results for Secchi Depth Evaluation of Effects, Doris Project, 2016

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1. ANALYSIS METHODS

1.1 ASSUMPTIONS

The key assumption was that the Secchi depth measurements included in this analysis were representative of each lake site's Secchi depth for that monitoring period.

1.2 TRANSFORMATIONS

No transformation was needed.

1.3 OUTLINE OF ANALYSIS PLAN

Two statistical tests were done to assess evidence of change in the Secchi depth over time and to assess if changes may reflect an impact of the Project.

1.3.1 Before vs. After Analysis

The first analysis compared the mean Secchi depth for all years prior to 2010 (before initiation of construction) to the mean for 2016. Each lake site was treated independently.

The final statistical model (in standard shorthand notation) was:

$$Y = Period\ Season\ Period*Season\ Year(period)\text{-}R$$

where *Y* is the mean Secchi depth for a year; *Period* is the effect of before vs. after Project initiation (which is the effect of interest); *Season* is the effect of season (three seasons in the sampling year: 1) July, 2) August, and 3) September); *Period*Season* is an interaction effect between period and season; and *Year(Period)* is a random year effect (applicable if more than one year was sampled during each period). If the data were too sparse (e.g., not all seasons measured in all periods), then the *Period*Season* interaction effect could not be estimated and was dropped.

This model is preferable to simply treating all measurement within a period (e.g., over two years pre-construction) as having the same mean and assuming that they are completely independent of each other. This model also "averages" the Secchi depth data in way that weights each baseline year equally rather than weighting by the sample size. For example, suppose that the Secchi depth measured in 2008 was 22 m, while the two Secchi depths measured in 2009 were 25 m and 27 m. The simple mean (22+25+27)/3=24.7 m would be more heavily weighted toward the mean in the second year. In order to give each year's data equal weight, the reading over both years should be computed as an average of averages:

$$\frac{\frac{22}{1}+\frac{25+27}{2}}{2}=24.0$$

This could be extended to multiple years in a similar fashion.

This model was fit using R version 3.2.2. In the monitoring context, a false positive (i.e., type I error, determining impact when none exists) is more tolerable than a false negative (i.e., type II error, determining no effect when in fact there is one). There is a direct trade-off between the two error rates, as reducing one type of error generally results in an increase in the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. A nominal significance level of 0.05 was used when reviewing the results.

The key disadvantage of this model was that changes in Secchi depth over time may be unrelated to the effects of the Project, e.g., the average Secchi depth in 2016 could be shallower than expected because of long term climate change that is unrelated to the Project. Consequently, if a statistically significant effect was detected, it would require further investigation.

1.3.2 BACI Analysis

Before-After-Control-Impact (BACI) analysis is the standard method used to assess a potential environmental impact (Smith 2002). BACI designs evaluate potential non-parallelism in response over time between exposure and reference waterbodies.

A BACI analysis was performed for each large Project lake (Doris Lake North and Doris Lake South) versus the corresponding reference lake (Reference Lake B). A BACI analysis was not performed for Little Roberts Lake (small lake) because there is no pre-construction data for Reference Lake D.

The formal statistical model (in standard shorthand notation) was:

$$Y = Period\ Class\ Period*Class\ Season\ Period*Season Year(Period)\text{-}R$$

where *Y* is the variable of interest; *Period* is the effect of period (before or after construction); *Class* is the effect of the site classification (Project or reference); *Period*Class* is the BACI effect of interest (i.e., is the effect of *Period* the same (parallel) for both classes of sites); *Season* is the seasonal (sampling month) effect; *Period*Season* is an interaction effect between period and season; and *Year(Period)* is the random year effect within each period (applicable if more than one year was sampled during each period). If the data were too sparse (e.g., not all seasons measured in all periods), then the *Period*Season* interaction effect could not be estimated and was dropped. Sites that were measured only in one period (i.e., pre- or post-construction) contribute some information on the year-effect which improves precision of the BACI estimate and were, therefore, included.

