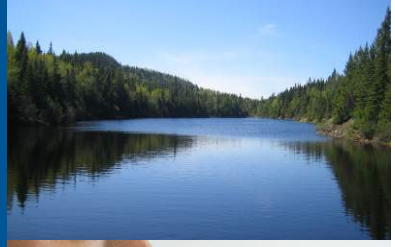
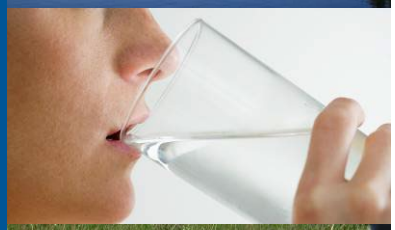



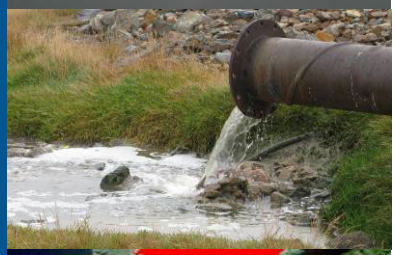


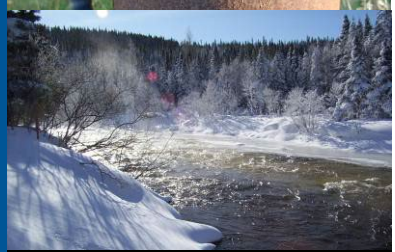

Real Time Water Quality Report

Humber River at Humber Village

Deployment Period
2022-04-08 to 2022-06-03

Newfoundland Labrador

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 period took place between April 8, and June 3, 2022.

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.

	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

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 of 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 (April 8, 2022)	Removal (June 3, 2022)
Parameter (Unit)	*Rank*	*Rank*
Temperature (°C)	Excellent	Excellent
pH (dimensionless unit)	Good	Good
Specific Conductivity (µs/cm)	Excellent	Good
Dissolved Oxygen (mg/L)	Good	Good
Turbidity (NTU)	Excellent	Excellent

Deployment Notes

This deployment took place over the course of 57 days (April 8, 2022, to June 3, 2022), during which there were no significant interruptions or data loss.

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 2.30 m and 4.73 m with an average stage height of 3.72 m
- Flow ranged from 269.97 m^3/s to 801.13 m^3/s with an average speed of 566.86 m^3/s.
- Stage/Flow gradually increased throughout the rest of the winter and into the subsequent spring season, reaching their highest levels during May.
- Climate data (see in Appendix B) showed a combination of warming weather and precipitation events, which contributed to spring runoff causing the increased levels in the data. Levels began to lower towards the end of the deployment.

