

Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
July 26, 2016 to September 15, 2016



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

Prepared by:

Paul Rideout
Environmental Scientist
Water Resources Management Division
Department of Environment & Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No.: (709) 729 - 0351
Fax No.: (709) 729 - 0320
paulrideout@gov.nl.ca

General

- The Water Resources Management Division (WRMD), in partnership with Environment and Climate Change Canada, maintains 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 July 26, 2016 and removal on September 15, 2016.

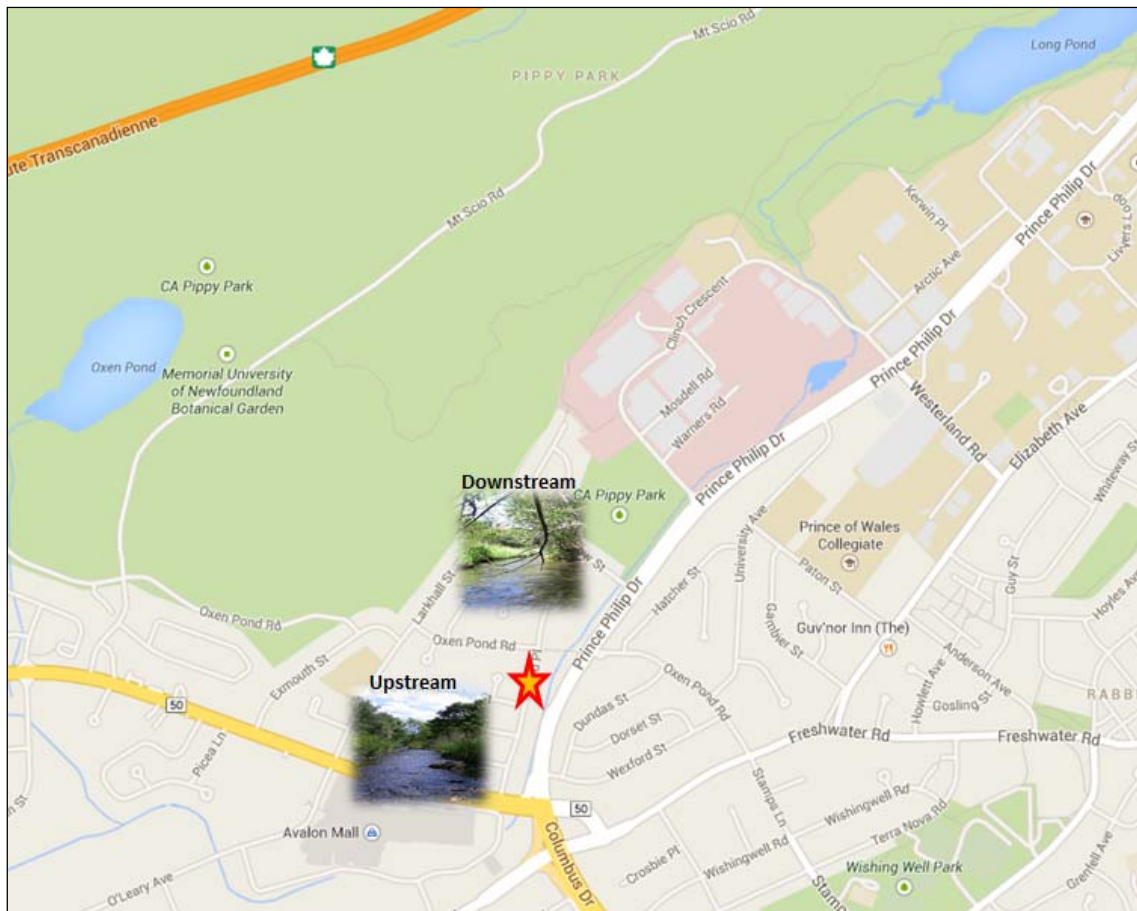


Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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

