Bills Lake Association

Lake Testing Report

May, 2011

Results of Bills Lake's Annual Physical Exam

Introduction

If you are wise, you see the doctor at least once a year for a check-up. He/She runs tests, looks them over, discusses them with you, and then — even if you are healthy — says: "Looks good, *see you next year."*

Over the past eight years, three tests have been conducted on Bills Lake waters periodically each summer.* The results are translated into what is known as the Carlson Trophic Index, a scale that seeks to measure the productivity of a lake. The higher the number, the more the lake is able to produce algae and weeds, not a particularly bad thing if you happen to be a fisherman but a very bad thing, most agree, if our productivity borders on swamp-like conditions.

Instead of grading the lake in terms of a scale of A-E or 100-0 as in our school days, scientists categorize lakes using the terms oligotrophic, mesotrophic, and eutrophic. An extensive description of these terms can be found at **http://www.mlswa.org/lkclassif1.htm**.

Suffice it to say here that the lower the number, the clearer and purer the water. Using the Carlson numbers, dividing lines are roughly: oligotrophic: 20-37, mesotrophic: 38-53, and eutrophic: 54-65. The various Carlson charts presented in the next few pages illustrate this.

"Looks good, see you next year."

Over the past eight years, our results have been stable and consistent, despite one bad year when we endured a bout of microcystis, green pond scum that came from the initial onslaught of zebra mussels. In terms of average scores, **we are at the top of the mesotrophic category or at the bottom of the oligotrophic category,** depending on how you want to look at it.

A graph of our transparency readings, taken since 1981, shows a gradual decline in lake clarity (see page 7). However, our phosphorous and chlorophyll scores are not only consistently good but put us in the bottom of the oligotrophic category. It is only the transparency that usually suffers throughout the summer, the result of warm temperatures that produce algae and increased boat traffic that stirs up sediment such as marl.

Good health can be defined as taking care of yourself *before* you get sick. To be sure, our lake ecology will continue to be hit with the results of increased population and development, i.e. the increase of paved surfaces which promote run-off of impurities into the lake, poorly maintained septic systems which deposit impurities of a different sort into the lake, and motorized boat traffic that sometimes leaks gas and oil into the lake and deposits plenty of CO_2

But for the most part, we are fortunate to have an educated populace that takes precautions to avoid these consequences, and reminds neighbors and guests to do the same. There is an awareness on the part of most people that, in one form or another, Mother Nature bats last, either by rewarding us with an esthetically pleasing environment or by punishing us with a visually ugly result of our neglect.

* Actually, the phosphorous test has been administered for the past nine years and the transparency test has been conducted since 1981. The purpose of this discussion is to use the results of *all three tests administered during the same summer* to form a composite average. This has occurred from 2003-2010.

2010 Lake Testing Results

Seechi Disk -- During the summer of 2010, an eight-inch disk the circumference of which consists of alternating black and white quadrants attached to a tape measure was placed in the deep basin of Bills Lake once per week. The average depth at which the disk disappeared (actually drawn back up until it could be barely seen) was **13.0** feet. This gave us a Carlson Trophic Index score of **40** which places Bills Lake at the top of the mesotrophic category in terms of transparency. The best reading during the sample period -- May through September -- was a whopping **27** feet. The worst was **7** feet.

