

Real-Time Water Quality Report

Waterford River at Kilbride NL02ZM0009

Deployment Period
August 22 to October 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.

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 August 22, 2023 until removal on October 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	August 22	Deployment	Excellent	Good	Excellent	Excellent	Excellent
		Grab Sample # 1712	N/A	Good	Excellent	N/A	Good
	October 20	Removal	Excellent	Excellent	Excellent	Excellent	Fair

Waterford River at Kilbride, Newfoundland and Labrador

Upon deployment and removal all sensors ranked 'Excellent' or 'Good' with the exception of turbidity upon removal. The 'poor' ranking was likely due to some sediment buildup on the sensor after the long 58-day deployment.

DATA INTERPRETATION

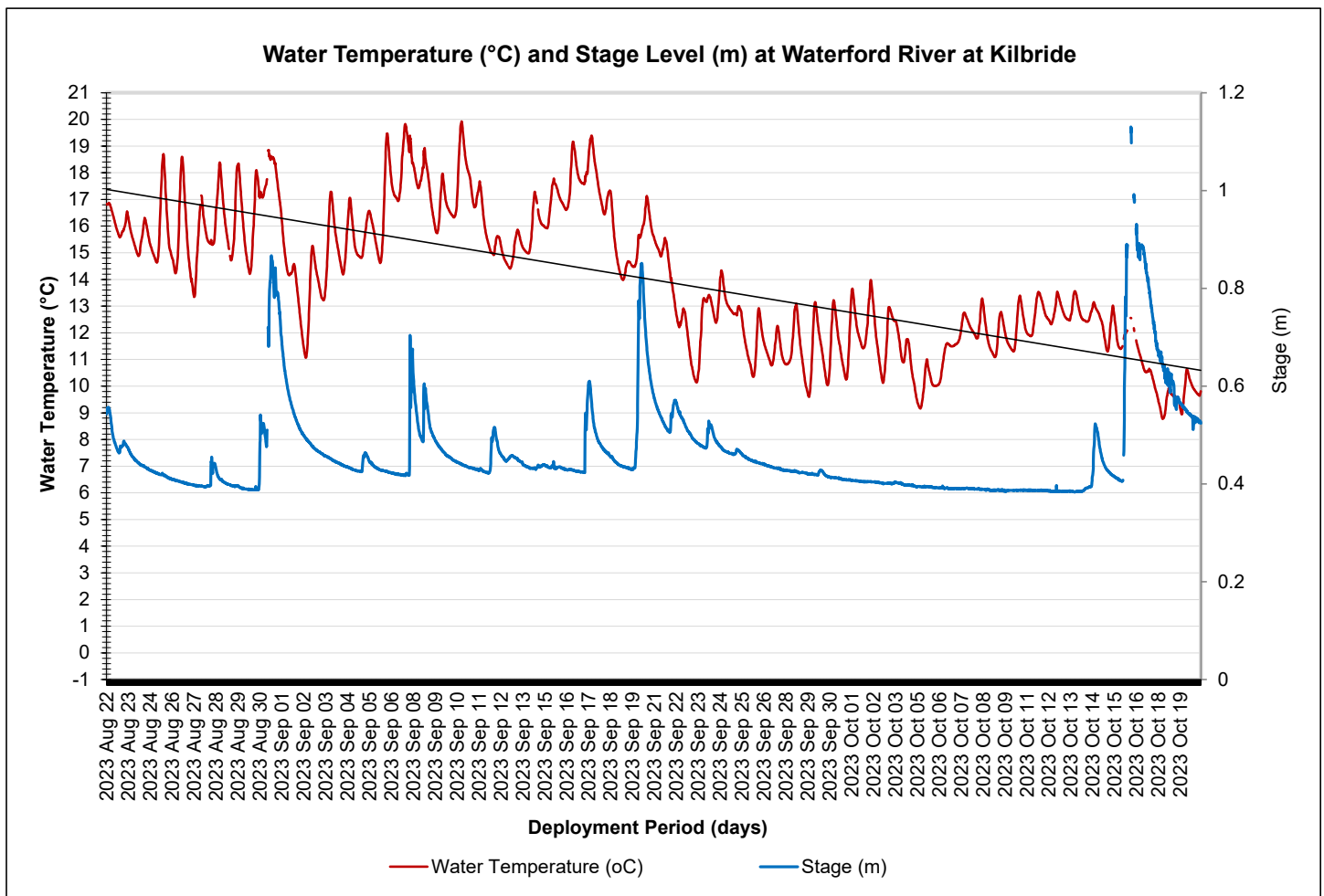
Water Temperature

Water temperature ranged from 8.77 °C to 19.92 °C during this deployment period (Figure 2).

