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

February 10, 2021

Henderson Lake Property Owners,

It has really been a pleasure managing Henderson Lake over the years. Every year seems to bring a unique set of challenges and we welcome the opportunity to meet these challenges for you every single year. Last year was a very challenging year for us as we had to overcome many obstacles due to Covid-19. With mandatory stay at home orders and our industry not receiving the classification of being an “essential industry” until the end of April. We started our season 6 weeks behind schedule and had a lot to do and only a little bit of time to do it in. As if that was not challenging enough, we battled shortages and delays in our supply chain causing treatments to be delayed and rescheduled. Thanks to our fantastic group of team members, we were able to overcome all obstacles and complete the work with minimal delays or impacts to our customers.

We hope that you continue to feel that your lake was managed professionally, economically, and effectively. We are hopeful that this year will be another great year with an even healthier ecosystem, and continued reduction of the invasive plant communities. I have prepared and attached to this document the 2020 annual report for Henderson Lake. This report includes a descriptive timeline of services rendered, a brief summary, the 2020 treatment maps, and the water quality report for Henderson Lake.

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.

We look forward to continuing as the Lakes Management service provider for Henderson Lake again next year. Until then; if you have any questions, comments, or require additional information, feel free to contact us.

Sincerely,

Paul Barber

Paul Barber - Operations Manager
Savin Lake Services Inc.

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Henderson Lake - 2020 Lake Management Report

In 2020, Savin Lake Services was on Henderson Lake a total of 7 times to provide services. Henderson Lake received 3 herbicide and algaecide applications, 3 Bacterial Augmentation (Mukk Busster) treatments, and water quality monitoring was completed in the fall. Below is a descriptive timeline and information pertaining to the services we completed.

June 16th, 2020

- Savin Lake Services conducted our initial treatment
  - This treatment was for any non-native invasive plant communities that existed throughout the entire lake.
    - 5 acres of the lake was treated for Curly Leaf Pondweed
  - We also treated for algae and nuisance natives in the near shore developed areas of the lake that required treatment.
    - 12.5 acres of the lake for Algae
    - 8.5 acres of various native pondweeds like Large leaf pondweed, Richardson's Pondweed, and Robbin's Pondweed.
- Observations
  - The lake required minimal treatment and vegetation growth was delayed in most areas of the lake.
  - No Eurasian Watermilfoil detected
  - Natives just beginning their growth cycle could be found in all the typical areas we have found them in the past, with only the shallower areas ready for treatment.

July 13th, 2020

- Savin Lake Services completed our second treatment
  - This treatment was for algae and nuisance native plant communities in the near shore developed areas of the lake.
    - 19.5 acres of the lake was treated for algae
    - 17.5 acres of the lake was treated for nuisance Large Leaf and Robbin's pondweeds
    - 7.5 acres of the lake was treated for Bladderwort and Naiad

- Observations
  - Native plants could be found in all the usual areas but still below the surface of the water.
  - Many developed areas of the lake contained nuisance natives that reached a level to impede desired recreational use and required treatment.
  - Only native vegetation present

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July 15th, 2020

- Savin Lake Services conducted the initial Bacterial Augmentation treatment
  - Treatment was delayed due to shortage in supply chain
    - Manufacturer of Mukk Busster could not meet demand due to Covid 19 related reason
    - Received partial shipment of product and treatment took place immediately
  - 5.5 acres received treatment
    - Same areas that we treated in 2019

August 19th, 2020

- Savin Lake Services conducted our final herbicide application of the year
  - This treatment was for algae, nuisance natives, and emergent plants in near shore developed areas.
    - 19 acres of the lake was treated for algae
    - 15 acres of the lake was treated for various pondweeds like Large Leaf Pondweed, Robbin's Pondweed, Richardson's Pondweed, and Thin leaf Pondweed
    - 5 acres of the lake was treated for Naiad
    - Approximately (10) 40 ft. X 40 ft. areas of the lake were treated with Imazapyr for Emergent plants in near shore developed areas
      - Emergent plants treated include Lily Pads, Watershield, and Cattails
- Observations
  - The lake was in good shape and just needed some touching up in some areas
  - Only native plant species found
  - Increased native plant diversity and densities

September 3rd, 2020

- Savin Lake Services conducted second bacterial augmentation treatment.
  - Treatment delayed again due to shortage in supply chain
    - Finally received remaining portion of the product we ordered and treatment took place the following day
  - Treated the same 5.5 acres we did earlier in the year

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September 24th, 2020

- Savin Lake Services conducted fall portion of the water quality studies
  - Our Aquatic Biologist collected data and samples to test the water quality of the lake
    - Report was generated from data and can be found after the treatment maps of this document
  - Spring data was not collected due to Covid 19 restrictions
  - Water quality monitoring for 2020 was not invoiced.
  - Fall water quality data was collected, water samples were taken, and report was generated at no cost for Henderson Lake.

September 26th, 2020

- Savin Lake Services conducted the final bacterial augmentation treatment for the season
  - Same 5.5 acres treated as earlier in the season
  - Treatment completed a little sooner than normal due to water temperature rapidly declining

- Observations of Bacterial Augmentation treatments
  - Noticeable difference in canal we continue to see improvement each year
  - We see a difference in the area we have been doing by the boat lauch in the Northeast portion of the lake.
  - In Southeast portion of the lake receiving bacteria treatment improvement is not as noticeable

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Summary:

With so many negative things going on in the world today. I am happy to report that things went very well on Henderson Lake last year. We continue to see overall improvement in the ecology of the lake year after year. It has really been a great pleasure being involved, watching the transformations, and knowing the progress that has been made over the years.

