Real-Time Water Quality Deployment Report

Leary's Brook at Prince Philip Drive

Deployment Period
March 5, 2015 to April 14, 2015

Newfoundland Labrador

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

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General

- The Water Resources Management Division (WRMD), in partnership with Environment Canada, maintains a real-time water quality and water quantity monitoring station on Leary's Brook adjacent to Prince Phillip Parkway.
- The real-time station allows for assessment and management of the water body. This deployment report discusses water quality related events occurring at the Leary's Brook station.
- The purpose of this real-time station is to monitor, process and publish hydrometric (water quantity) and real-time water quality data for Leary's Brook. Leary's Brook is an urban stream that flows through industrial and commercial areas and adjacent to a major roadway.
- This report covers the 40-day period from deployment on March 5, 2015 until removal on April 14, 2015.

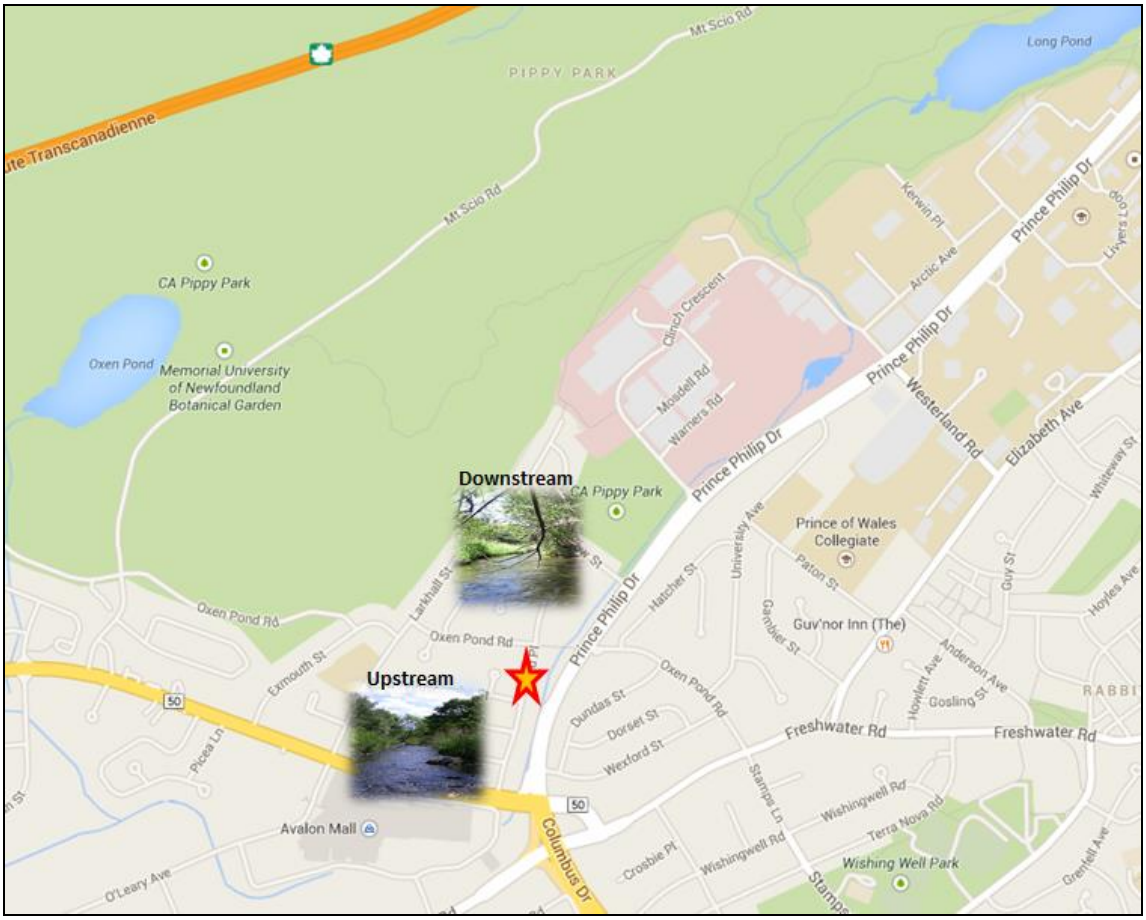

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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).

