2015 Water Testing Report
Bridgton Area Lakes and Ponds
Lakes Environmental Association

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Please join LEA!

If you swim, boat, fish or simply believe Maine wouldn't be Maine without clear, clean lakes and ponds, please join the Lakes Environmental Association and protect Maine's lakes now and for future generations. Our lakes face serious threats, from erosion to invasive plants. Since 1970, LEA has worked to protect the lakes and ponds of Western Maine through water quality testing, watershed education and outreach programs.

40 lakes tested

LEA protects water quality by helping landowners avoid problems such as erosion and by testing the waters of 40 lakes in Western Maine with help from volunteers and support from the Towns of Bridgton, Denmark, Harrison, Naples, Sweden and Waterford.

LEA leads the milfoil battle

Invasive aquatic plants, such as milfoil, are not native to Maine waters. Once they invade a lake or stream, they:

- Spread rapidly and kill beneficial native plants.
- Form dense mats of vegetation, making it difficult to swim, fish or boat.
- Alter native fish habitats
- Lower waterfront property values.

Watershed education

LEA offers environmental education programs to local schools, reaching over 1000 students annually. Many more people enjoy nature at LEA's Holt Pond Preserve and others join in the Caplan Series of nature programs.

Landowner and Municipal Assistance

LEA provides free technical assistance to watershed residents interested in preventing erosion on their property. This service, called the "Clean Lake Check Up" helps educate landowners about simple erosion control techniques and existing land use regulations. LEA also works with municipalities on comprehensive planning, natural resources inventories and ordinance development.

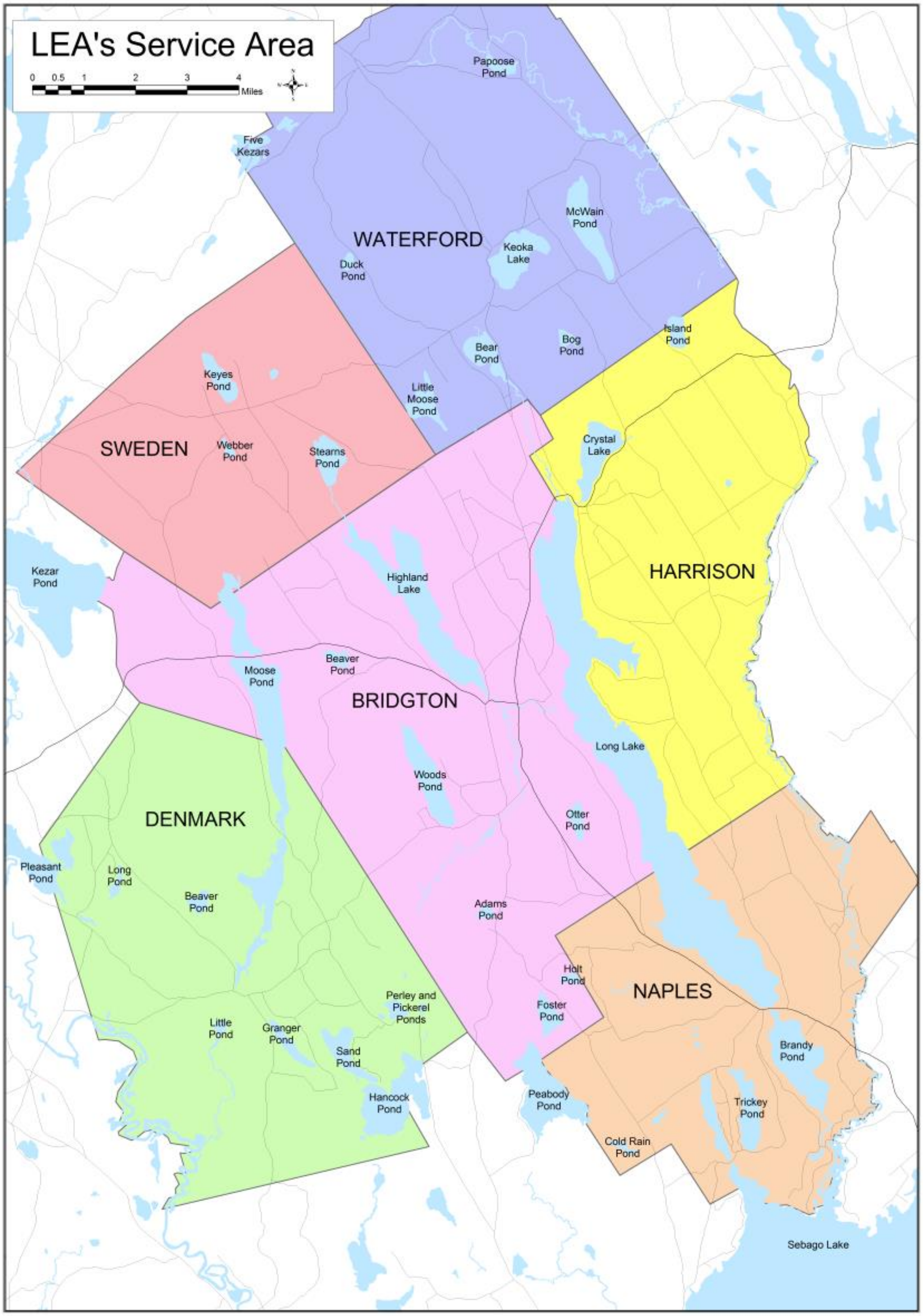
Thousands of students have learned about watersheds on LEA's "Hey You!" cruises.

You can become an LEA member with a donation of any amount. Just mail a check to LEA, 230 Main St., Bridgton, ME 04009 or join online at www.mainelakes.org.

2015 water quality at a glance

Lake	Surface Area (acres)	Watershed Area (acres)	Max. Depth (ft)	Av. Secchi (m)	Av. Color (SPU)	Av. Chl-A (ppb)	Av. Phos. (ppb)	Av. PH	Degree of Concern
ADAMS POND	43	196	51	7.8	23	5.1	8.0	6.8	High
BACK POND	62	584	33	7.1	26	2.8	5.6	6.6	High
BEAR POND	250	5,331	72	5.9	34	6.6	8.3	6.8	High
BEAVER P. (Bridgton)	69	1,648	35	6.4	48	2.3	6.0	6.8	Moderate
BEAVER P. (Denmark)	80	1,288	8	2.5	33	3.0	10.0	6.5	Moderate
BOG POND	57	254	5	1.5	60	4.5	18.0	6.5	Average
BRANDY POND	733	2,300	44	7.3	27	2.7	5.1	6.8	High
COLD RAIN POND	36	505	36	5.0	34	5.3	10.0	6.7	High
CRYSTAL LAKE	446	5,345	65	5.3	41	4.2	7.0	6.7	High
DUCK POND	38	308	11	3.3	40	7.2	13.0	8	Average
FOSTER POND	149	1,090	28	6.6	24	2.7	6.9	6.8	High
GRANGER POND	125	642	28	7.4	23	3.6	7.1	6.8	High
HANCOCK POND	858	2,222	59	7.5	23	2.8	5.9	6.8	High
HIGHLAND LAKE	1,295	5,101	50	7.6	26	3.3	6.1	6.6	High
HOLT POND	41	2,118	10	2.9	99	3.6	11.0	6.5	Average
ISLAND POND	115	1,128	48	6.7	29	2.8	6.1	6.7	High
JEWETT POND	43	638	41	5.2	49	2.8	6.0	6.8	High
KEOKA LAKE	460	3,808	42	6.4	31	3.1	6.1	6.8	Moderate
KEYES POND	191	1,213	42	6.9	27	3.6	6.9	6.6	High
KEZAR POND	1,851	10,779	12	3.1	49	2.5	12.0	6.7	Moderate
LITTLE POND	33	633	13	4.1	30	8.9	11.0	6.5	Average
LITTLE MOOSE POND	195	1,184	43	7.9	22	2.6	5.8	6.7	Mod/High
LITTLE MUD POND	5	1,661	19	2.7	90	4.2	20.0	6.3	Moderate
LONG LAKE	4,935	33,871	59	6.7	28	3.6	6.2	6.8	High
LONG POND	44	217	20	4.5	29	5.4	10.0	6.6	Moderate
McWAIN POND	445	2,505	42	6.6	28	3.3	5.8	6.8	Moderate
MIDDLE POND	72	231	50	6.0	33	4.4	6.6	6.6	Moderate
MOOSE POND (Main)	1695	11,170	70	7.4	25	2.6	4.1	6.7	High
MOOSE POND (North)	1695	11,170	20	5.2	34	5.2	9.3	6.7	Moderate
MOOSE POND (South)	1695	11,170	33	6.9	24	4.5	6.1	6.7	Moderate
MUD POND	40	1,661	35	3.9	59	1.8	8.0	6.5	Moderate
OTTER POND	90	814	21	5.0	57	2.4	6.0	6.7	Moderate
PAPOOSE POND	70	192	15	3.8	38	3.0	10.0	6.6	Moderate
PEABODY POND	740	2,522	64	8.9	24	2.6	4.6	6.8	Moderate
PERLEY POND	68	293	27	5.0	39	4.4	7.0	6.7	Moderate
PICKEREL POND	17	290	18	5.3	40	4.0	6.0	6.6	Moderate
PLEASANT POND	604	4,624	11	3.0	62	5.5	15.0	6.7	Moderate
SAND POND	256	1,394	49	5.9	27	4.0	7.3	6.8	High
SEBAGO LAKE	29,526	122,551	326	12	<10	1.2	4.4	6.7	Average
STEARNS POND	248	4,116	48	5.8	36	2.9	6.4	6.7	Moderate
TRICKEY POND	315	555	59	9.8	14	3.0	4.1	6.7	High
WEBBER POND	34	208	8	2.1	39	4.0	13.0	6.4	Average
WOODS POND	462	3,229	29	5.1	50	3.5	7.6	6.8	High

Note: Secchi disk readings, color, chlorophyll-a, phosphorus and pH are yearly averages from epilimnetic surface cores.


LEA's Service Area
0 0.5 1 2 3 4 Miles
WATERFORD
SWEDEN
HARRISON
BRIDGTON
DENMARK
NAPLES
Papoose Pond
Five Kezars
McWain Pond
Keoka Lake
Duck Pond
Island Pond
Bear Pond
Bog Pond
Keyes Pond
Little Moose Pond
Webber Pond
Stearns Pond
Crystal Lake
Kezar Pond
Highland Lake
Beaver Pond
Moose Pond
Long Lake
Woods Pond
Otter Pond
Pleasant Pond
Long Pond
Beaver Pond
Adams Pond
Holt Pond
Perley and Pickerel Ponds
Foster Pond
Little Pond
Granger Pond
Sand Pond
Brandy Pond
Hancock Pond
Peabody Pond
Trickey Pond
Cold Rain Pond
Sebago Lake

LEA would not be able to test the 40 lakes and ponds of this area without strong support from our surrounding community. Every year, we rely on volunteer monitors, lakefront landowners, summer interns and financial support from Lake Associations and the Towns of Bridgton, Denmark, Harrison, Naples, Sweden, and Waterford to continue to monitor and analyze lake water quality. **Thank you for all your help!**

2015 Volunteer Monitors and Lake Partners

Harold Arthur
Richard and Andy Buck
Steve Cavicci
Jeff and Susan Chormann
Janet Coulter
JoAnne Diller
Jane Forde
Joe and Carolee Garcia
Josh Gluck
Bill Grady
Shelly Hall
Carl and JoAnne Harbourt

Brie Holme
Kokosing
Richard LaRose
Bob Liberum
Amy March
Long Lake Marina
Bob Mahanor
Bob Mercier
Richard and Daphne Meyer
Papoose Pond Campground
Barry and Donna Patrie
Nancy Pike

Jean Preis
Carol and Stan Rothenberg
Don Rung
Jane Seeds
Carolyn Stanhope
Foster and Marcella Shibles
Arthur and Jean Schilling
Linda and Orrin Shane
Bob Simmons
Don and Pat Sutherland
Camp Wigwam
Michele Windsor

2015 Water Testing Crew

Leah Howard
Maddie Partridge
Clare Sevcik
Amanda Pratt

Lake Association Partners Who Contribute to Advanced Testing Initiatives

Five Kezar Ponds Watershed Assoc.
Hancock and Sand Ponds Association
Keoka Lake Association

McWain Pond Association
Moose Pond Association

Peabody Pond Protective Assoc.
Trickey Pond Env. Prot. Assoc.
Woods Pond Water Quality Comm.

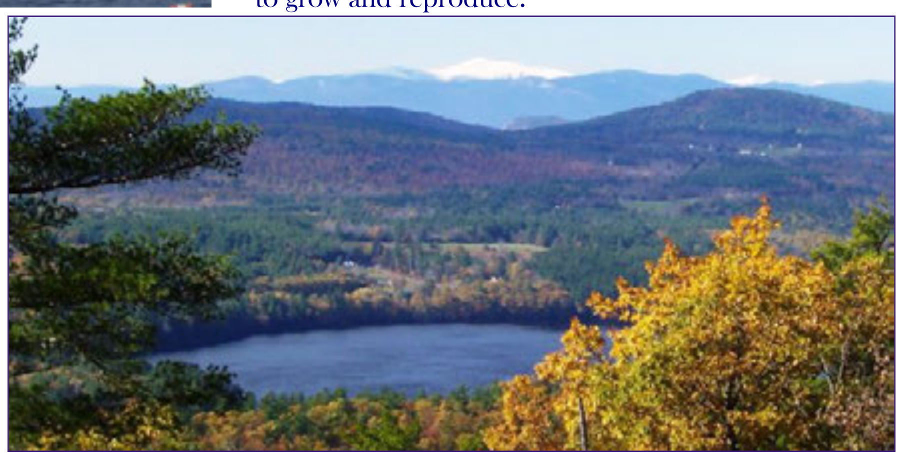
A year in the life of a lake

Winter is a quiet time. Ice blocks out the sunlight and also prevents oxygen from being replenished in lake waters because there is no wind mixing. With little light below the ice and gradually diminishing oxygen levels, plants stop growing. Most animals greatly slow their metabolism or go into hibernation.

Spring is a period of rejuvenation for the lake. After the ice melts, all of the water is nearly the same temperature from top to bottom. During this period, strong winds can thoroughly mix the water column allowing for oxygen to be replenished throughout the entire lake. This period is called spring turnover. Heavy rains, combined with snow melt and saturated soils are a big concern in the spring. Water-logged soils are very prone to erosion and can contribute a significant amount of phosphorus to the lake. Almost all soil particles that reach the lake have attached phosphorus.

Summer arrives and deeper lakes will gradually stratify into a warm top layer and a cold bottom layer, separated by a thermocline zone where temperature and oxygen levels change rapidly. The upper, warm layers are constantly mixed by winds, which "blend in" oxygen. The cold, bottom waters are essentially cut off from oxygen at the onset of stratification. Cold water fish, such as trout and landlocked salmon, need this thermal layering to survive in the warm summer months and they also need a healthy supply of oxygen in these deep waters to grow and reproduce.

Fall comes and so do the cooler winds that chill the warm upper waters until the temperature differential weakens and stratification breaks down. As in Spring, strong winds cause the lake to turn over, which allows oxygen to be replenished throughout the water column.



The three layers of lakes

The critical element for understanding lake health is phosphorus. It's the link between what goes on in the watershed and what happens in the lake. Activities that cause erosion and sedimentation allow phosphorus from the land to be transported to the lake water.

Phosphorus is a naturally occurring nutrient that's abundant on land but quite scarce in lake waters. Algae populations are typically limited by phosphorus concentrations in the water. But when more phosphorous comes into a lake, the added nutrients spur increases in algae growth.

More algae growth causes the water to be less clear. Too much algae will also use up the oxygen in the bottom of the lake. When algae die they drift to the lake bottom and are decomposed by bacteria in a process that consumes the limited oxygen supply. If deep water oxygen levels get too low, cold water fish are unable to grow or reproduce.

If there's no oxygen available at the bottom of a lake, another detrimental process called phosphorus recycling can occur. Phosphorus from sediments on the bottom become re-suspended in the water column. That doubles the lake's nutrient problem, since phosphorus is now coming from the watershed as well as the lake itself.

