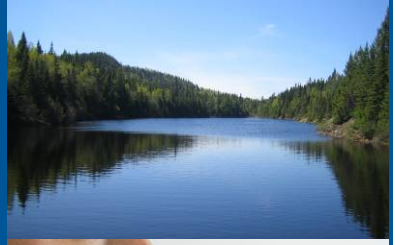







Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
April 15, 2015 to June 15, 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 April 15, 2015 until removal on June 15, 2015.

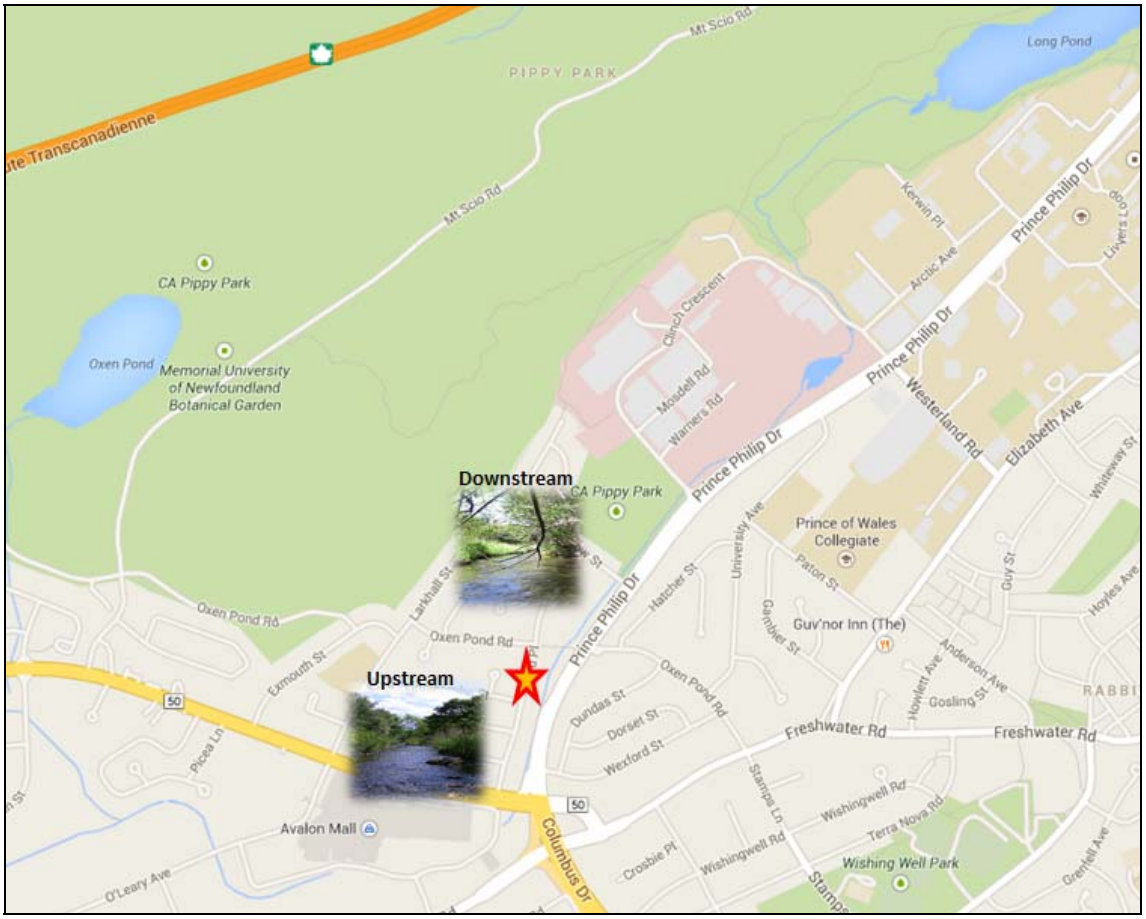

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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 April 15, 2015 to June 15, 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	**Apr 15 2015**	**Deployment**	Good	Good	Excellent	Excellent	Fair
	June 15 2015	**Removal**	Excellent	Good	Excellent	Excellent	Fair

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

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

Deployment Notes

- There were two transmission errors during this deployment period at Leary's Brook. The outages on April 16 and April 20 both lasted for approximately 2 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 April 15, 2015 to June 15, 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 0.63°C to 17.00°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.

