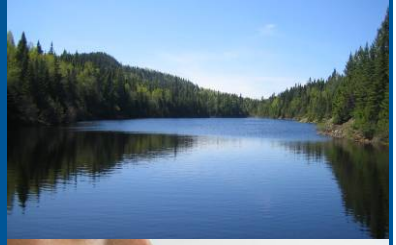







Real-Time Water Quality Report

Waterford River at Kilbride

Deployment Period
January 12, 2016 to February 17, 2016

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
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 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 January 12, 2016 until February 17, 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	Jan 12	Deployment	Poor	Good	Good	Excellent	Good
	Feb 17	Removal	Poor	Good	Marginal	Good	Excellent

On deployment the rankings of the field data against the QAQC data was as follows; water temperature ranked as 'Poor'. pH, conductivity and turbidity data ranked as 'Good' with dissolved oxygen data ranking as 'Excellent'. The 'Poor' ranking for water temperature may be a result of the readings taken too soon before the QAQC sonde had time to stabilize the temperature probe.

At removal of the instrument, the ranking for water temperature was 'Poor', pH and dissolved oxygen ranked as 'Good'. Conductivity ranked as 'Marginal' and Turbidity ranked as 'Excellent'. During removal it was determined that there was leaf litter and sediment in the sensor cage which likely influenced the conductivity values from the field sonde. The ranking for water temperature at removal along with the ranking of 'Poor' at deployment is indicating there might be a problem with the temperature probe on the field instrument. This instrument was removed for review and possible repairs.

Waterford River at Kilbride

Water Temperature

Water temperature ranged from -1.34°C to 2.73°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).

The water temperatures decrease across the deployment period. During the higher stage events in late January to early February the water temperatures do increase briefly before settling back down. The warmer water temperatures at this time of year are not usually expected.

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.