Lake Depth

0-30 feet

Smallmouth Bass

Epilimnion

The warm upper waters are sunlit, wind-mixed and oxygen rich.

30-36 feet

Landlocked salmon

Metalimnion

This layer in the water column, also known as the thermocline, acts as a thermal barrier that prevents the interchange of nutrients between the warm upper waters and the cold bottom waters.

Below 36 feet

Lake trout, also known as togue

Hypolimnion

In the cold water at the bottom of lakes, food for most creatures is in short supply, and the reduced temperatures and light penetration prevent plants from growing.

Water Quality Testing Parameters

LEA's testing program is based on parameters that provide a comprehensive indication of overall lake health. Tests are done for transparency, temperature, oxygen, phosphorus, chlorophyll, color, conductivity, pH, and alkalinity.

Transparency is a measure of clarity and is done using a Secchi disk. An 8 inch round disk divided into black and white quarters is lowered into the water until it can no longer be seen. The depth at which it disappears is recorded in meters. Transparency is affected by the color of the water and the presence of algae and suspended sediments.

Temperature is measured at one-meter intervals from the surface to the bottom of the lake. This sampling profile shows thermal stratification in the lake. Lakes deep enough to stratify will divide into three distinct layers: the epilimnion, metalimnion, and hypolimnion. The epilimnion is comprised of the warm surface waters. The hypolimnion is made up of the deep, colder waters. The metalimnion, also known as the thermocline, is a thin transition zone of rapidly decreasing temperature between the upper and lower layers. Temperature is recorded in degrees Celsius.

Phosphorus is a nutrient that is usually present in only small concentrations in the water column. It is needed by algae for growth and reproduction and can therefore give an indication of the potential for an algal bloom. Algal blooms caused by excess phosphorus loading can deplete dissolved oxygen levels in deep water. Phosphorus is measured in parts per billion (ppb).

Dissolved oxygen is also measured at one-meter intervals from the surface to the bottom of the lake. Over the course of the summer, oxygen is depleted in the bottom waters through the process of decomposition of organic matter like dead algae. When there is excessive decomposition, all available oxygen is used up and coldwater fisheries are threatened. If dissolved oxygen concentrations are significantly depleted in bottom waters, a condition occurs which allows phosphorus to be released into the water column from bottom sediments. This is called phosphorus recycling and can cause increased algal growth to further deplete lake oxygen levels. In this report, "oxygen depletion" refers to dissolved oxygen levels below 4 ppm. it During the fall, cooler temperatures and winds cause the lake to de-stratify and oxygen is replenished in the deep waters as the lake "turns over" and mixes. The same mixing of waters occurs in the early spring right after ice-out. Dissolved oxygen is measured in parts per million (ppm).

Chlorophyll-A is a pigment found in algae. Chlorophyll sampling in a lake gives a measure of the amount of algae present in the water column. Chlorophyll concentrations are measured in parts per billion (ppb).

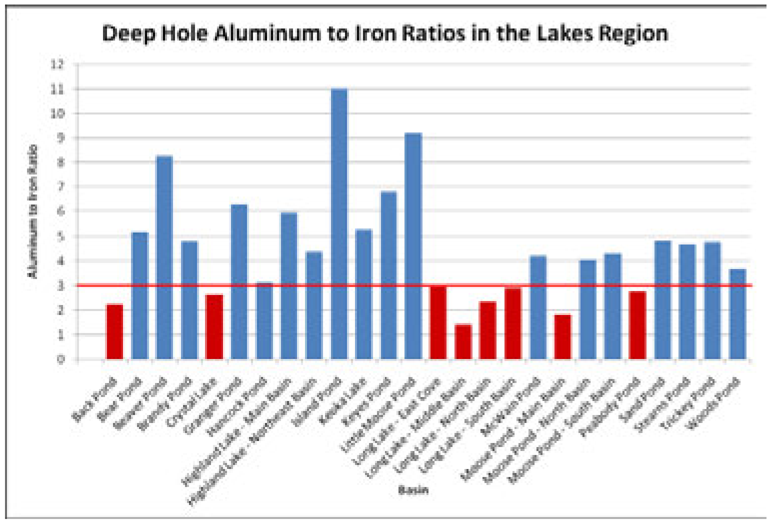
Conductivity measures the ability of water to carry electrical current. Pollutants in the water will generally increase lake conductivity. Fishery biologists will often use measurements of conductivity to calculate fish yield estimates. Conductivity is measured in micro Siemens (µs).

Color is a measure of tannic or humic acids in the water. These usually originate in upstream bogs from organic decomposition. Chlorophyll results are more important on lakes that are highly colored because phosphorus and transparency results in those lakes are less accurate. Color is measured in Standard Platinum Units (SPU).

pH is important in determining the plant and animal species living in a lake because it reflects how acidic or basic the water is. pH is a measurement of the instantaneous free hydrogen ion concentration in a water sample. Bogs or highly colored lakes tend to be more acidic (have a lower pH).

Alkalinity is a measure of the amount of calcium carbonate in the water and it reflects the ability of the water to buffer pH changes. In Maine lakes, alkalinity generally ranges from 4 - 20 parts per million (ppm). A higher alkalinity indicates that a lake will be able to withstand the effects of acid rain longer than lakes with lower alkalinity. If acidic precipitation is affecting a lake, a reduction in alkalinity will occur before a drop in pH.

Aluminum to Iron Ratio (Al:Fe) is a measure of metals in lake sediments. Recent research from the University of Maine has shown that lakes with ratios of Al:Fe above 3:1 do not release phosphorus from sediments, even under low oxygen conditions. This phosphorus instead gets bound to aluminum in the sediment. A ratio below 3:1 means that a lake is susceptible to phosphorus release from the sediments, although this may or may not actually happen and depends on other factors such as deep water oxygen levels. The graph to the right summarizes Al:Fe ratios for lakes in the Lake Region, from samples collected in 2013 at the deep-hole of each basin.



Water Quality Classification

While all lakes are sensitive to land use and activities within their watershed, the health and longevity of some lakes is more precarious than others. LEA classifies lakes into categories based on their overall health and susceptibility to algal blooms. Lakes in the *Average Degree of Concern* category are those lakes that are not currently showing water quality problems that are likely a result of human activity. The *Moderate Degree of Concern* category describes lakes where testing shows routine dissolved oxygen depletion and elevated phosphorus levels at depth that could contribute nutrients to the upper waters under certain mixing conditions. The *High Degree of Concern* category is reserved for those lakes that show signs of declining clarity or increasing phosphorus or chlorophyll levels based on long-term averages. Lakes with previous algae blooms, severe anoxia impacting fisheries, or other water quality problems are also in this category.

The following criteria are used for reviewing transparency, phosphorus, chlorophyll and color data for each lake:

Transparency (m) in meters		Phosphorus (ppb) in parts per billion		Chlorophyll-A (ppb) in parts per billion		Color (SPU) Standard Platinum Units	
10.0 +	excellent	less than 5.0	low	less than 2.0	low	less than 10.0	low
7.1 – 10.0	good	5.1 – 12.0	moderate	2.1 – 7.0	moderate	10.1 – 25.0	moderate
3.1 – 7.0	moderate	12.1 – 20.0	high	7.1 – 12.0	high	25.1 – 60.0	high
less than 3.0	poor	20.1 +	very high	12.1 +	very high	60.1 +	very high

Advanced Testing

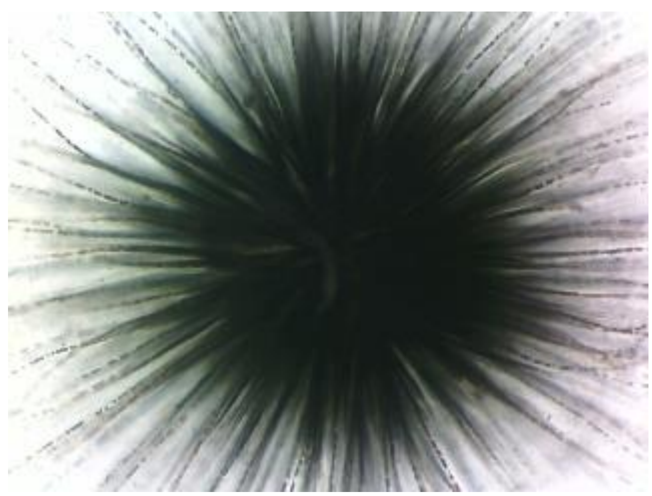
Beginning in 2012, LEA expanded its normal testing parameters and added new technology for measuring existing parameters such as temperature. Many of the results from these efforts are included in this report, where applicable. Please read below for details on this new testing and how to interpret the resulting data. The data included in this report is tailored to each specific lake. More in-depth summaries for individual projects will be released in early 2016 and available at mainelakes.org.

Gloeotrichia echinulata

Also known as "Gloeotrichia" or simply "Gloeo" (glee-oh), this is a type of algae belonging to a group called cyanobacteria (formerly referred to as "blue-green algae"). While all lakes contain algae, including cyanobacteria, understanding the relative amount and composition of algae is key to understanding lake water quality. Cyanobacteria in particular are a group of algae that are associated with water quality problems. They are usually less prevalent in low-nutrient lakes such as those in the Lakes Region. However, in the last decade or so lake scientists in the Northeast have recorded high levels of Gloeotrichia in a number of low-nutrient lakes. These algae look like tiny round balls and are much larger than most other floating algae, and are therefore very noticeable, even in small amounts. They are most abundant in late summer, usually between July and September.

LEA began sampling for Gloeotrichia in 2012. Samples are collected in shallow areas of lakes and ponds using a plankton tow net made of fine mesh, which strains the algae from the water. We measure abundance in a unit called "colonies per liter" (abbreviated col/L), which is just the number of Gloeotrichia you would see in an average liter of lake water (it helps to imagine the size of a 1 liter soda bottle). Anything below 1 col/L is very low and not a worry at this time. About 60% of the sites we've tested are in this category. The other 40%, which equates to 13 sites on 7 lakes, have all had concentrations above 1 col/L. These range from lakes that generally only have 1-2 col/L throughout the summer to those that peak at almost 200 col/L. A total of 24 lakes and ponds in this report have been sampled for Gloeotrichia, and their individual results can be found in the lake summaries. LEA will be releasing a separate overview of the 2015 Gloeotrichia sampling results in early 2016, which will be available at www.mainelakes.org.

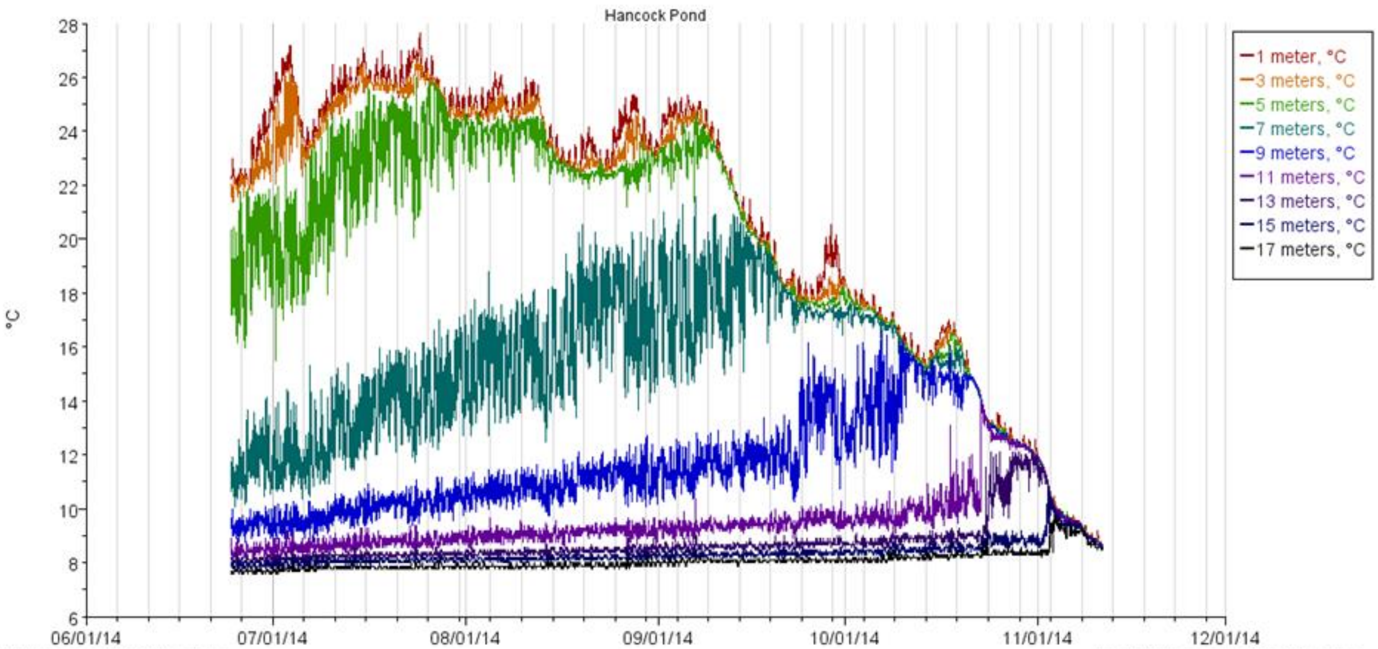
Collecting a Gloeo sample on Long Lake



Gloeotrichia echinulata colony.

HOBO Digital Temperature

LEA measured temperature on a number of lakes in this report using small Onset® HOBO digital sensors attached to a line and anchored at the deepest part of the lake. The sensors are attached at roughly 6 foot (2 meter) intervals from the top of the lake to the bottom and take temperature measurements every 15 minutes. The resulting graph can be tricky to understand, so here are a few pointers:

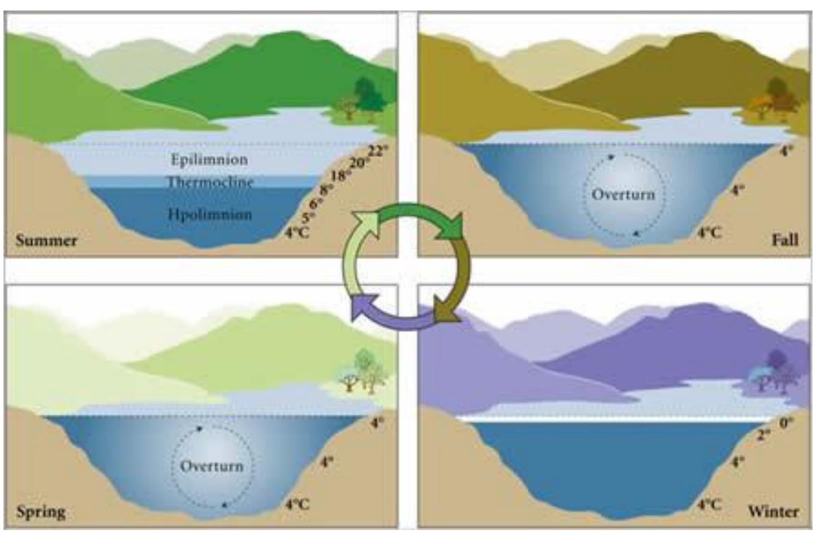


- Each colored line represents a different depth in the water. The topmost lines represent water near the top of the lake (red = 1 meter below the surface, etc.), with a difference of 2 meters (approx. 6 feet) in depth between each line.
- The graph shows temperature change over time – The horizontal axis shows the date, while the vertical axis shows the temperature (in degrees Celsius).
- When the lines are far apart, it means there is a large temperature difference between water at that depth and the water above and below it. So for example, in the above graph the teal line representing water temperatures at 7 meters has a large gap between it and the 5- or 9- meter lines throughout the first part of the graph. This large difference in temperature indicates an area of rapidly changing temperature known as the thermocline.
- On the above graph, the temperatures are fairly spread out to begin with. This indicates thermal stratification is occurring, which is the separation of water into distinct layers based on temperature: the epilimnion (warm upper water) and the hypolimnion (cold deep water). The thermocline (also known as the metalimnion) is the boundary between these layers.
- During stratification, the epilimnion does not easily mix with the hypolimnion (hence, these lines do not touch each other). It is only when the temperature of the upper water cools down that the lake can fully mix. You can see this at the right side of the graph: the temperatures near the surface get cooler and the lines converge one by one until the temperature is the same at each depth. This is known as lake turnover, which is the breakdown of thermal stratification. On the graph above, stratification fully broke down at the beginning of November.

