TAMARACK LAKE

HAMBURG TOWNSHIP

LIVINGSTON COUNTY

2004-2006 WATER QUALITY STUDIES

TAMARACK LAKE DATA

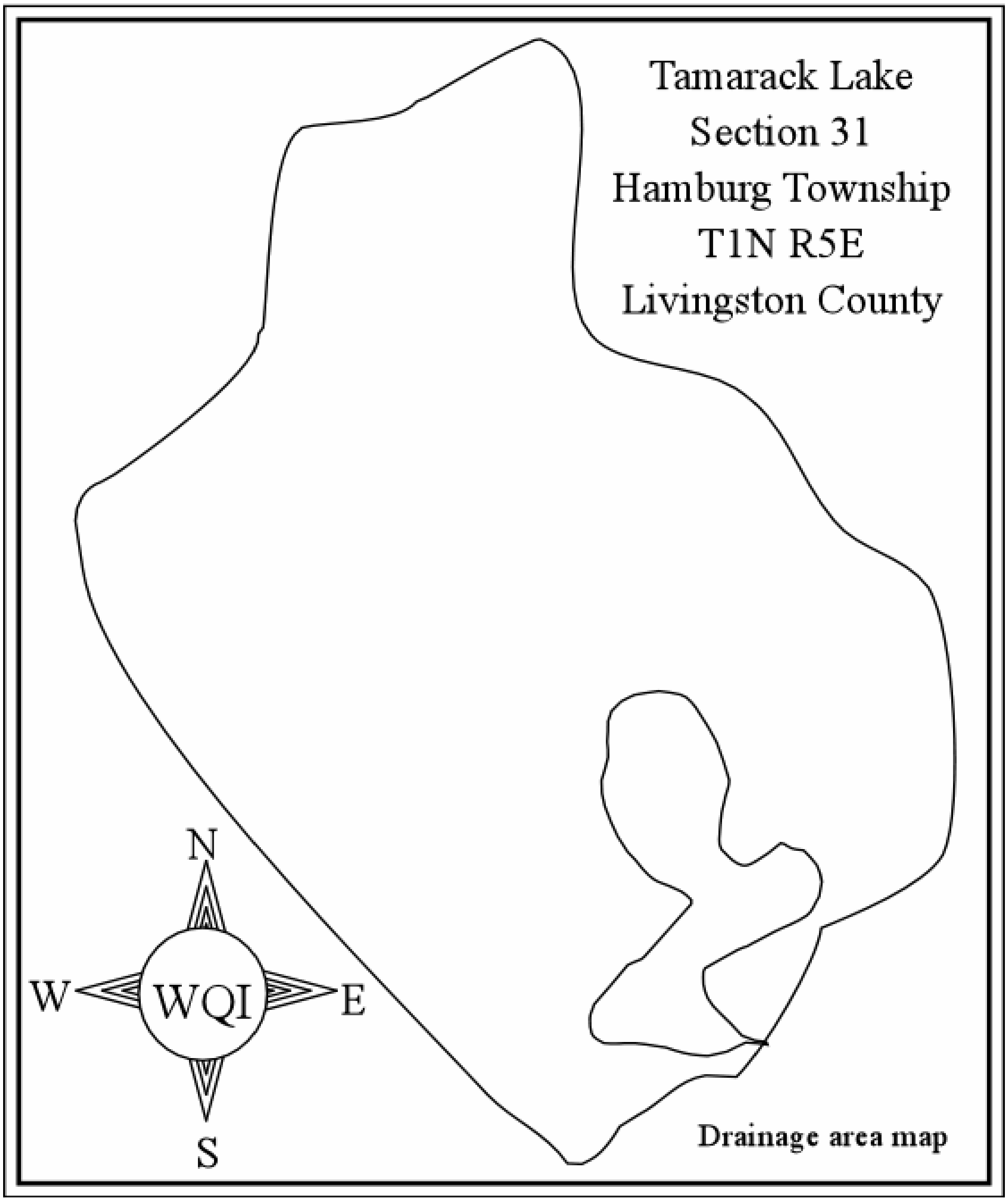
Tamarack Lake is a 17-acre moderately hard water to hard water natural kettle lake located in Section 31, Hamburg Township (T1N R5E), Livingston County, Michigan. The lake has a maximum depth of 34 feet, a water volume of 284 acre-feet, and a mean depth of 16.8 feet. The lake has 5210 feet of shoreline. There are no islands in the lake. The elevation of the lake is 850 feet above sea level.

The lake consists of three basins, a 26-foot deep south basin (Station 2), a 34-foot deep north basin (Station 1) and a 24-foot deep east basin (Station 3). The lake was formed when three blocks of ice broke off the melting glacier. Debris from the melting glacier then filled in around the ice blocks. Finally the blocks of ice melted, forming the present basins. However there were no fish in the basins when they were first formed.

The size of the watershed, which is the land area that contributes water to the lake, but does not include the lake, is 206 acres. The drainage area, which includes the lake and the watershed, is 223 acres. (See map below) The watershed to lake ratio is large, 12.1 to 1. The lake flushes about once every 2.6 years on an average.

There are no inlets other than groundwater (springs).

