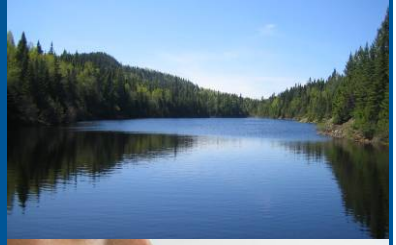







Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
October 21, 2015 to November 20, 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, maintain a real-time water quality and water quantity monitoring station at 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 at the real-time station. Leary's Brook is an urban stream that flows through industrial and commercial areas and adjacent to a major roadway.
- This report covers the period between the deployment on October 21, 2015 and removal on November 20, 2015.

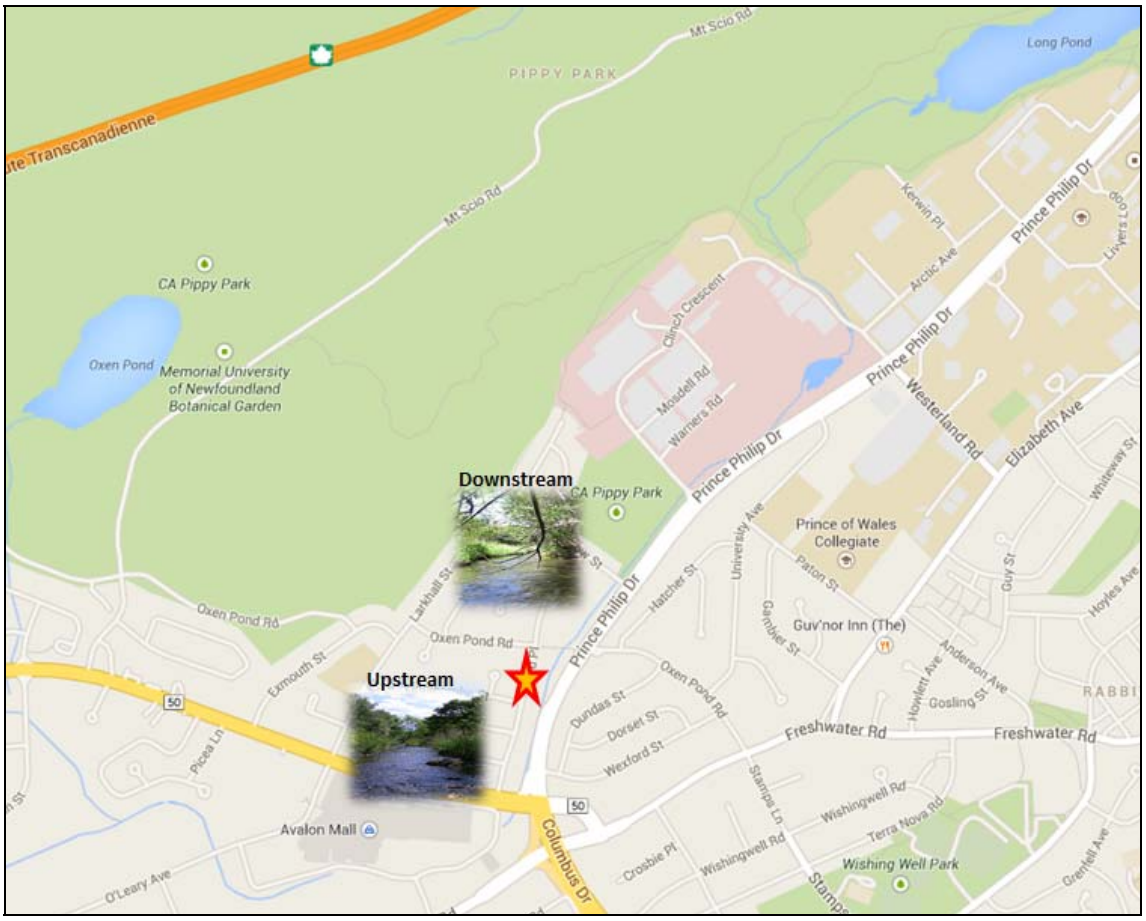

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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

- 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 October 21, 2015 to November 20, 2015 are summarized in Table 2.

