

Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
May 8, 2018 to July 12, 2018



Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
Water Resources Management Division

Prepared by:

Tara Clinton
Environmental Scientist
Water Resources Management Division
Department of Municipal Affairs and Environment
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No.: (709) 729 - 5925
Fax No.: (709) 729 - 0320
taracClinton@gov.nl.ca

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 instrument deployment on May 5, 2018 until removal on July 12, 2018.



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.

At deployment and removal, a QA/QC Sonde is temporarily deployed alongside 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 1).

WRMD staff at the Department of Municipal Affairs and Environment (MAE) are responsible 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-ECCC 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 dependant, 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	May 8	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	July 12	Removal	Good	Good	Poor	Poor	Excellent

On deployment the ranking of the field data against the QAQC data was: water temperature, pH, specific conductivity, dissolved oxygen and turbidity data ranked as 'Excellent'. Parameters were acceptable for the initial deployment of the field instrument.

At removal of the instrument, water temperature, pH, and turbidity ranked as 'Excellent' and 'Good', while the specific conductivity and dissolved oxygen data ranked as 'Poor'. The instrument was returned to the laboratory for further testing after deployment.

Concerns or Issues during the Deployment Period

Toward the end of the deployment the dissolved oxygen data was not representing the brook and the data was removed from the overall data set. The dissolved oxygen probe was evaluated at the laboratory for any failures and a new sonde was deployed in the brook for the next deployment period.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from 4.58°C to 20.50°C during this deployment period (Figure 2).

Over the duration of the deployment period the water temperature is generally consistent, as the weather warms into Summer the water temperatures start to increase. Several decreases and increases in water temperature correspond with the changes in the stage levels. During high stage events water temperature decreases for a short period of time before returning to the diurnal pattern.

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.

