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LAKE WATER QUALITY ASSESSMENT REPORT
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

CRYSTAL LAKE
WILLINGBORO TOWNSHIP, BURLINGTON COUNTY

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Appendix includes	
-Data	
-Algae identification	
-Map of lake and watershed	
-Map with sampling stations	

SCOPE OF SURVEY

The quality of a lake's water is determined by many factors. These factors may be found within the lake itself or they may come from the watershed surrounding it. The collection of data through sampling and measurements can help to determine what may be influencing the lake's water quality. Although the scope covered by this report is somewhat limited, the following data may be found:

1. Limited Historical Data
2. Geology
3. Morphology and Hydrology
4. Physical & Chemical Data Results
5. Biological Data

All lakes in the program were monitored three times during the year; once each during the spring, summer and fall. Samples were taken at the major inlets and at sites deemed representative of the entire lake. Samples were taken above the outlet when a boat was unavailable. The samples were analyzed for the following parameters:

In-situ analysis:

1. Temperature
2. Dissolved Oxygen
3. pH
4. Depth and Secchi readings
5. Visual check of Macrophytes

Laboratory Analysis (NJ Department of Health):

1. Bacterial Analysis
2. Alkalinity
3. Nutrients

Biological Analysis (Bio-Monitoring Unit of the NJDEP):

1. Chlorophyll a
2. Algal Scan (Microscopic)
3. Macrophyte Survey

EXPLANATION OF PARAMETERS SAMPLED

PHYSICAL AND CHEMICAL PARAMETERS

1. TEMPERATURE AND DISSOLVED OXYGEN (D.O.):

The temperature of a shallow lake generally follows climatic changes. As the temperature of the water increases the dissolved oxygen level of the water decreases. A deeper lake will usually stratify thermally, during the summer. A warmer, less dense layer of water (epilimnion) will float on a cooler, denser layer of water (hypolimnion). These two layers are separated by a zone of rapidly changing temperature and density called the metalimnion. The metalimnion, can form a barrier, which can keep the hypolimnion from being reoxygenated from the atmosphere. In a productive (eutrophic) lake this can cause anoxic conditions in the hypolimnion as oxygen is used up by animals and decomposers (bacteria).

2. ALKALINITY AND pH:

Alkalinity is a measurement that indicates the degree to which an aquatic system can buffer pH changes that can occur during photosynthesis and/or by the introduction of pollutants. The toxicity of certain pollutants can be reduced by this buffering action. A minimum of 20 mg/L CaCO₃ has been recommended, except where natural conditions are lower (Quality Criteria for Water, 1986, EPA 440/5-86-001). The Pine Barrens are an example of an area where natural conditions favor low alkalinity. PH is a measurement of hydrogen ion activity or the acid-base equilibrium in natural waters. The pH can be raised by the photosynthetic processes of algae and/or macrophytes.

EXPLANATION OF PARAMETERS SAMPLED

3. NUTRIENT ANALYSIS:

Phosphorus and nitrogen are the major nutrients required by algae for growth. In New Jersey's lakes, phosphorus is the nutrient most often responsible for limiting algal growth. Dissolved orthophosphorus is believed to approximate the solid reactive phosphorus used by all photosynthetic organisms (aquatic plants/algae). However, all forms of total phosphorus can become reactive through biological decomposition and can be used as nutrients to enhance weed growth and/or algae blooms.

Nutrients can enter a lake or its watershed via point (i.e. sewerage treatment plant) or nonpoint sources (i.e. fertilizer runoff from lawns). Nutrients may also be recycled from the sediments in the lake.

4. SECCHI DISC TRANSPARENCY:

A greater depth of light transmission generally indicates good water quality (low algal growth). However, heavy macrophyte growth can also keep the water clear. The macrophytes may outcompete the algae for nutrients and therefore, restrict most algal growth. Erosion from the watershed or upwelling of the lake's sediments, from adverse weather conditions, could also decrease the water's transparency. To determine the transparency of a lake's water a secchi disk is used. The secchi disk is an 8 inch black and white disk. Measurements are taken by lowering the disk until it is no longer visible.

EXPLANATION OF PARAMETERS SAMPLED

BIOLOGICAL DATA

1. BACTERIAL ANALYSIS:

Bacterial samples for Total coliform, Fecal coliform (FC) and Fecal streptococcus (FS) were taken at the inlets and in-lake. While sources are difficult to determine with 3 sampling runs, the ratio of FC/FS can imply whether the source is from human or animal waste.

