A Study of the Effectiveness, Longevity, and Ecological Impacts of Hypolimnetic Aluminum Injection in Kezar Lake, North Sutton, New Hampshire

Phase III Report
March 2000

NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

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March 2000

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March 2000

Warren K. Howard
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Dear Mr. Howard:

Transmitted herewith is the Phase III Kezar Lake monitoring project entitled, *"A Study of the Effectiveness, Longevity, and Ecological Impacts of Hypolimnetic Aluminum Injection in Kezar Lake, North Sutton, New Hampshire."* This report was prepared, in part, under the Clean Water Act, through a Section 314 Environmental Protection Agency Grant. This report culminates over 19 years of pre- and post treatment monitoring, and evaluates the effectiveness, longevity, and ecological impacts of sediment inactivation for reclaiming eutrophic lakes.

Kezar Lake is a significant public waterbody for the western section of the state, supplying a moderately sized state park managed by the Department of Resources and Economic Development, many seasonal and year round homes, and a public access to the lake. A vast amount of recreational opportunities are available to the public through Kezar Lake and its surrounding watershed. Thus, there is a strong commitment by the state of New Hampshire to manage the Kezar Lake watershed and protect the lake quality to sustain its ecological, recreational, and economical value.

This project is the first Phase III monitoring project in New Hampshire. It has provided a worldwide scientific community with a vast wealth of information on the new technologies that may provide reclamation to our nations waterbodies. With an expanding population and a greater demand for freshwater, watershed management and lake reclamation have become important tools that supply clean water for a vast array of competitive uses.

The 19 years of accumulated monitoring data reflect that watershed management and hypolimnetic aluminum salts injection are viable techniques to improve lake quality. Many recent New England studies have demonstrated that increased lake clarity results in a greater net worth of the property surrounding that particular lake. The Kezar Lake project has demonstrated that aluminum treatment and watershed management are not only cost effective, but can improve lake clarity by reducing productivity.

Once again, this study reflects the overall importance and value of the Clean Lakes Program in its efforts to protect and reclaim our nations' waters. With tourism being the second largest industry in New Hampshire and a major force in the state's economy, we are only beginning to realize how much our freshwater resources are worth. New Hampshire's clean lakes are a reminder of the natural features that reflect the scenic beauty of the state.

Respectfully submitted,

Jody Connor
Limnology Center Director

Robert W. Varney
Commissioner

TABLE OF CONTENTS

Page #

Title Page i
Letter of Transmittal iii
Table of Contents v
List of Figures ix
List of Tables xiii
List of Appendices xvii
Abstract xix
Acknowledgements xxi
Executive Summary xxiii

Chapters

I. INTRODUCTION AND HISTORICAL PERSPECTIVE I-1

II. WATERSHED CHARACTERISTICS II-1

A. Morphometry II-1
B. Climate II-1
C. Soils II-5
D. Watershed Characteristics and Land Use II-10

III. SITE DESCRIPTION, SCOPE AND METHODOLOGY III-1

A. Kezar Lake Station Locations and Descriptions III-1
B. Chadwick Meadows Station Locations and Descriptions III-1
C. Lake Sampling Procedures III-4
D. Stream Sampling Procedures III-4
E. Benthic Invertebrates III-5
F. Fish Tissue Analyses III-5
G. Sediments III-5
1. Sediment Composition III-5
2. Sediment Aluminum Release in Response to Acidification III-6
H. Aquatic Macrophytes III-6
I. Laboratory Methodology III-6
1. Chemical and Physical III-6
2. Biological III-7
J. Comparative Methodology III-7

IV. EFFECTS OF ALUMINUM SALTS ON LAKE BIOTA IV-1

A. Planktonic Community Assessment IV-2
1. Phytoplankton IV-3

2. Zooplankton IV-9
3. Chlorophyll-a and Transparency IV-12
B. Macroinvertebrates IV-15
1. Laboratory Bioassay IV-16
2. In-Situ Study IV-19
3. Bioassay Summary IV-19
4. Macroinvertebrate Aluminum Concentrations IV-20
C. Fisheries IV-21

V. EVALUATION OF TREATMENT EFFECTIVENESS AND LONGEVITY FROM HYPOLIMNETIC ALUMINUM SALTS INJECTION V-1

A. Overview V-1
B. Lake Quality Indicators V-4
1. Total Phosphorus V-4
a. Epilimnetic Phosphorus Trends V-4
b. Hypolimnetic Phosphorus Trends V-7
2. Dissolved Oxygen Trends V-10
3. Chlorophyll-a Trends V-14
4. Secchi Disk Transparency Trends V-18
5. Fate of Aluminum V-22

VI. HYDROLOGIC BUDGET VI-1

A. Surface and Groundwater Hydrology VI-1
B. Field Monitoring Program VI-2
1. Kezar Lake and Chadwick Meadows Stream Gauging VI-2
2. Precipitation Monitoring VI-2
C. Hydrologic Budget VI-3
1. Components VI-3
2. Kezar Lake Hydrologic Budget (1990-91) VI-4

VII. PHOSPHORUS BUDGET VII-1

A. Development of Phosphorus Budgets VII-1
B. Field Monitoring Program VII-1
C. Phosphorus Budget Components VII-2
1. Tributary Loading and Discharge VII-2
2. Internal Phosphorus Cycling VII-2
D. Annual Phosphorus Budget for Gauging Period (1990-91) VII-4
E. Internal Loading Comparisons Between Pre-Treatment Conditions (1980-81) and Post-Treatment Conditions (1990-91) VII-8
1. Mass Balance Equation VII-8
2. Hypolimnetic Volume/Mass Measurements VII-9

VIII. CHADWICK MEADOWS WETLANDS MANAGEMENT VIII-1

A. Phosphorus Dynamics in Wetlands VIII-1
B. Chadwick Meadows Wetlands Evaluation VIII-2
C. Chadwick Meadows Wetlands Macrophyte Succession VIII-4
D. Treatment Effectiveness VIII-7
1. Wetlands Performance VIII-7
a. Introduction VIII-7
b. Surface Hydrology VIII-7
E. Phosphorus Budget and Wetland Efficiency to Assimilate Phosphorus for the 1991 Sample Season VIII-7
F. Historical Trends of Chadwick Meadows Effectiveness to Assimilate Phosphorus VIII-13

IX. TROPHIC STATUS MODELLING IX-1

A. Introduction IX-1
B. Trophic Classification Schemes IX-1
1. State of New Hampshire Trophic Classification System IX-1
2. Carlson's Trophic Index IX-7
3. Dillon/Rigler Permissible Loading Model IX-10
4. Vollenweider Phosphorus Loading and Surface Overflow Rate Relationship IX-13
C. Trophic Classification Summary IX-15

BIBLIOGRAPHY ..... B-1 to B-4

APPENDICES ..... A-1 to A-112

LIST OF FIGURES

FIGURE #	DESCRIPTION	PAGE #
Figure I-1	Phosphorus Loading to Kezar Lake	I-9
Figure II-1	Bathymetric Map Showing Lake Outline and 4-Foot Contours	II-2
Figure II-2	Kezar Lake Watershed Featuring Roadways, Waterbodies and Tributaries	II-3
Figure II-3	General Soils Map for the Kezar Lake Watershed	II-6
Figure II-4	Soil Limitations for Septic Systems in the Kezar Lake Watershed	II-8
Figure II-5	Kezar Lake Watershed Soil Erodibility	II-9
Figure II-6	Base Map Features in the Kezar Lake Watershed	II-11
Figure II-7	Land Cover in the Kezar Lake Watershed	II-12
Figure III-1	Sample Stations for the Phase III Study Designated as Numbers 1 through 8	III-2
Figure IV-1	Pre-Aluminum Salts Injection- Mean Monthly Phytoplankton Relative Percent Values (1967-1982)	IV-4
Figure IV-2	Post-Aluminum Salts Injection- Mean Monthly Phytoplankton Relative Percent Values (July 1983-1999)	IV-7
Figure IV-3	Algal Dominance as Mean Annual Relative %	IV-8
Figure IV-4	Zooplankton Dominance as Mean Annual Relative %	IV-12
Figure IV-5	The Relationship Between Mean Monthly Chlorophyll-a Concentrations (mg/m^3) Before and After Aluminum Salts Injection	IV-14
Figure IV-6	A Comparison of Pre- and Post-Treatment Mean Monthly Transparency (m) in Kezar Lake, North Sutton	IV-15
Figure IV-7	A Comparison of Aluminum Concentrations in Invertebrates Collected at Kezar Lake and Various Reference Lakes	IV-21

FIGURE #	DESCRIPTION	PAGE #
Figure IV-8	A Comparison of Mean Aluminum Concentration in Whole Fish Studies Collected at Various Ponds	IV-23
Figure IV-9	A Comparison of Mean Aluminum Accumulation in Various Fish Organs/Portions Collected from Multiple Waterbodies	IV-24
Figure IV-10	A Comparison of Aluminum Concentration in Gills of Fish Collected at Kezar Lake and Reference Lakes	IV-25
Figure IV-11	A Comparison of Aluminum Concentrations in Fish Livers from Seven Area Lakes	IV-26
Figure IV-12	Kezar Lake Aquatic Plant Distribution, 6/25/79 and 8/17/93	IV-27
Figure V-1	Long-Term Epilimnetic Phosphorus Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire	V-5
Figure V-2	Long-Term Hypolimnetic Phosphorus Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire	V-8
Figure V-3	Dissolved Oxygen Isopleths for Kezar Lake, North Sutton, New Hampshire (mg/L)	V-11
Figure V-4	Results from the Effect of Aluminum Salts on Biochemical Oxygen Demand	V-15
Figure V-5	Long-Term Chlorophyll-a Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire	V-16
Figure V-6	Long-Term Transparency Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire	V-19
Figure V-7	Wadleigh State Park Attendance and Spring and Summer Precipitation Data	V-21
Figure V-8	Total Dissolved Aluminum Values for Various Kezar Lake Sample Stations	V-22
Figure VI-1	Total Inflow and Wetfall Contributions to Kezar Lake for 1990-91 Phase III	VI-6
Figure VI-2	A Comparison of Annual Tributary Inflow and Wetfall for Two Budget Years and Average Year	VI-9

FIGURE #	DESCRIPTION	PAGE #
Figure VII-1	A Comparison of Total Annual P Loading and Annual Wetfall	VII-7
Figure VII-2	A Comparison of Net Sediment Release and Uptake During the 1990-1991, 1980-1981, and Average Study Years, Respectively	VII-10
Figure VIII-1	A Comparison of Aquatic Plant Distributions at Chadwick Meadows from 1984 to 1991	VIII-3
Figure VIII-2	Chadwick Meadows Sampling Locations	VIII-7
Figure VIII-3	Relative Percent of Tributary Inflow to Chadwick Meadows	VIII-9
Figure VIII-4	Chadwick Meadows Performance for Assimilation of Phosphorus	VIII-13
Figure IX-1	Carlson's Trophic State Index	IX-8
Figure IX-2	Dillon/Rigler Trophic Status Graph Showing the Pre- and Post Results of Modeling Kezar Lake Data	IX-12
Figure IX-3	Vollenweider Phosphorus Loading and Surface Overflow Rate Relationships	IX-14

LIST OF TABLES

TABLE #	DESCRIPTION	PAGE #
Table I-1	Approximate Duration of *Aphanizomenon* Blooms and Unacceptable Water Transparencies	I-7
Table II-1	Kezar Lake Morphometry	II-1
Table II-2	Monthly Precipitation for Kezar Lake	II-4
Table II-3	Kezar Watershed Soil Properties	II-7
Table II-4	Kezar Lake Watershed Land Use	II-13
Table III-1	Sampling Site Descriptions	III-3
Table III-2	Laboratory Parameter and Method Use for Analysis	III-7
Table III-3	Sampling Stations Comparison	III-8
Table IV-1	Kezar and Reference Lake Parameters	IV-2
Table IV-2	Algal Groups and their Common Genera in Kezar Lake, North Sutton	IV-3
Table IV-3	Phytoplankton Seasonal Succession Before and After Aluminum Salts Injection	IV-5
Table IV-4	Zooplankton Groups and their Common Genera in Kezar Lake, North Sutton	IV-9
Table IV-5	Zooplankton Seasonal Succession Prior to Aluminum Salts Injection	IV-11
Table IV-6	Chlorophyll-a Categories	IV-13
Table IV-7	Bioassay Treatment Schedule	IV-17
Table IV-8	Bioassay Chemistry: Pre-Treatment	IV-17
Table IV-9	Bioassay Chemistry: Post-Treatment	IV-17
Table IV-10	Laboratory Bioassay Post Treatment Macroinvertebrate Count	IV-18
Table IV-11	In-Situ Macroinvertebrate Count from Sifting	IV-19
Table IV-12	Kezar Lake Aquatic Plant Distribution for 6/25/79 and 8/17/93	IV-28

TABLE #	DESCRIPTION	PAGE #
Table V-1	Total Dissolved Aluminum Concentration (mg/L)	V-23
Table VI-1	Kezar Lake Surface Volume Precipitation	VI-3
Table VI-2	Hydrologic Budget Equation	VI-4
Table VI-3	Kezar Lake Hydrologic Budget for Gauging Period (1990-1991)	VI-5
Table VI-4	A Comparison of Inflow and Outflow with Respect to Rainfall During the Average Year, the 1980-1981 year and the 1990-1991 Year	VI-8
Table VII-1	In-Lake Phosphorus Mass	VII-3
Table VII-2	Monthly Internal Phosphorus Cycling (1990-1991 Gauging Year)	VII-4
Table VII-3	Kezar Lake Phosphorus Budget for Gauging Period (1990-1991)	VII-5
Table VII-4	A Monthly Comparison of Phosphorus Load with Respect to Rainfall During the Average Year, the 1980-1981 Year and the 1990-1991 Year	VII-8
Table VII-5	A Comparison of Hypolimnetic Phosphorus Mass and Concentration for the Study Years 1980-1981 and 1990-1991	VII-11
Table VIII-1	Aquatic Plant Survey of Chadwick Meadows	VIII-5
Table VIII-2	Mean Monthly Hydrologic Discharge Values for Chadwick Meadows Tributaries	VIII-8
Table VIII-3	Chadwick Meadow Hydrologic Budget for Gauging Period (Dec 1990 – Nov 1991)	VIII-10
Table VIII-4	Phosphorus Import and Export from Chadwick Meadows for 1991	VIII-11
Table IX-1	Original Trophic Classification System for New Hampshire Lakes and Ponds	IX-3
Table IX-2	Trophic Classification Systems for New Hampshire Lakes and Ponds, Revised 1989	IX-4
Table IX-3	Trophic Classification of Kezar Lake Using Original Classification Methods	IX-5

TABLE #	DESCRIPTION	PAGE #
Table IX-4	Trophic Classification of Kezar Lake Using 1989 Revised Classification Methods	IX-6
Table IX-5	Carlson Trophic Classification for Kezar Lake	IX-9
Table IX-6	Dillon/Rigler Permissible Loading Tolerance	IX-10
Table IX-7	Dillon/Rigler Trophic Status Calculations for Kezar Lake in 1991	IX-11
Table IX-8	Vollenweider Phosphorus Concentration Prediction	IX-13
Table IX-9	Kezar Lake Trophic Classification Summary	IX-15

LIST OF APPENDICES

Appendix #	Description
1	Kezar Lake Study- Raw Data
2	Monthly Wetfall Data from Manchester Water Works
3	Kezar Lake Sediment Core Data
4	Raw Plankton Data for Kezar Lake, North Sutton, New Hampshire
5	Raw Fish Data from Aluminum Analyses
6	Stage/Discharge Relationships for Kezar Lake, North Sutton, New Hampshire

ABSTRACT

The effectiveness and longevity of hypolimnetic aluminum salts treatment were evaluated at Kezar Lake, North Sutton, New Hampshire. Effectiveness was judged by comparing pre- and post-treatment lake quality data over a 19-year period (1980-1999). Lake parameters in which trends were analyzed include epilimnetic phosphorus, hypolimnetic phosphorus, hypolimnetic dissolved oxygen, chlorophyll-a and transparency. Hydrologic and phosphorus budgets were compared prior to and after the treatment. Seasonal rainfall over the 19-year study period was compared to mean summer epilimnetic phosphorus to determine the relationship between rainfall and lake quality.

Chadwick Meadows, once a shallow, natural wetland artificially dammed to increase the depth for macrophyte nutrient uptake, was monitored for its role in decreasing the watershed phosphorus load to the lake.

Several trophic state models were compared to determine if the treatment yielded improvements in trophic indices. Models are important because they use a series of parameters rather than comparing single lake quality parameters.

The data reflect that the lake may have gone through an equilibration period or was influenced by watershed runoff two and three years after treatment, but recovered and has shown highly stable trends in phosphorus, productivity and transparency over the last ten years of monitoring.

A comparison of several trophic state models pre-treatment, immediate post-treatment and six years post-treatment reflect an improvement from eutrophy to mesotrophy.

DES will continue to work with volunteers to monitor the lake for many more years. Annual reports will be produced by DES to follow lake quality trends. A watershed committee will continue efforts to monitor the Kezar Lake watershed for new sources of non-point pollution.

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The Biology Section Staff of the Department of Environmental Services is acknowledged for its professional assistance in the field and laboratory. Particular thanks go to Stephanie Bowser for providing the essential volunteer training and maintaining the Volunteer Lake Assessment Program database.

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Kendall Perkins is acknowledged for implementing the field investigations and gathering data for this study.

The efforts of Gary Haworth and the staff of the DES Laboratory are greatly appreciated in coordinating and processing the chemical analyses for the study.

We are grateful to Region I of the United States Environmental Protection Agency for their financial assistance, and particularly Warren K. Howard for his support and guidance during each of the phases of this project.

Thanks to Biology Section secretary Judy Reid for her many hours typing this report.

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EXECUTIVE SUMMARY

1.0 Introduction and Historical Perspective

The Kezar Lake Project began in 1980 and was funded by an EPA, Section 314, Clean Lakes Program grant. The Kezar Lake Project continued throughout a 19-year period, which included an EPA Clean Lakes Phase II implementation grant and finally, a Phase III monitoring grant.

Each of the three projects had a specific goal and specific tasks to accomplish. The Phase I Diagnostic/Feasibility goal was to delineate the sources of nutrients and other pollutants and to recommend Best Management Practices for watershed management. Another Phase I goal was to reduce the supply of phosphorus from the lake sediments to the lake. The Phase II grant was an implementation project that provided funding for sediment inactivation and wetland management. The current Phase III project evaluates a 19-year period of pre- and post-treatment monitoring.

Historically, Kezar Lake has been plagued with a series of lake quality problems, first documented in the 1960s and extended into the early 1980s. Phosphorus loading from the Lyon Brook subwatershed and the New London sewage treatment facility accelerated the eutrophication of Kezar Lake. Phosphorus concentrations were dramatically elevated, while obnoxious blooms of Cyanobacteria were recorded each summer since the early 1960s. Chlorophyll levels remained high throughout the summer months and transparency was often less than 1.0 meters.

2.0 Watershed Characteristics

Kezar Lake, located in North Sutton, New Hampshire, is a shallow (Zmax = 8.1 m) northern dimictic lake with an area of 73.49 ha. It is located in an area of quite variable weather conditions with acidic wetfall. The watershed includes two public waterbodies and four major wetlands. Much of the soils surrounding these areas are poorly drained and highly erodible.

The watershed area is approximately 69.7 percent forested, 9.4% agriculture and 6.4% wetlands, while urban and cleared/open water areas comprise less than five percent of the area.

3.0 Site Description, Scope and Methodology

Sampling sites include two in-lake stations at 2.0m and 6.0m at the deep spot of the lake. The major tributary to Kezar Lake, Lyon Brook, was sampled at several different sites while the minor tributaries, King Hill Brook and Birch Brook, contained one sampling site each.

Sampling protocols were set up to monitor water quality trends in Chadwick Meadows, Kezar Lake and its tributaries. Sampling was also performed to evaluate phosphorus loading to the open water areas. Benthic invertebrates, fish, sediments and macrophytes were monitored to delineate possible effects of aluminum on each group.

EPA-approved methods were used in the DES Limnology Center and DES Chemistry Laboratory with strict quality assurance/quality control (QA/QC) designed programs for all analyses.

4.0 Effects of Aluminum Salts on Lake Biota

When aluminum infiltrates or is applied to a waterbody, it may have detrimental effects on the organisms living in that waterbody. When the pH of water decreases below 5 units, aluminum may become toxic in surface waters. To understand the overall effectiveness of the aluminum salts injection, it is important to understand the effects that the treatment had on the lake biota.

Microscopic analyses revealed that there were shifts in the overall dominance of phytoplankton species following the aluminum salts injection. Shifts from the dominant blue-green algae to diatoms and golden-brown algae were documented from pre-treatment to post-treatment sampling periods. Decreases in chlorophyll-a concentrations and increases in mean transparency were also observed as a result of changes in algal dominance and abundance.

Shifts in zooplankton species composition were also observed after the aluminum salts injection. These shifts were likely the result of changes in the algae, which are the primary food source of the zooplankton.

Laboratory bioassays and in-situ macroinvertebrates studies were also conducted as a part of the Phase III study. Results from the sediment bioassay suggest that there were no detrimental effects on midge or alderfly larvae after aluminum salts injection. Samples from the in-situ study revealed that no organisms were found in the sediments fifteen days following the aluminum

salts injection, but this may be the result of seasonal migration or maturation of the benthic invertebrates.

Fish studies were also a component of the Phase III project. Whole fish studies at Kezar Lake showed that aluminum concentrations were higher in hornpout than in other fish. Further studies revealed that the gills of fish from several other New Hampshire lakes had higher aluminum accumulations than either fillets or livers from the same set of lakes. The results of the studies were somewhat conflicting. The whole fish study showed that Kezar Lake had the highest aluminum concentration, both in yellow perch and hornpout, but the concentrations in the gills and livers were low compared to other ponds in the study. This suggests that the aluminum might have been accumulating in other portions of the fish that were not analyzed.

5.0 Evaluation of Treatment Effectiveness and Longevity from Hypolimnetic Aluminum Salts Injection

Epilimnetic phosphorus (P), hypolimnetic P, dissolved oxygen, chlorophyll-a and Secchi disk transparency trends were used over a 19-year period to monitor pre- and post-lake quality conditions. The data all reflect immediate lake quality improvement post-treatment. The lake appeared to enter an equilibration period four years post-treatment. All lake quality indicators improved by 1990, but suffered again in 1994. Lake quality indicators again improved in 1995 and have remained well within the reference line for good lake quality conditions through the 1999 sample year. Data variability has also decreased over time, reflecting the stable conditions measured within the lake. The data reflect some correlations between summer wetfall and lake quality. Increased wetfall and greater runoff of P to the lake may show correlations to higher lake productivity.

All lake quality indicators reflect an improvement in lake conditions and in parameter variability after hypolimnetic aluminum treatment.

6.0 Hydrologic Budget

A comparison of the average year budget with the 1980-1981 study year and the 1990-1991 study year reveal each year to be similar in wetfall (40.1 to 45.3 in.) and in tributary inflow (12507 to 15328 $10^3 m^3$). However, the 1990-1991 year received the most wetfall, yet showed the least inflow to the lake.

The 1990-1991 monitoring year showed that Lyon Brook contributed an overwhelming 73 percent of the water to Kezar Lake, while King Hill Brook resulted in 15%, wetfall was 7% and Birch Brook was responsible for 5% of the inflowing water.

7.0 Phosphorus Budget

A phosphorus budget was constructed for Kezar Lake using 1990-1991 data collected for the Phase III study. A phosphorus budget was necessary to compare P-loading for an average year, the 1980-1981 year and the 1990-1991 year. The P budget allows for the comparison of loading to the lake over a ten-year period. The P budget was also necessary to evaluate the internal supply of P from the lake sediments.

A comparison of the three budgets reflected that the 1990-1991 budget year contributed far less phosphorus (55 Kg P or 17% less) than the average year, with about ten more inches of wetfall. Possible conclusions from these results may indicate a more efficient uptake of P in the Chadwick Meadows wetland, or there may be less phosphorus in the Lyon Brook watershed since the sewage treatment facility has been off-line for 20 years.

When the hypolimnetic phosphorus mass was measured for the 1980-1981 season and the 1990-1991 season, it was concluded that both the phosphorus concentration and, therefore, the hypolimnetic P load to the lake decreased from the pre-treatment year of 1980-1981 to the 1990-1991 post-treatment year. In turn, there is less phosphorus provided to the total water column during mixing and less available P for phytoplankton use.

8.0 Chadwick Meadows Wetlands Management

During the fall of 1982 flashboards were installed and the water level was permanently raised in Chadwick Meadows. Aquatic plant surveys showed a succession of aquatic plants in the wetland over a seven-year period.

The constructed Chadwick Meadows phosphorus budget reflects that wetland phosphorus assimilation predominates over P-release rates. The data collected over a seven-year monitoring period suggests that the increased water level and creation of a more extensive wetland area was a successful strategy for reducing the supply of phosphorus to the receiving waterbody.

9.0 Trophic Status Modeling

Four different trophic classification schemes were used to; 1) model current trophic status based on water quality results and, 2) predict in-lake phosphorus concentrations based on areal loading.

The New Hampshire Lake Classification scheme rated Kezar Lake as Mesotrophic based on dissolved oxygen concentrations, Secchi disk depth, plant abundance, and chlorophyll-a concentrations.

Carlson's Trophic Status Index ranked Kezar Lake as mesotrophic based on chlorophyll-a concentrations, hypolimnetic phosphorus concentrations, and Secchi disk depth. This model rated the lake as borderline mesotrophic/oligotrophic based on epilimnetic phosphorus concentrations.

The Dillon/Rigler and the Vollenweider models rated Kezar Lake as oligotrophic based on areal loading to the lake.

CHAPTER I
INTRODUCTION AND HISTORICAL PERSPECTIVE

Kezar Lake has the distinction of being the most studied and most monitored lake in New Hampshire. Although the history is involved, an abbreviated and updated version is presented in this chapter. A more detailed history can be found in Connor, 1983.

Kezar Lake, as with many of New Hampshire's lakes, has a geomorphological origin as a glacial ice-scour lake. Prior to the early 1960's the lake was an attractive and profitable recreational area. Many people enjoyed the recreational activities of fishing, swimming, boating and picnicking while admiring the beautiful mountainous setting of Mount Kearsarge and King Ridge Hills. During the 1880's Kezar Lake was at its peak as a recreational area. Many of the farms and larger houses were converted into boarding houses and hotels. During this period, hundreds of people from New England, New York and New Jersey would make the long journey to Kezar Lake to enjoy their summer vacations. In fact, during the early 1900's there were a variety of summer resorts and two juvenile camps that surrounded the lake and were very prosperous.

In 1931, the New London sewage treatment facility, the first secondary sewage treatment facility in the State, began discharging treated effluent into Kezar Lake's most significant hydrologic tributary, Lyon Brook, approximately three and one half miles (5.6 km) upstream from Kezar Lake. This secondary effluent contributed high concentrations of phosphorus and nitrogen into Lyon Brook, much of which ultimately became entrapped in the sediment and biomass of Kezar Lake.

In 1934, Kezar Lake became the site of Wadleigh State Park. It appears that the lake still enjoyed a good reputation for aesthetically clean water, and the State felt confident that many people would continue to utilize the facilities for recreational activities into the future. Few recognized that, slowly, cultural eutrophication was progressing.

The New Hampshire Fish and Game Department surveyed Kezar Lake in August of 1938 as part of a statewide examination of its public waters. The survey reported a light brown color to the water, probably from tannins and lignins released from organic matter in the upper marshes, a transparency of 11 feet (3.3 m), a pH of 6.2 to 6.8 units and an alkalinity of 7 to 10 mg/L as $CaCO_3$. As a result of this first chemical, biological, and physical survey, the Fish and

Game Department recognized that the hypolimnion was deficient in oxygen and therefore classified the lake as being best suited to warm water fish (Fish and Game Survey Report No. 8b, 1963).

The first serious sign of trouble recorded was in 1963 when Sutton town officials were puzzled as to why the lake had turned a greenish color. At this point in time, biologists from the New Hampshire Water Supply and Pollution Control Commission (NHWS&PCC) were contacted by town officials to survey this anomaly. State biologists reported that the color of the water was due to a phytoplankton bloom but the water still met the B-1 classification that had been assigned to it in 1947. Bacterial samples showed water of good quality.

In 1964, the Water Resources Department constructed a new dam at the outlet of Kezar Lake, while a few miles away, Interstate I-89 was in the process of being constructed. Although there are no records on water quality at this time, it seems likely that heavy excavation in the Kezar Watershed may have upset the ecology and nutrient loading to Lyon Brook.

Again, in 1964, the lake bloomed with a blue-green phytoplankton, *Anabaena spp.*, reducing the water transparency to 1.2m (four feet). In an attempt to make the water aesthetically acceptable for recreation, the State applied 800 pounds of coarse copper sulfate crystals with favorable results.

The 1965 season saw the lake bloom once again with *Anabaena spp.* as well as *Microcystis aeruginosa*, another blue-green alga. The lake was treated June 7th with 875 pounds (0.2 mg/L) of copper sulfate with an additional 800 pounds of the algicide being applied June 30th. Again, it was noted that the copper sulfate was very effective in killing the algae, as was reflected by transparencies of at least 2.7 m (9 feet).

The future of Kezar Lake, as a recreational area, was in serious jeopardy as the lake's waters continued to deteriorate year after year with recurring blooms of blue-green algae. This phytoplankton growth reduced water clarity, often imparted offensive tastes and odors, initiated toxicity-caused fish kills, and produced a pea-soup appearance to the lake's surface, making recreational activities aesthetically unpleasant. Indeed, eutrophication processes had been accelerated in Kezar Lake due to the discharge of treated sewage from the New London wastewater treatment facility and the suburban development of properties adjacent to surface waters within the Kezar Lake watershed.

In 1966, Kezar Lake suffered yet another annual algal bloom; but unlike the previous seasons, the algae resisted a 0.5 mg/L concentration of copper sulfate. Many of the State's most prominent phycologists agreed that the species responsible for this bloom was *Aphanizomenon holsaticum*. On June 15th, 1966, 1,000 more pounds of copper sulfate were added to the lake with no appreciable results. A third attempt to remedy the bloom conditions was undertaken June 30th when 2,200 more pounds of copper sulfate were applied; but again, results were very unfavorable. The results were a massive fish-kill with an estimated seven to eleven tons of dead fish removed from the shoreline areas. Algae blooms could no longer be controlled in Kezar Lake. The poor aesthetic quality of the water discouraged any recreational use of the lake by the people who frequented the State Park or by the property owners adjacent to the lake.

In an attempt to avoid another season of unsightly phytoplankton blooms, 400 pounds of copper sulfate were applied to Kezar Lake June 5th, 1967, at pre-bloom stages. Again, it was found that the algicide was applied with no success. *Aphanizomenon* was the dominant genus now and resisted any reasonable control measures with copper sulfate. Therefore, the use of copper sulfate was abandoned at Kezar Lake when *Aphanizomenon* was known to be the predominant algae.

It was observed that the fish kills occurred when the algae numbers peaked and began their rapid decline. As the trichomes ceased being floaters and began to sink and die they released an endotoxin. It appears that fish kills occur when the cells of *Aphanizomenon flos-aquae* disintegrate in sufficient numbers. It matters not how this die-off occurs; whether it be naturally occurring, induced by algicides, such as copper sulfate; or a result of mechanical destratification.

The value of a lake is a most difficult thing to determine, but it can be judged somewhat by the price people are willing to pay for shore property. When real estate is the base of the tax structure, drastic realignments of the tax base must sometimes occur when algal nuisances devalue lakeshore property. This was the case with the shore property at Kezar Lake in 1968 when the State Tax Commission ordered a 30 percent across the board reduction in appraised evaluations (Town Report of Sutton, New Hampshire, 1968).

In an attempt to improve the clarity of the water to where it would be recreationally acceptable, a new approach (mechanical destratification) was instituted during the 1969 season. Briefly, the destratification process operated as follows: a PVC (Polyvinyl chloride) hose

conducted compressed air from a shore-located compressor unit to a diffuser unit anchored on the bottom at 8.0 m. The rising column of air bubbles carried cooler hypolimnetic water to the surface and, by mixing, effectively inhibited thermal stratification and induced homogenization of just about everything but light penetration. In addition, the suspended algae became more or less evenly distributed throughout the water column instead of forming dense accumulations in the surface layer. There is also some evidence that the cycle of the bloom of blue-green algae is accelerated, allowing more recreational use in the post-decline period. It is also thought that bottom sediments in contact with this well-oxygenated water may adsorb phosphorus compounds by chemical precipitation.

The mechanical destratification experiment was declared a success when water transparency greatly improved from 0.3 m (1 foot) to about 1.2 m (4 feet).

Destratification processes are thought to be responsible for the improved water conditions of Kezar Lake during the 1969 recreational season. Algae counts had diminished from previous seasons and summer Secchi disk measurements proved to be very promising. Transparency readings were greater than 1.2 m (4 feet) for 41 days and not less than 0.6 m (2 feet) for the entire recreational season. New improvements were rendered to the New London sewage treatment facility during the 1969 season. A series of 'algae-polishing' ponds were constructed in October of 1969 in an attempt to lower phosphorus concentrations being released into Lyon Brook, with the possibility of harvesting the algae.

A dense bloom of *Anabaena flos-aquae* and another bloom of *Aphanizomenon flos-aquae* began the 1970 season. The annual fish-kill occurred June 30th. For the third consecutive season, destratification techniques continued to increase water transparency in Kezar Lake. Recorded Secchi disk measurements revealed 44 days with water transparency greater than 1.2 m (4 feet). Again, for the second consecutive year, additional improvements were implemented at the New London sewage treatment facility with the addition of hot alum tertiary treatment to flocculate phosphorus from the nutrient-laden wastewater and dispose of the phosphorus-loaded floc on land. Tertiary treatment of the secondary effluent successfully reduced the phosphorus loading into Lyon Brook (Staff Report No. 59, NHWS&PCC). A large amount of the remaining nutrients released into the brook was stripped by plant nutrient uptake as it flowed through a several-acre alder swamp downstream of the discharge area in Lyon Brook. However, Uttormark, et al. (1974) found most nutrients taken up by wetlands are again released during

spring runoff. Although diversion of all sewage and much of the phosphorus source from Lyon Brook has occurred, it appears that damage to the lake has already been rendered through two major mechanisms:

(1) The sediments of Kezar Lake may play a substantial role in the recycling of nutrients into the water column. The uptake of phosphorus by the sediments and its subsequent release back into the water column, as the redox potential (a net change in the oxidation numbers of one or more elements in the reacting substances) supplies essential foodstuff for algal growth.

(2) Nitrogenous compounds and phosphorus entering the lake are taken up and incorporated into algal biomass. These nutrient compounds are released to the water environment for reuse upon the death and disintegration of the algae organisms. Lakes, in this way, become very efficient nutrient traps. The nutrients are thus cycled and recycled sufficiently to promote algal blooms without additional nutrient contributions to the lake system from point or non-point sources.

A massive *Aphanizomenon flos-aquae* bloom occurred during the June 1971 sampling season, reaching maximum (peak) concentrations of more than one million cells per mL and reducing water transparency to 0.75 m (1.5 feet). The subsequent decline and decay of the *Aphanizomenon* bloom resulted in the mortality of many yellow perch. However, Kezar Lake provided continuing acceptability with respect to water clarity. Sixty-two days were recorded with transparency measurements greater than 1.2 m (4 feet). At this time, there was no doubt that the recreational quality of Kezar Lake had improved steadily since the initiation of the destratification program.

The 1972 summer recreational season at Kezar Lake was somewhat less successful than the three previous seasons. Thirty-five days were recorded with transparency measurements greater than 1.2 m, while the *Aphanizomenon* bloom prevailed throughout the summer season. The effectiveness of lake mixing of Kezar Lake seemed to be waning and the procedure was thought to have a limited time of applicability.

An evaluation of the New London sewage treatment facility revealed major reductions in orthophosphate (PO_4-P). Annual mean concentrations of orthophosphate were reduced from 8.4 mg/L in 1968 to 1.1 mg/L in 1972 (New Hampshire Water Supply and Pollution Control Commission, Staff Report No. 64, 1974). Yet, in-lake phosphorus concentrations still supported unacceptable algal blooms.

Artificial destratification of Kezar Lake was unsuccessful in controlling the summer *Aphanizomenon* bloom during the 1973 season. *Aphanizomenon* cells persisted in abundance for the entire summer season, despite the isothermal conditions, which were maintained within the lake. Water clarity was recreationally unacceptable for the entire summer vacation period as transparency measurements of less than 1.2 meters were recorded from June 6th through September 11th.

Although initially, artificial destratification shortened the duration of blue-green algal blooms, the 1972 and 1973 seasons showed a gradual return to pre-destratification years. It appears that the blue-green algae had adapted to whatever environmental factors were altered as a result of the destratification, and the method was no longer useful for controlling algal blooms in Kezar Lake.

Destratification was employed for the final season in 1974 with little or no effect in the control of algae blooms.

When the lake was again allowed to stratify in 1975, *Aphanizomenon* blooms decreased transparency to less than 1.2 m for seven weeks of the summer recreational season. Table I-1 describes the approximate duration of *Aphanizomenon* blooms and unacceptable water transparencies for each study season.

In January of 1975, State and Federal permits were issued to New London. These permits contained, among other things, an implementation schedule, setting the date of April 1, 1975 for submission of a Planning Report, June 1, 1975 for commencement of preparation of construction drawings, and December 31, 1977 as the date for operation of a new or upgraded wastewater treatment facility.

Table I-1
Approximate Duration Of *Aphanizomenon* Blooms
And Unacceptable Water Transparencies
(From Staff Report No. 79, 1976)

Year	*Aphanizomenon* Bloom	Transparency (<4 ft)
1968	20 weeks	14 weeks
1969	14 weeks	4 weeks
1970	8 weeks	6 weeks
1971	4 weeks	4 weeks
1972	8 weeks	7 weeks
1973	14 weeks	14 weeks
1974	9 weeks	7 weeks
1975	10 weeks	7 weeks

In May of 1976 the towns of Sunapee and New London were ordered by NHWS&PCC:

1) to develop joint sewage treatment facilities utilizing the sewage treatment plant in existence in the adjoining town of Sunapee; and
2) construct interceptor sewers to deliver sewage from New London to Sunapee facilities.

From 1976 to 1978 little research or sampling of Kezar Lake was conducted. Lake sampling was limited to only routine seasonal surveys.

In March and August of 1978, Kezar Lake was surveyed as part of a Federal Grant. Section 314 of the Clean Water Act (PL95-217, as amended) specifically addressed the water quality of lakes and ponds of this country. The first part of this section instructed each state to identify and classify, according to trophic condition, all its publicly owned fresh water lakes and ponds. The resulting report, the Classification and Priority Listing of New Hampshire Lakes, (Staff Report No. 121, NHWS&PCC, 1981), classified Kezar Lake as eutrophic. This study also ranked Kezar Lake very high, first out of 171 surveyed New Hampshire lakes, for lake restoration and assigned a moderate ranking for lake preservation.

Due to Kezar Lake's number one ranking in restoration, a Federal Assistance Grant Notification was sent to the Environmental Protection Agency (EPA) in April of 1979. This

Diagnostic/Feasibility Study grant was to examine the desirability, technical feasibility and cost benefit factors involved in a restoration project for Kezar Lake and subsequently the EPA approved the grant in December 1979.

In March of 1980 the first samples were taken for the Diagnostic/Feasibility Study (raw data collected during this study can be found in Appendix I). Again, Kezar Lake suffered a blue-green algal bloom. This year the responsible phytoplankton was *Microcystis*. The lake turned a deep pea soup green color and looked as if one could walk across it with snowshoes.

A new era began in 1981, as New London began pumping their sewage to the Sunapee treatment plant on January 13th. Finally, the point source of phosphorus had been eliminated from Lyon Brook and Kezar Lake. With the long-awaited diversion of sewage came speculation as to the recovery rate of the lake.

The summer of 1981 saw yet another bloom of *Microcystis*, driving transparency down to 0.5 m (2.0 ft) in mid August. The bloom brought with it the familiar obnoxious odors and unsightliness of the water. People in the area were quite disappointed and Wadleigh State Park entertained few recreationalists.

The Diagnostic/Feasibility Study entered its second year at Kezar Lake and biologists were busy installing and checking water flow and seepage meters while sampling both the tributaries and lake.

The 1982 season brought on the final nine months of the Diagnostic/Feasibility Study. The lake visually improved for the first year since the study began. The reason of the improvement was that *Microcystis* was no longer the predominant phytoplankton during the summer months. However, a new blue-green alga, *Lyngbya limnetica*, invaded Kezar Lake. Water clarity improved, as minimum transparency measurements were 1.5 m (5.0 ft) considerably better than the previous summer.

In 1983, the EPA Diagnostic/Feasibility Study (Connor, 1983) was published and the results and recommendations were presented to the public. The phosphorus budget, Figure I-1, showed that 70 percent of the phosphorus load to Kezar Lake was a result of loading from Lyon

Brook. Internal phosphorus was a significant contribution to the lake. Lake modeling revealed that complete sewage effluent diversion from Lyon Brook would improve the lake condition to mesotrophic.

The report recommended that the most feasible and cost-effective reclamation action for Kezar Lake was hypolimnetic phosphorus inactivation. An area of 100 acres was recommended for the 1983 summer season. Another recommendation included phosphorus alteration on Lyon Brook, which was aimed at reducing the delivery of phosphorus to Kezar Lake by botanical utilization. The focus of the evaluation of phosphorus alteration is directed to the management and enhancement of Chadwick Meadows marsh area.

Aluminum sulfate and sodium aluminate were injected into the hypolimnion and bottom muck sediments of eutrophic Kezar Lake with a specially designed applicator mechanism. Approximately 100 acres of lake bottom were treated during a seven-day period in June 1984.

This new method of applying aluminum salts to achieve phosphorus inactivation included two separate chemical distribution systems mounted on a hydraulic weed harvester. No major mechanical problems or other difficulties were encountered during the seven-day treatment.

During the fall of 1983, the water level of Chadwick Meadows marsh was elevated by the installation of flashboards below the confluence of Lyon Brook and Clark Pond Brook. Wild rice (*Zizania aquatica*) was planted during the spring of 1985 in hopes that the aquatic vegetation would remove phosphorus from the wetland area.

In 1986, the report, "Wetlands Management and First Year Response of a Lake to Hypolimnetic Aluminum Salts Injection" (Connor and Martin, 1986) was released to EPA. The report concluded that the injection of aluminum salts resulted in a dramatic decrease in hypolimnetic phosphorus and an increase in water transparency as chlorophyll-a levels decreased. The results of this study led to the reclassification of Kezar Lake's trophic state from eutrophic to mesotrophic.

The phosphorus budget set up for Chadwick Meadows showed that there had been an increase in loading to Lyon Brook as a result of the increased water level. It was thought that the increased water level killed off much of the terrestrial vegetation, resulting in an increase in phosphorus from plant decomposition. In 1988, the Kezar Lake Protective Association joined the New Hampshire Volunteer Lake Assessment Program (NHVLAP), a program offered by the

Department of Environmental Services. Volunteer monitors were trained to collect tributary and lake samples on a weekly basis.

In 1989, the final Phase II Report "An Assessment of Wetland Management and Sediment Phosphorus Inactivation, Kezar Lake, New Hampshire," (Connor and Martin, 1989) was released to EPA. The report showed lasting effects of aluminum salt injections for a three-year period and a decrease in the effectiveness in the fourth year of monitoring.

Litigation between the Town of New London and members of the Kezar Lake Protective Association, which alleged that the town caused or contributed to the pollution of the waters of Lyon Brook and Kezar Lake, resulted in a Consent Decree. The town was ordered to pay $220,000.00 to the Kezar Lake Protective Association and to fund another treatment of the lake when certain water quality standards were exceeded. The Consent Decree is effective until December 30, 2004.

In 1995, at the recommendation of NHDES, the Kezar Lake Watershed Committee was founded. The Committee is comprised of six people, two from Sutton, two from New London and two from NHDES. The purpose of the Committee is to study and make recommendations to manage non-point sources of pollution along Lyon and Clark Pond Brooks, which are major water supplies to Kezar Lake.

From the period of time from 1995 through 2000, both the NHVLAP and the Watershed Committee continued to monitor the water and phosphorus concentrations flowing to the lake.

CHAPTER II
WATERSHED CHARACTERISTICS

A. Morphometry

Kezar Lake is located within the Township of Sutton, N.H. The northern half of its 2,697 ha watershed is located in New London, N.H. This dimictic, glacial ice-scour lake has a surface area of 73.49 ha and a shore length of 3,400 m. Kezar Lake has a mean depth of 2.82 m and a maximum depth of 8.1 m. Its total volume of water is 1,975,500 m^3, and it flushes 8.2 times per year. Table II-1 summarizes the Kezar Lake natural morphometry. Figures II-1 and II-2 display a bathymetric map of Kezar Lake and the extent of the watershed respectively.

Table II-1
Kezar Lake Morphometry

Town: Sutton	Lake Area (ha): 73.49
County: Merrimack	Maximum Depth (M): 8.1
River Basin: Merrimack	Mean Depth (M): 2.82
Latitude: 43^0 21'49"N	Volume (M^3): 1,975,500
Longitude: 71^0 51' 53" W	Elevation (Ft.): 906
Flushing Rate (yr^{-1}): 8.2	Shore Length (M): 3,400
P. Retention Coeff.: 0.38	Watershed Area (ha): 2,697

B. Climate

The climate of the region is characterized by moderately warm summers, cold, snowy winters and ample rainfall. The prevailing winds are from the Northwest, thus the climate is more influenced by air masses moving from the interior rather than by air moving landward from the Atlantic Ocean. Daily temperatures can be quite variable because of changing weather patterns that alternately transport warmer air from a southerly direction and colder air from a northerly direction. Generally, snow is present from mid-December to the end of March. Precipitation throughout the state is acidic.

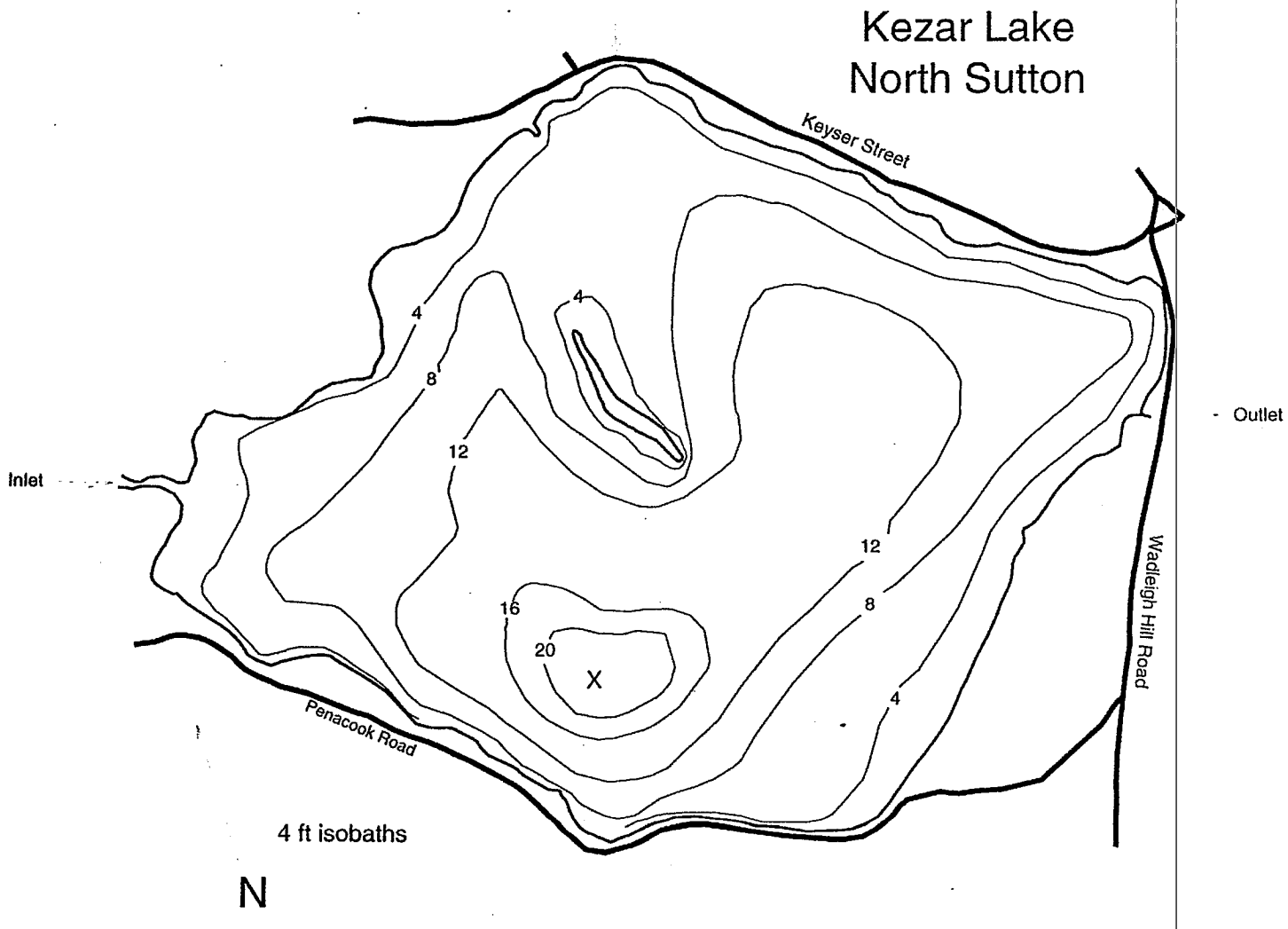


Figure II-1 Bathymetric Map Showing Lake Outline and 4-Foot Contours

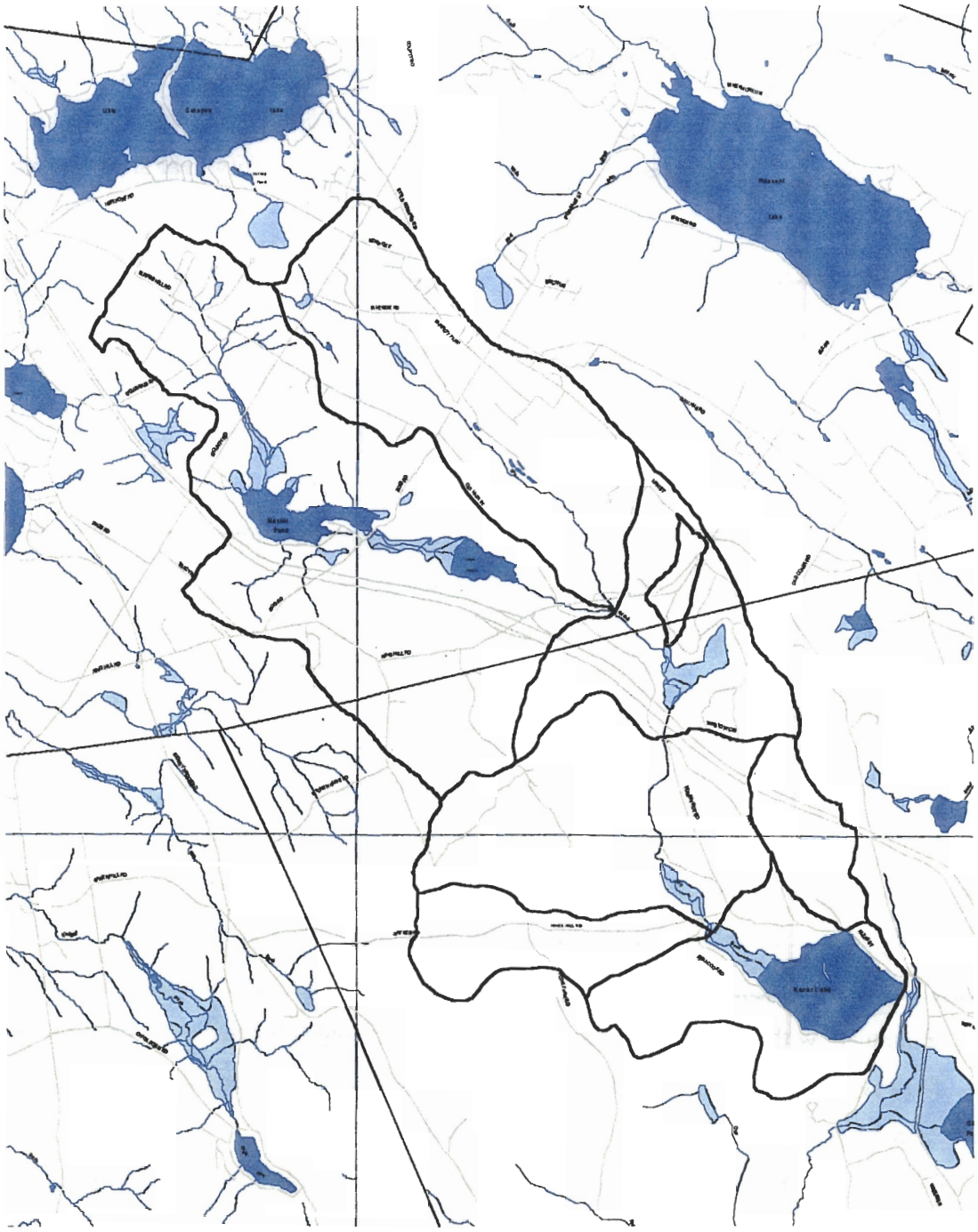


Figure II-2 Kezar Lake Watershed Featuring Roadways, Waterbodies and Tributaries

Monthly wetfall including the water equivalent of snow is presented in Appendix 2. The wetfall data was derived from the Manchester Water Works, Manchester, New Hampshire. Although Manchester is over 40 miles from Sutton, the water works maintains a complete and continuous wet fall record. Table II-2 represents regional changes in wetfall data. Although Bradford is the closest town with wetfall records, the data does not encompass the twenty-year study period.

Table II-2
Monthly Precipitation for Kezar Lake

Month/Year	Bradford	Concord	Manchester
Dec 90	5.53	4.12	4.63
Jan 91	2.65	1.85	2.25
Feb 91	2.03	1.42	1.64
Mar 91	4.76	3.01	3.06
Apr 91	3.48	2.61	2.02
May 91	4.23	2.51	3.16
Jun 91	3.14	1.72	3.26
Jul 91	2.66	1.80	2.92
Aug 91	7.80	7.26	8.38
Sept 91	5.97	5.52	6.40
Oct 91	4.40	3.32	2.80
Nov 91	4.21	4.84	4.76
Total	50.86	39.98	45.28

The data show that there are regional precipitation changes between the three sample stations. However, it appears that there is less variability between the closest weather station, Bradford, and Manchester than there is with the Concord station.

The twenty-year wetfall data is included to compare monthly and annual water quality trends with watershed runoff to the lake. An examination of many New Hampshire lakes and wetfall show that there is a relationship between wetfall, watershed runoff and water quality. Often, summer chlorophyll-a and transparency can be predicted on the basis of winter snow pack, spring rainfall and high intensity rainfall.

High rainfall or extensive snow pack melt results in the stripping of phosphorus from the watershed and an increase in lake phosphorus concentration. The phosphorus increase results in increased lake productivity. Conversely, dry seasons usually result in less phosphorus loading and less in-lake phosphorus concentration.

This information will be important in determining the effectiveness of hypolimnetic phosphorus inactivation because the additional spring phosphorus load from runoff can offset the reduction of internal phosphorus recycling from aluminum phosphate bonding.

C. Soils

The soils that occur in the Kezar Lake watershed reflect, in large measure, the underlying geologic types from which they were derived. Figure II-3 illustrates the soil types present within the watershed. Table II-3 presents characteristic of individual soil types. Soils within the watershed have developed, for the most part, from glacial till parent material. This is particularly true in the upland areas. Examples include Paxton, Herman, Canaan-Herman, and Woodbridge soils within the watershed. Along Lyon Brook, south of I-89, occur soils derived from glaciofluvial and alluvial deposition.

Soil properties of the utmost concern for the purposes of this study include drainage and erodibility. Drainage pertains to a soils ability to absorb water, while erodibility refers to how easily the soil is eroded by water moving over its surface as sheet or stream flow. In general, the better a soils internal drainage, the lower is its potential for erosion, though occurrence and slope may influence erodibility more so than the soils drainage properties. Figures II-4 and II-5 illustrate the variations in soil permeability (internal drainage) and erodability encountered within the watershed.

As Figure II-4 shows, the soils surrounding Kezar Lake both slight to severe and moderate to severe. Figure II-5 shows that the highly erodible soils are located north of Messer Pond and north of Kezar Lake.

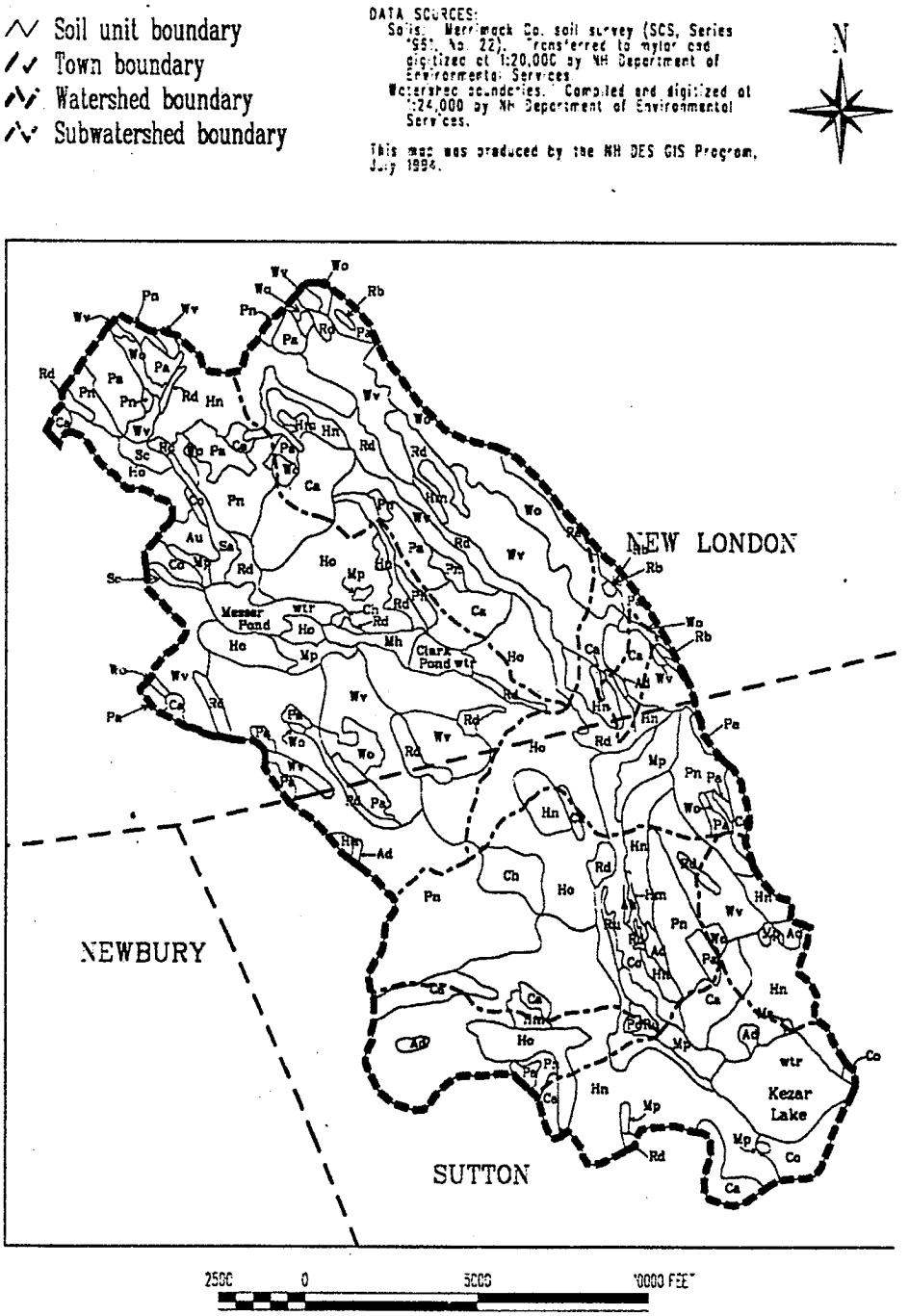


Figure II-3 General Soils Map for the Kezar Lake Watershed

Table II-3
Kezar Watershed Soil Properties

Soil	%	Erodibility	Name: Characteristics
Ad	0.68	fair	Acton: very stony fine sandy loam
Au	0.52	erodible	Au Gres: loamy sand
Ca	8.19	fair	Canaan-Hermon: very rocky sandy loams
Ch	0.87	fair	Canaan-Hermon: extremely rocky sandy loams
Co	3.67	fair	Colton: loamy sand
Gv	0.02	-	Gravel pits
Hm	0.66	fair	Hermon: sandy loam
Hn	18.60	fair	Hermon: very stony sandy loam
Ho	14.90	fair	Hermon: extremely stony sandy loam
Ma	0.03	variable	Made land
Mh	0.47	variable	Marsh
Mp	2.34	variable	Muck and peat
Pa	5.76	fair	Paxton: loam
Pn	13.72	fair	Paxton: very stony loam
Po	0.07	erodible	Podunk: fine sandy loam
Rb	0.14	fair	Ridgebury: loam
Rd	6.66	fair	Ridgebury and Whitman: very stony loams
Ru	0.29	erodible	Rumney: fine sandy loam
Sa	0.49	erodible	Saco: silt loam
Sc	0.46	erodible	Scarboro: fine sandy loam
Wo	4.47	fair	Woodbridge: loam
Wv	12.77	fair	Woodbridge: very stony loam

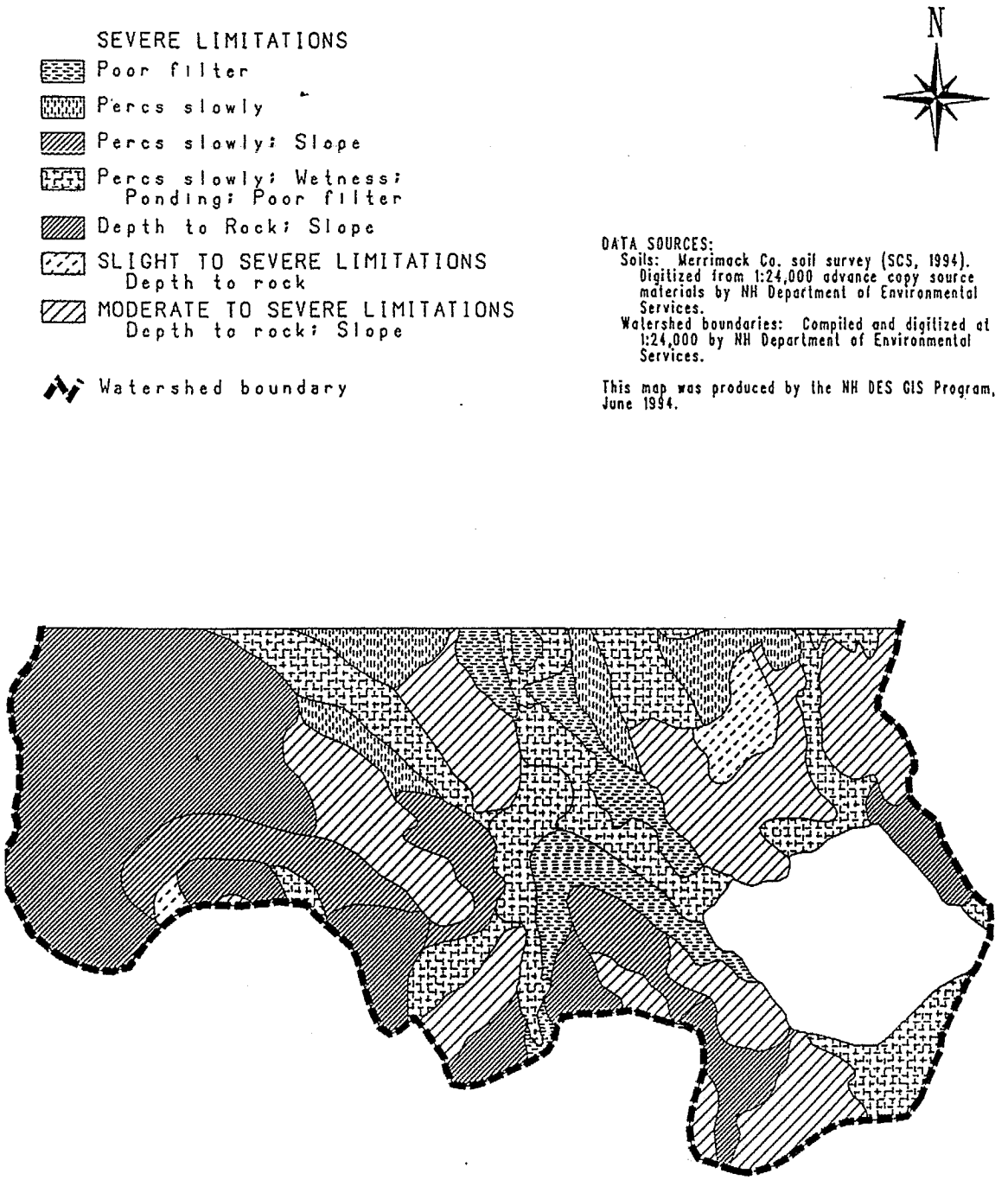


Figure II-4 Soil Limitations for Septic Systems in the Kezar Lake Watershed

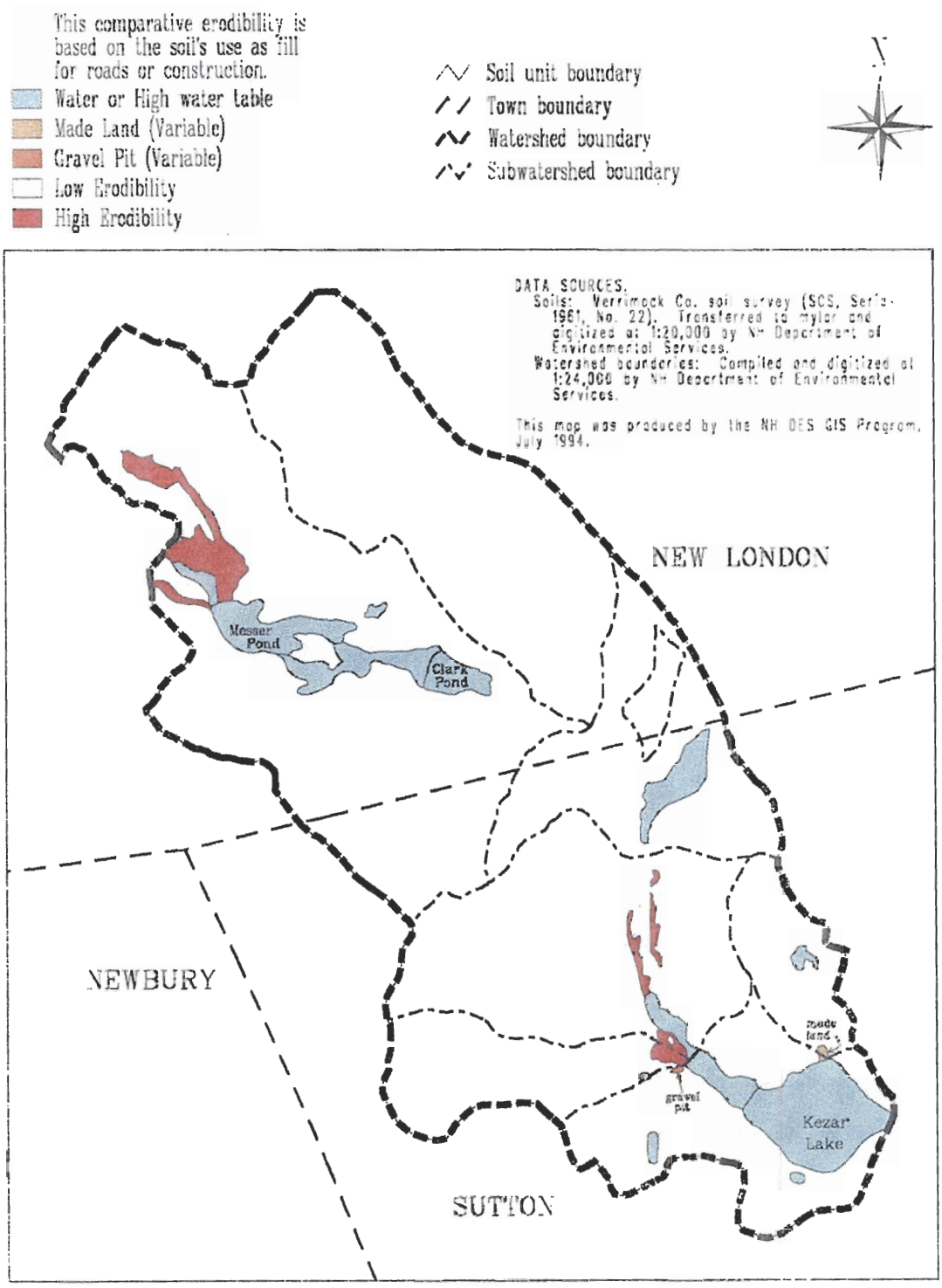


Figure II-5 Kezar Lake Watershed Soil Erodibility

D. Watershed Characteristics and Land Use

The northernmost segment of the Kezar Lake watershed occurs at the intersection of Main Street and Country Road in New London. Approximately 50 percent of the watershed is within the Town of New London while the remaining watershed in to the south in the Town of Sutton (Figure II-6). There are two great ponds, Messer and Clark that are located in New London, just east of Route I-89. These two ponds contribute approximately 55 percent of the hydrologic budget to Lyon Brook, the major source of water to Kezar Lake.

The watershed also includes four major wetlands. One wetland is located above Messer Pond and one between Messer and Clark Pond. Chadwick Meadows is a wetland area that was raised by damming to encourage phosphorus uptake. This wetland area is to the east of I-89, and just to the south of the New London/Sutton town line. This wetland is located in the Lyon Brook subwatershed. The other major wetland is also located along Lyon Brook and just above where the brook enters Kezar Lake. The wetland area lies between Penacook Road and Kezar Street.

Figure II-7 depicts the Kezar Lake watershed land use. Although there are several urbanized areas and several new developments (which include the Ridge Road development, the Trussel Ridge development and one that is being newly developed at the old King Ridge ski area), much of the watershed is still forested.

Land use within the watershed is extremely important in determining areas that are potential nutrient contributors to the lake system. Land cover types such as urban and agricultural usually offer a significant nutrient input that can accelerate lake eutrophication. Cover types such as forested and wetland usually contribute much less phosphorus than the aforementioned types.

Table II-4 presents the eight major watershed land uses. The watershed area is approximately 69.7 percent forested. Active agriculture ranks second to forested land use but makes up only 9.4 percent of the watershed land use. Wetlands make up 6.4 percent of the land use area of the watershed while urban, cleared/open and open water areas are each less than five percent. Bedrock and disturbed land uses cover the least percent of the watershed at 0.2 percent or less of the watershed.

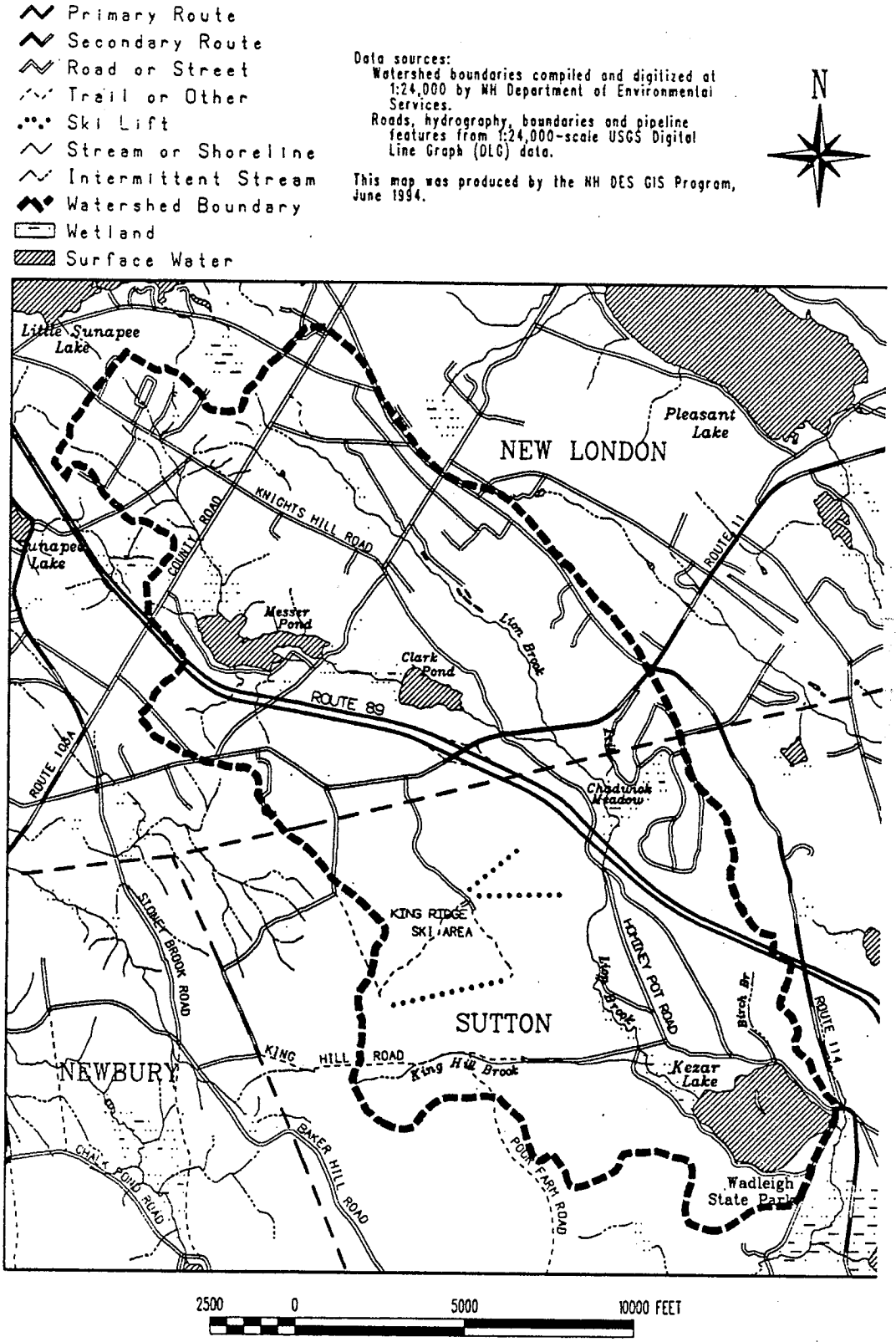


Figure II-6 Base Map Features in the Kezar Lake Watershed

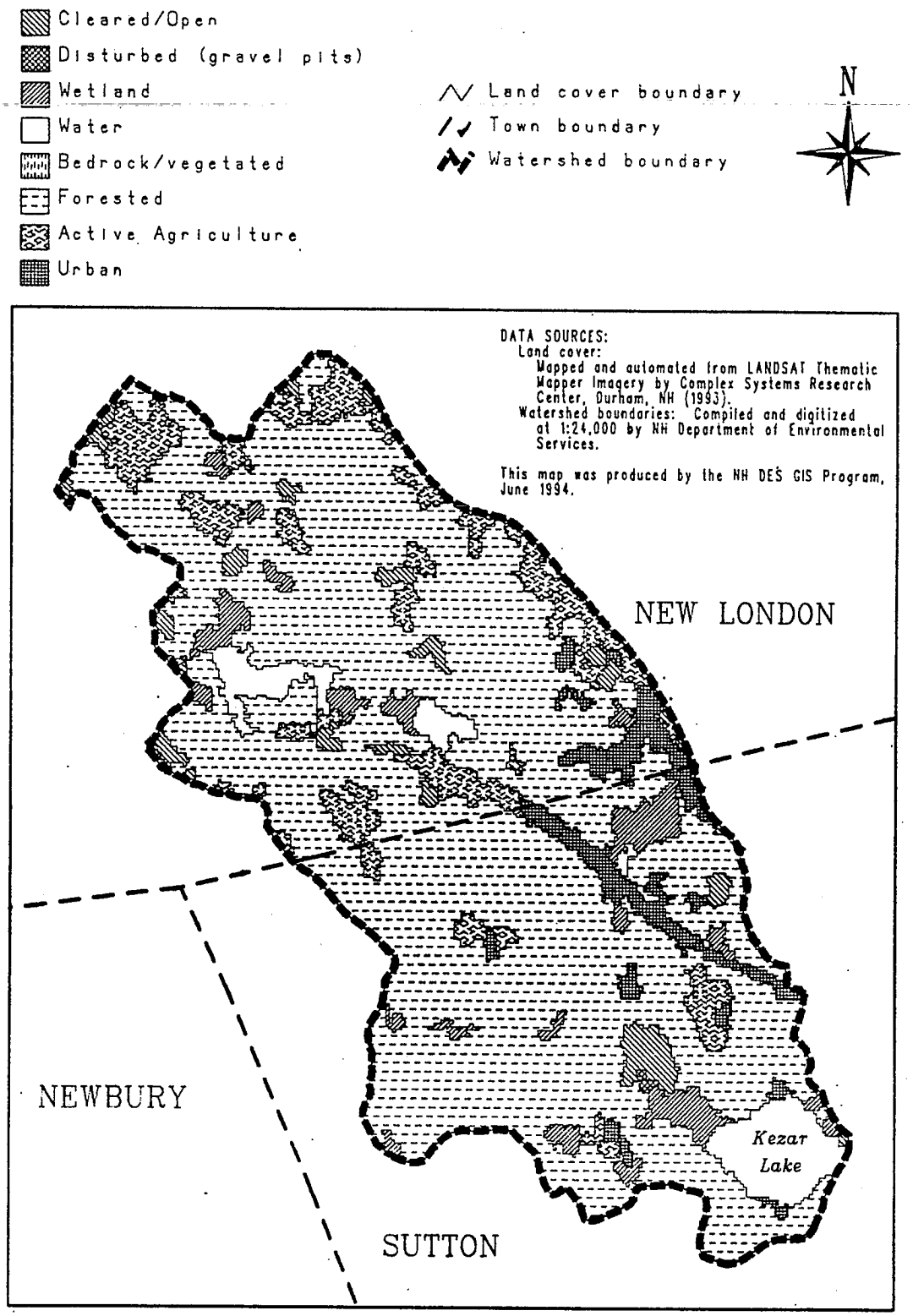


Figure II-7 Land Cover in the Kezar Lake Watershed

Table II-4
Kezar Lake Watershed Land Use

Land Use	Percent of Watershed
Forested	69.7
Active Agriculture	9.4
Wetland	6.4
Cleared/Open	4.9
Urban	4.7
Disturbed	0.2
Open Water	4.7
Bedrock/Vegetated	0.1

CHAPTER III

SITE DESCRIPTION, SCOPE AND METHODOLOGY

A. Kezar Lake Station Locations and Descriptions

Figure III-1 depicts the historical in-lake and watershed sampling locations. The station locations were selected to facilitate complete hydrologic, chemical and biological monitoring of the lake and watershed.

The in-lake quality monitoring station was established at the deepest part of Kezar Lake (8.1m) and sampled at two depths, 2.0m and 6.0m. Epilimnetic and hypolimnetic in-lake stations were selected to monitor any changes in internal phosphorus load of this weakly stratified dimictic lake.

Lyon Brook, King Hill Brook and Birch Brook were monitored as the three inflowing tributaries to Kezar Lake. King Hill Brook flows into Lyon Brook prior to entering the lake, however, the sampling locations were located upstream from the convergence and data are representative of two separate tributaries. Lyon Brook drains Chadwick Meadows (Figure III-I) and enters Kezar Lake through a marsh located along its northwestern shoreline. King Hill Brook drains a relatively steep subwatershed and flows into Lyon Brook approximately 0.5 miles upstream from the lake. Birch Brook drains a small subwatershed to Kezar's north and flows through a sparsely developed area before entering the lake.

