Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
March 22, 2016 to May 12, 2016

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division

Waterford River at Kilbride, Newfoundland and Labrador

Prepared by:

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General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada - Environment Canada (WSC-EC), maintain a real-time water quality and water quantity monitoring station on Waterford River at Kilbride.

This deployment report discusses water quality related events occurring at this station.

The purpose of the real-time water quality station is to monitor process and publish real-time water quality data.

This report covers the period from deployment on March 22, 2016 to May 12, 2016.

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 (Environment and Conservation (ENVC)) is responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton, under the supervision of Renee Paterson, is ENVC's main contact for the real-time water quality monitoring operation at Waterford River station, and is 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 (Environment Canada (EC)) under the management of Howie Wills, play an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC-EC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly. WSC is responsible for handling stage and streamflow issues. The quantity data is raw data that is transmitted via satellite and published online along with the water quality data on the Real-Time Stations website. 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 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 taken too soon 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	March 22	Deployment	Poor	Fair	Excellent	Excellent	Fair
	May 12	Removal	Good	Good	Excellent	Excellent	Excellent

On deployment the rankings of the field data against the QAQC data was: water temperature ranked as 'Poor', pH and turbidity data both ranked as 'Fair'. The dissolved oxygen and specific conductivity data ranked as 'Excellent'. The 'Poor' water temperature ranking and the 'Fair' ranking for pH may indicate that the instrument was not stabilized when the readings were taken. Water temperature and pH probes generally take slightly longer than the other sensors to stabilize.

At removal of the instrument, the rankings for the water quality parameters water temperature and pH were 'Good'. The ranking for conductivity, dissolved oxygen and turbidity were 'Excellent'. These were reasonable rankings after the instrument was in the brook for approximately 50 days.

Concerns or Issues during the Deployment Period

From April 29th through to April 30th, 2016 there was a technical problem with the network and the data for all Real-Time Stations dropped out for this period of time. Once the system was reset, the data resumed transmitting. All water quality parameter graphs in this report will have a gap in data for this timeframe.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from -1.55°C to 13.61°C during this deployment period (Figure 2).

The water temperature at this station displays diurnal variations although slightly elongated due to the depth of water at this station. Deeper streams are influenced more subtlety by natural diurnal variations in air temperatures (Appendix I). This time of the year there is more influence on the water quality parameters as melting snow banks and street runoff redirect into the urban brooks.

During the higher stage events there is more movement in the water temperature data values. Despite a few larger peaks in water temperature it remains reasonably consistent with a slight increase as deployment ends.

Please note the stage data is raw data that is published on the ENVC web page. 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.

