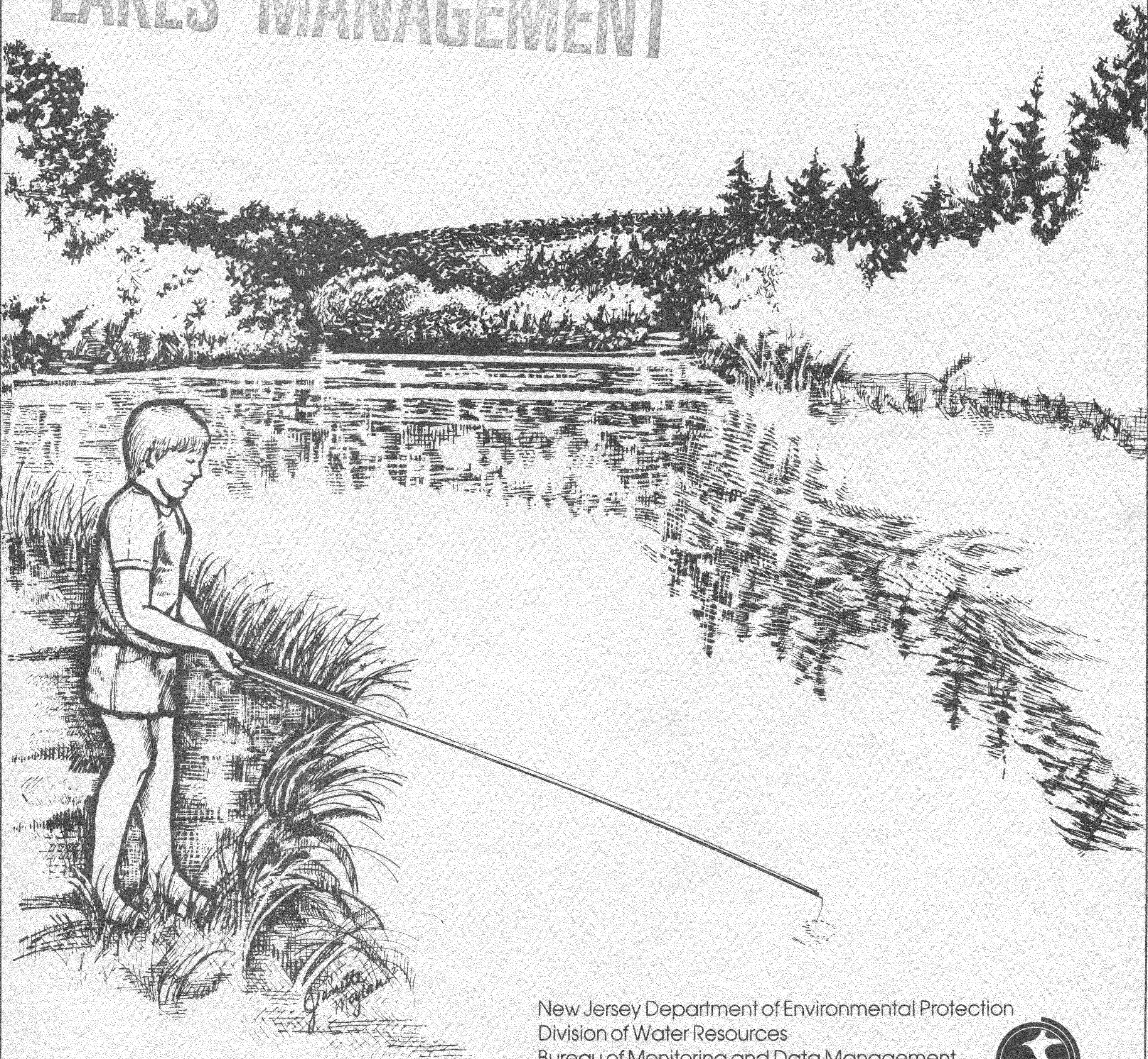
NEW JERSEY LAKES MANAGEMENT PROGRAM
LAKES CLASSIFICATION STUDY
NEW BROOKLYN LAKE • Winslow, Camden County



New Jersey Department of Environmental Protection
Division of Water Resources
Bureau of Monitoring and Data Management

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John Brzozowski
Lakes Management Coordinator

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SECTION I

INTRODUCTION[1]

Public awareness has heightened in recent years concerning the degradation in water quality and recreational potential of many of the lakes, ponds and reservoirs of New Jersey. The observed deterioration of water quality and its ramifications are accelerated by cultural factors. Although the eutrophication of a lake is a slow natural process - one which proceeds gradually over thousands of years, it may be accelerated by human activity. Watershed urbanization, the discharge of insufficiently treated sewage and septage, soil erosion, and the application of fertilizers all increase the nutrient load entering the receiving water body. Consequently, increased nutrient loads stimulate productivity and accelerate the eutrophication process. The fact that a lake is aging (eutrophic) is realized when symptoms such as taste and odor problems, algal blooms, nuisance growths of aquatic plants, oxygen depletion, the accumulation of organic sediments and fish kills are observed. It is at this point that a call for the improvement or restoration of the affected water body is publicly voiced.

Recognizing the need to assist local governments in managing their lakes, the Department's Lake Management Program was initiated in 1975. The development of a statewide inventory was followed shortly thereafter by water chemistry sampling at over 450 lakes. Approximately 30% of New Jersey's lakes were presumed to be eutrophic based on field observations and limited water chemistry data. Final determination of trophic state and the development of management plans, however, necessitated more extensive chemical sampling and analyses.

[1] A Glossary of Lake and Watershed Management Terms is presented in Appendix 2.

To carry out this phase, the Department secured a $100,000 Federal Lakes Classification Grant in November 1979. Areawide planning agency recommendations formed the basis for selecting twenty-five priority lake systems for intensive study. The results of one of these studies is contained herein. It is hoped that these limnological studies and management proposals will find enthusiastic support with which to finance much needed management programs.

SECTION II

ANALYTICAL APPROACH

The objectives of the New Jersey Lake Classification Study are to:

- o Conduct diagnostic studies on 25 priority lakes;
- o Calculate nutrient loadings for each lake based on existing land uses and measured nutrient contributions;
- o Determine the trophic status of each lake; and
- o Recommend appropriate restoration/management techniques which best meet the problems and conditions unique to each lake.

Diagnostic Studies

In 1979, the Lakes Management Program staff collected detailed chemical, bacteriological, biologicial and sediment data for each lake system. Point sources were identified and their physical and chemical characteristics measured. Together these data were used to assess the existing environmental condition of each water body. In addition, all available data related to the morphometry, hydrology, and geology/soils of each lake was tabulated.

The location (longitude/latitude), mean depth, maximum depth, volume, area, retention time, average inflow and discharge, average annual precipitation, areal water load, area of watershed, major soils, geologic designation, dominant summer phytoplankton and aquatic macrophyte species were determined. Mean summer chlorophyll a and mean annual secchi disk depth were calculated, as were summer nitrogen: phosphorus ratios.

Calculation of Annual Nutrient Loading

The annual total phosphorus and total nitrogen nonpoint source loads were calculated for each lake. Total nitrogen (TN-N) concentrations were obtained by adding measured total kjeldahl nitrogen (TKN) and Nitrite+Nitrate-Nitrogen (NO_2+NO_3-N) concentrations. Phosphorus was reported in the measured data base as total phosphate (T-PO_4) and was converted to total phosphorus (TP) using a conversion factor of 0.326. Tributary loads were obtained for each lake by multiplying mean nutrient concentrations, for both TN and TP, by the mean annual flow of each individual tributary. The annual load was then computued by summing the tributary loads. The resulting sum represented the annual nonpoint source load entering each lake.

In those cases where point sources, such as sewage treatment plants, existed in the watershed, mean TN and TP concentrations were multiplied by average annual point source discharge flow to yield the mean annual TN and TP point source load. The impact of point sources was tempered by their distance from the lake. The importance of point source contributions on the total annual nutrient budget is discussed in detail in the text.

These data provide a framework for the preliminary analysis of the trophic condition of each lake and serve as a means of verifying loads computed using unit areal loading methodology.

Unit areal loading (U.A.L.) methodology was utilized to calculate existing phosphorus loads on the basis of land use. An approach similar to that outlined in the Clean Lakes Program Guidance Manual (EPA, 1980) was utilized. In essence, the area of the watershed and its sub-basins was delineated and calculated for each lake on the basis of U.S.G.S. 7.5 Minute Topographic Contour Maps. Land use within each watershed was determined from recent (March 1979) aerial photographs (scale 1" = 1200'). Land use categories were developed and applied to each watershed using the following classification system:

o High Density Residential - one or more housing units/acre or 2.5 or more units/hectare;

o Low Density Residential - less than one housing unit/acre or less than 2.5 units/hectare;

o Commercial - business, industry, airports, and parking lots; land use in which the majority of the area is impervious;

o Disturbed - Open - landfills and construction sites, areas of barren, undeveloped land use characterized by exposed soils, lacking substantial vegetative cover;

o Covered - Open - vacant lots, parks, large lawn areas; land use which has vegetative cover, but no appreciable canopy;

o Agriculture - active productive farmland;

o Forested - areas covered by tree canopy.

The total phosphorus, total nitrogen, and total suspended solid loads contributed by each sub-basin as a result of land use practices were calculated through the application of loading coefficients as listed in Table 1 (Uttormark, et al. 1974, EPA 1979, EPA 1980). Loads were generated by multiplying the appropriate loading coefficient, specific for nutrient and land use, by the area of the land use type in the sub-basin or watershed. All data were reported in kg yr^{-1}. Under most circumstances the average loading coefficient developed for the land use in question was employed in calculating the annual load (Table 1). However, in certain cases, as determined from data or observations recorded during the sampling program, loading coefficients other than the average were employed.

A more accurate assessment of urban unit areal loading was obtained by differentiating the contributions associated with the major components of urban land use. From the available range of urban loading coefficients (Table 1), unit areal loading relationships were generated for high density residential, low density residential, and commercial applications. Loading coefficients were developed which best reflected the influence of population density, impervious surfaces, vehicular traffic, storm sewers, etc. on the loads eminating from these urban land use categories. The mean urban loading coefficients were utilized for the high density residential category, whereas the minimum urban loading coefficients were used for low density residential applications. Commercial land use activities were assigned loading coefficients double the mean urban loading values. In light of the urban nature of many of the lakes in this study, the use of these modified export coefficients appears to be more appropriate than lumping these categories under a single land use category through the application of an average loading coefficient.

Loading coefficients were also modified in some instances in which agriculture comprised the majority of land use in the drainage basin. These situations are treated specifically in the text of the report. Essentially, modifications were made to account for unique soil/slope conditions, agricultural practices, and nutrient contributions from livestock.

Table 1

APPROXIMATE RELATIONSHIP BETWEEN LAND USE
AND UNIT AREAL LOADING FROM NONPOINT SOURCES

	Average (kg ha^{-1} yr^{-1})			Range (kg ha^{-1} yr^{-1})			As Used in This Study (kg ha^{-1} yr^{-1})		
	TN	TP	TSS	TN	TP	TSS	TN	TP	TSS
Forest[a]	2.5	0.2	250	1-10	0.005-1	40-400	2.5	0.2	250
Range/Pasture[a]	5	0.3	400	2-10	0.2-0.6	10-1,000	5.0	0.3	400
Cropland[a]	10	0.6	1,600	1-40	0.03-0.7	300-4,000	10.0	0.6	1,600
Urban[a]	5	0.8	2,000	2-20	0.25-5	200-5,000	SEE TEXT FOR DETAILS		
Feedlots[a]	1,000	250	--	700-1,500	100-400	--	1,000	250	--
Precipitation[b,c]	10	0.25	--	1-100	0.25-1	--	10.0	0.25	--
Open-Disturbed[d]							10.0	0.6	2,000
Open-Covered[e]							5.0	0.3	400
Dryfall on Watershed							0.4	0.002	--

[a]Applied to watershed area.

[b]Applied to lake surface area.

[c]For 102 cm (40") per year.

[d]Assumed same as agricultural application, but ascribed higher TSS value to account for lack of cover.

[e]Assumed same as range/pastureland.

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

Determination of Trophic Status

Emphasis was placed on the role of phosphorus in determining the productivity of each lake. In most instances, phosphorus was found to be the element which limited the amount of primary production in the lake, as represented by algae or aquatic plant growth. The importance of phosphorus stems from its low availability in the water column relative to the phosphorus requirements of algae and aquatic plants in photosynthesis and subsequent tissue production. Phosphorus is usually depleted from the lake before other nutrients and thus becomes the factor that limits primary production.

On the basis of the unit areal loading data, the spring total phosphorus concentration (gm^{-3}) for each lake was calculated using the empirical model of Dillon (1974):

Equation 1: $$[P_s] = \frac{L\,(1-R)T}{\bar{Z}}$$

Where: $[P_s]$ = Spring phosphorus concentration (gm^{-3})

L = Areal Load ($gm^{-2}yr^{-1}$)=unit areal load/lake surface area

$\bar{Z}$ = Mean depth (m)

T = Hydraulic retention (yr)

R = Phoshorus retention

The utility of this approach is that the spring total phosphorus concentration can be computed from readily available morphometric data. This information is important in that it provides an estimate of the amount of TP available for utilization by primary producers at the onset of the growing season. This is a determining factor of summer productivity in most lakes. Developed primarily for use with phosphorus-poor Canadian Shield lakes, the model has been verified for use with north temperate nutrient enriched lakes (Reckhow, 1977). Although a robust model, it may underestimate spring total phosphorus in highly enriched lakes, and overestimate spring total phosphorus in lakes with a large areal water load (ratio of lake outflow:lake surface area).

The importance of areal water load on phosphorus availability and lake trophic status stems from its relationship with lake flushing. Areal water load, the amount of water which is exchanged in the lake during the course of a year is a function of the lake's surface area and the amount of water discharged from it annually. In those lakes with a short hydraulic retention time, less than approximately 34 days, flushing is fairly frequent and the resulting areal water load is usually high, greater than 30 m yr^{-1}. Under such circumstances, the bio-uptake of available phosphorus is reduced as is the deposition of phosphorus compounds to the lake's sediments due to the quick movement of water through the lake. Much of the available phosphorus may thus pass through the system without being utilized or deposited. The magnitude of the lake's productivity is thus less than would be expected on the basis of phosphorus loading alone.

The importance of areal water load is best observed in the computation of an intrinsic part of the Dillon model, (R), the phosphorus retention coefficient. Values for (R) are obtained independent of Equation 1, and various models have been developed for its estimation. Two models were utilized in this study. In those lakes where areal water loading was >30 m yr^{-1}, phosphorus retention was calculated using the model of Kirchner and Dillon (1974):

Equation 2: $$R=0.426e^{(-0.271qs)} + 0.574e^{(-0.00949qs)}$$

Where: R = Phosphorus retention

$$qs = \text{Areal water load} = \frac{\text{Annual Outflow from Lake}}{\text{Surface Area of Lake}}$$

e = Exponential of natural log e = 2.718

In lakes where areal water loading was low ($<30\ m\ yr^{-1}$), a modified phosphorus retention model was employed. This model, developed by Ostrofsky (1978), supplies a more accurate prediction of phosphorus retention for lakes which flush infrequently. In such cases, phosphorus retention was calculated as follows:

Equation 3: $$Rp = 0.201e^{(-0.0425qs)} + 0.5743e^{(-0.00949qs)}$$

Where: Rp = Phosphorus retention

$$qs = \text{Areal water load} = \frac{\text{Annual Outflow from Lake}}{\text{Surface Area of Lake}}$$

e = Exponential of natural log e= 2.718

The predicted maximum summer chlorophyll a concentration was derived from the data generated by Equation 1 through the use of the empirical model of Dillon and Rigler (1974):

Equation 4: $$\log_{10} [Chla_s] = 1.449 \log_{10} [P_{sp}] - 1.136$$

Where: $[Chla_s]$ = Summer chlorophyll a ($mg\ m^{-3}$)

$[P_{sp}]$ = Spring total phosphorus ($mg\ m^{-3}$)

An alternate model was used to predict maximum summer Chla in those lakes where the summer nitrogen:phosphorus (N:P) ratio was below 12:1. Under such circumstances, the Dillon-Rigler model is an inappropriate modeling tool, tending to overestimate the predicted summer Chla concentration. To compensate, the variable yield model of Smith and Shapiro (1980) was used in those lakes where the N:P ratio was <12:1. The model is as follows:

Equation 5: $$\log_{10}[Chla_s] = 1.55 \log_{10} [Psp] - b$$

Where: $[Chla_s]$ = Summer chlorophyll a (mg m^{-3})

$[P_{sp}]$ = Spring total phosphorus (mg m^{-3})

$$b = 1.55 \log_{10}\left[\frac{6.404}{0.0204\ (TN:TP) + .334}\right]$$

It should be remembered that the final predicted maximum chlorophyll a concentration is really a measure of potential primary production and general lake conditions. Other factors that affect primary production such as shading effects and competition for nutrients by macrophytes and benthic algae mats are not accounted for in the model. Thus, one expects discrepancies between actual measured phytoplankton chlorophyll a and predicted values. It may therefore be more appropriate to consider these values chlorophyll a equivalents, an estimate of total potential lake productivity.