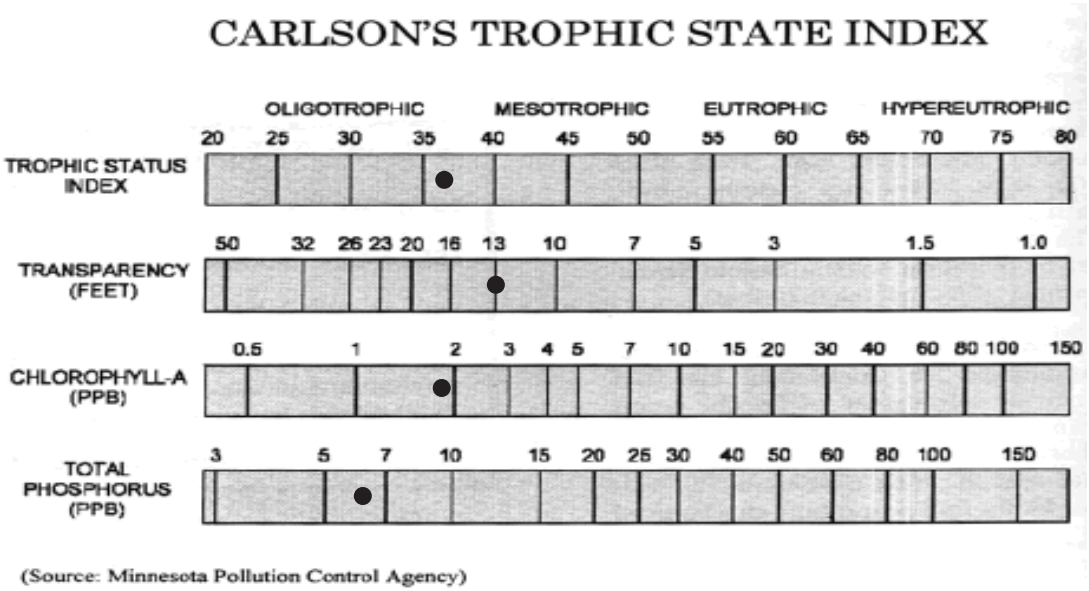
Chlorophyll -- From approximately the middle of the month from May through September, a sample of water was taken from the deep basin of Bills Lake, filtered for algae, and frozen for transport to the DEQ in Grand Rapids. The results of the testing is in parts per billion: **1.7, 1.1, 2.3, 2.1, and 2.3** This **1.9** parts per billion average gave Bills Lake a Carlson score of **38** which puts us toward the top of the oligotrophic category.

Phosphorous: Two samples were taken, one on approximately April 15th and the other on approximately September 15th. Each was frozen for transport to the DEQ office in Grand Rapids. Lab results: Spring: **7** parts per billion; Fall, **6** parts per billion. Carlson Score uses the fall figure-- **30**--which puts us in the middle of the oligotrophic category.

Composite Score: Because we perform these three tests, the averages of the Carlson scores can be taken together to produce a Composite Result. In 2010, our lake received a score of **36** which puts

