

Real Time Water Quality Report Humber River at Humber Village

Deployment Period
2021-01-27 to 2021-05-19



Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division

General

The following public report is a presentation and interpretation of qualitative and quantitative data taken in real-time at the Humber River in Humber Village station. The deployment took place between January 27, 2021 and May 19, 2021.

This station is a year-round operation as part of the Provincial Real Time Water Quality (RTWQ) network. A multi-parameter sonde device is deployed and tracks variables of interest including: temperature (°C), pH, dissolved oxygen (mg/L), specific conductivity (µS/cm), and turbidity (NTU). The sondes are linked to the monitoring network with staff at the Department of Environment and Climate Change (Water Resources Management Division - WRMD) monitoring the data remotely on a regular basis.

In the event of anomalous activity, staff can travel to the location and investigate any inquiries that could arise from internal or external disruptions. This site in particular is easy to access. Typically, the instrument is removed on monthly to bi-monthly intervals in order to conduct routine maintenance/calibration, after which the instrument is redeployed within 48 hours.

Quality Assurance/Quality Control (QA/QC)

During the beginning and end of deployment periods, a routine QA/QC performance test is administered on both the instrument that is being removed and the new one to be deployed. The methodology of this protocol can be found in Appendix A.

The purpose is to determine the accuracy of the instrument’s sensors by cross-examining its initial readings against a control sonde which is deployed at the same time to compare parameters. Depending on these readings, the sensors of each parameter receive a qualitative rank (See Table 1) based on whether or not readings fall within a specified threshold. This will further ensure the integrity of the data’s accuracy so that WRMD scientists deliver reliable results to the public.

Table 1: QA/QC protocol for deployment performance testing of sonde equipment for ranking of data accuracy.

Parameter	Rating				
	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

With the exception of water quantity data (i.e. stage height), all other data used in the preparation of graphs and subsequent discussion below adhere to the stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on WRMD’s webpage. 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 2: QA/QC water quality performance results for the beginning and end of deployment period.

Station: Humber River at Humber Village		
Stage of Deployment (Date)	Deployment (January 27, 2021)	Removal (May 19, 2021)
<i>Parameter (Unit)</i>	<i>Rank</i>	<i>Rank</i>
Temperature (°C)	Excellent	Good
pH (dimensionless unit)	Excellent	Good
Specific Conductivity (µs/cm)	Good	Good
Dissolved Oxygen (mg/L)	Good	Fair
Turbidity (NTU)	Excellent	Poor ¹
1) Possible issue with QA/QC sonde tainted result.		

Deployment Notes

This deployment took place over the course of 112 days (January 27, 2021 to May 19, 2021), during which there were no significant interruptions or data loss. Data interruptions did occur during switching out of sondes at the beginning and end of the deployment period.

A new pH sensor was installed for this deployment.

Data Interpretation

The following interpretations for the Humber River stations will cover the following six parameters: (1) Stage (m); (2) Temperature (°C); (3) pH; (4) Specific Conductivity (µS/cm); (5) Dissolved Oxygen (mg/L); (6) Turbidity (NTU).

1) Stage

- Stage ranged between 1.59 m and 3.29 m with an average stage height of 2.05 m
- Flow ranged from 159.74 m³/s to 459.38 m³/s with an average speed of 232.88 m³/s.
- Stage remained relatively stable throughout half of the deployment period, where it began to increase thereafter consistently over the course of a few weeks, peaking around approximately mid-April. This is reasonably due to seasonal ice melting while winter transitions into spring as snow and ice runoff enters the system, raising the stage of the water.
- There was a gradual decline in stage height for the rest of the deployment period. This is indicative of the spring thaw with fluctuating temperatures affecting the rates at which snow and ice melted in the watershed towards the latter part of May.
- Congruently, flow behaved much like stage. As temperatures increased throughout the spring months, the velocity of the water reacted accordingly to spring thaw, increasing in flow as water entered the system.
- The overall decrease in stage and flow after mid-April indicates that much of the snow/ice pack has likely runoff before this period.