The key variable of interest was the *Period*Class* effect as this measures the amount of non-parallelism between the changes in the mean (Before-After) over the two classes of sites (exposure or reference). The BACI estimate was computed as the "difference in the differences":

$$BACI = \left(\mu_{PA} - \mu_{PB}\right) - \left(\mu_{RA} - \mu_{RB}\right)$$

where μ_{PA} is the mean variable reading in the *Project* class of sites *after* Project initiation, μ_{PB} is the mean variable reading in the *Project* class of sites *before* Project initiation, μ_{RA} is the mean variable reading in the *reference* class of sites *after* Project initiation, and μ_{RB} is the mean variable reading in the *reference* class of sites *before* Project initiation. The BACI contrast was estimated by replacing the

population means above by the model-based estimates. Estimated differences close to 0 would indicate no evidence of non-parallelism.

Note that the hypothesis that the BACI contrast has the value of zero is identical to the hypothesis that the *Period*Class* interaction is zero with identical p-values. Consequently, only the results for the BACI contrast were reported here.

The BACI model was fit using R version 3.2.2.

2. RESULTS

Statistical analysis of Secchi depth was conducted only for large lake sites (Doris Lake North, Doris Lake South, and Reference Lake B). Marine (RBW, RBE, and REF-Marine 1) and small lake (Little Roberts Lake and Reference Lake D) Secchi depths were not included in the analysis because the Secchi disk reached the sea bed or lake bed during nearly all sampling periods in marine and small lake sites.

There was no censoring of the Secchi depth data and the plots of the data showed no obvious outliers.

The results from the analysis that compared the mean prior to 2010 (before initiation of construction) to the mean for 2016 are presented in Table Large Lake-1. There was no evidence of a change in the mean Secchi depth for any exposure lake between the before and after periods.

There was no evidence of a differential before-after response in the mean Secchi depth in large Project lakes compared to Reference Lake B (Table Large Lake-2).

REFERENCES

Helsel, D. R. 2005. *Nondetects and data analysis.* Wiley: New York.

McBride, G. B. 2005. *Using statistical methods for water quality management.* Wiley: New York.

Smith, E. P. 2002. BACI Design. *Encyclopedia of Environmetrics.* Wiley: New York.

TABLES

Table Large Lake-1. Summary of Test for No Difference in Mean between Before and After Periods for Large Lake Secchi Depth

	Large Lake Site		
Variable	**Doris North p-value**	**Doris South p-value**	**Reference B p-value**
Secchi Depth	0.2960	0.6831	-

Notes:
A significance level (alpha) of 0.05 was used to screen for effects and p-values less than 0.05 are bolded.
A before-after analysis was not possible for Reference Lake B.

Table Large Lake-2. Summary of BACI Comparison of Large Lake Secchi Depth for Individual Project Sites

	Large Lake Site	
Variable	**Doris North p-value**	**Doris South p-value**
Secchi Depth	0.5030	0.8406

Note:
A significance level (alpha) of 0.05 was used to screen for effects and p-values less than 0.05 are bolded.

Appendix B.2.2. Statistical Methodology and Results for Water Quality Evaluation of Effects, Doris Project, 2016

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1. ANALYSIS METHODS

1.1 ASSUMPTIONS

There are several assumptions made for the analyses of water quality. The key assumption is that the samples taken are a random sample of the site's water for that monitoring period (e.g., for that month in that year when measured).

Another necessary assumption is that missing data (e.g., a stream was not measured in a month in a particular year) is missing completely at random (MCAR), so that there is no information about the water quality from the "missingness". This assumption could be violated if, for example, samples were not taken because it was known that water quality was compromised on the selected sampling date. There is no way to assess this assumption except by carefully considering why data were not collected on a particular date. If, for example, data were not collected because the sampling vial broke in transit, this is likely a case of MCAR.