Summaries for each lake are included in this report. A full report summarizing this season's data will be available at mainelakes.org in early 2016.

Date of Fall Turnover (Complete Mixing) by Year			
LAKE	2013	2014	2015
Back Pond	N/A	after 10/25	10/26
Hancock Pond	N/A	11/3	after 11/10
Highland Lake	after 10/11	10/12	10/11
Island Pond	N/A	11/2	after 10/27
Keoka Lake	N/A	10/22	10/23
Keyes Pond	N/A	N/A	10/26
Long Lake North	10/25	10/23	N/A
Long Lake Middle	9/16	9/12	9/28
Long Lake South	N/A	N/A	10/11
McWain Pond	N/A	10/19	10/18
Moose Pond Main	11/3	11/2	11/2
Moose Pond North	N/A	9/12	9/22
Moose Pond South	N/A	10/22	10/3
Sand Pond	N/A	after 10/30	10/31
Trickey Pond	N/A	11/2	after 11/5
Woods Pond	N/A	9/13	9/30

The table above summarizes the dates of lake mixing events over the past 3 years. This data comes from HOBO digital temperature sensors and, in the case of Highland Lake in 2014 and 2015, the remote sensing buoy. In cases where turnover is specified as “after” a certain date, this means that the lake had not fully mixed at the time the sensors were removed. More information on individual lake temperature patterns can be found in the lake summaries in this report.



Annual Pattern of Mixing
Young, M. (2004). *Thermal Stratification in Lakes*. Baylor College of Medicine, Center For Educational Outreach.

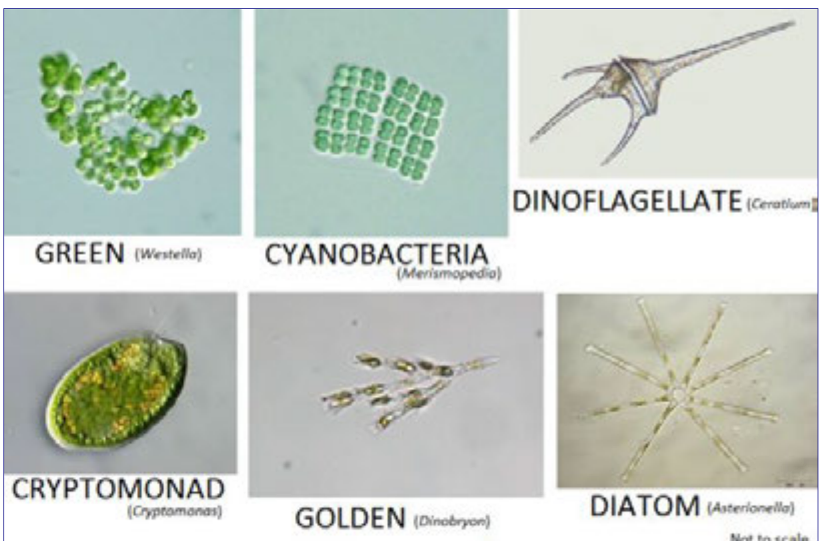
Algae Monitoring

Algae are a key parameter when it comes to measuring water quality. Algae are the foundation of lake food webs, meaning that they are the food source that directly or indirectly supports much of the animal life existing in a lake. Of course, algae are also the source of algal blooms, which result from an over-abundance of nutrients or a lack of algae-eating organisms. Either way, algal blooms are a sign of a water quality problem, a situation that is bad for people and for the lakes themselves. LEA began counting algae populations directly in several lakes in 2015. Samples from the epilimnion of these lakes were collected between July and September using a plastic coring tube. Samples were concentrated and then a subsample was counted. Algae were identified to genus level where possible.

All algae identified belonged to one of 6 categories: green algae, cyanobacteria, dinoflagellates, cryptomonads, golden algae, and diatoms. Green algae are a diverse group, with common characteristics including their dominant pigments, chlorophyll-a and chlorophyll-b, which give them a deep grassy green color. Cyanobacteria are the most liable to form blooms and are also known to produce toxins. They are actually more closely related to bacteria than to other algae, hence their name change from "blue-green algae" to cyanobacteria. Dinoflagellates are a small group made up of large, motile algae. Cryptomonads are one-celled algae with two flagella which allow them to move through water. Golden algae are a group distinguished by their brown or yellow color and tend to be more common in low-nutrient lakes. Finally, Diatoms have hard, silica-based outer shells which make them unique from other types of algae.

The algae collected by LEA were counted as individual cells, so the results presented are not biomass estimates and cannot be directly correlated with chlorophyll concentration. Some algae are very large one-celled organisms whereas others (notably many cyanobacteria) are made up of many very small cells. Additionally, it is difficult to draw conclusions about specific water quality consequences of algae because this varies greatly depending on other lake factors. For instance, some species of *Merismopedia* are associated with clean water, whereas others are found in polluted water. In general, a diverse array of algae is preferable to one or two dominant species and the amount of cyanobacteria should be relatively low.

Lakes and ponds with algae data will contain a short summary in that lake's section in this report. Further information on LEA's algae monitoring program and overall results from this year's monitoring will be compiled into a report which should be available in early 2016 at maine-lakes.org.

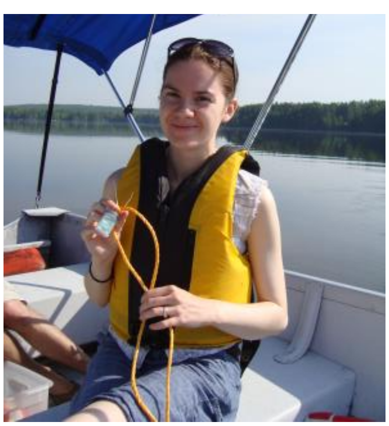


Examples of common algae in each of the 6 groups that were part of LEA's algae monitoring program.

2015 as a Year

2015 was a year of unusual weather patterns and broken records. This weather was the likely driver for many of the overall water quality patterns observed. Despite a bitterly cold winter and a cool June, temperature for the year was still above average. Rainfall, however, was below average during our testing season and for the year as a whole. In general, less precipitation means less particulates as well as nutrients from runoff in the water column and therefore better clarity. Overall, better-than-average clarity was observed in 76% of the lakes tested in our area and there was less phosphorus in 89% of the waterbodies tested. Both these statistics are good news and were likely a result of the weather. However, chlorophyll, which is the green pigment found in all plants and algae was above average on 59% of the lakes and ponds LEA tests. This is unusual because phosphorus levels were lower than average and this nutrient is generally the controlling factor for algae growth and thus chlorophyll. While these two parameters often do not follow the exact same pattern, they are often closely related. One possible explanation for this divergence is that the lakes were warmer overall and these conditions allowed for algae populations to continue to thrive later into the growing season. This corresponds with data from our in-lake temperature sensors, which showed that peak temperature was almost a month later in the year than recorded in the last few years.

2015 marked the 5th year of *Gloeotrichia* sampling, which is a species of blue-green algae that has been linked to water quality problems in other relatively pristine lakes in Maine. This past year, *Gloeotrichia* levels were lower in most lakes with the exception of sites in Harrison on Long Lake and one of the basins of Moose Pond. The highest concentrations of this algae also came later in the season than in the previous two years. In the spring of 2016 we added strings of high definition temperature sensors to Keyes Pond and the south basin of Long Lake. This brings the total number of continuous in-lake temperature monitoring locations to 16 in our service area, of which 15 are strings of sensors that record temperature and stratification from the surface to the bottom of the lake. In the spring of the year, we received an analysis back on deep sediment cores taken from Highland and Long Lakes from the University of Maine's Climate Change Institute. A summary of this information can be found in the individual summary reports of both of these lakes. After its second year of deployment, LEA has also compiled and summarized interesting findings and data from the automated water quality monitoring buoy on Highland Lake. Past readers will also notice that the format of this report has now changed to include data collected from LEA's advanced testing initiatives. We hope that this new format will give readers a more complete and accessible snapshot of current and past water quality conditions on each particular lake or pond.



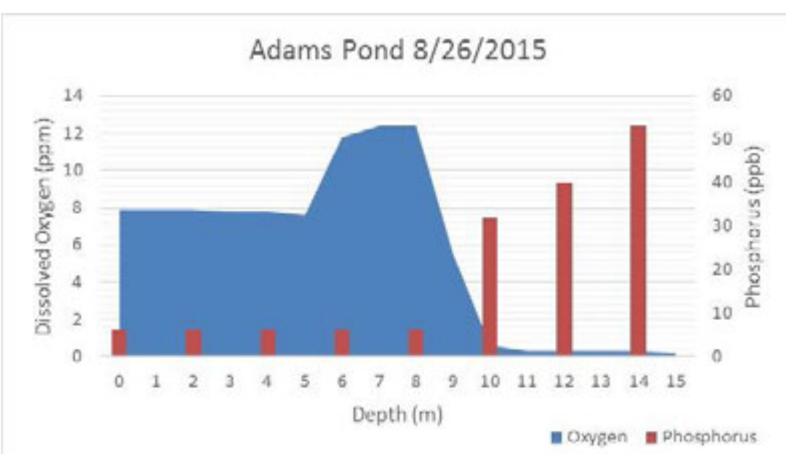
Individual Lake Summaries

The following pages present this year's data by lake, including results of routine monitoring and advanced testing.

Adams Pond

The average Secchi disk reading of 7.8 meters was deeper than the long-term average of 7.2 meters. Low oxygen conditions were first observed in May and for most of the summer the bottom 6 meters of the water column were depleted of oxygen. Phosphorus concentrations from the surface waters averaged 8.0 ppb for the season, which is higher than the long-term average of 6.9 ppb. In the waters below the thermocline, phosphorus concentrations increased to high levels and averaged 41 ppb. Alkalinity averaged 10 ppm, higher than the long-term average of 9 ppm. The pH was the same as the long-term average at 6.8. Chlorophyll averaged 5.1 ppb, which was above the long-term average of 2.7 ppb. Average conductivity was 37 µs, which was above the long-term average of 31 µs. Average color was 23 SPU. Dissolved oxygen depletion and elevated phosphorus levels in the bottom waters are frequently observed in Adams Pond. Long-term trends indicate an increasing trend in chlorophyll and phosphorus concentrations. For these reasons, Adams Pond remains in the HIGH degree of concern category.

Gloeotrichia: Very low levels of *Gloeotrichia* (well below 1 colony per liter) were found in a sample taken from Adams Pond in August. A sample from 2014 also showed a very low level of the algae present.



Adams Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi : Better
Chlorophyll: Worse
Phosphorus: Worse

Surface Area:	43 acres
Maximum Depth:	51 feet
Mean Depth:	27 feet
Volume:	955 acres/feet
Watershed Area:	196 acres
Flushing Rate:	0.54 flushes per year
Elevation:	640 feet

Beaver Pond (Bridgton)

The 2015 Secchi disk reading of 6.4 meters was deeper than the long-term average of 5.1. Oxygen depletion was slightly better than in previous years. Phosphorus concentrations in the surface waters were 6.0 ppb, which was below the long-term average of 9.2. Alkalinity was the same as the long-term average of 9 ppm. pH was 6.8, higher than the long-term average of 6.7. Chlorophyll was 2.3 ppb for the year, which is below the long-term average of 4.7 ppb. Conductivity was 63 µs, which is above the long-term average of 42 µs. Color was 48 SPU. The Al:Fe ratio is 8.3:1, indicating a low potential for internal phosphorus release. Due to dissolved oxygen depletion and high phosphorus levels at depth, Beaver Pond is in the MODERATE degree of concern category.

Beaver Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi : Better
Chlorophyll: Better
Phosphorus: Better

Surface Area:	69 acres
Maximum Depth:	35 feet
Watershed Area:	1,648 acres
Flushing Rate:	3.7 flushes per year
Elevation:	473 feet

Gloeotrichia: Beaver Pond was sampled for *Gloeotrichia* in late July. There was less than 1 col/L of the algae present. The sample collected in 2014 contained no *Gloeotrichia.*

Foster Pond

The 2015 Secchi disk average of 6.6 meters was less deep than the long-term average of 6.9 meters. Slight oxygen depletion was only evident at the bottom of the pond beginning in August. Phosphorus concentrations in the surface waters averaged 6.9 ppb for the year, which is below the long-term average of 7.1 ppb. Alkalinity was 6 ppm, matching the long-term average. Average chlorophyll was 2.7 ppb, which is above the long-term average of 2.3 ppb. Average conductivity was 18 µs, above the long-term average of 17 µs. Color was 24 SPU and pH matched the long-term average of 6.8. Due to deteriorating clarity and chlorophyll trends since 2000, Foster Pond has been elevated to the HIGH degree of concern category.

Gloeotrichia: A sample from Foster Pond collected in August contained no evidence of *Gloeotrichia.* A previous sample in 2014 did contain the algae in very low levels.

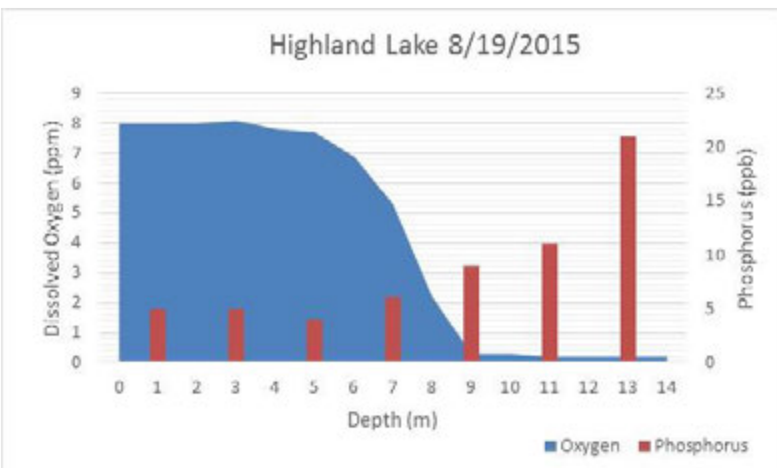
Foster Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi : Worse
Chlorophyll: Worse
Phosphorus: Better

Surface Area:	149 acres
Maximum Depth:	28 feet
Mean Depth:	17 feet
Volume:	2,382 acres/feet
Watershed Area:	1,090 acres
Flushing Rate:	0.93 flushes per year
Elevation:	470 feet

Highland Lake

The 2015 Secchi disk average of 7.6 meters was deeper than the long-term average of 6.7 meters. Dissolved oxygen depletion rapidly set in across the bottom 6 meters of the lake in mid-June. As the summer continued, the depletion increased in severity, eventually impacting the bottom 8 meters of the lake. Phosphorus concentrations in the surface waters averaged 6.1 ppb, which is below the long-term average 6.6. Below the thermocline, phosphorus concentration averaged 10.2 ppb. Average alkalinity was 7.5 ppm, which is above the long-term average of 7 ppm. Color was 26 SPU on average and pH was 6.6, slightly below the long-term average of 6.7. Chlorophyll readings averaged 3.3 ppb, which is higher than the long-term average of 2.9 ppb. Conductivity was 37 µs, which was above the long-term average of 29 µs. A deep sediment core, which was used to measure changes in diatom algae preserved in sediments, suggests that Highland Lake has been experiencing longer periods of stratification starting in the 1950s. The drivers from this shift may include lower wind strength, earlier ice-out, and/or warmer overall temperatures. Shallow sediment cores were collected from two sites in Highland Lake in 2013. Both sites had Al:Fe ratios higher than the 3:1 threshold which has been shown to suppress internal phosphorus release. Due to significant dissolved oxygen depletion and increasing anoxic extent, Highland Lake remains in the HIGH degree of concern category.



