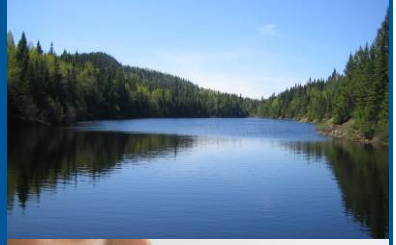







Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
June 15, 2015 to July 16, 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 deployment on June 15, 2015 until removal on July 16, 2015.

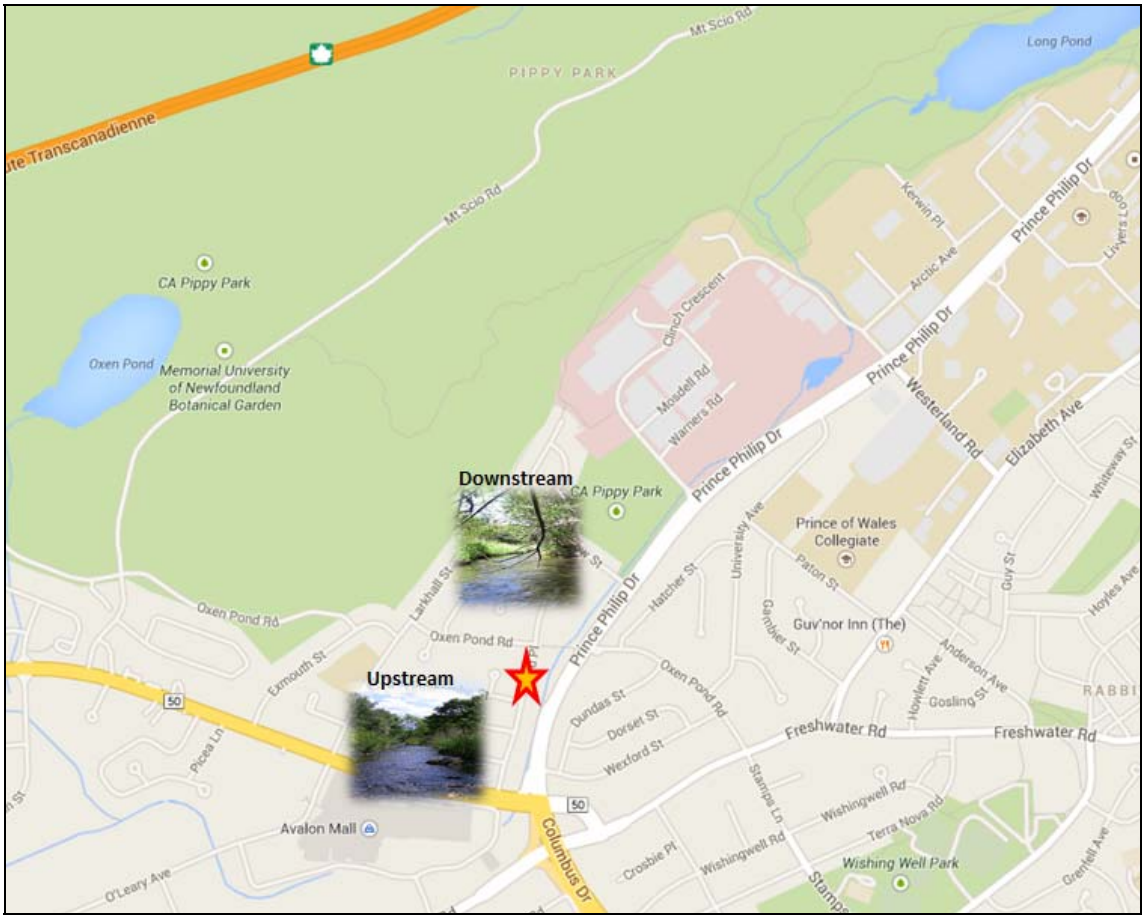

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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 June 15, 2015 to July 16, 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	June 15 2015	Deployment	Good	Good	Excellent	Fair	Excellent
	July 16 2015	Removal	Excellent	Excellent	Excellent	Fair	Excellent

- At the Leary's Brook station at the point of deployment, the conductivity and turbidity data ranked as 'Excellent'. The pH and temperature reading for deployment ranked as 'Good'. The dissolved oxygen data comparison ranked the data as 'Fair' during initial deployment.

