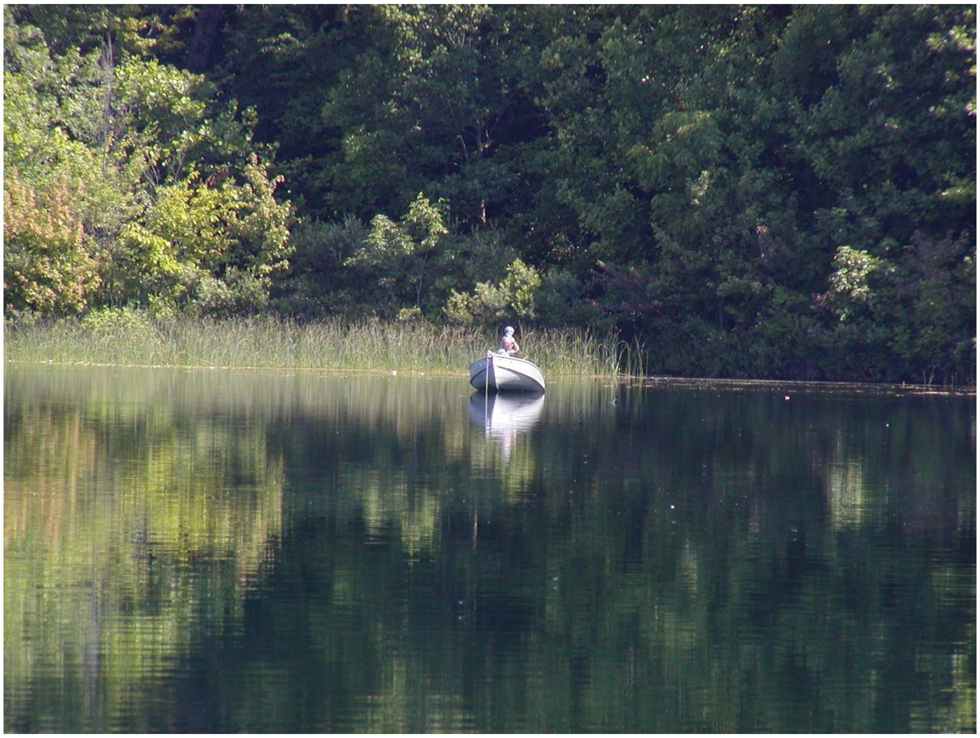
Indiana Lake Water Quality Assessment Report for 1994-1998



Prepared by:
School of Public & Environmental Affairs
Indiana University
Bloomington, Indiana

Prepared for:
Carol Newhouse
Indiana Department of Environmental Management
Office of Water Quality
Indianapolis, Indiana

September 2005

Acknowledgments

This report was written by William W. Jones with statistical analyses prepared by Becca Barnes, both of Indiana University's School of Public and Environmental Affairs (SPEA). It represents five years of traversing the State of Indiana, reading maps, searching for lake access, extracting stuck trailers, seemingly endless washing of laboratory glassware, and most importantly, having the opportunity to visit and sample the beautiful and varied lakes of Indiana. This work required the dedicated efforts of many people. Therefore, it is with gratitude that we recognize the superb efforts of the following SPEA graduate students who conducted the lake sampling and laboratory analyses of the water samples: Mark Goossen, George Antoniou, Kurt Stauffacher, Brad Hecht, Jennifer Burns, John Fisher, Lyn Hartman, Michelle Diller, Ponnappa Paleyanda, Robin Harris, Suzette Tay, Aylin Ozmelek, Rick Akin, Erin Meyer, Kate Wolfe, Steve Lundt, Josh Rubinstein, Kevin Beale, and Tim Kreps.

Table of Contents

LAKE WATER QUALITY ASSESSMENT IN INDIANA

Indiana has over 500 public lakes and reservoirs, ranging from 5-acre ponds to 10,700-acre Monroe Reservoir, the largest inland lake in the state. These lakes are a valuable resource for all Hoosiers. Protecting and managing the water quality of our public lakes is an important role of the Indiana Department of Environmental Management (IDEM).

How Does IDEM Monitor Indiana Lakes?

Comprehensive lake assessment is an important component of the ***Indiana Clean Lakes Program***. Through this program, the water quality of approximately 80 public lakes is assessed each year. The goals of this assessment program are to: a) identify water quality trends in individual lakes, b) identify lakes needing special management, and c) track water quality improvements due to industrial discharge and runoff reduction programs.

Public lakes in Indiana are defined as those having navigable inlets or outlets, or those occurring on public lands. However, a number of these public lakes have no boat access so they cannot be monitored in this program. In the 1970s, the lake survey crew dragged a small boat across fields to gain access to some lakes. For the present study, lakes were sampled only where a boat trailer or canoe could be launched from a public right-of-way. In addition, several more-or-less private lakes with public access are included in this report in cases where the public has reasonable access to the lake.

The sampling program generally proceeds from Steuben County in northeast Indiana southward until the entire state is covered. It takes approximately five years to sample all the state's lakes once and then the process is repeated. Sampling is conducted during July and August of each year. Lake conditions are generally more uniform in July and August so results from one year are more comparable to results from another year. In addition, the July-August period often represents worst-case water quality conditions in Indiana lakes because this is when algae are actively growing and lakes are most strongly stratified.

Most Indiana lakes having maximum depths of 16 to 23 feet or greater undergo thermal stratification during the summer. As the sun and air temperatures warm the surface water of a lake the warmed water becomes less dense. This "lighter" water floats on top of the cold, denser water at the lake's bottom. Summer wind and waves may not be strong enough to overcome the density differences between the surface and bottom waters and ***thermal stratification*** occurs. In a stratified lake, the surface waters (***epilimnion***) circulate and mix all summer while the bottom waters (***hypolimnion***) may stagnate because they are isolated from the surface (Figure 1). Thus, water characteristics in the epilimnion and hypolimnion of a given lake may be significantly different during stratification.

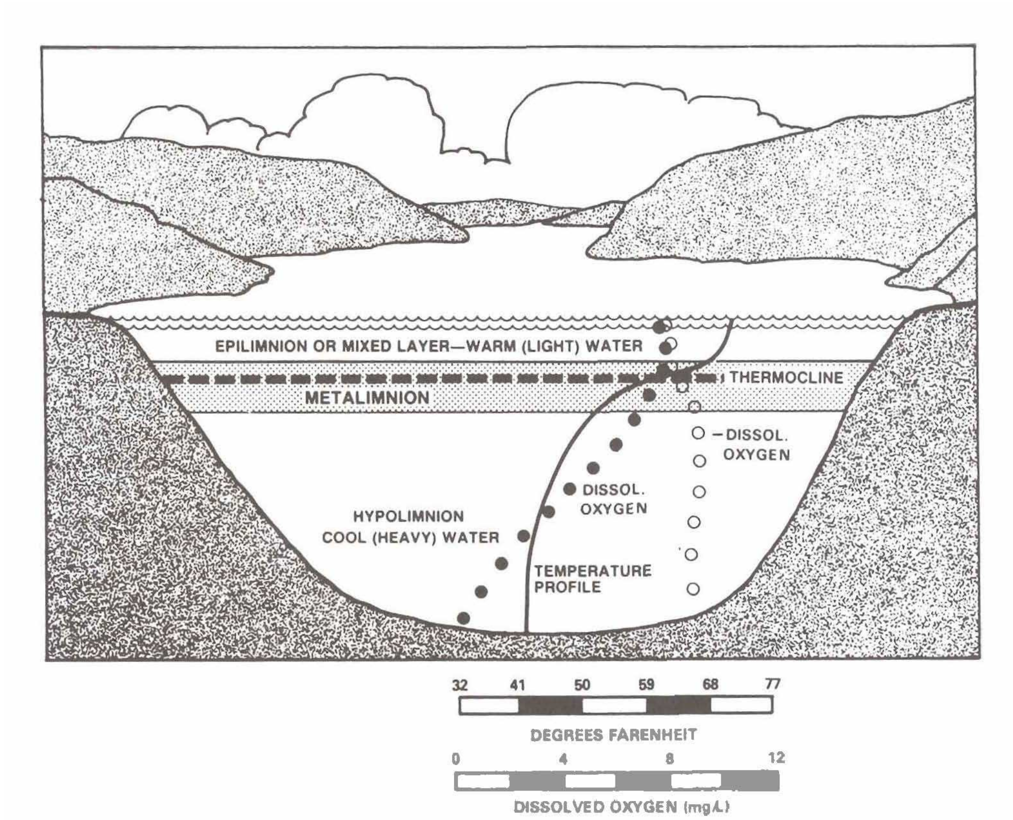


Figure 1. Summer thermal stratification prevents lake mixing because the cool waters of the hypolimnion are much denser than the warm waters of the epilimnion. Epilimnetic waters circulate with the wind but do not mix until the lake cools again in the fall. Adapted from: Olem and Flock, 1990

To account for potential differences between the epilimnion and hypolimnion of stratified lakes, water samples are collected from three feet below the surface and from three feet above the bottom. In addition, dissolved oxygen and temperature are measured at one-meter intervals from the surface to the bottom of each lake. Samples are collected from one site on each lake, usually over the deepest water.

This sampling protocol was chosen to gather data from as many lakes as possible, as frequently as possible, given the limited financial resources of the program. One sample per lake is not necessarily the ideal frequency of sampling to account for seasonal or spatial variability in lakes. However, if we collected three samples per year from each lake, or sampled three locations in each lake, available time and funds would permit us to monitor only 27 lakes each year instead of our target of 80 lakes. At this lower rate, it would take 15 years to sample all the Indiana public lakes instead of the current 5 years. Therefore, with the current protocol, the July/August sampling period helps standardize seasonal variability in the data and the 5-year sampling frequency allows more frequent monitoring of each lake to detect longer term changes in lake conditions.

What Water Quality Parameters are Included in These Assessments?

The comprehensive evaluation of lakes requires collecting data on a number of different, and sometimes hard-to-understand, water quality parameters. Some of the more important parameters include:

<u>Phosphorus</u>. An essential plant nutrient which most often controls aquatic plant growth. Phosphorus is found in fertilizers, human and animal wastes, and yard waste.

Soluble reactive phosphorus (SRP) - dissolved phosphorus readily usable by algae. SRP is often in very low concentrations in lakes with dense algae populations because it is all used up by the algae themselves. This form of phosphorus may be chemically released from storage in lake sediments when dissolved oxygen is lacking in the hypolimnion.

Total phosphorus (TP) - includes dissolved and particulate phosphorus. In most lakes, TP concentrations greater than 0.04 mg/L may cause algal blooms.

<u>Nitrogen</u>. An essential plant nutrient found in fertilizers, human and animal wastes, yard waste, and the air.

Nitrate (NO_3) - a chemically oxidized form of dissolved nitrogen which is used by algae. Nitrate is found in lakes when dissolved oxygen is present, usually the well-mixed surface waters.

Ammonia (NH_4) - a chemically reduced form of dissolved nitrogen. Ammonia is the preferred form of nitrogen for algal use. It is also produced by bacteria as they decompose dead plant and animal matter. Ammonia occurs most abundantly where dissolved oxygen is lacking, often in the anoxic hypolimnion of a eutrophic lake.

Organic Nitrogen (Org N) - includes nitrogen found in plant and animal matter. Organic nitrogen may be in dissolved or particulate form. In our analytical procedures, organic nitrogen plus ammonia equals total Kjeldahl nitrogen.

<u>Dissolved Oxygen (D.O.)</u>. Dissolved gas essential for respiration of fish and other aquatic organisms. Fish need at least 3-5 parts per million (ppm) of D.O. Lakes receive most of their dissolved oxygen by diffusion of oxygen from the atmosphere into the surface waters. The concentration of dissolved oxygen in the freely-mixing epilimnetic water maintains equilibrium with the concentration of oxygen in the atmosphere. Oxygen diffuses into the water or escapes from the water to maintain this equilibrium. Additional dissolved oxygen is released into lake water by aquatic plants as a by-product of photosynthesis. Occasionally, the rate of photosynthesis may exceed the rate of oxygen loss to the atmosphere, resulting in supersaturation of oxygen (greater than 100% saturation). Oxygen is consumed in the water by respiration of fish and other aquatic organisms, by bacterial decomposition of organic matter (dead algae, leaves, etc.), and by chemical reactions (for example, nitrification oxidizes ammonia (NH_4) to nitrate (NO_3) which removes 3 atoms of oxygen from the water). A lake's hypolimnion often has low D.O. concentrations because oxygen consumption by bacteria and chemical reactions may consume it, and there is no source of replacement oxygen during stratification.

Dissolved oxygen concentrations also affect chemical reactions in water. For example, low D.O. near the bottom sediments may allow dissolved phosphorus (SRP) to be released from the sediments into the water. If less than 50% of a lake's water column has oxygen (see % Water Column Oxic data), greater hypolimnetic concentrations of SRP and ammonia can result.

Secchi Disk Transparency. The depth to which the black & white Secchi disk can be seen. The Secchi disk transparency depth is reduced by suspended algae, soil and sediment particles in the water.

Light Transmission. Similar to the Secchi disk transparency, this measurement uses a light meter (photocell) to determine the rate at which light transmission is diminished in the upper portion of the water column. Another important light transmission measurement is the 1% light level. The 1% light level is the water depth to which one percent of the surface light penetrates. This depth is considered the lower limit where algae have enough light to photosynthesize.

Plankton. Important members of the aquatic food web. Include the algae (microscopic plants) and the zooplankton (small shrimp-like animals that eat algae). Determined by filtering water through a net having a very fine mesh (63 micron = 63/1000 millimeter). The plankton net is towed up through the water column from the one percent light level to the surface. Of the many different algal species present in the water, we are particularly interested in the blue-green algae. Blue-green algae are those which most often form nuisance blooms and their dominance in lakes may indicate poor water conditions. We record plankton as *natural units* per liter. A natural unit is the entire living organism. For example, one single-cell plankton and one filament containing 10 cells are both reported as one natural unit.

Chlorophyll *a*. The plant pigments of algae consist of the chlorophylls (green color) and carotenoids (yellow color). Chlorophyll *a* is by far the most dominant chlorophyll pigment and occurs in great abundance. Thus, chlorophyll *a* is often used as a direct estimate of algal biomass. Chlorophyll determination includes collecting algae from a known volume of water onto a filter. The chlorophyll in the algae is then dissolved and read on a spectrophotometer.

NOTE ON CONCENTRATION UNITS: Concentrations of materials in water are expressed as mass per unit volume of water. Usually these are in milligrams per liter (mg/L) which can also be considered as Parts per Million (PPM). For particularly low concentrations, micrograms per liter (μg/L or Parts per Billion (PPB)) are often used as the units. There are 1000 micrograms per milligram, thus a concentration of 134 μg/L is also equivalent to 0.134 mg/L. See Appendix A for commonly used equivalents and conversions.

Trophic State Indices

Because the numbers and units used to report water quality data vary so much, and because the data parameters themselves are somewhat difficult to interpret in total, a trophic state index (TSI) is often useful to help evaluate water quality data. A TSI condenses water quality data into a single, numerical index. Different index points are assigned for various water quality concentrations. These index or eutrophy points can then be used to compare the trophic state of one lake at different times, or to compare the trophic states of different lakes.

Because TSIs condense actual data into a single number, some information is lost. For example, a TSI change from 25 to 40 points suggests that a lake has gotten more productive, however, the TSI value of 40 alone does not give any information about the concentrations of phosphorus or oxygen, or about the transparency. Therefore, it is important to refer to the actual data in conjunction with the TSI value when evaluating lake conditions.

The Indiana Trophic State Index

In order to deal with the large variety of lakes found in Indiana, a substantial amount of information is needed on each lake and each lake's respective problems. The Indiana Trophic State Index (ITSI) was intended to characterize problem lakes and to define the reasons or sources behind complaints from lake users. The ITSI was not originally intended to be a tool for lake management. In the early 1970s, the ITSI was used primarily for same day recognition of lake problems, advanced eutrophy, and changes in lake regime. The ITSI was not used as a means of ranking Indiana public lakes until the mid-1970s.

The Indiana TSI is a multi-parameter index. Data must be collected for a number of physical, chemical and biological lake parameters. For phosphorus and nitrogen data, water samples are collected from a lake's epilimnion and hypolimnion and the mean of these values is used to determine the eutrophy points. Data for other index parameters are collected as indicated in Table 2.

Eutrophy points are assigned for various concentrations of each parameter in the index. More points are given for conditions which are likely to promote greater productivity or which are indicative of greater productivity. Most index parameters generate 1 to 4 eutrophy points. The scale is, however, weighted (up to 35 points maximum) towards the abundance of plankton and presence of blue-green algae dominance. Such heavy emphasis is given to algae in the index due to citizen perception of what constitutes poor lake water quality. Points for each index parameter are then totaled for the final lake TSI. The ITSI scale ranges from 0 to 75 eutrophy points. Trophic categories are designated according to Table 1 below. Trophic points are assigned according to Table 2 following.

TABLE 1. Trophic Class Designations in the Indiana TSI.

Trophic State	Trophic Points
Oligotrophic	0-15
Mesotrophic	16-30
Eutrophic	31-45
Hypereutrophic	46-75

TABLE 2. The Indiana Trophic State Index.

Parameter and Range			Eutrophy Points
I.	Total Phosphorus (mg/L)		
	A.	At least 0.03	1
	B.	0.04 to 0.05	2
	C.	0.06 to 0.19	3
	D.	0.2 to 0.99	4
	E.	1.0 or more	5
II.	Soluble Phosphorus (mg/L)		
	A.	At least 0.03	1
	B.	0.04 to 0.05	2
	C.	0.06 to 0.19	3
	D.	0.2 to 0.99	4
	E.	1.0 or more	5
III.	Organic Nitrogen (mg/L)		
	A.	At least 0.5	1
	B.	0.6 to 0.8	2
	C.	0.9 to 1.9	3
	D.	2.0 or more	4
IV.	Nitrate (mg/L)		
	A.	At least 0.3	1
	B.	0.4 to 0.8	2
	C.	0.9 to 1.9	3
	D.	2.0 or more	4
V.	Ammonia (mg/L)		
	A.	At least 0.3	1
	B.	0.4 to 0.5	2
	C.	0.6 to 0.9	3
	D.	1.0 or more	4
VI.	Dissolved Oxygen: Percent Saturation at 5 feet from surface		
	A.	114% or less	0
	B.	115% 50 119%	1
	C.	120% to 129%	2
	D.	130% to 149%	3
	E.	150% or more	4

Indiana Trophic State Index (continued)

VII.	Dissolved Oxygen: Percent of measured water column with at least 0.1 ppm dissolved oxygen		
	A.	28% or less	4
	B.	29% to 49%	3
	C.	50% to 65%	2
	D.	66% to 75%	1
	E.	76% 100%	0
VIII.	Light Penetration (Secchi Disk)		
	A.	Five feet or under	6
	B.	Greater than five feet	0
IX.	Light Transmission (Photocell) Percent of light transmission at a depth of 3 feet		
	A.	0 to 30%	4
	B.	31% to 50%	3
	C.	51% to 70%	2
	D.	71% and up	0
X.	Total Plankton per liter of water sampled from a single vertical tow between the 1% light level and the surface:		
	A.	less than 3,000 organisms/L	0
	B.	3,000 - 6,000 organisms/L	1
	C.	6,001 - 16,000 organisms/L	2
	D.	16,001 - 26,000 organisms/L	3
	E.	26,001 - 36,000 organisms/L	4
	F.	36,001 - 60,000 organisms/L	5
	G.	60,001 - 95,000 organisms/L	10
	H.	95,001 - 150,000 organisms/L	15
	I.	150,001 - 5000,000 organisms/L	20
	J.	greater than 500,000 organisms/L	25
	K.	Blue-Green Dominance: additional points	10

The Carlson Trophic State Index

The most widely used and accepted TSI in the United States is one developed by Bob Carlson called the Carlson TSI (Carlson 1977). Carlson analyzed summertime total phosphorus, chlorophyll *a*, and Secchi disk transparency data for numerous north temperate zone lakes and found statistically significant relationships among the three parameters. He developed mathematical equations for these relationships and these form the basis for the Carlson TSI (Figure 7). Using this index, a TSI value can be generated by one of three measurements: Secchi disk transparency, chlorophyll *a* or total phosphorus. Data for one parameter can also be used to predict a value for another. The TSI values range from 0 to 100. Each major TSI division (10, 20, 30, etc.) represents a doubling in algal biomass.