The water temperature was variable and correlated with air temperature (see Appendix A) throughout the deployment period, with an overall decreasing trend throughout the deployment. This is expected as air and water temperatures cool into the Fall months.

During high stage events, the water temperature often decreased for a short period due to the addition of cooler precipitation, as seen on August 30th and October 15th.

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
14.05	14.00	8.77	19.92

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

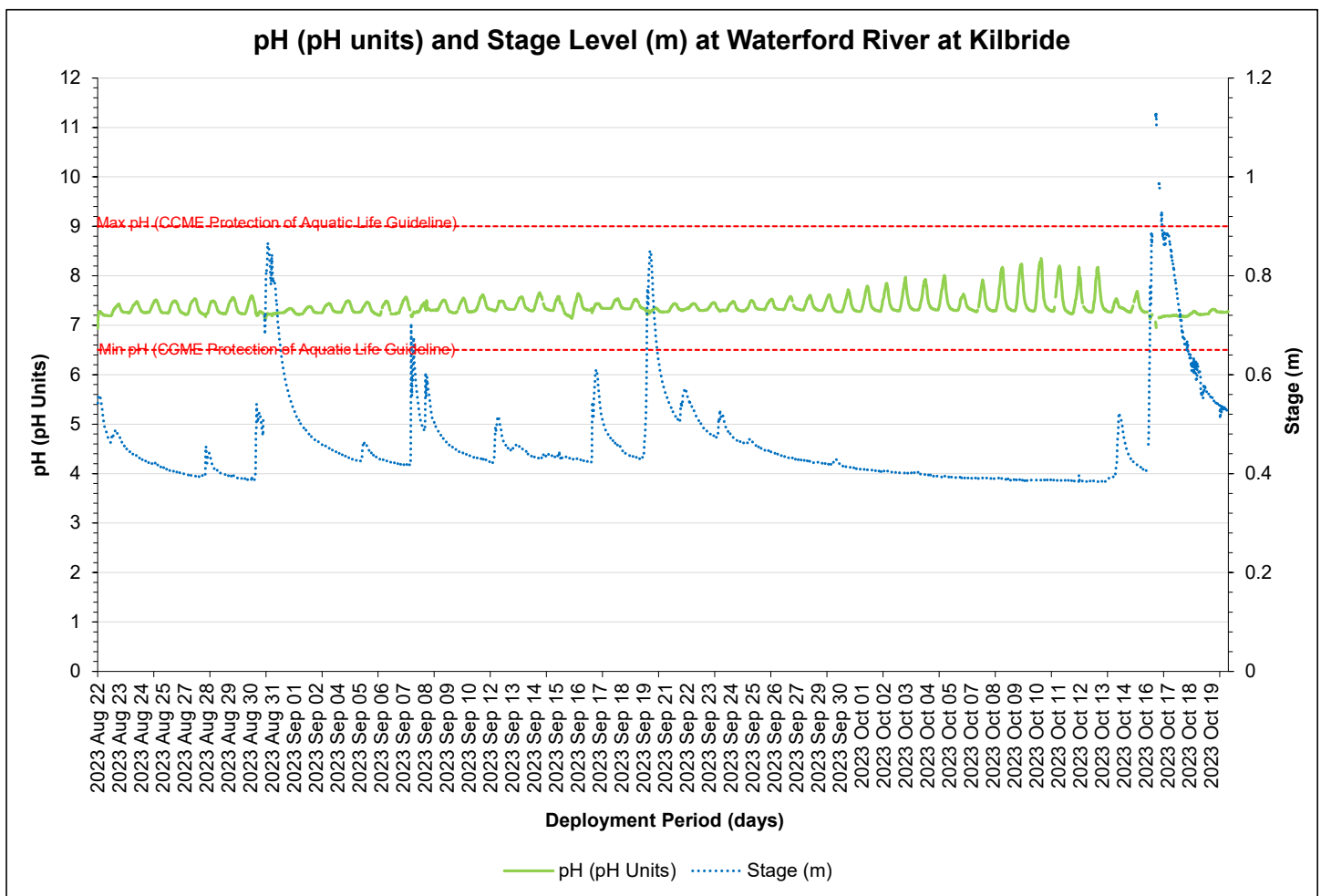
pH

Throughout the deployment period, pH was stable, with a range between 6.94 pH units and 8.35 pH units, a mean of 7.38 and median of 7.33 pH units (Figure 3). The highest values were reached near the end of the deployment.

