# LAKE WATER QUALITY ASSESSMENT REPORT

# NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

# DIVISION OF WATER RESOURCES

## BRAINERD LAKE

## CRANBURY TOWNSHIP, MIDDLESEX COUNTY


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# PREFACE

The 1986 revisions to the Clean Water Act requires states to provide the United States Environmental Protection Agency (USEPA) with water quality information on public lakes. This information is a prerequisite for eligibility in the USEPA Clean Lakes Program.

The New Jersey Department of Environmental Protection obtained a grant to assess the water quality of the State's lakes during 1989. The objectives of the FY 89 Project were to acquire limited limnological data for 21 lakes. The data was analyzed to determine the trophic status for each lake.

Lakes were selected based on several criteria which included; the amount of public access the lake provided, it's recreational usage (e.g. swimming, fishing, ...) and it's value as a local resource. The following lakes were surveyed during 1989:

| COUNTY | LAKE |
|---|---|
| Burlington | Lake Absegami |
| | Crystal Lake |
| | Evans Pond |
| | Indian Mills Lake |
| | Jefferson Lake |
| | Smithville Lake |
| Camden | Cooper River Lake |
| Cape May | East Creek Pond |
| | Lake Nummy |
| Gloucester | Greenwich Lake |
| | Iona Lake |
| | Narriticon Lake |
| Mercer | Mercer County Park Lake |
| | Rosedale Lake |
| Middlesex | Brainerd Lake |
| | Farrington Lake |
| Monmouth | Mac's Pond |
| Morris | Lake Ames |
| | Mount Hope Pond |
| Ocean | Lake Carasaljo |
| Passaic | Shepherds Lake |

CONTENTS

# 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 $CaCO_3$ has been recommended, except where natural conditions are lower (Quality Critera 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 equilibruim 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 it's 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.

# 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

Brainerd Lake is a 15 acre body of water located in Cranbury Township, Middlesex County. The lake has a maximum depth of about eight feet and is fed by one main source, which is the Cranbury Brook. The Cranbury brook flows through agricultural and developed areas before entering Brainerd Lake. The lake is bordered by a park on one side and homes on the other. The lake is accessible for fishing from the entire shoreline of the park.

LAKE NUM.AND NAME: #4072 BRAINERD LAKE

STUDY PERIOD: SPRING, SUMMER, FALL 1989

LOCATION: CRANBURY TWP., MIDDLESEX CO.

U.S.G.S. QUAD: #19 HIGHTSTOWN

LAKE AREA: 15 ACRES

LAKE MAXIMUM DEPTH: 8 ft.

GEOLOGIC DESIGNATION: KMU MERCHANTVILLE CLAY

TRIBUTARIES: CRANBURY BROOK

LAKE USE AND HISTORICAL NOTES: FISHING. SAMPLED BY NJDEP IN 1975 1976, 1977, 1978, 1981, AND 1983.

# RESULTS

## PHYSICAL/CHEMICAL PARAMETERS

### Temperatures and Dissolved Oxygen

Because of the shallow depth of the lake, the temperatures and dissolved oxygen levels throughout the water column were uniform for each monitoring run. Dissolved oxygen levels were at or above 8.0 mg/l for each sampling run.

### Secchi Disk

The transparency of the lake's water ranged from 2.0 feet to 2.5 feet.

### Alkalinity and pH

The alkalinity of the water ranged from 4 mg/l to 10 mg/l and therefore, had poor buffering capacity. The pH fluctuated from 6.00 in the spring, to 7.08 for the summer and to 5.23 in the fall.

### Nutrients

Total phosphorus levels in the water column ranged from 0.08 mg/l to 0.52 mg/l. The high level of phosphorus occurred after a rainy period.

# RESULTS

## BIOLOGICAL DATA

### Chlorophyll a/Algae

Chlorophyll a levels of 18.89 mg/$m^3$, 49.10 mg/$m^3$ and 2.78 mg/$m^3$ were observed for the spring, summer and fall respectively. There were no dominant algal species and there was a moderate level of species diversity during the blooms.

### Macrophytes

Areal coverage by yellow water lily (Nuphar spp.) was about 40%. It was found in the shallower areas of the upper region and along the sides of the lake. Fanwort (Cabomba caroliniana) was observed growing along the shoreline. It's areal coverage constituted about 10% of the lake.

### Bacteria

Fecal coliform counts ranged from less than 20 mpn/100ml to 130 mpn/100ml, indicating safe swimming conditions on the sampling days.

