2004 INTERPRETIVE SUMMARY

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

FINDLEY LAKE

NY Federation of Lake Associations
NYS Department of Environmental Conservation

October, 2005

BACKGROUND AND ACKNOWLEDGMENT

The Citizens Statewide Lake Assessment Program (CSLAP) is a volunteer lake monitoring program conducted by the NYS Department of Environmental Conservation (NYSDEC) and the NYS Federation of Lake Associations (FOLA). Founded in 1986 with 25 pilot lakes, the program has involved more than 200 lakes, ponds, and reservoirs and 1000 volunteers from eastern Long Island to the Northern Adirondacks to the western-most lake in New York, including 10 acre ponds to several Finger Lakes, Lake Ontario, Lake George, and lakes within state parks. In this program, lay volunteers trained by the NYSDEC and FOLA collect water samples, observations, and perception data every other week in a fifteen-week interval between May and October. Water samples are analyzed by certified laboratories. Analytical results are interpreted by the NYSDEC and FOLA, and utilized for a variety of purposes by the State of New York, local governments, researchers, and, most importantly, participating lake associations. This report summarizes the 2004 sampling results for **Findley Lake**.

Findley Lake is a 307 acre, class B lake found in the Town of Findley Lake in Chautauqua County, in (far) western New York State. It has been sampled as part of CSLAP since 1986. The following volunteers have participated in CSLAP, and deserve most of the credit for the success of this program at **Findley Lake**: **J. Ringo, John Henry, James R. Rothenberger, James H. Altman, Louis J. Passmore, G. Kowalski, Myra Bowers, Peggy Nasar, Jim Martin, Don and Marti Keppel, Mark and Karen Matrozza and Randy Boerst.**

In addition, the authors wish to acknowledge the following individuals, without whom this project and report would never have been completed:

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From the Federation of Lake Associations, Anne Saltman, Dr. John Colgan, Don Keppel, Bob Rosati, Nancy Mueller and the Board of Directors, for their continued strong support of CSLAP.

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Finally, but most importantly, the authors would like to thank the more than 1000 volunteers who have made CSLAP a model for lay monitoring programs throughout the country and the recipient of a national environmental achievement award. Their time and effort have served to greatly expand the efforts of the state and the public to protect and enhance the magnificent water resources of New York State.

FINDLEY LAKE
FINDINGS AND EXECUTIVE SUMMARY

Findley Lake was sampled as part of the New York Citizens Statewide Lake Assessment Program in 2004. For all program waters, water quality conditions and public perception of the lake each year and historically have been evaluated within annual reports issued after each sampling season. This report attempts to summarize both the 2004 CSLAP data and an historical comparison of the data collected within the 2004 sampling season and data collected at Findley Lake prior to 2004.

The majority of the short- and long-term analyses of the water quality conditions in Findley Lake are summarized in Table 2, divided into assessments of eutrophication indicators, other water quality indicators, and lake perception indicators. The 2003 and (to a lesser extent) the 2004 data indicate that the lake can be best classified as mesotrophic, or moderately productive, the “lowest” productivity classification yet measured at the lake. Phosphorus and algae levels were substantially lower and lake clarity was slightly higher for the last two years than in the typical sampling season, and perhaps this is an indication of lower lake productivity in the future. While the nitrogen to phosphorus ratios indicate that algae levels in Findley Lake may be influenced by both nitrogen and phosphorus, there remains a strong statistical correlation between phosphorus, algae, and water transparency. Findley Lake becomes more productive (lower clarity, higher nutrient and algae levels) in late summer and fall, due in part to elevated deepwater nutrient (although these readings have also been lower in the last two years), and it is likely that management geared toward improving water clarity will require addressing nutrient loading to the lake. Phosphorus levels in the lake regularly exceed the state phosphorus guidance value, and water transparency readings occasionally fall below the minimum recommended water clarity for swimming beaches, but these “violations” were much less frequent in 2003 and 2004.

The lake is weakly to moderately colored (low levels of dissolved organic matter) and it is likely that these readings reflect the soil and vegetation characteristics of the watershed (i.e. “natural” conditions at the lake). Color readings are not high enough to exert limits on the water transparency, even when algae levels are very low. Findley Lake has moderately hard water, alkaline (above neutral) pH readings, and low but mostly detectable nitrate readings. Conductivity readings do not vary much over the course of the sampling season, and have varied somewhat unpredictably from year to year. pH readings mostly fall between the NYS water quality standards (=6.5 to 8.5). Nitrate and ammonia levels do not appear to warrant a threat to the lake or human health, and the primary component of nitrogen appears to be organic (bound in algae cells). Calcium levels are high enough to support zebra mussel populations, although these have not yet been observed at Findley Lake.

The recreational suitability of Findley Lake has mostly been stable (especially in recent years), if somewhat unfavorable. Recreational conditions in the lake have most often been described as “slightly impaired” for most recreational uses, and the lake was also most often described as (having) “definite algal greenness”, mostly consistent with assessments in other lakes with similar water quality conditions. In general, assessments about how the lake looks are sensitive to changes in measured water clarity. Aquatic plants regularly grow to the lake surface, and continue to impact recreation. Recreational assessments generally degrade during the summer, coincident with seasonal changes in water quality and weed densities.

Findley Lake is presently among the lakes listed on the Allegany River drainage basin PWL (1999), with *aesthetics, fishing and fish survival* listed as *impaired* due to excessive nutrients, algae and weeds, and reduced water clarity. As a result, the lake is on the federal 303(d) list. The CSLAP data indicate that these listings are usually warranted, although this may change if water quality conditions continue to improve. The next PWL review cycle for this drainage basin will occur by 2005.

General Comments and Questions:

- ***What is the condition of Findley Lake?***

Water quality monitoring in Findley Lake historically indicated that the lake possesses relatively high nutrient (particularly phosphorus) readings, resulting in "slightly" to "substantially" impaired recreational conditions. In 2003 and 2004, however, nutrient and algae levels were lower, resulting in a rise in water clarity, although recreational assessments did not substantially improve. This may be due to the continuing presence of nuisance weeds, although the dominant plants may have changed from exotic plants (Eurasian watermilfoil) to native plants (leafy pondweed).

- ***What about the dark and murky bottom waters of the lake?***

In 2003 and 2004, nutrient levels at the lake bottom were comparable to those at the lake surface, although historically highly elevated readings suggested the bottom waters are poorly oxygenated and contribute to increases in surface water nutrient levels throughout the summer. This deepwater oxygen deficit was recorded in the lake at least back to the 1930s.

- ***How does this condition change from spring showers thru the changing of the leaves?***

Nutrient levels in Findley Lake increase significantly during the summer and fall, contributing to an increase in algae levels and decrease in water clarity over the same period. Recreational assessments of the lake degrade over the same period seasonally, although this might also be related to a higher density and coverage of aquatic plants (weeds) as the summer progresses, and the change in recreational conditions are less dramatic than the water quality changes over this period.

- ***How has the condition changed since CSLAP sampling began on the lake and/or relative to historical values?***

Water quality conditions were much more favorable (higher clarity, lower nutrient and algae levels) in 2003 and 2004 than in previous years, although at present it is not known if these "improvements" are part of a longer term trend toward lower lake productivity.

- ***How does Findley Lake compare to other similar lakes (nearby lakes, same lake use, etc.)?***

In 2003 and 2004, Findley Lake was about as productive (similar clarity, nutrient and algae levels) and as other Class B, Allegany River basin and other NYS lakes, although the recreational assessment of the lake was less favorable, due at least in part to the continuing influence of invasive weeds.

- ***Based on these data, what should be done to improve or maintain Findley Lake?***

Recreational assessments apparently continue to be dominated by excessive weed growth; as such, the lake association should continue to be actively involved in controlling the spread of nuisance weeds. However, recreational conditions may have been positively influenced by increased water clarity, and thus any efforts that were successful in reducing lake productivity should continue to be followed in the future. Given the lower nutrient and algae levels in the lake in recent years, it appears that any of these nutrient abatement strategies have been successful.

Context and Qualifiers

The NY Citizens Statewide Lake Assessment Program (CSLAP) is intended to be a long-term, standardized, trophic-based water quality monitoring program to facilitate comparison of water quality data from season to season, year to year, and from lake to lake. The data and information collected through CSLAP can be utilized to identify water quality problems, detect seasonal and long-term patterns, and educate sampling volunteers and lake residents about water quality conditions and stressors at their lakes. It is particularly useful in evaluating the over-enrichment of aquatic plant (algae and rooted plant) communities in a lake, and the response of the lake to these trophic stressors.

Shorefront residents, lake managers, and government agencies are increasingly tasked to better assess and evaluate water quality conditions and lake uses in NYS lakes, including those sampled through CSLAP, whether to address localized problems, meet water quality standards, satisfy state and federal environmental reporting requirements, or enhance and balance a suite of lake uses. CSLAP data should be a part of this process, but only a part. For some lakes, particularly small lakes and ponds with limited public access by those who don't reside on the lake shore, CSLAP may be the sole source of data used to assess lake conditions. In addition, studies conducted through CSLAP find strong similarities between sampling sites in many, but not all, large lakes, and generally find a strong convergence of perceptions about lake and recreational use conditions within most lakes, based on a local familiarity with "normal" conditions and factors that might affect lake use. For the purpose of broad water quality evaluations and understanding the connection between measured water quality indicators and the support of broadly-based recreational uses of the lake, CSLAP can be a singularly effective tool for standardizing the lake assessment process. CSLAP volunteers, lake associations, and others engaged in lake assessment and management should continue to utilize CSLAP in this context.

However, for large, multi-use lakes, or those lakes that are threatened by pollutants not captured in eutrophication-based monitoring programs, CSLAP becomes a less effective primary tool for assessing lake condition and use impairments. For example, CSLAP data have only limited utility in evaluating the following:

(a) contamination from bacteria or other biological toxins, particularly related to the safety of water use for potable intake or swimming
(b) contamination from inorganic (e.g., metals) and organic (e.g., PCBs, DDT) compounds
(c) portions of a lake not well-mixed with the "open water" or otherwise distant from the primary sampling site(s), including the shoreline, bottom sediment and isolated coves
(d) rooted aquatic plant impacts in areas of the lake not evaluated by the sampling volunteers
(e) diverging perceptions of recreational use impacts, particularly in lakes with shorelines or isolated coves exhibiting conditions very different from those sampled or evaluated by the sampling volunteers
(f) impacts to fish or other fauna due to factors unrelated to eutrophication
(g) PWL or 303(d) listings for other pollutants or portions of the lake not sampled through CSLAP

For these waterbodies, CSLAP can and should continue to be part of an extensive database used to comprehensively evaluate the entirety of the lake and its uses, but absent a more complete dataset, CSLAP data should be used with caution as a sole means for evaluating the lake. Water quality evaluations, recommended PWL listings, and other extrapolations of the data and analyses should be utilized in this context, and by no means should be considered "the last word" on the lake.

I. INTRODUCTION: CSLAP DATA AND YOUR LAKE

Lakes are dynamic and complex ecosystems. They contain a variety of aquatic plants and animals that interact and live with each other in their aquatic setting. As water quality changes, so too will the plants and animals that live there and these changes in the food web also may additionally affect water quality. Water quality monitoring provides a window into the numerous and complex interactions of lakes. Even the most extensive and expensive monitoring program cannot **completely assess** a lake's water quality. However, by looking at some basic chemical, physical, and biological properties, it is possible to gain a greater understanding of the general condition of lakes. CSLAP monitoring is a basic step in overall water quality monitoring.

Understanding Trophic States

All lakes and ponds undergo **eutrophication,** an aging process, which involves stages of succession in biological productivity and water quality (see Figure 1). **Limnologists** (scientists who study fresh water systems) divide these stages into **trophic** states. Each trophic state can represent a wide range of biological, physical, and chemical characteristics and any lake may "naturally" be categorized within any of these trophic states. In general, the increase in productivity and decrease in clarity corresponds with an enrichment of nutrients, plant and animal life. Lakes with low biological productivity and high clarity are considered **oligotrophic**. Highly productive lakes with low clarity are considered **eutrophic**. Lakes that are **mesotrophic** have intermediate or moderate productivity and clarity. It is important to remember that eutrophication is a natural process, and is not necessarily indicative of man-made pollution.

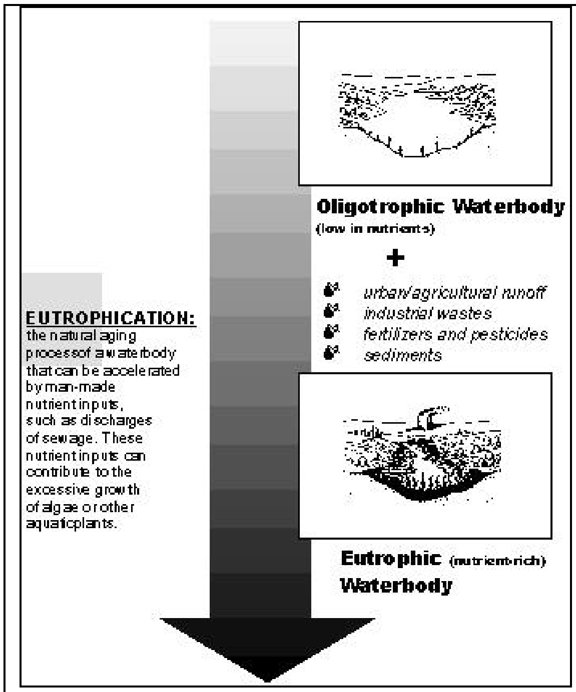


Figure 1. Trophic States

In fact, some lakes are thought to be "naturally" productive. Trophic classifications are not interchangeable with assessments of water quality. One person's opinion of degradation may be viewed by others as harmless or even beneficial. For example, a eutrophic lake may support an excellent warm-water fishery because it is nutrient rich, but a swimmer may describe that same lake as polluted. A lake's trophic state is still important because it provides lake managers with a reference point to view changes in a lake's water quality and begin to understand how these changes may cause **use impairments** (threaten the use of a lake or swimming, drinking water or fishing)**.**

When human activities accelerate lake eutrophication, it is referred to as **cultural eutrophication**. Cultural eutrophication may result from shoreline erosion, agricultural and urban runoff, wastewater discharges or septic seepage, and other nonpoint source pollution sources. These can greatly accelerate the natural aging process of lakes, cause succession changes in the plant and animal life within the lake, shoreline and surrounding watershed, and impair the water quality and value of a lake. They may ultimately extend aquatic plants and emergent vegetation throughout the lake, resulting in the transformation of the lake into a marsh, prairie, and forest. The extent of cultural eutrophication, and the corresponding pollution problems, can be signaled by significant changes in the trophic state over a short period of time.

II. CSLAP PARAMETERS

CSLAP monitors several parameters related to the trophic state of a lake, including the clarity of the water, the amount of nutrients in the water, and the amount of algae resulting from those nutrients. Three parameters are the most important measures of eutrophication in most New York lakes: **total phosphorus, chlorophyll *a*** (estimating the amount of algae), and **Secchi disk transparency**. Because these parameters are closely linked to the growth of weeds and algae, they provide insight into "how the lake looks" and its suitability for recreation and aesthetics. Other CSLAP parameters help characterize water quality at the lake while balancing fiscal and logistic necessities. In addition, CSLAP also uses the responses on the **Field Observation Forms** to gauge volunteer perceptions of lake water quality. Most water quality "problems" arise from impairment of accepted or desired lake uses, or the perception that such uses are somehow degraded. As such, any water quality monitoring program should attempt to understand the link between perception and measurable quality.

The parameters analyzed in CSLAP provide valuable information for characterizing lakes. By adhering to a consistent sampling protocol provided in the CSLAP Sampling Protocol, volunteers collect and use data to assess both seasonal and yearly fluctuations in these parameters, and to evaluate the water quality in their lake. By comparing a specific year's data to historical water quality information, lake managers can pinpoint trends and determine if water quality is improving, degrading or remaining stable. Such a determination answers a first critical question posed in the lake management process.

Ranges for Parameters Assessing Trophic Status and Findley Lake

The relationship between phosphorus, chlorophyll *a*, and Secchi disk transparency has been explored by many researchers, to assess the trophic status (the degree of eutrophication) of lakes. Figure 2 shows ranges for phosphorus, chlorophyll a, and Secchi disk transparency (summer median) are representative for the major trophic classifications:

Figure 2. Trophic Status Indicators

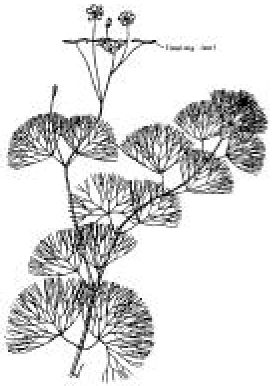
Parameter	Eutrophic	Mesotrophic	Oligotrophic	Findley Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.035**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**32.8**
Secchi Disk Clarity (m)	2	2- 5	> 5	**1.6**

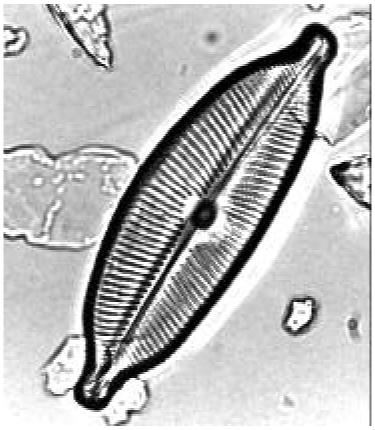
These classifications are valid for clear-water lakes only (with less than 30 platinum color units). Some humic or "tea color" lakes, for example, naturally have dissolved organic material with greater than 30 color units. This will cause the water transparency to be lower than expected given low phosphorus and chlorophyll *a* levels in the lake. Water transparency can also be unexpectedly lower in shallow lakes, due to influences from the bottom (or the inability to measure the maximum water clarity due to the visibility of the Secchi disk on the lake bottom). Even shallow lakes with high water clarity, low nutrient concentrations, and little algal growth may also have significant weed growth due to shallow water conditions. While such a lake may be considered unproductive by most standards, that same lake may experience severe aesthetic problems and recreational impairment related to weeds, not trophic state. Generally, however, the trophic relationships described above can be used as an accurate "first" gauge of productivity and overall water quality.

Figure 3. CSLAP Parameters

PARAMETER	SIGNIFICANCE
Water Temperature (°C)	Water temperature affects many lake activities, including the rate of biological growth and the amount of dissolved oxygen. It also affects the length of the recreational season
Secchi Disk Transparency (m)	Determined by measuring the depth at which a black and white disk disappears from sight, the Secchi disk transparency estimates the clarity of the water. In lakes with low color and rooted macrophyte ("weed") levels, it is related to algal productivity
Conductivity (µmho/cm)	Specific conductance measures the electrical current that passes through water, and is used to estimate the number of ions (charged particles). It is somewhat related to both the hardness and alkalinity (acid-buffering capacity) of the water, and may influence the degree to which nutrients remain in the water. Generally, lakes with conductivity less than 100 µmho/cm are considered softwater, while conductivity readings above 300 µmho/cm are found in hardwater lakes.
pH	pH is a measure of the (free) hydrogen ion concentration in solution. Most clearwater lakes must maintain a pH between 6 and 9 to support most types of plant and animal life. Low pH waters (<7) are acidic, while high pH waters (>7) are basic
Color (true) (platinum color units)	The color of dissolved materials in water usually consists of organic matter, such as decaying macrophytes or other vegetation. It is not necessarily indicative of water quality, but may significantly influence water transparency or algae growth. Color in excess of 30 ptu indicate sufficient quantities of dissolved organic matter to affect clarity by imparting a tannic color to the water.
Phosphorus (total, mg/l)	Phosphorus is one of the major nutrients needed for plant growth. It is often considered the "limiting" nutrient in NYS lakes, for biological productivity is often limited if phosphorus inputs are limited. Nitrogen to phosphorus ratios of >10 generally indicate phosphorus limitation. Many lake management plans are centered around phosphorus controls. It is measured as total phosphorus (TP)
Nitrogen (nitrate, ammonia, and total (dissolved), mg/l)	Nitrogen is another nutrient necessary for plant growth, and can act as a limiting nutrient in some lakes, particularly in the spring and early summer. Nitrogen to phosphorus ratios < 7 generally indicate nitrogen limitation (for algae growth). For much of the sampling season, many CSLAP lakes have very low or undetectable levels of one or more forms of nitrogen. It is measured in CSLAP in three forms- nitrate/nitrite (NO_x) ammonia ($NH_{3/4}$), and total nitrogen (TN or TDN).
Chlorophyll *a* (µg/l)	The measurement of chlorophyll *a*, the primary photosynthetic pigment found in green plants, provides an estimate of phytoplankton (algal) productivity, which may be strongly influenced by phosphorus
Calcium (mg/l)	Calcium is a required nutrient for most aquatic fauna, and is required for the shell growth for zebra mussels (at least 8-10 mg/l) and other aquatic organisms. It is naturally contributed to lakes from limestone deposits and is often strongly correlated with lake buffering capacity and conductivity.

By each of the trophic standards described above, Findley Lake would be considered to be a **eutrophic, or highly productive, lake. However, while this was a consistent assessment for each of the first fifteen CSLAP sampling seasons at the lake, the lake has been mesotrophic, or moderately productive, the last two years.**





III. AQUATIC PLANTS

Macrophytes:

Aquatic plants should be recognized for their contributions to lake beauty as well as for providing food and shelter for other life in the lake. Emergent and floating plants such as water lilies floating on the lake surface may provide aesthetic appeal with their colorful flowers; sedges and cattails help to prevent shoreline erosion, and may provide food and cover for birds. Submergent plants like pondweeds and leafy waterweed harbor insects, provide nurseries for amphibians and fish, and provide food for birds and other animals. Those who enjoy fishing at the lake appreciate a diverse plant population. Aquatic plants can be found throughout the *littoral zone*, the near-shore areas in which sufficient light reaches the lake bottom to promote photosynthesis. Plant growth in any particular part of the lake is a function of available light, nutrition and space, bottom substrate, wave action, and other factors, and extensive plant growth can occur in both "clean" and "polluted" lakes. A large portion of aquatic vegetation consists of the microscopic algae referred to as phytoplankton; the other portion is the larger rooted plants called **macrophytes.**

Of particular concern to many lakefront residents and recreational users are the *non-indigenous macrophytes* that can frequently dominate a native aquatic plant community and crowd out more beneficial plant species. The invasive plant species may be introduced to a lake by waterfowl, but in most cases they are introduced by fragments or seedlings that remain on watercraft from already-infested lakes. Once introduced, these species have tenacious survival skills, crowding out, dominating and eventually aggressively overtaking the indigenous (native) plant communities in a variety of water quality conditions. When this occurs, they interfere with recreational activities such as fishing, swimming or water-skiing. **These species need to be properly identified to be effectively managed.**

Non-native Invasive Macrophyte Species

Examples of **the common non-native invasive species found** in New York are:

- **Eurasian watermilfoil** *(Myriophyllum spicatum)*
- **Curly-leaf pondweed** *(Potamogeton crispus)*
- **Eurasian water chestnut** *(Trapa natans)*
- **Fanwort** *(Cabomba caroliniana).*

If these plants are not present, efforts should be made to continue protecting the lake from the introduction of these species.

Whether the role of the lake manager is to better understand the lake ecosystem or better manage the aquatic plant community, knowledge of plant distribution is paramount to the management process. There are many procedures available for assessing and monitoring aquatic vegetation. The CSLAP Sampling Protocol contains procedures for a "semi-quantitative" plant monitoring program. Volunteers collect plant specimens and provide field information and qualitative abundance estimates for an assessment of the macrophyte communities within critical areas of the lake. While these techniques are no substitute for professional plant surveys, they can help provide better information for lake managers. Lake associations planning to devote significant time and expenditures toward a plant management program are advised to pursue more extensive plant surveying activities.

Aquatic plant surveys conducted through CSLAP at Findley Lake have identified the following aquatic plants. Surveys conducted by the lake association independent of CSLAP in 2002 indicated the presence of *Potamogeton foliosus*, or leafy pondweed.

Species	CommonName	Exotic?	Type	Date	Location	%Cover	Abundance	Bottom
M.spicatum	Eurasian watermilfoil	yes	submergent	8/25/1990	site 1-Paradise Bay	4	scarce	mud
M.verticillatum	whorled watermilfoil	no	submergent	8/25/1990	site 1-Paradise Bay	6	scarce	mud
M.verticillatum	whorled watermilfoil	no	submergent	8/25/1990	site 2-Paradise Bay	4	scarce	mud
M.verticillatum	whorled watermilfoil	no	submergent	8/25/1990	site 3-Paradise Bay	1	scarce	mud
N.flexilis	bushy pondweed	no	submergent	8/25/1990	site 1-Paradise Bay	90	abundant	mud
N.flexilis	bushy pondweed	no	submergent	8/25/1990	site 2-Paradise Bay	96	abundant	mud
N.flexilis	bushy pondweed	no	submergent	8/25/1990	site 3-Paradise Bay	99	abundant	mud

So what do these survey results tell us…?

Some of the aquatic plants identified through CSLAP at Findley Lake are invasive or exotic species (Eurasian watermilfoil) that are typically associated with nuisance conditions- such conditions have existing for many years at Findley Lake. However, in recent years, it appears that native plants, such as the leafy pondweed, have spread and taken over at least portions of the lake previously colonized by Eurasian watermilfoil- it is believed that this is the result of herbivorous activity of native weevils on the milfoil plants. That said, the CSLAP use impairment (perception) surveys suggest that invasive conditions continue to occur, even with these native plants.

The Other Kind of Aquatic Vegetation

Microscopic algae referred to as phytoplankton make up much of aquatic vegetation found in lakes. For this reason, and since phytoplankton are the primary producers of food (through photosynthesis) in lakes, they are the most important component of the complex food web that governs ecological interactions in lakes.

In a lake, phytoplankton communities are usually very diverse, and are comprised of hundreds of species having different requirements for nutrients, temperature and light. In many lakes, including those of New York, diatom populations are greatest in the spring, due to a competitive advantage in cooler water and relatively high levels of silica. In most lakes, however, diatom densities rarely reach nuisance portions in the spring. By the summer, green algae take advantage of warmer temperatures and greater amounts of nutrients (particularly nitrogen) in the warm water and often increase in density. These alga often grow in higher densities than do diatoms or most other species, although they are often not the types of algae most frequently implicated in noxious algae blooms. Later in the summer and in the early fall, blue green algae, which possess the ability to utilize atmospheric nitrogen to provide this required nutrient, increase in response to higher phosphorus concentrations. This often happens right before turnover, or destratification in the fall. These alga are most often associated with taste and odor problems, bloom conditions, and the "spilled paint" slick that prompts the most complaints about algae. Each lake possesses a unique blend of algal communities, often varying in population size from year to year, and with differing species proportional in the entire population. The most common types range from the aforementioned diatoms, green, and blue-green algae, to golden-brown algae to dinoflagellates and many others, with any given species able to dominate each lake community.

So how can this be evaluated through CSLAP? While algal differentiation is important, many CSLAP lake associations are primarily interested in "how much?", not "what kind?", and this is assessed through the chlorophyll *a* measurement. Phytoplankton communities have not been regularly identified and monitored through CSLAP, in part due to the cost and difficulty in analyzing samples, and in part due to the difficulty in using a one-time sample to assess long-term variability in lake conditions. A phytoplankton analysis may reflect a temporary, highly unstable and dynamic water quality condition.

