Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2017-09-12 to 2018-01-25

Government of Newfoundland & Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division
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General

- This station is operated as part of the Provincial Real Time Water Quality (RTWQ) network.
- This station is operated year round.
- Staff of the Water Resources Management Division (WRMD) monitors the real-time web page on a regular basis. Any unusual observations are investigated.
- This site is easily accessed and the instrument is normally removed on a monthly to bi-monthly basis for maintenance and calibration and is reinstalled within one to two days. During the winter months the deployment periods tend to be longer as the instrument is often frozen into place and difficult to remove.
- This monthly deployment report, presents water quality and water quantity data recorded at the Humber River at Humber Village station from September 12, 2017, to January 25, 2018. It should be noted that at 135 days, this was a longer than normal deployment period.

Quality Assurance / Quality Control

- Water quality instrument performance is tested at the beginning and end of its deployment period. The process is outlined in Appendix A.
- Instruments are assigned a performance rating (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.
- Table 1 shows the performance ratings of five water quality parameters (i.e., temperature, pH, specific conductivity, dissolved oxygen and turbidity) measured by the deployed instrument.
- The performances of all sensors were rated good to excellent at the beginning, and fair to excellent at the end of the deployment period (Table 1).
- **With the exception of water quantity data (stage height), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.

Table 1: Water quality instrument performance at the beginning and end of the deployment

	Humber River	
Stage of deployment	**Beginning**	**End**
Date	2017-09-12	2018-01-25
Temperature	Excellent	Excellent
pH	Excellent	Good
Specific Conductivity	Good	Excellent
Dissolved Oxygen	Excellent	Fair
Turbidity	Excellent	Excellent

Deployment Notes

Water quality monitoring for this deployment period started on September 12, 2017 and continued without any significant operational issues until January 25, 2018, when the instrument was removed for routine calibration and maintenance.

Data Interpretation

- Data records were interpreted for each station during the deployment period for the following six parameters:

  (i.) Stage (m)
  (ii.) Temperature (^{o}C)
  (iii.) pH
  (iv.) Specific conductivity (µS/cm)
  (v.) Dissolved oxygen (mg/l)
  (vi.) Turbidity (NTU)

Stage

- **The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request**.

- During this deployment period stage values ranged from 1.72 m to 4.65 m at Humber River at Humber Village, with corresponding flow ranging from 178.20 m^3/sec to 780.22 m^3/sec (Figure 1).

- Flows over the first three months of the deployment period were typical for the fall period, with a series of ups and downs related to rainfall patterns over the fall. The last month of the deployment period was dominated by a significant peak flow which was related to heavy rainfall and significant snowmelt over several days in mid-January (see climate data located in Appendix B).

