January 8, 2018

Henderson Lake
Bill Olsen – Primary Contact
2937 Chippewa Trail
Lupton MI. 48635

Henderson Lake Property Owners:

It has been a pleasure managing Henderson Lake this past summer. Every year seems to bring a unique set of challenges and we welcome the opportunity to meet these challenges every single year. We hope that you continue to feel that your lake was managed professionally, economically, and effectively.

As we say goodbye to 2017 and look forward to 2018, we are happy to give you a brief re-cap of the work that was performed on Henderson Lake by Savin Lake Services. This year, we treated Henderson Lake (3) times, conducted water quality tests, and surveyed as follows:

On June 7th, 2017 Savin Lake Services sent our Aquatic Biologist out to Henderson Lake to pull a Spring set of water samples. During our telephone conference call in 2016 with myself, Bill Olsen, and many other HLMC Members, it was decided that we would do some water quality studies to ensure the lake was in a healthy state. There were (3) sites that we obtained water samples from on the lake, with one of the sites being the deepest spot in the lake. These samples and sites were analyzed for the following: Temperature, Dissolved oxygen, Total Alkalinity, Total Phosphorus, Total Nitrate Nitrogen, Conductivity, pH (surface only), Chlorophyll a (surface only), and a Secchi disk depth.

On June 9th, 2017, Savin Lake Services surveyed the entirety of Henderson Lake. We utilized our GPS logging capabilities and sonar data collection to use a program called ciBiobase where we can obtain a contour map, biovolume map, and a bottom hardness map of Henderson Lake. This survey was a very informative tool that we used this year and will provide great benefits to upcoming years treatments.

On June 15th, 2017 Savin Lake Services conducted our initial application for non-native and exotic plant communities. Also during this treatment, we did an algae spray of the entire developed shoreline, treated native vegetation in the canal and around riparian owners' docks where needed, and a Bacterial Augmentation (Mukk Buster) treatment also took place at this time. Savin Lake Services treated 3 acres of Milfoil (treated systemically),7.5 acres of Curly Leaf Pondweed,17.5 acres of the lake for algae, and 12.5 acres of the lake for various pondweeds like Richardson's Pondweed and Baby Pondweed. There was also 5 acres of the lake that received a Mukk Buster treatment.

On July 20th, 2017 Savin Lake Services conducted our 2nd herbicide application, algae spray, and bacterial augmentation treatment. Savin Lake Services treated 2.5 acres of Bladderwort, and Baby Pondweed, 7.5 acres of various pondweeds like Richardson's Pondweed and Large Leaf Pondweed, and 8 acres of algae control. We only treated the areas that we felt needed to be treated in developed shoreline areas, in and around docks, and navigational boat ways. During this treatment, we conducted a bacterial augmentation treatment in the same 5 acres we did during our first application. Also, while we were on the lake we pulled a water sample for e-coli testing. There was some concern about some of the older cottages on the lake having septic systems that could possibly be leaching into the lake. We were happy to discover that no e-coli was detected in the sample.

On September 12th, 2017 Savin Lake Services conducted our final herbicide treatment, algae spray, and Bacterial Augmentation treatment for the year. This treatment consisted of an algae spray in the developed areas of the lake where needed (10 acres), and 5 acres of herbicide treatment for Richardson's pondweed, and treated 40X40 areas for lily pads, and Cattails where treatment was needed. Also during this time, we did the last Bacterial Augmentation treatment for the year in the same areas as we did earlier this year, as it requires 3 treatments per season for the greatest efficacy.

On October 4th, 2017 Savin Lake Services sent our Aquatic Biologist out to Henderson Lake again to pull a fall set water samples in the same 3 sites for testing. After all the Spring and Fall samples are analyzed there will be a report generated and made available for the Henderson Lake Property Owners. This report is in the process of being completed and should be done by mid-January. You can obtain this report by contacting myself, Bill Olsen, or any members of the weed control committee. We would like approval to plan to continue with the Water Quality testing through the 2018 season as it will give us a vast amount of information that we can use for a trending analysis.

Every treatment, survey, or water quality study that Savin Lake Services has performed, we have provided maps, or generated full reports on the work completed. All treatment maps and reports for 2015, 2016, and 2017 are available for you to view on your website HendersonLake.org.

Please keep in mind that we are a fully integrated lakes management company offering solutions including but not limited to mechanical harvesting, herbicide control, dredging, bio-augmentation, and aeration. Savin Lake Services also offers a complete range of water quality testing, depth contour mapping, individual property solutions, and even aquatic plant density reporting.

SAVIN LAKE SERVICES
3088 Hottis Rd. Hale, MI 48739 Hale: 989.728.2200 Clare: 989.386.0600 Fax: 989.516.5900

We look forward to serving you in 2018. We plan to keep the same treatment plans for this year as we did last year. We see no reason to deviate from the current treatment plan. We feel this plan is the most effective and efficient way to keep Henderson Lake clean and desirable for use by the Henderson Lake residents. Until then; if you have any questions, comments, or require additional information, feel free to contact us.

