Real-Time Water Quality Report

Leary's Brook at Prince Philip Drive

Deployment Period
January 18, 2016 to February 22, 2016

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, 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 January 18, 2016 and removal on February 22, 2016.

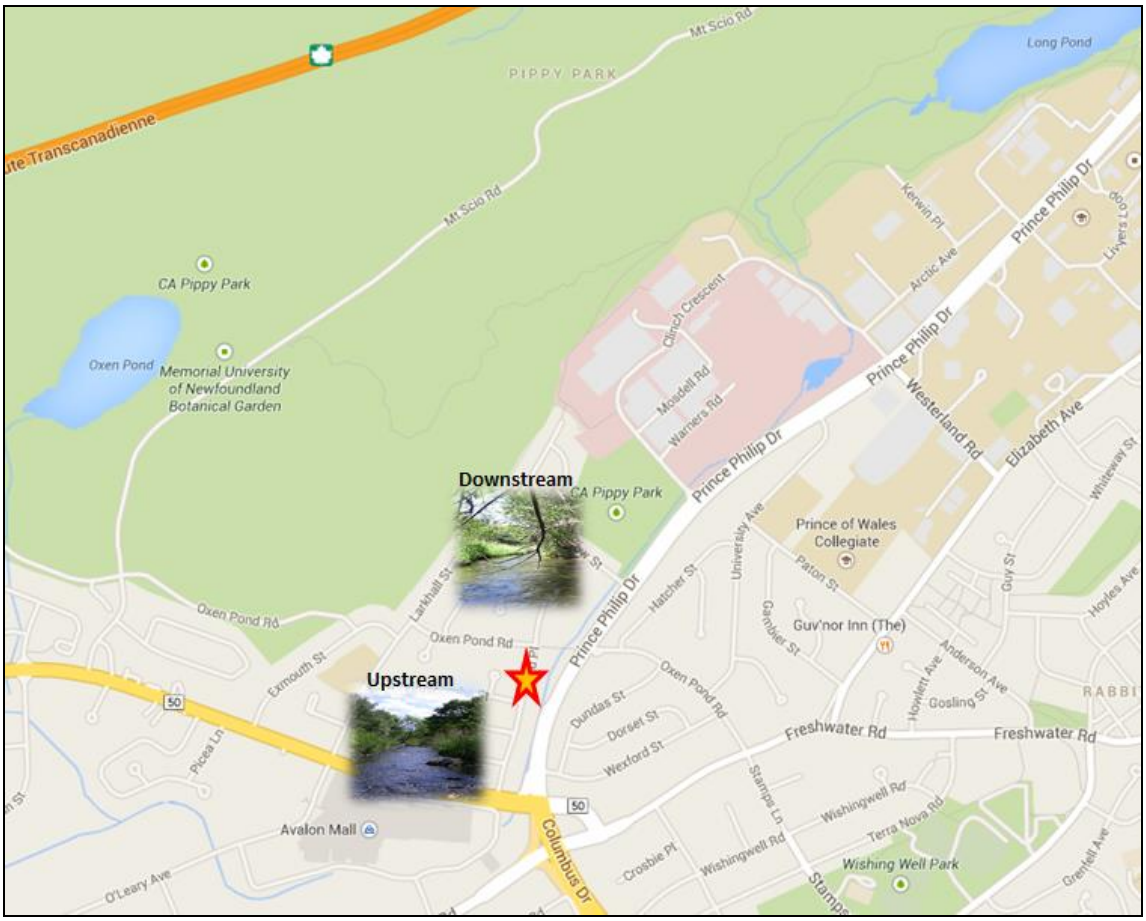

Figure 1: Leary's Brook Real-Time Water Quality and Quantity Station.