FC/FS Possible Bacterial source (Millipore Corp. 1972)

>4	-Human wastes
2-4	-Mainly human wastes and other sources
1-2	-Inconclusive
0.7-1	-Mainly animal wastes and other sources
<.7	-Animal wastes

A lake's water is considered unsafe for swimming when Fecal coliform levels exceed 200 mpn/100ml.

2. CHLOROPHYLL a/ALGAE

Chlorophyll a is a pigment that is present in all types of algae. The chlorophyll a content of the water can indicate the amount of planktonic algae present in the lake. Algae are an important part of a lake ecosystem because they are a vital part of the food chain. However, an excessive amount of algae can negatively impact a lake. Excessive algae growth can inhibit the growth of other plants, cause aesthetic problems and curtail recreational uses. Through the processes of photosynthesis, increased algal growth can raise the dissolved oxygen level in a lake during the daytime (sunlight) and decrease the dissolved oxygen level during the night (dark). Depressed dissolved oxygen levels, if extreme, could cause fishkills.

Handwritten note:
This document is a working copy (not for distribution) and does not constitute endorsement by the N.J. Geological Survey or the Department of Environmental Protection.

EXPLANATION OF PARAMETERS SAMPLED

3. ALGAL SURVEY:

As the growing season proceeds, a succession of algal communities typically occurs in a lake. During the spring and fall, diatoms are usually dominant. In the early summer, chlorophytes (green algae) become dominant. As available nutrients change during the summer, filamentous green or blue-green algae may become dominant. These may float to the surface forming mats that can cause aesthetic and recreational problems.

High chlorophyll a levels with little algal species diversity are indicative of nutrient-rich water.

4. MACROPHYTE SURVEY:

Macrophytes are also a vital part of a lake. They provide cover for fish and food for wildlife. However, excessive macrophyte growth can limit the recreational uses of a lake, including swimming, fishing and boating. A visual survey was done to identify and determine areal coverage of macrophytes.

LAKE TROPHIC STATES

Lake eutrophication (aging) is a natural process resulting from the gradual accumulation of nutrients, increased productivity, and filling in from sediments, silt and organic matter.

Lakes usually follow a progression through a series of trophic states, which are the following:

1. Oligotrophic
-nutrient poor and low biological productivity.
2. Mesotrophic
-intermediate levels of nutrients and biological productivity.
3. Eutrophic
-nutrient rich and highly productive.

Accelerated or cultural eutrophication occurs to a lake when nutrients, silt and organic matter inputs are increased by activity in the watershed. Several examples of increased inputs include; a sewage treatment plant discharging into a lake, runoff of fertilizers from farms or lawns, and erosion from new construction sites. Because of New Jersey's large population, all lakes in the State are considered to be threatened by accelerated eutrophication.

INTRODUCTION

Crystal Lake is a 20-acre body of water located in Willingboro Township, Burlington County. The lake was created in the early 1970's when a forty acre parcel of land deeded to the township was excavated and underground springs filled the area. The lake has a maximum depth of about 17 feet which is relatively deep for a lake in Southern New Jersey. Much of Crystal Lake is accessible to fishing from its shoreline and the State of New Jersey stocks the lake with trout.

40-acre
[LAKE] NUM. AND NAME: #968 CRYSTAL LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: WILLINGBORO TWP., BURLINGTON CO.

U.S.G.S. QUAD: #21 BEVERLY

[LAKE] AREA: 20 ACRES

[LAKE] MAXIMUM DEPTH: 17 ft.

GEOLOGIC DESIGNATION: QPS PENNSAUKEN FORMATION GRAVEL/ WOODBURY CLAY.

TRIBUTARIES: NONE

[LAKE] USE AND HISTORICAL NOTES: FISHING. SAMPLED BY NJDEP IN 1975, 1976, 1977 AND 1978.

COMMENTS: TOWNSHIP LEAF COLLECTION STORED WHERE LEACHATE CAN RUN INTO LAKE.

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

This sentence seems to be trying to say: "Because it is deep... or... deep enough... after all, a depth of 13ft would still be a depth. In other words, the sentence is unnecessarily vague."