Sincerely,

Paul Barber - Regional Lakes Manager
Savin Lake Services Inc.
3088 Hottis Road
Hale, Michigan 48739
Hale Office: 989-728-2200
Clare Office: 989-386-0600
Toll Free: 877-SAV-LAKE
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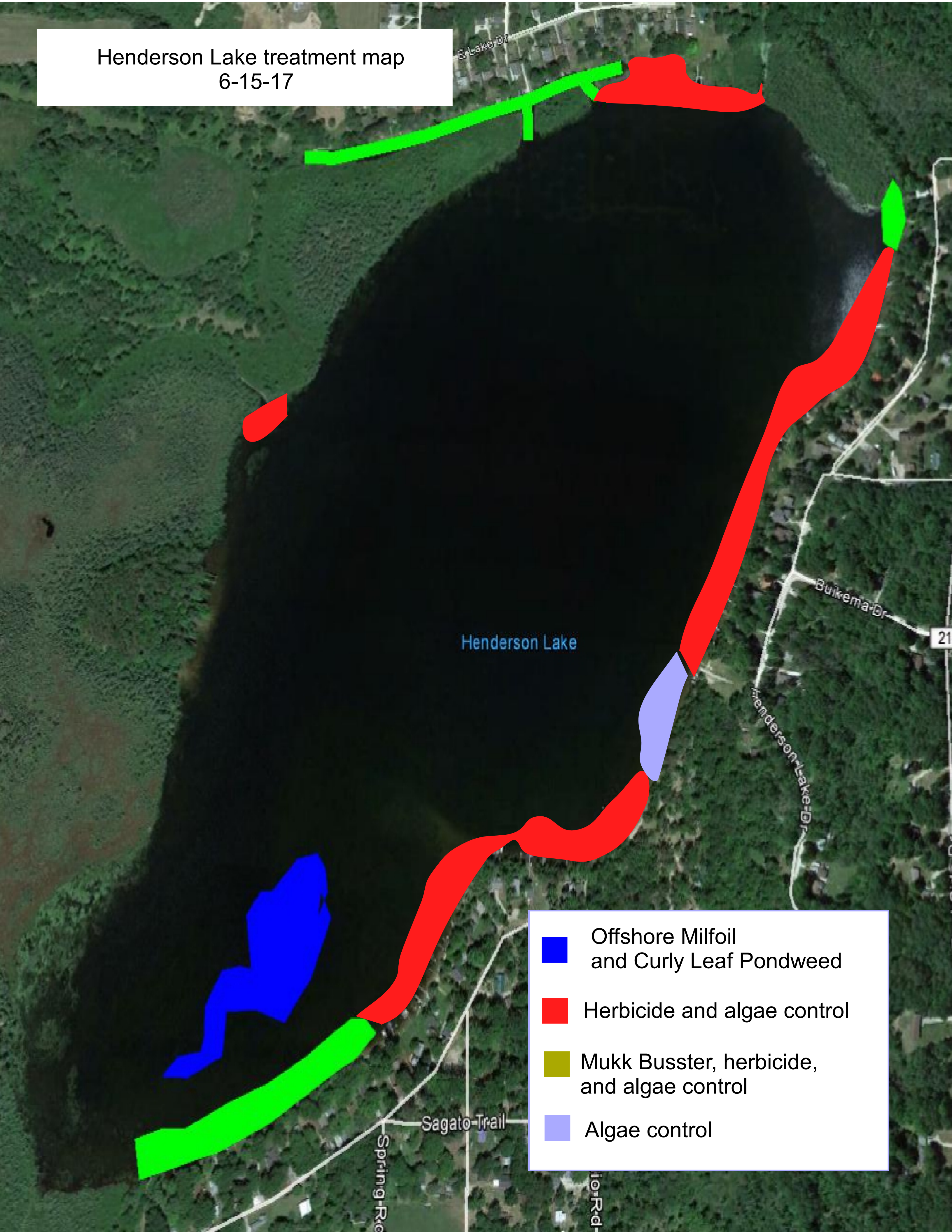
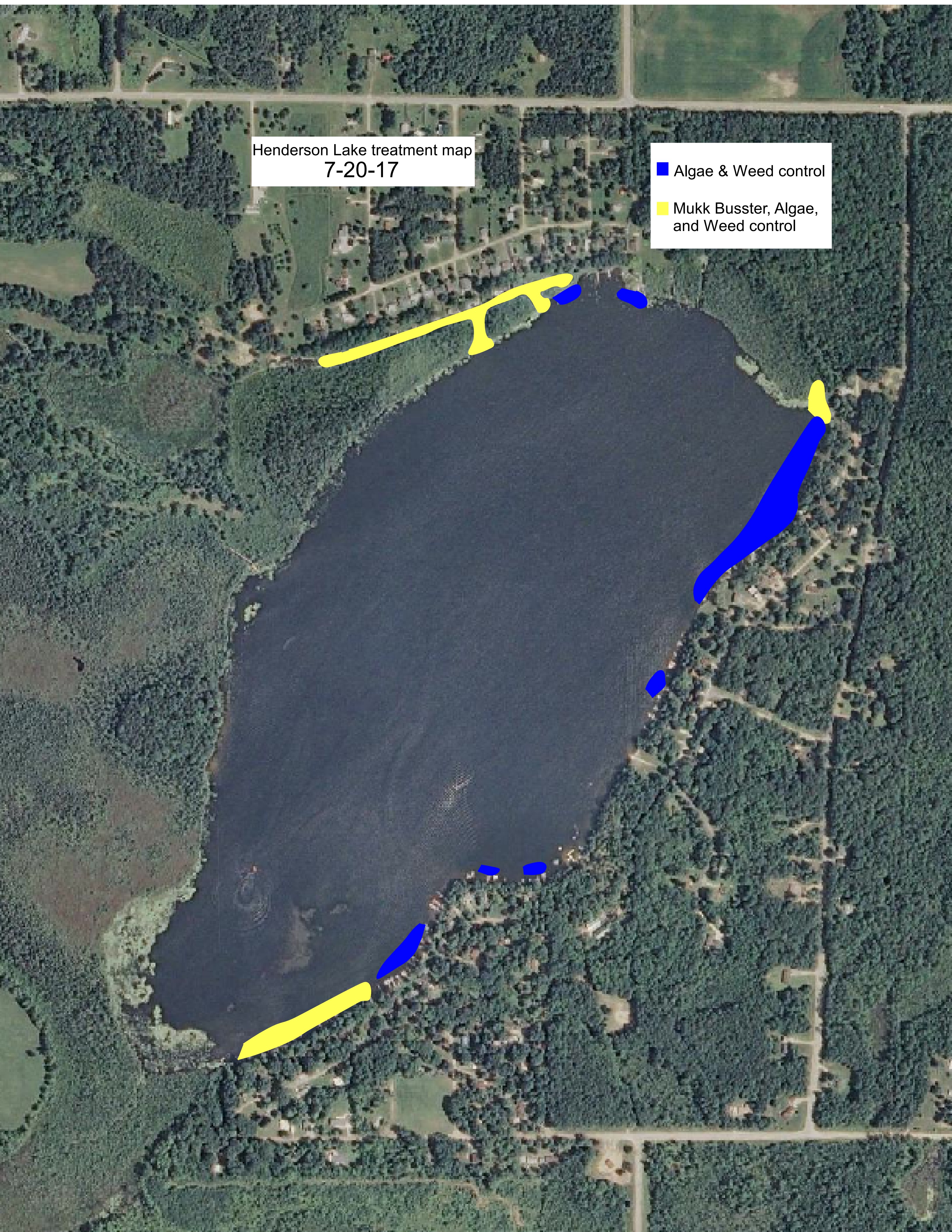
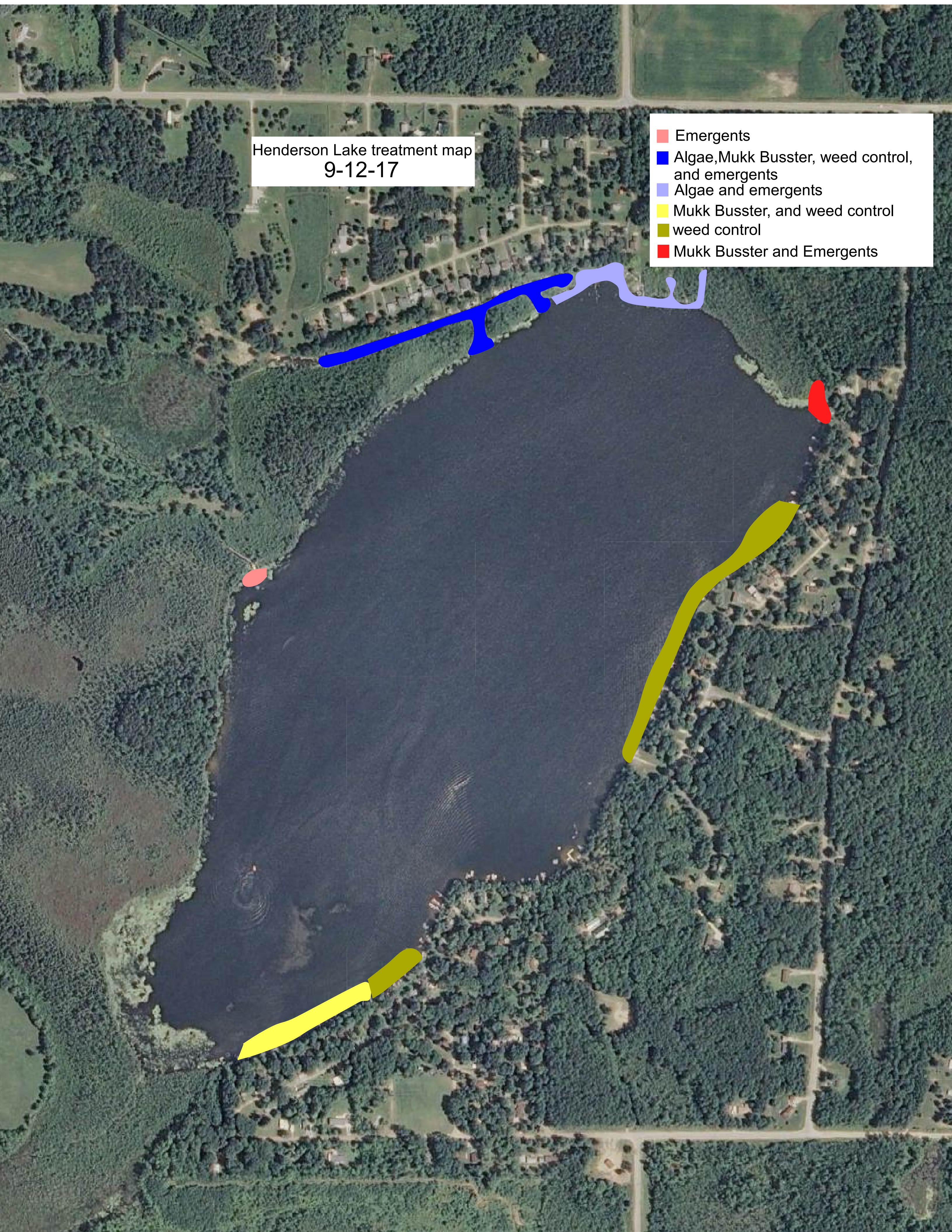