The Kezar Lake outlet serves as the headwaters for the Lane River, which eventually flows into the Atlantic Ocean by way of the Warner, Contoocook and Merrimack Rivers respectfully.

Table III-1 presents a brief description of each tributary sampling station for Kezar Lake and Chadwick Meadows.

B. Chadwick Meadows Station Locations and Descriptions

Figure III-1 depicts the sampling locations around Chadwick Meadows that were used to monitor the effectiveness of this wetland to assimilate phosphorus.

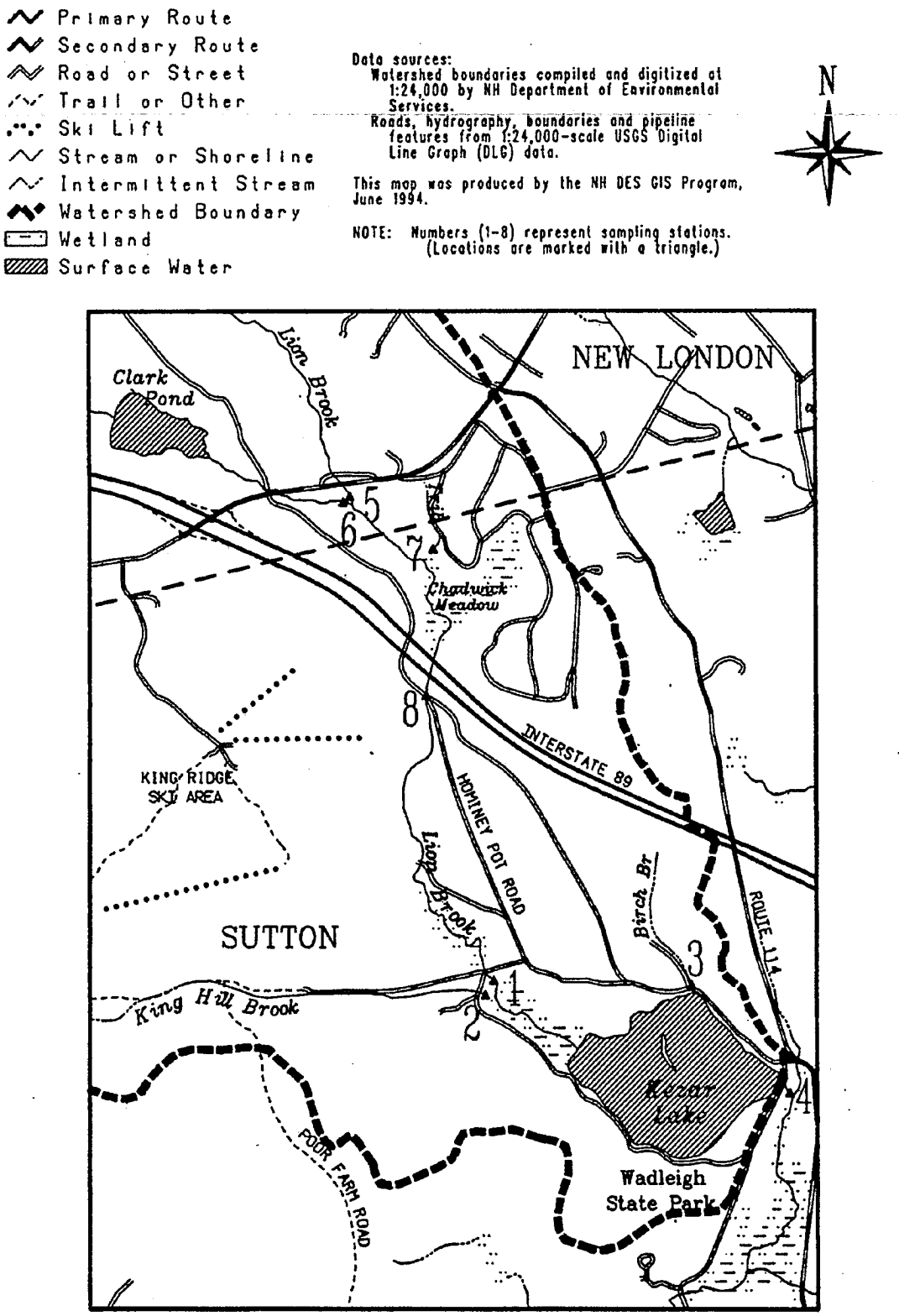


Figure III-1 Sample Stations for the Phase III Study Designated as Numbers 1-8

Table III-1
Sampling Site Descriptions

Site #	Site Name	Location
1	Lyon Brook Lake (LBL)	Lyon Brook, approximately ½ mile upstream from its confluence with lake
2	King Hill Brook (KHB)	King Hill Brook just before it flows into Lyon Brook
3	Birch Brook	Small Tributary entering Kezar Lake from the North
4	Outlet	Kezar Outlet, Lane River
5	Lyon Brook Above Chadwick Meadows (LBA)	Lyon Brook approx. 1.5 miles downstream of the New London pumping station. Immediately prior to its confluence with CPB
6	Clark Pond Brook (CP B)	Outlet of Clark Pond immediately prior to its confluence with LBA
7	Tributary Brook (TRIB)	Small brook entering Chadwick Meadows from the North
8	Lyon Brook Below Chadwick Meadows (LBB)	Chadwick Meadows outlet after it flows under I-89

Chadwick Meadows has three inflowing tributaries and one outlet. Both Lyon Brook and Clark Pond Brook carry runoff from the more intensively developed upper watershed into Chadwick Meadows. Clark Pond Brook is the primary contributor to the Chadwick Meadows water budget. It drains Messer Pond and Clark Pond located in the upper Kezar watershed. Lyon Brook flows by the decommissioned New London Wastewater Treatment Facility, through several developments and joins with Clark Pond Brook prior to entering Chadwick Meadows. Tributary Brook drains a small subwatershed and flows through scattered rural development before entering the meadow from the North. Subsequently, Lyon Brook is reestablished as the Chadwick Meadows outlet and becomes the primary water contributor to Kezar Lake.

C. Lake Sampling Procedures

Kezar has been sampled either regularly as part of a project or intermittently over the last 50 years. The Phase III sample program provides sampling data from May of 1984 through September of 1999. Bi-monthly sampling occurred from June through September throughout the study period. From 1990 through 1992, monthly samples were collected throughout the watershed.

Temperature and dissolved oxygen were measured at one meter intervals using a YSI model 50, 54, or 57 oxygen meter during open water periods, and hypolimnetic dissolved oxygen was measured using the Winkler method (azide modification) during the ice cover period. Temperature was recorded to the nearest 0.1 degree Celsius. Dissolved oxygen was recorded to the nearest 0.1 mg/L. Water samples for ANC, color, conductivity, dissolved aluminum, pH and total phosphorus were collected with a Wildco Kemmerer bottle. Nutrient samples were preserved with H_2SO_4, and all samples were stored in a cooler and returned to the DES Laboratory and the Limnology Center in Concord, New Hampshire for analysis.

Transparency was measured to the nearest 0.1 meter using a 20 cm diameter Secchi disk with alternate black and white quadrants. Net phytoplankton and zooplankton were collected by vertically hauling an 80-micron mesh net from mid-thermocline. One sample was preserved in the field with Lugol's solution to determine plankton abundance. A second sample was returned to the laboratory unpreserved to aid in identification. Whole water phytoplankton samples for inverted microscope density counts and chlorophyll-a were collected with an integrated tube sample (weighted tube, 1" diameter) or by compositing several discrete samples at successive depths from the surface to the mid-thermocline.

Water quality information was also obtained during summers from the Kezar Lake Protective Association as part of the DES VLAP (Volunteer Lake Assessment Program).

D. Stream Sampling Procedures

The Kezar Lake and Chadwick Meadows tributaries were sampled bi-monthly from October 1990 to November 1991. Staff gauge readings were recorded and total phosphorus samples were collected each sampling trip. Flow measurements were determined monthly using a Marsh-McBirney flow meter and discharge in cubic feet per second was calculated for each station. ANC, color, conductivity, dissolved aluminum, fecal coliform, pH and turbidity samples

were collected quarterly from each tributary throughout the study period. All samples were collected by dipping laboratory bottles to mid-depth at midstream into flowing water.

E. Benthic Invertebrates

Benthic invertebrates were collected from Kezar Lake and control lakes in January and June 1992. Two grab samples were collected each trip, from the deep spots, using a 24 cm^3 Ekman dredge. The samples were sealed in large plastic trays and transported to the Limnology Center where the sediment was sifted utilizing a stack of three USA standard testing sieves, numbers 7, 14 and 18 with pore sizes of 2.8 mm, 1.4 mm and 0.6 mm respectively. Benthic invertebrates were identified to genus and enumerated for each lake.

F. Fish Tissue Analyses

Yellow perch (*Perca flavescens*) and horned pout (*Ictalurus nebulosus*) were collected from Kezar Lake and several control lakes from April through August 1992. Yellow perch and horned pout were collected in accordance with Standard Methods 10600-B-3 (1992). The largest fish collected from each lake were measured, weighed, placed on ice and transported to the Limnology Center where individual specimens were homogenized by blending, digested in a CEM MDS-81D microwave and analyzed for aluminum concentration on the ICP (Inductively Coupled Plasma spectrometry).

A complete description of the control lakes, analytical methodology and results can be located in the Chapter IV of this report.

G. Sediments

1. Sediment Composition

A sediment core was extracted during October 1992 at the deep spot of Kezar Lake using a Wildco KBtm coring device. Individual centimeter increments were analyzed for recoverable Cd, Cu, Fe, Pb, Mg, Zn and P. Sediment Core Results are included in Appendix 3.

2. Sediment Aluminum Release in Response to Acidification

Forty-two sediment cores were collected in March 1992 from the alum (aluminum sulfate and sodium aluminates) treated area in Kezar Lake with a Wildco KB coring device. Individual increments of similar depth were composted in sterile Whirl-pac bags and transported to the Limnology Center. Microcosms of stratified Kezar Lake sediments and Kezar Lake water were constructed in a laboratory controlled experiment. Sulfuric acid was used to titrate specific treatments within the experiment to determine sediment aluminum release in response to acidification.

H. Aquatic Macrophytes

Aquatic macrophyte surveys were conducted during August of 1991 and 1993 on Chadwick Meadows and Kezar Lake respectively. Aquatic plants were classified to species and mapped to aquatic surface area. The Kezar Lake survey is compared to the 1979 pre-rehabilitation survey in the Effects On Lake Biota in Chapter 4 of this report.

Chapter VIII compares the 1991 Chadwick Meadows survey to the 1984 survey. The comparison demonstrates the natural progression of macrophytic growth within Chadwick Meadows.

I. Laboratory Methodology

1. Chemical and Physical

Table III-2 presents the laboratory methods utilized for chemical and physical parameters. Biologists in the Limnology Center performed ANC, pH, specific conductance and color analyses. The Laboratory Services Unit of DES performed total phosphorus and dissolved aluminum analyses. Both the Limnology Center and the Laboratory Services Unit are EPA inspected with approved quality assurance and quality control programs.

2. Biological

Table III-2 also presents the laboratory methodologies used for biological parameters. Biologists in the Limnology Center performed all biological analyses. Phytoplankton and zooplankton were identified to genus. Relative abundance was computed for net phytoplankton. Zooplankton and phytoplankton densities were also determined. Both chlorophyll-a content and

zooplankton were identified to genus. Relative abundance was computed for net phytoplankton. Zooplankton and phytoplankton densities were also determined. Both chlorophyll-a content and plankton counts were determined following procedures outlined in Standard Methods 18th Edition (1992 Storet #10200). Chlorophyll-a measurements and actual cell densities were use to determine algal biomass.

Table III-2
Laboratory Parameter and Method Used for Analysis

Parameter	Method
PH	Electrometric
Acid Neutralizing Capacity	Titration, Electrometric, Gran plot
Total Phosphorus	Colorimetric, persulfate digestion
Specific Conductance	Wheatstone bridge type meter
Apparent Color	Colorimetric, platinum-cobalt
Net Phytoplankton (relative abundance)	Phase Contrast Microscopy, Sedgwick-Rafter Cell
Zooplankton (density counts)	Phase Contrast Microscopy, Sedgwick-Rafter Cell
Whole water Phytoplankton	Inverted Microscope, settling chamber
Chlorophyll-a	Spectrophotometric Trichromatic
Aluminum	ICP Emission Spectroscopy
Bacteria	Membrane filter

J. Comparative Methodology

This report will continually refer to previous work on Kezar Lake, including DES staff reports, the Kezar Lake Phase I Study, New Hampshire Fish and Game Department (NHF&G) and university research offer data from the 1930's to the present. Organizing this data into comparable units was essential to facilitate analyses of long-term trends.

Staff Report #124 (Connor, 1981) completely summarizes the Kezar Lake historical events and data from the 1930's throughout the 1980's. Table III-3 relates the 1990-1991 watershed sampling locations with the sampling locations from Staff Report #124. Birch Brook and Tributary Brook were not included in any pre-1980 data.

Table III-3
Sampling Stations Comparison

Historical	Phase III
KRB	KHB
8g (outlet)	Outlet
8h	LBL
8i (twin culverts)	LBB
8 j (old road)	LBA
81	CPB
Surface	02 Meter
7.5 Meters	06 Meters

Pre-1980 lake samples were collected at the surface, 3.0m and 7.5m. Post-1980 lake samples were collected at 2.0m and 6.0m. For determination of long-term trends, the surface and 7.5m data from pre-1980 studies were compared to 2.0m and 6.0m data from post-1980, respectively.

Acid Neutralizing Capacity (ANC) was determined by fixed end point titrations prior to 1984. Gran plot titration was used to determine ANC values of all post 1984 data. The former method produced ANC values that were approximately 1.5 units higher than values obtained by the Gran plot titration method (Estabrook, 1993). The pre-1984 ANC data were corrected to 1.5 units lower for comparative analysis.

CHAPTER IV

EFFECTS OF ALUMINUM SALTS ON LAKE BIOTA

During the past 20 years, research has been conducted on the toxicity of aluminum to aquatic biota, in part due to an increase in the use of aluminum sulfate and sodium aluminate in the management of phosphorus in lakes and ponds. Kezar Lake was treated with aluminum salts injection in 1983 and 1984. To determine the effects of such treatments on the aquatic ecosystem of Kezar Lake, NHDES conducted long-term research on the planktonic communities, benthic macroinvertebrate communities, and the fisheries in the lake.

Freeman and Everhart (1971), Everhart and Freeman (1973), and Burrows (1977) have studied the effects of aluminum toxicity and stated that few investigators have accounted for the complex chemistry of aluminum in water. The amount of residual dissolved aluminum (RDA) is pH dependent and some test waters could receive large amounts of aluminum before RDA became sufficiently toxic (Cooke and Kennedy, 1981). Safe dose limits cannot be established unless they are correlated with actual RDA, alkalinity and pH. There is also little direct laboratory or field evidence available on the acute or chronic effects of aluminum on aquatic biota or aquatic communities.

Cooke and Kennedy (1981) state that aluminum toxicity does not appear to be a significant problem, as long as pH is controlled and/or RDA is not allowed to reach levels in excess of 50 ug Al/L. The long-term effects of aluminum salts injection seem to be small.

Reference lakes were used throughout the Phase III study, and were chosen based on similarities of bathymetric, trophic, chemical, and biological characteristics with Kezar Lake. Maximum depth, bottom dissolved oxygen concentration, pH, and alkalinity were the parameters used to select the reference lakes and ponds. The lakes that were selected include Onway Lake (Raymond), Pleasant Pond (Henniker), and Rollins Pond (Gilmanton). Table IV-1 summarizes the characteristics of each waterbody:

Table IV-1
Kezar and Reference Lake Parameters

Waterbody	Zmax	D.O. (mg/L)	pH	Alkalinity (mg/L as $CaCO_3$)	Status	Area (Ac)
Kezar Lake	26.9	0.1	6.7	4.8	Meso	181.5
Onway Lake	27.9	1.2	6.9	7.0	Meso	191.5
Pleasant Pond	27.9	0.1	6.7	5.6	Meso	92.1
Rollins Pond	27.9	0.2	7.1	6.0	Meso	37.0

Onway Lake and Pleasant Pond were reclaimed by the use of rotenone and restocked in 1964 and 1965, respectively. Rollins Pond was not previously reclaimed, and was picked as a control lake.

A. Planktonic Community Assessment

The planktonic community was analyzed to determine if the application of aluminum salts had an effect on the relative abundance of various groups of phytoplankton and zooplankton that are found in Kezar Lake. By removing phosphorus from the water column, and binding P to the aluminum salts particles in the sediments, a potential result could be a decline or a shift in the algal community that would subsequently result in the decline or shift of their associated zooplankton grazers.

Research conducted by Holz and Hoagland (1999) concluded that the application of aluminum sulfate does affect the phytoplankton and zooplankton communities in waterbodies. In Lake Leba, Nebraska, Holz and Hoagland documented declines in the Cyanobacteria followed by shifts in overall community assemblages, which resulted in an increase in the relative abundance of the Bacillariophytes and Chlorophytes after aluminum salts injection. Overall declines in chlorophyll-a and increases in transparency were also observed.

Lake Leba zooplankton exhibited small changes in community structure and relative abundance for particular species. Small changes were noted in the zooplankton relative abundance values soon after the aluminum salts injection, with obvious declines in rotifers and *Daphnia*, presumably due to the physical effects of aluminum salts floc traveling downward through the water column. Rotifers dominated in the treated area immediately following the aluminum salts injection. An eventual shift from rotifers and larger *Daphnia* species to smaller *Daphnia* and *Bosmina* species and cyclopoid and calanoid copepods took place in the water

column the summer following the aluminum salts injection. Shifts in zooplankton dominance and relative abundance values were thought to be a result of fish predation and changes in the algal food source of the zooplankton rather than aluminum toxicity.

1. Phytoplankton

Phytoplankton communities were intermittently sampled in Kezar Lake from 1976 through 1983 prior to the aluminum salts injection, and from 1983 to the present following the application of aluminum salts. Samples were collected by hauling an 80-micron mesh net from mid-thermocline to the surface at the deepest point of Kezar Lake.

Plankton samples were identified to the genus level under 100x magnification using a Sedgwick- Rafter enumeration chamber. Individual and colonial algae were counted, and relative percent values were calculated for each algal group. These numbers were then averaged over the course of the sample year, and monthly over the course of the pre- and post treatment periods (raw plankton data can be found in Appendix 4).

Three major algal groups have historically dominated the waters of Kezar Lake during the spring, summer, and fall seasons. The groups of algae that are represented in Kezar Lake include the Cyanobacteria, the Bacillariophyta, and the Chrysophyta. Due to problematic blooms, and their toxicity potential, the Cyanobacteria are the least preferred species. Table IV-2 lists the most commonly represented genera within each algal group at Kezar Lake.

Table IV-2
Algal Groups and their Common Genera in Kezar Lake, North Sutton

Cyanobacteria	Bacillariophytes	Chrysophytes
Anabaena	*Asterionella*	*Chrysosphaerella*
Aphanizomenon	*Melosira*	*Dinobryon*
Lyngbya	*Rhizosolenia*	*Mallomonas*
Microcystis	*Tabellaria*	

Seasonal changes in algal dominance are common in lakes and ponds. These changes usually occur due to the organism's response to changing environmental conditions brought on by seasonal changes, such as light, temperature, and nutrient conditions. Changes in algal community structure may also be influenced by zooplankton grazing.

General phytoplankton successions in New Hampshire are dependent upon environmental and ecological cycles that promote a dominance of Bacillariophyta and Chrysophyta during the spring season, with diatom blooms sometimes occurring below the ice. As the waters warm and the nutrient concentrations shift, the Bacillariophyta and the Chrysophyta may decline, leading to an increase in the Chlorophyta. Later in the summer, particularly August, some of the more nutrient-rich waters may have conditions that encourage the dominance of the Cyanobacteria. Kezar Lake is one such waterbody.

Figure IV-1 illustrates the mean monthly relative percent values of algal groups identified in Kezar Lake during the pre-treatment sampling period from 1976 through 1982. The results of this comparison indicate that during the time period prior to the aluminum salts injection in June 1983, the Cyanobacteria were the dominant algal group in Kezar Lake each month, except for the month of February, when the Bacillariophyta became dominant.

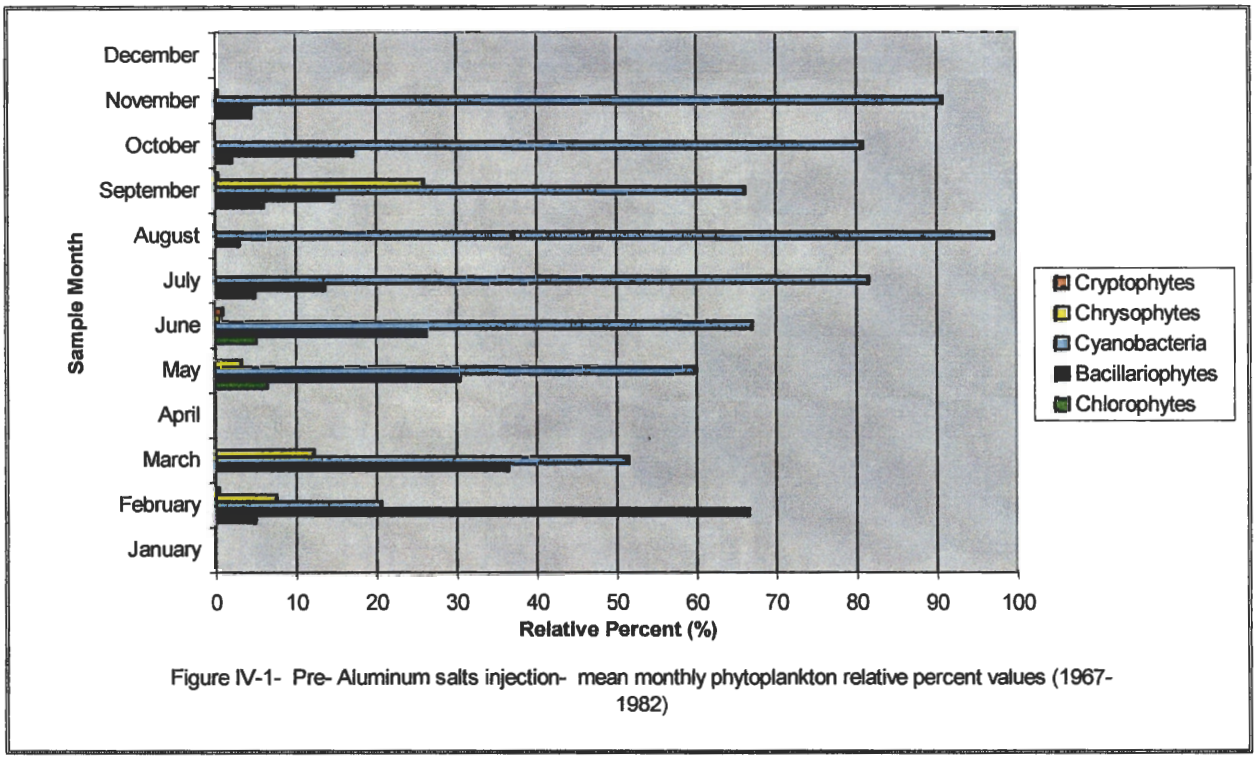


Figure IV-1- Pre- Aluminum salts injection- mean monthly phytoplankton relative percent values (1967-1982)

The Bacillariophytes maintained the next highest relative abundance values in Kezar Lake, followed by the Chlorophytes and periodic increases in the Chrysophytes. Cryptophytes did not prove to be a large component of the algal community of Kezar Lake.

Data collected from spring, summer and fall sampling events from 1980 through 1982 (during the diagnostic phase of the study) show the Bacillariophytes to be the dominant taxa in Kezar Lake. During late summer and during the fall season, the Cyanobacteria became dominant. Table IV-3 shows the phytoplankton seasonal succession before treatment (1980-1983) and after treatment (1984-1999). By July of 1981 and 1982 there were large increases in Cyanobacteria that persisted through October.

Table IV-3
Phytoplankton Seasonal Succession Before and After Aluminum Salts Injection

Year	Season	March	%	April	%	May	%
1980	Spring	*N/A*		*N/A*		*Asterionella*	49
1981		*Asterionella*	71	*Asterionella*	38	*Melosira*	40
1982		*Microcystis*	76	*Melosira*	35	*Melosira*	70
1984		*Lyngbya*	82	*NA*		*NA*	
1985		*Dinobryon*	64	*Dinobryon*	34	*Asterionella*	43
1986		*Melosira*	50	*Melosira*	61	*Melosira*	57
1987		*Lyngbya*	92	*Lyngbya*	62	*Melosira*	68
1988		*NA*		*Dinobryon*	40	*Melosira*	72
1991		*Asterionella*	89	*Asterionella*	56	*Melosira*	36
1992		*NA*		*NA*		*Asterionella*	31
1995		*NA*		*NA*		*Dinobryon*	46
1996		*NA*		*NA*		*Tabellaria* *Melosira*	32 29
1997		*NA*		*NA*		*Melosira* *Oscillatoria*	45 25
1998		*NA*		*NA*		*Melosira* *Tabellaria*	69 28
1999		*NA*		*NA*		*Melosira*	63
Year	**Summer**	**June**	**%**	**July**	**%**	**August**	**%**
1980		*Asterionella*	95	*Asterionella* *Mallamonas*	40 33	*Microcystis* *Microcystis*	70 29
1981		*Asterionella* *Tabellaria*	70 31	*Anabaena* *Anabaena*	91 91	*Anabaena*	85
1982		*Melosira* *Melosira*	46 41	*Lyngbya* *Lyngbya*	77 88	*Lyngbya* *Lyngbya*	77 71
1984		*Melosira* *Lyngbya*	48 42	*Dinobryon*	36	*Lyngbya*	28
1985		*Tabellaria*	38	*Tabellaria*	86	*Melosira*	46
1986		*Asterionella*	38	*Melosira*	55	*Lyngbya*	70
1987		*Melosira*	50	*Lyngbya*	44	*Lyngbya*	47
1988		*Melosira*	88	*Melosira*	88	*Lyngbya*	95

Table IV-3, cont.

1991		*Asterionella*	46	*Melosira*	37	*Asterionella*	66
1992		*Asterionella*	34	*Melosira*	37	*Melosira*	42
1996		*Anabaena*	39	*Melosira*	23	*Synedra*	51
		Asterionella	30	*Fragillaria*	21		
1996		*Dinobryon*	33	*Melosira*	69	*Synedra*	40
		Melosira	19			*Rhizosolenia*	29
1997		*Melosira*	50	*NA*		*Melosira*	60
		Tabellaria	34			*Tabellaria*	24
1998		*NA*		*Melosira*	55	*Melosira*	62
				Tabellaria	15	*Synedra*	19
1999		*Melosira*	32	*Oscillatoria*	67	*Melosira*	40
		Dinobryon	24			*Lyngbya*	33
Year	**Fall**	**September**	**%**	**October**	**%**	**November**	**%**
1980		*Aphanizomenon*	42	*Microcystis*	24	*Asterionella*	76
				Melosira	33		
				Dinobryon	37		
1981		*Microcystis*	44	*Rhizosolenia*	41	*Asterionella*	72
1982		*Lyngbya*	30	*Asterionella*	45	*N/A*	
1984		*Melosira*	42	*Anacystis*	44	*Melosira*	50
1985		*Melosira*	32	*Tabellaria*	55	*Tabellaria*	65
1986		*Tabellaria*	39	*Chrysosphaerella*	66	*Dinobryon*	45
1987		*Asterionella*	25	*Melosira*	55	*Melosira*	68
1988		*Melosira*	40	*NA*		*NA*	
1990		*NA*		*Asterionella*	71	*Asterionella*	76
1991		*Asterionella*	22	*Filamentous sp.*	73	*Asterionella*	45
		Filamentous sp.	66				
1992		*Melosira*	32	*Anabaena*	67	*NA*	
1994		*Melosira*	23	*NA*		*NA*	
		Tabellaria	17				
1995		*Synedra*	46	*NA*		*NA*	
		Melosira	20				
1996		*Lyngbya*	54	*NA*		*NA*	
		Chrysosphaerella	28				
1997		*Lyngbya*	41	*NA*		*NA*	
		Melosira	26				
1998		*Gleotrichia*	66	*NA*		*NA*	
1999		*Tabellaria*	57	*NA*		*NA*	
		Melosira	40				

Data gathered on the phytoplankton communities following the 1983 copper sulfate and aluminum salts injection, and the 1984 aluminum salts injection of Kezar Lake suggest that there

was an overall shift in dominance from the Cyanobacteria to the Bacillariophytes (similar to the results from Holz and Hoagland, 1999). The Bacillariophyte relative percent values increased to the point where they became the dominant algal group in Kezar Lake. The Cyanobacteria moved to second in abundance to the Bacillariophytes. There was also a large increase in the Chrysophytes, which is more typical of New Hampshire Lakes. Figure IV-2 shows the mean monthly relative percent values of the five algal groups identified in Kezar Lake following the aluminum salt injection.

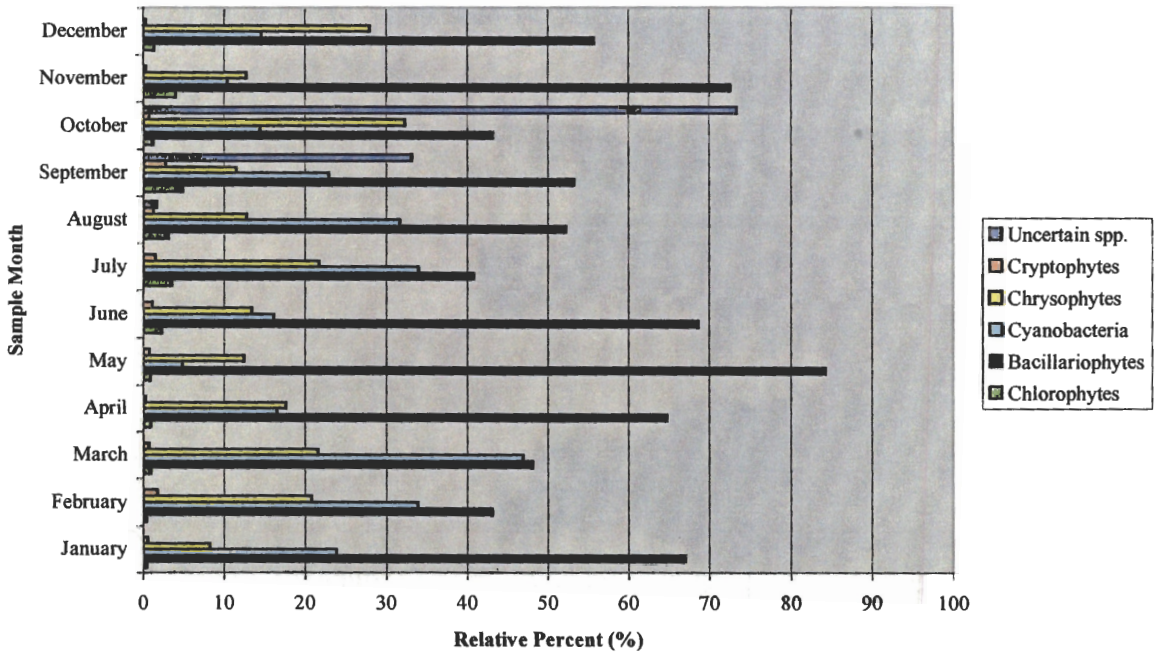


Figure IV-2- Post-aluminum salts injection- mean monthly phytoplankton relative percent values: July 1983-1999

A comparison of pre- and post treatment mean monthly algal relative percentages shows that prior to the aluminum salts injection the Cyanobacteria comprised greater than sixty percent of the algal communities present in Kezar Lake. Following the aluminum salts injection, the mean relative abundance of the Cyanobacteria dropped to below forty percent of the algal community make-up. The Bacillariophytes replaced the Cyanobacteria in mean monthly dominance, with mean monthly relative percent values greater than 40 percent.

As shown in Table IV-3, post-treatment algal relative percent values are higher for the Bacillariophytes. Algal samples show more frequent dominance by the Bacillariophytes than by the Cyanobacteria. Further, the Cyanophyte relative percent values increased somewhat only from July to August, where prior to treatment these peaks formerly extended from July into October.

By examining mean annual relative percent values for each group of algae, it is further evident that the Cyanobacteria were prevalent prior to the aluminum salts injection in 1983, and that after the injection, the mean annual relative percent values of the Bacillariophytes increased considerably, and have, through 1999, remained the dominant algal group in Kezar Lake. This shift in algal dominance is likely due to the reduction in phosphorus in the water column, and a lessening of the effects of internal loading due to the layer of aluminum salts over the sediments. Figure IV-3 shows the breakdown of the mean annual relative percent values by algal group.

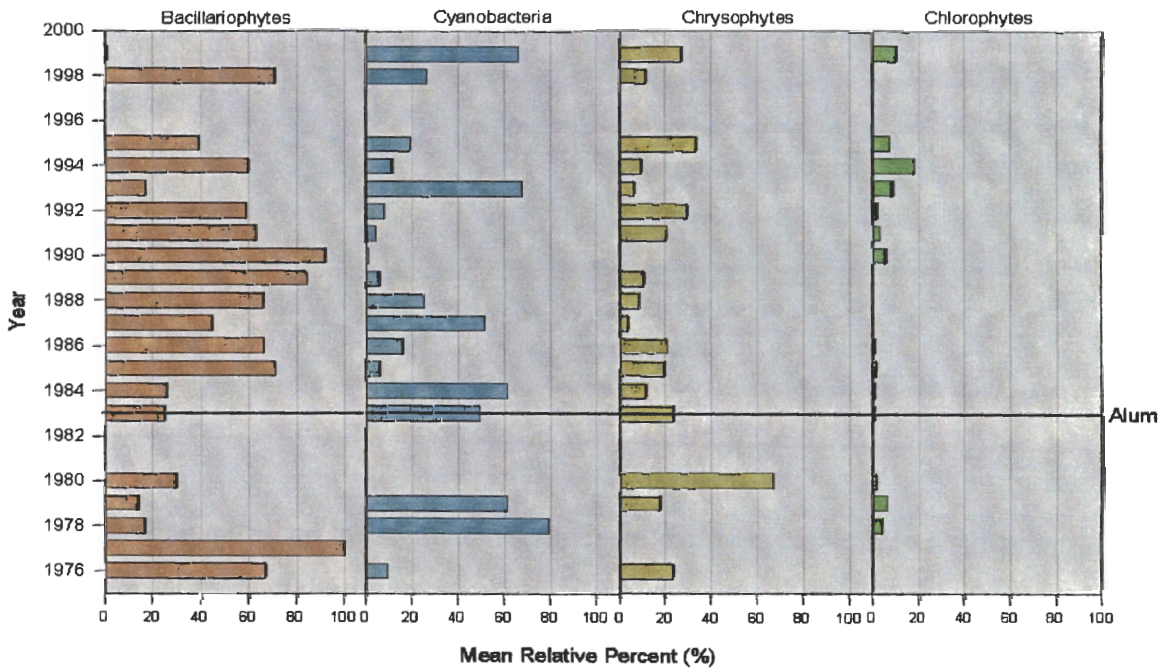


Figure IV-3- Algal Dominance as Mean Annual Relative %

In recent years, mean annual cyanobacteria relative percent values have exhibited fluctuating trends, with relative percent values greater than sixty percent in 1993 and 1999. The graph also suggests a gradual increase in the Chlorophytes, but their overall mean annual relative percent values have not exceeded twenty percent in any one year.

2. Zooplankton

Zooplankton make up the animal component of the planktonic community in a waterbody. These organisms are the next level from the algae in the aquatic food web. As such, these organisms influence the algal communities through their grazing pressures. This may work in reverse as well, with shifting algal dominance affecting the type and abundance of zooplankton grazers.

Zooplankton include the rotifers, cladocerans, copepods, ciliates and nematodes, among others. The Rotifers are typically more abundant in the mesotrophic to eutrophic waterbodies, while the copepods are usually higher in abundance in the more oligotrophic waters. This component of the aquatic food web was also studied in the Phase III project to determine if the aluminum salts injection had an effect on the zooplankton communities. Table IV-4 shows the common zooplankton groups and the genera found in Kezar Lake.

Table IV-4
Zooplankton Groups and their Common Genera in Kezar Lake, North Sutton

Rotifers	Cladocerans	Copepods
Keratella	*Daphnia*	Calanoid
Kellicottia	*Bosmina*	Cyclopoid
Polyarthra		Nauplius larvae

Research on the effects of aluminum salts injection on zooplankton populations in treated lakes suggests that these organisms may be affected by three factors: precipitation of aluminum hydroxide, the change in algal species dominance, and the increase in predation by planktivorous fish due to an increase in water clarity (Moffett, 1979). Conflicting results have been presented by numerous researchers, with results of studies suggesting a decline in zooplankton species diversity due to aluminum salts injection (Moffett, 1979) or to a change in the dominance of

zooplankton (Holz and Hoagland, 1999). Other results suggest no lasting impacts on zooplankton communities due to aluminum salts injection (Gibbons et. al, 1984).

The precipitation of aluminum salts floc could significantly influence the abundance and dominance of small zooplankton such as the rotifers and cladocerans. Due to their small size and weak swimming abilities, rotifers may be carried downwards through the water column with the precipitating floc (Holz and Hoagland, 1999). Though the aluminum salts injection at Kezar Lake was injected mostly into the hypolimnion, non-stratified areas of the lake were subjected to aluminum floc, thus allowing for some movement of the aluminum salts throughout the water column.

A decline in available phosphorus due to the aluminum salts injection could alter the species dominance of the algae, as discussed above. Shifts from Cyanobacteria to other more desirable species of the Chlorophytes or the Bacillariophytes may result in a shift in zooplankton species. Increases in relative percent values for such zooplankton species as *Daphnia* and *Bosmina* are correlated with increases in green algae and diatoms (Arnold, 1971 and Porter, 1973).

Significant diversity declines have been reported by Cooke and Myers (1981) and Moffett (1979) of planktonic microcrustacea in West Twin Lake, Ohio, after a hypolimnetic aluminum sulfate injection. The diversity decline, however, was not attributed to aluminum toxicity in the water column, but to changes of phytoplankton species, low pH, or high RDA in interstitial waters where ephippia, or other resting stages, might be found.

With shifting algal dominance and reductions in overall algae due to a decline in available phosphorus, it is likely that water clarity will increase (changes in clarity are discussed further in Section 3 of this chapter). Along with increased clarity, there may be an increase in grazing pressures of planktivorous fish that are more able to identify food sources in clearer waters. Large zooplankton, such as the Copepods and members of the Cladocera may be more heavily grazed in clearer waters (Brooks and Dodson, 1965).

Prior to the aluminum salts injection in 1983, Kezar Lake was dominated by rotifers. Common genera found in Kezar Lake included *Keratella*, *Kellicottia*, and *Polyarthra*. Table IV-5 shows the zooplankton succession from 1980-1982 (pre-treatment).

Table IV-5
Zooplankton Seasonal Succession Prior to Aluminum Salts Injection*

Year	Season	Month	%	Month	%	Month	%
	Spring	**March**	**%**	**April**	**%**	**May**	**%**
1980		*NA*		*NA*		*Polyarthra*	35
						Keratella	28
						Calanoid	13
1981		*Keratella*	33	*NA*		*Polyarthra*	45
		Bosmina	25			*Keratella*	30
1982		*Polyarthra*	40	*NA*		*Kellicottia*	40
		Nauplius	37			*Keratella*	25
						Polyarthra	20
	Summer	**June**	**%**	**July**	**%**	**August**	**%**
1980		*Codonella*	33	*Daphnia*	60	*Kellicottia*	90
		Keratella	28	*Nauplius*	20		
		Synchaeta	16				
1981		*NA*		*NA*		*Calanoid*	26
						Keratella	21
						Nauplius	19
1982		*Polyarthra*	33.5	*NA*		*Nauplius*	67
		Kellicottia	42.5			*Cyclopoid*	17
		Nauplius	13			*Kellicottia*	14
	Fall	**September**	**%**	**October**	**%**	**November**	**%**
1980		*Polyarthra*	25	*Rotifer sp.*	53	*NA*	
		Nauplius	13	*Keratella*	26		
		Calanoid	11	*Polyarthra*	26		
1981		*Nauplius*	26	*NA*		*Bosmina*	31
		Cyclopoid	22			*Polyarthra*	29
		Simocephal	18			*Nauplius*	10
1982		*Nauplius*	45	*Kellicottia*	NA	*NA*	
		Cyclopoid	29				

*Data are mean monthly relative percentages

The seasonal data suggest that rotifers persist throughout most of the year, with small increases in crustacean zooplankton occurring in later summer and early fall.

An examination of the mean annual relative percent values of each group of zooplankton reveals that there were no long-term shifts in zooplankton composition following the aluminum salts injection. This is consistent with other data published by Gibbons et al., 1984 and Schumaker et al., 1993. Figure IV-4 shows the mean annual relative percent values for the zooplankton before and after the aluminum salts injection.

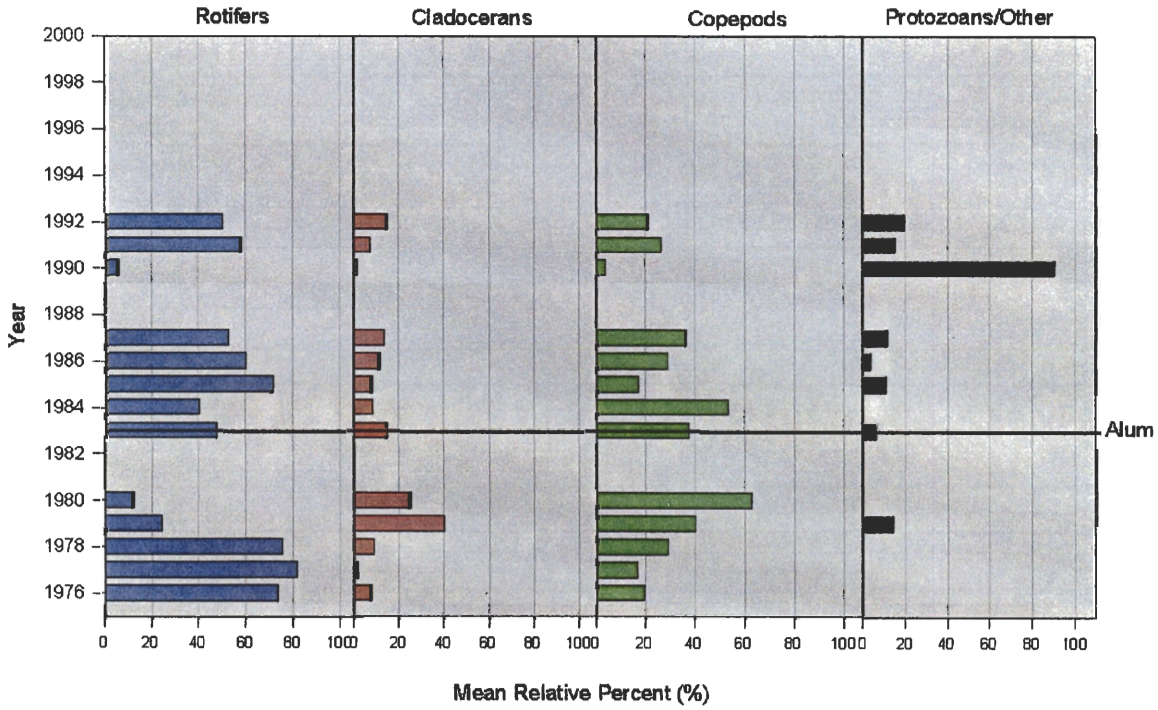


Figure IV-4- Zooplankton Dominance as Mean Annual Relative %

In 1984, the year following the pilot aluminum salts injection, data showed a small decline in the overall abundance of rotifers, cladocerans, and 'other' zooplankton species. The copepod species, on the other hand, increased by approximately sixteen percent. In 1985, following the large-scale aluminum salts injection, the rotifer population increased by over thirty percent, the cladoceran population decreased by approximately one percent (basically unchanged), and the copepod population declined by thirty-seven percent.

3. Chlorophyll-a and Transparency

Chlorophyll-a is a green photosynthetic pigment in plant cells. By obtaining a measure of chlorophyll-a, it is possible to extrapolate the biomass of the phytoplankton in the water column. The mean of chlorophyll-a data collected from over 700 lakes and ponds in New

Hampshire is 6.0 mg/m^3. Table IV-6 lists the ratings for chlorophyll-a densities in New Hampshire.

Table IV-6
Chlorophyll-a Categories

Category	mg/m^3
Good	0.0-5.0
More than Desirable	5.1-15.0
Nuisance	>15
N.H. Mean	6.0
Oligotrophic	<4.0
Eutrophic	>10.0

Prior to the copper sulfate and aluminum salts injections (1978-1982), the Kezar Lake chlorophyll-a concentration began at a mean monthly concentration of 12.42 mg/m^3 in June, and reached a maximum mean monthly chlorophyll-a concentration in August at 19.26 mg/m^3. Mean monthly chlorophyll-a concentrations did not decrease below 10 mg/m^3 during the summer and fall season prior to the 1983 and 1984 in-lake injections. In fact, during the months of July, August and October they reached nuisance proportions (Table IV-6). Figure IV-5 shows the mean monthly chlorophyll-a trends at Kezar Lake from 1976-1982.

There was a noticeable decline in the mean monthly Kezar Lake chlorophyll-a concentrations following the copper sulfate treatment and aluminum salts injections in 1983 and 1984. Figure IV-5 shows the trends in chlorophyll-a concentration following the injections (1984-1999). Though the chlorophyll-a concentrations still fell within the 'more than desirable' category following the aluminum salts injections, they no longer surpassed the 'nuisance' threshold. As discussed in Chapter V, the peaks in chlorophyll-a were less after the aluminum salts injections.

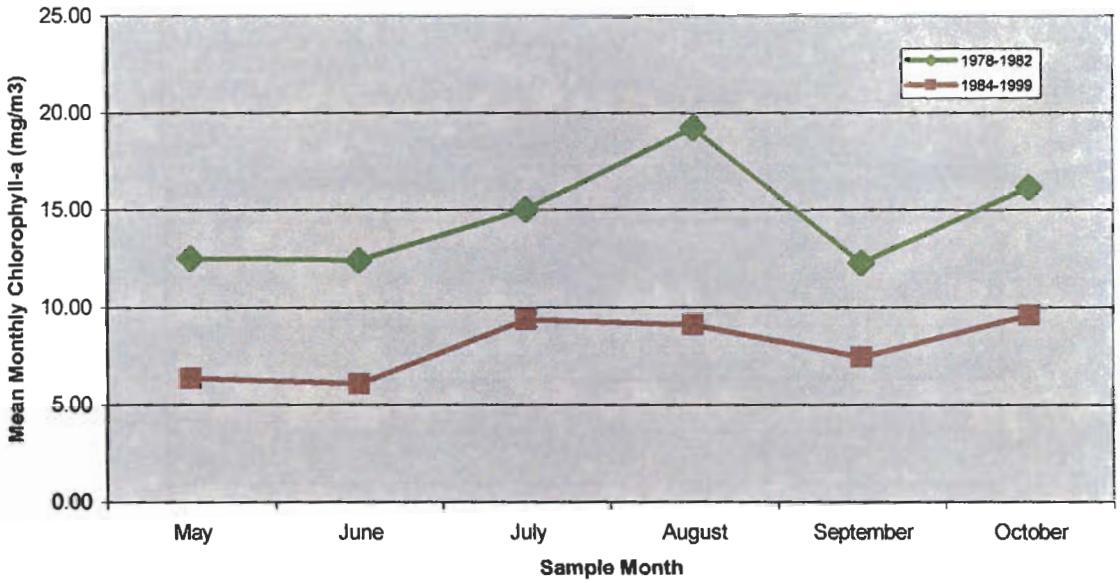


Figure IV-5 The relationship between mean monthly chlorophyll-a concentrations (mg/m3) before and after aluminum salts injection

After the aluminum salts injections in 1983 and 1984, the mean monthly summer and fall chlorophyll-a levels did not exceed 10 mg/m^3. A comparison of pre- and post injection mean monthly chlorophyll-a concentrations showed that there was a 51 percent decrease in chl-a in May, a 49 percent decrease in June, a 62 percent decrease in July, a 47 percent decrease in August, and a 60 percent decrease in September. Prior to the aluminum salts injection, the Cyanobacteria reached maximum dominance in August, which was a factor that caused this month to have the highest chlorophyll-a concentrations. With a decline in the blue-green algae as a result of the aluminum salts injections, the much-elevated August chlorophyll-a levels were reduced considerably.

These dramatic chlorophyll-a declines suggest that the aluminum salts injection and watershed management were effective in decreasing the internal and external phosphorus loading to a level that limited algal productivity, which decreased the chlorophyll-a concentration in the water.

Figure IV-6 shows the mean monthly transparency values before and following the aluminum salts injections. The decline in the chlorophyll-a concentration resulted in an increase of lake transparency. Generally, mean monthly Secchi disk readings observed before (May-September 1976-1982) and after (May through September 1983-1999) showed that there was a

half-meter or more increase in transparency after the aluminum salts injections of 1983 and 1984.

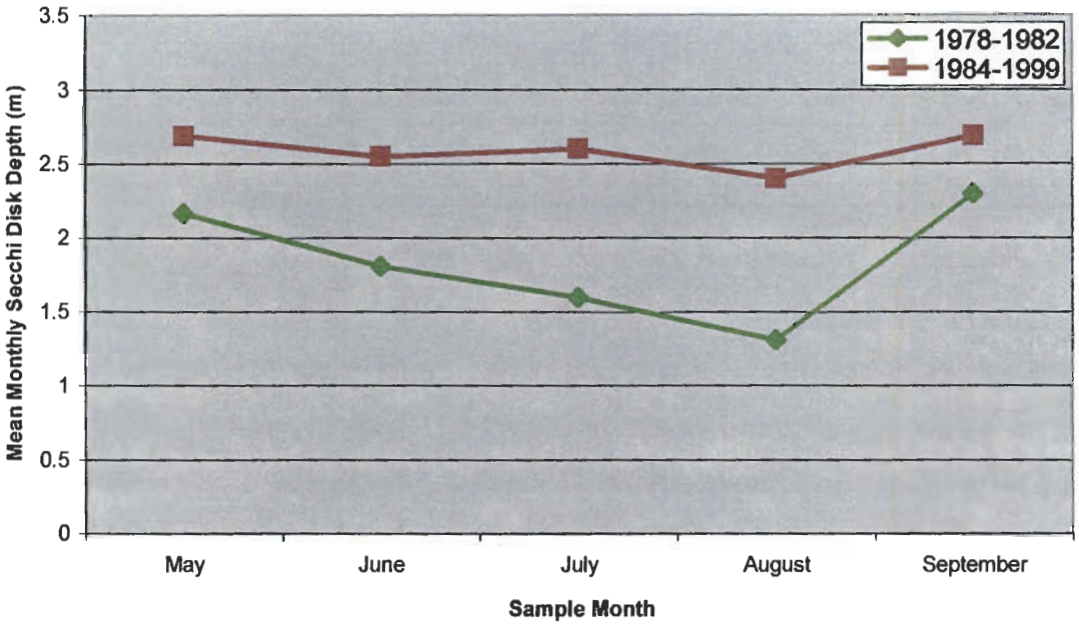


Figure IV-6 A comparison of pre- and post treatment mean monthly transparency (m) in Kezar Lake, North Sutton

B. Macroinvertebrates

To protect themselves from adverse environmental conditions, macroinvertebrates can seek refuge in bottom sediments and macrophyte communities in waterbodies. When hypolimnetic aluminum salts injections are conducted, however, these refugia become the zones where potential toxic effects on the macroinvertebrates may take place.

In 1984, bioassays of Kezar Lake water and sediments were performed to assess the impact of hypolimnetic aluminum sulfate and sodium aluminate injection on the naturally occurring benthic macroinvertebrates of Kezar Lake. Bioassays were performed with lake sediments and water transferred to laboratory test tanks, and with in-situ benthic community samples collected before, and one month after aluminum salts injection.

Sediments and lake water for in-lake benthos enumeration and for laboratory bioassay experiments were collected at the 7.5-meter deep site at Kezar Lake on June 4, 1984. The sediments were collected using an Eckman 24 cm square dredge. The samples were sealed in large plastic trays for transport back to the laboratory. The lake water was collected near the surface at the deep site in 20 L polypropylene jugs.

Fifteen days after the aluminum salts injection of Kezar Lake, a second sediment sample was taken from the deep spot in the same manner as the first. Eight liters of this sediment were sifted to enumerate the macroinvertebrates present, in-situ, after treatment.

1. Laboratory Bioassay

Once at the laboratory, the individual trays of sediments were combined and mixed. Sub-samples of the sediments were transferred to three 56.8 L (15 gallon) aquaria to a depth of 3 cm, equal to a volume of 6 liters. This was followed by the careful addition of 24.5 L of Kezar Lake water to each tank. The tanks were allowed to settle overnight, after which 13.1 L of lake water were added, bringing the total volume of water in each tank to 37.6 L (10 gallons). The experimental tanks were covered and the water in them was allowed to clear and equilibrate. Aliquots were taken from untreated lake water within the tanks and analyzed for background levels of pH, alkalinity, and total phosphorus.

The test tanks were treated according to Table IV-7 to simulate levels of treatment that were later applied to Kezar Lake. The algaecide, copper sulfate, was applied to tank 3 by placing the appropriate amount of coarse crystal in a metal strainer and gently swirling it in the surface water until dissolved. The appropriate amounts of aluminum sulfate and sodium aluminate were placed in plastic syringes and injected simultaneously into tanks 2 and 3 to produce flocculation. Following a 24-hour period, during which transparency increased remarkably, aliquots of the treated water were taken and analyzed for pH, alkalinity, total phosphorus, copper, and residual dissolved aluminum.

Table IV-7
Bioassay Treatment Schedule

Tank	Treatment	Basis
1	None	Control
2	Alum: 11.7 ml S.A. 5.8 ml	2:1 ratio 40 mg/L Al
3	CuSO4: 6.35 mg Alum: 11.7 ml S.A. 5.8 ml	0.169 mg/L (4.5 lb/acre/10 ft) 2:1 ratio 40 mg/L Al

Tables IV-8 and IV-9 summarize the water chemistry within the test tanks before and after treatment. The total phosphorus level in tank 2 before treatment was assumed to represent total phosphorus levels in all tanks, since the water in all tanks came from the same source.

Table IV-8
Bioassay Chemistry: Pre-Treatment

Tank	PH	Alkalinity mg/m3	Total Phosphorus mg/L
1	6.35	4.4	---
2	6.18	4.4	0.011
3	6.17	3.9	---

Table IV-9
Bioassay Chemistry: Post-Treatment

Tank	PH	Alkalinity mg/m3	Total Phosphorus mg/L	Copper mg/L	Residual Dissolved Aluminum ug/L
1	6.02	3.4	---	<0.1	680
2	5.21	0.39	0.011	---	330
3	4.88	0.09	0.038	30.0	800

Total phosphorus levels in tank 2 remained unchanged after treatment, while a three-fold increase was observed in tank 3. One explanation for this is that treatment with $CuSO_4$ in tank 3 had caused algal cell lysis and release of phosphorus in the tank. All three tanks had *Microcystis* colonies visible on the surface prior to treatment. This scum persisted after treatment in all but tank 3, to which copper sulfate had been applied. Since the aliquots for analysis were taken below the water surface, total phosphorus values would not reflect the amount bound within surface algae in tanks 1 and 2, but would incorporate any phosphorus released from cells that had lysed or sunk into the water column after death, in tank 3.

As was expected, copper concentration in tank 3 increased over background levels, from 0.1 mg/L prior to treatment to 30 mg/L after treatment with copper sulfate.

Analysis for residual dissolved aluminum after aluminum salts injection yielded variable results. Background levels were high in the control tank, at 680 ug/L. Tank 3 exhibited an increase in RDA of 120 ug/L over background, to 800 ug/L. Such an increase is within the range predicted by Connor's sediment inactivation experiments (Connor and Smith, 1983). The RDA value for tank 2 was significantly lower than background and is suspect.

At the end of the seven-day treatment period, the water was drained from the test tanks. The sediments were sifted and the macroinvertebrates were enumerated. The life cycle of the midges was accelerated by the warmer laboratory temperatures resulting in the hatchout of midges in some of the test tanks during the treatment period. The results of the sifting of the test tank sediments after treatment are listed in Table IV-10.

Table IV-10
Laboratory Bioassay Post Treatment Macroinvertebrate Count

Tank	Organisms
1*	8 *Chaoborus* larvae (Diptera) or 1.3/L 1 alderfly larvae (Sialidae, Megaloptera) or 0.2/L
2	2 *Chaoborus* larvae (Diptera) or 0.3/L 1 alderfly larvae (Sialidae, Megaloptera) or 0.2/L 3 midge adults (hatchout) (Chironomidae, Diptera) or 0.5/L
3	2 *Chaoborus* larvae (Diptera) or 0.3/L 1 alderfly (Sialidae, Megaloptera) or 0.2/L 1 midge adult (hatchout) (Chironomidae, Diptera) or 0.2/L

*No midge larvae or hatchouts were recorded for tank 1

2. In-Situ Study

Eight liters of the Kezar Lake sediment collected prior to the treatment were sifted to identify and quantify the macroinvertebrates present, representing in-situ densities in Kezar Lake before any chemical addition. Sifting was accomplished utilizing a stack of three USA standard testing-sieves, numbers 7, 14, and 18, with corresponding opening sizes of 2.8 mm, 1.4 mm, and 0.6 mm. The results of the sifting are listed in table IV-11.

Table IV-11
In-Situ Macroinvertebrate Count from Sifting

Results of Sifting 8 Liters of Kezar Lake Sediment
29 *Chaoborus* larvae (Diptera) or 3.625/L
2 alderfly larvae (Sialidae, Megaloptera) or 0.25/L
5 midge larvae (Chironomidae, Diptera) or 0.625/L.

At the time of collection, the dissolved oxygen level in the hypolimnion was 7.5 mg/L. The mucky sediment was of a very fine texture with little odor. Soft larval cases were very abundant, but empty. Chironomid larvae are known to produce such tubes in the bottom substrates of lakes and streams (Mason, 1973), and were probably responsible for the empty cases found in Kezar Lake sediment.

Eight liters of mucky sediments were collected and sifted 15 days after completion of the lake treatment. Small, grayish-brown clumps, presumably aluminum salts floc, were found throughout the sample. None of the chironomid larval cases were found, though they had been very abundant in the samples collected one month earlier. The muck had the distinct odor of anoxic sediments. No organisms were found.

3. Bioassay Summary

Results from the sediment bioassay indicated no detrimental effect on midge or alderfly larvae. Densities present in the treated tanks were the same as in the control tank, and approximated the densities found in-situ. Chaoborus densities were lower in all tanks than in-situ. The treated tanks showed a significantly lowered density over the control tank, attributable to the treatment or loss during tank draindown.

The lack of benthic insects within the in-situ sample taken after lake treatment can most probably be attributed to maturation and migration rather than to effects of the treatment. Chironomids are reported to be adapted for survival in waters with low dissolved oxygen (Mason, 1973). The hemoglobin present in their blood may aid in extracting what little O_2 may be available in near-anoxic waters. In mid-July, dissolved oxygen within the hypolimnion at Kezar Lake was near 2 mg/L and had been at that level for a period of 2-4 weeks. During the week of treatment in the test tanks, all the chironomids had matured and hatched out, accelerated by the warm laboratory temperatures. By mid-July, when the after-treatment sediment sample was collected, the natural population in Kezar Lake may have also reached the adult stage.

Sialids, on the other hand, require well-aerated water (Chandler, 1958) and are only occasionally collected as deep as 15 m in lakes. Their customary habitat is along the margins of ponds and lakes, buried in the muddy substrate, or among the stones of stream and river beds (Pennak, 1978). Megaloptera larvae are capable of long migration. With well-developed legs, the larva typically crawls along the surface of the substrate, but can also swim by undulations of the body. Mature larvae crawl as far as 50 m from the water just before pupation. It is conceivable that the sialids in Kezar Lake had migrated to better conditions or matured by mid-July.

4. Macroinvertebrate Aluminum Concentrations

Further studies were conducted with macroinvertebrates to determine the concentration of aluminum in the bodies of organisms collected in Kezar Lake and the reference lakes. Macroinvertebrates collected at Kezar Lake, Pleasant Lake, and Rollins Pond were macerated and analyzed for elemental aluminum to determine if uptake of aluminum is a factor in mortality.

Research by Doke et al. (1995) on the benthic macroinvertebrate communities of Newman Lake, WA, before and following an aluminum sulfate injection showed no adverse effects as a result of the treatment. Benthic samples collected several days after the aluminum sulfate injection contained chaoborid, oligochaete, and chironomid densities similar to pre-treatment samples. There was a two-fold increase in the chaoborid population, which the researcher contributed to the change in available food for the chaoborid instar larvae and a decrease in predation due to a decrease in the numbers of stocked rainbow trout.

Figure IV-7 shows the results of a macroinvertebrate aluminum concentration study conducted on Kezar Lake benthic samples. Results from these studies at Kezar Lake and two reference lakes showed that Pleasant Lake macroinvertebrates had almost double the aluminum content than Kezar Lake macroinvertebrates. Pleasant Lake may naturally have higher aluminum concentrations than Kezar Lake and other lakes in the area.

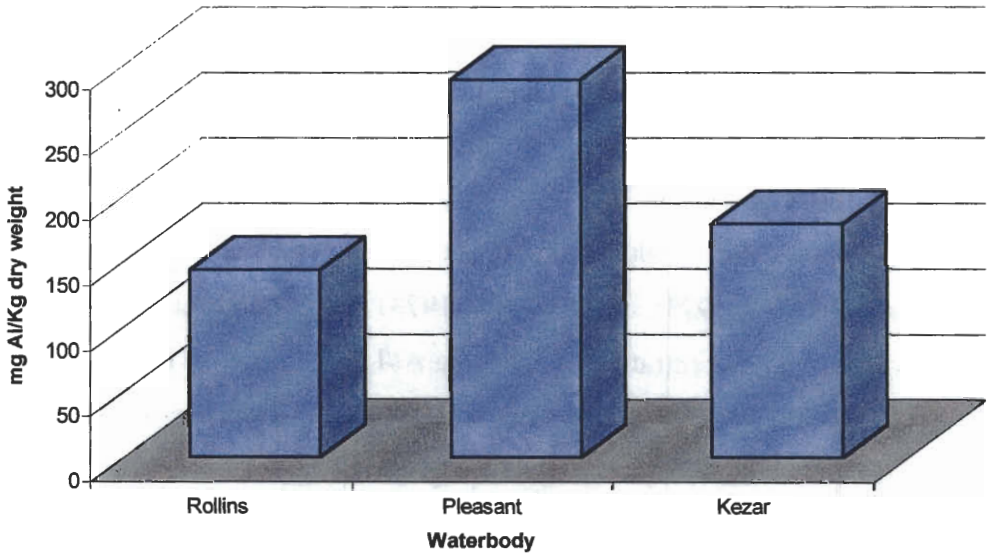


Figure IV-7 A comparison of aluminum concentrations in invertebrates collected at Kezar Lake and various reference lakes.

C. Fisheries

Fish are an important component of any waterbody. They influence, and are influenced by, changes in the chemistry and the biology of the aquatic environment. In many waterbodies fish, such as bass, are the top predator in the food chain, thereby influencing the nutrient and planktonic components of the systems, which they inhabit.

A major concern stemming from the aluminum salts injection of Kezar Lake was the effect that the treatment would have on the fishery of the lake. Poleo et al. (1997) have concluded that aluminum is acutely toxic to various fish species. Fortunately fish, unlike other aquatic organisms already discussed in this chapter, have the ability to quickly seek refuge in other areas of the lake, or in upstream locations that were not treated, thereby ameliorating some of the potential stressors derived from such a treatment.

Havas and Rosseland (1995) have shown that in zones where aluminum-rich waters mix with neutral water, prime conditions exist for the transformation of low molecular forms of aluminum into higher molecular weight molecules, which precipitate onto the breathing and filtering devices of aquatic organisms such as fish. Gill lesions, stunted fish growth (likely due to reduced appetite), failure in osmo-regulatory balance, and enzyme disruption can occur due to aluminum accumulation in fish tissues.

The accumulation of aluminum on the gills of fish is explained by the attraction of the positively charged aluminum molecules to the negatively charged organic molecules on the gill membrane (Exley and Phillips, 1988; Exley et al. 1991). Aluminum bound to the gill membrane may interfere with diffusion and uptake processes, the excretion of nitrogenous wastes, and respiration (Havas and Rosseland, 1995).

Research on fish exposure to aluminum has shown mixed results. Freeman and Everhart (1971), Everhart and Freeman (1973), and Freeman (1973) used a constant flow bioassay to test toxicity to rainbow trout. A concentration of 5,200 ug Al/L, whether at pH 9.0, where it is totally soluble, or at pH 7.0, where it is nearly insoluble, seriously disturbed trout for exposures in excess of six weeks. Dominie (1981) reported that golden shiners (*Notemigonus crysoleucas*) showed no mortality, did not appear to be stressed by the test conditions, and did not avoid the aluminum floc even in the 100 mg Al/L jars. At 52 ug Al/L, there was no obvious effect on growth or behavior on trout, leading Kennedy (1978) and Cooke et al. (1981) to adopt this value as the allowable upper RDA limit for lake treatment.

In Kezar Lake, studies of the fish communities were conducted in 1994. Whole fish digestions, and digestions of fish gills, livers, and fillets were conducted to determine if aluminum was accumulating in the fish in Kezar Lake (raw data can be found in Appendix 5).

Yellow perch and hornpout were collected from Kezar Lake and each of the reference lakes. Yellow perch were collected by placing fyke nets in the water overnight. Hornpout were collected by angling. The five largest fish of each species, from each lake, were collected for analyses. EPA methodologies for tissue analyses were used. The weights, lengths, and ages (scale ring) were measured for each fish.

The results of the whole fish study showed that Kezar Lake perch had slightly higher mean aluminum concentrations than the perch collected at Rollins Pond and Onway Lake. The results of the whole fish analyses on hornpout showed that Kezar Lake hornpout had nearly

double the mean aluminum concentration that the Onway Lake hornpout exhibited. Perch are planktivorous in their feeding habit, and are unlikely to be heavily impacted by the aluminum salts injection (unless their food supply was significantly disrupted, which did not appear to be the case in Kezar Lake, as discussed in section A of this chapter). Hornpout are bottom feeding fish, and as such, could have ingested small amounts of aluminum during their feeding activities, thereby increasing the mass of aluminum in their tissues. Figure IV-8 shows the mean aluminum concentrations in whole fish digestion analyses.

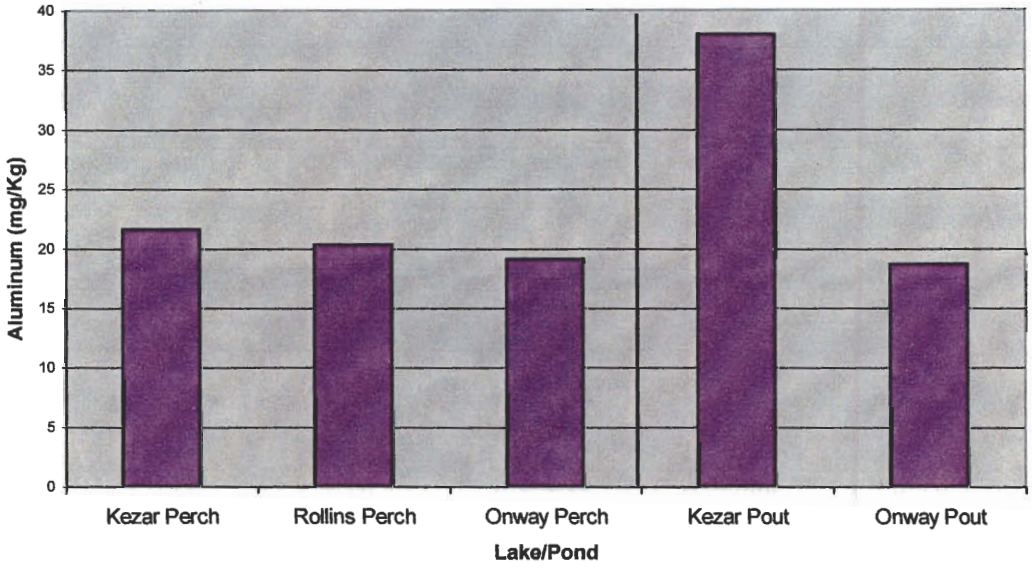


Figure IV-8 A comparison of mean aluminum concentration in whole fish studies collected at various ponds

To determine if aluminum accumulates in different organs or tissues in the fish, specimens were collected from Kezar Lake and the reference lakes for analysis. Samples of gill tissue, liver tissue, and fillets were separated from the fish collected at each waterbody. Samples were analyzed for aluminum content, and mean concentrations for each tissue/portion are shown in Figure IV-9.

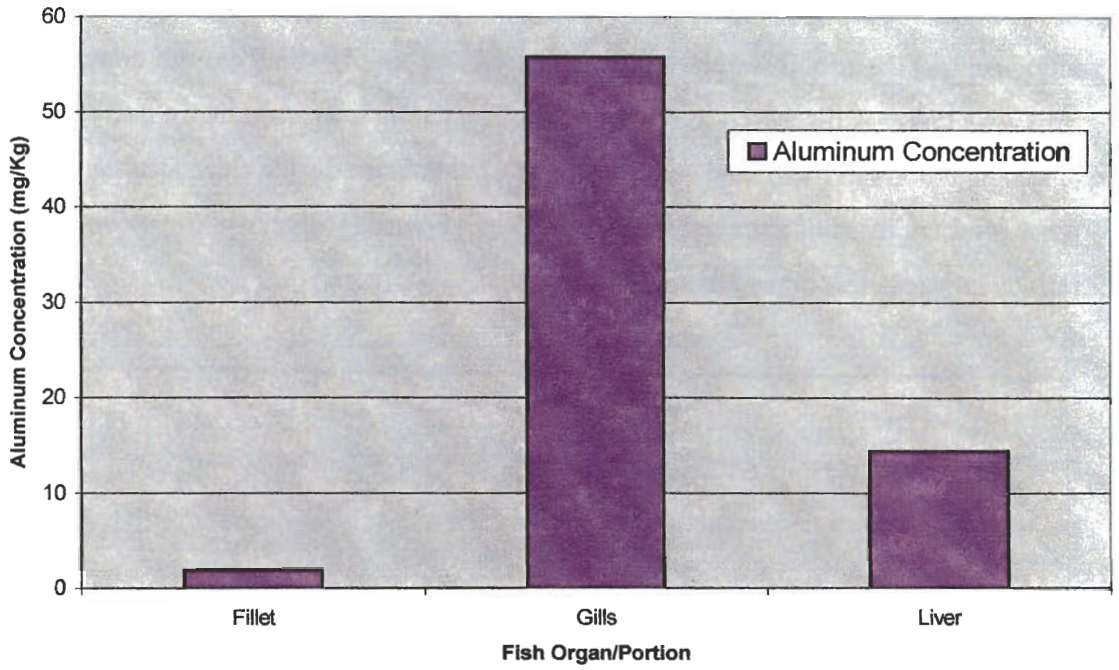


Figure IV-9 A comparison of mean aluminum accumulation in various fish organs/portions collected from multiple waterbodies (n=15)

Results of this study clearly show that the gills of the fish have much higher concentrations of aluminum than the fillets or the liver. Havas and Rosseland (1995) and Freeman (1973) have suggested that the gills are the first and most heavily impacted organ in fish.

Figure IV-10 shows a comparison of mean aluminum concentration in the gill tissues of fish collected from Kezar Lake and reference lakes. A closer evaluation of the mean aluminum content of the gill study shows that Kezar Lake had the lowest concentration of aluminum in the gill tissues compared to four reference lakes. Onway Lake had the highest aluminum content in fish gill tissue, followed closely by Jenness Pond.

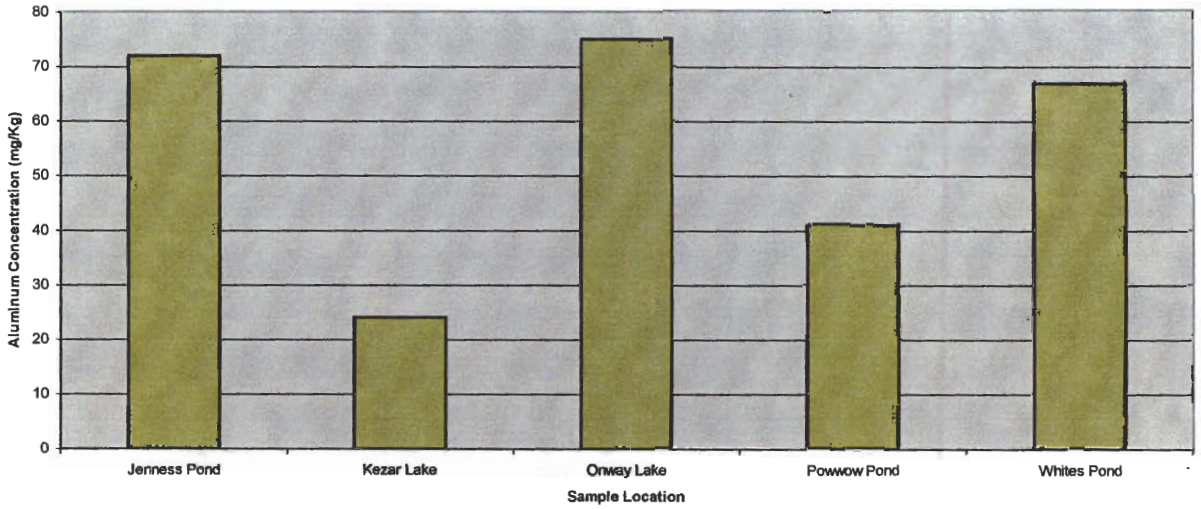


Figure IV-10 A comparison of aluminum concentration in gills of fish collected at Kezar Lake and reference lakes

Figure IV-11 shows the results of a comparison of aluminum content in fish livers. Kezar Lake ranked third highest in concentration compared to six reference lakes. No aluminum was detected in liver tissue from fish collected at Whites Pond (third highest in gill Al content), and less than 10 mg/Kg of aluminum were detected in livers from fish in Powwow Pond and Jenness Pond.

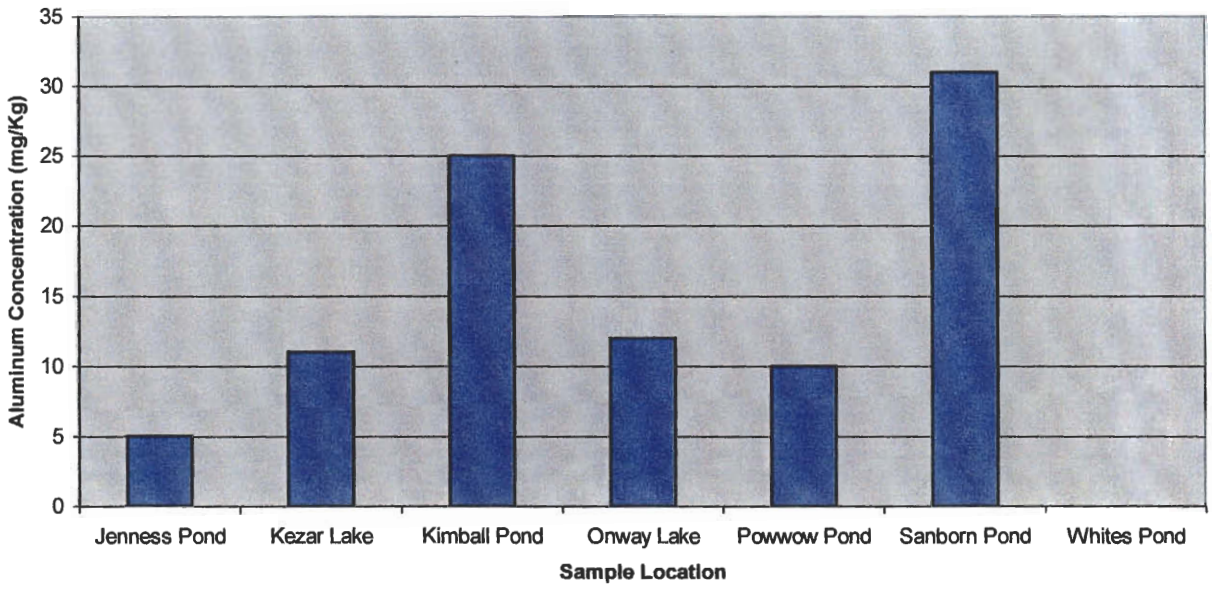


Figure IV-11 A comparison of aluminum concentrations in fish livers from seven area lakes.

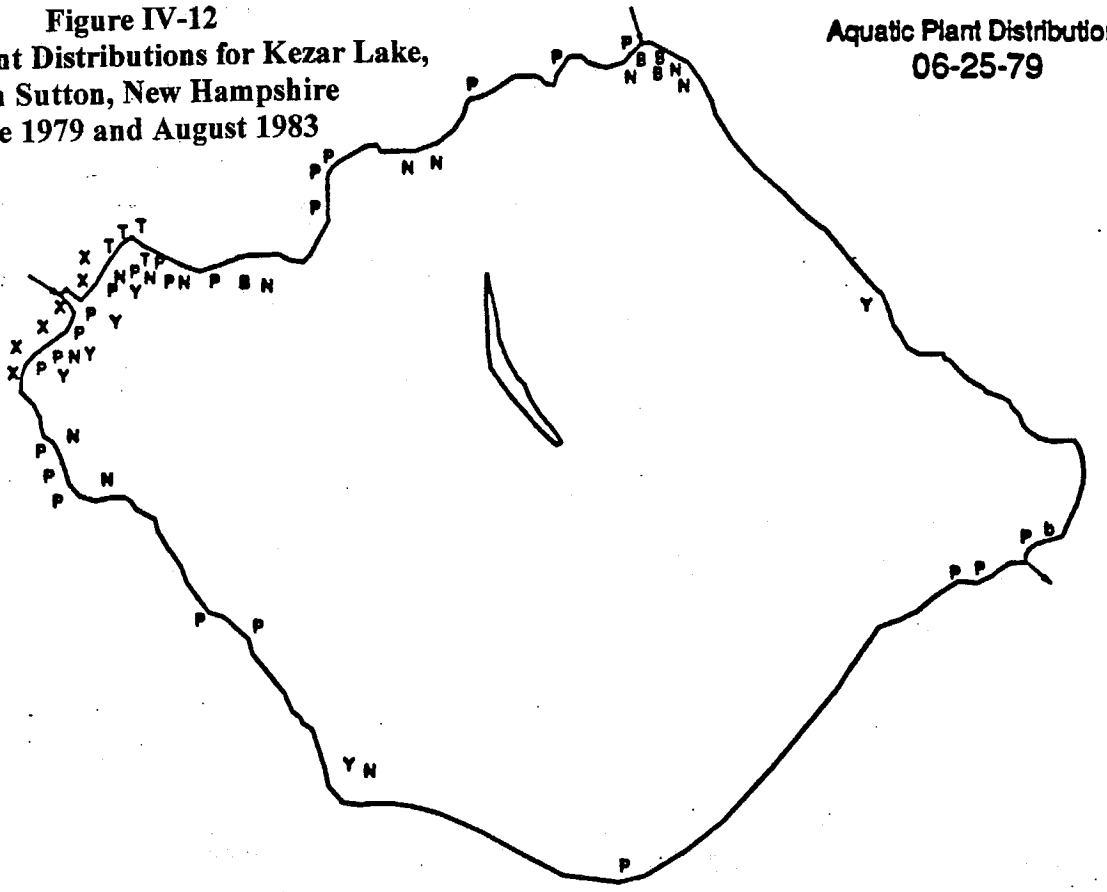
The results of these comparisons suggest that the bulk of the aluminum detected in the whole fish maceration study was derived from gill tissue. This is consistent with the results of a number of studies that report the gills tend to accumulate more aluminum than the other portions of the fish. The uptake mechanisms for bringing the aluminum into the fish are still uncertain. Those fish showing higher concentrations in the livers may have been exposed to higher concentrations over longer time periods.