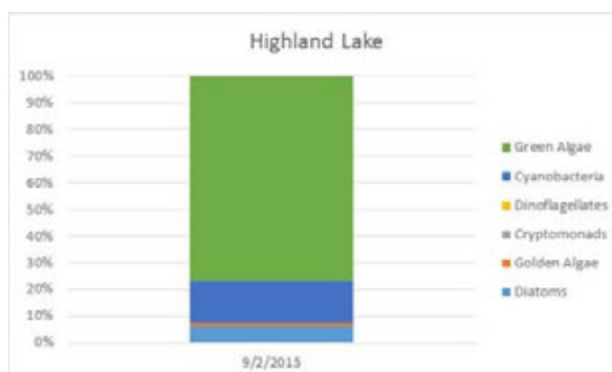
Highland Lake Quick Statistics
2015 Average Versus the Long-term Average:

Secchi: Better
Chlorophyll: Worse
Phosphorus: Better

Surface Area:	1,334 acres
Maximum Depth:	50 feet
Mean Depth:	20 feet
Volume:	44,030 acres/feet
Watershed Area:	5,178 acres
Flushing Rate:	0.94 flushes per year
Elevation:	426 feet

Gloeotrichia: Two sites on Highland Lake have been tested for *Gloeotrichia* in each of the past three years. The public boat launch site has had slightly higher levels than the northwestern cove site, but in every case the overall levels have been less than 1 col/L.

Algae: One algae sample was collected from Highland Lake in early September. The majority of algae counted were green algae at 77% of the sample. Cyanobacteria (blue-green algae)made up about 16% of algae counted. The most common genus of algae seen was *Westella,* a small green algae that forms clusters of cells. Ten other types of algae were identified in the sample.



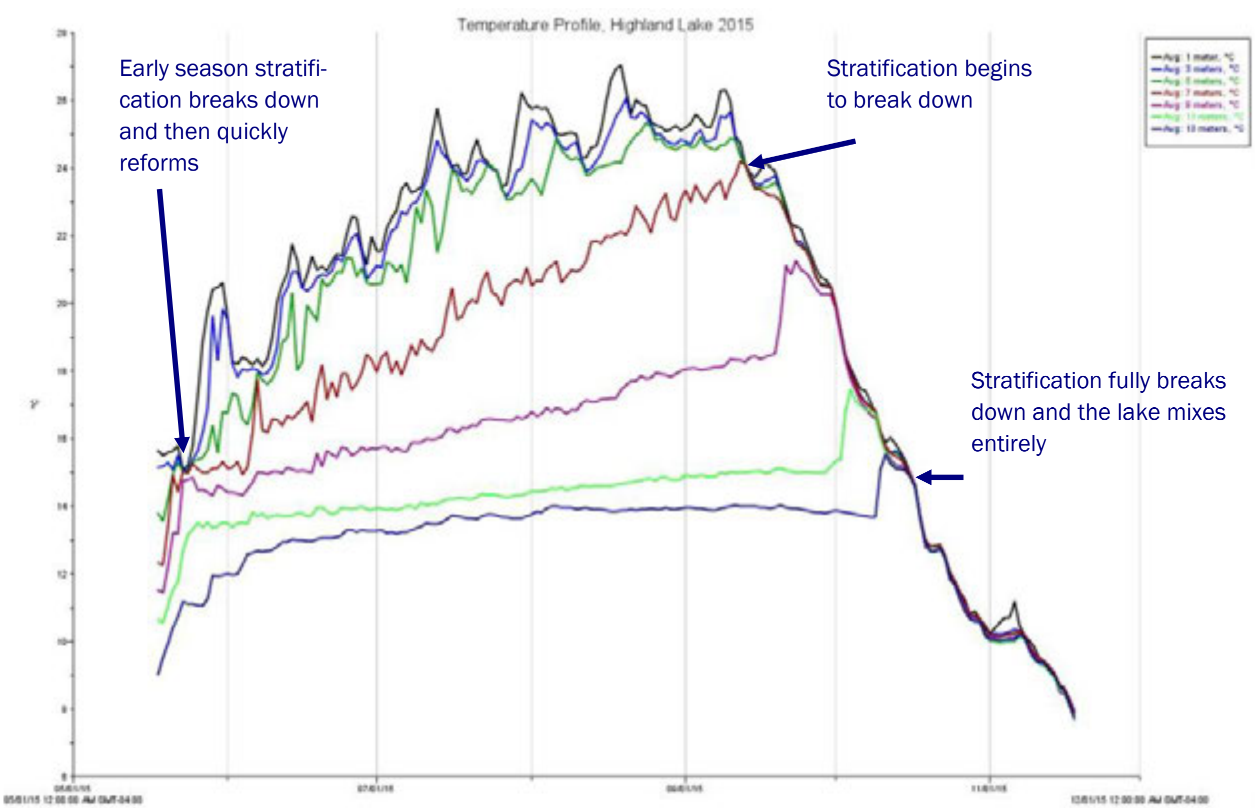
Date of Fall Turnover (Complete Mixing)			
	2013	2014	2015
Highland Lake	after 10/11	10/12	10/11

Highland Lake Automated Buoy

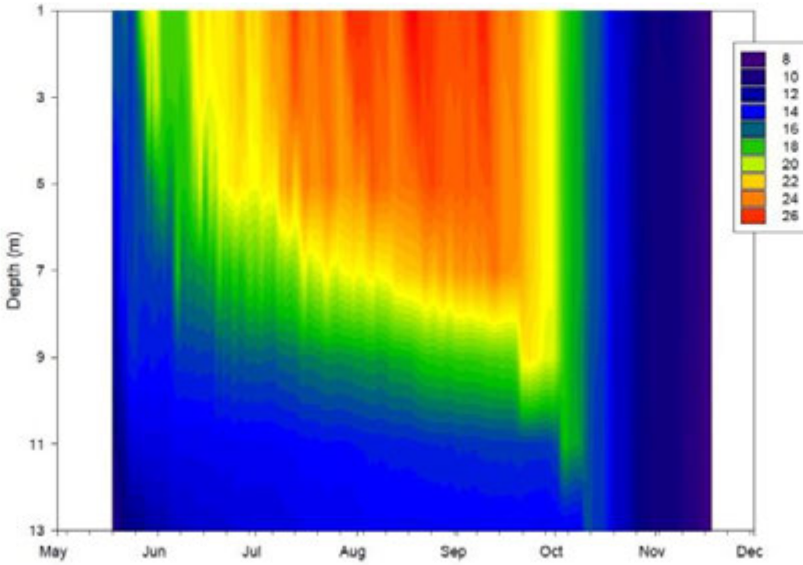
2015 was the second year of deployment for LEA's high-tech, automated sampling buoy on Highland Lake. The buoy monitors oxygen concentrations and temperature at every other meter from the surface to the bottom of the lake, chlorophyll concentrations via a fluorometer and relative clarity by monitoring light conditions in the air and underwater. The buoy takes readings every 15 minutes and sends those readings back to LEA through a cell signal. This information is then coupled with live weather data from a station on the ridge overlooking the lake.

In 2015, the buoy was launched on May 18th and removed from the lake on November 18th.

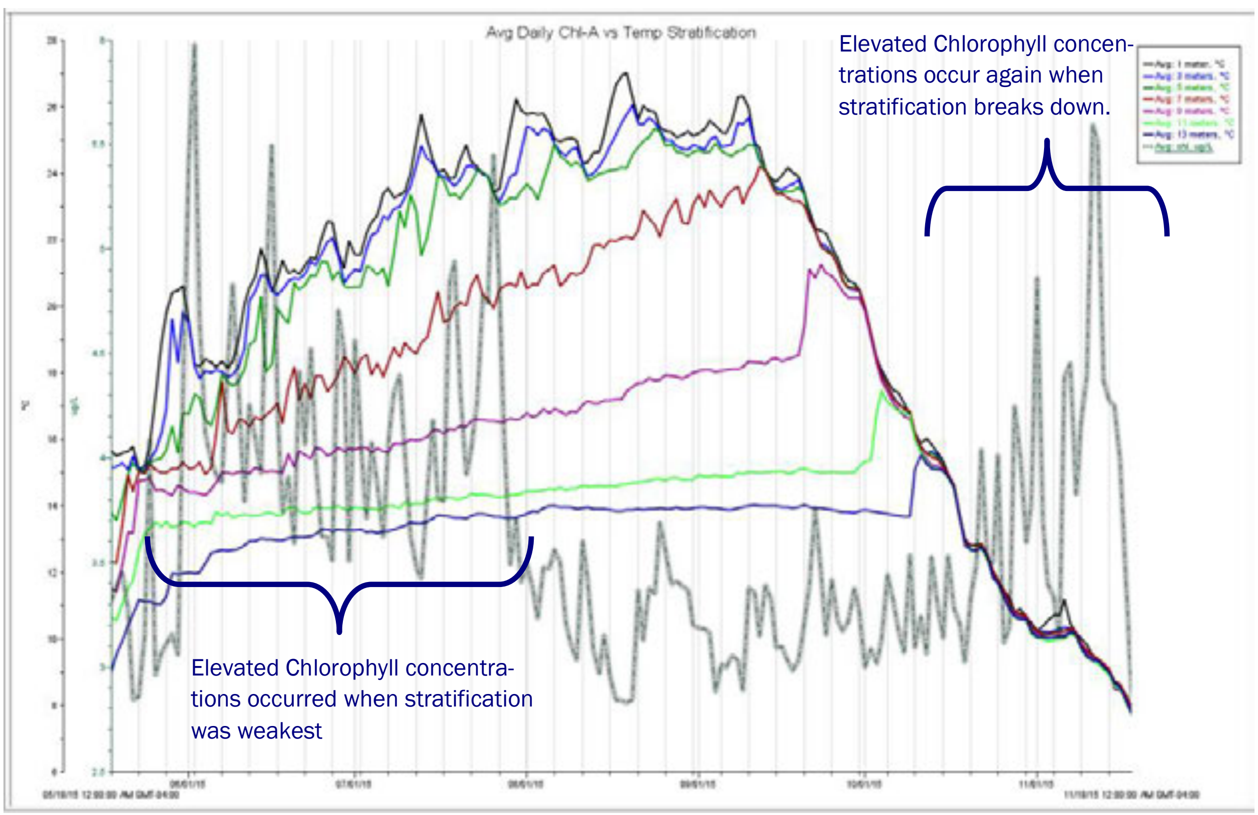
Temperature and Stratification: The warmest temperature recorded in the surface water was 27.8°C (82.0 °F). The entire water column was uniformly around 8°C (46 °F) when the buoy was removed and this was the coolest water temperature reading. The lake had just begun to stratify when the buoy was installed on May 18th. However, a few days after deployment, winds broke down this early stratification in all the water down to at least 9 meters. Soon after this time stratification began to reform and for the majority of the summer, the top 5 meters were isolated by differences in temperature and pressure from the lower waters. Stratification remained strong until mid September when upper waters began to cool slightly and mix with lower waters. A full breakdown of the lake's layers occurred on October 11th.



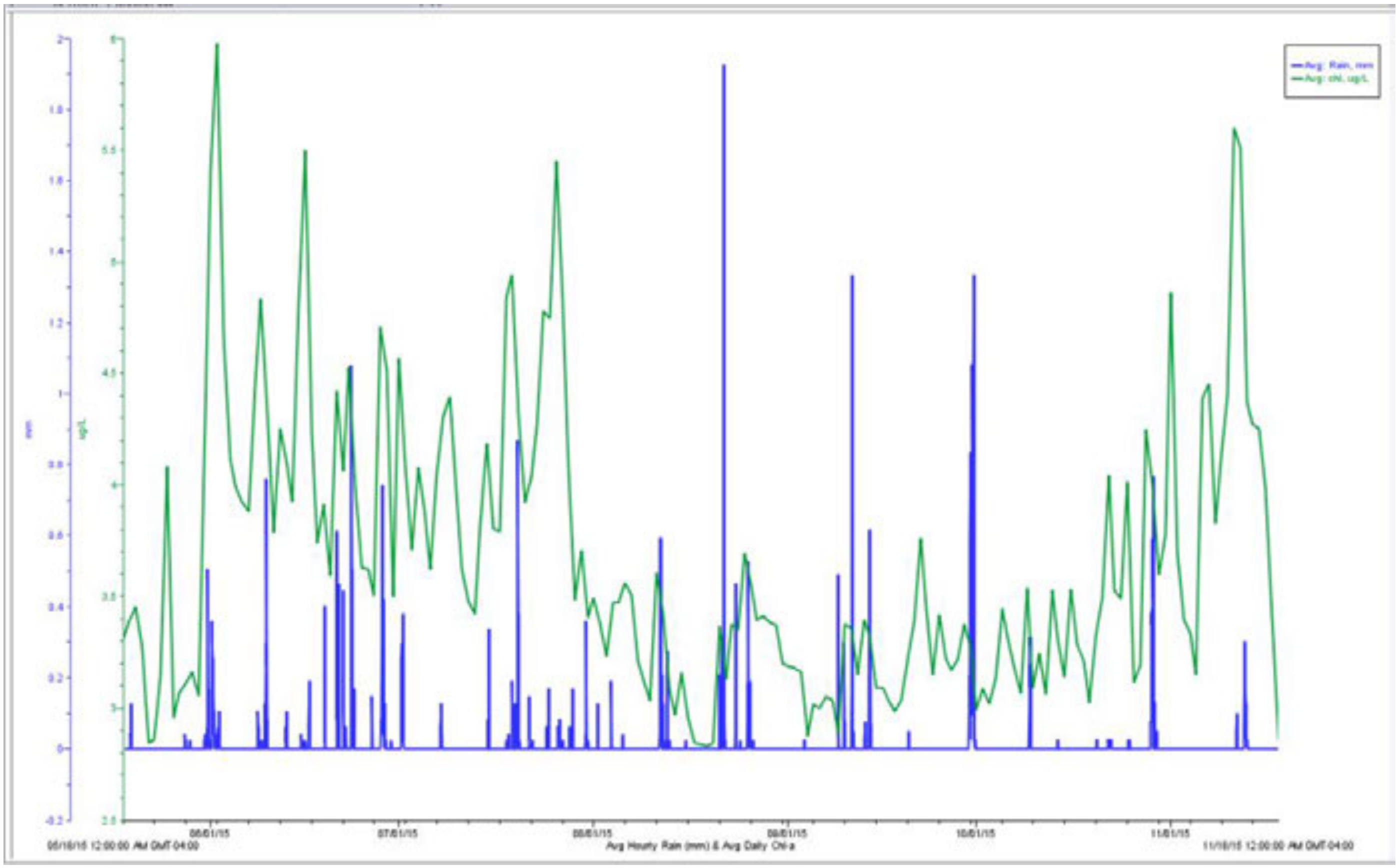
Highland Lake Heat Map: The image to the right represents the temperature conditions in Highland Lake over the course of the summer. The top of the image is the top of the lake. Reds and oranges are warmer waters and blues and purples are colder waters. The blue/purple stretching from the top to the bottom shows how the lake was uniformly mixed in the early and late season. This image quickly expresses the duration and extent of warmed water over the course of the season.



