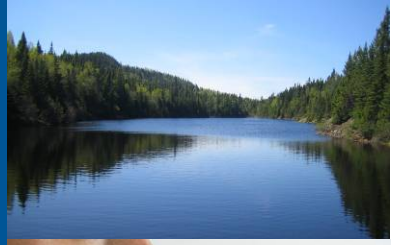




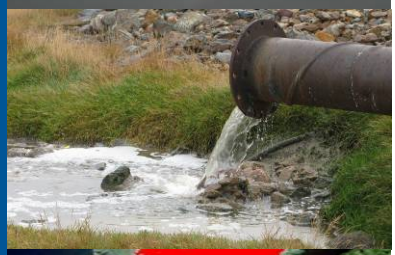


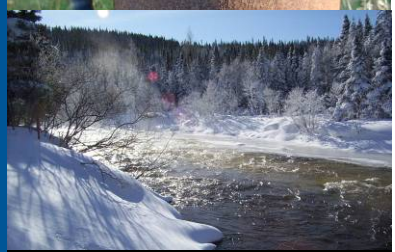

Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2013-08-22 to 2013-11-05

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 daily 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 August 22, 2013, to November 5, 2013.

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.

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

	Humber River	
Stage of deployment	**Beginning**	**End**
Date	2013-08-22	2013-11-05
Temperature	Good	Excellent
pH	Excellent	Good
Specific Conductivity	Good	Good
Dissolved Oxygen	Excellent	Excellent
Turbidity	Excellent	Excellent

The performances of all sensors were rated good to excellent at the beginning and end of the deployment period (Table 1).

Deployment Notes

- Water quality monitoring for this deployment period started on August 22, 2013 at 1:30 pm and continued without any significant operational issues until November 5, 2013, at 10:30 am 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

- During this deployment period stage values ranged from 1.75 m to 3.04 m at Humber River, with corresponding flow ranging from 183.00 m^3/sec to 415.0 m^3/sec (Figure 1).