The results of these comparisons lead to some conflicting results. The whole fish study shows that Kezar Lake has the highest aluminum concentration in both yellow perch and hornpout, yet the concentrations detected in the gills and livers are low compared to the other ponds in the study. These results suggest that the aluminum may be accumulating in other portions of the fish that were not analyzed.

D. Aquatic Macrophytes

Aquatic plant surveys were conducted prior to the Diagnostic Phase of the Kezar Lake studies (1979), and again ten years following the aluminum salts injection in the lake (1993).

Figure IV-12
Aquatic Plant Distributions for Kezar Lake, North Sutton, New Hampshire June 1979 and August 1983



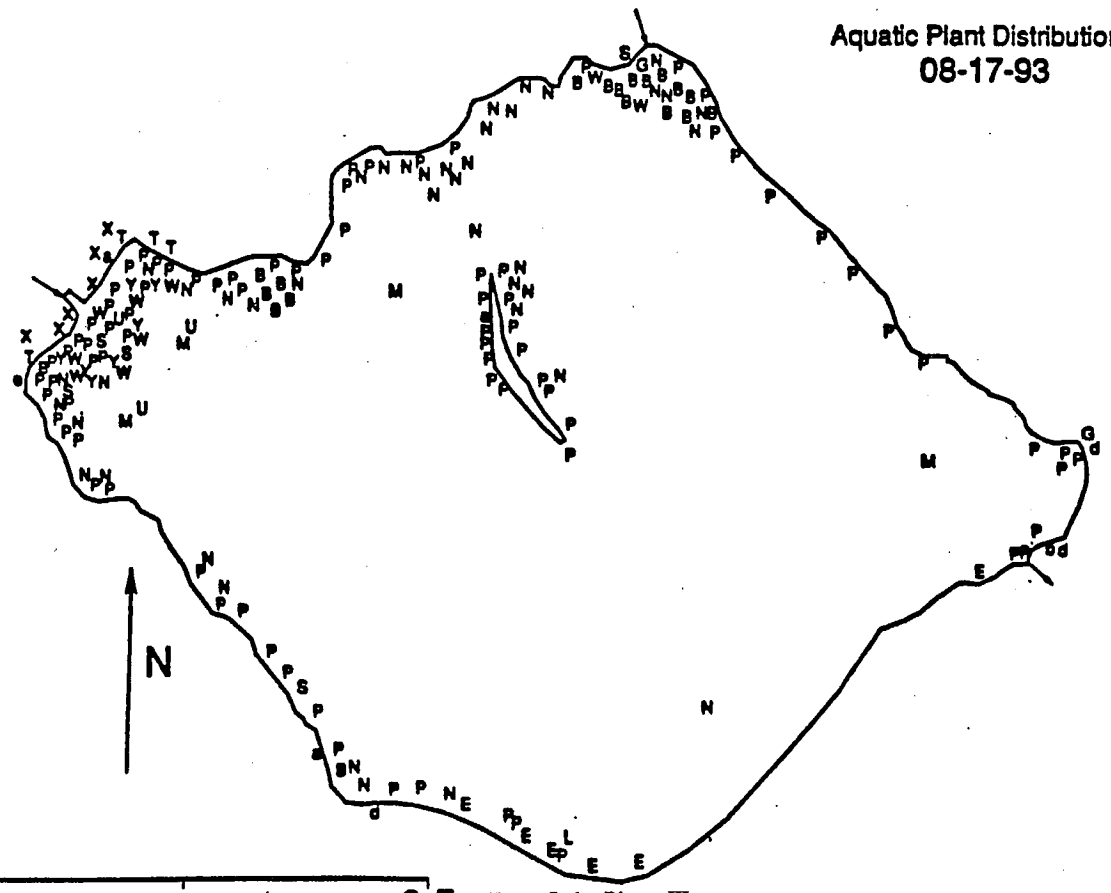


Figure IV-11 shows the results of these surveys. Table IV-12 a & b are keys to the symbols used in the map.

Figure IV-12-a
Kezar Lake Aquatic Plant Distribution, June 25, 1979

Symbol	Generic Name	Common Name	Abundance
Y	*Nuphar*	Yellow Water Lily	Sparse
N	*Nymphea*	White Water Lily	Scattered
B	*Brasenia schreberi*	Water Shield	Sparse
P	*Pontedaria cordata*	Pickerelweed	Scattered
T	*Typha*	Cattail	Sparse
X	*Myrica gale*	Sweet Gale	Scattered
b	*Juncus*	Rush	Sparse

Figure IV-12-b
Kezar Lake Aquatic Plant Distribution, August 17, 1983

Symbol	Generic Name	Common Name	Abundance
Y	*Nuphar*	Yellow Water Lily	Sparse
N	*Nymphea*	White Water Lily	Scattered-Common
B	*Brasenia schreberi*	Water Shield	Scattered
P	*Pontedaria cordata*	Pickerelweed	Common
T	*Typha*	Cattail	Sparse
X	*Myrica gale*	Sweet Gale	Sparse
b	*Juncus*	Rush	Sparse
U	*Utricularia*	Bladderwort	Scattered
W	*Potamogeton*	Pondweed	Scattered
d	*Dulichium*	Three-Way Sedge	Sparse
G	*Graminae*	Grasses	Sparse
a	*Peltandra virginica*	Arrow Arum	Sparse
e	*Equisetum*	Horse Tail	Sparse
L	*Lobelia dortmanna*	Water Lobelia	Sparse
E	*Eriocaulon*	Pipewort	Sparse
M	*Chara*	Musk Grass	Sparse
S	*Sparganium*	Bur Reed	Sparse

In 1979, plant abundance was scattered, with most of the macrophyte growth occurring along the northwestern shoreline where Lyon Brook enters the lake. The plants were mostly comprised of sweet gale (*Myrica gale*), white water lilies (*Nymphea*), pickerelweed (*Pontedaria*), and yellow water lilies (*Nuphar*). Pickerelweed was scattered around portions of the shoreline of Kezar Lake, as were the yellow and white water lilies. No vegetation was evident along the shores of the island.

The aquatic plant survey in 1993 revealed an increase in overall plant abundance. Over the fourteen-year period since the initial survey, the macrophytes spread from the scattered communities in the northwest cove of the lake to fairly common stands of plants along the northern and southwestern shores of Kezar Lake. Pickerelweed and the water lilies also ringed the lake and the island in scattered stands.

The 1993 survey also showed an increase not only in the abundance of macrophyte growth, but an increase in the overall plant diversity as well. In 1979, only seven plant species were mapped in Kezar Lake. In 1993, seventeen species were documented. The overall abundance values also increased from a rating of 'scattered' in 1979, to a rating of 'common' in 1993. The 10 new species that were identified in the 1993 survey were still classified with density ratings of 'sparse'.

Overall, it does not appear that the hypolimnetic salts treatment applied to Kezar Lake had any limiting effects on the growth of aquatic macrophytes. Macrophytes obtain their nutrients both from the sediments and from the surrounding water. It is not likely that the injection of aluminum salts to the hypolimnion would affect the plants growing in the littoral zones of the lake and the island. It is likely, however, that the increase in water clarity, and therefore an increase in sunlight over the littoral zone, may have influenced the increase in macrophyte growth.

CHAPTER V

EVALUATION OF TREATMENT EFFECTIVENESS AND LONGEVITY FROM HYPOLIMNETIC ALUMINUM SALTS INJECTION

Overview

An increase of planktonic algae, especially cyanobacteria is a good indication that excessive phosphorus loading is occurring within the watershed or the lake. Excessive algae or algal blooms lead to degraded lake quality, impaired recreation, odor problems and fish kills. New Hampshire's approach to solving excessive algal productivity is through long-term solutions, rather than the quick-fix bandade approach.. The reduction of algal biomass must include reductions in external phosphorus loading to the lake. Any management practice must focus on mechanisms that reduce the supply of phosphorus to the lake since phosphorus is the biomass-limiting nutrient in New Hampshire.

Many researchers have documented an improvement in lake quality after in-lake phosphorus concentrations have been reduced. In the 1970's, Lake Winnisquam had severe cyanobacteria blooms and recovered quickly once the source of excessive phosphorus was removed. In-lake phosphorus concentrations should decline proportionately as external phosphorus loading declines, modified by dilution and phosphorus sedimentation (Welch and Cooke, 1999).

When internal phosphorus loading is providing the necessary amount of P to maintain nuisance algae blooms, a lake may not recover. Lake recovery may be slow and incomplete depending on P retention of bottom sediments (Welch and Cooke, 1999). This was the case for Kezar Lake. Even after 71 percent of the external phosphorus supply to the lake was eliminated by treated effluent diversion, the lake continued to reflect poor water quality (Connor and Smith, 1983). Welch and Cooke maintain that if lake sediments do not retain P, then reduction in lake concentration following external load reduction is due mainly to dilution, and sediment release may continue, perhaps for 20 years or longer.

In the event that internal phosphorus loading prevents lake recovery, in-lake treatment becomes necessary to hasten the recovery time. Phosphorus inactivation by aluminum salts injection has shown a great deal of promise over the past twenty years. However, Welch and Cooke have examined 19 lakes that have undergone aluminum treatments, and have found that

the long-term response of internal loading to P input reduction is unpredictable and suggest that many treatments may be successful for a 10-year period.

There have also been some real success stories for lakes treated with aluminum. Smeltzer, Kirn and Fiske (1999) have documented a sustained improvement in Lake Morey quality over thirteen years. Significant improvements occurred in spring P (reduced by 66%), summer photic zone TP (reduced 68%), summer photic zone chlorophyll-a (reduced 61%), summer Secchi disk transparency (increased 79%), late summer hypolimnetic TP (reduced 83%), and summer hypolimnetic DO (increased 193%). Phosphorus inactivation is a method of controlling sediment P release by binding inorganic sediment P with an aluminum salt such as aluminum sulfate or sodium aluminate. The effectiveness of aluminum salts application rests on the ability of aluminum to form complexes, chelates and insoluble precipitates with phosphorus, thereby inactivating or altering its forms to make it unusable by phytoplankton and by reducing its release to the water from the sediments.

Depending on the pH, phosphorus concentration, aluminum concentration, and the rate at which additional phosphorus is supplied, aluminum salts can provide long-term inactivation of sediment phosphorus (Connor and Martin 1989). Furthermore, aluminum has been shown to have no toxicity to aquatic life at the pH and dose necessary to reclaim a lake (Cooke and Kennedy, 1981).

Long-term lake quality improvements and aquatic biota enhancement are possible achievements following aluminum salts treatment if external P loads can be controlled. These improvements will also enhance the recreational quality and aesthetic values of a waterbody. However, aluminum salts treatments should always be designed carefully to minimize risks to the biological community.

Longevity of aluminum salts injection is defined by Welch and Cooke as the number of years in which the rate of treated sediment P release is less than pretreatment rates, or less than the rates of a control lake. Effectiveness has two components: (1) effectiveness in controlling sediment release, which is a difficult task, and (2) improvement in lake quality.

Welch and Cooke also discuss another problems of evaluating aluminum treatment in lakes that have gone through watershed management programs that have reduced the external P load to the lake, like Kezar Lake. How can the effects of aluminum application on lake quality be separated from the effects of reduced loading? In the case of weakly stratified Kezar Lake,

the water quality still suffered from cyanobacteria blooms three years after the external watershed P load was reduced. This indicates that lake sediments may be the primary P source to the water column during the summer months.

Welch and Cooke have calculated sediment P release rates using the following equation $[CTP_2 - TP_1) \times V/(t_2 - t_1)]/A$, where $(TP_2 - TP_1)$ = the increase in hypolimnetic TP concentrations,

V= hypolimnetic volume, and

A= hypolimnetic sediment area.

A lake P mass balance calculated at Kezar Lake before and ten years after treatment revealed that the total hypolimnetic P mass has been reduced in the lake. However, even though Kezar is dimictic, its shallowness suggests a high probability that partial mixing of P-rich hypolimnetic waters with surface waters could subsidize algal growth. In fact, Welch and Cooke suggest that vertical entrainment of internally loaded P was important, a conclusion supported by the lakes comparatively low Osgood Index of 3.14.

After three years of exceptional quality, the 1988 sample results at Kezar were less than pleasing with reduced transparency and elevated levels of chlorophyll and phosphorus. The deterioration of lake quality indicators led Connor and Martin to speculate that the aluminum salts treatment may be showing signs of weakening. They hypothesized that a saturation of aluminum bonding sites may have increased the amount of P loading, that the aluminum may have migrated into the sediments and that there may be a new organic layer responsible for the additional P load.

However, the lake quality rebounded quickly in 1989 and in subsequent years. Connor observed that during years of high wetfall lake indicators reflected poorer quality, but years with average or below average wetfall, lake quality indicators reflected good summer conditions. It was concluded that excessive wetfall and additional watershed P loading may be a controlling factor in summer lake quality rather than the release of P from the sediments.

Overall, Welch and Cooke have shown that the effectiveness of aluminum salts at controlling internal loading in stratified lakes averaged 80 percent over the 4 to 21 years of observation after treatment. Surface quality in terms of chlorophyll-a improved by 57 percent on average, and remained improved for 4 to 18 years.

A. Lake Quality Indicators

1. Total Phosphorus

Phosphorus is an essential element for plant growth, and is the limiting nutrient that regulates the productivity of Kezar Lake. In fact, the goal of the Kezar Lake Reclamation Project was to reduce both the external and internal supply of P to the lake. Any evaluation of treatment effectiveness is based on the control of P loading from the watershed and from the sediments of the lake. This section examines epilimnetic and hypolimnetic phosphorus trends from pre-aluminum salts injection (1980 to 1983) through the post treatment era from (1984 through 1999).

a. Epilimnetic Phosphorus Trends

Epilimnetic phosphorus is important to the growth and productivity of photosynthesizing organisms. The epilimnetic area of the lake provides both nutrients and the necessary photic zone to allow plant growth, and is usually warm enough to accelerate biological productivity. Once the phytoplankton exit the epilimnion, sunlight can be the limiting factor for growth.

Phosphorus can enter the epilimnion through several mechanisms: the combination of wet and dryfall, watershed direct runoff, tributaries, near-shore groundwater seepage, spring and fall mixing and the partial mixing of P-rich hypolimnetic waters with surface waters. Lake reclamation projects focus on activities that reduce P loading from one or more of these mechanisms.

Figure V-1 reflects the mean annual epilimnetic summer phosphorus concentration over a 19-year period, 1980 through 1999. The graph compares phosphorus concentration before aluminum salts treatment with the post-treatment concentrations. The figure outlines a 0.020 mg/L threshold line to provide a horizontal axis to gauge improvement. New Hampshire lakes can usually withstand P concentrations up to 0.020 mg/L before algal populations become an aesthetic problem. New Hampshire lake quality evaluations (New Hampshire Lakes and Ponds Inventory, 1999) suggests that P concentrations from 0.011 mg/L and 0.020 mg/L are average and 0.021 mg/L to 0.040 mg/L is more than desirable for New Hampshire lakes.

Spring and summer total wetfall is also available in Figure V-1 as a comparison of rainfall, runoff and in-lake P concentration.

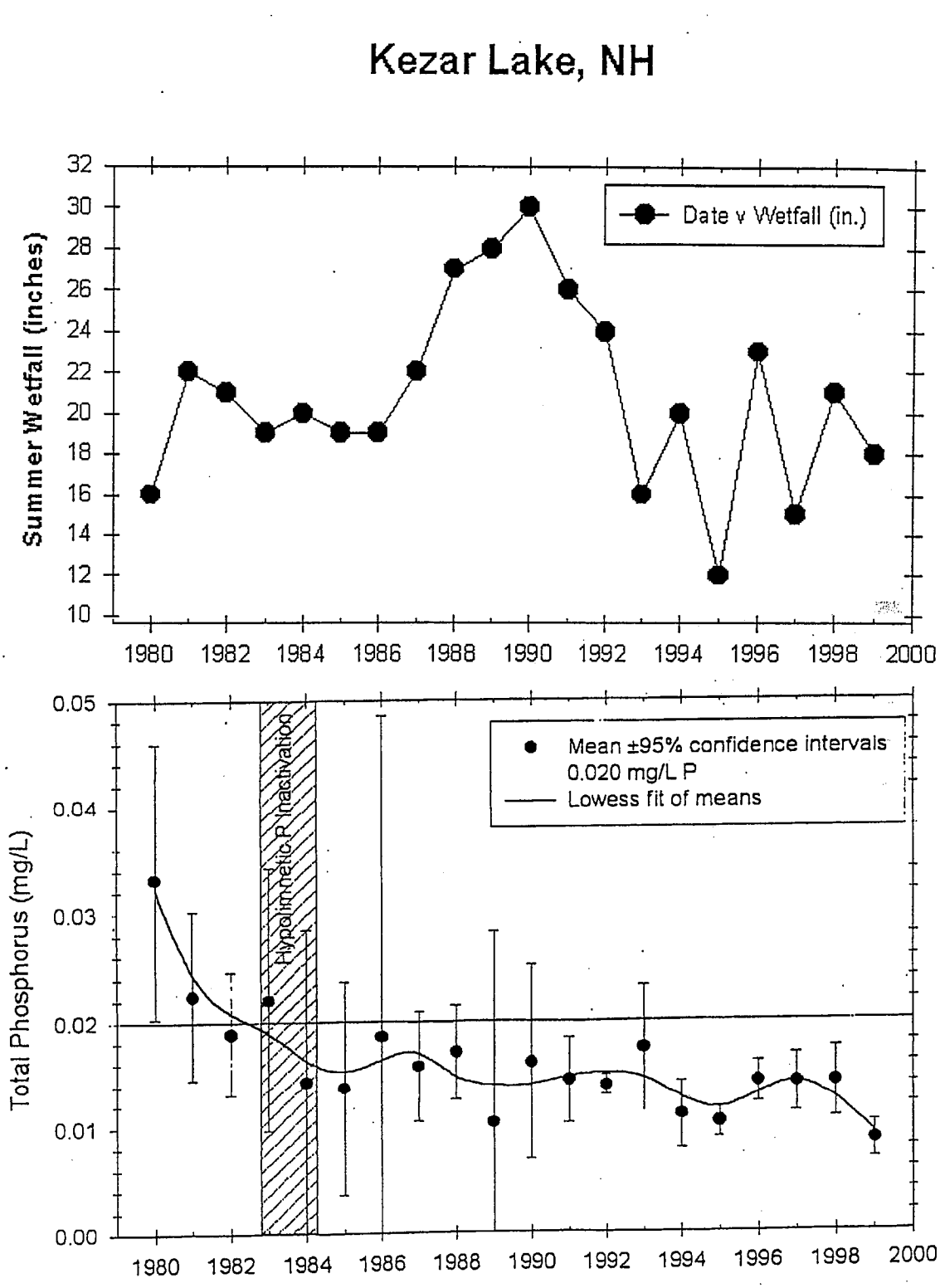


Figure V-I Long-Term Epilimnetic Phosphorus Trends for Pre- and Post-Treatment Eras and Summer Wetfall for Each Study Year.

By 1980, the New London Sewage Treatment Facility was offline and only used as a storage site for sewage. Although there was some observed leakage from the tertiary treatment system at this site, the actual phosphorus load to Lyon Brook from this site was low and seasonal. The mean summer P concentration remained high during the 1980 season and the 95% confidence intervals were wide. Phosphorus concentration was extremely variable throughout the season.

Two years after sewage diversion phosphorus was still above the 0.020 mg/L threshold, and the 95% confidence interval was still moderately high. Mean summer P levels had decreased 30% from 0.033 mg/L to 0.022 mg/L. A smaller reduction was observed from 1981 to 1982 when mean summer P concentrations reached the 0.020 mg/L threshold for the first time since the initiation of sampling at Kezar. Historical data reflect mean summer P values from 0.070 mg/L to 0.080 mg/L during the late 1960s and in the 0.020 to 0.030 mg/L range in the late 1970s.

Mean summer data collected during the 1983 pilot treatment year included P data before and after the initial treatment and this is reflected in the wide range of the 95% confidence range. Similarly, during the lake treatment, the 95% confidence interval showed a large interval. However, the mean summer P concentration was measured to be significantly lower than the 0.020 mg/L reference line and reflected a 32% reduction in mean P concentration.

Mean summer P concentration decreased slightly in 1985, but the 95% confidence level narrowed. What actually occurred in 1986 is still a mystery. Although phosphorus still remained below the threshold line, concentrations did increase, and the 95% confidence intervals reflected extreme variability in P concentration. The 1987 and 1988 samples years appeared to be very similar, with lower mean summer P concentrations, narrow 95% confidence intervals and lower variation in P concentration.

Although the summer mean P concentration lowered dramatically in 1989, the interval increase was just as dramatic. The increase of phosphorus in 1990 along with another year of variable P concentrations led Connor to speculate that the amounts of wetfall and watershed runoff may have had an impact on the observed variable P concentrations in the epilimnion. The 1988 through 1991 years reflected the highest seasonal wetfall over the 19-year monitoring period. During 1990, seasonal wetfall increased by 43%. The seasonal wetfall ranged from 26 inches in 1991 to 30 inches in 1990.

In 1991, the summer mean P concentration trends began to change for the better. The 1991 and1992 seasons had similar summer mean P values with narrow 95% confidence intervals. An increase of phosphorus was observed during the 1993 season, even though wetfall was well below the summer mean. Mean summer P values decreased in 1994 and 1995 with a slight increase in 1996. The 1996 through 1998 years had almost identical summer mean P values with extremely narrow 95% confidence intervals. The 1999 season appears to be the best year as far as having the lowest summer mean P value and one of the tightest 95% intervals over the past 19 monitoring years and the lowest summer mean P value over the last 40 years. However, the 1999 summer season also received less wetfall than normal.

During the past 19 years of pre- and post-aluminum treatment, a significant declining trend is observed in summer mean phosphorus. Another positive trend is observed in the reduction in the seasonal range of P concentration as the 95% confidence intervals have become significantly tighter. Another significant trend that merits attention is that no summer mean epilimnetic phosphorus value has been equal to or above the 0.020 mg/L reference line since the 1984 aluminum treatment.

b. Hypolimnetic Phosphorus Trends

The determination of hypolimnetic phosphorus trends in Kezar Lake is a key component in evaluating the aluminum treatment project. Treatment effectiveness and longevity are often evaluated and judged by the reduction of interval phosphorus loading rates. As discussed in the introduction, lake recovery is dependent upon the P retention of bottom sediments. If internal P loading continues at a high rate this production of phosphorus to the lake can negate positive water quality trends due to watershed management practices that have reduced the load of P to the lake from external sources.

By far, phosphorus inactivation is the most frequently used method to combat internal P loading and has the most available research data to demonstrate its effectiveness and longevity. In fact, Welch and Cooke evaluated 21 lakes across the United States, including Kezar Lake. Their research efforts have shown that internal P loading rates in dimictic lakes remained reduced by an average of 80% for 4 to 21 years (average 13 years).

Limnologists also recognize the relationship between hypolimnetic P release with the onset of hypolimnetic anoxia. Because this relationship is important in any dimictic lake, summer oxygen profiles will also be discussed in this section.

Figure V-2 reflects the mean annual hypolimnetic summer phosphorus concentration over a 19-year monitoring period, 1980 through1999. This graphic compares mean phosphorus concentrations before aluminum salts treatment, prior to 1984, and post-treatment years, 1984 through the 1999 summer season. The figure outlines a 0.020 mg/L reference or threshold line to provide a horizontal axis to gauge improvement. Another way to gauge improvement of the Kezar hypolimnetic P concentration is to compare the data to the state range of 0.001 to 0.245 mg/L and the state mean of 0.022 mg/L from a database that includes analyses of over 700 New Hampshire lakes and ponds. Finally, Figure V-2 provides mean ± 95% confidence intervals, which relays that on the average 95 out of 100 confidence intervals similarly obtained would cover the mean.

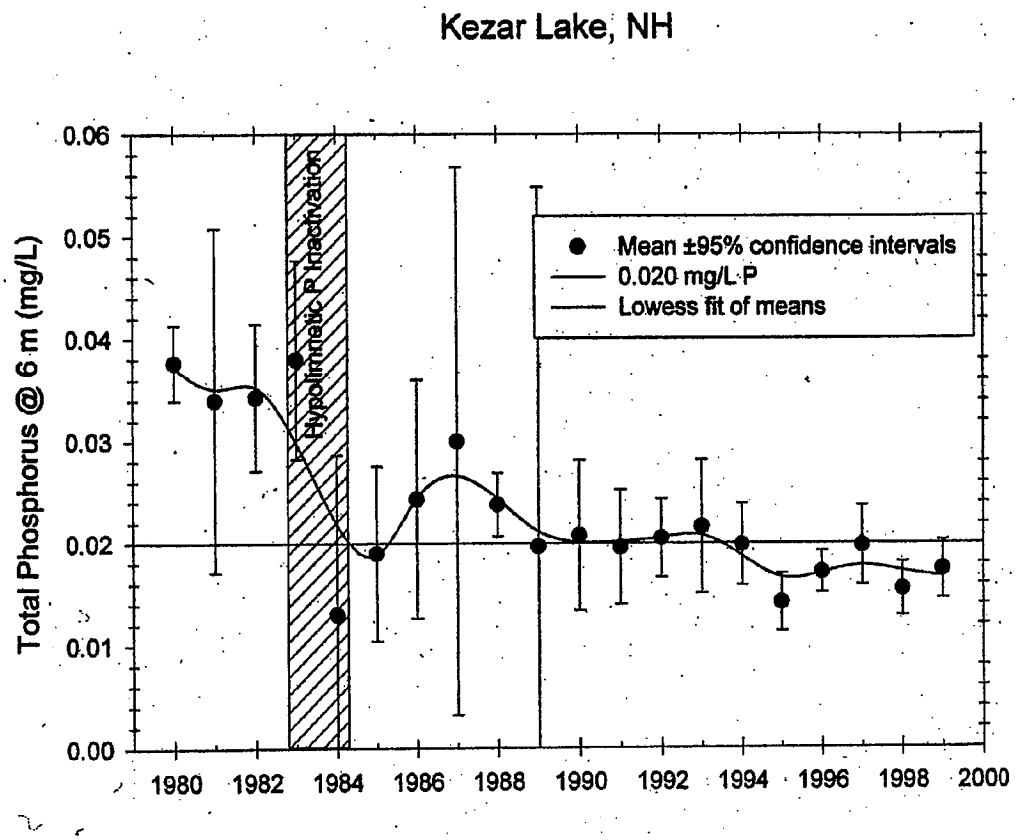


Figure V-2 Long-Term Hypolimnetic Phosphorus Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire.

The figure clearly shows that mean summer hypolimnetic P values were well above the 0.020 reference line during the pre-treatment era. In fact, the mean summer hypolimnetic P concentrations fell in the 0.034 mg/L to 0.040 mg/L range. Single P values for pre-treatment years exceeded the 0.050 mg/L level. With the exception of 1980 the 95% confidence intervals were fairly wide, revealing the high variance of phosphorus concentration during the pre-treatment years.

The 1984 extensive lake treatment showed a dramatic decrease in hypolimnetic mean summer phosphorus. The wide range of the 95% interval is expected because phosphorus analyses included both pre- and post-phosphorus concentrations that included high pre P levels and low post P levels as all the phosphorus was stripped from the hypolimnetic column. Concentrations later moderated as the summer period waned.

Mean summer hypolimnetic P concentrations showed unstable trends during the next three years, from 1985 through 1987. This disturbing increase of hypolimnetic P release and the variability in P values is not fully understood. Ranges in P concentration were both well below the 0.020 mg/L and well above that threshold in each of the three years following aluminum treatment. There appears to be a chemical equilibrium period post-treatment.

Mean summer hypolimnetic phosphorus decreased in both the 1988 and 1989 sample seasons. The 1988 season showed less variation in phosphorus concentration, as reflected in the tight 95% confidence intervals. Although mean summer hypolimnetic phosphorus fell below the 0.020 mg/L threshold in 1989, the variability in P data increased dramatically over the previous season. Investigators speculated that the weak stratification of Kezar waters might be allowing the mixing of the rich hypolimnetic P water with the epilimnetic water.

The mean summer hypolimnetic trends from 1990 through 1999 showed both a decreasing hypolimnetic P concentration and a decrease in P concentration variability through each season and over the remaining 10-year monitoring program. The mean summer hypolimnetic value decreased to its lowest value of 0.015 mg/L in 1995 since the 1984 post-treatment year. P concentration showed the least variability within the last five monitoring seasons. The 95% intervals were extremely tight since the 1995 season and remained stable throughout the 1999 sample season.

The measured hypolimnetic P trends over the last ten years reflect that the treatment was extremely successful in reducing the amount of internal loading from the sediments. Although there was a period of extreme variability after treatment, the data show that the treatment longevity is 19-plus years.

2. Dissolved Oxygen Trends

Dissolved oxygen and temperature profile data were collected at a minimum of once per month during the ice-free period at Kezar Lake since at least 1980. Here we will first examine the typical ice-free dissolved oxygen distribution before aluminum treatment was applied at Kezar Lake. We will then examine the effect of that treatment on the distribution of dissolved oxygen in the lake and how dissolved oxygen distribution has reacted over time since the treatment. Throughout this discussion, reference will be made to the dissolved oxygen isopleths presented in Figure V-3.

Dissolved oxygen distribution in 1980, 1981 and 1982 may be considered typical for Kezar Lake prior to any sediment treatments. Examining the dissolved oxygen data of the selected pre-treatment years (1980-1982), we see that the hypolimnion is near anoxic (<2 mg/L DO) from early June until mid to late September. The area of total anoxia, typically one month in duration, often extended to at least the five-meter contour. Elevated summer dissolved oxygen concentration in the epilimnion due to algal blooms was typical, as can be seen in 1981 and 1982.

As a result of the aluminum salts treatment in 1984, the period of near-anoxic conditions was reduced from a period of nearly four months to less than two months. The period of total anoxia, while still lasting approximately one month, extended upwards only to the six-meter contour. It became apparent that the aluminum treatment had a positive effect on the hypolimnetic-dissolved oxygen.

To determine whether the treatment had suppressed bacterial decomposition in the sediments and hypolimnion, and thereby reduce the biochemical oxygen demand (BOD) within Kezar Lake, a BOD experiment was run (Connor & Martin, 1986). In this experiment, samples of lake water were taken directly from the hypolimnion of Kezar Lake. One sample was treated with aluminum salts in the exact concentration and ratio as was applied to Kezar Lake in 1984 (Alum: Sodium Aluminate, 2:1, at 40 mg/L total aluminum). The other sample was treated as a

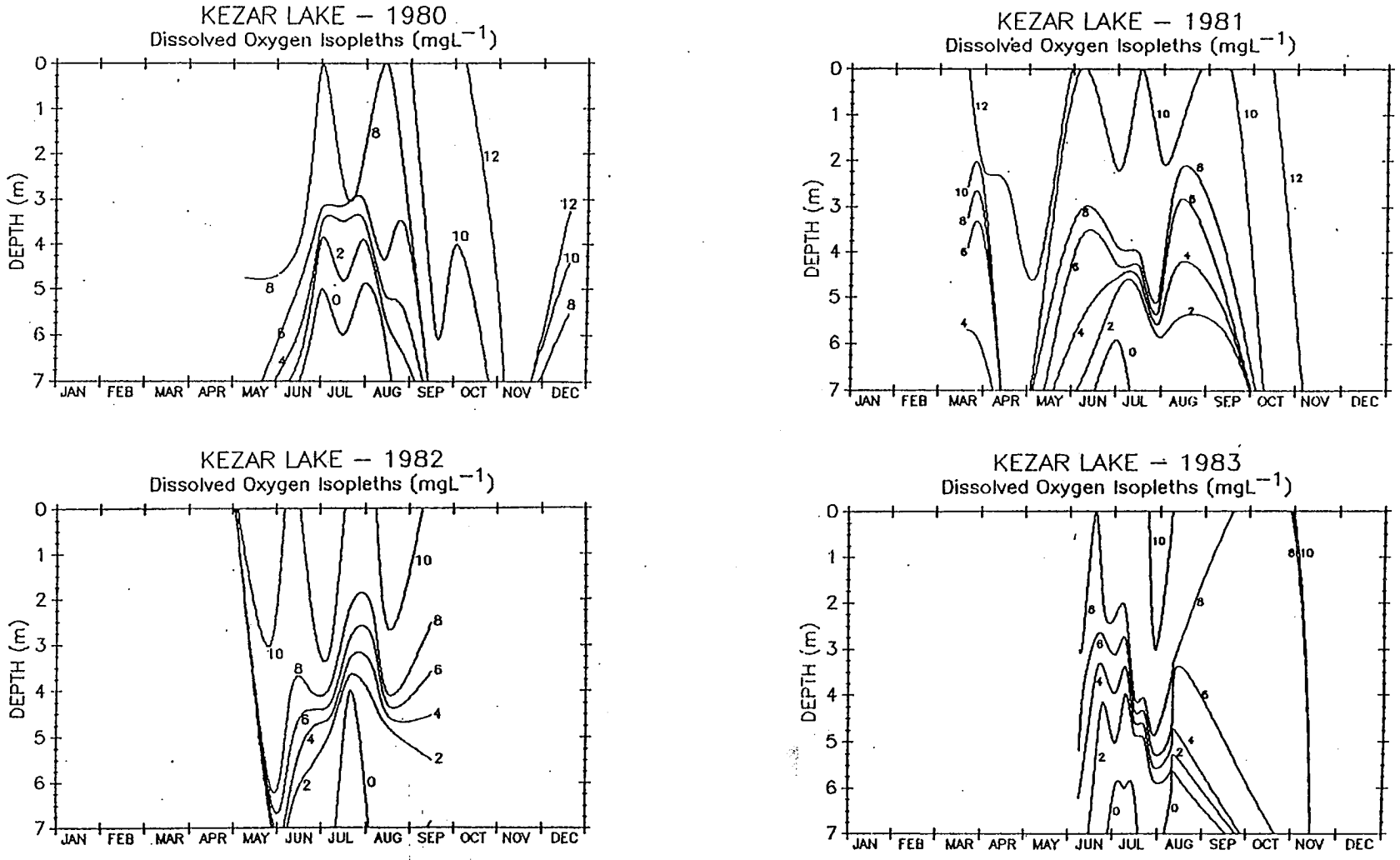
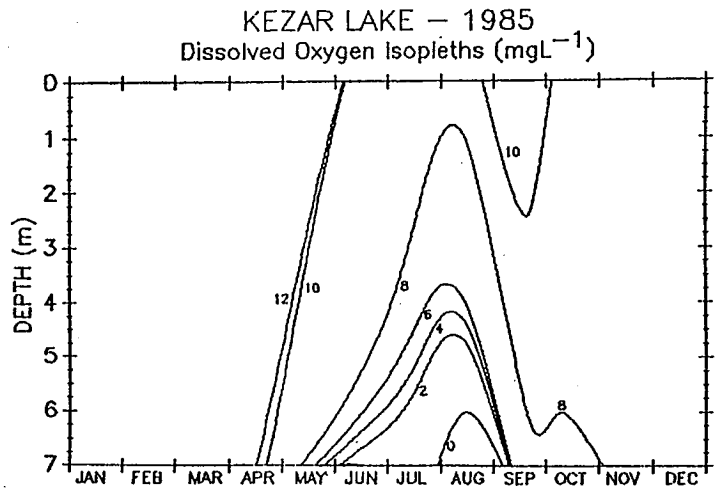
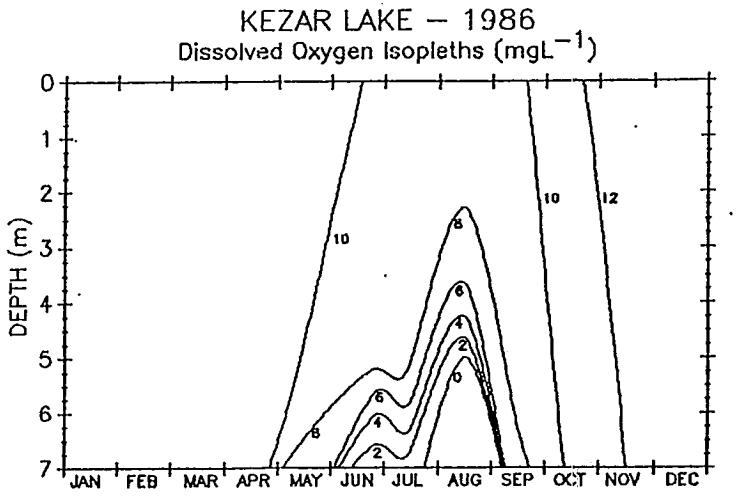
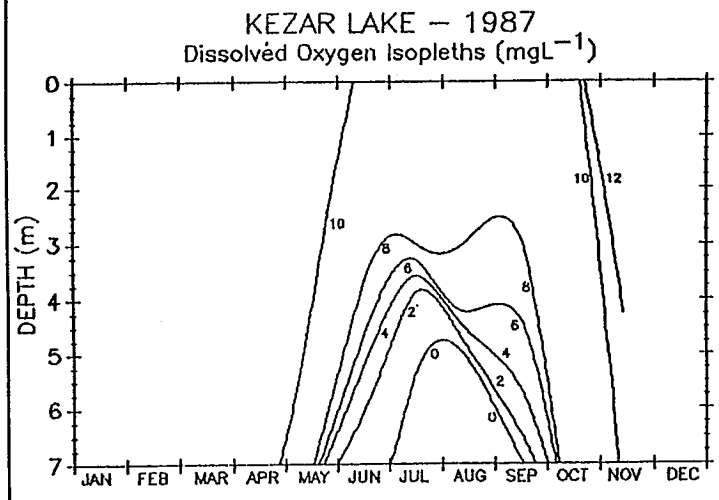


Figure V-3 Dissolved oxygen isopleths from Kezar Lake, North Sutton, New Hampshire (mg/L)







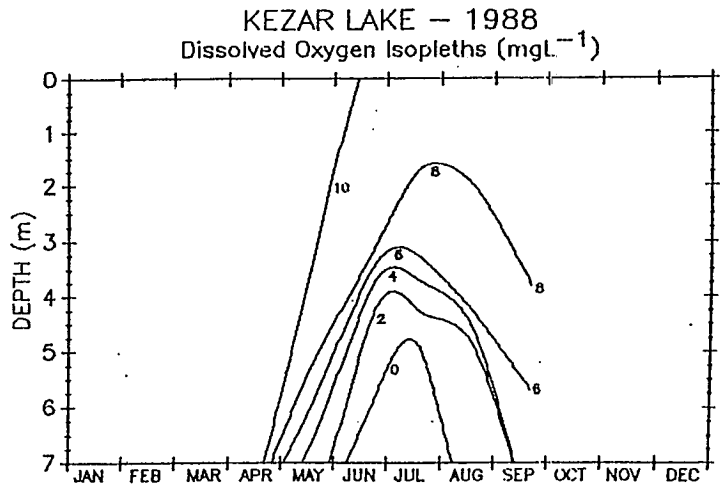


Figure V-3, continued (mg/L)

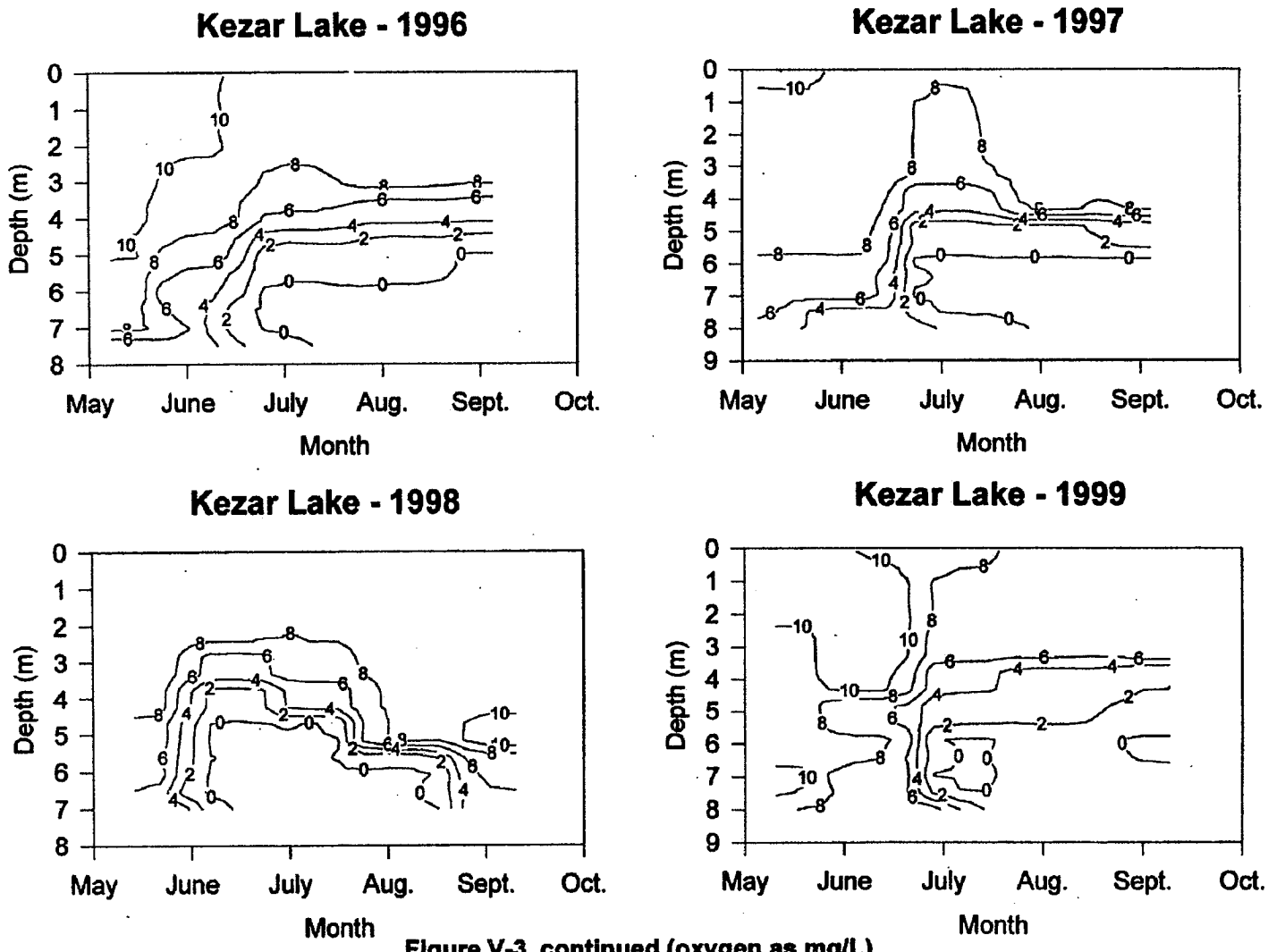


Figure V-3, continued (oxygen as mg/L)

control. Five replicates of each sample were run for five-day BOD determination (Standard Methods, 1985). The results of this experiment (Figure V-4) showed conclusively that the aluminum treatment suppressed the BOD of hypolimnetic water. The exact mechanisms of this suppression, i.e. toxicity, pH or other, were not examined.

The effect of this BOD suppression is short-lived. By 1985, low-oxygen conditions were occurring from early June into September, though not to the same extent on a volume basis. Beginning in 1987, the magnitude of the region with less than 2 mg/L of DO was as it had been prior to the treatment.

3. Chlorophyll-a Trends

Next to an overabundance of aquatic macrophytes, excessive phytoplankton growth and reduced water transparency are probably the most common water quality problems perceived by recreational lake users. While mitigating phosphorus loading is often the goal of lake management, the resultant improvement in lake aesthetics, as measured by chlorophyll-a and Secchi disk transparency, is the ultimate aim.

Nuisance cyanobacteria blooms had plagued Kezar Lake for many years, impairing recreational use and enjoyment, and lowering property values around the lake. Prior to the 1984-lake treatment summer chlorophyll-a peaks were above 20 mg/m^3, and often over 30 mg/m^3.

Figure V-5 shows the mean annual chlorophyll-a concentration over a 19-year monitoring period, 1980 through 1999. This graphic compares mean chlorophyll-a values before aluminum salts treatment, prior to 1984, and post-treatment years, 1984 through the 1999 summer season. This figure outlines a 10 mg/m^3 threshold line to provide a horizontal axis to gauge improvement. The mean concentration for chlorophyll-a of over 730 sampled New Hampshire lakes is 7.4 mg/m^3, with a state range of 0.19 to 144 mg/m^3. New Hampshire has set a general trophic classification for biological parameters. Chlorophyll values in the range of 0-4 mg/m^3 fall in the oligotrophic range, concentrations within 4-15 mg/m^3 are considered mesotrophic, while any chlorophyll reading greater than 15 mg/m^3 would fall into the eutrophic category. Generally, New Hampshire biologists recognize that nuisance blooms of algae, which can decrease the lake aesthetics and recreational value, are observed when chlorophyll-a values approach 10 mg/m^3 or greater. Therefore, we used 10 mg/m^3 as our threshold or reference line.

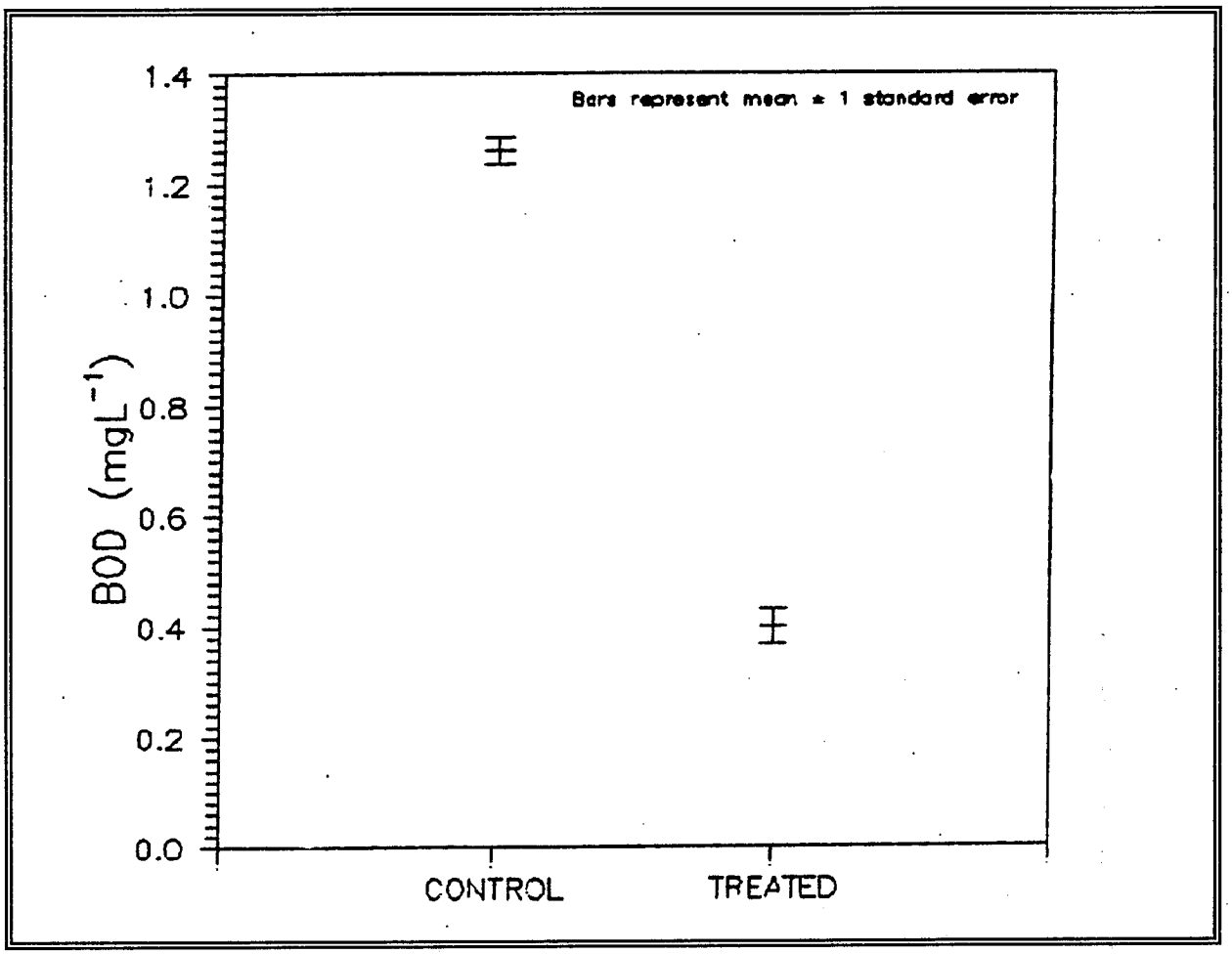


Figure V-4 Effect of Aluminum Salts on Biochemical Oxygen Demand

Chlorophyll-a values of greater than 10 mg/m^3 are considered undesirable for New Hampshire lakes.

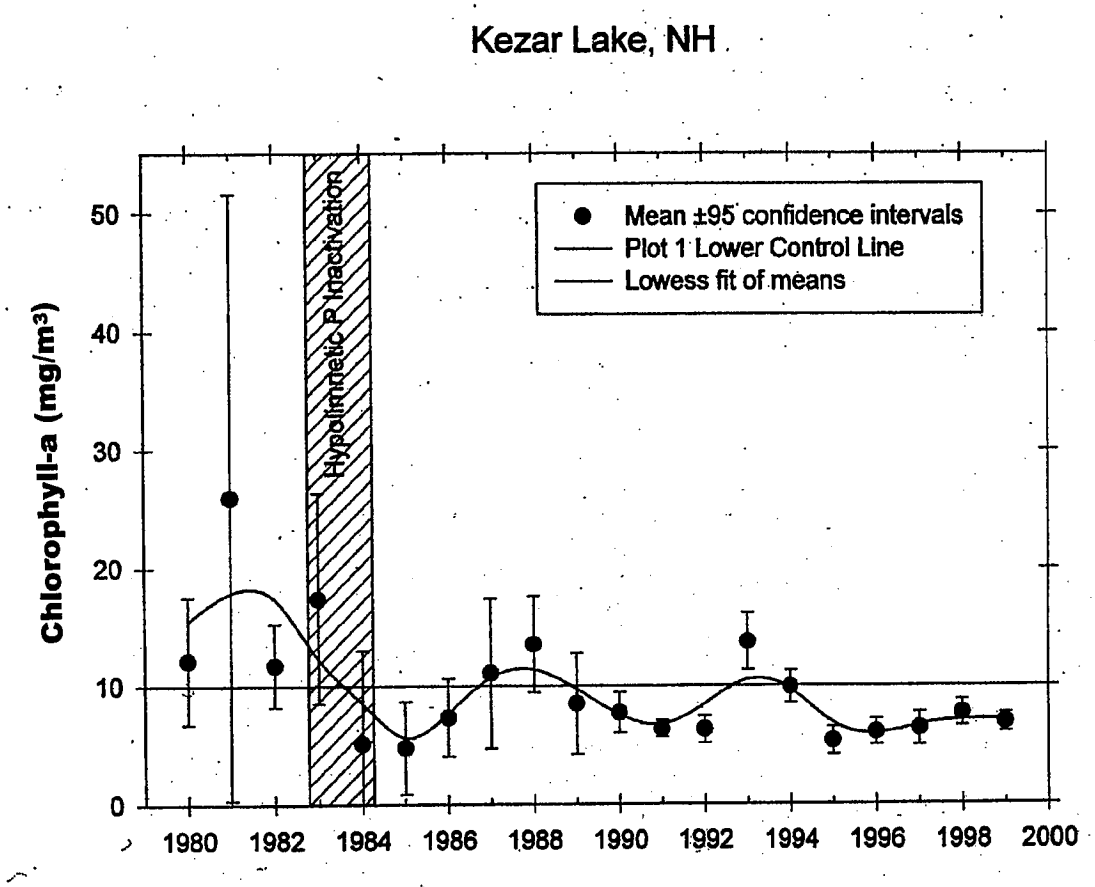


Figure V-5 Long-Term Chlorophyll-*a* Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire.

Figure V-5 also provides the 95% confidence intervals for all summer chlorophyll-a data. Again, these intervals allow us to examine the data variability between single seasons and over the 19-year monitoring period.

Figure V-5 shows that prior to treatment, chlorophyll-a values were not only above the 10 mg/m^3 reference line, but the chlorophyll concentrations were extremely variable. Following the treatment, which included both pre- and post-chlorophyll data, chlorophyll concentrations ranged from 15 mg/m^3 to below detectable levels. The mean summer chlorophyll-a concentration

dramatically decreased to about 5 mg/m^3 and dropped below the 10 mg/m^3 reference line for the first time since 1973.

The mean summer chlorophyll-a value remained at about 5 mg/m^3 one year after treatment (1985) and chlorophyll-a never approached the 10-mg/m^3 threshold during this sample season. Data variability during 1985 was extremely low. Although the mean summer chlorophyll level increased during the 1986 sample season, the summer mean remained below the reference line and data variability remained low, even though epilimnetic phosphorus concentrations increased along with phosphorus variability.

Mean summer chlorophyll-a increased above the reference line in 1987 and 1988 for the first time since the aluminum treatment, although the data variability remained fairly stable. The chlorophyll increases coincided with elevated epilimnetic P concentrations measured during the same period of time.

Mean summer chlorophyll values showed a decreasing trend from 1988 through the 1992 sample seasons. During this same four-year period the summer means never exceeded the 10 mg/m^3 reference line and data variability significantly decreased. Both sample years 1991 and 1992 were exceptional years, with low summer mean chlorophyll-a values and extremely tight 95% confidence intervals.

The 1993 sample year reflected elevated epilimnetic P concentrations and responding elevated chlorophyll values. In fact, all chlorophyll values during this season were slightly above the reference line. Both epilimnetic phosphorus and chlorophyll-a decreased within the acceptable range for the 1994 sample season.

Another dramatic drop in mean summer chlorophyll-a values was observed in 1995 when summer mean concentrations approached the 5 mg/m^3 concentration. Analyzed chlorophyll-a showed extremely low variability from 1995 through the 1999 sample years. Mean summer chlorophyll values, as well as single chlorophyll-a concentrations, remained well below the reference line through the 1999 sample season.

The lowess fit of the means shows a significant chlorophyll decrease during and post-treatment, a slight rise during the 1986 through 1988 seasons with a moderate decreasing chlorophyll trend through the 1992 monitoring season. Although mean summer chlorophyll increased during the 1993 season it showed a decreasing concentration trend through 1995 and a stable trend from 1995 through 1999.

The extremely low variability in post-treatment chlorophyll-a data, the fact that mean summer chlorophyll values have only exceeded the reference line in only three of the 16 post-treatment years, and the overall decreasing chlorophyll trend all indicate that the treatment was successful in both the goals of effectiveness and longevity.

4. Secchi Disk Transparency Trends

The lake transparency measured with a Secchi disk is the best indication that reflects the water's recreational value and aesthetic conditions. Figure V-6 reflects the mean annual transparency over a 19-year period, 1980 through 1999. The graph compares pre- and post-treatment transparency. This figure also shows a 2-meter reference line or threshold to provide a horizontal axis to gauge improvement. The mean transparency value for the over 620 New Hampshire lakes sampled is 3.7 meters. New Hampshire transparency ranges from a minimum of 0.25 m to a maximum of 13.0 m. New Hampshire has set a general trophic classification scheme for transparency. Transparency readings greater than 4.0 m fall under the oligotrophic classification; all measurements between 1.8 and 4.0 m are classified as mesotrophic; and any lakes with Secchi disk readings recorded below 1.8 m are classified as eutrophic. The threshold limit of 2.0 m was chosen because, generally, a Secchi disk reading of 2.0 m or greater is acceptable for lake aesthetics and recreation.

Figure V-6 demonstrates that the treatment had an immediate positive impact on lake transparency. Historical data reflect that mean summer transparency never exceeded the 2.0 m threshold from 1968 through the 1983 sample season. In fact, it wasn't until 1980 that a single Secchi disk reading was recorded above 2.0 m.

Mean summer transparency values fell below the 2.0 m reference line and recordings were fairly variable three years prior to treatment. The 1984 treatment year (Figure V-6) showed that the mean summer transparency value was above the 2.0 m threshold and data variability was low. The mean summer transparency again increased dramatically one year after treatment (1985), but transparency increased in variability as the 95% intervals increased. Following the trends of increased epilimnetic phosphorus and increased productivity, mean summer transparency recordings decreased from a high of about 3.7 meters in 1985 to almost 2 m in 1988.

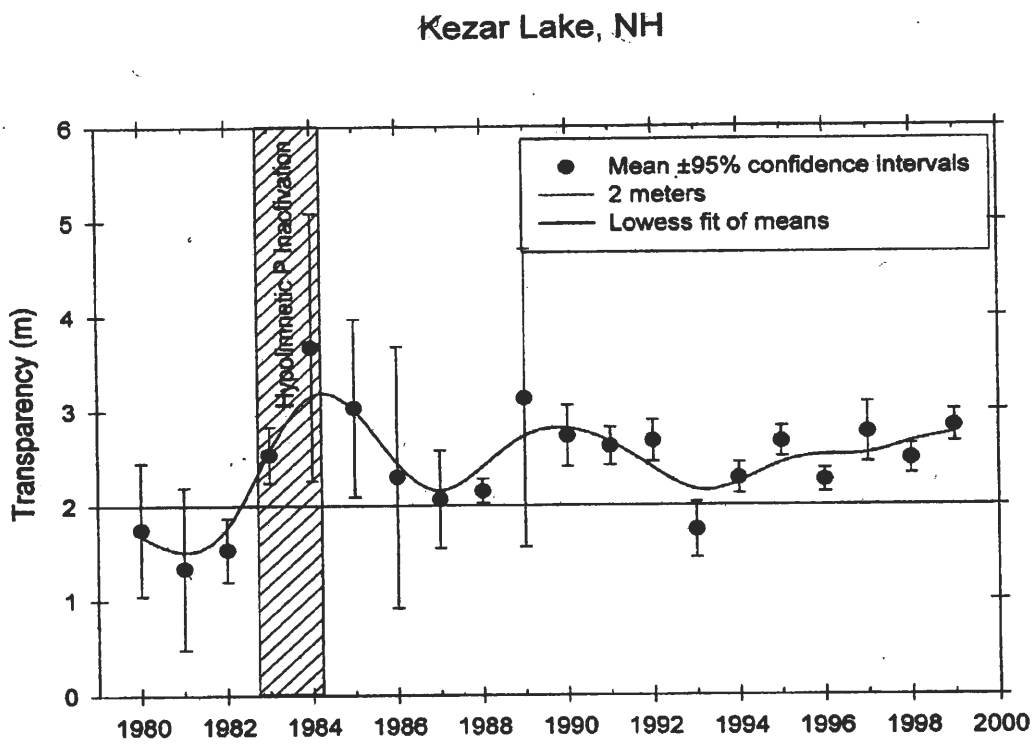


Figure V-6 Long-Term Transparency Trends for Pre- and Post-Treatment Eras at Kezar Lake, North Sutton, New Hampshire.

Mean summer transparency rebounded in 1988 with a slight increase and lower variability. A greater increase of mean summer transparency was observed during 1990 as lake productivity again decreased.

Mean summer transparency remained stable from 1990 through 1993. The sample years between 1991 and 1993 showed very similar summer mean transparencies of just below 3.0 m with low data variability. As productivity increased during the 1993 summer season, transparency decreased below the two-meter threshold.

Mean summer transparency increased in both the 1994 and 1995 seasons and decreased slightly during the 1997 year before rebounding again in 1998. Data variability remained low as each year following the 1990 season showed tight 95% confidence intervals. It should be noted that the mean summer transparency dipped below the 2.0 m reference line in only one of the 16 post-treatment years. This bodes well for lake recreation and aesthetics.

The transparency data collected over the pre- and post-19 years of monitoring reflect dramatic increases of transparency post-treatment, a slow decreasing trend in transparency, probably a result of the lake again reaching equilibrium, and a steady stable trend (with the exception of 1994) of acceptable water clarity.

Figure V-7 reflects the importance of this treatment by increasing the recreational value and aesthetic perception of the lake by the user. The number of state park visitors increased following the aluminum salts injection. Information provided on Figure V-7 compares the summer wetfall and the summer attendance at Wadleigh State Park. Unfortunately attendance data was not collected regularly during the period of time from 1991 through 1999.

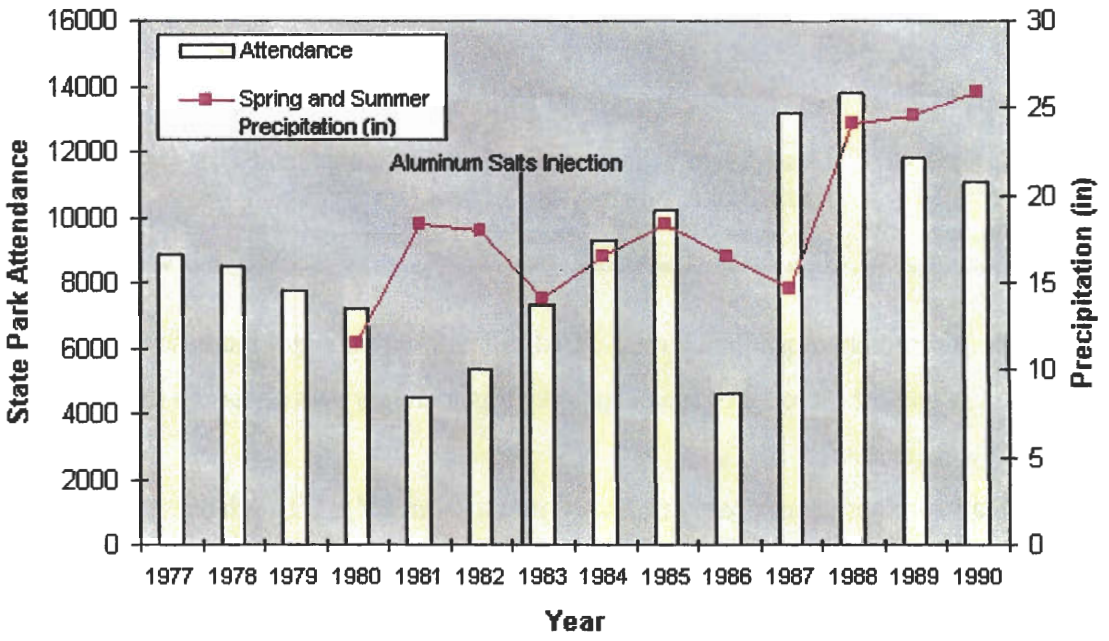


Figure V-7 Wadleigh State Park Attendance and Spring and Summer Precipitation Data

5. Fate of Aluminum

Monthly total dissolved aluminum (TDA) was measured at six stations during the period from June through November 1984, primarily to ensure that aluminum concentrations were not elevated beyond background levels by the hypolimnetic aluminum treatment. While there appeared to be no significant differences between stations, TDA levels were highest at the outlet and lowest in Clark Pond Brook (Figure V-8). Background levels may have been high in the watershed in general since the New London Treatment Facility used alum in its lagoons which discharged into Lyon Brook. Clark Pond Brook was the only station situated in a subwatershed not influenced by the wastewater treatment facility.

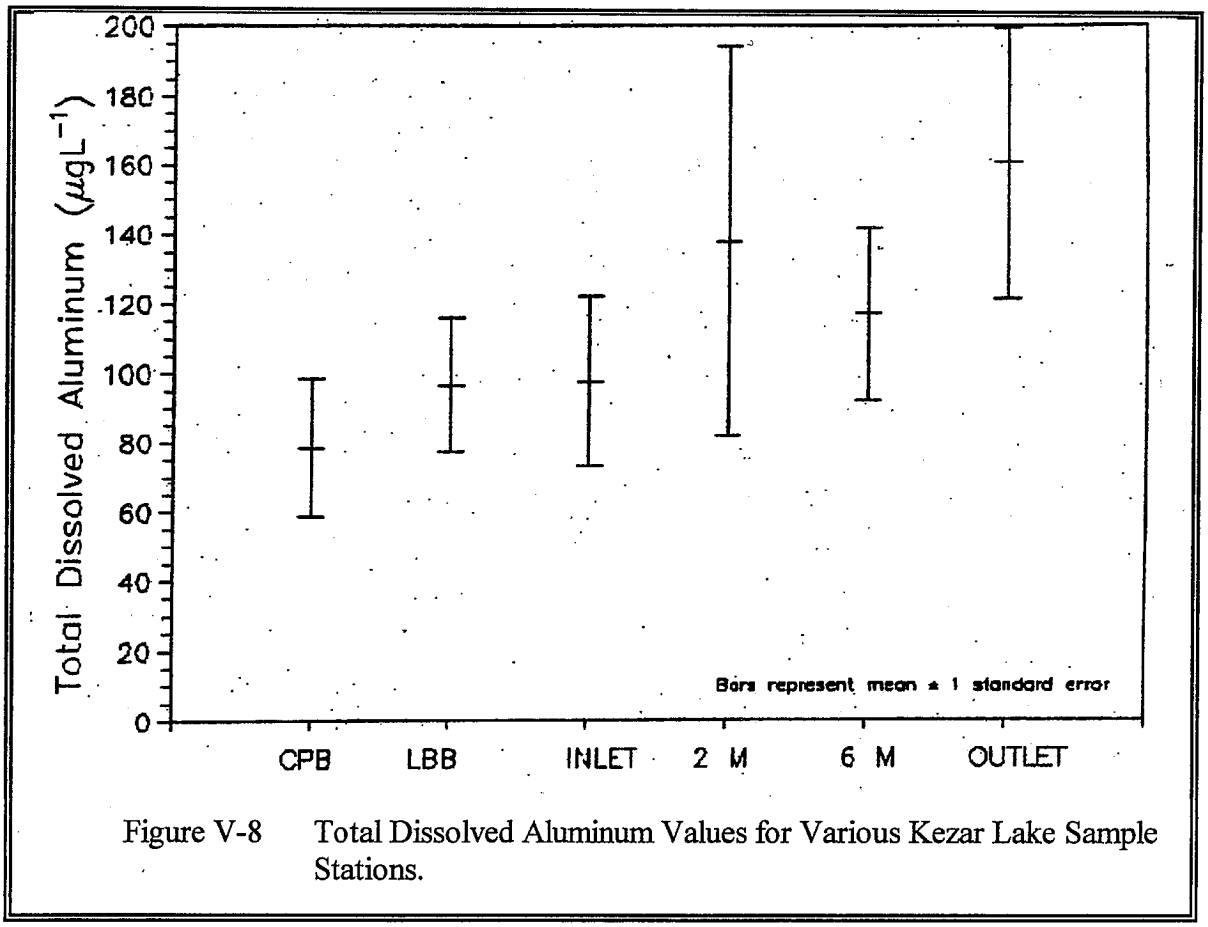


Figure V-8 Total Dissolved Aluminum Values for Various Kezar Lake Sample Stations.

Without background data from pre-treatment years it is difficult to assess the impact, if any, of the aluminum treatment on TDA concentrations. For comparison, 19 remote ponds in

New Hampshire having a pH >6 and monitored since 1982 had total dissolved aluminum at the surface ranged from <0.015 mg/L to 0.500 mg/L (n=41, median=0.080 mg/L) (Warren and Martin, 1988). An ongoing study of headwater outlets showed that at least 50% of the samples analyzed were less than 0.050 mg/L and the maximum value was 0.371 mg/L (n=546). Epilimnetic values in Kezar Lake were more comparable to the remote pond data, but less comparable to the headwater outlet study, ranging from 0.030 mg/L to 0.400 mg/L. Epilimnetic and hypolimnetic concentrations were highest on July 17, 1984, but quickly decreased to pre-treatment levels. The greatest in-lake change in concentration between pre- and post-treatment was in the epilimnion, where alum floc would be thermally isolated from the sediments for a period of time (Table V-1).

Table V-1
Total Dissolve Aluminum Concentration (mg/L)

Sample Date	Clark Pond Brook	Lyon Brook Below Chadwick	Inlet	2 M	6 M	Outlet
6/5/84	0.161	0.177	0.179	0.148	0.143	0.157
Alum	Alum	Alum	Alum	Alum	Alum	Alum
7/17/84	0.260	0.113		0.400	0.177	
8/13/84	0.065	0.075	0.110	0.135	0.135	0.175
9/13/84	0.050	0.040	0.030	0.030	0.030	0.060
10/9/84	0.110	0.070	0.100	0.080	0.100	0.250
11/15/84	0.060	0.105	0.070	0.035		
12/12/84	0.0209	0.227				0.165

Aluminum in the sediment of treated lakes could be distinguished visually for at least one year after treatment as grayish spheres resting on the lake bottom. Within two years after treatment the visual signs of aluminum disappeared. The alum floc or particles probably settle gradually into the low-density sediments and were covered over by new layers of organic fallout.

Welch and Cooke have observed that treatment effectiveness might be related to dose and ultimate Al/Fe ratio. Several of the studied lakes showed greater effectiveness and longevity where sediment Al/Fe ratios were greater than 1.0. The ratio of Al/Fe for Kezar Lake sediments was 1.54.

CHAPTER VI
HYDROLOGIC BUDGET

A. Surface and Groundwater Hydrology

The hydrologic budget for a lake equates the total water input to the total water output for specified time increments during a specified period. The water flow rates through the lake are thereby quantified. The development of a hydrologic budget is essential in calculating the loading (mass per unit time) of eutrophying nutrients as well as in evaluating a lake's tolerance of these nutrients. The balance between hydrologic inputs and outputs influence the nutrient supply to the lake, the lake's water residence time, and consequently the lake's productivity and water quality. An accurate and detailed hydrologic budget will thus permit an accurate determination of current trophic status and will provide a sound basis for evaluating the effectiveness of watershed and in-lake management strategies.

The quantification of the components of the Kezar Lake hydrologic budget was based on an intensive one-year study (December 1990, through November 1991), developed as a basis for a complete hydrologic year and phosphorus budget. The budget quantifies the monthly and annual water inflow from each source to Kezar Lake. Additionally, the monthly variations of the lakes hydraulic retention (flushing) time and fraction of exchanged lake water volume are specified.

In conjunction with the hydrologic budget for Kezar Lake, mean monthly surface water discharge volumes for each station in the watershed were calculated and tabulated for the gauging year. This information is valuable for comparing the relative hydrologic (and hence nutrient) contributions from various tributary areas within the watershed.

The quantification of the 1990-91 hydrologic budget was necessary to compare loading to the lake during the 1981-82 study year. Increases or decreases in water, and hence phosphorus, will help limnologists better understand lake quality variations. The tributary loading will also help us determine if the watershed has reached an equilibrium from the entrainment of nutrients derived from 50 years of discharging treated sewage to Lyon Brook.

B. Field Monitoring Program

Field investigations and data collection occurred during the period from September 1990 through November 1991. The actual gauging year budget presented in this chapter will encompass a complete year, beginning December 1990 and ending November 1991.

1. Kezar Lake and Chadwick Meadow Stream Gauging

Three inflowing tributaries and one outlet station were monitored for flow within the immediate Kezar Lake watershed. Three inflowing tributaries and one outlet were monitored for flow within the immediate Chadwick Meadows watershed. The Chadwick Meadows data will be analyzed in another chapter that looks at this wetland's effectiveness for assimilating phosphorus. Data consisting of staff gauge readings and actual flows were collected either on a twice a month or weekly basis throughout the study year. To determine the gauge-discharge relationships at each station, measurements of flow were obtained using flow meters and correlated with staff gauge readings. Gauge-discharge relationships and discharge summaries for each station can be found in Appendix 6.

Direct discharge measurements do have some disadvantages. Schroeder (1979) and Dennis (1986) point out that periods of peak discharge during storm events and spring melt off may be missed, resulting in lower estimates of inflow and thus nutrient loading. In fact, both spring melt off and storm events could represent a high percent of the total hydrologic and phosphorus budget in a given watershed.

A variety of methods have been utilized to calculate runoff and water budgets. Each method has drawbacks. Estimates of flow rates on tributary streams from interpolation of flows from neighboring watersheds can have significant errors (Kemp, 1979). Dillon (1975) cautions against predicting water budgets through empirical methods using long-term runoff maps. He suggests that measurements versus estimation provides more accurate results and should be utilized where possible. In general, values will usually fall within 25% of those predicted using long-term runoff maps.

2. Precipitation Monitoring

Monthly rainfall and water equivalent snowfall data were collected from the NOAA climatalogical stations in Concord, Manchester and the Department of Geography, UNH

climatological stations in Bradford. Table VI-1 presents the surface volume precipitation upon Kezar Lake for the study period.

Table VI-1
Kezar Lake Surface Volume Precipitation
(Mean Monthly Precipitation) (Lake Surface Area (734,900 m^2)

Month	Mean Monthly Water Eq. (in)	Mean Monthly Water Eq. (m)	Lake Precip. Volume (m^3)	Lake Precip. Volume ($10^3 m^3$)
Dec 90	5.53	0.140	102,886	102.89
Jan 91	2.65	0.067	49,238	49.24
Feb	2.03	0.052	38,215	38.22
Mar	4.76	0.121	88,923	88.92
Apr	3.48	0.088	64,671	64.67
May	4.23	0.107	78,634	78.63
Jun	3.14	0.080	58,792	58.79
Jul	2.66	0.068	49,973	49.97
Aug	7.80	0.198	145,510	145.51
Sept	5.97	0.152	111,705	111.70
Oct	4.40	0.112	82,309	82.31
Nov	4.21	0.107	78,634	78.63
Total	50.86	1.292	949,490	949.49

C. Hydrologic Budget

1. Components

The hydrologic budget for the Kezar Lake watershed, equating all measurable inflowing and outflowing waters over a designated period of time, was determined by the equation in Table VI-2.

Each component of this budget has been adjusted to volumetric units of $10^3 m^3$ (1000 cubic meters). This specific report will not discuss groundwater seepage or discharge or direct

runoff to the lake since the 1981 study revealed that groundwater and runoff only accounted for four percent of the water input to Kezar Lake.

Table VI-2
Hydrologic Budget Equation

Inflow Volume = Outflow Volume $Qi_1+Qi_2+Qi_3+R+P = Qo+EV$	
Where,	
Qi_1	Lyon Brook at Lake, LBL
Qi_2	King Hill Brook, KHB
Qi_3	Birch Brook
R	Surface water runoff from the direct drainage area
P	Precipitation volume on lake
Qo	Outflow
EV	Lake surface evaporation

2. Kezar Lake Hydrologic Budget (1990-91)

Kezar Lake has three direct annual inflows (Qi_1 through Qi_3) and one annual discharge, Qo. These flow values were converted to metric units for incorporation into the hydrologic budget.

The total volume of precipitation on the lake (P) is the product of the precipitation (meters) times the lake area. Both rainfall and snowfall depths (water equivalents) were collected as discussed in Section 3.

Evaporation rates were not measured directly at Kezar Lake. Pan evaporation records for the NOAA weather station at Massabesic Lake, Manchester, N.H. were obtained for the study period. A pan coefficient of 0.77 was selected for the study region from the NOAA Atlas (1979).

Table VI-3 represents the 1990-91 hydrologic budget for Kezar Lake, while Figure VI-1 shows the total inflow and wetfall contributions to Kezar Lake. Lyon Brook represents 78 percent of the tributary flow to Kezar Lake. The months of March and April accounted for 25

Table VI-3
Kezar Lake Hydrologic Budget for Gauging Period (Dec 1990 - Nov 1991)
Water Volume ($10^3 m^3$)

Component	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean	Annual
Qi1	944.3	608.3	526.8	1365.0	1084.0	663.6	483.3	105.4	452.8	1093.0	1547.0	931.4	817.1	9805.0
Qi2	279.9	178.2	139.1	474.0	270.8	131.2	22.0	0.0	30.3	206.2	167.6	120.4	168.3	2020.0
Qi3	93.6	61.4	41.8	99.3	103.6	56.8	26.2	0.0	6.1	25.0	112.7	57.3	57.0	683.8
P	102.9	49.2	38.2	88.9	64.7	78.6	58.8	50.0	145.5	111.7	82.3	78.6	79.1	949.5
Total In	1420.7	897.1	745.9	2027.4	1523.2	930.2	590.3	155.4	740.1	1435.9	1909.8	1187.7	1121.4	13458.4
Qo	2645.0	1567.0	982.0	2504.0	2995.0	1502.0	651.0	0.0	3.0	504.2	2089.0	1602.0	1420.0	17045.0
Ev	0.0	0.0	0.0	0.0	0.0	0.0	56.0	80.4	70.2	37.3	37.3	4.0	47.5	285.2
Total Out	2645.0	1567.0	982.0	2504.0	2995.0	1502.0	707.0	80.4	73.2	541.5	2126.0	1606.0	1467.0	17330.0
Inflow/Outflow Difference	-1224.3	-669.9	-236.1	-476.6	-1471.8	-571.8	-116.7	75.0	666.9	894.4	-216.2	-418.3	-345.6	-3871.6

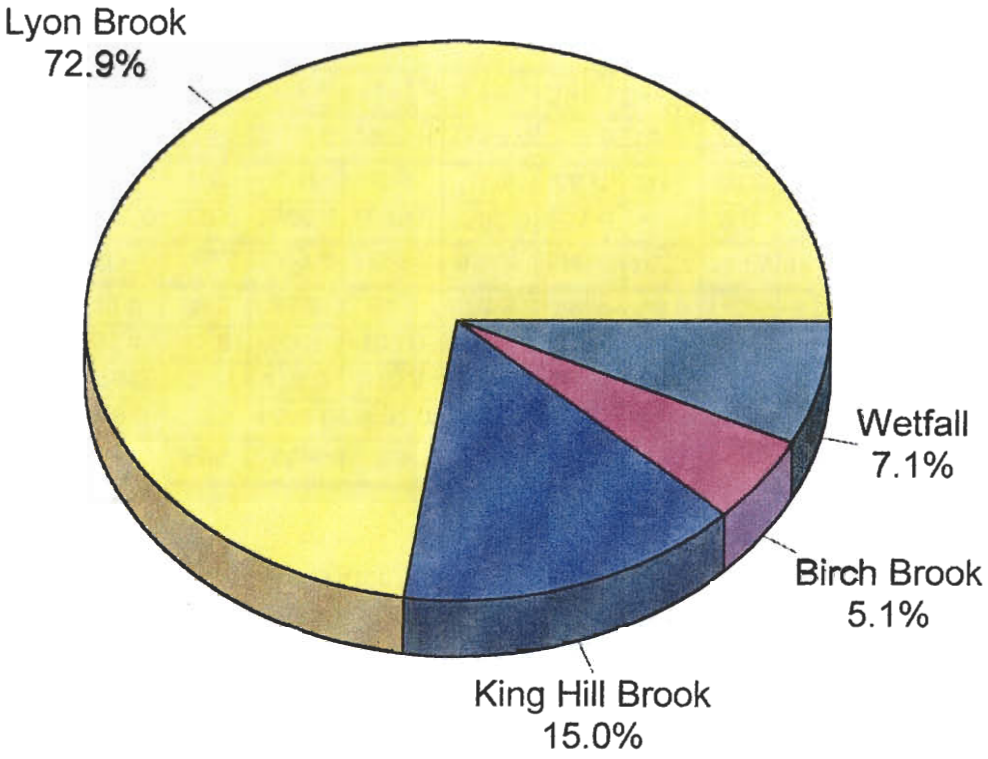


Figure - VI-1: Total Inflow and Wetfall Contributions to Kezar Lake for 1990-91 Phase III

percent of the total Lyon Brook flow. Typically, these months account for a high percent of the flow because of the winter snow pack melt over an impermeable frozen ground.

