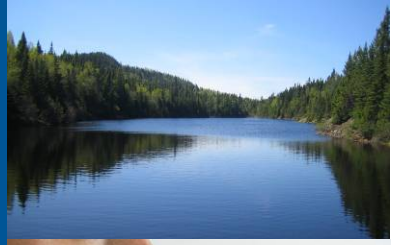




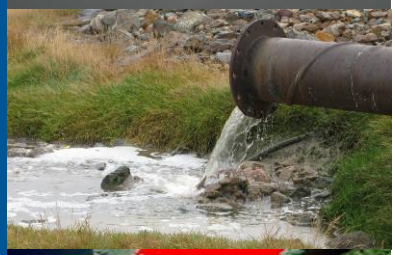


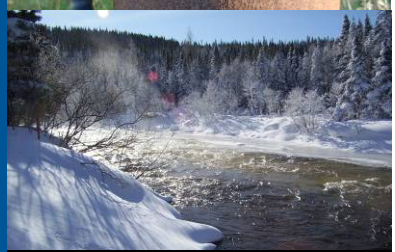

Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2015-06-09 to 2015-09-22

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

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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.
- This monthly deployment report, presents water quality and water quantity data recorded at the Humber River at Humber Village station from June 9, 2015, to September 22, 2015.

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 instruments deployed at the water monitoring stations.
- The performances of all sensors were rated 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	2015-06-09	2015-09-22
Temperature	Excellent	Excellent
pH	Excellent	Good
Specific Conductivity	Excellent	Fair
Dissolved Oxygen	Excellent	Excellent
Turbidity	Excellent	Excellent

Deployment Notes

Water quality monitoring for this deployment period started on June 09, 2015 and continued without any significant operational issues until September 22, 2015, when the instrument was removed for routine calibration and maintenance. This was a relatively long deployment period of 105 days. While the field instrument kept reasonably good calibration for this extended deployment it did drift off calibration by the end.

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 1.57 m to 2.99 m at Humber River, with corresponding flow ranging from 157.97 m^3/sec to 397.84 m^3/sec (Figure 1).

- Flows over the deployment period were typical for the summer season. There are numerous ups and downs with the most significant spike around September 16th (see inside red oval). This spike was related to heavy rainfall for several days preceding it (see climate data in Appendix B).