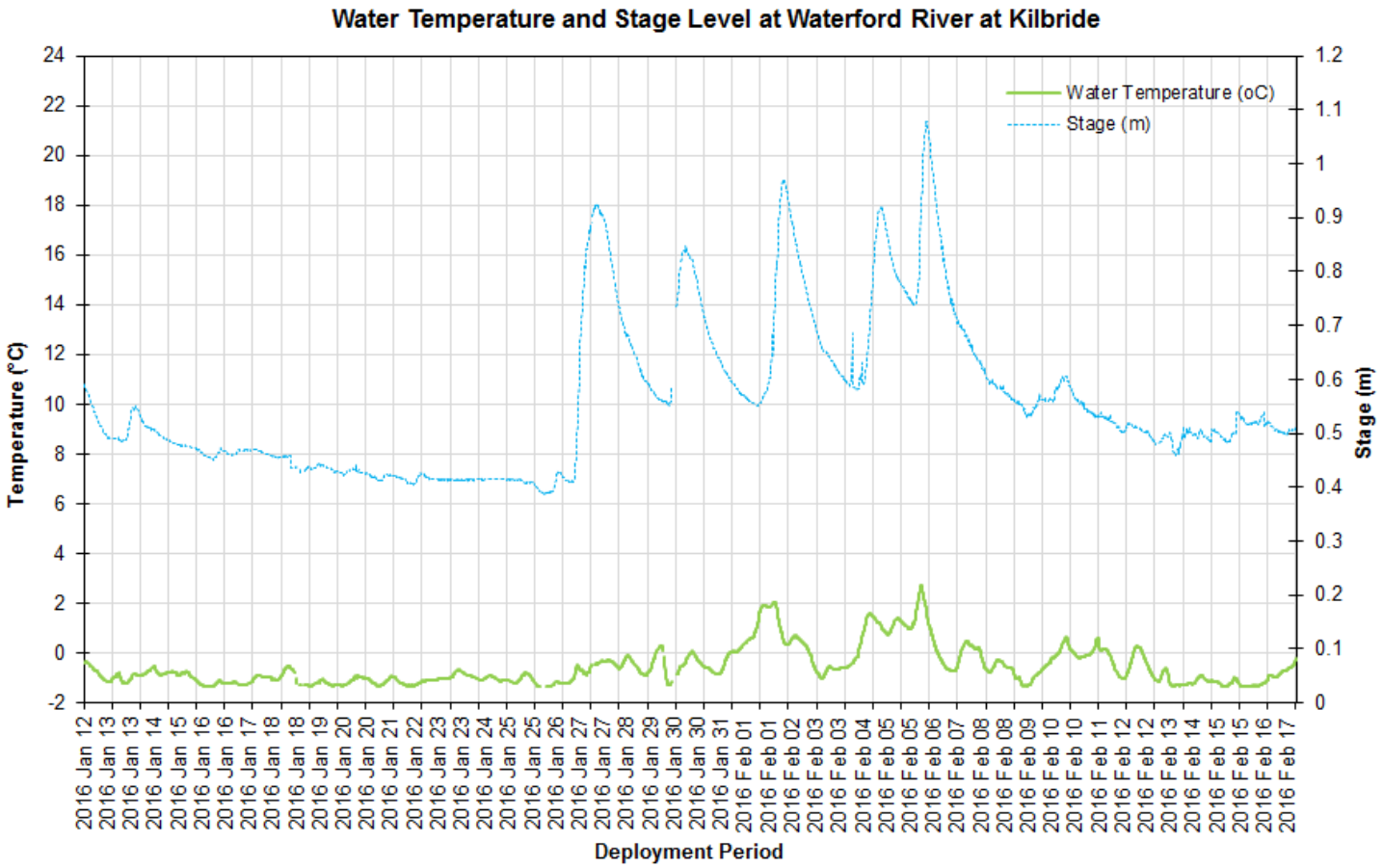

Figure 2: Water temperature (°C) and Stage (m) values at Waterford River at Kilbride

pH

Throughout the deployment period, pH values ranged between 6.22 pH units and 7.12 pH units (Figure 3).

The pH levels at the beginning of deployment were consistent; however as the stage level decreased the pH levels increased slightly. As the stage level