The spring total phosphorus concentration generated by Equation 1, was plotted on a trophic status graph developed by Dillon (1974) for use in conjunction with that model. The graph is provided with acceptable and dangerous loading levels, variable for each lake depending on the lake's depth and flushing rate. By plotting L(1-R)T vs. Z, an estimate of the lake's trophic status was obtained. This procedure was carried out for each lake using nutrient loading data calculated from the U.A.L.

computations. The predicted summer TP concentrations and maximum summer chlorophyll a concentrations were compared to in-lake concentrations actually measured during the 1979 intensive lake survey.

An additional method was utilized to determine trophic status. The Trophic State Index (TSI) of Carlson (1977) was calculated using the mean summer chlorophyll a concentration measured in the lake. The lakes were graded on a scale of 0 - 100 depending on the density of summer chlorophyll a (mg m^{-3}). The scores for each lake were compiled, and a ranking system based on the magnitude of scores was used to compare the relative trophic status of each lake.

Restoration/Management Recommendations

Lake restoration/management strategies have been recommended based on the current trophic state and the calculated nutrient loadings. Suggested techniques consider cost-effectiveness, public benefit, water quality improvements and long term effectiveness.

SECTION III

DESCRIPTION OF LAKE AND WATERSHED

New Brooklyn Lake is a small impoundment located in Winslow, Camden County, New Jersey. The 16.19 hectare (ha) lake receives the majority of its hydrologic load from Great Egg Harbor River. This river, and its numerous tributaries, drain a 5626.7 ha watershed. Inflow to the lake, is estimated to total 21.6 x $10^6 m^3 yr^{-1}$. Outflow from the eastern and western outlets of the lake's spillway could not be accurately measured due to irregularities in the dam structure. Total annual outflow was assumed to equal total inflow. It should be noted that a substantial groundwater contribution to the lake is suspected to exist. The lake's hydraulic retention time is 2.2 days, but this is highly variable.

Land use in the drainage basin is dominated by forested land (50%), some of which occurs within the boundaries of New Brooklyn County Park. Much of the forested land is characterized as swampy, particularly along the stream corridor of Great Egg Harbor River. Other land use interspersed throughout the basin includes agricultural (10.9%) and commercial (5.3%) (Table 2). High density residential and low density residential account for 16.4% and 6.5% of the total watershed areas, respectively. The developed sections of the watershed are associated with the towns of Berlin and Gloucester and urbanized corridors along Blackwood Road and New Freedon Road (Figure 1). A sewage treatment plant (STP), located in Berlin, is a point source to the lake. The plant discharges effluent into Great Egg Harbor River approximately 8 km upstream of the lake. Outflow from the STP averages 2.03 x $10^3 m^3 day^{-1}$ (0.54 MGD).

Table 2

DESCRIPTION OF LAKE AND WATERSHED

Lake Name	New Brooklyn Lake, Winslow, Camden County, NJ
Survey Number	793404
Study Period	4/79 - 12/79
Location	$39^{o}42'10''$ x $74^{o}56'21''$
Lake Elevation	31.1 m
Lake Area	16.19 ha
Lake Mean Depth	0.76 m
Lake Volume	$1.2 \times 10^{5} m^{3}$
Estimated Mean Detention Time	2.2 days
Thermal Stratification	None
Land Use	
High Density Residential	924.0 ha
Low Density Residential	368.1 ha
Commercial	296.2 ha
Open Covered	433.0 ha
Open Exposed	181.8 ha
Agriculture	612.1 ha
Forest	2811.5 ha
Total Watershed Area	5626.7 ha

The major soils in the basin are alluvial, emphasizing the swampy nature of the basin. Such soils are poorly drained, and are severely limited for septic and sanitiary landfill applications. The geologic designation is Cohansey sand and is typical for much of the land in southern New Jersey (SCS, 1961).

In the past, New Brooklyn Lake has been used for fishing, boating and swimming. The dense weed problem presently characteristic of the lake has precluded most recreation. The lake is still used for boating and fishing. However, these activities are restricted to the few open areas of the lake.

SECTION IV

EXISTING WATER QUALITY

Due to its shallow depth (Z = 0.76m), the lake does not become thermally stratified. Dissolved oxygen concentrations measured in the deeper parts of the lake are occasionally unacceptable (<5.0 mg l^{-1}). This was particularly evident in the summer as observed in the 1979 field survey (NJDEP, 1981). These low D.O. concentrations are attributed to bacterial respiration. Suggested causes of high benthic oxygen demand include organic inputs from developed areas, and the decay of aquatic macrophytes and plankton cells. Nocturnal community respiration is assumed to cause a substantial decrease in dissolved oxygen concentrations, while daytime photosynthetic oxygen production is responsible for the occasional supersaturation of the surface layers.

Throughout the lake, the mean pH value is below neutral, averaging approximately 6.0. The lake has a moderate to low buffering capacity, as indicated by an average alkalinity of 33.7 mgl^{-1} ($CaCO_3$). Such conditions are typical of most lakes of the southern New Jersey pineland region.

Nitrite concentrations are high, averaging 0.16 gm^{-3} with a maximum, measured at the Berlin STP outfall, of 0.36 gm^{-3}. The concentration of ammonia, total kjeldahl nitrogen, and nitrate in the Great Egg Harbor River are likewise highest at the Berlin STP outfall. Due to the shallow gradient of Great Egg Harbor River, the effluent from the Berlin STP backs upstream approximately 0.4 km. As a result, the water quality upstream as well as downstream of the plant is affected. In terms of volume, the Berlin STP hydrologic load is substantially more than the average background flow of the receiving stream.

The concentrations of orthophosphate (PO_4) and total phosphorus (TP) were highest at the Berlin STP outfall. Average instream concentrations are sufficient enough to support algal blooms (Appendix 1).

Overall, the nutrient concentrations are highest just downstream of Berlin and decrease somewhat downstream. In-stream biological uptake and sedimentation, as well as other processes in the wetlands through which Great Egg Harbor River passes decrease a large portion of the TN and TP loads, but a considerable amount of nitrogen and phosphorus still reach the lake.

Nitrogen:phosphorus ratios indicate nitrogen to most frequently be the limiting nutrient in the lake. However, the total load of both TN and TP are excessive. Light and biological interactions are probably influential primary productivity, and may exert a limiting effect more important than that caused by nutrients (NJDEP, 1981).

The major problems associated with the lake are the accumulation of eroded sediments, and the density of aquatic weeds. The density of aquatic macrophytes contributes, in part, to the generally low secchi disc transparencey ($\bar{x}$=0.5m), a measurement of the attenuation of light in lake water. Eroded sediments have contributed to the filling of the lake.

Zooplankton and phytoplankton populations are relatively sparse. The mean phytoplankton cell density is just over 200 cell ml^{-1}. More than half of the lake's surface are may become covered by vascular plants and algal mats. This may lead to the competitive inhibition of phytoplankton development. Vascular plants indicative of nutrient enrichment and acidic conditions such as Cabomba and Utricularia, respectively, predominate.

The concentration of coliform and streptococcus bacteria occasionally did exceed the State Standard at all stream and lake stations. Bacterial contributions from the Berlin STP are considered to be minimal. Residential runoff and septic system malfunctions are believed to be the likely sources. An unknown source of bacterial contamination, occurs in the vicinity of station 5 (Appendix 1).

The lake's fishery appears to be in fair condition. Most of the sampled fish were of harvestable size, and most game fish display about average growth rates. Spawning success is variable, with pumpkinseeds (*Lepomis gibbosus*) and largemouth bass (*Micropterus salmoides*) having discontinuous year class representation. The dense vegetation which characterizes the lake, limits access to anglers. As a result, most fishing occurs in the few open areas of the lake, particularly near the dam. The density of aquatic macrophytes also presented a problem during the fishery survey of the lake and may have biased the findings somewhat (NJDEP, 1981). Some of the other fish sampled from the lake are characteristic of acid habitats. Species such as blackbanded sunfish (*Enneacanthus chaetodon*), blue spotted sunfish (*E. gloriosus*), banded sunfish (*E. gobesus*), mud sunfish (*Acantharchus pomotis*) and swamp darter (*Etheostoma fusiforme*) are reported to occur in New Brooklyn Lake.

SECTION V

TROPHIC STATE ANALYSIS

The nutrient loading data, in conjunction with lake morphometry and hydrology, were utilized to calculate the trophic status of the lake. Features of New Brooklyn Lake which call for close attention are the extensive marsh area immediately upstream of the lake, point source nutrient contributions from the Berlin STP, the acidic pH of the lake, the large ratio of watershed area to lake surface area, and the low nitrogen:phosphorus ratios. All these factors play an intrinsic role in the biology of New Brooklyn Lake. This is particularly true in regard to in-lake productivity and the relative densities of phytoplankton and aquatic macrophytes.

The Unit Areal Load (U.A.L.) contributions to the lake, excluding point source contributions, total 2459.5 kg for Total Phosphorus (TP) yr^{-1} and 28047.8 kg for Total Nitrogen (TN) yr^{-1}. The annual loads, as measured in 1979 at the head of the lake (Station 5, Appendix 1) are 6504.7 kg TP yr^{-1} and 53784.0 kg TN yr^{-1}. The measured data is suspect, in that stream flows were measured on only one date. The lack of flow data from most of the other tributaries increases the difficulty of ascertaining the actual measured load. For these reasons, the U.A.L. data will be used as the sole estimate of nutrient loading to New Brooklyn Lake (Table 3).

The measured annual mean TN and TP loads discharged from the Berlin STP are 18307.2 kg yr^{-1} and 5127.1 kg yr^{-1}, respectively. This effluent is discharged into Great Egg Harbor River, approximately 8 km upstream of New Brooklyn Lake. Throughout the majority of its course, Great Egg Harbor River flows through marsh and swamp land. The distance of the STP from the lake and the uptake of nutrients in the marsh mitigates some of the impacts of the STP on the lake. The magnitude of the

Table 3

NEW BROOKLYN LAKE
UNIT AREAL LOADING FOR TOTAL NITROGEN
TOTAL PHOSPHORUS AND TOTAL SUSPENDED
SOLIDS AS BASED ON WATERSHED LAND USE

Land Use	Computed Load kg yr^{-1}		
	TP	TN	TSS
Residential			
High Density Housing	739.2	4620.0	1848000.0
Low Density Housing	92.0	920.3	73620.0
Commercial	444.3	2962.0	1184800.0
Open Covered	129.9	2165.0	173200.0
Open Exposed	109.1	1818	363600.0
Agriculture	367.3	6121	979360.0
Forest	562.3	7028.8	702875.0
Fallout on Lake	4.1	162.0	-
Fallout on Watershed	11.3	2250.7	-

measured annual point source load is very high. Although it is difficult to assess the full effect this STP has had on the eutrophication of the lake, it has undoubtedly influenced the productivity and water quality of both the lake and Great Egg Harbor River. Although the wetland in the headwaters of New Brooklyn Lake provide a natural "filter" for the lake, this effect is seasonal. In the fall, the extensive marsh and swamp land also serves as a source of organic material and nutrients to the lake.

The majority of biological and chemical indicators of accelerated eutrophication suggest that New Brooklyn Lake is in a later stage of lake succession. The majority of the lake's bottom is covered by dense growths of submergent and emergent vegetation. Dissolved oxygen concentrations are variable and a substantial benthic oxygen demand is suspected. Secchi transparancy is low (<0.56 m), although this is in part due to the humic color of the lake. The perimeter of the lake is characterized by marsh land and swamp.

Phosphorus retention was calculated by Equation 2 to be 0.160. However, this value is based on limited hydrological data. The predicted spring TP concentration is 0.638 g m^{-3}, approximately triple the measured concentration of 0.225 g m^{-3} (Table 4).

The low N:P ratio recorded for the lake throughout the year suggests that the productivity in the lake is not phosphorus limited. This contradicts the assumptions intrinsic to the use of the Dillon-Rigler model (eq 4). An alternate model (Smith 1980) was employed which accounts for this factor. Data generated by this model (eq 5) predicts a summer Chl a value of 280.4 mg m^{-3}. The measured mean summer Chl a value for the lake was 11.0 mg m^{-3}. This discrepancy between observed and predicted values is attributable to the assumptions of the model. The chlorophyll a models assume lake productivity will be expressed in the form of phytoplankton rather than aquatic macrophytes and benthic

Table 4

TROPHIC STATUS DATA
NEW BROOKLYN LAKE

Mean Secchi Disc Depth	0.523 m
Summer N:P Ratio	2.3:1
Total Phosphorus Annual Load*	
As measured in 1979	6504.7 kg yr^{-1}
As computed by U.A.L. method	2459.5 kg yr^{-1}
Spring TP Concentration	
As measured in 1979	0.225 g m^{-3}
As predicted by Equation 1	0.638 g m^{-3}
Summer Chlorophyll a Concentration	
Mean as measured in 1979	11.0 mg m^{-3}
Maximum as measured in 1979	18.9 mg m^{-3}
Maximum as predicted by Equation 5	280.4 mg m^{-3}
Trophic Status	
Dillon Criteria	Hyper-eutrophic
Carlson's Trophic State Index	44

*(includes point source contributions as measured in 1979 survey)

algae. Although New Brooklyn Lake is highly productive, very little of this is in the form of phytoplankton. In addition, phytoplankton growth is probably negatively affected by the acidic pH of the lake and the poor transmittance of light resulting from macrophyte shading and the humic coloration of the water.

The results of the Dillon model (Table 3, Figure 2) indicate that the lake is hyper-eutrophic. The annual phosphorus load is excessive, and well beyond that needed to stimulate and support the growth and development of primary producers at nuisance densities. A trophic classification of hyper-eutrophic indicates that the waterbody is in the latter stages of eutrophication.

The Carlson Trophic State Index (TSI) was also used to categorize the lake's condition. This index is based on the concentration of Chl a, as measured in the summer. As mentioned previously, the majority of primary production in New Brooklyn Lake is associated with aquatic macrophytes, not phytoplankton. Chlorophyll a is used as a measure of phytoplankton density. Use of this water quality parameter to predict the trophic state of lakes, such as New Brooklyn, where productivity is predominately in the form of macrophytes yields erroneous conclusion. The resulting TSI of 44 greatly underestimates the trophic state of the lake (Table 3, Figure 3). Therefore, Dillon's classification is more indicative of in-lake conditions.

The morphometry, hydrology, and trophic state of New Brooklyn Lake is compared to the other New Jersey waterbodies studied as part of the 1979 Intensive Lake Survey in Table 5, 6, and 7.

