Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2013-06-11 to 2013-08-20

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

Prepared by:

Ian Bell
Environmental Scientist

Department of Environment & Conservation
Water Resources Management Division
PO Box 2006, Corner Brook, NL, A2H 6J8

t. 709.637.2431
f. 709.637.2541
e. ianbell@gov.nl.ca

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 June 11, 2013, to August 20, 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	2013-06-11	2013-08-20
Temperature	Fair	Good
pH	Excellent	Good
Specific Conductivity	Excellent	Excellent
Dissolved Oxygen	Excellent	Marginal
Turbidity	Excellent	Excellent

The performances of all sensors were rated fair to excellent at the beginning of the deployment period, while all sensors were rated marginal to excellent at the end of the deployment period (Table 1). The fair rating for temperature at the beginning of the deployment is based on a relatively small difference of 0.55 ^{o} C which is due to the fact that the QA instrument was deployed at the edge of the river in shallower water than the field instrument. The marginal rating for oxygen at the end of the deployment is due to the instrument drifting off calibration after a relatively long deployment period during warm water conditions, when biofouling is more prevalent.

Deployment Notes

- Water quality monitoring for this deployment period started on June 11, 2013 at 12:50 pm and continued without any significant operational issues until August 20, 2013, at 2:40 pm 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 1.58 m to 2.31 m at Humber River, with corresponding flow ranging from 156.00 m^3/sec to 278.0 m^3/sec (Figure 1).

- There are two noticeable peaks in stage height and flow during the deployment period (See inside red ovals – Figure 1) which are related to a combination of rain and Deer Lake Power spilling excess water from the Grand Lake reservoir.

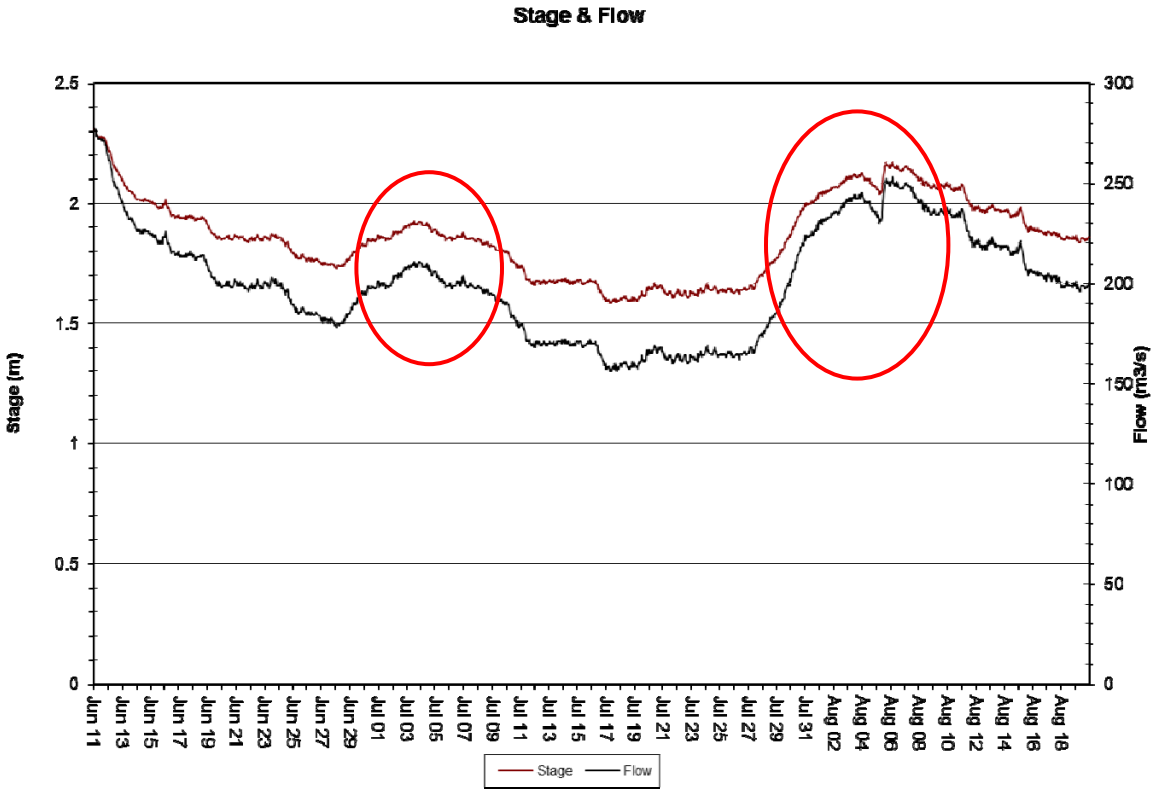

Figure 1: Stage Height (m) at Humber River from June 11, 2013, to August 20, 2013