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

	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 January 18, 2016 to February 22, 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	**January 18, 2016**	**Deployment**	Excellent	Fair	Excellent	Good	Poor
	February 22, 2016	**Removal**	Good	Excellent	Excellent	Excellent	Poor

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

- Leary's Brook water was very cloudy at the time of deployment on January 18. The QA/QC sonde recorded a turbidity value of 40.1 NTU while the field (deployed) sonde recorded a value of 67.2 NTU. As both sondes had performed well during recent calibration for turbidity against a known laboratory standard, this difference, resulting in a "Poor ranking as noted above, may have been caused by variations occurring naturally in the brook.
- At the time of removal, pH, conductivity and dissolved oxygen ranked as "Excellent", temperature ranked as "Good" and turbidity ranked as "Poor".
- The "Poor" ranking for turbidity at the time of removal was likely caused by an extreme siltation event that occurred during the early morning on February 18. Over a period of 7 hours, from approximately 9:00 PM on February 17 to 4:00 AM on February 18, flow increased 330% in Leary's Brook. Turbidity data collected subsequent to this event is considered to be unreliable and has been removed from the data set.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from January 18, 2016 to February 22, 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 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 -0.08°C to 4.58°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.

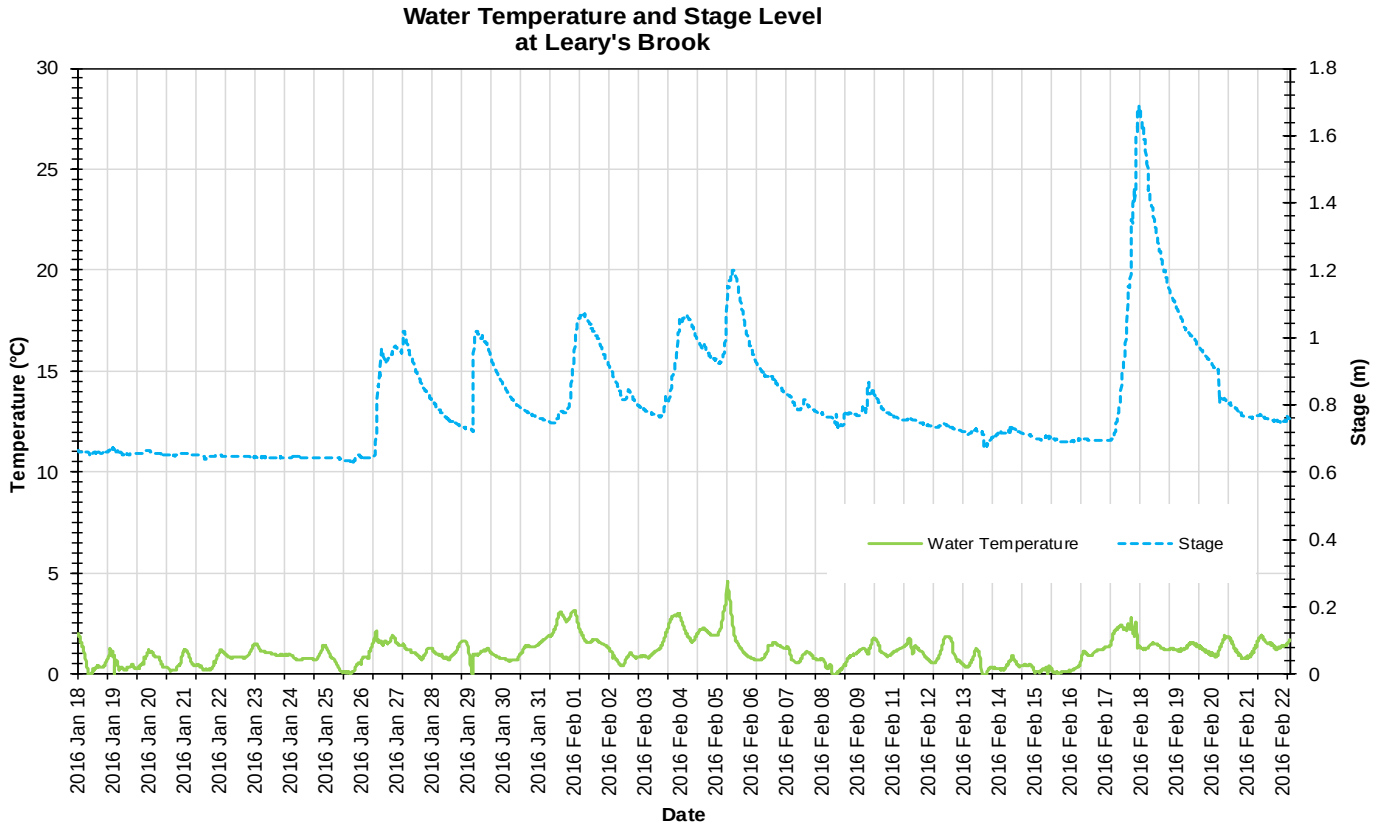

Figure 2: Water Temperature and Stage Level at Leary's Brook

pH

- Throughout this deployment period pH values ranged between 5.56 pH units and 7.06 pH units (Figure 3).
- For most of the deployment, pH values were near or 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 6.69 (pH units) for this deployment period.
- As illustrated below, pH typically falls 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.