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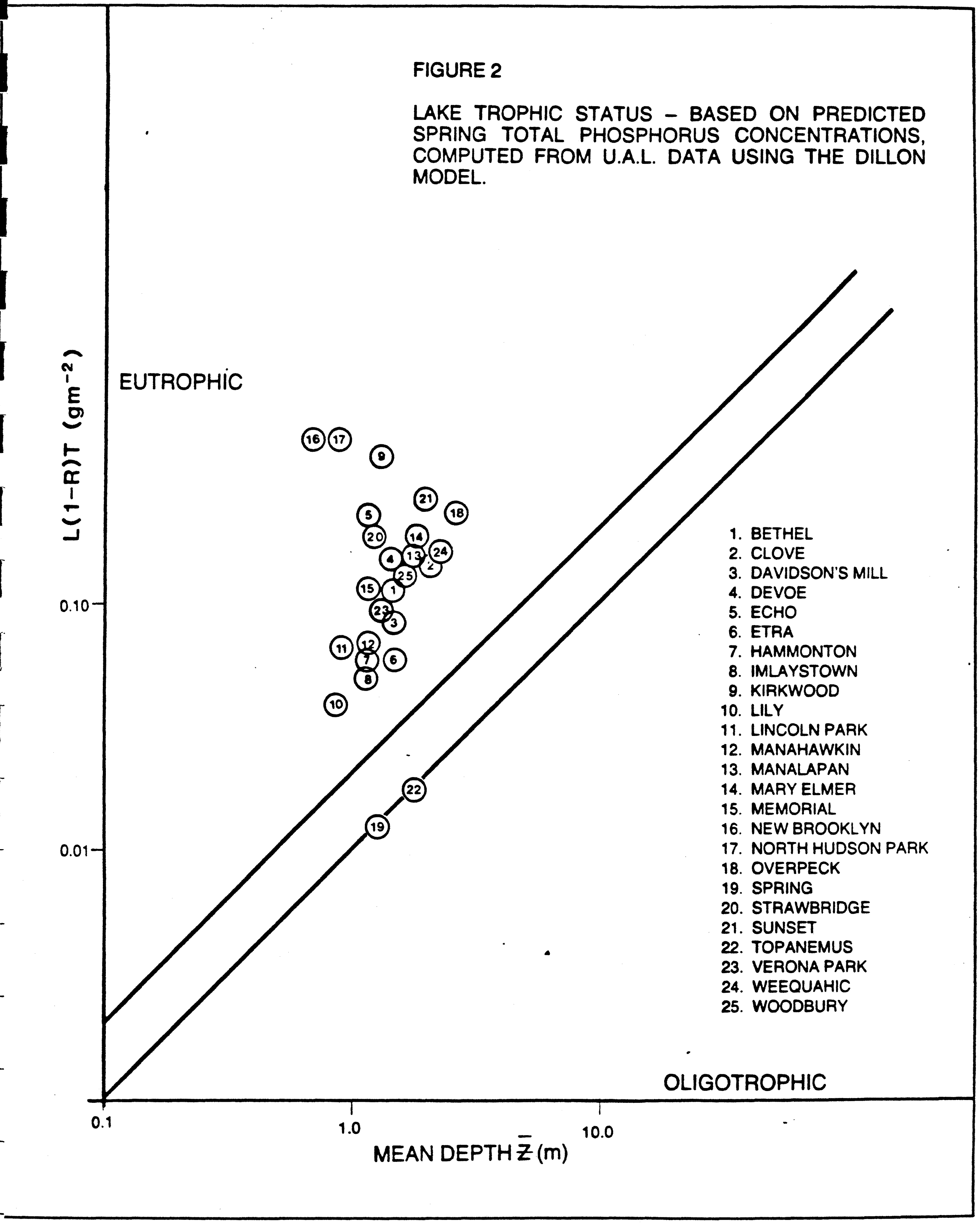
FIGURE 2
LAKE TROPHIC STATUS – BASED ON PREDICTED SPRING TOTAL PHOSPHORUS CONCENTRATIONS, COMPUTED FROM U.A.L. DATA USING THE DILLON MODEL.
L(1-R)T (gm⁻²)
EUTROPHIC
OLIGOTROPHIC
0.10
0.01
0.1
1.0
10.0
MEAN DEPTH Z̄ (m)
1. BETHEL
2. CLOVE
3. DAVIDSON'S MILL
4. DEVOE
5. ECHO
6. ETRA
7. HAMMONTON
8. IMLAYSTOWN
9. KIRKWOOD
10. LILY
11. LINCOLN PARK
12. MANAHAWKIN
13. MANALAPAN
14. MARY ELMER
15. MEMORIAL
16. NEW BROOKLYN
17. NORTH HUDSON PARK
18. OVERPECK
19. SPRING
20. STRAWBRIDGE
21. SUNSET
22. TOPANEMUS
23. VERONA PARK
24. WEEQUAHIC
25. WOODBURY

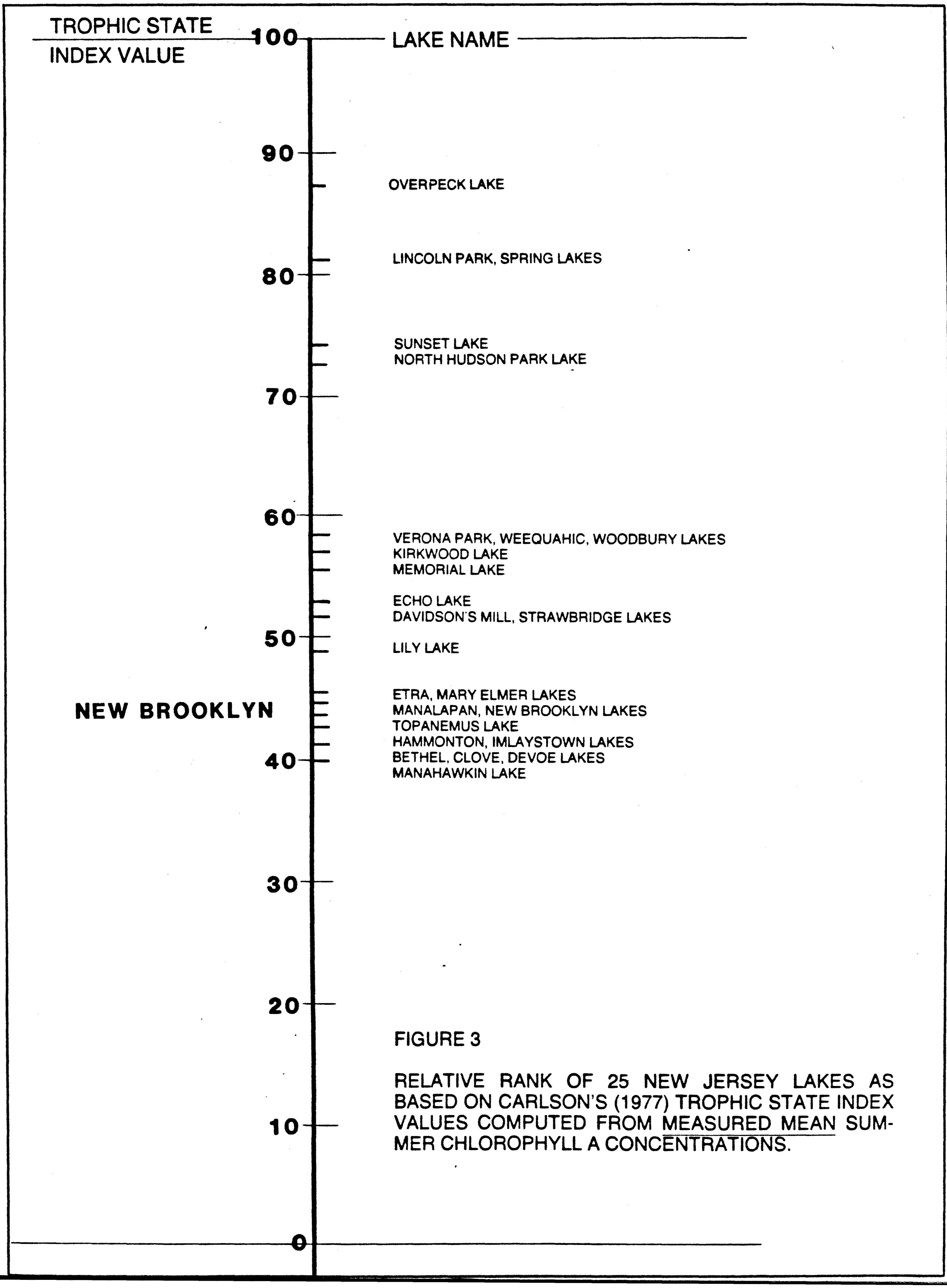

FIGURE 3

RELATIVE RANK OF 25 NEW JERSEY LAKES AS BASED ON CARLSON'S (1977) TROPHIC STATE INDEX VALUES COMPUTED FROM MEASURED MEAN SUMMER CHLOROPHYLL A CONCENTRATIONS.

Table 5

PERTINENT MORPHOMETRIC AND HYDROLOGIC DATA

Lake Name & County	Location in Longitude & Latitude	(m) Maximum Depth	(m) Mean Depth	(m^3) Volume	(ha) Lake Surface Area	($m^3 yr^{-1} \times 10^6$) Annual Inflow	($m^3 yr^{-1} \times 10^6$) Annual Discharge	(cm) Annual Mean Precipitation	($m\ yr^{-1}$) Areal Water Load	(years) Hydraulic Retention Time	(ha) Area of Watershed	Geologic Designation	Soil Designation
Bethel Lake, Manuta, Gloucester Co.	39°45'01" x 75°07'22"	3.05	1.5	$.06 \times 10^6$	1.5	14.54	12.61	110.59	840.7	0.0047	1862.7	Mount Laurel and Wenonah Sand	Westphalia Series
Clove Lake, Sussex, Sussex Co.	41°12'50" x 74°36'40"	5.5	1.83	$.26 \times 10^6$	14.0	24.37	32.00	110.39	228.5	0.0095	5190.9	Martinsburg Shale	Nassau-Bath Norwich Assoc.
Davidson's Mill Lake, So. Brunswick, Middlesex Co.	40°24'38" x 74°30'05"	3.05	1.52	$.15 \times 10^6$	9.7	18.26	13.2	109.8	136.08	0.016	3348.4	Cape May Formation	Woodstown Soils
Devoe (Spotswood) Lake, So. Brunswick, Middlesex Co.	40°20'48" x 74°26'05"	3.05	1.52	$.25 \times 10^6$	16.0	53.6	53.6[A]	109.80	335.0	0.005	10050.5	Magothy and Raritan Formation	Evesboro Sand
Echo Lakes, Mountainside, Union Co.	40°40'37" x 74°20'22"	2.44	1.22	$.11 \times 10^6$	8.9	1.18[B]	0.617[C]	119.36	6.93	0.132	644.2	Brunswick Formation with Basalt flows	--
Etra Lake, E. Windsor, Mercer Co.	40°15'12" x 74°30'00"	2.13	1.52	$.13 \times 10^6$	8.0	25.26	25.13	107.3	314.12	0.006	2048.6	Englishtown Sand	Sassafras-Dragston Assoc.
Hammonton Lake, Hammonton, Atlantic Co.	39°37'48" x 74°47'11"	3.05	1.22	$.46 \times 10^6$	30.0	2.86	2.86[A]	112.78	9.53	0.169	557.3	Cohansey Sand	Klej Lakehurst Evesboro Assoc.
Imlaystown Lake, Imlaystown, Monmouth Co.	40°9'53" x 74°30'40"	1.83	1.22	$.14 \times 10^6$	11.0	20.3[D]	20.3	113.59	184.5	0.007	1997.5	Merchantville Clay	Primarily Sandy

Table 5 (Continued)

Lake Name & County	Location in Longitude & Latitude	(m) Maximum Depth	(m) Mean Depth	(m^3) Volume	(ha) Lake Surface Area	($m^3 yr^{-1} \times 10^6$) Annual Inflow	($m^3 yr^{-1} \times 10^6$) Annual Discharge	(cm) Annual Mean Precipitation	($m\ yr^{-1}$) Areal Water Load	(years) Hydraulic Retention Time	(ha) Area of Watershed	Geologic Designation	Soil Designation
Kirkwood Lake, Lindenwold, Camden Co.	39°50'10" x 75°00'05"	2.13	1.4	$.18 \times 10^6$	13.0	9.47	9.14	107.24	70.30	0.017	1182.3	Kirkwood Sand	Westphalia Nixtonton Barclay Assoc.
Lily Lake, Cape May Point, Cape May Co.	38°56'16" x 74°74'49"	1.52	.91	$.08 \times 10^6$	4.65	--[E]	0.964	104.4	20.73	0.082	73.1	Cape May Formation	Downer-Sassafras Fort Mott Assoc.
Lincoln Park Lakes, Jersey City, Hudson Co.	40°43'32" x 74°05'10"	1.52	.91	$.06 \times 10^6$	6	0.363[F]	0.379	105.16	6.32	0.156	143.8	Newark Formation Diabase Intrusion	--
Manahawkin Lake, Stafford, Ocean Co.	39°41'52" x 74°15'40"	2.44	1.22	$.23 \times 10^6$	19.0	23.89	27.06	--	142.42	0.0096	5260.1	Cohansey Sand	Downer Loamy Sand
Manalapan Lake, Monroe Middlesex Co.	40°20'48" x 74°26'05"	3.35	1.68	$.27 \times 10^6$	16	24.1	24.1	109.80	150.6	0.011	6806.0	Magothy and Raritan Formation	Elkton Soils
Mary Elmer Lake, Hopewell, Cumberland Co.	39°16'49" x 75°15'00"	3.05	1.83	$.13 \times 10^6$	7.0	6.3	8.9	111.8	127.1	0.015	1856.4	Cohansey Sand	Mattapeake Chillam Mattapex Assoc.
Memorial Lake	39°38'42" x 75°19'49"	1.83	1.22	$.1 \times 10^6$	8.0	25.00	25.00	-	312.5	0.004	4342.2	Kirkwood Sand	Mattapex-Mattapeake Assoc.
New Brooklyn Lake, Winslow, Camden Co.	39°42'10" x 74°46'21"	1.22	0.76	$.12 \times 10^6$	16.0	21.6	21.6[A]	111.6	135.0	0.006	5626.7	Cohansey Sand	Muck Alluvial Land Assoc.
No. Hudson Park Lake, North Bergen, Hudson Co.	40°48'06" x 74°00'00"	1.68	.914	$.09 \times 10^6$	8.0	0.05	0.05[A]	105.16	0.625	1.75[G]	26.7	Newark Formation Diabase Intrusion	--

Table 5 (continued)

Lake Name & County	Location in Longitude & Latitude	(m) Maximum Depth	(m) Mean Depth	(m^3) Volume	(ha) Lake Surface Area	($m^3 yr^{-1} \times 10^6$) Annual Inflow	($m^3 yr^{-1} \times 10^6$) Annual Discharge	(cm) Annual Mean Precipitation	($m\ yr^{-1}$) Areal Water Load	(years) Hydraulic Retention Time	(ha) Area of Watershed	Geologic Designation	Soil Designation
Overpeck Lake, Teaneck, Bergen Co.	40°52'100" x 74°00'01"	4.57	2.74	3.2×10^6	117.0	14.89	14.89[A]	105.16	12.72	0.215	4200.1	Brunswick Formation	--
Spring Lake, Hamilton, Mercer Co.	40°11'37" x 74°43'55"	1.52	1.22	$.07 \times 10^6$	6.07	--[A]	.379	102.03	6.24	0.194	10.0	Wisconsin Stratified Drift	Alluvial F.W. Marsh Assoc.
Strawbridge Lakes, Moorestown, Burlington Co.	39°56'59" x 74°57'27"	1.83	1.22	$.12 \times 10^6$	10.0	3.42 upper lake 7.21 lower lake	10.32[C]	107.24	103.2	0.0099	3161.1	English-town Sand	Woodstown Sassafras Assoc.
Sunset Lake, Upper Deerfield Cumberland Co.	37°26'54" x 75°14'16"	3.35	1.98	$.71 \times 10^6$	36.0	58.0	66.0	111.8	183.3	0.011	11649.8	Cohansey Sand	Muck-Atsion Betyland Assoc.
Topanemus Lake, Freehold, Monmouth Co.	40°16'34" x 74°16'59"	2.44	1.83	$.16 \times 10^6$	8.5	1.74	2.32	113.59	27.29	0.084	299.2	Vincetown Sand	Primarily Sandy Soils
Verona Park Lake, Verona, Essex Co.	49°9'35" x 74°14'50"	2.44	1.37	$.07 \times 10^6$	5.0	4.62	4.62[A]	105.54	92.4	0.015	704.4	Brunswick Formula-tion and Basalt flows	--
Weequahic Lake, Newark, Essex Co.	40°42'18" x 74°11'49"	2.44	1.98	$.64 \times 10^6$	32.0	1.50	1.50[A]	105.59	4.69	0.427	231.2	Brunswick Formation	--
Woodbury Lake, Woodbury, Gloucester Co.	39°50'28" x 74°08'29"	2.44	1.52	$.28 \times 10^6$	18.0	7.78	7.38	110.65	41.0	0.038	1352.2	English-town Sand	Freehold-Colts Neck Collington Assoc.

Notes:

A. Outflow assumed to equal inflow.
B. Flow entering upper lake.
C. Flow eminating from lower lake.
D. Does not include all inflow, some ephemeral streams in watershed.
E. No tributaries, inflow from springs and stormwater discharge pipes.
F. Estimate, most inflow from stream and stormwater discharge pipes.
G. Actual retention time may be less, spring fed.
H. No tributaries, spring fed.
I. Majority of inflow from stormwater discharge pipes.

