

# **BLACK STURGEON LAKES WATER QUALITY MONITORING 2017 REPORT**

Prepared by:



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## 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, and 2017, 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 2017 season, a spring session on April 30<sup>th</sup> and a late summer session on August 27<sup>th</sup>. 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.

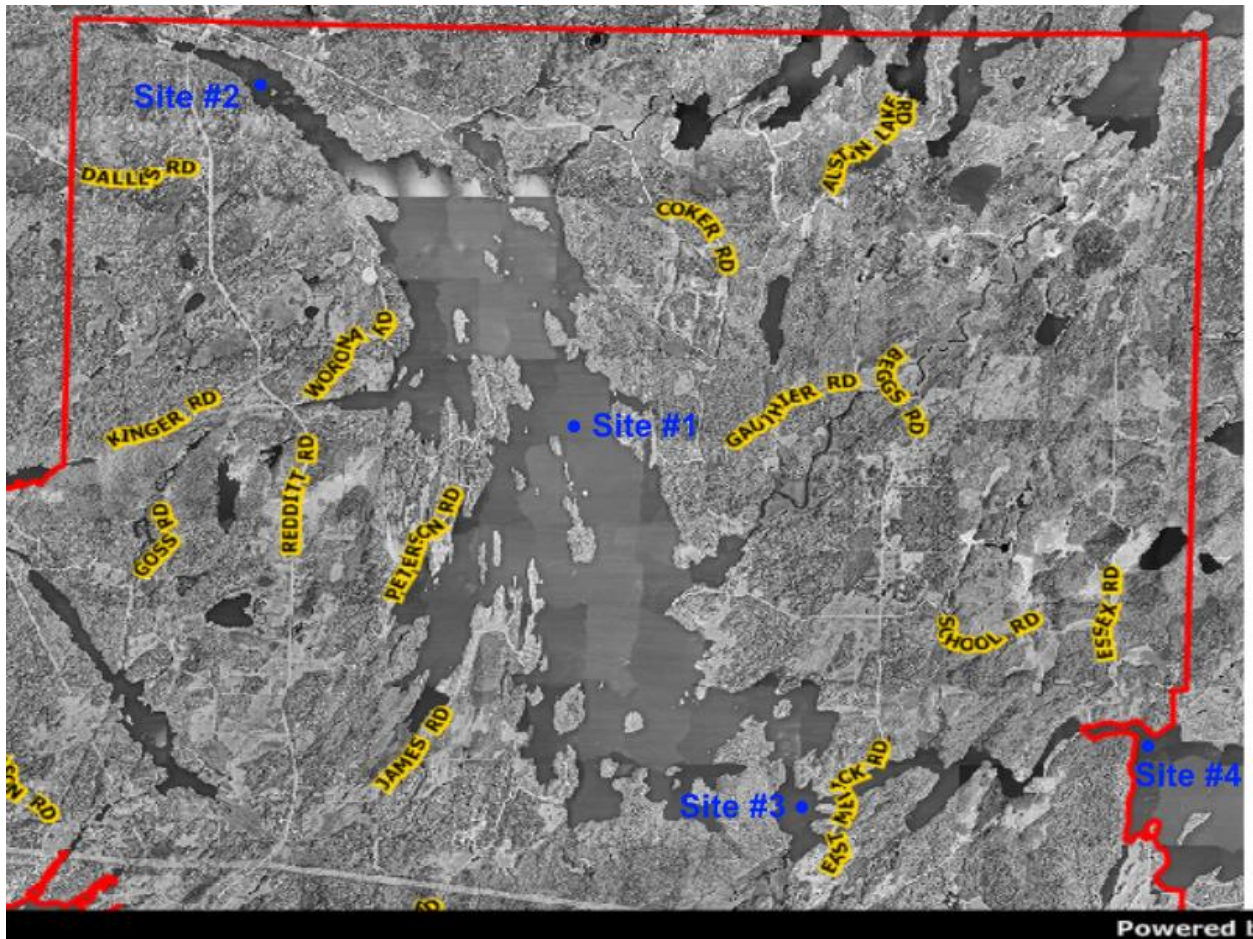


Figure 1 – Sampling Sites for Water Quality Monitoring on Black Sturgeon Lakes for 2015 sampling season

## 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 2017 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 and Climate Change (MOECC) laboratory in Dorset as part of the Lake Partner Program.

