United States Department of the Interior

NATIONAL PARK SERVICE

Gateway National Recreation Area

Directorate Cultural/Natural Resources
Fort Wadsworth, Staten Island Unit
Staten Island, New York 10305

1996 Water Quality Sampling Program

Division of Natural Resources

Gateway


Manhattan
Queens
New York
New Jersey
Brooklyn
Jamaica Bay Unit
Staten Island Unit
Breezy Point Unit
Atlantic Ocean
Sandy Hook Unit
New Jersey


JB-16
Belt Parkway
John F. Kennedy
International Airport
JB-9A
Jamaica Bay
JB-6A
JB-9
JB-6
JB-12
Cross Bay
Bridge
Rockaway Freeway
Jamaica Bay
JB-15
JB-5A
Dead Horse
Bay
Plumb Beach
Rockaway Inlet
JB-3
ATL-1
Atlantic Ocean

Map 1

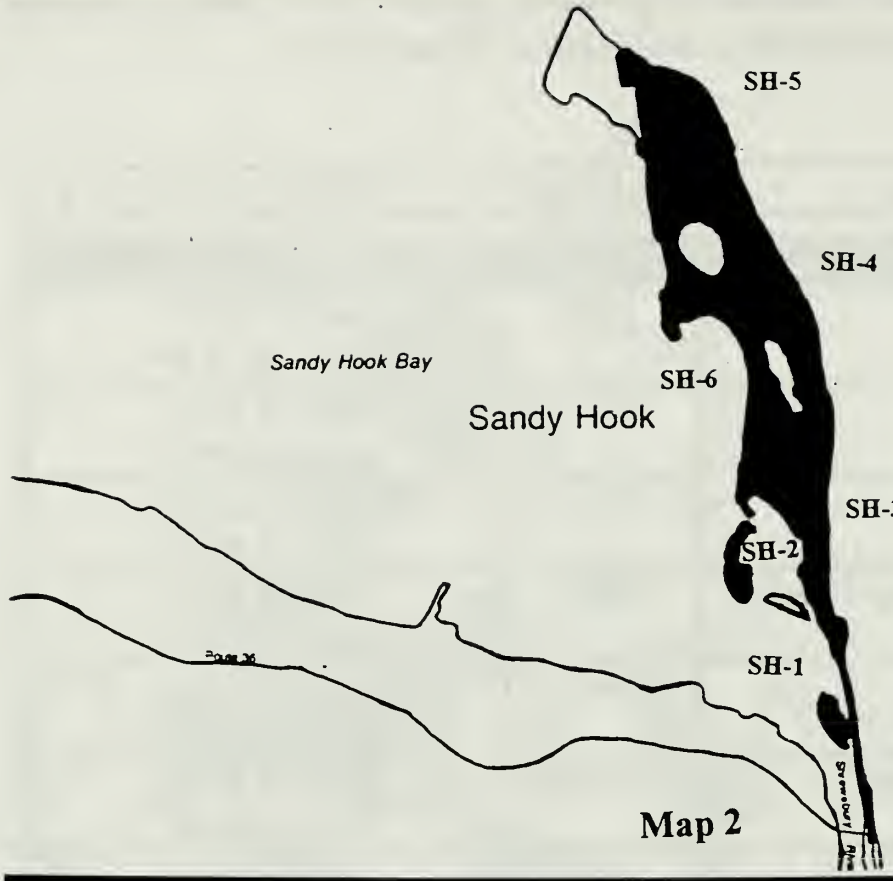
G.P.S. Positions for Gateway National Recreation Area Water Quality Sampling Sites: Jamaica Bay and Atlantic Beach Sites

Site Name	Site Code	G.P.S. Position
Jamaica Bay Sites		
Rockaway Inlet	JB-3	40° 33.99 N 073° 56.26 W
Nova Scotia Bar	JB-5A	40° 34.66 N 073° 52.19 W
Canarsie Pier	JB-6	40° 37.66 N 073° 52.96 W
Pennsylvania Avenue Landfill	JB-6A	40° 38.30 N 073° 52.66 W
Bergen Basin	JB-16	40° 39.21 N 073° 49.34 W
Bergen Basin Outflow	JB-9A	40° 38.47 N 073° 49.21 W
Grassy Bay	JB-9	40° 38.08 N 073° 47.39 W
JoCo Marsh	JB-12	40° 37.43 N 073° 46.44 W
Beach Channel	JB-15	40° 35.17 N 073° 49.86 W
Atlantic Beach Sites		
Riis Park	ATL-1	40° 33.93 N 073° 52.12 W
Breezy Point	ATL-2	40° 32.87 N 073° 55.78 W

Site coordinates were taken by a Magellan GPS Meridian XL Receiver and are not Differential Corrected. These GPS positions are only accurate within 100 meters.

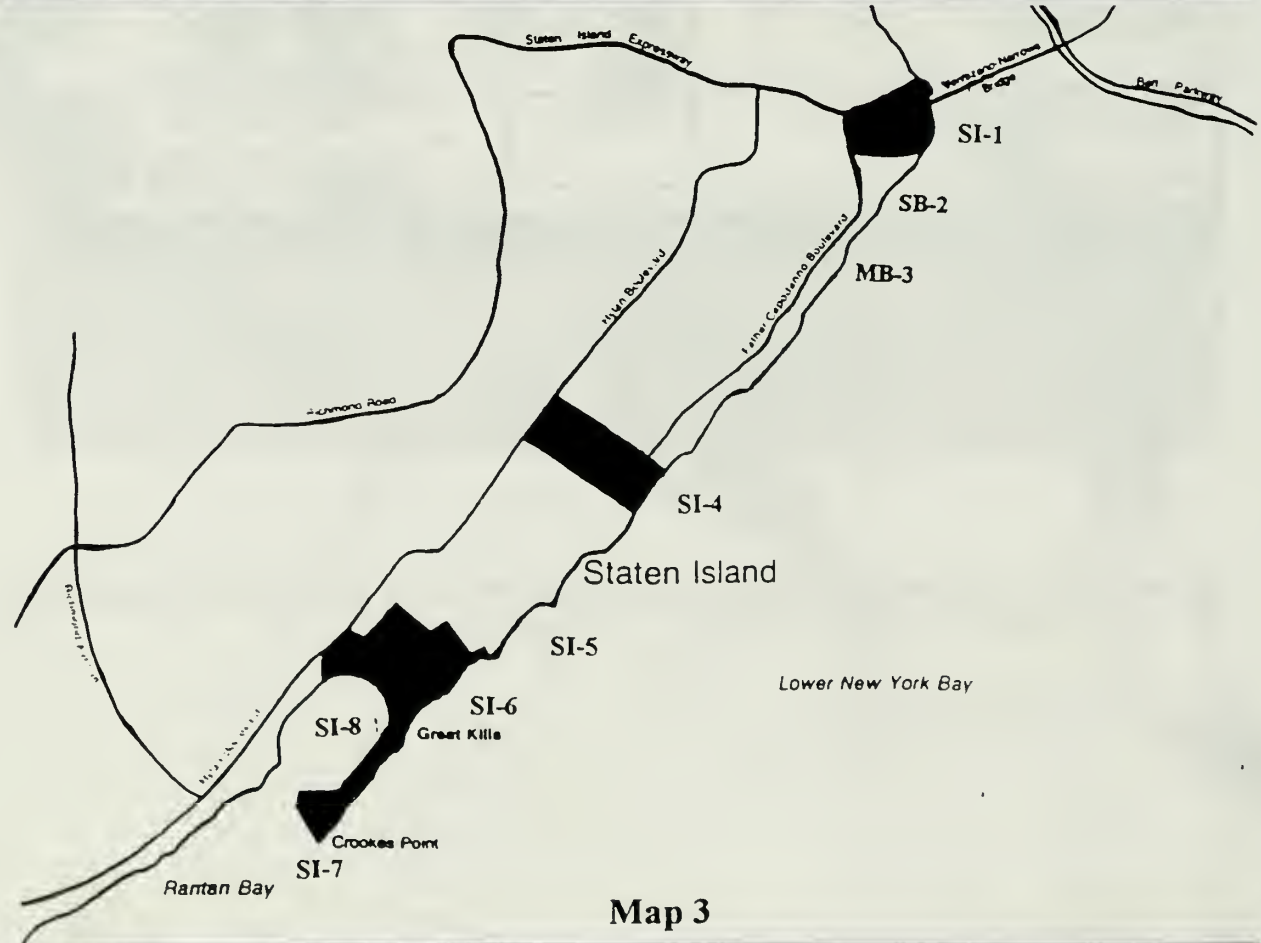
Bathing Beach Sites are shaded.

Sandy Hook Unit



Map 2

Staten Island Unit



Map 3

G.P.S. Positions for Gateway National Recreation Area Water Quality Sampling Sites: Staten Island and Sandy Hook Sites

Site Name	Site Code	G.P.S. Position
Staten Island Sites		
Fort Wadsworth	SI-1	40° 35.84 N 074° 03.42 W
South Beach	SI-2	40° 35.37 N 074° 03.91 W
Midland Beach	SI-3	40° 34.34 N 074° 05.09 W
New Dorp Beach	SI-4	40° 33.78 N 074° 05.68 W
Oakwood Beach	SI-5	40° 33.06 N 074° 06.79 W
Great Kills	SI-6	40° 32.20 N 074° 07.85 W
Crooke's Point	SI-7	40° 31.84 N 074° 08.28 W
Great Kills Marina	SI-8	40° 32.62 N 074° 07.67 W
Sandy Hook Sites		
Plum Island	SH-1	40° 23.51 N 073° 58.39 W
Spermaceti Cove	SH-2	40° 25.41 N 073° 59.17 W
Lot D	SH-3	40° 25.39 N 073° 59.00 W
Gunnison Beach	SH-4	40° 27.45 N 073° 59.29 W
North Beach	SH-5	40° 28.13 N 073° 59.53 W
Horseshoe Cove	SH-6	40° 26.56 N 073° 59.58 W

Site coordinates were taken by a Magellan GPS Meridian XL Receiver and are not Differential Corrected. These GPS positions are only accurate within 100 meters.

Bathing Beach Sites are shaded.

SI-2, SI-3, SH-1, and SH-6 were not tested in 1996 due to budgetary constraints.

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I. BACKGROUND AND HISTORY

Gateway's Water Quality Program was initiated in 1977 to form a data base for the management of park waters for public health and ecological quality. The information collected and analyzed from the program aids in the evaluation of health conditions at public beaches, and in providing baseline data for research management decisions. Water quality data was collected for the following purposes:

1. **To monitor bacterial levels at public beaches under Gateway National Recreation Area jurisdiction for compliance with city, state and federal public health standards for contact-recreational beaches.**

2. **To monitor bacterial levels at other sites within the park to determine trends in water quality.**

3. **To identify potential long-term acceptable beach sites.**

4. **To provide data for the evaluation and review of Gateway's Natural Resources Management Plan regarding fish and wildlife management, as well as visitor public health and safety.**

The sampling program has been evolving since its inception in 1976. This year we have adapted a few changes to the program by including the standardization of sites names and codes, the design and creation of a computer-based template to simplify the preparation of annual Water Quality reports, and the use of a GPS (Global Position System) receiver to provide consistently accurate locational site coordinates.

Identical sample sites and methods have been used from 1981 to the present. This year, due to budgetary constraints, two sites in Staten Island (South Beach and Midland Beach), and two sites in Sandy Hook (Plum Island and Horseshoe Cove) were not tested. The remaining sites were tested from June 3rd to Labor Day. All Sandy Hook, Staten Island, and Atlantic Beach sites were tested at the surf zone for total and fecal coliform. Jamaica Bay sites, sampled by the Division of Natural Resources 19' Boston whaler (Ms. Jamaica Bay) at both the surface and bottom levels, were tested for water temperature, pH, salinity, conductivity, dissolved oxygen, nitrates, Secchi disk, total and free chlorine, orthophosphate and chlorophyll a, as well as total and fecal coliform.

This monitoring program included some of Gateway's most heavily impacted sites, areas which are impacted by sewage treatment plants/combined sewer outflows (CSOs), Pennsylvania and Fountain Avenue Landfills, and JFK International Airport.

The sample locations of primary concern within park boundaries are those sites which are designated as bathing beaches. They are located at Riis Park (ATL-1), Breezy Point (ATL-2), Staten Island (SI-6), and Sandy Hook (SH-3, SH-4, SH-5).

The basis for water quality classification is total and fecal coliform enumeration. Coliform analysis of each site has been performed using the membrane filter technique. Coliforms are a group of specific

microorganisms whose densities can be related quantitatively to swimming related health hazards. The concern is with infectious, enteric diseases, such as cholera and typhoid fever, whose etiological agents are excreted in feces and are spread by water and food contaminated with fecal wastes (Cabelli et al., 1983). Total coliform counts of 2400 colonies/100ml and fecal coliform counts of 200 colonies/100ml are the respective New York State and New Jersey State bacterial standard limits and have the following advantages:

1. Relative simplicity and accuracy of measurement with the Membrane Filter Method (Approved in Standard Methods).

2. Speed of Results: Counts are available within 24 hours of filtration.

3. Ease of comparison with previous data.

4. Measurement of a broader spectrum of coliform bacteria insures the inclusion of most potential pathogens.

II. WATER QUALITY TRENDS

Water quality classification, based on New York State and New Jersey State criteria, has remained the same in all three units. Breezy Point sites have been classified as acceptable, Jamaica Bay sites as unacceptable and Staten Island sites acceptable (but marginal over short periods) for bathing.

Atlantic Beaches

Water quality conditions at the two Atlantic Beach Sites, Riis Park (ATL-1) and Breezy Point (ATL-2), continue to be excellent. No sample taken from either site has exceeded state or federal guidelines for fecal and total coliform levels for the last three years. Average total coliform counts for Atlantic Beach sites have decreased from 49 to 25 colonies/100ml (2400 col/100ml standard) over the last three years; fecal coliform counts have declined from 34 to 11 col/100ml (200 col/100ml standard). In 1996, total coliform counts increased slightly over the summer before decreasing toward the end of August; fecal coliform counts showed two spikes of higher readings; July 2 and August 13.

Riis Park (ATL-1)

Riis Park has tested slightly higher for fecal and total coliform than Breezy Point this year, as in the two years previous. However, counts have continuously been far below the standards of 2400 colonies/100ml and 200 colonies/100ml for total and fecal coliform, respectively. Average total coliform counts for 1996 were 36 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 116 colonies/100ml). Average fecal coliform counts were 12 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 87 col/100ml).

Breezy Point (ATL-2)

Breezy Point continues to have the highest quality water results with respect to coliform counts of Gateway's six bathing beaches. Average total coliform counts for 1996 were 13 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 58 colonies/100ml). Average fecal coliform counts were 9 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 87 col/100ml).

Jamaica Bay

The waters of Jamaica Bay are the most heavily impacted bacteriologically in Gateway National Recreation Area. The sewage treatment plants and CSOs emptying into Jamaica Bay combine with its poor flushing action (35 day residence time) produce occasionally high total and fecal coliform counts in peripheral channels and in areas where circulation is poor such as the Bergen Basin, Grassy Bay area. However, the waters of Jamaica Bay continue to improve in quality. In 1996, no individual samples were found to be confluent (CON), or have coliform colonies too numerous to count (TNTC), which was a common occurrence in years past. While the percentage of samples that exceeded total coliform criteria increased slightly from 5% to 9%, this is still far below 1994's averages of 22%. The percentage of samples that exceeded fecal coliform standards decreased dramatically, from 30% in 1994 and 38% in 1995, to 21% this past summer. While average total and fecal coliform counts rose slightly from 1995's levels (mainly due to some very high individual counts this year, obtained during rainy periods), there was still a tremendous reduction from 1994's averages. These results are most impressive considering that rainfall amounts in 1996 were the third highest in the last 10 years of recorded data, and easily exceeded both 1994 and 1995's levels.