In previous CSLAP sampling seasons, nearly all lakes were sampled once for phytoplankton identification, and since then some lakes have been sampled on one or more occasions. For these lakes, a summary of the most abundant phytoplankton species is included below. Some algal species are frequently associated with taste and odor problems, although it should be mentioned that these samples, like all other water samples collected through CSLAP, come from near the center of the lake, a location not usually near water intakes or swimming beaches. Since algal communities can also be spatially quite variable, even a preponderance of taste and odor-causing species in the water samples might not necessarily translate to potable water intake or aesthetic impairments, although the threat of such an impairment might be duly noted in the "Considerations" section below.

Phytoplankton surveys conducted through CSLAP at Findley Lake have identified the following algae:

Date: 7/18/92 **Most Abundant Species:** ***Dinobryon divergens.*** **(golden-brown algae)- 42%,** ***Cyclotella planktonica*** **(diatoms)- 35%,** ***Gomphosphaeria aponina*** **(blue-green algae)- 12%**
Most Abundant Genera: ***Chrysophyta*** **(golden-brown algae)- 42%,** ***Bacillariophyta*** **(diatoms)- 35%,** ***Cyanophyta*** **(blue-green algae)- 17%**

So what do these survey results tell us…?

The phytoplankton (algae) species most frequently found in Findley Lake samples, at least in 1992, are often associated with taste or odor problems, although it is not known if this contributed to depressed recreational assessments of the lake. The overall abundance of phytoplankton, as measured by chlorophyll *a* concentrations, has been high throughout most of the CSLAP sampling sessions at Findley Lake, although, as noted above, readings were lower in 2003 than in the typical sampling season.

<u>Historical Information for Findley Lake</u>

Findley Lake was sampled by the NYSDEC as part of the state ambient lake monitoring program (referred to as the LCI, or Lake Classification and Inventory Survey) in 1976 and 1985. A summary of the results from these studies are reported in Table 1. These sampling programs indicated water quality conditions that were probably similar to those measured through CSLAP- the lake was less productive in 1985 (with nutrient and clarity readings similar to those measured in 2003 and 2004), and more productive in 1976. Conductivity readings have steadily increased from the 1970s sampling to the present day, but this has also occurred in most NYS lakes, and at present the increase in conductivity has not been connected to any other water quality changes.

Findley Lake was also sampled in 1937 as part of the Conservation Department (predecessor to the NYSDEC) Biological Survey of the Allegheny River basin. This survey showed slightly higher pH than in the typical CSLAP (or other contemporary monitoring program) sampling season, and oxygen deficits starting at a depth between 15 and 20 feet from the lake surface. The field notes for the 1937 survey included the following:

> *"This, the westernmost lake in New York State, is a very irregularly shaped body of water with numerous shallow bays and several islands. The level is maintained by a dam at the north end. A large part of the south end is a shallow area with flat bottom covered with a thick growth of hornwort, waterweed, and Robbins pondweed. These plants cover almost the entire bottom and apparently have been the most successful invaders of what was once a wooded area, as evidenced by the numerous large submerged stumps. In this same weed bed are found many plants of the broad-leaved pondweed (P.amplifolius), of najad and bladderwort, as well as the ubiquitous waterlilies and water shield. Along the marshy shore, at the south end of the lake, are extensive marshes of cattail and large floating masses of water smartweed. Other large weed beds were found at the north end of the lake and along the east side.*
>
> *Findley Lake has very poor bottom chemical conditions in the face of which it will be difficult if not impossible to improve production by stocking alone. To form the present lake, an 8-foot dam was built across the outlet of two small ponds. The total area of the two ponds was slightly more than half the area of the new lake. As a result about one-half of Findley Lake is less than 10 feet deep. Within recent years this shallow area has become quite completely choked with vegetation. During the summer this vegetation becomes so dense that only the tops are alive. In the lower levels where sufficient light fails to penetrate, the vegetation is dead or dying. While green plants normally aerate the water, here so little of the plant actually is green that stagnant conditions prevail on the bottom. It is not unusual for algal and rooted aquatic plant growths to become sufficiently unpleasant although these growths seldom become sufficiently abundant to affect fish life adversely. The conditions in Findley Lake, however, leads one to conclude that vegetation may become so abundant as to be detrimental to fishing and fish production....*
>
> *Bottom samples of water taken among the vegetation at a depth of 8 feet had only 0.4 parts per million of oxygen. In contrast to this in deeper water where vegetation is lacking and where surface winds can mix the water more completely, at a depth of 14 feet there were 3.96 parts per million of oxygen at one station. At this same station below the plane of the 14-foot contour or in that areas not greatly affected by surface winds, the oxygen dropped from 0.84 parts per million at 15 feet to 0.0 parts per million on the bottom at 31 feet. From this it can be seen that among the vegetation the oxygen is less at 8 feet than at almost twice the depth where the oxygen is lacking. The bottom chemical conditions were inadequate for fish needs. A probably contributing factor is the nature of the bottom. Most of the area flooded when the dam was built was low, muck land that in earlier times had probably been covered by natural ponds.*
>
> *To remedy the condition here will not be easy. Weed elimination by chemical methods is out of the question for the present since so far as is known, chemicals sufficiently strong to eliminate rooted vegetation on a large scale would kill all fish life. Algal blooms in water supply reservoirs are controlled by chemical means but here it probably could not be done without some harmful effect to fish life. Mechanical methods are the only safe means of removing rooted aquatic plants, laborious as the task may be. Wood saws or rakes may be used for the purpose but it should be pointed out that the weeds should be completely removed after they are cut for two reasons: (1) if left in the water to decompose and use up oxygen, the main purpose of their destruction would be defeated and (2) since many aquatic plants reproduce asexually, more cutting is not sufficient to stop their growth or to prevent them from spreading into other suitable areas. The process would have to be repeated as often as necessary"*

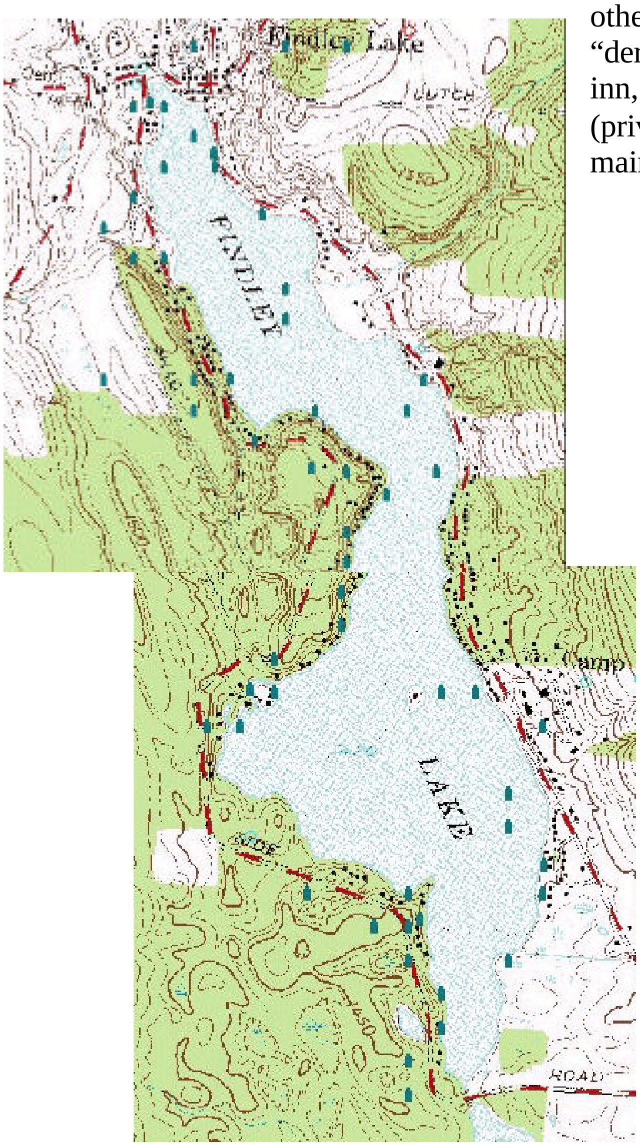
Rooted aquatic plant surveys were also conducted as part of this study, yielding the following results:

Common	Frequent	Infrequent	Rare
Elodea canadensis	*Isoetes echinospora*	*Sparganium americanum*	*Equisetum limosum*
Potamogeton praelongus	*Najas flexilis*	*Sparganium eurycarpum*	*Typha latifolia*
Potamogeton dimorphus	*Sagittaria heterophylla*	*Potamogeton natans*	*Brasenia schreberi*
	Dulichium arundinaceum	*Pontederia cordata*	
	Eleocharis smallii	*Polygonum coccineum*	
	Scirpus validus		
	Heteranthera dubia		
	Nymphozanthus variegatus		
	Ludvigia palustris		

It is likely that many of the plants found in the 1937 Biological Survey can still be found in the lake. However, neither the milfoil nor the pondweed species identified in relatively recent surveys were reported in the lake in this 1937 survey.

Regulated Facilities Associated with Findley Lake

There are several facilities or activities associated with Findley Lake that require permits or are otherwise regulated by the NYSDEC, as represented by "derricks" on the map to the left. These correspond to a an inn, apartments, and especially activities on individual (private) properties associated with the construction or maintenance of retaining walls.



IV. NYS AND CSLAP WATER QUALITY DATA: 1986-2004

Overall Summary:

Although water quality conditions at each CSLAP lake have varied each year since 1986, and although detailed statistical analyses of the entire CSLAP dataset has not yet been conducted, general water quality trends can be evaluated after 5-19 years worth of CSLAP data from these lakes. Overall (regional and statewide) water quality conditions and trends can be evaluated by a variety of different means. Each of the tested parameters ("analytes") can be evaluated by looking at the how the analyte varies from year to year from the long-term average ("normal") condition for each lake, and by comparing these parameters across a variety of categories, such across regions of the state, across seasons (or months within a few seasons), and across designated best uses for these lakes. Such evaluations are provided in the second part of this summary, via Figures 4 through 13. The annual variability is expressed as the difference in the annual average (mean) from both the long-term average and the normal variability expected from this long-term average. The latter can be presented as the "standard error" (SE- calculated here within the 95% confidence interval) - one standard error away from the long-term average can be considered a moderate change from "normal", with a deviation of two or more standard errors considered to be a significant change. For each of these parameters, the percentage of lakes with annual data falling within one standard error from the long-term average are considered to exhibit "no change", with the percentage of lakes demonstrating moderate to significant changes also displayed on these graphs. These methods are described in greater detail in Appendix D. Assessments of weather patterns- whether a given year was wetter or drier than usual- accounts for broad statewide patterns, not weather conditions at any particular CSLAP lake. As such, weather may have very different at some (but not most) CSLAP lakes in some of these years.

Long-term trends can also be evaluated by looking at the summary findings of individual lakes, and attempting to extrapolate consistent findings to the rest of the lakes. Given the (non-Gaussian) distribution of many of the water quality parameters evaluated in this report, non-parametric tools may be the most effective means for assessing the presence of a water quality trend. However, these tools do not indicate the magnitude of the trend. As such, a combination of parametric and non-parametric tools are employed here to evaluate trends. The Kendall tau ranking coefficient has been utilized by several researchers and state water quality agencies to evaluate water quality trends via non-parametric analyses, and is utilized here. For parametric analyses, best-fit analysis of summer (June 15 through September 15) averages for each of the eutrophication indicators can be evaluated, with trends attributable to instances in which deviations in annual means exceed the deviations found in the calculation of any single annual mean. The standard t-test can also be utilized to compare one set of data (such as the first five years of data versus the last five years of data, or data collected in the 1980s versus 1990s or 2000s data). It has been demonstrated in many of these programs that long-term trend analyses cannot be utilized to evaluate lake datasets until at least five years worth of data have been collected.

As of 2004, there were 142 CSLAP lakes that have been sampled for at least five years- the change in these lakes is demonstrated in Figures 4a through 4i. When these lakes are analyzed by this combination of parametric and non-parametric analyses, these data suggest that while most NYS lakes have not demonstrated a significant change (either t or $R^2 > 0.5$), those lakes that have experienced some change show a trend toward less productive conditions (as manifested by lower algae levels and, to a lesser extent, higher water clarity). There does not appear to be any obvious shared characteristics among these lakes. Some are highly productive, others are quite unproductive, some have been actively managed, some have been sampled for only a few years, and so on.

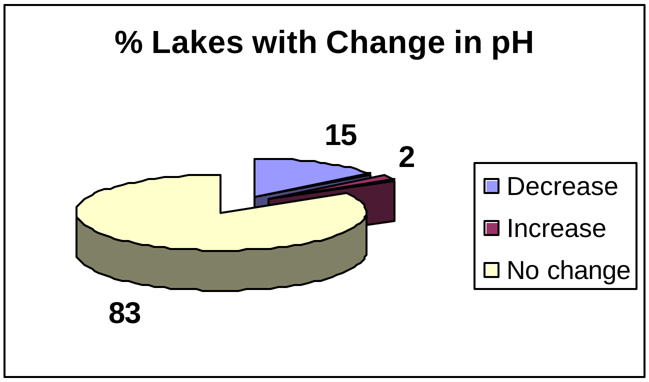


Figure 4a. %CSLAP Lakes Exhibiting Long-Term Change in pH

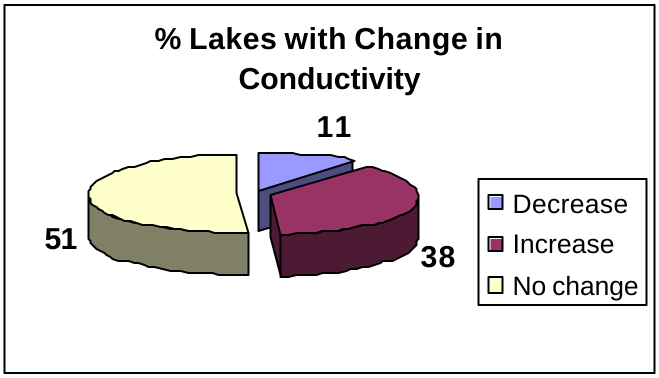


Figure 4b. %CSLAP Lakes Exhibiting Long-Term Change in Conductivity

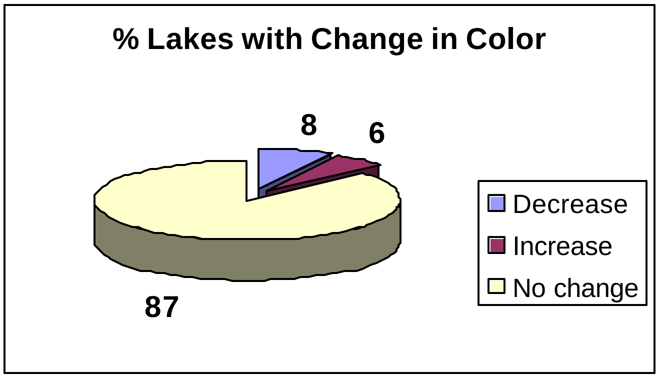


Figure 4c. %CSLAP Lakes Exhibiting Long-Term Change in Color

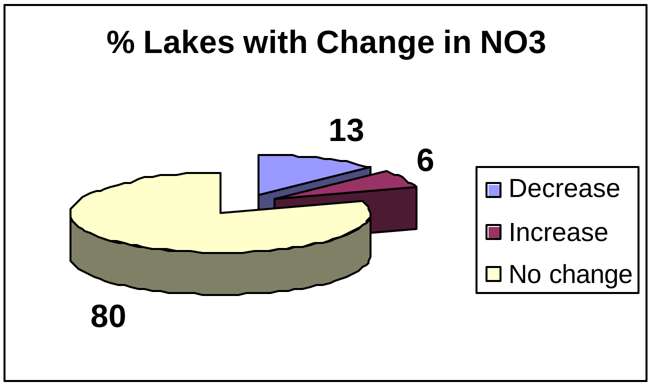


Figure 4d. %CSLAP Lakes Exhibiting Long-Term Change in Nitrate

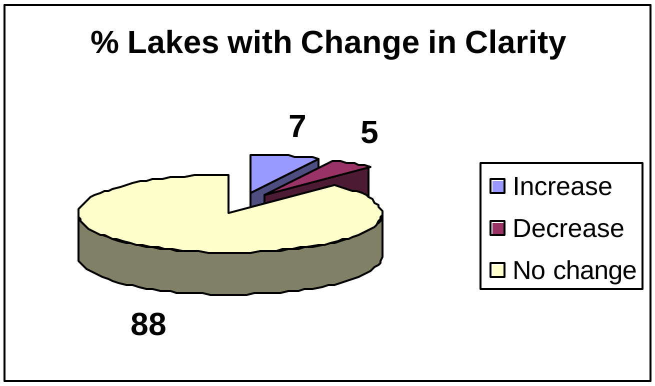


Figure 4e. %CSLAP Lakes Exhibiting Long-Term Change in Water Clarity

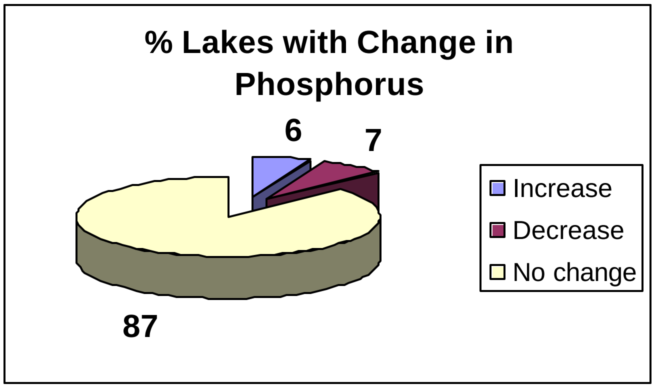


Figure 4f. %CSLAP Lakes Exhibiting Long-Term Change in Phosphorus

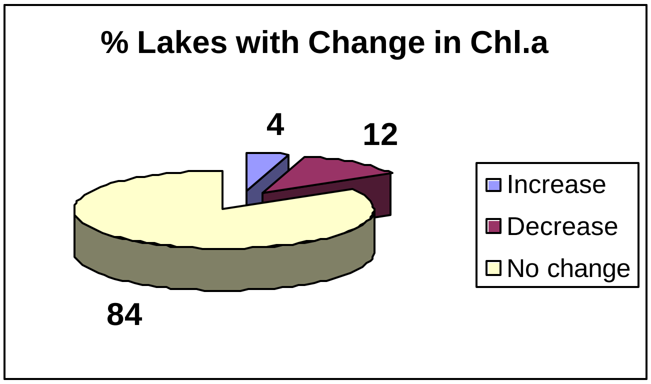


Figure 4g. %CSLAP Lakes Exhibiting Long-Term Change in Chlorophyll *a*

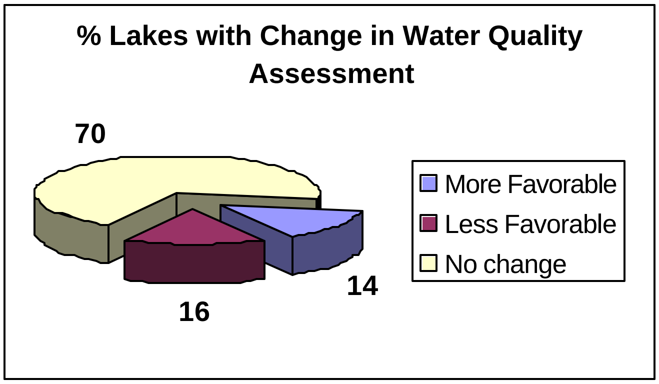


Figure 4h. %CSLAP Lakes Exhibiting Long-Term Change in Water Quality Assessment

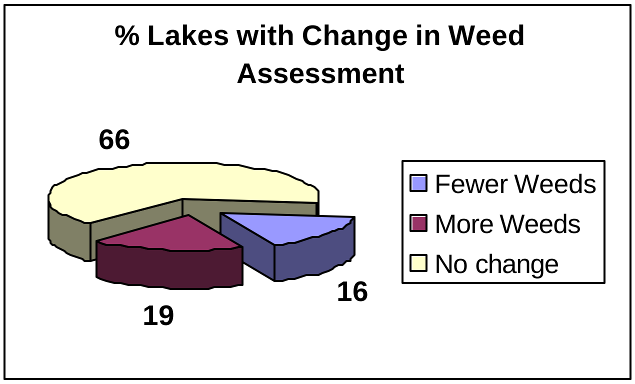


Figure 4i. %CSLAP Lakes Exhibiting Long-Term Change in Weed Assessment

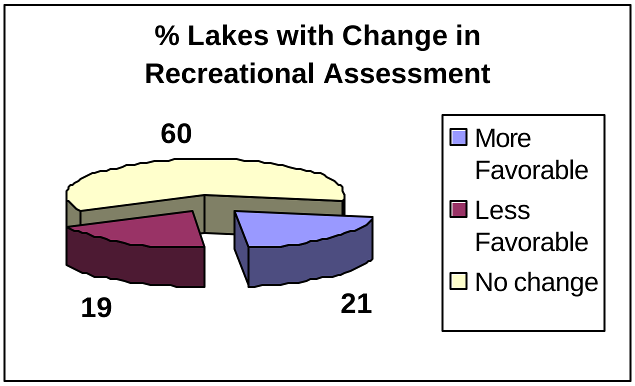


Figure 4j. %CSLAP Lakes Exhibiting Long-Term Change in Recreational Assessment

As noted above, there does not appear to be any clear pattern between weather and water quality changes, although some connection between changes in precipitation and changes in some water quality indicators is at least alluded to in some cases. However, all of these lakes may be the long-term beneficiaries of the ban on phosphorus in detergents in the early 1970's, which with other local circumstances (perhaps locally more "favorable" weather, local management, etc.) has resulted in less productive conditions. Without these circumstances, water quality conditions in many of these lakes might otherwise be more productive, in the creeping march toward aging, eutrophication, and succession.

Figures 4 demonstrate that significant changes have not occurred in most CSLAP lakes since sampling began on their lake. As might be expected, the most significant change occurred in conductivity, with about 1/3 of all CSLAP lakes exhibiting a significant increase in conductivity. This likely reflects a steady increase in materials (solids, nutrients, metals, etc.) loading to these lakes, although, as noted in other Figures shown above, this has not necessarily resulted in other water quality impacts.

Figures 4e, 4f, and 4g indicate that CSLAP lakes have, on average, become slightly less productive over time, although the majority of these lakes have not exhibited any significant change in trophic condition over the time of sampling. The patterns of change in water clarity, phosphorus, and chlorophyll *a* are all internally consistent (transparency increasing as algae and nutrients decreasing). Changes in other sampling parameters, such as pH and color, are relatively small and not readily explainable by any of the above phenomena, although lower pH in NYS lakes (at least until recently) has been studied at length within the Adirondacks and may continue to be attributable to acid rain.

Lake perception has changed more significantly than water quality (except conductivity), due in part to the shorter timeframe for evaluation and thus a lower statistical hurdle for quantifying change (11 years versus up to 17 years for some lakes), but perhaps due to the multiple influences of these phenomena. None of these indicators- water quality perception, weeds perception, or recreational perception- have varied in a consistent manner, although variability is more common in each of these indicators. The largest change is in recreational assessments, with more than 1/3 of all lakes exhibiting some change; a more detailed analysis of these assessments (not presented here) indicate that the Adirondacks have demonstrated more "positive" change than other regions of the state, due to the perception that aquatic weed densities have not increased as significantly (and water quality conditions have improved in some cases). However, the rapid spread of *Myriophyllum spicatum* into the interior Adirondacks will likely reverse this "trend" in coming years, and it is not clear if these "findings" can be extrapolated to other lakes within the Adirondack Park.

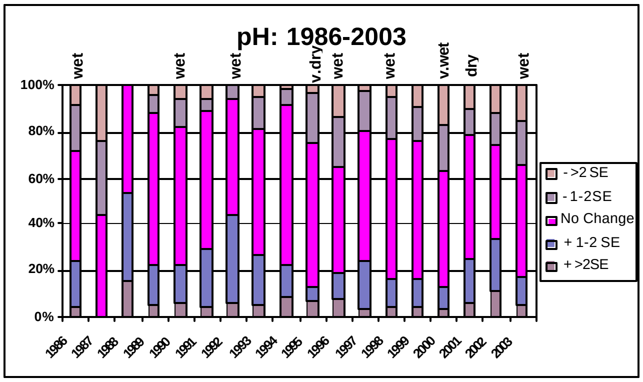


Figure 5a. *Annual Change from "Normal" pH in CSLAP Lakes (SE = Standard Error)*

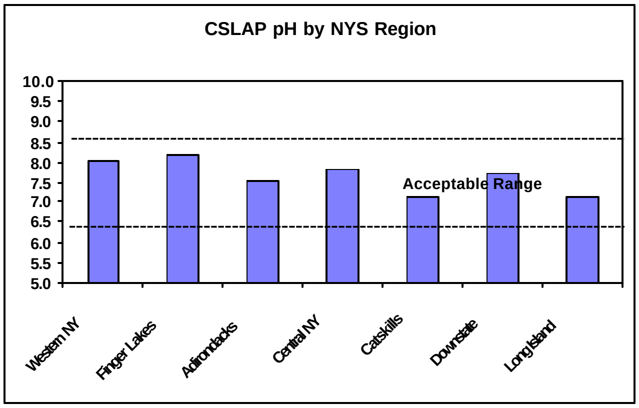


Figure 5b. *pH in CSLAP Lakes by NYS Region*

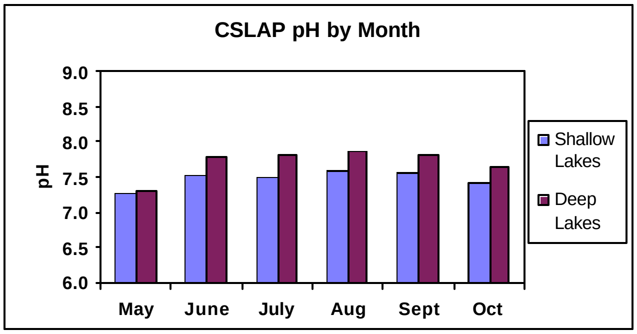


Figure 5c. *pH in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

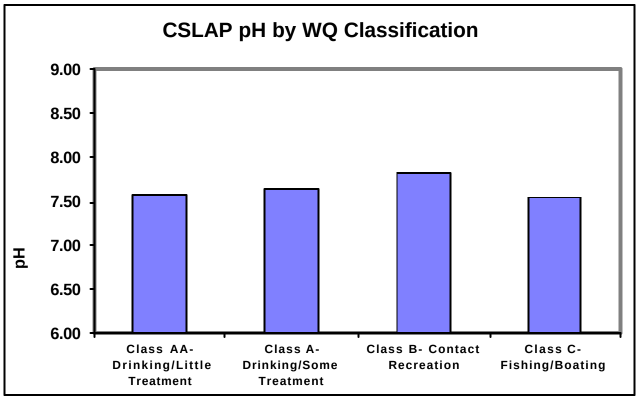


Figure 5d. *pH in CSLAP Lakes by Lake Use*

<u>pH</u>

Annual Variability

The pH of most CSLAP lakes has consistently been well within acceptable ranges for most aquatic organisms during each sampling season. The average pH has not varied significantly from one sampling season to the next. There does not appear to be a strong connection between pH and weather; the years with the relatively highest pH, 1988 and 1992, and the lowest pH, 1987, correspond to years with relatively normal precipitation, although some of the other years with relatively low pH corresponded to wetter years (1996 and 2000). There does not appear to be any significant annual pH trends in the CSLAP dataset. 90% of all samples had pH between 6.5 and 8.5 (the state water quality standards); 6% of samples have pH > 8.5 and 4% have pH < 6.5.