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.

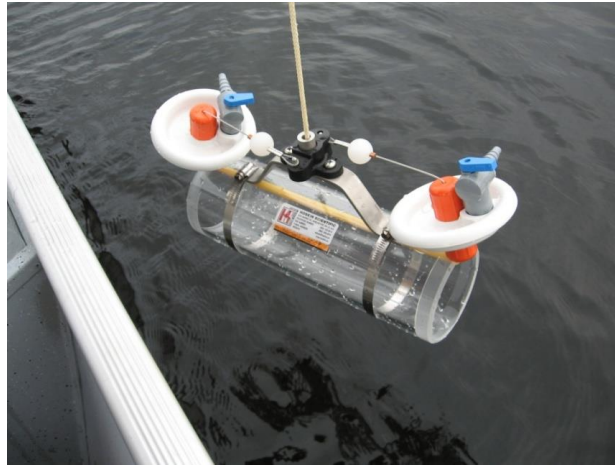


Figure 4 – Horizontal Beta Sampler prior to deployment

All water samples collected were transferred immediately upon collection to sample bottles for analysis at a laboratory. Samples were shipped via Greyhound bus to ALS Laboratory Group in Winnipeg, MB, for analysis.

## 3.0 RESULTS

### 3.1 Sampling Session Dates and Locations

The 2017 sampling sessions were conducted on April 30<sup>th</sup> and August 27<sup>th</sup>. The depth of the sampling sites was 28.8 m for Site 1, 16.9 m for Site 2, 9.8 m for Site 3, and 6.9 m for Site 4.

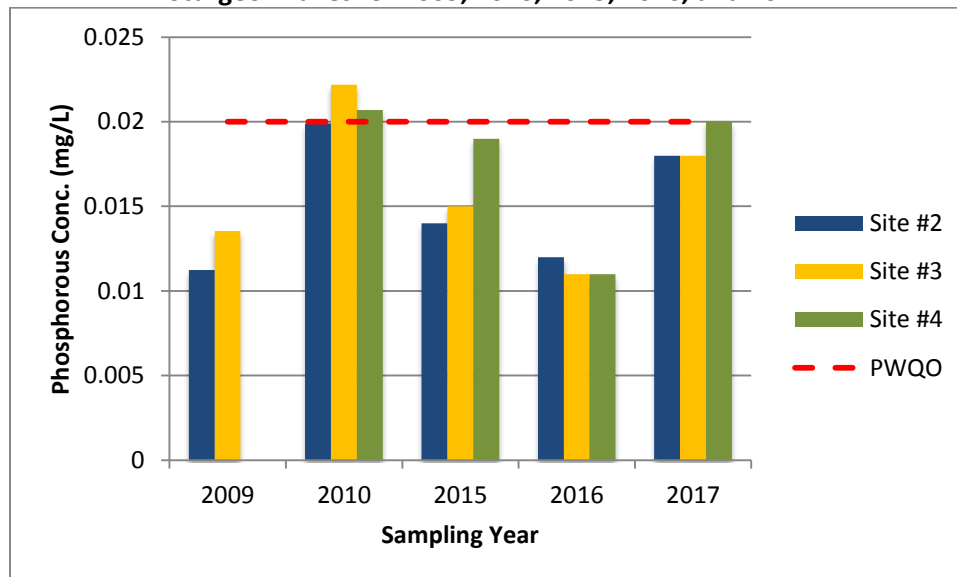
### 3.2 Total Phosphorous

The 2017 spring sampling results for phosphorous concentrations were at or below the provincial water quality objective (PWQO) of 0.0200 mg/L for all sites. During 2017, the spring turnover euphotic zone phosphorous concentrations taken at Site 2 (0.018 mg/L), Site 3 (0.018 mg/L) and Site 4 (0.020 mg/L) were all above the concentrations found in 2009, 2015, and 2016, but below the results found in 2010 (Figure 5). The phosphorous results from the samples sent in to the Dorset laboratory from site 1 in Lower Black Sturgeon Lake were 0.0128 mg/L and 0.0136 mg/L and samples from the middle of the basin of Upper Black Sturgeon Lake were 0.0128 mg/L and 0.0140 mg/L. Note that the Lake Partner



