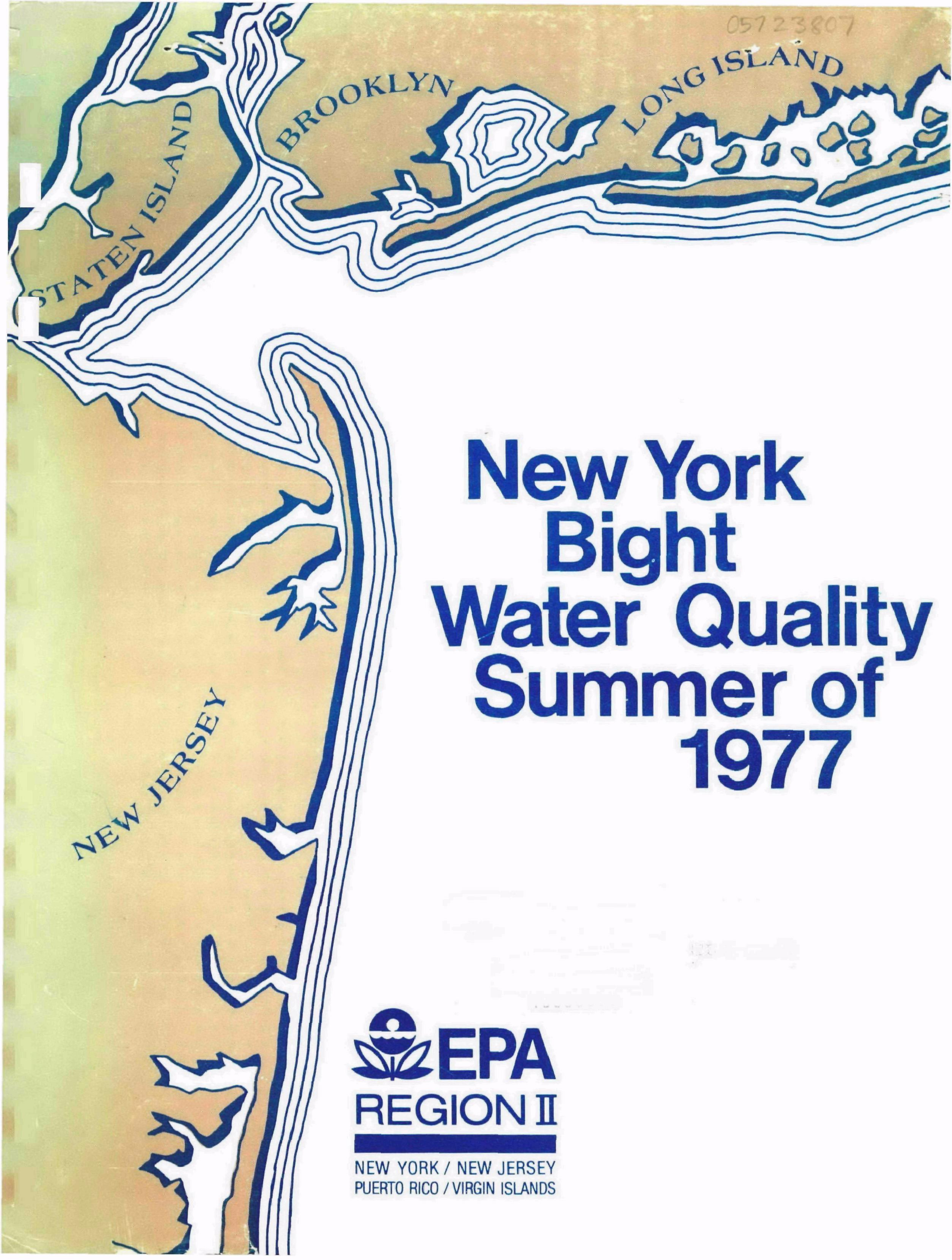

New York Bight Water Quality Summer of 1977

EPA
REGION II
NEW YORK / NEW JERSEY
PUERTO RICO / VIRGIN ISLANDS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE March 16, 1979

SUBJECT Report on the New York Bight Water Quality -- Summer of 1977

FROM Barbara Metzger, Director
Surveillance & Analysis Division

TO Dorothy Szefczyk
EPA Library

The attached report has been prepared by the S&A Division as part of the Region's ocean monitoring efforts in the New York Bight. The report encompasses the period between May 1 and September 30, 1977.

If you have any questions concerning the content of the report, contact either Rick Spear or Rollie Hemmett at FTS 340-6685 or 6687.

Attachment: a/s

ABSTRACT

The purpose of this report is to disseminate technical information gathered by the U. S. Environmental Protection Agency, Region II, during the 1977 New York Bight Water Quality Monitoring Program. The monitoring program was conducted using an EPA helicopter for water quality sample collection. During the summer period of May 15 to September 30, 1977, 195 stations were sampled each week. The Bight sampling program was conducted 6 days a week and consisted of four separate sampling networks. The beach station network gathered bacteriological water quality information at 26 Long Island coast stations and 19 New Jersey coast stations. The New York Bight station network gathered chemical and bacteriological information at 20 stations in the inner New York Bight. The perpendicular network consisted of ten transects with four stations on each transect. Five transects extended south from the Long Island coast and five transects extended east from the New Jersey coast. The transects covered the inner Bight from Jones Beach on Long Island to Strathmere along the New Jersey Coast. Samples were collected for dissolved oxygen and other chemical parameter analysis. The last network consisted of a series of stations located off Atlantic City, New Jersey. These samples were also collected for dissolved oxygen and other chemical parameter analysis.

All water quality samples were collected using a Kemmerer sampler. The results indicated that, while there were some minor water quality problems, the water quality of the New York Bight Apex

was generally excellent. Dissolved oxygen levels were good along the Long Island coast and did not drop to "stressful" levels for significant lengths to time in the Bight. Dissolved oxygen depression was more pronounced off the New Jersey coast than off the Long Island coast. Bacteriological data indicated total and fecal coliform densities at the beaches along both the New Jersey and Long Island coasts were well below acceptable limits for water contact recreation. The nutrient data indicated that a substantial quantity of the nutrient material leaving the lower bay area moves south along the New Jersey coast, indicating a possible nutrient source for recurrent algae blooms off the New Jersey coast.

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I. INTRODUCTION

The U.S. Environmental Protection Agency has prepared this report as part of its continued efforts to monitor, evaluate, and disseminate environmental data concerning the ambient conditions of the oceanic waters in the New York Bight in the vicinity of the ocean disposal sites and along the shorelines of New York and New Jersey. This report encompasses the data gathered during the summer period between May 1 and September 30, 1977. This is the fifth in a series of publications concerning the New York Bight resulting from EPA's action in response to its mandated responsibilities as defined under the Marine Protection, Research and Sanctuaries Act of 1972 and the Water Pollution Control Act Amendments of 1972 and 1977. Previous reports are cited in the Bibliography (1-4) and are available upon request.

The New York Bight oceanic monitoring program was initiated in April 1974 when public concern over the bacteriological quality of the New York and New Jersey beaches demonstrated a need for more comprehensive monitoring in this area and the need of the Agency for "real-time" data to evaluate water quality conditions on a continuous basis. Other governmental agencies gathered data which were and are duplicated to some degree by EPA's monitoring program. These other data were not always comparable and accessible in the time frame necessary for EPA's program.

A brief outline of the scope and purpose of the 1974 program follows:

1) to determine to what extent, if any, the practice of ocean disposal of sewage sludge at the 20-km site and dredge spoils at the 10-km site was impacting the ambient water quality of the bathing beaches along the Long Island and New Jersey coasts;
2) to assess any probable or potential imminent threat(s) to the health and welfare of the public in the inner New York Bight, incident to correct ocean disposal practices;
3) to delineate the extent, if any, of the spread of sewage sludge shoreward from the sewage sludge disposal site;
4) to aid the Agency in its decision making process regarding the need for the use of alternate disposal sites or the implementation of alternate land based disposal methods.

Further details of the program are given in EPA report entitled, "Ocean Disposal in the New York Bight: Technical Briefing Report No. 2".

The surveillance and monitoring program continued through the summer of 1975 using the 1974 sampling frequencies and monitoring stations. However, during the summer period of 1976 several environmental episodes led to the reorientation and expansion of this program.

The first event and most environmentally significant was the development of depressed values of dissolved oxygen within the inner Bight which gradually spread over several hundred square kilometers and reached anoxic conditions in some areas as early as the Fourth of July weekend. Dissolved oxygen values continued to decline and resulted in massive fish and other marine life morbidity and deaths. The magnitude and severity of the event pointed out the need for a greatly expanded monitoring program encompassing wider areal coverage as well as the inclusion of dissolved oxygen measurements in the routine sampling program.

The second event was the unusual washup of debris onto the beaches of Long Island. The debris included, in addition to normal seaweed and other detritus, numerous artifacts of life such as condom rings, tampon inserters, orange peels, and milk cartons.

It was evident from the experiences of 1976 that the existing monitoring program as well as the mode of operation; automobiles for beach sampling, the EPA vessel Clean Waters for open ocean sampling, and the occasional use of rental helicopters for aerial surveillance, was inadequate and not responsive enough timewise. There was a need for expansion of the program to include the ability to:

1) quickly and comprehensively collect and assimilate data on the water quality of the New York Bight as well as the New York and New Jersey beaches;
2) respond in a responsible fashion to environmental crises;
3) gather sufficient data to guide and direct the decision making process, should corrective measures be necessary to protect the Bight water quality; and,
4) investigate the origin or source of such crises where possible.

Past experience with local rental helicopter service during routine surveillance and emergencies, such as oil spills, chemical fires, beach washups, or other environmental episodes indicated the potential for use of this mode of operation to satisfy the expanded needs of this program.

In December of 1976, with the cooperation and aid of EPA's Environmental Monitoring Laboratory located in Las Vegas, Nevada, the Region obtained one of the Agency's specially modified support helicopters (Huey) which was used successfully in the national Lake Eutrophication Program for a trial use for operations in the New York Bight area. The pilot program proved so successful that arrangements were made for transfer of the aircraft to the regional office at Edison to be utilized routinely for operations of the ocean monitoring program.

II. MONITORING PROGRAM DESCRIPTION

The experiences of the summer of 1976 indicated the need for an expanded ocean monitoring program as well as a rapid response capability. In addition to extending the beach monitoring southward along the New Jersey coast to Island Beach State Park and eastward along Long Island to Shinnecock Inlet, three dissolved oxygen monitoring configurations were added to the program (Table 1). Previously the dissolved oxygen values recorded by EPA were on an "as needed" basis and were collected using the vessel Clean Waters. A listing of the expanded coverage for the program is given in Table 2.

III. SAMPLING STATION DESCRIPTION

Beach Stations

A total of 45 bathing beach areas were sampled routinely for bacteriological water quality along the Long Island and New Jersey coastlines. The Long Island sampling stations extend from the western tip of Rockaway peninsula to Shinnecock Inlet some 130 km eastward encompassing a total of 26 stations (LIC01-LIC28). Sample station location, nomenclature, and description are given in Table 3 and Figure 1. Nineteen New Jersey coast stations from Sandy Hook at the north to mid-Island Beach State Park at the south (JC01 through JC55), are described and identified in Table 4

Table 1

Outline of 1977 Sampling Program

Station Group	Frequency	Parameter	Sample Location
Long Island Beaches & New Jersey Beaches	3/week	Bacteriological	Top
Long Island Beaches & New Jersey Beaches	3-4 stations/ season	Pathogen, Virus	Top
New York Bight	1/week	Bacteriological, Dissolved Oxygen, Nutrients	Top, Bottom
Long Island and New Jersey Perpendiculars	1/week	Dissolved Oxygen	Top, Bottom
Atlantic City Area	Occasional	Dissolved Oxygen	Top, Bottom

Table 2

Parameters Evaluated for Each Station Group

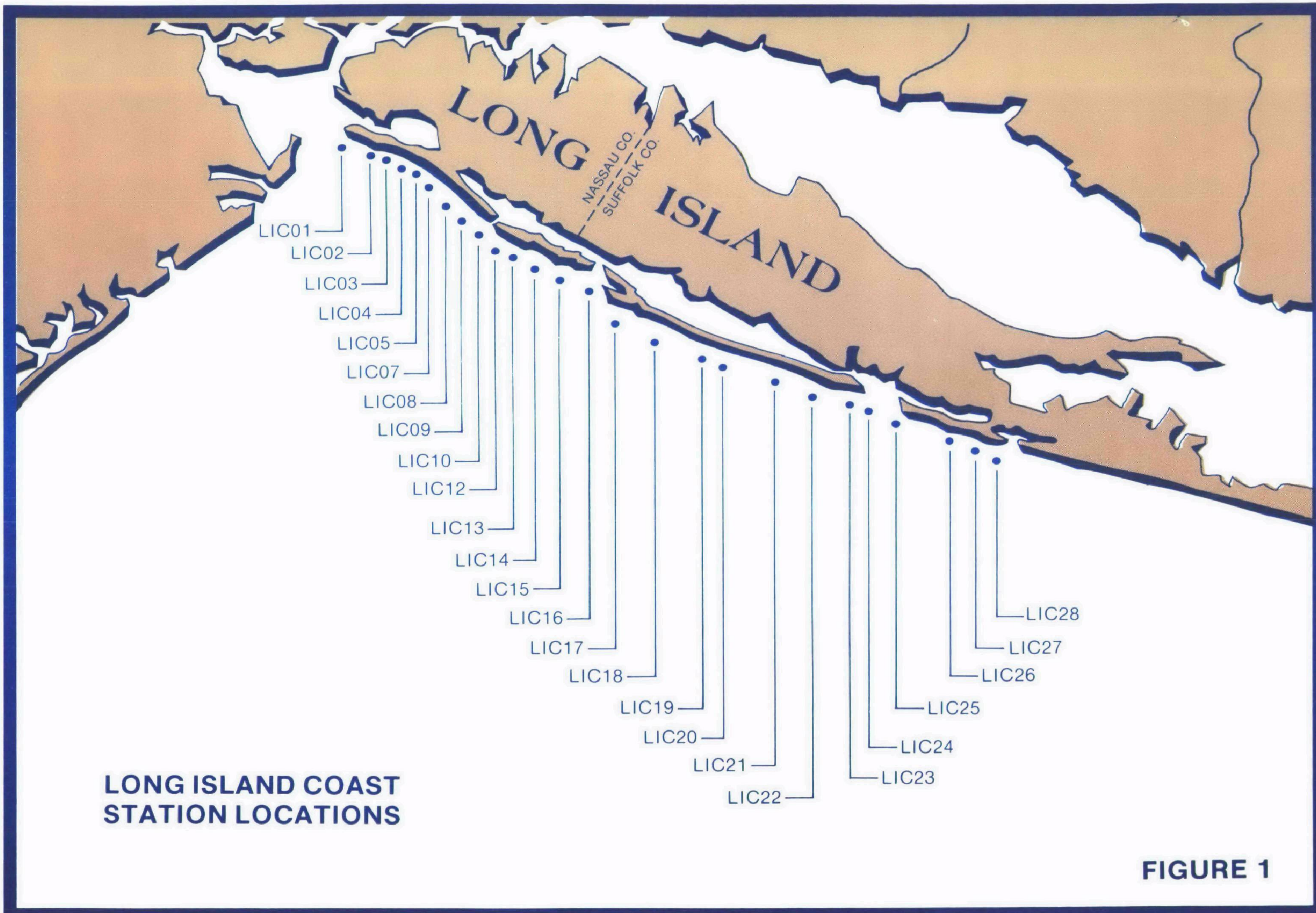
Parameters	L.I. & N.J.* Beaches	L.I. & N.J.** Perpendiculars	Atlantic City**	N.Y. Bight**
Total Coliform	X			X
Fecal Coliform	X			X
Pathogen, Virus	X			
Salinity, Chlorinity				X
Temperature		X	X	X
Dissolved Oxygen (DO)		X	X	X
Total Organic Carbon (TOC)				X
Total Suspended Solids (TSS)				X
Total Phosphorous (TP)				X
Phosphate Phosphorous (PO_4-P)				X
Ammonia Nitrogen (NH_3-N)				X
Nitrite Nitrogen (NO_2-N)				X
Nitrate Nitrogen (NO_3-N)				X
Silica (SiO_2)				X

* Sample Depth: 1 meter below surface.
** Sample Depths: 1 meter below surface and 1 meter above bottom.

Table 3

Long Island Coast Station Locations

Station No.	Location
LIC01	Rockaway Point, Breezy Point Surf Club
LIC02	Rockaway, off foot of B169 Road
LIC03	Rockaway, off foot of B129 Road
LIC04	Rockaway, off foot of B92 Road
LIC05	Far Rockaway, off foot of B41 Road
LIC07	Atlantic Beach, Silver Point Beach Club
LIC08	Long Beach, off foot of Grand Avenue
LIC09	Long Beach, off foot of Pacific Boulevard
LIC10	Point Lookout, off Hempstead public beach
LIC12	Short Beach (Jones Beach), off "West End 2" parking lot
LIC13	Jones Beach
LIC14	East Overlook
LIC15	Gilgo Beach
LIC16	Cedar Island Beach
LIC17	Robert Moses State Park
LIC18	Great South Beach
LIC19	Cherry Grove
LIC20	Water Island
LIC21	Bellport Beach
LIC22	Fire Island
LIC23	Moriches Inlet West
LIC24	Moriches Inlet East
LIC25	West Hampton Beach
LIC26	Tiana Beach
LIC27	Shinnecock Inlet West
LIC28	Shinnecock Inlet East



LONG ISLAND COAST STATION LOCATIONS

FIGURE 1

Table 4

New Jersey Coast Station Locations

Station No.	Location
JC01A	Sandy Hook, 1.2 km south of tip
JC02	Sandy Hook, off large radome
JC03	Sandy Hook, off Nature Center building (tower)
JC05	Sandy Hook, just north of Park entrance
JC08	Sea Bright, at public beach
JC11	Monmouth Beach Bath & Tennis Club
JC14	Long Branch, off foot of S. Bath Avenue
JC21	Asbury Park, off building north of Convention Hall
JC24	Bradley Beach, off foot of Cliff Avenue
JC27	Belmar, off the "White House" near fishing club pier
JC30	Spring Lake, south of yellow brick building on beach
JC33	Sea Girt, off foot of Chicago Avenue
JC37	Point Pleasant, south of Manasquan Inlet
JC41	Bay Head, off foot of Johnson Street
JC44	Mantoloking, off foot of Albertson Street
JC47A	Silver Beach, off foot of Colony Road
JC49	Lavallette, off foot of Washington Avenue
JC53	Seaside Park, off foot of 5th Avenue
JC55	Island Beach State Park, off white building, north of Park Hq.

and Figure 2.

New York Bight Stations

The New York Bight stations established as part of the original ocean monitoring program cover the inner Bight area in 3-km intervals via three transects as follows: New Jersey Transect (NYB20-NYB27) extending from Sandy Hook 20 km eastward to the sewage sludge disposal site; Raritan Bay Transect (NYB32-NYB35) projecting along the Ambrose Channel from the Lower Hudson Bay complex southeast to the sewage sludge disposal site; and the Long Island Transect (NYB40-NYB47) from Atlantic Beach, Long Island southward to just beyond the sewage sludge disposal site.

Perpendicular Stations

Sampling stations were established perpendicular to the Long Island and New Jersey coastlines at 4.8 km, 11.4 km, 17.7 km, and 24.1 km offshore. These stations were established to gather necessary near surface and near bottom dissolved oxygen values in the critical areas of the inner New York Bight. Previous agreements had been made with NOAA to provide dissolved oxygen profiles from stations further out in the Bight in conjunction with their MESA project and Marine Fisheries Laboratory's activities.

The perpendicular stations described above are plotted as squares in Figure 3 and where they are common with the Bight transect stations they are designated by circles. Tables 3 and 4

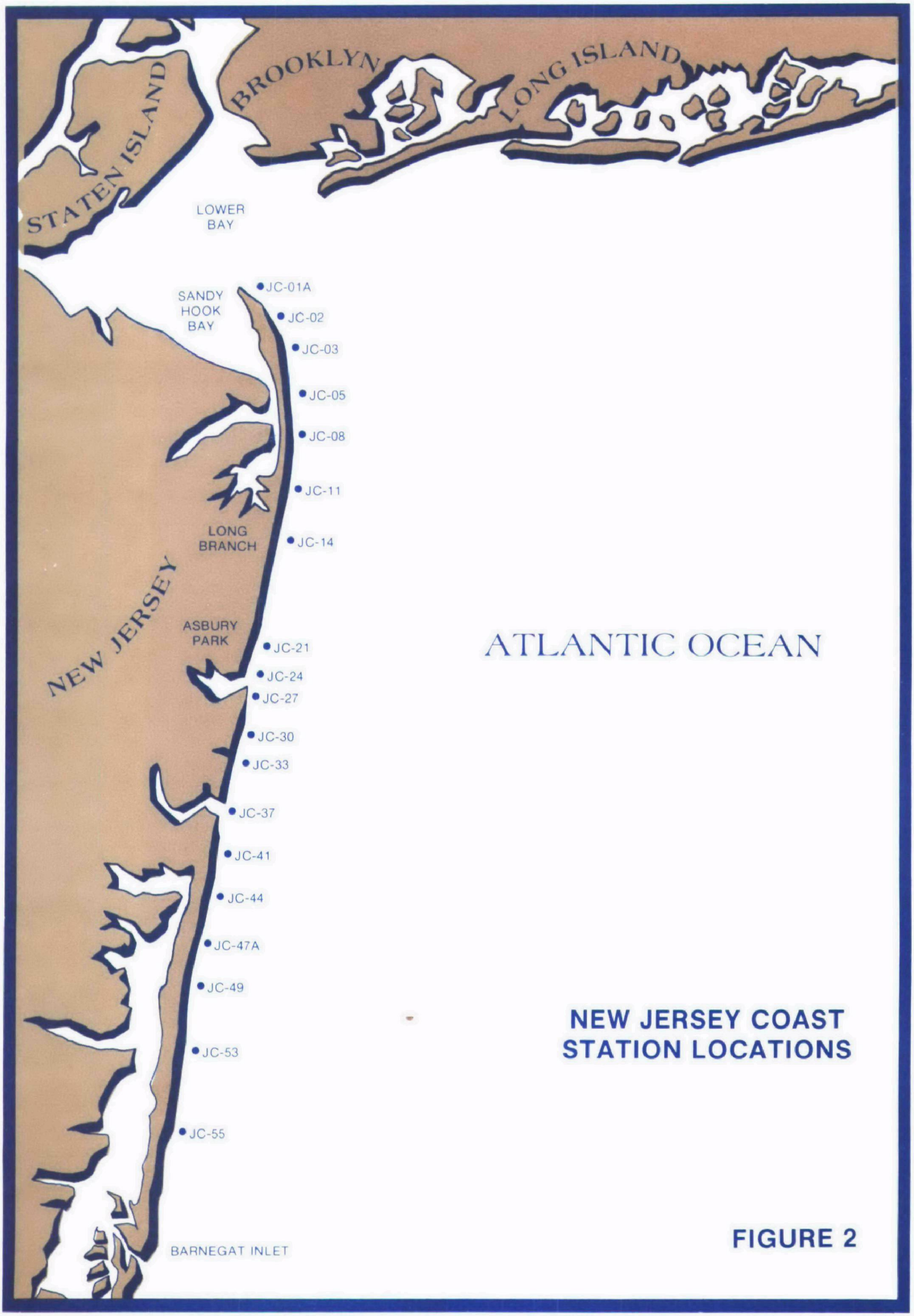

BROOKLYN
LONG ISLAND
STATEN ISLAND
LOWER BAY
SANDY HOOK BAY
JC-01A
JC-02
JC-03
JC-05
JC-08
JC-11
LONG BRANCH
JC-14
NEW JERSEY
ASBURY PARK
JC-21
JC-24
JC-27
JC-30
JC-33
JC-37
JC-41
JC-44
JC-47A
JC-49
JC-53
JC-55
BARNEGAT INLET
ATLANTIC OCEAN
NEW JERSEY COAST
STATION LOCATIONS

FIGURE 2

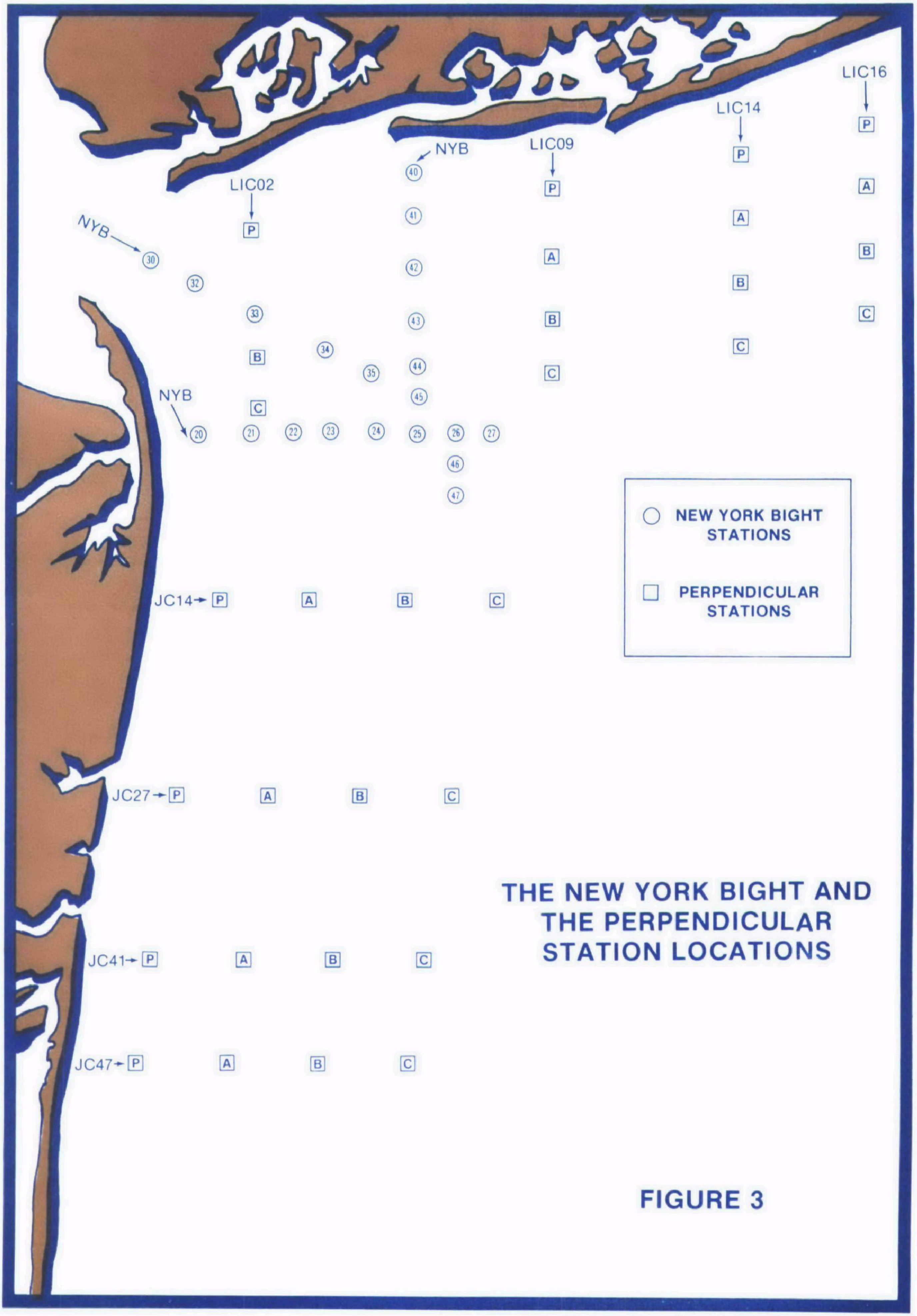

LIC16
LIC14
LIC09
LIC02
NYB
NYB
NYB
JC14
JC27
JC41
JC47
P
A
B
C
NEW YORK BIGHT STATIONS
PERPENDICULAR STATIONS
THE NEW YORK BIGHT AND THE PERPENDICULAR STATION LOCATIONS

FIGURE 3

describe the shore station locations from which the perpendicular stations originate.

Additional Stations

Several additional stations were established during the course of the summer program in response to detected potential environmental problem areas. These areas were in the Atlantic City, Seaside Heights, and Barnegat areas, a short distance off the New Jersey coast. The station locations are plotted in Figures 4 and 5. No station code designations were established for these stations.

Sample Collection Program

During the period between May 1 and September 30, 1977 ambient water monitoring was carried out using the EPA Huey helicopter (Photographs 1-5) 6 days per week and on several occasions sampling continued into Sunday when ambient conditions deemed this necessary.

The weekly sampling program averaged approximately 195 stations. The beach stations along New York and New Jersey were sampled on Mondays, Wednesdays, and Saturdays. These stations were sampled for total and fecal coliform bacteria. This portion of the sampling program totaled 45 stations.

Samples were collected just off shore in the surf zone while the helicopter hovered approximately 3 meters from the surface. This was accomplished by dropping a 1-liter Kemmerer sampler (Photograph 2) from the mid-section of the helicopter approximately

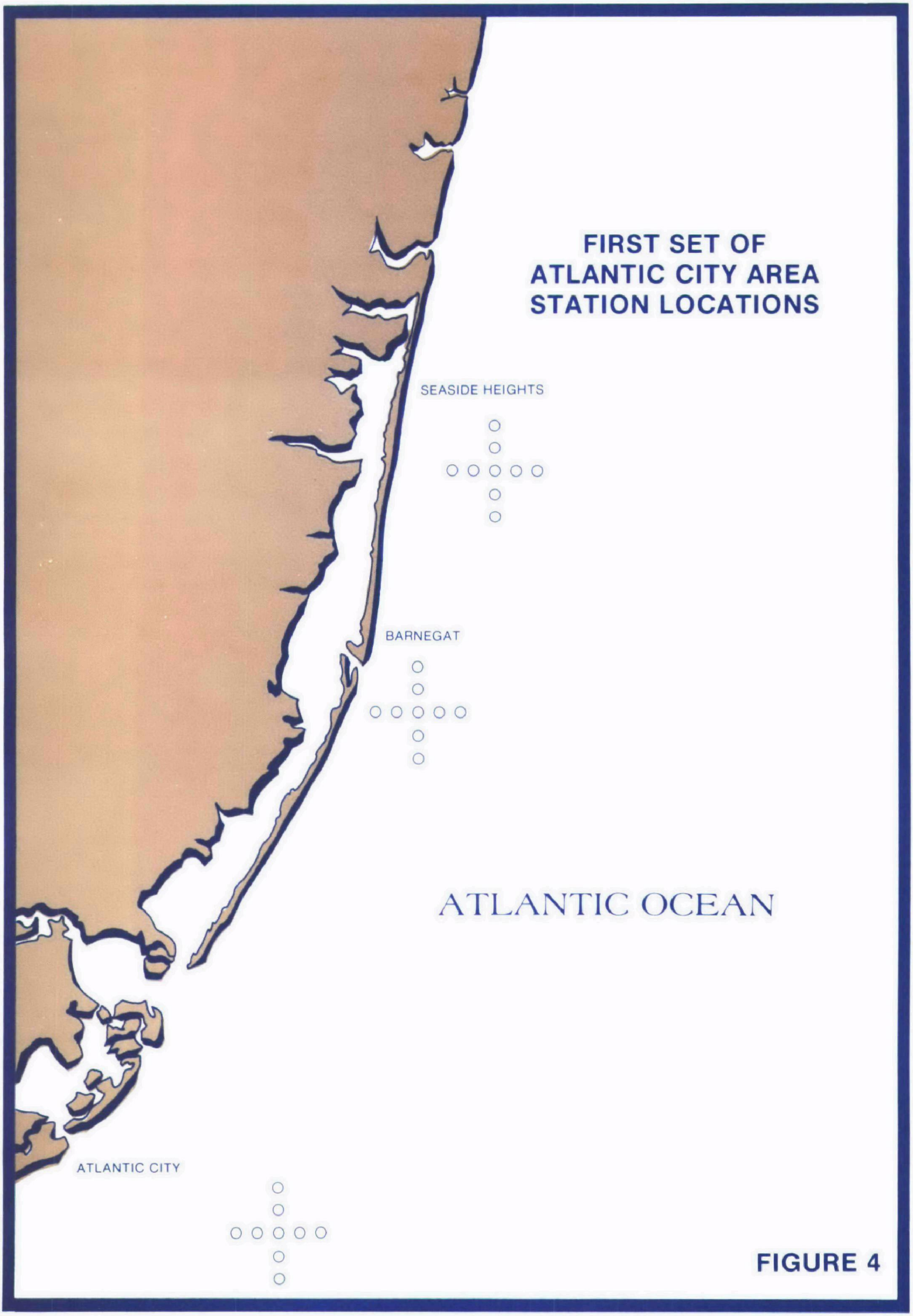

FIRST SET OF
ATLANTIC CITY AREA
STATION LOCATIONS
SEASIDE HEIGHTS
BARNEGAT
ATLANTIC OCEAN
ATLANTIC CITY

FIGURE 4

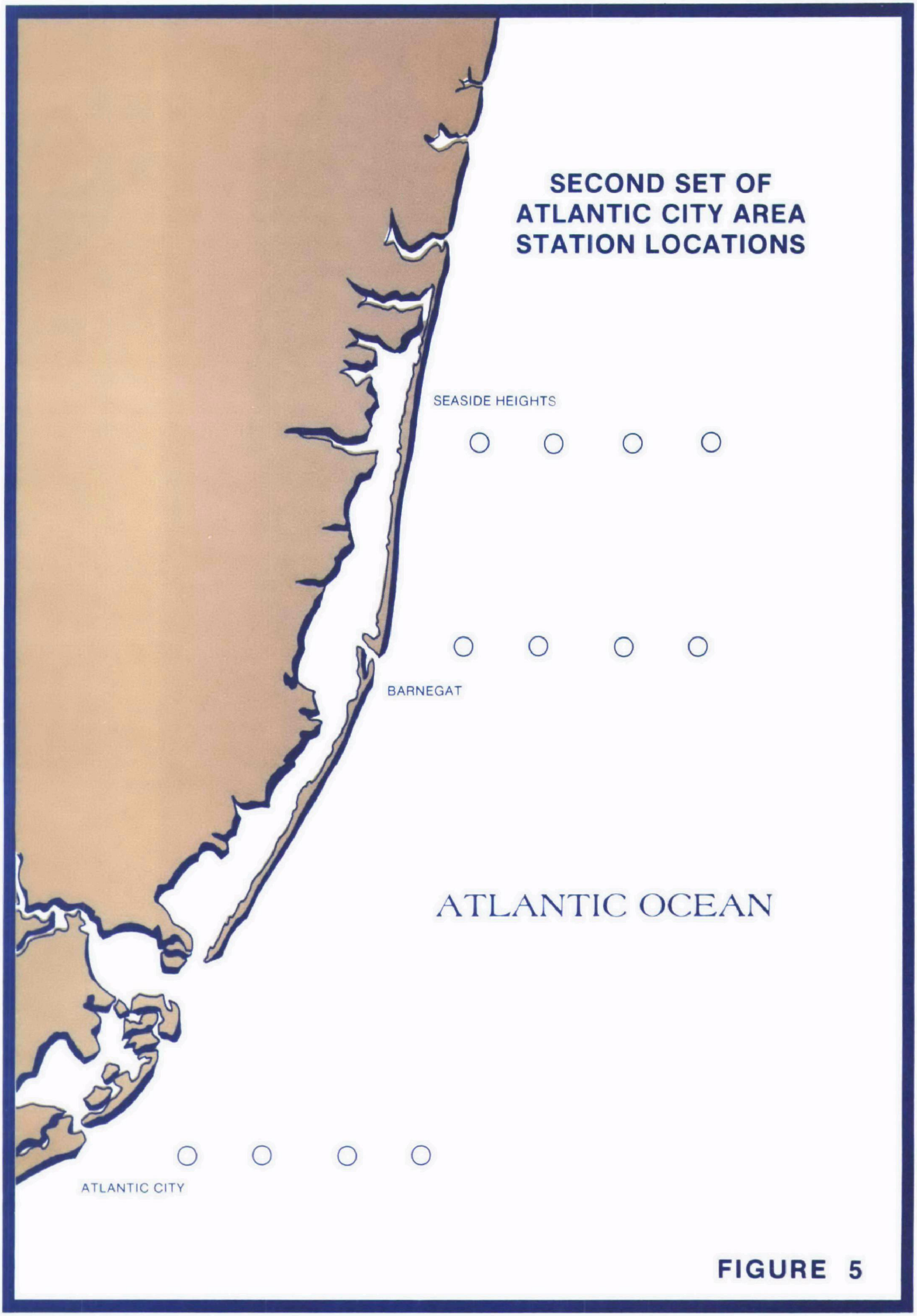
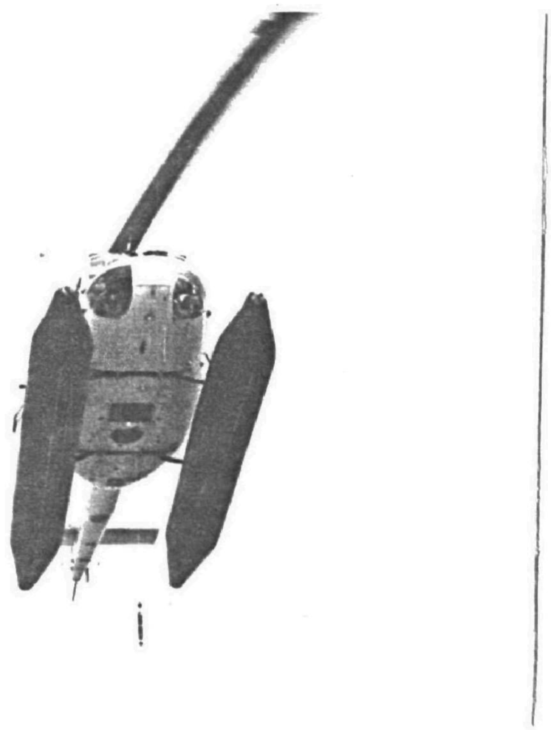

SECOND SET OF
ATLANTIC CITY AREA
STATION LOCATIONS
SEASIDE HEIGHTS
BARNEGAT
ATLANTIC OCEAN
ATLANTIC CITY

FIGURE 5

Photograph 1 - EPA helicopter taking off for sampling run.



Photograph 2 - EPA helicopter - The sampling port in the bottom of the helicopter is readily visible, and a Kemmerer sampler can be seen hanging from the sampling port.

Photograph 3 - Two EPA technicians putting on Mae West life jackets before entering helicopter.

Photograph 4 - EPA helicopter leaving for sampling run.

Photograph 5 - EPA helicopter at helipad.

1 meter below the water surface. The sample would next be transferred to a sterile plastic container and subsequently (within 6 hours) transferred to the Edison Laboratory for bacteriological analysis.

On Tuesdays, 20 stations in the apex of the Bight (Figure 3) were sampled. Depending upon sea state, the EPA helicopter would hover or land at the designated station and two, 3 liter Kemmerer samplers would be used to obtain water samples at 1 meter below the surface and 1 meter above the ocean bottom. After collection, portions of the sample water would be transferred to: 1) a BOD bottle for dissolved oxygen analysis; 2) a sterile plastic bottle for total and fecal coliform analysis; 3) a 1 liter plastic cubitainer for total suspended solids, total organic carbon, and nutrient analysis; and 4) an insulated glass beaker for water temperature analysis.

The dissolved oxygen sample was immediately fixed at the station by the addition of 2 ml of manganous sulfate followed by 2 ml of alkali-iodide-azide reagent. The sample was shaken to facilitate floc formation and allowed to settle. Next, 2 ml of concentrated sulfuric acid were added and the sample shaken to affect precipitate dissolution. This solution was then placed in a metal rack, covered to prevent degradation from sunlight, and returned to the laboratory for titration.

The remaining samples were held for less than 6 hours before returning to the laboratory for analysis.

The third scheduled sampling portion of the program was carried out on Thursdays and Fridays when perpendicular stations (Figure 2) were sampled for dissolved oxygen and temperature. On Thursdays, 20 stations perpendicular to the New Jersey coastline were sampled and on Fridays the remaining 20 stations perpendicular to the Long Island coast were collected. Again as with the inner Bight stations, samples were collected while hovering or landing and at 1 meter below the surface and 1 meter above the bottom.

IV. RESULTS AND DISCUSSION

Normal Trends in the Ocean

There are two major processes which act to replenish dissolved oxygen in the water column of the New York Bight area. These are the photosynthetic conversion of carbon dioxide to molecular oxygen and active transport of oxygen across the air-water interface. Subsequent turbulent diffusion processes then distribute the dissolved oxygen throughout the water column or into the upper surface layer when stratified conditions prevail. Concurrent oxygen utilization (depletion) processes such as bacterial respiration and sediment oxygen demand act to influence the amount of oxygen in the water column at any one time or location.

A general description of the oxygen cycle during a calendar year may be described as follows:

In early January the waters of the Bight are completely mixed throughout the water column with temperatures ranging from $4^{o}C$ to $10^{o}C$ and dissolved oxygen values are between 8 and 10 mg/l with slightly depressed values at the sediment-water interface. The warm spring air temperatures and solar energy increase the upper water layer temperature, and in the absence of high energy input from local storms or tropical hurricanes a thermally stratified water column develops. This stratification effectively blocks the free transport of the oxygen rich upper layer into the cool oxygen poor bottom waters of the Bight.

As hot summer weather conditions set in the warmer upper layer of water remains completely mixed and rich in oxygen (7 to 9 mg/l). This upper layer ranges from 20 to 60 meters in depth depending on time and location. The bottom cooler water is effectively isolated from the upper layer by a $10^{o}C$ temperature gradient. Respiration of bottom organisms, bacterial action on algal remains and detritus, and sediment oxygen demand depress the residual dissolved oxygen values in the bottom waters. In a "normal" year, the dissolved oxygen concentration in the bottom waters of the Bight reaches a minimum in early September of approximately 4 mg/l. At this time cool evenings and less solar input cool the upper waters decreasing the temperature gradient between the two water masses. As the two masses become closer and closer in temperature differential, the energy input required to breakdown the thermocline gradient becomes less and less until finally, in many instances after a local storm, there is a complete mixing of the water column with concommittant reaeration of the bottom waters. The annual cycle again begins. Figures 6 through 31 depict the dissolved oxygen concentrations at selected sites for the duration of the 1977 monitoring program.

Dissolved Oxygen Criteria

The dissolved oxygen levels necessary for survival and/or reproduction vary among biological species. Insufficient data have been assimilated to assign definitive limits or lower levels of tolerance for each species at various growth states. Rough guidelines are available for aquatic species in general for purposes of surveillance and monitoring. These are as follows:

5 mg/l DO and greater - healthy
4 - 5 mg/l DO - borderline to healthy
3 - 4 mg/l DO - stressful if prolonged
2 - 3 mg/l DO - lethal if prolonged
less than 2 mg/l - lethal in a relatively short time period.