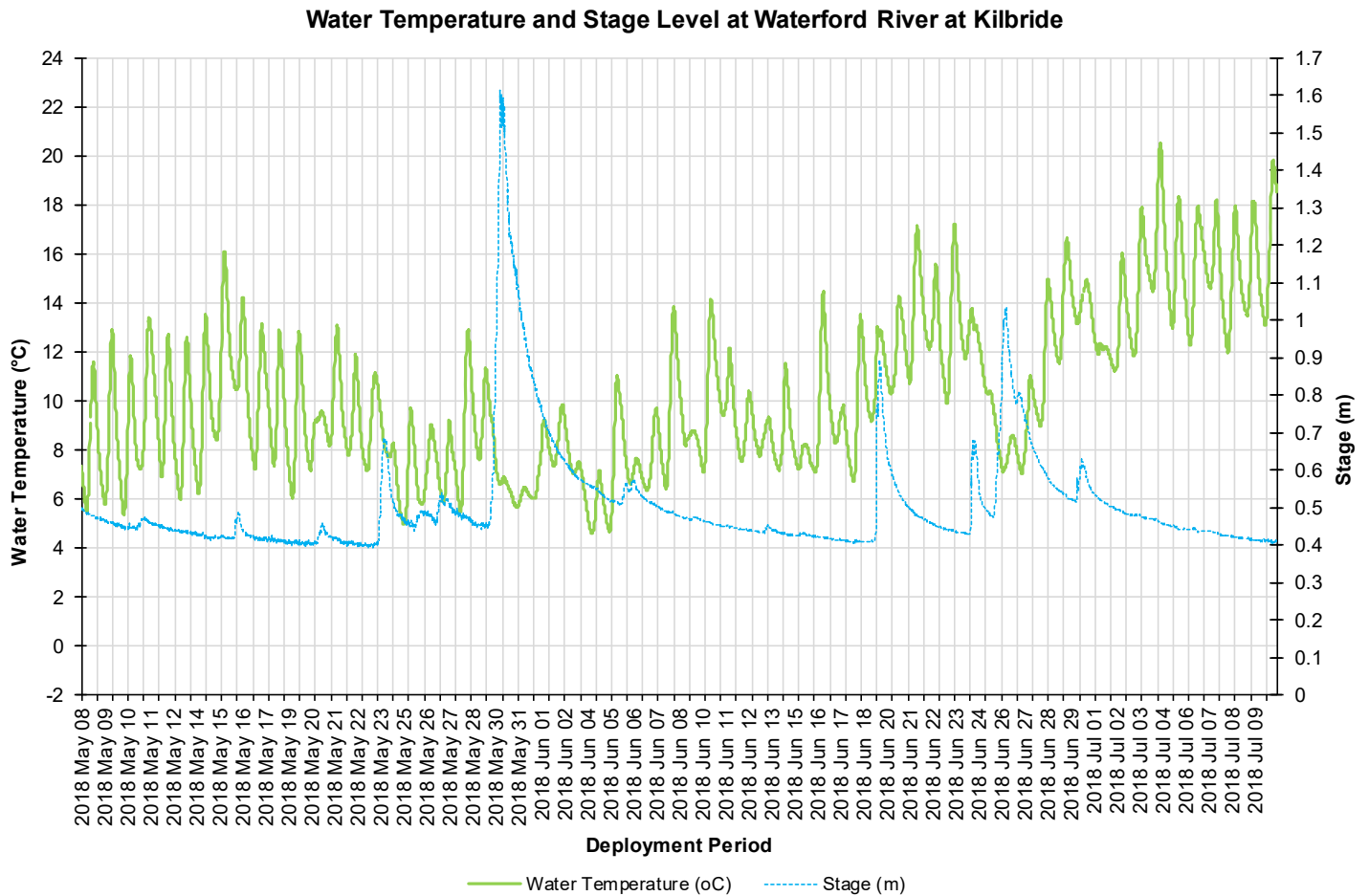


Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.75 pH units and 7.67 pH units (Figure 3).

In this graph the CCME guideline provides a basis by which to judge the overall health of the brook. During this deployment the pH levels did not indicate that there were