Rockaway Inlet (JB-3)

Located at the mouth of Jamaica Bay, Rockaway Inlet continue to feature the lowest coliform counts of any Jamaica Bay site. Rockaway Inlet's 1996 averages of 113 col/100ml total coliform and 1 col/100ml fecal coliform are the lowest in Jamaica Bay for the last three years. In addition, in 1996 no samples exceed state and federal guidelines for either total or fecal coliform, the first time in the last three years that this has happened.

Nova Scotia Bar (JB-5A)

This site was renamed to more accurately reflect its location, being incorrectly noted as Ruffle Bar in 1994 & 1995's reports. Average seasonal total coliform counts, which had risen dramatically in 1995 from 1994's low levels, decreased almost as dramatically in 1996. Only 4% of total and fecal coliform counts exceeded coliform criteria; while this is higher than the 0% exceeding registered in 1994, it is a great decrease from the 8% of total coliform samples and 18% of fecal coliform samples that exceeded standards in 1995. Nova Scotia Bar's average total and fecal coliform counts of 344 and 29 respectively compare very favorably with federal and state standards, and were far below the average for Jamaica Bay as a whole. After initial high counts on June 4 (during high tide and a very rainy period), counts were dramatically lower for the rest of the summer. No samples exceed coliform standards after June 4.

Canarsie Pier (JB-6)

Formerly called Hendrix Creek (JB-6A) in 1994 and 1995, this site was renamed to more accurately reflect its location. At this site, percentage of samples that exceeded total coliform standards rose to a three year high of 15%, while those that exceeded fecal coliform standards decreased to a three year low of 8%. Total coliform averages of 827 col/100ml were slightly above Jamaica Bay's average as a whole in 1996, while fecal coliform averages of 29 col/100ml were much less than Jamaica Bay's overall average.

Pennsylvania Avenue Landfill (JB-6A)

The percentage of samples that exceeded total and fecal coliform standards fell to three year lows of 4% and 23%, respectively. While average total coliform counts fell to a three year low of 687 col/100ml, fecal coliform counts rose to a three year high of 3209 col/100ml. This was mainly due to a count of 67660 col/100ml recorded on an individual top sample on June 4 (during a rainy period at high tide); only 4 of the remaining 24 samples exceeded fecal coliform standards. The only total coliform sample to exceed standards was also recorded on June 4; counts decreased throughout the remainder of the summer before increasing slightly at the end of August. The two highest weekly averages for fecal coliform were recorded during the two wettest sample periods, at high tide. All the counts that exceeded state and federal standards were recorded from samples taken during high tide, when at least 0.3 inches of rain had fallen within the 72 hours preceding sampling.

Bergen Basin (JB-16)

This site continues to have the distinction of having the highest fecal coliform readings in Jamaica Bay. While total coliform averages rose slightly from 1995 levels (to 902 colonies/100ml), they were much lower than 1994 levels. Although fecal coliform averages were 3749 col/100ml, only 58% of individual samples exceeded criteria, a three year low down from a high of 82% in 1995. Only 15% of total coliform samples exceeded standards, down from a high of 60% in 1994, but up from 8% in 1995. Samples taken during high tide were almost twice as likely to exceed standards as those taken during low tide. Total coliform counts peaked early in the summer then decreased steadily before rising at the end of August; fecal coliform levels were much higher in top samples than in bottom samples.

Bergen Basin Outflow (JB-9A)

This site is located a short distance from the mouth of Bergen Basin; hence it's name. In 1996, total coliform averages and percentage of samples exceeding standards were slightly increased from 1995, to 1455 col/100ml and 23%, respectively, but well below the levels of 1994; fecal coliform averages (of 850 col/100ml) and percentages of samples exceeding standards were at a three year low (46%). Total coliform counts were highest in June and August; fecal coliform counts were highest through July 16; only one sample exceeded fecal coliform standards in the last five weeks of samples.

Grassy Bay (JB-9)

This site was renamed to more accurately reflect its location in 1996; in 1994 and 1995 it was called JFK North of Runway Extension. Total coliform averages and percentage of samples exceeding standards were slightly increased from 1995, to 682 col/100ml and 12% respectively, but well below the levels of 1994; fecal coliform averages and percentages of samples exceeding standards were at a three year low, to 666 col/100ml and 27% respectively. Total coliform counts spiked in both the first and last week of sampling; fecal counts also included higher spikes on July 1 & 16, during rainy periods. No samples exceeding state or federal guidelines for either fecal or total coliform were taken during low tide.

JoCo Marsh (JB-12)

This site was renamed in 1996; in 1994 & 1995 it was called JFK South of Runway Extension. Total coliform averages continued to increase slightly for this site in 1996, to 266 colonies/100ml, as well as the percentage of total coliform samples exceeding standards. The percentage of samples exceeding fecal coliform standards decreased from 1995 to 1996, as well as fecal coliform averages (to 35 col/100ml). No samples exceeded total or fecal coliform standards after week one (June 4). Mirroring a pattern shown by Grassy Bay (on the opposite side of the runway), counts were highest on June 4, July 1, July 16 and August 29. The samples that were taken on the first three dates mentioned were all taken during rainy periods at high tide.

Beach Channel (JB-15)

Percentages of samples (both total and fecal coliform) that exceeded state and federal standards continued a slight upward rise in 1996 (to 8% exceeding total coliform samples and 15% exceeding fecal coliform samples), while otherwise remaining below average for Jamaica Bay as a whole. Average counts for both total and fecal coliform samples were well below Jamaica Bay's overall average: to 441 col/100ml total coliform and 114 col/100ml fecal coliform. Only on July 1 and 16 did any samples exceed standards; both samples were taken during rainy periods at high tide.

Staten Island

Water quality at sample sites in Staten Island have been "marginal" in past years, with South Beach (SB2) being officially closed to swimming by the New York City Department of Health. Other sites have seasonal averages below city and federal standards, but show occasional unhealthy counts throughout the bathing season. Staten Island's overall coliform averages continued a slight downward trend in 1996. Both total and fecal coliform averages showed some increases as the testing season progressed, peaking on July 23, then decreasing thereafter. Overall fecal coliform averages were skewed by a single Fort Wadsworth sample that registered over 25,800 col/100ml; most sites showed continued decreases in fecal coliform levels. Total coliform levels were mixed; three sites showed increases and three decreases. Fort Wadsworth and Great Kills showed increasing levels of both total and fecal coliform counts over the summer; Fort Wadsworth peaking on July 23 and Great Kills on July 31.

Fort Wadsworth (SI-1)

Fort Wadsworth showed a slight increase in total coliform samples exceeding standards from 1994-1996, while also showing a marked decrease in fecal samples exceeding guidelines during the same period. Total coliform averages increased during the three year period while still remaining well below standards; fecal coliform averages were distorted by a single sample of >25,800 in 1996. Average total coliform counts for 1996 were 493 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 2500 colonies/100ml). Average fecal coliform counts were 2011 colonies/100ml, which was distorted by the aforementioned July 23 sample, and which exceeded the fecal coliform standard of 200 col/100ml.

South Beach (SI-2)

Not tested in 1996 due to budgetary constraints.

Midland Beach (SI-3)

Not tested in 1996 due to budgetary constraints.

New Dorp Beach (SI-4)

One of two sites in Staten Island with no counts that exceeded either total or fecal coliform standards in 1996; a three year low for this site. Total and fecal coliform count averages decreased from 1995's levels, while still being higher than levels in 1994. Average total coliform counts for 1996 were 161 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 435 colonies/100ml). Average fecal coliform counts were 38 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 87 col/100ml).

Oakwood Beach (SI-5)

In 1996, the percentage of total and fecal coliform counts exceeding standards, as well as average total and fecal coliform counts, decreased to three year lows. Average total coliform counts for 1996 were 112 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 464 colonies/100ml). Average fecal coliform counts were 36 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 232 col/100ml). Only one sample exceeded either total or fecal coliform standards in 1996.

Great Kills (SI-6)

Great Kills Beach did not exceed total coliform criteria this year; however, 25% of fecal coliform samples did exceed state and federal standards. Averages for both total and fecal coliform counts increased from 1995 while being still lower than levels in 1994. Both total and fecal coliform counts peaked on July 30-August 1 and decreased thereafter. Average total coliform counts for 1996 were 163 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 1150 colonies/100ml). Average fecal coliform counts were 188 colonies/100ml, also below the fecal coliform standard of 200 col/100ml (highest count in 1996, 870 col/100ml).

Crooke's Point (SI-7)

Total coliform averages increased slightly in 1996, to 100 colonies/100ml, while being well below standards; fecal coliform averages decreased from 1995, to 40 col/100ml.. Only one fecal coliform sample exceeded standards in 1996. Average total coliform counts for 1996 were 100 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 493 colonies/100ml). Average fecal coliform counts were 40 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 261 col/100ml).

Great Kills Marina (SI-8)

No samples exceeded either total or fecal coliform standards in 1996; total and fecal coliform averages were at a three year low. Average total coliform counts for 1996 were a Staten Island best of 33 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 116 colonies/100ml). Average fecal coliform counts were 7 col/100ml, also a Staten Island best for 1996, far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 87 col/100ml). Only one sample taken at Great Kills Marina recorded a fecal coliform count of more than zero in 1996.

Sandy Hook

In 1996, as in 1994 & 1995, no total coliform samples exceeded state and federal guidelines. Two percent of fecal coliform counts exceeded guidelines; this was the lowest level in the last three years. Average total coliform counts decreased dramatically for the second year in a row (from 222 colonies/100ml in 1994, 123 col/100ml in 1995, to 41 col/100ml in 1996. Fecal coliform counts also declined precipitously, from 153 col/100ml in 1994, to 134 col/100ml in 1995, and finally to 15 col/100ml in 1996.

Plum Island (SH-1)

Not tested in 1996 due to budgetary constraints.

Spermaceti Cove (SH-2)

The percentage of total and fecal coliform samples exceeding standards was at a three year low in 1996, as were average total and fecal coliform counts. Average total coliform counts for 1996 were 40 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 174 colonies/100ml). Average fecal coliform counts were 36 colonies/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 261 col/100ml). Only one sample exceeded either total or fecal coliform standards in 1996; this was also the only sample to exceed standards for the whole of Sandy Hook.

Lot D (SH-3)

No samples exceeded total and fecal coliform standards during 1996. Both total and fecal

coliform averages decreased to three year lows in 1996. The average total coliform count for 1996 was 23 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 145 colonies/100ml). Average fecal coliform counts were 13 col/100ml, also far below the fecal coliform standard of 200 col/100ml (highest count in 1996, 87 col/100ml). Over half of the samples taken at Lot D in 1996 registered 0 total and fecal coliform counts.

Gunnison Beach (SH-4)

No samples exceeded total and fecal coliform standards during 1996. Both total and fecal coliform averages decreased to a three year low in 1996. The average total coliform count for 1996 was 13 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 87 colonies/100ml). The average fecal coliform count was 11 colonies/100ml, also below the fecal coliform standard of 200 col/100ml (highest count in 1996, 145 col/100ml). Only 1 sample registered any fecal coliform counts in 1996; only three registered above zero for total coliform. Gunnison Beach had the lowest total coliform average for any site in Sandy Hook.

North Beach (SH-5)

No samples exceeded total and fecal coliform standards during 1996. Total coliform averages increased slightly while being well below state and federal standards; fecal coliform averages decreased to a three year low in 1996. The average total coliform count for 1996 was 89 colonies/100ml, far below the standard of 2400 col/100ml (highest count of 1996, 667 colonies/100ml). Average fecal coliform counts were 9 colonies/100ml, also below the fecal coliform standard of 200 col/100ml (highest count in 1996, 58 col/100ml). This site had the lowest average fecal coliform counts in Sandy Hook in 1996.

Horseshoe Cove (SH-6)

Not tested in 1996 due to budgetary constraints

III. METHODS

Sampling And Coliform Testing

Sampling and Membrane Filter culture methods followed standard EPA procedures for wastewater analysis (Bordner and Winter, eds., 1978) with minor modifications. Gateway's Operations Manual for Bacteriological Analysis of Beach Water using the Membrane Filter Technique (Simon, 1984) provides a detailed description of methods used. Total and fecal coliform measurements were obtained for all sample sites on a weekly basis between June 3rd and Labor Day.

In Jamaica Bay, surface and bottom water samples were collected by boat **(Map 1)** while Staten Island **(Map 3)**, Breezy Point **(Map 1)** and Sandy Hook **(Map 2)** samples were collected by wading into the surf zone at mid-depth (18") in three feet of water. Samples were then stored in ice-filled coolers and transported to Floyd Bennett Field to be picked up by Ecotest Laboratories Inc.

Based on data from previous years for all sites sampled, a standard dilution scheme for each site was developed to optimize the number of countable plates obtained (**Table I**). Data was recorded for sampling time and any unusual water conditions, and counts for each dilution were summarized on weekly data sheets.

Standard counts (colonies/100ml) were calculated for each site using the following formula:

Count/100ml = # colonies counted/volume filtered X 100ml

The densities for each site were calculated to be the arithmetic means of the dilutions that showed 20-200 colonies for that week.

$$\text{Count/100ml} = \frac{\frac{\text{colony count}}{\text{Vol. 1}} + \frac{\text{colony count}}{\text{Vol. 2}} + \frac{\text{colony count}}{\text{Vol. 3}}}{} \times 100$$

If no plates were found to have less than 200 colonies for a given site, the smallest volume sampled was used to calculate density. If the plate was completely overgrown and no count could be made, the density was determined by dividing 200 colonies by the smallest volume filtered.

IV. DISCUSSION

Water Quality Parameters

Water quality parameters include dissolved oxygen (DO), temperature, pH, salinity, and conductivity. These have been taken at both the surface and bottom of nine sites in Jamaica Bay in order to better assess the physical characteristics of these waters throughout the season. However, this season it was determined that it would be beneficial to the Park's water quality program to also sample some important nutrients in Jamaica Bay. The results for all water quality sampling at Gateway National Recreation Area are expressed by site in **Tables VII-XVIII (Figures 7-50)**, and by parameters in **Tables XIX-XXXI (Figures 51-82).**

Total and Fecal Coliform

Coliforms are indicator species, or microorganisms whose densities can be related quantitatively to swimming associated health hazards. Total and fecal coliform serve as nonconservative tracers of sewage related pollution (Dyer, 1973). They are nonconservative in the sense that they are rapidly removed from the marine environment by dieaway and incorporated into the sediments and decreases in their concentrations are not solely dependent on their physical transport and diffusion. Dieaway for total coliforms in Jamaica Bay was estimated to be 1.3 days and 1.5 days for fecal coliform (Cardenas, 1983).

Total coliform refers to species of Escherichia, Klebsiella, Serratia, Edwardsiella, Enterobacter and Citrobacter. Except for Escherichia and Klebsiella, all can exist as free-living saprophytes as well as in the intestinal tract of a host. Total coliform tests are the standard test for drinking water quality. (Scaglione, 1989). Fecal coliform refers mainly to Escherichia and Klebsiella, which are indicative of recent fecal pollution. Higher incubation temperatures can isolate them from the rest of the group which makes up total coliform. Fecal coliform tests are the standard measure for testing pollution in recreational and other waters. (Scaglione, 1989).

