Real-Time Water Quality Report Leary's Brook at Prince Philip Drive

Deployment Period
September 1st to October 26th, 2022

Newfoundland Labrador

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

Prepared by:
Adrian Rogers
Environmental Scientist
Water Resources Management Division
Department of Environment and Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No: (709) 729 - 0351
adrianrogers@gov.nl.ca

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General

The Water Resources Management Division, 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 Drive in St. John's, Newfoundland.

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 station. Leary's Brook is an urban stream which flows through industrial and commercial areas and is adjacent to a major roadway.

This report covers the period between the September 1st, 2022 deployment and October 26th, 2022 removal.

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

Quality Assurance and Quality Control

To ensure the effectiveness and reliability of the real time water quality monitoring program, quality assurance, quality control, and quality assessment procedures have been implemented. 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 adjacent to 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 most important sensor on any sonde is the temperature sensor. 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 device 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.

The deployment and removal instrument performance rankings for Leary's Brook for this period 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	Sept 1, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Oct 26, 2022	Removal	Excellent	Good	Poor	Fair	Good

When the sonde was removed on October 26th, there was substantial biofouling growth, particularly on the sensors. The sonde was buried with sediment following a large rainfall event on September 12th. On September 15th, the sonde was removed from the water and the sediment that had accumulated in the cage was removed. Data from September 12th to 15th was omitted from analysis.

Data Interpretation

The following graphs and discussion illustrate water quality-related events from September 1st, 2022 to October 26th, 2022 at the Leary's Brook station.

With the exception of water quantity data (stage) and precipitation data, 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 Pippy Park weather station.

Results

Water Temperature

- Water temperature ranged from 9.08°C to 20.70°C during this deployment period, with a median value of 13.20°C and a mean value of 13.45°C.
- The water temperature data displayed in Figure 2, is typical of shallow streams and ponds. Water temperatures in shallow streams respond quickly to changes in air temperature. Water temperatures usually fall overnight and rise during daylight hours. As seen in Figure 2, water temperature is also impacted by stage. During this deployment, there is a general cooling trend of the water temperature. This corresponds to the cooling air temperatures as fall approaches.
- 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.