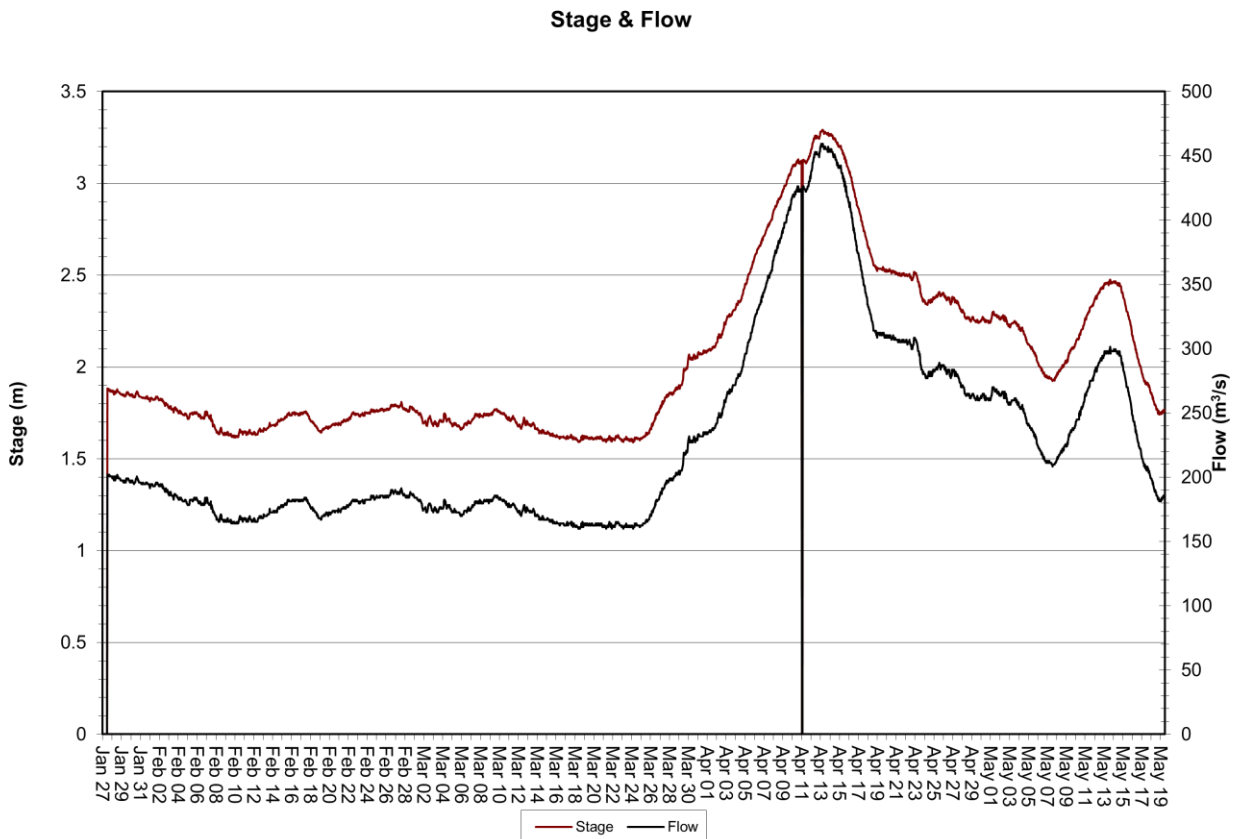


Figure 1: Stage & Flow at Humber River from January 27 to May 19, 2021

2) Temperature

- Throughout the deployment period, the water temperature ranged between 0.85 °C and 6.46 °C, with an average temperature of 2.72 °C.
- The water temperature was relatively stable throughout the first half of the deployment. It slowly begin to warm up as winter transitioned into spring.
- Note the diurnal highs and lows between each data point, indicative that it was warmer during daylight hours and cooler during nightfall.