Table 6

MEASURED AND PREDICTED NUTRIENT LOADS
SPRING TOTAL PHOSPHORUS CONCENTRATION, AND SUMMER CHLOROPHYLL A CONCENTRATION

Lake Name	(m) Mean Depth	(m^2) Area	(yr) Hydraulic Retention	($kg\ yr^{-1}$) Measured TN	($kg\ yr^{-1}$) Measured TP	($kg\ yr^{-1}$) U.A.L. TN	($kg\ yr^{-1}$) U.A.L. TP	($gm^{-2} yr^{-1}$) U.A.L. Areal TP Load	Phosphorus Retention	gm^{-3} Predicted Spring TP	gm^{-3} Measured Mean Spring TP	$mg\ m^{-3}$ Predicted Maximum Summer Chlorophyll a	$mg\ m^{-3}$ Measured Mean Summer Chlorophyll a
Bethel	1.5	4×10^4	0.0047	29408.9	688.8	13326.7	1071.2	26.78	0.0002	0.084	0.016	44.9	7.6
Clove	1.83	1.4×10^5	0.0095	31938.4	3008.7	40679.3	3567.6	25.5	0.395	0.080	0.055	41.8	7.7
Davidson's Mill	1.52	9.7×10^4	0.016	38493.8	746.0	20630.7	1488.5	15.4	0.205	0.129	0.018	83.6	25.8
Devoe +	1.52	1.6×10^5	0.005	100461.6	4193.7	76260.6	5053.8	31.6	0.024	0.102	0.049	59.5	7.7
Echo	1.22	8.9×10^4	0.132	4552.3	94.1	3457.0	406.9	4.6	0.687*	0.189	0.046	145.4	36.8
Etra	1.52	8×10^4	0.006	55366.9	1063.4	13258.2	858.2	10.7	0.040	0.041	0.023	15.9	13.3
Hammonton+	1.22	3.0×10^5	0.169	5404.6	666.5	3553.8	348.2	1.2	0.683	0.051	0.009	11.2**	8.4
Imlaystown	1.22	1.1×10^5	0.007	30500.7	1414.5	15219.3	926.5	8.4	0.100	0.043	0.326	6.4**	8.8
Kirkwood+	1.4	1.3×10^5	0.017	113524.5	4069.8	109664.1	4322.3	33.3	0.295	0.285	0.447	166.6**	48.1
Lily	0.91	4.65×10^4	0.082	2034.0	44.0	822.4	43.2	0.9	0.488*	0.043	0.033	17.0	18.9
Lincoln Park	0.91	6×10^4	0.156	3254.7	199.5	897.6	86.2	1.4	0.694*	0.076	0.189	10.9**	174.9
Manahawkin	1.22	1.9×10^5	0.0096	27201.2	303.6	19667.8	1666.1	8.8	0.171	0.057	0.003	9.0**	2.7
Manalapan	1.68	1.6×10^5	0.011	60732.0	2288.2	42865.9	2760.4	17.3	0.140	0.098	0.055	23.3**	11.4
Mary Elmer	1.83	7.0×10^4	0.015	37516.5	285.0	16455.7	1091.6	15.6	0.172	0.106	0.038	62.9	13.7
Memorial	1.22	8×10^4	0.004	97000.0	5368.8	34952.9	2448.9	30.6	0.030	0.097	0.092	55.3	42.2
New Brooklyn +	0.76	1.6×10^4	0.06	53784.0	6504.7	54705.8	2459,5	15.4	0.160	0.638	0.225	280.4	11.0
North Hudson Pk	0.914	8.0×10^4	1.75	166.9	5.6	807.5	91.4	1.1	0.767*	0.509	0.051	217.0**	77.9
Overpeck	2.74	1.17×10^6	0.215	44524.6	1699.4	140084.8	3267.4	2.8	0.626*	0.084	0.077	22.0**	355.2
Spring	1.22	6.07×10^4	0.194	No Data	No Data	116.4	5.3	0.3	0.695*	0.010	0.020	5.12**	67.0
Strawbridge+	1.22	1×10^5	0.0099	29209.8	1839.8	27526.6	2525.1	25.3	0.216	0.161	0.041	115.3	27.6
Sunset +	1.98	3.6×10^5	0.017	296815.0	4443.4	110995.9	9852.0	27.4	0.101	0.137	0.069	91.2	94.6
Topanemus	1.83	8.5×10^4	0.084	7028.1	58.3	2069.0	161.7	1.9	0.506*	0.043	0.042	17.0	10.3
Verona Park	1.37	5×10^4	0.015	8484.4	226.6	3651.3	416.8	8.3	0.239	0.070	0.038	9.1**	52.4
Weequahic	1.98	3.2×10^5	0.427	7113.3	225.3	2583.2	368.7	1.15	0.688*	0.077	0.053	39.4	52.8
Woodbury	1.52	1.8×10^5	0.038	18832.0	833.0	7985.6	978.5	5.4	0.395	0.082	0.117	43.4	52.9

KEY +Indicates point source nutrient contribution
*calculated using Ostrofsky, 1978
**calculated using Smith and Shapiro, 1980

Table 7

RELATIVE TROPHIC STATUS AND PHOSPHORUS-CHLOROPHYLL A RELATIONSHIP FOR 25 NEW JERSEY LAKES

Lake Name & County	Observed Dominant Phytoplankton	Observed Dominant Macrophyte	Measured* In-Lake Summer N:P Ratio	(m) Mean** Annual Secchi Disc Depth	($g\ m^3$) Predicted Maximum Spring Total Phosphorus Concentration	($mg\ m^3$) Predicted Maximum Summer Chlorophyll a Concentration	Predicted Trophic Status (Dillon)	Trophic*** Status Index Value (Carlson)	Relative Trophic Rank as Based on TSI
Bethel Lake	None	Lemna sp.	67.0:1	1.15	0.084	42.9	Eutrophic	41	22
Clove Lake	None	Lemna sp.	13.8:1	1.125	0.080	41.8	Eutrophic	41	22
Davidson's Mill Lake	None	Myriophyllum, Cabomba, Nuphar sp.	24.8:1	.725	0.033	11.6	Eutrophic	52	12
Devoe Lake	Asterionella	Myriophillum, Cabomba	33.6:1	.775	0.102	59.5	Eutrophic	41	22
Echo Lakes Upper Lower	 Chroococus Chroococus	 Potamogeton Nuphar sp. Lemna minor	 29.3:1 17.1:1	 .575 .750	 0.189	 145.4	 Highly Eutrophic	 55	 11
Etra Lake	Fragelaria	Cabomba Myriophyllum Potamogeton	64.5:1	1.00	0.041	15.9	Eutrophic	45	15
Hammonton Lake	Chrysosphaer-ella Peridinium	Utricularia	12.8:1	1.62	0.051	11.2	Eutrophic	42	20
Imlaystown Lake	None	Nuphar sp. w/Cabomba & Ceratophyllum	7.8:1	0.900	0.043	6.4	Eutrophic	42	20
Kirkwood Lake	Actinastrum Chlamydomonus Melosira	Nuphar sp. w/some Lemna and Cabomba	13.5:1	0.59	0.285	166.6	Highly Eutrophic	58	9

Table 7 (continued)

Lake Name & County	Observed Dominant Phytoplankton	Observed Dominant Macrophyte	Measured* In-Lake Summer N:P Ratio	(m) Mean** Annual Secchi Disc Depth	$(g\ m^3)$ Predicted Maximum Spring Total Phosphorus Concentration	$(mg\ m^3)$ Predicted Maximum Summer Chlorophyll a Concentration	Predicted Trophic Status (Dillon)	Trophic*** Status Index Value (Carlson)	Relative Trophic Rank as Based on TSI
Lily Lake	Oscillatoria	Potamogeton sp.	17.3:1	.75	0.043	17.0	Eutrophic	49	14
Lincoln Park Lakes Upper / Lower	Actinastrum, Coelastrum, Oscillatoria	Lemna sp.	.87:1 / 4.9:1	.378 / .298	0.076	10.9	Eutrophic	81	2
Manahawkin Lake	None	Utricularia, Potamogeton	6.4:1	1.035	0.057	9.0	Eutrophic	40	25
Manalapan Lake	None	Myriophillum	8.0:1	.725	0.098	23.3	Eutrophic	44	17
Mary Elmer Lake	None	Nuphar sp. Elodea	178.6:1	0.913	0.106	62.9	Eutrophic	45	15
Memorial Lake	Melosira	Nuphar sp.	33.2:1	.354	0.097	55.3	Eutrophic	57	10
New Brooklyn Lake	None	Cabomba Callitriche	2.4:1	0.523	0.638	280.4	Hyper Eutrophic	44	17
North Hudson Park Lake	Chlorococcal-ean algae, Spirogyra	None	3.4:1	.501	0.509	217.0	Hyper Eutrophic	72	5
Overpeck Lake	Anabaena Aphanizomenon	None	11:1	0.317	0.054	11.2	Eutrophic	87	1
Spring Lake	Cyanophyta in Summer	Potamogeton crispus Nuphar sp.	3.8:1 +	.50	0.010	5.12	Mesotrophic	81	2

Table 7 (continued)

Lake Name & County	Observed Dominant Phytoplankton	Observed Dominant Macrophyte	Measured* In-Lake Summer N:P Ratio	(m)+ Mean** Annual Secchi Disc Depth	($g\ m^3$) Predicted Maximum Spring Total Phosphorus Concentration	($mg\ m^3$) Predicted Maximum Summer Chlorophyll a Concentration	Predicted Trophic Status (Dillon)	Trophic*** Status Index Value (Carlson)	Relative Trophic Rank as Based on TSI
Strawbridge Lakes									
Upper	Melosira	Nuphar sp.	28.9:1	.400	0.161	115.3	Eutrophic	52	12
Mid			21.0:1	.425					
Lower			26.2:1	.300					
Sunset Lake	Chlorococcal-ean algae	Nuphar sp.	213.2:1	0.638	0.137	91.2	Eutrophic	74	4
Topanemus Lake	Asterionella	Myriophyllum Elodea	80.8:1	1.29	0.043	17.0	Mesotrophic	43	19
Verona Park Lake	Chlorella Crucingenia Pediastrum	Potamogeton crispus & Elodea cana-densis	2.0:1 ++	.663	0.070	9.1	Eutrophic	59	6
Weequahic Lake	Asterionella Chlorococcal-ean algae	Potamogeton crispus	6.1:1	.761	0.077	39.4	Eutrophic	59	6
Woodbury Lake									
Western Arm	Chlorococcal-ean and Cyano-phyta algae	Nuphar	19.5:1	.375	0.082	43.4	Eutrophic	59	6
Eastern Arm			17.7:1	.30					

*N:P = $\left(\frac{mg\ [NO_2 + NO_3 - N) + (NH_3 + NH_4 - N)]/L}{mg\ (TP)/L} \times 2.21\right)$.

***Based on measured mean Summer Chlorophyll a concentration.

**May be based on readings from 2 or more in-lake stations.

+No summer measurements, based on spring data (6-5-79).

++Based on only the 7-16-79 measurement.

SECTION VI

SUMMARY OF EXISTING CONDITIONS

New Brooklyn Lake is in a state of advanced eutrophication. The lake experiences aquatic macrophyte densities which impede the recreational utilization of the lake. The weeds have altered the habitat of the lake which probably has negatively affected its fishery. The internal generation of organic sediments, resulting from the seasonal decomposition of these plants, has contributed to the filling of the lake. Bacterial respiration associated with the decomposition of this material is responsible for the lake's variable D.O. concentrations and suspected high benthic oxygen demand. In general, the density of aquatic macrophytes has led to noticeable deterioration of the lake's biota, water quality, and recreational potential.

Both non-point and point source nutrient loads are responsible for the excessive influx of TN and TP to New Brooklyn Lake. The Berlin STP is located 8 km upstream of the lake. The magnitude of the daily discharge and water quality of the effluent, relative to the flow and water quality of the receiving stream, suggests that the STP has had an impact on the lake and its main tributary, Great Egg Harbor River. The effects of this point source are evident in relation to the water quality of the stream.

The non-point source loads of total nitrogen and total phosphorus are also excessive. The large area of the watershed relative to the lake surface area results in a substantial areal TP load, 15.4 g m^{-2} yr^{-1} (Table 6). The magnitude of this value indicates that nutrient loading from non-point sources are an important component in the lake's nutrient budget. In view of these data, it becomes apparent that restoration/management efforts will have to be directed at minimizing both non-point and point source loads to New Brooklyn Lake.

The area of the watershed of New Brooklyn Lake is 350 times the surface area of the lake. As a result the lake is subject to a considerable annual hydraulic load (21.6 x $10^6 m^3 yr^{-1}$). In this case, it may not be possible to lower the lake enough to expose a considerable area of the lake's bottom. Unless the sediments are allowed to adequately dewater and consolidate the use of dragline or conventional construction equipment to dredge the lake becomes highly unfeasible. In addition, it is suspected that there is a considerable groundwater input to the lake. This also inhibits the desiccation and consolidation of the sediments, thus preventing the use of conventional construction equipment. It appears that hydraulic dredging is the most feasible means of sediment removal for New Brooklyn Lake.

There are some negative aspects associated with hydraulic dredging. The cost of such an operation is typically high and the disposal of the dredge spoils may be difficult if contaminated with hazardous materials. If the entire lake were dredged and approximately 1 meter of muck removed, the cost would range from $50,000 to $70,000. Due to the extensive filling of the lake, spot dredging does not appear logical, and total lake dredging is recommended.

The concentration of DDT derivitives were found to exceed USGS flag limits. The high concentration of these pesticides may pose some problems in the disposal of dredge spoils. An EP toxicity analysis should be conducted on sediment samples, to establish the leachability of these pesticides. Additional expenses may result in insuring that the sediments are contained and disposed of properly. If there is a problem, care will have to be taken during the dredging operation to protect the fauna of the lake and the downstream receiving waters from pesticides liberated as a result of the dredging operation.

Other problems which may occur as a result of hydraulic dredging are dissolved oxygen depression, nutrient liberation, and increased turbidity (Peterson, 1982). These problems will be short term. In view of the quick flushing of the lake (once every 2.2 days) these temporary disruptions should have little effect on the fauna of the system. As with any extensive dredging operation the benthic community will be destroyed as will the aquatic macrophytes. By leaving a littoral buffer some of the benthic fauna would remain undisturbed as would some of the aquatic macrophytes. In this manner the total benthic community would not be erradicated. In addition, by allowing some macrophytes to remain, valuable fish habitat would be preserved. These remaining macrophytes could be managed, by harvestsing, at the density amendable to the use of the lake through the judicious application of herbicides.

Other in-lake restoration techniques such as bottom sealing, nutrient inactivation, aeration, and dilution/flushing do not appear feasible due to the morphometry and hydrology of the lake (Cooke and Kennedy, 1981; Welch, 1981; Pastorok, 1981).

Once the lake has been dredged restocking with warm water game species such as largemouth bass and pickerel is recommended. In this manner the angling attractiveness of the system could be improved.

Watershed Management

Although in-lake restoration techniques are highly effective when properly implemented, they tend to treat the symptoms and not the causes of accelerated eutrophication. Nutrients and sediments resulting from man's activities in the watershed promote lake eutrophication. If the restoration of a waterbody is to be successful, the nutrient and sediment load must be reduced. Thus a long-term, effective restoration/management program should address the reduction of these loads through the development of a sound watershed management program.

In the New Brooklyn Lake watershed both non-point and point sources contribute nutrients to the lake. As mentioned previously, the actual impact of the Berlin STP on New Brooklyn Lake is unclear. However, it is obvious that the effluent discharged by this plant is of significantly different water quality than that of the receiving stream. In addition, the volume of the discharge from the plant is 2.03 x $10^3 m^3 d^{-1}$, while the flow of the river upstream of the plant is 3.42 x $10^3 m^3 d^{-1}$. Thus, discharge from the STP represents approximately 40% of the combined total flow just below the STP outfall. The water quality of the effluent undoubtably has an influence on the environmental status of the stream. In this respect, some action should be taken to improve the quality of effluent discharged by this plant. This is particularly true in regard to TP which has an average concentration of 6.9 gm^{-3}.

Aside from the Berlin STP, nutrient/sediment loading to New Brooklyn lake originates mostly from diffuse sources. Stormwater runoff from both urban and cultivated land contribute substantially to the total TP and TN loads (Table 3).

The water quality of urban runoff can be improved through its passive treatment. A number of different methods of passive treatment are available which can reduce the TP loads associated with stormwater runoff by 90% (Wanielista, et al., 1981). Those measures which have been most successful are those which promote the detention and percolation of stormwater, particularly the first flush. Detention basins, percolation basins, grit chambers etc. which allow for the settling of sediment particles are recommended. In all cases, the structure should be designed to intercept and treat the first flush.

An additional method by which the quality of stormwater can be improved is through the routine sweeping of streets and impervious areas in urbanized sections of the watershed. A well carried out street sweeping program will help minimize the amount of sediment, debris, and animal waste swept into the receiving streams following storm events. This will reduce the storm related nutrient/sediment load.

In those areas of the watershed which are cultivated (367.3 ha), the incorporation of Best Management Practices (BMPs) will help reduce agricultural inputs. BMPs are essentially designed to decrease soil erosion, and the associated loss of fertilizers and pesticides, from farm land (USEPA, 1980). They encourage conservation tillage, short fallow periods, winter cover crop and grassed buffers as means of minimizing soil loss. In addition, the proper timing and application of fertilizers and the avoidance of the winter spreading of manure are stressed as means to minimize the export of nutrients. Also, methods for the control of nutrient contributions from livestock wastes are available. Implementing these BMPs usually can be done with little or no effect on the farmer.

On the basis of Unit Areal Loading calculations, the various urban land-uses contribute the greatest load of nutrients (TN-TP) and total suspended solids (TSS) per unit area. In the case of New Brooklyn Lake, 28% of the watershed is urbanized. This land has the potential for contributing 52% of the total external TP load, 30% of the TN load and 58% of the TSS load. Storm water would be the primary vehicle responsible for transporting these materials to the lake.

Judging from the magnitude of these data, a comprehensive urban stormwater runoff water quality management program will have to be implemented to improve water quality in New Brooklyn Lake.

