Real-Time Water Quality Deployment Report

Rattling Brook Network

December 14, 2017 to January 25, 2018

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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General

- During deployment on December 14th and December 15th a problem with the QAQC sonde meant QAQC Ranking values in Table 1 couldn't be calculated.
- On January 14, 2018, approximately 100 m^3 of alkaline residue slurry was released from a pipeline leading to the Residue Storage Area. Some of the slurry made its way to a small tributary to Rattling Brook. Residue entry to Rattling Brook would be downstream of Bridge station and upstream of Plant Discharge station. Containment and remediation efforts were implemented soon after the release was discovered. There did not appear to be any discernable effect on pH or specific conductivity at Plant Discharge station around the time of release over and above the variation caused by unstable weather conditions.
- Rattling Brook Big Pond instrumentation was not removed for the winter season starting in the 2017-2018 field season, due to ice conditions. QAQC Rankings on January 25th represent mid-deployment rankings and were recorded by a through-ice measurement as close to the field sonde as possible. The rankings may not be fully representative of the field sonde conditions.

Maintenance and Calibration of Instrument

- As part of the Quality Assurance and Quality Control protocol (QAQC), 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.
    - Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QAQC sondes a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.
    - At the end of a deployment period, a freshly cleaned and calibrated QAQC Sonde is placed *in situ*, adjacent to the Field Sonde. Values are compared between all parameters and differences are ranked for placement in Table 1.

Table 1: Qualitative QAQC Ranking

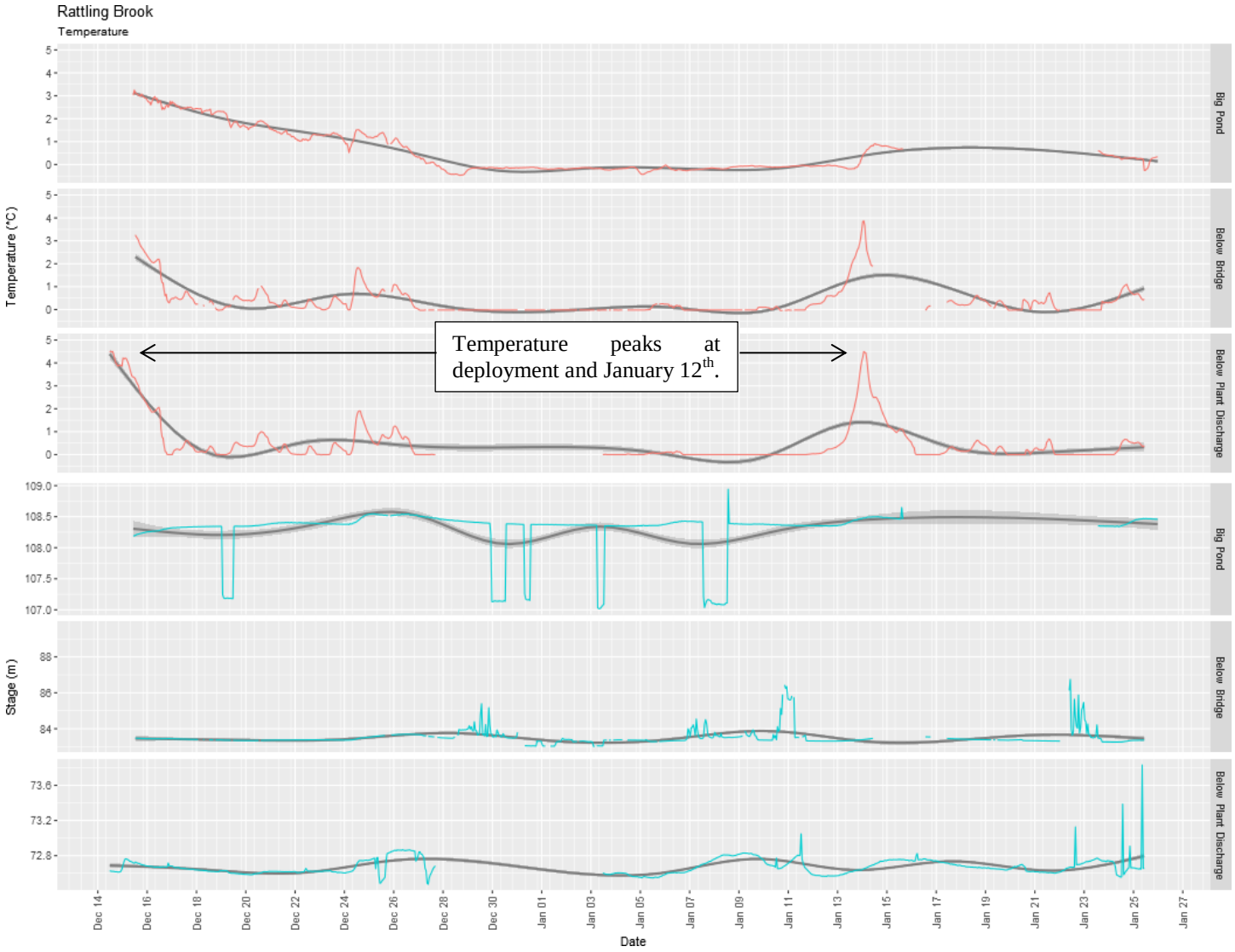
Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Rattling Brook Big Pond	December 15, 2017	Deployment	NA	NA	NA	NA	NA
	January 25, 2018	Mid-deployment	Good	Good	Marginal	Marginal	Excellent
Rattling Brook below Bridge	December 15, 2017	Deployment	NA	NA	NA	NA	NA
	January 25, 2018	Removal	Excellent	Excellent	Marginal	Poor	Excellent
Rattling Brook below Plant Discharge	December 14, 2017	Deployment	NA	NA	NA	NA	NA
	January 25, 2018	Removal	Excellent	Excellent	Good	Excellent	Good