Temperature

- During this deployment period water temperature at Humber River ranged from 6.41˚C to 19.12˚C (Figure 2).
- Water temperature displays diurnal variations which are related to diurnal variations in ambient air temperatures.
- There is a gentle increasing temperature trend over the deployment period which is consistent with the transition from late spring to summer.
- Throughout the deployment period there are numerous occasions when temperature takes a noticeable dip. Three examples of this are highlighted inside red ovals (Figure 2). These dips in water temperature are related to daily air temperature trends and indicate periods when the minimum air temperatures for the preceding day/s were relatively cool.

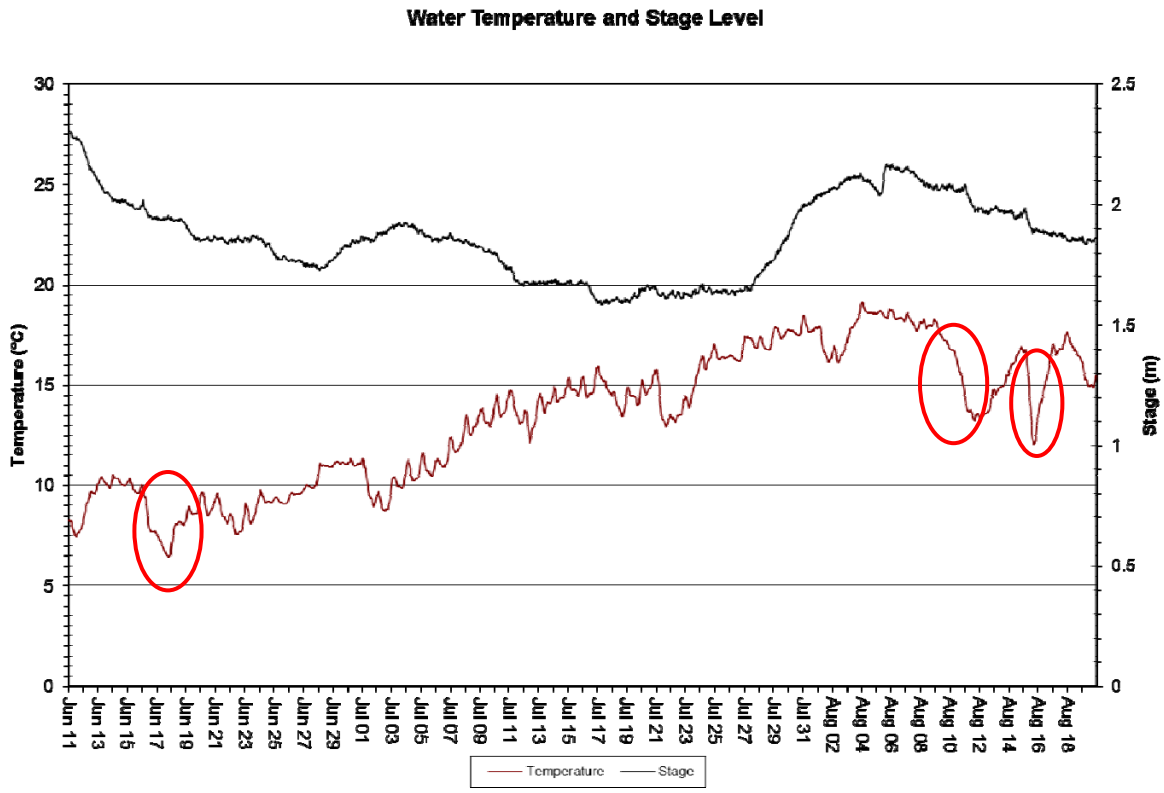

Figure 2: Temperature (°C) at Humber River from June 11, 2013, to August 20, 2013

pH

- During this deployment period pH values at Humber River ranged from 6.79 units to 7.57 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 7.23, pH values recorded at Humber River 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).

