Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
May 16, 2022 to June 24, 2022

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

Waterford River at Kilbride, Newfoundland and Labrador

Prepared by:

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GENERAL

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada -Environment and Climate Change Canada (WSC-ECCC), maintain a real-time water quality and water quantity monitoring station on Waterford River at Kilbride.

The purpose of the real-time water quality station is to monitor, process and publish real-time water quality data. It should be noted that the sonde was removed on May 16, 2022 but due to calibration issues, was not re-deployed until May 17, 2022.

This deployment report discusses water quality related events occurring at this station from the instrument deployment on May 17, 2022 until removal on June 24, 2022.

Figure 1: Waterford River at Kilbride Real-Time Water Quality and Quantity Station.

QUALITY ASSURANCE AND QUALITY CONTROL

As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey (Table 1).

At deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.**

Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 2).

WRMD staff at the Department of Environment & Climate Change (ECC) are responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

WSC staff are responsible for the data logging/communication aspect of the network and maintenance of the water quantity monitoring equipment. WSC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly, and are responsible for handling stage and streamflow data issues. The water quantity data is transmitted via satellite and published online with the water quality data on the WRMD website. Water quantity data has not been corrected or groomed when published online or used in the monthly reports for the stations. WSC is responsible for QA/QC of water quantity data. Corrected stage and streamflow data can be obtained upon request to WSC.

Table 1: Instrument Performance Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (°C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent, temperature compensated and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is recorded to early it may not accurately portray the water body.

Table 2: Instrument performance rankings for Waterford River at Kilbride

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Waterford River @ Kilbride	**May 17, 2022**	**Deployment**	Excellent	Fair	Fair	Fair	Good
		Grab Sample # 1705	N/A	Excellent	Good	N/A	Good
	June 24, 2022	**Removal**	Excellent	Excellent	Excellent	Fair	Good

Waterford River at Kilbride, Newfoundland and Labrador

Upon deployment, all sensors ranked ‘Excellent’, ‘Good’ or ‘Fair’ against the QA/QC sonde.

All measured grab sample (#2022-1705-00-SI-SP) parameters ranked ‘Excellent’ and ‘Good’ in comparison to the field sonde.

At the removal of the instrument, after a 39-day deployment period, parameters ranked ‘Excellent’, ‘Good’ and ‘Fair’ against the QA/QC sonde

DATA INTERPRETATION

Water Temperature

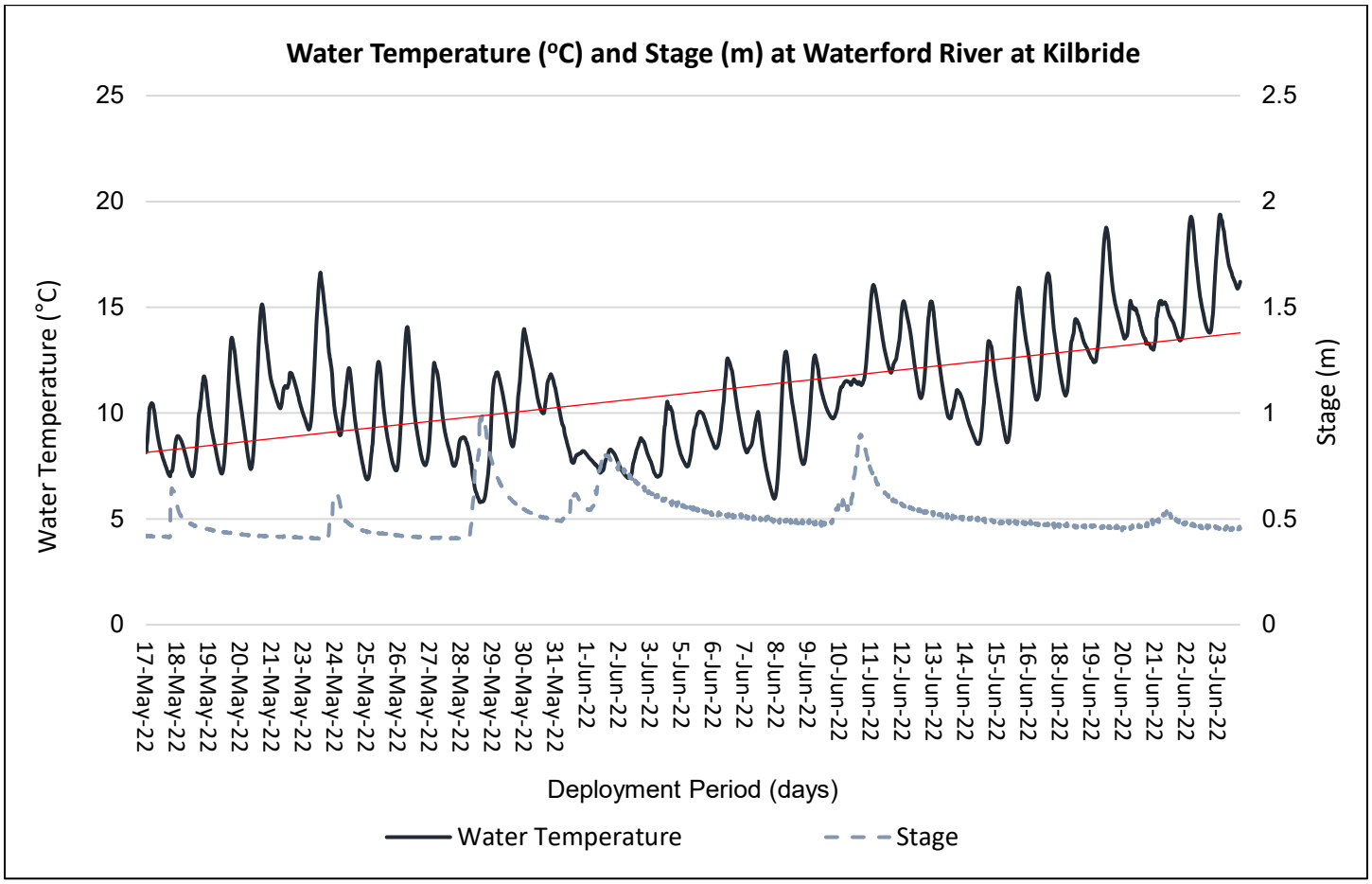
Water temperature ranged from 5.79 °C to 19.38 °C during this deployment period (Figure 2).