Henderson Lake treatment map
6-15-17
E Lake Dr
Henderson Lake
Buikema Dr
21
Henderson Lake Dr
Sagato Trail
Offshore Milfoil
and Curly Leaf Pondweed
Herbicide and algae control
Mukk Busster, herbicide,
and algae control
Algae control


Henderson Lake treatment map
7-20-17
Algae & Weed control
Mukk Busster, Algae, and Weed control


Henderson Lake treatment map
9-12-17
Emergents
Algae,Mukk Busster, weed control, and emergents
Algae and emergents
Mukk Busster, and weed control
weed control
Mukk Busster and Emergents

Henderson Lake

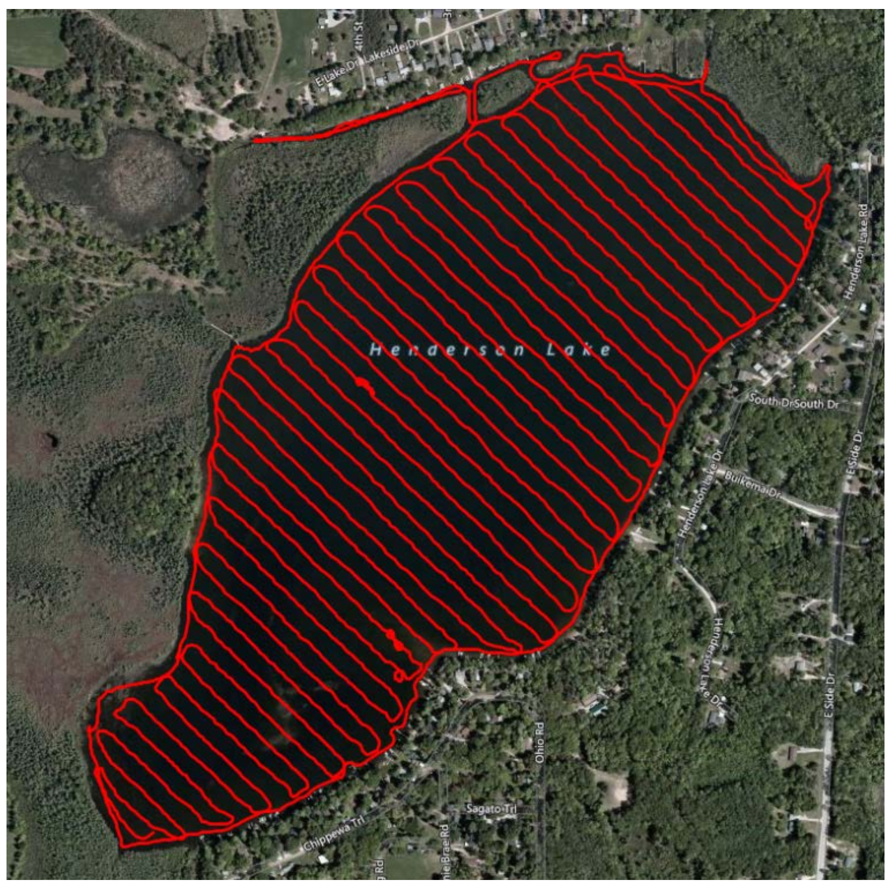
BioBase Survey Report

On June 9th, 2017, Savin Lake Services surveyed the entirety of Henderson Lake. We utilized our GPS logging capabilities and sonar data collection to use a program called ciBiobase where we are able to obtain a contour map, biovolume map, and a bottom hardness map of Henderson Lake.

Boat Path Map

To ensure that we travel the entirety of the lakes we survey, we use a GPS technology related to agriculture applications for crops. After traveling the shoreline of the lake, we can start a linear path across lake body and produce a graph for our boat to travel. This way, every trip across the lake is equally spaced from the last, which ensures our other survey methods work correctly and covers the entire lake area.

Shown is the map displaying our boat's route using this process.



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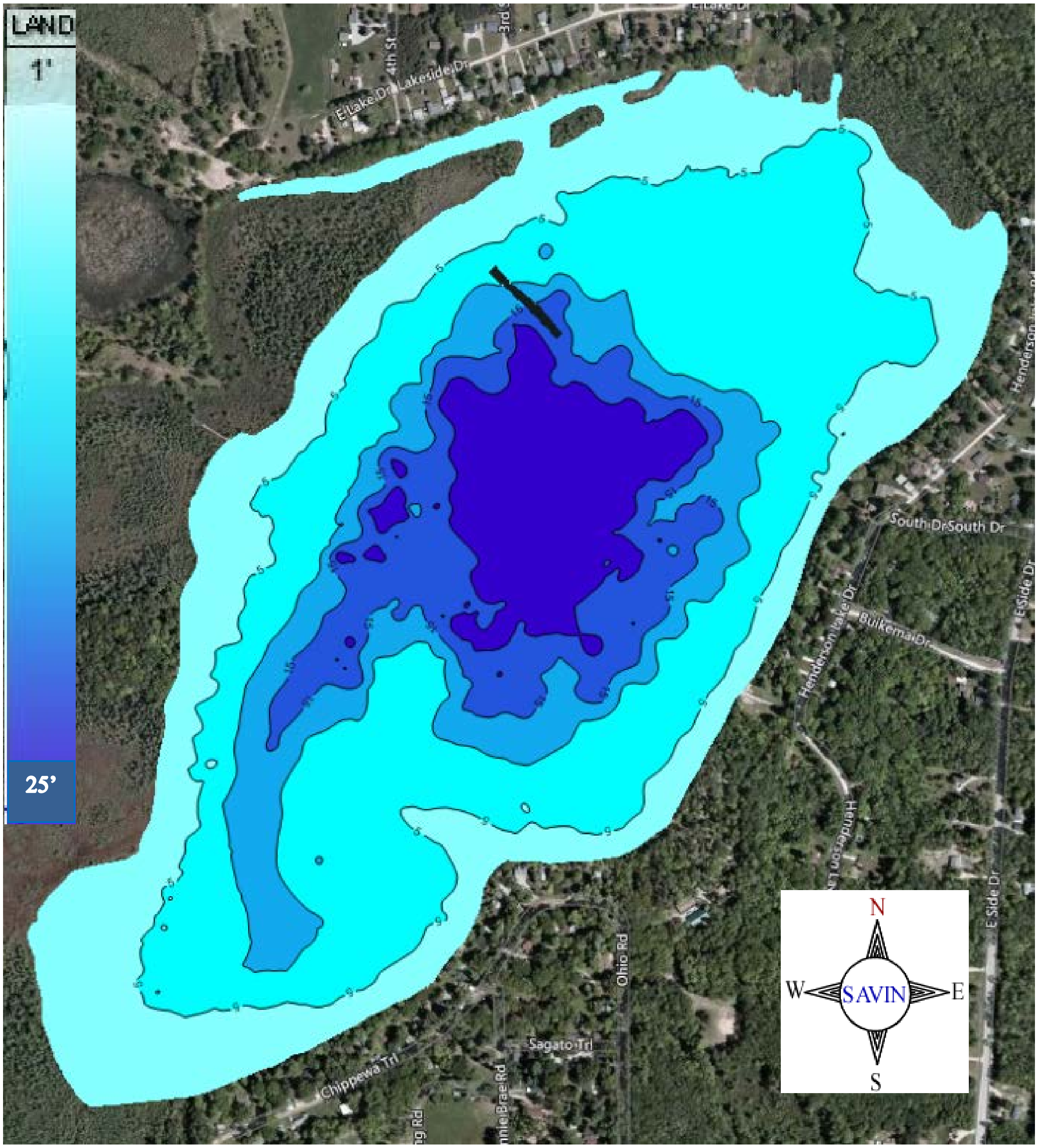
BioBase Survey

As we traveled around the lake, we logged a number of frequencies. When uploaded to the BioBase software, a number of reports are generated. The next few pages show the results of the mapping.