In 2020, we saw a large decrease in invasive plant presence compared to previous years. We also saw an increase in native plant densities and plant diversity/species richness. These are both great to see and tells me we are properly managing the lake. Native plants are very important to a lake's ecosystem and play a key role in helping to prevent new infestations of non-native invasive plant species.

Spring acreages of the lake that were treated for Curly Leaf Pondweed last spring decreased from 8 acres in 2019 to only 5 acres treated in Spring of 2020. That is a decrease of 37.5%, which is a great reduction to see in a single year. Early season treatments have been very successful and by doing these treatments we are able to treat the Curly Leaf Pondweed before it is able to complete its growth cycle and produce its reproductive turions.

As if that news wasn't good enough, I have even better data regarding the decrease in Eurasian Watermilfoil presence in the lake in 2020. I'm extremely happy to report that there was no Eurasian Watermilfoil found in the lake the entire 2020 season. Yes, you read that correctly we achieved a 100% reduction in Eurasian Watermilfoil from 2019 to 2020. I cannot put into words how outstanding this accomplishment is! This accomplishment would not of have been possible without everyone's help, awareness, devotion, and participation.

As much as we would like to take all the credit for this accomplishment, I would like to take a minute and acknowledge and give credit where credit is due. I believe an immense amount of gratitude and credit should be given to the Henderson Lake Milfoil Committee. I would like to personally congratulate and thank everyone on the committee, especially Mr. Bill Olsen. Without the committee being so involved none of this would have been possible. The committee has volunteered countless hours organizing funding vehicles, surveying the lake, participating in conferences and meetings, keeping open lines communication, and continuously gathering and sharing information.

We plan to approach next year with a very similar management strategy as we have in the past. We will be monitoring the lake regularly, aggressively managing the invasive plants throughout the entire lake, and manage nuisance natives (when necessary) in the near shore developed areas. We will continue to monitor the native plants offshore and implement a change to manage them if they reach the nuisance level threshold. We feel this plan is the most effective and efficient way to keep Henderson Lake healthy, clean, and desirable for use by the Henderson Lake residents.

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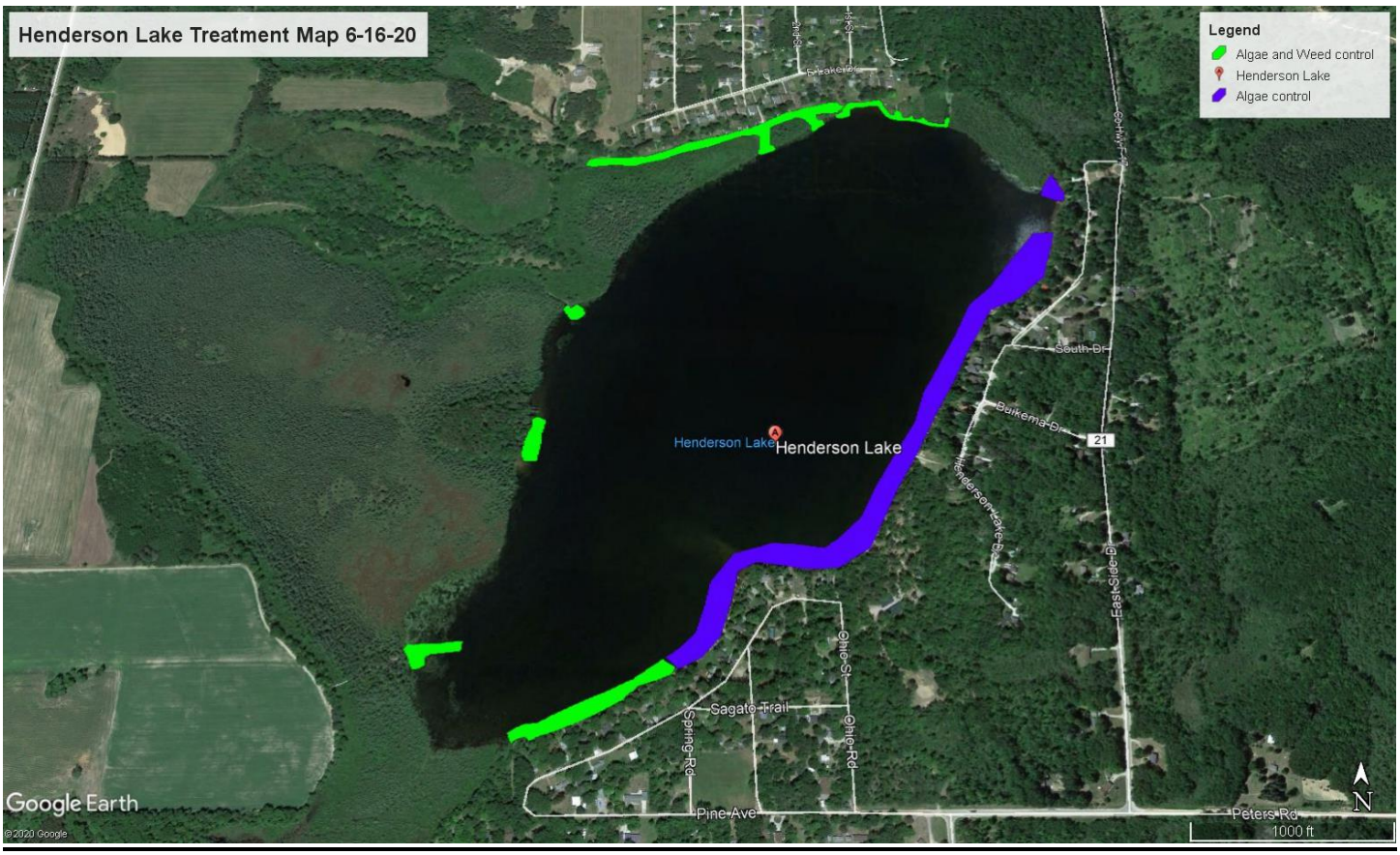
Treatment Maps:

June 16th, 2020



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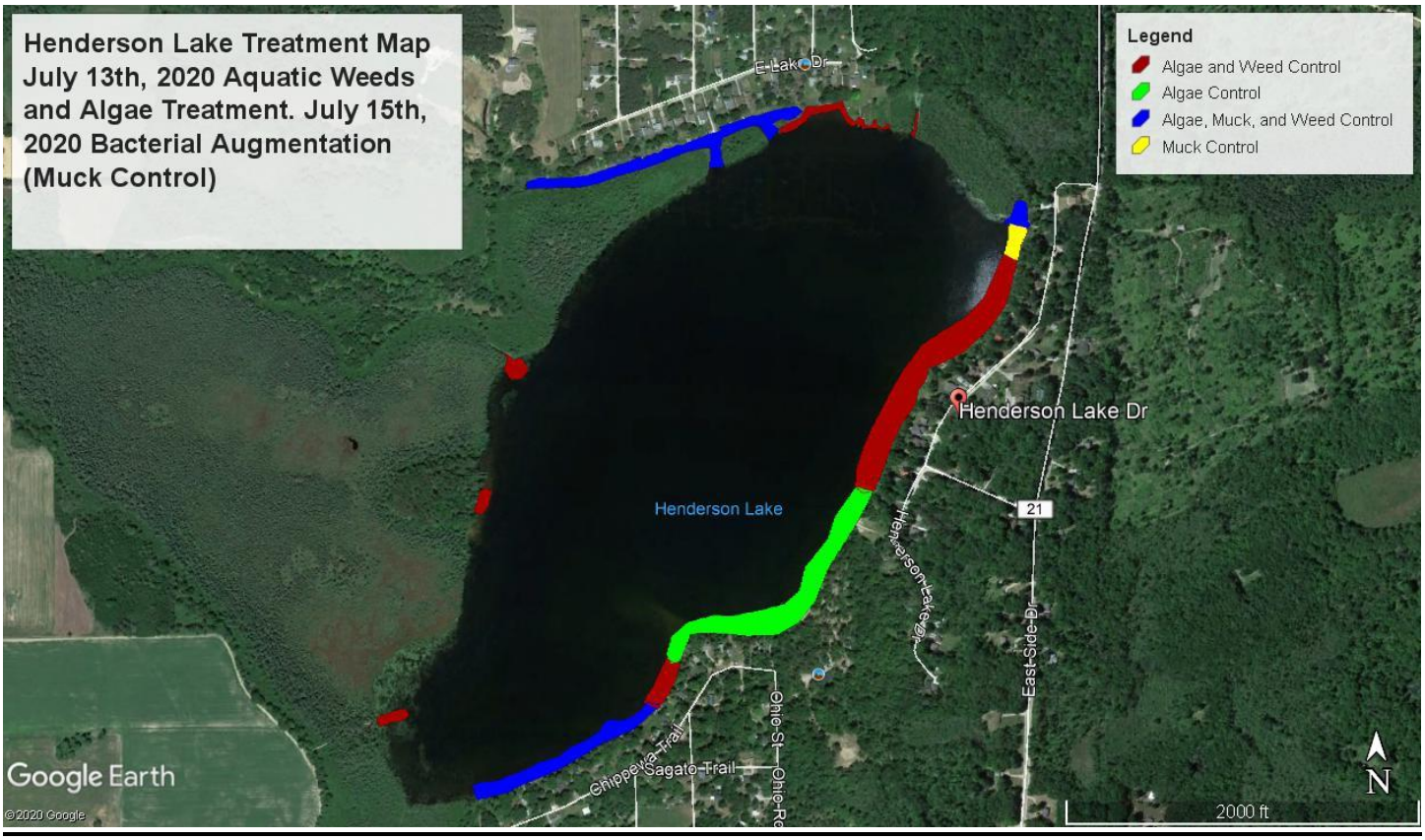
July 13th & 15th, 2020



