



Real-Time Water Quality Report

Waterford River at Kilbride (NF02ZM0009)

Deployment Period
December 12, 2022 to January 20, 2023



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

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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 (NF02ZM0009). Water Survey Canada operates the hydrometric component of this station. Due to differences in protocols, Water Survey Canada hydrometric data is quality controlled on a less frequent basis than water quality data. The hydrometric data shown in this report is provisional and has not undergone quality control checks. Corrected hydrometric data can be obtained at <https://wateroffice.ec.gc.ca/> or upon request to Water Survey Canada.

The purpose of the real-time water quality station is to monitor, process and publish real-time water quality data. The 70km² watershed is semi-urban and consists of urban areas, forest, waterbodies, wetland, barren lands and open areas. The urban areas encompass residential, agricultural, commercial and industrial areas and transportation corridors, which can heavily influence water quality parameters throughout the year.

This deployment report discusses water quality related events occurring at this station from the instrument deployment on December 12, 2022, until removal on January 20, 2023.



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.

Parameter	Rank				
	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 too 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 12, 2022	Deployment	Excellent	Good	Excellent	Excellent	Good
		Grab Sample # 1731	N/A	Good	Good	N/A	Good
	Jan 20, 2023	Removal	Excellent	Poor	Good	Good	Poor

Upon deployment, all sensors ranked 'Excellent' and 'Good' when compared to the QA/QC sonde.

All measured grab sample (#2022-1731-00-SI-SP) parameters collected upon deployment ranked 'Good' in comparison to the field sonde.

Upon removal of the instrument, after a 38-day deployment, the parameters ranked 'Excellent' and 'Good' against the QA/QC sonde with exception of pH and turbidity which ranked 'Poor'. Based on a review of the data, this is likely due to sensor drift and a buildup of sediment around both of these sensors.

DATA INTERPRETATION

Water Temperature

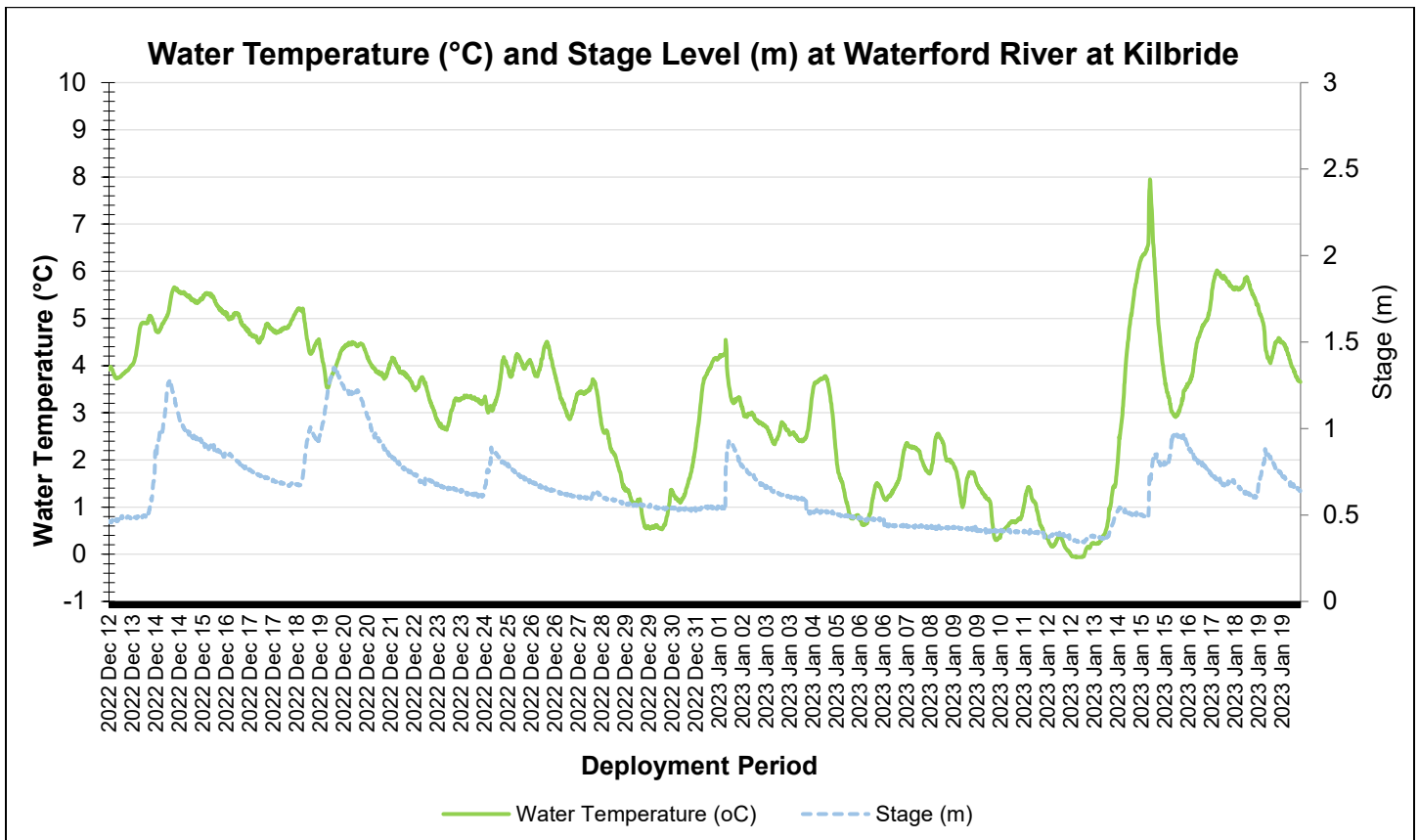
Water temperature ranged from 2.64 °C to 5.66 °C during this deployment period (Figure 2).