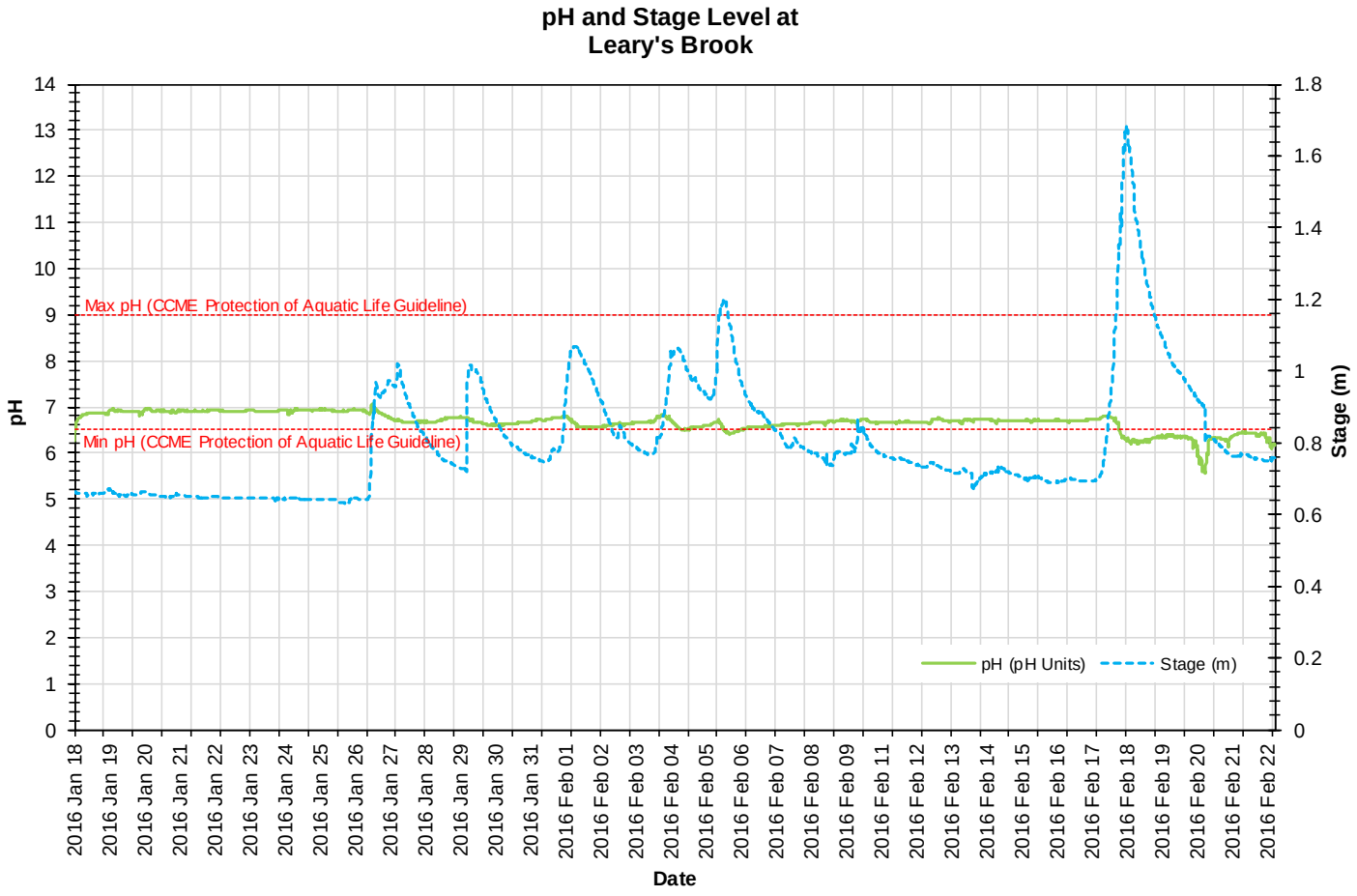

Figure 3: pH (pH units) values at Leary's Brook Station

Specific Conductivity

- The conductivity levels ranged between 206.0 µS/cm and 10853.0 µS/cm during this deployment period. The median was 1257.5 µS/cm. TDS ranged from 0.1320 g/ml to 6.950 g/ml.
- The peaks in conductivity seen during the early part of this deployment period are believed to be associated with road and parking lot salting adjacent and upstream of Leary's Brook due to low temperatures encountered nightly. The highest conductivity and TDS occurred during the January 26 to January 27 period when rain fell in significant amounts after a period of cold weather and snow. This rain flushed large amounts of road salt and other debris into the brook.
- Peaks in conductivity recorded during the February 10 to February 18 period are again associated with road salting and runoff during colder weather with no rain.
- Maximum stage occurred after a significant rainfall event (with snow on the ground) overnight on February 18. The lowest conductivity was also recorded at this time as rainwater and snowmelt entered the brook, diluting salts and other solids that were present.

