Water Quality 2015

Daniel Spitzer, April 2016

Introduction

The water quality was tested by the Water Quality Director on 5 occasions in 2015. The water clarity (Secchi Disk depth) was measured and deep-water samples were taken at sites DP1 and DP3 on June 23, July 07, August 05, September 07 and October 16. The samples were analyzed for total phosphorus (TP) concentration through the Lake Partner Program (Ontario Ministry of the Environment). Deep and shallow-water samples were also taken at several sites by the Rideau Valley Conservation Authority (RVCA) on May 19, July 07, August 19 and October 16. These were analyzed for a number of variables including TP, calcium, total nitrogen, E. coli and dissolved oxygen concentration. The laboratory results from the Lake Partner Program are summarized in Table 1 and those from the RVCA in Tables 2 and 3. Figure 1 shows the map of the Wolfe Lake with sampling sites and depth contours indicated. In Figure 2, multi-year trends of annual averages of the sampled water quality parameters are presented. Figure 3 displays correlations among the water quality parameters. Application of satellite remote sensing is discussed and demonstrated in Figure 4.

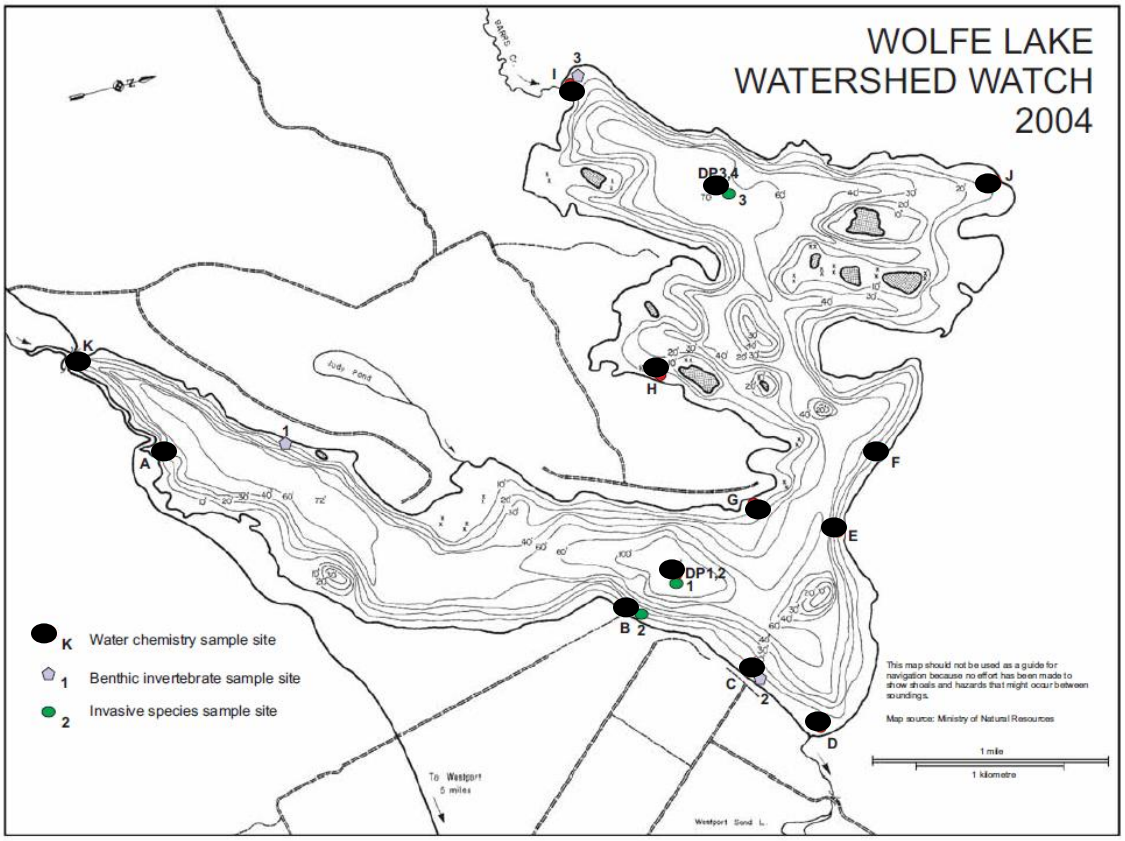


Figure 1. Water Testing in Wolfe Lake

Results

Table 1: TP Concentration, µg/L (Lake Partner Program Data)

