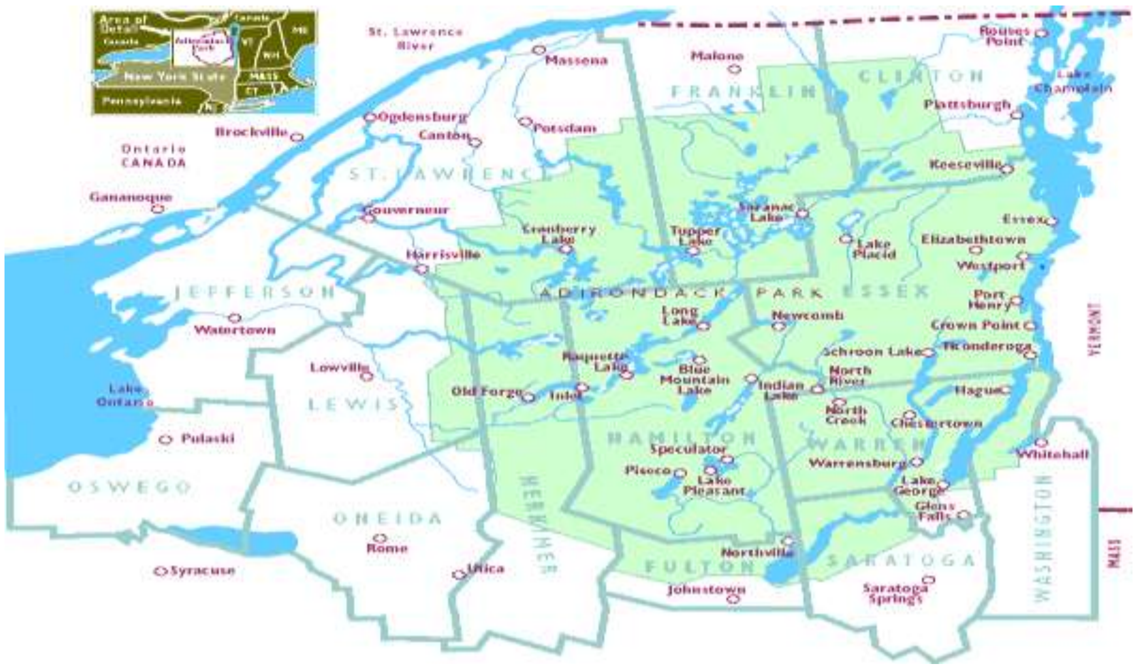
Adirondack Lake Assessment Program 2012



<u>**Fifteen Years in the program**</u>
Cranberry Lake, Loon Lake, Oven Mountain Pond, Blue Mountain Lake, Silver Lake, Eagle Lake
<u>**Fourteen Years in the program**</u>
Little Long Lake, Gull Pond, Stony Creek Ponds, Thirteenth Lake, Eli Pond
<u>**Thirteen Years in the program**</u>
Austin Pond, Osgood Pond, Middle Saranac Lake, White Lake, Brandreth Lake, Trout Lake
<u>**Twelve Years in the program**</u>
Hoel Pond, Tripp Lake, Sherman Lake, Wolf Lake, Twitchell Lake, Deer Lake, Arbutus Pond, Rich Lake, Catlin Lake, Pine Lake, Lake of the Pines, Pleasant Lake
<u>**Eleven Years in the program**</u>
Spitfire Lake, Upper St. Regis, Lower St. Regis, Garnet Lake, Lens Lake, Snowshoe Pond, Lake Ozonia, Long Pond, Lower Saranac Lake, Balfour Lake
<u>**Ten Years in the program**</u>
Raquette Lake, Lake Colby, Kiwassa Lake, Canada Lake
<u>**Nine Years in the program**</u>
Indian Lake, Big Moose Lake
<u>**Eight Years in the program**</u>
Dug Mountain Pond, Abanakee Lake, Moss Lake, Mountain View Lake, Indian Lake, Tupper Lake
<u>**Seven Years in the program**</u>
Sylvia Lake, Fern Lake, Hewitt Lake
<u>**Six Years in the program**</u>
Adirondack Lake, Lower Chateaugay Lake, Upper Chateaugay Lake, Lake Easka, Lake Tekeni
<u>**Five Years in the program**</u>
Simon Pond
<u>**Four Years in the program**</u>
Amber Lake, Jordan Lake, Otter Pond
<u>**Three Years in the program**</u>
Auger Lake, Lake Titus, Star Lake
<u>**Two Years in the program**</u>
Chapel Pond, Lake Durant, Upper Cascade Lake

Adirondack Lake Assessment Program

Lake Colby

Summer 2012

January 2013

Author
Michael De Angelo

Project Participants

Michael De Angelo, Environmental Chemist, Aquatics Director of the AWI
Cory Laxson, Research Associate, AWI
Elizabeth Yerger, Laboratory and Field Technician, AWI

Prepared by:
The Adirondack Watershed Institute at Paul Smith's College
P.O. Box 265, Paul Smiths, NY 12970-0244
Phone: 518-327-6270; Fax: 518-327-6369; E-mail: mdeangelo@paulsmiths.edu

Program Management by:
Protect the Adirondacks! Inc.
P.O. Box 769
Lake George, NY 12845
Phone: 518-685-3088
E-mail: info@protectadks.org

Introduction

The Adirondack Lake Assessment Program is a volunteer monitoring program established by the Residents' Committee to Protect the Adirondacks (RCPA) and the Adirondack Watershed Institute (AWI). The program is now in its' fifteenth year. The program was established to help develop a current database of water quality in Adirondack lakes and ponds. There were 69 participating lakes in the program in year 2012.

Methodology

Each month participants (trained by AWI staff) measured transparency with a secchi disk and collected a 2-meter composite of lake water for chlorophyll-a analysis and a separate 2-meter composite for total phosphorus and other chemical analyses. The participants filtered the chlorophyll-a sample prior to storage. Both the chlorophyll-a filter and water chemistry samples were frozen for transport to the laboratory at Paul Smith's College.

In addition to the volunteer samples, AWI staff sampled water quality parameters in most of the participating lakes as time and weather allowed. In most instances, a 2-meter composite of lake water was collected for chlorophyll-a analysis. Samples were also collected at depths of 1.5 meters from the surface (epilimnion) and within 1.5 meters of the bottom (hypolimnion) for chemical analysis. Once collected, samples were stored in a cooler and transported to the laboratory at Paul Smith's College.

All samples were analyzed by AWI staff in the Paul Smith's College laboratory using the methods detailed in *Standard Methods for the Examination of Water and Wastewater, 21st edition* (Greenberg, *et al*, 2005). Volunteer samples were analyzed for pH, alkalinity, conductivity, color, nitrate, chlorophyll a and total phosphorus concentrations. Samples taken by AWI staff were analyzed for the same parameters, as well as for calcium, chloride, and aluminum concentrations.

Results Summary

Lake Colby was sampled three times by a volunteer in 2012. Samples were collected for the lake on the following dates: 7/05/12, 8/12/12 and 9/03/12. The results for 2012 are presented in Appendix A and will be discussed in the following sections. Results are presented as concentrations in milligrams per liter (mg/L) or its equivalent of parts per million (ppm) and micrograms per liter (μg/L) or its equivalent of parts per billion (ppb).

$$1 \text{ mg/L} = 1 \text{ ppm}; 1 \text{ μg/L} = 1 \text{ ppb}; 1 \text{ ppm} = 1000 \text{ ppb}.$$

Adirondack lakes are subject to the effects of acidic precipitation (i.e. snow, rain). A water body's susceptibility to acid producing ions is assessed by measuring pH, alkalinity, calcium concentrations, and the Calcite Saturation Index (CSI). These parameters define both the acidity of the water and its buffering capacity. Based on the results of the 2012 Adirondack Lake Assessment program, the acidity status of Lake Colby is considered to be satisfactory with no threat from further acidic inputs.