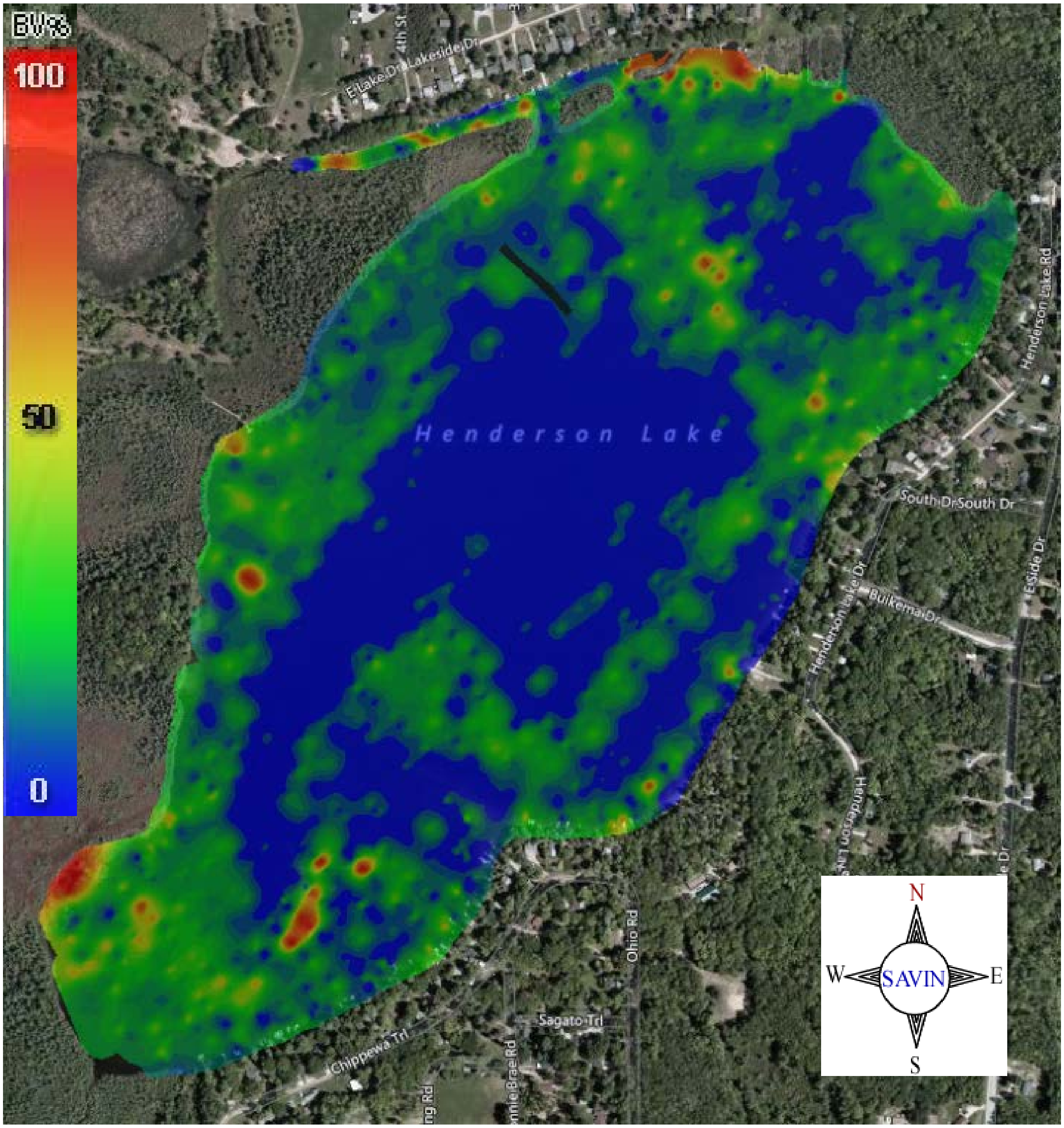
First is the contour map, additionally color shaded blue to show the depths of Henderson Lake. Each contour line is 5' of depth. The deepest location on the lake was 25' deep.

The second map shows the vegetation on the lake. It shows this by a metric called BioVolume. BioVolume is the percent of vegetation in the water column. By using this, we can see what areas of the lake has vegetation that is reaching the surface of the water or has yet to reach it. Coupled with a visual survey of the lake, we can determine what areas are problematic and what vegetation exist in those areas to properly plan management strategies.

The last map shows the bottom hardness of the lake. This is not the hardness of the water of the lake, but the actual physical characteristic of the lake sediment as being 'hard' or 'soft'. Silt and muck are generally soft, rocks are obviously hard, and sand is shown in between. However it is useful to note these are general observations and this information does not necessarily show the bottom being exactly muck, sand, or rocks.



(Depth Contour Map)



(Vegetation BioVolume Map

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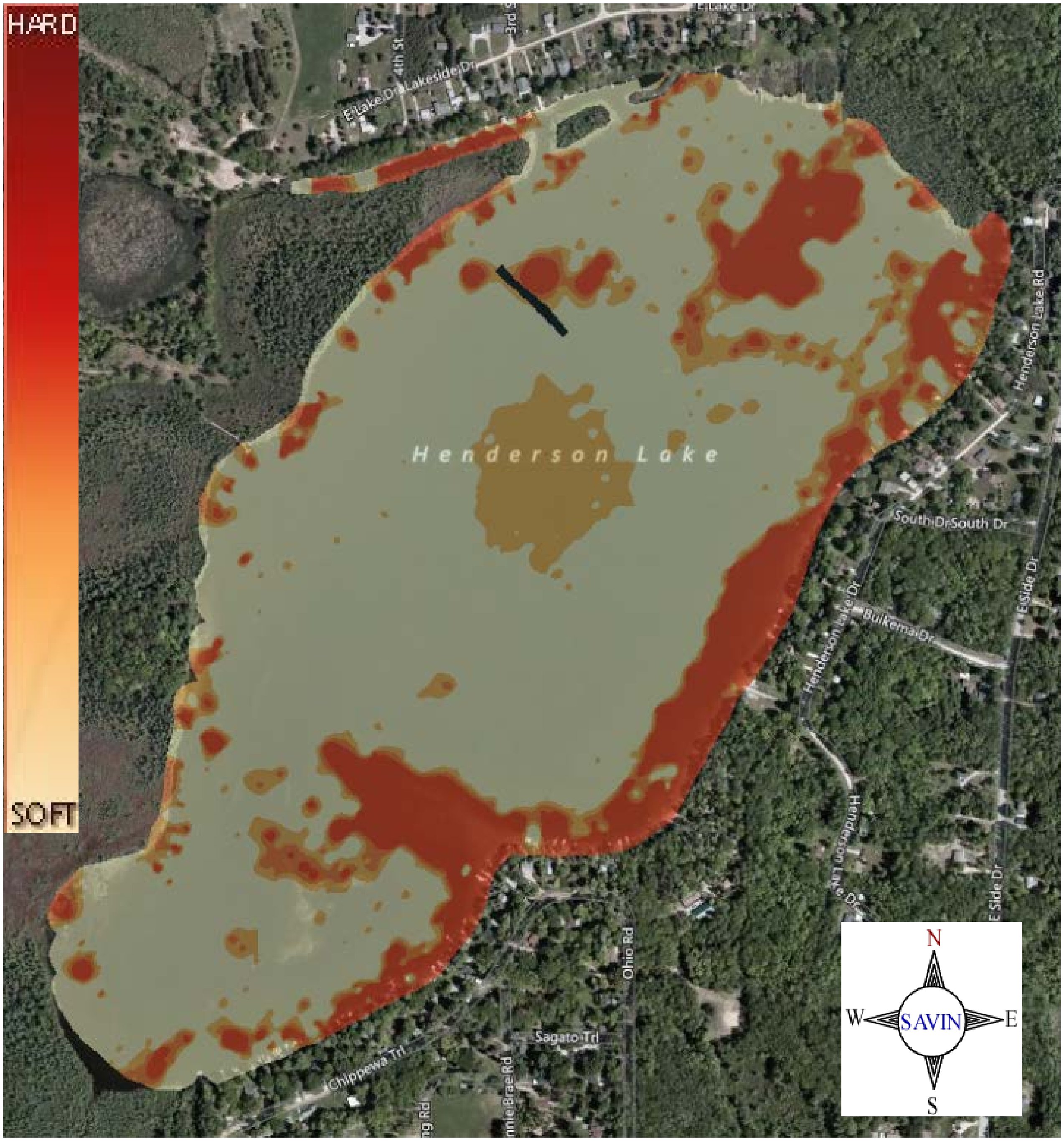