Parameter	Rank				
	Excellent	Good	Fair	Marginal	Poor
Temperature (°C)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$< \pm 1$
pH (unit)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Sp. Conductance ($\mu\text{S}/\text{cm}$)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Sp. Conductance $> 35 \mu\text{S}/\text{cm}$ (%)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Dissolved Oxygen (mg/L) (% Sat)	$\leq \pm 0.3$	$> \pm 0.3$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Turbidity < 40 NTU (NTU)	$\leq \pm 2$	$> \pm 2$ to 5	$> \pm 5$ to 8	$> \pm 8$ to 10	$> \pm 10$
Turbidity > 40 NTU (%)	$\leq \pm 5$	$> \pm 5$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$

- The temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent, 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 July 26, 2016 to September 15, 2016 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	July 26, 2016	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	September 15, 2016	Removal	Good	Excellent	Fair	Excellent	Excellent

- At the Leary's Brook station at the time of deployment, the temperature, conductivity, dissolved oxygen and turbidity readings all ranked as "Excellent". The pH readings ranked as "Good".
- At the time of removal, pH, dissolved oxygen and turbidity ranked as "Excellent", temperature ranked as "Good" and conductivity ranked as "Fair".
- The conductivity sensor may have lost calibration or been otherwise adversely affected by a period of time after August 7 when it was entirely covered by sediment.
- Because the sensors were covered by sediment after the August 7 precipitation event, turbidity and specific conductivity data for the period from August 8, 2016 at 02:02 AM to August 11, 2016 at 12:32 PM has been removed from the data set.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from July 26, 2016 to September 15, 2016 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 (WSC) is responsible for QA/QC of water quantity data. Corrected and finalized data may be retrieved from the WSC website (<http://www.ec.gc.ca/rhc-wsc/>)
- Precipitation data from the deployment period was retrieved from the Environment and Climate Change Canada weather station at St. John's International Airport.

Leary's Brook

Water Temperature

- Water temperature ranged from 10.20°C to 20.90 °C during this deployment period (Figure 2).
- Water temperature at Leary's Brook displays a typical variation over the deployment period. Water temperature is influenced by air temperature.
- 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 also falls overnight and rises during daylight hours.
- The period of August 2 to August 4 was particularly cool with a mean air temperature over the three days between 5.5 °C and 7.8 °C . (See inside oval on graph below).
- Please note the stage data is raw data that is published on the ECC 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.