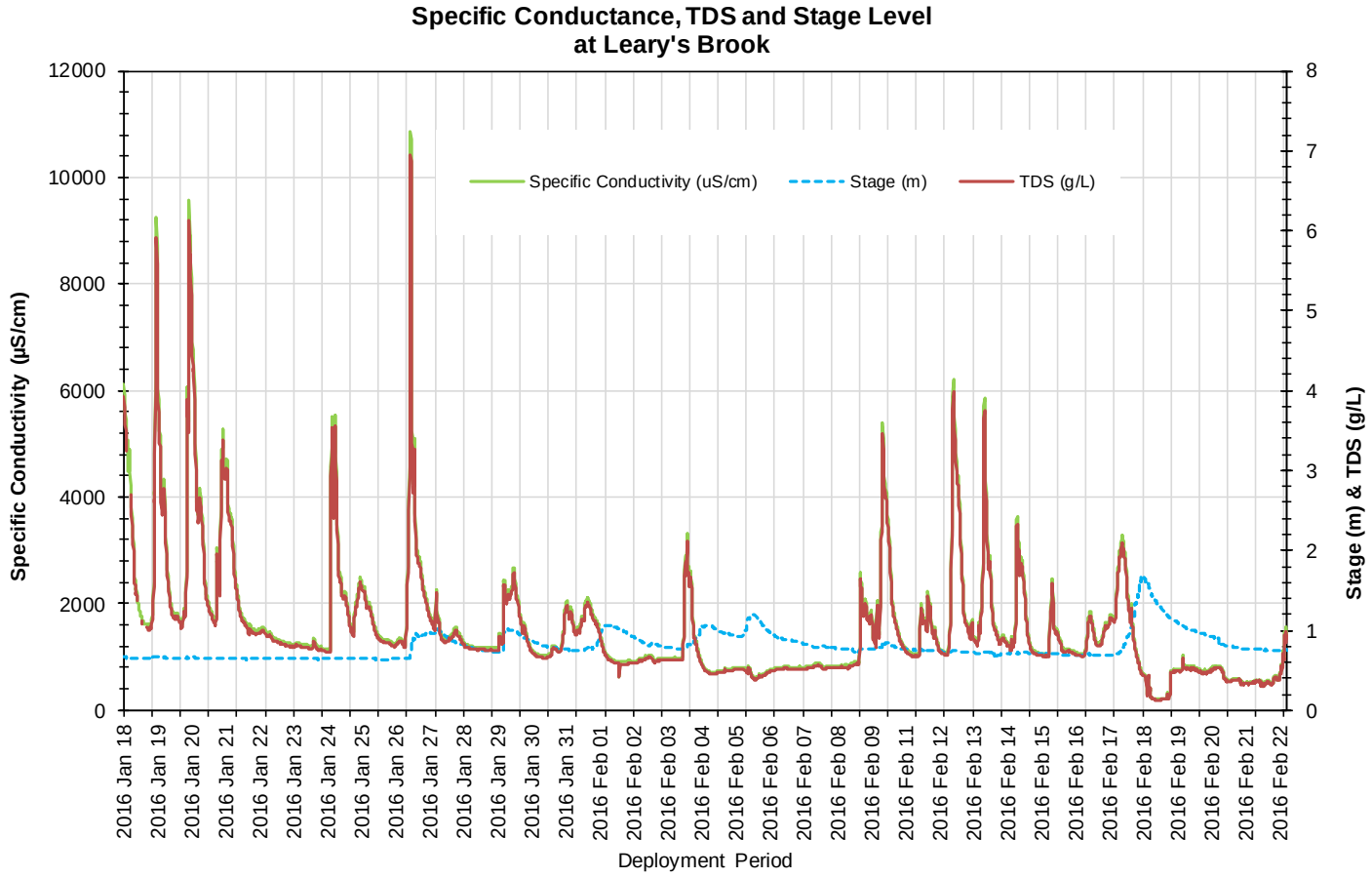

Figure 4: Specific conductivity (µS/cm), TDS (g/L) and stage (m) values at Leary's Brook Station

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 91.9% Sat and 101.1% Sat. Dissolved Oxygen (mg/L) measured between 12.27 mg/L and 14.43 mg/L.
- The DO mg/L values are consistently above the minimum DO CCME guideline for early life stages for 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.