This year's total coliform averages for Jamaica Bay have shown a marginal decrease over preceding years (**TABLE II**), with Breezy Point, Staten Island and Sandy Hook all exhibiting substantial decreases. Fecal coliform levels, considered to be the more reliable indication of the risk of enteric disease, have not shown the same trend, with averages in Jamaica Bay and Staten Island increasing slightly, while Sandy Hook and Breezy Point have shown substantial decreases. In 1996, no samples for fecal or total coliform were found to be confluent **(CON)** or have colonies too numerous too count **(TNTC).**

Temperature

Water temperature profoundly influences the lives of most marine plants and animals. These plants and animals are adapted to a normal seasonal temperature regime and are commonly affected adversely by unusual temperatures (Royce, 1984) . Many animals reproduce, feed or migrate only within certain temperature ranges.

The temperature of the open ocean varies from 0 to 20 °C at the surface. Radiation from the sun warms waters in only a thin surface layer; 20 meters in clear ocean water and 4 meters in coastal waters, like those of Jamaica Bay. At the bottom of the mixed layer is a thermocline, a layer in which temperature changes rapidly with depth. Waters that are below the thermocline are of a more constant temperature. The seasonal variations in temperature are related to the size of Jamaica Bay and its proximity to land. The closer to land a body of water is, the more variation there will be in temperature (Royce 1984).

As can be seen in Table XIX and Figures 51-53, water temperatures in Jamaica Bay in 1996 averaged from about 17° C on June 4 to 24° C on August 26. Bottom temperatures, while slightly depressed by up to 0.5° C from surface temperatures, closely paralleled them throughout the summer. Average water temperatures were highest at the JoCo Marsh and Grassy Bay sample sites (closest to the Head of the Bay and JFK International Airport); they were lowest at Rockaway Inlet and Nova Scotia Bar sample sites, which are closest to the mouth of Jamaica Bay.

pH

pH is the standard measure of acidity, and a pH value of 7 represents neutral conditions. A low pH value (less than 5) indicates acidic conditions; a high pH (greater then 9) indicates alkaline conditions. Many biological processes, such as reproduction, cannot function in acidic or alkaline waters. Few organisms can exist where pH levels are lower than 4 or higher than 9. Water with a pH of between 6.5 and 8.5 will support the highest variety of aquatic plant and animal life.

Weekly sampling indicated that Jamaica Bay's pH averaged between 7.4 and 8.0 for the sites tested. Baywide, pH averages decreased slightly on July to 7.4 before increasing to nearly 8.0 on August 12; levels then returned just as quickly to 7.5 the following week. Sites located closer to the ocean had seasonal pH averages of 7.7 to 7.9. Sites located farther into the bay had pHs averaging between 7.3 and 7.7.

Salinity

Salinity is the total amount of solid material in grams/Kg of seawater when the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine and the organic material completely oxidized. Seawater is a mixture of constant proportions of halide, carbonate and sulfate salts of sodium, magnesium, calcium, potassium and strontium, together with small quantities of other substances and minute traces of other elements.

The salinity of the open ocean varies from only about 33% to 37%, because of different evaporation and rainfall amounts. In estuaries, the effects of evaporation and rainfall are much greater. Salinity varies in the bay from site to site because of depth, location in the estuary, tide level. and seasonal changes in temperature.

Salinity in Jamaica Bay in 1996 featured baywide weekly averages remaining fairly constant throughout the sample period. Bottom samples were slightly more saline than top samples, running 3 to 5 ppt higher. Seasonal top and bottom samples were nearly identical for most sites with the exception of Bergen Basin and Bergen Basin Outflow, where top samples had far lower salinity than bottom samples. Rockaway Inlet and Nova Scotia Bar, near the mouth of the bay, were the most saline sample sites.

Conductivity

Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. It depends on the presence of ions, their total concentrations, mobility, valence and relative concentrations. Conductivity is important in determining the inorganic equilibria, the physiological effect on plants and animals, and the corrosion rate of the environment.

The conductivity seasonal average graph for Jamaica Bay in 1996 resembled that of the salinity readings; top and bottom samples averaging nearly the same except for Bergen Basin and Bergen Basin Outflow. Weekly averages were similar throughout the summer; top sample conductivity readings were slightly lower than bottom samples.

Dissolved Oxygen

Dissolved Oxygen (DO) is a common measurement of biological significance. Oxygen dissolved in the water is a function of barometric pressure, temperature, salinity and proportion of oxygen in the air. Temperature and salinity cause the greatest variables in the amount of oxygen. Fish and other aquatic organisms "breath" oxygen dissolved in the water column and can recover from short periods of low dissolved oxygen availability, prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/l or less can result in "dead" water bodies. Oxygen levels are usually high in estuaries because of

the constant inflow and mixing of both freshwater and salt water, although the naturally high levels of organic matter may reduce oxygen levels during times of low flow. Suspended organic and inorganic materials from runoff during heavy rains, CSO's and sewage treatment plants also affect oxygen levels in the bay.

In Jamaica Bay on June 4, 1996, top samples averaged over 4 mg/l less than bottom samples, which were 10.38 mg/l. Top DO remained substantially lower than bottom DO until July 22, when surface sample DO levels began to rise dramatically. On August 9, 1996, top DO and bottom DO both surpassed 8 mg/l, with top DO averaging in excess of 9.0 mg/l. What is most noticeable over the summer sample period is that bottom DO levels were consistently high and stable throughout the bay; top DO was much lower in the north and northeastern sample sites, JB-6, JB-6A, JB-16 and JB-9A. Top samples for these sites in the bay fail to meet NYS standards for dissolved oxygen (6.0 ppm) for most of the summer and into the fall.

Nitrates

Nitrates have two main sources. They are the major component of fertilizer used in agricultural practices, which can be washed from fields into streams and other waterbodies during periods of rainfall. However, since the area surrounding Jamaica Bay is a highly developed urban area, there is little input of nitrates to the bay from fertilizer. The second source of nitrate, however, is human sewage and animal waste. Several sewage treatment plants discharge into Jamaica Bay and its tributaries; it is likely that this is the most significant source of nitrate to the Jamaica Bay ecosystem. Nitrates in the bay are a source of nutrients for Jamaica Bay's plant life, including both vascular plants and algae. High nitrate levels can lead to algal blooms, which can cause severe oxygen depletions during summer dieoffs. If all inorganic nitrogen (nitrate, nitrite and ammonia) exceeds 0.3 mg/l, algal blooms may be caused; more than 4.5 mg/l nitrate can be dangerous to most animals.

Baywide averages of samples taken in 1996 slightly exceeded 0.3 mg/l in July. Of the samples taken in 1996, 44.4% indicated nitrate averages of 0.3 mg/l or higher. Only two sites averaged higher than .0.3 mg/l for the summer: Pennsylvania Avenue Landfill and Canarsie Pier. Neither site averaged in excess of 0.45 mg/l; however, 3.3% of samples baywide did exceed 0.45 mg/l over the summer. No algal blooms were noted by park personnel.

Secchi Disk

Secchi Disks are used to determine the degree of clarity or turbidity in a body of water. By lowering the secchi disk, a white circular plate, over the side of the boat until it disappears from site, readings were obtained to indicate how far below the surface visibility extended.

Secchi Disk readings were highest at Rockaway Inlet and Nova Scotia Bar, near the mouth of Jamaica Bay, with averages of 3.4 and 2.2 meters respectively; they were lowest in the northeastern part of the bay, with averages of 0.79 meters for Bergen Basin, 1.15 meters for Bergen Basin Outflow & 1.17 meters for Grassy Bay. Weekly averages for Jamaica Bay were generally in the 1-2 meter range.

Total and Free Chlorine

Chlorine applied to water in its molecular or hypochlorite form initially forms **free chlorine** consisting of aqueous molecular chlorine, hypochlorous acid, and hypochlorite ion. The relative proportion of

these free chlorine forms are pH and temperature dependent. At normal pH levels, hypochlorous acid and hypochlorite ion will predominate. **Total chlorine**, also known as combined chlorine, occurs when free chlorine combines with ammonia and certain nitrogenous compounds. The presence and concentration of combined forms is dependent on pH, temperature, initial chlorine-to-nitrogen ratio, absolute chlorine demand and reaction time. Chlorinated wastewater effluents, as well as certain chlorinated industrial effluents, normally contains only combined chlorine. In the last two years in Jamaica Bay, only one sample has exceed the minimum detection limit of 0.05 mg/l of either total or free chlorine. On June 11, 1996, a top sample at Pennsylvania Avenue Landfill contained 0.08 mg/l of total chlorine.

Orthophosphate

Phosphates can be found in fertilizers, like nitrates; other sources include human and animal wastes and industrial plants. They are only dangerous in very large amounts, and are utilized as nutrients by plant life.

Jamaica Bay seasonal averages indicate that most sites registered 0.1 and 0 .4 mg/l of orthophosphate, except for Bergen Basin, which registered a seasonal average of 1.85 mg/l. Other sites with high levels of orthophosphates include Bergen Basin Outflow and JoCo Marsh. Seasonal averages baywide for top samples ranged from 0.39 mg/l to 0.54 mg/l., while bottom samples ranged from 0.25 to 0.28 mg/l.

Chlorophyll a

Chlorophyll a is a common indicator of phytoplankton biomass. Phytoplankton are microscopic, unicellular algae which contribute oxygen and function as a food source for marine zooplankton, thus are an integral part of the estuarine food web.

Phytoplankton have long been used as an indicator of water quality (Palmer, 1969). Some species flourish in eutrophic waters, while other display sensitivity to organic and/or chemical wastes. Some species are associated with noxious blooms which may cause offensive odors or tastes, while others may produce toxic conditions. Plankton respond quickly to environmental changes because of their short life span. Their influence can alter the pH, color, taste and odor of a waterbody. In order to flourish, plankton have their own environmental criteria. Light of the right intensity is vital to phytoplankton, as are sufficient quantities of nutrients; including vitamin B-12, biotin, carbon dioxide, and a variety of minerals in specific concentrations (Vineyard, 1979). Temperature variations also influence algal biomass.

Chlorophyll a averages decreased monthly, with the highest average in June and the lowest in August, in 1996. Most sites had top chlorophyll a averages of between 1.8 and 6.0 mg/m^3, and bottom samples with between 2.0 and 5.5 mg/m^3. Grassy Bay and Bergen Basin had averages of 9.844 mg/l and 40.7 mg/3 respectively for top samples; Canarsie Pier averaged 9.756 mg/m^3 for bottom samples. Grassy Bay had the highest reading, 112.4 mg/m^3 on June 4. Lowest readings occurred on August 12, when JoCo Marsh, Beach Channel, and Bergen Basin Ouflow all had readings of zero chlorophyll a.

Factors Effecting Water Quality

The quality of the waters surrounding Gateway is determined largely by pollutant inputs such as treated and untreated sewage, CSOs, industrial effluent, ocean dumping of sewage sludge, and toxic waste leachates. The concentrations of these pollutants are controlled by chemical, physical, and biological processes in the marine environment (Dyer, 1973). At any given time water quality will vary depending on a variety of other factors. These include tidal mixing, vertical mixing of the water column by wind and wave, biological oxygen demand (BOD), photosynthesis by phytoplankton, and water temperature.

Precipitation And Tides

Precipitation is a known cause of intermittent decreases in water quality. It produces shock loading of pollutants to local waters by storm waters and combined sewage overflows. (NYC DEP, 1987). Total and fecal coliform counts have been consistently higher following rainfall in local waters (NYC Department of Health, 1983) **(Table VI). Rainfall amounts occurring within the 72 hours preceding sampling are indicated on Figure 6.**

Tidal currents and tidal flushing account for much of the transport and dilution in estuaries (Dyer, 1973). Sampling at Gateway sites is performed irrespective of the tidal state, although tidal state was noted on individual sample location tables in Jamaica Bay (Table VII-Table XV).

It has long been felt by Park Service staff that the two greatest impacts on total and fecal coliform levels in Jamaica Bay are tide height at sampling time and rainfall that may lead to CSO failure preceding sampling. In 1996, the following results were found when comparing rainfall in the 72 hours preceding testing. "Dry samples" were recorded when less than 0.05 of an inch of rainfall fell in the 72 hour period preceding testing times; "wet samples" were recorded when at least 0.05 inches of rain was recorded. Comparisons were also made for tide height.

	Total Coliform Samples	Fecal Coliform Samples
Precipitation		
Wet Sample	12.69%	29.36%
Dry Samples	6.48%	10.19%
Tide		
High Tide	15.38%	35.58%
Mid Tide	6.90%	10.34%
Low Tide	4.17%	4.17%

As can be seen from the above chart, "dry samples" were much less likely to exceed standards for both total and fecal coliform. Only three of the nine sites in Jamaica Bay exceeded coliform standards during dry sample periods; Bergen Basin and Bergen Basin Outflow, located in close proximity to each other, were responsible for 6 of the 7 total coliform samples which exceeded standards during "dry samples", as well as 8 of the 9 samples that exceeded fecal coliform

standards. Tide was also an important factor. There was a much greater probability of a sample exceeding total or fecal coliform standards if it was taken at high tide.

When comparisons were made using all combinations of tide height and precipitation, the following results were obtained:

Total Coliform Samples				
	Wet Samples		Dry Samples	
Tide Height	No.	% Exceeding Standards	No.	% Exceeding Standards
High	68	22.1%	36	2.7%
Mid	16	0%	42	6.7%
Low	42	2.4%	30	8.6%

Fecal Coliform Samples				
	Wet Samples		Dry Samples	
Tide Height	No.	% Exceeding Standards	No.	% Exceeding Standards
High	68	48.5%	36	11.1%
Mid	16	18.8%	42	7.1%
Low	42	2.4%	30	6.7%

As can be seen from the above, high tides combined with "wet samples" resulted in the highest probability for exceeding total coliform samples. Few samples taken during wet periods exceeded standards for total coliform if the tide was low or at mid levels. The probability of dry samples exceeding standards for total coliform was low respective of tide level, although slightly higher for low tide.

Samples had a much higher probability of exceeding fecal coliform standards if taken during rainy periods at high tide. Almost 50% of samples exceeded fecal coliform standards baywide when sampling was done during rainy periods at high tide. Only 2.4% of samples taken during rainy periods at low tide exceeded standards. "Dry samples" taken at high tide were more likely than those taken at low tide to exceed fecal coliform standards, and were also more likely than "wet samples" taken at low tide to exceed fecal coliform standards. Dry samples taken at high and mid tide were much less likely to exceed standards; those taken at low tide were slightly more likely to do so than those taken during rainy periods.

Water Quality Emergencies

In the past, Gateway's policy for the protection of public health at bathing beaches has been to officially close beaches by public notice when individual samples with total coliform values greater than 2400/100ml and fecal coliform values greater than 200/100ml are detected over a three consecutive period at a given beach. Although this is an effective response to a persistent problem, it does leave a three day period during which bathers are potentially exposed to unhealthy concentrations of coliform organisms. Literature indicates that swimmers stand a much greater risk of contacting disease from

polluted water than nonswimmers, when swimmers are defined as those who undergo total immersion (Cabelli et al., 1983).

