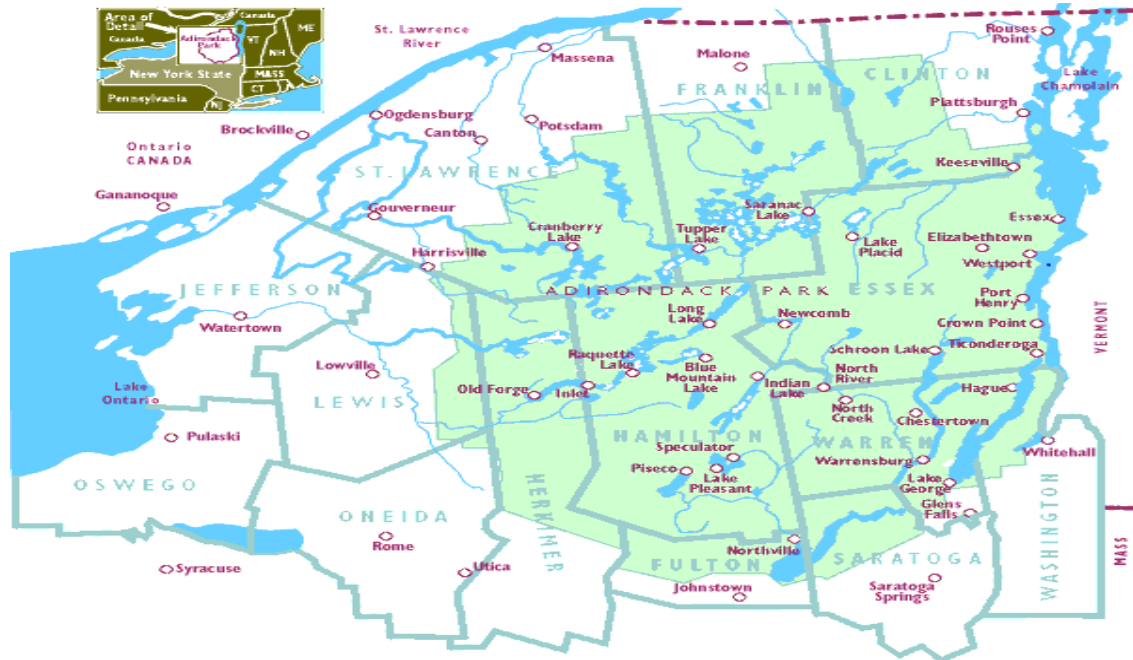


Adirondack Lake Assessment Program 2010



Thirteen Years in the program

Cranberry Lake, Loon Lake, Oven Mountain Pond, Blue Mountain Lake, Silver Lake, Eagle Lake

Twelve Years in the program

Little Long Lake, Gull Pond, Stony Creek Ponds, Thirteenth Lake, Eli Pond

Eleven Years in the program

Austin Pond, Osgood Pond, Middle Saranac Lake, White Lake, Brandreth Lake, Trout Lake

Ten Years in the program

Hoel Pond, Great Sacandaga Lake, Tripp Lake, Sherman Lake, Wolf Lake, Twitchell Lake, Deer Lake, Arbutus Pond, Rich Lake, Catlin Lake, Pine Lake, Lake of the Pines, Pleasant Lake

Nine Years in the program

Spitfire Lake, Upper St. Regis, Lower St. Regis, Garnet Lake, Lens Lake, Snowshoe Pond, Lake Ozonia, Long Pond, Lower Saranac Lake

Eight Years in the program

Raquette Lake, Lake Colby, Kiwassa Lake, Canada Lake

Seven Years in the program

Indian Lake, Schroon Lake, Lake Eaton, Chazy Lake, Big Moose Lake

Six Years in the program

Dug Mountain Pond, Seventh Lake, Abanakee Lake, Moss Lake, Mountain View Lake, Indian Lake, Tupper Lake

Five Years in the program

Sylvia Lake, Fern Lake

Four Years in the program

Adirondack Lake, Lower Chateaugay Lake, Upper Chateaugay Lake, Lake Easka, Lake Tekeni

Three Years in the program

Simon Pond

Two Years in the program

Amber Lake, Jordan Lake, Otter Pond, Rondaxe Lake

One Year in the program

Auger Lake, Lake Titus, Star Lake

Adirondack Lake
Assessment Program

Lake Easka

Summer 2010

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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' thirteenth year. The program was established to help develop a current database of water quality in Adirondack lakes and ponds. There were 70 participating lakes in the program in 2010.

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.

Results Summary

Lake Easka was sampled three times by a volunteer in 2010. Samples were collected on the following dates: 6/19/10, 7/15/10, and 8/20/10. Results for 2010 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 ($\mu\text{g/L}$) or its equivalent of parts per billion (ppb).