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.
- Deployment and removal instrument performance rankings for **Leary's Brook** for the period of on March 5, 2015 through to April 14, 2015 are summarized in Table 2.

Table 2: Instrument performance rankings for Leary's Brook Jan 14, 2014 – March 12, 2014

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Leary's Brook	**March 5 2015**	**Deployment**	Good	Fair	Good	Good	Fair
	April 14 2015	**Removal**	Good	Excellent	Excellent	Excellent	Good

Deployment Notes

- There were two transmission errors during this deployment period at Leary's Brook. The outage on March 16 lasted for 21 hours and the outage on March 19, for approximately 5 hours. Due to the nature of the data transmission, it is not uncommon to have data drop out of transmission.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from March 5, 2015 through to April 14, 2015 at the Leary's Brook station.
- With the exception of hydrometric (stage) data, all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Hydrometric data included in this report is provisional and is used for illustrative purposes only. Corrected and finalized data may be retrieved from the Water Survey of Canada website (http://www.ec.gc.ca/rhc-wsc/)
- Precipitation data from the deployment period was retrieved from the Environment Canada's weather station at St. John's International Airport.

Leary's Brook

Water Temperature

- Water temperature ranged from -0.39°C to 2.30°C during this deployment period (Figure 2).
- Water temperature at this brook displays a typical variation in pattern over the deployment period. Water temperature is influenced by air temperature. On the coldest days the water temperature drops to just below the freezing point. For the most part, the temperatures remain just above 0°C.
- The water temperature displayed on Figure 2 is typical of shallow streams and ponds. Shallow water bodies are highly influenced by variations in ambient air temperatures.
- Water temperature is an important parameter and it influences the other parameters that are measured by the water quality instrument.