Because of ^{its} it's depth, the lake was stratified during the summer sampling run. There was a low level of dissolved oxygen in the hypolimnion during the summer. While the dissolved oxygen was 14.4 mg/l at the surface, it was only 4.6 mg/l in the hypolimnion. The temperature and dissolved oxygen were nearly uniform throughout the water column during the spring and fall sampling runs.

Secchi Disk

Transparency of the lake's water was poor ^{were} with secchi disk readings of 1.0 foot and 0.5 foot during the summer and fall.

Alkalinity and pH

Alkalinity of the lake's water ranged from 28 mg/l to 33 mg/l. These numbers indicate a limited buffering capacity. There was a large fluctuation in the pH (6.80 during the spring to 9.77 during the summer).

Nutrients

Total phosphorus levels in the water column ^{were} high ranging from 0.06 mg/l to 0.08 mg/l.

RESULTS

BIOLOGICAL DATA

Chlorophyll a/Algae

There were heavy algal blooms during the summer (29.78 mg/m³) and fall (78.48 mg/m³). There was no analysis for the spring sample due to a lab malfunction. There was a fair amount of diversity for each sample but blue-green algae were dominant for both the summer and fall samples (see Appendix). Blue-green algae are usually indicative of nutrient-rich water.

Macrophytes

No aquatic macrophytes were observed in the lake during the monitoring period.

Bacteria

Fecal coliform levels ranged from less than 20 mpn/100ml to 50 mpn/100ml, indicating safe swimming conditions on these sampling dates. However, this lake is not utilized for swimming.

CONCLUSION

Crystal Lake is considered to be in a eutrophic state because of high algal productivity. Blue-green algae, which are indicative of nutrient-rich water, were the dominant species during the summer and fall. Algal blooms were possible because total phosphorus levels were high for each sampling run. A possible source of nutrients to the lake was the township's leaf piles, composting within 100 feet of the lake. Leachate from rainfall, which was above normal during the spring and summer of 1989, may have enhanced the high nutrient levels.

The heavy algal productivity was impacting the ecology of Crystal Lake. The low dissolved oxygen in the hypolimnion may have been caused by the combination of several factors. As the algae die, they settle to the lake bottom. The decomposition of the algae by bacteria increases the consumption of dissolved oxygen in the hypolimnion. Stratification of the lake restricts oxygen from the surface mixing with the hypolimnion. And, depth along with turbidity does not allow oxygen producing photosynthesis by algae or macrophytes to occur in the lower depths. *depth significant*

Dissolved oxygen levels under 4.0 mg/l could be stressful to certain organisms which inhabit this part of the lake including favorable fish species. Anoxic conditions near the lake bottom also favors the release of phosphorus from the sediments which could lead to more algae blooms. *which is this?*

Subject is concerning phosphorus

REFERENCES

Author
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Lake and Reservoir Restoration Guidance Manual, 1988, North American Lake Management Society. First Edition. — p.

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NJDEP, 1987. Water Resources Field Procedures Manual. — p.

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USEPA, 1980. Clean Lakes Program Guidance Manual: EPA 440/5-81-003. — p.

Wetzel, Robert G., 1983. Limnology: Saunders College Publishing, New York, — p.

APPENDIX

*units they are reported
it should be shown
2.9*

STATION	DATE	TEMP (°C)	DO	pH	ALK	TOT.P	ORTHO P	F COLI	F STREP	TOT COLI	FC/FS	SECCHI (feet)
LAKE	05/03/89	12.5	10.5	6.80	30	.07	<.01	<20	2		NA	
	08/15/89	26.1	14.4	9.77	33	.06	<.01	<20	<2	<20	NA	1.5
	10/23/89	13.7	10.4	7.65	28	.08	.01	50	21	130	NA	1.5

*what
unit?*

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/05/03
Sample No. 64002
Lakes Management
Crystal Lake

Plankton Identification

CHLOROPHYCEAE (green)

Ankistrodesmus convolutus
A. falcatus
Chlamydomonas sp.
Coelastrum cambricum
Cosmarium phaseolus
Crucigenia quadrata
Dictyosphaerium pulchellum
Micratinium pusillum
Oedogonium multispora
Scenedesmus acuminatus
S. dimorphus
S. quadricauda
Staurostrum chaetoceras
S. glabrum