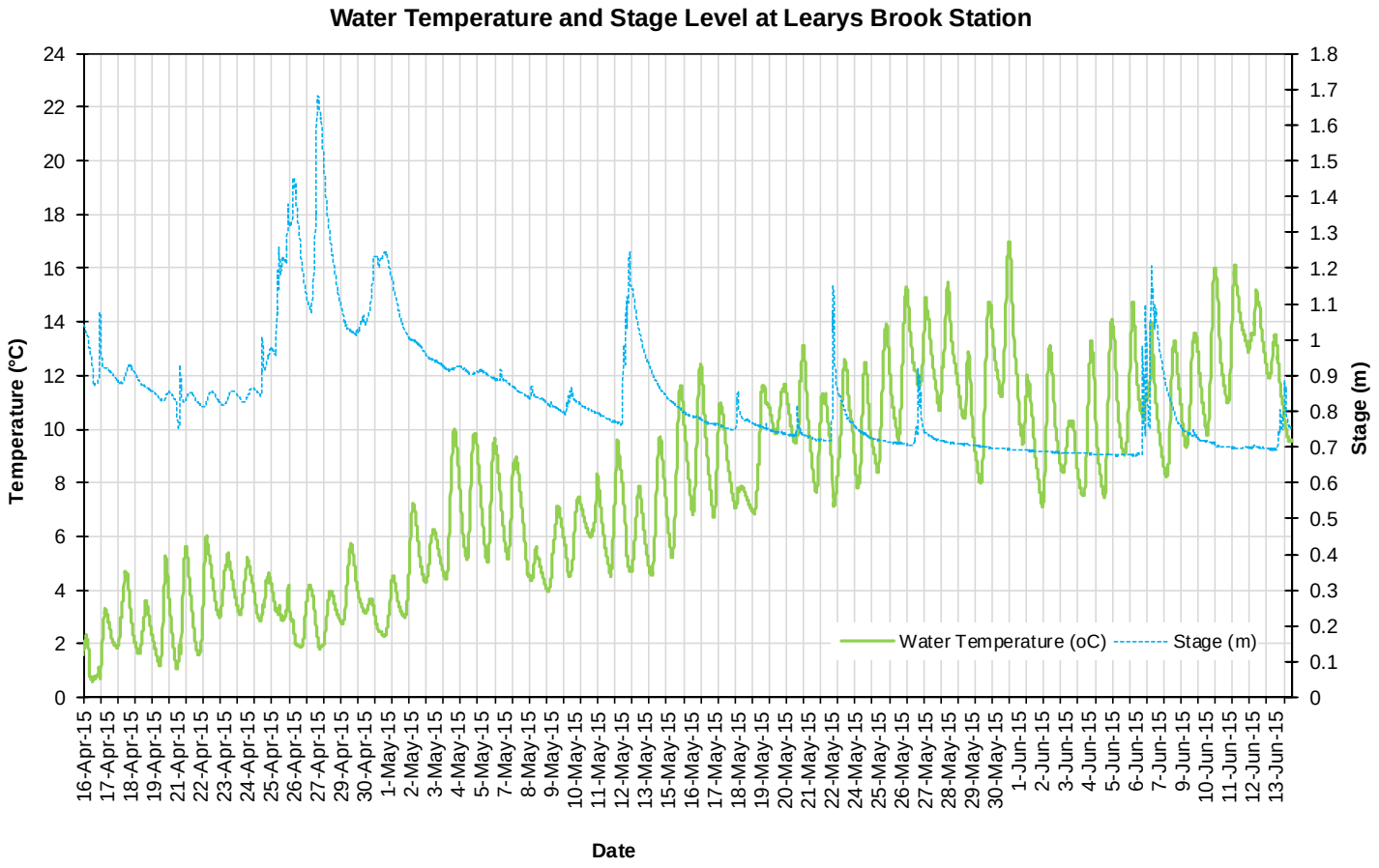

Figure 2: Water temperature (°C) values at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 6.09 pH units and 7.16 pH units (Figure 3).
- During the deployment, the majority of pH values were near 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 6.59 (pH units) for this deployment period.