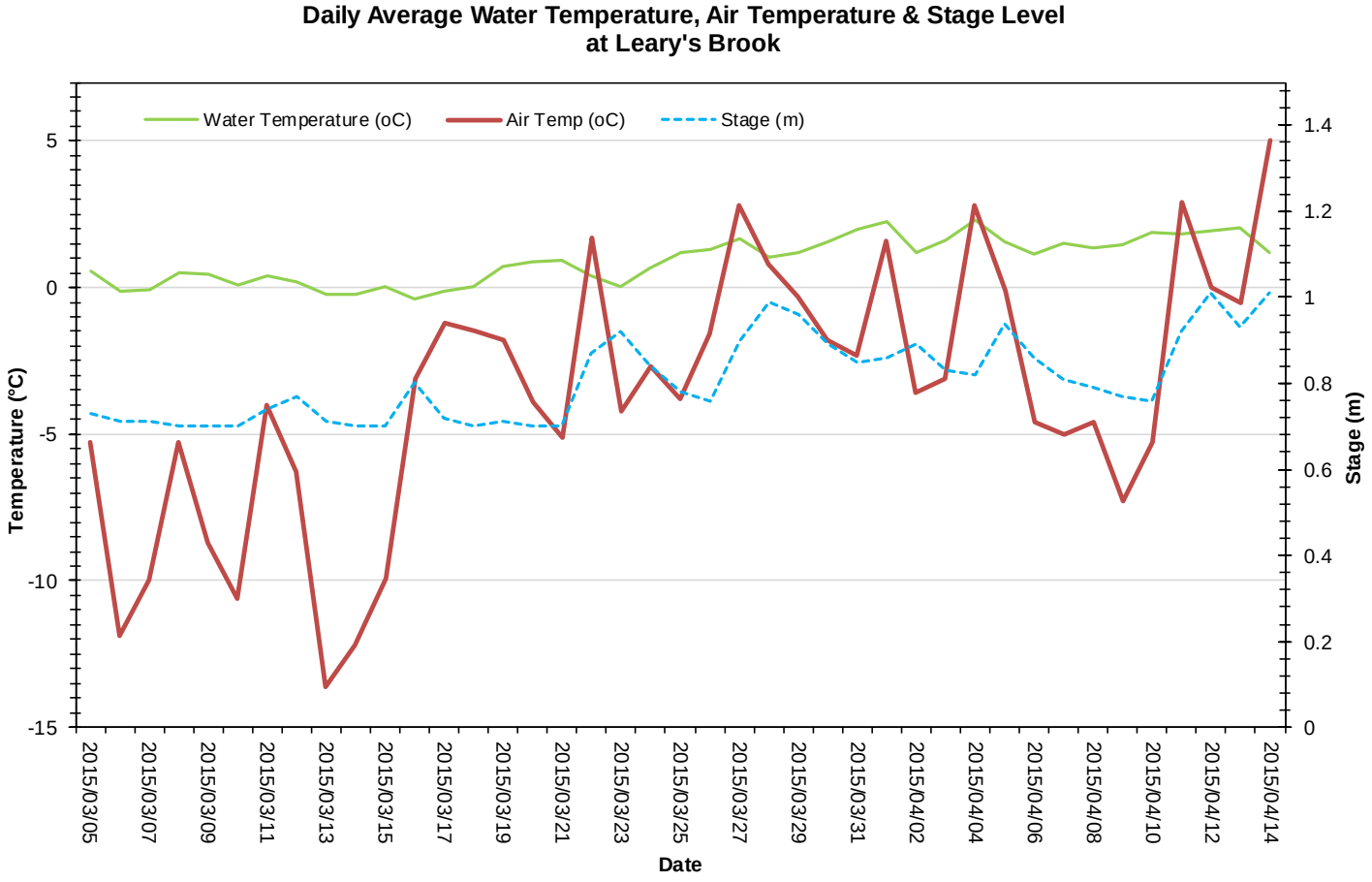

Figure 2: Daily Averaged water temperature (°C) and stage level (m) values at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.64 pH units and 6.94 pH units (Figure 3).
- During the deployment, the pH values were between the minimum and maximum CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).
- The CCME guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. Leary's Brook pH median was 6.80 (pH units) for this deployment period.

