2000 INTERPRETIVE SUMMARY

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

FINDLEY LAKE

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BACKGROUND AND ACKNOWLEDGMENT

The Citizens Statewide Lake Assessment Program (CSLAP) is a volunteer lake monitoring program conducted by the NYS Department of Environmental Conservation and the NYS Federation of Lake Associations. Founded in 1986 with 25 pilot lakes, the program now involves more than 150 lakes, ponds, and reservoirs and 1000 volunteers from eastern Long Island to the Northern Adirondacks to the western-most lake in New York, including several Finger Lakes, Lake Ontario, and lakes with state parks. In this program, lay volunteers trained by the NYSDEC collect water samples, observations, and perception data every other week in a fifteen-week interval between May and October. Water samples are analyzed by the NYS Department of Health. Analytical results are interpreted by the NYSDEC 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 2000 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, Onda Keppel, and especially Don Keppel.**

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, John Miller, Nancy Mueller, Dr. John Colgan and the Board of Directors, for their continued strong support of CSLAP.

The New York State Department of Health, particularly Jean White, provided laboratory materials and all analytical services, reviewed the raw data, and implemented the quality assurance/quality control program.

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 has been sampled as part of the New York Citizens Statewide Lake Assessment Program since 1986. Water quality conditions and public perception of the lake each year have been evaluated within annual reports issued after each sampling season. Historical water quality summaries of the CSLAP data have also been undertaken within each annual report. This report attempts to summarize both the 2000 CSLAP data and an historical comparison of the data collected within the 2000 sampling season and data collected at Findley Lake since 1986.

Due to a delay in receiving phosphorus data from the analytical laboratory, and the resulting expediency required to get this information into the hands of the sampling volunteers, a preliminary assessment of the data is offered without a complete dataset. As such, any general assessments of lake eutrophication, and specific assessments of phosphorus must be considered preliminary, and may be subject to change with the benefit of a full dataset. Such an assessment, through either an addendum to this report or a complete reissue of the report, will be provided after the full dataset is received.

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. These assessments indicate that chlorophyll *a* readings were lower than normal for Findley Lake. While water clarity was slightly higher than usual (with fewer readings below the "acceptable" level for swimming beaches (= 1.2 meters, or 4 feet)), water transparency readings generally fell within the normal range for Findley Lake. The preliminary phosphorus levels were lower than usual for Findley Lake, although the overall assessment of phosphorus levels for Findley Lake in 2000 cannot be completed until the balance of the phosphorus results are received by the NYSDEC. Consistent with the slightly lower productivity measured in 2000, lake perception was slightly more favorable at Findley Lake in 2000 than in the typical sampling season at the lake, although at present it appears that the "improvement" is still within the normal range of variability for the lake. The improvement in lake perception may also have been attributable to the lower than usual aquatic plant densities in the lake, which in turn may have been due to more significant herbivorous insect (weevil) activity.

The 1998 NYSDEC Priority Waterbody Listing (PWL) for Findley Lake indicates that *Aesthetics, Fishing* and *Fish Survival* are impaired. The CSLAP dataset suggests that the aesthtics listing may be warranted, while the fishing and fish survival listings cannot be well evaluated through CSLAP. In addition, *Bathing* may be *Impaired* and *Boating* may be *Stressed* as a result of excessive nutrients, algae and weeds. The next review of the Allegany basin PWL listings, including those for Findley Lake, will occur in 2003.

In summary, lake conditions were less productive and were perceived more favorably at Findley Lake in 2000 than in the typical year, although there is not significant evidence that this is the start of a longer-term trend toward consistently more favorable water quality conditions in the lake. Additional phosphorus data is expected to confirm these conditions, although this will not be clearer until these data are received and analyzed.

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. Eutrophication is a natural process, and is not necessarily indicative of man-made pollution.

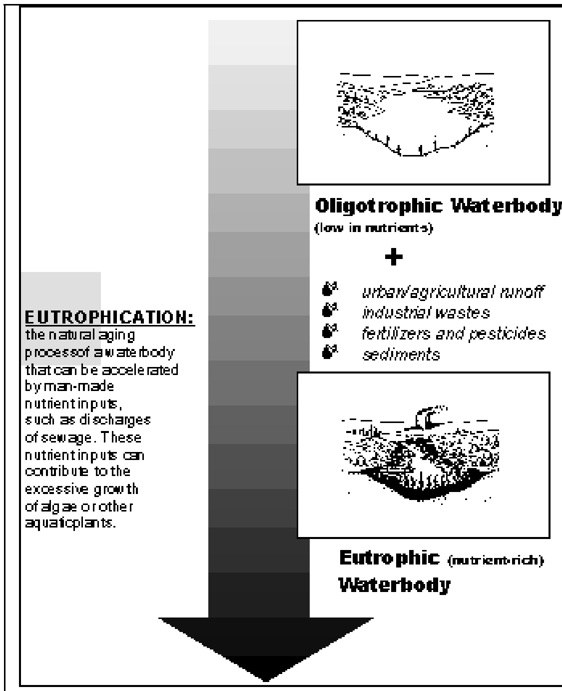


Figure 1. Trophic States

In fact, some lakes are thought to be "naturally" productive. It is important to understand that 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 how clear the water is, the amount of nutrients in the water, and the amount of algae growth resulting from those nutrients. Three parameters are the most important measures of eutrophication in most New York lakes: **total phosphorus, chlorophyll *a*** (measuring algal standing crop), 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, in hopes of assessing the trophic status (the degree of eutrophication) of lakes. Figure 3 shows ranges for phosphorus, chlorophyll a, and Secchi disk transparency (summer averages) are representative for the major trophic classifications:

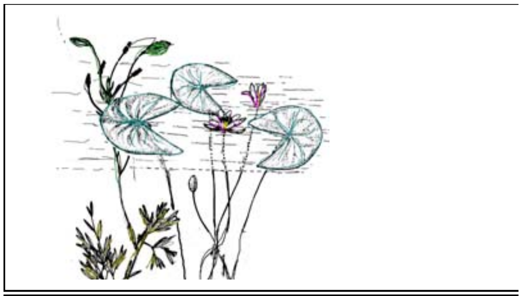
Figure 2. Trophic Status Indicators

Parameter	Eutrophic	Mesotrophic	Oligotrophic	Findley Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.037**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**35.0**
Secchi Disk Clarity (m)	2	2- 5	> 5	**1.5**

These classifications are valid for clear-water lakes only (waters 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 unexpectedly poor relative to low phosphorus and chlorophyll *a* levels. Water transparency can also be surprisingly lower than expected in shallow lakes, due to influences from the 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. Many lake management plans are centered around phosphorus controls.
Nitrogen (nitrate, 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. For much of the sampling season, many CSLAP lakes have very low or undetectable (<0.02 mg/l) levels.
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

By the trophic standards described above, Findley Lake would be considered to be a **eutrophic** lake.