The following procedures are followed when a sample, determined to have greater than 200/100ml fecal coliform and greater than 2400/100ml total coliform, count is collected at one of Gateway's beaches:

1. Immediately contact the Water Quality Specialist in the Division of Natural Resources, who will notify the Superintendent of the unit affected by the potential problem and advise to alert lifeguards to look for unusual odors, fecal matter, algae, oil, or grease in water or on the beach, and to pull swimmers from the water at their discretion.

2. Check with New York City Health Department to determine if any overflow incident or accidental release of raw sewage has occurred at local sewage treatment plants. Advise park's Chief, Division of Natural Resources, and document all communication with New York City Health Department.

3. Collect 5 samples at different locations (at least 50 yards apart) on the suspect beach and filter volumes of 2.0, 1.0 and 0.5 ml for each sample.

Swimmers should be prevented from bathing by lifeguards if any of the following is observed:

1. Elevated average total (greater than 2400 colonies/100ml) and fecal coliform (greater than 200 colonies/100ml) counts of replicate samples.

2. Presence of oil, grease, or fecal matter in water or on the beach in large quantities.

3. Accidental spillage of raw sewage or of any toxic substance in the waters adjacent to the beach which may adversely effect public health.

4. Any other environmental incident which may be detrimental to the health and safety of the bathers.

Swimmers should be kept out of the water as long as replicate testing continues to show elevated coliform levels or other adverse environmental conditions persist. This will allow continued public access to the beach while still protecting the public health. If these conditions persist for three days or more, however, the beach should be closed officially by public notice and should remain closed until water quality has returned to normal levels. **It is the responsibility of the park's Water Quality Specialist to carefully document water quality and environmental conditions when beach closure is considered.** A looseleaf laboratory notebook is to be carefully maintained for each season's data. The notebook should contain all data and summary sheets, and be used as a log for all laboratory and field operations.

DATA

Coliform data throughout the season at most sites showed high variability. This was probably due to error implicit in the method (Fleisher and McFadden, 1979) and various environmental factors. **TABLE III** exhibits the percentage of sample days during which standard water quality values were exceeded.

V. NOTE:

1996 Water Quality testing was not conducted at Gateway National Recreation Area laboratory due to relocation of the Division Natural Resources and construction of new laboratory facilities. All analysis of water quality was performed by:

EcoTest Laboratories, Inc.
377 Sheffield Ave.
N. Babylon, N.Y. 11703

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Table I

Dilutions (Volumes) By Site For MF Analysis

Sample Site	Volumes To Be Filtered (ml)	
	Total Coliform	Fecal Coliform
Staten Island		
Fort Wadsworth	2.0, 1.0, 0.5	2.0, 1.0, 0.5
New Dorp Beach	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Oakwood Beach	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Great Kills Beach	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Crooke's Point	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Great Kills Marina	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Breezy Point		
Riis Park	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Breezy Point	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Jamaica Bay		
Rockaway Inlet	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Nova Scotia Bar	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Canarsie Pier	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Pennsylvania Avenue Landfill	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Bergen Basin	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Bergen Basin Outflow	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Grassy Bay	2.0, 1.0, 0.5	2.0, 1.0, 0.5
JoCo Marsh	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Beach Channel	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Sandy Hook		
Spermaceti Cove	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Lot D	2.0, 1.0, 0.5	2.0, 1.0, 0.5
Gunnison Beach	2.0, 1.0, 0.5	2.0, 1.0, 0.5
North Beach	2.0, 1.0, 0.5	2.0, 1.0, 0.5

Example: **Smallest volume filtered = 0.5ml**

$$\frac{\text{20 colonies}}{\text{0.5ml}} \times 100 = 4{,}000/100\text{ml}$$

The density would then be logged as 4,000/100ml.

Table II

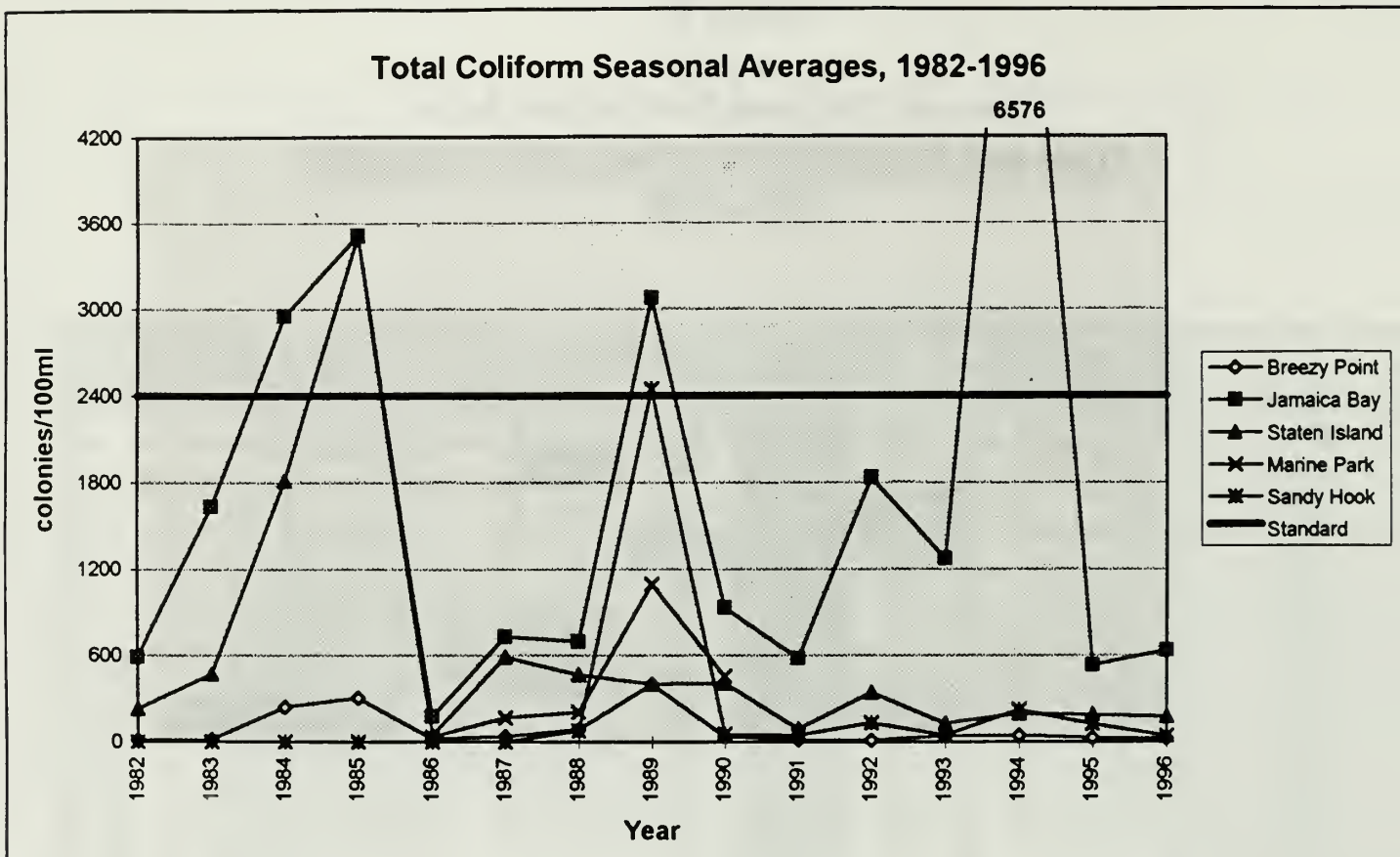
Gateway National Recreation Area
Total and Fecal Coliform Seasonal Averages
1982-1996

Year	Breezy Point		Jamaica Bay		Staten Island		Marine Park		Sandy Hook	
	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
1982	15	8	588	**217**	229	71				
1983	19	14	1631	**1150**	466	**229**				
1984	242	18	**2955**	**500**	1812	87				
1985	307	37	**3513**	**429**	**3508**	42				
1986	21	7	176	**277**	47	23	35	36		
1987	37	21	731	**277**	589	**307**	167	49		
1988	85	29	964	**336**	464	**261**	208	45	78	43
1989	401	77	**3077**	**1324**	401	77	1097	**266**	**2450**	29
1990	38	27	932	**301**	408	105	454	69	56	20
1991	16	19	580	**900**	92	88			48	38
1992	12	14	1832	**1098**	344	56			135	31
1993	42	24	1268	**435**	130	113			49	130
1994: Top	47	34	**6525**	**4355**	198	144			220	150
1994: Bottom			1266	**243**						
1995: Top	62	43	786	**660**	197	169			124	134
1995: Bottom			406	**280**						
1996: Top	25	11	587	**1785**	177	**387**			41	15
1996: Bottom			699	**219**						

Blank cells indicate no data available.

Black cells indicate seasonal averages that exceeded total coliform levels of 2400mg/100ml & fecal coliform counts of 200mg/100ml (New York & New Jersey State bacterial standard limits).

Gateway National Recreation Area Total and Fecal Coliform Averages, 1982-1996



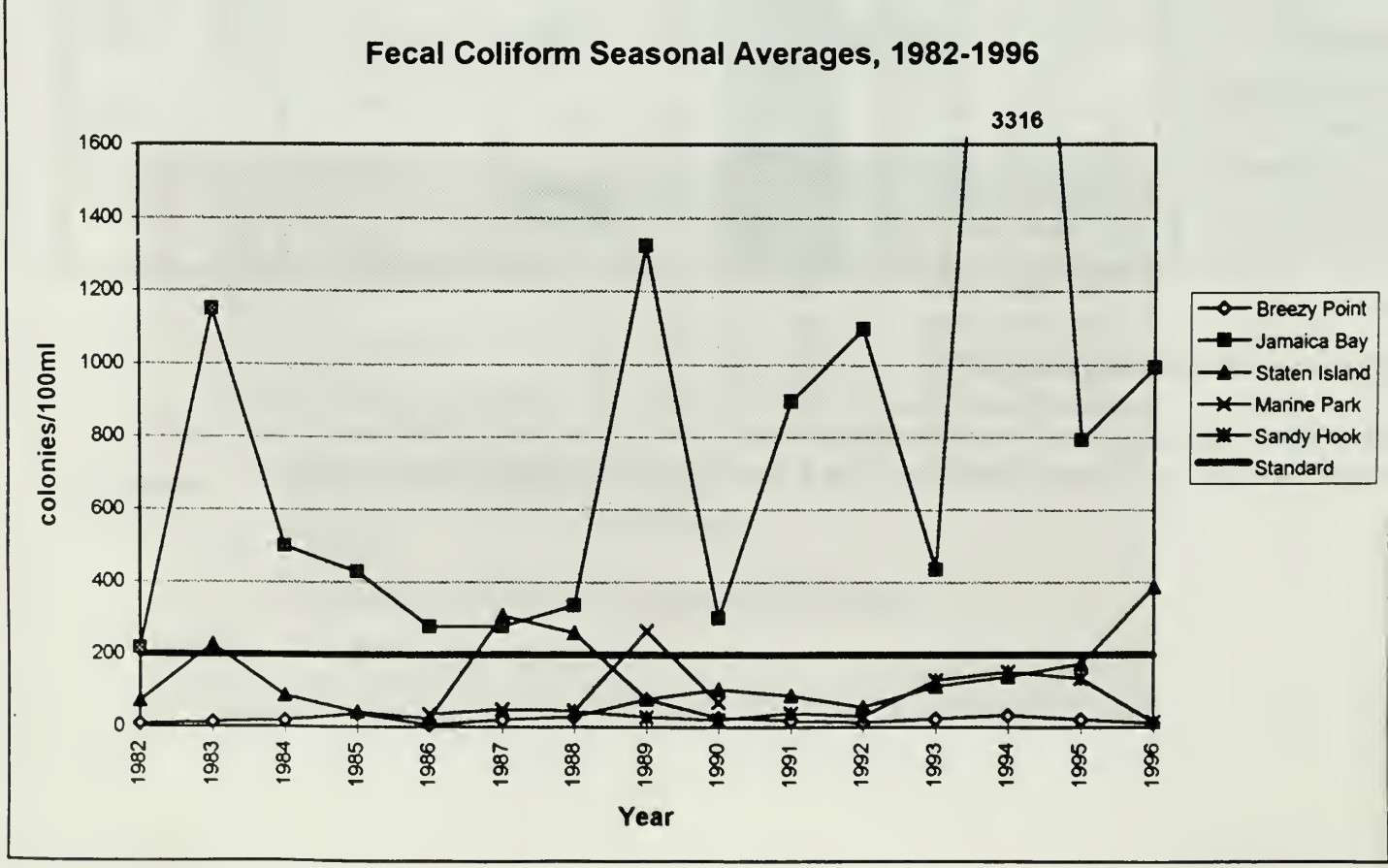


Figure 1

Table III

Sample Days Surpassing Coliform Criteria, 1996

Site		Sample Days		
		Total Number	# Surpassing Criteria	% Surpassing Criteria
Riis Park		**13**	**0**	**0%**
Breezy Point		**13**	**0**	**0%**
Atlantic Beaches Averages		**13**	**0**	**0%**
Rockaway Inlet	Top	13	0	0%
	Bottom	13	0	0%
Novia Scotia Bar	Top	13	1	7.69%
	Bottom	13	1	7.69%
Canarsie Pier	Top	13	2	15.38%
	Bottom	13	2	15.38%
Pennsylvania Avenue Landfill	Top	13	3	23.08%
	Bottom	13	3	23.08%
Bergen Basin	Top	13	10	76.92%
	Bottom	13	6	46.15%
Bergen Basin Outflow	Top	13	9	69.23%
	Bottom	13	6	46.15%
Grassy Bay	Top	13	4	30.77%
	Bottom	13	3	23.08%
JoCo Marsh	Top	13	1	7.69%
	Bottom	13	1	7.69%
Beach Channel	Top	13	2	15.38%
	Bottom	13	2	15.38%
Jamaica Bay Averages	**Top**	**13**	**3.56**	**27.34%**
Jamaica Bay Averages	**Bottom**	**13**	**2.46**	**20.05%**
Fort Wadsworth		13	1	7.69%
New Dorp Beach		13	0	0
Oakwood Beach		13	1	7.69%
Great Kills		**16**	**4**	**25.00%**
Crooke's Point		13	1	7.69%
Great Kills Marina		13	0	0
Staten Island Averages		**13.5**	**1.17**	**8.01%**
Spermaceti Cove		13	1	7.69%
Lot D		**13**	**0**	**0**
Gunnison Beach		**13**	**0**	**0**
North Beach		**13**	**0**	**0**
Sandy Hook Averages		**13**	**0.25**	**1.92%**

Bathing beach sites are shaded.

Note: No beaches were closed during 1996 due to bacterial contamination, even though standards may have been exceeded on initial counts.