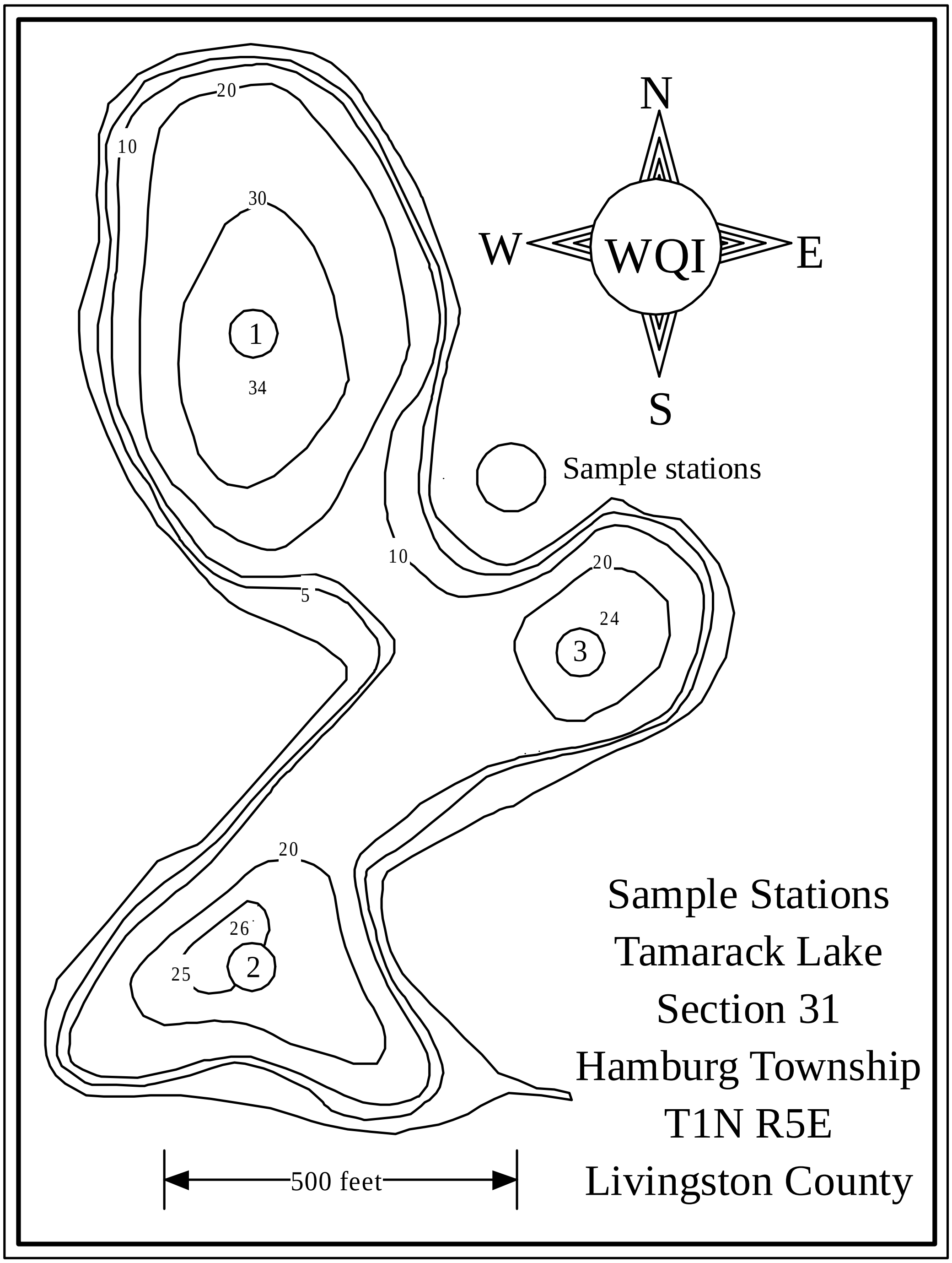
The Tamarack Lake outlet is on the southeast corner. After leaving the lake, the water from Tamarack Lake flows through the Tamarack Lake outlet into the Huron River above Base Lake. The Huron River flows into Lake Erie at Monroe, Michigan.



The longitude and latitude of the 34-foot deep hole is 83° 53.254W and 42° 25.993N.

THE SAMPLE DATES

WQI limnologists took spring samples for water quality testing at the three surface stations shown on the map May 11, 2004, April 18, 2005 and April 19, 2006.



They collected three late summer surface samples for water quality testing August 2, 2004, August 3, 2005 and August 1, 2006. Top to bottom temperature and dissolved oxygen profiles were collected when the lake was sampled in late summer at the deepest part of the lake. Bottom sediments were collected from the three in-lake stations in spring 2005.

THE SAMPLE STATIONS

The locations of the three in-lake sample stations are shown on the hydrographic map of the lake.

THE ANALYSES

The tests performed on the samples included total phosphorus, total nitrate nitrogen, total alkalinity, pH, conductivity, chlorophyll a, Secchi disk depth, and in summer, temperature and dissolved oxygen.

Temperature, dissolved oxygen and Secchi disk depths were measured in the field. Chlorophyll a, phosphorus, nitrate nitrogen, alkalinity, pH and conductivity tests were performed at the Water Quality Investigators laboratory in Dexter, Michigan. All test procedures followed those outlined in APHA's *Standard Methods for the Examination of Water and Wastewater* (1985).

THE WATER QUALITY STUDY

During certain periods of the year, Michigan lakes have poorer water quality than the remainder of the year. Usually the water quality sampling is designed to look at two of those poor water quality periods, one in early spring when phosphorus which may released from the bottom sediments is distributed throughout the water column by spring mixing, and a second in late summer when the water is warmest, and the lake is stratified. During most of the remainder of the year, the water quality is better. Thus if the lake gets high marks for water quality during early spring and late summer, it probably has pretty good water quality all year long.

THE TEST RESULTS

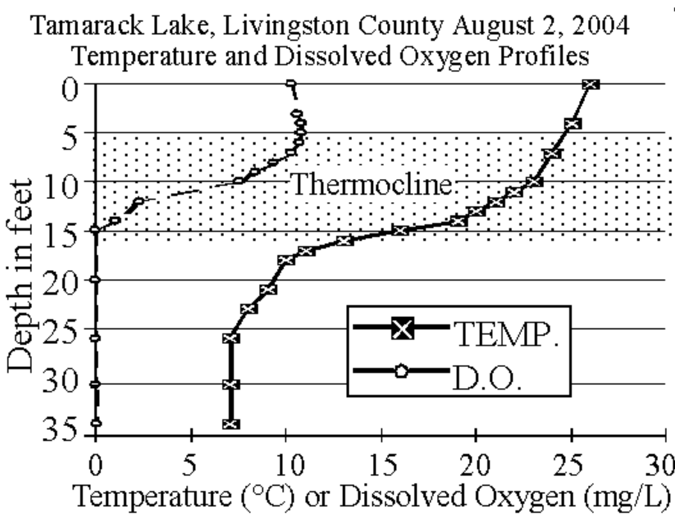
The results of the tests are found in the text, in the table at the end of this report and on the enclosed atlas pages.