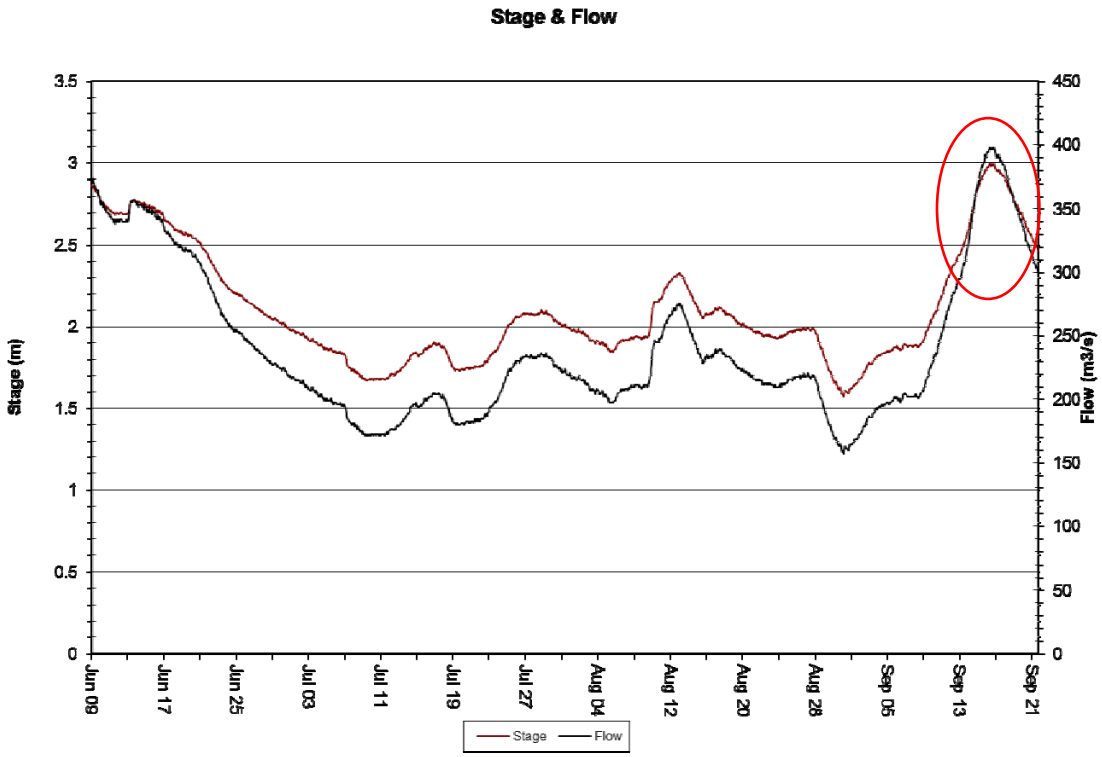

Figure 1: Stage Height (m) at Humber River from June 09, 2015, to September 22, 2015

Temperature

- During this deployment period water temperature at Humber River ranged from 5.48˚C to 19.92˚C (Figure 2).
- Temperature shows a steady increasing trend for the first three quarters of the deployment period which is consistent with the transition from spring to summer.
- The water temperature shows a diurnal trend which is related to the diurnal air temperature trend.

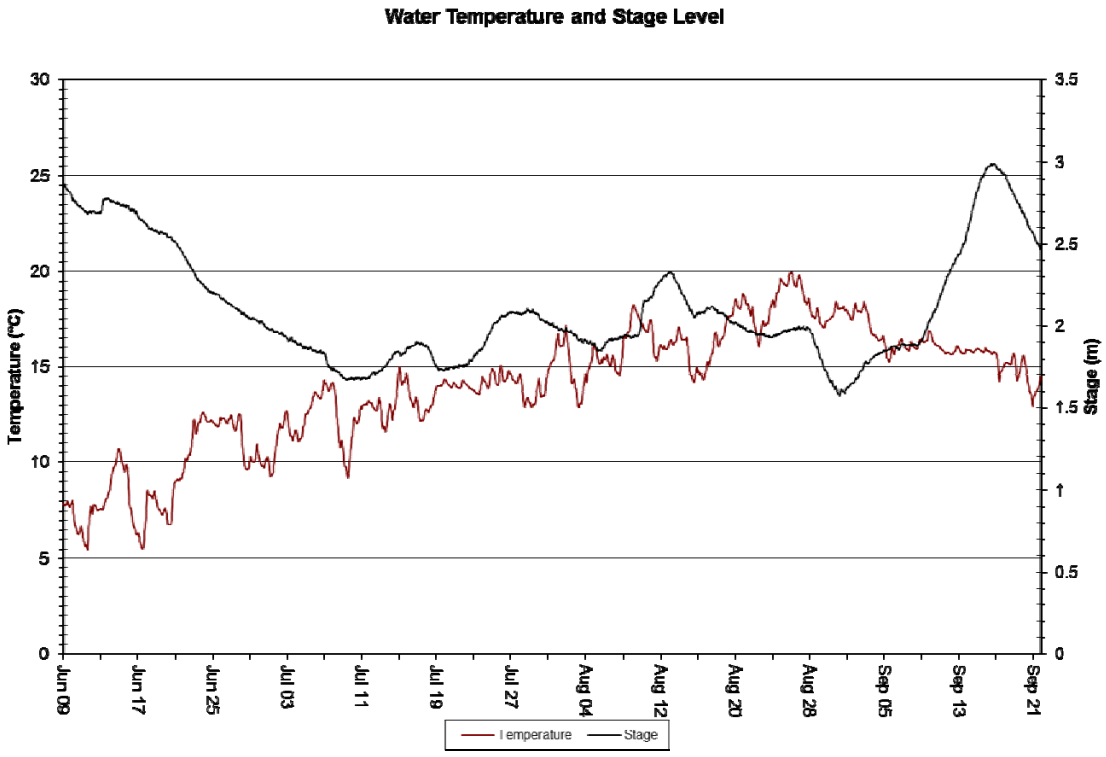

Figure 2: Temperature (°C) at Humber River from June 09, 2015, to September 22, 2015

pH

- During this deployment period pH values at Humber River ranged from 6.73 units to 7.52 units (Figure 3).
- pH was quite stable throughout the deployment period.
- pH shows diurnal fluctuations which are related to the diurnal temperature fluctuations.
- With a median value of 7.24, 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).