DATE	SITE			
	DP1		DP3	
	Sample #1	Sample #2	Sample #1	Sample #2
23-Jun-15	8.8	8.6	9.2	9.0
07-Jul-15	9.8	9.4	10.8	12.0
05-Aug-15	9.8	10.2	11.0	10.4
07-Sep-15	10.2	10.2	12.4	12.2
16-Oct-15	10.6	10.6	10.0	10.8

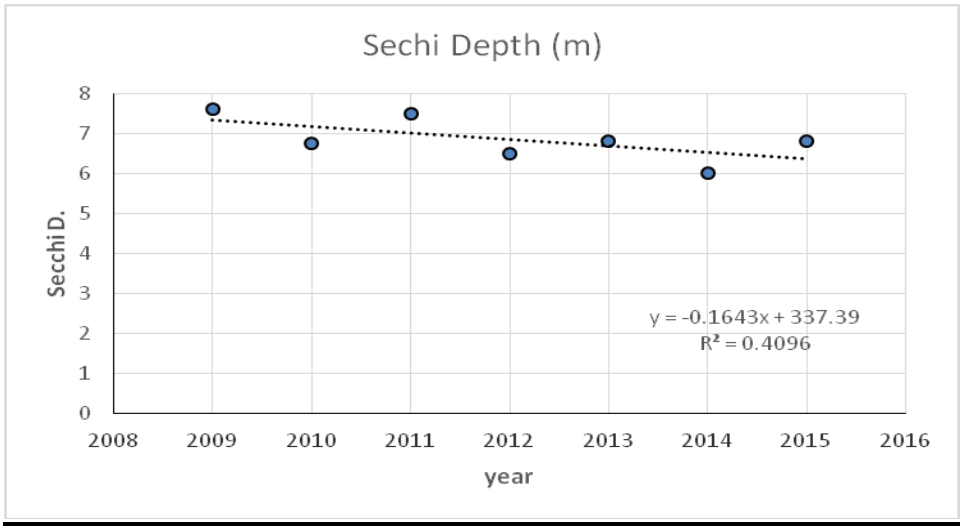
Table 2: Field Data Rideau Valley Conservation Authority