It should not be the goal to convert every lake into an oligotrophic water body. This would be impossible to achieve in most cases and would be cost prohibitive. Rather, the lake should be restored to the point where the resulting water quality and environmental status is amenable to the recreational needs of the area. For New Brooklyn Lake an achievable goal would be restoration of the lake so that boating and fishing would be improved. Reduction of the in-lake fecal coliform concentrations below that considered suitable by state standards for contact recreation will be more difficult to achieve. Implementation of sound watershed management practices will be needed.

The prescribed restoration/management plan for New Brooklyn Lake should encompass:

1. Implementation of agricultural BMPs to reduce nutrient/sediment export from cultivated land.

2. Use of passive treatment techniques in the treatment of urban stormwater. Those methods which emphasize the detention of at least the first flush are recommended.

3. Street sweeping in urban areas.

4. Dredging of the lake primarily as a means of increasing its depth, but also as a means of reducing the internal nutrient/organic load.

5. Control and management of the lake's aquatic macrophyte community. The density of weeds should be reduced, but enough plants allowed to remain to provide the habitat needed by the fauna of the lake, particularly fish fry.

6. Restocking and improvement of the lake's fishery.

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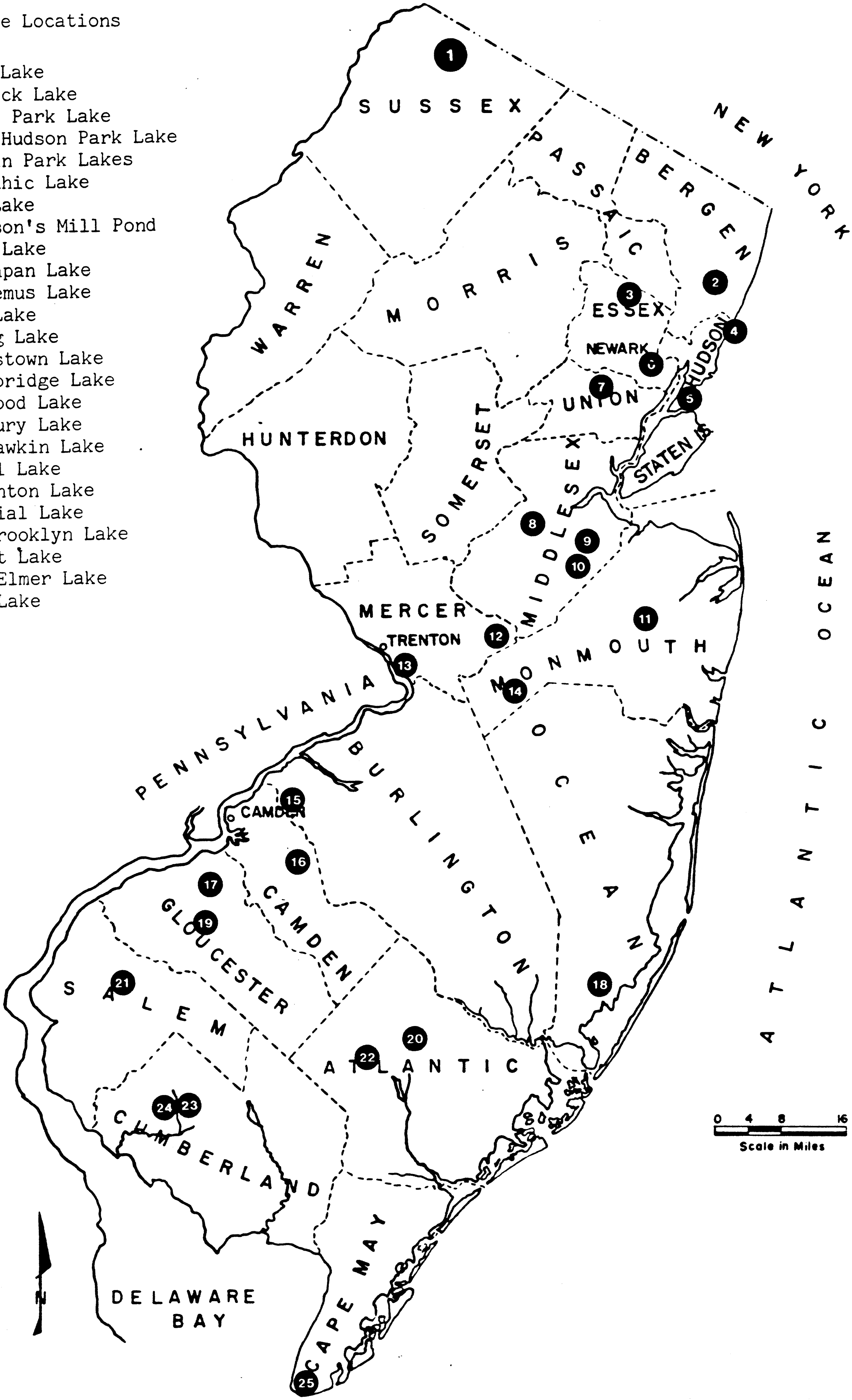
APPENDIX 1

MONITORING DATA FROM
NJDEP INTENSIVE LAKE SURVEY REPORT

FIGURE 4

Key to Lake Locations

Clove Lake
2. Overpeck Lake
3. Verona Park Lake
North Hudson Park Lake
Lincoln Park Lakes
6. Weequahic Lake
Echo Lake
Davidson's Mill Pond
9. DeVoe Lake
10. Manalapan Lake
Topanemus Lake
12. Etra Lake
13. Spring Lake
Imlaystown Lake
Strawbridge Lake
16. Kirkwood Lake
Woodbury Lake
Manahawkin Lake
19. Bethel Lake
20. Hammonton Lake
Memorial Lake
22. New Brooklyn Lake
23. Sunset Lake
Mary Elmer Lake
Lily Lake



LAKE: New Brooklyn COUNTY: Camden SURVEY NUMBER: 793404

FIELD STATION NUMBER	COMPUTER STATION NUMBER	STATION LOCATION	LATITUDE/ LONGITUDE	USGS QUAD.
1	LS CA 1500	New Brooklyn Lake - Great Egg Harbor River at Berlin Road (County Park)	39° 47' 39" 74° 56' 15"	CLEMENTON
2	1520	New Brooklyn Lake - Outfall Berlin STP	39° 46' 52" 74° 56' 39"	CLEMENTON
3	1501	New Brooklyn Lake - Great Egg Harbor River at New Freedom Road	39° 44' 05" 74° 57' 04"	WILLIAMSTOWN
4	1502	New Brooklyn Lake - Tributary from West at New Freedom Road	39° 43' 32" 74° 57' 37"	WILLIAMSTOWN
5	1530	New Brooklyn Lake - Great Egg Harbor River off New Brooklyn Road (at pump house)	39° 42' 52" 74° 57' 01"	WILLIAMSTOWN
6	1580	New Brooklyn Lake - Eastern Outlet (spillway) Rt. 536	39° 42' 07" 74° 56' 14"	WILLIAMSTOWN
7	1581	New Brooklyn Lake - Western Outlet (spillway) Rt. 536	39° 42' 03" 74° 56' 26"	WILLIAMSTOWN
8	1560	New Brooklyn Lake - In-Lake Composite	39° 42' 10" 74° 56' 21"	WILLIAMSTOWN
9	1503	New Brooklyn Lake - Tinkers Branch at Watson Road (Rt. 691)	39° 46' 41" 74° 56' 28"	CLEMENTON

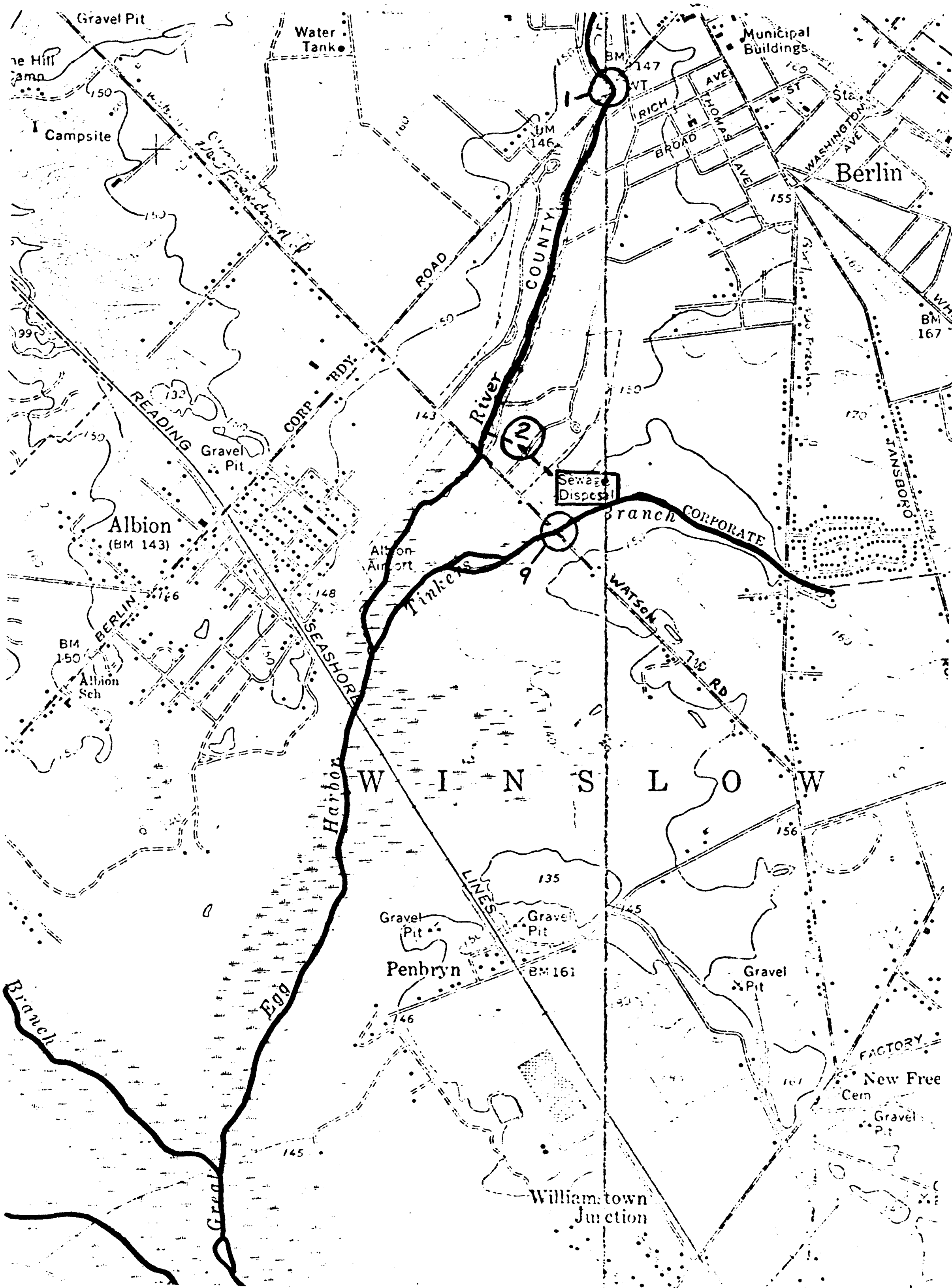
FIGURE 5

NEW BROOKLYN LAKE
STATION LOCATIONS

1 KM

1 MILE

N



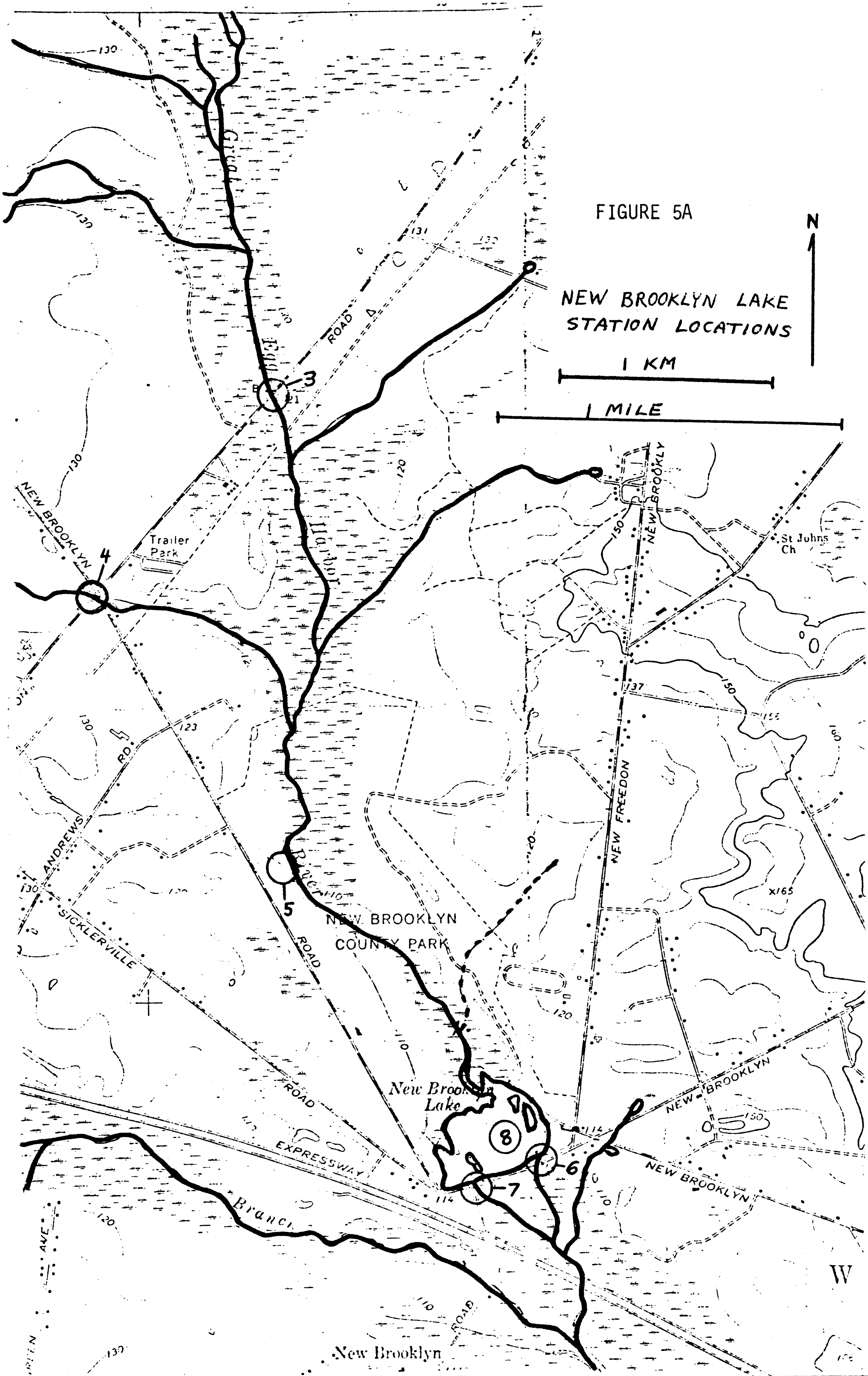
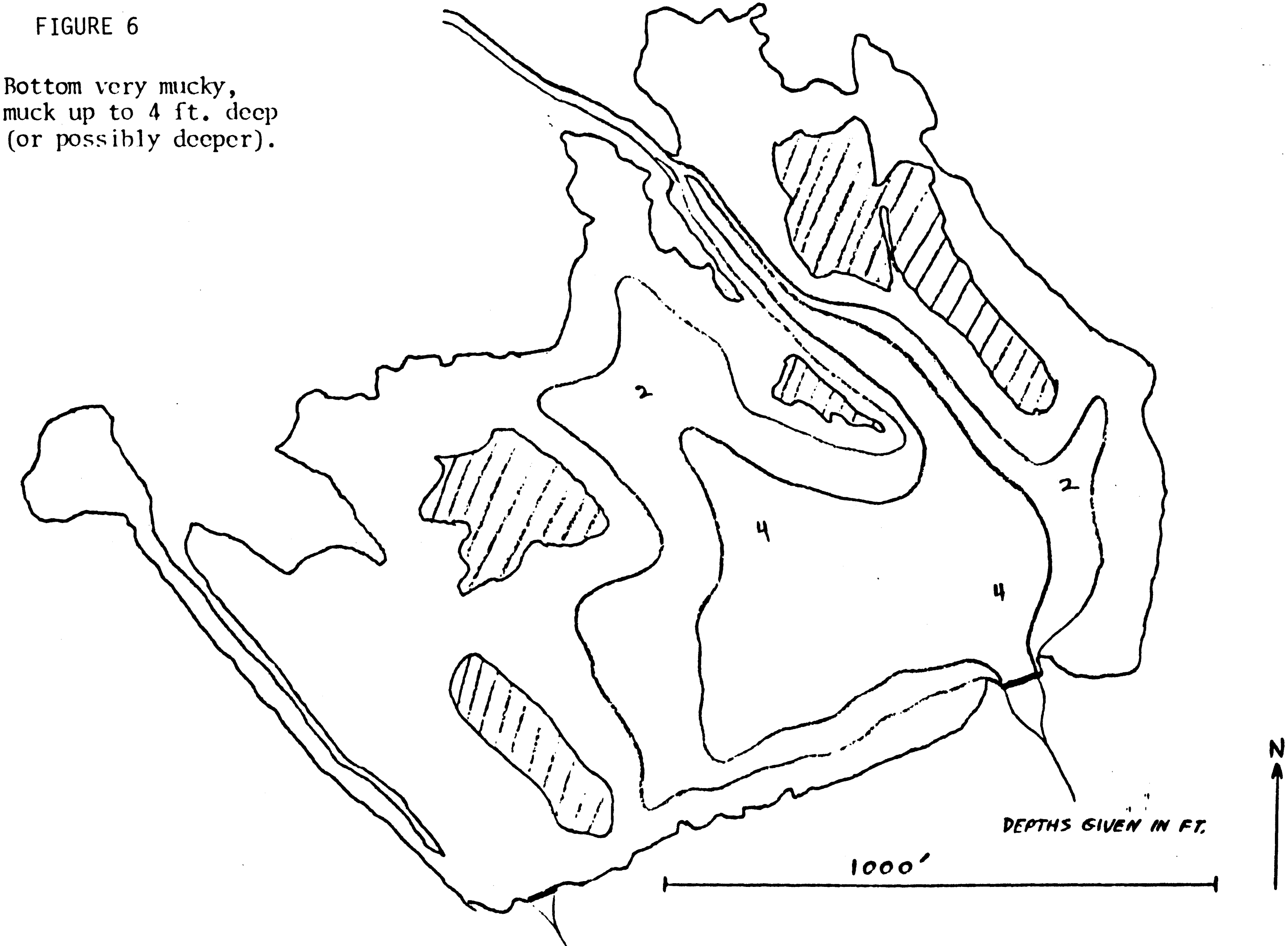


FIGURE 5A

NEW BROOKLYN LAKE STATION LOCATIONS

FIGURE 6

Bottom very mucky,
muck up to 4 ft. deep
(or possibly deeper).



