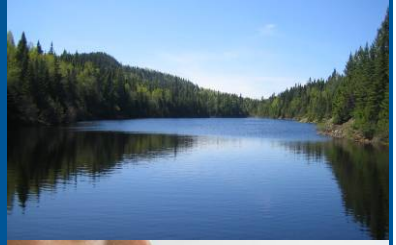
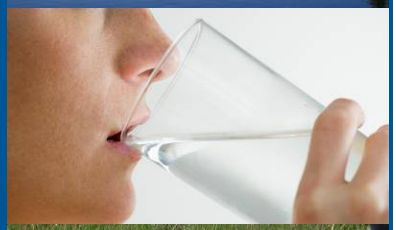






Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
June 30, 2017 to August 14, 2017

Newfoundland Labrador

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

Leary's Brook, Newfoundland and Labrador

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General

- The Water Resources Management Division (WRMD), in partnership with Environment and Climate Change Canada (ECCC), 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 June 30, 2017 and removal on August 14, 2017.

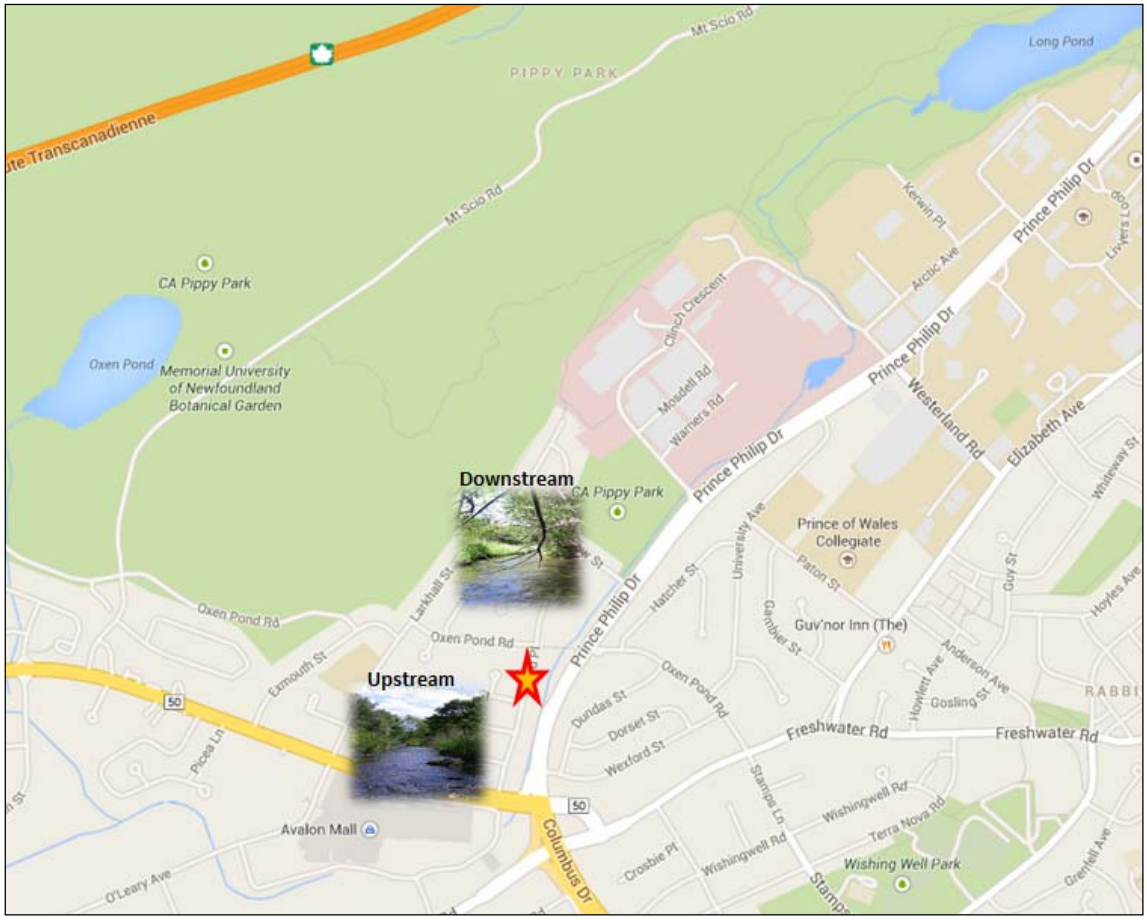

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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 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 June 30, 2017 to August 14, 2017 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	**June 30, 2017**	**Deployment**	Good	Excellent	Excellent	Excellent	Excellent
	August 14, 2017	**Removal**	Good	Excellent	Excellent	Excellent	Good