As a further aid in interpreting TSI results, Carlson's scale is divided into four lake productivity categories: oligotrophic (least productive), mesotrophic (moderately productive); eutrophic (very productive) and hypereutrophic (extremely productive). Using Carlson's index, a lake with a summertime Secchi disk depth of 2 meters would have a TSI of 50 points (located on the in line with the 2 meters). This lake would be in the mesotrophic category. Because the index was constructed using relationships among transparency, chlorophyll, and total phosphorus, a lake having a Secchi disk depth of 2 meters would be expected to have 8 µg/L (PPB) chlorophyll and 25 µg/L (PPB) total phosphorus (see Figure 2).

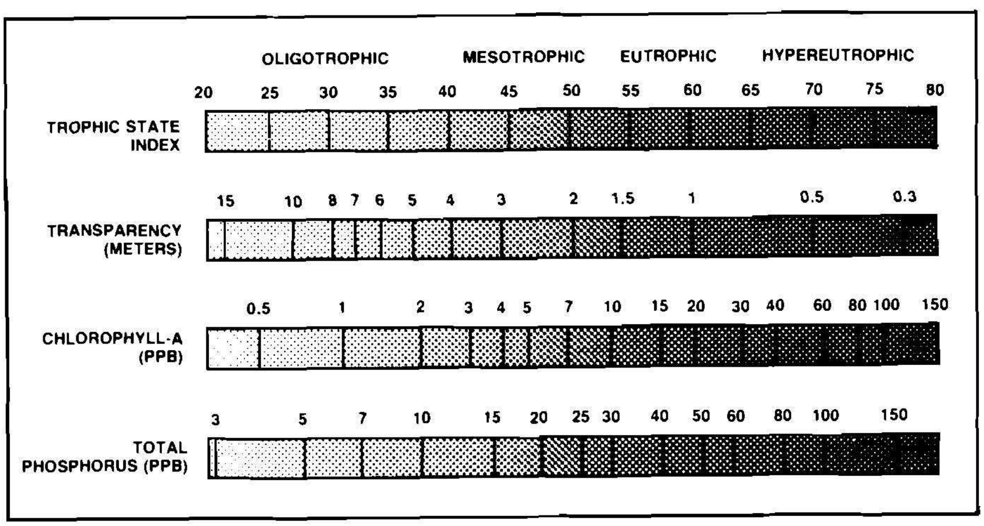


Figure 2. Carlson's Trophic State Index. Source: Olem and Flock (1990)

Not all lakes have the same relationship between transparency, chlorophyll and total phosphorus as Carlson's lakes do. Other factors such as high suspended sediments or heavy predation of algae by zooplankton may keep chlorophyll concentrations lower than might be otherwise expected from the total phosphorus concentrations. For example, the high suspended sediments in many Indiana lakes tend to make transparency worse than otherwise predicted by Carlson's index. While results such as this may suggest that Carlson's TSI does not work well in Indiana, a limnologist can evaluate the relative positions of transparency, chlorophyll *a*, and total phosphorus for a particular lake using Figure 2 above and gain valuable insights into how that lake functions.

RESULTS

Physical, chemical and biological data collected for all 424 lake samples collected during the 1994-98 period are included in Appendix B. Lakes are listed alphabetically. The mean value of the epilimnetic and hypolimnetic samples for water quality parameters is included in this appendix since it is this value that is used to calculate the Indiana TSI. Because 69 lakes were sampled twice during the 1994-98 period, the data in Appendix represents 355 different lakes.

Table 3 illustrates summary statistics for all 424 lake samples collected and analyzed during 1994 and 1998. With this table, it is possible to compare results for one particular lake with the mean or median value for all lakes. In addition, we can compare the 'average' Indiana lake against Carlson's Trophic State Index (Figure 2 previous) and see that the average (mean) value of Secchi disk transparency, total phosphorus, and chlorophyll *a* all fall within the 'eutrophic' class in Carlson's Index.

TABLE 3. Summary statistics for selected parameters for Indiana lakes sampled between 1994-98.

	Secchi Disk (m)	NO_3 (mg/L)	NH_4 (mg/L)	TKN (mg/L)	SRP (mg/L)	TP (mg/L)	Chl a (mg/m3)	Plankton (nu/L)	% Blue-greens
Mean	2.1	0.290	0.750	1.580	0.110	0.180	14.5	39282	59
Median	1.8	0.025	0.472	1.161	0.033	0.097	5.3	13103.2	64
Maximum	9.2	9.303	11.248	13.794	0.782	4.894	230.9	543219	100
Minimum	0.1	0.016	0.018	0.230	0.005	0.010	0.0	80	0
Standard Deviation	1.5	0.84	0.98	1.64	0.15	0.31	23.10	73407	28

The Indiana Trophic State Index (TSI) score for each lake is included in Appendix C for the current data, and the change in trophic points between the most recent sample and the present sample is also given. The Indiana TSI is used because this index has been the basis for evaluating lake condition in Indiana since the 1970s. In cases where a particular lake was sampled twice during the sampling period (69 lakes) only the most recent TSI value is given and compared.

A frequency distribution of Indiana Trophic State Index scores for the lakes sampled during 1994-98 is shown in Figure 3. Most of the 355 lakes had TSIs ranging between 10 - 40 points. When grouped according to trophic class based on the Indiana Trophic State Index, 67 lakes (18.9% of all lakes sampled) were in oligotrophic, 127 lakes (35.8%) were mesotrophic, 125 lakes (35.2%) were eutrophic, and 36 lakes (10.1%) were hypereutrophic (Figure 4).

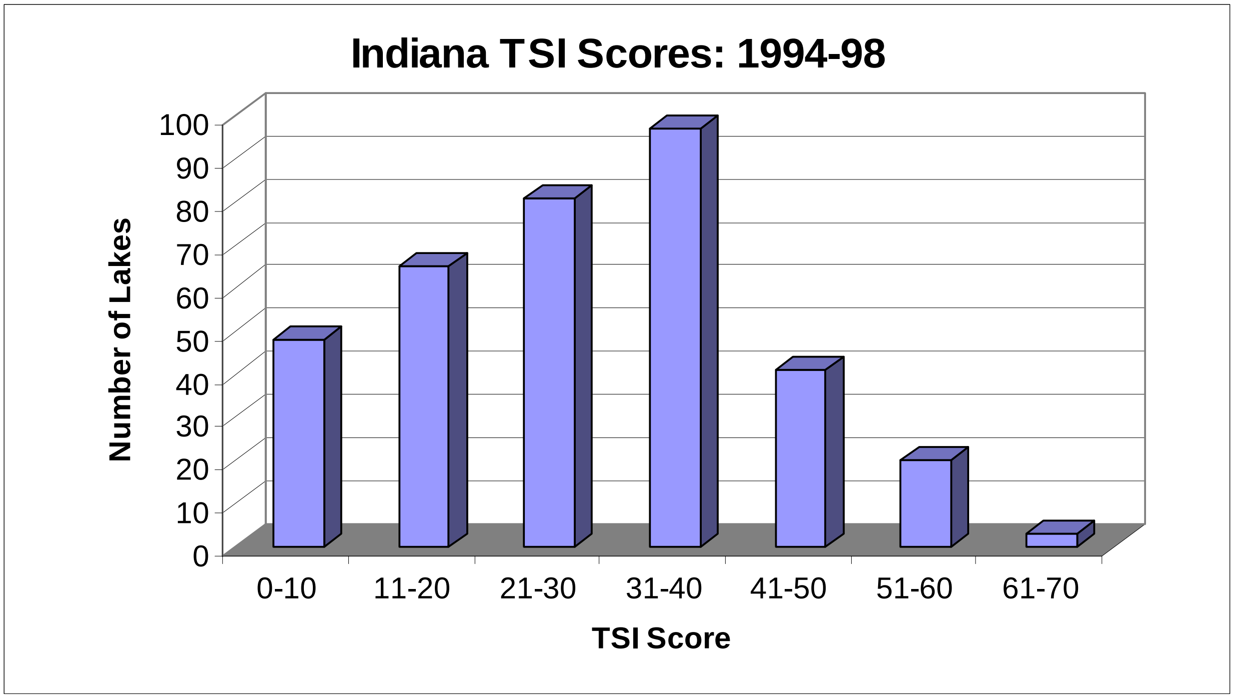


Figure 3. Indiana TSI scores for lakes sampled during 1994-98.

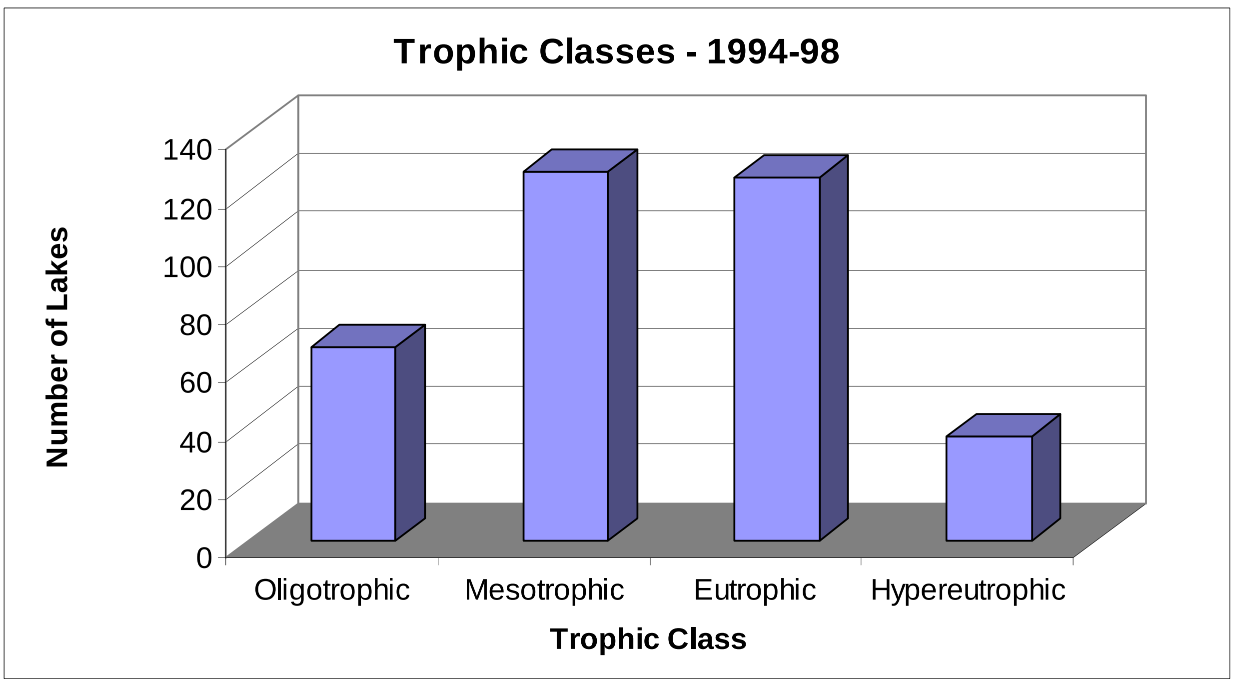


Figure 4. Trophic rank of 355 lakes sampled during 1994-98.

The cumulative surface area of lakes and reservoirs within each of the trophic classes is shown in Figure 5. Nearly 12% of the lakes sampled (10,547 acres) were classified as oligotrophic by the Indiana TSI. The trophic class with the greatest cumulative area was mesotrophic, with 46% (41,076 acres) of the total area of lakes sampled. More than 42% of lakes sampled (37,725 acres) were classified as eutrophic or hypereutrophic.

One of the uses of a trophic state index is to track changes in lake trophic state from one sampling period to another. An increase in TSI between the two periods indicates an increase in conditions which can promote eutrophication. A decrease in TSI suggests a decrease in trophic state at a particular lake. Figure 6 shows the change in Indiana TSI scores for the 355 different lakes sampled during 1994-98. Since our sampling interval is approximately five years, the results shown in Figure 6 offer a glimpse into statewide lake changes over that five-year period.

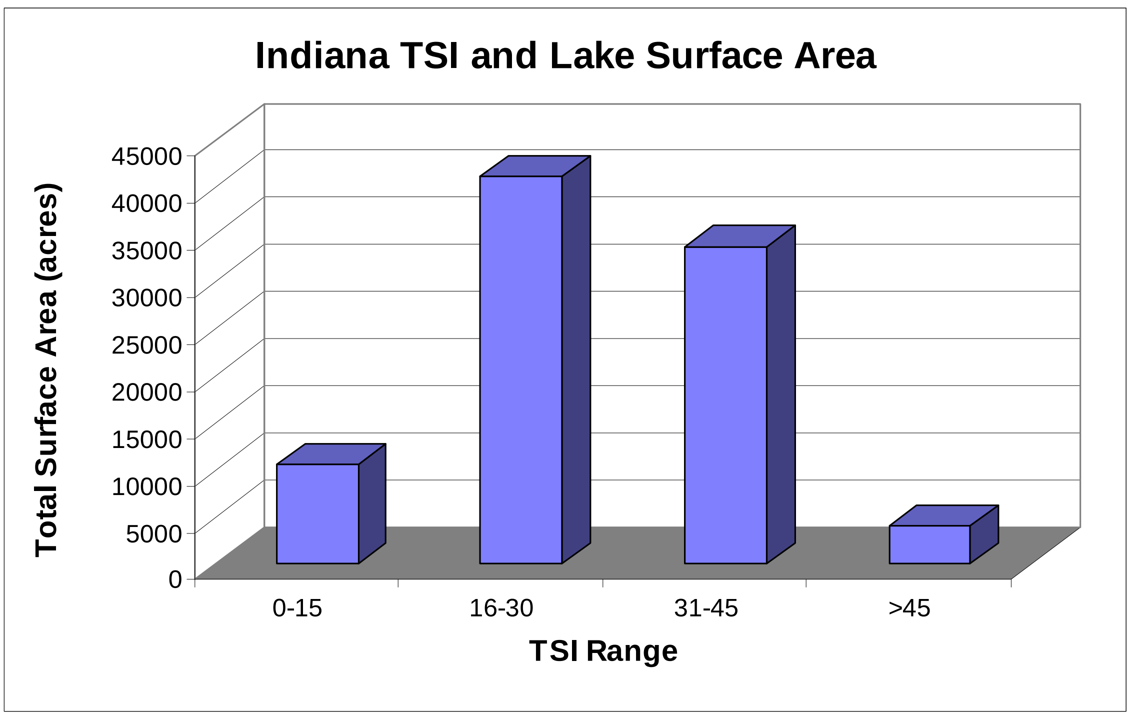


Figure 5. Cumulative area of lakes sampled within each trophic class.

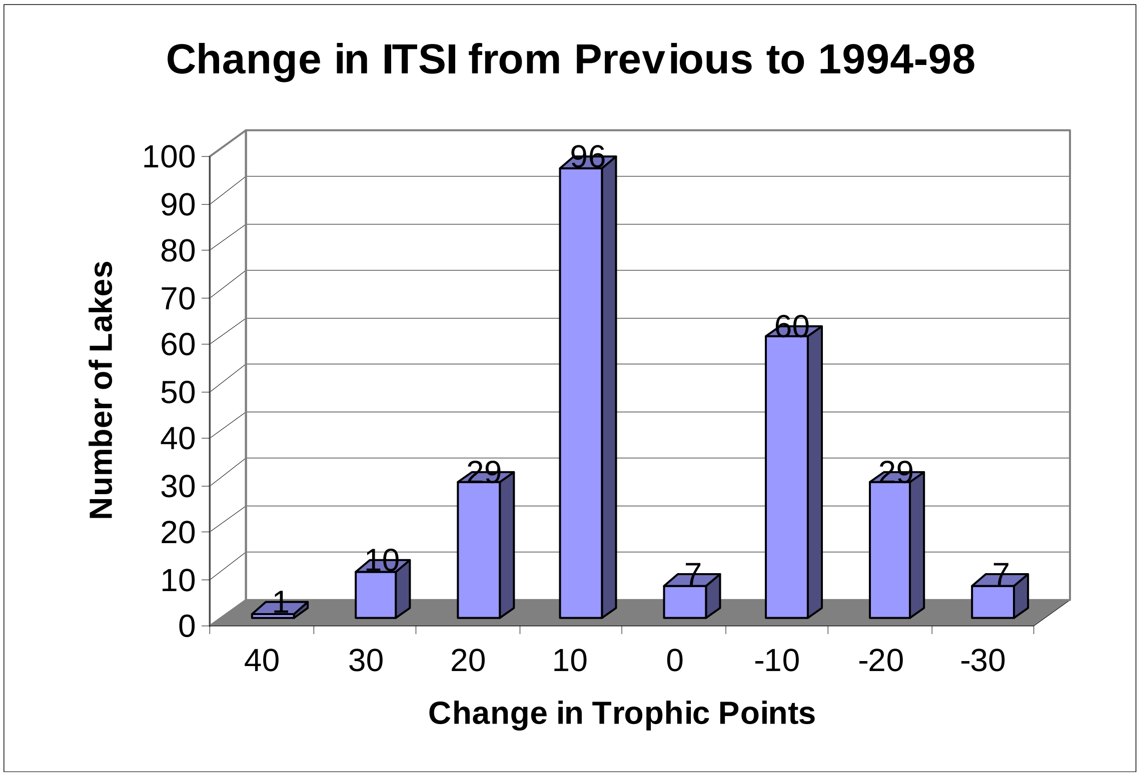


Figure 6. Change in Indiana Trophic State Index scores.

Since the last round of lake assessment, 102 lakes had improving TSI scores. This represents 42% of the lakes assessed during the 1994-98 period (Figure 7). During this same period, 7 (3%) of the lakes had no change in TSI score while 136 lakes (55%) had higher TSI scores. Of these, the TSI score for 96 lakes increased (worsened) by 10 or fewer points. Eleven lakes assessed had large TSI score increases of over 20 points. These lakes are listed in Table 4. Likewise, twelve lakes had TSI score decreases (improvement) of over 20 points (Table 5).

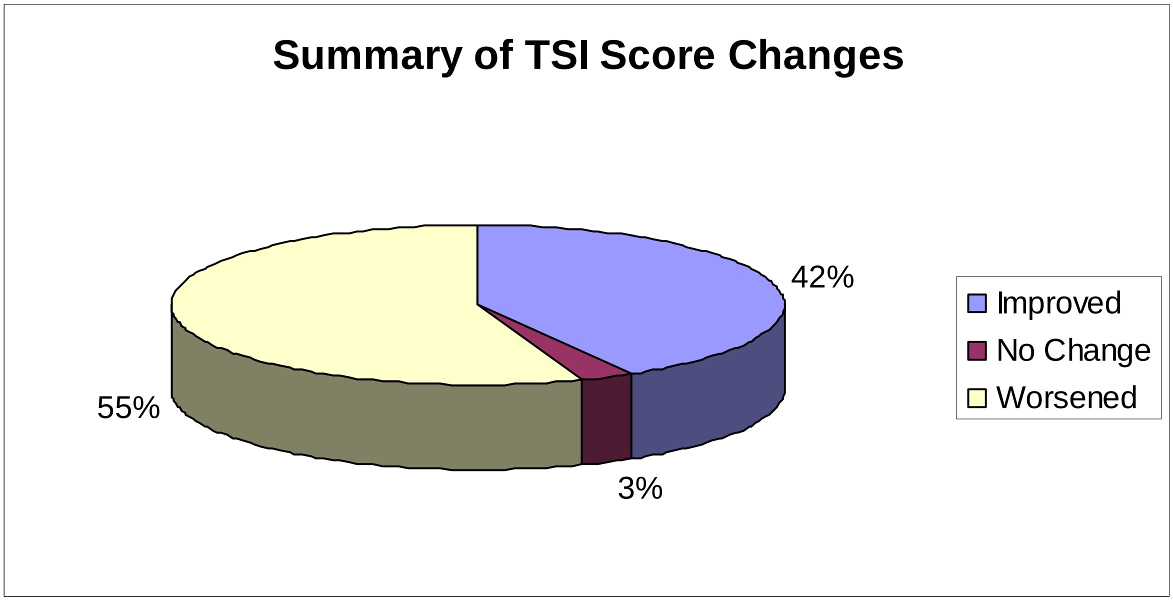


Figure 7. Percentage of lakes with improved, no change, or worsened TSI scores.

TABLE 4. Lakes with the greatest increase in Indiana TSI score between 1994 and 1998.