**DISSOLVED OXYGEN (BOTTOM VALUES)
LONG ISLAND COAST PERPENDICULAR
FROM LICO2**

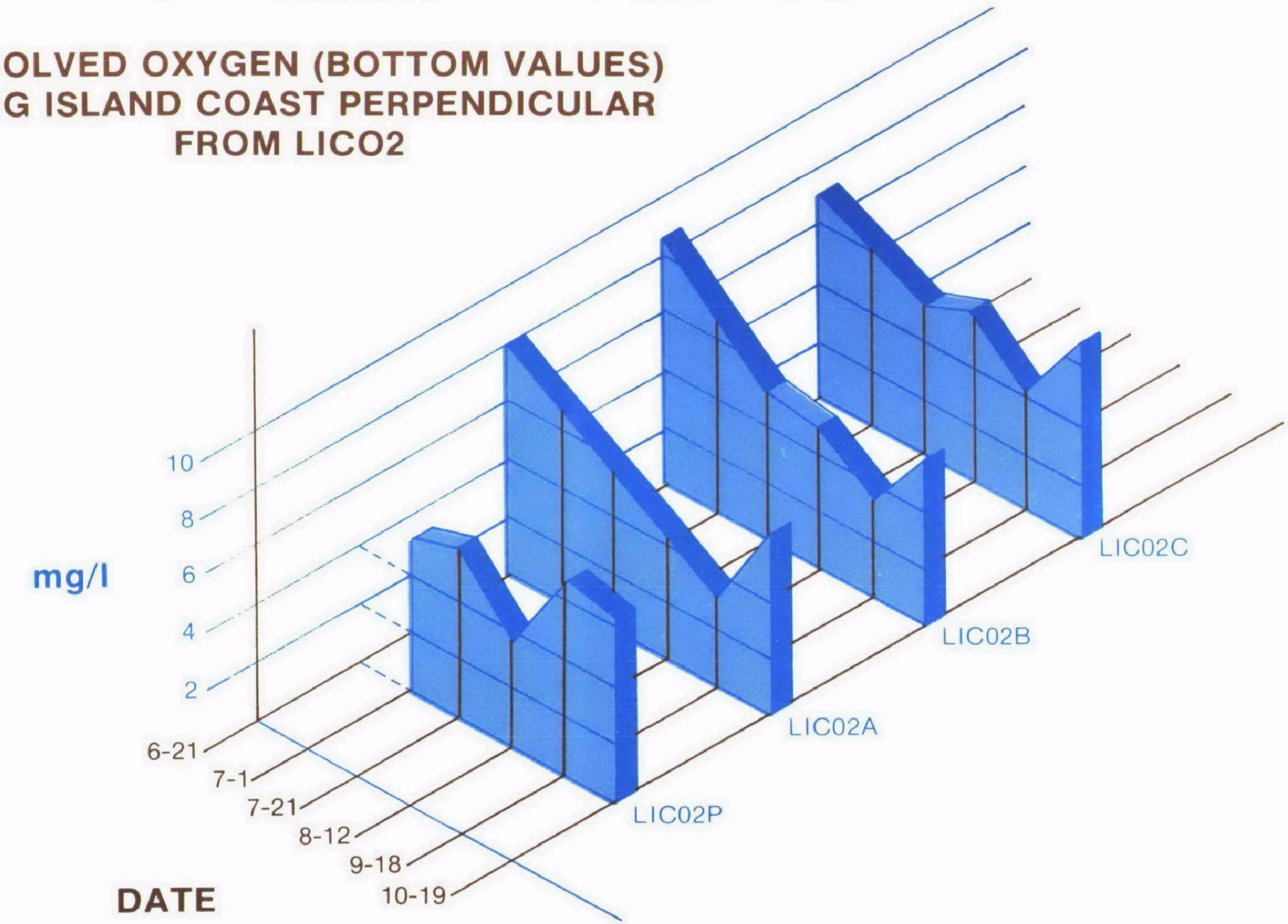


FIGURE 6

DISSOLVED OXYGEN (BOTTOM VALUES)
LONG ISLAND COAST PERPENDICULAR
FROM LIC07

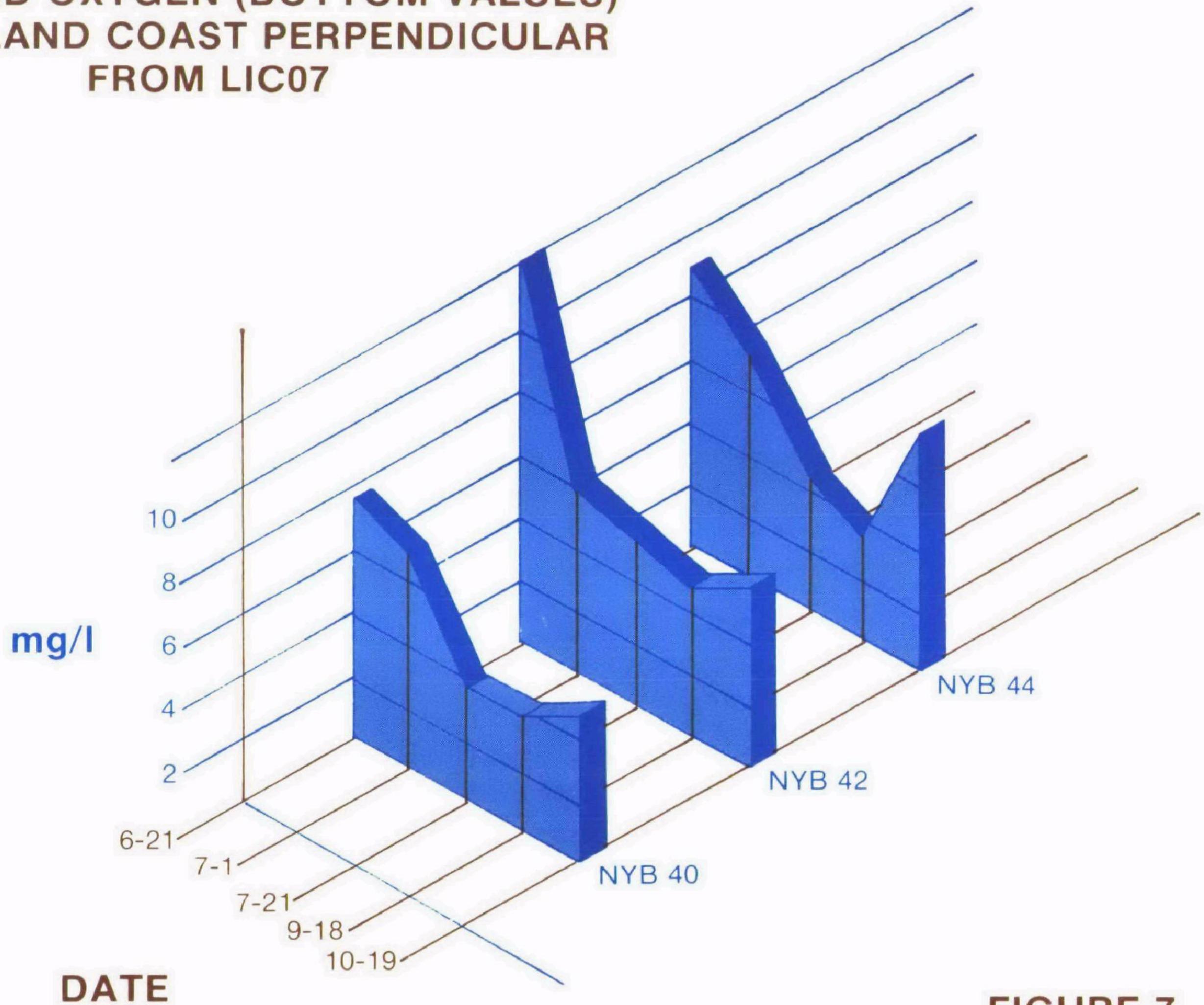


FIGURE 7

DISSOLVED OXYGEN (BOTTOM VALUES)
LONG ISLAND COAST PERPENDICULAR
FROM LIC09

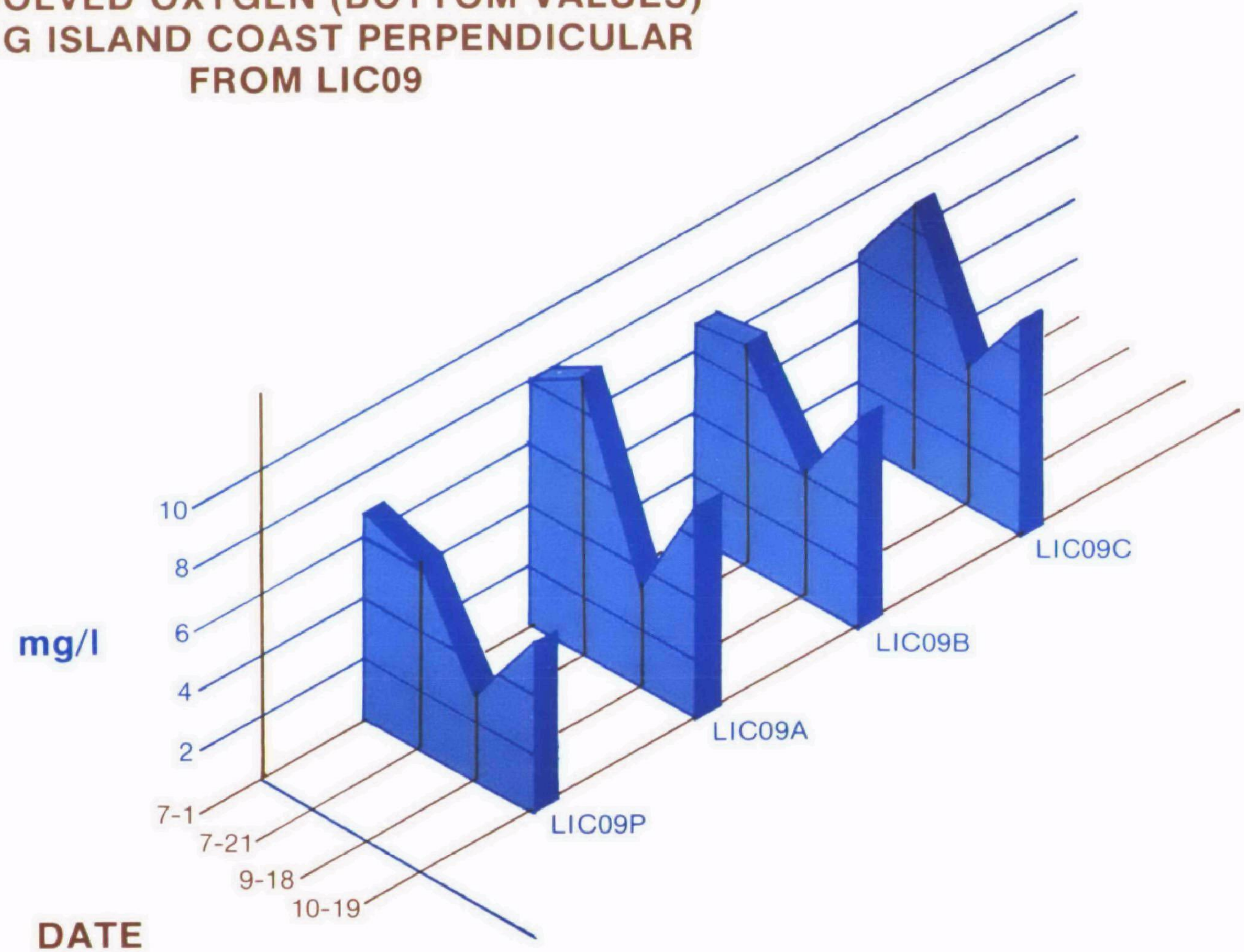


FIGURE 8

DISSOLVED OXYGEN (BOTTOM VALUES)
LONG ISLAND COAST PERPENDICULAR
FROM LIC14

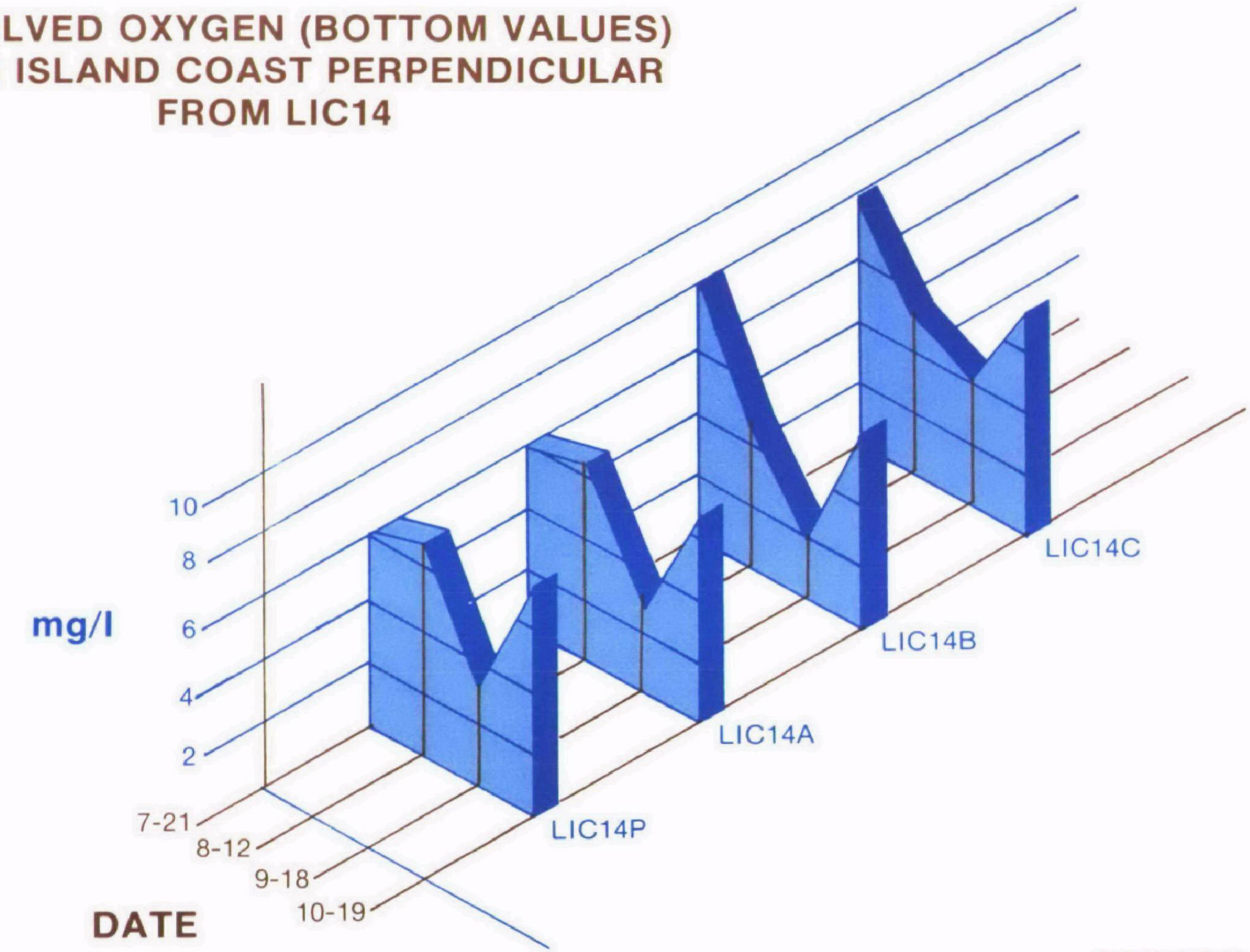


FIGURE 9

**DISSOLVED OXYGEN (BOTTOM VALUES)
NEW JERSEY COAST PERPENDICULAR
FROM JC05**

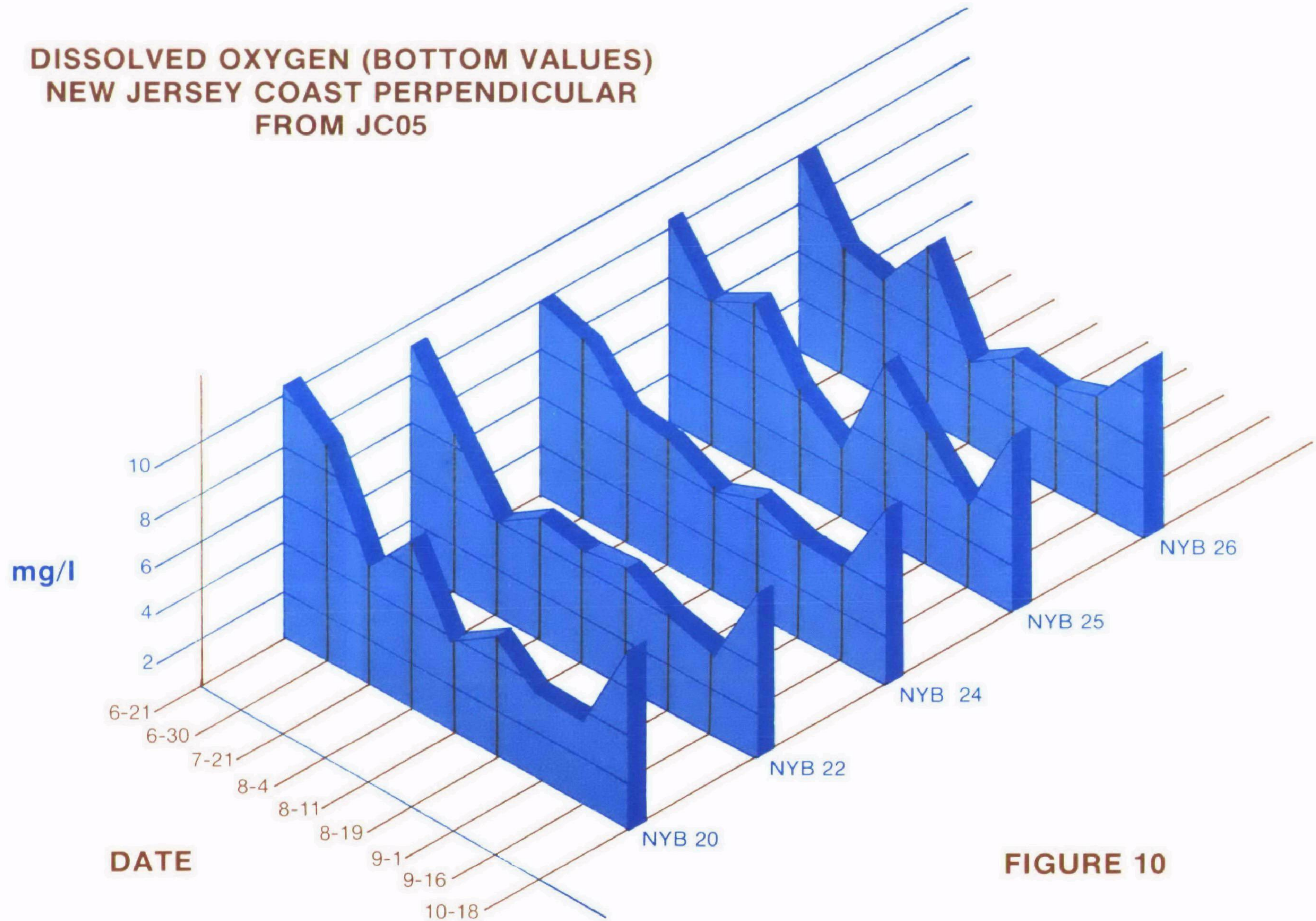


FIGURE 10

DISSOLVED OXYGEN (BOTTOM VALUES) NEW JERSEY COAST PERPENDICULAR FROM JC14

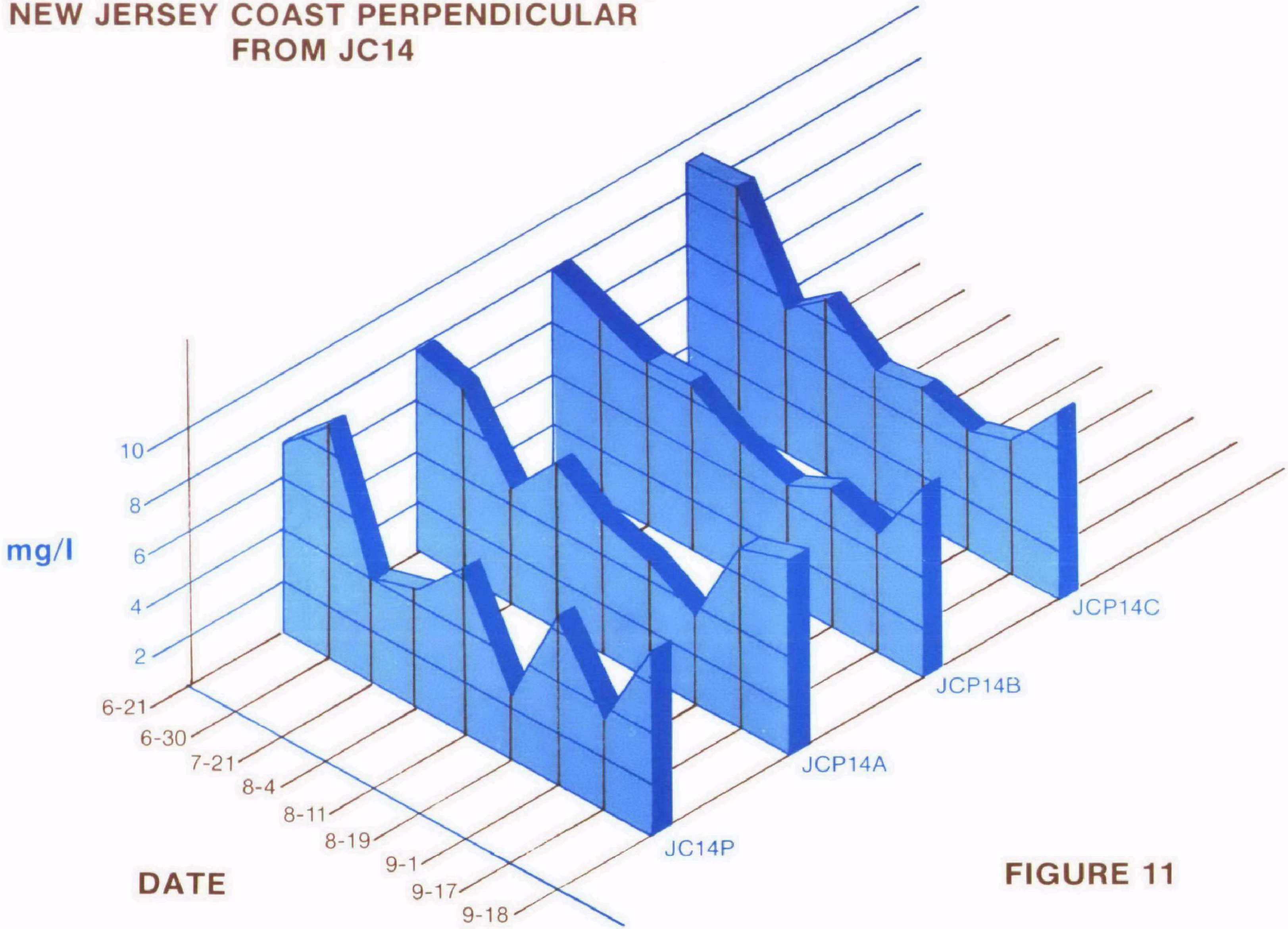


FIGURE 11

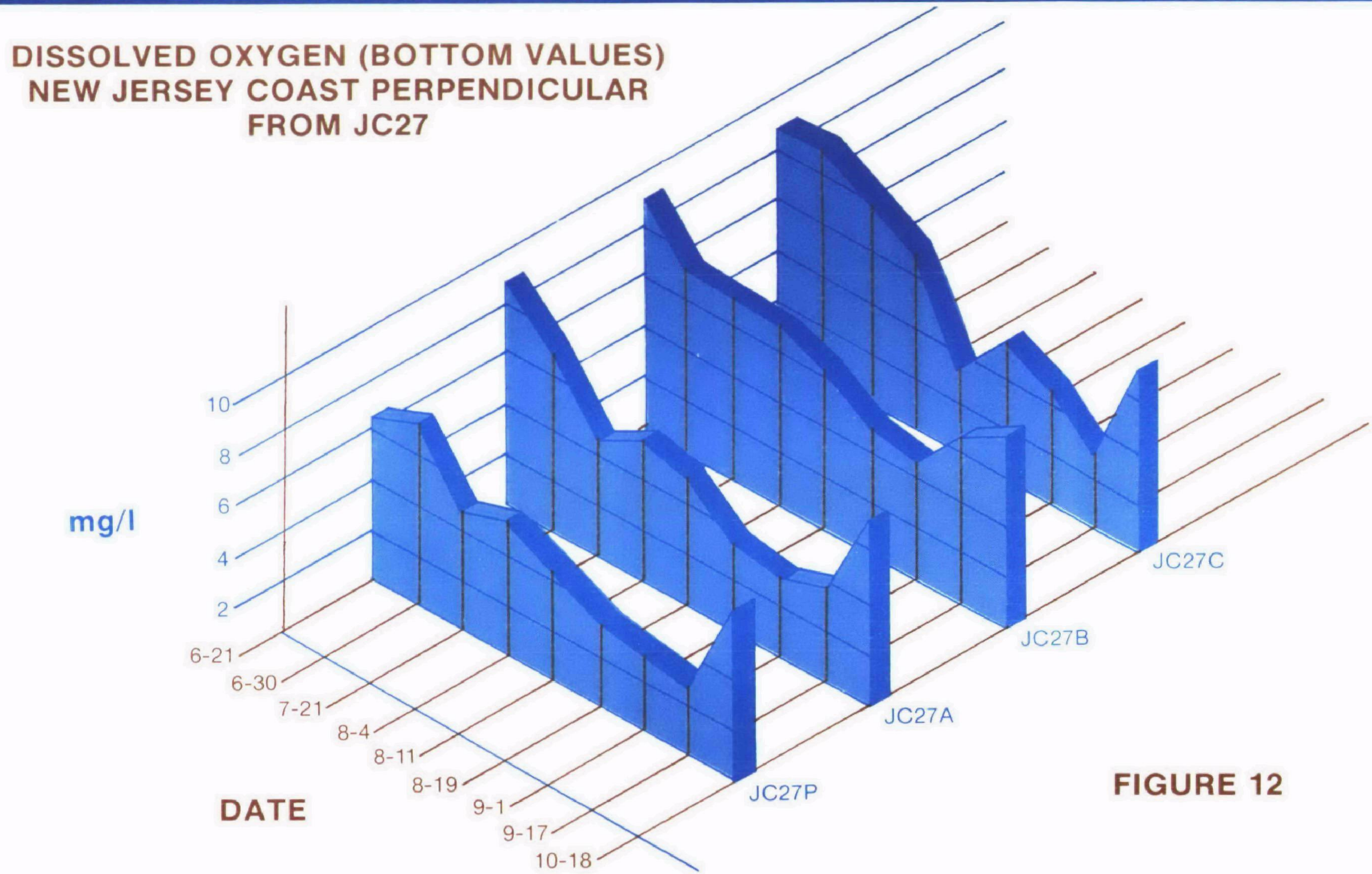

DISSOLVED OXYGEN (BOTTOM VALUES)
NEW JERSEY COAST PERPENDICULAR
FROM JC27
mg/l
10
8
6
4
2
DATE
6-21
6-30
7-21
8-4
8-11
8-19
9-1
9-17
10-18
JC27P
JC27A
JC27B
JC27C

FIGURE 12

**DISSOLVED OXYGEN (BOTTOM VALUES)
NEW JERSEY COAST PERPENDICULAR
FROM JC41**

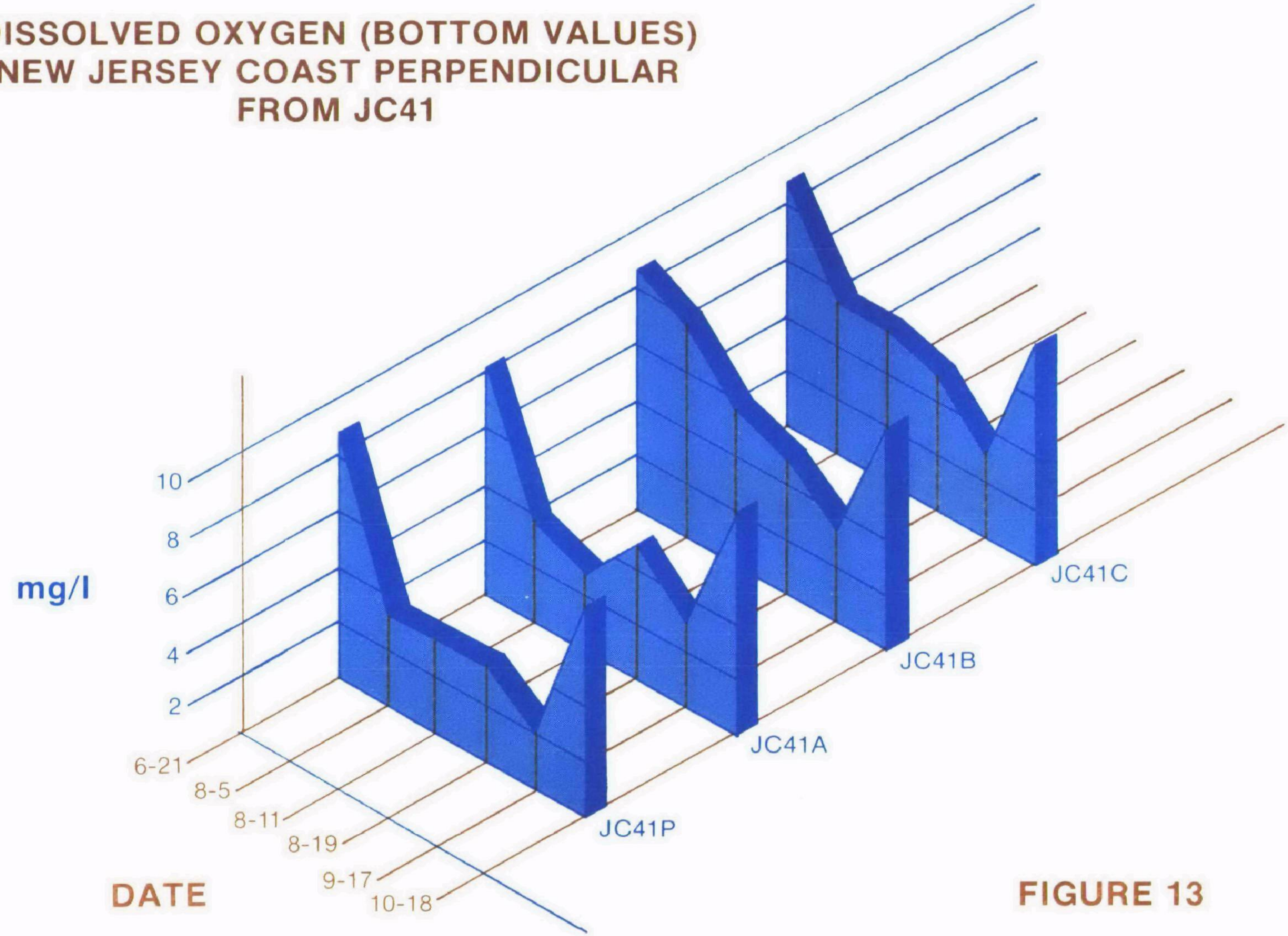


FIGURE 13

DISSOLVED OXYGEN (BOTTOM VALUES) NEW JERSEY COAST PERPENDICULAR FROM JC47

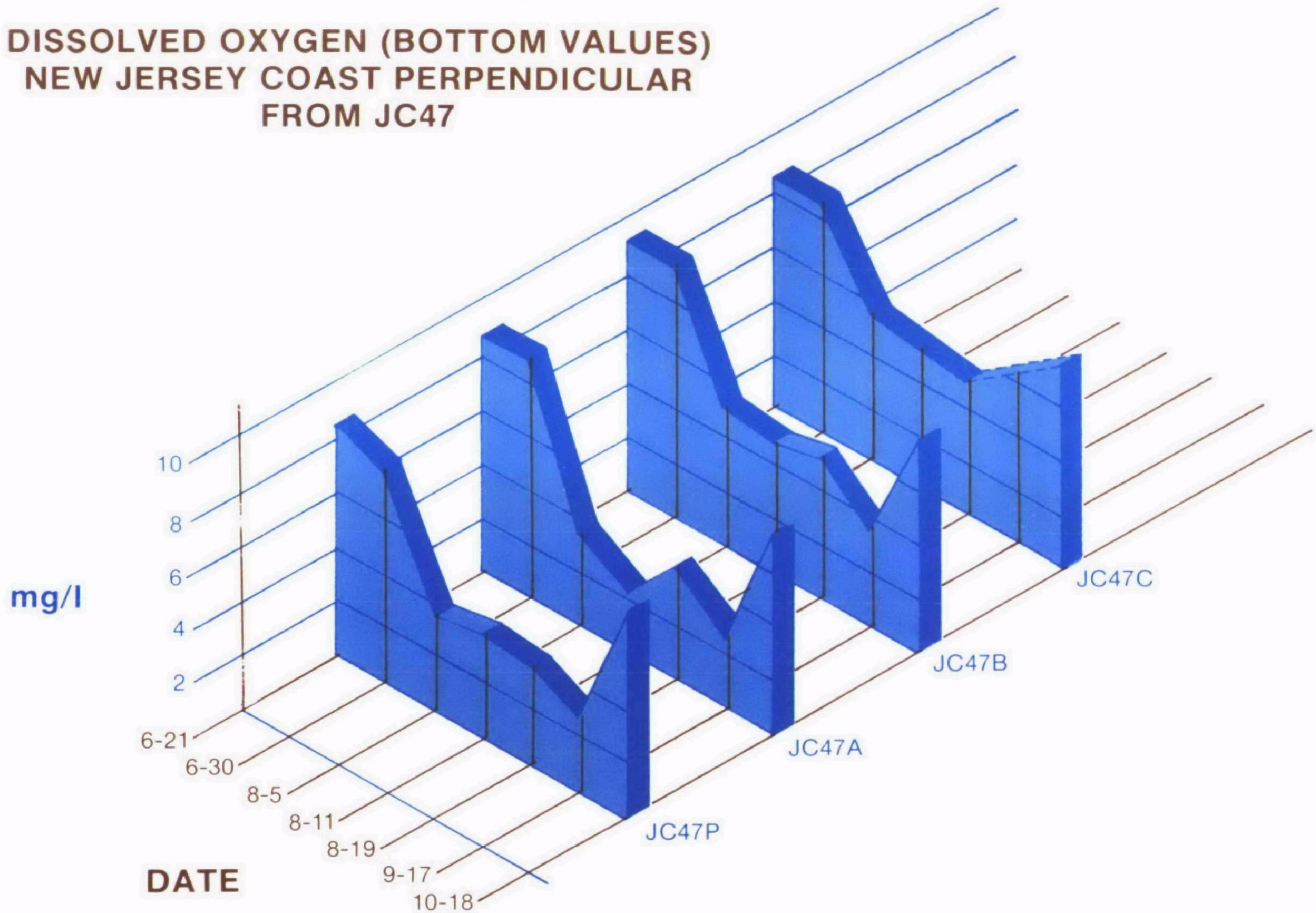


FIGURE 14

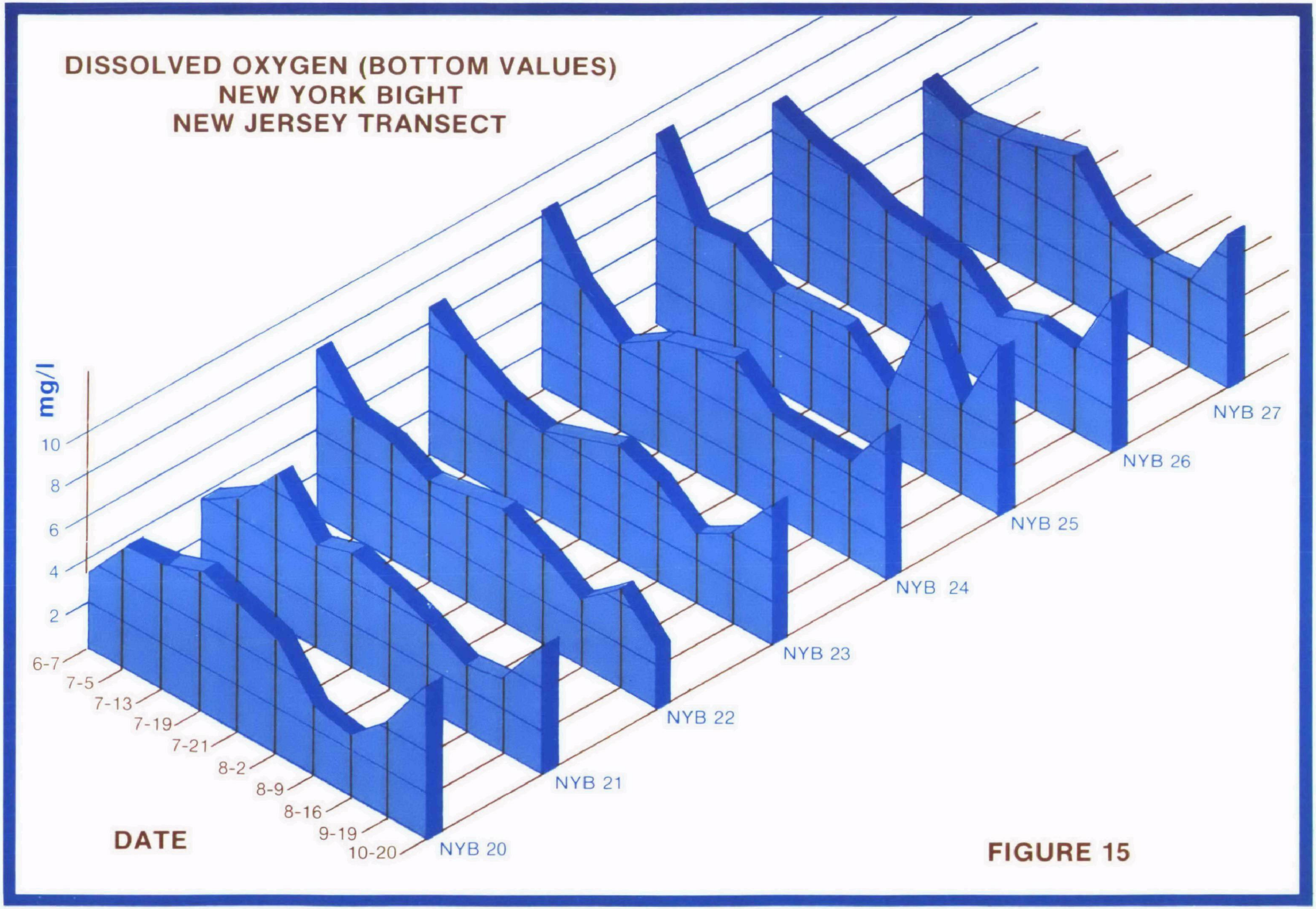
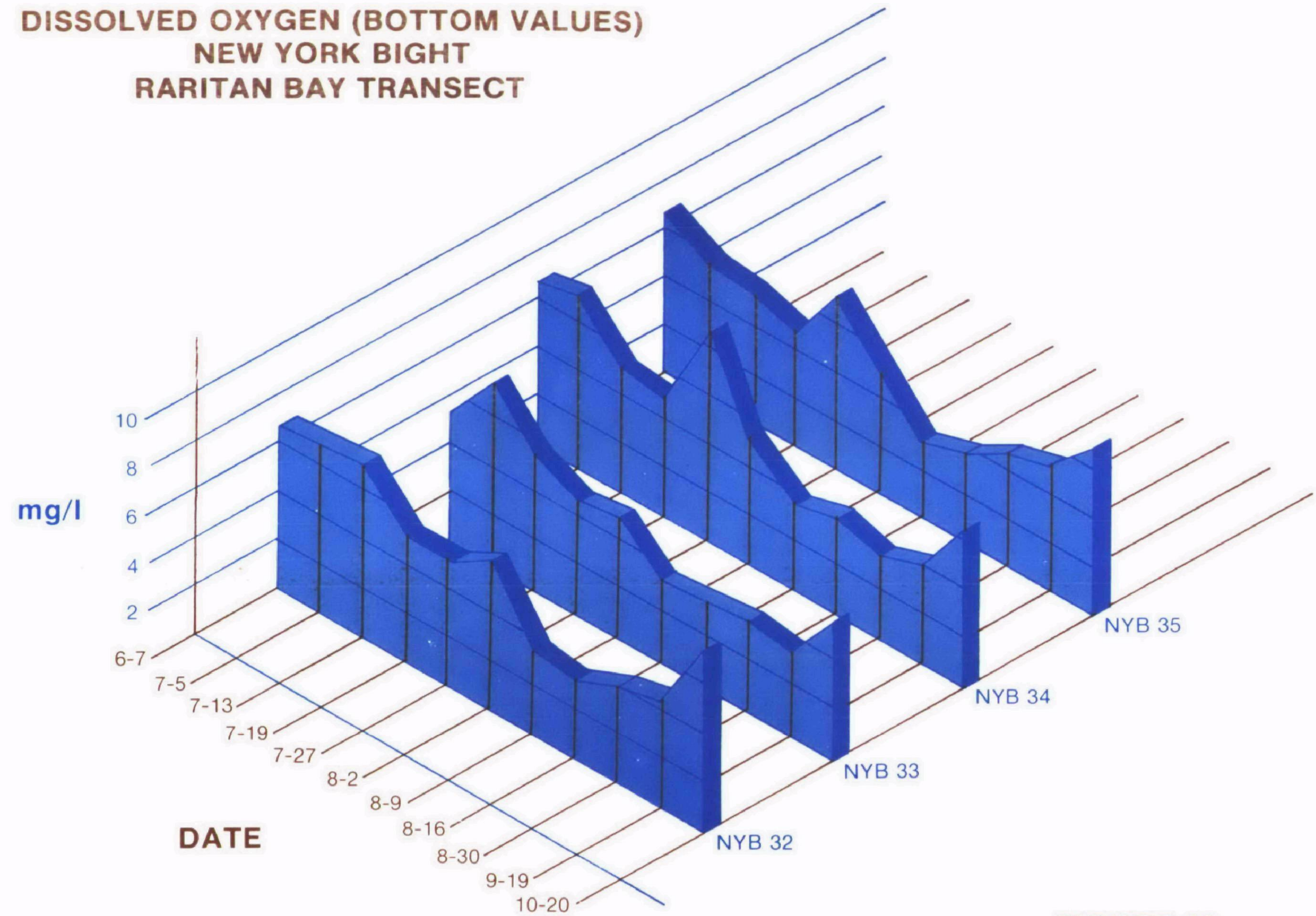

DISSOLVED OXYGEN (BOTTOM VALUES)
NEW YORK BIGHT
NEW JERSEY TRANSECT
mg/l
10
8
6
4
2
6-7
7-5
7-13
7-19
7-21
8-2
8-9
8-16
9-19
10-20
DATE
NYB 20
NYB 21
NYB 22
NYB 23
NYB 24
NYB 25
NYB 26
NYB 27

FIGURE 15



DISSOLVED OXYGEN (BOTTOM VALUES)
NEW YORK BIGHT
RARITAN BAY TRANSECT

FIGURE 16

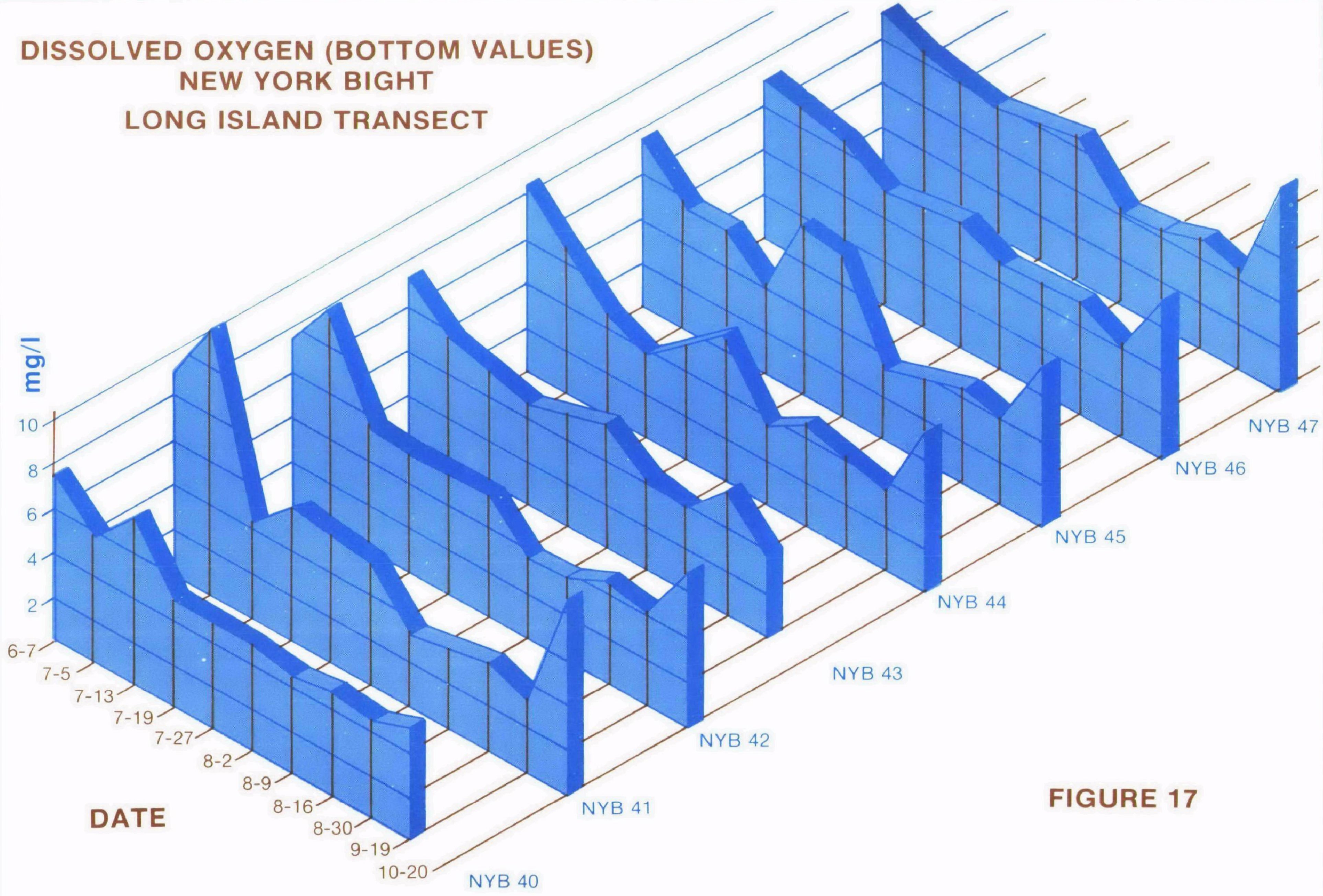

DISSOLVED OXYGEN (BOTTOM VALUES)
NEW YORK BIGHT
LONG ISLAND TRANSECT
mg/l
10
8
6
4
2
6-7
7-5
7-13
7-19
7-27
8-2
8-9
8-16
8-30
9-19
10-20
DATE
NYB 40
NYB 41
NYB 42
NYB 43
NYB 44
NYB 45
NYB 46
NYB 47

FIGURE 17

Figure 18

Bottom Dissolved Oxygen Levels vs. Date & Station
Long Island Perpendiculars (Except NYB40-46)

	July		August	September	October
Station	1	21	12	18	19
LIC02P	.	.	+	.	.
LIC02A*					
LIC02B	.	.	.	+	.
LIC02C	.	.	.	+	.
LIC09P	.	.		**	.
LIC09A	.	.		+	.
LIC09B	.	.		.	.
LIC09C	.	.		.	.
LIC14P		.	.	+	.
LIC14A		.	.	**	.
LIC14B		.	.	**	.
LIC14C		.	.	.	.
LIC16P			.	.	.
LIC16A			.	.	.
LIC16B			.	.	.
LIC16C			.	.	.

. = DO >4
+ = DO 3 to 4
** = DO 2 to 3
Blank = No sample that date

*LIC02A data combined with NYB33 data

Figure 19

Bottom Dissolved Oxygen Levels vs. Date & Station
New Jersey Perpendiculars (Except NYB20-26)

	July	August				September		October	
Station	21	4	5	11	19	1	16/17	18	20
JC14P	.	.		.	*	.	+	.	
JC14A	.	.		.		+	.	.	
JC14B	.	.		.	.	.	.	.	
JC14C	.	.		.	.	.	.		.
JC27P	.	.		.	+	.	*	.	
JC27A	.	.		.	+	+	+	.	
JC27B			.	.	.	.		.	
JC27C			.	.	.	.	+	.	
JC41P			+	+	+		*	.	
JC41A			+	*	.		*	.	
JC41B			.	.	.		+	.	
JC41C			.	.	.		*	.	
JC47P			+	+	+		*	.	
JC47A			+	*	.		*	.	
JC47B			.	.	.		+	.	
JC47C			.	.	.			.	

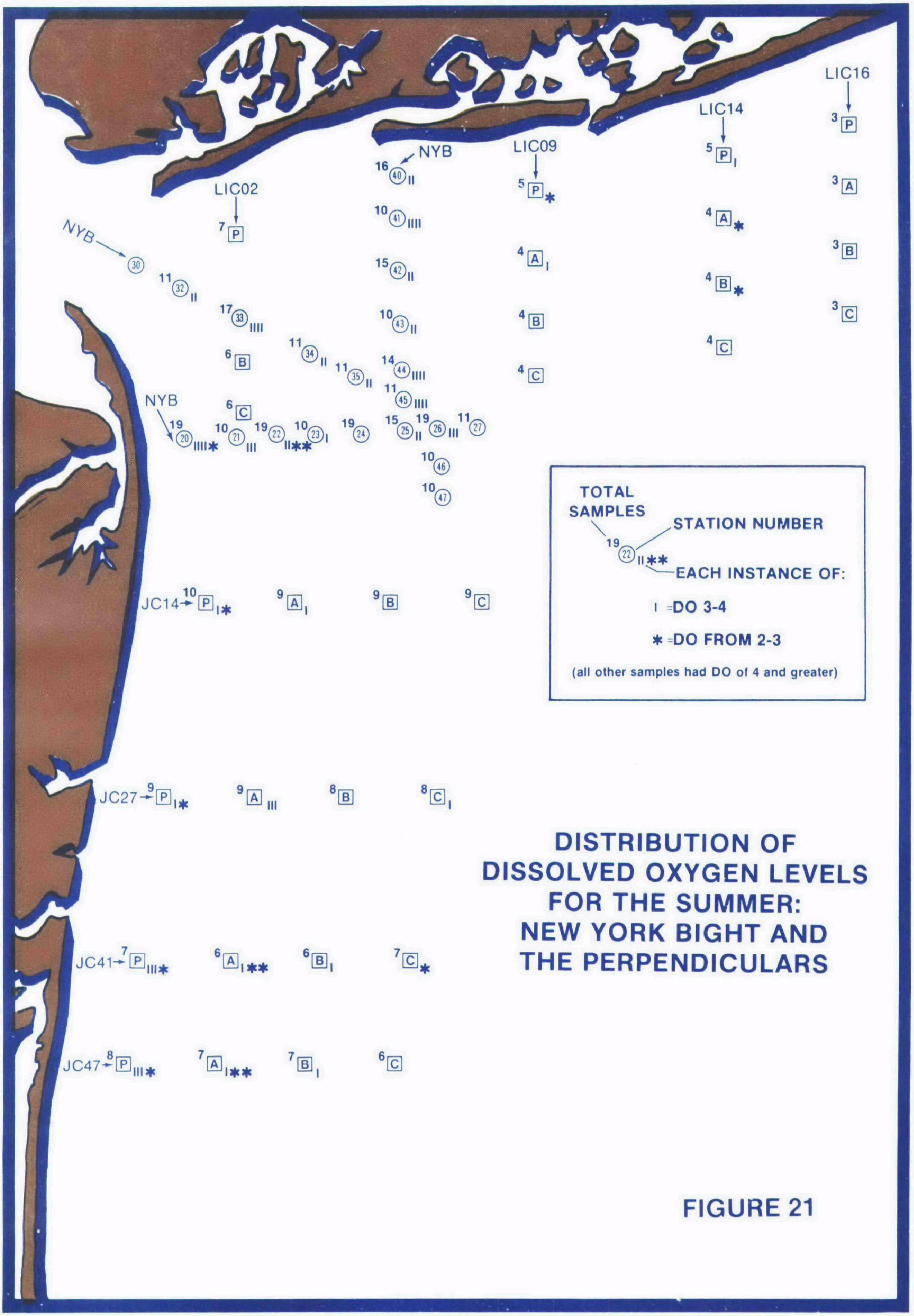
. = DO >4
+ = DO 3 to 4
* = DO 2 to 3
Blank = No sample that date

Figure 20

Bottom Dissolved Oxygen Levels vs. Date & Station
New York Bight (Including NYB20-26 and NYB40-46,
Perpendiculars, and LICO2A)

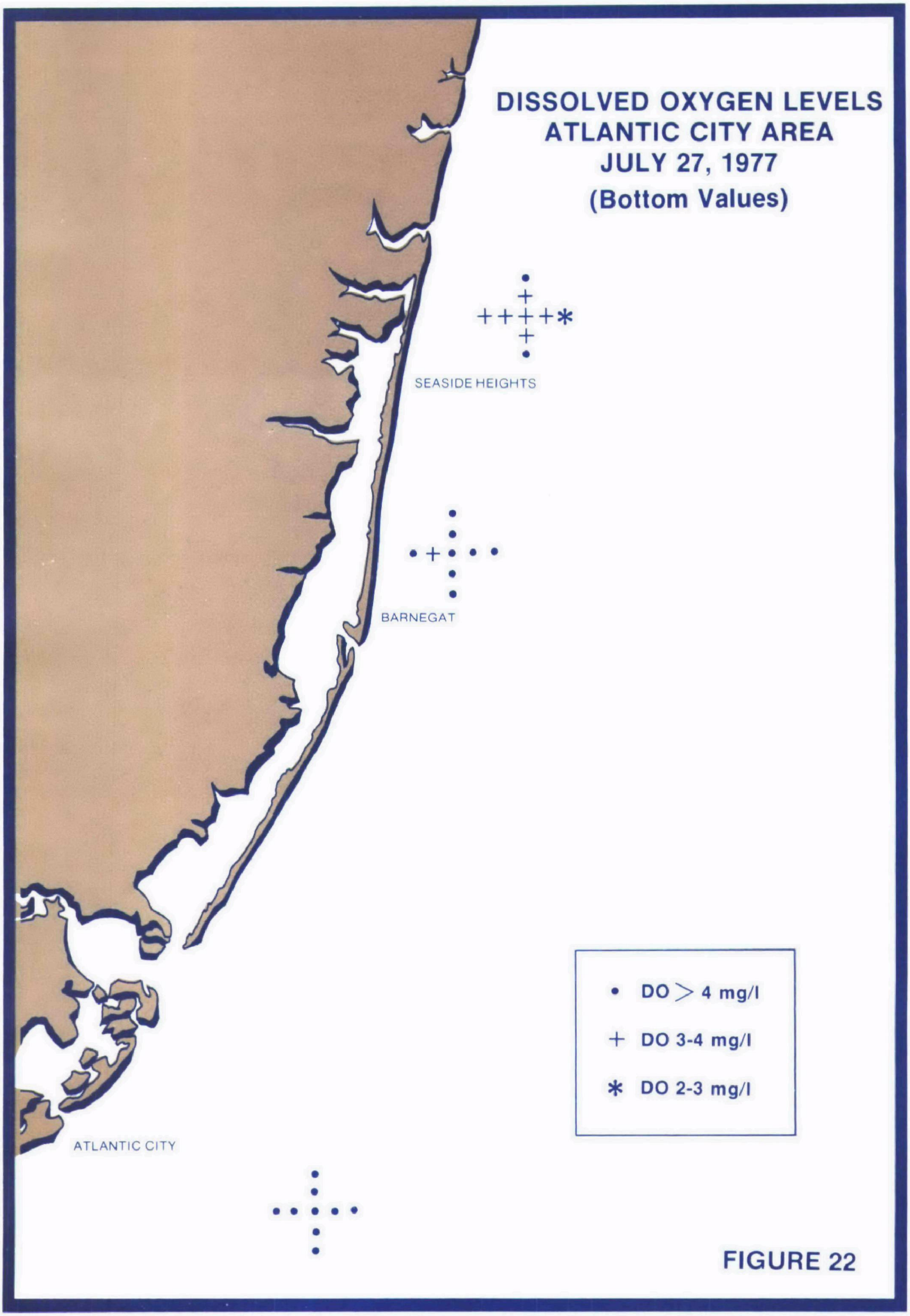
	July					August							September				October	
Station	5	13	19	21	27	2	4	9	11	16	19	30	1	16	18	19	18	20
NYB20	.	.	.	.		.	.	+	+	*	.		+	+			.	.
NYB21	.	.	.	.		.		.		+						+		.
NYB22	.	.	.	+	.	.	.	.	+	.	.		.	*			.	*
NYB23	.	.	.		.	.		.		+						.		.
NYB24	.	.	.	.	.	.	.	.	.	.	.		.	.		.	.	.
NYB25	.	.	.		.	.		.		+						+	.	.
NYB26	.	.	.	.		.	.	+	.	.	.			.		+	.	.
NYB27	.	.	.		.	.		.		.		.				.		.
NYB32	.	.	.		.			+		+		.				.		.
NYB33	.	.	.	.	.	+		.	.	+		+			+	+	.	.
NYB34	.	.	.		.	.		+		.		+				.		.
NYB35	.	.	.		.	.		+		+		.				.		.
NYB40	.	.	.	.	+	.		.		.		.			+			.
NYB41	.	.	.			.		+		+		+				+		.
NYB42	.	.	.		+	.		+		+		.				.		.
NYB43	.	.	.			.		.		+		.				+		.
NYB44	.	.	+			.		+		.		.			+	+		.
NYB45	.	.	+		.	.		+		+		.				+		.
NYB46	.	.	.			.		.		.		.				.		.
NYB47	.	.	.			.		.		.		.				.		.