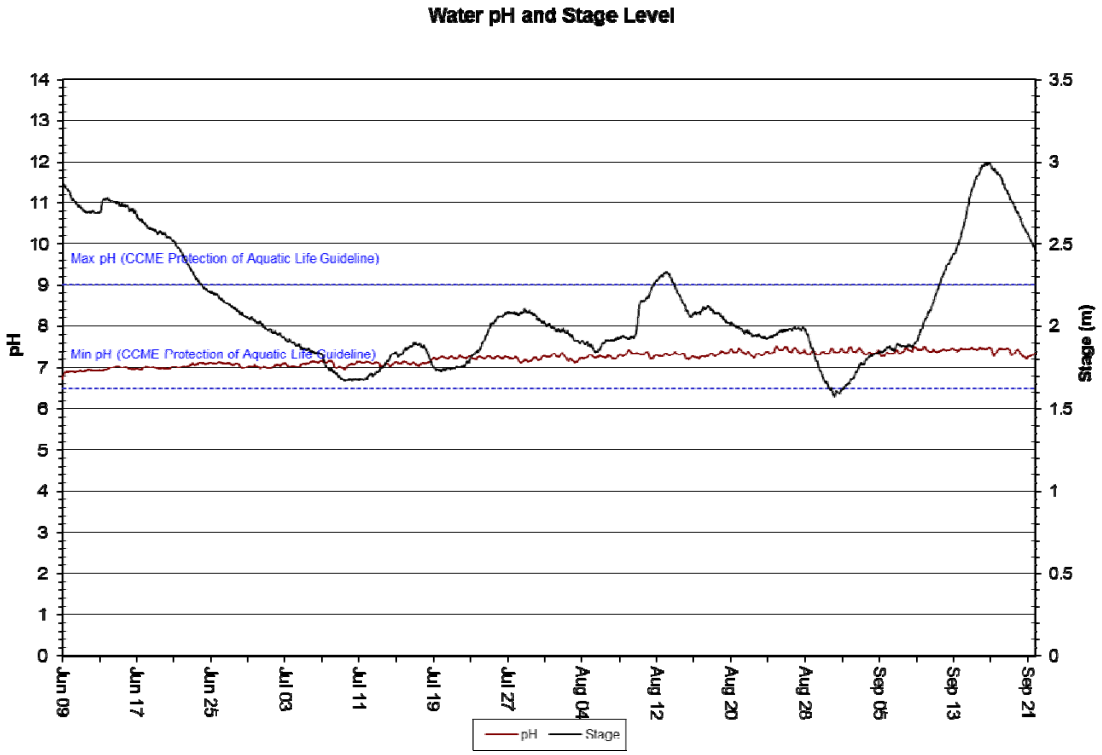

Figure 3: pH values recorded at Humber River from June 09, 2015, to September 22, 2015

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 29.2 µS/cm to 35.1 µS/cm (Figure 4).
- Specific conductivity appears to be relatively stable during the deployment period showing a slight increasing trend which is related to the increasing temperature trend.