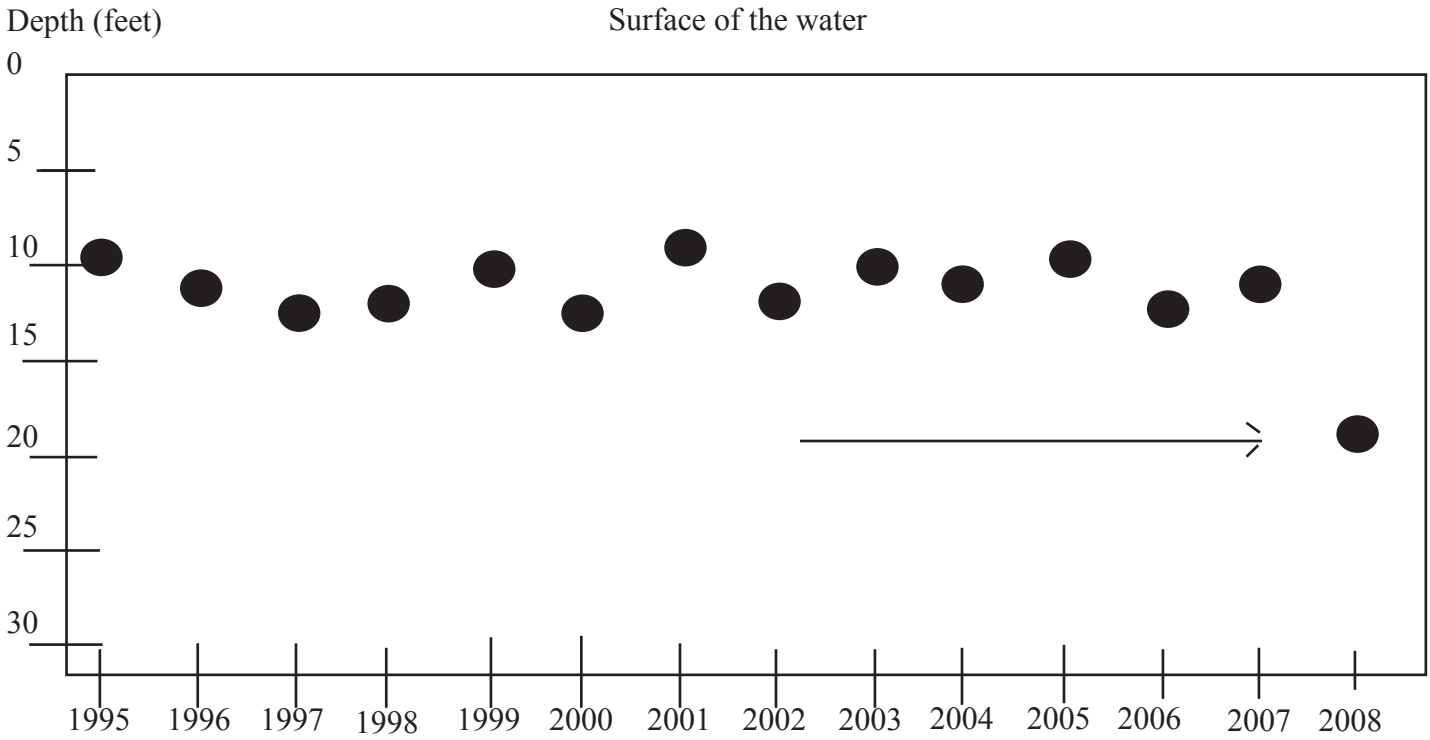
Composite Score: Carlson score of 36

Seechi Disk: **17** readings, **13.0** feet average = Carlson score of **40**
Chlorophyll: **Five** samples, **1.9** parts per billion average = Carlson score of **38**
Phosphorous: **Two** samples, average of **6.5** parts per billion = Carlson score of **30**



(Source: Minnesota Pollution Control Agency)

What happened in 2008?



Although Bills Lake is renowned for its lake transparency, data over the past 30 years suggests that our reputation is a bit overblown. According to the Carlson Trophic State Index, a standard by which lake clarity can be measured and compared, to be placed in the highest category is to have an average Seechi Disk reading of 15 feet or higher. Our average – the depth at which an eight-inch metal disk connected to a measuring tape can be seen before it disappears— has been a bit over 11 feet over the past 30 years. This puts us toward the top of Carlson's middle category. We are regarded as a oligotrophic-mesotrophic lake.

Not last year. Residents who pay attention to these things noticed how exceptionally clear our waters were throughout the summer. This was borne out by the measurements. Our average, as compared to previous years (see chart) was astronomical: almost 20 feet. The best reading was an amazing 36 feet. The worst reading – 10 feet – approached previous years' averages.

Why? Scientists from the Michigan Lake and Stream Associations (they train the local lake testers, a.k.a. citizen scientists) refer to such aberrations as natural variabilities: sort of freak accidents. After all, the lake, as a living organism, is impacted by a variety of factors.

One such factor is our recent infestation of zebra mussels. We, as in the case of virtually all inland lakes in Michigan, have been infested with them in recent years. This exotic species (not native to Michigan but instead brought in on the bottoms of boats) is both a cleaning and corrupting agent. They eat algae on the surface of the lake, thus improving transparency. But they also spit out a green substance – microcystin, akin to pond scum – which accumulates once or twice a year on our shores.

A study (which Bills Lake participated in) was conducted by the ML&SA two years ago. Results were presented by Prof. Orlando Sarnelle of Michigan State University at a lake testers workshop held at Houghton Lake on Oct. 21, 2008. He said that we in Michigan lead the nation in the number of lakes with zebra mussels. "This organism shouldn't be in an oligotrophic lake," he said, "but they are."