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, oxygen is involved in phenomena such as phosphorus precipitation and release from the lake bottom sediments and decomposition of organic material in the lake.

2004



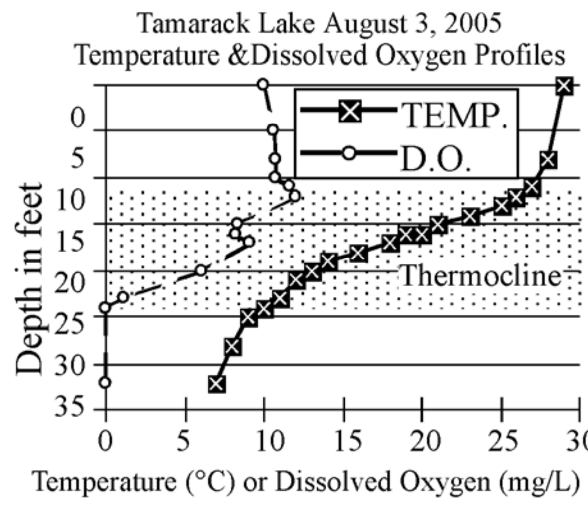
Temp.	Depth	D.O.	Depth
26	0	10.3	0
25	4	10.6	3
24	7	10.8	4
23	10	10.8	5
22	11	10.7	6
21	12	10.3	7
20	13	9.4	8
19	14	8.4	9
16	15	7.6	10
13	16	2.3	12
11	17	1.0	14
10	18	0.0	15
9	21	0.0	20
8	23	0.0	26
7	26	0.0	30
7	34	0.0	34

In late summer 2004, Tamarack Lake formed a 12-foot-thick thermocline from 5 to 17 feet. (A thermocline is defined as a change in temperature of more than one degree C per meter of depth and is shown shaded on the graphs.)

Dissolved oxygen was supersaturated in the top 12 feet. The lake started to lose dissolved oxygen below 5 feet, and at 15 feet it was zero. That condition remained to the bottom. The hypsographic (depth-area) graph shows about 52 percent of the lake is deeper than 15 feet.

2005

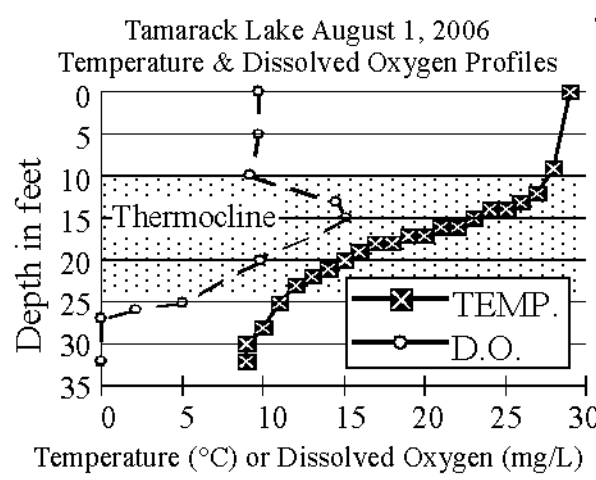
In late summer 2005 Tamarack Lake formed a 15-foot thick thermocline from 10 to 25 feet. Dissolved oxygen was supersaturated above the thermocline. It increased slightly at the top of the thermocline to 12.0 mg/L, then started to decrease. It was zero at 24 feet, and that condition remained to the bottom. About 22 percent of the lake is deeper than 24 feet.



Temp.	Depth	D.O.	Depth
29	0	10.0	0
28	8	10.6	5
27	11	10.8	8
26	12	10.8	10
25	13	11.6	11
23	14	12.0	12
21	15	8.4	15
20	16	8.2	16
19	16	9.1	17
18	17	6.1	20
16	18	1.1	23
14	19	0.0	24
13	20	0.0	32
12	21		
11	23		
10	24		
9	25		
8	28		
7	32		

2006

In late summer 2006 the lake formed a 15-foot-thick thermocline from 10 to 25 feet. Dissolved oxygen was supersaturated above the thermocline, and reached a peak of 15.2 mg/L at 15 feet, probably the result of an algal bloom which settled there. From that depth, the dissolved oxygen gradually decreased, and was zero at 27 feet. That condition remained to the bottom About 15 percent of the lake is deeper than 27 feet.

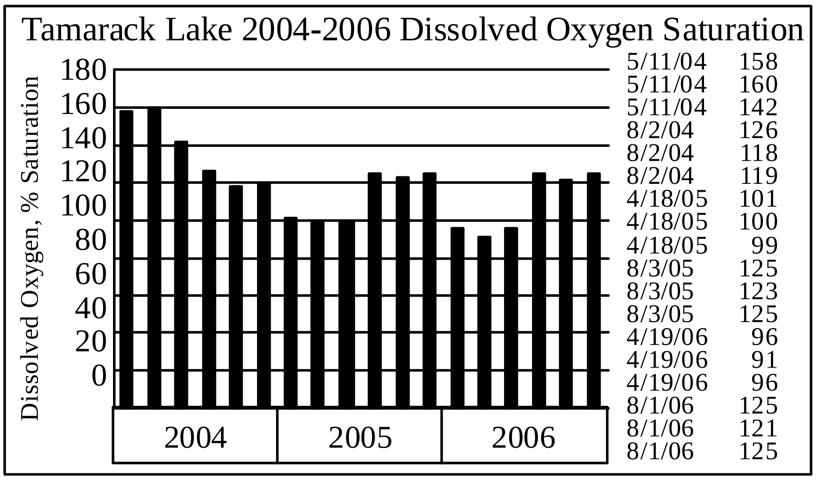


Temp.	Depth	D.O.	Depth
29	0	9.8	0
28	9	9.7	5
27	12	9.3	10
26	13	14.6	13
25	14	15.2	15
23	15	9.9	20
22	16	5.0	25
20	17	2.2	26
18	18	0.0	27
16	19	0.0	32
15	20		
14	21		
13	22		
12	23		
11	25		
10	28		
9	30		
9	32		