- At removal, the temperature, conductivity, turbidity and pH data all ranked 'Excellent'. The dissolved oxygen ranked as "Fair".

Deployment Notes

There were no transmission errors during this deployment period at Leary's Brook.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 15, 2015 to July 16, 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's weather station at St. John's International Airport.

Leary's Brook

Water Temperature

- Water temperature ranged from 8.82°C to 18.20°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. As the seasonal air temperatures start to increase there is an increase in the average water temperature as the deployment period continues.
- 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.

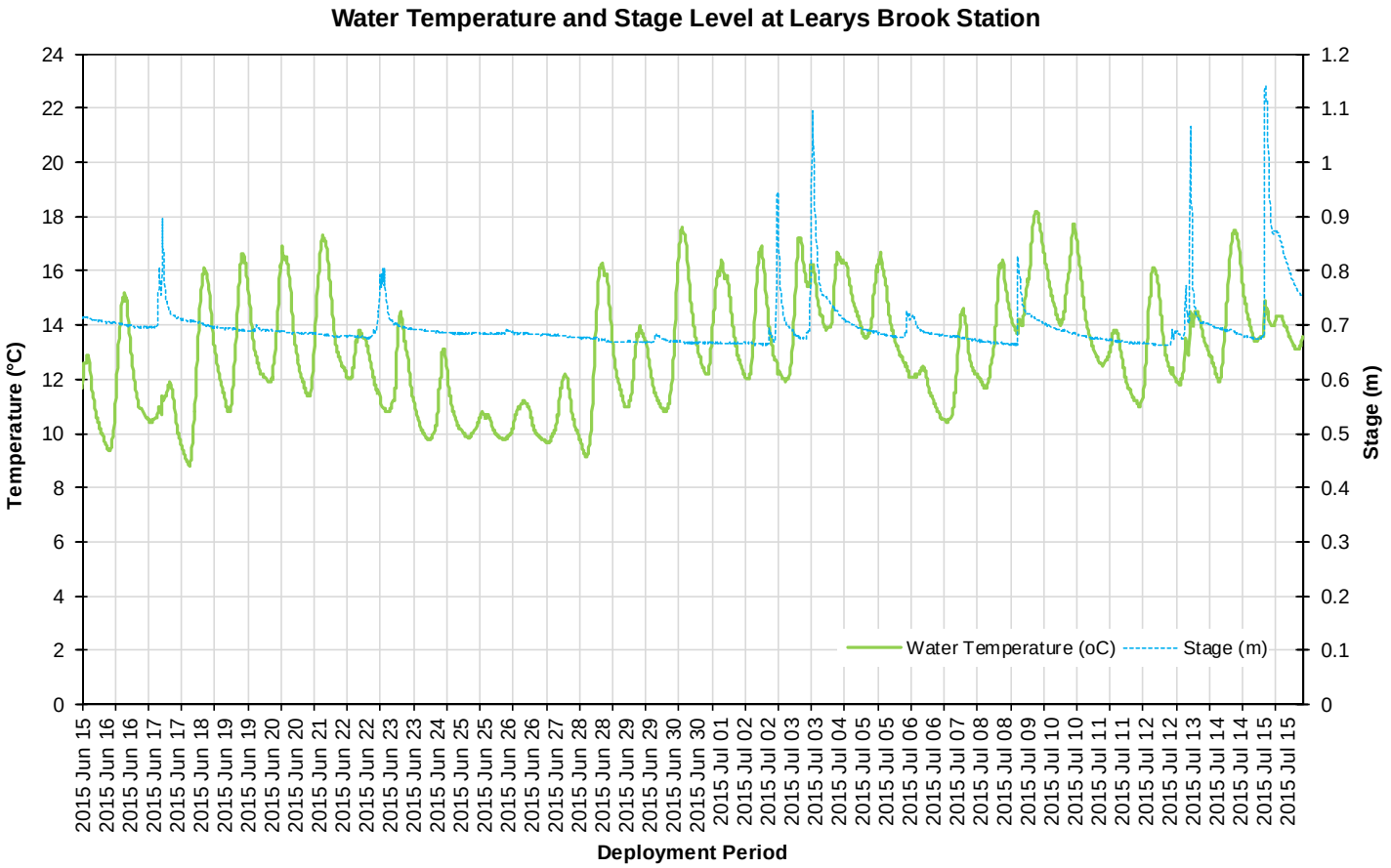

Figure 2: Water temperature (°C) values at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.55 pH units and 7.83 pH units (Figure 3).
- During 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 7.01 (pH units) for this deployment period.