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

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 2010 Adirondack Lakes Assessment program, the acidity status of Lake

Easka is considered to have a satisfactory pH, alkalinity, and calcium level. The calcite saturation index shows a lake with a moderate sensitivity to 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 2010 Adirondack Lakes Assessment Program, Lake Easka is considered to be a 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 Easka ranged from 7.18 to 7.23. The average pH was 7.20. Based solely on pH, Lake Easka'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 microequivalents per liter ($\mu\text{eq/L}$). Typical summer concentrations of alkalinity in northeastern lakes are around 10 mg/l (200 $\mu\text{eq/L}$). Lake acidification status can be assessed from alkalinity as follows:

Alkalinity less than 0 ppm	Acidified
----------------------------	-----------

Alkalinity between 0 and 2 ppm	Extremely sensitive
Alkalinity between 2 and 10 ppm	Moderately sensitive
Alkalinity between 10 and 25 ppm	Low sensitivity
Alkalinity greater than 25 ppm	Not sensitive

The alkalinity of the upper waters of Lake Easka ranged from 10.8 ppm to 13.0 ppm. The average alkalinity was 11.8ppm. 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 ppm of calcium are considered to be sensitive to acidification.

The calcium in Lake Easka was measured in 2010 and it ranged from 3.46 ppm to 4.12 ppm. The average calcium concentration was found to be 3.71 ppm. These values show a lake that is not sensitive to acidification.

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:

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

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

A CSI value for Lake Easka was calculated and found to be 3.05. This value shows a lake with a moderate 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 10 ppb are associated with oligotrophic (clean, clear water) conditions. Concentrations greater than 25 ppb are associated with eutrophic (nutrient-rich) conditions.

The total phosphorus in the upper waters of Lake Easka ranged from 19 ppb to 26 ppb and averaged 21.7 ppb. This is indicative of mesotrophic 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 ppb is associated with oligotrophic conditions and those greater than 8 ppb are associated with eutrophic conditions.

The chlorophyll-a concentrations in the upper waters of Lake Easka ranged from 6.67 ppb to 7.87 ppb. The average concentration was 7.16 ppb. 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 is also 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 Easka ranged from 2.0 to 2.5 meters and the average was 2.3 meters. These values are indicative of 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 ppm in most

lakes. Elevated levels of nitrate concentration may be indicative of lake acidification or wastewater pollution.

The nitrate concentrations in Lake Easka for 2010 ranged from 0.19 ppm to 0.21 ppm and the average nitrate value was 0.20 ppm. This value is normal for an Adirondack Lake.

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 ppm. Chloride levels 10 ppm 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 ppm or less.

The chloride in the upper waters of Lake Easka was measured in 2010 and ranged from 3.2 ppm to 3.3 ppm. The average chloride concentration was found to be 3.23ppm. This value is normal for an Adirondack Lake.

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 $\mu\text{ohms/cm}$) 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 $\mu\text{ohms/cm}$, but may not be characterized by pollution inputs. Clean, clear-water lakes in our region typically have conductivities up to 30 $\mu\text{ohms/cm}$, but values less than 50 $\mu\text{ohms/cm}$ are considered normal.

The conductivity in the upper waters of Lake Easka ranged from 27.7 $\mu\text{ohms/cm}$ to 31.8 $\mu\text{ohms/cm}$. The average conductivity was 29.4 $\mu\text{ohms/cm}$.

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 Easka ranged from 52 Pt-Co to 69 Pt-Co. The average color was 59.3 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 Easka was measured in 2010 and ranged from 0.060 ppm to 0.100 ppm. The average aluminum concentration was found to be low at 0.080 ppm.

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 profile for Lake Easka for 2010 was not measured due to the lack of an AWI staff person site visit. The dissolved oxygen and temperature profile for Lake Easka for 2008 were measured and can be found in Appendix A. The dissolved oxygen stays steady from the surface to about three meters and then slightly decreases to the bottom. The oxygen level is sufficient for cold and

warm-water fish survival, although the temperature is probably too warm for cold-water fish.

Summary

Lake Easka was a moderately productive mesotrophic lake during 2007, 2008, 2009 and 2010. Based on the results of the 2007-2010 Adirondack Lakes Assessment program, the acidity status of Lake Easka is considered to have a satisfactory pH, alkalinity, and calcium level. The calcite saturation index shows a lake with a moderate sensitivity to further acidic inputs. The oxygen level is sufficient for cold and warm-water fish survival, although the temperature is probably too warm for cold-water fish.