DISSOLVED OXYGEN SATURATION

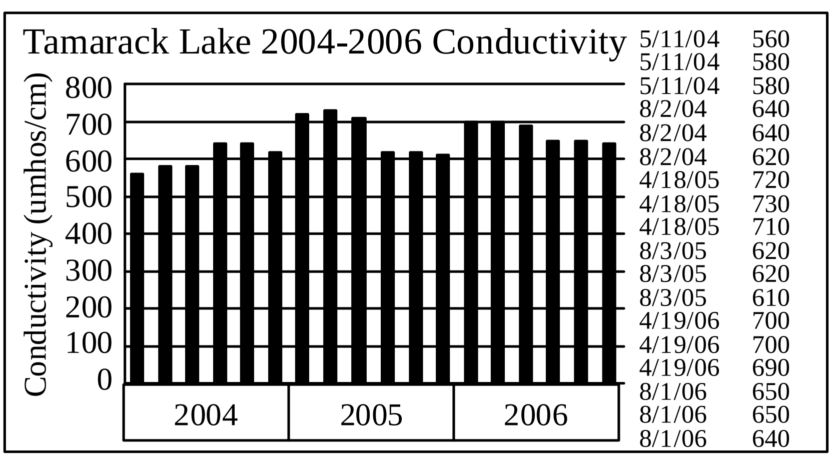
Since the amount of oxygen dissolved in water varies with temperature, with cold water holding more dissolved oxygen than warm water, dissolved oxygen saturation is often a better way to determine if the amount of oxygen dissolved in the water is adequate. Best is near 100 percent.

The graph of surface dissolved oxygen saturation values shows when the lake was sampled in spring 2004 it had dissolved oxygen saturation values ranging from 142 to 160 percent, which are high.



These high dissolved oxygen concentrations were caused by the intense spring algal bloom in the lake that year.

Late summer 2004 dissolved oxygen saturation values ranged from 118 to 126 percent. In 2005 spring values were ideal, ranging from 99 to 101 percent. Late summer 2005 dissolved oxygen saturation values were 123 to 125 percent, which are high, but not nearly as high as the spring 2004 saturation values. In 2006 spring values ranged from 91 to 96 percent, while summer values were higher, ranging from 121 to 125 percent.



CONDUCTIVITY

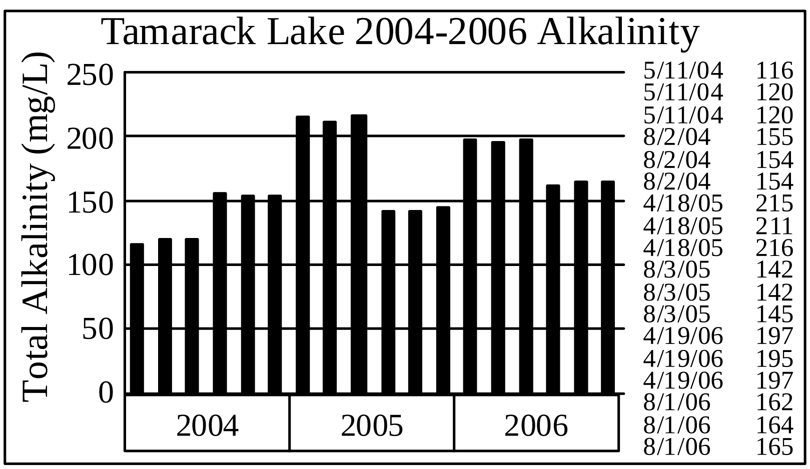
Conductivity generally measures salts, and lower is usually better.

The graph shows the surface water conductivity of Tamarack Lake ranges from a low of 560 micromhos per centimeter to a high of 730 micromhos per centimeter. These are higher than normal conductivities for a Michigan moderately hard water to hard water inland lake. The data shows salts may be entering the lake from either road salting activities or water softeners, or both.

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.

Soft water lakes have alkalinities below 75 milligrams per liter. Moderately hard water lakes have alkalinities between 75 and 150 milligrams per liter. Hard water lakes have alkalinities above 150 milligrams per liter.



The graph shows the alkalinity of Tamarack Lake surface samples ranges from 116 to 216 milligrams per liter. This indicates Tamarack Lake is a moderately hard water to hard water lake.

In 2004 summer alkalinities were higher than spring alkalinities, but that may have been because the large spring algal bloom used the carbonates as a carbon source, reducing the amount of carbonates and bicarbonates in the water.

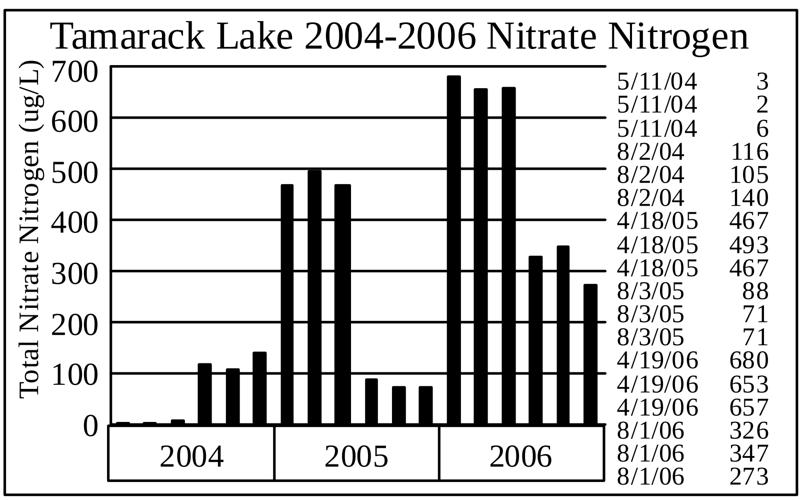
In 2005 and 2006 spring alkalinities were higher than summer alkalinities, which is normal. This is because carbonates and bicarbonates are less soluble in warm water than in cold water, so in summer they precipitate to the bottom sediments. Hence the lower summer surface alkalinities.

Hard water lakes are tougher than soft water lakes because they have the ability to precipitate some phosphorus to the bottom sediments as calcium phosphate. That pretty much ties up the phosphorus.

