2017 Water Quality Report
and
Historical Analysis

Long Lake
Mickey Lake
Ruth Lake

Monitoring Years 1993-2017

Submitted to:

Long Lake Association

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Prepared by:

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Section I

Figure 1. Water quality sampling sites on Long Lake, 1997-2017

Table 1. Trophic State Classification (Chapra, 1997)

Variable	**Oligotrophic**	**Mesotrophic**	**Eutrophic**
Total Phosphorus (µg/L)	<10	10-20	>20
Chlorophyll a (µg/L)	<4	4-10	>10
Secchi depth (ft)	>13	6.6-13	>6.6

Table 4. Phosphorus Data for Area Lakes and Sediments

Lake	Water Total Phosphorus (µg/L)	Sediment Phosphorus (mg TP/kg DW)
Torch	1.7	86
Burt	2.2	119
Lime	4.4	200
Crystal	4.8	332
North Leelanau	4.8	489
South Leelanau	4.9	398
Glen	5.1	326
Little Traverse	5.1	401
Cedar	5.3	396
Platte	7.7	620
Mickey Site 1	11.5 (top) 19.1 (bottom)	1625
Mickey Site 2	7.6 (top) 7.3 (bottom)	87

Section I
2017 Long Lake, Mickey Lake, and Page Lake Water Quality Assessment

The 2017 Long Lake, Mickey Lake, and Page Lake monitoring was initiated by the Long Lake Association in partnership with Great Lakes Environmental Center (GLEC) and Great Lakes Water Studies Institute. The point of this monitoring was to continue assessing the lake water quality and compare it to the collection of older data. By looking at emerging trends in water quality, concerns can be addressed and appropriate action plans created.

The 2017 season's monitoring of Long, Mickey and Ruth Lake's water quality data was collected using the following equipment: 1) Water quality and measurement of water chemistry by using a YSI multiparameter water quality probe (supplied by GLEC), as well as collecting water samples for analysis of total phosphorus at the surface and near bottom, and a single calcium sample at each sampling site; 2) levels of Chlorophyll a at each sampling site (an indirect indicator of algae in the water column); and 3) measurement for secchi disk depth at each of the sampling points.

Long Lake Water Chemistry Data
June 9, 2017

Chlorophyll a (µg/L)

Site 1	Site 2	Site 3
.86	.92	1.25

Total Phosphorus (µg/L)

Sample Location	Site 1	Site 2	Site 3
Near Surface	4.2	2.6	2.5
Near Bottom	4.6	0.30	3.5
	---	4.2	---

Calcium (mg/L)

Site 1	Site 2	Site 3
21.6	20.8	20.2

Long Lake Water Chemistry Data
August 9, 2017

Chlorophyll a (µg/L)

Site 1	Site 2	Site 3
1.57	1.44	1.18
1.50	---	---

Total Phosphorus (µg/L)

Sample Location	Site 1	Site 2	Site 3
Near Surface	6.1	4.9	3.4
Near Bottom	22.3	14.8	10.0

Calcium (mg/L)

Site 1	Site 2	Site 3
24.6	24.4	24.6

Mickey Lake Water Chemistry Data
June 9, 2017

Chlorophyll a (µg/L)

Site 1	Site 2
2.84	3.10
---	2.97

Total Phosphorus (µg/L)

Sample Location	Site 1	Site 2
Near Surface	8.6	8.9
	8.7	---
Near Bottom	28.1*	9.6

* Possible contamination from bottom sediment

Calcium (mg/L)

Site 1	Site 2
20.6	21.9

Mickey Lake Water Chemistry Data
August 9, 2017

Chlorophyll a(µg/L)

Site 1	Site 2
2.35	2.22

Total Phosphorus (µg/L)

Sample Location	Site 1	Site 2
Near Surface	7.1	8.2
Near Bottom	13.5	6.5

Calcium (mg/L)

Site 1
21.0

Ruth Lake Water Chemistry Data
June 9, 2017

Chlorophyll a (µg/L)

Site 1
6.14
6.27

Total Phosphorus (µg/L)

Sample Location	Site 1
Near Surface	17.8

* Possible contamination from bottom sediment

Calcium (mg/L)

Site 1
20.0

Ruth Lake Chemistry Data
August 9, 2017

Chlorophyll a (µg/L)

Site 1
5.17

Total Phosphorus (µg/L)

Location	Site 1
Near Surface	13.7

Calcium (mg/L)

Site 1
12.2

Physical Data 2017

Long Lake Site #1 May 25th 2017

Air temperature: 52℉	Weather: overcast	Average Secchi Depth: 10.1 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	14.3	10.4	8.08	260.9
3	14.3	10.4	8.07	260.8
6	14.2	10.39	8.06	260.8
9	14.1	10.36	8.04	261.1
12	13.9	10.23	7.99	261.3
14	13.8	9.9	7.94	261.4

Long Lake Site #1 August 9th 2017

Air temperature: 73℉	Weather: Sunny	Average Secchi Depth: 5.95 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	23	8.62	8.26	159.2
3	23	8.6	8.28	159.1
6	23	8.57	8.25	159.2
9	22.8	8.18	8.14	159.4
12	22.6	7.47	7.94	160
15	16.4	0.06	7.13	184.9

Long Lake Site #2 May 25th 2017

Air temperature: 54°F	Weather: overcast	Average Secchi Depth: 9.8 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	15.2	10.38	8.09	260.9
3	14.5	10.41	8.09	260.9
6	14.4	10.42	8.09	260.9
9	14.3	10.41	8.08	261.0
12	14.2	10.38	8.05	261.9
15	12.4	10.57	7.96	261.0
18	12.1	10.52	7.88	261.4
21	11.5	10.32	7.80	261.2
~25	11.4	10.11	7.76	261.9

Long Lake Site #2 August 9th 2017

Air temperature: 76°F	Weather: partly sunny	Average Secchi Depth: 6.1 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	23.2	8.65	8.35	159.1
3	23.1	8.64	8.31	159.1
6	23	8.63	8.3	159.0
9	22.8	8.37	8.21	159.2
12	17.4	1.79	7.39	163.8
15	14.6	0.13	7.12	167.9
18	14.2	0.06	7.04	168.9
21	13.9	0.03	7.01	170.6

Long Lake Site #3 May 25th 2017

Air temperature: 54°F	Weather: light rain	Average Secchi Depth: 10.3 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	14.6	10.46	8.12	260.7
3	14.6	10.48	8.12	260.7
6	14.5	10.46	8.11	261.4
9	14.1	10.48	8.08	261.2
12	13.6	10.48	8.03	261.4
15	12.2	10.55	7.89	261.3
18	11.4	8.78	7.57	262.5

Long Lake Site #3 August 9th 2017

Air temperature: 78°F	Weather: sunny	Average Secchi Depth: 5.75 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	23.2	8.63	8.36	159.1
3	22.9	8.64	8.32	159.0
6	22.8	8.63	8.32	158.9
9	22.8	8.43	8.29	159.2
12	16.7	0.71	7.40	164.2
15	14.7	0.09	7.15	167.1

Mickey Lake Site #1 May 25th 2017

Air temperature: 57°F	Weather: overcast	Average Secchi Depth: 4.1 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	16.6	10.46	8.40	246.1
3	16.4	10.5	8.42	247.7
6	12.3	11.95	8.40	244.7
8	9.7	5.75	7.18	250.1

Mickey Lake Site #1 August 9th 2017

Air temperature: 78°F	Weather: sunny	Average Secchi Depth: 3.85 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	24.1	9.44	8.80	142.7
3	23.4	9.16	8.72	143.1
6	21.1	7.99	7.90	146.7
8	14.7	0.72	7.35	160.2

Mickey Lake Site #2 May 25th 2017

Air temperature: 57°F	Weather: light rain	Average Secchi Depth: 4.4 m.

Depth (m.)	Temperature(°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	16.6	10.53	8.47	246.0
3	16.2	10.45	8.40	247.8
~4	15.7	9.85	8.24	248.5

Mickey Lake Site #2 August 9th 2017

Air temperature: 78°F	Weather: sunny	Average Secchi Depth: 4.45 m.

Depth (m.)	Temperature(°C)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	24	9.53	8.74	143.0
3	23.5	9.42	8.76	142.7

Ruth Lake Site #1 May 25th 2017

Air temperature: 52°F	Weather: light rain	Average Secchi Depth: 1.1 m.

Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	16.5	9.08	7.40	121.0

Ruth Lake Site #1 August 9th 2017

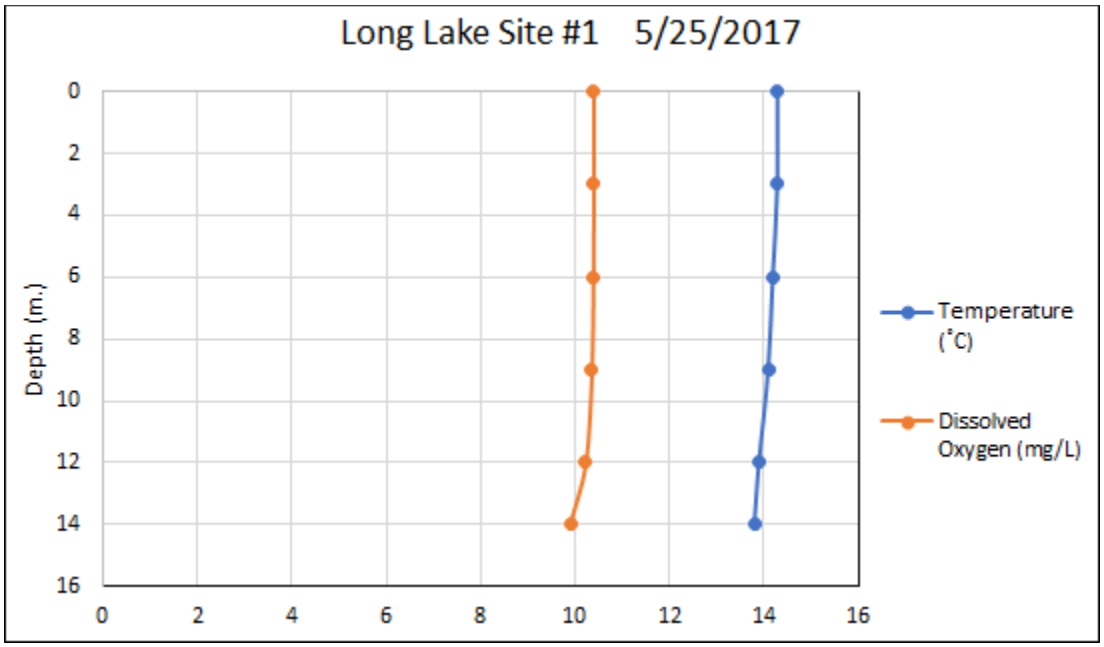
Air temperature: 80°F	Weather: sunny	Average Secchi Depth: 0.75 m.