Table 2: Instrument performance rankings for Leary's Brook

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Leary's Brook	**October 21 2015**	**Deployment**	Excellent	Good	Excellent	Excellent	Good
	November 20 2015	**Removal**	Excellent	Excellent	Excellent	Excellent	Good

- At the Leary's Brook station at the time of deployment the temperature, conductivity and dissolved oxygen data ranked as "Excellent. The pH and turbidity data ranked as "Good. At removal the temperature, conductivity, dissolved oxygen and pH data ranked as 'Excellent" while the turbidity data ranked as "Good".

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from October 21, 2015 to November 20, 2015 at the Leary's Brook station.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. 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 weather station at St. John's International Airport.

Leary's Brook

Water Temperature

- Water temperature ranged from 3.48°C to 12.6°C during this deployment period (Figure 2).
- Water temperature at Leary's Brook displays a typical variation in pattern over the deployment period. Water temperature is influenced by air temperature. Water temperature gradually decreased over the course of this deployment.
- The water temperature data 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 falls overnight and rises during daylight hours.

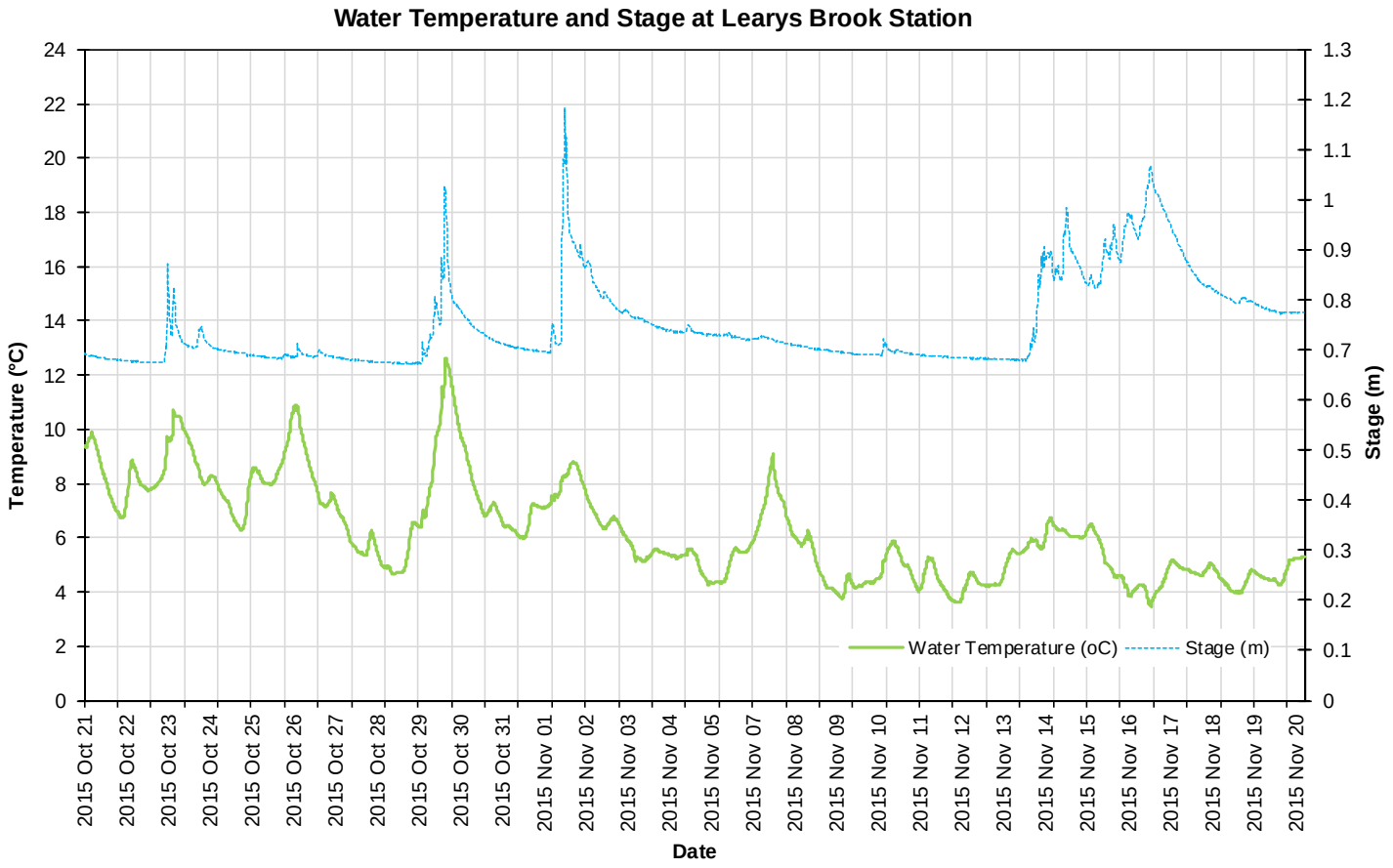

Figure 2: Water temperature (°C) values at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.35 pH units and 7.01 pH units (Figure 3).
- During most of the deployment, pH values were above the minimum CCME Guidelines for the Protection of Aquatic Life (6.5 pH units).
- As the graph below illustrates, pH declines slightly in response to an increase in stage caused by precipitation. Rainwater generally has a lower pH than surface water.
- 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 6.88 (pH units) for this deployment period.

