KENORA RESOURCE CONSULTANTS

BLACK STURGEON LAKES WATER QUALITY MONITORING

2019 REPORT

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Contents

LIST OF FIGURES

1.0 BACKGROUND

In the fall of 2007, the City of Kenora was presented with the results of the *Lake Capacity and Management Study for Black Sturgeon Lake*. One of the recommendations of this study was to conduct a water quality assessment on Lower Black Sturgeon Lake for two consecutive years to establish baseline data and then once every five years to monitor changes to the water quality in the lake. Based on the results of the 2009, 2010, and 2015 sampling seasons, it was recommended by the consultant (Kenora Resource Consultants Inc.) that annual sampling focussing on one spring sampling session and one late summer sampling session would provide a more effective monitoring program than the original project design of 10 sampling sessions conducted every five years.

In 2009 and 2010, the City of Kenora awarded the contract to conduct the baseline data work for the first two-years of water quality monitoring on Black Sturgeon Lakes to Ryan Haines Consulting. In 2015, 2016, 2017, 2018, and 2019 the water quality assessment contract was awarded to Kenora Resource Consultants Inc. (note – Ryan Haines Consulting was incorporated into Kenora Resource Consultants Inc. in 2012).

2.0 METHODOLOGY

Two sampling sessions were conducted during the 2019 season, a spring session on May 17th and a late summer session on August 21st. Water samples were taken at two locations on Lower Black Sturgeon Lake and one location at Upper Black Sturgeon during each sampling session. Sample locations on Lower Black Sturgeon correspond to sites identified in the *Lake Capacity and Management Study for Black Sturgeon Lake*. The site on Upper Black Sturgeon was added during the 2010 sampling season to help to better understand potential sources of the higher nutrient levels found at the upstream site on Lower Black Sturgeon during the 2009 sampling season.

The selection of the site locations has been designed to determine the impacts of development on the water quality of Black Sturgeon Lakes. Site 2 is located at the outlet of Black Sturgeon Lakes into the Winnipeg River, Site 3 is located at inlet of Black Sturgeon Creek into Lower Black Sturgeon Lake, and Site 4 is located at the outlet of Upper Black Sturgeon Lake (Figure 1) into Black Sturgeon Creek. Site 2 is the main sampling location used to assess the impacts of development on water quality because the new and proposed developments on Lower Black Sturgeon Lake are occurring upstream of this site.

All field work was conducted from a small motorboat with a sonar unit mounted to the stern. At each sampling site, an anchor was used to keep the boat in one location.