- A 1.25 mg/l difference in DO concentration resulted in a "Poor" ranking during removal at Bridge station on January 25th.

Data Interpretation

Temperature

Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.



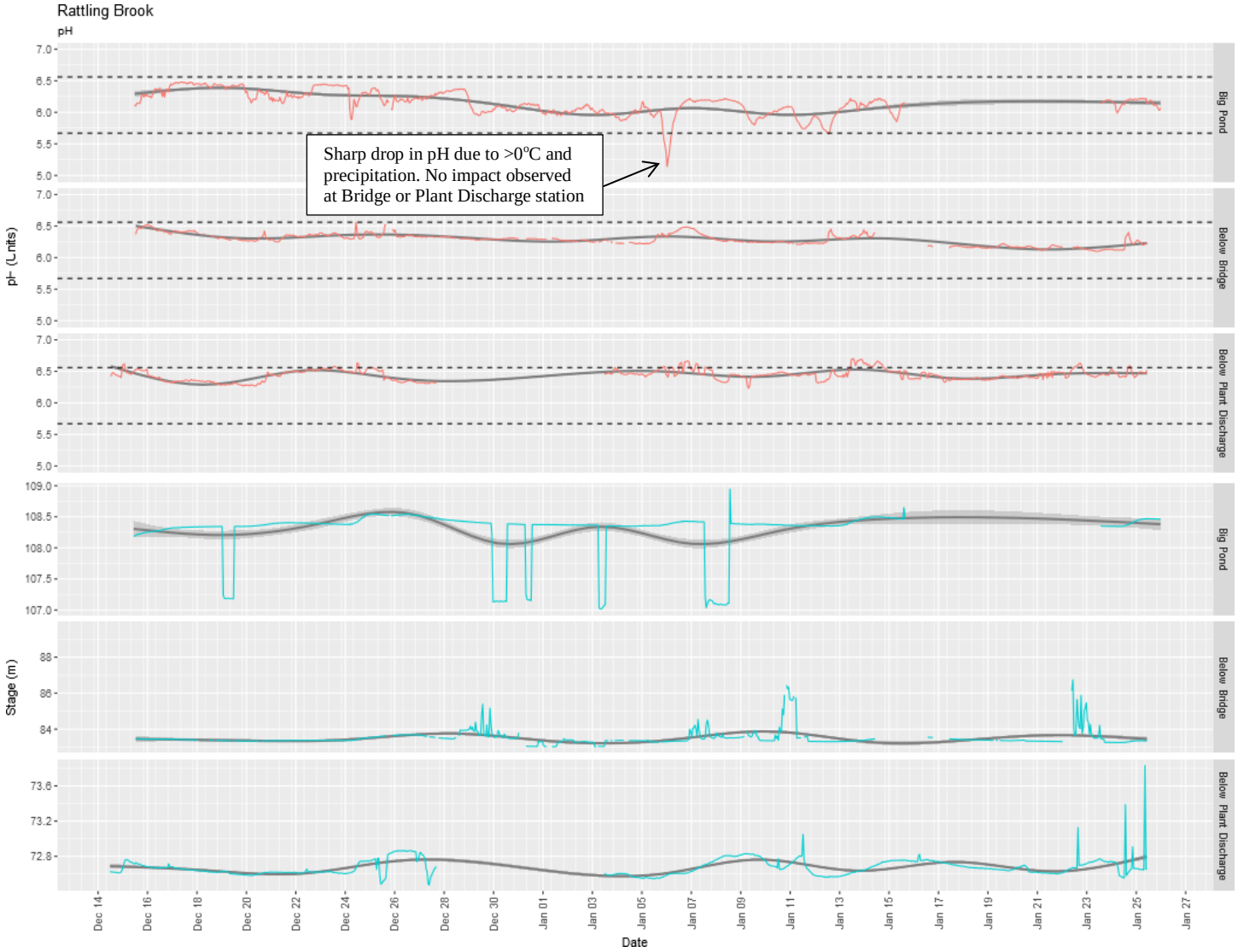
Station	Mean	Median	Min	Max
Big Pond	0.56	-0.04	-0.47	3.25
Below Bridge	0.35	0.12	-0.05	3.87
Below Plant Discharge	0.51	0.12	-0.01	4.51

