Real-Time Water Quality Report

Waterford River at Kilbride
NL02ZM0009

Deployment Period
December 5, 2023 to February 26, 2024

Newfoundland Labrador

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

Waterford River at Kilbride, Newfoundland and Labrador

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TABLE OF CONTENTS

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.

This deployment report discusses water quality related events occurring at this station from the instrument deployment on December 5, 2023 until removal on February 26, 2024, 81 days later.

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).

Waterford River at Kilbride, Newfoundland and Labrador

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	**Dec 5, 2023**	**Deployment**	Excellent	Fair	Excellent	Good	Excellent
		Grab Sample # 1717	N/A	Fair	Fair	N/A	Excellent
	Feb 26, 2024	**Removal**	Good	Good	Good	Good	Excellent

Upon deployment, all sensors ranked 'Excellent' or 'Good' with exception to pH of which ranked 'Fair' when compared to the QA/QC sonde recorded measurements. Upon review of the grab sample (2023-1717-00-SI-SP)

pH ranking it and the ‘good’ ranking for the sensor upon removal, it is likely the result of the sensor not having stabilized before the values were recorded.

Measured grab sample (#2023-1717-00-SI-SP) parameters pH and Conductivity ranked ‘Fair’ in comparison to the field sonde with exception of Turbidity, with a ranking of Excellent.

Upon removal of the instrument, all parameters ranked ‘Good’ or ‘Excellent’.

DATA INTERPRETATION

Water Temperature

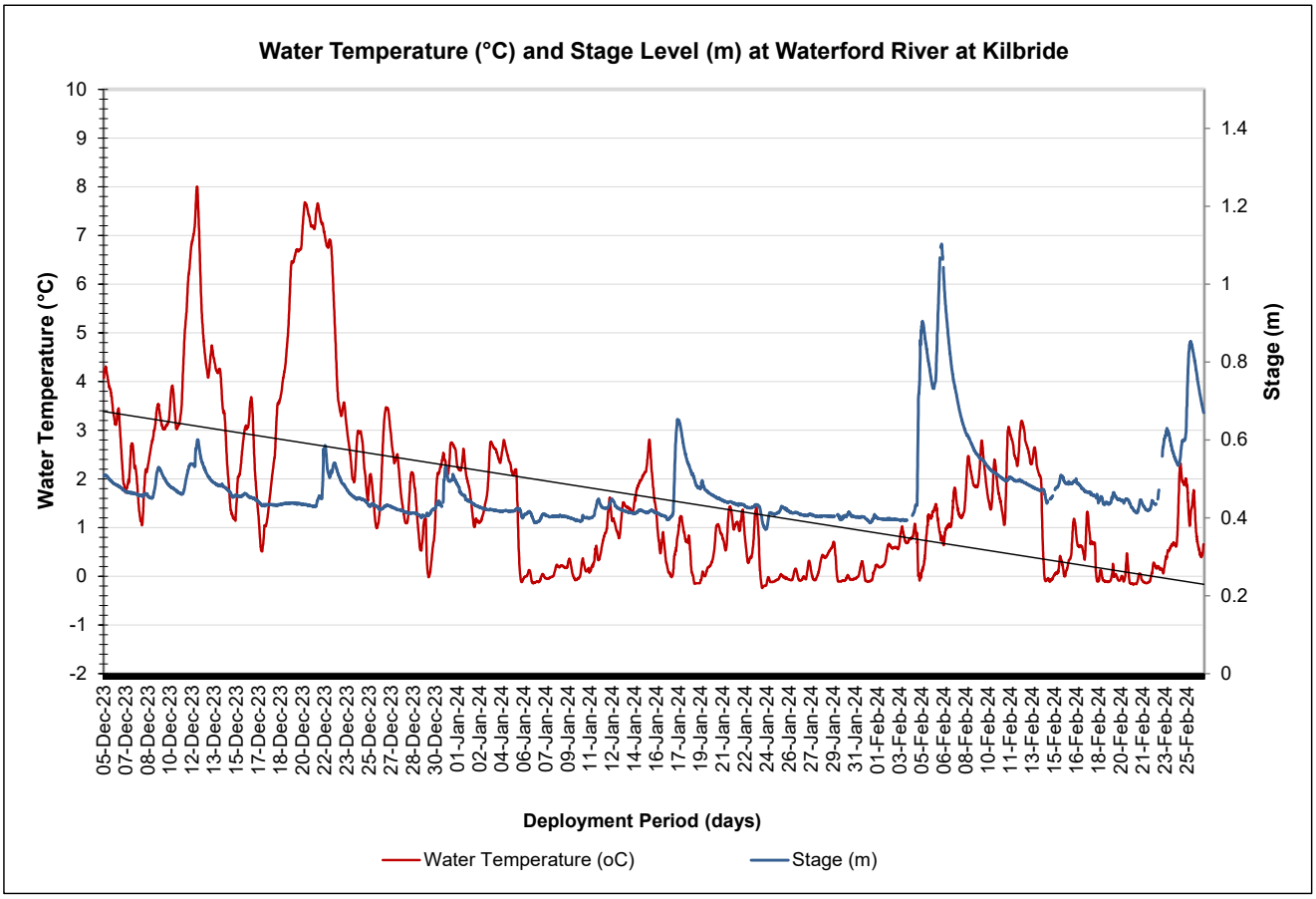
Water temperature ranged from -0.24 °C to 8.0 °C during this deployment period (Figure 2).