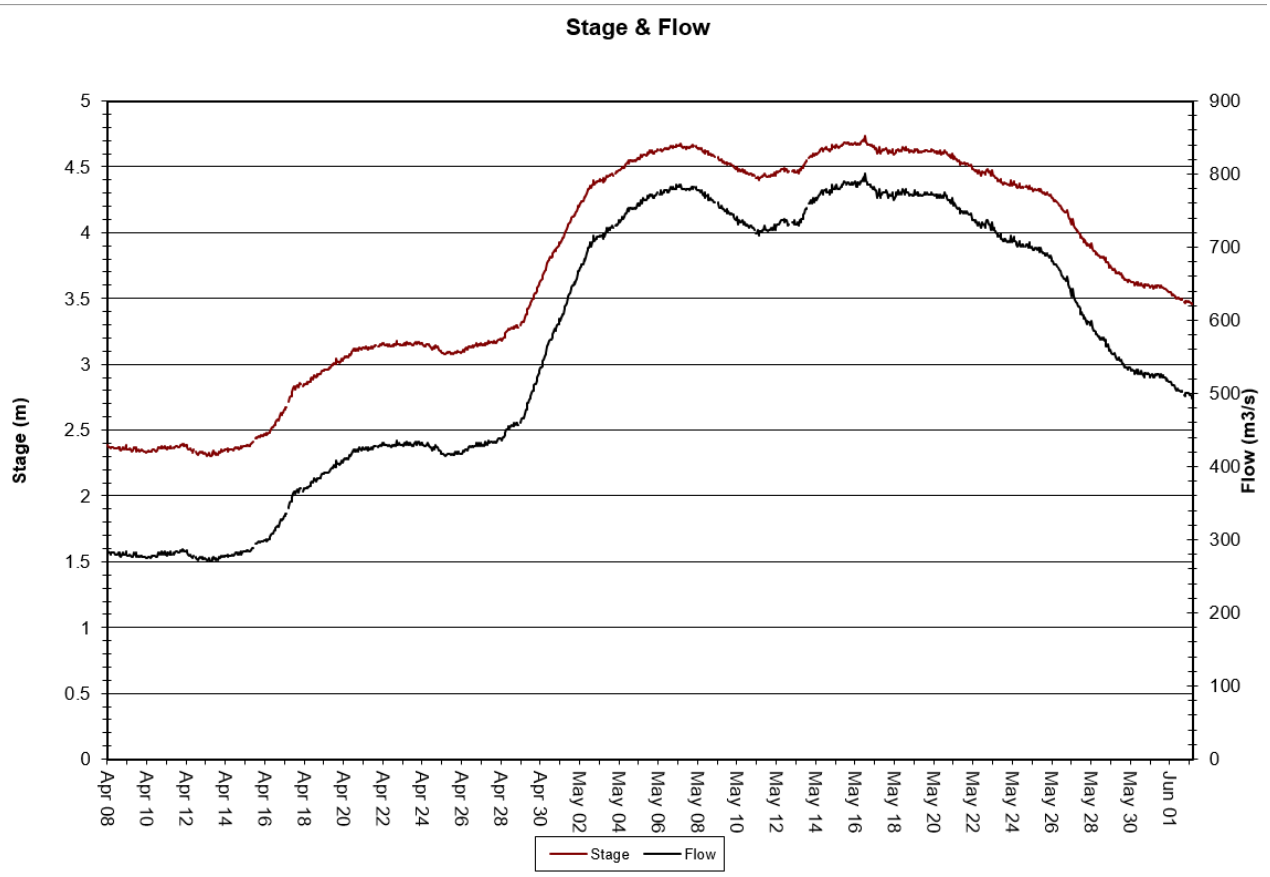

Figure 1: Stage & Flow at Humber River from April 8, 2022, to June 3, 2022

2) Temperature

- Throughout the deployment period, the water temperature ranged between 1.05 °C and 7.85 °C, with an average temperature of 3.56 °C.
- Temperatures gradually increased throughout the deployment, typical of the spring season.
- The combination of air temperatures and precipitation through mid to late May caused some notable fluctuations in water temperatures; the data is otherwise normal.