The months of September and October accounted for 27 percent of the total Lyon Brook flow to Kezar Lake. High flows were recorded during this period because these two months also represented 20 percent of the wetfall. The 1990-91 hydrologic budget also shows that the months of July and August were the smallest products of flow to the lake. Again, this is typical of the summer months when rainfall is sparse and evaporation is high.

Table VI-4 shows a comparison of three hydrologic budgets prepared for Kezar Lake. The three years compared are the average year (according to wetfall), the 1981-82 Diagnostic budget and the 1990-91 Phase III budget. Five months show dramatic changes from the average year flow rate. September flows for Lyon Brook shows an increase from the average year of 88 to 646 in 1981 and 1093 in 1991. This can be explained by monthly increases in rainfall. Similar trends are observed in October flows, however, 1991 cannot be explained. The high flow rate cannot be explained by increasing wetfall.

Although the April average year and the 1982 flows correspond to one another, the April 1991 flow is 69 percent below the average year flow. The wetfall was greater in 1991 than it was in 1982.

Both the May 1982 and 1991 flow rates are well below the average year flows for Lyon Brook.

In August of 1991, 12.55 inches of rainfall fell on the Kezar Lake watershed resulting in a 40 percent increase in water flow to Lyon Brook. The opposite occurred in August of 1982 when 2.19 inches of rainfall resulted in a 60 percent reduction in flow from the average year.

However, when the total monthly tributary flow and the total annual rainfall are compared between the three years, they are fairly typical. As Figure VI-2 shows, the total annual flow was lowest in the 1990-91 season, with 12,507 10^3m^3 flow but recorded the highest wetfall of 45.28 inches. The 1980-81 season had the highest flow rate of 15,328 10^3m^3, but recorded the least wetfall of the three budget years. The average tributary contribution to Kezar Lake was 13,693 10^3m^3 with 43.36 inches of wetfall.

Table VI-4
A Comparison of Inflow and Outflow with Respect to Rainfall During the Average Year, the 1980-1981 Year, and the 1990-1991 Year

Tributaries	Lyon Brook (10^3 m^3)	King Hill Brook (10^3 m^3)	Birch Brook (10^3 m^3)	Total inflow (10^3 m^3)	Outlet (10^3 m^3)	Wetfall (inches)
Ave year	88	25	8	121	156	
Sep-81	646	220	58	924	1091	3.7
Sep-91	1093	206	25	1324	504	6.4
Ave year	258	27	13	298	359	
Oct-81	1070	174	64	1308	1507	4.75
Oct-91	1547	168	113	1828	2089	2.8
Ave year	1013	154	55	1222	1404	
Nov-81	976	242	66	1284	1435	3.15
Nov-91	931	120	57	1108	1602	4.76
Ave year	963	228	61	1252	1426	
Dec-81	971	296	58	1325	1495	3.33
Dec-90	944	280	94	1318	2645	4.67
Ave year	576	159	48	783	909	
Jan-82	736	273	73	1082	1232	1.68
Jan-91	608	178	61	847	1567	3.84
Ave year	452	103	25	580	690	
Feb-82	699	219	48	966	1107	2.92
Feb-91	527	139	42	708	982	2.55
Ave year	1578	379	106	2063	2362	
Mar-82	1100	372	99	1571	1795	1.45
Mar-91	1365	474	99	1938	2504	1.48
Ave year	3487	771	198	4456	4964	
Apr-82	3788	881	176	4845	5407	3.0
Apr-91	1084	271	104	1459	2995	3.82
Ave year	1507	334	83	1924	2315	
May-82	463	76	33	572	599	2.56
May-91	664	131	57	852	1502	6.07
Ave year	352	55	17	424	467	
Jun-82	771	117	110	998	1168	7.77
Jun-91	483	22	26	531	651	2.63
Ave year	129	14	11	154	161	
Jul-82	319	30	33	382	372	3.57
Jul-91	105	0	0	105	0	3.17
Ave year	129	24	14	167	180	
Aug-82	51	6	14	71	62	2.19
Aug-91	453	30	6	489	3	12.55

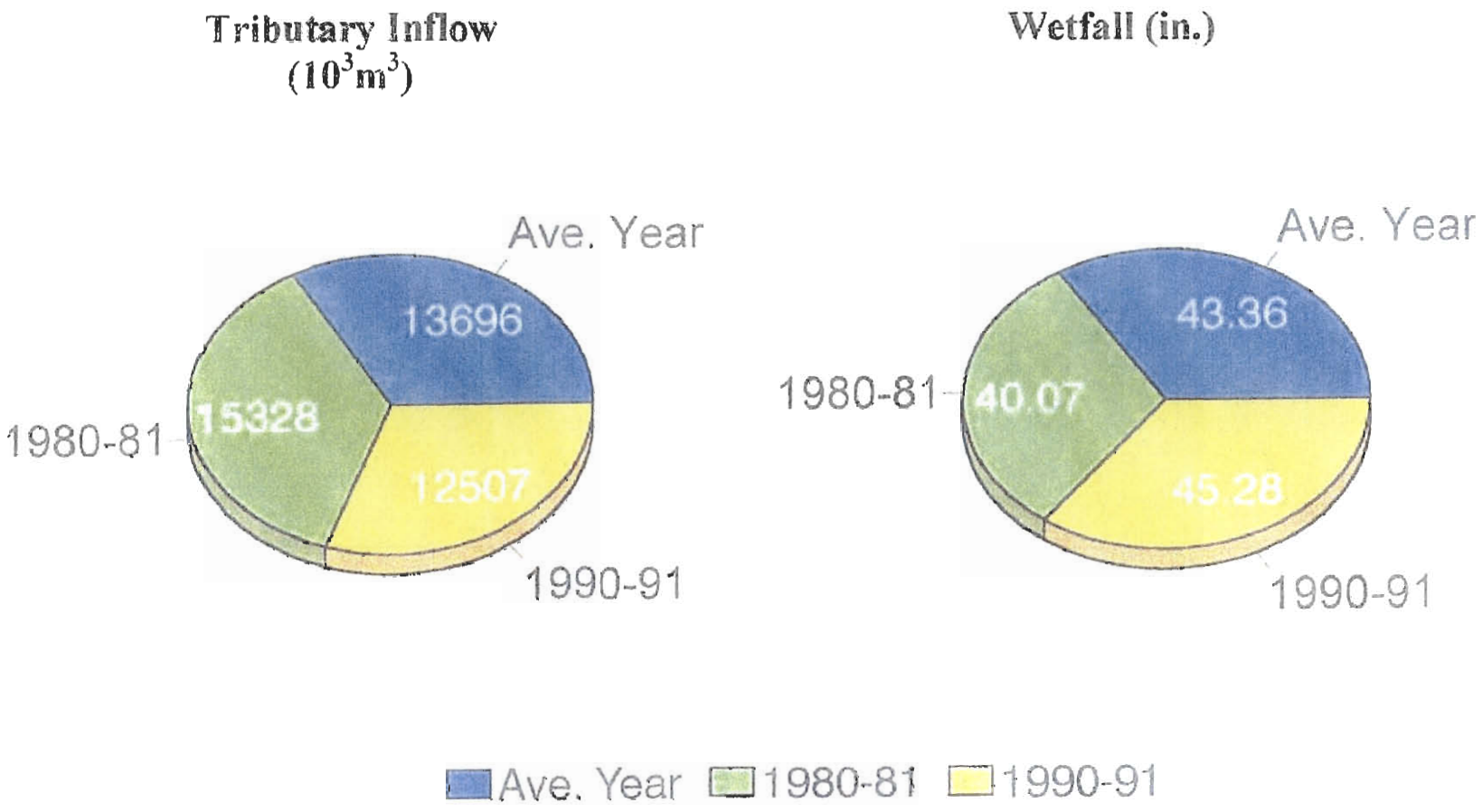


Figure VI-2 A Comparison of Annual Tributary Inflow and Wetfall for Two Budget Years and Average Year

CHAPTER VII
PHOSPHORUS BUDGET

A. Development of Phosphorus Budgets

The calculation of a phosphorus budget is an essential step in the evaluation of a lake's trophic status. A phosphorus budget provides a means to evaluate and rank phosphorus sources that may contribute to lake productivity. It is most important to determine the quantity of nutrients (especially phosphorus) entering the lake, as well as the ultimate fate of those nutrients. The phosphorus budget relies heavily upon the accuracy of the hydrologic budget for its input and output variables.

Many extensive nutrient budgets have been reported in the literature. Lake Washington in Seattle, Washington (Edmondson, 1972), Lake Erie (Burns, 1970), and Kezar Lake, North Sutton, New Hampshire (Connor and Smith, 1983) have all been studied in great detail.

Nutrient loading rates have been reported as either "surface loading rates" or "volumetric loading rates" and are usually expressed in terms of mass per unit area-time, or mass per unit volume-time.

The purpose of this chapter is to quantify the various avenues of phosphorus inputs into Kezar Lake and to explore the various phosphorus sinks and exports from the watershed. Phosphorus loadings (flux) were calculated for each tributary inflow, outflow and atmospheric contribution to Kezar Lake. Direct runoff and groundwater phosphorus contributions were estimated using 1981-82 data. A phosphorus budget was then prepared for the 1990-91 study year.

B. Field Monitoring Program

Field investigations and data collection occurred during the period from September 1990 through April 1993. The phosphorus budget is based on the October 1990 through September 1991 hydrologic budget.

Three inflowing tributaries and the outlet station were monitored for phosphorus concentration within the immediate Kezar Lake watershed.

C. Phosphorus Budget Components

1. Tributary Loading and Discharge

Tributary phosphorus concentrations were analyzed and monthly loadings were calculated for each of the Kezar Lake tributaries. Phosphorus loadings were determined by calculating monthly tributary flows ($10^3 m^3$) and multiplying these values by mean monthly phosphorus concentrations (mg/L). The resultant values represent mean monthly phosphorus loading or flux (kg P). The summations of each of the calculated monthly values equal the total tributary annual phosphorus loading.

As discussed in the hydrologic section, this report will focus on tributary phosphorus loading to Kezar Lake since Lyon Brook contributed 70 percent of the phosphorus load during the 1981-82 diagnostic study period.

2. Internal Phosphorus Cycling

The fate of phosphorus in water is usually considered to consist of: 1) chemical, physical, or biological transformation of the ionic form into a particle; 2) sedimentation of this particle to the bottom; 3) partial breakdown in the sediment; and, 4) the release of some of the ionic phosphorus back into the lake water if conditions are favorable.

The actual measurement of total phosphorus release or uptake from the sediment is an unrealistic task to accomplish. Since sediment release and uptake are simultaneously ongoing functions in different sections of a lake and other chemical, physical and biological activities are also occurring, it is virtually impossible to establish a realistic total phosphorus release or uptake figure. These figures are unknown. However, calculating an internal phosphorus-loading model can derive an estimation of net differences between total uptake and total release. A positive mass balance solution represents net uptake.

An essential component of the nutrient budget is the monthly net release or uptake of phosphorus from or to the lake sediments. In order to quantify this component, a phosphorus mass-balance equation was solved for each month of the average year and for the gauging year. Thus, by knowing the masses of phosphorus entering the lake and flowing out of the lake and the change of mass in the lake, the equation can be solved for the mass released or absorbed by the sediments.

Mass is calculated as the product of concentration and volume. Table VII-1 shows how the phosphorus mass in Kezar Lake, at the beginning of each month of the gauging year, was calculated as the sum of the masses in each stratum. The values of concentration are weighted averages of collected sampling data. The volume of each stratum was calculated from areal measurements of contours on the bathymetric map.

Table VII-1
In-Lake Phosphorus Mass
1990-1991 Gauging Year

DATE	Epi/Metalimnion P (mg/L)	M (Kg)	Hypolimnion P (mg/L)	M (Kg)	Total P Mass (Kg)
Dec-01-90	0.009	17.5914	0.004	0.1368	17.7282
Jan-01-91	0.009	17.5914	0.004	0.1368	17.7282
Feb-01-91	0.005	9.773	0.003	0.1026	9.8756
Mar-01-91	0.009	17.5914	0.011	0.3762	17.9676
Apr-01-91	0.019	37.1374	0.013	0.4446	37.582
May-01-91	0.013	25.4098	0.014	0.4788	25.8886
Jun-01-91	0.013	25.4098	0.016	0.5472	25.957
Jul-01-91	0.016	31.2736	0.026	0.8892	32.1628
Aug-01-91	0.013	25.4098	0.016	0.5472	25.957
Sep-01-91	0.016	31.2736	0.025	0.855	32.1286
Oct-01-91	0.014	27.3644	0.014	0.4788	27.8432
Nov-01-91	0.013	25.4098	0.013	0.4446	25.8544

Table VII-2 reflects monthly values of each variable of the mass-balance equation and the resulting net uptake or release for the gauging year.

The mass-balance equation is:

$P_{int} = (P_2-P_1) - (P_{in}-P_{out}) = P_2-P_1 - P_{in}+P_{out}$

Where:

P_{int} = net phosphorus release (+) or uptake (-) by the sediments

P_1 = in-lake phosphorus mass, beginning of month

P_2 = in-lake phosphorus mass, end of month

P_{in} = phosphorus mass flowing in during the month

P_{out} = phosphorus mass flowing out during the month

Table VII-2
Monthly Internal Phosphorus Cycling
(1990-1991 Gauging Year)

Months	P_{in} inflow	P_{out} outflow	P_{lake1} (kg)	P_{lake2} (kg)	P_{int} (kg)
Dec	19.7	31.8	17.7	17.7	12.1
Jan	13.2	15.7	9.9	17.7	10.3
Feb	11.7	4.9	18.0	9.9	-4.9
Mar	62.5	20.0	37.6	18.0	-62.1
Apr	18.7	32.9	25.9	37.6	25.9
May	18.2	16.5	26.0	25.9	-1.8
Jun	13.7	4.6	32.2	26.0	-15.3
Jul	6.5	0.0	26.0	32.2	-0.3
Aug	21.4	0.0	32.1	26.0	-25.8
Sep	38.2	7.6	27.8	32.1	-26.3
Oct	30.7	33.4	25.9	27.8	-0.8
Nov	13.9	16.0	25.9	25.9	2.1

D. Annual Phosphorus Budget for Gauging Period (1990-1991)

The monthly and total phosphorus budget was derived from the aforementioned components and measured phosphorus concentrations. It is evident that a valid phosphorus budget is dependent on a well-quantified hydrologic budget and is essential to the calculation of phosphorus loading, as well as the lake's tolerance to inflowing phosphorus. Phosphorus budgets and their components provide important information, which is valuable to the comparison of relative phosphorus contributions from various tributary areas within the watershed.

Table VII-3 depicts the 1990-91 phosphorus budget for Kezar Lake. Lyon Brook represents 57 percent of the total P budget and 79 percent of the tributary P loading to the lake. March accounted for 20 percent of the annual tributary P load to the lake. Generally, the spring months account for a high percent of the melting of the winter snow pack.

Table VII-3
Kezar Lake Phosphorus Budget for Gauging Period (1990-1991)
(Phosphorus Load (KG))

COMPONENT	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	MEAN MONTHLY	TOTAL ANNUAL	PERCENTAGE
Qi1 (Inlet)	10.4	7.3	7.4	31.4	9.8	11.3	8.7	3.5	12.2	24.0	20.1	7.4	12.8	153.5	57.0
Qi2 (KHB)	1.7	1.2	0.4	12.3	2.4	1.3	0.1	0.0	0.5	3.3	1.3	1.0	2.1	25.7	9.5
Qi3 (Birch)	0.8	0.7	0.5	6.6	1.1	0.8	0.4	0.0	0.2	1.2	1.7	0.3	1.2	14.2	5.3
Atmospheric	4.1	2.2	1.8	3.6	2.8	2.3	2.6	2.1	5.6	4.4	3.4	3.3	3.2	38.2	14.2
Groundwater and Runoff Estimates	2.7	1.8	1.6	8.6	2.6	2.5	1.9	0.9	2.9	5.3	4.2	1.9	3.1	36.9	13.7
Sub Total	19.7	13.2	11.7	62.5	18.7	18.2	13.7	6.5	21.4	38.2	30.7	13.9	22.4	268.4	
Net Sediment Release (+) Uptake (-)	12.1	10.3	-4.9	-62.1	25.9	-1.8	-15.3	-0.3	-25.8	-26.3	-0.8	2.1		-86.9	
Total Influx	31.8	23.5	6.8	0.4	44.6	16.4	-1.6	6.2	-4.4	11.9	29.9	16.0		181.5	
Qo (Outlet)	31.8	15.7	4.9	20.0	32.9	16.5	4.6	0.0	0.0	7.6	33.4	16.0	15.3	183.4	

The combined months of September and October accounted for 29 percent of the P load to Kezar Lake. Since these two months accounted for 20 percent of the wetfall, the increased watershed runoff and elevated flows produced the high P load to the lake.

The 1990-91 budget year reflects that the least phosphorus flux to the lake occurred during February, June and July. Usually there is minimal P loading during the winter because most precipitation is in the form of snow. Summers are characteristically dry and evaporation rates are high, which results in both minimal flow rates and decreased P loading.

Table VII-4 shows a comparison of three phosphorus budgets prepared for Kezar Lake. The monthly budgets compare the 1980-81 sample year, the average year and the 1990-91 sample year. Five months show large deviations in phosphorus load to Kezar Lake. Much of the snow pack melted during March of the 1990-91 year, accounting for 23 percent of the phosphorus input to Kezar Lake. Both the average year and 1980-81 year reflect that the snow pack melt had the greatest impact to phosphorus loading in April where phosphorus load is 23 and 22 percent respectively of the annual supply. May phosphorus loadings corresponded well between the 1980-81 season and 1990-91 season but the P loading for these years was dramatically lower than the average year. The same relationship is observed in September and October between the three years. The higher phosphorus loading during the 1990-91 year was a result of above average wetfall and an increase in watershed runoff. Phosphorus loading was lower during 7 months of the 1990-91 sample year than both the average year and the 1980-81 year.

A comparison of total annual phosphorus loading and annual wetfall is shown in Figure VII-1. Both the average year and the 1980-81 year were similar in phosphorus loading and rainfall. The average year contributed 323.3 kg P with a wetfall of 43.4 inches while the 1980-81 year resulted in 356.4 kg P and 40.3 inches of rainfall. The interesting observation is that the 1990-91 year contributed far less phosphorus (268.4 kg) with about ten more inches of wetfall than previous years. The 1990-91 year phosphorus load was reduced by almost 100 kg P from the 1980-81 year. Possible conclusions from these results may be an increase in the effectiveness of Chadwick Meadows in taking-up phosphorus, with subsequently less phosphorus entering the watershed system.

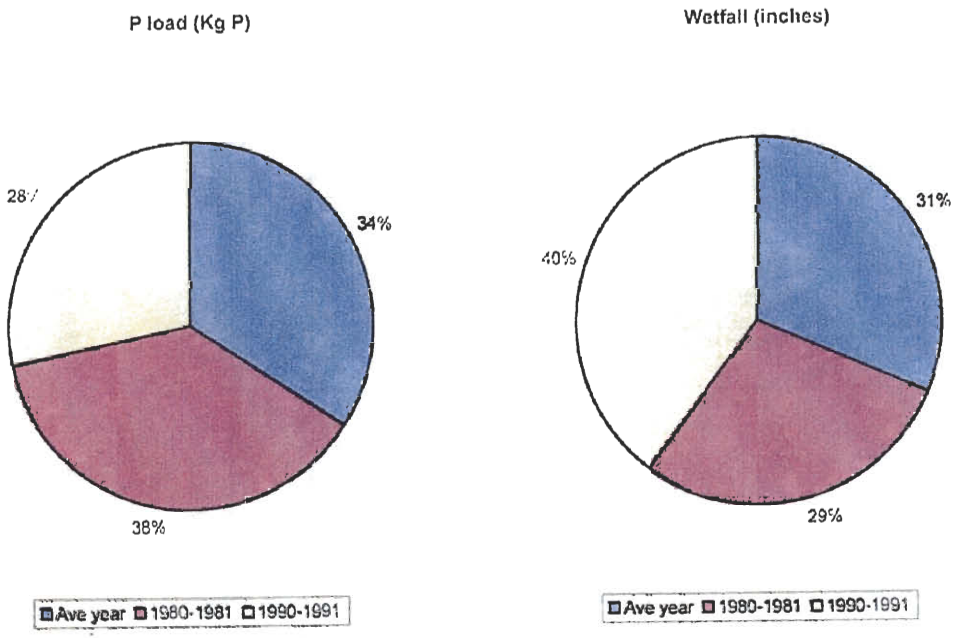


Figure VII-1. A comparison of total annual phosphorus loading and annual wetfall from the 1980-1981 year, the 1990-1991 year, and the average year.

Table VII-4
A Monthly Comparison of Phosphorus Load with Respect to Rainfall During the Average Year, the 1980-1981 Year and the 1990-1991 Year

Months	Average year (Kg p)	1980-1981 year (Kg p)	1990-1991 year (Kg p)	Wetfall (inches) 1981	Wetfall (inches) 1991
Jan	14.5	18.3	13.2	1.7	3.8
Feb	14.0	20.7	11.7	2.9	2.6
Mar	41.3	32.3	62.5	1.5	1.5
Apr	73.0	79.1	18.7	3.0	3.8
May	72.3	24.3	18.2	2.6	6.1
Jun	15.7	29.9	13.7	7.8	2.6
Jul	12.5	23.6	6.5	3.6	3.2
Aug	13.6	8.5	21.4	2.2	12.6
Sep	9.7	45.1	38.2	3.7	6.4
Oct	17.1	33.3	30.7	4.8	2.8
Nov	21.2	22.0	13.9	3.2	4.8
Dec	18.4	19.3	19.7	3.3	4.7
Total	323.3	356.4	268.4	40.3	54.9

E. Internal Loading Comparisons Between Pre-Treatment Conditions (1980-81) and Post Treatment Conditions (1990-91)

1. Mass Balance Equation

The main goal for the reclamation of Kezar Lake was a two-phase approach. The first phase was to reduce the external supply of phosphorus to the lake. This was achieved by routing the sewage to a new sewage facility and enhancing a wetland area to be a more efficient sink for phosphorus. The second phase was to reduce the supply of phosphorus from the sediment to the hypolimnion.

Reducing the external phosphorus supply was extremely successful as New London effluent is now treated outside the watershed at the Sunapee Sewage Treatment facility. Additionally, Chadwick Meadows appears to be reducing the phosphorus load to Lyon Brook.

This section examines the effectiveness of hypolimnetic injection of aluminum salts to reduce the internal supply of phosphorus to Kezar Lake.

Figure VII-2 shows an estimation of net differences between total uptake and total release. A positive mass balance solution signifies a release of phosphorus to the water while a negative solution represents net uptake. The 1980-81 gauging year shows P release to the water during the four months of May, August, October and November while the four months that represent P release during the 1990-91 year are January, February, May and December. The average year showed P release only during the months of April and November.

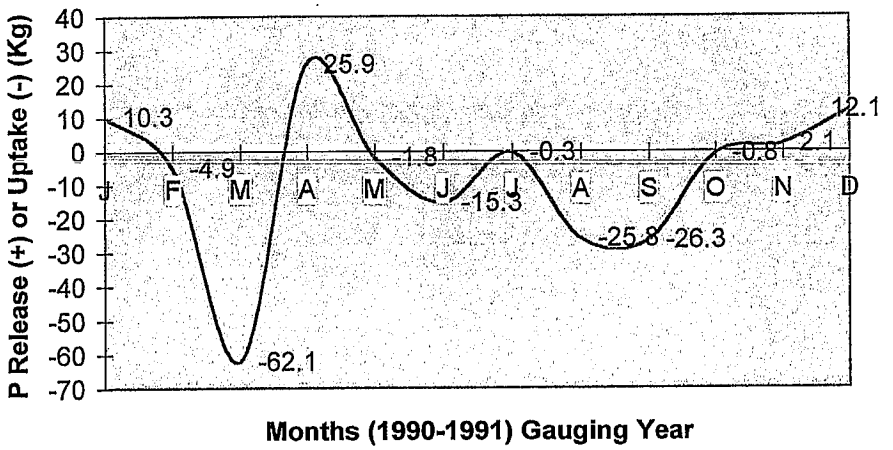
The amount of P release from the 1980-81 year ranges from 1.7 to 11.3 kg P while the P release is more elevated during the 1990-91 year ranging from 2.1 to 25.9 kg P. The total net uptake for each of the years is fairly constant, ranging from –86.9 kg P during the 1990-91 year to –124.3 kg P during the average year.

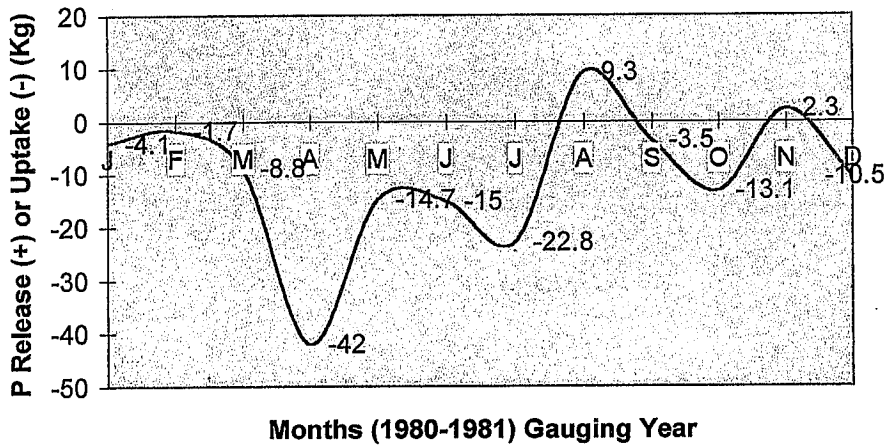
2. Hypolimnetic Volume/Mass Measurements

The hypolimnetic volume of Kezar Lake was calculated and multiplied by the stratified seasonal mean phosphorus concentrations measured in the hypolimnion. Table VII-5 reflects the bottom water phosphorus concentrations for each study year and the mass of phosphorus contained in the hypolimnion during stratification.

A comparison between the 1980-81 year and the 1990-91 year shows that the bottom water phosphorus concentration during the 1990-91 year is lower than the 1980-81 year in eleven months and equal in one month.

The total P mass in the hypolimnetic waters during stratification shows that the P mass was lower during the 1990-91 season than the 1980-81 season. Since the hypolimnetic area of Kezar Lake is relatively small, the total loading from this area is comparatively lower when considering the external phosphorus supply. However, the actual measurement of phosphorus release or uptake from the sediment is an unrealistic task to accomplish, since sediment release and uptake are simultaneously ongoing functions in different sections of a lake and other chemical, physical and biological activities are also occurring.





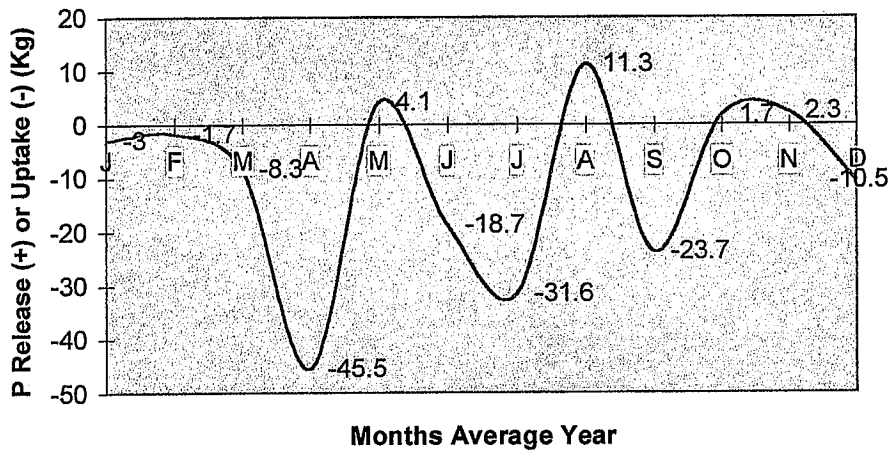


Figure VII-2. A comparison of net sediment phosphorus release and uptake during the 1990-1991, 1980-1981, and average study years, respectively.

Table VII-5
A Comparison of Hypolimnetic Phosphorus Mass and Concentration
For the Study Years 1980-1981 and 1990-1991

	1980-1981 Study Year		1990-1991 Study Year	
MONTH	BOTTOM P CONCENTRATION (mg/L)	HYPOLIMNETIC P MASS (Kg P)	BOTTOM P CONCENTRATION (mg/L)	HYPOLIMNETIC P MASS (Kg P)
JAN	0.027	-	0.003	-
FEB	0.024	-	0.003	-
MAR	0.023	-	0.012	-
APR	0.019	-	0.013	-
MAY	0.016	0.5	0.016	0.5
JUN	0.033	1.1	0.018	0.6
JUL	0.038	1.3	0.026	0.9
AUG	0.025	0.9	0.017	0.6
SEP	0.037	1.3	0.027	0.9
OCT	0.032	1.1	0.014	0.5
NOV	0.030	-	0.012	-
DEC	0.030	-	0.003	-
TOTAL		6.2		4.0

What we can deduce from this exercise is that both the phosphorus concentration and therefore, the hypolimnetic P load to the lake decreased from the 1980-81 season to the 1990-91 season. The obvious goal of a hypolimnetic injection of aluminum salts is to reduce the volume of phosphorus that is transmitted from the sediments to the water throughout the year. In turn, there is less phosphorus provided to the water column during mixing and less available P for phytoplankton.

CHAPTER VIII
CHADWICK MEADOWS WETLANDS MANAGEMENT

A. Phosphorus Dynamics in Wetlands

Most studies examining water quality changes in temperate wetlands found distinct seasonal variations in wetland attenuation of phosphorus. Although these variations were generally marked by minimum attenuation or even release of phosphorus during the fall and spring high flows, the specific conditions at any particular site appear to alter this seasonal pattern. Several studies indicated that wetlands were net accumulators of phosphorus on an annual basis, and may have maximum seasonal removal efficiencies from 80 to 98 percent during the summer growing season. This seasonal attenuation of phosphorus by the wetlands may be significant in as much as it may delay the entry of nutrients into downstream water bodies until the fall, winter, or in some cases, spring, when their impact may be less severe (Lee et. al., 1975).

Bentley (1969) studied four wetlands in Wisconsin and estimated that on a long-term basis, they were neither nutrient sources nor sinks; but that the marshes tended to accumulate nutrients during the growing season and release them during spring runoff. However, even during periods of active photosynthesis, the wetlands were not a barrier to nutrient transport.

Richardson (1988) examined the ecological value of wetlands in terms of the ability to filter materials, transform nutrients, or function as sources or sinks. Macrophytes are mainly responsible for the recycling of phosphorus through root uptake from the soil; plants are the source of phosphorus for the water rather than the reverse. Richardson concluded that wetlands are incorrectly depicted as sinks when, in fact, they should be recognized as transformers. Wetlands with organic soils do not retain phosphorus as efficiently as forested systems and are often a source of nutrients rather than a sink for them.

In addition to incorporating nutrients into plant tissue, marshes also serve to settle out a large portion of the suspended particulate materials and to remove nitrogen through denitrification reactions. On the other hand, the periodic occurrence of anaerobic conditions increases the possibility for discharge of ammonia and soluble inorganic phosphorus, particularly in wetlands subject to pulses of high discharge from runoff.

B. Chadwick Meadows Wetlands Evaluation

Topographically, Chadwick Meadows was thought to be an excellent location for wetlands manipulation to encourage phosphorus removal by sedimentation and vegetative uptake. This publicly owned 50-acre wetland is a predominantly deep and shallow marsh with minor components of other wetland types, including shrub swamp and wooded swamp. Chadwick Meadows has little surrounding development and a narrow outlet at which a variable stage control structure has been constructed. Both Lyon Brook and Clark Pond Brook, carrying runoff water from the more intensively developed upper watershed, must flow through Chadwick Meadows before entering Kezar Lake.

A thorough hydrological analysis of induced flooding at Chadwick Meadows has shown that the existing outlet control structure is very capable of maintaining desirable flood levels. Moreover, no adverse flooding of surrounding areas would occur during an intense (100-year) rainstorm and a decrease in outflow from the wetland would occur only during rare drought periods.

A macrophyte survey of Chadwick Meadows, completed in July of 1984 (Connor and Martin, 1985), showed that much of the marsh was composed of the blue-joint grass (*Calamagrostis canadensis*). Figure VIII-1 shows the location and abundance of each plant, while Table VIII-1 lists the symbol, generic name, common name and abundance of each plant. It was feared that this plant, among others, would be detrimentally impacted by the higher water levels; however, the blue-joint grass was observed to be doing very well two years after flooding. Both *Potamogeton* and *Typha* were observed to be common within Chadwick Meadows. *Utricularia* was observed to be common along much of the entire shoreline area of the marsh.

Wild rice (*Zizania aquatica*) was planted in the shallow and deeper marsh areas of Chadwick Meadows during the spring of 1985 and 1986. Since these seeds sink immediately, there is little chance that they could ever reach Kezar Lake. Wild rice was the chosen macrophyte because it grows in one to three feet of water, is excellent in aiding in phosphorus attenuation, and at the same time, provides waterfowl with food and cover.

One of our greatest concerns with Chadwick Meadows was how the higher water level would affect the established macrophyte community. Research of flooded marsh areas has shown that some plant species cannot tolerate continuously high water levels. Some studies have shown that it took two or three years of continuous flooding before macrophyte mortality

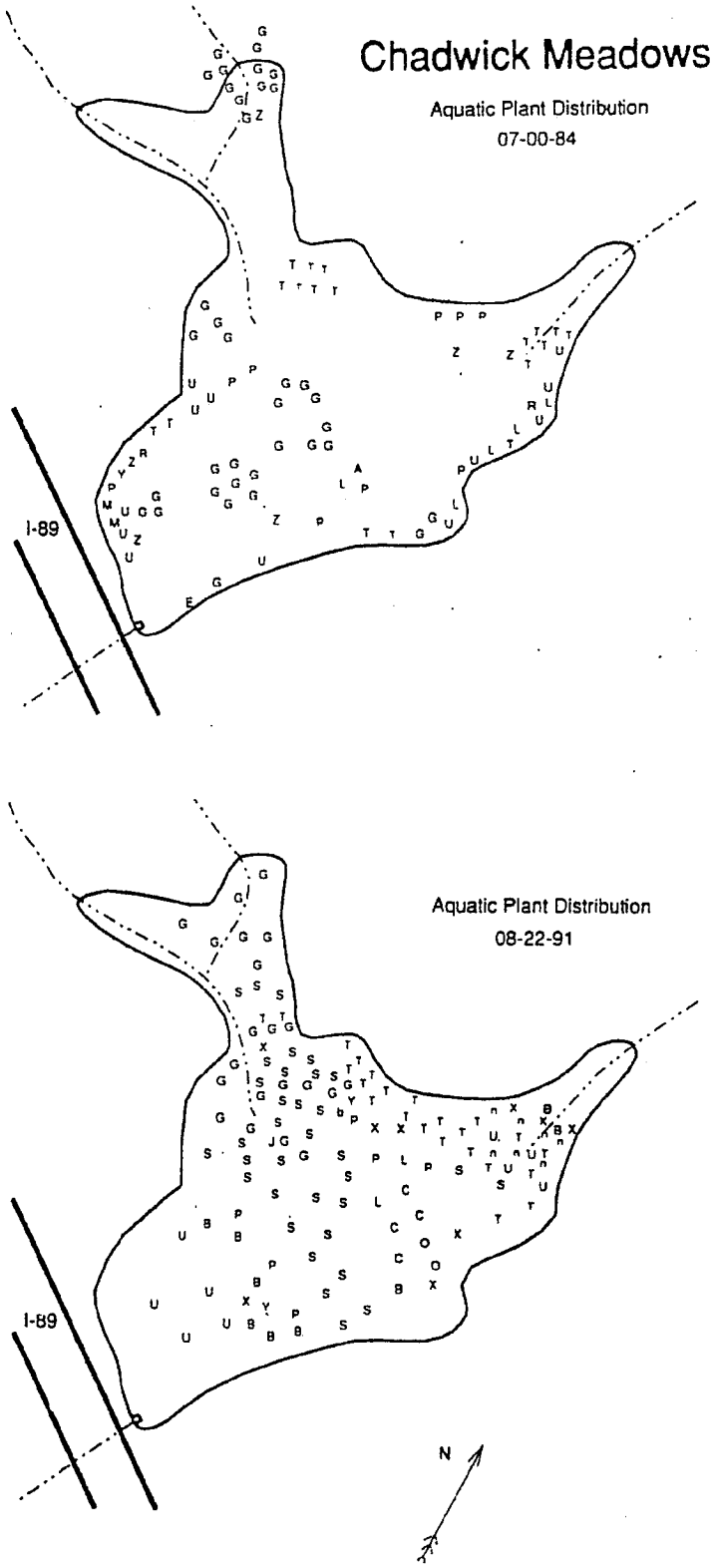


Figure VIII-1 A Comparison of Aquatic Plant Distribution at Chadwick Meadows from 1984 to 1991

occurred. Some change in vegetation was expected to occur, as it would from any change in surface water hydrology. However, with management, these changes can result in both phosphorus attenuation and increased food production for waterfowl.

It was anticipated that Chadwick Meadows could act as an effective wetland for decreasing phosphorus concentrations in Lyon Brook below the marsh and would potentially benefit Kezar Lake by limiting phosphorus availability. A monitoring program was established in July of 1984 and again in 1990 to measure phosphorus loading into and out of Chadwick Meadows. Trends of net phosphorus uptake or release, which determines the effectiveness of this wetland for removing phosphorus, are discussed in the following section.

C. Chadwick Meadows Wetlands Macrophyte Succession

During the fall of 1982, flashboards were installed and the water level was permanently raised. Since that time, the meadows have been managed by New Hampshire Fish & Game for waterfowl and fur-bearing mammals.

Aquatic Plant surveys were conducted in July of 1984, as previously mentioned, and again in August of 1991. Figure VIII-1 and Table VIII-1 also display information on the 1991 survey to show the succession of aquatic plants in the wetland over the seven-year period.

Three aquatic plants disappeared from the meadows including *Myrica gale*, *Sagittaria* and *Eleocharis* while *Typha* and *Potamogeton natans* decreased in abundance. During the same period of time, five new aquatic plants were observed to be growing in the meadows. *Najas, Brasenia, Ceratophyllum, Juncus,* and *Scirpus* were all new additions to the meadows while *Pontederia* increased in abundance.

As can be observed by the two aquatic plant maps, the overall abundance increased from abundant to very abundant. This increase of overall abundance may be an indication of the wetlands adaptation to decreased water currents and increased water depth. The increased biomass and the elapsed time from terrestrial macrophyte death and decomposition may be factors that aid in the assimilation of nutrients by Chadwick Meadows.

Table VIII-1
Aquatic Plant Survey of Chadwick Meadows, Sutton, New Hampshire
By the New Hampshire WSPCD, July 1984

ID	Generic Name	Common Name	Abundance
U	Utricularia	Bladderwort	Common
Y	Nuphar	Yellow Water Lily	Sparse
G	Gramineae	Grass Family	NA
M	Myrica gale	Sweet Gale	Sparse
S	Sparganium	Bur Reed	Scattered
T	Typha	Cattail	Common
X	Potamogeton natans	Pondweed	Common
A	Sagittaria	Arrowhead	Sparse
L	Lemna	Duckweed	Sparse
R	Rosaceae	Wild Rose	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
E	Eleocharis	Spike Rush	Sparse
O	Polygonum	Water Smartweed	Sparse
Z	Zizania aquatica	Wild Rice	Sparse
OVERALL ABUNDANCE: Abundant			

Aquatic Plant Survey of Chadwick Meadows, Sutton, New Hampshire
By the New Hampshire WSPCD, August 1991

ID	Generic Name	Common Name	Abundance
U	Utricularia	Bladderwort	Common
Y	Nuphar	Yellow Water Lily	Sparse
G	Gramineae	Grass Family	NA
S	Sparganium	Bur Reed	Scattered
T	Typha	Cattail	Common
X	Potamogeton natans	Pondweed	Common
L	Lemna	Duckweed	Sparse
P	Pontederia cordata	Pickerelweed	Sparse
O	Polygonum	Water Smartweed	Sparse
N	Najas	Bushy Pondweed	Sparse
B	Brasenia	Water Shield	Scattered
C	Ceratophyllum	Coontail	Sparse
J	Juncus	Rush	Sparse
b	Scirpus	Bulrush	Sparse
OVERALL ABUNDANCE: Very Abundant			

D. Treatment Effectiveness

1. Wetlands Performance

a. Introduction

With the complex hydrology of wetland areas, the development of nutrient budgets is a difficult task. Groundwater seepage often accounts for the majority of water input, evaporation accounts for much of the output, and the rates of water exchange by these mechanisms has proven to be very difficult to measure.

b. Surface Hydrology

Throughout the two study periods, staff gauge readings and, whenever possible, flow measurements were taken at the three main tributaries of Chadwick Meadows and at its outlet. Station locations are depicted in Figure VIII-2. Table VIII-2 depicts the 1990-91 hydrologic inflows and outflow of Chadwick Meadows. Sixty percent of the water volume flowing into Chadwick Meadows is derived from Clark Pond Brook while Lyon Brook contributes 38 percent of the inflowing water, and Trib Brook contributes two percent (Figure VIII-3).

Table VIII-3 shows a detailed hydrologic budget for the 1990-91 study year. The total water input during the study year was 11,286 10^3m^3 and the total measured volume leaving Chadwick Meadows was 11, 422 10^3m^3.

E. Phosphorus Budget and Wetland Efficiency to Assimilate Phosphorus for the 1991 Sample Season.

Tributary phosphorus concentrations were measured in conjunction with flow measurement at the three tributaries and outlet of Chadwick Meadows. Phosphorus loadings were determined by calculating the mean monthly tributary flow (10^3m^3) and multiplying these values by mean monthly phosphorus concentrations at each station. Summing the monthly tributary values resulted in the total tributary phosphorus load into Chadwick Meadows.

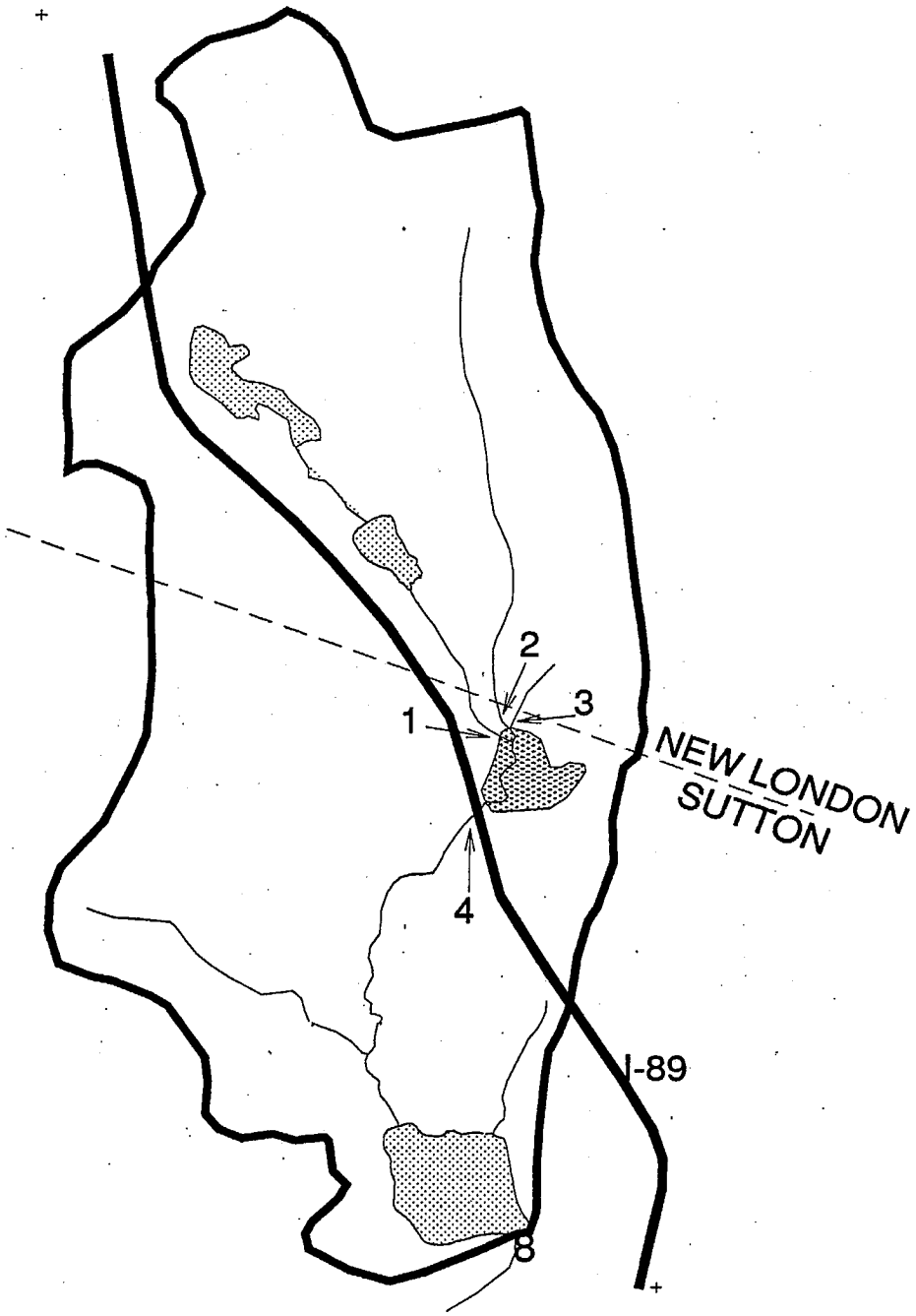


Figure VIII-2 **Chadwick Meadows Sampling Station Locations, Kezar Lake, North Sutton, New Hampshire**

Table VIII-2
Mean Monthly Hydrologic Discharge Values
For Chadwick Meadows Tributaries ($10^3 m^3$)

Month	Clark Pond Brook	Lyon Brook Above	Trib Brook	Total Inflow	Total Outflow
Dec 90	1014	581	22	1617	1556
Jan 91	676	285	44	1005	723
Feb 91	450	600	20	1070	623
Mar 91	1040	1086	127	2253	2852
Apr 91	1025	504	21	1550	1884
May 91	562	227	5	794	830
Jun 91	110	44	0	154	148
Jul 91	0	0	0	0	0
Aug 91	0	0	0	0	27
Sep 91	259	233	11	503	657
Oct 91	805	352	9	1166	1210
Nov 91	640	265	7	912	835
Total	6581	4177	266	11,024	11,345
Mean	548	348	22	918	945

Table VIII-4 reflects the phosphorus import and export from the inflowing tributaries and the outlet. Lyon Brook contributes the greatest phosphorus load to Chadwick Meadows, producing 65 percent of the total phosphorus influx. Although Clark Pond Brook accounts for the greatest water inflow, it only produces 23 percent of the phosphorus loading to the meadows. Tributary Brook contributes 12 percent of the phosphorus load to the wetlands.

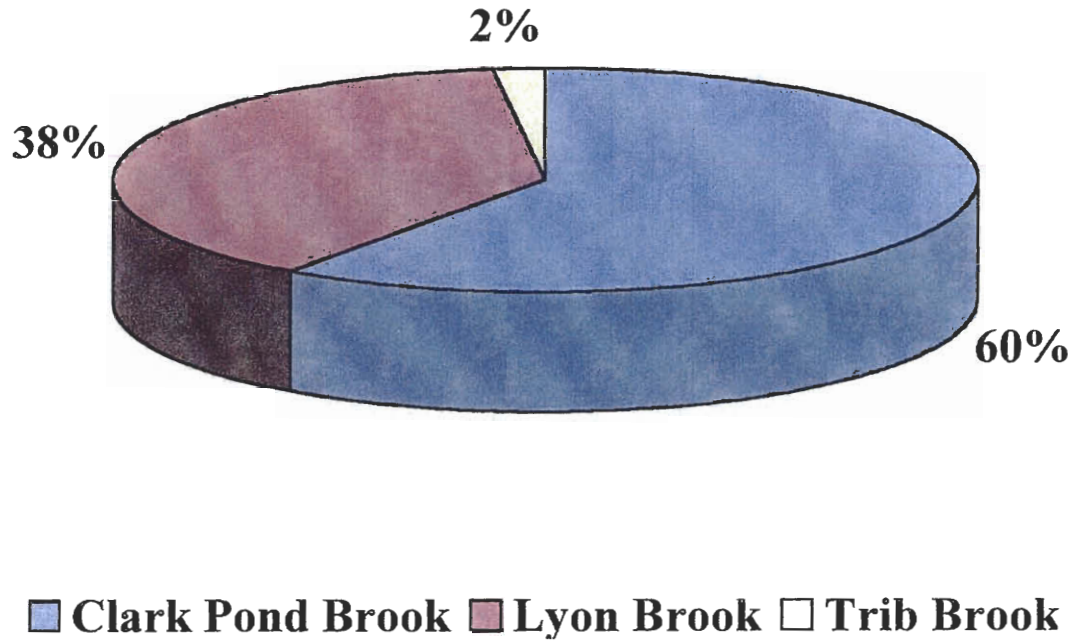


Figure VIII-4 Relative Percent of Tributary Inflow to Chadwick Meadows

Table VIII-3
Chadwick Meadows Hydrologic Budget for Gauging Period
(Dec 1990 - Nov 1991)

Component	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Mean	Annual
Qi1	1014	676	450	1040	1025	562	110	0	0	259	805	640	548	6581
Qi2	581	285	600	1086	504	227	44	0	0	233	352	265	348	4177
Qi3	22	44	20	127	21	5	0	0	0	11	9	7	22	266
Precip	28	14	10	24	18	22	16	14	40	31	23	22	22	262
Total In	1645	1019	1080	2277	1568	816	170	14	40	534	1189	934	940	11286
Qo	1556	723	623	2852	1884	830	148	0	27	657	1210	835	945	11345
EV	0	0	0	0	0	0	15	22	19	10	10	1	6.4	77
Total Out	1556	723	623	2852	1884	830	163	22	46	667	1220	836	952	11422

Table VIII-4
Phosphorus Import and Export From Chadwick Meadows for 1991 (kg P)

Month	Clark Pond	Lyon Brook	Trib Brook	Total Inflowing	Chadwick Meadows Outlet	Net Uptake(-) Release (+)
Jan	5.46	1.96	1.90	9.32	7.57	-1.75
Feb	2.23	7.21	0.53	9.97	5.70	-4.27
Mar	17.53	161.66	31.19	210.38	95.86	-114.552
Apr	11.74	3.84	0.28	15.86	22.20	+6.34
May	6.10	1.60	0.32	8.02	13.44	+5.42
Jun	0.87	0.47	0.01	1.35	4.36	+3.01
Jul	0.18	0.51	0.00	0.69	0.54	-0.15
Aug	0.53	0.98	0.02	1.53	2.43	+0.9
Sept	2.70	4.57	0.94	8.21	15.64	+7.43
Oct	6.48	3.19	0.13	9.8	15.70	+5.9
Nov	4.16	1.16	0.04	5.36	7.19	+1.83
*Dec	8.53	3.06	0.24	11.83	14.52	+2.69
Monthly Mean	5.54	15.85	2.97	24.36	17.10	-7.26
Yearly Total	66.48	190.2	35.6	292.32	205.15	87.17

* December of 1990

Seasonally, the month of March is by far the greatest producer of phosphorus loading to Chadwick Meadows, contributing 210 kg and 72 percent of the total monthly loading from the tributaries. This high seasonal phosphorus load is from watershed meltwater. The least seasonal loading to the wetlands occurs during the driest season, which includes the months of June, July and August. These three months combined only account for one percent of the total phosphorus load for 1991.

The net phosphorus uptake/release is the factor that must be examined to determine how effective Chadwick Meadows is in assimilating phosphorus and thereby removing or utilizing it before it reaches Kezar Lake. The 1991 budget shows that on a monthly basis, Chadwick Meadows outflowing phosphorus exceeded the inflowing phosphorus during eight months, with

a range of release of 0.9 kg to 7.4 kg. The months of April, May, June, August, September, October, November and December all showed a release of phosphorus to Kezar Lake.

Although the wetlands acted as a phosphorus sink only four months of the year, the total annual phosphorus input exceeded the total annual phosphorus export to Lyon Brook. The total phosphorus load to Chadwick Meadows was 292.3 kg for 1991 while the total annual export to Lyon Brook was 205 kg, resulting in a net uptake of 87 kg of P for 1991. Much of the phosphorus uptake occurred in March when the wetlands removed 54 percent of the phosphorus flux or 114.5 kg. Much of the phosphorus was probably removed by particulate sedimentation rather than plant uptake since it was still too early for aggressive plant growth.

The late spring and summer are key periods of time for the wetland uptake of phosphorus. It is during this period when the environmental conditions are favorable for biological productivity.

If the phosphorus loading to the lake is excessive, phytoplankton productivity will reach its maximum growth rate. Also this should be the time when maximum phosphorus uptake in the wetlands occurs because the aquatic macrophytes are reaching their peak productivity. Both July and August showed either uptake or very minimal release to Lyon Brook.

F. Historical Trends of Chadwick Meadows Effectiveness to Assimilate Phosphorus

Figure VIII-4 demonstrates the effectiveness of Chadwick Meadows for assimilating phosphorus. The area below the dotted line represents phosphorus uptake or sedimentation while the area above the dotted line represents phosphorus release from the wetlands to Lyon Brook.

In general, the sample years reflect that wetland phosphorus assimilation is predominant over phosphorus release. In only 13 months of the seven-year wetland study period was phosphorus release dominant. In the years 1985 through 1987 and in 1990 wetland phosphorus release occurred during March or April, while wetland phosphorus release occurred in September and October of 1983. Although wetland phosphorus assimilation does occur during the spring seasonal cycle, the wetland may not be capable of uptaking the vast amount of loading that occurs during the high spring snowmelt. Other than May and June of 1986, much of the summer phosphorus loading to the Chadwick Meadows is reduced by either sedimentation or macrophyte

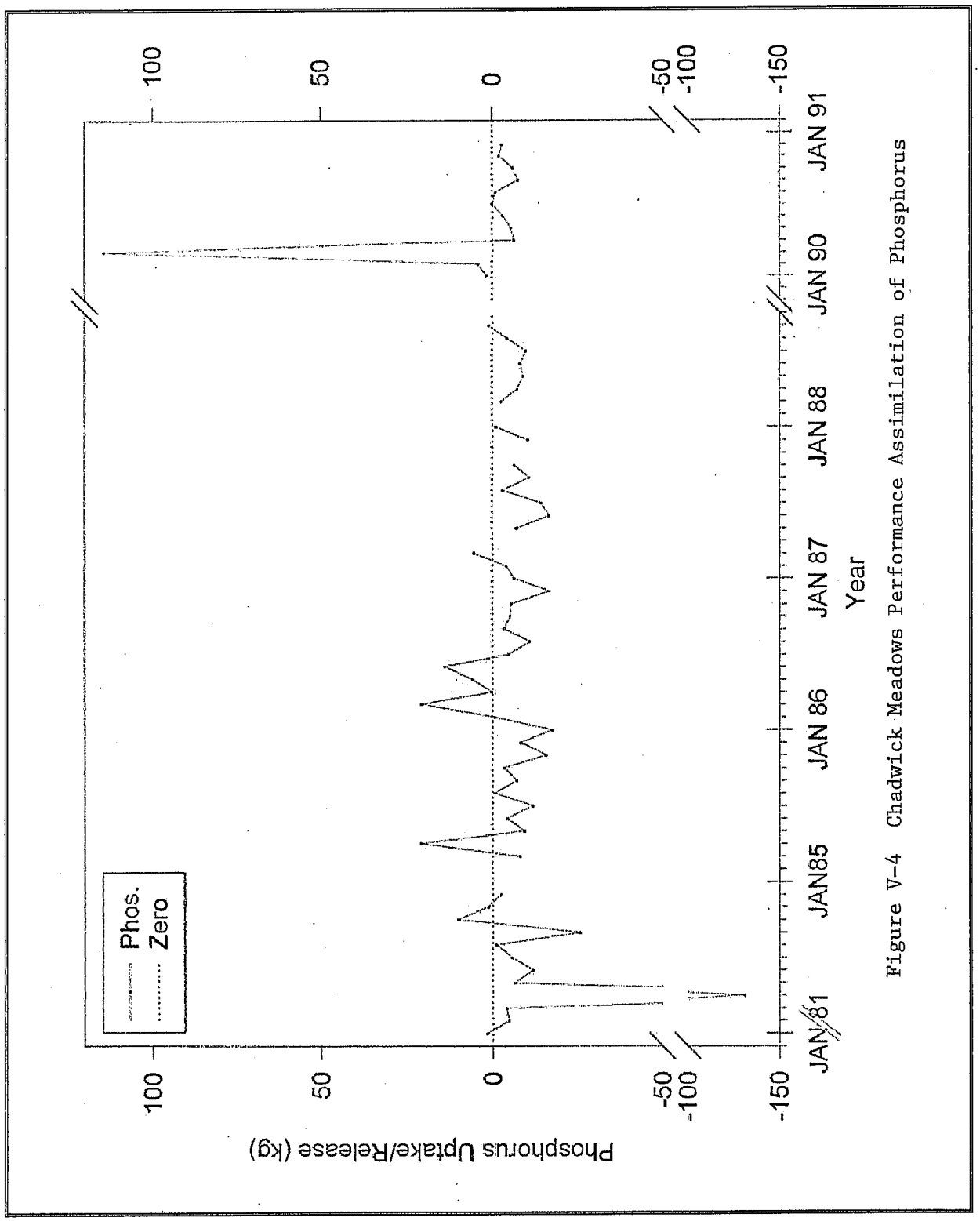


Figure V-4 Chadwick Meadows Performance Assimilation of Phosphorus

assimilation. The reduction of external phosphorus to the lake during this critical growth period can reduce the phytoplankton production.

The data collected over this seven year monitoring period reflects that the increased water level and the creation of a more extensive wetland area appears to have been a successful strategy in reducing the supply of phosphorus to the receiving waterbody.

CHAPTER IX
TROPHIC STATUS MODELLING

A. Introduction

The trophic status of a waterbody refers to the nutritive state (especially phosphorus) of a lake or pond, but is often described in terms of the biological activity that occurs as a result of nutrient levels. Trophic state indices have been developed using a single parameter or several parameters. This chapter will examine several trophic classifications for Kezar Lake prior to (1978 and 1982), and following the aluminum salts injection (1984, 1990/91, and 1999).

B. Trophic Classification Schemes

1. State of New Hampshire Trophic Classification System

The classification system developed by the DES Biology Bureau (Table IX-1) utilizes four parameters to classify the lakes and ponds of New Hampshire (NHWSPCC, 1981). The system used to trophically classify New Hampshire lakes and ponds was revised in 1989 (Table IX-2). The purpose of the revision was to provide for equal points under each attribute and to reduce the impact of the bottom dissolved oxygen criterion. Unlike the previous system, the extent of oxygen depletion (as it relates to the water column) is evaluated in the new system.

Table IX-3 presents the calculated value of each classified parameter for the 1978, 1982, 1984, and 1999 surveys of Kezar, with the trophic points received and the trophic status.

Prior to the implementation of a diagnostic study and any rehabilitation efforts, a trophic classification applied to the data collected at Kezar Lake showed the lake to be in a eutrophic state. Bottom dissolved oxygen levels were just above zero milligrams per liter, transparency averaged a half a meter, and chlorophyll-a densities were very high. Seventeen trophic points were earned in 1978, yielding a lake classification of eutrophic.

Historical data from 1982 show a classification of mesotrophic with the lake earning a total of 8 trophic points. The mean dissolved oxygen concentrations during this year were higher than those recorded in 1978, but were still considered low. Mean secchi disk depth improved by nearly a meter, and mean chlorophyll-a concentrations in 1982 were considerably lower than those recorded in 1978.

At the end of the 1984 summer sampling period (the year of the aluminum salts injection), the lake had lost one trophic point since the 1982 classification. It appears that the aluminum salts injection showed immediate positive results in the water quality of Kezar Lake. Mean dissolved oxygen levels were higher than those recorded in 1982, transparency increased by more than one meter, and chlorophyll-a densities were reduced by nearly 3 mg/m^3 since the 1982 trophic classification.

In 1999, Kezar Lake received a total of 6 trophic points and was classified as mesotrophic (one point higher than the high end of the oligotrophic range). Vascular plants were rated as being common, and chlorophyll concentrations of 6.87 mg/m^3 fell within the mesotrophic range. The transparency was also in the mesotrophic range with a Secchi depth of 2.83 meters, though this reading was no different than that recorded in 1984. The bottom dissolved oxygen concentration was 4.65 mg/L at a depth of 6.5 meters, which is higher than the mean oxygen levels recorded in 1984 and previous years.

Table IX-4 summarizes the results of applying the 1989 revised trophic classification. The classifications determined in this scheme remain fairly the same, with a slight increase (or worsening) in the eutrophic rating for 1978, and a slight decrease, or improvement in the 1999 oligotrophic rating.

Table IX-1
Original Trophic Classification System For New Hampshire Lakes and Ponds

1. Summer Bottom Dissolved Oxygen:	**Trophic Points**
a. D.O. $\geq$ 5 mg/L	0
b. 2 mg/L $\leq$ D.O. < 5mg/L & < 30 foot depth	1
c. 2 mg/L $\leq$ D.O. < 5mg/L & $\geq$ 30 foot depth	2
d. .5 mg/L $\leq$ D.O. <2 mg/L & < 30 foot depth	3
e. .5 mg/L $\leq$ D.O. <2 mg/L & $\geq$ 30 foot depth	4
f. D.O. < .5 mg/L & <30 foot depth	5
g. D.O. < .5 mg/L & $\geq$ 30 foot depth	6
2. Summer Secchi Disk Transparency:	**Trophic Points**
a. > 24 feet	0
b. > 12 feet to 24 feet	1
c. > 6 feet to 12 feet	2
d. > 3 feet to 6 feet	3
e. > 1 foot to 3 feet	4
f. > .5 foot to 1 foot	5
g. $\leq$ .5 foot	6
3. Aquatic Vascular Plant Abundance:	**Trophic Points**
a. Sparse	0
b. Scattered	1
c. Common	2
d. Abundant	3
e. Very Abundant	4
4. Summer Epilimnetic Chlorophyll-a (mg/M^3):	**Trophic Points**
a. Chl a < 5	0
b. 5 $\leq$ Chl a < 10	1
c. 10 $\leq$ Chl a < 20	3
d. Chl a $\geq$ 20	5

		Trophic Points
Trophic Classification	Stratified	*Unstratified
Oligotrophic	0-5	0-3
Mesotrophic	6-10	4-6
Eutrophic	11-21	7-15

*Unstratified lakes are not evaluated by the bottom dissolved oxygen criterion.

Table IX-2
Trophic Classification Systems for New Hampshire Lakes and Ponds, Revised 1989

1. Summer Bottom Dissolved Oxygen:	**Trophic Points**
a. D.O. > 4 mg/L	0
b. D.O. = 1 to 4 mg/L & hypolimnion volume ≤ 10% of lake volume	1
c. D.O. = 1 to 4 mg/L & hypolimnion volume > 10% of lake volume	2
d. D.O. < 1 mg/L in < 1/3 hypo. volume & hypo. volume < 10% lake volume	3
e. D.O. < 1 mg/L in ≥ 1/3 hypo. volume & hypo. volume ≤ 10% lake volume	4
f. D.O. < 1 mg/L in < 1/3 hypo. volume & hypo. volume > 10% lake volume	5
g. D.O. < 1 mg/L in ≥ 1/3 hypo. volume & hypo. volume > 10% lake volume	6
2. Summer Secchi Disk Transparency:	**Trophic Points**
a. > 7 m	0
b. > 5 m - 7 m	1
c. > 3 m - 5 m	2
d. > 2 m - 3 m	3
e. > 1 m - 2 m	4
f. > 0.5 m - 1 m	5
g. ≤ 0.5 m	6
3. Aquatic Vascular Plant Abundance:	**Trophic Points**
a. Sparse	0
b. Scattered	1
c. Scattered/Common	2
d. Common	3
e. Common/Abundant	4
f. Abundant	5
g. Very Abundant	6
4. Summer Epilimnetic Chlorophyll-a (mg/m^3):	**Trophic Points**
a. < 4	0
b. 4 - < 8	1
c. 8 - < 12	2
d. 12 - < 18	3
e. 18 - < 24	4
f. 24 - < 32	5
g. ≥ 32	6

	Trophic Points	
Trophic Classification	Stratified	*Unstratified
Oligotrophic	0-6	0-4
Mesotrophic	7-12	5-9
Eutrophic	13-24	10-18

*Lakes without hypolimnions are not evaluated by the bottom dissolved oxygen criterion.

Table IX-3
Trophic Classification of Kezar Lake Using Original Classification Methods

Trophic Classification – 1978 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	.1	5
Secchi Disk (ft)	.5	6
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	52.72	5
Classification: Eutrophic		17
Trophic Classification – 1982 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	1.93	3
Secchi Disk (ft)	1.29	3
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	8.53	1
Classification: Mesotrophic		8
Trophic Classification – 1984 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	3.92	1
Secchi Disk (ft)	2.84	4
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	5.10	1
Classification: Mesotrophic		7
Trophic Classification - Summer 1999		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	4.65	1
Secchi Disk (ft)	2.83	2
Plant Abundance	Common	2
Chlorophyll-a (mg/m^3)	6.87	1
Classification : Oligotrophic		Total = 6

Table IX-4
Trophic Classification of Kezar Lake Using 1989 Revised Classification Methods

Trophic Classification – 1978 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	.1	6
Secchi Disk (ft)	.5	6
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	52.72	5
Classification: Eutrophic		18
Trophic Classification – 1982 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	1.93	2
Secchi Disk (ft)	1.29	3
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	8.53	1
Classification: Mesotrophic		7
Trophic Classification – 1984 Survey		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	3.92	2
Secchi Disk (ft)	2.84	4
Plant Abundance	Scattered	1
Chlorophyll-a (mg/m^3)	5.10	1
Classification: Mesotrophic		8
Trophic Classification - Summer 1999		
Parameter	**Value**	**Trophic Points**
Dissolved Oxygen (mg/L)	4.65	0
Secchi Disk (ft)	2.83	2
Plant Abundance	Common	2
Chlorophyll-a (mg/m^3)	6.87	1
Classification : Oligotrophic		Total = 5

2. Carlson's Trophic Index

Carlson's (1977) Trophic State Index (TSI) system is based on Secchi depth as a means of characterizing algal biomass. This parameter, in the absence of turbidity and colored materials in water, is a direct measure of "plankton-algal manifested eutrophication processes" in natural waters. Its range of values can easily be transformed into a convenient scale. Further, by using empirically derived relationships between Secchi depth and both phosphorus and chlorophyll-a concentrations, Carlson derived equations to estimate the same index value from these two parameters as well as from Secchi depth. Carlson's trophic index is basically a linear transformation of Secchi depth, such that each 10-unit increase in his TSI scale represents a halving of the Secchi visibility. Conversely, for total phosphorus each 10-unit increase represents a doubling in phosphorus concentrations. The computational form of the equations for his trophic scheme is as follows:

$$TSI(SD) = 10\left(6 - \frac{\ln SD}{\ln 2}\right)$$

$$TSI(Chl) = 10\left(6 - \frac{2.04 - 0.68 \ln Chl}{\ln 2}\right)$$

$$TSI(TP) = 10\left(6 - \frac{\ln \frac{48}{Tp}}{\ln 2}\right)$$

According to Carlson (1977), this index system has the advantages of easily obtained data, simplicity, absolute TSI values, valid relationships, retrieval of data from the index, and can be grasped by the layman in much the same manner as the Richter earthquake scale. The TSI incorporates most lakes in a scale of 0 to 100 as Figure IX-1 demonstrates. Each major division (10, 20, 30, etc.) represents a doubling of phosphorus and about a 2.8 fold increase in algal biomass.

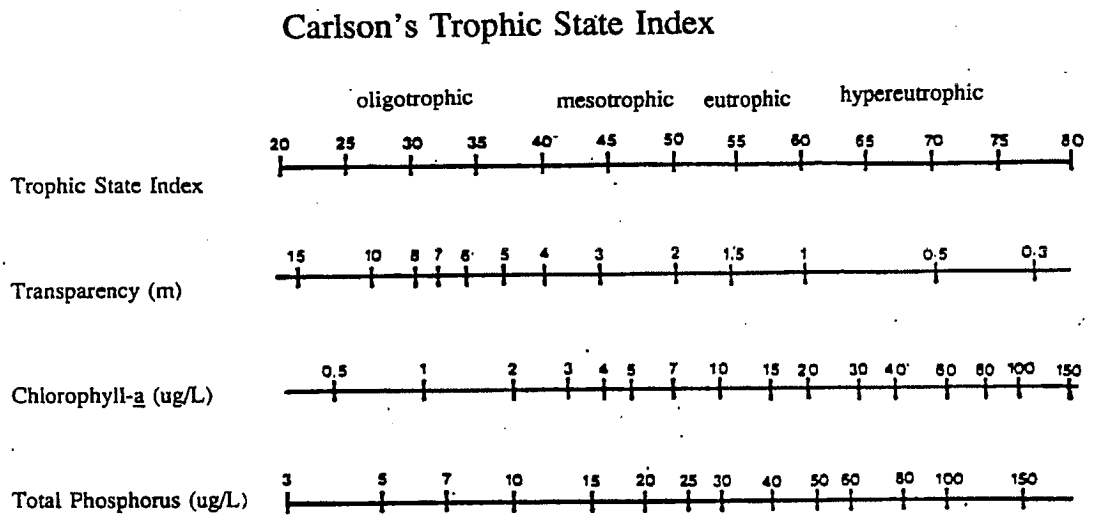


Figure IX-1 Carlson's Trophic State Index

Results of the Carlson TSI were obtained by substituting summer mean Secchi depth, chlorophyll-a, and phosphorus values from Kezar Lake into the equations to compute the TSI. Table IX-5 shows the mean summer values for 1978, 1982, 1984, and 1999, as well as the TSI number and the classification for each measured parameter.

Data from 1978 show a trophic status of hypereutrophic for all categories except epilimnetic oxygen concentrations, which were low enough to be considered eutrophic. Since 1978, there have been gradual increases in the trophic classifications yielded from the TSI index calculations. Data from the summer of 1982 show an increasing trend in water quality to the point where the index yields a borderline mesotrophic/eutrophic classification. In 1984 and again in 1999 a borderline mesotrophic/oligotrophic classification was achieved.

Table IX-5
Carlson Trophic Classification for Kezar Lake

1978			
Parameter	**Mean Summer Value**	**Trophic Points**	**Classification**
Chlorophyll-a (µg/L)	52.72	69.4	Hypereutrophic
Secchi Disk (m)	.5	70	Hypereutrophic
Epilimnetic Phosphorus (µg/L)	30	53.2	Eutrophic
Hypolimnetic Phosphorus (µg/L)	109*	71.9	Hypereutrophic
1982			
Parameter	**Mean Summer Value**	**Trophic Points**	**Classification**
Chlorophyll-a (µg/L)	11.75	51.6	Meso/Eutrophic
Secchi Disk (m)	1.53	51.6	Meso/Eutrophic
Epilimnetic Phosphorus (µg/L)	21	48	Mesotrophic
Hypolimnetic Phosphorus (µg/L)	33	54.64	Eutrophic
1984			
Parameter	**Mean Summer Value**	**Trophic Points**	**Classification**
Chlorophyll-a (µg/L)	5.10	46.5	Mesotrophic
Secchi Disk (m)	2.84	44.9	Mesotrophic
Epilimnetic Phosphorus (µg/L)	11	38.7	Oligo/Meso
Hypolimnetic Phosphorus (µg/L)	12.5	40.4	Oligo/Meso
1999			
Parameter	**Mean Summer Value**	**Trophic Points**	**Classification**
Chlorophyll-a (µg/L)	6.87	49.4	Mesotrophic
Secchi Disk (m)	2.83	44.9	Mesotrophic
Epilimnetic Phosphorus (µg/L)	8.57	35.1	Oligo/Meso
Hypolimnetic Phosphorus (µg/L)	16.71	44.6	Mesotrophic

*Average between 3 m and bottom sample

3. Dillon/Rigler Permissible Loading Model

The trophic model developed by Dillon/Rigler (1974) has been widely utilized and well documented by researchers. Its application classifies a lake as oligotrophic, mesotrophic or eutrophic by comparing calculated annual loadings with permissible annual loadings. The tolerance of the lake to phosphorus loading is predicted as a function of two morphological parameters, mean depth (z) and water retention time (T), which have been proven by several researchers to be the primary determinants of loading permissibility. Additionally, the model considers the phosphorus retention in the lake sediments. The retention coefficient (R) may be empirically calculated from morphological data or may be derived from a definitive phosphorus budget.

Table IX-6 shows the qualitative relationship between the model input parameters and phosphorus loading tolerance.

Table IX-6
Dillon/Rigler Permissible Loading Tolerance

High Phosphorus Loading Tolerance	Low Phosphorus Loading Tolerance
Large mean water depth	Small mean water depth
Rapid flushing rate	Slow flushing rate
High sediment retention	Low sediment retention

Thus, existing trophic status is set by existing values for these parameters and annual phosphorus loading. Similarly, historical trophic status can be determined from estimates of previous phosphorus loading. The degree of trophic state improvement, which would result from the implementation of watershed and in-lake management strategies, can be gauged from predicted changes of loading and morphology. Table IX-7 presents the Dillon/Rigler trophic status calculations for Kezar Lake using 1990/91 data.

Table IX-7
Dillon/Rigler Trophic Status Calculations for Kezar Lake in 1991

Parameter	Calculation
Lake area (m^2)	725,000
Mean depth (m)	2.82
Total loading (kg)	181.5
Flushing rate (yr^{-1})	8.2
Water retention time (yr) (T)	0.134
P coefficient (R)	.38
Total areal loading ($g/m^2/yr$) (Lp)	0.25
LT (1-R) (g/m^2)	0.04

Figure IX-2 is a graphical representation of the Dillon/Rigler model showing trophic zones, plotted on axes of mean depth and areal loading (Table IX-7) with the data point for the Kezar Lake study year. The solution of the Dillon/Rigler equation for Kezar Lake data shows the existing trophic status of the lake as oligotrophic based on an a budgeted loading of 181.5 kg p/yr. The results of the Dillon/Rigler model when run using 1982 data classified Kezar Lake as mesotrophic with a budgeted loading of 256.4 kg P/yr. It is evident that watershed management activities have reduced the amount of phosphorus entering Kezar Lake, thereby improving the modeled trophic classification.

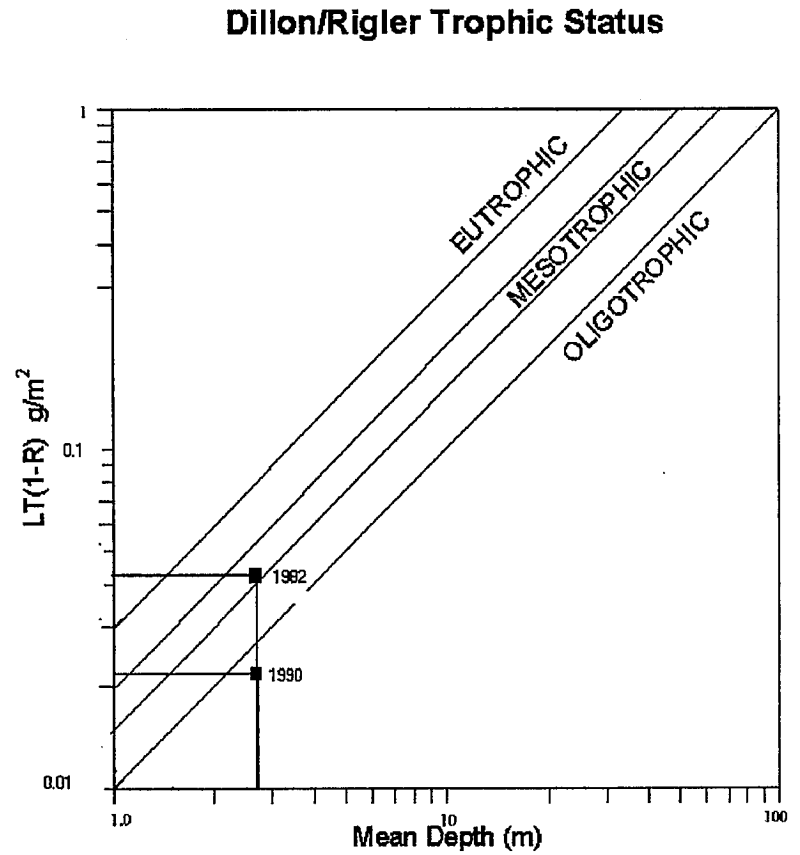


Figure IX-2 Dillon/Rigler Trophic Status graph showing the pre- and post results of modeling Kezar Lake data.

The Dillon/Rigler model also predicts in-lake phosphorus concentration. Utilizing the Dillon/Rigler equation P=Lp(1-R)/qs, the calculated predicted in-lake epilimnetic phosphorus concentration for Kezar Lake was 7 ug/L. This was lower than the 1991 study year mean epilimnetic phosphorus concentration of 12 ug/L in Kezar Lake. The actual mean epilimnetic phosphorus concentration was calculated from the summer phosphorus data collected by the Biology Bureau during the 1990/91 sample year.

4. Vollenweider Phosphorus Loading and Surface Overflow Rate Relationship

The Vollenweider model is based on a five-year study involving the examination of phosphorus load and response characteristics for about 200 waterbodies in 22 countries in Western Europe, North America, Japan and Australia. Vollenweider, working on the Organization for Economic Cooperation and Development (OECD) Eutrophication Study, developed a model describing the relationship of phosphorus load and the relative general acceptability of the water for recreational use (Vollenweider, 1975). Vollenweider found that when the annual phosphorus load to a lake is plotted as a function of the quotient of the mean depth and hydraulic residence time, lakes, which were eutrophic, tended to cluster in one area and oligotrophic lakes in another.

Vollenweider developed a statistical relationship between areal annual phosphorus loading (Lp) to a lake normalized by mean depth (Z) and hydraulic residence time (T), to predict lake phosphorus concentration (P). Table IX-8 summarizes the Vollenweider model parameters for the Kezar Lake sample year.

Table IX-8
Vollenweider Phosphorus Concentration Prediction

Parameter	Equation	Kezar Lake
1. Hydraulic residence time (T)	$T = \frac{V}{Q}$	0.134 yr
2. Surface overflow rate (qs)	$qs = \frac{z}{T}$	21.04 (m/y)
3. Areal phosphorus load (Lp)	$Lp = \frac{P\ load}{lake\ surface\ area}$	.25 ($g/m^2/yr$)
4. Mean depth (Z)	measured	2.82 (m)
5. Phosphorus concentration prediction (P)	$P = \frac{Lp}{qs}\left[\frac{1}{1+\sqrt{\frac{z}{qs}}}\right]$	0.008 (mg/L)

Thus, based on the physical constraints that control water volume, the hydraulic residence time in the lake, and mean lake depth, combined with phosphorus loading, the Vollenweider model predicts the existing in-lake phosphorus concentration to be 8 ug/L in Kezar Lake. An examination of actual mean epilimnetic in-lake phosphorus concentrations during the 1991 summer study period revealed that the mean measured phosphorus concentration of 12 ug/L at Kezar Lake was higher than the predicted value of 8 ug/L.

Figure IX-3 graphically portrays the measured loading rates for Kezar Lake and compares this lake with other New Hampshire Diagnostic/Feasibility study results. Based on the permissible and excessive loading curves, it can be seen that Kezar Lake lies in the oligotrophic zone, in the vicinity of the low loading range. It is in fact slightly lower than the model run before phosphorus removal from the New London sewage treatment facility.