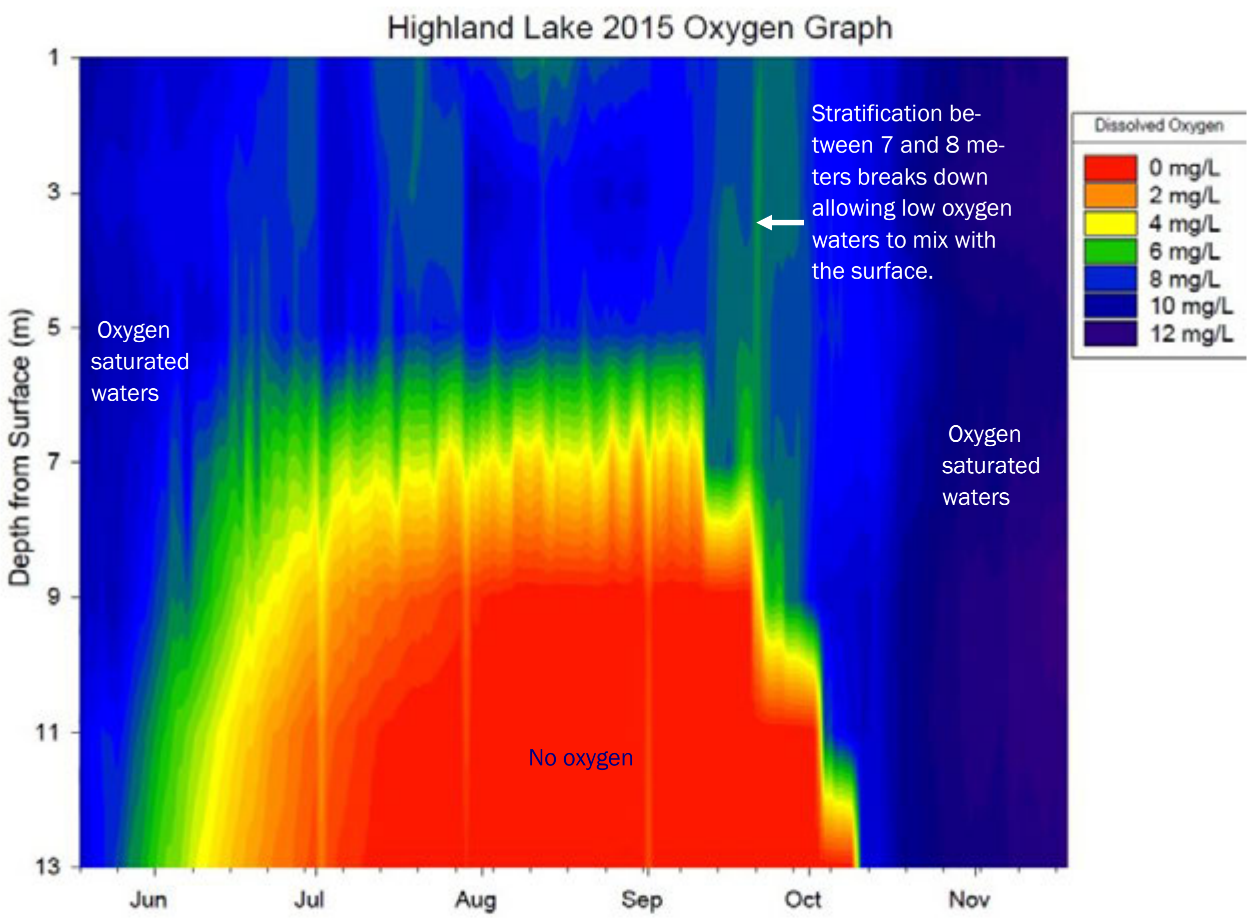
Chlorophyll/Algae growth: Chlorophyll, which is the green pigment in all plants and algae was measured with an optical fluorometer installed at 1.7 meters below the surface. Fluorometers can give immediate data on relative chlorophyll concentrations and while it is reported here in ug/l (which is the same as ppb), it is important to recognize these readings are relative and not the same as the results acquired through water samples analyzed through spectrophotometry (which is LEA's standard methodology for assessing chlorophyll concentrations). From the buoy's fluorometer, peak chlorophyll concentrations of 21.8 ug/l occurred on May 25. The average chlorophyll concentration at this depth for the season was 3.7ug/l. Elevated levels were seen in the spring when stratification was weak and again in the fall after the stratification broke down. This information indicates that lake layering plays a major role in algae concentrations.



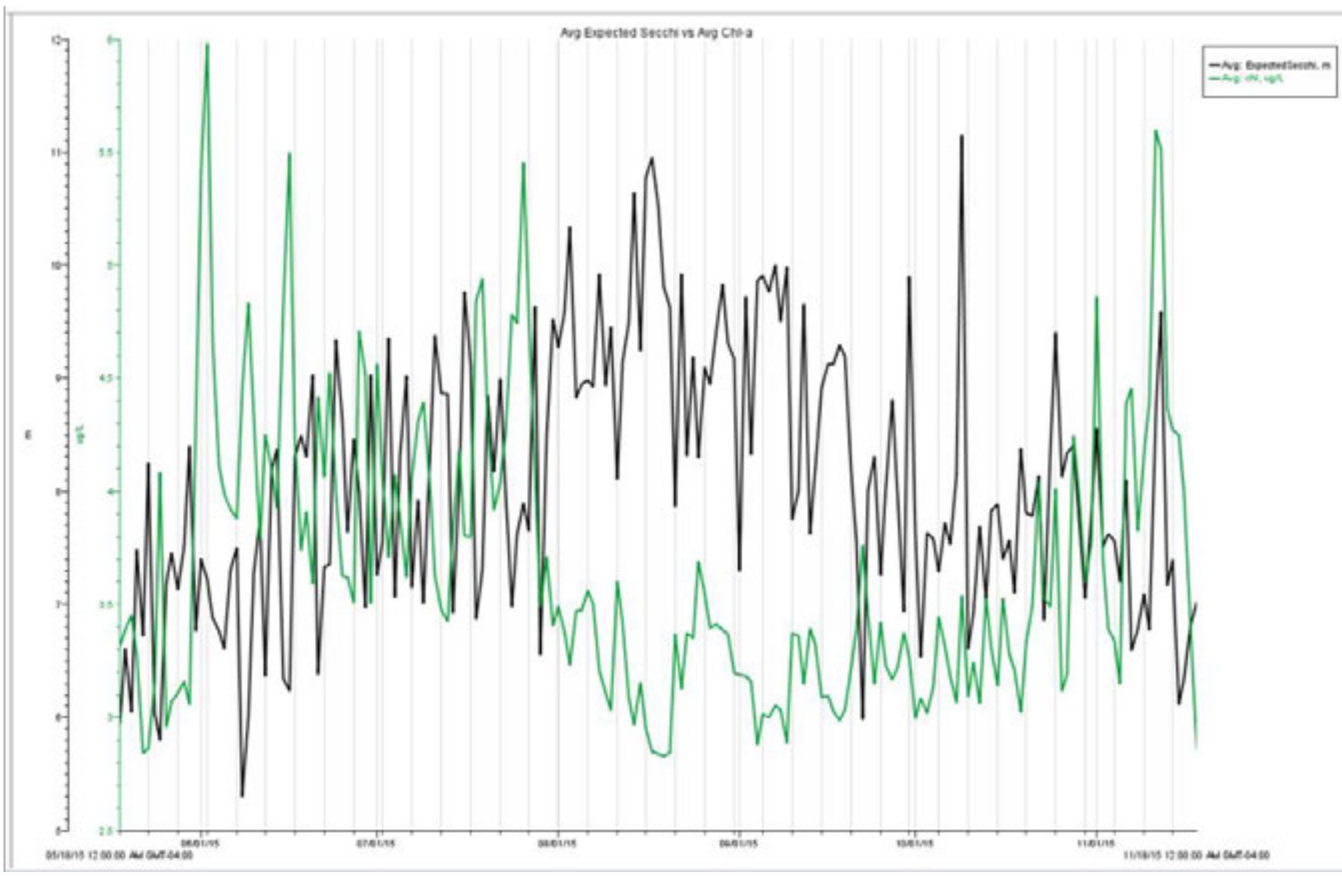
Precipitation: A correlation between precipitation events and chlorophyll concentrations was not as easily discernible from data gathered in 2015. However, elevated chlorophyll levels do coincide with the more regular rainfall events in the spring and for most large rainstorms, there are subsequent elevated chlorophyll levels. The connection between rainfall and algae growth merits further study to better understand lag times and other controlling factors.



Oxygen Conditions: By having continuous oxygen monitoring from the surface to the bottom of the lake, we can better understand the extent and duration of oxygen depletion. The image below gives a quick overview of oxygen conditions in the lake throughout the season. Similar to the heat map already discussed, the top of the graphic represents the top of the lake and time from deployment to removal is represented along the bottom axis. Blues and purples represent fully oxygenated waters, green is moderately oxygenated and yellow and orange are severely depleted. Red indicates anoxia or no oxygen. Most aquatic life is unable to survive when oxygen levels are below 4 mg/l. The light yellow vertical lines that extend above "Jul", "Aug" and Sep" are a result of sensor calibrations and not a deviation in condition. The severity and breadth of oxygen depletion is quite dramatic in the image, however it is important to understand that this information is compiled from the deepest portion of the lake only. Areas that are shallower would have less dramatic anoxia but still virtually no habitat for native, cold water fish. This is a result of low oxygen conditions within 7 meters of the surface and warm water that is inhospitable to trout species reaching down to that same depth from mid June through mid October. Notice that while oxygen depletion occurs in a linear progression in the early season (shown on the graph as relatively smooth, upward, rainbow-like curve from the bottom), re-oxygenation occurs in a more stepped fashion. This is a result of surface water cooling down and individual lake layers mixing and is shown on the graph in the September through October time period. The vertical "horn" of green that occurred in late September is likely a result of low oxygen water from mid-depths mixing with the surface as stratification begins to break down.



Light attenuation/clarity: Photosynthetically Active Radiation (PAR) sensors are installed on the top of the buoy and at 1.7 meters below the surface of the water. These sensors measure solar radiation over the range of wavelengths that plants use to photosynthesize (400–700 nanometers). By measuring the difference between these two sensors, we can estimate changes in water clarity that would effect algae growth. By applying a formula developed from past research and individual clarity readings taken by Secchi Disk on Highland Lake, this data may be able to be used in the future as a surrogate for Secchi Disk readings. The graph below shows average clarity based on data from the two PAR sensors in black versus average chlorophyll readings (in green) from the buoy's fluorometer. This graph shows that during the mid summer months, the water was most clear and that matched up with the time when there was the least amount of algae.



Holt Pond

The 2015 Secchi disk reading reached the bottom of the pond at 2.9 meters. Dissolved oxygen depletion was observed in the bottom two meters of the shallow water column during August sampling. The phosphorus concentration was 11.0 ppb, which is less than the long-term average of 13.1 ppb. Alkalinity was 10 ppm, which is more than the long-term average of 9 ppm and pH was 6.5, which is above the long-term average of 6.4. Chlorophyll was 3.6 ppb, which is below the long-term average of 3.9 ppb. Conductivity was 46 µs, which is above the long-term average of 35 µs and color was 99 SPU. Holt Pond's large watershed, shallow depth and surrounding wetlands are likely accountable for much of the pond's water quality characteristics. Holt Pond remains in the AVERAGE degree of concern category.

Holt Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi: Hit Bottom
Chlorophyll: Better
Phosphorus: Better

Surface Area:	41 acres
Maximum Depth:	10 feet
Mean Depth:	7 feet
Watershed Area:	2,118 acres
Flushing Rate:	46 flushes per year
Elevation:	455 feet

Kezar Pond

The 2015 Secchi disk reading on Kezar Pond was 3.1 meters, with the disk hitting the bottom of the pond. Dissolved oxygen depletion was not observed in Kezar Pond's shallow water column this year. The phosphorus concentration was 12.0 ppb, below the long-term average of 18.8 ppb. Alkalinity was 9 ppm, exceeding the long-term average of 8 ppb, and pH matched the long-term average of 6.7. The chlorophyll concentration was 2.5 ppb, which is below the long-term average of 4.5 ppb. Conductivity was 33 µs, which is more than the long-term average of 26 µs and color was 49 SPU. There are increasing chlorophyll and phosphorus trends on the pond, however because it is only sampled once a year, there is not enough data available to adequately assess these trends. Kezar Pond is in the MODERATE degree of concern category.

Kezar Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi: Hit Bottom
Chlorophyll: Better
Phosphorus: Better

Surface Area:	1,851 acres
Maximum Depth:	12 feet
Watershed Area:	10,779 acres
Elevation:	369 feet

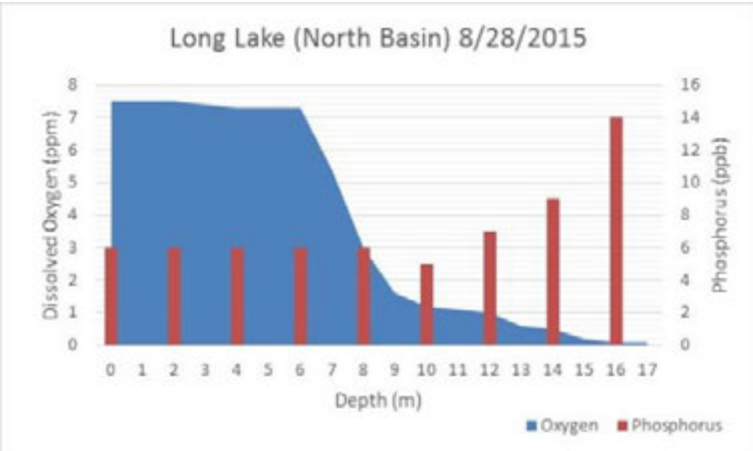
Long Lake

North Basin – The 2015 Secchi disk average was 6.5 meters, deeper than the long-term average of 6.2 meters. A lack of deep-water oxygen was evident in July and by the last sampling in September the bottom 9 meters, or half of the water column, was affected by oxygen depletion. Oxygen and temperature data from much of the summer showed no suitable habitat for cold water fish species. Phosphorus concentrations in the surface waters were 6.8 ppb, which is below the long-term average of 7.5 ppb. Phosphorus levels below the thermocline averaged 8.2 ppb. Alkalinity was 9 ppm, which was above the long-term average of 8 ppm. Conductivity was 47 µs on average, which is above the long-term average of 39 µs and pH was the same as the long-term average of 6.8. Chlorophyll was 3.9 ppb, which is above the long-term average of 3.0 ppb. Average color was 28 SPU. The Al:Fe ratio of north basin sediments is 2.4:1, which is under the 3:1 threshold that prevents internal phosphorus release. However, the Al:P ratio was high, indicating that there is enough aluminum in the sediment to counteract any phosphorus release that may occur.

Middle Basin – The 2015 Secchi disk average was 6.9 meters, which is deeper than the long-term average of 6.3 meters. Dissolved oxygen depletion was first observed in July. The lack of oxygen affected the bottom 8 meters of the water column by September. Suitable habitat for cold water fish was absent from the middle basin's water column for the majority of the summer. Phosphorus concentrations in the surface waters averaged 5.6 ppb, which is below the long-term average of 6.8 ppb. Phosphorus concentrations below the thermocline averaged 8 ppb. Average alkalinity was the same as the long-term average of 8 ppm and pH was 6.7, matching the long-term average. Chlorophyll was 3.8 ppb, which is above the long-term average of 2.9 ppb. Conductivity was 47 µs on average, which is above the long-term average of 39 µs and color was 28 SPU. The Al:Fe ratio of middle basin sediments is 1.4:1, which is under the 3:1 threshold that prevents internal phosphorus release. However, the Al:P ratio was high, indicating that there is enough aluminum in the sediment to counteract any phosphorus release that may occur.

South Basin – The 2015 Secchi disk average was 6.7 meters, better than the long-term average of 6.4 meters. Dissolved oxygen depletion was first observed in July, affecting the bottom half of the of the water column until September. During most of the summer, oxygen and temperature data showed no suitable habitat for most cold water fish species. Phosphorus concentrations in the upper waters averaged 6.3 ppb, which is below the long-term average of 6.6 ppb. Phosphorus concentrations below the thermocline were moderate and averaged 6.8 ppb. Alkalinity was 9 ppm, higher than the long-term average of 8 ppm and pH matched the long-term average of 6.8. Chlorophyll was 3.2 ppb, which is above the long-term average of 2.9 ppb. Conductivity averaged 48 µs, which is above the long-term average of 39 µs and color was 28 SPU. The Al:Fe ratio of south basin sediments is 2.9:1, which is under the 3:1 threshold that prevents internal phosphorus release. However, the Al:P ratio was high, indicating that there is enough aluminum in the sediment to counteract any phosphorus release that may occur.

The trend in chlorophyll concentration is increasing across all basins of Long Lake over time. Phosphorus is also on a slight upward trend in the north and middle basins. Long Lake suffers from consistent dissolved oxygen depletion in the deeper waters, which negatively affects the lake's cold-water fishery. Because of these issues and relatively high summer *Gloeotrichia* algae populations, Long Lake remains in the HIGH degree of concern category.



