2002 INTERPRETIVE SUMMARY

NEW YORK
CITIZENS STATEWIDE
LAKE ASSESSMENT PROGRAM
(CSLAP)

OQUAGA LAKE

NY Federation of Lake Associations
NYS Department of Environmental Conservation

March, 2003

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 now involves more than 125 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 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 the NYS Department of Health and other 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 2002 sampling results for **Oquaga Lake**.

Oquaga Lake is a 134 acre, class AA lake found in the Town of Deposit in Broome County in the Southern Tier region of New York State. It was first sampled as part of CSLAP in 1987. The following volunteers have participated in CSLAP, and deserve most of the credit for the success of this program at **Oquaga Lake**: **Kathy Greenman, Barbara Fenning, Fred Fenning, Joan Peduto, Ross Peduto, James Peduto, Carole Peduto, Mark Millspaugh, and Andrew Millspaugh.**

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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The New York State Department of Health (prior to 2002), particularly Jean White, and Upstate Freshwater Institute (in 2002), particularly Carol Matthews, 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.

OQUAGA LAKE
FINDINGS AND EXECUTIVE SUMMARY

Oquaga Lake was sampled as part of the New York Citizens Statewide Lake Assessment Program in 2002. 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 2002 CSLAP data and an historical comparison of the data collected within the 2002 sampling season and data collected at Oquaga Lake prior to 2002.

The majority of the short- and long-term analyses of the water quality conditions in Oquaga Lake are summarized in Table 2, divided into assessments of eutrophication indicators, other water quality indicators, and lake perception indicators. The 2002 data indicate that the lake can be classified as oligotrophic, or highly unproductive- this assessment demonstrates an "improvement" relative to many years ago, when the lake could be classified as mesoligotrophic. Water quality data suggest that the lake is less productive (higher clarity, lower nutrient and algae levels) than in the early 1990s, although it is likely that these changes have not been statistically significant (but could be better evaluated with additional contemporary data). Water clarity readings appear to be most influenced by algae levels, which in turn are driven by nutrient (particularly phosphorus) levels. The nitrogen to phosphorus ratios indicate that algae levels in Oquaga Lake are controlled by phosphorus. There appears to be only weak seasonal water quality patterns, and deepwater nutrient data are similar to those from the lake surface, suggesting that internal nutrient loading (from bottom sediments into bottom waters) is not significant. Phosphorus levels in the lake at no times have exceeded the state phosphorus guidance value, and water transparency readings have never fallen below the minimum recommended water clarity for swimming beaches. In short, water quality conditions suggest an "improvement" since the early years of CSLAP sampling, with higher water transparency and lower nutrient and algae levels, although these changes might not be statistically significant.

The lake is weakly 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). The lake has soft water, circumneutral pH readings, and mostly undetectable nitrate readings. pH readings have fallen between the lower and upper NYS water quality standards (=6.5 to 8.5) since CSLAP sampling began in 1987, and show no signs of significant change. Conductivity readings were higher in 2002 than in the previous sampling seasons, but it is not yet clear if this is indicative of a water quality trend. Nitrate and ammonia levels do not appear to warrant a threat to the lake, and the primary component of nitrogen appears to be organic (bound in algae cells).

The recreational suitability of Oquaga Lake is most often described as "could not be nicer" for most uses- this assessment is consistent with the measured and perceived water quality conditions in the lake, which are most often described as "crystal clear". This assessment may also reflect the lack of invasive weed growth, since aquatic plants still do not grow to the lake surface or otherwise impede recreational uses of the lake. These assessments are very consistent throughout the sampling season.

The 2000 NYSDEC Priority Waterbody Listings (PWL) for the Delaware River basin does not include any listings for Oquaga Lake. The CSLAP dataset suggests that no listings appear to be warranted. The next PWL cycle for this basin will probably occur by 2006.

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.

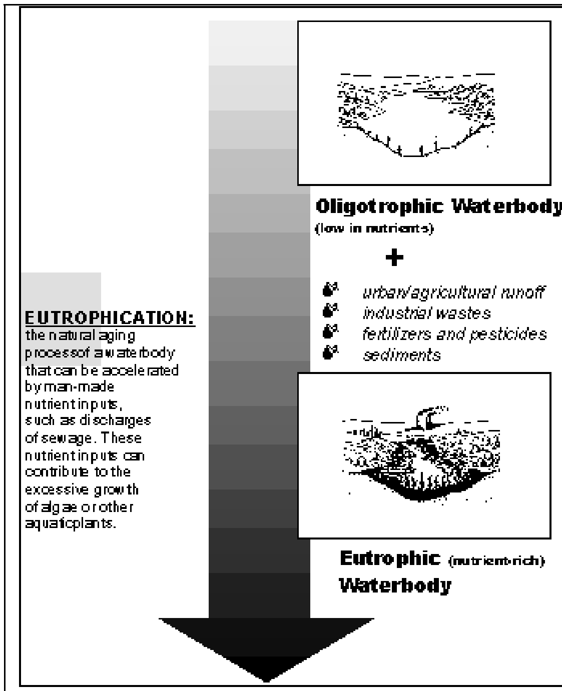

Figure 1. Trophic States

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 Canada. 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 Oquaga 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 median) are representative for the major trophic classifications:

Figure 2. Trophic Status Indicators

Parameter	Eutrophic	Mesotrophic	Oligotrophic	Oquaga Lake
Phosphorus (mg/l)	> 0.020	0.010 - 0.020	< 0.010	**0.007**
Chlorophyll a (µg/l)	> 8	2- 8	< 2	**3.9**
Secchi Disk Clarity (m)	2	2- 5	> 5	**5.6**

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. 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 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 the chlorophyll *a* trophic standards listed above, the lake would be considered **mesotrophic, or moderately productive**, while by the Secchi disk transparency and total phosphorus trophic standards listed above, the lake would be considered **oligotrophic**, or **highly unproductive**. **Water quality conditions in 2002 at Oquaga Lake were more typical of oligotrophic lakes, and as such this is probably the most appropriate trophic designation for the 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.

Aquatic plants surveys have not been conducted through CSLAP at Oquaga Lake.