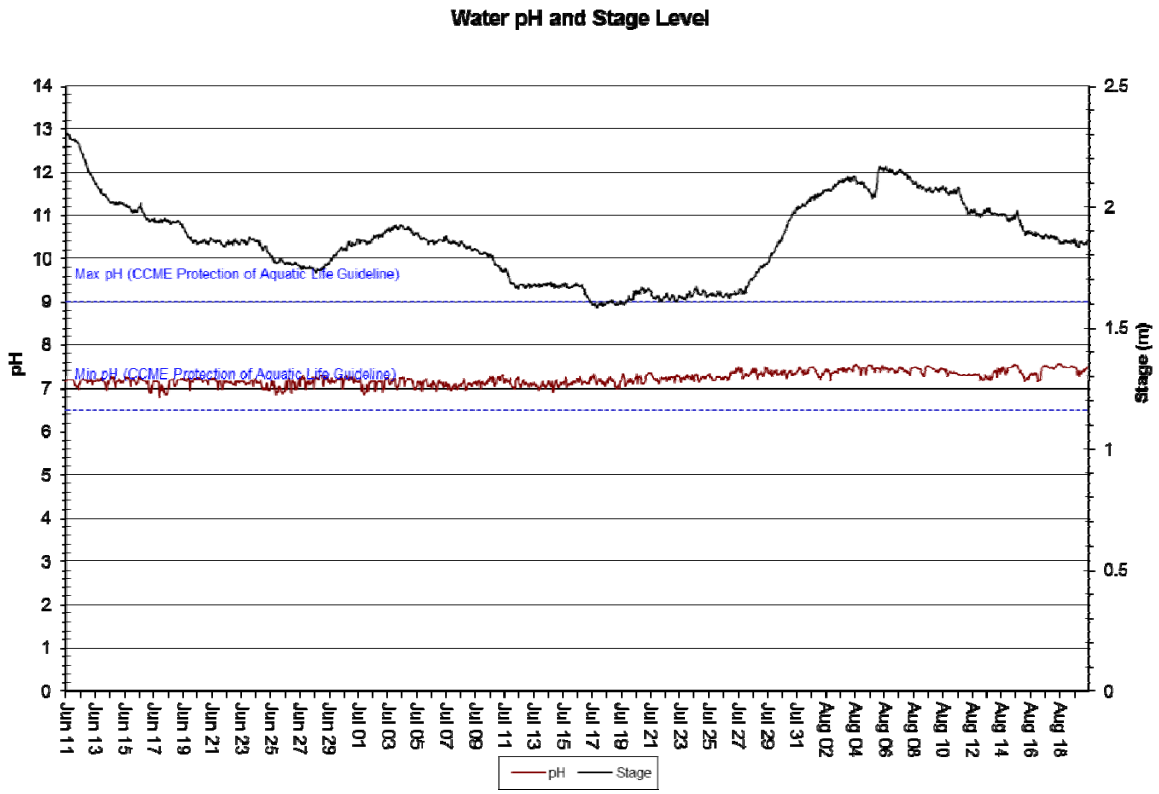

Figure 3: pH values recorded at Humber River from June 11, 2013, to August 20, 2013

Specific Conductivity

- During this deployment period specific conductivity at Humber River ranged from 37.1 µS/cm to 42.1 µS/cm (Figure 4).
- Specific conductivity appears to be relatively stable during the deployment period with a slight increasing trend which is related to the increasing temperature trend (i.e. specific conductivity increases with increasing temperature).
- At 4:30 am, August 11, 2013, there is a small spike in specific conductivity (see inside red oval – Figure 4) with a single reading of 42.1 µS/cm. Most likely this single high reading is an anomaly related to interference from some organic debris around the sensor, rather than an actual increase in specific conductivity. If there was an actual increase in specific conductivity it would most likely take place over several hourly readings, with an increase up to a peak and then a decline back to the normal range, rather than a single short term spike.