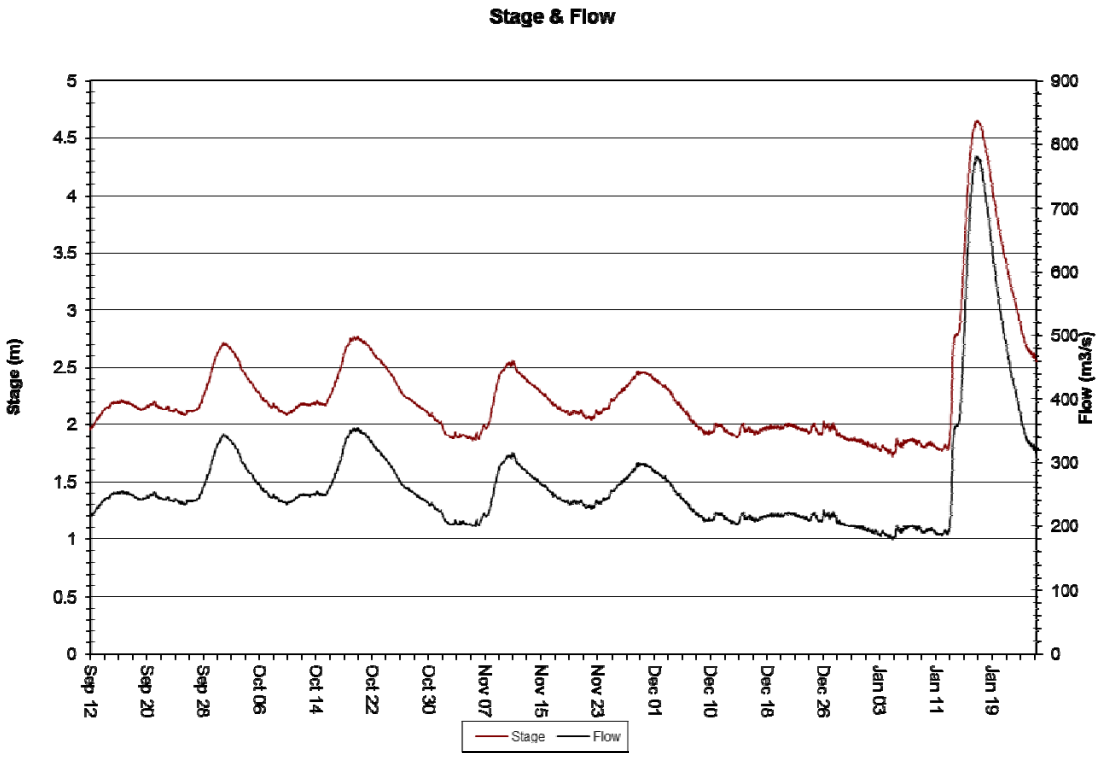

Figure 1: Stage Height (m) at Humber River from September 12, 2017, to January 25, 2018

Temperature

- During this deployment period the water temperature at Humber River ranged from 1.08˚C to 16.58 ˚C (Figure 2).
- Water temperature shows a steady decline over the deployment period which is consistent with the transition from fall to winter.
- The water temperature shows a diurnal trend which is related to the diurnal air temperature trend.

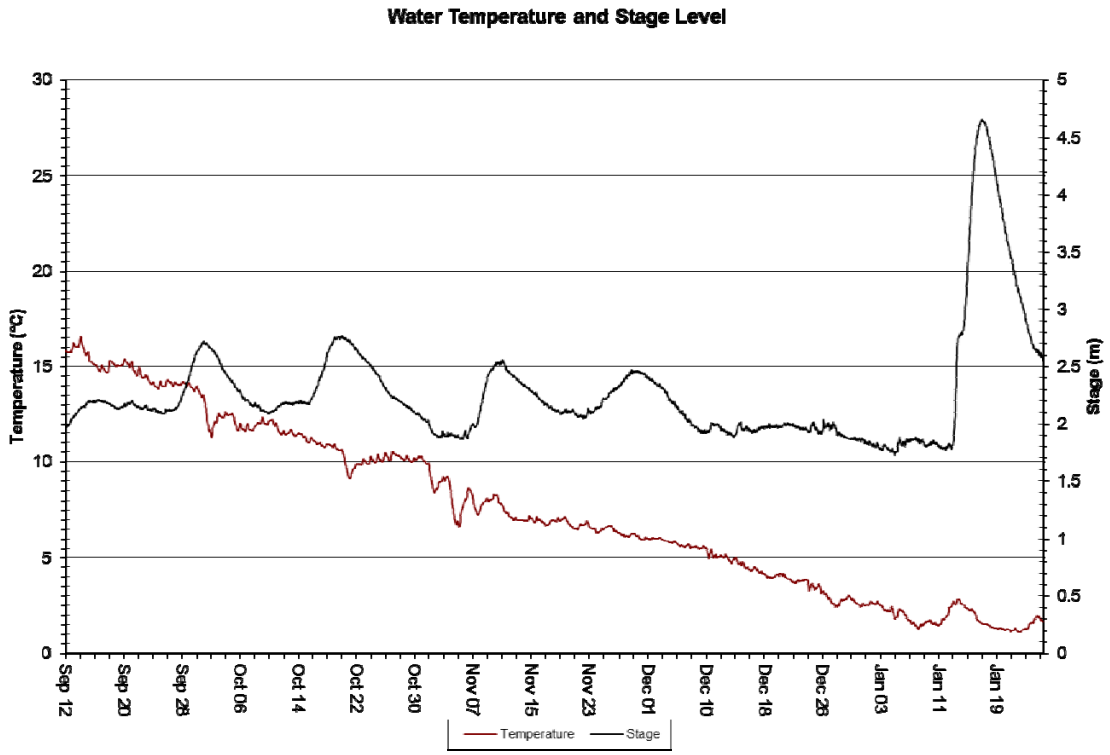

Figure 2: Temperature (^{o}C) at Humber River from September 12, 2017, to January 25, 2018

pH

- During this deployment period pH values at Humber River ranged from 6.88 units to 7.41 units (Figure 3).
- pH was relatively stable throughout the deployment period.
- With a median value of 7.13, all of the pH values recorded at Humber River during this deployment period were within the guidelines for pH for the protection of aquatic life (i.e., 6.5 to 9.0 units), as defined by the Canadian Council of Ministers of the Environment (2007).