III. AQUATIC PLANTS

Macrophytes:

Aquatic plants should be recognized for their contributions to lake beauty as well as 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. 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 macrophyte species* that can frequently dominate a native aquatic plant community and crowd out more beneficial species. The 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. 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.

The following aquatic plant species have been identified in Findley Lake:

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

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 mentioned diatoms, green, and blue-green algae, to golden-brown algae to dinoflagellates and many others, dominating each lake community.

So how can this be evaluated through CSLAP? CSLAP does assess algal biomass through the chlorophyll *a* measurement. 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. Algal species frequently associated with taste and odor problems are specifically noted in this table, 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 alga:

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

Most Abundant Genera- ***Chrysophyta*** **(golden brown algae)- 42%,** ***Bacillariophyta*** **(diatoms)- 36%,** ***Cyanophyta*** **(blue-green algae)- 18%**

IV. FINDLEY LAKE CSLAP WATER QUALITY DATA

CSLAP is intended to provide the strong data base which will help lake associations understand lake conditions and foster sound lake protection and pollution prevention decisions. This individual lake summary for 2000 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 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 certain data point perhaps for the current sampling year with historical data information. Table 2 includes more detailed summaries of the 2000 and historical data sets, including some evaluation of water quality trends, comparison against existing water quality standards, and whether 2000 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 may 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 while 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 CSLAP 2000 report attempts to standardize some comparisons by limiting the evaluation to common sampling periods (July through August).**
- **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).

TABLE 1: CSLAP Data Summary for Findley Lake

Year	Min	Avg	Max	N	Parameter
1986-00	**0.33**	**1.54**	**5.13**	**136**	**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
1986-00	**0.011**	**0.036**	**0.082**	**125**	**CSLAP Tot.P**
2000	0.017	0.019	0.020	3	CSLAP Tot.P
1999	0.031	0.056	0.081	8	CSLAP Tot.P
1998	0.025	0.046	0.067	2	CSLAP Tot.P
1998	0.211	0.564	0.960	4	CSLAP Hypo TP
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, in mg/l
NO3	Nitrate nitrogen as N, 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) other

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

Year	Min	Avg	Max	N	Parameter
1986-00	**0.01**	**0.03**	**0.17**	**94**	**CSLAP NO3**
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
Year	Min	Avg	Max	N	Parameter
1986-00	**2**	**9**	**20**	**132**	**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
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	CSLAP TColor
1985	5	7	10	5	LCI

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

Year	Min	Avg	Max	N	Parameter
1986-00	**6.92**	**7.93**	**9.05**	**135**	**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
1986-00	**173**	**210**	**237**	**134**	**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
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

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

Year	Min	Avg	Max	N	Parameter
1986-00	**0.80**	**35.02**	**274.00**	**128**	**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
Year	Min	Avg	Max	N	Parameter
1986-00	**1.0**	**2.8**	**5.0**	**62**	**QA**
2000	2.0	2.4	3.0	8	QA
1999	3.0	3.4	4.0	8	QA
1998	2.0	3.4	5.0	8	QA
1997	1.0	2.5	3.0	8	QA
1996	1.0	2.1	3.0	7	QA
1995	2.0	3.0	4.0	6	QA
1994	2.0	2.8	4.0	6	QA
1993	2.0	2.8	3.0	6	QA
1992	2.0	2.6	3.0	5	QA
Year	Min	Avg	Max	N	Parameter
1986-00	**2.0**	**2.7**	**4.0**	**62**	**QB**
2000	2.0	2.5	3.0	8	QB
1999	2.0	2.9	3.0	8	QB
1998	3.0	3.8	4.0	8	QB
1997	2.0	2.9	3.0	8	QB
1996	2.0	2.6	4.0	7	QB
1995	2.0	2.3	3.0	6	QB
1994	2.0	2.2	3.0	6	QB
1993	2.0	2.7	4.0	6	QB
1992	2.0	2.2	3.0	5	QB

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

Year	Min	Avg	Max	N	Parameter
1986-00	**1.0**	**3.2**	**4.0**	**62**	**QC**
2000	2.0	2.9	4.0	8	QC
1999	3.0	3.5	4.0	8	QC
1998	4.0	4.0	4.0	8	QC
1997	3.0	3.4	4.0	8	QC
1996	1.0	2.9	4.0	7	QC
1995	2.0	3.0	4.0	6	QC
1994	2.0	3.2	4.0	6	QC
1993	2.0	3.3	4.0	6	QC
1992	2.0	2.6	3.0	5	QC

- **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	2000	1.09	1.80	2.95
(meters)	All Years	0.33	1.54	5.13
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Phosphorus	2000	0.000	#DIV/0!	0.000
(mg/l)	All Years	0.011	0.037	0.082
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Chl.a	2000	4.54	16.22	42.10
(μg/l)	All Years	0.80	35.02	274.00

Parameter	Year	Was 2000 Clarity the Highest or Lowest on Record?	Was 2000 a Typical Year?	Trophic Category	Zsd Changing?	% Samples Violating DOH Beach Std?+
Zsd	2000	Within Normal Range	Yes	Eutrophic	No	25
(meters)	All Years			Eutrophic		44
Parameter	**Year**	**Was 2000 TP the Highest or Lowest on Record?**	**Was 2000 a Typical Year?**	**Trophic Category**	**TP Changing?**	**% Samples Exceeding TP Guidance Value+**
Phosphorus	2000	Within Normal Range	NA	NA	NA	NA!
(mg/l)	All Years			Eutrophic		85
Parameter	**Year**	**Was 2000 Algae the Highest or Lowest on Record?**	**Was 2000 a Typical Year?**	**Trophic Category**	**Chl.a Changing?**	
Chl.a	2000	Within Normal Range	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