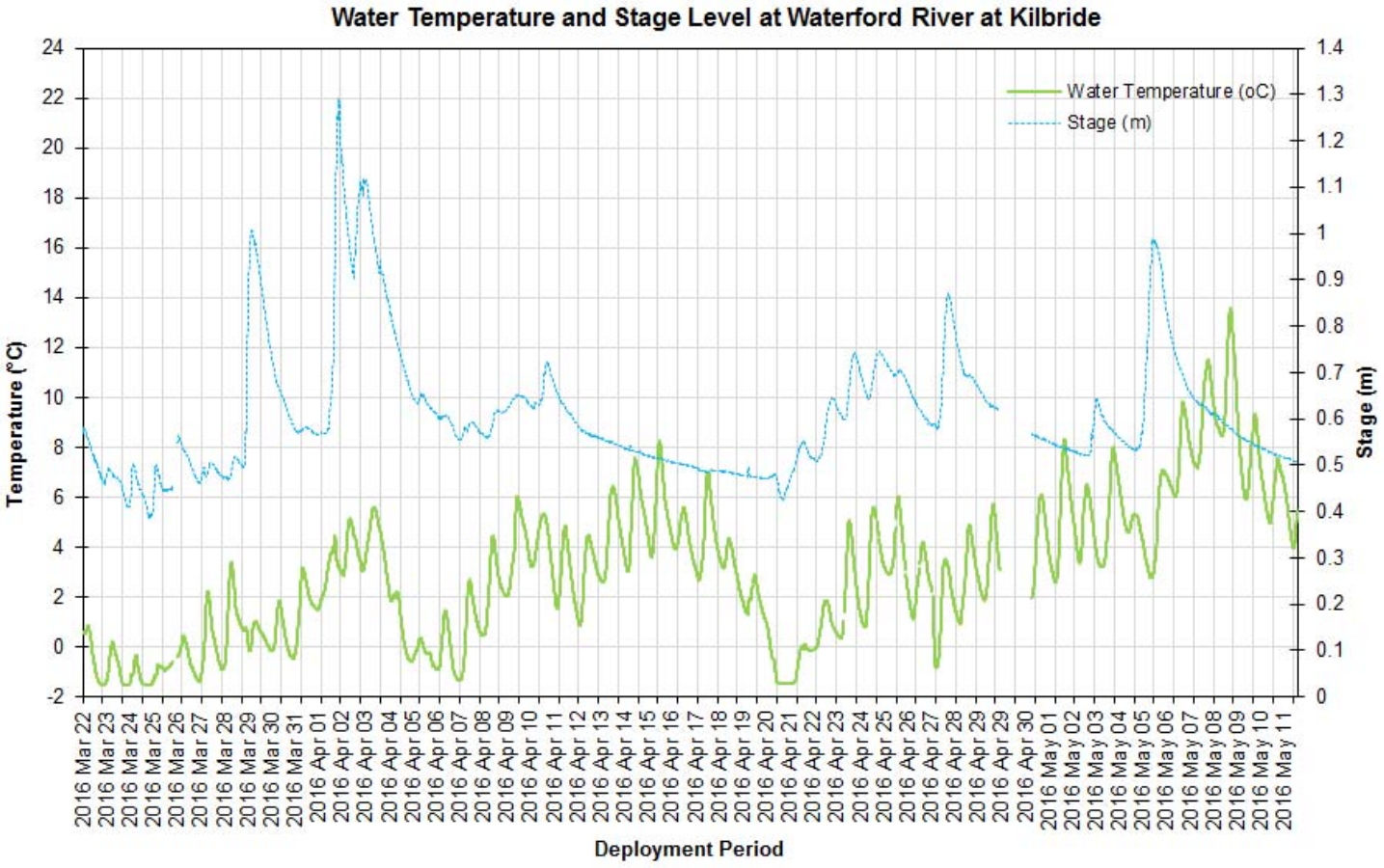

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.47 pH units and 7.37 pH units (Figure 3).

The pH levels are consistent; however during high stage levels the pH data decreases slightly for short period of times. The pH values only dropped below the minimum CCME guideline for the Protection of Aquatic Life Guideline on May 8th, 2016. This dip in pH was during a drop in stage level.

The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. During the deployment period the median pH level was 7.08 pH units.