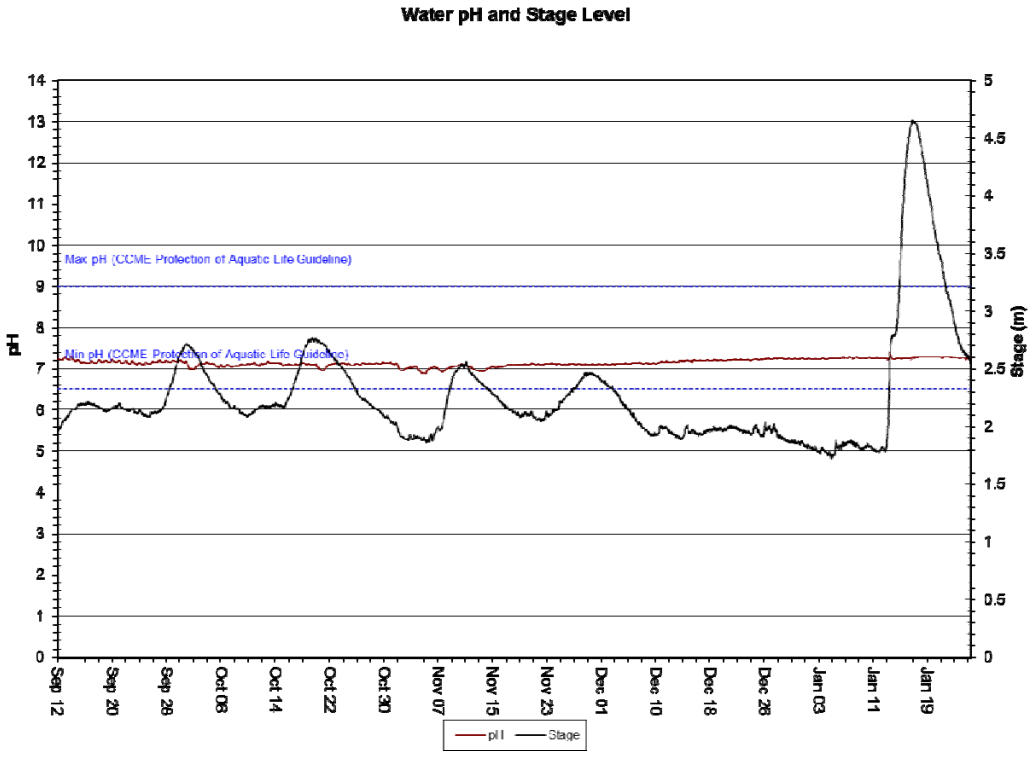

Figure 3: pH values recorded at Humber River from September 12, 2017, to January 25, 2018

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 39.4 µS/cm to 51.4 µS/cm (Figure 4).
- Specific conductivity is relatively stable over the deployment period, however there is a significant spike around January 13, 2018 (see inside red oval). This spike in specific conductivity corresponds with a period of rapid increase in flow, when a combination of rainfall and snowmelt increased the level of dissolved material in the river water.