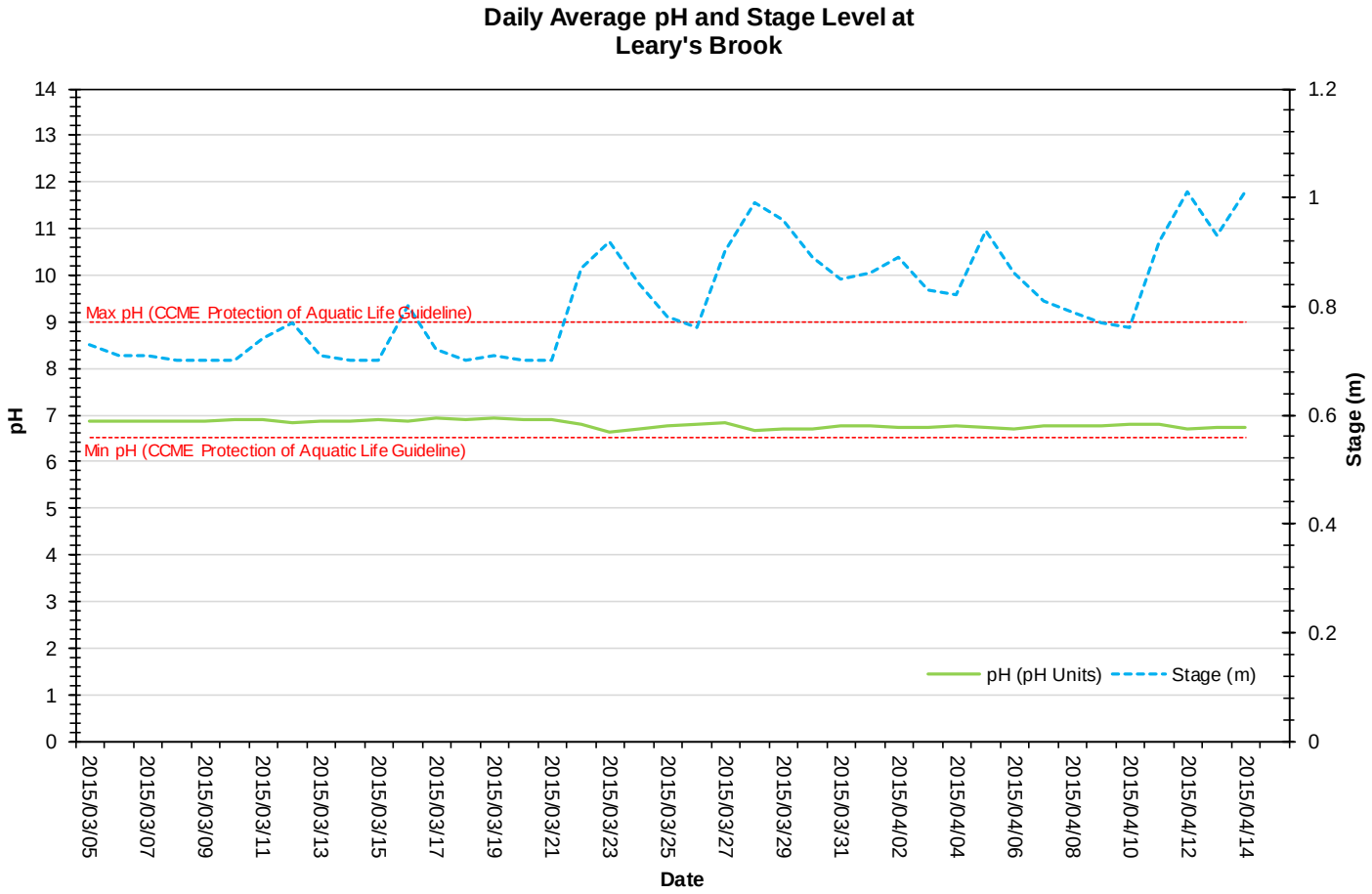

Figure 3: Daily Averaged pH (pH units) and stage level (m) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels were between 786.03 µS/cm and 5033.73 µS/cm during this deployment period. TDS ranged from 0.05 g/L to 3.22 g/L.
- Increases in conductivity generally correspond with higher stage levels on Figure 4. Increases in stage result in conductivity increases, as additional run off material is carried into the brook.
- During below freezing temperatures roads are heavily salted and as the ice and snow melts it flows into the surrounding urban rivers and brooks.