- Water temperatures at Bridge and Plant Discharge stations closely matched the air temperatures depicted in the Appendix, especially when there are multiple, consecutive days with mean air temperature >0°C. Two substantial instances are noted in the figure above. Big Pond station showed similar, but much more muted, tendencies.

*All hydrometric data is provisional and is subject to correction. Please consult Water survey of Canada for finalized data and interpretation.

pH

pH is used to give an indication of the acidity or basicity of a solution. A pH of 7 denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.



Station	Mean	Median	Min	Max
Big Pond	6.15	6.16	5.14	6.48
Below Bridge	6.29	6.29	6.10	6.56
Below Plant Discharge	6.44	6.44	6.23	6.70

- A slight downward trend was observed at Bridge station over the course of the deployment period. Most values at Bridge and Plant Discharge station were found to be within the CCME Guidelines for the protection of aquatic life (dashed lines in figure above).
- A sharp decline in pH was observed as indicated in the figure above. Differences in water quality between Big Pond and Bridge and Plant Discharge stations can be especially pronounced during ice cover.

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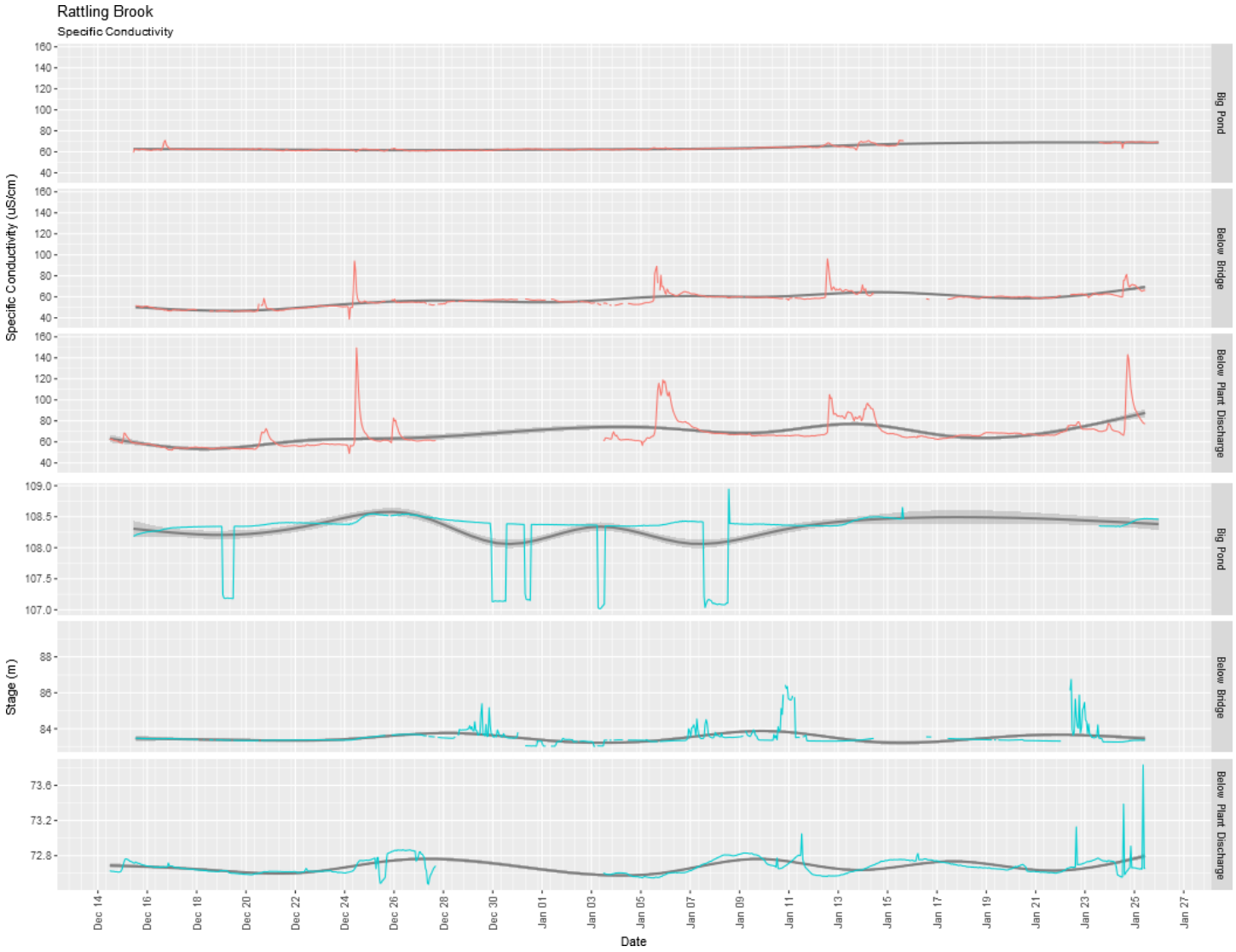
Specific Conductivity

Conductivity relates to the ease of passing an electric charge – or resistance – through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25°C to allow comparison across variable temperatures.



Station	Mean	Median	Min	Max
Big Pond	63.4	62.5	59.3	71.1
Below Bridge	57.0	57.4	38.8	96.2
Below Plant Discharge	67.2	66.0	49.0	149.6

- Several peaks in specific conductivity were noted on December 24th, January 5th, January 12th, and January 24th at Bridge and Plant Discharge stations. These peaks are closely associated with days having a mean temperature >0°C, which facilitates movement of silt, sediment, and debris into the river channel. Big Pond station did not show similar changes, likely due to ice cover.