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

- At the time of removal, temperature and turbidity ranked as "Good" while pH, conductivity and dissolved oxygen readings ranked as "Excellent".

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 30, 2017 to August 14, 2017 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 ECCC weather station at St. John's International Airport.
- A number of interruptions in data transmission occurred during this deployment period, likely the result of transmission equipment failures.

Leary's Brook

Water Temperature

- Water temperature ranged from 10.40 °C to 21.10 °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.
- Please note the stage data is raw data that is published on the ECCC 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.

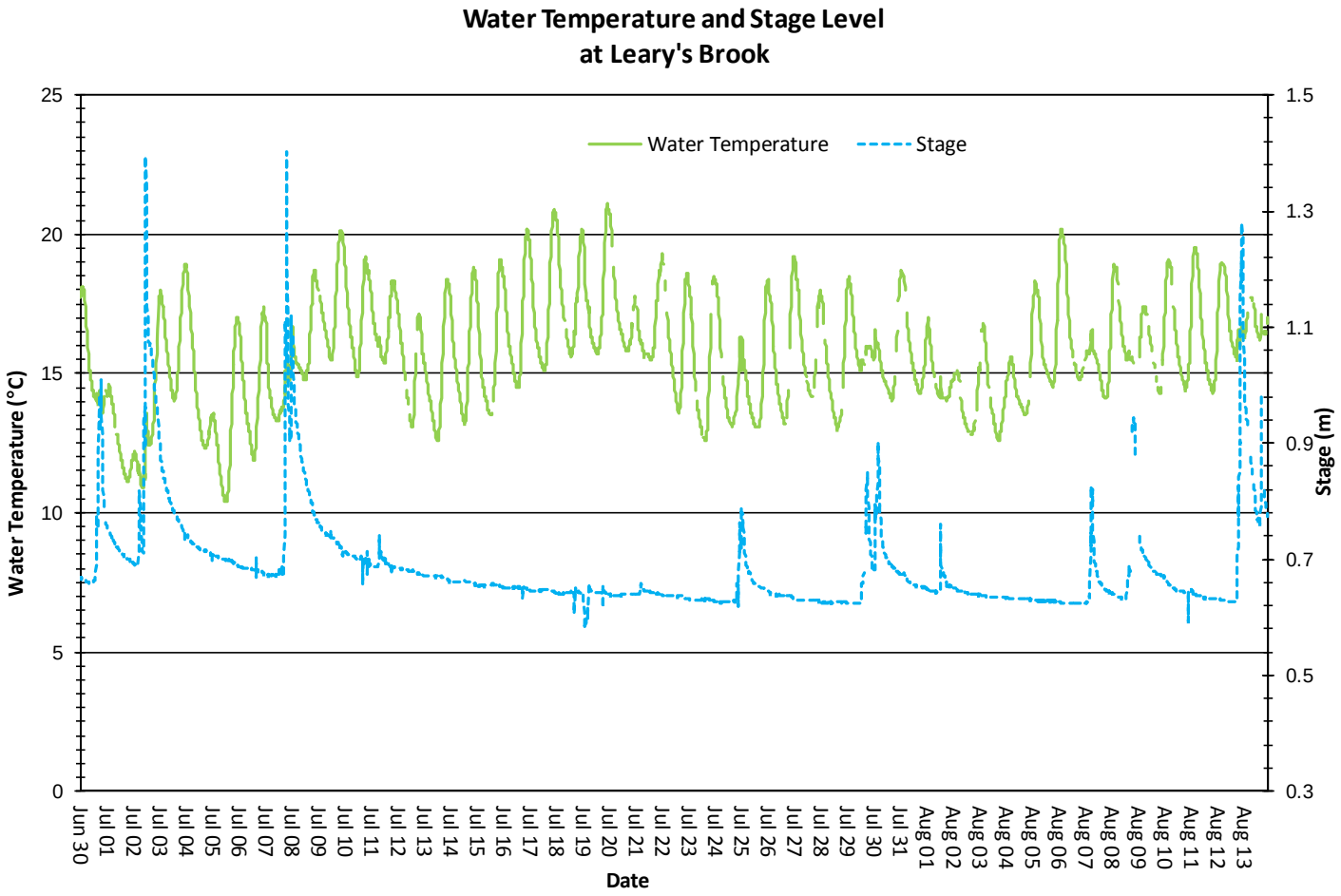

Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.63 pH units and 10.94 pH units (Figure 3).
- 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 6.94 (pH units) for this deployment period.
- During the period from the afternoon of July 4, 2017 to the afternoon of July 6, 2017 pH in Leary's Brook spiked very high in three separate incidents. These spikes, reaching a high of pH 10.94 were likely caused by upstream construction and the deposit into the brook of cement/concrete runoff or washout.
- pH typically falls slightly in Leary's Brook (the water becomes more acidic) at the same time as stage and flow are increasing 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.