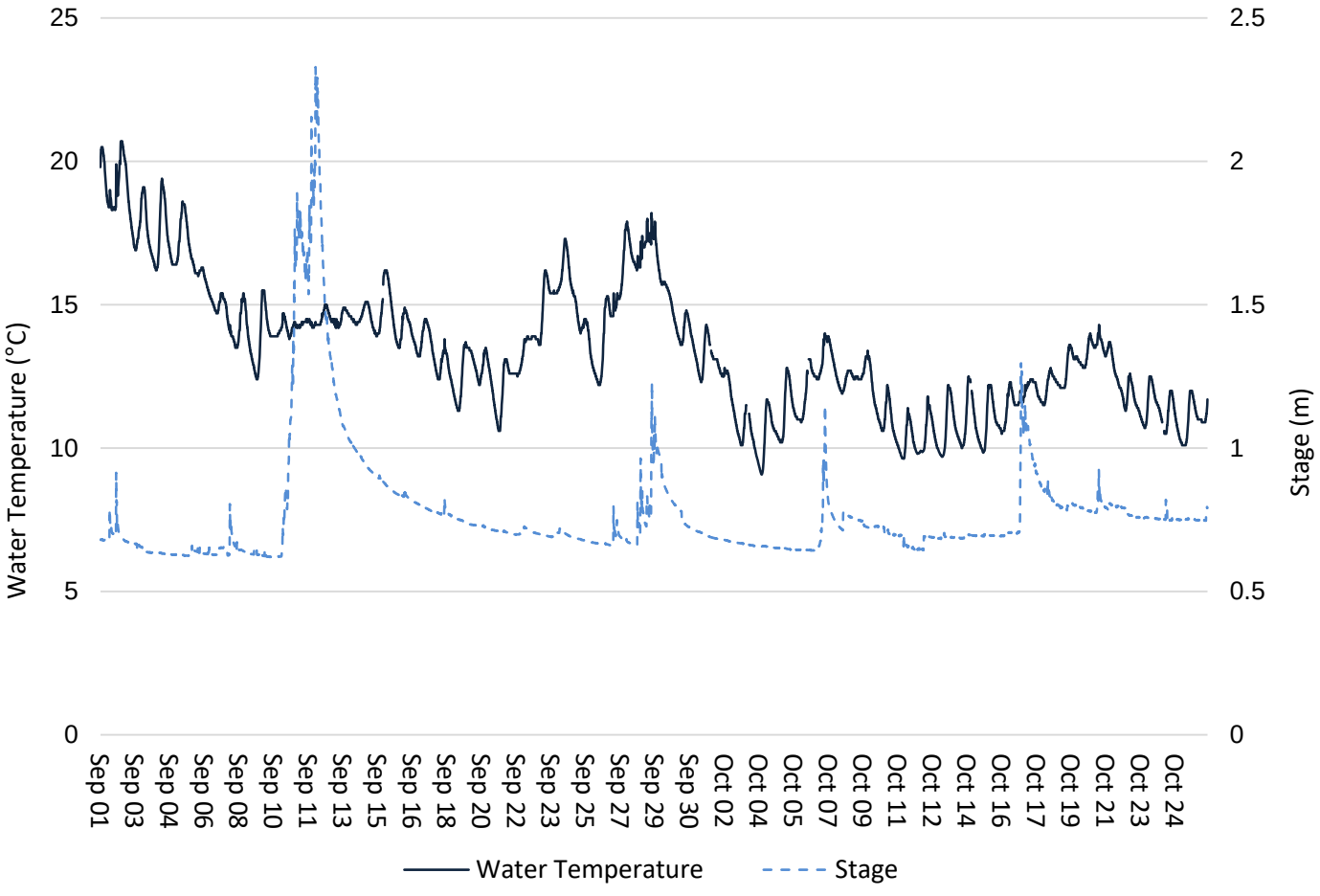

Figure 2 Water Temperature and Stage Level at Leary's Brook

pH

- Throughout the deployment period, the pH at Leary's Brook Station ranged from 6.17 to 6.88.
- The CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. The median and mean pH at Leary's Brook were both 6.57 for this deployment period. The pH at Leary's Brook mostly falls between the guidelines throughout this deployment; however, at times it was slightly below. The sedimentation or algal growth may have caused the pH sensor to slightly drift. At the time of removal, the field sensor was reading a pH of 6.4 compared to the QAQC sonde which was reading a pH of 6.89; however, this is still ranked as 'Good'.
- Generally there is a slight dip in pH in Leary's Brook (the water becomes more acidic) when stage increases. In general, precipitation entering Leary's Brook has a lower pH than local surface water causing a small reduction in the pH of the brook. Daily fluctuations can be caused by respiration and photosynthesis of aquatic plants and algae.