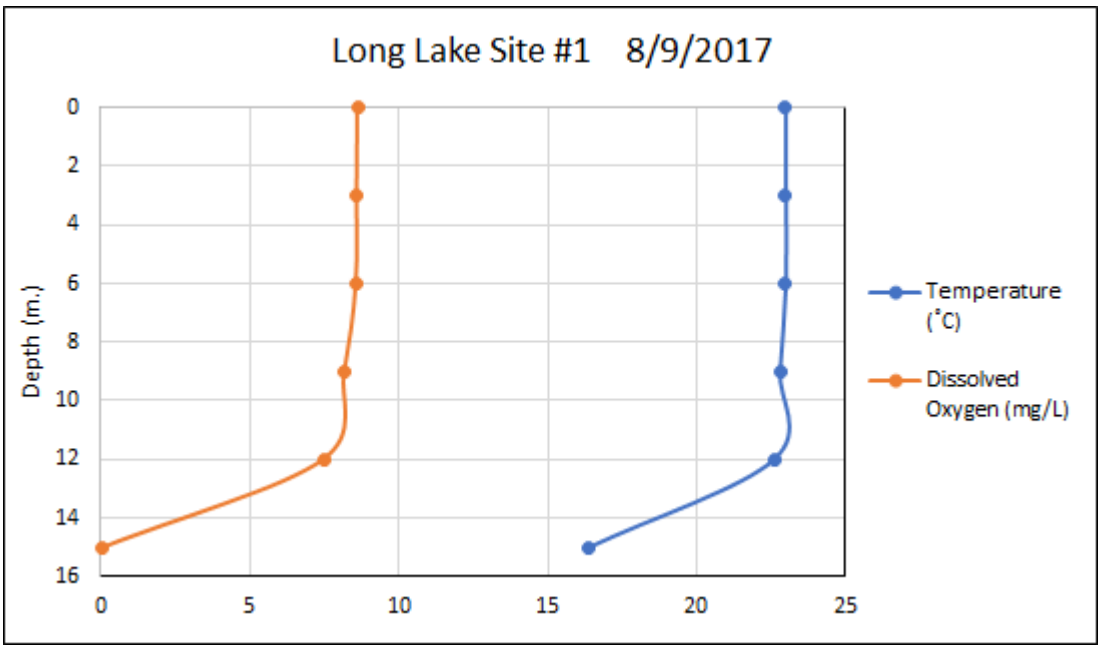
Depth (m.)	Temperature(℃)	Dissolved Oxygen (mg/L)	pH	Conductivity (µS/m)
Surface	24.1	8.49	7.41	74.7
3	18.4	0.14	6.74	84.5

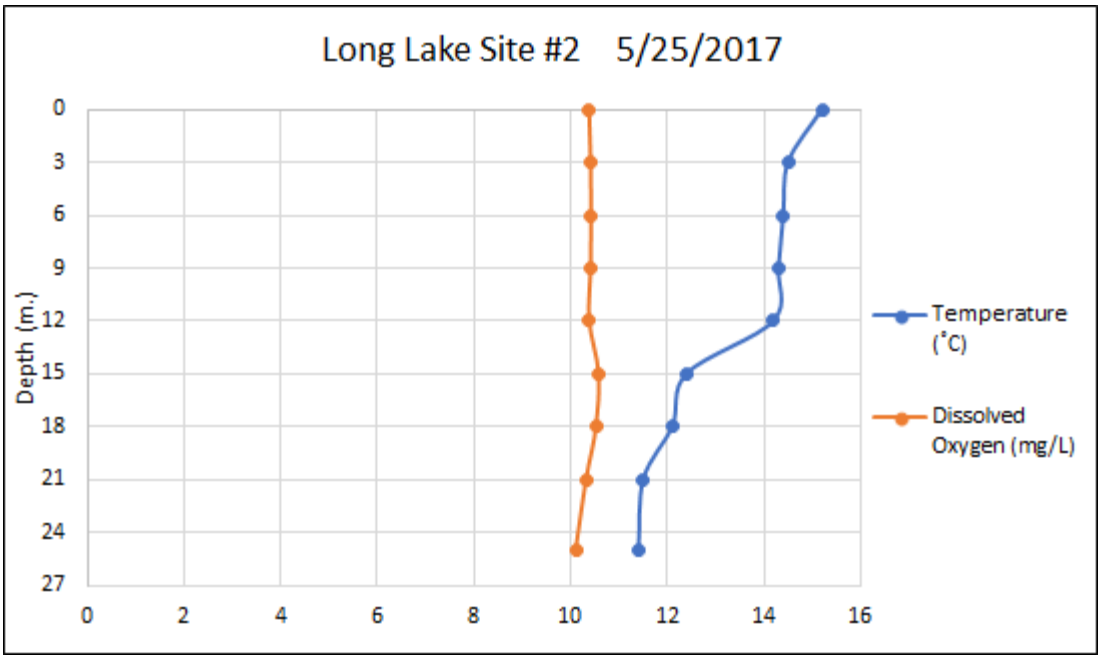
Conclusion

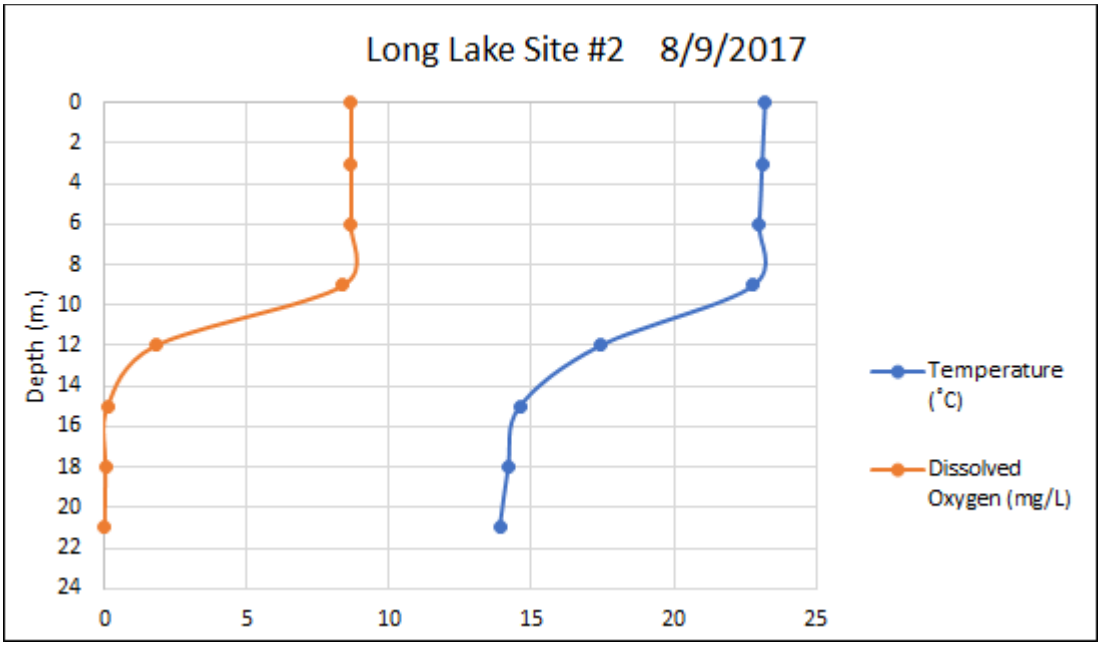
The data from this year's sampling season indicate that Long Lake would continue to be considered an oligotrophic, high quality lake based on total phosphorus in the water, chlorophyll a and secchi disk readings. This oligotrophic classification has been maintained for the past 20 years, since formal documentation of the lake first began.

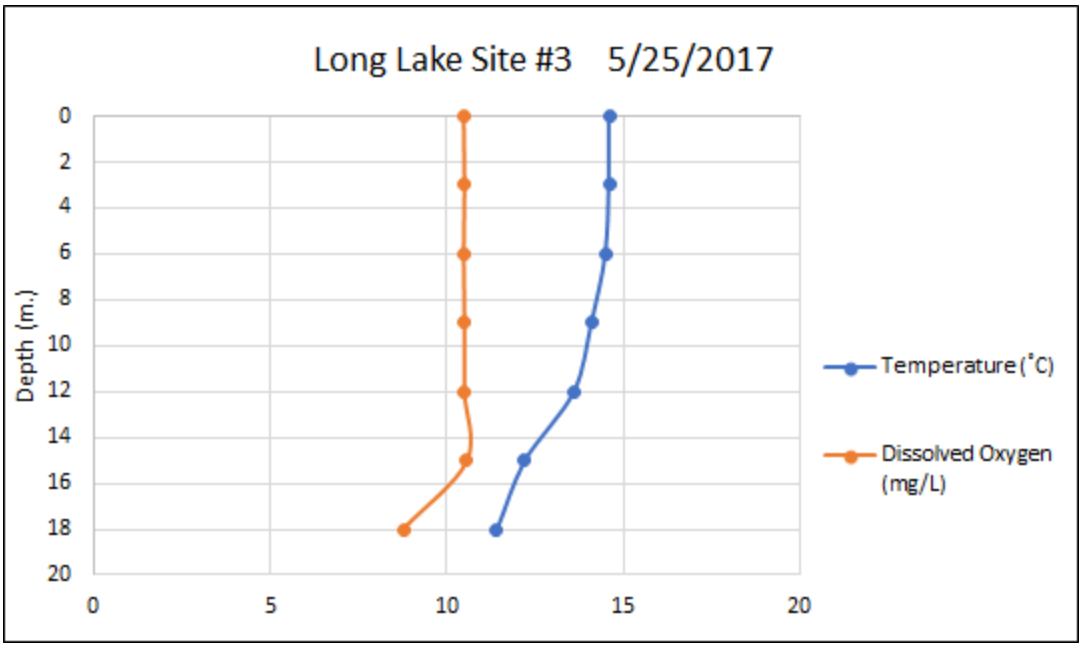
Dissolved Oxygen/Temperature Depth Profiles 2017