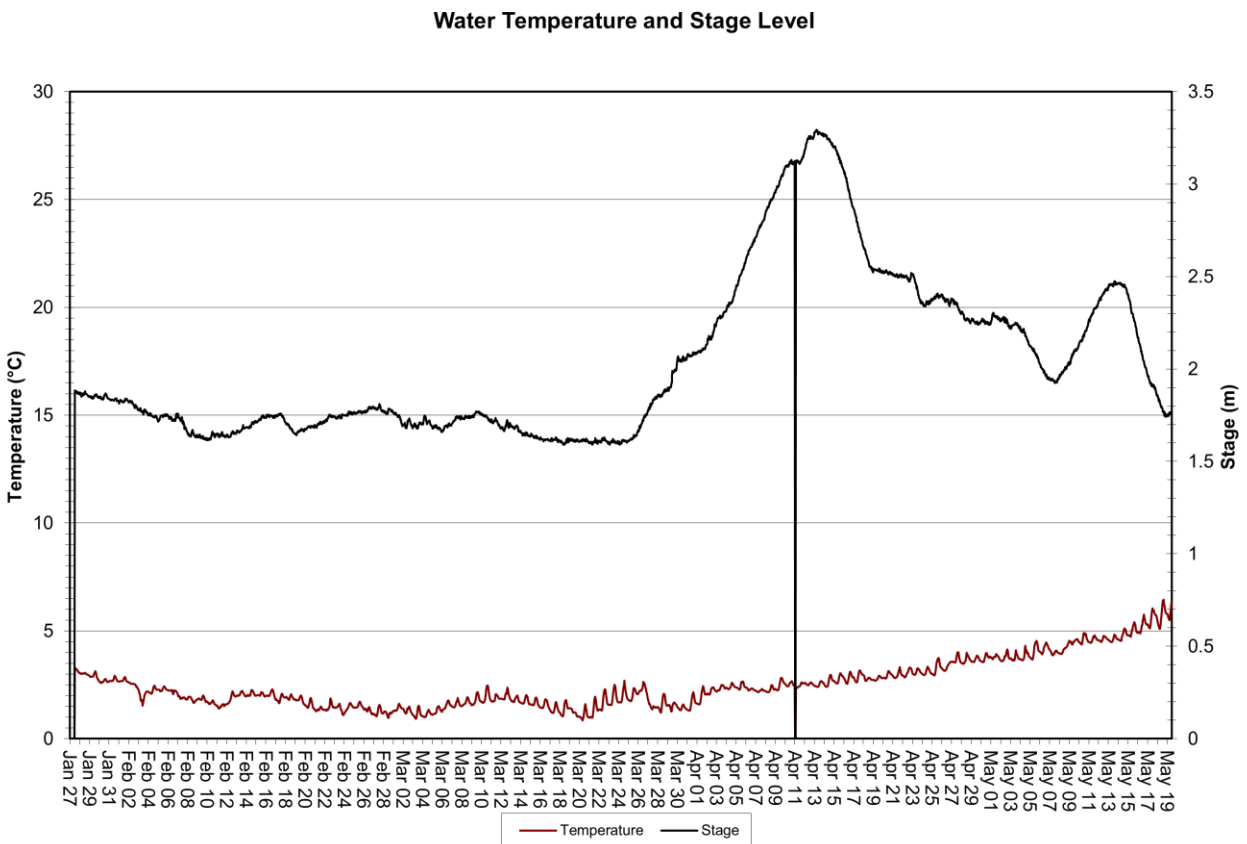


Figure 2: Temperature (°C) at Humber River from January 27 to May 19, 2021

3) pH

- pH ranged between 7.16 and 7.30 during the deployment period, with an average of 7.24 pH units.
- This parameter was stable throughout the course of the deployment period with no profound findings.
- The overall pH data falls within the threshold of acceptance for the protection of aquatic life as outlined by the Canadian Council of Ministers of the Environment (CCME) (2007).