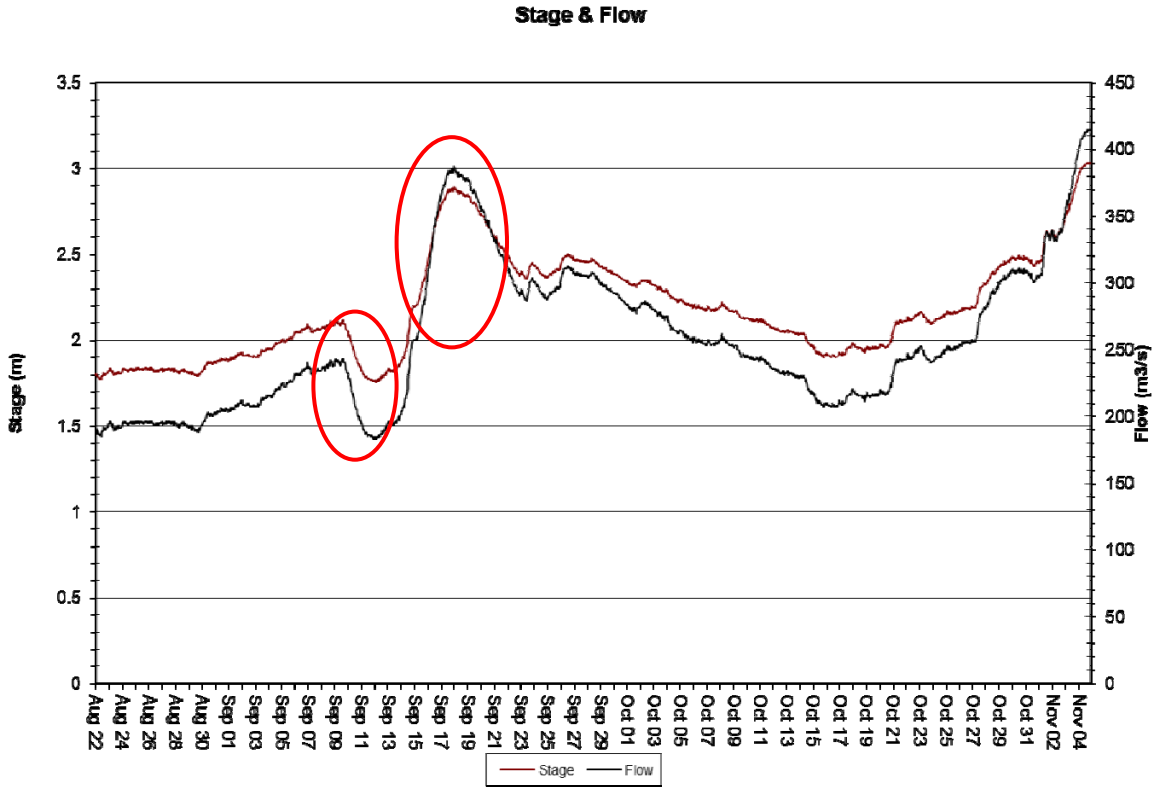

Figure 1: Stage Height (m) at Humber River from August 22, 2013, to November 5, 2013

- During the deployment period there is both a significant drop in flow over a relatively short period of time, and a significant spike in flow (See inside red ovals – Figure 1). The significant drop in flow from around September 10th to 12th is related to a reduction in flow through the Deer Lake Power hydroelectric generating plant in Deer Lake and/or a

reduction of the spilling of excess water from the Grand Lake Reservoir. The spike in flow from September 14th to 18th is related to a period of heavy rainfall (Climate data is located in Appendix B), possibly combined with an increase in flow through the hydroelectric generating plant and/or additional spilling of excess water from the Grand Lake Reservoir.

- Stage and flow show an increasing trend over the last 10 days of the deployment due to sustained precipitation for that period.

Temperature

- During this deployment period water temperature at Humber River ranged from 7.73˚C to 17.80˚C (Figure 2).
- Water temperature displays diurnal variations which are related to diurnal variations in ambient air temperatures.
- There is a gentle decreasing temperature trend over the deployment period which is consistent with the transition from late summer to fall.

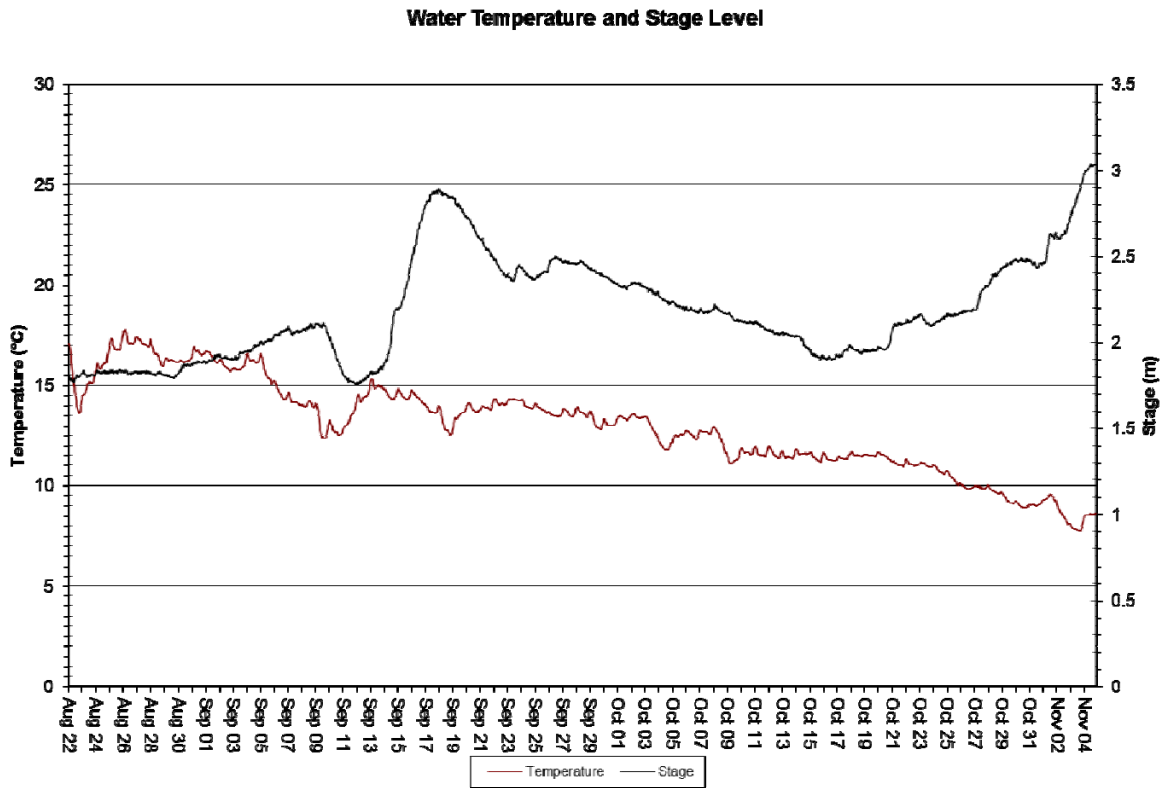

Figure 2: Temperature (°C) at Humber River from August 22, 2013, to November 5, 2013