But are they the cause of our increased transparency? Our own Carol Dalebout of Deer Point, who has a Bachelor's degree in biology from Hope College and a Master's degree from Central Michigan University, says that the introduction of zebra mussels, which she calls "invader species," will increase the clarity of the lake. "With the clarity of the water, there will be more photosynthetic activity which will create many more weedy spots," she adds. From her experience working in labs and doing lake testing, she calls these "predictable changes."

However, Prof. Sarnelle stopped short of saying that, in the long term, zebra mussels clean up lakes and improve transparency. He admits to the short term effects but asserts that nobody really knows what the long range result is. After all, there is a concept called "collapse," the point at which the zebra mussels have done their work, have nothing to feed on, overpopulate, and lose their effect.

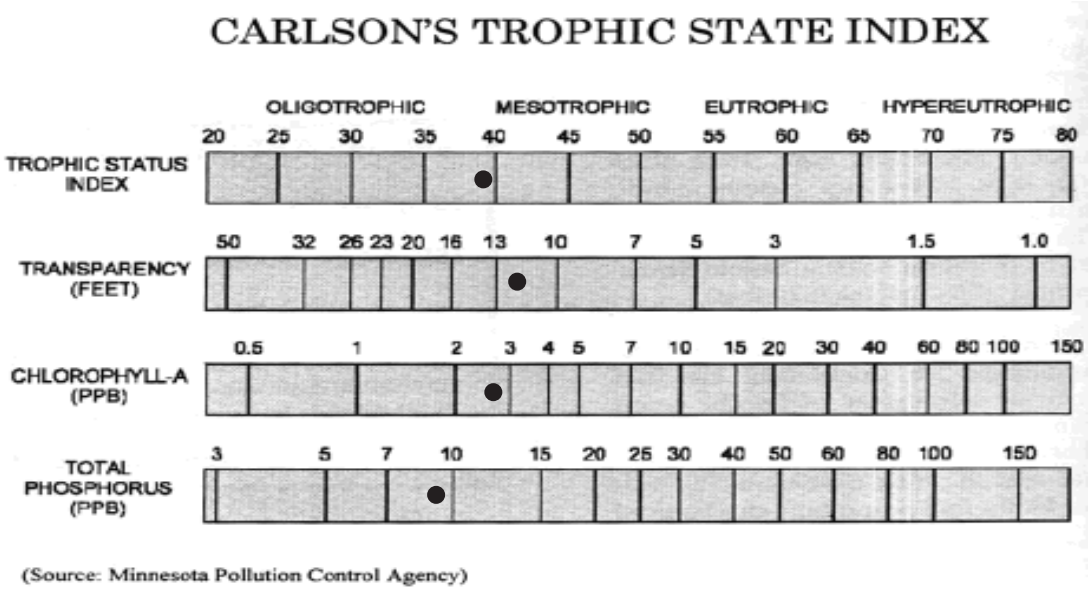
This is why we do lake testing year after year. It will be interesting to see if last year's extraordinary readings were a one-shot natural variability or a trend toward increasing our lake's clarity. In the meantime, be sure to avoid stepping on the critters with your bare feet, especially if they are dry. And be sure to raise your motors out of the water when docked so that they don't cling to and clog intakes.

Lake Testing Composite Scores Over the Past Seven* Years

The purpose of data over time is to assess trends. Because we have been conducting the three tests over half a decade, we have been able to produce Carlson data that enables us to make comparisons. The chart below gives us the Carlson results for years 2003 through last summer. We can see that the scores are remarkably consistent. We have a good (not great, but not horrible) lake in terms of water clarity and purity.

Year	Composite	Transparency	Chlorophyll	Phosphorous
2003	40	45	41	34
2004	38	42	38	34
2005	41	46	43	34
2006	39	42	39	36
2007	37	43	36	32
2009	37	32	39	32
2010	36	40	38	30
Average	**38**	**41**	**39**	**33**

A Carlson Trophic Index chart of Bills Lake average scores over the past seven* years



(Source: Minnesota Pollution Control Agency)

The Carlson composite average over five years is **39** which puts Bills Lake at the bottom of the mesotrophic category. A description of what a mesotrophic lake looks like can be found at **http://www.mlswa.org/lkclassif1.htm**.