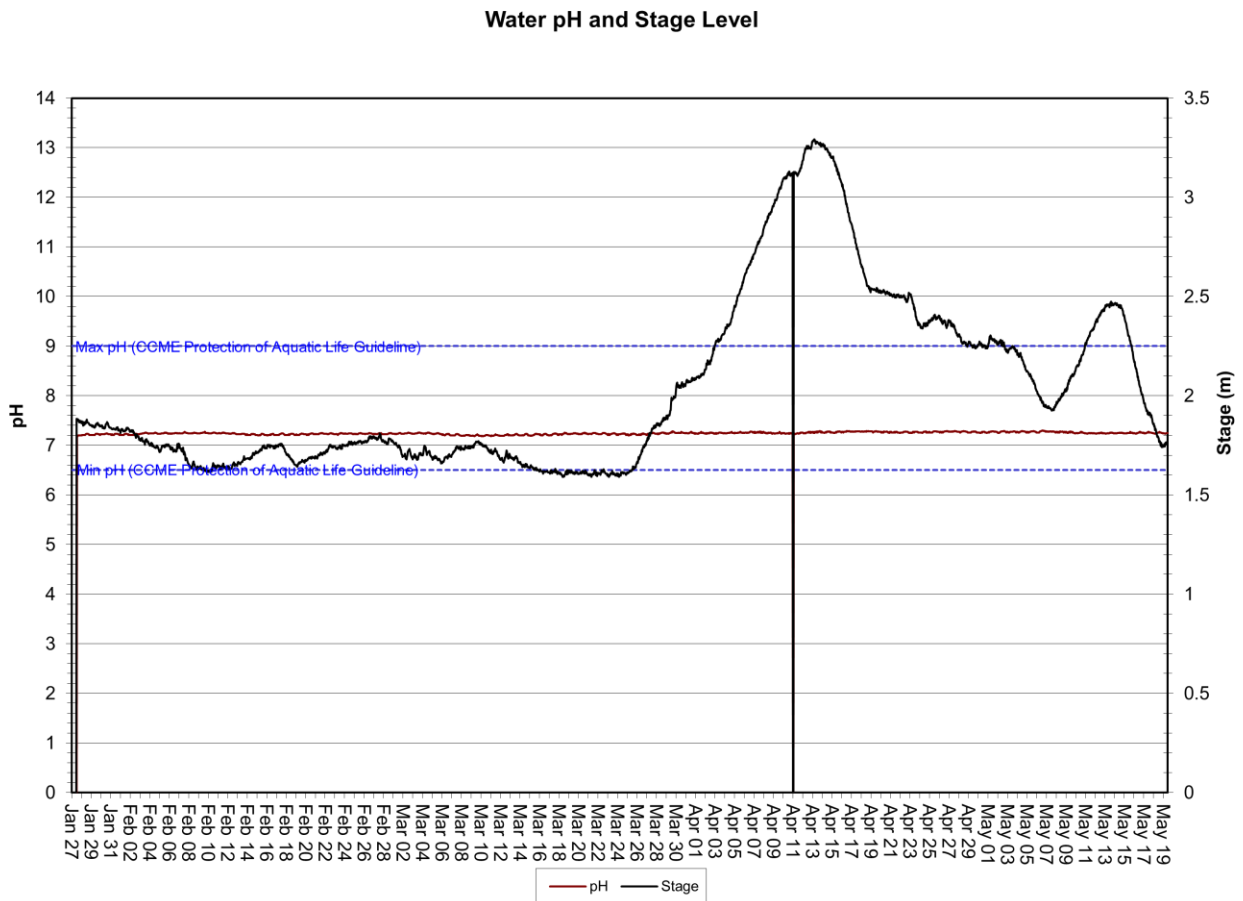


Figure 3: pH values recorded at Humber River from January 27 to May 19, 2021

4) Specific Conductivity

- Throughout the deployment period, specific conductivity ranged between 41.1 $\mu\text{S}/\text{cm}$ and 45.3 $\mu\text{S}/\text{cm}$, with an average of 42.9 $\mu\text{S}/\text{cm}$.
- Across the first portion of the deployment, specific conductivity remained stable before gradually increasing during the second portion.
- There was a sudden drop in conductivity that started on May 8th, 2021, that lasted for about a week thereafter. According to climate station data (Appendix B), there was significant springtime precipitation that took place over the course of this week, introducing freshwater into the system.
- This precipitation in combination with warming spring temperatures could have accelerated the melting of snow and ice, likely adding more runoff into the system, as evident by the increased stage levels at the same time.
- The factors stated above show a possible correlation that likely decreased the concentration of solutes in the water, thereby decreasing the specific conductivity.
- At the end of the deployment period, the conductivity began to increase again.