Water temperature was variable and correlated with air temperature (see Appendix A), with an overall decreasing trend as expected as Fall progresses into Winter.

During high stage events in winter, water temperature may increase or decrease depending on if the precipitation being added to the system is warmer or cooler than the water. The largest stage increase was February 5-7 and caused an immediate drop in water temperature, followed by a gradual climb as the water warmer up.

Water temperature values display a natural diurnal pattern with temperatures increasing during the day and decreasing overnight. The magnitude of variation was influenced by daily air temperature fluctuations as well as precipitation events.

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
1.61	1.14	-0.24	8.00

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

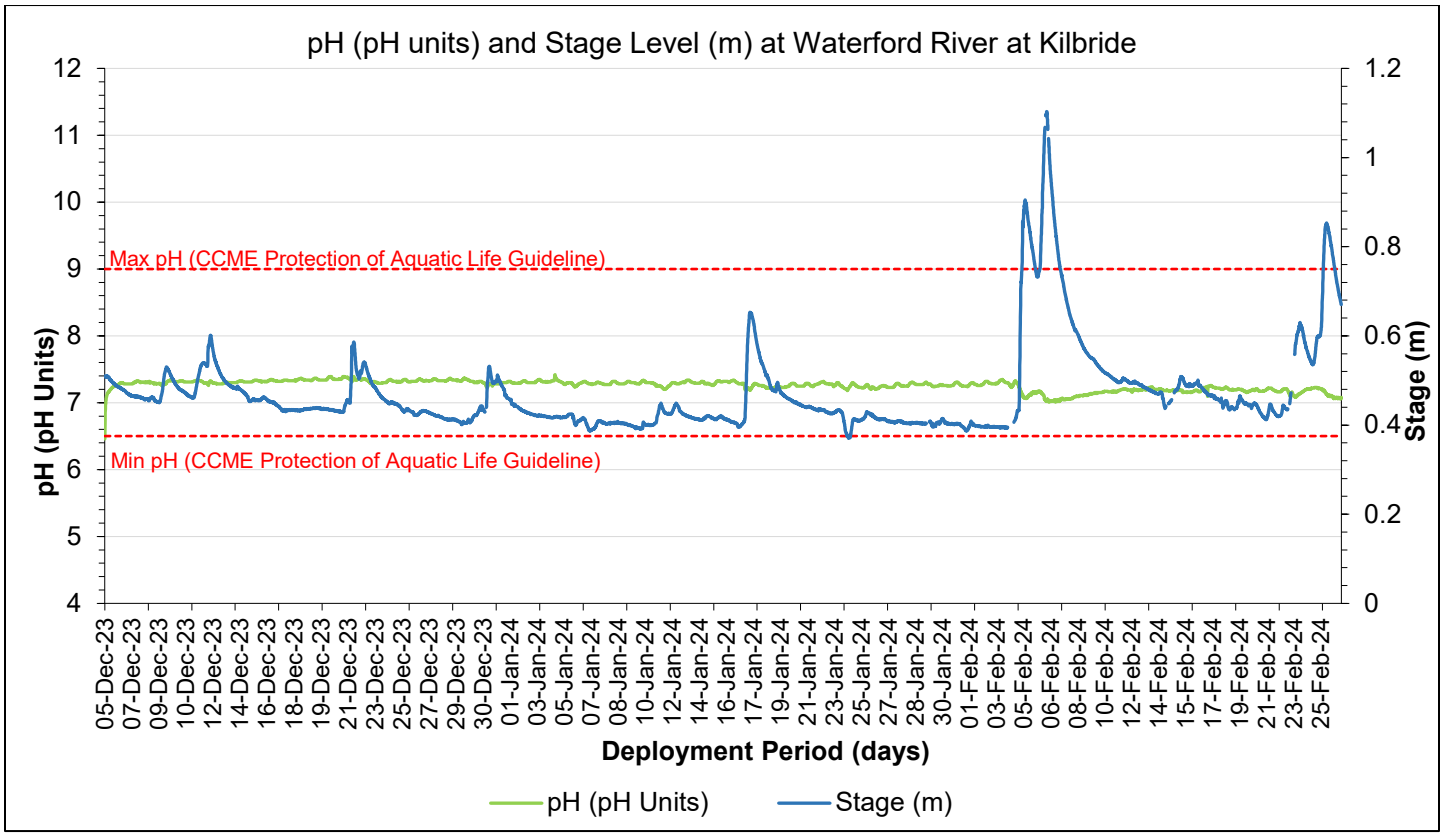
pH

Throughout the deployment period, pH baseline values were stable, with a range between 6.46 pH units and 7.42 pH units, a mean of 7.26 and median of 7.28 pH units (Figure 3).

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 maintained a pH level within these guidelines for the duration of the deployment period.

Variation of pH values decreased during higher stage events due to the addition of lower pH rainwater, as can be seen on February 4th. Values slowly returned to baseline after several days.

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
7.26	7.28	6.46	7.42

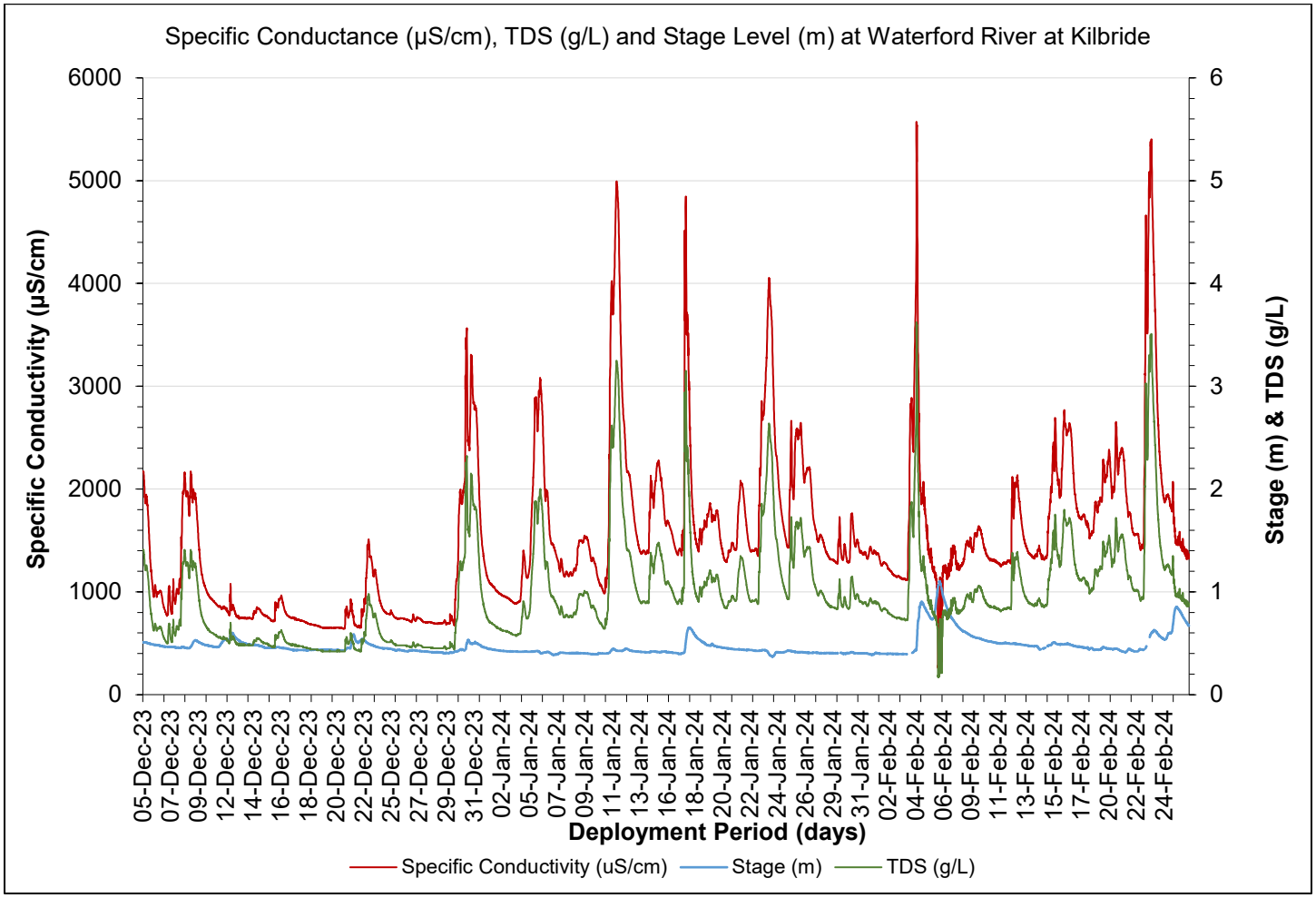
Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride.