pH

- During this deployment period pH values at Humber River ranged from 6.33 units to 7.28 units (Figure 3).
- pH was very stable throughout the deployment period.
- pH shows diurnal fluctuations which are related to the diurnal temperature fluctuations.
- With a mean value of 7.02, all but a few 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). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below this 6.5 unit guideline.

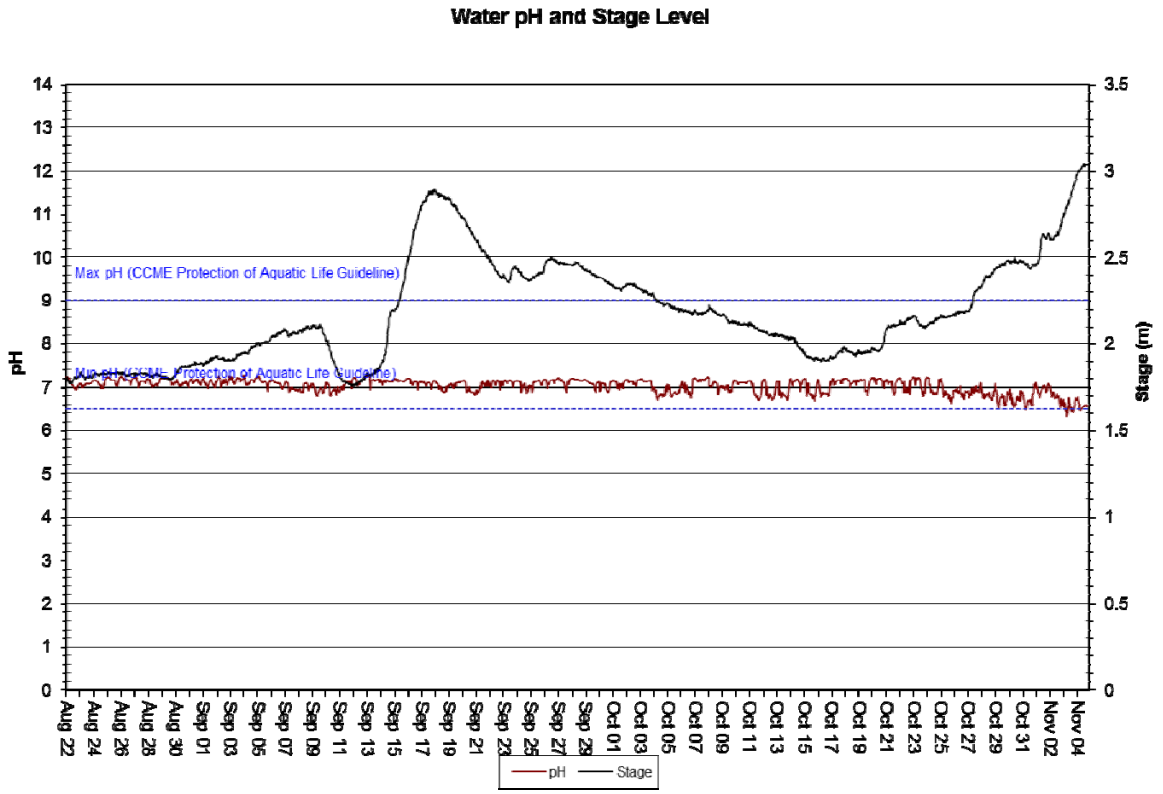

Figure 3: pH values recorded at Humber River from August 22, 2013, to November 5, 2013

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 37.7 µS/cm to 40.6 µS/cm (Figure 4).
- Specific conductivity appears to be relatively stable during the deployment period.

