Walled Lake 2018 Water Quality Report

Summary:

Water Quality Testing was completed 2 times on Walled Lake in 2018 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 2018 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 Walled Lake, it should be noted that the application of herbicide no direct impact to the water quality of Walled Lake.

Overall in 2018 based on the analysis results, Walled Lake had a standard year. In both the spring and the fall Walled Lake had an average grade B for all 3 sites. The historically high conductivity did not change this year either. All of the values are constant with years past, nothing stands out as being unique this year. Walled Lake looks great.

(Walled Lake Sampling Sites)

2018 Results:

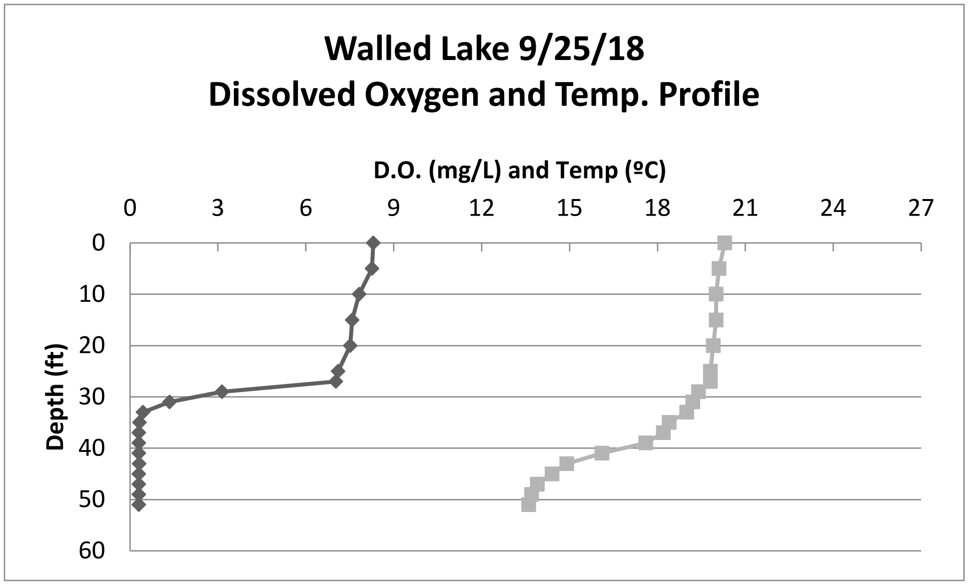
Date	6/11/2018		6/11/2018		6/11/2018		9/25/2018		9/25/2018		9/25/2018	
Station Number	1		2		3		1		2		3	
Temp (ºC)	20.7	A	20.7	A	20.6	A	20.1	A	20.3	A	20.4	A
Dissolved Oxygen (mg/L)	9.0		8.99		8.70		8.18		8.30		8.42	
Dissolved Oxygen (%saturation)	101.1	A	101.0	A	97.8	A	90.2	A	91.5	A	92.8	A
Chlorophyll a (ug/L)	0.4	A	0.0	A	0.4	A	1.4	A	1.7	A	2.1	B
Secchi Disk Depth (ft)	18.0	B	24.0	A	22.0	A	16.0	B	16.0	B	17.0	B
Total Nitrate Nitrogen (ug/L)	<80	A	<80	A	<80	A	<80	A	<80	A	<80	A
Alkalinity (mg/L)	110.0	A	110	A	110	A	100	A	100	A	100	A
pH	8.5	C	8.48	C	8.33	B	8.28	B	8.29	B	8.26	A
Conductivity (umhos/cm)	1000.0	F	1000	F	1000	F	980	F	980	F	990	F
Total Phosphorus (ug/L)	23.0	B	<8	A	<8	A	<8	A	<8	A	<8	A
Overall Grade		B		B		B		B		B		B

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 and D.O.:

Temp (ºC)	D.O. (mg/L)	Depth (ft)
20.3	8.3	0
20.1	8.26	5
20.0	7.82	10
20.0	7.58	15
19.9	7.51	20
19.8	7.10	25
19.8	7.02	27
19.4	3.14	29
19.2	1.35	31
19.0	0.44	33
18.4	0.32	35
18.2	0.30	37
17.6	0.30	39
16.1	0.30	41
14.9	0.31	43
14.4	0.30	45
13.9	0.30	47
13.7	0.30	49
13.6	0.30	51