Long Lake (average of all basins) Quick Statistics 2015 Average Versus the Long-term Average:

Secchi: Better
Chlorophyll: Worse
Phosphorus: Better

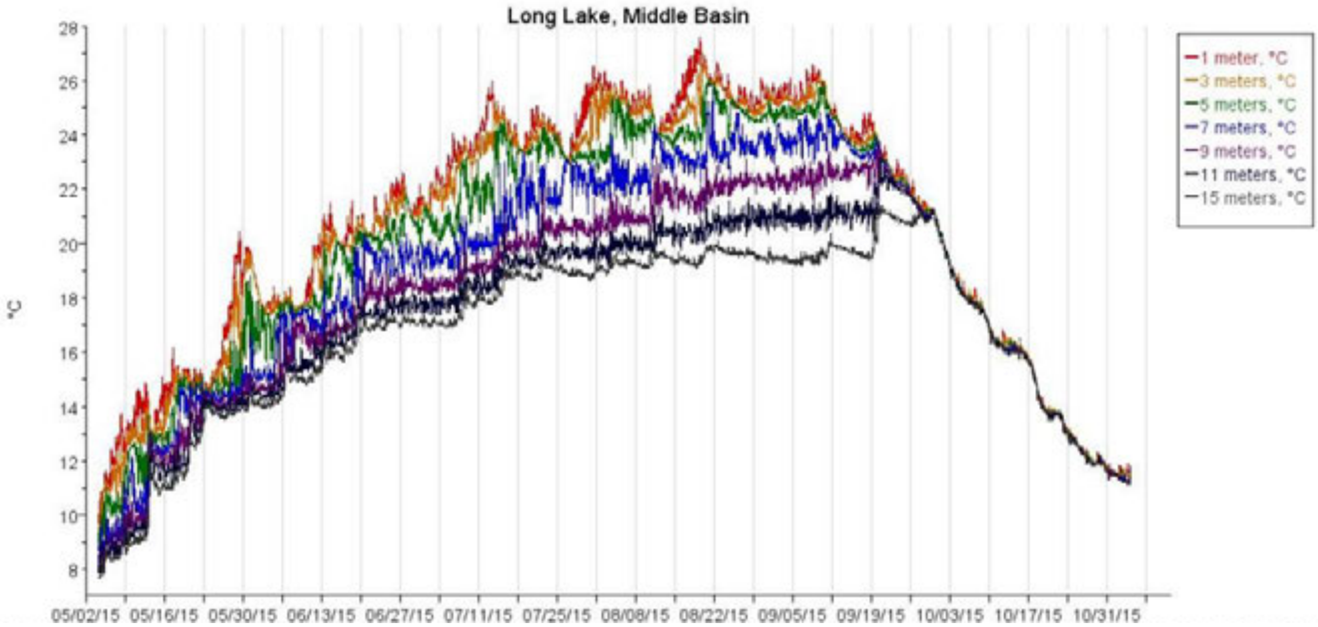
Surface Area:	4,935 acres
Maximum Depth:	59 feet
Mean Depth:	34 feet
Volume:	165,500 acres/feet
Watershed Area:	33,871 acres
Flushing Rate:	0.94 flushes per year
Elevation:	267 feet

Gloeotrichia: There are four sites sampled for *Gloeotrichia* on Long Lake. They are located in Cape Monday Cove on the eastern side of the lake, the northwest shore of the lake in Harrison, the west shore in Bridgton, and the south shore on the Naples Causeway. Each site was sampled four times in 2015 between July 21 and August 13. *Gloeotrichia* levels were much higher at the Harrison site, with a maximum of 42.2 col/L, than at the other three sites, which ranged from 4.1 and 6.1 col/L. The Harrison site's 42.2 col/L was a record high for that location and was the second highest recorded concentration in all the lakes tested in 2015. In contrast, the other three sites saw their lowest levels in three years of testing, with one exception being the Cape Monday site which in 2013 had a maximum of 1.8 col/L, lower than this year's 6.1 col/L.

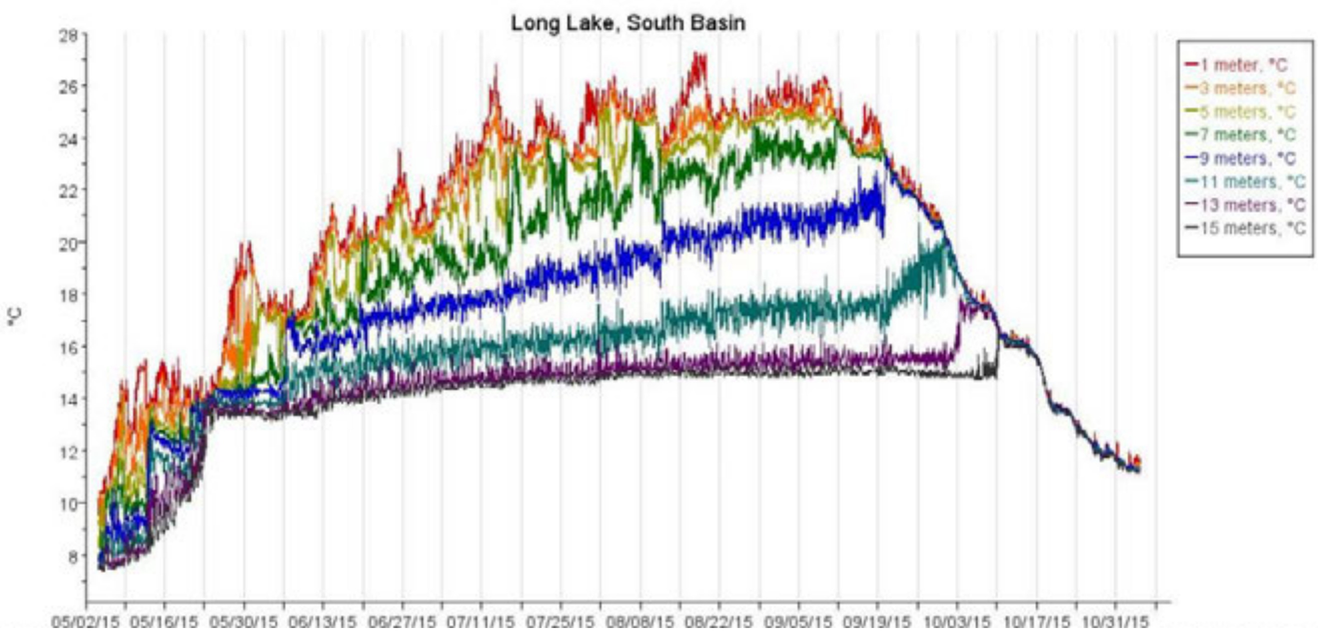
HOBO Digital Temperature (see graphs on next page): Long Lake's middle and south basins contained temperature sensors from early May through early November. These basins differ in their temperature patterns compared to the other lakes monitored because of their large size and the lake's shape. These characteristics mean that the lake basins mix more easily because they are exposed to more wind and wave action. You can see in the temperature graphs that the temperature difference is much lower from top to bottom than many other lakes and ponds, and that the lake has a couple temporary mixing events in May. Destratification (complete mixing) occurred much earlier in Long Lake than in lakes of comparable depth as well. The warmer bottom temperatures also have significant impacts on the lake's water quality and ecology.

The middle and south basins both began to stratify (layer) shortly before the temperature sensors were deployed. The depth of the epilimnion (top layer) changed throughout the season on both basins but generally stayed between 6 and 7 meters. The boundary layer separating the top and bottom layers was around 7-8 meters in depth, with the hypolimnion (bottom layer) reaching from around 8 meters to the bottom of the lake. The middle basin reached a high of 27.6 °C (81.7 °F) at one meters' depth on August 19th, whereas the south basin had a high of 27.3 °C (81.1 °F) two days earlier. The south basin also destratified (fully mixed) later than the middle basin. This is likely due to the greater temperature difference between the top and bottom waters of the south basin, which meant it took more energy (and therefore more time) for the lake to "turn over". In the middle basin, full mixing occurred at the end of September, whereas the south basin did not mix until close to mid-October.

Date of Fall Turnover (Complete Mixing)		
	2013	2014
Long Lake North	10/25	10/23

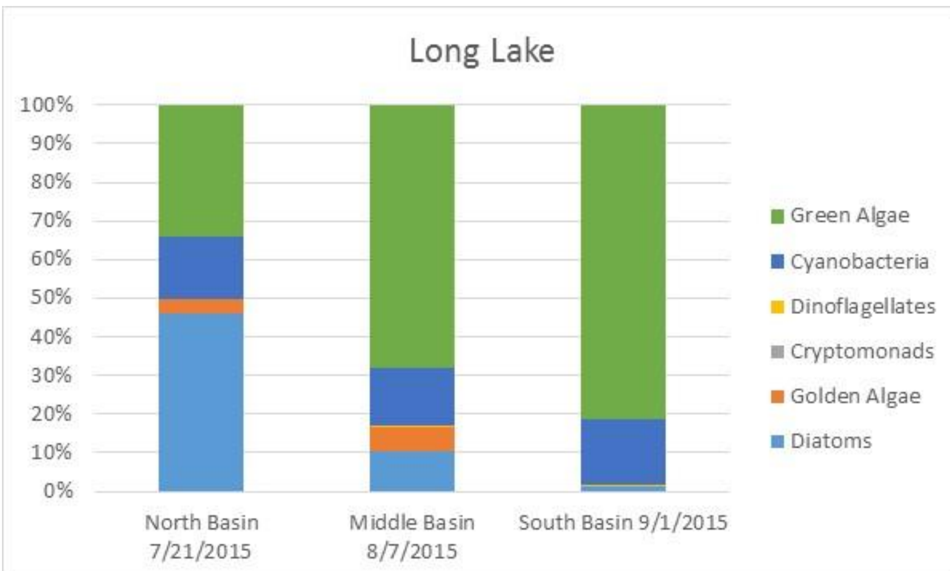


Date of Fall Turnover (Complete Mixing)			
	2013	2014	2015
Long Lake Middle	9/16	9/12	9/28

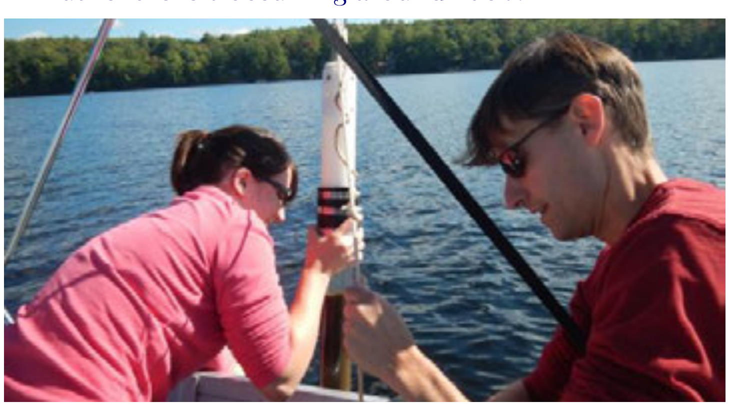


Date of Fall Turnover	
	2015
Long Lake South	10/11

Algae (all basins): Each basin of Long Lake was sampled once for algae. The north basin was sampled in July, the middle basin in August, and the south basin in September, so the algae results are not directly comparable between sites. The level of diatoms and green algae differed greatly between the three sites. Diatoms made up nearly 50% of the algae in the north basin but were almost non-existent in the south basin. Again, this may have to do with the timing of sample collection, since the two samples were collected over a month apart. However, the amount of cyanobacteria (blue-green algae) was similar at all three sites, staying between 15-17% of the total algae counted. The dominant genus identified in the north basin was a diatom called *Asterionella*. In the middle basin, *Dinobryon*, a golden algae, was counted most often. Although golden algae only make up about 6.5% of the algae counted, almost all of that 6.5% was *Dinobryon*. In the case of diatoms, which made up 10% of the sample, there were a few different types of diatom present (such as *Asterionella, Cyclotella*, *Stephanodiscus* and *Tabellaria*) making their individual contributions less than that of *Dinobryon*. In the south basin, a green alga called *Rhabdoderma* was the most common genus.

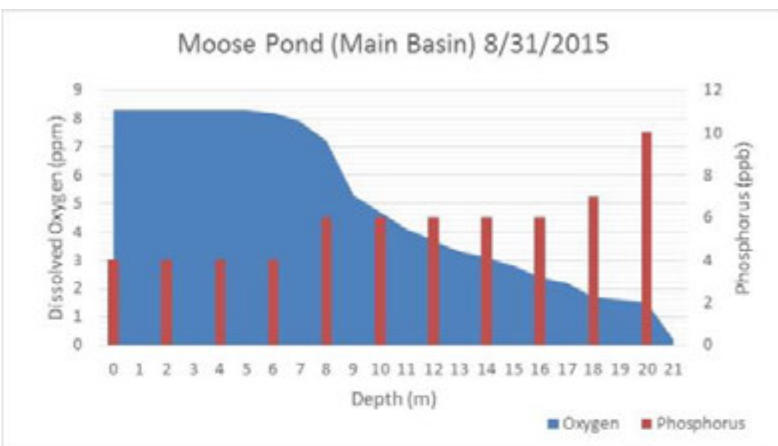


Deep Sediment Coring: A deep sediment core, which was used to measure changes in diatom algae preserved in sediments, suggests that Long Lake has been experiencing longer periods of stratification starting in the early 1900s. The drivers from this shift may include lower wind strength, earlier ice-out, and/or warmer overall temperatures. The diatom record also shows a small (2-4%) increase in nutrient levels occurring around 1950.



Moose Pond (Main Basin)

The 2015 Secchi disk average was 8.2 meters, deeper than the long-term average of 7.4 meters for the main basin. Dissolved oxygen depletion was mild for much of the season, but began to severely impact the deeper waters in August. Phosphorus concentrations in the upper waters averaged 4.1 ppb, below the long-term average of 5.8 ppb. Phosphorus concentrations below the thermocline were moderate and averaged 6.7 ppb. Color averaged 25 SPU. Average pH was 6.7, which is below the long-term average of 6.8. Chlorophyll averaged 2.6 ppb, which is below the long-term average of 2.9 ppb. Conductivity was 42 µs, which is above the long-term average of 33 µs and alkalinity was the same as the long-term average of 7 ppm. The Al:Fe ratio of sediments collected from Moose Pond's main basin is 1.8:1, which is below the 3:1 threshold that prevents phosphorus from being re-released from sediments. However, the Al:P ratio was 106:1, indicating that even if phosphorus recycling does occur, there is not an overly abundant supply of phosphorus in the sediments to fuel algae growth. Dissolved oxygen depletion limits the amount of suitable habitat for cold-water fish in Moose Pond in late summer and early fall. The pond also has relatively high levels of *Gloeotrichia* algae in late summer. For these reasons, the main basin of Moose Pond is in the HIGH degree of concern category.