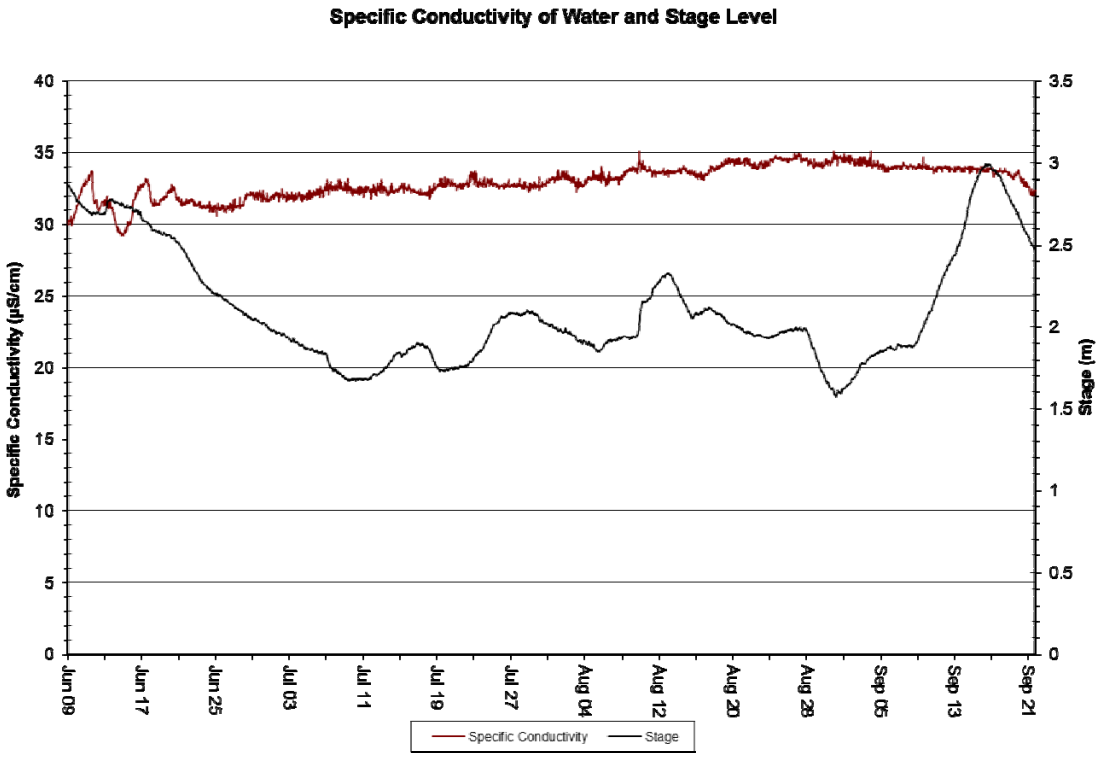

Figure 4: Specific conductivity (µs/cm) at Humber River from June 09, 2015, to Sept. 22, 2015

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 9.07 mg/l (94.2% saturation) to 12.37 mg/l (104.8% saturation) (Figure 5).
- Over the deployment period DO(mg/l)shows a steady decreasing trend which is related to a warming water temperature trend for the same period.
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
- All of the DO values at Humber River were above both the minimum guideline set for other life stages (6.5 mg/l), and mostly above the minimum guideline (9.5 mg/l) set for the protection of early life stages, as determined by the Canadian Council of Ministers of the Environment (2007).