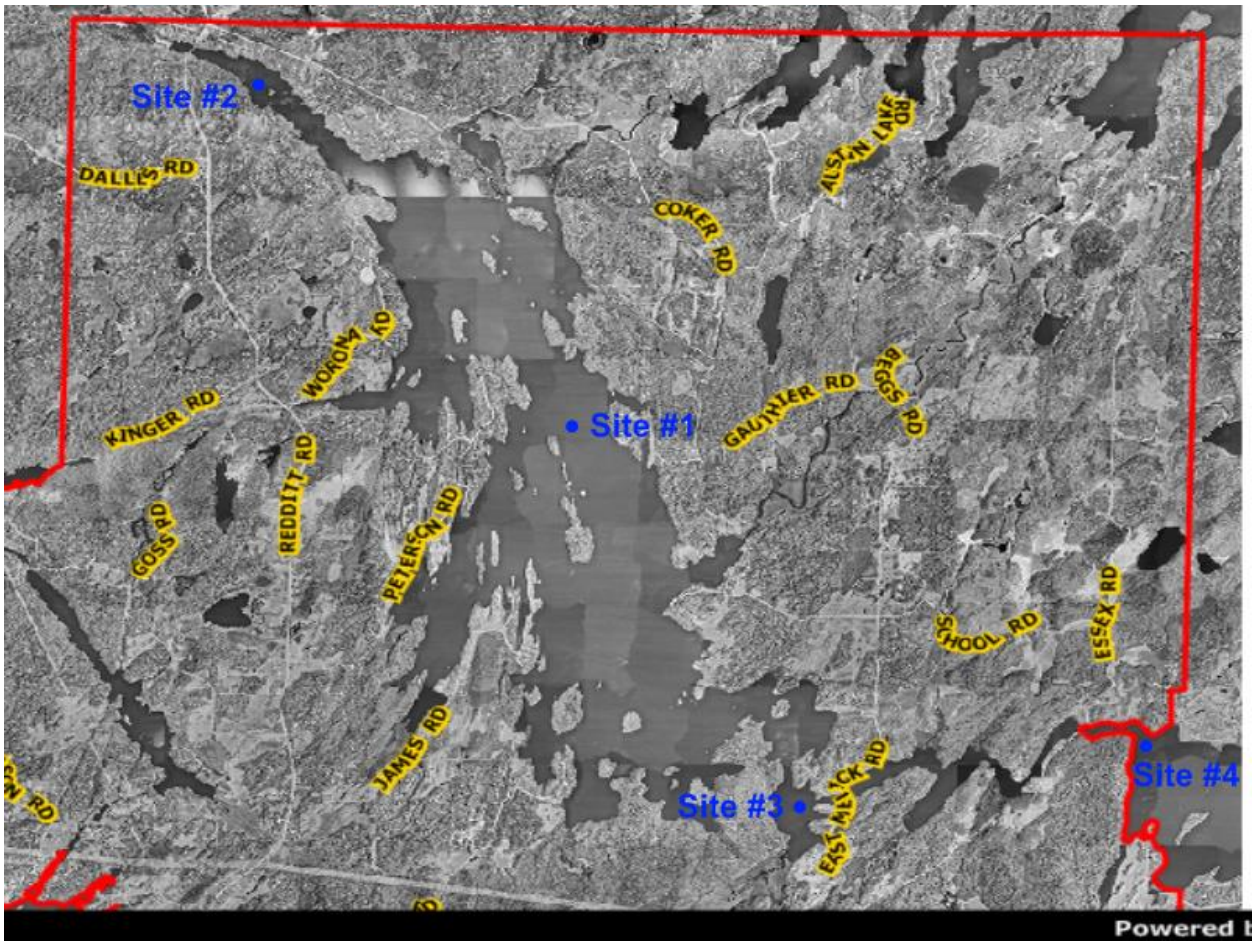


Figure 1 – Sampling Sites for Water Quality Monitoring on Black Sturgeon Lakes for 2019 sampling season

2.1 Spring Sampling

During the spring sampling session, the focus was on the euphotic zone (surface water) sampling to capture spring turnover or mixing of the lake. The spring field work consisted of recording Secchi depths and collecting euphotic zone composites at sites #2, #3, and #4. During the 2019 field season, spring euphotic zone composite samples were also collected from site #1 as well as the middle of the basin of Upper Black Sturgeon Lake for submission to the Ministry of the Environment, Conservation, and Parks (MECP) laboratory in Dorset as part of the Lake Partner Program. Results from the Lake Partner Program were not available when this report was submitted and will be provided in an addendum at a future date.

Secchi depth was determined at each site by lowering a Secchi disk (20-cm disk with alternating black and white quadrants) over the shady side of the boat (Figure 2). The disk was lowered until the observer could no longer distinguish between the white and black quadrants and then raised until the disk came back into view. This was repeated three times and then the depths at which the disk disappeared and then reappeared were averaged to give the Secchi depth.

Figure 2 – Lowering of Secchi disk

The euphotic zone is the section of the water column where enough light penetrates to facilitate algae growth (measured as 2X the Secchi depth). In order to obtain a water sample containing water from the euphotic zone, a weighted, 500 mL, small neck bottle (Figure 3) was lowered with a rope in the water column to a depth of 2X Secchi depth then quickly brought to the surface before the bottle became completely filled. For the two Lake Partner Program sampling sites, the water was filtered with an 80-micron filter as it was poured into the sampling bottles.