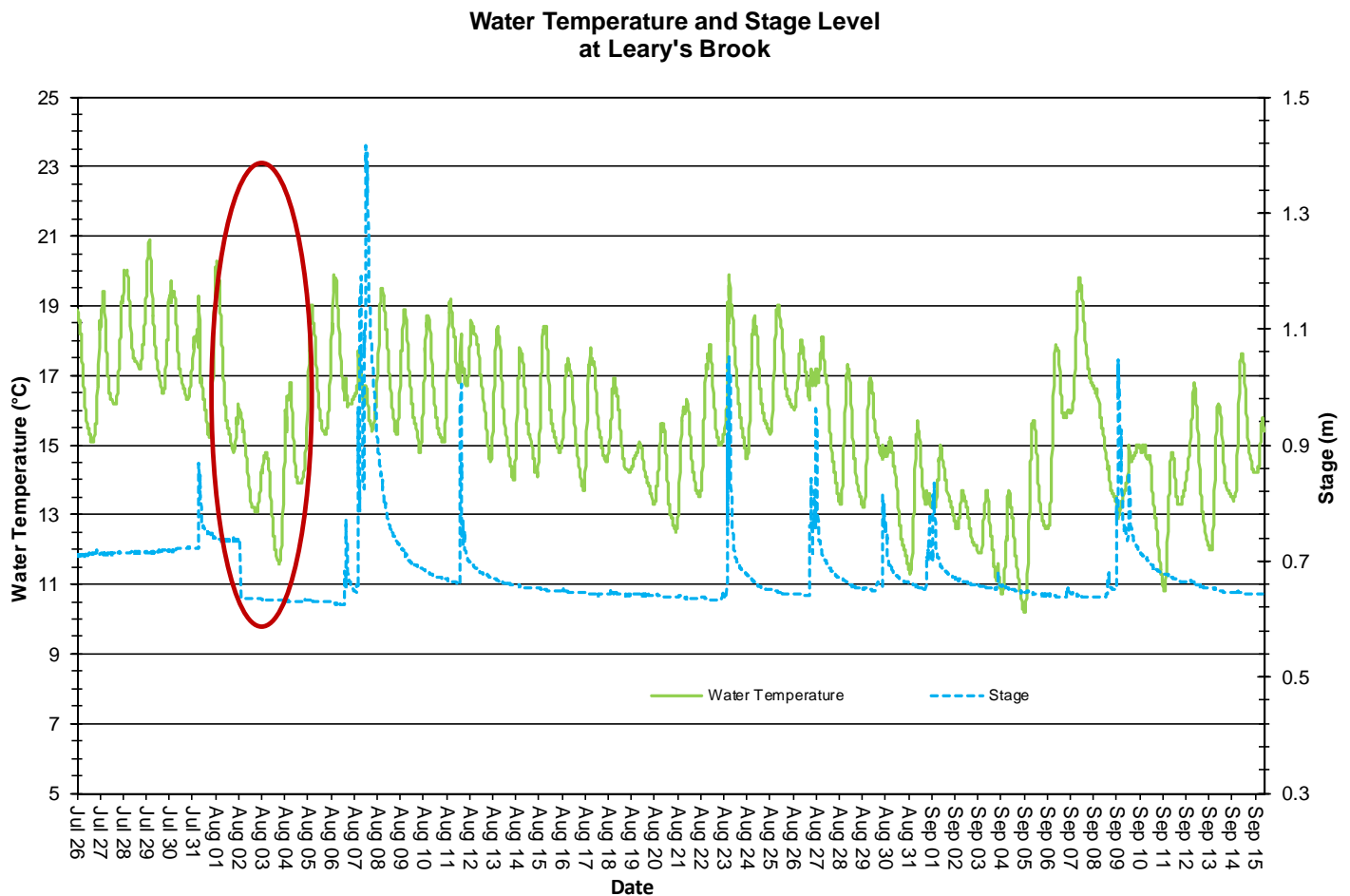


Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.35 pH units and 7.47 pH units (Figure 3).
- For most of the deployment, pH values were above the minimum CCME Guidelines for the Protection of Aquatic Life (6.5 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 6.95 (pH units) for this deployment period.
- As illustrated below, pH typically falls slightly in Leary's Brook (the water becomes more acidic) at the same time as stage and flow are increasing (see inside oval). In general, precipitation entering Leary's Brook has a lower pH than local surface water and this causes a reduction in the pH of the brook.
- Please note the stage data is raw data that is published on the ECC 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.