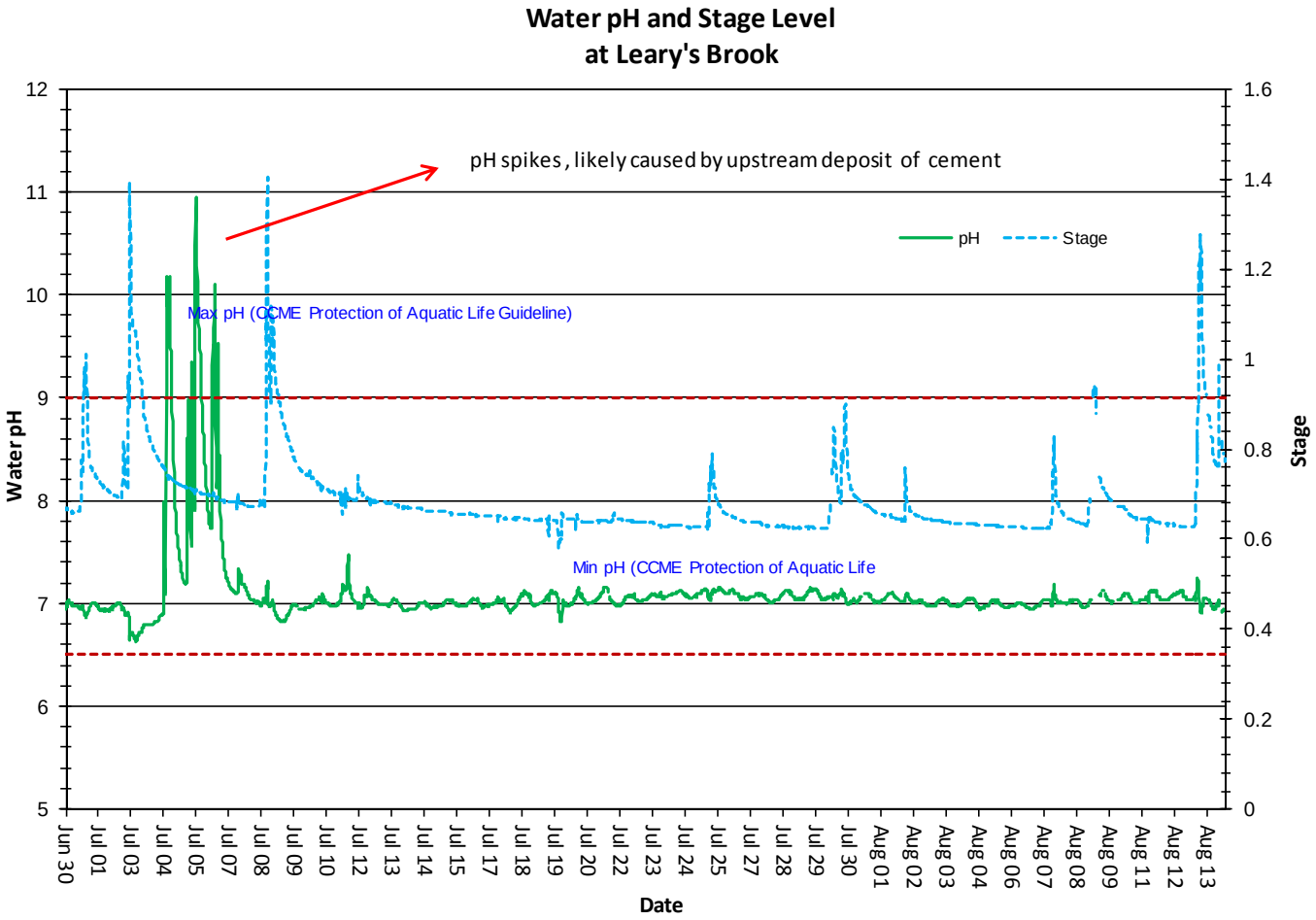

Figure 3: Water pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 149.8 µS/cm and 909.0 µS/cm during this deployment period. The median was 699.0 µS/cm. TDS ranged from 0.0959 g/ml to 0.5820 g/ml. (Figure 4)
- Decreases in conductivity seen during this deployment period are associated with precipitation runoff and increasing flows. This is typical for this time of the year as runoff from precipitation dilutes salts carried into the brook from urban environments.
- A spike in conductivity recorded during the July 4 to 6 period corresponds with the elevated pH recorded at that time.