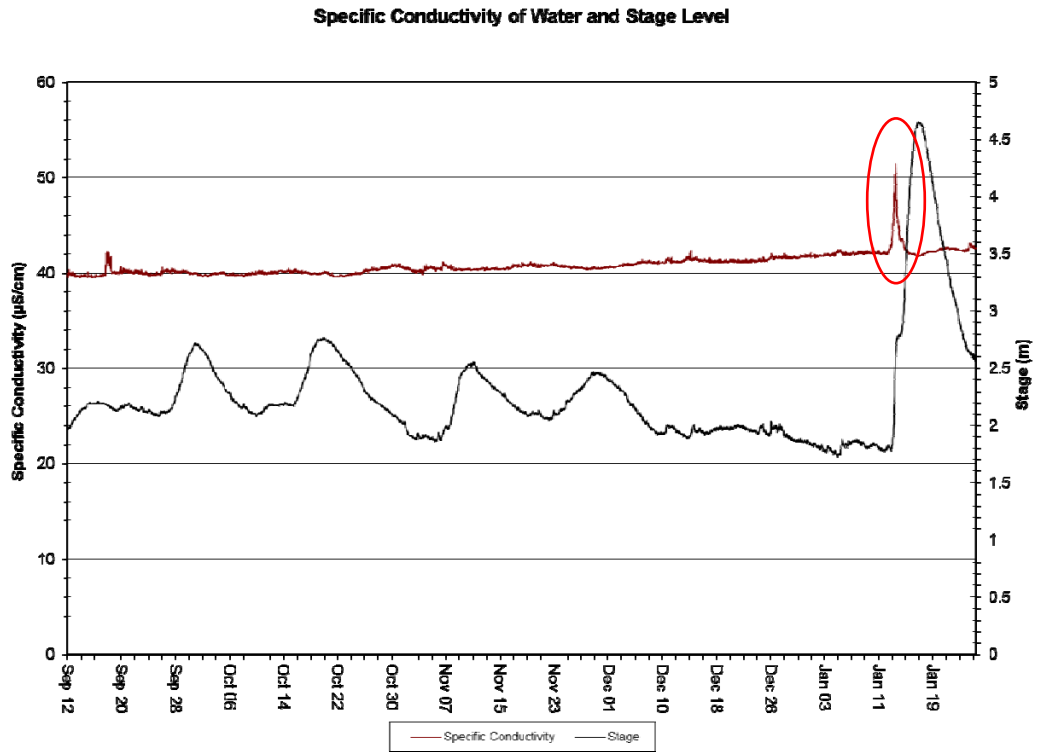

Figure 4: Specific conductivity (µs/cm) at Humber River from September 12, 2017, to January 25, 2018

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 9.81 mg/l (94.3% saturation) to 13.90 mg/l (102.5% saturation) (Figure 5).
- DO, % saturation, was relatively stable over the duration of the deployment period, while DO (mg/L) shows a steady increasing trend. This increasing trend is related to the decreasing temperature trend as colder water can hold more oxygen than warmer water.
- DO shows diurnal fluctuations which are related to the diurnal temperature trends for the same period.
- During this deployment period all of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l) and most of the DO values were at, or above, the minimum guideline set for the protection of early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