Over the duration of the deployment period, the water temperature, in correlation with air temperatures increased as seasonal temperatures continued to rise. (See Appendix A).

During high stage events, the water temperature often decreased for a short period due to the addition of cooler precipitation.

Water temperature values display a natural diurnal pattern with temperatures increasing during the day and decreasing overnight. All brooks and ambient waterways have natural diurnal patterns.

Please note the stage data is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.



Mean	Median	Min	Max
10.97	10.63	5.79	19.38

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH baseline values were relatively stable, with a range between 6.91 pH units and 8.65 pH units, a mean of 7.25 and median of 7.10 pH units (Figure 3).

Upon deployment, the sonde appeared to require additional time to acclimate to water conditions.

The CCME guideline for the protection of aquatic life states the requirement of a minimum pH value of 6.5 and maximum value of 9.0. The CCME guideline provides a basis by which to judge the overall health of the brook. Waterford River pH values remained within the guidelines throughout the duration of the deployment period. (See Figure #7).

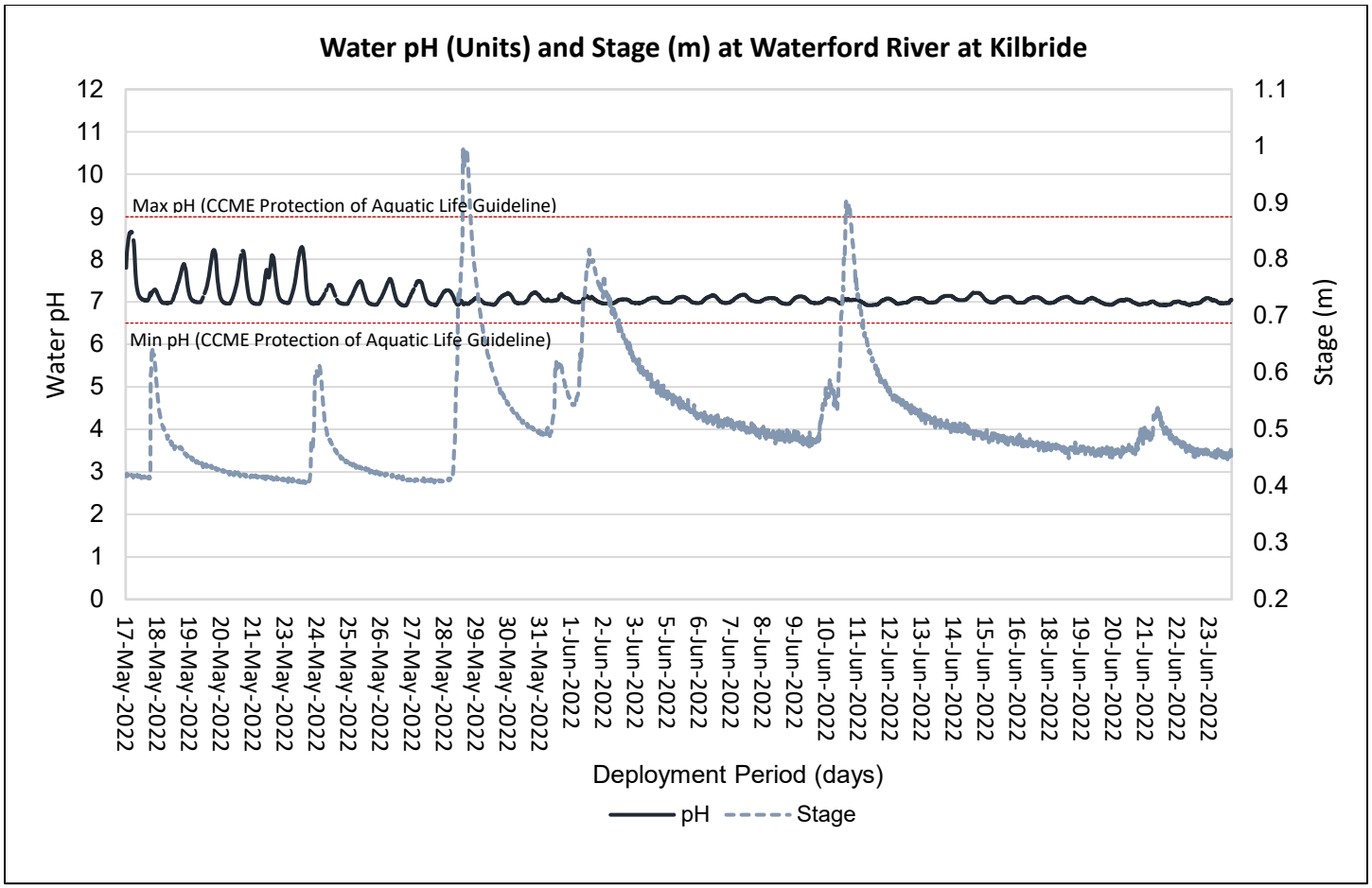
From May 17, 2022 up to and including May 24, 2022, afternoon pH levels were observed to be abnormally greater than historical baseline levels with a maximum value of 8.65 pH units. This may be attributed to ongoing civil work upstream at this time.