Specific Conductivity & Total Dissolved Solids

Conductivity levels during winter season are influenced heavily by road salts and debris that are washed into the river. This occurs frequently at Waterford River as it is surrounded by urban development and roadways.

The conductivity levels were within 259.6 µS/cm and 5568.9 µS/cm. TDS (a calculated value) ranged from 0.1700 g/L to 3.6200 g/L. An increasing trend is observed from December into February, as can be expected, as winter season brings cooler temperatures and the addition of more road salts. Spikes in conductivity are frequent and may occur without stage increases as salts can be blown into the river by wind.

Please note that 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)	1508.2	1379.5	259.6	5568.9
TDS (mg/L)	0.9803	0.9000	0.1700	3.6200

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

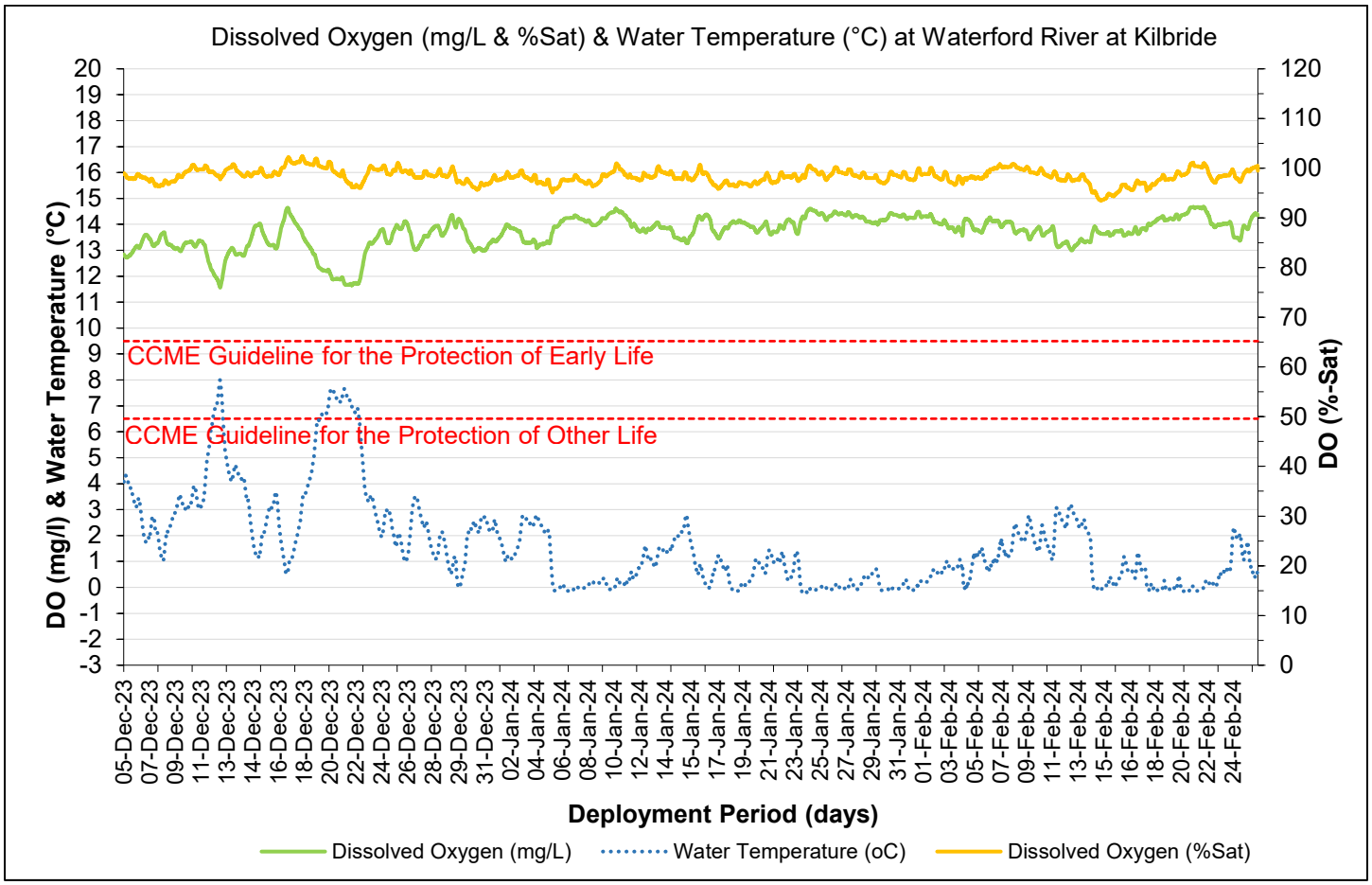
Dissolved Oxygen