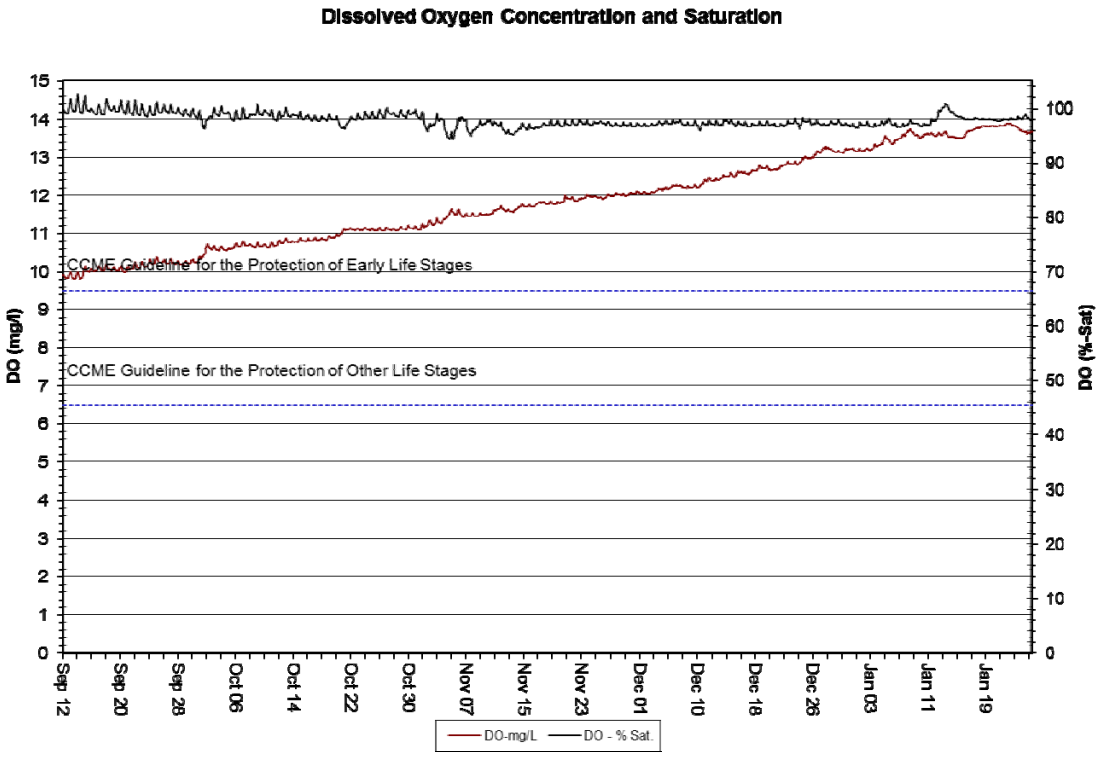

Figure 5: DO (mg/l & % saturation) at Humber River from September 12, 2017, to January 25, 2018

Turbidity

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 236.3 NTU (Figure 6).
- A block of turbidity data from Oct 24 to November 4 was removed from the dataset as it appeared that some organic debris or other material may have been trapped near the sensor heads causing false readings.
- Near the end of the deployment period an extreme increase in flow due to rainfall and snowmelt appears to have triggered some elevated levels of turbidity. These turbidity values could be associated with sedimentation caused by the rapid runoff due to rain and snowmelt. It should also be noted that during peak flows there tends to be more organic matter and debris floating in the river and these may have caused some of the high turbidity values.

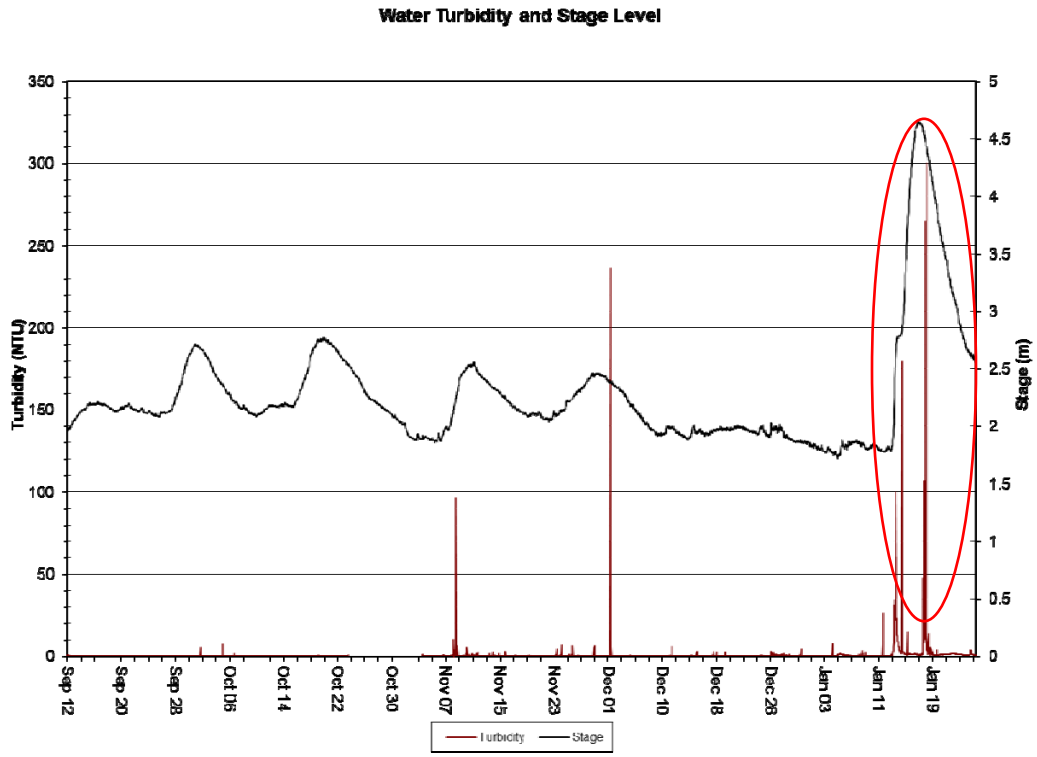

Figure 6: Turbidity (NTU) at Humber River from September 12, 2017, to January 25, 2018