Graphs showing trends in Lake Easka over the last four years are included in Appendix A. When comparing the results for 2007, 2008, 2009 and 2010 the pH has been fairly stable year to year with a slight increase in 2010. This has been offset by a falling alkalinity but the level still is acceptable and shows a low sensitivity to further acidic inputs. The conductivity, color, nitrate, chloride and aluminum have been fairly stable with small year to year fluctuations. The total phosphorous concentration has increased slightly over the entire four years. This has led to increased growth of algae as shown by the increasing chlorophyll-a concentrations. This increased algae growth has also caused a year to year small decline in the Secchi disk transparency readings. This should be closely monitored in the future and if the water quality continues to show this trend then sources of this increasing total phosphorous concentration should be investigated further.

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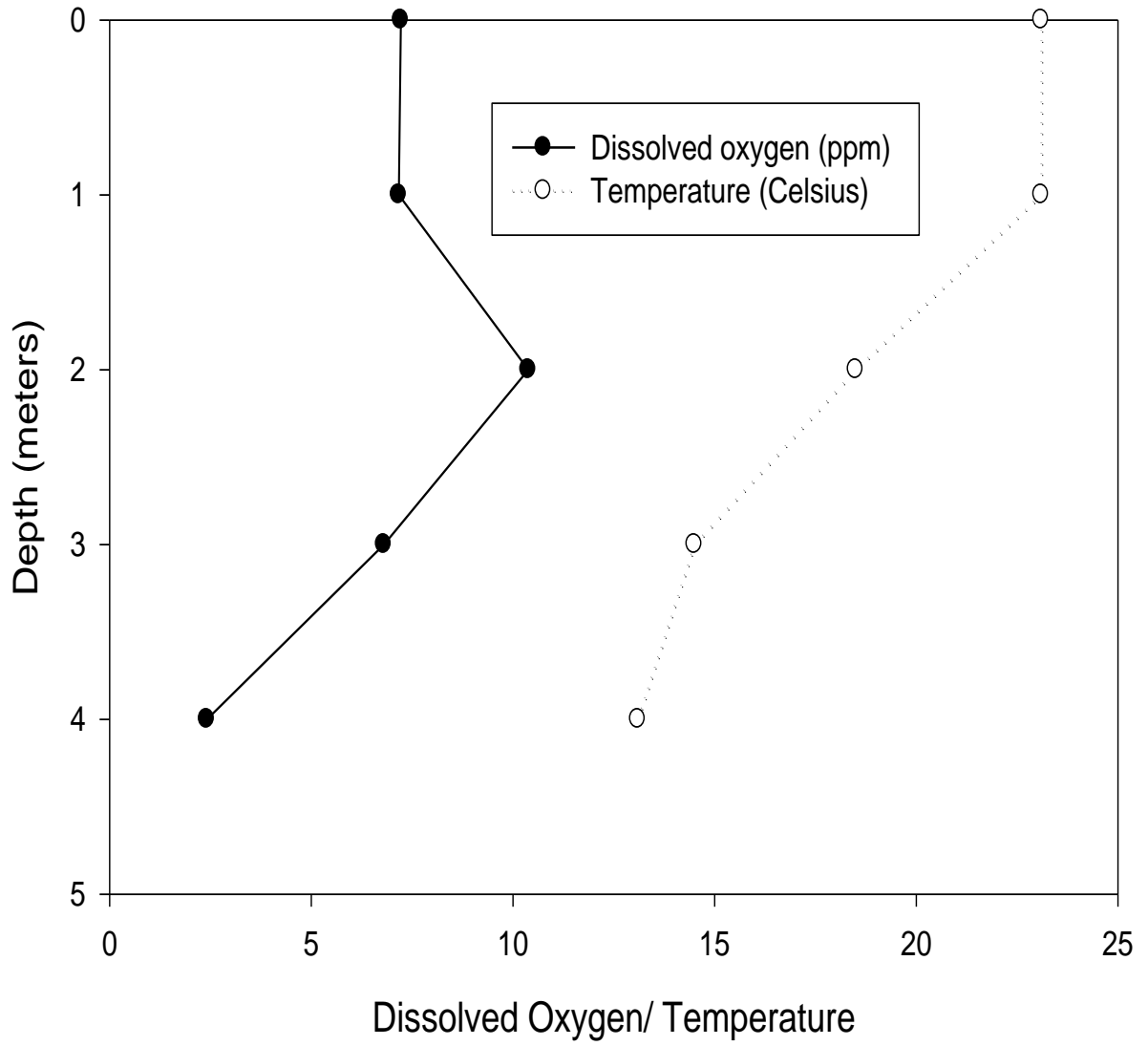
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Appendix A