* Through a series of mishaps in the summer of 2008, not enough data were collected to render a Carlson score for phosphorous and chlorophyll. The transparency readings were superb and the phosphorous and chlorophyll tests that were administered obtained results consistent with the above.

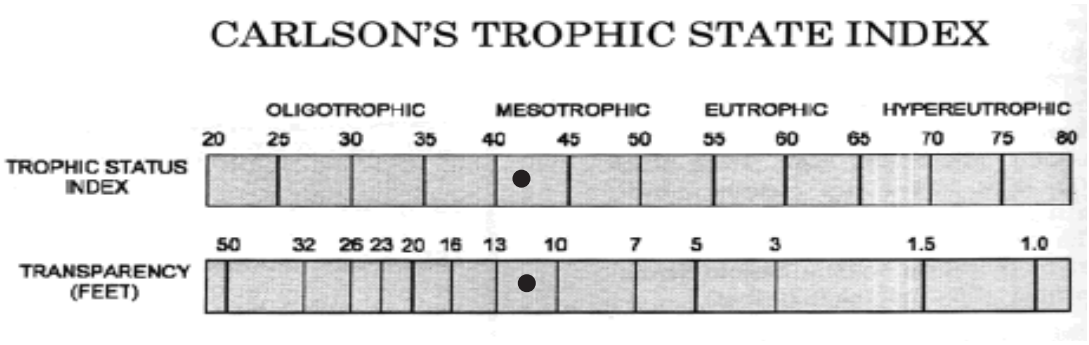
Bills Lake transparency over 17 years

Each spring, the Michigan Lake and Stream Associations, Inc provides a CLMP Annual Summary Report which provides data derived from information submitted by the volunteers. In terms of transparency, this includes the number of readings, the maximum reading, the minimum reading, and an average. The data is then translated into a Carlson score.

Data from 1994 through 1997 was provided at our request from the ML&SA. The rest can be obtained from Annual Reports dating from 1998 to 2007 at **www.mlswa.org** Click on the CLMP link and then go to the bottom of the ensuing page.

Below are results of the data that we have obtained. If someone asks you how clear the water is in Bills Lake, the most accurate answer is, on average, **12 feet**. However, our water is much more transparent than this in the early spring and late fall. Our Carlson score of **41** puts us at the top of the middle category but be reminded that transparency is only one test of three. It just happens to be the one conducted over the greatest number of years.

Year	Seechi Disk Average	Carlson Score
2010	13.0	40
2009	14.0	39
2008	19.6	34
2007	10.4	43
2006	13.0	40
2005	9.8	44
2004	11.2	42
2003	10.0	44
2002	12.7	40
2001	9.2	45
2000	13.0	40
1999	9.9	44
1998	12.4	41
1997	13.1	40
1996	11.3	42
1995	9.7	44
1994	12.4	41
Average	**12.0**	**41**



Bills Lake Transparency over three decades

Over the past 30 years, Bills Lake has been tested to ascertain the clarity of its water using a device which has become standard throughout the state. A Seechi Disk is simply an eight-inch disk — the circumference consisting of alternating black and white quadrants — which is attached to a tape measure. The person who does the testing goes to the deep basin of the lake (in our case the 90-foot area just off the tip of Deer Point), slides the disk into the water, and lets out enough measuring tape until he can't see the disk. Then he brings it back until he can barely see it. He records that measurement.

A Seechi disk reading, therefore, is the distance into the lake that you can see this disk just before it disappears from view. The disk is standardized so that clarity of lake water can be compared to that of other lakes whose testers use the same device.

Everyone in the Co-operative Lakes Monitoring Program (CLMP) tests at the same time of the year. Each season, nine to 18 equally spaced readings (once per week or once per two weeks) are taken from mid-May to mid-September to gather sufficient data for an overall perspective. After all, algal species composition in lakes can change significantly during the summer months. Increased temperature can dramatically alter the transparency of the water

Primarily due to the efforts of the Reinhardt family, we at Bills Lake have been fortunate to have Seechi disk results ranging from 1981 to the present and annually, the Michigan Lakes and Streams Association distributes an updated graph showing these findings.