Specific Conductivity of Water and Stage Level

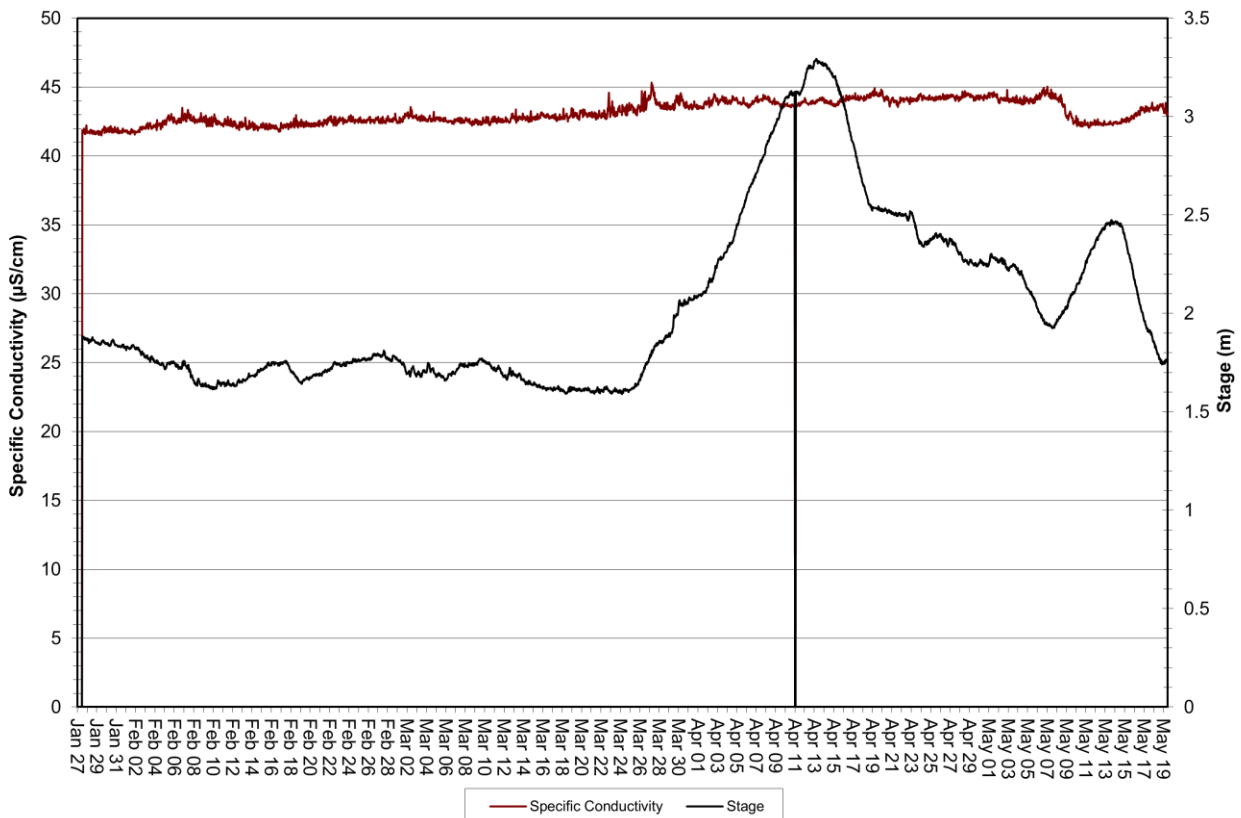


Figure 4: Specific conductivity ($\mu\text{S}/\text{cm}$) at Humber River from January 27 to May 19, 2021

5) Dissolved Oxygen

- During the deployment period, dissolved oxygen values ranged from 12.16 mg/L to 14.26 mg/L, with an average of 13.58 mg/L.
- Dissolved oxygen steadily increased over the course of the winter, peaking around the start of April, where thereafter is started to decline back towards concentrations similar to the start of the deployment period.
 It's expected that concentrations will continue to decrease as the water temperature warms. Oxygen dissolves into water better in cooler temperatures, explaining the steady increase during winter. Conversely, warm water will hold less oxygen, as demonstrated by the decrease in oxygen seen in the latter part of the deployment period.
- The data meets the guidelines for the protection of other and early life stages as set by the CCME (2007).

Dissolved Oxygen Concentration and Saturation with Water Temperature

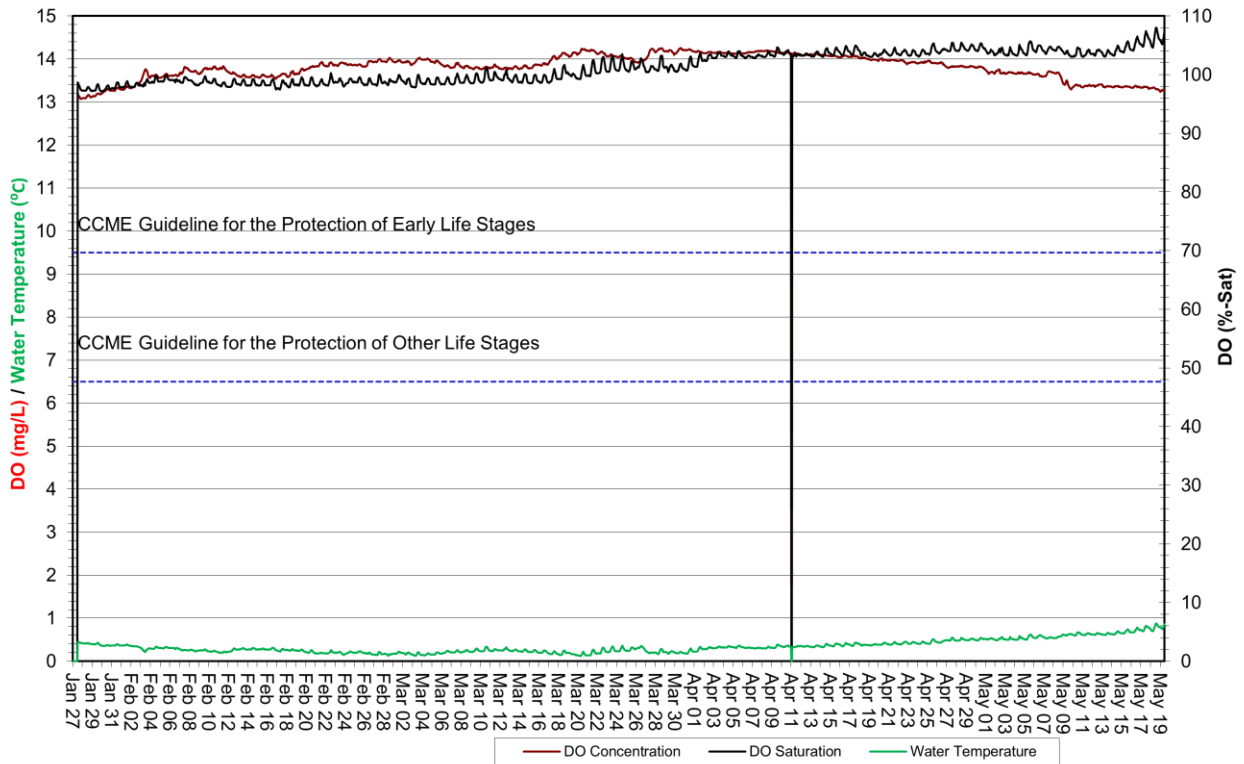


Figure 5: DO (mg/L & % saturation) and Water Temperature (°C) at Humber River from January 27 to May 19, 2021

6) Turbidity

- Throughout the deployment period, turbidity ranged from 1.1 NTU to 3.0 NTU, with an average turbidity of 1.3 NTU.
- Findings show that the turbidity remained relatively stable through the winter but began to fluctuate as the season transitioned. The spring thaw likely contributed to the fluctuations in the water.