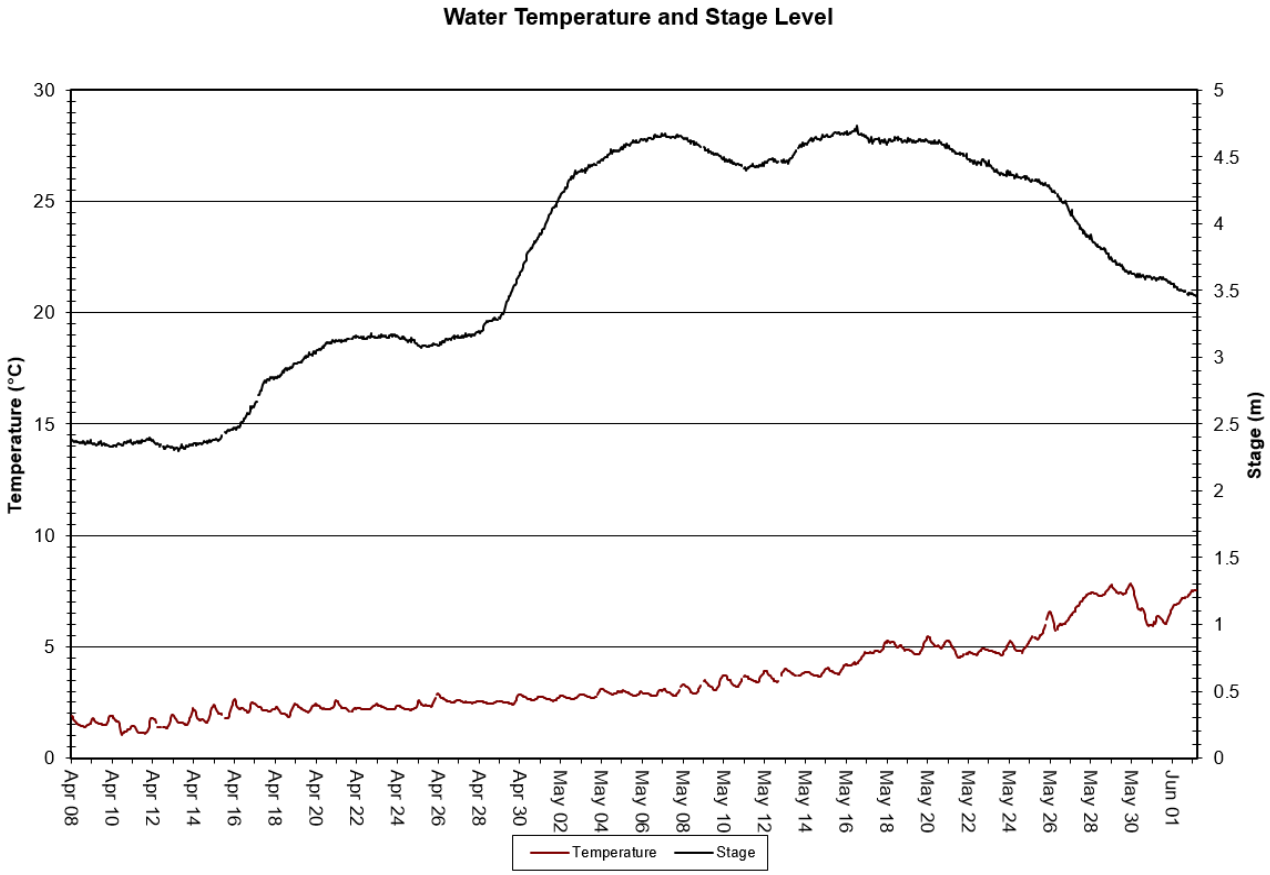

Figure 2: Water Temperature at Humber River from April 8, 2022, to June 3, 2022

3) pH

- pH ranged between 6.73 and 6.91 during the deployment period, with an average of 6.82 pH units.
- The pH data remained within the threshold of acceptance for the protection of aquatic life as outlined by the Canadian Council of Ministers of the Environment (CCME) (2007).