***- Chlorophyll *a* readings were lower than "normal" for Findley Lake in 2000**

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

Other Water Quality Indicators

Parameter	Year	Minimum	Average	Maximum
Nitrate	2000	0.01	0.01	0.04
(mg/l)	All Years	0.01	0.03	0.17
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
True Color	2000	4	7	9
(ptu)	All Years	2	9	20
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
pH	2000	7.38	8.08	8.62
(std units)	All Years	6.92	7.93	9.05
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Conductivity	2000	208	214	222
(µmho/cm)	All Years	173	210	237

Parameter	Year	Was 2000 Nitrate the Highest or Lowest on Record?	Was 2000 a Typical Year?	Nitrate High?	Nitrate Changing?	% Samples Exceeding NO3 Standard+	
Nitrate	2000	Lowest at Times	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2000 Color the Highest or Lowest on Record?**	**Was 2000 a Typical Year?**	**Colored Lake?**	**Color Changing?**		
True Color	2000	Within Normal Range	Lower Than Normal	No	No		
(ptu)	All Years			No			
Parameter	**Year**	**Was 2000 pH the Highest or Lowest on Record?**	**Was 2000 a Typical Year?**	**Acceptable Range?**	**pH Changing?**	**% Samples > Upper pH Standard+**	**% Samples < Lower pH Standard+**
pH	2000	Within Normal Range	Yes	Yes	No	13	0
(std units)	All Years			Yes		5	0
Parameter	**Year**	**Was 2000 Conductivity Highest or Lowest on Record?**	**Was 2000 a Typical Year?**	**Relative Hardness**	**Conduct. Changing?**		
Conductivity	2000	Within Normal Range	Yes	Intermediate	No		
(µmho/cm)	All Years						

+- NYS Nitrate standard = 10 mg/l

- NYS pH standard- not to exceed 8.5 or fall below 6.5

None of the other (non-eutrophication) water quality indicators have demonstrated significant change in Findley Lake since CSLAP sampling began in 1986.

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

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

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QA	2000	2	2.4	3
(Clarity)	All Years	1	2.8	5
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QB	2000	2	2.5	3
(Plants)	All Years	2	2.7	4
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QC	2000	2	2.9	4
(Recreation)	All Years	1	3.2	4

Parameter	**Year**	**Was 2000 Clarity the Highest or Lowest on Record?**	**Was 2000 a Typical Year?**		**Clarity Changed?**	
QA	2000	Within Normal Range	Yes		No	
(Clarity)	All Years					
Parameter	**Year**	**Was 2000 Weed Growth the Heaviest on Record?**	**Was 2000 a Typical Year?**		**Weeds Changed?**	
QB	2000	Lightest at Times	Yes		Yes	
(Plants)	All Years					
Parameter	**Year**	**Was 2000 Recreation the Best or Worst on Record?**	**Was 2000 a Typical Year?**		**Recreation Changed?**	
QC	2000	Worst at Times	Yes		No	
(Recreation)	All Years					

How Do the 2000 Seasonal Data Compare to Historical Seasonal Data?

Seasonal Comparison of Eutrophication and Lake Perception Indicators–2000 Sampling Season and in the Typical Sampling Season at Findley Lake

Figures 4 and 5 compare data for the measured eutrophication parameters for Findley Lake in 2000 and since CSLAP sampling began at Findley Lake. Figures 6 and 7 compare volunteer perception responses over the same time periods.

