

**The State of Hamilton County Lakes  
an  
Analysis of Water Quality Trends  
1993-1998**



*“A lake is the landscape’s most beautiful and expressive feature. It is the earth’s eye”*  
--Henry David Thoreau

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## **Section I – INTRODUCTION**

Water is necessary for life, not only for the physical health of Hamilton County, but also for our economic well being. The Thoreau quote once described water bodies as “..the Earth’s eye.” This is fitting to the situation here. Many of us are drawn to this area because of the abundance of water. Some prefer to paddle canoes, some fish, some like to water ski, others to swim or just gaze at the sparkling reflection of sunlight as it dances across the tops of the waves. Whatever the reason, this attraction to the water has resulted in residential development along the waters edge. While we enjoy the beauty of our lakes, keep in mind that we cannot let the rhythm of the wind swept waves lull us into a false sense of security that these waters are unchanging, healthy and clean. Industry has developed over the past few decades to produce more complex chemicals for manufacture and medicine and we have yet to realize the side effects to the environment. Regulations on emissions from cars, smokestacks and pipes have been increasing, but the timing of putting controls into effect falls behind the timing of the pollution. It is our duty to keep an eye on our impacts so that we are not remembered in history as the generation that despoiled our greatest asset.

### **Acknowledgments**

The Soil and Water Conservation District would like to take this opportunity to thank a few of the many people who have made this program and report possible:

- \* Hamilton County Board of Supervisors
- \* Hamilton County Soil & Water Conservation District past/present Board of Directors
- \* Hamilton County Water Quality Coordinating Committee Members
- \* Finger Lakes – Lake Ontario Watershed Protection Alliance
- \* New York State DEC, Scott Kishbaugh, Division of Water
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- \* And especially all the private citizens of this county who have provided equipment, boat launches, and support throughout the years.

The collecting of data, analyzing, writing and editing of this report has been accomplished with the hard work of the following past and present staff of the Hamilton County Soil & Water Conservation District with special acknowledgments to: Candace Ambrosino, Alex Chaucer, Del Cook, Ian Drew, Laura Flanagan, Elizabeth Mangle, Casey Michasiow and Janice Reynolds.

## **Report Organization**

This report has been organized to first present the history of the water monitoring program and the methodologies used to help prepare the reader as to the scope and presentation. Next presented are the results starting with the county trends, then individual lake information sheets, followed by the statistical analysis. The report closes with references and appendices.

## **History**

Recognizing the need to protect our vital water resources, the Hamilton County Board of Supervisors contracted with the Hamilton County Soil and Water Conservation District in 1993 to conduct a comprehensive water monitoring program. With great foresight, the elected officials of Hamilton County decided to keep an eye on the quality of water within their political boundary. This monitoring program follows efforts dating back to the mid-seventies when public management of septic systems became a necessary reality. Increasing development along shorelines and inadequate septic systems were beginning to take their toll on lake water quality. People began to take notice and the County and State took action. Local Law # 1 of 1976 was signed into effect and stated that no sewage could be discharged into the waters of Hamilton County. The enforcement of this law was in everyone's best interest and had a measurable impact on water quality. Looking back at historical data our present water quality is now closer to data collected in the 1930's than data collected in the 1970's. Changes in lake water quality are expected over time, but they are supposed to happen over geologic time not within 20 years. In this case the change was positive due to the foresight of the local officials. Much is still unknown about the effect of lakefront and watershed growth, highway runoff and even acid precipitation. The monitoring program is in place to detect these changes.

In the beginning, the water monitoring program had limited resources and equipment. The effort was admirable and relied on volunteers, like Jay Cummings of Raquette Lake and Bob Dechene Sr., to ferry the water monitoring crew out to the sampling locations where the 6 hp outboard on the water monitoring boat would prove to be inefficient.

In 1996, the Hamilton County Soil and Water Conservation District became a member of the Finger Lakes-Lake Ontario Watershed Protection Alliance. State funds are allocated to this group to further water quality efforts in the Finger Lakes and Lake Ontario watersheds. Funds are divided equally among the twenty-five member counties. In 1997, we received the first check and were able to hire additional staff, upgrade computers, equipment, and purchase a new water monitoring boat and pro-environment (4 stroke) 25 hp outboard motor. We have continued to receive this vital funding allowing us to further our mission.