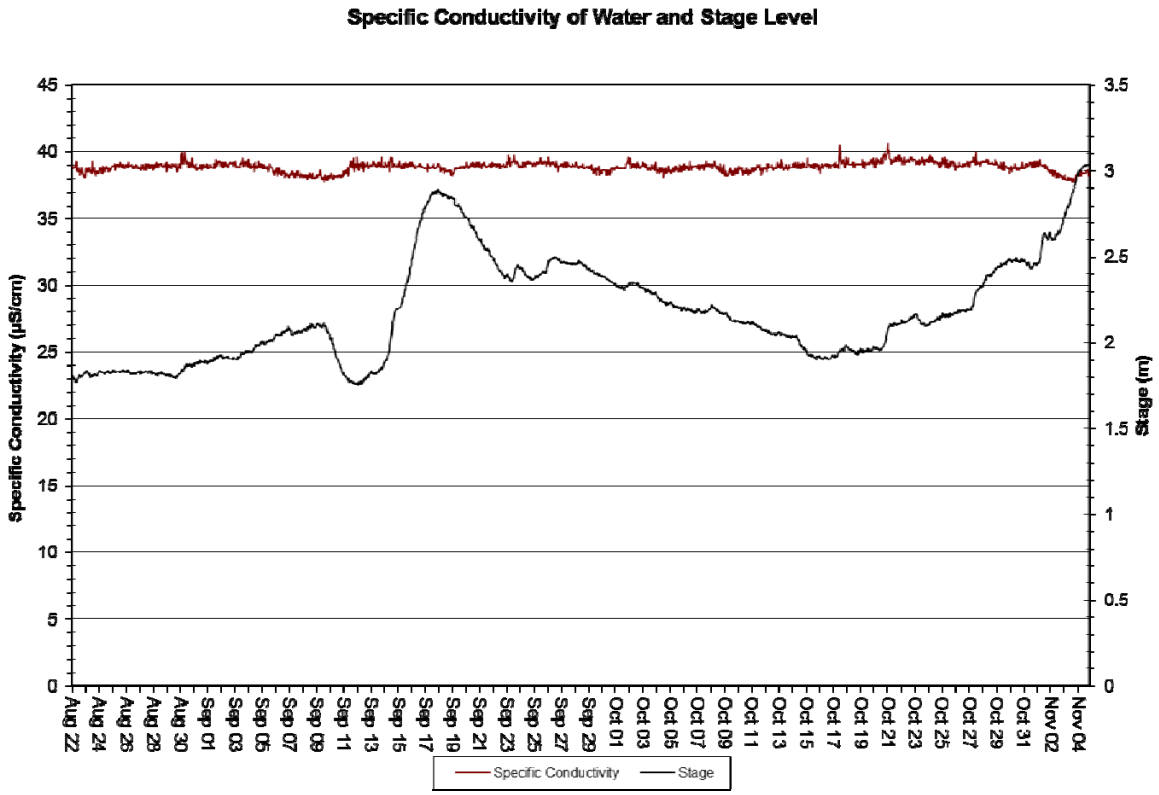

Figure 4: Specific conductivity (µs/cm) at Humber River from August 22, 2013, to November 5, 2013

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 9.04 mg/l (87.8% saturation) to 11.06 mg/l (100.4% saturation) (Figure 5).
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
- DO (mg/l) shows a gentle increasing trend over the deployment period which is related to the decreasing temperature trend (i.e. cooler water holds more oxygen).
- All of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007). From mid-September onwards the DO values were also above the minimum guideline (9.5 mg/l) set for the protection of early life stages, which is the pertinent guideline in October and November during the salmon spawning season.