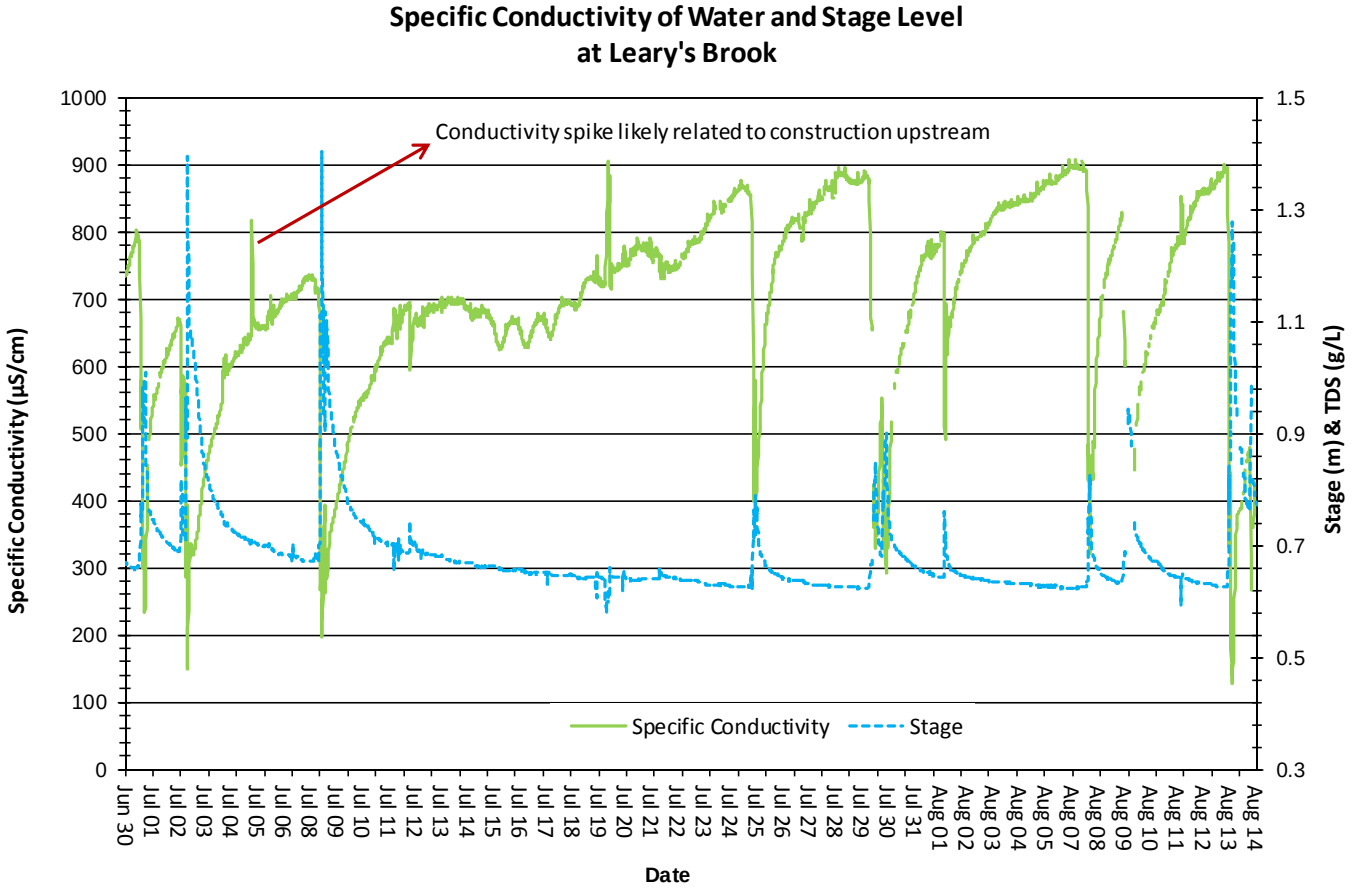

Figure 4: Specific conductivity values at Leary's Brook Station

Dissolved Oxygen

- The instrument measures dissolved oxygen (mg/L) and then calculates the percent saturation (% Sat.).
- The Dissolved Oxygen % Sat levels within this deployment period were between 86.5 % Sat and 99.1 % Sat. Dissolved Oxygen (mg/L) measured between 8.23 mg/L and 10.87 mg/L. (Figure 5)
- The DO mg/L values were often below the minimum DO CCME guideline for the protection of early life stages during this deployment period (Figure 5). DO values remained above the guideline for the protection of other life stages throughout the deployment period.
- Decreases in available oxygen are associated with increases in water temperature. Warm water can hold less dissolved oxygen than cooler water.
- The lowest levels of DO correspond with the highest water temperatures recorded during this deployment period. Water temperatures in Leary's Brook reached 21.10 ^{o}C on July 20.