. = DO >4
+ = DO 3 to 4
* = DO 2 to 3
Blank = No sample that date



DISTRIBUTION OF DISSOLVED OXYGEN LEVELS FOR THE SUMMER: NEW YORK BIGHT AND THE PERPENDICULARS

FIGURE 21


DISSOLVED OXYGEN LEVELS
ATLANTIC CITY AREA
JULY 27, 1977
(Bottom Values)
SEASIDE HEIGHTS
BARNEGAT
ATLANTIC CITY
• DO > 4 mg/l
+ DO 3-4 mg/l
* DO 2-3 mg/l
FIGURE 22

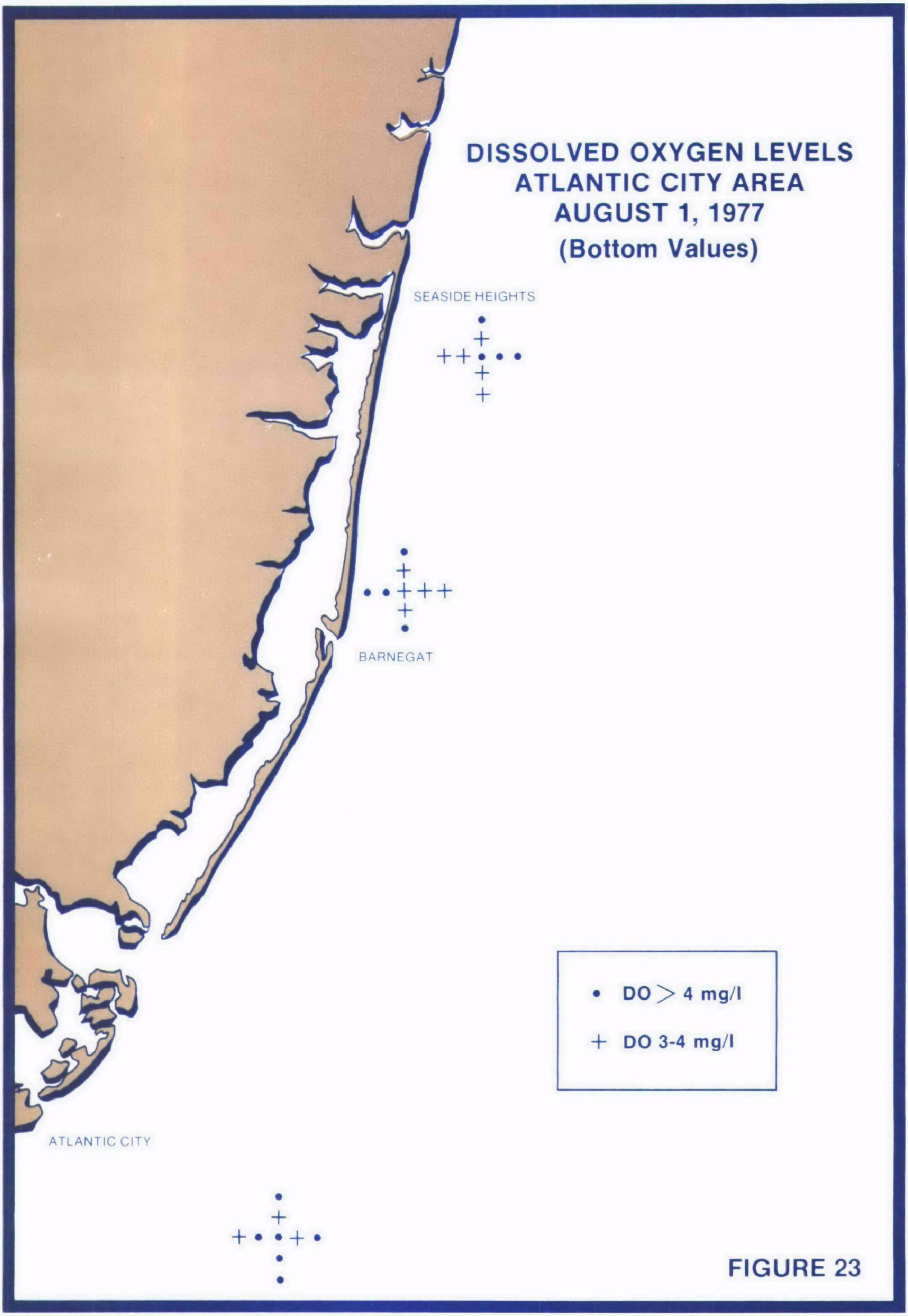

DISSOLVED OXYGEN LEVELS
ATLANTIC CITY AREA
AUGUST 1, 1977
(Bottom Values)
SEASIDE HEIGHTS
BARNEGAT
ATLANTIC CITY
• DO > 4 mg/l
+ DO 3-4 mg/l

FIGURE 23

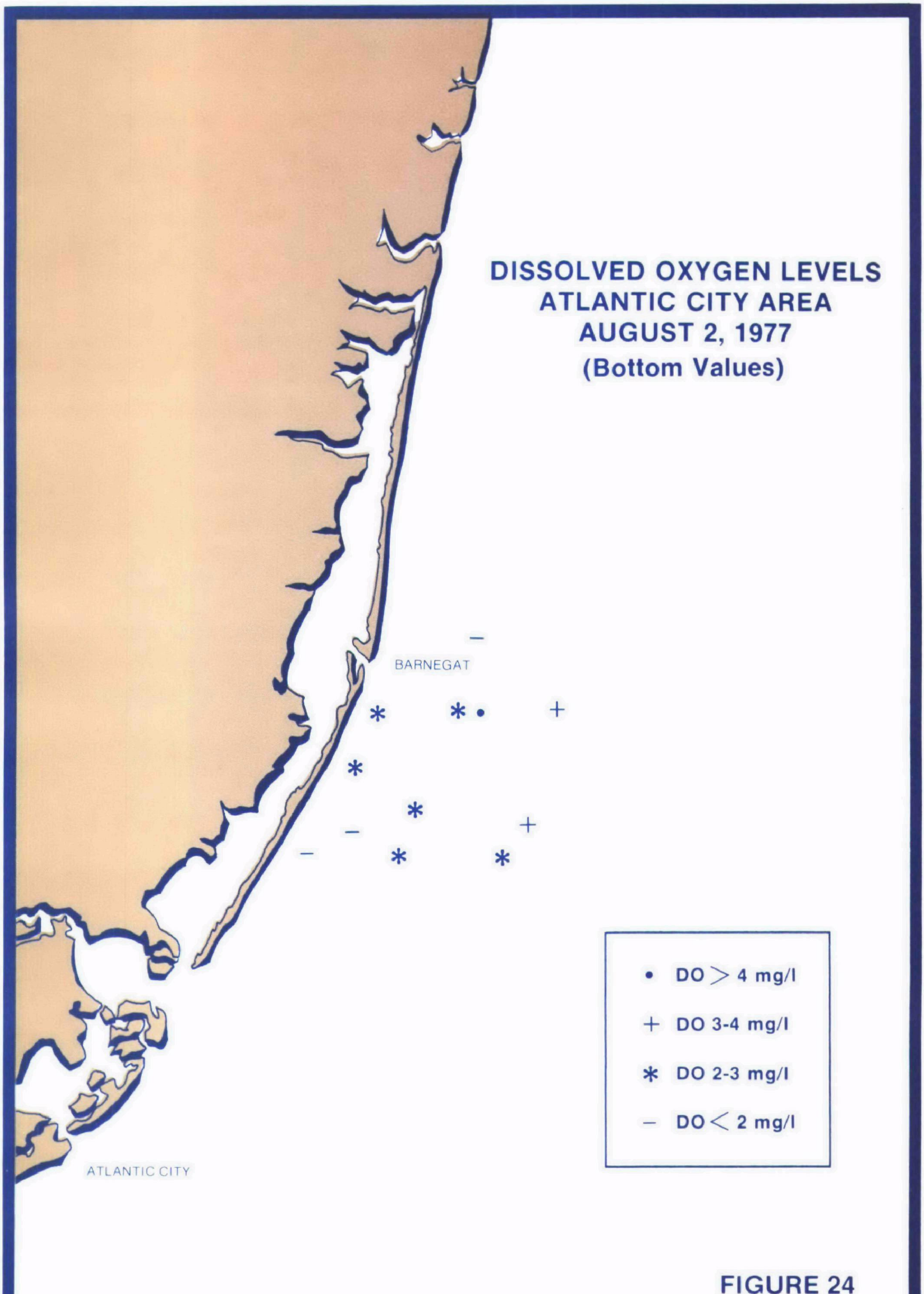

DISSOLVED OXYGEN LEVELS
ATLANTIC CITY AREA
AUGUST 2, 1977
(Bottom Values)
BARNEGAT
ATLANTIC CITY
• DO > 4 mg/l
+ DO 3-4 mg/l
* DO 2-3 mg/l
– DO < 2 mg/l

FIGURE 24

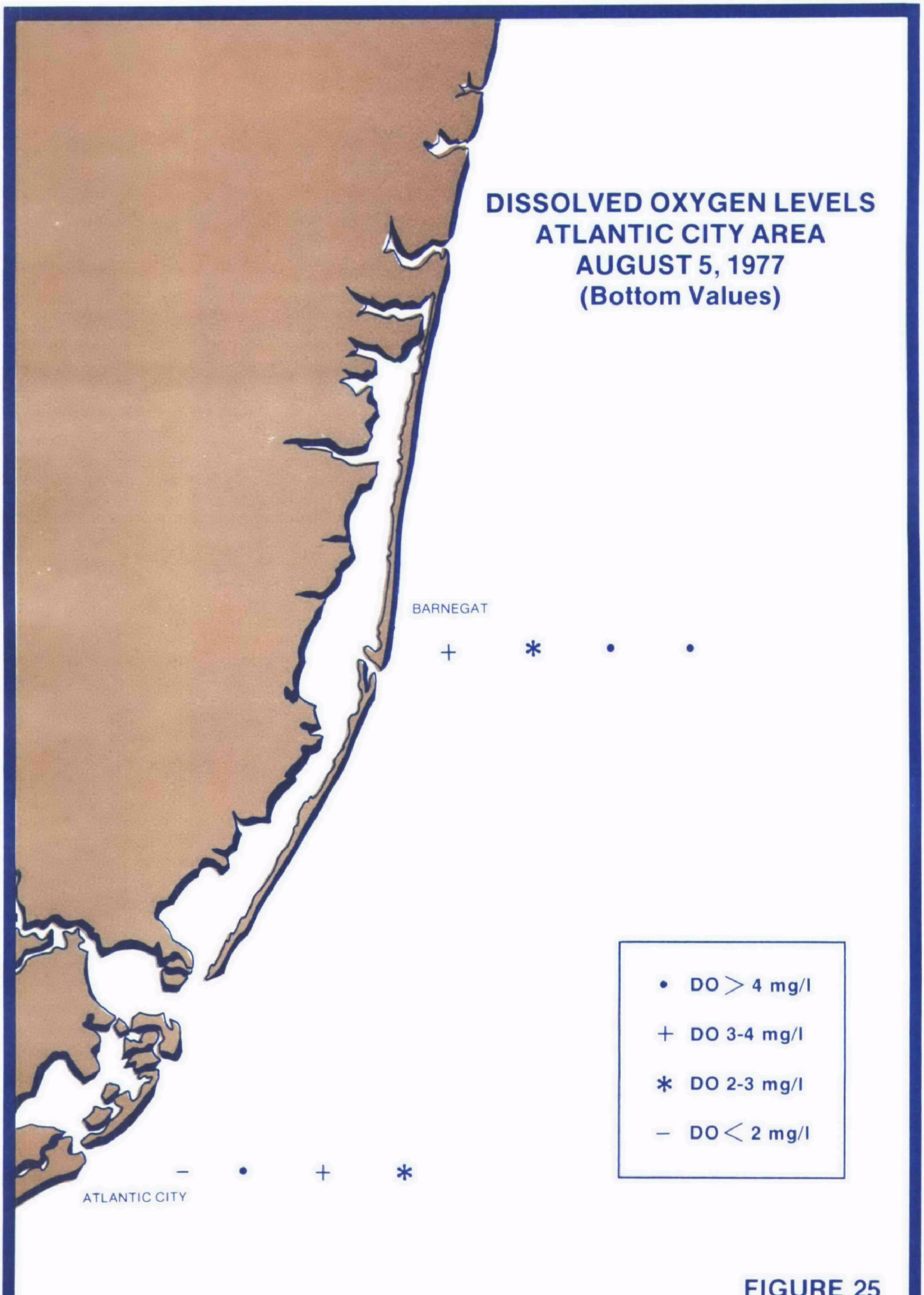

DISSOLVED OXYGEN LEVELS
ATLANTIC CITY AREA
AUGUST 5, 1977
(Bottom Values)
BARNEGAT
ATLANTIC CITY
• DO > 4 mg/l
+ DO 3-4 mg/l
* DO 2-3 mg/l
– DO < 2 mg/l

FIGURE 25

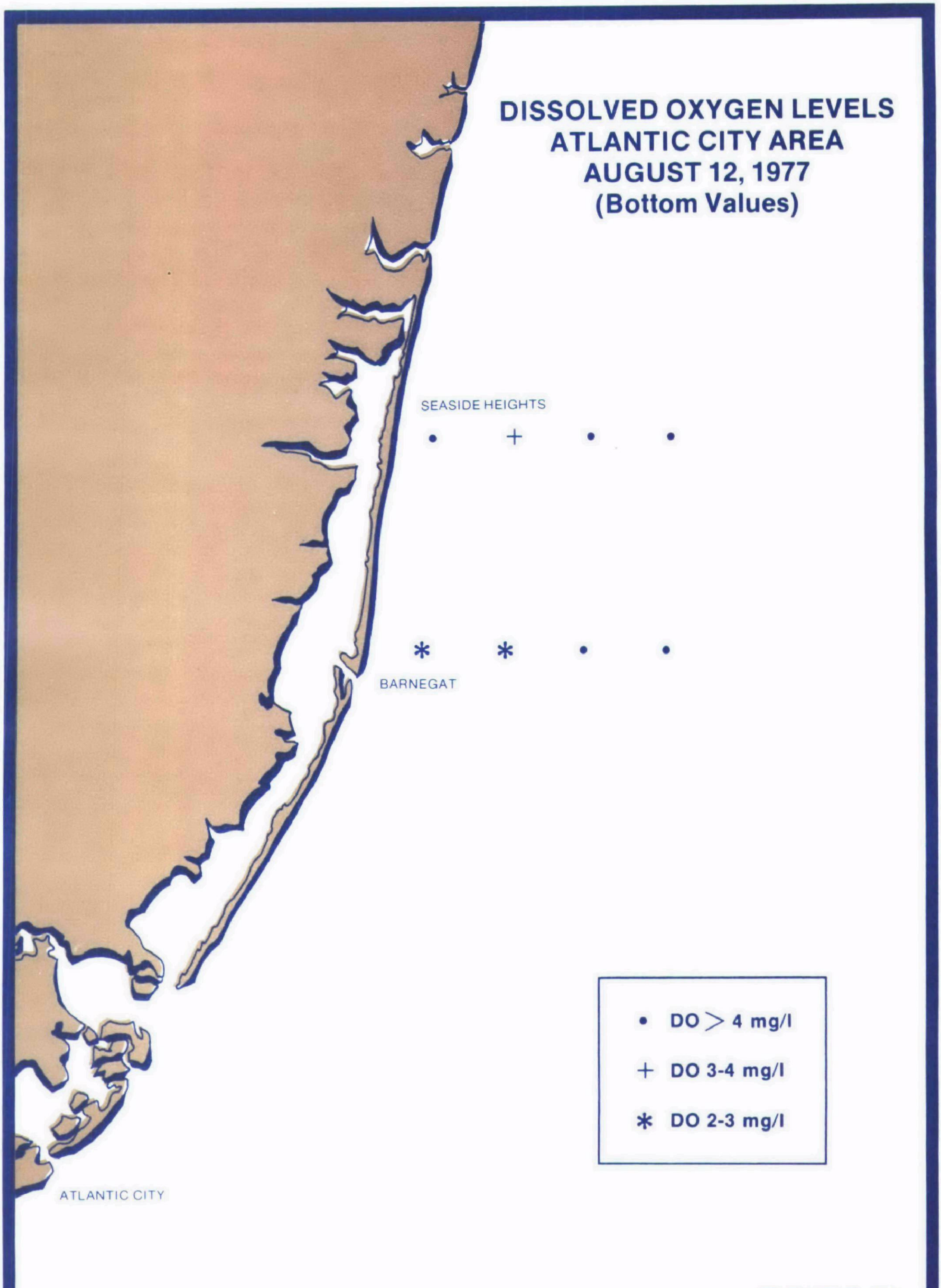

DISSOLVED OXYGEN LEVELS
ATLANTIC CITY AREA
AUGUST 12, 1977
(Bottom Values)
SEASIDE HEIGHTS
BARNEGAT
ATLANTIC CITY
• DO > 4 mg/l
+ DO 3-4 mg/l
* DO 2-3 mg/l

FIGURE 26

SEMI-MONTHLY DISTRIBUTION OF DISSOLVED OXYGEN LEVELS LONG ISLAND COAST PERPENDICULARS

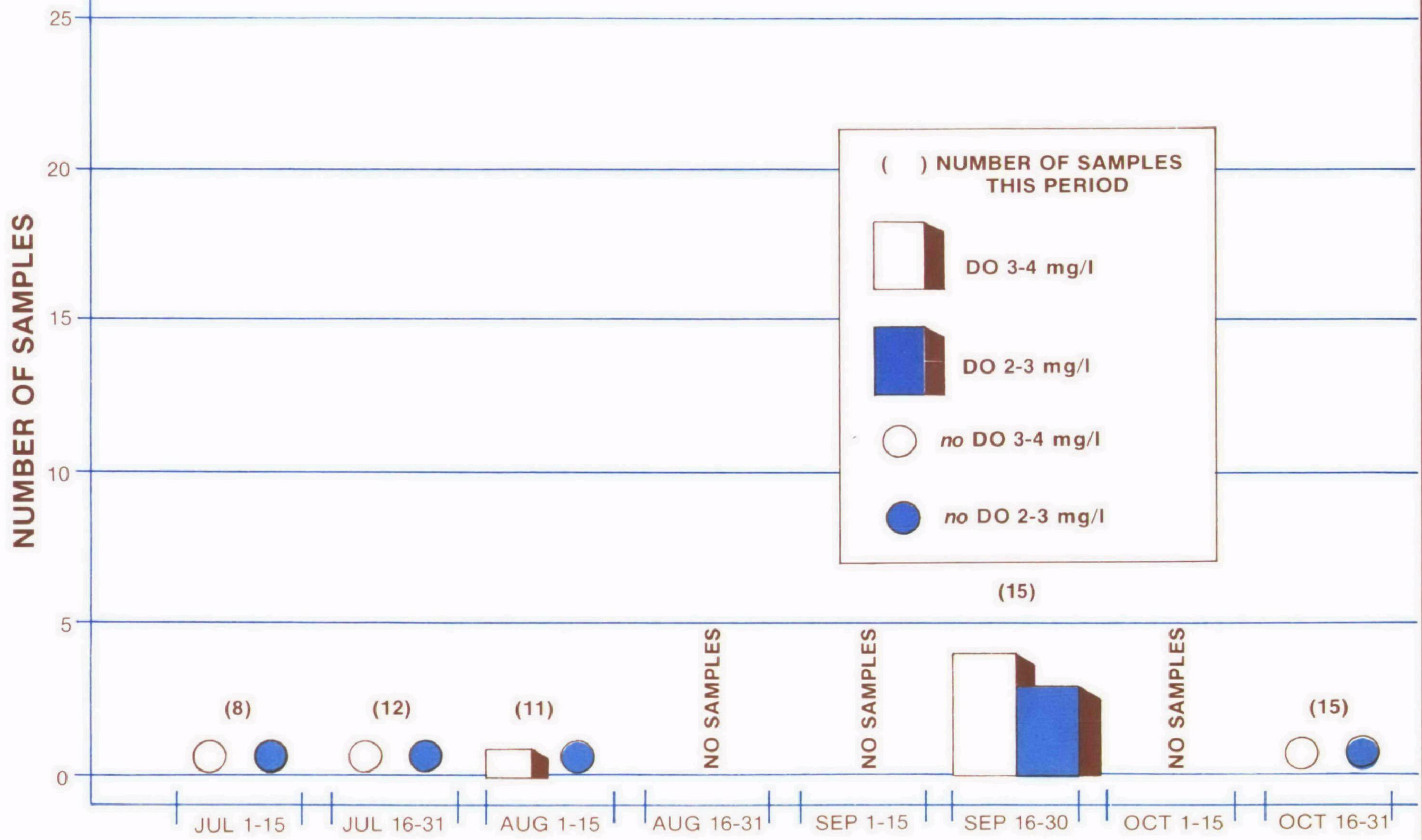


FIGURE 27

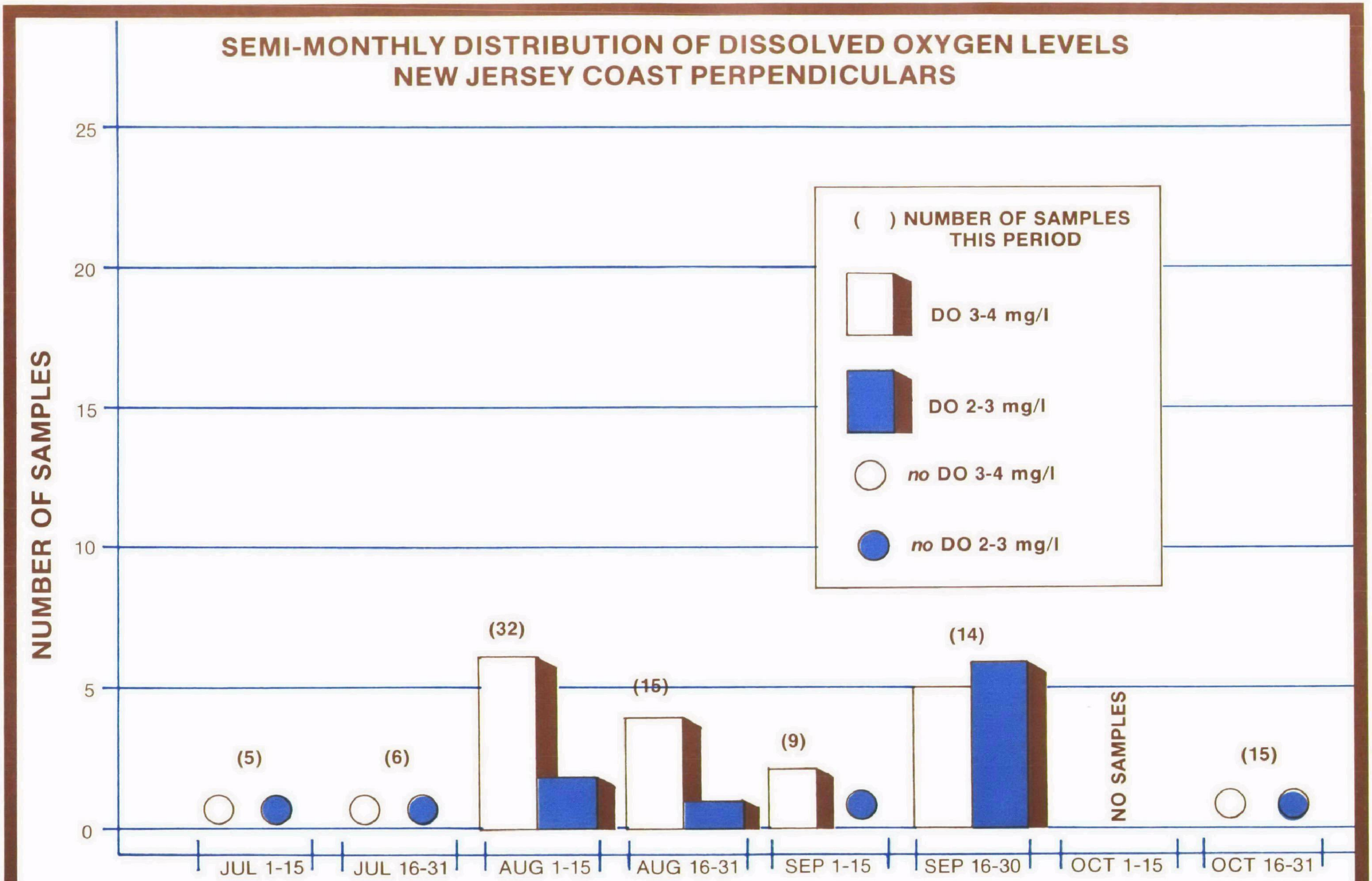

SEMI-MONTHLY DISTRIBUTION OF DISSOLVED OXYGEN LEVELS
NEW JERSEY COAST PERPENDICULARS
NUMBER OF SAMPLES
25
20
15
10
5
0
( ) NUMBER OF SAMPLES THIS PERIOD
DO 3-4 mg/l
DO 2-3 mg/l
no DO 3-4 mg/l
no DO 2-3 mg/l
(5)
(6)
(32)
(15)
(9)
(14)
NO SAMPLES
(15)
JUL 1-15
JUL 16-31
AUG 1-15
AUG 16-31
SEP 1-15
SEP 16-30
OCT 1-15
OCT 16-31

FIGURE 28

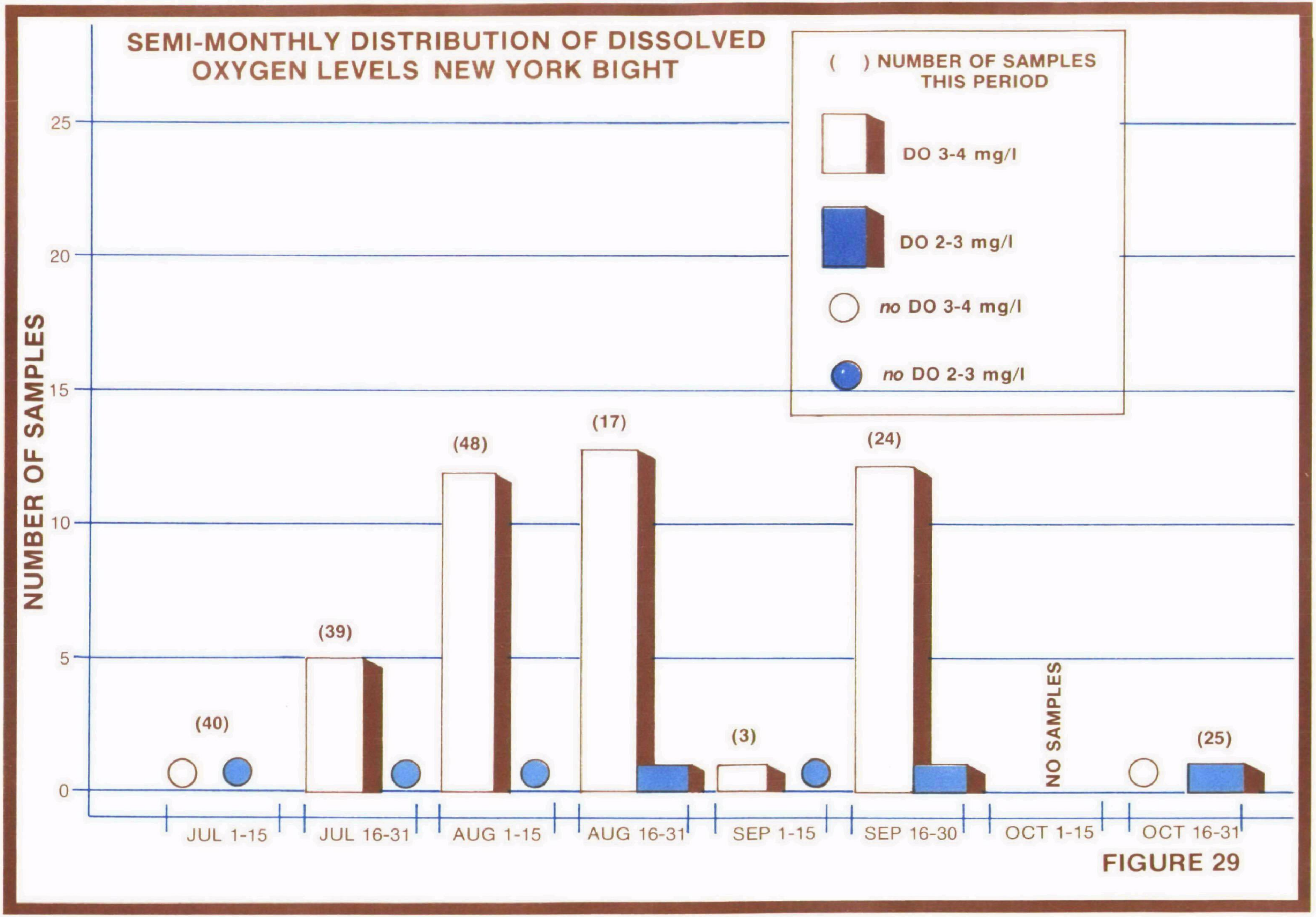

SEMI-MONTHLY DISTRIBUTION OF DISSOLVED OXYGEN LEVELS NEW YORK BIGHT
( ) NUMBER OF SAMPLES THIS PERIOD
DO 3-4 mg/l
DO 2-3 mg/l
no DO 3-4 mg/l
no DO 2-3 mg/l
NUMBER OF SAMPLES
25
20
15
10
5
0
(40)
(39)
(48)
(17)
(3)
(24)
NO SAMPLES
(25)
JUL 1-15
JUL 16-31
AUG 1-15
AUG 16-31
SEP 1-15
SEP 16-30
OCT 1-15
OCT 16-31

FIGURE 29

SEMI-MONTHLY DISTRIBUTION OF DISSOLVED OXYGEN LEVELS
ATLANTIC CITY—SEASIDE HEIGHTS—BARNEGAT AREA

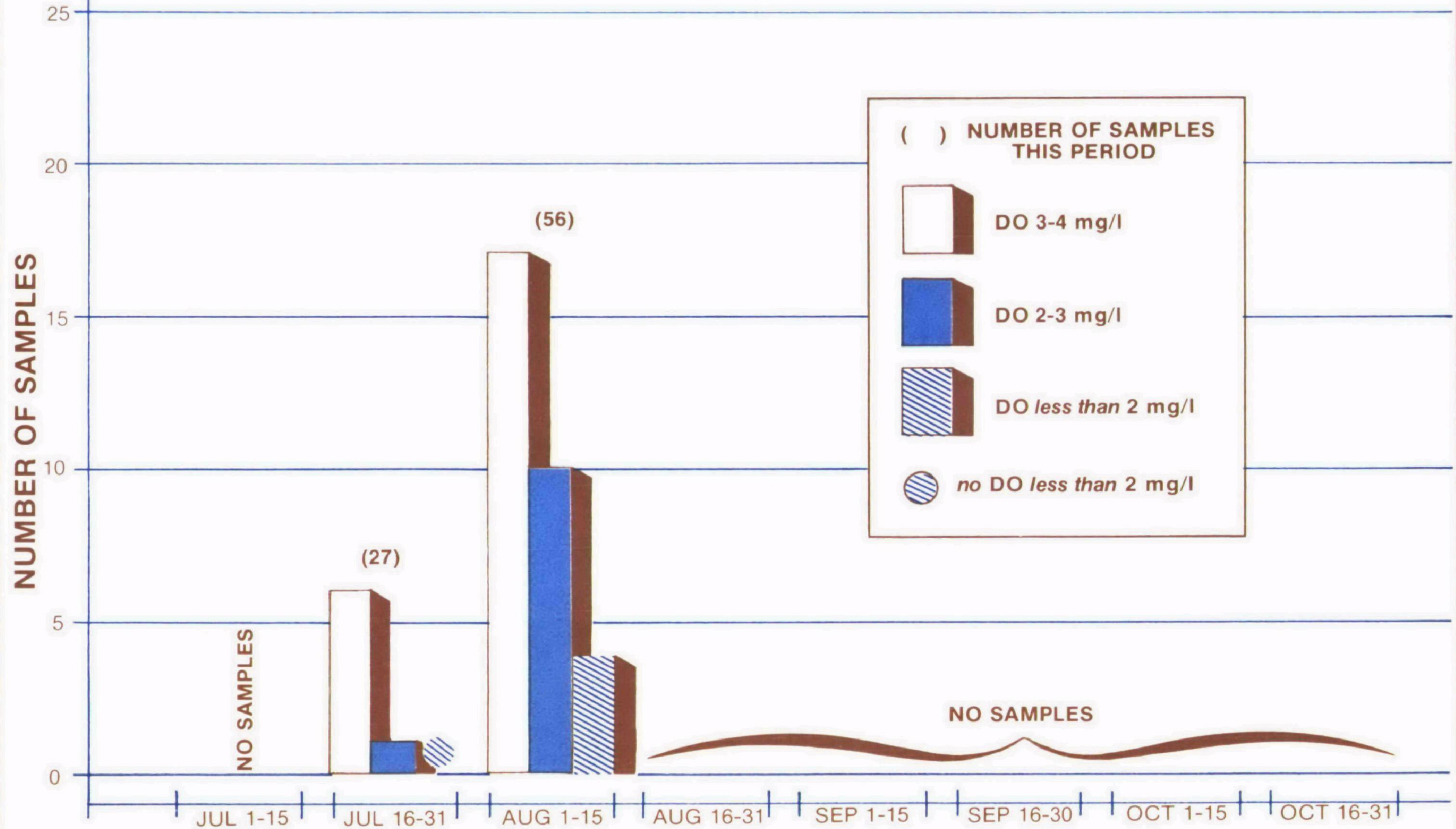
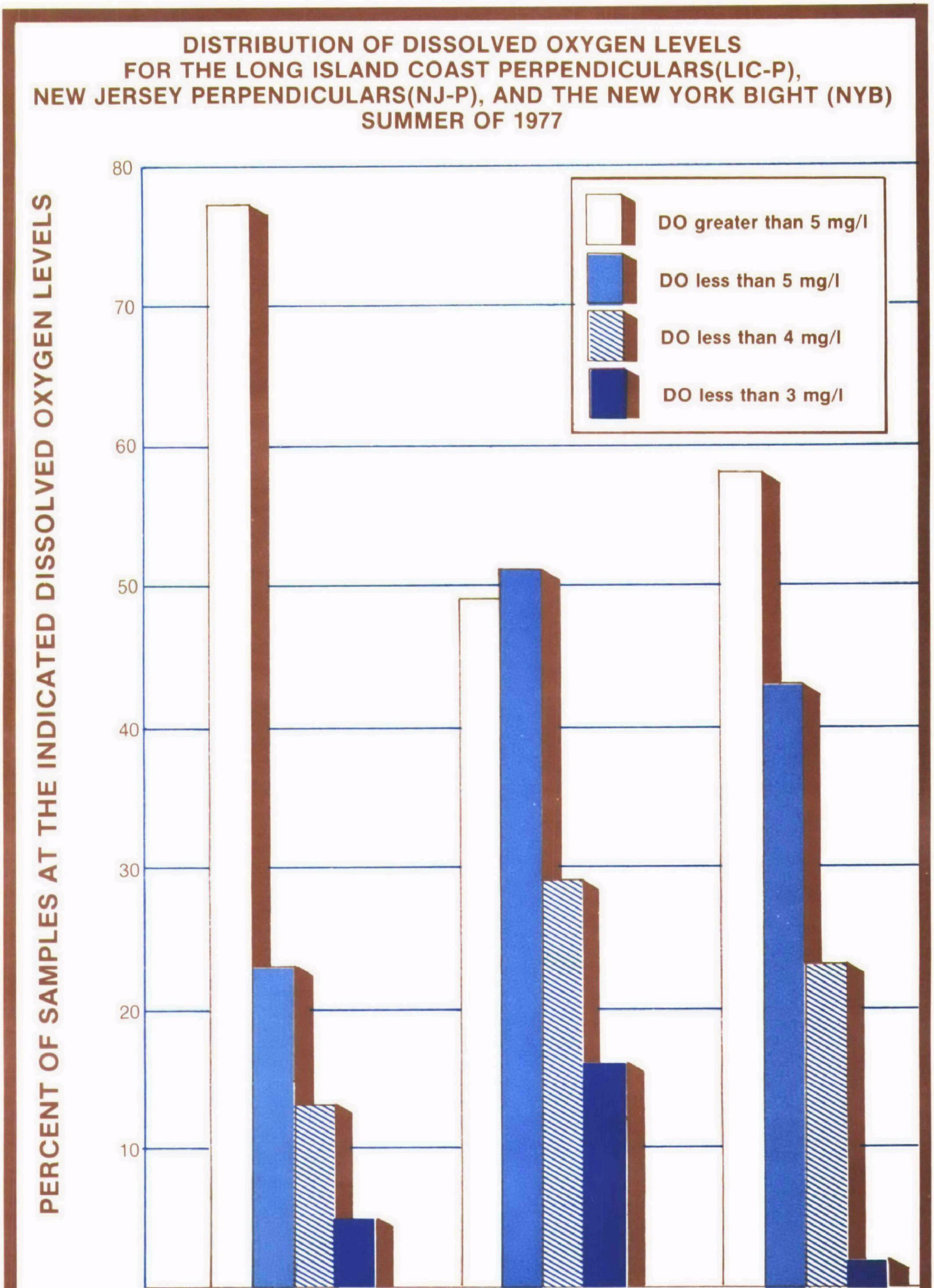


FIGURE 30


DISTRIBUTION OF DISSOLVED OXYGEN LEVELS
FOR THE LONG ISLAND COAST PERPENDICULARS(LIC-P),
NEW JERSEY PERPENDICULARS(NJ-P), AND THE NEW YORK BIGHT (NYB)
SUMMER OF 1977
PERCENT OF SAMPLES AT THE INDICATED DISSOLVED OXYGEN LEVELS
80
70
60
50
40
30
20
10
DO greater than 5 mg/l
DO less than 5 mg/l
DO less than 4 mg/l
DO less than 3 mg/l
LIC-P
NJ-P
NY BIGHT
FIGURE 31

These criteria are consistent with the biological information recorded in the New York Bight over the past several years. Most data concerning the lower tolerance levels were recorded during the summer of 1976. In 1976, widespread and persistent dissolved oxygen levels between 2.0 mg/l and 0 occurred over a large area of the Bight. This resulted in extensive fish kills and bottom dwelling organism mortalities. In contrast to this environmental disaster was the summer of 1977. The dissolved oxygen values reached a "stressful" condition (3.0 to 4.0 mg/l) at about only 20 percent of the bottom stations. Only occassional values dipped below the 3.0 mg/l mark and were more transient than persistent. The summer of 1977 had no recorded fish kills and divers along the coast indicated a generally healthy condition in the bottom waters.

Surface Dissolved Oxygen

The completely mixed upper water layer of the New York Bight exhibited dissolved oxygen values at or near saturation during the entire sampling period (May 1 through September 30, 1977). A total of 400 dissolved oxygen values were recorded over this period. Of these, only six values were lower than 5.0 mg/l. These data are presented in Appendix A.

Bottom Dissolved Oxygen

Bottom dissolved oxygen values recorded for the summer of 1977 are presented in Figures 6 through 31. These figures present the dissolved oxygen values using dissolved oxygen station locations and time of year as variables.

The general dissolved oxygen levels throughout the Bight are summarized according to the previously discussed dissolved oxygen criteria for biologic communities. These values include both the transect and the New Jersey and Long Island perpendicular data. A breakdown of data from these three areas follows:

	Number of Samples (Percent)			
	L.I. Perp.	N.J. Perp.	N.Y. Bight	Total of all Three
No. of Samples	57	92	196	345
DO Levels:				
>5 mg/l	41 (77)	45 (49)	112 (57)	198 (58)
4-5 mg/l	9 (9)	20 (22)	39 (20)	68 (20)
3-4 mg/l	4 (8)	12 (13)	41 (21)	57 (17)
2-3 mg/l	3 (6)	15 (16)	4 (2)	22 (5)
<2 mg/l	0	0	0	0

The chart of values above indicates the Long Island coastline out to the 24 km sampling limit was virtually free from any "stressful" conditions during the 1977 period with over three fourths of the values in the "healthy" dissolved oxygen concentration level. The areas in the inner Bight apex and along the New Jersey coastline however present a less optimistic picture with close to 50 percent of the values at or below the 5 mg/l level. The New Jersey coastline had the greatest number of critical and subcritical values with 16 percent of the samples in the 2 to 3 mg/l range. For purposes of comparison, the dissolved oxygen data collected by the New York City Department of Environmental Protection are given in Appendix B.

Figures 6 through 17 graphically depict the dissolved oxygen values of the inner Bight, Long Island, and New Jersey coastlines as a function of time between the period May 1 and September 30, 1977. All the stations exhibit the classical oxygen depression/reaeration curve with the lowest dissolved oxygen reading recorded in late August through mid-September followed by thermocline breakdown and complete mixing reflected in the saturated dissolved oxygen values of mid-October. The bar frequency charts (Figures 27 through 29) show the incidence of lowest dissolved oxygen occurred during the sampling period in mid-September for the Long Island and New Jersey coastlines. The data for the inner Bight stations showed only sporadic incidences of low dissolved oxygen with no definitive time-dependent trends evident. This can be attributed to the effects of sewage sludge disposal and dredge materials in this sector as well as the inflow of waters from the Hudson River estuary.

The Atlantic City-lower New Jersey coastline area elicited special attention late in the summer period when the New Jersey

State Department of Environmental Protection reported low dissolved oxygen values off the Atlantic City-Seaside Heights-Barnegat shoreline (Figures 22 through 26 and 30). A total of 83 bottom dissolved oxygen values were recorded for this area with 53 percent of the values in excess of 4 mg/l, 28 percent in the 3 to 4 mg/l range, 14 percent between 2 to 3 mg/l, and 5 percent with less than 2 mg/l. No samples taken had a zero dissolved oxygen residual.

The synoptic map (Figure 21) and the Atlantic City-Seaside Heights-Barnegat area maps (Figures 22 through 26) indicate lower dissolved oxygen values are primarily found along the New Jersey coast and extend from the Sandy Hook area southward to Atlantic City. As a result of these 1977 data, the lower area of the New Jersey coast is included in the dissolved oxygen surveillance program for 1978.

Summary

Dissolved oxygen levels in the warm upper layer of the New York Bight and off the Long Island and New Jersey coasts were at a "healthy" level throughout the summer.

Dissolved oxygen levels in the bottom, cool layer of these waters showed the following characteristics:

1) a normal decreasing trend through the summer and recovering to higher levels in the early autumn.
2) a "healthy" condition off the Long Island coast;

3) did not remain at "stressful" levels for significant lengths of time in the Bight;
4) the depression was more pronounced off the New Jersey coast than anywhere else, although conditions were less severe than the summer of 1976;
5) no fish kills were reported in the New York Bight -- this confirms that the dissolved oxygen patterns found, although to some degree "stressful", were not "lethal".

V. BACTERIOLOGICAL RESULTS

The geometric means for all bacteriological samples collected between May 1 and September 30, 1977 along the New Jersey shore are plotted in Figure 32, while the monthly geometric means for fecal coliform are summarized in Table 5. The bacteriological standard for primary contact recreation (bathing) in New Jersey coastal waters is that the monthly geometric mean of five or more samples shall not exceed 50 fecal coliform per 100 ml of sample. As can be seen in Figure 32, the highest five month geometric mean had a density of 2.6 fecal coliform per 100 ml at Station JC37. The data in Table 5 show that the highest monthly geometric mean value, taken during a month when 5 or more samples were collected, had a density of 4.7 fecal coliform per 100 ml at Station JC21. Table 5 further shows that the highest monthly geometric means occurred in

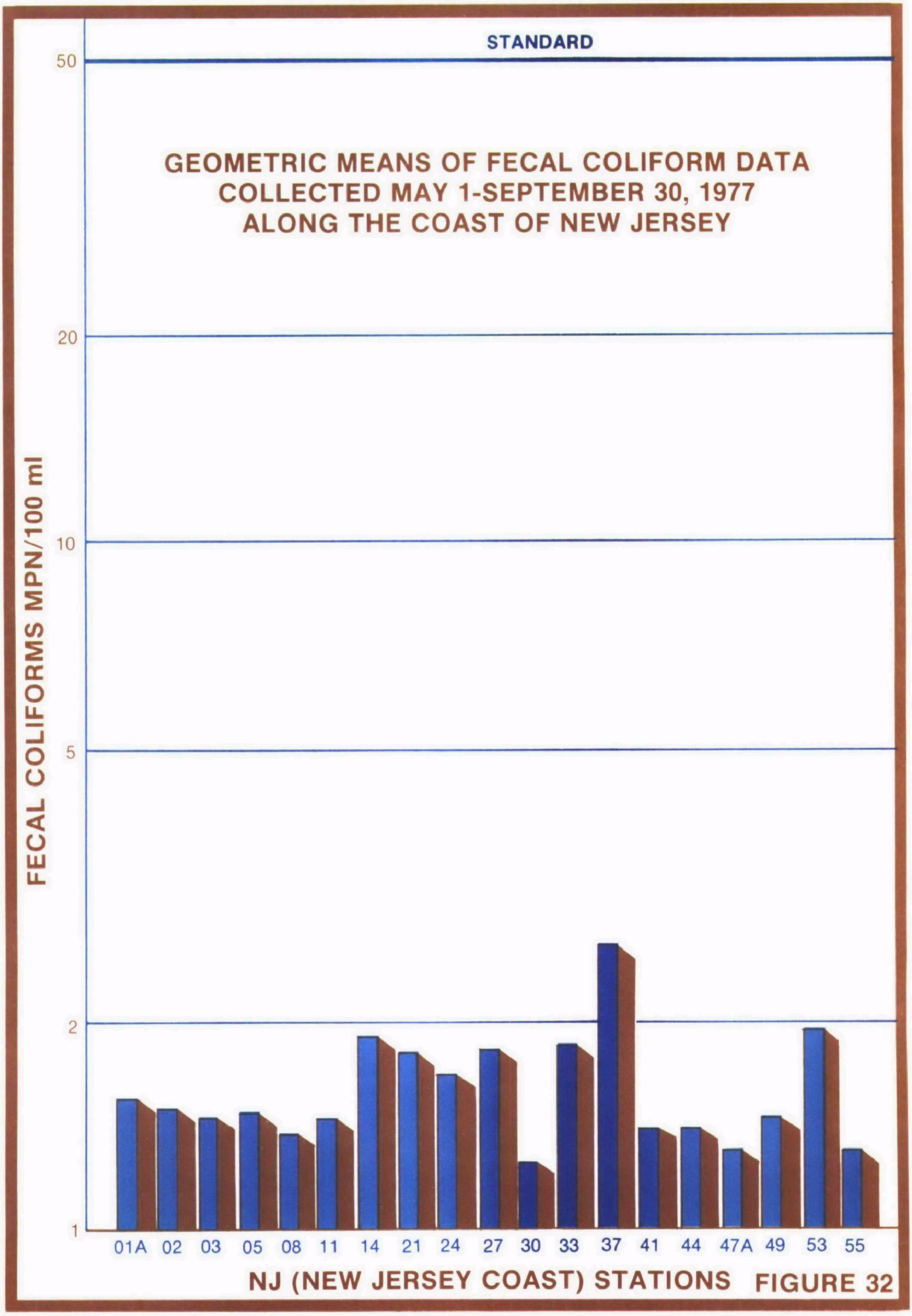

STANDARD
GEOMETRIC MEANS OF FECAL COLIFORM DATA
COLLECTED MAY 1-SEPTEMBER 30, 1977
ALONG THE COAST OF NEW JERSEY
FECAL COLIFORMS MPN/100 ml
50
20
10
5
2
1
01A 02 03 05 08 11 14 21 24 27 30 33 37 41 44 47A 49 53 55
NJ (NEW JERSEY COAST) STATIONS
FIGURE 32

Table 5

Jersey Coast Stations--Fecal Coliform
Geometric Means for the Months of May,
June, July, August, September, and October

Station	May*	June*	July*	August*	September*	October*
JC01A	2/3.5	10/1.1	15/1.6	8/1.7	1/2.0	1/23.0
JC02	2/3.2	10/1.1	15/1.6	8/1.6	1/5.0	1/42.0
JC03	2/2.2	10/1.0	16/1.7	8/1.7	1/1.0	1/21.0
JC05	2/1.7	10/1.6	15/1.2	8/2.0	1/1.0	1/16.0
JC08	2/2.4	10/1.0	15/1.5	8/1.4	1/3.0	1/5.0
JC11	2/2.2	10/1.1	15/1.5	8/1.7	1/2.0	1/16.0
JC14	2/2.6	10/1.0	15/1.6	8/4.4	1/16.0	1/4.0
JC21	2/1.0	10/1.1	15/1.5	8/4.7	1/9.0	1/3.0
JC24	2/1.0	10/1.1	15/1.8	7/1.9	1/104.0	1/4.0
JC27	2/1.0	10/1.0	15/2.4	9/2.4	1/3.0	1/5.0
JC30	2/1.0	10/1.0	15/1.7	8/1.6	1/2.0	1/6.0
JC33	2/1.0	10/1.6	15/1.8	9/2.9	1/1.0	1/6.0
JC37	2/2.4	10/1.7	15/2.8	9/3.8	-	1/11.0
JC41	2/1.0	10/1.3	15/1.4	8/1.4	1/9.0	1/4.0
JC44	2/1.0	10/1.0	15/1.9	8/1.3	1/1.0	1/4.0
JC47A	2/1.0	10/1.0	15/1.6	8/1.4	1/1.0	1/5.0
JC49	2/1.7	10/1.3	15/1.5	7/1.5	1/2.0	1/2.0
JC53	2/2.4	10/1.1	15/2.7	8/1.6	1/8.0	1/4.0
JC55	2/1.0	10/1.2	15/1.5	8/1.0	1/3.0	1/1.0

*The first number is the number of samples collected for the month, the second number is the geometric mean for the month.

August. However, these values were less than the permitted bacteriological water quality standard.

Throughout the 5-month period there were only five samples out of approximately 700 that were collected along New Jersey that had fecal coliform densities above 50 per 100 ml. These samples were as follows:

Station	Date Collected	Fecal Coliform per 100 ml
JC21	8/13/77	83
JC24	9/07/77	104
JC27	7/25/77	268
JC33	8/13/77	144
JC37	7/30/77	92

An attempt was made to link high bacteriological densities with rainfall as recorded in New Brunswick (Table 6 presents the rainfall data); however, no such relationship was established. The five high values do not appear to be related to any specific environmental factors such as rainfall, illegal discharges, power failures, etc.

Throughout the summer the water quality along the coast of New Jersey, judged by fecal coliform densities, was excellent. The tabulated data for individual New Jersey beach stations as well as Long Island beach stations are presented in Appendix C.