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, dissolved oxygen concentration levels range within a minimum of 11.56 mg/L to a maximum of 14.69 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 93.5% to 102.4% saturation (Figure 5).

A gradual increase in dissolved oxygen concentration was observed in correlation with natural cooling water temperatures. Sudden decreases in dissolved oxygen, such as December 12th and 22nd, correspond to abnormally high water temperatures at these times, but are natural occurrences dependent on weather patterns.

Dissolved oxygen concentrations remained above the Guidelines for Other Life Stages (6.5 mg/L) and Early life stages (9.5mg/L) throughout the deployment period.



	Mean	Median	Min	Max
DO (%Sat)	98.4	98.4	93.5	102.4
DO (mg/L)	13.70	13.82	11.56	14.69

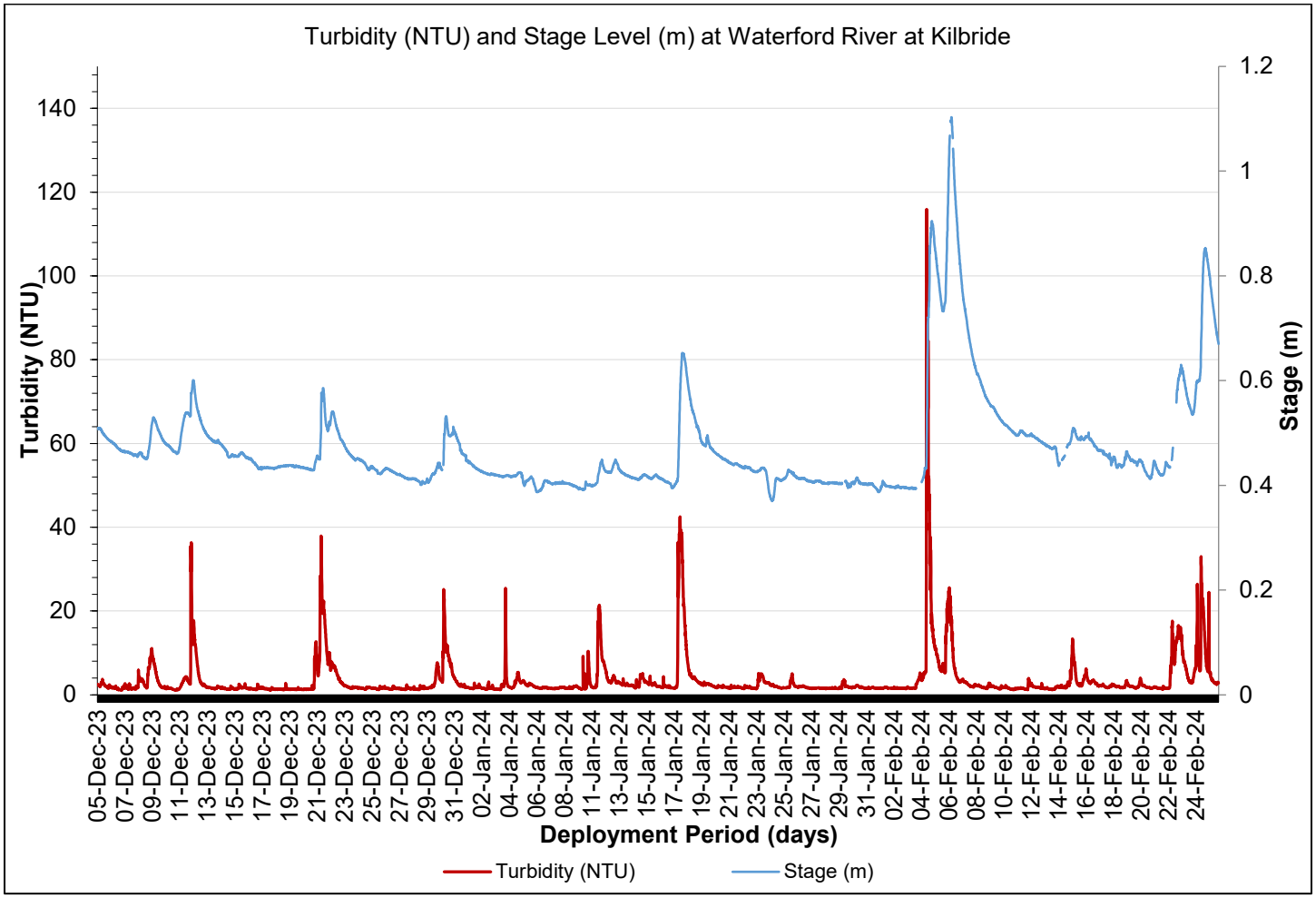
Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment period range from 1.1 NTU to 115.9 NTU, with a mean of 3.5 NTU and median of 1.8 NTU (Figure 6).