# CONCLUSION

Brainerd Lake supports heavy production of both algae and aquatic macrophytes and therefore, it is considered to be in a eutrophic state. The productivity is enhanced by elevated levels of total phosphorus.

The recreational use of Brainerd Lake was impacted by the macrophyte and algal growth. Several shallow areas along the park had heavy macrophyte growth which hampered bank fishing and the heavier algal bloom imparted a turbid quality to the water which detracted from the lake and surrounding park.

# REFERENCES

Aquatic Vegetation of New Jersey. 1965. Rutgers Extension Service Bulletin # 382.

Lake and Reservoir Restoration Guidance Manual. 1988. North American Lake Management Society. First Edition.

NJDEP. 1987. Water Resources Field Procedures Manual.

Trudeau, Philip N. 1982. Nuisance Aquatic Plants and Aquatic Plant Management Programs in The United States.

USEPA 1980. Clean Lakes Program Guidance Manual. EPA 440/5-81-003.

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

# APPENDIX

| STATION | DATE | TEMP | D O | pH | ALK | TOT P | ORTHO P | F COLI | F STREP | TOT COLI | FC/FS | SECCHI (feet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INLET | 05/31/89 | 14.7 | 9.3 | 5.60 | 7 | .41 | <.01 | <20 | 79 | 260 | NA | |
| | 08/24/89 | 22.2 | 5.3 | 6.51 | 12 | .09 | <.01 | 5400 | >2400 | >24000 | NA | |
| | 10/25/89 | 10.4 | 10.6 | 4.82 | 2 | .05 | .01 | 80 | 79 | 80 | NA | |
| LAKE | 05/31/89 | 18.2 | 12.5 | 6.00 | 5 | .52 | <.01 | <20 | 4 | 20 | NA | 2.5 |
| | 08/24/89 | 25.9 | 10.4 | 7.08 | 10 | .10 | <.01 | 130 | 79 | 9200 | 1.65 | 2.0 |
| | 10/25/89 | 12.2 | 8.5 | 5.23 | 4 | .08 | .03 | 50 | 70 | 5400 | NA | 2.5 |

**NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION**
**GEOLOGICAL SURVEY**
**LABORATORY OPERATIONS SECTION**

89/05/31
Sample No. None
Lakes Management
Brainard Lake, Cranbury, NJ

Plankton Identification

**CHLOROPHYCEAE (green)**
Ankistrodesmus convolutus
Chlamydomonas patellaria
Crucigenia irregularis

**EUGLENOPHYCEAE (motile green)**
Phacus suecicus
Trachelomonas robusta

**CHRYSOPHYCEAE (golden or brown)**
Dinobryon sertularia
Mallomonas caudata
Synura uvella

**CRYPTOPHYCEAE (colorless or brownish)**
Cryptomonas ovata

**MYXOPHYCEAE (blue-green or other color)**
Oscillatoria chlorina

Chlorophyll Analysis

**Chlorophyll "a" ($mg/m^3$) = 18.89**

Analyst/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/08/24
Sample No. 69322
Lakes Management
Brainard Lake, NJ

Plankton Identification

**CHLOROPHYCEAE (green)**
- Ankistrodesmus falcatus
- Chlamydomonas sp.
- Chlorella vulgaris
- Closterium abruptum
- Dictyosphaerium pulchellum
- Gloeocystis gigas
- Nannochloris sp.
- Selenastrum bibraianum