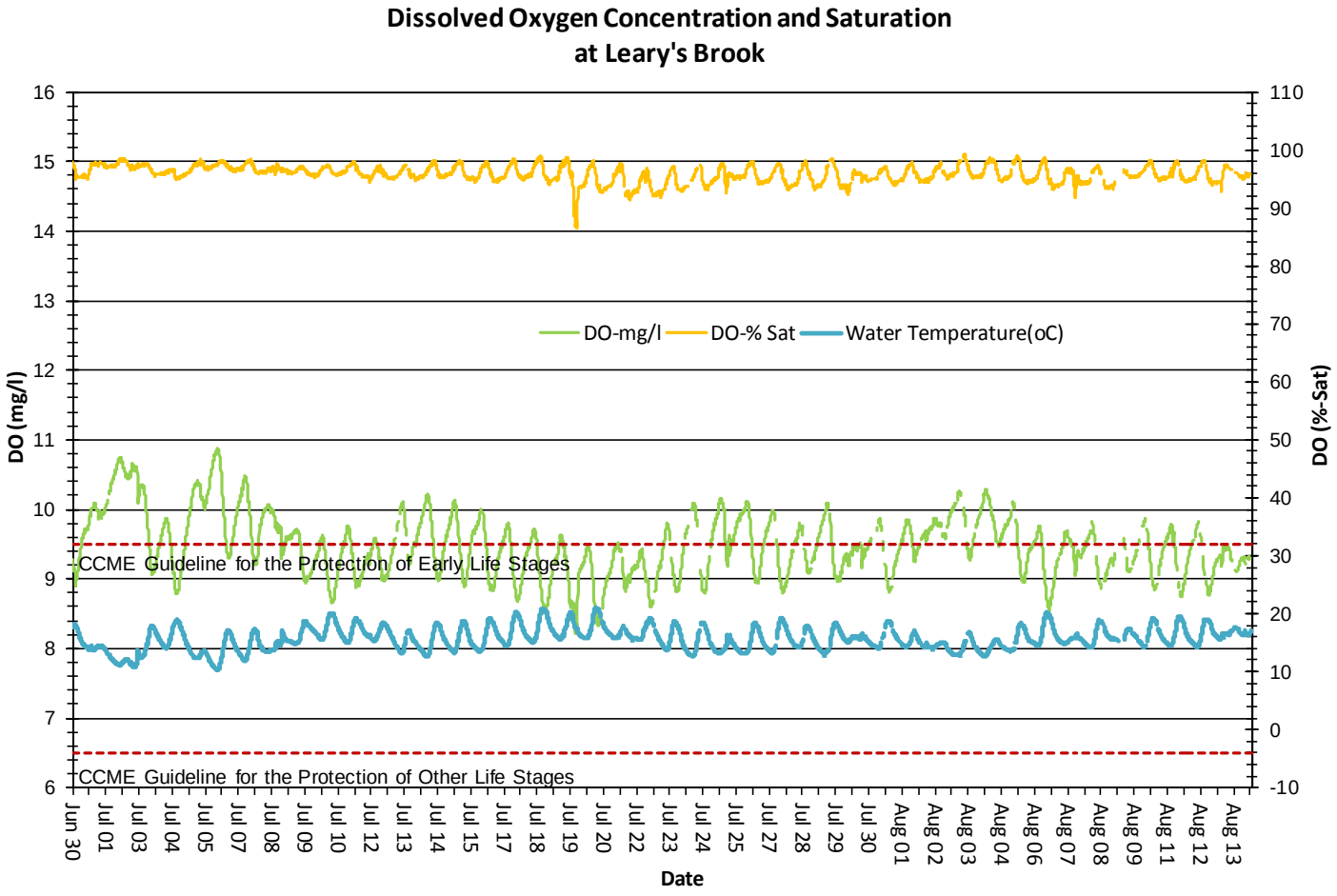

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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 sensor was believed to be covered in sediment from the morning of August 9 to mid-morning on August 11. Turbidity readings recorded during this period are not reliable and have been removed from the dataset.
- The turbidity readings during this deployment ranged between 0.0 NTU to 111.3 NTU (Figure 6).
- Highest turbidity levels usually correspond with the early stage of precipitation events and elevated river stage and runoff. Rainfall and subsequent runoff along with increased flow carries sediment and other material into the brook which is captured by the turbidity sensor. This is typical of Leary's Brook where significant sediment loading is associated with even minor precipitation events.
- High turbidity levels were also recorded during the July 4 to July 6 period and are likely associated with the same upstream construction that also caused pH and conductivity to peak.