LAKE	COUNTY	PREVIOUS TSI	NEW TSI	CHANGE IN TSI
JC Murphy	Newton	20	62	+42
Mollenkramer	Ripley	21	47	+26
Moser	Wells	19	44	+25
Ball	Steuben	21	46	+25
Mill Pond	Kosciusko	26	51	+25
Kunkel	Wells	29	53	+24
Beaver Creek	Dubois	14	37	23
Bruce	Fulton	25	47	+22
Whitewater	Union	35	57	+22
Clair	Huntington	5	26	+21
Fish	Steuben	24	45	+21

TABLE 5. Lakes with the greatest improvement in Indiana TSI score between 1994-1998.

LAKE	COUNTY	PREVIOUS TSI	NEW TSI	CHANGE IN TSI
Indian	Noble	51	5	-46
Lily	LaPorte	55	20	-35
Everett	Allen	66	33	-33
Prairie Creek	Delaware	55	24	-31
Hominy Ridge	Wabash	44	13	-31
Bartley	Noble	56	27	-29
Green Valley	Vigo	60	32	-28
Mansfield	Parke	59	32	-27
Williams	Noble	63	38	-25
Appleman	LaGrange	53	28	-25
Bass	Starke	42	20	-22
Old	Whitley	50	29	-21

ANALYSIS

Lake Morphology

The morphology (form and structure) of lake basins has important effects on nearly all of the physical, chemical and biological parameters of lakes (Wetzel 2001). For example, lake depth affects whether a lake stratifies. Lake size affects wind fetch and thus the amount and depth of turbulent mixing. Lakes with a large volume (large mean depth) have more dilutional capacity and should be able to resist trophic changes due to nutrient additions better than small volume lakes receiving the same quantity of nutrients.

To investigate the relationship between a lake's morphology and its water quality we tested several morphological parameters for which we had data against water quality data. Statistically significant relationships were found between Secchi Disk transparency, total phosphorus and nitrate concentrations in the epilimnion, and chlorophyll *a* concentrations and various lake morphology parameters. The morphological parameters considered in the models include the following: type of lake (impoundment, natural, or coal mine), maximum depth, watershed area, and surface area of the lake.

We had surface areas for 412 of the 424 lake observations, maximum depths for all the lakes, the type of lake for 372 of the observations and watershed areas for 206 of the lake observations. SAS, a widely used statistical analytical software package was used to test the following model:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$$

Y_i=Water Quality Parameter (Secchi Disk transparency, Total Phosphorus,
Nitrate, or Chlorophyll *a* concentration)
β_0= y-intercept
$\beta_{1,2,3,4,5}$ = slope
X_1= surface area (hectares)
X_2= maximum depth (meters)
X_3= watershed area (square miles)
X_4= impoundment (1 for impoundments, 0 otherwise)
X_5= natural (1 for natural lakes, 0 otherwise)

Hypothesis 1*:* the Secchi Disk transparency of a lake is related to the lake's surface area, watershed area, maximum depth and whether it is a natural or man-made lake.

The null hypothesis (H_o) for this test was that all slopes (β values) are equal to zero. If the slope relating Secchi Disk transparency (measured in meters) with the morphological parameters are zero, that means that Secchi Disk transparency does not change with changes in a lake's morphology. The alternative hypothesis (H_A) is that all β values are not equal to zero. Results of the test were:

$F = 10.06$
$P < 0.0001$
$R^2 = 0.2059$

The very low probability statistic (p-value) means that the slopes are not equal to zero and there is a relationship relating Secchi Disk transparency with lake morphology. The p-value of less than 0.0001 means that there is only a 1 in 10,000 probability that the relationship observed is due entirely to chance. Although this proves there is a relationship between the variables, the model only accounts for 20.59% of data's variation (R^2). This is not necessarily bad, since one would not expect the R^2 to be high since there are so many factors that contribute to a lake's transparency that are *not* accounted for in this model.

Hypothesis 2*:* the concentration of total phosphorus in the epilimnion of a lake is related to the lake's surface area, watershed area, maximum depth and whether it is a natural or man-made lake.

The null hypothesis (H_o) for this test was that all slopes (β values) are equal to zero. If the slope relating total phosphorus (TP) concentrations (measured in mg/L) with the morphological parameters are zero, that means that TP does not change with changes in a lake's morphology. The alternative hypothesis (H_A) is that all β values are not equal to zero. Results of the test were:

$F = 8.08$
$P < 0.0001$
$R^2 = 0.1723$

The very low probability statistic (p-value) means that the slopes are not equal to zero and there is a relationship relating TP concentrations with lake morphology. The p-value of less than 0.0001 means that there is only a 1 in 10,000 probability that the relationship observed is due entirely to chance. Although this proves there is a relationship between the variables, the model only accounts for 17.23% of data's variation (R^2). This is not necessarily bad, since one would not expect the R^2 to be high since there are so many factors that contribute to a lake's phosphorus concentration that are *not* accounted for in this model.

Hypothesis 3*:* the concentration of nitrate in the epilimnion of a lake is related to the lake's surface area, watershed area, maximum depth and whether it is a natural or man-made lake.

The null hypothesis (H_o) for this test was that all slopes (β values) are equal to zero. If the slope relating nitrate concentrations (measured in mg/L) with the morphological parameters are zero that means that nitrate does not change with changes in a lake's morphology. The alternative hypothesis (H_A) is that all β values are not equal to zero. Results of the test were:

$F = 3.17$
$P < 0.0090$
$R^2 = 0.0754$

The low probability statistic (p-value) means that the slopes are not equal to zero and there is a relationship relating nitrate concentrations with lake morphology. The p-value of less than 0.0090 means that there is only a 9 in 1000 probability that the relationship observed is due entirely to chance. Although this proves there is a relationship between the variables, the model only accounts for 7.54% of data's variation (R^2). This is not necessarily bad, since one would not expect the R^2 to be high since there are so many factors that contribute to a lake's nitrate concentration that are *not* accounted for in this model.

***Hypothesis 4**:* the concentration of chlorophyll *a* in a lake is related to the lake's surface area, watershed area, maximum depth and whether it is a natural or man-made lake.

The null hypothesis (H_o) for this test was that all slopes (β values) are equal to zero. If the slope relating chlorophyll *a* concentrations (measured in *u*g/L) with the morphological parameters are zero, that means that chlorophyll *a* does not change with changes in a lake's morphology. The alternative hypothesis (H_A) is that all β values are not equal to zero. Results of the test were:

$F = 6.65$
$P < 0.0001$
$R^2 = 0.1464$

The very low probability statistic (p-value) means that the slopes are not equal to zero and there is a relationship relating chlorophyll *a* concentrations with lake morphology. The p-value of less than 0.0001 means that there is only a 1 in 10,000 probability that the relationship observed is due entirely to chance. Although there this proves there is a relationship between the variables, the model only accounts for 14.64% of data's variation (R^2). This is not necessarily bad, since one would not expect the R^2 to be high since there are so many factors that contribute to a lake's chlorophyll production that are *not* accounted for in this model.

Shoreline Land Use

In addition to lake morphology, the land use within a given watershed will affect a lake's water quality. In general, altering the landscape (whether the land is used for agriculture or home development) degrades a lake's water quality by increasing run-off rates (more impermeable surfaces and less natural cover) resulting in the addition of sediment and nutrients into the lake. In an effort to separate out the effects of lake type from the lake's morphological characteristics land use variables were added to the above model.

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9$

Y_i=Water Quality Parameter (Secchi Disk transparency, Total Phosphorus, Nitrate, or Chlorophyll *a* concentration)

β_0= y-intercept
$\beta_{1,2,3,4,5,6,7,8,9}$ = slope
X_1= surface area (hectares)
X_2= maximum depth (meters)
X_3= watershed area (square miles)
X_4= impoundment (1 for impoundments, 0 otherwise)
X_5= natural (1 for natural lakes, 0 otherwise)
X_6= percent of lake surrounded by agriculture
X_7= percent of lake surrounded by wetlands
X_8= percent of lake surrounded by forest
X_9= percent of shoreline occupied by homes

Hypothesis 5*:* the Secchi Disk transparency of a lake is impacted by its shoreline's land use.

The null hypothesis (H_o) for this test is that $\beta_{6,7,8,9}$ are equal to zero (from the previous tests we know that $\beta_{1,2,3,4,5}$ are not equal to zero). If these slopes are indeed zero it means that the land use directly adjacent to the lake does not have a statistically significant impact on the Secchi Disk transparency. The alternative hypothesis (H_A) is that all β values are not equal to zero. Results of the test were:

$F = 7.23$
$P < 0.0001$
$R^2 = 0.2560$

Once again the p-value is very low, indicating that there is a relationship between the independent variables (morphological and/or land use). To further investigate the impact of the different types of land use on Secchi Disk transparency we examined the slope coefficients for each of the land use variables. The results are listed below:

variable	slope estimate	standard error	t-value	p-value
agriculture	-0.01992	0.01128	-1.77	0.0791
wetlands	-0.00003864	0.00498	-0.01	0.9938
Forest	0.00788	0.00390	2.02	0.0445
Homes	0.00397	0.00367	1.08	0.2809

Examination of the p-values indicates that individually the slope estimates are not as statistically significant as the model when taken in its entirety. The slope estimate for agricultural and forested land are statistically significant at an α of 0.10. While the estimates of the slopes appear very small, it is important to remember the units of the different variables. For example, the slope estimate for agriculture means the following: by increasing the amount of shoreline used for agriculture by 10% the Secchi Disk transparency of a given lake will decrease by 1.99 meters.

The slope estimates for the land use variables (agriculture, wetlands, forest, and homes) were not statistically significant when compared to the other water quality parameters (total phosphorus, nitrate, and chlorophyll *a* concentrations). This is due in most part to the nature of the data and the relationships between land use and water quality. First, the data is purely observational, i.e. what the shoreline land use appears to be from the vantage point of someone on a boat in the middle of the lake. Second, while the land use directly adjacent to the lake is likely to have a more direct impact on water quality than the land use at the furthest point in the watershed, all activities within the basin have the potential to impact the lake. Finally, the impacts of land use on water quality are complicated by soil type, slope, and management efforts within the watershed.

Although individual shoreline land use parameters were not statistically significant by themselves, graphs of % forest and % agriculture versus Secchi disk transparency depth do show apparent trends. Figure 8 below, shows that as the % forest land use on lakeshores increases, the Secchi disk transparency increases. This makes intuitive sense because a forest buffer is very effective in trapping runoff and eroded soil from the land.

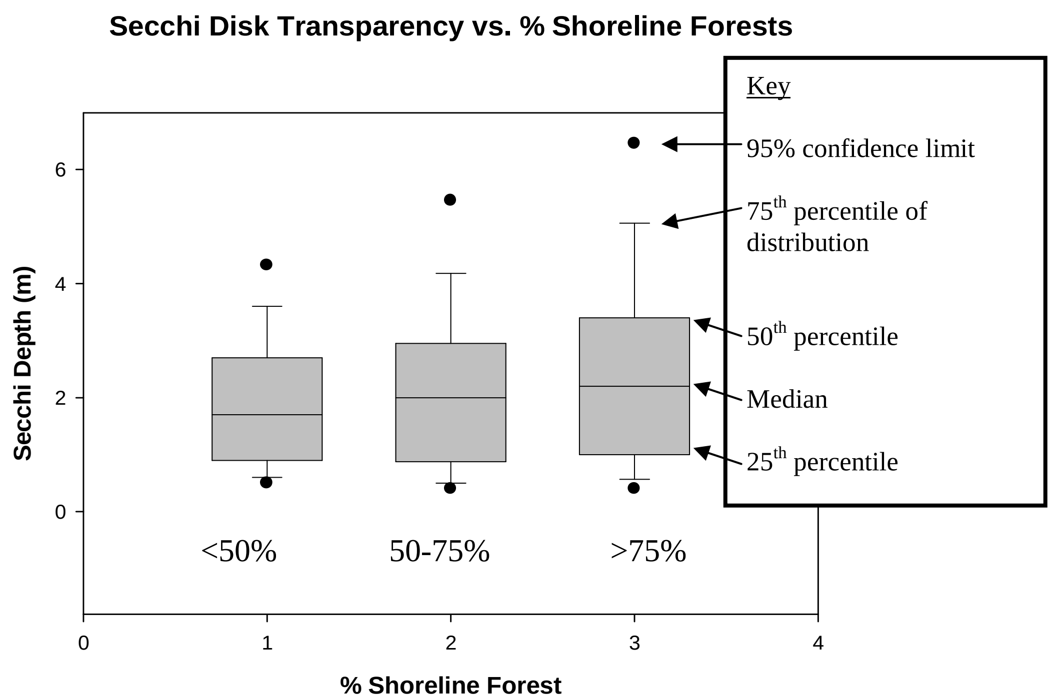


Figure 8. Median Secchi disk transparency increases in lakes having a higher percentage of forests on their shores.

Similarly, when we plot Secchi disk transparency in lakes against the percentage of agricultural land on the lakes' shoreline, we see the opposite trend (Figure 9). Water transparency decreases generally with increasing shoreline agricultural land.

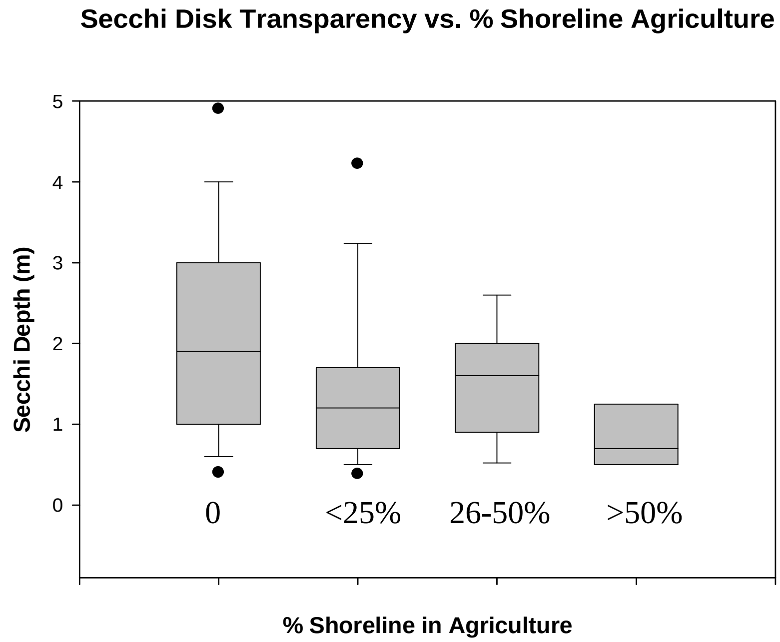


Figure 9. Median Secchi disk transparency decreases in lakes as the percent of shoreline in agricultural land use increases.

Lake Type

We conducted additional statistical analyses to determine if lake type (e.g., coal mine lake, natural lake, and impoundment) influences the water quality of any given lake. For this analysis lakes were divided into groups based on type, the following table shows the break down of the lakes sampled from 1994 to 1998 by type (49 were unknown) (Table 6).

TABLE 6. Distribution of Lake Types Among the Lakes Assessed Between 1994-1998.

Type	**Frequency**	**Percent of total**
Natural	233	62.6%
Impoundments	88	23.7%
Coal Mine Lakes	43	11.6%
Quarries	5	1.3%
Farm Pond	1	0.3%
Municipal Pond	1	0.3%
Borrow Pit	1	0.3%

The farm pond, municipal pond, and borrow pit were not included in the statistical analysis due to their small sample size. Statistically significant differences were seen between the remaining groups for the following parameters: Secchi Disk transparency ($p < 0.0001$), epilimnetic nitrate ($p<.0001$), hypolimnetic nitrate ($p=0.0004$), hypolimnetic TKN ($p=0.001$), epilimnetic total phosphorus ($p<0.0001$), and chlorophyll *a* ($p<0.0001$). Impoundments displayed the lowest water quality as indicated by a majority of the parameters (lowest Secchi Disk transparency, highest nitrate levels, highest phosphorus levels, and the highest concentration of chlorophyll *a*). These results are logical due to the tendency of impoundments to have higher watershed to lake area ratios and thus a relatively greater amount of material and runoff draining into these lakes as compared to natural lakes. In addition, impoundments are often less circular than natural lakes, creating more opportunities for shoreline development, which removes riparian vegetation and thus increases the potential of nutrient and sediment additions.

Some of these trends are apparent in the following plots. Secchi disk transparency is highest in the coal mine lakes of Greene and Sullivan counties, which generally have small watersheds and are nutrient poor (Figure 10). Natural lakes have the next highest transparency as a group. Impoundments have the worst overall transparency.

Coal mine lakes had the lowest epilimnetic total phosphorus concentrations and a very narrow range of values, as indicated by the narrow height of the shaded box (Figure 11). Natural lakes also have a relatively low median total phosphorus concentration but the range is much higher since some natural lakes are hypereutrophic. Impoundments have the highest median total phosphorus concentration and the highest range of values.

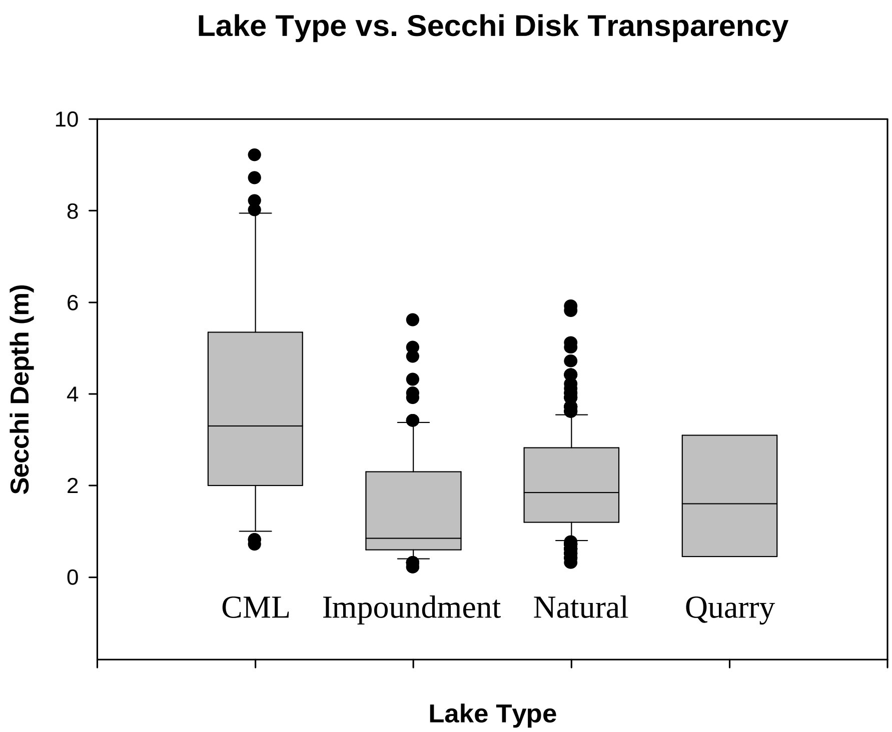


Figure 10. Lake type and Secchi disk transparency distribution.

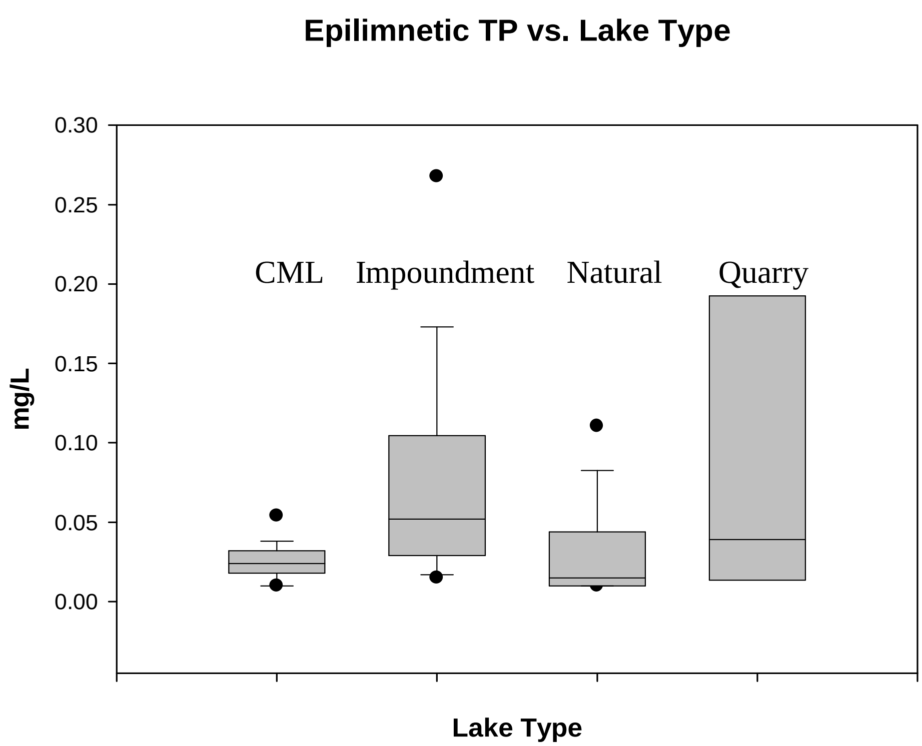


Figure 11. Lake type and epilimnetic total phosphorus distribution.