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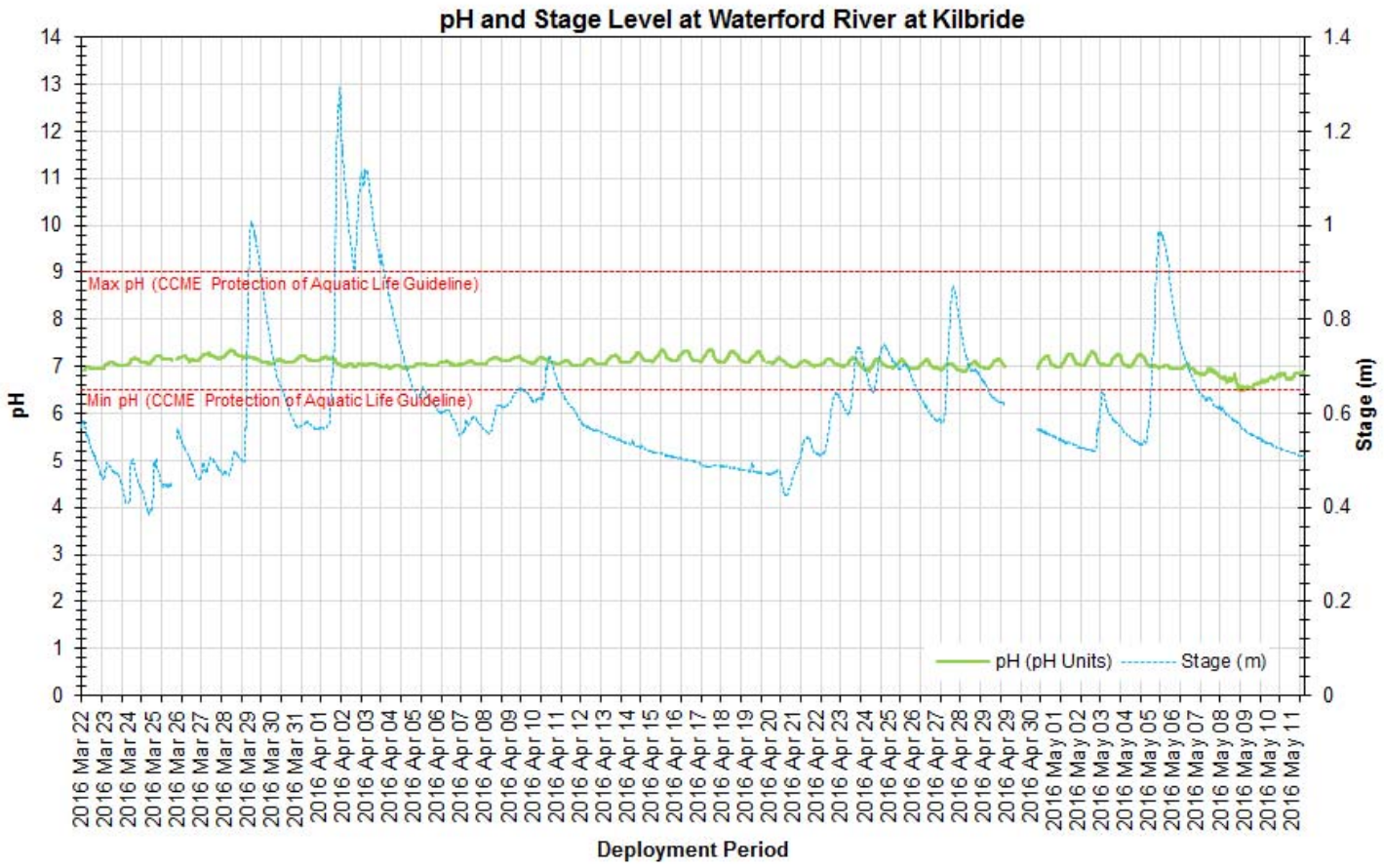

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 360 µS/cm and 3003 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.234 g/L to 1.952 g/L (Figure 4).

Commonly the relationship between conductivity and stage level is inversed. When stage levels rise, the specific conductance levels drop in response as the increased amount of water in the river system dilutes the solids that are present. This is evident on April 1st to April 4th and May 6th (as noted on Figure 4).

Spikes in conductivity, can be a result of road salting or runoff into the brook. Any additional material and dissolved substances present in the brook are captured by the conductivity probe. The beginning of the deployment period displays several high conductivity events without any increase in stage. This was likely a result of road salting at these times.