Limnologists, the scientists who study bodies of fresh water, classify lake health (trophic status) into three main categories: oligotrophic, mesotrophic, and eutrophic. The trophic status of a lake is determined by measuring the level of three basic water quality parameters: total phosphorus, chlorophyll-a, and secchi disk transparency. These parameters will be defined in the sections that follow. Oligotrophic lakes are characterized as having low levels of total phosphorus, and, as a consequence, low levels of chlorophyll-a and high transparencies. Eutrophic lakes have high levels of total phosphorus and chlorophyll-a, and, as a consequence, low transparencies. Mesotrophic lakes have moderate levels of all three of these water quality parameters. Based upon the results of the 2012 Adirondack Lake Assessment Program, Lake Colby is considered to be an early mesotrophic water body.

pH

The pH level is a measure of acidity (concentration of hydrogen ions in water), reported in standard units on a logarithmic scale that ranges from 1 to 14. On the pH scale, 7 is neutral, lower values are more acidic, and higher numbers are more basic. In general, pH values between 6.0 and 8.0 are considered optimal for the maintenance of a healthy lake ecosystem. Many species of fish and amphibians have difficulty with growth and reproduction when pH levels fall below 5.5 standard units. Lake acidification status can be assessed from pH as follows:

pH less than 5.0	Critical or Impaired
pH between 5.0 and 6.0	Endangered or Threatened
pH greater than 6.0	Satisfactory or Acceptable

The pH in the upper waters of Lake Colby ranged from 7.27 to 7.52 and averaged 7.43. Based solely on pH, Lake Colby’s acidity levels should be considered satisfactory.

Alkalinity

Alkalinity (acid neutralizing capacity) is a measure of the buffering capacity of water, and in lake ecosystems refers to the ability of a lake to absorb or withstand acidic inputs. In the northeast, most lakes have low alkalinities, which mean they are sensitive to the effects of acidic precipitation. This is a particular concern during the spring when large amounts of low pH snowmelt runs into lakes with little to no contact with the soil’s natural buffering agents. Alkalinity is reported in milligrams per liter (mg/L) or microequivelents per liter (μeq/L). Typical summer concentrations of alkalinity in northeastern lakes are around 10 mg/l (200 μeq/L). Lake acidification status can be assessed from alkalinity as follows:

Alkalinity less than 0 mg/L	Acidified

Alkalinity between 0 and 2 mg/L	Extremely sensitive
Alkalinity between 2 and 10 mg/L	Moderately sensitive
Alkalinity between 10 and 25 mg/L	Low sensitivity
Alkalinity greater than 25 pmg/L	Not sensitive

The alkalinity of the upper waters of Lake Colby ranged from 17.2 mg/L to 24.1 mg/L and averaged 21.7 mg/L. These values indicate a low sensitivity to acidification.

Calcium

Calcium is one of the buffering materials that occur naturally in the environment. However, it is often in short supply in Adirondack lakes and ponds, making these bodies of water susceptible to acidification by acid precipitation. Calcium concentrations provide information on the buffering capacity of that lake, and can assist in determining the timing and dosage for acid mitigation (liming) activities. Adirondack lakes containing less than 2.5 mg/L of calcium are considered to be sensitive to acidification.

The calcium in Lake Colby was found to range from 8.25 to 11.20 mg/L. The average calcium concentration was found to be 9.55 mg/L. This shows us a lake that is not sensitive to further acidification at this time.

Calcite Saturation Index

The Calcite Saturation Index (CSI) is another method that is used to determine the sensitivity of a lake to acidification. High CSI values are indicative of increasing sensitivity to acidic inputs. CSI is calculated using the following formula:

$$CSI = -\log_{10} 40000 \quad -\log_{10} \frac{Ca}{50000} \; - pH + \frac{Alk}{2}$$

Where *Ca* = Calcium level of water sample in ppm or mg/L
Alk = Alkalinity of the water sample in ppm or mg/L
pH = pH of the water sample in standard units

Lake sensitivity to acidic inputs is assessed from CSI as follows:

CSI greater than 4	Very vulnerable to acidic inputs
CSI between 3 & 4	Moderately vulnerable to acidic inputs
CSI less than 3	Low vulnerability to acidic inputs

The CSI value for Lake Colby was found to be 1.55 in 2012. This shows that Lake Colby has a very low vulnerability to further acidic inputs.

Total Phosphorus

Phosphorus is one of the three essential nutrients for life, and in northeastern lakes, it is often the controlling, or limiting, nutrient in lake productivity. Total phosphorus is a measure of all forms of phosphorus, both organic and inorganic. Total phosphorus concentrations are directly related to the trophic status (water quality conditions) of a lake. Excessive amounts of phosphorus can lead to algae blooms and a loss of dissolved oxygen within the lake. Surface water (epilimnion) concentrations of total phosphorus less than 0.010 mg/L are associated with oligotrophic (clean, clear water) conditions. Concentrations greater than 0.025 mg/L are associated with eutrophic (nutrient-rich) conditions.

The total phosphorus in the upper waters of Lake Colby ranged from 0.006 to 0.008 mg/L and they averaged 0.0067 mg/L. This is indicative of oligotrophic conditions.

Chlorophyll-a

Chlorophyll-a is the green pigment in plants used for photosynthesis, and measuring it provides information on the amount of algae (microscopic plants) in lakes. Chlorophyll-a concentrations are also used to classify a lakes trophic status. Concentrations less than 2 ug/L are associated with oligotrophic conditions and those greater than 8 ug/L are associated with eutrophic conditions.

The chlorophyll-a concentrations in the upper waters of Lake Colby ranged from 2.02 ug/L to 4.12 ug/L and averaged 2.93 ug/L. This is indicative of mesotrophic conditions.

Secchi Disk Transparency

Transparency is a measure of water clarity in lakes and ponds. It is determined by lowering a 20 cm black and white disk (Secchi) into a lake to the depth where it is no longer visible from the surface. This depth is then recorded in meters. Since algae are the main determinant of water clarity in non-stained, low turbidity (suspended silt) lakes, transparency also is used as an indicator of the trophic status of a body of water. Secchi disk transparencies greater than 4.6 meters (15.1 feet) are associated with oligotrophic conditions, while values less than 2 meters (6.6 feet) are associated with eutrophic conditions (DEC & FOLA, 1990).

Secchi disk transparency in Lake Colby ranged from 4.0 meters to 5.0 meters and averaged 4.50 meters. This value is indicative of early mesotrophic conditions.

Nitrate

Nitrogen is another essential nutrient for life. Nitrate is an inorganic form of nitrogen that is naturally occurring in the environment. It is also a component of atmospheric pollution. Nitrogen concentrations are usually less than 1 mg/L in most lakes. Elevated levels of nitrate concentration may be indicative of lake acidification or wastewater pollution.

The nitrate in the upper waters of Lake Colby ranged from 0.003 to 0.012 mg/L. The average nitrate for Lake Colby was a very low 0.0073 mg/L.

Chloride

Chloride is an anion that occurs naturally in surface waters, though typically in low concentrations. Background concentrations of chloride in Adirondack Lakes are usually less than 1 mg/L. Chloride levels 10 mg/L and higher is usually indicative of pollution and, if sustained, can alter the distribution and abundance of aquatic plant and animal species. The primary sources of additional chloride in Adirondack lakes are road salt (from winter road de-icing) and wastewater (usually from faulty septic systems). The most salt impacted waters in the Adirondacks usually have chloride concentrations of 100 mg/L or less.

The chloride in the upper waters of Lake Colby ranged from 41.0 mg/L to 50.3 mg/L and the average value was 44.2 mg/L. This level is almost the highest in the Adirondack Park and should raise concern as well as levels found in past years.