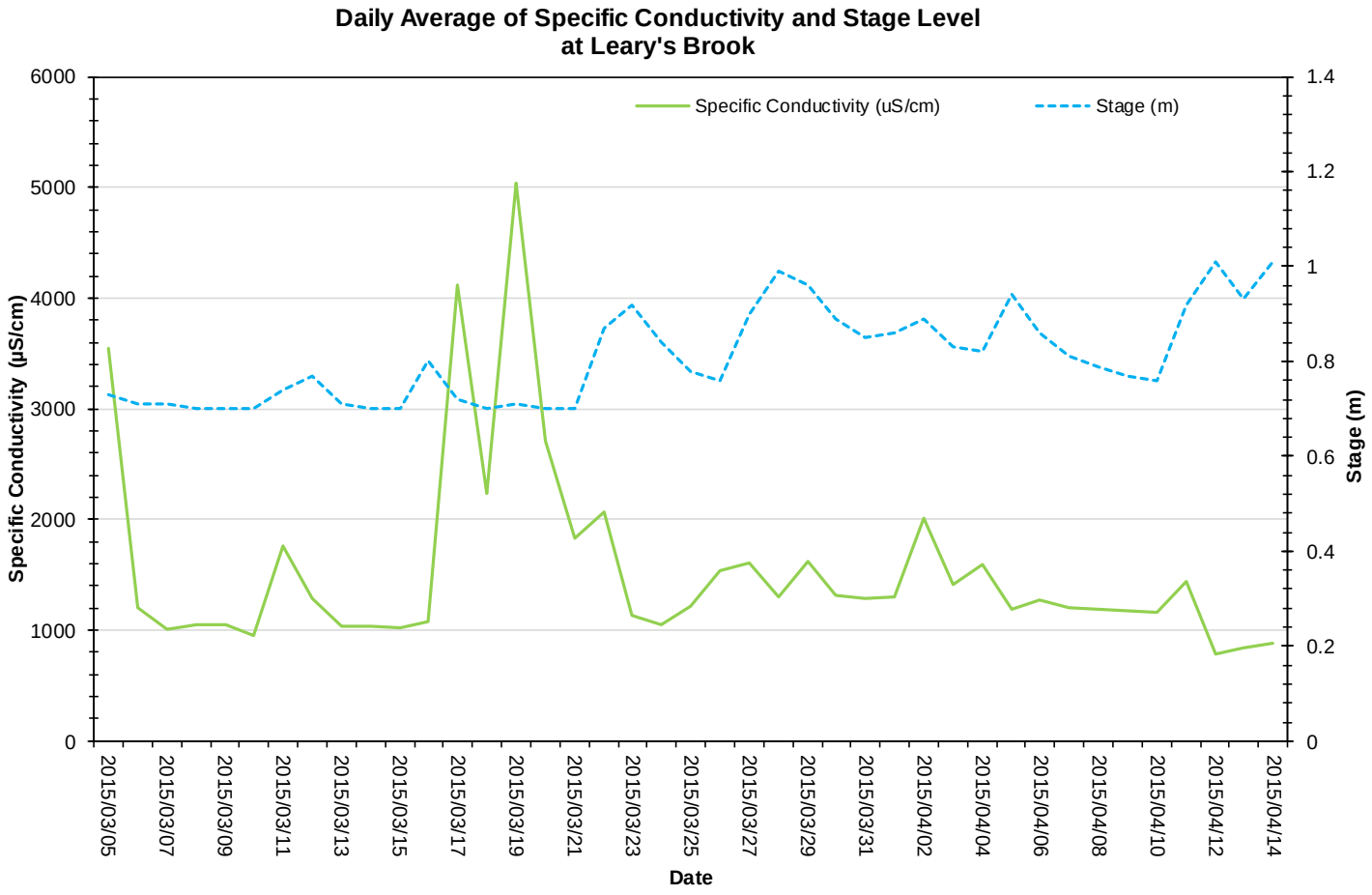

Figure 4: Daily Averaged specific conductivity (µS/cm) and stage (m) values at Leary's Brook Station

Dissolved Oxygen

- The instrument measures dissolved oxygen (mg/L) directly then calculates percent saturation (% Sat.).
- The Dissolved Oxygen % Sat levels within this deployment period were between 96.4 % Sat and 101.2 % Sat. Dissolved Oxygen (mg/L) measured 13.13 mg/L to 14.27 mg/L.
- The DO mg/L values are well above the minimum DO CCME guideline for early life stages throughout this deployment period (Figure 5).
- The Dissolved Oxygen percent saturation essentially remains constant throughout the deployment period.