Figure 3 – Transferring water sample from euphotic zone composite into lab sample bottle

2.2 Late Summer Sampling

Late summer sampling included all of the field work conducted during the spring (Secchi depths and euphotic zone composite water sampling), but with the addition of temperature/oxygen profiles and lower water column samples to measure the impacts of the summer thermal stratification and oxygen depletion on water quality.

Temperature/oxygen profiles were obtained at Sites #1, #2, #3, and #4 during the late summer sampling session using an YSI 55 Dissolved Oxygen Meter.

During the later summer sampling session, an additional water sample was taken at sites #2, #3, and #4 approximately one meter from the bottom of the lake using a Beta horizontal water sampler (Figure 4). Both ends of the water sampler were opened prior to lowering it (using a rope) to the desired water depth. At the desired depth, a small weight was sent down through the water column along the length of the rope triggering a release mechanism on the sampler and causing the sampler caps to close.

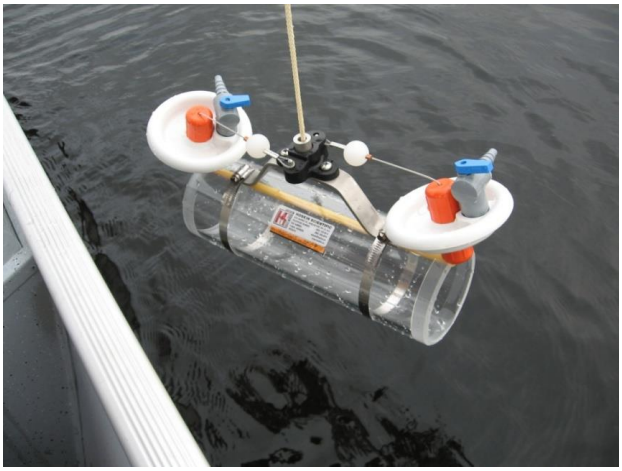


Figure 4 – Horizontal Beta Sampler prior to deployment

All water samples collected were transferred immediately upon collection to sample bottles for analysis at a laboratory. Samples were delivered by vehicle to the ALS Laboratory Group in Winnipeg, MB, for analyses.

3.0 RESULTS

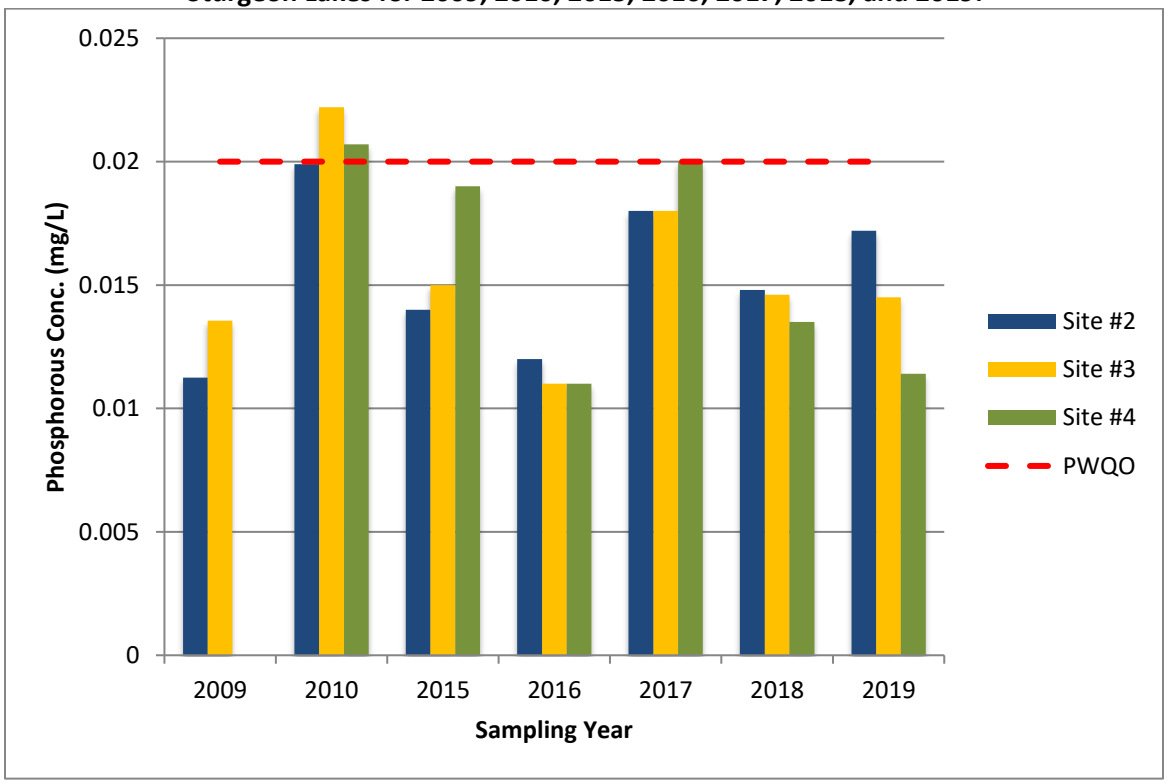
3.1 Sampling Session Dates and Locations