The top of the graph on the next page (turned sideways to make it fit: you can flip it because it is a pdf) represents the surface of the water. The dots represent the average depth per summer that a Seechi disk could be seen when dipped into the deep basin of the lake.

The dotted line on the graph indicates that the waters of Bills Lake have diminished slightly in clarity over the past 27 years. Of course, it would be truly fascinating to know what the Seechi disk readings would have been, say, 50 years ago.

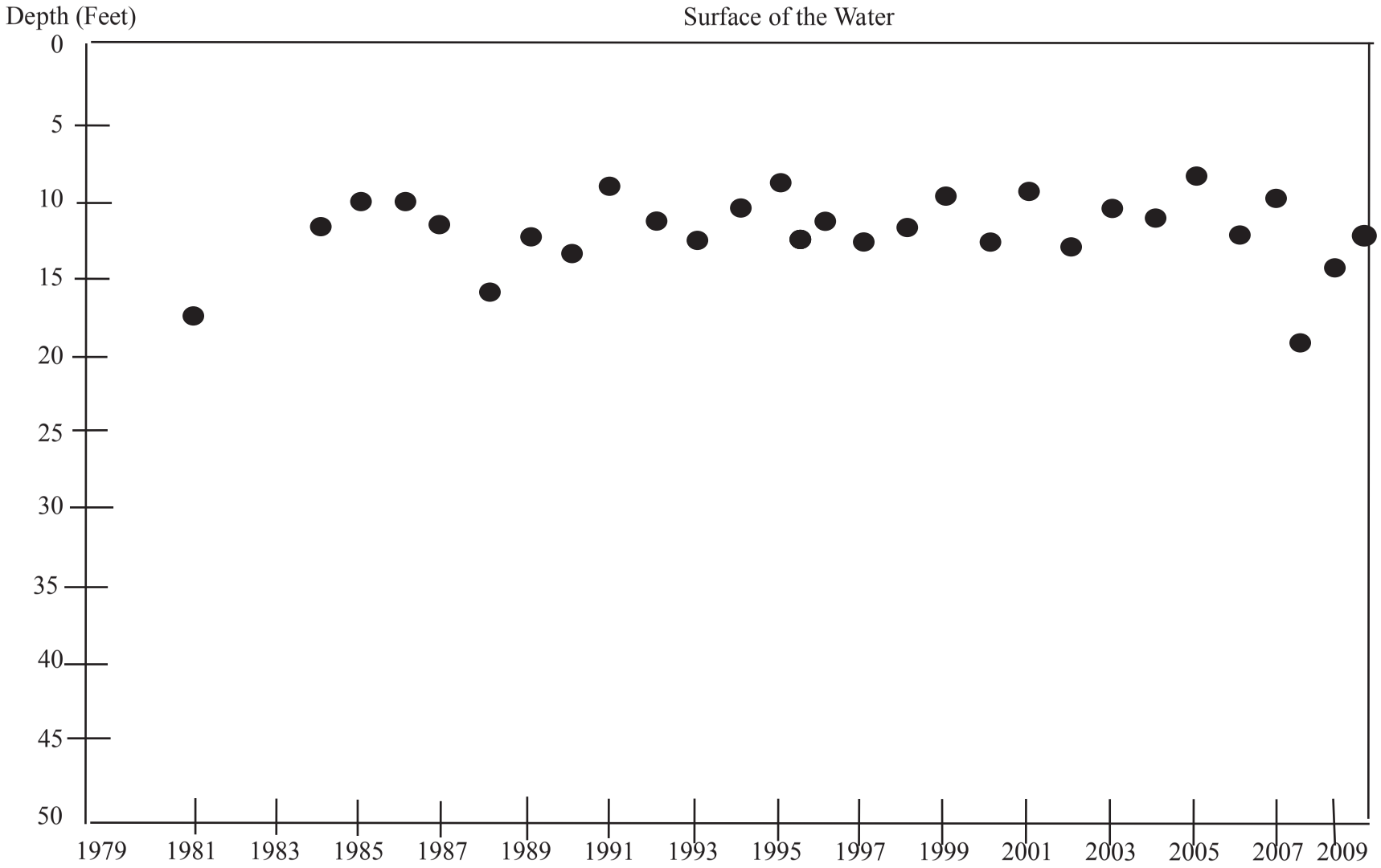
Using Carlson's Trophic State Index, Bills Lake is classified as a mesotrophic lake in terms of lake clarity. But the oligotrophic-mesotrophic-eutrophic hierarchy is a measurement not merely of clarity but instead of productivity, i.e. a lake's ability to support plant and animal life. Given that the Bills Lake phosphorous and chlorophyll readings are always in the oligotrophic category and given that Bills Lake is a marl lake wherein bits of calcium carbonate are easily stirred up and suspended in the water during the summertime – thus impeding clarity — it can be concluded that the waters of Bills Lake are in between the mesotrophic and oligotrophic categories in terms of productivity potential.

