Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
June 24, 2022 to August 1, 2022

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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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 dissolved oxygen and turbidity data was removed from June 24 to June 29, 2022 due to instrumentation parameter programming issues.

This deployment report discusses water quality related events occurring at this station from the instrument deployment on June 24, 2022 until removed on August 1, 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	**June 24, 2022**	**Deployment**	Excellent	Marginal	Excellent	Excellent	Excellent
		Grab Sample # 1707	N/A	Poor	Excellent	N/A	Excellent
	August 1, 2022	**Removal**	Excellent	Excellent	Excellent	Good	Excellent

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Upon deployment, all sensors ranked ‘Excellent’ and ‘Marginal’ against the QA/QC sonde.

All measured grab sample (#2022-1707-00-SI-SP) parameters ranked ‘Excellent’ in comparison to the field sonde with exception of a pH ranking of ‘Poor’. This may be the result of insufficient time given for the field sonde to acclimate to the existing water conditions or fluctuation of the grab sample pH between sample collection and laboratory analysis.

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

DATA INTERPRETATION

Water Temperature

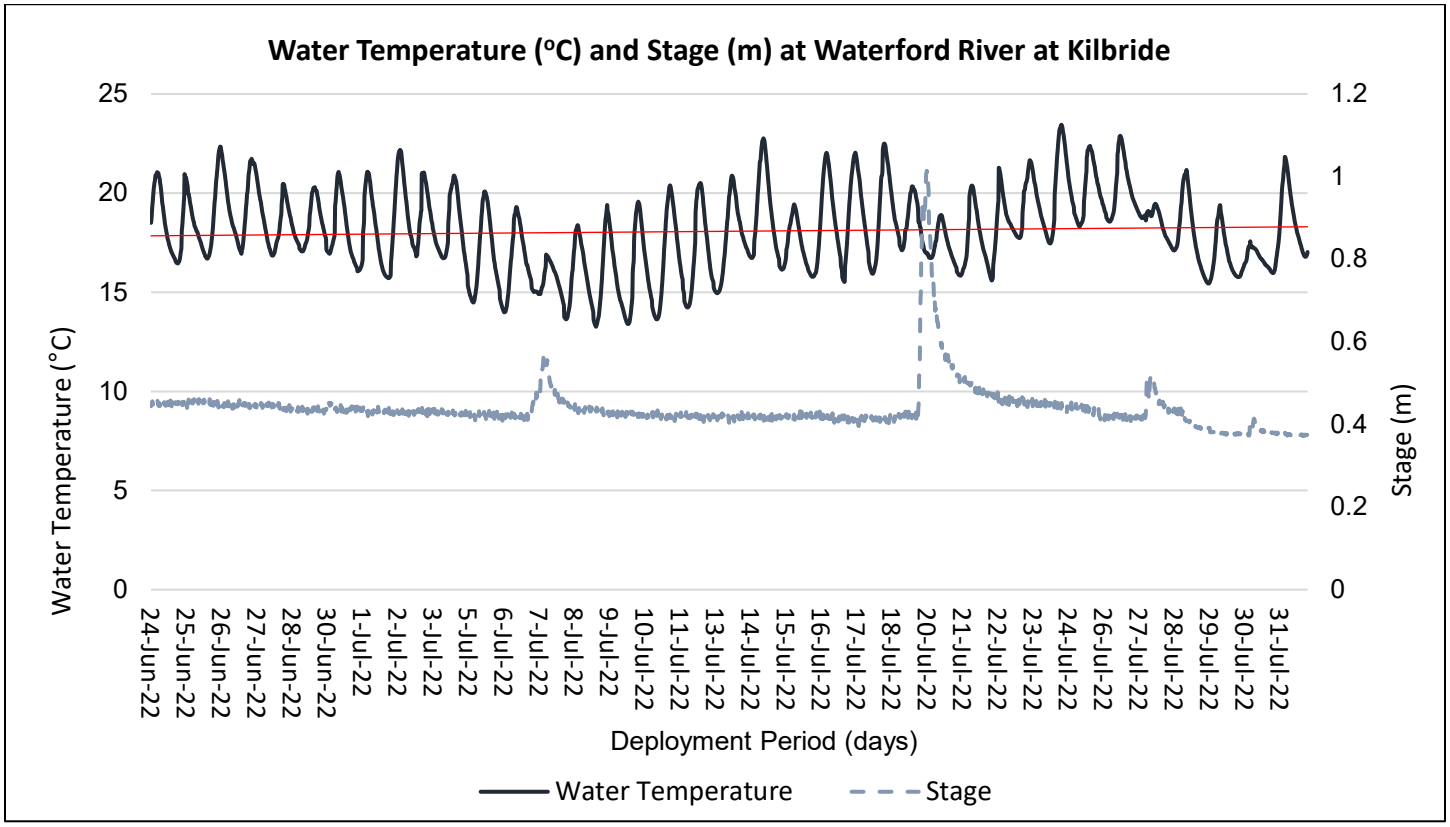
Water temperature ranged from 13.26 ºC to 23.44 ºC during this deployment period (Figure 2).