The 2019 sampling sessions were conducted on May 17th and August 21st. The depth of the sampling sites was 28.9 m for Site 1, 13.9 m for Site 2, 10.1 m for Site 3, and 7.1 m for Site 4.

3.2 Total Phosphorous

During 2019, the spring turnover euphotic zone phosphorous concentrations taken at Site 2 (0.0172 mg/L), Site 3 (0.0145 mg/L) and Site 4 (0.0114 mg/L) were all below the provincial water quality objective (PWQO) of 0.0200 mg/L. The phosphorous concentrations found at Site 2 (the outlet of Black Sturgeon Lakes) in 2019 was above the concentrations found in 2009, 2015, 2016, and 2018, but below the results found in 2010 and 2017 (Figure 5).

Figure 5 – Spring Turnover Total Phosphorous Concentrations for Three Sampling Sites on Black Sturgeon Lakes for 2009, 2010, 2015, 2016, 2017, 2018, and 2019.



3.3 Chemical Analyses - Water Quality Characteristics

The spring turnover water samples were analyzed for 54 parameters encompassing dissolved organic carbon, colour, pH, alkalinity, turbidity and scans for cations/anions and trace metals. The 2019 results for Site 2 (outlet of Black Sturgeon Lakes and downstream of new development activities) were comparable to the results for the 2010, 2015, 2016, 2017, and 2018 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided. The full results can be found in Appendix 1.

4.0 DISCUSSION

4.1 Copper

The copper concentration for Site #2 exceeded the PWQO in 2017 (lab result of 0.00116 mg/L with a PWQO of 0.001). The copper concentrations found in 2018 (0.00088 mg/L) and 2019 (0.00078 mg/L) were below the PWQO and within levels found in 2010, 2015, and 2016, indicating that the copper concentration found in 2017 was an anomaly and not indicative of a consistent copper exceedance within the waterbody.

4.2 Total Phosphorous

The total phosphorous readings that are of the most interest for water quality analyses are the ones taken during spring turnover. The reason for this is that turnover is when the phosphorous is mixed

throughout the water column and provides an indication of overall phosphorous concentrations in the waterbody. Spring turnover is also when past phosphorous concentrations (i.e. Lake Partner Program) have been measured, which enable analysis of trends over time using a larger database over a longer time period.