It is further assumed that the water columns of all sampled waterbodies are completely mixed so that depth effects can be ignored. This assumption was verified by examining the raw sample means at various depths and fitting statistical models to examine the effects of depth, and few depth effects were seen.

1.2 REPLICATE SAMPLES

Replicate samples collected within the same day and at the same depth were treated as pseudo-replicates (Hurlbert 1984) and values were averaged before further analyses. This is an approximate analysis (compared to actually modelling replicated values as nested within a particular day), but given the low variability seen for most of the replicates, the reported results should be insensitive to this averaging.

1.3 DEALING WITH CENSORING (VALUES BELOW DETECTION LIMITS)

The proportion of data with measurements below the detection limit varies by waterbody and by water quality variable. The analyses below follow the advice of McBride (2005; Section 11.4.3).

- When the dataset includes a small number of below detection values, these values will be replaced by ½ of the detection limit for the analysis.
- When the majority of the dataset consists of values below the detection limit (e.g., more than about 70% below detection limit), there is very little that can be done as there is essentially no information (other than the values are below the detection limit). The analyses will be performed as above, but interpreting the results should be done carefully. Helsel (2005) has other suggestions for analysis (e.g., comparing the proportions below the detection limits) but these tests will require much larger sample sizes than available here.

It should be noted that for data collected in the late 1990s, the detection limits were often considerably higher than the detection limits available for more recent sampling (often 5× or 6× higher). Consequently, there is little to be gained from using this very early data and it was often removed prior to analysis and treated as outliers as noted in the sections below.

1.4 TRANSFORMATIONS

For all water quality variables, the values were fairly homogeneous and no obvious transformation was suggested, i.e., metals analyzed on the parts per million (ppm) scale and pH measured on the log-scale.

1.5 DEALING WITH SPARSE DATA IN SOME CLASSIFICATIONS SUCH AS SEASON

In models with season effects, samples were not always collected during all seasons of all years or periods. In these cases, interaction effects involving season cannot be fit but additive models can still be fit.

1.6 OUTLINE OF ANALYSIS PLAN

Two statistical tests were done to assess evidence of change in the mean of the water quality variable over time and to assess if changes in the means may reflect an impact of the Project.

1.6.1 Before vs. After Analysis

The first analysis conducted compares the mean measurements for all years prior to 2010 (before initiation of construction) to the mean for 2016. Each waterbody is treated independently, and each water quality variable is treated separately.

The final statistical model (in standard shorthand notation) is:

$$Y = Period\ Season\ Period*Season\ Year(Period)\text{-}R$$

where *Y* is the (mean) variable reading for a date within a year; *Period* is the effect of before vs. after Project initiation (which is the effect of interest); *Season* is the effect of early or late in the year; *Period*Season* represents the interaction between Project and season effects (i.e., is the effect of the period consistent in both seasons); and *Year(Period)* is a random year effect (applicable if more than one year was sampled during each period). This separates the variation in water quality into components representing variation within a season in a year and year-to-year variation. If the data are too sparse (e.g., not all seasons measured in all periods), then the *Period*Season* interaction effect cannot be estimated and is dropped.

This model is preferable to simply treating all measurement within a period (e.g., over several years pre-construction) as having the same mean and assuming that they are completely independent of each other. This model also "averages" the water quality values collected over the baseline years in way that weights each year equally rather than weighting by the sample size. For example, suppose that the water quality variable measured in 2008 was 22 µg/L, while the two measurements in 2009 were 25 and 27 µg/L. The simple mean (22+25+27)/3=24.7 µg/L would be more heavily weighted

toward the mean in 2009. In order to give each year's data equal weight, the measurements over both years is computed as an average of averages:

$$\frac{\frac{22}{1}+\frac{25+27}{2}}{2}=24.0\ \mu g/L$$

This can be extended to multiple years in a similar fashion.

The model was fit using R version 3.2.2. In the monitoring context, a false positive (i.e., type I error, determining impact when none exists) is more tolerable than a false negative (i.e., type II error, determining no effect when in fact there is one). There is a direct trade-off between the two error rates, as reducing one type of error generally results in an increase in the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. A nominal significance level of 0.05 was used when reviewing the results.