Figure 12 shows the distribution of chlorophyll a by lake type. It isn't surprising that the lake types with the highest total phosphorus concentrations also have the highest chlorophyll production. Again, there is a very tight range of chlorophyll concentrations for the coal mine lakes.

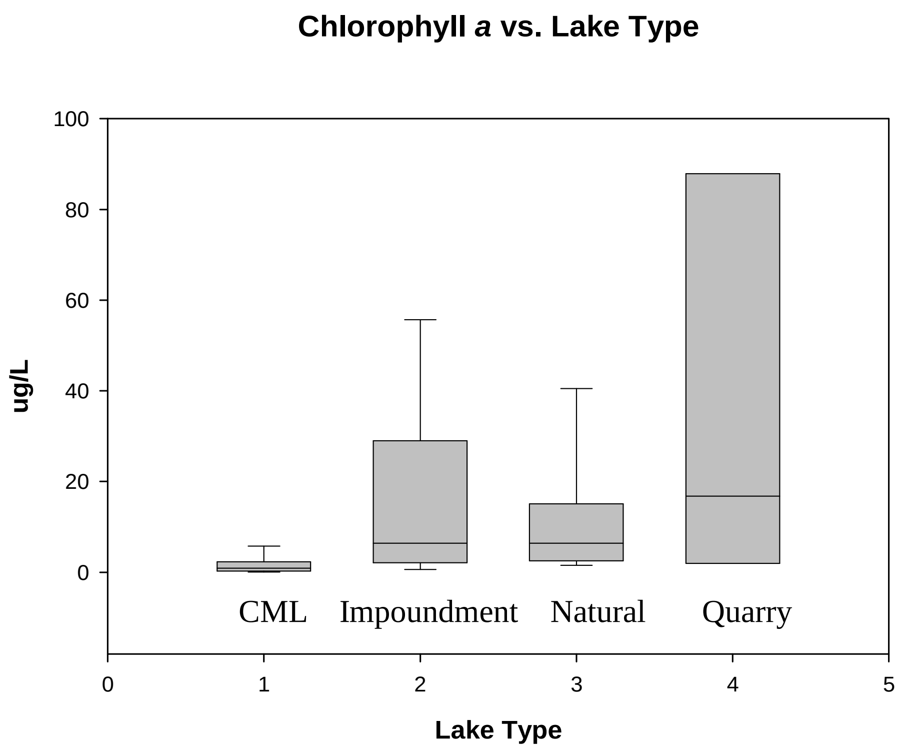


Figure 12. Lake type and chlorophyll *a* distribution.

Lake Depth

Shallow lakes are thought to behave differently than other lakes due to their smaller volumes, a greater percentage of their volume falling within the euphotic zone, and their tendency to not stratify. Therefore, the lakes were divided into two groups, those having a maximum depth greater than 5 meters and those whose maximum depth is less than 5 meters. Statistically significant differences were seen for the following parameters: Secchi disk transparency ($p<0.0001$), TKN ($p<0.001$), total phosphorus ($p<0.001$), and chlorophyll *a* ($p<0.0001$); the only parameter to not show a difference was nitrate. In all cases, the shallow lakes displayed values which indicated poorer water quality than the deeper lakes

CONCLUSION

The trophic state of Indiana lakes is determined by a complex interplay of lake morphology, geology, topography and watershed land uses. Lakes with large watersheds relative to their lake volumes are flushed more frequently with runoff and this is largely a benefit to the lake, especially when watershed best management practices have been applied. However, in watersheds where native vegetation has been removed and soils disturbed, runoff can be loaded with nutrients and eroded soil. This has obvious deleterious effects on lake water quality.

One difficulty in analyzing Indiana lake data is that the data are not at the same scale. Chemistry and biology data are available at the lake level. Morphology data are generally available at the lake level but they are incomplete because lake volumes are not measured for all Indiana lakes. The watershed is an ideal unit for geology, topography, and land use data but this information is largely available only at the county level. The more widespread use of geographic information systems (GIS) is helping to make these watershed-level data more available. A goal for future work should be to develop watershed-level data for lake basins.

REFERENCES CITED

Carlson, R.E. 1977. A trophic state index for lakes. Limnology and Oceanography, 2(2):361-369.

Olem, H. And G. Flock, eds. 1990. Lake and Reservoir Restoration Guidance Manual. 2nd edition. EPA 440/4-90-006. Prep. By North American lake management Society for U.S. Environmental Protection Agency, Washington, D.C.

Wetzel, R.G. 2001. Limnology – Lake and River Ecosystems, Third Edition. Academic Press, San Diego.

APPENDIX A:

Useful Metric Equivalents and Conversions

Metric Prefix[a]	**Value**		**Scientific Notation**
nanogram (ng)	0.000000001	grams	10^{-9} grams
microgram (µg)	0.000001	grams	10^{-6} grams
milligram (mg)	0.001	grams	10^{-3} grams
centigram (cg)	0.01	grams	10^{-2} grams
decigram (dg)	0.1	grams	10^{-1} grams
gram (g)	1.0	gram	10^{1} grams
kilogram (kg)	1000.0	grams	10^{3} grams

----

[a]also applies to metric volumes, for example milliliters, liters, etc.

Conversions/Equivalents

1 kg	=	2.205 lb
1 ton	=	2000 lb
1 meter	=	3.28 ft
1 mile	=	5280 ft
1 gal	=	3.785 liters
1 ft^3	=	28.3 liters
1 m^3	=	1000 liters
1 m^3	=	35.3 ft^3
1 acre	=	43,560 ft^2
1 hectare	=	10,000 m^2
1 hectare	=	2.47 acres

APPENDIX B:

Raw Water Quality Data for Lakes Sampled Between 1989 and 1993

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Airline Pit	Greene	13-Aug-96	8.7	44.0	41.0	100	99
Allen	Kosciusko	02-Aug-94	2.3	40	12	104	39
Appleman	LaGrange	25-Aug-97	2.3	31.0	15.0	81	67
Arnold's Creek Embay	Ohio	15-Jul-96	0.1	0.0	1.5	50	100
Arnolds Pit	Whitley	28-Jul-98	0.4	1.0	2.75	166	50
Axel	Noble	09-Aug-94	3.7	54	18	78	100
Backwater	Kosciusko	15-Aug-94	1.0	25	1.5	127	100
Backwaters	Koscuisko	29-Jun-98	1.6	37.7	12.30	1	50
Ball	Steuben	04-Aug-97	0.9	25.0	10.0	148	33
Banning	Kosciusko	09-Aug-94	1.5	12	11.5	65	100
Banning	Kosciusko	06-Jul-98	1.4	45.0	12.25	103	75
Barrel and 1/2	Kosciusko	02-Aug-94	2.4	45	14	109	32
Bartley	Noble	06-Jul-94	1.4	33	11	131	46
Barton	Steuben	29-Jul-97	3.5	48.0	29.0	114	88
Bass	Starke	07-Aug-95	0.6	28.0	9.0	0	0
Bass	Sullivan	19-Aug-96	1.2	47.5	14.0	100	63
Bass (N. Chain)	St. Joseph	24-Jul-95	3.2	20.0	20.0	0	0
Bass Lake	Steuben	05-Aug-97	3.1	50.0	16.0	81	83
Baugher	Noble	19-Jul-94	1.2	37	9.5	132	45
Baugher	Noble	27-Jul-98	0.8	20.0	8.25	63	30
Bear Creek	Brown	19-Aug-96	4.3	19.0	15.4	13	100
Beaver Creek Res.	Dubois	23-Jul-96	0.9	16.0	7.3	110	50
Beaver Dam	Kosciusko	22-Aug-94	1.0	17	11	110	25
Beaver Dam	Kosciusko	10-Aug-98	0.7	20.0	7.25	136	22
Beaver Dam (Greene)	Greene	14-Jul-97	4.1	70.0	20.5	97	100
Beaver Dam (Steuben)	Steuben	19-Aug-97	3.4	46.0	18.0	76	75
Beigh	Kosciusko	06-Jul-95	0.7	8.0	5.0	94	50
Benefiel	Sullivan	20-Aug-96	8.0	64.0	29.5	98	100
Between-the lakes Channel	Kosciusko	14-Aug-96	1.4	26.0			100
Big	Noble	18-Jul-94	2.8	38	15	115	60
Big	Noble	13-Jul-98	2.2	28.0	13.25	139	52
Big Barbee	Kosciusko	09-Aug-94	1.1	16	12.5	83	40
Big Barbee	Kosciusko	06-Jul-98	1.3	34.0	13.5	96	46
Big Cedar	Whitley	14-Aug-95	5.7	76.0	30.0	0	0
Big Cedar	Whitley	14-Jul-98	4.6	62.0	35.75	111	91
Big Chapman	Kosciusko	15-Aug-94	2.7	54	23	95	85
Big Chapman	Koscuisko	30-Jun-98	3.1	55.6	20.30	106	64
Big Long	LaGrange	26-Aug-97	4.2	60.0	30.0	88	36
Big Otter	Steuben	29-Jul-97	2.4	40.0	18.0	126	75
Big Turkey	Steuben	25-Aug-97	1.2	27.0	12.0	97	40
Bischoff Res	Ripley	09-Jul-96	0.5	12.0	5.5	101	63
Black	Whitley	26-Jul-94	0.5	20	4	106	27

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
7.4	924.2	0.022	2.979	13.640	0.409	0.620	0.2	274	83
7.8	192.5	0.022	1.297	1.793	0.227	0.284	0.7	39830	74.2
7.6	158.4	0.022	1.211	3.100	0.422	0.473	20.0	43485	24.0
7.7	176.2	0.367	0.291	1.183	0.101	0.373	21.1	43794	88
7.8	249.5	0.619	2.673	4.505	0.229	0.485	158.9	43157	64.93%
8.0	184.3	0.025	0.020	0.382	0.001	0.038	2.0	5125	40.7
8.0	216.1	0.050	0.018	0.455	0.005	0.068	32.1	12955	5.7
7.5	200.9	0.059	0.098	1.006	0.072	0.095	14.6	7501	24.56%
8.1	185.8	1.137	0.429	1.379	0.121	0.260	11.2	50781	94.0
7.7	148.9	0.022	0.051	0.556	0.001	0.042	7.5	5011	72.5
7.9	144.6	0.022	0.018	0.782	0.003	0.063	13.0	11951	90.26%
7.9	223.3	0.022	1.961	2.089	0.524	0.644	1.8	79664	95.0
7.9	205.7	0.151	0.626	0.869	0.033	0.096	21.5	58401	20.1
7.8	161.8	0.047	0.263	0.727	0.003	0.094	1.4	1476	32.2
8.0	85.0	0.022	0.289	2.422	0.015	0.075	6.1	24384	23.7
8.0	166.7	0.034	1.489	1.795	0.327	0.276	0.1	8366	93
7.8	125.5	0.022	0.060	0.796	0.005	0.036	2.1	4396	74.6
7.3	103.6	0.050	0.018	0.729	0.001	0.063	1.9	4029	34.8
8.0	209.0	0.022	1.763	1.456	0.345	0.412	11.3	51224	63.2
7.5	191.3	0.105	1.599	2.718	0.424	0.482	36.9	51072	80.85%
7.4	32.6	0.052	0.019	0.269	0.005	0.024	1.0	7251	25
8.0	55.7	0.022	1.079	1.752	0.228	0.225	23.1	15525	86
8.0	166.2	0.022	1.971	2.488	0.297	0.313	11.6	9188	58.1
8.2	150.6	0.022	2.187	3.718	0.256	0.287	37.3	64028	86.75%
7.4	379.4	0.022	3.532	4.383	0.325		0.1	11263	0.1
7.9	206.6	0.269	0.416	1.000	0.005	0.028	1.6	2534	44.2
7.5	169.0	0.034	1.083	2.834	0.421	0.385	7.6	200192	96.2
7.2	403.4	0.046	2.613	2.706	0.005	0.056	0.5	6068	11
8.0	174.5	0.023	0.021	1.476	0.005	0.022	3.3	4341	66
8.2	160.8	0.430	0.211	0.427	0.118	0.166	7.7	19512	69.4
8.1	159.1	0.329	0.433	1.483	0.214	0.243	7.8	33843	93.86%
7.9	208.0	0.022	1.218	1.556	0.206	0.272	7.8	28119	65.5
7.9	207.5	0.178	0.654	0.999	0.229	0.232	10.2	14647	89.21%
7.8	153.8	0.022	0.393	0.703	0.168	0.172	0.7	7226	35.9
7.9	150.0	0.022	0.225	0.355	0.066	0.074	2.0	1621	30.60%
8.0	152.5	0.022	0.260	0.744	0.000	0.034	3.2	8603	32.0
7.9	144.8	0.022	0.163	0.429	0.003	0.020	2.6	17944	16.23%
7.8	133.3	0.022	0.191	1.150	0.098	0.103	1.7	1741	57.4
8.0	224.6	0.040	0.513	1.762	0.095	0.243	4.8	14673	82.0
8.0	217.5	0.213	1.312	2.100	0.133	0.148	9.6	50667	71.7
7.8	64.3	0.087	0.794	1.408	0.208	0.230		27414	64
8.1	174.3	0.416	2.010	2.190	0.378	0.473	55.2	218925	76.9

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Black	Whitley	27-Jul-98	0.5	5.0	4.5	135	30
Black Pond	Kosciusko	23-Aug-94	0.5	0	1.7	90	100
Blue	Whitley	14-Aug-95	1.4	30.0	15.0	0	0
Blue	Whitley	14-Jul-98	1.9	43.0	18.5	121	46
Boner	Kosciusko	01-Aug-94	3.2	53	18	100	90
Boone's Pond	Boone	22-Aug-95	2.8	70.0	26.5	0	0
Booth	Steuben	18-Aug-97	2.1	31.0	14.0	55	93
Bowen	Noble	12-Jul-94	3.1	60	17	101	38
Bower	Steuben	05-Aug-97	1.5	25.0	10.0	131	43
Bristol	Noble	18-Jul-94	1.7	22	10	137	100
Brookville Res	Union	09-Jul-96	2.6	48.0	18.0	95	96
Bruce	Fulton	08-Aug-95	0.5	17.0	7.5	0	0
Bruce	Fulton	11-Aug-98	0.5	8.0	5	131	33
Brush Creek	Jennings	16-Jul-96	0.6	18.0	7.5	78	80
Bryant's Creek	Monroe	19-Aug-96	3.2	25.7	12.0	104	100
Bryants Creek Embay	Switzerland	15-Jul-96	0.3	0.0	2.0	51	100
Buck	Steuben	11-Aug-97	2.4	30.0	11.0	76	36
Bushong	Noble	09-Aug-94	0.8	10	6	142	100
Caldwell	Kosciusko	23-Aug-94	1.7	19	11	117	64
Caldwell	Kosciusko	28-Jul-98	1.1	17.6	8.25	141	27
Canvasback	Sullivan	07-Jul-97	3.6	58.0	45.0	96	100
Carr	Kosciusko	23-Aug-94	1.5	14	10	96	43
Cataract (Leiber)	Putnam	22-Jul-97	1.9	27.5	15.5	107	46
Cedar	Lake	10-Jul-95	0.3	1.0	3.0	105	100
Cedarville Res	Allen	15-Aug-95	0.4	3.0	3.5	0	0
Celina	Perry	22-Jul-96	3.1	33.0	18.0	97	88
Center	Kosciusko	16-Aug-94	2.2	45	19	94	53
Center	Koscuisko	29-Jun-98	1.9	42.3	13.90	129	36
Cherry	Monroe	19-Aug-96	2.2	21.8	12.1	109	100
Chrisney	Spencer	23-Jul-96	0.7	7.0	5.0	78	67
Cicott	Cass	21-Aug-95	2.3	43.0	18.5	0	0
Cicott	Cass	17-Aug-98	2.1	35.0	10	73	13
Clair	Huntington	15-Aug-95	2.5	77.0	23.0	0	0
Clair	Huntington	18-Aug-98	1.6	36.0	13.5	154	33
Clear	LaPorte	31-Jul-95	3.5	45.0	16.0	0	0
Clear	Greene	01-Jul-97	2.6	66.0	16.0	77	86
Clear (LaPorte City)	LaPorte	18-Jul-95	2.0	55.0	11.8	0	0
Clear	Steuben	28-Jul-97	4.4	61.0	40.0	106	97
Cline	Lagrange	08-Aug-94	1.4	43	19.5	67	100
Cook	Marshall	31-Jul-95	0.7	10.0	5.8	0	0
Corky	Greene	13-Aug-96	2.7	58.0	31.0	101	100
Crane	Noble	18-Jul-94	1.3	25	9	191	100

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
8.0	169.1	0.662	1.736	3.404	0.435	0.541	95.0	539143	98.41%
9.1	81.0	0.022	0.023	0.854	0.002	0.053	5.9	8380	70.8
8.1	184.5	0.022	0.736	1.404	0.267	0.298	0.9	10509	70.9
8.0	151.1	0.022	0.477	1.005	0.222	0.244	3.5	5144	57.85%
8.1	146.0	0.022	0.018	0.598	0.003	0.036	0.8	21021	59.7
8.3	118.0	0.022	0.018	0.537	0.005	0.040	1.7	1448	42.9
7.4	168.5	0.022	0.728	1.500	0.189	0.225	3.3	13149	3.9
8.0	222.4	0.031	1.797	2.945	0.537	0.401	3.6	39347	74.9
7.9	281.1	0.624	1.382	1.274	0.234	0.331	24.4	16502	18.9
8.1	214.0	1.385	0.697	0.549	0.331	0.336	4.0	57107	67.0
8.0	153.9	2.939	0.023	0.260	0.052	0.064	1.5	16681	96
8.0	183.0	0.022	3.655	2.428	0.086	0.130	23.8	13778	41.5
7.9	191.1	0.022	0.672	5.124	0.033	0.117	38.9	92476	77.73%
7.7	100.9	0.030	1.349	1.895	0.205	0.245	10.1	9490	81
8.6	50.0	0.046	0.018	0.257	0.006	0.022	1.0	16637	70
7.6	114.5	0.085	0.083	0.718	0.029	0.272	51.6	1348	41
7.5	238.8	0.023	1.761	2.750	0.409	0.468	5.6	39984	46.8
8.0	250.0	0.022	1.853	2.398	0.325	0.431	37.2	52722	95.2
8.0	203.9	0.022	0.576	1.380	0.005	0.056	7.0	200547	94.8
8.0	196.2	0.028	1.254	2.517	0.260	0.335	37.7	48975	86.62%
7.4	445.6	0.075	0.443	0.552	0.006	0.039	0.9	80	11.2
7.9	208.5	0.022	1.846	2.783	0.453	0.460	8.3	63271	84.8
7.9	140.8	2.426	0.358	0.908	0.008	0.088	5.2	1557	30.8
8.7	91.8	0.022	0.029	2.512	0.007	0.171	65.1	119051	95.3
8.2	187.5	0.397	0.087	1.283	0.027	0.165	29.2	7571	28.6
7.4	36.1	0.102	0.086	0.309	0.007	0.033	0.7	1206	74
8.0	173.8	0.022	0.670	1.057	0.108	0.123	8.9	11568	33.8
8.0	156.9	0.022	0.062	0.496	0.010	0.026	8.6	1720	22.91%
7.9	74.2	0.046	0.018	0.372	0.006	0.018	0.6	1681	15
7.5	92.8	0.022	0.917	1.413	0.006	0.060	3.4	5838	57
8.1	131.0	0.022	0.880	1.499	0.090	0.132	0.4	5082	62.7
7.2	128.6	0.022	0.878	1.418	0.108	0.125	2.8	31378	76.33%
8.1	198.3	0.357	0.265	0.631	0.013	0.036	2.5	519	17.5
8.2	181.0	1.251	0.704	1.368	0.107	0.137	16.7	13566	30.87%
7.4	46.0	0.024	0.436	1.305	0.005	0.076	2.0	7272	71.1
7.6	108.5	0.022	0.013	0.350	0.003	0.039	4.6	8184	44.3
8.7	49.3	0.030	0.018	0.628	0.007	0.036	4.9	10727	14.0
7.9	127.7	0.161	0.058	0.497	0.039	0.048	1.8	1838	77.0
8.2	218.5	0.592	0.175	0.518	0.002	0.025	0.1	1100	77.5
7.6	178.5	0.022	1.438	2.771	0.270	0.295	45.8	543219	93.2
7.1	216.0	0.022	0.357	0.583	0.006	0.009	0.4	298	63
8.3	199.0	1.015	1.309	2.637	0.665	0.534	60.9	184095	7.7