The water temperature trend was seasonably stable throughout the deployment period. Decreases in temperature were observed during higher stage events, as seen on July 7, July 19 and on July 27, 2022 (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
18.07	17.96	13.26	23.44

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 6.87 pH units and 7.49 pH units, a mean of 7.12 and median of 7.10 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 pH values remained within the guidelines throughout the duration of the deployment period (see Figure #7).

During higher stage events, as observed on July 7, July 19, and on July 27, 2022, pH values slightly decreased temporarily and then returned to background levels as the stage returned 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 stable throughout the deployment period with the exception of temporary decreases during higher stage events due to the addition of lower pH rainwater.

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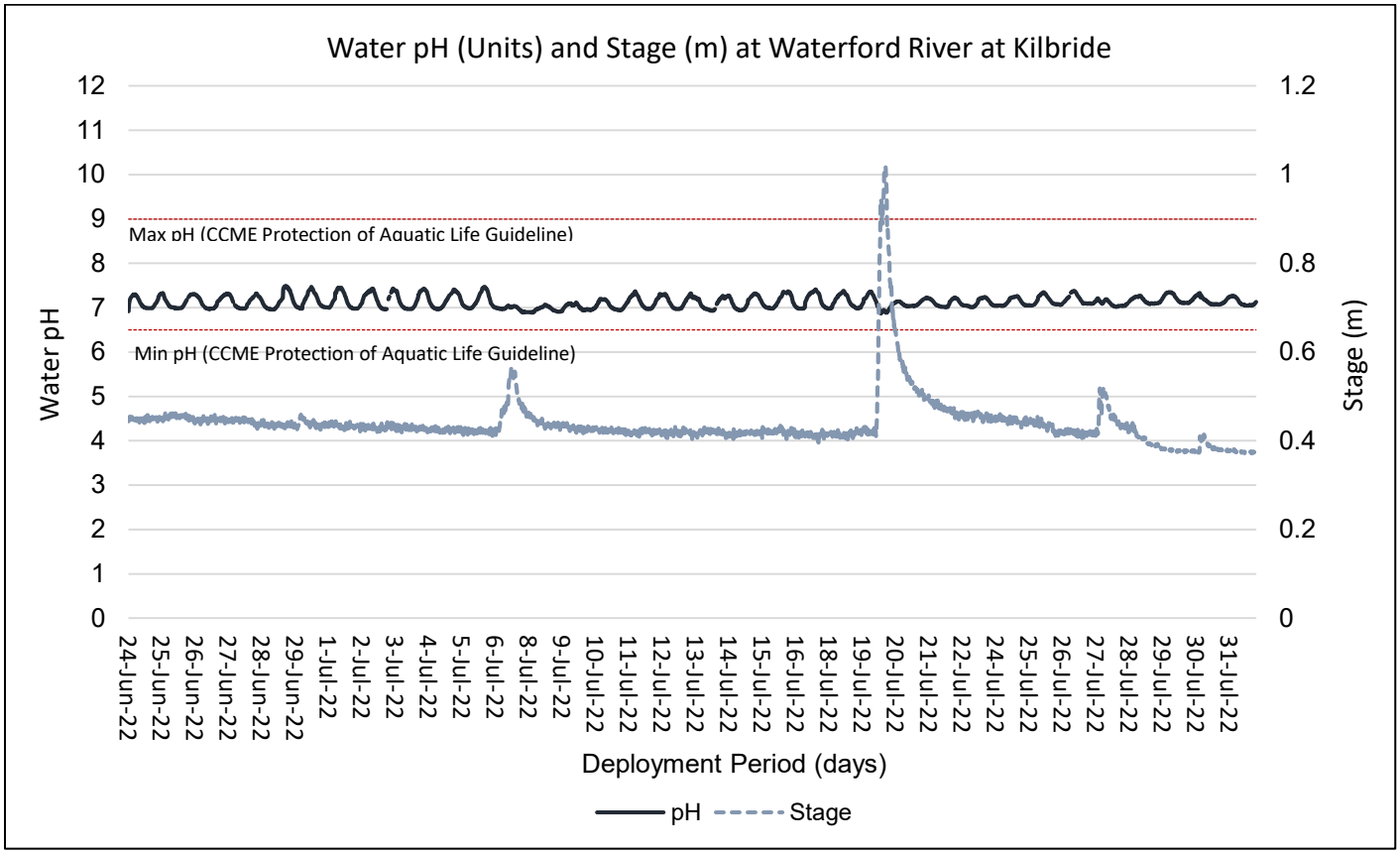