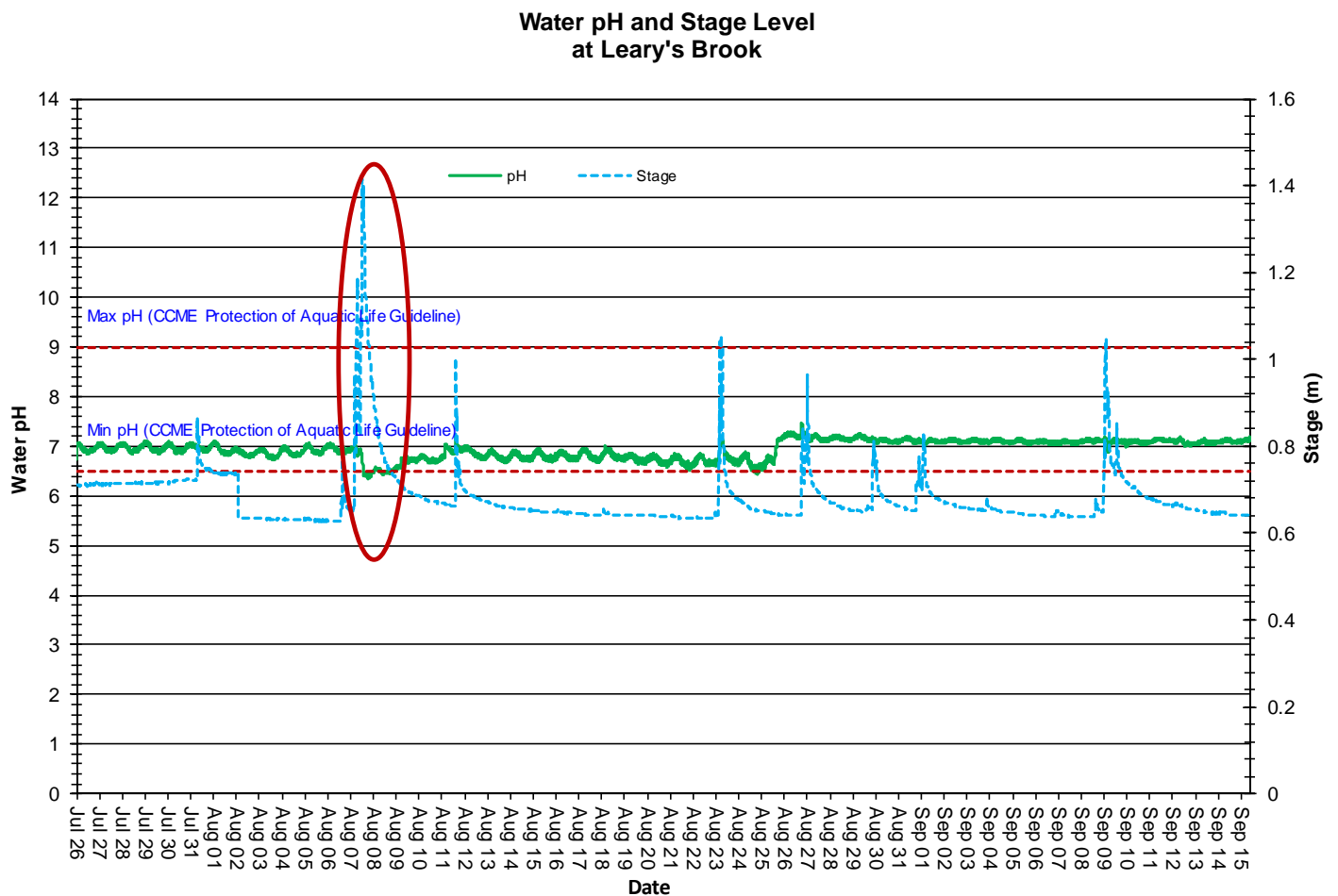


Figure 3: Water pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 122.1 $\mu\text{S}/\text{cm}$ and 890.0 $\mu\text{S}/\text{cm}$ during this deployment period. The median was 721.0 $\mu\text{S}/\text{cm}$. TDS ranged from 0.0654 g/ml to 0.5690 g/ml. (Figure 4)
- Specific conductivity readings from August 8 at 2:02 AM to August 11 at 12:32 PM have been removed from the data set and are not included in graphs or statistics used in this report. During this time, after a heavy rainfall overnight on August 7-8, the conductivity sensor was covered in sediment and was returning readings that are assumed to be inaccurate.
- In general, decreases in conductivity seen during this deployment period are associated with precipitation runoff and rising stage. This is typical for this time of the year as runoff from precipitation dilutes the dissolved solids present in the brook.
- Please note the stage data is raw data that is published on the ECC 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.