any immediate issues with water quality in Waterford River as values remained between the guidelines. The median pH level was 7.06 pH units, slightly higher than that of the past deployment pH median of 6.94 pH units.

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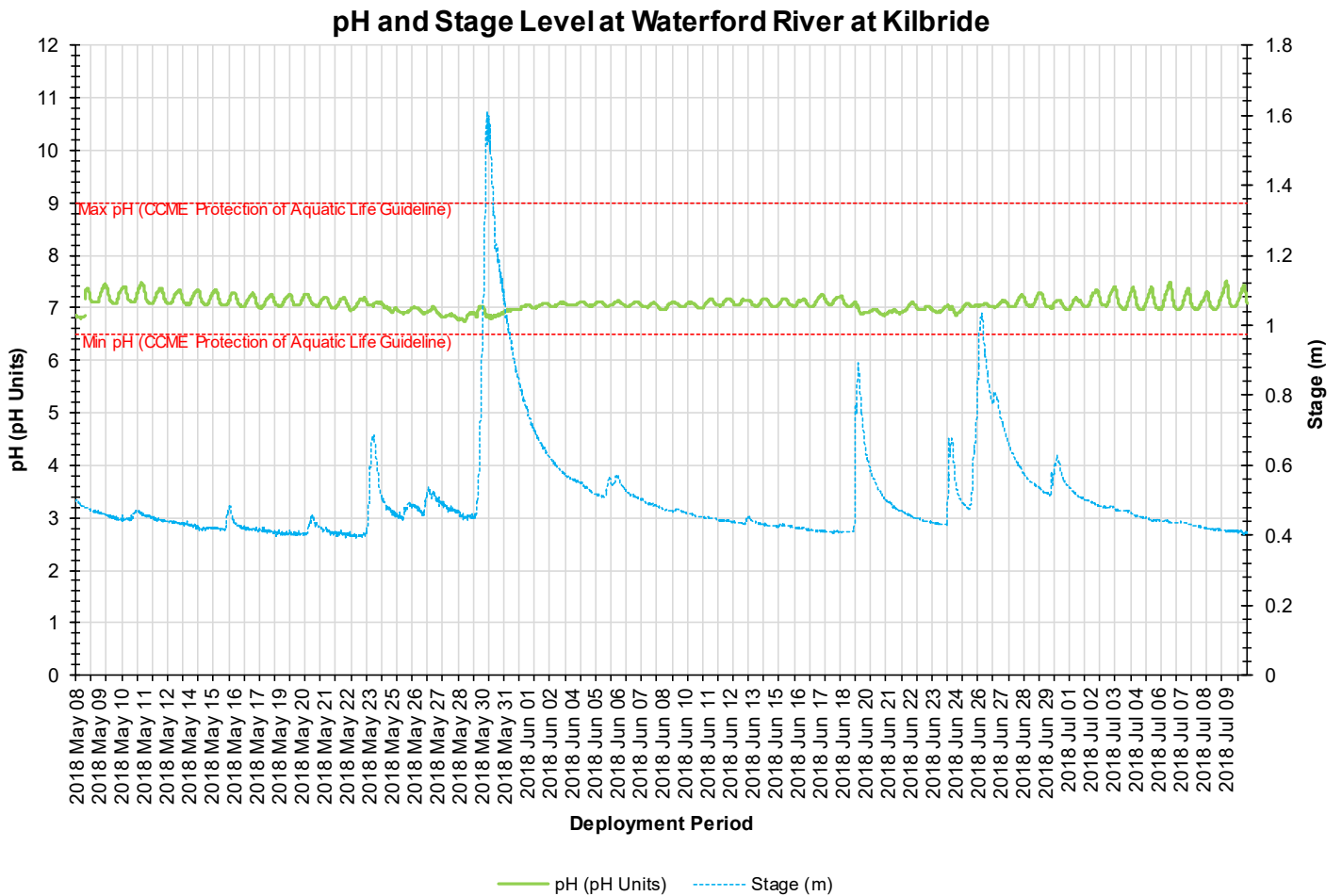


Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 202.0 $\mu\text{S}/\text{cm}$ and 895.0 $\mu\text{S}/\text{cm}$ during this deployment period. TDS (a calculated value) ranged from 0.1310 g/L to 0.5820 g/L (Figure 4).

At the beginning of the deployment period, the conductivity levels are high. After a couple of large spikes in stage level the conductivity values decrease slightly. During the highest peak in stage the conductivity levels dip significantly, this is likely a result of rainfall.

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.

Specific Conductance, TDS and Stage Level at Waterford River at Kilbride

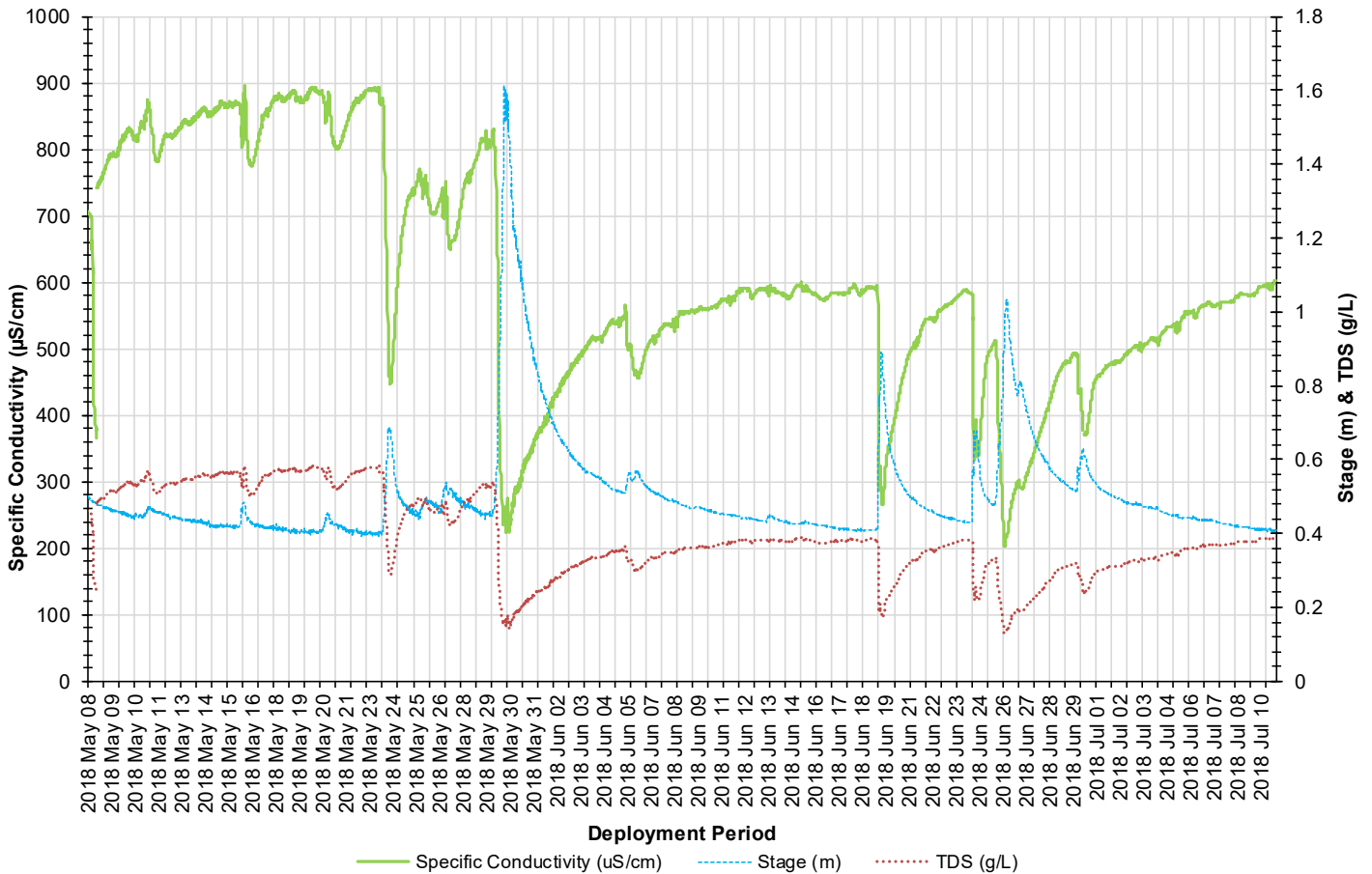


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

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, the dissolved oxygen concentration levels ranged within a minimum of 9.84 mg/L to a maximum of 12.76 mg/L. The percent saturation levels for dissolved oxygen ranged within 86.8 % Saturation to 107.4 % Saturation (Figure 5).

Higher water temperatures decrease the concentration level of dissolved oxygen present in the brook. For the majority of this deployment, the dissolved oxygen levels remained above the CCME Guideline for the Protection of Early life stages (9.5mg/L) and other life stages. After a spike in stage around May 29, 2018 the dissolved oxygen levels were irregular and not representative of the brook, likely a result of debris covering the sensor.

The dissolved oxygen data was removed from the report from May 29 until the end of deployment.