The bacteriological water quality standard for New York State coastal waters used for primary contact recreation (bathing) is that the monthly geometric mean of five or more samples shall not

Table 6

Rainfall in New Brunswick, New Jersey
For the Months of June, July, August, and September 1977

JUNE		JULY		AUGUST		SEPTEMBER	
Date	Rainfall (cm)	Date	Rainfall (cm)	Date	Rainfall (cm)	Date	Rainfall (cm)
1	0.00	1	0.00	1	0.00	1	0.08
2	0.18	2	0.00	2	1.32	2	0.00
3	0.00	3	0.00	3	0.15	3	0.00
4	0.00	4	0.00	4	2.01	4	0.00
5	0.00	5	0.00	5	0.00	5	0.00
6	0.00	6	0.00	6	0.00	6	0.99
7	1.40	7	0.33	7	0.46	7	0.03
8	0.00	8	1.45	8	0.00	8	0.00
9	0.91	9	0.03	9	0.00	9	0.00
10	4.24	10	0.00	10	0.00	10	0.51
11	0.03	11	0.00	11	1.02	11	0.00
12	0.00	12	0.00	12	0.00	12	0.00
13	0.00	13	5.46	13	1.22	13	0.00
14	0.00	14	0.00	14	0.81	14	0.00
15	0.03	15	0.00	15	0.51	15	0.05
16	0.00	16	0.00	16	0.00	16	0.05
17	0.00	17	0.00	17	0.08	17	0.97
18	0.00	18	0.03	18	0.51	18	0.00
19	0.00	19	0.00	19	0.00	19	0.00
20	0.00	20	0.33	20	0.00	20	0.41
21	1.22	21	0.00	21	0.00	21	0.33
22	0.00	22	0.00	22	1.85	22	0.08
23	0.00	23	0.00	23	0.48	23	0.15
24	0.00	24	0.00	24	0.18	24	3.48
25	0.00	25	0.00	25	1.96	25	2.95
26	1.50	26	4.47	26	0.00	26	0.20
27	0.00	27	0.00	27	0.00	27	0.94
28	0.00	28	[illegible]	28	0.00	28	0.76
29	1.07	29	0.00	29	0.00	29	0.00
30	0.00	30	0.15	30	0.00	30	0.00
		31	0.51	31	0.00		

Source: Recorded by the Rutgers University Meteorology Department.

exceed 200 fecal coliform per 100 ml of sample. The five month geometric mean of the fecal coliform data for all Long Island beach stations is shown in Figure 33. The monthly geometric means for fecal coliform along the Long Island coast are summarized in Table 7. Both Figure 33 and Table 7 show that the bacteriological water quality standard was never approached throughout the summer at any of the Long Island beach stations. Figure 33 shows that the highest geometric mean for the five-month period from May 1 through September 30, 1977 is 3.9 fecal coliform per 100 ml of sample at Station LIC04. This station had higher total and fecal coliform densities than the other Long Island stations consistently throughout the summer. A dredging operation, conducted along the Rockaways to restore the beach area is believed to be the reason for the elevated densities. Sand from approximately 1.6 km offshore was dredged and pumped onto the beach. The dredging disturbed bottom sediments and crushed clams and worms, thus leading to an increase in bacteriological densities in the water. Photograph 6 shows this dredge with the pipe discharging sediment-laden water onto the beach. Photograph 7 shows scum on the beach in the Rockaways. The action of surf on the rich, sediment-laden water being pumped onto the beach created the scum, which was present throughout most of the summer. There were only two instances during the entire summer that individual densities exceeded the 200 fecal coliform per 100 ml value, and both occurred at Station

GEOMETRIC MEANS OF FECAL COLIFORM DATA COLLECTED MAY 1 - SEPTEMBER 30, 1977 ALONG THE COAST OF LONG ISLAND

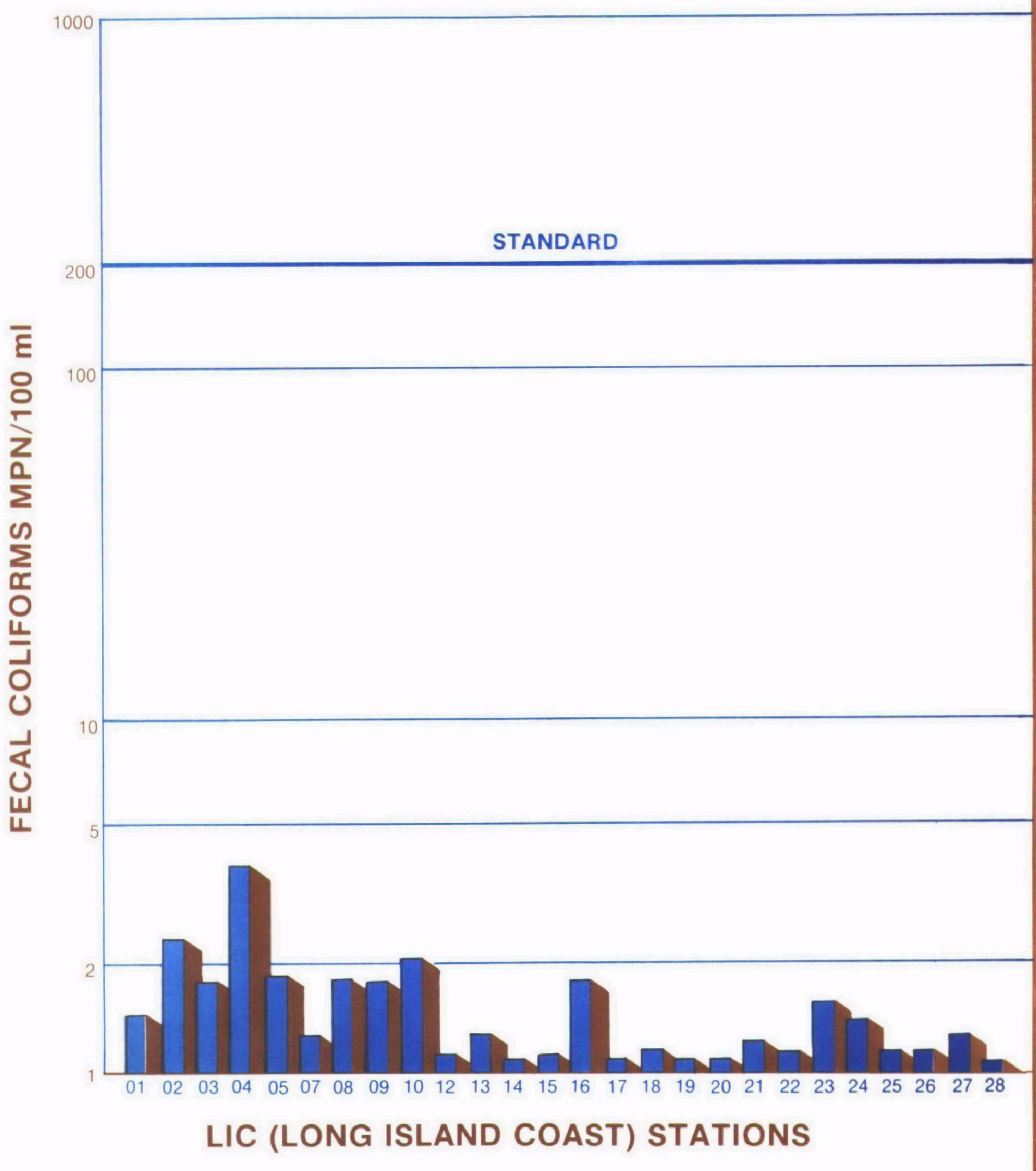


FIGURE 33

Table 7

Long Island Coast Stations - Fecal Coliform Geometric Means for the Months of May, June, July, August, September, and October

Station	May*	June*	July*	August*	September*	October*
LIC01	2/1.0	10/1.0	12/1.4	9/2.2	1/7.0	1/64.0
LIC02	2/1.0	10/1.2	11/1.9	9/3.6	1/14.0	1/47.0
LIC03	2/1.0	10/1.1	11/1.7	9/3.7	1/3.0	1/8.0
LIC04	2/1.0	10/1.3	12/5.9	9/9.1	1/13.0	1/26.0
LIC05	2/1.0	10/1.2	12/2.9	9/2.4	1/1.0	1/32.0
LIC07	2/1.0	10/1.1	12/1.2	9/1.4	1/9.0	1/9.0
LIC08	2/1.0	10/1.2	12/2.3	9/2.2	1/4.0	1/11.0
LIC09	2/1.0	10/2.0	12/1.8	9/2.0	1/1.0	1/8.0
LIC10	2/1.0	10/1.8	12/1.6	9/3.3	1/9.0	1/1.0
LIC12	2/1.0	10/1.0	12/1.0	9/1.6	1/1.0	1/3.0
LIC13	2/1.0	10/1.1	12/1.1	9/1.8	1/2.0	1/3.0
LIC14	2/1.0	10/1.0	12/1.1	9/1.1	1/1.0	1/8.0
LIC15	2/1.0	10/1.1	12/1.1	9/1.2	1/1.0	1/16.0
LIC16	2/1.0	11/1.3	12/1.7	9/3.7	1/1.0	1/3.0
LIC17	1/1.0	10/1.0	13/1.1	9/1.1	1/1.0	1/3.0
LIC18	1/1.0	10/1.1	13/1.1	9/1.3	1/1.0	1/2.0
LIC19	1/1.0	10/1.0	13/1.2	9/1.0	1/1.0	1/5.0
LIC20	1/1.0	10/1.0	13/1.0	9/1.2	1/3.0	1/12.0
LIC21	1/1.0	10/1.0	12/1.3	9/1.3	1/3.0	1/10.0
LIC22	1/1.0	10/1.1	12/1.9	9/1.1	1/1.0	1/20.0
LIC23	1/2.0	10/1.5	12/1.3	9/2.4	1/1.0	1/9.0
LIC24	1/1.0	9/1.3	12/1.3	9/1.7	1/3.0	1/1.0
LIC25	1/1.0	9/1.2	12/1.2	9/1.0	1/1.0	1/5.0
LIC26	1/1.0	9/1.7	12/1.3	8/1.0	1/1.0	1/3.0
LIC27	1/2.0	9/1.2	12/1.4	8/1.9	1/1.0	1/10.0
LIC28	1/1.0	9/1.0	12/1.2	7/1.0	1/1.0	1/2.0

*The first number is the number of samples collected for the month, the second number is the geometric mean for the month.

Photograph 6 - Dredging operation off of Rockaway Beach, Long Island. The dredge can be seen approximately 1.6 km out in the ocean, and the pipe in the front right-hand corner is discharging sediment-laden water on the beach.

Photograph 7 - Scum on Rockaway Beach, Long Island. The action of the surf on the sediment-laden water from the offshore dredging created the scum which was present throughout the summer on the beach.

LICO4. The values were 316 and 560 fecal coliform per 100 ml from samples collected on July 18 and August 6, 1977, respectively. On the basis of fecal coliform content, the water quality along the coast of Long Island was excellent throughout the summer. The tabulated data for individual Long Island beach stations are in Appendix C.

Bacteriological analyses, total and fecal coliform, were conducted once a week at the 20 inner New York Bight stations. Of the 360 samples collected, only two had fecal coliform densities in excess of 50 per 100 ml of water. On August 2, 1977 the shallow sample at Station NYB44 had a fecal coliform density of 420 per 100 ml while on September 19, 1977 the shallow sample at Station NYB32 had a fecal coliform density of 96 per 100 ml. The cause of these two isolated high values is unknown. The other 358 were all below 50 fecal coliform per 100 ml with a majority of the values in the 0 to 2 per 100 ml range. All of the bacteriological data collected at the New York Bight stations are shown in Appendix D.

VI. NUTRIENTS AND TOTAL ORGANIC CARBON

Nutrients and total organic carbon data were gathered for the New York Bight transects (Figure 3). The transects (New Jersey-Stations NYB20-NYB27, Raritan Bay-Stations NYB32-NYB35, and Long Island-Stations NYB40-NYB47) were sampled nine times between June 7 and September 19. The bulk of the samples (seven) were collected in July and August. The samples were analyzed for NH_3-N, NO_3-N, NO_2-N, TP, PO_4-P, SiO_2, and TOC. The parameters discussed are total inorganic nitrogen (TIN), TP, SiO_2, and TOC. All raw nutrient data for the New York Bight stations are listed in Appendix D.

Phosphorus

The total phosphorus (TP) values (Table 8) for the New Jersey transect exhibited variations among stations and depths. The stations closer to the shore (NYB20 and NYB21) generally had higher TP levels than the other transect stations (Figure 34), and the TP values of the shallow samples at Stations NYB20 and NYB21 were higher than the deep samples. The reverse was generally true for the other transect stations.

The TP values (Table 8) from the Raritan Bay transect also showed variations from station to station and between depths. In June and July, TP values were similar for all stations; however, in August, Station NYB32 had higher TP levels in the shallow water samples than did the other transect stations (Figure 35).

The TP values in Table 8 from the Long Island transect were relatively uniform for a given date and depth. There did appear to be a general trend of increasing TP values in August.

The results showed that the TP levels were relatively uniform throughout the Bight area except for the stations closest to the New Jersey coast (Stations NYB20 and NYB21) and the mouth of

Table 8

Total Phosphorus In mg/l For
The New York Bight Transects Stations

Date Sampled	20	21	22	23	24	25	26	27	32	33	34	35	40	41	42	43	44	45	46	47
	New York Bight Station Numbers																			
6/7/77																				
Shallow	.061	.035	.018	.021	.015	.018	.015	.018	.010	.010	.015	.021	.021	.012	.012	.018	.018	.012	.012	.012
Deep	.032	.026	.024	.026	.032	.024	.024	-	.026	.023	.026	.029	.026	.018	.021	.018	.021	.024	.024	.026
7/5/77																				
Shallow	.058	.052	.037	.030	.030	.025	.030	.030	.021	.012	.027	.025	.025	.020	.022	.022	.030	.037	.050	.032
Deep	.042	.042	.032	.032	.035	.032	.027	.025	.025	.034	.020	.030	.030	.030	.020	.072	.025	.040	.027	.027
7/13/77																				
Shallow	.073	.052	.038	.028	.026	.021	.017	.021	.058	.022	.024	.021	.028	.017	.019	.019	.021	.021	.019	.021
Deep	.054	.031	.043	.057	.061	.040	.045	.045	.026	.023	.043	.054	.026	.050	.052	.045	.057	.047	.038	.036
7/19/77																				
Shallow	.083	.065	.038	.032	.029	.020	.020	.029	.024	.040	.032	.023	.020	.017	.017	.017	.023	.023	.014	.014
Deep	.029	.047	.044	.047	.038	.053	.044	.032	.033	.033	.041	.053	.038	.031	.038	.047	.056	.050	.029	.029
8/2/77																				
Shallow	.105	.084	.046	.027	.031	.023	.023	.023	.096	.037	.035	.042	.039	.035	.027	.019	.243	.023	.039	.042
Deep	.054	.046	.046	.039	.031	.061	.042	.023	.048	.033	.035	.031	.039	.031	.027	.042	.035	.023	.039	.035
8/9/77																				
Shallow	.106	.091	.062	.055	.045	.038	.038	.030	.094	.040	.071	.059	.026	.043	.050	.057	.052	.043	.026	.016
Deep	.056	.045	.047	.045	.050	.086	.040	.045	.047	.047	.047	.050	.043	.040	.047	.043	.050	.067	.040	.035
8/16/77																				
Shallow	.019	.017	.017	.014	.019	.017	.087	.025	.081	.049	.048	.040	.030	.041	.025	.054	.063	.063	.018	.017
Deep	.070	.076	.052	.047	.036	.019	.052	.039	.052	.053	.048	.139	.041	.041	.048	.041	.043	.055	.176	.043
8/30/77																				
Shallow	-	-	-	-	-	-	-	.025	.061	.061	.065	.049	.042	.039	.061	.061	.023	.020	.020	.023
Deep	-	-	-	-	-	-	-	.035	.044	.049	.044	.054	.058	.044	.044	.037	.044	.042	.032	.037
9/19/77																				
Shallow	.052	.073	.057	.051	.043	.038	.031	.023	.060	.043	.033	.043	.028	.026	.022	.023	.030	.033	.023	.021
Deep	.055	.053	.046	.046	.046	.046	.048	.043	.048	.046	.042	.033	.051	.053	.042	.046	.053	.055	.046	.046

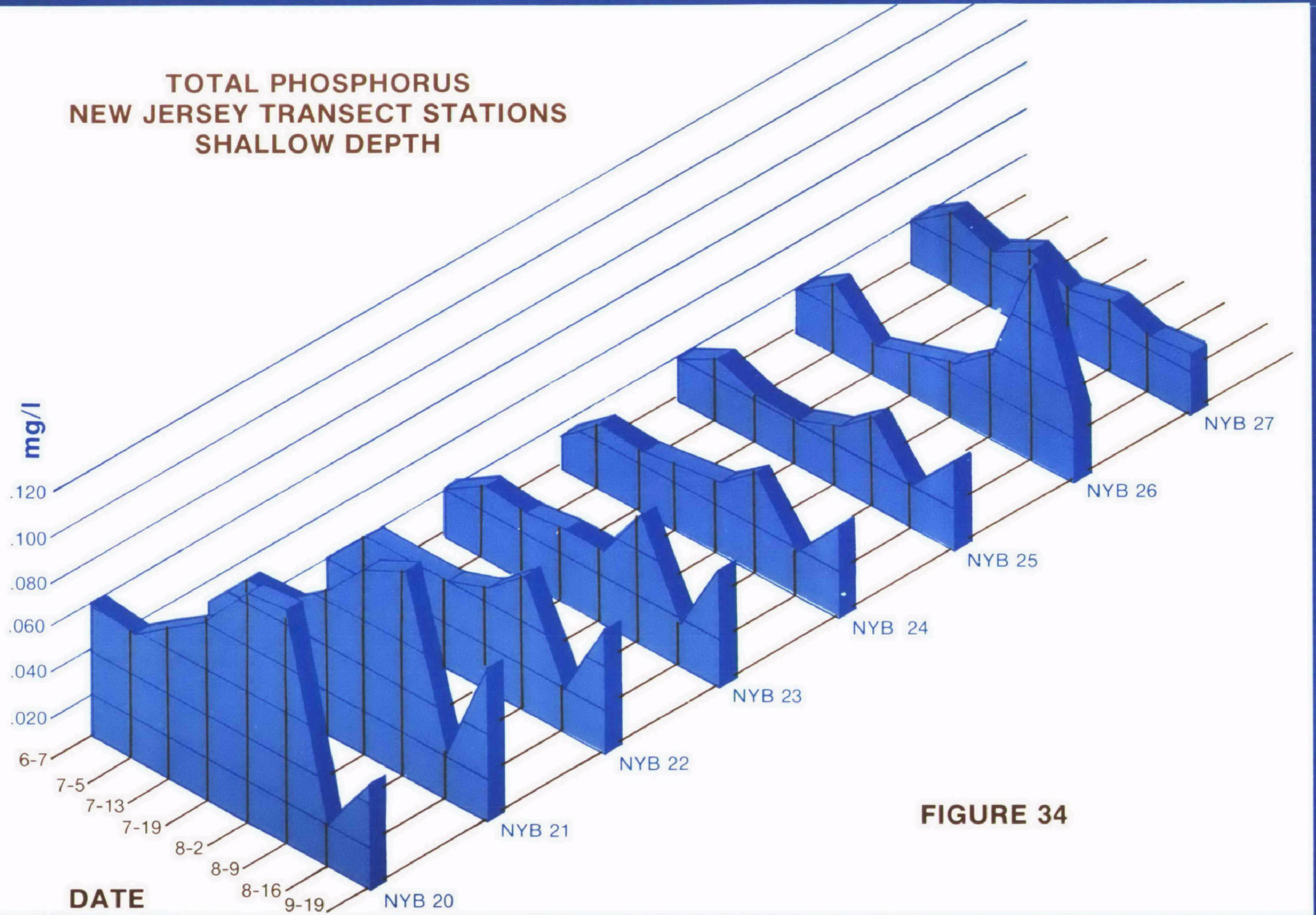

TOTAL PHOSPHORUS
NEW JERSEY TRANSECT STATIONS
SHALLOW DEPTH
mg/l
.120
.100
.080
.060
.040
.020
6-7
7-5
7-13
7-19
8-2
8-9
8-16
9-19
DATE
NYB 20
NYB 21
NYB 22
NYB 23
NYB 24
NYB 25
NYB 26
NYB 27

FIGURE 34

TOTAL PHOSPHORUS
RARITAN BAY TRANSECT STATIONS
SHALLOW DEPTH

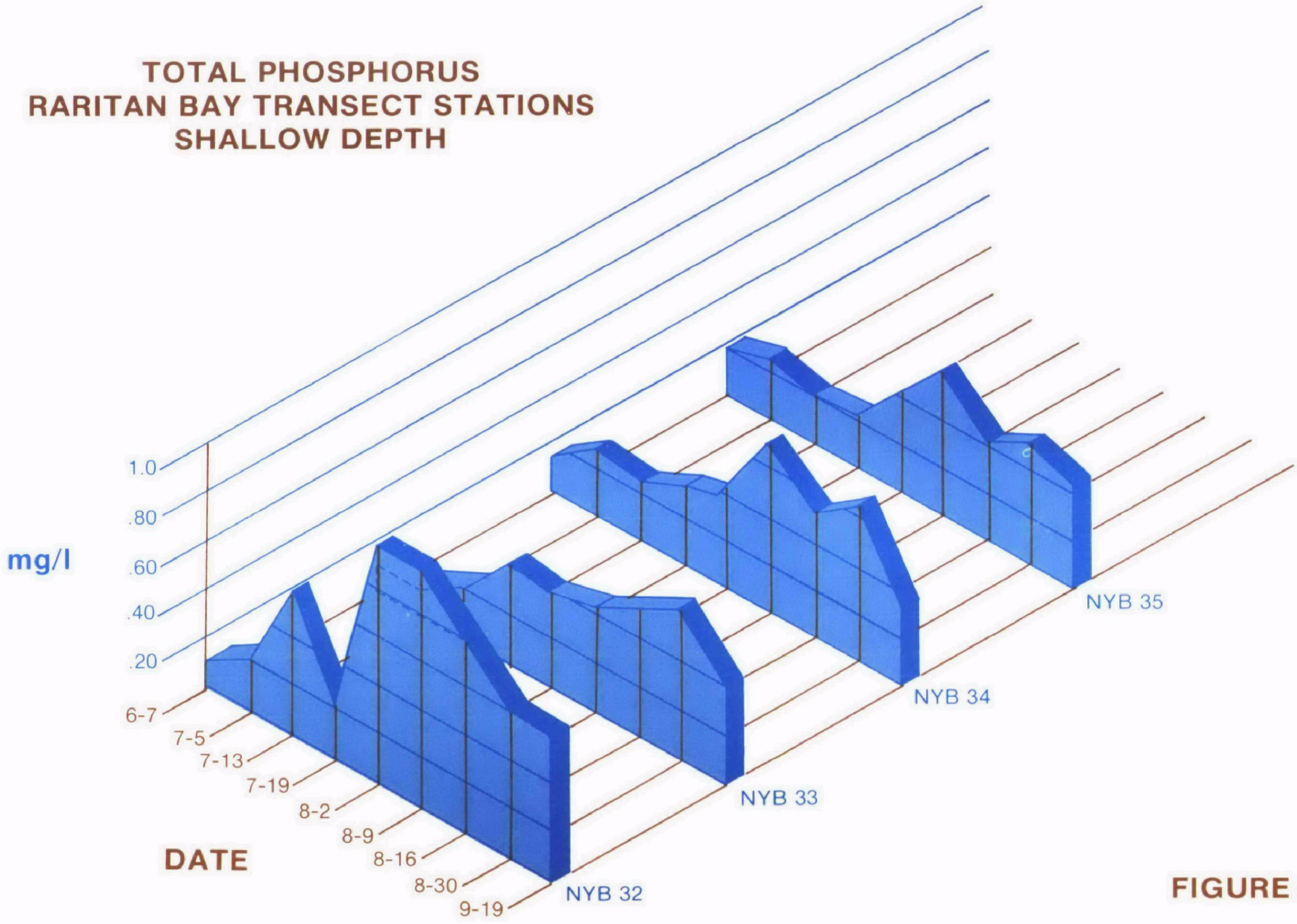


FIGURE 35

Raritan Bay (Station NYB32).

Total Inorganic Nitrogen

The total inorganic nitrogen (TIN) values (Table 9) for the New Jersey transect showed some variation between stations and depths at each station. The stations closest to the Jersey coast generally had the highest TIN values (Figure 36) with the shallow depth having the higher value. At the other stations, the deep value was generally greater than the shallow value.

The TIN values (Table 9) from the Raritan Bay transect exhibited a variation similar to that of the New Jersey transect, i.e. higher TIN values at the near-mouth station (Figure 37) and at the shallow depth.

The TIN values for the Long Island transect showed the greatest variation between stations, but there was no uniform pattern or trend. Unlike the New Jersey and Raritan Bay transects, there was no trend for near-shore stations to be higher than offshore stations (Table 9).

In general, the near-shore stations, close to the New Jersey coast, exhibited higher nitrogen values than the other stations in the Bight area.

Silica

The reactive silica (as SiO_2) concentrations (Table 10) for the New Jersey transect were rather uniform among stations for a given

Table 9

Total Inorganic Nitrogen In mg/l For
The New York Bight Transects Stations

Date Sampled	New York Bight Station Numbers																			
	20	21	22	23	24	25	26	27	32	33	34	35	40	41	42	43	44	45	46	47
6/7/77																				
Shallow	.139	.078	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Deep	.032	.025	.038	.032	.000	.000	.032	-	.000	.038	.000	.038	.025	.000	.032	.025	.000	.025	.045	.051
7/5/77																				
Shallow	.021	.054	.000	.000	.021	.028	.021	.000	.021	.021	.021	.015	.021	.000	.000	.021	.000	.000	.000	.000
Deep	.083	.128	.109	.122	.059	.059	.046	.040	.040	.065	.059	.085	.052	.046	.000	.164	.028	.040	.065	.071
7/13/77																				
Shallow	.119	.000	.020	.020	.020	.020	.020	.020	.183	.033	.020	.020	.033	.000	.020	.020	.020	.000	.020	.020
Deep	.094	.026	.065	.065	.090	.058	.079	.058	.058	.033	.084	.058	.039	.117	.065	.098	.052	.052	.079	.079
7/19/77																				
Shallow	.047	.049	.062	.023	.023	.000	.000	.000	.046	.066	.000	.000	.000	.023	.023	.000	.000	.000	.000	.000
Deep	.050	.123	.132	.168	.141	.103	.116	.096	.097	.090	.110	.066	.036	.043	.128	.136	.103	.110	.103	.099
8/2/77																				
Shallow	.222	.226	.000	.000	.000	.000	.000	.000	.358	.078	.000	.000	.000	.000	.000	.000	.140	.000	.000	.000
Deep	.112	.098	.098	.111	.092	.046	.092	.019	.125	.033	.051	.071	.026	.000	.000	.033	.033	.000	.78	.098
8/9/77																				
Shallow	.233	.089	.076	.022	.022	.022	.022	.022	.365	.126	.194	.122	.000	.086	.110	.070	.061	.000	.000	.000
Deep	.131	.119	.150	.144	.162	.077	.100	.112	.137	.113	.149	.149	.131	.100	.131	.131	.102	.083	.131	.107
8/16/77																				
Shallow	.000	.000	.000	.000	.020	.020	.000	.000	.325	.117	.077	.000	.000	.000	.000	.083	.128	.131	.000	.000
Deep	.076	.062	.149	.231	.187	.000	.097	.091	.097	.167	.180	.088	.000	.071	.110	.117	.123	.135	.097	.116
8/30/77																				
Shallow	-	-	-	-	-	-	-	.000	.152	.110	.126	.098	.000	.000	.075	.136	.000	.000	.000	.021
Deep	-	-	-	-	-	-	-	.86	.127	.168	.167	.140	.120	.140	.155	.067	.146	.109	.100	.120
9/19/77																				
Shallow	.328	.402	.281	.079	.056	.082	.000	.000	.306	.162	.000	.062	.000	.023	.023	.000	.023	.045	.023	.023
Deep	.214	.240	.236	.206	.177	.131	.129	.121	.166	.234	.176	.082	.150	.232	.182	.190	.232	.184	.152	.154

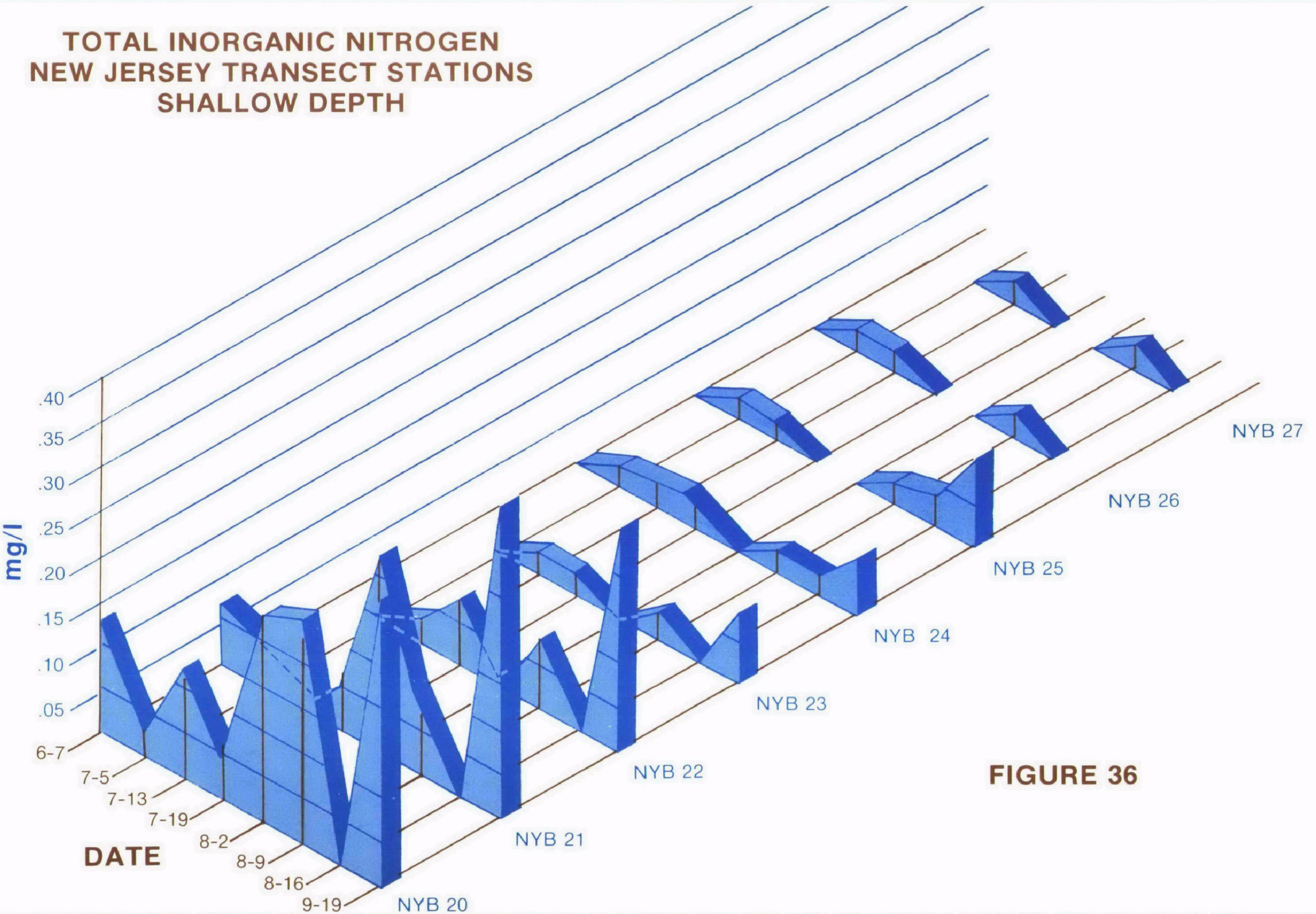

TOTAL INORGANIC NITROGEN
NEW JERSEY TRANSECT STATIONS
SHALLOW DEPTH
mg/l
.40
.35
.30
.25
.20
.15
.10
.05
6-7
7-5
7-13
7-19
8-2
8-9
8-16
9-19
DATE
NYB 20
NYB 21
NYB 22
NYB 23
NYB 24
NYB 25
NYB 26
NYB 27

FIGURE 36

TOTAL INORGANIC NITROGEN RARITAN BAY TRANSECT STATIONS SHALLOW DEPTH

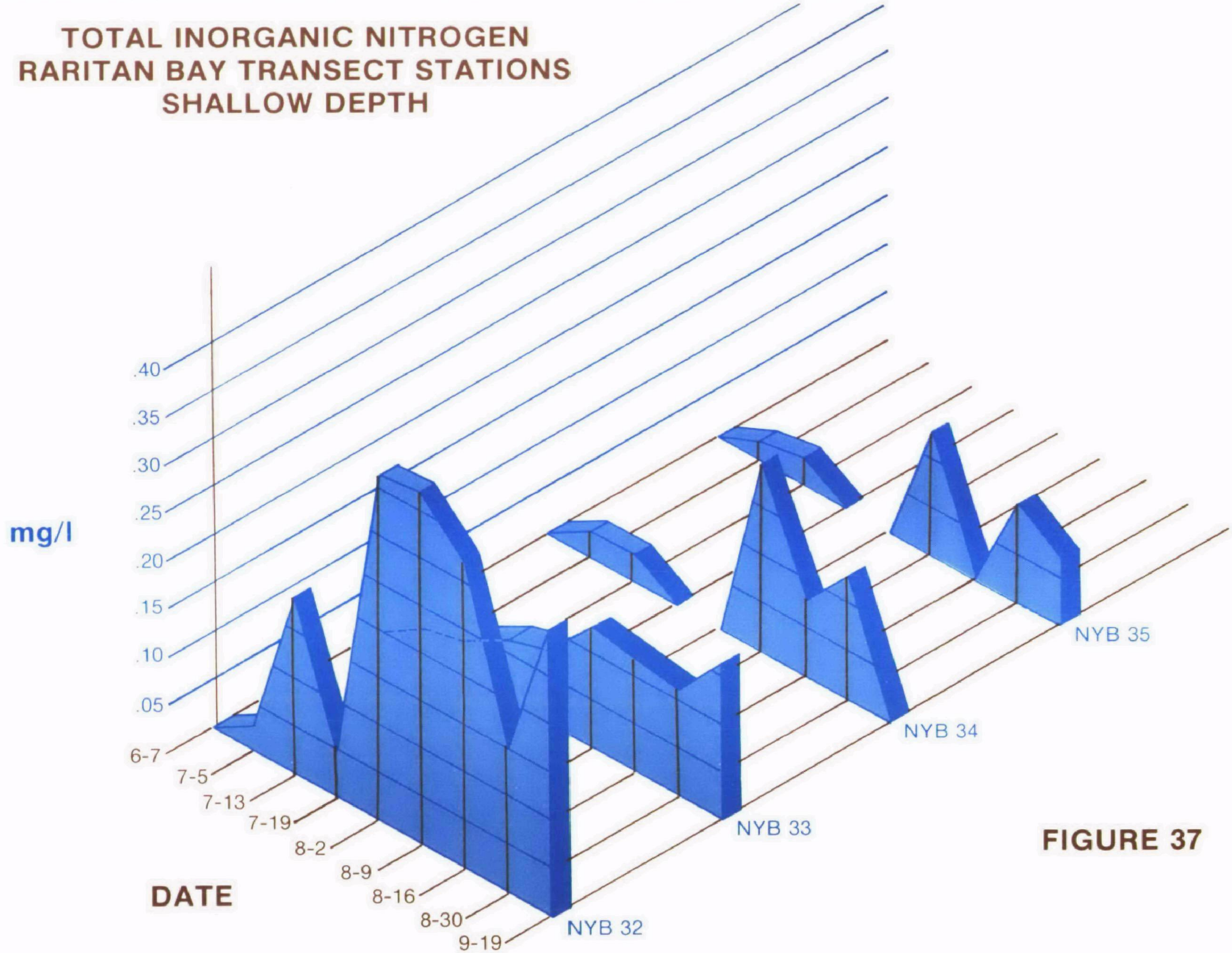


FIGURE 37

Table 10

Total Reactive Silica As SiO_2 In mg/l
For The New York Bight Transects Stations

Date Sampled	New York Bight Station Numbers																			
	20	21	22	23	24	25	26	27	32	33	34	35	40	41	42	43	44	45	46	47
6/7/77																				
Shallow	.276	.303	.142	.169	.209	.249	.223	.330	.209	.169	.196	.236	.384	.330	.33	.317	.303	.236	.223	.209
Deep	.223	.371	.223	.505	.236	.263	.438	-	.438	.532	.532	.546	.451	.398	.424	.384	.317	.438	.519	.586
7/5/77																				
Shallow	.157	.220	.173	.173	.141	.314	.094	.094	.204	.157	.157	.173	.251	.188	.141	.157	.157	.141	.173	.204
Deep	.424	.565	.471	.565	.408	.345	.314	.345	.330	.392	.345	.487	.502	.455	.235	.487	.314	.377	.549	.455
7/13/77																				
Shallow	.262	.265	.234	.220	.207	.207	.207	.193	.262	.262	.220	.220	.289	.248	.234	.234	.220	.234	.220	.193
Deep	.524	.345	.427	.400	.469	.455	.413	.386	.345	.303	.455	.441	.303	.634	.551	.551	.441	.455	.455	.441
7/19/77																				
Shallow	.693	.729	.512	.512	.512	.440	.440	.476	.693	.765	.549	.512	.621	.476	.440	.440	.440	.440	.404	.404
Deep	.693	1.523	1.379	1.523	1.343	1.162	1.198	1.162	1.343	1.198	1.415	1.271	1.343	1.162	1.307	1.235	1.198	1.090	1.126	1.126
8/2/77																				
Shallow	1.076	1.041	.762	.692	.657	.657	.587	.622	1.076	.797	.692	.587	.762	.692	.587	.587	.622	.552	.727	.727
Deep	1.251	1.356	1.391	1.356	1.181	1.181	1.216	.832	1.007	1.007	1.076	1.041	1.041	.902	.937	1.076	.832	.552	1.146	1.111
8/9/77																				
Shallow	1.052	.981	.840	.805	.734	.664	.558	.593	1.228	.911	.946	.840	.629	.734	.875	.840	.805	.734	.588	.488
Deep	1.757	1.404	1.616	1.581	1.722	1.334	1.263	1.440	1.334	1.440	1.510	1.510	1.263	1.369	1.440	1.404	1.369	1.299	1.404	1.299
8/16/77																				
Shallow	.553	.595	.553	.553	.553	.510	.595	.533	.978	.935	.765	.680	.553	.638	.595	.808	.893	.850	.553	.595
Deep	1.700	1.615	1.615	1.530	1.403	.533	1.233	1.233	1.318	1.360	1.275	1.488	.808	1.190	1.360	1.360	1.403	1.360	1.233	1.445
8/30/77																				
Shallow	-	-	-	-	-	-	-	.617	.835	.835	.835	.908	.544	.544	.835	.908	.617	.653	.617	.617
Deep	-	-	-	-	-	-	-	.872	1.236	1.491	1.455	1.345	1.163	1.382	1.455	.945	1.345	1.200	1.054	1.200
9/19/77																				
Shallow	.645	.869	.679	.439	.370	.473	.404	1.439	.748	.473	.404	.439	.335	.301	.301	.335	.370	.370	.370	.404
Deep	1.436	1.677	1.643	1.540	1.540	1.368	1.402	1.402	1.161	1.712	1.609	.886	.783	1.574	1.402	1.574	1.471	1.402	1.402	1.436

depth and date. There was variation between depths with the deep sample usually being higher than the shallow. There was a three-fold increase in the silica concentrations for the deep sample between July 13 and July 19; these high values stayed for the rest of the sampling period. On August 2 and August 9 high levels of silica were found at the near-shore stations (NYB20 and NYB21) (Figure 38) in the shallow sample. There was a general trend for the shallow values to increase into August and then fluctuate for the rest of the sampling period.

The Raritan Bay transect exhibited results similar to those of the New Jersey transect. The data in Table 10 show a general uniformity of values among stations on a specific date and at the same depth. The shallow values increased from June to August, followed by a period of fluctuation, and then decreased in September (Figure 39). The near-shore shallow values (Station NYB32) increased on August 2 and 9, although the deep values were higher than the shallow values.

The Long Island transect values were similar to the New Jersey and the Raritan Bay transects except that no high shallow silica values were found on August 2 and 9.

It is unclear why on August 2 and 9 Stations NYB20, NYB21, and NYB32 exhibited such high silica values in the shallow samples.

Total Organic Carbon

The total organic carbon (TOC) levels remained relatively uni-

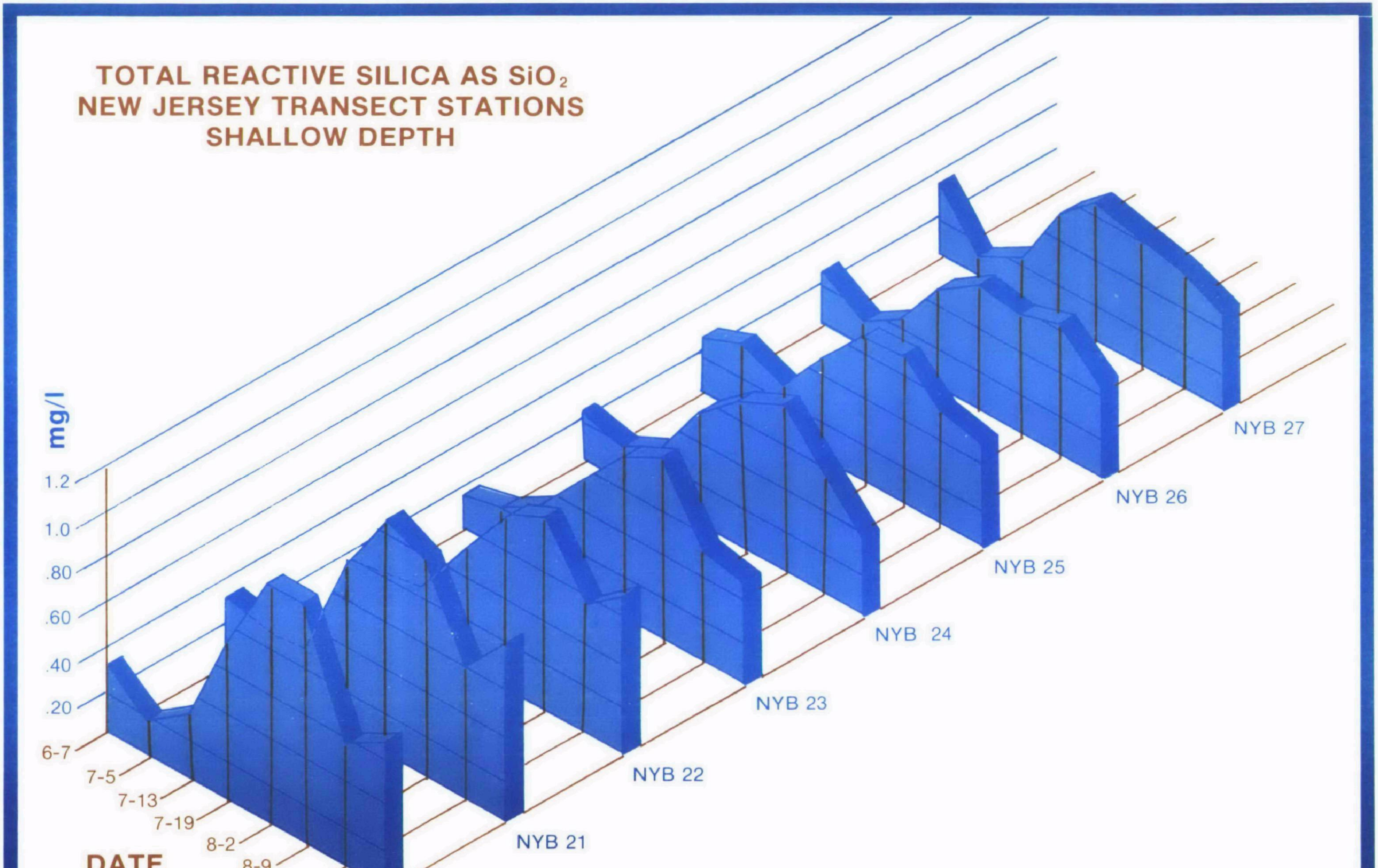

TOTAL REACTIVE SILICA AS SiO2
NEW JERSEY TRANSECT STATIONS
SHALLOW DEPTH
mg/l
1.2
1.0
.80
.60
.40
.20
6-7
7-5
7-13
7-19
8-2
8-9
8-16
9-19
DATE
NYB 20
NYB 21
NYB 22
NYB 23
NYB 24
NYB 25
NYB 26
NYB 27

FIGURE 38

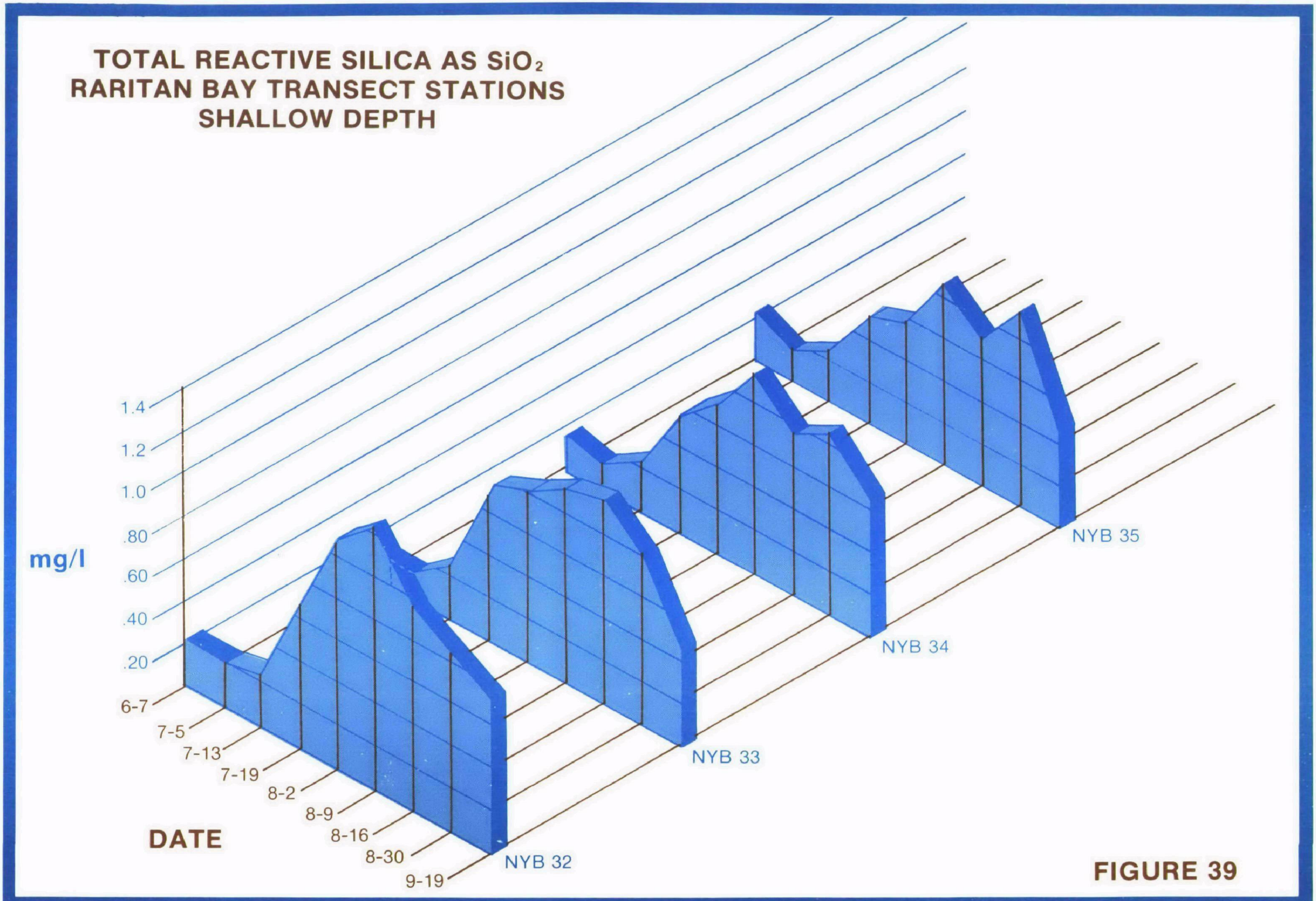

TOTAL REACTIVE SILICA AS SiO2
RARITAN BAY TRANSECT STATIONS
SHALLOW DEPTH
mg/l
1.4
1.2
1.0
.80
.60
.40
.20
DATE
6-7
7-5
7-13
7-19
8-2
8-9
8-16
8-30
9-19
NYB 32
NYB 33
NYB 34
NYB 35

FIGURE 39

form for all stations on a given date and at a given depth (Table 11). There was no evidence of a TOC concentration gradient either along the New Jersey coastline or at the stations further out in the New York Bight.

The TOC values usually were in the range of 1.50 to 3.00 mg/l, except for the values reported on July 5 and July 19 for the New Jersey transect and on August 9 for the entire Bight. It is probable the algal concentrations were high on these dates. On August 9 three very high values were observed: 10.55 mg/l from the shallow sample at Station NYB41, 9.85 mg/l from the shallow sample at Station NYB43, and 12.34 mg/l from the deep sample at Station NYB25. Also, on August 16 the shallow sample from Station NYB34 had a TOC value of 13.09 mg/l. The high values in the shallow samples may be attributable to pockets of very dense algal material. However, an apparent reason for the deep sample value being so high is lacking.

Discussion

It is known that the Raritan Bay-Lower Bay comples transports large quantities of nutrient-rich water out into the New York Bight apex. It has been demonstrated (Duedall, et al., 1977)[5] that the largest tidal variation in salinity, nutrients, and Chlorophyll a concentrations occurred near Sandy Hook where the discharge from the Lower Hudson estuary has the greatest influence. It has been hypothesized that a substantial quantity of the nutrient-rich

Table 11

Total Organic Carbon In mg/l For The
New York Bight Transects Stations

Date Sampled	New York Bight Station Numbers 20	21	22	23	24	25	26	27	32	33	34	35	40	41	42	43	44	45	46	47
6/7/77																				
Shallow	4.16	2.86	1.83	1.94	3.99	2.06	1.90	1.59	3.80	2.00	1.88	2.95	2.14	2.97	1.58	1.72	2.26	1.91	5.85	1.59
Deep	2.77	2.47	2.50	1.53	2.43	2.17	1.75	-	-	1.68	1.81	1.68	1.78	2.21	1.72	1.41	2.45	2.91	1.37	1.53
7/5/77																				
Shallow	5.07	4.45	3.90	4.32	4.80	3.85	3.77	4.10	3.88	3.07	3.72	3.45	2.63	2.95	3.30	3.33	4.16	4.64	5.73	3.75
Deep	1.97	1.30	4.52	1.62	1.72	-	2.50	6.95	2.21	1.49	1.38	1.51	5.42	1.45	1.97	2.75	1.46	4.44	1.17	1.54
7/13/77																				
Shallow	2.99	3.26	2.52	2.37	2.22	2.01	2.13	0.193	2.84	2.22	3.83	2.26	2.45	1.94	1.85	4.34	2.43	2.20	2.76	2.22
Deep	1.52	1.53	3.59	1.29	1.28	1.10	1.32	0.386	1.94	1.35	1.23	1.90	7.78	1.65	1.58	1.29	1.35	5.75	1.34	1.90
7/19/77																				
Shallow	4.64	3.39	3.25	3.08	2.92	2.86	3.19	3.43	3.18	4.14	2.71	2.87	2.56	2.69	2.49	2.49	3.66	3.24	2.46	2.53
Deep	2.13	1.80	1.38	1.26	1.44	1.85	1.87	1.83	1.71	1.71	1.26	1.94	1.86	1.59	1.97	2.34	1.62	1.91	1.53	4.80
8/9/77																				
Shallow	4.90	5.09	3.88	3.42	4.33	3.44	2.80	2.93	3.18	3.09	3.19	3.15	2.47	10.55	2.87	9.85	3.44	3.37	5.17	2.01
Deep	0.83	1.26	1.75	1.07	2.23	12.34	1.06	1.69	2.24	0.97	1.52	1.56	2.88	3.37	1.23	1.71	1.62	1.72	1.42	1.34
8/16/77																				
Shallow	2.75	2.42	2.58	-	3.12	2.42	3.31	2.54	2.54	2.13	13.09	2.28	1.84	3.24	2.42	7.64	-	3.25	3.59	2.61
Deep	1.56	2.06	1.85	1.36	1.42	2.00	1.45	1.45	2.28	3.40	1.67	1.60	1.96	1.09	1.43	0.83	2.16	3.16	1.18	1.07
8/30/77																				
Shallow	-	-	-	-	-	-	-	2.40	2.842	2.56	2.84	2.58	3.49	3.06	3.53	2.90	1.56	2.02	1.81	2.07
Deep	-	-	-	-	-	-	-	1.54	1.101	2.13	0.91	0.94	2.02	1.07	1.01	1.66	0.74	1.30	0.86	1.30
9/19/77																				
Shallow	2.77	2.64	2.22	2.96	2.52	2.04	-	2.13	2.02	2.20	2.88	2.32	2.74	2.42	2.43	2.02	1.91	2.06	1.52	1.48
Deep	1.73	1.83	1.67	0.91	1.08	1.29	1.27	1.32	2.06	1.13	0.96	2.32	1.66	1.33	1.23	-	1.02	0.99	1.01	0.87

waters eminate from the Raritan Bay down along the New Jersey coast. The nutrient data presented for 1977 tend to support the above assumption as the stations closest to the New Jersey coast (i.e. NYB20, NYB21, and NYB32) have the highest nutrient values. It is also likely that these nutrient-rich waters serve to promote algal growth along the Jersey coast. However, there are numerous data gaps that must be filled before a clear understanding of the relationship between the waters leaving the Lower Hudson estuary and the red tide blooms along the northern New Jersey coast can be obtained.