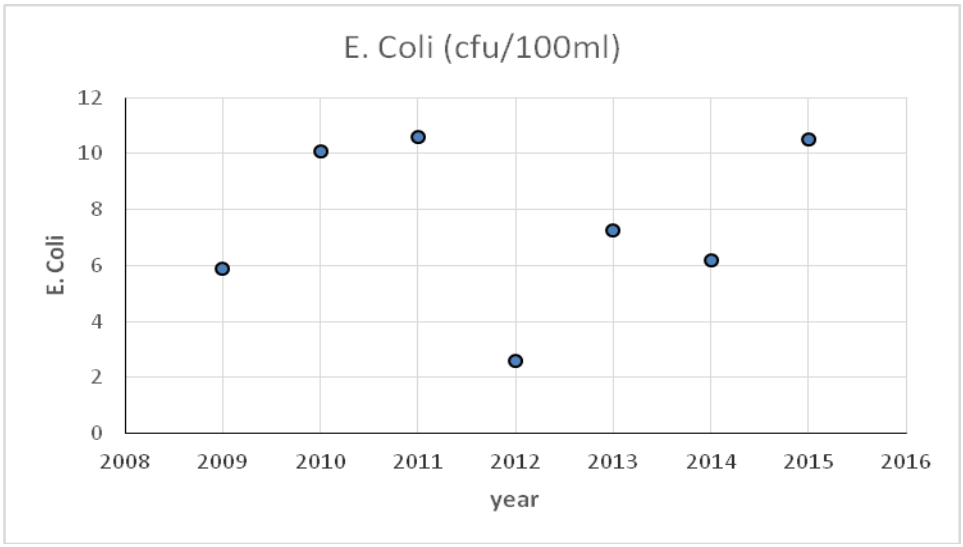
SITE	DATE	TIME	WEATHER	WATER TEMP.	SECCHI DEPTH	pH	Dissolved Organics
	dd/mm/yy	24:00 hour	Wind	(deg C)	(m)		(mg/L)
DP1	19-May-15	11:48	windy	17.43	8.1	8.26	10.75
DP1	7-Jul-15	11:56		25.4	7	8.34	10.25
DP1	19-Aug-15	11:58	moderate winds	25.7	5.94	8.61	9.34
DP1	16-Oct-15	11:46	light winds	14.36	5	7.84	10.01
DP3	19-May-15	11:04	windy	17.65	9.33	8.33	10.83
DP3	7-Jul-15	10:09	windy	23.12	6.72	7.96	10.23
DP3	19-Aug-15	10:19	light winds	25.82	6.9	8.5	9.47
DP3	16-Oct-15	10:33	light winds	14.23	5.25	7.78	9.7
I	07-Jul-15	11:23		24.63		7.71	8.8
I	19-Aug-15	11:17		25.94		8.78	10.46
J	07-Jul-15	11:30		25.1		8.44	11.36
J	19-Aug-15	11:33		26.27		8.43	8.72
D	07-Jul-15	13:10		24.92		8.47	11.92
D	19-Aug-15	11:51		26.03		8.55	9.45
K	07-Jul-15	13:42		21.79			10.66
K	19-Aug-15	13:34		25.11			10.35

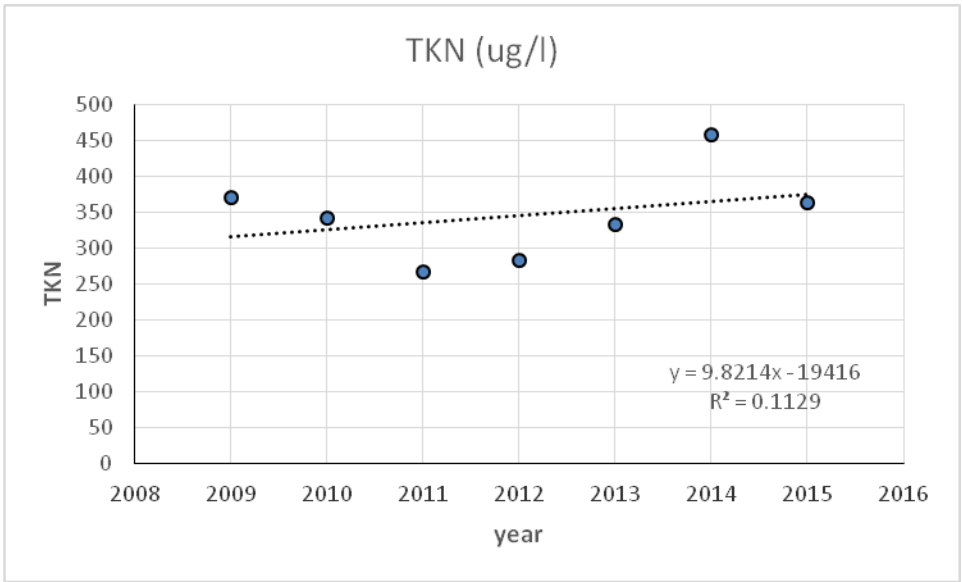
Table 3: Sample Analyses Rideau Valley Conservation Authority

SITE	DATE	E.COLI (cfu/100 mL)	TOTAL KJELDAHL Nitrogen (µg/L)	TOTAL Phosphorus (µg/L)
DP3	19-May-15		340	6
DP1	19-May-15		340	7
DP1	16-Oct-15		370	11
DP3	16-Oct-15		460	10
DP1	19-Aug-15		320	5
DP3	19-Aug-15		300	4
I	19-Aug-15	2	370	7
J	19-Aug-15	2	370	5
D	19-Aug-15	4	360	4
K	19-Aug-15	2	400	6
I	07-Jul-15	62	540	25
DP3	07-Jul-15		350	8
J	07-Jul-15	8	350	10
DP1	07-Jul-15		280	5
K	07-Jul-15	2	330	8
D	07-Jul-15	2	330	7