A more complete discussion of lake classification can be found at

http://www.mlswa.org/lkclassif1.htm

Cooperative Lakes Monitoring Program
Summer Mean Transparency

Bills Lake (Newaygo County)



Phosphorous readings over the years

A lake's clarity is influenced by several factors. In the case of Bills Lake, marl comes into play, but there are many other factors as well. There may be suspended particles in the water because of boat activity. Rough waves on certain days make it difficult to see the Seechi Disk. The angle of the sun, the eyesight of the tester, and the weather conditions (cloudy, sunny, rainy) all come into play. Consequently, taken by themselves the Seechi disk readings should only be a very general indicator of algae levels. Fortunately, there are other tests.

For most lakes, the amount of algae in the water is a major cause of reduced lake transparency. As more nutrients enter the lake, more algae are produced. As more algae are produced, the less the clarity. As a result, the Seechi disk disappears at a reduced depth.

This doesn't seem to be the case for Bills Lake. Although our Seechi disk readings place our lake in the mesotrophic portion of the Carlson Trophic Index scale, our phosphorous readings have been remarkably good.

The test is very simple to administer. On approximately April 15, the volunteer goes to the Deep Basin of the lake (for us, the 90 feet area just off Deer Point), and dips a sample bottle elbow-deep into the water. The bottle is placed in a cooler and after arriving back on shore, into a freezer. Shortly after (this year, April 18), it is taken to the DEQ office in Grand Rapids where it is shipped to a lab in Lansing for testing. The same procedure is performed on approximately Sept. 20th.

There should be a difference in readings between the spring and summer tests. In the spring, the lake is well-mixed, i.e. the water at the top is the same as at the bottom. Thus, a phosphorous sample taken from elbow-depth will produce the same reading as that taken from the middle and bottom of a water column. Not so at the end of the summer when the water has stratified because of temperature (warm on top with predictably more algae as a result).

Taken year after year, we can spot a trend. Fortunately for Bills Lake, there hasn't been much of one. Phosphorous tests come back as part per billion (ppb). Although we have not done the phosphorous test long enough to generate a graph (it takes eight years of testing before the CLMP will give us one), the numbers are low, indicating very little productivity.

Year	Spring	Late Summer	Carlson Score
2002	7	10	34
2003	4	8	34
2004	11	8	34
2005	6	8	34
2006	6	9	36
2007	8	7	32
2008	5	*	*
2009	3	8	32
2010	7	6	30
Average	**6.3**	**8.0**	**33**

* A spring sample was taken, turned in, and analyzed. However, the fall sample was not turned in on time; therefore, a Carlson score was not generated.

Chlorophyll readings over the years

Chlorophyll is the green photosynthetic pigment in the cells of plants. The amount of algae in a lake can be estimated by measuring the chlorophyll a concentration in the water. As an algal productivity indicator, it can be used to measure how nutrient-filled a lake is.