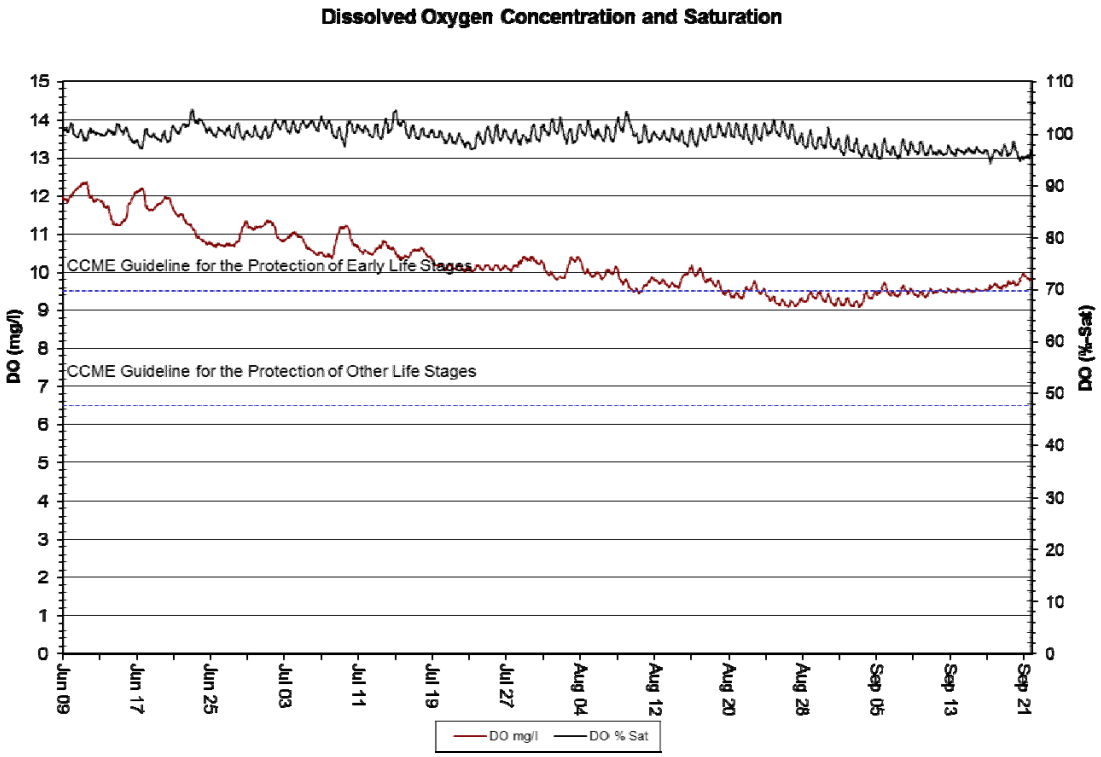

Figure 5: DO (mg/l & % saturation) at Humber River from June 09, 2015, to September 22, 2015

Turbidity

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 25.0 NTU (Figure 6).
- During this deployment period there were only several spikes in turbidity beyond normal background turbidity levels. From approximately August 14th to August 20th there were continuous elevated turbidity readings (see inside red oval) which were most likely related to organic debris, such as leaves or other plant matter, being temporarily lodged around the sensor head. Data for this period are false readings and will be removed from the dataset.

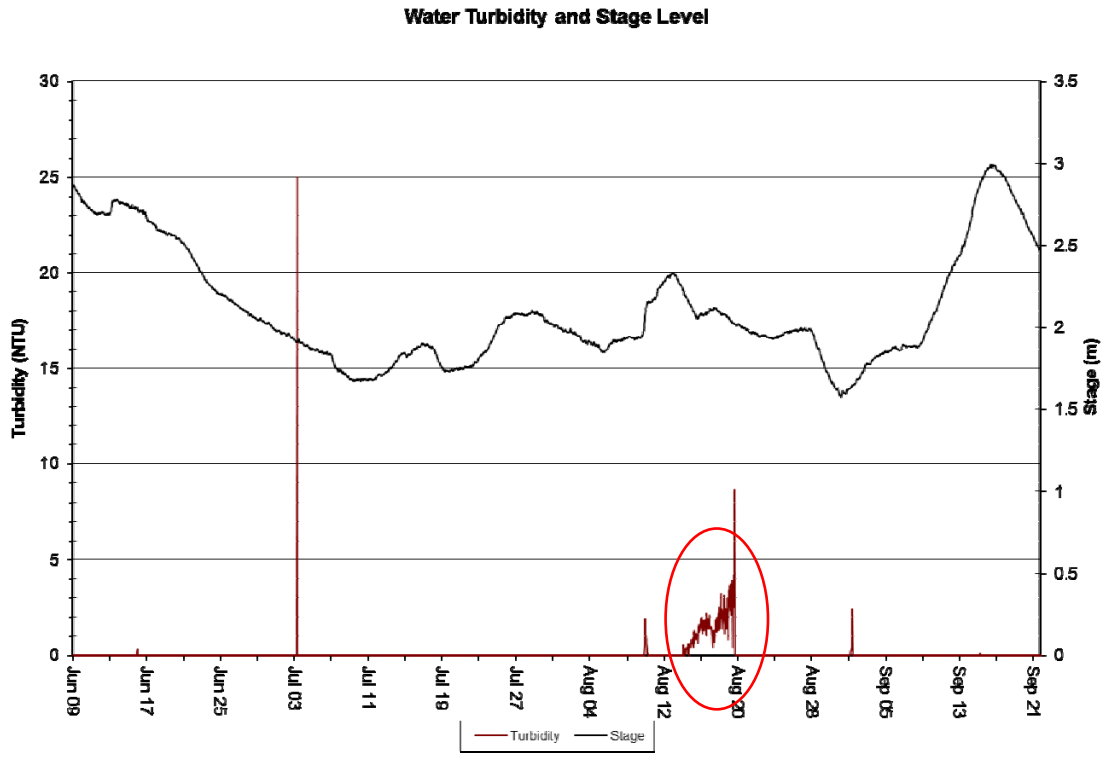

Figure 6: Turbidity (NTU) at Humber River from June 09, 2015, to September 22, 2015