The water temperature was variable throughout the deployment period with an overall decreasing trend as fall progressed into winter and air temperatures cooled correspondingly.

During high stage events, the water temperature often increased for a short period due to the addition of warmer precipitation, as seen on December 14th and January 14th.

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
4.30	4.37	2.64	5.66

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

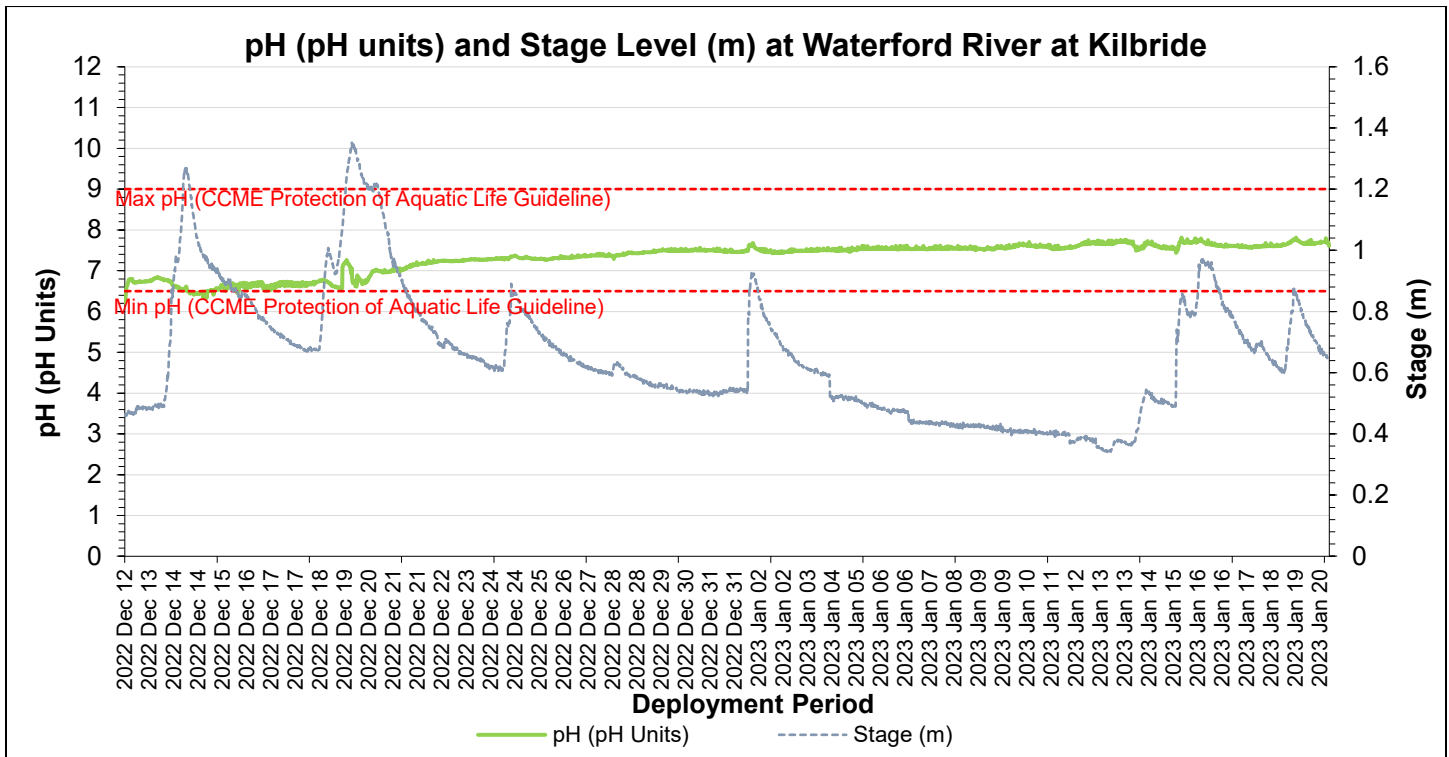
pH

Throughout the deployment period, pH baseline values were stable, with a range between 6.22 pH units and 7.37 pH units, a mean of 6.86 and median of 6.75 pH units (Figure 3).