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.

A diurnal variation pattern was visible throughout the deployment period. The magnitude of variation correlates to daily water temperature range, length of days and fluctuations in photosynthesis and respiration rates as expected at this time of the year. Variation decreased during higher stage events due to the addition of lower pH rainwater, as seen around August 30th, September 19th and October 15th.

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
7.38	7.33	6.94	8.35

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

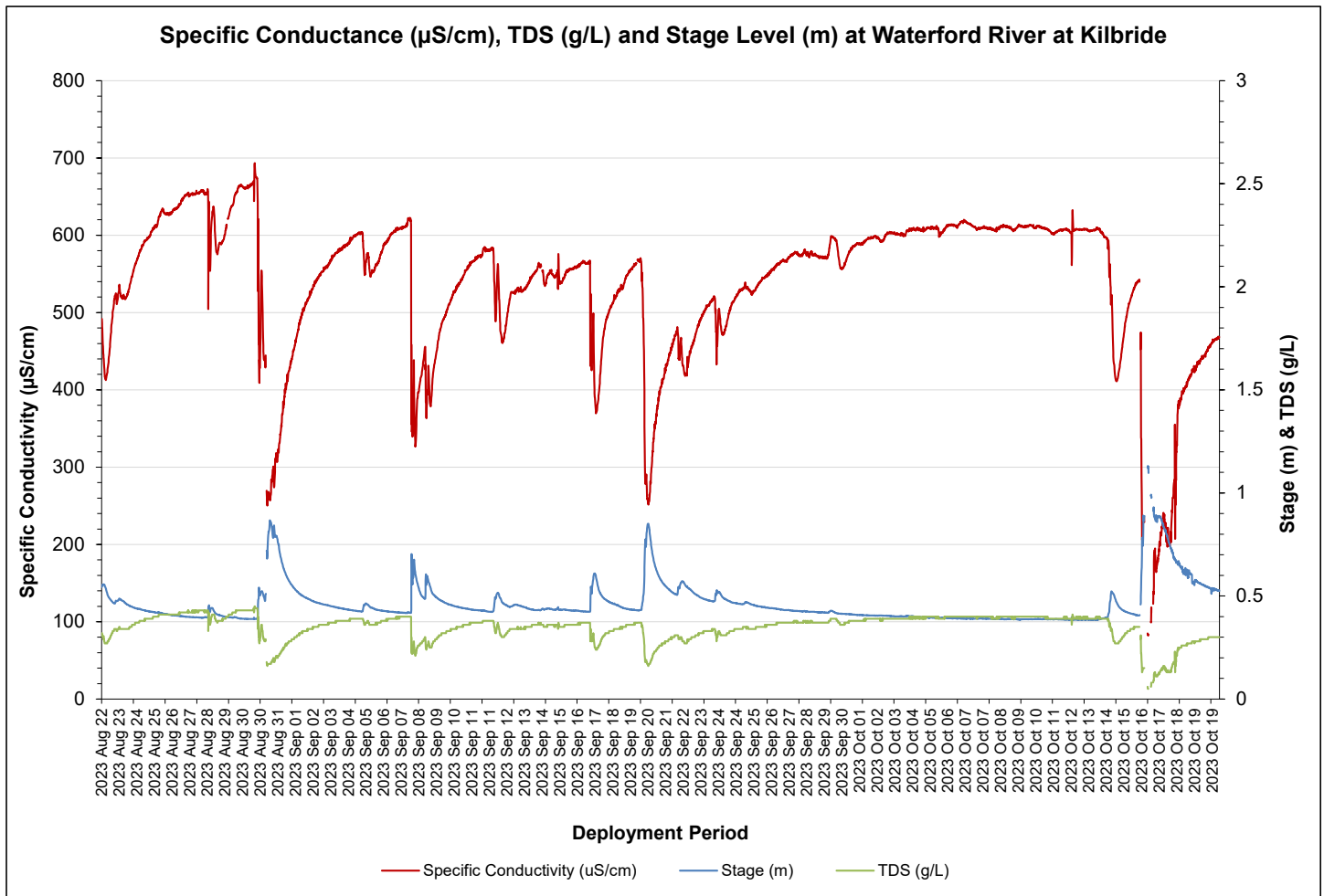
Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 82.3 $\mu\text{S}/\text{cm}$ and 693.4 $\mu\text{S}/\text{cm}$. TDS (a calculated value) ranged from 0.0500 g/L to 0.4500 g/L.