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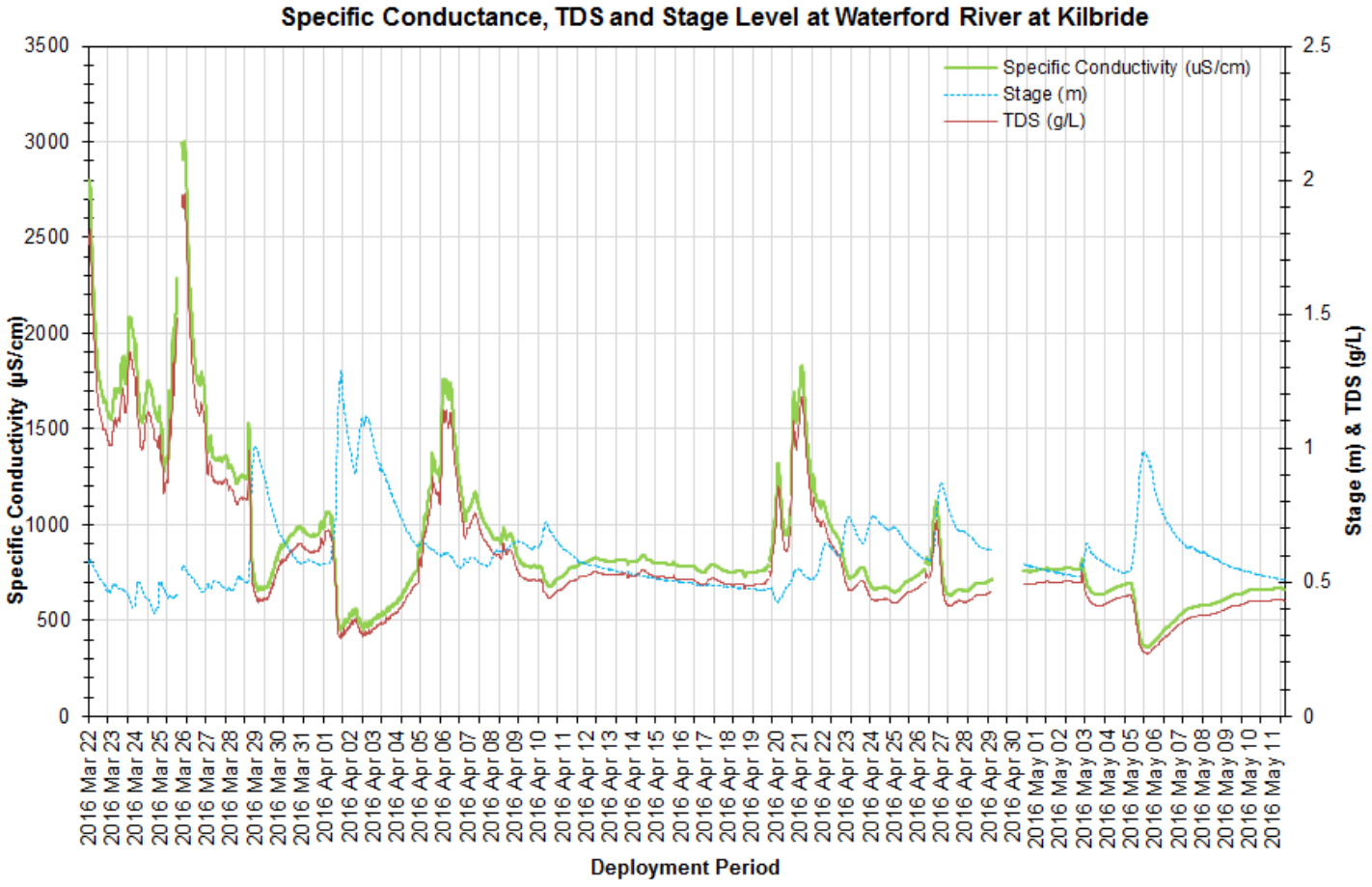

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

Dissolved Oxygen

The water quality instrument measures dissolved oxygen (mg/L) with the dissolved oxygen probe and then the instrument calculates percent saturation (% Sat) with water temperature.

During the deployment the dissolved oxygen concentration levels ranged within a minimum of 10.54 mg/L to a maximum of 15.28 mg/L. The percent saturation levels for dissolved oxygen ranged within 95.0 % Saturation to 105.1 % Saturation (Figure 5).

Dissolved oxygen remained above the maximum CCME guideline for the Protection of Early Life Stages for the entire deployment period. The cooler water temperatures allow for larger amounts of dissolved oxygen to be present in the brook. The larger decrease on May 9th coincides with warmer water temperatures for that time frame.