Conductivity

Conductivity is a measure of the ability of water to conduct electric current, and will increase as dissolved minerals build up within a body of water. As a result, conductivity is also an indirect measure of the number of ions in solution, mostly as inorganic substances. High conductivity values (greater than 50 μohms/cm) may be indicative of pollution by road salt runoff or faulty septic systems. Conductivities may be naturally high in water that drains from bogs or marshes. Eutrophic lakes often have conductivities near 100 μohms/cm, but may not be characterized by pollution inputs. Clean, clear-water lakes in our region typically have conductivities up to 30 μohms/cm, but values less than 50 μohms/cm are considered normal.

The conductivity in the upper waters of Lake Colby ranged from 192.9μohms/cm to 260.0μohms/cm and averaged 231.3μohms/cm. These levels raise concern and are most likely high due to the very high chloride levels.

Color

The color of water is affected by both dissolved materials (e.g., metallic ions, organic acids) and suspended materials (e.g., silt and plant pigments). Water samples are collected and compared to a set of standardized chloroplatinate solutions in order to assess the degree of coloration. The measurement of color is usually used in lake classification to describe the degree to which the water body is stained due to the accumulation of organic acids. The standard for drinking water color, as set by the

United States Environmental Protection Agency (US EPA) using the platinum-cobalt method, is 15 Pt-Co. However, dystrophic lakes (heavily stained, often the color of tea) are common in this part of the country, and are usually found in areas with poorly drained soils and large amounts of coniferous vegetation (i.e., pines, spruce, hemlock). Dystrophic lakes usually have color values upwards of 75 Pt-Co.

Color can often be used as a possible index of organic acid content since higher amounts of total organic carbon (TOC) are usually found in colored waters. TOC is important because it can bond with aluminum in water, locking it up within the aquatic system and resulting in possible toxicity to fish (see Aluminum).

The color in the upper waters of Lake Colby ranged from 50 Pt-Co to 53 Pt-Co and averaged 51 Pt-Co.

Aluminum

Aluminum is one of the most abundant elements found within the earth's crust. Acidic runoff (from rainwater and snowmelt) can leach aluminum out of the soil as it flows into streams and lakes. If a lake is acidic enough, aluminum may also be leached from the sediment at the bottom of it. Low concentrations of aluminum can be toxic to aquatic fauna in acidified water bodies, depending on the type of aluminum available, the amount of dissolved organic carbon available to bond with the aluminum, and the pH of the water. Aluminum can form thick mucus that has been shown to cause gill destruction in aquatic fauna (i.e., fish, insects) and, in cases of prolonged exposure, can cause mortality in native fish populations (Potter, 1982). Aluminum concentrations are reported as mg/L of total dissolved aluminum.

The aluminum in Lake Colby was found to range from 0.081 to 0.116 mg/L and the average was a very low 0.107 mg/L.

Dissolved Oxygen

The dissolved oxygen in a lake is an extremely important parameter to measure. If dissolved oxygen decreases as we approach the bottom of a lake we know that there is a great amount of bacterial decay that is going on. This usually means that there is an abundance of nutrients, like phosphorous that have collected on the lake bottom. Oligotrophic lakes tend to have the same amount of dissolved oxygen from the surface waters to the lake bottom, thus showing very little bacterial decay. Eutrophic lakes tend to have so much decay that their bottom waters will have very little dissolved oxygen. Cold-water fish need 6.0 ppm dissolved oxygen to thrive and reproduce. Warm water fish need 4.0 ppm oxygen.

The dissolved oxygen and temperature profiles for Lake Colby for 2012 were not measured due to lack of a site visit by AWI staff. The profile from 2004 can be found in the Appendix.

Summary

Lake Colby was a moderately productive early mesotrophic lake during 2012. Based on the results of the 2012 Adirondack Lake Assessment program, the acidity status of Lake Colby is considered to be satisfactory with no threat from further acidic inputs.

If we look at the yearly averages for total precipitation in the Adirondacks, the amount of precipitation last year was normal. We had very dry conditions during the spring and early summer followed by very wet conditions during the late summer and fall. These conditions followed a record year for precipitation during 2011. Some of the changes to water quality on Lake Colby could have been weather related.

Ten years of data is sufficient to begin to detect water quality trends. In 2012, the alkalinity, total phosphorous, chlorophyll-a, nitrate, calcium, chloride and aluminum levels decreased as compared to 2011 levels. Most of the other tests increased in concentration from 2011 to 2012 including the pH, conductivity, color, and Secchi disk transparency levels. The lake looked healthy and did not experience an algae bloom during the 2012 sampling period.

The 2012 year was a normal year for precipitation in the Adirondacks but it was very dry during most of the time the samples were collected. This lack of runoff could have affected the water quality of Lake Colby. Road salt, chloride concentrations, continues to be a problem for Lake Colby as shown by the high conductivity and extremely high chloride levels. These chloride levels were some of the highest we have ever seen in the Adirondack Park but were a little lower during 2012.

Little Colby Pond was sampled on 9/11/2010. The pH and alkalinity were very similar to that of Lake Colby. The other parameters show a pond that has about the same water quality as Lake Colby. The conductivity and chloride concentrations were actually lower for Little Colby over Lake Colby.

Literature Cited

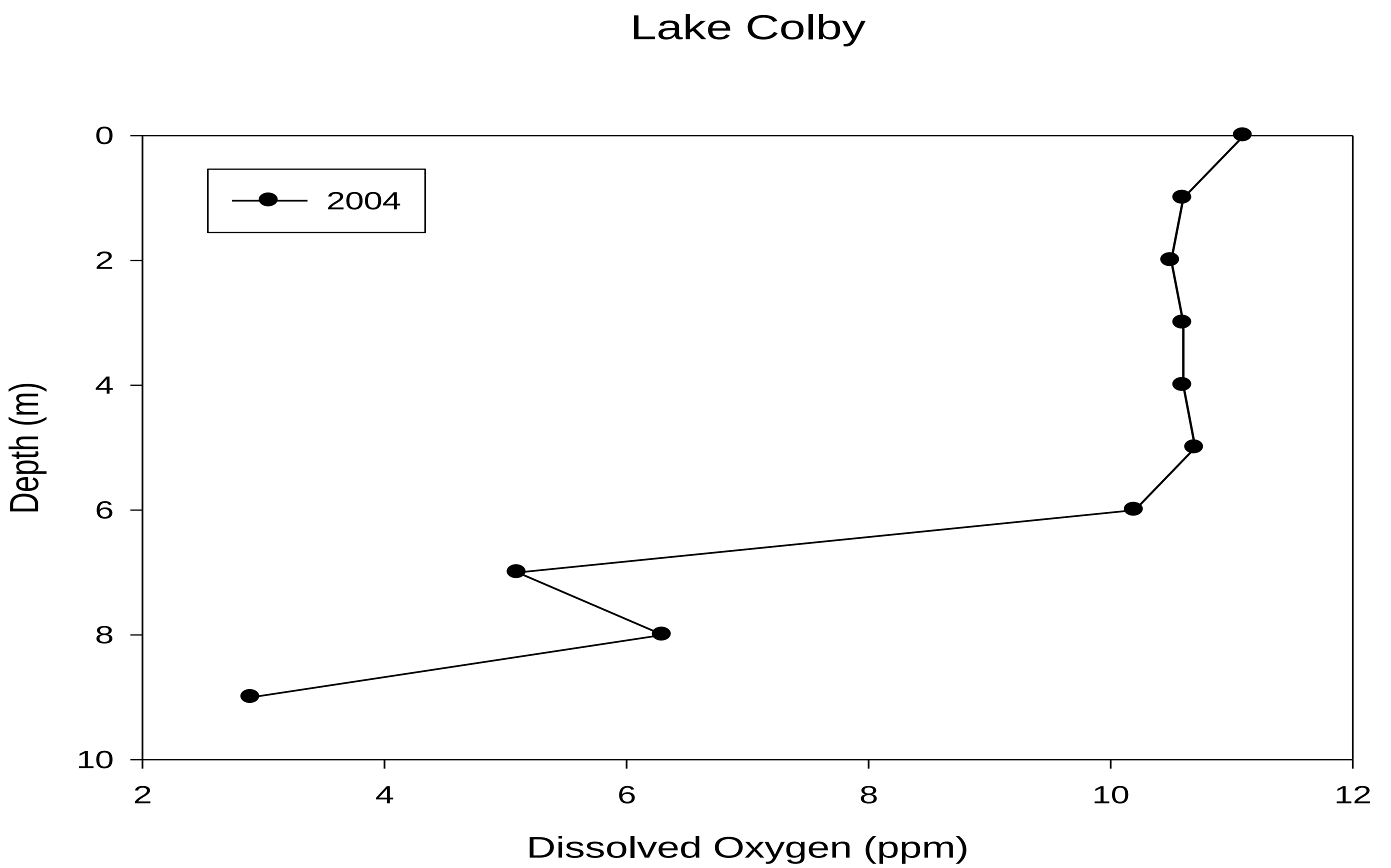
DEC & FOLA. (1990). Diet for a Small Lake: A New Yorker's Guide to Lake Management. New York State Department of Environmental Conservation & The Federation of Lake Associations, Inc.: Albany, New York.