Conductivity levels were noticeably influenced by high stage events, decreasing as stage rose. 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.

During a prolonged period without precipitation and associated stage increases, conductivity was able to stabilize before again decreasing for the last week of the deployment.

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 ($\mu\text{S}/\text{cm}$)	538.1	564.3	82.3	693.4
TDS (mg/L)	0.3499	0.3700	0.0500	0.4500

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

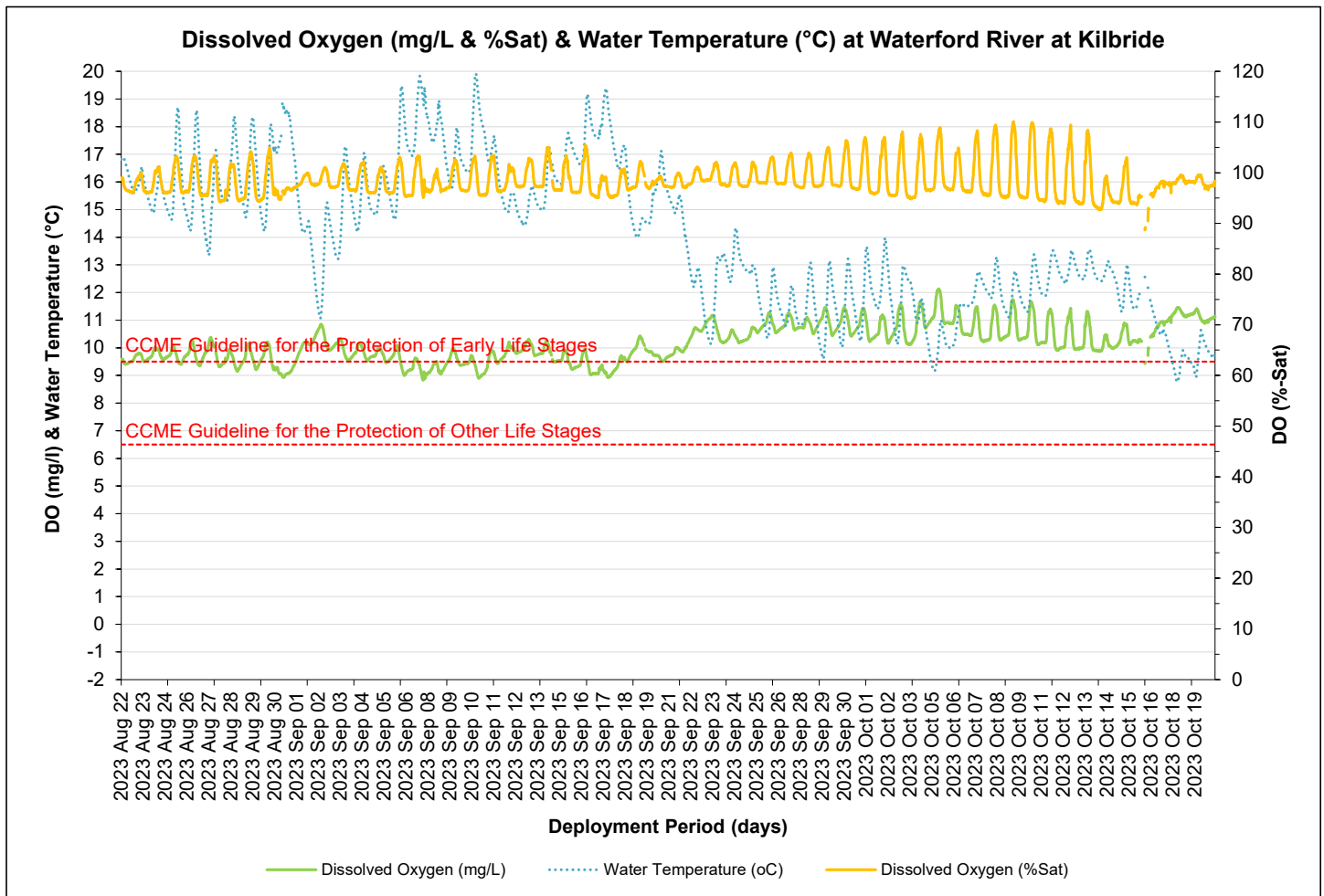
Dissolved Oxygen

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 8.83 mg/L to a maximum of 12.13 mg/L. The percent saturation (%) levels for dissolved oxygen ranged within 88.7% to 110.1% saturation (Figure 5).