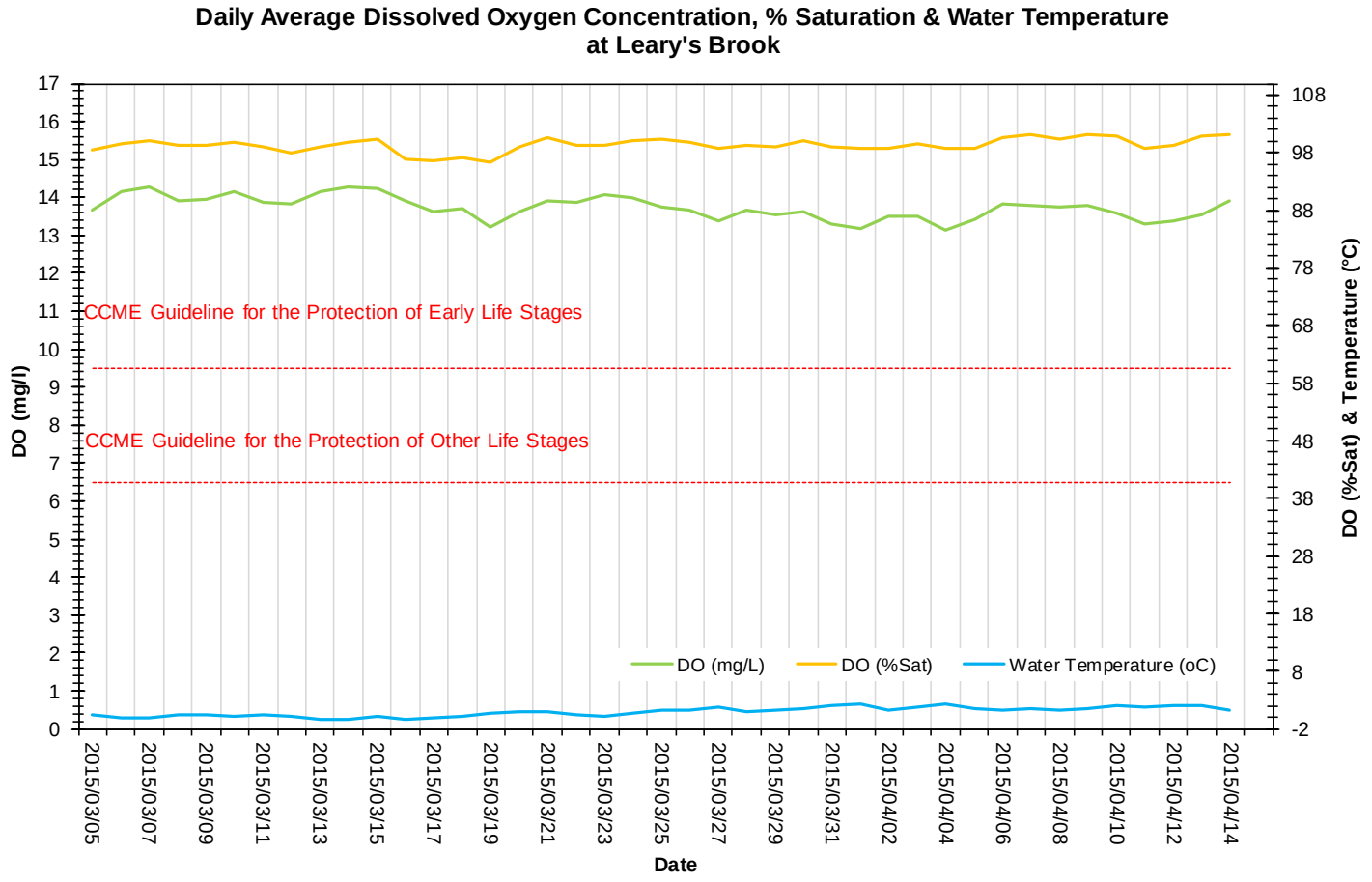

Figure 5: Daily Averaged dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

Turbidity

- The turbidity sensor records values between 0 NTU and 3000 NTU. However a turbidity reading of 3000NTU is identified as an error and is not a true turbidity value. Readings of 3000 NTU should not be included in any statistical analysis.
- The daily average turbidity readings during this deployment ranged between 0.89 NTU to 94.2 NTU (Figure 6).
- The turbidity events evident on the graph in Figure 6 generally correspond with higher stage levels at those times. With rainfall and runoff comes an increase in sediment and material flowing into the brook and this is what is captured by the turbidity sensor.