Percentage of Sample Days Surpassing Coliform Criteria, 1996

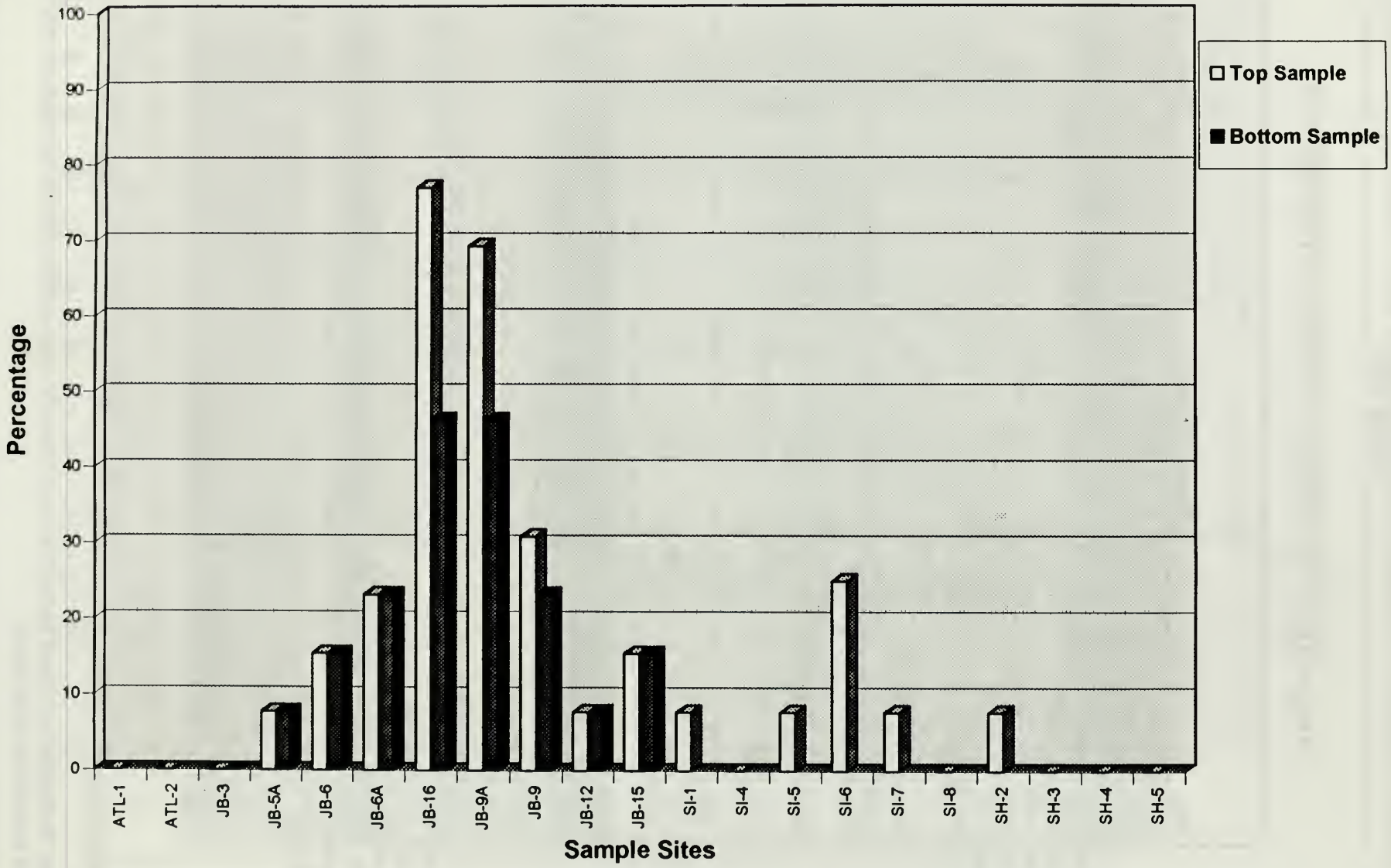


Table IV

Gateway National Recreation Area
Percentage of Total & Fecal Coliform Samples that Exceeded State & Federal Standards, 1994-1996

Location	Site	% of Total Coliform Samples			% of Fecal Coliform Samples		
		1994	1995	1996	1994	1995	1996
Riis Park	**ATL-1**	**0**	**0**	**0**	**0**	**0**	**0**
Breezy Point	**ATL-2**	**0**	**8**	**8**	**8**	**0**	**0**
Atlantic Beach Averages	**All**	**0**	**0**	**0**	**5**	**0**	**0**
Rockaway Inlet	JB-3	0	8	8	8	0	0
Nova Scotia Bar	JB-9A	0	0	0	0	15	0
Canarsie Pier	JB-6	12	0	15	11	29	0
Pennsylvania Avenue Landfill	JB-6A	23	8	8	43	68	23
Bergen Basin	JB-16	60	0	15	68	82	58
Bergen Basin Outflow	JB-9A	67	11	23	73	79	46
Grassy Bay	JB-9	33	0	12	67	42	27
JoCo Marsh	JB-12	0	0	0	0	15	0
Beach Channel	JB-15	0	0	0	7	0	15
Jamaica Bay Averages	**All**	**22%**	**5%**	**9%**	**30%**	**38%**	**21%**
Fort Wadsworth	SI-1	0	7	0	33	14	0
South Beach	SI-2	0	0	ND	8	7	ND
Midland Beach	SI-3	0	0	ND	18	7	ND
New Dorp Beach	SI-4	0	0	0	0	14	0
Oakwood Beach	SI-5	9	0	0	0	14	0
Great Kills Beach	**SI-6**	**0**	**8**	**0**	**29**	**0**	**25**
Crooke's Point	SI-2	0	0	0	0	0	8
Great Kills Marina	SI-8	0	7	0	0	21	0
Staten Island Averages	**All**	**1%**	**2%**	**1%**	**12%**	**10%**	**8%**
Plum Island	SH-1	0	0	ND	0	29	ND
Spermaceti Cove	SH-2	0	0	0	29	29	0
Lot D	**SH-3**	**0**	**0**	**0**	**0**	**7**	**0**
Gunnison Beach	**SH-4**	**0**	**0**	**0**	**0**	**7**	**0**
North Beach	**SH-5**	**0**	**0**	**0**	**0**	**7**	**0**
Horseshoe Cove	SH-6	0	0	ND	0	17	ND
Sandy Hook Averages	**All**	**0%**	**0%**	**0%**	**8%**	**16%**	**2%**

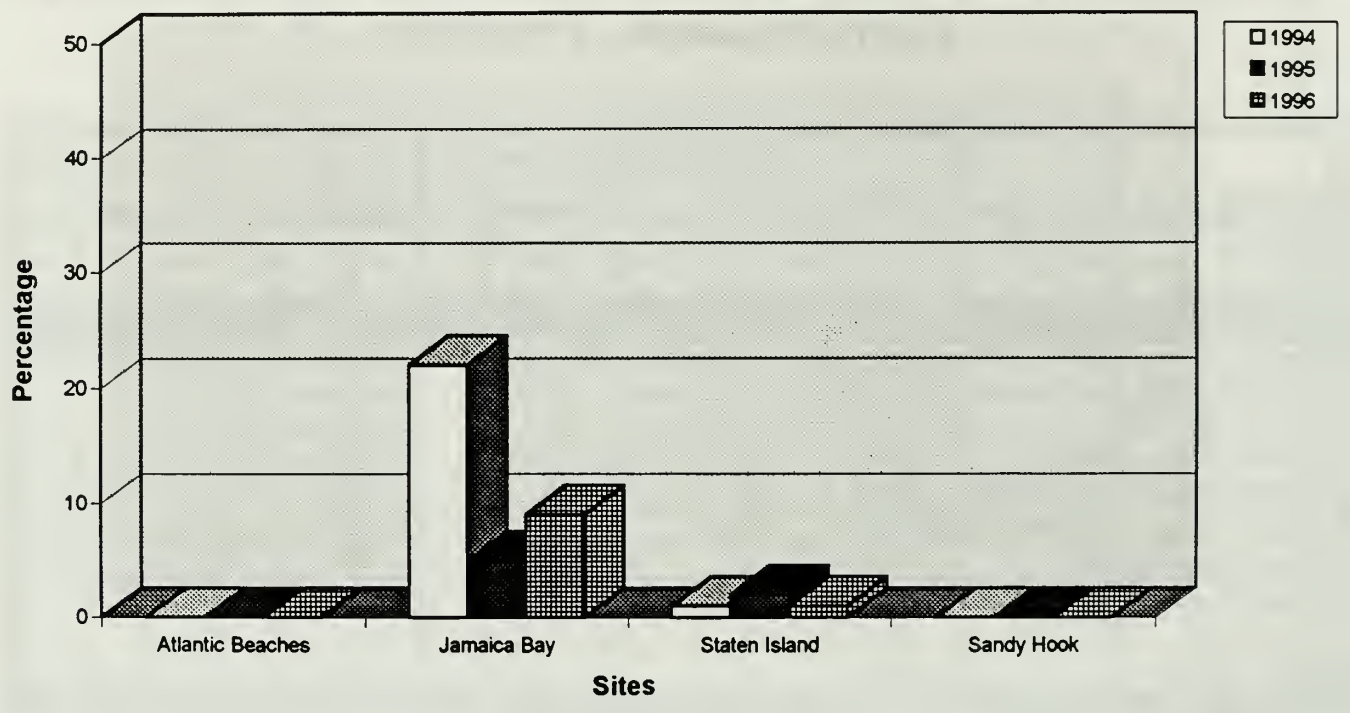
ND: No Data.

Bathing beach sites are in bold.

Jamaica Bay percentages are averages of top and bottom samples; all other samples are top samples.

1994 results are based on year-round testing for some sites in Jamaica Bay; other years involve testing from June 4 through September 5.

Percentage of Total and Fecal Coliform Samples Exceeding Federal Standards, 1994-1996



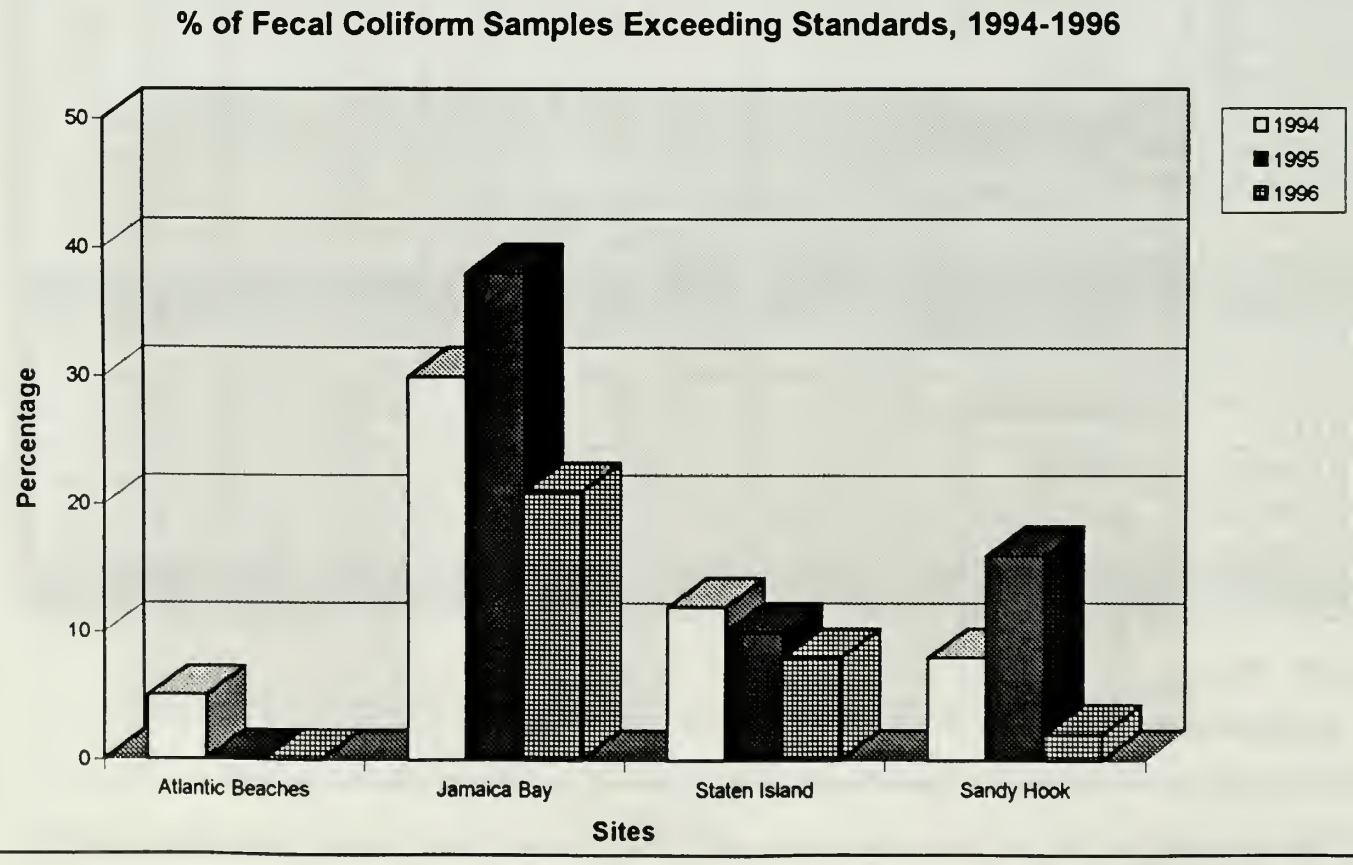


Figure 3

Table V

Gateway National Recreation Area
Total & Fecal Coliform Averages, 1994-1996

Location	Site	Total Coliform Averages			Fecal Coliform Averages		
		1994	1995	1996	1994	1995	1996
Riis Park	**ATL-1**	**51**	**50**	**36**	**40**	**31**	**12**
Breezy Point	**ATL-2**	**46**	**12**	13	**28**	**12**	9
Atlantic Beach Averages	**All**	**49**	**31**	**25**	**34**	**22**	**11**
Rockaway Inlet	JB-3	127	268	113	31	77	1
Nova Scotia Bar	JB-5A	125	516	344	15	1062	29
Canarsie Pier	JB-6	1046	519	827	199	351	286
Pennsylvania Avenue Landfill	JB-6A	3026	946	687	2143	460	3209
Bergen Basin	JB-16	34401	755	902	21657	2116	3749
Bergen Basin Outflow	JB-9A	6775	1023	1455	3332	1698	850
Grassy Bay	JB-9	12762	191	682	2426	701	668
JoCo Marsh	JB-12	129	210	266	7	65	35
Beach Channel	JB-15	791	347	441	33	607	114
Jamaica Bay Averages	**All**	**6576**	**531**	**635**	**3316**	**793**	**993**
Fort Wadsworth	SI-1	279	210	493	144	193	2011
South Beach	SI-2	144	172	ND	69	52	ND
Midland Beach	SI-3	265	176	ND	445	120	ND
New Dorp Beach	SI-4	90	246.5	161	31	87	38
Oakwood Beach	SI-5	436	152	112	121	91	36
Great Kills Beach	**SI-6**	**225**	**68**	163	**261**	**70**	188
Crooke's Point	SI-7	39	31	100	17	75	40
Great Kills Marina	SI-8	103	402	33	25	712	7
Staten Island Averages	**All**	**198**	**191**	**177**	**139**	**175**	**387**
Plum Island	SH-1	58	250	ND	67	292	ND
Spermaceti Cove	SH-2	491	134	40	712	186	38
Lot D	**SH-3**	**180**	**41**	23	**38**	**73**	13
Gunnison Beach	**SH-4**	**241**	**99**	13	31	**75**	11
North Beach	**SH-5**	**213**	**56**	89	**28**	**41**	9
Horseshoe Cove	SH-6	151	160	ND	43	134	ND
Sandy Hook Averages	**All**	**222**	**123**	**41**	**153**	**134**	**15**