Statewide Variability:

As expected, pH readings are lowest in the high elevation regions (Adirondacks and Catskills) or Long Island, which has primarily shallow and slightly colored lakes, and highest in regions with relatively high conductivity (Western NY and the Finger Lakes region). All of these readings are consistently within the acceptable range for most aquatic organisms. However, the CSLAP dataset does not reflect the low pH found in many high elevation NYS lakes overlying granite and poorly buffered soils, since the typical CSLAP lake resides in geological settings (primarily limestone) that allow for residential development.

Seasonal Variability:

pH readings tend to increase slightly over the course of the summer, due largely to increasing algal photosynthesis (which consumes CO_2 and drives pH upward), although these seasonal changes are probably not significant. Low pH depressions are most common early in the sampling season (due to lingering effects from snowpack runoff) and high pH spikes occur mostly in mid to late summer.

Lake Use Variability

pH does not vary significant from one lake use to another, although in general pH readings are slightly higher for lakes used primarily for contact recreation (Class B). However, this is probably more reflective of geographical differences (there are relatively more Class B CSLAP lakes in higher pH regions, and more Class A lakes in lower pH regions) than any inherent link between pH and lake usage.

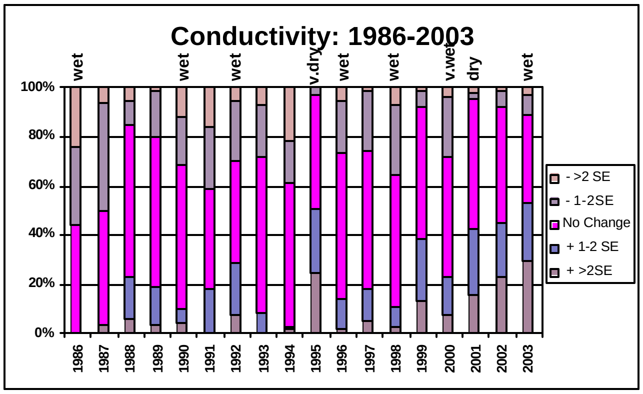


Figure 6a. *Annual Change from "Normal" Conductivity in CSLAP Lakes (SE = Standard Error)*

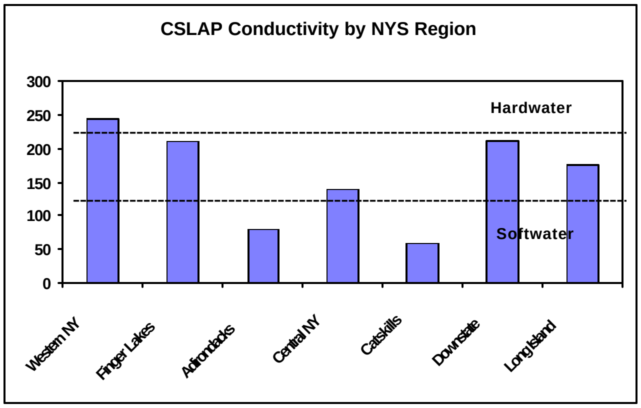


Figure 6b. *Conductivity in CSLAP Lakes by NYS Region*

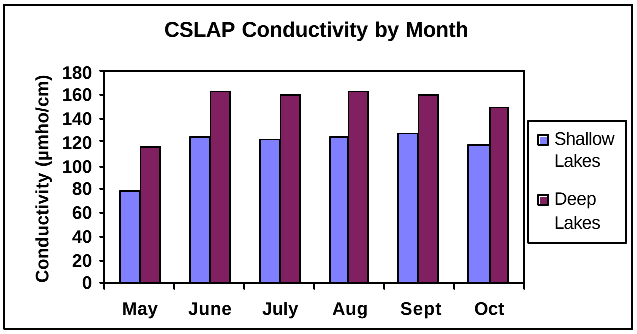


Figure 6c. *Conductivity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

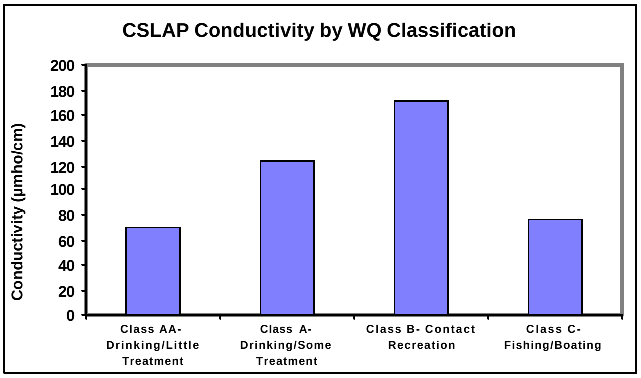


Figure 6d. *Conductivity in CSLAP Lakes by Lake Use*

Conductivity

Annual Variability

The conductivity of most CSLAP lakes has varied somewhat from year to year, and has been (slightly) increasing overall and in specific lakes since 1986. Readings are generally higher in dry weather and lower in wetter weather, although the overall annual trend appears to be stronger than weather-impacted changes.

Statewide Variability:

Although "hardwater" and "softwater" is not consistently defined by conductivity, in general lakes in the Adirondacks and Catskills have lower conductivity (softer water), and lakes downstate, in Western NY, and in the Finger Lakes region have higher conductivity (hard water). These regional differences are due primary to surficial geology and "natural" conditions in these areas.

Seasonal Variability:

Conductivity readings were higher in the summer than in the late spring, and increased substantially in shallow lakes in the fall. Although lake destratification (turnover) brings bottom waters with higher conductivity to the lake surface in deeper lakes, this does not appear to have resulted in a consistent increase in surface water conductivity readings in the fall (although fully mixed conditions may be missed in some NYS lakes by discontinuing sampling after the end of October). Conductivity readings overall were slightly higher in deep lakes, although this is probably an artifact of the sampling set (there are more CSLAP deep lakes in areas that "naturally" have harder water)

Lake Use Variability

Conductivity readings are substantially higher for lakes used primarily for contact recreation (Class B), and somewhat higher for lakes used for drinking water with some treatment (Class A). However, this is probably more reflective of geographical differences (there are relatively more softwater CSLAP lakes in the Adirondacks, which tend to have more Class A or higher lakes, at least in CSLAP, and more Class B lakes in hardwater regions) than any inherent connection between conductivity and lake usage.

Color

Annual Variability

The color of most CSLAP lakes has varied from year to year. The year with the lowest color readings, 1993, had "normal" levels of precipitation, although two of the years with the highest color readings (2003 and 1992) were wet, and the least colored waters generally occurred during dry conditions. Most lake samples (92%) correspond to water color readings too low (< 30 ptu) to significantly influence water clarity.

Statewide Variability:

Water color is highest in Long Island and the Adirondacks, and lowest in the Finger Lakes and Western NY regions. This is mostly coincident with the statewide conductivity distribution (with softwater lakes more likely to be colored)

Seasonal Variability:

Color readings are significantly higher in shallow lakes than in deepwater lakes; these readings increase from spring to summer in these shallower lakes (perhaps due to dissolution of organic material, including algae, and wind-induced mixing during the summer) and then drop off in the fall. Color generally follows the opposite trend in deeper lakes, with slightly decreasing levels perhaps due to more particle setting in the summer and remixing in the fall, although the seasonal trend in the deeper lakes is not as significant as in shallow lakes.

Lake Use Variability

Color readings are substantially higher for lakes used primarily for non-contact recreation (Class C), but this is probably more reflective of morphometric differences, for Class C lakes tend to be shallow lakes (mean depth = 4 meters), while the other classes tend to be deeper lakes (mean depth = 9 meters). However, the elevated color readings correspond to elevated levels of dissolved organic matter, and may also reflect impediments (via economically viable water treatment, aesthetics, and potential formation of hazardous compounds during chlorination) to the use of these waters for potable water.

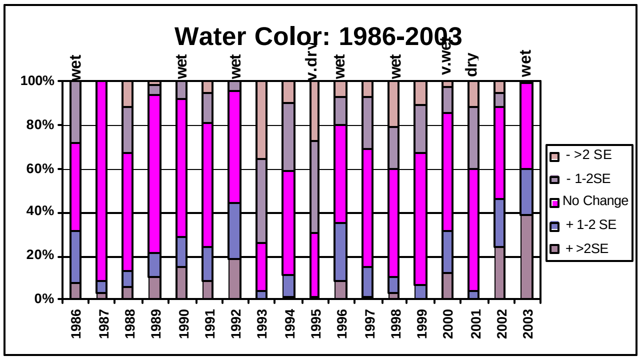


Figure 7a. *Annual Change from "Normal" Color in CSLAP Lakes (SE = Standard Error)*

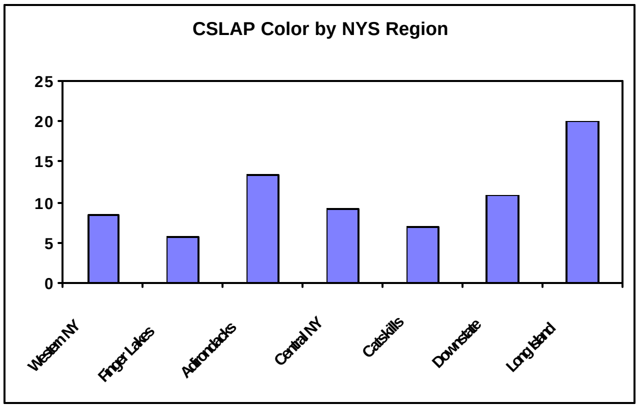


Figure 7b. *Color in CSLAP Lakes by NYS Region*

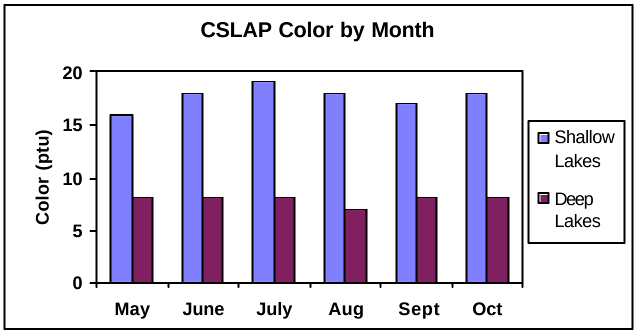


Figure 7c. *Color in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

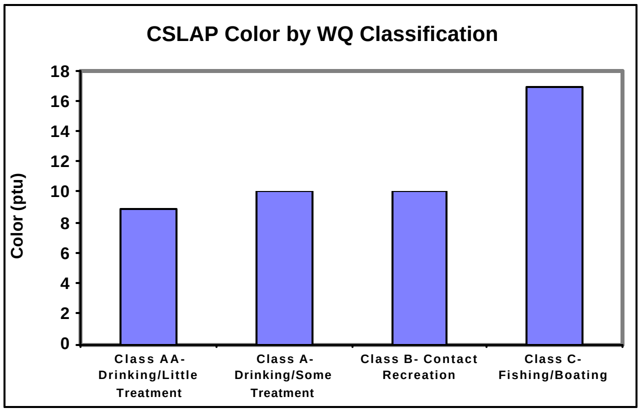


Figure 7d. *Color in CSLAP Lakes by Lake Use*

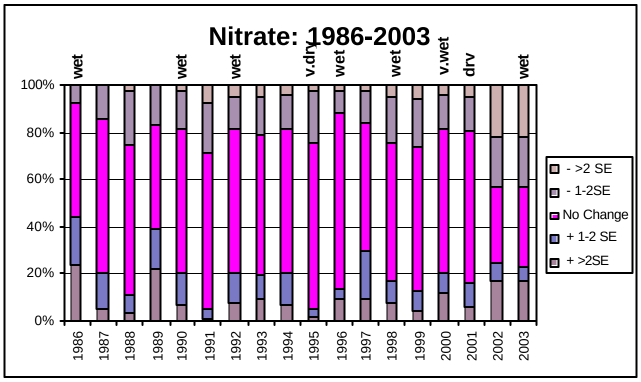


Figure 8a. *Annual Change from "Normal" Nitrate in CSLAP Lakes (SE = Standard Error)*

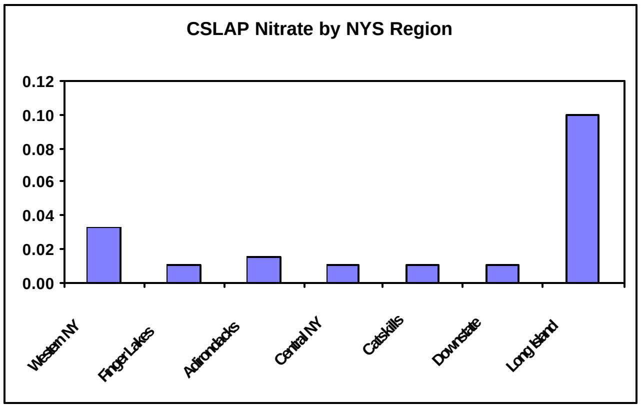


Figure 8b. *Nitrate in CSLAP Lakes by NYS Region*

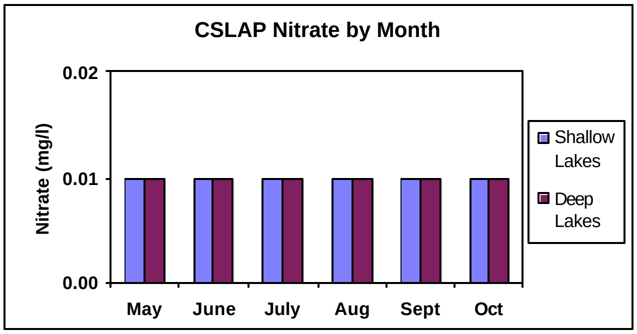


Figure 8c. *Nitrate in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

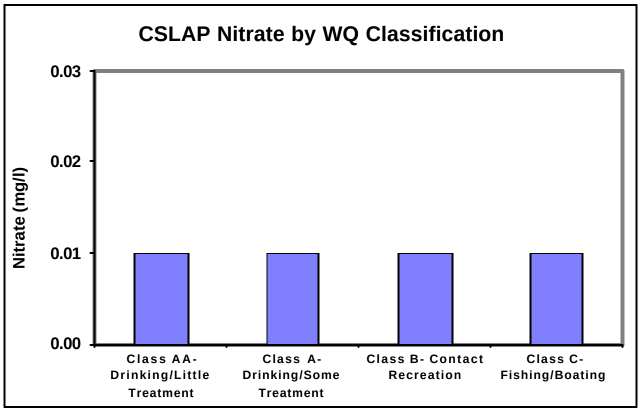


Figure 8d. *Nitrate in CSLAP Lakes by Lake Use*

Nitrate

Annual Variability

Evaluating nitrate in CSLAP lakes is confounded by the relative lack of nitrate data for many sampling seasons (it was analyzed in water samples at a lower frequency, or not at all, in many years), the high number of undetectable nitrate readings, and some changes in detection levels. The limited data indicated that nitrate was highest in 1986 and 1989, two early CSLAP years in which nitrate was analyzed more frequently (including a relatively large number of early season samples), and lowest in 1995, 2002 and 2003. Although nitrate levels are probably closely related to winter and spring precipitation levels (due to the higher nitrate readings in snowpacks), this is not apparent from Figure 8a. No readings approached the state water quality standard (= 10 mg/l).

Statewide Variability:

Nitrate levels are highest in Long Island, Western NY, and the Adirondacks, and lowest in the other NYS regions. However, none of these regions demonstrate readings that are particularly high. Readings from individual lakes in the Long Island, Madison County, and the Adirondacks (spring only) are often elevated, although still well below water quality standards.

Seasonal Variability:

Nitrate readings are not seasonally variable, as indicated in Figure 8c. However, in some individual lakes, in the regions listed above, nitrate is often detectable until early summer, and then undetectable through the rest of the sampling season (the large number of lakes with undetectable nitrate levels throughout the year overwhelm the statistics in Figure 8c).

Lake Use Variability

Nitrate readings appeared to be identical for all classes of lake uses, as indicated in Figure 8d. Higher early season nitrate readings are found in some lakes influenced by the melting of large winter snowpacks, such as some Class AA and A lakes in the Adirondacks, but these statistics cannot be easily teased from datasets strongly influenced by the large number of lakes with undetectable nitrate readings).

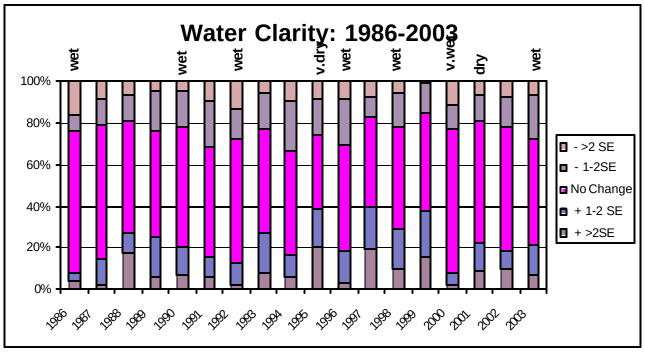


Figure 9a. *Change from "Normal" Water Clarity in CSLAP Lakes (SE = Standard Error)*

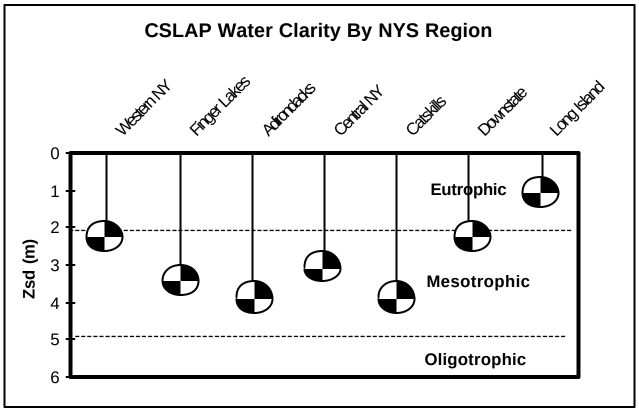


Figure 9b. *Water Clarity in CSLAP Lakes by NYS Region*

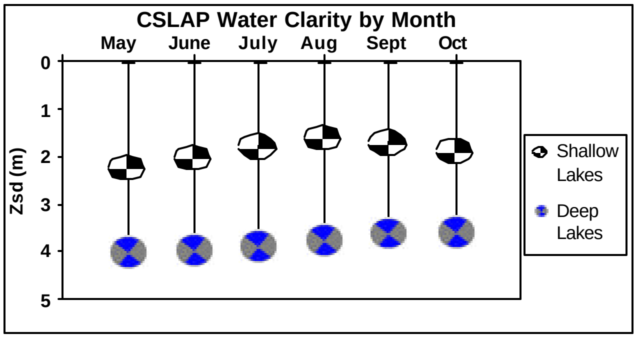


Figure 9c. *Water Clarity in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

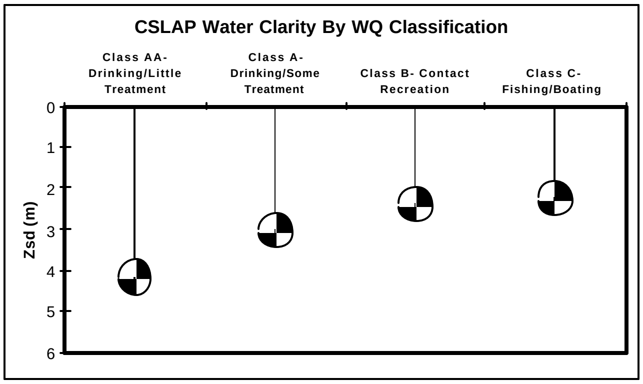


Figure 9d. *Water Clarity in CSLAP Lakes by Lake Use*

Trophic Indicators: Water Clarity

Annual Variability

Water clarity (transparency) has varied annually in most CSLAP lakes. There appears to be at least a weak correlation between clarity and precipitation- the highest clarity occurred during the driest year (1995), and the lowest clarity during the two wettest years (1996 and 2000). There are no significant broad statewide water clarity trends, although (as described in other portions of this report), clear trends do exist on some lakes. The majority of water clarity readings in CSLAP lakes (56%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 27% corresponding to *eutrophic* conditions (Zsd < 2) and 17% corresponding to *oligotrophic* conditions (Zsd > 5).

Statewide Variability:

As expected, water clarity is highest in the Adirondacks, Catskills, and Finger Lakes regions, and lowest in Long Island, Downstate, and Western NY. The differences are more pronounced (at least for the Adirondacks) when "naturally" colored lakes are not considered. However, except for Long Island (for which water clarity is at least partially limited by the shallow water depth), the "typical" lake in each of these regions would be classified as *mesotrophic.*

Seasonal Variability:

Water clarity readings are lower, as expected, in shallow lakes, even when water depth does not physically limit a water transparency measurement. Clarity decreases in both shallow and deep lakes over the course of the sampling season (the drop in clarity in shallower lakes is somewhat more significant), although clarity rebounds slightly in shallower lakes in the fall, due to a drop in nutrient levels. The lack of "rebound" in deeper lakes may be due to occasional fall algal blooms in response to surface nutrient enrichment after lake turnover (see below)

Lake Use Variability

Water transparency decreases as the "sensitivity" of the lake use decreases, with higher clarity found in lakes used for potable water (Class AA), and lower clarity found in lakes used primarily for contact and non-contact (fishing and boating) recreation. As with many of the other water quality indicators, this is due to both geographical and morphometric (depth) differences, although the original designation of these uses may also reflect these measurable and visually apparent water quality differences.

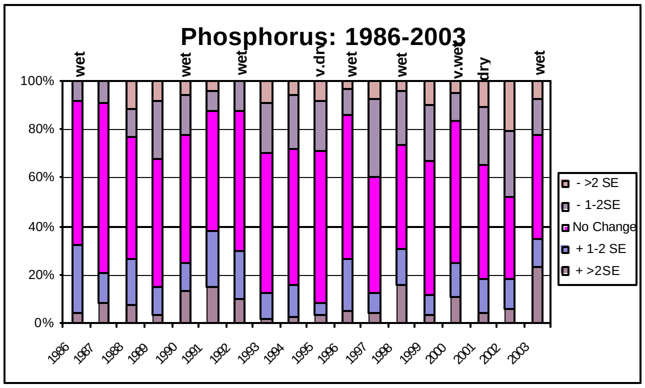


Figure 10a. *Annual Change from "Normal" TP in CSLAP Lakes (SE = Standard Error)*

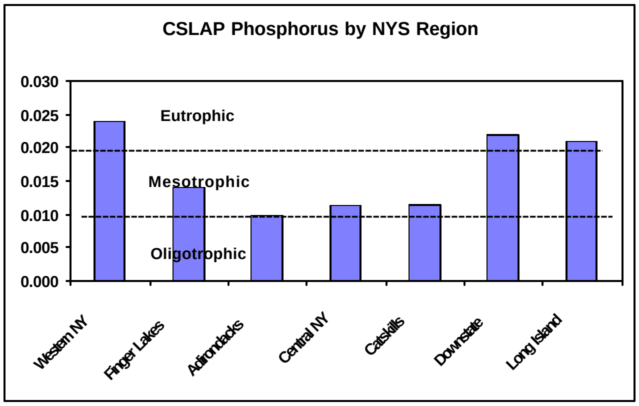


Figure 10b. *TP in CSLAP Lakes by NYS Region*

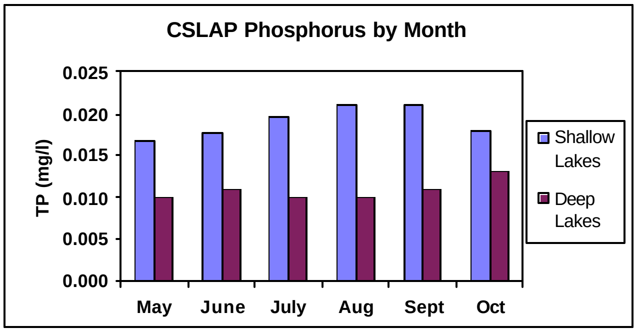


Figure 10c. *TP in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

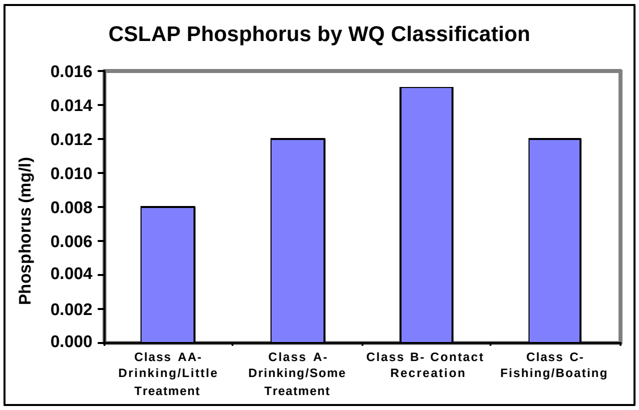


Figure 10d. *TP in CSLAP Lakes by Lake Use*

Trophic Indicators: Phosphorus (TP)

Annual Variability

Total phosphorus (TP) has varied annually in most CSLAP lakes. As with clarity, there appears to be at least a weak correlation between phosphorus and precipitation- the highest phosphorus concentrations occurred during 1991, 1996, 1998, 2000, and 2003, the latter four of which corresponded to wet years. However, the lowest readings, from 1989, 1997, and 2002, did not correspond to unusually dry years. The majority of phosphorus readings in CSLAP lakes (39%) correspond to *mesotrophic* conditions (clarity of 2 to 5m), with 27% corresponding to *eutrophic* conditions (< 2m clarity) and 34% corresponding to *oligotrophic* conditions (> 5m clarity); the latter is a much higher percentage than the trophic designation for water clarity.

Statewide Variability:

As expected, nutrient levels are lowest in the Adirondacks, Catskills, and Central New York (where clarity is highest) and highest in Long Island, Downstate, and Western NY, where clarity is lowest. In the latter three regions, the "typical" lake in each of these regions would be classified as *eutrophic*, while only in the Adirondacks could most lakes be described as *oligotrophic*, based on nutrients.

Seasonal Variability:

Nutrient levels are higher, as expected, in shallow lakes, and phosphorus levels increase in shallow lakes over the course of the sampling season, until dropping in the fall. However, phosphorus levels in deeper lakes are lower and decrease slightly through July, then increase into the fall. The latter phenomenon is due to surface nutrient enrichment after lake turnover (high nutrient water from the lake bottom, due to release of nutrients from poorly oxygenated lake sediments in the summer, migrates to the lake surface when the lake destratifies).

Lake Use Variability

Phosphorus readings are lower in lakes used for minimally treated potable water intakes (Class AA), and are higher for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have higher nutrient levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation.