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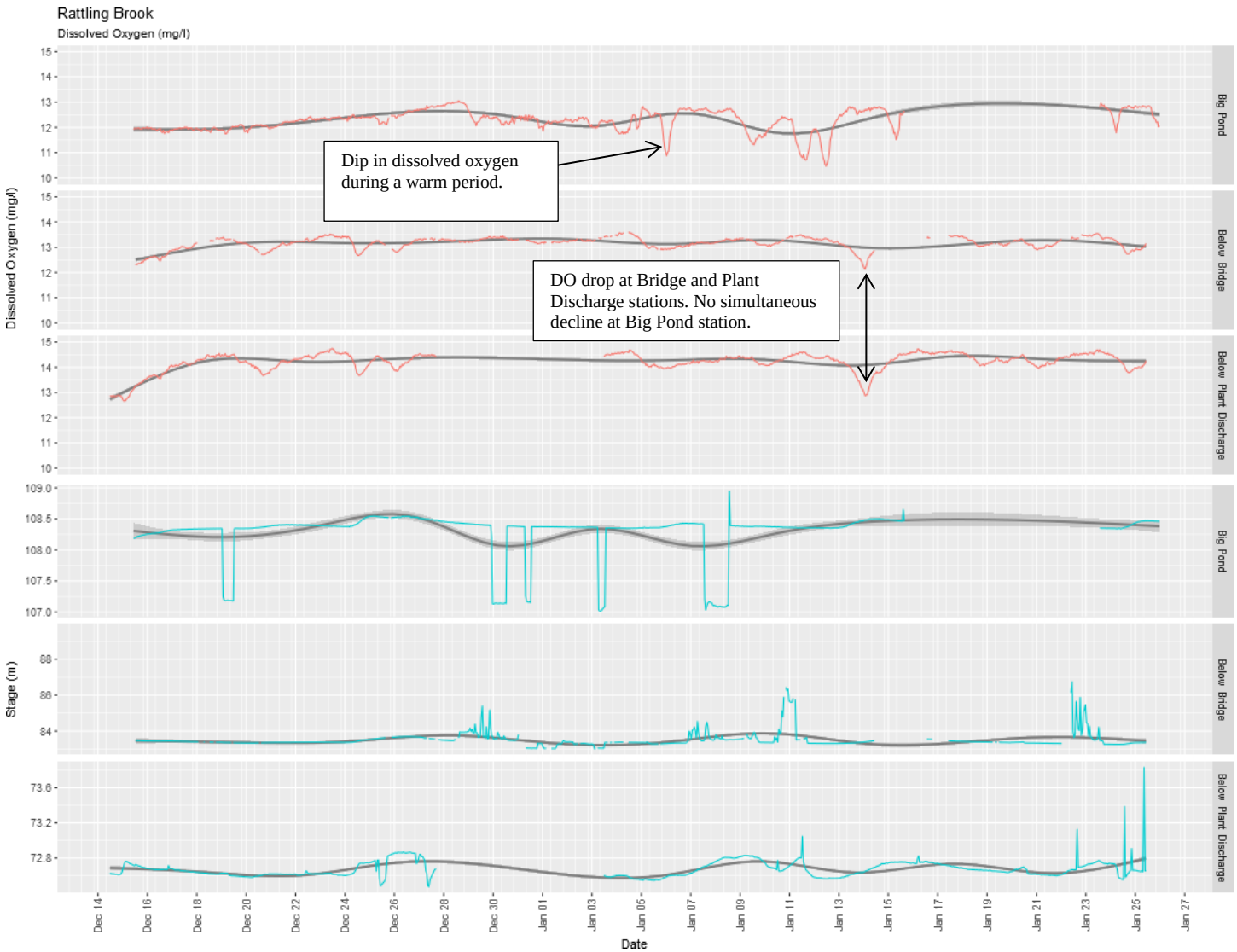
Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.



Station	Mean	Median	Min	Max
Big Pond	12.27	12.30	10.46	13.06
Below Bridge	13.17	13.23	12.16	13.61
Below Plant Discharge	14.21	14.28	12.66	14.75

- Dissolved oxygen values were mostly stable at Big Pond, Bridge, and Plant Discharge station. All values were found to be above the CCME Guidelines for the protection of cold water biota.
- On January 6, a short term drop in dissolved oxygen at Big Pond mirrored a similar drop in pH.