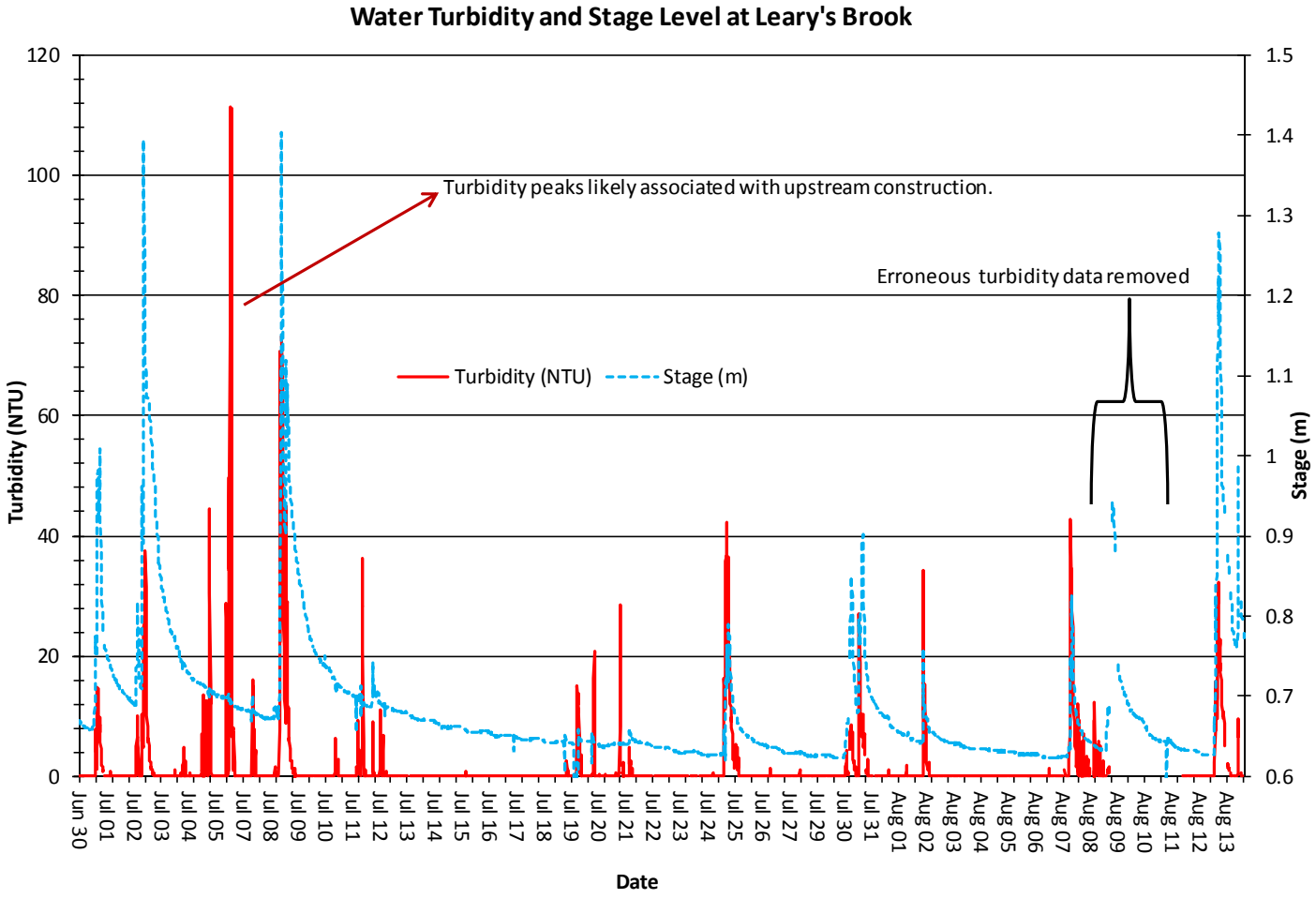

Figure 6: Turbidity (NTU) values at Leary's Brook Station

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(Figure 7). 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.