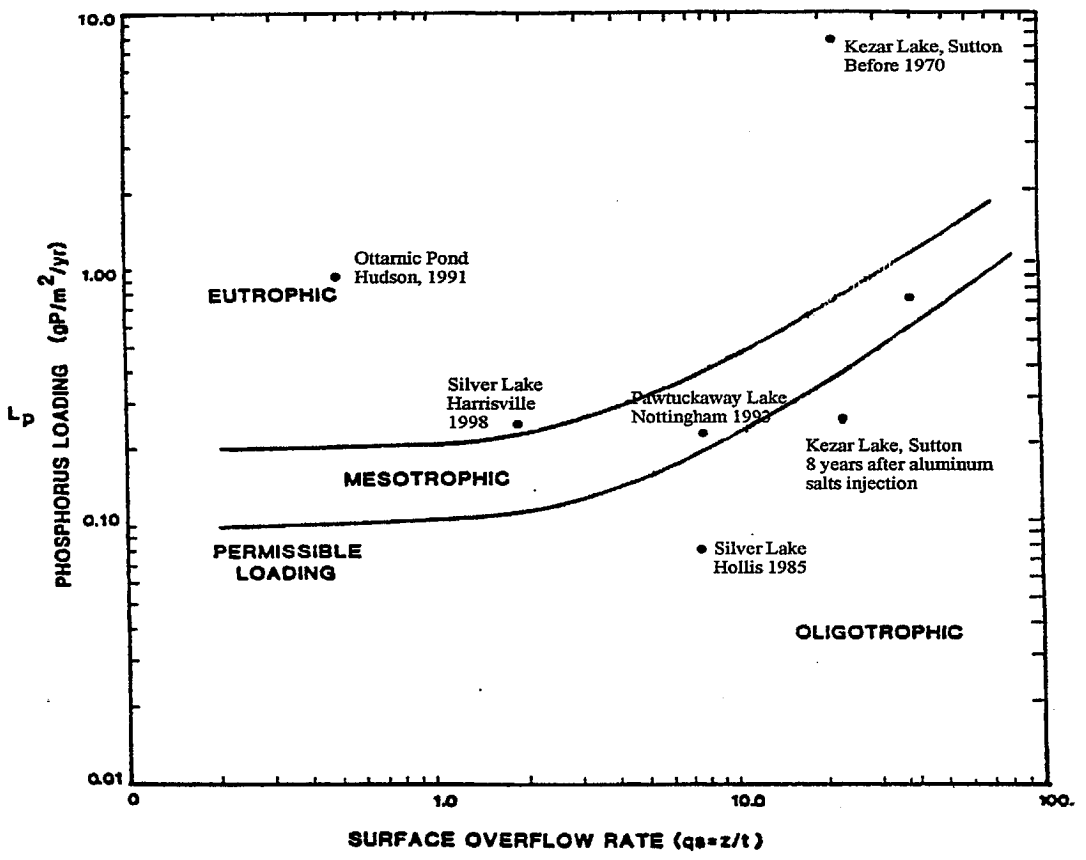


Figure IX-3 Vollenweider Phosphorus Loading and Surface Overflow Rate Relationships

C. Trophic Classification Summary

A summary of the four classification schemes utilized in this study is shown in Table IX-9. The New Hampshire lake classification system classifies Kezar Lake as a borderline oligotrophic/mesotrophic waterbody as of 1999. Both the Vollenweider Phosphorus Loading model and the Dillon/Rigler model classify the lake as oligotrophic based on a 1990-1991 nutrient budget. The Carlson Trophic Status Index defines a trophic class for several parameters. Secchi disk transparency, chlorophyll-a concentrations, and hypolimnetic phosphorus concentrations indicate mesotrophic conditions, while epilimnetic phosphorus measurements in Kezar Lake fell into the oligotrophic/mesotrophic boundary. This TSI classification shows improvement in trophic classification since 1978.

Table IX-9
Kezar Lake Trophic Classification Summary

Classification Model	Trophic Status
1. New Hampshire Lake Classification	Mesotrophic
2. Carlson's TSI	
Chlorophyll-a	Mesotrophic
Secchi Disk	Mesotrophic
Phosphorus (Epilimnion)	Meso/Oligotrophic
Phosphorus (Hypolimnion)	Mesotrophic
3. Dillon/Rigler	Oligotrophic
4. Vollenweider	Oligotrophic

The 1982 assessment of Kezar Lake predicted that an oligotrophic status was attainable with the implementation of management strategies such as hypolimnetic salts injection. Overall, it is evident that conditions have improved since the treatment, and the oligotrophic classification has been obtained.

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Appendix 1

Kezar Lake Study- Raw Data

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
05/08/1980	02 METERS	6.60	5.80	-99	0.0260	0.47	-0.05	98.00	-99.00	-99.00
06/16/1980	02 METERS	6.40	7.40	-99	0.0370	0.31	-0.05	111.00	-99.00	-99.00
06/30/1980	02 METERS	-99.00	6.70	-99	0.0350	0.68	-0.05	102.80	-99.00	-99.00
07/15/1980	02 METERS	7.00	8.00	-99	0.0540	0.50	-0.05	102.00	-99.00	-99.00
07/29/1980	02 METERS	6.90	8.30	-99	0.0240	0.62	-0.05	103.00	-99.00	-99.00
08/13/1980	02 METERS	6.70	8.80	-99	0.0300	0.39	-99.00	110.00	-99.00	-99.00
08/27/1980	02 METERS	7.10	8.30	-99	0.0190	-0.99	-0.05	117.00	-99.00	-99.00
09/18/1980	02 METERS	6.80	8.10	-99	0.0260	0.42	-0.05	105.00	-99.00	-99.00
10/01/1980	02 METERS	7.10	9.80	-99	0.0230	0.52	-0.05	117.00	-99.00	-99.00
10/16/1980	02 METERS	6.70	8.10	-99	0.0200	0.54	-0.05	115.00	-99.00	-99.00
10/30/1980	02 METERS	6.60	6.80	-99	0.0380	0.52	-0.05	146.00	-99.00	-99.00
11/13/1980	02 METERS	6.50	6.40	-99	0.0360	-0.10	0.06	112.00	-99.00	-99.00
12/18/1980	02 METERS	6.00	4.90	-99	0.0280	0.54	0.59	118.00	-99.00	-99.00
01/08/1981	02 METERS	-99.00	6.20	-99	0.0320	0.60	0.16	127.00	-99.00	-99.00
01/22/1981	02 METERS	5.90	7.10	-99	0.0250	2.40	0.14	156.00	-99.00	-99.00
02/05/1981	02 METERS	6.20	12.00	-99	0.0630	0.97	0.36	148.00	-99.00	-99.00
03/03/1981	02 METERS	5.80	4.20	-99	0.0210	0.26	0.13	92.50	-99.00	-99.00
03/19/1981	02 METERS	6.00	5.00	-99	0.0220	0.31	0.22	107.30	-99.00	-99.00
03/31/1981	02 METERS	6.00	4.50	-99	0.0270	0.31	0.12	102.00	-99.00	-99.00
04/17/1981	02 METERS	6.10	5.20	-99	0.0240	0.42	-0.05	99.30	-99.00	-99.00
05/06/1981	02 METERS	6.70	5.00	-99	0.0150	0.28	-0.05	112.00	-99.00	-99.00
06/04/1981	02 METERS	6.70	5.60	-99	0.0250	0.42	-0.05	103.00	-99.00	-99.00
06/30/1981	02 METERS	6.70	-99.00	-99	0.0290	0.44	-0.05	105.00	-99.00	-99.00
07/15/1981	02 METERS	6.40	-99.00	-99	0.0230	0.48	-0.05	101.00	-99.00	-99.00
07/28/1981	02 METERS	7.10	6.60	-99	0.0120	0.94	-0.05	104.00	-99.00	-99.00
08/12/1981	02 METERS	9.40	-99.00	-99	0.0230	1.00	-0.05	109.00	-99.00	-99.00
09/15/1981	02 METERS	6.60	-99.00	-99	0.0250	-99.00	-99.00	114.00	-99.00	-99.00
10/13/1981	02 METERS	6.90	-99.00	-99	0.0260	-99.00	-0.05	112.00	-99.00	-99.00
11/09/1981	02 METERS	6.60	6.00	-99	0.0210	0.46	-0.05	101.00	-99.00	-99.00
12/01/1981	02 METERS	6.40	-99.00	-99	0.0220	0.34	-0.05	98.00	-99.00	-99.00
01/20/1982	02 METERS	6.00	-99.00	-99	0.0130	0.42	0.10	107.00	-99.00	-99.00
02/16/1982	02 METERS	6.00	6.00	-99	0.0180	0.29	0.13	116.00	-99.00	-99.00
03/09/1982	02 METERS	6.20	-99.00	-99	0.0140	0.34	0.22	119.00	-99.00	-99.00
04/29/1982	02 METERS	6.20	-99.00	-99	0.0150	0.39	0.06	77.90	-99.00	-99.00
05/26/1982	02 METERS	6.00	-99.00	-99	0.0220	0.56	-0.05	67.00	-99.00	-99.00
06/09/1982	02 METERS	6.60	-99.00	-99	0.0260	0.28	-0.05	91.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/23/1982	02 METERS	6.70	6.00	-99	0.0230	0.63	0.63	93.00	-99.00	-99.00
07/07/1982	02 METERS	7.40	6.50	-99	0.0170	0.54	-0.05	98.50	-99.00	-99.00
07/20/1982	02 METERS	8.40	6.90	-99	0.0110	0.73	-0.05	96.80	-99.00	-99.00
08/05/1982	02 METERS	7.30	12.00	-99	0.0150	0.72	-0.05	94.80	-99.00	-99.00
08/16/1982	02 METERS	6.70	-99.00	-99	0.0210	0.29	-0.05	113.30	-99.00	-99.00
09/15/1982	02 METERS	6.70	-99.00	-99	0.0260	-99.00	-0.05	90.00	-99.00	-99.00
06/10/1983	02 METERS	6.70	7.00	-99	0.0260	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1983	02 METERS	7.00	6.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
07/01/1983	02 METERS	7.00	7.00	-99	0.0230	-99.00	-99.00	-99.00	-99.00	-99.00
07/08/1983	02 METERS	6.80	4.00	-99	0.0160	-99.00	-99.00	-99.00	-99.00	-99.00
07/14/1983	02 METERS	6.50	-99.00	-99	0.0560	-99.00	-99.00	95.00	-99.00	-99.00
07/21/1983	02 METERS	6.90	7.00	-99	0.0130	-99.00	-99.00	100.00	-99.00	-99.00
07/28/1983	02 METERS	6.80	7.50	-99	0.0100	-99.00	-99.00	99.00	-99.00	-99.00
08/10/1983	02 METERS	7.00	-99.00	-99	0.0150	-99.00	-99.00	98.00	-99.00	-99.00
08/19/1983	02 METERS	-99.00	-99.00	-99	0.0170	-99.00	-99.00	-99.00	-99.00	-99.00
09/08/1983	02 METERS	-99.00	-99.00	-99	0.0140	-99.00	-99.00	-99.00	-99.00	-99.00
10/20/1983	02 METERS	6.40	-99.00	-99	0.0400	-99.00	-99.00	-99.00	-99.00	-99.00
11/14/1983	02 METERS	6.40	-99.00	35	0.0400	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1984	02 METERS	-99.00	-99.00	-99	0.0090	-99.00	-99.00	-99.00	-99.00	-99.00
02/22/1984	02 METERS	6.00	3.20	30	0.0130	-99.00	-99.00	120.00	-99.00	-99.00
03/19/1984	02 METERS	6.00	4.20	30	0.0140	-99.00	-99.00	137.00	-99.00	-99.00
06/05/1984	02 METERS	6.50	-99.00	40	0.0230	-99.00	-99.00	65.60	148.00	-99.00
06/15/1984	02 METERS	-99.00	4.00	-99	0.0180	-99.00	-99.00	-99.00	-99.00	-99.00
06/28/1984	02 METERS	-99.00	2.88	-99	-99.000	-99.00	-99.00	102.30	-99.00	-99.00
07/17/1984	02 METERS	6.40	-99.00	-99	0.0140	-99.00	-99.00	103.70	400.00	-99.00
08/13/1984	02 METERS	6.70	4.80	15	0.0020	-99.00	-99.00	108.10	135.00	-99.00
09/13/1984	02 METERS	7.00	5.20	15	0.0050	-99.00	-99.00	109.50	30.00	-99.00
10/09/1984	02 METERS	6.80	5.10	10	0.0180	-99.00	-99.00	113.60	80.00	-99.00
11/15/1984	02 METERS	6.90	5.60	15	0.0150	-99.00	-99.00	128.00	35.00	-99.00
01/25/1985	02 METERS	6.60	6.70	15	0.1060	-99.00	-99.00	131.90	-99.00	-99.00
02/22/1985	02 METERS	6.30	5.30	30	0.0190	-99.00	-99.00	136.80	-99.00	-99.00
03/20/1985	02 METERS	6.20	3.50	30	0.0080	-99.00	-99.00	102.00	-99.00	-99.00
04/16/1985	02 METERS	6.70	4.10	25	0.0160	-99.00	-99.00	104.00	-99.00	-99.00
05/14/1985	02 METERS	6.90	4.10	25	0.0210	-99.00	-99.00	106.90	-99.00	-99.00
06/14/1985	02 METERS	6.90	-99.00	25	0.0180	-99.00	-99.00	113.50	-99.00	-99.00
07/16/1985	02 METERS	7.00	5.20	20	0.0100	-99.00	-99.00	117.80	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
08/14/1985	02 METERS	-99.00	-99.00	-99	0.0130	-99.00	-99.00	-99.00	-99.00	-99.00
09/19/1985	02 METERS	7.20	-99.00	25	0.0160	-99.00	-99.00	122.60	-99.00	-99.00
10/09/1985	02 METERS	6.70	5.60	30	0.0160	-99.00	-99.00	121.00	-99.00	-99.00
11/19/1985	02 METERS	6.70	4.60	35	0.0220	-99.00	-99.00	101.90	-99.00	-99.00
01/09/1986	02 METERS	6.50	5.10	40	0.0180	0.29	0.05	104.90	-99.00	-99.00
02/13/1986	02 METERS	6.10	3.10	40	0.0170	0.63	0.90	93.90	-99.00	-99.00
03/20/1986	02 METERS	6.10	3.34	35	0.0160	0.30	0.14	129.60	-99.00	-99.00
04/14/1986	02 METERS	6.40	-99.00	25	0.0120	1.85	0.11	96.80	-99.00	-99.00
05/14/1986	02 METERS	6.90	-99.00	19	0.0290	0.35	-0.25	107.10	-99.00	-99.00
07/15/1986	02 METERS	6.80	-99.00	32	0.0160	0.49	-0.05	119.50	-99.00	-99.00
08/15/1986	02 METERS	7.10	-99.00	27	0.0210	0.60	-0.25	121.90	-99.00	-99.00
09/15/1986	02 METERS	7.10	6.50	-99	0.0470	0.58	-99.00	121.00	-99.00	-99.00
10/15/1986	02 METERS	7.00	6.20	23	0.0140	0.45	-0.05	126.50	-99.00	-99.00
11/18/1986	02 METERS	7.00	-99.00	23	0.0140	0.50	-0.05	134.20	-99.00	-99.00
12/17/1986	02 METERS	6.50	-99.00	38	0.0130	0.33	-0.05	120.80	-99.00	-99.00
01/14/1987	02 METERS	6.40	-99.00	32	0.0140	0.48	0.05	123.80	-99.00	-99.00
02/11/1987	02 METERS	6.20	-99.00	29	0.0130	0.50	0.07	123.30	-99.00	-99.00
03/12/1987	02 METERS	6.20	-99.00	32	0.0150	0.78	0.16	141.60	-99.00	-99.00
04/13/1987	02 METERS	6.00	-99.00	33	0.0160	0.43	0.07	78.70	-99.00	-99.00
05/06/1987	02 METERS	6.50	-99.00	27	0.0170	0.45	-0.05	92.10	-99.00	-99.00
06/17/1987	02 METERS	6.40	5.40	23	0.0140	0.42	-0.05	106.50	-99.00	-99.00
07/15/1987	02 METERS	6.90	6.00	34	0.0150	0.21	-0.05	103.40	-99.00	-99.00
08/12/1987	02 METERS	7.10	-99.00	37	0.0180	0.25	-0.05	108.60	-99.00	-99.00
09/16/1987	02 METERS	6.60	7.70	27	0.0350	0.23	0.05	109.20	-99.00	-99.00
10/13/1987	02 METERS	6.57	-99.00	35	0.0170	0.67	-0.05	105.44	-99.00	-99.00
11/13/1987	02 METERS	6.63	-99.00	32	0.0140	0.32	-0.05	106.45	-99.00	-99.00
04/13/1988	02 METERS	6.35	-99.00	-99	0.0080	-99.00	-99.00	110.40	-99.00	-99.00
05/17/1988	02 METERS	6.73	-99.00	29	0.0120	-99.00	-0.05	-99.00	-99.00	-99.00
06/01/1988	02 METERS	6.64	-99.00	33	0.0170	-99.00	-99.00	102.24	-99.00	-99.00
06/23/1988	02 METERS	7.09	-99.00	28	0.0140	-99.00	-99.00	107.30	-99.00	-99.00
07/01/1988	02 METERS	6.64	-99.00	33	0.0170	-99.00	-99.00	102.24	-99.00	-99.00
07/19/1988	02 METERS	7.04	-99.00	25	0.0250	-99.00	-99.00	110.03	-99.00	-99.00
08/04/1988	02 METERS	9.19	6.30	25	0.0160	-99.00	-99.00	118.80	-99.00	-99.00
08/18/1988	02 METERS	6.73	-99.00	26	0.0130	-99.00	-99.00	119.70	-99.00	-99.00
09/08/1988	02 METERS	6.68	7.20	25	0.0140	-99.00	-99.00	115.02	-99.00	-99.00
09/21/1988	02 METERS	6.87	7.60	24	0.0160	-99.00	-0.05	118.37	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
07/13/1988	03 METERS	6.78	7.60	25	0.0350	-99.00	-99.00	114.46	-99.00	-99.00
06/17/1986	04 METERS	6.70	-99.00	35	0.0210	0.45	-0.25	113.50	-99.00	-99.00
05/08/1980	06 METERS	6.50	5.10	-99	0.0410	0.48	-0.09	99.00	-99.00	-99.00
06/16/1980	06 METERS	6.40	7.40	-99	0.0400	0.45	-0.05	107.00	-99.00	-99.00
06/30/1980	06 METERS	6.20	9.50	-99	0.0420	0.84	-0.05	113.50	-99.00	-99.00
07/15/1980	06 METERS	6.40	9.50	-99	0.0360	0.64	-0.05	103.00	-99.00	-99.00
07/29/1980	06 METERS	6.40	15.10	-99	0.0400	1.20	-0.05	118.00	-99.00	-99.00
08/13/1980	06 METERS	6.40	13.40	-99	0.0350	0.80	-99.00	107.00	-99.00	-99.00
08/27/1980	06 METERS	6.70	8.60	-99	0.0330	0.64	-0.05	113.00	-99.00	-99.00
09/18/1980	06 METERS	6.80	8.60	-99	0.0240	0.64	-0.05	111.00	-99.00	-99.00
10/01/1980	06 METERS	6.80	8.40	-99	0.0300	0.62	-0.05	119.00	-99.00	-99.00
10/16/1980	06 METERS	6.70	7.90	-99	0.0200	0.52	-0.05	115.00	-99.00	-99.00
10/30/1980	06 METERS	6.60	6.20	-99	0.0370	0.60	-0.05	150.00	-99.00	-99.00
11/13/1980	06 METERS	6.60	6.40	-99	0.0390	-0.10	0.07	112.00	-99.00	-99.00
12/18/1980	06 METERS	6.10	6.80	-99	0.0300	0.70	0.39	111.00	-99.00	-99.00
01/08/1981	06 METERS	-99.00	8.40	-99	0.0350	0.70	0.14	127.00	-99.00	-99.00
01/22/1981	06 METERS	6.00	9.10	-99	0.0450	0.98	0.20	153.00	-99.00	-99.00
02/05/1981	06 METERS	6.20	8.30	-99	0.0380	1.20	0.38	168.00	-99.00	-99.00
03/03/1981	06 METERS	5.80	7.50	-99	0.0270	0.48	0.42	171.00	-99.00	-99.00
03/19/1981	06 METERS	5.70	7.00	-99	0.0330	0.44	0.54	146.30	-99.00	-99.00
03/31/1981	06 METERS	5.80	7.80	-99	0.0340	0.46	0.42	150.00	-99.00	-99.00
04/17/1981	06 METERS	6.00	5.50	-99	0.0250	0.39	-0.05	102.00	-99.00	-99.00
05/06/1981	06 METERS	6.50	5.30	-99	0.0130	0.27	-0.05	105.00	-99.00	-99.00
06/04/1981	06 METERS	6.00	6.50	-99	0.0310	0.42	-0.05	102.00	-99.00	-99.00
06/30/1981	06 METERS	6.10	-99.00	-99	0.0350	0.52	-0.05	107.00	-99.00	-99.00
07/15/1981	06 METERS	6.30	-99.00	-99	0.0360	0.64	-0.05	107.00	-99.00	-99.00
07/28/1981	06 METERS	6.50	9.40	-99	0.0150	0.96	-0.05	109.00	-99.00	-99.00
08/12/1981	06 METERS	6.20	-99.00	-99	0.0530	0.86	-0.05	128.00	-99.00	-99.00
09/15/1981	06 METERS	6.50	-99.00	-99	0.0240	-99.00	-99.00	114.00	-99.00	-99.00
10/13/1981	06 METERS	6.70	-99.00	-99	0.0380	-99.00	-0.05	112.00	-99.00	-99.00
11/09/1981	06 METERS	5.90	3.10	-99	0.0260	0.40	-0.05	106.00	-99.00	-99.00
12/01/1981	06 METERS	6.50	-99.00	-99	0.0330	0.40	-0.05	96.00	-99.00	-99.00
01/20/1982	06 METERS	6.00	-99.00	-99	0.0230	0.72	0.14	105.00	-99.00	-99.00
02/16/1982	06 METERS	5.90	7.90	-99	0.0260	0.48	0.30	109.00	-99.00	-99.00
03/09/1982	06 METERS	5.90	-99.00	-99	0.0210	0.41	0.32	113.00	-99.00	-99.00
04/29/1982	06 METERS	6.20	-99.00	-99	0.0160	0.39	0.06	75.60	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
05/26/1982	06 METERS	6.10	-99.00	-99	0.0300	0.60	-0.05	98.00	-99.00	-99.00
06/09/1982	06 METERS	6.20	-99.00	-99	0.0370	0.34	-0.05	94.00	-99.00	-99.00
06/23/1982	06 METERS	6.20	7.00	-99	0.0340	0.44	0.44	95.00	-99.00	-99.00
07/07/1982	06 METERS	6.80	18.00	-99	0.0420	0.63	-0.05	92.90	-99.00	-99.00
07/20/1982	06 METERS	6.40	15.50	-99	0.0330	0.94	-0.05	103.00	-99.00	-99.00
08/05/1982	06 METERS	6.60	18.00	-99	0.0220	0.95	-0.05	109.20	-99.00	-99.00
08/16/1982	06 METERS	6.40	-99.00	-99	0.0380	1.00	-0.05	105.10	-99.00	-99.00
09/15/1982	06 METERS	5.90	-99.00	-99	0.0280	-99.00	-0.05	80.00	-99.00	-99.00
06/07/1983	06 METERS	-99.00	-99.00	-99	0.0400	-99.00	-99.00	-99.00	-99.00	-99.00
06/10/1983	06 METERS	6.10	7.00	-99	0.0260	-99.00	-99.00	-99.00	-99.00	-99.00
06/17/1983	06 METERS	-99.00	-99.00	-99	0.0360	-99.00	-99.00	-99.00	310.00	-99.00
06/23/1983	06 METERS	7.10	8.00	-99	0.0190	-99.00	-99.00	-99.00	355.00	-99.00
07/01/1983	06 METERS	6.00	4.00	-99	0.0320	-99.00	-99.00	-99.00	195.00	-99.00
07/08/1983	06 METERS	5.90	3.90	-99	0.0450	-99.00	-99.00	-99.00	135.00	-99.00
07/14/1983	06 METERS	5.90	-99.00	-99	0.0570	-99.00	-99.00	87.00	-99.00	-99.00
07/21/1983	06 METERS	6.20	10.00	-99	0.0650	-99.00	-99.00	85.00	125.00	-99.00
07/28/1983	06 METERS	6.20	9.00	-99	0.0400	-99.00	-99.00	95.00	-99.00	-99.00
08/10/1983	06 METERS	6.20	-99.00	-99	0.0400	-99.00	-99.00	95.00	-99.00	-99.00
08/19/1983	06 METERS	-99.00	-99.00	-99	0.0180	-99.00	-99.00	-99.00	-99.00	-99.00
09/08/1983	06 METERS	-99.00	-99.00	-99	0.0600	-99.00	-99.00	-99.00	-99.00	-99.00
10/20/1983	06 METERS	6.80	-99.00	-99	0.0400	-99.00	-99.00	-99.00	-99.00	-99.00
11/14/1983	06 METERS	6.20	-99.00	40	0.0400	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1984	06 METERS	5.80	-99.00	-99	0.0120	-99.00	-99.00	-99.00	-99.00	-99.00
02/22/1984	06 METERS	6.00	5.10	35	0.0140	-99.00	-99.00	116.00	-99.00	-99.00
03/19/1984	06 METERS	6.00	4.90	30	0.0180	-99.00	-99.00	220.00	-99.00	-99.00
06/05/1984	06 METERS	6.10	3.10	45	0.0250	-99.00	-99.00	65.60	143.00	-99.00
06/15/1984	06 METERS	-99.00	-99.00	-99	0.0280	-99.00	-99.00	-99.00	-99.00	-99.00
06/28/1984	06 METERS	-99.00	0.06	-99	-99.000	-99.00	-99.00	149.60	-99.00	-99.00
07/17/1984	06 METERS	5.50	-99.00	-99	0.0060	-99.00	-99.00	138.70	177.00	-99.00
08/13/1984	06 METERS	6.00	4.30	15	0.0060	-99.00	-99.00	137.50	135.00	-99.00
09/13/1984	06 METERS	7.00	5.20	15	-99.000	-99.00	-99.00	109.50	30.00	-99.00
10/09/1984	06 METERS	6.80	5.60	10	0.0120	-99.00	-99.00	113.60	100.00	-99.00
11/15/1984	06 METERS	6.70	5.30	15	0.0170	-99.00	-99.00	129.20	-10.00	-99.00
01/25/1985	06 METERS	6.50	6.90	20	0.0180	-99.00	-99.00	135.20	-99.00	-99.00
02/22/1985	06 METERS	6.30	6.80	20	0.0150	-99.00	-99.00	153.80	-99.00	-99.00
03/20/1985	06 METERS	6.30	6.30	20	0.0080	-99.00	-99.00	141.40	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
04/16/1985	06 METERS	6.70	3.90	25	0.0120	-99.00	-99.00	105.20	-99.00	-99.00
05/14/1985	06 METERS	-99.00	-99.00	25	0.0170	-99.00	-99.00	107.90	-99.00	-99.00
06/14/1985	06 METERS	6.80	-99.00	25	0.0210	-99.00	-99.00	113.50	51.00	-99.00
07/16/1985	06 METERS	6.30	8.30	20	0.0150	-99.00	-99.00	127.50	-99.00	-99.00
08/14/1985	06 METERS	-99.00	-99.00	-99	0.0210	-99.00	-99.00	-99.00	-99.00	-99.00
09/19/1985	06 METERS	7.00	-99.00	30	0.0170	-99.00	-99.00	122.80	-99.00	-99.00
10/09/1985	06 METERS	6.60	5.50	35	0.0160	-99.00	-99.00	120.00	-99.00	-99.00
11/19/1985	06 METERS	6.60	4.50	35	0.0240	-99.00	-99.00	100.90	-99.00	-99.00
01/09/1986	06 METERS	6.20	7.10	35	0.0240	0.72	0.07	110.90	-99.00	-99.00
02/13/1986	06 METERS	6.20	6.90	30	0.0130	-99.00	0.07	115.70	-99.00	-99.00
03/20/1986	06 METERS	6.20	6.92	35	0.0180	0.53	0.21	126.40	-99.00	-99.00
04/14/1986	06 METERS	6.40	-99.00	25	0.0150	0.35	0.09	96.90	-99.00	-99.00
05/14/1986	06 METERS	6.50	-99.00	18	0.0260	0.56	-0.25	107.10	-99.00	-99.00
06/17/1986	06 METERS	6.50	-99.00	37	0.0260	0.45	-0.25	115.60	-99.00	-99.00
07/15/1986	06 METERS	6.50	-99.00	37	0.0190	0.35	-0.05	120.50	-99.00	-99.00
08/15/1986	06 METERS	6.40	-99.00	33	0.0280	0.50	-0.25	125.00	-99.00	-99.00
09/15/1986	06 METERS	6.80	6.60	-99	0.0210	0.40	-99.00	122.50	-99.00	-99.00
10/15/1986	06 METERS	7.00	6.20	23	0.0170	0.47	-0.05	129.50	-99.00	-99.00
11/18/1986	06 METERS	7.00	6.50	22	0.0150	0.43	-0.05	133.10	-99.00	-99.00
12/17/1986	06 METERS	6.50	-99.00	33	0.0140	0.63	-0.05	123.10	-99.00	-99.00
01/14/1987	06 METERS	6.20	-99.00	28	0.0160	0.53	-0.05	129.60	-99.00	-99.00
02/11/1987	06 METERS	6.10	-99.00	28	0.0130	0.58	0.11	131.60	-99.00	-99.00
03/12/1987	06 METERS	6.10	-99.00	33	0.0170	0.78	0.16	142.20	-99.00	-99.00
04/13/1987	06 METERS	6.00	-99.00	36	0.0170	0.28	0.08	78.10	-99.00	-99.00
05/06/1987	06 METERS	6.60	-99.00	29	0.0180	0.36	-0.05	94.20	-99.00	-99.00
06/17/1987	06 METERS	6.90	-99.00	28	0.0330	0.42	-0.05	106.20	-99.00	-99.00
07/15/1987	06 METERS	6.40	11.80	48	0.0180	0.44	-0.05	100.90	-99.00	-99.00
08/12/1987	06 METERS	6.60	-99.00	40	0.0390	0.71	-0.05	110.40	-99.00	-99.00
09/16/1987	06 METERS	6.10	7.70	53	0.0570	0.44	0.06	119.20	-99.00	-99.00
10/13/1987	06 METERS	6.37	-99.00	40	0.0220	0.38	-0.05	105.24	-99.00	-99.00
11/13/1987	06 METERS	6.70	-99.00	32	-99.000	-99.00	-99.00	105.63	-99.00	-99.00
04/13/1988	06 METERS	6.40	-99.00	-99	0.0100	-99.00	-99.00	108.90	-99.00	-99.00
05/17/1988	06 METERS	6.37	-99.00	33	0.0180	-99.00	-0.05	-99.00	-99.00	-99.00
06/01/1988	06 METERS	6.14	-99.00	33	0.0240	-99.00	-99.00	106.30	-99.00	-99.00
06/23/1988	06 METERS	6.20	-99.00	44	0.0280	-99.00	-99.00	110.00	-99.00	-99.00
07/01/1988	06 METERS	6.14	-99.00	33	0.0240	-99.00	-99.00	106.30	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
07/13/1988	06 METERS	6.24	-99.00	39	0.0160	-99.00	-99.00	115.80	-99.00	-99.00
07/19/1988	06 METERS	6.34	-99.00	36	0.0270	-99.00	-99.00	114.69	-99.00	-99.00
08/04/1988	06 METERS	6.49	-99.00	95	0.0270	-99.00	-99.00	123.00	-99.00	-99.00
08/18/1988	06 METERS	6.53	-99.00	120	0.0250	-99.00	-99.00	126.25	-99.00	-99.00
09/08/1988	06 METERS	6.56	-99.00	23	0.0260	-99.00	-99.00	118.52	-99.00	-99.00
09/21/1988	06 METERS	6.36	-99.00	27	0.0150	-99.00	-0.05	119.68	-99.00	-99.00
06/11/1980	CPB	6.80	6.00	-99	0.0070	-99.00	-0.05	118.00	-99.00	-99.00
07/15/1980	CPB	6.50	6.60	-99	0.1460	0.42	0.14	116.00	-99.00	-99.00
08/13/1980	CPB	6.40	8.90	-99	0.0200	0.44	-99.00	297.00	-99.00	-99.00
09/18/1980	CPB	6.50	7.60	-99	0.0330	0.37	0.30	374.00	-99.00	-99.00
10/16/1980	CPB	6.40	5.70	-99	-0.0010	3.70	-0.05	146.00	-99.00	-99.00
10/30/1980	CPB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
11/13/1980	CPB	6.20	7.60	-99	0.0110	0.44	0.06	110.00	-99.00	-99.00
12/03/1980	CPB	5.80	2.50	-99	0.0070	0.33	0.14	112.00	-99.00	-99.00
02/18/1981	CPB	5.70	4.10	-99	0.0270	0.40	-0.30	102.00	-99.00	-99.00
04/16/1981	CPB	6.30	4.00	-99	0.0110	0.29	0.05	115.00	-99.00	-99.00
05/07/1981	CPB	6.60	3.90	-99	0.0110	0.38	-0.05	111.00	-99.00	-99.00
06/10/1981	CPB	6.40	4.30	-99	0.0110	0.38	-0.05	118.00	-99.00	-99.00
07/27/1981	CPB	6.30	5.40	-99	0.0130	0.35	0.10	188.00	-99.00	-99.00
08/31/1981	CPB	6.30	5.40	-99	0.0010	0.42	0.07	139.00	-99.00	-99.00
09/16/1981	CPB	6.30	-99.00	-99	-0.0010	0.32	0.07	176.00	-99.00	-99.00
10/14/1981	CPB	6.40	-99.00	-99	0.0080	0.42	-0.05	115.00	-99.00	-99.00
11/10/1981	CPB	6.20	4.10	-99	0.0080	-99.00	-0.05	94.00	-99.00	-99.00
12/01/1981	CPB	6.20	-99.00	-99	0.0050	0.37	-0.05	92.00	-99.00	-99.00
02/16/1982	CPB	6.00	5.30	-99	0.0150	0.14	0.13	154.00	-99.00	-99.00
03/18/1982	CPB	6.20	6.90	-99	0.0110	0.39	0.10	126.00	-99.00	-99.00
04/14/1982	CPB	-99.00	4.10	-99	0.0060	0.24	0.16	120.00	-99.00	-99.00
05/19/1982	CPB	6.10	-99.00	-99	0.0150	-99.00	0.07	106.00	-99.00	-99.00
06/16/1982	CPB	6.50	-99.00	-99	0.0130	-99.00	-0.05	116.00	-99.00	-99.00
07/15/1982	CPB	6.60	-99.00	-99	0.0140	-99.00	0.08	128.00	-99.00	-99.00
08/12/1982	CPB	6.50	-99.00	-99	0.0180	-99.00	0.10	161.30	-99.00	-99.00
09/20/1982	CPB	-99.00	-99.00	-99	0.0220	-99.00	0.13	-99.00	-99.00	-99.00
06/23/1983	CPB	6.50	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
07/01/1983	CPB	6.50	6.09	-99	0.0070	-99.00	-99.00	-99.00	-99.00	-99.00
07/08/1983	CPB	6.60	-99.00	-99	0.0240	-99.00	-99.00	-99.00	-99.00	-99.00
07/14/1983	CPB	6.60	-99.00	35	0.0100	-99.00	-99.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
07/21/1983	CPB	6.40	-99.00	30	0.0070	-99.00	-99.00	-99.00	-99.00	-99.00
07/28/1983	CPB	6.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
08/10/1983	CPB	6.30	-99.00	-99	0.0020	-99.00	-99.00	220.00	-99.00	-99.00
08/19/1983	CPB	-99.00	-99.00	-99	0.0020	-99.00	-99.00	-99.00	-99.00	-99.00
09/08/1983	CPB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
10/20/1983	CPB	6.50	-99.00	-99	0.0300	-99.00	-99.00	-99.00	-99.00	-99.00
11/14/1983	CPB	6.00	-99.00	30	0.0100	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1984	CPB	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	-99.00	-99.00
02/22/1984	CPB	6.30	2.20	35	0.0030	-99.00	-99.00	135.00	-99.00	-99.00
03/19/1984	CPB	6.40	3.00	40	0.0180	-99.00	-99.00	220.00	-99.00	-99.00
06/05/1984	CPB	6.20	2.30	55	0.0500	-99.00	-99.00	71.60	161.00	-99.00
07/17/1984	CPB	6.40	-99.00	-99	0.0070	-99.00	-99.00	131.00	26.00	-99.00
08/13/1984	CPB	6.70	4.90	25	-99.000	-99.00	-99.00	189.90	65.00	-99.00
09/13/1984	CPB	6.80	4.40	20	-99.000	-99.00	-99.00	188.00	50.00	-99.00
10/09/1984	CPB	6.50	4.30	25	0.0050	-99.00	-99.00	298.90	110.00	-99.00
11/15/1984	CPB	6.60	5.00	20	0.0060	-99.00	-99.00	346.90	60.00	-99.00
12/12/1984	CPB	6.90	4.60	-99	0.0080	-99.00	-99.00	141.90	209.00	-99.00
01/02/1985	CPB	-99.00	-99.00	-99	0.0030	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1985	CPB	6.80	5.50	30	0.0090	-99.00	-99.00	147.30	-99.00	-99.00
02/14/1985	CPB	6.60	4.40	35	0.0150	-99.00	-99.00	196.00	-99.00	-99.00
02/22/1985	CPB	6.70	-99.00	35	0.0110	-99.00	-99.00	146.80	-99.00	-99.00
03/20/1985	CPB	6.50	-99.00	40	0.0050	-99.00	-99.00	110.10	-99.00	-99.00
04/04/1985	CPB	6.60	3.00	30	0.0090	-99.00	-99.00	112.40	-99.00	-99.00
04/16/1985	CPB	6.60	2.60	25	0.0840	-99.00	-99.00	129.20	-99.00	-99.00
05/01/1985	CPB	6.60	2.80	25	-99.000	-99.00	-99.00	137.40	-99.00	-99.00
05/14/1985	CPB	6.80	-99.00	25	0.0090	-99.00	-99.00	190.80	-99.00	-99.00
05/29/1985	CPB	6.70	-99.00	-99	0.0190	-99.00	-99.00	-99.00	-99.00	-99.00
06/14/1985	CPB	6.80	-99.00	30	0.0040	-99.00	-99.00	196.30	-99.00	-99.00
07/02/1985	CPB	6.70	3.50	30	0.0140	-99.00	-99.00	142.80	-99.00	-99.00
07/16/1985	CPB	6.70	3.70	25	0.0060	-99.00	-99.00	197.30	-99.00	-99.00
08/07/1985	CPB	6.70	3.40	15	0.0060	-99.00	-99.00	375.30	-99.00	-99.00
08/14/1985	CPB	6.70	-99.00	15	0.0040	-99.00	-99.00	324.60	-99.00	-99.00
09/19/1985	CPB	6.80	-99.00	30	0.0060	-99.00	-99.00	178.40	-99.00	-99.00
10/09/1985	CPB	6.70	4.20	45	0.0080	-99.00	-99.00	127.40	-99.00	-99.00
11/19/1985	CPB	6.40	3.00	45	0.0070	-99.00	-99.00	100.90	-99.00	-99.00
12/04/1985	CPB	6.50	3.40	45	0.0100	0.40	-0.25	102.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
12/07/1985	CPB	6.50	3.80	45	0.0060	0.88	-0.25	110.30	-99.00	-99.00
01/09/1986	CPB	6.60	4.70	55	0.0100	0.29	0.09	111.40	-99.00	-99.00
01/23/1986	CPB	6.70	5.30	55	0.0040	0.44	-0.25	118.50	-99.00	-99.00
02/05/1986	CPB	-99.00	-99.00	-99	0.0100	0.44	0.12	90.80	-99.00	-99.00
02/13/1986	CPB	6.30	3.50	50	0.0120	0.48	0.10	97.50	-99.00	-99.00
02/24/1986	CPB	6.60	4.43	50	0.0100	0.38	0.09	113.50	-99.00	-99.00
03/20/1986	CPB	6.40	3.17	40	0.0180	0.28	0.17	184.60	-99.00	-99.00
03/31/1986	CPB	6.20	-99.00	35	0.0060	0.17	0.12	103.30	-99.00	-99.00
04/14/1986	CPB	6.60	-99.00	25	0.0170	0.27	-0.05	140.80	-99.00	-99.00
04/28/1986	CPB	6.60	-99.00	27	0.0100	-99.00	-0.25	153.20	-99.00	-99.00
05/14/1986	CPB	6.60	-99.00	23	0.0180	0.06	-0.25	172.00	-99.00	-99.00
05/27/1986	CPB	6.60	-99.00	31	0.0150	0.40	-0.25	146.80	-99.00	-99.00
06/12/1986	CPB	6.60	-99.00	54	0.0480	0.73	-0.05	151.00	-99.00	-99.00
06/25/1986	CPB	6.60	-99.00	37	0.0080	0.38	-0.05	155.50	-99.00	-99.00
07/09/1986	CPB	6.70	-99.00	33	0.0070	0.48	0.07	172.30	-99.00	-99.00
07/21/1986	CPB	6.80	-99.00	33	0.0070	0.21	-0.05	159.70	-99.00	-99.00
08/07/1986	CPB	6.80	-99.00	34	0.0090	0.38	0.07	151.80	-99.00	-99.00
08/20/1986	CPB	6.90	-99.00	28	0.0080	0.50	0.06	160.90	-99.00	-99.00
09/03/1986	CPB	6.80	-99.00	22	0.0060	0.25	0.09	188.60	-99.00	-99.00
09/30/1986	CPB	6.70	-99.00	25	0.0040	0.33	-0.25	196.00	-99.00	-99.00
10/16/1986	CPB	6.60	4.50	26	0.0080	0.28	-0.05	166.30	-99.00	-99.00
10/28/1986	CPB	6.70	-99.00	27	0.0050	0.35	-0.05	169.30	8.00	-99.00
11/10/1986	CPB	6.60	-99.00	32	0.0110	0.38	-0.05	148.20	-99.00	-99.00
11/26/1986	CPB	6.60	-99.00	31	0.0080	0.53	-0.05	143.40	-99.00	-99.00
12/10/1986	CPB	6.60	-99.00	47	0.0150	0.22	-0.05	119.70	-99.00	-99.00
12/22/1986	CPB	6.60	-99.00	50	0.0080	0.38	-0.05	114.60	-99.00	-99.00
01/12/1987	CPB	-99.00	-99.00	44	0.0540	0.50	0.06	124.30	-99.00	-99.00
01/27/1987	CPB	6.60	-99.00	44	0.0080	0.65	0.11	127.20	-99.00	-99.00
02/11/1987	CPB	6.80	-99.00	46	0.0140	0.48	0.07	131.60	-99.00	-99.00
02/25/1987	CPB	6.80	-99.00	42	0.0100	0.60	0.06	135.10	-99.00	-99.00
03/10/1987	CPB	6.60	-99.00	50	0.0140	0.40	0.05	222.60	-99.00	-99.00
03/26/1987	CPB	6.70	-99.00	48	0.0170	0.95	0.12	223.60	-99.00	-99.00
04/15/1987	CPB	6.40	-99.00	36	0.0070	0.28	-0.05	110.80	-99.00	-99.00
04/30/1987	CPB	6.70	-99.00	34	0.0150	0.33	-0.05	159.60	-99.00	-99.00
05/12/1987	CPB	6.60	-99.00	28	0.0080	0.41	-0.05	138.60	-99.00	-99.00
05/27/1987	CPB	6.50	-99.00	27	0.0070	0.22	-0.05	163.60	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/11/1987	CPB	6.50	-99.00	26	0.0120	0.27	-0.05	172.60	-99.00	-99.00
06/25/1987	CPB	6.70	-99.00	28	0.0550	0.39	-0.05	115.00	-99.00	-99.00
07/07/1987	CPB	6.60	-99.00	42	0.0130	1.20	0.05	116.40	-99.00	-99.00
07/22/1987	CPB	6.70	5.50	34	0.0110	-0.10	0.06	154.90	-99.00	-99.00
08/05/1987	CPB	6.90	-99.00	29	0.0100	0.19	0.08	184.90	-99.00	-99.00
08/19/1987	CPB	6.80	-99.00	22	0.0150	0.17	0.12	254.00	-99.00	-99.00
09/10/1987	CPB	6.60	-99.00	24	0.0160	0.41	0.06	204.90	-99.00	-99.00
09/24/1987	CPB	6.90	-99.00	30	0.0050	0.13	-0.05	130.70	-99.00	-99.00
10/08/1987	CPB	6.53	3.80	39	0.0100	0.26	-99.00	107.90	-99.00	-99.00
10/21/1987	CPB	6.50	-99.00	38	0.0070	0.45	-0.05	121.90	-99.00	-99.00
12/10/1987	CPB	-99.00	-99.00	-99	0.0040	-99.00	-99.00	-99.00	-99.00	-99.00
01/04/1988	CPB	-99.00	-99.00	-99	-0.0010	-99.00	-99.00	-99.00	-99.00	-99.00
02/09/1988	CPB	-99.00	-99.00	-99	0.0060	-99.00	-99.00	-99.00	-99.00	-99.00
03/18/1988	CPB	-99.00	-99.00	-99	0.0060	-99.00	-99.00	-99.00	-99.00	-99.00
04/13/1988	CPB	-99.00	-99.00	-99	0.0050	-99.00	-99.00	-99.00	-99.00	-99.00
05/17/1988	CPB	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1988	CPB	-99.00	-99.00	-99	0.0050	-99.00	-99.00	-99.00	-99.00	-99.00
07/19/1988	CPB	-99.00	-99.00	-99	0.0090	-99.00	-99.00	-99.00	-99.00	-99.00
08/18/1988	CPB	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	-99.00	0.00
09/21/1988	CPB	-99.00	-99.00	-99	0.0060	-99.00	-99.00	-99.00	-99.00	-99.00
05/08/1980	INLET	6.60	5.90	-99	0.0510	0.48	0.24	121.00	-99.00	-99.00
06/11/1980	INLET	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
07/15/1980	INLET	6.30	7.90	-99	0.0780	0.56	0.45	177.00	-99.00	-99.00
08/13/1980	INLET	6.20	12.50	-99	0.1020	0.68	-99.00	248.00	-99.00	-99.00
09/18/1980	INLET	6.00	4.20	-99	0.0190	0.66	1.18	305.00	-99.00	-99.00
10/16/1980	INLET	6.20	6.80	-99	-0.0010	0.63	0.42	254.00	-99.00	-99.00
10/30/1980	INLET	6.20	5.20	-99	0.0390	0.64	0.53	218.00	-99.00	-99.00
11/13/1980	INLET	6.40	5.30	-99	-0.0010	0.82	0.47	159.00	-99.00	-99.00
12/03/1980	INLET	5.80	3.70	-99	0.0270	-0.10	0.21	122.00	-99.00	-99.00
02/18/1981	INLET	6.00	4.70	-99	0.0380	0.36	0.20	105.00	-99.00	-99.00
04/16/1981	INLET	6.20	4.70	-99	0.0210	0.26	0.08	122.00	-99.00	-99.00
05/07/1981	INLET	6.40	5.80	-99	0.0200	0.36	-0.05	123.00	-99.00	-99.00
06/10/1981	INLET	6.40	7.90	-99	0.0490	0.46	-0.05	120.00	-99.00	-99.00
07/27/1981	INLET	6.70	12.90	-99	0.0970	0.38	-0.05	193.00	-99.00	-99.00
08/31/1981	INLET	6.70	9.50	-99	0.0390	0.42	-0.05	163.00	-99.00	-99.00
09/16/1981	INLET	6.70	-99.00	-99	0.0410	0.38	-0.05	199.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
10/14/1981	INLET	6.40	-99.00	-99	0.0190	0.36	-0.05	134.00	-99.00	-99.00
11/10/1981	INLET	6.40	5.80	-99	0.0120	-99.00	-0.05	109.00	-99.00	-99.00
12/01/1981	INLET	6.30	-99.00	-99	0.0100	0.37	-0.05	107.00	-99.00	-99.00
02/16/1982	INLET	6.20	5.90	-99	0.0130	0.13	0.13	115.00	-99.00	-99.00
03/18/1982	INLET	6.60	6.70	-99	0.0150	0.34	0.09	168.00	-99.00	-99.00
04/14/1982	INLET	-99.00	5.00	-99	0.0120	0.30	0.15	138.00	-99.00	-99.00
05/19/1982	INLET	6.70	-99.00	-99	0.0320	-99.00	-0.05	154.00	-99.00	-99.00
06/16/1982	INLET	6.60	-99.00	-99	0.0230	-99.00	-0.05	124.00	-99.00	-99.00
07/15/1982	INLET	6.80	-99.00	-99	0.0440	-99.00	-0.05	151.00	-99.00	-99.00
08/12/1982	INLET	6.60	-99.00	-99	0.0480	-99.00	-0.05	183.30	-99.00	-99.00
09/20/1982	INLET	-99.00	-99.00	-99	0.0290	-99.00	-0.05	-99.00	-99.00	-99.00
06/05/1984	INLET	6.20	3.10	50	0.0200	-99.00	-99.00	75.20	179.00	-99.00
07/17/1984	INLET	6.50	-99.00	-99	0.0360	-99.00	-99.00	133.20	-99.00	-99.00
08/13/1984	INLET	6.80	10.50	60	-99.000	-99.00	-99.00	166.50	110.00	-99.00
09/13/1984	INLET	6.90	8.90	30	0.0020	-99.00	-99.00	156.00	30.00	-99.00
10/09/1984	INLET	6.50	6.80	35	0.0260	-99.00	-99.00	183.90	100.00	-99.00
11/15/1984	INLET	6.60	6.80	70	0.0240	-99.00	-99.00	219.60	70.00	-99.00
12/12/1984	INLET	6.70	8.60	-99	0.0180	-99.00	-99.00	173.00	0.09	-99.00
01/25/1985	INLET	6.50	7.90	40	0.0230	-99.00	-99.00	162.30	-99.00	-99.00
02/14/1985	INLET	6.20	3.70	45	0.0420	-99.00	-99.00	161.10	-99.00	-99.00
02/22/1985	INLET	6.50	-99.00	35	0.0230	-99.00	-99.00	140.00	-99.00	-99.00
03/20/1985	INLET	6.40	3.50	30	0.0090	-99.00	-99.00	117.20	-99.00	-99.00
04/04/1985	INLET	6.60	3.40	30	0.0180	-99.00	-99.00	122.40	-99.00	-99.00
04/16/1985	INLET	6.60	3.70	25	0.0120	-99.00	-99.00	130.30	-99.00	-99.00
05/01/1985	INLET	6.80	-99.00	35	-99.000	-99.00	-99.00	133.60	-99.00	-99.00
05/14/1985	INLET	6.90	-99.00	50	0.0290	-99.00	-99.00	156.80	-99.00	-99.00
05/29/1985	INLET	6.60	-99.00	-99	0.0260	-99.00	-99.00	-99.00	-99.00	-99.00
06/14/1985	INLET	6.80	-99.00	50	0.0320	-99.00	-99.00	169.70	-99.00	-99.00
07/02/1985	INLET	6.60	6.20	60	0.0360	-99.00	-99.00	164.40	-99.00	-99.00
07/16/1985	INLET	6.50	8.00	60	0.0500	-99.00	-99.00	169.70	-99.00	-99.00
08/07/1985	INLET	6.40	9.80	80	0.0610	-99.00	-99.00	209.80	-99.00	-99.00
08/14/1985	INLET	6.30	-99.00	90	0.0680	-99.00	-99.00	224.70	-99.00	-99.00
09/19/1985	INLET	6.60	-99.00	45	0.0240	-99.00	-99.00	169.20	-99.00	-99.00
10/09/1985	INLET	6.30	-99.00	55	0.0160	-99.00	-99.00	132.70	-99.00	-99.00
11/19/1985	INLET	6.40	-99.00	45	0.0130	-99.00	-99.00	103.00	-99.00	-99.00
12/04/1985	INLET	6.30	-99.00	45	0.0150	0.42	-0.25	113.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
12/07/1985	INLET	6.50	5.40	45	0.0110	0.33	-0.25	122.40	-99.00	-99.00
01/09/1986	INLET	6.40	6.50	50	0.0200	0.31	0.12	123.20	-99.00	-99.00
01/23/1986	INLET	6.50	5.80	45	0.0180	0.41	-0.25	140.30	-99.00	-99.00
02/05/1986	INLET	-99.00	-99.00	-99	0.0270	0.51	0.12	101.60	-99.00	-99.00
02/13/1986	INLET	6.40	5.10	40	0.0130	0.48	0.11	112.50	-99.00	-99.00
02/24/1986	INLET	6.50	5.57	45	0.0140	0.43	0.10	138.70	-99.00	-99.00
03/20/1986	INLET	6.20	3.02	40	0.0260	0.12	0.15	158.00	-99.00	-99.00
03/31/1986	INLET	6.20	-99.00	35	0.0080	-0.10	0.09	100.00	-99.00	-99.00
04/14/1986	INLET	6.50	-99.00	30	0.0160	0.16	0.05	135.80	-99.00	-99.00
04/28/1986	INLET	6.70	-99.00	37	0.0240	0.73	-0.25	156.60	-99.00	-99.00
05/14/1986	INLET	6.60	-99.00	36	0.0330	0.42	-0.25	164.80	-99.00	-99.00
05/27/1986	INLET	6.70	-99.00	51	0.0280	0.48	-0.25	149.80	-99.00	-99.00
06/12/1986	INLET	6.60	-99.00	74	0.0450	0.60	-0.05	143.00	-99.00	-99.00
06/25/1986	INLET	6.60	-99.00	49	0.0240	0.40	-0.05	149.90	-99.00	-99.00
07/09/1986	INLET	6.70	-99.00	52	0.0330	0.65	-0.05	180.00	-99.00	-99.00
07/21/1986	INLET	6.60	-99.00	52	0.0320	0.34	-0.05	157.60	-99.00	-99.00
08/07/1986	INLET	6.70	-99.00	60	0.0300	0.55	0.06	156.80	-99.00	-99.00
08/20/1986	INLET	6.80	-99.00	58	0.0310	0.53	-0.05	171.40	-99.00	-99.00
09/03/1986	INLET	6.70	-99.00	47	0.0510	0.45	0.05	194.60	-99.00	-99.00
09/30/1986	INLET	6.60	-99.00	52	0.0250	0.35	-0.25	204.50	-99.00	-99.00
10/16/1986	INLET	6.90	8.10	47	0.0210	0.33	-0.05	190.00	-99.00	-99.00
10/28/1986	INLET	6.80	-99.00	43	0.0220	0.43	-0.05	172.40	-99.00	-99.00
11/10/1986	INLET	6.70	-99.00	53	0.0190	0.48	-0.05	159.80	-99.00	-99.00
11/26/1986	INLET	6.70	-99.00	33	0.0140	0.60	-0.05	161.60	-99.00	-99.00
12/10/1986	INLET	6.50	-99.00	40	0.0140	0.19	0.05	124.90	-99.00	-99.00
12/22/1986	INLET	6.50	-99.00	38	0.0140	0.40	0.06	128.70	-99.00	-99.00
01/12/1987	INLET	6.60	-99.00	42	0.0580	0.53	0.06	135.80	-99.00	-99.00
01/27/1987	INLET	6.40	-99.00	46	0.0170	0.68	0.09	141.70	-99.00	-99.00
02/11/1987	INLET	6.70	-99.00	43	0.0180	0.45	0.09	146.30	-99.00	-99.00
02/25/1987	INLET	6.50	-99.00	45	0.0190	0.55	0.08	150.70	-99.00	-99.00
03/10/1987	INLET	6.40	-99.00	38	0.0220	0.43	0.10	266.10	-99.00	-99.00
03/26/1987	INLET	6.40	-99.00	41	0.0190	0.48	0.14	188.40	-99.00	-99.00
04/15/1987	INLET	6.40	-99.00	36	0.0110	0.38	0.05	118.60	-99.00	-99.00
04/30/1987	INLET	6.70	-99.00	35	0.0220	0.38	-0.05	164.90	-99.00	-99.00
05/12/1987	INLET	6.60	-99.00	37	0.0230	0.15	-0.05	138.70	-99.00	-99.00
05/27/1987	INLET	6.60	-99.00	46	0.0240	0.24	-0.05	155.70	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/11/1987	INLET	6.70	-99.00	54	0.0230	0.34	-0.05	168.20	-99.00	-99.00
06/25/1987	INLET	6.60	-99.00	54	0.0800	0.42	-0.05	120.30	-99.00	-99.00
07/07/1987	INLET	6.80	-99.00	60	0.0350	-0.10	0.05	124.70	-99.00	-99.00
07/22/1987	INLET	6.70	8.20	75	0.0420	0.20	-0.05	151.50	-99.00	-99.00
08/05/1987	INLET	6.80	-99.00	55	0.0440	0.39	-0.05	175.80	-99.00	-99.00
08/19/1987	INLET	6.60	-99.00	38	0.0280	0.25	0.06	181.60	-99.00	-99.00
09/10/1987	INLET	6.50	-99.00	98	0.0450	0.27	-0.05	159.70	-99.00	-99.00
09/24/1987	INLET	6.71	-99.00	47	0.0240	1.42	-0.05	147.20	-99.00	-99.00
10/08/1987	INLET	6.27	5.50	51	0.0180	-99.00	-99.00	117.50	-99.00	-99.00
10/21/1987	INLET	6.59	-99.00	45	0.0160	0.40	-0.05	130.50	-99.00	-99.00
06/01/1988	INLET	6.51	-99.00	45	0.0100	-99.00	-99.00	139.78	-99.00	-99.00
07/01/1988	INLET	6.51	-99.00	45	0.0100	-99.00	-99.00	139.78	-99.00	-99.00
07/13/1988	INLET	6.49	-99.00	60	0.0450	-99.00	-99.00	197.00	-99.00	-99.00
08/04/1988	INLET	6.84	-99.00	57	0.0320	-99.00	-99.00	164.24	-99.00	-99.00
09/08/1988	INLET	6.48	-99.00	40	0.0170	-99.00	-99.00	156.31	-99.00	-99.00
06/11/1980	LBA	6.70	12.80	-99	0.2200	-99.00	1.82	283.00	-99.00	-99.00
07/15/1980	LBA	6.70	22.60	-99	0.4000	4.20	2.00	384.00	-99.00	-99.00
08/13/1980	LBA	4.60	0.50	-99	0.0800	7.00	-99.00	452.00	-99.00	-99.00
09/18/1980	LBA	6.80	8.20	-99	0.0970	3.80	1.47	358.00	-99.00	-99.00
10/16/1980	LBA	6.80	19.20	-99	0.1980	7.40	1.73	387.00	-99.00	-99.00
11/13/1980	LBA	6.80	-99.00	-99	-99.000	-0.10	0.86	-99.00	-99.00	-99.00
12/03/1980	LBA	6.30	5.70	-99	0.0840	0.51	0.46	172.00	-99.00	-99.00
02/18/1981	LBA	6.20	6.50	-99	0.0510	0.41	0.27	136.00	-99.00	-99.00
04/16/1981	LBA	6.80	6.20	-99	0.0240	0.25	0.09	122.00	-99.00	-99.00
05/07/1981	LBA	7.00	7.60	-99	0.0360	0.34	-0.05	117.00	-99.00	-99.00
06/10/1981	2LBA	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
07/27/1981	LBA	7.10	19.60	-99	0.1080	0.40	0.21	208.00	-99.00	-99.00
08/31/1981	LBA	7.10	17.60	-99	0.1670	0.39	0.24	203.00	-99.00	-99.00
09/16/1981	LBA	7.00	-99.00	-99	0.0910	0.32	-0.14	214.00	-99.00	-99.00
10/14/1981	LBA	6.80	-99.00	-99	0.0290	0.32	-0.05	167.00	-99.00	-99.00
11/10/1981	LBA	6.90	9.50	-99	0.0170	-99.00	-0.05	117.00	-99.00	-99.00
12/01/1981	LBA	6.70	-99.00	-99	0.0140	0.32	0.13	122.00	-99.00	-99.00
02/16/1982	LBA	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
03/18/1982	LBA	6.90	9.60	-99	0.0080	0.28	0.14	196.00	-99.00	-99.00
04/14/1982	LBA	-99.00	7.50	-99	0.0460	0.30	0.20	130.00	-99.00	-99.00
05/19/1982	LBA	6.90	-99.00	-99	0.0420	-99.00	0.08	135.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/16/1982	LBA	7.00	-99.00	-99	0.0380	-99.00	0.12	134.00	-99.00	-99.00
07/15/1982	LBA	6.90	-99.00	-99	0.0910	-99.00	0.25	159.00	-99.00	-99.00
08/12/1982	LBA	6.80	-99.00	-99	0.0970	-99.00	0.20	214.50	-99.00	-99.00
09/20/1982	LBA	-99.00	-99.00	-99	0.1160	-99.00	-99.00	-99.00	-99.00	-99.00
12/12/1984	LBA	6.80	11.70	-99	0.0190	-99.00	-99.00	228.20	273.00	-99.00
01/02/1985	LBA	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1985	LBA	7.00	10.80	25	0.0290	-99.00	-99.00	187.80	-99.00	-99.00
02/14/1985	LBA	6.30	2.60	40	0.0300	-99.00	-99.00	143.80	-99.00	-99.00
02/22/1985	LBA	6.60	-99.00	20	0.0170	-99.00	-99.00	158.10	-99.00	-99.00
03/20/1985	LBA	6.60	4.30	20	0.0070	-99.00	-99.00	126.50	-99.00	-99.00
04/04/1985	LBA	6.60	4.20	22	0.0130	-99.00	-99.00	126.80	-99.00	-99.00
04/16/1985	LBA	6.80	4.80	30	0.0270	-99.00	-99.00	125.80	-99.00	-99.00
05/01/1985	LBA	6.90	6.20	25	-99.000	-99.00	-99.00	137.00	-99.00	-99.00
05/14/1985	LBA	7.00	7.50	30	0.0260	-99.00	-99.00	143.90	-99.00	-99.00
05/29/1985	LBA	6.90	-99.00	-99	0.0340	-99.00	-99.00	-99.00	-99.00	-99.00
06/14/1985	LBA	7.20	-99.00	45	0.0470	-99.00	-99.00	197.90	-99.00	-99.00
07/02/1985	LBA	7.00	10.20	50	0.0140	-99.00	-99.00	155.70	-99.00	-99.00
07/16/1985	LBA	7.20	13.00	60	0.0740	-99.00	-99.00	197.30	-99.00	-99.00
08/07/1985	LBA	7.00	11.30	40	0.0610	-99.00	-99.00	203.30	-99.00	-99.00
09/19/1985	LBA	7.00	-99.00	40	0.0460	-99.00	-99.00	199.20	-99.00	-99.00
10/09/1985	LBA	6.80	8.50	45	0.0240	-99.00	-99.00	143.90	-99.00	-99.00
11/19/1985	LBA	6.60	5.40	35	0.0100	-99.00	-99.00	121.90	-99.00	-99.00
12/04/1985	LBA	6.70	5.32	35	0.0210	0.38	-0.25	141.00	-99.00	-99.00
12/07/1985	LBA	6.90	7.68	25	0.0160	0.31	-0.25	139.10	-99.00	-99.00
01/09/1986	LBA	6.90	9.50	30	0.0230	0.37	0.21	135.00	-99.00	-99.00
01/23/1986	LBA	6.80	6.60	25	0.0110	0.31	-0.25	166.00	-99.00	-99.00
02/05/1986	LBA	-99.00	-99.00	-99	0.0140	0.27	0.15	114.90	-99.00	-99.00
02/13/1986	LBA	6.70	6.60	25	0.0140	0.33	0.16	122.40	-99.00	-99.00
02/24/1986	LBA	6.80	7.01	20	0.0110	0.28	0.18	205.90	-99.00	-99.00
03/20/1986	LBA	6.40	-99.00	35	0.0370	0.12	0.20	140.00	-99.00	-99.00
03/31/1986	LBA	6.60	-99.00	35	0.0140	-0.10	0.09	97.70	-99.00	-99.00
04/14/1986	LBA	6.80	-99.00	25	0.0140	0.16	0.06	140.40	-99.00	-99.00
04/28/1986	LBA	7.00	-99.00	34	0.0340	0.23	-0.25	156.80	-99.00	-99.00
05/14/1986	LBA	7.00	-99.00	26	0.0300	0.13	-0.25	173.00	-99.00	-99.00
05/27/1986	LBA	6.90	-99.00	47	0.0290	0.45	-0.25	161.80	-99.00	-99.00
06/12/1986	LBA	6.90	-99.00	72	0.0640	0.60	-0.05	130.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/25/1986	LBA	6.90	-99.00	48	0.0400	0.45	0.10	164.70	-99.00	-99.00
07/09/1986	LBA	6.90	-99.00	44	0.0470	0.48	0.19	201.70	-99.00	-99.00
07/21/1986	LBA	7.20	-99.00	70	0.0590	0.31	0.59	235.50	-99.00	-99.00
08/07/1986	LBA	6.90	-99.00	65	0.1370	0.78	0.16	-99.00	-99.00	-99.00
08/20/1986	LBA	7.20	-99.00	52	0.0450	0.33	0.11	236.90	-99.00	-99.00
09/03/1986	LBA	6.90	-99.00	34	0.0320	0.28	0.16	248.20	-99.00	-99.00
09/30/1986	LBA	7.00	-99.00	39	0.0540	0.35	-0.25	257.20	-99.00	-99.00
10/16/1986	LBA	7.10	13.80	49	0.0250	0.33	-0.05	203.00	-99.00	-99.00
10/28/1986	LBA	7.20	-99.00	33	0.0160	0.38	-0.05	205.00	-99.00	-99.00
11/10/1986	LBA	6.90	-99.00	52	0.0190	0.40	-0.05	161.40	-99.00	-99.00
11/26/1986	LBA	6.80	-99.00	32	0.0120	0.30	-0.05	173.00	-99.00	-99.00
12/10/1986	LBA	6.70	-99.00	28	0.0130	0.10	0.10	141.00	-99.00	-99.00
12/22/1986	LBA	6.80	-99.00	28	0.0140	0.33	0.10	144.30	-99.00	-99.00
01/12/1987	LBA	6.80	-99.00	23	0.0580	0.35	0.28	161.20	-99.00	-99.00
01/27/1987	LBA	6.80	-99.00	25	0.0140	0.53	0.41	161.70	-99.00	-99.00
02/11/1987	LBA	7.00	-99.00	24	0.0160	0.40	0.17	164.50	-99.00	-99.00
02/25/1987	LBA	6.90	-99.00	19	0.0140	0.65	0.16	170.80	-99.00	-99.00
03/10/1987	LBA	6.60	-99.00	27	0.0200	0.33	0.15	224.70	-99.00	-99.00
03/26/1987	LBA	6.60	-99.00	33	0.0430	0.93	0.23	161.10	-99.00	-99.00
04/15/1987	LBA	6.70	-99.00	23	0.0160	0.30	0.07	141.50	-99.00	-99.00
04/30/1987	LBA	7.00	-99.00	32	0.0300	0.26	0.07	144.20	-99.00	-99.00
05/12/1987	LBA	7.00	-99.00	28	0.0180	0.28	-0.05	141.90	-99.00	-99.00
05/27/1987	LBA	6.80	-99.00	28	0.0210	0.22	-0.05	154.00	-99.00	-99.00
06/11/1987	LBA	7.00	-99.00	33	0.0280	0.29	0.07	179.50	-99.00	-99.00
06/25/1987	LBA	6.80	-99.00	51	0.0670	0.39	0.06	134.90	-99.00	-99.00
07/07/1987	LBA	6.70	-99.00	48	0.0360	1.40	0.10	148.60	-99.00	-99.00
07/22/1987	LBA	7.00	14.80	38	0.0490	0.26	0.13	182.30	-99.00	-99.00
08/05/1987	LBA	7.00	-99.00	41	0.0400	0.41	0.08	207.10	-99.00	-99.00
08/19/1987	LBA	6.70	-99.00	23	0.0300	0.25	-0.05	198.30	-99.00	-99.00
09/10/1987	LBA	6.70	-99.00	65	0.0360	0.13	-0.05	188.90	-99.00	-99.00
09/24/1987	LBA	7.00	-99.00	38	0.0250	0.13	-0.05	174.30	-99.00	-99.00
10/08/1987	LBA	6.67	10.50	46	0.0200	0.32	-99.00	134.30	-99.00	-99.00
10/21/1987	LBA	6.75	-99.00	37	0.0220	0.38	-0.05	140.90	-99.00	-99.00
12/10/1987	LBA	-99.00	-99.00	-99	0.0120	-99.00	-99.00	-99.00	-99.00	-99.00
01/04/1988	LBA	-99.00	-99.00	-99	0.0100	-99.00	-99.00	-99.00	-99.00	-99.00
02/09/1988	LBA	-99.00	-99.00	-99	0.0070	-99.00	-99.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
03/18/1988	LBA	-99.00	-99.00	-99	0.0070	-99.00	-99.00	-99.00	-99.00	-99.00
04/13/1988	LBA	6.80	-99.00	-99	0.0080	-99.00	-99.00	130.40	-99.00	-99.00
05/17/1988	LBA	-99.00	-99.00	-99	0.0160	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1988	LBA	-99.00	-99.00	-99	0.0270	-99.00	-99.00	-99.00	-99.00	-99.00
07/19/1988	LBA	-99.00	-99.00	-99	0.0630	-99.00	-99.00	-99.00	-99.00	-99.00
08/18/1988	LBA	-99.00	-99.00	-99	0.0320	-99.00	-99.00	-99.00	-99.00	-99.00
09/21/1988	LBA	-99.00	-99.00	-99	0.0380	-99.00	-99.00	-99.00	-99.00	-99.00
06/11/1980	LBB	6.60	5.80	-99	0.0050	-99.00	0.50	141.00	-99.00	-99.00
07/15/1980	LBB	6.20	9.50	-99	0.1250	0.62	0.50	187.00	-99.00	-99.00
08/13/1980	LBB	6.00	13.20	-99	0.1030	2.10	-99.00	345.00	-99.00	-99.00
09/18/1980	LBB	5.70	3.30	-99	0.0110	3.20	1.50	358.00	-99.00	-99.00
10/16/1980	LBB	6.10	4.90	-99	0.0130	1.20	1.07	246.00	-99.00	-99.00
10/30/1980	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
11/13/1980	LBB	6.20	5.50	-99	0.0690	-0.10	0.45	170.00	-99.00	-99.00
12/03/1980	LBB	5.80	3.00	-99	0.6890	0.24	0.21	143.00	-99.00	-99.00
02/18/1981	LBB	5.80	4.20	-99	0.0240	0.37	0.22	136.00	-99.00	-99.00
04/16/1981	LBB	6.10	4.60	-99	0.0190	0.30	0.06	128.00	-99.00	-99.00
05/07/1981	LBB	6.40	6.00	-99	0.0250	0.36	-0.05	120.00	-99.00	-99.00
06/10/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
07/27/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
08/31/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
09/16/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
10/14/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
11/10/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
12/01/1981	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
02/16/1982	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
03/18/1982	LBB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
04/14/1982	LBB	-99.00	5.20	-99	0.0120	0.24	0.16	142.00	-99.00	-99.00
05/19/1982	LBB	7.20	-99.00	-99	0.0490	-99.00	-0.05	88.00	-99.00	-99.00
06/16/1982	LBB	6.60	-99.00	-99	0.0320	-99.00	-0.05	128.00	-99.00	-99.00
07/15/1982	LBB	6.40	-99.00	-99	0.0590	-99.00	-0.05	163.00	-99.00	-99.00
08/12/1982	LBB	6.30	-99.00	-99	0.0700	-99.00	-0.05	196.20	-99.00	-99.00
09/20/1982	LBB	-99.00	-99.00	-99	0.0560	-99.00	0.12	-99.00	-99.00	-99.00
06/05/1984	LBB	6.20	3.30	50	0.0190	-99.00	-99.00	76.30	177.00	-99.00
07/17/1984	LBB	6.20	-99.00	-99	0.0440	-99.00	-99.00	129.80	113.00	-99.00
08/13/1984	LBB	6.50	11.80	-99	0.0810	-99.00	-99.00	164.30	75.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
09/13/1984	LBB	6.50	8.10	45	0.0210	-99.00	-99.00	168.40	40.00	-99.00
10/09/1984	LBB	6.20	6.30	50	0.0300	-99.00	-99.00	193.90	70.00	-99.00
11/15/1984	LBB	6.30	6.40	80	0.0280	-99.00	-99.00	241.20	105.00	-99.00
12/12/1984	LBB	6.40	7.90	-99	0.0180	-99.00	-99.00	178.50	227.00	-99.00
01/02/1985	LBB	-99.00	-99.00	-99	0.0010	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1985	LBB	6.40	8.40	45	0.0320	-99.00	-99.00	172.00	-99.00	-99.00
02/14/1985	LBB	6.00	3.80	75	0.0330	-99.00	-99.00	157.50	-99.00	-99.00
02/22/1985	LBB	6.40	5.80	35	0.0200	-99.00	-99.00	144.60	-99.00	-99.00
03/20/1985	LBB	6.20	3.50	35	0.0110	-99.00	-99.00	119.60	-99.00	-99.00
04/04/1985	LBB	6.40	3.30	30	0.0010	-99.00	-99.00	120.10	-99.00	-99.00
04/16/1985	LBB	6.50	4.10	30	0.0140	-99.00	-99.00	131.50	-99.00	-99.00
05/01/1985	LBB	6.50	5.10	40	-99.000	-99.00	-99.00	139.40	-99.00	-99.00
05/14/1985	LBB	6.60	7.30	70	0.0470	-99.00	-99.00	163.80	-99.00	-99.00
05/29/1985	LBB	6.40	-99.00	-99	0.0260	-99.00	-99.00	-99.00	-99.00	-99.00
06/14/1985	LBB	6.70	-99.00	65	0.0340	-99.00	-99.00	177.80	-99.00	-99.00
07/02/1985	LBB	6.50	6.30	60	0.0430	-99.00	-99.00	158.50	-99.00	-99.00
07/16/1985	LBB	6.40	7.60	80	0.0580	-99.00	-99.00	160.20	-99.00	-99.00
08/07/1985	LBB	6.40	9.30	-99	0.0790	-99.00	-99.00	234.60	-99.00	-99.00
08/14/1985	LBB	6.60	-99.00	80	0.0530	-99.00	-99.00	252.80	-99.00	-99.00
09/19/1985	LBB	6.50	-99.00	50	0.0270	-99.00	-99.00	168.70	-99.00	-99.00
10/09/1985	LBB	6.40	5.30	55	0.0160	-99.00	-99.00	135.00	-99.00	-99.00
11/19/1985	LBB	6.30	4.10	50	0.0160	-99.00	-99.00	107.20	-99.00	-99.00
12/04/1985	LBB	6.30	4.06	45	0.0150	0.40	-0.25	116.00	-99.00	-99.00
12/07/1985	LBB	6.20	5.62	50	0.0200	0.39	-0.25	127.90	-99.00	-99.00
01/09/1986	LBB	6.30	6.70	55	0.0270	0.37	0.11	121.00	-99.00	-99.00
01/23/1986	LBB	6.40	5.70	50	0.0150	0.41	-0.25	147.10	-99.00	-99.00
02/05/1986	LBB	-99.00	-99.00	-99	0.0140	0.36	0.11	103.70	-99.00	-99.00
02/13/1986	LBB	6.30	4.50	50	0.0170	-99.00	0.11	113.50	-99.00	-99.00
02/24/1986	LBB	6.40	5.70	45	0.0210	0.43	0.11	138.70	-99.00	-99.00
03/20/1986	LBB	6.20	-99.00	40	0.0190	0.09	0.16	174.00	-99.00	-99.00
03/31/1986	LBB	6.20	-99.00	35	0.0050	0.12	0.10	107.50	-99.00	-99.00
04/14/1986	LBB	6.40	-99.00	30	0.0150	0.10	-0.05	141.10	-99.00	-99.00
04/28/1986	LBB	6.40	-99.00	39	0.0240	0.34	-0.25	160.80	-99.00	-99.00
05/14/1986	LBB	6.50	-99.00	40	0.0320	0.21	-0.25	170.00	-99.00	-99.00
05/27/1986	LBB	6.40	-99.00	52	0.0270	0.50	-0.25	150.00	-99.00	-99.00
06/12/1986	LBB	6.40	-99.00	74	0.0360	0.58	-0.05	146.30	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/25/1986	LBB	6.50	-99.00	53	0.0250	0.40	-0.05	152.10	-99.00	-99.00
07/09/1986	LBB	6.50	-99.00	65	0.0360	0.63	-0.50	182.30	-99.00	-99.00
07/21/1986	LBB	6.50	-99.00	63	0.0350	0.34	-0.05	161.20	-99.00	-99.00
08/07/1986	LBB	6.50	-99.00	62	0.0330	0.58	-0.05	161.60	-99.00	-99.00
08/20/1986	LBB	6.40	-99.00	75	0.0370	0.48	-0.05	175.80	-99.00	-99.00
09/03/1986	LBB	6.40	-99.00	57	0.0370	0.43	0.05	209.10	-99.00	-99.00
09/30/1986	LBB	6.40	-99.00	56	0.0300	0.50	-0.25	204.90	-99.00	-99.00
10/16/1986	LBB	6.60	8.90	48	0.0280	0.42	-0.05	196.10	-99.00	-99.00
10/28/1986	LBB	6.50	-99.00	48	0.0230	1.13	-0.05	179.00	-99.00	-99.00
11/10/1986	LBB	6.50	-99.00	60	0.0210	0.48	-0.05	159.70	-99.00	-99.00
11/26/1986	LBB	6.50	-99.00	38	0.0140	0.38	-0.05	164.50	-99.00	-99.00
12/10/1986	LBB	6.30	-99.00	42	0.0190	0.19	0.06	129.60	-99.00	-99.00
12/22/1986	LBB	6.30	-99.00	48	0.0200	0.43	0.05	131.70	-99.00	-99.00
01/12/1987	LBB	6.30	-99.00	43	0.0610	0.50	0.06	146.20	-99.00	-99.00
01/27/1987	LBB	6.40	-99.00	48	0.0400	0.68	0.09	141.00	-99.00	-99.00
02/11/1987	LBB	6.40	-99.00	47	0.0250	0.65	0.09	150.20	-99.00	-99.00
02/25/1987	LBB	6.30	-99.00	48	0.0290	0.63	0.08	153.70	-99.00	-99.00
03/10/1987	LBB	6.50	-99.00	38	0.0210	0.38	0.11	249.90	-99.00	-99.00
03/26/1987	LBB	6.40	-99.00	40	0.0210	0.85	0.15	205.90	-99.00	-99.00
04/15/1987	LBB	6.30	-99.00	41	0.0130	0.38	0.05	117.90	-99.00	-99.00
04/30/1987	LBB	6.60	-99.00	30	0.0180	0.23	-0.05	161.60	-99.00	-99.00
05/12/1987	LBB	6.50	-99.00	39	0.0200	0.20	-0.05	144.70	-99.00	-99.00
05/27/1987	LBB	6.50	-99.00	50	0.0260	0.29	-0.05	156.00	-99.00	-99.00
06/11/1987	LBB	6.60	-99.00	52	0.0340	0.54	-0.05	168.90	-99.00	-99.00
06/25/1987	LBB	6.40	-99.00	56	0.0730	0.47	-0.05	128.30	-99.00	-99.00
07/07/1987	LBB	6.40	-99.00	65	0.0450	0.46	-0.05	126.70	-99.00	-99.00
07/22/1987	LBB	6.50	8.90	85	0.0670	0.43	-0.05	156.10	-99.00	-99.00
08/05/1987	LBB	6.60	-99.00	65	0.0440	0.41	-0.05	185.00	-99.00	-99.00
08/19/1987	LBB	6.40	-99.00	57	0.0450	0.92	-0.05	246.50	-99.00	-99.00
09/10/1987	LBB	6.50	-99.00	108	0.0500	0.34	-0.05	166.30	-99.00	-99.00
09/24/1987	LBB	6.50	-99.00	48	0.0270	2.97	-0.05	143.50	-99.00	-99.00
10/08/1987	LBB	6.32	5.50	51	0.0190	0.32	-99.00	123.20	-99.00	-99.00
10/21/1987	LBB	6.35	-99.00	49	0.0180	-0.05	0.24	131.30	-99.00	-99.00
12/10/1987	LBB	-99.00	-99.00	-99	0.0180	-99.00	-99.00	-99.00	-99.00	-99.00
01/04/1988	LBB	-99.00	-99.00	-99	0.0150	-99.00	-99.00	-99.00	-99.00	-99.00
02/09/1988	LBB	-99.00	-99.00	-99	0.0120	-99.00	-99.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
03/18/1988	LBB	-99.00	-99.00	-99	0.0090	-99.00	-99.00	-99.00	-99.00	-99.00
04/13/1988	LBB	6.51	-99.00	-99	0.0100	-99.00	-99.00	127.30	-99.00	-99.00
05/17/1988	LBB	-99.00	-99.00	-99	0.0200	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1988	LBB	-99.00	-99.00	-99	0.0640	-99.00	-99.00	-99.00	-99.00	-99.00
07/19/1988	LBB	-99.00	-99.00	-99	0.0470	-99.00	-99.00	-99.00	-99.00	-99.00
08/18/1988	LBB	-99.00	-99.00	-99	0.0410	-99.00	-99.00	-99.00	-99.00	-99.00
09/21/1988	LBB	-99.00	-99.00	-99	0.0230	-99.00	-99.00	-99.00	-99.00	-99.00
05/08/1980	OUTLET	6.60	5.50	-99	0.0200	0.82	-0.05	98.00	-99.00	-99.00
06/11/1980	OUTLET	6.90	6.50	-99	-0.0010	-99.00	-0.05	106.00	-99.00	-99.00
07/15/1980	OUTLET	7.10	8.10	-99	0.0070	0.44	0.15	101.00	-99.00	-99.00
08/13/1980	OUTLET	6.60	10.90	-99	0.0190	0.48	-99.00	112.00	-99.00	-99.00
09/18/1980	OUTLET	6.80	7.70	-99	-99.000	0.55	0.14	102.00	-99.00	-99.00
10/16/1980	OUTLET	6.40	6.50	-99	0.0100	0.44	-0.05	123.00	-99.00	-99.00
10/30/1980	OUTLET	-99.00	6.80	-99	0.0410	0.54	-0.05	146.00	-99.00	-99.00
11/13/1980	OUTLET	6.70	5.80	-99	0.0280	-0.10	0.08	115.00	-99.00	-99.00
12/03/1980	OUTLET	6.20	4.40	-99	0.0270	0.52	0.12	134.00	-99.00	-99.00
02/18/1981	OUTLET	5.90	5.20	-99	0.0290	0.48	0.27	132.00	-99.00	-99.00
04/16/1981	OUTLET	6.40	5.10	-99	0.0200	0.28	0.05	105.00	-99.00	-99.00
05/07/1981	OUTLET	6.30	5.40	-99	0.0190	0.34	-0.05	102.00	-99.00	-99.00
06/10/1981	OUTLET	6.50	-99.00	-99	0.0290	0.36	-0.05	100.00	-99.00	-99.00
07/27/1981	OUTLET	6.90	6.60	-99	0.0140	0.98	-0.05	106.00	-99.00	-99.00
08/31/1981	OUTLET	8.10	7.70	-99	0.0160	0.76	-0.05	109.00	-99.00	-99.00
09/16/1981	OUTLET	6.70	-99.00	-99	0.0170	0.70	-0.05	116.00	-99.00	-99.00
10/14/1981	OUTLET	6.80	-99.00	-99	0.0270	0.48	-0.05	113.00	-99.00	-99.00
11/10/1981	OUTLET	6.70	6.00	-99	0.0180	-99.00	-0.05	102.00	-99.00	-99.00
12/01/1981	OUTLET	6.70	-99.00	-99	0.0130	0.48	-0.05	101.00	-99.00	-99.00
02/16/1982	OUTLET	6.10	6.20	-99	0.0160	0.34	0.14	115.00	-99.00	-99.00
03/18/1982	OUTLET	6.40	8.60	-99	0.0150	0.38	0.12	146.00	-99.00	-99.00
04/14/1982	OUTLET	-99.00	4.80	-99	0.0060	0.27	0.14	111.00	-99.00	-99.00
05/19/1982	OUTLET	6.60	-99.00	-99	0.0190	-99.00	-0.05	84.00	-99.00	-99.00
06/16/1982	OUTLET	6.80	-99.00	-99	0.0150	-99.00	-0.05	94.00	-99.00	-99.00
07/15/1982	OUTLET	8.20	-99.00	-99	0.0110	-99.00	-0.05	92.00	-99.00	-99.00
08/12/1982	OUTLET	6.70	-99.00	-99	0.0200	-99.00	-0.05	100.80	-99.00	-99.00
09/20/1982	OUTLET	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1983	OUTLET	6.10	-99.00	-99	0.0330	-99.00	-99.00	-99.00	-99.00	-99.00
07/01/1983	OUTLET	-99.00	-99.00	-99	0.0450	-99.00	-99.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
07/08/1983	OUTLET	6.10	-99.00	-99	0.0620	-99.00	-99.00	-99.00	-99.00	-99.00
07/14/1983	OUTLET	6.20	-99.00	80	0.0460	-99.00	-99.00	-99.00	-99.00	-99.00
07/21/1983	OUTLET	6.10	-99.00	-99	0.0490	-99.00	-99.00	-99.00	-99.00	-99.00
07/28/1983	OUTLET	6.30	-99.00	-99	0.0510	-99.00	-99.00	-99.00	-99.00	-99.00
08/10/1983	OUTLET	8.00	-99.00	-99	0.0620	-99.00	-99.00	155.00	-99.00	-99.00
08/19/1983	OUTLET	-99.00	-99.00	-99	0.0240	-99.00	-99.00	-99.00	-99.00	-99.00
09/08/1983	OUTLET	-99.00	-99.00	-99	0.0440	-99.00	-99.00	-99.00	-99.00	-99.00
10/20/1983	OUTLET	6.40	-99.00	-99	0.0300	-99.00	-99.00	-99.00	-99.00	-99.00
11/14/1983	OUTLET	5.70	-99.00	55	0.0200	-99.00	-99.00	-99.00	-99.00	-99.00
01/25/1984	OUTLET	-99.00	-99.00	-99	0.0270	-99.00	-99.00	-99.00	-99.00	-99.00
02/22/1984	OUTLET	6.00	2.80	35	0.0070	-99.00	-99.00	148.00	-99.00	-99.00
03/19/1984	OUTLET	6.10	3.70	40	0.0180	-99.00	-99.00	183.00	-99.00	-99.00
06/05/1984	OUTLET	6.20	3.00	45	0.3000	-99.00	-99.00	66.00	157.00	-99.00
07/17/1984	OUTLET	6.50	-99.00	-99	0.0120	-99.00	-99.00	162.60	-99.00	-99.00
08/13/1984	OUTLET	6.60	4.80	15	-99.000	-99.00	-99.00	109.20	175.00	-99.00
09/13/1984	OUTLET	7.10	4.80	15	-99.000	-99.00	-99.00	106.10	60.00	-99.00
10/09/1984	OUTLET	6.70	5.60	10	0.0110	-99.00	-99.00	114.60	250.00	-99.00
11/15/1984	OUTLET	6.80	5.30	15	0.0120	-99.00	-99.00	117.60	-99.00	-99.00
12/12/1984	OUTLET	6.70	6.20	-99	0.0080	-99.00	-99.00	125.40	165.00	-99.00
01/25/1985	OUTLET	6.60	6.50	15	0.0140	-99.00	-99.00	135.20	-99.00	-99.00
02/14/1985	OUTLET	6.50	6.90	15	0.0060	-99.00	-99.00	138.40	-99.00	-99.00
02/22/1985	OUTLET	6.30	-99.00	20	-99.000	-99.00	-99.00	143.80	-99.00	-99.00
04/04/1985	OUTLET	6.60	3.70	25	0.0230	-99.00	-99.00	99.40	-99.00	-99.00
04/16/1985	OUTLET	6.80	4.00	25	0.0120	-99.00	-99.00	104.00	-99.00	-99.00
05/01/1985	OUTLET	6.90	4.10	20	-99.000	-99.00	-99.00	102.60	-99.00	-99.00
05/14/1985	OUTLET	6.90	4.20	25	0.0140	-99.00	-99.00	106.80	-99.00	-99.00
05/29/1985	OUTLET	6.80	-99.00	-99	0.0100	-99.00	-99.00	-99.00	-99.00	-99.00
06/14/1985	OUTLET	7.00	-99.00	25	0.0120	-99.00	-99.00	113.50	-99.00	-99.00
07/02/1985	OUTLET	7.00	4.70	20	0.0120	-99.00	-99.00	114.60	-99.00	-99.00
07/16/1985	OUTLET	6.90	5.00	20	0.0090	-99.00	-99.00	115.60	-99.00	-99.00
08/07/1985	OUTLET	7.10	5.70	15	0.0100	-99.00	-99.00	119.80	-99.00	-99.00
08/14/1985	OUTLET	7.50	-99.00	15	0.0410	-99.00	-99.00	128.20	-99.00	-99.00
09/19/1985	OUTLET	-99.00	-99.00	-99	0.0220	-99.00	-99.00	-99.00	-99.00	-99.00
10/09/1985	OUTLET	6.70	-99.00	35	0.0140	-99.00	-99.00	121.00	-99.00	-99.00
11/19/1985	OUTLET	6.70	-99.00	35	0.0180	-99.00	-99.00	101.90	-99.00	-99.00
12/04/1985	OUTLET	6.50	-99.00	35	-0.0010	0.38	-0.25	113.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
12/07/1985	OUTLET	6.50	4.61	35	0.0110	0.70	-0.25	105.10	-99.00	-99.00
01/09/1986	OUTLET	6.40	5.50	40	0.0220	4.24	-99.00	109.30	-99.00	-99.00
01/23/1986	OUTLET	6.40	5.60	40	0.0060	0.46	-0.25	115.40	-99.00	-99.00
02/05/1986	OUTLET	-99.00	-99.00	-99	0.0190	0.36	0.10	99.50	-99.00	-99.00
02/13/1986	OUTLET	6.20	3.80	40	0.0110	0.70	0.09	100.70	-99.00	-99.00
02/24/1986	OUTLET	6.20	4.36	40	0.0160	0.45	0.09	94.80	-99.00	-99.00
03/20/1986	OUTLET	6.30	-99.00	35	0.0180	0.30	0.14	137.90	-99.00	-99.00
03/31/1986	OUTLET	6.10	-99.00	25	0.0020	0.25	0.12	101.20	-99.00	-99.00
04/14/1986	OUTLET	6.40	-99.00	25	0.0090	0.10	0.11	94.90	-99.00	-99.00
04/28/1986	OUTLET	7.00	-99.00	27	0.0100	0.20	-0.25	102.60	-99.00	-99.00
05/14/1986	OUTLET	6.80	-99.00	22	0.0180	0.21	-0.25	109.10	-99.00	-99.00
05/27/1986	OUTLET	6.80	-99.00	21	0.0230	0.54	-0.25	112.50	-99.00	-99.00
06/12/1986	OUTLET	6.70	-99.00	23	0.0210	0.45	-0.05	114.60	-99.00	-99.00
06/25/1986	OUTLET	6.90	-99.00	32	0.0170	0.33	-0.50	117.90	-99.00	-99.00
07/09/1986	OUTLET	7.00	-99.00	24	0.0120	0.48	-0.05	119.50	-99.00	-99.00
07/21/1986	OUTLET	7.00	-99.00	22	0.0130	0.26	-0.05	119.80	-99.00	-99.00
08/07/1986	OUTLET	7.00	-99.00	21	0.0110	0.50	-0.05	123.20	-99.00	-99.00
08/20/1986	OUTLET	7.10	-99.00	27	0.0120	0.33	-0.05	121.00	-99.00	-99.00
09/03/1986	OUTLET	7.20	-99.00	26	0.0130	0.33	-0.05	126.90	-99.00	-99.00
09/30/1986	OUTLET	7.10	-99.00	23	0.0160	0.33	-0.25	129.00	-99.00	-99.00
10/16/1986	OUTLET	6.80	6.30	23	0.0150	0.31	-0.05	130.00	-99.00	-99.00
10/28/1986	OUTLET	7.10	-99.00	22	0.0160	0.43	-0.05	133.30	-99.00	-99.00
11/10/1986	OUTLET	7.00	-99.00	27	0.0130	0.40	-0.05	133.20	-99.00	-99.00
11/26/1986	OUTLET	6.90	-99.00	23	0.0120	0.40	-0.05	130.50	-99.00	-99.00
12/10/1986	OUTLET	6.50	-99.00	27	0.0130	0.26	-0.05	120.20	-99.00	-99.00
12/22/1986	OUTLET	6.40	-99.00	36	0.0120	0.40	-0.05	120.10	-99.00	-99.00
01/12/1987	OUTLET	6.40	-99.00	33	0.0580	0.53	-0.05	122.50	-99.00	-99.00
01/27/1987	OUTLET	6.30	-99.00	37	0.0100	0.60	0.07	122.50	-99.00	-99.00
02/11/1987	OUTLET	6.20	-99.00	32	0.0130	0.43	0.06	120.40	-99.00	-99.00
02/25/1987	OUTLET	6.20	-99.00	33	0.0100	0.50	0.06	126.40	-99.00	-99.00
03/10/1987	OUTLET	6.20	-99.00	33	0.0120	0.30	0.11	127.80	-99.00	-99.00
03/26/1987	OUTLET	6.10	-99.00	28	0.0120	0.33	0.18	147.70	-99.00	-99.00
04/15/1987	OUTLET	6.10	-99.00	32	0.0280	0.38	0.06	78.60	-99.00	-99.00
04/30/1987	OUTLET	6.70	-99.00	31	0.0220	0.43	-0.05	88.00	-99.00	-99.00
05/12/1987	OUTLET	6.70	-99.00	26	0.0150	0.12	-0.05	98.50	-99.00	-99.00
05/27/1987	OUTLET	6.60	-99.00	23	0.0120	0.22	-0.05	101.20	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
06/11/1987	OUTLET	6.40	-99.00	24	0.0210	0.27	-0.05	116.30	-99.00	-99.00
06/25/1987	OUTLET	6.90	-99.00	22	0.1180	0.27	-0.05	102.90	-99.00	-99.00
07/07/1987	OUTLET	6.90	-99.00	33	0.0160	-0.10	-0.05	100.00	-99.00	-99.00
07/22/1987	OUTLET	6.80	5.80	34	0.0170	0.42	-0.05	105.60	-99.00	-99.00
08/05/1987	OUTLET	7.20	-99.00	32	0.0150	0.41	-0.05	108.30	-99.00	-99.00
08/19/1987	OUTLET	7.10	-99.00	23	0.0090	0.38	-0.05	113.50	-99.00	-99.00
09/10/1987	OUTLET	6.80	-99.00	25	0.0160	0.34	-0.05	106.50	-99.00	-99.00
09/24/1987	OUTLET	6.75	-99.00	29	0.0180	0.69	-0.05	111.90	-99.00	-99.00
10/08/1987	OUTLET	6.62	6.30	32	0.0160	0.50	-99.00	108.80	-99.00	-99.00
10/21/1987	OUTLET	6.65	-99.00	32	0.0120	0.58	-0.05	106.10	-99.00	-99.00
06/01/1988	OUTLET	6.57	-99.00	33	0.0160	-99.00	-99.00	104.00	-99.00	-99.00
07/01/1988	OUTLET	6.57	-99.00	33	0.0160	-99.00	-99.00	104.00	-99.00	-99.00
07/13/1988	OUTLET	6.68	-99.00	23	0.0100	-99.00	-99.00	113.52	-99.00	-99.00
09/08/1988	OUTLET	6.81	-99.00	21	0.0150	-99.00	-99.00	120.02	-99.00	-99.00
12/12/1984	TRIB	6.60	6.20	-99	0.0040	-99.00	-99.00	344.90	279.00	-99.00
01/02/1985	TRIB	-99.00	-99.00	-99	-99.000	-99.00	-99.00	-99.00	-99.00	-99.00
02/14/1985	TRIB	6.00	1.70	25	0.0270	-99.00	-99.00	191.40	-99.00	-99.00
02/22/1985	TRIB	6.30	-99.00	10	0.0090	-99.00	-99.00	280.10	-99.00	-99.00
03/20/1985	TRIB	6.40	-99.00	10	-99.000	-99.00	-99.00	253.50	-99.00	-99.00
04/04/1985	TRIB	6.50	3.20	10	0.0050	-99.00	-99.00	271.40	-99.00	-99.00
04/16/1985	TRIB	6.60	3.50	15	0.0070	-99.00	-99.00	228.80	-99.00	-99.00
05/01/1985	TRIB	6.60	-99.00	10	-99.000	-99.00	-99.00	217.80	-99.00	-99.00
05/14/1985	TRIB	6.80	-99.00	10	0.0060	-99.00	-99.00	226.60	-99.00	-99.00
05/29/1985	TRIB	6.70	-99.00	-99	0.0030	-99.00	-99.00	-99.00	-99.00	-99.00
09/19/1985	TRIB	6.90	-99.00	10	0.0030	-99.00	-99.00	285.40	-99.00	-99.00
10/09/1985	TRIB	6.80	-99.00	15	0.0020	-99.00	-99.00	247.70	-99.00	-99.00
11/19/1985	TRIB	6.50	-99.00	25	0.0060	-99.00	-99.00	205.90	-99.00	-99.00
12/04/1985	TRIB	6.50	4.33	15	0.0220	0.40	0.26	116.00	-99.00	-99.00
12/07/1985	TRIB	6.40	4.89	10	0.0100	0.28	0.41	229.30	-99.00	-99.00
01/23/1986	TRIB	6.40	3.40	-99	0.0800	0.46	-0.25	286.30	-99.00	-99.00
02/05/1986	TRIB	-99.00	-99.00	-99	0.0390	0.51	0.33	224.10	-99.00	-99.00
02/24/1986	TRIB	6.60	4.30	10	0.0080	0.28	0.28	285.80	-99.00	-99.00
03/20/1986	TRIB	6.30	2.46	25	0.0340	0.06	0.13	324.60	-99.00	-99.00
03/31/1986	TRIB	6.40	-99.00	30	0.0100	0.23	0.14	197.10	-99.00	-99.00
04/14/1986	TRIB	6.60	-99.00	15	0.0090	0.21	0.23	247.50	-99.00	-99.00
04/28/1986	TRIB	6.70	-99.00	20	0.0130	0.08	1.13	277.80	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
05/14/1986	TRIB	6.70	-99.00	13	0.0120	0.28	1.59	283.20	-99.00	-99.00
05/27/1986	TRIB	6.70	-99.00	22	0.0100	0.47	0.76	314.90	-99.00	-99.00
06/12/1986	TRIB	6.50	-99.00	70	0.1200	0.80	-0.05	262.20	-99.00	-99.00
06/25/1986	TRIB	6.80	-99.00	17	0.0100	0.28	0.88	257.10	-99.00	-99.00
07/09/1986	TRIB	6.80	-99.00	13	0.0070	0.33	0.45	292.80	-99.00	-99.00
07/21/1986	TRIB	6.90	-99.00	18	0.0080	0.15	1.28	284.90	-99.00	-99.00
08/07/1986	TRIB	6.80	-99.00	22	0.0130	0.35	0.36	263.10	-99.00	-99.00
08/20/1986	TRIB	6.90	-99.00	17	0.0050	0.23	0.43	291.40	-99.00	-99.00
09/03/1986	TRIB	6.70	-99.00	8	0.0040	0.13	0.48	326.60	-99.00	-99.00
09/30/1986	TRIB	6.70	-99.00	13	0.0080	0.23	0.26	371.60	-99.00	-99.00
10/16/1986	TRIB	6.80	7.80	14	0.0080	0.16	0.18	324.00	-99.00	-99.00
10/28/1986	TRIB	6.80	-99.00	13	0.0060	0.30	0.18	315.20	-99.00	-99.00
11/10/1986	TRIB	6.60	-99.00	23	0.0110	0.40	0.08	316.20	-99.00	-99.00
11/26/1986	TRIB	6.50	-99.00	17	0.0270	0.35	0.06	322.30	-99.00	-99.00
12/10/1986	TRIB	6.40	-99.00	12	0.0060	0.10	0.25	269.30	-99.00	-99.00
12/22/1986	TRIB	6.30	-99.00	9	0.0110	0.38	0.26	280.90	-99.00	-99.00
01/12/1987	TRIB	6.80	-99.00	8	0.0490	0.38	0.24	283.60	-99.00	-99.00
02/11/1987	TRIB	6.60	-99.00	8	0.0070	0.43	0.27	293.20	-99.00	-99.00
02/25/1987	TRIB	6.50	-99.00	7	0.0070	0.65	0.28	312.00	-99.00	-99.00
03/10/1987	TRIB	6.30	-99.00	12	0.0140	0.23	0.06	464.40	-99.00	-99.00
03/26/1987	TRIB	6.30	-99.00	21	0.0160	0.63	0.11	299.20	-99.00	-99.00
04/15/1987	TRIB	6.40	-99.00	11	0.0100	0.55	0.29	215.30	-99.00	-99.00
04/30/1987	TRIB	6.60	-99.00	32	0.0680	0.45	0.08	319.20	-99.00	-99.00
05/12/1987	TRIB	6.70	-99.00	10	0.0070	0.07	0.22	236.30	-99.00	-99.00
05/27/1987	TRIB	6.60	-99.00	11	0.0030	0.12	0.25	251.30	-99.00	-99.00
06/11/1987	TRIB	6.80	-99.00	21	0.0120	0.29	0.26	284.00	-99.00	-99.00
06/25/1987	TRIB	6.80	-99.00	21	0.0520	0.32	0.20	215.00	-99.00	-99.00
07/07/1987	TRIB	6.80	-99.00	20	0.0120	1.10	0.37	218.60	-99.00	-99.00
07/22/1987	TRIB	6.70	8.40	8	0.0120	0.20	0.50	254.60	-99.00	-99.00
08/05/1987	TRIB	6.60	-99.00	7	0.0070	0.19	0.24	266.20	-99.00	-99.00
09/10/1987	TRIB	6.40	-99.00	10	0.0100	-0.10	0.14	394.20	-99.00	-99.00
09/24/1987	TRIB	6.80	-99.00	18	0.0090	-0.10	0.24	266.80	-99.00	-99.00
10/08/1987	TRIB	6.53	6.80	27	0.0110	0.32	-99.00	224.50	-99.00	-99.00
10/21/1987	TRIB	6.43	-99.00	15	0.0070	0.38	0.24	250.40	-99.00	-99.00
12/10/1987	TRIB	-99.00	-99.00	-99	0.0160	-99.00	-99.00	-99.00	-99.00	-99.00
01/04/1988	TRIB	-99.00	-99.00	-99	-0.0010	-99.00	-99.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
02/09/1988	TRIB	-99.00	-99.00	-99	0.0050	-99.00	-99.00	-99.00	-99.00	-99.00
03/18/1988	TRIB	-99.00	-99.00	-99	0.0050	-99.00	-99.00	-99.00	-99.00	-99.00
04/13/1988	TRIB	6.58	-99.00	-99	0.0030	-99.00	-99.00	240.50	-99.00	-99.00
05/17/1988	TRIB	-99.00	-99.00	-99	0.0070	-99.00	-99.00	-99.00	-99.00	-99.00
06/23/1988	TRIB	-99.00	-99.00	-99	0.0090	-99.00	-99.00	-99.00	-99.00	-99.00
07/19/1988	TRIB	-99.00	-99.00	-99	0.0060	-99.00	-99.00	-99.00	-99.00	-99.00
08/18/1988	TRIB	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	-99.00	-99.00
09/21/1988	TRIB	-99.00	-99.00	-99	0.0270	-99.00	-99.00	-99.00	-99.00	-99.00
11/15/1990	02 METERS	6.73	4.70	48	0.0140	0.28	0.00	86.20	96.00	-99.00
11/15/1990	06 METERS	6.70	5.00	50	0.0250	0.33	0.00	86.20	300.00	-99.00
01/17/1991	02 METERS	6.21	5.50	42	0.0090	0.22	0.00	100.50	-99.00	-99.00
01/17/1991	06 METERS	6.13	5.50	42	0.0040	0.28	0.00	100.10	-99.00	-99.00
03/18/1991	02 METERS	6.48	6.70	20	0.0090	0.20	0.00	123.60	102.00	-99.00
03/18/1991	06 METERS	6.36	6.60	22	0.0110	0.27	0.00	155.50	114.00	-99.00
04/18/1991	02 METERS	6.31	4.44	22	0.0190	0.26	0.00	112.00	50.00	-99.00
04/18/1991	06 METERS	6.51	4.70	23	0.0130	0.33	0.00	112.30	50.00	-99.00
05/15/1991	02 METERS	6.88	5.30	26	0.0130	0.29	0.00	110.30	50.00	-99.00
05/15/1991	06 METERS	6.52	5.40	29	0.0140	0.25	0.00	110.10	50.00	-99.00
07/03/1991	02 METERS	-99.00	-99.00	16	0.0160	0.00	0.00	-99.00	-99.00	-99.00
07/03/1991	INLET	-99.00	-99.00	55	0.0320	0.00	0.00	-99.00	-99.00	1.40
07/03/1991	OUTLET	-99.00	-99.00	18	0.0120	0.00	0.00	-99.00	-99.00	0.50
07/03/1991	06 METERS	-99.00	-99.00	29	0.0260	0.00	0.00	-99.00	-99.00	-99.00
07/18/1991	02 METERS	7.11	6.80	18	0.0110	0.00	0.00	121.00	-99.00	-99.00
07/18/1991	06 METERS	6.71	-99.00	24	0.0150	0.00	0.00	121.20	-99.00	-99.00
07/11/1991	02 METERS	6.98	6.80	19	0.0150	0.00	0.00	121.20	50.00	-99.00
07/11/1991	06 METERS	6.44	7.30	21	0.0190	0.00	0.00	120.80	50.00	-99.00
07/25/1991	02 METERS	7.20	6.90	21	0.0130	0.00	0.00	123.60	87.00	-99.00
07/25/1991	06 METERS	6.42	10.60	28	0.0210	0.00	0.00	123.50	50.00	-99.00
08/08/1991	02 METERS	7.14	8.60	19	0.0130	0.00	0.00	125.00	50.00	-99.00
08/08/1991	06 METERS	6.59	6.50	32	0.0160	0.00	0.00	124.30	50.00	-99.00
09/05/1991	02 METERS	7.06	6.70	17	0.0160	0.00	0.00	125.30	-99.00	-99.00
09/05/1991	06 METERS	6.51	7.60	28	0.0250	0.00	0.00	131.80	-99.00	-99.00
06/13/1991	02 METERS	6.82	6.30	22	0.0130	0.00	0.00	117.70	50.00	-99.00
06/13/1991	06 METERS	6.38	6.70	24	0.0160	0.00	0.00	116.00	93.00	-99.00
08/22/1991	02 METERS	6.90	6.50	11	0.0150	0.00	0.00	121.40	50.00	-99.00
08/22/1991	06 METERS	6.33	6.30	17	0.0180	0.00	0.00	131.30	66.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
09/18/1991	02 METERS	6.84	7.60	21	0.0140	0.00	0.00	127.70	104.00	-99.00
09/18/1991	06 METERS	6.42	7.60	24	0.0140	0.00	0.00	128.30	89.00	-99.00
10/11/1990	OUTLET	-99.00	-99.00	-99	0.0110	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	INLET	-99.00	-99.00	-99	0.0140	0.00	0.00	-99.00	-99.00	-99.00
10/18/1990	OUTLET	-99.00	-99.00	48	0.0220	0.00	0.00	-99.00	-99.00	1.00
10/18/1990	INLET	-99.00	-99.00	65	0.0160	0.00	0.00	-99.00	-99.00	0.80
11/01/1990	OUTLET	-99.00	-99.00	55	0.0120	0.00	0.00	-99.00	-99.00	1.00
11/01/1990	INLET	-99.00	-99.00	55	0.0140	0.00	0.00	-99.00	-99.00	0.80
11/29/1990	OUTLET	6.66	5.70	47	0.0100	0.00	0.00	87.50	61.00	0.70
11/29/1990	INLET	6.65	6.80	52	0.0090	0.00	0.00	104.70	72.00	2.90
12/06/1990	OUTLET	-99.00	-99.00	44	0.0130	0.00	0.00	-99.00	-99.00	1.80
12/06/1990	INLET	-99.00	-99.00	50	0.0100	0.00	0.00	-99.00	-99.00	1.10
12/13/1990	OUTLET	-99.00	-99.00	44	0.0100	0.00	0.00	-99.00	-99.00	0.60
12/13/1990	INLET	-99.00	-99.00	45	0.0070	0.00	0.00	-99.00	-99.00	0.50
12/20/1990	OUTLET	-99.00	-99.00	47	0.0130	0.00	0.00	-99.00	-99.00	0.50
12/20/1990	INLET	-99.00	-99.00	43	0.0100	0.00	0.00	-99.00	-99.00	0.60
12/27/1990	OUTLET	-99.00	-99.00	44	0.0120	0.00	0.00	-99.00	-99.00	1.10
12/27/1990	INLET	-99.00	-99.00	44	0.0160	0.00	0.00	-99.00	-99.00	0.80
01/03/1991	OUTLET	6.28	4.70	43	0.0130	0.00	0.00	88.60	58.00	0.50
01/03/1991	INLET	6.49	5.70	40	0.0130	0.00	0.00	103.06	76.00	0.50
01/09/1991	OUTLET	-99.00	-99.00	33	0.0150	0.00	0.00	-99.00	-99.00	0.80
01/09/1991	INLET	-99.00	-99.00	33	0.0260	0.00	0.00	-99.00	-99.00	0.80
01/24/1991	OUTLET	-99.00	-99.00	31	0.0070	0.00	0.00	-99.00	-99.00	0.40
01/24/1991	INLET	-99.00	-99.00	33	0.0060	0.00	0.00	-99.00	-99.00	0.60
01/31/1991	OUTLET	6.35	6.70	29	0.0060	0.00	0.00	106.20	59.00	0.50
01/31/1991	INLET	6.52	7.90	30	0.0020	0.00	0.00	199.00	50.00	0.80
02/07/1991	OUTLET	-99.00	-99.00	28	0.0050	0.00	0.00	-99.00	-99.00	0.50
02/07/1991	INLET	-99.00	-99.00	26	0.0100	0.00	0.00	-99.00	-99.00	1.00
02/28/1991	OUTLET	-99.00	-99.00	-99	0.0050	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	INLET	-99.00	-99.00	-99	0.0180	0.00	0.00	-99.00	-99.00	-99.00
03/15/1991	OUTLET	-99.00	-99.00	23	0.0050	0.00	0.00	-99.00	-99.00	0.80
03/15/1991	INLET	-99.00	-99.00	22	0.0080	0.00	0.00	-99.00	-99.00	0.70
03/07/1991	OUTLET	6.35	5.50	32	0.0150	0.00	0.00	115.90	143.00	1.40
03/07/1991	INLET	6.38	5.10	40	0.0400	0.00	0.00	144.40	91.00	4.00
03/28/1991	OUTLET	-99.00	-99.00	-99	0.0040	0.00	0.00	-99.00	-99.00	0.70
03/28/1991	INLET	-99.00	-99.00	-99	0.0210	0.00	0.00	-99.00	-99.00	3.40