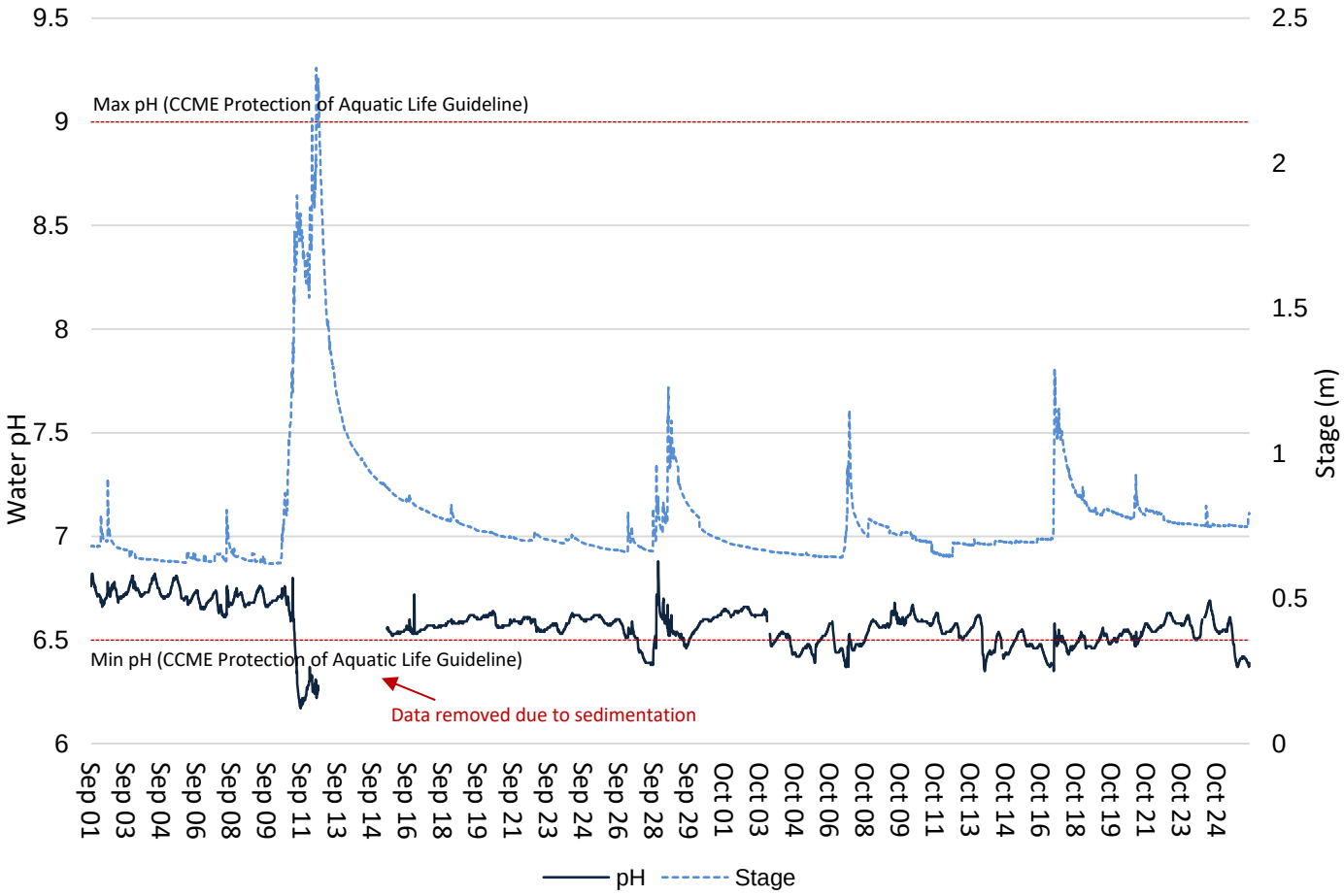

Figure 3 Water pH and Stage at Leary's Brook

Specific Conductivity

- The conductivity levels ranged from 34.6 µS/cm to 752.0 µS/cm during this deployment period. The median and mean specific conductivities were 508.0 µS/cm and 501.0 µS/cm respectively.
- Figure 4 illustrates how precipitation and specific conductivity are related. Rain water has a lower specific conductivity than Leary's Brook. During the summer and fall, rainfall results in a temporary decrease in conductivity as the system is diluted; however, when road salts are present in the winter and spring, precipitation washes them into Leary's Brook, which increases the specific conductance of the system.