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Crane	Noble	13-Jul-98	0.6	13.0	5.25	92	22
Crooked	Whitley	26-Jul-94	4.5	50	36	103	85
Crooked	Steuben	18-Aug-97	1.7	49.0	19.0	99	36
Crooked	Whitley	13-Jul-98	7.8	92.0	42.75	113	97
Crooked Creek	Brown	20-Aug-96	3.4	13.3	14.8	90	100
Crosley	Jennings	16-Jul-96	1.6	36.0	10.0	93	86
Crystal	Kosciusko	16-Aug-94	3.3	72	23	94	65
Crystal	Greene	14-Jul-97	0.7	25.0	8.5	24	31
Crystal	Kosciusko	28-Jul-98	2.4	55.0	23	106	80
Dale Reservoir	Spencer	23-Jul-96	0.6	9.0	5.0	44	60
Deam	Clark	22-Jul-96	2.3	43.0	16.0	92	89
Decatur Co. Cons. Club	Decatur	16-Jul-96	0.7	10.0	6.0	41	71
Deer Creek	Perry	23-Jul-96	0.4	5.5	4.5	64	100
Dewart	Whitley	01-Aug-94	2.3	40	20	108	37
Diamond	Kosciusko	21-Jul-98	0.6	18.0	8.25	192	50
Dipper	St. Joseph	24-Jul-95	0.8	18.0	4.5	0	0
Dixon	Marshall	01-Aug-95	1.2	14.0	9.0	0	0
Dock	Noble	12-Jul-94	1.1	26	9	126	70
Dogwood (Glendale)	Daviess	12-Aug-96	4.0	54.0	17.0	109	58
Dollar	Lagrange	08-Aug-94	2.4	25	11	86	100
Downing	Sullivan	19-Aug-96	6.7	57.0	27.0	109	100
Duck	Sullivan	19-Aug-96	4.5	47.0	26.0	92	83
Dunten	Dekalb	05-Jul-94	0.9	15	6.5	94	29
Eagle Creek Res.	Marion	22-Aug-95	0.5	9.5	5.5	0	0
Eliza	Porter	10-Jul-95	0.4	9.0	4.5	134	50
Eve	Lagrange	08-Aug-94	2.5	58	24	92	100
Everett	Allen	27-Jul-98	2.2	33.0	11.25	107	67
Failing	Steuben	18-Aug-97	3.4	47.0	23.0	97	71
Fancher	Lake	31-Jul-95	3.6	50.0	26.4	0	0
Ferdinand Forest	Dubois	29-Jul-96	2.0	22.0	10.0	112	88
Ferdinand New	Dubois	29-Jul-96	1.0	8.5	5.0	145	83
Ferdinand Old	Dubois	29-Jul-96	2.9	28.0	13.0	97	86
Finster	Noble	22-Aug-94	3.0	45	20	97	100
Fish	Steuben	28-Jul-97	1.5	33.0	9.0	101	50
Flat	Marshall	01-Aug-95	1.4	14.0	7.5	0	0
Fletcher	Fulton	17-Aug-98	2.0	60.0	14.75	116	50
Flint	Porter	11-Jul-95	3.9	62.5	26.0	110	29
Fowler Parke	Vigo	15-Jul-97	0.7	35.0	11.5	92	1
Fox	Steuben	11-Aug-97	3.5	45.0	46.0	100	53
France Park	Cass	21-Aug-95	3.7	45.0	0.0	0	0
Frank	Greene	30-Jun-97	2.4	32.0	22.0	132	63
Freeman	Carroll	22-Aug-95	0.7	16.0	7.5	0	0

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
8.1	175.1	0.543	1.221	3.190	0.435	0.496	28.0	288762	95.21%
8.0	134.5	0.066	0.204	0.269	0.103	0.142	2.4	7183	21.9
7.9	149.7	0.022	0.679	1.400	0.056	0.073	3.8	6067	66.5
8.0	136.3	0.077	0.222	0.417	0.092	0.123	1.2	6346	94.71%
7.1	24.4	0.046	0.018	0.512	0.006	0.037	1.5	6450	78
7.9	86.2	0.059	0.500	0.769	0.005	0.046	5.3	7308	42
7.9	196.9	0.026	1.515	2.146	0.009	0.032	1.9	2238	41.4
7.2	539.7	0.022	5.105	0.560	0.202	0.130	0.8	8076	77.0
7.9	198.8	0.067	1.343	2.261	0.010	0.060	2.0	2319	38.55%
8.3	85.3	0.033	0.018	3.016	2.070	0.215	9.1	10027	82
6.5	20.1	0.022	0.150	0.360	0.005	0.045	3.4	2958	58
8.2	115.2	0.039	2.892	4.025	0.682	0.798	75.9	82911	94
7.5	102.6	1.315	0.023	0.502	0.061	0.120		6932	93
8.2	149.0	0.022	0.392	0.455	0.038	0.056	1.0	7213	70.3
8.3	168.1	0.485	1.598	2.482	0.294	0.392	82.5	10082	81.07%
6.7	137.5	0.052	0.084	2.861	0.029	0.225	230.9	31966	47.9
8.4	156.5	0.022	0.018	0.940	0.005	0.050	12.5	12582	71.2
8.1	182.5	0.056	0.197	0.498	0.055	0.130	34.6	119183	88.7
7.9	66.0	0.022	0.459	0.842	0.022	0.054	2.7	8669	83
7.4	48.8	0.030	2.258	3.159	0.154	0.226	4.7	14685	84.6
7.3	368.7	0.046	0.090	0.842	0.012	0.067	0.6	1533	5
8.3	101.4	0.049	0.458	0.790	0.011	0.038	0.3	4302	91
8.1	158.6	0.022	2.126	2.305	0.455	0.535	43.3	3249	56.0
8.3	144.3	0.194	1.433	2.408	0.111	0.175	13.6	5305	27.0
7.9	117.5	0.022	0.352	1.708	0.176	0.236	58.1	21479	70.1
8.1	168.0	0.022	0.654	1.038	0.002	0.054	1.3	3750	40.6
7.9	177.3	0.022	1.687	3.028	0.359	0.376	5.7	32650	92.52%
7.9	202.5	0.022	0.563	1.100	0.072	0.180	2.4	914	81.0
7.9	115.5	0.022	0.202	0.615	0.029	0.063	0.9	13520	72.0
7.6	48.1	0.022	0.985	1.777	0.027	0.088	5.4	146088	98
8.2	56.7	0.689	0.239	1.324	0.012	0.079	42.6	136907	5
7.4	54.7	0.030	0.031	0.839	0.007	0.061	2.0	55085	57
7.4	305.2	0.022	11.248	13.682	0.530	0.674	3.0	892	25.4
7.7	188.9	0.029	1.407	2.700	0.188	0.243	10.3	60200	66.6
7.8	188.3	0.022	0.731	1.498	0.129	0.180	12.3	76898	19.9
8.9	97.8	0.022	0.020	0.787	0.182	0.018	5.1	27037	95.13%
7.8	107.5	0.022	0.442	1.130	0.160	0.174	2.7	3573	34.5
7.9	273.1	0.161	0.240	0.953	0.001	0.036	6.5	1858	10.8
8.0	167.4	0.023	0.666	1.250	0.054	0.073	2.0	2323	90.4
8.5	107.5	0.079	0.018	0.179	0.005	0.010	1.4	1039	45.2
7.3	602.1	0.022	3.910	5.317	0.124	0.391	2.2	1279	7.3
8.0	184.0	0.065	0.868	1.786	0.124	0.224	31.8	13577	55.6

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Freeman	Carroll	17-Aug-98	1.1	11.0	6.5	150	100
Gage	Steuben	18-Aug-97	3.6	40.0	33.0	105	67
Gambill	Sullivan	19-Aug-96	9.2	57.0	38.0	98	100
Geist Res	Marion	08-Jul-96	0.8	25.0	11.0	121	75
George	Steuben	28-Jul-97	4.0	43.0	29.0	104	57
George (Hammond)	Lake	10-Jul-95	0.6	0.0	2.5		100
George (Hobart)	Lake	11-Jul-95	0.4	2.0	3.0	86	100
Georgetown Res.	Floyd	22-Jul-96	3.1	42.0	18.5	92	100
Gibson	Gibson	05-Aug-96	0.6	15.0	7.0	146	100
Gilbert	Marshall	01-Aug-95	0.9	29.0	11.5	157	50
Gilbert	Noble	20-Jul-98	3.7	82.0	28	110	89
Glen Flint	Putnam	22-Jul-97	2.6	67.0	19.5	110	55
Golden	Steuben	05-Aug-97	1.3	23.0	12.0	130	44
Goose	Whitley	26-Jul-94	1.1	34	11	117	22
Goose	Kosciusko	16-Aug-94	3.7	48	19	100	56
Goose	Whitley	20-Jul-98	2.2	49.0	12.75	136	32
Goose	Kosciusko	28-Jul-98	3.0	48.0	17.75	108	42
Goose (Dugger)	Sullivan	12-Aug-96	6.5	47.0	30.0	114	100
Goose (Minnehaha)	Sullivan	26-Aug-96	0.8	27.0	10.0	94	100
Goshen Pond	Elkhart	07-Aug-95	0.6	12.0	5.5	0	0
Grannis	Noble	19-Jul-94	2.2	65	17.5	120	86
Graveyard	Sullivan	20-Aug-96	2.6	57.0	5.8	97	47
Green	Noble	25-Jul-94	0.9	3	3.5	14	35
Green	LaGrange	25-Aug-97	2.0	27.0	8.0	92	100
Green Valley	Vigo	21-Jul-97	0.6	21.0	6.5	14	50
Greensburg	Decatur	19-Aug-96	0.6	3.3	4.3		50
Greenwood (Crane)	Martin	12-Aug-96	2.3	38.0	18.0	99	57
Griffy	Monroe	22-Jul-97	5.0	52.0	27.5	101	78
Grouse Ridge	Bartholomew	16-Jul-96	2.0	38.0	13.0	119	89
Hale	Sullivan	20-Aug-96	2.5	55.0	14.0	100	67
Hamilton	Steuben	04-Aug-97	1.3	40.0	15.0	98	32
Hammond	Whitley	02-Aug-94	2.0	33	11	112	49
Hartz	Starke	07-Aug-95	2.9	31.0	16.0	0	0
Hartz	Starke	11-Aug-98	2.9	55.0	16.5	89	66
Heaton	Elkhart	05-Jul-95	1.6	37.0	13.0	107	67
Henry	Steuben	25-Aug-97	0.9	16.0	6.0	90	67
Hill	Kosciusko	23-Aug-94	2.9	28	19.5	110	69
Hill	Kosciusko	21-Jul-98	1.5	46.0	15.5	119	67
Hoffman	Kosciusko	16-Aug-94	1.4	40	12	135	66
Hoffman	Kosciusko	28-Jul-98	1.3	35.0	13.5	124	56
Hog	Steuben	29-Jul-97	2.8	60.0	20.0	123	75
Hogback	Steuben	05-Aug-97	1.2	35.0	10.5	129	71

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m$_3$)	Total Plankton	Blue-greens %
8.2	188.4	1.622	0.108	1.032	0.035	0.097	28.9	13103	0.2
7.9	158.4	0.089	0.590	1.000	0.006	0.015	1.6	745	51.9
7.2	151.0	0.060	0.105	0.344	0.005	0.022	0.2	602	23.0
7.9	191.2	2.112	0.182	0.677	0.005	0.047	9.9	5162	18.0
7.8	148.9	0.032	0.370	0.877	0.013	0.030	2.0	1126	16.7
8.2	160.0	0.022	0.151	1.567	0.016	0.049	23.7	29925	64.0
7.8	209.0	0.221	0.033	1.906	0.006	0.173	65.2	14569	39.8
7.7	142.1	0.023	0.018	0.659	0.005	0.067	1.6	11852	71.0
8.8	101.1	0.022	0.054	1.030	0.005	0.064	6.4	29932	84.0
8.3	169.0	0.022	3.657	5.329	0.547	0.688	11.3	5348	86.7
7.8	185.7	0.022	0.544	1.167	0.000	0.031	2.5	675	0.2
8.0	143.3	0.522	0.563	1.137	0.056	0.119	1.7	10781	49.7
7.8	271.3	0.563	1.458	2.579	0.193	0.267	11.3	18312	41.7
8.1	143.7	0.022	0.856	0.635	0.273	0.324	11.1	10114	83.1
7.8	160.5	0.026	1.549	2.237	0.192	0.255	2.0	9312	81.6
8.0	130.6	0.022	0.398	1.579	0.182	0.215	8.1	50577	0.8
7.9	162.7	0.022	0.806	1.008	0.164	0.225	0.3	85422	0.8
7.8	154.5	0.022	0.018	0.245	0.005	0.022		1094	32.0
8.0	141.4	0.022	1.078	1.906	0.224	0.425	7.2	6936	73.0
7.9	206.0	1.288	0.087	0.953	0.042	0.120	16.7	13008	67.0
8.2	199.0	0.022	0.156	0.262	0.002	0.072	4.1	18855	36.0
7.5	349.5	0.203	1.039	5.229	0.005	0.048	0.3	5133	91.0
7.9	163.8	0.666	0.492	2.206	0.165	0.252	30.3	503176	2.6
7.3	133.9	0.022	0.044	1.600	0.002	0.015	5.6	2554	54.7
8.3	90.6	0.022	0.260	1.274	0.007	0.053	34.9	56049	93.5
8.9	152.2	0.046	0.128	3.488	0.873	1.196	74.1	82911	94.0
6.9	26.0	0.022	0.280	0.429	0.005	0.024	1.3	14028	11.0
7.8	114.4	0.163	0.098	0.436	0.002	0.062	0.9	6726	14.6
8.0	69.3	0.030	0.361	0.657	0.027	0.054	3.4	17377	89.0
7.3	682.9	0.046	1.389	7.158	0.376	0.609		1235	66.0
7.8	161.6	0.059	0.891	1.373	0.262	0.340	9.0	3977	20.1
7.7	202.0	0.022	1.298	1.373	0.233	0.288	2.8	31822	79.3
7.5	114.3	0.022	0.811	2.045	0.027	0.096	0.0	12354	84.4
7.3	114.6	0.022	0.810	1.686	0.008	0.056	6.4	11938	0.4
7.5	218.0	0.022	0.134	0.702	0.006	0.039	7.8	29387	59.7
7.9	273.6	0.728	1.214	2.650	0.124	0.180	39.5	244940	68.4
7.9	171.8	0.022	1.527	1.858	0.058	0.086	4.7	7053	83.3
8.0	159.8	0.022	0.890	1.641	0.042	0.095	3.3	7597	0.6
8.0	223.1	0.595	1.159	1.797	0.026	0.068	7.4	8725	37.1
7.9	207.9	0.819	0.970	1.581	0.007	0.049	9.8	2666	0.6
7.9	170.3	0.146	0.313	0.960	0.003	0.026	2.6	1763	27.7
7.9	270.6	0.419	1.955	3.300	0.335	0.385	13.5	102215	73.2

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Holem	Marshall	31-Jul-95	3.2	25.0	17.0	0	0
Holland 1	Dubois	29-Jul-96	0.3	0.0	2.5	5	57
Holland 2	Dubois	29-Jul-96	0.6	13.0	6.0	108	100
Hominy Ridge	Wabash	15-Aug-95	2.3	53.0	12.5	0	0
Horseshoe	Noble	20-Jul-98	1.8	42.0	12.25	91	75
Hovey	Posey	05-Aug-96	0.3	1.0	3.0	40	100
Hudson	LaPorte	17-Jul-95	4.1	90.0	26.5	0	0
Huntingburg City	Dubios	29-Jul-96	1.0	20.0	10.0	96	63
Huntington	Huntington	18-Aug-98	0.7	12.0	6	72	45
Huntington Res	Huntington	15-Aug-95	0.5	6.0	4.0	0	0
Indian	Dekalb	05-Jul-94	1.3	35	12	116	33
Indian (Ligonier)	Noble	09-Aug-94	1.8	28	12	103	100
Indiana	Elkhart	05-Jul-95	2.6	52.0	32.0	99	90
Irish	Kosciusko	09-Aug-94	1.0	13	11.5	84	63
Irish	Kosciusko	06-Jul-98	1.3	35.0	13.25	119	56
Island	Sullivan	26-Aug-96	1.4	37.0	23.0	103	100
James	Kosciusko	08-Aug-94	1.4	18	14	104	36
James	Kosciusko	14-Aug-96	2.2	23.0	15.0	102	22
James	Steuben	12-Aug-97	3.7	50.0	33.0	94	63
James	Koscuisko	30-Jun-98	2.2	45.7	15.24	96	33
JCMurphy	Newton	10-Jul-95	0.4	3.0	3.5	101	100
Jimmerson	Steuben	12-Aug-97	3.4	42.0	28.0	88	67
John Hay	Washington	30-Jul-96	3.9	55.0	19.5	110	100
Keister	Noble	09-Aug-94	1.7	26	9	125	100
Kickapoo	Sullivan	08-Jul-97	3.4	60.0	23.0	108	62
Kings	Fulton	08-Aug-95	1.9	40.0	9.5	0	0
Kings	Fulton	11-Aug-98	1.3	19.0	8	7	38
Kiser	Kosciusko	15-Aug-94	1.7	33	13	83	82
Kiser	Kosciusko	29-Jun-98	2.9	53.8	19.23	66	83
Knightstown	Henry	02-Jul-96	0.6	21.0	6.8	164	71
Knop	Carroll	22-Aug-95	0.3	4.0	3.8	0	0
Koontz	Marshall	25-Jul-95	0.7	20.0	9.0	0	0
Kreighbaum	Marshall	31-Jul-95	3.0	24.0	18.0	0	0
Kuhn	Kosciusko	09-Aug-94	1.9	11	18	93	100
Kuhn	Kosciusko	06-Jul-98	2.7	40.0	20.5	100	75
Kunkel	Wells	01-Jul-96	0.5	8.0	5.0	51	67
Lake of the Woods	Marshall	25-Jul-95	1.1	23.0	8.5	0	0
Lake of the Woods	LaGrange	26-Aug-97	1.7	30.0	13.0	121	28
Langenbaum	Starke	08-Aug-95	1.6	43.0	10.0	0	0
Langenbaum	Starke	11-Aug-98	1.2	17.0	8.5	67	75
Larwill	Whitley	26-Jul-94	1.6	43	8.5	78	22
Larwill	Whitley	21-Jul-98	1.6	42.0	12	141	40