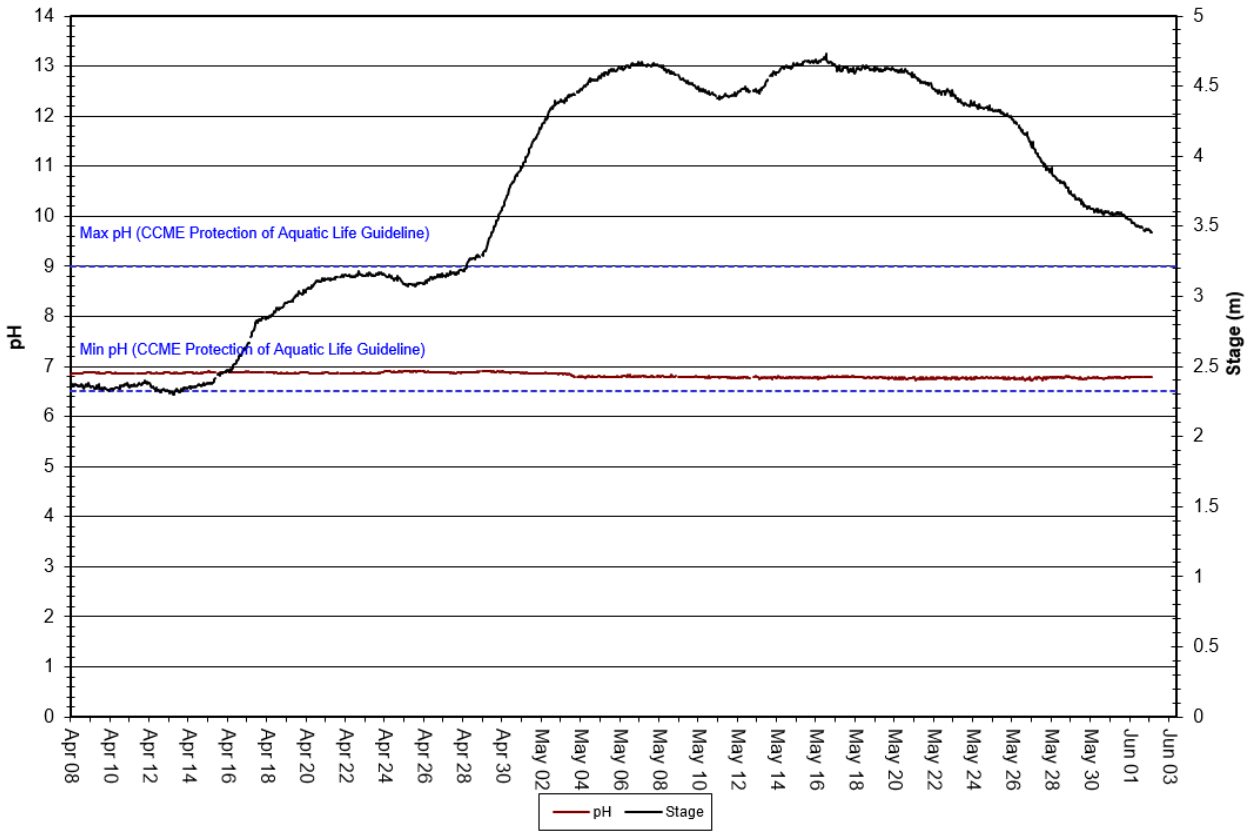

Figure 3: pH values recorded at Humber River from April 8, 2022, to June 3, 2022

4) Specific Conductivity

- Throughout the deployment period, specific conductivity ranged between 35.0 µS/cm and 47.2 µS/cm, with an average of 42.5 µS/cm.
- Conductivity decreased across the remainder of the winter and into the spring season. Fluctuations would be more noteworthy because of the spring climate and subsequent spring runoff causing more fresh water to be added into the system, lowering the conductivity level more significantly.
- These events are typical of the spring season and these fluctuations in the data are expected for this station.

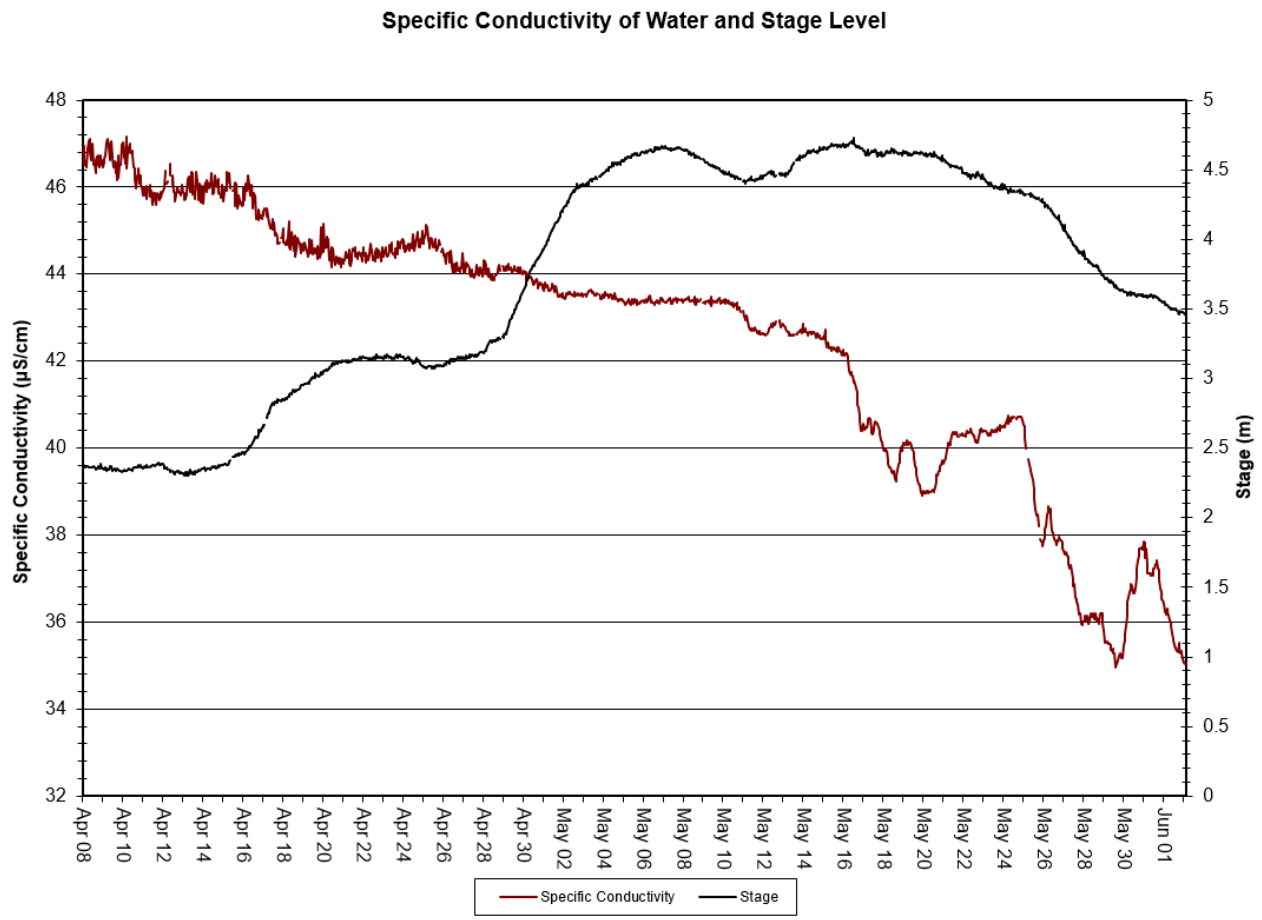

Figure 4: Specific conductivity at Humber River from April 8, 2022, to June 3, 2022

5) Dissolved Oxygen

- During the deployment period, dissolved oxygen concentrations ranged from 12.19 mg/L to 13.47 mg/L, with an average of 13.13 mg/L. Dissolved oxygen percent-saturation ranged from 93.6% to 103.7%, with an average of 98.9%.
- Dissolved oxygen has a tendency to have an inverted response to changes in water temperature, meaning that oxygen level increases in lower temperatures, and decreases in higher temperatures.
- This data shows a normal trend as winter transitions into spring onward, with warming water bringing lower levels of concentrated oxygen.
- Values remained above the thresholds of the CCME guidelines for the protection of both early and other life stages (CCME, 2007).

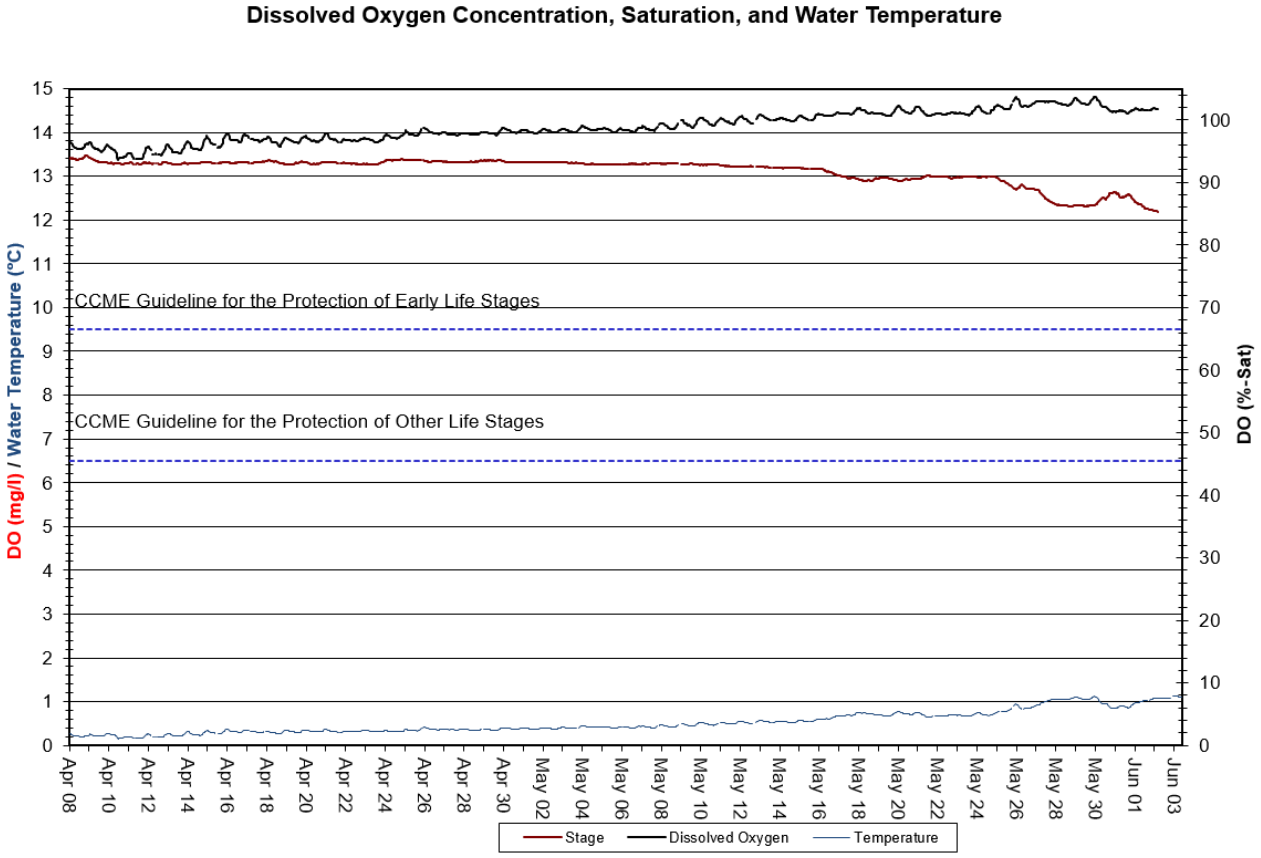

Figure 5: DO (mg/L & % saturation) with Water Temperature (^{o}C) at Humber River April 8, 2022, to June 3, 2022