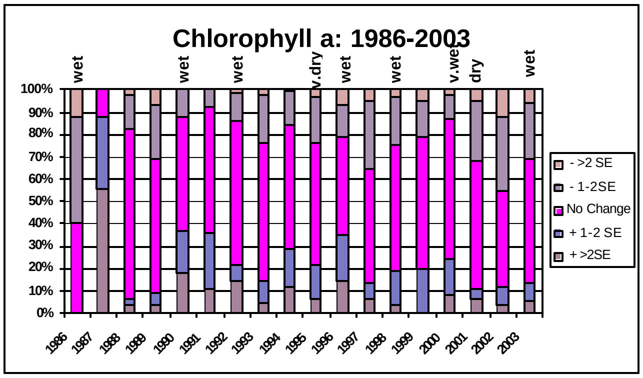


Figure 11a. *Annual Change from "Normal" Chlorophyll a in CSLAP Lakes (SE = Standard Error)*

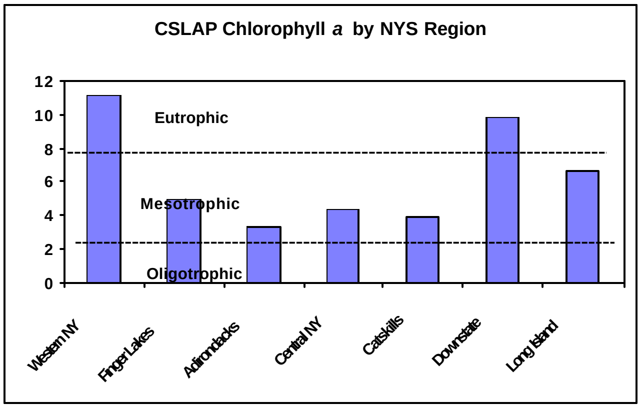


Figure 11b. *Chlorophyll a in CSLAP Lakes by NYS Region*

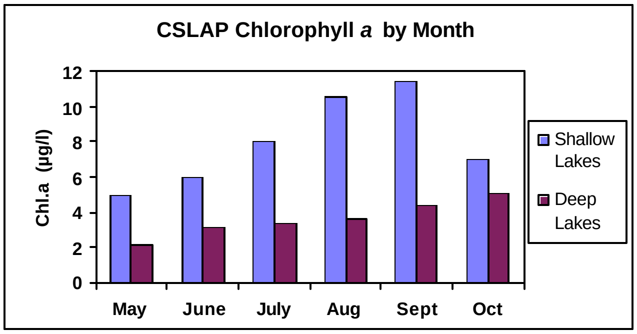


Figure 11c. *Chlorophyll a in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

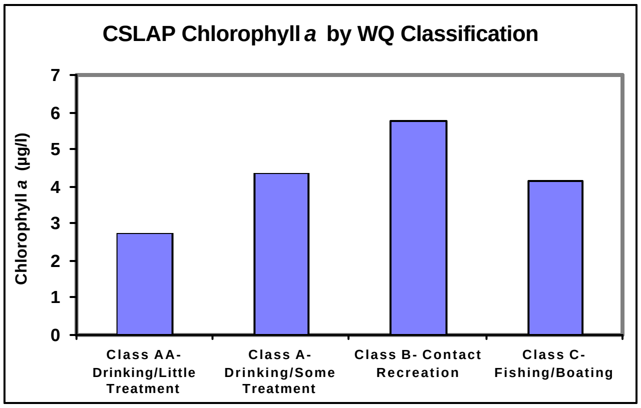


Figure 11d. *Chlorophyll a in CSLAP Lakes by Lake Use*

Trophic Indicators: Chlorophyll *a* (Chl.a)

Annual Variability

Chlorophyll *a* (Chl.a) has varied in most CSLAP lakes more significantly that the other trophic indicators, as is typical of biological indicators (which tend to grow "patchy"). With the exception of the very high readings in 1987 (probably due to a lab "problem"), the highest phosphorus concentrations occurred during 1990, 1996, and 2000, corresponded to wet years. However, the lowest readings, from 1989, 1997, and 2001, 2002, and 2003 did not correspond to unusually dry years (except in 2001). The near majority of chlorophyll readings in CSLAP lakes (49%) correspond to *mesotrophic* conditions (clarity between 2 and 5 meters), with 33% corresponding to *eutrophic* conditions (Zsd < 2) and 18% corresponding to *oligotrophic* conditions (Zsd > 5); these percentages are more like those for water clarity rather than those for phosphorus.

Statewide Variability:

As with phosphorus, chlorophyll levels are lowest in the Adirondacks, Central New York, and the Catskills (where clarity is highest) and highest in Long Island, Downstate, and Western NY, where clarity is lowest. In the latter two regions, the "typical" lake in each of these regions would be classified as *eutrophic*, while lakes in the other regions would be described as *mesotrophic*.

Seasonal Variability:

Chlorophyll levels are higher, as expected, in shallow lakes, and increase in both shallow and deep lakes over the course of the sampling season, with chlorophyll readings dropping in shallow lakes in the fall. The steady increase in chlorophyll in both shallow and (to a lesser extent) deep lakes is consistent with the change in phosphorus over the same period, due to steady migration of nutrients released from poorly oxygenated lake sediments during the summer and especially in the fall.

Lake Use Variability

Chlorophyll readings are lower in lakes used for minimally treated potable water intakes (Class AA), and are higher for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar levels, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation. This is similar to the use pattern for phosphorus.

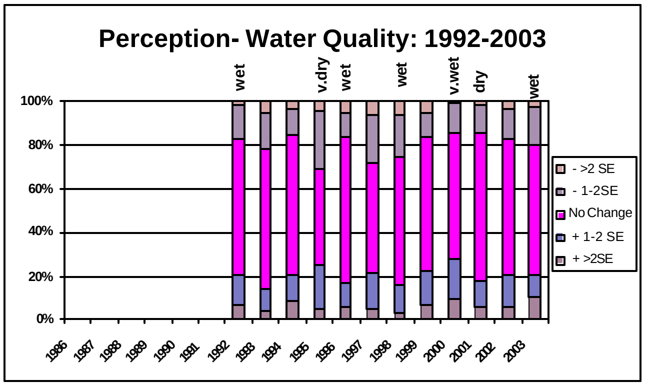


Figure 12a. *Annual Change from "Normal" Water Quality Assessment in CSLAP Lakes (SE = Standard Error)*

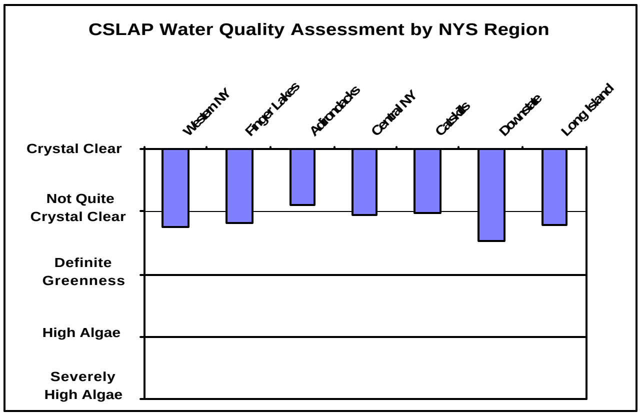


Figure 12b. *Water Quality Assessment in CSLAP Lakes by NYS Region*

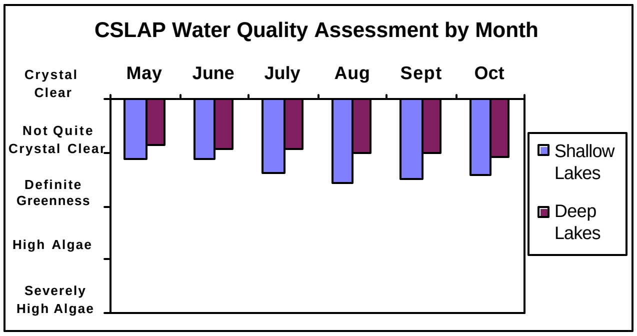


Figure 12c. *Water Quality Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

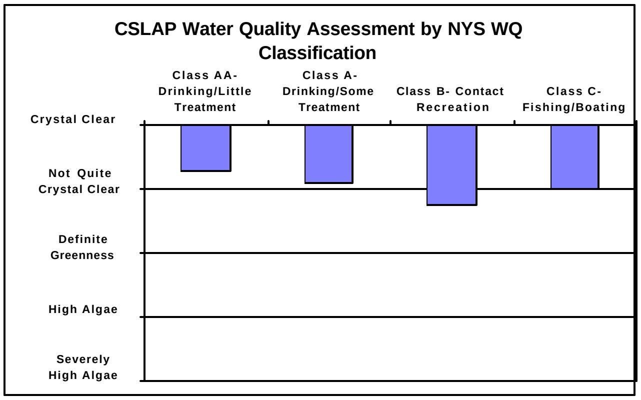


Figure 12d. *Water Quality Assessment in CSLAP Lakes by Lake Use*

Water Quality Assessment (QA)

Annual Variability

Water quality assessments (the perceived physical condition of the lake, or QA on the use impairment surveys) were least favorable in the very wet (2000) and very dry (1995) years, suggesting the lack of correlation between weather and perceived water quality (although 1995 was also the year with the most "improved" conditions). Although there is a strong connection between measured and perceived water clarity in most CSLAP lakes, this is not closely reflected in Figure 12a.

Statewide Variability:

The most favorable water quality assessments (at least in support of contact recreation) occurred in the Adirondacks, as expected, and water quality assessments were slightly less favorable in Downstate, Western NY, and Long Island. However, the overall similarity in the assessments suggests that the relatively low water clarity in the latter regions may be considered "normal" by lake residents.

Seasonal Variability:

Water quality assessments become less favorable as the summer progresses in both deep and (especially) shallow lakes, coincident with similar patterns for the trophic indicators. These assessments become slightly more favorable in shallow lakes in the fall, consistent with the improved (measured) water clarity, although overall water quality assessments are less favorable all year in shallow lakes.

Lake Use Variability

Water quality assessments are more favorable in lakes used for minimally treated potable water intakes (Class AA), and less favorable for other lake uses. Although Class B waters are utilized for a "higher" lake use than Class C lakes (contact recreation versus non-contact recreation), these lakes actually have similar water quality assessments, perhaps reflecting the influence of deepwater nutrient enrichments (these lakes are typically deeper) and the "unofficial" use of Class C waters for bathing and contact recreation. This is similar to the pattern seen for the trophic indicators.

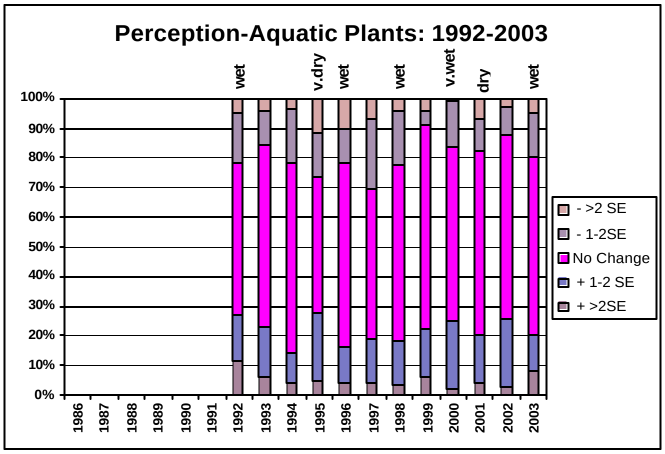


Figure 13a. *Annual Change from "Normal" Weed Assessment in CSLAP Lakes (SE = Standard Error)*

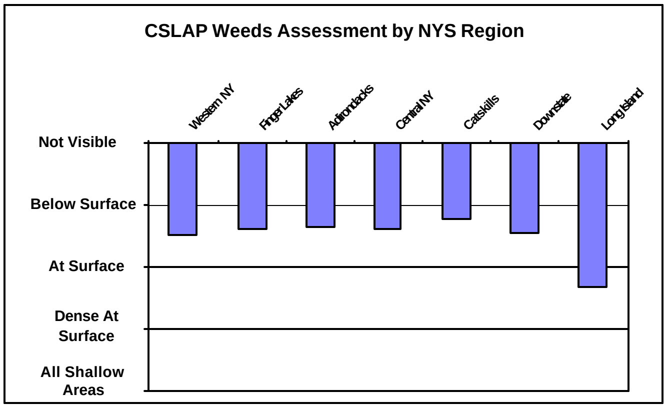


Figure 13b. *Weed Assessment in CSLAP Lakes by NYS Region*

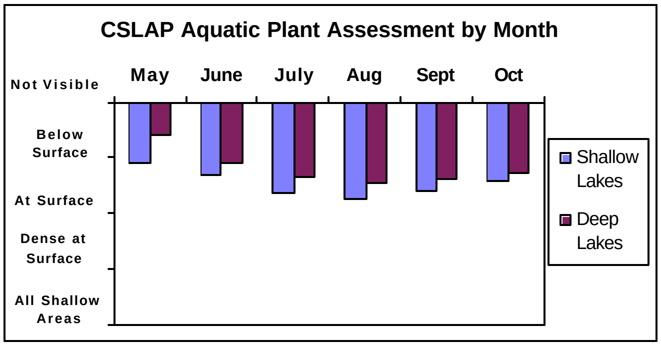


Figure 13c. *Weed Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

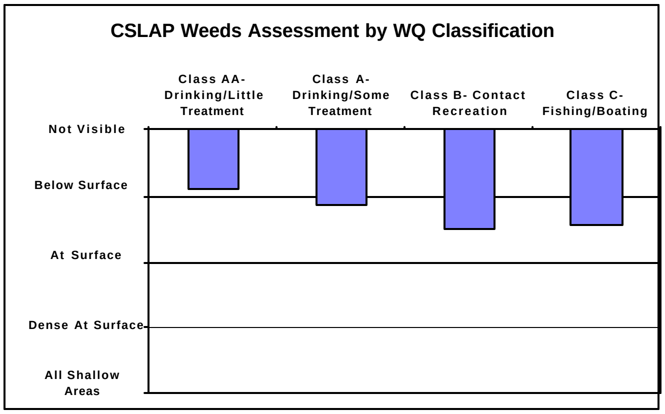


Figure 13d. *Weed Assessment in CSLAP Lakes by Lake Use*

Aquatic Plant (Weed) Assessment (QB)

Annual Variability

Aquatic plant assessments (the perceived extent of weed growth in the lake, or QB on the use impairment surveys) indicated that weeds grew most significantly in 1995 (very dry conditions) and 2000 (very wet conditions), and least significantly in 1994 and 1999, suggesting the lack of correlation between weather and weed densities. The highest weed growth occurred when the perceived physical condition (clarity) of the lake was also least favorable- these conditions may offer a selective advantage to invasive or exotic weeds (such as *Myriophyllum spicatum*).

Statewide Variability:

Aquatic plant growth was most significant in Long Island (and to a lesser extent Downstate and Western NY) and least significant in the Catskills and Finger Lakes area. The former may have a larger concentration of shallow lakes (Long Island) or preponderance of exotic weeds (Downstate and Western NY), while the latter may correspond to deeper lakes or fewer instances of these invasive weeds.

Seasonal Variability:

As expected, aquatic plant densities and coverage increase seasonally (through late summer) in both shallow and deep lakes, with greater coverage found in shallow lakes. Peak aquatic plant densities tend to occur in late summer. The variability from one lake to another (from very little growth to dense growth at the lake surface) is more pronounced later in the summer. Despite higher clarity in shallow lakes in the fall, aquatic plant coverage decreases, while the drop in fall plant coverage in deeper lakes is less pronounced.

Lake Use Variability

Aquatic plant coverage was more significant in Class B lakes than in other lakes, but this (again) is probably a greater reflection of geography or lake size and depth (Class B lakes tend to be found outside the high elevation areas in the Catskills and Adirondacks, and with Class C lakes tend to be shallower than Class AA or Class A lakes).

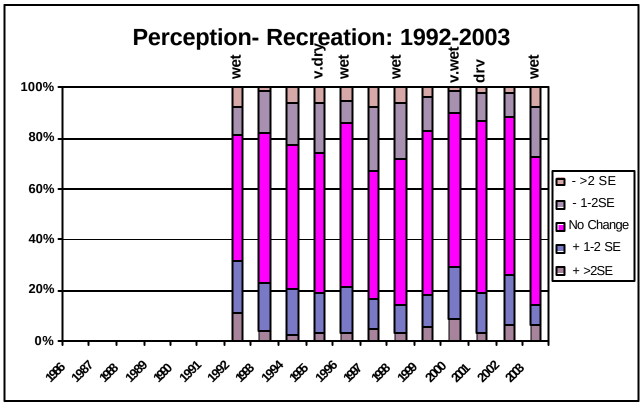


Figure 14a. *Annual Change from “Normal” Recreational Assessment in CSLAP Lakes (SE = Standard Error)*

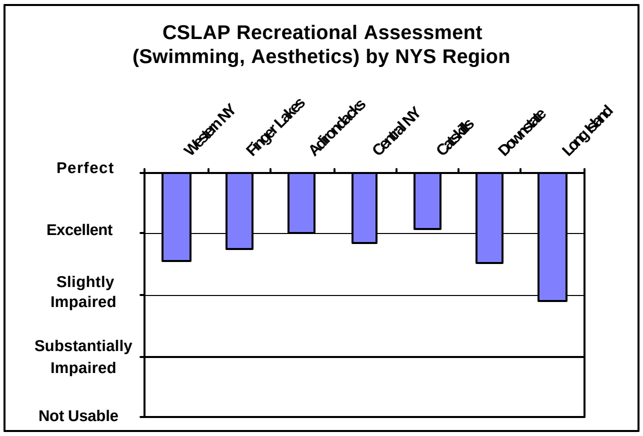


Figure 14b. *Recreational Assessment in CSLAP Lakes by NYS Region*

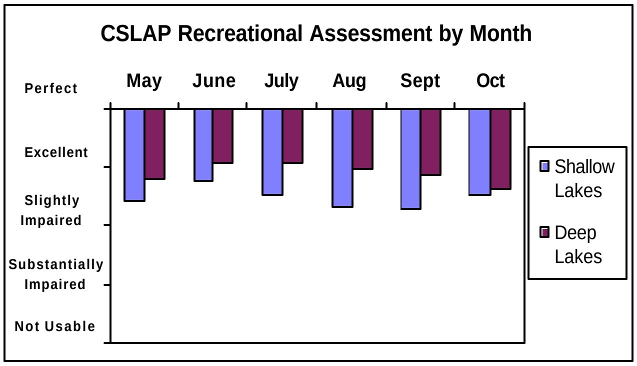


Figure 14c. *Recreational Assessment in Shallow (<20ft deep) and Deep CSLAP Lakes by Month*

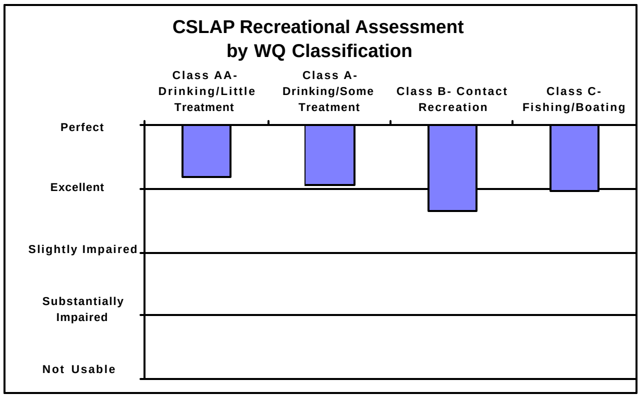


Figure 14d. *Recreational Assessment in CSLAP Lakes by Lake Use*

Recreational Assessment (QC)

Annual Variability

Recreational assessments (the perceived recreational suitability of the lake, or QC on the use impairment surveys) have been less favorable in the last several years (prior to 2004), and have varied somewhat from year to year in response to changes in both the perceived physical conditions and aquatic plant coverages. The extent of “normal” conditions (the middle bar in Figure 14a) has generally not changed significantly since perception surveys were first conducted in 2002.

Statewide Variability:

Recreational assessments are most favorable in the Adirondacks and Catskills, and less favorable in Long Island and Downstate. This appears to be in response to less favorable assessments of water quality and aquatic plant growth, respectively. Except for (the small number of CSLAP lakes in) Long Island, overall recreational assessments in all regions are, in general, highly favorable.

Seasonal Variability:

Recreational assessments in both shallow and deep lakes tend to improve from spring to early summer, and then degrade through the summer, improving in shallow lakes in the fall. As expected, this generally corresponds to seasonal increases in aquatic plant coverage in deep lakes, and also to seasonally degrading water quality in shallow lakes. Overall recreational assessments are more favorable in deep lakes every month of the sampling season, although the differences are less pronounced in the fall (and winter, when every lake looks nice!)

Lake Use Variability

Recreational assessments become less favorable as the designated lake use becomes less sensitive (drinking water to contact recreation), although recreational assessments of Class C lakes are only slightly less favorable than in Class A lakes. This may be considered a validation of these classifications (recognizing, again, that many Class C lakes continue to fully support contact recreation and perhaps even potable water use).

V. FINDLEY LAKE CSLAP WATER QUALITY DATA

CSLAP is intended to provide the strong database, which will help lake associations understand lake conditions and foster sound lake protection and pollution prevention decisions. This individual lake summary for **2004** contains two forms of information. The **raw data** and **graphs** present a snapshot or glimpse of water quality conditions at each lake. They are based on (at most) eight or nine sampling events during the summer. As lakes are sampled through CSLAP for a number of years, the database for each lake will expand, and assessments of lake conditions and water quality data become more accurate. For this reason, lakes new to CSLAP for only one year will not have information about annual trends.

Raw Data

Two **"data sets"** are provided below. The data presented in Table 1 include an annual summary of the minimum, maximum, and average for each of the CSLAP sampling parameters, including data from other sources for which sufficient quality assurance/quality control documentation is available for assessing the validity of the results. This data may be useful for comparing a particular data point for the current sampling year with historical data information. Table 2 includes more detailed summaries of the 2004 and historical data sets, including some evaluation of water quality trends, comparison against existing water quality standards, and whether 2004 represented a typical year.

Graphs

The second form of data analysis for your lake is presented in the form of **graphs**. These graphs are based on the raw data sets to represent a snapshot of water quality conditions at your lake. The more sampling that has been done on a particular lake, the more information that can be presented on the graph, and the more information you have to identify annual trends for your lake. For example, a lake that has been doing CSLAP monitoring consistently for five years will have a graph depicting five years worth of data, whereas a lake that has been doing CSLAP sampling for only one year will only have one. Therefore, it is important to consider the number of sampling years of information in addition to where the data points fall on a graph when trying to draw conclusions about annual trends. There are certain factors not accounted for in this report that lake managers should consider:

- **Local weather conditions** (high or low temperatures, rainfall, droughts or hurricanes). Due to delays in receiving meteorological data from NOAA stations within NYS, weather data are not included in these reports. It is certain that some of the variability reported below can be attributed more to weather patterns than to a "real" water trend or change. However, it is presumed that much of the sampling "noise" associated with weather is dampened over multiple years of data collection, and thus should not significantly influence the limited trend analyses provided for CSLAP lakes with longer and larger databases.

- **Sampling season and parameter limitations**. Because sampling is generally confined to June-September, this report does not look at CSLAP parameters during the winter and other seasons. Winter conditions can impact the usability and water quality of a lake conditions. In addition, there are other sampling parameters (fecal coliform, dissolved oxygen, etc.) that may be responsible for chemical and biological processes and changes in physical measurements (such as water clarity) and the perceived conditions in the lake. **The 2004 CSLAP report attempts to standardize some comparisons by limiting the evaluation to the summer recreational season and the most common sampling periods (mid-June through mid-September), in the event that samples are collected at other times of the year (such as May or October).**

TABLE 1: CSLAP Data Summary for Findley Lake

Year	Min	Avg	Max	N	Parameter
1986-04	**0.33**	**1.63**	**5.35**	**148**	**CSLAP Zsd**
2004	1.20	2.28	3.20	4	CSLAP Zsd
2003	1.15	2.69	5.35	8	CSLAP Zsd
2000	1.09	1.80	2.95	8	CSLAP Zsd
1999	0.50	0.79	1.19	8	CSLAP Zsd
1998	0.78	1.39	3.13	8	CSLAP Zsd
1997	1.28	2.30	5.13	8	CSLAP Zsd
1996	1.65	2.99	4.75	8	CSLAP Zsd
1995	0.33	0.90	2.00	6	CSLAP Zsd
1994	0.80	1.70	3.63	6	CSLAP Zsd
1993	0.75	1.22	1.50	6	CSLAP Zsd
1992	1.33	1.64	2.00	6	CSLAP Zsd
1991	0.33	0.68	1.00	6	CSLAP Zsd
1990	0.75	1.20	2.50	8	CSLAP Zsd
1989	1.00	2.12	3.25	13	CSLAP Zsd
1988	0.75	1.35	2.25	15	CSLAP Zsd
1987	0.50	1.14	3.00	15	CSLAP Zsd
1986	0.63	1.63	3.13	15	CSLAP Zsd
1985	1.00	2.12	4.00	5	LCI
1976	0.61	0.61	0.61	1	DEC
Year	Min	Avg	Max	N	Parameter
1986-04	**0.005**	**0.034**	**0.082**	**141**	**CSLAP Tot.P**
2004	0.017	0.021	0.029	3	CSLAP Tot.P
2004	0.036	0.036	0.036	1	CSLAP HypoTP
2003	0.005	0.019	0.032	8	CSLAP Tot.P
2003	0.003	0.016	0.028	8	CSLAP HypoTP
2000	0.017	0.026	0.042	8	CSLAP Tot.P
1999	0.031	0.056	0.081	8	CSLAP Tot.P
1998	0.025	0.046	0.067	2	CSLA P Tot.P
1998	0.211	0.564	0.960	4	CSLAP HypoTP
1997	0.013	0.026	0.032	8	CSLAP Tot.P
1996	0.013	0.024	0.056	8	CSLAP Tot.P
1995	0.020	0.047	0.082	6	CSLAP Tot.P
1994	0.015	0.036	0.059	6	CSLAP Tot.P
1993	0.030	0.046	0.063	6	CSLAP Tot.P
1992	0.013	0.026	0.035	6	CSLAP Tot.P
1991	0.049	0.061	0.079	6	CSLAP Tot.P
1990	0.037	0.049	0.062	8	CSLAP Tot.P
1989	0.015	0.024	0.038	13	CSLAP Tot.P
1988	0.020	0.032	0.042	15	CSLAP Tot.P
1987	0.018	0.041	0.060	15	CSLAP Tot.P
1986	0.011	0.027	0.039	15	CSLAP Tot.P
1985	0.010	0.011	0.012	3	LCI
1976	0.022	0.022	0.022	1	DEC

DATA SOURCE KEY

CSLAP	New York Citizens Statewide Lake Assessment Program
LCI	the NYSDEC Lake Classification and Inventory Survey conducted during the 1980s and again beginning in 1996 on select sets of lakes, typically 1 to 4x per year
DEC	other water quality data collected by the NYSDEC Divisions of Water and Fish and Wildlife, typically 1 to 2x in any give year
ALSC	the NYSDEC (and other partners) Adirondack Lake Survey Corporation study of more than 1500 Adirondack and Catskill lakes during the mid 1980s, typically 1 to 2x
ELS	USEPA's Eastern Lakes Survey, conducted in the fall of 1982, 1x
NES	USEPA's National Eutrophication Survey, conducted in 1972, 2 to 10x
EMAP	USEPA and US Dept. of Interior's Environmental Monitoring and Assessment Program conducted from 1990 to present, 1 to 2x in four year cycles