increased on January 26th the pH levels started to drop onto and below the minimum CCME guideline for the Protection of Aquatic Life Guideline. The pH levels stayed within this range for the remainder of the deployment period.

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 6.62 pH units.

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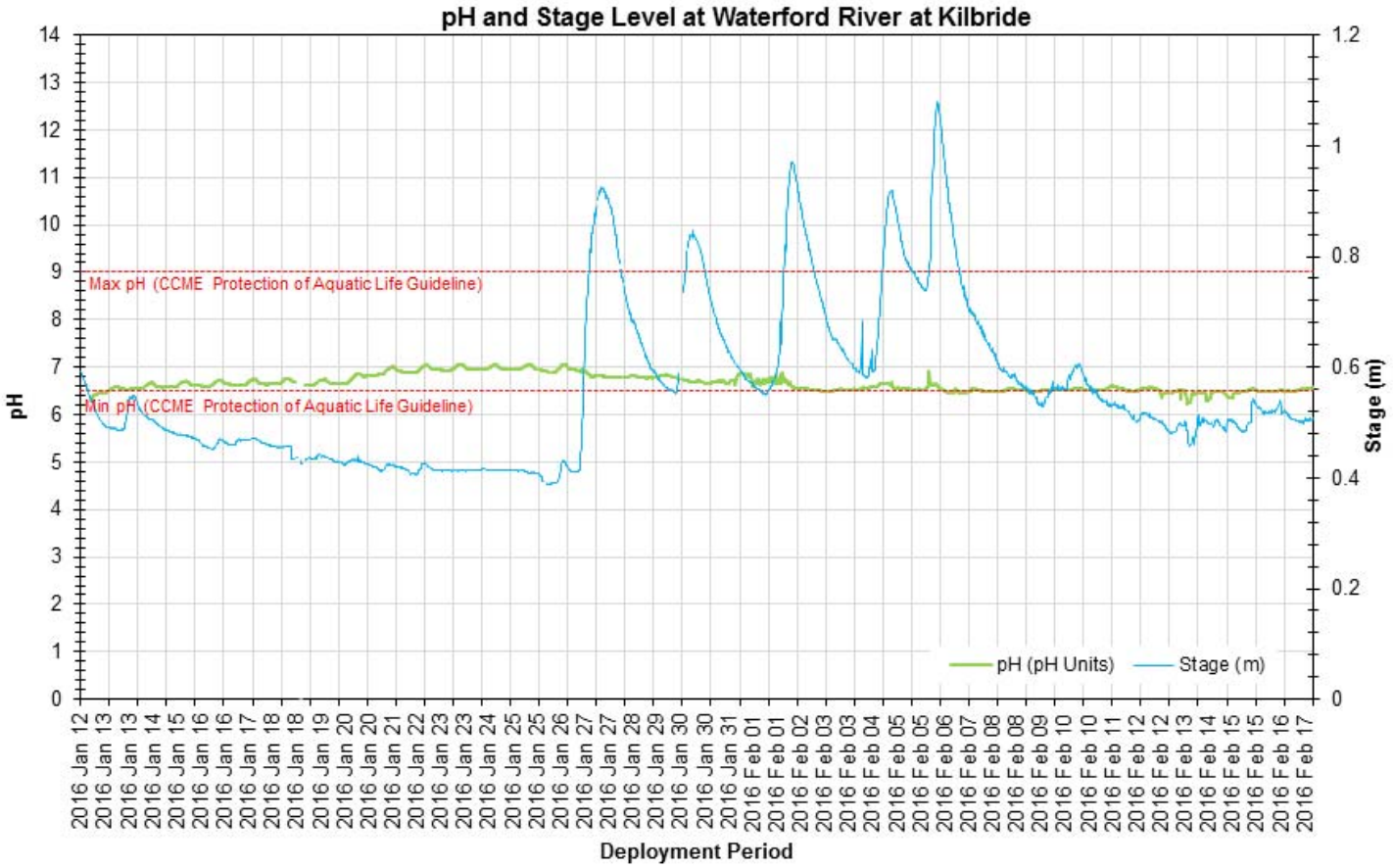