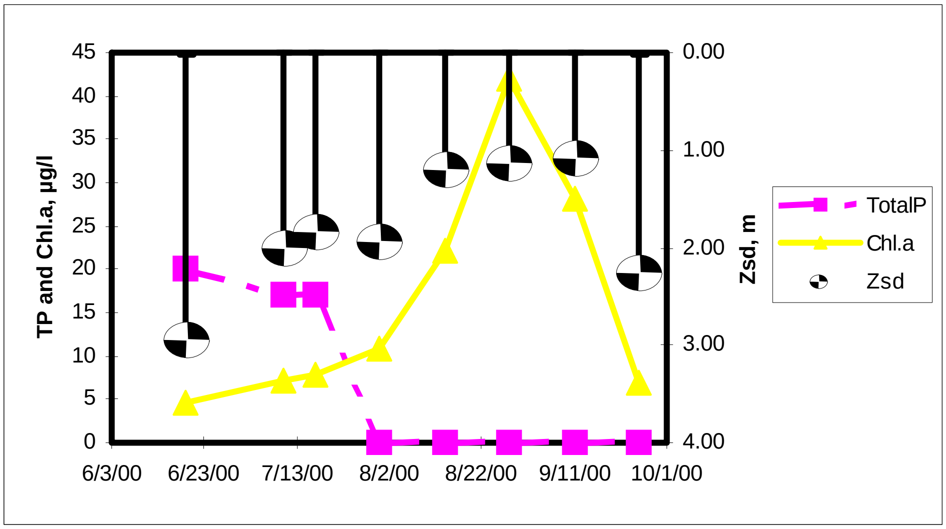


Figure 4. 2000 Eutrophication Data for Findley Lake

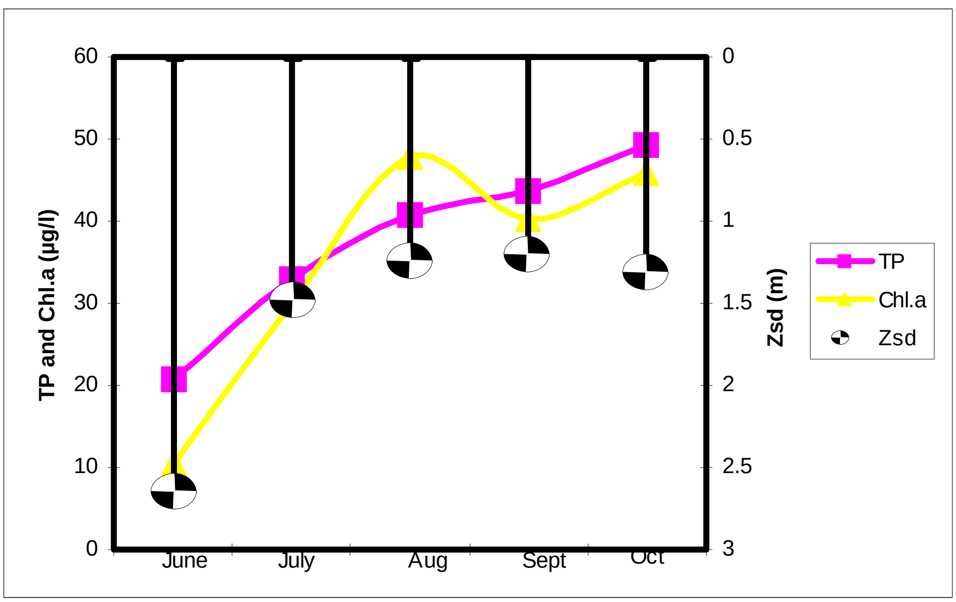


Figure 5- Eutrophication Data in a Typical (Monthly Mean) Year for Findley Lake

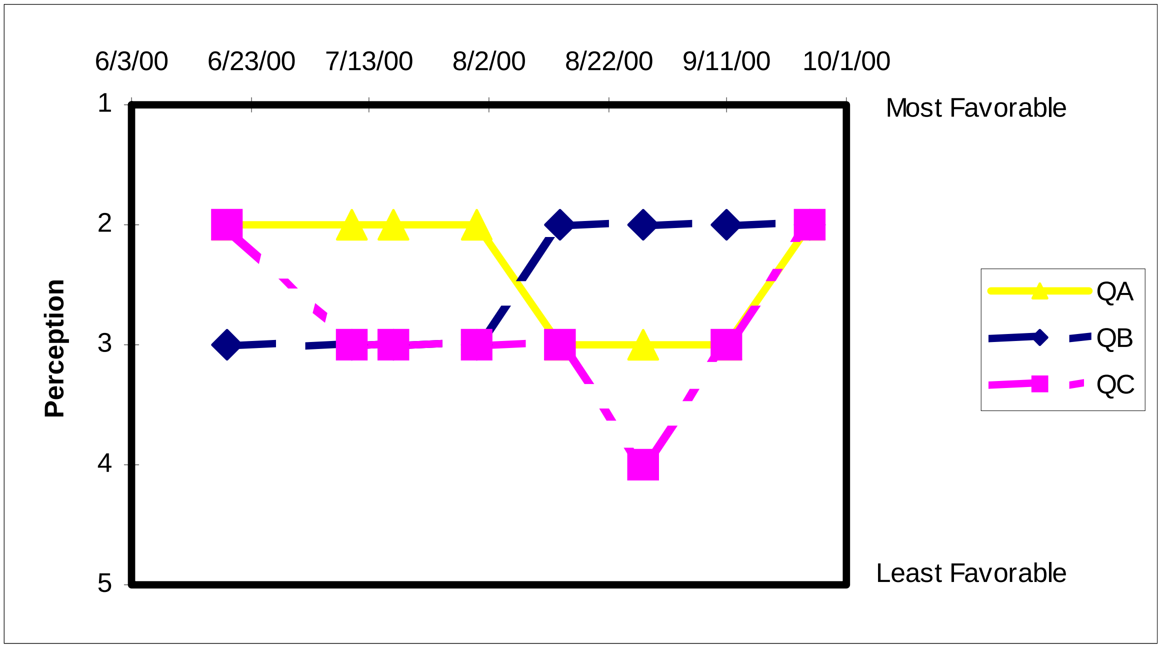


Figure 6. 2000 Lake Perception Data for Findley Lake

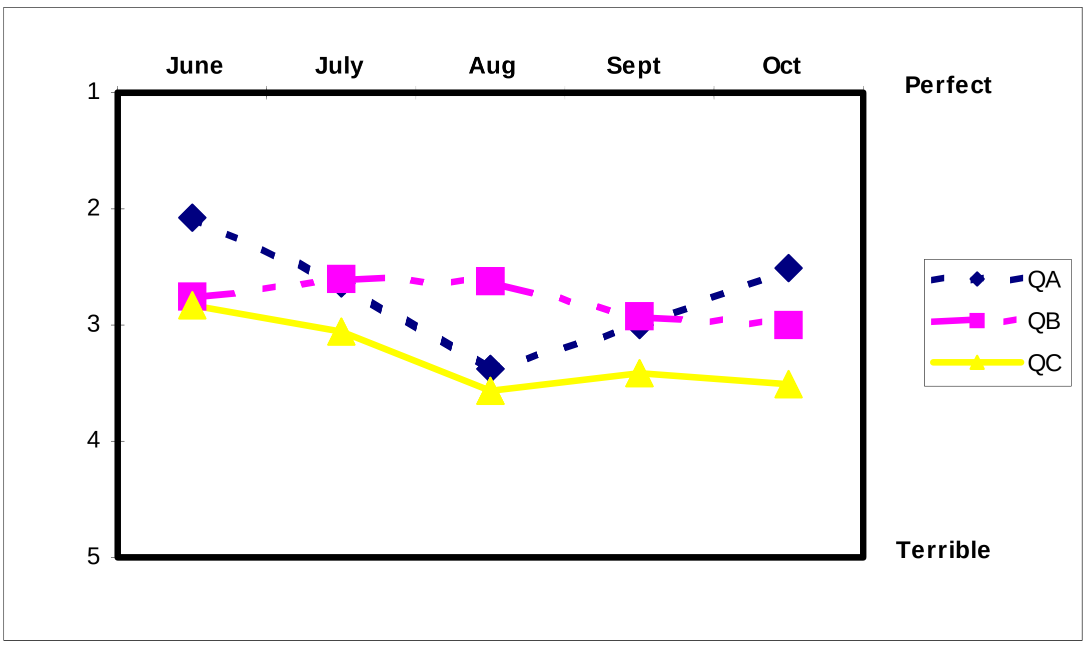


Figure 7- Lake Perception Data in a Typical (Monthly Mean) Year for Findley Lake

(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)