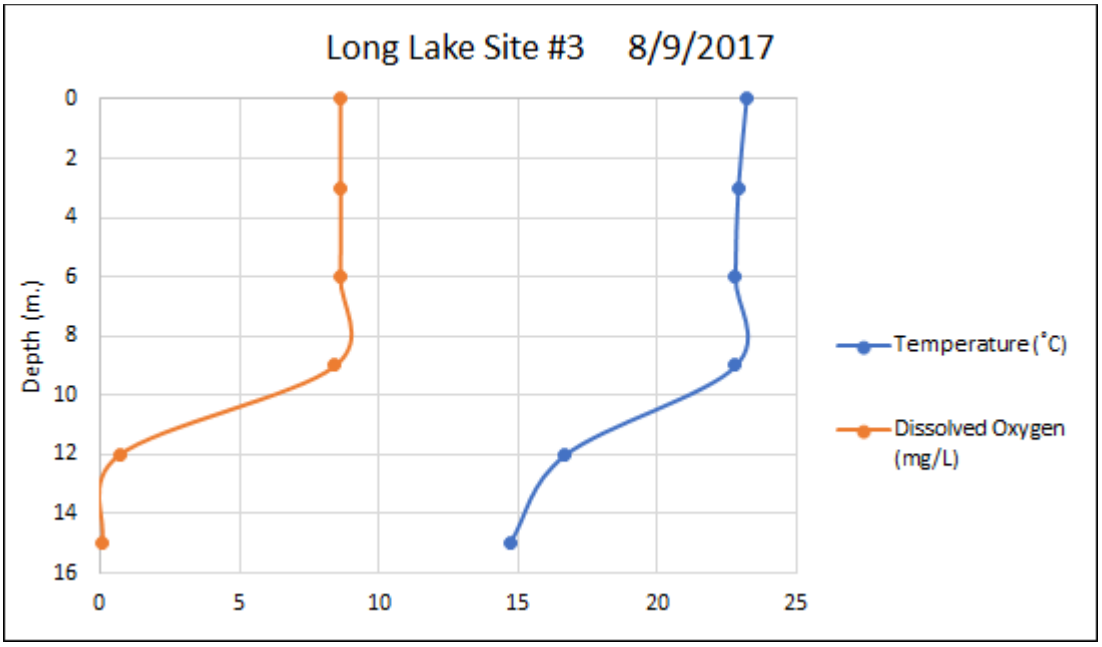


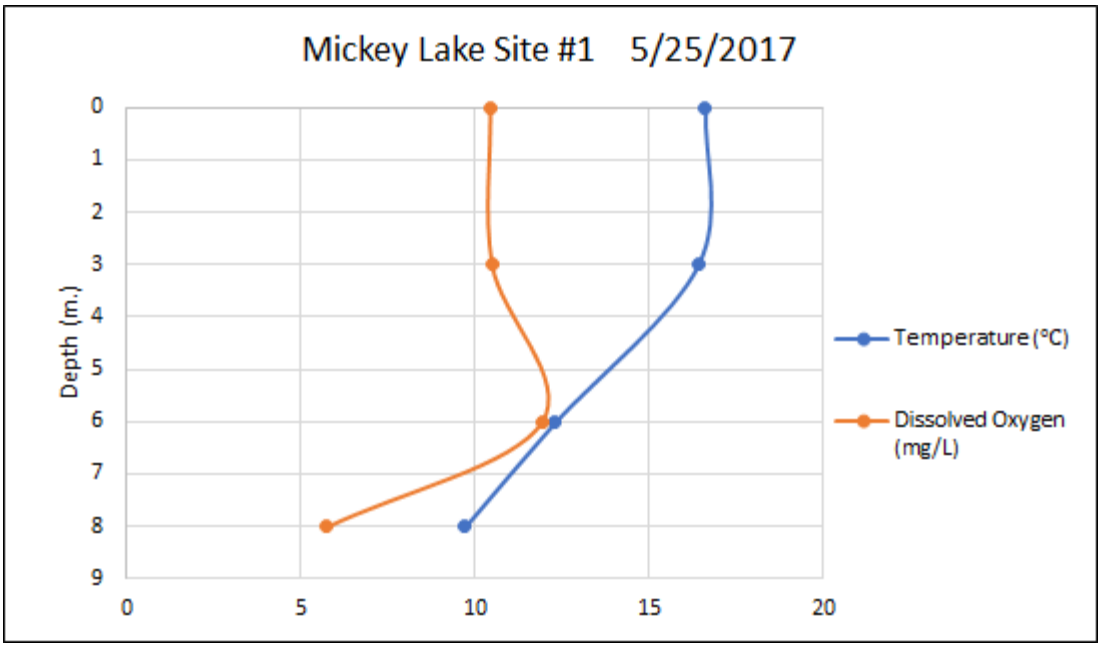


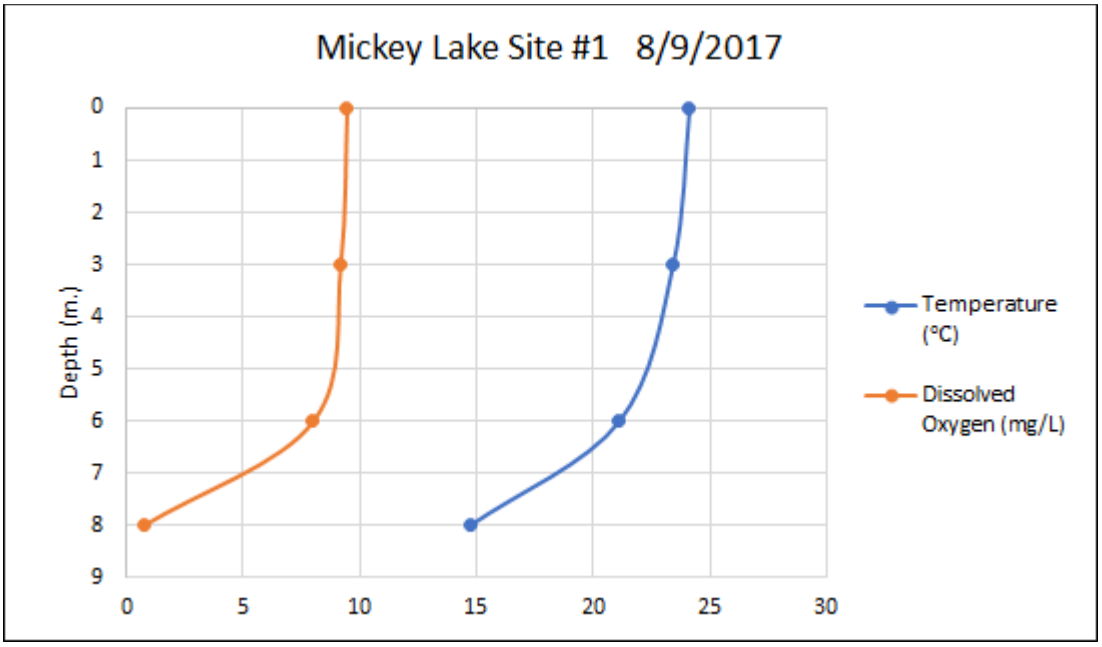

Long Lake Site #2 5/25/2017
Depth (m.)
0
3
6
9
12
15
18
21
24
27
0
2
4
6
8
10
12
14
16
Temperature (˚C)
Dissolved Oxygen (mg/L)

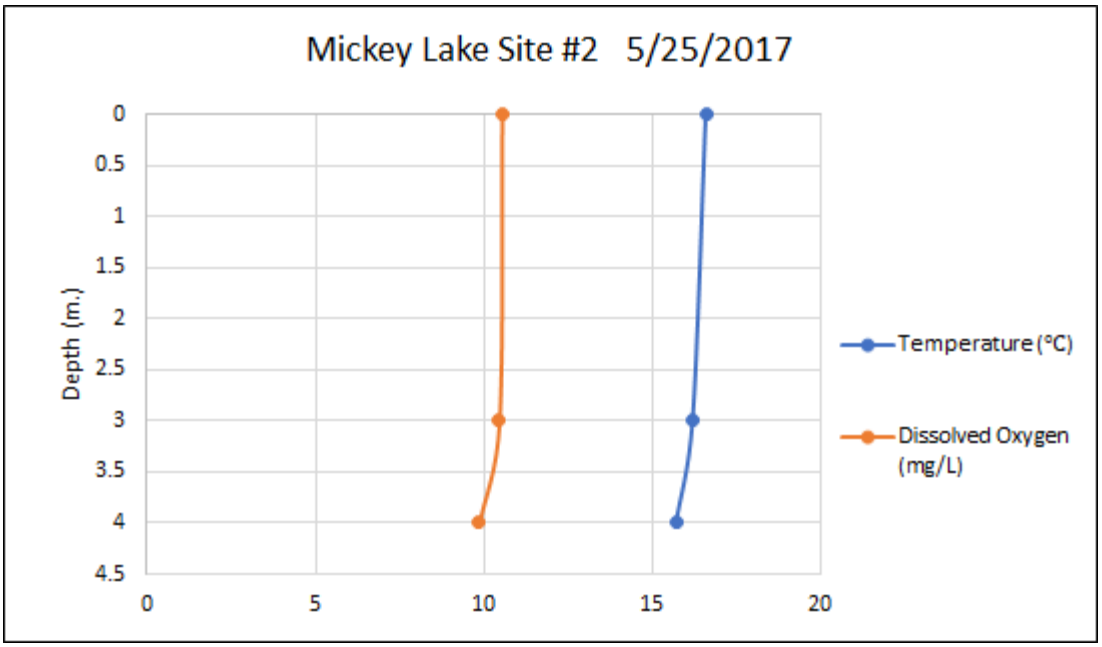

Long Lake Site #2 8/9/2017
Depth (m.)
0
2
4
6
8
10
12
14
16
18
20
22
24
0
5
10
15
20
25
Temperature (˚C)
Dissolved Oxygen (mg/L)

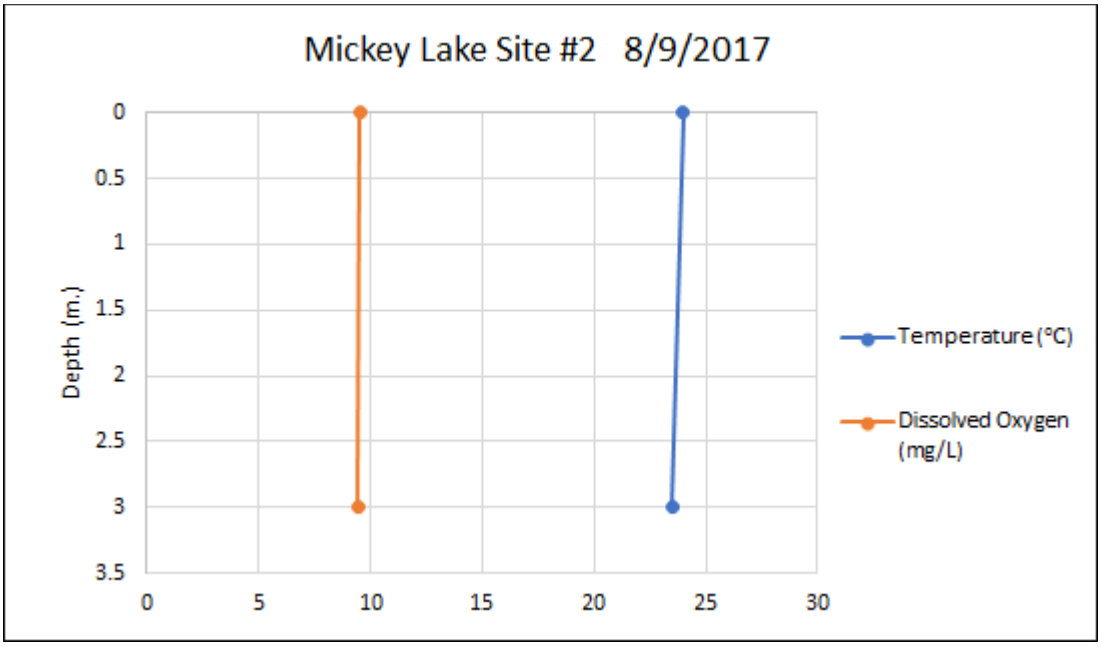

Long Lake Site #3 5/25/2017
Depth (m.)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
Temperature (˚C)
Dissolved Oxygen (mg/L)