VII. ENVIRONMENTAL EPISODES

Red Tide, 1977

On Monday, June 13 the EPA helicopter crew sighted a phytoplankton bloom off Manasquan Inlet. The bloom began at the mouth of the inlet, was approximately 1 km in width, and extended 1.6 to 3 km out into the ocean. Samples were collected 30 meters off the beach. The phytoplankton species causing the bloom was *Olisthodiscus luteus*, a relatively innocuous red tide organism. The bloom was moderate with cell counts of 30,000 per ml of sample. The bloom was again present on June 14; however, it had increased to approximately 8 km in length along the coast. A sample collected 30 meters from the Manasquan Inlet showed 84,640 *Olisthodiscus* cells per ml which is indicative of a fairly heavy bloom. A moderate bloom was also observed on June 13 in the area of

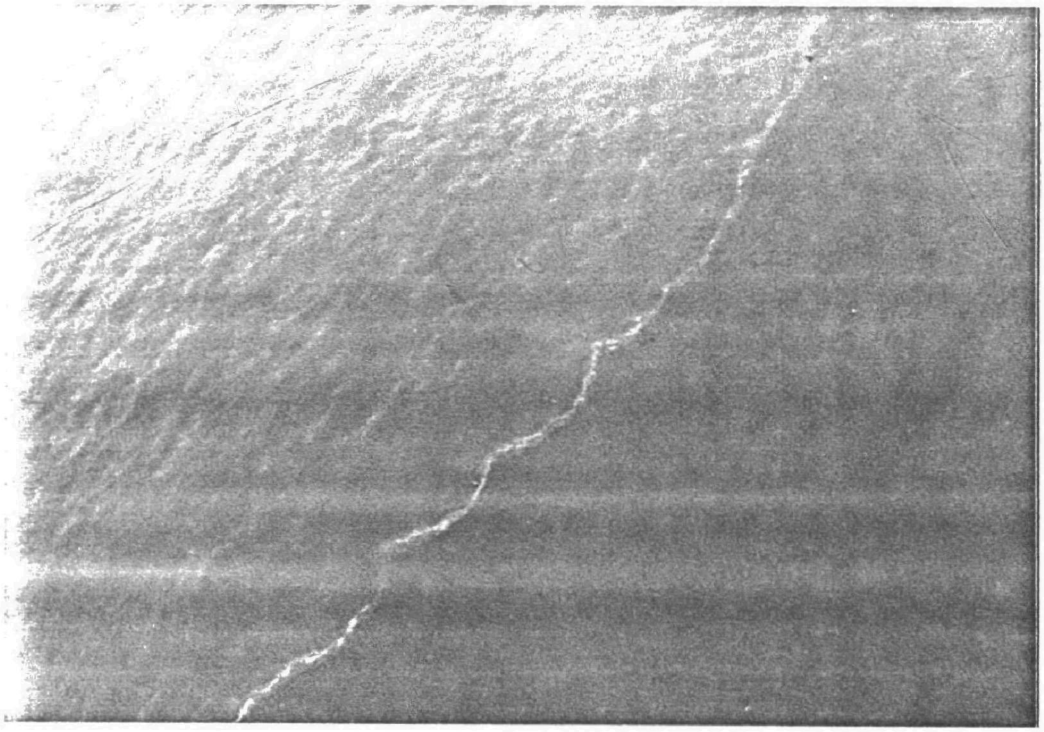
Seaside Heights. The bloom was small (approximately 1.6 km long and .4 km wide) and cell counts revealed it was of moderate density at 25,000 Olisthodiscus cells per ml of sample.

On June 15 it appeared that the blooms along the New Jersey coast had dissipated. However, on June 16, helicopter personnel observed an extremely long patch of red tide beginning 6.4 km south of the tip of Sandy Hook extending southward to Manasquan. The bloom was 11 to 12 km wide and 48 km long. Photograph 8 shows the very distinct interface of the red tide bloom and "clean" algae-free water. The picture was taken off Manasquan Inlet. Two samples were collected on June 16, one where the bloom began off Sandy Hook, and the other just off the beach at Deal, New Jersey. Both samples were indicative of a moderate bloom with Olisthodiscus luteus the dominant organism. Cell counts were 40,480 per ml off Sandy Hook and 57,040 per ml off Deal.

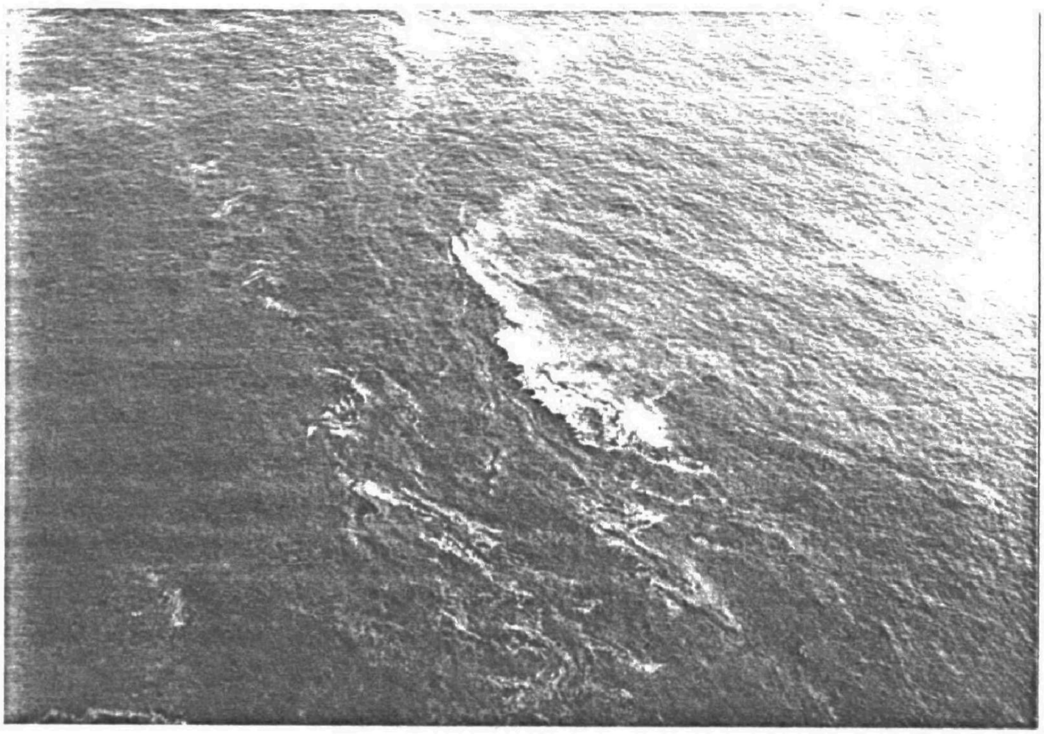
On June 9 and 10 over 5 cm of rain fell (Table 6). The bloom began on June 13, just 3 days later. It seems quite probable that the rain washed nutrients into the river which triggered the bloom. This is further evidenced by the fact that the bloom began around the Manasquan Inlet.

On June 17 the red tide along the New Jersey coast had dissipated.

On June 18 an extensive bloom was sighted in Raritan Bay (Photograph 9). Two samples were collected off Princess Cove,



Photograph 8 - Red tide (left) and algae-free water (right) interface off Manasquan Inlet.



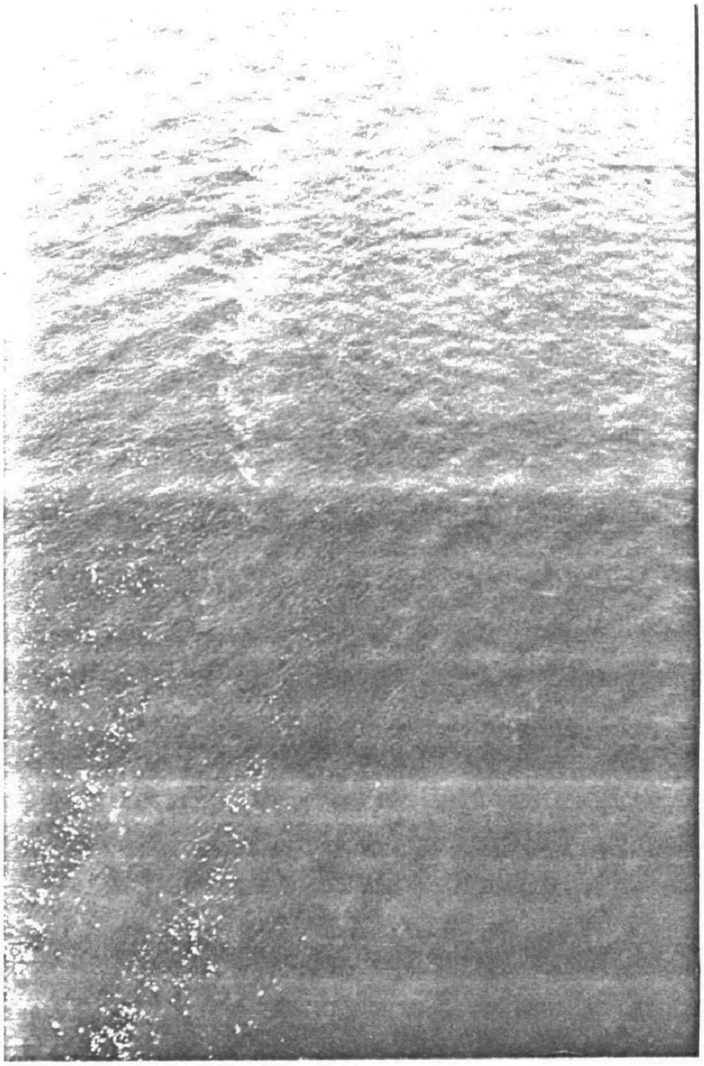
Photograph 9 - Red tide in Raritan Bay.

Staten Island. Analysis of the samples showed an average cell count of 122,667 _Olisthodiscus luteus_ cells per ml of sample. This is considered a heavy bloom. The red tide was visually observed to persist in Raritan Bay through June 22.

On Friday, July 8 we received a report of red tide in a marina at Atlantic City, New Jersey. The helicopter was dispatched to investigate the report. A small red paint spill was found in the marina (approximately 4 to 20 liters). No evidence of red tide was observed in the ocean along the entire New Jersey coast to Atlantic City.

On Saturday, July 9 red tide was observed in Raritan Bay. It extended from just west of the Earle Pier to Sandy Hook. Photograph 10 shows the red tide in the bay as it appeared in a boat wake. A sample was collected off the end of Earle Pier and had a count of 18,750 _Olisthodiscus luteus_ cells per ml. This is a fairly minor bloom. Also on July 9 a red tide bloom was observed from Monmouth Beach to Long Branch. The bloom extended from the surf zone out to approximately 15 km from shore. A sample collected off Monmouth Beach had 40,625 _Olisthodiscus luteus_ cells per ml of sample. This was a moderate bloom.

On Friday, July 15 the EPA helicopter crew saw extensive red tide blooms off Long Branch, New Jersey and in Sandy Hook Bay. Photograph 11 shows the red tide off Long Branch. Samples were collected; however, no cell counts were conducted over the weekend.



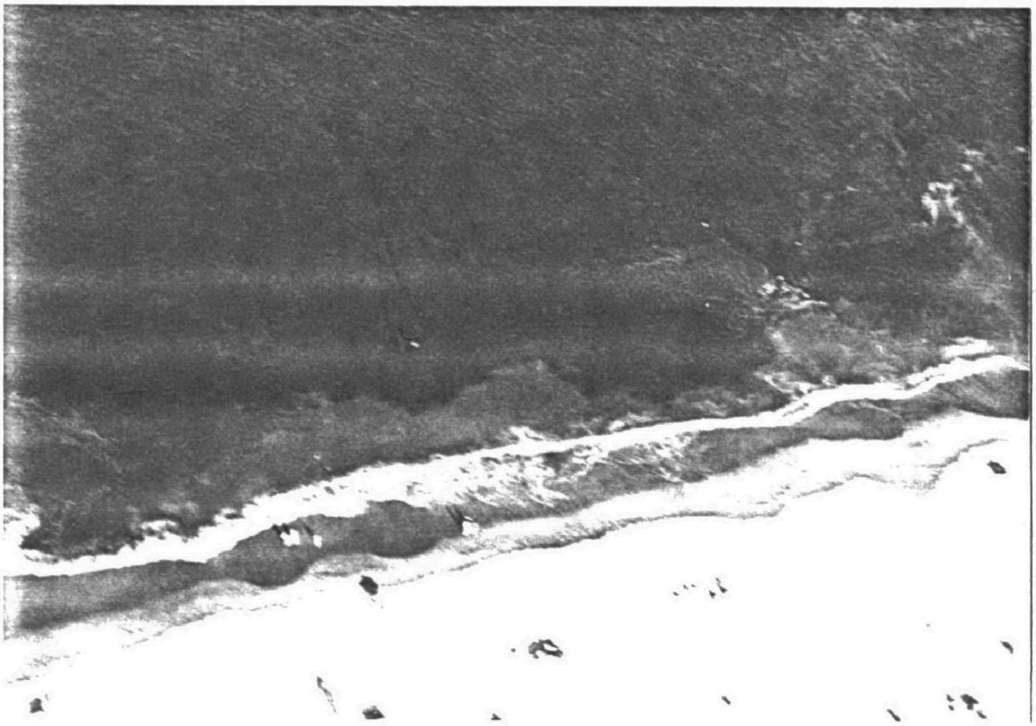
Photograph 10 - Red tide in Raritan Bay as seen in a boat wake.

Photograph 11 - Red tide off Long Branch, New Jersey.

On Monday, July 18 red tide was observed from Seaside Park, north to Point Pleasant. It appeared very dense at the Mantoloking Bridge. A sample was collected in this dense area and analyzed. The dominant organism was Massartia, a non-toxic red tide organism; however, no cell count was made.

On Thursday, July 21 the helicopter crew again observed a dense red-brown discoloration in Sandy Hook Bay from Earle Pier to Sandy Hook. The same red-brown color was also present in the mouth of the Raritan River. A sample collected off Earle Pier showed 8,832 Massartia cells per ml, 300,900 nanoplankters per ml, 44,000 Euglena cells per ml, and 10,000 Olisthodiscus cells per ml.

On Saturday, July 23 the helicopter crew observed a bloom in Sandy Hook Bay extending from Sandy Hook all the way to the mouth of the Raritan River. No sample was taken since this was judged to be the same bloom that had been present continuously for the previous 1.5 months. Out in the ocean the red tide extended from Sandy Hook to Seaside Heights. In the Seaside Heights area the bloom appeared to disperse. Continuous red-brown water extended from shore out 4 km to sea. The red tide in the surf zone off Sandy Hook can be seen in Photograph 12. A scum and foam line ranging from 10 to 30 meters wide and anywhere from the surf zone to 3 km out was present throughout the length of the bloom. This scum and foam line can be seen in Photograph 13. A sample was collected east of Manasquan Inlet approximately 1.2 km offshore.



Photograph 12 - Red tide in the surf zone at Sandy Hook, New Jersey.

Photograph 13 - Scum layer and red tide off Long Branch, New Jersey.

A scan of the sample showed a nanoplankter (150,000 cells per ml) to be dominant with a few Olisthodiscus, Massartia, and Prorocentrum also present.

During the month of August, the only major red tide incident was observed on August 8. It extended from Sandy Hook south to Asbury Park and ranged from the shore out 2.5 km. It was very patchy and not dense. A sample was collected; however, no cell counts were performed.

In September the red tide was non-existent in the ocean or Sandy Hook Bay. This is attributed to the cooling trend in the weather that takes place in September.

A complete description of all red tide episodes is contained in Appendix E.

Floatables

On June 7 the helicopter became fogged in at Fort Tilden, Long Island and was forced to land on the beach. Considerable debris covered the beach. Photographs 14 and 15 show this debris. Photograph 14 shows a tampon inserter. These inserters, which float, sporatically wash up on the Long Island and New Jersey beaches. Their origin is believed to be sewage bypasses and/or untreated sewage discharges from areas such as Manhattan Island or Brooklyn. New York City has a combined sewerage system (sanitary and stormwater flow through the same pipes). Whenever it rains heavily for a few hours the sewage treatment plants cannot handle the large

Photograph 14 - Tampon inserter and other debris on the beach at Fort Tilden, Long Island.

Photograph 15 - Debris on the beach at Fort Tilden, Long Island.

stormwater flow; therefore, raw sewage is bypassed and discharged without any treatment. Many areas in New Jersey also have the same problem.

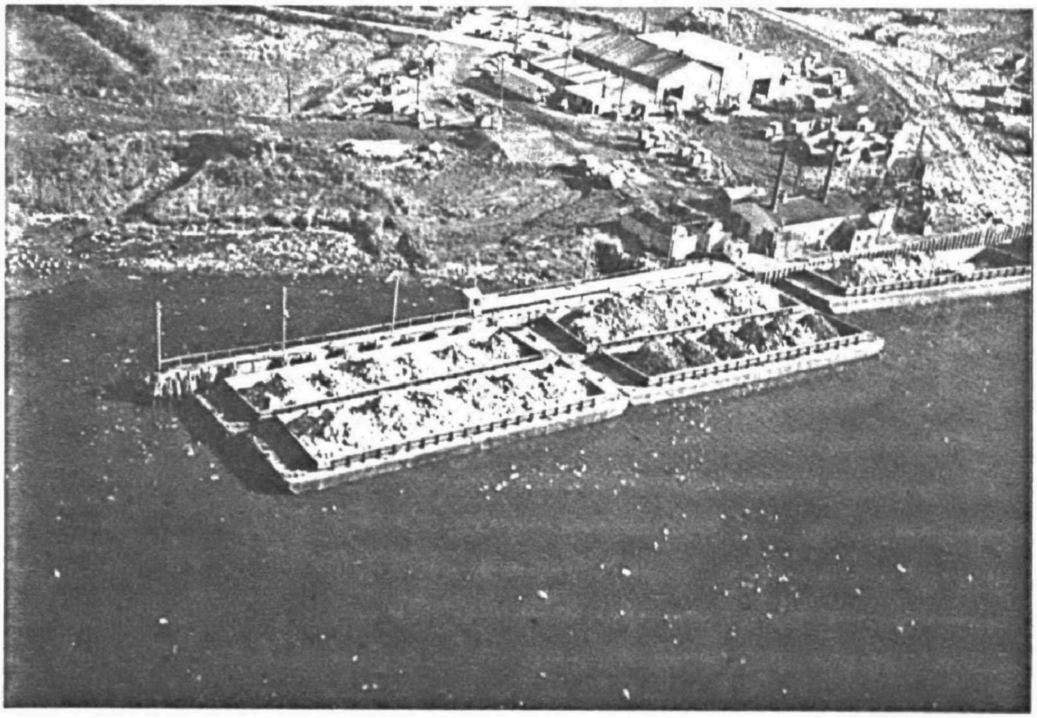
Photograph 15 shows reeds which frequently wash up onto beaches. Reeds are constantly flushed out of tidal marshes by exceptionally high tides and by storms. Although reeds do not pose any health problem to bathers, they do present a cleanup problem for the local shore municipalities.

On Wednesday, July 20 Nassau County closed some of its beaches due to the washup of "sewage-related materials" and other debris. The beaches were closed only long enough to clean them. Bacteriological analyses indicated they were safe for swimming. Photograph 16 shows some of the debris that washed up on Long Beach, Long Island.

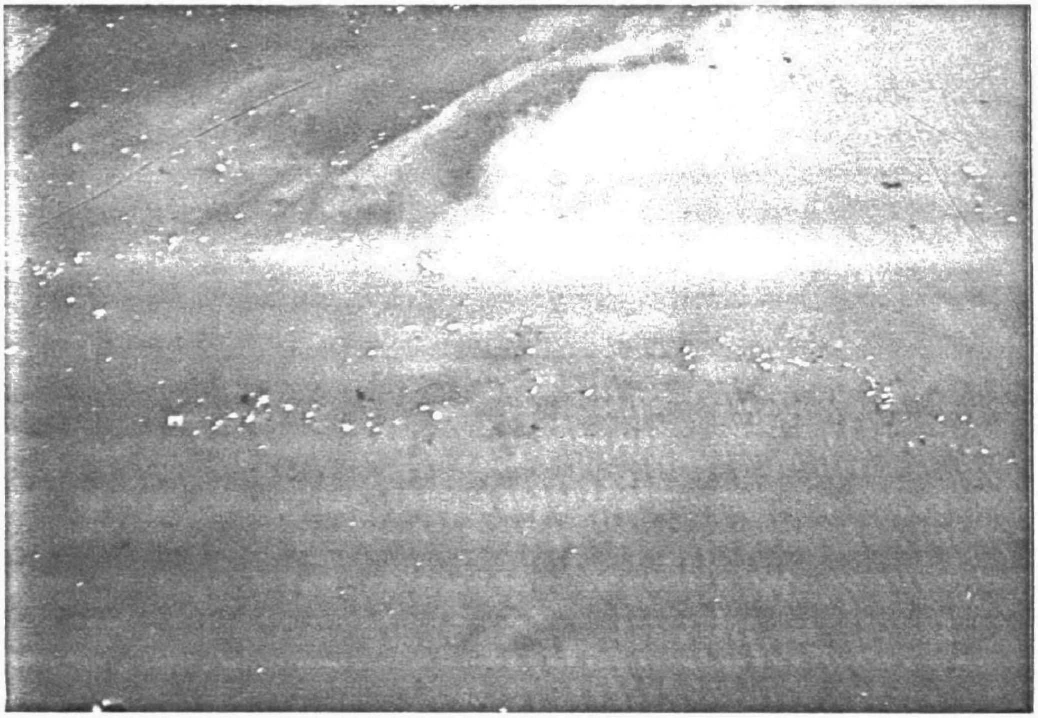
Floating garbage was seen in the Arthur Kill and Raritan Bay on each day that the helicopter flew over these bodies of water. The source appears to be the Fresh Kills Landfill in Staten Island, New York.

Photograph 17 shows the barges which are used to carry garbage from Manhattan to the Fresh Kills Landfill. When these barges are unloaded, garbage spills into the river. Photographs 17, 18, and 19 all show garbage in the waterways surrounding the Fresh Kills Landfill.

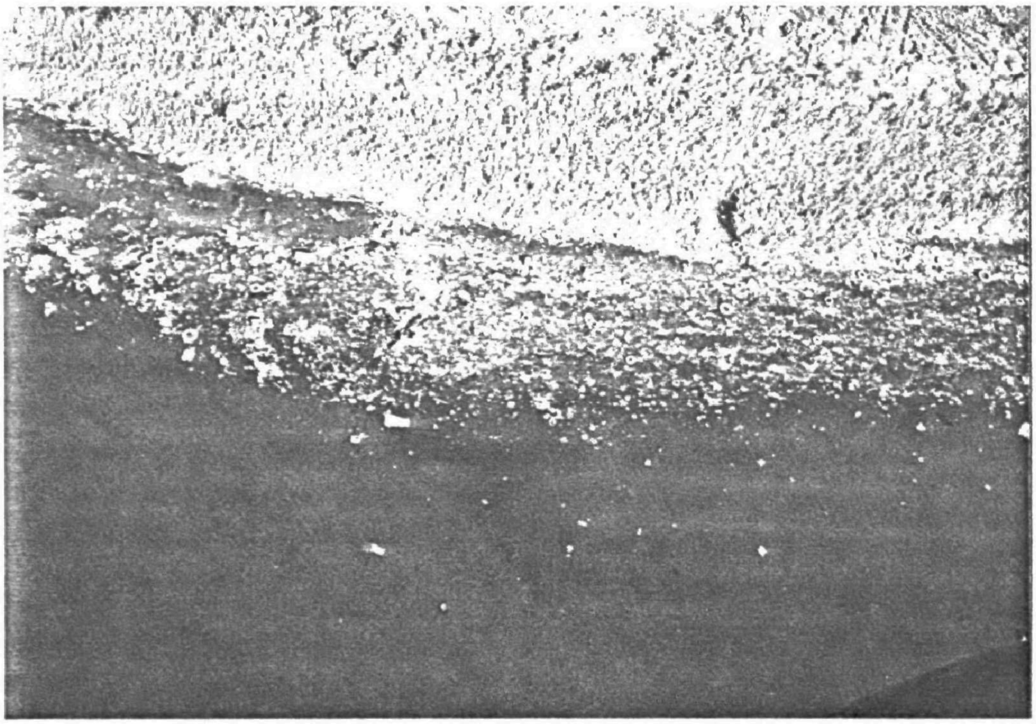
Photograph 16 - Debris on the beach at Long Beach, Long Island.



Photograph 17 - Fresh Kills Landfill, Staten Island - Barges used for carrying garbage. Note garbage in water.



Photograph 18 - Garbage in water by Fresh Kills Landfill, Staten Island, New York.



Photograph 19 - Garbage in water, Fresh Kills Landfill, Staten Island, New York.

Scum Lines

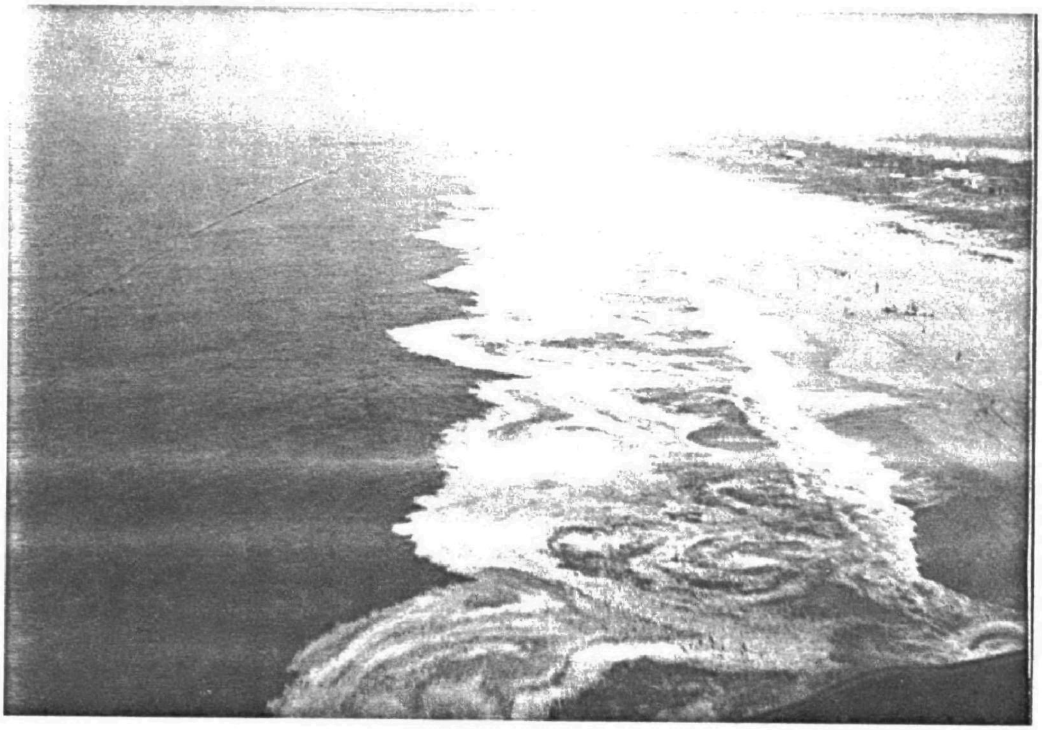
On Friday, May 27 a scum line was observed in the Loveladies to Ship Bottom region of New Jersey. The scum line was approximately 30 meters from shore, 100 to 130 meters wide, and 8 km long. A sample of the material was collected and examined in the laboratory. The sample contained detritus, probably the remnants of an algal bloom.

On August 3 while sampling the beaches from Moriches Inlet to Shinnecock Inlet, a brown frothy "scum layer" was noted extending from the surf zone out 7 to 16 meters. Photographs 20 and 21 show this layer quite clearly. A sample was collected and found to contain detritus, possibly the remnant of a decaying algal bloom. The samples collected that day in the surf were low in both total and fecal coliform. Thus, the water was safe for swimming, although it was aesthetically displeasing.

Governor Carey of New York flew over the same area on August 4 and observed the scum layer. He contacted New York State Department of Environmental Conservation (NYSDEC) and authorized them to take action. NYSDEC contacted EPA and both agencies on August 5 sent helicopters to investigate. Upon arriving at the scene, neither NYSDEC nor EPA could locate any trace of the "scum layer" which was present on the two previous days.

New York City Power Failure

On Wednesday, July 13 in the late evening, a power failure



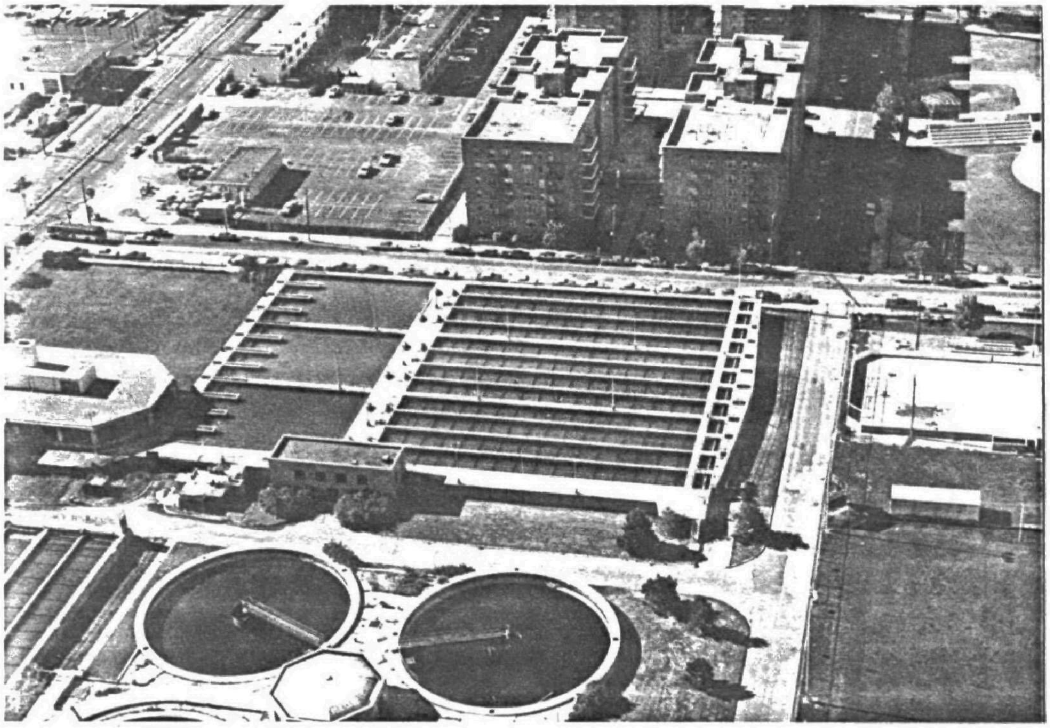
Photograph 20 - Scum layer in the surf zone at the Hamptons, Long Island.

Photograph 21 - Scum layer in the surf zone at the Hamptons, Long Island.

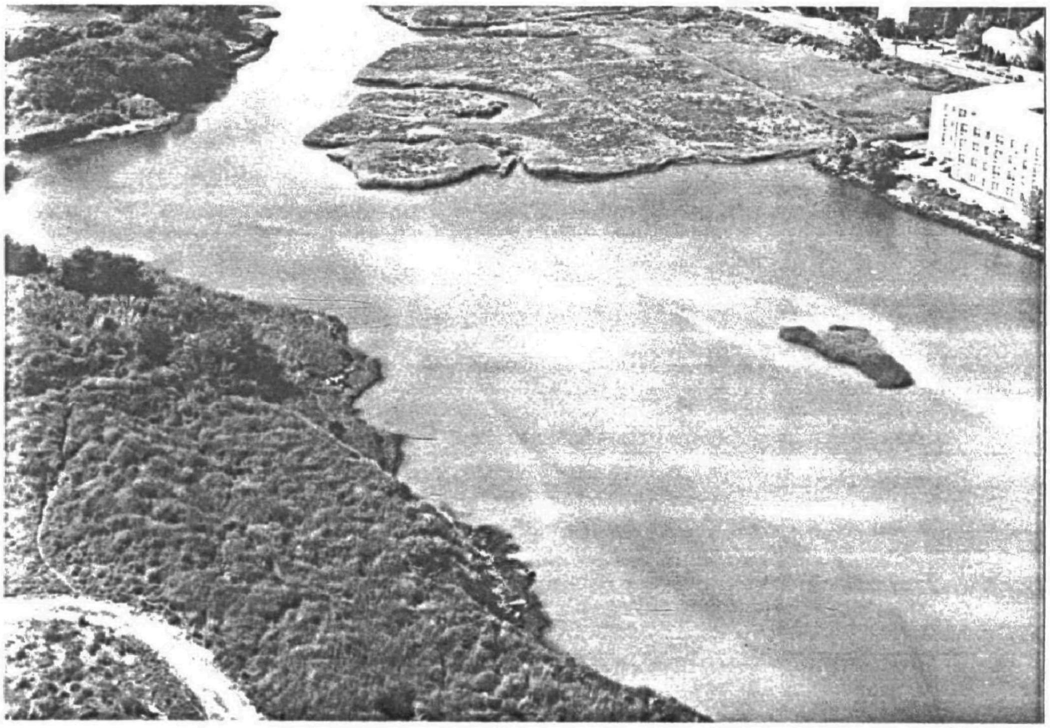
occurred in the New York City metropolitan area. During the power failure, which lasted approximately 20 to 24 hours, New York City's sewage treatment plants bypassed an estimated 3.5 million cubic meters of raw sewage. Photograph 22 shows Rockaway Sewage Treatment Plant. As can be seen from the photograph, the aerators in the plant's activated sludge tanks were not functioning. Photograph 23 shows raw sewage from one of New York City's sewage treatment plants flowing towards the ocean. Because of the tremendous volume of untreated sewage discharge during the power failure, EPA increased the sampling frequencies of the Long Island and New Jersey beaches to daily, through Monday, July 18. EPA also sampled stations along Coney Island and Staten Island. The Coney Island and Staten Island beaches had elevated coliform densities, but this could not specifically be related to the power failure. These beaches consistently have elevated values even when there is no power failure. The results of the increased sampling of the Long Island and New Jersey beaches are given in Appendix C. The raw sewage discharge resulting from the power failure showed no significant adverse effect on the water quality of the Long Island and New Jersey beaches.

Virus Survey

In addition to the previously mentioned surveys conducted during the summer of 1977 an ongoing viral assay and potential bacterial pathogen survey was continued in selected areas of the Bight. Appendix F presents the results of the data collected to date.



Photograph 22 - Rockaway Sewage Treatment Plant, Rockaway, Long Island. Note the aerators are not operating in the activated sludge tanks due to the power failure.



Photograph 23 - Raw sewage from the Jamaica Sewage Treatment Plant bypass, flowing toward the ocean.

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APPENDIX A

Dissolved Oxygen Values Recorded

in the New York Bight

May 1 - September 30, 1977

Perpendicular Stations

Station NYB20

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^oC)
6/17/77	02	10.1	18.0
	47	7.3	15.0
6/21/77	02	10.2	17.0
	47	11.2	16.0
6/30/77	02	10.40	19.0
	47	9.10	17.0
7/21/77	02	9.1	19.0
	47	4.9	24.5
8/4/77	02	6.75	21.0
	47	6.75	17.0
8/11/77	02	7.10	24.5
	47	3.85	18.5
8/19/77	02	7.55	22.1
	47	4.70	20.4
9/1/77	02	8.35	23.5
	47	3.80	16.5
9/16/77	02	6.70	19.1
	47	3.70	15.6

Perpendicular Stations

Station NYB22

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	10.2	16.5
	88	9.6	16.4
6/30/77	02	8.35	19.0
	88	6.70	14.5
7/21/77	02	8.8	24.5
	88	3.9	14.0
8/4/77	02	8.10	22.0
	88	4.95	16.1
8/11/77	02	8.20	19.5
	88	4.55	17.5
8/19/77	02	7.65	22.0
	88	4.65	16.5
9/1/77	02	7.55	22.5
	88	4.00	14.5
9/16/77	02	6.35	20.0
	88	2.85	15.5

Perpendicular Stations

Station NYB24

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	11.15	17.0
	125	8.50	15.8
6/30/77	02	10.45	20.0
	125	7.50	14.6
7/21/77	02	8.8	25.5
	125	5.5	15.0
8/4/77	02	9.00	21.5
	125	5.25	15.8
8/11/77	02	8.10	24.0
	125	4.25	14.5
8/19/77	02	7.20	20.3
	125	4.70	17.0
9/1/77	02	7.70	23.0
	125	4.05	14.0
9/16/77	02	5.75	20.1
	125	4.05	15.2

Perpendicular Stations

Station NYB26

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	9.95	17.2
	78	8.80	15.8
6/30/77	02	10.05	21.0
	78	5.70	16.9
7/21/77	02	9.1	26.0
	78	4.8	17.0
8/4/77	02	7.90	20.7
	78	7.10*	20.5*
8/11/77	02	7.80	24.0
	78	3.70	15.0
8/19/77	02	7.65	22.0
	78	4.60	17.3
9/1/77	02	7.70	23.5
	78	4.40	15.5
9/16/77	02	7.15	20.2
	78	5.05	14.1

* Data Suspect

Perpendicular Stations

Station JC14C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	9.25	17.2
	84	8.80	14.8
6/30/77	02	8.35	21.0
	84	8.95	17.0
7/21/77	02	7.3	25.5
	84	5.8	16.5
8/4/77	02	7.55	22.0
	84	6.80*	21.0*
8/11/77	02	7.75	23.8
	84	5.30	15.0
8/19/77	02	7.65	22.3
	84	5.75	18.2
9/1/77	02	7.00	23.0
	84	4.60	15.5
9/16/77	02	7.45	20.2
	84	5.15	15.5

* Data Suspect

Perpendicular Stations

Station JC14A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (°C)
6/21/77	02	8.90	16.8
	78	8.0	13.0
6/30/77	02	12.15	9.9
	78	7.65	15.0
7/21/77	02	8.6	16.0
	78	4.2	25.0
8/4/77	02	9.15	21.5
	78	6.05	14.5
8/11/77	02	8.50	24.2
	78	5.25	15.8
8/19/77	02	7.35	22.9
	78	4.60	15.8
9/1/77	02	7.35	21.0
	78	3.80	16.0
9/17/77	02	7.60	20.5
	78	7.15	19.2

Perpendicular Stations

Station JC14B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	9.15	17.2
	120	7.85	14.8
6/30/77	02	10.20	20.5
	120	7.30	15.0
7/21/77	02	7.6	19.0
	120	6.2	25.5
8/4/77	02	8.10	22.0
	120	6.50	15.0
8/11/77	02	7.55	24.1
	120	5.35	14.1
8/19/77	02	7.55	22.7
	120	4.65	15.0
9/1/77	02	7.30	22.5
	120	5.40	15.5
9/17/77	02	4.75	20.0
	120	4.80	15.0

Perpendicular Stations

Station JC14P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/13/77	02	6.90	17.2
	46	5.25	15.1
6/21/77	02	10.30	17.0
	50	7.60	14.0
6/30/77	02	10.75	19.2
	50	8.55	17.0
7/21/77	02	11.8	17.0
	50	4.0	24.9
8/4/77	02	7.70	21.0
	50	4.75	16.0
8/11/77	02	8.10	24.0
	50	6.10	15.5
8/19/77	02	7.50	22.7
	50	2.30	17.0
9/1/77	02	7.50	22.0
	50	6.25	20.5
9/17/77	02	7.35	19.8
	50	3.55	17.9

Perpendicular Stations

Station JC27A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	8.80	16.1
	72	8.95	14.9
6/30/77	02	8.40	19.0
	72	7.05	15.2
7/21/77	02	8.0	25.5
	72	4.3	17.0
8/4/77	02	8.40	21.8
	72	5.70	13.5
8/11/77	02	7.85	24.0
	72	5.40	12.0
8/19/77	02	7.55	23.0
	72	3.80	18.5
9/1/77	02	8.50	22.0
	72	3.35	15.0
9/17/77	02	7.40	20.7
	72	3.85	16.2

Perpendicular Stations

Station JC27B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	8.85	18.0
	96	9.55	14.0
6/30/77	02	9.50	21.0
	96	7.30	15.0
8/5/77	02	8.85	21.8
	96	7.15	15.5
8/11/77	02	6.10	23.5
	96	6.05	14.0
8/19/77	02	7.55	23.1
	96	5.30	16.5
9/1/77	02	7.45	23.0
	96	4.55	16.0
9/17/77	02	6.90	20.2
	96	6.35	19.6

Perpendicular Stations

Station JC27C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	8.90	17.3
	102	8.20	13.0
6/30/77	02	8.50	20.5
	102	9.10	15.5
8/5/77	02	7.65	22.0
	102	7.10	15.7
8/11/77	02	5.50	23.9
	102	3.10	16.0
8/19/77	02	7.50	22.4
	102	5.50	15.0
9/1/77	02	7.40	23.0
	102	4.70	16.0
9/17/77	02	7.55	20.5
	102	3.10	15.2

Perpendicular Stations

Station JC27P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (^{o}C)
6/13/77	02	7.0	17.5
	46	5.3	14.0
6/21/77	02	11.35	17.2
	50	6.20	14.3
6/30/77	02	10.10	19.0
	50	7.40	16.0
7/21/77	02	9.1	24.0
	50	4.4	12.5
8/4/77	02	8.10	21.0
	50	5.20	17.2
8/11/77	02	9.10	25.5
	50	4.30	12.8
8/19/77	02	7.55	22.8
	50	3.50	17.0
9/1/77	02	-	-
	50	-	-
9/17/77	02	7.80	20.1
	50	2.55	15.0

Perpendicular Stations

Station JC41P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/13/77	02	8.7	17.0
	46	6.8	14.0
6/21/77	02	9.50	16.2
	50	8.95	14.0
8/5/77	02	10.25	23.1
	50	3.75	15.8
8/11/77	02	8.55	25.0
	50	3.80	18.2
8/19/77	02	7.50	23.0
	50	3.70	15.8
9/17/77	02	5.05	21.0
	50	2.10	16.0

Perpendicular Stations

Station JC41A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (^{o}C)
6/21/77	02	8.65	16.0
	63	8.40	13.0
8/5/77	02	9.15	22.5
	63	3.75	14.9
8/11/77	02	7.00	24.8
	63	2.65	16.0
8/19/77	02	6.90	22.4
	63	4.70	16.1
9/17/77	02	4.35	21.0
	63	2.95	16.5

Perpendicular Stations

Station JC41B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	9.05	16.8
	72	8.60	13.0
8/5/77	02	7.95	23.0
	72	7.80	15.2
8/11/77	02	6.55	24.8
	72	5.75	17.5
8/19/77	02	7.60	22.6
	72	4.80	16.3
9/17/77	02	6.25	21.0
	72	3.35	16.0

Perpendicular Stations

Station JC41C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	9.55	17.2
	96	9.15	14.0
6/30/77	02	8.07	20.5
	96	8.10	15.0
8/5/77	02	7.85	22.0
	96	5.55	14.0
8/11/77	02	6.65	24.5
	96	5.70	18.5
8/19/77	02	7.50	22.0
	96	4.80	16.4
9/17/77	02	7.40	21.0
	96	2.80	15.0

Perpendicular Stations

Station JC47P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/13/77	02	9.8	17.1
	64	7.7	14.0
6/21/77	02	9.10	16.8
	68	8.25	14.0
6/30/77	02	8.55	18.0
	68	7.75	16.0
8/5/77	02	10.85	23.0
	68	3.50	14.4
8/11/77	02	8.75	25.2
	68	3.90	16.5
8/19/77	02	7.75	22.5
	68	3.80	16.4
9/17/77	02	7.25	21.0
	68	2.60	16.0

Perpendicular Stations

Station JC47A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	8.70	17.0
	70	8.40	14.8
6/30/77	02	8.30	19.0
	70	8.55	15.0
8/5/77	02	8.45	23.0
	70	3.55	14.9
8/11/77	02	5.00	24.0
	70	2.20	15.5
8/19/77	02	7.45	22.1
	70	4.05	16.2
9/17/77	02	7.15	21.0
	70	2.45	16.0

Perpendicular Stations

Station JC47B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	8.80	17.0
	72	9.05	13.2
6/30/77	02	8.25	18.8
	72	9.15	16.0
8/5/77	02	7.60	23.5
	72	4.95	15.1
8/11/77	02	8.00	19.5
	72	4.65	15.0
8/19/77	02	7.25	22.4
	72	4.95	15.6
9/17/77	02	8.15	21.0
	72	3.40	16.0

Perpendicular Stations

Station JC47C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	9.55	17.2
	108	8.85	13.8
6/30/77	02	7.85	20.2
	108	8.50	15.0
8/5/77	02	6.80	23.5
	108	5.50	14.2
8/11/77	02	7.90	24.2
	108	5.20	14.6
8/19/77	02	7.70	22.3
	108	4.90	16.0

Perpendicular Stations

Station LIC02P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/13/77	02	6.2	15.0
	40	7.3	14.5
6/30/77	02	9.05	14.8
	40	6.90	12.8
7/1/77	02	7.50	16.5
	40	5.35	14.5
7/21/77	02	8.8	25.0
	40	5.9	-
8/12/77	02	7.50	22.0
	40	3.80	18.1
9/18/77	02	7.05	19.5
	40	6.65	19.0

Perpendicular Stations

Station LIC02A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	10.50	15.8
	48	7.95	13.0
7/1/77	02	8.45	14.0
	48	6.75	18.0
7/21/77	02	8.9	24.0
	48	5.8	16.0
8/12/77	02	6.90	22.0
	48	4.50	18.3
9/18/77	02	5.70	19.7
	48	3.40	16.2

Perpendicular Stations

Station LIC02B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	11.20	17.0
	48	8.55	15.0
7/1/77	02	8.40	18.0
	48	7.05	17.5
7/21/77	02	8.8	21.5
	48	5.3	16.0
8/12/77	02	7.15	22.8
	48	4.70	18.2
9/18/77	02	5.75	19.2
	48	3.60	15.2

Perpendicular Stations

Station LIC02C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (^{o}C)
6/21/77	02	11.20	16.9
	78	7.35	13.0
7/1/77	02	9.10	19.0
	78	6.15	16.0
7/21/77	02	6.9	22.0
	78	5.6	16.0
8/12/77	02	9.45	23.5
	78	5.95	17.8
9/18/77	02	5.30	18.8
	78	3.80	15.1

Perpendicular Stations

Station NYB40

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
6/21/77	02	7.35	13.0
	43	7.75	14.0
7/1/77	02	8.10	17.5
	43	6.85	17.0
7/21/77	02	8.5	25.0
	43	3.8	18.5
9/18/77	02	7.50	19.0
	43	3.65	17.3

Perpendicular Stations

Station NYB42

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/21/77	02	12.00	16.5
	75	12.20	16.2
7/1/77	02	8.75	16.0
	75	5.90	14.2
7/21/77	02	7.9	25.5
	75	5.7	19.5
9/18/77	02	8.35	20.0
	75	4.30	15.8

Perpendicular Stations

Station NYB44

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (°C)
6/21/77	02	11.40	17.6
	93	8.60	14.0
7/1/77	02	9.00	17.5
	93	7.30	13.5
7/21/77	02	9.2	24.5
	93	4.4	16.0
9/18/77	02	8.40	19.8
	93	3.70	15.2

Perpendicular Stations

Station NYB25

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (°C)
6/21/77	02	11.20	17.0
	78	8.60	13.2
7/1/77	02	9.00	18.0
	78	5.75	13.0
7/21/77	02	8.7	25.0
	78	7.1	20.0
9/18/77	02	5.10	20.0
	78	3.55	16.5

Perpendicular Stations

Station LIC09P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
6/13/77	02	8.7	15.5
	46	7.9	13.0
7/1/77	02	8.80	18.5
	46	6.45	16.0
7/21/77	02	8.2	20.0
	46	6.0	18.0
9/18/77	02	9.15	19.8
	46	2.80	16.0

Perpendicular Stations

Station LIC09A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
7/1/77	02	9.00	19.0
	60	8.10	17.8
7/21/77	02	8.3	25.0
	60	8.8	22.0
9/18/77	02	8.35	20.0
	60	3.05	15.5

Perpendicular Stations

Station LIC09B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
7/1/77	02	9.35	16.0
	66	6.95	13.5
7/21/77	02	7.9	23.5
	66	7.3	22.0
9/18/77	02	8.50	20.0
	66	4.00	16.0

Perpendicular Stations

Station LIC09C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
7/1/77	02	9.45	15.5
	72	6.20	13.0
7/21/77	02	8.1	25.0
	72	8.4	17.0
9/18/77	02	7.75	20.0
	72	4.20	16.5

Perpendicular Stations

Station LIC14P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (°C)
6/13/77	02	8.7	15.2
	49	8.1	14.1
7/21/77	02	8.7	24.0
	49	6.4	17.5
8/12/77	02	7.75	22.0
	43	6.70	17.0
9/18/77	02	9.30	20.1
	43	3.55	17.2

Perpendicular Stations

Station LIC14A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
7/21/77	02	8.5	25.0
	60	6.0	17.0
8/12/77	02	9.00	22.3
	60	6.35	17.2
9/18/77	02	9.10	20.2
	60	2.80	17.0

Perpendicular Stations

Station LIC14B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
7/21/77	02	14.6	25.0
	72	8.9	21.0
8/12/77	02	9.85	23.2
	72	4.70	16.5
9/18/77	02	7.60	20.5
	72	2.00	15.5

Perpendicular Stations

Station LIC14C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
7/21/77	02	8.1	26.0
	78	8.3	18.0
8/12/77	02	9.20	23.5
	78	5.15	17.0
9/18/77	02	7.20	20.7
	78	4.15	15.1

Perpendicular Stations

Station LIC16P

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
8/12/77	02	7.85	22.1
	43	6.85	17.2
9/18/77	02	6.70	20.0
	43	6.00	15.8

Perpendicular Stations

Station LIC16B

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (^{o}C)
8/12/77	02	7.80	22.0
	69	6.40	17.5
9/18/77	02	8.60	20.5
	69	6.25	15.0

Perpendicular Stations

Station LIC16C

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/1)	Temperature (^{o}C)
8/12/77	02	9.10	23.0
	84	6.35	16.5
9/18/77	02	8.90	21.0
	84	6.25	15.8

Perpendicular Stations

Station LIC16A

Date Sampled	Depth (ft.)	Dissolved Oxygen (mg/l)	Temperature (°C)
8/12/77	02	7.75	22.0
	72	6.50	16.8
9/18/77	02	8.50	20.2
	72	5.95	16.0

APPENDIX B

Dissolved Oxygen Data Collected by the New York City Department of Environmental Protection--Summer 1977