Conclusion

- This monthly deployment report presents water quality and water quantity data recorded at Humber River from June 09, 2015, to September 22, 2016.
- The performances of all sensors were rated excellent at the beginning of the deployment period, and fair to excellent at the end.

- Variations in water quality/quantity values recorded at each station are summarized below:

- During this deployment period stage values ranged from 1.57 m to 2.99 m at Humber River, with corresponding flow ranging from 157.97 m^3/sec to 397.84 m^3/sec. Flows over the deployment period were typical for the summer season.

- During this deployment period water temperature at Humber River ranged from 5.48˚C to 19.92˚C. Temperature shows a steady increasing trend for the first three quarters of the deployment period which is consistent with the transition from spring to summer.

- During this deployment period pH values at Humber River ranged from 6.73 units to 7.52 units. pH was quite stable throughout the deployment period and with a median value of 7.24, 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 29.2 µS/cm to 35.1 µS/cm. Specific conductivity appears to be relatively stable during the deployment period showing a slight increasing trend which is related to the increasing temperature trend.
- During this deployment period DO values at Humber River ranged from 9.07 mg/l (94.2% saturation) to 12.37 mg/l (104.8% saturation). Over the deployment period DO(mg/l)shows a steady decreasing trend which is related to a warming water temperature trend for the same period. All of the DO values at Humber River were above both the minimum guideline set for other life stages (6.5 mg/l), and mostly above the minimum guideline (9.5 mg/l) set for the protection of early life stages, 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 25.0 NTU.

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 (June 09, 2015, to Sept. 22, 2015)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
6/9/2015	12	6	0	0	0	0
6/10/2015	17.3	0.7	0	0	0	0
6/11/2015	18	0	0	0	0	0
6/12/2015	16.5	1.5	0	0	0	0
6/13/2015	12.3	5.7	0	25.6	0	25.6
6/14/2015	7.5	10.5	0	0.3	0	0.3
6/15/2015	10.3	7.7	0	0	0	0
6/16/2015	11.5	6.5	0	8	0	8
6/17/2015	10.3	7.7	0	2.8	0	2.8
6/18/2015	14.8	3.2	0	0	0	0
6/19/2015	14.5	3.5	0	0	0	0
6/20/2015	11.5	6.5	0	0.3	0	0.3
6/21/2015	12.8	5.2	0	0	0	0
6/22/2015	16.5	1.5	0	0	0	0
6/23/2015	16.5	1.5	0	0	0	0
6/24/2015	11.3	6.7	0	4.9	0	4.9
6/25/2015	9.3	8.7	0	12.2	0	12.2
6/26/2015	9	9	0	0	0	0
6/27/2015	11.5	6.5	0	0	0	0
6/28/2015	16.3	1.7	0	0	0	0
6/29/2015	15	3	0	0	0	0
6/30/2015	14.8	3.2	0	0	0	0
7/1/2015	18	0	0	0	0	0
7/2/2015	19.3	0	1.3	0	0	0
7/3/2015	19.3	0	1.3	0	0	0
7/4/2015	17.5	0.5	0	0	0	0
7/5/2015	15.3	2.7	0	0	0	0
7/6/2015	13.5	4.5	0	0	0	0
7/7/2015	16.3	1.7	0	0	0	0
7/8/2015	17.8	0.2	0	5.9	0	5.9
7/9/2015	16.8	1.2	0	0	0	0
7/10/2015	18.5	0	0.5	4.2	0	4.2
7/11/2015	13.5	4.5	0	4.3	0	4.3
7/12/2015	12.5	5.5	0	5.6	0	5.6
7/13/2015	16.3	1.7	0	0	0	0
7/14/2015	17.8	0.2	0	0	0	0