EUGLENOPHYCEAE (motile green)

Trachelomonas robusta

BACILLARIOPHYCEAE (diatom)

Nitzschia acicularis

CRYPTOPHYCEAE (colorless or brownish)

Cryptomonas ovata

MYXOPHYCEAE (blue-green or other color)

Gomphosphaeria sp.
Microchaetaceae sp.
Oscillatoria chlorina

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/08/15
Sample No. 69319
Lakes Management
Crystal Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)

Actinastrum hantschii
Ankistrodesmus falcatus
Dictyosphaerium pulchellum CO-DOMINANT
Pediastrum simplex
Staurastrum chaetoceras
S. paradoxum
Tetraedron minimum

EUGLENOPHYCEAE (motile green)

Trachelomonas hispida
T. volvocina

BACILLARIOPHYCEAE (diatom)

Cyclotella meneghiniana
Synedra rumpens

CRYPTOPHYCEAE (colorless or brownish)

Cryptomonas ovata

MYXOPHYCEAE (blue-green or other color)

Chroococcus varius
Oscillatoria putrida CO-DOMINANT

=====
Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 29.78

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/23
Sample No. 79062
Lakes Management
Crystal Lake, NJ

Plankton Identification

CHLOROPHYCEAE (green)

Ankistrodesmus falcatus
Dictyosphaerium pulchellum
Lauterborniella elegantissima
Nannochloris sp.
Pediastrum duplex
P. tetras
Scenedesmus dimorphus
S. producto-capitatus
S. quadricauda
Staurastrum chaetoceras
Tetraedron minimum

EUGLENOPHYCEAE (motile green)

Trachelomonas hispida

BACILLARIOPHYCEAE (diatom)

Nitzschia acicularis

CRYPTOPHYCEAE (colorless or brownish)

Cryptomonas erosa

MYXOPHYCEAE (blue-green or other color)

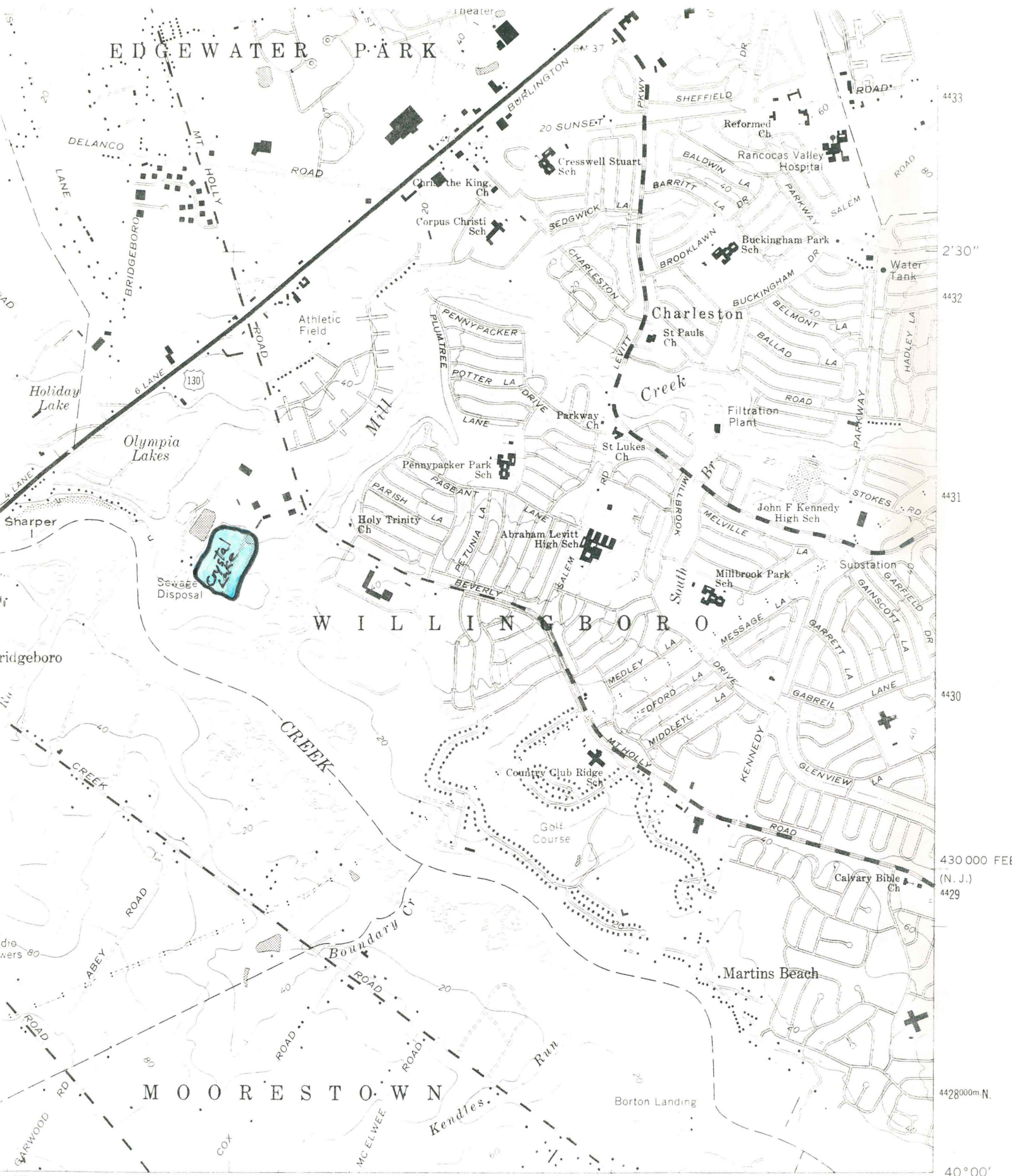
Anabaena constricta
Gomphosphaeria lacustris CO-DOMINANT
Oscillatoria subtilissima CO-DOMINANT