## **Purpose**

The purpose of the water monitoring program is to collect data over a long period of time and keep a watchful eye out for any changes. This is called baseline data collection. The standard minimum period of time necessary to collect baseline data before analyzing for long-term trends is currently considered to be ten years. We now have seven years of data. Within our sampling

years we have had some strange weather, which invariably will increase the time necessary to reduce the “noise” caused by such events so that we might “hear” more clearly what the lakes are trying to tell us. With these facts in mind, please read this report carefully. The data set is young and full of “noise” that can only be sorted out by continuing to monitor the water quality over time. Instead of jumping to conclusions that the sky is falling or that all is fine, enjoy instead a peek at what lies ahead in our understanding of the water quality of lakes in Hamilton County.

Lakes are dynamic and complex ecosystems, and each one is different. We will often refer to the water quality of a lake compared to the overall average water quality of Hamilton County. The purpose of this is for reference only and comparison of trends. A little knowledge can be dangerous, and we caution you not to try to draw conclusions that aren’t based on statistical analysis.

This report has been designed to be readable while providing a vast amount of technical information. Realizing that definitions for each technical term would make the report cumbersome, a glossary of terms has been included in the appendix instead. Please refer to the glossary for definitions.

With that in mind we present to the people of Hamilton County this report on  
“The State of Hamilton County Lakes 1993-1998.”

## **Section II - METHODOLOGY**

Lakes are complex systems containing plants and animals which interact in an environment created by and impacted by geology and geography. The most extensive and expensive studies cannot completely account for all conditions within the lake. By looking at some basic chemical, physical, and biological properties, however, it is possible to gain a greater understanding of the general condition of a lake. The methodology of studying lakes has come from years of research and statistical modeling. Thanks to the effort of researchers we are better able to understand and classify our lakes so that we have an even better understanding of our lakes and any changes that might occur.

The lakes involved in the study were chosen by the Hamilton County Board of Supervisors except for Fawn Lake in Lake Pleasant which was chosen for inclusion as a control since it has no development within its' watershed. A lake will remain in the study for a minimum time frame of five years before another lake can be "appointed" for monitoring in its place. To date the Soil and Water Conservation District has collected water quality data on 22 lakes and 20 of the 22 have been studied for all six years of the data set discussed in this report. The following lakes have been involved in the study:

<i>Lake</i>	<i>1993</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>
Blue Mountain Lake	x	x	x	x	x	x
Eighth Lake	x	x	x	x	x	x
Fifth Lake	x	x	x	x	x	x
Fourth Lake	x	x	x	x	x	x
Indian Lake	x	x	x	x	x	x
Lake Adirondack	x	x	x	x	x	x
Lake Algonquin	x	x	x	x	x	x
Lake Durant	x	x	x	x	x	-
Lake Eaton	x	x	x	x	x	x
Lake Pleasant	x	x	x	x	x	x
Limekiln Lake	x	x	x	x	x	x
Long Lake	x	x	x	x	x	x
Morehouse Lake	x	x	x	x	x	x
Oxbow Lake	x	x	x	x	x	x
Piseco Lake	x	x	x	x	x	x
Raquette Lake	x	x	x	x	x	x
Sacandaga Lake	x	x	x	x	x	x
Seventh Lake	x	x	x	x	x	x
Sixth Lake	x	x	x	x	x	x
Spy Lake	x	x	x	x	x	x
Fawn Lake (control)	-	-	-	-	x	x
Lake Abanakee	-	-	-	-	-	x

("x" indicates that the lake was sampled during that year)

The water monitoring crew currently launches the water monitoring boat on all but three of these lakes once a month during the months of May to October. Lake Durant has been dropped from the sampling program; Fawn Lake is not accessible by car, and Lake Adirondack has a horsepower restriction that excludes our motor. In order to sample Fawn Lake, the water monitoring crew hikes into the lake with a canoe full of equipment on a boat cart. Lake Adirondack has been handled through the generosity of its residents. Mr. Geandreau allowed us to use his row boats for many years and Mr. Bob Levinson has always made his personal motor boat available for our use.

Standard limnological sampling protocol when gathering general water quality information for a large water body is followed for the water monitoring program. In order to collect the most representative water quality data for a lake, while minimizing variation from boat traffic, recent rainfall, shoreline activities, and thousands of other variables, water samples are best collected from the deepest part of the lake. This is the portion of the lake that has the greatest volume and therefore, it has the most stable water quality. The best picture of the overall water quality of a lake can be painted from data collected in this area. While the water quality data will not represent the water quality of each individual bay, any changes to water quality in those bays will eventually impact the overall water quality and be seen in analysis of the water quality data.