Program requires duplicate samples be sent to their laboratory as part of their volunteer sampling protocol.

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



### 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 2017 results for Site 2 were comparable to the results for the 2010, 2015, and 2016 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided, with the exception of copper (lab result of 0.00116 mg/L with a PWQO of 0.001). The full results can be found in Appendix 1.

## 4.0 DISCUSSION

### 4.1 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 2017 spring sampling results for phosphorous concentrations were at or below the provincial water quality objective (PWQO)

of 0.0200 mg/L for all five sites (Site 1, Site 2, Site 3, Site 4, and middle of the basin for Upper Black Sturgeon Lake).

During 2017, the spring turnover euphotic zone phosphorous concentrations taken at Site 2 (0.018 mg/L), Site 3 (0.018 mg/L) and Site 4 (0.020 mg/L) were all above the concentrations found in 2009, 2015, and 2016, but below the results found in 2010. These values were within the Lake Partner Program range of total phosphorous samples analyzed between 2004 and 2014 on lower Black Sturgeon Lake (0.012 to 0.022 mg/L), but are above the mean of 0.017 mg/L over this same time period (Ministry of Environment 2015a). The duplicate samples sent in to the MOECC Dorset lab from Site #1 (0.0128 mg/L and 0.0136 mg/L) and the middle of the basin of Upper Black Sturgeon Lake (0.0128 mg/L and 0.0140 mg/L) were all below the mean of the Lake Partner Program results found between 2004 and 2014. This indicates that the phosphorous concentrations on Lower Black Sturgeon Lake appear to have been relatively stable (and at or below the water quality objective) for the past decade. However, the upward trend from 2016 and 2017 should be noted and, should this trend continue in the 2018 field season, this may be cause for concern.

#### **4.2 Chemical Analysis - Water Quality Characteristics**

The 2017 Site 2 results were comparable to the results for the 2010, 2015 and 2016 analyses and were all within the provincial water quality objectives (PWQO) for the parameters where an objective is provided, with the exception of copper (lab result of 0.00116 mg/L with a PWQO of 0.001). 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 several years.

### **5.0 SUMMARY AND RECOMMENDATIONS**

Lower Black Sturgeon Lake is within the provincial water quality objectives for a healthy lake for all of the parameters measured and analyzed in this study, with the exception of copper. All 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 2017 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.

The results for copper in 2017 at site 2 (0.00116 mg/L) are higher than those found in the 2010 (0.00073 mg/L), 2015 (0.00087 mg/L) and 2016 (0.00062 mg/L). Given that the site 2 results exceed the provincial water quality objective (0.001 mg/L) by a small amount (and one that would not be found if the 2017 number was rounded), in addition to the downward trend in copper found between the 2015 and 2016 results, it is felt that this result is not a significant issue at this time. However it is felt that the upward trend from 2016 and 2017 should be noted and, if this trend continues in the 2018 field season, this may be cause for concern.

The variation shown during the 2009, 2010, 2015, 2016, and 2017 sampling seasons demonstrates the importance of collecting data annually to establish and maintain robust data sets. The summer of 2009

was characterized by relatively cool conditions and therefore the information collected during this season provides a detailed synopsis of Lower Black Sturgeon Lake water quality during a cool summer. The 2010 open water season was exceptionally long and wet which produced a data set that reflects these climatic conditions. However, the results of these varying summer patterns was that despite the fact there were no major changes to land use, the 2009 and 2010 sampling seasons produced different water quality sampling results. The 2015 sampling season produced results from a more *average* or *typical* open water season with results that were often in between the two baseline sampling seasons. The 2016 season phosphorous concentrations were lower than those found in the previous sampling seasons, potentially the result of cool, dry spring conditions and a snow pack that had seen significant melting well before ice-out on Black Sturgeon Lakes. The 2017 sampling season demonstrated not only the annual variations in results, but also the benefit of collecting additional samples from more sampling sites and taking advantage of the Lake Partner Program for a larger and more robust data set.