Figure 3: pH (pH units) and stage level (m) values at Waterford River at Kilbride

Specific Conductivity & Total Dissolved Solids

The conductivity levels were within 586.0 µS/cm and 3663.00 µS/cm during this deployment period. TDS (a calculated value) ranged from 0.3810 g/L to 2.3810g/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. However during this time of year the conductivity and stage relationship is different, and as the stage levels elevate the conductivity levels respond the same (as noted on Figure 4).

During the colder times of the year when ice and snow build up on the roadways, salting of the roadways is done to ensure safe driving conditions. The majority of the conductivity spikes on this graph are likely a result of road salt in the brook.

The decrease in conductivity on February 6th was during an increase in stage and increase in temperatures. With warmer temperatures there is no need for road salting. Therefore the increased volume of water likely flushed and diluted the brook of dissolved substances, lowering the conductivity for that period of time.

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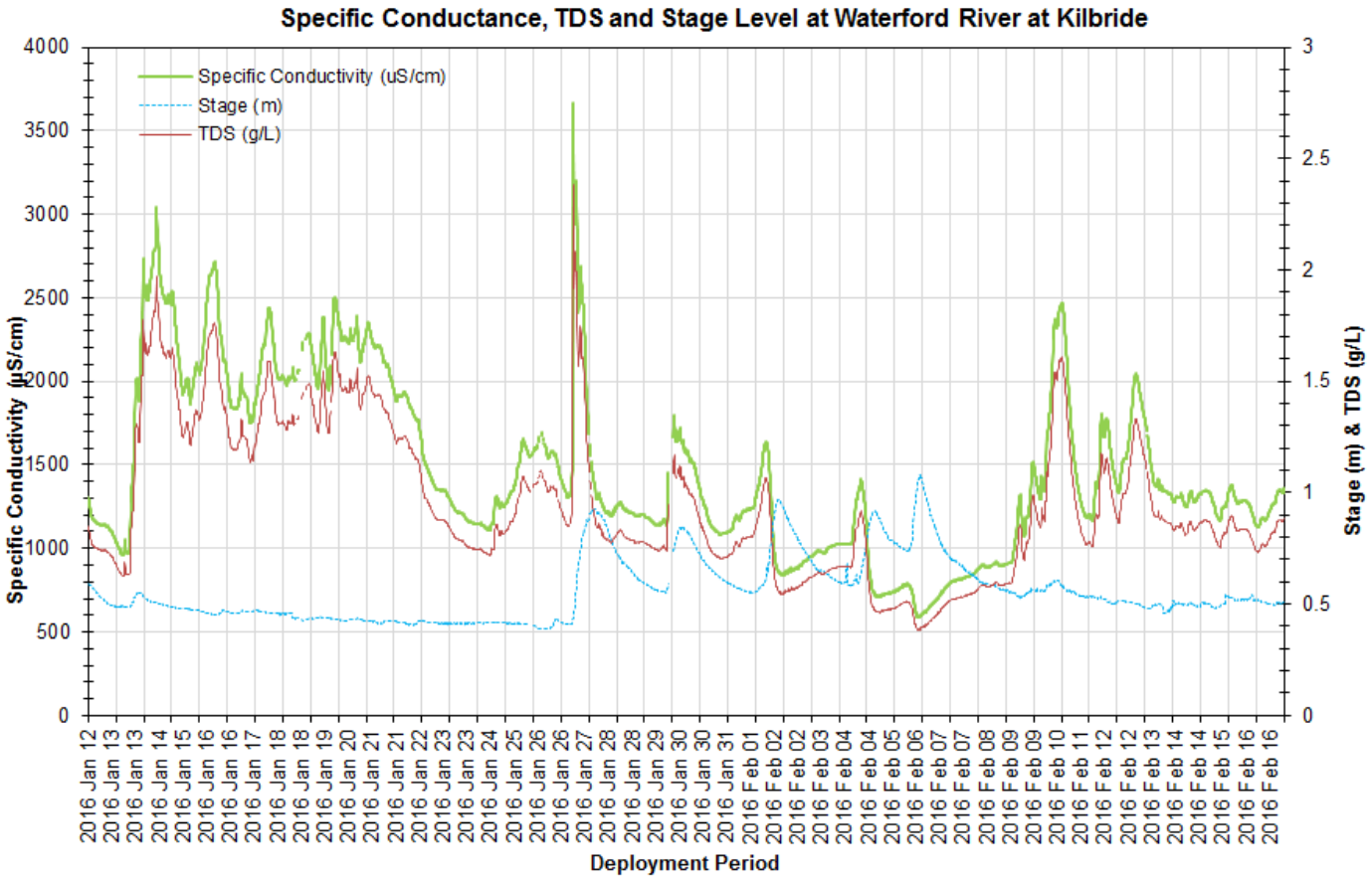

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Waterford River at Kilbride.

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 13.06mg/L to a maximum of 15.28mg/L. The percent saturation levels for dissolved oxygen ranged within 93.3 %Sat to 101.7 %Sat (Figure 5).

Dissolved oxygen remained above the 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 more exaggerated dissolved oxygen values from January 27th to February 9th, 2016 are a result of the higher stage levels and an increase in the water temperatures during that time frame.