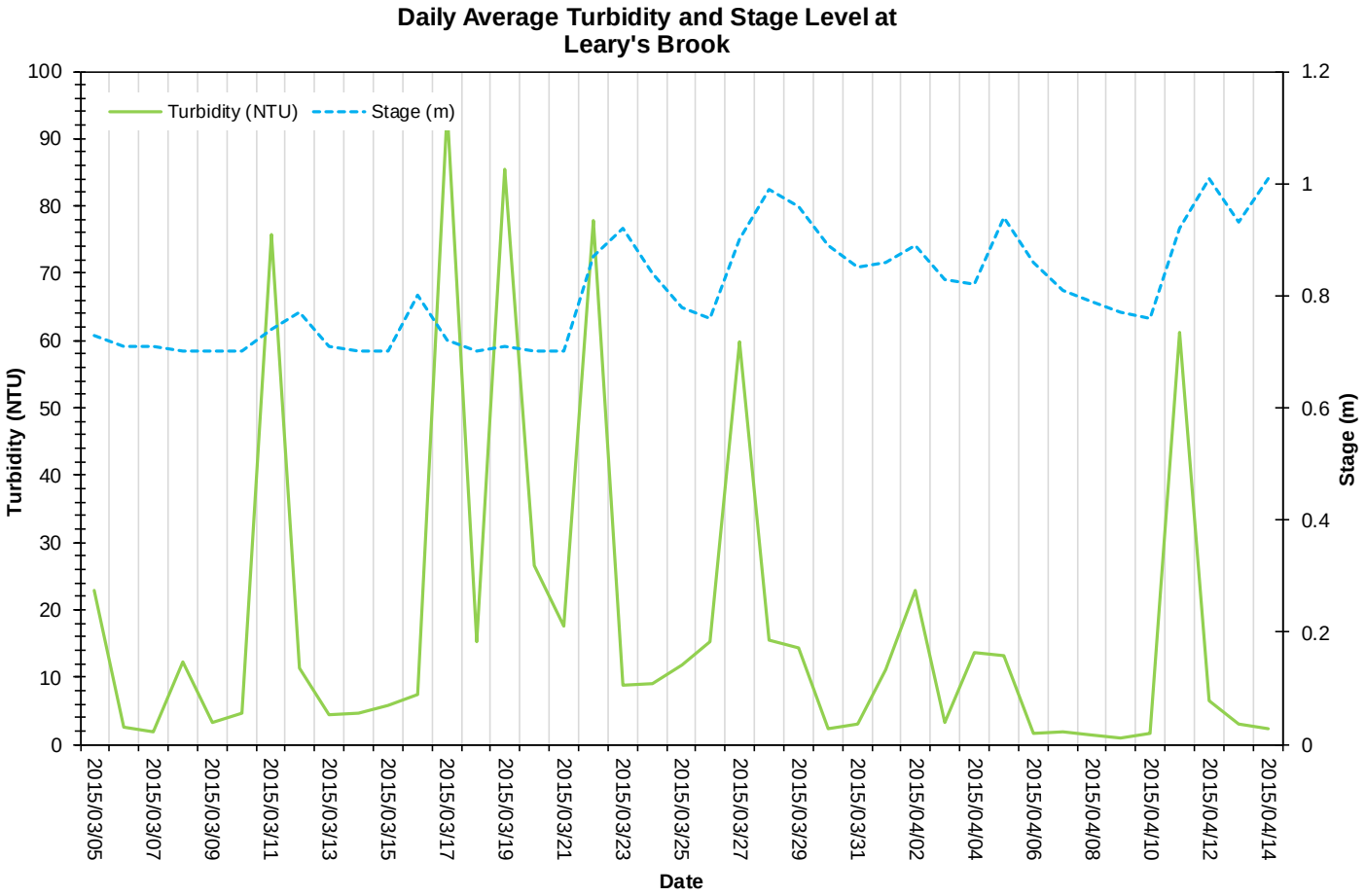

Figure 6: Daily Averaged turbidity (NTU) and stage level (m) values at Leary's Brook Station

Stage

- Stage can be defined as the height or elevation of the stream's water surface above a reference elevation (sea level, gage level)**.** 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 usually vary throughout the deployment period (Figure 7) and is directly influenced by precipitation and subsequent runoff.
- Most of the peaks in stage in Figure 7 were a response to the rainfall or melting that occurred during this deployment period. The high precipitation for the period, on March 16, was a snowfall event and did not significantly influence stage at that time.
- Hydrometric data included in this report is provisional and is used for illustrative purposes only. Corrected and finalized data may be retrieved from the Water Survey of Canada website (http://www.ec.gc.ca/rhc-wsc/)