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 Oquaga Lake have identified the following algae:

Date: 7/24/92 **Most Abundant Species:** ***Gymnodinium spp.*** **(dinoflagellates)- 57%,** ***Dinobryon sociale*** **(golden brown algae)- 31%,** ***Peridinium spp.*** **(dinoflagellates)- 6%**
Most Abundant Genera: ***Pyrrhophyta*** **(dinoflagellates)- 63%,** ***Chrysophyta*** **(golden brown algae)- 33%,** ***Cyanophyta*** **(blue-green algae)- 3%**

IV. OQUAGA 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 <u>2002</u> contains two forms of information. The **raw data** and **graphs** present a <u>snapshot</u> 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 2002 and historical data sets, including some evaluation of water quality trends, comparison against existing water quality standards, and whether 2002 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 2002 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).**

TABLE 1: CSLAP Data Summary for Oquaga Lake

Year	Min	Avg	Max	N	Parameter
1987-02	**1.75**	**5.59**	**12.30**	**57**	**CSLAP Zsd**
2002	5.45	8.49	12.30	9	CSLAP Zsd
1992	3.50	4.57	5.75	3	CSLAP Zsd
1991	1.75	4.58	6.50	6	CSLAP Zsd
1990	4.25	5.64	6.50	7	CSLAP Zsd
1989	4.25	4.88	5.63	7	CSLAP Zsd
1988	4.75	5.65	6.50	10	CSLAP Zsd
1987	2.75	4.73	6.00	15	CSLAP Zsd
Year	Min	Avg	Max	N	Parameter
1987-02	**0.003**	**0.007**	**0.014**	**55**	**CSLAP Tot.P**
2002	0.003	0.005	0.007	8	CSLAP Tot.P
2002	0.006	0.009	0.017	6	CSLAP Hypo TP
1992	0.008	0.011	0.014	3	CSLAP Tot.P
1991	0.007	0.009	0.012	6	CSLAP Tot.P
1990	0.004	0.008	0.012	7	CSLAP Tot.P
1989	0.005	0.008	0.013	7	CSLAP Tot.P
1988	0.005	0.007	0.011	10	CSLAP Tot.P
1987	0.003	0.007	0.012	14	CSLAP Tot.P
Year	Min	Avg	Max	N	Parameter
1988-02	**0.00**	**0.01**	**0.18**	**40**	**CSLAP NO3**
2002	0.00	0.01	0.01	9	CSLAP NO3
1992	0.01	0.01	0.01	1	CSLAP NO3
1991	0.01	0.01	0.01	3	CSLAP NO3
1990	0.01	0.01	0.01	4	CSLAP NO3
1989	0.01	0.01	0.01	3	CSLAP NO3
1988	0.01	0.01	0.01	6	CSLAP NO3
1987	0.01	0.02	0.18	14	CSLAP NO3
Year	Min	Avg	Max	N	Parameter
2002-02	**0.01**	**0.04**	**0.06**	**9**	**CSLAP TKN**
2002	0.01	0.04	0.06	9	CSLAP TKN
Year	Min	Avg	Max	N	Parameter
2002-02	**0.26**	**0.37**	**0.53**	**9**	**CSLAP TN**
2002	0.26	0.37	0.53	9	CSLAP TN
Year	Min	Avg	Max	N	Parameter
2002-02	**42.60**	**73.59**	**108.34**	**8**	**CSLAP TN/TP**
2002	42.60	73.59	108.34	8	CSLAP TN/TP

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 Oquaga Lake (cont)

Year	Min	Avg	Max	N	Parameter
1987-02	**1**	**5**	**45**	**55**	**CSLAP TColor**
2002	2	5	9	8	CSLAP TColor
1992	2	4	5	3	CSLAP TColor
1991	2	10	45	6	CSLAP TColor
1990	1	2	5	7	CSLAP TColor
1989	2	2	4	7	CSLAP TColor
1987	3	5	8	10	CSLAP TColor
1987	2	5	9	14	CSLAP TColor
Year	Min	Avg	Max	N	Parameter
1987-02	**6.33**	**7.36**	**8.06**	**52**	**CSLAP pH**
2002	6.90	7.31	7.52	7	CSLAP pH
1992	7.68	7.71	7.75	3	CSLAP pH
1991	6.95	7.43	7.63	6	CSLAP pH
1990	6.60	7.29	7.89	7	CSLAP pH
1989	7.36	7.62	7.89	7	CSLAP pH
1987	6.33	7.48	8.06	8	CSLAP pH
1987	6.85	7.11	7.49	14	CSLAP pH
Year	Min	Avg	Max	N	Parameter
1987-02	**53**	**60**	**79**	**51**	**CSLAP Cond25**
2002	72	73	74	7	CSLAP Cond25
1992	59	60	60	3	CSLAP Cond25
1991	57	58	59	6	CSLAP Cond25
1990	56	61	79	7	CSLAP Cond25
1989	55	57	58	6	CSLAP Cond25
1987	56	59	66	8	CSLAP Cond25
1987	53	55	63	14	CSLAP Cond25
Year	Min	Avg	Max	N	Parameter
2002-02	**0.00**	**#DIV/0!**	**0.00**	**0**	**CSLAP Ca**
2002	0.00	#DIV/0!	0.00	0	CSLAP Ca
Year	Min	Avg	Max	N	Parameter
1987-02	**0.41**	**3.92**	**23.80**	**51**	**CSLAP Chl.a**
2002	0.41	0.80	1.25	8	CSLAP Chl.a
1992	1.98	4.48	6.97	3	CSLAP Chl.a
1991	1.26	8.44	23.80	6	CSLAP Chl.a
1990	0.63	2.06	3.01	7	CSLAP Chl.a
1989	0.43	2.22	4.11	6	CSLAP Chl.a
1988	1.06	2.41	4.66	10	CSLAP Chl.a
1987	1.20	7.06	19.20	11	CSLAP Chl.a
Year	Min	Avg	Max	N	Parameter
1992-02	**1**	**1.1**	**2**	**10**	**QA**
2002	1	1.1	2	8	QA
1992	1	1.0	1	2	QA

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

Year	Min	Avg	Max	N	Parameter
1992-02	**1**	**1.4**	**2**	**10**	**QB**
2002	1	1.5	2	8	QB
1992	1	1.0	1	2	QB
Year	Min	Avg	Max	N	Parameter
1992-02	**1**	**1.1**	**2**	**10**	**QC**
2002	1	1.1	2	8	QC
1992	1	1.0	1	2	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 Oquaga Lake