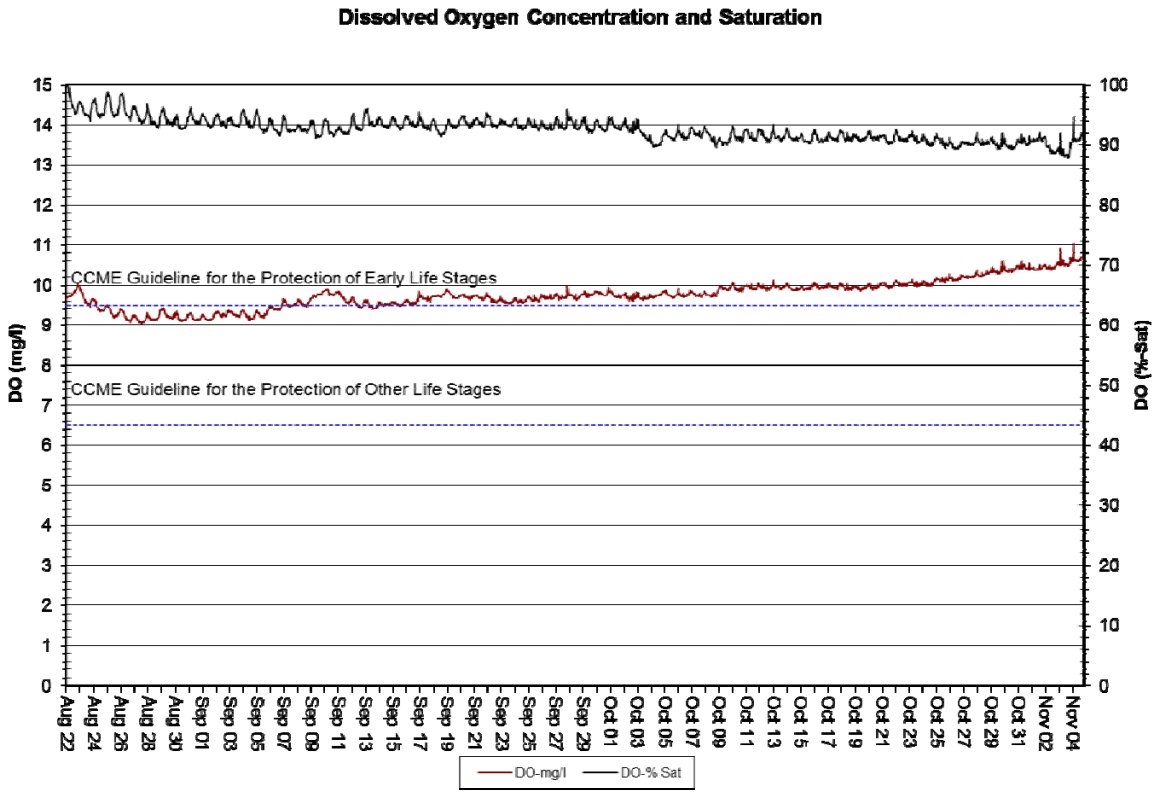

Figure 5: DO (mg/l & % saturation) at Humber River from August 22, 2013, to November 5, 2013

Turbidity

- During this deployment period turbidity values at Humber River ranged from 0.0 NTU to 9.2 NTU (Figure 6).
- From about September 11th to October 21st there are a series of turbidity readings ranging from 0 NTU up to 9.2 NTU, which are most likely false readings related to biofouling and/or organic matter trapped around the sensor. These high readings are unreliable and do not reflect the actual turbidity readings at the station.