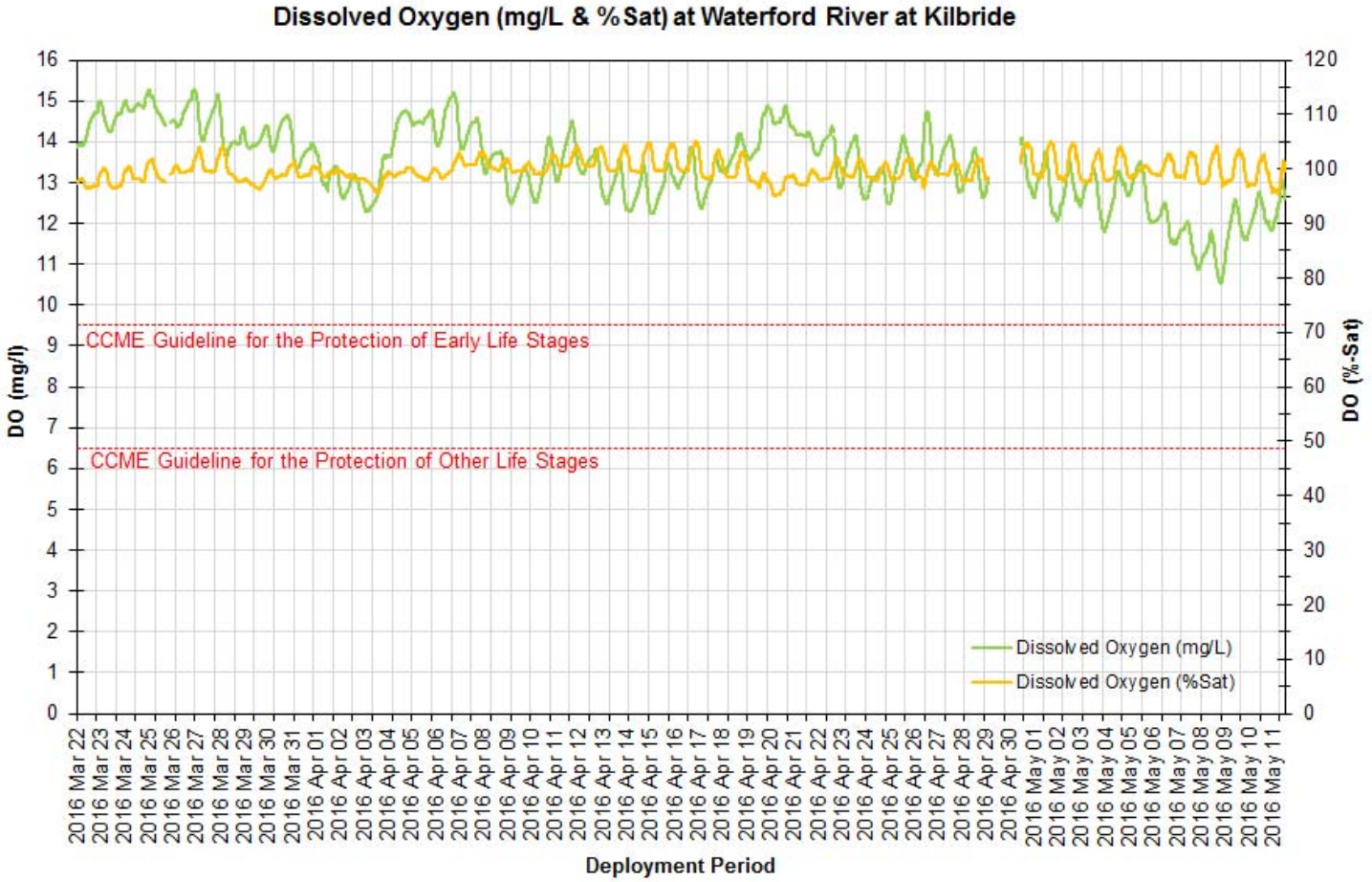

Figure 5: Dissolved Oxygen (mg/L & Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 1.3 NTU and 870.3 NTU (Figure 6). The deployment data had a median of 4.6 NTU.

The higher turbidity events in the deployment period correlate with increases in stage potentially from precipitation. Precipitation can increase the presence of suspended material in water. The turbidity data does return to lower levels after the high peaks.

The highest turbidity value of 870.3 NTU was recorded during a high stage event. The turbidity data did return to a lower value as the stage level decreased. Turbidity levels can change quickly at Waterford River. This brook has a significant streamflow rate (this deployment median was 2.134 m^3/s) which can flush the turbid water or sediments from the brook. Being an urban brook in the heart of the City of St. John's the turbidity values in this brook can be heavily influenced by its surroundings.