Trends


Sechi Depth (m)
Secchi D.
year
y = -0.1643x + 337.39
R² = 0.4096


E. Coli (cfu/100ml)
E. Coli
year


TKN (ug/l)
TKN
year
y = 9.8214x - 19416
R² = 0.1129

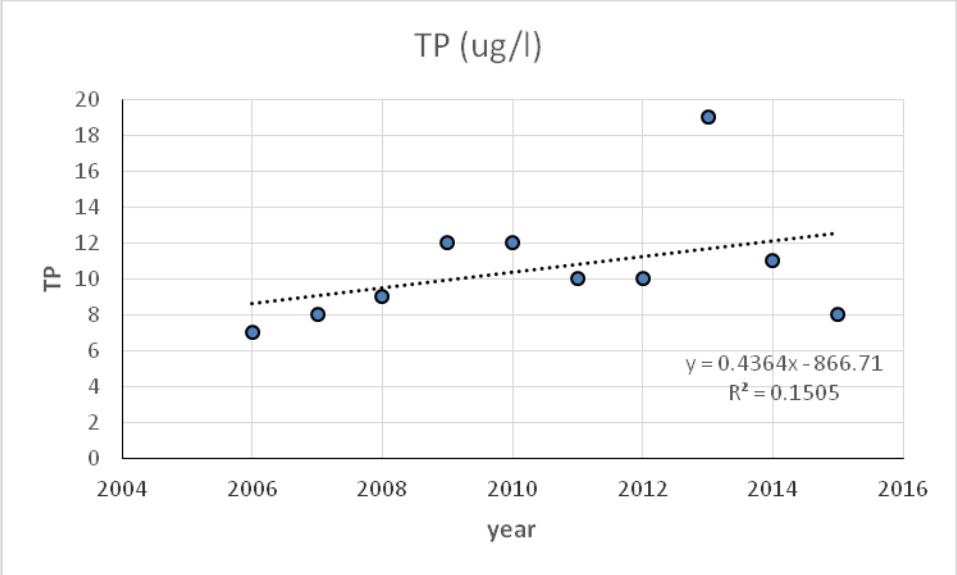
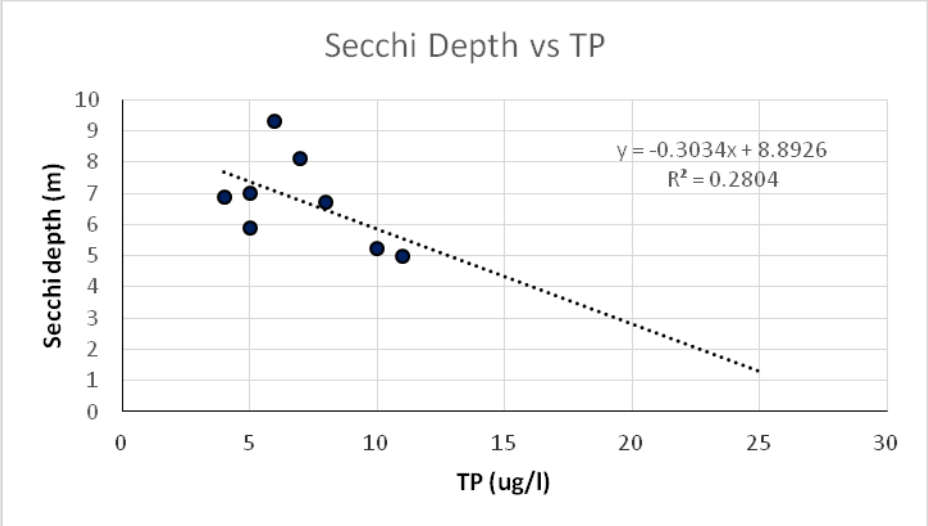


Figure 2: Annual averages of water quality parameters

Correlations

The measured TKN (Total Kjeldahl Nitrogen) and TP (Total Phosphorus) concentration values appear to be well correlated. This is not surprising since the both nutrients may have the same discharge origins. The Secchi Disc Depth values are correlated to the both nutrient concentrations, as indicated in the graphs below.