**EUGLENOPHYCEAE (motile green)**
- Trachelomonas robusta
- T. volvocina

**CHRYSOPHYCEAE (golden or brown)**
- Mallomonas caudata

**BACILLARIOPHYCEAE (diatom)**
- Nitzschia acicularis
- N. palea

**CRYPTOPHYCEAE (colorless or brownish)**
- Cryptomonas marsonii
- C. ovata

**MYXOPHYCEAE (blue-green or other color)**
- Oscillatoria chlorina

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Chlorophyll Analysis

**Chlorophyll "a" ($mg/m^3$) = 49.10**

Analyst(s)/Unit _____

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
GEOLOGICAL SURVEY
LABORATORY OPERATIONS SECTION

89/10/25
Sample No. 79066
Lakes Management
Brainard Lake, NJ

Plankton Identification

**CHLOROPHYCEAE (green)**
Ankistrodesmus falcatus
Chlorella vulgaris
Nannochloris sp.

**CHRYSOPHYCEAE (golden or brown)**
Mallomonas caudata

**CRYPTOPHYCEAE (colorless or brownish)**
Cryptomonas ovata

**MYXOPHYCEAE (blue-green or other color)**
Oscillatoria chlorina
O. subtilissima

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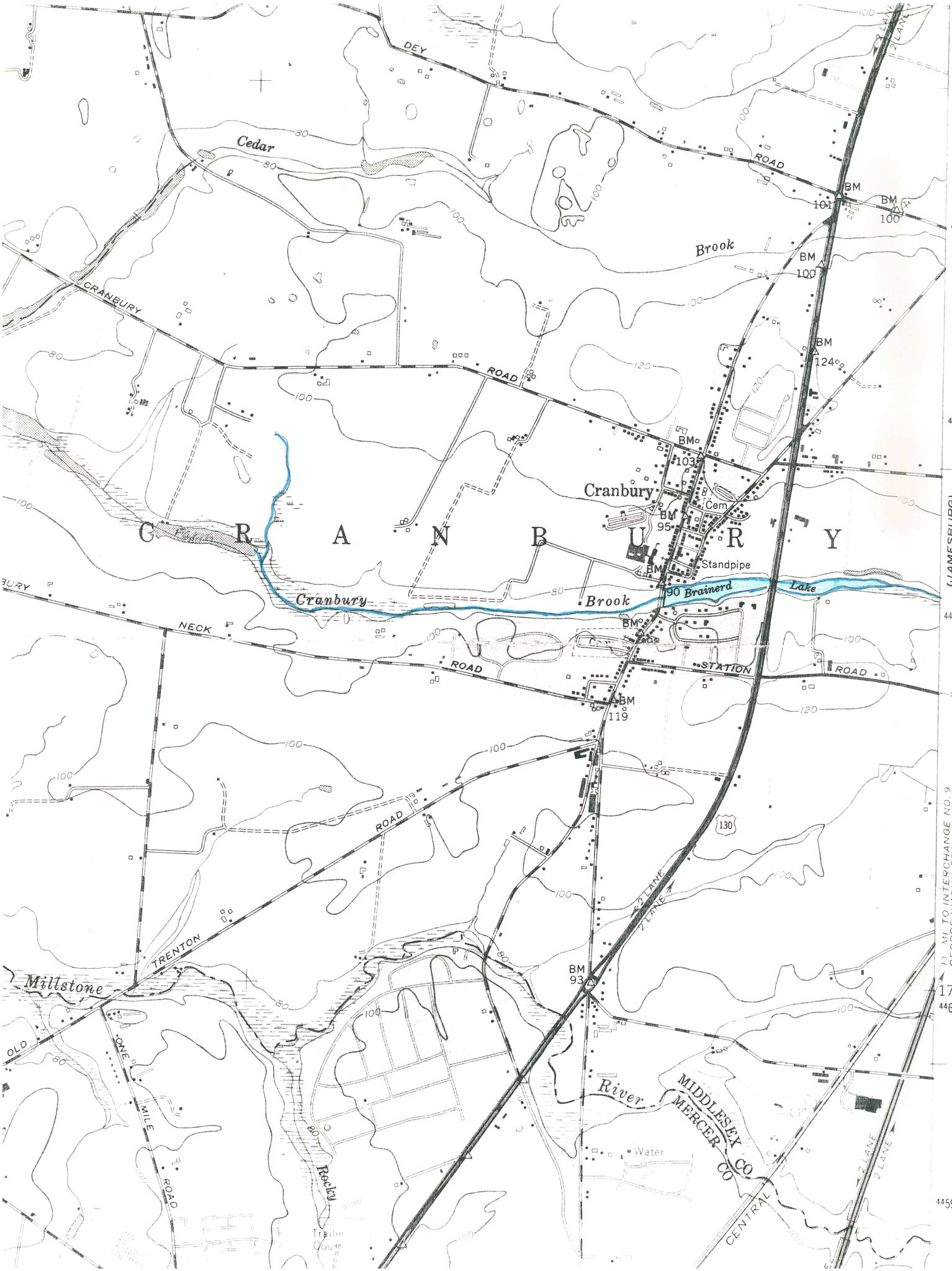
Chlorophyll Analysis