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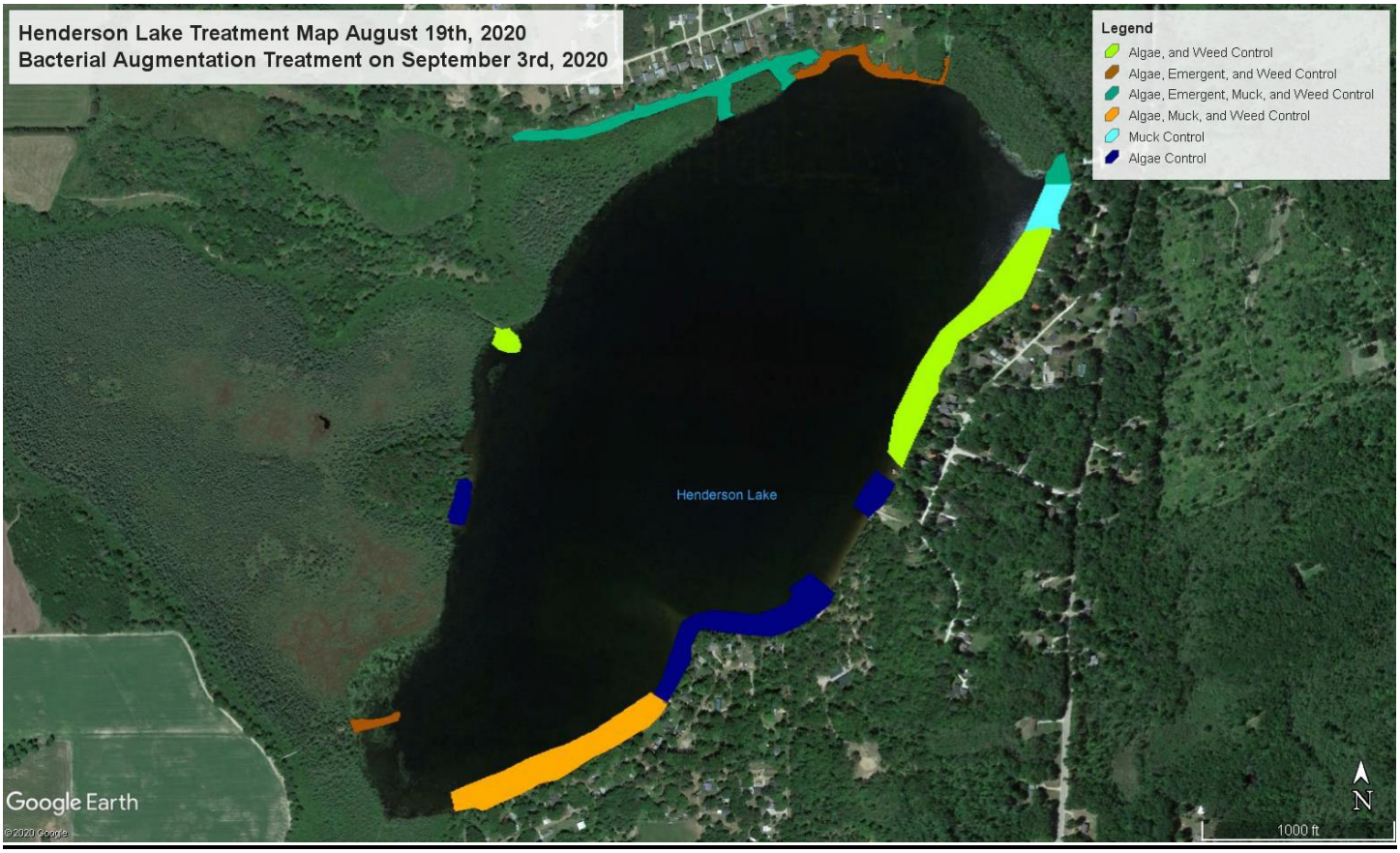
August 19th Herbicide Treatment & September 3rd & 26th Bacterial Treatment



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Henderson Lake 2020 Water Quality Report

Summary:

Due to Covid-19 restrictions on businesses in the spring of 2020, Water Quality Testing was only completed 1 time on Henderson Lake 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 2020 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 2020 based on the analysis results, Henderson Lake had excellent water quality figures again. Everything seems to fall in line with what has been seen in previous years. The only exception is the relatively low Conductivity results. Generally, lower conductivity is seen as better. The lake in general had great water quality results!