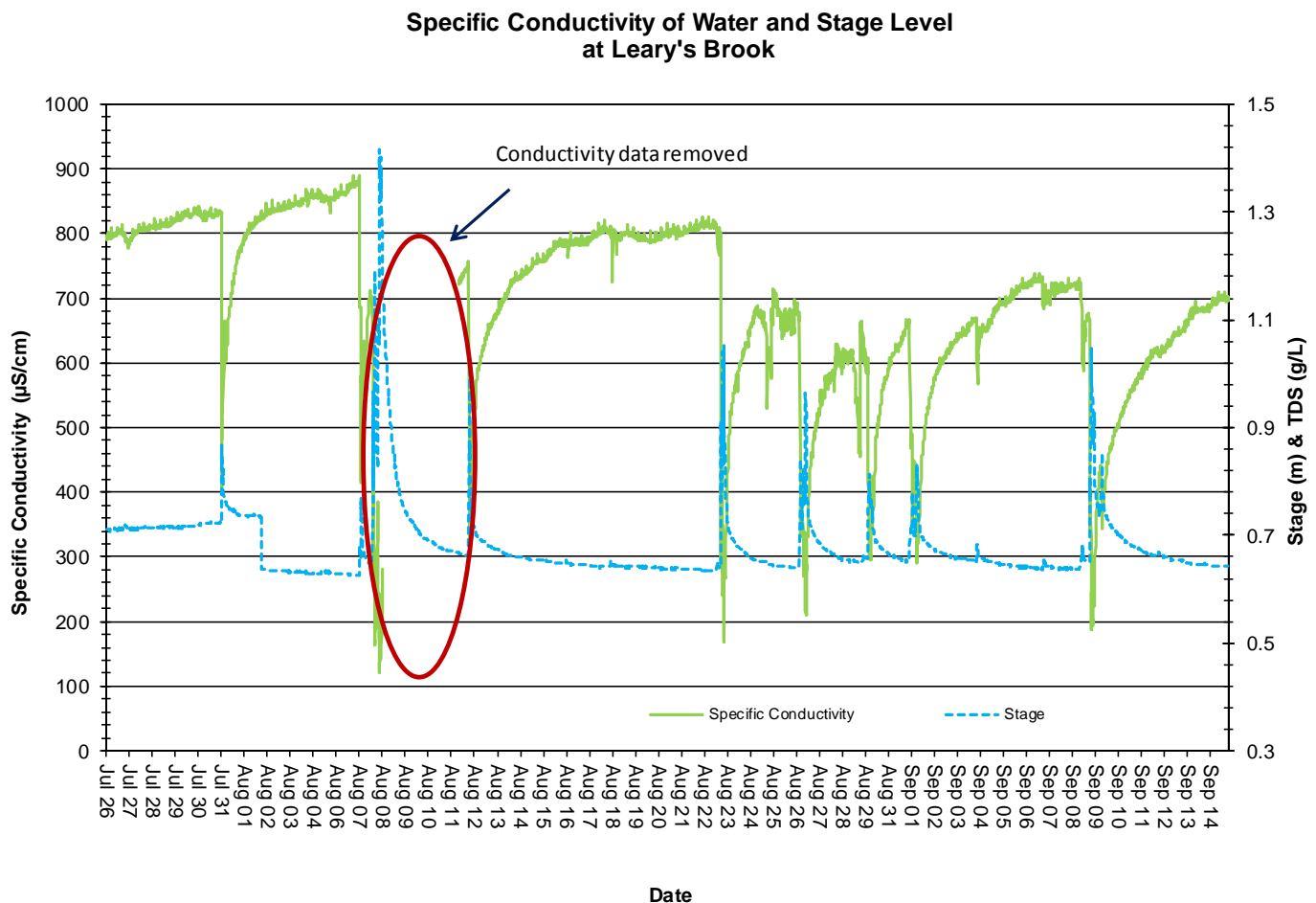


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$), TDS (g/L) and stage (m) values at Leary's Brook Station

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 89.2 % Sat and 98.7 % Sat. Dissolved Oxygen (mg/L) measured between 8.48 mg/L and 10.88 mg/L. (Figure 5)
- The DO mg/L values were slightly below the minimum DO CCME guideline for the protection of early life stages for much of this deployment period (Figure 5).
- Small dips in mg/L values are associated with increases in water temperature. Cool water can hold more dissolved oxygen than warmer water.