Turbidity events above baseline values are the result of higher stage events and an associated increase in flow. Large stage increases were frequent during this deployment and continually flushed the system, preventing sedimentation buildup on the turbidity sensor.

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
3.5	1.8	1.1	115.9

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

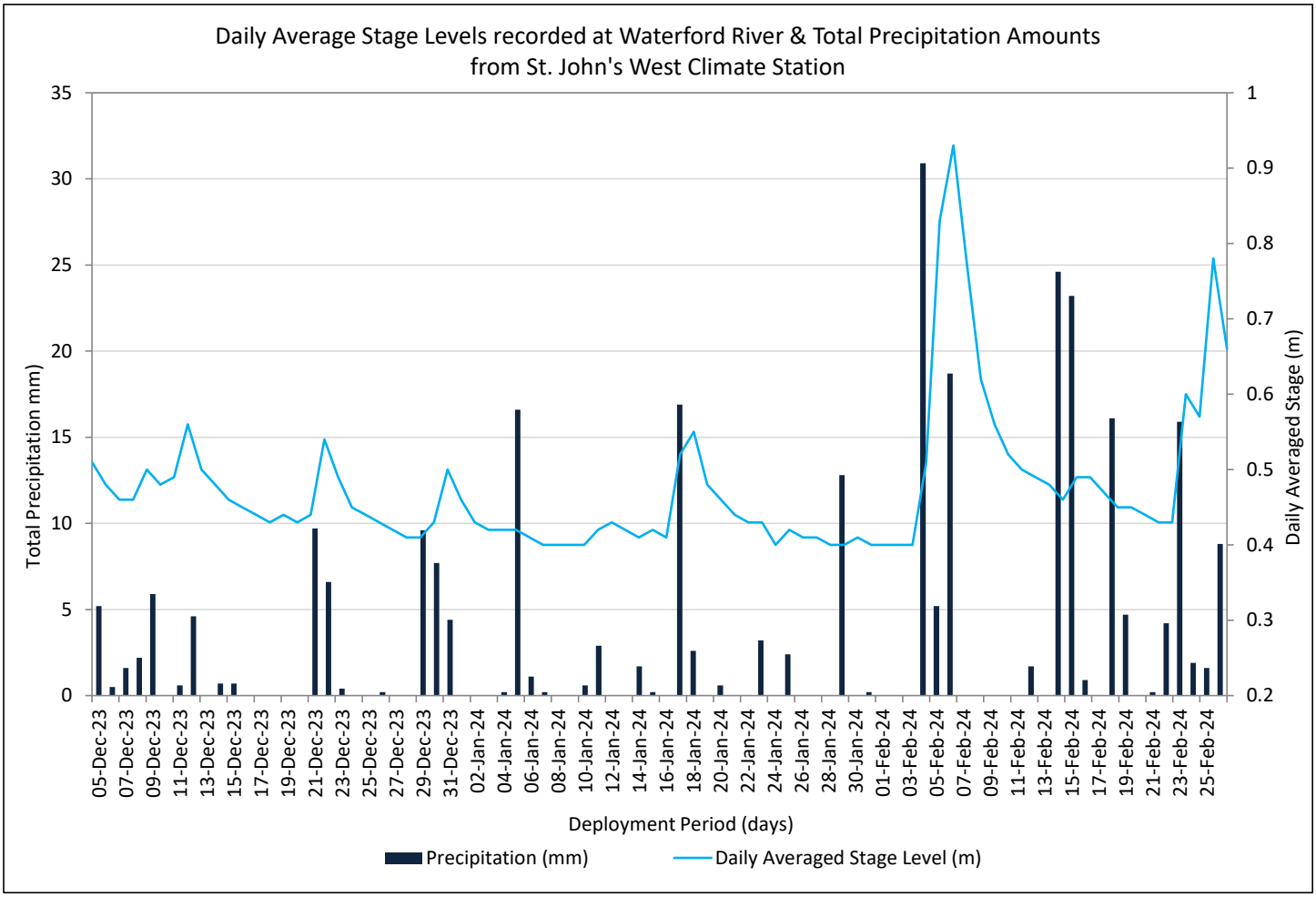
Stage and Precipitation

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, but may not increase substantially during snowfall.

During the deployment period, the stage values range from 0.37 m to 1.10 m. Many precipitation events occurred as snow and had minimal affect on stage levels. The larger peaks in stage correspond with substantial rainfall events as observed on February 4th.

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 30.9 mm on February 4th, 2024.