During higher stage events, the pH values dip temporarily then returned to background levels as the stage returns to baseline levels.

pH values are temperature dependent as well as influenced by photosynthesis and respiration by aquatic organisms. Dissolved oxygen concentrations decrease throughout the day as CO_2 is extracted via photosynthesis at a faster rate than it is produced through respiration. Overnight, dissolved CO_2 concentration increases, as the rate of CO_2 production is greater than that of photosynthetic consumption. Carbon dioxide dissolved in water yields a slightly acidic solution and as such, a decrease in pH is observed.

The diurnal variation pattern was variable throughout the deployment period. The magnitude of variation was more significant from May 17 to May 24, 2022. Diurnal pH variation decreased temporarily due to higher stage events as a result of the addition of rainwater.

Please note the stage data is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.



Mean	Median	Min	Max
7.25	7.10	6.91	8.65

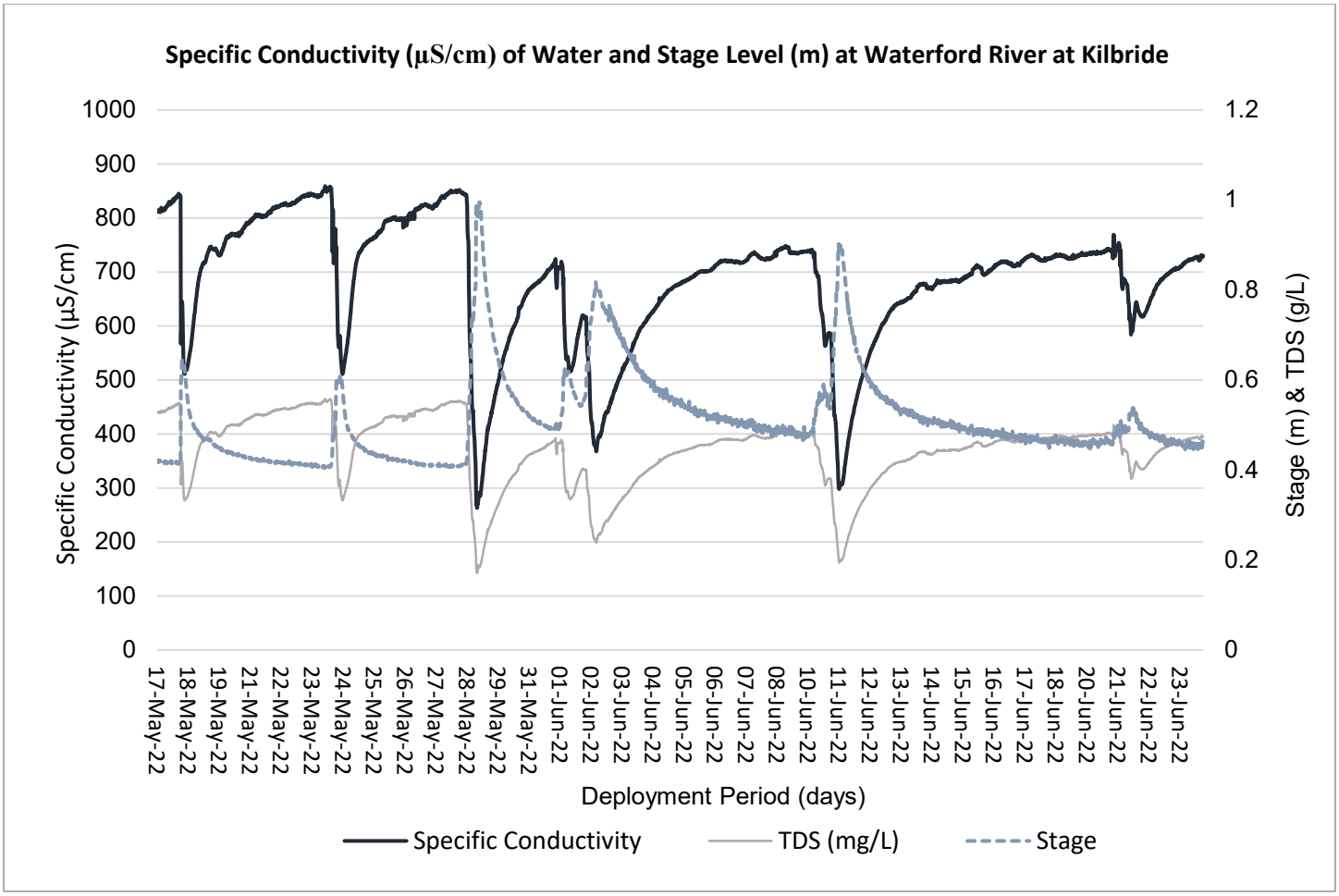
Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride.