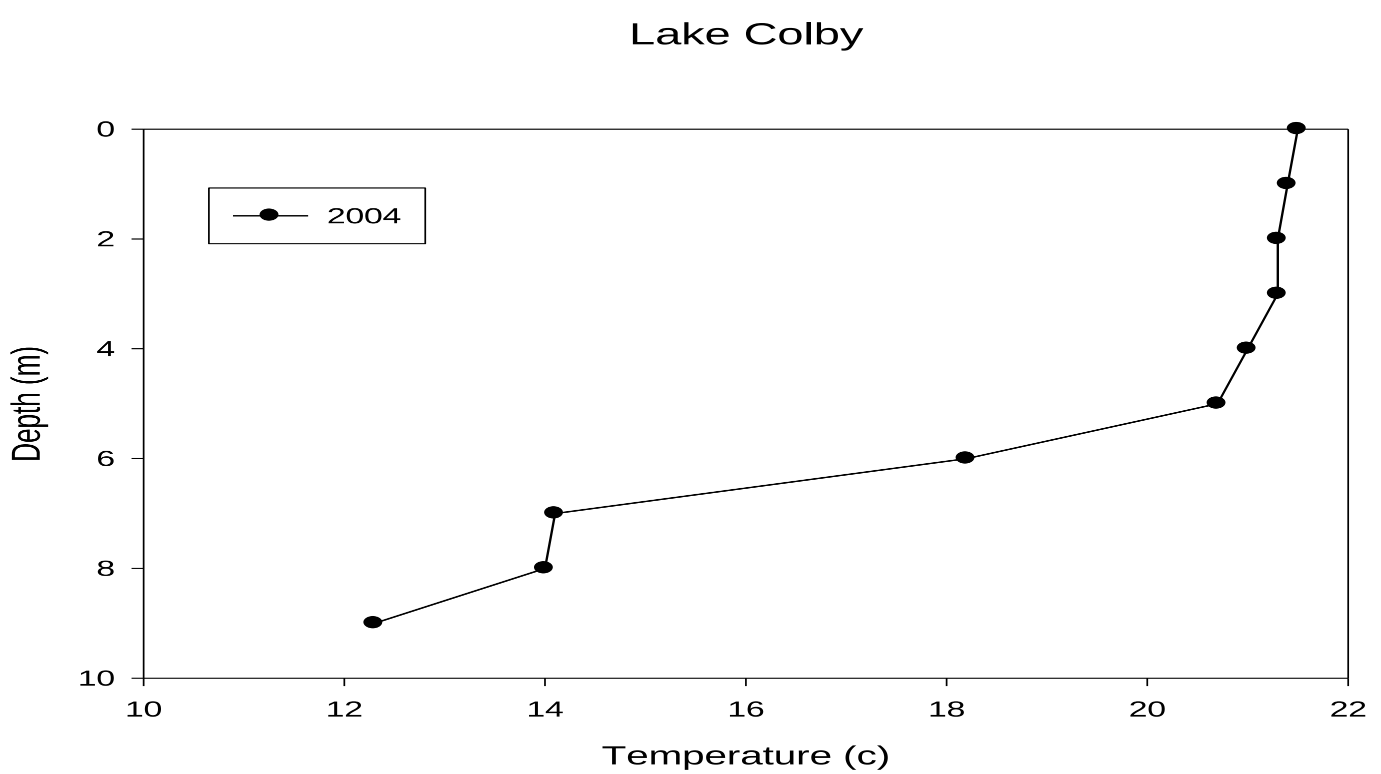
Greenberg, A.E., Eaton, A.D., and Leseri, L.A. (editors). (2005). Standard Methods for the Examination of Water and Wastewater, 21st Edition. American Public Health Association: Washington, D.C.

Potter, W. (1982). *The Effects of Air Pollution and Acid Rain on Fish, Wildlife and Their Habitats – Lakes*. Technical Report FWS/OBS – 80/50.4. United States Fish and Wildlife Service, Biological Services Program: Washington, D.C.

Appendix A

Water Quality Data


Lake Colby
2004
Depth (m)
0
2
4
6
8
10
2
4
6
8
10
12
Dissolved Oxygen (ppm)


Lake Colby
2004
Depth (m)
0
2
4
6
8
10
10
12
14
16
18
20
22
Temperature (c)