Mean	Median	Min	Max
7.12	7.10	6.87	7.49

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

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 239.0 µS/cm and 844.0 µS/cm from June 24th to August 1st, 2022. TDS (a calculated value) ranged from 0.1550 g/L to 0.5480 g/L (Figure 4).

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

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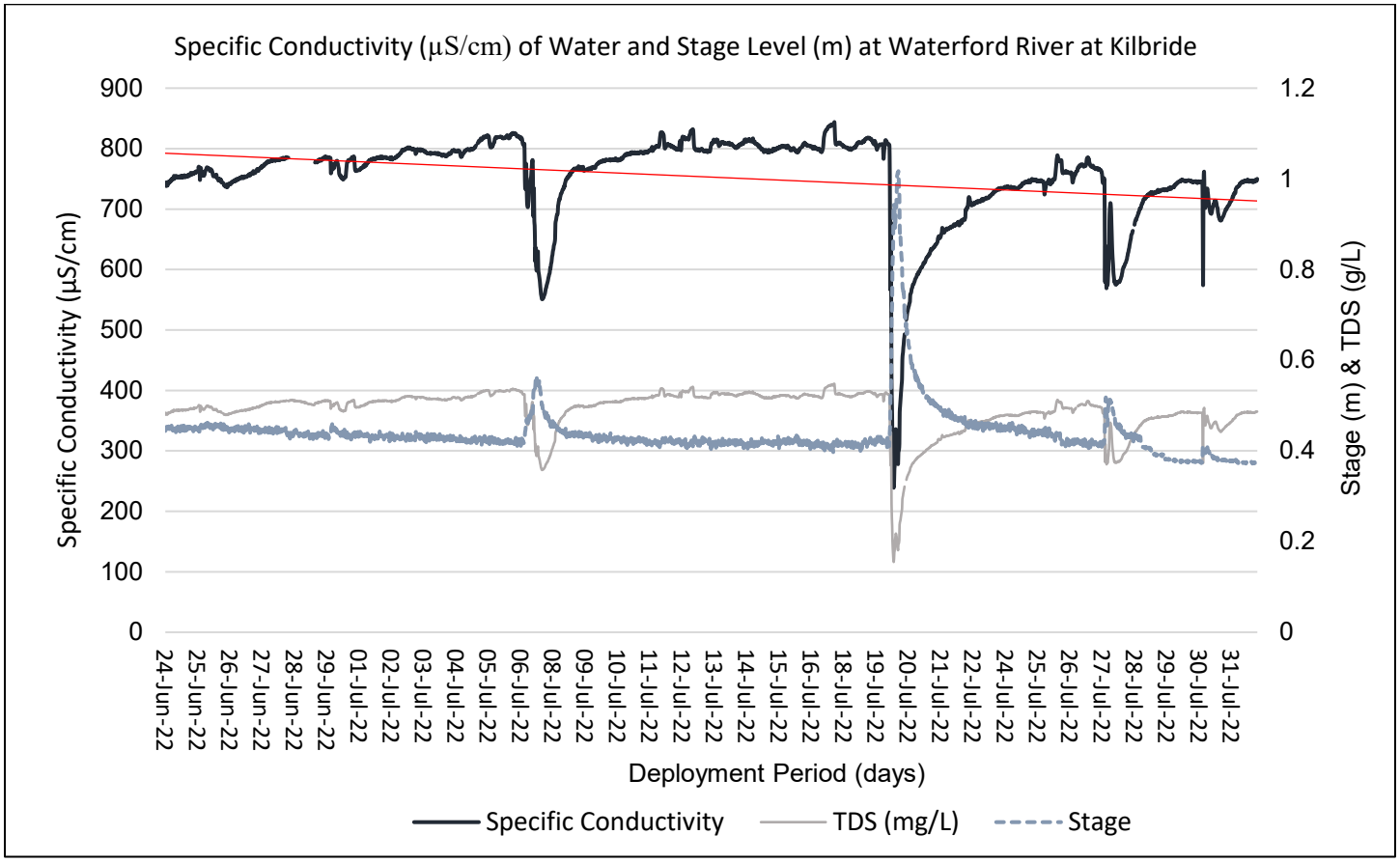


	Mean	Median	Min	Max
Specific Conductivity (µS/cm)	752.0	770.0	239.0	844.0
TDS (mg/L)	0.4892	0.5020	0.1550	0.5480