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
7.4	200.0	0.022	1.168	2.032	0.040	0.089	2.3	24705	79.5
8.5	100.5	0.022	1.210	2.872	0.257	0.267	67.1	149803	94.0
8.3	71.0	0.022	0.136	1.071	0.005	0.115	25.9	76903	92.0
7.9	118.5	0.303	0.401	1.345	0.026	0.140	2.6	11151	11.7
7.7	237.3	0.022	1.019	1.839	0.204	0.227	9.0	40634	0.8
7.8	150.3	0.138	0.202	1.584	0.005	0.217	28.1	10370	42.0
8.0	139.3	0.022	0.163	0.870	0.008	0.035	3.4	7408	71.7
7.4	36.1	0.022	0.118	0.737	0.005	0.051	8.0	5622	66.0
7.7	106.8	0.222	0.207	1.271	0.277	0.205	38.5	2672	0.4
7.6	103.8	2.161	0.086	1.738	0.264	0.327	0.2	3140	47.0
7.8	192.4	0.022	0.273	0.259	0.007	0.069	6.4	9864	73.2
7.9	178.5	0.063	0.083	0.579	0.002	0.033	5.2	3156	7.9
7.2	170.5	0.319	0.649	1.060	0.015	0.021	0.5	1421	49.9
7.9	190.8	0.022	1.024	1.234	0.054	0.098	10.5	50971	76.8
8.0	186.6	0.092	0.546	1.203	0.004	0.027	9.4	11062	0.8
7.6	415.8	0.022	1.012	1.290	0.005	0.019	2.8	530	50.0
8.0	190.5	0.022	0.018	1.094	0.065	0.080	2.9	2920	84.6
7.7	176.0	0.039	0.922	1.492	0.084	0.098	7.3	7318	69.7
7.9	183.6	0.023	0.291	0.850	0.007	0.015	2.2	1223	63.8
7.8	178.0	0.116	0.631	1.000	0.119	0.122	7.2	7809	0.9
7.0	131.0	0.022	0.021	2.023	0.015	0.137	70.4	258580	92.7
7.9	188.1	0.026	0.722	1.400	0.010	0.028	1.9	1353	59.3
7.9	119.5	0.022	0.151	0.695	0.005	0.054	4.0	14817	87.0
7.8	233.1	0.022	2.890	4.277	0.529	0.555	6.4	16203	50.4
7.9	80.8	0.022	0.466	0.782	0.041	0.041	2.3	15226	77.0
7.2	151.5	0.022	1.709	3.509	0.612	0.929	3.1	2015	63.0
7.0	142.7	0.056	1.700	2.978	0.540	0.767	5.4	11211	0.9
7.9	238.0	0.022	0.048	0.303	0.003	0.028	5.4	4070	51.3
7.7	230.0	0.022	0.038	0.741	0.003	0.026	3.0	3204	0.2
7.9	256.1	4.829	0.712	1.092	0.013	0.056	2.6	3020	45.0
8.4	109.3	3.459	0.329	2.213	0.016	0.226	31.4	8997	34.4
7.8	158.0	0.022	0.785	1.579	0.011	0.045	20.1	106357	48.3
7.7	178.0	0.022	1.127	2.182	0.174	0.207	3.7	28018	85.0
8.1	180.5	0.022	0.073	0.230	0.002	0.030	1.8	4887	72.3
7.9	189.3	0.022	0.110	0.446	0.004	0.040	8.1	1022	0.9
8.0	85.9	0.032	0.528	1.691	0.137	0.225	70.4	412056	98.0
7.9	344.5	0.366	0.018	2.791	0.131	0.170	28.0	35864	95.9
8.0	172.5	0.529	0.712	1.900	0.120	0.153	18.1	406370	92.1
7.3	155.8	0.031	0.098	1.205	0.008	0.084	3.9	6111	14.1
7.3	134.3	0.022	0.022	1.048	0.001	0.048	41.4	3014	0.6
7.6	177.4	0.022	0.979	1.465	0.139	0.166	13.2	187272	91.2
8.0	173.9	0.410	1.121	1.927	0.136	0.197	9.7	42285	0.9

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Lawrence	Marshall	31-Jul-95	3.4	25.0	21.0	0	0
Lemon	Monroe	27-Aug-96	0.7	27.0	9.0	84	67
Lenape	Greene	08-Jul-97	0.8	21.0	8.0	138	43
Lilly	LaPorte	17-Jul-95	2.4	68.0	5.3	0	0
Lime (Gage)	Steuben	18-Aug-97	2.7	45.0	20.0	98	100
Lincoln	Spencer	23-Jul-96	4.2	65.0	19.0	96	100
Lindsey	Noble	19-Jul-94	1.7	37	9	126	35
Little Barbee	Kosciusko	09-Aug-94	0.9	5	8	80	57
Little Barbee	Kosciusko	06-Jul-98	1.0	25.0	12.5	113	43
Little Bower	Steuben	04-Aug-97	1.1	20.0	9.0	185	83
Little Cedar	Whitley	14-Aug-95	2.0	54.0	12.0	0	0
Little Cedar	Whitley	14-Jul-98	1.8	48.0	14	174	44
Little Chapman	Kosciusko	15-Aug-94	1.4	23	11	106	65
Little Chapman	Koscuisko	30-Jun-98	1.1	27.5	9.64	128	50
Little Crooked	Whitley	26-Jul-94	3.5	44	18	105	56
Little Crooked	Whitley	13-Jul-98	2.7	55.0	14.5	113	40
Little Otter	Steuben	29-Jul-97	3.0	57.0	18.5	117	55
Little Pike	Kosciusko	16-Aug-94	0.6	12	5	95	100
Little Pike	Koscuisko	29-Jun-98	0.6	8.8	6.71	108	67
Little Turkey (LaGrange)	LaGrange	25-Aug-97	1.0	25.0	9.0	106	55
Little Turkey (Steuben)	Steuben	26-Aug-97	0.6	5.0	5.0	57	50
Little Wilson	Whitley	26-Jul-94	3.4	54	22	74	83
Long	Kosciusko	09-Aug-94	4.6	31	21.5	100	82
Long	Porter	11-Jul-95	1.7	35.0	4.3	0	0
Long	Wabash	18-Aug-98	1.3	36.0	12.75	128	40
Long (Chain O' Lakes)	Noble	12-Jul-94	2.4	48	14	127	56
Long (Clear)	Steuben	28-Jul-97	1.9	32.0	14.0	96	36
Long (Dugger)	Sullivan	12-Aug-96	7.9	42.0	36.0	109	100
Long (Hillenbrand)	Greene	14-Jul-97	1.0	13.0	7.5	10	57
Long (Pleasant)	Steuben	04-Aug-97	1.1	40.0	9.0	138	44
Lonnie	Sullivan	01-Jul-97	3.5	49.0	13.5	77	50
Loomis	Porter	11-Jul-95	1.3	33.0	10.0	0	0
Loon	Whitley	25-Jul-94	1.7	47	13	112	22
Loon	Kosciusko	22-Aug-94	1.5	17	12	101	38
Loon	Steuben	18-Aug-97	1.9	35.0	15.0	88	83
Loon	Whitley	13-Jul-98	0.7	23.0	8.5	142	11
Loon	Kosciusko	10-Aug-98	0.9	15.0	7.25	102	25
Lower Fish	LaPorte	18-Jul-95	1.7	49.0	13.3	139	100
Lower Long	Noble	11-Jul-94	3.4	35	17	104	34
Lukens	Fulton	23-Aug-94	2.6	19	16.5	96	52
Lukens	Wabash	17-Aug-98	1.8	33.0	11.25	131	36
Manitou	Fulton	08-Aug-95	0.9	20.0	9.0	0	0

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
7.5	170.0	0.022	0.652	1.319	0.086	0.104	6.3	4993	65.2
7.9	80.1	0.022	0.200	0.445	0.012	0.054	6.9	2231	77.0
8.2	87.1	0.025	0.319	0.932	0.036	0.060	29.9	61996	95.4
6.8	94.8	0.022	0.061	0.818	0.006	0.055		27693	55.0
8.0	153.5	0.062	0.321	1.200	0.004	0.033	3.1	2767	38.5
7.2	37.8	0.030	0.018	0.301	0.007	0.031	0.8	11111	39.0
8.9	155.7	0.451	2.601	2.162	0.424	0.502	11.0	159050	97.4
7.8	209.7	0.022	1.683	1.927	0.256	0.373	11.0	30840	72.4
8.0	207.4	0.440	0.617	1.161	0.101	0.148	2.2	13819	0.9
8.1	256.2	0.603	0.637	1.705	0.006	0.081	22.0	86458	44.9
8.1	154.8	0.041	1.122	1.554	0.307	0.547	6.3	75671	92.8
8.0	143.5	0.022	0.723	0.983	0.333	0.320	8.1	90601	1.0
8.1	160.3	0.022	1.004	1.525	0.128	0.185	15.1	18563	35.3
8.0	152.8	0.022	0.046	0.943	0.111	0.133	11.9	52715	0.5
7.7	190.4	0.179	2.905	3.184	0.612	0.934	4.1	17892	71.8
7.7	186.9	0.022	3.609	4.150	0.782	1.305	4.1	13605	0.7
8.0	257.0	0.058	1.156	1.950	0.370	0.408	3.5	48855	66.1
8.5	172.0	0.056	0.018	0.989	0.003	0.079	51.3	34437	22.4
8.2	162.8	0.401	0.055	1.337	0.007	0.071	47.3	9898	0.2
7.8	223.2	0.223	1.916	3.400	0.281	0.330	59.6	75169	39.3
7.6	255.5	1.148	2.268	3.950	0.260	0.345	41.2	120036	72.5
7.6	174.0	0.022	0.391	0.674	0.032	0.087	2.2	14875	50.1
8.0	135.8	0.050	0.672	1.223	0.004	0.072	1.5	40990	92.1
7.5	72.3	0.022	0.274	1.057	0.052	0.081	10.6	62036	79.4
7.9	174.5	0.022	2.361	3.067	0.065	0.110	11.6	8257	0.9
8.0	257.3	0.496	1.664	1.384	0.153	0.312	9.9	23372	67.9
7.8	144.6	0.031	0.549	1.250	0.105	0.140	6.1	8711	52.9
8.0	90.3	0.069	0.051		0.006	#DIV/0!	0.2	755	38.0
7.9	224.1	0.039	1.700	2.560	0.557		2.4	66531	3.5
8.0	282.4	0.650	1.612	2.800	0.368	0.425	31.5	73621	44.5
7.2	546.9	0.022	5.652	9.431	0.313	1.170	1.7	39537	12.2
8.2	110.0	0.022	0.927	1.974	0.139	0.161	20.0	36962	0.1
8.1	163.1	0.022	0.573	0.816	0.195	0.251	4.6	76172	94.5
8.2	182.5	0.022	2.686	3.373	0.359	0.370	9.1	2316	30.4
7.8	146.5	0.023	0.059	0.900	0.005	0.015	5.8	8878	14.5
8.1	153.5	0.022	0.573	1.176	0.197	0.258	15.9	48378	0.9
7.8	158.6	0.022	0.545	4.045	0.274	0.302	15.9	23491	0.8
7.8	176.0	0.022	0.135	0.883	0.006	0.032	7.8	11672	22.7
8.1	182.3	0.022	0.835	0.230	0.128	0.268	3.8	61027	85.5
7.7	192.4	0.022	2.391	2.530	0.484	0.415	4.2	2825	76.6
7.9	169.6	0.022	1.640	2.379	0.275	0.286	3.3	8714	0.8
7.9	194.3	0.022	1.224	2.181	0.154	0.184	17.5	15836	72.3

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Manitou	Fulton	11-Aug-98	0.8	8.0	5.75	108	31
Manlove	Fayette	09-Jul-96	0.6	10.0	6.0	121	100
Mansfield Res	Parke	14-Aug-97	1.5	53.0	6.7	93	60
Marsh	Steuben	28-Jul-97	2.2	25.0	13.0	177	60
Maxinkuckee	Marshall	08-Aug-95	2.9	63.0	32.0	0	0
Maxinkuckee	Marshall	11-Aug-98	2.1	60.0	26.25	97	32
Mayfield	Greene	13-Aug-96	3.7	59.0	24.0	81	100
McClish	Steuben	26-Aug-97	1.8	29.0	13.0	131	41
McClures	Kosciusko	22-Aug-94	1.4	22	12	108	55
Meyers	Marshall	31-Jul-95	3.4	29.0	15.0	0	0
Middlefork Res.	Wayne	08-Jul-96	2.4	50.0	4.5	115	62
Midland	Greene	08-Jul-97	1.2	26.0	11.0	91	40
Mill Pond	Marshall	31-Jul-95	0.5	2.0	3.3	0	0
Miller (Chain O')	Noble	12-Jul-94	2.2	46	12	81	59
Mississinewa Res.	Miami	21-Aug-95	1.8	43.0	16.0	0	0
Mollenkramer Res.	Ripley	09-Jul-96	0.2	1.0	2.0	0	100
Monroe (Lower)	Monroe	27-Aug-96	1.0	27.0	9.0	117	100
Monroe (Upper)	Monroe	27-Aug-96	0.8	17.0	8.0	102	83
Morse Res	Hamilton	08-Jul-96	1.1	36.0	16.0	133	54
Moser	Wells	01-Jul-96	0.6	20.0	4.7	6	100
Moss	Greene	14-Jul-97	1.0	24.0	6.2	6	50
Mt. Zion	Fulton	10-Aug-98	0.8	4.0	4.75	43	100
Mud (Chain o Lakes)	Noble	22-Aug-94	2.0	32	9.5	37	100
Muncie	Noble	11-Jul-94	1.2	37	11	129	52
Narrow	Sullivan	20-Aug-96	3.1	62.0	13.5	106	86
Narrow	Sullivan	01-Jul-97	1.8	42.0	10.0	237	63
New	Whitley	20-Jul-98	3.9	67.0	23	123	80
Norman	Noble	12-Jul-94	2.1	45	13	99	39
North	Vigo	21-Jul-97	0.8	30.0	9.0	2	33
North Little	Kosciusko	22-Aug-94	0.8	5	5	90	32
North Little	Kosciusko	10-Aug-98	1.3	21.0	8.25	65	43
Nyona	Fulton	07-Aug-95	0.6	11.0	17.0	0	0
Nyona	Fulton	17-Aug-98	0.9	8.0	5.25	38	33
Oak	Clark	22-Jul-96	2.0	29.0	9.0	60	1
Ogle	Brown	20-Aug-96	3.4	24.4	14.8	88	100
Old	Whitley	25-Jul-94	2.4	50	12	128	38
Old	Whitley	13-Jul-98	1.8	33.0	10	127	100
Oswego	Koscuisko	30-Jun-98	2.3	47.5	16.03	88	50
Palestine	Kosciusko	23-Aug-94	0.8	5	5	92	6
Palestine	Kosciusko	28-Jul-98	0.5	4.0	4.5	57	43
Patoka Res	Dubois	30-Jul-96	2.6	40.0	20.0	103	47
Pigeon	Steuben	11-Aug-97	1.6	20.0	9.0	147	44

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
7.8	200.1	0.032	1.851	3.041	0.292	0.348	34.3	122688	0.2
8.6	109.0	3.045	0.122	1.264	0.009	0.083	19.9	11032	69.0
7.9	176.5	1.311	1.141	1.800	0.021	0.168	5.0	1999	73.4
8.0	253.4	0.068	0.524	1.036	0.123	0.170	3.1	21733	47.5
8.1	148.8	0.022	0.301	0.778	0.009	0.020	2.8	808	77.8
8.0	149.2	0.022	0.385	0.959	0.003	0.012	3.3	1731	0.6
7.0	313.2	0.022	0.843	1.059	0.005	0.015	1.3	544	41.0
8.0	235.2	0.295	1.406	2.800	0.206	0.230	17.8	147369	84.5
7.8	216.1	0.031	2.912	3.401	0.118	0.145	8.3	4251	25.4
7.4	166.5	0.022	0.472	0.963	0.101	0.129	2.5	19472	59.7
7.9	237.6	1.263	1.150	1.357	0.111	0.121	1.9	8306	49.0
8.0	87.9	0.022	0.303	0.756	0.014	0.066	13.6	156934	93.3
7.5	164.0	0.022	0.710	2.270	0.044	0.138	84.7	385144	89.8
7.9	185.8	0.022	0.775	0.937	0.148	0.293	8.7	266715	8.1
8.0	162.0	3.196	0.524	1.021	0.026	0.050	5.7	1707	9.6
7.5	84.5	0.053	0.105	1.571	0.038	0.277	16.9	61052	92.0
7.8	40.4	0.022	0.210	0.627	0.005	0.039	2.1	3748	79.0
7.5	51.2	0.022	0.654	1.057	0.075	0.110	13.4	12873	92.0
8.4	130.6	6.305	0.668	0.230	0.046	0.030	7.9	9287	42.0
7.8	115.1	0.938	0.021	1.476	0.011	0.126	19.2	10075	59.0
7.2	216.4	0.022	0.105	1.168	0.035	0.320	6.0	77610	0.3
7.4	186.0	0.322	0.135	1.368	0.099	0.147	3.4	4373	0.4
7.2	240.3	0.022	3.579	4.437	0.581	0.029	17.9	67130	30.5
8.1	217.0	0.500	0.784	0.674	0.016	0.087	23.0	229734	46.0
7.8	166.0	0.052	0.839	1.145	0.155	0.233	3.2	0	#DIV/0!
7.8	253.3	0.012	2.513	3.722	0.412	0.583	5.5	97200	69.1
7.9	154.0	0.022	0.595	1.198	0.076	0.117	1.8	4062	0.8
7.8	169.2	0.022	0.828	0.899	0.281	0.340	9.3	94232	50.1
7.7	263.5	0.025	0.756	1.497	0.156	0.183	13.2	18076	92.9
7.9	239.4	0.022	2.431	3.044	0.537	0.573	68.1	14162	68.6
7.6	219.1	0.634	0.909	1.887	0.093	0.141	21.2	12497	0.2
8.2	202.5	0.022	1.446	2.693	0.255	0.321	43.7	9759	82.6
7.9	220.3	0.022	1.837	2.911	0.483	0.518	45.3	48059	0.8
6.8	27.3	0.022	0.018	0.545	0.005	0.063	0.5	5079	28.0
7.1	29.7	0.047	0.018	0.566	0.007	0.049	0.4	7431	91.0
7.9	212.8	0.051	1.024	1.408	0.389	0.347	4.9	223667	96.7
8.0	195.4	0.022	0.595	1.219	0.237	0.288	6.9	15133	0.9
7.8	188.0	0.091	0.742	1.295	0.084	0.110	0.0	3373	0.5
7.8	252.0	0.022	2.496	3.345	0.603	0.790	38.1	27447	23.2
8.0	202.8	0.022	1.343	2.851	0.318	0.395	89.4	55256	0.2
7.8	58.2	0.022	0.282	0.483	0.009	0.028	4.5	8812	77.0
8.0	285.2	0.694	1.107	2.350	0.256	0.310	32.0	105791	16.0

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Pike	Kosciusko	16-Aug-94	0.8	12	7	112	59
Pike	Koscuisko	29-Jun-98	0.9	20.6	8.30	172	22
Pine (North)	LaPorte	18-Jul-95	2.5	55.0	19.5	0	0
Pine (South)	LaPorte	18-Jul-95	3.1	45.0	53.0	0	0
Pinhook	St. Joseph	24-Jul-95	2.8	60.0	21.0	0	0
Pintail	Sullivan	07-Jul-97	4.6	71.0	28.0	101	73
Placid	Blackford	01-Jul-96	0.5	4.0	4.0	23	60
Pleasant	Noble	11-Jul-94	4.0	45	20	100	34
Pleasant	St. Joseph	25-Jul-95	2.7	6.0	4.5	0	0
Pleasant	Steuben	29-Jul-97	2.2	49.0	24.0	110	60
Pleasant	Steuben	04-Aug-97	3.2	58.0	26.0	119	57
Port Mitchell	Noble	06-Jul-94	1.3	32	11	148	51
Prairie Creek	Delaware	01-Jul-96	2.7	37.0	13.0	120	60
Pretty	Marshall	31-Jul-95	3.6	15.0	16.5	0	0
Pretty	LaGrange	26-Aug-97	3.4	48.0	28.0	103	32
Price	Kosciusko	09-Aug-94	3.1	16	20	50	60
Prides Creek	Pike	06-Aug-96	1.1	37.0	12.0	108	46
Pump	Sullivan	19-Aug-96	5.6	78.0	44.0	102	100
Redbud	Sullivan	01-Jul-97	5.5	52.0	21.0	82	100
Reservoir 26	Sullivan	19-Aug-96	2.6	59.0	8.5	82	100
Reservoir 29	Sullivan	13-Aug-96	6.0	68.0	20.0	94	100
Riddles	St. Joseph	25-Jul-95	0.4	6.5	4.7	0	0
Ridinger	Kosciusko	07-Jul-98	0.7	9.0	6	146	25
Rivir (Chain O')	Noble	12-Jul-94	2.0	40	11	136	48
Robinson	Kosciusko	07-Jul-98	0.9	11.0	7	85	21
Rock	Fulton	21-Aug-95	0.5	5.0	4.0	0	0
Rock	Kosciusko	10-Aug-98	0.6	4.0	3.75	131	66
Rock/Mud (Pleasant)	Steuben	04-Aug-97	1.0	15.0	6.0	71	100
Rockville	Parke	14-Aug-97	0.6	19.0	8.0	122	100
Rothenberger	Kosciusko	02-Aug-94	1.5	36	9	131	46
Round	Whitley	14-Aug-95	3.1	53.0	22.0	0	0
Round	Whitley	14-Jul-98	3.4	55.0	17.5	120	33
Round	Wabash	18-Aug-98	0.9	19.0	8.25	115	60
Round B (Clear)(Ray)	Steuben	28-Jul-97	3.9	48.0	22.0	95	75
Salamonie Res	Wabash	15-Aug-95	1.0	28.0	13.5	0	0
Salinda	Washington	30-Jul-96	1.3	30.0	12.0	84	56
Sally Owen	Steuben	19-Aug-97	2.0	28.0	9.0	95	100
Sand (Chain o' Lakes)	Noble	12-Jul-94	4.4	62	21	99	43
Saugany	LaPorte	17-Jul-95	5.9	70.0	31.5	0	0
Sawmill	Kosciusko	09-Aug-94	0.8	13	11	88	60
Sawmill	Kosciusko	06-Jul-98	1.9	32.0	15	121	67
Scales	Warrick	05-Aug-96	2.8	45.0	14.0	107	100