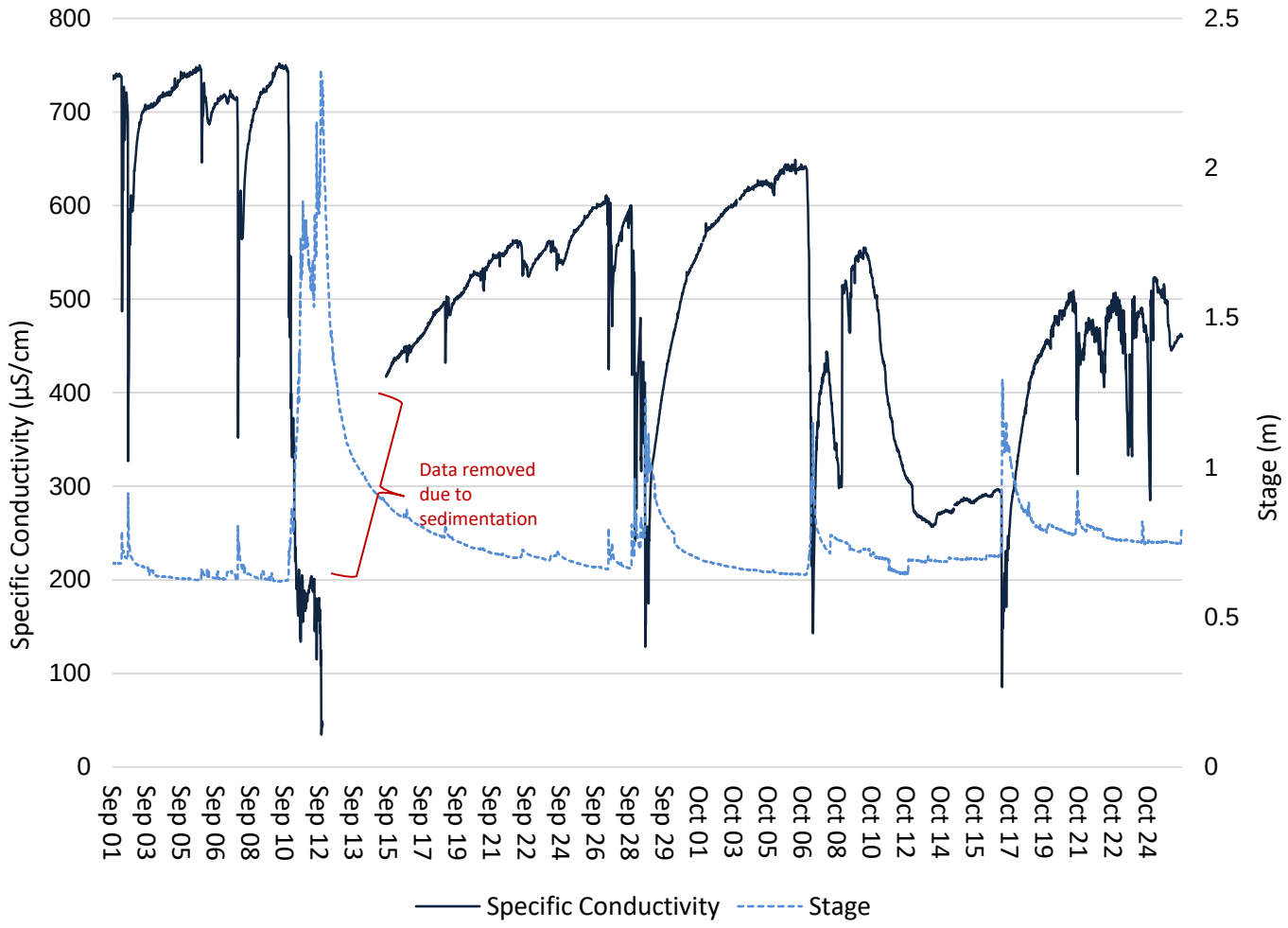

Figure 4 Specific conductivity values at Leary's Brook Station.

Total Dissolved Solids

- The values for total dissolved solids (TDS) ranged from 0.0222 g/mL to 0.4820 g/mL during this deployment period. The median and mean for TDS were 0.3250 g/mL and 0.3206 g/mL respectively.
- TDS is calculated using the conductivity and temperate probes. Pure water has low conductivity. Electrical currents are conducted by ions in solution, so increases in TDS will result in an increase in conductivity. Figure 5, below, illustrates how an increase to stage can lead to a decrease in TDS during seasons when road salts are not applied to nearby surfaces.