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
04/04/1991	OUTLET	-99.00	-99.00	-99	0.0010	0.00	0.00	-99.00	-99.00	-99.00
04/04/1991	INLET	-99.00	-99.00	-99	0.0010	0.00	0.00	-99.00	-99.00	-99.00
04/11/1991	OUTLET	-99.00	-99.00	22	0.0210	0.00	0.00	-99.00	-99.00	1.10
04/11/1991	INLET	-99.00	-99.00	24	0.0150	0.00	0.00	-99.00	-99.00	0.80
04/24/1991	OUTLET	-99.00	-99.00	43	0.0110	0.00	0.00	-99.00	-99.00	0.70
04/24/1991	INLET	-99.00	-99.00	54	0.0120	0.00	0.00	-99.00	-99.00	0.80
05/02/1991	OUTLET	6.95	4.90	22	0.0100	0.00	0.00	110.90	50.00	0.80
05/02/1991	INLET	6.56	5.40	34	0.0150	0.00	0.00	129.30	50.00	1.00
05/10/1991	OUTLET	-99.00	-99.00	27	0.0140	0.00	0.00	-99.00	-99.00	1.00
05/10/1991	INLET	-99.00	-99.00	39	0.0130	0.00	0.00	-99.00	-99.00	0.90
05/23/1991	OUTLET	-99.00	-99.00	22	0.0090	0.00	0.00	-99.00	-99.00	0.40
05/23/1991	INLET	-99.00	-99.00	39	0.0220	0.00	0.00	-99.00	-99.00	0.80
06/06/1991	OUTLET	6.46	6.30	20	0.0070	0.00	0.00	114.60	50.00	-99.00
06/06/1991	INLET	6.38	8.80	43	0.0150	0.00	0.00	149.40	50.00	-99.00
06/20/1991	OUTLET	6.96	-99.00	17	0.0070	0.00	0.00	-99.00	-99.00	0.60
06/20/1991	INLET	6.51	-99.00	44	0.0200	0.00	0.00	-99.00	-99.00	1.10
07/18/1991	OUTLET	-99.00	-99.00	18	0.0390	0.00	0.00	-99.00	-99.00	0.85
07/18/1991	INLET	-99.00	-99.00	65	0.0330	0.00	0.00	-99.00	-99.00	2.90
09/12/1991	OUTLET	-99.00	-99.00	24	0.0160	0.00	0.00	-99.00	-99.00	1.20
09/12/1991	INLET	-99.00	-99.00	38	0.0220	0.00	0.00	-99.00	-99.00	1.00
09/26/1991	OUTLET	6.17	7.10	20	0.0150	0.00	0.00	127.20	-99.00	1.00
09/26/1991	INLET	6.27	-99.00	70	0.0250	0.00	0.00	138.80	-99.00	1.40
10/04/1991	OUTLET	-99.00	-99.00	20	0.0130	0.00	0.00	-99.00	50.00	-99.00
10/04/1991	INLET	-99.00	-99.00	34	0.0130	0.00	0.00	-99.00	51.00	-99.00
10/08/1991	OUTLET	-99.00	-99.00	23	0.0160	0.00	0.00	-99.00	-99.00	1.10
10/08/1991	INLET	-99.00	-99.00	49	0.0160	0.00	0.00	-99.00	-99.00	0.60
08/30/1991	OUTLET	-99.00	-99.00	-99	0.0090	0.00	0.00	-99.00	-99.00	0.40
08/30/1991	INLET	-99.00	-99.00	-99	0.0270	0.00	0.00	-99.00	-99.00	1.10
09/05/1991	OUTLET	-99.00	-99.00	18	0.0150	0.00	0.00	-99.00	-99.00	-99.00
09/05/1991	INLET	-99.00	-99.00	32	0.0190	0.00	0.00	-99.00	-99.00	-99.00
10/18/1990	KHB	-99.00	-99.00	35	0.0090	0.00	0.00	-99.00	-99.00	0.50
10/18/1990	LBB	-99.00	-99.00	70	0.0180	0.00	0.00	-99.00	-99.00	1.00
10/18/1990	CPB	-99.00	-99.00	55	0.0090	0.00	0.00	-99.00	-99.00	0.60
10/18/1990	LBA	-99.00	-99.00	40	0.0180	0.00	0.00	-99.00	-99.00	0.70
10/18/1990	TRIB	-99.00	-99.00	23	0.0100	0.00	0.00	-99.00	-99.00	0.60
10/18/1990	BIRCH	-99.00	-99.00	70	0.0220	0.00	0.00	-99.00	-99.00	0.70

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
11/01/1990	KHB	-99.00	-99.00	33	0.0100	0.00	0.00	-99.00	-99.00	0.30
11/01/1990	LBB	-99.00	-99.00	55	0.0120	0.00	0.00	-99.00	-99.00	0.80
11/01/1990	CPB	-99.00	-99.00	55	0.0040	0.00	0.00	-99.00	-99.00	0.60
11/01/1990	LBA	-99.00	-99.00	33	0.0090	0.00	0.00	-99.00	-99.00	0.90
11/01/1990	TRIB	-99.00	-99.00	21	0.0020	0.00	0.00	-99.00	-99.00	0.50
11/01/1990	BIRCH	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
11/29/1990	KHB	6.36	4.40	26	0.0040	0.00	0.00	31.70	70.00	0.60
11/29/1990	LBB	6.51	6.70	55	0.0080	0.00	0.00	112.40	87.00	0.80
11/29/1990	CPB	6.62	4.40	58	0.0070	0.00	0.00	94.70	76.00	1.10
11/29/1990	LBA	7.03	9.80	30	0.0120	0.00	0.00	136.40	50.00	1.00
11/29/1990	TRIB	6.72	6.40	24	0.0030	0.00	0.00	238.90	50.00	1.70
11/29/1990	BIRCH	6.76	9.00	37	0.0150	0.00	0.00	141.70	50.00	1.50
12/06/1990	KHB	-99.00	-99.00	13	0.0080	0.00	0.00	-99.00	-99.00	0.40
12/06/1990	LBB	-99.00	-99.00	50	0.0100	0.00	0.00	-99.00	-99.00	1.90
12/06/1990	CPB	-99.00	-99.00	55	0.0090	0.00	0.00	-99.00	-99.00	0.40
12/06/1990	LBA	-99.00	-99.00	33	0.0050	0.00	0.00	-99.00	-99.00	0.80
12/06/1990	TRIB	-99.00	-99.00	22	0.0060	0.00	0.00	-99.00	-99.00	0.50
12/06/1990	BIRCH	-99.00	-99.00	37	0.0090	0.00	0.00	-99.00	-99.00	0.90
12/13/1990	KHB	-99.00	-99.00	17	0.0060	0.00	0.00	-99.00	-99.00	0.50
12/13/1990	LBB	-99.00	-99.00	49	0.0100	0.00	0.00	-99.00	-99.00	1.00
12/13/1990	CPB	-99.00	-99.00	52	0.0070	0.00	0.00	-99.00	-99.00	0.40
12/13/1990	LBA	-99.00	-99.00	24	0.0120	0.00	0.00	-99.00	-99.00	1.00
12/13/1990	TRIB	-99.00	-99.00	16	0.0080	0.00	0.00	-99.00	-99.00	0.50
12/13/1990	BIRCH	-99.00	-99.00	27	0.0070	0.00	0.00	-99.00	-99.00	0.70
12/20/1990	KHB	-99.00	-99.00	17	0.0050	0.00	0.00	-99.00	-99.00	0.30
12/20/1990	LBB	-99.00	-99.00	49	0.0120	0.00	0.00	-99.00	-99.00	0.60
12/20/1990	CPB	-99.00	-99.00	55	0.0110	0.00	0.00	-99.00	-99.00	0.30
12/20/1990	LBA	-99.00	-99.00	32	0.0120	0.00	0.00	-99.00	-99.00	0.90
12/20/1990	TRIB	-99.00	-99.00	17	0.0070	0.00	0.00	-99.00	-99.00	0.40
12/20/1990	BIRCH	-99.00	-99.00	24	0.0060	0.00	0.00	-99.00	-99.00	0.50
12/27/1990	KHB	-99.00	-99.00	19	0.0040	0.00	0.00	-99.00	-99.00	0.70
12/27/1990	LBB	-99.00	-99.00	46	0.0080	0.00	0.00	-99.00	-99.00	0.70
12/27/1990	CPB	-99.00	-99.00	57	0.0080	0.00	0.00	-99.00	-99.00	0.70
12/27/1990	LBA	-99.00	-99.00	29	0.0100	0.00	0.00	-99.00	-99.00	0.80
12/27/1990	TRIB	-99.00	-99.00	16	0.0060	0.00	0.00	-99.00	-99.00	0.80
12/27/1990	BIRCH	-99.00	-99.00	30	0.0080	0.00	0.00	-99.00	-99.00	0.80

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
01/03/1991	KHB	6.53	4.20	14	0.0100	0.00	0.00	29.90	56.00	0.40
01/03/1991	LBB	6.64	7.40	44	0.0130	0.00	0.00	109.37	117.00	0.60
01/03/1991	CPB	6.65	6.00	45	0.0110	0.00	0.00	92.90	111.00	0.40
01/03/1991	LBA	6.80	8.60	23	0.0220	0.00	0.00	137.40	76.00	0.60
01/03/1991	TRIB	6.67	6.80	15	0.0080	0.00	0.00	262.10	50.00	0.80
01/03/1991	BIRCH	7.47	12.20	23	0.0140	0.00	0.00	191.03	128.00	0.60
01/09/1991	KHB	-99.00	-99.00	8	0.0150	0.00	0.00	-99.00	-99.00	0.80
01/09/1991	LBB	-99.00	-99.00	40	0.0150	0.00	0.00	-99.00	-99.00	0.80
01/09/1991	CPB	-99.00	-99.00	42	0.0230	0.00	0.00	-99.00	-99.00	0.60
01/09/1991	LBA	-99.00	-99.00	15	0.0170	0.00	0.00	-99.00	-99.00	1.00
01/09/1991	TRIB	-99.00	-99.00	4	0.0100	0.00	0.00	-99.00	-99.00	0.70
01/09/1991	BIRCH	-99.00	-99.00	7	0.0200	0.00	0.00	-99.00	-99.00	0.80
01/24/1991	KHB	-99.00	-99.00	7	0.0010	0.00	0.00	-99.00	-99.00	0.40
01/24/1991	LBB	-99.00	-99.00	38	0.0100	0.00	0.00	-99.00	-99.00	0.90
01/24/1991	CPB	-99.00	-99.00	37	0.0050	0.00	0.00	-99.00	-99.00	0.40
01/24/1991	LBA	-99.00	-99.00	12	0.0040	0.00	0.00	-99.00	-99.00	1.20
01/24/1991	TRIB	-99.00	-99.00	8	0.0290	0.00	0.00	-99.00	-99.00	2.30
01/24/1991	BIRCH	-99.00	-99.00	9	0.0030	0.00	0.00	-99.00	-99.00	0.80
01/31/1991	KHB	6.34	4.20	9	0.0010	0.00	0.00	33.40	93.00	0.80
01/31/1991	LBB	6.36	8.40	40	0.0120	0.00	0.00	203.00	67.00	0.90
01/31/1991	CPB	6.72	5.80	34	0.0030	0.00	0.00	446.80	63.00	0.60
01/31/1991	LBA	7.06	10.40	13	0.0100	0.00	0.00	201.00	59.00	2.50
01/31/1991	TRIB	6.56	5.50	7	0.0050	0.00	0.00	715.00	50.00	1.20
01/31/1991	BIRCH	6.64	7.80	9	0.0080	0.00	0.00	365.00	50.00	1.40
02/07/1991	KHB	-99.00	-99.00	8	0.0020	0.00	0.00	-99.00	-99.00	0.40
02/07/1991	LBB	-99.00	-99.00	33	0.0110	0.00	0.00	-99.00	-99.00	1.20
02/07/1991	CPB	-99.00	-99.00	33	0.0040	0.00	0.00	-99.00	-99.00	0.80
02/07/1991	LBA	-99.00	-99.00	16	0.0100	0.00	0.00	-99.00	-99.00	1.80
02/07/1991	TRIB	-99.00	-99.00	14	0.0170	0.00	0.00	-99.00	-99.00	2.10
02/07/1991	BIRCH	-99.00	-99.00	15	0.0140	0.00	0.00	-99.00	-99.00	1.50
02/21/1991	OUTLET	-99.00	-99.00	26	-9.9000	0.00	0.00	-99.00	-99.00	0.40
02/21/1991	KHB	-99.00	-99.00	13	-9.9000	0.00	0.00	-99.00	-99.00	0.30
02/21/1991	INLET	-99.00	-99.00	34	-9.9000	0.00	0.00	-99.00	-99.00	1.00
02/21/1991	LBB	-99.00	-99.00	39	-9.9000	0.00	0.00	-99.00	-99.00	1.20
02/21/1991	CPB	-99.00	-99.00	43	-9.9000	0.00	0.00	-99.00	-99.00	0.30
02/21/1991	LBA	-99.00	-99.00	24	-9.9000	0.00	0.00	-99.00	-99.00	1.60

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
02/21/1991	TRIB	-99.00	-99.00	18	-9.9000	0.00	0.00	-99.00	-99.00	0.60
02/21/1991	BIRCH	-99.00	-99.00	17	-9.9000	0.00	0.00	-99.00	-99.00	0.50
03/07/1991	KHB	6.09	1.70	23	0.0470	0.00	0.00	26.70	130.00	5.60
03/07/1991	LBB	6.45	4.30	45	0.0560	0.00	0.00	152.50	105.00	7.60
03/07/1991	CPB	6.48	4.50	38	0.0240	0.00	0.00	146.80	116.00	2.20
03/07/1991	LBA	6.57	6.90	55	0.1000	0.00	0.00	126.80	119.00	12.30
03/07/1991	TRIB	6.39	4.20	41	0.0690	0.00	0.00	292.00	145.00	4.33
03/07/1991	BIRCH	6.20	3.40	38	0.0670	0.00	0.00	124.70	144.00	5.30
03/14/1991	KHB	-99.00	-99.00	9	0.0060	0.00	0.00	-99.00	-99.00	0.70
03/14/1991	LBB	-99.00	-99.00	24	0.0080	0.00	0.00	-99.00	-99.00	0.80
03/14/1991	CPB	-99.00	-99.00	29	0.0030	0.00	0.00	-99.00	-99.00	0.40
03/14/1991	LBA	-99.00	-99.00	12	0.0030	0.00	0.00	-99.00	-99.00	0.80
03/14/1991	TRIB	-99.00	-99.00	6	0.0010	0.00	0.00	-99.00	-99.00	0.30
03/14/1991	BIRCH	-99.00	-99.00	8	0.0040	0.00	0.00	-99.00	-99.00	0.90
04/11/1991	KHB	-99.00	-99.00	16	0.0100	0.00	0.00	-99.00	-99.00	0.60
04/11/1991	LBB	-99.00	-99.00	23	0.0130	0.00	0.00	-99.00	-99.00	0.80
04/11/1991	CPB	-99.00	-99.00	26	0.0110	0.00	0.00	-99.00	-99.00	0.52
04/11/1991	LBA	-99.00	-99.00	22	0.0140	0.00	0.00	-99.00	-99.00	0.60
04/11/1991	TRIB	-99.00	-99.00	9	0.0100	0.00	0.00	-99.00	-99.00	0.50
04/11/1991	BIRCH	-99.00	-99.00	23	0.0140	0.00	0.00	-99.00	-99.00	1.23
04/24/1991	KHB	-99.00	-99.00	23	0.0070	0.00	0.00	-99.00	-99.00	0.40
04/24/1991	LBB	-99.00	-99.00	55	0.0100	0.00	0.00	-99.00	-99.00	0.60
04/24/1991	CPB	-99.00	-99.00	47	0.0100	0.00	0.00	-99.00	-99.00	0.60
04/24/1991	LBA	-99.00	-99.00	38	0.0080	0.00	0.00	-99.00	-99.00	0.50
04/24/1991	TRIB	-99.00	-99.00	24	0.0060	0.00	0.00	-99.00	-99.00	0.50
04/24/1991	BIRCH	-99.00	-99.00	34	0.0070	0.00	0.00	-99.00	-99.00	0.40
05/02/1991	KHB	6.51	3.30	16	0.0070	0.00	0.00	27.60	60.00	0.70
05/02/1991	LBB	6.47	5.80	38	0.0150	0.00	0.00	132.80	50.00	1.20
05/02/1991	CPB	6.23	4.10	28	0.0100	0.00	0.00	126.60	50.00	1.00
05/02/1991	LBA	6.74	7.70	26	0.0100	0.00	0.00	140.50	81.00	1.10
05/02/1991	TRIB	6.57	4.90	12	0.0140	0.00	0.00	291.70	59.00	0.80
05/02/1991	BIRCH	6.62	5.80	17	0.0090	0.00	0.00	219.00	53.00	1.80
05/10/1991	KHB	-99.00	-99.00	23	0.0110	0.00	0.00	-99.00	-99.00	0.80
05/10/1991	LBB	-99.00	-99.00	43	0.0140	0.00	0.00	-99.00	-99.00	0.70
05/10/1991	CPB	-99.00	-99.00	36	0.0130	0.00	0.00	-99.00	-99.00	0.70
05/10/1991	LBA	-99.00	-99.00	26	0.0080	0.00	0.00	-99.00	-99.00	0.90

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
05/10/1991	TRIB	-99.00	-99.00	16	0.0570	0.00	0.00	-99.00	-99.00	0.30
05/10/1991	BIRCH	-99.00	-99.00	24	0.0220	0.00	0.00	-99.00	-99.00	0.50
05/23/1991	KHB	-99.00	-99.00	29	0.0110	0.00	0.00	-99.00	-99.00	0.40
05/23/1991	LBB	-99.00	-99.00	46	0.0220	0.00	0.00	-99.00	-99.00	-99.00
05/23/1991	CPB	-99.00	-99.00	26	0.0100	0.00	0.00	-99.00	-99.00	-99.00
05/23/1991	LBA	-99.00	-99.00	28	0.0120	0.00	0.00	-99.00	-99.00	-99.00
05/23/1991	TRIB	-99.00	-99.00	8	0.0050	0.00	0.00	-99.00	-99.00	-99.00
05/23/1991	BIRCH	-99.00	-99.00	19	0.0130	0.00	0.00	-99.00	-99.00	-99.00
06/06/1991	KHB	6.25	5.30	18	0.0040	0.00	0.00	31.90	50.00	-99.00
06/06/1991	LBB	6.35	8.50	43	0.0150	0.00	0.00	160.00	53.00	-99.00
06/06/1991	CPB	6.32	5.00	30	0.0120	0.00	0.00	150.70	50.00	-99.00
06/06/1991	LBA	7.02	14.30	28	0.0100	0.00	0.00	169.60	51.00	-99.00
06/06/1991	TRIB	6.54	8.00	14	0.0190	0.00	0.00	263.00	50.00	-99.00
06/06/1991	BIRCH	6.71	12.00	24	0.0090	0.00	0.00	312.40	50.00	-99.00
06/20/1991	KHB	-99.00	-99.00	32	0.0070	0.00	0.00	-99.00	-99.00	0.70
06/20/1991	LBB	-99.00	-99.00	65	0.0240	0.00	0.00	-99.00	-99.00	1.90
06/20/1991	CPB	-99.00	-99.00	25	0.0050	0.00	0.00	-99.00	-99.00	0.80
06/20/1991	LBA	-99.00	-99.00	27	0.0010	0.00	0.00	-99.00	-99.00	0.70
06/20/1991	TRIB	-99.00	-99.00	10	0.0010	0.00	0.00	-99.00	-99.00	0.70
06/20/1991	BIRCH	-99.00	-99.00	24	0.0240	0.00	0.00	-99.00	-99.00	1.20
07/03/1991	KHB	-99.00	-99.00	46	0.0220	0.00	0.00	-99.00	-99.00	3.90
07/03/1991	LBB	-99.00	-99.00	85	0.0570	0.00	0.00	-99.00	-99.00	3.10
07/03/1991	CPB	-99.00	-99.00	15	0.0060	0.00	0.00	-99.00	-99.00	0.20
07/03/1991	LBA	-99.00	-99.00	17	0.0140	0.00	0.00	-99.00	-99.00	0.20
07/03/1991	TRIB	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
07/03/1991	BIRCH	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
07/18/1991	KHB	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	3.90
07/18/1991	LBB	-99.00	-99.00	95	0.0450	0.00	0.00	-99.00	-99.00	4.30
07/18/1991	CPB	-99.00	-99.00	9	0.0070	0.00	0.00	-99.00	-99.00	0.32
07/18/1991	LBA	-99.00	-99.00	20	0.0140	0.00	0.00	-99.00	-99.00	0.32
07/18/1991	TRIB	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
07/18/1991	BIRCH	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
09/06/1991	KHB	-99.00	-99.00	23	0.0160	0.00	0.00	-99.00	-99.00	-99.00
09/06/1991	LBB	-99.00	-99.00	34	0.0210	0.00	0.00	-99.00	-99.00	-99.00
09/06/1991	CPB	-99.00	-99.00	23	0.0090	0.00	0.00	-99.00	-99.00	-99.00
09/06/1991	LBA	-99.00	-99.00	18	0.0130	0.00	0.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
09/06/1991	TRIB	-99.00	-99.00	7	0.0210	0.00	0.00	-99.00	-99.00	-99.00
09/06/1991	BIRCH	-99.00	-99.00	16	0.0720	0.00	0.00	-99.00	-99.00	-99.00
09/12/1991	KHB	-99.00	-99.00	47	0.0170	0.00	0.00	-99.00	-99.00	4.00
09/12/1991	LBB	-99.00	-99.00	46	0.0320	0.00	0.00	-99.00	-99.00	1.60
09/12/1991	CPB	-99.00	-99.00	20	0.0070	0.00	0.00	-99.00	-99.00	0.40
09/12/1991	LBA	-99.00	-99.00	12	0.0100	0.00	0.00	-99.00	-99.00	0.30
09/12/1991	TRIB	-99.00	-99.00	4	0.0220	0.00	0.00	-99.00	-99.00	0.10
09/12/1991	BIRCH	-99.00	-99.00	-99	-9.9000	0.00	0.00	-99.00	-99.00	-99.00
09/26/1991	KHB	5.88	2.60	17	0.0150	0.00	0.00	30.20	-99.00	1.70
09/26/1991	LBB	6.05	-99.00	55	0.0200	0.00	0.00	157.10	-99.00	1.20
09/26/1991	CPB	6.25	4.00	42	0.0180	0.00	0.00	152.50	-99.00	1.40
09/26/1991	LBA	6.42	9.00	55	0.0310	0.00	0.00	152.00	-99.00	1.80
09/26/1991	TRIB	6.06	5.30	44	0.0210	0.00	0.00	202.80	-99.00	1.30
09/26/1991	BIRCH	6.30	-99.00	48	0.0240	0.00	0.00	232.70	-99.00	1.20
10/04/1991	KHB	-99.00	-99.00	15	0.0140	0.00	0.00	-99.00	76.00	-99.00
10/04/1991	LBB	-99.00	-99.00	36	0.0170	0.00	0.00	-99.00	50.00	-99.00
10/04/1991	CPB	-99.00	-99.00	30	0.0080	0.00	0.00	-99.00	52.00	-99.00
10/04/1991	LBA	-99.00	-99.00	21	0.0140	0.00	0.00	-99.00	52.00	-99.00
10/04/1991	TRIB	-99.00	-99.00	9	0.0050	0.00	0.00	-99.00	50.00	-99.00
10/04/1991	BIRCH	-99.00	-99.00	19	0.0250	0.00	0.00	-99.00	58.00	-99.00
10/08/1991	KHB	-99.00	-99.00	12	0.0060	0.00	0.00	-99.00	-99.00	0.40
10/08/1991	LBB	-99.00	-99.00	50	0.0180	0.00	0.00	-99.00	-99.00	0.80
10/08/1991	CPB	-99.00	-99.00	36	0.0120	0.00	0.00	-99.00	-99.00	0.60
10/08/1991	LBA	-99.00	-99.00	34	0.0160	0.00	0.00	-99.00	-99.00	0.60
10/08/1991	TRIB	-99.00	-99.00	21	0.0090	0.00	0.00	-99.00	-99.00	0.60
10/08/1991	BIRCH	-99.00	-99.00	49	0.0150	0.00	0.00	-99.00	-99.00	0.60
10/25/1991	OUTLET	6.62	5.60	29	0.0190	0.00	0.00	113.70	50.00	1.20
10/25/1991	KHB	6.19	3.10	14	0.0060	0.00	0.00	31.30	83.00	1.50
10/25/1991	INLET	6.46	5.90	32	0.0110	0.00	0.00	127.20	72.00	0.90
10/25/1991	LBB	6.39	5.90	39	0.0130	0.00	0.00	133.60	86.00	2.00
10/25/1991	CPB	6.22	2.80	37	0.0080	0.00	0.00	121.80	72.00	1.00
10/25/1991	LBA	6.61	9.50	24	0.0190	0.00	0.00	146.40	69.00	1.90
10/25/1991	TRIB	6.72	7.10	11	0.0100	0.00	0.00	257.00	60.00	0.30
10/25/1991	BIRCH	6.60	7.90	36	0.0100	0.00	0.00	157.70	88.00	0.60
11/21/1991	OUTLET	6.68	-99.00	24	0.0110	0.00	0.00	113.40	50.00	0.60
11/21/1991	KHB	6.47	-99.00	12	0.0120	0.00	0.00	32.10	50.00	0.80

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
11/21/1991	INLET	6.52	-99.00	33	0.0100	0.00	0.00	129.70	50.00	0.50
11/21/1991	LBB	6.52	-99.00	37	0.0110	0.00	0.00	135.30	57.00	0.70
11/21/1991	CPB	6.66	-99.00	34	0.0070	0.00	0.00	121.20	50.00	0.40
11/21/1991	LBA	6.95	-99.00	20	0.0070	0.00	0.00	149.40	50.00	0.40
11/21/1991	TRIB	6.77	-99.00	11	0.0040	0.00	0.00	266.20	50.00	0.50
11/21/1991	BIRCH	6.74	-99.00	22	0.0060	0.00	0.00	161.50	50.00	0.30
11/27/1991	OUTLET	-99.00	-99.00	28	0.0100	0.00	0.00	-99.00	-99.00	0.70
11/27/1991	KHB	-99.00	-99.00	7	0.0080	0.00	0.00	-99.00	-99.00	0.40
11/27/1991	INLET	-99.00	-99.00	39	0.0070	0.00	0.00	-99.00	-99.00	0.50
11/27/1991	LBB	-99.00	-99.00	38	0.0080	0.00	0.00	-99.00	-99.00	0.60
11/27/1991	CPB	-99.00	-99.00	38	0.0090	0.00	0.00	-99.00	-99.00	0.50
11/27/1991	LBA	-99.00	-99.00	18	0.0060	0.00	0.00	-99.00	-99.00	0.70
11/27/1991	TRIB	-99.00	-99.00	10	0.0030	0.00	0.00	-99.00	-99.00	0.30
11/27/1991	BIRCH	-99.00	-99.00	32	0.0060	0.00	0.00	-99.00	-99.00	0.40
02/14/1991	02 METERS	6.54	5.80	22	0.0050	0.00	0.00	123.40	50.00	-99.00
02/14/1991	06 METERS	6.44	6.00	28	0.0030	0.00	0.00	130.00	55.00	-99.00
06/07/1991	02 METERS	6.81	5.66	20	0.0060	0.00	0.00	114.70	-99.00	-99.00
06/07/1991	06 METERS	6.41	-99.00	24	0.0100	0.00	0.00	115.20	-99.00	-99.00
06/20/1991	02 METERS	7.10	6.40	25	0.0120	0.00	0.00	117.00	-99.00	-99.00
06/20/1991	06 METERS	6.53	-99.00	32	0.0150	0.00	0.00	124.50	-99.00	-99.00
07/31/1991	02 METERS	7.03	8.10	23	0.0150	0.00	0.00	124.70	-99.00	-99.00
07/31/1991	06 METERS	6.33	-99.00	46	0.0160	0.00	0.00	126.50	-99.00	-99.00
08/16/1991	02 METERS	7.11	9.10	33	0.0110	0.00	0.00	123.70	-99.00	-99.00
08/16/1991	06 METERS	6.58	-99.00	38	0.0150	0.00	0.00	124.50	-99.00	-99.00
10/17/1991	02 METERS	6.56	6.00	29	0.0140	0.00	0.00	116.70	50.00	-99.00
10/17/1991	06 METERS	6.61	6.50	30	0.0140	0.00	0.00	116.50	53.00	-99.00
11/14/1991	02 METERS	6.78	6.00	27	0.0130	0.00	0.00	113.30	50.00	-99.00
11/14/1991	06 METERS	6.79	6.10	29	0.0130	0.00	0.00	112.90	50.00	-99.00
12/26/1991	02 METERS	6.49	5.60	50	0.0080	0.00	0.00	107.80	-99.00	-99.00
12/26/1991	06 METERS	6.40	6.00	48	0.0100	0.00	0.00	107.80	-99.00	-99.00
10/25/1990	02 METERS	6.58	5.90	55	0.0180	0.00	0.00	89.80	135.00	-99.00
10/25/1990	06 METERS	6.60	5.90	60	0.0200	0.00	0.00	90.20	228.00	-99.00
06/28/1991	02 METERS	7.19	4.60	20	0.0470	0.00	0.00	-99.00	50.00	-99.00
06/28/1991	06 METERS	6.42	7.40	33	0.0640	0.00	0.00	-99.00	64.00	-99.00
01/22/1992	02 METERS	6.40	6.50	31	0.0080	0.00	0.00	123.10	74.00	-99.00
01/22/1992	06 METERS	6.38	6.40	29	0.0080	0.00	0.00	117.80	50.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
02/14/1992	02 METERS	6.37	6.60	25	0.0070	0.00	0.00	-99.00	58.00	-99.00
02/14/1992	06 METERS	6.17	5.50	24	0.0100	0.00	0.00	-99.00	55.00	-99.00
04/28/1992	02 METERS	6.64	5.20	22	0.0150	0.00	0.00	141.20	50.00	-99.00
04/28/1992	06 METERS	6.40	4.90	23	0.0150	0.00	0.00	143.30	50.00	-99.00
05/11/1992	02 METERS	6.93	5.20	22	0.0130	0.00	0.00	136.20	54.00	-99.00
05/11/1992	06 METERS	6.35	5.20	28	0.0160	0.00	0.00	139.30	68.00	-99.00
06/11/1992	02 METERS	6.71	6.00	-99	0.0150	0.00	0.00	138.00	-99.00	-99.00
06/11/1992	06 METERS	6.16	7.10	-99	0.0240	0.00	0.00	142.90	-99.00	-99.00
06/24/1992	02 METERS	6.94	6.70	24	0.0150	0.00	0.00	140.30	50.00	-99.00
06/24/1992	06 METERS	6.42	9.00	35	0.0250	0.00	0.00	150.00	50.00	-99.00
07/11/1992	02 METERS	-99.00	-99.00	-99	0.0000	0.00	0.00	121.20	-99.00	-99.00
07/11/1992	06 METERS	-99.00	-99.00	-99	0.0000	0.00	0.00	120.80	-99.00	-99.00
07/03/1992	02 METERS	-99.00	-99.00	-99	0.0130	0.00	0.00	118.90	-99.00	-99.00
07/03/1992	06 METERS	-99.00	-99.00	-99	0.0120	0.00	0.00	116.20	-99.00	-99.00
10/11/1990	KHB	-99.00	-99.00	-99	0.0140	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	LBB	-99.00	-99.00	-99	0.0240	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	CPB	-99.00	-99.00	-99	0.0100	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	LBA	-99.00	-99.00	-99	0.0380	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	TRIB	-99.00	-99.00	-99	0.0100	0.00	0.00	-99.00	-99.00	-99.00
10/11/1990	BIRCH	-99.00	-99.00	-99	0.0230	-99.00	-99.00	-99.00	-99.00	-99.00
02/28/1991	KHB	-99.00	-99.00	-99	0.0030	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	LBB	-99.00	-99.00	-99	0.0110	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	CPB	-99.00	-99.00	-99	0.0100	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	LBA	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	TRIB	-99.00	-99.00	-99	0.0030	0.00	0.00	-99.00	-99.00	-99.00
02/28/1991	BIRCH	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
03/28/1991	KHB	-99.00	-99.00	-99	0.0240	0.00	0.00	-99.00	-99.00	-99.00
03/28/1991	LBB	-99.00	-99.00	-99	0.0150	0.00	0.00	-99.00	-99.00	-99.00
03/28/1991	CPB	-99.00	-99.00	-99	0.0140	0.00	0.00	-99.00	-99.00	-99.00
03/28/1991	LBA	-99.00	-99.00	-99	0.2180	0.00	0.00	-99.00	-99.00	-99.00
03/28/1991	TRIB	-99.00	-99.00	-99	0.1960	0.00	0.00	-99.00	-99.00	0.00
03/28/1991	BIRCH	-99.00	-99.00	-99	0.1260	0.00	0.00	-99.00	-99.00	-99.00
08/30/1991	KHB	-99.00	-99.00	-99	0.0170	0.00	0.00	-99.00	-99.00	-99.00
08/30/1991	LBB	-99.00	-99.00	-99	0.0400	0.00	0.00	-99.00	-99.00	-99.00
08/30/1991	CPB	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.90
08/30/1991	LBA	-99.00	-99.00	-99	0.0110	0.00	0.00	-99.00	-99.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
08/30/1991	TRIB	-99.00	-99.00	-99	0.0090	0.00	0.00	-99.00	-99.00	-99.00
08/30/1991	BIRCH	-99.00	-99.00	-99	0.0240	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	KHB	-99.00	-99.00	-99	0.0050	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	LBB	-99.00	-99.00	-99	0.0110	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	CPB	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	LBA	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	TRIB	-99.00	-99.00	-99	0.0050	0.00	0.00	-99.00	-99.00	-99.00
10/31/1991	BIRCH	-99.00	-99.00	-99	0.0100	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	OUTLET	-99.00	-99.00	-99	0.0100	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	KHB	-99.00	-99.00	-99	0.0040	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	INLET	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	LBB	-99.00	-99.00	-99	0.0120	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	CPB	-99.00	-99.00	-99	0.0080	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	LBA	-99.00	-99.00	-99	0.0060	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	TRIB	-99.00	-99.00	-99	0.0020	0.00	0.00	-99.00	-99.00	-99.00
11/07/1991	BIRCH	-99.00	-99.00	-99	0.0070	0.00	0.00	-99.00	-99.00	-99.00
07/16/1992	02 METERS	6.86	7.70	18	0.0150	0.00	0.00	142.40	-99.00	-99.00
07/17/1992	06 METERS	-99.00	-99.00	27	0.0230	0.00	0.00	154.00	-99.00	-99.00
07/29/1992	02 METERS	-99.00	-99.00	25	0.0120	0.00	0.00	146.20	-99.00	-99.00
07/29/1992	06 METERS	-99.00	-99.00	35	0.0160	0.00	0.00	148.40	-99.00	-99.00
08/05/1992	02 METERS	7.06	7.50	22	0.0130	0.00	0.00	146.50	-99.00	-99.00
08/05/1992	06 METERS	-99.00	-99.00	80	0.0310	0.00	0.00	159.10	-99.00	-99.00
08/13/1992	02 METERS	7.07	7.70	18	0.0160	0.00	0.00	145.60	-99.00	-99.00
08/13/1992	06 METERS	-99.00	-99.00	36	0.0210	0.00	0.00	152.70	-99.00	-99.00
08/21/1992	02 METERS	6.93	6.30	24	0.0150	0.00	0.00	141.70	50.00	-99.00
08/21/1992	06 METERS	6.66	5.90	29	0.0270	0.00	0.00	145.90	50.00	-99.00
08/28/1992	02 METERS	6.91	8.50	18	0.0130	0.00	0.00	146.10	-99.00	-99.00
08/28/1992	06 METERS	-99.00	-99.00	33	0.0270	0.00	0.00	152.60	-99.00	-99.00
09/11/1992	02 METERS	7.24	6.50	16	0.0140	0.00	0.00	134.10	-99.00	-99.00
09/11/1992	06 METERS	-99.00	-99.00	21	0.0170	0.00	0.00	147.80	-99.00	-99.00
09/18/1992	02 METERS	6.44	5.50	18	0.0160	0.00	0.00	151.10	50.00	-99.00
09/18/1992	06 METERS	6.63	9.70	27	0.0180	0.00	0.00	152.70	50.00	-99.00
09/24/1992	02 METERS	7.09	8.80	22	0.0130	0.00	0.00	147.00	-99.00	-99.00
09/24/1992	06 METERS	-99.00	-99.00	24	0.0130	0.00	0.00	150.40	-99.00	-99.00
10/01/1992	02 METERS	7.00	9.30	24	0.0200	0.00	0.00	150.90	50.00	-99.00
10/01/1992	06 METERS	6.88	9.10	24	0.0180	0.00	0.00	153.40	50.00	-99.00

Kezar Lake Study Raw Chemistry Data

Date	Station	Ph	Alk	Color	Tp	Tkn	Nitrate	Cond	Al	Turbidity
10/15/1992	02 METERS	6.90	7.70	-99	0.0130	0.00	0.00	152.00	-99.00	-99.00
10/15/1992	06 METERS	6.70	7.60	-99	0.0170	0.00	0.00	153.00	-99.00	-99.00
10/28/1992	02 METERS	6.99	6.10	17	0.0270	0.00	0.00	152.80	-99.00	-99.00
10/28/1992	06 METERS	6.97	6.10	17	0.0170	0.00	0.00	153.20	-99.00	-99.00
07/08/1992	02 METERS	7.12	7.10	19	0.0130	0.00	0.00	-99.00	50.00	-99.00
07/08/1992	06 METERS	6.23	9.20	29	0.0220	0.00	0.00	-99.00	50.00	-99.00
03/29/1993	OUTLET	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	50.00	0.00
03/29/1993	KHB	-99.00	-99.00	-99	0.0190	-99.00	-99.00	-99.00	195.00	0.00
03/29/1993	INLET	-99.00	-99.00	-99	0.0310	-99.00	-99.00	-99.00	173.00	0.00
03/29/1993	BIRCH	-99.00	-99.00	-99	0.0920	-99.00	-99.00	-99.00	146.00	0.00
03/30/1993	OUTLET	-99.00	-99.00	-99	0.0130	-99.00	-99.00	-99.00	50.00	0.00
03/30/1993	KHB	-99.00	-99.00	-99	0.0580	-99.00	-99.00	-99.00	107.00	0.00
03/30/1993	INLET	-99.00	-99.00	-99	0.0320	-99.00	-99.00	-99.00	126.00	0.00
03/30/1993	BIRCH	-99.00	-99.00	-99	0.0570	-99.00	-99.00	-99.00	142.00	0.00
04/01/1993	OUTLET	-99.00	-99.00	-99	0.0140	-99.00	-99.00	-99.00	110.00	0.00
04/01/1993	KHB	-99.00	-99.00	-99	0.0070	-99.00	-99.00	-99.00	104.00	0.00
04/01/1993	INLET	-99.00	-99.00	-99	0.0140	-99.00	-99.00	-99.00	175.00	0.00
04/01/1993	BIRCH	-99.00	-99.00	-99	0.0220	-99.00	-99.00	-99.00	142.00	0.00
04/06/1993	OUTLET	-99.00	-99.00	-99	0.0140	-99.00	-99.00	-99.00	120.00	0.00
04/06/1993	KHB	-99.00	-99.00	-99	0.0150	-99.00	-99.00	-99.00	94.00	0.00
04/06/1993	INLET	-99.00	-99.00	-99	0.0140	-99.00	-99.00	-99.00	109.00	0.00
04/06/1993	BIRCH	-99.00	-99.00	-99	0.0160	-99.00	-99.00	-99.00	100.00	0.00
04/08/1993	OUTLET	-99.00	-99.00	-99	0.0070	-99.00	-99.00	-99.00	97.00	0.00
04/08/1993	KHB	-99.00	-99.00	-99	0.0080	-99.00	-99.00	-99.00	118.00	0.00
04/08/1993	INLET	-99.00	-99.00	-99	0.0170	-99.00	-99.00	-99.00	128.00	0.00
04/08/1993	BIRCH	-99.00	-99.00	-99	0.0110	-99.00	-99.00	-99.00	144.00	0.00

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	06/01/1988	0.1	18.5	9.7	101.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	1.0	18.5	9.5	99.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	2.0	18.4	9.3	98.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	3.0	18.2	9.4	98.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	4.0	13.6	7.4	70.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	5.0	11.2	3.6	32.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	6.0	10.1	2.5	22.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/01/1988	6.5	10.0	2.7	24.0	1030	7.0	partly sunny, light wind, mild
KEZAR LAKE	NORTH SUTTON	06/23/1988	0.1	23.6	8.7	103.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	1.0	23.6	8.7	103.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	2.0	23.6	8.7	103.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	3.0	23.5	8.7	103.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	4.0	16.5	2.2	24.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	5.0	15.8	1.4	15.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	6.0	14.4	-0.5	0.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	7.0	12.4	-0.5	0.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/23/1988	7.5	11.5	-0.5	0.0	1150	8.0	breezy, partly cloudy
KEZAR LAKE	NORTH SUTTON	06/20/1989	6.5	11.0	0.0	0.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	6.0	12.0	0.2	2.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	5.0	13.5	5.3	50.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	4.0	15.0	6.7	65.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	3.0	17.0	9.4	96.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	2.0	18.0	9.6	100.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	1.0	19.0	10.2	110.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/20/1989	0.1	20.0	10.0	110.0	1030	7.0	SUNNY & WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	0.1	24.9	8.8	103.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	1.0	23.5	8.7	100.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	2.0	22.0	9.1	104.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	3.0	18.1	8.6	90.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	4.0	16.1	5.0	51.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	5.0	15.0	4.0	40.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	6.0	12.8	1.9	17.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	7.0	12.0	1.4	13.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	06/19/1990	7.5	11.0	0.8	7.0	1030	7.5	VERY CLOUDY, WARM
KEZAR LAKE	NORTH SUTTON	07/17/1990	0.1	24.3	8.2	98.4	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	1.0	24.0	8.2	97.9	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	2.0	24.0	8.2	97.9	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	3.0	22.0	8.1	93.2	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	4.0	21.2	6.8	77.0	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	5.0	17.0	0.5	5.2	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	6.0	14.0	0.5	4.9	1134	7.5	CLEAR HOT SLIGHT BREEZE
KEZAR LAKE	NORTH SUTTON	07/17/1990	7.0	13.0	0.5	4.7	1134	7.5	CLEAR HOT SLIGHT BREEZE

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	08/14/1990	0.1	22.5	7.5	87.1	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	1.0	22.3	7.2	83.3	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	2.0	22.2	7.0	80.9	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	3.0	22.1	7.0	80.7	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	4.0	20.2	4.5	50.0	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	5.0	20.0	4.5	49.8	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	6.0	19.2	2.5	27.2	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	7.0	15.5	0.2	2.0	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	08/14/1990	8.0	13.0	0.2	1.9	1142	8.5	WINDY COOL CLOUDY
KEZAR LAKE	NORTH SUTTON	06/13/1991	0.1	20.9	8.8	99.1	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	1.0	20.9	8.7	98.0	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	2.0	20.9	8.7	98.0	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	3.0	20.8	8.7	97.8	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	4.0	20.8	8.6	96.7	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	5.0	20.4	8.5	94.8	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	6.0	14.2	0.3	2.9	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/13/1991	7.0	12.8	0.0	0.0	1200	7.2	partly sunny and very windy
KEZAR LAKE	NORTH SUTTON	06/28/1991	0.1	23.8	9.2	109.5	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	1.0	23.1	9.2	108.1	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	2.0	22.7	9.3	108.4	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	3.0	22.6	9.2	107.1	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	4.0	19.3	7.1	77.4	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	5.0	17.1	3.0	31.2	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	6.0	15.5	0.0	0.0	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	06/28/1991	7.0	13.6	0.0	0.0	1215	7.4	hot, hazy, slight breeze
KEZAR LAKE	NORTH SUTTON	07/11/1991	0.1	21.8	8.5	97.4	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	1.0	21.8	8.3	95.1	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	2.0	21.7	8.2	93.8	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	3.0	21.5	8.0	91.2	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	4.0	21.1	7.9	89.3	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	5.0	20.8	7.3	82.1	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	6.0	16.6	0.0	0.0	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	7.0	13.5	0.0	0.0	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/11/1991	7.3	13.0	0.0	0.0	1035	7.6	sunny, few clouds, breezy
KEZAR LAKE	NORTH SUTTON	07/25/1991	0.1	25.0	8.4	102.1	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	1.0	25.0	8.4	102.1	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	2.0	25.0	8.2	99.6	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	3.0	25.0	7.6	92.3	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	4.0	23.0	5.0	58.6	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	5.0	20.0	1.6	17.7	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	6.0	18.0	0.2	2.1	1125	6.9	overcast, calm, and warm
KEZAR LAKE	NORTH SUTTON	07/25/1991	6.5	15.0	0.2	2.0	1125	6.9	overcast, calm, and warm

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	08/08/1991	0.1	22.2	8.4	97.0	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	1.0	22.3	8.3	96.1	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	2.0	22.2	8.4	97.0	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	3.0	22.0	8.3	95.5	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	4.0	22.0	8.0	92.1	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	5.0	21.0	6.8	76.7	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	6.0	17.0	0.2	2.1	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/08/1991	6.5	15.7	0.3	3.0	1030	6.9	clear, sunny and windy
KEZAR LAKE	NORTH SUTTON	08/22/1991	0.1	21.6	8.2	93.6	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	1.0	21.5	8.3	94.6	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	2.0	21.0	8.3	93.7	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	3.0	20.8	8.3	93.3	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	4.0	20.0	7.6	84.1	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	5.0	19.0	6.0	65.0	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	6.0	18.5	6.2	66.5	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	7.0	16.0	0.5	5.1	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	08/22/1991	7.5	14.2	0.5	4.9	1223	8.0	partly cloudy, warm, breezy
KEZAR LAKE	NORTH SUTTON	06/11/1992	7.5	10.0	0.3	2.6	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	7.0	10.0	0.3	2.6	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	6.0	10.0	1.4	12.4	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	5.0	11.6	4.5	41.3	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	4.0	13.4	4.5	43.1	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	3.0	18.0	9.0	95.5	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	2.0	20.0	9.6	106.2	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	1.0	20.2	9.8	108.8	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	06/11/1992	0.1	20.3	9.9	110.2	1445	7.9	SUNNY AND BREEZY
KEZAR LAKE	NORTH SUTTON	07/08/1992	0.1	21.4	8.4	95.6	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	1.0	20.8	8.5	95.6	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	2.0	20.4	8.4	93.7	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	3.0	20.1	8.1	89.8	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	4.0	18.6	5.1	54.8	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	5.0	13.8	0.3	2.9	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	6.0	10.1	0.3	2.7	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	7.0	9.7	0.3	2.6	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	07/08/1992	7.5	9.5	0.6	5.2	1030	7.9	MOSTLY SUNNY NICE
KEZAR LAKE	NORTH SUTTON	08/05/1992	0.1	20.2	9.0	100.0	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	1.0	20.2	9.0	100.0	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	2.0	20.2	9.0	100.0	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	3.0	20.0	9.0	99.6	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	4.0	20.0	9.0	99.6	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	5.0	17.3	3.8	39.7	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	6.0	12.3	0.2	1.9	1030	7.7	WINDY AND PARTLY CLOUDY

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	08/05/1992	7.0	11.0	0.2	1.8	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/05/1992	7.5	11.0	0.2	1.8	1030	7.7	WINDY AND PARTLY CLOUDY
KEZAR LAKE	NORTH SUTTON	08/04/1993	0.1	25.0	10.8	126.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	1.0	24.2	10.8	126.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	2.0	23.1	10.0	117.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	3.0	22.0	7.9	89.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	4.0	20.5	3.7	40.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	5.0	19.8	0.6	6.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	08/04/1993	6.0	17.5	0.3	3.0	1000	6.5	OVERCAST, WARM
KEZAR LAKE	NORTH SUTTON	09/01/1994	0.1	20.5	7.1	78.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	1.0	20.5	7.0	77.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	2.0	20.4	7.0	77.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	3.0	20.4	7.0	77.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	4.0	20.3	6.6	72.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	5.0	19.8	5.3	57.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	6.0	16.5	0.1	1.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	09/01/1994	6.9	14.8	0.4	4.0	1000	6.9	CLOUDY, WINDY
KEZAR LAKE	NORTH SUTTON	05/03/1995	0.1	12.5	12.0	111.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	1.0	11.5	12.0	109.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	2.0	11.3	12.0	109.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	3.0	11.0	12.0	109.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	4.0	10.5	11.0	97.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	5.0	10.5	11.0	97.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	6.0	10.0	10.0	89.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/03/1995	7.5	9.5	8.4	72.0	1000	7.6	PARTLY CLOUDY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	06/05/1995	0.1	21.0	9.3	104.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	1.0	20.7	9.3	102.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	2.0	20.3	9.2	101.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	3.0	19.7	9.1	98.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	4.0	17.3	7.8	79.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	5.0	14.5	5.4	52.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	6.0	12.0	2.1	19.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	7.0	11.0	0.5	4.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	06/05/1995	7.5	11.0	0.0	0.0	1000	7.9	CLEAR
KEZAR LAKE	NORTH SUTTON	08/07/1995	0.1	22.6	7.9	89.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	1.0	22.4	7.9	89.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	2.0	22.3	7.9	89.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	3.0	22.5	7.9	89.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	4.0	21.8	7.2	80.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	5.0	20.5	1.1	12.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	6.0	14.7	0.2	2.0	1000	7.5	CLEAR, SUNNY, WARM
KEZAR LAKE	NORTH SUTTON	08/07/1995	6.5	14.7	0.2	2.0	1000	7.5	CLEAR, SUNNY, WARM