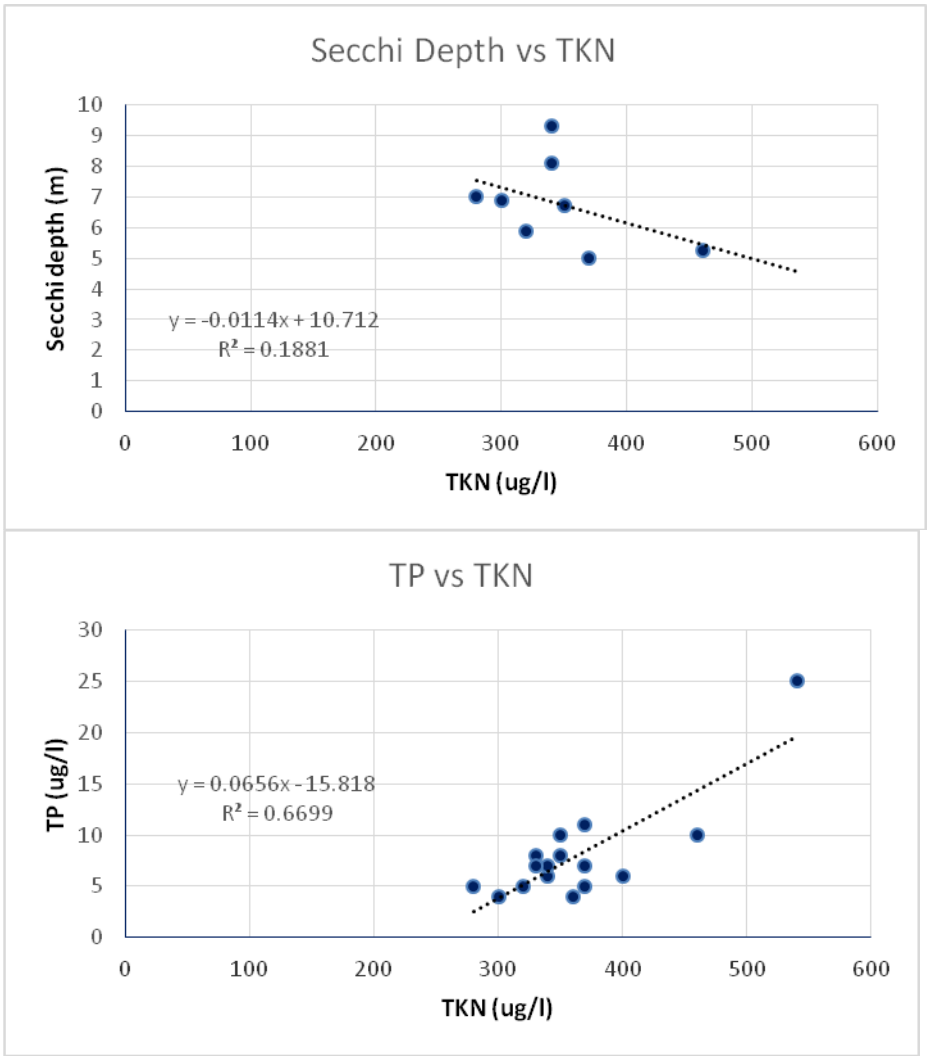


Figure 3: Correlations among the water quality parameters

Analysis

Overall results were very comparable to the period on record. Total Phosphorus (TP) concentrations were all below the Provincial Water Quality Objective (PWQO) of 20 micrograms/litre (µg/l) at all monitored sites. Higher readings of nutrients were observed in July at the most western bay of the Lake (site I). These elevated values are probably due to the presence of cattle in the shore area close to the sampling site. E. Coli values were well below the PWQO of 100 colony forming units/100 milliliters (CFU/100ml) at all monitored sites.