NITRATE NITROGEN

Nitrate, also measured in the parts per billion range, has traditionally been considered by lake scientists to also 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 this author was 48,000 parts per billion in a river which flowed into an Ottawa County lake.

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



The graph shows 2004 spring Tamarack Lake nitrate nitrogen concentrations were low, 2 to 6 micrograms per liter. The reason for the low spring nitrates was the intense algal bloom in the lake used the nitrates for algal growth.

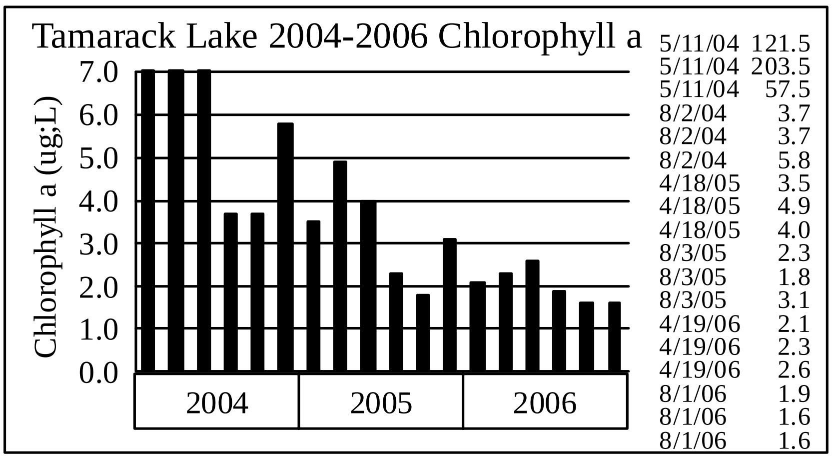
Spring 2005 and 2006 nitrates were high for a Michigan inland lake. And the chlorophyll a data (below) show algae were not present in numbers which would seriously decrease the nitrates.

Summer nitrates in all three years were higher than we normally see. These data essentially indicate Tamarack Lake is probably phosphorus limited in both spring and summer. That means don't use lawn fertilizers on near-lake areas.

CHLOROPHYLL A

Chlorophyll a is used by lake scientists as a measure of the biological productivity (amount of algae) of the water. Generally, the lower the chlorophyll a, the better. High concentrations of chlorophyll a are indicative of an algal bloom in the lake, an indication of poor lake water quality.

The highest surface chlorophyll a concentration found by this writer in a Michigan lake was 216 micrograms per liter. Best is below one microgram per liter.



The graph shows chlorophyll concentrations were very high in spring 2004, ranging from 57.5 to 203.5 micrograms per liter. (The bars were truncated because they were high enough to make the remainder of the chlorophyll data appear insignificant, which is not the case.) These data show why dissolved oxygen was supersaturated and Secchi disk readings were only two feet.

2005 chlorophylls were lower, ranging from 1.8 to 5.8 micrograms per liter. Although these are much lower chlorophyll a concentrations than in spring 2004, they still indicate algal blooms. But they were similar to algal blooms in many Michigan inland lakes. In 2006 they were the lowest of the three years, ranging from 2.1 to 2.6 in spring and 1.6 to 1.9 in summer. Let’s hope this trend continues.

TOTAL PHOSPHORUS

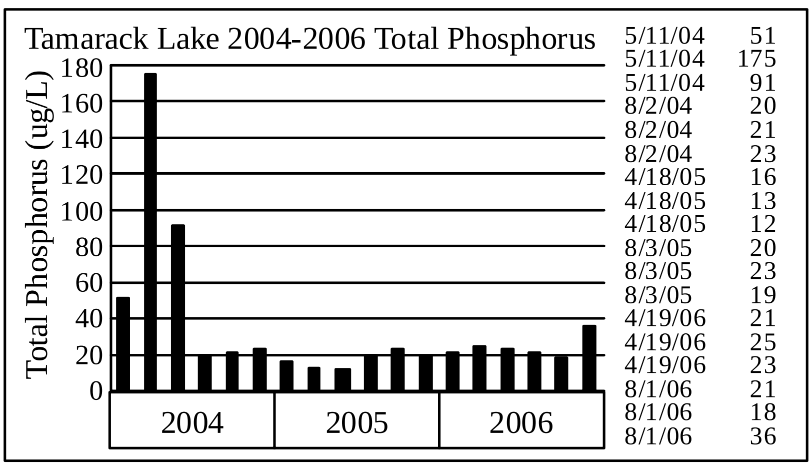
Although there are several forms of phosphorus found in lakes, the experts selected total phosphorus as being most important. This is probably because all forms of phosphorus can be converted to the other forms. Currently, most lake scientists feel phosphorus, which is measured in parts per billion

(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.

However, based on our studies of many Michigan inland lakes, we'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 high by many limnologists.

The graph shows spring 2004 phosphorus concentrations were high, 51 to 175 micrograms per liter. This was the reason for the spring algal bloom.



Late summer 2004 and spring and summer 2005 in-lake phosphorus concentrations ranged from 13 to 23 ug/L.

2006 spring phosphorus concentrations ranged from 21 to 25 ug/L, while summer phosphorus concentrations ranged form 18 to 36 ug/L.

As the concentration of phosphorus nears 20 ug/L, it will cause algal blooms if other nutrients are also present in sufficient quantities.

SECCHI DISK TRANSPARENCY (originally Secchi's disk)

In 1865, Angelo Secchi of 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 in summer. 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.

We do it slightly differently. We lower the disk on the shaded side of an anchored boat until the disk disappears, and note the depth, then report the depth to the next deepest foot. For example if the disk disappears at six and a half feet, we report the Secchi disk depth as 7 feet. The reason we do this is that some suggest using a water telescope (a device that works like an underwater mask and eliminates water roughness) to view the disk as it disappears. Since we don't use this device, we compensate for it by noting the slightly deeper depth.