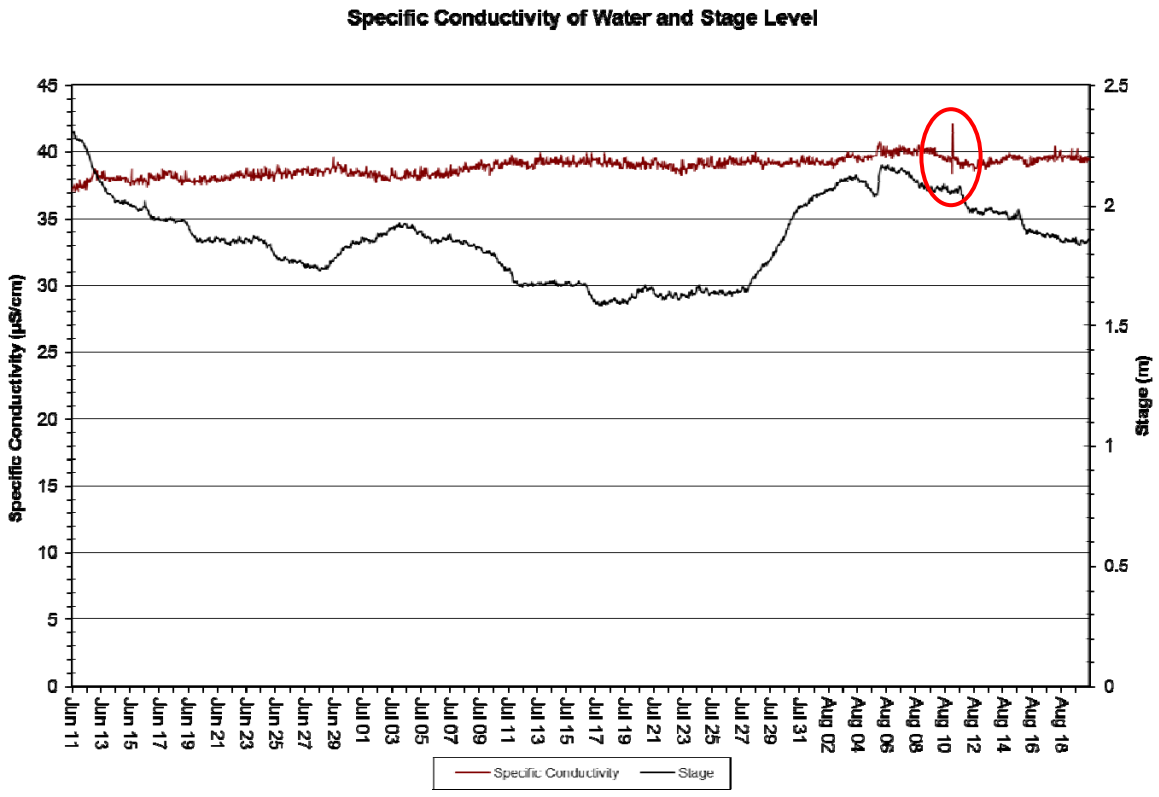

Figure 4: Specific conductivity (µs/cm) at Humber River from June 11, 2013, to August 20, 2013

Dissolved Oxygen

- During this deployment period dissolved oxygen [DO] values at Humber River ranged from 8.76 mg/l (88.4% saturation) to 11.95 mg/l (101.6% saturation) (Figure 5).
- DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
- DO (mg/l) shows a gentle decreasing trend over the deployment period which is related to the increasing temperature trend (i.e. warmer water holds less oxygen).
- 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). The minimum guideline set for other life stages is the pertinent guideline at this time of the year.