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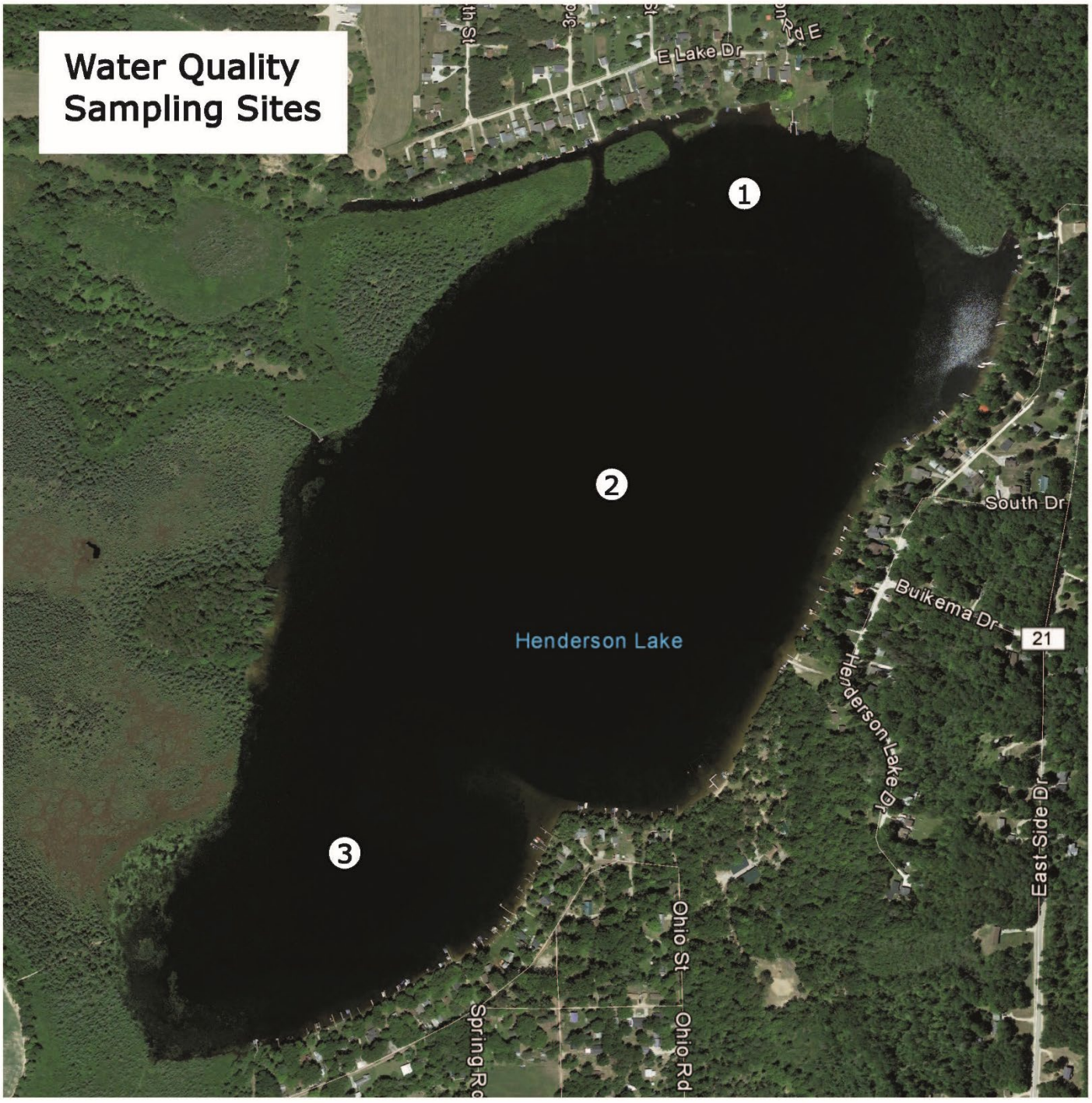

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2020 Results:

Date	9/24/2020			9/24/2020			9/24/2020		
Station Number	1			2			3		
Temp (ºC)	16.1	A		16.2	A		16.4	A	
Dissolved Oxygen (mg/L)	9.9			9.87			10.12		
Dissolved Oxygen (%saturation)	100.8	A		100.2	A		102.7	A	
Chlorophyll a (ug/L)	2.7	B		2.1	B		0.8	A	
Secchi Disk Depth (ft)	Bottom	D		12.0	D		Bottom	D	
Total Nitrate Nitrogen (ug/L)	<130	A		<130	A		<130	A	
Alkalinity (mg/L)	78.0	A		71	A		72	A	
pH	8.5	C		7.91	A		7.82	A	
Conductivity (umhos/cm)	94.0	A		150	A		110	A	
Total Phosphorus (ug/L)	12.0	A		11	A		12	A	
Overall Grade		B			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

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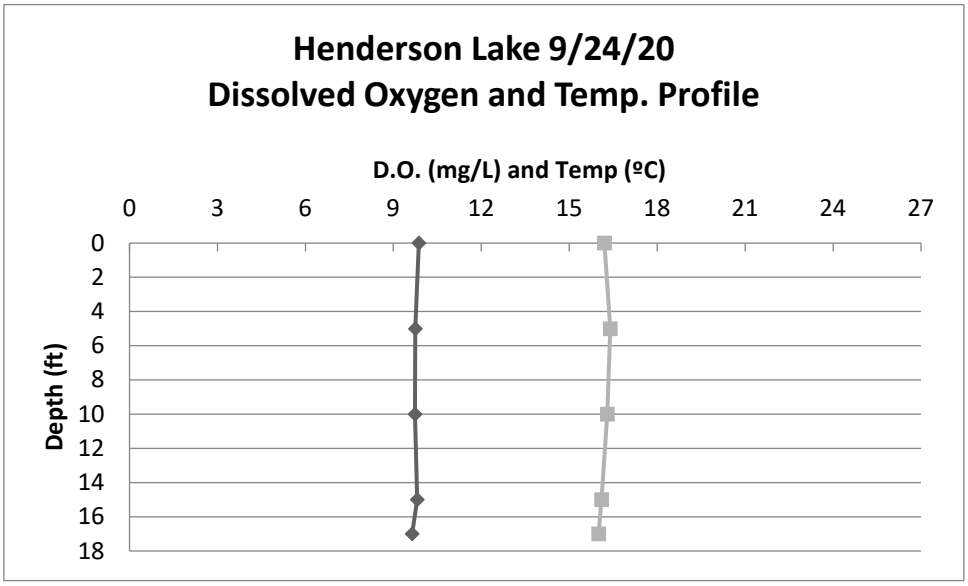
Dissolved Oxygen and Temp. Profile