(Bottom Hardness Map)

Henderson Lake 2017 Water Quality Report

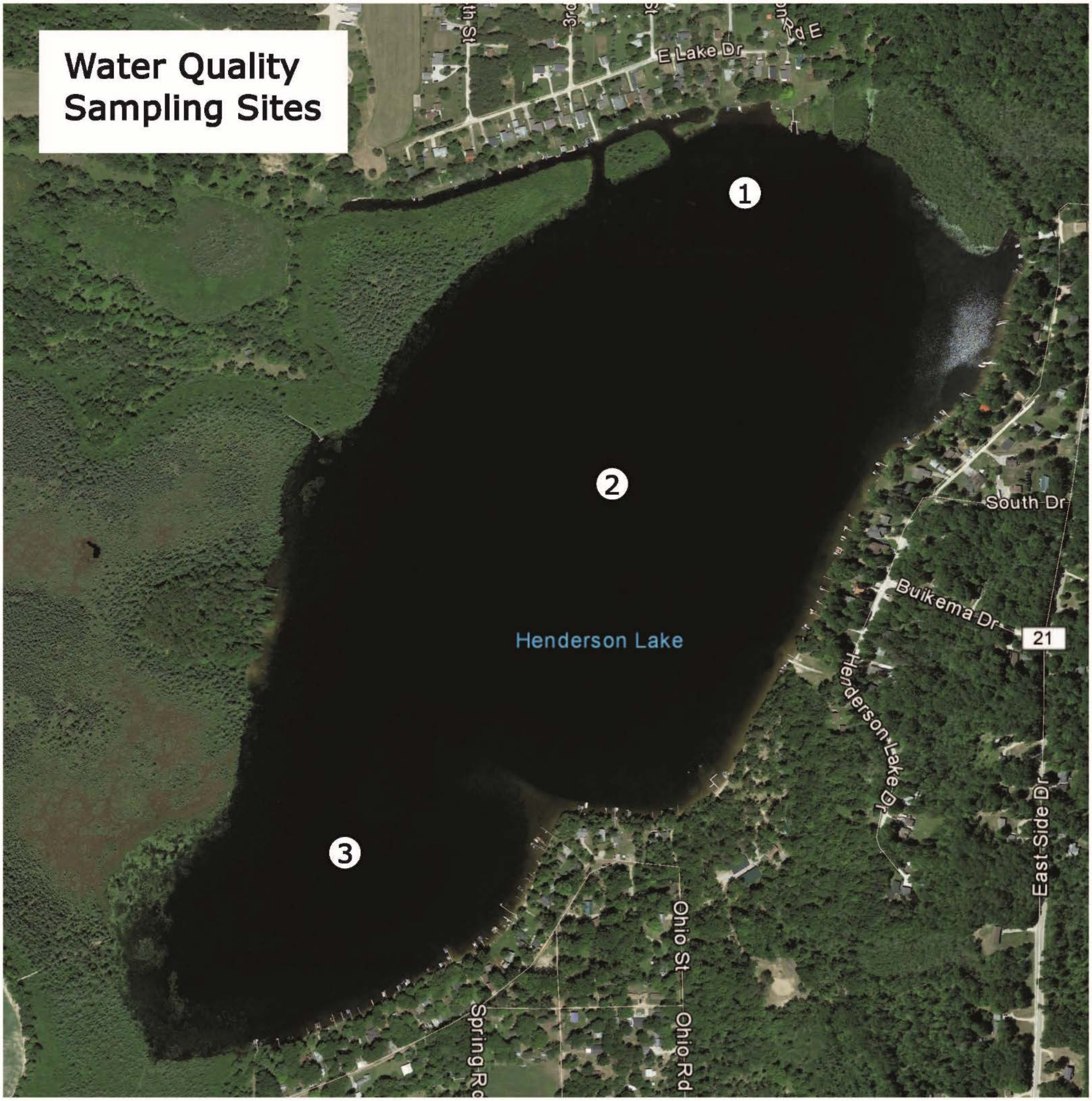
Summary:

Water Quality Testing was completed 2 times on Henderson Lake in 2017 at 3 different locations around the lake. Of the parameters tested, Temperature, Dissolved Oxygen, Secchi Disk, and pH were sampled while on the lake. Chlorophyll α, Nitrate-N, Phosphorus, Alkalinity, and Conductivity were sampled by sending the water in sample bottles to an independent laboratory, White Water Associates located in Amasa, MI, where the analysis was ran.

A well known limnologist named Wally Fusilier developed a grading scale for various parameters of water quality. Data collected in 2017 is shown below and given a grade based on Fusilier's scale. Additionally, historical data and parameter descriptions are provided at the end of this report.

Because herbicide treatment of aquatic vegetation has occurred on Henderson Lake, it should be noted that the application of herbicide no direct impact to the water quality of Henderson Lake.

Overall in 2017 based on the analysis results, Henderson Lake had excellent water quality figures. In both the spring and the fall Henderson Lake had average grades of A. The only blemish on the results is that spring phosphorus levels were slightly high near the outlet. Other than that the lake is great!


Water Quality
Sampling Sites
E Lake Dr
1
2
3
Henderson Lake
South Dr
Buikema Dr
21
Henderson Lake Dr
East Side Dr
Ohio St
Ohio Rd
Spring Rd

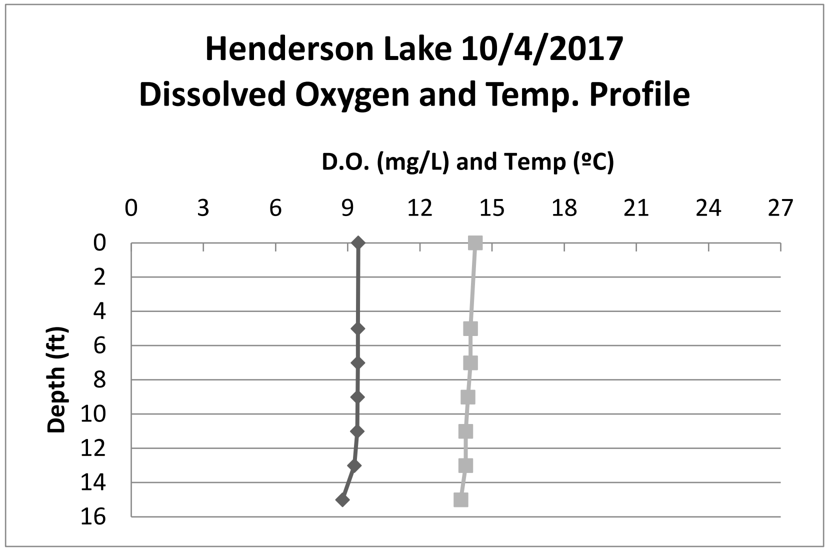
2017 Results:

Date	6/7/2017		6/7/2017		6/7/2017		10/4/2017		10/4/2017		10/4/2017	
Station Number	1		2		3		1		2		3	
Temp (ºC)	23.4	A	23.1	A	22.4	A	14.0	A	14.3	A	14.1	A
Dissolved Oxygen (mg/L)	9.14		9.17		9.13		9.64		9.44		9.43	
Dissolved Oxygen (%saturation)	106.78	A	107.1	A	104.7	A	93.6	A	91.7	A	91.6	A
Chlorophyll a (ug/L)	0.4	A	0.4	A	0.0	A	1.4	A	1.4	A	1.4	A
Secchi Disk Depth (ft)	Bottom		11.0	B	10.5	B	Bottom		13.0	A	Bottom	
Total Nitrate Nitrogen (ug/L)	ND	A	ND	A	ND	A	ND	A	ND	A	ND	A
Alkalinity (mg/L)	73	A	74	A	73	A	160	A	110	A	110	A
pH	7.61	A	7.55	A	7.62	A	7.63	A	7.74	A	7.60	A
Conductivity (umhos/cm)	210	A	200	A	200	A	200	A	210	A	210	A
Total Phosphorus (ug/L)	13	A	13	A	41	D	ND	A	ND	A	ND	A
Overall Grade		A		A		A		A		A		A