Eutrophication Indicators

Parameter	Year	Minimum	Average	Maximum
Zsd	2002	5.45	8.49	12.30
(meters)	All Years	1.75	5.59	12.30
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Phosphorus	2002	0.003	0.005	0.007
(mg/l)	All Years	0.003	0.007	0.014
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Chl.a	2002	0.41	0.80	1.25
(µg/l)	All Years	0.41	3.9	23.8

Parameter	Year	Was 2002 Clarity the Highest or Lowest on Record?	Was 2002 a Typical Year?	Trophic Category	Zsd Changing?	% Samples Violating DOH Beach Std?+
Zsd	2002	Highest at Times	Higher than Normal	Oligotrophic	No	0
(meters)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2002 TP the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**Trophic Category**	**TP Changing?**	**% Samples Exceeding TP Guidance Value**
Phosphorus	2002	Within Normal Range	No	Oligotrophic	No	0
(mg/l)	All Years			Oligotrophic		0
Parameter	**Year**	**Was 2002 Algae the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**Trophic Category**	**Chl.a Changing?**	
Chl.a	2002	Lowest at Times	Yes	Oligotrophic	No	
(µg/l)	All Years			Mesotrophic		

+- 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 CSLAP data in 2002 showed that Oquaga Lake exhibited characteristics of a highly unproductive (oligotrophic) lake. In fact, water clarity was the highest, and phosphorus and algae levels were among the lowest recorded since CSLAP sampling began in 1987. This suggests that the lake is "improving", at least as it relates to most standard measures of water quality, although additional data will be required before a trend can be verified. There does not appear to be a moderately strong correlation among the trophic indicators, although it is likely that changes in phosphorus concentrations cause changes in chlorophyll levels, which will result in shifts in water transparency. As such, it is likely that lake management activities instituted to maintain or improve water transparency will necessarily have to address nutrient loading to and algal densities within the lake. There also does not appear to be a strong seasonal pattern among these indicators; with the deepwater data, this suggests that internal nutrient release is probably not significant (nutrient enriched deepwater would mix with surface water when the lake turns over in the late summer and fall). At no time have phosphorus readings exceeded the state phosphorus guidance value at Oquaga Lake, and as a result water transparency readings have at all times exceeded the minimum recommended water clarity for (siting) swimming beaches.

TABLE 2- Present Year and Historical Data Summaries for Oquaga Lake (cont)
Other Water Quality Indicators

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Nitrate	2002	0.00	0.01	0.01
(mg/l)	All Years	0.00	0.01	0.18
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
NH4	2002	0.01	0.04	0.06
(mg/l)	All Years	0.01	0.04	0.06
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
TDN	2002	0.26	0.37	0.53
(mg/l)	All Years	0.26	0.37	0.53
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
True Color	2002	2	5	9
(ptu)	All Years	1	5	45
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
pH	2002	6.90	7.31	7.52
(std units)	All Years	6.33	7.36	8.06
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Conductivity	2002	72	73	74
(µmho/cm)	All Years	53	60	79
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
Calcium	2002	0		0
(mg/l)	All Years	0		0

+- NYS Nitrate standard = 10 mg/l
+- NYS pH standard- 6.5 < acceptable pH < 8.5

***- These data suggest Oquaga Lake is a weakly colored, circumneutral (near neutral pH) lake with mostly undetectable nitrate levels and soft water, mostly typical of other lakes in the area. Water color readings are not high enough to influence water transparency, even when algal densities are very low (as in 2002). Nitrogen levels, primarily organic nitrogen, are sufficiently high that it appears that phosphorus controls algae growth (nitrogen to phosphorus ratios exceed 25 at nearly all times), although overall nitrogen levels are low. Nitrate levels are mostly undetectable, and neither nitrate nor ammonia appear to represent a threat to water quality. Conductivity readings may be increasing, although additional data will be required to fully evaluate any changes. pH readings consistently fall within the state water quality standards (= 6.5 to 8.5), and are not likely to change in at least the near future.**

TABLE 2- Present Year and Historical Data Summaries for Oquaga Lake (cont)
Other Water Quality Indicators (cont)

Parameter	**Year**	**Was 2002 Nitrate the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**Nitrate High?**	**Nitrate Changing?**	**% Samples Exceeding NO3 Standard**	
Nitrate	2002	Lowest at Times	Yes	No	No	0	
(mg/l)	All Years			No		0	
Parameter	**Year**	**Was 2002 NH4 the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**NH4 High?**	**NH4 Changing?**		
NH4	2002	Both Highest and Lowest at Times	Yes	No	No		
(mg/l)	All Years			No			
Parameter	**Year**	**Was 2002 TDN the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**TDN High?**	**TDN Changing?**	**Ratios of TN/TP Indicate P or N Limitation?**	
TDN	2002	Both Highest and Lowest at Times	Yes	No	No	P Limitation	
(mg/l)	All Years			No		P Limitation	
Parameter	**Year**	**Was 2002 Color the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**Colored Lake?**	**Color Changing?**		
True Color	2002	Within Normal Range	Yes	No	No		
(ptu)	All Years			No			
Parameter	**Year**	**Was 2002 pH the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**	**Acceptable Range?**	**pH Changing?**	**% Samples > Upper pH Standard**	**% Samples < Lower pH Standard**
pH	2002	Within Normal Range	Yes	Yes	No	0	0
(std units)	All Years			Yes		0	2
Parameter	**Year**	**Was 2002 Conductivity Highest or Lowest on Record?**	**Was 2002 a Typical Year?**		**Conduct. Changing?**		
Conductivity	2002	Within Normal Range	Higher than Normal		No		
(µmho/cm)	All Years						
Parameter	**Year**	**Was 2002 Calcium Highest or Lowest on Record?**	**Was 2002 a Typical Year?**		**Calcium Changing?**		
Calcium	2002	Both Highest and Lowest at Times	#		No		
(µmho/cm)	All Years						