=====
Chlorophyll Analysis

Chlorophyll "a" (mg/m³) = 78.48

Analyst/Unit _____

EDGEWATER PARK

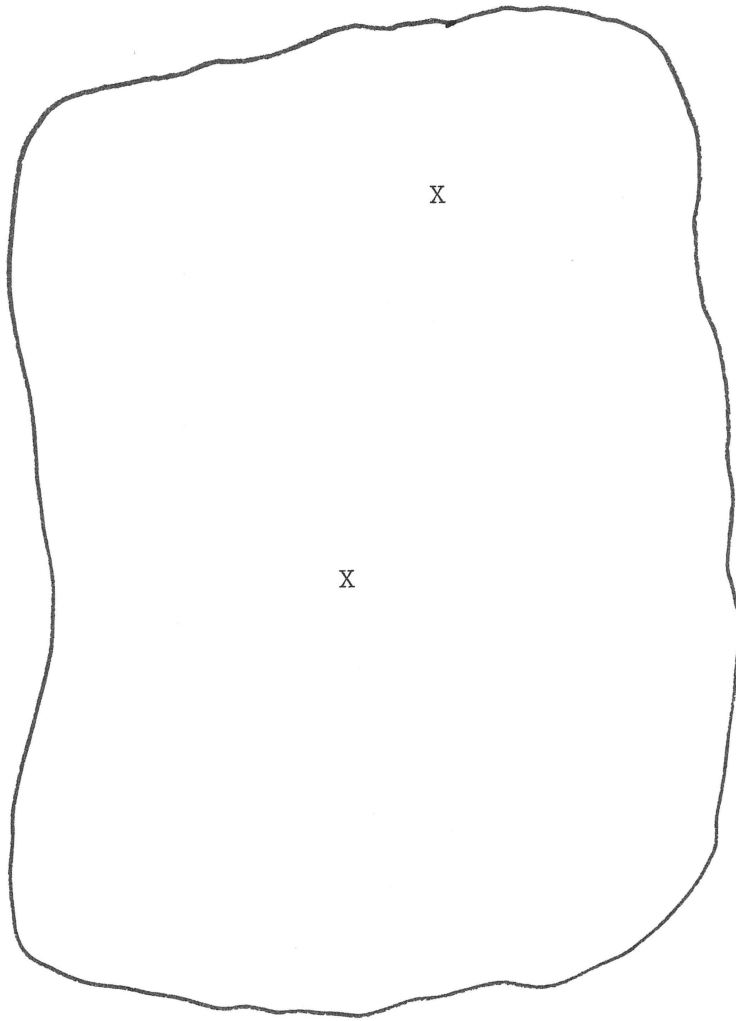


4433
2'30"
4432
4431
4430
430 000 FEET
(N. J.)
4429
4428 000m. N.
40°00'