**Chlorophyll "a" ($mg/m^3$) = 2.78**

Analyst/Unit _____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ROAD
Cedar
Brook
BM
101
BM
100
BM
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CRANBURY
ROAD
BM
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BM
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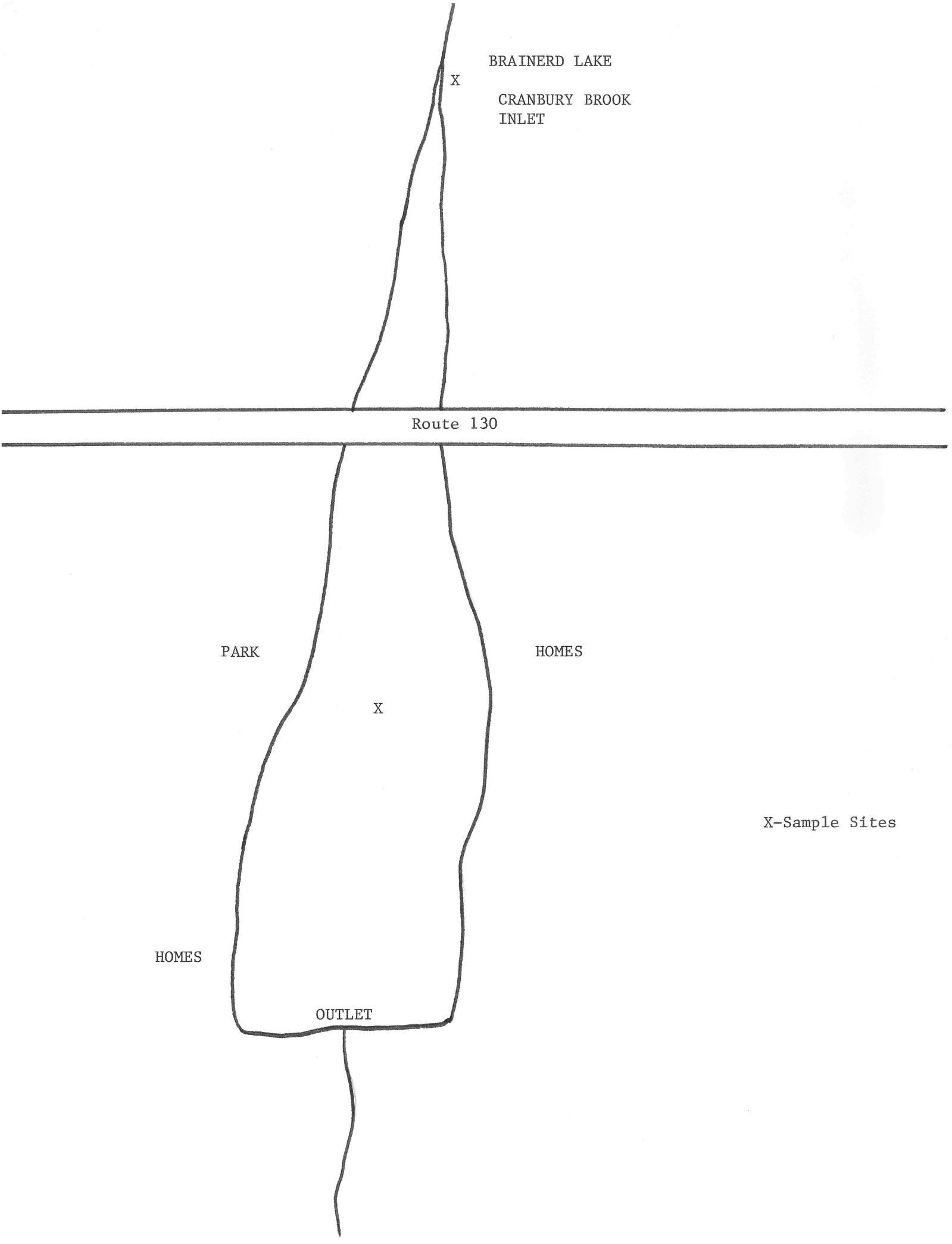
Cem
BM
95
CRANBURY
Standpipe
BM
90
Brainerd
Lake
Cranbury
Brook
NECK
ROAD
BM
STATION
ROAD
BM
119
ROAD
130
TRENTON
Millstone
OLD
ONE
MILE
ROAD
BM
93
River
MIDDLESEX CO
MERCER CO
Water
Rocky
Trailer
Court
CENTRAL
4465
20'
4464
4463
4462
4460
17'30"
4459
(JAMESBURG)
6164 IV SW
CRANBURY STA. 0.6 MI.
12 MI. TO INTERCHANGE NO. 9
GEORGE WASHINGTON BRIDGE 53 MI.


BRAINERD LAKE
X
CRANBURY BROOK
INLET
Route 130
PARK
HOMES
X
X-Sample Sites
HOMES
OUTLET