## 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 2017 LATE SUMMER SAMPLING SESSION**

**Site 1**

**Secchi Depth (m)                      B.P. (mmHg)                      Time                      Depth (m)**  
3.0    752.7    10:35    28.8

<b>Depth</b>	<b>Temp</b>	<b>DO (%)</b>	<b>DO (mg/L)</b>
0.5	19.5	96.2	8.83
1	19.6	95.6	8.72
2	19.6	95.0	8.70
3	19.6	94.4	8.65
4	19.6	94.0	8.62
5	19.6	93.7	8.59
6	19.6	93.6	8.58
7	19.6	93.1	8.54
8	18.2	77.3	7.26
9	15.6	53.6	5.35
10	14.4	50.5	5.18
11	13.0	50.3	5.30
12	11.7	51.7	5.62
13	10.8	51.7	5.75
14	9.6	50.2	5.72
15	9.2	49.8	5.73
16	8.7	48.7	5.67
17	8.4	48.1	5.59
18	7.9	46.3	5.50
19	7.9	46.0	5.46
20	7.8	45.6	5.42
21	7.7	44.7	5.33
22	7.6	43.9	5.25
23	7.6	42.8	5.13
24	7.5	42.2	5.06
25	7.5	41.2	4.84
26	7.3	36.5	4.37
27	7.3	34.6	4.15
28	7.3	33.3	4.01



**Site 2**

**Secchi Depth (m)**      **B.P.**  
3.0                      **(mmHg)**  
752.8                      **Time**  
12:35                      **Depth (m)**  
16.9

<b>Depth</b>	<b>Temp</b>	<b>DO (%)</b>	<b>DO (mg/L)</b>
0.5	20.1	97.3	8.77
1	20.0	96.0	8.74
2	20.0	95.8	8.71
3	20.0	95.4	8.73
4	20.0	95.0	8.65
5	19.9	93.6	8.58
6	19.9	93.6	8.50
7	19.9	93.4	8.46
8	19.4	86.3	7.90
9	14.7	54.7	5.54
10	12.4	48.8	5.21
11	11.3	46.8	5.14
12	10.1	44.4	5.00
13	9.7	41.5	4.73
14	9.4	39.7	4.54
15	9.1	35.5	4.04
16	9.1	31.4	3.60

**Site 3**

**Secchi Depth (m)**      **B.P. (mmHg)**      **Time**      **Depth (m)**  
2.25                      752.8                      11:48                      9.8

<b>Depth</b>	<b>Temp</b>	<b>DO (%)</b>	<b>DO (mg/L)</b>
0.5	19.5	93.5	8.56
1	19.4	93.3	8.59
2	19.3	92.3	8.52
3	19.3	91.8	8.47
4	19.2	91.6	8.41
5	18.9	71.1	6.54
6	16.3	11.4	1.03
7	11.5	5.2	0.57
8	9.5	3.5	0.40
9	8.3	2.6	0.30

**Site 4**

**Secchi Depth (m)**      **B.P. (mmHg)**      **Time**      **Depth (m)**  
2.75                      752.9                      11:15                      6.9

<b>Depth</b>	<b>Temp</b>	<b>DO (%)</b>	<b>DO (mg/L)</b>
0.5	20.0	97.8	8.82
1	20.1	97.4	8.80
2	20.1	96.4	8.73
3	20.1	96.2	8.72
4	20.1	95.5	8.65
5	20.0	95.0	8.62
6	20.0	94.6	8.58