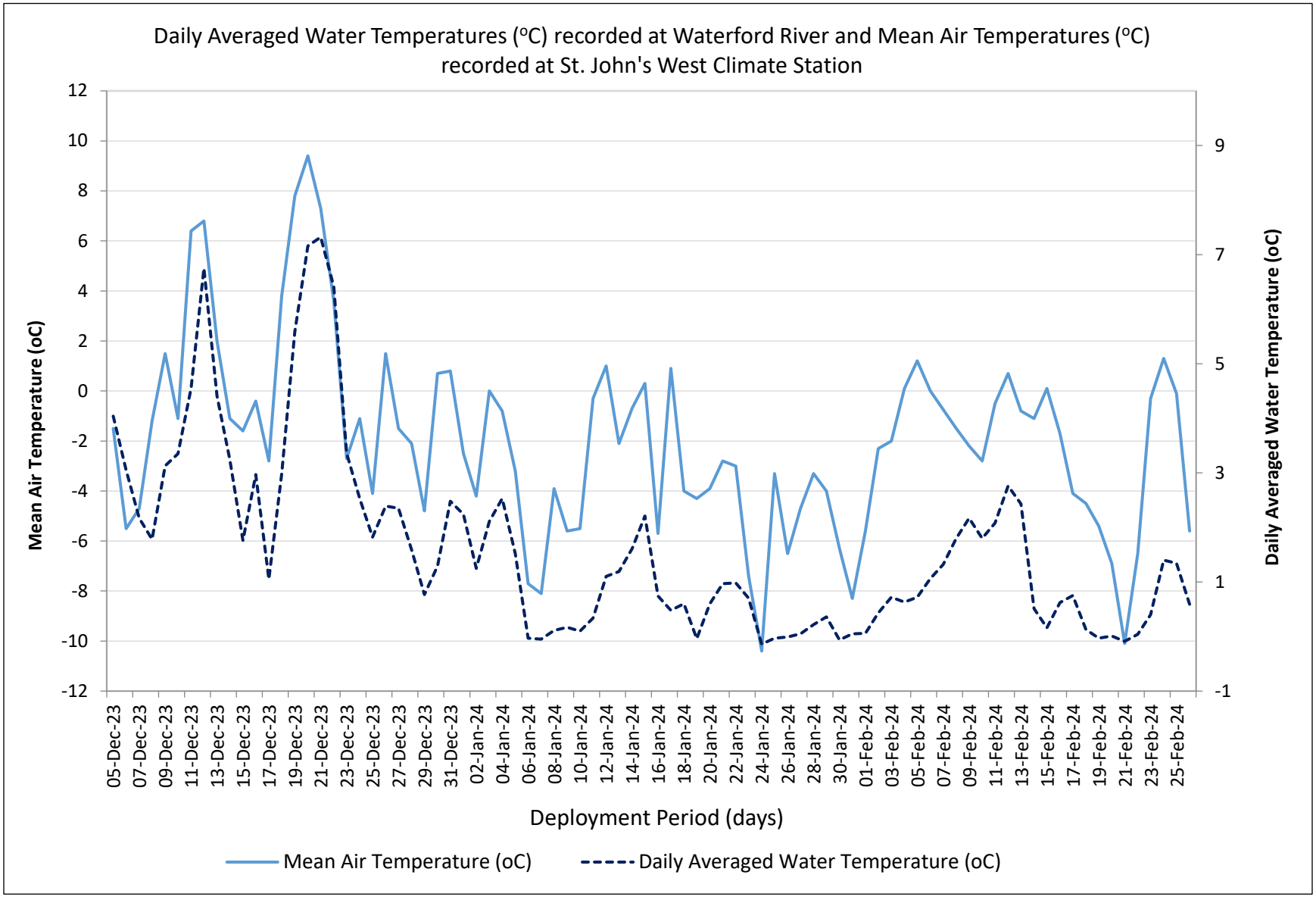


Mean	Median	Min	Max
0.47	0.44	0.37	1.10

Figure 7: Daily average 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

Bureau Veritas Job #: C3AV936
Report Date: 2023/12/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-9
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
XUN997 WATERFORD RIVER @ KILBRIDE								
Sampling Date 2023/12/05 11:20								
Matrix W								
Sample # 2023-1717-00-SI-SP								
Registration # SA-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	69	1.0	mg/L	N/A	2023/12/13		9093868
Nitrate (N)	-	1.1	0.050	mg/L	N/A	2023/12/13		9093872
Total dissolved solids (calc., EC)	-	1400	1.0	mg/L	N/A	2023/12/11		9093732
Inorganics								
Conductivity	-	2400	1.0	uS/cm	N/A	2023/12/11	KMC	9103136
Chloride (Cl-)	-	680	5.0	mg/L	N/A	2023/12/08	LKH	9098807
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/12/08	LKH	9098807
Sulphate (SO4)	-	31	1.0	mg/L	N/A	2023/12/08	LKH	9098807
Total Alkalinity (Total as CaCO3)	-	14	2.0	mg/L	N/A	2023/12/11	KMC	9103138
Colour	-	17	5.0	TCU	N/A	2023/12/13	MCN	9106725
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2023/12/11	KMC	9103140
Total Kjeldahl Nitrogen (TKN)	-	0.23	0.10	mg/L	2023/12/12	2023/12/14	RTY	9107460
Nitrate + Nitrite (N)	-	1.1	0.050	mg/L	N/A	2023/12/13	MCN	9106721
Nitrite (N)	-	ND	0.010	mg/L	N/A	2023/12/12	MCN	9106588
Nitrogen (Ammonia Nitrogen)	-	0.22	0.050	mg/L	N/A	2023/12/11	MCN	9103767
Dissolved Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2023/12/09	CPP	9100365
Total Organic Carbon (C)	-	3.8	0.50	mg/L	N/A	2023/12/10	CPP	9100816
pH	-	7.15		pH	N/A	2023/12/11	KMC	9103135
Total Phosphorus	-	0.016	0.004	mg/L	2023/12/13	2023/12/13	SPC	9109025
Total Suspended Solids	-	2.4	1.0	mg/L	2023/12/11	2023/12/13	DME	9103408
Turbidity	-	2.8	0.10	NTU	N/A	2023/12/11	KMC	9103727
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/12/14	2023/12/15	EPU	9111924