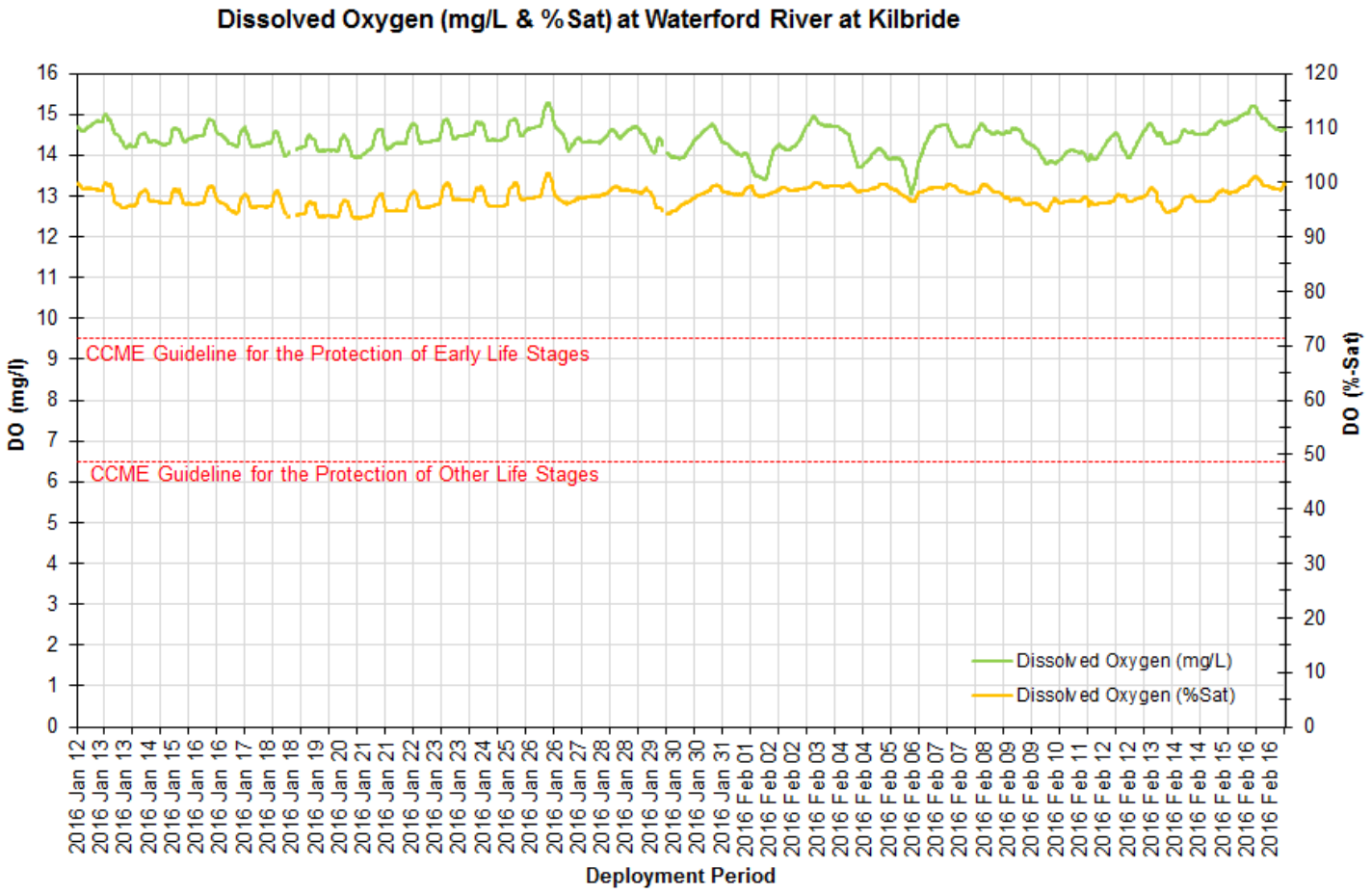

Figure 5: Dissolved Oxygen (mg/L and Percent Saturation) values at Waterford River at Kilbride.

Turbidity

Turbidity levels during the deployment ranged within 1.6 NTU and 184.9 NTU (Figure 6). The deployment data had a median of 3.1 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.

Turbidity levels can change quickly at Waterford River. This brook has a significant streamflow rate (median of 1.56m^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.

From January 27th through to February 9th there are several turbidity events. It is during these events that temperatures are warmer and likely initiating snow and ice melt into the brook. It may be the surge in snow and ice runoff that has the turbidity levels increasing during this time frame.