6) Turbidity

- Throughout the deployment period, turbidity ranged from 1.3 NTU to 1.9 NTU, with an average turbidity of 1.5 NTU.
- Turbidity fluctuated slightly throughout deployment, although keeping within a < 1.0 NTU range, with several spikes corresponding to precipitation events and changes in stage activity.

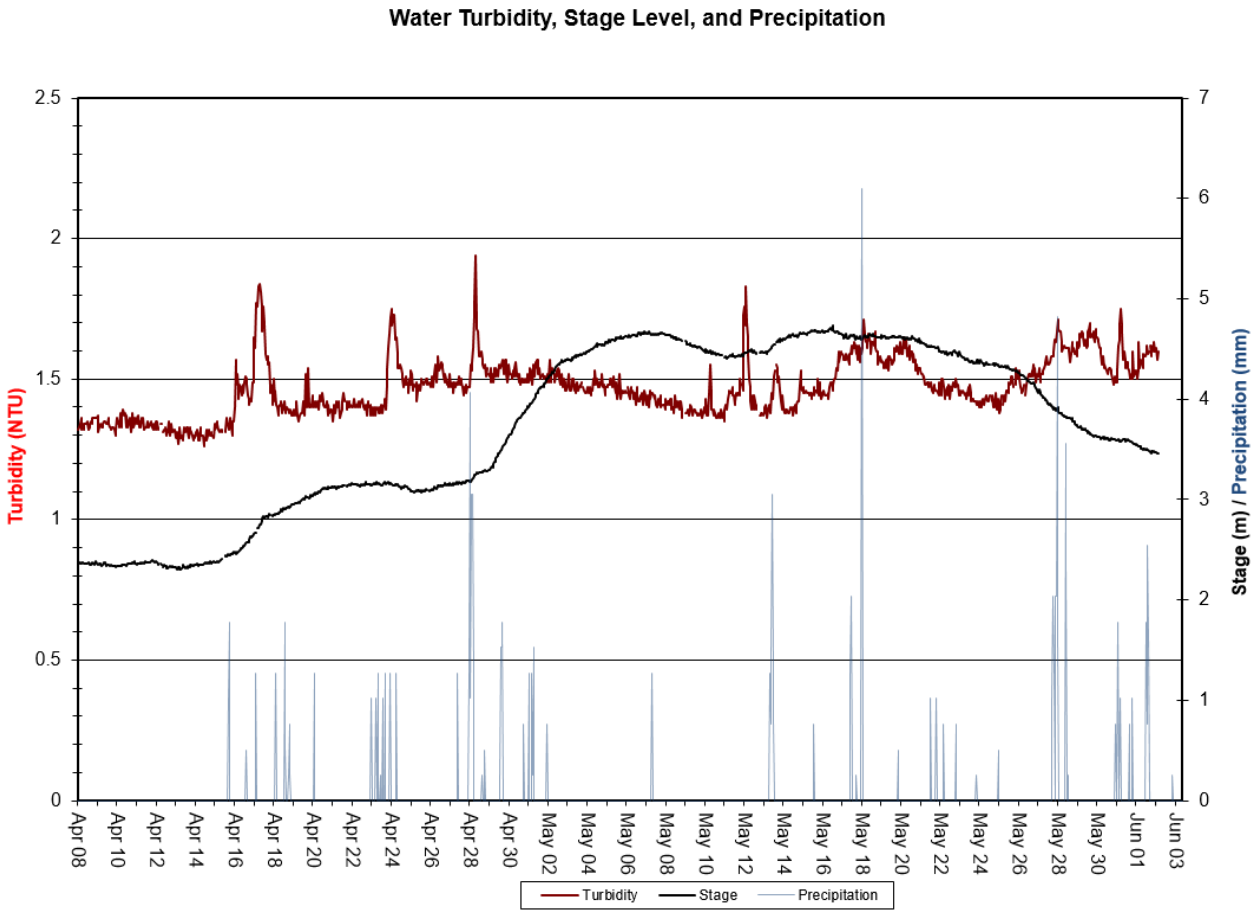

Figure 6: Turbidity, Stage, & Precipitation at Humber River from April 8, 2022, to June 3, 2022