**APPENDIX 2 – 2010 TO 2017 LABORATORY RESULTS FOR WATER  
QUALITY CHARACTERISTICS – SITE 2 (OUTLET OF LOWER BLACK  
STURGEON LAKE)**

<b>Parameter</b>	<b>2010</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Unit</b>	<b>PWQO</b>
Alkalinity, Bicarbonate (HCO <sub>3</sub> )	21.3	16.8	26.5	21.2	mg/L	n/a
Alkalinity, Carbonate (CO <sub>3</sub> )	<	<	<	<	mg/L	n/a
Alkalinity, Hydroxide (OH)	<	<	<	<	mg/L	n/a
Total Alkalinity (CaCO <sub>3</sub> )	17.5	16.8	21.7	17.4	mg/L	n/a
Chloride (Cl)	<	3.76	4.16	3.86	mg/L	n/a
Flouride (F)	0.15	0.037	0.044	0.045	mg/L	n/a
Sulphate (SO <sub>4</sub> )	<	1.93	1.97	1.81	mg/L	n/a
Colour, True	20	18	24.2	30.1	CU	n/a
Dissolved Organic Carbon	8.7	7.5	7.78	8.14	mg/L	n/a
Turbidity	1.2	1.1	1.31	1.34	NTU	n/a
pH	7.3	7.44	6.78	7.11	pH units	6.5 - 8.5
Aluminum (Al)-Total	0.044	0.0513	0.0655	0.0641	mg/L	0.075
Antimony (Sb)-Total	<	<	<	<	mg/L	0.02
Arsenic (As)-Total	<	0.00032	0.003	0.00037	mg/L	0.005
Barium (Ba)-Total	0.00832	0.00845	0.00822	0.00808	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	mg/L	n/a
Cesium (Cs)-Total	<	<	<	<	mg/L	n/a
Chromium (Cr)-Total	<	<	<	<	mg/L	0.001
Cobalt (Co)-Total	<	<	<	<	mg/L	0.0009
Copper (Cu)-Total	0.00073	0.00087	0.00062	0.00116	mg/L	0.001
Iron (Fe)-Total	0.065	<	0.111	0.119	mg/L	0.3
Lead (Pb)-Total	<	0.0001	<	<	mg/L	0.001
Lithium (Li)-Total	n/a	<	<	<	mg/L	n/a
Magnesium (Mg)-Total	1.5	1.79	1.61	1.62	mg/L	n/a
Manganese (Mn)-Total	0.00496	0.00529	0.0151	0.0127	mg/L	n/a
Molybdenum (Mo)-Total	<	<	<	<	mg/L	0.04
Nickel (Ni)-Total	0.00048	<	<	<	mg/L	0.025
Phosphorus (P)-Total	0.0199	0.0140	0.0120	0.0180	mg/L	0.02
Potassium (K)-Total	0.954	1.08	0.995	1.02	mg/L	n/a
Rubidium (Rb)-Total	0.00161	0.00202	0.00193	0.00198	mg/L	n/a
Selenium (Se)-Total	<	<	<	<	mg/L	0.1
Silicon (Si)-Total	1.16	0.88	1.07	1.43	mg/L	n/a

Silver (Ag)-Total	<	<	<	<	mg/L	0.0001
<b>Parameter</b>	<b>2010</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Unit</b>	<b>PWQO</b>
Sodium (Na)-Total	2.53	3.25	3.07	3.04	mg/L	n/a
Strontium (Sr)-Total	0.0219	0.0239	0.023	0.0244	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	mg/L	n/a
Tungsten (W)-Total	<	<	<	<	mg/L	0.03
Uranium (U)-Total	<	<	<	<	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	<	<	<	<	mg/L	0.004
Nitrate	n/a	<	0.049	0.0623	mg/L	n/a
Nitrate + Nitrite	0.057	<	n/a	<	mg/L	n/a
Nitrite	n/a	<	<	<	mg/L	n/a
Total Kjeldahl Nitrogen	n/a	0.37	0.35	0.38	mg/L	n/a
Total Nitrogen Calculated	n/a	0.37	n/a	0.38	mg/L	n/a