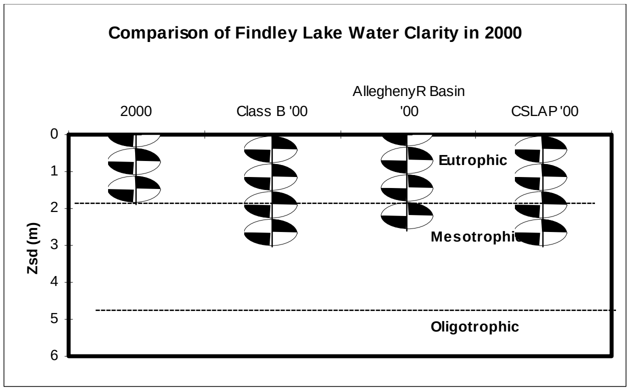


Figure 8. *Comparison of 2000 Secchi Disk Transparency to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2000*

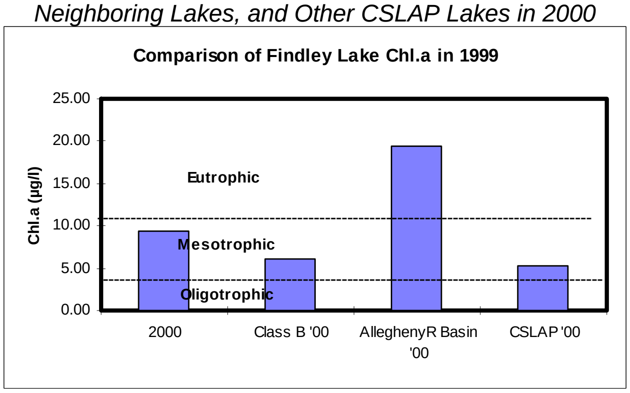


Figure 9. *Comparison of 2000 Chlorophyll a to Lakes with the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2000*

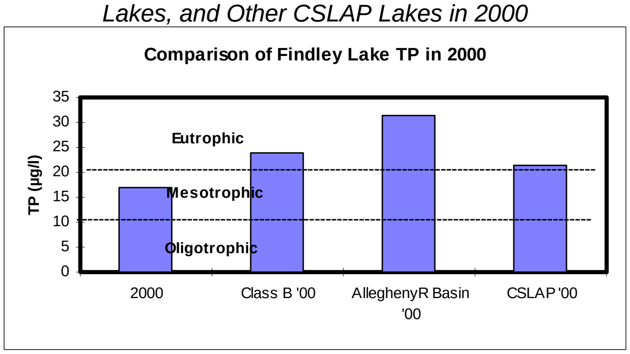


Figure 10. *Comparison of 2000 Total Phosphorus to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2000*

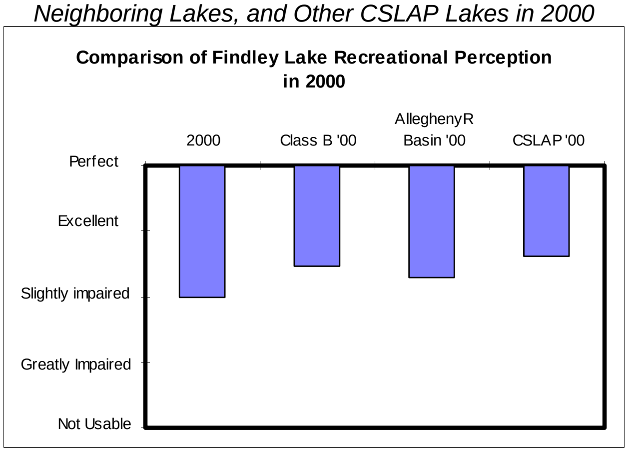


Figure 11. *Comparison of 2000 Recreational Perception*

How does Findley Lake compare to other lakes?

Annual Comparison of Median Readings for Eutrophication Parameters and Recreational Assessment For Findley Lake in 2000, 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 2000, 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 2000:

a) Using water clarity as an indicator, Findley Lake was more productive than other Allegany River drainage basin lakes, other lakes with the same water quality classification (Class B), and other CSLAP lakes.
b) Using chlorophyll *a* as an indicator, Findley Lake was more productive than other Class B and CSLAP lakes, but less productive than other Allegany River drainage basin lakes.
c) Using preliminary total phosphorus concentrations as an indicator, Findley Lake was less productive than other Class B, other Allegany River drainage basin and other CSLAP lakes.
d) Using QC on the field observations form as an indicator, Findley Lake was less suitable for recreation than other Class B, other Allegany River drainage basin, and other CSLAP lakes.

V: 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 <u>Diet for a Small Lake</u>, 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 related to lower-than-desired water transparency. 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,...

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.

FINDLEY LAKE HAS BEEN HARVESTED TO CONTROL EURASIAN WATERMILFOIL. IN 1999, AN EXPERIMENTAL STOCKING OF HERBIVOROUS WEEVILS WAS UNDERTAKEN- AT THIS POINT, IT IS TOO EARLY TO EVALUATE THE RESULTS FROM THIS STUDY.