Bottom Dissolved Oxygen Values vs. Date & Station

New York Bight-New York City Samples

Station EPA/NYC	June 29	July 14	July 20	July 28	August 3	August 10	August 23	August 30	September 7	September 15	September 22	September 29	October 12	October 20	Total No. Samples	No. 3-4	No. 2-3
NYB40 - W5	+	.	.	.	.	+	*	.	+	.	.	.	.	.	14	3	1
NYB41 - W4	.	.	.	+	.	+	+	+	+	.	.	.	.	.	14	5	0
NYB42 - W3	.	.	.	.	.	.	*	+	*	.	+	.	.	.	14	2	2
NYB43 - W2	.	.	+	.	.	.	+	+	*	.	*	.	.	.	14	3	2
NYB45 - D1	.	.	*	.	.	.	+	.	*	.	+	.	.	.	14	2	2
NYB35 - D2	.	.	+	.	.	.	+	.	*	.	*	.	*	.	14	2	3
NYB34 - D3	.	.	.	.	.	.	*	*	+	+	.	.	+	.	14	3	2
NYB20 - W9	.	.	+	+	.	+	.	+	+	.	.	.	.	.	14	5	0
NYB21 - W8	.	.	+	.	.	+	+	+	+	.	.	.	.	.	14	5	0
NYB22 - W7	.	.	.	.	.	.	+	+	.	.	.	.	.	.	14	2	0
NYB24 - W6	.	.	+	.	.	.	*	.	+	.	.	.	.	.	14	1	1

. = DO >4
+ = DO 3 to 4
* = DO 2 to 3
Blank = No sample that date

APPENDIX C

Bacteriological Water Quality Data,

New Jersey and Long Island Beach Stations --

Summer 1977

BEACHES

Station JC01A

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	14	0
6/4/77	10	0
6/6/77	5	0
6/18/77	3	0
6/20/77	0	0
6/22/77	2	0
6/23/77	3	0
6/27/77	4	0
7/2/77	28	1
7/6/77	2	0
7/9/77	4	0
7/11/77	12	3
7/14/77	8	0
7/15/77	8	2
7/16/77	12	2
7/17/77	14	1
7/18/77	16	0
7/20/77	7	0
7/23/77	3	0
7/24/77	144	8
7/25/77	11	1
7/27/77	172	4

BEACHES

Station JC01A

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	232	28
8/6/77	7	0
8/8/77	3	0
8/10/77	8	1
8/13/77	132	5
8/15/77	164	2
8/17/77	128	9
8/20/77	15	0
8/22/77	18	0
8/25/77	31	3
8/27/77	60	1
8/31/77	24	4
9/7/77	11	2

BEACHES

Station JC02

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	14	0
6/4/77	14	0
6/6/77	9	0
6/18/77	8	0
6/20/77	0	0
6/22/77	1	0
6/23/77	3	0
6/27/77	3	0
7/2/77	2	0
7/6/77	1	0
7/9/77	3	1
7/11/77	6	1
7/14/77	2	0
7/15/77	20	10
7/16/77	6	1
7/17/77	4	0
7/18/77	21	1
7/20/77	20	0
7/23/77	8	0
7/24/77	148	0
7/25/77	27	2
7/27/77	66	8

BEACHES

Station JC02

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	28	5
8/6/77	5	0
8/8/77	9	0
8/10/77	17	0
8/13/77	41	4
8/15/77	7	0
8/17/77	46	0
8/20/77	5	0
8/22/77	28	2
8/25/77	21	3
8/27/77	8	0
8/31/77	72	2
9/7/77	16	5

BEACHES

Station JC03

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	7	0
6/4/77	4	1
6/6/77	4	0
6/18/77	7	0
6/20/77	0	0
6/22/77	2	0
6/23/77	2	0
6/27/77	2	0
7/2/77	1	0
7/6/77	1	0
7/9/77	6	0
7/11/77	24	3
7/14/77	0	0
7/15/77	14	3
7/16/77	6	1
7/17/77	6	1
7/18/77	2	0
7/20/77	0	0
7/23/77	4	0
7/24/77	6	0
7/25/77	11	1
7/27/77	16	10

BEACHES

Station JC03

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	25	5
8/6/77	2	0
8/8/77	7	0
8/10/77	7	1
8/13/77	79	0
8/15/77	22	0
8/17/77	46	3
8/20/77	22	0
8/22/77	84	5
8/25/77	7	1
8/27/77	2	0
8/31/77	208	14
9/7/77	3	0

BEACHES

Station JC05

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	5	3
6/4/77	5	3
6/6/77	1	0
6/18/77	5	0
6/20/77	3	0
6/22/77	32	15
6/23/77	2	0
6/27/77	2	0
7/2/77	0	0
7/6/77	2	0
7/9/77	5	2
7/11/77	16	1
7/14/77	0	0
7/15/77	8	1
7/16/77	4	0
7/17/77	4	0
7/18/77	4	1
7/20/77	1	0
7/23/77	3	1
7/24/77	9	0
7/25/77	8	2
7/27/77	2	0

BEACHES

Station JC05

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	12	4
8/6/77	2	0
8/8/77	4	0
8/10/77	6	3
8/13/77	25	3
8/15/77	5	0
8/17/77	21	2
8/20/77	11	3
8/22/77	22	1
8/25/77	17	0
8/27/77	7	0
8/31/77	460	9
9/7/77	9	1

BEACHES

Station JC08

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	3	0
6/4/77	2	0
6/6/77	0	0
6/18/77	20	0
6/20/77	2	0
6/22/77	1	0
6/23/77	6	0
6/27/77	7	1
7/2/77	2	0
7/6/77	1	0
7/9/77	52	5
7/11/77	28	0
7/14/77	18	0
7/15/77	12	2
7/16/77	7	2
7/17/77	2	0
7/18/77	6	2
7/20/77	4	0
7/23/77	0	0
7/24/77	6	0
7/25/77	24	3
7/27/77	1	0

BEACHES

Station JC08

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	7	4
8/6/77	5	0
8/8/77	21	0
8/10/77	11	2
8/13/77	11	0
8/15/77	23	0
8/17/77	26	0
8/20/77	6	0
8/22/77	38	2
8/25/77	3	0
8/27/77	124	1
8/31/77	40	3
9/7/77	29	3

BEACHES

Station JC11

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	0
6/4/77	4	0
6/6/77	1	0
6/18/77	1	0
6/20/77	0	0
6/22/77	1	0
6/23/77	0	0
6/27/77	1	0
7/2/77	2	0
7/6/77	2	1
7/9/77	12	1
7/11/77	32	2
7/14/77	11	1
7/15/77	16	0
7/16/77	14	2
7/17/77	30	5
7/18/77	3	2
7/20/77	3	3
7/23/77	4	1
7/24/77	7	1
7/25/77	12	0
7/27/77	8	0

BEACHES

Station JC11

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	32	3
8/6/77	6	0
8/8/77	8	0
8/10/77	84	5
8/13/77	2	0
8/15/77	7	0
8/17/77	42	1
8/20/77	10	1
8/22/77	4	0
8/25/77	2	0
8/27/77	21	0
8/31/77	92	14
9/7/77	8	2

BEACHES

Station JC14

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	5	1
6/4/77	3	0
6/6/77	1	0
6/18/77	2	0
6/20/77	4	0
6/22/77	5	0
6/23/77	0	0
6/27/77	2	0
7/2/77	4	1
7/6/77	0	0
7/9/77	20	5
7/11/77	28	4
7/14/77	6	2
7/15/77	39	4
7/16/77	3	1
7/17/77	2	0
7/18/77	3	0
7/20/77	1	0
7/23/77	3	0
7/24/77	9	0
7/25/77	12	1
7/27/77	8	0

BEACHES

Station JC14

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	14	7
8/6/77	4	0
8/8/77	22	0
8/10/77	8	0
8/13/77	400	31
8/15/77	33	1
8/17/77	144	4
8/20/77	4	0
8/22/77	1020	39
8/25/77	20	5
8/27/77	92	0
8/31/77	116	23
9/7/77	44	16

BEACHES

Station JC21

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	1
6/4/77	3	0
6/6/77	44	1
6/18/77	2	0
6/20/77	3	1
6/22/77	8	0
6/23/77	4	0
6/27/77	0	0
7/2/77	6	1
7/6/77	1	0
7/9/77	3	0
7/11/77	8	5
7/14/77	13	0
7/15/77	7	0
7/16/77	16	1
7/17/77	4	0
7/18/77	8	0
7/20/77	3	0
7/23/77	4	0
7/24/77	12	0
7/25/77	25	8
7/27/77	9	1

BEACHES

Station JC21

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	45	9
8/6/77	4	1
8/8/77	40	0
8/10/77	840	7
8/13/77	1320	83
8/15/77	33	4
8/17/77	420	36
8/20/77	8	1
8/22/77	520	18
8/25/77	30	0
8/27/77	248	3
8/31/77	192	24
9/7/77	108	9

BEACHES

Station JC24

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	3	1
6/4/77	6	0
6/6/77	0	0
6/18/77	1	0
6/20/77	44	0
6/22/77	56	1
6/23/77	64	0
6/27/77	2	1
7/2/77	3	1
7/6/77	2	0
7/9/77	4	1
7/11/77	54	4
7/14/77	21	1
7/15/77	11	1
7/16/77	4	0
7/17/77	0	0
7/18/77	1	0
7/20/77	22	5
7/23/77	4	0
7/24/77	5	1
7/25/77	13	0
7/27/77	140	6

BEACHES

Station JC24

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	132	44
8/6/77	9	1
8/8/77	41	0
8/10/77	60	2
8/13/77	9	0
8/15/77	0	0
8/17/77	120	3
8/20/77	9	1
8/22/77	22	1
8/25/77	-	-
8/27/77	60	0
8/31/77	312	38
9/7/77	1040	104

BEACHES

Station JC27

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	2	0
6/6/77	1	0
6/18/77	2	0
6/20/77	12	0
6/22/77	3	0
7/2/77	5	0
7/6/77	1	0
7/9/77	5	0
7/11/77	16	3
7/14/77	3	0
7/15/77	48	4
7/16/77	4	1
7/17/77	3	1
7/18/77	1	0
7/20/77	9	4
7/23/77	6	1
7/24/77	7	0
7/25/77	1820	268
7/27/77	40	4

BEACHES

Station JC27

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	80	12
8/6/77	20	1
8/8/77	33	1
8/10/77	84	2
8/13/77	84	7
8/15/77	25	1
8/17/77	96	6
8/20/77	17	0
8/22/77	100	3
8/25/77	112	9
8/27/77	27	1
8/31/77	184	7
9/7/77	60	3

BEACHES

Station JC30

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	0
6/4/77	2	0
6/6/77	1	0
6/18/77	1	0
6/20/77	2	0
6/22/77	0	0
6/23/77	0	0
6/27/77	1	0
7/2/77	1	0
7/6/77	1	0
7/9/77	4	1
7/11/77	28	1
7/14/77	8	0
7/15/77	10	0
7/16/77	6	0
7/17/77	9	0
7/18/77	2	0
7/20/77	3	0
7/23/77	4	0
7/24/77	3	0
7/25/77	20	0
7/27/77	13	3

BEACHES

Station JC30

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	100	12
8/6/77	3	0
8/8/77	15	1
8/10/77	28	2
8/13/77	5	0
8/15/77	1	0
8/17/77	216	8
8/20/77	1	0
8/22/77	28	0
8/25/77	116	5
8/27/77	84	0
8/31/77	92	5
9/7/77	16	2

BEACHES

Station JC33

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	240	0
6/4/77	54	6
6/6/77	25	3
6/18/77	1	0
6/20/77	1	0
6/22/77	2	1
6/23/77	0	0
6/27/77	0	0
7/2/77	2	0
7/6/77	0	0
7/9/77	1	0
7/11/77	108	9
7/14/77	14	2
7/15/77	112	4
7/16/77	12	0
7/17/77	4	2
7/18/77	0	0
7/20/77	4	0
7/23/77	54	4
7/24/77	4	0
7/25/77	17	1
7/27/77	8	1

BEACHES

Station JC33

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	88	15
8/6/77	24	1
8/8/77	6	2
8/10/77	120	5
8/13/77	2600	144
8/15/77	21	2
8/17/77	192	3
8/20/77	11	0
8/22/77	8	0
8/25/77	28	3
8/27/77	28	0
8/31/77	56	3
9/7/77	23	1

BEACHES

Station JC37

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	5	1
6/4/77	6	2
6/6/77	13	1
6/18/77	0	0
6/20/77	56	4
6/22/77	0	0
6/23/77	0	0
6/27/77	0	0
7/2/77	1	0
7/6/77	0	0
7/9/77	16	1
7/11/77	4	1
7/14/77	42	20
7/15/77	6	0
7/16/77	10	3
7/17/77	16	3
7/18/77	44	21
7/20/77	6	0
7/23/77	2	0
7/24/77	5	0
7/25/77	60	2
7/27/77	42	9

BEACHES

Station JC37

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	288	92
8/6/77	7	0
8/8/77	19	1
8/10/77	2	0
8/13/77	248	41
8/15/77	152	22
8/17/77	340	45
8/20/77	10	0
8/22/77	7	3
8/25/77	500	42
8/27/77	116	15
8/31/77	112	15
9/7/77	-	-

BEACHES

Station JC41

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	10	2
6/6/77	1	0
6/18/77	0	0
6/20/77	0	0
6/22/77	1	0
6/23/77	1	0
6/27/77	0	0
7/2/77	0	0
7/6/77	10	0
7/9/77	11	1
7/11/77	12	0
7/14/77	14	3
7/15/77	21	0
7/16/77	15	2
7/17/77	24	0
7/18/77	1	1
7/20/77	1	0
7/23/77	6	1
7/24/77	3	0
7/25/77	84	1
7/27/77	2	0

BEACHES

Station JC41

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	41	18
8/6/77	1	0
8/8/77	2	0
8/10/77	4	0
8/13/77	14	0
8/15/77	200	30
8/17/77	232	8
8/20/77	1	0
8/22/77	16	2
8/25/77	22	0
8/27/77	16	3
8/31/77	36	8
9/7/77	188	9

BEACHES

Station JC44

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	3	0
6/4/77	5	1
6/6/77	25	0
6/18/77	12	0
6/20/77	1	0
6/22/77	0	0
6/23/77	0	0
6/27/77	0	0
7/2/77	0	0
7/6/77	0	0
7/9/77	8	3
7/11/77	28	1
7/14/77	12	1
7/15/77	18	1
7/16/77	6	0
7/17/77	12	0
7/18/77	4	2
7/20/77	2	0
7/23/77	16	7
7/24/77	1	1
7/25/77	124	22
7/27/77	4	0

BEACHES

Station JC44

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	49	22
8/6/77	0	0
8/8/77	3	0
8/10/77	2	0
8/13/77	3	0
8/15/77	3	0
8/17/77	208	10
8/20/77	0	0
8/22/77	5	1
8/25/77	148	7
8/27/77	7	1
8/31/77	92	1
9/7/77	132	1

BEACHES

Station JC47A

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	2	0
6/4/77	1	0
6/6/77	7	1
6/18/77	1	0
6/20/77	0	0
6/22/77	2	0
6/23/77	0	0
6/27/77	0	0
7/2/77	1	0
7/6/77	6	0
7/9/77	4	0
7/11/77	11	0
7/14/77	1	0
7/15/77	112	4
7/16/77	14	1
7/17/77	6	0
7/18/77	1	0
7/20/77	0	0
7/23/77	21	3
7/24/77	5	0
7/25/77	152	2
7/27/77	6	3

BEACHES

Station JC47A

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	60	21
8/6/77	0	0
8/8/77	0	0
8/10/77	3	0
8/13/77	10	0
8/15/77	16	1
8/17/77	116	6
8/20/77	1	0
8/22/77	40	3
8/25/77	23	2
8/27/77	15	1
8/31/77	7	2
9/7/77	96	1

BEACHES

Station JC49

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	420	0
6/4/77	1	0
6/6/77	24	5
6/18/77	1	0
6/20/77	0	0
6/22/77	0	0
6/23/77	0	0
6/27/77	1	0
7/2/77	8	0
7/6/77	1	1
7/9/77	6	1
7/11/77	9	1
7/14/77	13	3
7/15/77	9	1
7/16/77	3	0
7/17/77	1	0
7/18/77	2	1
7/20/77	1	0
7/23/77	23	4
7/24/77	4	0
7/25/77	244	4
7/27/77	4	0

BEACHES

Station JC49

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	27	11
8/6/77	0	0
8/8/77	3	0
8/10/77	5	1
8/13/77	12	1
8/15/77	18	4
8/17/77	38	1
8/20/77	4	0
8/22/77	44	17
8/25/77	-	-
8/27/77	13	0
8/31/77	6	0
9/7/77	88	2

BEACHES

Station JC53

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1080	0
6/4/77	10	2
6/6/77	5	0
6/18/77	10	0
6/20/77	2	0
6/22/77	0	0
6/23/77	1	0
6/27/77	0	0
7/2/77	6	8
7/6/77	0	4
7/9/77	16	4
7/11/77	8	4
7/14/77	2	1
7/15/77	18	7
7/16/77	20	3
7/17/77	68	4
7/18/77	1	0
7/20/77	47	7
7/23/77	22	4
7/24/77	69	0
7/25/77	27	0
7/27/77	2	0

BEACHES

Station JC53

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	56	22
8/6/77	2	1
8/8/77	104	1
8/10/77	44	2
8/13/77	13	0
8/15/77	25	1
8/17/77	3620	12
8/20/77	2	0
8/22/77	28	4
8/25/77	11	1
8/27/77	11	0
8/31/77	40	5
9/7/77	540	8

BEACHES

Station JC55

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	0
6/4/77	0	0
6/6/77	2	0
6/18/77	0	0
6/20/77	0	0
6/22/77	0	0
6/23/77	0	0
6/27/77	0	0
7/2/77	2	0
7/6/77	6	0
7/9/77	13	4
7/11/77	4	1
7/14/77	2	0
7/15/77	0	0
7/16/77	6	3
7/17/77	16	0
7/18/77	0	0
7/20/77	2	1
7/23/77	26	4
7/24/77	840	0
7/25/77	36	0
7/27/77	0	0

BEACHES

Station JC55

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
7/30/77	49	12
8/6/77	0	0
8/8/77	18	0
8/10/77	1	0
8/13/77	0	0
8/15/77	10	0
8/17/77	820	7
8/20/77	1	0
8/22/77	3	1
8/25/77	1	0
8/27/77	3	0
8/31/77	4	0
9/7/77	308	3

BEACHES

Station LIC01

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	2	1
6/4/77	0	0
6/6/77	3	0
6/18/77	8	1
6/20/77	1	0
6/22/77	0	0
6/23/77	2	0
6/27/77	0	0
7/2/77	2	0
7/6/77	0	0
7/11/77	8	0
7/14/77	1	0
7/16/77	2	0
7/17/77	3	0
7/18/77	0	0
7/20/77	104	0
7/23/77	4	0
7/25/77	11	1
7/27/77	1	0
7/30/77	460	84
8/3/77	10	2

BEACHES

Station LIC01

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	2	0
8/8/77	5	1
8/10/77	12	0
8/13/77	2	0
8/15/77	44	3
8/17/77	80	19
8/20/77	21	11
8/22/77	3	1
8/25/77	26	13
8/27/77	11	0
8/31/77	11	4
9/7/77	13	7

BEACHES

Station LIC02

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	2
6/4/77	4	2
6/6/77	2	0
6/18/77	34	2
6/20/77	3	1
6/22/77	0	0
6/23/77	1	0
6/27/77	1	1
7/2/77	12	4
7/6/77	0	0
7/11/77	8	3
7/14/77	2	1
7/16/77	3	0
7/17/77	6	0
7/18/77	2	0
7/20/77	200	0
7/23/77	36	2
7/25/77	20	0
7/27/77	2	1
7/30/77	228	58
8/3/77	9	0

BEACHES

Station LIC02

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	8	2
8/8/77	8	1
8/10/77	7	0
8/13/77	2	0
8/15/77	172	20
8/17/77	132	42
8/20/77	120	40
8/22/77	25	5
8/25/77	84	21
8/27/77	14	2
8/31/77	84	13
9/7/77	28	14

BEACHES

Station LIC03

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	3
6/4/77	5	0
6/6/77	8	0
6/18/77	48	0
6/20/77	2	1
6/22/77	1	1
6/23/77	6	0
6/27/77	4	0
7/2/77	1	0
7/6/77	0	0
7/11/77	14	0
7/14/77	9	1
7/16/77	11	0
7/17/77	46	0
7/18/77	3	1
7/20/77	128	0
7/23/77	48	8
7/25/77	8	1
7/27/77	11	0
7/30/77	184	39
8/3/77	68	11

BEACHES

Station LIC03

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	6	0
8/8/77	26	8
8/10/77	5	0
8/13/77	84	24
8/15/77	760	224
8/17/77	480	152
8/20/77	80	11
8/22/77	29	5
8/25/77	22	1
8/27/77	440	20
8/31/77	32	1
9/7/77	24	3

BEACHES

Station LIC04

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	0
6/4/77	0	0
6/6/77	1	0
6/18/77	44	2
6/20/77	2	0
6/22/77	4	4
6/23/77	3	0
6/27/77	3	0
7/2/77	112	16
7/6/77	0	0
7/11/77	3	0
7/14/77	16	2
7/16/77	192	84
7/17/77	84	35
7/18/77	600	316
7/20/77	15	4
7/23/77	2	1
7/25/77	28	5
7/27/77	7	1
7/30/77	32	3
8/3/77	28	1

BEACHES

Station LIC04

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	1380	560
8/8/77	260	132
8/10/77	19	2
8/13/77	80	3
8/15/77	108	30
8/17/77	560	180
8/20/77	16	2
8/22/77	84	20
8/25/77	29	5
8/27/77	108	14
8/31/77	112	5
9/7/77	64	13

BEACHES

Station LIC05

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	2
6/4/77	1	1
6/6/77	7	0
6/18/77	40	3
6/20/77	5	0
6/22/77	2	1
6/23/77	11	1
6/27/77	2	0
7/2/77	312	16
7/6/77	10	0
7/11/77	11	0
7/14/77	3	1
7/16/77	28	21
7/17/77	4	1
7/18/77	4	2
7/20/77	4	4
7/23/77	8	0
7/25/77	820	52
7/27/77	5	3
7/30/77	13	1
8/3/77	29	0

BEACHES

Station LIC05

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	88	5
8/8/77	32	2
8/10/77	7	0
8/13/77	100	9
8/15/77	180	12
8/17/77	23	6
8/20/77	18	7
8/22/77	40	5
8/25/77	10	1
8/27/77	32	1
8/31/77	5	0
9/7/77	36	1

BEACHES

Station LIC07

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	10	2
6/4/77	1	0
6/6/77	3	0
6/18/77	9	0
6/20/77	2	0
6/22/77	6	0
6/23/77	1	0
6/27/77	0	0
7/2/77	1	0
7/6/77	0	0
7/11/77	12	1
7/14/77	4	0
7/16/77	2	0
7/17/77	1	0
7/18/77	0	0
7/20/77	4	0
7/23/77	1	0
7/25/77	6	1
7/27/77	8	4
7/30/77	28	2
8/3/77	24	2

BEACHES

Station LIC07

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	40	0
8/8/77	6	0
8/10/77	12	1
8/13/77	18	2
8/15/77	25	0
8/17/77	92	11
8/20/77	9	0
8/22/77	8	3
8/25/77	92	2
8/27/77	7	1
8/31/77	13	1
9/7/77	17	9

BEACHES

Station LIC08

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	8	4
6/4/77	2	0
6/6/77	20	2
6/18/77	52	1
6/20/77	2	0
6/22/77	0	0
6/23/77	2	0
6/27/77	5	1
7/2/77	20	6
7/6/77	1	0
7/11/77	6	1
7/14/77	4	2
7/16/77	1	0
7/17/77	36	7
7/18/77	5	1
7/20/77	440	5
7/23/77	0	0
7/25/77	28	3
7/27/77	5	4
7/30/77	16	5
8/3/77	7	0

BEACHES

Station LIC08

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	5	0
8/8/77	21	2
8/10/77	2	1
8/13/77	120	7
8/15/77	240	23
8/17/77	560	22
8/20/77	20	2
8/22/77	6	1
8/25/77	60	5
8/27/77	18	0
8/31/77	44	8
9/7/77	16	4

BEACHES

Station LIC09

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	24	9
6/4/77	4	2
6/6/77	17	0
6/18/77	14	2
6/20/77	16	2
6/22/77	19	4
6/23/77	5	0
6/27/77	12	1
7/2/77	56	3
7/6/77	23	1
7/11/77	4	1
7/14/77	11	3
7/16/77	6	2
7/17/77	3	1
7/18/77	9	1
7/20/77	3	1
7/23/77	0	0
7/25/77	16	2
7/27/77	10	6
7/30/77	44	6
8/3/77	36	1

BEACHES

Station LIC09

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	24	5
8/8/77	20	0
8/10/77	5	0
8/13/77	40	2
8/15/77	92	10
8/17/77	128	15
8/20/77	22	5
8/22/77	2	0
8/25/77	84	0
8/27/77	54	0
8/31/77	88	12
9/7/77	20	1

BEACHES

Station LIC10

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	20	12
6/4/77	1	0
6/6/77	3	0
6/18/77	24	0
6/20/77	62	5
6/22/77	116	1
6/23/77	30	1
6/27/77	8	1
7/2/77	16	0
7/6/77	0	0
7/11/77	3	0
7/14/77	3	0
7/16/77	4	0
7/17/77	1	0
7/18/77	10	3
7/20/77	3	1
7/23/77	0	0
7/25/77	16	2
7/27/77	10	6
7/30/77	8	1
8/3/77	31	4

BEACHES

Station LIC10

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	27	3
8/8/77	18	1
8/10/77	6	0
8/13/77	20	3
8/15/77	300	4
8/17/77	136	14
8/20/77	28	5
8/22/77	68	8
8/25/77	52	2
8/27/77	84	6
8/31/77	84	16
9/7/77	112	9

BEACHES

Station LIC12

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	4	1
6/18/77	0	0
6/20/77	0	0
6/22/77	2	0
6/23/77	0	0
6/27/77	0	0
7/2/77	1	0
7/6/77	0	0
7/12/77	0	0
7/14/77	13	1
7/16/77	1	0
7/17/77	2	0
7/18/77	1	0
7/20/77	12	0
7/23/77	0	0
7/25/77	4	1
7/27/77	1	0
7/30/77	6	0
8/3/77	3	1

BEACHES

Station LIC12

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	3	0
8/8/77	9	1
8/10/77	0	0
8/13/77	4	1
8/15/77	12	0
8/17/77	42	13
8/20/77	32	13
8/22/77	1	0
8/25/77	1	0
8/27/77	2	0
8/31/77	68	6
9/7/77	4	0

BEACHES

Station LIC13

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	4	2
6/4/77	1	1
6/6/77	2	0
6/18/77	3	1
6/20/77	4	1
6/22/77	1	0
6/23/77	0	0
6/27/77	2	0
7/2/77	36	1
7/6/77	0	0
7/11/77	2	0
7/14/77	1	0
7/16/77	1	1
7/17/77	1	0
7/18/77	4	2
7/20/77	24	0
7/23/77	0	0
7/25/77	3	0
7/27/77	1	0
7/30/77	12	2
8/3/77	4	0

BEACHES

Station LIC13

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	1	0
8/8/77	3	0
8/10/77	7	0
8/13/77	16	3
8/15/77	7	2
8/17/77	21	0
8/20/77	8	0
8/22/77	8	3
8/25/77	8	1
8/27/77	13	4
8/31/77	72	24
9/7/77	20	2

BEACHES

Station LIC14

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	1	0
6/6/77	0	0
6/18/77	4	0
6/20/77	0	0
6/22/77	0	0
6/23/77	1	0
6/27/77	4	0
7/2/77	12	0
7/6/77	0	0
7/11/77	1	0
7/14/77	3	0
7/16/77	2	0
7/17/77	3	1
7/18/77	4	0
7/20/77	84	0
7/23/77	4	0
7/25/77	4	1
7/27/77	0	0
7/30/77	14	5
8/3/77	8	1

BEACHES

Station LIC14

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	2	1
8/8/77	3	1
8/10/77	3	0
8/13/77	2	0
8/15/77	20	0
8/17/77	180	7
8/20/77	5	3
8/22/77	7	0
8/25/77	20	0
8/27/77	3	1
8/31/77	32	0
9/7/77	0	0

BEACHES

Station LIC15

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	1
6/4/77	0	0
6/6/77	2	0
6/18/77	11	1
6/20/77	1	0
6/22/77	4	0
6/23/77	0	0
6/27/77	1	0
7/2/77	0	0
7/6/77	0	0
7/11/77	0	0
7/14/77	1	0
7/16/77	0	0
7/17/77	0	0
7/18/77	7	3
7/20/77	28	0
7/23/77	1	0
7/25/77	3	1
7/27/77	1	0
7/30/77	9	1
8/3/77	0	0

BEACHES

Station LIC15

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	4	0
8/8/77	2	0
8/10/77	1	0
8/13/77	3	0
8/15/77	44	4
8/17/77	620	43
8/20/77	3	1
8/22/77	4	2
8/25/77	0	0
8/27/77	8	3
8/31/77	10	3
9/7/77	12	0

Station LIC16

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	0	0
6/18/77	10	0
6/20/77	4	0
6/22/77	3	3
6/23/77	0	0
6/27/77	3	1
7/2/77	8	0
7/6/77	4	1
7/11/77	3	1
7/14/77	12	5
7/16/77	3	2
7/17/77	0	0
7/18/77	8	2
7/20/77	1	0
7/23/77	11	3
7/25/77	8	3
7/27/77	0	0
7/30/77	23	4
8/3/77	18	3

BEACHES

Station LIC16

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	27	4
8/8/77	21	6
8/10/77	20	5
8/13/77	51	8
8/15/77	1020	88
8/17/77	480	28
8/20/77	58	4
8/22/77	2	0
8/25/77	6	1
8/27/77	7	0
8/31/77	44	11
9/7/77	8	1

BEACHES

Station LIC17

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	1	1
6/18/77	2	1
6/20/77	3	1
6/22/77	0	0
6/24/77	0	0
6/28/77	2	0
7/2/77	1	0
7/6/77	0	0
7/9/77	0	0
7/11/77	0	0
7/14/77	1	0
7/16/77	5	0
7/17/77	0	0
7/18/77	0	0
7/20/77	1	0
7/23/77	0	0
7/26/77	4	2
7/28/77	2	0
7/30/77	18	3
8/3/77	8	1

BEACHES

Station LIC17

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	0	0
8/8/77	2	0
8/10/77	2	0
8/13/77	2	0
8/15/77	6	0
8/17/77	84	6
8/20/77	4	1
8/23/77	2	0
8/26/77	0	0
8/27/77	5	0
8/31/77	6	2
9/8/77	0	0

BEACHES

Station LIC18

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	2	2
6/4/77	0	0
6/6/77	0	0
6/18/77	2	1
6/20/77	3	1
6/22/77	1	0
6/24/77	0	0
6/28/77	0	0
7/2/77	2	0
7/6/77	0	0
7/9/77	0	0
7/11/77	0	0
7/14/77	0	0
7/16/77	0	0
7/17/77	2	0
7/18/77	1	0
7/20/77	15	2
7/23/77	0	0
7/26/77	3	0
7/28/77	1	0
7/30/77	10	3
8/3/77	8	0

BEACHES

Station LIC18

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	3	0
8/8/77	7	0
8/10/77	3	1
8/13/77	5	1
8/15/77	52	2
8/17/77	124	45
8/20/77	5	2
8/23/77	7	1
8/26/77	18	0
8/27/77	5	2
8/31/77	16	4
9/8/77	2	1

BEACHES

Station LIC19

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	0
6/4/77	0	0
6/6/77	0	0
6/18/77	3	0
6/20/77	4	1
6/22/77	0	0
6/24/77	0	0
6/28/77	0	0
7/2/77	20	3
7/6/77	0	0
7/9/77	0	0
7/11/77	0	0
7/14/77	1	0
7/16/77	2	0
7/17/77	4	0
7/18/77	0	0
7/20/77	0	0
7/23/77	4	0
7/26/77	4	0
7/28/77	1	0
7/30/77	8	4
8/3/77	0	0

BEACHES

Station LIC19

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	0	0
8/8/77	1	0
8/10/77	2	0
8/13/77	13	0
8/15/77	29	3
8/17/77	96	23
8/20/77	2	1
8/23/77	6	1
8/26/77	0	0
8/27/77	2	0
8/31/77	16	1
9/8/77	11	1

BEACHES

Station LIC20

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	3	0
6/18/77	5	1
6/20/77	0	0
6/22/77	1	0
6/24/77	0	0
6/28/77	0	0
7/2/77	12	1
7/6/77	0	0
7/9/77	0	0
7/11/77	4	0
7/14/77	0	0
7/16/77	3	0
7/17/77	0	0
7/18/77	1	0
7/20/77	0	0
7/23/77	1	0
7/26/77	4	1
7/28/77	2	0
7/30/77	6	1
8/3/77	0	0

BEACHES

Station LIC20

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	0	0
8/8/77	2	0
8/10/77	2	0
8/13/77	6	1
8/15/77	64	0
8/17/77	88	14
8/20/77	5	0
8/23/77	10	5
8/26/77	2	0
8/27/77	5	1
8/31/77	52	0
9/8/77	6	3

BEACHES

Station LIC21

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	0	0
6/18/77	1	0
6/20/77	0	0
6/22/77	0	0
6/24/77	0	0
6/28/77	0	0
7/2/77	1	0
7/6/77	0	0
7/9/77	16	2
7/11/77	0	0
7/16/77	0	0
7/17/77	3	1
7/18/77	1	0
7/20/77	2	0
7/23/77	0	0
7/26/77	20	10
7/28/77	0	0
7/30/77	7	1
8/3/77	1	0

BEACHES

Station LIC21

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	16	2
8/8/77	0	0
8/10/77	3	0
8/13/77	48	0
8/15/77	96	9
8/17/77	340	20
8/20/77	0	0
8/23/77	22	6
8/26/77	2	0
8/27/77	3	0
8/31/77	10	1
9/8/77	5	3

BEACHES

Station LIC22

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	6	4
6/6/77	2	1
6/18/77	2	0
6/20/77	3	1
6/22/77	0	0
6/24/77	0	0
6/28/77	0	0
7/2/77	12	2
7/6/77	1	0
7/9/77	0	0
7/11/77	5	0
7/16/77	1	0
7/17/77	2	0
7/18/77	0	0
7/20/77	8	0
7/23/77	0	0
7/26/77	20	1
7/28/77	0	0
7/30/77	11	4
8/3/77	0	0

Station LIC22

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	3	1
8/8/77	3	0
8/10/77	5	0
8/13/77	100	2
8/15/77	120	2
8/17/77	64	3
8/20/77	0	0
8/23/77	16	1
8/26/77	2	1
8/27/77	11	0
8/31/77	32	1
9/8/77	3	1

BEACHES

Station LIC23

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	2	2
6/4/77	0	0
6/6/77	2	1
6/18/77	3	0
6/20/77	1	0
6/22/77	8	0
6/24/77	0	0
6/28/77	1	0
7/2/77	8	0
7/6/77	12	0
7/9/77	0	0
7/11/77	1	1
7/16/77	5	1
7/17/77	1	0
7/18/77	0	0
7/20/77	2	0
7/23/77	7	3
7/26/77	17	6
7/28/77	8	1
7/30/77	2	0
8/3/77	32	0

BEACHES

Station LIC23

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	128	3
8/8/77	108	0
8/10/77	78	0
8/13/77	26	2
8/15/77	188	7
8/17/77	88	3
8/20/77	84	3
8/23/77	580	168
8/26/77	32	0
8/27/77	9	3
8/31/77	14	0
9/8/77	5	1

BEACHES

Station LIC24

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	2	1
6/4/77	0	0
6/6/77	1	0
6/18/77	3	0
6/20/77	3	0
6/22/77	0	0
6/24/77	0	0
7/2/77	1	0
7/6/77	6	1
7/9/77	0	0
7/11/77	0	0
7/16/77	0	0
7/17/77	0	0
7/18/77	0	0
7/20/77	1	0
7/23/77	0	0
7/26/77	21	5
7/28/77	0	0
7/30/77	5	1
8/3/77	0	0

<u>BEACHES</u>

Station LIC24

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	7	0
8/8/77	4	1
8/10/77	1	0
8/13/77	4	0
8/15/77	3	1
8/17/77	10	2
8/20/77	0	0
8/23/77	260	96
8/26/77	0	0
8/27/77	4	1
8/31/77	0	0
9/8/77	7	3

BEACHES

Station LIC25

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	2	1
6/6/77	0	0
6/18/77	8	3
6/20/77	2	0
6/22/77	0	0
6/24/77	0	0
7/2/77	1	0
7/6/77	0	0
7/9/77	9	0
7/11/77	2	0
7/16/77	100	9
7/17/77	0	0
7/18/77	1	0
7/20/77	0	0
7/23/77	0	0
7/26/77	4	1
7/28/77	0	0
7/30/77	2	0
8/3/77	1	0

BEACHES

Station LIC25

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	1	0
8/8/77	1	0
8/10/77	4	1
8/13/77	44	0
8/15/77	51	6
8/17/77	36	1
8/20/77	1	0
8/23/77	1	1
8/26/77	0	0
8/27/77	3	0
8/31/77	0	0
9/8/77	2	0

BEACHES

Station LIC26

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	1	1
6/4/77	1	0
6/6/77	3	1
6/18/77	1	0
6/20/77	4	1
6/22/77	0	0
6/24/77	0	0
7/2/77	4	1
7/6/77	0	0
7/9/77	0	0
7/11/77	0	0
7/16/77	3	0
7/17/77	3	0
7/18/77	0	0
7/20/77	12	4
7/23/77	1	0
7/26/77	16	2
7/28/77	2	0
7/30/77	8	3
8/3/77	0	0

BEACHES

Station LIC26

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	6	0
8/8/77	0	0
8/10/77	1	0
8/13/77	20	1
8/15/77	84	15
8/17/77	88	1
8/20/77	2	1
8/26/77	4	0
8/27/77	9	0
8/31/77	0	0
9/8/77	0	0

BEACHES

Station LIC27

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	0	0
6/4/77	0	0
6/6/77	0	0
6/18/77	2	0
6/20/77	3	1
6/22/77	0	0
6/24/77	0	0
7/2/77	12	4
7/6/77	3	0
7/9/77	1	0
7/11/77	1	0
7/16/77	0	0
7/17/77	4	1
7/18/77	0	0
7/20/77	2	0
7/23/77	15	2
7/26/77	0	0
7/28/77	1	0
7/30/77	9	5
8/3/77	2	0

BEACHES

Station LIC27

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/6/77	9	1
8/8/77	12	2
8/10/77	3	0
8/13/77	24	0
8/15/77	68	7
8/17/77	124	18
8/20/77	4	2
8/26/77	1	0
8/27/77	6	2
8/31/77	2	0
9/8/77	1	0

BEACHES

Station LIC28

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
6/2/77	3	1
6/4/77	0	0
6/6/77	0	0
6/18/77	0	0
6/20/77	0	0
6/22/77	0	0
6/24/77	0	0
7/2/77	16	3
7/6/77	0	0
7/9/77	0	0
7/11/77	1	0
7/16/77	0	0
7/17/77	4	0
7/18/77	0	0
7/20/77	0	0
7/23/77	0	0
7/26/77	9	2
7/28/77	0	0
7/30/77	2	0
8/6/77	0	0

BEACHES

Station LIC28

Date Sampled	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)
8/8/77	1	0
8/10/77	1	0
8/13/77	2	0
8/15/77	3	0
8/17/77	14	4
8/20/77	0	0
8/26/77	8	0
8/27/77	0	0
8/31/77	3	0
9/8/77	1	0

APPENDIX D

Water Quality Data

New York Bight Apex--

Summer 1977

NEW YORK BIGHT

Station NYB20

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (^oC)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	4.0	13.7	4	0	13960	4.16	12	.061	.033	.045	.024	.070	.276
Deep	3.10	13.6	0	0	15090	2.77	17	.032	.019	.032	.01K	.02K	.223
7/5/77													
Shallow	12.00	20.0	1	0	15200	5.07	22	.058	.018	.021	.01K	.02K	.157
Deep	5.50	16.0	0	0	16100	1.97	9	.042	.034	.083	.01K	.02K	.424
7/13/77													
Shallow	8.1	20.5	7	1	13333	2.99	11	.073	.044	.045	<.01	.074	.262
Deep	5.5	15.0	6	0	15000	1.52	7	.054	.049	.074	<.01	.02	.524
7/19/77													
Shallow	11.50	24.0	2	0	15000	4.64	13	.083	.035	.027	<.01	.02	.693
Deep	6.16	20.0	4	1	15690	2.13	3	.029	.020	.027	<.01	.023	.693
8/2/77													
Shallow	7.75	21.4	2	1	14419	-	-	.105	.078	.107	.019	.096	1.076
Deep	5.10	16.3	25	0	15349	-	-	.054	.048	.080	<.01	.032	1.251
8/9/77													
Shallow	9.50	28.0	5	0	14528	4.90	18	.106	.066	.083	.028	.122	1.052
Deep	3.20	17.5	3	0	16038	0.83	2	.056	.057	.102	<.01	.029	1.757
8/16/77													
Shallow	7.65	22.5	21	0	15741	2.75	26	.019	<.01	<.02	<.01	<.02	.553
Deep	2.90	16.0	15	0	16111	1.56	13	.070	.068	.038	<.01	.038	1.700
9/19/77													
Shallow	7.35	20.0	10	0	14423	2.77	18	.052	.052	.114	.041	.177	.645
Deep	4.30	16.2	400	2	15385	1.73	23	.055	.061	.095	.016	.103	1.436

NEW YORK BIGHT

Station NYB21

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	3.90	12.4	3	0	15090	2.86	2	.035	.030	.045	.01K	.033	.303
Deep	3.90	9.9	9	0	15660	2.47	6	.026	.028	.025	.01K	.02K	.371
7/5/77													
Shallow	8.90	19.5	2	0	15400	4.45	6	.052	.025	.028	.01K	.026	.220
Deep	5.00	12.0	0	0	16200	1.30	22	.042	.039	.102	.01K	.026	.565
7/13/77													
Shallow	8.65	21.0	0	0	14167	3.26	23	.052	.022	<.02	<.01	<.02	.265
Deep	7.00	17.0	10	0	15000	1.53	7	.031	.024	.026	<.01	<.02	.345
7/19/77													
Shallow	9.70	23.0	65	1	15172	3.39	21	.065	.035	.023	<.01	.026	.729
Deep	4.40	13.5	3	0	16552	1.80	8	.047	.051	.083	<.01	.040	1.523
7/21/77													
Shallow	6.4	18.8	-	-	-	-	-	-	-	-	-	-	-
Deep	5.6	9.3	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	6.90	21.2	23	7	14651	-	-	.084	.073	.127	.016	.083	1.041
Deep	4.70	15.8	2	0	15581	-	-	.046	.042	.073	<.01	.025	1.356
8/9/77													
Shallow	11.80	24.5	2	0	14906	5.09	26	.091	.040	.022	.019	.048	.981
Deep	4.00	15.0	4	0	16226	1.26	10	.045	.045	.090	<.01	.029	1.404
8/16/77													
Shallow	7.90	22.5	12	0	15741	2.42	3	.017	.017	<.02	<.01	<.02	.595
Deep	3.05	14.1	26	0	16111	2.06	23	.076	.076	.031	<.01	.031	1.615
9/19/77													
Shallow	6.15	19.1	30	1	14423	2.64	22	.073	.074	.203	.029	.170	.869
Deep	3.40	14.5	500	3	15577	1.83	10	.053	.059	.045	.032	.163	1.677

NEW YORK BIGHT

Station NYB22

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.40	15.0	0	0	15660	1.83	6	.018	.014	.02K	.01K	.02K	.142
Deep	7.80	15.2	15	0	15660	2.50	7	.024	.021	.038	.01K	.02K	.223
7/5/77													
Shallow	10.75	19.0	0	0	15400	3.90	14	.037	.012	.02K	.01K	.02K	.173
Deep	5.75	13.0	1	0	16400	4.52	18	.032	.027	.083	.01K	.026	.471
7/13/77													
Shallow	8.50	21.5	3	0	14333	2.52	15	.038	.017	.020	<.01	<.02	.234
Deep	5.35	13.0	25	2	15333	3.59	14	.043	.040	.065	<.01	<.02	.427
7/19/77													
Shallow	8.45	24.0	1	0	15345	3.25	7	.038	.017	.030	<.01	.031	.512
Deep	4.53	14.0	8	1	16552	1.38	30	.044	.051	.089	<.01	.043	1.379
7/27/77													
Shallow	8.3	19.9	-	-	-	-	-	-	-	-	-	-	-
Deep	5.6	13.0	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	8.40	21.5	1	0	15116	-	-	.046	.017	<.02	<.01	<.02	.762
Deep	5.00	13.1	1	0	15814	-	-	.046	.039	.066	<.01	.032	1.391
8/9/77													
Shallow	10.65	24.0	9	0	15094	3.88	23	.062	.031	.028	.013	.035	.840
Deep	4.15	14.0	2	0	16226	1.75	19	.047	.050	.108	<.01	.042	1.616
8/16/77													
Shallow	7.85	21.0	3	0	15741	2.58	28	.017	<.01	<.02	<.01	<.02	.553
Deep	3.10	14.0	12	0	16111	1.85	22	.052	.054	.118	<.01	.031	1.615
9/19/77													
Shallow	6.80	19.8	132	13	14808	2.22	19	.057	.057	.139	.013	.129	.679
Deep	4.50	14.0	520	1	15385	1.67	28	.046	.052	.020	.026	.190	1.643

NEW YORK BIGHT

Station NYB23

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.60	14.5	2	0	15660	1.94	4	.021	.019	.02K	.01K	.02K	.169
Deep	6.60	8.0	27	0	16040	1.53	5	.026	.023	.032	.01K	.02K	.505
7/5/77													
Shallow	12.25	20.0	0	0	15500	4.32	7	.030	.012	.02K	.01K	.02K	.173
Deep	5.60	11.5	0	0	16400	1.62	20	.032	.032	.083	.01K	.039	.565
7/13/77													
Shallow	8.15	21.5	2	0	14500	2.37	13	.028	.015	.020	<.01	<.02	.220
Deep	4.50	13.8	11	0	15333	1.29	9	.057	.049	.065	<.01	<.02	.400
7/19/77													
Shallow	10.15	25.0	0	0	15517	3.08	9	.032	.011	.023	<.01	<.02	.512
Deep	4.05	12.0	2	0	16552	1.26	3	.047	.049	.116	<.01	.052	1.523
7/27/77													
Shallow	8.5	19.0	-	-	-	-	-	-	-	-	-	-	-
Deep	6.4	8.6	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	8.55	22.1	0	0	15116	-	-	.027	.010	<.021	<.01	<.02	.692
Deep	5.45	14.9	2	0	16847	-	-	.039	.035	.073	<.01	.038	1.356
8/9/77													
Shallow	11.00	24.0	0	0	15283	3.42	20	.055	.055	.022	<.01	<.02	.805
Deep	4.35	14.5	13	1	16226	1.07	5	.045	.045	.102	<.01	.042	1.581
8/16/77													
Shallow	7.80	22.6	7	0	15741	-	22	.014	.014	<.01	<.02	<.02	.553
Deep	3.40	14.1	5	0	16111	1.36	29	.047	.047	.057	.124	.050	1.530
9/19/77													
Shallow	9.00	19.0	18	0	15000	2.96	12	.051	.031	.02K	.010	.069	.439
Deep	4.10	13.3	680	0	15769	0.91	27	.046	.048	.02K	.016	.190	1.540

NEW YORK BIGHT

Station NYB24

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (^{o}C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^{-} (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.6	14.0	0	0	15470	3.99	12	.015	.010	.02	.01	.02	.209
Deep	8.6	13.8	1	0	15470	2.43	8	.032	.028	.02	.01	.02	.236
7/5/77													
Shallow	12.15	19.5	0	0	15700	4.80	10	.030	.014	.021	.01K	.02K	.141
Deep	5.90	13.0	43	0	16200	1.72	19	.035	.041	.059	.01K	.02K	.408
7/13/77													
Shallow	8.00	21.5	4	0	14667	2.22	17	.026	.013	.020	<.01	<.02	.207
Deep	4.10	12.0	12	0	15500	1.28	13	.061	.053	.090	<.01	<.02	.469
7/19/77													
Shallow	9.02	26.0	0	0	15345	2.92	16	.029	<.01	<.02	<.01	.023	.512
Deep	5.30	13.0	3	0	16552	1.44	7	.038	.035	.089	<.01	.052	1.343
7/27/77													
Shallow	8.4	19.6	-	-	-	-	-	-	-	-	-	-	-
Deep	7.1	8.3	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	8.05	22.5	0	0	15814	-	-	.031	.014	<.02	<.01	<.02	.657
Deep	6.10	16.0	0	0	15814	-	-	.031	.030	.060	<.01	.032	1.181
8/9/77													
Shallow	10.80	24.0	0	0	15283	4.33	26	.045	.019	.022	<.01	<.02	.734
Deep	4.65	13.0	0	0	16321	2.23	5	.050	.052	.133	<.01	.029	1.722
8/16/77													
Shallow	8.05	22.7	2	0	15741	3.12	5	.019	<.01	.020	<.01	<.02	.553
Deep	4.60	13.2	28	0	16204	1.42	12	.036	.044	.118	<.01	.069	1.403
9/19/77													
Shallow	9.45	19.7	46	0	15000	2.52	18	.043	.031	.02K	.01K	.056	.370
Deep	4.60	13.9	660	3	15962	1.08	10	.046	.050	.02K	.01K	.177	1.540

NEW YORK BIGHT

Station NYB25

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	8.65	14.3	132	7	15850	2.06	1	.018	.010	.02K	.01K	.02K	.249
Deep	8.70	14.2	100	4	15660	2.17	7	.024	.017	.02K	.01K	.02K	.263
7/5/77													
Shallow	12.15	19.0	0	0	15200	3.85	4	.025	.01K	.028	.01K	.02K	.314
Deep	5.55	13.5	9	0	16100	-	13	.032	.030	.059	.01K	.02K	.345
7/13/77													
Shallow	8.00	21.5	1	0	14833	2.01	3	.021	.013	.020	<.01	<.02	.207
Deep	5.80	12.9	3	1	15500	1.10	10	.040	.037	.058	<.01	<.02	.455
7/19/77													
Shallow	8.76	24.5	0	0	15000	2.86	7	.020	<.01	<.02	<.01	<.02	.440
Deep	4.45	13.5	40	1	16207	1.85	26	.053	.051	.076	<.01	.027	1.162
7/27/77													
Shallow	8.2	20.5	-	-	-	-	-	-	-	-	-	-	-
Deep	6.2	9.4	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.90	22.7	0	0	15349	-	-	.023	<.01	<.02	<.01	<.02	.657
Deep	4.65	16.4	1680	17	15581	-	-	.061	.051	.046	<.01	<.02	1.181
8/9/77													
Shallow	10.60	24.9	2	1	15472	3.44	14	.038	.012	.022	<.01	<.02	.664
Deep	3.00	22.0	1240	40	16226	12.34	31	.086	.075	.077	<.01	<.02	1.334
8/16/77													
Shallow	8.00	22.3	2	0	15926	2.42	17	.017	.017	.020	<.01	<.02	.510
Deep	7.70	22.0	2	0	15741	2.00	19	.019	.019	<.02	<.01	<.02	.553
9/19/77													
Shallow	9.20	20.0	45	0	15192	2.04	24	.038	.031	.02	.01K	.062	.473
Deep	4.10	14.5	620	2	15962	1.29	18	.046	.046	.035	.01K	.096	1.368