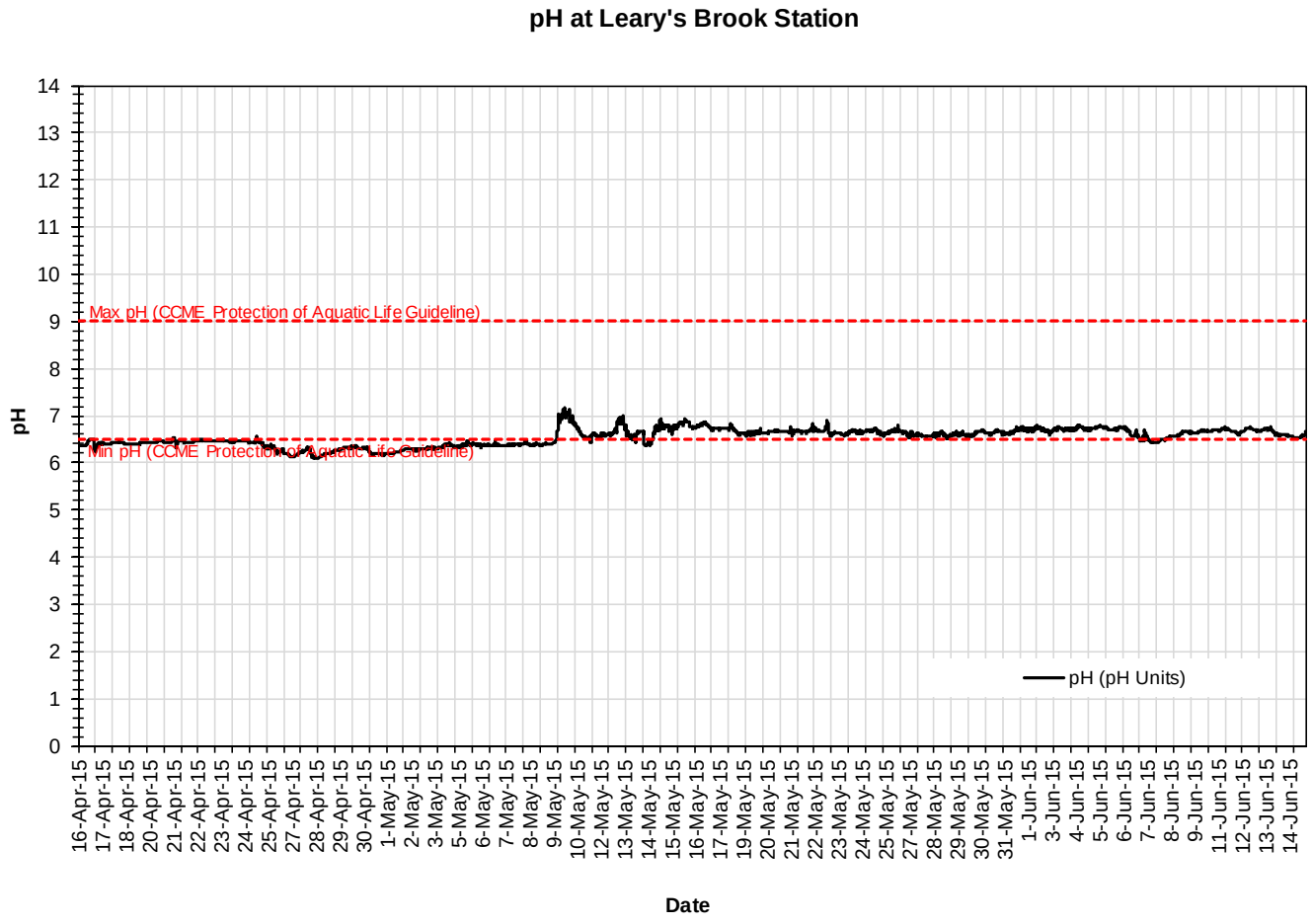

Figure 3: pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 187.3 µS/cm and 1146.9 µS/cm during this deployment period. TDS ranged from 0.1199 g/ml to 0.7340 g/ml.
- During the beginning of the deployment the peaks in conductivity are likely a result of the road salting that occurs during the colder periods (Figure 4). Notable peaks in conductivity occurred during the morning hours of April 25 and May 8. Freezing drizzle and freezing fog was reported from the St. John's weather station overnight on April 24 and roads were likely salted at that time. Similarly, on May 8 snow was falling during the morning commute hours and road salting had likely occurred.
- After May 8 the higher spikes in conductivity dissipate as overnight temperatures rise and the road salting is no longer occurring.