Specific Conductivity & Total Dissolved Solids

The conductivity concentration levels were within 263.0 µS/cm and 859.0 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.1710 g/L to 0.5580 g/L (Figure 4).

Throughout the deployment period, conductivity levels at Waterford decreased during high stage events before rebounding slightly. This is likely a result of the minerals and dissolved material present in the brook being diluted and flushed for a short period of time before returning to background levels. Given the location, the river highly influenced by urban roads, residential housing and pedestrian traffic.

Please note the stage data is raw. It is not corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.



	Mean	Median	Min	Max
Specific Conductivity (µS/cm)	684.0	711.0	263.0	859.0
TDS (mg/L)	0.4446	0.4620	0.1710	0.5580

Figure 4: Specific conductivity (µS/cm), TDS (g/mL) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

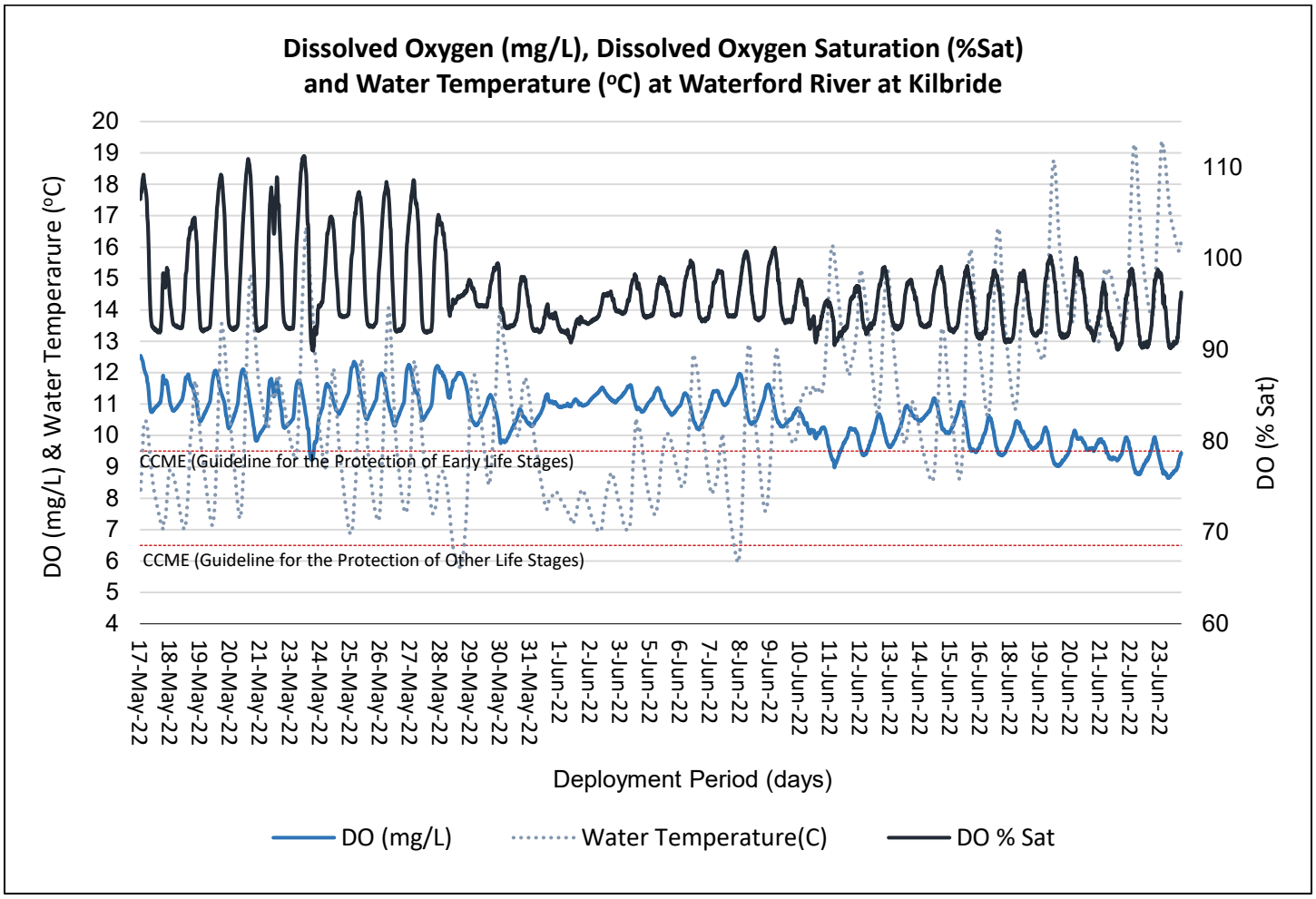
Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account the water temperature.

During the deployment, the dissolved oxygen concentration levels ranged within a minimum of 9.22 mg/L to a maximum of 12.54 mg/L. The percent saturation levels for dissolved oxygen ranged within 89.9 % Saturation to 111.2 % Saturation (Figure 5).