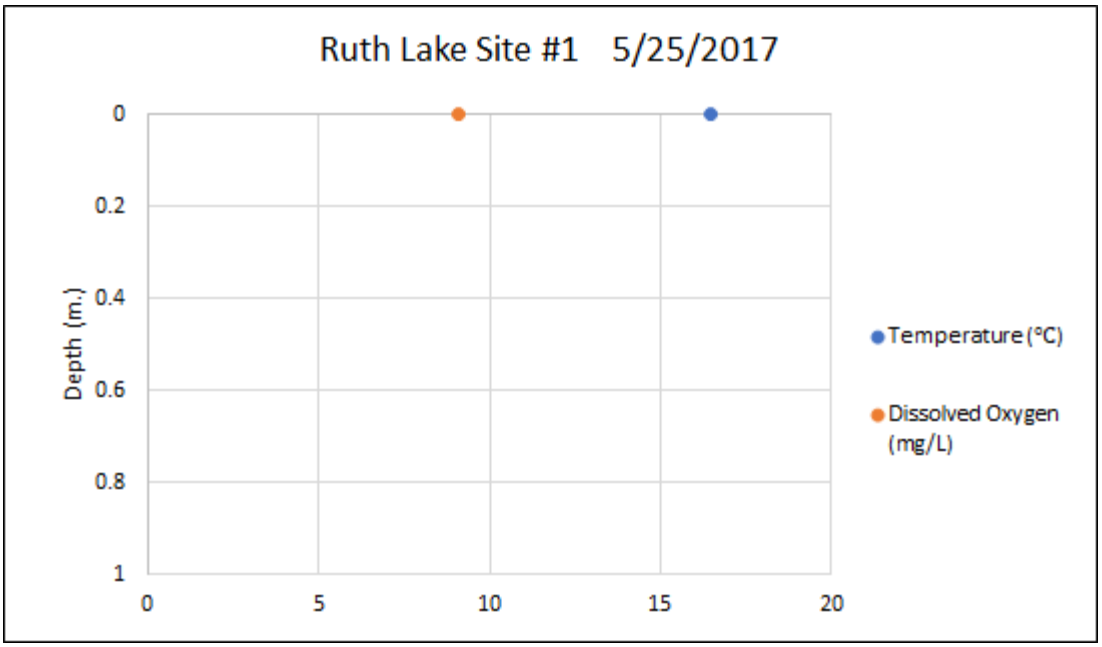

Long Lake Site #3 8/9/2017
Depth (m.)
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25
Temperature (˚C)
Dissolved Oxygen (mg/L)

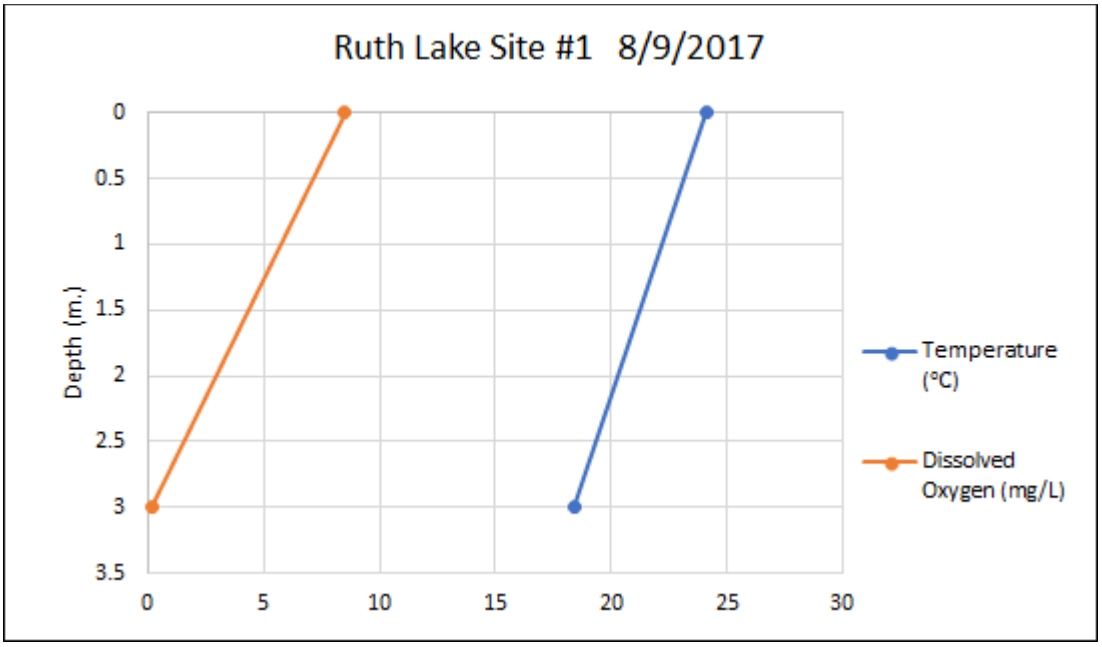

Mickey Lake Site #1 5/25/2017
Depth (m.)
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
Temperature (°C)
Dissolved Oxygen (mg/L)


Mickey Lake Site #1 8/9/2017
Depth (m.)
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
Temperature (°C)
Dissolved Oxygen (mg/L)


Mickey Lake Site #2 5/25/2017
Depth (m.)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
5
10
15
20
Temperature (°C)
Dissolved Oxygen (mg/L)


Mickey Lake Site #2 8/9/2017
Depth (m.)
0
0.5
1
1.5
2
2.5
3
3.5
0
5
10
15
20
25
30
Temperature (°C)
Dissolved Oxygen (mg/L)


Ruth Lake Site #1 5/25/2017
Depth (m.)
0
0.2
0.4
0.6
0.8
1
0
5
10
15
20
Temperature (°C)
Dissolved Oxygen (mg/L)


Ruth Lake Site #1 8/9/2017
Depth (m.)
0
0.5
1
1.5
2
2.5
3
3.5
0
5
10
15
20
25
30
Temperature (°C)
Dissolved Oxygen (mg/L)

Section II
Historic Data Trends

Historical data trends for Mickey Lake, Ruth Lake, and Long Lake were established by processing yearly data reports from 1993-2017 which were submitted by GLEC, Dr. Fusilier, and raw data collected by the Northwestern Michigan College interns in 2017. The intention is to create a long term picture of the lakes over time. This allows damaging trends in water quality to be identified and corrected, while also maintaining the healthy parameters already established.

Parameters include seasonal total water Phosphorus, sediment Phosphorus, seasonal Chlorophyll a, seasonal secchi depth readings, total Nitrate Nitrogen, and Calcium. Dissolved Oxygen and temperature profiles are not included in this report and it is recommended that this historical data should be included in future reports. There is also historical pH, alkalinity, conductivity, and lake water quality index data that can also be added to this report at a later time.

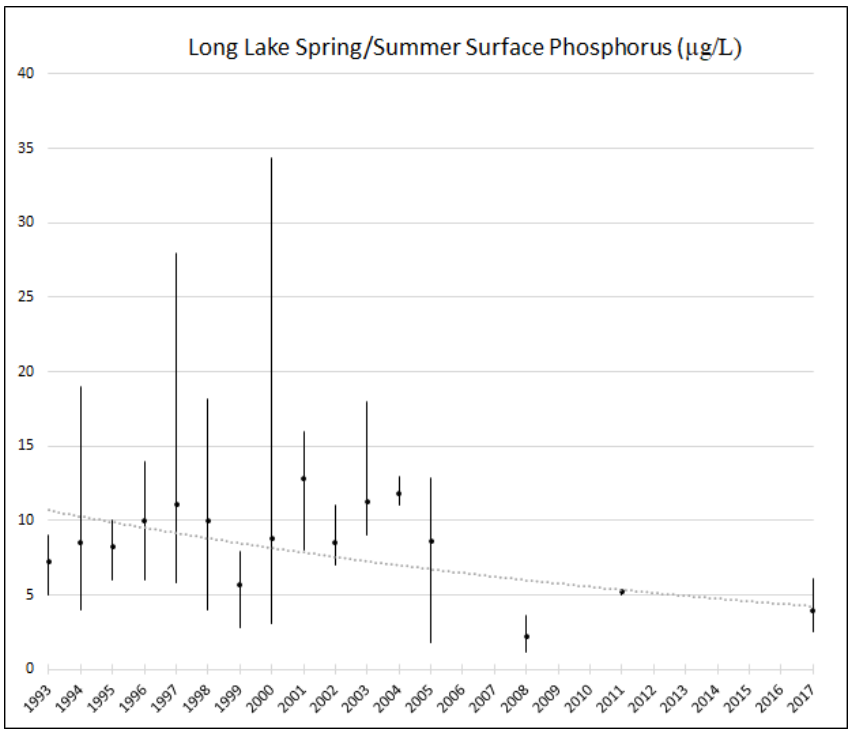
In collecting the data and creating consistency across the various years, several issues needed to be addressed. Data found within reports was assumed to be accurate, unless discrepancies were noted across the historical data. The original report data was used in instances where there were discrepancies. The transition from Spring/Summer to Autumn was established as October 15. Some measurements were converted to create a complete metric record. Possibly contaminated samples are noted in the data when noted in the reports.

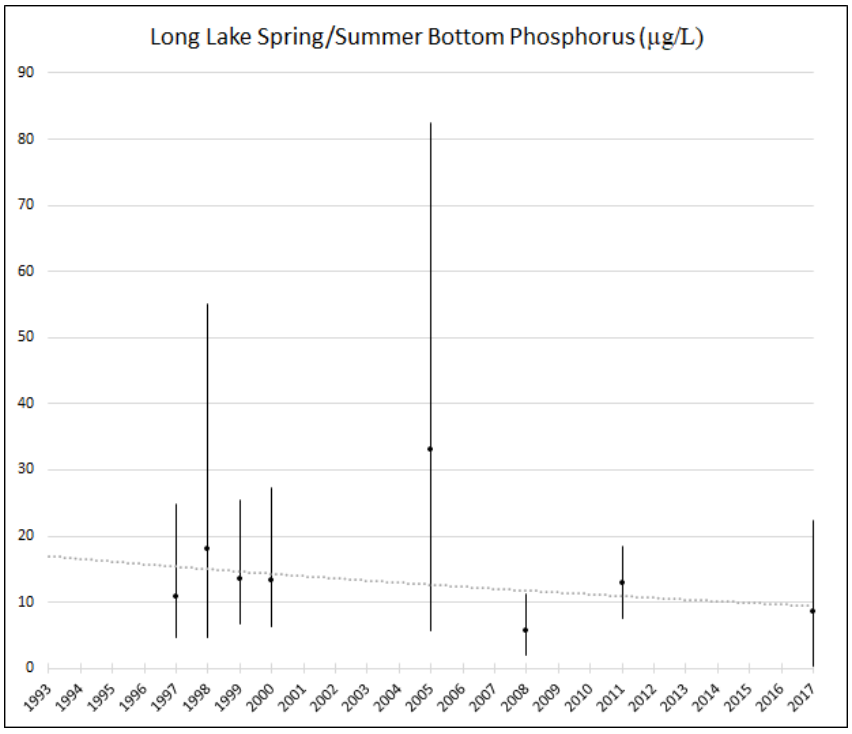
In the cases where only one sample has been collected, no graphs were created since no trend could be established.