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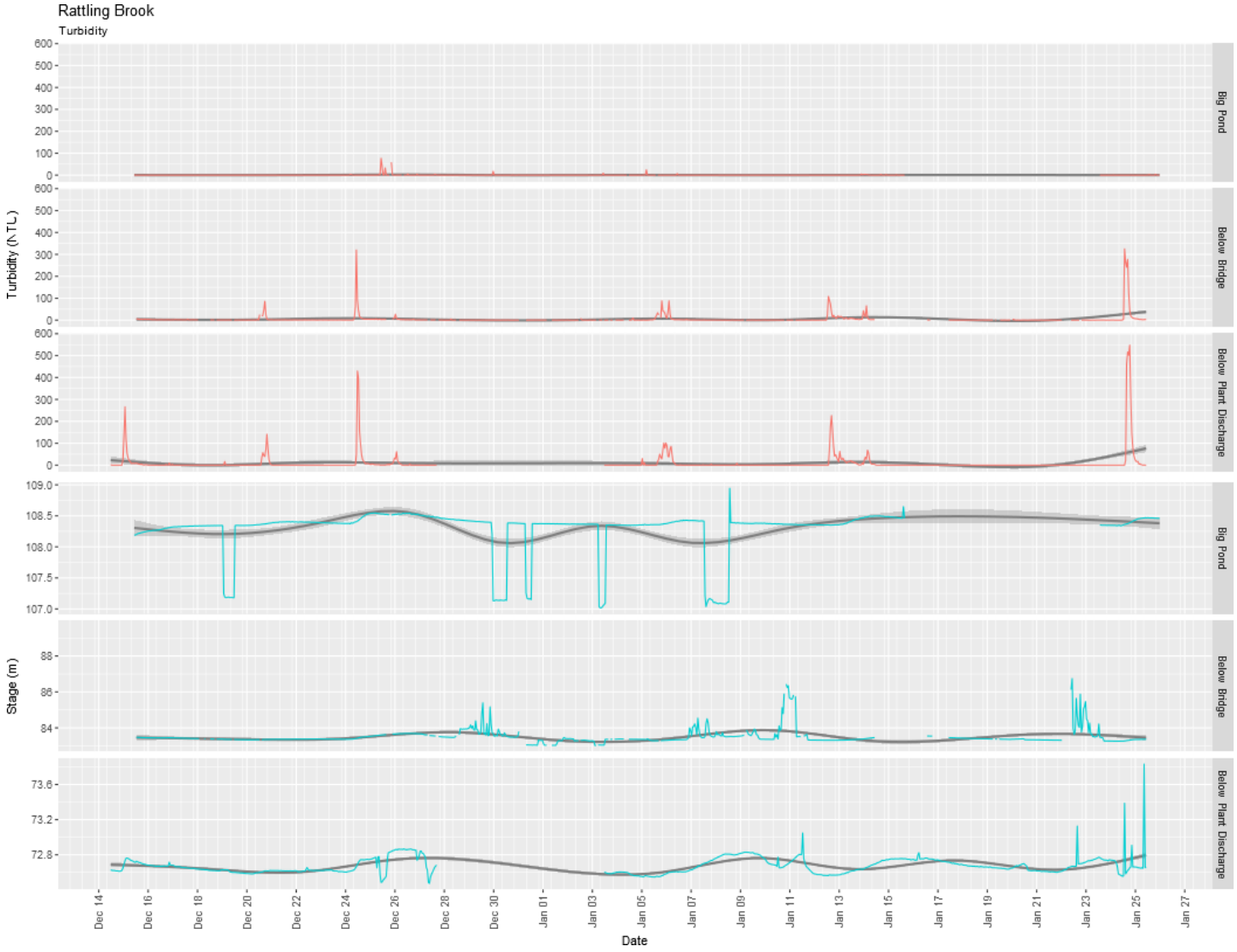
Turbidity

Turbidity is typically caused by fine suspended solids such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.



Station	Mean	Median	Min	Max
Big Pond	0.4	0.0	0.0	77.0
Below Bridge	4.9	0.6	0.0	325.4
Below Plant Discharge	9.5	0.0	0.0	548.0

- Peaks in turbidity occur simultaneously with peaks in conductivity seen above. These occurrences are generally associated with warm periods (mean daily temperatures >0^{o}C) and precipitation. Turbidity was generally low during the deployment period and did not last for a long period of time.