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

Dissolved Oxygen

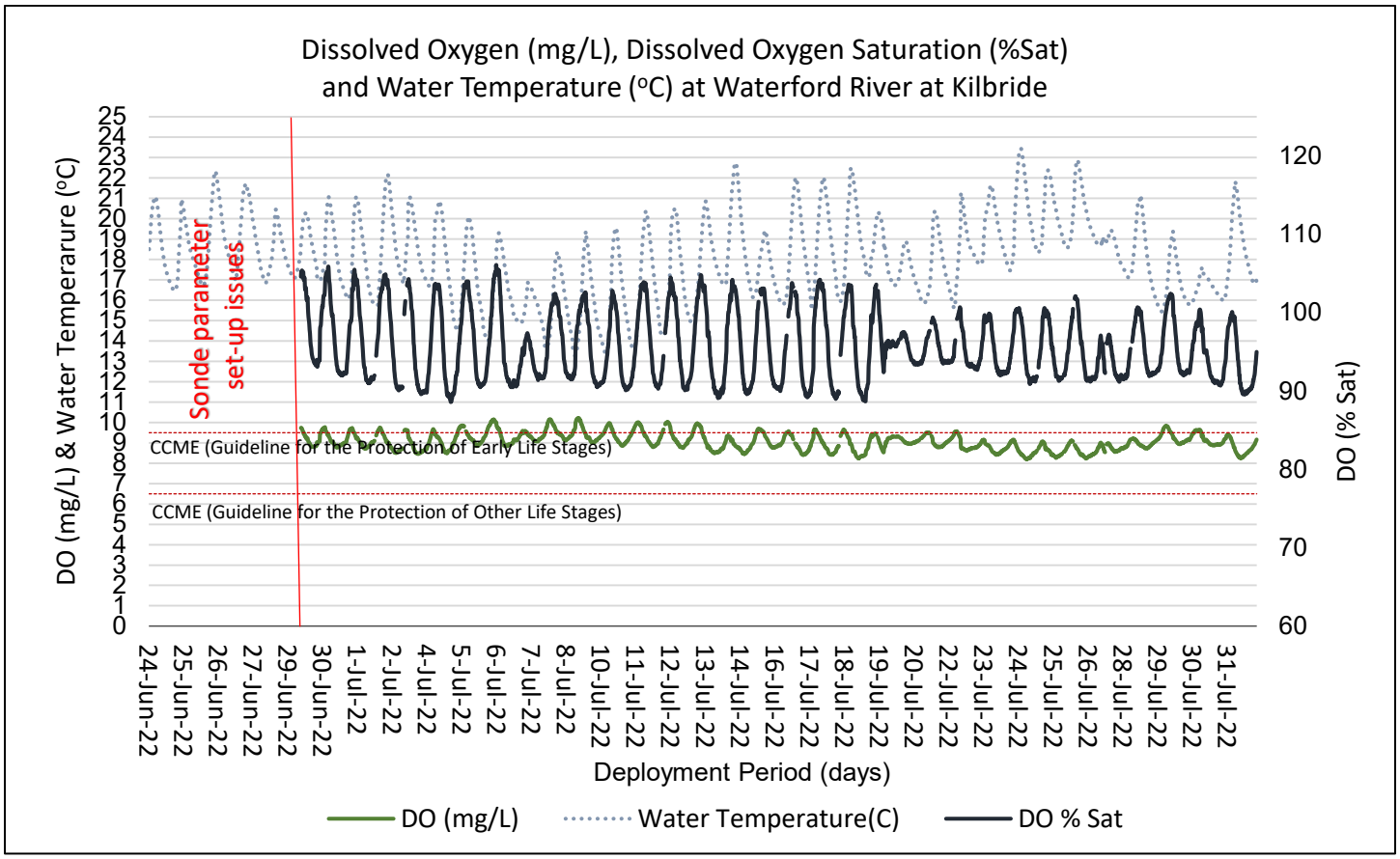
Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water 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 8.19 mg/L to a maximum of 10.22 mg/L. The percent saturation levels for dissolved oxygen ranged within 88.6 % Saturation to 106.1% Saturation (Figure 5).

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.

Dissolved oxygen concentrations remained above the Guideline for Other Life Stages (6.5 mg/L) and predominantly near and below the CCME Guideline for the Protection of Early life stages (9.5mg/L) throughout the deployment period. This is expected for the time of the year as most aquatic organisms have developed beyond sensitivities.



	Mean	Median	Min	Max
DO (%Sat)	96.0	95.3	88.6	106.1
DO (mg/L)	9.08	9.05	8.19	10.22

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

Turbidity

Turbidity levels during the deployment period range from 0.2 NTU and 47.8 NTU, with a mean of 1.3 NTU and median of 0.6 NTU (Figure 6).

Turbidity events above baseline values as seen on July 7th, July 27th and July 30th, 2022 are the result of higher stage events. Turbidity spikes (47.8 NTU) as observed on July 19-20th, 2022 (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 also become temporarily lodged within the sonde casing during normal water flow and cause increases in turbidity values as observed on July 11, 2022.