The key disadvantage of this model is that changes over time may be unrelated to the effects of the Project, e.g., the mean water quality measurements in 2016 could be worse than expected because of long term climate change that is unrelated to the Project. Consequently, if a statistically significant effect is detected, it will require further investigation.

1.6.2 BACI Analysis

The standard method to assess an environmental impact is through a Before-After-Control-Impact (BACI) analysis (Smith 2002). The analysis of these designs looks for non-parallelism in response over time between the Project and reference waterbodies. A BACI analysis was performed for each Project waterbody versus the corresponding reference waterbody.

The formal statistical model (in standard shorthand notation) is:

*Y = Period Season Period*Season Class Period*Class Year(Period)-R*

where *Y* is the variable of interest; *Period* is the effect of period (before or after construction); *Season* is the effect of season (early (June or earlier) or late (July or later)); *Period*Season* represents the interaction between Project and season effects (i.e., is the effect of the period consistent in both seasons); *Class* is the effect of the site classification (Project or reference); *Period*Class* is the BACI effect of interest (i.e., is the effect of Period the same (parallel) for both classes of sites); and *Year(Period)* is the random year effect within each period (applicable if more than one year was sampled during each period). If the data are too sparse (e.g., not all seasons measured in all periods), then the *Period*Season* interaction effect cannot be estimated and is dropped. If there were multiple reference waterbodies (as is the case for streams), a term *Body(Class)-R* (the random site effect within each class) would also be added to the model so that the change in the mean for the Project site is compared to the average change in the mean for the reference bodies. Sites that were measured only in one period (e.g., Reference D OF measured only post-construction) contribute some information on the year-effect which improves precision of the BACI estimate.

Not all sites were measured in all years and only those Project-reference pairs of sites that were measured both in the before and after period can be used to estimate this BACI contrast. The results from this comparison are specific to the particular Project-reference sites.

The key variable of interest is the *Period*Class* effect as this measures the amount of non-parallelism between the changes in the mean (Before-After) over the two classes of sites (Project or reference). The BACI estimate is computed as the "difference in the differences":

$$BACI = \left(\mu_{PA} - \mu_{PB}\right) - \left(\mu_{RA} - \mu_{RB}\right)$$

where μ_{PA} is the mean variable reading in the *Project* class of sites *after* Project initiation, μ_{PB} is the mean variable reading in the *Project* class of sites *before* Project initiation, μ_{RA} is the mean variable reading in the *reference* class of sites *after* Project initiation, and μ_{RB} is the mean variable measurement in the *reference* class of sites *before* Project initiation. The BACI contrast is estimated by replacing the population means above by the model-based estimates. Estimated differences close to 0 would indicate no evidence of non-parallelism.

Note that the hypothesis that the BACI contrast has the value of zero is identical to the hypothesis that the *Period*Class* interaction is zero with identical p-values. Consequently, only the results for the BACI contrast are reported here.

The model was fit using R version 3.2.2. In the monitoring context, a false positive (i.e., type I error, determining impact when none exists) is more tolerable than a false negative (i.e., type II error, determining no effect when in fact there is one). There is a direct trade-off between the two error rates, as reducing one type of error generally results in an increase in the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. A nominal significance level of 0.05 was used when reviewing the results.

2. RESULTS

2.1 STREAM DATA

A summary of the amount of censoring (values below the detection limit) for the stream data is found in Table Stream-1. High levels of censoring in all streams were found for cadmium, cyanide, nitrate, and radium-226 variables and the results of the analyses for these variables are non-informative and should be discarded.

Plots of the data showed some outliers, primarily from measurements in the late 1990s where the detection limit was much higher than in recent times (Table Stream-2). These were discarded as such a large detection limit compared to more recent data provides little information on the actual value. Some other outliers that were not related to high detection limits were also discarded.