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

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

Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QA	2002	1	1.1	2
(Clarity)	All Years	1	1.1	2
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QB	2002	1	1.5	2
(Plants)	All Years	1	1.4	2
Parameter	**Year**	**Minimum**	**Average**	**Maximum**
QC	2002	1	1.1	2
(Recreation)	All Years	1	1.1	2

Parameter	**Year**	**Was 2002 Clarity the Highest or Lowest on Record?**	**Was 2002 a Typical Year?**		**Clarity Changed?**
QA	2002	Highest and Lowest	Yes		No
(Clarity)	All Years				
Parameter	**Year**	**Was 2002 Weed Growth the Heaviest on Record?**	**Was 2002 a Typical Year?**		**Weeds Changed?**
QB	2002	Heaviest and Lightest	Yes		No
(Plants)	All Years				
Parameter	**Year**	**Was 2002 Recreation the Best or Worst on Record?**	**Was 2002 a Typical Year?**		**Recreation Changed?**
QC	2002	Both Best and Worst at Times	Yes		No
(Recreation)	All Years				

-Recreational assessments of Oquaga Lake continue to be highly favorable and consistent with the water quality conditions in the lake. The lake is most often described as “could not be nicer” for most recreational uses, an assessment that is consistent with both the measured water clarity and a lake that is described as “crystal clear” during the majority of the summer. Rooted aquatic plants do not grow to the lake surface, and are usually visible from the lake surface only in late summer. At no times do either macrophytes (weeds) or water quality problems appear to adversely affect the recreational suitability of the lake, which has remains consistently favorable throughout the sampling season.

How Do the 2002 Seasonal Data Compare to Historical Seasonal Data?

Seasonal Comparison of Eutrophication and Lake Perception Indicators–2002 Sampling Season and in the Typical Sampling Season at Oquaga Lake

Figures 4 and 5 compare data for the measured eutrophication parameters for Oquaga Lake in 2002 and since CSLAP sampling began at Oquaga Lake. Figures 6 and 7 compare volunteer perception responses over the same time periods.