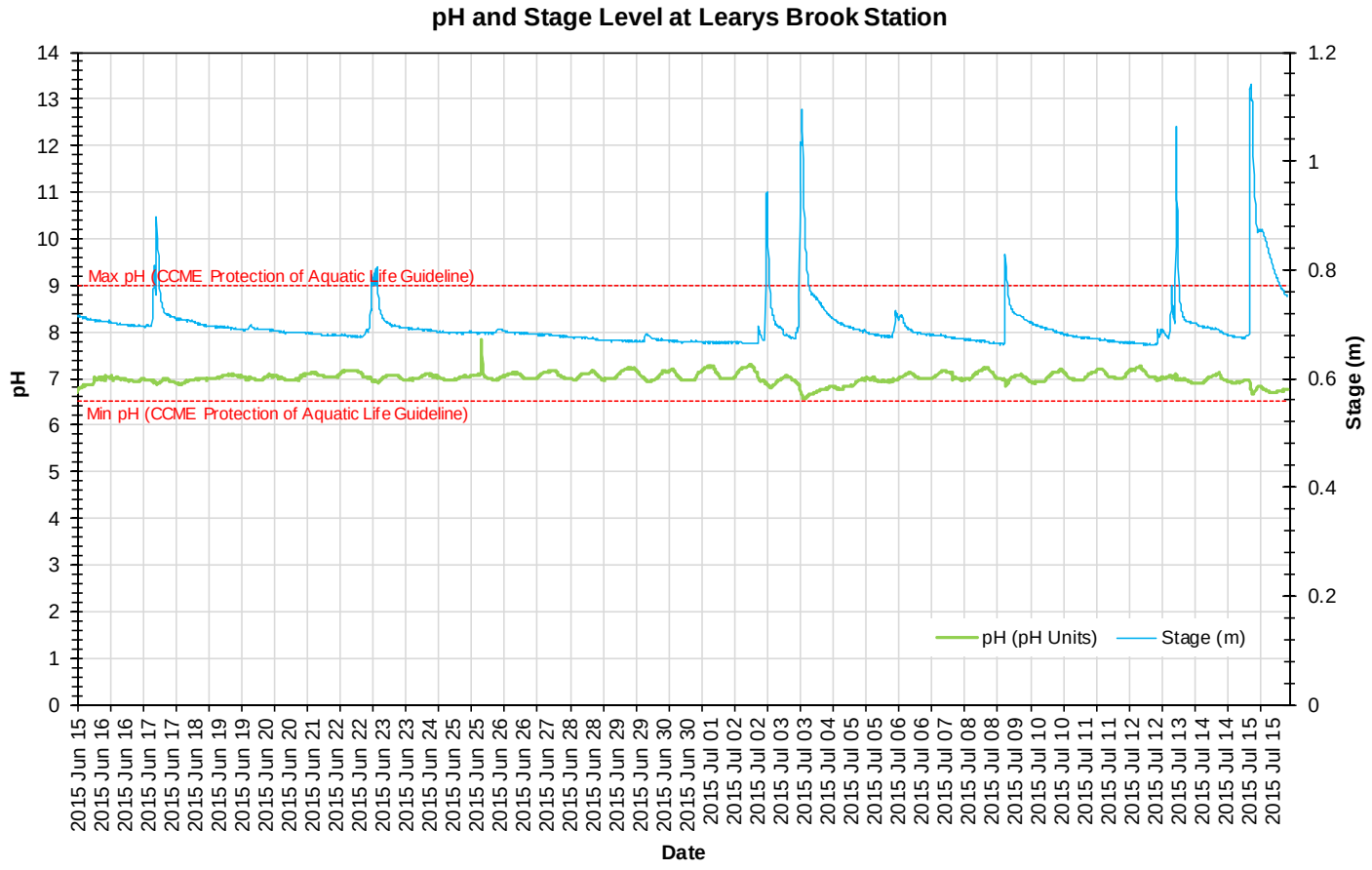

Figure 3: pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 173.4 µS/cm and 819 µS/cm during this deployment period. TDS ranged from 0.1110 g/ml to 0.5240 g/ml.
- 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. This is evident on Figure 4.
- The dips in conductivity data after increases in stage indicate that the brook is being flushed naturally. The suspended matter and dissolved substances in the brook are flushed for a short period of time with the higher flow. This is evident on several occasions during this deployment.