Temp (ºC)	D.O. (mg/L)	Depth (ft)
16.2	9.87	0
16.4	9.75	5
16.3	9.74	10
16.1	9.81	15
16.0	9.64	17



Matt Novotny

Environmental Scientist

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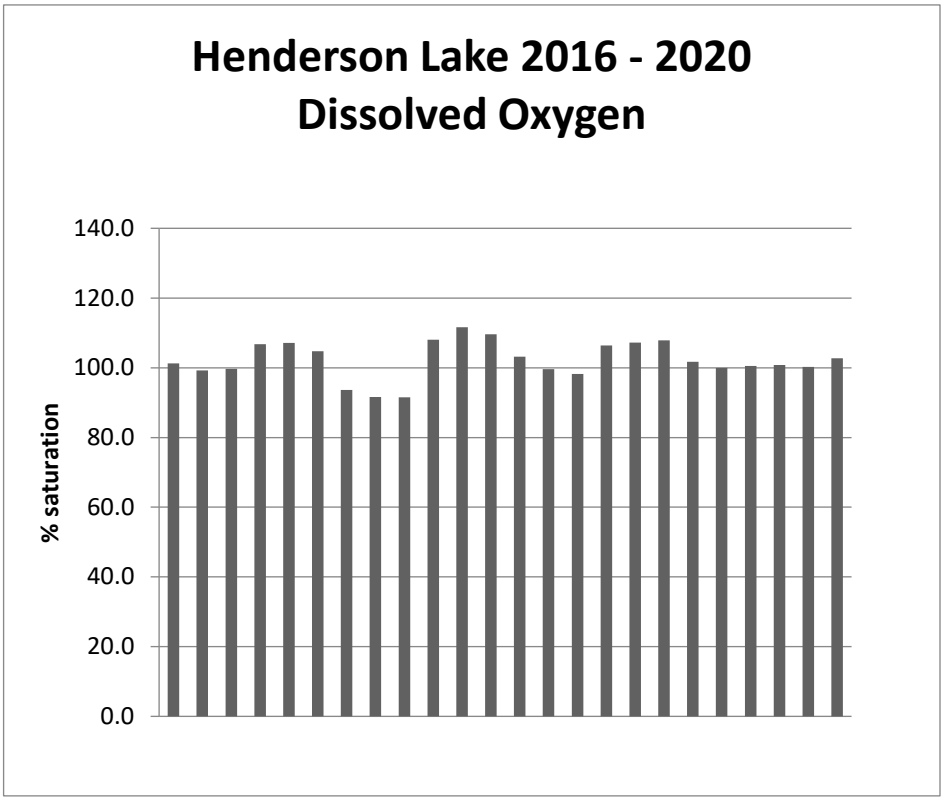
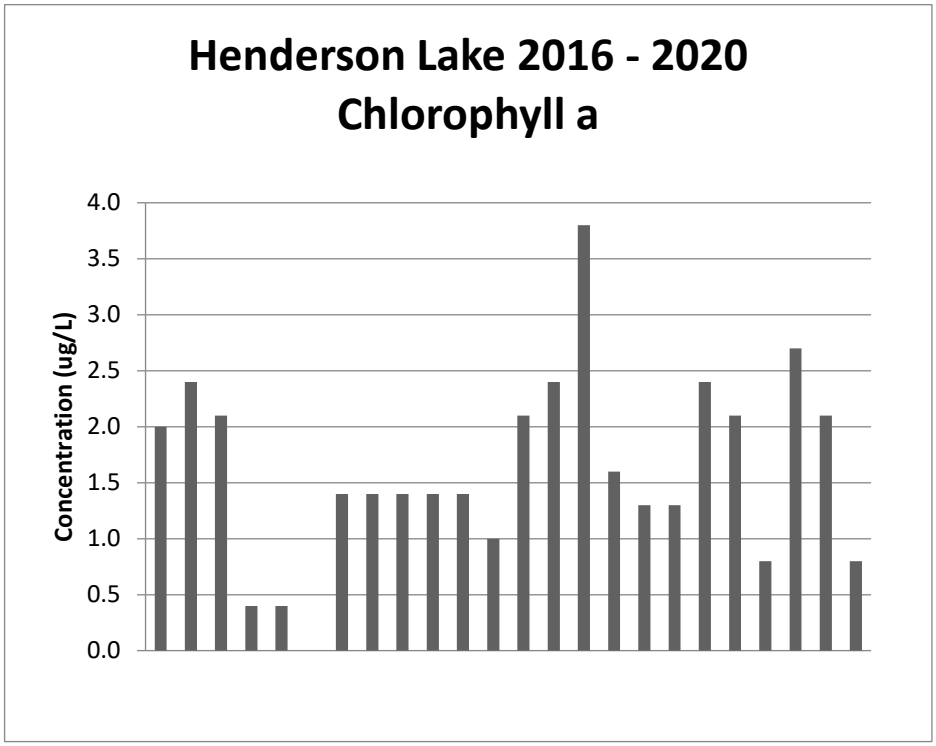
Historical Data:





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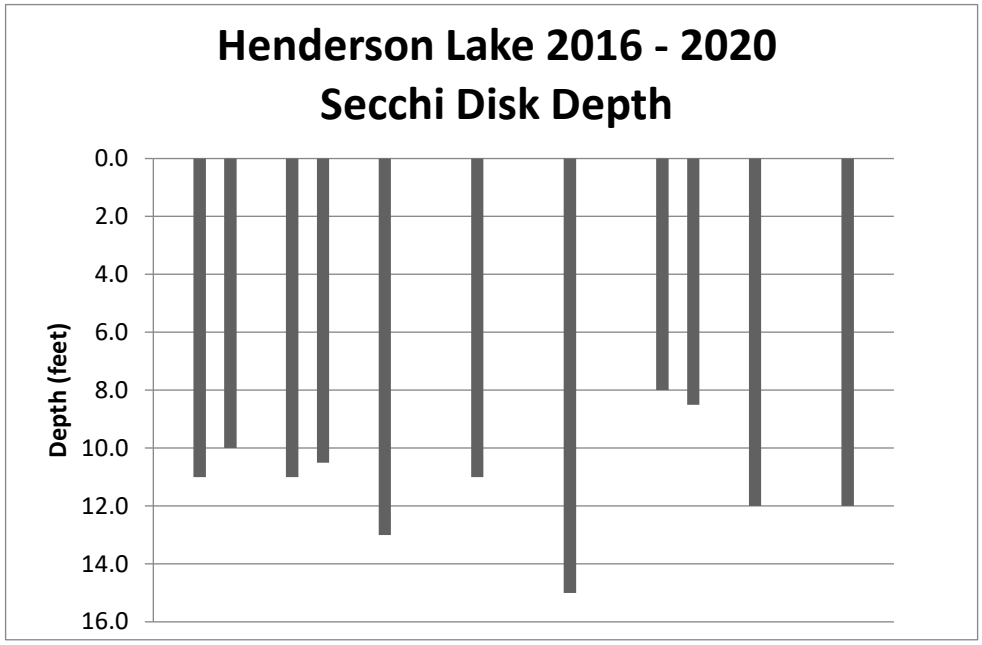