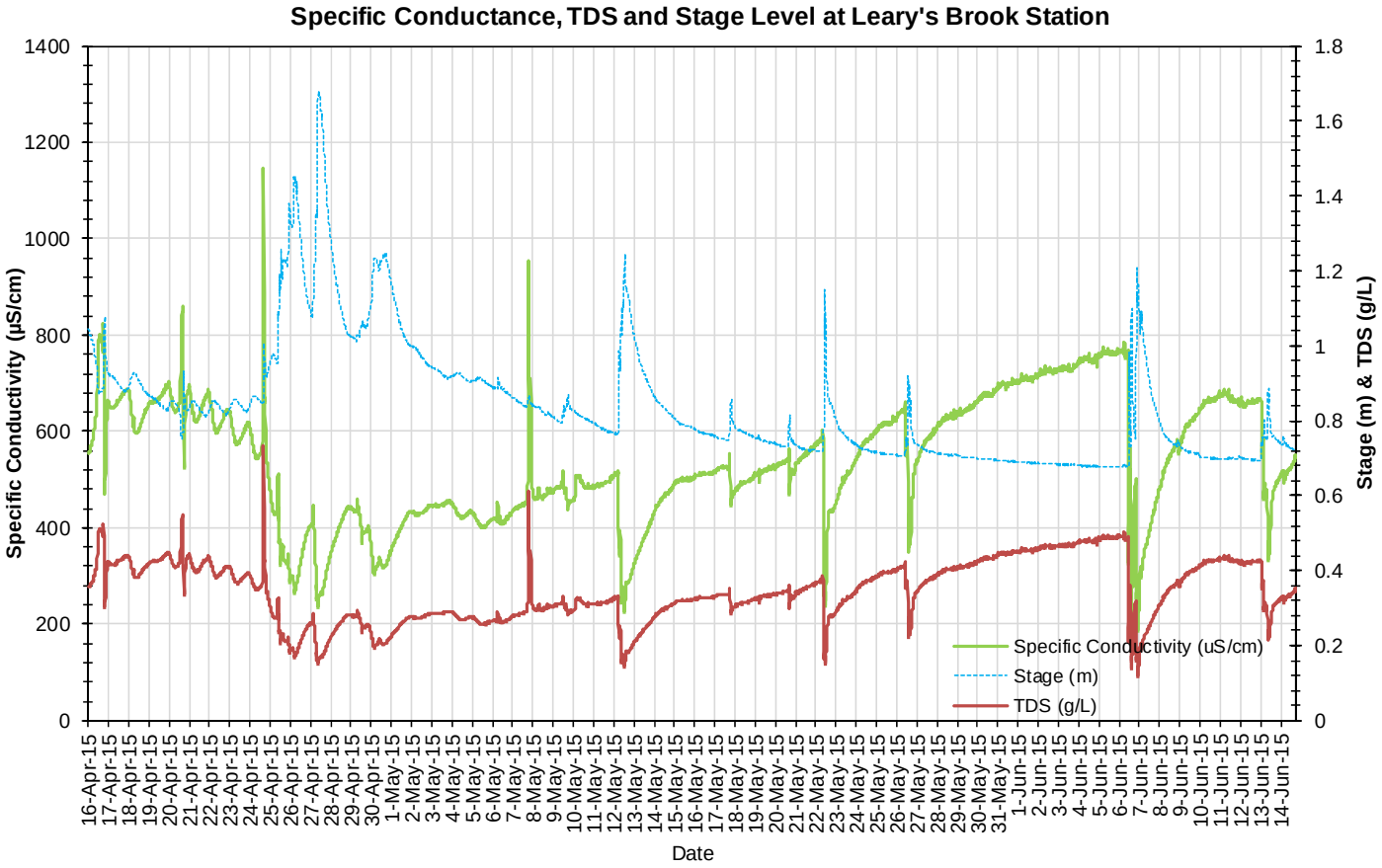

Figure 4: Specific conductivity (µS/cm) & TDS (g/L) values at Leary's Brook Station

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 93.3% Sat and 101.7% Sat. Dissolved Oxygen (mg/L) measured between 9.30 mg/L and 13.98 mg/L.
- The DO mg/L values are generally above the minimum DO CCME guideline for early life stages for the majority of this deployment period (Figure 5).
- 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 spring advances. Cold water can hold more dissolved oxygen than warm water.