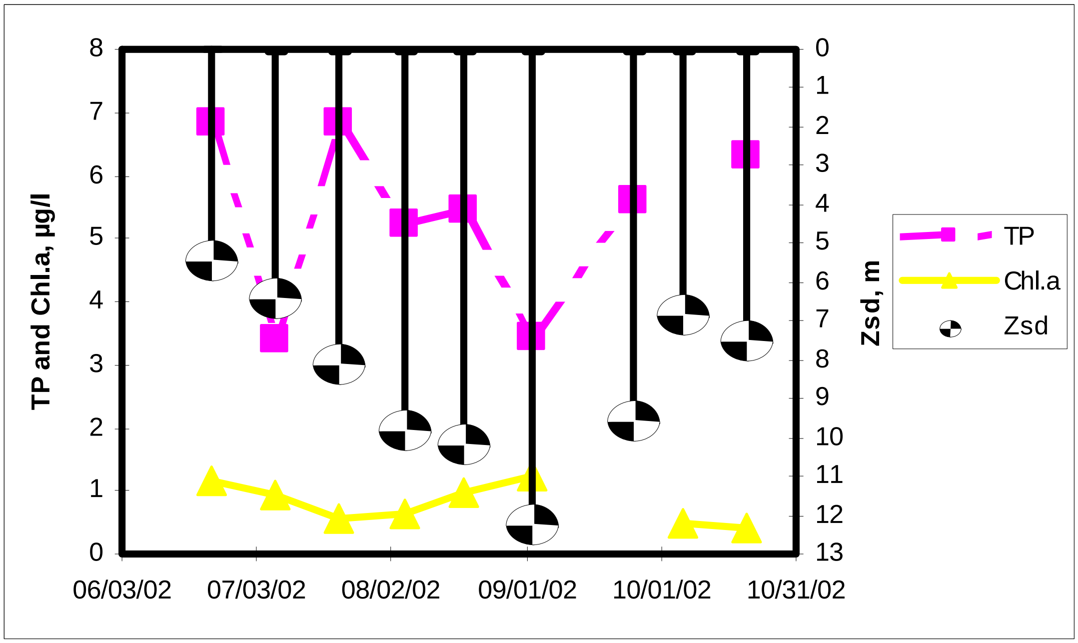

Figure 4. 2002 Eutrophication Data for Oquaga Lake

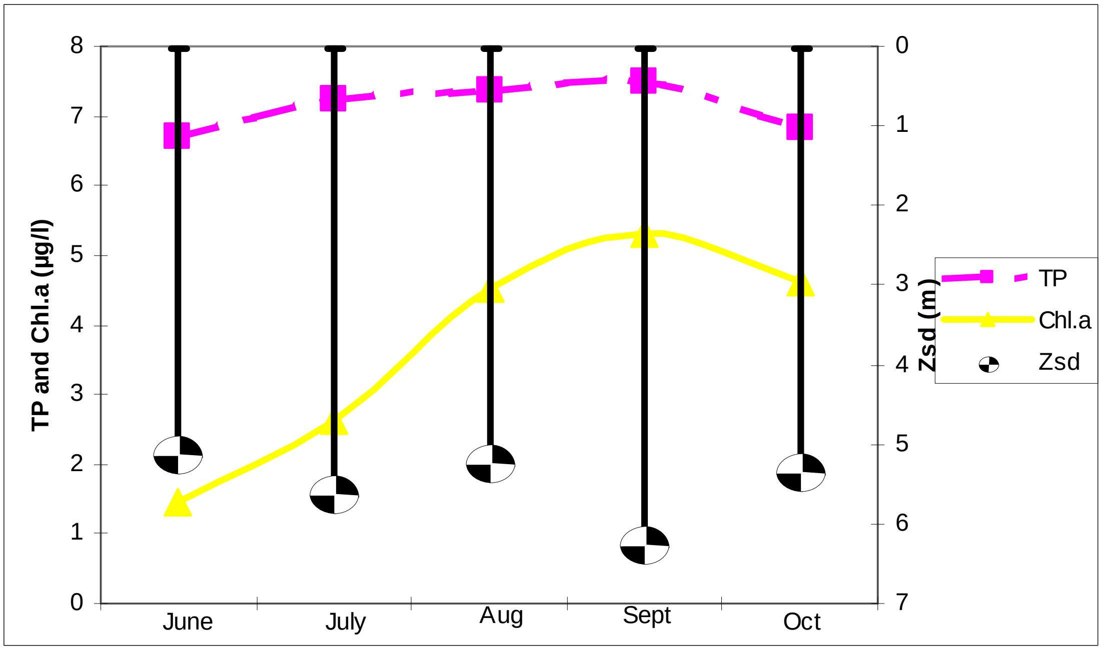

Figure 5- Eutrophication Data in a Typical (Monthly Mean) Year for Oquaga Lake

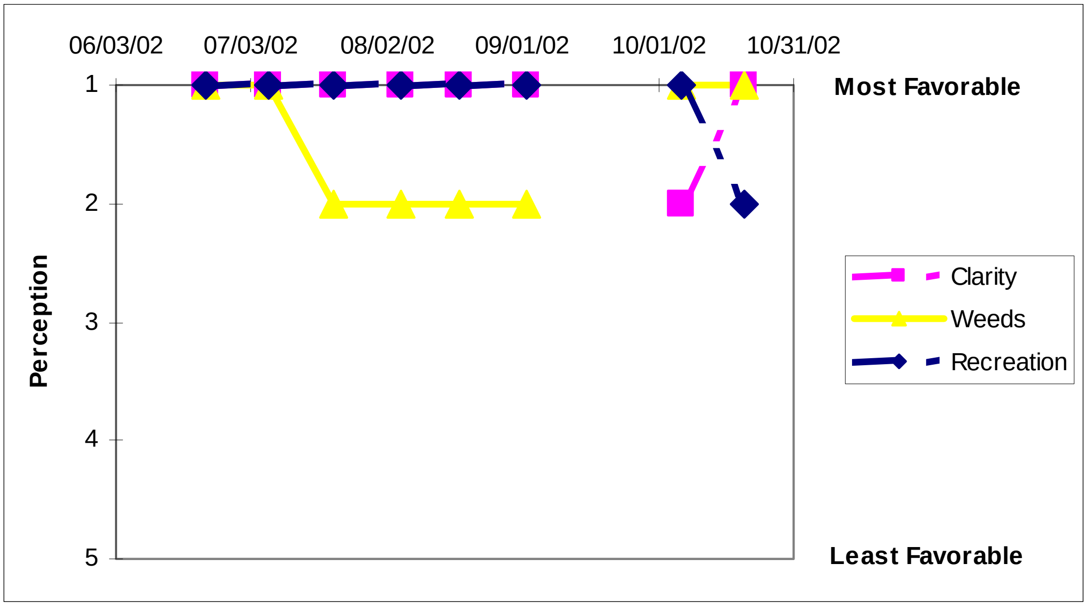

Figure 6. 2002 Lake Perception Data for Oquaga Lake

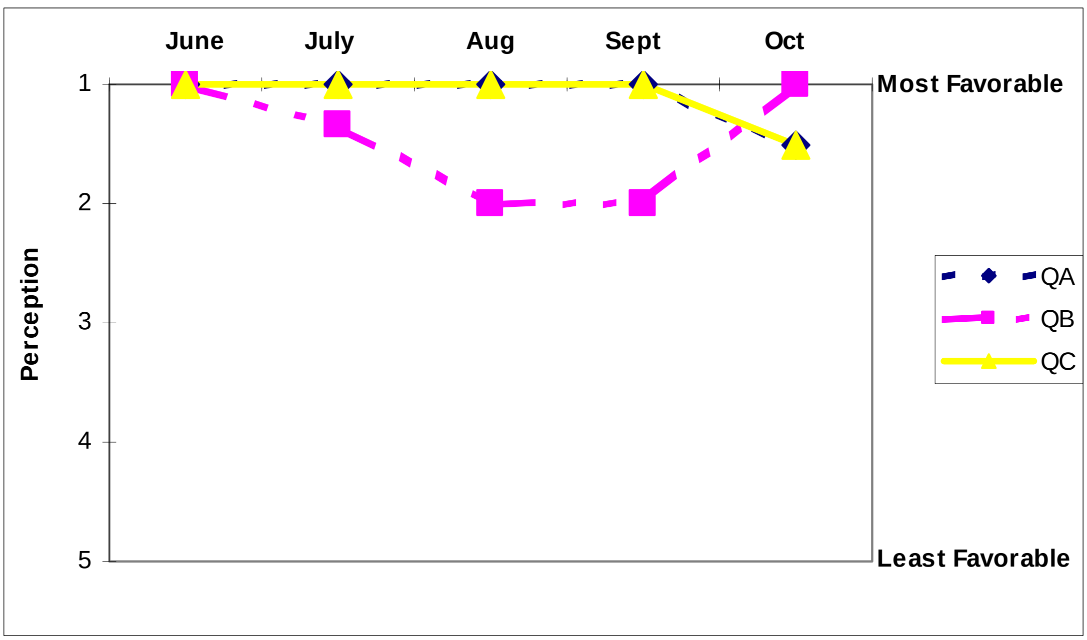

Figure 7- Lake Perception Data in a Typical (Monthly Mean) Year for Oquaga Lake

(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 Oquaga Lake compare to other lakes?

Annual Comparison of Median Readings for Eutrophication Parameters and Recreational Assessment For Oquaga Lake in 2002, 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 Oquaga Lake-in 2002, 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 Oquaga Lake in 2002:

a) Using water clarity as an indicator, Oquaga Lake was less productive than other lakes in the Delaware River drainage basin, other lakes with the same water quality classification (Class AA), and other CSLAP lakes.

b) Using chlorophyll *a* concentrations as an indicator, Oquaga Lake was less productive than other Class AA, Delaware River drainage basin, and other CSLAP lakes.

c) Using total phosphorus concentrations as an indicator, Oquaga Lake was less productive than other CSLAP lakes, other Class AA lakes, and other Delaware River basin lakes

d) Using QC on the field observations form as an indicator, Oquaga Lake was about as suitable for recreation as other Class AA and Delaware River basin lakes, and more suitable for recreation than the typical CSLAP lake.