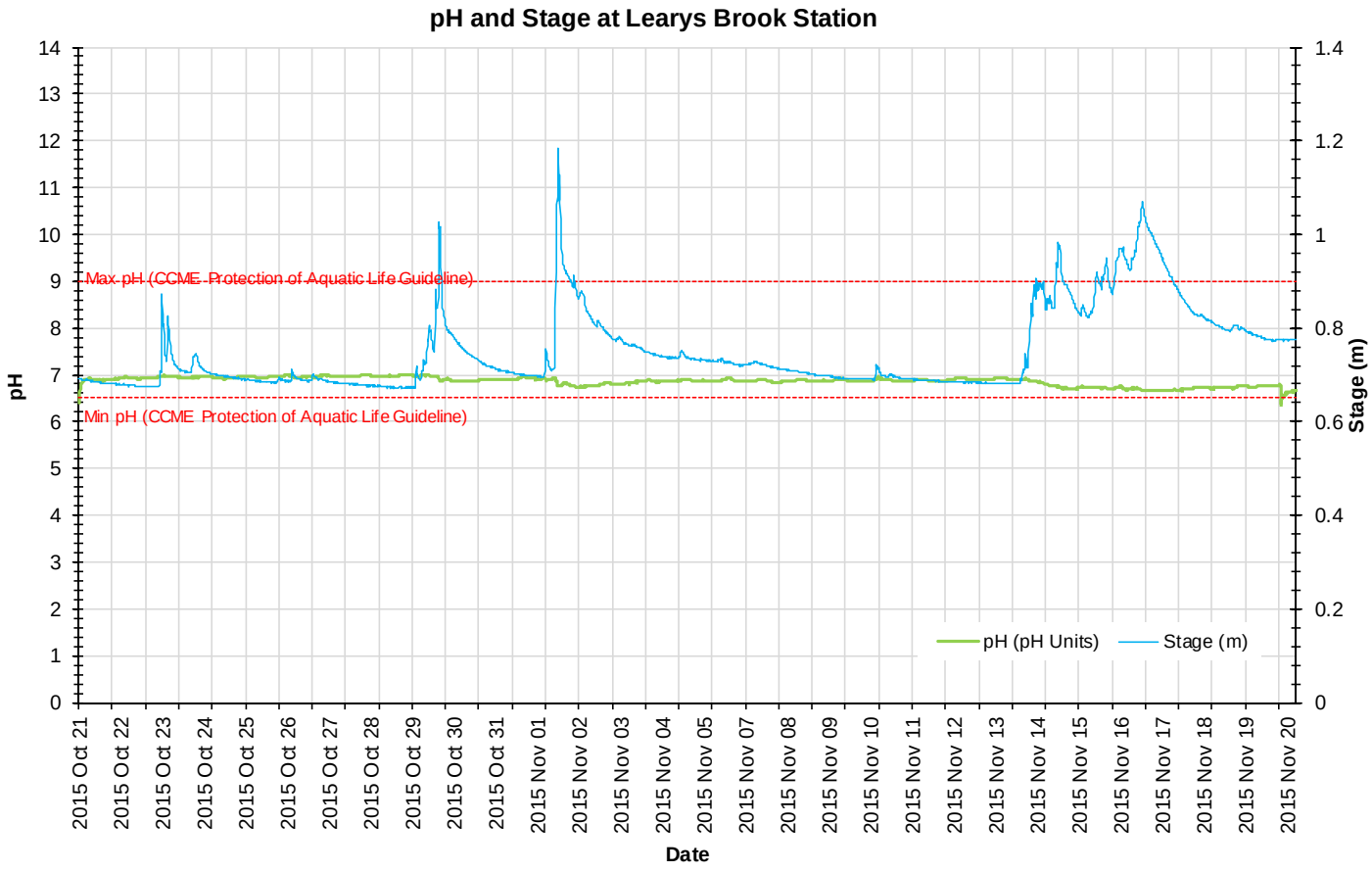

Figure 3: pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 112.7 µS/cm and 3232.9 µS/cm during this deployment period. The median was 514.0 µS/cm. TDS ranged from 0.0701 g/ml to 0.4910 g/ml.
- During the early part of this deployment, as the graph below illustrates, increases in stage caused by precipitation results in a decrease in total dissolved solids (TDS) and conductivity as stream water is diluted. In the early part of November we see the appearance of much higher peaks in conductivity and TDS. This is likely caused by runoff from recently salted roads as temperatures begin to fall below zero at night. During the colder months when roads are routinely and regularly salted, runoff entering Leary's Brook contains a high amount of dissolved solids. TDS and conductivity often peak following precipitation or melting events.