Dissolved Oxygen Concentration and Saturation

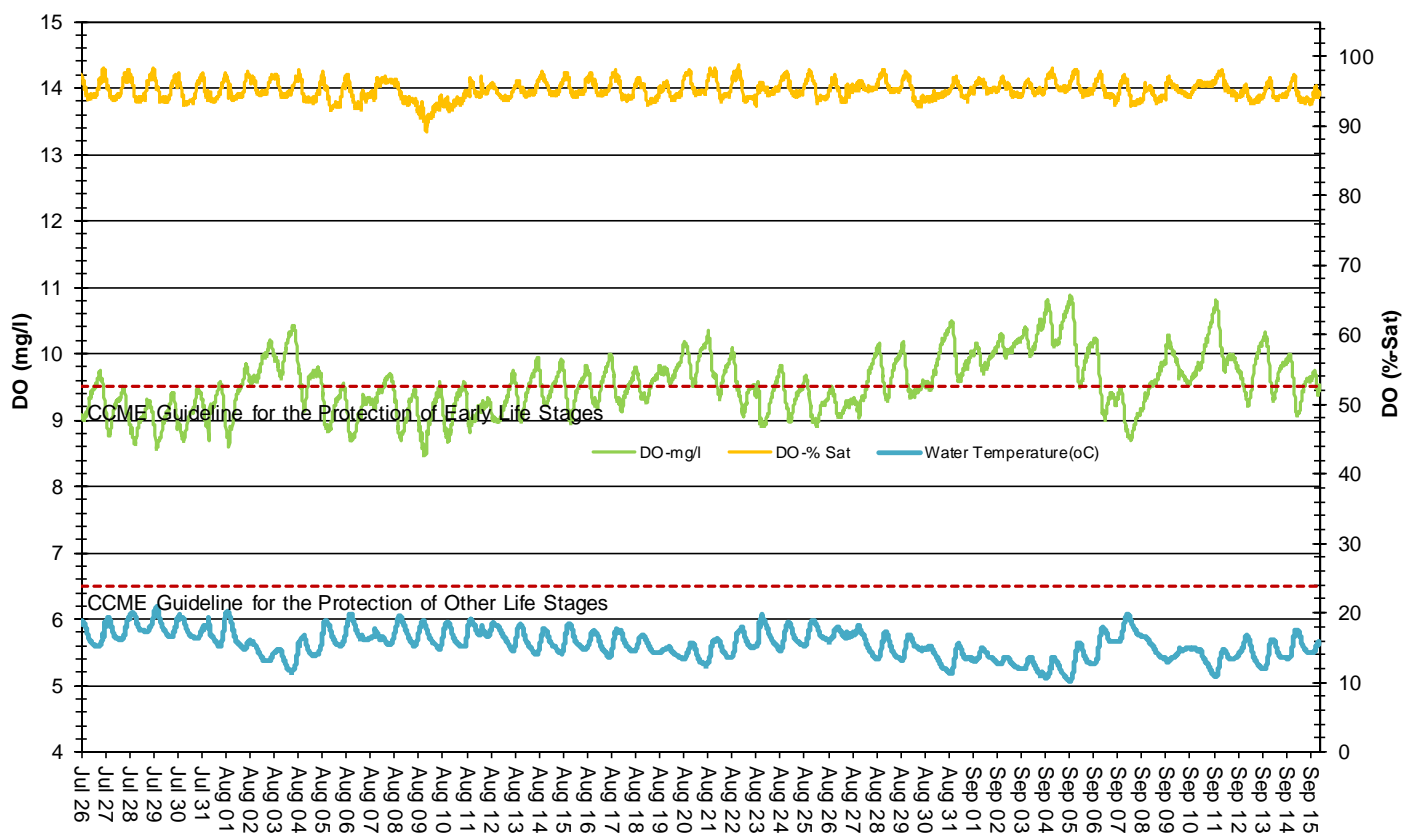


Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

Turbidity

- The turbidity sensor records values between 0 NTU and 3000 NTU. A turbidity reading of 3000 NTU 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 between 0.0 NTU to 497.0 NTU (Figure 6).
- Most 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 causing the water to turn cloudy, which is recorded by the turbidity sensor. This is typical of an urban stream where significant sediment loading is associated with even minor precipitation events.
- Turbidity readings from August 8, 2:02 AM to August 11 at 12:32 PM have been removed from the data set and are not included in graphs or statistics used in this report. During this time the turbidity sensor was covered in sediment and was returning readings that are assumed to be inaccurate. (See inside oval)
- Please note the stage data is raw data that is published on the ECC 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.