NEW BROOKLYN LAKE

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137605181

NO.	DESCRIPTION	05/16/79	07/05/79	08/01/79	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6048120	6035261	6014871	6003761	6004241	6026501	6031411
00041	WEATHER WMO CODE 4501	0	0	1	1	1	2	5
00010	WATER TEMP (CENT)	19.5	17.0	25.0	23.0	8.5	9.0	7.0
00299	DO PROBE (MG/L)	9.10	10.00	5.50	2.80	5.50	7.10	10.00
00300	DO LAB (MG/L)							
00400	PH (STANDARD UNITS)	6.70	5.90	6.50	6.30	5.30	5.70	5.70
00410	ALKALINITY,TOTAL CACO3 (MG/L)	30	27	25	26	22	21	20
00610	NH3&NH4- N TOTAL (MG/L)	0.600	0.160	0.070	0.440	0.690	0.260	0.230
00615	NO2-N TOTAL (MG/L)	0.051	0.044	0.041	0.027	0.022	0.021	0.017
00630	NO2&NO3-N TOTAL (MG/L)	0.970	1.000	0.740	0.990	1.440	0.400	1.270
00625	TOTAL KJEL N (MG/L)	1.350	3.180	1.710	1.680	1.200	0.690	0.570
00650	PO4 TOTAL (MG/L AS PO4)	0.120	0.060	0.310	0.410	0.150	0.410	0.130
00660	PO4 ORTHO (MG/L AS PO4)	0.110	0.040	0.050	0.100	0.140	0.240	0.130
31505	TOTAL COLI CONFIRM (MPN/100ML)	2800	3500	220	5400	940	9200	80
31615	FECAL COLI EC MED (MPN/100ML)	80	330	50	790	140	230	<20
31677	FECAL STREP AD EVA (MPN/100ML)	49	>2400	540	920	33	>2400	79
32210	CHLOROPHYLL-A (UG/L)							
00078	TRANSPARENCY SECCHI (METERS)							
00061	STREAM FLOW INST (CUBIC FT/S)			0.88	1.54	0.86	2.20	1.52
50051	FLOW RATE INST (MGD)							

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137605181. LSCA1500
39 47 39.0 074 56 15.0 2
NEW BROOKLYN LAKE/GEH RI AT BERLIN RD
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559421-0431979

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/05/16	1445		98.9130	.0013936							1.63265
79/07/05	1400		103.093	.0000490							.137500
79/08/01	1400		65.4762	.0001525	.332256	.194607	3.51242	8.11654	1.47142	.237326	.0925925
79/08/29	1415		32.1839	.0005249	3.65432	.224273	8.22334	13.9548	3.40563	.830640	.858696
79/10/16	0830		47.4138	.0000276	3.20066	.102050	6.67964	5.56637	.695796	.649410	4.24242
79/11/13	0930		61.2069	.0000272	3.06524	.249192	4.74652	8.18774	4.86518	2.84791	.0958333
79/12/13	0800		81.9672	.0000205	1.88566	.139375	10.4121	4.67316	1.06581	1.06581	.253165

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137605105

NO.	DESCRIPTION	05/16/79	05/16/79	07/05/79	08/01/79	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6048118	6048119	6035260	6014872	6003762	6004242	6026502	6031412
00041	WEATHER WMO CODE 4501	0	0	0	1	2	1	2	5
00010	WATER TEMP (CENT)	19.5	18.0	21.0	25.0	25.0	17.0	11.0	12.0
00299	DO PROBE (MG/L)	5.70	3.30	5.20	7.00	5.10	7.00	7.00	8.00
00300	DO LAB (MG/L)								
00400	PH (STANDARD UNITS)	6.90	6.70	7.00	6.60	6.00	7.60	5.90	6.70
00410	ALKALINITY,TOTAL CACO3 (MG/L)	247	78	196	188	192	157	173	159
00610	NH3&NH4- N TOTAL (MG/L)	32.100	8.200		19.700	22.600	13.200	14.800	17.300
00615	NO2-N TOTAL (MG/L)	0.051	0.053	0.033	0.043	0.027	0.027	0.029	0.024
00630	NO2&NO3-N TOTAL (MG/L)	0.540	0.780	0.510	0.110	0.160	0.340	0.060	0.340
00625	TOTAL KJEL N (MG/L)	39.450	13.400		23.300	31.600	19.630	18.990	24.100
00650	PO4 TOTAL (MG/L AS PO4)	27.000		17.500	19.500	20.200	21.100	20.000	23.300
00660	PO4 ORTHO (MG/L AS PO4)	27.000		16.600	17.000	19.700	19.600	18.900	21.100
31505	TOTAL COLI CONFIRM (MPN/100ML)	<20		<20	20	20	<20	<20	<20
31615	FECAL COLI EC MED (MPN/100ML)	<20		<20	20	<20	<20	<20	<20
31677	FECAL STREP AD EVA (MPN/100ML)	<2		<2	8	5	<2	8	<2
32210	CHLOROPHYLL-A (UG/L)								
00078	TRANSPARENCY SECCHI (METERS)								
00061	STREAM FLOW INST (CUBIC FT/S)								
50051	FLOW RATE INST (MGD)	0.680		0.530	0.480	0.690		0.430	0.400

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137605105. LSCA1520
39 46 52.0 074 56 39.0 2
NEW BROOKLYN LAKE/OUTFALL BERLIN STP
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559420-0431978

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/05/16	1415		61.9565	.118034	182.152	.289400	3.06423	223.859	153.212	153.212	10.0000
79/05/16	1430		34.7368	.0170545							
79/07/05	1330		57.7777			.145952	2.25562		77.3986	73.4180	10.0000
79/08/01	1340		83.3333	.0539943	78.9090	.172238	.440609	93.3289	78.1079	68.0941	2.50000
79/08/29	1400		60.7142	.0155857	130.130	.155465	.921273	181.951	116.311	113.432	4.00000
79/10/16	0910		72.1649	.200250							10.0000
79/11/13	0940		63.0631	.0028709	53.1067	.104060	.215297	68.1416	71.7658	67.8187	2.50000
79/12/13	0830		74.0741	.0228607	57.7464	.0801106	1.13490	80.4444	77.7741	70.4306	10.0000

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137604750

NO.	DESCRIPTION	04/09/79	05/16/79	07/05/79	08/01/79	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6032898	6035250	6035259	6014873	6003763	6004243	6026503	6031413
00041	WEATHER WMO CODE 4501	6	0	0	1	2	1	2	5
00010	WATER TEMP (CENT)	9.0	9.0	15.0	27.0	26.5	7.0	8.0	6.2
00299	DO PROBE (MG/L)	9.40	5.60	8.30			8.30	7.00	8.50
00300	DO LAB (MG/L)					8.00			
00400	PH (STANDARD UNITS)	6.30	5.00	6.00		5.80	6.70	5.40	6.00
00410	ALKALINITY,TOTAL CACO3 (MG/L)	13	5	20	20	10	5	4	12
00610	NH3&NH4- N TOTAL (MG/L)	0.770	0.310	0.470	0.120	0.280	0.590	0.180	0.660
00615	NO2-N TOTAL (MG/L)	0.019	0.014	0.025	0.008	0.013	0.018	0.015	0.015
00630	NO2&NO3-N TOTAL (MG/L)	1.180	<0.010	1.370	2.040	1.140	0.940	0.350	1.990
00625	TOTAL KJEL N (MG/L)	1.230	1.600	1.500	1.230	1.140	1.170	1.200	1.440
00650	PO4 TOTAL (MG/L AS PO4)	1.400	1.200	1.900	2.200	1.500	7.000	0.590	1.700
00660	PO4 ORTHO (MG/L AS PO4)	0.920	0.950	1.890	1.930	1.140	0.500	0.520	1.240
31505	TOTAL COLI CONFIRM (MPN/100ML)	330	490	790	1300	1700	790	940	60
31615	FECAL COLI EC MED (MPN/100ML)	50	490	70	80	790	790	330	<20
31677	FECAL STREP AD EVA (MPN/100ML)	70	350	>2400	>2400	920	350	240	25
32210	CHLOROPHYLL-A (UG/L)								
00078	TRANSPARENCY SECCHI (METERS)								
00061	STREAM FLOW INST (CUBIC FT/S)								
50051	FLOW RATE INST (MGD)								

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137604750. LSCA1501
39 44 05.0 074 57 04.0 2
NEW BROOKLYN LAKE/GEH RI AT NEW FREEDON RD
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559419-0431977

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/04/09	1500		81.0345	.0003207							.714286
79/05/16	1330		48.2758	.0000065							1.40000
79/07/05	1300		81.3725	.0001560							.0291667
79/08/01	1320										.0333333
79/08/29	1315		98.7654	.0001354							.858696
79/10/16	0930		68.0328	.0005263							2.25714
79/11/13	1005		58.8235	.0000087							1.37500
79/12/13	0920		68.0000	.0001102							.800000

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4381600060

NO.	DESCRIPTION	05/16/79	07/05/79	08/01/79	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6035249	6035258	6014870	6003764	3004244	6026504	6031414
00041	WEATHER WMO CODE 4501	0	0	1	2	1	2	5
00010	WATER TEMP (CENT)	17.5	18.0	29.0	31.0	10.0	9.0	6.0
00299	DO PROBE (MG/L)	9.00	8.70			10.00	8.00	12.80
00300	DO LAB (MG/L)				6.50			
00400	PH (STANDARD UNITS)	5.70	6.90	7.70	7.00	7.30	6.10	6.40
00410	ALKALINITY,TOTAL CACO3 (MG/L)	13	45	55	45	25	24	27
00610	NH3&NH4- N TOTAL (MG/L)	0.080	0.080	0.040	0.080	0.320	0.120	0.170
00615	NO2-N TOTAL (MG/L)	0.004	0.009	0.005	0.010	0.008	0.017	0.014
00630	NO2&NO3-N TOTAL (MG/L)	<0.010	0.510	0.200	0.220	0.500	0.450	0.940
00625	TOTAL KJEL N (MG/L)	0.500	0.780	1.020	1.050	0.840	0.570	1.140
00650	PO4 TOTAL (MG/L AS PO4)	0.060	0.020	0.040	0.180	0.040	0.110	0.310
00660	PO4 ORTHO (MG/L AS PO4)	0.060	0.020	<0.010	0.040	0.040	0.100	0.270
31505	TOTAL COLI CONFIRM (MPN/100ML)	1300	490	3500	2200	1300	9200	330
31615	FECAL COLI EC MED (MPN/100ML)	1300	70	20	460	1300	2400	230
31677	FECAL STREP AD EVA (MPN/100ML)	49	>2400	1600	1600	350	>2400	79
32210	CHLOROPHYLL-A (UG/L)							
00078	TRANSPARENCY SECCHI (METERS)							
00061	STREAM FLOW INST (CUBIC FT/S)							
50051	FLOW RATE INST (MGD)							

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4381600060. LSCA1502
39 45 32.0 074 57 37.0 2
NEW BROOKLYN LAKE/UNN TRIB NEW FREEDON RD
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559422-0431980

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/05/16	1320		94.7368	.0000161							26.5306
79/07/05	1240		91.5789	.0002634							.0291667
79/08/01	1310			.0017622							.0125000
79/08/29	1300		86.6667	.0008295							.287500
79/10/16	1015		88.4956	.0014370							3.71428
79/11/13	1020		68.9655	.0000315							1.00000
79/12/13	0945		102.400	.0000702							2.91139

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137604605

NO.	DESCRIPTION	04/09/79	05/16/79	07/05/79	08/01/79	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6032897	6035248	6035257	6014866	6003765	6004245	6026505	6031415
00041	WEATHER WMO CODE 4501	6	0	0	1	2	1	2	5
00010	WATER TEMP (CENT)	9.0	19.0	16.0	30.0	26.0	10.0	9.0	6.5
00299	DO PROBE (MG/L)	9.40	7.60	4.20			9.30	7.80	10.80
00300	DO LAB (MG/L)					1.40			
00400	PH (STANDARD UNITS)	6.00	5.50	5.80	6.30	6.00	6.50	5.80	6.10
00410	ALKALINITY,TOTAL CACO3 (MG/L)	11	11	15	75	11	5	6	14
00610	NH3&NH4- N TOTAL (MG/L)	0.330	0.190	0.190	0.070	0.110	0.350	0.170	0.260
00615	NO2-N TOTAL (MG/L)	0.010	0.009	0.010	0.016	0.006	0.009	0.008	0.016
00630	NO2&NO3-N TOTAL (MG/L)	1.350	<0.010	1.470	1.850	0.720	0.940	0.450	1.660
00625	TOTAL KJEL N (MG/L)	0.930	2.200	2.670	0.840	1.350	1.050	1.080	1.320
00650	PO4 TOTAL (MG/L AS PO4)	0.580	0.540	1.400	1.700	1.000	0.470	0.500	1.200
00660	PO4 ORTHO (MG/L AS PO4)	0.510	0.540	1.350	1.310	0.670	0.060	0.440	0.880
31505	TOTAL COLI CONFIRM (MPN/100ML)	>24000	5400	2400	3500	5400	16000	1700	1700
31615	FECAL COLI EC MED (MPN/100ML)	16000	5400	330	1300	3500	580	1700	1100
31677	FECAL STREP AD EVA (MPN/100ML)	130	110	>2400	>2400	220	350	920	23
32210	CHLOROPHYLL-A (UG/L)								
00078	TRANSPARENCY SECCHI (METERS)								
00061	STREAM FLOW INST (CUBIC FT/S)				2.70				
50051	FLOW RATE INST (MGD)								

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137604605 LSCA1530
39 42 52.0 074 57 01.0 2
NEW BROOKLYN LAKE/GEH RI OFF NEW BROOKLYN RD
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559418-0431976

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/04/09	1445		31.0345	.0000689							123.077
79/05/16	1310		80.8510	.0000269							49.0909
79/07/05	1215		42.0000	.0000429							.137500
79/08/01	1250			.0001362	1.01942	.233011	26.9419	12.2331	24.7574	19.0778	.541667
79/08/29	1245		17.0731	.0000814							15.9091
79/10/16	1030		82.3009	.0002499							1.65714
79/11/13	1030		67.2413	.0000224							1.84783
79/12/13	1000		88.5246	.0000560							47.8261