Conclusions

- This deployment report outlines the findings of water quality and water quantity data recorded over a period of 57 days at the Humber River at Humber Village April 8, 2022, to June 3, 2022.
- QA/CA rankings at the start of the deployment were satisfactory, with 3/5 sensors ranking "Excellent", 2/5 sensors ranking "Good". At removal, the QA/QC ranking for specific conductivity downgraded from "Excellent" to "Good". There were no other QA/QC rank changes to the other sensors.
- The following are summarized statements regarding the findings at Humber River:
    - Stage & Flow: Stage ranged from 2.30 m to 4.73 m, averaging at 3.72 m. Flow ranged from 269.97 m^3/s to 801.13 m^3/s, averaging 566.86 m^3/s. The increases in the data are likely attributed to a combination of precipitation events and a warming spring climate that progressed throughout the deployment period, melting accumulated snow in the upper reaches of the watershed.
    - Water Temperature: Ranged from 1.05 °C to 7.85 °C, averaging 3.56 °C. Temperature gradually increased throughout the transition from winter to spring.
    - pH: Ranged from 6.73 to 6.91, averaging 6.82 pH units. pH remained stable, and data was within the threshold of acceptance for the protection of aquatic life as outlined by the CCME.
    - Specific Conductivity: Ranged from 35.0 µS/cm to 47.2 µS/cm, averaging at 42.5 µS/cm. Fluctuations occurred due to ice-melt and spring runoff from the land which added substantial freshwater to the system(decreased conductivity).
    - Dissolved Oxygen: Concentration ranged from 12.19 mg/L to 13.47 mg/L, averaging at 13.13 mg/L; percent-saturation ranged from 93.6% to 103.7%, averaging at 98.9%. Concentrations began to taper downward due to the warming climate over the spring. Data met the acceptance thresholds of the CCME's guidelines for the protection of both early and other life stages.
    - Turbidity: Ranged from 1.3 NTU to 1.9 NTU, averaging 1.5 NTU. Turbidity was relatively stable throughout deployment, with spikes corresponding to precipitation events and subsequent stage increases.

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Water Resources Management Division
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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

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)
April 8, 2022	4.03	0.49	8.0	0.00
April 9, 2022	5.19	2.92	9.7	0.00
April 10, 2022	5.19	1.90	9.5	0.00
April 11, 2022	3.77	0.47	6.8	0.00
April 12, 2022	4.48	2.74	6.9	0.00
April 13, 2022	3.83	1.90	6.6	0.00
April 14, 2022	4.67	0.07	9.9	0.00
April 15, 2022	4.88	-1.46	12.0	0.00
April 16, 2022	6.22	1.42	14.8	2.79
April 17, 2022	8.01	2.04	13.5	1.78
April 18, 2022	3.03	0.27	4.6	1.27
April 19, 2022	3.59	-3.31	10.2	3.56
April 20, 2022	6.31	3.97	8.9	1.27
April 21, 2022	4.07	0.04	6.3	0.00
April 22, 2022	4.07	-0.27	7.7	0.00
April 23, 2022	4.94	2.15	7.8	3.30
April 24, 2022	3.26	1.83	5.3	5.08
April 25, 2022	5.75	3.19	11.5	0.00
April 26, 2022	7.92	3.43	15.8	0.00
April 27, 2022	7.10	4.95	10.2	0.00
April 28, 2022	5.19	3.51	6.8	14.99
April 29, 2022	3.92	2.87	5.5	0.76
April 30, 2022	5.60	1.69	9.7	5.08
May 1, 2022	4.68	2.67	6.8	5.08
May 2, 2022	4.72	2.35	7.9	0.76
May 3, 2022	6.07	2.68	10.6	0.00
May 4, 2022	8.66	4.54	14.4	0.00
May 5, 2022	7.09	4.00	8.7	0.00
May 6, 2022	3.92	1.68	7.5	0.00
May 7, 2022	2.24	1.02	3.5	1.27
May 8, 2022	4.69	-1.56	9.8	0.00
May 9, 2022	6.95	-0.31	14.4	0.00
May 10, 2022	8.72	0.41	16.9	0.00
May 11, 2022	11.20	0.67	18.6	0.00
May 12, 2022	13.25	5.17	16.7	0.00
May 13, 2022	10.45	1.07	19.4	2.03