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
8.1	231.2	0.150	1.864	3.098	0.196	0.345	46.7	9221	31.8
8.0	204.2	0.243	1.171	2.218	0.052	0.086	45.5	6184	0.4
7.6	98.8	0.022	0.093	0.811	0.009	0.044	4.0	10134	72.3
7.4	104.0	0.022	0.427	1.026	0.096	0.121	3.3	14612	80.8
7.7	254.0	0.216	0.055	0.398	0.005	0.024	3.2	1777	16.7
7.3	449.4	0.022	0.785	1.017	0.003	0.045	0.5	420	6.0
8.2	100.2	0.125	0.051	1.185	0.040	0.116	16.8	24900	96.0
8.0	122.3	0.022	0.219	0.368	0.123	0.155	3.0	69782	78.1
7.5	119.0	0.022	0.691	2.336	0.175	0.273	61.9	75988	68.3
7.9	135.4	0.028	0.327	0.752	0.007	0.032	1.9	2200	51.1
8.0	139.8	0.029	0.026	0.650	0.003	0.028	1.8	1227	80.3
7.9	231.8	0.071	1.023	0.772	0.005	0.097	17.3	220508	76.0
8.0	143.3	0.104	0.373	0.890	0.017	0.044	3.8	19243	94.0
7.9	100.5	0.022	0.039	0.843	0.005	0.067	1.3	1998	39.9
8.1	138.9	0.022	0.165	0.750	0.028	0.043	3.0	7483	74.1
7.4	173.3	0.022	2.562	2.773	0.060	0.130	2.2	29499	71.4
7.9	98.1	0.022	1.917	2.538	0.132	0.149	3.6	52962	88.0
7.9	158.3	0.049	0.384	0.542	0.006	0.011	0.1	458	56.0
7.6	90.8	0.022	0.042	0.354	0.003	0.025	0.9	6219	49.3
3.4	-	0.022	2.850	13.794	0.008	0.028	2.3	1289	14.0
3.7	-	0.267	0.711	0.417	0.005	0.013	0.9	173	13.0
7.3	146.7	0.022	0.756	2.193	0.254	0.352	61.8	79298	51.0
8.0	176.6	0.850	0.682	1.542	0.097	0.216	34.0	34723	0.9
8.1	192.8	0.041	0.769	0.625	0.328	0.378	10.2	131296	20.6
8.0	180.0	0.627	0.509	1.237	0.058	0.139	27.2	8015	0.5
8.8	174.5	0.022	0.052	1.977	0.005	0.092	35.0	107847	90.2
7.6	162.5	0.028	3.301	3.310	0.217	0.318	53.2	20815	0.5
7.8	273.5	1.850	0.227	1.950	0.006	0.100	77.6	34260	24.9
8.3	176.3	0.029	2.211	3.250	0.033	0.185	5.0	175788	91.7
8.3	171.0	0.022	0.018	0.810	0.008	0.045	3.4	105829	70.6
8.0	109.3	0.022	1.122	1.480	0.358	0.356	2.5	7587	76.3
8.0	133.8	0.022	1.183	1.477	0.347	0.397	3.0	24627	0.9
8.0	216.4	0.022	1.653	2.462	0.010	0.050	13.5	59407	0.5
8.1	140.8	0.027	0.134	0.701	0.002	0.010	1.8	3218	34.0
8.1	142.5	3.031	0.719	1.338	0.041	0.081	6.6	507	40.8
7.8	125.0	0.134	1.349	1.856	0.011	0.046	9.3	22334	49.0
8.2	129.0	0.035	0.054	0.900	0.003	0.015	5.9	31560	4.4
8.0	195.8	0.022	0.637	0.514	0.213	0.253	3.1	17434	41.9
7.6	69.5	0.051	0.152	0.672	0.018	0.038	1.2	10479	89.7
7.8	203.0	0.022	1.490	1.877	0.126	0.191	15.2	18906	44.1
8.0	208.9	0.185	0.774	1.398	0.058	0.115	15.1	14419	0.9
7.8	113.5	0.022	0.043	0.348	0.005	0.034	1.7	13065	53.0

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Schlamm	Clark	22-Jul-96	1.2	9.0	5.5	38	100
Scott	Greene	20-Aug-96	5.4	48.0	22.0	97	63
Sechrist	Kosciusko	09-Aug-94	2.9	29	26	98	49
Sechrist	Kosciusko	06-Jul-98	2.7	45.0	21.75	113	47
Sellers	Kosciusko	27-Jul-98	0.5	5.0	4	125	50
Shafer	White	22-Aug-95	0.5	13.0	18.0	0	0
Shaffer	White	17-Aug-98	0.6	12.0	6	105	100
Shakamak	Sullivan	08-Jul-97	1.2	17.5	8.0	51	67
Shake 1	Greene	30-Jun-97	3.6	50.0	27.0	33	100
Shake 2	Greene	30-Jun-97	2.5	30.0	11.0	87	100
Shock	Kosciusko	02-Aug-94	4.4	44	18	99	28
Shoe	Kosciusko	15-Aug-94	4.7	63	22	88	82
Shriner	Whitley	14-Aug-95	5.0	63.0	30.0	0	0
Shriner	Whitley	14-Jul-98	5.8	59.0	28	107	67
Silver	Noble	11-Jul-94	1.7	70	11	98	67
Silver	Kosciusko	06-Jul-95	0.8	14.0	7.0	92	67
Silver	Steuben	05-Aug-97	2.7	42.0	22.5	104	100
Silver	Kosciusko	20-Jul-98	0.7	13.0	0.75	152	38
Simonton	Elkhart	05-Jul-95	1.6	37.0	19.0	88	86
Smalley	Noble	20-Jul-98	1.3	43.0	11.5	150	31
Snow	Steuben	12-Aug-97	3.1	43.0	23.0	89	40
South	Sullivan	20-Aug-96	0.8	17.0	6.0	88	57
South	Vigo	15-Jul-97	0.5	19.0	8.0	138	1
South Mud	Fulton	21-Aug-95	0.4	15.0	5.5	0	0
South Mud	Fulton	17-Aug-98	0.4	3.0	3.25	105	38
Spear	Whitley	02-Aug-94	2.3	39	15.5	122	55
Spectacle	Porter	31-Jul-95	1.4	34.0	5.0	0	0
Spring Mill Park	Lawrence	20-Aug-96	1.4	13.4	1.9	43	100
Springs Valley (Tucker)	Orange	30-Jul-96	3.2	46.0	17.0	88	55
St. Joseph Res	Allen	01-Jul-96	0.3	1.0	2.8	79	100
Stanton	Kosciusko	15-Aug-94	5.1	61	20	84	100
Staynor/Gannon	Steuben	25-Aug-97	3.7	45.0	18.0	84	100
Stick Pit No. 2	Vigo	15-Jul-97	2.2	64.0	18.0	90	100
Stone	LaPorte	18-Jul-95	3.5	45.0	20.8	0	0
Story (Lower)	Dekalb	06-Jul-94	2.0	42	12.5	110	56
Story (Upper)	Dekalb	06-Jul-94	1.9	43	16	104	60
Strahl	Brown	20-Aug-96	1.8	17.6	11.5	79	100
Sullivan	Sullivan	07-Jul-97	0.4	15.0	7.0	146	83
Summit	Noble	18-Jul-94	2.1	33	14.5	110	100
Summit	Henry	02-Jul-96	5.6	54.0	31.0	115	100
Sweet	Noble	19-Jul-94	1.5	42	13	130	78
Tamarack	Steuben	07-Sep-95	1.2	12.0	7.0	0	0

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
6.5	27.7	0.022	0.167	0.522	0.010	0.040	3.2	9217	13.0
7.4	568.3	0.121	1.076	8.045	0.106	0.129	0.4	3470	4.0
8.0	167.5	0.022	0.684	0.969	0.043	0.066	3.0	44772	91.3
7.9	155.8	0.081	0.153	0.598	0.009	0.044	3.5	18444	0.9
8.1	190.0	0.026	0.965	2.266	0.310	0.446	86.1	36633	0.1
8.0	1056.5	0.080	0.285	1.013	0.068	0.154	32.4	3020	20.8
8.0	206.8	1.151	0.046	0.965	0.032	0.102	24.6	13071	0.1
7.5	84.9	0.024	0.547	1.236	0.176	0.260	29.2	155663	95.9
7.3	313.4	0.022	0.018	0.363	0.003	0.023	2.3	332	13.2
7.2	357.7	0.022	0.018	0.281	0.007	0.035	1.0	968	17.0
7.9	202.0	0.022	1.244	1.509	0.385	0.411	0.8	21873	89.9
7.8	119.0	0.022	0.018	0.000	0.001	0.073	1.8	6412	71.9
8.0	134.5	0.022	0.514	0.870	0.236	0.282	0.5	3522	75.2
7.9	133.2	0.022	0.234	0.477	0.190	0.229	2.2	8789	0.9
8.0	144.0	0.096	0.055	0.244	0.005	0.060	6.3	18041	72.5
7.2	222.5	0.391	1.587	2.856	0.473	0.381	22.4	105224	90.4
8.1	175.0	0.029	0.378	1.012	0.003	0.064	2.2	1638	37.3
8.1	187.8	0.135	1.699	2.407	0.562	0.699	48.3	36025	0.6
7.5	174.5	0.473	0.267	0.618	0.005	0.036	1.7	3402	89.3
7.9	196.5	0.118	1.017	1.843	0.473	4.894	14.8	19810	0.8
8.0	191.8	0.182	0.185	0.900	0.057	0.073	4.0	14946	81.5
7.4	444.3	0.051	1.199	1.402	0.006	0.037	7.5	2269	62.0
8.1	139.6	3.180	0.164	1.113	0.003	0.080	32.2	4351	13.7
8.2	203.8	0.026	3.855	5.348	0.070	0.077	21.1	37822	98.2
8.1	201.9	0.022	3.127	4.977	0.196	0.249	45.1	25468	0.7
7.9	186.5	0.022	1.817	2.022	0.294	0.335	0.6	13375	50.1
7.3	122.0	0.022	0.018	0.846	0.006	0.084	16.3	69417	7.2
7.8	202.4	1.146	0.078	0.758	0.017	0.053	5.3	23439	1.0
7.4	55.9	0.022	0.459	0.610	0.005	0.032	1.7	3695	58.0
8.0	213.8	1.297	0.022	0.919	0.072	0.161	15.0	12560	74.0
7.9	110.5	0.022	0.018	0.615	0.004	0.016	1.7	6874	23.1
8.2	142.8	0.022	0.064	0.850	0.001	0.015	1.8	844	65.2
7.4	201.7	0.024	0.229	0.516	0.000		0.3	1726	5.2
7.5	99.3	0.046	0.243	0.927	0.007	0.050	2.3	14265	52.7
7.9	209.5	0.022	0.076	0.393	0.081	0.156	6.9	63790	60.4
7.8	235.6	0.022	1.952	0.230	0.582	0.028	4.6	21352	88.9
6.9	27.6	0.046	0.018	0.466	0.005	0.026	0.6	88697	42.0
8.1	76.8	0.091	0.446	1.353	0.020	0.089	56.2	12083	50.2
7.8	182.8	0.022	1.072	0.992	0.352	0.403	3.1	77588	97.4
8.0	0.0	0.279	0.124	0.339	0.007	0.013	0.4	3269	17.0
8.1	184.0	0.022	0.995	1.013	0.067	0.104	8.4	5340	53.8
7.8	104.5	0.022	0.027	0.635	0.005	0.041	7.2	20337	5.8

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Thomas	Marshall	01-Aug-95	2.7	13.0	11.0	0	0
Tippecanoe	Kosciusko	08-Aug-94	1.7	40	24	95	54
Tippecanoe	Kosciusko	14-Aug-96	1.8	28.0	15.0	104	73
Tippecanoe	Koscuisko	30-Jun-98	2.7	51.3	17.90	105	94
Todd	Greene	30-Jun-97	8.2	63.0	34.0	103	100
Troy Cedar	Whitley	26-Jul-94	0.9	15	10	100	19
Troy Cedar	Whitley	20-Jul-98	1.0	5.5	8.25	120	12
Turtle	Sullivan	01-Jul-97	3.1	50.0	20.5	97	100
Turtle Creek Embay	Switzerland	15-Jul-96	0.3	0.0	2.8	40	100
Turtle Creek Res	Sullivan	08-Jul-97	0.4	15.0	7.0	60	60
Twin Pit	Sullivan	07-Jul-97	4.8	75.0	22.5	101	100
Twin Pits, East	Pike	06-Aug-96	4.1	68.0	5.1	83	100
Twin Pits, West	Pike	06-Aug-96	1.9	45.0	2.4	59	100
Upper Fish	LaPorte	18-Jul-95	2.1	40.0	13.3	115	83
Upper Long	Noble	06-Jul-94	2.1	31	16	114	39
Versailles	Ripley	15-Jul-96	0.4	7.0	4.5	35	50
Wabee	Kosciusko	01-Aug-94	2.5	62	27	129	49
Wade & Goose Cr Emb.	Switzerland	15-Jul-96	0.2	0.0	2.0	72	100
Wall	LaGrange	19-Aug-97	2.9	38.0	22.0	96	70
Wampler	Greene	26-Aug-96	4.5	43.0	17.0	95	100
Warner	Steuben	19-Aug-97	0.7	8.5	2.0	90	50
Wauhob	Porter	31-Jul-95	2.9	48.0	15.5	0	0
Wawasee	Kosciusko	01-Aug-94	2.4	62	27	106	36
Webster	Kosciusko	15-Aug-94	1.3	38	13	99	50
Webster	Kosciusko	29-Jun-98	1.3	32.1	10.70	104	29
Weir	Lagrange	08-Aug-94	2.3	55	14	58	100
West Boggs Res.	Martin	12-Aug-96	0.6	7.0	5.0	60	56
West Otter	Steuben	19-Aug-97	1.0	31.0	13.0	135	67
Westwood	Henry	02-Jul-96	2.4	74.5	3.6	135	39
White Oak #1	Knox	06-Aug-96	0.5	7.0	4.0	2	100
White Oak #2	Knox	06-Aug-96	0.9	20.0	6.5	23	75
Whitewater	Union	08-Jul-96	1.1	25.0	9.0	153	67
Whitford	Noble	18-Jul-94	1.0	40	10.5	154	100
Wiley	Dekalb	05-Jul-94	1.0	24	11	106	41
Williams	Noble	11-Jul-94	1.4	37	11	142	34
Willow	Sullivan	01-Jul-97	5.2	63.0	24.0	97	100
Wilmot Pond	Noble	09-Aug-94	1.8	24	9	53	100
Wilson	Whitley	26-Jul-94	3.1	45	16	85	67
Winona	Kosciusko	16-Aug-94	2.3	38	14	89	28
Winona	Kosciusko	07-Jul-98	1.2	32.0	12.5	118	19
Wolf	Lake	10-Jul-95	0.8	17.0	7.0	0	0
Woods(Big Blue #3)	Rush	02-Jul-96	0.7	15.0	6.0	149	71

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
6.9	38.0	0.022	1.011	1.674	0.138	0.170	2.5	8578	95.7
8.0	180.5	0.329	0.050	0.237	0.060	0.070	3.3	7880	73.8
7.8	174.7	0.236	0.120	0.752	0.029	0.037	5.0	6460	78.7
7.9	177.0	0.432	0.165	0.528	0.122	0.006	4.6	3165	0.4
7.5	156.9	0.022	0.164	0.397	0.003	0.033	0.2	551	16.7
8.0	168.7	0.031	0.555	1.136	0.197	0.249	3.3	17668	80.5
8.0	162.3	0.580	0.310	1.185	0.144	0.198	19.6	10636	0.3
7.9	105.2	0.022	0.018	0.432	0.002	0.027	1.4	2681	17.5
7.5	112.8	0.586	0.191	1.002	0.041	0.204	20.3	13549	88.0
7.9	99.3	0.022	0.137	1.202	0.014	0.093	50.7	46666	96.8
7.3	433.9	0.022	1.137	1.440	0.027	0.061	0.9	372	6.4
7.3	269.0	0.029	0.027	0.263	0.005	0.024	0.8	10987	26.0
7.7	133.0	0.022	0.054	0.267	0.005	0.020	3.0	6569	69.0
7.6	1066.5	0.026	0.094	0.893	0.008	0.050	6.4	16780	71.3
7.9	182.6	0.022	0.780	0.754	0.275	0.310	2.3	66333	75.2
7.7	143.2	0.221	1.274	1.826	0.090	0.146	31.5	16303	68.0
8.1	196.3	0.685	0.988	0.942	0.006	0.028	0.4	4084	44.5
7.7	107.3	0.169	0.130	1.264	0.032	0.258	36.3	65003	93.0
8.0	143.8	0.022	0.259	1.050	0.004	0.033	3.4	2260	52.9
7.9	171.2	0.022	0.449	0.784	0.007	0.047	0.8	9272	53.0
7.8	232.0	0.022	3.314	4.500	0.518	0.605	38.9	31691	66.6
7.5	88.5	0.022	0.705	1.338	0.272	0.337	1.5	12212	44.0
7.9	146.0	0.022	0.167	0.301	0.015	0.032	1.4	3126	66.5
8.0	191.5	0.022	1.764	1.715	0.128	0.150	8.0	33825	34.5
7.9	179.0	0.022	0.836	1.530	0.131	0.150	10.9	25032	0.5
8.2	273.3	0.538	0.055	0.530	0.000	0.049	1.2	1362	54.6
8.0	100.3	0.022	1.548	2.638	0.487	0.464	33.1	126320	100.0
8.0	237.3	0.091	1.872	2.365	0.006	0.038	25.5	19683	77.4
8.2	126.2	0.054	0.490	1.324	0.083	0.139	0.6	70099	91.0
8.3	102.8	0.022	0.068	1.453	0.110	0.158	53.7	40134	76.0
7.7	95.3	0.023	0.345	1.024	0.005	0.062	1.0	10634	94.0
8.1	165.7	2.601	0.699	0.999	0.068	0.100	6.4	216010	98.0
7.9	220.0	0.196	1.407	1.227	0.198	0.224	3.0	33968	67.5
7.7	295.9	0.022	1.932	1.300	0.368	0.435	4.2	21310	33.7
8.1	204.3	0.345	1.297	1.324	0.312	0.374	11.0	92225	28.8
7.4	266.8	0.022	1.045	1.423	0.003	0.039	1.1	2032	52.7
7.6	194.5	0.022	0.020	0.620	0.036	0.097	15.0	11508	26.9
7.6	190.2	0.022	1.025	1.028	0.177	0.197	0.5	141331	93.9
8.1	195.8	0.185	0.585	1.075	0.155	0.197	10.5	111776	75.1
8.0	194.4	0.566	0.219	0.753	0.098	0.145	11.1	7150	0.6
8.3	99.3	0.022	0.030	1.043	0.007	0.049	21.3	94985	91.7
8.0	191.3	4.278	0.580	1.173	0.030	0.113	27.3	13130	51.0