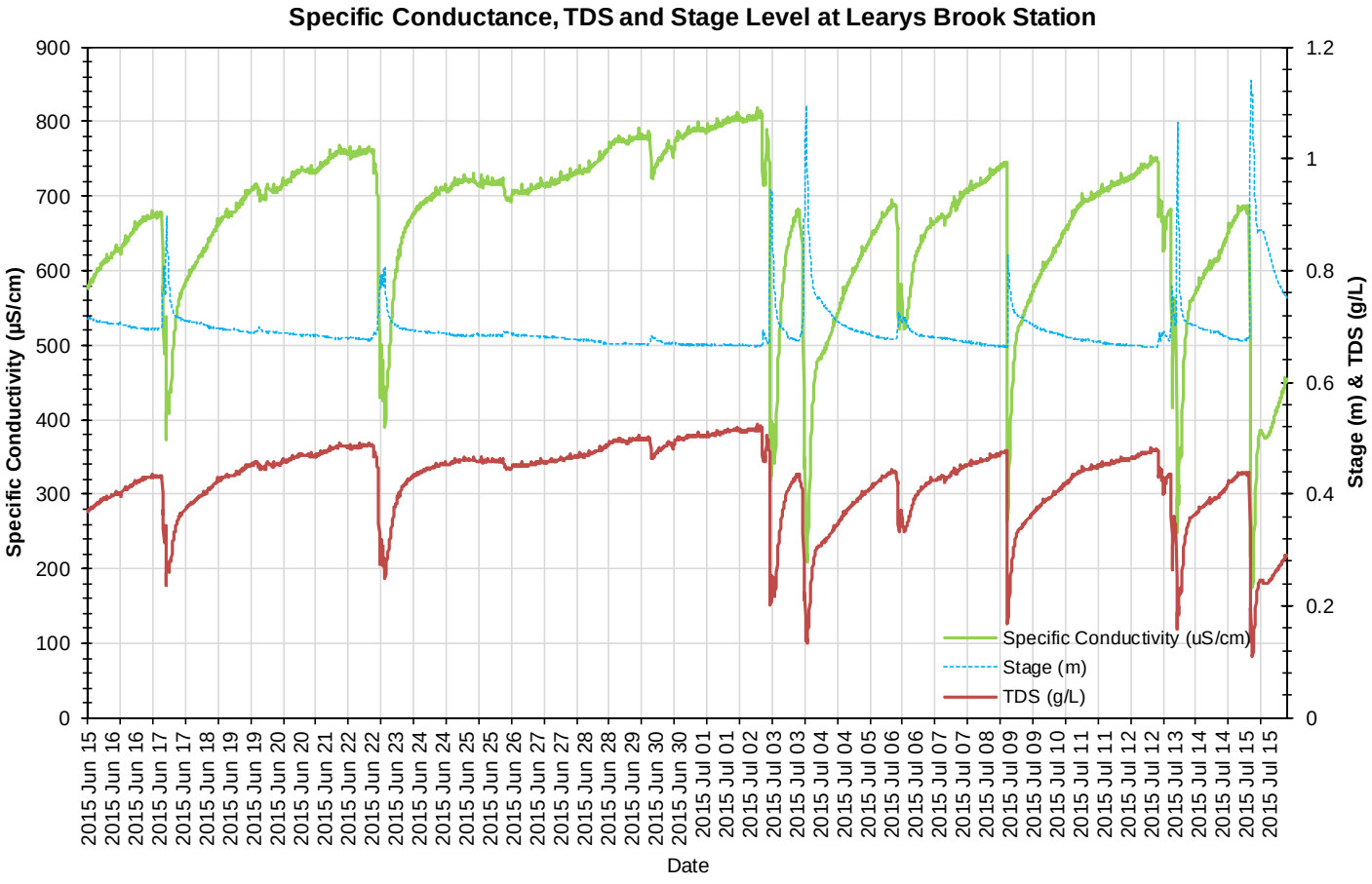

Figure 4: Specific conductivity (µS/cm) & TDS (g/L) values at Leary's Brook Station

Dissolved Oxygen

- The instrument measures dissolved oxygen (mg/L) directly then calculates percent saturation (% Sat.).
- The Dissolved Oxygen % Sat levels recorded within this deployment period were between 84.2% Sat and 97.6% Sat. Dissolved Oxygen (mg/L) measured between 8.14 mg/L and 10.48 mg/L.
- The DO mg/L values are generally lower than the minimum DO CCME guideline for early life stages for the majority of this deployment period (Figure 5). Dissolved oxygen data ranked only as "fair" when compared to readings from the QA/QC sonde at the beginning and end of this deployment period. Values recorded by the field sonde are likely lower than actual conditions.
- There is a slight decrease in dissolved oxygen concentration across the deployment period. This is to be expected as the air and water temperatures start to increase as summer advances. Cold water can hold more dissolved oxygen than warm water.