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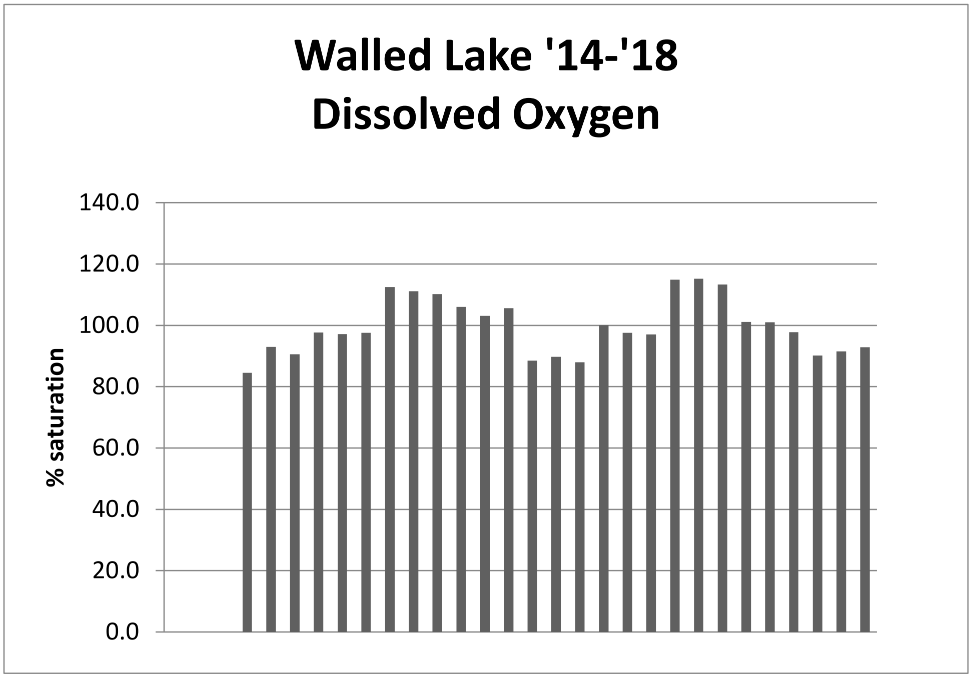
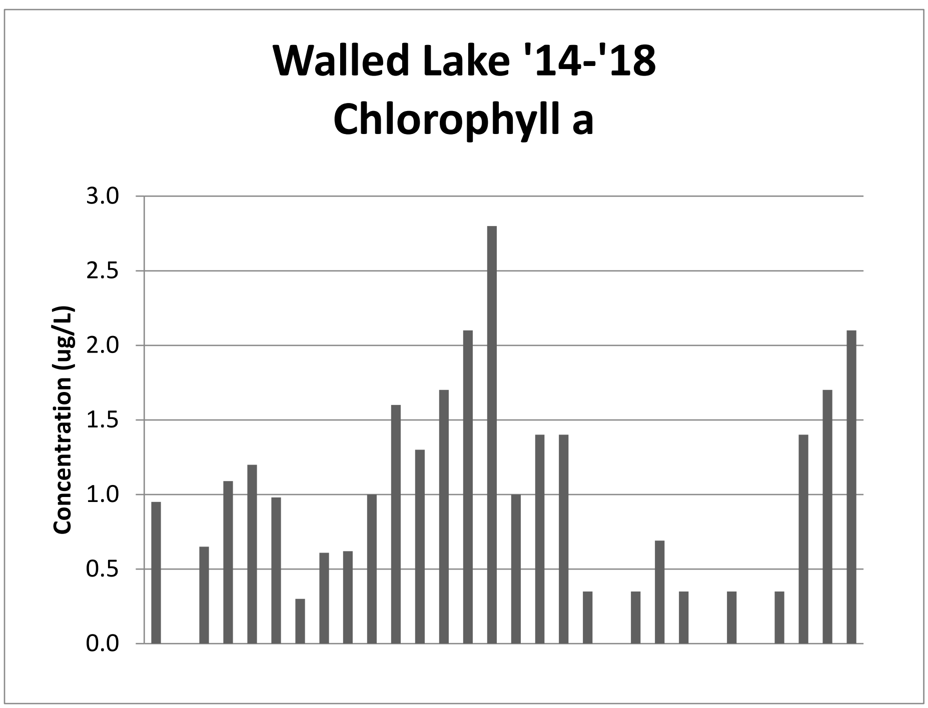