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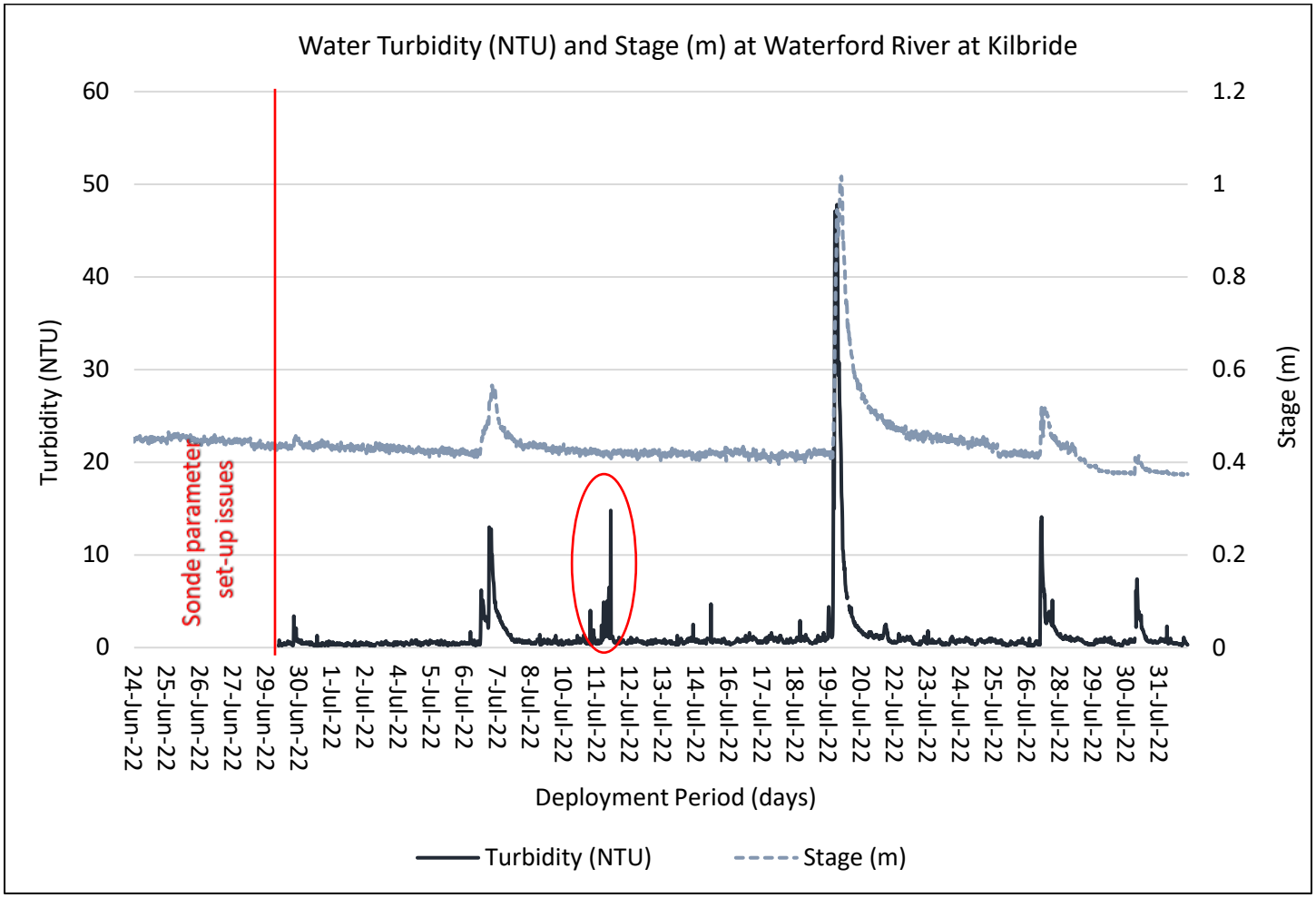