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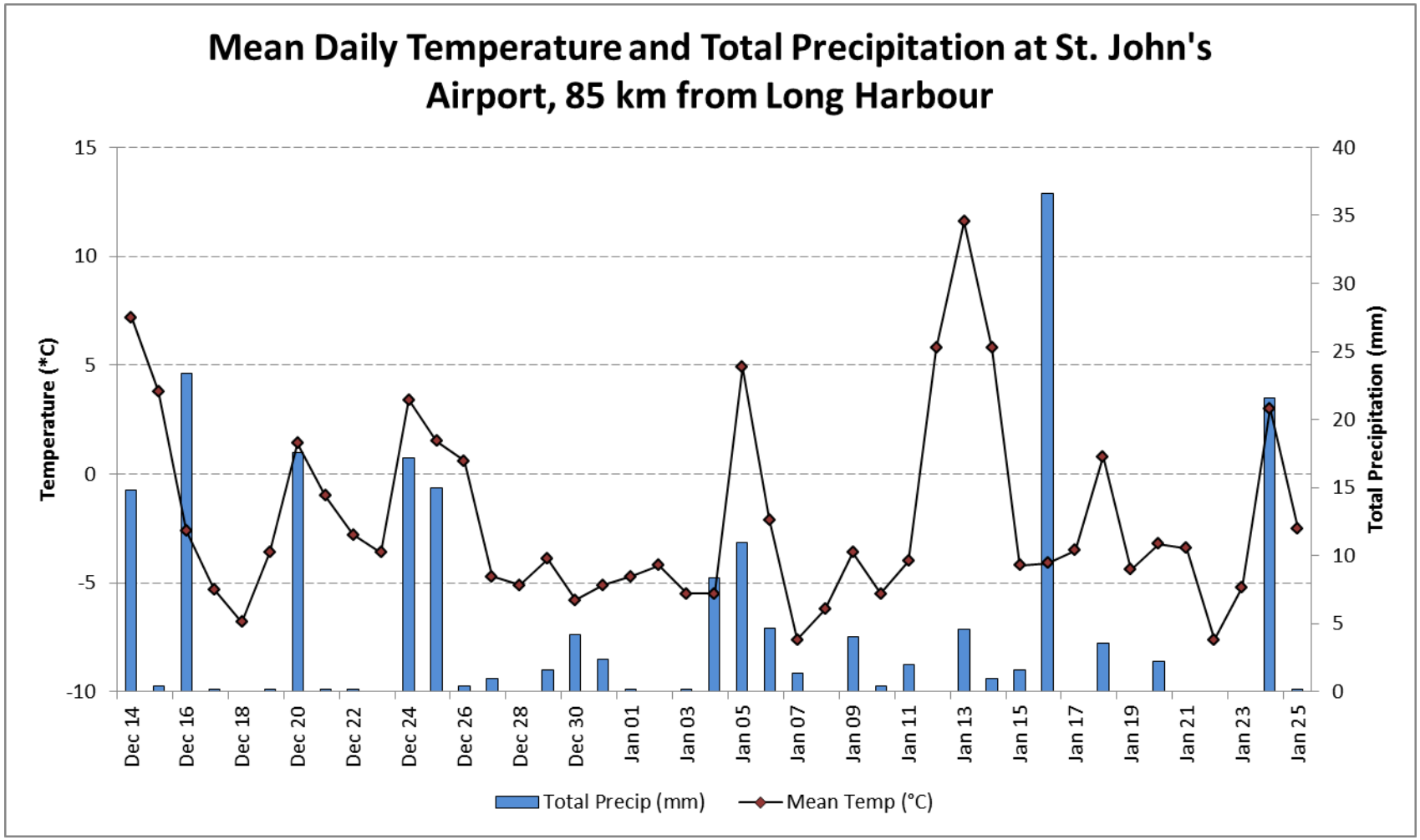
Appendix


Mean Daily Temperature and Total Precipitation at St. John's Airport, 85 km from Long Harbour
Temperature (*C)
Total Precipitation (mm)
15
10
5
0
-5
-10
40
35
30
25
20
15
10
5
0
Dec 14
Dec 16
Dec 18
Dec 20
Dec 22
Dec 24
Dec 26
Dec 28
Dec 30
Jan 01
Jan 03
Jan 05
Jan 07
Jan 09
Jan 11
Jan 13
Jan 15
Jan 17
Jan 19
Jan 21
Jan 23
Jan 25
Total Precip (mm)
Mean Temp (°C)