Additional data source codes are provided in the individual lake reports

CSLAP DATA KEY:

The following key defines column headings and parameter results for each sampling season:

L Name	Lake name
Date	Date of sampling
Zbot	Depth of the lake at the sampling site, meters
Zsd	Secchi disk transparency, meters
Zsp	Depth of the sample, meters
TAir	Temp of Air, °C
TH2O	Temp of Water Sample, °C
TotP	Total Phosphorus as P, in mg/l (Hypo = bottom sample)
NO3	Nitrate + Nitrite nitrogen as N, in mg/l
$NH_{3/4}$	Ammonia as N, in mg/l
TN-TDN	Total Nitrogen = NO_x + $NH_{3/4}$ + organic nitrogen, as N, in mg/l
TP/TN	Phosphorus/Nitrogen ratios
Ca	Calcium, in mg/l
Tcolor	True color, as platinum color units
pH	(negative logarithm of hydrogen ion concentration), standard pH
Cond25	Specific conductance corrected to 25°C, in µmho/cm
Chl.a	Chlorophyll *a*, in µg/l
QA	Survey question re: physical condition of lake: (1) crystal clear; (2) not quite crystal clear; (3) definite algae greenness; (4) high algae levels; and (5) severely high algae levels
QB	Survey question re: aquatic plant populations of lake: (1) none visible; (2) visible underwater; (3) visible at lake surface; (4) dense growth at lake surface; (5) dense growth completely covering the nearshore lake surface
QC	Survey question re: recreational suitability of lake: (1) couldn't be nicer; (2) very minor aesthetic problems but excellent for overall use; (3) slightly impaired; (4) substantially impaired, although lake can be used; (5) recreation impossible
QD	Survey question re: factors affecting answer QC: (1) poor water clarity; (2) excessive weeds; (3) too much algae/odor; (4) lake looks bad; (5) poor weather; (6) litter, surface debris, beached/floating material; (7) too many lake users (boats, jetskis, etc); (8) other

TABLE 1: CSLAP Data Summary for Findley Lake (cont)

Year	Min	Avg	Max	N	Parameter
1986-04	**0.00**	**0.03**	**0.25**	**106**	**CSLAP NO3**
2004	0.01	0.08	0.25	4	CSLAP NO3
2004	0.07	0.07	0.07	1	CSLAP HypoNO3
2003	0.00	0.03	0.09	8	CSLAP NO3
2003	0.00	0.04	0.11	8	CSLAP HypoNO3
2000	0.01	0.01	0.04	8	CSLAP NO3
1999	0.01	0.01	0.02	8	CSLAP NO3
1998	0.01	0.04	0.14	7	CSLAP NO3
1997	0.01	0.03	0.10	8	CSLAP NO3
1996	0.01	0.03	0.08	8	CSLAP NO3
1995	0.01	0.01	0.01	1	CSLAP NO3
1994	0.03	0.08	0.12	2	CSLAP NO3
1991	0.01	0.01	0.01	4	CSLAP NO3
1990	0.01	0.01	0.02	6	CSLAP NO3
1989	0.01	0.07	0.14	3	CSLAP NO3
1988	0.01	0.01	0.03	15	CSLAP NO3
1987	0.01	0.03	0.17	9	CSLAP NO3
1986	0.03	0.05	0.12	15	CSLAP NO3
1985	0.01	0.05	0.13	4	LCI
1976	0.02	0.02	0.02	1	DEC
1986-04	**0.00**	**0.02**	**0.04**	**12**	**CSLAP NH4**
2004	0.01	0.02	0.02	4	CSLAP NH4
2004	0.02	0.02	0.02	1	CSLAP HypoNH4
2003	0.00	0.03	0.04	8	CSLAP NH4
2003	0.00	0.03	0.08	8	CSLAP HypoNH4
1986-04	**0.16**	**0.44**	**1.36**	**11**	**CSLAP TDN**
2004	0.27	0.60	1.36	4	CSLAP TDN
2004	0.50	0.50	0.50	1	CSLAP HypoTDN
2003	0.16	0.35	0.59	7	CSLAP TDN
2003	0.05	0.35	0.63	7	CSLAP HypoTDN
1986-04	**7.76**	**25.33**	**57.69**	**10**	**CSLAP TN/TP**
2004	16.05	27.13	46.86	3	CSLAP TN/TP
2004	13.87	13.87	13.87	1	CSLAP HypoTN/TP
2003	7.76	24.55	57.69	7	CSLAP TN/TP
2003	2.50	44.25	186.11	7	CSLAP HypoTN/TP
Year	Min	Avg	Max	N	Parameter
1986-04	**2**	**10**	**46**	**144**	**CSLAP TColor**
2004	10	16	20	4	CSLAP TColor
2003	6	23	46	8	CSLAP TColor
2000	4	7	9	8	CSLAP TColor
1999	6	9	12	8	CSLAP TColor
1998	2	7	14	8	CSLAP TColor
1997	7	9	10	8	CSLAP TColor
1996	5	11	20	8	CSLAP TColor
1995	5	7	10	5	CSLAP TColor

TABLE 1: CSLAP Data Summary for Findley Lake (cont)

Year	**Min**	**Avg**	**Max**	**N**	**Parameter**
1986-04	**2**	**10**	**46**	**144**	**CSLAP TColor**
1994	4	8	12	6	CSLAP TColor
1993	2	6	7	6	CSLAP TColor
1992	6	8	11	6	CSLAP TColor
1991	7	10	14	5	CSLAP TColor
1990	10	12	17	6	CSLAP TColor
1989	2	8	15	13	CSLAP TColor
1988	6	9	14	15	CSLAP TColor
1987	6	12	15	15	CSLAP TColor
1986	2	9	15	15	CSLA P TColor
1985	5	7	10	5	LCI
Year	Min	Avg	Max	N	Parameter
1986-04	**6.92**	**7.94**	**9.05**	**147**	**CSLAP pH**
2004	7.01	7.42	8.20	4	CSLAP pH
2003	7.95	8.33	8.52	8	CSLAP pH
2000	7.38	8.08	8.62	8	CSLAP pH
1999	7.21	7.66	8.33	8	CSLAP pH
1998	7.51	8.38	9.05	8	CSLAP pH
1997	7.39	7.85	8.48	8	CSLAP pH
1996	7.84	8.02	8.43	8	CSLAP pH
1995	7.48	7.91	8.16	5	CSLAP pH
1994	7.70	8.01	8.60	6	CSLAP pH
1993	7.75	8.10	8.26	6	CSLAP pH
1992	7.81	8.12	8.34	6	CSLAP pH
1991	7.59	7.91	8.28	6	CSLAP pH
1990	7.24	7.74	8.23	8	CSLAP pH
1989	7.76	8.05	8.24	13	CSLAP pH
1988	7.71	8.02	8.32	15	CSLAP pH
1987	7.14	7.60	8.22	15	CSLAP pH
1986	6.92	7.85	8.98	15	CSLAP pH
1985	7.20	7.67	8.08	5	LCI
1976	7.27	7.27	7.27	1	DEC
Year	Min	Avg	Max	N	Parameter
1986-04	**173**	**212**	**251**	**146**	**CSLAP Cond25**
2004	211	225	241	4	CSLAP Cond25
2003	218	234	251	8	CSLAP Cond25
2000	208	214	222	8	CSLAP Cond25
1999	196	209	227	8	CSLAP Cond25
1998	173	183	194	8	CSLAP Cond25
1997	186	199	207	8	CSLAP Cond25
1996	210	217	225	8	CSLAP Cond25
1995	230	233	237	5	CSLAP Cond25

TABLE 1: CSLAP Data Summary for Findley Lake (cont)

Year	Min	Avg	Max	N	Parameter
1986-04	**173**	**212**	**251**	**146**	**CSLAP Cond25**
1994	206	215	224	6	CSLAP Cond25
1993	202	211	216	6	CSLAP Cond25
1992	218	227	237	6	CSLAP Cond25
1991	215	220	224	6	CSLAP Cond25
1990	199	206	222	7	CSLAP Cond25
1989	198	207	214	13	CSLAP Cond25
1988	213	224	234	15	CSLAP Cond25
1987	198	208	221	15	CSLAP Cond25
1986	180	197	215	15	CSLAP Cond25
1985	140	170	200	5	LCI
1976	140	140	140	1	DEC
Year	Min	Avg	Max	N	Parameter
1986-04	**23.8**	**27.9**	**31.0**	**3**	**CSLAP Ca**
2004	23.8	23.8	23.8	1	CSLAP Ca
2003	29.0	30.0	31.0	2	CSLAP Ca
Year	Min	Avg	Max	N	Parameter
1986-04	**0.61**	**32.77**	**274.00**	**140**	**CSLAP Chl.a**
2004	0.61	10.78	29.20	4	CSLAP Chl.a
2003	1.09	7.73	32.94	8	CSLAP Chl.a
2000	4.54	16.22	42.10	8	CSLAP Chl.a
1999	19.20	46.73	69.00	8	CSLAP Chl.a
1998	6.32	34.67	57.10	8	CSLAP Chl.a
1997	2.60	15.96	27.80	8	CSLAP Chl.a
1996	3.50	10.53	20.50	8	CSLAP Chl.a
1995	9.86	66.34	172.00	6	CSLAP Chl.a
1994	3.73	26.31	50.30	6	CSLAP Chl.a
1993	15.50	30.75	49.30	6	CSLAP Chl.a
1992	9.18	15.11	28.50	6	CSLAP Chl.a
1991	30.90	98.25	149.00	6	CSLAP Chl.a
1990	9.40	42.39	62.70	7	CSLAP Chl.a
1989	2.16	10.53	19.60	13	CSLAP Chl.a
1988	1.78	23.81	52.50	14	CSLAP Chl.a
1987	17.00	93.94	274.00	11	CSLAP Chl.a
1986	0.80	20.69	53.30	13	CSLAP Chl.a
1985	4.80	10.62	22.70	5	LCI
1976	40.90	40.90	40.90	1	DEC

TABLE 1: CSLAP Data Summary for Findley Lake (cont)

Year	Min	Avg	Max	N	Parameter
1986-04	**1**	**2.8**	**5**	**70**	**QA**
2004	2	2.5	3	4	QA
2003	2	2.8	4	4	QA
2000	2	2.4	3	8	QA
1999	3	3.4	4	8	QA
1998	2	3.4	5	8	QA
1997	1	2.5	3	8	QA
1996	1	2.1	3	7	QA
1995	2	3.0	4	6	QA
1994	2	2.8	4	6	QA
1993	2	2.8	3	6	QA
1992	2	2.6	3	5	QA
Year	Min	Avg	Max	N	Parameter
1986-04	**2**	**2.7**	**4**	**70**	**QB**
2004	2	2.5	3	4	QB
2003	2	3.0	4	4	QB
2000	2	2.5	3	8	QB
1999	2	2.9	3	8	QB
1998	3	3.8	4	8	QB
1997	2	2.9	3	8	QB
1996	2	2.6	4	7	QB
1995	2	2.3	3	6	QB
1994	2	2.2	3	6	QB
1993	2	2.7	4	6	QB
1992	2	2.2	3	5	QB
Year	Min	Avg	Max	N	Parameter
1986-04	**1**	**3.2**	**4**	**70**	**QC**
2004	3	3.0	3	4	QC
2003	2	3.3	4	4	QC
2000	2	2.9	4	8	QC
1999	3	3.5	4	8	QC
1998	4	4.0	4	8	QC
1997	3	3.4	4	8	QC
1996	1	2.9	4	7	QC
1995	2	3.0	4	6	QC
1994	2	3.2	4	6	QC
1993	2	3.3	4	6	QC
1992	2	2.6	3	5	QC

- **Statistical analyses**. True assessments of water quality trends and comparison to other lakes involve rigid statistical analyses. Such analyses are generally beyond the scope of this program, in part due to limitations on the time available to summarize data from nearly 100 lakes in the five months from data receipt to next sampling season. This may be due in part to the inevitable inter-lake inconsistencies in sampling dates from year to year, and in part to the limited scope of monitoring. Where appropriate, some statistical summaries, utilizing both parametric and non-parametric statistics, have been provided within the report (primarily in Table 2).

- **Mean versus Median-** Much of the water quality summary data presented in this report is reported as the **mean**, or the average of all of the readings in the period in question (summer, annual, year to year). However, while mean remains one of the most useful, and often most powerful, ways to estimate the most typical reading for many of the measured water quality indicators, it is a less useful and perhaps misleading estimate when the data are not "normally" distributed (most common readings in the middle of the range of all readings, with readings less common toward the end of the range).

  In particular, comparisons of one lake to another, such as comparisons within a particular basin, can be greatly affected by the spread of the data across the range of all readings. For example, the average phosphorus level of nine lakes with very low readings (say 10 µg/l) and one lake with very high readings (say 110 µg/l) could be much higher (in this case, 20 µg/l) than in the "typical lake" in this set of lakes (much closer to 10 µg/l). In this case, **median**, or the middle reading in the range, is probably the most accurate representation of "typical".

  This report will include the use of both mean and median to evaluate "central tendency", or the most typical reading, for the indicator in question. In most cases, "mean" is used most often to estimate central tendency. However, where noted, "median" may also be used.

TABLE 2- Present Year and Historical Data Summaries for Findley Lake
Eutrophication Indicators

Parameter	Year	Minimum	Average	Maximum
Zsd	2004	1.20	2.28	3.20
(meters)	All Years	0.33	1.63	5.35
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Phosphorus	2004	0.017	0.021	0.029
(mg/l)	All Years	0.005	0.035	0.082
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Chl.a	2004	0.61	10.78	29.20
(µg/l)	All Years	0.61	32.77	274.00

Parameter	Year	Was 2004 Clarity the Highest or Lowest on Record?	Was 2004 a Typical Year?	Trophic Category	Zsd Changing?	% Samples Violating DOH Beach Std?+
Zsd	2004	Within Normal Range	Yes	Mesotrophic	No	0
(meters)	All Years			Eutrophic		41
Parameter	**Year**	**Was 2004 TP the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Trophic Category**	**TP Changing?**	**% Samples Exceeding TP Guidance Value**
Phosphorus	2004	Lowest at Times	No	Eutrophic	No	33
(mg/l)	All Years			Eutrophic		81
Parameter	**Year**	**Was 2004 Algae the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Trophic Category**	**Chl.a Changing?**	
Chl.a	2004	Lowest at Times	No	Eutrophic	No	
(µg/l)	All Years			Eutrophic		

+- Minimum allowable water clarity for siting a new NYS swimming beach = 1.2 meters
+- NYS Total Phosphorus Guidance Value for Class B and Higher Lakes = 0.020 mg/l

-The 2004 CSLAP dataset indicates that Findley Lake was less productive than in most previous CSLAP sampling seasons, based on the slightly higher water clarity and substantially lower nutrient and algae levels. The lower phosphorus and chlorophyll readings in 2004 repeated the drop found in 2003, and both indicate a trend toward lower lake productivity (although the changes in water transparency have not been as pronounced). This is also manifested in much lower deepwater nutrient concentrations in the past two years. There continues to be a very strong correlation between changes in clarity and algae, and between changes in phosphorus and algae, indicating that improvements in water transparency have and will continue to result from reductions in algae levels in the lake and nutrient loading to the lake. Lake productivity increases over the course of the summer, though less so than in many previous years, due at least in part to deepwater nutrient levels that are (at least historically) substantially higher than those measured at the lake surface. Phosphorus levels in Findley Lake regularly exceed the state guidance value for lakes used for contact recreation (swimming), occasionally resulting in water clarity readings that fail to exceed the minimum recommended water transparency for swimming beaches (= 1.2 meters). In short, Findley Lake was less productive in 2004 than in the typical CSLAP sampling season, following a pattern observed in 2003, and this may signal a trend toward lower lake productivity into the future.

TABLE 2- Present Year and Historical Data Summaries for Findley Lake (cont)

Other Water Quality Indicators

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Nitrate	2004	0.01	0.08	0.25
(mg/l)	All Years	0.00	0.03	0.25
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Ammonia	2004	0.01	0.02	0.02
(mg/l)	All Years	0.00	0.02	0.04
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
TDN	2004	0.27	0.60	1.36
(mg/l)	All Years	0.16	0.44	1.36
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
True Color	2004	10	16	20
(ptu)	All Years	2	10	46
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
pH	2004	7.01	7.42	8.20
(std units)	All Years	6.92	7.94	9.05
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Conductivity	2004	211	225	241
(µmho/cm)	All Years	173	212	251
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Calcium	2004	23.8	23.8	23.8
(mg/l)	All Years	23.8	27.9	31.0

***- These data indicate Findley Lake is a weakly to moderately colored, alkaline (above neutral pH) lake with mostly low nitrate levels and moderately hard water. Color readings do not appear to limit water clarity, even when algae levels are very low. Nitrogen levels are probably high enough to indicate that phosphorus controls algae growth (actual nitrogen to phosphorus ratios probably exceed 15-25), although overall nitrogen levels remain very low. It does not appear that either nitrate or ammonia appear to represent a threat to human health and water quality, and deepwater ammonia and nitrate levels are similar to those measured at the lake surface (and are low). The single elevated nitrate reading in 2004 was probably not representative of the lake. Conductivity readings have varied somewhat from year to year, with no clear pattern, although it does not appear that these changes in conductivity have created any ecological impacts (although sources of materials loading to the lake should continue to be evaluated). pH readings are usually within the state water quality standards (=6.5 to 8.5), and should be adequate to support most aquatic organisms. Calcium levels are above the threshold found to support zebra mussels, although it is not believed that these exotic animals have been found in Findley Lake.**

TABLE 2- Present Year and Historical Data Summaries for Findley Lake (cont)

Other Water Quality Indicators (cont)

Parameter	**Year**	**Was 2004 Nitrate the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Nitrate High?**	**Nitrate Changing?**	**% Samples Exceeding NO3 Standard**	
Nitrate	2004	Highest at Times	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2004 Ammonia the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Ammonia High?**	**Ammonia Changing?**	**% Samples Exceeding NH4 Standard**	
Ammonia	2004	Within Normal Range	Yes	No	Not yet known	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2004 TDN the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**TDN High?**	**TDN Changing?**	**Ratios of TN/TP Indicate P or N Limitation?**	
TDN	2004	Highest at Times	Yes	No	Not yet known	P Limitation	
(mg/l)	All Years			No		Unclear	
Parameter	**Year**	**Was 2004 Color the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Colored Lake?**	**Color Changing?**		
True Color	2004	Within Normal Range	Yes	No	No		
(ptu)	All Years			No			
Parameter	**Year**	**Was 2004 pH the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Acceptable Range?**	**pH Changing?**	**% Samples > Upper pH Standard**	**% Samples < Lower pH Standard**
pH	2004	Within Normal Range	Yes	Yes	No	0	0
(std units)	All Years			Yes		5	0
Parameter	**Year**	**Was 2004 Conductivity Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Relative Hardness**	**Conduct. Changing?**		
Conductivity	2004	Within Normal Range	Yes	Intermediate	No		
(µmho/cm)	All Years						
Parameter	**Year**	**Was 2004 Calcium Highest or Lowest on Record?**	**Was 2004 a Typical Year?**	**Support Zebra Mussels?**	**Calcium Changing?**		
Calcium	2004	Lowest at Times	Yes	Yes	Probably not		
(mg/l)	All Years			Yes			

+- NYS Nitrate standard = 10 mg/l

+- NYS Ammonia standard = 2 mg/l (as NH_3-NH_4)

+- NYS pH standard- 6.5 < acceptable pH < 8.5

TABLE 2- Present Year and Historical Data Summaries for Findley Lake (cont)

Lake Perception Indicators (1= most favorable, 5= least favorable)

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QA	2004	2	2.5	3
(Clarity)	All Years	1	2.8	5
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QB	2004	2	2.5	3
(Plants)	All Years	2	2.7	4
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QC	2004	3	3.0	3
(Recreation)	All Years	1	3.2	4

Parameter	**Year**	**Was 2004 Clarity the Highest or Lowest on Record?**	**Was 2004 a Typical Year?**		**Clarity Changed?**
QA	2004	Within Normal Range	Yes		No
(Clarity)	All Years				
Parameter	**Year**	**Was 2004 Weed Growth the Heaviest on Record?**	**Was 2004 a Typical Year?**		**Weeds Changed?**
QB	2004	Lightest at Times	Yes		No
(Plants)	All Years				
Parameter	**Year**	**Was 2004 Recreation the Best or Worst on Record?**	**Was 2004 a Typical Year?**		**Recreation Changed?**
QC	2004	Within Normal Range	Yes		No
(Recreation)	All Years				

- Recreational assessments of Findley Lake were about as favorable in the last two years as in the typical CSLAP sampling season, despite the higher lake productivity. The recreational suitability of the lake has most often been described as "slightly impaired" for most recreational uses, most consistent with the water quality conditions in the lake. Findley Lake has most often been described as having "definite algal greenness", although these assessments have been slightly more favorable in years when water clarity is higher. These assessments are mostly consistent with the measured water quality (clarity) conditions in the lake. Aquatic plants regularly grow to the lake surface, and "excessive weed growth" is frequently cited as impacting the recreational use of the lake. Recreational assessments are usually sensitive to changes in both water quality and rooted aquatic plants. These assessments degrade slightly over the course of the summer, coincident with increases in aquatic plant densities and lake productivity (algae) over this period.

How Do the 2004 Data Compare to Historical Data from Findley Lake?

Seasonal Comparison of Eutrophication, Other Water Quality, and Lake Perception Indicators–2004 Sampling Season and in the Typical or Previous Sampling Seasons at Findley Lake

Figures 15 and 16 compare data for the measured eutrophication parameters for Findley Lake in 2004 and since CSLAP sampling began at Findley Lake. Figures 17 and 18 compare nitrogen to phosphorus ratios, Figures 19 through 26 compare other sampling indicators, and Figures 27 and 28 compare volunteer perception responses over the same time periods.