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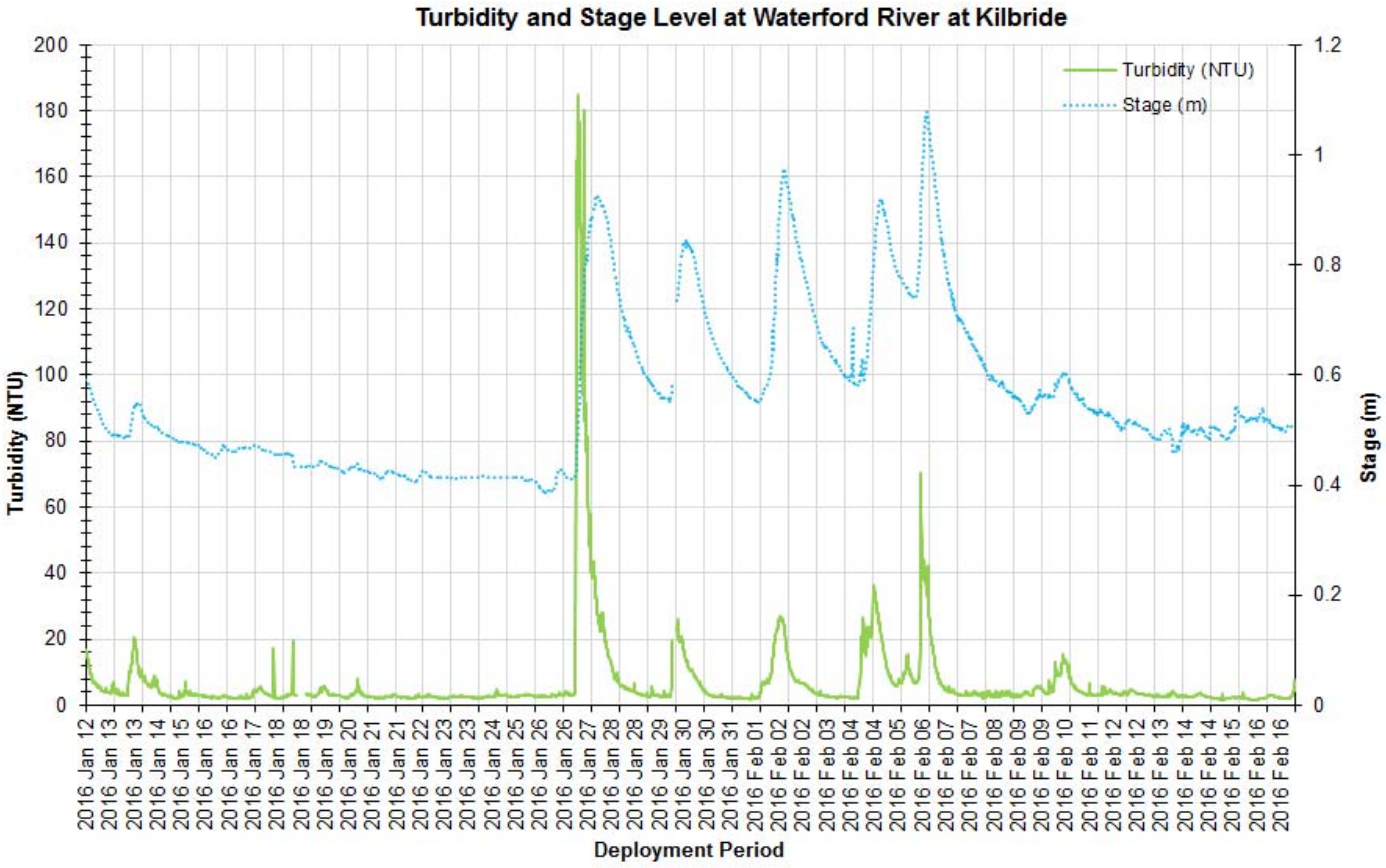


Figure 6: Turbidity (NTU) and stage level (m) values at Waterford River at Kilbride.

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 0.39m to 1.08m. The larger stage peaks from January 27th to February 9th do correspond with substantial rainfall events as noted on Figure 7. These stage events also correspond with warmer temperatures which prompted snow and ice melt runoff into the brook.

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 28.6 mm on January 18th, 2016.