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
7/15/2015	20.8	0	2.8	0	0	0
7/16/2015	16.8	1.2	0	0	0	0
7/17/2015	13.8	4.2	0	0	0	0
7/18/2015	12.5	5.5	0	3.1	0	3.1
7/19/2015	10.5	7.5	0	0	0	0
7/20/2015	12.5	5.5	0	0	0	0
7/21/2015	14	4	0	0	0	0
7/22/2015	13.5	4.5	0	14.4	0	14.4
7/23/2015	10.8	7.2	0	6.1	0	6.1
7/24/2015	12.8	5.2	0	0	0	0
7/25/2015	13	5	0	0	0	0
7/26/2015	12.8	5.2	0	0	0	0
7/27/2015	14.3	3.7	0	0	0	0
7/28/2015	20	0	2	19.1	0	19.1
7/29/2015	17	1	0	1.9	0	1.9
7/30/2015	16.5	1.5	0	0	0	0
7/31/2015	17.3	0.7	0	0	0	0
8/1/2015	20.5	0	2.5	0	0	0
8/2/2015	21.5	0	3.5	0	0	0
8/3/2015	20.8	0	2.8	0	0	0
8/4/2015	22.5	0	4.5	3.6	0	3.6
8/5/2015	23.5	0	5.5	0.5	0	0.5
8/6/2015	18.3	0	0.3	14.1	0	14.1
8/7/2015	14.5	3.5	0	0	0	0
8/8/2015	15.5	2.5	0	0	0	0
8/9/2015	17.3	0.7	0	17.1	0	17.1
8/10/2015	13.3	4.7	0	25.1	0	25.1
8/11/2015	18.3	0	0.3	0	0	0
8/12/2015	16.8	1.2	0	5	0	5
8/13/2015	19.3	0	1.3	0	0	0
8/14/2015	22.8	0	4.8	0	0	0
8/15/2015	21	0	3	0	0	0
8/16/2015	22	0	4	0	0	0
8/17/2015	22	0	4	0	0	0
8/18/2015	23.3	0	5.3	0	0	0
8/19/2015	18.3	0	0.3	0.4	0	0.4
8/20/2015	22	0	4	0	0	0
8/21/2015	22.3	0	4.3	0	0	0

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Precip (mm)
8/22/2015	23	0	5	2.2	0	2.2
8/23/2015	21.5	0	3.5	0	0	0
8/24/2015	21	0	3	0	0	0
8/25/2015	19.3	0	1.3	0	0	0
8/26/2015	18.8	0	0.8	0	0	0
8/27/2015	18.8	0	0.8	1.5	0	1.5
8/28/2015	18	0	0	0.3	0	0.3
8/29/2015	19	0	1	1.1	0	1.1
8/30/2015	18	0	0	4.1	0	4.1
8/31/2015	20.5	0	2.5	8.5	0	8.5
9/1/2015	15	3	0	1.9	0	1.9
9/2/2015	11	7	0	0	0	0
9/3/2015	17.3	0.7	0	14.7	0	14.7
9/4/2015	13.5	4.5	0	0.4	0	0.4
9/5/2015	12.5	5.5	0	0	0	0
9/6/2015	10.5	7.5	0	0.4	0	0.4
9/7/2015	17.3	0.7	0	4.4	0	4.4
9/8/2015	12.3	5.7	0	0	0	0
9/9/2015	12.5	5.5	0	11.5	0	11.5
9/10/2015	18	0	0	0	0	0
9/11/2015	15.5	2.5	0	4.5	0	4.5
9/12/2015	14.5	3.5	0	6.1	0	6.1
9/13/2015	13.8	4.2	0	0.4	0	0.4
9/14/2015	13.3	4.7	0	23.9	0	23.9
9/15/2015	15.3	2.7	0	0	0	0
9/16/2015	14	4	0	0	0	0
9/17/2015	12	6	0	1.7	0	1.7
9/18/2015	13.5	4.5	0	0	0	0
9/19/2015	19.3	0	1.3	1	0	1
9/20/2015	20.8	0	2.8	5.9	0	5.9
9/21/2015	14.3	3.7	0	0.9	0	0.9
9/22/2015	11.8	6.2	0	0	0	0