Dissolved oxygen was variable throughout the deployment, affected by the varying water temperatures during this extended period. As temperatures dropped, dissolved oxygen increased. This is a natural relationship as cooler water holds more oxygen. From September 18 onwards, dissolved oxygen was gradually increasing as water temperatures cooled into Fall.

Dissolved oxygen concentrations remained above the Guideline for Other Life Stages (6.5 mg/L) and hovered around the CCME Guideline for the Protection of Early life stages (9.5mg/L) for the first half of the deployment period, climbing above for the second portion.



	Mean	Median	Min	Max
DO (%Sat)	98.5	97.7	88.7	110.1
DO (mg/L)	10.16	10.09	8.83	12.13

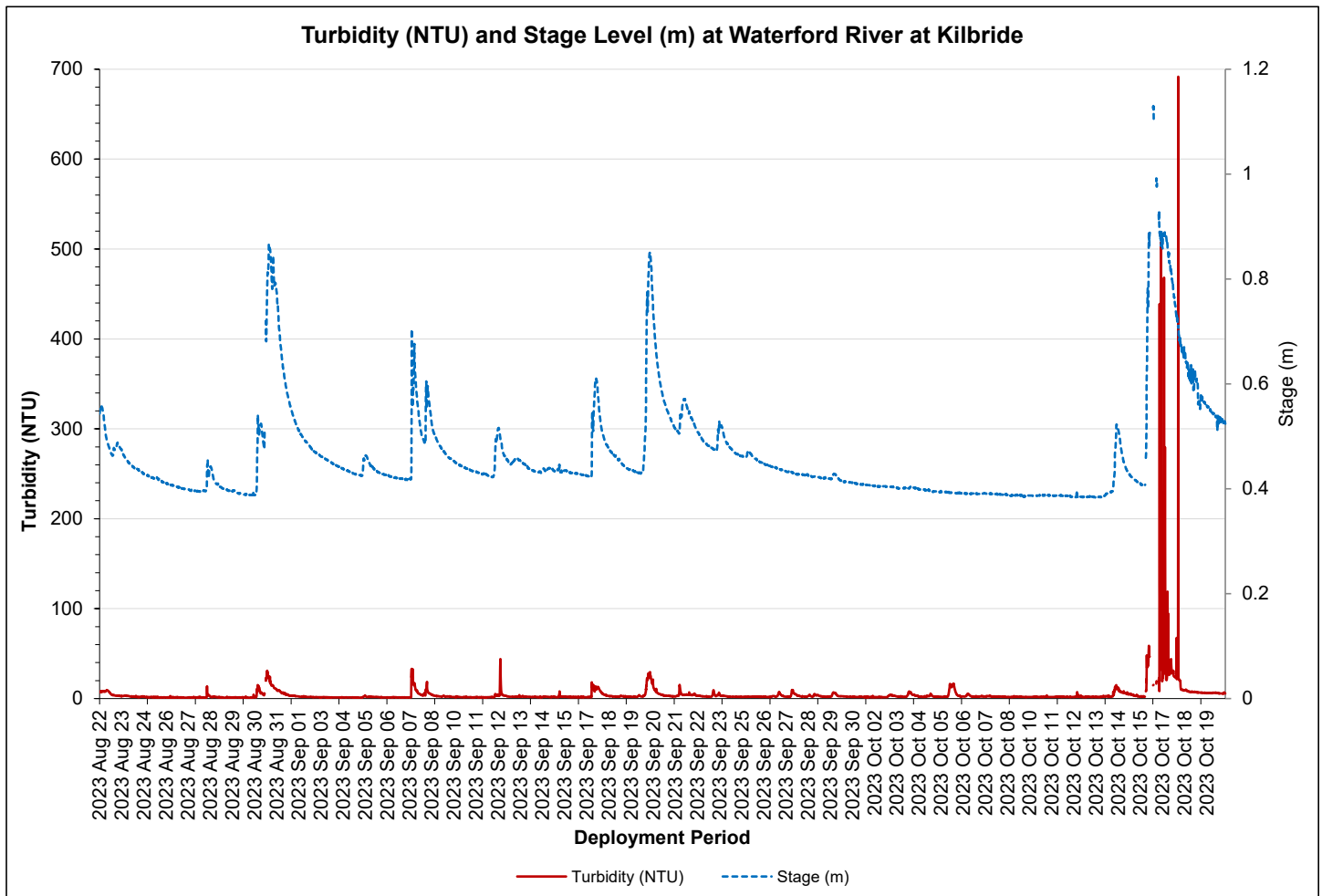
Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment period range from 0.9 NTU and 691.6 NTU, with a mean of 4.7 NTU and median of 2.1 NTU (Figure 6).