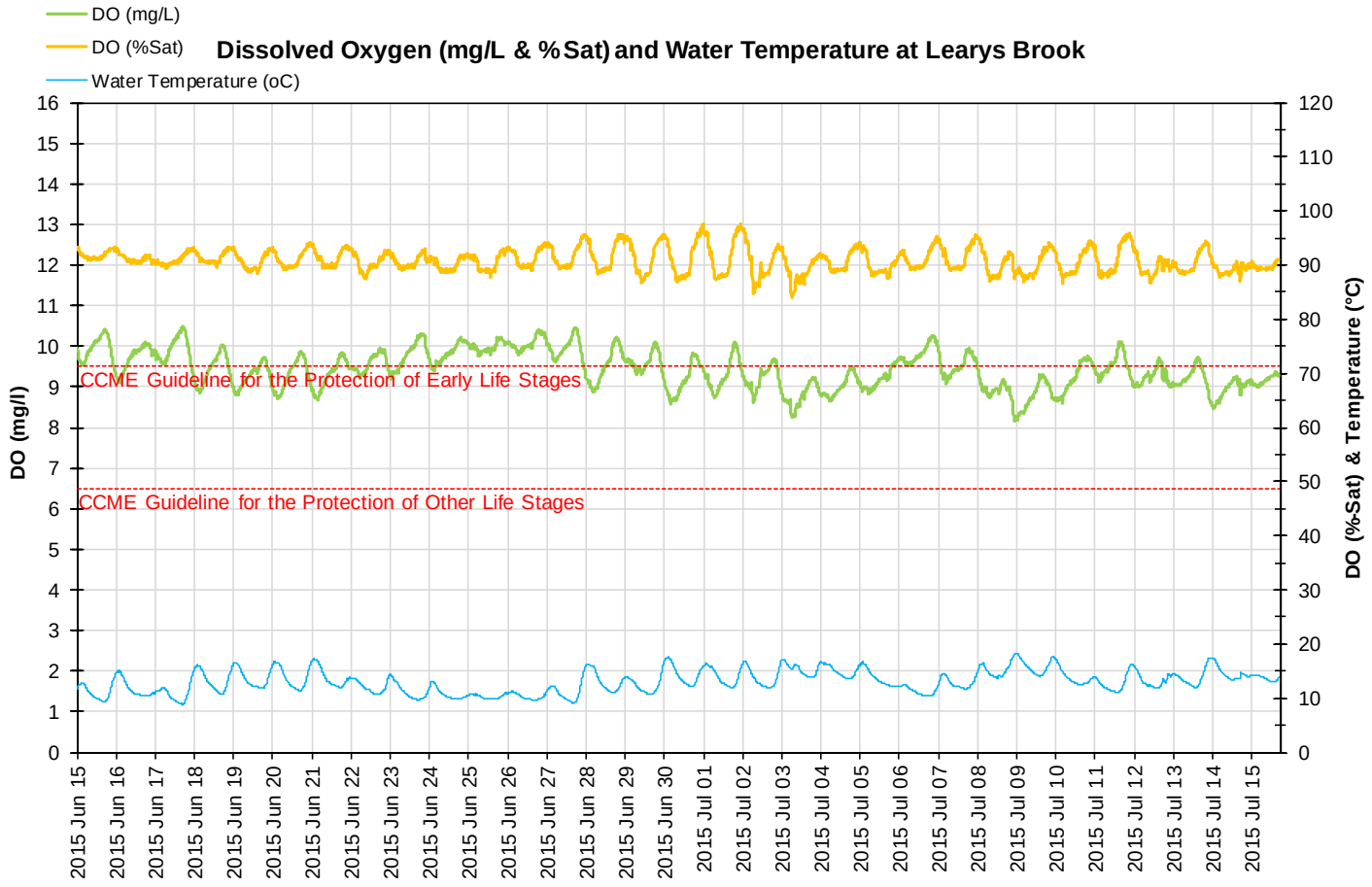

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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.
- Almost all of the turbidity readings recorded during this deployment were 0.0 NTU with one recorded value of 7.2 NTU (Figure 6).
- Increases in turbidity usually correlate with elevated stage during a deployment period. Rainfall and subsequent runoff carries road sediment and other material into the brook and this is what the turbidity sensor captures. No such correlation occurred during this deployment.
- Data collected by the turbidity sensor during this deployment period is suspect as it does not correlate to increased runoff and (at 0) is not representative of conditions usually measured in Learys Brook at this time of the year.
- The turbidity data for this deployment period has been removed from the dataset.

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 not unusual to see stage (and streamflow) vary throughout the deployment period (Figure 7). Stage is directly influenced by rainfall and subsequent runoff from the surrounding environment.
- The highest total precipitation occurs on July 2, 2015 at 22.2mm. This precipitation event corresponds with stage increases near the same timeframe.
- June was relatively dry in 2015 and stage did not correspond immediately with precipitation events as most precipitation was absorbed by the ground. July was much wetter than June and stage was more immediately affected by precipitation.