Mean	Median	Min	Max
1.3	0.6	0.2	47.8

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

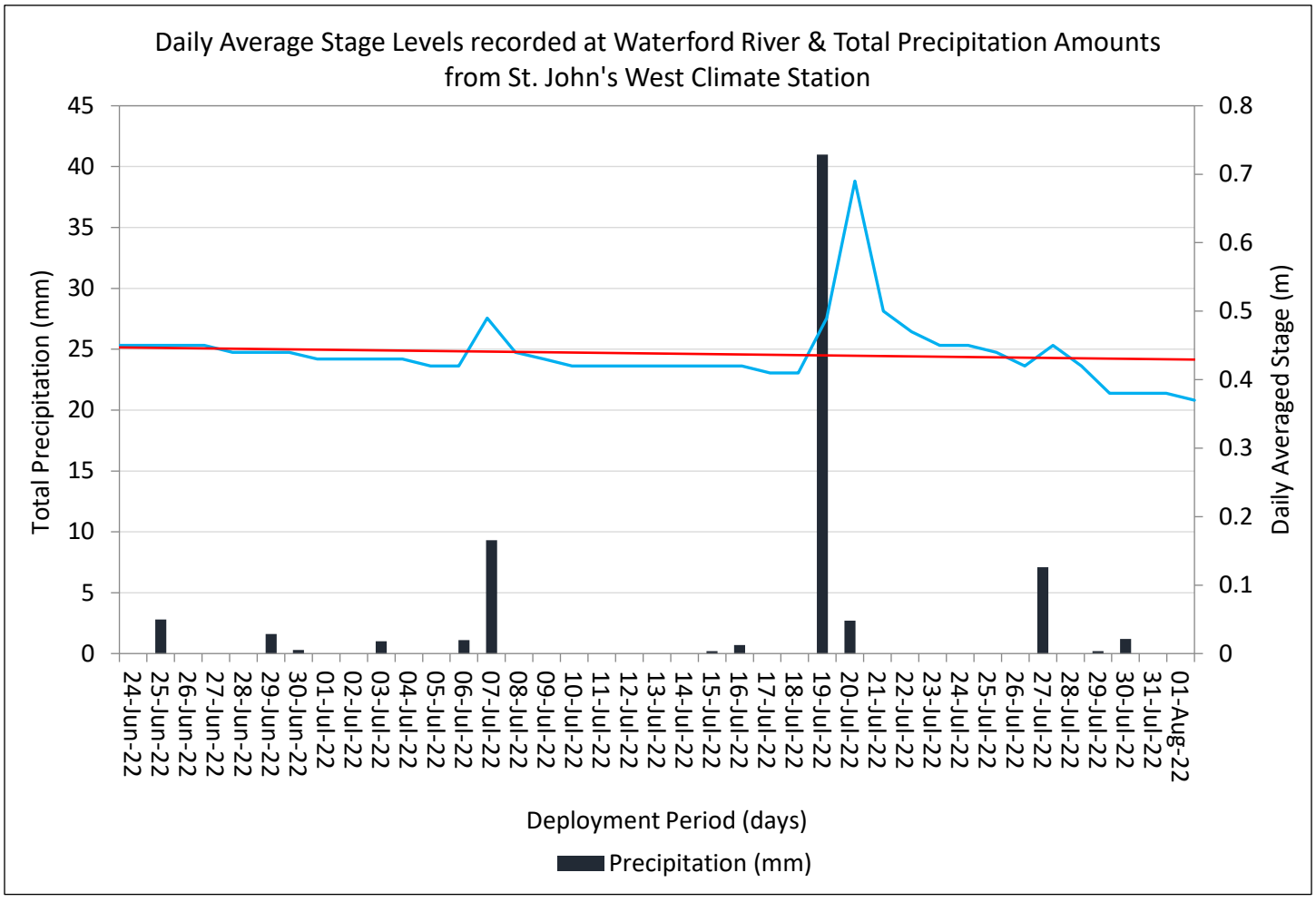
Stage and Precipitation

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 daily average stage values range from 0.37 m to 0.69 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 41.0 mm on July 19, 2022.

A slight decrease in the daily average stage was observed late June through the beginning of August as a result of low precipitation events.