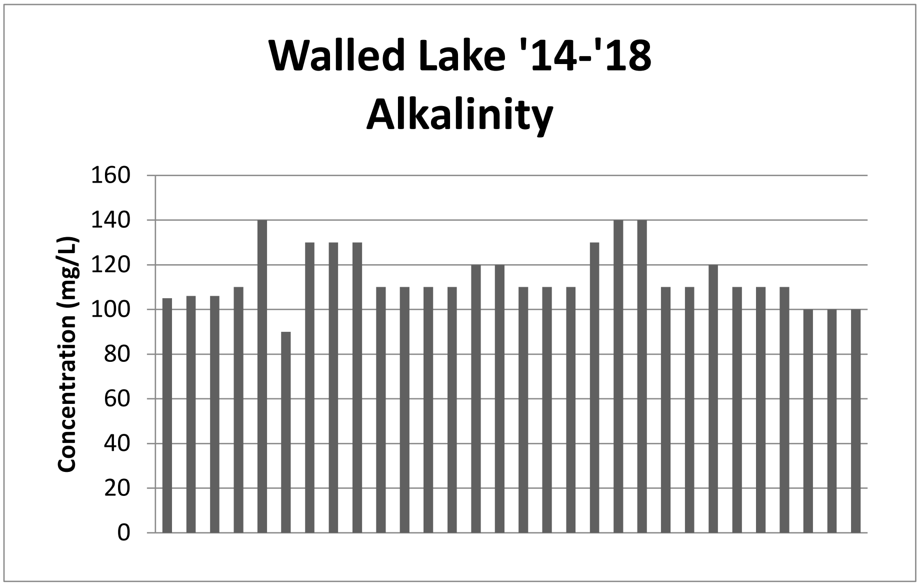
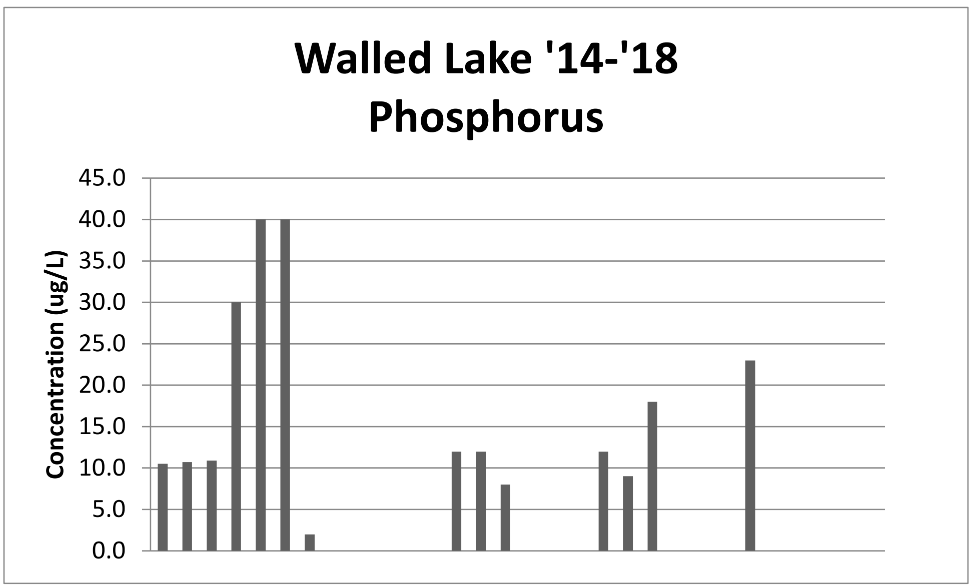
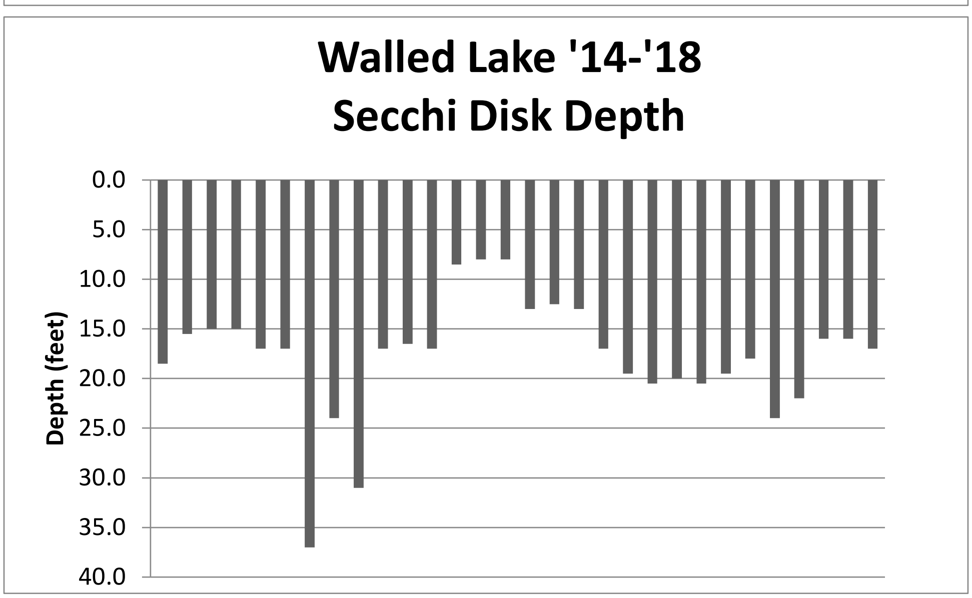
Historical Data:

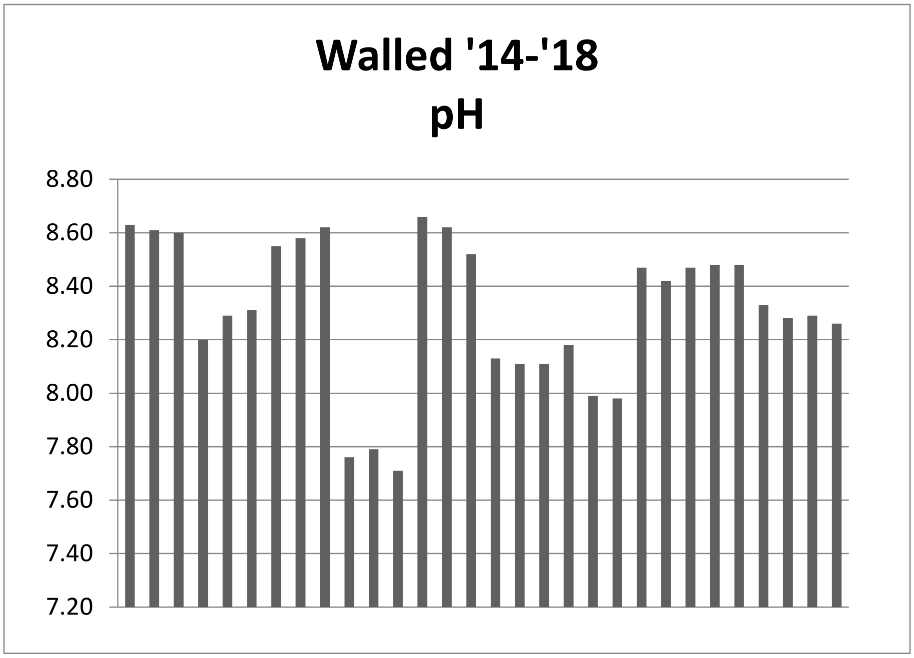


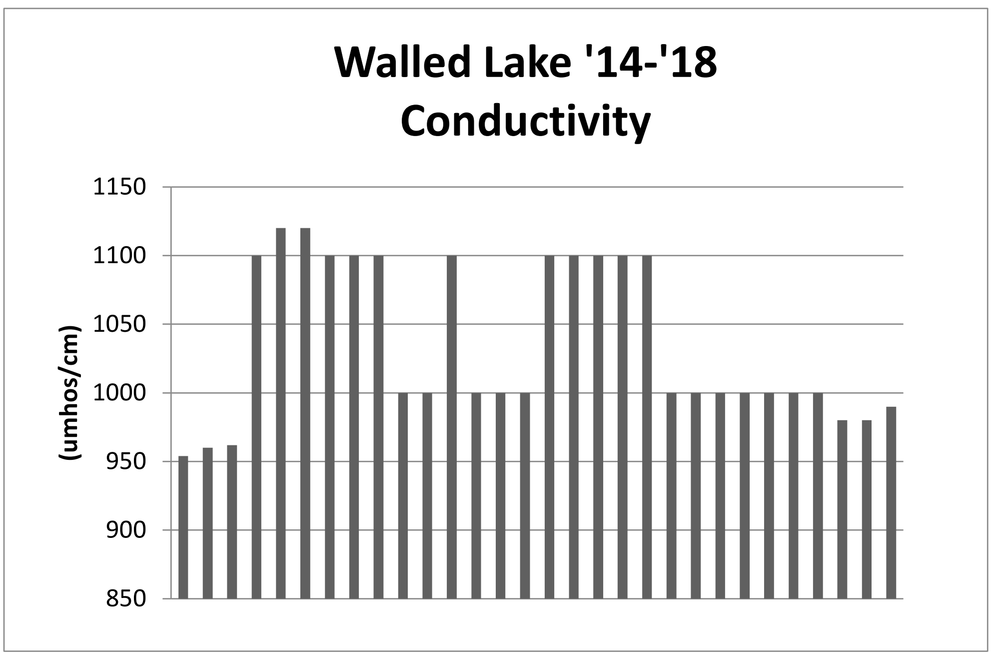



Walled Lake '14-'18
Alkalinity
Concentration (mg/L)
160
140
120
100
80
60
40
20
0