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137604495

NO.	DESCRIPTION	04/09/79	07/05/79	10/16/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6032895	6035255	6004246	6031416
00041	WEATHER WMO CODE 4501	6	0	1	5
00010	WATER TEMP (CENT)	9.5	18.0	8.5	6.5
00299	DO PROBE (MG/L)	9.30	9.70	8.70	11.60
00300	DO LAB (MG/L)				
00400	PH (STANDARD UNITS)	6.40	5.90	6.70	6.10
00410	ALKALINITY,TOTAL CACO3 (MG/L)	10	13	6	7
00610	NH3&NH4- N TOTAL (MG/L)	0.150	0.130	0.460	0.150
00615	NO2-N TOTAL (MG/L)	0.006	0.007	0.012	0.009
00630	NO2&NO3-N TOTAL (MG/L)	1.040	0.870	0.450	1.100
00625	TOTAL KJEL N (MG/L)	0.510	1.350	0.630	0.840
00650	PO4 TOTAL (MG/L AS PO4)	0.530	1.000	0.340	0.420
00660	PO4 ORTHO (MG/L AS PO4)	0.450	0.910	0.290	0.420
31505	TOTAL COLI CONFIRM (MPN/100ML)	>24000	2400	460	490
31615	FECAL COLI EC MED (MPN/100ML)	490	1300	460	110
31677	FECAL STREP AD EVA (MPN/100ML)	540	>2400	130	9
32210	CHLOROPHYLL-A (UG/L)	3.60	3.80	6.00	1.34
00078	TRANSPARENCY SECCHI (METERS)				
00061	STREAM FLOW INST (CUBIC FT/S)				
50051	FLOW RATE INST (MGD)				

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137604495. LSCA1580
39 42 07.0 074 56 14.0 2
NEW BROOKLYN LAKE/EASTERN SPILLWAY
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN

/TYPA/AMBNT/LAKE

21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559416-0431974

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/04/09	1415		82.3009	.0000318							.907407
79/07/05	1130		102.105	.0000429							.541667
79/10/16	1100		75.0000	.0004624							3.53846
79/12/13	1020		95.0819	.0000323							12.2222

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137604494

NO.	DESCRIPTION	04/09/79	07/05/79	10/16/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6032896	6035256	6004247	6031417
00041	WEATHER WMO CODE 4501	6	0	1	5
00010	WATER TEMP (CENT)	9.0	18.0	10.0	5.5
00299	DO PROBE (MG/L)	10.60	7.00	8.70	10.40
00300	DO LAB (MG/L)				
00400	PH (STANDARD UNITS)	6.30	5.70	6.50	6.00
00410	ALKALINITY,TOTAL CACO3 (MG/L)	10	8	4	9
00610	NH3&NH4- N TOTAL (MG/L)	0.230	0.310	0.540	0.350
00615	NO2-N TOTAL (MG/L)	0.008	0.010	0.009	0.016
00630	NO2&NO3-N TOTAL (MG/L)	1.240	1.250	0.750	1.360
00625	TOTAL KJEL N (MG/L)	0.810	3.030	1.650	1.140
00650	PO4 TOTAL (MG/L AS PO4)	0.560	1.400	0.460	0.610
00660	PO4 ORTHO (MG/L AS PO4)	0.510	1.210	0.340	0.530
31505	TOTAL COLI CONFIRM (MPN/100ML)	9200	1300		790
31615	FECAL COLI EC MED (MPN/100ML)	490	490		<20
31677	FECAL STREP AD EVA (MPN/100ML)	350	>2400		<2
32210	CHLOROPHYLL-A (UG/L)				
00078	TRANSPARENCY SECCHI (METERS)				
00061	STREAM FLOW INST (CUBIC FT/S)		5.40		8.00
50051	FLOW RATE INST (MGD)				

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

/TYPA/AMBNT/LAKE

413760-494. LSCA1581
39 42 03.0 074 56 26.0 2
NEW BROOKLYN LAKE/WESTERN SPILLWAY
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559415-0431973

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/04/09	1430		91.3793	.0000953							1.40000
79/07/05	1150		73.6842	.0000646	9.02917	.291263	36.4079	88.2528	40.7769	35.2429	.204167
79/10/16	1045		76.9911	.0003855							
79/12/13	1030		83.2000	.0000552	15.1026	.690402	58.6842	49.1911	26.3216	22.8696	10.0000

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4137604515

NO.	DESCRIPTION	05/16/79	08/01/79	08/29/79	11/13/79
00008	LAB IDENTIFICATION NUMBER	6035247	6014865	6003760	6026507
00041	WEATHER WMO CODE 4501	0	1	1	2
00010	WATER TEMP (CENT)	20.0	30.1	26.0	8.0
00299	DO PROBE (MG/L)	7.10	7.10	5.40	7.50
00300	DO LAB (MG/L)				
00400	PH (STANDARD UNITS)	5.70	5.30	5.70	5.40
00410	ALKALINITY,TOTAL CACO3 (MG/L)	12	20	<1	6
00610	NH3&NH4- N TOTAL (MG/L)	0.210	0.080	0.170	0.120
00615	NO2-N TOTAL (MG/L)	0.010	0.005	0.013	0.012
00630	NO2&NO3-N TOTAL (MG/L)	<0.010	<0.010	0.420	0.470
00625	TOTAL KJEL N (MG/L)	0.600	1.080	0.810	0.390
00650	PO4 TOTAL (MG/L AS PO4)	0.690	1.070	1.000	0.580
00660	PO4 ORTHO (MG/L AS PO4)	0.640	0.630	0.700	0.470
31505	TOTAL COLI CONFIRM (MPN/100ML)	1800	790	1300	>24000
31615	FECAL COLI EC MED (MPN/100ML)	1800	220	790	>24000
31677	FECAL STREP AD EVA (MPN/100ML)	4	240	540	>2400
32210	CHLOROPHYLL-A (UG/L)	13.50	18.90	10.40	6.70
00078	TRANSPARENCY SECCHI (METERS)		0.5	0.5	0.6
00061	STREAM FLOW INST (CUBIC FT/S)				
50051	FLOW RATE INST (MGD)				

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4137604515. LSCA1560
39 42 10.0 074 56 21.0 2
NEW BROOKLYN LAKE/LOWER LAKE COMPOSITE SURFACE
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
/TYPA/AMBNT/LAKE
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559417-0431975

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/05/16	1300		77.1739	.0000507							450.000
79/08/01	1300		93.4210	.0000157							.916667
79/08/29	1320		65.8536	.0000631							1.46296
79/11/13	1100		63.0252	.0000058							10.0000

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

LAKES INTENSIVE SURVEY PROGRAM
INTENSIVE SURVEY NUMBER 793404
NEW BROOKLYN LAKE

STATION NUMBER: 4388800035

NO.	DESCRIPTION	08/29/79	10/16/79	11/13/79	12/13/79
00008	LAB IDENTIFICATION NUMBER	6003767	6004248	6026506	6031418
00041	WEATHER WMO CODE 4501	2	1	2	5
00010	WATER TEMP (CENT)	22.5	8.0	9.0	7.5
00299	DO PROBE (MG/L)	4.30	5.80	5.30	6.40
00300	DO LAB (MG/L)				
00400	PH (STANDARD UNITS)	6.00	6.80	7.00	5.80
00410	ALKALINITY,TOTAL CACO3 (MG/L)	21	13	13	15
00610	NH3&NH4- N TOTAL (MG/L)	0.100	0.440	0.250	0.440
00615	NO2-N TOTAL (MG/L)	0.005	0.007	0.005	0.036
00630	NO2&NO3-N TOTAL (MG/L)	0.560	0.650	0.450	3.000
00625	TOTAL KJEL N (MG/L)	0.810		0.420	1.350
00650	PO4 TOTAL (MG/L AS PO4)	0.200	0.110	0.110	0.600
00660	PO4 ORTHO (MG/L AS PO4)	0.070	0.070	0.070	0.470
31505	TOTAL COLI CONFIRM (MPN/100ML)	1300	110	700	1400
31615	FECAL COLI EC MED (MPN/100ML)	230	110	20	320
31677	FECAL STREP AD EVA (MPN/100ML)	540	350	110	1600
32210	CHLOROPHYLL-A (UG/L)				
00078	TRANSPARENCY SECCHI (METERS)				
00061	STREAM FLOW INST (CUBIC FT/S)				
50051	FLOW RATE INST (MGD)				

LEGEND: C - CALCULATED VALUE. E - ESTIMATED VALUE. * - REMARKED VALUE.

STORET RETRIEVAL DATE 81/04/08

4388800035. LSCA1503
39 46 41.0 074 56 28.0 2
NEW BROOKLYN LAKE/ TINKERS BR AT WATSON RD
34007 NEW JERSEY CAMDEN
NORTHEAST MAJOR BASIN 013406
NEW JERSEY COASTAL MINOR BASIN
21NJDEP1 800816
0000 FEET DEPTH CLASS 00 CSN-RSP 0559423-0431981

/TYPA/AMBNT/LAKE

DATE FROM TO	TIME OF DAY	DEPTH FEET	00301 DO SATUR PERCENT	00619 UN-IONZD NH3-NH3 MG/L	00610 NH3+NH4- N TOTAL LB/D	00615 NO2-N TOTAL LB/D	00630 NO2&NO3 N-TOTAL LB/D	00625 TOT KJEL N LB/D	00650 T PO4 PO4 LB/D	00660 ORTHOPO4 PO4 LB/D	82028 RATIO FEC COL FEC STRP
79/08/29	1345		49.4252	.0000577							.425926
79/10/16	0930		48.7395	.0005350							.314286
79/11/13	0950		45.6896	.0005211							.181818
79/12/13	0900		53.7815	.0000515							.200000

SEDIMENT ANALYSES FOR

NEW BROOKLYN LAKE, CAMDEN COUNTY

AUGUST 29, 1979

HEAVY METALS (MG/KG)	CONCENTRATION
Cadmium	.780
Chromium	.590
Copper	6.500
Iron	2685.200
Lead	14.760
Mercury	.180
Zinc	101.580
PESTICIDES (UG/KG)	
Chlordane	10 K
DDE	21.150
DDD	46.880
DDT	10 K

NEW BROOKLYN LAKE

N:P Ratios (Based on the Formula $\frac{mg\,[(NO_2+NO_3\text{-}N) + (NH_3+NH_4\text{-}N)]/1}{mg\,(total\ P)/1} \times 2.21$)

DATE	STATION ST 1	ST 2	ST 3	ST 4	ST 5	ST 6	ST 7	ST 8	ST 9
79-04-09	-	-	9.6	-	20.0	15.5	18.1	-	-
79-05-16	90.4	8.3	1.8	10.4	2.6	-	-	2.2	-
79-07-05	133.5	-	6.7	203.7	8.2	6.9	7.7	-	-
79-08-01	18.0	7.0	6.8	41.4	7.8	-	-	0.6	-
79-08-29	24.1	7.8	6.5	11.5	5.7	-	-	4.1	22.8
79-10-16	98.1	4.4	1.5	141.6	19.0	18.5	19.4	-	68.4
79-11-13	11.1	5.1	6.2	35.8	8.6	-	-	7.0	43.9
79-12-13	79.7	5.2	10.8	24.7	11.1	20.6	19.4	-	39.6

New Brooklyn Lake

Qualitative and Semi-Quantitative Biological Data and Observations

4/9/79	ST 6	Some emergent vegetation
	ST 7	Dense emergent vegetation, Lemna minor and periphyton present.
5/16/79	ST 1	Callitriche and some periphyton present, consisting of; Eunotia Hyalotheca Mougeotia Oedogonium Pleurotaenium Spirogyra Synedra Tabellaria Ulothrix + Chydorus
	ST 3	Some Valisneria and Elodea present.
	ST 8	Sagittaria, Elodea, Callitriche, Lemna and Utricularia present and dense in some places, plus algal growths consisting of; Cladophora (dominant) Closterium Eudorina Eunotia Gyrosigma Hydrodictyon Nitzschia Spiroygyra Tabellaria + rotifers & cladocerans
7/5/79	ST 1	Cabomba caroliniana, Callitriche, Potamogeton crispus, Polygonum amphibium and Elodea canadensis present.
	ST 6	Callitriche, Elodea and Lemna present, plus algal growths consisting of; Cladophora + epiphytes Eunotia Spirogyra

8/1/79	ST 8	Considerable macrophyte growths, especially Utricularia, plus algal growths consisting of; Cladophora (dominant) Eunotia Fragilaria Oedogonium Peridinium Spirogyra Trachelomonas + rotifers, protozoans, copepods and cladocerans.
8/29/79	ST 8	Vegetation similar to that observed on 8/1/79, with bottom cover at about 100%. Additional algae seen in significant quantities included Nitella and Rhizoclonium, and the vascular macrophyte Eleocharis was also present.
10/16/79	ST 8	Lemna abundant, most macrophytes dying off.
11/13/79	ST 8	Lemna minor, Wolffia and Callitriche growths still significant, algal growths present, consisting of; Hyalotheca Rhizoclonium + epiphytes (codominant) Spirogyra (codominant)
12/13/79	ST 5	Lemna present.

NEW BROOKLYN LAKE PLANKTON

STATION

TAXON	ST 6 32895 4/9/79	ST 8 35247 5/16/79	ST 6 35255 7/5/79	ST 8 14865 8/1/79	ST 8 03760 8/29/79	ST 6 04246 10/16/79	ST 8 26507 11/13/79	ST 6 31416 12/13/79
PHYTOPLANKTON/ML								
CHLOROPHYTES:								
Ankistrodesmus					8			2
Chlamydomonas					1			
Chlorella				96	6			
Closteriopsis							7	
Closterium		6		12				
Eudorina		288			34			
Micrasterias								
Mougeotia	3							
Oedogonium					1			
Pediastrum				48	6			
Scenedesmus		6	10		6			
Selenastrum					22			
Spirogyra								
Staurastrum					1			
CHRYSOPHYTES:								
Mallomonas	3		15					
CRYPTOPHYTES:								
Cryptomonas						5	7	
CYANOPHYTES:								
Anabaena				144	21			
Oscillatoria	30							
DIATOMS:								
Achnanthes	9							4
Amphora			5					
Asterionella							7	2
Cocconeis	3	6						
Cymbella					1			
Eunotia	33	72	25	84	42	15	28	6
Fragilaria	3		5	24	2		7	16
Gomphonema	18	18			1		7	2
Meridion	6						35	4
Navicula	6		15	12	6	5	14	4
Neidium								

NEW BROOKLYN LAKE PLANKTON

STATION

TAXON	ST 6 32895 4/9/79	ST 8 35247 5/16/79	ST 6 35255 7/5/79	ST 8 14865 8/1/79	ST 8 03760 8/29/79	ST 6 04246 10/16/79	ST 8 26507 11/13/79	ST 6 31416 12/13/79
Nitzschia	30	36			2		14	2
Pinnularia	6	6		36	1			
Stauroneis		6						
Surirella			5					
Synedra	3	18		36	3		14	2
Tabellaria	3	6	5	12			7	4
DINOFLAGELLATES:								
Glenodinium				12				
Peridinium					1			
EUGLENOIDS:								
Euglena	6	12	5	12	4			
Phacus				12	1			
Trachelomonas				24	5			2
TOTAL PHYTOPLANKTON CELLS/ML	162	480	90	564	174	25	147	50
CHLOROPHYLL A (MG/M^3)	3.6	13.5	3.8	18.9	10.4	6.0	6.7	1.3
EVENNESS	.84	.58	.91	.85	.77	.86	.92	.89
ZOOPLANKTON/L								
PROTOZOANS:								
Amoeboids					70			
Ciliates		72		96	140			
Gastrotrichs					70			
Nematodes					70			
ROTIFERS:								
Keratella		24						
Synchaeta					210			
Unidentified Rotifer							95	
TOTAL ZOOPLANKTERS/L		96		96	560		95	
COMMUNITY DRY WT. (MG/L)		4.4		40.6	13.3		0.5	

New Brooklyn Lake
Winslow, Camden County

Area: 40 Acres
Drainage: Great Egg Harbor River
Maximum depth: 7 feet
Mean depth: 2 feet

Summary of Angling Potential

Species	Yr. Class Representation	Abundance	Fishing Prospects
Pumpkinseed	Yr. Class Missing	Good	Good
Largemouth bass	Sporadic	Scarce	Poor
Chain pickerel	Continuous	Fair	Fair

General Conditions:
New Brooklyn Lake is very shallow with most of the shoreline being marsh land. Access for boat and shoreline fishermen is available at a small area near the dam. Because of this shallow nature, the entire lake contains a dense growth of submergent and emergent aquatic vegetation. Vegetation made sampling very difficult and this reflects in the low numbers of fish captured. It also creates a big nuisance for boat and shoreline fishermen by limiting fishing to small open areas of the lake.

Findings:
The diversity of fish species captured (Table I) was limited and these were typical of a South Jersey acid water lake. The major portion of the fish captured, both by number and weight, were considered to be harvestable (Table II). Because of the difficulty in sampling, the species composition may not show an accurate picture. Largemouth bass and chain pickerel reproduced, but their young-of-the-year were difficult to find through the dense vegetation. Intermediate largemouth bass were not observed and may be a result of sporadic annual recruitment. The pumpkinseeds show good growth but few intermediate class fishes were found (Table III). The absence of older chain pickerel is probably the result of the difficulty in sampling this body of water and not due to heavy fishing presence. This lake is typical of a low pH and low productive South Jersey lake.