Long Lake

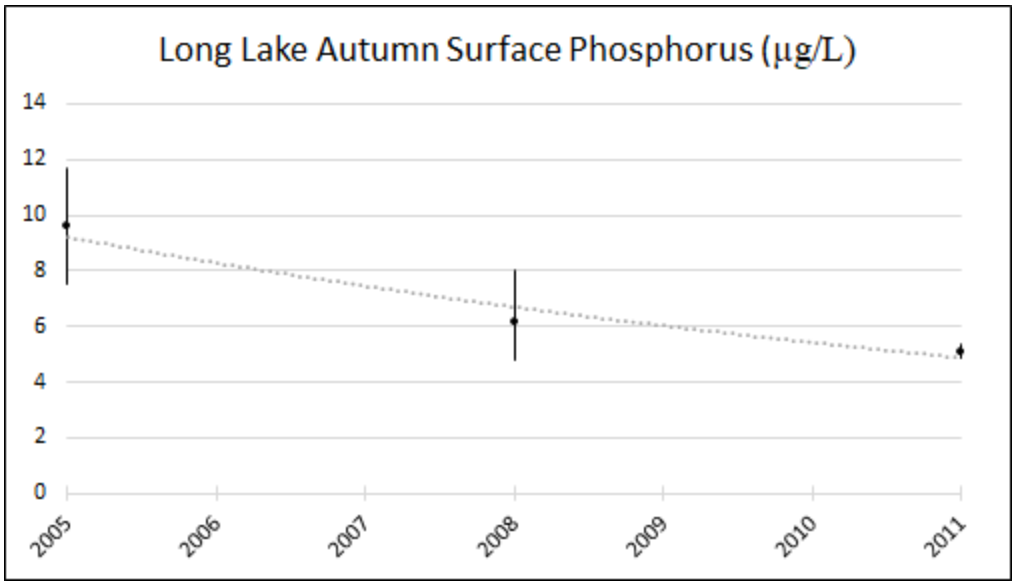
---	---	6	---	---	---	14	---	---	---	10.00	---	---	---
---	---	5.8	4.7	---	---	28	24.9	---	---	11.09	10.87	---	---
---	---	4	4.7	---	---	18.2	55	---	---	9.99	18.1	---	---
---	---	2.8	6.8	---	---	7.9	25.4	---	---	5.67	13.47	---	---
22	18	3.1	6.4	3.3	4.2	34.4	27.4	10.6	21	8.77	13.25	7.37	9.92
---	---	8	---	---	---	16	---	---	---	12.83	---	---	---
---	---	7	---	---	---	11	---	---	---	8.50	---	---	---
---	---	9	---	---	---	18	---	---	---	11.27	---	---	---
---	---	11	---	---	---	13	---	---	---	11.83	---	---	---
---	---	1.8	5.7	---	---	12.9	82.5*	---	---	8.65	33.17	---	---
---	---	1.2	1.9	---	---	3.6	11.3	---	---	2.20	5.77	---	---
---	---	5	7.5	---	---	5.4	18.4	---	---	5.20	12.95	---	---
---	---	2.5	0.3	---	---	6.1	22.3	---	---	3.95	8.53	---	---

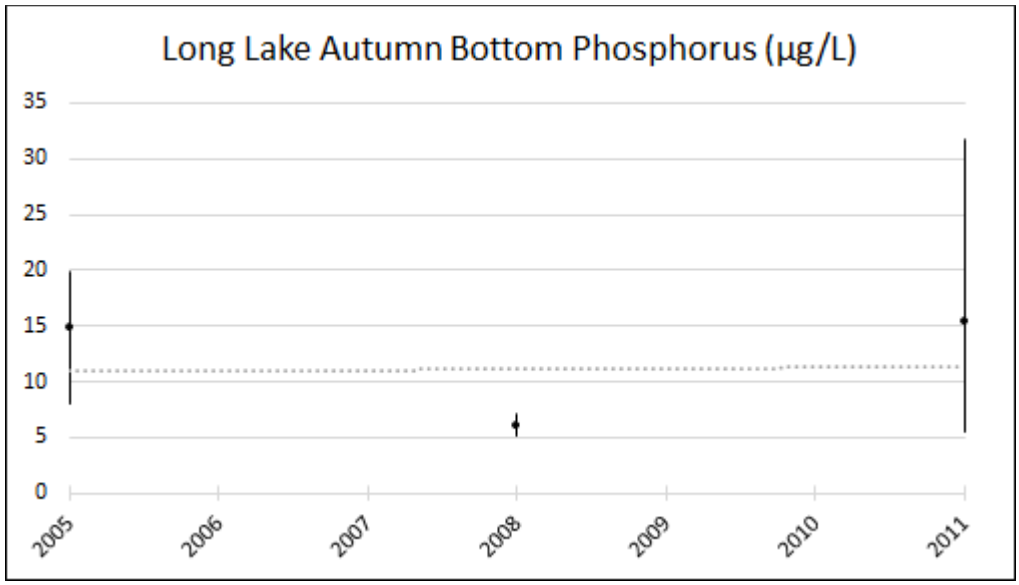
diment



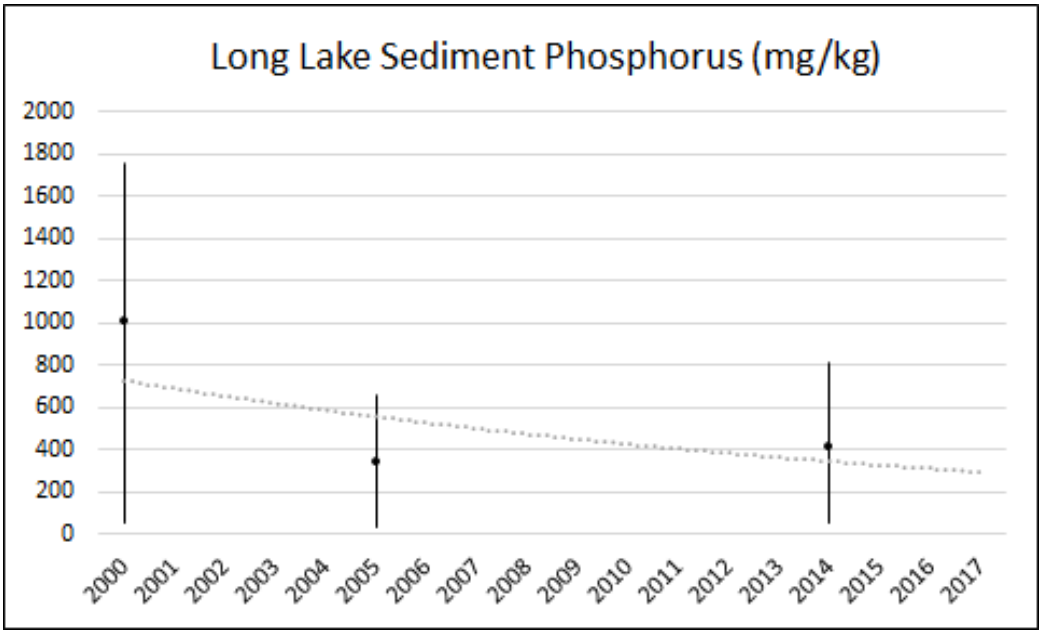


* In 2005 there was possible sediment contamination in a sample. This sample was included in the graph, but the overall trend downward is still consistent with what we see in the spring/summer samples. This trend could be slightly more significant if not considering this sample.


Long Lake Autumn Surface Phosphorus (µg/L)
14
12
10
8
6
4
2
0
2005
2006
2007
2008
2009
2010
2011

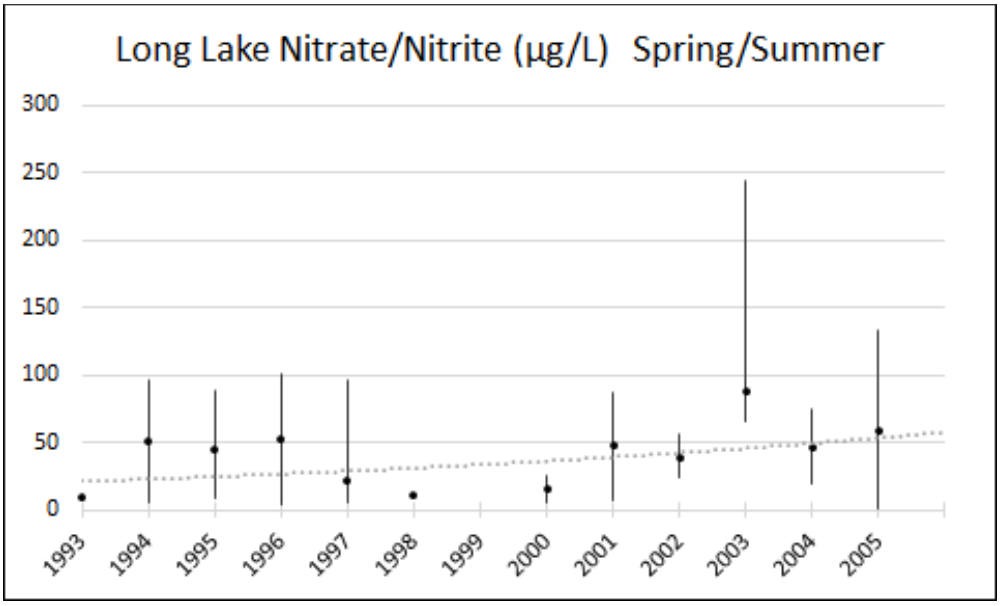

Long Lake Autumn Bottom Phosphorus (µg/L)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011

Sediment Phosphorus (mg/kg) SPRING/SUMMER				
Year	# samples	min	max	mean
2000	3	50.6	1754	1005.30
2005	3	33	654	336.33
2014	3	48	811	412.67



Nitrate-Nitrite Nitrogen (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
1993	4	---	8	---	12	---	10.00	---
1994	6	---	5	---	97	---	51.50	---
1995	4	---	9	---	89	---	44.25	---
1996	4	---	4	---	101	---	52.75	---
1997	13	---	6	---	96	---	22.15	---
1998	3	---	11	---	12	---	11.33	---
1999	---	---	---	---	---	---	---	---
2000	6	---	6	---	26	---	16.17	---
2001	6	---	7	---	88	---	47.50	---
2002	6	---	24	---	57	---	39.33	---
2003	15	---	65	---	245	---	87.87	---
2004	6	---	20	---	75	---	47.17	---
2005	6	3	< 1.4	< 1.4	133	34.1	59.27	16.97
2008	---	---	---	---	---	---	---	---
2011	---	---	---	---	---	---	---	---
2014	---	---	---	---	---	---	---	---
2017	---	---	---	---	---	---	---	---