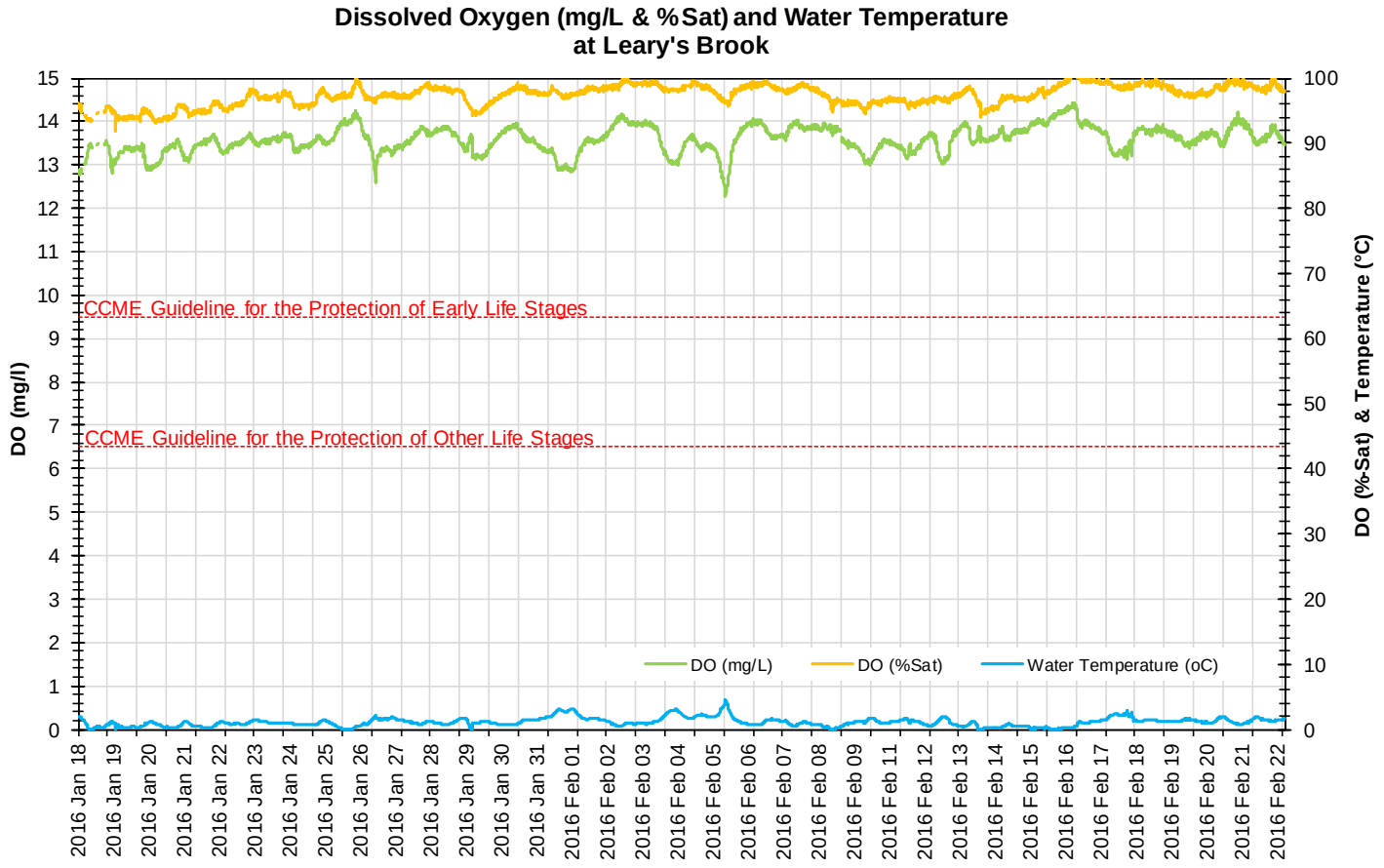

Figure 5: Dissolved oxygen (mg/L & % sat) and water temperature (°C) values at Leary's Brook Station

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 between 0.0 NTU to 965.0 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 which is captured by the turbidity sensor.
- A significant rainfall and associated peak in stage and flow on the night of February 18 caused the turbidity sensor to be covered in sediment. Turbidity readings collected subsequent to this event are considered to be unreliable and have been removed from the data set.