Table I. Checklist of Fish Species Captured in New Brooklyn Lake

Chain pickerel
Golden shiner
Creek chubsucker
Brown bullhead
Pumpkinseed
Largemouth bass ***
Blackbanded sunfish
Bluespotted sunfish
Yellow bullhead **
Mud sunfish **
Swamp darter **
Banded sunfish **

** These species were documented by the Bureau of Fisheries in its 1953 lake survey but were not found in this survey.

*** Three adults observed and two young-of-the-year captured.

Table II A. Composition of Fishes Captured by Electrofishing, New Brooklyn Lake, September 26, 1979

				Harvestable		
Species	No.	Wgt. (lbs.)	% of Population by weight	No.	Wgt. (lbs.)	% of Total Wgt.
Creek chubsucker*	10	3.3	44.00			
Brown bullhead	2	0.5	6.67	2	0.5	6.67
Pumpkinseed	27	2.7	36.00	18	2.5	33.33
Golden shiner*	2	0.3	4.00			
Chain pickerel*	4	0.7	9.33			
Blackbanded sunfish	1					
Largemouth bass*	2					
Bluespotted sunfish	2					
Totals	48	7.5	100%	20	3.0	40.00

* Species found to have reproduced in 1979.

Table II B. Composition of Fishes Captured by Gill Netting*, New Brooklyn Lake, October 31 - November 1, 1979

				Harvestable		
Species	No.	Wgt. (lbs.)	% of Population by weight	No.	Wgt. (lbs.)	% of Total Wgt.
Golden shiner	6	1.0	14.93			
Creek chubsucker	3	1.0	14.93			
Brown bullhead	1	0.8	11.94	1	0.8	11.94
Chain pickerel	5	3.9	58.20	5	3.9	58.20
Totals	15	6.7	100%	6	4.7	70.14

* One gill net set

Table III. Age and Size Composition of Important Fish Species, New Brooklyn Lake

	Age Group	No. in sample	$\bar{x}$ length (inches)	Range (inches)
Pumpkinseed	Young-of-the-year	10*	-	-
	Intermediate	9	4.6	4.0 - 4.9
	Catchable	18	5.6	5.2 - 6.0

Table IV. Growth of Principal Predator Species, New Brooklyn Lake

	Age Class	No. in sample	$\bar{x}$ length (inches)	Range (inches)
Chain pickerel	0	1	4.5	-
	I	4	10.5	9.0 - 12.0
	II	4	16.1	14.0 - 17.7

* Approximate

APPENDIX 2

GLOSSARY OF LAKES AND WATERSHED MANAGEMENT TERMS

APPENDIX 2

GLOSSARY OF LAKE AND WATERSHED MANAGEMENT TERMS[1]

Aeration: A process in which water is treated with air or other gases, usually oxygen. In lake restoration, aeration is used to prevent anaerobic condition or to provide artificial destratification.

Algal bloom: A high concentration of a specific algal species in a water body, usually caused by nutrient enrichment.

Algicide: A chemical highly toxic to algae.

Alkalinity: A quantitative measure of water's capacity to neutralize acids. Alkalinity results from the presence of bicarbonates, carbonates, hydroxides, salts, and occasionally of borates, silicates, and phosphates. Numerically, it is expressed as the concentration of calcium carbonate that has an equivalent capacity to neutralize strong acids.

Allochthonous: Describes organic matter produced outside of a specific stream or lake system.

Alluvial: Pertaining to sediments gradually deposited by moving water.

Artificial destratification: The process of inducing water currents in a lake to produce partial or total vertical circulation.

Artificial recharge: The addition of water to the groundwater reservoir by activities of man, such as irrigation or induced infiltration.

Assimilation: The absorption and conversion of nutritive elements into protoplasm.

Autochthon: Any organic matter indigenous to a specific stream or lake.

Autotrophic: The ability to synthesize organic matter from inorganic substances.

Background loading of concentration: The concentration of a chemical constituent arising from natural sources.

Base flow: Stream discharge due to groundwater flow.

Benthic oxygen demand: Oxygen demand exerted from the bottom of a stream or lake, usually by biochemical oxidation of organic material in the sediments.

Benthos: Organisms living on or in the bottom of a body of water.

Best management practices: Practices, either structural or non-structural, which are used to control nonpoint source pollution.

Bioassay: The use of living organisms to determine the biological effect of some substance, factor, or condition.

Biochemical oxidation: The process by which bacteria and other microorganisms break down organic material and remove organic matter from solution.

Biochemical oxygen demand (BOD), biological oxygen demand: The amount of oxygen used by aerobic organisms to decompose organic material. Provides an indirect measure of the concentration of biologically degradable material present in water or wastewater.

Biological control: A method of controlling pest organisms by introduced or naturally occurring predatory organisms, sterilization, inhibiting hormones, or other nonmechanical or nonchemical means.

Biological magnification, biomagnification: An increase in concentration of a substance along succeeding steps in a food chain.

[1] U.S. EPA. 1980 Clean Lakes Program Guidance Manual. EPA Report No. EPA 440/5-81-003.

Biomass: The total mass of living organisms in a particular volume or area.

Biota: All living matter in a particular region.

Blue-green algae: The phylum Cyanophyta, characterized by the presence of blue pigment in addition to green chlorophyll.

Catch basin: A collection chamber usually built at the curb line of a street, designed to admit surface water to a sewer or subdrain and to retain matter that would block the sewer.

Catchment: Surface drainage area.

Chemical control: A method of controlling pest organisms through exposure to specific toxic chemicals.

Chlorophyll: Green pigment in plants and algae necessary for photosynthesis.

Circulation period: The interval of time in which the thermal stratification of a lake is destroyed, resulting in the mixing of the entire water body.

Coagulation: The aggregation of colloidal particles, often induced by chemicals such as lime or alum.

Coliform bacteria: Nonpathogenic organisms considered a good indicator of pathogenic bacterial pollution.

Colorimetry: The technique used to infer the concentration of a dissolved substance in solution by comparison of its color intensity with that of a solution of known concentration.

Combined sewer: A sewer receiving both stormwater runoff and sewage.

Compensation point: The depth of water at which oxygen production by photosynthesis and respiration by plants and animals are at equilibrium due to light intensity.

Cover crop: A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.

Crustacea: Aquatic animals with a rigid outer covering, jointed appendages, and gills.

Culture: A growth of microorganisms in an artificial medium.

Denitrification: Reduction of nitrates to nitrites or to elemental nitrogen by bacterial action.

Depression storage: Water retained in surface depressions when precipitation intensity is greater than infiltration capacity.

Design storm: A rainfall pattern of specified amount, intensity, duration, and frequency that is used as a basis for design.

Detention: Managing stormwater runoff or sewer flows through temporary holding and controlled release.

Detritus: Finely divided material of organic or inorganic origin.

Diatoms: Organisms belonging to the group Bacillariophyceae, characterized by the presence of silica in its cell walls.

Dilution: A lake restorative measure aimed at reducing nutrient levels within a water body by the replacement of nutrient-rich waters with nutrient-poor waters.

Discharge: A volume of fluid passing a point per unit time, commonly expressed as cubic meters per second.

Dissolved oxygen (DO): The quantity of oxygen present in water in a dissolved state, usually expressed as milligrams per liter of water, or as a percent of saturation at a specific temperature.

Dissolved solids (DS): The total amount of dissolved material, organic and inorganic, contained in water or wastes.

Diversion: A channel or berm constructed across or at the bottom of a slope for the purpose of intercepting surface runoff.

Drainage basin, watershed, drainage area: A geographical area where surface runoff from streams and other natural watercourses is carried by a single drainage system to a common outlet.

Dry weather flow: The combination of sanitary sewage and industrial and commercial wastes normally found in the sanitary sewers during the dry weather season of the year; or, flow in streams during dry seasons.

Dystrophic lakes: Brown-water lakes with a low lime content and a high humus content, often severely lacking nutrients.

Enrichment: The addition to or accumulation of plant nutrients in water.

Epilimnion: The upper, circulating layer of a thermally stratified lake.

Erosion: The process by which the soils of the earth's crust are worn away and carried from one place to another by weathering, corrosion, solution, and transportation.

Eutrophication: A natural enrichment process of a lake, which may be accelerated by man's activities. Usually manifested by one or more of the following characteristics: (a) excessive biomass accumulations of primary producers; (b) rapid organic and/or inorganic sedimentation and shallowing; or (c) seasonal and/or diurnal dissolved oxygen deficiencies.

Fecal streptococcus: A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals.

First flush: The first, and generally most polluted, portion of runoff generated by rainfall.

Flocculation: The process by which suspended particles collide and combine into larger particles or floccules and settle out of solution.

Gabion: A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used to protect against erosion.

Gaging station: A selected section of a stream channel equipped with a gage, recorder, and/or other facilities for determining stream discharge.

Grassed waterway: A natural or constructed waterway covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate.

Green algae: Algae characterized by the presence of photosynthetic pigments similar in color to those of the higher green plants.

Heavy metals: Metals of high specific gravity, including cadmium, chromium, cobalt, copper, lead, mercury. They are toxic to many organisms even in low concentrations.

Hydrograph: A continuous graph showing the properties of stream flow with respect to time.

Hydrologic cycle: The movement of water from the oceans to the atmosphere and back to the sea. Many subcycles exist including precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hypolimnion: The lower, non-circulating layer of a thermally stratified lake.

Intermittent stream: A stream or portion of a stream that flows only when replenished by frequent precipitation.

Irrigation return flow: Irrigation water which is not consumed in evaporation or plant growth, and which returns to a surface stream or groundwater reservoir.

Leaching: Removal of the more soluble materials from the soil by percolating waters.

Limiting nutrient: The substance that is limiting to biological growth due to its short supply with respect to other substances necessary for the growth of an organism.

Littoral: The region along the shore of a body of water.

Macrophytes: Large vascular, aquatic plants which are either rooted or floating.

Mesotrophic lake: A trophic condition between an oligotrophic and an eutrophic water body.

Metalimnion: The middle layer of a thermally stratified lake in which temperature rapidly decreases with depth.

Most probable number (MPN): A statistical indication of the number of bacteria present in a given volume (usually 100 ml).

Nannoplankton: Those organisms suspended in open water which because of their small size, cannot be collected by nets (usually smaller than approximately 25 microns).

Nitrification: The biochemical oxidation process by which ammonia is changed first to nitrates and then to nitrites by bacterial action.

Nitrogen, available: Includes ammonium, nitrate ions, ammonia, and certain simple amines readily available for plant growth.

Nitrogen cycle: The sequence of biochemical changes in which atmospheric nitrogen is "fixed," then used by a living organism, liberated upon the death and decomposition of the organism, and reduced to its original state.

Nitrogen fixation: The biological process of removing elemental nitrogen from the atmosphere and incorporating it into organic compounds.

Nitrogen, organic: Nitrogen components of biological origin such as amino acids, proteins, and peptides.

Nonpoint source: Nonpoint source pollutants are not traceable to a discrete origin, but generally result from land runoff, precipitation, drainage, or seepage.

Nutrient, available: That portion of an element or compound that can be readily absorbed and assimilated by growing plants.

Nutrient budget: An analysis of the nutrients entering a lake, discharging from the lake, and accumulating in the lake (e.g., input minus output = accumulation).

Nutrient inactivation: The process of rendering nutrients inactive by one of three methods: (1) Changing the form of a nutrient to make it unavailable to plants, (2) removing the nutrient from the photic zone, or (3) preventing the release or recycling of potentially available nutrients within a lake.

Oligotrophic lake: A lake with a small supply of nutrients, and consequently a low level of primary production. Oligotrophic lakes are often characterized by a high level of species diversification.

Orthophosphate: See phosphorus, available.

Outfall: The point where wastewater or drainage discharges from a sewer to a receiving body of water.

Overturn, turnovers: The complete mixing of a previously thermally stratified lake. This occurs in the spring and fall when water temperatures in the lake are uniform.

Oxygen deficit: The difference between observed oxygen concentrations and the amount that would be present at 100 percent saturation at a specific temperature.

Peak discharge: The maximum instantaneous flow from a given storm condition at a specific location.

Percolation test: A test used to determine the rate of percolation or seepage of water through natural soils. The percolation rate is expressed as time in minutes for a 1-inch fall of water in a test hold and is used to determine the acceptability of a site for treatment of domestic wastes by a septic system.

Perennial stream: A stream that maintains water in its channel throughout the year.

Periphyton: Microorganisms that are attached to or growing on submerged surfaces in a waterway.

Phosphorus, available: Phosphorus which is readily available for plant growth. Usually in the form of soluble orthophosphates.

Phosphorus, total (TP): All of the phosphorus present in a sample regardless of form. Usually measured by the persulfate digestion procedure.

Photic zone: The upper layer in a lake where sufficient light is available for photosynthesis.

Photosynthesis: The process occurring in green plants in which light energy is used to convert inorganic compounds to carbohydrates. In this process, carbon dioxide is consumed and oxygen is released.

Phytoplankton: Plant microorganisms, such as algae, living unattached in the water.

Plankton: Unattached aquatic microorganisms which drift passively through water.

Point source: A discreet pollutant discharge such as a pipe, ditch, channel, or concentrated animal feeding operation.

Population equivalent: An expression of the amount of a given waste load in terms of the size of human population that would contribute the same amount of biochemical oxygen demand (BOD) per day. A common base is 0.17 pounds (7.72 grams) of 5-day BOD per capita per day.

Primary production: The production of organic matter from light energy and inorganic materials, by autotrophic organisms.

Protozoa: Unicellular animals, including the ciliates and nonchlorophyllous flagellates.

Rainfall intensity: The rate at which rain falls, usually expressed in centimeters per hour.

Rational method: A means of computing peak storm drainage runoff (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the average rainfall intensity, and A is the size of the drainage area.

Raw water: A water supply which is available for use but which has not yet been treated or purified.

Recurrence interval: The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus, a 10-year storm can be expected to occur on the average once every 10 years. Sewers are generally designed for a specific design storm frequency.

Riprap: Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves).

Saprophytic: Pertaining to those organisms that live on dead or decaying organic matter.

Scouring: The clearing and digging action of flowing water, especially the downward erosion caused by stream water in sweeping away mud and silt, usually during a flood.

Secchi depth: A measure of optical water clarity as determined by lowering a weighted Secchi disk into a water body to the point where it is no longer visible.

Sediment basin: A structure designed to slow the velocity of runoff water and facilitate the settling and retention of sediment and debris.

Sediment delivery ratio: The fraction of soil eroded from upland sources that reaches a continuous stream channel or storage reservoir.

Sediment discharge: The quantity of sediment, expressed as a dry weight or volume, transported through a stream cross-section in a given time. Sediment discharge consists of both suspended load and bedload.

Septic: A putrefactive condition produced by anaerobic decomposition of organic wastes, usually accompanied by production of malodorous gases.

Standing crop: The biomass present in a body of water at a particular time.

Sub-basin: A physical division of a larger basin, associated with one reach of the storm drainage system.

Substrate: The substance or base upon which an organism grows.

Suspended solids: Refers to the particulate matter in a sample, including the material that settles readily as well as the material that remains dispersed.

Swale: An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales conduct stormwater into primary drainage channels and provide some groundwater recharge.

Terrace: An embankment or combination of an embankment and channel built across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Thermal stratification: The layering of water bodies due to temperature-induced density differences.

Thermocline: See metalimnion.

Tile drainage: Land drainage by means of a series of tile lines laid at a specified depth and grade.

Total solids: The solids in water, sewage, or other liquids, including the dissolved, filterable, and nonfilterable solids. The residue left when a sample is evaporated and dried at a specified temperature.

Trace elements: Those elements which are needed in low concentrations for the growth of an organism.

Trophic condition: A relative description of a lake's biological productivity. The range of trophic conditions is characterized by the terms oligotrophic for the least biologically productive, to eutrophic for the most biologically productive.

Turbidity: A measure of the cloudiness of a liquid. Turbidity provides an indirect measure of the suspended solids concentration in water.

Urban runoff: Surface runoff from an urban drainage area.

Volatile solids: The quantity of solids in water, sewage, or other liquid, which is lost upon ignition at 600° C.

Waste load allocation: The assignment of target pollutant loads to point sources so as to achieve water quality standards in a stream segment in the most effective manner.

Water quality: A term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water quality standards: State-enforced standards describing the required physical and chemical properties of water according to its designated uses.

Watershed: See drainage basin.

Weir: Device for measuring or regulating the flow of water.

Zooplankton: Protozoa and other animal microorganisms living unattached in water.

NEW JERSEY DEPARTMENT
OF ENVIRONMENTAL PROTECTION
Division of Water Resources
Lakes Management Program

LAKES CLASSIFICATION SURVEY
Watershed Land-Use/Topographic Map

FIGURE 1 NEW BROOKLYN LAKE 39°37'48" x 74°47'11"
WINSLOW, CAMDEN CO., N.J.

PRINCETON AQUA SCIENCE