NEW YORK BIGHT

Station NYB26

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (^oC)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.80	13.8	0	0	15850	1.90	8	.015	.01K	.02K	.01K	.02K	.223
Deep	7.15	9.3	49	4	16230	1.75	5	.024	.023	.032	.01K	.02K	.438
7/5/77													
Shallow	12.30	19.0	0	0	15200	3.77	16	.030	.012	.021	.01K	.02K	.094
Deep	6.25	13.0	16	0	16100	2.50	18	.027	.023	.046	.01K	.02K	.314
7/13/77													
Shallow	7.80	21.0	7	0	15667	2.13	20	.017	.011	.020	<.01	<.02	.207
Deep	6.00	13.5	41	2	16167	1.32	19	.045	.040	.058	<.01	.021	.413
7/19/77													
Shallow	8.65	25.0	0	0	15517	3.19	2	.020	<.01	<.02	<.01	<.02	.440
Deep	5.46	15.0	9	0	16379	1.87	13	.044	.044	.083	<.01	.033	1.198
8/2/77													
Shallow	7.85	23.0	0	0	15349	-	-	.023	<.01	<.02	<.01	<.02	.587
Deep	5.05	17.1	33	1	16279	-	-	.042	.037	.060	<.01	.032	1.216
8/9/77													
Shallow	11.00	24.9	3	0	15472	2.80	26	.038	<.01	.022	<.01	<.02	.558
Deep	3.65	16.5	92	2	16038	1.06	7	.040	.038	.077	<.01	.023	1.263
8/16/77													
Shallow	6.90	23.2	21	3	15185	3.31	17	.087	.066	<.02	<.01	<.02	.595
Deep	4.00	16.0	22	1	15741	1.45	23	.052	.053	.066	<.01	.031	1.233
9/19/77													
Shallow	8.95	20.0	36	0	15577	-	3	.031	.020	.02K	.01K	.02K	.404
Deep	3.90	15.7	700	4	15962	1.27	22	.048	.052	.040	.01K	.089	1.402

NEW YORK BIGHT

Station NYB27

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.50	14.3	0	0	16230	1.59	-	.018	.010	.02	.01	.02	.330
Deep	No Sample Taken												
7/5/77													
Shallow	12.00	19.0	1	0	15200	4.10	15	.030	.014	.02K	.01K	.02K	.094
Deep	6.10	13.5	0	0	16100	6.95	18	.025	.018	.040	.01K	.02K	.345
7/13/77													
Shallow	7.55	21.0	16	0	15833	0.193	35	.021	.015	.020	<.01	<.02	.193
Deep	5.60	16.0	44	1	16333	0.386	20	.045	.040	.058	<.01	<.02	.386
7/19/77													
Shallow	8.46	25.0	20	3	15690	3.43	19	.029	.013	<.02	<.01	<.02	.476
Deep	5.79	13.0	0	0	16379	1.83	2	.032	.033	.063	<.01	.033	1.162
7/27/77													
Shallow	5.1	21.4	-	-	-	-	-	-	-	-	-	-	-
Middepth	5.1	16.4	-	-	-	-	-	-	-	-	-	-	-
Deep	5.1	16.8	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.85	23.1	2	0	16047	-	-	.023	<.01	<.02	<.01	<.02	.622
Deep	6.70	16.5	0	0	16279	-	-	.023	.017	.019	<.01	<.02	.832
8/9/77													
Shallow	10.00	24.9	3	0	15660	2.93	25	.030	<.01	.022	<.01	<.02	.593
Deep	4.45	14.5	0	0	16226	1.69	2	.045	.036	.077	<.01	.035	1.440
8/16/77													
Shallow	8.50	22.5	2	0	15370	2.54	11	.025	<.01	<.02	<.01	<.02	.533
Deep	4.00	15.2	12	1	15741	1.45	11	.039	.043	.053	<.01	.038	1.233

NEW YORK BIGHT

Station NYB27

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	6.80	22.0	6	0	15283	2.407	23	.025	.011	.02K	.01K	.02K	.617
Deep	5.55	18.0	18	0	15472	1.540	23	.035	.033	.043	.01K	.043	.872
9/19/77													
Shallow	9.05	20.2	192	0	15769	2.13	20	.023	.013	.02K	.01K	.02K	.439
Deep	4.05	16.0	1020	0	15962	1.32	10	.043	.047	.065	.01K	.056	1.402

NEW YORK BIGHT

Station NYB32

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.60	-	0	0	15660	3.80	8	.018	.010	<.02	<.01	<.02	.209
Deep	6.65	-	15	0	15850	-	7	.026	.026	<.02	<.01	<.02	.438
7/5/77													
Shallow	9.50	18.0	1	0	15660	3.88	7	.042	.021	.021	<.01	<.02	.204
Deep	6.85	14.5	148	12	15850	2.21	11	.030	.025	.040	<.01	<.02	.330
7/13/77													
Shallow	7.30	21.0	136	23	14333	2.84	10	.080	.058	.096	<.01	.087	.262
Deep	6.75	20.0	3	0	16000	1.94	21	.036	.026	.058	<.01	<.02	.345
7/19/77													
Shallow	8.56	22.0	4	0	15517	3.18	11	.053	.024	.023	<.01	.023	.693
Deep	5.19	17.0	1	0	16379	1.71	18	.038	.033	.063	<.01	.034	1.343
7/27/77													
Shallow	5.0	20.2	-	-	-	-	-	-	-	-	-	-	-
Middepth	5.1	15.4	-	-	-	-	-	-	-	-	-	-	-
Deep	5.1	14.8	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	5.70	21.0	92	4	13721	-	-	.102	.096	.201	.029	.128	1.076
Deep	6.05	18.7	21	1	14651	-	-	.058	.048	.080	<.01	.045	1.007
8/9/77													
Shallow	6.10	23.0	148	12	13962	3.18	40	.105	.094	.194	.031	.140	1.228
Deep	3.75	16.2	9	0	15472	2.24	2	.045	.047	.108	<.01	.029	1.334
8/16/77													
Shallow	5.50	24.0	400	21	15000	2.54	15	.080	.081	.189	.030	.106	.978
Deep	3.30	16.0	22	0	15741	2.28	28	.044	.052	.072	<.01	.025	1.318

NEW YORK BIGHT

Station NYB32

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	7.05	20.0	3	1	14811	2.842	6	.061	.044	.064	.01K	.088	.835
Deep	4.00	15.0	23	0	15660	1.101	7	.044	.046	.064	.01K	.063	1.236
9/19/77													
Shallow	6.50	19.5	660	96	15385	2.02	22	.060	.060	.203	.01K	.103	.748
Deep	4.25	16.3	460	5	15962	2.06	19	.048	.052	.090	.01K	.076	1.161

NEW YORK BIGHT

Station NYB33

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	8.70	-	0	0	15660	2.00	9	.015	.010	.02K	.01K	.02K	.169
Deep	-	-	0	0	16040	1.68	7	.029	.023	.038	.01K	.02K	.532
7/5/77													
Shallow	11.20	19.0	0	0	15500	3.07	9	.025	.012	.021	.01K	.02K	.157
Deep	5.55	14.0	6	0	16200	1.49	18	.032	.034	.065	.01K	.02K	.392
7/13/77													
Shallow	7.80	21.5	3	0	15667	2.22	18	.036	.022	.033	<.01	<.02	.262
Deep	7.60	17.0	0	0	16000	1.35	9	.026	.023	.033	<.01	<.02	.303
7/19/77													
Shallow	8.15	23.0	54	1	15000	4.14	4	.071	.040	.023	<.01	<.043	.765
Deep	5.68	14.5	27	0	16034	1.71	3	.041	.033	.056	<.01	<.034	1.198
7/27/77													
Shallow	6.4	6.4	-	-	-	-	-	-	-	-	-	-	-
Middepth	5.0	5.0	-	-	-	-	-	-	-	-	-	-	-
Deep	4.8	4.8	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.25	21.0	5	0	14419	-	-	.050	.037	.040	<.01	.038	.797
Deep	5.05	16.8	5	0	14884	-	-	.039	.033	.033	<.01	<.02	1.007
8/9/77													
Shallow	9.00	23.0	5	0	14528	3.09	18	.067	.040	.022	.019	.085	.911
Deep	3.56	16.8	3	1	15660	0.97	4	.045	.047	.090	<.01	.023	1.440
8/16/77													
Shallow	5.65	20.0	37	4	15370	2.13	22	.052	.049	.079	<.01	.038	.935
Deep	3.75	17.8	5	0	15741	3.40	28	.052	.053	.111	<.01	.056	1.360

NEW YORK BIGHT

Station NYB33

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	7.55	20.0	4	0	15000	2.56	26	.061	.039	.029	.01K	.081	.835
Deep	3.90	14.0	212	2	15849	2.13	24	.049	.052	.093	.01K	.075	1.491
9/19/77													
Shallow	7.75	19.0	80	5	15577	2.20	5	.043	.039	.080	.01K	.082	.473
Deep	3.50	14.1	840	3	16154	1.13	22	.046	.052	.045	.026	.163	1.712

NEW YORK BIGHT

Station NYB34

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.75	-	0	0	15850	1.88	11	.015	.010	.02K	.02K	.02K	.196
Deep	6.80	-	1	0	16040	1.81	8	.026	.023	.02K	.02K	.02K	.532
7/5/77													
Shallow	10.65	19.5	0	0	15500	3.72	16	.027	.012	.021	.01K	.02K	.157
Deep	7.05	13.5	0	0	16400	1.38	19	.020	.018	.059	.01K	.02K	.345
7/13/77													
Shallow	8.25	21.5	0	0	15833	3.83	27	.024	.013	.020	<.01	<.02	.220
Deep	5.25	18.5	2	0	16667	1.23	10	.043	.040	.084	<.01	<.02	.455
7/19/77													
Shallow	10.05	25.0	1	0	15690	2.71	13	.032	<.01	<.02	<.01	<.02	.549
Deep	4.95	13.0	0	0	17069	1.26	10	.041	.037	.070	<.01	.040	1.415
7/27/77													
Shallow	6.0	19.4	-	-	-	-	-	-	-	-	-	-	-
Deep	8.5	9.5	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.85	21.2	0	0	14651	-	-	.035	.019	<.02	<.01	<.02	.692
Deep	5.55	13.5	2	0	15349	-	-	.035	.028	.026	<.01	.025	1.076
8/9/77													
Shallow	7.20	23.0	17	0	14528	3.19	19	.071	.057	.090	.019	.085	.946
Deep	3.80	14.8	0	0	15660	1.52	20	.047	.050	.114	<.01	.035	1.510
8/16/77													
Shallow	7.00	22.0	21	1	15185	13.09	18	.048	.039	.033	<.01	.044	.765
Deep	4.00	17.0	14	0	15741	1.67	12	.048	.053	.124	<.01	.056	1.275

NEW YORK BIGHT

Station NYB34

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	7.50	20.0	2	0	14906	2.84	6	.065	.039	.032	.01K	.094	.835
Deep	3.70	12.5	16	1	15943	0.91	7	.044	.048	.086	.01K	.081	1.455
9/19/77													
Shallow	10.50	19.5	88	0	15769	2.88	13	.033	.022	.02K	.01K	.02K	.404
Deep	4.15	13.0	820	0	16346	0.96	15	.042	.048	.02K	.013	.163	1.609

NEW YORK BIGHT

Station NYB35

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.75	-	0	0	15850	2.95	8	.021	.012	.02K	.01K	.02K	.236
Deep	6.80	-	7	0	16040	1.68	6	.029	.023	.038	.01K	.02K	.546
7/5/77													
Shallow	11.20	19.5	0	0	15400	3.45	5	.025	.012	.015	.01K	.02K	.173
Deep	5.80	12.5	3	0	14600	1.51	11	.030	.032	.065	.01K	.020	.487
7/13/77													
Shallow	8.00	22.5	2	0	16000	2.26	2	.021	.013	.020	.01K	.02K	.220
Deep	5.50	13.0	27	2	16667	1.90	13	.054	.051	.058	.01K	.02K	.441
7/19/77													
Shallow	9.05	24.5	1	0	15517	2.87	3	.023	.01K	.02K	.01K	.02K	.512
Deep	4.60	13.0	8	0	16552	1.94	21	.053	.051	.033	.01K	.033	1.271
7/27/77													
Shallow	8.5	20.0	-	-	-	-	-	-	-	-	-	-	-
Deep	7.1	8.9	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.60	21.6	4	0	14651	-	-	.042	.042	.02K	.01K	.02K	.587
Deep	5.20	13.1	0	0	15349	-	-	.031	.031	.046	.01K	.025	1.041
8/9/77													
Shallow	8.60	23.2	4	0	14717	3.15	15	.059	.040	.034	.016	.072	.840
Deep	3.65	14.7	7	0	15849	1.56	4	.050	.050	.120	.01K	.029	1.510
8/16/77													
Shallow	7.70	22.8	18	1	15185	2.28	12	.040	.027	.02K	.01K	.02K	.680
Deep	3.95	13.8	60	1	15926	1.60	71	.139	.070	.044	.01K	.044	1.488

NEW YORK BIGHT

Station NYB35

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	7.15	20.0	4	0	15094	2.58	20	.049	.035	.029	.01K	.069	.908
Deep	4.75	13.0	40	0	15943	0.94	15	.054	.052	.071	.01K	.069	1.345
9/19/77													
Shallow	9.15	19.7	3	0	15577	2.32	22	.043	.028	.02K	.01K	.062	.439
Deep	5.05	16.9	460	0	15962	2.32	21	.033	.033	.040	.01K	.042	.886

NEW YORK BIGHT

Station NYB40

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.90	-	0	0	15850	2.14	3	.021	.012	.02K	.01K	.02K	.384
Deep	7.65	-	0	0	15850	1.78	12	.026	.017	.025	.01K	.02K	.451
7/5/77													
Shallow	12.10	20.0	0	0	15900	2.63	28	.025	.012	.021	.01K	.02K	.251
Deep	5.60	16.0	0	0	15900	5.42	39	.030	.027	.052	.01K	.02K	.502
7/13/77													
Shallow	7.50	22.0	5	0	16867	2.45	27	.028	.017	.033	.01K	.02K	.289
Deep	7.30	21.0	0	0	16333	7.78	51	.026	.017	.039	.01K	.02K	.303
7/19/77													
Shallow	8.55	24.0	1	0	16034	2.56	8	.020	.01K	.02K	.01K	.02K	.621
Deep	4.61	17.0	1	0	16207	1.86	4	.038	.035	.036	.01K	.02K	1.343
8/2/77													
Shallow	7.35	22.0	6	0	14651	-	-	.039	.019	.02K	.01K	.02K	.762
Deep	4.55	17.2	1	0	15116	-	-	.039	.033	.026	.01K	.02K	1.041
8/9/77													
Shallow	7.45	21.8	9	2	15472	2.47	9	.026	.01K	.02K	.01K	.02K	.629
Deep	4.35	17.6	1	3	15660	2.88	1	.043	.038	.096	.01K	.035	1.263
8/16/77													
Shallow	8.05	21.0	3	0	15370	1.84	21	.030	.016	.02K	.01K	.02K	.553
Deep	4.60	17.8	1	0	15741	1.96	23	.041	.041	.02K	.01K	.02K	.808
8/30/77													
Shallow	8.40	22.0	0	0	15755	3.49	29	.042	.01K	.02K	.01K	.02K	.544
Deep	4.05	18.0	3	0	16226	2.02	63	.058	.039	.057	.01K	.063	1.163

NEW YORK BIGHT

Station NYB40

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	9.85	21.2	0	0	15769	2.74	13	.028	.015	.02K	.01K	.02K	.335
Deep	4.75	19.0	1160	0	15769	1.66	19	.051	.048	.090	.01K	.060	.783

NEW YORK BIGHT

Station NYB41

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	8.85	-	0	0	16040	2.97	11	.012	.01	.02	.01	.02	.330
Deep	8.70	-	0	0	16040	2.21	3	.018	.014	.02	.01	.02	.398
7/5/77													
Shallow	5.45	19.5	0	0	15500	2.95	10	.020	.01	.02	.02	.01	.188
Deep	9.90	14.5	0	0	16100	1.45	23	.030	.025	.046	.02	.01	.455
7/13/77													
Shallow	7.75	-	1	0	16333	1.94	30	.017	.011	.02K	.02K	.01K	.248
Deep	4.20	-	1	0	16500	1.65	23	.050	.044	.096	.021	.01K	.634
7/19/77													
Shallow	8.69	24.5	0	0	15862	2.69	13	.017	.01K	.023	.01K	.02K	.476
Deep	5.80	15.0	1	0	16379	1.59	3	.031	.031	.043	.01K	.02K	1.162
8/2/77													
Shallow	7.75	22.1	1	0	14651	-	-	.035	.012	.02K	.01K	.02K	.692
Deep	5.40	18.0	0	0	15116	-	-	.031	.023	.02K	.01K	.02K	.902
8/9/77													
Shallow	8.00	22.0	0	0	15283	10.55	20	.043	.026	.028	.010	.048	.734
Deep	3.35	16.0	1	0	15660	3.37	8	.040	.040	.071	.01K	.029	1.369
8/16/77													
Shallow	8.35	21.0	4	0	15370	3.24	12	.041	.024	.02K	.01K	.02K	.638
Deep	3.65	16.0	6	0	15926	1.09	11	.041	.047	.046	.01K	.025	1.190
8/30/77													
Shallow	9.05	23.0	0	0	15472	3.06	20	.039	.018	.02K	.01K	.02K	.544
Deep	3.85	18.0	9	0	16226	1.07	23	.044	.044	.071	.01K	.069	1.382

NEW YORK BIGHT

Station NYB41

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	10.25	21.0	1	0	15769	2.42	18	.026	.025	.02K	.01K	.023	.301
Deep	3.40	16.0	1840	0	16346	1.33	3	.053	.052	.050	.026	.156	1.574

NEW YORK BIGHT

Station NYB42

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.70	-	0	0	15850	1.58	9	.012	.01K	.02K	.01K	.02K	.33
Deep	7.40	-	0	0	16230	1.72	5	.021	.021	.032	.01K	.02K	.424
7/5/77													
Shallow	9.90	20.0	0	0	15500	3.30	12	.022	.01K	.02K	.01K	.02K	.141
Deep	7.85	16.0	0	0	16100	1.97	20	.020	.01K	.02K	.01K	.02K	.235
7/13/77													
Shallow	7.80	21.0	11	1	16167	1.85	25	.019	.011	.020	.01K	.02K	.234
Deep	5.55	15.0	0	0	16667	1.58	43	.052	.042	.065	.01K	.02K	.551
7/19/77													
Shallow	8.68	24.8	0	0	16034	2.49	21	.017	.01K	.023	.01K	.02K	.440
Deep	5.20	13.0	1	0	16724	1.97	29	.038	.042	.089	.01K	.039	1.307
8/2/77													
Shallow	8.45	21.0	0	0	14884	-	-	.027	.01K	.02K	.01K	.02K	.587
Deep	5.70	15.5	0	0	15349	-	-	.027	.021	.02K	.01K	.02K	.937
8/9/77													
Shallow	8.45	22.8	1	0	14906	2.87	12	.050	.036	.022	.016	.072	.875
Deep	3.65	15.5	3	1	16038	1.23	13	.047	.050	.102	.01K	.029	1.440
8/16/77													
Shallow	8.00	22.0	15	0	15556	2.42	18	.025	.014	.02K	.01K	.02K	.595
Deep	3.65	15.0	3	0	15926	1.43	26	.048	.057	.085	.01K	.025	1.360
8/30/77													
Shallow	8.30	22.0	0	0	15283	3.53	19	.061	.035	.02K	.01K	.075	.835
Deep	4.35	14.8	22	0	16226	1.01	16	.044	.046	.086	.01K	.069	1.455

NEW YORK BIGHT

Station NYB42

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	10.25	20.9	20	0	15962	2.43	45	.022	.039	.02K	.01K	.023	.301
Deep	4.05	14.0	1080	2	16346	1.23	29	.042	.046	.02K	.019	.163	1.402

NEW YORK BIGHT

Station NYB43

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	8.75	-	0	0	16040	1.72	15	.018	.012	.02K	.01K	.02K	.317
Deep	7.50	-	0	0	16230	1.41	10	.018	.017	.025	.01K	.02K	.384
7/5/77													
Shallow	10.60	19.5	0	0	15500	3.33	34	.022	.012	.021	.01K	.02K	.157
Deep	5.55	14.0	6	0	16200	2.75	23	.072	.061	.164	.01K	.02K	.487
7/13/77													
Shallow	7.80	22.0	76	0	16167	4.34	26	.019	.011	.020	.01K	.02K	.234
Deep	5.15	15.0	4	1	16667	1.29	38	.045	.040	.077	.01K	.021	.551
7/19/77													
Shallow	8.50	25.0	0	0	15862	2.49	13	.017	.01K	.02K	.01K	.02K	.440
Deep	4.38	12.5	18	1	16552	2.34	8	.047	.053	.103	.01K	.033	1.235
8/2/77													
Shallow	7.65	22.0	0	0	14884	-	-	.019	.01K	.02K	.01K	.02K	.587
Deep	5.75	15.8	3	0	15581	-	-	.042	.030	.033	.01K	.02K	1.076
8/9/77													
Shallow	9.30	23.0	0	0	14906	9.85	29	.057	.036	.02K	.016	.054	.840
Deep	4.15	16.5	4	0	16038	1.71	10	.043	.045	.102	.01K	.029	1.404
8/16/77													
Shallow	7.20	20.5	14	1	15370	7.64	29	.054	.042	.027	.01K	.056	.808
Deep	3.90	13.9	21	2	15926	0.83	83	.041	.049	.079	.01K	.038	1.360
8/30/77													
Shallow	8.30	21.0	6	0	15283	2.90	17	.061	.046	.036	.01K	.100	.908
Deep	5.70	16.0	7	0	15849	1.66	18	.037	.028	.036	.01K	.031	.945

NEW YORK BIGHT

Station NYB43

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	10.50	21.0	2	0	15962	2.02	7	.023	.022	.02K	.01K	.02K	.335
Deep	3.85	13.6	900	1	16346	-	27	.046	.050	.02	.019	.171	1.574

NEW YORK BIGHT

Station NYB44

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.70	-	0	0	16040	2.26	12	.018	.012	.02K	.01K	.02K	.303
Deep	8.80	13.8	0	0	16040	2.45	4	.021	.014	.02K	.01K	.02K	.317
7/5/77													
Shallow	11.80	19.5	0	0	15400	4.16	20	.030	.014	.02K	.01K	.02K	.157
Deep	6.55	13.0	3	0	16200	1.46	26	.025	.021	.028	.01K	.02K	.314
7/13/77													
Shallow	7.75	22.5	28	0	16167	2.43	29	.021	.021	.020	.01K	.02K	.220
Deep	4.65	14.5	80	9	16667	1.35	26	.057	.057	.052	.01K	.02K	.441
7/19/77													
Shallow	9.00	25.0	0	0	15862	3.66	16	.023	.01K	.02K	.01K	.02K	.440
Deep	3.88	13.0	15	0	16897	1.62	19	.056	.060	.076	.01K	.027	1.198
8/2/77													
Shallow	7.50	22.1	1020	420	14884	-	-	.243	.217	.140	.01K	.02K	.622
Deep	6.25	15.1	53	11	15349	-	-	.035	.028	.033	.01K	.02K	.832
8/9/77													
Shallow	9.15	23.5	1	0	15904	3.44	23	.052	.031	.02K	.013	.048	.805
Deep	3.45	14.8	17	0	16038	1.62	12	.050	.052	.102	.01K	.02K	1.369
8/16/77													
Shallow	6.40	20.5	30	2	15278	-	11	.063	.053	.072	.01K	.056	.893
Deep	4.25	13.0	22	2	16111	2.16	16	.043	.047	.079	.01K	.044	1.403
8/30/77													
Shallow	7.45	23.0	0	0	15849	1.56	16	.023	.01K	.02K	.01K	.02K	.617
Deep	4.00	16.0	54	0	16226	0.74	22	.044	.01K	.071	.01K	.075	1.345

NEW YORK BIGHT

Station NYB44

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	10.15	21.0	2	0	15769	1.91	21	.030	.022	.02K	.01K	.023	.370
Deep	3.70	14.0	1080	3	16346	1.02	7	.053	.061	.050	.019	.163	1.471

NEW YORK BIGHT

Station NYB45

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.85	8.9	0	0	16040	1.91	14	.012	.01K	.02K	.01K	.02K	.236
Deep	7.30	-	0	0	16420	2.91	10	.024	.021	.025	.01K	.02K	.438
7/5/77													
Shallow	12.30	19.0	0	0	15400	4.64	20	.037	.014	.02K	.01K	.02K	.141
Deep	5.60	14.0	28	0	16400	4.44	20	.040	.041	.040	.01K	.02K	.377
7/13/77													
Shallow	7.75	21.5	10	1	16167	2.20	26	.021	.013	.02K	.01K	.02K	.234
Deep	5.40	14.0	8	0	16667	5.75	25	.047	.040	.052	.01K	.02K	.455
7/19/77													
Shallow	8.95	24.5	0	0	15862	3.24	22	.023	.01K	.02K	.01K	.02K	.440
Deep	3.80	13.0	29	2	16724	1.91	3	.050	.053	.083	.01K	.027	1.090
7/27/77													
Shallow	9.0	20.4	-	-	-	-	-	-	-	-	-	-	-
Deep	7.7	9.6	-	-	-	-	-	-	-	-	-	-	-
8/2/77													
Shallow	7.80	21.8	2	0	14884	-	-	.023	.010	.02K	.01K	.02K	.552
Deep	7.50	15.3	16	1	15116	-	-	.023	.01K	.02K	.01K	.02K	.552
8/9/77													
Shallow	9.30	23.2	0	0	15094	3.37	17	.043	.022	.02K	.01K	.02K	.734
Deep	3.00	14.8	136	1	16038	1.72	21	.067	.068	.083	.01K	.02K	1.299
8/16/77													
Shallow	7.00	21.8	18	1	15370	3.25	15	.063	.051	.072	.01K	.059	.850
Deep	3.50	15.8	16	2	16111	3.16	42	.055	.060	.085	.01K	.050	1.360

NEW YORK BIGHT

Station NYB45

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
8/30/77													
Shallow	6.50	22.0	14	0	15283	2.02	8	.020	.020	.02K	.01K	.02K	.653
Deep	4.15	13.0	204	17	15660	1.30	23	.042	.048	.071	.01K	.038	1.200
9/19/77													
Shallow	9.90	20.9	84	0	15769	2.06	28	.033	.023	.02K	.01K	.045	.370
Deep	3.70	14.7	480	9	16346	0.99	22	.055	.059	.045	.013	.126	1.402

NEW YORK BIGHT

Station NYB46

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
6/7/77													
Shallow	8.70	14.0	1	0	16230	5.85	8	.012	.010	.02K	.01K	.02K	.223
Deep	7.10	8.5	1	0	16230	1.37	8	.024	.021	.045	.01K	.02K	.519
7/5/77													
Shallow	-	19.0	0	0	15400	5.73	5	.050	.016	.02K	.01K	.02K	.173
Deep	-	14.0	3	0	16600	1.17	4	.027	.025	.065	.01K	.02K	.549
7/13/77													
Shallow	7.90	22.0	9	0	16333	2.76	12	.019	.011	.020	.01K	.02K	.220
Deep	6.05	14.0	2	0	16833	1.34	17	.038	.033	.058	.01K	.021	.455
7/19/77													
Shallow	8.07	25.0	0	0	16207	2.46	8	.014	.01K	.02K	.01K	.02K	.404
Deep	5.14	14.0	1	0	16897	1.53	6	.029	.033	.070	.01K	.033	1.126
8/2/77													
Shallow	8.55	21.0	0	0	14884	-	-	.039	.017	.02K	.01K	.02K	.727
Deep	5.75	16.1	0	0	15581	-	-	.039	.030	.046	.01K	.032	1.146
8/9/77													
Shallow	8.70	24.0	0	0	15472	5.17	35	.026	.01K	.02K	.01K	.02K	.588
Deep	4.65	14.8	0	0	16038	1.42	18	.040	.036	.083	.01K	.048	1.404
8/16/77													
Shallow	7.80	22.5	5	0	15833	3.59	13	.018	.01K	.02K	.01K	.02K	.553
Deep	5.00	16.5	16	0	16111	1.18	55	.176	.057	.059	.01K	.038	1.233
8/30/77													
Shallow	6.80	22.0	0	0	15755	1.81	14	.020	.01K	.02K	.01K	.02K	.617
Deep	5.05	15.0	8	0	15899	0.86	45	.032	.037	.050	.01K	.050	1.054

NEW YORK BIGHT

Station NYB46

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (^oC)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	7.65	20.9	1	0	16154	1.52	20	.023	.014	.02K	.01K	.023	.370
Deep	4.15	15.1	560	0	16346	1.01	27	.046	.047	.070	.01K	.082	1.402

NEW YORK BIGHT

Station NYB47

Date Sampled	Dissolved Oxygen (mg/1)	Temperature (°C)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/1)	TOC (mg/1)	TSS (mg/1)	Total-P (mg/1)	Total PO_4-P (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)	SiO_2 (mg/1)
6/7/77													
Shallow	8.75	-	0	0	16040	1.59	9	.012	.010	.02K	.01K	.02K	.209
Deep	7.40	-	0	0	16600	1.53	9	.026	.023	.051	.01K	.02K	.586
7/5/77													
Shallow	11.60	19.5	1	0	15500	3.75	3	.032	.014	.02K	.01K	.02K	.204
Deep	6.70	13.0	0	0	16600	1.54	20	.027	.023	.071	.01K	.02K	.455
7/13/77													
Shallow	7.85	22.0	1	0	16333	2.22	19	.021	.011	.020	.01K	.02K	.193
Deep	6.00	14.0	2	0	17000	1.90	18	.036	.033	.058	.01K	.021	.441
7/19/77													
Shallow	7.96	24.5	0	0	16207	2.53	12	.014	.01K	.02K	.01K	.02K	.404
Deep	5.85	14.0	0	0	16897	4.80	15	.029	.031	.066	.01K	.033	1.126
8/2/77													
Shallow	8.35	21.0	1	0	14884	-	-	.042	.019	.02K	.01K	.02K	.727
Deep	6.25	14.5	0	0	15581	-	-	.035	.028	.060	.01K	.038	1.111
8/9/77													
Shallow	7.75	24.0	0	0	15660	2.01	8	.016	.01K	.02K	.01K	.02K	.488
Deep	4.05	14.8	0	0	16038	1.34	14	.035	.031	.065	.01K	.042	1.299
8/16/77													
Shallow	7.90	22.5	2	0	15926	2.61	6	.017	.01K	.02K	.01K	.02K	.595
Deep	4.20	14.0	5	0	16204	1.07	41	.043	.047	.066	.01K	.50	1.445
8/30/77													
Shallow	7.30	22.0	0	0	15660	2.07	6	.023	.01K	.021	.01K	.02K	.617
Deep	4.70	14.0	5	0	16038	1.30	18	.037	.044	.057	.01K	.063	1.200

NEW YORK BIGHT

Station NYB47

Date Sampled	Dissolved Oxygen (mg/l)	Temperature (^oC)	Total Coliform (MF/100 ml)	Fecal Coliform (MF/100 ml)	Cl^- (mg/l)	TOC (mg/l)	TSS (mg/l)	Total-P (mg/l)	Total PO_4-P (mg/l)	NH_3-N (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	SiO_2 (mg/l)
9/19/77													
Shallow	8.25	21.1	0	0	16154	1.48	23	.021	.013	.02K	.01K	.023	.404
Deep	4.15	15.2	520	0	16346	0.87	27	.046	.045	.065	.01K	.089	1.436

APPENDIX E

Phytoplankton Blooms in New Jersey Coastal Waters--Summer 1977

PHYTOPLANKTON BLOOMS
IN
NEW JERSEY COASTAL WATERS

by

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PHYTOPLANKTON BLOOMS IN
NEW JERSEY COASTAL WATERS

January 1978

INTRODUCTION

Red tide is a common term for a discoloration of natural waters caused by a localized superabundance of microscopic organisms. Most microorganism-caused water discolorations are caused by photosynthetic species although bacteria and zooplankters can also produce discoloration.

There is little doubt that the abundance and seasonal distribution of phytoplankton are related to temperature, light intensity, salinity, nutrients (macro and micro), and the hydrological and meterological conditions prevailing in a particular area (i.e. warm, sunny, calm weather and calm seas usually promotes bloom development). Many bodies of water are sufficiently rich in the essential nutrients that these nutrients do not serve as limiting factors in determining the abundance of algae. Mahoney et al. (1976) reports there is evidence that throughout the year and during the summer, the Raritan-Lower Hudson estuary is "nutrient saturated". Other factors such as high temperatures, high light intensities, turbidity, grazing, a stable water column, wind and wave action are involved in creating optimum conditions for phytoplankton growth. The mechanisms involved in triggering blooms remain obscure.

The initiation of a bloom appears to be largely a matter of biological conditioning of sea water which favors an exponential growth of a phytoplankton species and involves primarily biological and chemical factors. The continuation of a bloom is largely influenced by physical factors (i.e., light intensity, temperature, salinity, etc.). Phytoplankton blooms are associated with conditions of low salinity and high organic enrichment. Both these conditions prevail in coastal waters particularly in areas of river discharge and/or after heavy rain-fall. Individual algae vary in their nutrient requirements and this variation, superimposed on physical factors accounts for the phenomenon of phytoplankton succession, i.e. one dominant species following another at a given place in a given season with some degree of regularity.

In the New York - New Jersey metropolitan area, ever increasing amounts of trace metals, plant nutrients, organic compounds, and synthetic materials are entering the Raritan-Hudson River estuary. These activities profoundly affect the species composition and production of plankton in the area. Mahoney et al. (1976) reports phytoplankton primary productivity within the Raritan, Lower, and Sandy Hook Bays to be the highest recorded for any estuary in the world. Development of a phytoplankton bloom is both a product as well as a process of the general eutrophication of the coastal ecosystem.

Phytoplankton blooms have been responsible for a number of harmful effects. In New England and Canadian waters, a dinoflagellate Gonyaulax tamarensis has been responsible for toxic blooms. When molluscs (blue mussel, soft clam, surf clam, etc.) filter large numbers of these organisms from the water, they accumulate a paralyzing poison in their tissues. When animals higher in the food chain such as man, eat molluscs, they suffer sever symptoms, even death. In 1972, a bloom of G. tamarensis in Massachusetts resulted in the illness of thirty-three people and the death of over 2,000 waterfowl. Toxic blooms have resulted in banning the harvesting and sale of edible molluscs in Canadian and New England waters, resulting in large economic losses for the seafood industry. Fortunately, the toxic organism of the Canadian and New England red tides has not yet been found in New York and New Jersey waters.

Fish and other marine organisms may die of suffocation when the oxygen in the water is depleted during a bloom. Oxygen depletion can result from the metabolic requirements of the living organisms or from the death and decay of the organisms after a bloom has peaked. The fish and invertebrate kill in the spring of 1976 (June) caused by a bloom of Ceratium tripos off the New Jersey coast, is a good example of how disastrous the effects can be. Three previous fish kills (1968, 1973, 1974) of this nature have been reported in this area within the last eight years but only the first (1968) was as extensive as the 1976 fish kill. Reports of these kills have indicated a strong similarity to the 1976 kill but the role of a phytoplankton bloom as the causative agent was not investigated.

Phytoplankton blooms can also cause eye irritation, sore throats, respiratory and intestinal disorders for bathers and sometimes for people who are just near the water.

Mahoney et. al. (1976) reports the annual cycle of phytoplankton productivity in Raritan, Lower, and Sandy Hook Bays to be characterized by low winter productivity, a spring bloom and summer maximum followed by a rapid decline in productivity during the fall. The spring bloom (March) is dominated principally by the diatoms, Skeletonoma costatum. Rhizosolenia delicatula and Asterionella japonica. The summer bloom is dominated principally by phytoflagellates and nannoplankton (organisms smaller than 20 microns) until autumn when the diatoms once again prevail.

Scientists at the Sandy Hook Marine Laboratory have investigated the annual occurrence of phytoplankton blooms in the Raritan-Lower Hudson estuary from 1962 to 1976. Mahoney et.al. (1976) reports that three species, Olisthodiscus luteus, Massartia rotundata, and Prorocentrum micans dominated most of the bloom occurrences. The phytoflagellate blooms occurred during the warmer months, from the middle of June to the end of September. The order of bloom dominance frequency was O. luteus followed by M. rotundata and P. micans. In New York Harbor waters, the greatest bloom incidence was in Sandy Hook Bay and in the tidal Navesink and Shrewsbury Rivers. In the ocean, the most frequent bloom occurrences were between the tip of Sandy Hook and Belmar, New Jersey; but on several occasions, blooms have extended much further south.

The pattern of bloom development (Mahoney et.al. 1976) is initiated in the Bay area where it spreads to the coastal area several days later. In other cases, blooms develop in the tidal rivers and then flow out to both the bay and ocean. In the bays, dispersion of a bloom is usually uniform. In the ocean, dispersion varies from isolated patches to continuous but irregularly dense bands along shore. At times, blooms may impinge on the beaches and at other times, they lay some distance offshore. The impingement of a bloom on a beach is largely a function of the tide. Wind influences distribution to a lesser degree except during storms; storms and heavy seas generally disperse blooms.

The impact of algal blooms in the New York Harbor and adjacent waters is the loss of aesthetic appeal and loss of water quality for recreational use. This condition has caused large economic losses for communities. Mahoney et.al. (1976) reported a major bloom in 1968 that caused massive reductions in seafood consumption and tourism, resulting in a 1.1 million dollar loss to Monmouth County, New Jersey alone. The fish kill caused by a bloom of Ceratium tripos in 1976 caused a large economic loss to the state fishing industry. Dr. Glenn Paulson, NJDEP, estimated the 1976 fish kill cost the state fishing industry approximately $26 million.

The impact of the algal blooms has aroused much regional interest. The communications media (newspapers, radio and television) has created significant public awareness for algal blooms. However, the general severity of the blooms has not been comparable to that of blooms of highly toxic species in other locales (i.e. Canada, New England, Florida).

SUMMARY:

The phytoplankton bloom season of 1977 essentially followed the same sequence as reported by Mahoney et.al (1976). The blooms started in the middle of June and diminished in the middle of September. The order of bloom dominance was Olisthodiscus luteus, Massartia rotundata, nannoplankton (Nannochoris atomus). Prorcentrum micans was present but never in densities that would be considered of bloom proportions.

CHRONOLOGY

The Sandy Hook Marine Laboratory has investigated the annual occurrence of algal blooms since 1962. Under the direction of Dr. John Mahoney, they have continued this surveillance until 1977. In 1974, the New Jersey Department of Environmental Protection in cooperation with the Sandy Hook Marine Laboratory initiated a monitoring program involving analysis and taxonomy of phytoplankton cycles in the Sandy Hook area. Intensive sampling and analysis for this program has been conducted by Paul Olson (NJDEP). In 1977, funding problems and a change in the directorship of the Sandy Hook Marine Laboratory resulted in a change in the role that the laboratory will play in phtyoplankton surveillance. The involvement of Dr. Mahoney and Myra Cohen will be very limited. During the summer of 1977, the U.S. Environmental Protection Agency in cooperation with the New Jersey Department of Environmental Protection became involved in the surveillance of phytoplankton blooms. The following is a chronology of surveillance activities carried out by the USEPA and the NJDEP during the summer of 1977.

January 4 to January 5, 1977

Water samples were collected at seven stations in the New York Bight. They were: NYB21, 23, 26, 42, 44, 47, 33. See attached map.

The data indicates that Skeletonema costatum, a marine diatom, was the dominant phytoplankton species at all seven stations. It comprised 86 to 96% of total phytoplankton numbers.

March 28, 1977

A single water sample was collected at a station in the New York Bight NYB 34A. Three species of phytoplankton were found.

Skeletonema costatum was the dominant phytoplankton species at this station comprising 85% of the population.

April 25, 1977

A single water sample was collected at a station off Long Island, New York LIC-03. Four species of phytoplankton were found.

Skeletonema costatum was the dominant phytoplankton species at this station comprising 78% of the total numbers.

May 2, 1977

A single water sample was collected at a station off Long Island, New York LIC-02. Three species of phytoplankton were found.

Skeletonema costatum was the dominant phytoplankton species comprising 58% of the population. Thalassiosira gravida was the sub dominant species comprising 38% of total phytoplankton cell density.

Friday, May 27, 1977

A scum line 100 feet off shore, 300-400 feet wide and 5 miles long was reported off Ship Bottom, New Jersey by Richard Dewling of the USEPA. A single sample was taken. Analysis of the sample indicated a large quantity of decomposing filamentous algae.

June 4, 1977

A water sample was collected at Deal, New Jersey. Analysis of the sample did not indicate the presence of bloom concentration. The dominant and sub dominant species were marine diatoms.

June 9, 1977

Twelve water samples were collected in the New York Bight. Analysis of the samples indicated normal phytoplankton populations.

Monday, June 13, 1977

The USEPA sampling crew reported blooms off Manasquan Inlet, New Jersey and Seaside Heights, New Jersey. Two water samples were collected. Analysis of the samples indicated a moderate bloom of Olisthodiscus luteus (25,000 - 30,000 cells/ml)

Tuesday, June 14, 1977

The NJDEP sampled their 12 routine beach stations. Analysis of the samples indicated that Olisthodiscus luteus was present in low concentrations (not a bloom condition).

The USEPA helicopter sampling crew collected two water samples; one off Manasquan Inlet and the other off Point Pleasant. Analysis of the samples indicated a very minor bloom of Olisthodiscus luteus (1,000 - 2,000 cells/ml).

Wednesday, June 15, 1977'

The USEPA helicopter surveyed the coast of New Jersey. There was no indication of a phytoplankton bloom reported by the helicopter crew.

Frank Takacs of the New Jersey Department of Environmental Protection reported that the Mayor of Point Pleasant Beach, New Jersey, reported brownish-reddish water along the beach. No sample was taken.

Thursday, June 16, 1977

The USEPA helicopter crew reported a bloom extending from Sandy Hook to Manasquan Inlet (approximately 30 miles long and 7 to 8 miles wide). Two samples were collected. Analysis of the samples indicated a bloom of Olisthodiscus luteus (40,000 -57,000 cells/ml).

The NJDEP Shellfish Control Unit collected three samples (Two samples .one mile out from Manasquan Inlet and one sample from the Manasquan River). Analysis of the samples indicated a bloom of Olisthodiscus luteus in the 2 ocean samples (73,000 - 84,000 cells/ml) and a bloom of mixed organisms. In the other sample, O. lutues was present but not dominant.

Friday, June 17, 1977

The USEPA helicopter sampling crew collected two water samples off the New Jersey coast. The first was collected four nautical miles south of the tip of Sandy Hook. The second was collected between Asbury Park and Long Branch, New Jersey. Analysis of the samples indicated a moderate bloom of Olisthodiscus luteus.

A reported fish kill in the Raritan River behind the Raritan Center was investigated. There were many dead Atlantic Menhaden in the water. This die-off was attributed to naturally occurring conditions which happens every year.

Saturday, June 18, 1977

The USEPA helicopter sampling crew collected a water sample off Princess Cove, Staten Island, New York. Analysis of the sample indicated a heavy bloom of Olisthodiscus luteus (120,000 cells/ml).

Sunday, June 19, 1977

Mike Talpas of the NJDEP reported red-brown water in Raritan Bay and from Sandy Hook to the western end of Long Branch. From the southern end of Long Branch to Toms River the water was clear.

Monday, June 20, 1977

Barbara Kurtz of the NJDEP collected 12 samples from the NJDEP routine beach stations. She reported dark red-brown water off Earle Pier. All coastal stations were clear.

Tuesday, June 21, 1977

The USEPA helicopter sampling crew reported there was no indication of a phytoplankton bloom in Raritan Bay or from Sandy Hook to Long Branch. No samples were taken.

Wednesday, June 22, 1977

Dr. John Mahoney of the Sandy Hook Marine Laboratory reported a bloom in Raritan Bay. Olisthodiscus luteus was the dominant bloom organism.

Dr. John Pearce, NOAA, Sandy Hook Marine Laboratory notified Frank Takacs of the NJDEP of a reported bloom of Ceratium tripos 50 miles off Long Island, New York.

Thursday, June 23, 1977

Dr. John Mahoney of the Sandy Hook Marine Laboratory reported a bloom from the Ocean Dumping grounds to the Rockaways, Long Island. Olisthodiscus luteus was the dominant species. Dr. Mahoney also reported a bloom of Olisthodiscus luteus in Sandy Hook Bay.

Monday, June 27, 1977

The NJDEP sampled the 12 routine beach stations and sampled seven ocean stations by boat. Analysis of the samples indicated no blooms were present at the 19 stations. Olisthodiscus luteus and chlorophytes were present but in low numbers.

Tuesday, June 28, 1977

Frank Takacs of the NJDEP reported tar balls washing up on the beach at Monmouth Beach. The USEPA helicopter investigated the shore area along Monmouth Beach and two miles off the beach. Only one tar ball was found. There was no water discoloration in the area.

Wednesday, June 29, 1977

Frank Takacs of the NJDEP was notified by Ed Inman, New Jersey Department of Water Resources, of black water in the surf line at Beach Haven, New Jersey. An investigation by the NJDEP indicated no black water. Three water samples were collected. Analysis of the samples indicated normal plankton populations but a great deal of debris and detritus.

Thursday, June 30, 1977

The USEPA helicopter investigated the black water situation at Beach Haven, New Jersey. There was no indication of black water in the area.

Frank Takacs of the NJDEP reported thousands of green worms invading Normandy Beach, Avon and Belmar, New Jersey. Samples were collected by the NJDEP. The worm samples were identified by Dr. Royal Nadeau, USEPA, as being the polychaete worm Scolelepsis squamata. This was the same worm whose fecal pellets washed up on New Jersey beaches the previous summer (1976)

Friday, July 1, 1977

The USEPA helicopter sampling crew reported no water discoloration observed in their flight over Long Island, New York.

Barbara Kurtz of the NJDEP reported clear water from Shark River to Sandy Hook. Three samples were collected (Avon, North Beach, and Earle Pier). Analysis of the samples indicated a few nannoplankton and diatoms at North Beach and Earle Pier and sparse numbers of *Prorocentrum minimum* and *Massartia rotundata* at Avon.

Saturday, July 2, 1977

The USEPA helicopter sampling crew reported no water discoloration along Long Island, New York shore, in the New York Bight, or along the New Jersey shore.

Tuesday, July 5, 1977

The USEPA helicopter sampling crew reported no water discoloration along the Long Island, New York shore, in the New York Bight, or along the New Jersey shore.

Wednesday, July 6, 1977

No reported water discoloration by the NJDEP or USEPA.

Thursday, July 7, 1977

No reported water discoloration by the USEPA helicopter. Frank Takacs of the NJDEP was notified of a possible bloom 3½ miles off Atlantic City, approximately ½ mile long and 100 yards wide. No samples were taken.

Friday, July 8, 1977

Frank Takacs of the NJDEP was notified of a possible bloom at Pier 7, Atlantic City Marina. The USEPA helicopter investigated the bloom. The investigation revealed the discoloration was due to red paint. The ocean was clear along the entire flight to Atlantic City.

Saturday, July 9, 1977

The USEPA sampling crew reported a bloom in Sandy Hook Bay one half mile off Earle Pier. Two samples were taken. Analysis of the samples revealed a bloom of Olisthodiscus luteus in Sandy Hook Bay (18,750 cells/ml).

Monday, July 11, 1977

Barbara Kurtz of the NJDEP reported no water discoloration along the beaches from Avon to Sandy Hook or in Sandy Hook Bay. Samples were collected. Analysis of the samples did not indicate the presence of a bloom condition.

The USEPA helicopter sampling crew reported water discoloration from Monmouth Beach to Long Branch (from beach to approximately 9 miles offshore). Samples were taken. Analysis of the samples indicated a bloom of Olisthodiscus luteus (40,625 cells/ml).

Tuesday, July 12, 1977

Barbara Kurtz of the NJDEP reported no water discoloration on her routine sampling run. Samples were taken. Analysis of the samples indicated a non-visual bloom of a green nannoplankter from the Sandy Hook Coast Guard Dock to the Park Gate. The nannoplankter was present in non-bloom numbers at the other routine stations down to Avon. Olisthodiscus luteus was present in sparse numbers at Avon.

Wednesday, July 13, 1977

Barbara Kurtz of the NJDEP reported the beaches, ocean, and bay were clear from Sandy Hook to Avon. Samples were taken. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier. At Sandy Hook Park Gate and Long Branch Pier, no bloom levels were observed.

Thursday, July 14, 1977

Barbara Kurtz of the NJDEP reported the beaches, ocean, and bay clear from Sandy Hook to Avon. Samples were taken. Analysis of the samples indicated nothing indicative of a bloom condition.

The USEPA helicopter sampling crew reported water discoloration approximately 1 mile offshore from Sea Bright south to Long Branch. A sample was taken. Analysis of the sample indicated a bloom of a green nannoplankter (dominant species). Ciliated protozoa and diatoms were also present.

Dr. John Mahoney of the Samdy Hook Marine Laboratory reported the presence of Prorocentrum micans in Sandy Hook Bay.

Friday, July 15, 1977

Barbara Kurtz and Doris Cone of the NJDEP collected samples from the routine in-shore stations. Analysis of the samples indicated a green nannoplankter (500,000 cells/ml) at Earle Pier, a mild bloom of Olisthodiscus luteus and Massartia rotundata at Sandy Hook Park Gate and Bradley Beach. A moderate bloom of Olisthodiscus luteus at Long Branch Pier. Asbury Park was relatively clear but flagellates were present.

The USEPA helicopter sampling crew reported water discoloration off Long Branch and in Sandy Hook Bay. Water samples were collected. Analysis of the samples indicated a bloom of Olisthodiscus luteus at Long Branch and a bloom of a green nannoplankter in Sandy Hook Bay.

Saturday, July 16, 1977

The USEPA helicopter sampling crew observed water discoloration off Earle Pier and some streaks off Long Island. The water off Sandy Hook appeared clear. No samples were taken.

Doris Cone of the NJDEP collected water samples at five stations. Analysis of the samples indicated a heavy bloom of a green nannoplankter at Sea Bright. There was no indication of a bloom condition at Bradley Beach, Long Branch Pier, or Sandy Hook Park Gate.

Sunday, July 17, 1978

Barbara Kurtz of the NJDEP collected water samples at five stations. Analysis of the samples indicated a heavy bloom of a green nannoplankter at Earle Pier (400,000 cells/ml) and a mild bloom of Massartia rotundata (10,000 cells/ml) at Sandy Hook Park gate. There was no indication of a bloom condition at Bradley Beach, Long Branch Pier, or Monmouth Beach.

Tuesday, July 19, 1977

Frank Takacs of the NJDEP was notified of water discoloration off Seaside Park and Point Pleasant. Samples were taken. Analysis of the samples indicated light concentrations of Massartia rotundata along the beaches from Point Pleasant to Seaside Park (2,000 cells/ml) with a mild bloom at Bay Head (10,000 cells/ml).

Barbara Kurtz of the NJDEP reported water discoloration at Earle Pier and the Sandy Hook Coast Guard Dock. Samples were taken. Analysis of the samples indicated a heavy bloom of a green nannoplankter (250,000 cells/ml) in Sandy Hook Bay.

Wednesday, July 20, 1977

Barbara Kurtz of the NJDEP collected two samples. Analysis of the samples indicated a heavy bloom of Massartia rotundata (250,000 cells/ml) and a moderate bloom of Massartia rotundata (22,000 cells/ml) at Earle Pier. There was no indication of bloom conditions at Long Branch Pier.

The USEPA helicopter sampling crew reported water discoloration 100 yards off Sandy Hook, 2 miles long and ¼ mile wide extending southward from the tip of Sandy Hook. A sample was taken. Analysis of the samples indicated a heavy bloom of a green nannoplankter (250,000 cells/ml), and a mild bloom of Massartia rotundata (22,000 cells/ml).