The results from the analysis that compared the means before and after Project construction are presented in Table Stream-3. There was evidence of a change in the mean between the before and

after periods for radium-226 and alkalinity in Little Roberts OF; and aluminum, arsenic, nickel, and lead in Roberts OF.

The results of the BACI comparison of each Project stream against the reference streams (Table Stream-4) found evidence of a differential response in the mean total mercury concentration between Roberts OF and reference streams over the before and after periods.

2.2 MARINE DATA

A summary of the amount of censoring (values below the detection limit) for the site data is found in Table Marine-1. High levels of censoring in all marine exposure sites were found for cyanide, mercury, and radium-226 and the results of the analyses for these variables are non-informative and should be discarded.

Plots of the data showed some outliers which were removed prior to analysis (Table Marine-2). Of particular concern are the arsenic measurements at the RBE site, which were substantially elevated between 2004 and 2006, but then fell to near or below detection limits from 2007 to 2016. The elevated readings prior to 2007 were treated as outliers and removed from the analysis to ensure that these observations did not artificially inflate the variance estimates, leading to a reduced power to detect effects.

The results from the analysis that compared the means before and after Project construction are presented in Table Marine-3. There was evidence of a change in the mean between the before and after periods for TSS, nitrate, and mercury at RBW. The results of the BACI comparison (Table Marine-4) found evidence of a differential response in the mean ammonia concentration between RBW and the reference site over the before and after periods.

2.3 SMALL LAKE DATA

A summary of the amount of censoring (values below the detection limit) for the small lake data is found in Table Small Lake-1. High levels of censoring in all streams were found for cadmium, cyanide, nitrate, and radium-226 variables and the results of the analyses for these variables are non-informative and should be discarded.

Plots of the data showed some outliers that were primarily censored data from the early 1990s. The observations listed in Table Small Lake-2 were discarded prior to analysis to ensure that these observations did not artificially inflate the variance estimates leading to a reduced power to detect effects.

The results from the analysis that compared the means before and after Project construction are presented in Table Small Lake-3. There was evidence of a change in the mean between the before and after periods for pH and molybdenum variables. Because water quality samples were not collected at Reference Lake D before construction started, no BACI analysis is possible.

2.4 LARGE LAKE DATA

A summary of the amount of censoring (values below the detection limit) for the large lake data is found in Table Large Lake-1. High levels of censoring in all lakes were found for cadmium, cyanide, and radium-226 variables and the results of the analyses for these variables will be non-informative and should be discarded.

Plots of the data showed some potential outliers that were excluded from the analysis (Table Large Lake-2).

There was evidence of a difference in the means between the before and after periods for arsenic and molybdenum in Doris North, and cyanide and mercury in Doris Lake South. The BACI comparison found evidence of a differential response for arsenic and mercury in Doris North, and for mercury and lead in Doris South compared to the reference site over the before and after periods (Table Large Lake-4).

REFERENCES

Helsel, D. R. 2005. *Nondetects and Data Analysis*. Wiley: New York.

Hurlbert, S. H. 1984. *Pseudoreplication and the Design of Ecological Field Experiments*. Ecological Monographs 54: 187-211.

McBride, G. B. 2005. *Using Statistical Methods for Water Quality Management.* Wiley: New York.

Smith, E. P. 2002. BACI Design. *Encyclopedia of Environmetrics.* Wiley: New York.