Technically, the chlorophyll test is the hardest to administer. The volunteer has to go to the Deep Basin (the 90' area just off Deer Point), take a Seechi Disk reading, and double it to determine the extent of the sample depth. He then collects a sample using a specially-prepared jar that takes in water slowly and steadily as it is drawn up. This means that once it reaches the surface, the jar contains water from a column that goes twice as deep as you can see with a Seechi disk that day.

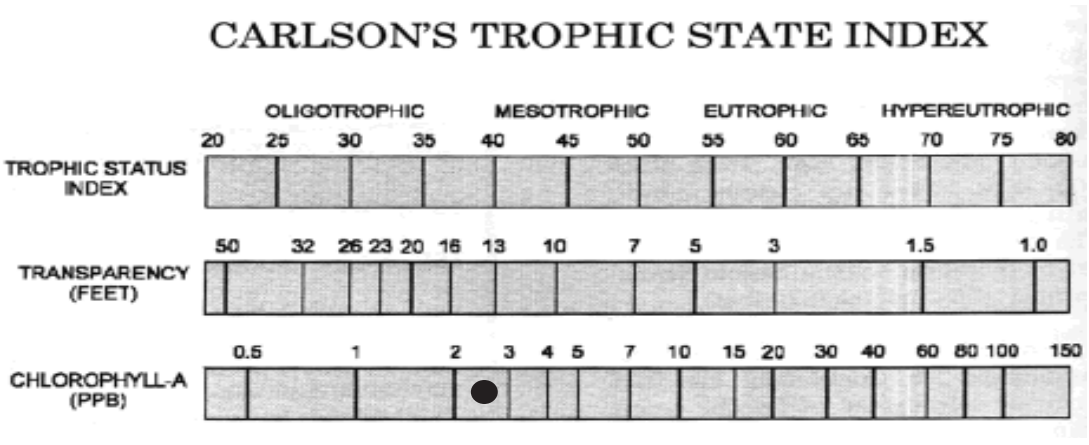
The sample is put into dark brown jars so that light doesn't affect it, stabilized with a few drops of magnesium choloride, and placed in a cooler. The volunteer immediately takes the sample back to his "lab," usually a basement sink where he filters 50cc of the water through a filter using a special tube. What comes off onto the filter is algae cells. This filter is then placed in another tube, labeled, and frozen.

Five chlorophyll samples per summer are taken, one each in the approximate middle of the months May through September. Three of the frozen samples are transported to the DEQ office on or about July 20. The last two are turned in with the final phosphorous test on or about Sept. 20. All samples go to a Lansing lab for analysis.

As with the phosphorous test, measurements are in parts per billion. Results of five tests per year:

Year	Average	Carlson Score
2003	3.5	41
2004	2.3	38
2005	3.0	43
2006	2.1	39
2007	1.8	36
2008	*	*
2009	1.9	37
2010	1.9	38
Average	**2.4**	**39**

* 2008 was a disastrous year with regard to chlorophyll testing. The May reading was 1.0, very low. However, during the June test, the rope that attaches the composite sampler came loose as the device was being retrieved; hence the sample was lost. Once a new sampler was delivered the July reading showed, again, a low 1.1. However, the lake tester misread the date that the final two tests (Aug. 15 and Sept 15th were to be delivered to the DEQ. Thus no analysis and test results. The CLMP will not calculate a Carlson score without data from at least four of the five tests.



Comparison of Newaygo lakes Summer, 2010

Approximately 200 lakes take part in the Co-operative Lake Monitoring Program (CLMP), an effort initiated by the Michigan Lake and Stream Associations, Inc in 1973. But many of them only do the Seechi Disk testing. Below are results of Newaygo County lakes which participated in the transparency/clarity test during summer, 2010.

Lake	Transparency Average - ft.	Carlson Score
Sylvan	19.9	34
Pickerel	13.8	39
Emerald	13.7	39
Bills	**13.0**	**40**
Fremont	10.3	43
Kimball	9.0	45
Hess	2.6	63