To travel to all the lakes in the study and collect samples takes about a week and a day. When you add the time in the laboratory for analysis and the computer data entry and management the entire process takes two to three weeks of time for two staff members.

The Hamilton County water monitoring program as administered by the Soil and Water Conservation District takes into account chemical, physical and biological parameters. The core parameters that have been sampled for over the entire six years include: secchi disk transparency, pH, alkalinity, total phosphorous, nitrates, temperature and dissolved oxygen. Since our inclusion in the Finger Lakes-Lake Ontario Watershed Protection Alliance, we have added the following parameters: aluminum, calcium, conductivity, and chlorophyll *a*. Water samples are collected with a bomb sampler or a Kemmerer bottle and brought back to the laboratory in a cooler for analysis for some of the parameters. Other parameters are more easily measured in the field. Equipment for measurement in the field will be described with the parameter specifically being tested.

Data exists for the following parameters in the laboratory data set:

<i>Year</i>	<i>pH</i>	<i>Alk</i>	<i>Nit</i>	<i>Phos</i>	<i>DO</i>	<i>Temp</i>	<i>Secchi</i>	<i>Chl-a</i>	<i>Cond*</i>	<i>Ca*</i>	<i>Al*</i>
<b>1993</b>	x	x	x	x	x	x	x	-	-	-	-
<b>1994</b>	x	x	x	x	x	x	x	-	-	-	-
<b>1995</b>	x	x	x	x	x	x	x	-	-	-	-
<b>1996</b>	x	x	x	x	x	x	x	-	-	-	-
<b>1997</b>	x	x	x	x	x	x	x	x	-	-	-
<b>1998</b>	x	x	x	x	x	x	x	x	x	x	x

Note: Samples were also collected during the winter of 1997-1998 on some of the lakes for all 11 parameters.

## Transparency

Transparency is measured with a secchi disk which is a circular plastic disk that is divided into quarters and painted alternately white and black. The disk is lowered into the water until it can no longer be seen and the depth is recorded, then the disk is raised until it returns to view and the depth is recorded. The average of these depths is then recorded as the secchi reading.

The secchi disk transparency relates directly to the depth of the photic zone within a lake. At two times the depth where the secchi disk can no longer be seen there is only one percent of the light that penetrates the surface of the lake remaining. This is important to the plants of a lake whether rooted, or planktonic like algae or phytoplankton.

Since the depth of light penetration corresponds to particulate matter in the water, the secchi disk transparency is also a measure of the amount of plankton and algae in the water column. Plankton and algae populations are linked to nutrient levels and therefore, secchi disk transparency can be used as a measure of a lake's productivity. Since one simple measurement can provide a wealth of information, the secchi disk is a valuable tool in water quality monitoring.

The Soil & Water Conservation District provides secchi disks to volunteers who want to monitor their own lake. A report on the volunteer secchi monitoring program is included as an appendix to this report.

## pH

Measurements of pH are taken to compare lake water to neutral on a 14 point logarithmic scale where pH 7 is neutral. A pH less than 7 is acidic and a pH greater than 7 is basic. Since the scale is logarithmic, a pH change of one point represents a change of ten in the number of hydrogen ions, which determine a liquids' acidity or alkalinity. In plain terms, pH 7 is neutral, pH 5 is approximately 10 times more acidic than pH 6, pH 4 is approximately 100 times more acidic than pH 6 and so on.

For the purpose of water quality monitoring, pH is important as a measure of a lake's natural state and a measure of any impact of acid rain. The measurement is taken by dipping a probe into water and recording the measurement. For the first five years the Soil and Water Conservation District used an Orion pH meter and recently switched to a Yellow Springs Instrument (YSI) multi-probe. Both probes are low ionic strength probes for measuring water typical in Hamilton County, however the YSI multi-probe gives us the ability to record the pH in one meter increments from the surface to the bottom where the Orion was limited to the depth of a water sample.