Water clarity, as expressed by the annual average Secchi Disk depth, seems to have decreased in the past few years. This goes along with the increase of the annual averages of the nutrient concentrations (TP and TKN). A probable cause for the decrease in water clarity over the past few years may be the rapid decline in zebra mussel numbers which has occurred over that time. Before zebra mussels first appeared in our lake in 2006, there was always a good inverse correlation between Secchi disc readings and TP concentrations. With the sudden increase in zebra mussel after that year, however, there was also a sudden increase in water clarity because of their increased filtration of plankton. As a result it was felt that the Secchi disc readings could be misleading and we stopped including them in the water quality report. Although there is still a large population of zebra mussels in our lake, their numbers have greatly declined over the past few years. Another possible cause of this trend may be the gradual nutrification of our Lake and the associated algal growth. Not yet an alarming situation, but it may need attention during the upcoming sampling seasons, in particular in relation to the possible sources of nutrient discharges.

Satellite Observations

Processed spectral satellite imagery of water bodies can reveal patterns in suspended particulate matter (mainly algae and sediment). Also, after complex analyses of the satellite data in combination with surveys, information can be obtained regarding the Eurasian Milfoil growth. We intend to put more effort in analyzing the satellite remote sensing imagery in combination with water sampling and milfoil survey data.

An example of a pre-processed satellite image is shown below, regarding the suspended particulate matter distribution for a specific date in 2015. The concentration levels are indicated by means of a relative “gray” scale.

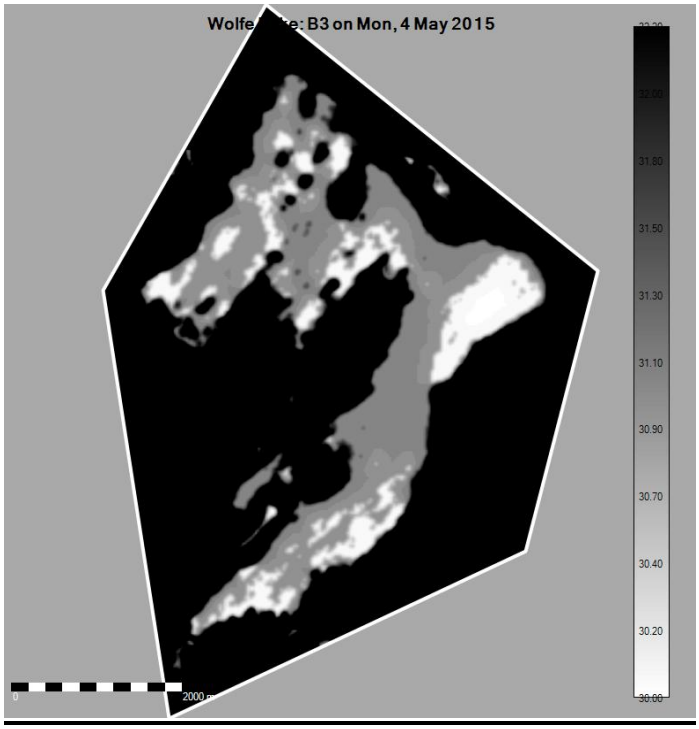


Figure 4: Satellite image of particulate matter distribution on 04 May 2015 across the Wolfe Lake

In Figure 4, light shades of the patterns indicate areas of elevated concentration levels of the suspended particulate matter, possibly of algae and/or pollen origins. Westerly wind blew the patches of the particulates to the eastern shores.

Acknowledgments

For writing the Water Quality report 2015, the Water Quality report 2014 was used as a background document. The RVCA water quality data were kindly provided by Kaitlin Brady. The LPP data were downloaded from the Ontario Lake Partner website of the Ontario Ministry of the Environment and Climate Change https://www.ontario.ca/data/ontario-lake-partner. Additional information was communicated by Anna DeSellas. The Level 2 satellite imagery was downloaded from the US Geological Survey website. Final comments to the report were kindly provided by Duncan MacDougall.