Water Turbidity and Stage Level

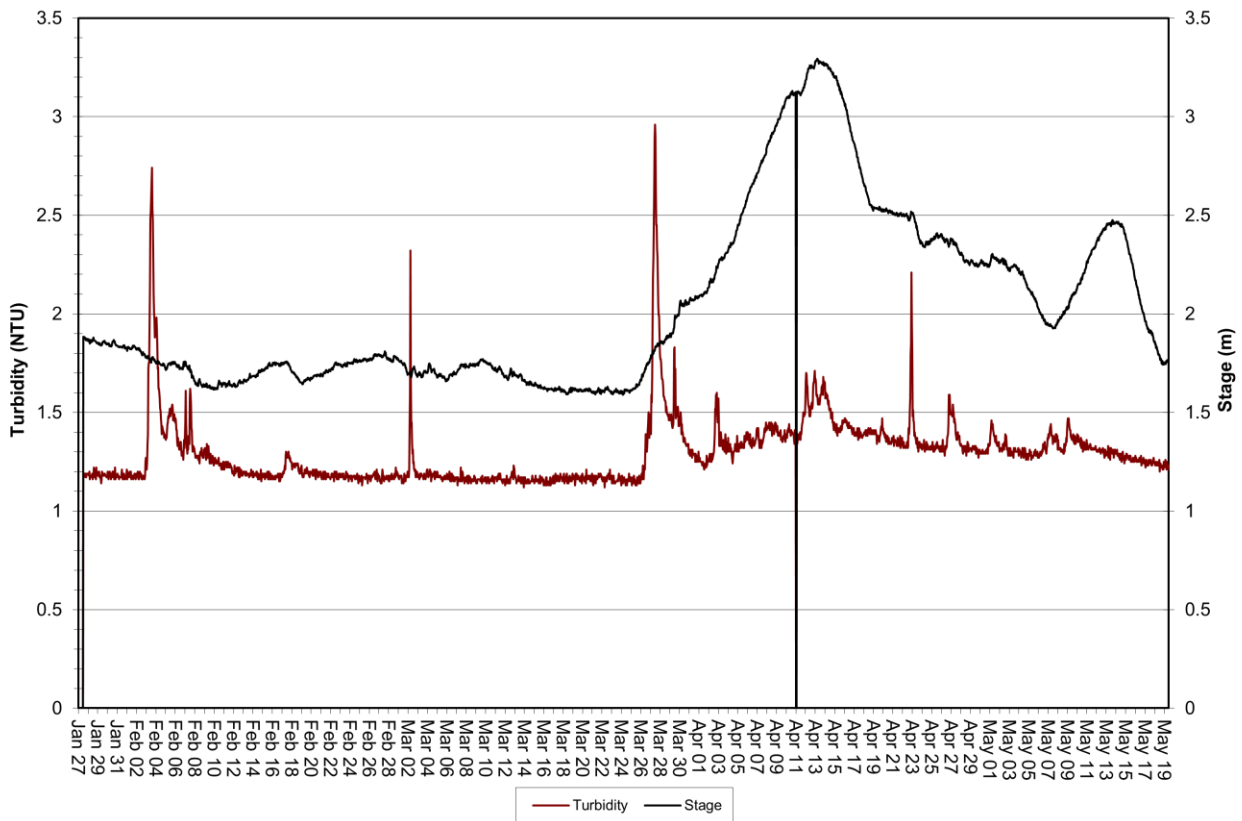


Figure 6: Turbidity (NTU) at Humber River from January 27 to May 19, 2021

Conclusions

- This deployment report outlines the findings of water quality and water quantity data recorded over a period of 112 days at the Humber River at Humber Village between January 27, 2021 and May 19, 2021.
- QA/QC rankings at the start of the deployment duration were satisfactory, with 3/5 sensors ranking “Excellent” and 2/5 sensors ranking “Good”. At removal, most performances had deteriorated with the exception of specific conductivity; its absolute difference remained within the threshold to maintain a “Good” ranking. 3/5 sensors ranked “Good”, 1/5 sensors ranked “Fair”, and 1/5 sensors (turbidity) ranked “Poor”.