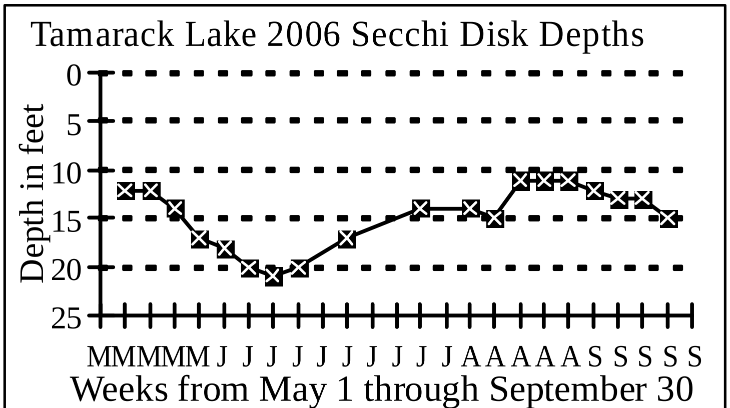
We feel it is only necessary to report Secchi disk measurements to the closest foot. Secchi disk measurements should be taken between 10 AM and 4 PM. Rough water will give slightly shallower readings than smooth water. Sunny days will give slightly deeper readings than cloudy days. However, roughness influences the visibility of the disk more than sunny or cloudy days. Furthermore, it's been reported that most adults can see the Secchi disk disappear at about the same depth, but grand-children see it disappear 3-4 feet deeper than grand-parents.

If there are sample sites where the lake is too shallow and the disk is visible when resting on the bottom, the reading should be taken at a nearby deeper site. Since the sampling procedure is designed to obtain "representative samples" moving the boat to an area where a Secchi disk transparency reading can be properly taken is appropriate. In the case of Secchi disk readings, this procedure is more valid than reporting the disk is visible on the lake bottom.

2004-2006 TAMARACK LAKE SECCHI DISK DATA

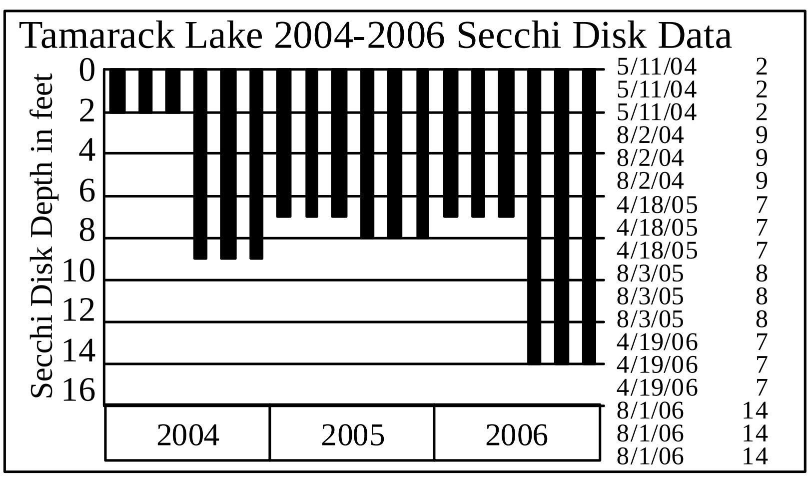
2006

In 2006 Jim Meyer did a good job of collecting Secchi disk data. The graph shows his data. The graph shows 12 foot readings in early spring, probably the result of a diatom bloom, an alga that likes cold water. Then as the water started to warm, the clarity increased to a maximum of 21 feet in mid-June. From that depth the clarity gradually decreased to 11 feet in August. The year ended with 15 foot readings at the end of September.



MAY	.	12	12	14	17
JUN	18	20	21	20	.
JUL	17	.	.	14	.
AUG	14	15	11	11	11
SEP	12	13	13	15	.

Other than Meyer's 2006 data, the only Secchi disk data available were those collected with the water samples. The graph shows these data.



The graph shows spring 2004 Secchi disk readings were 2 feet, which is poor. These shallow Secchi disk readings were the result of the algal bloom in the lake.

The graph shows the late summer 2004 and spring and summer 2005 Secchi disk readings ranged from 7 to 9 feet. This indicates the lake still had algal blooms at those times, but they were much smaller than the spring 2004 bloom.

2006 spring Secchi disk readings were 7 feet, which was about the same as in the past, but the summer readings were much better, 14 feet. Again, let's hope this trend continues.

THE SECCHI DISK TREND GRAPH

Since there are no long-term Secchi disk data, a Secchi disk trend graph could not be developed.

Secchi disk readings should be taken on a regular basis through the warm months every year to follow changes in the lake.

THE LAKE WATER QUALITY INDEX

The Lake Water Quality Index used in this study to define the water quality of Tamarack Lake was developed for two reasons.

First, there was no agreement among lake scientists regarding which tests should be used to define the water quality of lakes, and second, there was no agreement among lake scientists regarding what the results of various tests meant in terms of lake water quality.

Development of the index invoked the use of two questionnaires sent to a panel of 555 lake scientists who were members of the American Society of Limnology and Oceanography. The panel was specifically selected because they were chemists and biologists with advanced degrees who studied lake water quality.

The first questionnaire asked the scientists to select tests which they felt should be used to define lake water quality. The tests most often selected by the panel became the index parameters (or tests). They were:

Dissolved oxygen (percent saturation)
Total phosphorus
Chlorophyll a
Secchi disk depth
Total nitrate nitrogen
Total alkalinity
Temperature
Conductivity
pH

The second questionnaire, sent out after the first was returned, asked the scientists what the results of the tests they selected as good indicators of lake water quality meant.

After the responses to the second questionnaire were returned and tabulated, the nine parameters and the accompanying rating curves were combined into a Lake Water Quality Index.

The index ranges from 1 to 100 and rates lakes about the same way professors rate students: 90-100=A, 80-90=B, 70-80=C, 60-70=D, and below 60 = E. The lake with the highest LWQI was Long Lake in Grand Traverse County, with a spring LQWI of 100. The lowest LWQI seen by this author was 16 in an Ottawa County lake.

HOW TO READ THE LAKE WATER QUALITY INDEX CALCULATION SHEETS.

Listed across the top of the calculation sheets are the tests selected by the panel of experts as being good indicators of lake water quality. The results of the tests are entered into the square boxes immediately under the names of the tests.