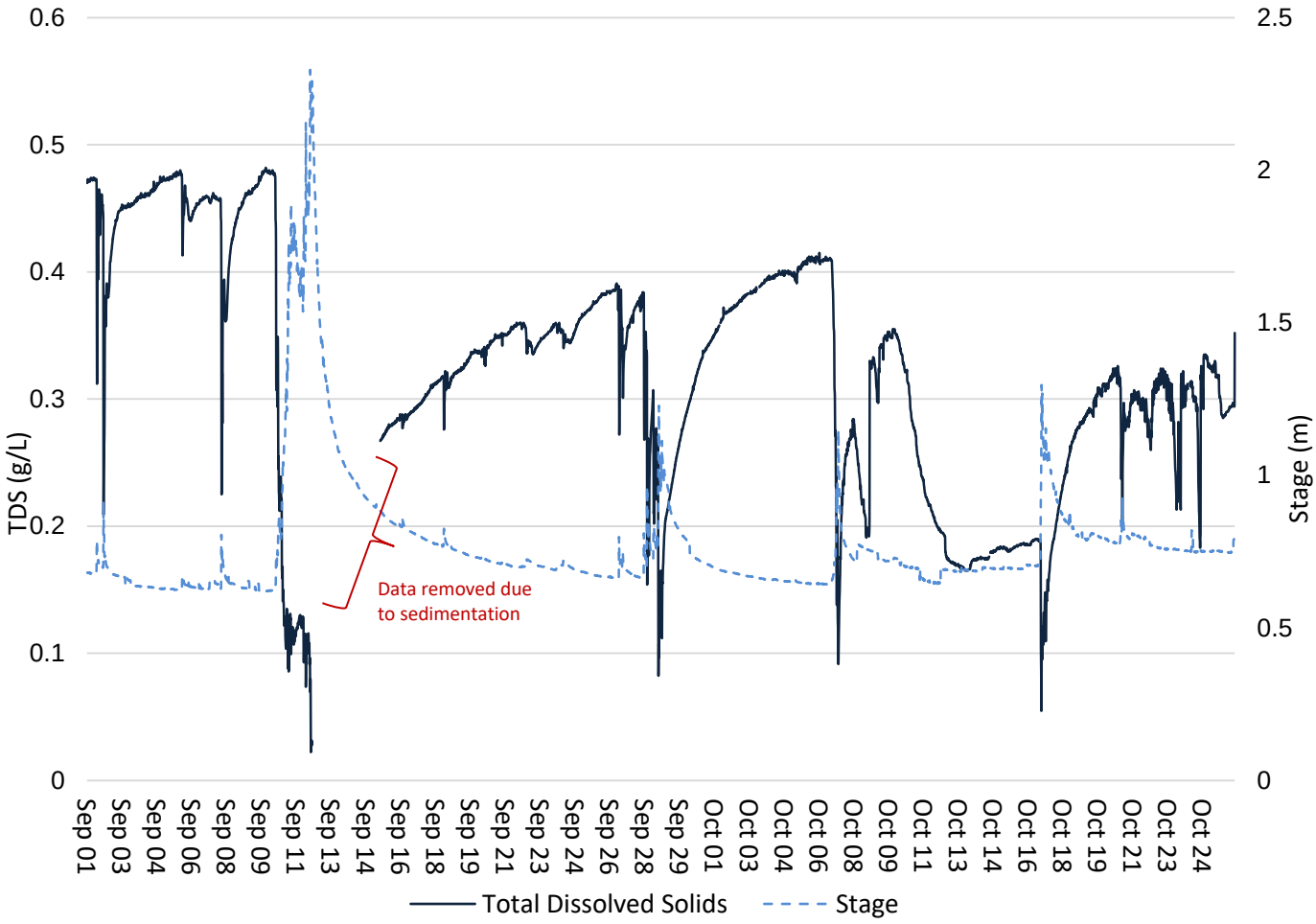

Figure 5 Total Dissolved Solids in Water and Stage Level at Leary's Brook.

Dissolved Oxygen

- The sonde measures dissolved oxygen (DO) (mg/L) and then calculates the percent saturation (% Sat) using the dissolved oxygen and temperature sensors.
- The DO sensor started to show signs of failure midway through the deployment. A number of sections have been removed due to irregularities. As a result of the failure, the max, min, median, and mean values may not be truly reflective of the deployment period. The DO % sat levels during the deployment period ranged from 82.6% to 99.9%, with a median and mean value of 95.0% and 94.6% respectively. Dissolved oxygen (mg/L) measured from 8.51 mg/L to 11.00 mg/L, with a median and mean value of 9.92 mg/L and 9.84 mg/L respectively. The dissolved oxygen (mg/L) values were above the minimum dissolved oxygen CCME Guidelines for the protection of other life stages throughout the deployment period; however, the dissolved oxygen levels dropped below the CCME guideline for the protection of early stage life throughout some of the deployment.
- Small decreases in available oxygen are associated with increases in water temperature, because warm water can hold less dissolved oxygen than cold water.