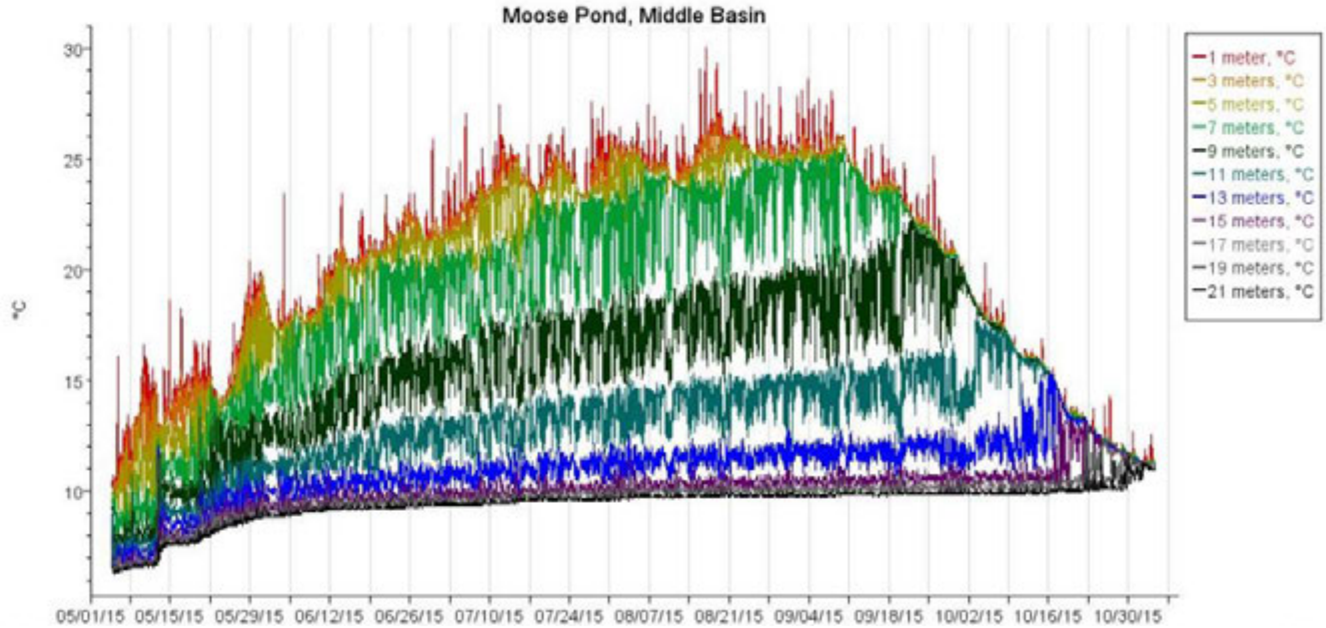


Moose Pond (Main Basin) Quick Statistics
2015 Average Versus the Long-term Average:

Secchi: Better
Chlorophyll: Better
Phosphorus: Better

Surface Area:	1,695 acres
Maximum Depth:	70 feet
Mean Depth:	20 feet
Volume:	30,722 acres/feet
Watershed Area:	11,170 acres
Flushing Rate:	3.69 flushes per year
Elevation:	418 feet

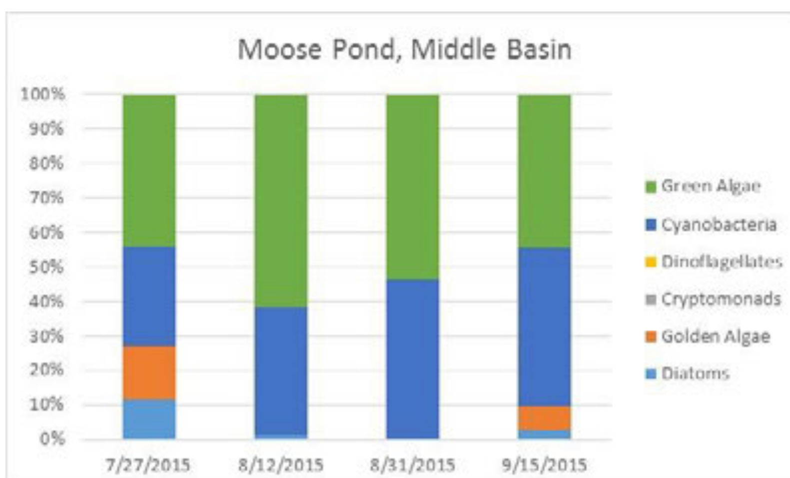
Gloeotrichia (all three basins): Five samples were collected from the main basin of Moose Pond between July 22 and August 19. The high of 192.4 col/L greatly exceeds the previous two years' highs of 16.6 and 16.2 col/L as well as levels on other lakes measured by LEA in this and previous years. The highs on Moose Pond in previous years occurred in the first week of August whereas this year it was later in the month, a delay likely caused by colder spring temperatures. The north and south basins of Moose Pond were sampled once, in late July. The north basin sample contained 1.4 col/L of Gloeotrichia and the south basin had 1.8 col/L. This is similar to 2014 results, where the north basin maximum was just under 1 col/L and the south basin had a maximum of 1.5 col/L.



Date of Fall Turnover (Complete Mixing)			
	2013	2014	2015
Moose Pond Main	11/3	11/2	11/2

HOBO Digital Temperature (Main Basin): Moose Pond's temperature sensors were in place from early May through early November. Stratification (the separation of the water column into layers based on temperature) had just begun to set up when the sensors were deployed. The top stratified layer, called the epilimnion, occupied the top 7 meters of the water column for most of the season. The zone of rapid temperature change known as the thermocline was somewhere between 7 and 8 meters, with the water deeper than 8 meters being part of the hypolimnion, or bottom layer. Stratification began to break down in mid-September as air temperatures cooled. The pond did not completely destratify until early November. Moose Pond's main basin reached its highest temperature on August 17th, with the temperature at a depth of 1 meter peaking at 30.1 °C (86.2 °F).

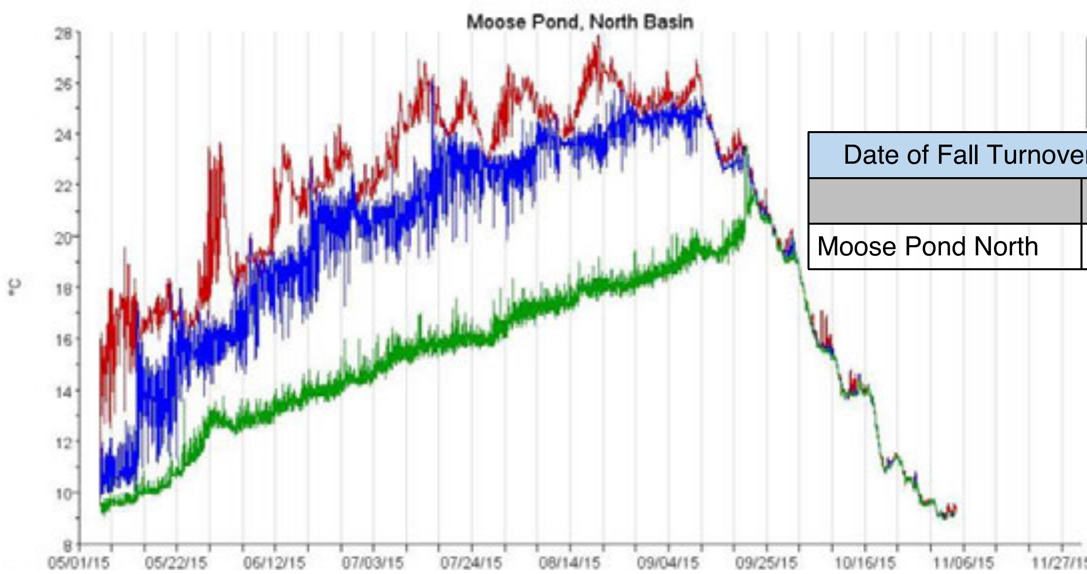
Algae (Main Basin): Four samples from Moose Pond's main basin were collected between July and September. On average, 51% of each sample was made up of green algae. The amount of cyanobacteria (blue-green algae) was relatively high at almost 40% on average. Diatoms and golden algae each only made up 4-6% of the cells in an average sample, although the two August samples contained no golden algae and very few diatoms. The most common types of algae in the Moose Pond samples included the green algae *Westella* and the cyanobacteria *Merismopedia* and *Aphanocapsa.*



Moose Pond (North Basin)

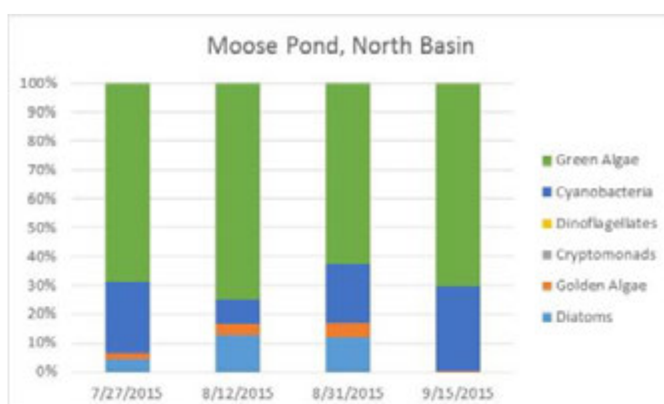
The 2015 Secchi disk average was 5.2 meters, deeper than the long-term average of 5.1 meters. Dissolved oxygen depletion was observed near the bottom of this 6-meter-deep basin for the duration of the testing season. Phosphorus concentrations in the surface waters were 9.3 ppb on average, which is below the long-term average of 9.4 ppb. A deep water sample taken from near the bottom of this basin had a phosphorus level of 22 ppb. Alkalinity averaged 7 ppm, which is below the long-term average of 8 ppm and color averaged 34 SPU. Chlorophyll was 5.2 ppb on average, which is above the long-term average of 4.1 ppb. Conductivity averaged 34 µs, which is above the long-term average of 31 µs. The average pH was the same as the long-term average of 6.7. The Al:Fe ratio of sediments from the north basin of Moose Pond is 4:1, indicating a low potential for internal phosphorus release. Due to periodic dissolved oxygen depletion in the bottom waters, the north basin of Moose Pond remains in the MODERATE degree of concern category.

HOBO Digital Temperature (North Basin): The north basin of Moose Pond is the least deep of the three basins at about 6 meters. Even so, it remained continuously stratified (layered) from before sensors were deployed in May through the end of September. The top stratified layer (the epilimnion) occupied a zone within the first 3 meters of the water column for most of the summer, while at 5 meters deep the colder, relatively constant temperatures mean that water at this depth was part of the cold bottom layer known as the hypolimnion. The north basin reached a maximum temperature of 27.8 °C (82.2 °F) at a depth of 1 meter on August 20th.



Date of Fall Turnover (Complete Mixing)		
	2014	2015
Moose Pond North	9/12	9/22

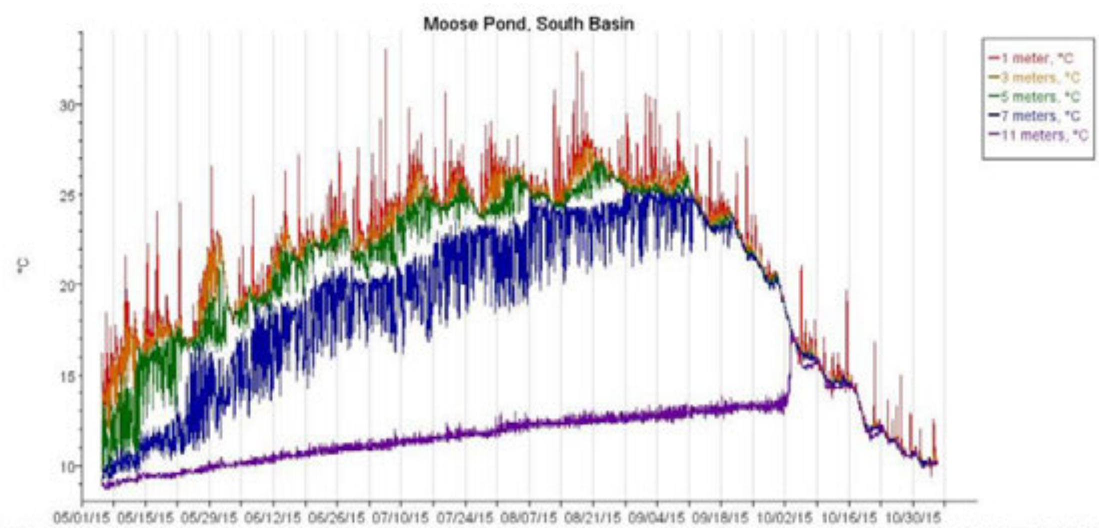
Algae (North Basin): Four samples were collected from the north basin of Moose Pond between July and September. The samples contained primarily green algae, with 69% of the algae cells being this type. Cyanobacteria (blue-green algae) made up 21% of the average sample, with diatoms at 7% and golden algae at 3%. The most common types seen included the green algae *Westella*, the diatom *Asterionella*, and the cyanobacteria *Merismopedia*.



Moose Pond (South Basin)

The 2015 season was the first time regular water testing was done on the south basin of Moose Pond, therefore there are no long-term averages with which to compare this year's data. The 2015 Secchi disk average was 6.9 meters. Dissolved oxygen depletion was observed near the bottom of the basin from June through September, affecting the bottom 4 meters of the 10-meter water column. Phosphorus concentrations in the surface waters were 6.1 ppb on average. The average deep-water phosphorus level was 10.5 ppb. Alkalinity averaged 8 ppm and color averaged 24 SPU. Chlorophyll was 4.5 ppb on average. Conductivity averaged 40 µs. The average pH was 6.7. The Al:Fe ratio of sediments from Moose Pond's south basin is 4.3:1, indicating a low potential for sediment phosphorus release. Due to deep water dissolved oxygen depletion and high phosphorus levels in the bottom waters, this basin is in the MODERATE degree of concern category.

HOBO Digital Temperature (South Basin): The south basin of Moose Pond had already begun to stratify (separate into layers based on temperature) by the time sensors were deployed in early May. This stratification broke down in early October, well before the sensors were removed in November. The three stratification layers – the epilimnion, thermocline, and hypolimnion – are evident on the graph of the data from this basin. From 0-5 meters, the temperatures are very close to one another, indicating that these depths make up the epilimnion. The 7 meter line tracks with the upper lines, but is at a lower temperature. This indicates the location of the thermocline. The 9 meter line is missing from the graph due to sensor malfunction, but the 11 meter sensor data shows that water at this depth is clearly much colder and part of the hypolimnion. Because the thermocline (located around 7 meters) is generally a very narrow layer, we can estimate the hypolimnion occurs from 7-8 meters depth to the bottom of the basin. At 1 meters' depth, the maximum temperature recorded was 33.0 °C (91.4 °F) on July 6. The second warmest temperature was 32.9 °C (91.2 °F), recorded on August 17th. The temperature spikes of the 1-meter sensor as well as the very high temperature suggest that this logger was actually very close to or at the surface. This would also mean that all the sensors were slightly less deep than labeled. This could be due to anchor placement, drift, and/or fluctuating lake levels.



Date of Fall Turnover (Complete Mixing)		
	2014	2015
Moose Pond South	10/22	10/3

Otter Pond

The 2015 Secchi disk reading of 5.0 meters was deeper than the long-term average of 3.6 meters. Oxygen depletion was observed in the bottom 3 meters of the water column during August sampling. The surface water phosphorus concentration was moderate at 6.0 ppb, which is below the long-term average of 12.5 ppb. Alkalinity was the same as the long-term average of 8 ppm and pH was 6.7, which is above the long-term average of 6.6. Chlorophyll was moderate at 2.4 ppb, which is less than the long-term average of 4.8 ppb. Conductivity was 45 µs, above the long-term average of 35 µs and color was 57 SPU. Due to periodic elevated phosphorus levels and dissolved oxygen depletion, Otter Pond remains in the MODERATE degree of concern category.

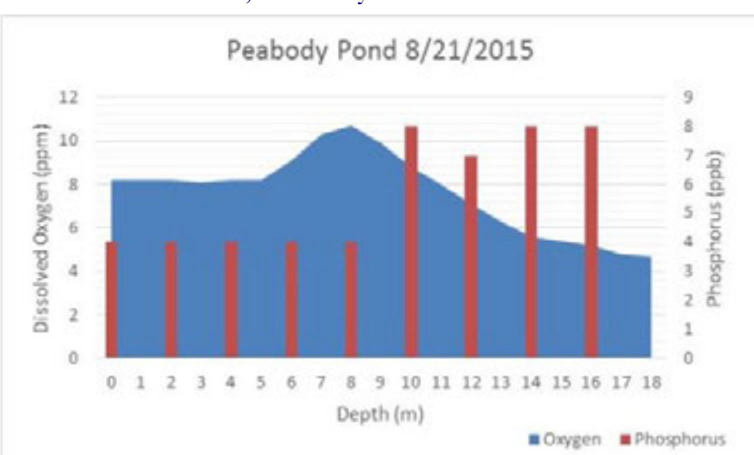
Otter Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi : Better
Chlorophyll: Better
Phosphorus: Better

Surface Area:	90 acres
Maximum Depth:	21 feet
Mean Depth:	10 feet
Volume:	814 acres/feet
Watershed Area:	790 acres
Flushing Rate:	0.7 flushes per year
Elevation:	392 feet

Peabody Pond

The 2015 Secchi disk average of 8.9 meters was deeper than the long-term average of 7.3 meters. Dissolved oxygen depletion was slight and appeared in September. During that month, approximately 6 meters of the water column had suitable habitat for coldwater fish species such as salmon and trout. Phosphorus levels in the surface waters were low, averaging 4.6 ppb, which is below the long-term average of 5.7 ppb. Phosphorus concentrations below the thermocline were moderate, averaging 7.8 ppb. Alkalinity matched the long-term average of 6 ppm and pH was 6.8, higher than the long-term average of 6.7. Chlorophyll levels averaged 2.6 ppb, just under the long-term average of 2.7 ppb. Conductivity was 22 µs, which is above the long-term average of 20 µs and color was 24 SPU. The Al:Fe ratio of Peabody Pond sediments is 2.8:1, which is below the desired 3:1 threshold that protects against internal phosphorus release. However, the Al:P ratio is 40.9:1, which indicates that there is enough aluminum in the sediment to counteract any phosphorus release that may occur. Although the water quality is generally good on Peabody Pond, low oxygen conditions limit habitat for the pond's cold water fishery in the summer and early fall. For this reason, Peabody Pond is in the MODERATE degree of concern category.