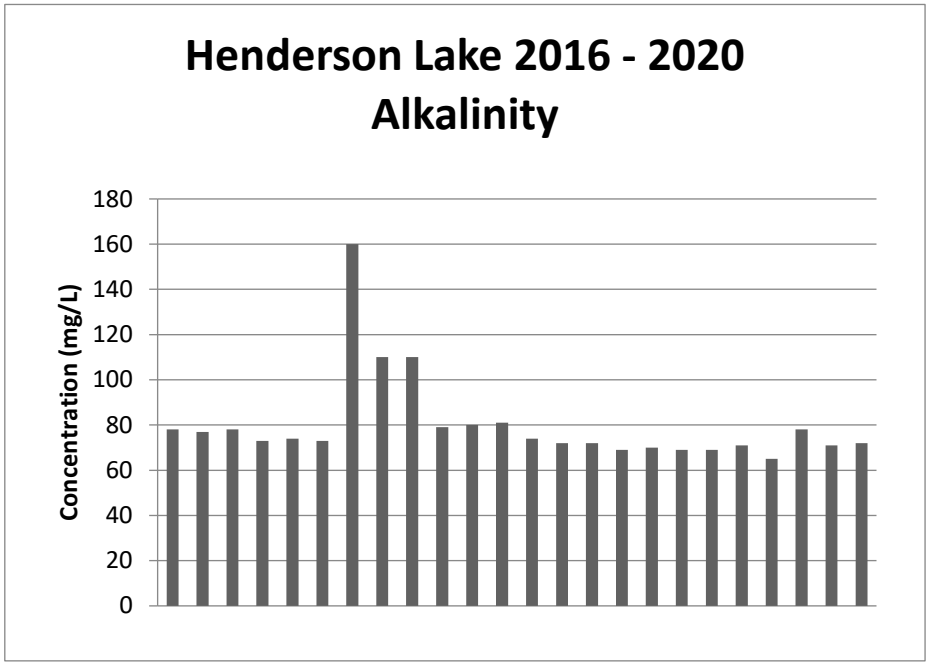

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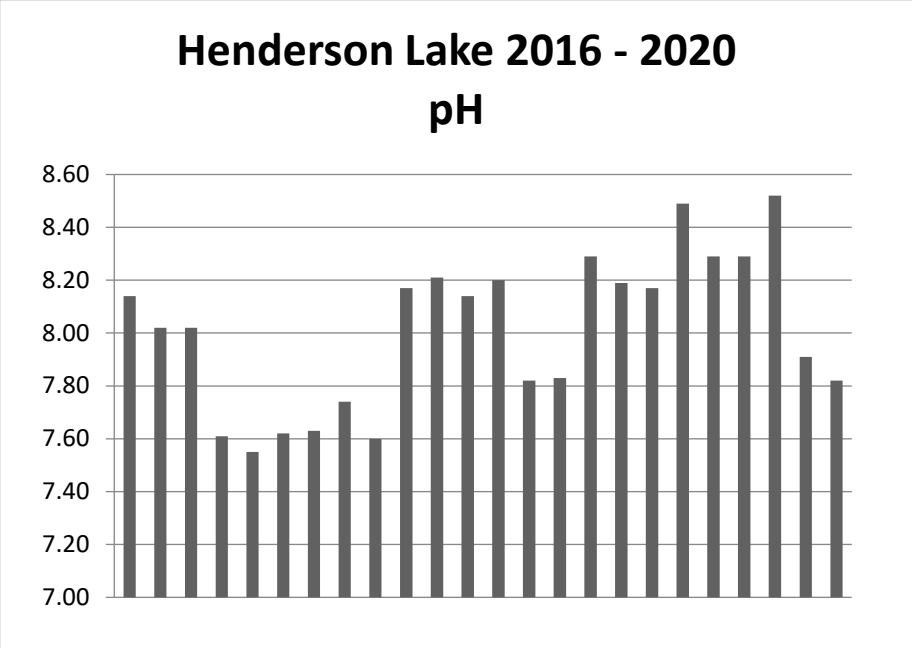

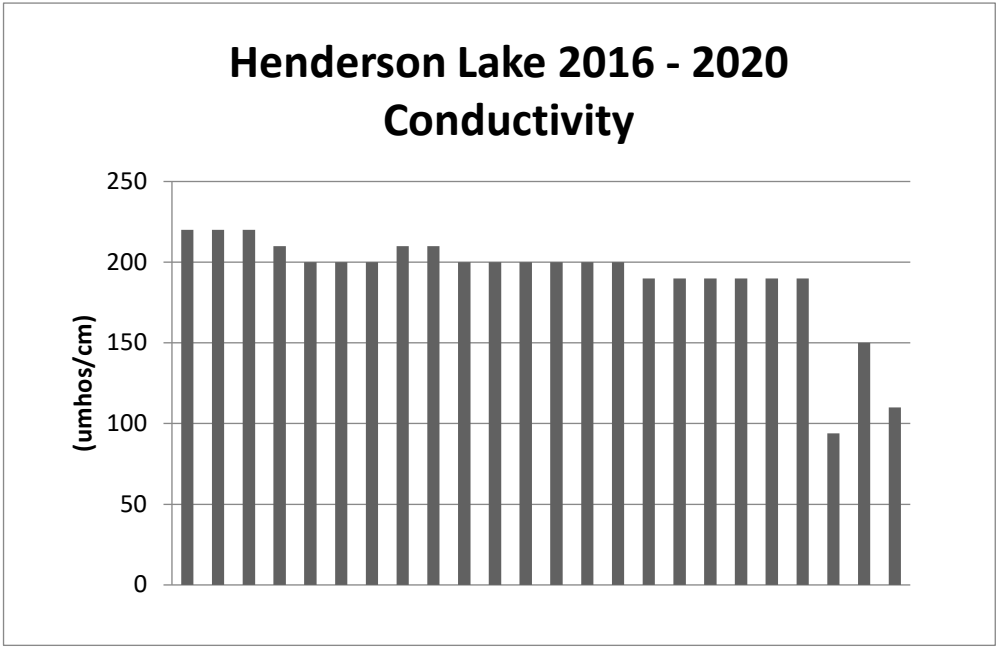

(Nitrate and Total Phosphorus not shown due to majority of undefined values. Information contained in data on next page)

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Henderson Lake Water Quality Data												
Date	Sample Station Number	Temperature (ºC)	Dissolved Oxygen		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
			(mg/L)	Percent Saturation								
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
6/22/2018	1	25.3	8.90	108.0	1.4	Bottom	<80	79.0	8.17	200.0	<8	A
6/22/2018	2	24.7	9.20	111.7	1.4	11.0	<80	80.0	8.21	200.0	<8	A
6/22/2018	3	24.8	9.03	109.6	1.0	Bottom	<80	81.0	8.14	200.0	12.0	A
10/2/2018	1	15.8	10.2	103.1	2.1	Bottom	<80	74.0	8.2	200.0	<8	A
10/2/2018	2	15.3	10.0	99.6	2.4	15.0	<80	72.0	7.8	200.0	<8	A
10/2/2018	3	15.1	9.9	98.2	3.8	Bottom	<80	72.0	7.8	200.0	<8	A
5/24/2019	1	15.9	10.5	106.4	1.6	Bottom	<130	69	8.29	190	12.0	B
5/24/2019	2	15.7	10.6	107.2	1.3	8.0	<130	70	8.19	190	16.0	A
5/24/2019	3	15.7	10.6	107.8	1.3	8.5	<130	69	8.17	190	14.0	A
9/30/2019	1	14.5	10.2	101.7	2.4	Bottom	<130	69	8.49	190	<8	B
9/30/2019	2	14.8	10.1	100.0	2.1	12.0	<130	71	8.29	190	<8	B
9/30/2019	3	14.9	10.1	100.5	0.8	Bottom	<130	65	8.29	190	<8	A
9/24/2020	1	16.1	9.9	100.8	2.7	Bottom	<130	78	8.52	94	12	B
9/24/2020	2	16.2	9.9	100.2	2.1	12.0	<130	71	7.91	150	11	A
9/24/2020	3	16.4	10.1	102.7	0.8	Bottom	<130	72	7.82	110	12	A

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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.

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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.

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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.

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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.

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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