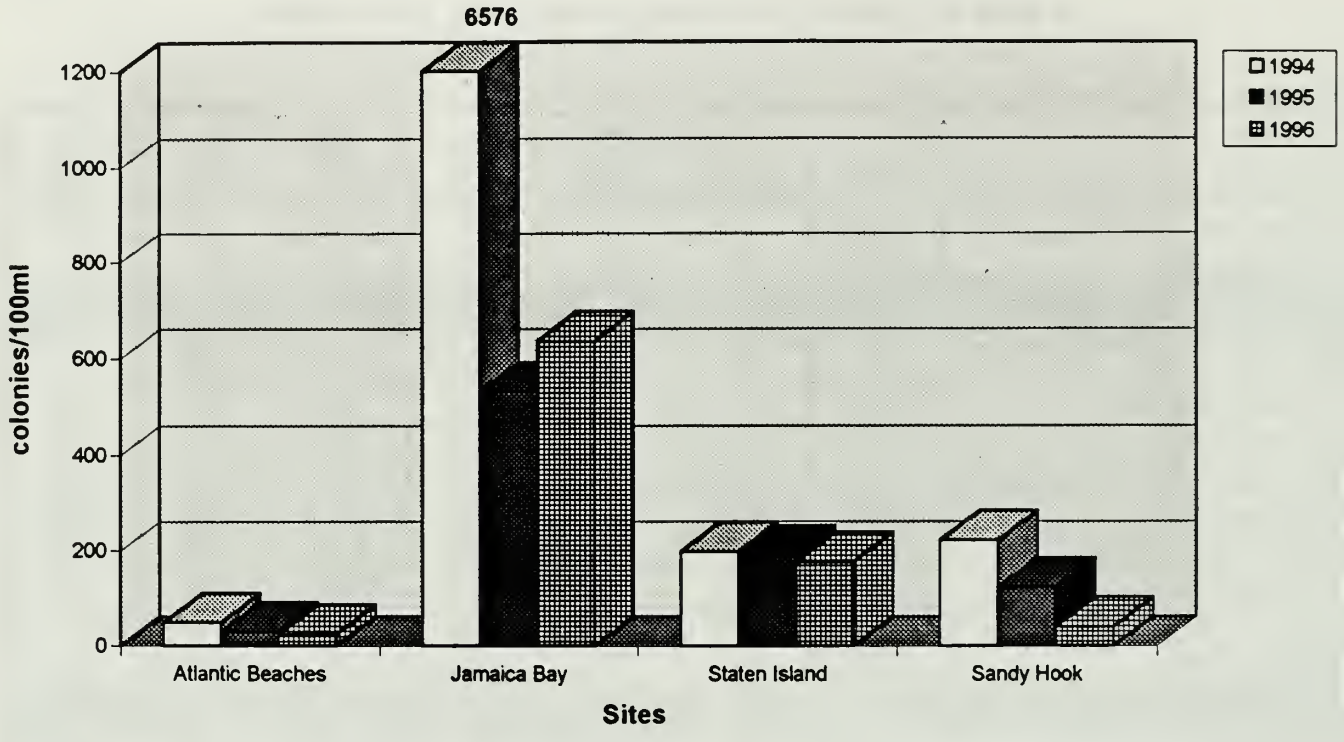
ND: **No Data.**

Bathing beach sites are in bold.

Jamaica Bay percentages are averages of top and bottom samples; all other samples are top samples.

1994 results are based on year-round testing for some sites in Jamaica Bay; other years involve testing from June 4 through September 5.

Gateway N.R.A. Average Total and Fecal Coliform Counts, 1994-1996



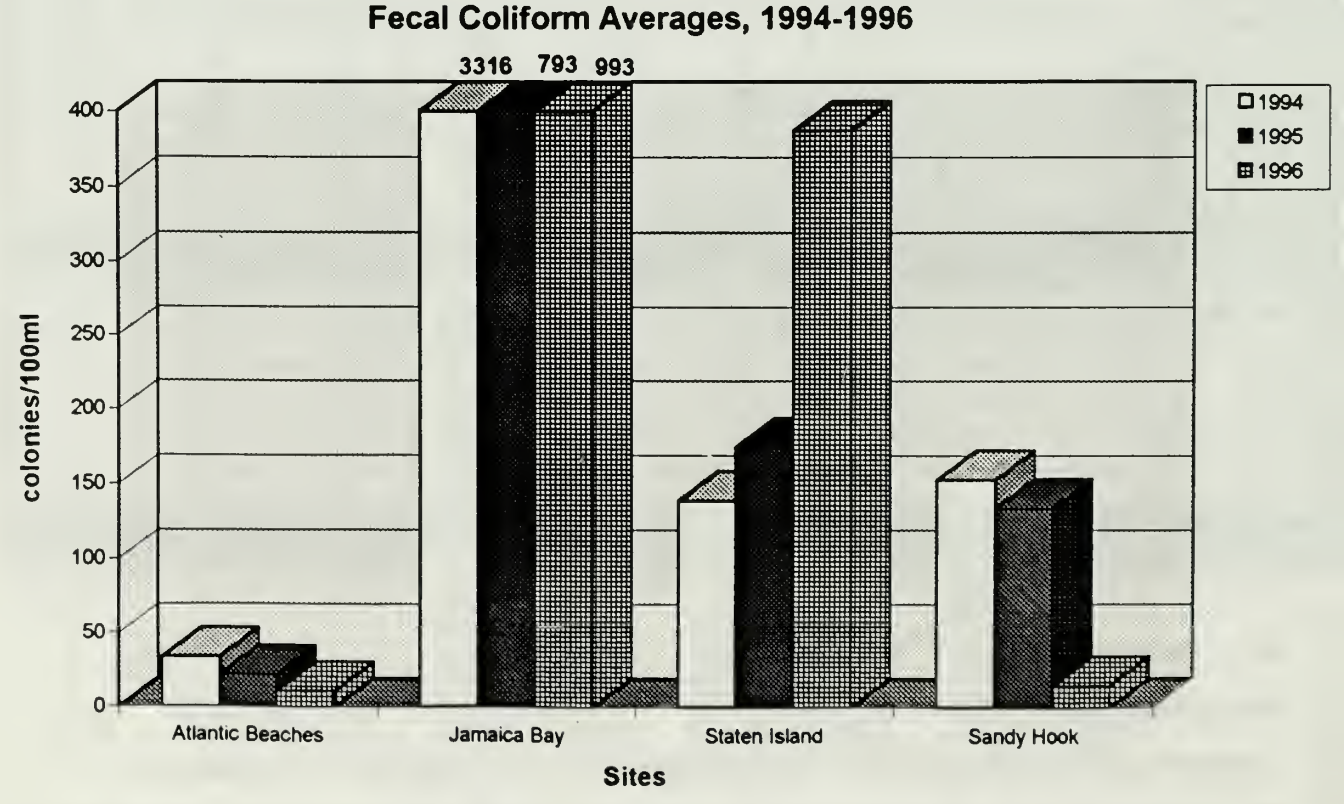


Figure 4

Table VI
June, July, & August Precipitation, 1986-1996

Year	June	July	August	Total
1986	1.86	5.56	4.42	11.64
1987	4.22	3.71	3.84	11.77
1988	1.29	8.14	2.19	11.62
1989	8.47	5.99	8.35	22.81
1990	2.50	3.51	12.36	18.37
1991	ND	ND	ND	ND
1992	0.08	0.24	0.23	0.55
1993	0.10	0.08	0.09	0.27
1994	3.17	2.54	7.07	12.75
1995	2.94	3.56	0.25	6.75
1996	3.96	8.48	2.41	14.85
Average	**2.859**	**4.181**	**4.121**	**11.161**

ND: No Data.

Precipitation amounts for 1986-1990 are for the New York Area.
Precipitation amounts for 1992-1996 are for Floyd Bennett Field, taken from Gateway N.R.A.'s weather station.

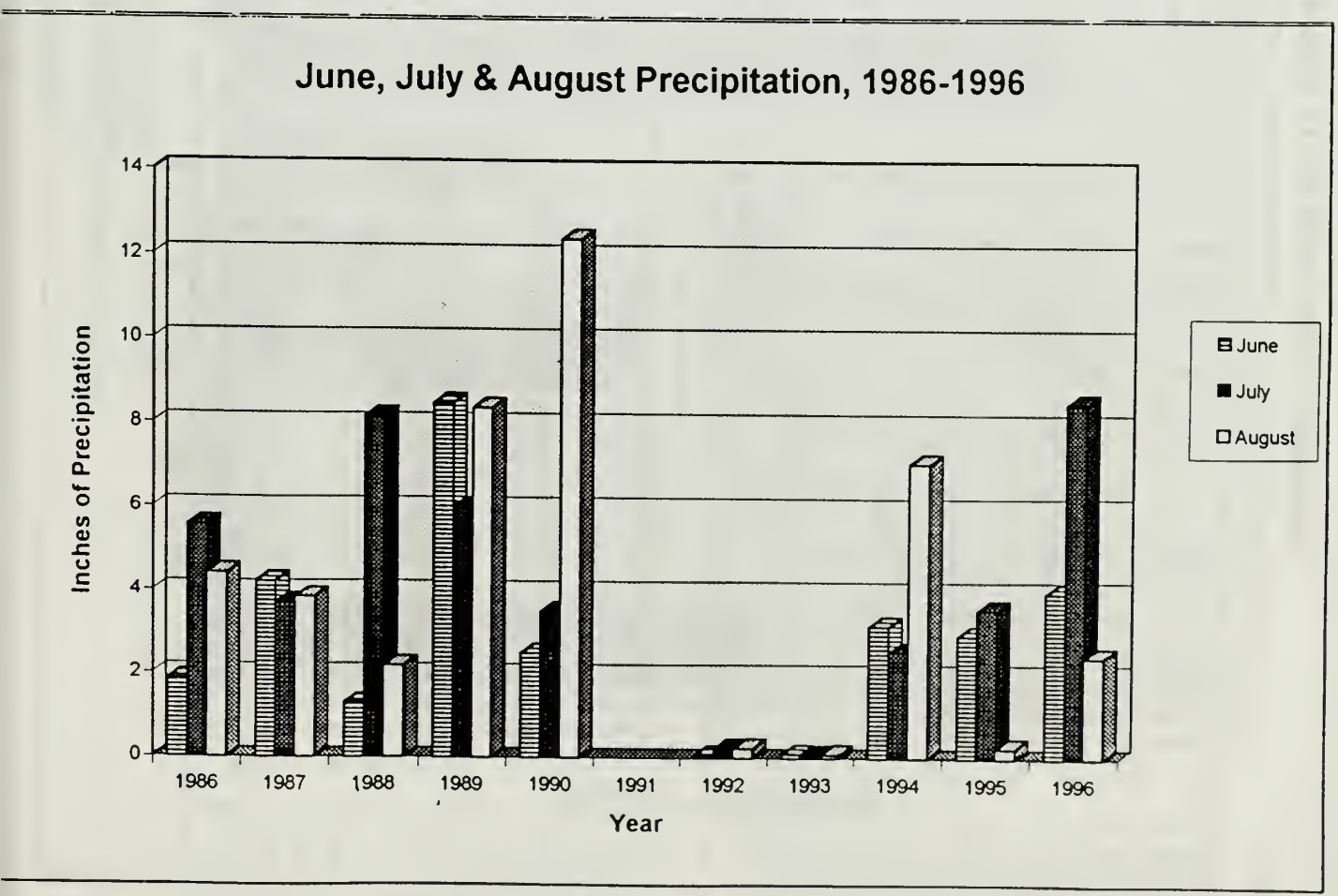


Figure 5

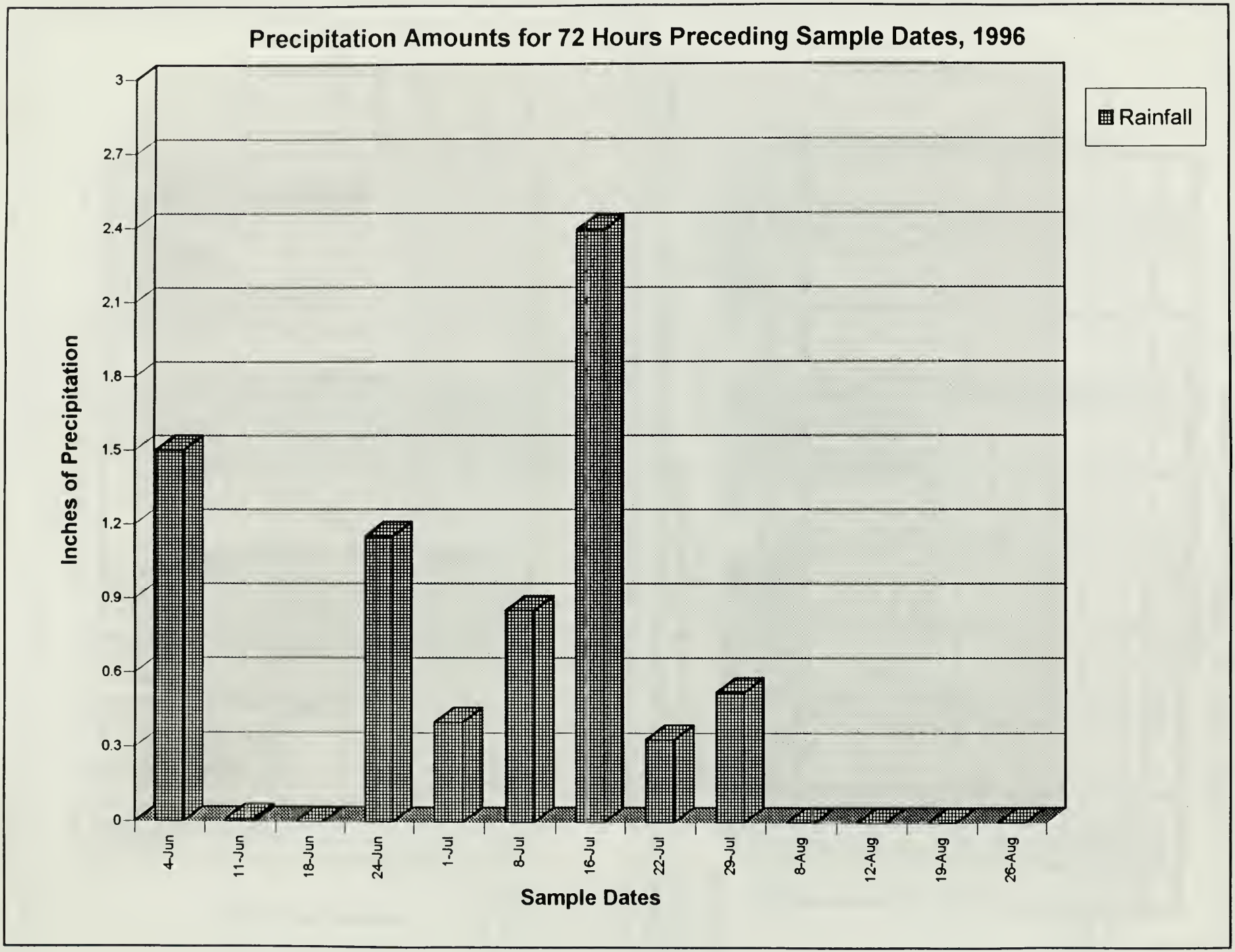

Precipitation Amounts for 72 Hours Preceding Sample Dates, 1996
Rainfall
Inches of Precipitation
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates

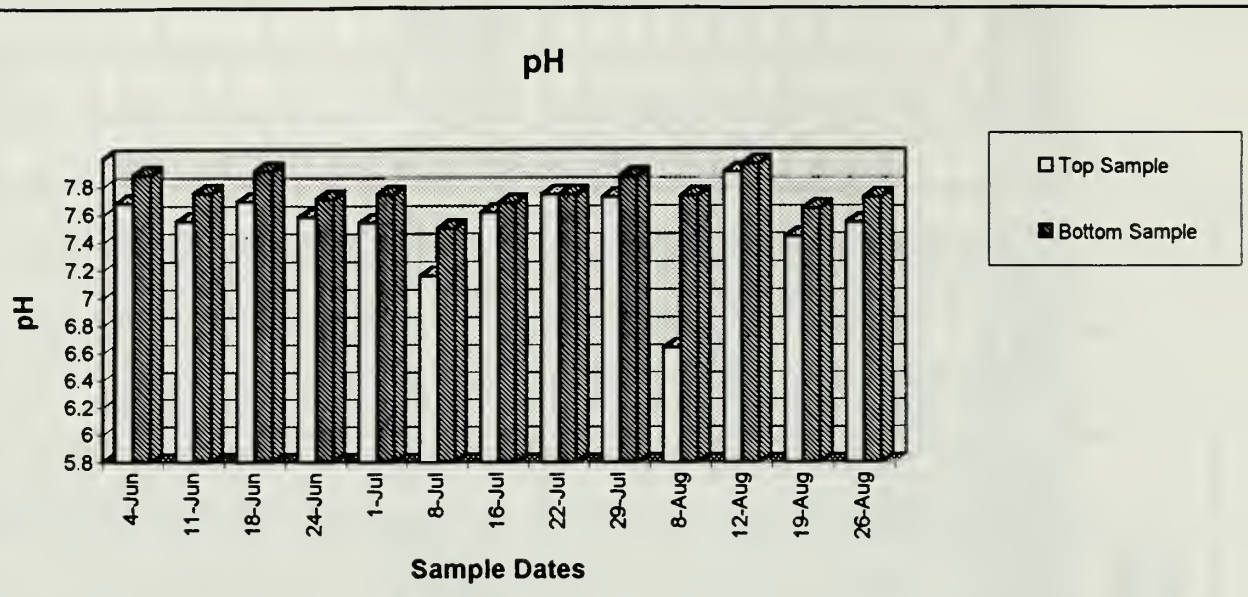
Table VII
Environmental Water Quality Monitoring
Jamaica Bay: Rockaway Inlet [JB-3], 1996

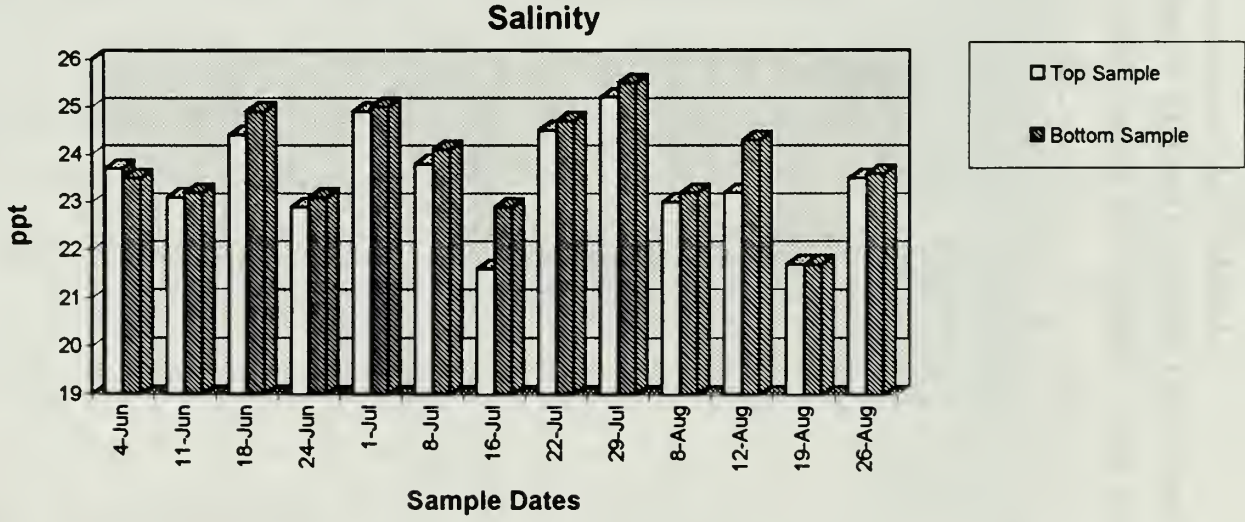
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0905	H	17.0	14.9	14.8	7.68	7.88	23.7	23.5	376	374	8.06	10.44	ND	ND
6/11	0809		20.5	17.7	17.6	7.55	7.75	23.1	23.2	365	366	7.46	10.02	<0.1	<0.1
6/18	0803	H	20.5	19.0	18.8	7.69	7.91	24.4	24.9	383	390	7.13	9.68	ND	ND
6/24	0759	L	22.0	20.7	20.5	7.58	7.71	22.9	23.1	360	364	6.33	7.94	0.12	0.20
7/01	0803	H	19.5	17.8	17.8	7.54	7.74	24.9	25.0	390	392	6.13	9.92	ND	ND
7/08	0812	L	22.0	20.0	19.6	7.16	7.50	23.8	24.1	374	378	4.61	9.86	0.18	0.16
7/16	1059	H	25.0	22.0	20.8	7.61	7.68	21.6	22.9	342	361	5.25	9.71	ND	ND
7/22	1045		17.0	13.6	13.4	7.74	7.74	24.5	24.7	389	390	7.30	11.21	0.11	0.11
7/29	0804	H	22.0	19.0	18.8	7.72	7.87	25.2	25.5	394	399	5.97	9.50	ND	ND
8/08	0820	L	22.0	22.7	22.9	6.64	7.73	23.0	23.2	362	365	6.22	8.52	ND	ND
8/12	0823	H	21.0	21.6	21.1	7.90	7.96	23.2	24.3	365	382	6.12	9.22	<0.1	<0.1
8/19	0805		23.0	22.6	22.6	7.44	7.64	21.7	21.7	342	343	8.99	9.02	ND	ND
8/26	0811	H	25.0	21.5	21.2	7.54	7.77	23.5	23.6	369	371	9.17	6.26	0.07	0.06

Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0905	H	6.00	ND	ND	ND	ND	ND	ND	ND	ND	638	609	0	0
6/11	0809		2.75	<0.05	<0.05	<0.05	<0.05	0.39	0.05	ND	ND	29	145	0	0
6/18	0803	H	2.75	ND	ND	ND	ND	ND	ND	2.370	2.370	0	261	0	0
6/24	0759	L	1.75	<0.05	<0.05	<0.05	<0.05	0.15	0.20	ND	ND	0	116	0	0
7/01	0803	H	3.75	ND	ND	ND	ND	ND	ND	ND	ND	0	174	0	0
7/08	0812	L	3.75	<0.05	<0.05	<0.05	<0.05	0.15	0.13	ND	ND	0	145	0	0
7/16	1059	H	2.75	ND	ND	ND	ND	ND	ND	2.046	4.092	87	377	0	0
7/22	1045		4.50	<0.05	<0.05	<0.05	<0.05	0.05	0.06	ND	ND	29	116	0	0
7/29	0804	H	3.50	ND	ND	ND	ND	ND	ND	ND	ND	0	116	0	0
8/08	0820	L	3.00	ND	ND	ND	ND	ND	ND	ND	ND	0	0	0	0
8/12	0823	H	2.75	<0.05	<0.05	<0.05	<0.05	0.04	0.05	0.160	4.740	0	29	0	0
8/19	0805		3.25	ND	ND	ND	ND	ND	ND	ND	ND	0	29	0	0
8/26	0811	H	3.00	<0.05	<0.05	<0.05	<0.05	0.04	0.04	ND	ND	29	0	0	29

ND: No Data.

Rockaway Inlet (JB-3) Water Quality Measurements, 1996





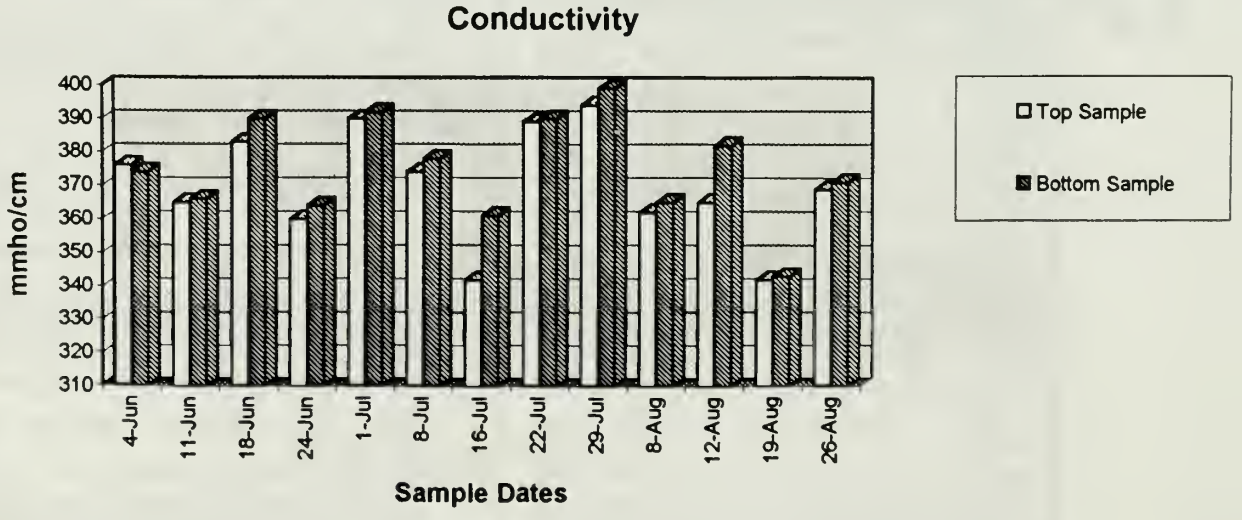
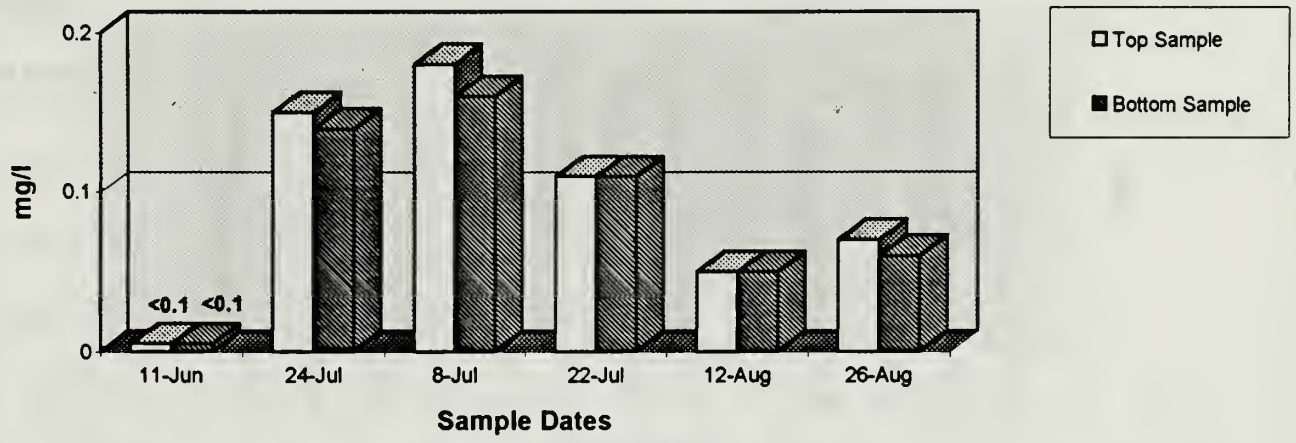


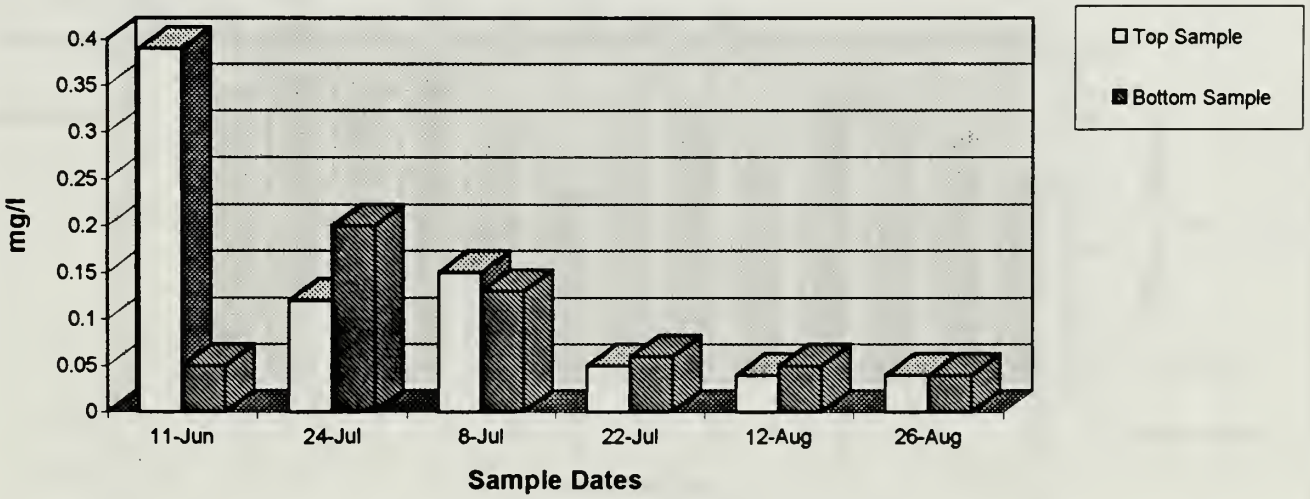
Figure 7

Rockaway Inlet (JB-3) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

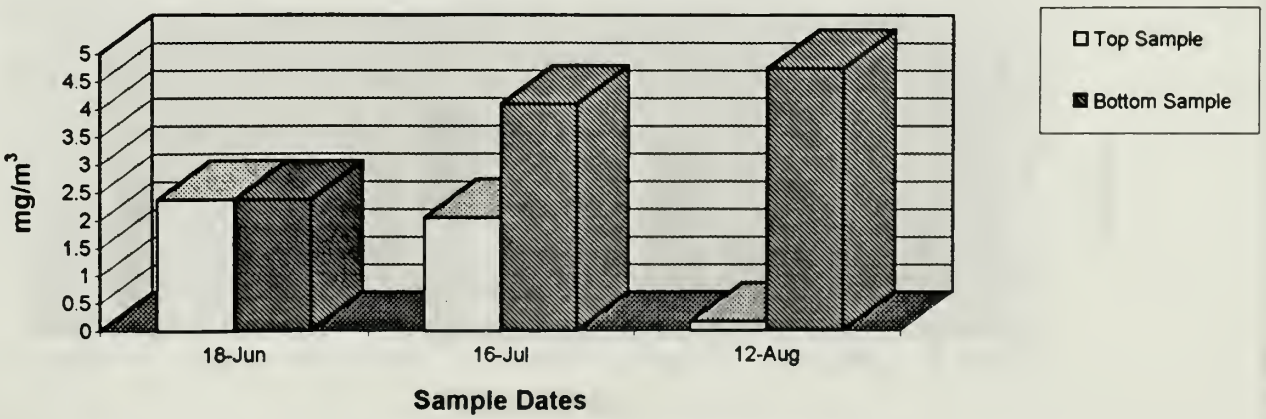
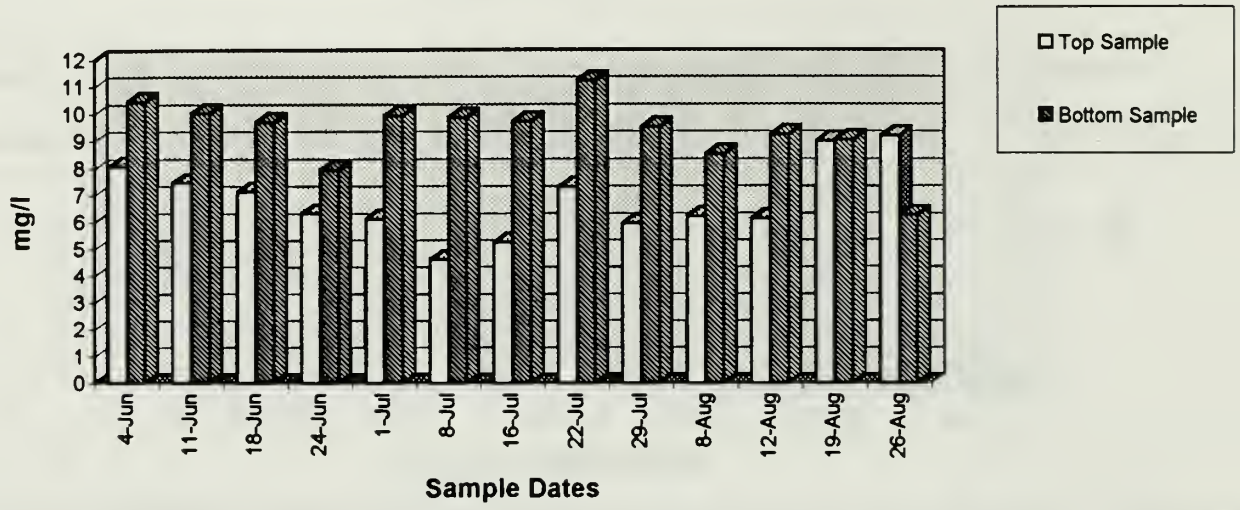