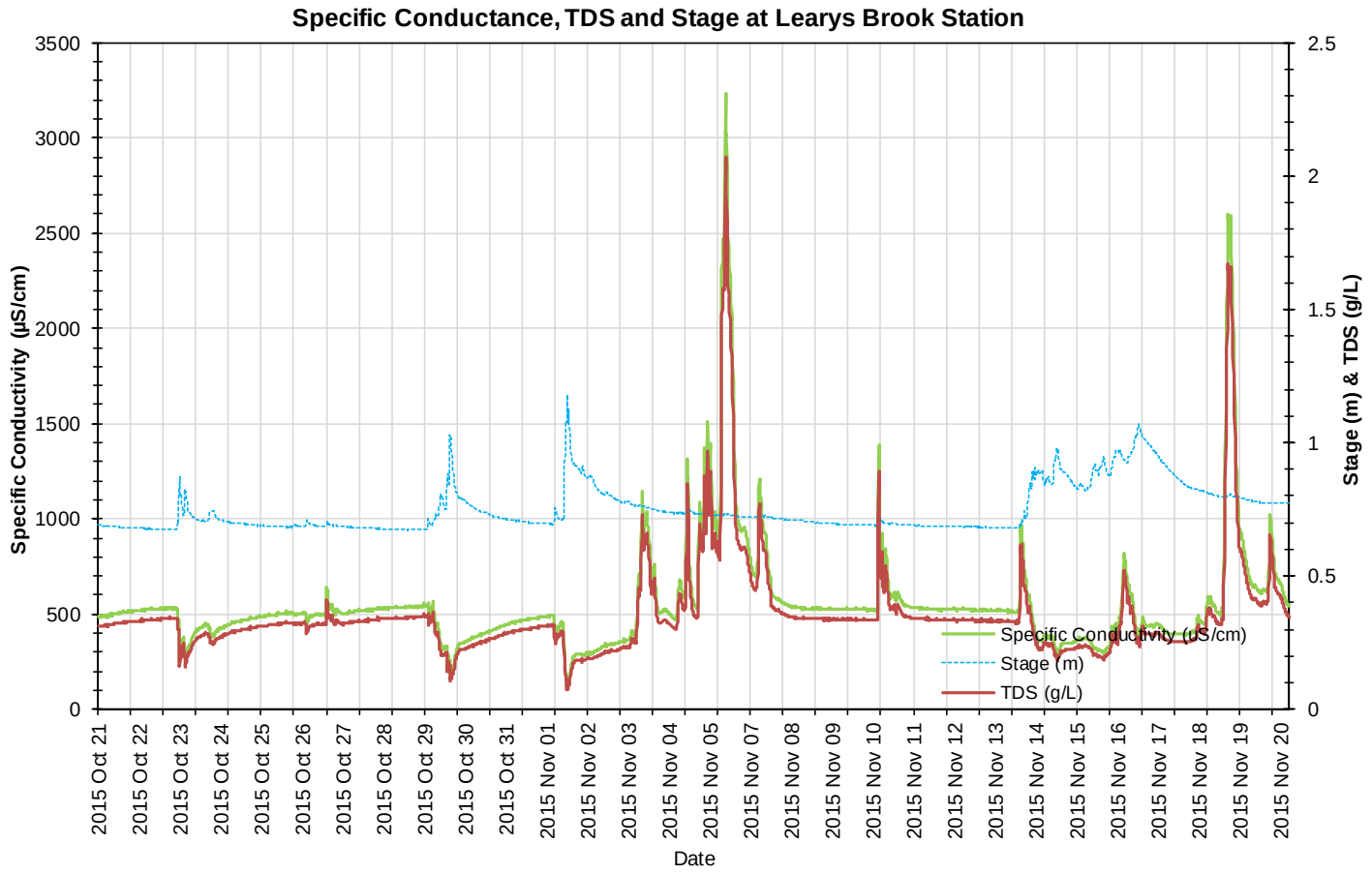

Figure 4: Specific conductivity (µS/cm) & TDS (g/L) values at Leary's Brook Station

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 94.1% Sat and 100.3% Sat. Dissolved Oxygen (mg/L) measured between 10.00 mg/L and 12.85 mg/L.
- The DO mg/L values were above the minimum DO CCME guideline for early life stages for the duration of this deployment period (Figure 5).
- There is a slight increase in dissolved oxygen concentration across the deployment period. This is to be expected as the air and water temperatures begin to fall as nights get cooler and fall advances. Cool water can hold more dissolved oxygen than warmer water.