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 Regional Offices and the Adirondack Park Agency 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.**

Appendix A. Raw Data for Findley Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TColor	pH	Cond25	Chl.a	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	6/15/86	11.5	3.00	1.5	0.026	0.12	5	6.92	190	2.22	1	18	19				
24	Findley L	6/21/86	11.5	3.13	1.5	0.013	0.11	5	7.50	180	2.29	1	23	20				
24	Findley L	6/29/86	11.5	2.25	1.5	0.011	0.09	10	7.62	185	2.00	1	22	21				
24	Findley L	7/3/86	11.5	2.75	1.5	0.022	0.11	15	7.82	194	0.80	1	15	20				
24	Findley L	7/11/86	11.5	2.00	1.5	0.021	0.03	2	7.84	185	5.03	1	15	20				
24	Findley L	7/18/86	11.5	1.50	1.5	0.030	0.06	5	8.38	194		1	30	24				
24	Findley L	7/24/86	11.5	2.63								1	30	25				
24	Findley L	8/1/86	11.5	1.63	1.5	0.028	0.03	14	8.05	197		1	26	24				
24	Findley L	8/5/86	11.5	1.13	1.5	0.018	0.03	11	7.75	191	53.30	1	26	25				
24	Findley L	8/12/86			1.5	0.023	0.03	13	8.15	199	15.30	1						
24	Findley L	8/16/86	11.5	0.75	1.5	0.035	0.03	12	8.98	195	36.30	1	24	24				
24	Findley L	8/21/86	11.5	0.63	1.5	0.037	0.03	15	8.12	198	40.00	1	26	25				
24	Findley L	8/30/86	11.5	1.00	1.5	0.034	0.03	3	7.60	205	29.60	1	20	19				
24	Findley L	9/5/86	11.5	0.75	1.5	0.033	0.03	3	8.17	206	25.90	1	21	20				
24	Findley L	9/14/86	11.5	0.63	1.5	0.036	0.03	13	7.55	215	22.20	1	14	19				
24	Findley L	9/21/86	11.5	0.75	1.5	0.039	0.03	8	7.29	214	34.00	1	17	18				
24	Findley L	6/8/87	11.5	2.75	1.5	0.023	0.03	15	8.10	201		1	22	24				
24	Findley L	6/14/87	11.5	3.00	1.5	0.018		12	8.22	198		1	25	22				
24	Findley L	6/21/87	11.5	2.00	1.5	0.023	0.01	15	7.83	203	17.00	1	27	25				
24	Findley L	6/28/87	11.8	1.25	1.5	0.021	0.01	15	7.76	202	37.70	1	19	23				
24	Findley L	7/5/87	11.8	0.75	1.5	0.032	0.01	11	7.70	206		1	23	23				
24	Findley L	7/12/87	11.5	0.63	1.5	0.033		11	7.86	206	116.00	1	30	27				
24	Findley L	7/19/87	11.5	0.75	1.5	0.040	0.01	15	7.49	206	109.00	1	27	26				
24	Findley L	7/26/87	11.5	1.00	1.5	0.052		13	7.63	209	45.10	1	24	27				
24	Findley L	7/30/87	11.5	0.75	1.5	0.056		12	7.38	210	73.30	1	25	27				
24	Findley L	8/9/87	11.5	0.75	1.5	0.042	0.01	7	7.33	208	116.00	1	24	24				
24	Findley L	8/16/87	11.5	0.50	1.5	0.060		6	7.14	216	274.00	1	27	27				
24	Findley L	8/23/87	11.5	0.75	1.5	0.054	0.01	10	7.42	208		1	18	22				
24	Findley L	8/30/87	11.5	0.75	1.5	0.052		12	7.46	204	73.00	1	21	20				
24	Findley L	9/6/87	11.5	0.75	1.5	0.059	0.17	8	7.36	221	99.00	1	19	19				
24	Findley L	10/1/87	11.5	0.75	1.5	0.049	0.03	11	7.30	215	73.20	1	14	17				
24	Findley L	6/21/88	12.0	2.25	1.5	0.022	0.01	8	7.72	213	17.50	1	25	24				
24	Findley L	6/28/88	11.5	1.75	1.5	0.022	0.01	7	7.77	219	10.10	1	20	24				
24	Findley L	7/5/88	11.5	1.50	1.5	0.020	0.01	9	8.10	220	10.40	1	29	25				
24	Findley L	7/12/88	11.0	1.00	1.5	0.023	0.01	11	8.19	234		1	28	27				
24	Findley L	7/19/88	11.5	1.00	1.5	0.025	0.01	7	8.31	223	20.70	1	26	28				
24	Findley L	7/26/88	12.0	1.50	1.5	0.029	0.01	10	7.71	221	1.78	1	26	25				
24	Findley L	7/31/88	11.5	1.25	1.5	0.031	0.01	10	8.10	223	17.80	1	24	26				
24	Findley L	8/8/88	11.5	1.00	1.5	0.037	0.01	11	7.97	219	31.10	1	27	28				
24	Findley L	8/12/88	11.5	0.75	1.5	0.042	0.01	10	7.96	221	52.50	1	26	27				
24	Findley L	8/21/88	11.8	0.75	1.5	0.042	0.01	6	8.32	227	49.60	1	20	25				
24	Findley L	8/30/88	11.5	2.25	1.5	0.032	0.02	11	7.97	227	10.10	1	18	23				
24	Findley L	9/6/88	11.3	1.75	1.5	0.037	0.03	14	7.86	227	18.50	1	15	20				
24	Findley L	9/12/88	11.5	1.50	1.5	0.035	0.03	12	7.95	229	24.40	1	24	20				
24	Findley L	9/19/88	11.8	1.00	1.5	0.040	0.01	8	8.09	230	38.50	1	24	20				
24	Findley L	9/25/88	11.8	1.00	1.5	0.039	0.01	6	8.27	227	30.30	1	24	18				
24	Findley L	6/26/89	11.0	3.25	1.5	0.017	0.14	7	7.94	198	2.16	1	29	27				
24	Findley L	7/2/89	11.0	2.25	1.5	0.015		12	7.98	199	18.50	1	22	23				
24	Findley L	7/9/89	11.0	2.25	1.5	0.022		15	7.76	204	6.45	1	27	25				
24	Findley L	7/16/89	11.5	2.50	1.5	0.020		11	7.85	210	6.18	1	25	24				