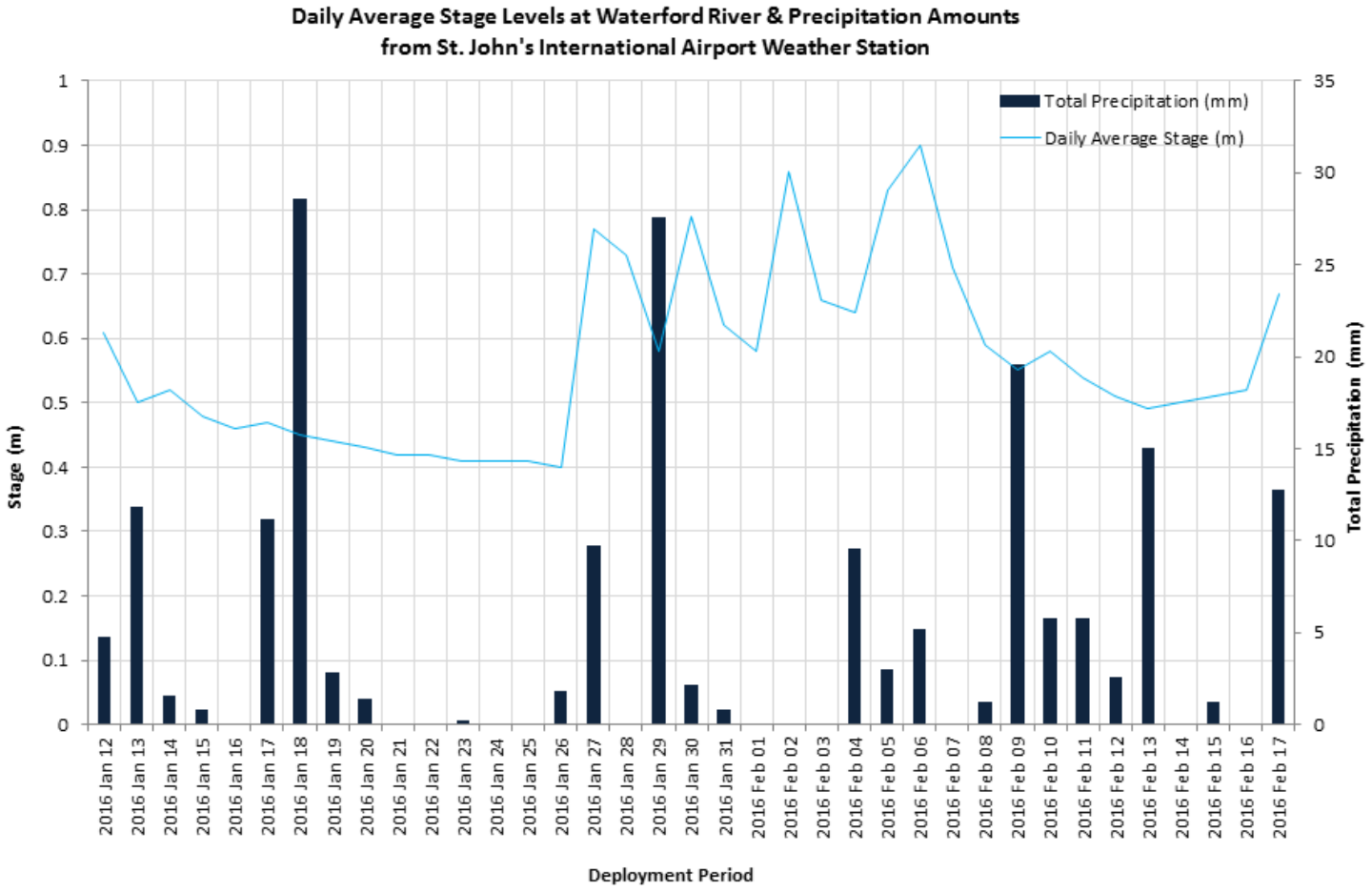


Figure 7: Daily average stage values at Waterford River at Kilbride and daily total precipitation from St. John's Airport Weather Station.