- The turbidity sensor ranking upon removal is questionable. In examining the two values compared for the QA/QC check, the field sonde returned a value of 1.2 NTU, which was consistent with the trend throughout the deployment. The QA/QC sonde returned a value of 19.9 NTU, which exceeds the recorded maximum 3.0 NTU over sixfold. For further investigation, the May 19th grab sample record was consulted, which indicated a turbidity reading of 0.72 NTU, supportive evidence that there may have been a discrepancy during the calibration of the turbidity sensor of the QA/QC sonde that led to an abnormal reading.
- The following are summarized statements regarding the findings at Humber River:
 - o Stage & Flow: Stage ranged from 1.59 m to 3.29 m, averaging at 2.05 m. Flow ranged from 159.74 m³/s to 459.38 m³/s, averaging 232.88 m³/s. Both behaviors of the parameters were stable until the spring thaw; both increased drastically at that time and would gradually decrease over time.
 - o Water Temperature: Ranged from 0.85 °C to 6.46 °C, averaging 2.72 °C. Stable throughout deployment period until the spring thaw where it would gradually increase.
 - o pH: Ranged from 7.16 to 7.30, averaging at 7.24. Remained stable, no profound findings. Data fell within the threshold of acceptance for the protection of aquatic life as outlined by the CCME.
 - o Specific Conductivity: Ranged from 41.1 µS/cm to 45.3 µS/cm, averaging at 42.9 µS/cm. Remained stable overall, increasing gradually with the exception of one high-precipitation event which decreased conductivity during its duration.
 - o Dissolved Oxygen: Ranged from 12.16 mg/L to 14.26 mg/L, averaging at 13.58 mg/L. Gradually increased over the winter, but began decreasing as spring transitioned. Data surpassed the minimum threshold of acceptance for the protection of early and other life stages of aquatic life as outlined by the CCME.
 - o Turbidity: Ranged from 1.1 NTU to 3.0 NTU, averaging at 1.3 NTU. Remained relatively stable, showing frequent fluctuation as winter transitioned into spring.

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://cegg-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.

Parameter	Rating				
	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

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>

Dissolved Oxygen (mg/l) (% Sat)	$\leq \pm 0.3$	$> \pm 0.3$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Turbidity <40 NTU (NTU)	$\leq \pm 2$	$> \pm 2$ to 5	$> \pm 5$ to 8	$> \pm 8$ to 10	$> \pm 10$
Turbidity > 40 NTU (%)	$\leq \pm 5$	$> \pm 5$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$

APPENDIX B

WRMD Climate Station – Humber Village at Humber Village Bridge

Date	Air Temp (Avg) °C	Air Temp (Min) °C	Air Temp (Max) °C	Total Precipitation (mm)
January 27, 2021	-0.544	-3.111	0.944	0.762
January 28, 2021	-3.965	-4.971	-2.997	0
January 29, 2021	-4.425	-7.489	-0.952	0
January 30, 2021	-3.437	-8.32	-1.361	0
January 31, 2021	-0.240	-1.842	2.546	1.524
February 1, 2021	-2.369	-4.098	-0.792	0
February 2, 2021	-4.082	-7.415	-0.792	0
February 3, 2021	0.872	-2.012	3.406	22.606
February 4, 2021	3.486	0.85	7.087	4.572
February 5, 2021	2.088	1.342	3.089	10.922
February 6, 2021	1.787	0.257	4.043	7.112
February 7, 2021	-0.894	-2.539	1.303	1.016
February 8, 2021	-1.062	-2.606	1.036	12.954
February 9, 2021	-1.680	-3.697	-0.184	2.794
February 10, 2021	-5.327	-6.854	-3.822	0.508
February 11, 2021	-6.088	-7.055	-4.767	4.064
February 12, 2021	-1.383	-4.764	2.148	5.588
February 13, 2021	-3.199	-6.13	-0.543	0
February 14, 2021	-4.806	-7.329	-2.799	0.254
February 15, 2021	-4.160	-5.193	-3.072	1.27
February 16, 2021	-3.865	-5.286	-2.043	7.874
February 17, 2021	-2.357	-4.227	0.232	10.414
February 18, 2021	-4.520	-5.812	-3.012	3.556
February 19, 2021	-4.686	-7.009	-2.377	0.508
February 20, 2021	-8.630	-13.93	-3.251	0
February 21, 2021	-9.616	-14.21	-5.934	0
February 22, 2021	-3.496	-5.646	-0.783	0.508
February 23, 2021	-1.437	-3.98	0.596	5.08
February 24, 2021	-0.245	-0.971	1.273	0.762
February 25, 2021	1.625	0.071	4.418	6.35
February 26, 2021	-4.916	-7.951	0.669	4.318
February 27, 2021	-4.953	-9.17	-0.517	5.842
February 28, 2021	-2.152	-5.732	0.095	6.604
March 1, 2021	-0.967	-3.488	1.217	0.762
March 2, 2021	-2.123	-9.48	3.814	7.366
March 3, 2021	-8.516	-17.54	-1.085	0