Waterford River pH values remained within the CCME guidelines for the protection of aquatic life throughout the duration of the deployment period with exception to December 15th when pH decreased temporarily below the minimum guideline due to a significant precipitation event before returning to background levels.

A steady increasing trend after a large stage increase December 18th may indicate sensor drift for the remainder of the deployment. This would explain the ‘poor’ performance ranking upon removal at the end of the deployment.

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
6.86	6.75	6.22	7.37

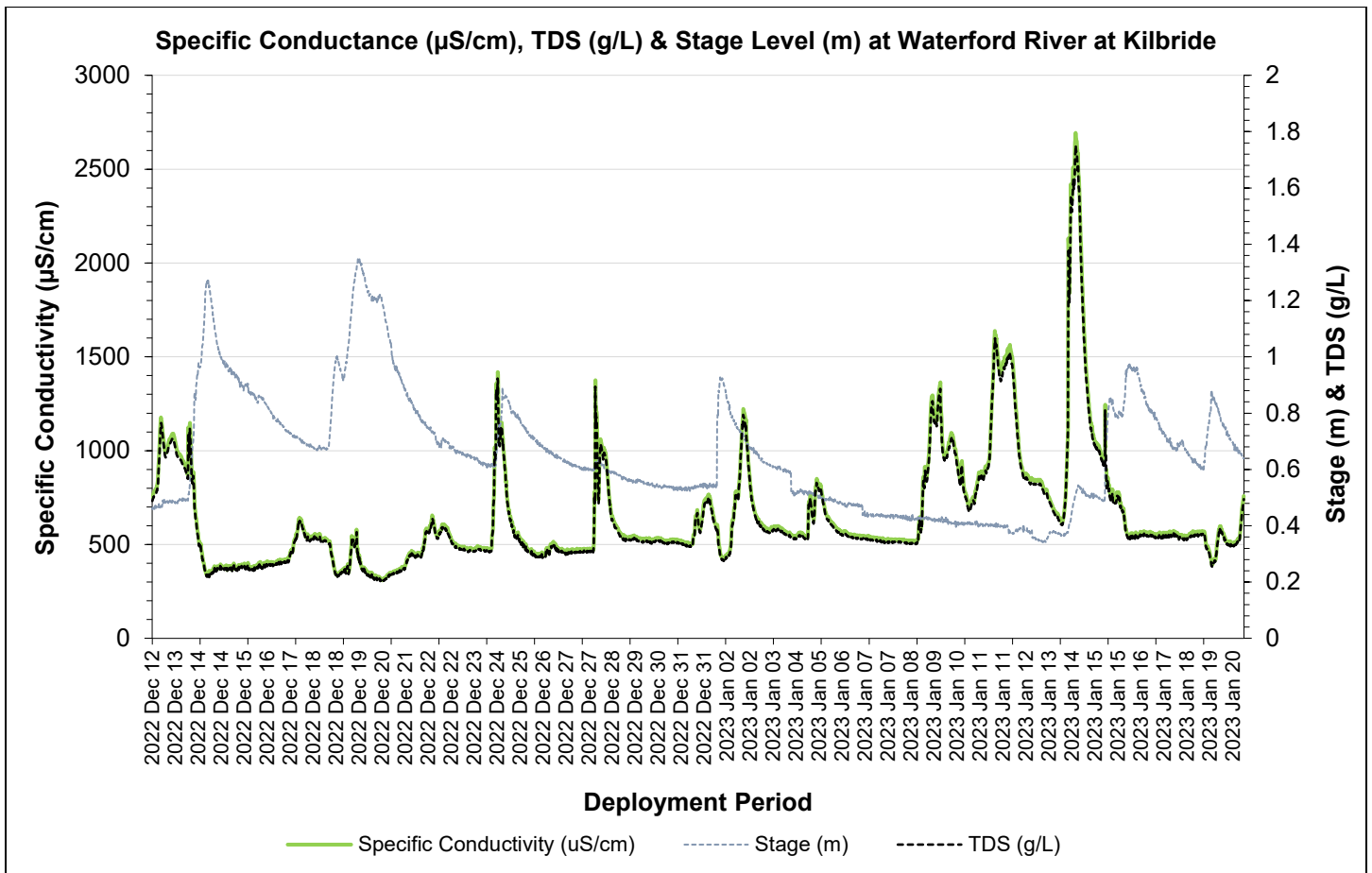
Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride.