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TColor	pH	Cond25	Chl.a	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	7/27/89	11.5	2.50	1.5	0.025		10	8.13	200	9.77	1	27	25				
24	Findley L	7/31/89	11.0	2.00	1.5	0.026		8	7.82	210	6.36	1	21	24				
24	Findley L	8/7/89	10.5	2.50	1.5	0.029	0.06	8	8.18	214	7.19	1	17	23				
24	Findley L	8/14/89	11.3	2.00	1.5	0.020		7	7.98	211	6.45	1	24	22				
24	Findley L	8/20/89	11.5	2.00	1.5	0.024		2	8.24	212	6.65	1	20	23				
24	Findley L	8/29/89	11.5	2.25	1.5	0.028		2	8.24	208	11.30	1	26	24				
24	Findley L	9/11/89	11.0	1.75	1.5	0.025	0.01	5	8.16	211	17.80	1	21	22				
24	Findley L	9/25/89	11.5	1.00	1.5	0.029		6	8.18	203	19.60	1	14	16				
24	Findley L	10/11/89	11.0	1.25	1.5	0.038		5	8.16	210	18.50	1	11	12				
24	Findley L	7/10/90	11.5	1.25	1.5	0.046	0.01		7.95			1	22	23				
24	Findley L	7/17/90	11.3	1.25	1.5	0.037	0.01	13	7.72	209	36.60	1	25	23				
24	Findley L	7/31/90	11.5	0.75	1.5	0.048	0.01	10	7.40	199	57.40	1	21	24				
24	Findley L	8/14/90	11.5	0.81	1.5	0.044		10	7.24	199	45.10	1	22	23				
24	Findley L	8/28/90	11.5	0.75	1.5	0.053	0.01	10	7.50	206	58.60	1	23	23				
24	Findley L	9/11/90	11.0	0.75	1.5	0.051	0.01	12	8.11	205	62.70	1	21	22				
24	Findley L	9/25/90	11.0	1.50	1.5	0.048	0.02	17	7.78	222	26.90	1	14	15				
24	Findley L	10/10/90	11.0	2.50	1.5	0.062			8.23	205	9.40	1	21	16				
24	Findley L	7/22/91	11.3	1.00	1.5	0.049	0.01	10	8.22	215	30.90	1	26	27				
24	Findley L	8/5/91	13.0	0.75	1.5	0.055	0.01	14	7.63	220	82.80	1	24	23				
24	Findley L	8/19/91	11.0	0.75	1.5	0.054	0.01	11	8.28	224	68.80	1	23	24				
24	Findley L	9/4/91	11.7	0.33	1.5	0.079	0.01	9	7.59	219	149.00	1	20	22				
24	Findley L	9/18/91	11.0	0.67	1.5	0.065			7.90	221	132.00	1	20	22				
24	Findley L	10/1/91	11.5	0.58	1.5	0.064		7	7.81	220	126.00	1	19	17				
24	Findley L	6/29/92	11.5	2.00	1.5	0.023		6	7.81	237	9.18	1	22	21	3	2	3	1
24	Findley L	7/18/92	11.5	1.50	1.5	0.013		6	8.05	232	15.40	1	22	23	3	2	3	14
24	Findley L	8/11/92	11.3	1.33	1.5	0.025		8	8.34	223	11.60	1	23	24				
24	Findley L	8/31/92	11.5	1.75	1.5	0.035		9	8.23	228	10.20	1	17	20	3	2	2	15
24	Findley L	9/28/92	11.5	1.75	1.5	0.024		8	8.24	218	15.80	1	20	18	2	2	2	5
24	Findley L	10/10/92	11.6	1.50	1.5	0.034		11	8.06	225	28.50	1	14	15	2	3	3	5
24	Findley L	7/6/93	11.5	1.50	1.5	0.030		7	8.20	210	21.70	1	26	25	3	2	2	
24	Findley L	7/20/93	11.5	1.50	1.5	0.043		2	7.75	210	15.50	1	21	24	3	2	3	5
24	Findley L	8/9/93	11.0	1.00	1.5	0.049		7	8.15	211	49.30	1	24	23	3	2	3	1
24	Findley L	8/30/93	11.3	0.75	1.5	0.063		7	8.16	202	45.90	1	27	26	3	3	4	123
24	Findley L	9/21/93	11.5	1.25	1.5	0.044		6	8.26	214	33.20	1	15	18	2	4	4	25
24	Findley L	10/4/93	11.5	1.29	1.5	0.048		5	8.07	216	18.90	1	17	14	3	3	4	125
24	Findley L	6/14/94	11.3	3.63	1.5	0.015	0.12	6	8.60	222	3.73	1	31	23	2	2	2	
24	Findley L	7/5/94	11.5	2.00	1.5	0.023		7	7.90	221	10.20	1	27	24	2	2	3	56
24	Findley L	7/25/94	11.5	1.50	1.5	0.031		4	8.04	224	21.50	1	23	25	3	2	3	14
24	Findley L	8/15/94	11.8	1.25	1.5	0.039	0.03	11	7.96	206	32.70	1	21	21	3	2	4	135
24	Findley L	9/5/94	11.5	1.00	1.5	0.048		10	7.70	206	39.40	1	19	20	4	2	3	134
24	Findley L	9/26/94	13.0	0.80	1.5	0.059		12	7.83	208	50.30	1	19	19	3	3	4	135
24	Findley L	6/5/95	11.0	2.00	1.5	0.020		6			9.86	1	25	22	2	2	2	
24	Findley L	6/20/95	11.0	1.00	1.5	0.028		7	8.16	230	24.40	1	30	27	3	2	4	14
24	Findley L	7/10/95	11.3	0.77	1.5	0.037			7.76	235	51.30	1	23	23	3	3	3	15
24	Findley L	7/17/95	11.4	0.75	1.5	0.053	0.01	5	8.07	237	53.80	1	28	27	3	2	3	14
24	Findley L	7/31/95	11.0	0.55	1.5	0.059		10	8.07	231	86.70	1	30	28	3	3	3	134
24	Findley L	8/14/95	11.5	0.33	1.5	0.082		5	7.48	232	172.00	1	31	27	4	2	3	134
24	Findley L	6/17/96	11.3	4.75	1.5	0.013	0.05	5	8.18	225	3.50	1	24	22	1	2	1	
24	Findley L	7/12/96	11.5	1.65	1.5	0.023	0.08	10	7.84	218	20.50	1	27	25	2	2	3	14
24	Findley L	7/17/96	11.0	3.25	1.5	0.015	0.07	20	7.85	220	8.20	1	32	25	2	2	3	
24	Findley L	7/29/96	11.0	3.25	1.5	0.018	0.04	10	8.03	218	5.90	1	22	23	2	2	2	5
24	Findley L	8/12/96	11.0	2.75	1.5	0.023	0.01	20	7.93	217	7.70	1	22	23	2	2	3	2