The dissolved oxygen values remained above the CCME Guideline for the Protection of Early life stages (9.5mg/L) for the majority of the deployment about above the guideline for other life stages (6.5 mg/L) throughout.

A gradual decrease in dissolved oxygen concentration was observed in correlation with natural warming water temperatures. Sudden dips in dissolved oxygen are in relation to peaks in water temperature.



	Mean	Median	Min	Max
DO (%Sat)	98.3	96.4	89.9	111.2
DO (mg/L)	11.13	11.08	9.22	12.54

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

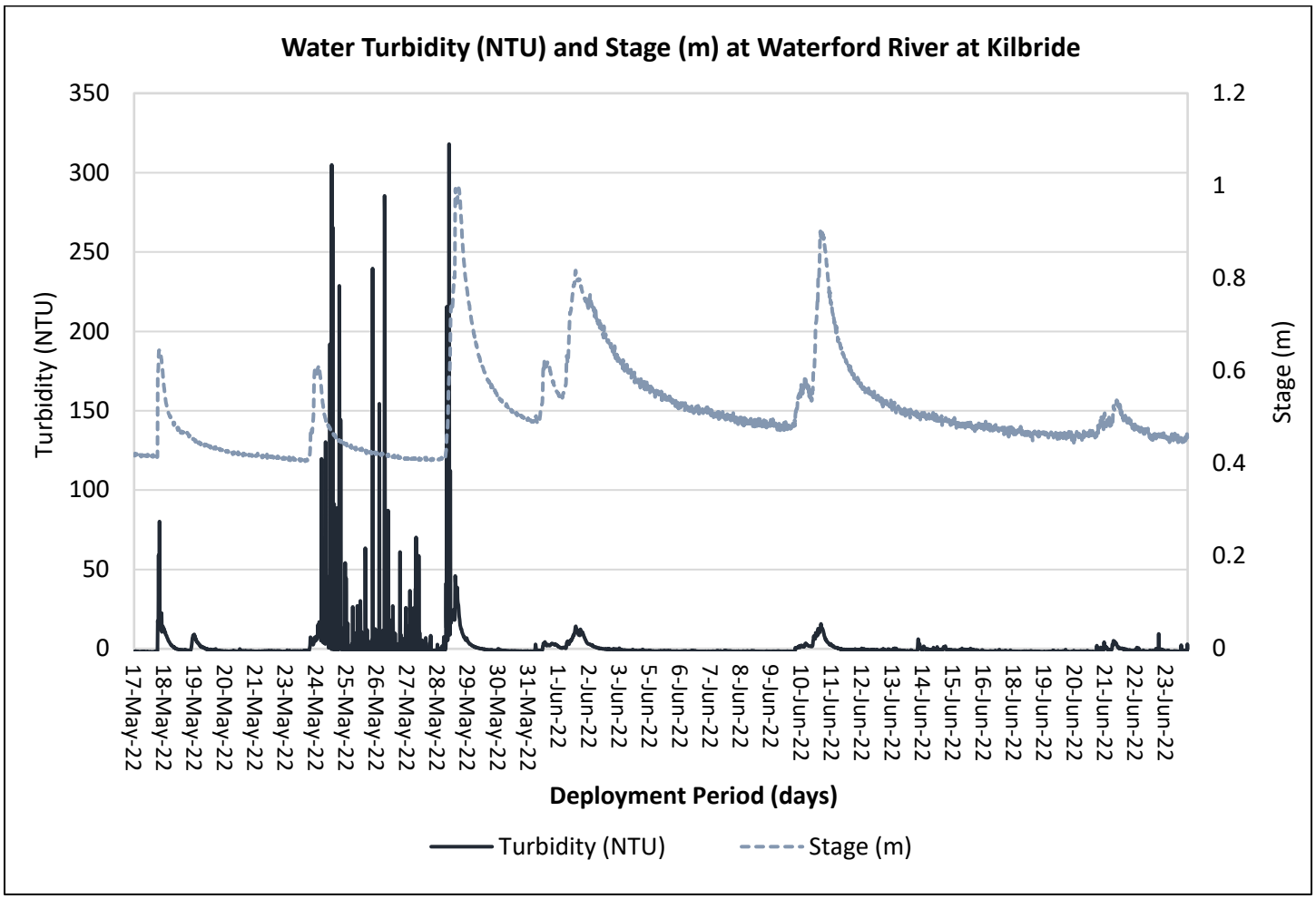
Turbidity

Turbidity levels during the deployment period ranged from -2.0 NTU and 318 NTU, with a mean of 5.9 NTU and median of -0.8 NTU (Figure 6).

Turbidity measurements throughout the beginning of the deployment period indicated very low turbidity including negative values. This situation is most likely to happen when measuring low-level turbidity. Natural variations in all measurements, instrument and non-instrument related, can lead to a negative result. Some other turbidimeters are designed to round up a negative number to 0.00 NTU, since a result of less than 0.00 NTU is theoretically impossible. However, in practice, these results are actually quite meaningful. The problem could be operator technique or sonde error. It could also indicate a problem with the low turbidity/turbidity-free water used for a blank or a problem with the calibration. If the meter rounds the negative result to 0.00 NTU, the user will not be alerted to a potential problem.