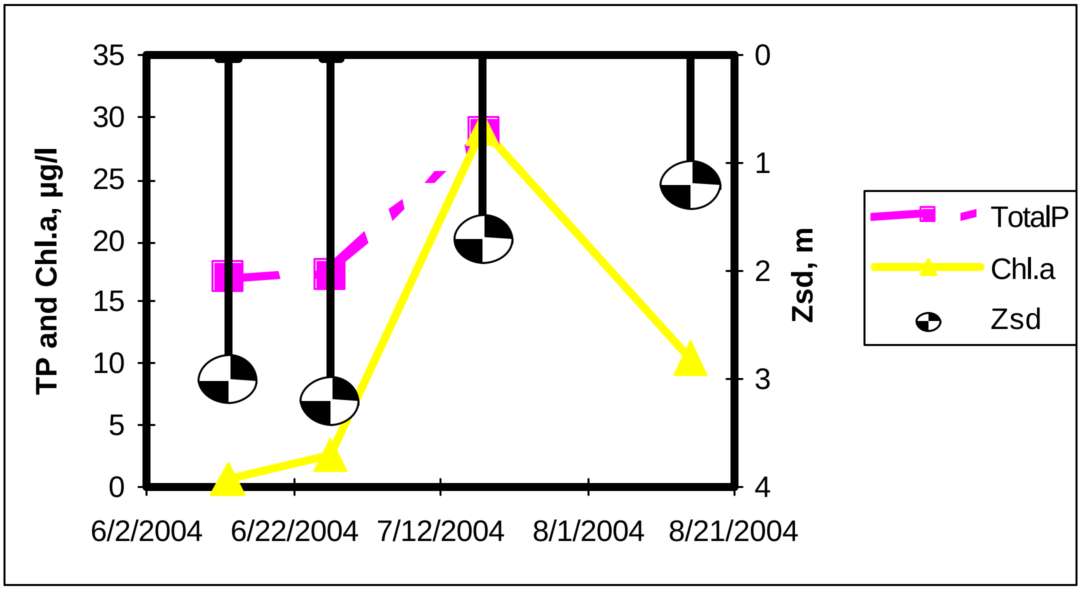


Figure 15. 2004 Eutrophication Data for Findley Lake

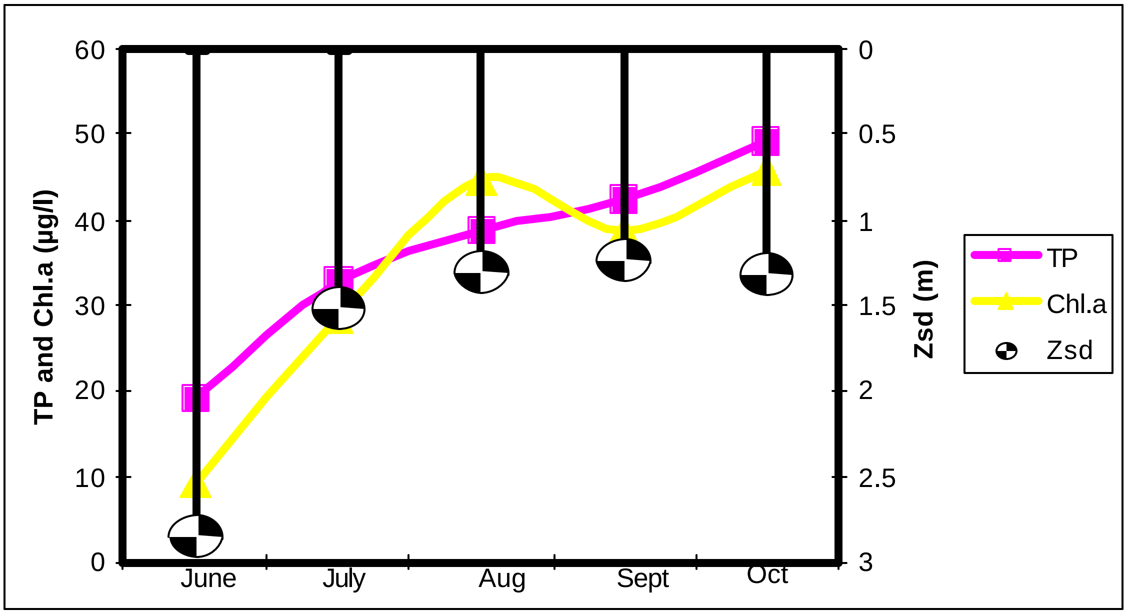


Figure 16- Eutrophication Data in a Typical (Monthly Mean) Year for Findley Lake

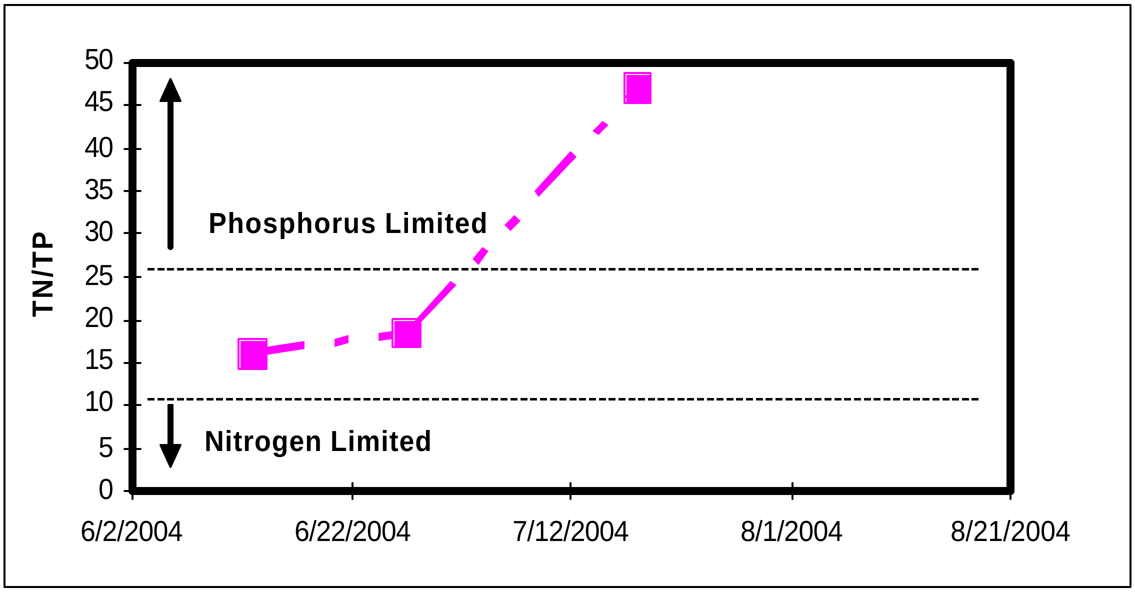


Figure 17. 2004 Nitrogen to Phosphorus Ratios for Findley Lake

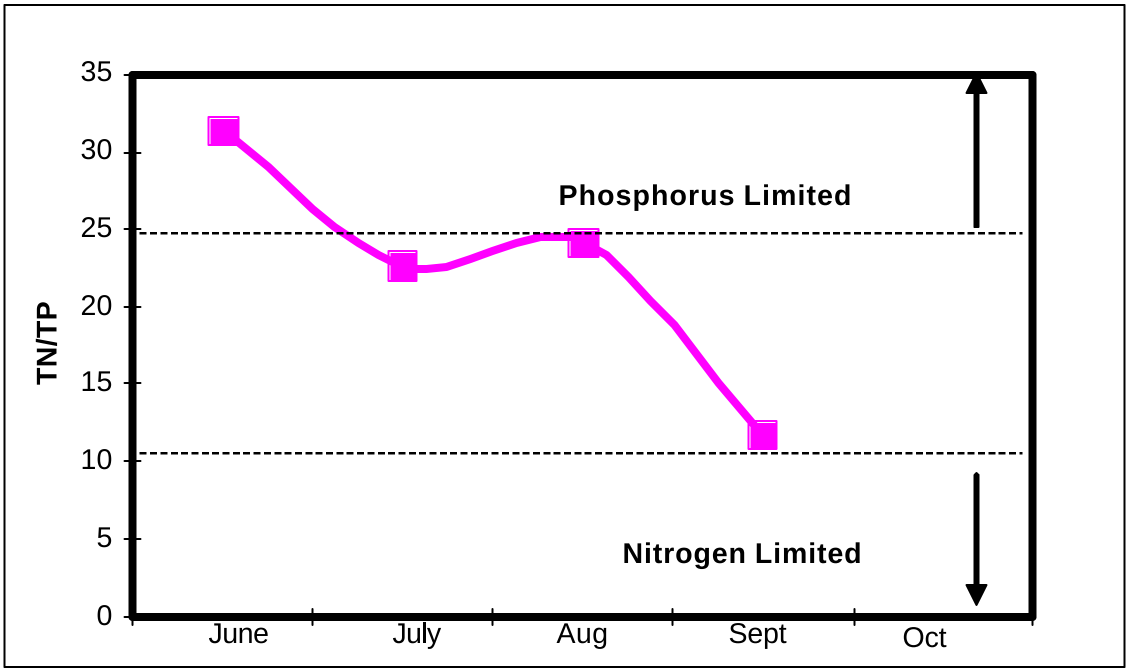


Figure 18- Nitrogen to Phosphorus Ratios in a Typical (Monthly Mean) Year for Findley Lake

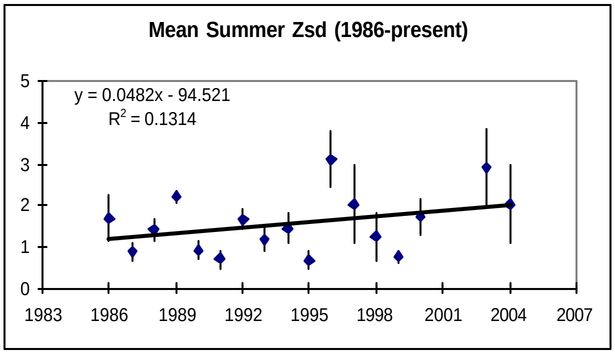


Figure 19. Annual Average Summer Water Clarity for Findley Lake

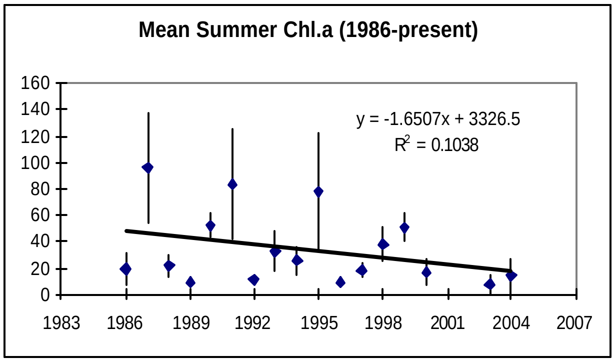


Figure 20. Annual Average Summer Chlorophyll a for Findley Lake

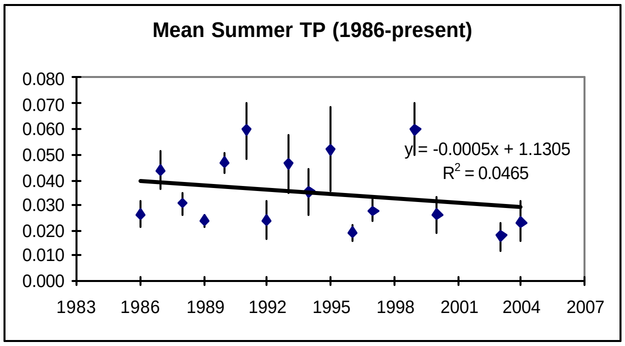


Figure 21. Annual Average Summer Total Phosphorus for Findley Lake

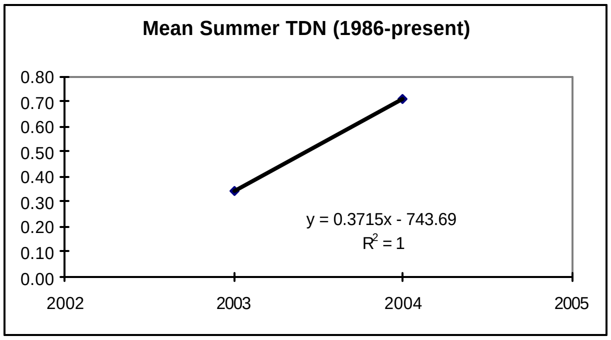


Figure 22. Annual Average Summer Total Nitrogen for Findley Lake

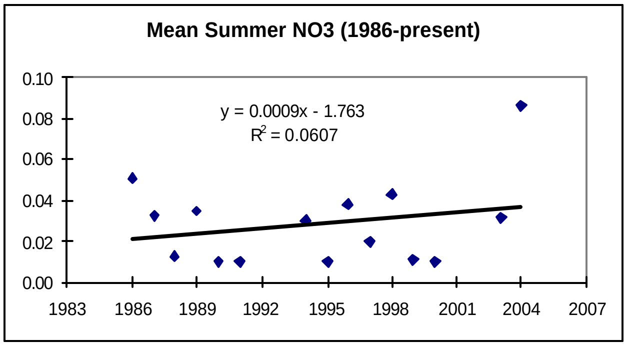


Figure 23. Annual Average Summer Nitrate for Findley Lake

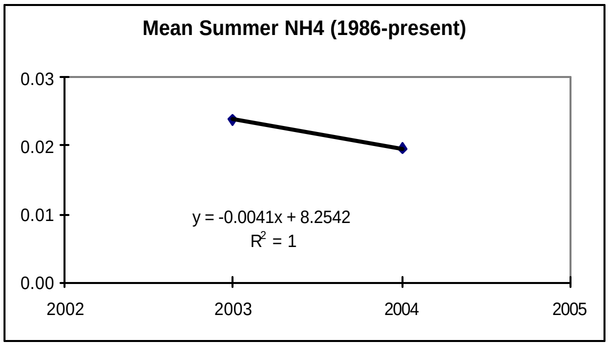


Figure 24. Annual Average Summer Ammonia for Findley Lake

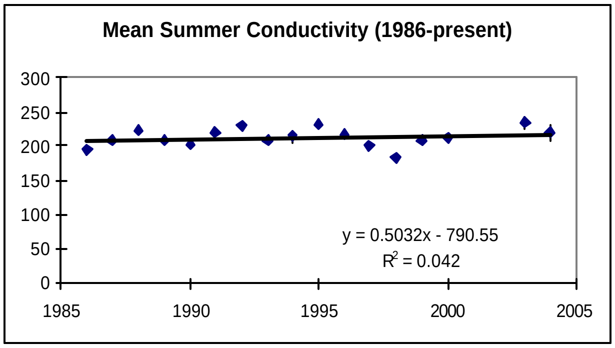


Figure 25. Annual Average Summer Conductivity for Findley Lake

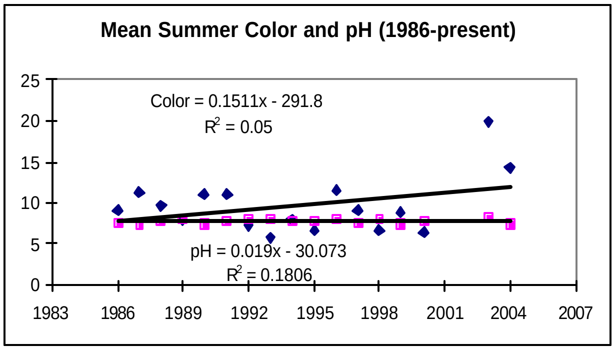


Figure 26. Annual Average Summer pH and Color for Findley Lake

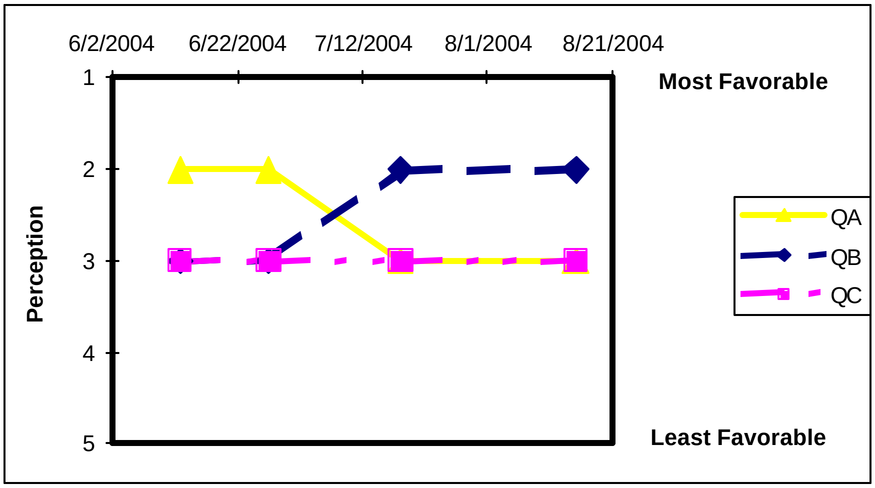


Figure 27. 2004 Lake Perception Data for Findley Lake

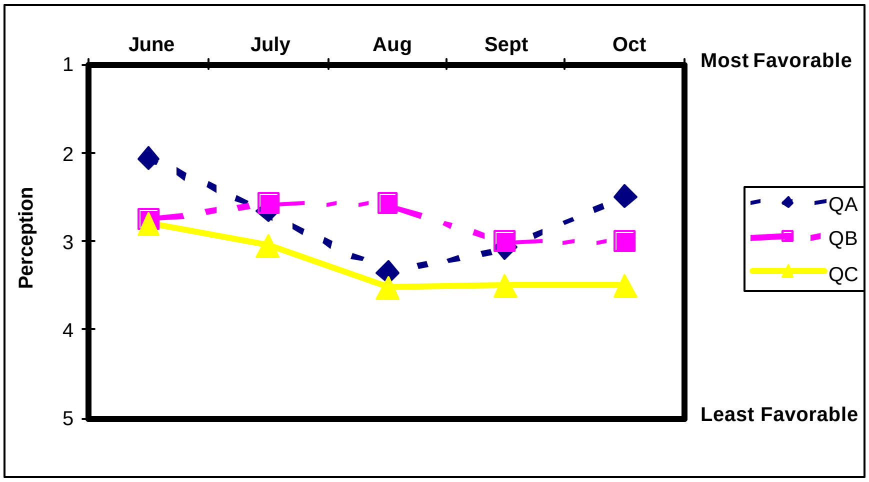


Figure 28- Lake Perception Data in a Typical (Monthly Mean) Year for Findley Lake

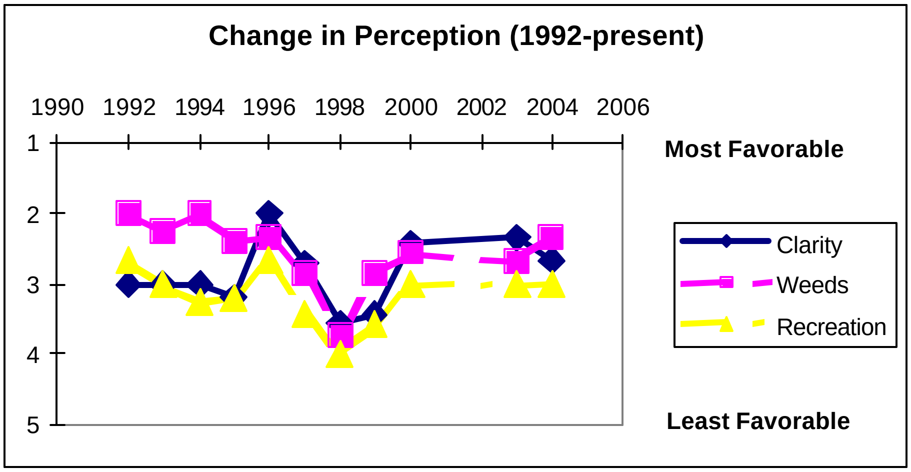


Figure 29- Annual Average Lake Assessments for Findley Lake

(QA = clarity, ranging from (1) crystal clear to (3) definite algae greenness to (5) severely high algae levels
QB = weeds, ranging from (1) not visible to (3) growing to the surface to (5) dense growth covers lake;
QC = recreation, ranging from (1) could not be nicer to (3) slightly impaired to (5) lake not usable)

How does Findley Lake compare to other lakes?

Annual Comparison of Median Readings for Eutrophication Parameters and Recreational Assessment For Findley Lake in 2004 to Historical Data for Findley Lake, Neighboring Lakes, Lakes with the Same Lake Classification, and Other CSLAP Lakes

The graphs to the left illustrate comparisons of each eutrophication parameter and recreational perception at Findley Lake-in 2004, other lakes in the same drainage basin, lakes with the same water quality classification (each classification is summarized in Appendix B), and all of CSLAP. Please keep in mind that differences in watershed types, activities, lake history and other factors may result in differing water quality conditions at your lake relative to other nearby lakes. In addition, the limited data base for some regions of the state preclude a comprehensive comparison to neighboring lakes.

Based on these graphs, the following conclusions can be made about Findley Lake in 2004:

a) Using water clarity as an indicator, Findley Lake is usually more productive as other Class B lakes, other Allegany River basin lakes, and other NYS lakes, although in recent years it has been about as productive as other nearby and NYS lakes.

b) Using chlorophyll *a* concentrations as an indicator, Findley Lake is usually more productive than other NYS lakes, Class B, and Allegany River basin lakes, although in 2004 it was less productive other nearby and Class B lakes.

c) Using total phosphorus concentrations as an indicator, Findley Lake is usually more productive than other Class B, other Allegany River basin and other NYS lakes, although in 2004, it was less productive than all but other nearby lakes.

d) Using QC on the field observations form as an indicator, Findley Lake has been less suitable for recreation than other Allegany River basin, other Class B, and other CSLAP lakes.

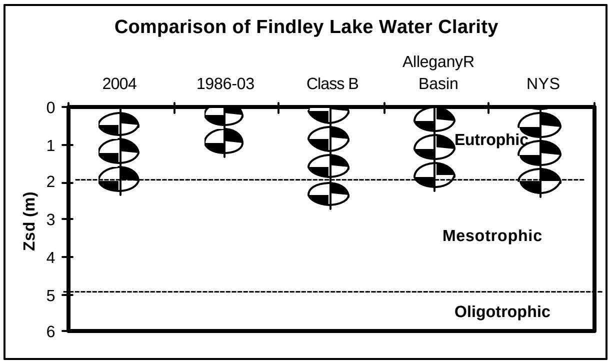


Figure 30. *Comparison of 2004 Secchi Disk Transparency to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2004*

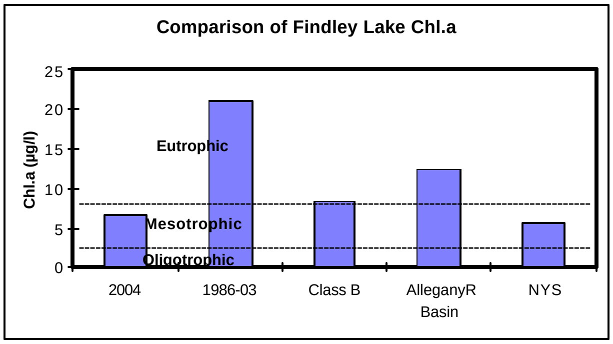


Figure 31. *Comparison of 2004 Chlorophyll a to Lakes with the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2004*

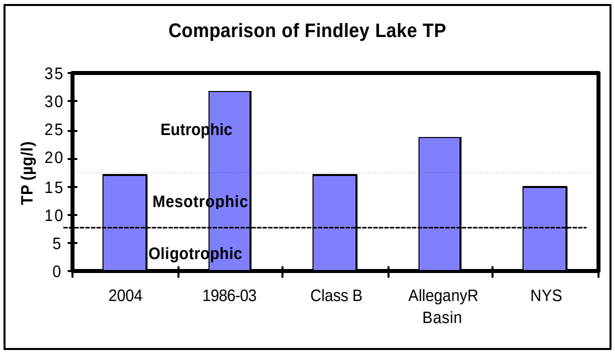


Figure 32. *Comparison of 2004 Total Phosphorus to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2004*

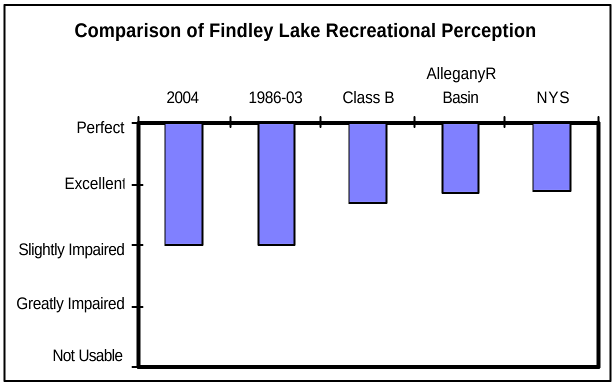


Figure 33. *Comparison of 2004 Recreational Perception*

VI: PRIORITY WATERBODY AND IMPAIRED WATERS LIST

The Priority Waterbody List (PWL) is presently an inventory of all waters in New York State (lakes, ponds, reservoirs, rivers, streams, and estuaries) known to have designated water uses with some degree of impairment of which are threatened by potential impairment. However, the PWL is slowly evolving into an inventory of all waterbodies for which sufficient information is available to assess the condition and/or usability of the waterbody. PWL waterbodies are identified through a broad network of county and state agencies, with significant public outreach and input, and the list is maintained and compiled by the NYSDEC Division of Water. Monitoring data from a variety of sources, including CSLAP, have been utilized by state and agencies to evaluate lakes for inclusion on the PWL, and the process for incorporating lakes data has become more standardized.

Specific numeric criteria have recently been developed to characterize sampled lakes in the available use-based PWL categories (precluded, impaired, stressed, or threatened). Evaluations utilize the NYS phosphorus guidance value, water quality standards, criteria utilized by other states, and the trophic ranges described earlier to supplement the other more antidotal inputs to the listing. The procedures by which waterbodies are evaluated are known as the Consolidated Assessment and Listing Methodology (CALM) process. This process is undertaken on an annual rotating basin, with waterbodies in several drainage basins evaluated each year. Each of the 17 drainage basins in the state are assessed within every five years. In general, waterbodies that violate pertinent water quality standards (such as those listed in Table 3) at a frequency of greater than 25% are identified as *impaired*, at a frequency of 10-25% are identified as *stressed*, and at a frequency of 0-10% are identified as *threatened*, although some evidence of use impairment (including through CSLAP lake perception surveys) might also be required. Evidence of restricted uses (thru beach closures, etc.) are often required to identify a waterbody as *precluded*.

Lakes that have been identified as *precluded* or *impaired* on the PWL are likely candidates for the federal 303(d) list, an “Impaired Waters” designation mandated by the federal Clean Water Act. Lakes on this list must be closely evaluated for the causes and sources of these problems. Remedial measures must be undertaken, under a defined schedule, to solve these water quality problems. This entire evaluation and remediation process is known as the “TMDL” process, which refers to the Total Maximum Daily Load calculations necessary to determine how much (pollution that causes the water quality problems) is too much.

TABLE 3- Water Quality Standards Associated With Class B and Higher Lakes

Parameter	Acceptable Level	To Protect…..
Secchi Disk Transparency	> 1.2 meters*	Swimming
Total Phosphorus	< 0.020 mg/L and Narrative*	Swimming
Chlorophyll a	none	NA
Nitrate Nitrogen	< 10 mg/L and Narrative*	Drinking Water
Ammonia Nitrogen	2 mg/L*	Drinking Water
True Color	Narrative*	Swimming
pH	< 8.5 and > 6.5*	Aquatic Life
Conductivity	None	NA

*- Narrative Standards and Notes:

Secchi Disk Transparency: The 1.2 meter (4 feet) guidance is applied for safety reasons (to see submerged swimmers or bottom debris), and strictly applies only to citing new swimming beaches, but may be appropriate for all waterbodies used for contact recreation (swimming)

Phosphorus and Nitrogen: "None in amounts that will result in the growths of algae, weeds and slimes that will impair the waters for their best usages" (Class B= swimming)

-The 0.020 mg/l threshold for TP corresponds to a guidance value, not a standard; it strictly applies to Class B and higher waters, but may be appropriate for other waterbodies used for contact recreation (swimming). NYS (and other states) are in the process of identifying numerical nutrient (phosphorus, and perhaps Secchi disk transparency, chlorophyll *a*, and nitrogen) standards, but this is unlikely to be finalized within the next several years.

-The 10 mg/L Nitrate standard strictly applies to only Class A or higher waters, but is included here since some Class B lakes are informally used for potable water intake.

-For the form of ammonia (NH3+NH4) analyzed, a 2 mg/l human health standard applies to Class A or higher waters; while lower un-ionized ammonia standards apply to all classes of NYS lakes, this form is not analyzed through CSLAP

Color: "None in amounts that will adversely affect the color or impair the waters for their best usages" (for Class B waters, this is swimming)

pH: The standard applies to all classes of waterbodies

pH readings exceed the NYS pH standards (= 6.5 to 8.5) during about 5% of the CSLAP sampling sessions at Findley Lake, and it is likely that these pH readings are adequate to support most aquatic organisms. Phosphorus levels at Findley Lake exceeded the phosphorus guidance value for NYS lakes (=0.020 mg/l) during about 80% of the CSLAP sampling sessions at the lake, resulting in water transparency readings that fail to reach the minimum recommended water clarity for swimming beaches (= 1.2 meters) during about 40% of the sampling sessions at the lake. However, these violations only occurred at a frequency of 33% and 0%, respectively, in 2004. It is not known if any of the narrative water quality standards listed in Table 3 have been violated at Findley Lake.

Findley Lake is presently among the lakes listed on the Allegany River drainage basin PWL (1999), with *aesthetics, fishing and fish survival* listed as *impaired* due to

excessive nutrients, algae and weeds, and reduced water clarity. The actual PWL listing is as follows:

"*D.O. depletion in the hypolimnion has been documented by Region 9 Fisheries Unit. The impact of anoxic conditions below the thermocline (10-13) is to crowd salmonid fish into a very limited area during the summer months. Young fish become more vulnerable to predation and some fish are forced into warmer upper waters than preferred cooler water temperatures.*

Excessive growth of algae and rooted aquatic vegetation impairs contact recreation. Mechanical harvesting is being used to control the vegetation. This is typical for a small inland lake.

Additional nutrients are added by the waste of the year-round population of several hundred Canadian geese. Seasonally, there would be some geese, however the artificial year-round feeding supports an abnormally high population.

Source of Information: Central Office"

This has resulted in Findley Lake being included on the federal 303(d) list. The CSLAP dataset, including water chemistry data, physical measurements, and volunteer samplers' perception data suggest that these listings are warranted, although the "improvement" in water quality in 2003 should continue to be watched. The next PWL listing cycle for the Allegany River drainage basin will occur in 2006.

VII: CONSIDERATIONS FOR LAKE MANAGEMENT

CSLAP is intended for a variety of uses, such as collecting needed information for comprehensive lake management, although it is not capable of collecting all the needed information. To this end, this section includes a ***broad summary of the major lake problems and "considerations" for lake management.*** These include only those lake problems which may have been defined by CSLAP sampling, such as physical condition (algae and water clarity), aquatic plant coverage (type and extent of weed populations), and recreational suitability of the lake, as related to contact recreation. These broad categories may not encompass the most pressing issue at a particular time at any given CSLAP lake; for example, local concerns about filamentous algae or concerns about other parameters not analyzed in the CSLAP sampling. While there is some opportunity for CLSAP trained volunteers to report and assess some site-specific conditions or concerns on the CSLAP Field Observations Form, such as algae blooms or shoreline vegetation, this section is limited to the confines of this program. The categories represent the most common, broadest issues within the lake management as reported through CSLAP.

Each summarized management strategy is more extensively outlined in Diet for a Small Lake, and this joint NYSDEC-NYSFLA publication should be consulted for more details and for a broader context of in-lake or watershed management techniques. These "considerations" should not be construed as "recommendations", since there is insufficient information available through CSLAP to assess if or how a lake should be managed. Issues associated with local environmental sensitivity, permits, and broad community management objectives also cannot be addressed here. Rather, the following section should be considered as “tips” or a compilation of suggestions for a lake association to manage problems defined by CSLAP water quality data or articulated by perception data. When appropriate, lake-specific management information, and other lake-specific or local “data” (such as the presence of a controllable outlet structure) is reported in ***bold*** in this “considerations” section.