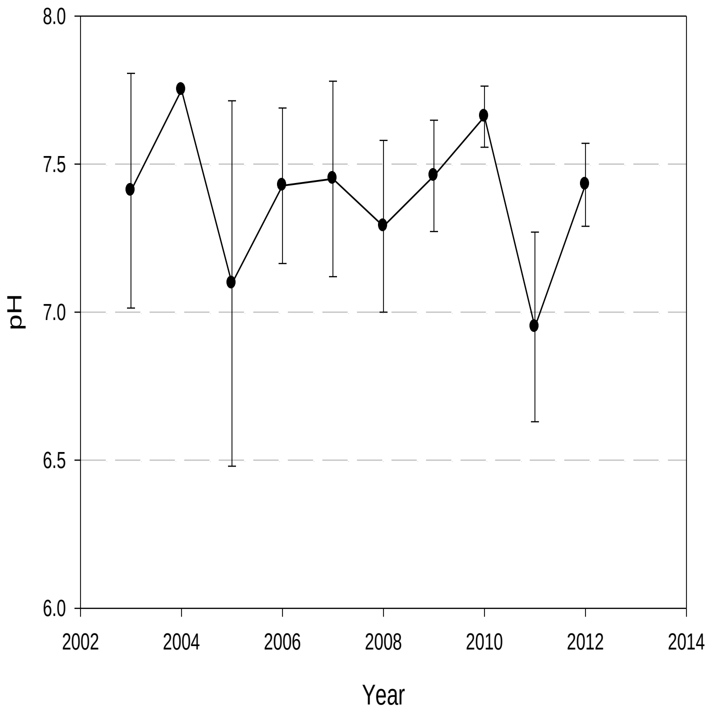
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (mg/L)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (mg/L)	Chl a (μg/l)
AWI	Lake Colby	Deephole	8/7/2003	7.8700	52.4000	171.1000	10.0000	0.0130	2.5000
Vol	Lake Colby	Deephole	9/6/2003	7.2100	44.4000	240.0000	49.0000	0.0130	1.4300
Vol	Lake Colby	Deephole	10/8/2003	7.1600	26.0000	259.0000	10.0000	0.0140	5.5100
			Mean	7.4133	40.9333	223.3667	23.0000	0.0133	3.1467
			Std Dev	0.3963	13.5371	46.2504	22.5167	0.0006	2.1155
Vol	Lake Colby	Brook	8/7/2003	7.2000	318.0000	1720.0000		0.0520	
Vol	Lake Colby	Brook	10/8/2003	6.8900	98.0000	2120.0000		0.0640	
AWI	Lake Colby	Epilimnion	8/18/2004	7.7500	46.2000	234.0000	17.0000	0.0140	2.9500
AWI	Lake Colby	Hypolimnion	8/18/2004	7.1300	54.0000	241.0000	45.0000	0.0190	
Vol	Lake Colby	Brook	4/1/2004	7.1200	44.0000	337.0000		0.0600	
Vol	Lake Colby	Brook	4/19/2004	7.0000	50.0000	466.0000		0.0500	
Vol	Lake Colby	Brook	5/5/2004	7.2100	54.0000	497.0000	26.0000	0.0300	
Vol	Lake Colby	Deephole	6/30/2005	7.5300	52.0000	220.0000	21.0000	0.0120	1.9700
Vol	Lake Colby	Deephole	7/30/2005	7.3700	55.6000	240.0000	11.0000	0.0120	3.0200
AWI	Lake Colby	Dip	11/8/2005	6.3900	54.0000	196.9000	50.0000	0.0120	5.0220
			Mean	7.0967	53.8667	218.9667	27.3333	0.0120	3.3373
			Std Dev	0.6172	1.8037	21.5686	20.2567	0.0000	1.5505
Vol	Lake Colby	Brook	6/30/2005	6.9400	122.8000	430.0000	96.0000	0.0220	5.4500
Vol	Lake Colby	Brook	7/30/2005	7.4200	148.4000	663.0000	68.0000	0.0720	6.1700
AWI	Lake Colby	Brook	11/8/2005	6.3200	108.4000	631.0000	114.0000	0.0080	23.0790
			Mean	6.8933	126.5333	574.6667	92.6667	0.0340	11.5663
			Std Dev	0.5515	20.2596	126.3025	23.1805	0.0336	9.9768
AWI	Lake Colby	Deephole	5/10/2006	7.2800	52.2000	225.0000	14.0000	0.0170	13.7000
AWI	Lake Colby	Deephole	7/15/2006	7.7300	51.6000	189.8000	10.0000	0.0160	5.8700
AWI	Lake Colby	Deephole	8/26/2006	7.2700	49.2000	195.0000	10.0000	0.0160	6.0200
			Mean	7.4267	51.0000	203.2667	11.3333	0.0163	8.5300
			Std Dev	0.2627	1.5875	19.0004	2.3094	0.0006	4.4780
Vol	Lake Colby	Deephole	5/19/2007	7.0300	51.2000	218.0000	29.0000	0.0140	3.8900
Vol	Lake Colby	Deephole	6/28/2007	7.3700	63.6000	222.0000	15.0000	0.0090	2.2300
Vol	Lake Colby	Deephole	8/1/2007	7.2900	57.8000	178.0000	35.0000	0.0110	2.7800
Vol	Lake Colby	Deephole	9/2/2007	7.7800	72.4000	190.1000	23.0000	0.0090	1.9600
Vol	Lake Colby	Deephole	9/25/2007	7.7700	66.8000	221.0000	34.0000	0.0160	5.2800
			Mean	7.4480	62.3600	205.8200	27.2000	0.0118	3.2280
			Std Dev	0.3239	8.1761	20.3817	8.3187	0.0031	1.3651
Vol	Lake Colby	Brook	3/27/2007	7.1300	76.4000	385.0000	34.0000	0.0520	
Vol	Lake Colby	Trestle	7/11/2007	7.3400	64.8000	238.0000	32.0000	0.0220	2.9500
			Mean	7.2350	70.6000	311.5000	33.0000	0.0370	2.9500
			Std Dev	0.1485	8.2024	103.9447	1.4142	0.0212	
Vol	Lake Colby	Deephole	6/27/2008	7.6800	66.8000	216.0000	19.0000	0.0190	6.1400
Vol	Lake Colby	Deephole	7/26/2008	7.2800	44.4000	169.0000	12.0000	0.0180	6.2500
Vol	Lake Colby	Deephole	9/1/2008	6.9800	42.0000	210.0000	11.0000	0.0110	2.1300
Vol	Lake Colby	Deephole	9/29/2009	7.2300	52.0000	171.4000	19.0000	0.0090	1.9600
			Mean	7.2925	51.3000	191.6000	15.2500	0.0143	4.1200
			Std Dev	0.2898	11.1780	24.8510	4.3493	0.0050	2.3974

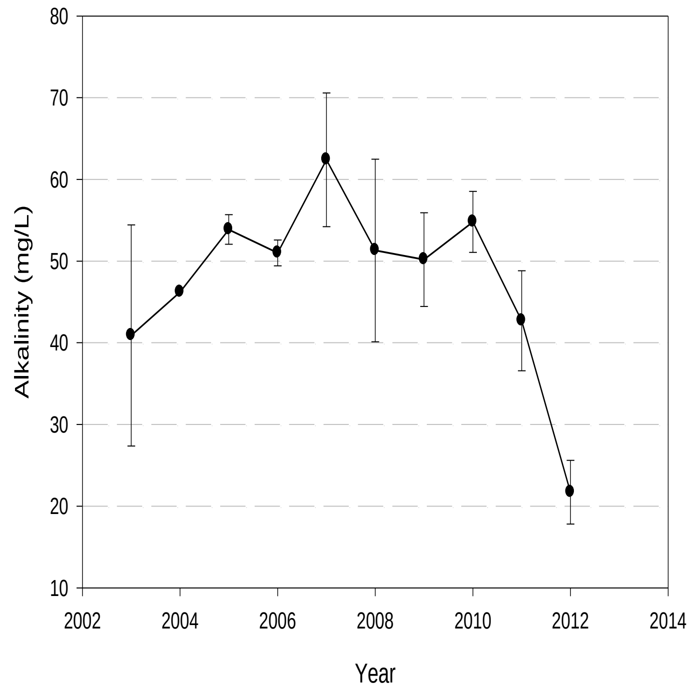
Source	Lake/Pond Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (mg/L)	Conductivity (μohms/cm)	Color (Pt-Co)	Total P (mg/L)	Chl a (μg/l)
Vol	Little Colby	Deephole	7/26/2008	7.7400	58.8000	214.0000	21.0000	0.0220	7.7900
Vol	Little Colby	Deephole	9/29/2008	7.4400	48.8000	224.0000	23.0000	0.0210	
			Mean	7.5900	53.8000	219.0000	22.0000	0.0215	7.7900
			Std Dev	0.2121	7.0711	7.0711	1.4142	0.0007	#DIV/0!
Vol	Lake Colby	Deephole	6/24/2009	7.4400	48.6000	148.8000	10.0000	0.0170	4.8800
Vol	Lake Colby	Deephole	7/18/2009	7.5000	52.4000	178.6000	9.0000	0.0220	7.1500
Vol	Lake Colby	Deephole	8/16/2009	7.2800	43.7000	235.0000	17.0000	0.0140	3.8900
Vol	Lake Colby	Deephole	8/30/2009	7.7600	58.8000	165.5000	7.0000	0.0150	4.0800
Vol	Lake Colby	Deephole	10/2/2009	7.3300	47.4000	239.0000	29.0000	0.0120	2.8000
			Mean	7.4620	50.1800	193.3800	14.4000	0.0160	4.5600
			Std Dev	0.1879	5.7325	41.2205	8.9889	0.0038	1.6269
Vol	Lake Colby	Deephole	6/27/2010	7.5700	51.4000	189.4000	20.0000	0.0100	1.9500
Vol	Lake Colby	Deephole	7/30/2010	7.6300	54.2000	210.0000	17.0000	0.0100	2.0100
Vol	Lake Colby	Deephole	9/11/2010	7.7700	58.8000	199.0000	14.0000	0.0130	4.0500
			Mean	7.6567	54.8000	199.4667	17.0000	0.0110	2.6700
			Std Dev	0.1026	3.7363	10.3079	3.0000	0.0017	1.1955
Vol	Little Colby	Deephole	9/11/2010	7.9700	50.8000	173.6000	21.0000	0.0120	5.4100
Vol	Lake Colby	Deephole	7/5/2011	7.2500	46.4000	186.0000	20.0000	0.0080	3.4800
Vol	Lake Colby	Deephole	8/9/2011	6.6100	35.6000	202.0000	19.0000	0.0070	3.0200
Vol	Lake Colby	Deephole	8/27/2011	6.9900	46.0000	201.0000	11.0000	0.0120	4.6100
			Mean	6.9500	42.6667	196.3333	16.6667	0.0090	3.7033
			Std Dev	0.3219	6.1232	8.9629	4.9329	0.0026	0.8182
Vol	Lake Colby	Deephole	7/5/2012	7.5200	24.1000	192.9000	53.0000	0.0080	4.1200
Vol	Lake Colby	Deephole	8/12/2012	7.5100	23.8000	241.0000	50.0000	0.0060	2.0200
Vol	Lake Colby	Deephole	9/3/2012	7.2700	17.2000	260.0000	50.0000	0.0060	2.6500
			Mean	7.4333	21.7000	231.3000	51.0000	0.0067	2.9300
			Std Dev	0.1415	3.9000	34.5857	1.7321	0.0012	1.0776