Thursday, July 21, 1977

Barbara Kurtz of the NJDEP collected three water samples. Analysis of the samples indicated a heavy bloom of a green nannoplankter at Earle Pier (300,000 cells/ml). There was no indication of a bloom condition at the Sandy Hook Park gate or at Long Branch Pier.

The USEPA helicopter sampling crew reported dense red brown discoloration in Sandy Hook Bay from Earle Pier to Sandy Hook. The mouth of the Raritan River also had red brown discoloration. The ocean south of Long Branch to 12 miles offshore was clear. A sample was taken in Sandy Hook Bay. Analysis of the samples indicated a heavy bloom of a green nannoplankter (300,000 cells/ml) and a mild bloom of Massartia rotundata (9,000 cells/ml) and Euglena sp. (44,000 cells/ml). Olisthodiscus luteus was also present (10,000 cells/ml).

Friday, July 22, 1977

Barbara Kurtz of the NJDEP collected three water samples. Analysis of the samples indicated a heavy bloom of a green nannoplankter (220,000 cells/ml) and a mild bloom of unidentified Cryptophytes (37,000 cells/ml) at Earle Pier. A bloom of a green nannoplankter (92,000 cells/ml) at the Sandy Hook Park gate and Long Branch Pier (35,000 cells/ml) was also present.

Saturday, July 23, 1977

The USEPA helicopter sampling crew reported water discoloration in Raritan-Sandy Hook Bay extending from Sandy Hook to the mouth of the Raritan River and the mouth of the Great Kill. In the ocean, discoloration extended from Sandy Hook to Seaside Heights (from shore to 24 miles). The discoloration was intense off Monmouth Beach and Long Branch. A sample was taken east of Manasquan Inlet 3/4 miles offshore and 2.4 miles off Manasquan. Analysis of the sample indicated a heavy bloom of a green nannoplankter (150,000 cells/ml). Prorocentrum minimum, Prorocentrum micans, Massartia rotundata, and Olisthodiscus luteus were present in low numbers (≤100 cells/ml).

Sunday, July 24, 1977

The USEPA helicopter sampling crew reported patches of water discoloration from Long Branch to Asbury Park. At Asbury Park, Ulva (a green alga) was floating on the beach. At Seaside Park, the water was greenish brown. Sandy Hook Bay appeared clear. A water sample was taken ½ mile south of Long Branch. Analysis of the sample did not indicate a bloom condition.

Monday, July 25, 1977

Barbara Kurtz of the NJDEP collected five water samples at the routine stations. Analysis of the samples indicated blooms of a green nannoplankter at Earle Pier (150,000 cells/ml), North Beach, Sandy Hook (100,000 cells/ml), Sandy Hook Park gate (100,000 cells/ml), Long Branch pier (100,000 cells/ml), Avon (29,000 cells/ml).

Tuesday, July 26, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated blooms of a green nannoplankter, at Earle Pier (175,000 cells/ml), Bahrs Dock (220,000 cells/ml), Sandy Hook Park gate (117,000 cells/ml), North Beach, Sandy Hook (75,000 cells/ml), Coast Guard Dock, Sandy Hook (140,000 cells/ml), Long Branch pier (40,000 cells/ml), Avon (7,000 cells/ml), Oceanic Bridge (225,000 cells/ml).

Thursday, July 28, 1977

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier, Sandy Hook Park gate, and Long Branch Pier.

Friday, July 29, 1977

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated blooms of a green nannoplankter at Earle Pier (300,000 cells/ml), Sandy Hook Park gate (150,000 cells/ml), and Long Branch Pier (75,000 cells/ml).

Saturday, July 20, 1977

The USEPA helicopter crew reported that the water looked clear in Raritan-Sandy Hook bay and along the New Jersey coast south to Island Beach State Park. No samples were taken.

Monday, August 1, 1977

The USEPA helicopter sampling crew reported a long line of detritus along the Long Island surf extending from Jones Beach to Fire Island. A sample was taken. Analysis of the sample indicated a heavy concentration of detritus. No bloom condition was evident. The helicopter also conducted transects along the New Jersey coast off Atlantic City, Barnegat Light, and Seaside Heights. No water discoloration was observed or samples taken.

Tueaday, August 2, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (100,000 cells/ml). North Beach, Sandy Hook was heavy with detritus (45,000 particles/ml). All the other stations were clear.

The USEPA helicopter sampling crew reported no water discoloration along the New Jersey Coast from Raritan Bay to Asbury Park. No water discoloration was observed in the New York Bight or along the coast of Long Island.

Thursday, August 4, 1977

The USEPA helicopter sampling crew reported water discoloration about 20 feet off the surf line from Sandy Hook to possibly Point Pleasant. A sample was taken at Sandy Hook Park Gate. Analysis of the sample indicated a bloom of Massartia rotundata (13,000 cells/ml) and a green nannoplankter (84,000 cells/ml).

In a second observation flight, the crew observed three areas of water discoloration. 1. 1½ miles south of the tip of Sandy Hook to Long Branch from the surf to about 1½ to 2 miles off shore. 2. Allenhurst to the south end of Asbury Park, patches 50-100 feet wide from the surf to ½ miles out. 3. South side of Shark River Inlet to South end of Spring Lake from the surf to ½ mile out. Three samples were taken.

At Sandy Hook Park gate, a bloom of Massartia rotundata (13,000 cells/ml) and a green nannoplankter (280,000 cells/ml). At Long Branch, a bloom of a green nannoplankter (150,000 cells/ml). At Allenhurst, a bloom of Massartia rotundata (10,000 cells/ml) and a green nannoplankter (110,00 cells/ml). At Shark River Inlet, a bloom of Massartia Rotundata(12,000 cells/ml and a green nannoplankter (230,000 cells/ml).

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated a bloom of Massartia rotundata (50,000 cells/ml) and a green nannoplankter (150,000 cells/ml) at Earle Pier. At Sandy Hook Park gate, and Long Branch Pier, Massartia rotundata (1,000 - 2,000 cells/ml) and a green nannoplankter (50,000 - 70,000 cells/ml) were present.

Friday, August 5, 1977

The USEPA helicopter sampling crew reported the New Jersey coast from Atlantic City to Lavallette was clear. From Lavallette to Belmar, water discoloration was observed ¼ to ½ miles in width. The discoloration was in the surf zone in some areas and about 1,000 feet off the beach in other areas. No samples were taken.

Barbara Kurtz of the NJDEP collected six water samples at the routine stations. Analysis of the samples indicated the presence of a green nannoplankter at all the stations: Seaside Park (70,000 cells/ml), Point Pleasant (90,000 cells/ml), Asbury Park (30,000 cells/ml), Long Beach Pier (50,000 cells/ml), Sandy Hook Park gate (90,000 cells/ml), Earle Pier (80,000 cells/ml). Massartia rotundata was present in minor bloom concentrations at Seaside Park (5,000 cells/ml), Long Branch Pier (7,000 cells/ml) and Earle Pier (6,000 cells/ml).

Tueady, August 9, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated the presence of a green nannoplankter at all stations. Navesink River (80,000 cells/ml), Shrewsbury Beach (40,000 cells/ml), Earle Pier (50,000 cells/ml), Coast Guard Station (47,000 cells/ml), North Beach, Sandy Hook (47,000 cells/ml) Shark River (51,000 cells/ml). A mild bloom of Massartia rotundata was present at the Sandy Hook Coast Guard Station (8,000 cells/ml).

Thursday, August 11, 1977

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated the presence of a green nannoplankter (100,000 cells/ml) and Massartia rotundata 4,000 cells /ml at Earle Pier. The green nannoplankter was also present at Sandy Hook Park gate (86,000 cells/ml) and Long Branch Pier (50,000 cells/ml).

The USEPA helicopter sampling crew reported some water discoloration in Raritan Bay from Keyport out to Lower New York Harbor. No samples were taken.

Friday, August 12, 1977

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (140,000 cells/ml). The green nannoplankter was also present at Sandy Hook Park gate (68,000 cells/ml) and Long Branch Pier (40,000 cells/ml).

Tuesday, August 16, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (140,000 cells/ml) and Sandy Hook Park gate (100,000 cells/ml). The green nannoplankter was also present at Bahrs Dock (50,000 cells/ml), North Beach, Sandy Hook (53,000 cells/ml), Coast

Guard Dock, Sandy Hook (87,000 cells/ml), Long Branch Pier (50,000 cells/ml), Avon (71,000 cells/ml), and Oceanic Bridge (71,000 cells/ml).

The USEPA helicopter sampling crew reported no water discoloration in their flight. They did collect a sample of a slimy mass observed off Long Island. Analysis of the sample indicated the mass was composed of comb Jellys (ctenaphores).

Thursday, August 18, 1977

Barbara Kurtz of the NJDEP collected three water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (230,000 cells/ml). The green nannoplankter was also present at Sandy Hook Park gate (75,000 cells/ml), and Long Branch Pier (40,000 cells/ml).

Friday, August 19, 1977

The USEPA helicopter sampling crew reported no water discoloration in perpendicular coastal flights off Sandy Hook, Sea Bright, Long Branch, Lavallette, and Seaside. No samples were collected.

Tuesday, August 23, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated the presence of primarily a green nannoplankter at all the stations. The range was from 11,000 to 36,000 cells/ml. The stations were: Earle Pier, Bahr's Dock, Sandy Hook Park gate, North Beach Sandy Hook, Sandy Hook Coast Guard Dock, Long Branch Pier, Avon, Oceanic Bridge.

The USEPA helicopter sampling crew reported water discoloration off Staten Island and in Sandy Hook Bay off Leonardo (100-200 yds from shore). No samples were taken.

Tuesday, August 30, 1977

Barbara Kurtz of the NJDEP collected eight water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (101,000 cells/ml). The green nannoplankter was also present at the other stations ranging from 52,000 to 69,000 cells/ml.

The NJDEP was notified by the shellfish personnel of streaks and patches of discoloration about 1 mile offshore extending about 12 miles from Sea Isle City to Hereford Inlet (North Wildwood). A sample was taken. Analysis of the sample indicated the discoloration was caused by chlorophytes (green algae).

Friday, September 2, 1977

Barbara Kurtz of the NJDEP collected four water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (113,000 cells/ml). The green nannoplankter was also present at the other stations: Sandy Hook Park gate (44,000 cells/ml) Long Branch Pier, (19,000 cells/ml), Avon (35,000 cells/ml).

Tuesday, September 6, 1977

Barbara Kurtz of the NJDEP collected five water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (100,000 cells/ml). The green nannoplankter was present at the other stations, with the exception of Sandy Hook Park gate (72,000 cells/ml), in relatively low numbers. There was an increase in the number of diatoms present at all the stations.

Wednesday, September 14, 1977

Barbara Kurtz of the NJDEP collected seven water samples at the routine stations. Analysis of the samples indicated a bloom of a green nannoplankter at Earle Pier (100,000 cells/ml) and its presence at the other stations in low numbers (≃15,000 cells/ml).

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APPENDIX F

Viral and Bacterial Studies in the New York Bight--Summer 1977

VIRAL AND BACTERIAL STUDIES CONDUCTED IN THE NEW YORK BIGHT

1976 & 1977

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INTRODUCTION

For the past several years, EPA Region II has been monitoring the Long Island and New Jersey beach areas. The standard parameters of total and fecal coliforms were used to assess the bacterial quality of bathing beach waters. Values received were evaluated on the basis of conformance or non-conformance to state bacteriological bathing beach standards and those recommended by EPA. Records indicate that during this time, water quality of the beaches has been acceptable in terms of those criteria.

Public awareness, however, has shifted to the detrimental effects of sludge disposal in the New York Bight. Main concern was for the possible transport of contaminants from the sludge disposal site 12 miles off the coast, to the Long Island and New Jersey beaches. EPA responded by increasing its monitoring activities at the beaches and in the Bight. First, additional stations for bacteriological monitoring were established. Testing parameters included total and fecal coliform bacteria. Second, selected stations were sampled and analyzed directly for bacterial pathogens. Such data was to supplement the coliform results, which are supposed to indicate the possible presence of disease causing agents. The third step was to initiate a viral study in the area of the Long Island and New Jersey beaches. This was in response to queries concerning the possible presence of viruses in the recreational beach waters. So far, seven beach areas were sampled for viruses.

In order to keep beach viral data in the proper perspective, additional areas were sampled in the New York Bight. This was necessary since pollution loadings emanating from the Hudson-Raritan estuarine system contain raw sewage, partially treated municipal and industrial waste, combined storm-sewer discharges and urban runoff. Additional loading from sludge disposal constituted another potential viral source.

During the treatment process in sewage plants, bacteria and viruses are sedimented with the solids that settle as sludge. In this medium, bacteria may multiply while the viruses cannot. Consequently, the ratios of bacteria to viruses become distorted and of little value in establishing viral-indicator relationships. With digested sludge, wide ranges in the ratios exist. However, during the sludge digestion process, there is some degree of consistency. Mesophilic digestion of raw sludge (35°C) for approximately 20 days destroys 76.0 to 96% of the viruses, 95.0 to 99.3% of the fecal coliforms, 86.0 to 99.5% of the total coliforms and 88.0 to 97.0% of the fecal streptococci. In mesophilic digestion, coliforms are destroyed about ten times faster than that at which the viruses are destroyed. The fecal streptococci on the other hand, appear to be destroyed by mesophilic digestion at rates that closely resemble that for the destruction of viruses. In thermophilic digested sludge (50°C), total coliforms are destroyed more rapidly than fecal coliforms which in turn are destroyed ten to one hundred times more rapidly than viruses. The fecal streptococcal rates closely paralleled those of the viruses.[1] It is obvious then that in sludge receiving waters, poor correlations between coliform numbers and viruses can be expected. The relationship can be further distorted since viral survival in seawater differs markedly from that of the coliform bacteria. Viral-indicator relationships are important -- especially since bathing beach criteria are based on the fecal coliform bacteria.

This report summarizes the data collected up to this time. The data are preliminary and all of the potential viral sources were not sufficiently sampled. Consequently, interpretation of the data becomes difficult until all of the facts are in. Also, in assessing the relative magnitude of virus numbers, recovery efficiency must be considered. With this system, maximum viral recovery was 35-40 percent, while the average recovery was 25 percent.

METHODOLOGY

Seawater samples for bacteriological assays were collected five feet below the surface and filtered immediately on board the EPA vessel or in a mobile laboratory. Total and fecal coliform bacteria and *Pseudomonas aeruginosa* were determined according to membrane filter techniques outlined in *Standard Methods*.[2] For salmonella, specific volumes of water were filtered using a Balston filtration system, consisting of a Grade C pre-filter 8.0 μm followed by a Grade AA 0.3 μm filter. After sample filtration, the filters were cut in half. One portion was placed in 300 ml of Selenite Cystine Broth while the other was placed in 300 ml of Tetrathionate Broth. Subsequent isolation and identification was carried out according to the procedures of Edwards and Ewing.[3]

Viruses were recovered from seawater by the filter adsorption-elution technique using the Aquella virus concentrator on board the EPA vessel. Up to 217 gallons of seawater were passed through a series of filters designed to retain the viruses, specially when pH conditions were lowered to approximately 3.2. Elution of the viruses at pH 11.5 produced a concentrated sample which was then transported to the Edison Laboratory where additional concentration was carried out to reduce the sample volume. The final concentrate was frozen at -70°C and shipped to the EPA Laboratory in Cincinnati, Ohio for virus assay. The plaque forming unit (PFU) method using BGM cells was used to assay the viruses. In general, the sampling procedure and isolation methodology was optimized and largely selective for the detection of enteroviruses which included Poliovirus, Coxsackie A and B and Echoviruses (ECHO). These viruses are members of the picornavirus group which comprise the largest and most important group of human pathogens. The viruses initiate infection in the alimentary tract causing local symptoms of illness that may vary from severe to nonclinical signs. The symptoms of the disease may then spread to various target organs including the central nervous system causing paralysis and death.[4]

<u>VIRUS RESULTS</u>

Using the Aquella virus concentrator on board the EPA vessel, sixteen (16) sites in the New York Bight were sampled for enteroviruses. Sampling for virus was conducted in June, September, October and November of 1976. In 1977, sample runs were made in February, March, April, May, June, July, September and October. The somewhat irregular sampling schedule was caused by a number of factors: bad weather, availability of the vessel, modifications in the sampling equipment and availability of the EPA Cincinnati, Ohio Laboratory to assay the concentrates. This prevented sampling at times which would more effectively coincide with seasonal changes and maximum beach usage. Sixteen (16) stations which include six (6) beach areas on Long Island and one on Sandy Hook were sampled at least once. One station on Long Island, (LIC-02) was sampled three times and (LIC-04) was sampled twice. A total of nineteen (19) samples were processed during this phase of the study.

Table 1 provides a description of the sampling stations and their location. The selection of sampling sites was based on the following: (1) historical bacteriological data, (2) potential nearby sources of virus, and (3) the proximity of coastal beaches. As a result, one beach area at Sandy Hook and six beach areas in Nassau County were sampled.

Table 2 presents data on enterovirus isolations in the Bight area. Eleven of sixteen stations gave positive results. Coxsackie B2, B3, B4 and ECHO 5 were isolated at Seagate (SG) where the count was 14 PFU. (During a trial run on September 5, 1975, the count was 5 PFU). Dye dispersion studies conducted by the FWPCA in 1964[5] demonstrated that material introduced in the northwest section of the Upper New York Bay can be found on the Coney Island Shore within 32 hours after release. The raw sewage emanating from the Upper Bay may then serve as a source of the viruses. The effect of the Hudson-Raritan estuarine flow can be seen further south at station NYB30 where the virus count was 9 PFU. The viruses were identified as Coxsackie B3, ECHO 7 and Polio.

The highest viral density was obtained at station J17B where the PFU was 481. Isolates included Coxsackie A7, B3 and B5; ECHO 15 and polioviruses. Besides the Upper Harbor flow, the high viral density reflects the discharges of Coney Island sewage treatment facility and the treatment plants in Jamaica Bay (especially on the outgoing tide). The treatment plants only practice seasonal chlorination and it is not uncommon to observe high densities of microorganisms during the non-chlorination period. On February 28, 1977 when sampling occurred, the total and fecal coliform density was 34,000/100 ml and 4900/100 ml respectively.

Station LIC01-0.125 miles off Rockaway Point, had a viral density of 4 PFU. Isolates included polioviruses and Coxsackie B3 viruses. Eddy areas along the Long Island coast probably explain the difference in viral numbers. The same reduction in bacterial densities occur at this point also. Progressing in a southerly direction from the Narrows, bacterial densities continue to decrease dramatically. Dilution and die-off are probably responsible for the low numbers. The enteroviruses, however, persist. NYB-32A, located 2.5 miles south of Rockaway Point, at Ambrose Channel shows an increase in PFU's. The total PFU for that sample was 58. Viral isolates included Coxsackie A16, B1, B2, B3, B5

* Polioviruses have not been characterized as to type, vaccine or non-vaccine strain.

ECHO 29 and polioviruses. Pollution originating from the Upper New York Harbor system apparently flows in a south easterly direction out into the Bight and towards the New Jersey Shore. Station JC-03, 0.125 miles off Sandy Hook, consequently, showed a higher virus count (41 PFU). Isolates included Coxsackie B1, B2, B3; ECHO 7 and polioviruses.

The sample collected at station SDS, located approximately 12 miles offshore in the sludge disposal site contained 17 PFU. The isolates included Coxsackie B2, B3, B4, B5; ECHO 15 and polioviruses. In a northerly direction from the sludge disposal site, station NYB 42, 4.5 miles off Atlantic Beach, contained 9 PFU. Enteroviruses isolated were Coxsackie B2, B3, B4 and polioviruses type 2. Viruses were not detected in the sample collected at LIC-07, 0.125 miles offshore at Atlantic Beach. The same was true for station LIC-08 at Long Beach, LIC-04 and LIC-03 at Rockaway Beach and at Jacob Riis Park. Two of the three samples collected at station LIC-02 (Rockaway) gave negative results. The third sample contained 1 PFU. The virus was identified as Coxsackie B3.

Station NYB-34A, located 1.5 miles south of Rockaway Beach contained 66 PFU -- the second highest density observed. Enteroviruses identified were Coxsackie A16, B2, B3, B4, B5; ECHO 15 and polioviruses. Station NYB-34A, 4.5 miles south of Rockaway Beach (B-92 Rd.) had a count of 4 PFU. The isolates were identified as Coxsackie B2 and polioviruses.

DISCUSSION

The results of this study while preliminary in nature, indicate that pathogenic human enteric viruses are present in the New York Bight waters. Viruses were isolated twelve miles offshore at the sludge disposal site; 4.5 miles south of Atlantic Beach, 4.5 and 1.5 miles south of Rockaway Beach and 0.125 miles off Rockaway Point. Viruses were not detected at five of six beach areas sampled at Long Island. The only positive beach sample on Long Island was 0.125 miles off Rockaway Beach (B169 Rd.) where 1 PFU was recorded. The only beach station sampled for viruses on the New Jersey Coast was at Sandy Hook 0.125 miles offshore the Nature Center Building - Tower. The sample contained 41 PFU. In addition, viruses were isolated at specific stations which suggest potential viral sources. In summation, the preliminary data strongly suggest that the Hudson-Raritan estuarine system flow and sludge discharges are major sources of virus to the New York Bight. Raw sewage emanating from the Upper Harbor and non-chlorinated waste from the Coney Island sewage treatment facility and Jamaica Bay treatment facilities from Sept 30 to May 15 constitute significant contamination to the New York Bight.

Coxsackie viruses were detected at ten of the eleven positive stations, (in addition, they were the largest number of viruses isolated); polioviruses were detected at nine stations while ECHO viruses were detected at six stations. The Coxsackie viruses probably survive longer in seawater than do polioviruses or ECHO viruses. This may partially account for their predominance in the samples analyzed.

Coxsackie viruses are causative agents of numerous different clinical entities which range from typical common cold syndrome to gastroenteritis to severe aseptic meningitis and paralysis. The viruses have worldwide distribution and man appears to be the only natural host.

The presence of viruses pathogenic for humans in coastal waters, create potential health hazards in two ways. First, they can serve as a source of infection for bathers and others using the waters for recreational purposes. Second, they contaminate overlying waters of shellfish beds.[6] In the New York Bight, shellfish harvesting is prohibited in the area extending from east Rockaway Inlet south to Shark River Inlet and a circular area extending out 18 miles west of the Sandy Hook, New Jersey shore because water bacterial densities exceed FDA standards. (See Figure 4).

There are no documented reports of viral disease outbreaks traced to swimming in contaminated seawater. The lack of such evidence, however, does not completely exclude that such infections have occurred. Infections contracted may not have been reported, or if they were, they probably were not linked with exposure to contaminated waters.

Although there is a lack of epidemiological data on viral diseases associated with swimming in polluted water, several facts indicate that even low levels of enteroviruses in water are of public health importance. First, the minimal infective dose of enteroviruses for humans is very low. Only 1 to 2 plaque-forming units of poliomyelitis is required to infect a human being[7]. Second, most of the enterovirus infections are sub-clinical in nature. However, individuals with such infections can transmit the clinical diseases and wide range of incubation periods can further complicate the epidemiology of waterborne viral infection.[6]

The growing concern of viruses in coastal waters has prompted the establishment of permissible virus levels in recreational waters. Melnick in 1976 recommended a limit of one infectious virus unit per 10 gallons of recreational water.[8] Shuval (1976) proposed a standard of no detectable virus in 10 gallon samples.[9] Using the more liberal standard of one viral unit per 10 gallons of water, four stations studied are in violation. None of the six beach stations sampled on Long Island would exceed the standard while JC-02, Sandy Hook Beach with 2.0 viral units per 10 gallons of water would exceed the standard.

INDICATOR-VIRAL RELATIONSHIPS

It was pointed out earlier that viruses may survive for many months in marine waters. Survival is dependent on water temperature, pollution levels and virus identity. Coxsackie viruses exhibit the longest survival capacity, polioviruses the least and the echoviruses are intermediate. Sewage affords some protection to the viruses and when present in water, viral longevity is increased. During winter, when water temperatures are lower, survival appears to be greater than during the summer months. This effect is probably not due to temperature alone but may result from an interaction between the viruses and soluble by-products of the biological flora that damaged or inactivated the viruses. Consequently, the longer survival of the viruses during winter months could be attributed in part or in total to reduced biotic flora activity at low temperature.[10]

There are a number of studies which present good comparative data on the relationship of viruses and coliforms. The consensus appears to be a general tendency of larger numbers of total and fecal coliforms to larger numbers of viruses, however, there appears to be no consistent relationship of proportion between the indicator and virus densities in marine waters.[1] As distance and time from the waste discharge point increase, the ratio of indicators to viruses diminishes. In the New York Bight study, the ratios indicate a longer exposure of the coliforms and viruses to the ocean water environment. This is indicated by the lower densities of coliforms as the distance from the Upper Harbor increases out into the open ocean. Table 3 presents ratios of total and fecal coliforms to viruses at stations in the New York Bight. The data indicate that fecal coliforms were always recovered when viruses were present. In six cases, however, the fecal coliform density was less than 200/100 ml. (Of those, four were 17 or less). At one station that yielded viruses, the fecal coliform count was only 4/100 ml. In a study conducted by EPA on New Jersey coastal sludge disposal outfalls during 1971 and 1972, fecal coliforms were absent in 100 ml samples while 6, 4 and 1 PFU of viruses were recovered from 100 gallon ocean samples. The ratios of fecal coliforms to viruses ranged from 3,170:1 to 350,000:1 while the ratios of total coliforms to viruses ranged from 66,000:1 to 1,700,000:1. Although there was a general tendency of larger numbers of viruses to be accompanied by larger numbers of total and fecal coliforms, there was no consistent relationship of proportion between indicator and viral densities.

Since there was no constant ratio of coliforms to viruses, it was expected that at times, viruses would be isolated when indicators were absent or in low numbers. This in fact was the case. Fifty-four percent of the positive virus samples contained fecal coliform densities less than 200/100 ml.

BACTERIAL PATHOGEN RESULTS

Selected stations on the New Jersey and Long Island coast were sampled from June 9, 1977 to August 19, 1977 for Salmonella, *Pseudomonas aeruginosa*, and total and fecal coliform bacteria. Results and sampling locations are presented in Table 4. Total coliform levels for the 15 stations ranged from 1 to 41/100 ml. Fecal coliform levels were extremely low with no value exceeding 6/100 ml. Concurrent assays for *P. aeruginosa* gave the same type of results with the exception of one station JC-21 which had a count of 64/100 ml. *P. aeruginosa* is an opportunistic pathogen of man and animals capable of causing a wide variety of infections. 11
Since there are no *P. aeruginosa* standards for recreational marine waters, it is difficult to explain the significance of that value. However, some perspective can be gained by using information

developed by other studies. It was suggested in one study[12] that P. aeruginosa probably does not occur in waters not recently affected by human activity or the activity of domestic animals. Where there was human activity, low levels of less than 100 organisms/100 ml could be demonstrated in adjacent waters. Densities exceeding 100 organisms/100 ml were observed in waters receiving surface drainage from urban areas or recently contaminated by sewage. P. aeruginosa densities from 1000 to 10,000/100 ml were observed in small streams below sewage outfalls. The P. aeruginosa value received for station JC-21, would then fall in the first category of low level density. The lack of standards based on epidemiological study, prevents an assessment of health hazard due to this organism.

Two of the fifteen stations sampled contained salmonellae. Salmonellae are enteric pathogenic bacteria capable of causing gastroenteritis in man. There are over 1000 recognized salmonella serotypes. At station LIC-01 (Rockaway), S. enteritidis ser. enteritidis was isolated from a two gallon water sample. The fecal coliform count for the 100 ml sample was zero while the P. aeruginosa count was 4/100 ml. S. enteritidis ser. senftenberg was isolated from five gallons of water. The fecal coliform count was 3/100 ml while the P. aeruginosa count was 1/100 ml. While the presence of salmonellae indicate a potential health hazard, the full significance in these marine waters is unknown since the bacteria were not quantitated. Without density information, it is impractical to assess the health risk for the organisms whose reported ID_{50} is 10^5 to 10^7 organisms.

CONCLUSIONS

In response to public concern about sludge disposal in the New York Bight, increased bacterial monitoring was initiated. In addition to routine parameters, samples were analyzed for enteroviruses and bacterial pathogens. The results presented here are preliminary since the study is on-going. It was possible, however, to formulate certain conclusions concerning viral presence in the New York Bight.

1. Pathogenic human enteric viruses are present in New York Bight Waters. The presence of enteroviruses in marine waters creates a potential health hazard to bathers and others using the waters for recreational purposes. In addition, the viruses contaminate overlying waters of shellfish beds.

2. Coxsackie, echoviruses and polioviruses were identified. The predominant isolates were Coxsackie virus types which were detected at ten of the eleven positive stations. The higher isolation frequency may be due to the greater stability of these organisms in seawater.

3. Of nine samples collected 0.125 miles off Long Island beaches, only one was positive for enterovirus. The positive sampling off Rockaway contained 1 PFU which was identified as Coxsackie type B3 virus.

4. The data indicate that one significant viral source to the Bight is the Hudson-Raritan estuarine flow. Investigators purport that this system is the most significant source of wastes into the Bight.[13] The plume carrying most of the contamination, normally flows along the New Jersey coast in the western Apex. Viruses were isolated from several stations located in the flow extending from Seagate south to Sandy Hook Beach.

During high river flow, the plume may spread into the eastern Apex and it has been observed at times to cover the entire Apex. This pattern of flow may, therefore, account for the viral isolates at stations located further east. Sewage sludge discharged in the Bight is a potential secondary viral source, however, it is not possible at this time to differentiate its contribution from that of the Hudson-Raritan estuarine flow even though viruses were recovered at the 12 mile site (17 PFU). Among researchers, there is consensus that sewage sludge contributes a relatively small quantity of the total contaminant load in the Bight. Additional sampling in this area will hopefully further clarify sludge viral contribution.

5. There was no consistency in the ratio of coliforms to viruses. Wide ranges in ratios of total coliforms and fecal coliforms to viruses were observed. Over 50 percent of the fecal coliform values for positive virus samples were less than 200/100 ml. However, it must be noted that whenever viruses were detected in the samples, fecal coliforms were also detected.

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TABLE 1 — VIRUS SAMPLE STATIONS — NEW YORK BIGHT

STATION NUMBER	STATION LOCATION
SG	Sea Gate, 0.125 miles offshore (Norton Point)
J17-B	Midway Between Rockaway and Coney Island (Buoy FIR-2)
NYB-30	Ambrose Channel, Buoy 3.5 mi. from Coney Island, and 2.5 mi. from Rockaway Point, (Buoy FI-5)
NYB-32A	Ambrose Channel, 2.5 miles from Rockaway, (Buoy FI-R-2)
LIC-01	Rockaway Point at Breezey Point Surf Club (0.125 mi. offshore)
LIC-02	Rockaway, off B169 Rd. (0.125 mi. offshore)
RP	Riis Park, (0.125 mi. offshore)
LIC-03	Rockaway Beach, off 129 Rd. (0.125 mi. offshore)
LIC-04	Rockaway Beach, off foot of B92 Road
LIC-07	Atlantic Beach at Silver Point Beach Club (0.125 mi. offshore)
LIC-09	Long Beach, off foot of Grand Avenue (0.125 mi. offshore)
NYB-34A	1.5 miles south of Rockaway between B169 and B129 Rd.
NYB-34B	Ambrose Horn, 4.5 miles south of Rockaway B-92 Rd.
NYB-42	4.5 miles south of Atlantic Beach
SDS	Sludge Disposal Site (between NYB 26 and 27)
JC-03	Sandy Hook Beach (0.125 miles offshore — Tower)

TABLE 2 — ENTEROVIRUS ISOLATIONS IN THE NEW YORK BIGHT

STATION	DATE SAMPLED	SALINITY °/oo	WATER TEMPERATURE °C	pH (Su)	ENTEROVIRUS PFU
Seagate Norton Pt.	6/10/76	-	-	-	14
J17B	2/28/77	29.6	2.1	8.3	481
NYB30 Ambrose Channel	2/22/77	30.4	0.5	7.6	9
NYB32A Ambrose Channel	2/14/77	29.4	0.4	7.9	59
LIC-01 Rockaway Point	3/21/77	30.6	3.1	7.9	4
LIC-02 Rockaway	5/2/77	28.5	10.0	8.0	1
	6/29/77	28.7	19.6	8.1	0
	9/29/77	-	-	7.8	0
Riis Park	6/13/77	28.7	13.8	7.9	0
LIC-03 Rockaway	4/24/77	29.5	10.5	8.2	0
LIC-04 Rockaway	6/23/77	30.6	12.7	7.9	0
	7/21/77	30.2	24.4	8.2	0
LIC-07 Atlantic Beach	9/20/76	29.8	19.0	7.9	0
LIC-08 Long Beach	10/19/76	30.5	12.8	7.6	0
NYB34A	3/28/77	30.3	3.2	8.5	66
NYB34B Ambrose Horn	3/7/77	29.1	2.1	7.7	4
NYB42	11/18/76	32.7	9.2	7.8	9
SDS	9/13/76				17
JC-03 Sandy Hook	10/5/77		16.9	7.9	41

TABLE 3 — RATIOS OF TOTAL AND FECAL COLIFORMS TO VIRUSES AT STATIONS IN THE NEW YORK BIGHT

STATION	VIRUSES (PFU/100ml)	FECAL COLIFORMS : (CFU/100ml)	FECAL COLIFORMS : VIRUSES	TOTAL COLIFORMS : (CFU/100ml)	TOTAL COLIFORMS : VIRUSES
SG	0.0037 (14.0)*	1,300	350,000:1	6,300	1,700,000:1
SDS	0.0041 (15.5)	13	3,170:1	330	80,500:1
NYB-42	0.0012 (4.5)	172	140,000:1	490	410,000:1
NYB-32A	0.0075 (28.4)	330	44,000:1	790	110,000:1
NYB-30	0.0012 (4.5)	17	14,000:1	230	190,000:1
J17-B	0.0620 (235.0)	4,900	79,000:1	35,000	560,000:1
NYB-34B	0.005 (2.0)	4	8,000:1	33	66,000:1
LIC-01	0.005 (2.0)	49	98,000:1	70	140,000:1
NYB-34A	0.0086 (32.4)	1,300	150,000:1	1,300	150,000:1
LIC-02	0.00013 (0.5)	8	62,000:1	13	100,000:1
JC-03	0.005 (20.0)	330	66,000:1	1,090	218,000:1

* = ( ) - PFU/100 gallons
CFU = Colony Forming Units

TABLE 4 — INDICATOR AND BACTERIAL PATHOGEN ISOLATIONS AT SELECTED STATIONS ALONG THE LONG ISLAND AND NEW JERSEY COAST

Station No.	Location	Date	Total Coliform MF/100ml	Fecal Coliform MF/100ml	Pseudomonas aeruginosa MF/100ml	Salmonella * Serotypes Isolated
LIC-01	Rockaway Pt.	6/9/77	11	0	4	*S. enteritidis* ser. *enteritidis*
LIC-02	Rockaway	6/9/77	41	0	2	ND
LIC-04	Rockaway	6/9/77	21	0	2	ND
JC-21	Deal, NJ	6/29/77	3	0	64	ND
JC-24	Bradley Beach New Jersey	6/29/77	2	0	1	ND
JC-14	Long Branch, NJ	7/21/77	6	0	0	ND
JC-08	Sea Bright New Jersey	7/29/77	28	3	1	*S. enteritidis* ser. *senftenberg*
JC-03	Sandy Hook Beach	7/29/77	8	2	0	ND
JC-53	Seaside Park	8/5/77	4	0	0	ND
JC-49	Lavallette, NJ	8/5/77	29	6	3	ND
LIC-03	Rockaway	8/12/77	23	1	0	ND
LIC-12	Jones Beach	8/12/77	1	0	0	ND
JC-27	Belmar, NJ	8/19/77	5	0	0	ND
JC-33	Sea Girt, NJ	8/19/77	20	1	1	ND
JC-37	Pt. Pleasant	8/19/77	6	2	0	ND

ND = None Detected
* = For LIC-01, LIC-02, LIC-04, two (2) gallons were filtered
For JC-21 and JC-24, three (3) gallons were filtered
For remaining samples, five (5) gallons were filtered

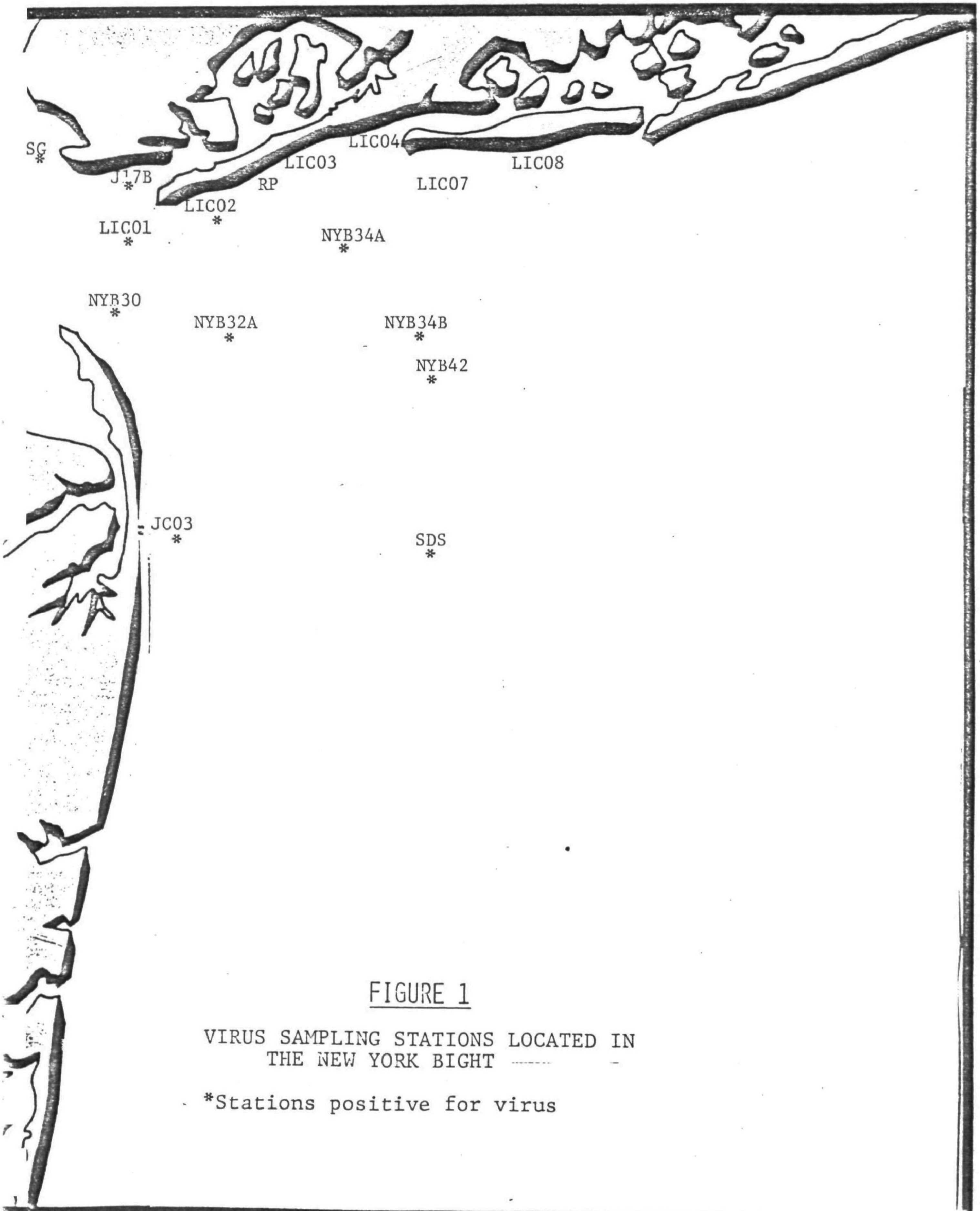
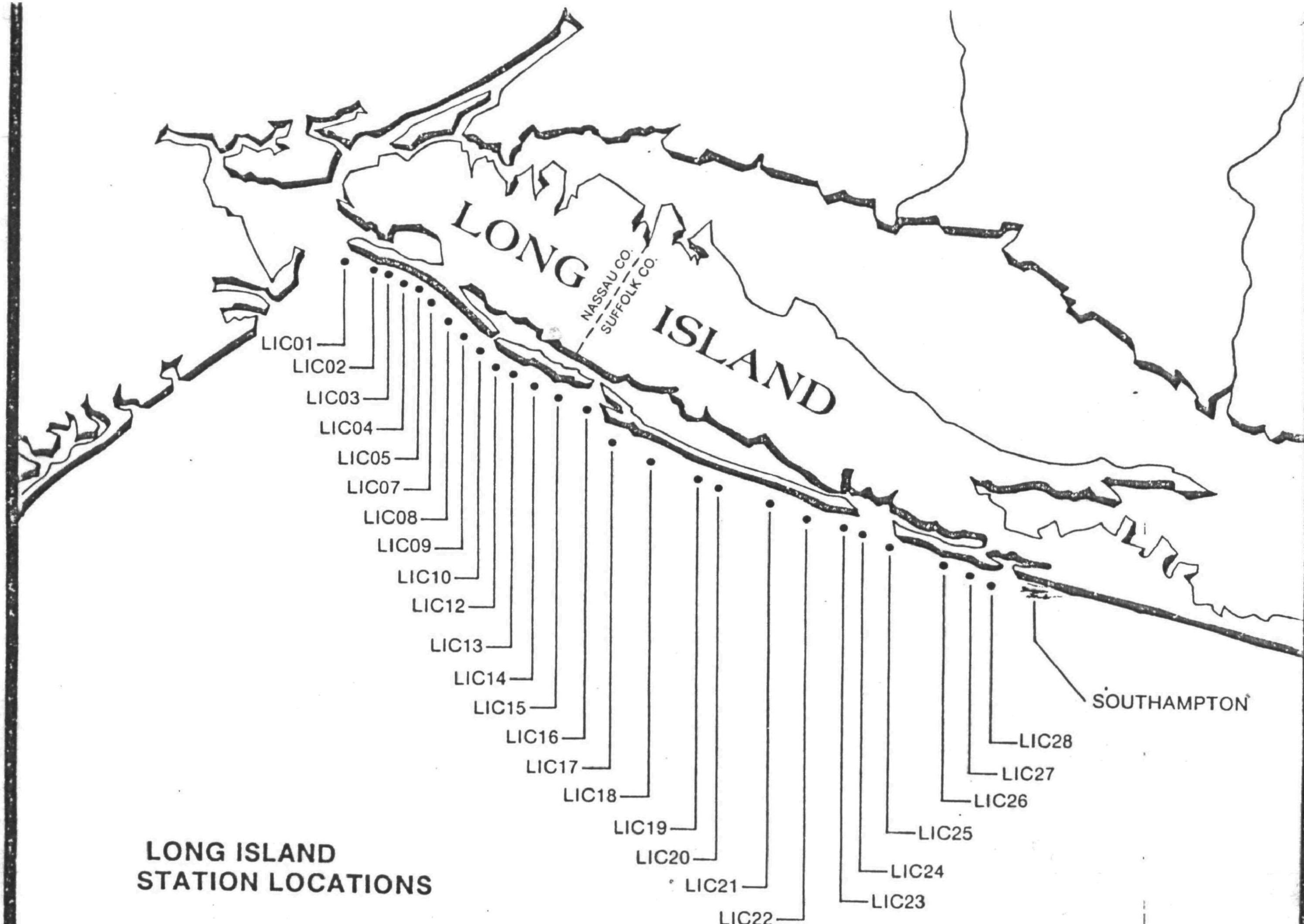


FIGURE 1

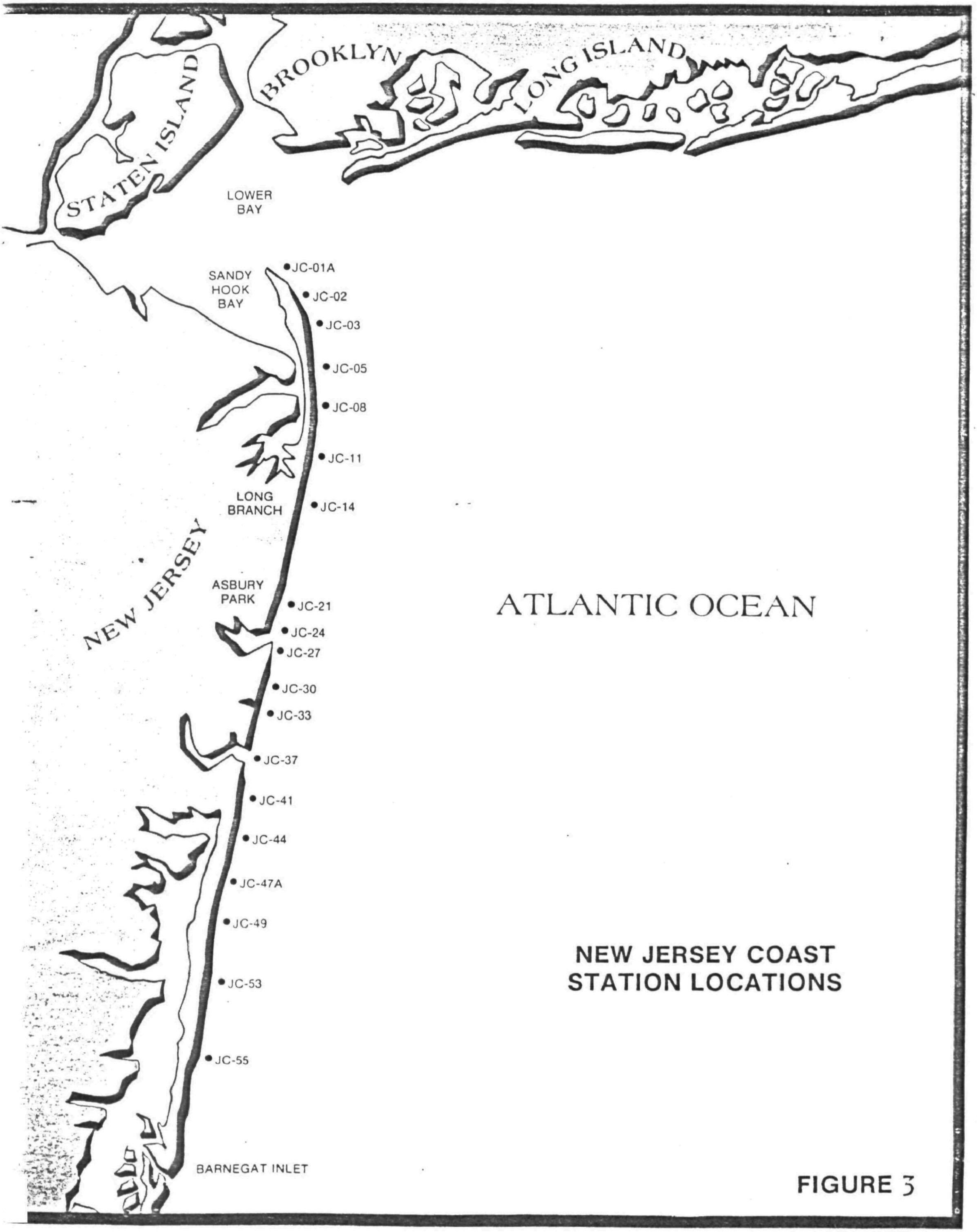
VIRUS SAMPLING STATIONS LOCATED IN THE NEW YORK BIGHT

*Stations positive for virus



LONG ISLAND STATION LOCATIONS

FIGURE 2



NEW JERSEY COAST STATION LOCATIONS

FIGURE 3

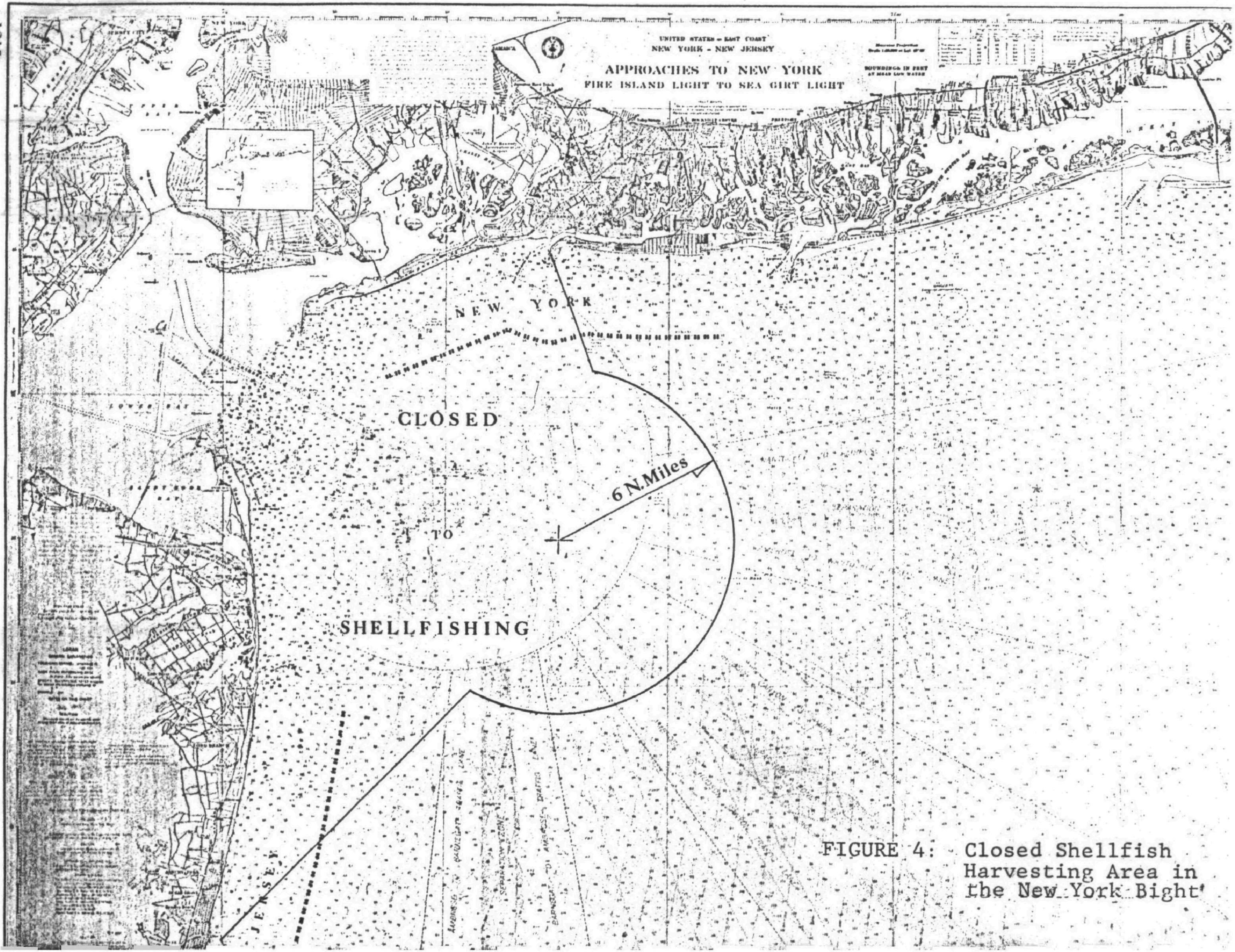


FIGURE 4: Closed Shellfish Harvesting Area in the New York Bight