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TColor	pH	Cond25	Chl.a	QaQc	TAir	TH20	QA	QB	QC	QD
24	Findley L	8/26/96	11.0	3.75	1.5	0.018	0.01	5	8.43	214	5.20	1	23	24				
24	Findley L	9/9/96	11.0	2.25	1.5	0.024	0.01	10	7.95	212	14.10	1	25	22	3	4	4	24
24	Findley L	9/23/96	11.5	2.28	1.5	0.056	0.01	10	7.96	210	19.10	1	19	17	3	4	4	24
24	Findley L	6/9/97	11.0	4.25	1.5	0.013	0.10	10	7.52	190	2.60	1	24	19	1	3	3	2
24	Findley L	6/23/97	11.0	5.13	1.5	0.015	0.08	10	8.07	186	3.08	1	24	23	1	3	3	2
24	Findley L	7/7/97	11.3	1.50	1.5	0.031	0.01	10	7.56	200	18.50	1	20	23	3	2	3	1
24	Findley L	7/21/97	11.8	1.28	1.5	0.030	0.01	10	7.83	202	19.70	1	26	25	3	3	3	134
24	Findley L	8/4/97	11.0	1.42	1.5	0.029	0.01	10	7.39	207	27.80	1	20	23	3	3	3	2334
24	Findley L	8/18/97	11.5	1.71	1.5	0.032	0.01	7	7.56	206	20.20	1	19	22	3	3	4	124
24	Findley L	9/1/97	11.7	1.40	1.5	0.032	0.01	7	8.48	202	21.90	1	26	22	3	3	4	124
24	Findley L	9/15/97	11.3	1.75	1.5	0.025	0.01	9	8.41	200	13.90	1	24	21	3	3	4	12
24	Findley L	6/8/98	12.0	2.42	1.5	0.025	0.01	5	8.41	178	9.34	1	17	18	2	4	4	2
24	Findley L	9/14/98	10.8	0.80	1.5	0.067		6	7.80	194	43.20	1	22	20	4	3	4	1234
24	Findley L	6/22/98	11.5	3.13	1.5	0.020	0.01	3	7.51	185	6.32	1	25	24	2	4	4	24
24	Findley L	7/7/98	11.5	1.38	1.5	0.038	0.01	2	8.53	186	22.10	1	26	25	3	4	4	124
24	Findley L	7/20/98	11.5	0.78	1.5	0.044	0.14	5	8.61	173	40.50	1	29	26	3	4	4	1234
24	Findley L	8/3/98	11.5	0.83	1.5	0.053	0.01	5	8.13	181	51.60	1	25	23	5	4	4	1234
24	Findley L	8/17/98	11.8	0.83	1.5	0.070		14	9.05	183	57.10	1	30	25	4	3	4	124
24	Findley L	8/31/98	11.5	0.94	1.5	0.067		12	8.96	184	47.20	1	24	23	4	4	4	1234
24	Findley L	6/7/99	11.5	1.05	1.5	0.031	0.01	8	7.47	211	19.20	1	35	25	3	3	3	234
24	Findley L	6/21/99	11.8	1.19	1.5	0.035	0.01	6	8.21	204	21.90	1	20	22	3	3	3	24
24	Findley L	7/5/99	11.3	0.78	1.5	0.061	0.02	10	7.54	196	63.50	1	33	24	3	3	4	124
24	Findley L	7/19/99	11.7	0.71	1.5	0.081	0.01	12	7.36	198	69.00	1	27	26	3	3	3	1234
24	Findley L	8/2/99	11.0	0.50	1.5	0.069	0.01	11	8.33	202	53.50	1	23	26	4	3	4	134
24	Findley L	8/16/99	11.0	0.55	1.5	0.068	0.01	7	7.33	215	45.90	1	28	22	3	3	4	134
24	Findley L	8/30/99	11.0	0.85	1.5	0.050	0.01	10	7.85	221	43.80	1	20	22	4	2	4	134
24	Findley L	9/12/99	11.0	0.68	1.5	0.054	0.01	6	7.21	227	57.00	1	22	21	4	3	3	134
24	Findley L	6/19/00	11.3	2.95	1.5	0.020	0.01	8	8.18	218	4.54	1	26	22	2	3	2	2
24	Findley L	7/10/00	12.0	2.00	1.5	0.017	0.01	4	7.80	217	7.10	1	26		2	3	3	2
24	Findley L	7/17/00	11.8	1.85	1.5	0.017	0.01	6	8.36	214	7.85	1	27	24	2	3	3	2
24	Findley L	7/31/00	11.0	1.95	1.5		0.01	4	8.62	210	10.80	1	29	26	2	3	3	12
24	Findley L	8/14/00	11.5	1.22	1.5		0.01	6	7.38	208	22.20	1	27	25	3	2	3	125
24	Findley L	8/28/00	11.5	1.13	1.5		0.01	8	8.20	210	42.10	1	27	23	3	2	4	13
24	Findley L	9/11/00	11.0	1.09	1.5		0.01	9	8.04	215	28.20	1	26	24	3	2	3	134
24	Findley L	9/25/00	11.8	2.25	1.5		0.04	8	8.09	222	6.95	1	12	18	2	2	2	5
24	Findley L	6/22/98			10.0	0.211						2		14				
24	Findley L	7/20/98				0.465						2		15				
24	Findley L	8/17/98				0.618						2						
24	Findley L	9/14/98				0.960						2		12				

Appendix B. New York State Water Clarity 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 $AA_{special}$: 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 $A_{special}$: 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: BACKGROUND INFORMATION FOR FINDLEY LAKE

CSLAP Number	**24**
Lake Name	Findley L
First CSLAP Year	1986
Sampled in 1999?	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-N, Cuba L, Findley L