## Alkalinity

Alkalinity is a measurement of the ability of a substance to buffer or neutralize acid. As long as a lake has a high enough alkalinity, acid rain will not cause the pH of the water body to drop. Inorganic carbon, present in the water column as carbon dioxide (CO<sub>2</sub>), bicarbonate (HCO<sub>3</sub><sup>-</sup>), and carbonate (CO<sub>3</sub><sup>2-</sup>) and ever changing between these various forms, is the major pH buffering system for lakes. The underlying geology of a watershed will determine the natural levels of these compounds and each lake will have a unique normal alkalinity. Once a lake's buffering capacity is used up, the lake will turn acidic rapidly since acid rain will continue to fall and more easily influence the pH of the lake.

The Hudson Headwaters River Watch Program method is used for testing alkalinity. A digital titrator and the Orion pH meter are used to add acid slowly to a sample of lake water until the pH reaches 4.5 the amount is recorded in digits, more acid is added until the pH reaches 4.2 the digits are recorded. Then the digits to 4.5 are multiplied by 2 and the digits to 4.2 are subtracted. This number multiplied by 0.1 and the result is alkalinity in mg/L.

The following table is used to rank lakes by their alkalinity:

<0 * mg/L:	Acidified * - and pH less than 5.0
0-2 mg/L:	Critical
2-5 mg/L:	Endangered
5-10 mg/L:	Highly Sensitive
10-20 mg/L:	Sensitive
>20 mg/L:	Not Sensitive

## Total Phosphorus

Excess concentration of the nutrient phosphorus is the most common cause of water quality problems in New York. However, some phosphorus is essential as a nutrient for plant growth and as a fundamental element in the metabolic reactions of both plants and animals. In New York, phosphorus is the nutrient that most often controls productivity of lake systems. It is often considered the "limiting" nutrient in NYS lakes, since growth is "limited by the amount of phosphorous". In other words, any addition of phosphorous to a lake system would result in more growth. Therefore, many lake management plans are centered around phosphorus controls.

Phosphorus is perhaps the most frequently sampled nutrient in any water monitoring program. Total phosphorus is a measure of all forms of phosphorus, both organic and inorganic. Total phosphorus concentrations are often directly related to the trophic condition of a lake. Excessive amounts of phosphorus lead to algae blooms and loss of oxygen in lakes. Epilimnetic total phosphorus concentrations less than 10 micrograms per liter (µg/L) are associated with oligotrophic conditions and concentrations greater than 25 µg/L are associated with eutrophic conditions.

Total phosphorus is tested using a HACH DR/3000 spectrophotometer and the EPA approved Acid Persulfate Digestion Method test to hydrolyze condensed phosphate forms to reactive

orthophosphates. This procedure is followed by an EPA-approved reactive phosphorus (orthophosphate) analysis method (low range 0-0.2 mg/L PO<sub>4</sub>) test, known as the ascorbic acid (PhosVer 3) method (standard method 425F), to determine the phosphorus concentration in the sample. The District method has a minimum detection limit of 0.010 µg/L +/- 0.010 µg/L.

### **Nitrate**

Nitrogen is much more common than phosphorus so it rarely limits plant growth. Nitrate is an inorganic form of nitrogen that occurs naturally. Ammonia is oxidized biologically to nitrate, the final oxidation state of nitrogen compounds. Nitrate is used by plants as a nutrient source, but water bodies are not as sensitive to additions of nitrates as they are to phosphorus. In the form of ammonia and nitrates, nitrogen contributes to lake eutrophication. In addition, nitrates are a component of atmospheric pollution and elevated concentrations in lakes and ponds may be associated with acidification. Elevated concentrations of nitrate may also be indicative of wastewater pollution.

Nitrate, a form of nitrogen, is an element needed by all living plants and animals to build protein. Nitrogen is one of the three main nutrients of life, along with phosphorus and carbon. In aquatic ecosystems, nitrogen is present in many forms. It is commonly found in its molecular form (N<sub>2</sub>) which makes up 79 percent of the air we breathe. This form, however, is useless for most aquatic plant growth.

A wet chemistry reduction of nitrite to nitrate (cadmium reduction) is followed by a colorimetric analysis to determine nitrate levels. A HACH DR/3000 spectrophotometer is used to measure nitrates using a low range (0-0.50 mg/L NO<sub>3</sub>-N) test.

### **Dissolved Oxygen**

The amount of oxygen dissolved in a lake can be related to many different factors, and it can provide a useful tool in understanding organic production and decomposition. The main source of oxygen for all aquatic ecosystems is the atmosphere. Much of this atmospheric oxygen readily enters the water when mixing occurs, such as through wave action. Additional O<sub>2</sub> is released during photosynthesis. Hence, higher levels of dissolved oxygen are found in the photic zone and lower levels are found deeper in the water. Since sun light is needed for photosynthesis, at night the photosynthesis stops and dissolved oxygen production stops. Plants and animals continue to consume oxygen through respiration at night including bacteria in lake sediment. In the morning dissolved oxygen levels are at their lowest.