Mean	Median	Min	Max
0.44	0.43	0.37	0.69

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

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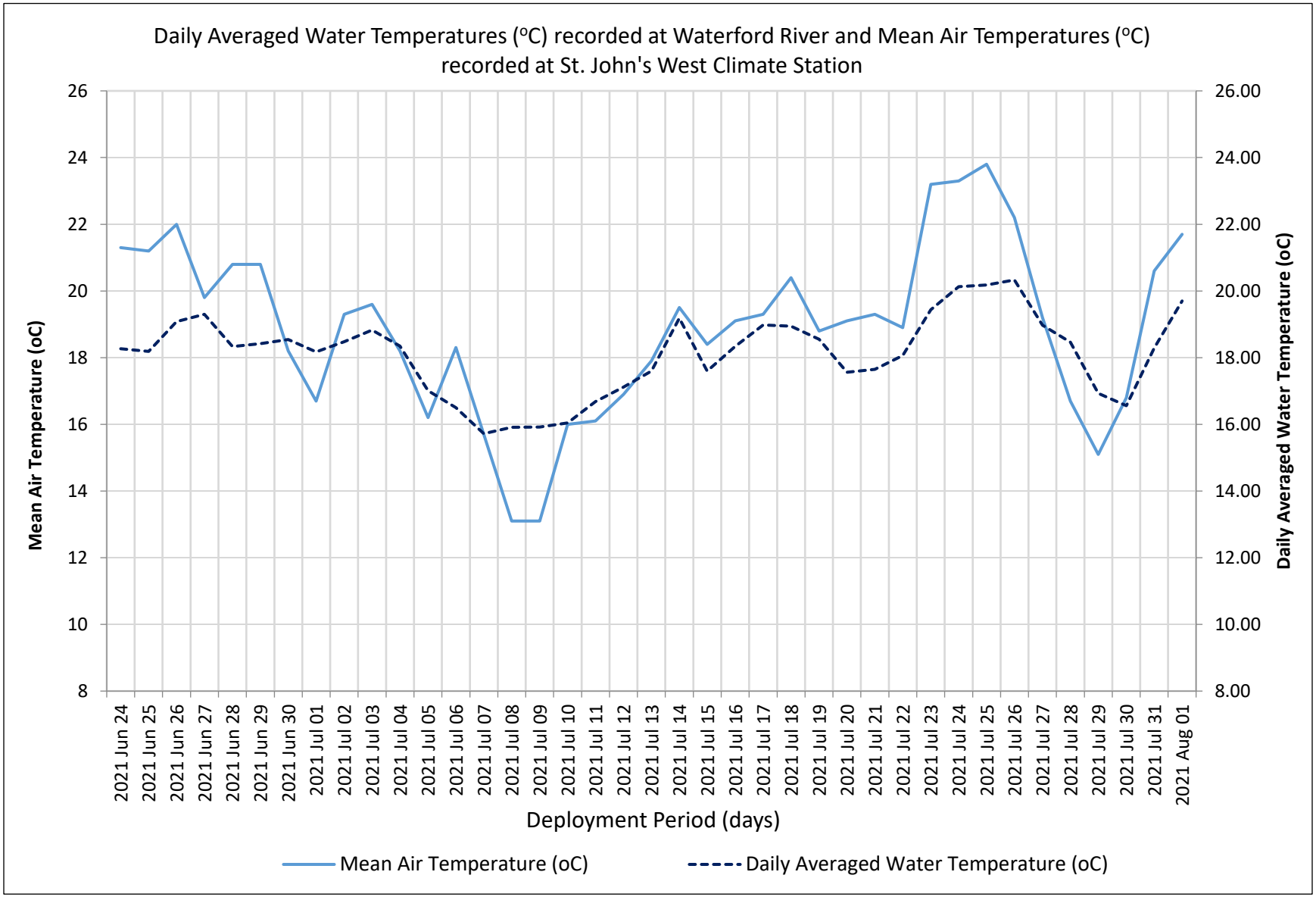

APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS