



# Real-Time Water Quality Deployment Report

## Paddy's Pond at Outlet

April 5, 2022 to May 5, 2022



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

## CONTENTS

<b>GENERAL .....</b>	<b>3</b>
<b>MAINTENANCE AND CALIBRATION OF INSTRUMENT .....</b>	<b>3</b>
<b>DATA INTERPRETATION.....</b>	<b>5</b>
WATER TEMPERATURE.....	5
PH .....	7
SPECIFIC CONDUCTIVITY .....	8
DISSOLVED OXYGEN .....	10
TURBIDITY .....	11
<b>APPENDIX A : MEAN DAILY TEMPERATURE AND TOTAL PRECIPITATION .....</b>	<b>13</b>
<b>APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS .....</b>	<b>15</b>

## General

The Department of Environment and Climate Change, Water Quality Management Division staff monitors the real-time water quality at Paddy's Pond at outlet to Three Arm Pond (47.488129N, 52.893809W).



Figure 1: Paddy's Pond at Outlet Real-Time Water Quality Station location

## Maintenance and Calibration of Instrument

As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QAQC sondes a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.

**Table 1: Ranking classifications for deployment and removal**

Parameter	Rank				
	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

At the end of a deployment period, a freshly cleaned and calibrated QA/QC Sonde is placed *in situ*, adjacent to the Field Sonde. Deployment and removal comparison rankings for the station at Paddy's Pond deployed between Nov. 3, 2021 and Dec. 15, 2021 are summarized in Table 2.

**Table 2: Qualitative QA/QC comparison rankings for Paddy's Pond at outlet station Nov. 3, 2021 through Dec. 15, 2021.**

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Paddy's Pond at Outlet	2022-04-05	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	2022-04-05	Grab Sample #2021-1702-00-SI-SP	N/A	Marginal	Good	N/A	Excellent
	2022-05-05	Removal	Excellent	Good	Excellent	Good	Excellent

- On April 5, 2022, a real-time water quality monitoring instrument was deployed at the station Paddy's Pond at Outlet. The instrument was deployed for a period of 31 days and was removed on May 5, 2022.
- Upon deployment, all sensors ranked 'Excellent' and 'Good' against the calibrated QA/QC sonde. Potential causes for less than excellent QA/QC rankings to be obtained include: the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.
- At removal of the instrument, parameter rankings varied between 'Excellent' and 'Good' against the QA/QC sonde.

## DATA INTERPRETATION

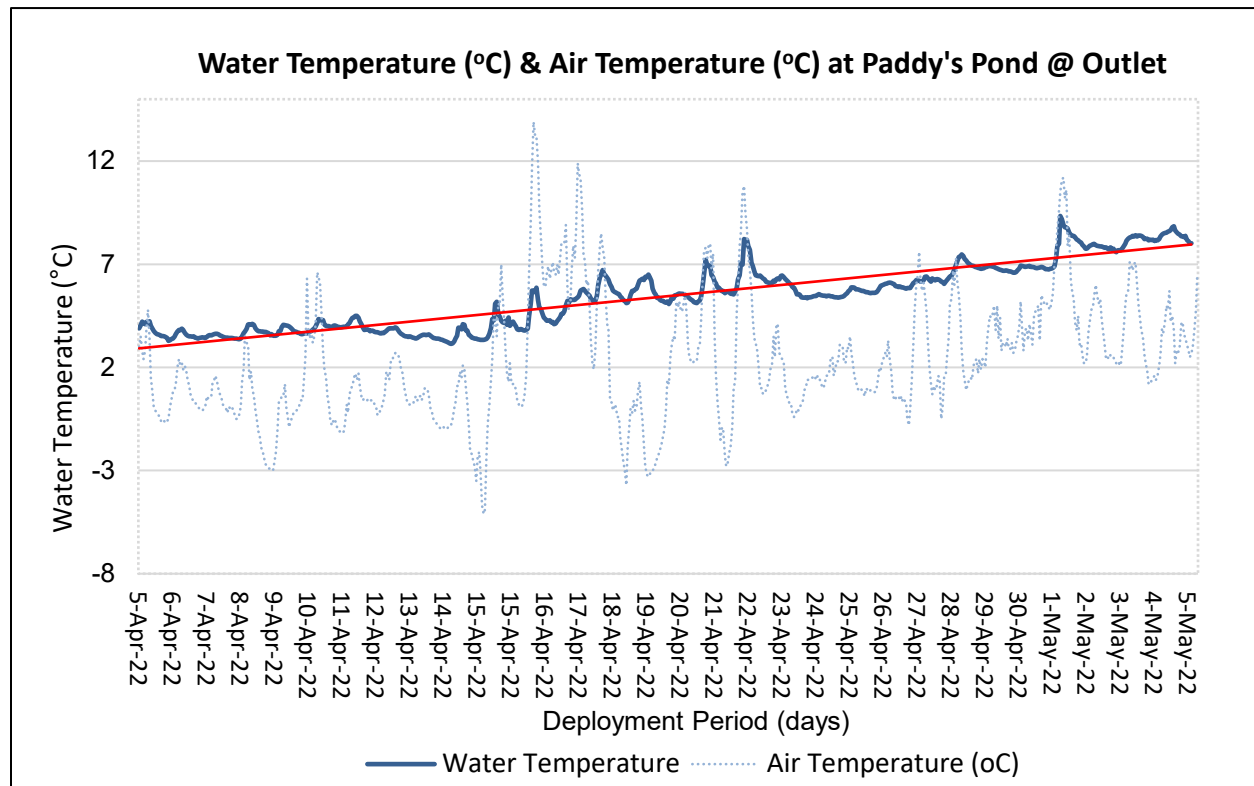
The following graphs and discussion illustrate water quality data obtained hourly from April 5, 2022 through May 5, 2022 at Paddy's Pond at outlet to Three Arm Pond, St. John's, NL.

Stage is not monitored at this station and as such cannot be discussed with respect to other monitored water quality parameters. All data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol.

Mean daily temperature and total precipitation data was obtained from the ECCC historical weather data at [https://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](https://climate.weather.gc.ca/historical_data/search_historic_data_e.html) and can be found illustrated in Appendix A. Gaps in available daily data were removed for graphing purposes.

### Water Temperature

- Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.
- It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be broken down into three groups: temperature dependent, temperature compensated and temperature independent. As the temperature sensor is not isolated from the rest of the sonde the entire sonde must be at the same temperature before the sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.



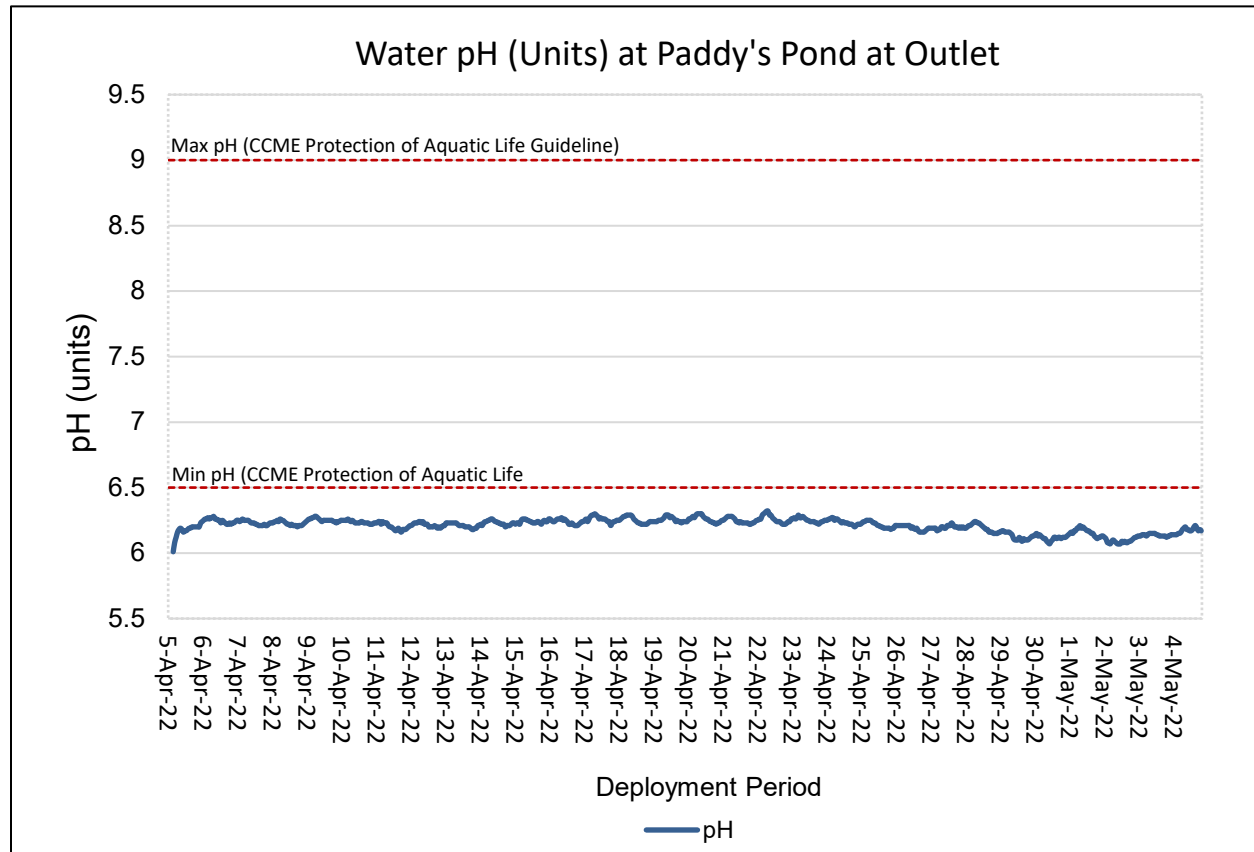
Mean	Median	Min	Max
5.45	5.49	3.14	9.34

Figure 2: Water temperature (°C) values at Paddy's Pond at Outlet.

- Over the 31-day deployment period, water temperature increased naturally in relation to steadily increasing air temperatures as the summer season nears. The mean temperature was 5.45°C with a median of 5.49°C.
- Minimum water temperature of 3.14°C was observed on April 14, 2022 and a maximum water temperature of 9.34 °C was observed on May 1, 2022 and (Figure 2).
- Decreases in water temperature observed below the trendline, in addition to decreasing air temperatures, can be associated precipitation events and the addition of cool water.
- A natural diurnal temperature pattern with temperatures increasing during the day and decreasing overnight was observed. During mid-April, the pattern was more significant when daytime air temperatures were higher as the temperature range from day to night was greater.

pH

- pH is used to give an indication of the acidity or basicity of a solution. A pH of seven (7) denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.



Mean	Median	Min	Max
6.21	6.22	6.01	6.32

**Figure 3: pH (pH units) at Paddy's Pond at outlet from Nov. 3, 2021 through Dec. 15, 2021.**

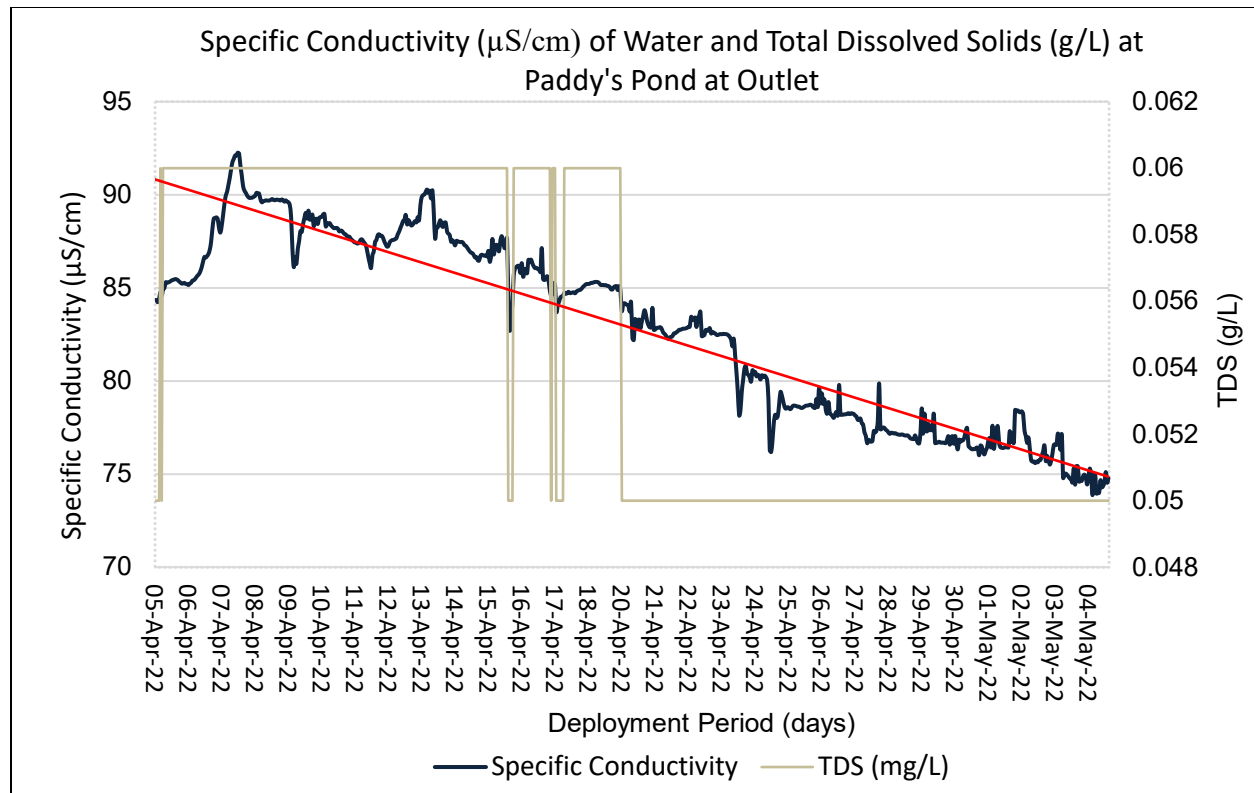
- Throughout the deployment period, pH values remained stable with a range from 6.01 to 6.32 pH units, with a mean unit value of 6.21 and median of 6.22 units (Figure 3).
- A slight gradual decrease in pH was observed near the end of the deployment period and is most likely correlated to the large precipitation event that occurred April 22-23, as that is when the decline began.

- The CCME guideline for the protection of aquatic life states the requirement of a minimum pH value of 6.5 and max value of 9.0. This guideline provides a basis for the overall health the waterbody. Paddy's Pond at Outlet pH values were slightly below the minimum guideline. This may be a result of the recent spring snow/ice thaw and higher levels of carbon dioxide concentrations from increased rates of photosynthesis, respiration and decomposition of organic matter normal for the time of year.
- pH values are temperature dependant as well as influenced by photosynthesis and respiration by aquatic organisms. The concentration of dissolved carbon dioxide in the water throughout the day, especially overnight when oxygen production is reduced relative to carbon dioxide levels. Carbon dioxide dissolved in water yields a slightly acidic solution.
- A small diurnal variation pattern was visible throughout the deployment period. The magnitude of variation is in correlation to the smaller daily water temperature range and length of days as expected at this time of the year.

#### Specific Conductivity

- Conductivity relates to the ease of passing an electric charge – or resistance – through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25°C to allow comparison across variable temperatures.





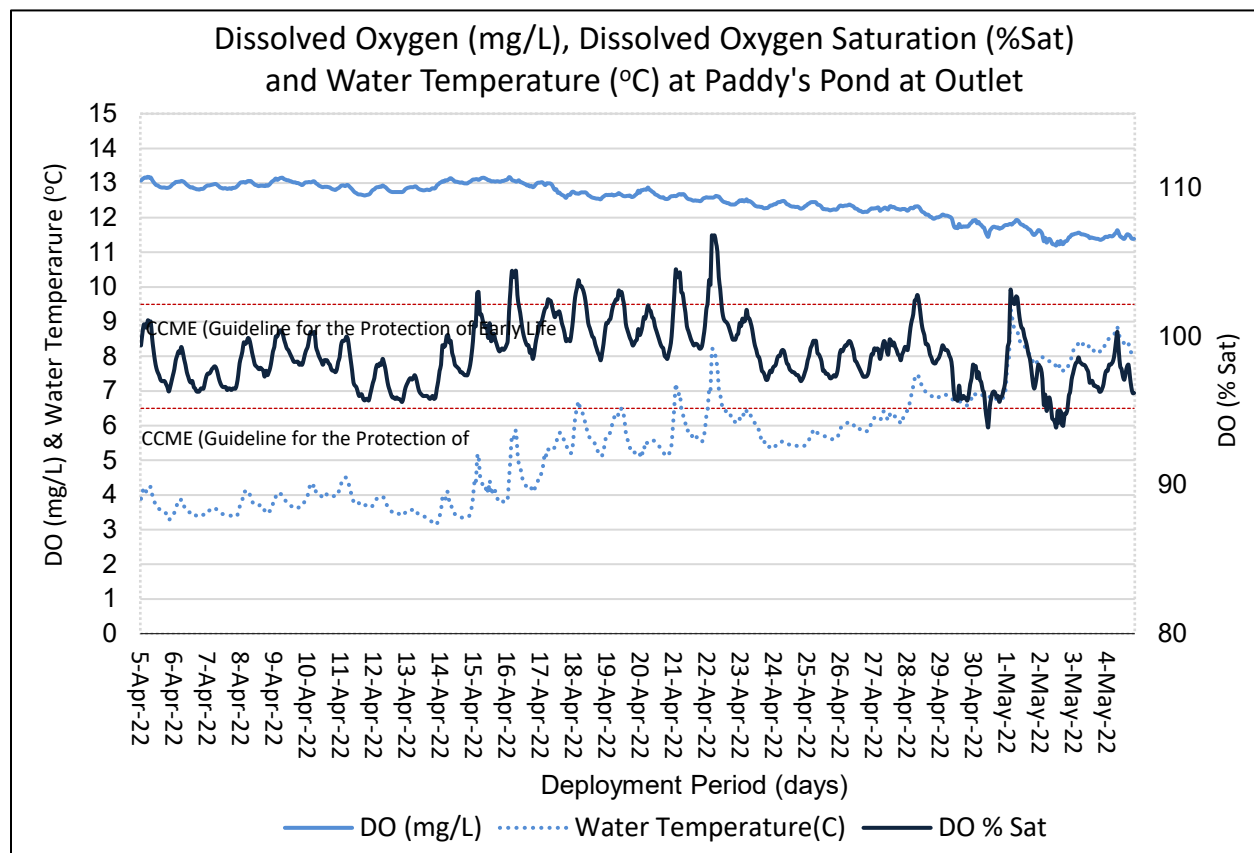
Mean	Median	Min	Max
82.8	83.6	73.9	92.3

Figure 4: Specific conductivity ( $\mu\text{S}/\text{cm}$ ) values at Paddy's Pond at Outlet.

- Specific conductivity values decreased throughout the deployment period with a maximum value of 92.3  $\mu\text{S}/\text{cm}$  and a minimum value of 73.9  $\mu\text{S}/\text{cm}$  (Figure 4). Mean conductivity was 82.8  $\mu\text{S}/\text{cm}$  with a median conductivity of 83.6  $\mu\text{S}/\text{cm}$ . This trend (indicated in red on Figure 4) may be the result of decreasing ion concentrations post spring snow/ice melt within the watershed as well as dilution during precipitation events.
- Upon recalibration of the sonde S/N 14M100733, it was observed that the conductivity sensor may have experienced drift and as a result, been an additional cause of the decreasing conductivity concentrations over the deployment period.
- Variability in specific conductivity values throughout the deployment period is likely the result of temperature variations and precipitation events (Appendix A – Figure 7). A reduction in conductivity can be expected after rainfall: as the amount of water increases, solids concentration is reduced, decreasing conductivity.
- Given the isolated station location, sources of disturbances that may affect conductivity are considered minimal

### Dissolved Oxygen

- Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.



Parameter	Mean	Median	Min	Max
DO (mg/L)	12.49	12.63	11.20	13.18
DO ( % Sat)	98.8	98.6	93.9	106.8

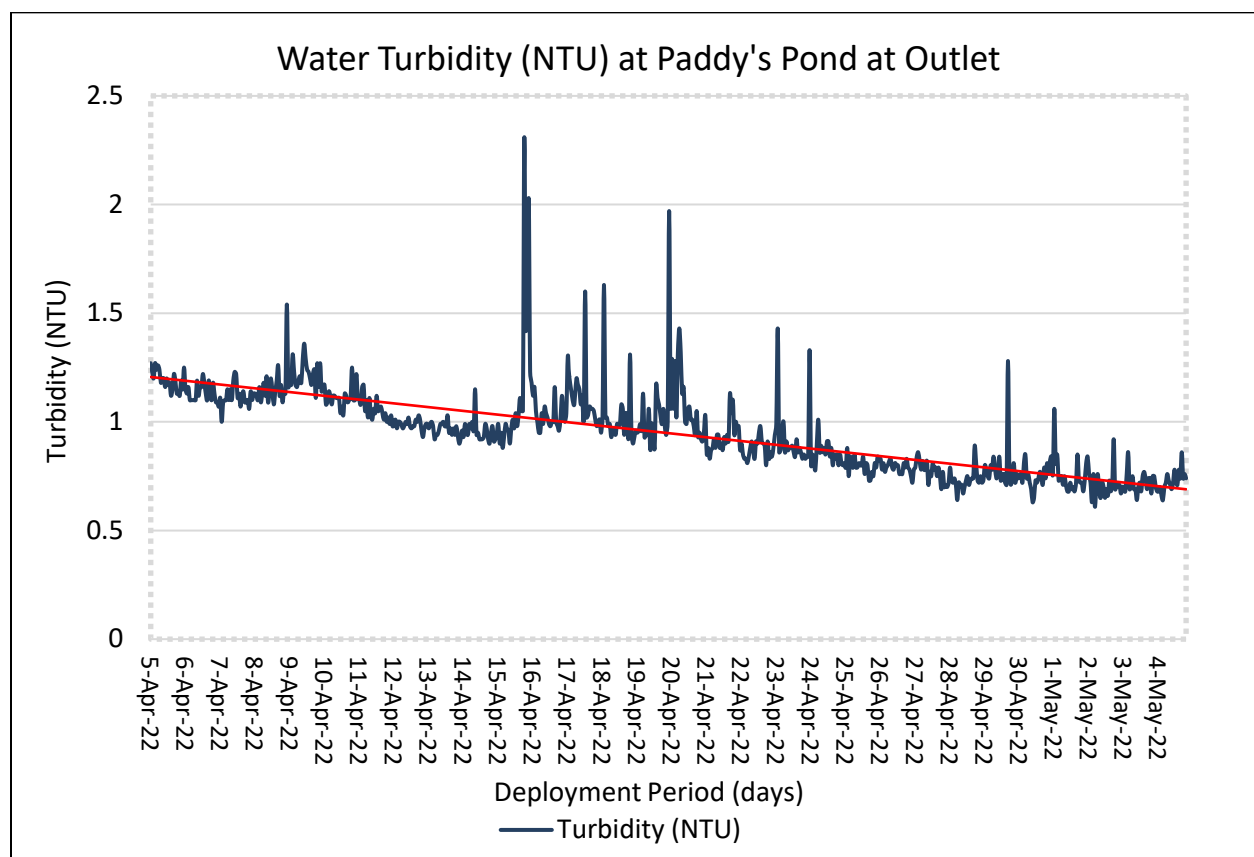
Figure 5: Dissolved Oxygen (mg/L & Percent (%) Saturation) values at Paddy's Pond at Outlet.

- Dissolved Oxygen (DO) concentrations decreased over the deployment period with a maximum DO of 13.18 mg/L (106.8% Sat) to a minimum DO of 11.20 mg/L (93.9 % Sat). This is an expected natural trend due to the seasonal increase in water temperature.

- Slight diurnal variations were observed throughout the deployment period due to the temperature range from day to night. Diurnal variation can be influenced by water depth during deployment as well as number of sunlight hours.

**Turbidity**

- Turbidity is typically caused by fine suspended solids such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.



**Figure 6: Water turbidity (NTU) values at Paddy's Pond at Outlet during deployment period April 5, 2022 through May 5, 2022.**

- Turbidity values range from 0.6 to 2.3 NTU, with a mean of 0.9 and a median value of 1.0 NTU (Figure 6). Turbidity measurements over the deployment period indicated low turbidity values with a slight decline over time.

- Turbidity levels remained low during this deployment period. Events above baseline level as seen in mid-to-late April, are likely influenced by debris, suspended algae, siltation due to wave action and precipitation events.

**APPENDIX A : MEAN DAILY TEMPERATURE AND TOTAL PRECIPITATION**

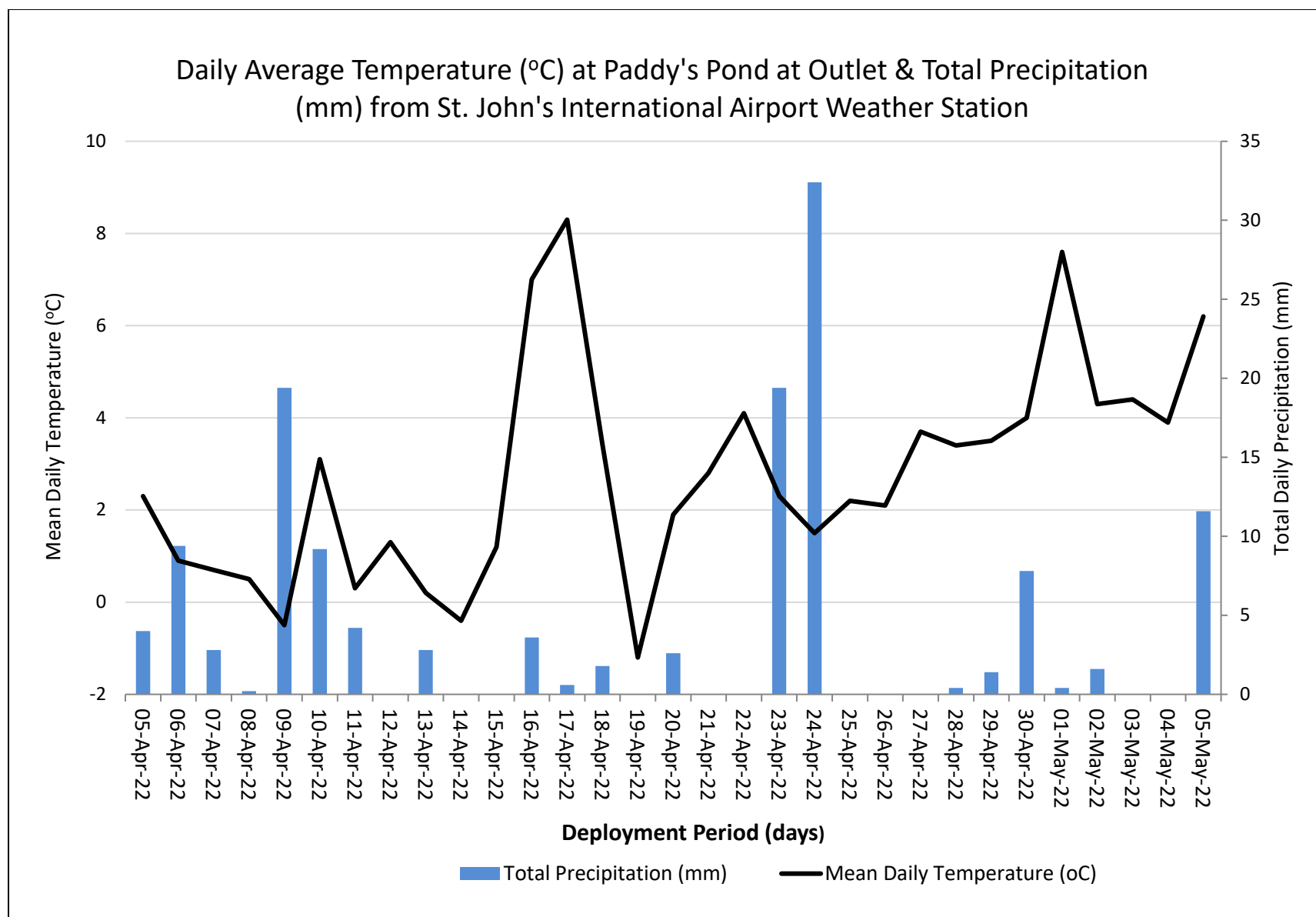


Figure 7: Mean daily air temperature and total precipitation at St. John's West near Paddy's Pond between April 5, 2022 to May 5, 2022.

**APPENDIX B : QA/QC GRAB SAMPLE FIELD RESULTS**



Your P.O. #: 220028978-5  
 Site Location: PADDY'S POND @ OUTLET  
 Your C.O.C. #: N/A, 2022-1702-00-SI-SP

**Attention: Janice McCarthy**

NL Department of Environment, Climate Change and Municipalities  
 Water Resources  
 PO Box 8700  
 St. John's, NL  
 CANADA A1B 4J6