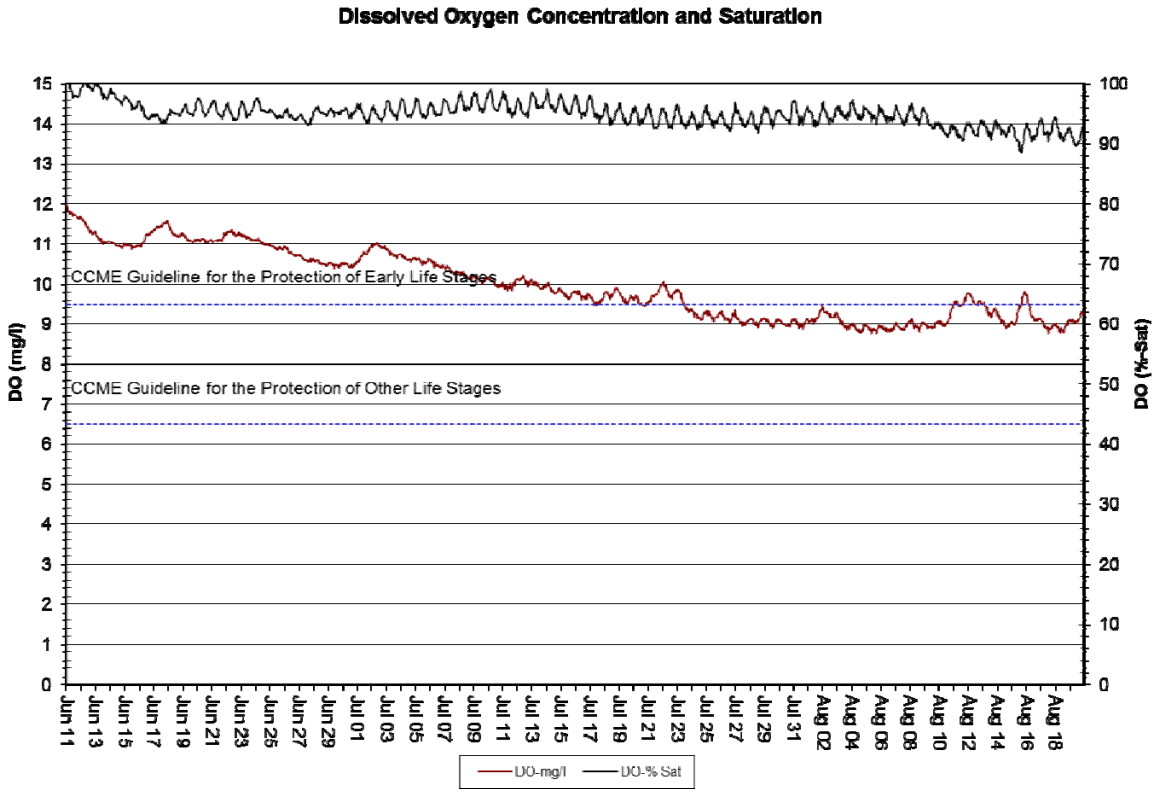

Figure 5: DO (mg/l & % saturation) at Humber River from June 11, 2013, to August 20, 2013

Turbidity

- Turbidity values remained at 0.0 NTU at Humber River from the initial deployment up until August 2, 2013 (Figure 6).
- From August 3, 2013, until the end of the deployment turbidity readings are dominated by a series of high readings which were caused by biofouling and/or organic debris trapped around the sensor (see inside red oval – Figure 6). These high readings are unreliable and do not reflect the actual turbidity readings at the station.