Most aquatic plants and animals require dissolved oxygen for survival. Certain fish require high levels of oxygen to survive, such as trout and pike. Other aquatic organisms, such as carp and catfish, exist in waters of low dissolved oxygen. Some Hamilton County lakes may experience anoxic (low oxygen levels) conditions within the bottom few meters during portions of the summer. Phosphorus is released from the bottom sediments during anoxic conditions. Fish can cope with these changes in oxygen by moving up the water column in the lake where they are able to get the oxygen they need, but may be pushed into areas with less desirable temperatures.

However, over time, depletion in dissolved oxygen can cause major changes in the aquatic organism populations. Species which cannot tolerate low oxygen levels may be replaced by those which are able to tolerate the low levels. Dissolved oxygen readings are taken with a YSI multi-probe at one meter intervals.

### **Chlorophyll a**

Chlorophyll a is the primary photosynthetic pigment found in green plants, and measuring it provides information on the amount of algae in lakes. Chlorophyll a is the only form of algae that can pass electrons, excited by light energy, to produce chemical energy in photosynthesis. In some eutrophic lakes most chlorophyll is contained in large clumps of blue-green algae. Other phytoplankton is dispersed throughout the water as individuals or short filaments. Chlorophyll a concentrations can be used to classify a lake's trophic state. Chlorophyll a levels directly correlate with phosphorous and secchi disk readings and can be used to cross check data sets and to determine a lake's trophic level. Chlorophyll a concentrations less than 2 micrograms per liter ( $\mu\text{g/L}$ ) are associated with oligotrophic conditions, while concentrations greater than 8  $\mu\text{g/L}$  are associated with eutrophic conditions. Water samples are collected by the Soil and Water Conservation District and taken to a contracted outside lab for analysis.

### **Calcium**

Calcium is one of the buffering materials to acidity that occurs naturally. It is often in short supply in Adirondack lakes and ponds, making these bodies of water susceptible to acidification by acid precipitation. A measure of the amount of calcium in a lake provides additional information on the buffering capacity of that lake, and can assist in determining the timing and dosage for acid mitigation (liming) activities. Adirondack lakes containing less than 2.5 mg/L of calcium are considered to be sensitive to acidification. Calcium is also important to the development of mollusks, especially Zebra Mussels. Water samples are collected by the Soil and Water Conservation District and taken to a contracted outside lab for analysis.

### **Aluminum**

Aluminum is one of the most abundant elements found in the earth's crust. Acid rainwater leaches the aluminum from the soils, where it then may flow into nearby streams and lakes. Aluminum is also deposited through atmospheric deposition. If a lake becomes acidified, Aluminum may be leached from the sediments in the bottom of the lake as well. Elevated concentrations of aluminum can be toxic to fish in acidified water bodies, depending on the type of aluminum available, the pH, and the amount of dissolved organic carbon available to bind inorganic aluminum. Values are reported as mg/L of total dissolved aluminum. Water samples are collected by the Soil and Water Conservation District Water and taken to a contracted outside lab for analysis.

Aluminum levels over 200 mg/L in waters with a pH less than 6.2 are toxic to fish. At these levels an aluminum ion precipitates on the fish's gills and interferes with mineral transfers between the blood and water. The fish then produces a mucus to remove the toxic aluminum ions

from the gills, but this also prevents an efficient transfer of oxygen. The build up of mucus does not allow proper ion transfer between the fish and the water and eventually causes respiratory stress and an imbalance of blood minerals that kills the fish.

### **Statistical Analysis**

Data for these analyses were provided by the Soil and Water Conservation District in digital form (spreadsheets and database files) to the Adirondack Aquatic Institute. All data were assumed to be correct and were generally used as is. Corrections were made to data where obvious outliers were observed and where decimal error may have been made during data entry. These were noted in the text, however.

Climate data was extracted from National Climatic Data Center (NCDC) records. Graphical analyses were prepared using SigmaPlot software v.5 (SPSS). Seasonal averages for each year consist of all data from May through September. Error bars shown represent the 95% confidence intervals for the data.