TABLES

Table Stream-1. Summary of the Proportion of Measurements that were Below Detection Limit (Before Outliers Removed) for Stream Sampling

Variable	Stream Site				
	Doris OF Proportion Censored	Little Roberts OF Proportion Censored	Ref. B OF Proportion Censored	Ref. D OF Proportion Censored	Roberts OF Proportion Censored
Aluminum (Al)	0.00	0.00	0.00	0.00	0.00
Alkalinity	0.00	0.00	0.00	0.00	0.00
Ammonia	0.32	0.41	**0.86**	**1.00**	0.32
Arsenic (As)	0.06	0.03	0.00	0.00	0.00
Cyanide (CN)	**0.88**	**0.77**	**1.00**	**1.00**	**0.81**
Cadmium (Cd)	**0.78**	0.69	**1.00**	**1.00**	**0.71**
Copper (Cu)	0.00	0.00	0.00	0.00	0.00
Iron (Fe)	0.00	0.00	0.00	0.00	0.00
Hardness	0.00	0.00	0.00	0.00	0.00
Mercury (Hg)	**0.75**	**0.71**	**0.71**	0.38	0.58
Molybdenum(Mo)	0.05	0.00	**0.71**	0.00	0.00
Nickel (Ni)	0.05	0.00	0.14	0.00	0.00
Nitrate	**0.86**	**0.95**	0.23	**1.00**	**0.77**
Lead (Pb)	0.24	0.21	**1.00**	**0.88**	0.19
Radium-226 (Ra)	**0.91**	**0.94**	**1.00**	**1.00**	**1.00**
Total Suspended Solids (TSS)	0.14	0.05	**1.00**	0.62	0.03
Zinc (Zn)	0.28	0.33	**1.00**	**1.00**	0.29
pH	0.00	0.00	0.00	0.00	0.00

Notes:
Dataset includes all baseline years up to and including 2009, and 2016.
Proportions ≥0.70 are bolded.

Table Stream-2. Summary of Potential Outliers from the Stream Data

Stream	Variable	Year	Date	Rep	Value	Censored (1=yes 0=no)
Doris OF	Ammonia	1997	19JUL97	1	1.359800	0
Doris OF	Ammonia	1997	19JUL97	2	1.402400	0
Doris OF	Ammonia	1997	20AUG97	1	1.353300	0
Doris OF	As	1996	23JUN96	1	0.002000	1
Doris OF	As	1996	22AUG96	1	0.003000	0
Doris OF	Cd	1996	23JUN96	1	0.000190	0
Doris OF	Cd	1996	22AUG96	1	0.000025	1
Doris OF	Cd	1997	19JUN97	1	0.000100	1
Doris OF	Cd	1997	19JUL97	1	0.000100	1
Doris OF	Cd	1997	19JUL97	2	0.000100	1
Doris OF	Cd	1997	20AUG97	1	0.000100	1
Doris OF	Cd	2000	20JUN00	1	0.000025	1
Doris OF	Cd	2000	20JUN00	2	0.000025	1
Doris OF	Cd	2000	14SEP00	1	0.000025	1
Doris OF	Cd	2000	14SEP00	2	0.000025	1
Doris OF	Cd	2004	24JUN04	1	0.000025	1
Doris OF	Hg	1997	20AUG97	1	0.000025	1
Doris OF	Hg	2000	20JUN00	1	0.000025	1
Doris OF	Hg	2000	20JUN00	2	0.000025	1
Doris OF	Hg	2000	14SEP00	1	0.000025	1
Doris OF	Hg	2000	14SEP00	2	0.000025	1
Doris OF	Hg	2003	28JUL03	1	0.000025	1
Doris OF	Mo	1997	19JUN97	1	0.000500	1
Doris OF	Mo	1997	19JUL97	1	0.000500	1
Doris OF	Mo	1997	19JUL97	2	0.000500	1
Doris OF	Mo	1997	20AUG97	1	0.000500	1
Doris OF	Pb	1997	19JUN97	1	0.000500	1
Doris OF	Pb	1997	19JUL97	1	0.000500	1
Doris OF	Pb	1997	19JUL97	2	0.000500	1
Doris OF	Pb	1997	20AUG97	1	0.000500	1
Little Roberts OF	Hg	2003	28JUL03	1	0.000025	1

Notes:
Censored values were replaced by ½ of the detection limit.