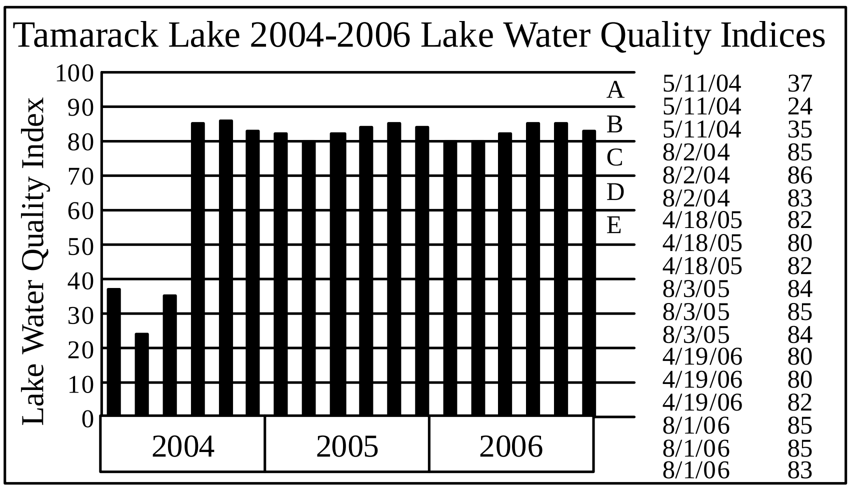
The figures which look like thermometers are actually graphs which convert the test results (the numbers found outside the thermometer) to a uniform 1-100 lake water quality rating (found inside the thermometer).

The calculation sheet permits calculation of the Lake Water Quality Index, using the results of all nine lake water quality tests.

The position of the red lines across the thermometer indicates how the results of each test compare in terms of lake water quality. Test results indicating excellent water quality are indicated by red lines near the top of the thermometer. Test results indicating poor water quality are indicated by red lines lower on the thermometer. And the lower the red line on the thermometer, the greater the water quality problem. A glance at the top of the calculation sheet indicates the test and the actual test results.

The thermometer rating scales also allow you to determine what test results would be considered excellent in terms of lake water quality. They are the numbers found outside the thermometer near the top.

The index is shown three different ways, as a number between 1 and 100 in the circle marked LWQI, and by a color and position on the sheet edge scale. The purpose of the sheet edge scale is to review quickly large numbers of lakes or test sites within a lake, and determine how the water quality of the various lakes, or test sites within a lake compare.



THE 2004-2006 TAMARACK LAKE WATER QUALITY INDICES

The graph shows the spring 2004 Lake Water Quality Indices for Tamarack Lake ranged from 24 to 37, or in the E range. These low LWQIs were caused by high dissolved oxygen saturations, shallow Secchi disk readings, high chlorophyll a concentrations and high phosphorus concentrations.

The remaining LWQIs in both spring and summer ranged from 80 to 86, or in the B range.

THE 2006 LAKE WATER QUALITY INDEX CALCULATION SHEETS

Because the spring 2006 water quality indices were about the same (80 or 82), one Lake Water Quality Index calculation sheet is included in this report for the three spring 2006 surface samples, using averaged data.

Because the late summer 2006 water quality indices were almost the same (83 or 85), a second Lake Water Quality Index calculation sheet is included in this report for the three late summer 2006 surface samples, using averaged data.

In the report marked MASTER, all six of the LWQI calculation sheets are included. That is the only difference between the MASTER and the rest of the reports.

BOTTOM SEDIMENTS

Many times bottom sediments tell us more about what is happening in a lake than the water quality tests do. That's because bottom sediments provide sort of a history of what's been happening in a lake, while water testing just provides a snapshot.

Bottom sediments are collected with a Pederson dredge, transferred to pint freezer containers and allowed to air dry. Once they are dry, the (usually) shrunken block of material is measured to determine volume, then ground, placed in porcelain dishes, dried at 100 degrees C, weighed, burned at 550 degrees C, and weighed again. Color after air-drying and after burning is also noted.

Bottom sediments almost always come up from the lake bottom black, and many people consider these black sediments "muck". However that's not usually the case.

The bottom sediments are black because no oxygen penetrates them, so the decomposition processes which occur use sulfur rather than oxygen, and in this process, they produce iron sulfides, which are black. However once the sediments are exposed to air, they usually turn some other color.

If the sediments remain black after air drying it usually means they are less than about 65 percent mineral (or more than 35% organic material). Sediments also remain black if they are from soft water lakes, but there's a reason for that.

If the sediments turn gray after air drying it usually means they are made up primarily of carbonates. This is what we usually see in moderately hard water and hard water lakes.

If the sediments turn tan, it usually means they are made up primarily of clays. Further evidence of this occurs when we burn the sediments at 550 degrees C.

We determine how much bottom sediments shrink when they air dry because this information is useful when considering dredging a lake. Normal shrinkage after air-drying is in the range of 50 to 80 percent. However sands and gravels don't shrink at all. Excessive shrinkage is more than 95 percent. In other words, there is only five percent or less of the material remaining after air-drying.

If the gray bottom sediments remain gray after burning they are considered carbonates, and the loss of material during this process is considered organic material. The results are expressed in the percentage of minerals in the bottom sediments.

If the tan bottom sediments turn red after burning, it means the lake is filling with clay. Clay enters the lake from near-lake activities such as road building, home building or farming. Usually clay is not a material that makes up the bottom sediments of most inland lakes.

Highly organic sediments that remained black after air drying usually turn tan after burning, but the mineral content is usually quite low.