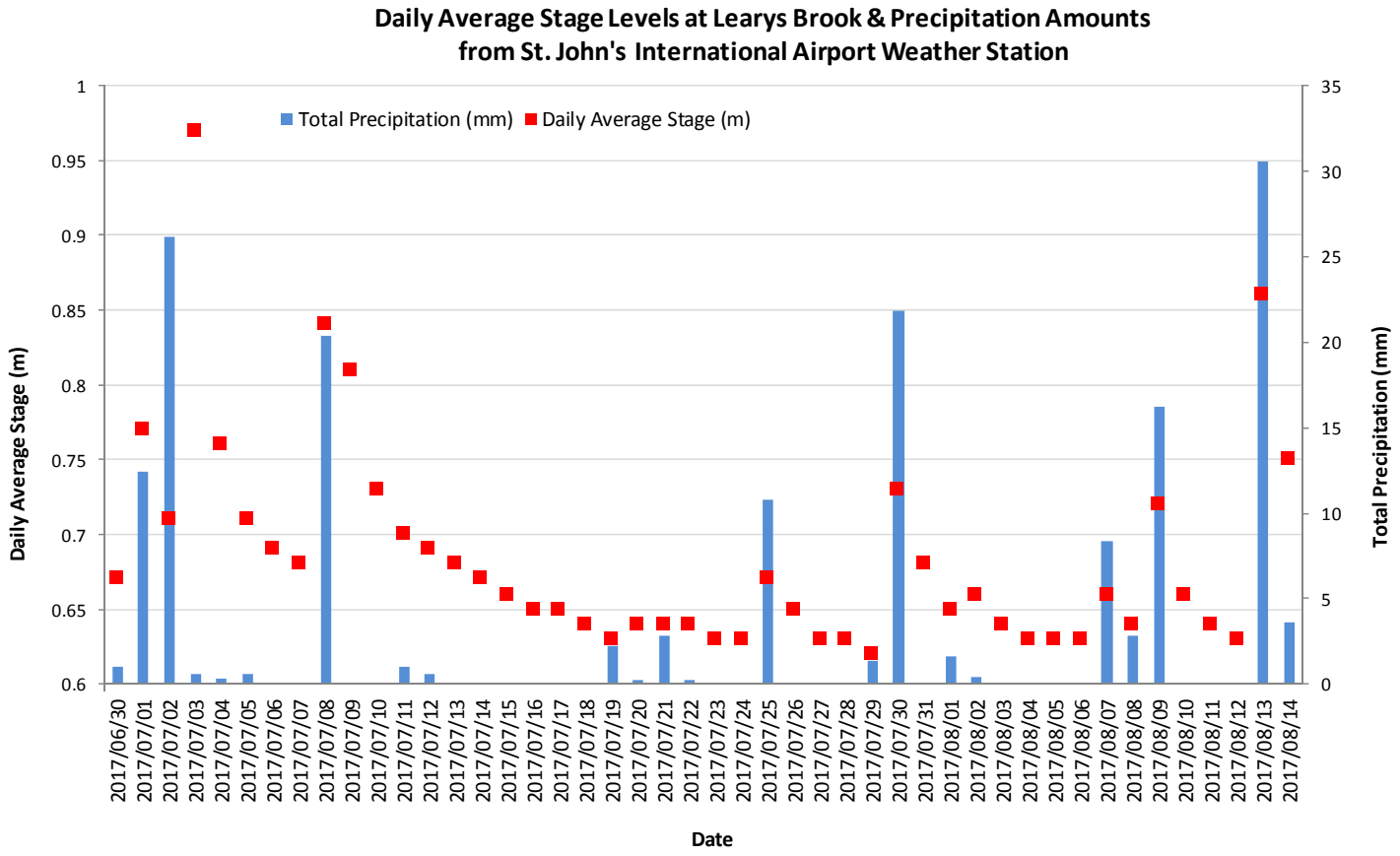

Figure 7: Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from St. John's International Airport.

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.

Also evident during this deployment period were instances when water quality in Leary's Brook was significantly adversely impacted by instream or near stream construction activities upstream of the monitoring station. From July 4 to July 6, on three occasions, recorded pH levels in Leary's Brook exceeded 10, peaking near pH 11 on July 5. For a period of approximately 9 hours on July 5, recorded pH levels in Leary's Brook exceeded 9. High turbidity levels were also recorded during this period.

WRMD staff visited Leary's Brook on July 6 and confirmed that both pH and turbidity were high. Construction for the new Leary's Brook Bridge on O'Leary Avenue was underway at this time as was construction at the Avalon Mall parking lot. These activities likely contributed to the water quality deterioration in Leary's Brook.

Precipitation and runoff 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 15.5°C.

The median pH value for Leary's Brook Station was 7.02 (pH units). The pH level usually decreases at this station during rainfall events and increases during dry periods.

Conductivity had a median value of 699.0 µS/cm. The maximum conductivity was 909.0 µS/cm. At this time of year, conductivity increases in Leary's Brook as water levels decline and dissolved salts become more concentrated.

Dissolved Oxygen at Leary's Brook had a median of 95.9 %Sat and 9.48 mg/L during the deployment period. Reductions in DO (mg/L and % Sat) correspond with increases in water temperatures. DO levels often fell below the "CCME Guideline for the Protection of Early Life Stages".

The turbidity median value at Leary's Brook during deployment was 0.0 NTU. Increases in stage level can explain most, though not all, 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. As discussed above, turbidity values also increased due to upstream construction activity or some other disturbance.