Table Steam-3. Summary of Test for No Difference in Mean between Before and After Periods for Stream Water Quality Variables

	Stream Site				
	Doris OF p-value	**Little Roberts OF p-value**	**Ref. B OF p-value**	**Ref. D OF p-value**	**Roberts OF p-value**
Aluminum (Al)	0.7776	0.0519	0.3535	.	**0.0169**
Alkalinity	0.2208	**0.0051**	0.0600	.	0.7766
Ammonia	0.5168	0.2296	**<0.0001**	.	0.1909
Arsenic (As)	0.2467	0.1389	**0.0449**	.	**0.0010**
Cyanide (CN)	0.6344	0.3238	.	.	0.3110
Cadmium (Cd)	0.6952	0.7289	**<0.0001**	.	0.7195
Copper (Cu)	0.5883	0.7251	0.6135	.	0.4418
Iron (Fe)	0.8540	0.6182	0.2239	.	0.1004
Hardness	0.2193	0.0687	0.1652	.	0.3403
Mercury (Hg)	0.7667	0.7492	**0.0002**	.	0.4409
Molybdenum (Mo)	0.2559	0.8709	0.2895	.	0.8875
Nickel (Ni)	0.9713	0.5069	0.5745	.	**0.0147**
Nitrate	0.4294	0.5926	0.1436	.	0.6368
Lead (Pb)	0.2746	0.2451	.	.	**0.0367**
Radium-226 (Ra)	0.1871	**0.0030**	.	.	.
Total Suspended Solids (TSS)	0.7932	0.4767	**<0.0001**	.	0.5933
Zinc (Zn)	0.5902	0.3005	**<0.0001**	.	0.2991
pH	0.4670	0.5659	0.7208	.	0.6200

Notes:
A significance level (alpha) of 0.05 was used to screen for effects and p-values less than 0.05 are bolded.
In some cases, no analysis can be done because of the high degree of censoring, the lack of variation in a variable over time, or data are only available from one period (i.e., no "before" data available).

Table Stream-4. Summary of BACI Comparison of Water Quality Variables for Individual Project Stream Sites

Variable	Stream Site		
	Doris OF p-value	Little Robert OF p-value	Roberts OF p-value
Aluminum (Al)	0.8940	0.4959	0.3135
Alkalinity	0.6121	0.3561	0.8053
Ammonia	0.6155	0.6025	0.5688
Arsenic (As)	0.6903	0.4560	0.0594
Cyanide (CN)	.	.	.
Cadmium (Cd)	0.4546	0.9240	0.8801
Copper (Cu)	0.6985	0.9540	0.5261
Iron (Fe)	0.8855	0.7317	0.4838
Hardness	0.7517	0.6880	0.7832
Mercury (Hg)	0.5383	0.5813	**0.0004**
Molybdenum (Mo)	0.4151	0.9245	0.8292
Nickel (Ni)	0.9555	0.4322	0.2776
Nitrate	0.7654	0.2846	0.8914
Lead (Pb)	0.5620	0.5198	0.2840
Radium-226 (Ra)	.	.	.
Total Suspended Solids (TSS)	0.7965	0.4880	0.5539
Zinc (Zn)	0.5634	0.4690	0.3031
pH	0.7088	0.9017	0.8200

Notes:
A significance level (alpha) of 0.05 was used to screen for effects and p-values less than 0.05 are bolded.
In some cases, no analysis can be done because of the high degree of censoring, the lack of variation in a variable over time, or data are only available from one period (i.e., no "before" data available).