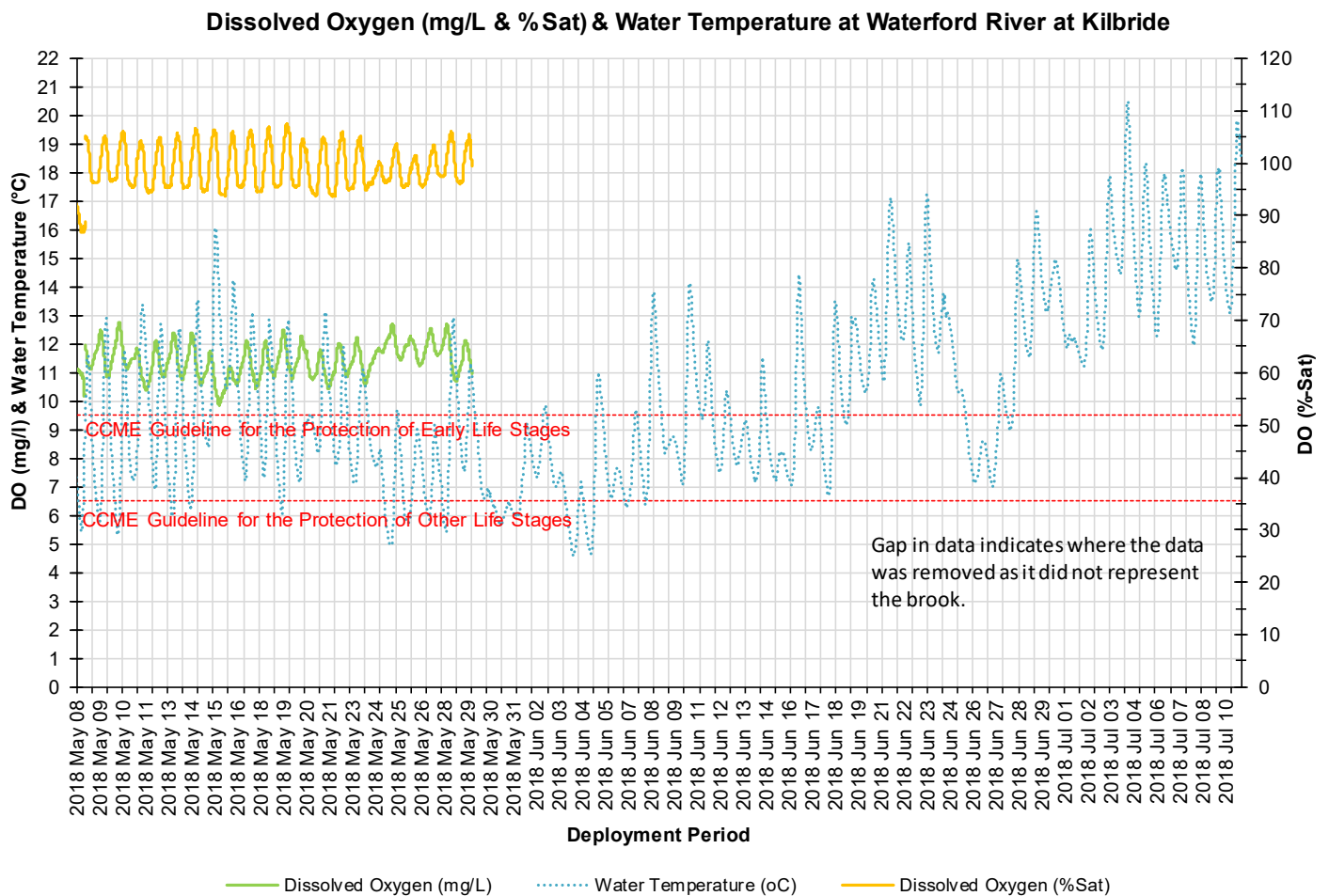


Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 0.2 NTU and 852.9 NTU (Figure 6). The deployment data had a median of 5.1 NTU which was higher than the median of the previous deployment, 2.0 NTU.

Turbidity levels can change quickly at Waterford River. This site has a significant streamflow rate which can flush turbid water or sediments quickly through the brook. As this brook is in the heart of the City of St. John's the turbidity values can be heavily influenced by its surroundings.

The higher turbidity events throughout the deployment period correlate with increases in stage. There was recorded rainfall during all of the high stage increases (Figure 7). Precipitation can increase the presence of suspended material in water through the movement of soil and sediment from nearby urban areas. Data was removed from the end of the deployment as there was evidence of a buildup of sediment around the sensor that impacted the data.

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.