Turbidity events above baseline values as seen on May 18-19, June 1-2 and on 10-11, 2022 are the result of higher stage events. Turbidity spikes as observed from May 24 through May 29 (Figure 6) correlate with an increase in stage where precipitation can increase the presence of suspended material in water through the movement of soil and sediment from nearby urban areas. Sediments and debris can temporarily become lodged within the sonde casing and cause spikes in turbidity values. It is likely that the larger precipitation event observed on May 28-29, 2022 dislodged the material from the casing as turbidity levels decreased to typical baseline values.

Please note the stage data is raw. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.



Mean	Median	Min	Max
5.9	-0.8	-2.0	318

Figure 6: Turbidity (NTU) and stage (m) values at Waterford River at Kilbride.

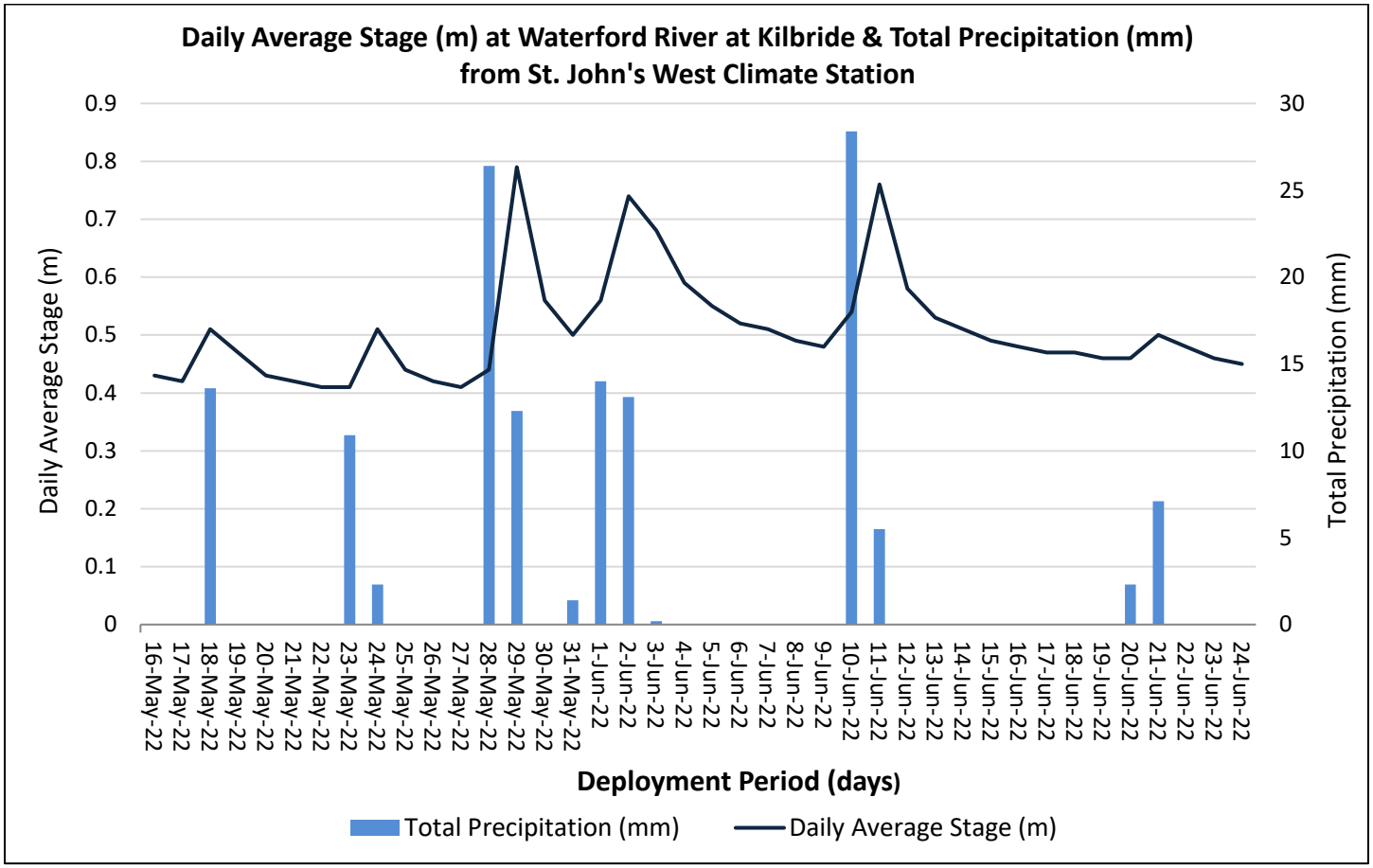
Stage and Precipitation

Please note the stage data graphed below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data is available upon request to WSC.

Stage is an estimation of water level at the station and can explain some of the events that are occurring with other parameters (i.e. Specific Conductivity, DO, turbidity). Stage will increase during rainfall events as depicted in Figure 7.

During the deployment period, the stage values ranged from 0.40 m to 1.00 m. The larger peaks in stage correspond with substantial rainfall events as noted on Figure 7. Precipitation data was collected by Environment Canada's St. John's West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 28.4 mm on June 10, 2022.

A slight increase in the daily average stage was observed late May to mid-June as a result of multiple precipitation events.