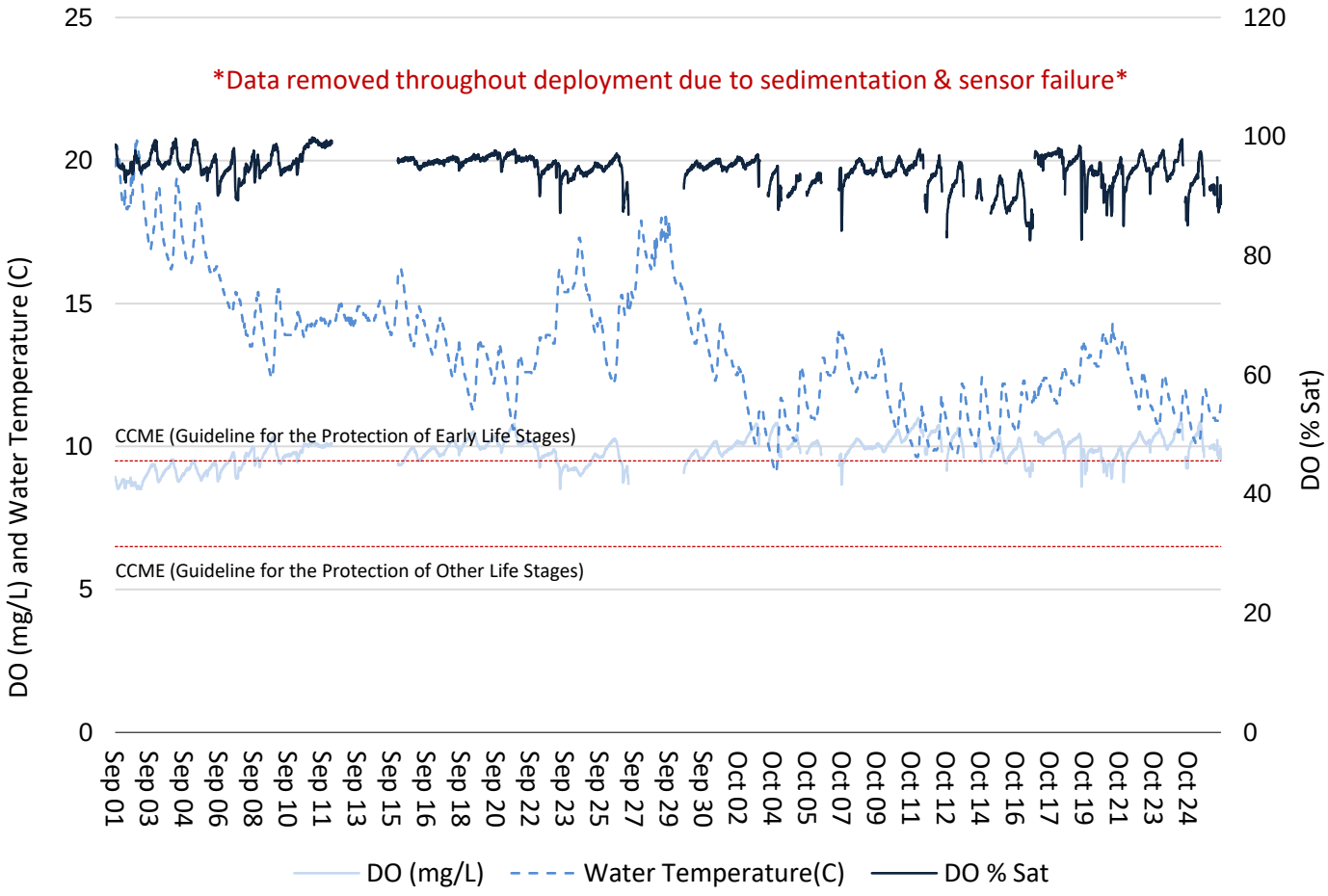

Figure 6 Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at Leary's Brook Station.

Turbidity

- There were issues with the turbidity sensor throughout deployment; as a result of the failure, the max, min, median, and mean values may not be truly reflective of the deployment period. The turbidity readings during this deployment ranged between 0.7 NTU to 219.9 NTU with median and mean values of 3.0 NTU and 11.3 NTU respectively.
- Increases in turbidity (cloudiness) are usually caused by increased runoff during precipitation events. Runoff carries silt and other debris into Leary's Brook. Upstream construction and the inadequate control of silt-laden runoff can also cause turbidity to increase. As shown in figure 7, turbidity increases during this period correlated with runoff from precipitation events.
- Turbidity data collected from September 2nd to September 12th was removed due to a sensor malfunction and sedimentation.