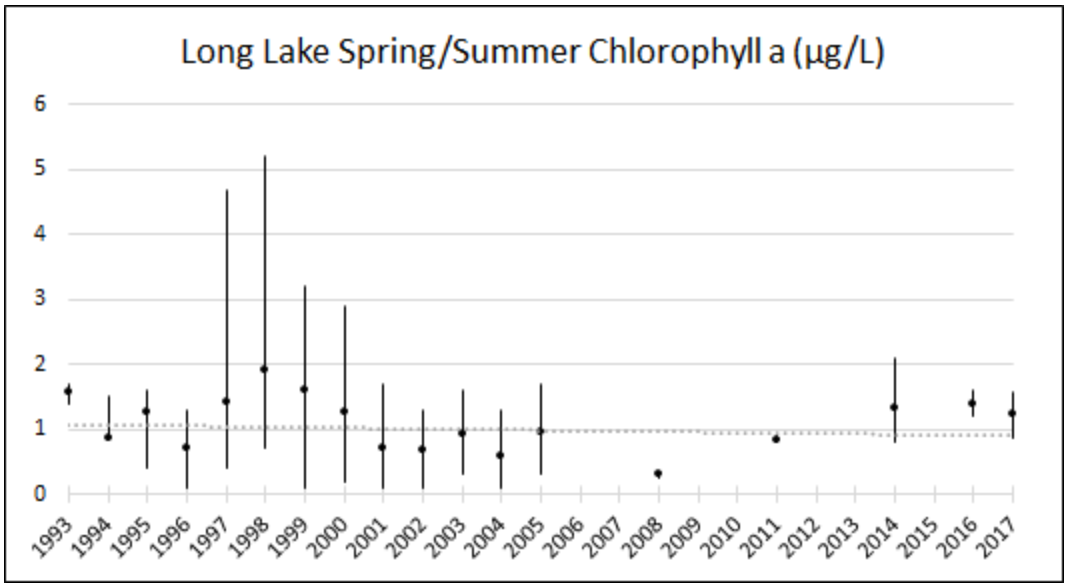
Nitrate-Nitrite Nitrogen (µg/L) AUTUMN								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2005	3	3	1.5	5.1	6.1	8	4.1	6.6

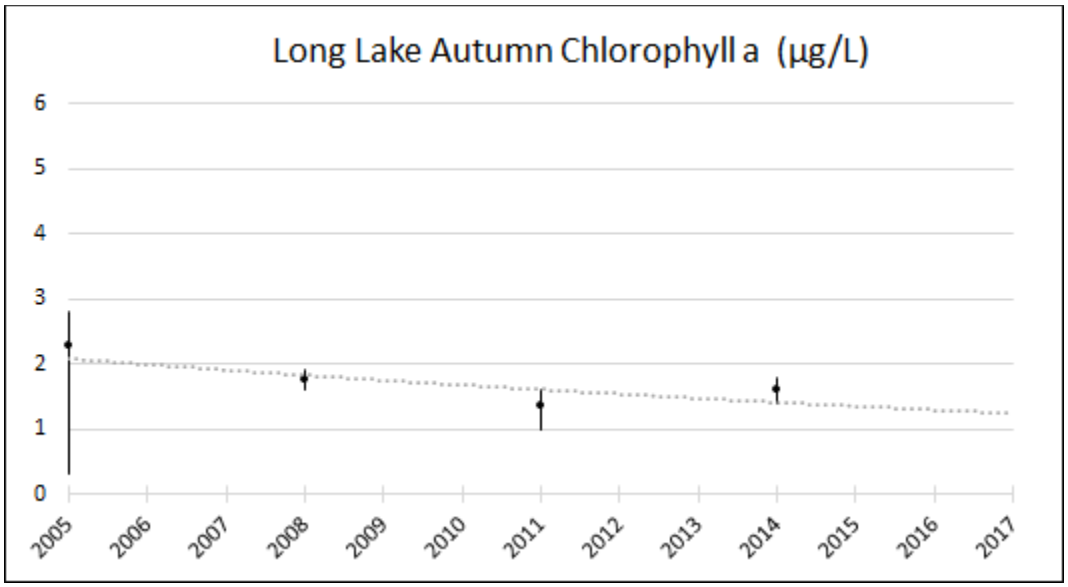


* There was only 1 bottom sample taken in 2005, so it is not included in the graph. It would have decreased the slope of the trend slightly, but not significantly. The one autumn sample year, 2005, is also not included since no trend could be established.

Chlorophyll a (µg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
1993	4	1.4	1.7	1.58
1994	6	0.9	1.5	0.88
1995	4	0.4	1.6	1.28
1996	4	0.1	1.3	0.70
1997	6	0.4	4.7	1.43
1998	5	0.7	5.2	1.92
1999	6	0.1	3.2	1.60
2000	12	0.2	2.9	1.26
2001	6	0.1	1.7	0.72
2002	6	0.1	1.3	0.68
2003	6	0.3	1.6	0.92
2004	6	0.1	1.3	0.60
2005	6	0.3	1.7	0.97
2008	3	0.25	0.35	0.30
2011	2	0.8	0.9	0.85
2014	3	0.8	2.1	1.33
2017	7	0.86	1.57	1.25

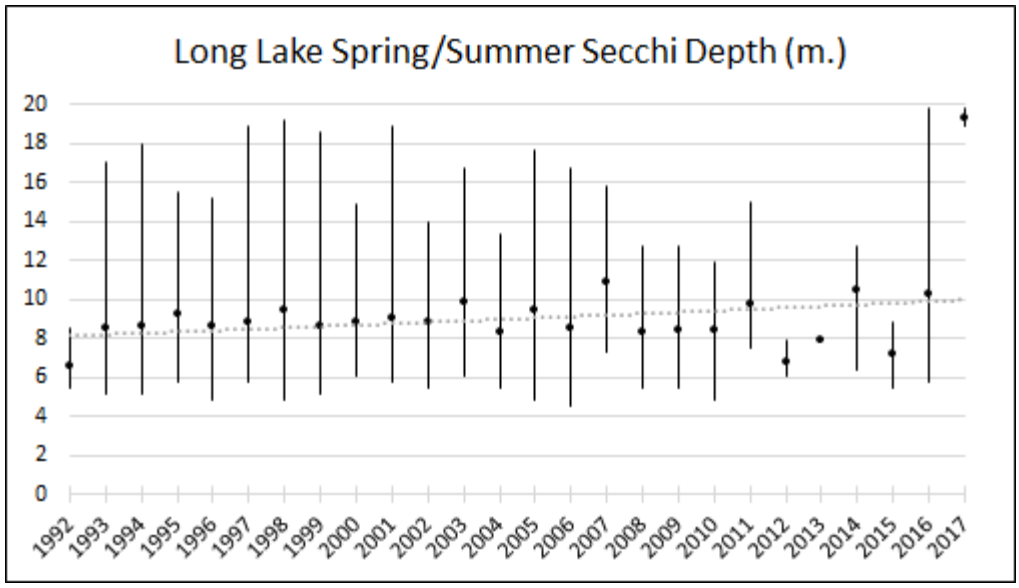
Chlorophyll a (µg/L) AUTUMN				
Year	# samples	min	max	mean
2005	3	0.3	2.8	2.27
2008	3	1.61	1.93	1.75
2011	3	1	1.6	1.37
2014	3	1.4	1.8	1.60

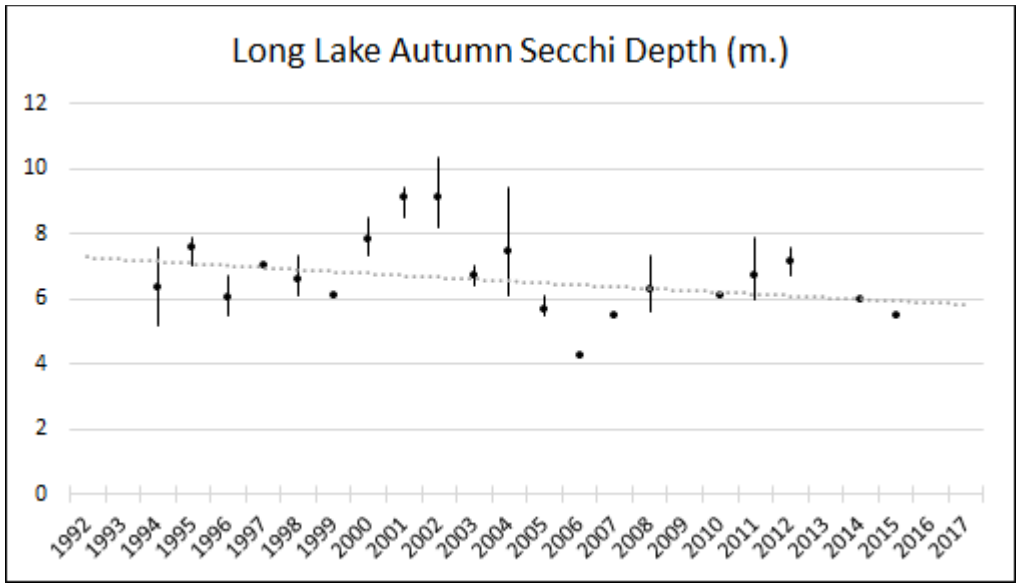

Long Lake Spring/Summer Chlorophyll a (µg/L)
6
5
4
3
2
1
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Long Lake Autumn Chlorophyll a (µg/L)
6
5
4
3
2
1
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

Secchi Disk (m.) SPRING/SUMMER				
Year	# samples	min	max	mean
1992	14	5.49	8.53	6.58
1993	25	5.18	17.07	8.56
1994	27	5.18	17.98	8.69
1995	28	5.79	15.54	9.30
1996	25	4.88	15.24	8.66
1997	33	5.79	18.9	8.87
1998	61	4.88	19.2	9.45
1999	24	5.18	18.59	8.65
2000	38	6.1	14.94	8.90
2001	30	5.79	18.9	9.08
2002	30	5.49	14.02	8.86
2003	32	6.1	16.76	9.88
2004	30	5.49	13.41	8.30
2005	27	4.88	17.68	9.42
2006	24	4.57	16.76	8.55
2007	6	7.32	15.85	10.87
2008	10	5.49	12.74	8.37
2009	7	5.49	12.8	8.40
2010	7	4.88	11.89	8.45
2011	4	7.5	15	9.79
2012	3	6.1	7.92	6.81
2013	1	7.92	7.92	7.92
2014	5	6.4	12.74	10.51
2015	2	5.49	8.84	7.17
2016	10	5.79	19.81	10.30
2017	8	5.5	19.81	9.29

Secchi Disk (m.) AUTUMN				
Year	# samples	min	max	mean
1994	4	5.18	7.62	6.33
1995	4	7.01	7.92	7.62
1996	4	5.49	6.71	6.02
1997	1	7.01	7.01	7.01
1998	4	6.1	7.32	6.63
1999	3	6.1	6.1	6.10
2000	3	7.32	8.53	7.82
2001	3	8.53	9.45	9.14
2002	4	8.23	10.36	9.14
2003	2	6.4	7.01	6.71
2004	5	6.1	9.45	7.44
2005	5	5.49	6.1	5.70
2006	1	4.27	4.27	4.27
2007	1	5.49	5.49	5.49
2008	4	5.64	7.32	6.31
2010	1	6.1	6.1	6.10
2011	4	6	7.92	6.73
2012	2	6.71	7.62	7.17
2014	3	6	6	6.00
2015	1	5.49	5.49	5.49
2017	---	---	---	---