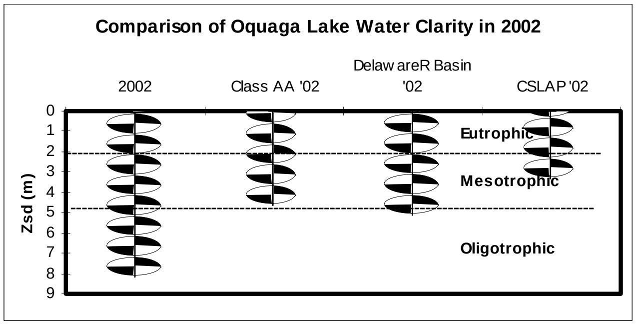

Figure 8. *Comparison of 2002 Secchi Disk Transparency to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2002*

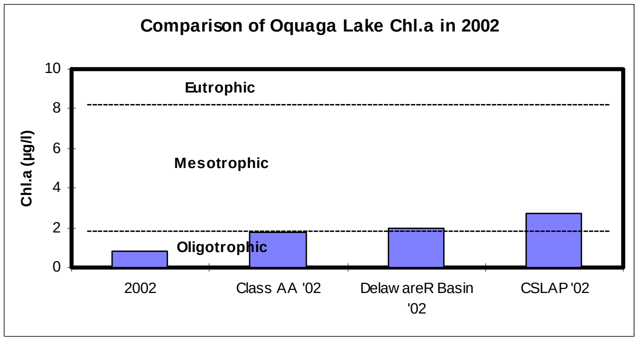

Figure 9. *Comparison of 2002 Chlorophyll a to Lakes with the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2002*

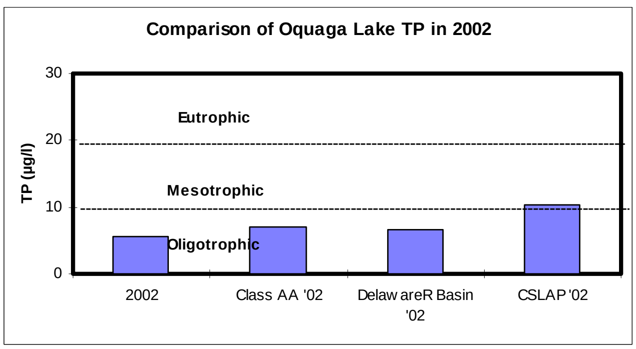

Figure 10. *Comparison of 2002 Total Phosphorus to Lakes With the Same Water Quality Classification, Neighboring Lakes, and Other CSLAP Lakes in 2002*

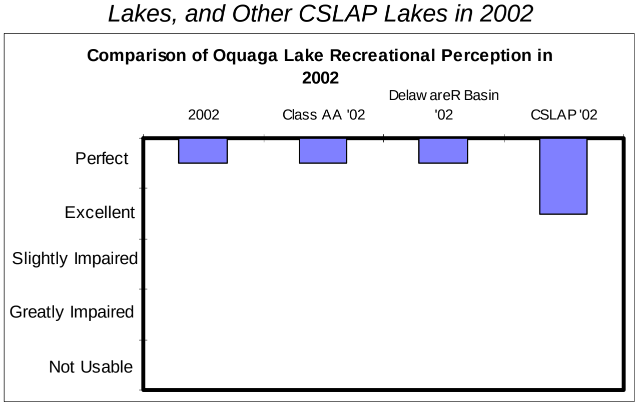

Figure 11. *Comparison of 2002 Recreational Perception*

V: PRIORITY WATERBODY AND IMPAIRED WATERS LIST

The Priority Waterbody List (PWL) is presently an inventory of all waters in New York State 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 waters 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.

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
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 standard; it strictly applies to Class B and higher waters, but may be appropriate for other waterbodies used for contact recreation (swimming). NYS (and the 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

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 fell below the lower water quality standard (=6.5) during one sampling session from 1989 to 2002 (in 1988), and in none of the sampling sessions in 2002. The phosphorus guidance value for NYS lakes (=0.020 mg/l) has not been exceeded during any CSLAP sampling sessions at Oquaga Lake, and as a result, water transparency readings have exceeded the minimum recommended water clarity for swimming beaches (= 1.2 meters) during each of the CSLAP sampling sessions. It is not known if any of the narrative water quality standards listed in Table 3 have been violated at Oquaga Lake.

Oquaga Lake is not presently among the lakes listed on the PWL. The CSLAP dataset, including water chemistry data, physical measurements, and volunteer samplers' perception data, suggest that no listings appear to be warranted. Based on these data, it is likely that the next generation of the PWL will identify Oquaga Lake as an "assessed" waterbody with no impairments. However, additional data will be required to fully evaluate any use impairments or water quality problems on Oquaga Lake. The next Delaware River basin PWL evaluation will likely occur by 2006.

VI: 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.

<u>GENERAL CONSIDERATIONS FOR ALL CSLAP LAKES</u>

<u>Nutrient controls</u> 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 OQUAGA LAKE

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

Issue	Through	By?
Maintain water clarity	Maintaining or reducing algae levels	Maintaining or reducing nutrient Inputs to the lake

Discussion:
User perception and water quality data indicate that water clarity readings are sufficient to support most uses of the lake. This places the focus of water clarity management on maintaining present conditions. Although some increase in nutrient loading is inevitable, the lake association should devote efforts to minimize the input of nutrients to the lake, or change activities that otherwise influence water clarity.

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

Issue	Effect on Lake Use
Low weed growth	**No use impairments associated with weed growth**

Discussion:
Weed growth in this lake is not dense enough to have an impact on recreational or aesthetic quality of the lake For many lake associations, this is the ideal situation, although an ideal condition for swimmers, boaters and lakefront residents may not be ideal for a significant sports fishery. For lakes in this condition, lake management is largely a task of maintaining course, of keeping nuisance plants out of the lake.

-*If you have a small amount of nuisance plant growth you may want to consider the following (consult the DEC Region 7 office to determine if permits are required for either of these activities within your lake):*

-*Hand harvesting* is a very labor-intensive means for controlling weed populations. If only a very small number of nuisance plant stems exist, this may be the best means of control, removing the roots and stems of the entire plant, and disposing properly before they propagate into larger, uncontrollable beds that become the obnoxious neighbors of beneficial native plants.