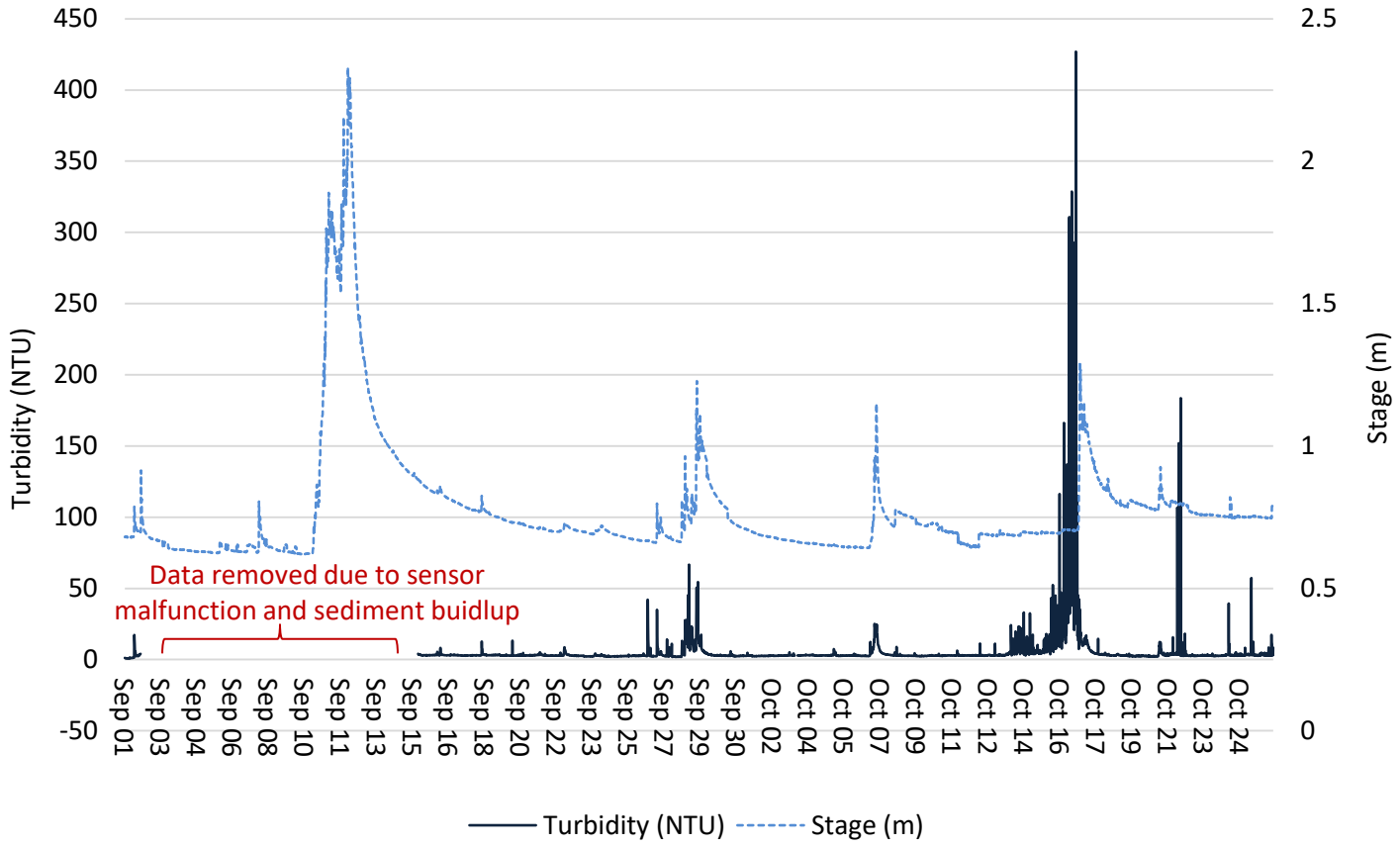

Figure 7 Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- Figure 8, below, shows daily total precipitation data from the Pippy Park weather station and the daily average stage. Stage levels were relatively low throughout much of the deployment; however, there was significant rainfall on September 11th.
- 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. Leary's Brook is an urban stream system that is subject to significant runoff; the river is considered 'flashy,' increasing and decreasing stage and streamflow quickly.