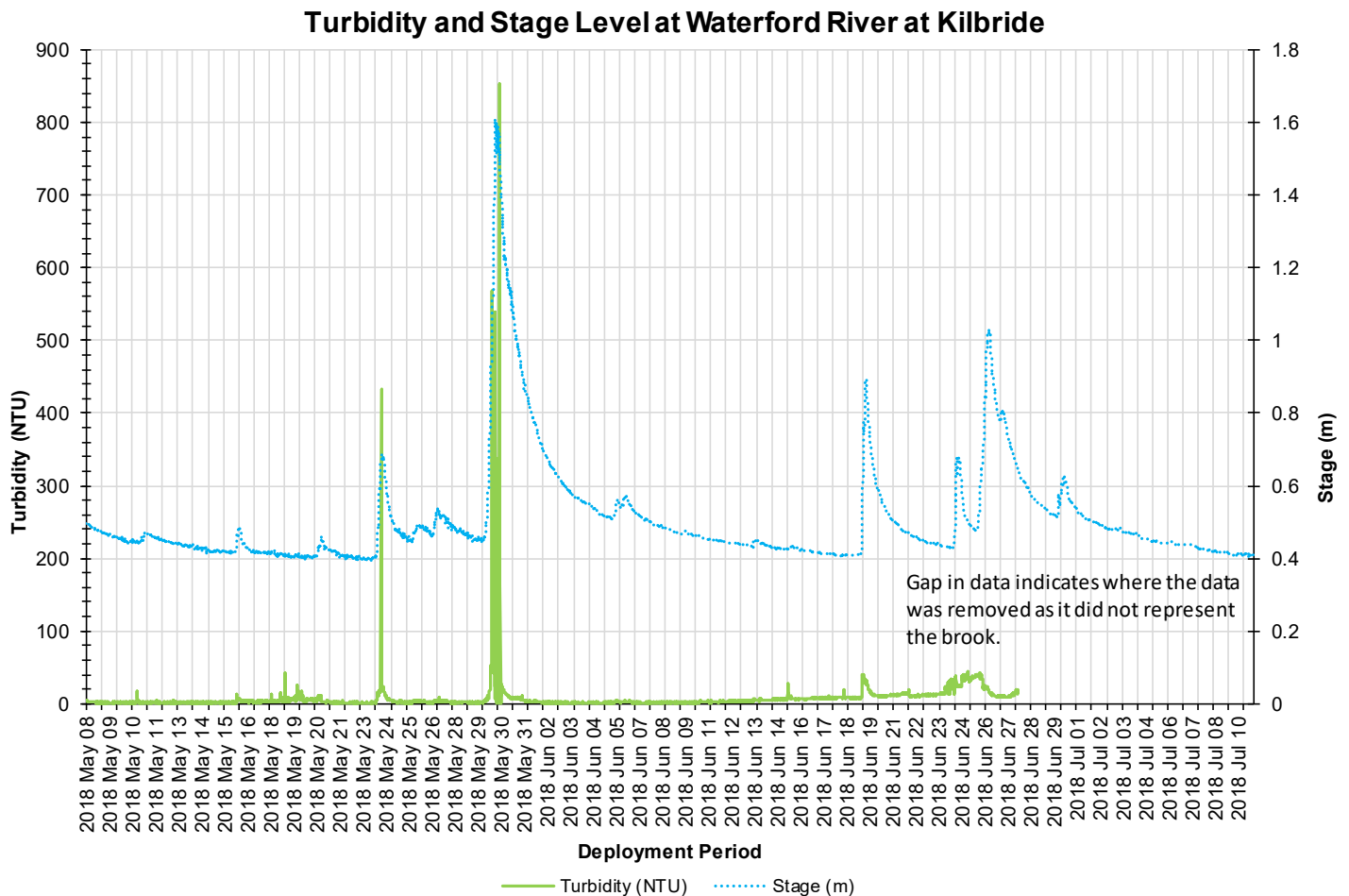


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 important to display as it provides 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 (Figure 7) and during any surrounding snow or ice melt, as runoff will collect in the brooks. However, direct snowfall will not cause stage to rise significantly.

During the deployment period, the stage values ranged from 0.39m to 1.61m. 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 International Airport weather station. Daily Total Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 60.6 mm on May 30th 2018.

Stage Levels at Waterford River & Total Precipitation Amounts from St. John’s International Airport Weather Station