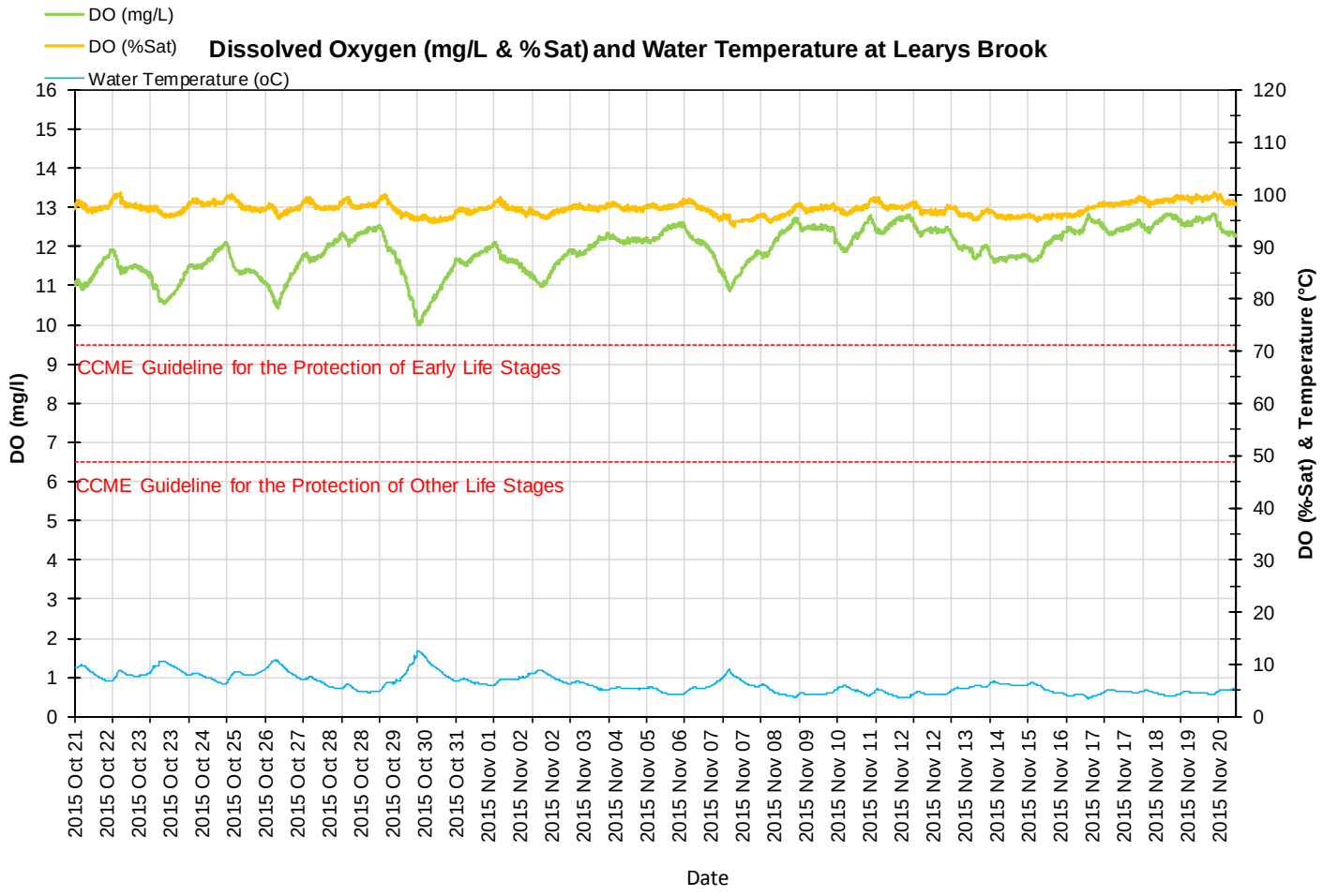

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

Turbidity

- The turbidity sensor records values between 0 NTU and 3000 NTU. A turbidity reading of 3000NTU is identified as an error and is not a true value. Readings of 3000 NTU should not be included in any statistical analysis.
- The turbidity readings during this deployment ranged within 1.2 NTU to 117.7 NTU (Figure 6).
- Higher turbidity values closely correspond with precipitation events and elevated river stage and runoff (Figure 7). Rainfall and subsequent runoff along with increased flow carries road and bank sediment and other material into the brook and this is what the turbidity sensor captures.