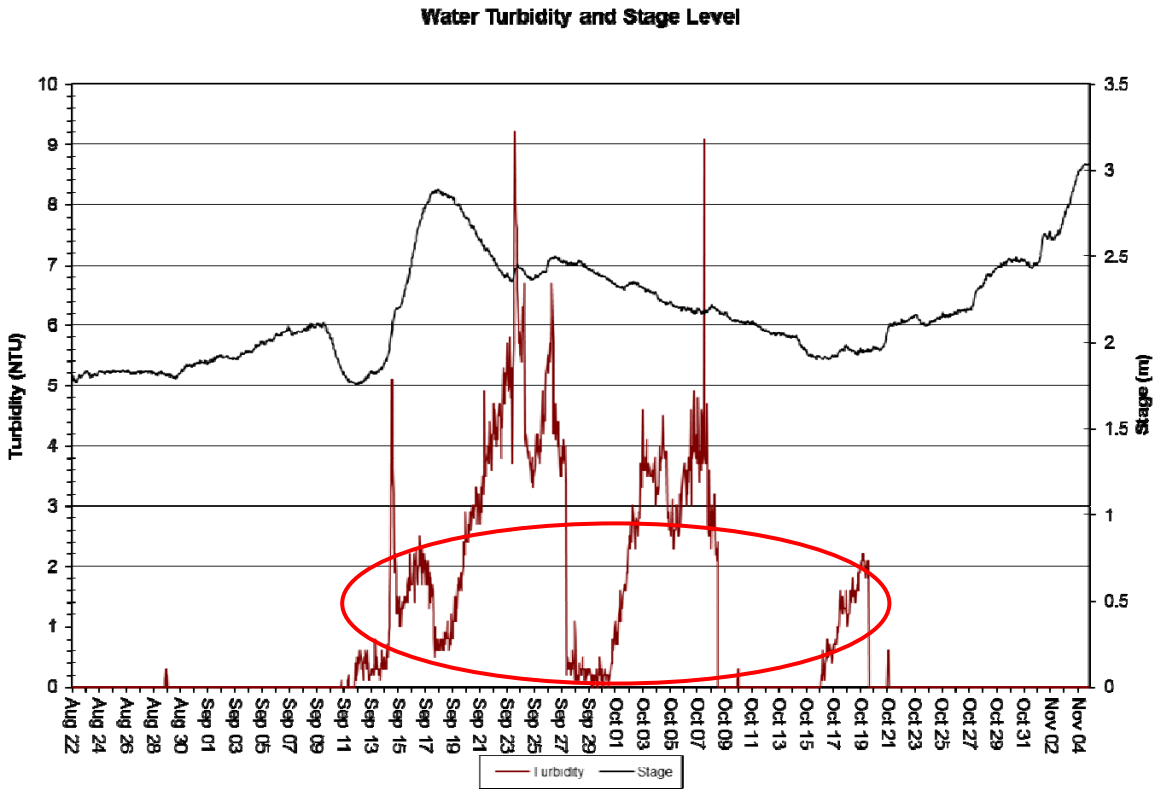

Figure 6: Turbidity (NTU) at Humber River from August 22, 2013, to November 5, 2013

Conclusion

- This monthly deployment report presents water quality and water quantity data recorded at Humber River from August 22, 2013, to November 5, 2013.
- The performances of all sensors were rated good to excellent at the beginning and end of the deployment period.

- Variations in water quality/quantity values recorded at each station are summarized below:
    - During the deployment period there is both a significant drop in flow over a relatively short period of time, and a significant spike in flow. The drop in flow is related to a reduction in flow through the Deer Lake Power hydroelectric generating plant in Deer Lake and/or a reduction of the spilling of excess water from the Grand Lake Reservoir. The spike in flow is related to a period of heavy rainfall possibly combined with an increase in flow through the hydroelectric generating plant and/or additional spilling of excess water from the Grand Lake Reservoir.
    - Stage and flow show an increasing trend over the last 10 days of the deployment due to sustained precipitation for that period.
    - Water temperature displays diurnal variations which are related to diurnal variations in ambient air temperatures.
    - There is a gentle decreasing temperature trend over the deployment period which is consistent with the transition from late summer to fall.
    - pH was very stable throughout the deployment period and shows regular diurnal fluctuations which are related to the diurnal temperature fluctuations.
    - All but a few 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).
    - Specific conductivity appears to be relatively stable during the deployment period.
    - DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
    - DO (mg/l) shows a gentle increasing trend over the deployment period which is related to the decreasing temperature trend (i.e. cooler water holds more oxygen).
    - All of the DO values at Humber River were above the minimum guideline set for other life stages (6.5 mg/l), and from mid-September onwards the DO values were also above the minimum guideline (9.5 mg/l) set for the protection of early life stages.
    - Turbidity values remained at 0.0 NTU for much of the deployment period however from about September 11th to October 21st there are a series of turbidity readings ranging from 0 NTU up to 9.2 NTU, which are most likely false readings related to biofouling and/or organic matter trapped around the sensor.

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 (August 22, 2013, to November 5, 2013)