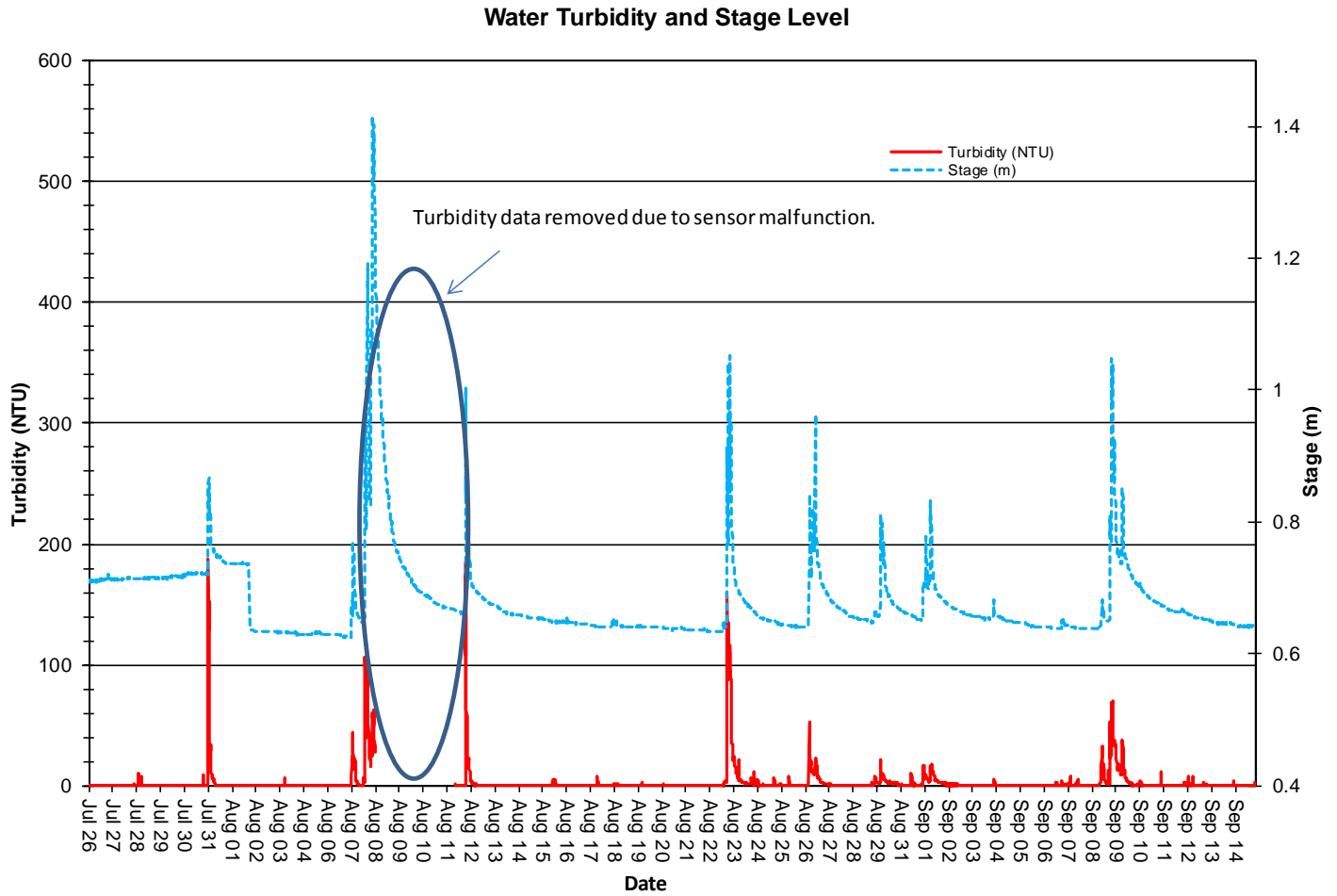


Figure 6: Turbidity (NTU) values at Leary's Brook Station

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.
- Stage (and streamflow) usually varies significantly throughout a deployment period in Leary's Brook. 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.