The Ontario provincial water quality objective for total phosphorous concentrations is less than 20 µg/L (0.02 mg/L) "to avoid nuisance concentrations of algae in lakes" (MOE 1994). The 2019 spring sampling results for phosphorous concentrations were below the provincial water quality objective (PWQO) of 0.0200 mg/L for all three sites (Site 2, Site 3, Site 4).

4.3 Chemical Analysis - Water Quality Characteristics

The 2019 Site 2 results were comparable to the results for the 2010, 2015, 2016, 2017, and 2018 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided. This data supports the findings of the phosphorous results indicating that the water quality health of Black Sturgeon Lakes has remained relatively consistent over the past decade.

5.0 SUMMARY AND RECOMMENDATIONS

Lower Black Sturgeon Lake is within the provincial water quality objectives for a healthy lake for all parameters measured and analyzed in this study. The results indicate that Black Sturgeon Lakes has the water quality characteristics to be expected in a dystrophic lake (i.e. heavily coloured due to presence of humic compounds of plant origin) located in northwestern Ontario. In addition, the 2019 water quality results are consistent with results of previous water monitoring studies conducted on Lower Black Sturgeon Lake. This indicates that the health of the water body has remained consistent and is not deteriorating over time.

6.0 REFERENCES

Gartner Lee Ltd. and Kelli Saunders Environmental Management. October 2007. *Lake Capacity and Management Study for Black Sturgeon Lake, City of Kenora*.

Ministry of the Environment. 2015a. Lake Partner Total Phosphorous Data. Found on website at: http://desc.ca/programs/lpp

Ministry of the Environment. 2015b. Lake Partner Secchi Depth Data. Found on website at: http://desc.ca/programs/lpp

Ministry of Environment and Energy. July 1994. *Water Management: Policies; Guidelines; Provincial Water Quality Objectives of the Ministry of Environment and Energy.* Found on website at: http://www.ontario.ca/document/water-management-policies-guidelines-provincial-water-quality-objectives

APPENDIX 1 – DISSOLVED OXYGEN/TEMPERATURE PROFILE RESULTS AND SECCHI DEPTHS FOR 2019 LATE SUMMER SAMPLING SESSION

Site 1

Secchi Depth (m)	B.P. (mmHg)	Time	Depth (m)
	752.5		29.2

Depth	Temp	DO (%)	DO (mg/L)
0.5	20.2	91.2	8.22
1	20.3	91.4	8.20
2	20.4	90.6	8.19
3	20.4	90.7	8.18
4	20.4	90.4	8.16
5	20.4	90.6	8.16
6	20.4	90.2	8.11
7	20.4	89.3	8.04
8	20.4	88.8	7.97
9	14.0	39.6	4.03
10	12.1	40.2	4.34
11	10.7	41.5	4.63
12	10.1	41.6	4.68
13	9.3	41.8	4.83
14	8.5	40.3	4.70
15	8.2	41.1	4.73
16	8.0	40.2	4.77
17	7.8	39.6	4.72
18	7.6	39.8	4.73
19	7.5	39.5	4.70
20	7.4	38.3	4.61
21	7.3	37.1	4.44
22	7.3	36.6	4.36
23	7.3	35.5	4.30
24	7.2	35.3	4.20
25	7.1	33.3	4.02
26	7.0	30.8	3.67
27	7.0	28.4	3.43
28	7.0	29.3	3.30
29	6.9	26.0	3.15

Site 2

Secchi Depth (m)	B.P. (mmHg)	Time	Depth (m)
3.25	752.2	18:27	13.7

Depth	Temp	DO (%)	DO (mg/L)
0.5	20.3	92.3	8.34
1	20.4	91.4	8.23
2	20.4	90.2	8.24
3	20.4	90.7	8.13
4	20.3	87.4	7.77
5	19.7	78.0	7.05
6	15.4	55.1	5.48
7	13.9	49.1	5.05
8	11.1	43.4	4.77
9	10.5	41.6	4.64
10	10.0	40.3	4.56
11	9.1	37.2	4.54
12	8.8	38.6	4.46
13	8.7	38.1	4.41