The primary focus of CSLAP monitoring is to evaluate lake condition and impacts associated with lake eutrophication. Since lake eutrophication is often manifested in excessive plant growth, whether algae or aquatic macrophytes (weeds), it is likely that lake management activities, whether promulgated to reduce algae or weed growth, or to maintain water clarity and the existing makeup and density of aquatic plants in the lake, will need to address watershed inputs of nutrients and sediment to the lake, since both can contribute to either algal blooms or excessive weed growth. A core group of nutrient and sediment control activities will likely serve as the foundation for most comprehensive lake management plans and activities, and can be summarized below.

GENERAL CONSIDERATIONS FOR ALL CSLAP LAKES

Nutrient controls can take several forms, depending on the original source of the nutrients:

- Septic systems can be regularly pumped or upgraded to reduce the stress on the leach fields which can be replaced with new soil or moving the discharge from the septic tank to a new field). Pumpout programs are usually quite inexpensive, particularly when lakefront residents negotiate a bulk rate discount with local pumping companies. Upgrading systems can be expensive, but may be necessary to handle the increased loading from camp expansion or conversion to year-round residency. Replacing leach fields alone can be expensive and limited by local soil or slope conditions, but may be the only way to reduce actual nutrient loading from septic systems to the lake. It should be noted that upgrading or replacing the leach field may do little to change any bacterial loading to the lake, since bacteria are controlled primarily within the septic tank, not the leach field.
- Stormwater runoff control plans include street cleaning, artificial marshes, sedimentation basins, runoff conveyance systems, and other strategies aimed at minimizing or intercepting pollutant discharge from impervious surfaces. The NYSDEC has developed a guide called Reducing the Impacts of Stormwater Runoff to provide more detailed information about developing a stormwater management plan. This is a strategy that cannot generally be tackled by an individual homeowner, but rather requires the effort and cooperation of lake residents and municipal officials.
- There are numerous agriculture management practices such as fertilizer controls, soil erosion practices, and control of animal wastes, which either reduce nutrient export or retain particles lost from agricultural fields. These practices are frequently employed in cooperation with county Soil and Water Conservation District offices, and are described in greater detail in the NYSDEC’s Controlling Agricultural Nonpoint Source Water Pollution in New York State. Like stormwater controls, these require the cooperation of many watershed partners, including farmers.
- Streambank erosion can be caused by increased flow due to poorly managed urban areas, agricultural fields, construction sites, and deforested areas, or it may simply come from

repetitive flow over disturbed streambanks. Control strategies may involve streambank stabilization, detention basins, revegetation, and water diversion.

Land use restrictions development and zoning tools such as floodplain management, master planning to allow for development clusters in more tolerant areas in the watershed and protection of more sensitive areas; deed or contracts which limit access to the lake, and cutting restrictions can be used to reduce pollutant loading to lakes. This approach varies greatly from one community to the next and frequently involves balancing lake use protection with land use restrictions. State law gives great latitude to local government in developing land use plans.

Lawn fertilizers frequently contain phosphorus, even though nitrogen is more likely to be the limiting nutrient for grasses and other terrestrial plants. By using lawn fertilizers with little or no phosphorus, eliminating lawn fertilizers or using lake water as a “fertilizer” at shoreline properties, fewer nutrients may enter the lake. Retaining the original flora as much as possible, or planting a buffer strip (trees, bushes, shrubs) along the shoreline, can reduce the nutrient load leaving a residential lawn.

Waterfowl introduce nutrients, plant fragments, and bacteria to the lake water through their feces. Feeding the waterfowl encourages congregation which in turn concentrates and increases this nutrient source, and will increase the likelihood that plant fragments, particularly from Eurasian watermilfoil and other plants that easily fragment and reproduce through small fragments, can be introduced to a previously uncolonized lake.

Although not really a “watershed control strategy”, establishing **no-wake zones** can reduce shoreline erosion and local turbidity. Wave action, which can disturb flocculent bottom sediments and unconsolidated shoreline terrain is ultimately reduced, minimizing the spread of fertile soils to susceptible portions of the lake.

Do not discard or introduce plants from one water source to another, or deliberately introduce a "new" species from catalogue or vendor. For example, do not empty bilge or bait bucket water from another lake upon arrival at another lake, for this may contain traces of exotic plants or animals. Do not empty aquaria wastewater or plants to the lake.

Boat propellers are a major mode of transport to uncolonized lakes. Propellers, hitches, and trailers frequently get entangled by weeds and weed fragments. Boats not cleaned of fragments after leaving a colonized lake may introduce plant fragments to another location. New introductions of plants are often found near public access sites.

SPECIFIC CONSIDERATIONS FOR FINDLEY LAKE

Management Focus: **Water Clarity/Algae/Physical Condition/Recreational Condition**

Problem	Probable cause	Probable source
Poor water clarity	Excessive algae	**Excessive phosphorus loading** from septics, watershed runoff (stormwater, construction sites, agriculture, ...)

Discussion:
The water sampling results indicate that recreational impairments in this lake are usually related to lower-than-desired water transparency. **However, clarity has been higher the last two years, somewhat reducing the impact of poor water quality on recreation conditions in Findley Lake.** The CSLAP data suggest that water clarity in this lake appears to be related to excessive densities of planktonic algae. A management focus to improve water clarity involves reducing algae levels, which is linked (and confirmed through CSLAP) to reducing nutrient concentrations in the lake and within the watershed. These considerations do not constitute recommendations, since it is not known if the lake association is attempting to improve water clarity, but these considerations are a discussion of some management alternatives which may have varying levels of success addressing these problems.

POTENTIAL IN-LAKE CONTROL TECHNIQUES

The strategies outlined below primarily address the cause, but not the ultimate source, of problems related to poor water clarity. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, relative to strategies that control the source of the problem. The problems may continue or worsen if the source of the problem, excessive nutrients, is not addressed, using strategies such as those described under **Watershed Controls** below. In-lake controls are listed in order of frequency of use in the “typical” NYS lake: *copper sulfate, precipitation/inactivation, hypolimnetic withdrawal, aeration, dilution/flushing, artificial circulation,* and *food web manipulation*.

- *Copper sulfate* is an algacide that is frequently used to control nuisance levels of planktonic algae (dots of algae throughout the water column) or filamentous algae (mats of algae on the lake surface, weeds, or rocks) throughout the lake. It is usually applied 1-3x per summer in granular or liquid form, usually by a licensed applicator. Many people feel that it is effective at reducing algae levels to below nuisance conditions, others feel it only “flattens the peak” of the worst blooms, and still others think it is merely a placebo, given the short – lived dominance of some phytoplankton species. There are concerns about the long-term affect of copper on the lake bottom, including the effects on bottom macroinvertebrate communities, and implications of increasing the concentrations of copper as a component of bottom sediments. Another concern is a possible deleterious affect of copper on the zooplankton (microscopic animals that feed on algae) community, which could, in some lakes, ultimately cause a “bounce-back” algae bloom that is worse than the original bloom. **It is not known to what extent copper products have been used for algae control at Findley Lake.**

- *Precipitation/Inactivation* involves adding a chemical binding agent, usually alum, to bind and precipitate phosphorus, removing it from the water column, and to seal bound phosphorus in the sediment, rendering it inactive for release to the overlying water (as often occurs in stratified lakes with low oxygen levels). It has a mixed rate of success in NYS, although when successful it usually provides long-term control of nutrient release from bottom sediments (it is only a short-term method for removing existing phosphorus from the water column). It is not recommended for lakes with low pH or buffering capacity (like most small NYS lakes at high elevation), for at low pH, aluminum can be toxic to fish. Since CSLAP does not conduct extensive deepwater monitoring, or any sediment release rate studies, the efficacy of this strategy, based on CSLAP data, is not known. **Findley Lake is sufficiently deep to consider using this method.**

- *Hypolimnetic withdrawal* takes deoxygenated, high nutrient water from the lake bottom and discharges the water downstream from the lake. This strategy is sort of a hybrid of aeration and dilution/flushing, and is usually limited to lakes in which control structure (such as a dam) exists where the release valve is located below the thermocline. It has been quite successful and usually inexpensive when applied properly, but must only be employed when downstream waterbodies will not be adversely impacted by the pulse of low oxygen water (which may include elevated levels of hydrogen sulfide, ammonia, and iron). **The dam at Findley Lake is not configured to release water from the hypolimnion.**

- *Aeration* involves pumping or lifting water from the lake bottom (hypolimnion) for exposure to the atmosphere, with the oxygenated waters returning to the lake bottom. The airlift device is usually quite expensive, and operating costs can be quite high. There is also a risk of breaking down the thermocline, which can result in an increase in algae levels and loss of fish habitat for many cold-water species. However, most of the limited number of aeration projects have been quite successful. Since CSLAP does not collect dissolved oxygen data for most program lakes, it is not definitively known whether aeration (or hypolimnetic withdrawal) would benefit this lake. *Artificial circulation* is the process by which air is injected into the hypolimnion to eliminate thermal stratification- it is aeration by circulation.

- *Dilution/flushing* involves using high quality dilution water to reduce the concentration of limiting nutrients and increase the rate at which these nutrients are flushed through the lake. This strategy requires the availability of high quality dilution water and works best when the lake is small, eutrophic, and no downstream waterbodies that may be affected by the pulse of nutrients leaving the lake. For these lakes, high quality dilution water is probably not available from the surrounding watershed, because such an input would already be flushing the lake. **It is unlikely that there is a sufficient nearby source of high quality water to flush Findley Lake.**

- *Food web manipulation* involves altering the population of one component within the food web, most frequently algae, by altering the populations of other components in the same web. For algae control, this would most frequently involve stocking the lake with herbivorous (algae-eating) fish, but this may be at the expense of other native fish. While this procedure has worked in some situations, as with most attempts at biomanipulation, altering the food chain may be risky to the whole ecosystem, and not recommended at lakes in which the native fisheries serve as a valuable local resource.

Management Focus: **The Impact of Weeds on Recreational Condition**

Problem	Probable Cause	Probable Source
Moderate to Excessive weed growth	Shallow water depth, excessive nutrients and sediment	Excessive pollutant loading from watershed runoff (stormwater, construction sites, agriculture, etc.), septics, bottom disturbance,...

Discussion:

Perception data indicate that aquatic weed growth is perceived to inhibit recreational use of this lake, at least in some parts of the lake or during certain times of the year. Nuisance weed growth in lakes is influenced by a variety of factors- water clarity, sediment characteristics, wave action, competition between individual plant species, sediment nutrient levels, etc. In most cases, excessive weed growth is associated with the presence of exotic, (non-native) submergent plant species such as Eurasian watermilfoil (*Myriophyllum spicatum*), although some lakes are inhibited by dense growth of native species. Some of these factors cannot be controlled by lake association activities, while others can only be addressed peripherally. For example, sediment characteristics can be influenced by the solids loading to the lake. With the exception of some hand harvesting activities, aquatic plant management should only be undertaken when lake uses (recreational, municipal, economic, etc.) are significantly and regularly threatened or impaired. Management strategies can be costly and controversial, and a variety of factors should be weighed. Aquatic plant management most efficiently involves a mix of immediate, in-lake controls, and long-term measures to address the causes and sources of this excessive weed growth.

POTENTIAL IN –LAKE CONTROL TECHNIQUES

The following strategies primarily address the cause, but not the ultimate source, of problems related to nuisance aquatic plant growth. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, than strategies that control the source of the problem. Until the sources of the problem are addressed, however, it is likely that these strategies will need to be continuously employed. Some of these are listed in the **Watershed Controls**, since many of the same pollutants contribute to excessive algae growth as well as nuisance weed growth. Except where noted, most of these in-lake techniques do not require permits in most parts of the state, but, as always, the NYDEC Region 9 Offices should be consulted before undertaking these strategies. These techniques are presented within the context of potential management for the conditions (types of nuisance plants, extent of problem) reported through CSLAP. In-lake control methods include*: physical/mechanical plant management techniques, chemical plant management techniques, and biological plant management techniques*

Physical/mechanical control techniques utilize several modes of operation to remove or reduce the growth of nuisance plants. The most commonly employed procedures are the following:

- *Mechanical harvesters* physically remove rooted aquatic plants by using a mechanical machine to cut and transport plants to the shore for proper storage. Mechanical harvesters are probably the most common "formal" plant management strategy in New York State. While it is essentially akin to "mowing the (lake) lawn", it usually provides access to the lake surface and may remove some lake nutrients if the cut plants are disposed out of the watershed. However, if some shallow areas of the lake are not infested with weeds, they will likely become infested after mechanical harvesting, since fragments frequently wander from cut areas to barren sediment and colonize new plant communities. Harvesters are very expensive, but can be rented or leased. *Rotovators* are rotovating mechanical harvesters, dislodging and removing plants and roots. *Mechanical cutters* cut, but don't remove, vegetation or fragments. Box springs, sickles, cutting bars, boat props, and anchors often serve as mechanical cutters. **This strategy has been employed at Findley Lake.**
- *Hand harvesting* is the fancy term for lake weeding- pulling out weeds and the root structure by hand. It is very labor intensive, but very plant selective (pull the "weeds", leave the "plants"); and can be effective if the entire plant is pulled and if the growth area is small enough to be fully cleared of the plant. *Diver dredging* is like hand harvesting with a vacuum cleaner- in this strategy, scuba divers hand-pull plants and place them into a suction hose for removal into a basket in a floating barge. It is also labor intensive and can be quite expensive, but it can be used in water deeper than about 5ft (the rough limit for hand harvesting). It works best where plant beds are dense, but is not very efficient when plant beds or stems are scattered. **It is certain that this strategy is regularly employed by individual shoreline owners at Findley Lake.**
- *Water level manipulation* is the same thing as *drawdown*, in which the lake surface is lowered, usually over the winter, to expose vegetation and sediments to freezing and drying conditions. Over time this affects the growing characteristics of the plants, and in many cases selectively eliminates susceptible plants. This is obviously limited to lakes that have a mechanism (dam structure, controlled culvert, etc.) for manipulating water level. It is usually very inexpensive, but doesn't work on all plants and there is a risk of insufficient lake refill the following spring (causing docks to be orphaned from the waterfront). **It is not believed by the report authors that Findley Lake can be sufficiently drawn down to utilize this technique.**
- *Bottom barriers* are screens or mats that are placed directly on the lake bottom to prevent the growth of weeds by eliminating sunlight needed for plant survival. The mats are held in place by anchors or stakes, and must be periodically cleaned or removed to detach any surface sediment that may serve as a medium for new growth. The mats, if installed properly, are almost always effective, with relatively few environmental side-effects, but are expensive and do not select for plant control under the mats. It is best used when plant communities are dense but small in area, and is not very efficient for lake-wide control.

- *Sediment removal,* also referred to as dredging, controls aquatic plants by physically removing vegetation and by increasing the depth of the lake so that plant growth is limited by light availability. Dredging projects are usually very successful at increasing depth and controlling vegetation, but they are very expensive, may result in significant side effects (turbidity, algal blooms, potential suspension of toxic materials), and may require significant area for disposal. This procedure usually triggers an extensive permitting process.

Chemical control techniques involve the use of aquatic herbicides to kill undesired aquatic vegetation and prevent future nuisance weed growth. These herbicides come in granular or liquid formulations, and can be applied in spot- or whole-lake treatments. Some herbicides provide plant control by disrupting part of the plants life cycle or ability to produce food, while others have more toxicological effects. Aquatic herbicides are usually effective at controlling plants, but other factors in considering this option include the long term control (longevity), efficiency, and plant selectivity. Effectiveness may also depend on dosage rate, extent of non-target (usually native) plant growth, flushing rate, and other factors. The use of herbicides is often a highly controversial matter frequently influenced by personal philosophies about introducing chemicals to lakes. Some of the more recently registered herbicides appear to be more selective and have fewer side effects than some of the previously utilized chemicals. Chemical control of nuisance plants can be quite expensive, and, with only few exceptions, require permits and licensed applicators. **Herbicides have historically been used at Findley Lake (at least the 1950s), although it is not known if they are still being considered for use given the efforts devoted to biological control and harvesting.**

Biological control techniques presently involve the stocking of sterile grass carp, which are herbivorous fish that feed exclusively on macrophytes (and macroalgae). Grass carp, when stocked at the appropriate rate, have been effective at controlling nuisance weeds in many southern states, although their track record in NYS is relatively short, particularly in lakes with shallow or adjacent wetlands or in larger (>100 acre) lakes. These carp may not prefer the nuisance plant species desired for control (in particular Eurasian watermilfoil), and they are quite efficient at converting macrophyte biomass into nutrients that become available for algae growth. This is, however, one of the less expensive means of plant control.

Naturally occurring biological controls may include native species of *aquatic weevils and moths* which burrow into and ultimately destroy some weeds. These organisms feed on Eurasian watermilfoil, and control nuisance plants in some Finger Lakes and throughout the Northeast. However, they also inhabit other lakes with varied or undocumented effectiveness for the long term. Because these organisms live in the canopy of weed beds and feed primarily on the top of the plants, harvesting may have a severe negative impact on the population. Research continues about their natural occurrence, and their effectiveness both as a natural or deliberately- introduced control mechanism for Eurasian watermilfoil. **Herbivorous weevils are found in large quantities in Findley Lake, and were also commercially stocked in 1999. There is some evidence that these have significantly impacted the Eurasian watermilfoil populations in the lake.**

Appendix A. Raw Data for Findley Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
24	Findley L	6/15/1986	11.5	3.00	1.5	0.026	0.12				5	6.92	190		2.22
24	Findley L	6/21/1986	11.5	3.13	1.5	0.013	0.11				5	7.50	180		2.29
24	Findley L	6/29/1986	11.5	2.25	1.5	0.011	0.09				10	7.62	185		2.00
24	Findley L	7/3/1986	11.5	2.75	1.5	0.022	0.11				15	7.82	194		0.80
24	Findley L	7/11/1986	11.5	2.00	1.5	0.021	0.03				2	7.84	185		5.03
24	Findley L	7/18/1986	11.5	1.50	1.5	0.030	0.06				5	8.38	194		
24	Findley L	7/24/1986	11.5	2.63											
24	Findley L	8/1/1986	11.5	1.63	1.5	0.028	0.03				14	8.05	197		
24	Findley L	8/5/1986	11.5	1.13	1.5	0.018	0.03				11	7.75	191		53.30
24	Findley L	8/12/1986			1.5	0.023	0.03				13	8.15	199		15.30
24	Findley L	8/16/1986	11.5	0.75	1.5	0.035	0.03				12	8.98	195		36.30
24	Findley L	8/21/1986	11.5	0.63	1.5	0.037	0.03				15	8.12	198		40.00
24	Findley L	8/30/1986	11.5	1.00	1.5	0.034	0.03				3	7.60	205		29.60
24	Findley L	9/5/1986	11.5	0.75	1.5	0.033	0.03				3	8.17	206		25.90
24	Findley L	9/14/1986	11.5	0.63	1.5	0.036	0.03				13	7.55	215		22.20
24	Findley L	9/21/1986	11.5	0.75	1.5	0.039	0.03				8	7.29	214		34.00
24	Findley L	6/8/1987	11.5	2.75	1.5	0.023	0.03				15	8.10	201		
24	Findley L	6/14/1987	11.5	3.00	1.5	0.018					12	8.22	198		
24	Findley L	6/21/1987	11.5	2.00	1.5	0.023	0.01				15	7.83	203		17.00
24	Findley L	6/28/1987	11.8	1.25	1.5	0.021	0.01				15	7.76	202		37.70
24	Findley L	7/5/1987	11.8	0.75	1.5	0.032	0.01				11	7.70	206		
24	Findley L	7/12/1987	11.5	0.63	1.5	0.033					11	7.86	206		116.00
24	Findley L	7/19/1987	11.5	0.75	1.5	0.040	0.01				15	7.49	206		109.00
24	Findley L	7/26/1987	11.5	1.00	1.5	0.052					13	7.63	209		45.10
24	Findley L	7/30/1987	11.5	0.75	1.5	0.056					12	7.38	210		73.30
24	Findley L	8/9/1987	11.5	0.75	1.5	0.042	0.01				7	7.33	208		116.00
24	Findley L	8/16/1987	11.5	0.50	1.5	0.060					6	7.14	216		274.00
24	Findley L	8/23/1987	11.5	0.75	1.5	0.054	0.01				10	7.42	208		
24	Findley L	8/30/1987	11.5	0.75	1.5	0.052					12	7.46	204		73.00
24	Findley L	9/6/1987	11.5	0.75	1.5	0.059	0.17				8	7.36	221		99.00
24	Findley L	10/1/1987	11.5	0.75	1.5	0.049	0.03				11	7.30	215		73.20
24	Findley L	6/21/1988	12.0	2.25	1.5	0.022	0.01				8	7.72	213		17.50
24	Findley L	6/28/1988	11.5	1.75	1.5	0.022	0.01				7	7.77	219		10.10
24	Findley L	7/5/1988	11.5	1.50	1.5	0.020	0.01				9	8.10	220		10.40
24	Findley L	7/12/1988	11.0	1.00	1.5	0.023	0.01				11	8.19	234		
24	Findley L	7/19/1988	11.5	1.00	1.5	0.025	0.01				7	8.31	223		20.70
24	Findley L	7/26/1988	12.0	1.50	1.5	0.029	0.01				10	7.71	221		1.78
24	Findley L	7/31/1988	11.5	1.25	1.5	0.031	0.01				10	8.10	223		17.80
24	Findley L	8/8/1988	11.5	1.00	1.5	0.037	0.01				11	7.97	219		31.10
24	Findley L	8/12/1988	11.5	0.75	1.5	0.042	0.01				10	7.96	221		52.50
24	Findley L	8/21/1988	11.8	0.75	1.5	0.042	0.01				6	8.32	227		49.60
24	Findley L	8/30/1988	11.5	2.25	1.5	0.032	0.02				11	7.97	227		10.10
24	Findley L	9/6/1988	11.3	1.75	1.5	0.037	0.03				14	7.86	227		18.50
24	Findley L	9/12/1988	11.5	1.50	1.5	0.035	0.03				12	7.95	229		24.40
24	Findley L	9/19/1988	11.8	1.00	1.5	0.040	0.01				8	8.09	230		38.50
24	Findley L	9/25/1988	11.8	1.00	1.5	0.039	0.01				6	8.27	227		30.30
24	Findley L	6/26/1989	11.0	3.25	1.5	0.017	0.14				7	7.94	198		2.16
24	Findley L	7/2/1989	11.0	2.25	1.5	0.015					12	7.98	199		18.50
24	Findley L	7/9/1989	11.0	2.25	1.5	0.022					15	7.76	204		6.45
24	Findley L	7/16/1989	11.5	2.50	1.5	0.020					11	7.85	210		6.18
24	Findley L	7/27/1989	11.5	2.50	1.5	0.025					10	8.13	200		9.77
24	Findley L	7/31/1989	11.0	2.00	1.5	0.026					8	7.82	210		6.36
24	Findley L	8/7/1989	10.5	2.50	1.5	0.029	0.06				8	8.18	214		7.19
24	Findley L	8/14/1989	11.3	2.00	1.5	0.020					7	7.98	211		6.45
24	Findley L	8/20/1989	11.5	2.00	1.5	0.024					2	8.24	212		6.65
24	Findley L	8/29/1989	11.5	2.25	1.5	0.028					2	8.24	208		11.30
24	Findley L	9/11/1989	11.0	1.75	1.5	0.025	0.01				5	8.16	211		17.80
24	Findley L	9/25/1989	11.5	1.00	1.5	0.029					6	8.18	203		19.60
24	Findley L	10/11/1989	11.0	1.25	1.5	0.038					5	8.16	210		18.50
24	Findley L	7/10/1990	11.5	1.25	1.5	0.046	0.01					7.95			
24	Findley L	7/17/1990	11.3	1.25	1.5	0.037	0.01				13	7.72	209		36.60

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
24	Findley L	7/31/1990	11.5	0.75	1.5	0.048	0.01				10	7.40	199		57.40
24	Findley L	8/14/1990	11.5	0.81	1.5	0.044					10	7.24	199		45.10
24	Findley L	8/28/1990	11.5	0.75	1.5	0.053	0.01				10	7.50	206		58.60
24	Findley L	9/11/1990	11.0	0.75	1.5	0.051	0.01				12	8.11	205		62.70
24	Findley L	9/25/1990	11.0	1.50	1.5	0.048	0.02				17	7.78	222		26.90
24	Findley L	10/10/1990	11.0	2.50	1.5	0.062						8.23	205		9.40
24	Findley L	7/22/1991	11.3	1.00	1.5	0.049	0.01				10	8.22	215		30.90
24	Findley L	8/5/1991	13.0	0.75	1.5	0.055	0.01				14	7.63	220		82.80
24	Findley L	8/19/1991	11.0	0.75	1.5	0.054	0.01				11	8.28	224		68.80
24	Findley L	9/4/1991	11.7	0.33	1.5	0.079	0.01				9	7.59	219		149.00
24	Findley L	9/18/1991	11.0	0.67	1.5	0.065						7.90	221		132.00
24	Findley L	10/1/1991	11.5	0.58	1.5	0.064					7	7.81	220		126.00
24	Findley L	6/29/1992	11.5	2.00	1.5	0.023					6	7.81	237		9.18
24	Findley L	7/18/1992	11.5	1.50	1.5	0.013					6	8.05	232		15.40
24	Findley L	8/11/1992	11.3	1.33	1.5	0.025					8	8.34	223		11.60
24	Findley L	8/31/1992	11.5	1.75	1.5	0.035					9	8.23	228		10.20
24	Findley L	9/28/1992	11.5	1.75	1.5	0.024					8	8.24	218		15.80
24	Findley L	10/10/1992	11.6	1.50	1.5	0.034					11	8.06	225		28.50
24	Findley L	7/6/1993	11.5	1.50	1.5	0.030					7	8.20	210		21.70
24	Findley L	7/20/1993	11.5	1.50	1.5	0.043					2	7.75	210		15.50
24	Findley L	8/9/1993	11.0	1.00	1.5	0.049					7	8.15	211		49.30
24	Findley L	8/30/1993	11.3	0.75	1.5	0.063					7	8.16	202		45.90
24	Findley L	9/21/1993	11.5	1.25	1.5	0.044					6	8.26	214		33.20
24	Findley L	10/4/1993	11.5	1.29	1.5	0.048					5	8.07	216		18.90
24	Findley L	6/14/1994	11.3	3.63	1.5	0.015	0.12				6	8.60	222		3.73
24	Findley L	7/5/1994	11.5	2.00	1.5	0.023					7	7.90	221		10.20
24	Findley L	7/25/1994	11.5	1.50	1.5	0.031					4	8.04	224		21.50
24	Findley L	8/15/1994	11.8	1.25	1.5	0.039	0.03				11	7.96	206		32.70
24	Findley L	9/5/1994	11.5	1.00	1.5	0.048					10	7.70	206		39.40
24	Findley L	9/26/1994	13.0	0.80	1.5	0.059					12	7.83	208		50.30
24	Findley L	6/5/1995	11.0	2.00	1.5	0.020					6				9.86
24	Findley L	6/20/1995	11.0	1.00	1.5	0.028					7	8.16	230		24.40
24	Findley L	7/10/1995	11.3	0.77	1.5	0.037						7.76	235		51.30
24	Findley L	7/17/1995	11.4	0.75	1.5	0.053	0.01				5	8.07	237		53.80
24	Findley L	7/31/1995	11.0	0.55	1.5	0.059					10	8.07	231		86.70
24	Findley L	8/14/1995	11.5	0.33	1.5	0.082					5	7.48	232		172.00
24	Findley L	6/17/1996	11.3	4.75	1.5	0.013	0.05				5	8.18	225		3.50
24	Findley L	7/12/1996	11.5	1.65	1.5	0.023	0.08				10	7.84	218		20.50
24	Findley L	7/17/1996	11.0	3.25	1.5	0.015	0.07				20	7.85	220		8.20
24	Findley L	7/29/1996	11.0	3.25	1.5	0.018	0.04				10	8.03	218		5.90
24	Findley L	8/12/1996	11.0	2.75	1.5	0.023	0.01				20	7.93	217		7.70
24	Findley L	8/26/1996	11.0	3.75	1.5	0.018	0.01				5	8.43	214		5.20
24	Findley L	9/9/1996	11.0	2.25	1.5	0.024	0.01				10	7.95	212		14.10
24	Findley L	9/23/1996	11.5	2.28	1.5	0.056	0.01				10	7.96	210		19.10
24	Findley L	6/9/1997	11.0	4.25	1.5	0.013	0.10				10	7.52	190		2.60
24	Findley L	6/23/1997	11.0	5.13	1.5	0.015	0.08				10	8.07	186		3.08
24	Findley L	7/7/1997	11.3	1.50	1.5	0.031	0.01				10	7.56	200		18.50
24	Findley L	7/21/1997	11.8	1.28	1.5	0.030	0.01				10	7.83	202		19.70
24	Findley L	8/4/1997	11.0	1.42	1.5	0.029	0.01				10	7.39	207		27.80
24	Findley L	8/18/1997	11.5	1.71	1.5	0.032	0.01				7	7.56	206		20.20
24	Findley L	9/1/1997	11.7	1.40	1.5	0.032	0.01				7	8.48	202		21.90
24	Findley L	9/15/1997	11.3	1.75	1.5	0.025	0.01				9	8.41	200		13.90
24	Findley L	6/8/1998	12.0	2.42	1.5	0.025	0.01				5	8.41	178		9.34
24	Findley L	6/22/1998	11.5	3.13	1.5	0.020	0.01				3	7.51	185		6.32
24	Findley L	7/7/1998	11.5	1.38	1.5	0.038	0.01				2	8.53	186		22.10
24	Findley L	7/20/1998	11.5	0.78	1.5	0.044	0.14				5	8.61	173		40.50
24	Findley L	8/3/1998	11.5	0.83	1.5	0.053	0.01				5	8.13	181		51.60
24	Findley L	8/17/1998	11.8	0.83	1.5	0.070					14	9.05	183		57.10
24	Findley L	8/31/1998	11.5	0.94	1.5	0.067					12	8.96	184		47.20
24	Findley L	9/14/1998	10.8	0.80	1.5	0.067					6	7.80	194		43.20
24	Findley L	6/7/1999	11.5	1.05	1.5	0.031	0.01				8	7.47	211		19.20
24	Findley L	6/21/1999	11.8	1.19	1.5	0.035	0.01				6	8.21	204		21.90
24	Findley L	7/5/1999	11.3	0.78	1.5	0.061	0.02				10	7.54	196		63.50
24	Findley L	7/19/1999	11.7	0.71	1.5	0.081	0.01				12	7.36	198		69.00