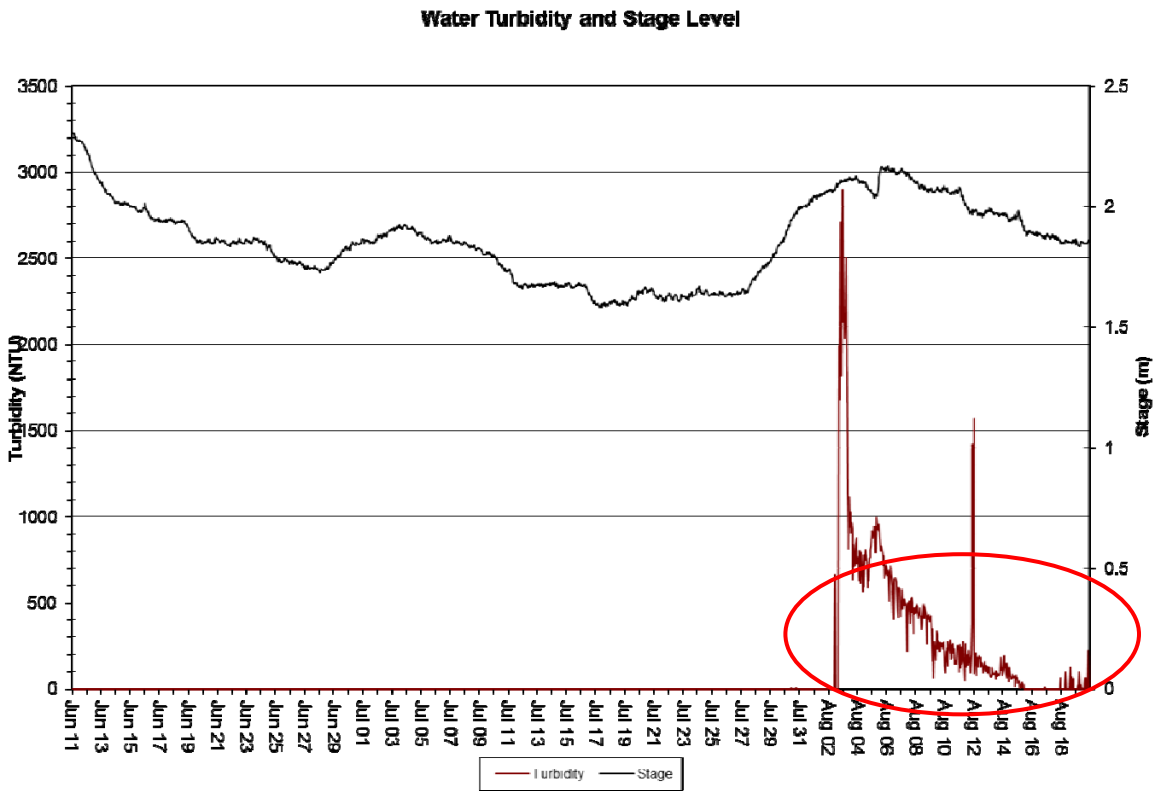

Figure 6: Turbidity (NTU) at Humber River from June 11, 2013, to August 20, 2013

Conclusion

- This monthly deployment report presents water quality and water quantity data recorded at Humber River from June 11, 2013, to August 20, 2013.
- The performances of all sensors were rated fair to excellent at the beginning of the deployment period, while all sensors were rated marginal to excellent at the end of the deployment period. The fair rating for temperature at the beginning of the deployment is based on a relatively small difference of 0.55 ^{o} C which is due to the fact that the QA instrument was deployed at the edge of the river in shallower water than the field

instrument. The marginal rating for oxygen at the end of the deployment is due to the instrument drifting off calibration after a relatively long deployment period during warm water conditions, when biofouling is more prevalent.

- Variations in water quality/quantity values recorded at each station are summarized below:
    - There are two noticeable peaks in stage height and flow during the deployment period which are related to a combination of rain and Deer Lake Power spilling excess water from the Grand Lake reservoir.
    - Water temperature displays diurnal variations which are related to diurnal variations in ambient air temperatures.
    - There is a gentle increasing temperature trend over the deployment period which is consistent with the transition from late spring to summer.
    - Throughout the deployment period there are numerous occasions when temperature takes a noticeable dip. These dips in water temperature are related to daily air temperature trends and indicate periods when the minimum air temperatures for the preceding day/s were relatively cool.
    - pH was very stable throughout the deployment period and shows regular diurnal fluctuations which are related to the diurnal temperature fluctuations.
    - With a mean value of 7.23, pH values recorded at Humber River 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).
    - Specific conductivity appears to be relatively stable to during the deployment period with a slight increasing trend which is related to the increasing temperature trend (i.e. specific conductivity increases with increasing temperature).
    - A small spike in specific conductivity at 4:30 am, August 11, 2013, is most likely an anomaly related to interference from some organic debris around the sensor.
    - DO shows diurnal fluctuations which can be attributed to the diurnal temperature fluctuations.
    - DO (mg/l) shows a gentle decreasing trend over the deployment period which is related to the increasing temperature trend (i.e. warmer water holds less oxygen).
    - 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). The minimum guideline set for other life stages is the pertinent guideline at this time of the year.
    - Turbidity values remained at 0.0 NTU at Humber River from the initial deployment up until the end of August 2, 2013. From August 3, 2013, until the end of the deployment, biofouling and/or organic debris trapped in the sensor was interfering with the proper functioning of the turbidity sensor and the readings are unreliable.