Conclusions

- This monthly deployment report presents water quality and water quantity data recorded at Humber River at Humber Village from September 12, 2017, to January 25, 2018.
- The performances of all sensors were rated fair to excellent at the beginning and excellent at the end of the deployment period.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - During this deployment period stage values ranged from 1.72 m to 4.65 m at Humber River at Humber Village, with corresponding flow ranging from 178.20 m^3/sec to 780.22 m^3/sec. While flows over the first three months of the deployment period were typical for the fall period, with a series of ups and downs related to rainfall patterns over the fall, the last month of the deployment period was dominated by a significant peak flow which was related to heavy rainfall and significant snowmelt over several days in mid-January.
    - During this deployment period the water temperature at Humber River ranged from 1.08˚C to 16.58 ˚C and shows a steady decline over the deployment period, which is consistent with the transition from fall to winter.
    - During this deployment period pH values at Humber River ranged from 6.88 units to 7.41 units and were relatively stable throughout the deployment period. With a median value of 7.13, all of the pH values recorded at Humber River during this deployment period were within the guidelines for pH for the protection of aquatic life (i.e., 6.5 to 9.0 units), as defined by the Canadian Council of Ministers of the Environment (2007).
    - During this deployment period specific conductivity at Humber River ranged from 37.9 µS/cm to 40.6 µS/cm and was relatively stable over the deployment period.
    - During this deployment period specific conductivity at Humber River ranged from 39.4 µS/cm to 51.4 µS/cm. Specific conductivity was relatively stable over the deployment period, however there is a significant spike around January 13, 2018, which corresponds with a period of rapid increase in flow due to rainfall and snowmelt.
    - During this deployment period dissolved oxygen [DO] values at Humber River ranged from 9.81 mg/l (94.3% saturation) to 13.90 mg/l (102.5% saturation). DO, % saturation, was relatively stable over the duration of the deployment period, while DO (mg/L) shows a steady increasing trend. This increasing trend is related to the decreasing temperature trend as colder water can hold more oxygen than warmer water. During this deployment period all of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l) and most of the DO values were at, or above, the minimum guideline set for the

protection of early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 236.3 NTU. A block of turbidity data from Oct 24 to November 4 was removed from the dataset as it appeared that some organic debris or other material may have been trapped near the sensor heads causing false readings. Near the end of the deployment period an extreme increase in flow due to rainfall and snowmelt appears to have triggered some elevated levels of turbidity.

References

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. (Website: http://ceqg-rcqe.ccme.ca/download/en/222/)

APPENDIX A
Quality Assurance / Quality Control Procedures

- As part of the Quality Assurance / Quality Control (QA/QC) protocol, the performance of a station's water quality instrument (i.e., Field Sonde) is rated at the beginning and end of its deployment period. The procedure is based on the approach used by the United States Geological Survey (Wagner *et al.* 2006)[1].
- At the beginning of the deployment period, a fully cleaned and calibrated QA/QC water quality instrument (i.e., QA/QC Sonde) is placed *in-situ* with the fully cleaned and calibrated Field Sonde. After Sonde readings have stabilized, which may take up to five minutes in some cases, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde. If the readings from both Sondes are in close agreement, the QA/QC Sonde can be removed from the water. If the readings are not in close agreement, there will be attempts to reconcile the problem on site (e.g., removing air bubbles from sensors, etc.). If no fix is made, the Field Sonde may be removed for recalibration.
- At the end of the deployment period, a fully cleaned and calibrated QA/QC Sonde is once again deployed *in-situ* with the Field Sonde, which has already been deployment for 30-40 days. After Sonde readings have stabilized, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde.
- Performance ratings are based on differences listed in the table below.