## **Section III – HAMILTON COUNTY TRENDS**

### *Climatic Conditions*

According to the NCDC weather station at Indian Lake, NY, the annual mean minimum temperatures for 1993-1998 were relatively constant, with a depression in the mean values in 1995, and a slight elevation in the mean values in 1998 (Figure 1 – please refer to Appendix C for all figures in section III). The annual mean minimum temperature over all the study years was 28° F. The annual mean maximum temperatures were also relatively constant, with a depression in 1995, and a slight elevation in the mean values in 1998. The annual mean maximum temperature over all the study years was 49° F. The annual precipitation totals for 1993-1998 were relatively constant from year to year, with a mean annual precipitation over all the study years of 38.5 inches (Figure 2).

The seasonal mean daily maximum temperatures (May through September) for 1993 through 1997 were relatively constant, with a slight decrease over the years (Figure 3). The seasonal mean daily minimum temperatures (May through September) for 1993 through 1997 were relatively constant, with a depression in 1995 and 1997. The mean daily maximum and minimum temperatures for the month of May from 1993 through 1997 showed a marked decrease over the years (Figure 4). The mean daily maximum and minimum temperatures for the months of June and July were relatively constant each year.

According to the NCDC weather station at Hope, NY, the maximum snow depth on the ground in March of 1993 and 1994 was much greater than in 1995-1997 (Figure 5). In 1993 and 1994, 16-18 inches of snow melted between March and April, as opposed to 2-4 inches melting between March and April of 1995-1997. The NCDC weather station at Newcomb, NY showed a similar pattern (Figure 6).

### **Current (1998) Conditions**

In 1998, the mean pH for all the lakes in the county was 7.06. The mean alkalinity was 6.22 mg/L. The mean total phosphorous was 0.016 µg/L, and the mean nitrate concentration was 0.10 mg/L. The mean transparency was 4.44 m, and the mean chlorophyll *a* value was 4.17 mg/L.

#### Temperature and Dissolved Oxygen

A county-wide mean temperature and dissolved oxygen trend were not determined since the lakes vary so widely in size and morphology.

#### **pH**

The lowest mean pH for all the Hamilton County lakes occurred in 1996 (5.62), and the highest mean pH occurred in 1998 (7.06). The general county mean trend was a relatively stable neutral pH from 1993 through 1998, with a depression in pH levels in 1995 and 1996 (Figure 7).

## Alkalinity

The lowest mean alkalinity for all the Hamilton County lakes occurred in 1996 (4.82 mg/L), and the highest mean alkalinity occurred in 1993 (6.65 mg/L). The general county mean trend was a relatively constant alkalinity from 1993 through 1998, with a depression in alkalinity levels in 1995 and 1996 (Figure 8).

## Total Phosphorus

The lowest mean total phosphorus for all the Hamilton County lakes occurred in 1994 and 1996 (0.014 µg/L), and the highest mean total phosphorus occurred in 1993 (0.028 µg/L). The general county mean trend was relatively constant, moderate levels of total phosphorus, with higher values in 1993 and 1995 (Figure 9; see Discussion section). Excluding the 1993 and 1995 values, there is some indication that total phosphorus may be increasing with time.

## Nitrate

The lowest mean nitrate concentration for all the Hamilton County lakes occurred in 1995 (0.09 mg/L), and the highest mean nitrate concentration occurred in 1994 (0.16 mg/L). The general county mean trend was low but relatively constant mean nitrate values from 1993 through 1998 (Figure 10). The variability apparent in Figure 10 is insignificant since no values were greater than 0.2 mg/L.

## Chlorophyll a

Chlorophyll *a* analysis was only performed for two years, 1997 and 1998, so a trend in chlorophyll *a* could not be determined. The mean chlorophyll *a* values for all the Hamilton County lakes did increase from 1997 to 1998 (Figure 11), but this is likely due at least in part to a change in contract laboratories and analytical methodology (see Discussion section).

## Transparency

The lowest mean transparency (Secchi disk) value for all the Hamilton County lakes occurred in 1996 (4.36 m), and the highest mean transparency value occurred in 1993 (5.20 m). The general county mean trend was relatively constant values from 1993 through 1998, with some indication that lake transparency is decreasing with time (Figure 12).

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### Lake Sheets – Pages LS 1 through LS 44

Due to large amount of graphs on each of the Lake Sheets, and to conserve WEB space we have elected to make the individual Lake Sheets for each of the 22 Lakes which the District has been and is currently monitoring available upon request .