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 11, 2013, to August 20, 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)
6/11/2013	20.5	9.5	15	3	0	0	0	0
6/12/2013	21	7.5	14.3	3.7	0	0	0	0
6/13/2013	16	7.5	11.8	6.2	0	0	0	0
6/14/2013	14.5	5.5	10	8	0	2.8	0	2.8
6/15/2013	13	6	9.5	8.5	0	0.5	0	0.5
6/16/2013	14.5	7	10.8	7.2	0	2.7	0	2.7
6/17/2013	15.5	7.5	11.5	6.5	0	0.9	0	0.9
6/18/2013	17.5	8.5	13	5	0	0.9	0	0.9
6/19/2013	16	11.5	13.8	4.2	0	0	0	0
6/20/2013	20.5	9.5	15	3	0	0	0	0
6/21/2013	22.5	8.5	15.5	2.5	0	0	0	0
6/22/2013	21	10	15.5	2.5	0	0	0	0
6/23/2013	25.5	10.5	18	0	0	0	0	0
6/24/2013	27	13.5	20.3	0	2.3	5.2	0	5.2
6/25/2013	15	12.5	13.8	4.2	0	0.9	0	0.9
6/26/2013	12	8.5	10.3	7.7	0	0.2	0	0.2
6/27/2013	11.5	7.5	9.5	8.5	0	0	0	0
6/28/2013	19	7.5	13.3	4.7	0	10.4	0	10.4
6/29/2013	21	11.5	16.3	1.7	0	7.6	0	7.6
6/30/2013	21.5	18	19.8	0	1.8	0	0	0
7/1/2013	21	17.5	19.3	0	1.3	0	0	0
7/2/2013	17	9.5	13.3	4.7	0	0	0	0
7/3/2013	24.5	7	15.8	2.2	0	0	0	0
7/4/2013	29	13.5	21.3	0	3.3	0	0	0
7/5/2013	29.5	15	22.3	0	4.3	0	0	0
7/6/2013	24	16	20	0	2	0	0	0
7/7/2013	27.5	17.5	22.5	0	4.5	0	0	0
7/8/2013	22.5	12.5	17.5	0.5	0	0	0	0
7/9/2013	20.5	7.5	14	4	0	0	0	0
7/10/2013	22	7	14.5	3.5	0	0	0	0
7/11/2013	24	12.5	18.3	0	0.3	0.8	0	0.8
7/12/2013	25	18.5	21.8	0	3.8	0	0	0
7/13/2013	25.5	11	18.3	0	0.3	0	0	0
7/14/2013	26	16	21	0	3	0	0	0
7/15/2013	28	15.5	21.8	0	3.8	0	0	0
7/16/2013	19	12	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)
7/17/2013	24	7	15.5	2.5	0	2.2	0	2.2
7/18/2013	21	15.5	18.3	0	0.3	0.4	0	0.4
7/19/2013	22	9	15.5	2.5	0	6.6	0	6.6
7/20/2013	24.5	12.5	18.5	0	0.5	0	0	0
7/21/2013	19.5	17.5	18.5	0	0.5	0	0	0
7/22/2013	23.5	11.5	17.5	0.5	0	0	0	0
7/23/2013	27.5	12	19.8	0	1.8	13.6	0	13.6
7/24/2013	25.5	15.5	20.5	0	2.5	2.8	0	2.8
7/25/2013	22.5	17.5	20	0	2	0	0	0
7/26/2013	18	14.5	16.3	1.7	0	9.1	0	9.1
7/27/2013	30	12.5	21.3	0	3.3	2.8	0	2.8
7/28/2013	19.5	11	15.3	2.7	0	0.3	0	0.3
7/29/2013	26.5	9.5	18	0	0	2.9	0	2.9
7/30/2013	26	15.5	20.8	0	2.8	11	0	11
7/31/2013	26	15.5	20.8	0	2.8	0	0	0
8/1/2013	25	15.5	20.3	0	2.3	0	0	0
8/2/2013	26.5	13	19.8	0	1.8	9.9	0	9.9
8/3/2013	21.5	14.5	18	0	0	6.8	0	6.8
8/4/2013	24	15	19.5	0	1.5	3	0	3
8/5/2013	20.5	12.5	16.5	1.5	0	33.6	0	33.6
8/6/2013	21.5	15	18.3	0	0.3	7.5	0	7.5
8/7/2013	20.5	12.5	16.5	1.5	0	0.9	0	0.9
8/8/2013	22.5	15.5	19	0	1	0.4	0	0.4
8/9/2013	26.5	15.5	21	0	3	1.8	0	1.8
8/10/2013	22.5	18.5	20.5	0	2.5	5.9	0	5.9
8/11/2013	23	15.5	19.3	0	1.3	0	0	0
8/12/2013	23	16	19.5	0	1.5	0	0	0
8/13/2013	26	12.5	19.3	0	1.3	0	0	0
8/14/2013	22	12.5	17.3	0.7	0	2.3	0	2.3
8/15/2013	20	16.5	18.3	0	0.3	0.6	0	0.6
8/16/2013	18.5	12	15.3	2.7	0	0	0	0
8/17/2013	23	10	16.5	1.5	0	0	0	0
8/18/2013	24	13	18.5	0	0.5	2.4	0	2.4
8/19/2013	22.5	18	20.3	0	2.3	2.1	0	2.1
8/20/2013	15.5	9	12.3	5.7	0	0	0	0