Walled Lake '14-'18
Phosphorus
Concentration (ug/L)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0


Walled Lake '14-'18
Secchi Disk Depth
Depth (feet)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0


Walled '14-'18
pH
8.80
8.60
8.40
8.20
8.00
7.80
7.60
7.40
7.20


Walled Lake '14-'18
Conductivity
(umhos/cm)
1150
1100
1050
1000
950
900
850

Walled Lake Water Quality Data												
Date	Sample Station Number	Temperature (ºC)	Dissolved Oxygen		Chlorophyll α (ug/L)	Secchi Disk Depth (ft)	Total Nitrate-N (ug/L)	Alkalinity (mg/L)	pH	Conductivity umhos per cm at 25 ºC	Total Phosphorus (ug/L)	Grade
			(mg/L)	Percent Saturation								
6/5/2014	1	22.8	N/A	N/A	1.0	18.5	3.4	105	8.63	954	10.5	B
6/5/2014	2	22.2	N/A	N/A	N/A	15.5	3.7	106	8.61	960	10.7	B
6/5/2014	3	22.1	N/A	N/A	0.7	15.0	3.2	106	8.60	962	10.9	B
9/21/2014	1	17.7	7.99	84.6	1.1	15.0	<100	110	8.20	1100	30.0	B
9/21/2014	2	17.5	8.78	92.9	1.2	17.0	<100	140	8.29	1120	40.0	B
9/21/2014	3	17.3	8.74	90.6	1.0	17.0	<100	90	8.31	1120	40.0	B
5/20/2015	1	17.9	9.23	97.7	0.3	37	<60	130	8.55	1100	2	B
5/20/2015	2	17.7	9.18	97.1	0.61	24	<60	130	8.58	1100	<1	B
5/20/2015	3	17.9	9.22	97.6	0.62	31	<60	130	8.62	1100	<1	B
8/31/2015	1	24.5	9.5	112.5	1.0	17.0	<60	110.0	7.76	1000	<5	B
8/31/2015	2	23.7	9.3	111.1	1.6	16.5	<60	110.0	7.79	1000	<5	B
8/31/2015	3	23.4	9.4	110.2	1.3	17.0	<60	110.0	7.71	1100	<5	B
5/17/2016	1	14.7	10.67	106.0	1.7	8.5	<60	110.0	8.66	1000	12.0	B
5/17/2016	2	14.4	10.61	103.1	2.1	8.0	<60	120.0	8.62	1000	12.0	B
5/17/2016	3	14.8	10.63	105.6	2.8	8.0	<60	120.0	8.52	1000	8.0	B
9/29/2016	1	16.6	8.54	88.5	1	13.0	<60	110.0	8.13	1100.0	<9	B
9/29/2016	2	16.6	8.66	89.7	1.4	12.5	<60	110.0	8.11	1100.0	<9	B
9/29/2016	3	16.4	8.66	87.9	1.4	13.0	<60	110.0	8.11	1100.0	<9	B
5/11/2017	1	14.1	10.30	100.1	0.35	17.0	110.0	130.0	8.18	1100.0	12.0	B
5/11/2017	2	13.4	10.26	97.5	0.00	19.5	70.0	140.0	7.99	1100.0	9.0	A
5/11/2017	3	13.0	10.21	97.1	0.35	20.5	100.0	140.0	7.98	1000.0	18.0	A
9/21/2017	1	22.4	10.02	114.9	0.69	20.0	<60	110.0	8.47	1000.0	<8	B
9/21/2017	2	22.8	9.86	115.2	0.35	20.5	<60	110.0	8.42	1000.0	<8	B
9/21/2017	3	21.6	9.88	113.3	0.00	19.5	<60	120	8.47	1000	<8	B
6/11/2018	1	20.7	9	101.1	0.35	18	<80	110	8.48	1000	23.0	B
6/11/2018	2	20.7	8.99	101.0	0	24.0	<80	110	8.48	1000	<8	B
6/11/2018	3	20.6	8.70	97.8	0.35	22.0	<80	110	8.33	1000	<8	B
9/25/2018	1	20.1	8.18	90.2	1.4	16.0	<80	100	8.28	980	<8	B
9/25/2018	2	20.3	8.3	91.5	1.7	16.0	<80	100	8.29	980	<8	B
9/25/2018	3	20.4	8.42	92.8	2.1	17.0	<80	100	8.26	990	<8	B

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