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	NH4	TDN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
24	Findley L	8/2/1999	11.0	0.50	1.5	0.069	0.01				11	8.33	202		53.50
24	Findley L	8/16/1999	11.0	0.55	1.5	0.068	0.01				7	7.33	215		45.90
24	Findley L	8/30/1999	11.0	0.85	1.5	0.050	0.01				10	7.85	221		43.80
24	Findley L	9/12/1999	11.0	0.68	1.5	0.054	0.01				6	7.21	227		57.00
24	Findley L	6/19/2000	11.3	2.95	1.5	0.020	0.01				8	8.18	218		4.54
24	Findley L	7/10/2000	12.0	2.00	1.5	0.017	0.01				4	7.80	217		7.10
24	Findley L	7/17/2000	11.8	1.85	1.5	0.017	0.01				6	8.36	214		7.85
24	Findley L	7/31/2000	11.0	1.95	1.5	0.023	0.01				4	8.62	210		10.80
24	Findley L	8/14/2000	11.5	1.22	1.5	0.028	0.01				6	7.38	208		22.20
24	Findley L	8/28/2000	11.5	1.13	1.5	0.042	0.01				8	8.20	210		42.10
24	Findley L	9/11/2000	11.0	1.09	1.5	0.038	0.01				9	8.04	215		28.20
24	Findley L	9/25/2000	11.8	2.25	1.5	0.023	0.04				8	8.09	222		6.95
24	Findley L	06/15/03	8.3	5.35		0.011	0.09	0.03	0.36	33.03	7	7.95	245	31.0	2.46
24	Findley L	06/29/03	11.5	4.15		0.005	0.04	0.02	0.30	57.69	6	8.33	251		7.79
24	Findley L	07/13/03	11.1	1.95		0.017	0.02	0.00	0.23	13.28	10	8.52	242		1.09
24	Findley L	07/28/03	10.9	2.00		0.021	0.01	0.02	0.16	7.76	9	8.33	233		3.33
24	Findley L	08/10/03	8.7	3.05		0.018	0.03	0.04	0.59	32.92	20	8.32	229	29.0	3.35
24	Findley L	08/24/03	9.0	2.00		0.027	0.00	0.01	0.41	15.47	45	8.50	223		5.90
24	Findley L	09/07/03	10.1	1.90		0.025	0.03	0.03			43	8.42	218		32.94
24	Findley L	09/21/03	11.1	1.15		0.032	0.02	0.04	0.37	11.73	46	8.26	227		4.99
24	Findley L	6/13/2004	13.0	3.00		0.017	0.05	0.01	0.27	16.05	20	7.01	241	23.8	0.61
24	Findley L	6/27/2004	10.3	3.20		0.017	0.01	0.01	0.32	18.47	20	7.34	233		2.70
24	Findley L	7/18/2004	11.0	1.70		0.029	0.25	0.02	1.36	46.86	10	8.20	211		29.20
24	Findley L	8/15/2004		1.20	0.6	0.000	0.01	0.02	0.46		13	7.14	214		10.60
24	Findley L	6/22/1998			10.0	0.211									
24	Findley L	7/20/1998				0.465									
24	Findley L	8/17/1998				0.618									
24	Findley L	9/14/1998				0.960									
24	Findley L	06/15/03				0.012	0.11	0.08	0.28	23.33					
24	Findley L	06/29/03				0.008	0.02	0.02	0.31	37.80					
24	Findley L	07/13/03				0.017	0.04	0.06	0.36	21.19					
24	Findley L	07/28/03				0.018	0.00	0.00	0.05	2.50					
24	Findley L	08/10/03				0.003	0.06	0.03	0.63	186.11					
24	Findley L	08/24/03				0.017	0.00	0.01	0.43	25.40					
24	Findley L	09/07/03				0.025	0.03	0.01							
24	Findley L	09/21/03				0.028	0.01	0.01	0.37	13.42					
24	Findley L	6/13/2004				0.036	0.07	0.02	0.50	13.87					

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	6/15/1986	11.5	3.00	1.5	1	18	19				
24	Findley L	6/21/1986	11.5	3.13	1.5	1	23	20				
24	Findley L	6/29/1986	11.5	2.25	1.5	1	22	21				
24	Findley L	7/3/1986	11.5	2.75	1.5	1	15	20				
24	Findley L	7/11/1986	11.5	2.00	1.5	1	15	20				
24	Findley L	7/18/1986	11.5	1.50	1.5	1	30	24				
24	Findley L	7/24/1986	11.5	2.63		1	30	25				
24	Findley L	8/1/1986	11.5	1.63	1.5	1	26	24				
24	Findley L	8/5/1986	11.5	1.13	1.5	1	26	25				
24	Findley L	8/12/1986			1.5	1						
24	Findley L	8/16/1986	11.5	0.75	1.5	1	24	24				
24	Findley L	8/21/1986	11.5	0.63	1.5	1	26	25				
24	Findley L	8/30/1986	11.5	1.00	1.5	1	20	19				
24	Findley L	9/5/1986	11.5	0.75	1.5	1	21	20				
24	Findley L	9/14/1986	11.5	0.63	1.5	1	14	19				
24	Findley L	9/21/1986	11.5	0.75	1.5	1	17	18				
24	Findley L	6/8/1987	11.5	2.75	1.5	1	22	24				
24	Findley L	6/14/1987	11.5	3.00	1.5	1	25	22				
24	Findley L	6/21/1987	11.5	2.00	1.5	1	27	25				
24	Findley L	6/28/1987	11.8	1.25	1.5	1	19	23				
24	Findley L	7/5/1987	11.8	0.75	1.5	1	23	23				
24	Findley L	7/12/1987	11.5	0.63	1.5	1	30	27				
24	Findley L	7/19/1987	11.5	0.75	1.5	1	27	26				
24	Findley L	7/26/1987	11.5	1.00	1.5	1	24	27				

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	7/30/1987	11.5	0.75	1.5	1	25	27				
24	Findley L	8/9/1987	11.5	0.75	1.5	1	24	24				
24	Findley L	8/16/1987	11.5	0.50	1.5	1	27	27				
24	Findley L	8/23/1987	11.5	0.75	1.5	1	18	22				
24	Findley L	8/30/1987	11.5	0.75	1.5	1	21	20				
24	Findley L	9/6/1987	11.5	0.75	1.5	1	19	19				
24	Findley L	10/1/1987	11.5	0.75	1.5	1	14	17				
24	Findley L	6/21/1988	12.0	2.25	1.5	1	25	24				
24	Findley L	6/28/1988	11.5	1.75	1.5	1	20	24				
24	Findley L	7/5/1988	11.5	1.50	1.5	1	29	25				
24	Findley L	7/12/1988	11.0	1.00	1.5	1	28	27				
24	Findley L	7/19/1988	11.5	1.00	1.5	1	26	28				
24	Findley L	7/26/1988	12.0	1.50	1.5	1	26	25				
24	Findley L	7/31/1988	11.5	1.25	1.5	1	24	26				
24	Findley L	8/8/1988	11.5	1.00	1.5	1	27	28				
24	Findley L	8/12/1988	11.5	0.75	1.5	1	26	27				
24	Findley L	8/21/1988	11.8	0.75	1.5	1	20	25				
24	Findley L	8/30/1988	11.5	2.25	1.5	1	18	23				
24	Findley L	9/6/1988	11.3	1.75	1.5	1	15	20				
24	Findley L	9/12/1988	11.5	1.50	1.5	1	24	20				
24	Findley L	9/19/1988	11.8	1.00	1.5	1	24	20				
24	Findley L	9/25/1988	11.8	1.00	1.5	1	24	18				
24	Findley L	6/26/1989	11.0	3.25	1.5	1	29	27				
24	Findley L	7/2/1989	11.0	2.25	1.5	1	22	23				
24	Findley L	7/9/1989	11.0	2.25	1.5	1	27	25				
24	Findley L	7/16/1989	11.5	2.50	1.5	1	25	24				
24	Findley L	7/27/1989	11.5	2.50	1.5	1	27	25				
24	Findley L	7/31/1989	11.0	2.00	1.5	1	21	24				
24	Findley L	8/7/1989	10.5	2.50	1.5	1	17	23				
24	Findley L	8/14/1989	11.3	2.00	1.5	1	24	22				
24	Findley L	8/20/1989	11.5	2.00	1.5	1	20	23				
24	Findley L	8/29/1989	11.5	2.25	1.5	1	26	24				
24	Findley L	9/11/1989	11.0	1.75	1.5	1	21	22				
24	Findley L	9/25/1989	11.5	1.00	1.5	1	14	16				
24	Findley L	10/11/1989	11.0	1.25	1.5	1	11	12				
24	Findley L	7/10/1990	11.5	1.25	1.5	1	22	23				
24	Findley L	7/17/1990	11.3	1.25	1.5	1	25	23				
24	Findley L	7/31/1990	11.5	0.75	1.5	1	21	24				
24	Findley L	8/14/1990	11.5	0.81	1.5	1	22	23				
24	Findley L	8/28/1990	11.5	0.75	1.5	1	23	23				
24	Findley L	9/11/1990	11.0	0.75	1.5	1	21	22				
24	Findley L	9/25/1990	11.0	1.50	1.5	1	14	15				
24	Findley L	10/10/1990	11.0	2.50	1.5	1	21	16				
24	Findley L	7/22/1991	11.3	1.00	1.5	1	26	27				
24	Findley L	8/5/1991	13.0	0.75	1.5	1	24	23				
24	Findley L	8/19/1991	11.0	0.75	1.5	1	23	24				
24	Findley L	9/4/1991	11.7	0.33	1.5	1	20	22				
24	Findley L	9/18/1991	11.0	0.67	1.5	1	20	22				
24	Findley L	10/1/1991	11.5	0.58	1.5	1	19	17				
24	Findley L	6/29/1992	11.5	2.00	1.5	1	22	21	3	2	3	1
24	Findley L	7/18/1992	11.5	1.50	1.5	1	22	23	3	2	3	14
24	Findley L	8/11/1992	11.3	1.33	1.5	1	23	24				
24	Findley L	8/31/1992	11.5	1.75	1.5	1	17	20	3	2	2	15
24	Findley L	9/28/1992	11.5	1.75	1.5	1	20	18	2	2	2	5
24	Findley L	10/10/1992	11.6	1.50	1.5	1	14	15	2	3	3	5
24	Findley L	7/6/1993	11.5	1.50	1.5	1	26	25	3	2	2	
24	Findley L	7/20/1993	11.5	1.50	1.5	1	21	24	3	2	3	5
24	Findley L	8/9/1993	11.0	1.00	1.5	1	24	23	3	2	3	1
24	Findley L	8/30/1993	11.3	0.75	1.5	1	27	26	3	3	4	123
24	Findley L	9/21/1993	11.5	1.25	1.5	1	15	18	2	4	4	25
24	Findley L	10/4/1993	11.5	1.29	1.5	1	17	14	3	3	4	125
24	Findley L	6/14/1994	11.3	3.63	1.5	1	31	23	2	2	2	
24	Findley L	7/5/1994	11.5	2.00	1.5	1	27	24	2	2	3	56
24	Findley L	7/25/1994	11.5	1.50	1.5	1	23	25	3	2	3	14

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	8/15/1994	11.8	1.25	1.5	1	21	21	3	2	4	135
24	Findley L	9/5/1994	11.5	1.00	1.5	1	19	20	4	2	3	134
24	Findley L	9/26/1994	13.0	0.80	1.5	1	19	19	3	3	4	135
24	Findley L	6/5/1995	11.0	2.00	1.5	1	25	22	2	2	2	
24	Findley L	6/20/1995	11.0	1.00	1.5	1	30	27	3	2	4	14
24	Findley L	7/10/1995	11.3	0.77	1.5	1	23	23	3	3	3	15
24	Findley L	7/17/1995	11.4	0.75	1.5	1	28	27	3	2	3	14
24	Findley L	7/31/1995	11.0	0.55	1.5	1	30	28	3	3	3	134
24	Findley L	8/14/1995	11.5	0.33	1.5	1	31	27	4	2	3	134
24	Findley L	6/17/1996	11.3	4.75	1.5	1	24	22	1	2	1	
24	Findley L	7/12/1996	11.5	1.65	1.5	1	27	25	2	2	3	14
24	Findley L	7/17/1996	11.0	3.25	1.5	1	32	25	2	2	3	
24	Findley L	7/29/1996	11.0	3.25	1.5	1	22	23	2	2	2	5
24	Findley L	8/12/1996	11.0	2.75	1.5	1	22	23	2	2	3	2
24	Findley L	8/26/1996	11.0	3.75	1.5	1	23	24				
24	Findley L	9/9/1996	11.0	2.25	1.5	1	25	22	3	4	4	24
24	Findley L	9/23/1996	11.5	2.28	1.5	1	19	17	3	4	4	24
24	Findley L	6/9/1997	11.0	4.25	1.5	1	24	19	1	3	3	2
24	Findley L	6/23/1997	11.0	5.13	1.5	1	24	23	1	3	3	2
24	Findley L	7/7/1997	11.3	1.50	1.5	1	20	23	3	2	3	1
24	Findley L	7/21/1997	11.8	1.28	1.5	1	26	25	3	3	3	134
24	Findley L	8/4/1997	11.0	1.42	1.5	1	20	23	3	3	3	2334
24	Findley L	8/18/1997	11.5	1.71	1.5	1	19	22	3	3	4	124
24	Findley L	9/1/1997	11.7	1.40	1.5	1	26	22	3	3	4	124
24	Findley L	9/15/1997	11.3	1.75	1.5	1	24	21	3	3	4	12
24	Findley L	6/8/1998	12.0	2.42	1.5	1	17	18	2	4	4	2
24	Findley L	6/22/1998	11.5	3.13	1.5	1	25	24	2	4	4	24
24	Findley L	7/7/1998	11.5	1.38	1.5	1	26	25	3	4	4	124
24	Findley L	7/20/1998	11.5	0.78	1.5	1	29	26	3	4	4	1234
24	Findley L	8/3/1998	11.5	0.83	1.5	1	25	23	5	4	4	1234
24	Findley L	8/17/1998	11.8	0.83	1.5	1	30	25	4	3	4	124
24	Findley L	8/31/1998	11.5	0.94	1.5	1	24	23	4	4	4	1234
24	Findley L	9/14/1998	10.8	0.80	1.5	1	22	20	4	3	4	1234
24	Findley L	6/7/1999	11.5	1.05	1.5	1	35	25	3	3	3	234
24	Findley L	6/21/1999	11.8	1.19	1.5	1	20	22	3	3	3	24
24	Findley L	7/5/1999	11.3	0.78	1.5	1	33	24	3	3	4	124
24	Findley L	7/19/1999	11.7	0.71	1.5	1	27	26	3	3	3	1234
24	Findley L	8/2/1999	11.0	0.50	1.5	1	23	26	4	3	4	134
24	Findley L	8/16/1999	11.0	0.55	1.5	1	28	22	3	3	4	134
24	Findley L	8/30/1999	11.0	0.85	1.5	1	20	22	4	2	4	134
24	Findley L	9/12/1999	11.0	0.68	1.5	1	22	21	4	3	3	134
24	Findley L	6/19/2000	11.3	2.95	1.5	1	26	22	2	3	2	2
24	Findley L	7/10/2000	12.0	2.00	1.5	1	26		2	3	3	2
24	Findley L	7/17/2000	11.8	1.85	1.5	1	27	24	2	3	3	2
24	Findley L	7/31/2000	11.0	1.95	1.5	1	29	26	2	3	3	12
24	Findley L	8/14/2000	11.5	1.22	1.5	1	27	25	3	2	3	125
24	Findley L	8/28/2000	11.5	1.13	1.5	1	27	23	3	2	4	13
24	Findley L	9/11/2000	11.0	1.09	1.5	1	26	24	3	2	3	134
24	Findley L	9/25/2000	11.8	2.25	1.5	1	12	18	2	2	2	5
24	Findley L	06/15/03	8.3	5.35		1	27		2	2	2	
24	Findley L	06/29/03	11.5	4.15		1	25	23	2	3	3	2
24	Findley L	07/13/03	11.1	1.95		1	36	24				
24	Findley L	07/28/03	10.9	2.00		1	22	23				
24	Findley L	08/10/03	8.7	3.05		1	26	25				
24	Findley L	08/24/03	9.0	2.00		1	20	25				
24	Findley L	09/07/03	10.1	1.90		1	20	22	3	3	4	25
24	Findley L	09/21/03	11.1	1.15		1	21	22	4	4	4	123
24	Findley L	6/13/2004	13.0	3.00		1	25	22	2	3	3	2
24	Findley L	6/27/2004	10.3	3.20		1	22	22	2	3	3	2
24	Findley L	7/18/2004	11.0	1.70		1	27	23	3	2	3	13
24	Findley L	8/15/2004		1.20	0.6	1	24	21	3	2	3	3
24	Findley L	6/22/1998			10.0	2		14				
24	Findley L	7/20/1998				2		15				
24	Findley L	8/17/1998				2						

LNum	PName	Date	Zbot	Zsd	Zsamp	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	9/14/1998				2		12				
24	Findley L	06/15/03				2						
24	Findley L	06/29/03				2						
24	Findley L	07/13/03				2						
24	Findley L	07/28/03				2						
24	Findley L	08/10/03				2						
24	Findley L	08/24/03				2						
24	Findley L	09/07/03				2						
24	Findley L	09/21/03				2						
24	Findley L	6/13/2004				2						

Appendix B. New York State Water Quality Classifications

Class N: Enjoyment of water in its natural condition and where compatible, as source of water for drinking or culinary purposes, bathing, fishing and fish propagation, recreation and any other usages except for the discharge of sewage, industrial wastes or other wastes or any sewage or waste effluent not having filtration resulting from at least 200 feet of lateral travel through unconsolidated earth. These waters should contain no deleterious substances, hydrocarbons or substances that would contribute to eutrophication, nor shall they receive surface runoff containing any such substance.

Class AA$_{\text{special}}$: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival, and shall contain no floating solids, settleable solids, oils, sludge deposits, toxic wastes, deleterious substances, colored or other wastes or heated liquids attributable to sewage, industrial wastes or other wastes. There shall be no discharge or disposal of sewage, industrial wastes or other wastes into these waters. These waters shall contain no phosphorus and nitrogen in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.

Class A$_{\text{special}}$: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These international boundary waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class AA: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health drinking water standards and will be considered safe and satisfactory for drinking water purposes

Class A: Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. These waters shall be suitable for fish propagation and survival. These waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to remove naturally present impurities, will meet New York State Department of Health

	drinking water standards and will be considered safe and satisfactory for drinking water purposes
Class B	Suitable for primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival
Class C:	Suitable for fishing, and fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class D:	Suitable for fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
Class (T):	Designated for trout survival, defined by the Environmental Conservation Law Article 11 (NYS, 1984b) as brook trout, brown trout, red throat trout, rainbow trout, and splake

APPENDIX C: SUMMARY OF STATISTICAL METHODS USED TO EVALUATE TRENDS

1. Non-Parametric Analyses

Kendall tau ranking orders paired observations by one of the variables (say arranging water clarity readings by date). Starting with the left-hand (say earliest date) pair, the number of times that the variable not ordered (in this case clarity readings) is exceeded by the same variable in subsequent pairs is computed as P, and the number of times in which the unordered variable is not exceeded is computed as Q. This computation is completed for each ordered pair, with N= total number of pairs, and the sum of the differences S = S P-Q. The Kendall tau rank correlation coefficient **t** is computed as:

$$t = 2S/(N*(N-1))$$

Values for t range from –1 (complete negative correlation) to +1 (complete positive correlation). As above, strong correlations (or simply "significance") may be associated with values for t greater than 0.5 (or less than –0.5), and moderate correlations may be associated with values for t between 0.3 and 0.5 (or between –0.3 and –0.5), but the "significance" of this correlation must be further computed. Standard charts for computing the probabilities for testing the significance of S are provided in most statistics text books, and for values of N greater than 10, a standard normal deviate D can be computed by calculating the quotient

$$D= S\sqrt{18} / \sqrt{[(N(N-1)(2N+5)]}$$

and attributing the following significance:

$D > 3.29$ = 0.05% significance
$2.58 < D < 3.29$ = 0.5% significance
$1.96 < D < 2.58$ = 2.5% significance
$D < 1.96$ = > 2.5% significance

For the purpose of this exercise, 2.5% significance or less is necessary to assign validity (or, using the vernacular above, "significance") to the trend determined by the Kendall tau correlation. It should be noted again that this evaluation does not determine the magnitude of the trend, but only if a trend is likely to occur.

Parametric trends can be defined by standard best-fit linear regression lines, with the significance of these data customarily defined by the magnitude of the best fit regression coefficient ® or R^2). This can be conducted using raw or individual data points, or seasonal summaries (using some indicator of central tendency, such as mean or median). Since the former can be adversely influenced by seasonal variability and/or imprecision in the length and breadth of the sampling season during any given year, seasonal summaries may provide more realistic measures for long-term trend analyses. However, since the summaries may not adequately reflect variability within any given sampling season, it may be appropriate to compare deviations from seasonal means or medians with the "modeled" change in the mean/median resulting from the regression analyses.

When similar parametric and non-parametric tools are utilized to evaluate long-term trends in NYS lakes, a few assumptions must be adopted:

- Using the non-parametric tools, trend “significance” (defined as no more than appx. 3% “likelihood” that a trend is calculated when none exists) can only be achieved with at least four years of averaged water quality data. When looking at all summer data points (as opposed to data averaging), a minimum of forty data points is required to achieve some confidence in data significance. This corresponds to at least five years of CSLAP data. The “lesson” in these assumptions is that data trends assigned to data sets collected over fewer than five years assume only marginal significance.

As noted above, summer data only are utilized (as in the previous analyses) to minimize seasonal effects and different sampling schedules around the fringes (primarily May and September) of the sampling season. This reduces the number of data points used to compile averages or whole data sets, but is considered necessary to best evaluate the CSLAP datasets.

2. Parametric Analyses

Parametric analyses are conducted by comparing annual changes in summer mean values for each of the analyzed sampling parameters. Summer is defined as the period from June 15 thru September 15, and roughly corresponds to the window between the end of spring runoff (after ice out) and start of thermal stratification, and the onset of thermal destratification. This period also corresponds to the peak summer recreational season and (for most lakes) the most critical period for water quality impacts. It also bounds the most frequent range of sampling dates for the majority of both the primarily seasonal volunteers and full time residents of CSLAP lakes.

Trends in the parametric analyses are determined by the least squares method, in which “significance” requires both a high correlation coefficient ($R^2>0.5$) and intra-seasonal variance to be lower than the predicted change (trend) over the period of sampling (roughly corresponding to ?y). Changes in water quality indicators are also evaluated by the two-sided t-test, in which the change (z statistic) in the mean summer value for each of the indicators by decade of sampling (1980s, 1990s, 2000s) is compared to the t statistic distribution within the 95% confidence interval, with the null hypothesis corresponding to no significant change.

APPENDIX D: BACKGROUND INFO FOR FINDLEY LAKE

CSLAP Number	24
Lake Name	Findley L
First CSLAP Year	1986
Sampled in 2003?	yes
Latitude	420709
Longitude	794404
Elevation (m)	433
Area (ha)	124.3
Volume Code	12
Volume Code Name	Allegheny/Chemung Rivers
Pond Number	153
Qualifier	none
Water Quality Classification	B
County	Chautauqua
Town	Findley Lake
Watershed Area (ha)	1240
Retention Time (years)	0.5
Mean Depth (m)	3.3
Runoff (m/yr)	0.661596774
Watershed Number	2
Watershed Name	Allegheny River
NOAA Section	9
Closest NOAA Station	Sherman
Closest USGS Gaging Station-Number	3014500
Closest USGS Gaging Station-Name	Chadakoun River at Falconer
CSLAP Lakes in Watershed	Chautauqua L, Cuba L, Findley L