Specific Conductivity & Total Dissolved Solids

Conductivity levels showed a slight overall increasing trend through the deployment, influenced heavily by stage increases (Figure 4). The conductivity levels were within 309 $\mu\text{S}/\text{cm}$ and 1420 $\mu\text{S}/\text{cm}$. TDS (a calculated value) ranged from 0.2010 g/L to 0.9230 g/L.

Early in the deployment period, conductivity levels decreased during high stage events as the system was diluted by the extra water. As winter approached, high stage events corresponded to spikes in conductivity as salt applied to nearby roadways enters the water as runoff during precipitation events. This events are high in magnitude, but short lived. Given the location, the river is highly influenced by urban roads, residential housing and pedestrian traffic.

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 ($\mu\text{S}/\text{cm}$)	533.6	475.0	309.0	1420.0
TDS (mg/L)	0.3471	0.3090	0.2010	0.9230

Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$), TDS (g/mL) and stage (m) values at Waterford River at Kilbride.

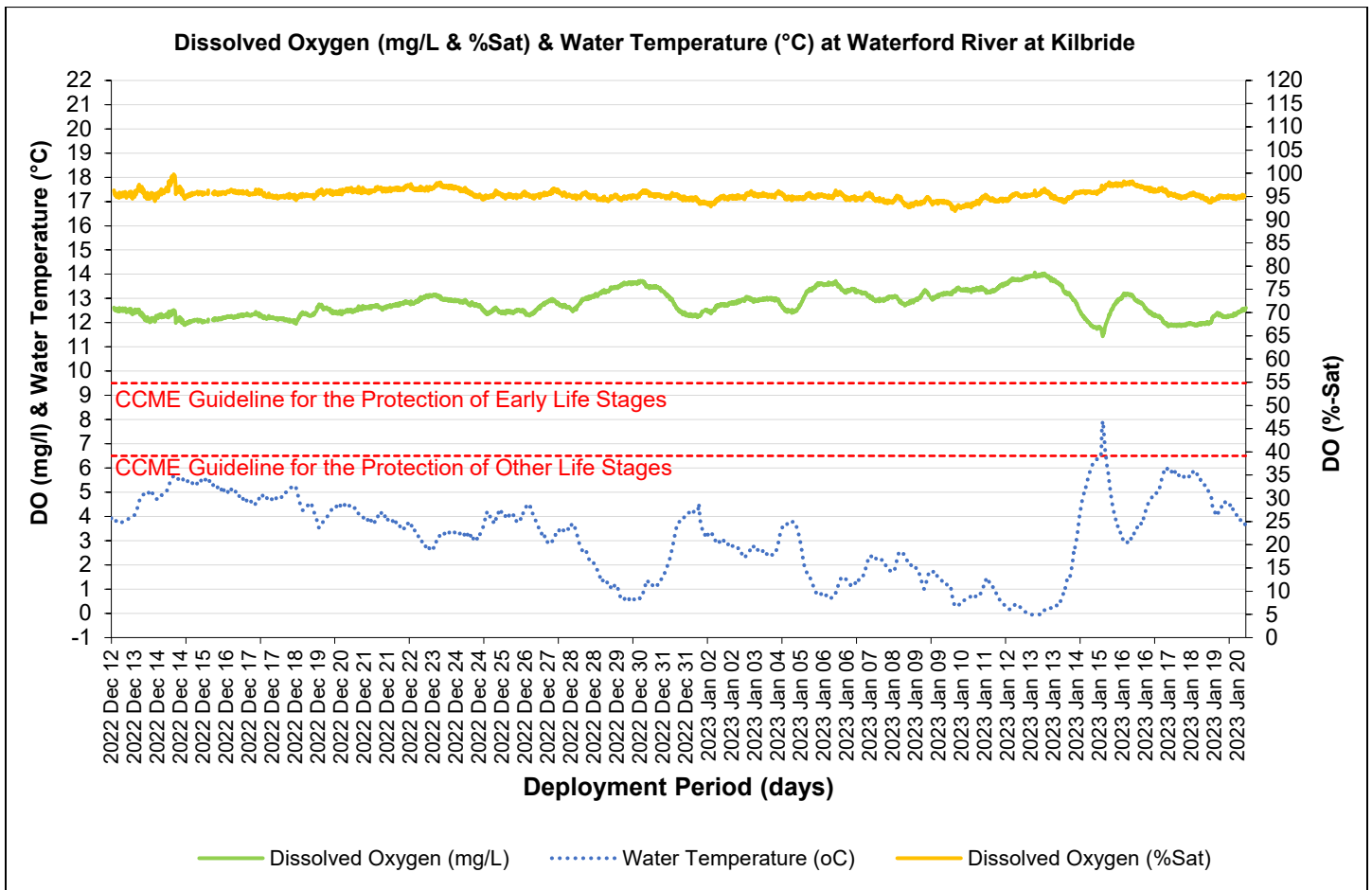
Dissolved Oxygen

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.

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 11.90 mg/L to a maximum of 13.15 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 94% to 99.8% saturation (Figure 5). Dissolved oxygen concentration increased slightly throughout the deployment as water temperatures continued cooling into winter. Sudden decreases in dissolved oxygen such as January 1st and 15th are associated with higher-than-normal water temperatures. Dissolved oxygen values increased again as water temperatures cooled.

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)	96.0	95.9	94.0	99.8
DO (mg/L)	12.48	12.45	11.90	13.15

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

Turbidity

Due to the lodging of sediment and organic matter within the sonde casing after the December 13-14, 2022 precipitation event, turbidity data is considered erroneous and statistical analysis was not completed for this parameter. This also explains the 'poor' performance ranking of the sensor upon removal.

Please note the stage data is raw. It has not been corrected for backwater effect. Corrected hydrometric data can be obtained at <https://wateroffice.ec.gc.ca/> or upon request to Water Survey Canada.