Scale:

Grade	Temp	Dissolved Oxygen	Chloro-phyll α	Secchi Disk Depth	Total Nitrate Nitrogen	Alkalinity	pH	Conduc-tivity	Total Phosphorus
A	0-26.5	85-115	0-2	>19	0-275	50-225	5.75-8.27	0-380	0-20
B	26.5-28.5	85-77; 115-122	2-3	19-16	275-360	50-35; 225-255	5.75-5.55; 8.27-8.47	380-590	20-28
C	28.5-30	77-69; 122-131	3-4	16-12	360-450	35-23; 255-280	5.55-5.33; 8.47-8.69	590-720	28-39
D	30-31.5	69-62; 131-140	4-5	12-9	450-540	23-17; 280-310	5.33-5.14; 8.69-8.88	720-800	39-46
F	>31.5	<62; >140	>5	<9	>540	<17; >310	<5.14; >8.88	>800	>46

Temp (ºC)	D.O. (mg/L)	Depth (ft)
14.3	9.44	0
14.1	9.42	5
14.1	9.42	7
14.0	9.41	9
13.9	9.39	11
13.9	9.28	13
13.7	8.78	15



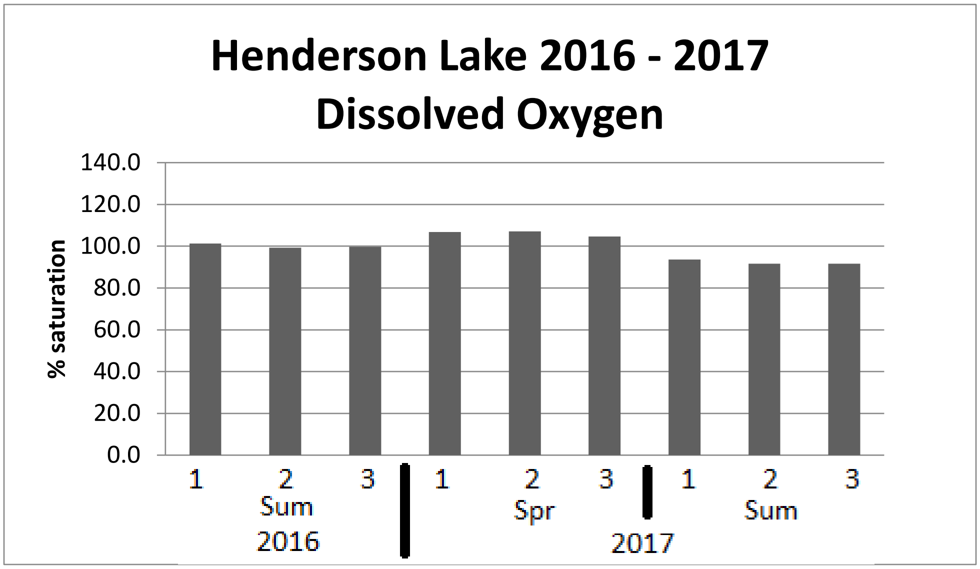
In late summer 2017 Henderson Lakes thermocline had already went away do to mixing. Sampling in 2018 must be done earlier in order to determine the thermocline. The dissolved oxygen concentration throughout the water column remained near 9 mg/L, which for the temperature of the water was quite adequate saturation.