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	07/05/1995	0.1	23.6	8.7	100.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	1.0	23.0	8.7	100.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	2.0	22.6	8.6	97.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	3.0	22.0	8.6	97.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	4.0	18.5	3.9	40.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	5.0	15.1	0.7	7.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	07/05/1995	6.0	13.1	0.3	3.0	1000	6.5	SUNNY, HAZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	0.1	20.5	9.1	100.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	1.0	20.5	9.0	99.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	2.0	20.5	8.8	95.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	3.0	20.4	9.1	100.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	4.0	20.1	8.7	94.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	5.0	19.2	7.6	81.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	6.0	18.4	4.6	48.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	09/06/1995	7.0	15.3	0.2	2.0	1030	7.2	CLEAR, SUNNY, BREEZY
KEZAR LAKE	NORTH SUTTON	05/07/1996	0.1	10.6	10.7	93.0	1000	8.1	SUNNY, WARM, BREEZY
KEZAR LAKE	NORTH SUTTON	05/07/1996	1.0	10.2	10.6	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	2.0	10.1	10.7	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	3.0	10.0	10.7	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	4.0	9.9	10.5	90.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	5.0	9.0	10.1	87.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	6.0	8.2	9.5	79.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	7.0	8.2	8.4	70.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/07/1996	7.5	8.0	4.3	36.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	0.1	18.5	10.1	106.0	1000	6.4	HAZY, BREEZY, WARM
KEZAR LAKE	NORTH SUTTON	06/03/1996	1.0	18.2	10.1	106.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	2.0	16.5	10.2	103.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	3.0	15.5	9.7	95.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	4.0	15.1	9.1	90.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	5.0	13.0	7.1	67.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	06/03/1996	6.0	13.0	4.3	41.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	0.1	18.5	9.4	98.0	1000	8.0	CLEAR, HOT, BREEZY
KEZAR LAKE	NORTH SUTTON	07/01/1996	1.0	19.2	9.2	99.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	2.0	19.1	8.7	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	3.0	19.2	7.7	82.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	4.0	16.8	5.7	57.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	5.0	13.5	0.7	7.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	6.0	10.6	0.3	3.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	07/01/1996	6.5	9.8	0.3	3.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	0.1	24.1	9.1	108.0	1000	7.9	SUNNY, HOT, BREEZY
KEZAR LAKE	NORTH SUTTON	08/05/1996	1.0	22.9	9.1	104.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	2.0	21.1	8.6	95.0	0	0.0	

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	08/05/1996	3.0	20.5	8.6	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	4.0	19.5	4.5	48.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	5.0	17.8	0.5	5.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	6.0	16.0	0.1	1.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	7.0	13.0	0.1	1.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	08/05/1996	7.5	11.7	0.2	2.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	0.1	23.3	8.6	99.0	1000	7.4	SUNNY, CALM
KEZAR LAKE	NORTH SUTTON	09/04/1996	1.0	22.5	8.5	96.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	2.0	22.1	8.2	93.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	3.0	22.1	8.0	92.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	4.0	21.0	4.3	48.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	5.0	18.1	0.2	2.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	6.0	15.1	0.2	2.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	09/04/1996	7.0	13.5	0.2	2.0	0	0.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	0.1	10.2	11.2	99.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	1.0	10.0	9.6	84.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	2.0	9.5	9.3	80.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	3.0	9.4	8.3	72.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	4.0	9.4	8.5	73.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	5.0	9.3	8.9	76.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	6.0	9.3	7.6	65.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	05/05/1997	7.0	9.2	6.6	56.0	1030	8.0	
KEZAR LAKE	NORTH SUTTON	06/02/1997	0.1	16.3	9.9	99.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	1.0	16.3	9.9	99.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	2.0	16.3	10.0	99.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	3.0	16.3	10.0	99.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	4.0	13.4	9.2	87.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	5.0	12.7	8.8	80.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	6.0	12.4	7.7	70.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	7.0	12.2	7.0	65.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/02/1997	7.5	11.9	3.4	31.0	1030	7.8	
KEZAR LAKE	NORTH SUTTON	06/30/1997	0.1	25.0	8.1	98.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	1.0	24.9	7.9	92.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	2.0	24.2	7.8	91.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	3.0	22.3	7.8	88.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	4.0	19.5	4.5	48.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	5.0	14.2	1.0	10.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	6.0	12.9	0.4	4.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	06/30/1997	7.0	12.2	0.4	4.0	1030	7.7	
KEZAR LAKE	NORTH SUTTON	08/04/1997	0.1	23.2	8.8	101.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	1.0	23.2	8.7	100.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	2.0	23.1	8.7	100.0	1030	7.5	

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	08/04/1997	3.0	23.1	8.7	101.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	4.0	22.9	8.5	96.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	5.0	19.6	1.7	18.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	6.0	14.3	0.3	3.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	08/04/1997	7.0	12.7	0.3	3.0	1030	7.5	
KEZAR LAKE	NORTH SUTTON	09/03/1997	0.1	22.0	8.9	100.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	1.0	22.2	8.9	100.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	2.0	22.2	8.8	99.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	3.0	22.2	8.5	96.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	4.0	21.6	8.3	93.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	5.0	20.2	3.0	33.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	6.0	16.8	0.3	3.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	7.0	14.8	0.3	3.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	09/03/1997	8.0	14.8	0.4	4.0	1000	8.4	
KEZAR LAKE	NORTH SUTTON	05/13/1998	0.1	14.2	10.0	95.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	1.0	13.8	10.0	95.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	2.0	13.5	9.9	92.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	3.0	13.3	9.9	92.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	4.0	12.5	9.0	81.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	5.0	11.4	7.3	66.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	6.0	10.3	6.8	59.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	05/13/1998	7.0	10.0	5.7	50.0	1000	7.3	
KEZAR LAKE	NORTH SUTTON	07/08/1998	0.1	22.7	8.8	99.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	1.0	22.2	8.6	97.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	2.0	21.9	8.5	94.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	3.0	19.3	5.3	57.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	4.0	15.8	1.3	13.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	5.0	15.0	0.3	3.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	6.0	14.6	0.3	3.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	07/08/1998	6.5	14.3	0.3	3.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	0.1	23.7	8.3	97.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	1.0	23.1	8.3	97.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	2.0	22.9	8.1	92.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	3.0	22.6	7.5	85.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	4.0	21.1	4.5	50.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	5.0	17.2	0.2	2.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	6.0	14.8	0.2	2.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	08/03/1998	7.0	14.1	0.2	2.0	1000	7.2	
KEZAR LAKE	NORTH SUTTON	09/09/1998	0.1	19.8	8.4	90.0	950	7.7	OVERCAST, COOL, BREEZY
KEZAR LAKE	NORTH SUTTON	09/09/1998	1.0	19.8	8.4	90.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	09/09/1998	2.0	19.8	8.4	90.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	09/09/1998	3.0	19.8	8.4	90.0	950	7.7	

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	09/09/1998	4.0	19.7	8.3	89.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	09/09/1998	5.0	19.4	8.1	87.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	09/09/1998	6.0	14.9	0.3	3.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	09/09/1998	7.0	14.3	0.3	3.0	950	7.7	
KEZAR LAKE	NORTH SUTTON	05/13/1998	0.1	14.1	9.9	95.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	1.0	13.8	10.0	95.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	2.0	13.5	9.9	92.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	3.0	13.3	9.9	92.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	4.0	12.5	8.9	81.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	5.0	11.4	11.4	66.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	6.0	10.3	6.7	59.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/13/1998	7.0	10.0	5.7	50.0	1000	7.3	Clear
KEZAR LAKE	NORTH SUTTON	05/10/1999	7.0	10.6	10.5	92.0	1319	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	6.0	10.8	9.4	84.5	1319	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	5.0	14.5	9.8	96.0	1320	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	4.0	14.8	9.6	94.6	1321	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	3.0	15.0	9.3	92.5	1322	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	2.0	15.0	10.3	102.6	1322	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	1.0	15.0	10.4	103.3	1323	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	05/10/1999	0.1	15.0	10.4	103.1	1323	7.4	Partly Cloudy, Windy
KEZAR LAKE	NORTH SUTTON	07/07/1999	8.0	14.3	7.7	75.5	1004	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	7.0	14.4	7.4	72.8	1004	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	6.0	16.2	8.5	86.3	1005	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	5.0	20.8	6.3	70.4	1006	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	4.0	25.8	10.6	130.1	1006	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	3.0	26.0	11.1	136.6	1007	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	2.0	26.0	11.0	136.0	1008	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	1.0	26.1	10.7	131.6	1008	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	07/07/1999	0.1	26.1	10.0	124.0	1008	8.5	Windy, Clear
KEZAR LAKE	NORTH SUTTON	09/08/1999	7.0	15.3	0.3	2.5	931	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	6.0	18.2	0.2	2.0	932	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	5.0	20.5	2.4	26.5	933	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	4.0	21.4	4.5	50.5	933	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	3.0	22.3	6.9	79.3	934	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	2.0	23.7	7.7	90.7	936	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	1.0	23.7	7.7	91.0	936	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	09/08/1999	0.1	23.9	7.7	91.3	937	7.7	Hazy
KEZAR LAKE	NORTH SUTTON	06/07/1999	0.1	21.8	5.6	62.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	1.0	21.7	5.6	62.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	2.0	21.5	5.6	62.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	3.0	21.4	5.7	63.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	4.0	18.3	4.6	48.0	1000	7.6	HAZY, HOT

Kezar Lake Study Raw Dissolved Oxygen Data

Lake	Town	Date	Depth	Temp	Do	Pcntsat	Time	Bottomz	Weather
KEZAR LAKE	NORTH SUTTON	06/07/1999	5.0	16.0	3.2	32.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	6.0	14.2	1.2	12.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	06/07/1999	7.0	13.1	0.6	6.0	1000	7.6	HAZY, HOT
KEZAR LAKE	NORTH SUTTON	08/02/1999	7.0	14.8	0.5	5.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	6.0	16.6	0.4	4.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	5.0	19.8	1.5	16.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	4.0	23.3	2.0	23.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	3.0	25.9	7.3	88.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	2.0	26.0	7.5	92.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	1.0	26.1	7.6	92.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	0.1	26.1	7.7	94.0	1000	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	7.0	14.8	0.5	5.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	6.0	16.6	0.4	4.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	5.0	19.8	1.5	16.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	4.0	23.3	2.0	23.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	3.0	25.9	7.3	88.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	2.0	26.0	7.5	92.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	1.0	26.1	7.6	92.0	900	8.0	Sunny, Warm
KEZAR LAKE	NORTH SUTTON	08/02/1999	0.1	26.1	7.7	94.0	900	8.0	Sunny, Warm

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
06/01/1988	2.2	9.46	MELOSIRA	88
07/13/1988	-99.0	14.88		
08/04/1988	-99.0	15.72		
09/08/1988	-99.0	8.73		
06/20/1989	2.4	6.75	ASTERIONELLA MELOSIRA	
07/23/1989	3.5	8.55		
08/27/1989	3.5	10.20		
09/30/1989	-99.0	4.70		
06/12/1990	3.0	4.74		
06/19/1990	3.5	4.35	MELOSIRA DINOBRYON UROGLENOPSIS	39 19 20
07/03/1990	2.8	5.21		
07/10/1990	2.7	6.38		
07/17/1990	3.3	7.44	DINOBRYON CHRYSOSPHAERELLA ASTERIONELLA	34 29 24

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
07/25/1990	2.8	5.60		
07/31/1990	3.3	18.50		
08/08/1990	2.8	5.18		
08/14/1990	2.1	8.53	CHRYSOSPHAERELLA	64
			TABELLARIA	17

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
08/14/1990	2.1	7.31	CHRYSOSPHAERELLA	64
			TABELLARIA	17

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
08/22/1990	2.5	8.65		
08/30/1990	1.9	6.95		
06/07/1991	-99.0	4.54		
06/19/1991	2.7	5.31		
06/28/1991	-99.0	10.10		
07/03/1991	3.0	5.29		
07/18/1991	2.7	5.45		
07/31/1991	2.0	7.25		
08/15/1991	2.3	7.05		
08/30/1991	3.0	6.20		
06/11/1992	-99.0	-99.00	ASTERIONELLA	34
			MELOSIRA	16
			DINOBRYON	14
06/20/1992	3.0	5.46		
07/08/1992	-99.0	-99.00	MELOSIRA	37
			CHRYSOSPHAERELLA	32
			SYNEDRA	12

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
07/15/1992	3.0	9.83		
07/28/1992	2.5	7.30		
08/05/1992	-99.0	-99.00	MELOSIRA	42
			SYNEDRA	26
			TABELLARIA	20
08/12/1992	3.0	6.49		
08/27/1992	2.7	3.46	ASTERIONELLA	45
			TABELLARIA	28
			MICROCYSTIS	9
09/09/1992	3.5	3.81		
09/22/1992	3.0	5.64		
06/27/1993	2.2	7.87		
07/11/1993	2.3	16.40		
07/18/1993	1.8	14.62		
07/25/1993	1.3	15.55		
08/01/1993	1.0	8.44		
08/04/1993	1.5	12.86	APHANIZOMENON	50
			LYNGBYA	17

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE
08/08/1993	2.0	13.05	
08/15/1993	1.8	15.72	
08/22/1993	1.5	18.65	
08/29/1993	2.0	14.43	
09/05/1993	2.5	10.96	
09/12/1993	2.0	4.50	
09/19/1993	-99.0	7.39	
06/26/1994	2.3	8.72	
07/10/1994	2.2	10.33	
07/17/1994	2.2	8.52	
07/25/1994	2.5	11.65	
08/07/1994	2.0	11.31	
08/14/1994	2.5	7.98	

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
08/22/1994	2.3	10.82		
09/01/1994	1.9	9.63	MELOSIRA	23
			TABELLARIA	17
			STAURASTRUM	11
09/18/1994	2.3	4.01		
10/02/1994	1.8	8.58		
05/03/1995	2.8	5.39	DINOBRYON	46
			MELOSIRA	20
			FRAGILARIA	12
06/05/1995	2.7	5.81	ANABAENA	39
			ASTERIONELLA	30
			MELOSIRA	21
06/12/1995	3.0	5.12		
06/19/1995	2.7	4.57		
06/26/1995	2.5	10.19		
07/05/1995	2.9	4.55	MELOSIRA	23
			FRAGILARIA	21
			CERATIUM	14
07/10/1995	3.0	3.82		
07/19/1995	2.7	5.47		
07/24/1995	2.8	4.55		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
07/31/1995	2.4	5.13		
08/07/1995	2.0	2.54	SYNEDRA	51
			DINOBRYON	18
			ANKISTRODESMUS	6
08/14/1995	2.6	5.45		
08/21/1995	2.6	6.59		
08/28/1995	2.8	-99.00		
09/06/1995	2.6	6.21	SYNEDRA	46
			MELOSIRA	20
			ASTERIONELLA	15
05/07/1996	2.3	5.55	TABELLARIA	32
			MELOSIRA	29
			ASTERIONELLA	22
06/03/1996	2.2	4.79	DINOBRYON	33
			MELOSIRA	19
			ASTERIONELLA	14
06/10/1996	2.4	8.11		
06/17/1996	2.5	3.13		
06/24/1996	2.6	5.19		
07/01/1996	2.4	7.52	MELOSIRA	69
			CHRYSOSPHAERELLA	21
			ASTERIONELLA	3
07/08/1996	2.3	7.11		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
07/15/1996	1.8	5.10		
07/22/1996	2.0	5.33		
07/29/1996	2.3	5.48		
08/05/1996	2.2	6.07	SYNEDRA	40
			RHIZOSOLENIA	29
			MELOSIRA	12
08/12/1996	2.2	5.48		
08/19/1996	2.2	10.21		
08/26/1996	2.3	5.14		
09/04/1996	2.0	9.05	LYNGBYA	54
			CHRYSOSPHAERELLA	28
			CERATIUM	9
05/05/1997	3.1	2.06	MELOSIRA	45
			OSCILLATORIA	25
			SYNEDRA	7
06/02/1997	3.2	2.42	MELOSIRA	48
			TABELLARIA	35
			CYCLOTELLA	6
06/09/1997	4.1	5.31		
06/16/1997	3.1	5.33		
06/23/1997	2.4	5.10		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
06/30/1997	2.5	4.03	MELOSIRA	50
			TABELLARIA	34
			ASTERIONELLA	14
07/07/1997	2.9	8.25		
07/14/1997	2.9	10.64		
07/23/1997	2.8	8.25		
07/28/1997	2.6	6.02		
08/04/1997	2.3	8.22	MELOSIRA	60
			TABELLARIA	24
			SYNEDRA	9
08/11/1997	2.9	7.54		
08/18/1997	2.3	7.85		
08/25/1997	2.0	3.63		
09/11/1997	-99.0	3.44	LYNGBYA	41
			MELOSIRA	26
			APHANIZOMENON	10
05/13/1998	2.5	5.86	MELOSIRA	69
			TABELLARIA	28
			ASTERIONELLA	3
06/08/1998	2.4	6.21		
06/15/1998	2.2	4.60		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
06/22/1998	2.3	5.69		
06/29/1998	2.1	6.45		
07/08/1998	2.6	6.99	MELOSIRA	55
			TABELLARIA	15
			DINOBRYON	11
07/13/1998	2.7	6.57		
07/21/1998	2.9	8.08		
07/27/1998	2.4	8.36		
08/03/1998	2.3	8.84	MELOSIRA	62
			SYNEDRA	19
			TABELLARIA	13
08/10/1998	2.3	10.85		
08/17/1998	2.7	10.78		
08/24/1998	2.5	8.60		
08/31/1998	2.9	7.87		
09/09/1998	2.0	2.54	LYNGBYA	66
			SYNEDRA	13
			BLUE GREEN SPECIES	5
04/18/1999	-99.0	-99.00		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE	
05/10/1999	3.0	-99.00		
06/07/1999	2.6	5.40		
06/14/1999	2.7	6.42		
06/21/1999	2.6	5.83		
06/28/1999	2.9	5.96		
07/07/1999	-99.0	8.78	OSCILLATORIA	67
			MELOSIRA	15
			TABELLARIA	4
07/12/1999	2.9	5.70		
07/19/1999	2.7	8.25		
07/26/1999	3.0	8.24		
08/02/1999	2.8	8.51		
08/09/1999	-99.0	-99.00		
08/16/1999	2.6	7.05		
08/23/1999	2.6	4.86		

NOTE: -99 indicates missing data

BIOLOGICAL RAW DATA REPORT

DATE	TRANSPARENCY (meters)	CHLOROPHYLL-A (mg/m3)	PHYTOPLANKTON & RELATIVE % ABUNDANCE
08/30/1999	-99.0	6.28	

NOTE: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
02 METERS						
06/01/1988	6.64		17	102.24	33	-99.00
08/04/1988	9.19		16	118.80	25	-99.00
09/08/1988	6.68		14	115.02	25	-99.00
06/20/1989	6.70		14	112.50	44	-99.00
07/23/1989	7.13		2	118.50	27	-99.00
08/27/1989	7.00		15	122.50	25	-99.00
09/30/1989	6.95		15	126.30	25	-99.00
06/12/1990	6.66		11	111.60	22	-99.00
07/03/1990	6.98		16	113.90	-99	-99.00
07/31/1990	7.03		13	119.70	24	-99.00
08/30/1990	6.57		24	85.60	63	-99.00
06/07/1991	6.81		6	115.40	20	-99.00
06/19/1991	7.10		12	116.90	25	-99.00
06/28/1991	-99.00		14	118.90	20	-99.00
07/03/1991	6.90		16	118.90	16	-99.00
07/18/1991	7.10		11	121.00	18	-99.00
07/31/1991	7.00		15	124.70	23	-99.00
08/15/1991	7.10		11	123.70	33	-99.00
08/30/1991	-99.00		-99	125.40	15	-99.00
07/03/1992	7.12		13	-99.00	19	-99.00
07/15/1992	6.86		15	142.40	18	-99.00
07/28/1992	7.06		12	146.20	25	-99.00
08/27/1992	6.91		13	146.10	18	-99.00
08/12/1992	7.07		16	145.60	18	-99.00
09/09/1992	6.55		14	148.50	16	-99.00
09/22/1992	7.09		13	147.00	22	-99.00
06/20/1992	6.93		12	139.40	24	-99.00
06/27/1993	6.60		20	143.70	-99	1.30
07/11/1993	7.40		-99	148.40	-99	1.50
07/18/1993	7.00		3	151.00	-99	3.00
07/25/1993	6.90		19	152.20	-99	3.40
08/01/1993	7.40		15	152.00	-99	6.90
08/04/1993	7.09		16	143.50	24	-99.00
08/08/1993	7.50		27	153.00	-99	2.80
08/15/1993	7.20		13	138.00	-99	2.20
08/22/1993	6.85		29	155.40	-99	4.80
08/29/1993	7.00		14	141.30	-99	3.50

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
09/05/1993	6.80		26	158.70	-99	1.70
09/12/1993	-99.00		26	159.30	-99	2.20
09/19/1993	6.80		20	160.50	-99	2.10
07/10/1994	6.81		8	121.10	-99	1.50
07/17/1994	6.75		17	122.30	-99	1.70
07/25/1994	6.76		7	110.40	-99	1.60
06/26/1994	6.79		12	125.70	-99	1.90
09/01/1994	6.83		15	139.70	27	-99.00
08/07/1994	7.01		13	140.10	-99	2.10
08/14/1994	7.01		9	140.10	-99	1.50
08/22/1994	6.96		11	139.50	-99	2.00
09/18/1994	6.62		9	124.40	-99	1.70
10/02/1994	7.14		28	25.50	-99	1.80
06/05/1995	7.05		7	136.60	24	-99.00
06/12/1995	7.08		11	138.20	30	-99.00
06/19/1995	6.97		14	140.00	35	-99.00
06/26/1995	5.98		6	139.20	40	-99.00
07/05/1995	7.39		8	145.00	37	-99.00
07/10/1995	6.83		13	147.50	25	-99.00
07/19/1995	6.93		10	147.30	22	-99.00
07/24/1995	7.01		11	150.00	30	-99.00
07/31/1995	6.89		10	148.10	50	-99.00
08/07/1995	6.87		9	146.90	60	-99.00
08/14/1995	6.86		12	151.60	60	-99.00
08/21/1995	6.99		12	151.70	55	-99.00
08/28/1995	6.96		11	154.90	37	-99.00
09/06/1995	7.18		13	158.20	38	-99.00
05/03/1995	7.35		11	131.20	22	-99.00
05/07/1996	6.53		9	101.50	29	-99.00
06/03/1996	6.67		12	103.10	29	-99.00
06/10/1996	6.52		17	103.10	40	-99.00
06/17/1996	6.64		11	105.70	29	-99.00
06/24/1996	6.27		13	108.90	28	-99.00
07/01/1996	6.74		16	109.50	35	-99.00
07/08/1996	6.59		20	110.90	45	-99.00
07/15/1996	6.73		12	108.30	35	-99.00
07/22/1996	6.61		17	108.60	47	-99.00
07/29/1996	6.92		18	109.70	72	-99.00
08/05/1996	6.83		12	112.00	70	-99.00

Note: **-99 indicates missing data**

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
08/12/1996	7.14		14	112.60	35	-99.00
08/19/1996	7.16		9	116.40	28	-99.00
08/26/1996	6.84		12	116.50	28	-99.00
09/04/1996	6.81		14	117.04	43	-99.00
05/05/1997	6.68		12	102.90	21	-99.00
06/02/1997	6.48		12	109.40	25	0.60
06/09/1997	6.58		20	115.60	17	0.59
06/16/1997	6.59		13	119.20	12	0.76
06/23/1997	7.00		18	123.30	16	1.02
06/30/1997	6.70		14	119.60	13	0.57
07/07/1997	6.74		14	121.30	22	0.82
07/14/1997	6.71		10	121.40	16	0.78
07/23/1997	6.75		15	123.60	14	1.26
07/28/1997	6.83		9	122.40	16	0.90
08/04/1997	6.77		11	125.30	17	0.93
08/11/1997	6.65		10	126.00	14	0.98
08/18/1997	6.91		25	124.70	25	1.19
08/25/1997	6.83		11	125.90	25	1.37
09/03/1997	6.98		14	124.90	13	1.33
05/13/1998	6.58		8	128.90	29	0.78
06/08/1998	6.94		10	135.20	41	1.35
06/15/1998	6.61		12	130.34	-99	1.03
06/22/1998	6.39		12	111.70	55	0.87
06/29/1998	6.43		19	115.00	55	1.13
07/08/1998	6.63		13	117.04	42	0.82
07/13/1998	6.70		15	118.53	47	1.15
07/21/1998	6.81		12	119.25	-99	0.73
07/27/1998	6.96		13	120.96	28	0.82
08/03/1998	6.97		13	123.32	27	0.90
08/10/1998	7.08		15	125.50	24	1.21
08/17/1998	6.49		30	123.10	27	1.60
08/24/1998	6.80		12	123.30	23	2.10
08/31/1998	6.93		7	125.40	24	1.31
09/09/1998	6.75		10	125.70	23	1.70
05/10/1999	6.59		11	131.00	-99	-99.00
06/07/1999	6.73		13	141.70	-99	0.73
06/14/1999	6.95		1	146.30	-99	0.70
06/21/1999	6.60		7	143.28	-99	0.91
06/28/1999	7.31		9	148.70	-99	0.95

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
07/07/1999	6.67		11	147.10	-99	0.83
07/12/1999	6.74		11	149.82	-99	1.19
07/19/1999	6.72		10	152.60	-99	0.92
07/26/1999	6.55		8	148.10	-99	0.75
08/02/1999	7.29		8	149.40	-99	0.93
08/16/1999	6.55		8	146.50	-99	0.97
08/23/1999	6.41		10	149.40	-99	0.98
08/30/1999	6.71		8	146.20	-99	0.92
03 METERS						
07/13/1988	6.78		35	114.46	25	-99.00
06 METERS						
06/01/1988	6.14		24	106.30	33	-99.00
07/13/1988	6.24		16	115.80	39	-99.00
08/04/1988	6.49		27	123.00	95	-99.00
09/08/1988	6.56		26	118.52	23	-99.00
06/20/1989	6.11		17	110.80	44	-99.00
07/23/1989	6.21		7	118.30	68	-99.00
08/27/1989	6.46		35	124.90	65	-99.00
09/30/1989	6.78		12	126.50	27	-99.00
06/12/1990	6.47		16	110.80	30	-99.00
07/03/1990	6.23		21	117.00	-99	-99.00
07/31/1990	6.59		19	119.30	84	-99.00
08/30/1990	6.28		27	93.50	104	-99.00
06/07/1991	6.38		10	115.40	24	-99.00
06/19/1991	6.53		15	124.50	31	-99.00
06/28/1991	-99.00		24	119.60	33	-99.00
07/03/1991	6.00		26	116.20	29	-99.00
07/18/1991	6.70		15	121.20	24	-99.00
07/31/1991	6.30		16	126.50	46	-99.00
08/15/1991	6.60		15	124.50	38	-99.00
08/30/1991	-99.00		-99	136.00	44	-99.00
07/03/1992	6.23		12	-99.00	29	-99.00
07/15/1992	6.44		23	154.00	27	-99.00
07/28/1992	6.61		16	148.40	35	-99.00
08/27/1992	6.24		27	152.60	33	-99.00
08/12/1992	6.62		21	152.70	36	-99.00
09/09/1992	6.34		17	150.70	21	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
09/22/1992	6.92		13	150.40	24	-99.00
06/20/1992	6.32		21	137.80	35	-99.00
06/27/1993	6.20		28	144.70	-99	2.60
07/11/1993	6.10		25	148.80	-99	2.10
07/18/1993	6.40		1	153.00	-99	3.10
07/25/1993	6.80		30	152.90	-99	3.40
08/01/1993	6.20		29	157.80	-99	4.10
08/04/1993	6.54		22	153.80	40	-99.00
08/08/1993	6.30		22	161.00	-99	3.40
08/15/1993	6.30		10	148.00	-99	4.40
08/22/1993	6.40		24	169.00	-99	5.90
08/29/1993	6.40		25	152.30	-99	6.10
09/05/1993	6.40		30	174.90	-99	4.90
09/12/1993	-99.00		29	158.30	-99	2.00
09/19/1993	7.07		17	160.10	-99	1.90
07/10/1994	6.47		12	121.20	-99	3.40
07/17/1994	6.29		23	116.00	-99	6.80
07/25/1994	6.31		19	108.20	-99	9.90
06/26/1994	6.08		19	125.10	-99	2.50
09/01/1994	6.40		45	166.00	39	-99.00
08/07/1994	6.33		26	141.60	-99	7.50
08/14/1994	6.88		21	140.10	-99	7.60
08/22/1994	6.24		19	146.10	-99	4.40
09/18/1994	6.97		11	125.80	-99	1.80
10/02/1994	6.72		24	127.20	-99	2.90
06/05/1995	6.28		20	136.80	34	-99.00
06/12/1995	6.94		13	137.20	32	-99.00
06/19/1995	6.33		15	137.00	45	-99.00
06/26/1995	6.32		2	138.20	35	-99.00
07/05/1995	6.24		17	140.00	50	-99.00
07/10/1995	6.70		17	147.10	25	-99.00
07/19/1995	6.90		11	146.50	33	-99.00
07/24/1995	6.80		17	151.00	38	-99.00
07/31/1995	6.65		12	148.00	50	-99.00
08/07/1995	6.39		15	148.60	60	-99.00
08/14/1995	6.35		18	153.90	60	-99.00
08/21/1995	6.89		17	152.60	58	-99.00
08/28/1995	6.90		10	155.10	37	-99.00
09/06/1995	6.81		14	157.10	42	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
05/03/1995	6.83		16	131.00	23	-99.00
05/07/1996	6.37		7	105.40	32	-99.00
06/03/1996	6.39		16	103.30	34	-99.00
06/10/1996	6.04		16	104.50	45	-99.00
06/17/1996	6.24		16	103.20	32	-99.00
06/24/1996	5.70		17	105.60	34	-99.00
07/01/1996	6.11		21	108.90	45	-99.00
07/08/1996	6.25		20	110.90	45	-99.00
07/15/1996	6.05		20	100.30	90	-99.00
07/22/1996	6.54		13	109.10	50	-99.00
07/29/1996	6.29		18	108.90	132	-99.00
08/05/1996	6.25		17	111.70	90	-99.00
08/12/1996	6.37		21	114.50	35	-99.00
08/19/1996	6.22		9	118.30	47	-99.00
08/26/1996	6.38		19	119.10	37	-99.00
09/04/1996	6.23		21	120.75	65	-99.00
05/05/1997	6.55		12	102.20	23	-99.00
06/02/1997	6.46		15	108.20	32	0.88
06/09/1997	6.25		24	109.90	18	1.25
06/16/1997	6.32		18	112.40	19	1.30
06/23/1997	6.36		26	118.00	32	2.00
06/30/1997	6.07		21	116.10	40	2.10
07/07/1997	6.41		20	118.60	30	1.71
07/14/1997	6.20		32	121.30	27	1.38
07/23/1997	6.64		14	121.30	18	1.18
07/28/1997	6.44		14	123.30	26	1.44
08/04/1997	6.35		28	126.80	55	6.50
08/11/1997	6.15		16	127.60	30	2.00
08/18/1997	6.25		20	127.70	35	1.80
08/25/1997	6.96		9	124.80	25	1.44
09/03/1997	6.49		9	128.70	24	1.60
05/13/1998	6.23		12	126.50	48	1.23
06/08/1998	6.88		9	136.90	43	1.25
06/15/1998	6.32		18	119.76	-99	1.71
06/22/1998	6.07		14	104.40	50	1.19
06/29/1998	6.12		15	107.30	50	1.38
07/08/1998	5.94		20	111.30	58	1.56
07/13/1998	6.26		19	116.80	85	3.60
07/21/1998	6.14		11	111.24	-99	4.50

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
07/27/1998	6.20		12	116.50	65	5.70
08/03/1998	6.36		11	124.36	90	6.00
08/10/1998	6.42		14	122.30	38	2.70
08/17/1998	6.28		23	120.10	85	9.40
08/24/1998	6.25		21	121.40	40	6.20
08/31/1998	6.26		14	124.50	38	3.60
09/09/1998	6.56		22	127.40	40	3.40
05/10/1999	6.50		8	133.10	-99	-99.00
06/07/1999	6.20		19	144.30	-99	2.20
06/14/1999	6.44		15	143.50	-99	1.88
06/21/1999	6.21		18	141.90	-99	2.10
06/28/1999	6.42		14	144.60	-99	1.50
07/07/1999	6.29		21	147.70	-99	4.30
07/12/1999	6.56		14	150.40	-99	1.28
07/19/1999	6.41		21	150.90	-99	3.50
07/26/1999	6.46		20	151.10	-99	3.50
08/02/1999	6.45		26	150.90	-99	6.20
08/16/1999	6.15		12	147.50	-99	2.40
08/23/1999	6.38		19	150.90	-99	1.09
08/30/1999	6.47		10	147.20	-99	1.23
BAXTER DOCK						
08/04/1993	-99.00		15	-99.00	-99	-99.00
HOMINY POT BRIDGE						
09/01/1994	6.46		-99	241.00	-99	-99.00
INLET						
06/01/1988	6.51		10	139.78	45	-99.00
07/13/1988	6.49		45	197.00	60	-99.00
08/04/1988	6.84		32	164.24	57	-99.00
09/08/1988	6.48		17	156.31	40	-99.00
06/20/1989	6.48		11	112.30	55	-99.00
07/23/1989	6.51		37	148.60	48	-99.00
08/27/1989	6.36		19	157.60	34	-99.00
09/30/1989	6.34		11	177.70	35	-99.00
06/12/1990	6.51		22	127.40	48	-99.00
07/03/1990	6.88		18	131.07	-99	-99.00
07/31/1990	6.64		24	157.90	56	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
08/30/1990	6.68		27	109.00	65	-99.00
06/07/1991	6.92		11	135.60	42	-99.00
06/19/1991	6.51		26	148.00	55	-99.00
07/03/1991	6.10		32	171.40	48	-99.00
07/18/1991	5.90		39	199.80	55	-99.00
07/31/1991	6.50		30	181.80	55	-99.00
08/15/1991	6.60		38	171.40	92	-99.00
08/30/1991	-99.00		27	202.00	41	-99.00
07/03/1992	-99.00		18	-99.00	-99	-99.00
07/15/1992	6.65		29	186.00	60	-99.00
07/28/1992	6.74		22	188.50	44	-99.00
08/27/1992	6.43		27	205.00	37	-99.00
08/12/1992	6.68		22	207.60	43	-99.00
09/09/1992	6.22		23	230.00	39	-99.00
09/22/1992	6.45		27	233.60	43	-99.00
06/20/1992	6.81		26	174.00	55	-99.00
06/27/1993	6.30		35	228.00	-99	1.90
07/11/1993	6.60		31	220.00	-99	3.00
07/18/1993	6.40		8	197.00	-99	2.50
07/25/1993	6.60		16	200.00	-99	1.10
08/01/1993	6.40		29	217.00	-99	3.60
08/04/1993	7.12		22	312.00	27	-99.00
08/08/1993	6.60		19	262.00	-99	1.30
08/15/1993	6.30		235	236.00	-99	2.00
08/22/1993	6.40		30	244.00	-99	1.90
08/29/1993	6.30		28	254.00	-99	1.80
09/05/1993	6.30		20	290.00	-99	2.00
09/12/1993	-99.00		22	320.00	-99	1.80
09/19/1993	6.40		19	257.00	-99	1.70
07/10/1994	6.35		23	126.50	-99	3.30
07/17/1994	6.33		29	114.60	-99	3.10
07/25/1994	6.29		25	108.60	-99	4.40
06/26/1994	6.52		17	135.70	-99	1.90
09/01/1994	6.44		34	236.00	63	-99.00
08/07/1994	6.37		19	206.00	-99	3.20
08/14/1994	6.41		19	190.00	-99	2.80
08/22/1994	6.25		24	194.20	-99	1.40
09/18/1994	6.55		22	211.00	-99	2.90
10/02/1994	6.23		16	176.90	-99	1.10

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
06/05/1995	6.85		18	183.30	45	-99.00
06/12/1995	6.75		24	189.00	45	-99.00
06/19/1995	6.76		23	199.00	100	-99.00
06/26/1995	6.50		23	208.00	100	-99.00
07/05/1995	6.44		38	217.00	140	-99.00
07/10/1995	6.39		37	206.00	110	-99.00
07/19/1995	6.46		35	2.00	111	-99.00
07/24/1995	6.37		34	226.10	130	-99.00
07/31/1995	6.39		29	205.80	140	-99.00
08/07/1995	6.37		18	181.70	120	-99.00
08/14/1995	6.40		20	201.00	140	-99.00
08/21/1995	6.35		24	204.00	120	-99.00
08/28/1995	6.28		26	203.00	110	-99.00
05/03/1995	6.84		8	163.90	28	-99.00
05/07/1996	6.45		5	128.70	29	-99.00
06/03/1996	6.40		15	151.90	31	-99.00
06/10/1996	6.65		12	146.40	43	-99.00
06/17/1996	6.52		25	160.80	55	-99.00
06/24/1996	6.00		26	137.00	55	-99.00
07/01/1996	6.60		19	178.10	60	-99.00
07/08/1996	6.62		18	153.50	65	-99.00
07/15/1996	6.02		17	114.50	80	-99.00
07/22/1996	6.48		16	138.80	-99	-99.00
07/29/1996	6.26		20	141.70	135	-99.00
08/05/1996	6.47		17	154.60	140	-99.00
08/12/1996	6.48		24	163.30	115	-99.00
08/19/1996	6.32		16	162.80	46	-99.00
08/26/1996	6.43		22	169.90	55	-99.00
09/04/1996	6.34		30	172.43	55	-99.00
05/05/1997	6.62		11	133.70	27	-99.00
06/02/1997	6.69		18	172.20	45	1.23
06/09/1997	6.61		19	189.00	30	0.91
06/16/1997	6.61		22	193.00	30	1.08
06/23/1997	6.64		25	198.00	48	1.90
06/30/1997	6.47		24	214.00	50	1.40
07/07/1997	6.71		25	188.20	60	2.10
07/14/1997	6.45		19	198.50	70	2.80
07/23/1997	6.62		25	217.30	60	2.10
07/28/1997	6.51		27	217.30	47	1.68

Note: **-99 indicates missing data**

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
08/04/1997	6.45		31	205.20	17	2.80
08/11/1997	6.38		20	213.20	46	1.54
08/18/1997	6.42		28	215.00	55	1.52
08/25/1997	6.44		16	253.00	45	1.12
09/03/1997	6.54		9	259.40	47	1.51
05/13/1998	6.63		10	170.50	60	0.80
06/01/1998	6.76		15	227.00	-99	0.99
06/08/1998	6.80		11	241.00	53	0.88
06/15/1998	6.16		17	123.19	-99	1.54
06/22/1998	6.29		10	128.30	44	0.57
06/29/1998	6.58		15	137.90	60	1.18
07/08/1998	6.45		21	150.90	70	1.75
07/13/1998	6.62		25	161.60	60	1.70
07/21/1998	6.53		26	177.20	-99	1.56
07/27/1998	6.57		24	194.00	70	1.55
08/03/1998	6.52		23	195.00	65	1.45
08/10/1998	6.36		26	198.30	70	1.67
08/17/1998	6.17		41	208.00	140	6.50
08/24/1998	6.29		20	201.00	47	2.80
08/31/1998	6.14		13	223.00	65	2.00
09/09/1998	6.35		11	224.00	43	1.60
05/10/1999	6.66		29	196.70	-99	-99.00
06/07/1999	6.42		22	241.30	-99	0.92
06/14/1999	6.35		24	258.50	-99	1.38
06/21/1999	6.37		26	245.90	-99	1.88
06/28/1999	6.52		26	239.00	-99	-99.00
07/07/1999	6.39		31	243.04	-99	2.60
07/12/1999	6.30		21	198.80	-99	2.40
07/19/1999	6.54		43	194.70	-99	2.70
08/09/1999	6.43		23	185.50	-99	2.30
07/26/1999	6.34		16	222.50	-99	1.14
08/02/1999	6.39		21	240.00	-99	1.86
08/16/1999	6.32		19	334.90	-99	1.54
08/23/1999	6.96		20	361.60	-99	1.03
08/30/1999	6.38		17	251.10	-99	2.20
KING HILL BK						
04/08/1999	-99.00		2	21.90	-99	0.18
06/07/1999	6.45		12	33.50	-99	0.50

Note: **-99 indicates missing data**

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
06/21/1999	6.33		-99	245.00	-99	3.70
06/28/1999	6.46		61	42.70	-99	5.20
07/26/1999	6.64		24	50.10	-99	4.70
08/16/1999	6.23		32	56.90	-99	10.60
KING HILL BRIDGE						
09/01/1994	7.08		-99	37.70	-99	-99.00
LOWMAN GRAB						
06/19/1991	-99.00		9	-99.00	-99	-99.00
LYON BK AT LAKE						
08/12/1996	6.24		24	154.50	110	-99.00
09/04/1996	6.52		15	166.20	43	-99.00
LYON BK AT TRUSSEL						
08/27/1992	6.43		97	-99.00	-99	-99.00
06/27/1993	6.75		24	284.00	-99	0.40
07/11/1993	6.65		29	175.80	-99	1.30
07/18/1993	6.80		24	121.00	-99	1.80
08/01/1993	6.80		25	358.00	-99	0.50
08/04/1993	6.75		19	233.00	49	-99.00
08/08/1993	7.10		16	382.00	-99	0.40
08/15/1993	7.10		7	300.00	-99	0.50
08/22/1993	6.90		23	328.00	-99	0.30
08/29/1993	6.90		14	331.00	-99	0.20
09/05/1993	6.95		13	370.00	-99	0.30
09/12/1993	-99.00		54	398.00	-99	0.40
09/19/1993	6.70		17	372.00	-99	0.50
07/10/1994	6.94		8	124.50	-99	2.10
07/17/1994	6.99		19	115.30	-99	0.70
07/25/1994	6.99		23	108.50	-99	1.40
09/01/1994	7.21		17	308.00	27	-99.00
08/07/1994	7.20		21	313.00	-99	1.70
08/14/1994	7.01		21	280.00	-99	1.60
08/22/1994	7.01		22	270.00	-99	1.30
09/18/1994	7.35		28	304.00	-99	0.50
10/02/1994	6.98		21	242.00	-99	0.90
06/05/1995	7.26		10	188.10	33	-99.00
06/12/1995	6.95		33	172.90	55	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
06/19/1995	7.06		36	196.00	40	-99.00
06/26/1995	7.21		16	213.00	45	-99.00
07/05/1995	6.97		20	143.00	35	-99.00
07/10/1995	6.88		30	237.00	26	-99.00
07/19/1995	7.03		25	284.00	42	-99.00
07/24/1995	7.12		17	263.20	28	-99.00
07/31/1995	6.89		28	232.10	60	-99.00
08/07/1995	7.01		18	197.80	120	-99.00
08/14/1995	6.89		32	259.00	60	-99.00
08/21/1995	7.18		132	215.00	50	-99.00
08/28/1995	7.19		18	181.10	28	-99.00
05/03/1995	7.10		5	170.70	24	-99.00
05/07/1996	6.68		5	138.90	27	-99.00
06/03/1996	6.80		13	170.80	23	-99.00
06/10/1996	6.92		13	172.70	40	-99.00
06/17/1996	7.10		16	189.20	24	-99.00
06/24/1996	6.61		17	204.50	33	-99.00
07/01/1996	7.04		20	230.90	50	-99.00
07/08/1996	6.75		21	214.20	45	-99.00
07/15/1996	6.79		14	131.10	70	-99.00
07/22/1996	6.96		13	186.30	40	-99.00
07/29/1996	6.96		18	185.00	125	-99.00
08/05/1996	6.81		27	196.60	65	-99.00
08/12/1996	7.36		26	187.80	25	-99.00
08/19/1996	6.80		15	179.40	17	-99.00
08/26/1996	6.90		14	167.70	14	-99.00
09/04/1996	6.56		16	127.68	12	-99.00
05/05/1997	6.90		8	140.90	26	-99.00
06/02/1997	7.16		12	175.30	30	0.34
06/09/1997	6.99		15	186.20	16	0.25
06/16/1997	7.04		15	198.00	16	0.41
06/23/1997	7.07		17	230.40	17	0.41
06/30/1997	7.11		13	182.60	9	0.15
07/07/1997	7.24		53	244.00	18	0.74
07/14/1997	7.30		97	249.20	17	0.25
07/23/1997	7.28		75	282.00	16	0.68
07/28/1997	7.10		17	238.00	16	0.25
08/04/1997	7.34		14	186.90	15	0.23
08/11/1997	6.25		14	195.60	13	0.88

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
08/18/1997	7.28		117	297.00	25	0.40
08/25/1997	7.36		9	331.00	20	0.25
09/03/1997	7.57		16	303.10	18	0.47
05/13/1998	7.04		5	167.00	70	0.22
06/01/1998	7.05		16	196.70	-99	0.46
06/08/1998	7.27		35	249.60	41	0.46
06/15/1998	6.76		14	112.20	-99	0.79
06/22/1998	6.92		14	137.20	60	0.38
06/29/1998	6.97		11	150.90	44	0.47
07/08/1998	6.93		13	174.10	40	0.56
07/13/1998	7.05		15	181.00	34	0.60
07/21/1998	7.06		16	218.00	-99	0.42
07/27/1998	7.07		12	216.00	32	0.46
08/03/1998	7.12		12	203.00	17	0.23
08/10/1998	7.10		15	230.00	16	0.40
08/17/1998	7.14		14	221.00	16	0.30
08/24/1998	7.00		31	253.00	38	4.20
08/31/1998	7.08		6	280.00	18	0.35
09/09/1998	7.12		8	290.00	17	0.30
05/10/1999	6.74		10	212.20	-99	-99.00
06/07/1999	7.00		16	233.70	-99	0.24
06/14/1999	7.26		15	239.20	-99	0.53
06/21/1999	6.95		8	245.40	-99	0.27
06/28/1999	7.16		15	226.00	-99	0.35
07/07/1999	6.97		18	271.50	-99	0.50
07/12/1999	6.66		10	225.00	-99	0.22
08/09/1999	7.13		10	319.00	-99	0.56
07/26/1999	7.06		15	366.50	-99	0.48
08/02/1999	6.94		17	332.50	-99	0.24
08/16/1999	6.71		22	283.90	-99	0.80
08/23/1999	6.47		12	280.60	-99	0.43
08/30/1999	7.07		12	418.90	-99	0.22
LYON BK FEEDER 1						
04/08/1999	-99.00		2	37.30	-99	0.69
LYON BK FEEDER 2						
04/08/1999	-99.00		5	24.80	-99	0.25
06/07/1999	4.85		31	21.80	-99	0.94

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
LYON BK FEEDER 3						
04/08/1999	-99.00		8	25.40	-99	0.18
06/07/1999	5.54		14	25.10	-99	0.59
LYON BK FEEDER 4						
04/08/1999	-99.00		4	25.90	-99	0.10
LYON BK TO LK STAR						
07/22/1996	6.29		18	126.40	80	-99.00
NORTH END						
06/28/1991	-99.00		11	-99.00	-99	-99.00
OUTLET						
06/01/1988	6.57		16	104.00	33	-99.00
07/13/1988	6.68		10	113.52	23	-99.00
09/08/1988	6.81		15	120.02	21	-99.00
06/20/1989	6.57		6	111.10	42	-99.00
07/23/1989	7.23		1	117.90	27	-99.00
08/27/1989	7.17		20	123.40	28	-99.00
09/30/1989	6.90		10	125.10	24	-99.00
06/12/1990	6.76		15	111.40	23	-99.00
07/03/1990	6.96		17	116.60	-99	-99.00
07/31/1990	7.25		8	118.80	23	-99.00
08/30/1990	6.92		16	85.00	62	-99.00
06/07/1991	6.93		5	115.70	21	-99.00
06/19/1991	6.96		9	117.00	21	-99.00
07/03/1991	6.60		12	114.50	18	-99.00
07/18/1991	7.00		12	121.40	18	-99.00
07/31/1991	-99.00		10	-99.00	-99	-99.00
08/15/1991	6.80		11	123.50	33	-99.00
08/30/1991	-99.00		9	124.00	15	-99.00
07/03/1992	-99.00		10	-99.00	-99	-99.00
07/15/1992	6.92		15	141.10	18	-99.00
07/28/1992	7.12		11	146.80	25	-99.00
08/27/1992	6.77		15	146.40	14	-99.00
08/12/1992	7.21		11	145.40	21	-99.00
09/09/1992	6.70		10	146.30	15	-99.00
09/22/1992	6.90		10	151.60	19	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
06/20/1992	6.93		27	139.50	-99	-99.00
06/27/1993	6.70		19	143.00	-99	1.10
07/11/1993	6.85		109	147.80	-99	1.80
07/18/1993	6.90		2	151.00	-99	2.30
07/25/1993	6.65		14	154.20	-99	3.00
08/01/1993	7.00		20	152.00	-99	7.00
08/04/1993	7.12		17	145.20	27	-99.00
08/08/1993	7.10		15	154.00	-99	2.20
08/15/1993	6.70		4	138.00	-99	2.00
08/22/1993	6.80		15	139.00	-99	3.40
08/29/1993	6.90		12	140.00	-99	2.40
09/05/1993	6.70		16	158.60	-99	1.40
09/12/1993	-99.00		68	159.40	-99	1.80
09/19/1993	6.70		20	161.30	-99	2.20
07/10/1994	6.70		8	121.00	-99	1.20
07/17/1994	6.69		14	117.20	-99	1.60
07/25/1994	6.65		7	107.80	-99	1.50
06/26/1994	6.67		12	126.50	-99	1.60
09/01/1994	6.80		14	139.40	27	-99.00
08/07/1994	6.66		8	140.00	-99	1.60
08/14/1994	6.71		11	110.00	-99	1.50
08/22/1994	7.02		11	138.70	-99	1.70
09/18/1994	6.54		14	130.80	-99	1.90
10/02/1994	6.78		15	124.30	-99	2.00
06/05/1995	7.21		9	136.60	21	-99.00
06/12/1995	6.91		12	134.90	30	-99.00
06/19/1995	6.97		9	139.70	40	-99.00
06/26/1995	7.30		8	141.30	43	-99.00
07/05/1995	6.95		7	145.00	30	-99.00
07/10/1995	6.91		11	145.80	23	-99.00
07/19/1995	6.92		7	145.40	30	-99.00
07/24/1995	6.93		8	145.80	25	-99.00
07/31/1995	6.89		9	144.90	40	-99.00
08/07/1995	6.71		19	148.00	120	-99.00
08/14/1995	6.80		13	149.40	50	-99.00
08/21/1995	7.21		12	154.70	52	-99.00
08/28/1995	7.15		8	154.90	37	-99.00
05/03/1995	7.13		5	129.60	21	-99.00
05/07/1996	6.49		8	102.20	29	-99.00

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
06/03/1996	6.42		13	100.60	30	-99.00
06/10/1996	6.72		12	101.90	38	-99.00
06/17/1996	6.71		12	105.40	27	-99.00
06/24/1996	6.24		13	109.90	32	-99.00
07/01/1996	6.73		15	107.20	40	-99.00
07/08/1996	6.80		19	109.40	40	-99.00
07/22/1996	6.70		13	108.70	45	-99.00
07/29/1996	6.51		22	107.70	69	-99.00
08/05/1996	7.02		11	110.00	70	-99.00
08/12/1996	7.17		13	111.30	35	-99.00
08/19/1996	6.90		7	115.10	26	-99.00
08/26/1996	6.94		8	116.30	27	-99.00
09/04/1996	6.73		8	116.66	27	-99.00
05/05/1997	6.72		11	99.80	21	-99.00
06/02/1997	6.54		11	111.10	25	0.71
06/09/1997	6.79		14	113.70	18	0.56
06/16/1997	6.71		11	117.30	16	0.67
06/23/1997	6.58		22	119.00	17	5.20
06/30/1997	6.89		7	118.10	12	0.55
07/07/1997	6.92		32	120.20	19	0.73
07/14/1997	7.06		15	122.10	15	0.75
07/23/1997	7.13		10	122.00	17	0.68
07/28/1997	7.11		11	123.00	17	0.78
08/04/1997	7.24		9	124.20	80	0.66
08/11/1997	6.88		25	124.20	18	0.88
08/18/1997	7.08		16	123.90	27	1.01
08/25/1997	7.13		7	125.70	20	1.13
09/03/1997	7.20		14	126.50	17	1.41
05/13/1998	6.60		8	129.30	30	0.92
06/01/1998	6.90		14	136.30	-99	1.03
06/08/1998	-99.00		13	-999.99	41	-99.99
06/15/1998	6.68		12	133.83	-99	0.83
06/22/1998	6.48		16	114.50	42	0.65
06/29/1998	6.65		10	115.60	42	0.61
07/08/1998	6.71		13	115.20	45	0.64
07/13/1998	6.90		11	117.95	42	0.73
07/21/1998	7.01		11	119.12	-99	0.56
07/27/1998	6.93		5	123.20	32	0.67
08/03/1998	6.95		11	123.83	32	0.85

Note: -99 indicates missing data

1999 SAMPLING SEASON
CHEMISTRY RAW DATA REPORT

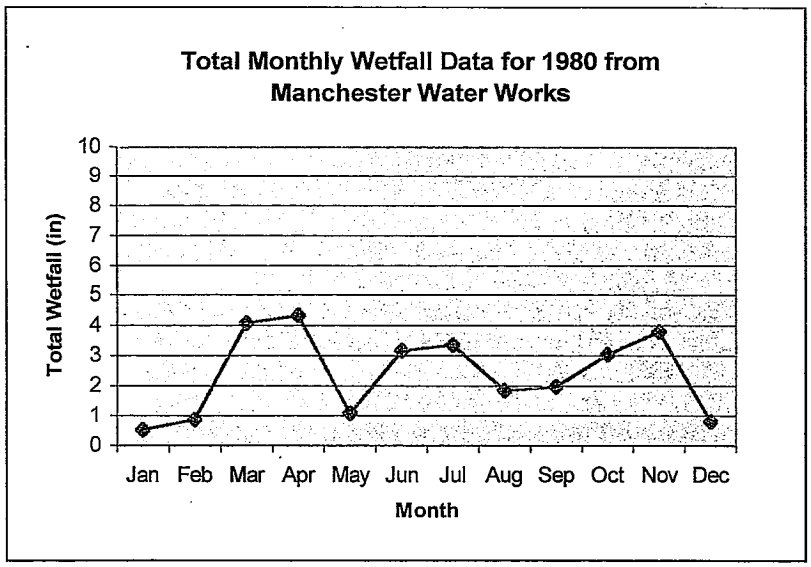
DATE	pH (units)	ANC (mg/L as CaCO3)	TP (ug/L)	COND (umhos/cm)	COLOR (cpu)	TURBIDITY (ntu)
08/10/1998	7.18		11	125.66	24	0.97
08/17/1998	7.07		14	124.10	27	1.20
08/24/1998	6.85		10	125.50	22	2.20
08/31/1998	6.88		6	126.50	22	1.06
09/09/1998	6.60		9	128.60	24	1.30
05/10/1999	6.63		11	132.10	-99	-99.00
06/07/1999	6.73		10	142.10	-99	0.53
06/14/1999	6.85		9	143.60	-99	0.60
06/21/1999	6.71		5	144.70	-99	0.54
06/28/1999	7.01		7	149.80	-99	0.49
07/07/1999	6.87		13	148.70	-99	0.83
07/12/1999	6.53		10	151.30	-99	0.67
07/19/1999	6.71		9	151.10	-99	1.99
08/09/1999	6.85		12	148.80	-99	1.05
07/26/1999	6.80		6	147.50	-99	0.51
08/02/1999	6.90		7	148.00	-99	0.57
08/16/1999	6.54		8	147.20	-99	0.67
08/23/1999	6.55		7	149.30	-99	0.50
08/30/1999	6.70		6	148.20	-99	0.50
RT 11						
09/01/1994	6.51		-99	163.00	-99	-99.00
SWAMP OUTLET						
08/21/1995	-99.00	-99.00	34	-99.00	-99	-99 -99.00 -99.00

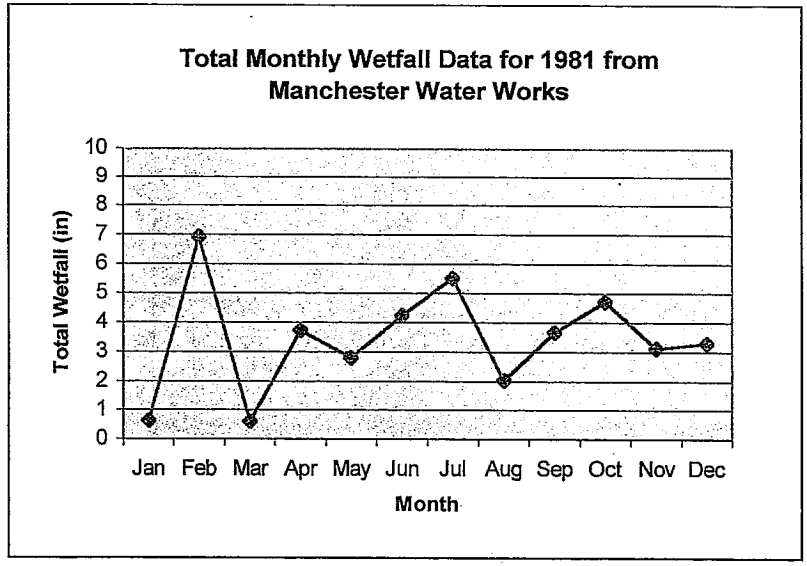
Note: -99 indicates missing data

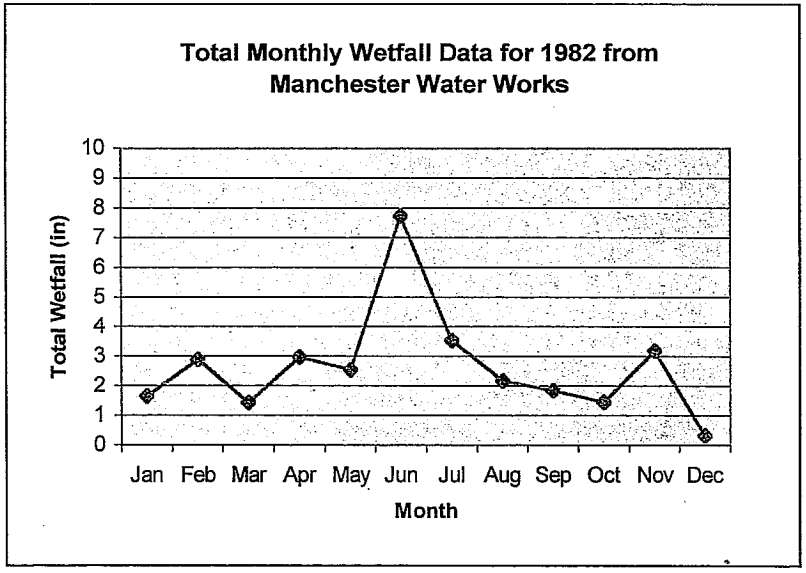
Appendix 2

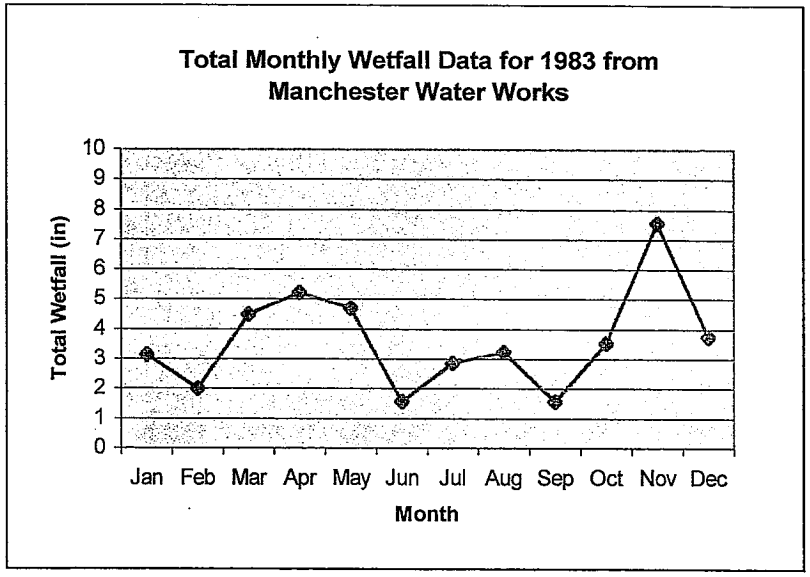
Monthly Wetfall Data from Manchester Water Works