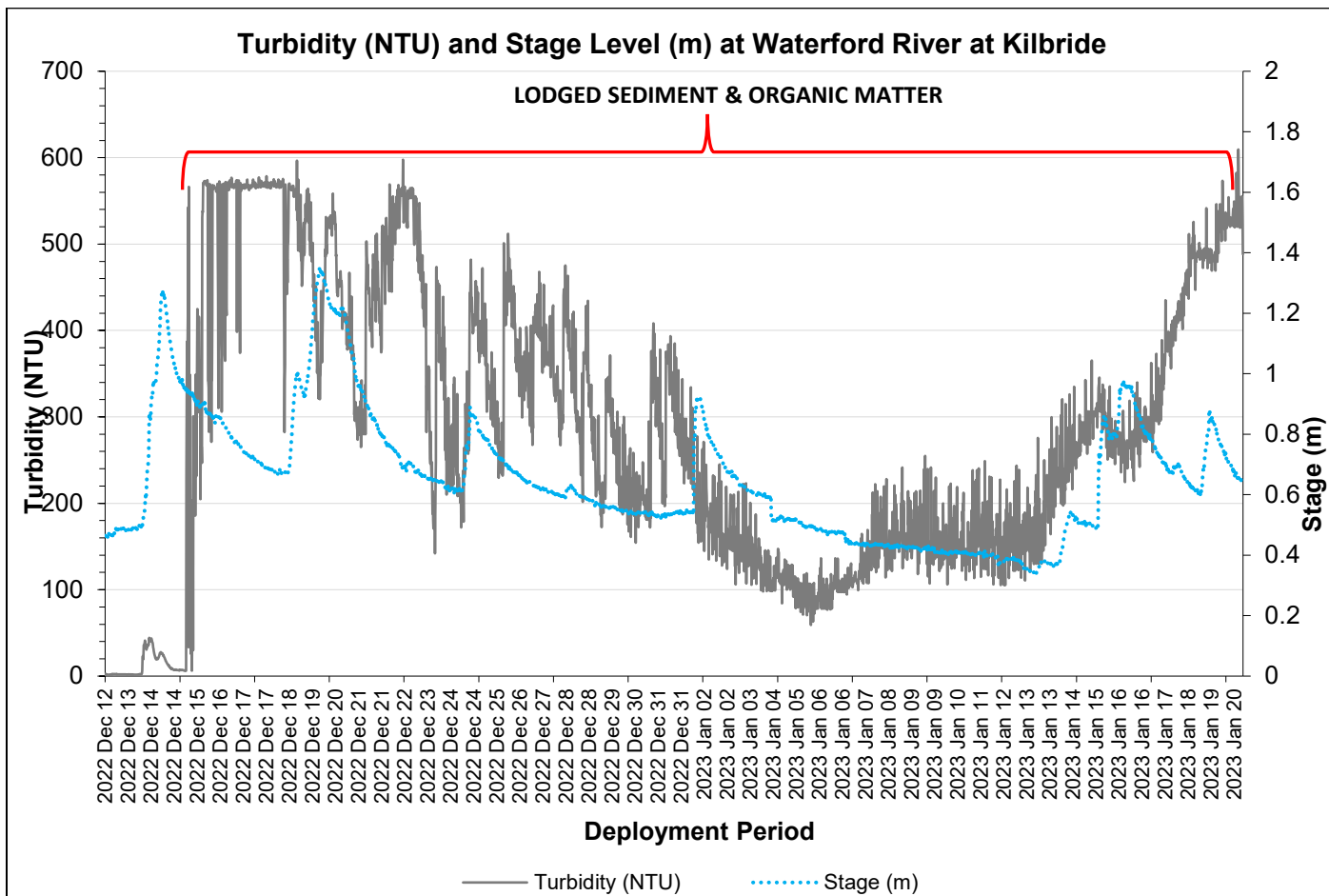


Figure 6: Turbidity (NTU) and stage (m) values at Waterford River at Kilbride.