Table Marine-1. Summary of the Proportion of Measurements that were Below Detection Limit (Before Outliers Removed) for Marine Sampling

Variable	Site		
	RBE Proportion Censored	RBW Proportion Censored	REF-Marine 1 Proportion Censored
Aluminum (Al)	0.03	0.18	0.00
Alkalinity	0.00	0.00	0.00
Ammonia	0.52	**1.00**	**0.89**
Arsenic (As)	0.13	0.00	0.00
Cyanide (CN)	**0.77**	**1.00**	**1.00**
Cadmium (Cd)	0.33	0.00	0.00
Copper (Cu)	0.00	0.00	0.00
Iron (Fe)	0.03	0.45	0.33
Hardness	0.00	0.00	0.00
Mercury (Hg)	**0.70**	**0.82**	**0.78**
Molybdenum (Mo)	0.14	0.09	0.00
Nickel (Ni)	0.10	0.00	0.00
Nitrate	**0.82**	0.64	**0.78**
Lead (Pb)	0.43	**0.73**	**0.89**
Radium-226 (Ra)	**0.93**	**1.00**	0.62
Total Suspended Solids (TSS)	0.10	0.27	**0.78**
Zinc (Zn)	0.23	0.64	0.67
pH	0.00	0.00	0.00

Notes:
Dataset includes all baseline years up to and including 2009, and 2016.
Proportions ≥0.70 are bolded.

Table Marine-2. Summary of Potential Outliers from the Marine Data

Site	Variable	Year	Date	Rep	Value	Censored (1=yes 0=no)
RBE	Ammonia	1996	28AUG96	1	2.500000	1
RBE	Ammonia	2007	23JUL07	1	0.214000	0
RBE	As	1996	28AUG96	1	0.002500	1
RBE	As	2004	19JUL04	1	0.008020	0
RBE	As	2004	14AUG04	1	0.015200	0
RBE	As	2004	16AUG04	1	0.013100	0
RBE	As	2004	09SEP04	1	0.022300	0
RBE	As	2005	21JUL05	1	0.004730	0
RBE	As	2005	18AUG05	1	0.022100	0
RBE	As	2005	14SEP05	1	0.021200	0
RBE	As	2006	31MAY06	1	0.015200	0
RBE	As	2006	20JUL06	1	0.013300	0
RBE	As	2006	12AUG06	1	0.025600	0
RBE	As	2006	11SEP06	1	0.023680	0
RBE	Cyanide	2007	27MAY07	1	0.250000	1
RBE	Cyanide	2007	23JUL07	1	2.500000	1
RBE	Cd	1996	28AUG96	1	0.003480	0
RBE	Ni	1996	28AUG96	1	0.021500	0
RBE	Nitrate	1996	28AUG96	1	2.500000	1
RBE	Nitrate	2007	23JUL07	1	0.250000	1
RBE	Nitrate	2007	15SEP07	1	0.250000	1

Notes:
Censored values were replaced by ½ of the detection limit.

Table Marine-3. Summary of Test for No Difference in Mean between Before and After Periods for Marine Water Quality Variables

	Marine Site		
	RBE p-value	**RBW p-value**	**REF-Marine 1 p-value**
Aluminum (Al)	0.7798	0.5609	0.4557
Alkalinity	0.8702	.	.
Ammonia	0.2528	.	**<0.0001**
Arsenic (As)	0.9248	0.3260	0.4225
Cyanide (CN)	0.7213	.	.
Cadmium (Cd)	0.7739	0.6630	0.5585
Copper (Cu)	0.6264	0.5782	0.9412
Iron (Fe)	0.7115	0.6392	0.7559
Hardness	0.8975	0.8869	.
Mercury (Hg)	0.3078	**0.0026**	**0.0025**
Molybdenum (Mo)	0.9659	0.7889	0.9954
Nickel (Ni)	0.7914	0.8605	0.5380
Nitrate	0.8829	**<0.0001**	.
Lead (Pb)	0.6778	0.0601	0.6667
Radium-226 (Ra)	0.9343	.	.
Total Suspended Solids (TSS)	0.3350	**0.0081**	0.0728
Zinc (Zn)	0.4610	0.5070	0.9647
pH	0.9243	0.6000	0.6175

Notes:
A significance level (alpha) of 0.05 was used to screen for effects and p-values less than 0.05 are bolded.
In some cases, no analysis can be done because of the high degree of censoring, the lack of variation in a variable over time, or data are only available from one period (i.e., no "before" data available).