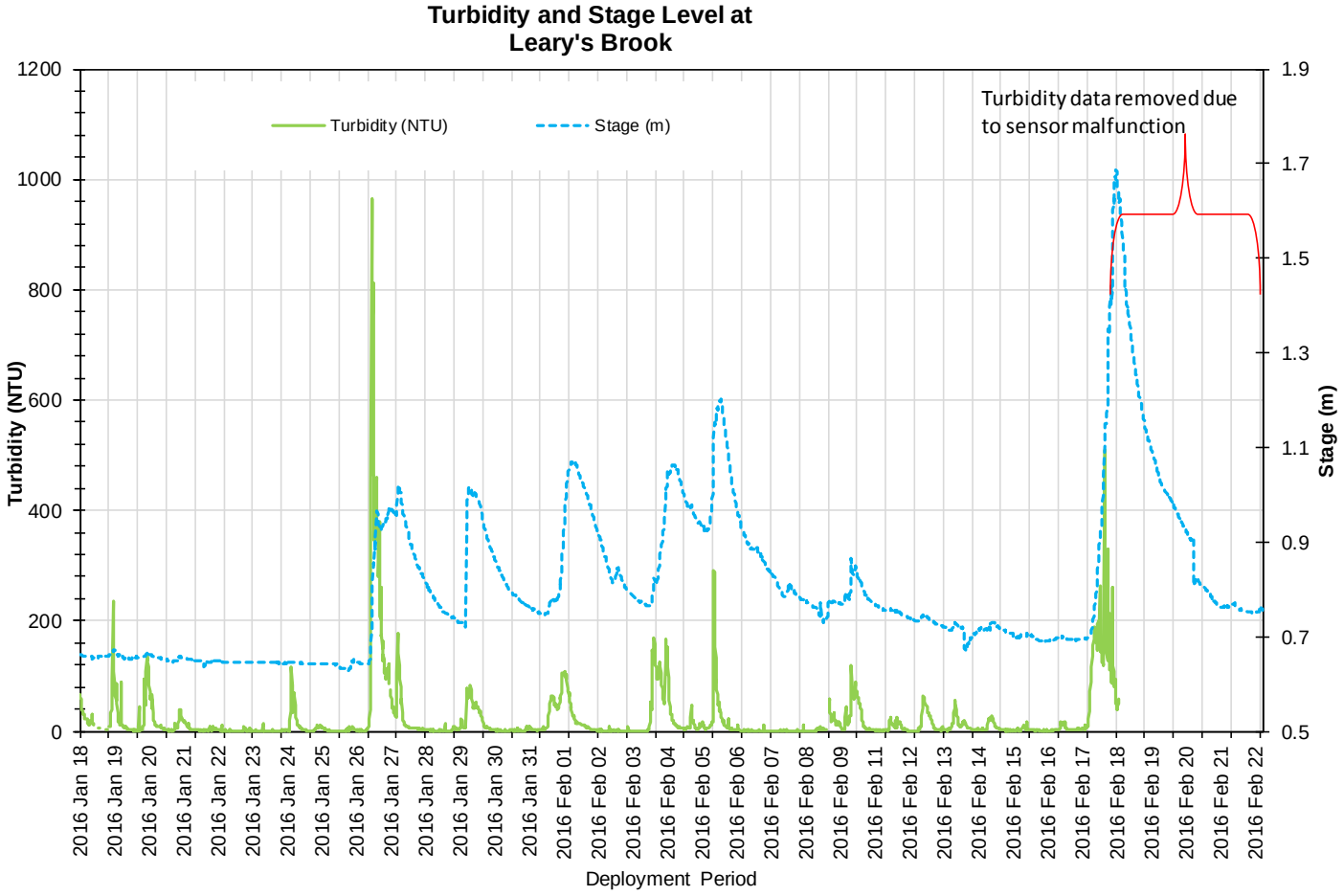

Figure 6: Turbidity (NTU) values at Leary's Brook Station

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 the 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.
- Precipitation occurring as snow or mostly snow does not cause an immediate significant increase in stage or flow. This can be seen on January 18 when a 31 cm snowfall was recorded and on January 29 when a 10.4 cm snowfall was recorded.
- Stage peaked on February 18 after significant rainfall occurred with 20 cm of snow on the ground.