-*Benthic barriers* are small opaque mats (usually constructed from plastic, burlap, or other materials) anchored down on top of plants to prevent sunlight from reaching the plants, thus eventually killing the plants. These are limited to only small areas, and the mats must be anchored and perforated to prevent gas bubbles from dislodging the mats.

Appendix A. Raw Data for Oquaga Lake

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TKN	TN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
30	Oquaga L	6/13/87	30.0	3.63	1.5	0.005	0.02				8	7.15	55		
30	Oquaga L	6/21/87	30.0	5.75	1.5	0.007	0.02				9	7.16	54		1.20
30	Oquaga L	7/5/87	30.0	5.25	1.5	0.009	0.01				5	7.08	54		2.70
30	Oquaga L	7/11/87	30.0	5.75	1.5	0.006	0.01				2	7.04	54		
30	Oquaga L	7/19/87	27.0	5.50	1.5	0.003	0.01				6	7.07	54		2.70
30	Oquaga L	7/26/87	30.0	3.88	1.5	0.006	0.01				5	6.95	54		6.40
30	Oquaga L	8/3/87	30.0	2.75	1.5	0.009	0.01				5	6.88	55		19.20
30	Oquaga L	8/10/87	30.0	3.38	1.5	0.008	0.01				5	6.85	55		14.40
30	Oquaga L	8/17/87	30.0	5.25	1.5	0.005	0.01				6	7.13	56		1.70
30	Oquaga L	8/23/87	30.0	5.25	1.5	0.005	0.01				4	7.07	53		3.90
30	Oquaga L	8/30/87	30.0	4.50	1.5	0.005	0.01				6	7.49	53		
30	Oquaga L	9/7/87	30.0	5.25	1.5	0.012	0.18				3	7.16	56		9.90
30	Oquaga L	9/16/87	30.0	6.00	1.5	0.005	0.02				2	7.39	63		5.00
30	Oquaga L	10/10/87	30.0	4.25	1.5	0.007	0.01				6	7.11	54		10.60
30	Oquaga L	10/23/87	30.0	4.63	1.5										
30	Oquaga L	7/1/88	30.0	5.75	1.5	0.007	0.01				5	6.33	61		3.25
30	Oquaga L	7/13/88	30.0	6.50	1.5	0.009					4	8.06	66		4.66
30	Oquaga L	7/21/88	30.0	5.00	1.5	0.011	0.01				5	7.39	57		2.74
30	Oquaga L	7/28/88	30.0	6.25	1.5	0.006					5	7.55	57		1.06
30	Oquaga L	8/4/88	30.0	6.00	1.5	0.005	0.01				3	7.98	60		1.37
30	Oquaga L	8/11/88	30.0	5.50	1.5	0.006					8				1.63
30	Oquaga L	8/18/88	30.0	5.50	1.5	0.006	0.01				7	7.14	56		2.07
30	Oquaga L	8/25/88	30.0	4.75	1.5	0.006					7				2.15
30	Oquaga L	9/2/88	30.0	5.50	1.5	0.008	0.01				3	7.78	57		2.00
30	Oquaga L	9/15/88	30.0	5.75	1.5	0.005	0.01				3	7.62	60		3.18
30	Oquaga L	7/10/89	30.0	4.88	1.5	0.005	0.01				3	7.85	57		2.33
30	Oquaga L	8/2/89	30.0	4.25	1.5	0.007					2	7.40	58		1.20
30	Oquaga L	8/9/89	30.0	4.25	1.5	0.009					2	7.89	55		
30	Oquaga L	8/19/89	30.0	5.25	1.5	0.010	0.01				4	7.83	56		0.43
30	Oquaga L	8/26/89	30.0	5.13	1.5	0.013					2	7.44			2.22
30	Oquaga L	9/4/89	30.0	4.75	1.5	0.008					2	7.36	56		4.11
30	Oquaga L	9/13/89	30.0	5.63	1.5	0.007	0.01				2	7.54	58		3.05
30	Oquaga L	7/14/90	30.0	4.25	1.5	0.011	0.01				5	7.23	64		3.01
30	Oquaga L	7/20/90	30.0	5.25	1.5	0.007					3	7.54	57		0.63
30	Oquaga L	8/3/90	30.0	5.25	1.5	0.008	0.01				1	7.89	56		2.08
30	Oquaga L	8/20/90	30.0	5.75	1.5	0.006					3	7.29	79		2.43
30	Oquaga L	9/1/90	30.0	6.25	1.5	0.004	0.01				2	6.60	57		1.34
30	Oquaga L	9/11/90	30.0	6.50	1.5	0.012					1	6.75	57		2.21
30	Oquaga L	9/27/90	30.0	6.25	1.5	0.008	0.01				3	7.74	57		2.75
30	Oquaga L	7/1/91	30.0	6.50	1.5	0.008	0.01				2	7.61	59		1.26
30	Oquaga L	7/15/91	30.0	6.25	1.5	0.007					3	7.52	59		2.41
30	Oquaga L	7/28/91	30.0	5.75	1.5	0.007	0.01				2	7.63	57		2.90
30	Oquaga L	8/13/91	30.0	4.50	1.5	0.010					2	7.29	58		6.88
30	Oquaga L	8/26/91	30.0	2.75	1.5	0.011	0.01				4	6.95	58		13.40
30	Oquaga L	9/9/91	30.0	1.75	1.5	0.012					45	7.60	59		23.80
30	Oquaga L	6/25/92	30.0	5.75	1.5	0.008					2	7.69	60		1.98
30	Oquaga L	7/24/92	30.0	4.45	1.5	0.011					4	7.75	59		4.48
30	Oquaga L	10/4/92	30.0	3.50	1.5	0.014	0.01				5	7.68	60		6.97
30	Oquaga L	06/23/02	16.0	5.45	1.5	0.007	0.00	0.02	0.40	58.90	8	7.52	72		1.17
30	Oquaga L	07/07/02	30.0	6.45	1.5	0.003	0.00	0.05	0.26	75.25	9				0.95
30	Oquaga L	07/21/02	30.0	8.15	1.5	0.007	0.01	0.05	0.29	42.60	6	7.47	73		0.56
30	Oquaga L	08/05/02	30.0	9.85	1.5	0.005	0.00	0.06	0.40	76.56	3	7.37	73		0.64
30	Oquaga L	08/18/02	30.0	10.20	1.5	0.005	0.01	0.03	0.40	74.42	3	6.90	74		0.97
30	Oquaga L	09/02/02	30.0	12.30	1.5	0.003	0.00	0.01	0.37	108.34	2	7.21	74		1.25