**Report Date: 2022/04/18**  
 Report #: R7089599  
 Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C292930**

**Received: 2022/04/07, 09:36**

Sample Matrix: Water  
 # Samples Received: 1

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Alkalinity	1	N/A	2022/04/13	ATL SOP 00142	SM 23 2320 B
Anions (1)	1	N/A	2022/04/11	CAM SOP-00435	SM 23 4110 B m
Colour	1	N/A	2022/04/13	ATL SOP 00020	SM 23 2120C m
Organic carbon - Diss (DOC) (2)	1	N/A	2022/04/13	ATL SOP 00203	SM 23 5310B m
Conductance - water	1	N/A	2022/04/13	ATL SOP 00004	SM 23 2510B m
Fluoride	1	N/A	2022/04/13	ATL SOP 00043	SM 23 4500-F- C m
Hardness (calculated as CaCO3)	1	N/A	2022/04/12	ATL SOP 00048	Auto Calc
Mercury - Total (CVAA,LL)	1	2022/04/12	2022/04/13	ATL SOP 00026	EPA 245.1 R3 m
Metals Water Total MS	1	2022/04/11	2022/04/11	ATL SOP 00058	EPA 6020B R2 m
Nitrogen Ammonia - water	1	N/A	2022/04/12	ATL SOP 00015	EPA 350.1 R2 m
Nitrogen - Nitrate + Nitrite	1	N/A	2022/04/13	ATL SOP 00016	USGS I-2547-11m
Nitrogen - Nitrite	1	N/A	2022/04/12	ATL SOP 00017	SM 23 4500-NO2- B m
Nitrogen - Nitrate (as N)	1	N/A	2022/04/13	ATL SOP 00018	ASTM D3867-16
pH (3)	1	N/A	2022/04/13	ATL SOP 00003	SM 23 4500-H+ B m
Calculated TDS (DW Pkg)	1	N/A	2022/04/13	N/A	Auto Calc
Total Kjeldahl Nitrogen in Water (1)	1	2022/04/12	2022/04/13	CAM SOP-00938	OMOE E3516 m
Organic carbon - Total (TOC) (2)	1	N/A	2022/04/11	ATL SOP 00203	SM 23 5310B m
Total Phosphorus (Colourimetric) (1)	1	2022/04/14	2022/04/14	CAM SOP-00407	SM 23 4500 P B H m
Total Suspended Solids	1	2022/04/08	2022/04/12	ATL SOP 00007	SM 23 2540D m
Turbidity	1	N/A	2022/04/12	ATL SOP 00011	EPA 180.1 R2 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

(3) The APHA Standard Method require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.