Please direct your request(s) to:

Hamilton County SWCD  
PO Box 166 Route 8  
Lake Pleasant, NY 12108

.....Or you may use the request form elsewhere at this site.

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## **Section V - Discussion**

### **Climate**

Climatic conditions were relatively stable throughout the study period (1993 - 1998). There was a drop in annual mean minimum and maximum temperatures in 1995 (Figure 1). An examination of the seasonal mean temperatures (May - September) during that same time period show that the mean daily maximum temperatures were relatively stable, but the mean daily minimum temperature also shows a drop in 1995 and 1997 (Figure 3). A further examination of monthly mean minimum and maximum temperatures for May, June and July show that, in general, May temperatures declined over the study period, while temperatures in June and July have remained relatively constant (Figure 4).

The amount of spring runoff was apparently greater during the earlier years of the program. A comparison of maximum snow on the ground shows the greatest amounts in March during 1993 and 1994 (Figure 5 & 6). Maximum snow on the ground in April was low in all study years. Therefore, relatively intensive snow melt events should have occurred in the spring of 1993 and 1994.

### **Water Quality**

The county lakes exhibited a trend of decreasing pH and alkalinity between 1993 and 1996, followed by a return to 1993 levels (Figure 7 & 8). This trend may be related to snow melt depression, which we know was particularly intensive in 1994. No other parameter shows any particular trend throughout the study period.

Based upon the county averages, the Hamilton County lakes exhibit good water quality overall. Values of pH and alkalinity are good and may be increasing in most recent years. The data do suggest, however, that total phosphorus may be increasing while transparency may be decreasing. This increasing productivity could be responsible for the increasing alkalinity and pH.

Examining the individual lakes, it can be observed that several lakes differ markedly from the County average. With respect to pH, the following lakes had somewhat higher than average pH values: Blue Mountain Lake, Eighth Lake, Lake Adirondack, Sacandaga Lake, Sixth Lake. The following lakes had significantly lower than average pH values: Limekiln Lake, Morehouse Lake.

With respect to alkalinity, the following lakes had significantly higher than average alkalinity values: Eighth Lake, Lake Adirondack, Sixth Lake. The following lakes had somewhat higher than average alkalinity values: Fifth Lake, Fourth Lake, Lake Algonquin, Lake Pleasant, Sacandaga Lake. The following lakes had significantly lower than average alkalinity values: Fawn Lake, Indian Lake, Lake Durant, Lake Eaton, Limekiln Lake, Long Lake, Morehouse Lake, Raquette Lake, Spy Lake. The following lakes had somewhat lower than average alkalinity values: Blue Mountain Lake, Lake Abanakee, Piseco Lake.

With respect to phosphorus, the majority of lakes exhibited mean values similar to the county average, and the 95% confidence intervals were greater than with other parameters. The following lakes had somewhat higher than average phosphorus values: Lake Adirondack, Oxbow Lake. The following lakes had somewhat lower than average phosphorus values: Limekiln Lake, Sixth Lake.

Nitrate values were extremely low in the county lakes. The highest seasonal mean value was less than 0.2 mg/L. Therefore, the differences between individual lakes and the county average are insignificant.

With respect to chlorophyll *a*, the following lakes had somewhat higher than average chlorophyll *a* values: Fawn Lake (1998), Indian Lake, Lake Adirondack, Spy Lake. The following lakes had significantly lower than average chlorophyll *a* values: Lake Eaton (1998). The following lakes had somewhat lower than average chlorophyll *a* values: Blue Mountain Lake, Eight Lake, Fifth Lake, Limekiln Lake, Sacandaga Lake, Seventh Lake, Sixth Lake (1998).

With respect to transparency, the following lakes had significantly higher than average transparency values: Blue Mountain Lake, Limekiln Lake. The following lakes had somewhat higher than average transparency values: Eight Lake, Fawn Lake, Fourth Lake, Lake Eaton, Morehouse Lake, Seventh Lake, Sixth Lake. The following lakes had significantly lower than average transparency values: Lake Abanakee, Lake Adirondack, Algonquin Lake, Lake Durant, Oxbow Lake. The following lakes had somewhat lower than average transparency values: Fifth Lake, Long Lake, Piseco Lake (except 1996 & 1997), Sacandaga Lake (except 1998), Spy Lake. Raquette Lake had somewhat higher than average transparency in 1993 - 1994, average transparency in 1995 - 1996, and somewhat lower than average transparency in 1997 - 1998.