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Rain (mm)	Total Snow (mm)	Total Precip (mm)
8/22/2013	28	19	23.5	0	5.5	0	0	0
8/23/2013	22.5	13.5	18	0	0	4.1	0	4.1
8/24/2013	19	7.5	13.3	4.7	0	0	0	0
8/25/2013	22.5	6.5	14.5	3.5	0	0	0	0
8/26/2013	26	8.5	17.3	0.7	0	0.9	0	0.9
8/27/2013	20.5	15	17.8	0.2	0	0.7	0	0.7
8/28/2013	23.5	15	19.3	0	1.3	0.5	0	0.5
8/29/2013	16.5	7.5	12	6	0	4.7	0	4.7
8/30/2013	17	10	13.5	4.5	0	4.9	0	4.9
8/31/2013	18.5	10.5	14.5	3.5	0	0	0	0
9/1/2013	19.5	9.5	14.5	3.5	0	7	0	7
9/2/2013	15	11	13	5	0	0.4	0	0.4
9/6/2013	14	8	11	7	0	4	0	4
9/7/2013	20	10	15	3	0	0	0	0
9/8/2013	17	14.5	15.8	2.2	0	9.1	0	9.1
9/9/2013	14.5	8	11.3	6.7	0	0	0	0
9/10/2013	19.5	10	14.8	3.2	0	0	0	0
9/11/2013	16.5	9.5	13	5	0	11.4	0	11.4
9/12/2013	21.5	10	15.8	2.2	0	2.4	0	2.4
9/13/2013	26	15	20.5	0	2.5	17.2	0	17.2
9/14/2013	18	10	14	4	0	29.5	0	29.5
9/15/2013	18	9.5	13.8	4.2	0	1.5	0	1.5
9/16/2013	19	11	15	3	0	6	0	6
9/17/2013	11.5	9	10.3	7.7	0	0	0	0
9/18/2013	19.5	7	13.3	4.7	0	0	0	0
9/19/2013	17	8.5	12.8	5.2	0	0	0	0
9/20/2013	11.5	7	9.3	8.7	0	0	0	0
9/21/2013	16	1.5	8.8	9.2	0	0	0	0
9/22/2013	24.5	10.5	17.5	0.5	0	1.2	0	1.2
9/23/2013	20.5	17	18.8	0	0.8	35.4	0	35.4
9/24/2013	19	15	17	1	0	1.6	0	1.6
9/25/2013	16	10	13	5	0	2.4	0	2.4
9/26/2013	11.5	9.5	10.5	7.5	0	0.7	0	0.7
9/27/2013	12.5	7.5	10	8	0	0	0	0
9/28/2013	18.5	5	11.8	6.2	0	0	0	0
9/29/2013	23.5	10.5	17	1	0	0	0	0
9/30/2013	20.5	10.5	15.5	2.5	0	0	0	0

Date/Time	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Rain (mm)	Total Snow (mm)	Total Precip (mm)
10/1/2013	20	8.5	14.3	3.7	0	18	0	18
10/2/2013	14.5	12	13.3	4.7	0	4.1	0	4.1
10/3/2013	14	9.5	11.8	6.2	0	0	0	0
10/4/2013	9	7.5	8.3	9.7	0	3.4	0	3.4
10/5/2013	11.5	7	9.3	8.7	0	0	0	0
10/6/2013	10	5	7.5	10.5	0	1.1	0	1.1
10/7/2013	13.5	1	7.3	10.7	0	0	0	0
10/8/2013	19	9	14	4	0	9	0	9
10/9/2013	10.5	5.5	8	10	0	9.1	0	9.1
10/10/2013	15.5	5	10.3	7.7	0	0	0	0
10/11/2013	9	5	7	11	0	0	0	0
10/12/2013	7.5	-2	2.8	15.2	0	0	0	0
10/13/2013	10	-2.5	3.8	14.2	0	0	0	0
10/14/2013	15	0	7.5	10.5	0	1.4	0	1.4
10/15/2013	9.5	8	8.8	9.2	0	0	0	0
10/16/2013	11.5	1.5	6.5	11.5	0	0	0	0
10/17/2013	12	4.5	8.3	9.7	0	18.6	0	18.6
10/18/2013	14	9	11.5	6.5	0	2.7	0	2.7
10/19/2013	9.5	8.5	9	9	0	3	0	3
10/20/2013	10.5	6	8.3	9.7	0	15	0	15
10/21/2013	7.5	6	6.8	11.2	0	5	0	5
10/22/2013	7.5	4.5	6	12	0	0	0	0
10/23/2013	13	2.5	7.8	10.2	0	0.9	0	0.9
10/24/2013	9	1.5	5.3	12.7	0	11.4	0	11.4
10/25/2013	7	1.5	4.3	13.7	0	1	0	1
10/26/2013	8	1	4.5	13.5	0	5	0	5
10/27/2013	7.5	0.5	4	14	0	16.5	0	16.5
10/28/2013	7	4	5.5	12.5	0	6.2	0.5	6.7
10/29/2013	7	1.5	4.3	13.7	0	1	2.2	3.2
10/30/2013	5	0	2.5	15.5	0	0.6	3.2	3.8
10/31/2013	4	-5	-0.5	18.5	0	3.4	0	3.4
11/1/2013	18.5	0	9.3	8.7	0	25	0	25
11/2/2013	12	9	10.5	7.5	0	0	0	0
11/3/2013	5	4	4.5	13.5	0	0	0	0
11/4/2013	5	1.5	3.3	14.7	0	0	0	0
11/5/2013	4	-1	1.5	16.5	0	0	0	0