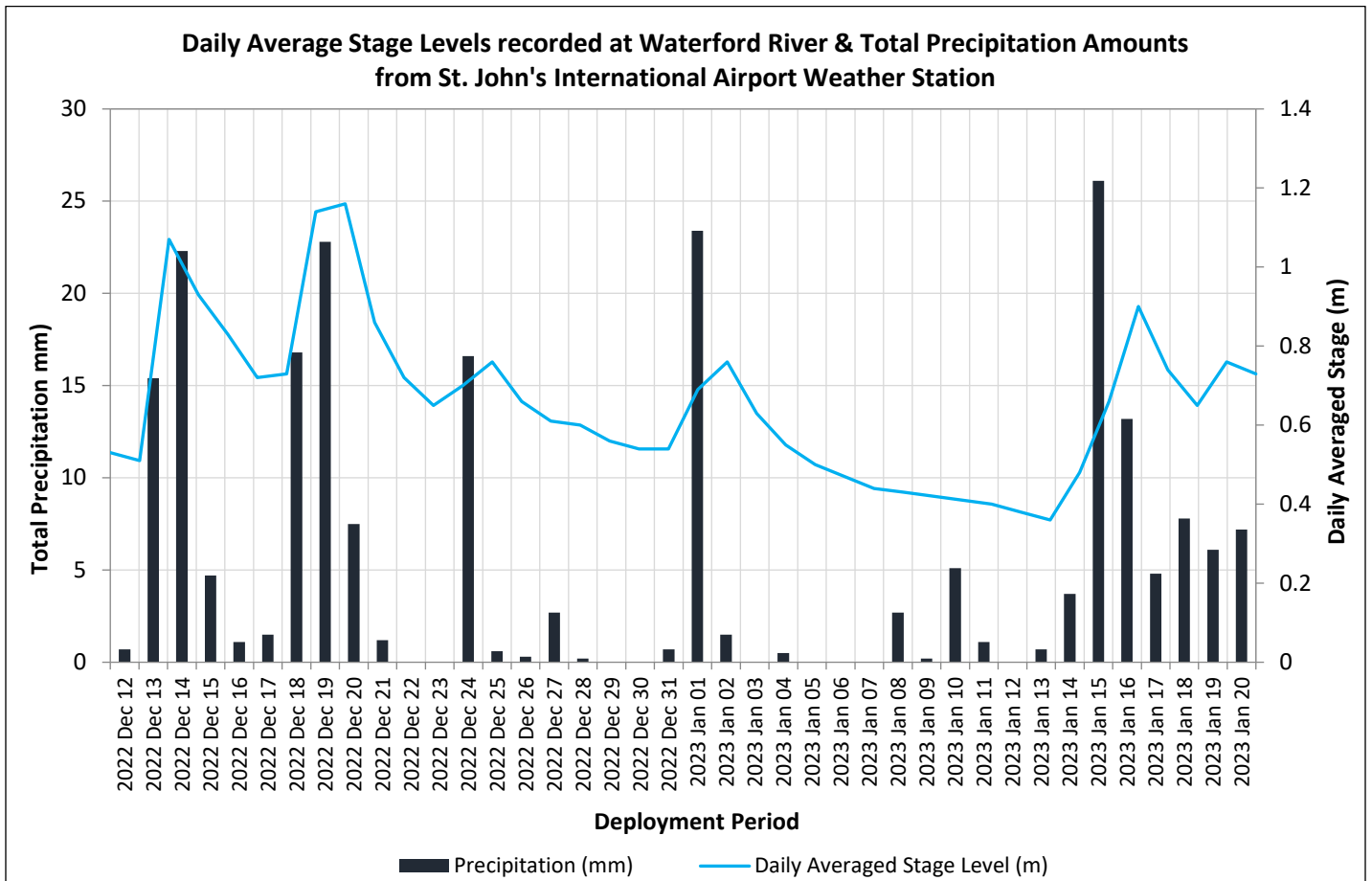
Stage and Precipitation

Please note the stage data graphed below is raw data. It has not been corrected for backwater effect. Corrected hydrometric data can be obtained at <https://wateroffice.ec.gc.ca/> or upon request to Water Survey Canada.

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 generally increase during rainfall events as depicted in Figure 7, but