Total Monthly Wetfall As Measured at
Manchester Water Works from 1980-1999

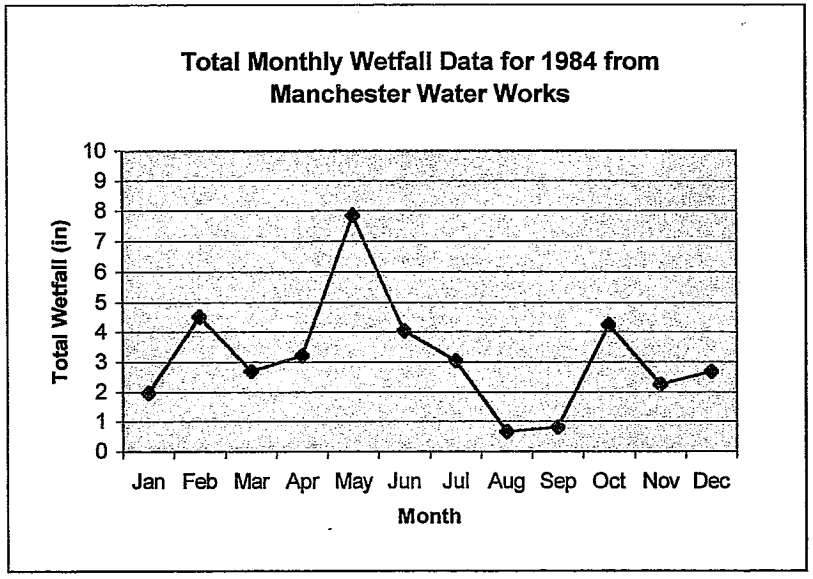


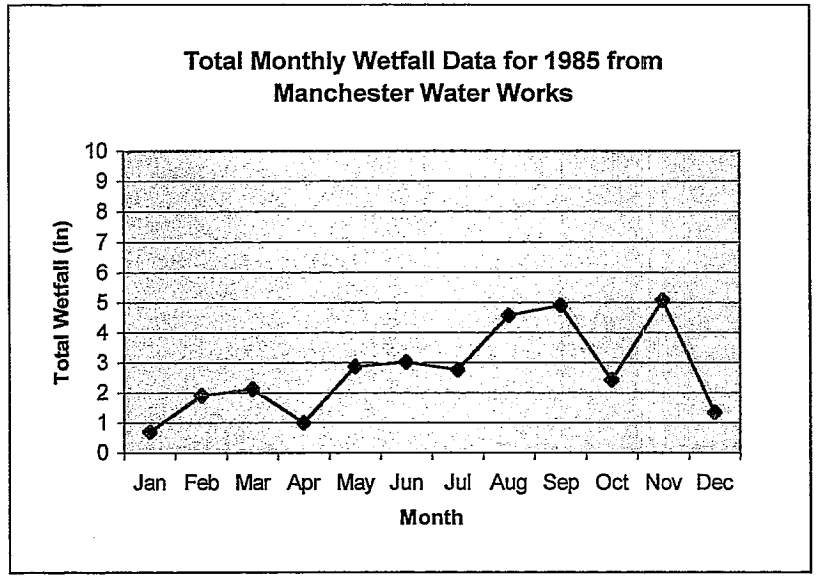


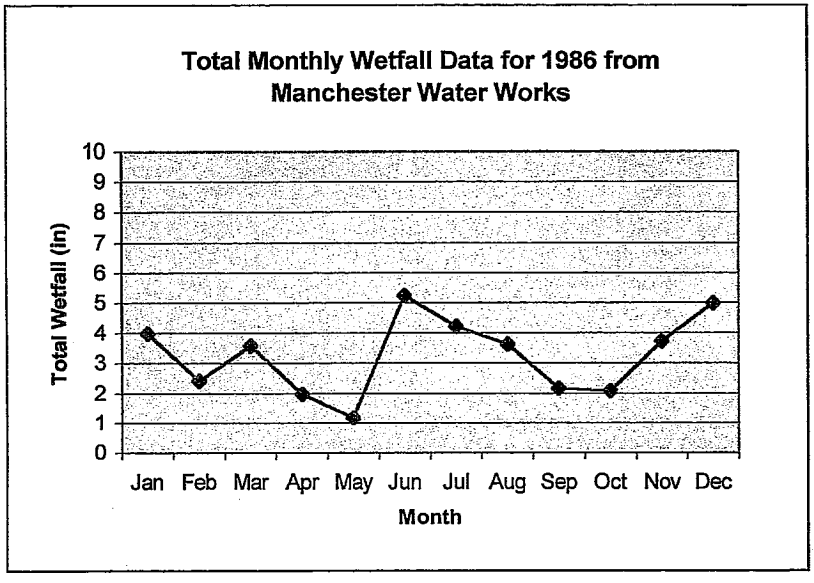


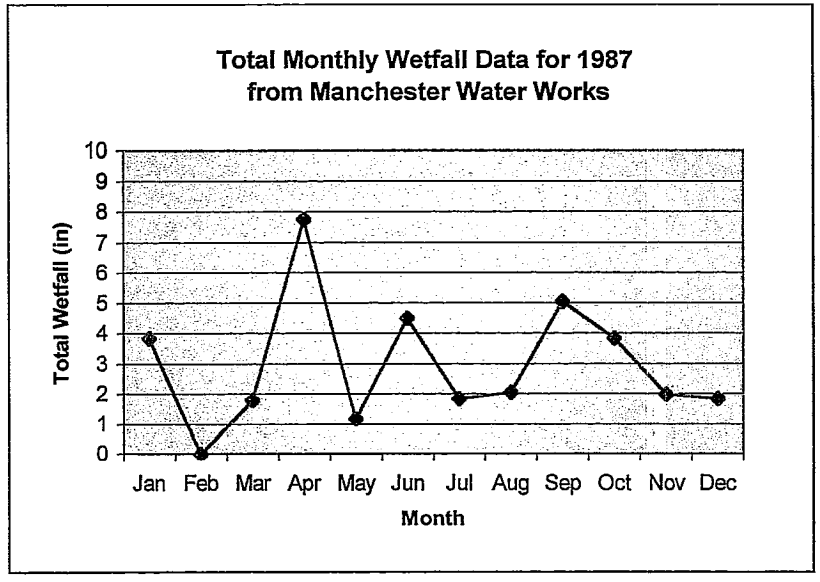


Total Monthly Wetfall As Measured at
Manchester Water Works from 1980-1999

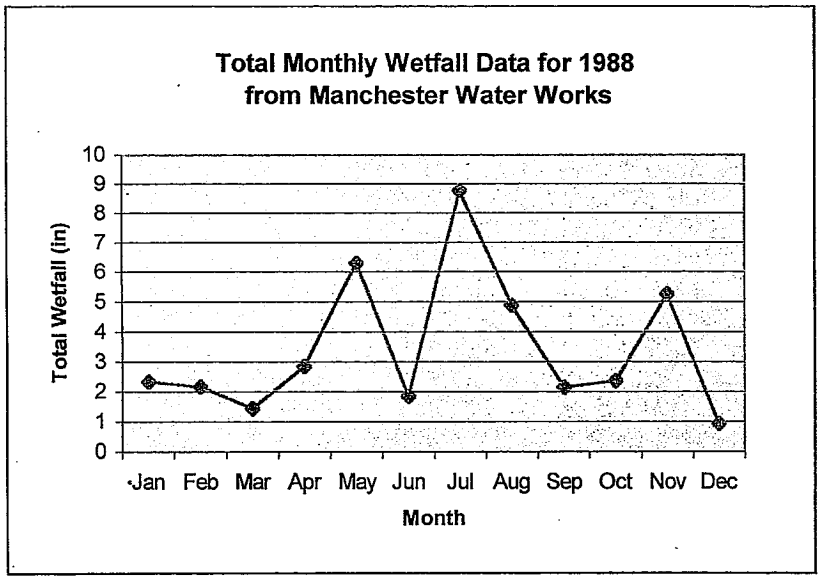


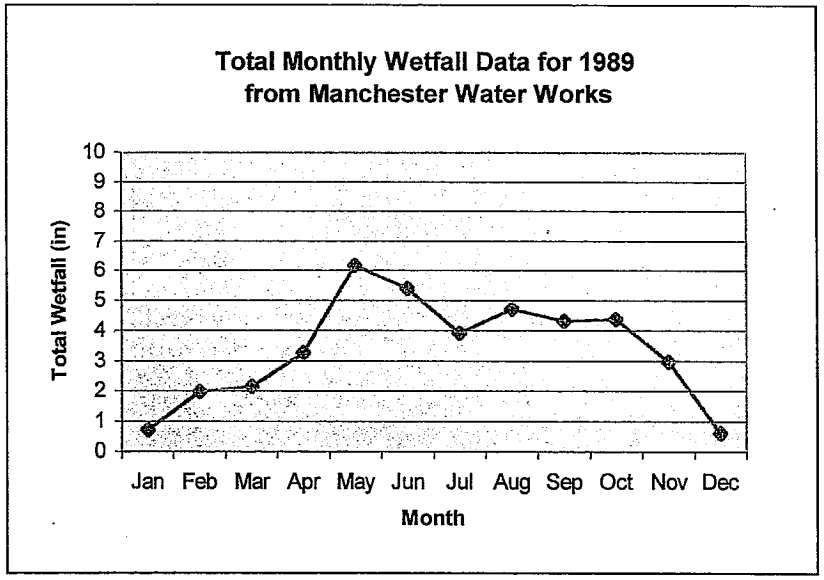


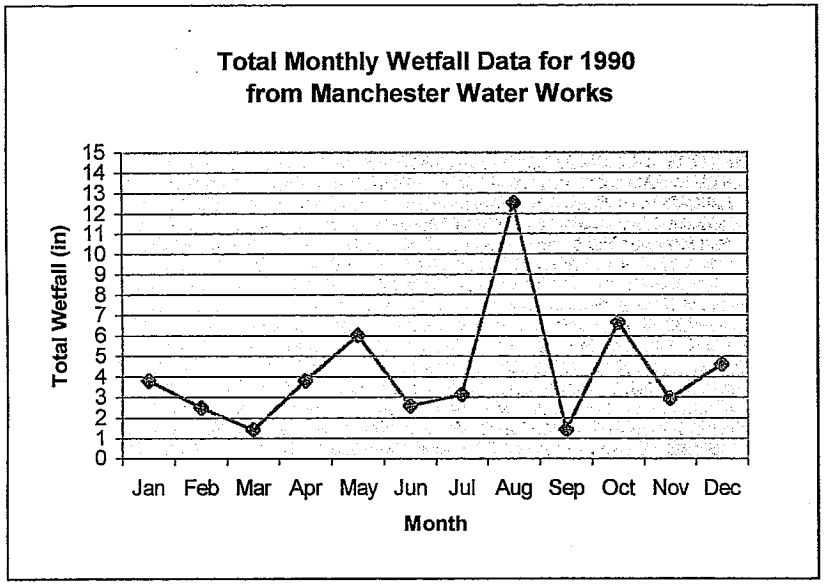


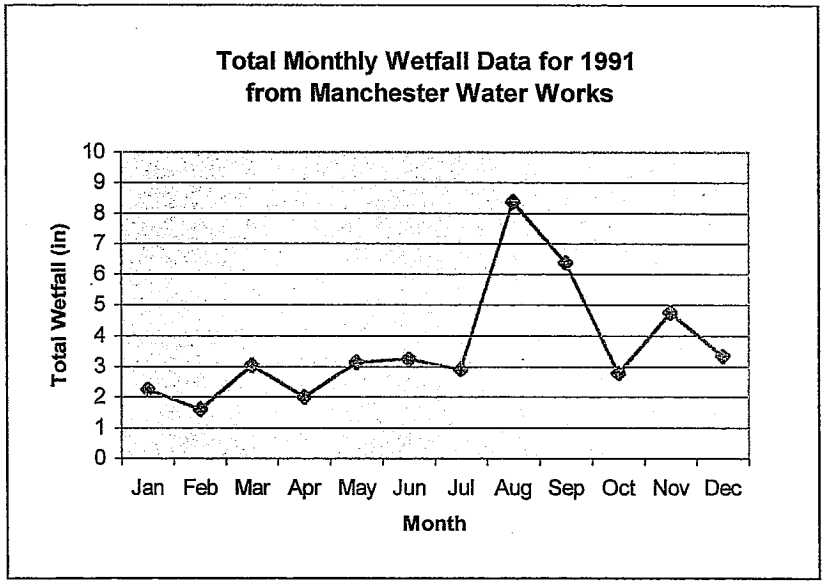


Total Monthly Wetfall As Measured at
Manchester Water Works from 1980-1999

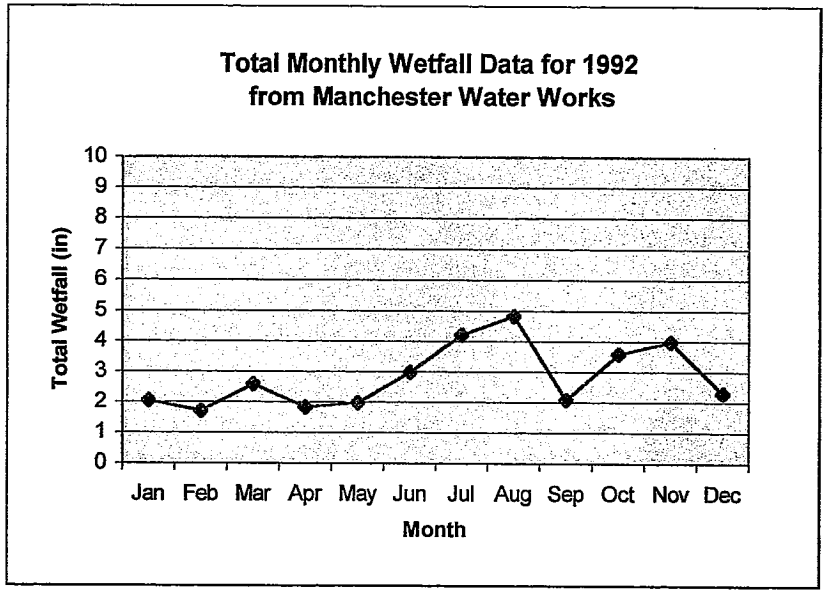


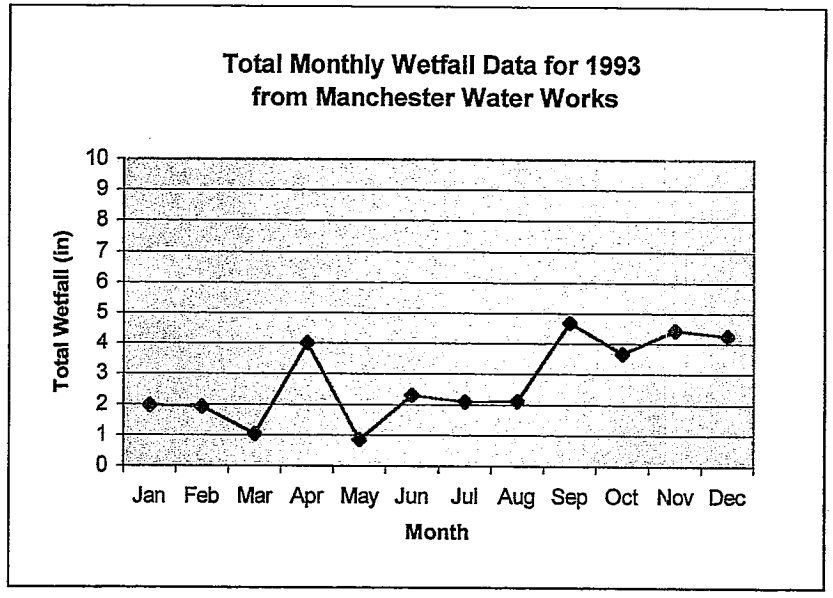


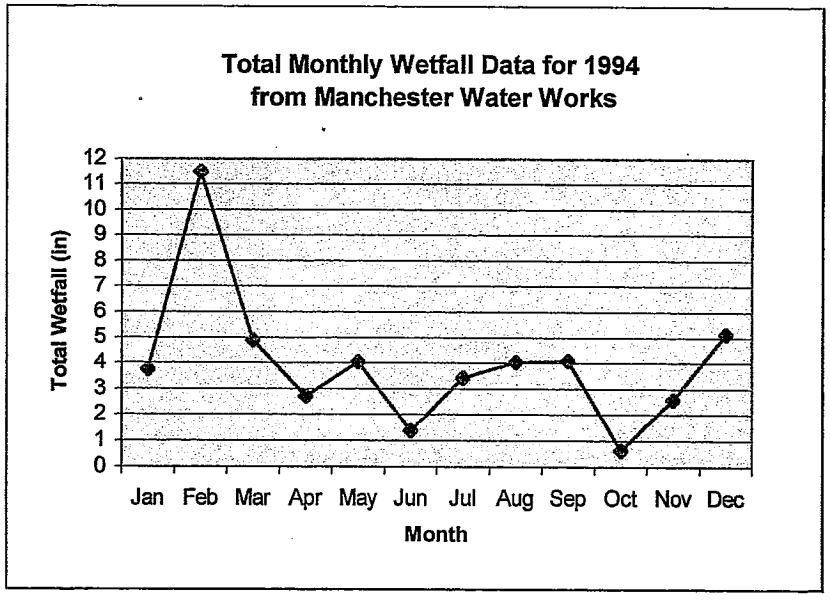


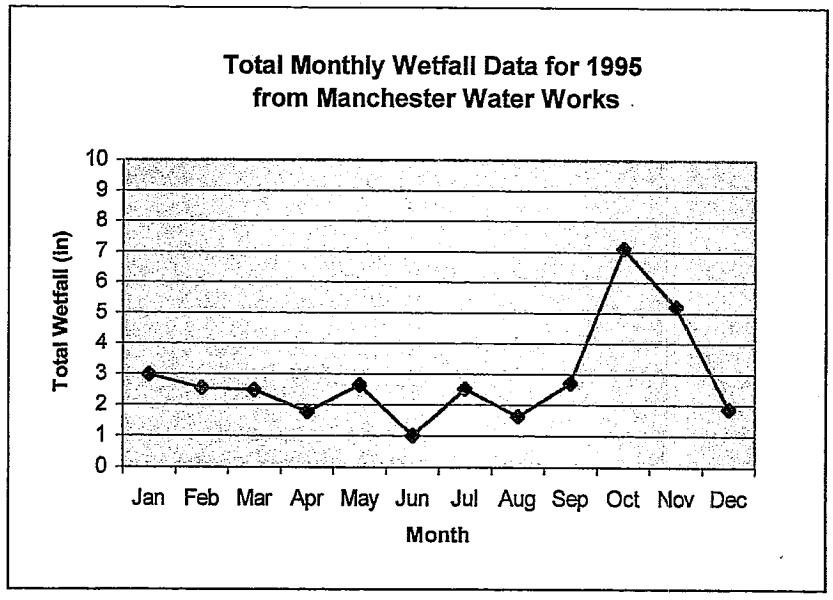


Total Monthly Wetfall As Measured at
Manchester Water Works from 1980-1999

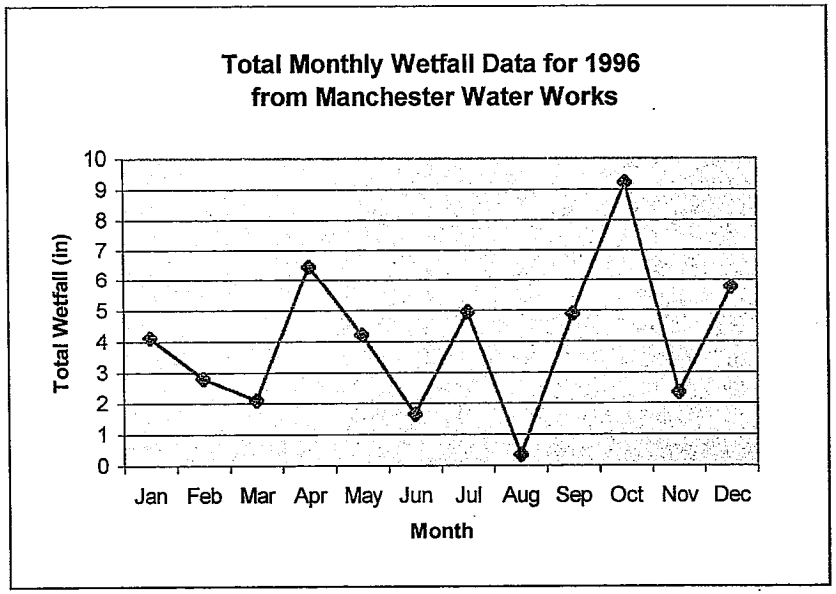


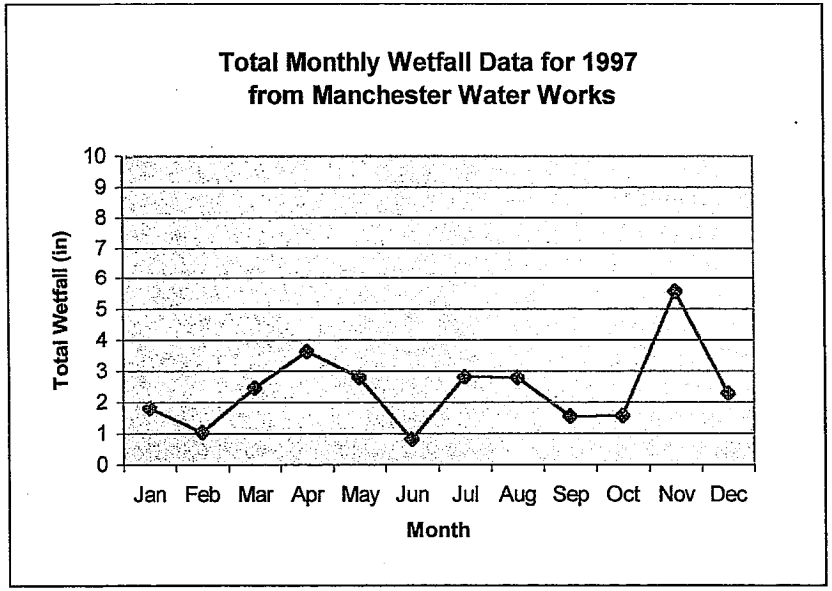


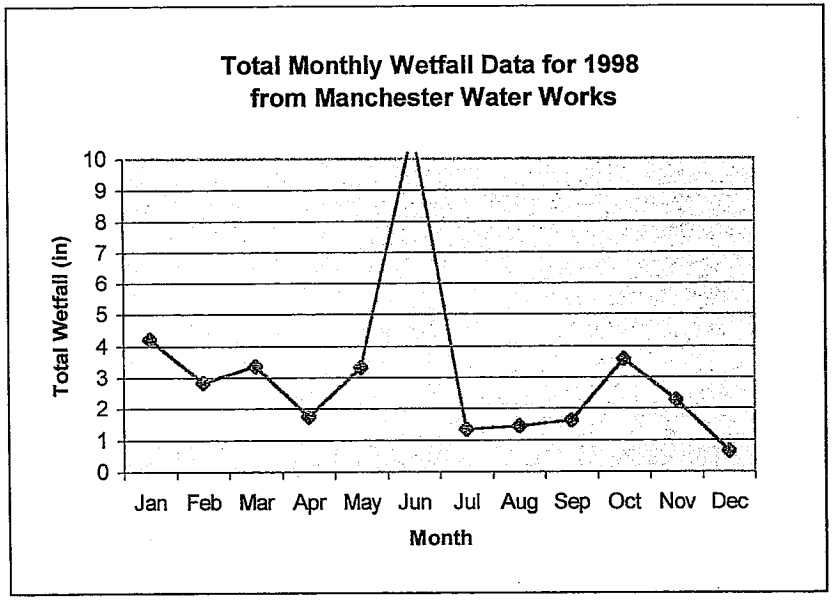


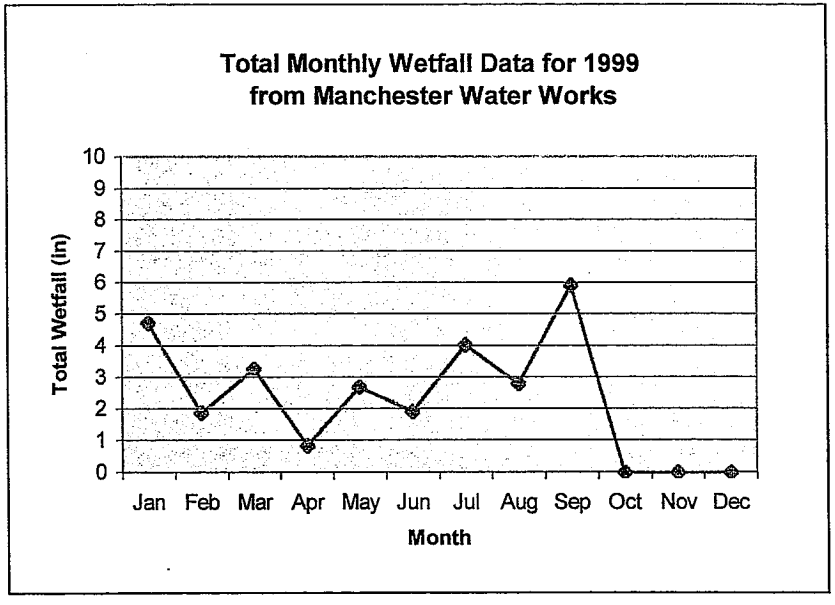


Total Monthly Wetfall As Measured at
Manchester Water Works from 1980-1999









Appendix 3

Kezar Lake Sediment Core Data

Kezar Lake Sediments

Date	Type	Class	Int.	Start	End	Al	Cd	Ca	Cu	Cr	Fe	Pb	Mg	Mn	P	Na	Zn
11/17/1986	SEDIMENT	M	in.	0.0	1.0	23585	-236	-99	83	-99	16038	58	-99	283	5569	3302	6604
11/17/1986	SEDIMENT	M	in.	1.0	2.0	33945	-229	-99	100	-99	20183	77	-99	550	5803	2294	13761
11/17/1986	SEDIMENT	M	in.	2.0	4.0	31373	-245	-99	104	-99	22059	59	-99	490	3916	1961	-4902
11/17/1986	SEDIMENT	M	in.	2.0	4.0	38000	-250	-99	105	-99	22500	92	-99	500	5381	2500	20000
11/17/1986	SEDIMENT	M	in.	4.0	6.0	55556	-253	-99	111	-99	20202	71	-99	404	6761	1515	-5051
11/17/1986	SEDIMENT	M	in.	6.0	8.0	30000	-250	-99	84	-99	20000	72	-99	400	6761	3000	20222
11/17/1986	SEDIMENT	M	in.	8.0	10.0	29907	-243	-99	103	-99	21028	90	-99	467	5347	1402	-4673
11/17/1986	SEDIMENT	M	in.	8.0	10.0	31313	-253	-99	91	-99	17677	97	-99	303	5647	2525	-5051
11/17/1986	SEDIMENT	M	in.	10.0	12.0	27273	-253	-99	93	-99	20202	99	-99	303	4517	2525	15151
11/17/1986	SEDIMENT	M	in.	12.0	14.0	27000	-250	-99	77	-99	15000	90	-99	250	5647	3500	25000
11/17/1986	SEDIMENT	M	in.	14.0	16.0	26263	-253	-99	62	-99	14141	-99	-99	252	-99	2020	-5051
03/11/1991	SEDIMENT	M	in.	0.0	1.0	27670	-99	3102	74	17	25310	88	-99	0	2050	368	223
03/11/1991	SEDIMENT	M	in.	1.0	2.0	29275	-99	3039	79	17	22522	88	-99	0	2212	338	205
03/11/1991	SEDIMENT	M	in.	2.0	3.0	29480	-99	3119	80	17	21388	89	-99	0	2129	348	215
03/11/1991	SEDIMENT	M	in.	3.0	4.0	29701	-99	3193	79	17	19562	85	-99	0	2119	328	206
03/11/1991	SEDIMENT	M	in.	1.0	2.0	28510	-99	3045	76	17	22244	89	-99	0	2029	336	200
03/11/1991	SEDIMENT	M	in.	4.0	5.0	32540	-99	3344	83	18	19520	86	-99	0	2230	386	216
03/11/1991	SEDIMENT	M	in.	5.0	7.0	27267	-99	3729	82	20	19168	99	-99	0	2319	388	220
03/11/1991	SEDIMENT	M	in.	7.0	9.0	24910	1	2299	83	20	19800	105	-99	0	2299	388	215
03/11/1991	SEDIMENT	M	in.	9.0	11.0	23493	-99	4090	49	19	16487	94	-99	0	1998	352	172
03/11/1991	SEDIMENT	M	in.	5.0	7.0	26793	1	3819	84	20	19442	109	-99	0	2359	429	237
03/24/1993	SEDIMENT	M	cm.	0.0	1.0	25759	5	3552	74	38	26174	92	2085	0	1854	709	228
03/24/1993	SEDIMENT	M	cm.	1.0	2.0	25406	6	3077	71	37	25520	110	2042	0	1820	598	225
03/24/1993	SEDIMENT	M	cm.	2.0	3.0	26750	6	3181	73	37	24288	96	2108	0	1908	673	228
03/24/1993	SEDIMENT	M	cm.	3.0	4.0	26369	6	3032	74	36	23313	93	2111	0	1928	612	231
03/24/1993	SEDIMENT	M	cm.	4.0	5.0	26360	6	3131	75	34	21957	93	2102	0	1902	661	233
03/24/1993	SEDIMENT	M	cm.	5.0	6.0	27520	6	3130	77	35	21712	97	2230	0	1945	609	232
03/24/1993	SEDIMENT	M	cm.	6.0	7.0	29467	6	3294	82	35	22031	96	2248	0	2457	670	247
03/24/1993	SEDIMENT	M	cm.	7.0	8.0	29880	5	3289	84	36	22092	102	2313	0	2480	661	248
03/24/1993	SEDIMENT	M	cm.	8.0	9.0	29248	5	3458	83	34	21676	94	2295	0	2505	771	249
03/24/1993	SEDIMENT	M	cm.	9.0	10.0	30936	5	3540	87	37	21949	103	2396	0	2684	741	263
03/24/1993	SEDIMENT	M	cm.	9.0	10.0	30735	-99	3408	85	37	21779	104	2420	0	2433	689	260
03/24/1993	SEDIMENT	M	cm.	10.0	11.0	29845	5	3413	85	36	20562	103	2384	0	2066	701	251
03/24/1993	SEDIMENT	M	cm.	11.0	12.0	28849	5	3077	85	36	20040	99	2397	0	2115	502	242
03/24/1993	SEDIMENT	M	cm.	12.0	13.0	23949	4	3582	85	35	18910	108	2504	0	1817	668	242
03/24/1993	SEDIMENT	M	cm.	13.0	14.0	22849	5	3512	84	35	18953	104	2465	0	1847	575	230

Kezar Lake Sediments

Date	Type	Class	Int.	Start	End	Al	Cd	Ca	Cu	Cr	Fe	Pb	Mg	Mn	P	Na	Zn
03/24/1993	SEDIMENT	M	cm.	14.0	15.0	23845	5	3659	87	36	19010	107	2575	0	2025	677	243
03/24/1993	SEDIMENT	M	cm.	15.0	16.0	23705	5	3659	86	36	18984	113	2584	0	1936	603	236
03/24/1993	SEDIMENT	M	cm.	16.0	17.0	24654	5	3692	93	38	20096	116	2690	0	2540	546	250
03/24/1993	SEDIMENT	M	cm.	17.0	18.0	25700	5	3873	95	40	19980	125	2765	0	2087	589	253
03/24/1993	SEDIMENT	M	cm.	18.0	19.0	25876	6	3860	96	40	20398	115	2779	0	2496	564	251
03/24/1993	SEDIMENT	M	cm.	19.0	20.0	25856	5	3986	100	42	20506	129	2852	0	2572	581	264
03/24/1993	SEDIMENT	M	cm.	20.0	21.0	25447	6	3798	97	38	20497	113	2749	0	2455	626	251
03/24/1993	SEDIMENT	M	cm.	21.0	22.0	25613	6	3798	96	37	20217	113	2702	0	2198	556	247
03/24/1993	SEDIMENT	M	cm.	22.0	23.0	25315	5	3876	97	38	20571	119	2779	0	2281	564	240
03/24/1993	SEDIMENT	M	cm.	23.0	24.0	26142	6	3935	104	40	20921	120	2971	0	2739	554	247
03/24/1993	SEDIMENT	M	cm.	24.0	25.0	29249	7	3915	110	47	23913	111	4109	0	2666	554	246
03/24/1993	SEDIMENT	M	cm.	25.0	30.0	23174	6	4136	134	36	16886	115	2641	0	2611	532	225

Appendix 4

Raw Plankton Data for Kezar Lake,

North Sutton, New Hampshire

Kezar Lake Study Raw Phytoplankton Data

Date	Phy1	Dphy1	Phy2	Dphy2	Phy3	Dphy3	Bluegree	Green	Desmid	Eugle	Diat	Crypto	Dino	Chryso	Tot Den
07/15/1986	TINY	773.3	ANKISTRODES	298.1	LYNGBYA	155.5	168.5	1239.8	0.0	0.0	337.0	56.2	8.6	25.9	1836.0
08/15/1986	LYNGBYA	5186.6	TINY	1398.1		0.0	5238.4	1544.8	8.6	25.9	215.8	17.3	0.0	43.2	7093.9
09/15/1986	LYNGBYA	1991.5	TINY	216.0		0.0	2013.1	457.9	25.9	13.0	414.7	51.8	0.0	146.9	3123.4
10/15/1986	LYNGBYA	375.8	ANKISTRODES	129.6	CHRYSOSPHAE	82.1	384.5	272.2	21.6	17.3	216.0	43.2	8.6	125.3	1088.6
04/13/1987	TINY	492.5	CHLAMYDOMON	112.3		0.0	60.5	639.4	0.0	13.0	21.6	56.2	13.0	8.6	812.2
05/06/1987	CHROOMONAS	704.2	TINY	635.0	RHIZOSOLENI	241.9	185.8	686.9	17.3	0.0	410.4	769.0	0.0	121.0	2190.2
06/17/1987	LYNGBYA	881.3	TINY	410.4	ASKISTRODES	224.6	898.6	669.6	34.6	0.0	535.7	30.2	8.6	30.2	2207.5
07/15/1987	LYNGBYA	1380.8	TINY	1294.5		0.0	1527.8	1700.1	17.3	17.3	310.7	51.8	0.0	86.3	3710.9
08/12/1987	LYNGBYA	9216.8	APHANIZOMEN	1898.6		0.0	11115.4	586.8	51.8	17.3	69.0	43.2	0.0	51.8	11935.3
09/16/1987	APHANIZOMEN	1803.7	COSMARIUM	569.6	ANKISTRODES	474.7	2217.9	716.3	578.2	8.6	466.0	448.8	0.0	207.1	4642.9
11/12/1987	TINY	397.4	APHANIZOMEN	345.6	CHROOMONAS	250.6	401.8	669.6	30.2	4.3	272.2	375.8	8.6	108.0	1870.6
04/13/1988	TINY	414.7	CHRYSOCHROM	86.4	CHROOMONAS	73.4	25.9	475.2	0.0	0.0	43.2	82.1	21.6	129.6	777.6
05/17/1988	CHRYSOCHROM	1570.7	TINY	604.1	RHIZOSOLENI	336.6	60.4	854.4	17.3	0.0	517.8	129.5	0.0	1613.8	3193.1
06/01/1988	SYNEDRA	527.0	CHRYSOCHROM	298.1	APHANIZOMEN	185.8	289.4	155.5	4.3	0.0	704.2	21.6	0.0	298.1	1473.1
06/23/1988	LYNGBYA	914.8	APHANIZOMEN	690.4	TINY	405.6	1631.1	716.3	86.3	0.0	690.4	94.9	17.3	414.2	3650.5
07/19/1988	LYNGBYA	4898.9	APHANIZOMEN	1952.6		0.0	6855.8	229.0	25.9	13.0	38.9	216.0	0.0	38.9	7417.4
08/18/1988	LYNGBYA	16923		0.0		0.0	17156.4	1726.0	414.2	51.8	138.1	422.9	43.2	25.9	19952.6
09/21/1988	LYNGBYA	2865.2		0.0		0.0	2873.8	336.6	0.0	25.9	362.5	198.5	17.3	172.6	3987.1
08/14/1990	CHROOMONAS	501.1	CRYPTOMONAS	293.8	MALLAMONAS	285.1	21.6	142.6	51.8	8.6	86.4	794.9	4.3	289.4	1399.7
11/15/1990	ASTERIONELL	181.4	MOUGEOTIA	99.4		0.0	8.6	108.0	112.3	4.3	337.0	73.4	0.0	0.0	643.7
10/25/1990	MOUGEOTIA	518.4	ASTERIONELL	164.2	MELOSIRA	47.5	34.6	64.8	522.7	8.6	289.4	47.5	0.0	0.0	0.0
05/15/1991	RHIZOSOLENI	131.8	TINY	58.3	SYNEDRA	43.2	0.0	95.0	0.0	4.3	265.7	71.3	4.3	38.9	479.5
06/13/1991	RHIZOSOLENI	164.2	CHROOMONAS	159.8	ANKISTRODES	116.6	0.0	302.4	17.3	0.0	267.8	194.4	13.0	47.5	842.4
06/28/1991	SYNEDRA	280.8	APHANOCAPSA	207.4	TABELLARIA	181.4	229.0	337.0	47.5	13.0	587.5	47.5	17.3	8.6	1287.4
07/11/1991	SYNEDRA	151.2	SCENEDESMUS	103.7	MELOSIRA/AN	95.0	73.4	332.6	51.8	51.8	293.8	103.7	17.3	25.9	950.4
07/25/1991	CRYPTOMONAS	164.2	SYNEDRA	138.2	CHROOMONAS	129.6	64.8	198.7	43.2	30.2	181.4	293.8	13.0	64.8	889.9
08/08/1991	SYNEDRA	190.1	DINOBRYON	142.6	ANKISTRODES	103.7	103.7	306.7	90.7	0.0	302.4	95.0	8.6	190.1	1097.3
09/05/1991	APHANOCAPSA	168.5	MOUGEOTIA	125.3	ANKISTRODES	90.7	207.4	354.2	159.8	13.0	116.6	138.2	8.6	38.9	1036.8
09/18/1991	MICROCYSTIS	509.8	MOUGEOTIA	159.8	ANKISTRODES	133.9	583.0	241.9	194.4	8.6	185.8	95.0	0.0	90.7	1404.0
10/17/1991	MOEGEOTIA	345.6	CLOSTERIUM	82.1	DINOBRYON	64.8	47.5	159.8	496.8	0.0	121.0	112.3	0.0	86.4	1023.8
11/14/1991	CLOSTERIOPS	108.0	CHROOMONAS	103.7	SCHRODERIA	64.8	4.3	203.0	64.8	0.0	121.0	142.6	0.0	8.6	544.3
08/22/1991	LYNGBYA	112.3	MICROCYSTIS	95.0	SYNEDRA	77.8	216.0	190.1	25.9	13.0	194.4	43.2	13.0	17.3	712.8
04/28/1992	CHROOMONAS	263.5	RHIZOSOLENI	259.2	TINY	34.6	17.3	43.2	4.3	0.0	285.1	293.8	0.0	8.6	652.3
07/08/1992	APHANOCAPSA	911.5	ANKISTRODES	95.0	TINY	86.4	928.8	289.4	82.1	8.6	298.1	95.0	34.6	86.4	1823.0
06/24/1992	CLOSTERIUM	181.4	CRYPTOMONAS	151.2	SYNEDRA	116.6	86.4	190.1	194.4	21.6	367.2	198.7	13.0	121.0	1192.3
06/11/1992	CLOSTERIUM	241.9	ANKISTRODES	151.2	CRYPTOMONAS	146.9	17.3	224.6	254.9	4.3	108.0	185.8	8.6	82.1	885.6
08/05/1992	CHROOMONAS	211.7	CLOSTERIUM	159.8	CRYPTOMONAS	95.0	51.8	280.8	185.8	38.9	254.9	306.7	0.0	13.0	0.0
08/21/1992	CRYPTOMONAS	285.1	CHROOMONAS	229.0	CLOSTERIUM	155.5	64.8	190.1	168.5	8.6	293.8	514.1	0.0	34.6	1274.4

Kezar Lake Study Raw Phytoplankton Data

Date	Phy1	Dphy1	Phy2	Dphy2	Phy3	Dphy3	Bluegree	Green	Desmid	Eugle	Diat	Crypto	Dino	Chryso	Tot Den
10/28/1992	CYCLOTELLA	669.6	CHROOMONAS	95.0	TINY	82.1	0.0	142.6	17.3	0.0	695.5	121.0	4.3	64.8	1045.4
09/17/1992	CRYPTOMONAS	514.1	CHROOMONAS	362.9	SPHAEROCYST	129.6	34.6	315.4	95.0	0.0	56.2	877.0	0.0	60.5	1438.6
10/01/1992	CHROOMONAS	332.6	APHANOCAPSA	220.3	SCHRODERIA	190.1	233.3	457.9	73.4	4.3	60.5	440.6	4.3	133.9	1408.3

Kezar Lake Study Raw Biology Data

Date	Chl	Sd	Netphy1	Pnetp	Netphy2	Pnetp	Netphy3	Pnetp	Zoo1	Dzoo1	Zoo2	Dzoo2	Zoo3	Dzoo3
05/08/1980	23.13	1.5	ASTERIONELLA	49.0	MELOSIRA	29.0		0.0	POLYARTHRA	0.0	KERATELLA	0.0	CALANOID	0.0
06/16/1980	17.75	0.9	ASTERIONELLA	95.0		0.0		0.0	CONDONELLA	0.0	KERATELLA	0.0	SYNCHAETA	0.0
06/30/1980	14.66	1.5		0.0		0.0		0.0		0.0		0.0		0.0
07/15/1980	19.85	1.5	MALLAMONAS	33.0	ASTERIONELLA	33.0	TABELLARIA	28.0	DAPHNIA	0.0	NAUPLIUS	0.0		0.0
07/29/1980	10.18	2.7	ASTERIONELLA	40.0	MICROCYSTIS	38.0	TABELLARIA	17.0	KELLICOTTIA	0.0	POLYARTHRA	0.0		0.0
08/13/1980	9.99	1.5	MICROCYSTIS	70.0	MELOSIRA	14.0		0.0	KELLICOTTIA	0.0		0.0		0.0
08/27/1980	10.18	2.4	MICROCYSTIS	29.0	TABELLARIA	28.0	DINOBRYON	20.0	DAPHNIA	0.0	CALANOID	0.0	KELLICOTTIA	0.0
09/18/1980	16.68	1.5	APHANIZOMENON	42.0	ASTERIONELLA	17.0	MICROCYSTIS	14.0	POLYARTHRA	0.0	NAUPLIUS	0.0	CALANOID	0.0
10/01/1980	12.92	1.6	MICROCYSTIS	24.0	ASTERIONELLA	22.0	TABELLARIA	20.0	ROTIFER SPP	0.0	KERATELLA	0.0	POLYARTHRA	0.0
10/16/1980	14.93	-99.0	MELOSIRA	33.0	ASTERIONELLA	26.0	DINOBRYON	23.0	KERATELLA	0.0	CILIATE SPP	0.0	POLYARTHRA	0.0
10/30/1980	10.44	2.0	DINOBRYON	37.0	MELOSIRA	26.0	ASTERIONELLA	25.0	KERATELLA	0.0	POLYARTHRA	0.0	CONDONELLA	0.0
11/13/1980	10.00	1.5	ASTERIONELLA	76.0	TABELLARIA	10.0		0.0	KERATELLA	0.0	POLYARTHRA	0.0	NAUPLIUS	0.0
12/18/1980	8.76	2.0	ASTERIONELLA	81.0		0.0		0.0	KERATELLA	0.0	NAUPLIUS	0.0	BOSMINA	0.0
01/08/1981	3.71	-99.0	ASTERIONELLA	74.0	MICROCYSTIS	10.0		0.0	NAUPLIUS	0.0	CALANOID	0.0		0.0
01/22/1981	3.29	-99.0	ASTERIONELLA	48.0	MICROCYSTIS	30.0		0.0	NAUPLIUS	0.0	CALANOID	0.0		0.0
02/05/1981	2.85	-99.0	ASTERIONELLA	31.0	MICROCYSTIS	28.0	MELOSIRA	24.0	NAUPLIUS	0.0	KERATELLA	0.0		0.0
02/18/1981	-99.0	-99.0	ASTERIONELLA	76.0	MICROCYSTIS	13.0		0.0	NAUPLIUS	0.0	KERATELLA	0.0	CALANOID	0.0
03/03/1981	3.09	-99.0	ASTERIONELLA	90.0		0.0		0.0	KELLICOTTIA	0.0	NAUPLIUS	0.0	KERATELLA	0.0
03/19/1981	4.63	2.3	ASTERIONELLA	68.0	DINOBRYON	27.0		0.0	CYCLOPOID	13.3	NAUPLIUS	11.1	BOSMINA	8.9
03/31/1981	4.71	2.5	ASTERIONELLA	56.0	DINOBRYON	29.0		0.0	KERATELLA	27.0	BOSMINA	20.0		0.0
04/17/1981	8.02	2.5	ASTERIONELLA	38.0	MELOSIRA	27.0	TABELLARIA	19.0	KERATELLA	0.0	POLYARTHRA	0.0		0.0
05/06/1981	7.03	2.5	MELOSIRA	40.0	ASTERIONELLA	40.0		0.0	POLYARTHRA	323.0	KERATELLA	211.0	ASPLANCHNA	56.0
06/04/1981	8.13	2.2	ASTERIONELLA	70.0		0.0		0.0	KELLICOTTIA	111.0	BOSMINA	84.0	NAUPLIUS	31.0
06/30/1981	16.32	1.7	TABELLARIA	31.0	ANABAENA	27.0	ASTERIONELLA	22.0	DAPHNIA	13.3	NAUPLIUS	13.3		0.0
07/15/1981	13.22	1.5	ANABAENA	91.0	MICROSCYTIS	31.0		0.0	DAPHNIA	31.0	CYCLOPOID	27.0	CALANOID	22.0
07/29/1981	33.39	0.8	ANABAENA	91.0		0.0		0.0	KERATELLA	18.0	DAPHNIA	8.9		0.0
08/12/1981	58.82	0.5	ANABAENA	85.0	MICROCYSTIS	16.0		0.0	CALANOID	49.0	KERATELLA	40.0	NAUPLIUS	36.0
09/15/1981	13.08	2.0	MICROCYSTIS	44.0	MELOSIRA	25.0	ANABAENA	21.0		0.0		0.0		0.0
10/13/1981	17.31	1.8	RHIZOSOLENIA	41.0	MELOSIRA	13.0		0.0	NAUPLIUS	0.0	CYCLOPOID	0.0	SIMOCEPHALS	0.0
11/09/1981	12.90	2.0	ASTERIONELLA	72.0	MELOSIRA	15.0		0.0	BOSMINA	40.0	POLYARTHRA	38.0	NAUPLIUS	13.0
12/01/1981	11.42	2.0	ASTERIONELLA	90.0		0.0		0.0	BOSMINA	0.0		0.0		0.0
01/20/1982	3.01	-99.0	ASTERIONELLA	49.0	MICROCYSTIS	31.0	COELOSPHAERIU	20.0	NAUPLIUS	0.0	CALANOID	0.0	BOSMINA	0.0
02/16/1982	1.95	-99.0	ASTERIONELLA	50.0	MICROCYSITS	47.0		0.0	NAUPLIUS	0.0	KERATELLA	0.0	SYNCHAETA/K	0.0
03/09/1982	1.71	-99.0	MICROCYSTIS	76.0	UROGLENOPSIS	11.0		0.0	POLYARTHRA	0.0	NAUPLIUS	0.0		0.0
04/29/1982	3.54	2.6	MELOSIRA	35.0	ASTERIONELLA	33.0	MICROCYSTIS	13.0	NAUPLIUS	0.0	CYCLOPOID	0.0		0.0
05/26/1982	7.24	2.5	MELOSIRA	70.0	ASTERIONELLA	25.0		0.0	KELLICOTTIA	0.0	KERATELLA	0.0	POLYARTHRA	0.0
06/09/1982	8.21	2.0	MELOSIRA	46.0	ASTERIONELLA	41.0		0.0	POLYARTHRA	0.0	KELLICOTTIA	0.0		0.0
06/23/1982	9.14	1.8	MELOSIRA	41.0	ASTERIONELLA	29.0		0.0	KELLICOTTIA	0.0	POLYARTHRA	0.0	NAUPLIUS	0.0

Kezar Lake Study Raw Biology Data

Date	Chl	Sd	Netphy1	Pnetp	Netphy2	Pnetp	Netphy3	Pnetp	Zoo1	Dzoo1	Zoo2	Dzoo2	Zoo3	Dzoo3
07/07/1982	14.02	1.2	LYNGBYA	77.0		0.0		0.0	NAUPLIUS	0.0	DIAPHANASOMA	0.0		0.0
07/20/1982	-99.0	1.2	LYNGBYA	88.0		0.0		0.0	KELLICOTTIA	0.0	NAUPLIUS	0.0		0.0
08/04/1982	14.07	1.5	LYNGBYA	77.0		0.0		0.0	CYCLOPOID	0.0	NAUPLIUS	0.0	KERATELLA	0.0
08/16/1982	13.31	1.5	LYNGBYA	71.0	MELOSIRA	15.0		0.0	NAUPLIUS	0.0	CYCLOPOID	0.0	KELLICOTTIA	0.0
09/15/1982	9.11	3.2	LYNGBYA	30.0	MELOSIRA	25.0	MICROCYSTIS	12.0	NAUPLIUS	0.0	CYCLOPOID	0.0		0.0
10/06/1982	17.01	-99.0	ASTERIONELLA	45.0	LYNGBYA	20.0	MELOSIRA	12.0	KELLICOTTIA	0.0		0.0		0.0
06/10/1983	6.53	2.1	MELOSIRA	55.0	ASTERIONELLA	20.0	LYNGBYA	15.0	POLYARTHRA	82.5	NAUPLIUS	33.0	KELLICOTTIA	30.2
06/23/1983	7.09	2.9	DINOBRYON	45.0	LYNGBYA	20.0	MALLAMONAS	20.0	KELLICOTTIA	154.0	POLYARTHRA	99.0		0.0
07/01/1983	10.75	2.2	MALLAMONAS	45.0	DINOBRYON	20.0	LYNGBYA	20.0	KELLICOTTIA	107.2	NAUPLIUS &	33.0	KERATELLA	27.5
07/08/1983	6.13	3.0	LYNGBYA	35.0	MELOSIRA	30.0	MALLAMONAS	25.0	KELLICOTTIA	137.5	NAUPLIUS	85.2	CYCLOPOID	38.5
07/14/1983	25.15	2.6	LYNGBYA	75.0	MELOSIRA	10.0	ASTERIONELLA	6.0	NAUPLIUS	101.8	KELLICOTTIA	55.0	KERATELLA	27.5
07/21/1983	28.25	2.5	LYNGBYA	90.0	MELOSIRA	6.0		0.0	CYCLOPOID	74.8	NAUPLIUS	61.6	KELLICOTTIA	55.0
07/28/1983	32.42	2.3	LYNGBYA	90.0	MALLAMONAS	14.0		0.0	NAUPLIUS	74.2	KELLICOTTIA	68.8	CYCLOPOID	30.2
08/10/1983	21.96	2.0	LYNGBYA	70.0	APHANIZOMENON	25.0		0.0	KELLICOTTIA	66.0	NAUPLIUS	62.7		0.0
08/19/1983	7.66	2.8	LYNGBYA	90.0		0.0		0.0	KELLICOTTIA	511.5	NAUPLIUS	93.5	KERATELLA	88.0
09/08/1983	11.22	2.8	LYNGBYA	50.0	ASTERIONELLA	30.0	CERATIUM	7.0	NAUPLIUS	137.5	CYCLOPOID	137.5	BOSMINA	46.8
10/20/1983	13.69	1.7	DINOBRYON	48.0	TABELLARIA	7.0	ANACYSTIS	7.0	BOSMINA	0.0	NAUPLIUS	0.0	CYCLOPOID	0.0
11/14/1983	9.78	1.8	LYNGBYA	30.0	TABELLARIA	25.0	FRAGILARIA	22.0	BOSMINA	0.0	ACANTHOCYSTIS	0.0		0.0
01/25/1984	2.06	-99.0	LYNGBYA	48.0	ASTERIONELLA	16.0	FRAGILARIA	13.0	NAUPLIUS	0.0	CALANOID	0.0	BOSMINA	0.0
02/22/1984	3.60	-99.0	LYNGBYA	69.0	MELOSIRA	10.0	ANACYSTIS	10.0	NAUPLIUS	0.0	KERATELLA	0.0	CYCLOPOID	0.0
03/19/1984	-99.0	-99.0	LYNGBYA	82.0		0.0		0.0	CALANOID	0.0	NAUPLIUS	0.0	CYCLOPOID	0.0
06/05/1984	5.26	2.0	MELOSIRA	57.0	TABELLARIA	31.0		0.0	POLYARTHRA	0.0	KERATELLA	0.0		0.0
06/15/1984	-99.0	2.0	MELOSIRA	40.0	LYNGBYA	28.0	TABELLARIA	16.0		0.0		0.0		0.0
06/19/1984	-99.0	-99.0	LYNGBYA	25.0	MELOSIRA	25.0	TABELLARIA	20.0	NAUPLIUS	0.0	KERATELLA/POL	0.0	KELLICOTTIA	0.0
06/28/1984	2.30	2.6	LYNGBYA	60.0	APHANIZOMENON	10.0		0.0	NAUPLIUS	0.0		0.0		0.0
07/17/1984	8.56	3.3	DINOBRYON	36.0	LYNGBYA	32.0	MELOSIRA	27.0	KELLICOTTIA	33.0	NAUPLIUS	28.6		0.0
08/13/1984	4.45	4.3	LYNGBYA	28.0	MELOSIRA	26.0	DINOBRYON	15.0	NAUPLIUS	154.0	CYCLOPOID	66.0	CALANOID	24.2
08/22/1984	-99.0	4.5		0.0		0.0		0.0		0.0		0.0		0.0
09/13/1984	2.57	4.5	MELOSIRA	42.0	LYNGBYA	10.0	TABELLARIA	8.0	NAUPLIUS	39.6	CALANOID	35.2	KERATELLA	28.6
10/09/1984	1.57	5.1	ANACYSTIS	44.0	MELOSIRA	35.0		0.0	KERATELLA	194.3	CALANOID	58.7	EPISTYLIS	36.7
11/15/1984	3.23	3.8	MELOSIRA	50.0	LYNGBYA	25.0	DINOBRYON	8.0	KERATELLA	302.5		0.0		0.0
01/25/1985	3.58	-99.0	ASTERIONELLA	43.5	DINOBRYON	27.4	LYNGBYA	10.0	KERATELLA	0.0	SYNCHAETA	0.0		0.0
02/22/1985	-99.0	-99.0	RHIZOSOLENIA	23.0	TABELLARIA &	20.0	ASTERIONELLA	19.0	KERATELLA	0.0		0.0		0.0
03/20/1985	2.69	-99.0	DINOBRYON	64.0	ASTERIONELLA	28.0		0.0	KERATELLA	30.5	KELLICOTTIA	10.9		0.0
04/16/1985	3.14	3.5	DINOBRYON	34.0	TABELLARIA	23.0	ASTERIONELLA	13.0	KERATELLA	13.1	KELLICOTTIA	10.9		0.0
05/14/1985	3.29	2.8	ASTERIONELLA	43.0	MELOSIRA	37.0		0.0	POLYARTHRA	196.2	KERATELLA	109.0	KELLICOTTIA	98.1
06/14/1985	5.76	2.6	TABELLARIA	56.0	MELOSIRA	24.0		0.0	POLYARTHRA	167.1	NAUPLIUS	29.1		0.0
07/16/1985	5.55	3.2	TABELLARIA	86.0		0.0		0.0	KELLICOTTIA	468.7	KERATELLA	60.0		0.0

Kezar Lake Study Raw Biology Data

Date	Chl	Sd	Netphy1	Pnetp	Netphy2	Pnetp	Netphy3	Pnetp	Zoo1	Dzoo1	Zoo2	Dzoo2	Zoo3	Dzoo3
08/14/1985	2.94	3.3	MELOSIRA	46.0	TABELLARIA	20.0	DINOBRYON	10.0	KERATELLA	207.1	NAUPLIUS	130.8	ROTIFER	103.0
09/19/1985	11.75	2.6	MELOSIRA	32.0	DINOBRYON	28.0	TABELLARIA	25.0	KERATELLA	152.6	RHIZOPODIAL	98.1		0.0
10/09/1985	7.40	2.6	TABELLARIA	55.0	DINOBRYON	18.0	MELOSIRA	16.0	NAUPLIUS	32.7	KERATELLA	26.2	CILIATE	26.1
11/19/1985	9.73	2.7	TABELLARIA	65.0	RHIZOSOLENIA	15.0	MELOSIRA	9.0	KERATELLA	13.2	POLYARTHRA	10.9		0.0
01/09/1986	1.92	-99.0	RHIZOSOLENIA	43.0	TABELLARIA	27.0	ASTERIONELLA	17.0	KERATELLA	0.0	POLYARTHRA	0.0	NAUPLIUS	0.0
02/13/1986	-99.0	-99.0	ASTERIONELLA	61.0	RHIZOSOLENIA	16.0		0.0	CALANOID	15.3	KERATELLA	13.1	BOSMINA	8.7
03/20/1986	-99.0	-99.0	MELOSIRA	50.0	PENNATE SPP	21.0		0.0	POLYARTHRA	0.0	NAUPLIUS	0.0		0.0
04/14/1986	1.95	3.8	MELOSIRA	61.0	LYNGBYA	10.0		0.0	NAUPLIUS	0.0	CALANOID	0.0		0.0
05/14/1986	6.00	3.2	MELOSIRA	57.0	PENNATE,SP.	16.0	RHIZOSOLENIA	12.0	POLYARTHRA	104.4	KERATELLA	97.2	ASPLANCHNA	0.0
06/17/1986	6.72	1.7	ASTERIONELLA	38.0	MELOSIRA	32.0	TABELLARIA	12.0	CONOCHILUS	30.0	NAUPLIUS	27.0	POLYARTHRA	21.8
07/15/1986	6.40	2.8	MELOSIRA	55.0	ASTERIONELLA	28.0		0.0	VORTICELLA	517.8	NAUPLIUS	81.8	POLYARTHRA	38.2
08/15/1986	8.84	2.4	LYNGBYA	70.0	TABELLARIA	17.0	MELOSIRA	13.0	KERATELLA	89.4	NAUPLIUS	63.2	KELLICOTTIA	52.3
09/15/1986	8.88	2.4	TABELLARIA	39.0	LYNGBYA	34.0	CHRYSOSPHAERE	20.0	KERATELLA	170.8	KELLICOTTIA	105.4	NAUPLIUS	87.2
10/15/1986	11.59	2.8	CHRYSOSPHAERE	66.0	ASTERIONELLA	11.0		0.0	KELLICOTTIA	103.7	KERATELLA	101.0		0.0
11/18/1986	8.21	2.6	DINOBRYON	45.0	ASTERIONELLA	22.0	CHRYSOSPHAERE	13.0	KERATELLA	226.2		0.0		0.0
12/17/1986	-99.0	-99.0	LYNGBYA	29.0	UROGIENOPSIS	17.0	ASTERIONELLA	13.0	BOSMINA	34.9	KERATELLA	26.2	DIAPTOMUS	13.1
01/14/1987	-99.0	-99.0	LYNGBYA	69.0	ASTERIONELLA	19.0		0.0	BOSMINA	19.6	NAUPLIUS	15.3	KERATELLA	13.1
02/11/1987	-99.0	-99.0	LYNGBYA	99.0		0.0		0.0	NAUPLIUS	22.9	BOSMINA	19.6		0.0
03/12/1987	-99.0	-99.0	LYNGBYA	92.0		0.0		0.0	NAUPLIUS	19.6	KELLICOTTIA/K	6.5	CALANOID	6.5
04/13/1987	2.05	2.5	LYNGBYA	62.0	MELOSIRA	33.0		0.0	DIAPTOMUS	8.7	BOSMINA	4.4		0.0
05/06/1987	5.92	2.5	MELOSIRA	68.0	LYNGBYA	11.0		0.0	KERATELLA	14.5	SYNCHAETA	11.8	KELLICOTTIA	8.1
06/17/1987	8.91	2.0	MELOSIRA	50.0	LYNGBYA	42.0		0.0	KELLICOTTIA	1095		0.0		0.0
07/15/1987	10.39	2.3	LYNGBYA	44.0	MELOSIRA	25.0	APHANIZOMENON	24.0	KELLICOTTIA	54.5	KERATELLA	32.7	NAUPLIUS	30.5
08/12/1987	13.90	1.9	LYNGBYA	47.0	MELOSIRA	30.0	APHANIZOMENON	19.0	NAUPLIUS	68.0	KELLICOTTIA	46.0		0.0
09/16/1987	11.95	1.9	ASTERIONELLA	25.0	LYNGBYA	20.0	MELOSIRA/RHIZ	20.0	KERATELLA	70.8	CYCLOPOID	51.8	NAUPLIUS	43.6
10/13/1987	13.70	1.5	MELOSIRA	55.0	APHANIZOMENON	15.0	ASTERIONELLA	15.0	CYCLOPOID	54.5	KERATELLA	51.8	DIFFLUGIA	32.7
11/13/1987	10.87	2.0	MELOSIRA	68.0		0.0		0.0	KERATELLA	290.4	CILIATE SPP.	65.3	KELLICOTTIA	54.5
04/13/1988	3.87	3.9	DINOBRYON	40.0	MELOSIRA	34.0	ASTERIONELLA	26.0	NAUPLIUS	4.4	DIAPTOMUS	4.4		0.0
05/17/1988	16.56	2.5	MELOSIRA	72.0	ASTERIONELLA	10.0		0.0	KERATELLA	100.3	POLYARTHRA	45.8	NAUPLIUS	26.2
06/01/1988	9.46	2.2	MELOSIRA	88.0		0.0		0.0		0.0		0.0		0.0
06/23/1988	11.60	2.3	MELOSIRA	67.0	LYNGBYA	19.0		0.0	KELLICOTTIA	174.0	KERATELLA	164.0	POLYARTHRA	120.0
07/01/1988	9.46	2.2	MELOSIRA	88.0		0.0		0.0	KERATELLA	102.5	KELLICOTTIA	30.5	CONOCHILUS	21.8
07/13/1988	14.88	-99.0		0.0		0.0		0.0		0.0		0.0		0.0
07/19/1988	7.05	2.0	LYNGBYA	90.0		0.0		0.0	NAUPLIUS	80.7	KERATELLA	50.1	CYCLOPOID	32.7
08/04/1988	15.72	-99.0		0.0		0.0		0.0		0.0		0.0		0.0
08/18/1988	27.18	2.0	LYNGBYA	95.0		0.0		0.0	NAUPLIUS	30.9	KELLICOTTIA	23.6	CONOCHILUS	10.9
09/08/1988	18.18	-99.0		0.0		0.0		0.0		0.0		0.0		0.0
09/21/1988	13.93	3.5	MELOSIRA	40.0	LYNGBYA	37.0		0.0	KERATELLA	262.1		0.0		0.0

Kezar Lake Study Raw Biology Data

Date	Chl	Sd	Netphy1	Pnetp	Netphy2	Pnetp	Netphy3	Pnetp	Zoo1	Dzoo1	Zoo2	Dzoo2	Zoo3	Dzoo3
10/25/1990	7.06	2.5	ASTERIONELLA	71.0	MELOSIRA	19.0		0.0	ACTINOPHYRS	724.8	PERITRICH	60.0	ROTIFER	32.7
11/15/1990	5.03	2.4	ASTERIONELLA	76.0		0.0		0.0	ACTINOPHYRS	1123	NAUPLIUS	36.0	KERATELLA	21.6
01/17/1990	0.00	2.6		0.0		0.0		0.0		0.0		0.0		0.0
04/18/1991	4.27	3.2	ASTERIONELLA	56.0	RHIZOSOLENIA	18.0		0.0	POLYARTHRA	55.8	NAUPLIUS	19.0		0.0
05/15/1991	4.90	2.9	MELOSIRA	36.0	ASTERIONELLA	24.0	DINOBRYON	24.0	KELLICOTTIA	74.6	KERATELLA	67.3		0.0
06/13/1991	5.49	2.5	ASTERIONELLA	46.0	TABELLARIA	33.0		0.0	KERATELLA	174.1	POLYARTHRA	70.7	NAUPLIUS	65.3
06/28/1991	10.10	3.4	CHRYSOSPHAERE	56.0		0.0		0.0	KERATELLA	119.7	POLYARTHRA	87.0		0.0
07/11/1991	7.03	2.4	MELOSIRA	36.8	CHRYSOSPHAERE	25.4		0.0	KERATELLA	87.0	KELLICOTTIA	24.0		0.0
07/25/1991	6.76	3.0	MELOSIRA	32.0	DINOBRYON	29.0	CHRYSOSPHAERE	28.0	NAUPLIUS	48.0	BOSMINA	41.4		0.0
08/08/1991	4.74	0.2	ASTERIONELLA	66.0	DINOBRYON	14.0		0.0	NAUPLIUS	101.4	POLYARTHRA	91.6	KERATELLA	62.1
08/22/1991	6.75	2.6	CHRYSOSPHAERE	42.5	MELOSIRA	25.0		0.0	NAUPLIUS	95.4	CYCLOPOID	40.9		0.0
09/05/1991	7.18	3.3	ASTERIONELLA	22.0	MELOSIRA	18.3	FILAMENTOUS	18.3	VORTICELLA	127.1	NAUPLIUS	76.2		0.0
09/18/1991	8.72	2.5	FRAG	66.0		0.0		0.0	NAUPLIUS	187.2	CYCLOPOID	93.6		0.0
10/17/1991	0.00	2.6	FILAMENTOUS	73.0		0.0		0.0	ACTINOPHYRS	670.4	KERATELLA	125.4		0.0
07/05/1990	5.21	0.0		0.0		0.0		0.0		0.0		0.0		0.0
07/10/1990	6.74	0.0		0.0		0.0		0.0		0.0		0.0		0.0
07/17/1990	7.45	0.0		0.0		0.0		0.0		0.0		0.0		0.0
07/25/1990	6.50	0.0		0.0		0.0		0.0		0.0		0.0		0.0
07/31/1990	18.50	0.0		0.0		0.0		0.0		0.0		0.0		0.0
08/09/1990	5.18	0.0		0.0		0.0		0.0		0.0		0.0		0.0
08/14/1990	7.92	0.0		0.0		0.0		0.0		0.0		0.0		0.0
08/23/1990	8.65	0.0		0.0		0.0		0.0		0.0		0.0		0.0
08/31/1990	6.95	0.0		0.0		0.0		0.0		0.0		0.0		0.0
01/17/1991	1.99	2.6	ASTERIONELLA	79.0	TABELLARIA	16.0		0.0	NAUPLIUS	32.7		0.0		0.0
06/07/1991	4.54	-9.9		0.0		0.0		0.0		0.0		0.0		0.0
06/20/1991	5.31	2.7		0.0		0.0		0.0		0.0		0.0		0.0
07/03/1991	5.29	3.0		0.0		0.0		0.0		0.0		0.0		0.0
07/18/1991	5.45	2.8		0.0		0.0		0.0		0.0		0.0		0.0
08/01/1991	7.25	2.0		0.0		0.0		0.0		0.0		0.0		0.0
08/16/1991	7.05	2.3		0.0		0.0		0.0		0.0		0.0		0.0
08/30/1991	6.21	0.0		0.0		0.0		0.0		0.0		0.0		0.0
02/14/1991	0.00	0.0	asterionella	60.0	dinobryon	34.0		0.0	nauplius	12.0	keratella	10.9		0.0
03/18/1991	0.00	0.0	asterionella	89.0		0.0		0.0	polyarthra	41.1		0.0		0.0
11/14/1991	0.00	0.0	ASTERIONELLA	45.0	MELOSIRA	19.0		0.0	KERATELLA	52.3	KELLICOTTIA	32.7	BOSMINA	30.5
12/26/1991	0.00	0.0	ASTERIONELLA	57.0	DINOBRYON	23.0		0.0	KERATELLA	143.9	KELLICOTTIA	63.2		0.0
01/22/1992	-99.0	-99.0	ASTERIONELLA	84.0		0.0		0.0	KERATELLA	234.0	KELLICOTTIA	140.4		0.0
02/14/1992	0.00	0.0	DINOBRYON	76.0	ASTERIONELLA	17.0		0.0	KERATELLA	105.4	KELLICOTTIA	47.2		0.0
04/28/1992	5.93	0.0		0.0		0.0		0.0	KERATELLA	34.0	KELLICOTTIA	25.0		0.0

Kezar Lake Study Raw Biology Data

Date	Chl	Sd	Netphy1	Pnetp	Netphy2	Pnetp	Netphy3	Pnetp	Zoo1	Dzoo1	Zoo2	Dzoo2	Zoo3	Dzoo3
05/11/1992	8.21	0.0	ASTERIONELLA	31.0	DINOBRYON	27.0	MELOSIRA	19.0	KERATELLA	42.0	KELLICOTTIA	22.0		0.0
06/11/1992	4.10	3.4	ASTERIONELLA	34.0	MELOSIRA	16.0	DINOBRYON	14.0	KERATELLA	26.2	NAUPLIUS	24.0	BOSMINA	19.6
06/24/1992	5.66	2.4	ASTERIONELLA	53.0	MELOSIRA	17.0	DINOBRYON	17.0	KERATELLA	71.9	NAUPLIUS	41.4		0.0
06/20/1992	5.74	0.0		0.0		0.0		0.0		0.0		0.0		0.0
07/08/1992	6.73	2.7	MELOSIRA	37.0	CHRYSOSPHEARE	32.0		0.0	ACTINOPHYRS	76.4	NAUPLIUS	51.0		0.0
08/05/1992	5.66	2.6	MELOSIRA	42.0	SYNEDRA	26.0	TABELLARIA	20.0	KERATELLA	61.0	NAUPLIUS	61.0	BOSMINA	34.9
08/21/1992	6.49	2.2	ASTERIONELLA	66.0	TABELLARIA	20.0		0.0	ACTINOPHYRS	675.8	NAUPLIUS	109.0	CILIATE SPP	87.0
09/17/1992	4.36	3.9	MELOSIRA	32.0	DINOBRYON	26.0	ASTERIONELLA	20.0	DAPHNIA	139.5	NAUPLIUS	100.3	CYCLOPOID	74.1
10/01/1992	6.92	2.3	ANABAENA	67.0		0.0		0.0	ACTINOPHYRS	1308		0.0		0.0
10/15/1992	7.13	3.3	DINOBRYON	58.0		0.0		0.0	KERATELLA	120.1	CALANOID	30.0		0.0
10/28/1992	7.05	3.0	DINOBRYON	58.0		0.0		0.0	KERATELLA	78.0	BOSMINA	51.5		0.0

Appendix 5

Raw Fish Data from Aluminum Analyses

Fillet, Gill, and Liver Aluminum Concentration
Raw Data

Lake	Medium	[Al]
Jenness Pond	Fillet	6
Kezar Lake	Fillet	0
Kimball Pond	Fillet	1
Onway Lake	Fillet	1
Powwow Pond	Fillet	0
Sanborn Pond	Fillet	4
Whites Pond	Fillet	1
Jenness Pond	Gills	72
Kezar Lake	Gills	24
Onway Lake	Gills	75
Powwow Pond	Gills	41
Whites Pond	Gills	67
Jenness Pond	Liver	5
Kezar Lake	Liver	11
Kezar Lake	Liver	11
Kimball Pond	Liver	25
Kimball Pond	Liver	25
Onway Lake	Liver	12
Powwow Pond	Liver	10
Sanborn Pond	Liver	31
Whites Pond	Liver	0
Standard		87
Standard		90
Standard		86

Whole Fish Digestions
Aluminum Concentrations

Lake	Fish	Sample	Aluminum Concentration (mg/Kg)
Kezar	Perch	1	20.25
	Perch	2	36.62
	Perch	3	16.68
	Perch	4	14.01
	Perch	5	20.44
Rollins	Perch	1	8.62
	Perch	2	7.87
	Perch	3	15.65
	Perch	4	38.99
	Perch	5	30.67
Onway	Perch	1	23.56
	Perch	2	12.92
	Perch	3	25.10
	Perch	4	14.74
	Perch	5	19.31
Onway	Pout	1	14.19
	Pout	2	29.98
	Pout	3	15.47
	Pout	4	20.94
	Pout	5	12.84
Kezar	Pout	1	30.14
	Pout	2	13.63
	Pout	3	49.80
	Pout	4	51.94
	Pout	5	44.54
Reference	Oyster	1	114.84
	Oyster	2	49.97
	Oyster	3	74.40
	Oyster	4	60.60
	Oyster	5	53.20

Appendix 6

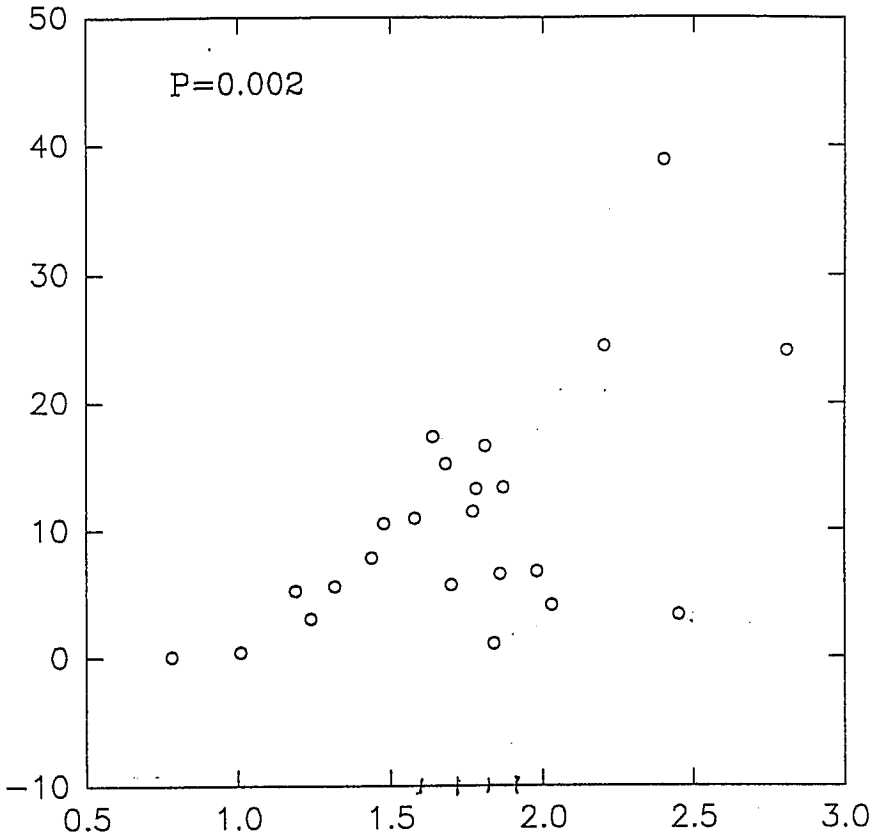
Stage/Discharge Relationships for Kezar Lake,

North Sutton, New Hampshire

HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Inlet (LBL)

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	8.02	0.012	608.27	7.30
FEBRUARY	28.00	7.69	0.014	526.80	7.38
MARCH	31.00	18.00	0.023	1365.19	31.40
APRIL	30.00	14.77	0.009	1084.08	9.76
MAY	31.00	8.75	0.017	663.63	11.28
JUNE	30.00	6.59	0.018	483.32	8.70
JULY	31.00	1.39	0.033	105.42	3.48
AUGUST	31.00	5.97	0.027	452.79	12.23
SEPTEMBER	30.00	14.89	0.022	1092.89	24.04
OCTOBER	31.00	20.40	0.013	1547.22	20.11
NOVEMBER	30.00	12.69	0.008	931.41	7.45
DECEMBER	31.00	12.45	0.011	944.26	10.39

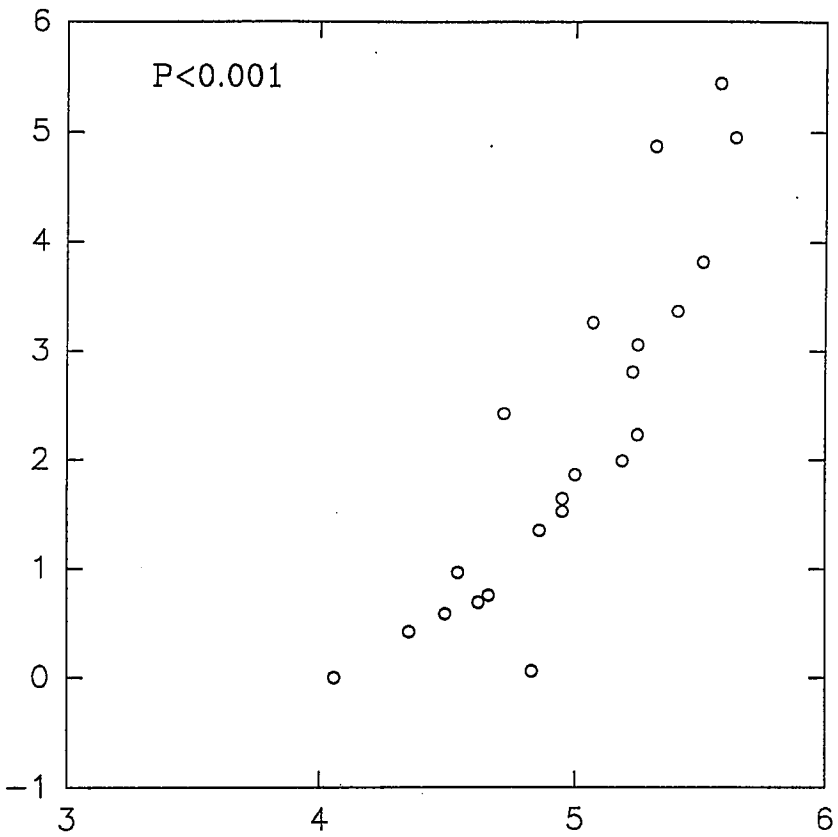
Inlet



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
King Hill Brook

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	2.35	0.007	178.23	1.25
FEBRUARY	28.00	2.03	0.003	139.06	0.42
MARCH	31.00	6.25	0.026	474.02	12.32
APRIL	30.00	3.69	0.009	270.84	2.44
MAY	31.00	1.73	0.010	131.21	1.31
JUNE	30.00	0.30	0.006	22.02	0.13
JULY	31.00	0.00	0.022	0.00	0.00
AUGUST	31.00	0.40	0.017	30.34	0.52
SEPTEMBER	30.00	2.81	0.016	206.25	3.30
OCTOBER	31.00	2.21	0.008	167.62	1.34
NOVEMBER	30.00	1.64	0.008	120.37	0.96
DECEMBER	31.00	3.69	0.006	279.86	1.68

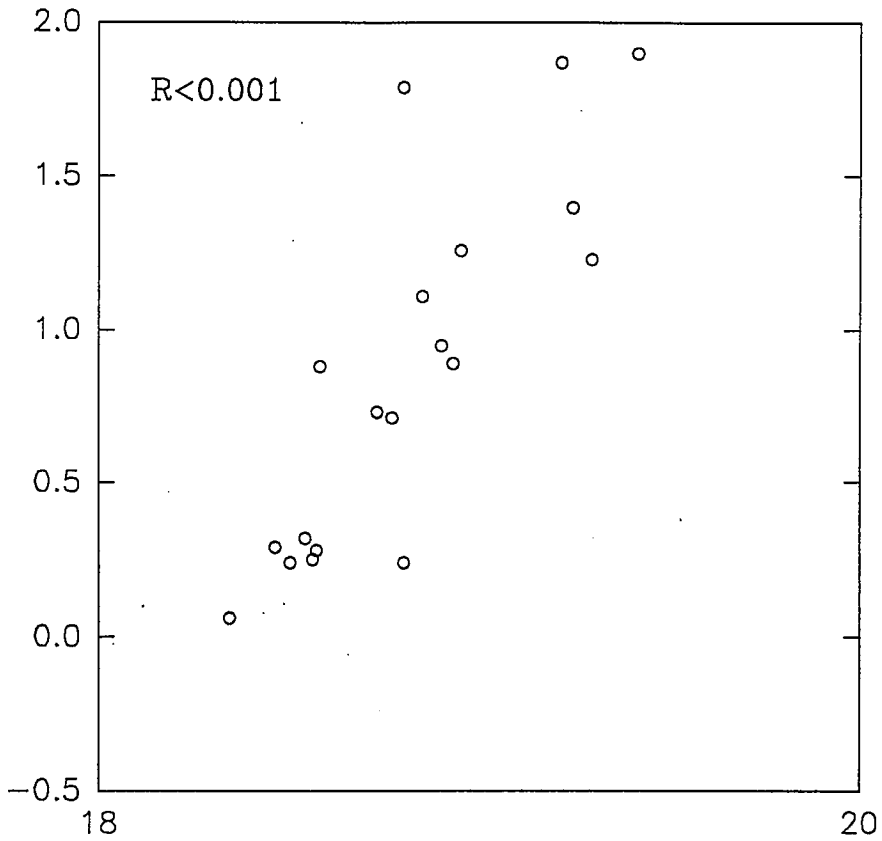
King Hill Brook



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Birch Brook

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	0.81	0.011	61.36	0.67
FEBRUARY	28.00	0.61	0.011	41.79	0.46
MARCH	31.00	1.31	0.066	99.28	6.55
APRIL	30.00	1.41	0.011	103.64	1.14
MAY	31.00	0.75	0.015	56.81	0.85
JUNE	30.00	0.36	0.017	26.20	0.45
JULY	31.00	0.00	0.000	0.00	0.00
AUGUST	31.00	0.08	0.024	6.07	0.15
SEPTEMBER	30.00	0.34	0.048	25.03	1.20
OCTOBER	31.00	1.49	0.015	112.70	1.69
NOVEMBER	30.00	0.78	0.006	57.32	0.34
DECEMBER	31.00	1.23	0.008	93.59	0.75

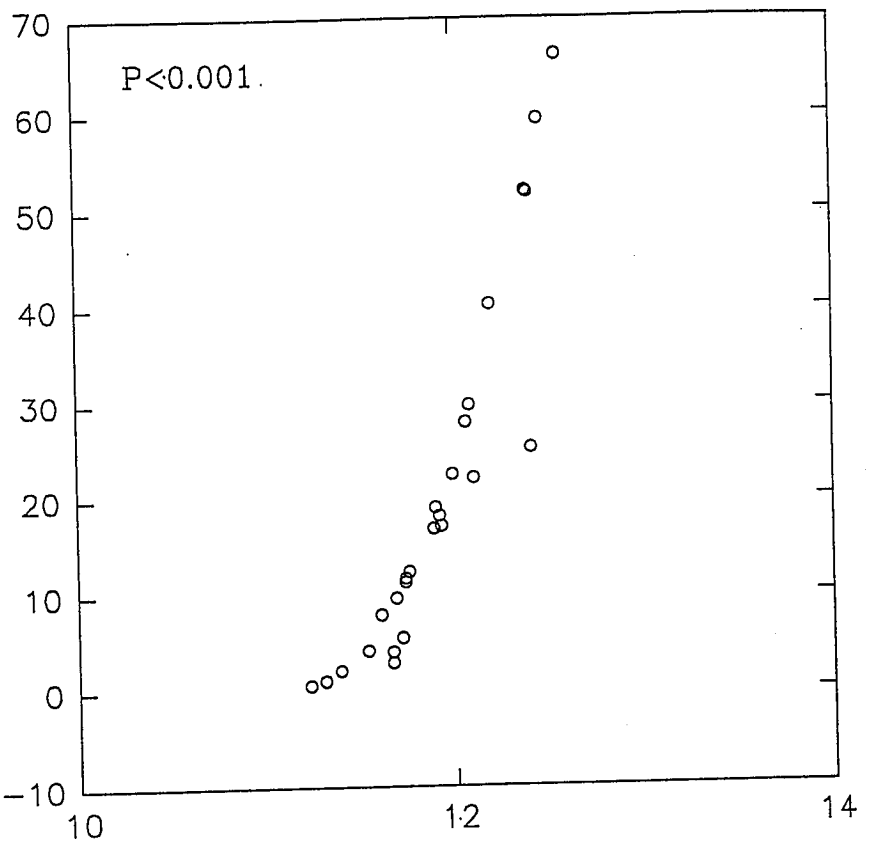
Birch Brook



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Lane River (outlet)

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	20.66	0.010	1566.94	15.67
FEBRUARY	28.00	14.34	0.005	982.35	4.91
MARCH	31.00	33.02	0.008	2504.37	20.03
APRIL	30.00	40.80	0.011	2994.61	32.94
MAY	31.00	19.81	0.011	1502.47	16.53
JUNE	30.00	8.87	0.007	651.03	4.56
JULY	31.00	0.00	0.026	0.00	0.00
AUGUST	31.00	0.04	0.009	3.03	0.03
SEPTEMBER	30.00	6.87	0.015	504.24	7.56
OCTOBER	31.00	27.54	0.016	2088.74	33.42
NOVEMBER	30.00	21.83	0.010	1602.27	16.02
DECEMBER	31.00	34.88	0.012	2645.44	31.75

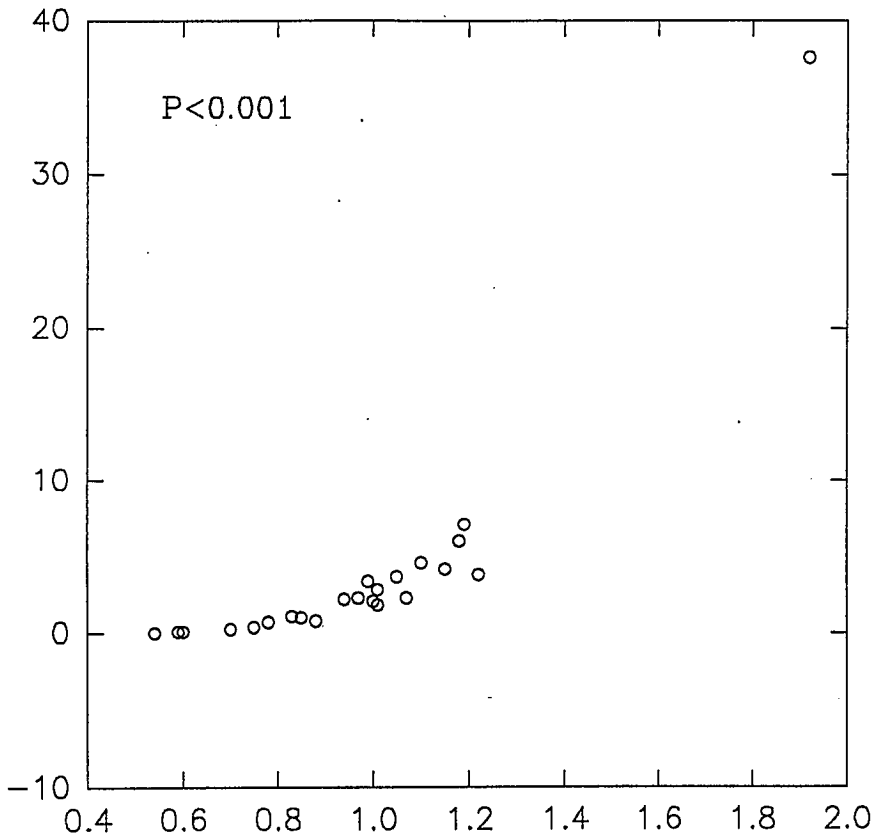
Outlet



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Lyon Brook Above CM

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	3.76	0.013	285.17	3.71
FEBRUARY	28.00	8.76	0.009	600.10	5.40
MARCH	31.00	14.32	0.107	1086.09	116.21
APRIL	30.00	6.86	0.011	503.51	5.54
MAY	31.00	2.99	0.010	226.77	2.27
JUNE	30.00	0.60	0.006	44.04	0.26
JULY	31.00	0.00	0.014	0.00	0.00
AUGUST	31.00	0.00	0.011	0.00	0.00
SEPTEMBER	30.00	3.18	0.018	233.40	4.20
OCTOBER	31.00	4.64	0.014	351.92	4.93
NOVEMBER	30.00	3.61	0.006	264.96	1.59
DECEMBER	31.00	7.66	0.010	580.96	5.81

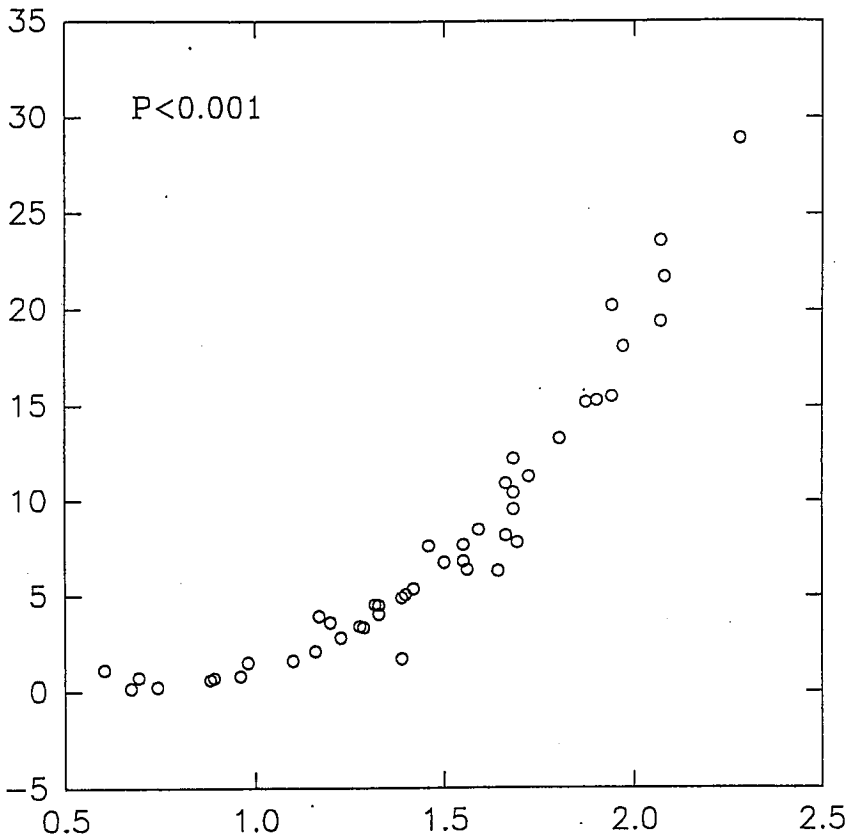
Lyon Brook Above CM



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Clark Pond Brook

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	8.91	0.011	676.00	7.44
FEBRUARY	28.00	6.57	0.007	450.07	3.15
MARCH	31.00	13.71	0.014	1039.82	14.56
APRIL	30.00	13.96	0.011	1024.63	11.27
MAY	31.00	7.41	0.011	562.00	6.18
JUNE	30.00	1.50	0.009	110.10	0.99
JULY	31.00	0.00	0.007	0.00	0.00
AUGUST	31.00	0.00	0.008	0.00	0.00
SEPTEMBER	30.00	3.53	0.011	259.09	2.85
OCTOBER	31.00	10.62	0.009	805.46	7.25
NOVEMBER	30.00	8.72	0.008	640.03	5.12
DECEMBER	31.00	13.37	0.009	1014.03	9.13

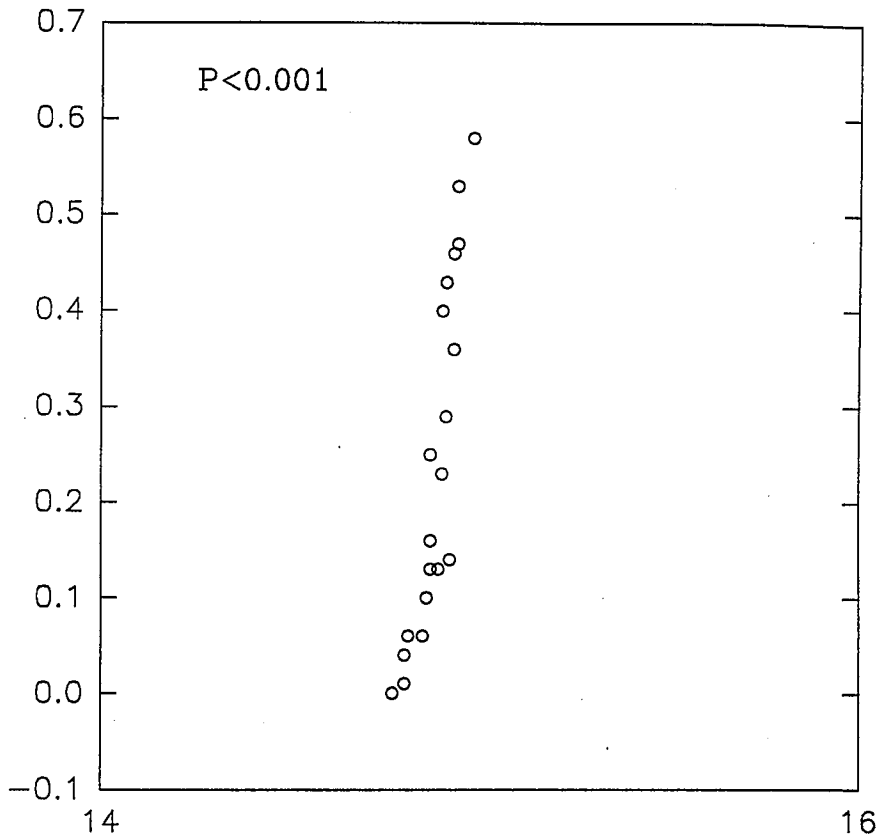
Clark Pond Brook



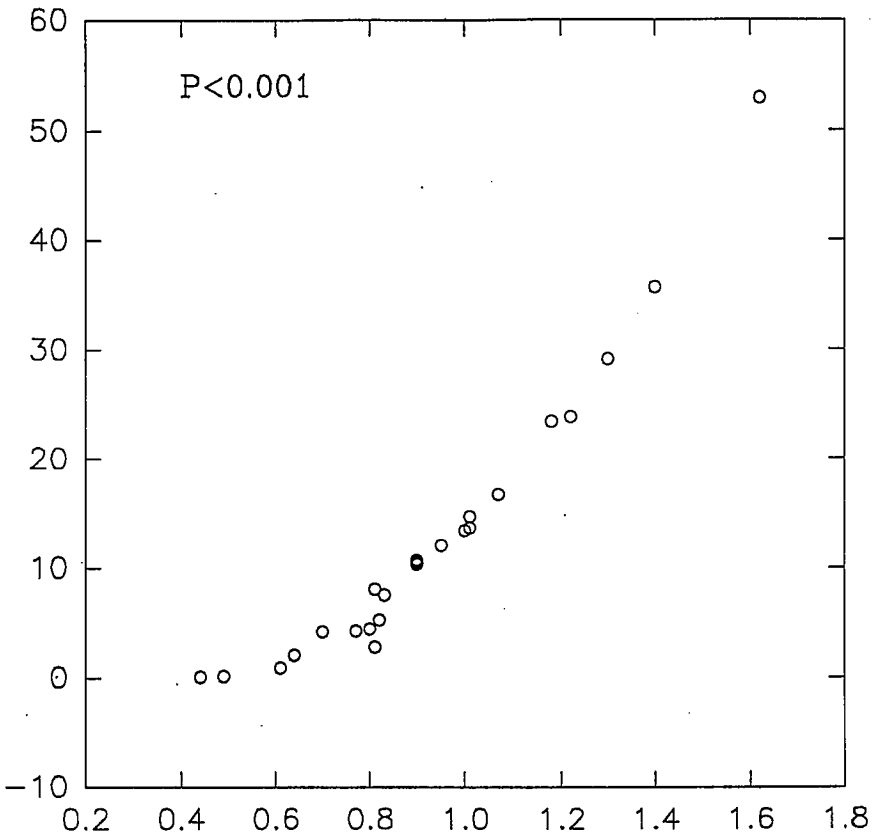
HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Tributary Brook

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	0.59	0.013	44.37	0.58
FEBRUARY	28.00	0.29	0.010	19.87	0.20
MARCH	31.00	1.67	0.089	126.66	11.27
APRIL	30.00	0.29	0.008	21.29	0.17
MAY	31.00	0.07	0.025	5.46	0.14
JUNE	30.00	0.00	0.010	0.00	0.00
JULY	31.00	0.00	0.000	0.00	0.00
AUGUST	31.00	0.00	0.009	0.00	0.00
SEPTEMBER	30.00	0.15	0.021	10.72	0.23
OCTOBER	31.00	0.12	0.007	9.10	0.06
NOVEMBER	30.00	0.10	0.003	7.12	0.02
DECEMBER	31.00	0.29	0.007	21.99	0.15

Tributary Brook



HYDROLOGIC AND TOTAL PHOSPHORUS LOADING
Lyon Brook Below CM

MONTH	DAYS/MTH	MEAN MTH FLOW (CFS)	MEAN MTH TP CONC (mg/L)	MEAN MTH. DISCHARGE (10E3 M3)	TOTAL P LOAD (KG P)
JANUARY	31.00	9.53	0.013	722.79	9.40
FEBRUARY	28.00	9.09	0.011	622.70	6.85
MARCH	31.00	37.61	0.026	2852.49	74.16
APRIL	30.00	25.67	0.012	1884.11	22.61
MAY	31.00	10.94	0.017	829.73	14.11
JUNE	30.00	2.02	0.020	148.26	2.97
JULY	31.00	0.00	0.051	0.00	0.00
AUGUST	31.00	0.36	0.040	27.30	1.09
SEPTEMBER	30.00	8.95	0.024	656.91	15.77
OCTOBER	31.00	15.95	0.015	1209.71	18.15
NOVEMBER	30.00	11.38	0.010	835.26	8.35
DECEMBER	31.00	20.52	0.010	1556.32	15.56

Lyon Brook Below CM