Site 3

Secchi Depth (m)	B.P. (mmHg)	Time	Depth (m)
3.5	752.5	19:25	10.0

Depth	Temp	DO (%)	DO (mg/L)
0.5	20.5	93.5	8.33
1	20.6	92.2	8.31
2	20.7	91.9	8.23
3	20.7	92.3	8.25
4	20.7	91.8	8.25
5	19.9	69.4	6.36
6	14.1	26.2	2.60
7	10.6	5.0	0.51
8	9.3	3.0	0.36
9	8.4	2.3	0.28

Site 4

Secchi Depth (m)	B.P. (mmHg)	Time	Depth (m)
3.5	752.5	19:55	6.8

Depth	Temp	DO (%)	DO (mg/L)
0.5	20.0	86.2	7.80
1	20.1	86.1	7.78
2	20.1	85.9	7.77
3	20.2	85.4	7.77
4	20.2	84.9	7.69
5	20.0	78.5	7.13
6	19.9	73.8	6.65

APPENDIX 2 – 2010 TO 2019 LABORATORY RESULTS FOR WATER QUALITY CHARACTERISTICS – SITE 2 (OUTLET OF LOWER BLACK STURGEON LAKE)

Parameter	2010	2015	2016	2017	2018	2019	Unit	PWQO
Alkalinity, Bicarbonate (HCO3)	21.3	16.8	26.5	21.2	20.5	24.4	mg/L	
Alkalinity, Carbonate (CO3)	<	<	<	<	<	<	mg/L	
Alkalinity, Hydroxide (OH)	<	<	<	<	<	<	mg/L	
Total Alkalinity (CaCO3)	17.5	16.8	21.7	17.4	16.8	20	mg/L	
Chloride (Cl)	<	3.76	4.16	3.86	3.83	4.35	mg/L	
Flouride (F)	0.15	0.037	0.044	0.045	0.042	0.043	mg/L	
Sulphate (SO4)	<	1.93	1.97	1.81	1.58	2.34	mg/L	
Colour, True	20	18	24.2	30.1	29	19.7	CU	
Dissolved Organic Carbon	8.7	7.5	7.78	8.14	8.84	7.73	mg/L	
Turbidity	1.2	1.1	1.31	1.34	1.28	1.81	NTU	
pH	7.3	7.44	6.78	7.11	7.44	7.3	pH units	6.5 - 8.5
Aluminum (Al)-Total	0.044	0.0513	0.0655	0.0641	0.0452	0.0489	mg/L	0.075
Antimony (Sb)-Total	<	<	<	<	<	<	mg/L	0.02
Arsenic (As)-Total	<	0.00032	0.003	0.00037	0.00036	0.00042	mg/L	0.005
Barium (Ba)-Total	0.00832	0.00845	0.00822	0.00808	0.00764	0.00821	mg/L	n/a
Beryllium (Be)-Total	<	<	<	<	<	<	mg/L	0.011
Bismuth (Bi)-Total	<	<	<	<	<	<	mg/L	n/a
Boron (B)-Total	<	<	<	<	<	<	mg/L	0.2
Cadmium (Cd)-Total	<	<	<	<	<	<	mg/L	0.0001
Calcium (Ca)-Total	5.05	5.77	5.25	5	4.85	5.01	mg/L	n/a
Cesium (Cs)-Total	<	<	<	<	<	<	mg/L	n/a
Chromium (Cr)-Total	<	<	<	<	0.00023	0.00018	mg/L	0.001
Cobalt (Co)-Total	<	<	<	<	<	<	mg/L	0.0009
Copper (Cu)-Total	0.00073	0.00087	0.00062	0.00116	0.00088	0.00078	mg/L	0.001