Turbidity events above baseline values are the result of higher stage events and an associated increase in flow which disturbs the water column. This increases the presence of suspended material in water through the movement of runoff, soil and sediment from nearby urban areas. The large stage increase October 15th caused significant fluctuation in turbidity for several days before returning to just above baseline.

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
4.7	2.1	0.9	691.6

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

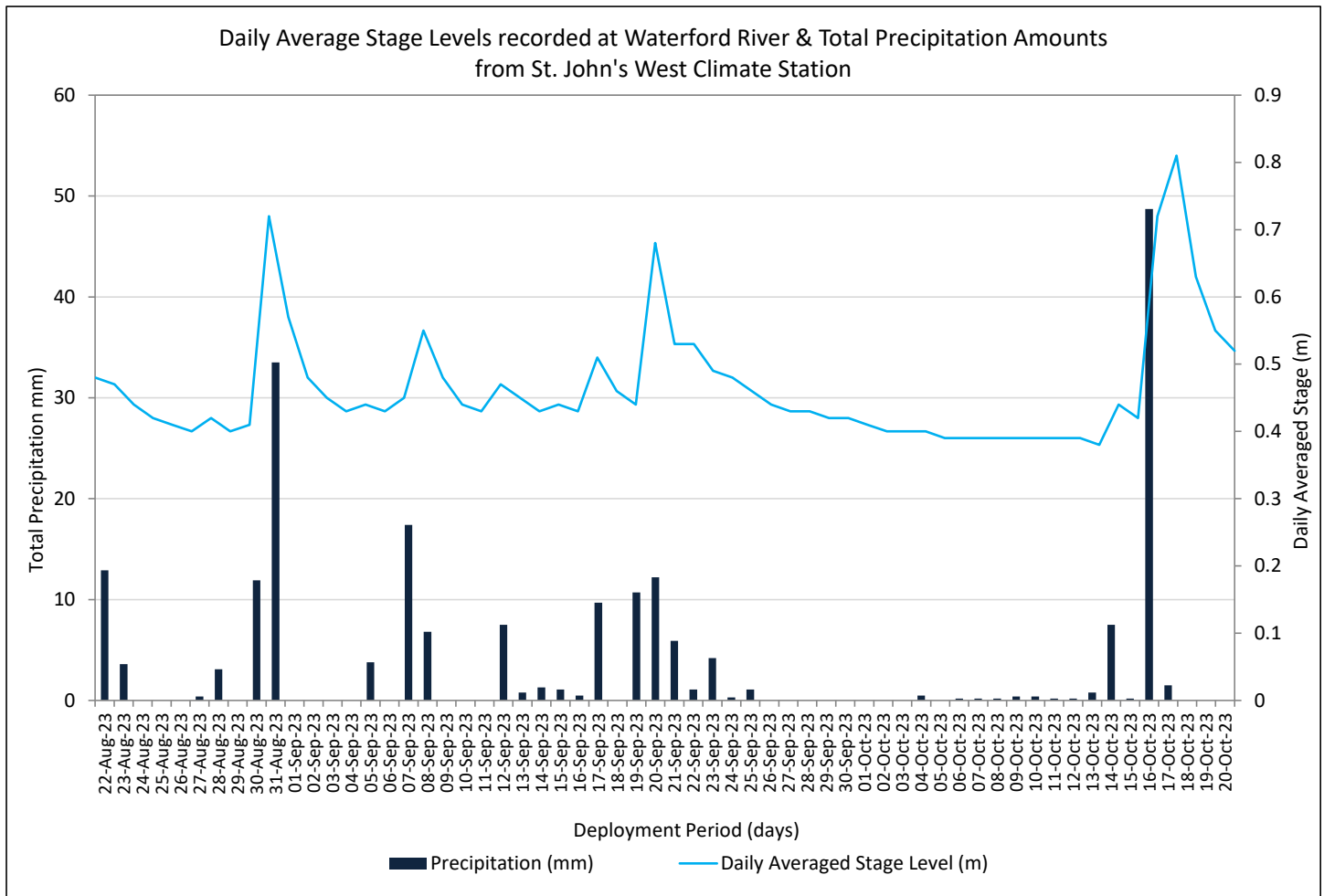
Stage and Precipitation

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 range from 0.38 m to 1.13 m. The larger peaks in stage correspond with substantial rainfall events as observed on August 30th, September 19th and October 16th. Stage was generally decreasing during this deployment period.

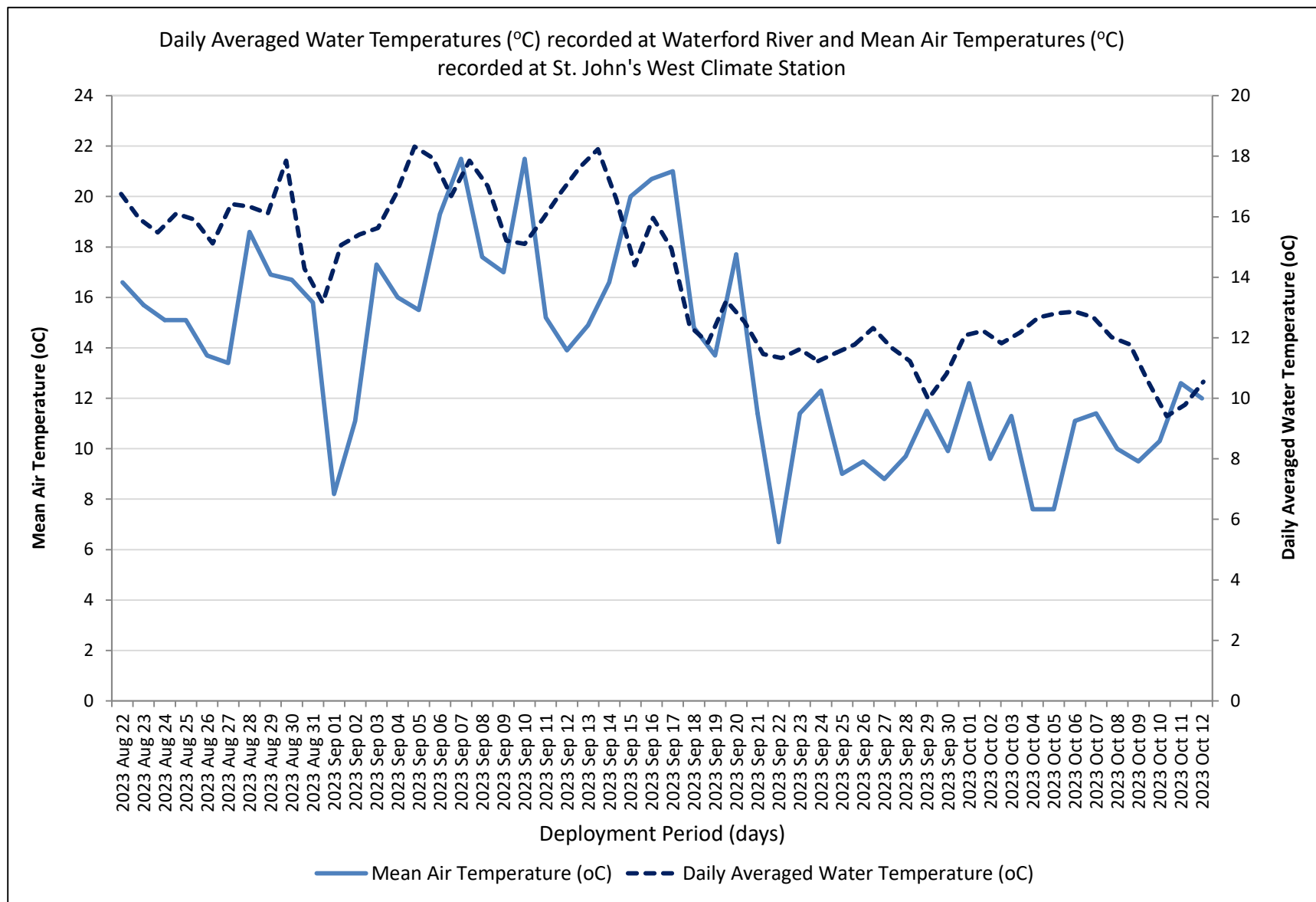
Precipitation data was collected by Environment Canada’s St. John’s West Climate station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 48.7 mm on October 16th, 2023.