March 4, 2021	-3.279	-3.935	-1.859	2.794
March 5, 2021	-3.349	-5.812	-2.051	0.254
March 6, 2021	-2.917	-4.906	0.201	0.508
March 7, 2021	-2.232	-4.549	-0.758	1.016
March 8, 2021	-2.017	-5.011	0.077	0
March 9, 2021	-1.528	-6.562	2.305	0.508
March 10, 2021	0.879	-2.053	4.511	0.254
March 11, 2021	1.974	-0.818	4.908	0
March 12, 2021	4.798	1.801	9.9	2.032
March 13, 2021	0.278	-1.808	2.213	0.254
March 14, 2021	-2.981	-5.135	-1.526	0.762
March 15, 2021	-4.612	-6.638	-2.162	16.256
March 16, 2021	-4.864	-8.73	-1.285	0
March 17, 2021	-4.220	-8.77	-1.78	0
March 18, 2021	-0.538	-8.67	7.251	0
March 19, 2021	-1.574	-6.291	4.054	0
March 20, 2021	-5.013	-7.151	-3.065	0
March 21, 2021	0.799	-5.707	6.282	1.27
March 22, 2021	6.467	0.739	11.27	0.254
March 23, 2021	6.510	2.417	11.84	0
March 24, 2021	7.145	1.737	14.95	0
March 25, 2021	5.858	0.252	13.32	0
March 26, 2021	6.874	-0.611	10.29	0.508
March 27, 2021	-2.231	-4.185	-0.419	14.224
March 28, 2021	-2.998	-11.67	5.277	1.016
March 29, 2021	2.547	-3.799	8.88	16.764
March 30, 2021	-3.046	-4.931	0.925	1.016
March 31, 2021	0.006	-8.17	10.59	1.524
April 1, 2021	6.887	-1.088	17.24	0
April 2, 2021	8.930	6.995	11.34	2.032
April 3, 2021	8.814	5.539	12.37	0
April 4, 2021	7.321	5.166	10.98	0
April 5, 2021	6.896	4.954	10.51	0
April 6, 2021	5.276	4.34	7.264	6.35
April 7, 2021	5.020	3.542	7.31	3.302
April 8, 2021	6.830	3.814	13.03	0
April 9, 2021	7.928	2.676	16.44	1.016
April 10, 2021	2.955	1.786	5.205	0
April 11, 2021	4.756	1.265	8.67	16.002
April 12, 2021	4.778	3.378	6.218	9.144
April 13, 2021	3.860	2.176	5.887	3.302

April 14, 2021	4.376	1.338	10.01	1.016
April 15, 2021	3.194	0.569	7.594	0
April 16, 2021	3.058	1.016	6.562	0.254
April 17, 2021	3.843	0.798	8.8	0
April 18, 2021	3.700	1.735	6.024	11.43
April 19, 2021	4.465	3.29	7.069	8.636
April 20, 2021	5.349	3.268	8.08	0.762
April 21, 2021	5.281	0.809	11.32	0
April 22, 2021	7.634	2.088	13.81	7.62
April 23, 2021	3.797	2.231	4.99	0.254
April 24, 2021	4.238	1.865	6.839	3.556
April 25, 2021	7.166	2.722	12.28	0.508
April 26, 2021	8.051	3.273	12.89	2.286
April 27, 2021	9.379	6.475	13.38	2.54
April 28, 2021	6.854	5.033	9.39	5.588
April 29, 2021	6.681	4.49	10.35	0.254
April 30, 2021	8.468	4.227	12.94	3.048
May 1, 2021	5.025	3.392	6.603	12.954
May 2, 2021	6.147	3.952	10.07	2.54
May 3, 2021	5.723	2.151	6.939	3.556
May 4, 2021	7.015	2.037	9.99	0
May 5, 2021	7.984	0.436	15.42	0.508
May 6, 2021	6.622	4.374	9.26	6.35
May 7, 2021	5.911	4.026	7.626	13.208
May 8, 2021	7.030	5.024	9.33	1.524
May 9, 2021	6.786	4.654	8.71	12.446
May 10, 2021	5.256	3.33	6.546	2.54
May 11, 2021	6.602	4.707	8.55	0
May 12, 2021	5.511	4.278	7.431	2.032
May 13, 2021	5.758	3.896	7.434	0
May 14, 2021	7.607	5.038	10.39	0
May 15, 2021	8.439	5.157	12.99	0
May 16, 2021	8.571	4.874	12.32	0
May 17, 2021	9.471	3.167	15.81	0
May 18, 2021	10.020	1.746	16.72	1.016
May 19, 2021	10.220	1.082	18.62	0