	Rating				
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

[1] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*

APPENDIX B

Environment Canada Weather Data – Corner Brook (09-12-2017 to 01-25-2018)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
9/12/2017	10	9	9.5	8.5	0	18.2
9/13/2017	16	8	12	6	0	0
9/14/2017	22.5	13	17.8	0.2	0	0
9/15/2017	17	8	12.5	5.5	0	0
9/16/2017	13	10	11.5	6.5	0	4
9/17/2017	16	5	10.5	7.5	0	0
9/18/2017	17.5	3.5	10.5	7.5	0	0
9/19/2017	20	8	14	4	0	14
9/20/2017	21.5	16	18.8	0	0.8	7.4
9/21/2017	15	11	13	5	0	0
9/22/2017	20	3.5	11.8	6.2	0	0
9/23/2017	20.5	7	13.8	4.2	0	0.4
9/24/2017	12.5	5	8.8	9.2	0	3.8
9/25/2017	21	9	15	3	0	5.8
9/26/2017	20	10	15	3	0	0
9/27/2017	15.5	3	9.3	8.7	0	16.4
9/28/2017	19	8	13.5	4.5	0	2
9/29/2017	12	8.5	10.3	7.7	0	3
9/30/2017	9	2	5.5	12.5	0	0
10/1/2017	15.5	1	8.3	9.7	0	0
10/2/2017	10.5	3	6.8	11.2	0	0
10/3/2017	10.5	-1.5	4.5	13.5	0	0
10/4/2017	15.5	2.5	9	9	0	9.2
10/5/2017	17.5	11	14.3	3.7	0	2
10/6/2017	13.5	6	9.8	8.2	0	0
10/7/2017	14	5	9.5	8.5	0	7.2
10/8/2017	20	7	13.5	4.5	0	4.2
10/9/2017	16.5	11.5	14	4	0	1.8
10/10/2017	16	10	13	5	0	7
10/11/2017	10	8	9	9	0	1.4
10/12/2017	9	5	7	11	0	1.4
10/13/2017	8	5	6.5	11.5	0	0
10/14/2017	11.5	2	6.8	11.2	0	3.4
10/15/2017	18	4	11	7	0	14
10/16/2017	15.5	6.5	11	7	0	1.6
10/17/2017	7	2	4.5	13.5	0	0.4
10/18/2017	8	0	4	14	0	1.4

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
10/19/2017	14	4	9	9	0	3
10/20/2017	12	6	9	9	0	3
10/21/2017	6	4	5	13	0	2.8
10/22/2017	7	0	3.5	14.5	0	0
10/23/2017	9	0	4.5	13.5	0	0
10/24/2017	15	0	7.5	10.5	0	0
10/25/2017	21.5	7.5	14.5	3.5	0	0
10/26/2017	21.5	12	16.8	1.2	0	0.2
10/27/2017	17.5	10.5	14	4	0	2
10/28/2017	10	7	8.5	9.5	0	0.2
10/29/2017	11.5	4	7.8	10.2	0	0
10/30/2017	16	0	8	10	0	3.2
10/31/2017	14.5	3.5	9	9	0	0.4
11/1/2017	10.5	7.5	9	9	0	0
11/2/2017	8.5	-1	3.8	14.2	0	2.2
11/3/2017	17.5	4	10.8	7.2	0	9
11/4/2017	7.5	3.5	5.5	12.5	0	0.2
11/5/2017	4.5	-1.5	1.5	16.5	0	0
11/6/2017	16.5	-3	6.8	11.2	0	44.4
11/7/2017	6.5	3.5	5	13	0	0
11/8/2017	4	-2	1	17	0	0
11/9/2017	5.5	-3	1.3	16.7	0	0
11/10/2017	9	-5	2	16	0	8
11/11/2017	0	-2.5	-1.3	19.3	0	0.4
11/12/2017	4	-1	1.5	16.5	0	0
11/13/2017	4	-3.5	0.3	17.7	0	0.2
11/14/2017	4.5	-1	1.8	16.2	0	0
11/15/2017	2.5	-5.5	-1.5	19.5	0	0
11/16/2017	4	-7.5	-1.8	19.8	0	0
11/17/2017	2	-5	-1.5	19.5	0	3
11/18/2017	3.5	0.5	2	16	0	2
11/19/2017	12	1	6.5	11.5	0	2.2
11/20/2017	8.5	1	4.8	13.2	0	3
11/21/2017	-1.5	-2	-1.8	19.8	0	0.4
11/22/2017	8	-3	2.5	15.5	0	1.8
11/23/2017	12.5	2	7.3	10.7	0	0.6
11/24/2017	1	0	0.5	17.5	0	2.4
11/25/2017	12.5	-4.5	4	14	0	0.6