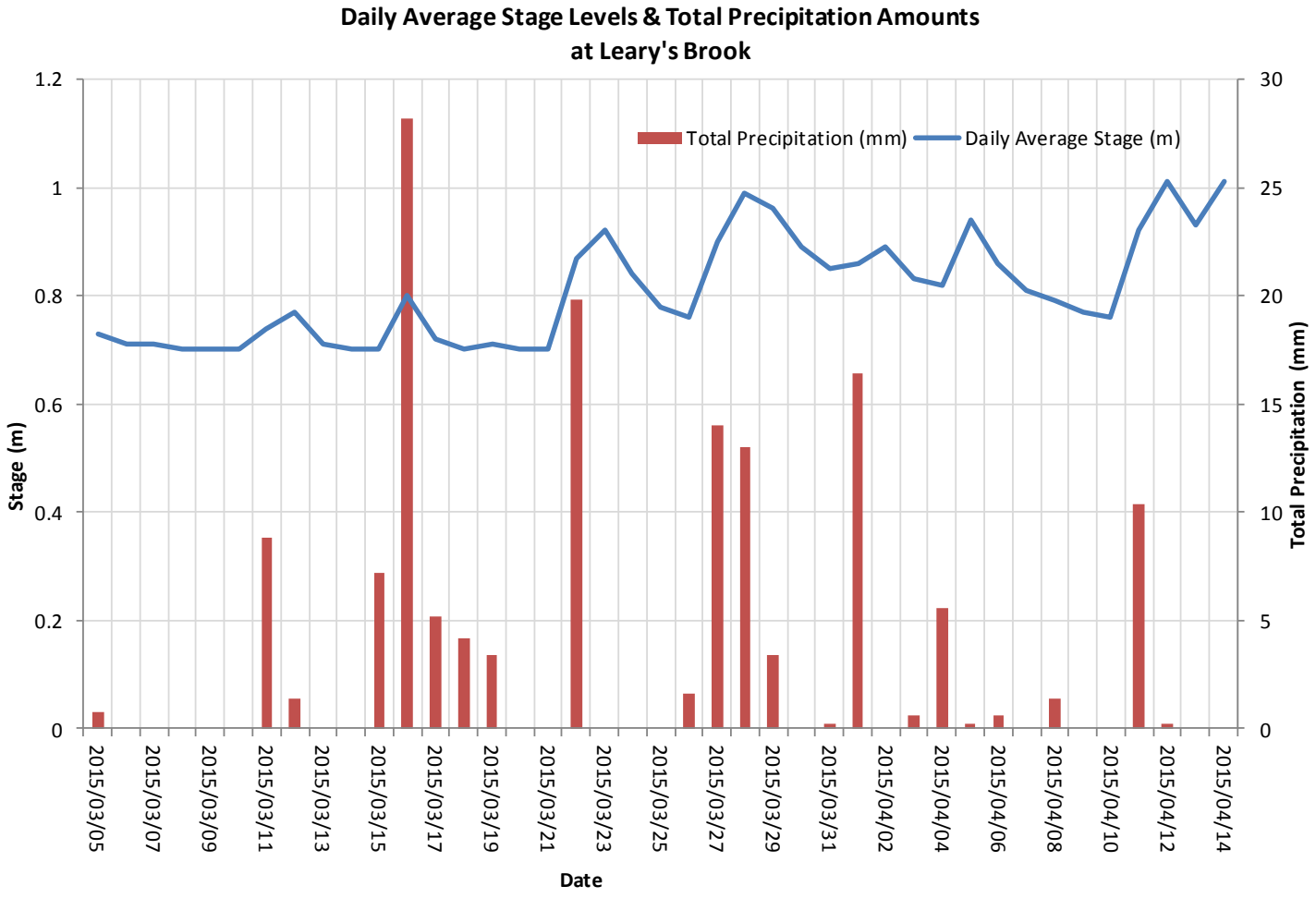

Figure 7: Daily average stage values (m), flow (m3/s) and daily total precipitation values (mm) for Leary's Brook

Conclusions

- Generally in natural environments, climate and weather conditions contribute in large part to the variation in water quality parameters. During this deployment it was evident that many of the changes in the parameter data displayed on the graphs, was related to the intermittent precipitation events and small climatic changes of the seasons (i.e. temperature decreases).
- Precipitation events during the deployment period often led to related fluctuations in stage, which thus influenced the values of turbidity, pH, specific conductance, and TDS. As ambient air temperatures decreased, there were correspondingly cooler water temperatures, which in turn increased the amount of dissolved oxygen in the water.
- The majority of turbidity events were correlated with increases in runoff and thus precipitation events.
- The addition of road salt to roadways during periods of snowfall and low ambient air temperatures led to increases in specific conductance and TDS as the salts were washed into the river system. This indicates that this river is influenced by runoff upstream of the station. These salts also briefly decreased dissolved oxygen values at the same time.
- During this deployment period the median water temperature at the Leary's Brook station was 1.01°C. Water Temperature will continue to fluctuate and be influenced by the surrounding winter air temperature; this is to be expected with the colder temperatures at night and slightly warmer temperatures during the day.
- The median pH value for Leary's Brook Station was 6.80 (pH units). The pH level is generally steady at this station.
- The Specific Conductivity median at Leary's Brook was 1276.6µS/cm. The Specific Conductivity graph for this station displays several intermittent peaks in conductivity over the deployment period. This can be attributed to road salt entering the brook.
- Dissolved Oxygen at Leary's Brook had a median of 99.3 % saturation during the deployment period. The small dips in DO (mg/L and % Sat) correspond with water temperatures. The larger dips in DO (mg/L and %Sat) at Leary's Brook correspond with rainfall events.
- The turbidity median value at Leary's Brook during deployment was 8.9 NTU and ranged from 0.89 to 94.18 NTU. This is evidence of the beginning of the spring thaw, as the turbidity readings start to fluctuate in response to increased runoff.