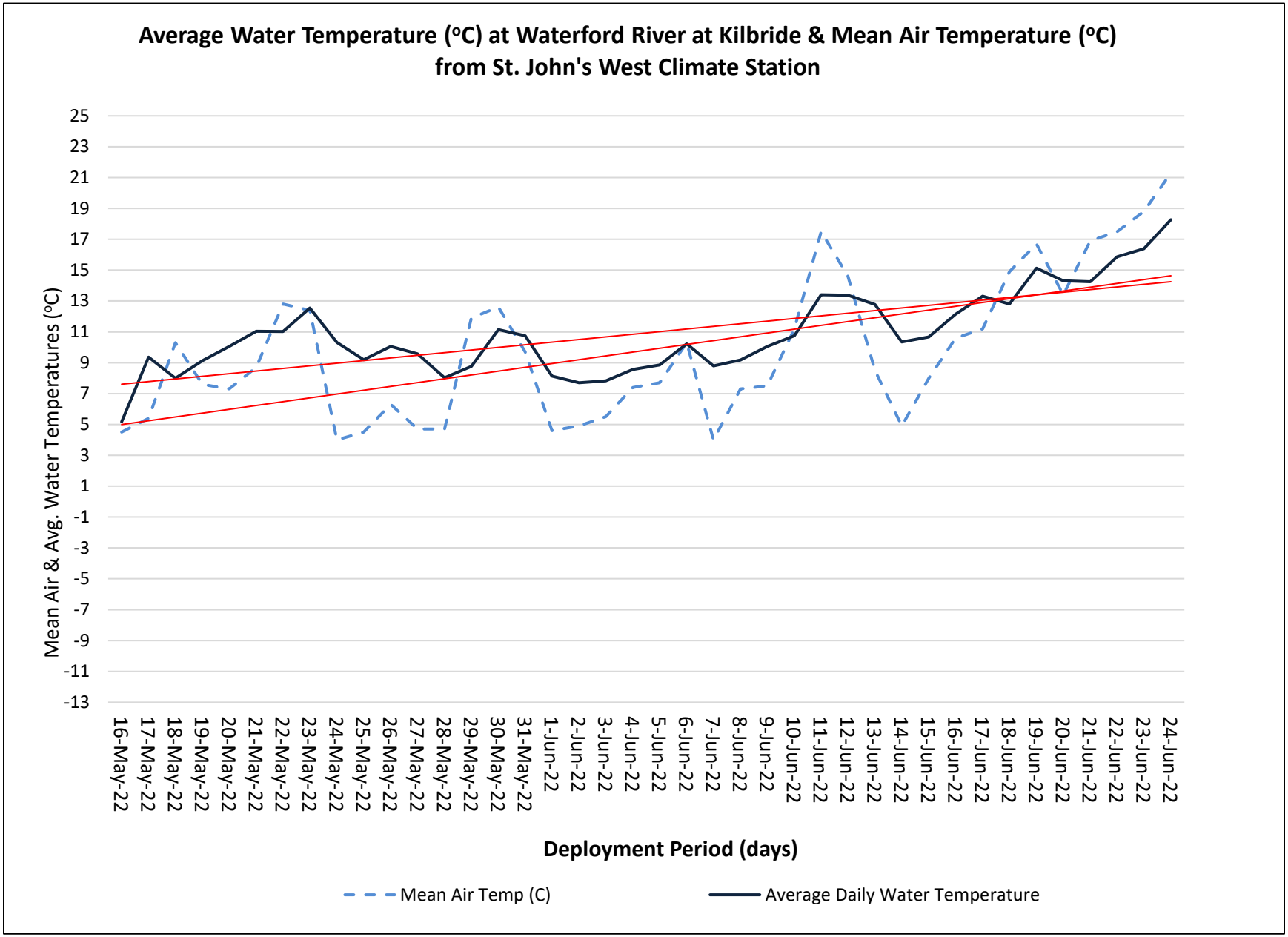


Mean	Median	Min	Max
0.51	0.49	0.40	1.00

Figure 7: Stage (m) values recorded at Waterford River at Kilbride and daily total precipitation (mm) from St. John's West Climate Station.

APPENDIX A : MEAN DAILY AIR TEMPERATURE AND AVERAGE WATER TEMPERATURE

Waterford River at Kilbride, Newfoundland and Labrador



APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS

Your P.O. #: 220028978-6
Site Location: PADDY'S POND @ OUTLET
Your C.O.C. #: N/A

Attention: Janice McCarthy

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
St. John's, NL
CANADA A1B 4J6

Report Date: 2022/05/31
Report #: R7145379
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2D4610
Received: 2022/05/18, 10:12

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity	1	N/A	2022/05/25	ATL SOP 00142	SM 23 2320 B
Anions (1)	1	N/A	2022/05/24	CAM SOP-00435	SM 23 4110 B m
Colour	1	N/A	2022/05/24	ATL SOP 00020	SM 23 2120C m
Organic carbon - Diss (DOC) (2)	1	N/A	2022/05/26	ATL SOP 00203	SM 23 5310B m
Conductance - water	1	N/A	2022/05/25	ATL SOP 00004	SM 23 2510B m
Fluoride	1	N/A	2022/05/25	ATL SOP 00043	SM 23 4500-F- C m
Hardness (calculated as CaCO3)	1	N/A	2022/05/20	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	1	2022/05/31	2022/05/31	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	1	2022/05/19	2022/05/19	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	1	N/A	2022/05/29	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2022/05/24	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2022/05/24	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2022/05/25	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2022/05/25	ATL SOP 00003	SM 23 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2022/05/26	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	1	2022/05/25	2022/05/26	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	1	N/A	2022/05/26	ATL SOP 00203	SM 23 5310B m
Total Phosphorus (Colourimetric) (1)	1	2022/05/26	2022/05/27	CAM SOP-00407	SM 23 4500 P B H m
Total Suspended Solids	1	2022/05/19	2022/05/24	ATL SOP 00007	SM 23 2540D m
Turbidity	1	N/A	2022/05/25	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.
(3) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.