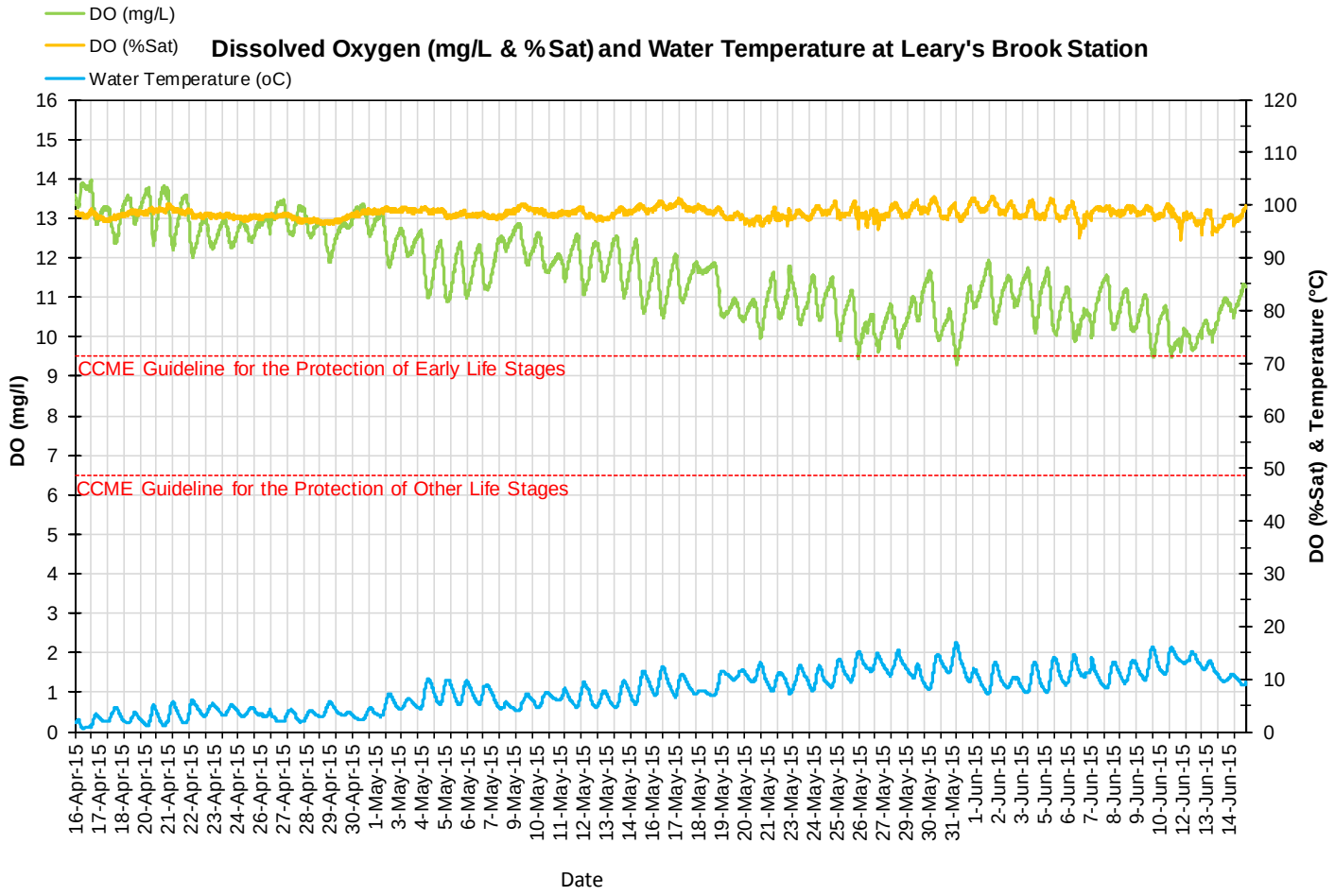

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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.
- The turbidity readings during this deployment ranged within 0.0 NTU to 63.5 NTU (Figure 6).
- It is likely that the higher turbidity values correspond with precipitation events and elevated river stage and runoff (Figure 7). Increases in turbidity closely correlate with elevated stage in the early part of the deployment period. Rainfall and subsequent runoff carries road sediment and other material into the brook and this is what the turbidity sensor captures.
- Data collected by the turbidity sensor after April 30th was invalid due to sensor malfunction.