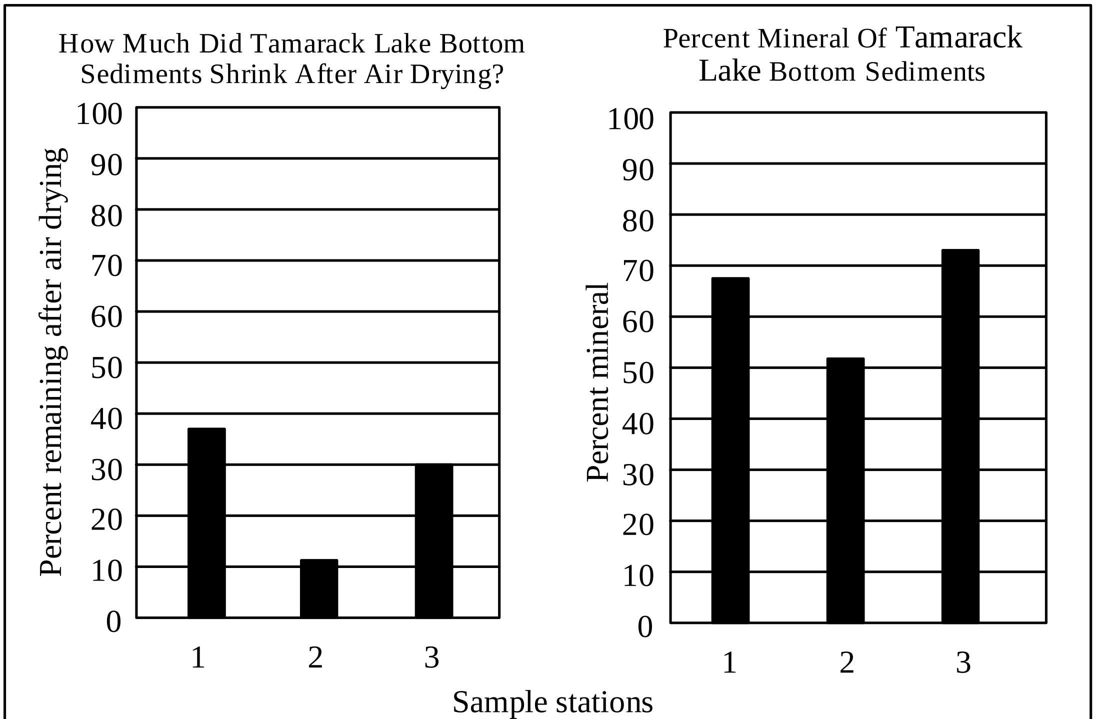
I consider high quality bottom sediments from natural lakes to be above 85 percent mineral. And I consider bottom sediments less than 50 percent mineral to be muck.

TAMARACK LAKE BOTTOM SEDIMENTS

Bottom sediment samples were collected in Tamarack Lake in spring 2005. The graph shows the data.

The sample from Station 1, collected in 34 feet of water, was black when recovered, turned gray and shrunk 63 percent after air-drying, and remained gray after burning at 550 degrees C. It was 68 percent mineral.

The sample from Station 2, collected in 20 feet of water, was black when recovered, remained black and shrunk 89 percent after air-drying, and turned gray after burning at 550 degrees C. It was 51 percent mineral.



Characteristics of Tamarack Lake Bottom Sediments (2005)					
Sample I.D.	Percent Shrinkage	Percent Mineral	Dried at 100°C Color & Description	Color after burning at 550°C	Depth of water (feet)
1	63	68	Gray	Gray	34
2	89	51	Black	Gray	20
3	70	73	Gray	Gray	18
Average mineral content of bottom sediments = 64%.					

The sample from Station 3, collected in 18 feet of water, was black when recovered, turned gray and shrunk 70 percent after air-drying, and remained gray after burning at 550 degrees C. It was 73 percent mineral.

None of the sediments shrunk excessively, although the one from Station 2 came close. Even the deeper sediment from Station 1 did not shrink as much.

The mineral content of all three sediments was low, ranging from 51 to 73 percent, indicating Tamarack is accumulating organic material in the bottom sediments at a faster than acceptable rate. Residents need to quit fertilizing their lawns.

COMMENTS

The probable reason for the very poor water quality in Tamarack Lake in spring 2004 was in April there was no precipitation, so many riparians fertilized their lawns. Then in May, 11 inches of rain fell. All of that rain washed much of the fertilizer on the lawns into the lake. That caused the algal bloom. If these conditions occur again, and if residents continue to fertilize their lawns, intense algal blooms are going to occur again.

Wallace E. Fusilier
Consulting Limnologist
Water Quality Investigators
Dexter, Michigan
May 2007

Tamarack Lake Water Quality Data

Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation	Chlorophyll a ug/L	Secchi Disk Depth (feet)	Total Nitrate Nitrogen ug/L	Alkalinity mg/L	pH	Conductivity umhos per cm at 25°C	Total Phosphorus ug/L	Lake Water Quality Index	Grade
5/11/04	1	22	13.8	158	121.5	2	3	116	9.2	560	51	37	E
5/11/04	2	22	14.0	160	203.5	2	2	120	9.2	580	175	24	E
5/11/04	3	22	12.4	142	57.5	2	6	120	9.0	580	91	35	E
8/2/04	1	26	10.3	126	3.7	9	116	155	8.5	640	20	85	B
8/2/04	2	26	9.7	118	3.7	9	105	154	8.5	640	21	86	B
8/2/04	3	26	9.8	119	5.8	9	140	154	8.5	620	23	83	B
4/18/05	1	17	9.8	101	3.5	7	467	215	8.2	720	16	82	B
4/18/05	2	17	9.7	100	4.9	7	493	211	8.2	730	13	80	B
4/18/05	3	17	9.6	99	4.0	7	467	216	8.2	710	12	82	B
8/3/05	1	29	10.0	125	2.3	8	88	142	8.4	620	20	84	B
8/3/05	2	28	9.7	123	1.8	8	71	142	8.4	620	23	85	B
8/3/05	3	28	9.9	125	3.1	8	71	145	8.4	610	19	84	B
4/19/06	1	15	9.8	96	2.1	7	680	197	8.2	700	21	80	B
4/19/06	2	15	9.3	91	2.3	7	653	195	8.2	700	25	80	B
4/19/06	3	15	9.8	96	2.6	7	657	197	8.2	690	23	82	B
8/1/06	1	29	9.8	125	1.9	14	326	162	8.5	650	21	85	B
8/1/06	2	29	9.4	121	1.6	14	347	164	8.6	650	18	85	B
8/1/06	3	29	9.8	125	1.6	14	273	165	8.6	640	36	83	B