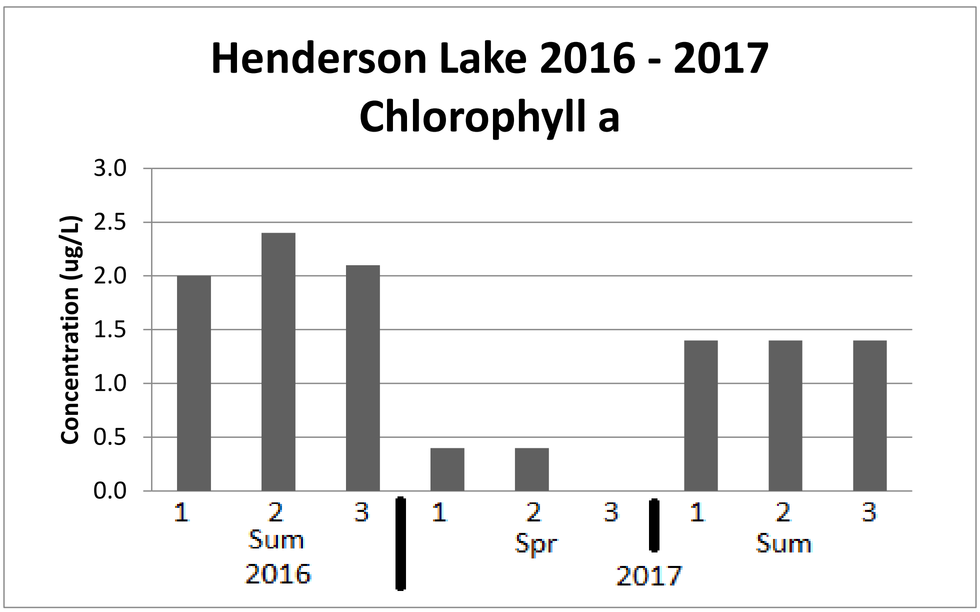
Matt Novotny

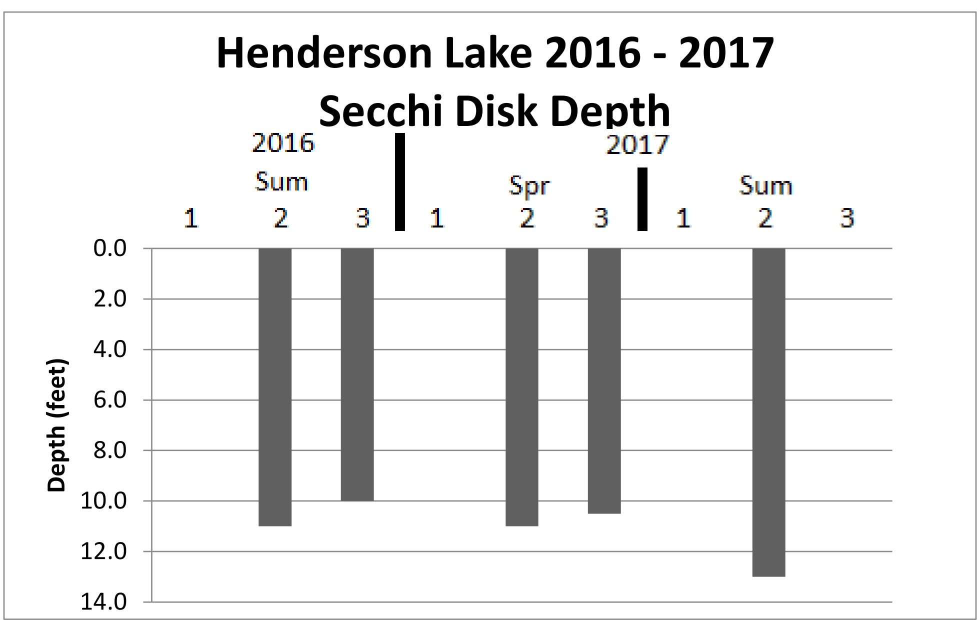
Matthew Novotny

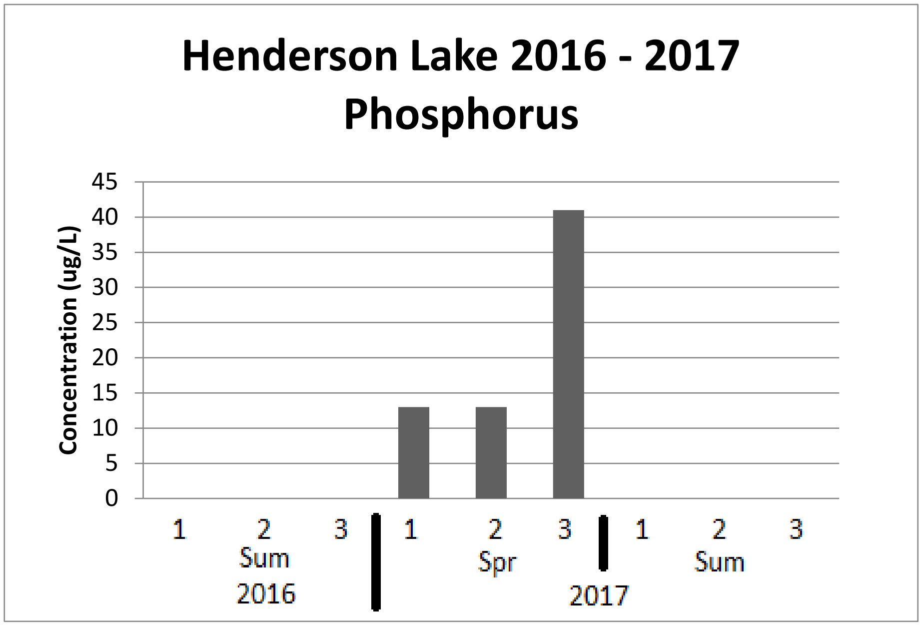
Environmental Scientist

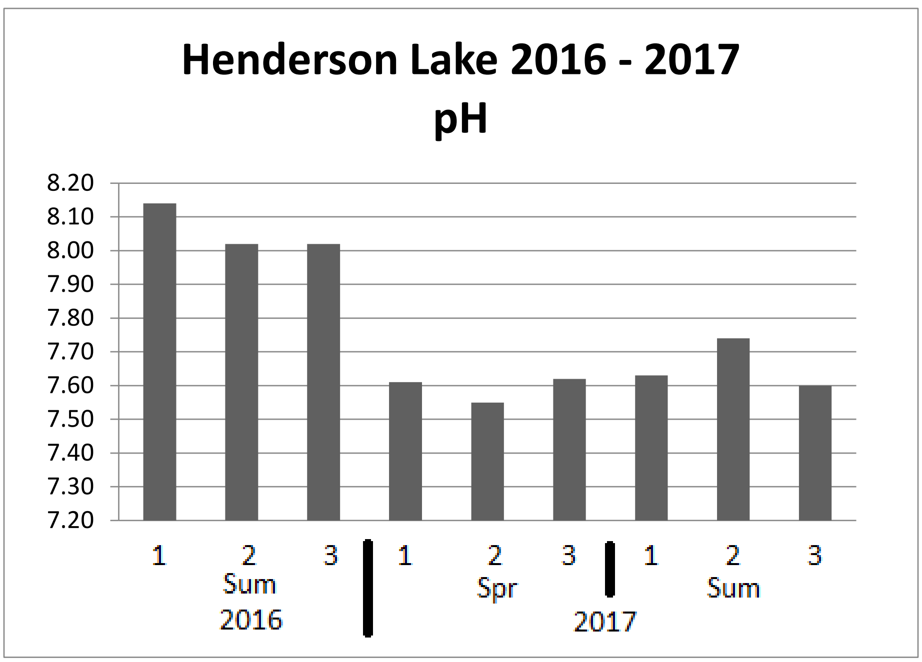
Historical Data:

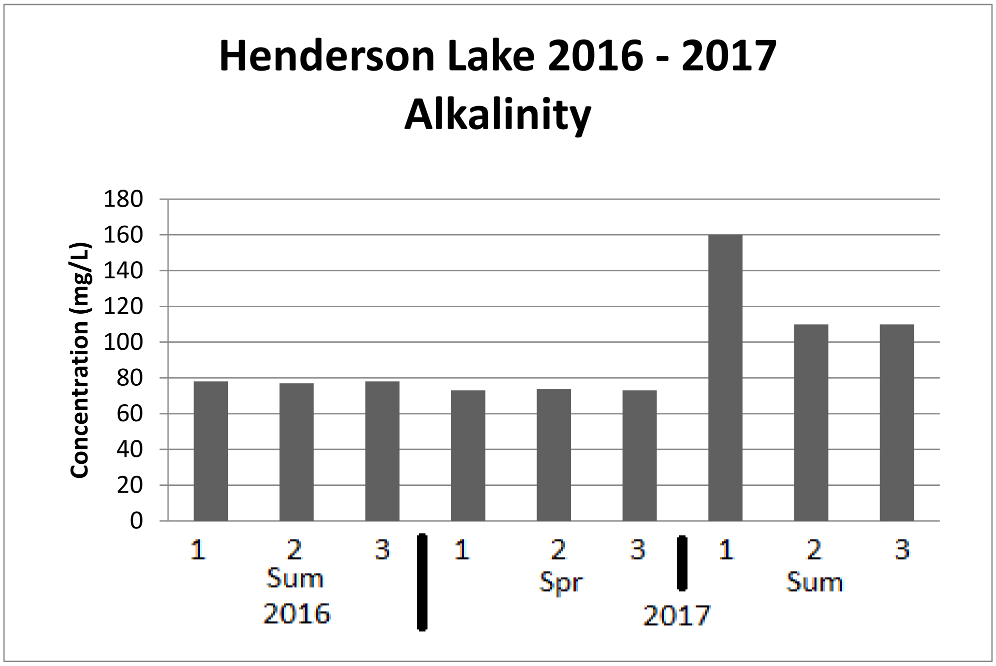


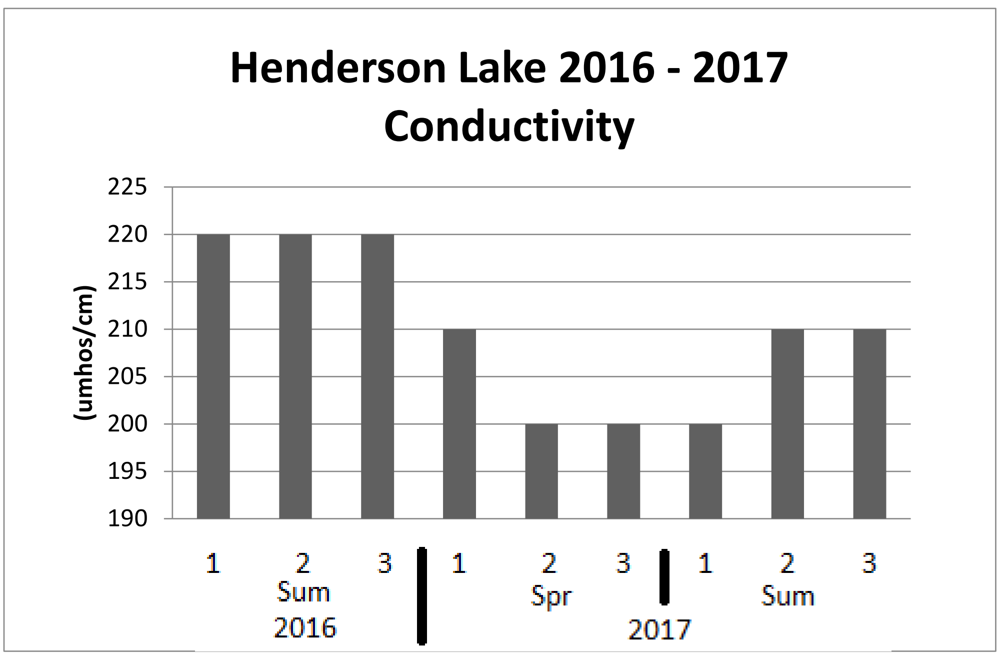





Henderson Lake 2016 - 2017
Phosphorus
Concentration (ug/L)
45
40
35
30
25
20
15
10
5
0
1 2 3 1 2 3 1 2 3
Sum
2016
Spr
2017
Sum