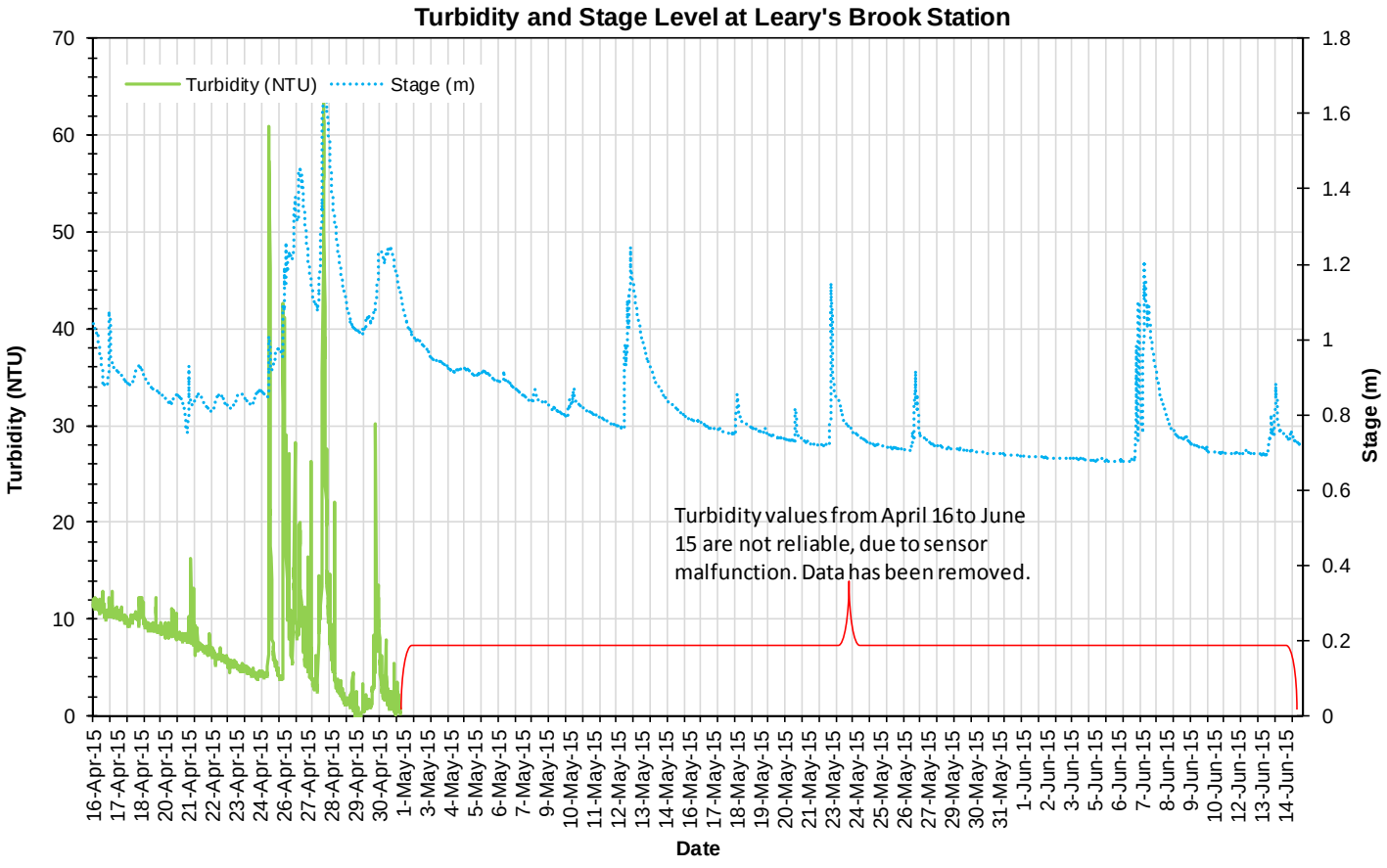

Figure 6: Turbidity (NTU) values at Leary's Brook Station

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 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 June 7th, 2015 at 37.2mm. This precipitation event corresponds with stage increases for the same timeframe.