Conclusion

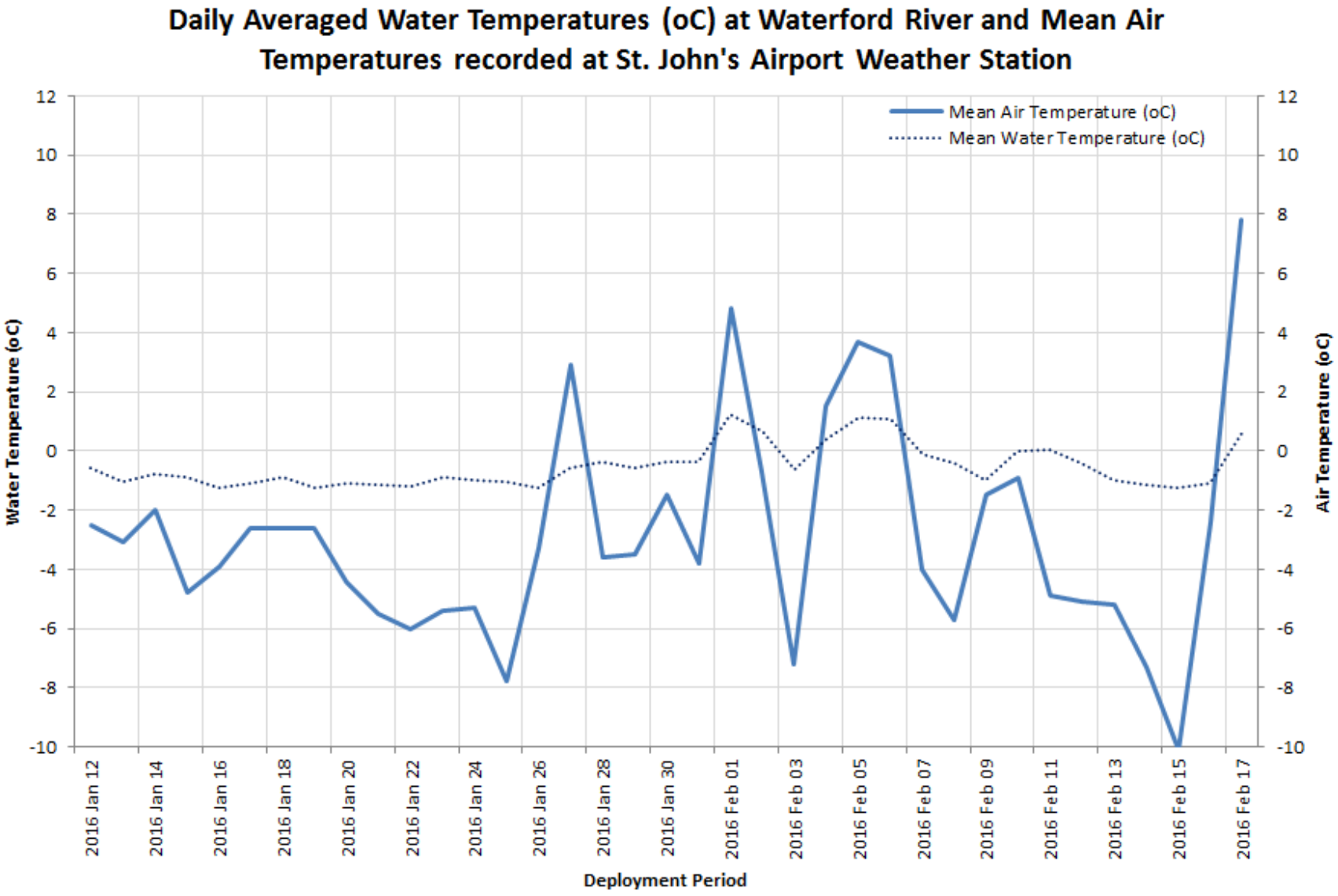
During this deployment there was an unseasonal warm period from January 27th through to February 9th. This warmer period influenced a number of water quality parameters. The warmer temperatures resulted in the ice and snow melt throughout the catchment area of this brook.

The brook displayed higher stage levels, a result of the runoff. Water temperature reached its highest values during this timeframe; conductivity levels had a mixed response of increasing with the initial stage increase but conductivity dropped around February 4th for a short period of time. Dissolved oxygen data did not display a clear diurnal pattern during this time, as dissolved oxygen levels did not change as much between night and day hours. The turbidity levels were at its highest during this period as well.

Despite changes in the water quality parameters due to the unseasonal temperatures and 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.

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 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

APPENDIX I


Daily Averaged Water Temperatures (oC) at Waterford River and Mean Air Temperatures recorded at St. John's Airport Weather Station
Mean Air Temperature (oC)
Mean Water Temperature (oC)
Water Temperature (oC)
Air Temperature (oC)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
2016 Jan 12
2016 Jan 14
2016 Jan 16
2016 Jan 18
2016 Jan 20
2016 Jan 22
2016 Jan 24
2016 Jan 26
2016 Jan 28
2016 Jan 30
2016 Feb 01
2016 Feb 03
2016 Feb 05
2016 Feb 07
2016 Feb 09
2016 Feb 11
2016 Feb 13
2016 Feb 15
2016 Feb 17
Deployment Period