May 14, 2022	8.07	4.64	12.0	6.60
May 15, 2022	6.66	3.99	10.9	0.00
May 16, 2022	9.61	1.65	18.0	0.76
May 17, 2022	9.31	5.14	13.1	0.00
May 18, 2022	11.42	7.21	18.7	10.16
May 19, 2022	7.08	5.45	9.7	0.00
May 20, 2022	10.71	0.97	18.7	0.51
May 21, 2022	13.34	2.46	22.1	0.00
May 22, 2022	13.39	10.73	15.9	2.79
May 23, 2022	14.08	9.59	18.9	0.76
May 24, 2022	9.82	4.41	14.5	0.25
May 25, 2022	11.24	2.03	18.1	0.51
May 26, 2022	11.57	6.20	16.9	0.00
May 27, 2022	9.38	4.94	13.9	0.00
May 28, 2022	8.03	6.41	9.0	14.73
May 29, 2022	11.73	7.95	15.9	6.10
May 30, 2022	13.43	6.92	19.4	0.00
May 31, 2022	8.03	6.46	8.8	4.32
June 1, 2022	6.60	5.68	7.8	1.78
June 2, 2022	8.59	6.10	11.9	6.60
June 3, 2022	8.59	5.62	12.5	0.25

APPENDIX C

Grab Sample Results (next page)

Bureau Veritas Job #: C299020
Report Date: 2022/04/25

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SJB097 HUMBER RIVER @ HUMBER VILLAGE BRIDGE								
Sampling Date 2022/04/08 14:43								
Matrix W								
Sample # 2022-5001-00-SI-SP								
Registration # WS-S-0000								
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	16	1.0	mg/L	N/A	2022/04/19		7940523
Nitrate (N)	-	0.094	0.050	mg/L	N/A	2022/04/20		7940528
Total dissolved solids (calc., EC)	-	27	1.0	mg/L	N/A	2022/04/19		7940578
Inorganics								
Conductivity	-	49	1.0	uS/cm	N/A	2022/04/19	SHW	7946040
Chloride (Cl-)	-	6.1	1.0	mg/L	N/A	2022/04/19	LKH	7947406
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/04/19	LKH	7947406
Sulphate (SO4)	-	1.7	1.0	mg/L	N/A	2022/04/19	LKH	7947406
Total Alkalinity (Total as CaCO3)	-	11	2.0	mg/L	N/A	2022/04/19	SHW	7946042
Colour	-	47	5.0	TCU	N/A	2022/04/20	MCN	7947021
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/04/19	SHW	7946043
Total Kjeldahl Nitrogen (TKN)	-	0.11	0.10	mg/L	2022/04/19	2022/04/20	MJ1	7947463
Nitrate + Nitrite (N)	-	0.11	0.050	mg/L	N/A	2022/04/20	MCN	7947019
Nitrite (N)	-	0.013	0.010	mg/L	N/A	2022/04/20	MCN	7947016
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/04/20	MCN	7948377
Dissolved Organic Carbon (C)	-	5.5	0.50	mg/L	N/A	2022/04/21	NGI	7948733
Total Organic Carbon (C)	-	5.6	0.50	mg/L	N/A	2022/04/20	NGI	7944410
pH	-	7.17		pH	N/A	2022/04/19	SHW	7946041
Total Phosphorus	-	0.005	0.004	mg/L	2022/04/22	2022/04/25	SSV	7954006
Total Suspended Solids	-	ND	1.0	mg/L	2022/04/14	2022/04/18	RMK	7941134
Turbidity	-	0.74	0.10	NTU	N/A	2022/04/19	SHW	7946184
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/04/19	2022/04/21	FJO	7946555
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.094	0.0050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Barium (Ba)	-	0.0084	0.0010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Boron (B)	-	ND	0.050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Calcium (Ca)	-	4.7	0.10	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Copper (Cu)	-	ND	0.00050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Iron (Fe)	-	0.12	0.050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Magnesium (Mg)	-	0.98	0.10	mg/L	2022/04/14	2022/04/18	JHY	7940684

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

Bureau Veritas Job #: C299020
Report Date: 2022/04/25

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5
Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SJB097 HUMBER RIVER @ HUMBER VILLAGE BRIDGE Sampling Date 2022/04/08 14:43 Matrix W Sample # 2022-5001-00-SI-SP Registration # WS-S-0000								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.0060	0.0020	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Potassium (K)	-	0.24	0.10	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Sodium (Na)	-	3.2	0.10	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Strontium (Sr)	-	0.021	0.0020	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Uranium (U)	-	ND	0.00010	mg/L	2022/04/14	2022/04/18	JHY	7940684
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/04/14	2022/04/18	JHY	7940684

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