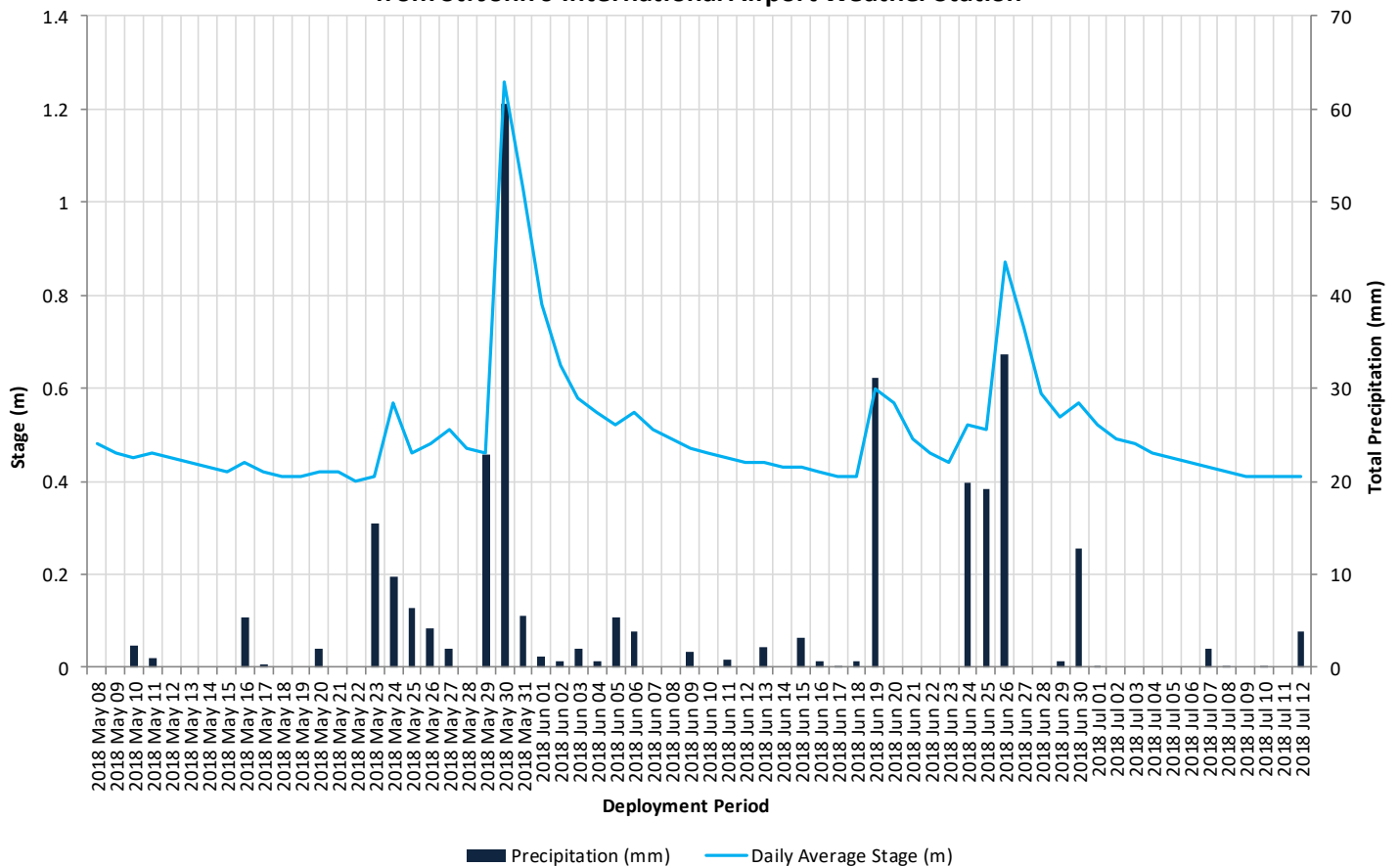


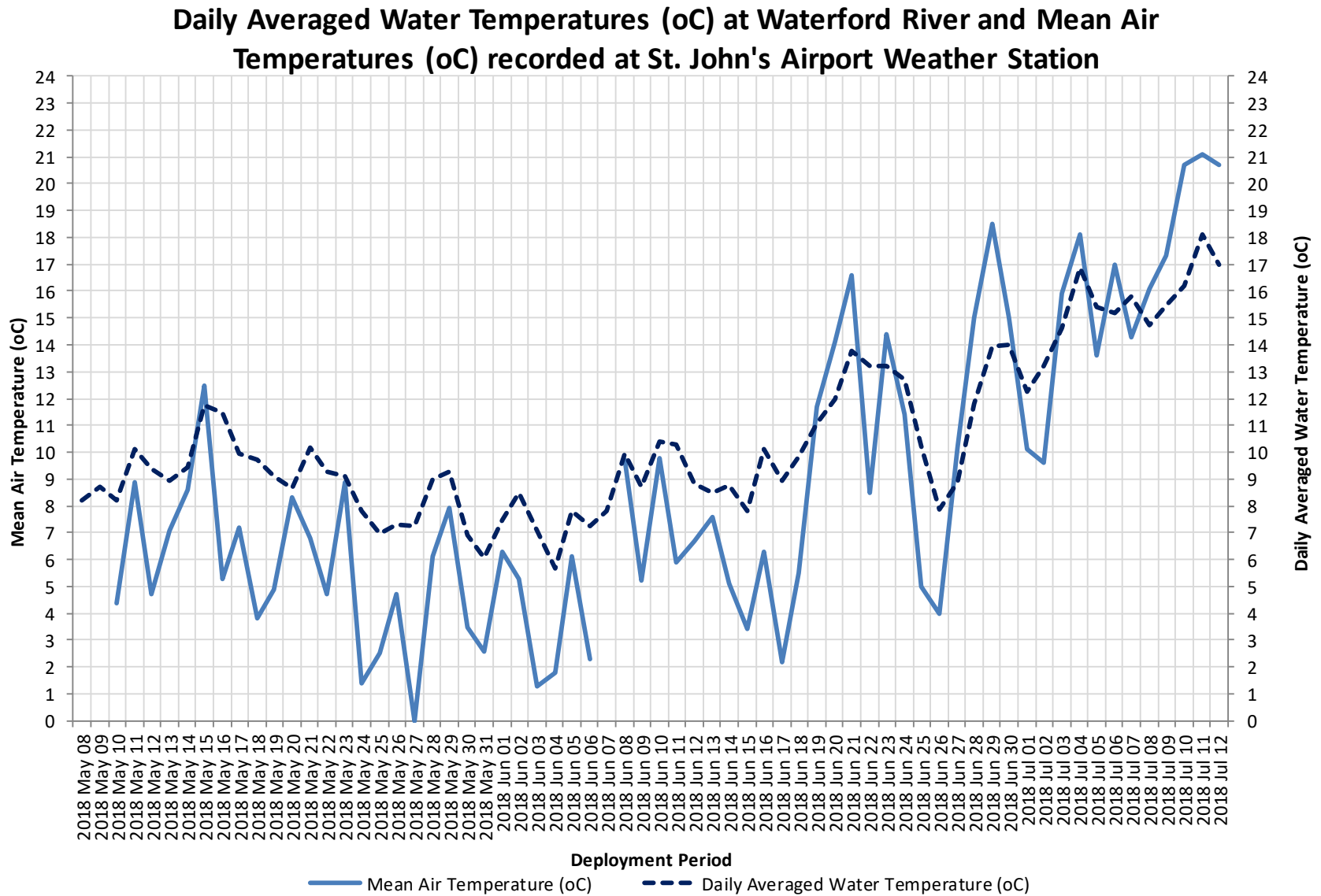
Figure 7: Stage values recorded at Waterford River at Kilbride and daily total precipitation from St. John’s Airport Weather Station.

Conclusion

When reviewing the graphs as a whole it is evident that the larger precipitation events influenced the water quality parameters pH, conductivity, dissolved oxygen and turbidity. As the seasons adjust, there is an increase in the air temperatures in the city. Air temperatures will influence the water temperatures in surrounding brooks and rivers. Waterford River data indicates that the slight warming of water temperatures influenced the changes in the dissolved oxygen concentrations in the brook.

After a large increase in conductivity at the beginning of the deployment period, the specific conductivity levels settled out toward the end of deployment as road salting was occurring less into the summer months. The pH values were consistent for this deployment. Majority of the dissolved oxygen data was removed due to it not representing the brook from May 29th 2018 to the end of deployment. There was evidence that the turbidity sensor was covered in debris after the last large stage spike in June, and the data did not readjust to background levels therefore it was removed from the brook.

APPENDIX I



Waterford River at Kilbride, Newfoundland and Labrador