Your P.O. #: 220028978-6
Site Location: PADDY'S POND @ OUTLET
Your C.O.C. #: N/A

Attention: Janice McCarthy

NL Department of Environment, Climate Change and Municipalities
Water Resources
PO Box 8700
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CANADA A1B 4J6

Report Date: 2022/05/31
Report #: R7145379
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2D4610
Received: 2022/05/18, 10:12

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Maryann Comeau, Customer Experience Supervisor/PM
Email: Maryann.COMEAU@bureauveritas.com
Phone# (902)420-0203 Ext:298

==========

Bureau Veritas Job #: C2D4610
Report Date: 2022/05/31

NL Department of Environment, Climate Change and Municipalities
Site Location: PADDY'S POND @ OUTLET
Your P.O. #: 220028978-6
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SQS400 2022-1705-00-SI-SP								
Sampling Date 2022/05/16								
Matrix W								
Sample # 2022-1705-00-SI-SP								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	56	1.0	mg/L	N/A	2022/05/20		8002494
Nitrate (N)	-	0.57	0.050	mg/L	N/A	2022/05/25		8001835
Total dissolved solids (calc., EC)	-	470	1.0	mg/L	N/A	2022/05/26		8002624
Inorganics								
Conductivity	-	840	1.0	uS/cm	N/A	2022/05/25	SHW	8013583
Chloride (Cl-)	-	220	2.0	mg/L	N/A	2022/05/24	SUR	8009222
Bromide (Br-)	-	ND	2.0	mg/L	N/A	2022/05/24	SUR	8009222
Sulphate (SO4)	-	15	2.0	mg/L	N/A	2022/05/24	SUR	8009222
Total Alkalinity (Total as CaCO3)	-	15	2.0	mg/L	N/A	2022/05/25	SHW	8013596
Colour	-	12	5.0	TCU	N/A	2022/05/24	MCN	8006734
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/05/25	SHW	8013597
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/05/25	2022/05/26	RTY	8012966
Nitrate + Nitrite (N)	-	0.57	0.050	mg/L	N/A	2022/05/24	MCN	8006736
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/05/24	MCN	8006738
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/05/29	MCN	8018998
Dissolved Organic Carbon (C)	-	3.0	0.50	mg/L	N/A	2022/05/26	NGI	8012749
Total Organic Carbon (C)	-	2.8	0.50	mg/L	N/A	2022/05/26	NGI	8015547
pH	-	7.38		pH	N/A	2022/05/25	SHW	8013595
Total Phosphorus	-	0.009	0.004	mg/L	2022/05/26	2022/05/27	SSV	8015639
Total Suspended Solids	-	ND	1.0	mg/L	2022/05/19	2022/05/24	KLE	8005129
Turbidity	-	0.71	0.10	NTU	N/A	2022/05/25	SHW	8012742
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/05/31	2022/05/31	FJO	8018120
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.036	0.0050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Barium (Ba)	-	0.024	0.0010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Boron (B)	-	ND	0.050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Cadmium (Cd)	-	0.000024	0.000010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Calcium (Ca)	-	18	0.10	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Copper (Cu)	-	0.0014	0.00050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Iron (Fe)	-	0.12	0.050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Magnesium (Mg)	-	2.9	0.10	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Manganese (Mn)	-	0.12	0.0020	mg/L	2022/05/19	2022/05/19	JHY	8004313

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

Bureau Veritas Job #: C2D4610
Report Date: 2022/05/31

NL Department of Environment, Climate Change and Municipalities
Site Location: PADDY'S POND @ OUTLET
Your P.O. #: 220028978-6
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SQS400 2022-1705-00-SI-SP								
Sampling Date 2022/05/16								
Matrix W								
Sample # 2022-1705-00-SI-SP								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Potassium (K)	-	1.9	0.10	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Sodium (Na)	-	140	0.10	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Strontium (Sr)	-	0.065	0.0020	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Uranium (U)	-	ND	0.00010	mg/L	2022/05/19	2022/05/19	JHY	8004313
Total Zinc (Zn)	-	0.0071	0.0050	mg/L	2022/05/19	2022/05/19	JHY	8004313

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NL Department of Environment, Climate Change and Municipalities
Site Location: PADDY'S POND @ OUTLET
Your P.O. #: 220028978-6
Sampler Initials: LB

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.7°C
Package 2	4.7°C
Package 3	3.3°C
Package 4	3.7°C

ANIONS-L: Due to high concentrations of the target analytes, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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Site Location: PADDY'S POND @ OUTLET
Your P.O. #: 220028978-6
Sampler Initials: LB

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

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