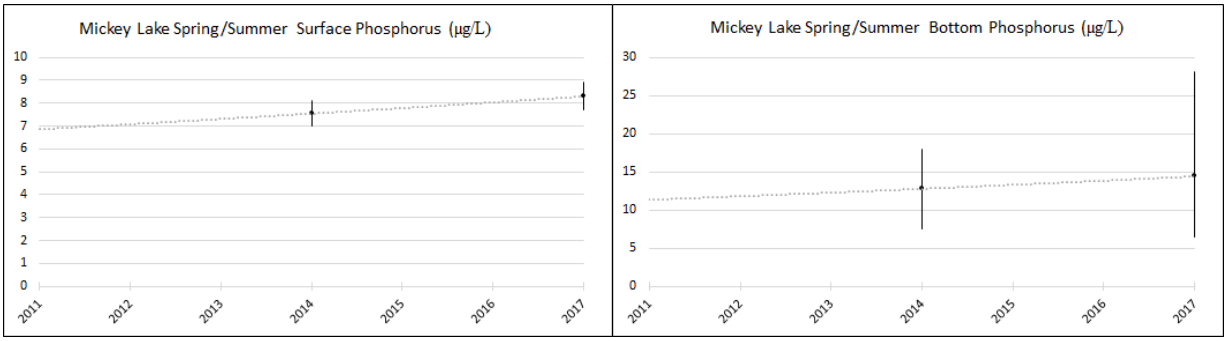
Calcium (mg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2017	6	20.2	24.6	22.70

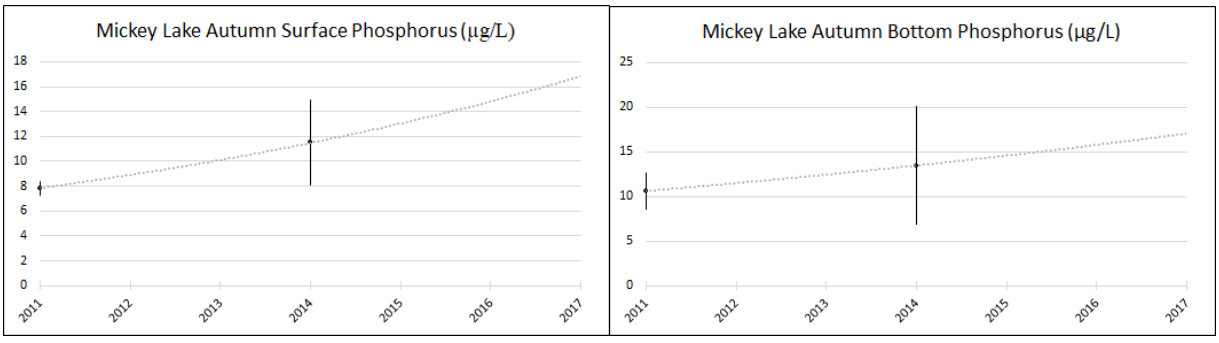
Mickey Lake

Total Phosphorus (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2011	---	---	---	---	---	---	---	---
2014	2	2	7	7.6	8.1	18	7.55	12.80
2017	5	4	7.71	6.5	8.9	28.1*	8.30	14.43

* Possible contamination from bottom sediment

Total Phosphorus (µg/L) AUTUMN								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2011	2	2	7.3	8.6	8.4	12.7	7.85	10.65
2014	2	2	8.1	6.9	14.9	20.1	11.50	13.50
2017	---	---	---	---	---	---	---	---



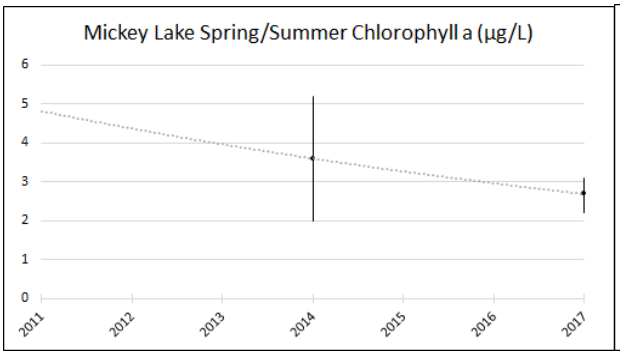


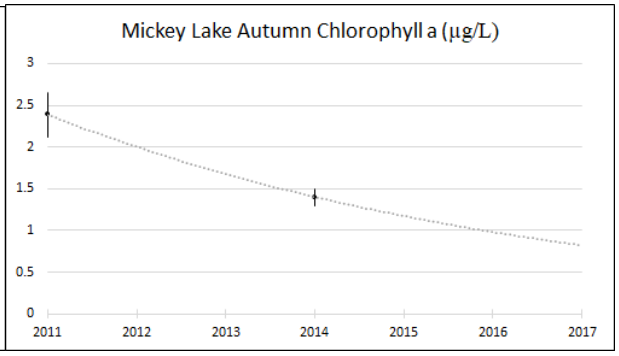
Sediment Phosphorus (mg/kg) SPRING/SUMMER				
Year	# samples	min	max	mean
2014	2	879	1625	1252

* There has been no Nitrate/Nitrite Nitrogen data collected on Mickey Lake.

Chlorophyll a (µg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2011	---	---	---	---
2014	2	2	5.2	3.6
2017	2	2.2	3.1	2.69

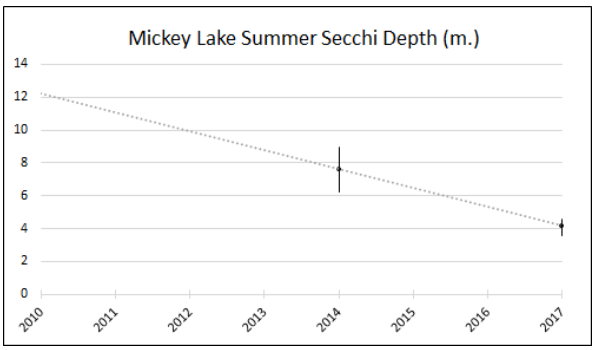
Chlorophyll a (µg/L) AUTUMN				
Year	# samples	min	max	mean
2011	2	2.12	2.65	2.39
2014	2	1.3	1.5	1.4
2017	---	---	---	---

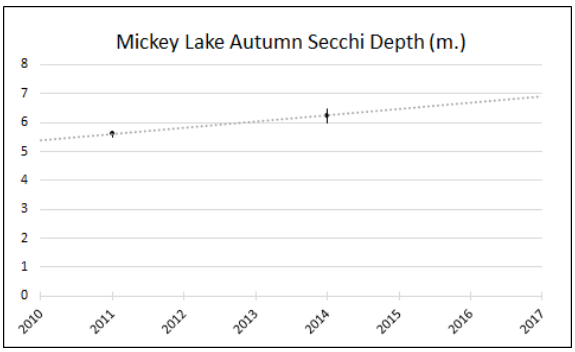




Secchi Disk (m.) SPRING/SUMMER				
Year	# samples	min	max	mean
2011	---	---	---	---
2014	2	6.25	8.99	7.62
2017	4	3.6	4.6	4.15

Secchi Disk (m.) AUTUMN				
Year	# samples	min	max	mean
2011	2	5.49	5.7	5.60
2014	2	6	6.49	6.25
2017	---	---	---	---





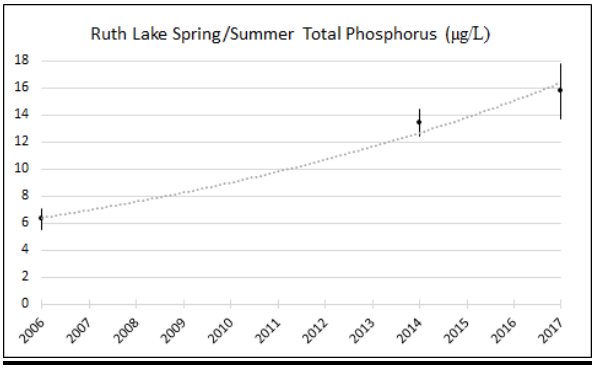
Calcium (mg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2017	3	20.6	21.9	21.17

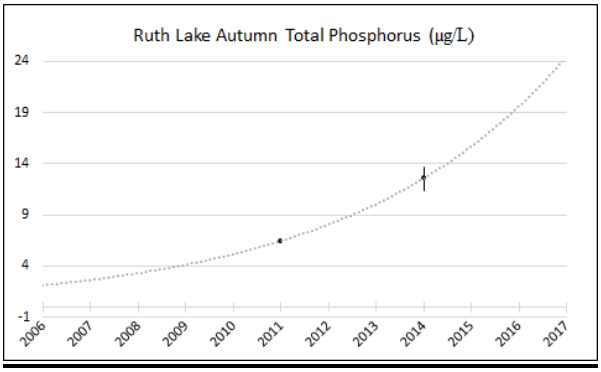
*No Autumn Calcium data has been collected for Mickey Lake.

Ruth Lake

Total Phosphorus (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2006	2	---	5.5	---	7.1	---	6.30	---
2011	---	---	---	---	---	---	---	---
2014	2	---	12.4	---	14.4	---	13.40	---
2017	2	---	13.7	---	17.8	---	15.75	---

Total Phosphorus (µg/L) AUTUMN								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2006	---	---	---	---	---	---	---	---
2011	2	---	6.3	---	6.6	---	6.45	---
2014	2	---	11.4	---	13.7	---	12.55	---
2017	---	---	---	---	---	---	---	---

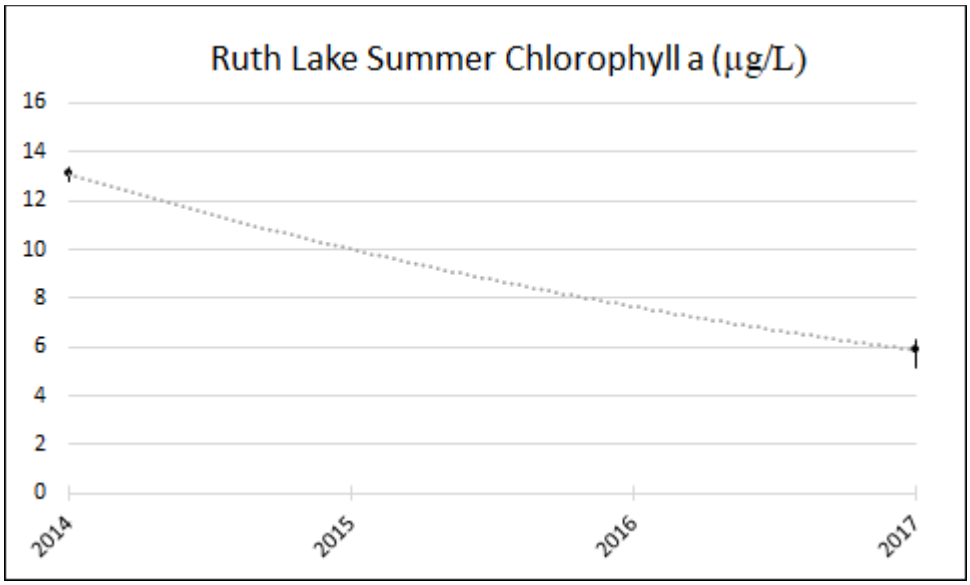




Sediment Phosphorus (mg/kg) SPRING/SUMMER				
Year	# samples	min	max	mean
2014	2	445	461	451
2017	---	---	---	---