Your P.O. #: 220028978-5  
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Your C.O.C. #: N/A, 2022-1702-00-SI-SP

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**CERTIFICATE OF ANALYSIS**

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**Received: 2022/04/07, 09:36**

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.  
Maryann Comeau, Customer Experience Supervisor/PM  
Email: Maryann.COMEAU@bureauveritas.com  
Phone# (902)420-0203 Ext:298

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Bureau Veritas Job #: C292930  
Report Date: 2022/04/18

NL Department of Environment, Climate Change and  
Municipalities

Site Location: PADDY'S POND @ OUTLET

Your P.O. #: 220028978-5

Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SHS512 PADDY'S POND @ OUTLET								
Sampling Date		2022/04/05						
Matrix		W						
Sample #		2022-1702-00-SI-SP						
Registration #		WS-S-0000						
<b>RESULTS OF ANALYSES OF WATER</b>								
<b>Calculated Parameters</b>								
Hardness (CaCO3)	-	7.0	1.0	mg/L	N/A	2022/04/12		7929303
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/04/13		7929306
Total dissolved solids (calc., EC)	-	44	1.0	mg/L	N/A	2022/04/13		7929394
<b>Inorganics</b>								
Conductivity	-	78	1.0	uS/cm	N/A	2022/04/13	SHW	7937498
Chloride (Cl-)	-	21	1.0	mg/L	N/A	2022/04/11	LKH	7931402
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/04/11	LKH	7931402
Sulphate (SO4)	-	2.4	1.0	mg/L	N/A	2022/04/11	LKH	7931402
Total Alkalinity (Total as CaCO3)	-	2.6	2.0	mg/L	N/A	2022/04/13	SHW	7937500
Colour	-	34	5.0	TCU	N/A	2022/04/13	MCN	7935261
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/04/13	SHW	7937502
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/04/12	2022/04/13	MJ1	7936329
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/04/13	MCN	7935273
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/04/12	MCN	7935274
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/04/12	MCN	7935042
Dissolved Organic Carbon (C)	-	4.7	0.50	mg/L	N/A	2022/04/13	NGI	7935142
Total Organic Carbon (C)	-	4.4	0.50	mg/L	N/A	2022/04/11	NGI	7932775
pH	-	6.34		pH	N/A	2022/04/13	SHW	7937499
Total Phosphorus	-	0.014	0.004	mg/L	2022/04/14	2022/04/14	SSV	7940365
Total Suspended Solids	-	2.0	1.0	mg/L	2022/04/08	2022/04/12	RMK	7930097
Turbidity	-	2.1	0.10	NTU	N/A	2022/04/12	SHW	7935405
<b>MERCURY BY COLD VAPOUR AA (WATER)</b>								
<b>Metals</b>								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/04/12	2022/04/13	EPU	7935239
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Aluminum (Al)	-	0.095	0.0050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Barium (Ba)	-	0.0030	0.0010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Boron (B)	-	ND	0.050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Calcium (Ca)	-	1.9	0.10	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Copper (Cu)	-	ND	0.00050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Iron (Fe)	-	0.20	0.050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Magnesium (Mg)	-	0.54	0.10	mg/L	2022/04/11	2022/04/11	BAN	7932709



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NL Department of Environment, Climate Change and  
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Site Location: PADDY'S POND @ OUTLET

Your P.O. #: 220028978-5

Sampler Initials: LB

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
SHS512 PADDY'S POND @ OUTLET								
Sampling Date 2022/04/05								
Matrix W								
Sample # 2022-1702-00-SI-SP								
Registration # WS-S-0000								
<b>ELEMENTS BY ICP/MS (WATER)</b>								
<b>Metals</b>								
Total Manganese (Mn)	-	0.031	0.0020	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Potassium (K)	-	0.33	0.10	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Sodium (Na)	-	12	0.10	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Strontium (Sr)	-	0.0061	0.0020	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Uranium (U)	-	ND	0.00010	mg/L	2022/04/11	2022/04/11	BAN	7932709
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/04/11	2022/04/11	BAN	7932709



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Report Date: 2022/04/18

NL Department of Environment, Climate Change and  
Municipalities  
Site Location: PADDY'S POND @ OUTLET  
Your P.O. #: 220028978-5  
Sampler Initials: LB

### GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.2°C
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**Results relate only to the items tested.**



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### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

Janah Rhyno, Metals Supervisor-Bedford

Mike MacGillivray, Scientific Specialist (Inorganics)

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