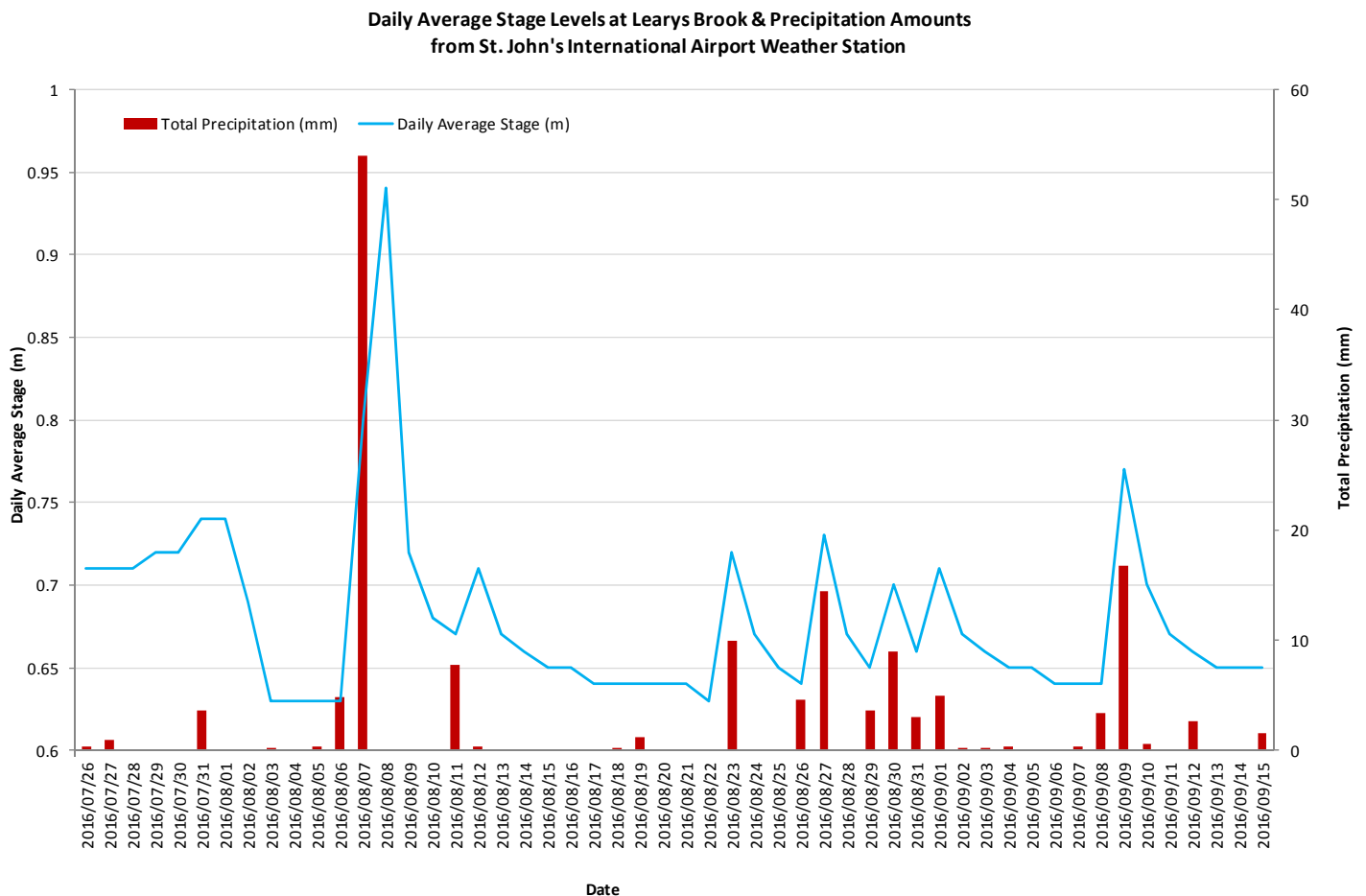


Figure 7: Daily average stage values (m) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

Generally in both natural and urban environments, climate and weather conditions can contribute in large part to variations in water quality. During this deployment it was evident that many of the changes in Leary's Brook water quality are related to intermittent precipitation events and small climatic changes of the seasons.

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

During this deployment period the median water temperature at the Leary's Brook station was 15.50°C.

The median pH value for Leary's Brook Station was 6.95 (pH units). The pH level for the most part, falls at this station during rainfall events and increases during dry periods.

Conductivity had a median value of 721.0 µS/cm. The maximum conductivity was 890.0 µS/cm. Conductivity generally peaked at periods of low stage.

Dissolved Oxygen at Leary's Brook had a median of 95.0 %Sat and 9.51 mg/L during the deployment period. Small reductions in DO (mg/L and % Sat) correspond with increases in water temperatures.

The turbidity median value at Leary's Brook during deployment was 2.9 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.