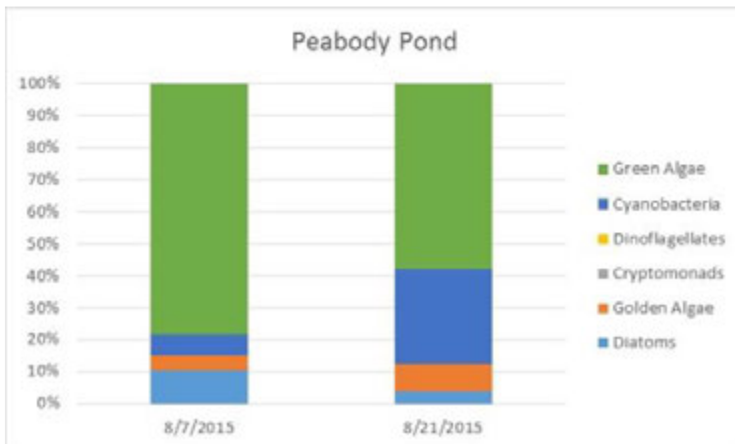
Peabody Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi: Better
Chlorophyll: Better
Phosphorus: Better

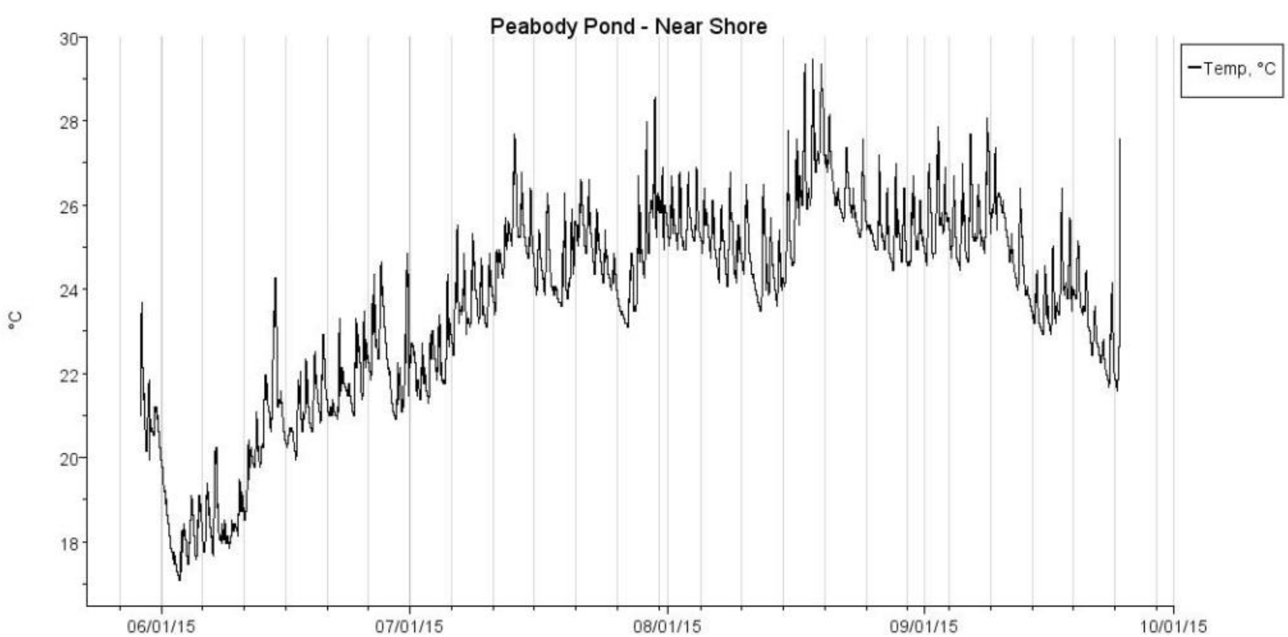
Surface Area:	740 acres
Maximum Depth:	64 feet
Mean Depth:	45 feet
Volume:	24,510 acres/feet
Watershed Area:	2,522 acres
Flushing Rate:	0.3 flushes per year
Elevation:	460 feet

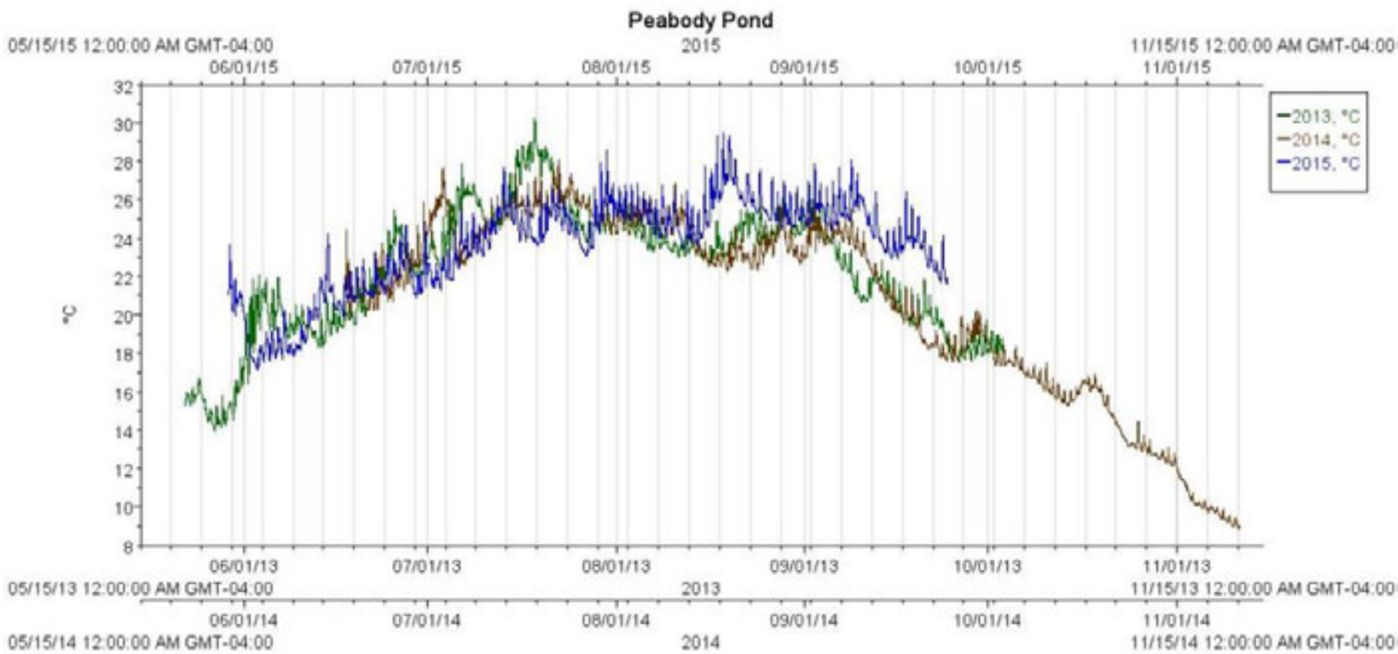
Gloeotrichia: Peabody Pond was sampled for *Gloeotrichia* four times between July 23 and August 14, at a site on the western shore of the lake. The high of 2.2 col/L was very similar to previous years' results, which were 1.9 col/L in 2013 and 2.4 col/L in 2014.

Algae: Two algae samples were collected from Peabody Pond on different dates in August. A majority of the cells (68% on average) counted in both samples were green algae, followed by cyanobacteria (blue-green algae) at an average of 18%, and diatoms and golden algae at about 7% each on average. The most common algae counted in the first sample were small green algae called *Westella*, and in the second sample the cyanobacteria *Merismopedia* was the most common.



HOBO Digital Temperature: A single temperature sensor was placed near the western shore of Peabody Pond at a depth of about 2 meters. It remained in place from late May through late September. The highest temperature reached was 29.5 °C (85.1 °F) on August 18th. The second graph (see next page) compares three years' worth of shallow temperature data from Peabody Pond. The overall range of temperatures is similar, however the pattern in 2015 shows the maximum temperature was reached almost a month later than in 2013 and 2014.





Woods Pond

The 2015 Secchi disk average of 5.1 meters was deeper than the long-term average of 5.0 meters. Dissolved oxygen depletion affected the bottom 4 meters of the 8-meter-deep pond from July through September. Phosphorus concentrations in the surface waters averaged 7.6 ppb, which is below the long-term average of 8.2 ppb. Alkalinity averaged 5 ppm, which is below the long-term average of 6 ppm and pH was 6.8 on average, which is higher than the long-term average of 6.6. Chlorophyll readings averaged 3.5 ppb, which is higher than the long-term average of 3.1 ppb. Conductivity was 24 µs on average, which is more than the long-term average of 21 µs and color averaged 50 SPU. The Al:Fe ratio of Woods Pond sediments is 3.7:1, indicating that there is a low potential for internal phosphorus release. Trend analysis of water quality data from the last 15 years revealed decreasing clarity and increased nutrient concentrations in Woods Pond. For this reason, the pond is in the HIGH degree of concern category.

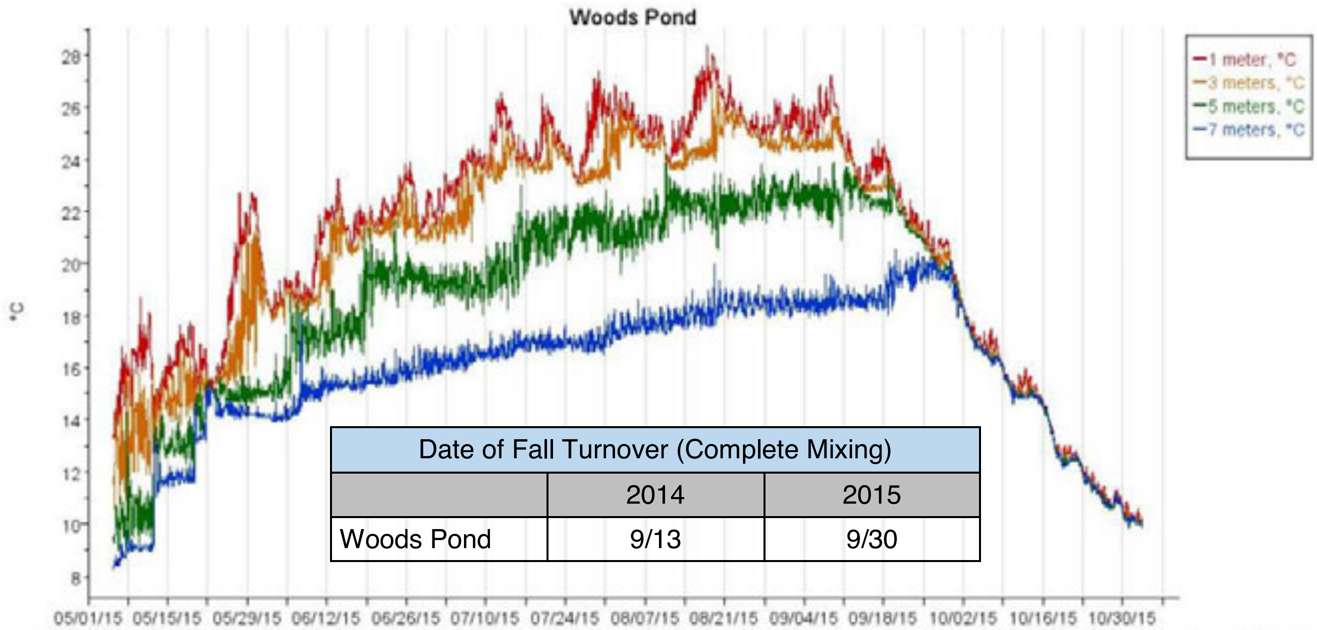
Woods Pond Quick Statistics
2015 Average Versus the Long-term Average:

Secchi : Better
Chlorophyll: Worse
Phosphorus: Better

Surface Area:	462 acres
Maximum Depth:	29 feet
Mean Depth:	17.5 feet
Volume:	17,890 acres/feet
Watershed Area:	3,329 acres
Flushing Rate:	0.77 flushes per year
Elevation:	456 feet

Period	Woods Pond Clarity (m)	Average Phosphorus (ppb)
1996-2005	5.1	7.3
2006-2015	4.8	8.4

Gloeotrichia: Woods Pond was sampled for Gloeotrichia in 2013, 2014 and 2015. In each case, there has been little to none of the algae present.

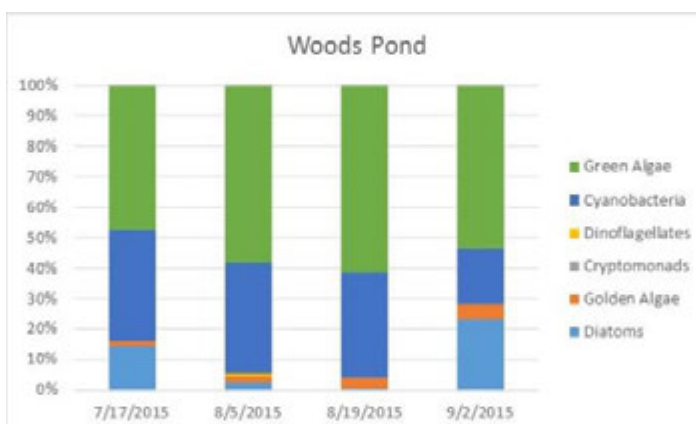


Date of Fall Turnover (Complete Mixing)		
	2014	2015
Woods Pond	9/13	9/30

HOBO Digital Temperature: Woods Pond had already begun to stratify by the time temperature sensors were deployed in early May. Because Woods Pond is relatively shallow, it is more susceptible to mixing than many other lakes. You can see on the accompanying graph that the lake fully mixed briefly around May 23rd after beginning to stratify (all the colored lines pinch together and then expand again). These sorts of events can be significant in explaining water quality patterns over the season and are one of the reasons LEA utilizes digital temperature monitoring.

In 2015, the upper layer of water, known as the epilimnion, was located between around 0-3 meters for much of the summer. Because sensors were located every 2 meters, it's difficult to pinpoint where the middle layer – the thermocline – was, but it's likely that it was somewhere between 3 and 5 meters deep for most of the season. The bottom layer (the hypolimnion) was situated between the thermocline and bottom of the pond. The maximum temperature reached at 1 meters' depth was 28.4 °C (83.1 °F) on August 18th.

Algae: Four algae samples were collected from Woods Pond between July and September. Green algae were the most commonly counted type of algae, with 55% of an average sample being in this category. Cyanobacteria (blue-green algae) were relatively high at 31.5%. Dinoflagellates contributed less than 1% on average and golden algae were around 3%. On average, samples contained 10% diatoms, though most diatoms were found in the July and September samples. Common algae found in the Woods Pond samples include *Westella* (green), *Merismopedia* (cyanobacteria), *Eucapsis* (cyanobacteria), and *Tabellaria* (diatom).



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