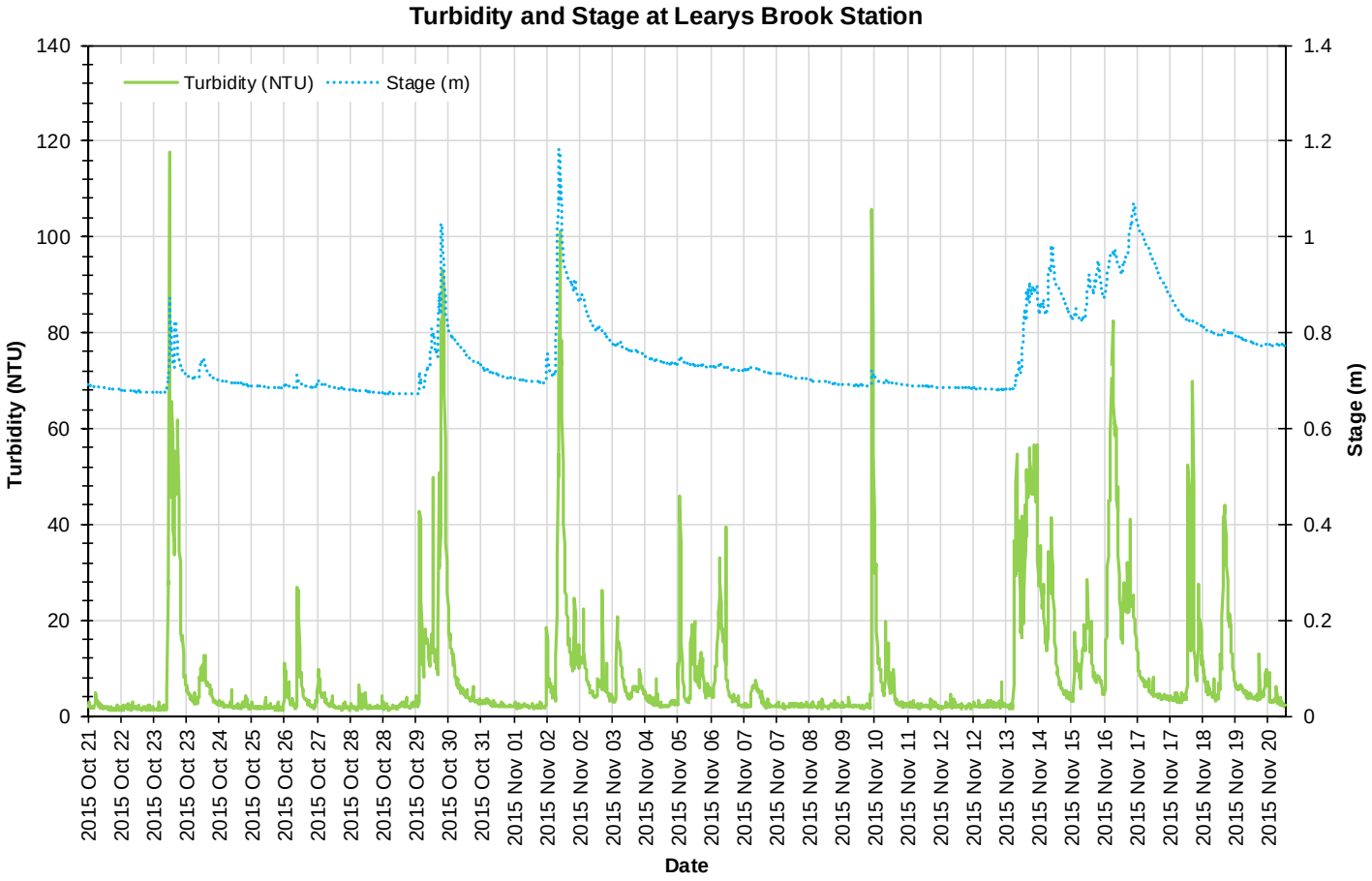

Figure 6: Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- The below graph includes daily total precipitation data from St. John's International Airport weather station and the daily average stage. Please note that the stage data in this report 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.
- It is normal to see stage (and streamflow) vary significantly throughout the deployment period in Leary's Brook (Figure 7). Stage is directly influenced by rainfall and subsequent runoff from the surrounding environment. Precipitation runoff impacts urban streams relatively quickly as rainfall flows across impervious surfaces such as roads and parking lots and then into storm drains.
- The highest total precipitation occurs over the November 14-16 period, which corresponds with a maximum stage level reached on November 17, 2015.