506 507 55' 508 509 900m E 1:940 000 FEET (N. J.) 74°52'30"

INTERIOR-GEN. & LOCAL SURVEY WASHINGTON, D. C. - 1974
ROAD CLASSIFICATION
Heavy duty ——— Light duty ———
Med. duty - - - - - Utility - - - - -
MOUNTAIN

CRYSTAL LAKE



SEWAGE TREATMENT
PLANT

X-Sample Sites ⁹

COMPOST
PILE

INDUSTRIAL ROAD

INTRODUCTION

Crystal Lake is a 20-acre body of water located in Willingboro Township, Burlington County. The lake was created in the early 1970's when a 40-acre parcel of land deeded to the township was excavated and [underground springs] filled the area. It has a maximum depth of about 17 feet, which is relatively deep for a lake in Southern New Jersey. Much of it is accessible to fishing from its shoreline and the State of New Jersey stocks the lake with trout.

NUMBER AND NAME: 968 CRYSTAL LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: WILLINGBORO TOWNSHIP, BURLINGTON COUNTY

U.S.G.S. QUAD: NO. 21 BEVERLY

LATITUDE: 40 01'40"

LONGITUDE: 74 55'01"

AREA: 20 ACRES

MAXIMUM DEPTH: 17 FEET

GEOLOGIC DESIGNATION: QPS PENNSAUKEN FORMATION GRAVEL/ WOODBURY CLAY.

TRIBUTARIES: NONE

USE AND HISTORICAL NOTES: FISHING. SAMPLED BY NJDEP IN 1975, 1976, 1977 AND 1978.

COMMENTS: TOWNSHIP LEAF COLLECTION STORED WHERE LEACHATE CAN RUN INTO LAKE.

1/ What is an "underground spring"? Can "ground water" be substituted for this Layman's term?

RESULTS

PHYSICAL/CHEMICAL PARAMETERS

Temperature and Dissolved Oxygen

Due to a depth of 17 feet, the lake was stratified during the summer sampling run. Dissolved oxygen levels were low in the hypolimnion during the summer. While dissolved oxygen levels were 14.4 mg/L at the surface, they were only 4.6 mg/L in the hypolimnion. Temperatures and dissolved oxygen levels were nearly uniform throughout the water column during the spring and fall sampling runs.

Secchi Disk

Transparency of the lake's water was poor, secchi disk readings were 1.0 foot or less during the summer and fall.

Alkalinity and pH

Alkalinity of the lake's water ranged from 28 to 33 mg/L. These numbers indicate a limited buffering capacity. There was a large fluctuation in the pH during the monitoring period (6.80 during the spring to 9.77 during the summer).

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The heavy algal productivity may have had an impact on the ecology of Crystal Lake. The low dissolved oxygen in the hypolimnion may have been caused by a combination of several factors. As the algae die, they settle to the lake bottom. The decomposition of the algae by bacteria increases the consumption of dissolved oxygen in the hypolimnion. Stratification of the lake restricts oxygen from the surface mixing with the hypolimnion. And, its significant depth along with turbidity did not allow oxygen producing photosynthesis by algae or macrophytes to occur in the lower depths. } 4

Dissolved oxygen levels under 4.0 mg/L could be stressful to certain organisms in the lower depths of the lake, including favorable fish species. Anoxic conditions near the lake bottom also encourages the release of phosphorus from the sediments, which can lead to more algal growth.

4 This sentence can be improved. How about:

"Moreover, its significant depth, combined with its high turbidity, prevented photosynthetic oxygen production by algae or macrophytes, especially in its lower depths." (?)

STATION	DATE	TEMP (celsius)	D.O. mg/L	pH	ALK mg/L	TOT P mg/L	ORTHO P mg/L	F COLI mpn/100ml	F STREP mpn/100ml	TOT COLI mpn/100ml	SECCHI (feet)
IN-LAKE	05/03/89	12.5	10.5	6.80	30	.07	<.01	<20	2		
	08/15/89	26.1	14.4	9.77	33	.06	<.01	<20	<2	<20	1.5
	10/23/89	13.7	10.4	7.65	28	.08	.01	50	21	130	1.5

↑
0°C (?)