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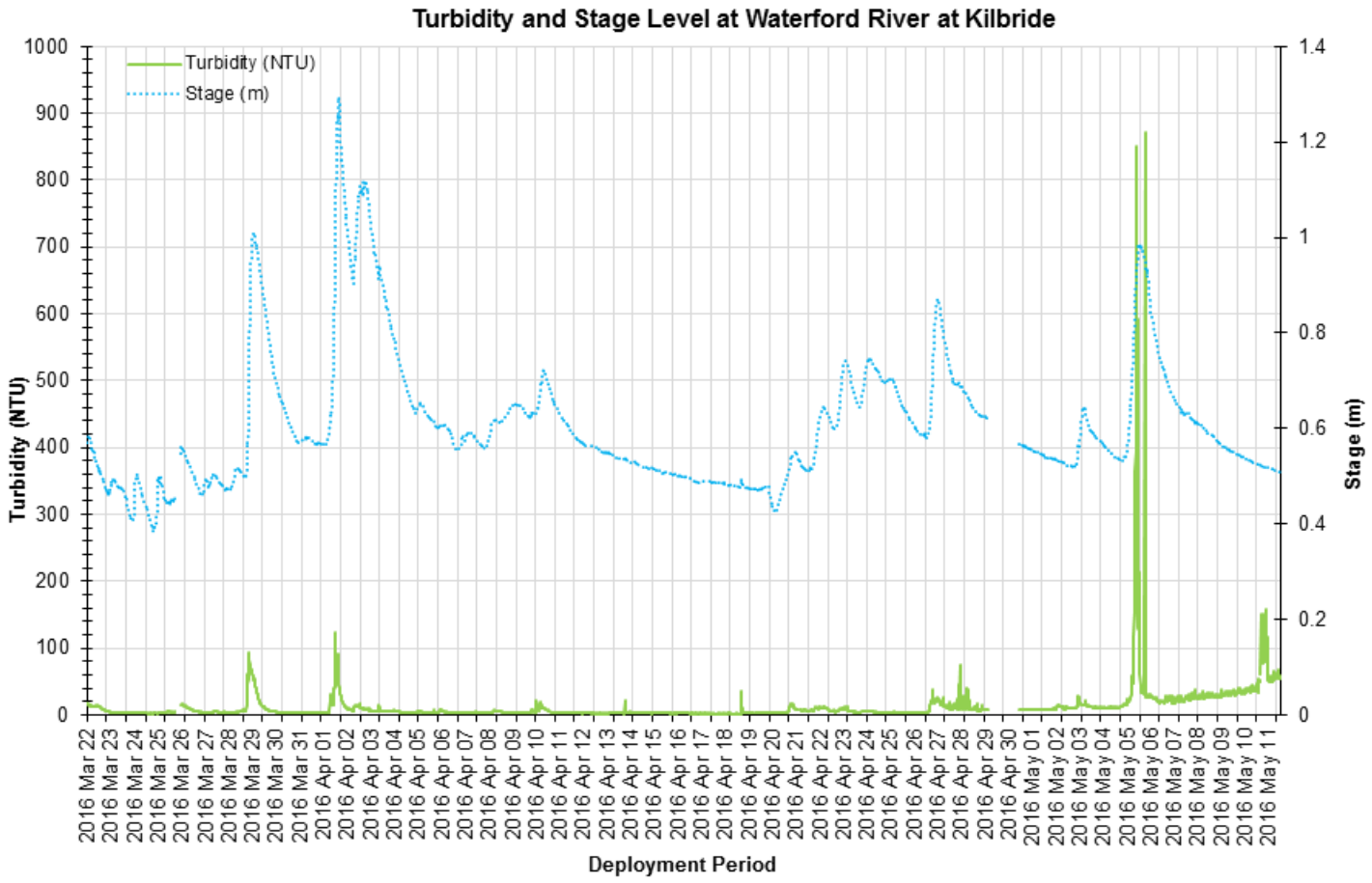


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 can be obtained 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 them to rise significantly.

During the deployment period, the stage values ranged from 0.38m to 1.29m. The larger peaks in stage do correspond with substantial rainfall events as noted on Figure 7. Precipitation data was obtained from Environment Canada's St. John's Airport weather station. Precipitation ranges for the deployment period were a minimum of 0.0 mm and a maximum of 44 mm on April 20th, 2016.