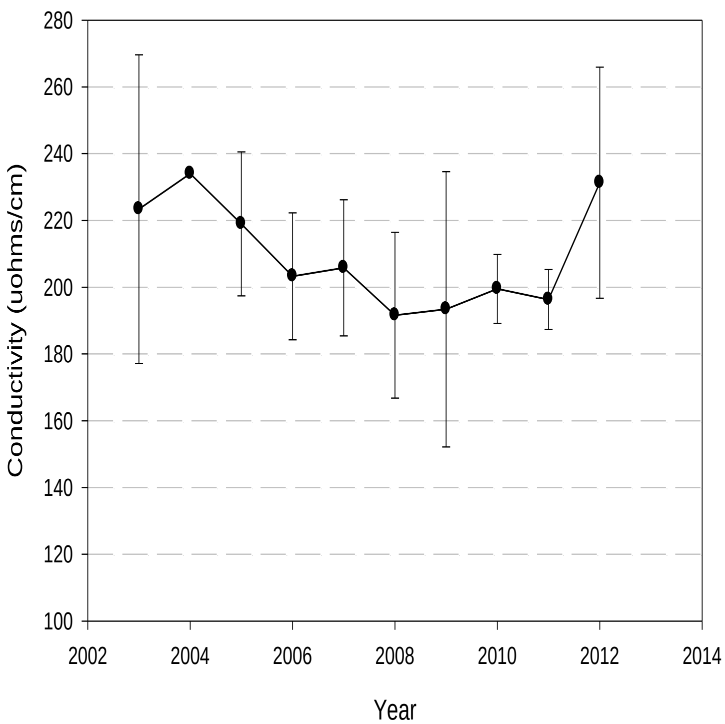
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Aluminum (mg/L)	CSI
AWI	Lake Colby	Deephole	8/7/2003	6.5000	0.0000				
Vol	Lake Colby	Deephole	9/6/2003	5.6000	0.2000				
Vol	Lake Colby	Deephole	10/8/2003		0.5000				
			Mean	6.0500	0.2333				
			Std Dev	0.6364	0.2517				
Vol	Lake Colby	Brook	8/7/2003		0.3000		469.0000		
Vol	Lake Colby	Brook	10/8/2003		1.5000		719.0000		
AWI	Lake Colby	Epilimnion	8/18/2004	4.3000	0.0000	8.8700	63.0000	0.0000	#REF!
AWI	Lake Colby	Hypolimnion	8/18/2004		0.0000	9.2500	64.0000	0.0000	#REF!
Vol	Lake Colby	Brook	4/1/2004		0.9000		112.0000		
Vol	Lake Colby	Brook	4/19/2004		0.6000		92.0000		
Vol	Lake Colby	Brook	5/5/2004		0.3000		161.0000		

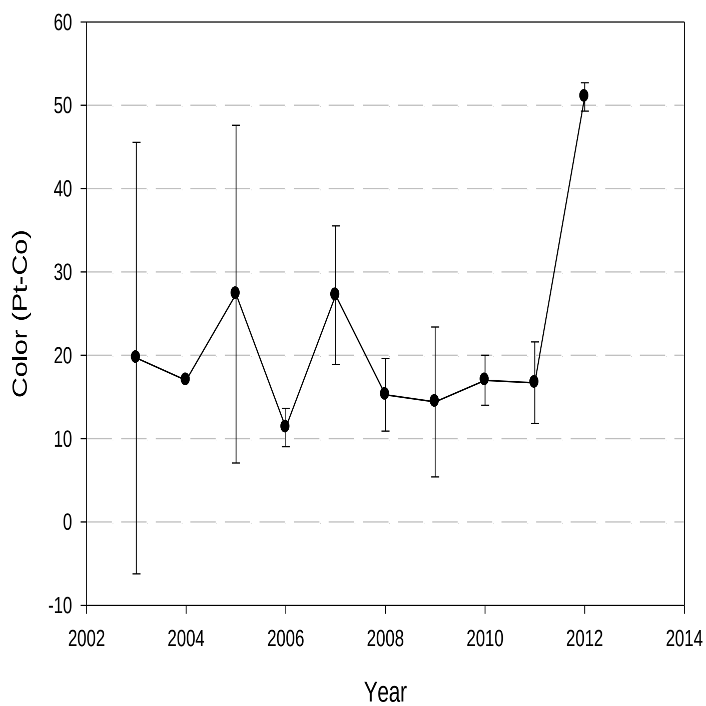
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Aluminum (mg/L)	CSI
Vol	Lake Colby	Deephole	6/30/2005	5.0000	0.1000		47.0000		
Vol	Lake Colby	Deephole	7/30/2005	4.3000	0.1000		49.0000		
AWI	Lake Colby	Dip	11/8/2005		0.2000		90.0000		
			Mean	4.6500	0.1333		62.0000		
			Std Dev	0.4950	0.0577		24.2693		
Vol	Lake Colby	Brook	6/30/2005		0.4000		93.0000		
Vol	Lake Colby	Brook	7/30/2005		0.2000		206.0000		
AWI	Lake Colby	Brook	11/8/2005		0.6000		177.0000		
			Mean		0.4000		158.6667		
			Std Dev		0.2000		58.6884		
AWI	Lake Colby	Deephole	5/10/2006	2.5000	0.0000	7.7200	46.0000	0.0000	#REF!
AWI	Lake Colby	Deephole	7/15/2006	3.5000	0.1000				
AWI	Lake Colby	Deephole	8/26/2006	3.5000	0.1000				
			Mean	3.1667	0.0667				
			Std Dev	0.5774	0.0577				
Vol	Lake Colby	Deephole	5/19/2007	3.0000	0.2000	7.4700	41.0000	0.0000	1.6710
Vol	Lake Colby	Deephole	6/28/2007	5.5000	0.1000		41.0000		
Vol	Lake Colby	Deephole	8/1/2007	4.5000	0.1000		32.0000		
Vol	Lake Colby	Deephole	9/2/2007	5.0000	0.4000				
Vol	Lake Colby	Deephole	9/25/2007	3.5000	0.2000				
			Mean	4.3000	0.2000				
			Std Dev	1.0368	0.1225				
Vol	Lake Colby	Brook	3/27/2007		0.3000		92.0000		
Vol	Lake Colby	Trestle	7/11/2007		0.2000		48.0000		
			Mean		0.2500				
			Std Dev		0.0707				
Vol	Lake Colby	Deephole	6/27/2008	3.0000	0.0000	7.9700	41.0000	0.0000	1.0000
Vol	Lake Colby	Deephole	7/26/2008	3.0000	0.1000		33.0000		
Vol	Lake Colby	Deephole	9/1/2008	5.0000	0.2000		40.0000		
Vol	Lake Colby	Deephole	9/29/2009	5.0000	0.2000		42.0000		
			Mean	4.0000	0.1250		39.0000		
			Std Dev	1.1547	0.0957		4.0825		
Vol	Little Colby	Deephole	7/26/2008	2.0000	0.0000				
Vol	Little Colby	Deephole	9/29/2008		0.2000		50.0000	0.0080	
			Mean	2.0000	0.1000				
			Std Dev	#DIV/0!	0.1414				
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Aluminum (mg/L)	CSI
Vol	Lake Colby	Deephole	6/24/2009	3.5000	0.1000	7.2900	31.0000	0.0000	1.2000
Vol	Lake Colby	Deephole	7/18/2009	2.5000	0.3000		37.0000		
Vol	Lake Colby	Deephole	8/16/2009	4.0000	0.1000		51.0000		
Vol	Lake Colby	Deephole	8/30/2009	4.0000	0.3000		34.0000		
Vol	Lake Colby	Deephole	10/2/2009	4.5000	0.0000		53.0000		
			Mean	3.7000	0.1600		41.2000		
			Std Dev	0.7583	0.1342		10.1094		