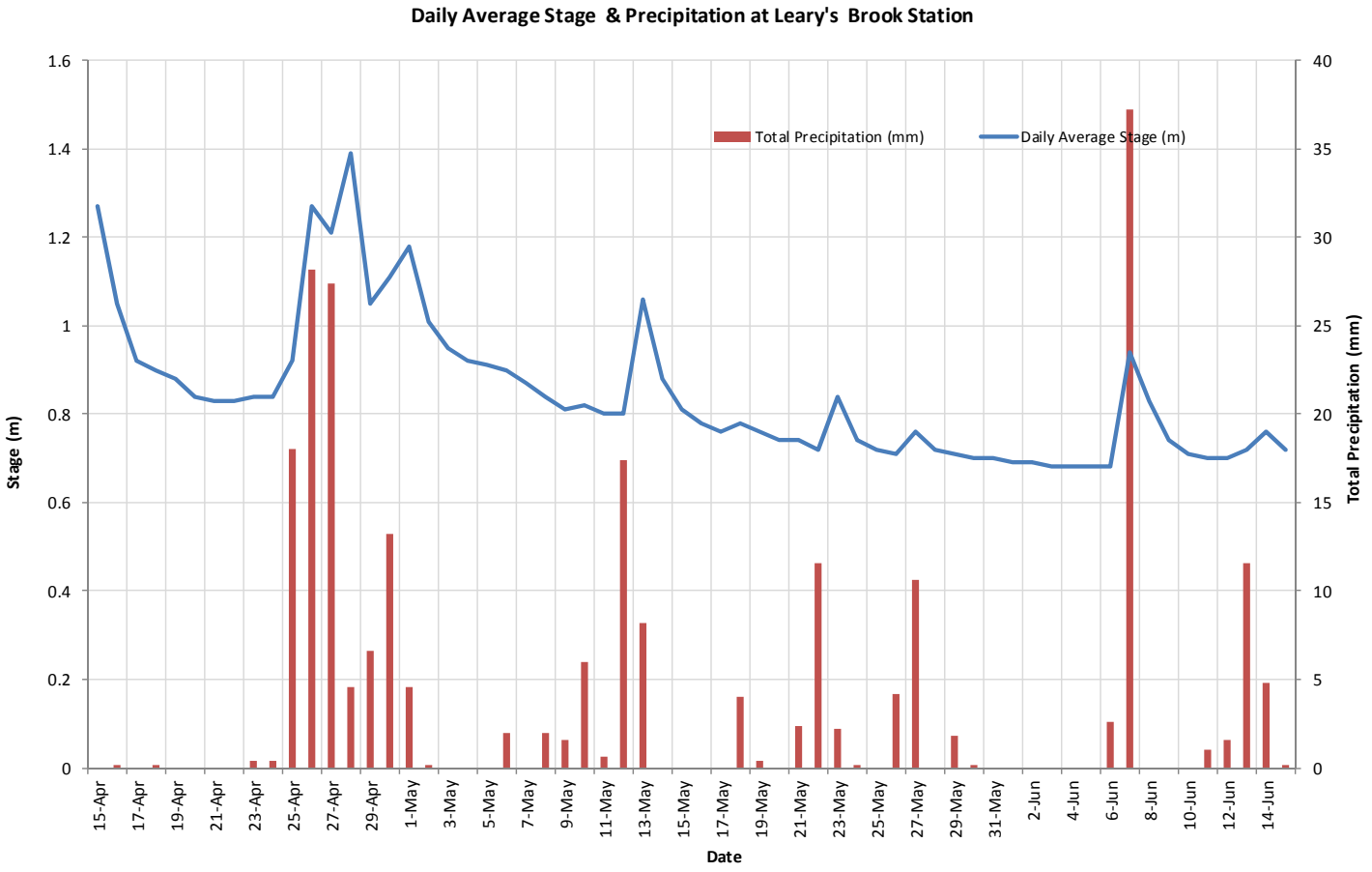

Figure 7: Stage values (m), flow (m3/s) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

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 the values of turbidity, 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 majority of turbidity events were correlated with increases in stage and thus precipitation events. The turbidity sensor likely did not return accurate readings during the final 70% of the deployment period, likely caused by fouling of the sensor or an accumulation of fine sediment around the sensor tip.

Early in the deployment and until May 8 weather conditions required the use of road salt. As salts are washed into the river system, increases in specific conductance and TDS are evident. As spring progressed and minimum temperatures increased, conductivity levels dropped and there were fewer spikes. Elevated runoff when road salting is not occurring has the opposite effect on specific conductance and TDS, causing them to decrease with the influx of relatively clean rainwater. The specific conductivity median at Leary's Brook was 525.0µS/cm, which was much lower than during the March 4 to April 14 deployment (1276.60µS/cm).

During this deployment period the median water temperature at the Leary's Brook station was 8.05°C. Water temperature will continue to fluctuate and be influenced by the surrounding spring air temperatures.

The median pH value for Leary's Brook Station was 6.59 (pH units). The pH level for the most part is steady at this station.

Dissolved Oxygen at Leary's Brook had a median of 98.4 %Sat during the deployment period. The 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.

The turbidity median value at Leary's Brook during deployment was 7.8 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 or haziness. Data quality from the turbidity sensor declined near the beginning of this deployment period and is likely not reflective of true water quality.