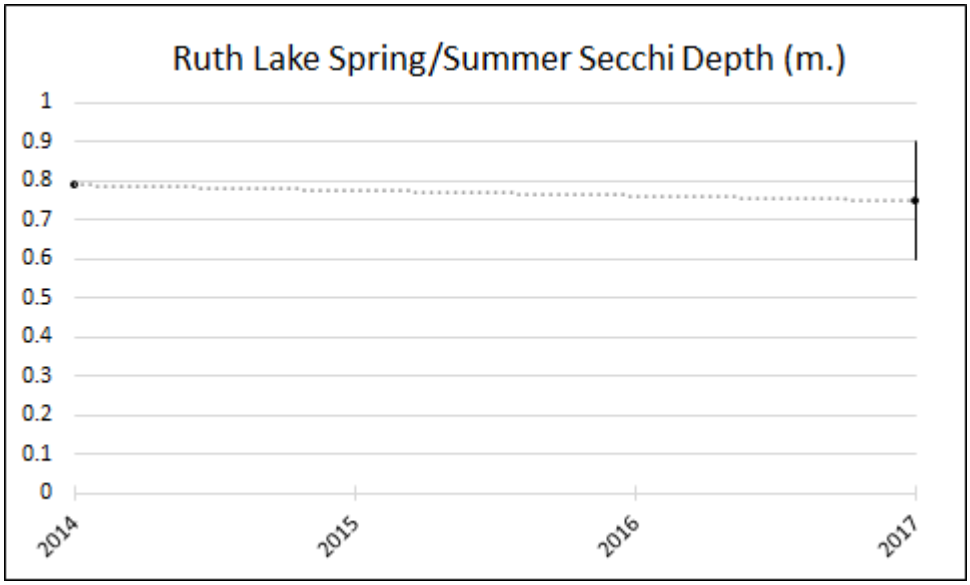
Chlorophyll a (µg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2014	2	12.8	13.4	13.1
2017	3	5.17	6.27	5.86

Chlorophyll a (µg/L) AUTUMN				
Year	# samples	min	max	mean
2014	2	3.7	10.7	7.2
2017	---	---	---	---



Secchi Disk (m.) SPRING/SUMMER				
Year	# samples	min	max	mean
2014	2	0.79	0.79	0.79
2017	2	0.6	0.9	0.75

Secchi Disk (m.) AUTUMN				
Year	# samples	min	max	mean
2014	2	1.01	1.01	1.01
2017	---	---	---	---



Calcium (mg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2017	2	12.2	20	16.10

*No Autumn Calcium data has been collected for Ruth Lake.

Page Lake

Total Phosphorus (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2016	1	1	20.8	63.7	20.8	63.7	20.8	63.7
2017	---	---	---	---	---	---	---	---

* No Autumn Total Phosphorus data has been collected for Page Lake

Sediment Phosphorus (mg/kg) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	1	700	700	700
2017	---	---	---	---

Nitrate-Nitrite Nitrogen (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2016	1	1	<1.1	5.7	<1.1	5.7	<1.1	5.70
2017	---	---	---	---	---	---	---	---

*No Autumn Nitrate-Nitrite Nitrogen data has been collected for Page Lake

Chlorophyll a (µg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	1	12.7	12.7	12.7
2017	---	---	---	---

* Mean of two samples

*No Autumn Chlorophyll a data has been collected for Page Lake.

Secchi Disk (m.) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	1	2.59	2.59	2.59
2017	---	---	---	---

*No Autumn Secchi Disk data has been collected for Page Lake.

Calcium (mg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	1	8.9	8.9	8.9

*No Autumn Calcium data has been collected for Page Lake.

Fern Lake

Total Phosphorus (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2016	2	2	6.5	8.8	7	13.6	6.75	11.20
2017	---	---	---	---	---	---	---	---

*No Autumn Total Phosphorus data has been collected for Fern Lake.

Sediment Phosphorus (mg/kg) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	2	770	791	780.5
2017	---	---	---	---

Nitrate-Nitrite Nitrogen (µg/L) SPRING/SUMMER								
Year	# samples		min		max		mean	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
2016	2	2	<1.1	<1.1	<1.1	5.4	<1.1	3.25
2017	---	---	---	---	---	---	---	---

*No Nitrate-Nitrite Nitrogen data has been collected for Fern Lake.

Chlorophyll a (µg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	3	5.3*	5.8	5.55
2017	---	---	---	---

* Mean of two samples

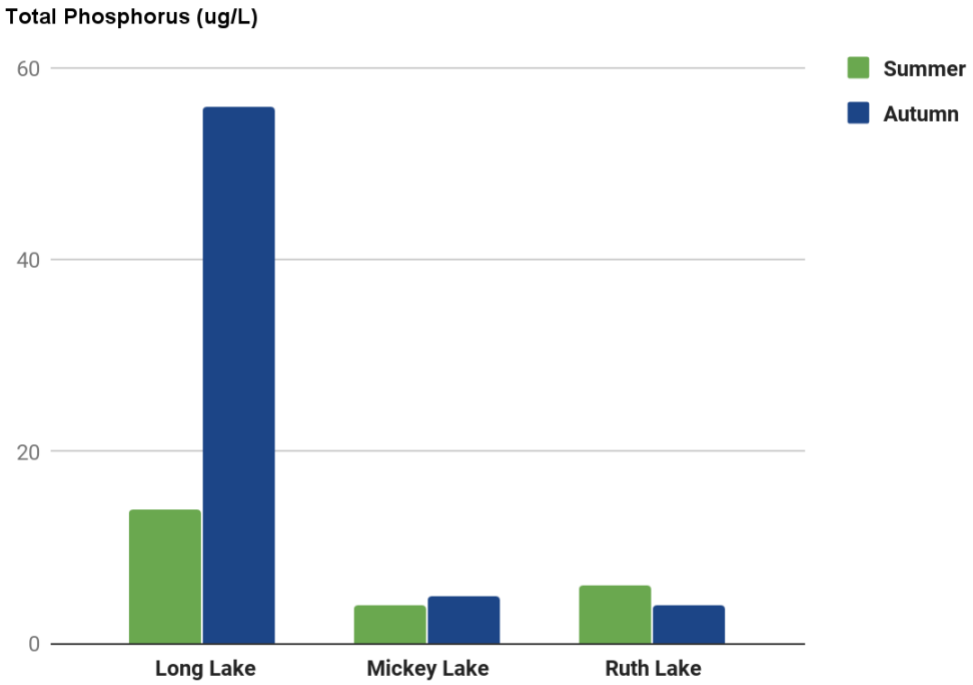
*No Chlorophyll a data has been collected for Fern Lake.

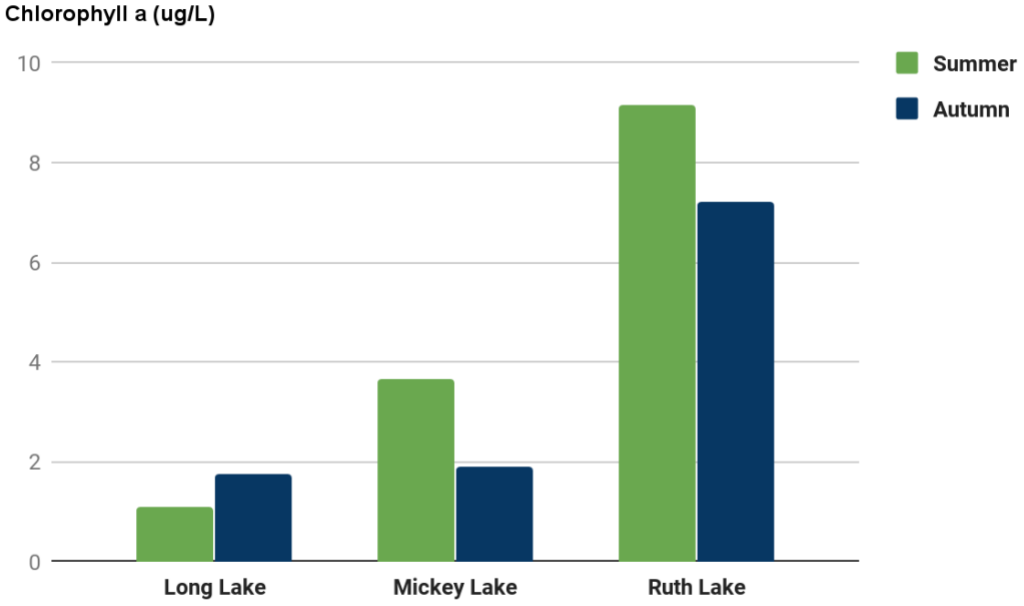
Secchi Disk (m.) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	2	4.39	4.45	4.42
2017	---	---	---	---

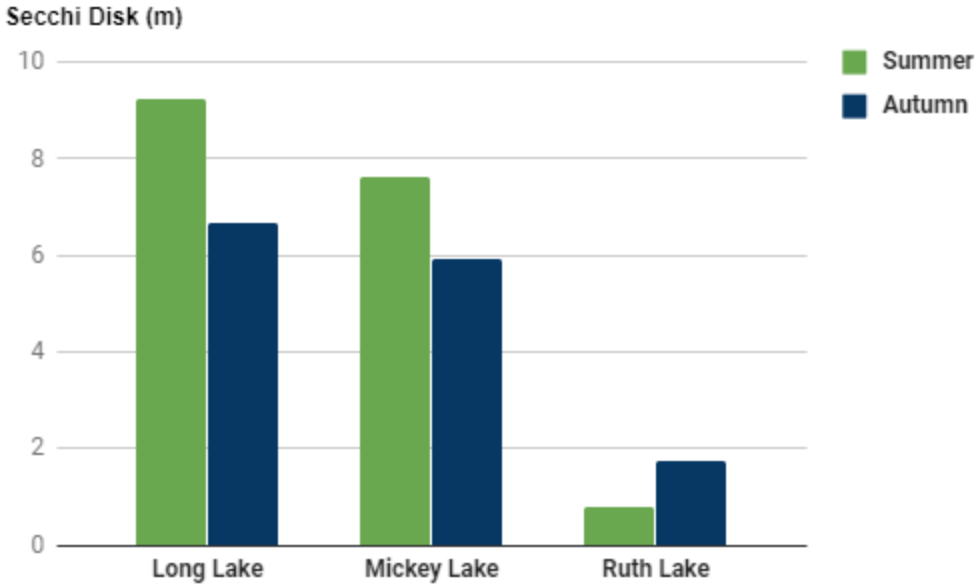
*No Secchi depth data has been collected for Fern Lake.

Calcium (mg/L) SPRING/SUMMER				
Year	# samples	min	max	mean
2016	2	30.9	32.2	31.55

*No Autumn Calcium data has been collected for Fern Lake.


Total Phosphorus (ug/L)
60
40
20
0
Long Lake
Mickey Lake
Ruth Lake
Summer
Autumn


Chlorophyll a (ug/L)
10
8
6
4
2
0
Long Lake
Mickey Lake
Ruth Lake
Summer
Autumn


Secchi Disk (m)
10
8
6
4
2
0
Long Lake
Mickey Lake
Ruth Lake
Summer
Autumn

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