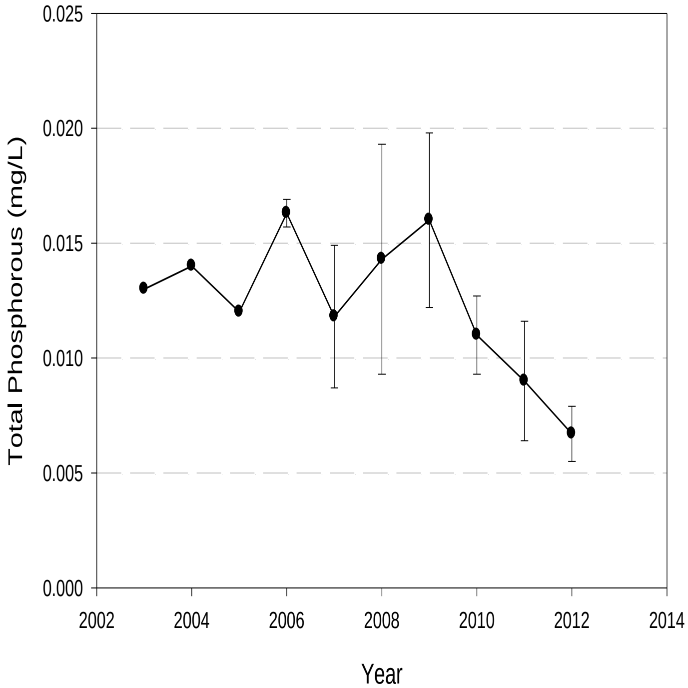
Source	Lake/Pond Name	Sampling Location	Sampling Date	Secchi (meters)	Nitrate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Aluminum (mg/L)	CSI
Vol	Lake Colby	Deephole	6/27/2010	5.0000	0.1700	13.2000	58.0000	0.0300	
Vol	Lake Colby	Deephole	7/30/2010	5.0000	0.1700	13.5400	56.6000	0.0100	
Vol	Lake Colby	Deephole	9/11/2010	4.0000	0.1500	13.7700	60.6000	0.0300	
			Mean	4.6667	0.1633	13.5033	58.4000	0.0233	
			Std Dev	0.5774	0.0115	0.2868	2.0298	0.0115	
Vol	Little Colby	Deephole	9/11/2010	vob	0.1600	13.9900	50.3000	0.0400	
Vol	Lake Colby	Deephole	7/5/2011	4.0000	0.0570	10.6000	48.1000	0.1600	
Vol	Lake Colby	Deephole	8/9/2011	4.5000	0.0520	11.2000	56.1000	0.1600	
Vol	Lake Colby	Deephole	8/27/2011	4.0000	0.0580	11.0000	52.7000	0.1600	
			Mean	4.1667	0.0557	10.9333	52.3000	0.1600	
			Std Dev	0.2887	0.0032	0.3055	4.0150	0.0000	
Vol	Lake Colby	Deephole	7/5/2012	4.0000	0.0070	9.2000	41.0000	0.0810	
Vol	Lake Colby	Deephole	8/12/2012	5.0000	0.0030	11.2000	50.3000	0.1050	
Vol	Lake Colby	Deephole	9/3/2012	4.5000	0.0120	8.2500	41.3000	0.1160	
			Mean	4.5000	0.0073	9.5500	44.2000	0.1007	1.5500
			Std Dev	0.5000	0.0045	1.5058	5.2849	0.0179	

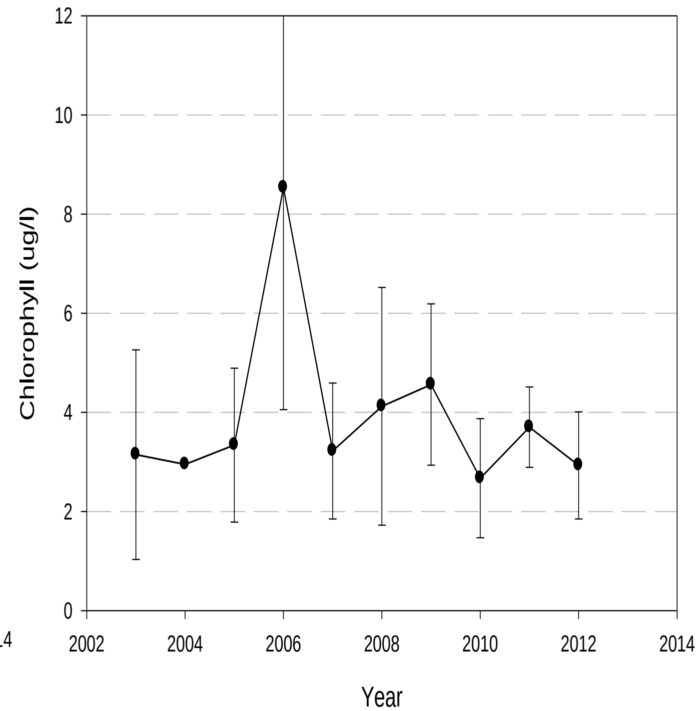

8.0
7.5
7.0
6.5
6.0
pH
2002
2004
2006
2008
2010
2012
2014
Year

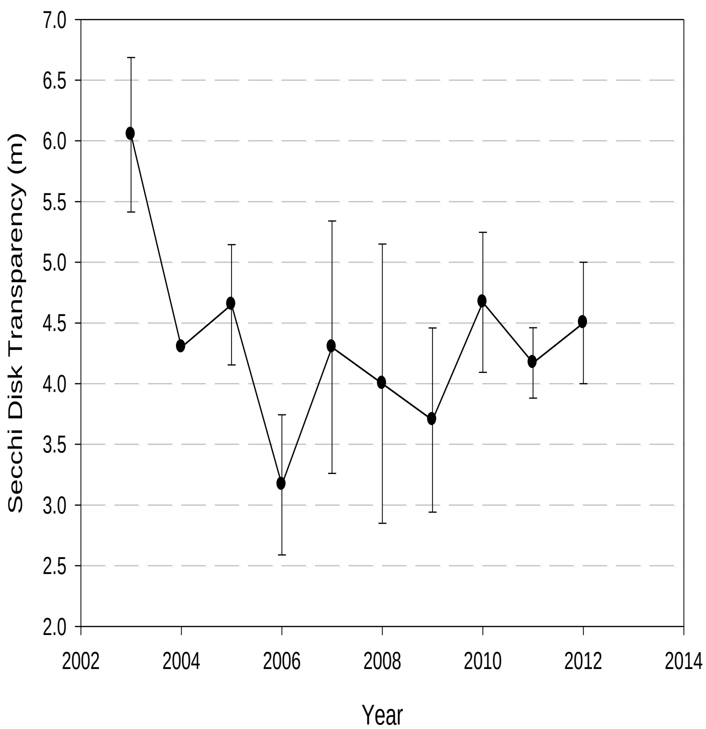

80
70
60
50
40
30
20
10
Alkalinity (mg/L)
2002
2004
2006
2008
2010
2012
2014
Year