Henderson Lake 2016 - 2017
pH
8.20
8.10
8.00
7.90
7.80
7.70
7.60
7.50
7.40
7.30
7.20
1 2 3 1 2 3 1 2 3
Sum
2016
Spr
2017
Sum





Henderson Lake Water Quality Data

Date	Sample Station Number	Temperature (ºC)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll α (ug/L)	Secchi Disk Depth (ft)	Total Nitrate Nitrogen (ug/L)	Alkalinity (mg/L)	pH	Conductivity umhos per cm at 25 ºC	Total Phosphorus (ug/L)	Grade
9/28/2016	1	17.2	9.77	101.2	2.0	Bottom	ND	78	8.14	220	<9	A
9/28/2016	2	17.0	9.58	99.3	2.4	11.0	ND	77	8.02	220	<9	A
9/28/2016	3	16.9	9.62	99.7	2.1	10.0	ND	78	8.02	220	<9	A
6/7/2017	1	23.4	9.14	106.8	0.4	Bottom	ND	73	7.61	210	13	A
6/7/2017	2	23.1	9.17	107.1	0.4	11.0	ND	74	7.55	200	13	A
6/7/2017	3	22.4	9.13	104.7	0.0	10.5	ND	73	7.62	200	41	A
10/4/2017	1	14.0	9.64	93.6	1.4	Bottom	ND	160	7.63	200	ND	A
10/4/2017	2	14.3	9.44	91.7	1.4	13.0	ND	110	7.74	210	ND	A
10/4/2017	3	14.1	9.43	91.6	1.4	Bottom	ND	110	7.60	210	ND	A

Parameter Descriptions:

TEMPERATURE AND DISSOLVED OXYGEN

Temperature exerts a wide variety of influences on most lakes, such as the separation of layers of water (stratification), solubility of gases, and biological activity.

Dissolved oxygen is the parameter most often selected by lake water quality scientists as being important. Besides providing oxygen for aquatic organisms in natural lakes, dissolved oxygen is involved in phenomena such as phosphorus precipitation to, and release from, the lake bottom sediments and decomposition of organic material in the lake.

Low dissolved oxygen concentrations (below 4 milligrams per liter) are generally insufficient to support fish life. In most Michigan lakes, there is no dissolved oxygen below the thermocline in late summer. Some experts like to see some dissolved oxygen in the bottom water of a lake, even if it is almost zero. This is because as long as there is some dissolved oxygen in the water at the bottom of the lake, phosphorus precipitated by iron to the bottom sediments will remain there. Once a lake runs out of dissolved oxygen in the water at the bottom iron comes back into solution. When that happens, it releases the phosphorus back into the water. This can cause additional algae to grow when the lake mixes.

DISSOLVED OXYGEN, PERCENT SATURATION

Because the amount of dissolved oxygen a water can hold is temperature dependent with cold water holding more than warm water, dissolved oxygen saturation is often a better way to determine if oxygen supplies are adequate. The best is between 90 and 110 percent.

CHLOROPHYLL α

Chlorophyll α is used by lake scientists as a measure of the biological productivity of the water. Generally, the lower the chlorophyll α, the better. High concentrations of chlorophyll α are indicative of an algal bloom in the lake, an indication of poor lake water quality. The highest surface chlorophyll α concentration found by Wallace Fusilier (Water Quality Investigators, WQI) in a Michigan lake was 216 micrograms per liter. Best is below one microgram per liter.

SECCHI DISK TRANSPARENCY (originally Secchi's disk)

In 1865, Angelo Secchi, the Pope's astronomer in Rome, Italy devised a 20-centimeter (8 inch) white disk for studying the transparency of the water in the Mediterranean Sea. Later an American limnologist (lake scientist) named Whipple divided the disk into black and white quadrants which many are familiar with today.

The Secchi disk transparency is a lake test widely used and accepted by limnologists. The experts generally felt the greater the Secchi disk depth, the better quality the water. However, one Canadian scientist pointed out acid lakes have very deep Secchi disk readings. (Would you consider a very clear lake a good quality lake, even if it had no fish in it? It would be almost like a swimming pool.) Most lakes in southeast Michigan have Secchi disk transparencies of less than ten feet. On the other hand, Elizabeth Lake in Oakland County had 34 foot Secchi disk readings in summer 1996, evidently caused by a zebra mussel invasion a couple of years earlier.

Most limnology texts recommend the following: to take a Secchi disk transparency reading, lower the disk into the water on the shaded side of an anchored boat to a point where it disappears. Then raise it to a point where it's visible. The average of these two readings is the Secchi disk transparency depth.

Secchi disk measurements should be taken between 10 AM and 4 PM. Rough water will give slightly shallower readings than smooth water. Sunny days will give slightly deeper readings than cloudy days. However, roughness influences the visibility of the disk more than sunny or cloudy days.

TOTAL PHOSPHORUS

Although there are several forms of phosphorus found in lakes, the experts selected total phosphorus as being most important. This is probably because all forms of phosphorus can be converted to the other forms. Currently, most lake scientists feel phosphorus, which is measured in parts per billion (1 part per billion is one second in 31 years) or micrograms per liter (ug/L), is the one nutrient which might be controlled. If its addition to lake water could be limited, the lake might not become covered with the algal communities so often found in eutrophic lakes.

Based on WQI's studies of many Michigan inland lakes, they've found many lakes were phosphorus limited in spring (so don't add phosphorus) and nitrate limited in summer (so don't add nitrogen).

10 parts per billion is considered a low concentration of phosphorus in a lake and 50 parts per billion is considered a high value in a lake by many limnologists.

NITRATE NITROGEN

Nitrate, also measured in the parts per billion range, has traditionally been considered by lake scientists to be a limiting nutrient. The experts felt any concentration below 200 parts per billion was excellent in terms of lake water quality. The highest value found by Fusilier was 48,000 parts per billion in an Ottawa County river which flowed into Lake Macatawa in Holland, Michigan

On the other hand, WQI has studied hundreds of Michigan inland lakes, and many times they find them nitrate limited (very low nitrate nitrogen concentrations), especially in summer.

WQI was finding many lakes have lower nitrate nitrogen concentrations in summer than in spring. This is probably due to two factors. First, plants and algae growing in lakes as water warms can remove nitrates from the water column. And second, bacterial denitrification (where nitrates are converted to nitrogen gas by bacteria) also occurs at a much faster rate in summer when the water is warmer.

Generally limnologists feel optimal nitrate nitrogen concentrations (which encourage maximum plant and algal growth) are about 10-20 times higher than phosphorus concentrations. The reason more nitrogen than phosphorus is needed is because nitrogen is one of the chemicals used in the production of plant proteins, while phosphorus is used in the transfer of energy, but is not used to create plant material. If the nitrate concentration is less than 10-20 times the phosphorus concentration, the lake is considered nitrogen limited. If the nitrate concentration is higher than 10-20 times the phosphorus concentration, the lake is considered phosphorus limited.

TOTAL ALKALINITY

Alkalinity is a measure of the ability of the water to absorb acids (or bases) without changing the hydrogen ion concentration (pH). It is, in effect, a chemical sponge. In most Michigan lakes, alkalinity is due to the presence of carbonates and bicarbonates which were introduced into the lake from ground water or streams which flow into the lake. In lower Michigan, acidification of most lakes should not be a problem because of the high alkalinity concentrations.

HYDROGEN ION CONCENTRATION (pH)

pH has traditionally been a measure of water quality. Today it is an excellent indicator of the effects of acid rain on lakes. About 99% of the rain events in southeastern Michigan are below a pH of 5.6 and are thus considered acid. However, there seems to be no lakes in southern Michigan which are being affected by acid rain. Most lakes have pH values between 7.5 and 9.0.

SPECIFIC CONDUCTIVITY

Conductivity, measured with a meter, detects the capacity of a water to conduct an electric current. More importantly however, it measures the amount of materials dissolved in the water, since only dissolved materials will permit an electric current to flow. Theoretically, pure water will not conduct an electric current. It is the perception of the experts that poor quality water has more dissolved materials than does good quality water