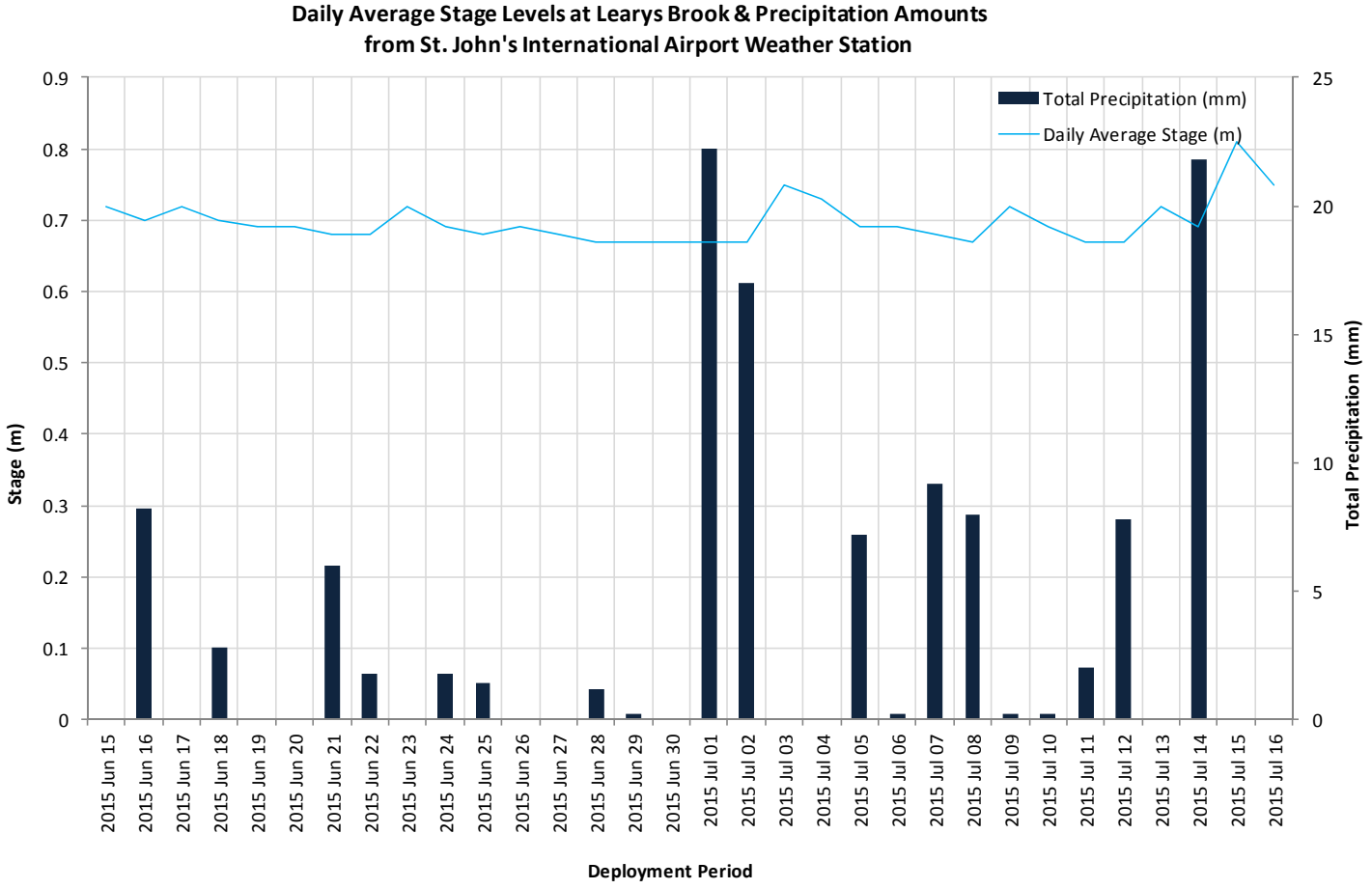

Figure 7: Stage values (m), flow (m3/s) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

Generally in natural environments, climate and weather conditions 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 and small climatic changes of the seasons.

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

The turbidity sensor did not return accurate readings during this deployment. The sensor was replaced at the conclusion of this deployment.

Elevated runoff when road salting is not occurring causes TDS and specific conductance to decrease with the influx of relatively clean rainwater. The specific conductivity median at Leary's Brook was 693.0µS/cm, which is approximately half the mean recorded during road salting season.

During this deployment period the median water temperature at the Leary's Brook station was 12.80°C. Water temperature will continue to fluctuate and be influenced by the surrounding summer air temperatures.

The median pH value for Leary's Brook Station was 7.01 (pH units). The pH level for the most part is steady at this station.

Dissolved Oxygen at Leary's Brook had a median of 90.6 %Sat during the deployment period. Small dips in DO (mg/L and % Sat) correspond with increases in water temperatures. The larger dips in DO (mg/L and %Sat) at Leary's Brook correspond with rainfall events.