Dup.Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/12/14	2023/12/15	EPU	9111924
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.097	0.0050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Arsenic (As)	-	ND	0.0010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Barium (Ba)	-	0.036	0.0010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Boron (B)	-	ND	0.050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Cadmium (Cd)	-	0.00014	0.000010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Calcium (Ca)	-	23	0.10	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Chromium (Cr)	-	ND	0.0010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Copper (Cu)	-	0.0023	0.00050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Iron (Fe)	-	0.23	0.050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Lead (Pb)	-	ND	0.00050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Magnesium (Mg)	-	2.7	0.10	mg/L	2023/12/11	2023/12/12	JHY	9103497

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.bvna.com

Bureau Veritas Job #: C3AV936
Report Date: 2023/12/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-9
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
XUN997 WATERFORD RIVER @ KILBRIDE Sampling Date 2023/12/05 11:20 Matrix W Sample # 2023-1717-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.14	0.0020	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Potassium (K)	-	3.7	0.10	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Selenium (Se)	-	ND	0.00050	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Sodium (Na)	-	450	0.10	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Strontium (Sr)	-	0.089	0.0020	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Uranium (U)	-	ND	0.00010	mg/L	2023/12/11	2023/12/12	JHY	9103497
Total Zinc (Zn)	-	0.019	0.0050	mg/L	2023/12/11	2023/12/12	JHY	9103497

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