may stage might not increase if precipitation falls as snow.

During the deployment period, the stage values range from 0.34 m to 1.36 m. The larger peaks in stage correspond with substantial rainfall events.

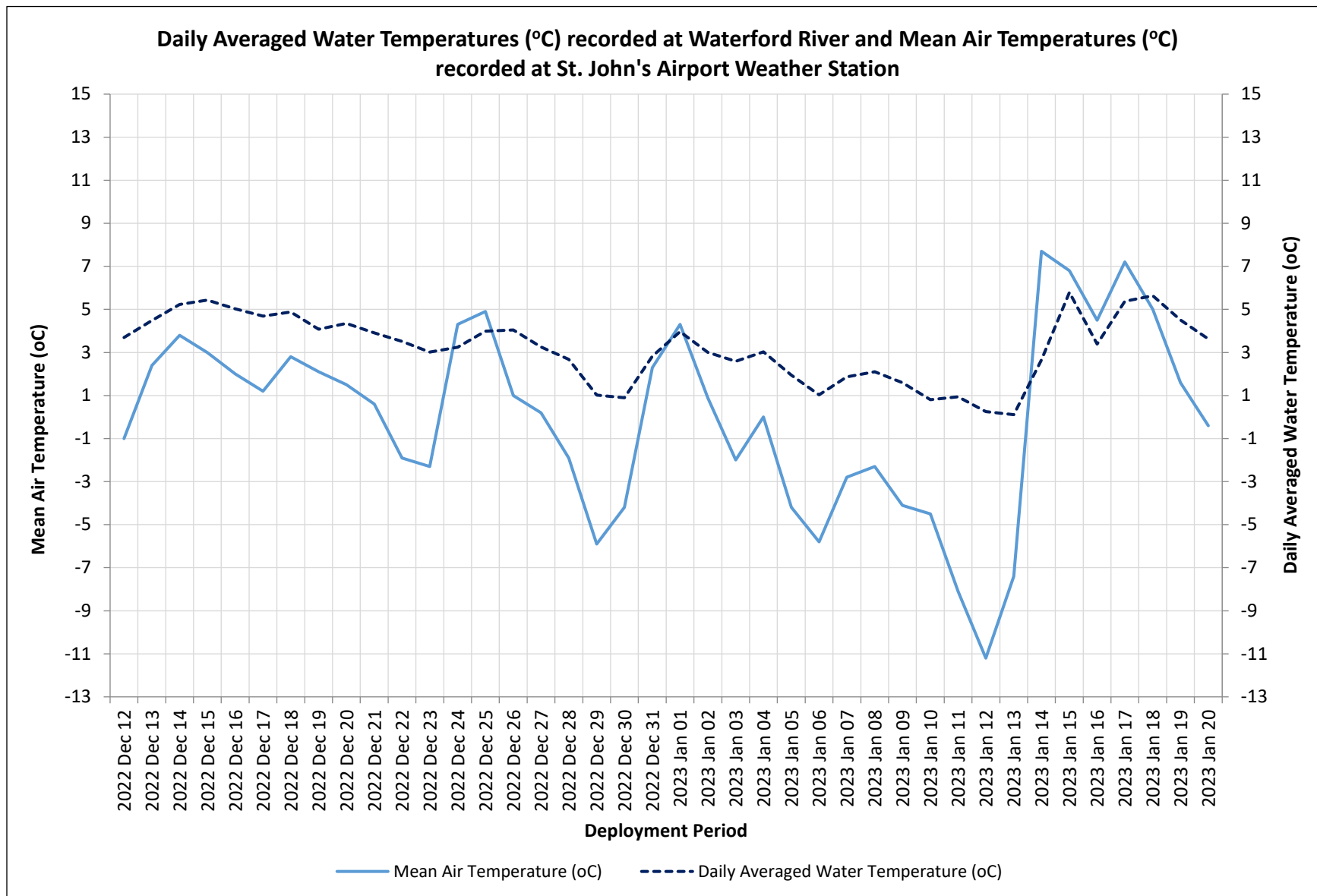
Precipitation data was collected by Environment Canada’s St. John’s West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 26.1 mm on January 15, 2023.