Mean	Median	Min	Max
0.46	0.43	0.38	1.13

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 #: C3P9610
Report Date: 2023/09/11

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
WUJ507 WATERFORD @ KILBRIDE								
Sampling Date		2023/08/22 13:50						
Matrix		W						
Sample #		2023-1712-000-SI-SP						
Registration #		SA-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	35	1.0	mg/L	N/A	2023/09/06		8876774
Nitrate (N)	-	0.55	0.050	mg/L	N/A	2023/09/11		8876777
Total dissolved solids (calc., EC)	-	280	1.0	mg/L	N/A	2023/09/07		8876510
Inorganics								
Conductivity	-	500	1.0	uS/cm	N/A	2023/09/06	LJV	8897989
Chloride (Cl-)	-	130	1.0	mg/L	N/A	2023/08/29	SUR	8884294
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2023/08/29	SUR	8884294
Sulphate (SO4)	-	12	1.0	mg/L	N/A	2023/08/29	SUR	8884294
Total Alkalinity (Total as CaCO3)	-	17	2.0	mg/L	N/A	2023/09/06	LJV	8897991
Colour	-	21	5.0	TCU	N/A	2023/09/09	MCN	8905095
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2023/09/06	LJV	8897993
Total Kjeldahl Nitrogen (TKN)	-	0.20	0.10	mg/L	2023/08/30	2023/09/01	RTY	8888145
Nitrate + Nitrite (N)	-	0.56	0.050	mg/L	N/A	2023/09/09	MCN	8905065
Nitrite (N)	-	0.011	0.010	mg/L	N/A	2023/09/09	MCN	8904906
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2023/09/06	HGV	8892846
Dissolved Organic Carbon (C)	-	3.3	0.50	mg/L	N/A	2023/09/07	ACK	8901143
Total Organic Carbon (C)	-	3.5	0.50	mg/L	N/A	2023/09/07	ACK	8899028
pH	-	7.37		pH	N/A	2023/09/06	LJV	8897987
Total Phosphorus	-	0.035	0.004	mg/L	2023/08/30	2023/09/01	MUM	8886879
Total Suspended Solids	-	7.2	2.0	mg/L	2023/08/29	2023/08/31	ZZH	8882834
Turbidity	-	2.2	0.10	NTU	N/A	2023/09/06	LJV	8898947
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2023/09/05	2023/09/06	SGK	8895812
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.17	0.0050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Antimony (Sb)	-	ND	0.0010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Arsenic (As)	-	ND	0.0010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Barium (Ba)	-	0.017	0.0010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Boron (B)	-	ND	0.050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Cadmium (Cd)	-	0.000020	0.000010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Calcium (Ca)	-	11	0.10	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Chromium (Cr)	-	0.0020	0.0010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Copper (Cu)	-	0.0023	0.00050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Iron (Fe)	-	0.38	0.050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Lead (Pb)	-	ND	0.00050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Magnesium (Mg)	-	1.7	0.10	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Manganese (Mn)	-	0.098	0.0020	mg/L	2023/08/30	2023/09/05	MTZ	8886686



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Your P.O. #: 220028978-9
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
WUJ507 WATERFORD @ KILBRIDE								
Sampling Date		2023/08/22 13:50						
Matrix		W						
Sample #		2023-1712-000-SI-SP						
Registration #		SA-0000						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Phosphorus (P)	-	ND	0.10	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Potassium (K)	-	1.5	0.10	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Selenium (Se)	-	ND	0.00050	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Sodium (Na)	-	74	0.10	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Strontium (Sr)	-	0.042	0.0020	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Uranium (U)	-	ND	0.00010	mg/L	2023/08/30	2023/09/05	MTZ	8886686
Total Zinc (Zn)	-	0.012	0.0050	mg/L	2023/08/30	2023/09/05	MTZ	8886686