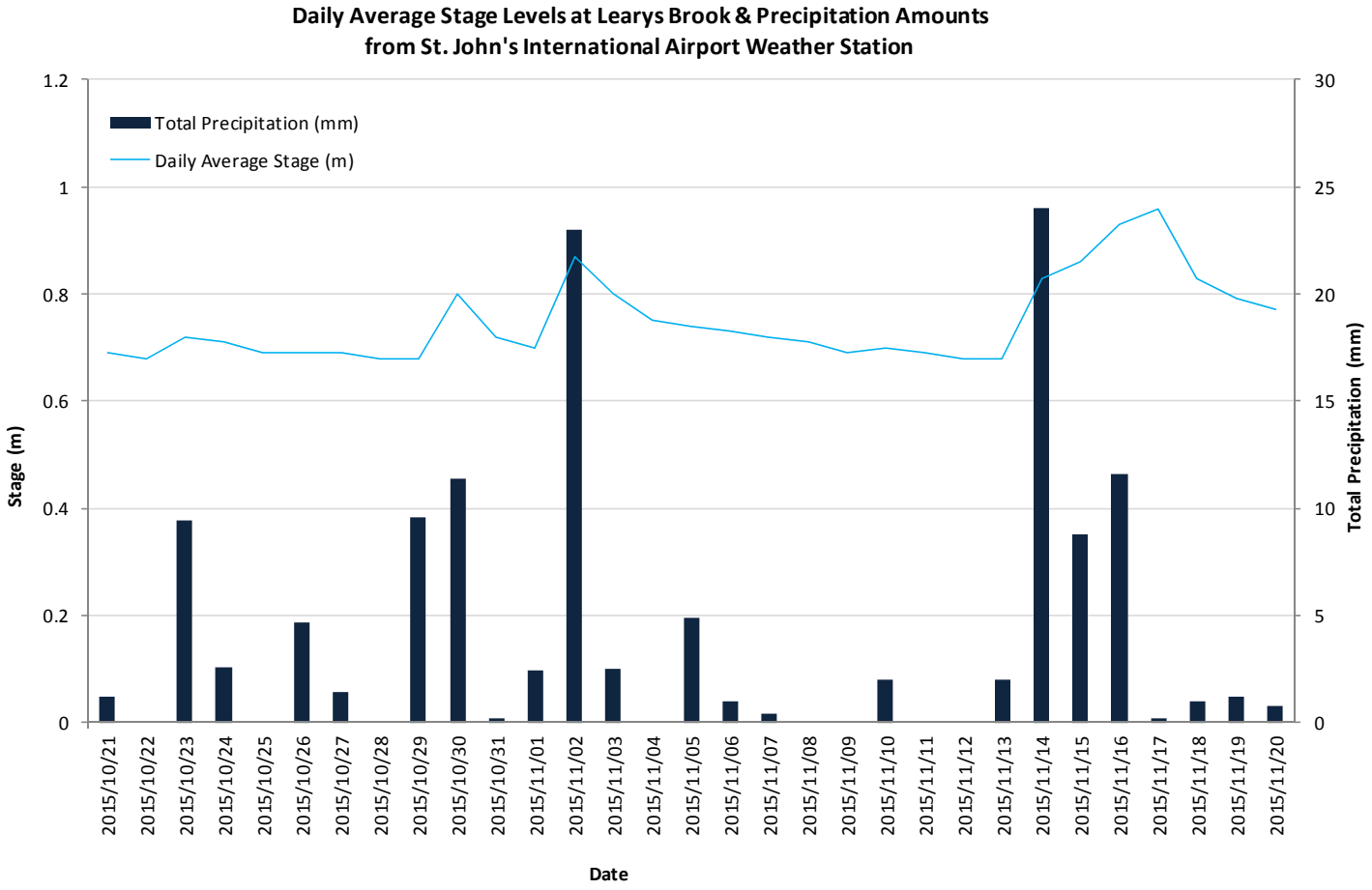

Figure 7: Daily average stage values (m) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

Generally in urban environments, climate, weather conditions and human activity contribute in large part to the variation in water quality. During this deployment it was evident that many of the changes displayed on the graphs are related to intermittent precipitation events, road salting and small climatic changes of the seasons.

Precipitation events during the deployment period led to related fluctuations in stage, which thus influenced the values of turbidity, pH, specific conductance, and TDS. As average ambient air temperatures decreased, there were correspondingly cooler water temperatures, which in turn slightly increased the amount of dissolved oxygen in the water.

The majority of turbidity events were correlated with increases in stage and thus precipitation events.

Runoff during late fall when road salting is occurring causes specific conductance and TDS to rapidly increase.

During this deployment period the median water temperature at the Leary's Brook station was 5.85°C.

The median pH value for Leary's Brook Station was 6.88 (pH units). The pH level for the most part is steady at this station.

Dissolved Oxygen at Leary's Brook had a median of 97.3%Sat during the deployment period. The small increases in DO (mg/L and % Sat) correspond with decreases in water temperatures.

The turbidity median value at Leary's Brook during deployment was 8.3 NTU. Increases in stage level can explain most of the peaks in the turbidity values during the deployment period. As organic matter and sediments are washed into the brook, the suspended matter in the water column will increase and the turbidity sensor will detect an increase in water cloudiness.