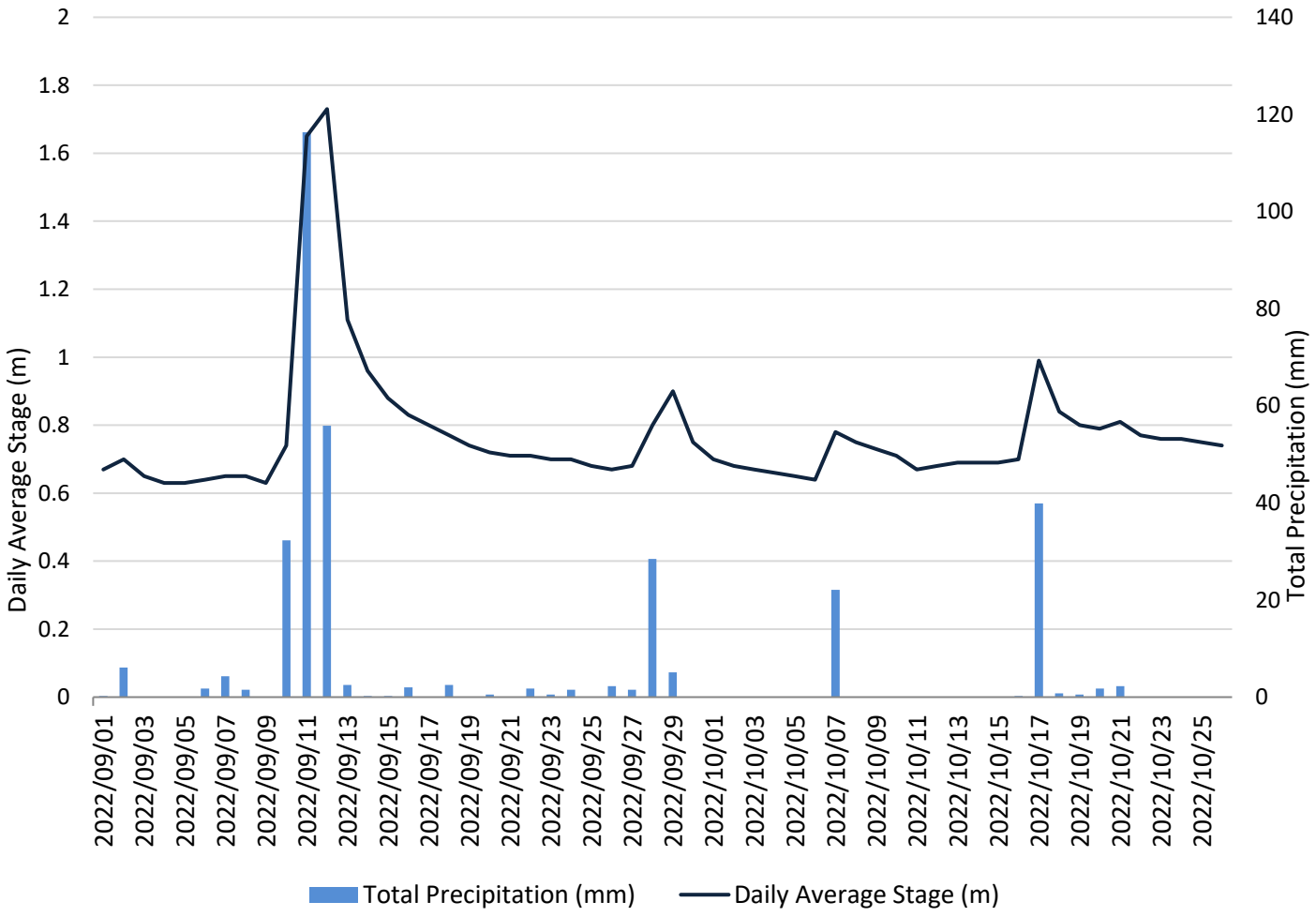

Figure 8 Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from Pippy Park weather station.

Conclusions

In both natural and developed environments, climate and weather conditions can contribute to variations in water quality. Leary's Brook is an urban stream surrounded by heavily developed land, so it is expected that observed and recorded changes in Leary's Brook water quality are related to anthropogenic disturbances or effects.

Peaking on September 11th, there was a large rainfall event which led to a significant increase in stage levels. This led to a large volume of sediment accumulating within the metal casing that protects the sonde. The accumulated sediment was not removed until September 15th when water levels were safer for staff to enter the waterway. The sonde deployed during this time did not have an internal power source, which may have caused issues for the two most power intensive sensors (DO and turbidity). During this deployment period, the median water temperature at the Leary's Brook station was 13.20°C. The median pH for Leary's Brook Station was 6.57. Increased turbidity levels can periodically be associated with upstream disturbances and construction, although most often they are caused by precipitation runoff. Runoff can carry sediments into the brook overland and via storm drains. Specific conductivity had a median value of 508.0 µS/cm. TDS had a median value of 0.3250 g/mL during the deployment period. Dissolved Oxygen at Leary's Brook had a median of 95% saturation and 9.92 mg/L during the deployment period. The mean turbidity during this deployment period was 11.3 NTUs.