Water Quality Data

Lake Easka 2008



Source	Lake Name	Sampling Location	Sampling Date	pH (units)	Alkalinity (ppm)	Conductivity (μ ohms/cm)	Color (Pt-Co)	Total P (ppm)	Chl a (μ g/l)	Secchi (meters)	Nitrate (ppm)
Vol	Easka Lake	Deephole	7/12/2007	6.55	20.40	40.2	19.0	0.0180	5.76	2.5	0.30
Vol	Easka Lake	Deephole	8/14/2007	6.54	26.80	41.0	54.0	0.0130	5.12	3.4	0.10
Vol	Easka Lake	Deephole	9/13/2007	6.56	27.20	40.5	31.0	0.0190	6.76	2.5	0.30
			MEAN	6.55	24.80	40.6	34.7	0.0167	5.88	2.8	0.23
			Std Dev	0.01	3.82	0.4	17.8	0.0032	0.83	0.5	0.12
AWI	Easka Lake	Epi	6/16/2008	6.8400	18.8000	37.2000	51.0000	0.0210	7.0400	2.2000	0.2000
Vol	Easka Lake	Deephole	6/16/2008	6.7600	18.2000	35.6000	45.0000	0.0200	6.8800	2.2500	0.2000
Vol	Easka Lake	Deephole	7/19/2008	6.5700	16.8000	31.4000	32.0000	0.0240	7.6500	2.0000	0.3000
Vol	Easka Lake	Deephole	8/20/2008	6.4900	16.2000	27.9000	34.0000	0.0180	6.7100	2.5000	0.3000
			MEAN	6.61	17.07	31.6	37.0	0.0207	7.08	2.3	0.27
			Std Dev	0.14	1.03	3.9	7.0	0.0031	0.50	0.3	0.06
AWI	Easka Lake	Hypo	6/16/2008	6.8300	18.6000	32.2000	45.0000	0.0220	x	x	0.2000
Vol	Easka lake	Deephole	6/17/2009	6.3900	12.8000	62.0000	221.00	0.0190	5.3300	2.5000	0.6000
Vol	Easka lake	Deephole	7/21/2009	6.5900	17.2000	33.4000	76.0000	0.0230	7.8600	2.0000	0.3000
Vol	Easka lake	Deephole	8/18/2009	6.5500	16.5000	33.9000	49.0000	0.0200	7.2700	2.5000	0.8000
			MEAN	6.51	15.50	43.1	115.3	0.0207	6.82	2.3	0.57
			Std Dev	0.11	2.36	16.4	92.5	0.0021	1.32	0.3	0.25
Vol	Easka Lake	Deephole	6/19/2010	7.1800	11.6000	28.8000	69.0000	0.0260	7.8700	2.0000	0.2000
Vol	Easka Lake	Deephole	7/15/2010	7.1800	10.8000	27.7000	52.0000	0.0190	6.6700	2.5000	0.2100
Vol	Easka Lake	Deephole	8/20/2010	7.2300	13.0000	31.8000	57.0000	0.0200	6.9500	2.5000	0.1900
			MEAN	7.20	11.80	29.4	59.3	0.0217	7.16	2.3	0.20
			Std Dev	0.03	1.11	2.1	8.7	0.0038	0.63	0.3	0.01
Source	Lake Name	Sampling Location	Sampling Date	Calcium (ppm)	Chloride (ppm)	Aluminum (ppm)	CSI	Acid Vulnerability			
Vol	Easka Lake	Deephole	7/12/2007								
Vol	Easka Lake	Deephole	8/14/2007								
Vol	Easka Lake	Deephole	9/13/2007								
			MEAN								
			Std Dev								
AWI	Easka Lake	Epi	6/16/2008	4.8600	3.5000	0.0020	2.5000	Low			
Vol	Easka Lake	Deephole	6/16/2008								
Vol	Easka Lake	Deephole	7/19/2008								
Vol	Easka Lake	Deephole	8/20/2008								
			MEAN								
			Std Dev								
AWI	Easka Lake	Hypo	6/16/2008	4.7200	3.5000	0.0020	2.5000				
Vol	Easka lake	Deephole	6/17/2009	3.7800	4.8000	0.0040	3.2000	Moderate			
Vol	Easka lake	Deephole	7/21/2009								
Vol	Easka lake	Deephole	8/18/2009								
			MEAN								
			Std Dev								
Vol	Easka Lake	Deephole	6/19/2010	3.4600	3.2000	0.0900					
Vol	Easka Lake	Deephole	7/15/2010	3.5600	3.2000	0.1000					
Vol	Easka Lake	Deephole	8/20/2010	4.1200	3.3000	0.0600					
			MEAN	3.71	3.23	0.08					
			Std Dev	0.36	0.06	0.02					