### **Data Integrity**

There is a normal amount of data variability that can be expected when dealing with data from natural (environmental) systems over the course of a monitoring season. The amount of natural variability is different for each parameter. Some parameters, such as chlorophyll *a* and transparency can be dramatically different in a lake from one month to the next. This natural variability leads to larger error bars when examining seasonal means. Other parameters, such as pH, alkalinity and nutrients such as total phosphorus may change throughout a monitoring season, but that change is typically gradual from one month to the next. Seasonal mean error should therefore be much smaller with these parameters. The exception would be a lake that exhibits a significant increase in one of these parameters over time. For instance, if a lake experiences a pH depression in the spring but quickly recovers during the summer, the seasonal mean error would still be high.

There are two issues that are evident in examining the Hamilton County data. The first relates to total phosphorus values. It is apparent that there were some problems with laboratory results during the first few years of monitoring. A long-term trend of total phosphorus data for these lakes should be a relatively straight line. The data show, however, high values in 1993. The bigger issue with total phosphorus values from SWCD is that the Hach kit has a minimum

detection limit of  $0.010 \mu\text{g/L} \pm 0.010 \mu\text{g/L}$ . Therefore, the SWCD analytical capability is not low enough for the lakes that are being monitored.

The second issue relates to chlorophyll *a*. In 1998, the chlorophyll *a* analyses were conducted by AAI using the trichromatic method. This method provides a more consistent result than monochromatic methods typically employed by other laboratories, but also tends to yield higher results since it does not include a correction for pheophyton. This correction is not typically required in samples that are not acidic and/or that have been treated with  $\text{MgCO}_3$  during filtration and processed or frozen promptly.

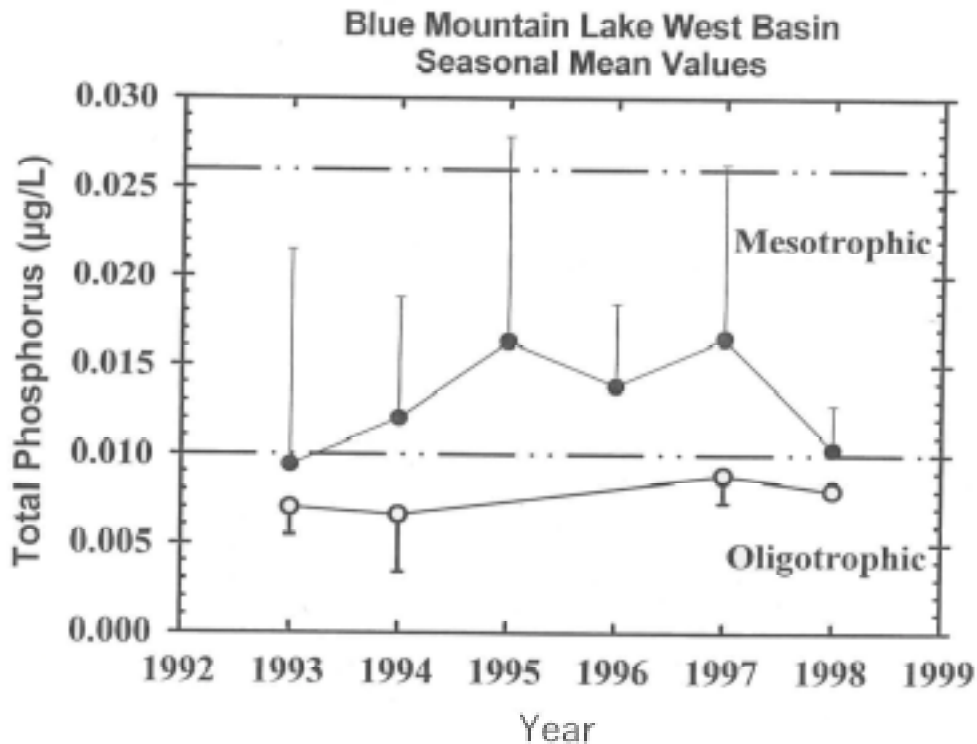


Figure A Comparison of seasonal mean total phosphorus concentrations in Blue Mountain Lake. White circles are data collected and analyzed by AAI, dark circles are data collected and analyzed by SWCD. Error bars equal 95% confidence intervals.