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
11/26/2017	9.5	7	8.3	9.7	0	7
11/27/2017	2	-0.5	0.8	17.2	0	2.6
11/28/2017	-2.5	-4.5	-3.5	21.5	0	1
11/29/2017	4	-5	-0.5	18.5	0	6.8
11/30/2017	-0.5	-2	-1.3	19.3	0	0
12/1/2017	2.5	-6	-1.8	19.8	0	0.6
12/2/2017	3	-0.5	1.3	16.7	0	0.6
12/3/2017	3	0	1.5	16.5	0	2.2
12/4/2017	-0.5	-1	-0.8	18.8	0	0.6
12/5/2017	0	-2	-1	19	0	0
12/6/2017	5.5	-2	1.8	16.2	0	2.6
12/7/2017	4.5	0	2.3	15.7	0	4
12/8/2017	-1	-2	-1.5	19.5	0	3
12/9/2017	1.5	-2	-0.3	18.3	0	17.2
12/10/2017	11	-3	4	14	0	6.6
12/11/2017	1	-2	-0.5	18.5	0	1.6
12/12/2017	-0.5	-7.5	-4	22	0	1
12/13/2017	11	-6	2.5	15.5	0	8.2
12/14/2017	-1.5	-3.5	-2.5	20.5	0	4
12/15/2017	-4.5	-7.5	-6	24	0	3.4
12/16/2017	-4.5	-5.5	-5	23	0	2.4
12/17/2017	-4	-8	-6	24	0	3.2
12/18/2017	-4	-9	-6.5	24.5	0	0.6
12/19/2017	2	-7	-2.5	20.5	0	1.8
12/20/2017	2	-1.5	0.3	17.7	0	11.8
12/21/2017	4	-4.5	-0.3	18.3	0	12.4
12/22/2017	-5	-6	-5.5	23.5	0	0.4
12/23/2017	2.5	-6.5	-2	20	0	13.5
12/24/2017	2.5	-5.5	-1.5	19.5	0	0
12/25/2017	1.5	-6.5	-2.5	20.5	0	8.4
12/26/2017	-6.5	-10.5	-8.5	26.5	0	5.6
12/27/2017	-4.5	-10.5	-7.5	25.5	0	10.2
12/28/2017	-3	-10	-6.5	24.5	0	2.2
12/29/2017	-3.5	-4.5	-4	22	0	0
12/30/2017	-6	-11.5	-8.8	26.8	0	2.6
12/31/2017	-4.5	-8.5	-6.5	24.5	0	0
1/1/2018	-1.5	-10.5	-6	24	0	3.2
1/2/2018	-2	-5.5	-3.8	21.8	0	3.2

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
1/3/2018	-4.5	-10	-7.3	25.3	0	6
1/4/2018	0.5	-11.5	-5.5	23.5	0	7.8
1/5/2018	5.5	-6	-0.3	18.3	0	10.1
1/6/2018	-8	-13.5	-10.8	28.8	0	7.4
1/7/2018	11	-13.5	-1.3	19.3	0	0
1/8/2018	-8	-12	-10	28	0	1
1/9/2018	-5	-10	-7.5	25.5	0	7
1/10/2018	-6.5	-11	-8.8	26.8	0	3
1/11/2018	2	-13	-5.5	23.5	0	0.4
1/12/2018	11	-1.5	4.8	13.2	0	35.6
1/13/2018	14	10	12	6	0	20
1/14/2018	-2	-5	-3.5	21.5	0	0.4
1/15/2018	-8	-10.5	-9.3	27.3	0	3.4
1/16/2018	-6	-12	-9	27	0	1.4
1/17/2018	-5	-7.5	-6.3	24.3	0	7
1/18/2018	-0.5	-5.5	-3	21	0	0.6
1/19/2018	-3	-6	-4.5	22.5	0	0
1/20/2018	0.5	-10.5	-5	23	0	10
1/21/2018	-8	-9.5	-8.8	26.8	0	3.8
1/22/2018	-7	-10.5	-8.8	26.8	0	0
1/23/2018	6	-12	-3	21	0	24.4
1/24/2018	7	-5	1	17	0	12.4
1/25/2018	-4.5	-8.5	-6.5	24.5	0	3.2