Lake Name	County	Date Sampled	Secchi (m)	Light trans @ 3' (%)	1% Light Level (ft)	D.O. Sat. @ 5' (%)	% Water Column Oxic
Worster	St. Joseph	24-Jul-95	0.9	22.0	9.0	0	0
Yellow Creek	Elkhart	06-Jul-95	1.0	13.0	7.0	0	33
Yellow Creek	Kosciusko	10-Aug-98	1.0	22.0	10	119	20
Yellowwood	Brown	22-Jul-97	4.8	58.0	21.0	96	100
Average			***2.1***	***34.0***	***13.8***	***100***	***70***
Median			***1.8***	***33.0***	***12.0***	***101***	***67***
Maximum			***9.2***	***92.0***	***53.0***	***192***	***110***
Minimum			***0.1***	***0***	***0.0***	***0***	***1***
Std Deviation			***1.5***	***19***	***8.7***	***33***	***27***

pH Ave	Alkalinity ave (mg/L)	NO_3 ave (mg/L)	NH_4 ave (mg/L)	TKN ave (mg/L)	SRP ave (mg/L)	Total Phos ave (mg/L)	Chlorophyll a (mg/m_3)	Total Plankton	Blue-greens %
8.1	158.0	0.022	0.018	0.837	0.005	0.079	20.1	12511	59.8
7.0	242.0	9.303	0.909	3.913	0.190	0.300	45.7	52296	1.8
8.0	151.9	0.049	0.505	1.288	0.101	0.131		23579	0.8
7.3	41.9	0.025	0.094	0.449	0.008	0.099	0.9	4055	22.6
7.8		***0.290***	***0.75***	***1.58***	***0.11***	***0.18***	***14.45***	***39282***	***59***
7.8		***0.025***	***0.472***	***1.161***	***0.033***	***0.097***	***5.33***	***13103***	***64***
9.1		***9.303***	***11.248***	***13.794***	***0.782***	***4.894***	***230.93***	***543219***	***100***
3.4		***0.016***	***0.013***	***0.000***	***0.000***	***0.001***	***0.00***	***80***	***0***

7.80	0.29	0.75	1.58	0.11	0.18	14.45	39282	59
7.88 5	0.025	0.472	1.161	0.033	0.097	5.330	13103. 2	64.0
9.10	9.303	11.248	13.794	0.782	4.894	230.93	543219	100
3.41	0.016	0.013	0.000	0.000	0.001	0.00	80	0
0.49	0.84	0.98	1.64	0.15	0.31	23.10	73407	28

APPENDIX C

Indiana Trophic State Scores

LAKE	COUNTY	Trophic points (most recent)	Trophic Points (1994-1998)	Change in TSI
Airline Pit	Greene	-	29	NA
Allen	Kosciusko	-	33	NA
Appleman	LaGrange	53	28	-25
Arnold's Creek Embkmt.	Ohio	-	47	NA
Arnolds Pit	Whitley	-	48	NA
Axel	Noble	-	3	NA
Backwaters	Kosciusko	15	18	3
Ball	Steuben	21	46	25
Banning	Kosciusko	22	27	5
Barrel and 1/2	Kosciusko	-	38	NA
Bartley	Noble	56	27	-29
Bass	Starke	42	20	-22
Bass	Sullivan	-	35	NA
Bass (N. Chain)	St. Joseph	22	18	-4
Bass Lake	Steuben	5	9	4
Baugher	Noble	42	43	1
Bear Creek	Brown	3	6	3
Beaver Creek Res.	Dubois	14	37	23
Beaver Dam	Kosciusko	39	52	13
Beaver Dam	Steuben	7	7	0
Beigh	Kosciusko	-	57	NA
Benefiel	Sullivan	-	10	NA
Big	Noble	27	37	10
Big Barbee	Kosciusko	39	35	-4
Big Blue #13 (Westwood)	Henry	16	26	10
Big Blue #7A (Knightstown)	Henry	-	25	NA
Big Cedar	Whitley	9	8	-1
Big Chapman	Kosciusko	4	7	3
Big Long	LaGrange	11	24	13
Big Turkey	Steuben	31	40	9
Bischoff Reservoir	Ripley	55	37	-18
Black	Whitley	61	68	7
Black Pond	Kosciusko	-	24	NA
Blue	Whitley	37	30	-7
Boner	Kosciusko	8	16	8
Boone's Pond	Boone	-	4	NA
Booth	Steuben	26	17	-9
Bowen	Noble	34	35	1
Bower	Steuben	33	35	2
Bristol	Noble	-	36	NA
Brookville Res	Union	31	25	-6
Bruce	Fulton	25	47	22
Brush Creek	Jennings	33	34	1
Bryant's Creek	Monroe	7	16	9

Bryants Creek Embayment	Switzerland	-	42	NA
Buck	Steuben	20	27	7
Bushong	Noble	-	41	NA
Caldwell	Kosciusko	42	47	5
Canvasback	Sullivan	-	5	NA
Carr	Kosciusko	36	48	12
Cataract (Leiber)	Putnam	-	16	NA
Cedar	Lake	48	42	-6
Cedarville Reservoir	Allen	24	18	-6
Celina	Perry	7	14	7
Center	Kosciusko	16	8	-8
Cherry	Monroe	10	7	-3
Chrisney	Spencer	-	27	NA
Cicott	Cass	27	31	4
Clair	Huntington	5	26	21
Clear	Greene	-	5	NA
Clear	LaPorte	32	22	-10
Clear	Steuben	16	15	-1
Clear (LaPorte City)	LaPorte	26	9	-17
Cline	Lagrange	9	21	12
Cook	Marshall	43	60	17
Corky	Greene	-	13	NA
Crane	Noble	52	61	9
Crooked	Steuben	19	28	9
Crooked	Whitley	11	18	7
Crooked Creek	Brown	23	17	-6
Crosley	Jennings	12	9	-3
Crystal	Kosciusko	8	11	3
Dale Reservoir	Spencer	-	40	NA
Deam	Clark	9	15	6
Decatur Co. Conservation Club	Decatur	-	46	NA
Deer Creek	Perry	-	44	NA
Dewart	Whitley	28	22	-6
Diamond	Kosciusko	55	44	-11
Dipper	St. Joseph	-	36	NA
Dixon	Marshall	35	30	-5
Dock	Noble	35	43	8
Dogwood (Glendale)	Daviess	8	20	12
Dollar	Lagrange	-	30	NA
Downing	Sullivan	-	7	NA
Duck	Sullivan	-	17	NA
Dunten	Dekalb	-	36	NA
Eagle Creek Res.	Marion	41	38	-3
Eliza	Porter	22	39	17
Eve	Lagrange	18	8	-10
Everett	Allen	66	33	-33
Failing	Steuben	26	23	-3

Fancher	Lake	-	20	NA
Ferdinand Forest	Dubois	39	37	-2
Ferdinand New	Dubois	-	36	NA
Ferdinand Old	Dubois	-	24	NA
Finster	Noble	-	19	NA
Fish	Steuben	24	45	21
Flat	Marshall	28	31	3
Fletcher	Fulton	34	24	-10
Flint	Porter	-	16	NA
Fowler Parke	Vigo	12	16	4
Fox	Steuben	23	24	1
France Park	Cass	-	13	NA
Frank	Greene	-	22	NA
Freeman	Carroll	36	26	-10
Gambill	Sullivan	-	2	NA
Geist Reservoir	Marion	31	20	-11
Georgetown Res.	Floyd	-	20	NA
Gibson	Gibson	33	33	0
Gilbert	Marshall	37	42	5
Gilbert	Noble	17	5	-12
Glen Flint	Putnam	-	16	NA
Golden	Steuben	33	35	2
Goose	Kosciusko	30	36	6
Goose	Whitley	37	35	-2
Goose (Dugger)	Sullivan	-	3	NA
Goose (Minnehaha)	Sullivan	-	36	NA
Goshen Pond	Elkhart	-	32	NA
Grannis	Noble	-	8	NA
Graveyard	Sullivan	-	26	NA
Green	LaGrange	16	34	18
Green	Noble	-	51	NA
Green Valley	Vigo	60	32	-28
Greensburg	Decatur	55	58	3
Griffy	Monroe	21	7	-14
Grouse Ridge	Bartholomew	19	20	1
Hale	Sullivan	-	29	NA
Hamilton	Steuben	37	24	-13
Hammond	Whitley	-	32	NA
Hartz	Starke	24	12	-12
Heaton	Elkhart	21	20	-1
Henry	Steuben	42	56	14
Hill	Kosciusko	26	33	7
Hoffman	Kosciusko	25	32	7
Hog	Steuben	7	8	1
Hogback	Steuben	37	54	17
Holem	Marshall	40	28	-12
Holland 1	Dubois	44	52	8

Holland 2	Dubois	36	36	0
Hominy Ridge	Wabash	44	13	-31
Horseshoe	Noble	27	33	6
Hovey	Posey	27	44	17
Hudson	LaPorte	13	15	2
Huntingburg City	Dubois	-	27	NA
Huntington	Huntington	35	24	-11
Indian	Dekalb	24	27	3
Indian (Ligonier)	Noble	51	5	-46
Indiana	Elkhart	21	16	-5
Irish	Kosciusko	36	28	-8
Island	Sullivan	-	23	NA
James	Kosciusko	32	27	-5
JCMurphy	Newton	20	62	42
Jimmerson	Steuben	9	19	10
John Hay	Washington	10	17	7
Keister	Noble	-	34	NA
Kickapoo	Sullivan	29	22	-7
Kings	Fulton	31	40	9
Kiser	Kosciusko	14	4	-10
Knop	Carroll	-	33	NA
Koontz	Marshall	24	34	10
Kreighbaum	Marshall	25	32	7
Kuhn	Kosciusko	29	15	-14
Kunkel	Wells	29	53	24
L. Greenwood (Crane)	Martin	-	7	NA
Lake Gage	Steuben	13	16	3
Lake George	Steuben	8	8	0
Lake George(Hobart)	Lake	-	34	NA
Lake James	Steuben	10	16	6
Lake Lincoln	Spencer	17	5	-12
Lake of the Woods	LaGrange	36	54	18
Lake of the Woods	Marshall	33	42	9
Lake Placid	Blackford	-	32	NA
Lake Pleasant	Steuben	11	17	6
Lake Sullivan	Sullivan	19	33	14
Langenbaum	Starke	11	26	15
Larwill	Whitley	46	38	-8
Lawrence	Marshall	32	26	-6
Lemon	Monroe	26	23	-3
Lenape	Greene	41	43	2
Lily	LaPorte	55	20	-35
Lime (Gage)	Steuben	6	7	1
Lindsey	Noble	-	52	NA
Little Barbee	Kosciusko	38	37	-1
Little Bower	Steuben	36	35	-1
Little Cedar	Whitley	38	41	3

Little Chapman	Kosciusko	26	37	11
Little Crooked	Whitley	30	31	1
Little Otter	Steuben	25	34	9
Little Pike	Kosciusko	18	21	3
Little Turkey	LaGrange	39	37	-2
Little Turkey	Steuben	56	55	-1
Little Wilson	Whitley	-	19	NA
Lk George(Hammond)	Lake	-	50	NA
Long	Kosciusko	-	25	NA
Long	Porter	34	31	-3
Long	Wabash	36	38	2
Long (Chain O' Lakes)	Noble	-	33	NA
Long (Clear)	Steuben	19	28	9
Long (Dugger)	Sullivan	-	3	NA
Long (Pleasant)	Steuben	42	42	0
Lonnie	Sullivan	-	27	NA
Loomis	Porter	45	32	-13
Loon	Kosciusko	27	41	14
Loon	Steuben	12	7	-5
Loon	Whitley	36	43	7
Lower Fish	LaPorte	17	11	-6
Lower Long	Noble	20	36	16
Lukens	Wabash	28	35	7
Manitou	Fulton	37	43	6
Manlove	Fayette	-	46	NA
Mansfield Reservoir (Hardin)	Parke	59	32	-27
Marsh	Steuben	36	22	-14
Maxinkuckee	Marshall	13	17	4
Mayfield	Greene	-	5	NA
McClish	Steuben	36	50	14
McClures	Kosciusko	32	23	-9
Meyers	Marshall	34	25	-9
Middlefork Res.	Wayne	36	21	-15
Midland	Greene	-	47	NA
Mill Pond	Marshall	26	51	25
Miller (Chain O')	Noble	-	35	NA
Mississinewa Res.	Miami	25	11	-14
Mohawk (Glendora)	Sullivan	-	25	NA
Mollenkramer Res.	Ripley	21	47	26
Monroe (Lower)	Monroe	6	23	17
Monroe (Upper)	Monroe	15	31	16
Morse Reservoir	Hamilton	29	23	-6
Moser	Wells	19	44	25
Mt. Zion	Fulton	-	21	NA
Mud (Chain o Lakes)	Noble	-	23	NA
Muncie	Noble	-	40	NA
New	Whitley	23	25	2

Norman	Noble	26	37	11
North	Vigo	-	37	NA
North Little	Kosciusko	39	29	-10
Nyona	Fulton	37	43	6
Oak	Clark	-	13	NA
Ogle	Brown	21	19	-2
Old	Whitley	50	29	-21
Oswego	Kosciusko	29	26	-3
Palestine	Kosciusko	32	33	1
Patoka Reservoir	Dubois	5	18	13
Pigeon	Steuben	32	42	10
Pike	Kosciusko	28	31	3
Pine (North)	LaPorte	30	18	-12
Pine(South)	LaPorte	30	24	-6
Pinhook	St. Joseph	-	2	NA
Pintail	Sullivan	-	6	NA
Pleasant	Noble	-	32	NA
Pleasant	St. Joseph	33	37	4
Pleasant	Steuben	28	17	-11
Port Mitchell	Noble	55	51	-4
Prairie Creek	Delaware	55	24	-31
Pretty	LaGrange	20	21	1
Pretty	Marshall	20	21	1
Price	Kosciusko	27	29	2
Prides Creek	Pike	30	39	9
Pump	Sullivan	-	11	NA
Redbud	Sullivan	-	4	NA
Reservoir 26	Sullivan	23	24	1
Reservoir 29	Sullivan	-	5	NA
Riddles	St. Joseph	28	44	16
Ridinger	Kosciusko	-	45	NA
Rivir (Chain O')	Noble	32	35	3
Robinson	Kosciusko	-	37	NA
Rock	Fulton	-	57	NA
Rock	Kosciusko	31	42	11
Rock/Mud (Pleasant)	Steuben	28	23	-5
Rockville	Parke	42	53	11
Rothenberger	Kosciusko	-	42	NA
Round	Wabash	44	36	-8
Round	Whitley	26	32	6
Round B (Clear)(Ray)	Steuben	12	6	-6
Salamonie Reservoir	Wabash	26	35	9
Salinda	Washington	38	22	-16
Sally Owen	Steuben	-	26	NA
Sand (Chain o' Lakes)	Noble	16	19	3
Saugany	LaPorte	22	16	-6
Sawmill	Kosciusko	25	28	3

Scales	Warrick	25	16	-9
Schlamm	Clark	15	13	-2
Scott	Greene	-	20	NA
Sechrist	Kosciusko	29	21	-8
Sellers	Kosciusko	-	32	NA
Shaffer	White	22	22	0
Shakamak	Sullivan	43	52	9
Shake 1	Greene	-	3	NA
Shake 2	Greene	-	5	NA
Shock	Kosciusko	29	32	3
Shoe	Kosciusko	14	17	3
Shriner	Whitley	23	22	-1
Silver	Kosciusko	52	45	-7
Silver	Noble	-	18	NA
Silver	Steuben	20	9	-11
Simonton	Elkhart	25	17	-8
Smalley	Noble	40	44	4
Snow	Steuben	15	25	10
South	Sullivan	20	28	8
South	Vigo	20	28	8
South Mud	Fulton	41	40	-1
Spear	Whitley	-	31	NA
Spectacle	Porter	-	41	NA
Spring Mill Park	Lawrence	25	35	10
Springs Valley (Tucker)	Orange	18	19	1
St. Joseph Reservoir	Allen	-	32	NA
Stanton	Kosciusko	15	5	-10
Staynor/Gannon	Steuben	8	15	7
Stone	LaPorte	25	19	-6
Story (Lower)	Dekalb	25	31	6
Story (Upper)	Dekalb	23	26	3
Strahl	Brown	15	14	-1
Summit	Henry	13	4	-9
Summit	Noble	-	35	NA
Sweet	Noble	-	32	NA
Syracuse	Kosciusko	-	24	NA
Tamarack	Steuben	-	34	NA
Thomas	Marshall	29	28	-1
Tippecanoe	Kosciusko	22	8	-14
Todd	Greene	-	3	NA
Troy Cedar	Whitley	37	29	-8
Turtle	Sullivan	-	3	NA
Turtle Creek Embayment	Switzerland	-	31	NA
Turtle Creek Reservoir	Sullivan	25	33	8
Twin Pit	Sullivan	-	7	NA
Twin Pits, East	Pike	-	4	NA
Twin Pits, West	Pike	-	37	NA

Upper Fish	LaPorte	29	21	-8
Upper Long	Noble	31	37	6
Versailles	Ripley	30	35	5
Wabee	Kosciusko	19	13	-6
Wade and Goose Creek Emb.	Switzerland	-	52	NA
Wall	LaGrange	8	17	9
Wampler	Greene	-	19	NA
Warner	Steuben	28	41	13
Wauhob	Porter	38	21	-17
Wawasee	Kosciusko	16	16	0
Webster	Kosciusko	25	36	11
Weir	Lagrange	10	15	5
West Boggs Res.	Martin	41	52	11
West Otter	Steuben	18	31	13
White Oak #1	Knox	42	47	5
White Oak #2	Knox	-	29	NA
Whitewater	Union	35	57	22
Whitford	Noble	-	37	NA
Wiley	Dekalb	-	28	NA
Williams	Noble	63	38	-25
Wilmot Pond	Noble	-	10	NA
Wilson	Whitley	-	39	NA
Winona	Kosciusko	40	35	-5
Wolf	Lake	-	38	NA
Woods(Big Blue #3)	Rush	-	36	NA
Worster	St. Joseph	19	27	8
Yellow Creek	Elkhart	-	36	NA
Yellow Creek	Kosciusko	-	38	NA
Yellowwood	Brown	7	6	-1

APPENDIX D:

Glossary

anaerobic	being able to survive in the absence of oxygen
anoxic	having no oxygen
benthic	referring to bottom zones of lakes or bottom-dwelling forms
benthivore	organism that feeds on the lake bottom
chlorophyll	the green pigment in plants
density	weight in grams per unit volume (1 ml) of a substance
detritus	dead organic matter and its associated microbial elements, particulate (POM) or dissolved (DOM) organic matter
dimixis	two circulation or mixing periods, vernal and autumnal, per year; dimictic lakes circulate after the ice melts before summer stratification and after temperature stratification is destroyed and before the ice forms
epilimnion	the upper, well-mixed, well-illuminated, nearly isothermal region of a stratified lake
eutrophy	the condition of water being rich in plant nutrients and in organic production
fetch	the distance over which wind can blow uninterrupted by land
hypolimnion	the poorly illuminated lower region of a directly stratified lake; denser, colder water protected from wind action; lies below the metalimnion; overlies the profundal zone
internal loading	nutrients or pollutants entering a body of water from its sediments
inverse stratification	condition where warm water lies beneath colder water in a vertical temperature profile; winter stratification beneath ice cover

limnology the study of inland waters

littoral referring to the marginal region of a body of water; the shallow, near-shore region; often defined by the band from zero depth to the outer edge of the rooted plants

macrophytes large plants

metalimnion the central water layer between the epilimnion and hypolimnion in a stratified lake

nanoplankton composed of plankters sized from 2 to 20 µm

net plankton the portion of the plankton community retained by a net with interstices of 50 to 63µm

oligotrophy the condition of water being poor in plant nutrients, and the results

oxidation a chemical process that can occur: (1) in the uptake of oxygen (combustion); (2) in the removal of hydrogen (H_2S-S); (3) in the increase of the valence. *Reduction* in the reverse process.

pH the negative logarithm of the hydrogen ion concentration expressed in gram equivalents (for example, lake pH of 7 means that the hydrogen ion concentration in the water is 10^{-7})

photosynthesis the process by which plants convert water and carbon dioxide (CO_2) into organic matter (carbohydrates) with the aid of light energy

phytoplankton that portion of the plankton community composed of microscopic plants; also known as the algae

piscivore organism that eats fish

planktivore organism that eats plankton, especially zooplankton

plankton the community of microscopic aquatic plants (phytoplankton) and animals (zooplankton)

polymixis many circulation or mixing periods per year or nearly continuous circulation

primary production the production of organic matter from inorganic materials by plants with the help of light energy

profundal the deep region of a lake or reservoir below the light-controlled limit of plant production

Secchi disk a white disc about 20 cm in diameter, lowered into water to measure transparency on the basis of visibility

thermocline the imaginary plane within the metalimnion at the depth where the rate of temperature change is the greatest in a vertical temperature profile

turnover the circulation period when the density stratification of a lake or reservoir is destroyed by the equalization of temperature, resulting in the mixing of the entire water mass; also known as overturn

zooplankton the fraction of the plankton community composed of animals; the individual is the zooplankter