Parameter	2010	2015	2016	2017	2018	2019	Unit	PWQO
Iron (Fe)-Total	0.065	<	0.111	0.119	0.097	0.097	mg/L	0.3
Lead (Pb)-Total	<	0.0001	<	<	<	0.000050	mg/L	0.001
Lithium (Li)-Total	n/a	<	<	<	0.0013	0.0012	mg/L	n/a
Magnesium (Mg)-Total	1.5	1.79	1.61	1.62	1.63	1.82	mg/L	n/a
Manganese (Mn)-Total	0.00496	0.00529	0.0151	0.0127	0.00929	0.0113	mg/L	n/a
Molybdenum (Mo)-Total	<	<	<	<	0.000066	<	mg/L	0.04
Nickel (Ni)-Total	0.00048	<	<	<	0.00065	0.00057	mg/L	0.025
Phosphorus (P)-Total	<	<	<	<	<	<	mg/L	0.02
Potassium (K)-Total	0.954	1.08	0.995	1.02	0.968	0.980	mg/L	n/a
Rubidium (Rb)-Total	0.00161	0.00202	0.00193	0.00198	0.00194	0.00189	mg/L	n/a
Selenium (Se)-Total	<	<	<	<	0.000131	0.000116	mg/L	0.1
Silicon (Si)-Total	1.16	0.88	1.07	1.43	0.7	0.80	mg/L	n/a
Silver (Ag)-Total	<	<	<	<	<	<	mg/L	0.0001
Sodium (Na)-Total	2.53	3.25	3.07	3.04	3.1	3.27	mg/L	n/a
Strontium (Sr)-Total	0.0219	0.0239	0.023	0.0244	0.0234	0.0231	mg/L	n/a
Tellurium (Te)-Total	<	<	<	<	<	<	mg/L	n/a
Thallium (Tl)-Total	<	<	<	<	<	<	mg/L	0.0003
Thorium (Th)-Total	n/a	<	<	<	<	<	mg/L	n/a
Tin (Sn)-Total	<	<	<	<	<	<	mg/L	n/a
Titanium (Ti)-Total	0.00094	0.00124	0.00162	0.00136	0.00099	0.00091	mg/L	n/a
Tungsten (W)-Total	<	<	<	<	<	<	mg/L	0.03
Uranium (U)-Total	<	<	<	<	0.000089	0.000072	mg/L	0.005
Vanadium (V)-Total	<	0.0002	0.00022	0.00023	<	<	mg/L	0.006
Zinc (Zn)-Total	<	<	<	<	<	<	mg/L	0.03
Zirconium (Zr)-Total	<	<	<	<	0.000122	0.000060	mg/L	0.004
Nitrate	n/a	<	0.049	0.0623	<	0.0276	mg/L	
Nitrate + Nitrite	0.057	<	n/a	<	<	<	mg/L	
Nitrite	n/a	<	<	<	<	<	mg/L	
Total Kjeldahl Nitrogen	n/a	0.37	0.35	0.38	0.29	0.58	mg/L	

Parameter	2010	2015	2016	2017	2018	2019	Unit	PWQO
Total Nitrogen Calculated	n/a	0.37	n/a	0.38	0.29	0.58	mg/L	
Total Organic Carbon			8.14	7.84	8.11	7.57	mg/L	
Phosphorus (P)-Total	0.0157	0.014	0.012	0.018	0.0148	0.0172	mg/L	0.02
UV Transmittance			58.6	55.1	54.7	60.3	% T	
Total Dissolved Solids			52	42.6	45.3	39	mg/L	
Langelier Index 4C			-2.7	-2.5	-2.2	-2.2		
Langelier Index 60C			-1.9	-1.7	-1.4	-1.5		
Hardness Calculated	18.8		19.7	19.2	18.9	20	mg/L	
Conductivity	52.6		57.3	56.4	53.2	54.6	umhos/cm	
Bromide in Water by IC			<0.10		<	<	mg/L	

< - concentrations are below the laboratory detection limit
PWQO – Provincial Water Quality Objective