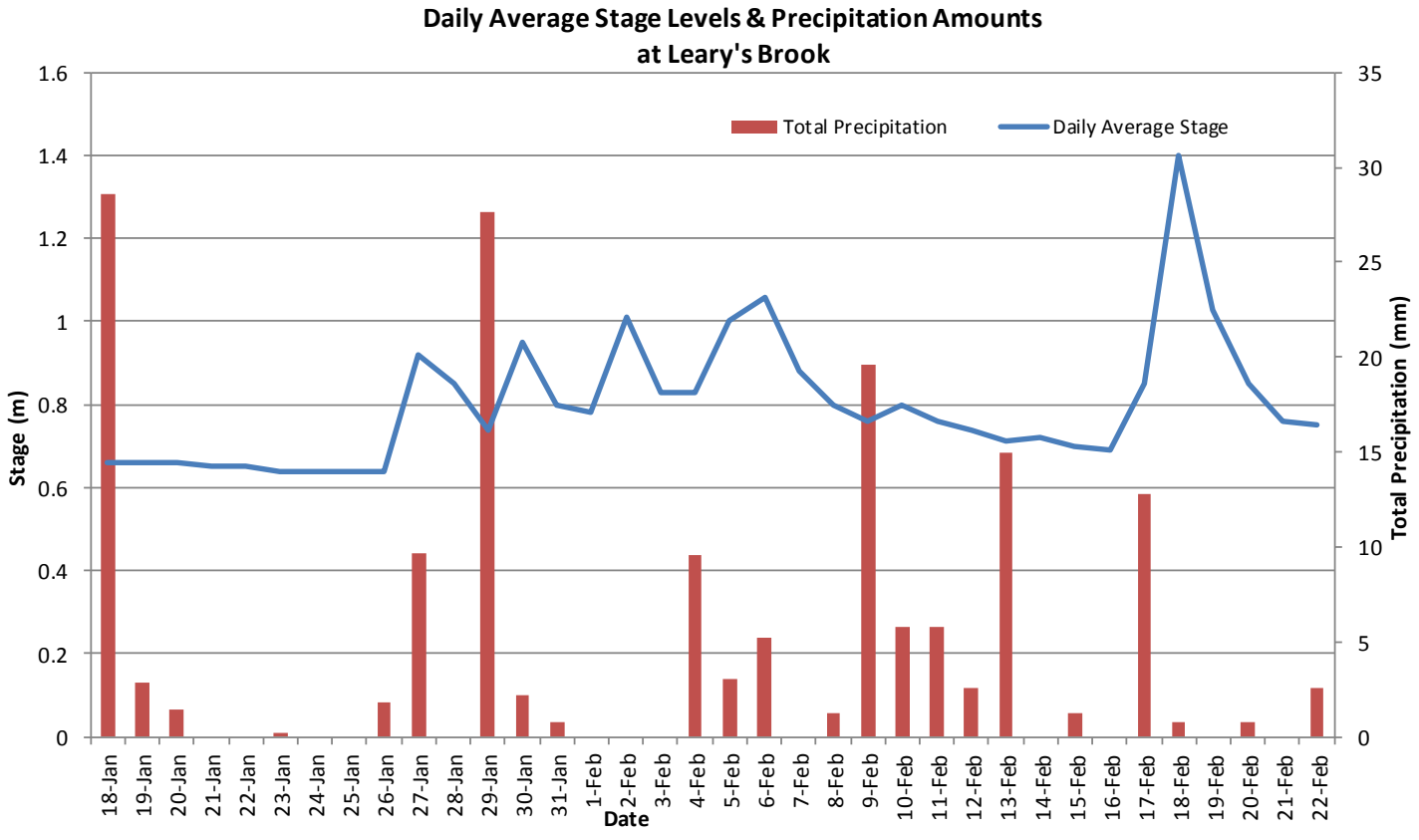

Figure 7: Daily average stage values (m) from Leary's Brook Station and daily total precipitation values (mm) from St. John's International Airport.

Conclusions

Generally in 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. The impact of road salting and heavy rain on snow was also seen during this deployment period.

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

During this deployment period the median water temperature at the Leary's Brook station was 1.02°C.

The median pH value for Leary's Brook Station was 6.69 (pH units). The pH level for the most part is steady at this station.

Dissolved Oxygen at Leary's Brook had a median of 97.6%Sat 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 3.3 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.