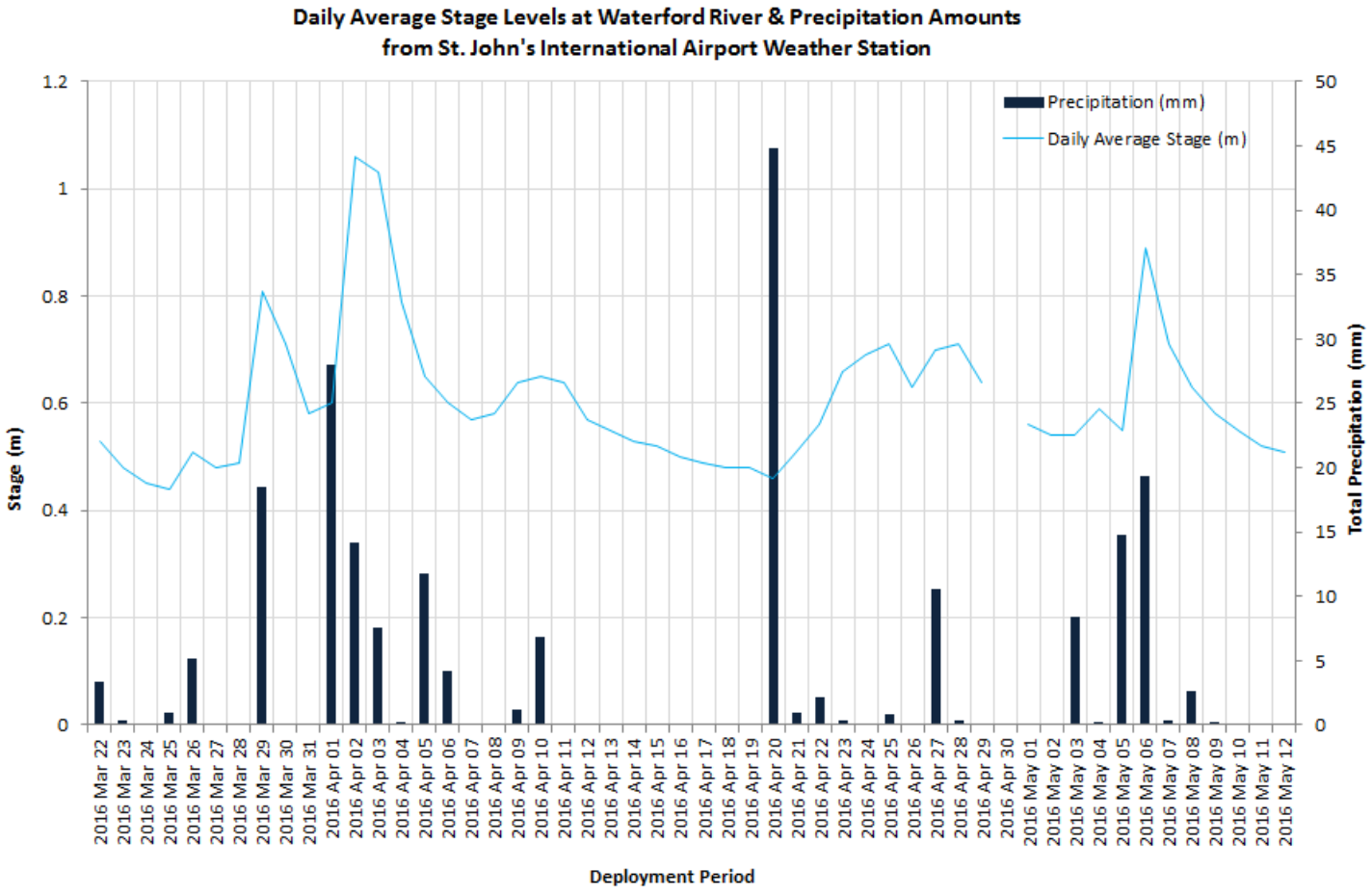


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

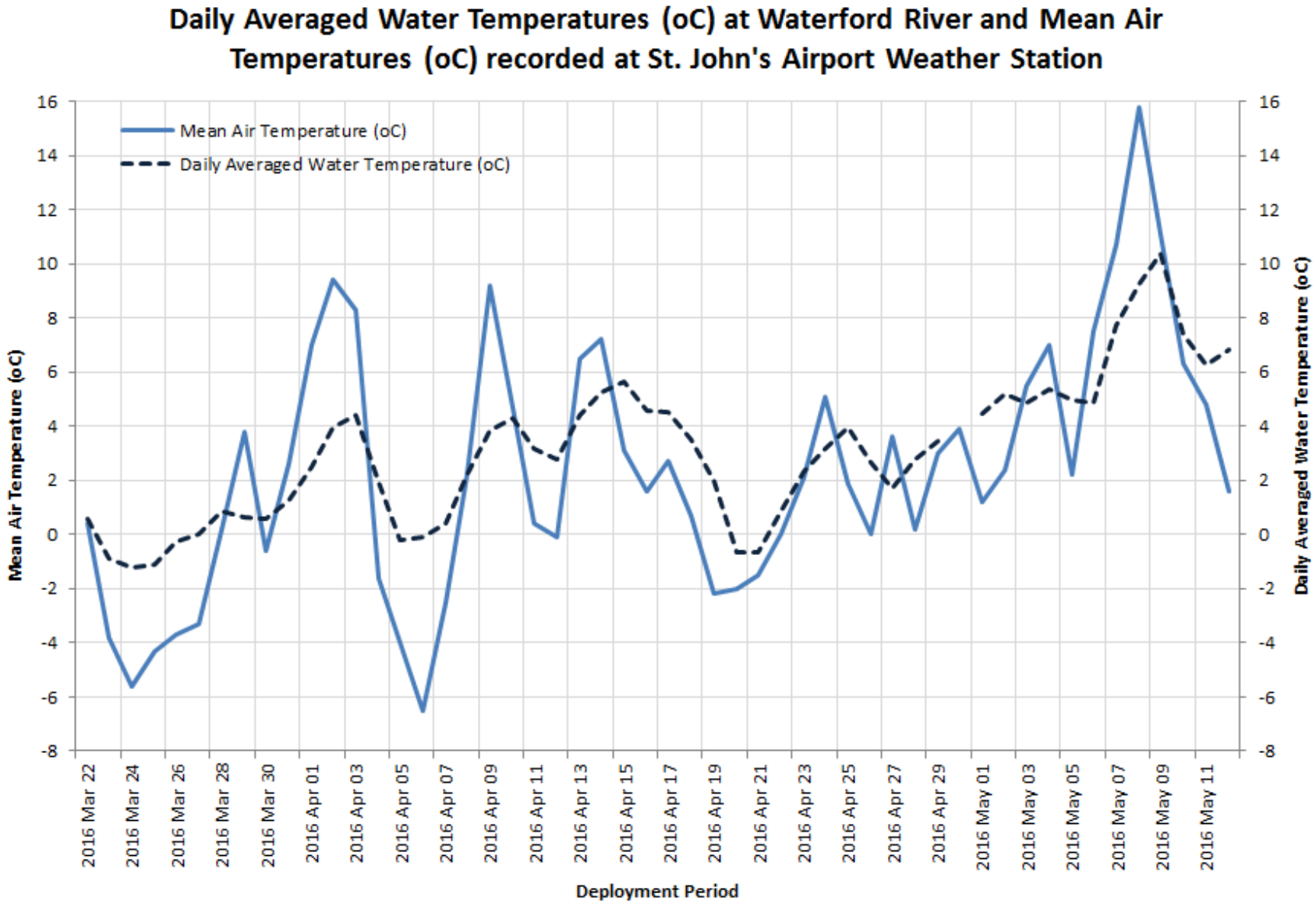
Conclusion

As with many urban brooks and streams, precipitation and runoff events play a role in influencing the water quality within the water body. Waterford River at Kilbride flows through significant developed areas, including residential and industrial zones, the brook can also be found along the boundaries of heavily used road ways, all these factors can influence the parameters that are recorded by the water quality instrument.

When reviewing the graphs as a whole it is evident that the larger precipitation events did create varying effects with the water quality parameters pH, conductivity, dissolved oxygen and turbidity. The movement in the water temperature data indicates the influences from precipitation events (warming the waters) and snow melt runoff into the brook (cooling the waters). The pH values during deployment are consistent with slight changes during changes in the stage level. Conductivity levels were a result of high stage levels and likely rainfall events. High peaks in conductivity during low stage levels are likely a result of salting on roadways. Dissolved oxygen concentration (mg/L) was influenced by the cooler water temperatures. Turbidity had a several events but they were also during high stage levels and rainfall periods. After stage settled down the turbidity returned to normal.

Despite some changes in the water quality parameters during the higher stage events the data was as expected of an urban brook during this time of the year. After each event the data for all the parameters returned to its previous levels. Overall the water quality parameters recorded at Waterford River at Kilbride displayed natural events expected of a brook in an urbanized environment.

APPENDIX I


Daily Averaged Water Temperatures (oC) at Waterford River and Mean Air Temperatures (oC) recorded at St. John's Airport Weather Station
Mean Air Temperature (oC)
Daily Averaged Water Temperature (oC)
Mean Air Temperature (oC)
Daily Averaged Water Temperature (oC)
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
2016 Mar 22
2016 Mar 24
2016 Mar 26
2016 Mar 28
2016 Mar 30
2016 Apr 01
2016 Apr 03
2016 Apr 05
2016 Apr 07
2016 Apr 09
2016 Apr 11
2016 Apr 13
2016 Apr 15
2016 Apr 17
2016 Apr 19
2016 Apr 21
2016 Apr 23
2016 Apr 25
2016 Apr 27
2016 Apr 29
2016 May 01
2016 May 03
2016 May 05
2016 May 07
2016 May 09
2016 May 11
Deployment Period