Mean	Median	Min	Max
0.65	0.62	0.34	1.36

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



APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS



BUREAU
VERITAS

Bureau Veritas Job #: C2AI242
Report Date: 2022/12/28

NL Department of Environment, Climate Change and
Municipalities

Site Location: WATERFORD RIVER @ KILBRIDE

Your P.O. #: 220028978-6

Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
UPC872 WATERFORD RIVER @ KILBRIDGE								
Sampling Date		2022/12/12 13:28						
Matrix		W						
Sample #		2022-1731-00-SI-SP						
Registration #		SA-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	43	1.0	mg/L	N/A	2022/12/22		8405584
Nitrate (N)	-	0.97	0.050	mg/L	N/A	2022/12/28		8405395
Total dissolved solids (calc., EC)	-	420	1.0	mg/L	N/A	2022/12/23		8405400
Inorganics								
Conductivity	-	760	1.0	uS/cm	N/A	2022/12/22	NGI	8416646
Chloride (Cl-)	-	200	2.0	mg/L	N/A	2022/12/22	LKH	8419394
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/12/22	LKH	8419394
Sulphate (SO4)	-	18	1.0	mg/L	N/A	2022/12/22	LKH	8419394
Total Alkalinity (Total as CaCO3)	-	15	2.0	mg/L	N/A	2022/12/22	NGI	8416670
Colour	-	20	5.0	TCU	N/A	2022/12/23	TGO	8419157
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/12/22	NGI	8416671
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/12/21	2022/12/22	RTY	8416307
Nitrate + Nitrite (N)	-	0.97	0.050	mg/L	N/A	2022/12/27	TGO	8419165
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/12/22	TGO	8419166
Nitrogen (Ammonia Nitrogen)	-	0.062	0.050	mg/L	N/A	2022/12/21	TGO	8415793
Dissolved Organic Carbon (C)	-	3.4	0.50	mg/L	N/A	2022/12/22	RSL	8416813
Total Organic Carbon (C)	-	3.5	0.50	mg/L	N/A	2022/12/22	RSL	8415802
pH	-	7.31		pH	N/A	2022/12/22	NGI	8416660
Total Phosphorus	-	0.017	0.004	mg/L	2022/12/21	2022/12/22	SPC	8416374
Total Suspended Solids	-	1.4	1.0	mg/L	2022/12/19	2022/12/23	RMK	8411292
Turbidity	-	0.65	0.10	NTU	N/A	2022/12/22	AAO	8418564
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/12/26	2022/12/26	FJO	8421667
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.052	0.0050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Barium (Ba)	-	0.018	0.0010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Boron (B)	-	ND	0.050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Cadmium (Cd)	-	0.000021	0.000010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Calcium (Ca)	-	14	0.10	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Copper (Cu)	-	0.0018	0.00050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Iron (Fe)	-	0.15	0.050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Magnesium (Mg)	-	2.2	0.10	mg/L	2022/12/19	2022/12/21	JHY	8411529



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UPC872 WATERFORD RIVER @ KILBRIDGE								
Sampling Date 2022/12/12 13:28								
Matrix W								
Sample # 2022-1731-00-SI-SP								
Registration # SA-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.10	0.0020	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Potassium (K)	-	2.0	0.10	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Sodium (Na)	-	120	0.10	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Strontium (Sr)	-	0.050	0.0020	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Uranium (U)	-	ND	0.00010	mg/L	2022/12/19	2022/12/21	JHY	8411529
Total Zinc (Zn)	-	0.011	0.0050	mg/L	2022/12/19	2022/12/21	JHY	8411529