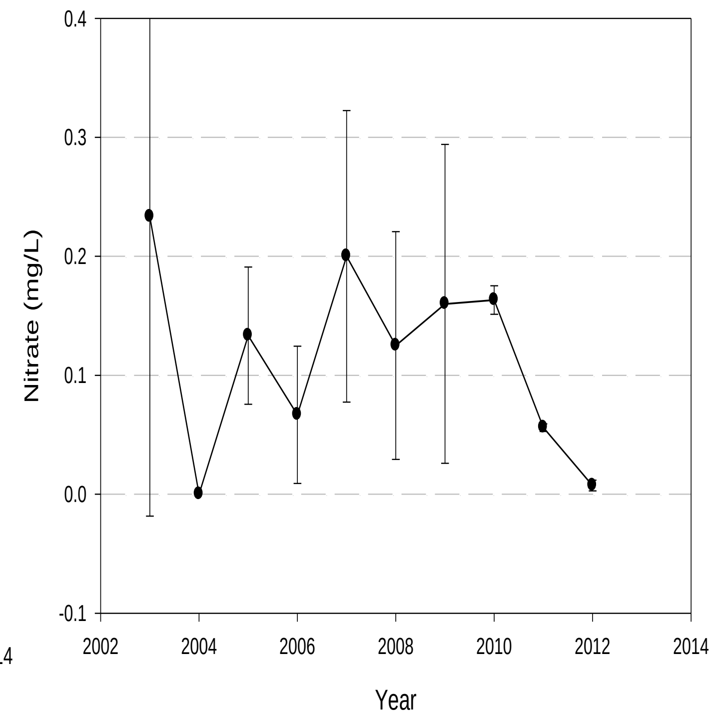

280
260
240
220
200
180
160
140
120
100
Conductivity (uohms/cm)
2002
2004
2006
2008
2010
2012
2014
Year

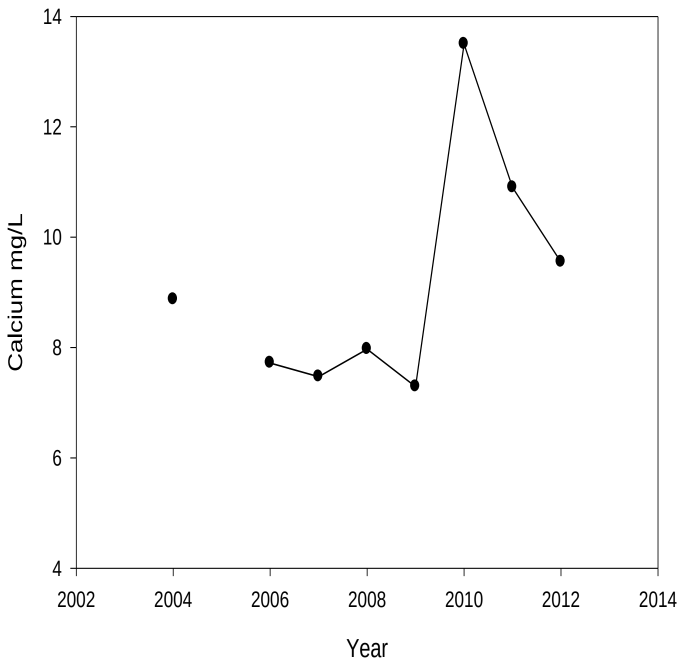

60
50
40
30
20
10
0
-10
Color (Pt-Co)
2002
2004
2006
2008
2010
2012
2014
Year


Total Phosphorous (mg/L)
0.025
0.020
0.015
0.010
0.005
0.000
2002
2004
2006
2008
2010
2012
2014
Year

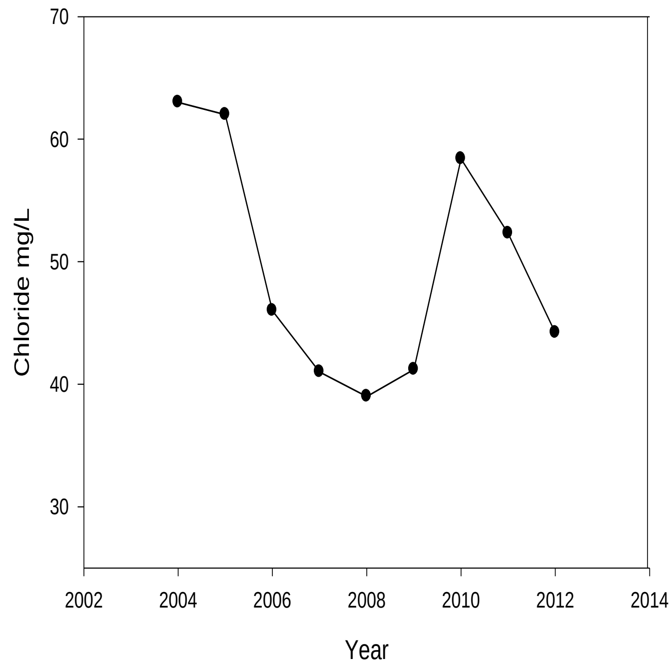

Chlorophyll (ug/l)
12
10
8
6
4
2
0
2002
2004
2006
2008
2010
2012
2014
Year


Secchi Disk Transparency (m)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2002
2004
2006
2008
2010
2012
2014
Year

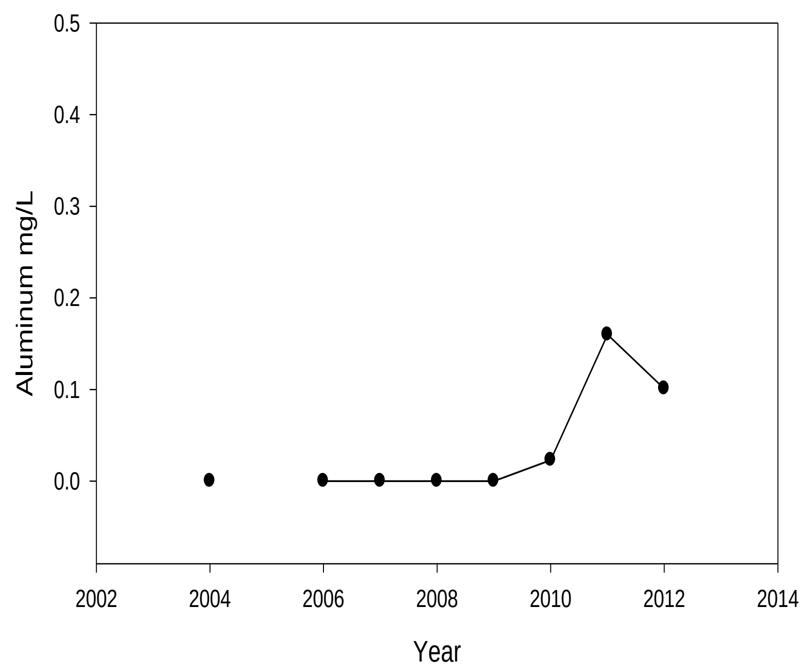

Nitrate (mg/L)
0.4
0.3
0.2
0.1
0.0
-0.1
2002
2004
2006
2008
2010
2012
2014
Year



Calcium mg/L
14
12
10
8
6
4
2002
2004
2006
2008
2010
2012
2014
Year



Chloride mg/L
70
60
50
40
30
2002
2004
2006
2008
2010
2012
2014
Year



Aluminum mg/L
0.5
0.4
0.3
0.2
0.1
0.0
2002
2004
2006
2008
2010
2012
2014
Year