LNum	PName	Date	Zbot	Zsd	Zsamp	Tot.P	NO3	TKN	TN	TN/TP	TColor	pH	Cond25	Ca	Chl.a
30	Oquaga L	09/25/02	26.0	9.58		0.006	0.00	0.02	0.53	94.04					
30	Oquaga L	10/06/02		6.85			0.01	0.03	0.26		7	7.46	73		0.48
30	Oquaga L	10/20/02	30.0	7.55		0.006	0.01	0.05	0.37	58.59	5	7.26	72		0.41
30	Oquaga L	06/23/02	16.0			0.008	0.01	0.02	0.39	46.14					
30	Oquaga L	07/07/02	30.0			0.006	0.00	0.04	0.29	48.10					
30	Oquaga L	07/21/02	30.0			0.017	0.01	0.08	0.48	28.53					
30	Oquaga L	08/05/02	30.0			0.008	0.00	0.04	0.39	48.65					2.58
30	Oquaga L	08/18/02	30.0			0.007	0.02	0.04	0.46	65.00					
30	Oquaga L	09/02/02	30.0	8.15			0.00	0.01	0.37						
30	Oquaga L	09/25/02	26.0	9.58	24.0	0.008	0.00	0.04	0.37	46.20					
30	Oquaga L	10/06/02		6.85	20.0		0.01	0.05	0.34						
30	Oquaga L	10/20/02	30.0	7.55	15.0		0.01	0.05	0.33						

LNum	PName	Date	TAir	TH20	QA	QB	QC	QD
30	Oquaga L	6/13/87	23	19				
30	Oquaga L	6/21/87	21	23				
30	Oquaga L	7/5/87	24	23				
30	Oquaga L	7/11/87	85	78				
30	Oquaga L	7/19/87	29	25				
30	Oquaga L	7/26/87	30	26				
30	Oquaga L	8/3/87	25	24				
30	Oquaga L	8/10/87	25	24				
30	Oquaga L	8/17/87	29	26				
30	Oquaga L	8/23/87	16	23				
30	Oquaga L	8/30/87	26	19				
30	Oquaga L	9/7/87	22	18				
30	Oquaga L	9/16/87	22	19				
30	Oquaga L	10/10/87	13	14				
30	Oquaga L	10/23/87	17	12				
30	Oquaga L	7/1/88	19	17				
30	Oquaga L	7/13/88	28	24				
30	Oquaga L	7/21/88	18	23				
30	Oquaga L	7/28/88	26	24				
30	Oquaga L	8/4/88	25	26				
30	Oquaga L	8/11/88	27	25				
30	Oquaga L	8/18/88	21	23				
30	Oquaga L	8/25/88	20	21				
30	Oquaga L	9/2/88	23	21				
30	Oquaga L	9/15/88	14	16				
30	Oquaga L	7/10/89	20	22				
30	Oquaga L	8/2/89	22	24				
30	Oquaga L	8/9/89	20	20				
30	Oquaga L	8/19/89	21	24				
30	Oquaga L	8/26/89	21	21				
30	Oquaga L	9/4/89	18	20				
30	Oquaga L	9/13/89	21	21				
30	Oquaga L	7/14/90						
30	Oquaga L	7/20/90	30	25				
30	Oquaga L	8/3/90	27	24				
30	Oquaga L	8/20/90	15	21				
30	Oquaga L	9/1/90	25	23				
30	Oquaga L	9/11/90	20	21				
30	Oquaga L	9/27/90	21	13				
30	Oquaga L	7/1/91	18	26				
30	Oquaga L	7/15/91	25	22				
30	Oquaga L	7/28/91	23	24				

LNum	PName	Date	TAir	TH20	QA	QB	QC	QD
30	Oquaga L	8/13/91	24	23				
30	Oquaga L	8/26/91	18	23				
30	Oquaga L	9/9/91	20	22				
30	Oquaga L	6/25/92	23	19	1	1	1	
30	Oquaga L	7/24/92	17	20	1	1	1	5
30	Oquaga L	10/4/92	19	16				
30	Oquaga L	06/23/02	20	17	1	1	1	
30	Oquaga L	07/07/02	25	19	1	1	1	
30	Oquaga L	07/21/02	25	22	1	2	1	
30	Oquaga L	08/05/02	22	24	1	2	1	
30	Oquaga L	08/18/02	24		1	2	1	
30	Oquaga L	09/02/02	23	22	1	2	1	
30	Oquaga L	09/25/02	13					
30	Oquaga L	10/06/02	16		2	1	1	5
30	Oquaga L	10/20/02	10		1	1	2	5
30	Oquaga L	06/23/02	20					
30	Oquaga L	07/07/02	25					
30	Oquaga L	07/21/02	25					
30	Oquaga L	08/05/02	22					
30	Oquaga L	08/18/02	24					
30	Oquaga L	09/02/02	23	10				
30	Oquaga L	09/25/02	13	14				
30	Oquaga L	10/06/02	16	9				
30	Oquaga L	10/20/02	10	55				

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 INFO FOR OQUAGA LAKE

CSLAP Number	30
Lake Name	Oquaga L
First CSLAP Year	1987
Sampled in 2002?	yes
Latitude	420111
Longitude	752714
Elevation (m)	479
Area (ha)	54.4
Volume Code	9
Volume Code Name	Delaware River
Pond Number	383
Qualifier	none
Water Quality Classification	AA
County	Broome
Town	Deposit
Watershed Area (ha)	630
Retention Time (years)	3.3
Mean Depth (m)	13.9
Runoff (m/yr)	0.363713324
Watershed Number	14
Watershed Name	Delaware River
NOAA Section	2
Closest NOAA Station	Deposit
Closest USGS Gaging Station-Number	1426500
Closest USGS Gaging Station-Name	West Branch Delaware River at Hale Eddy
CSLAP Lakes in Watershed	Anawanda L, Crystal L, L Guymard, L Wanaksink, Oquaga L, Somerset L, Wolf L