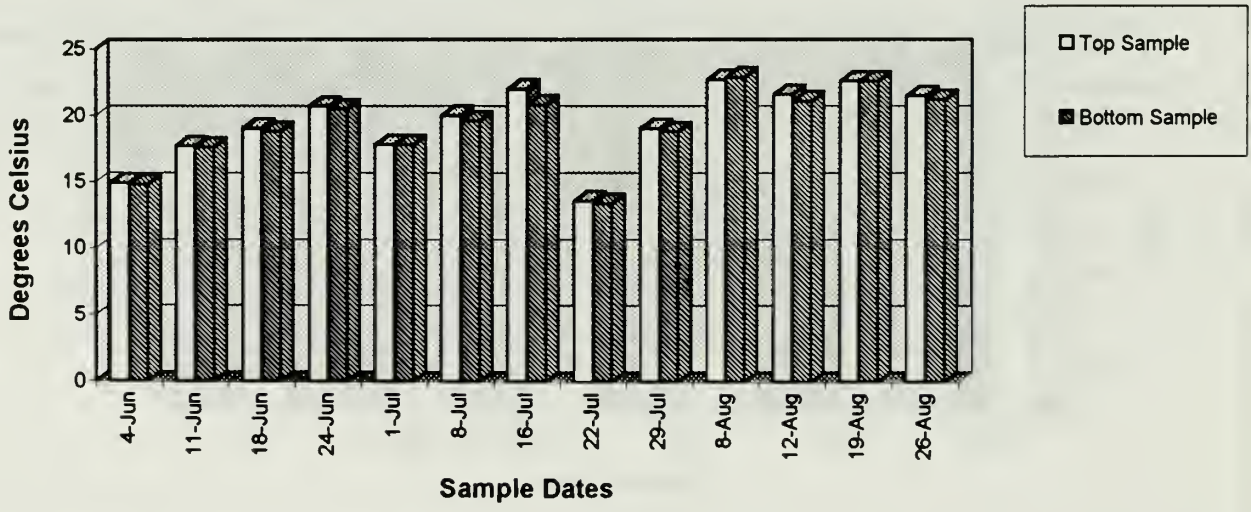
Figure 8

Rockaway Inlet (JB-3) Water Quality Measurements, 1996

Dissolved Oxygen



Water Temperature



Secchi Disk Readings

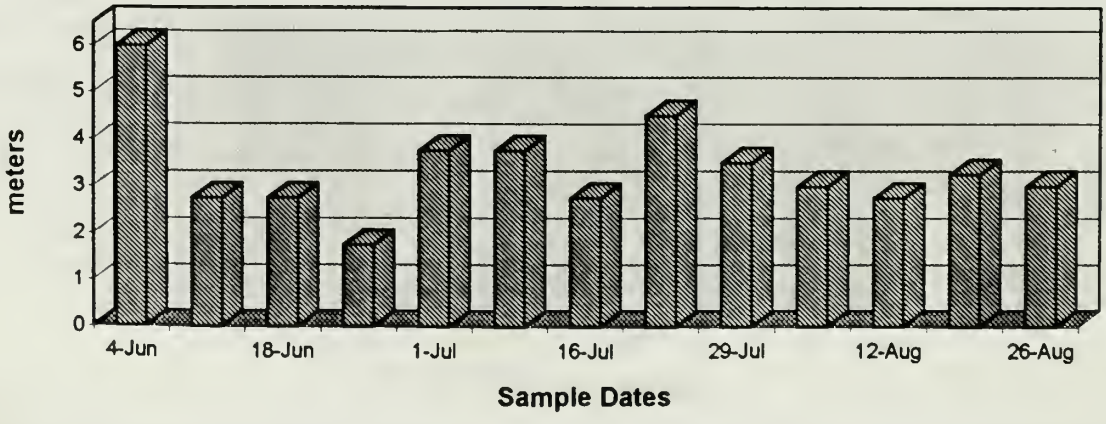
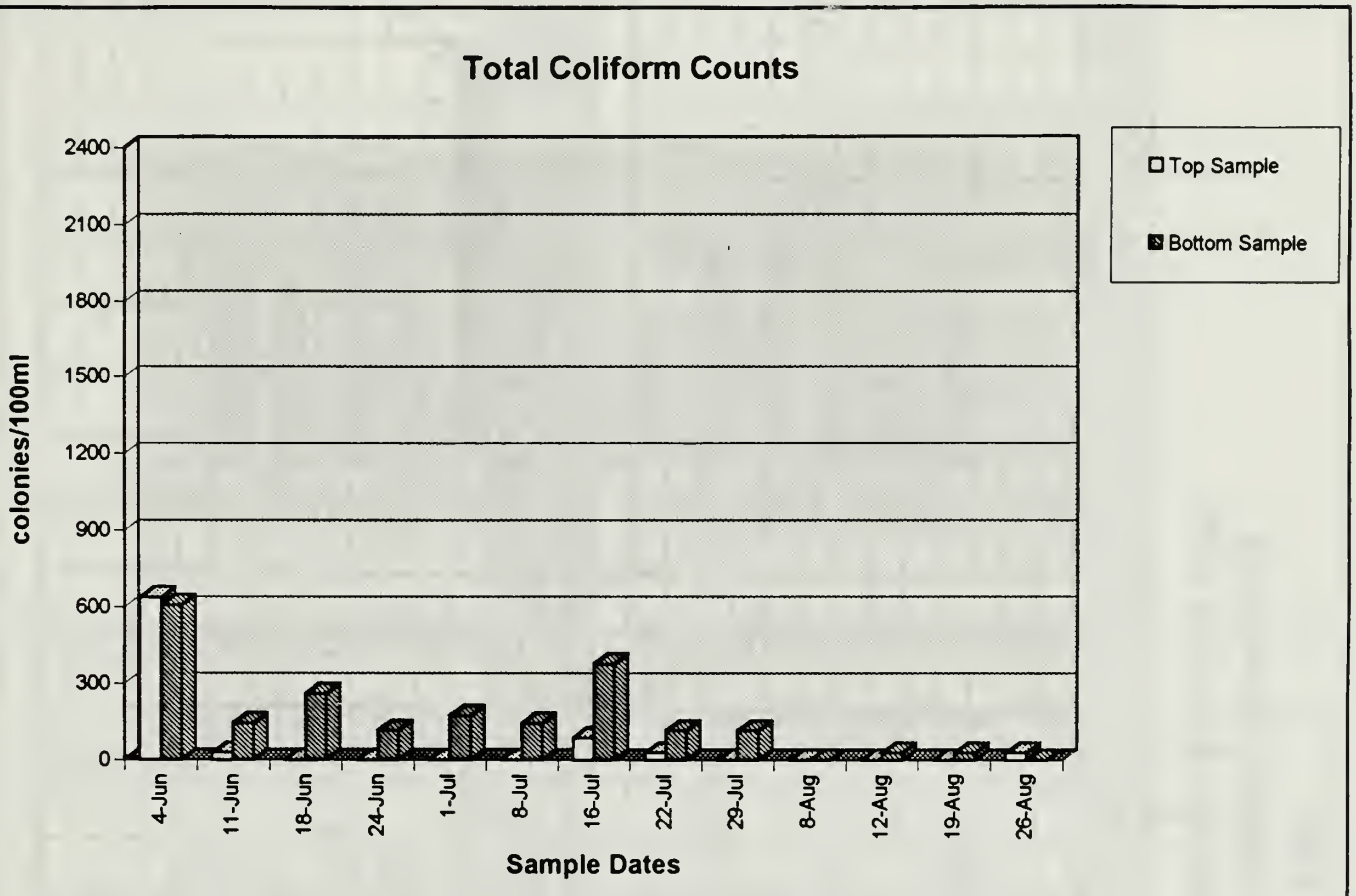


Figure 9

Rockaway Inlet (JB-3) Water Quality Measurements, 1996



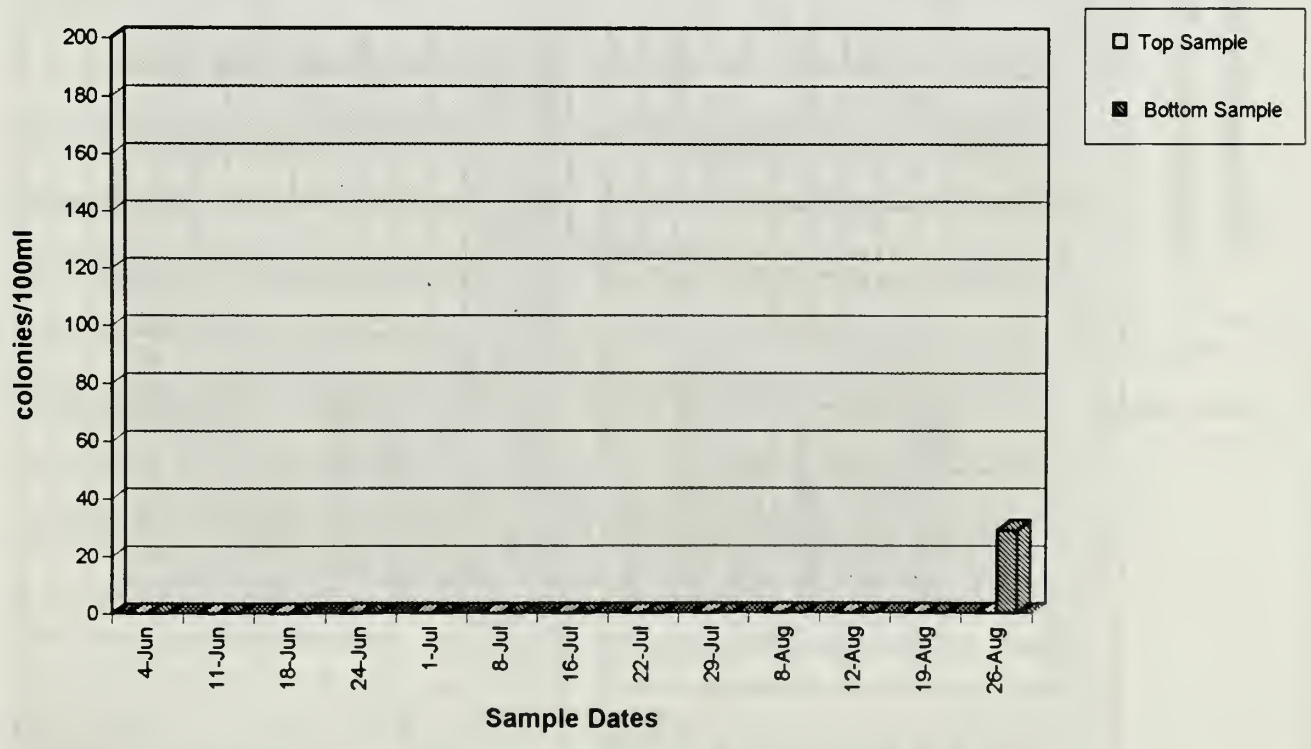


Figure 10

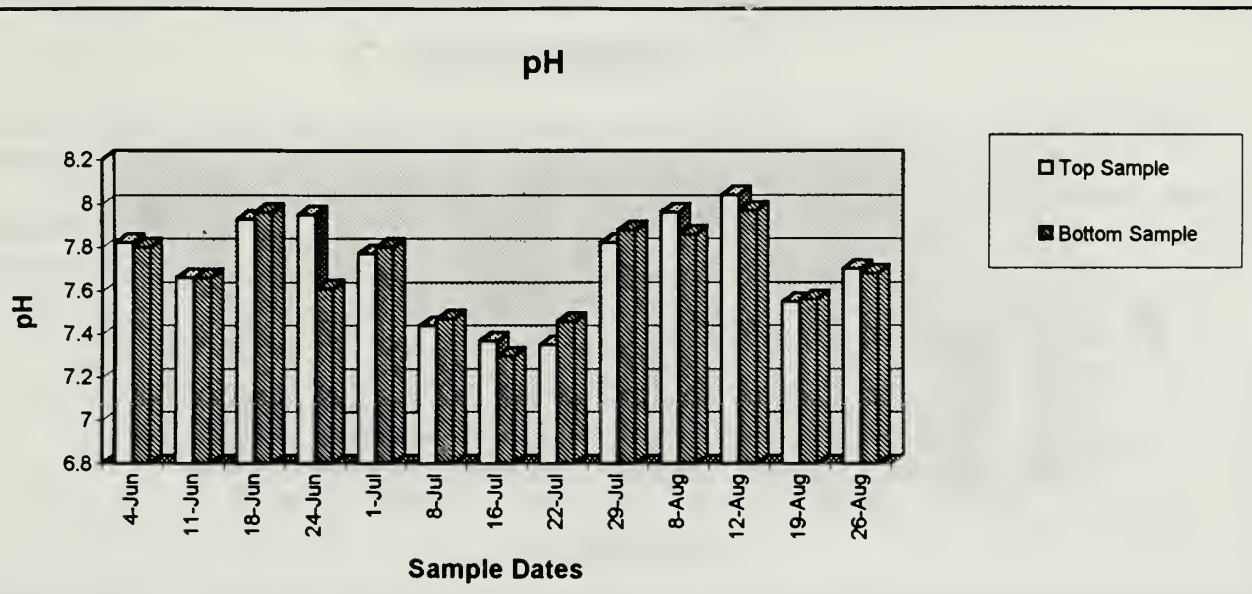
Table VIII
Environmental Water Quality Monitoring
Jamaica Bay: Nova Scotia Bar [JB-5A], 1996

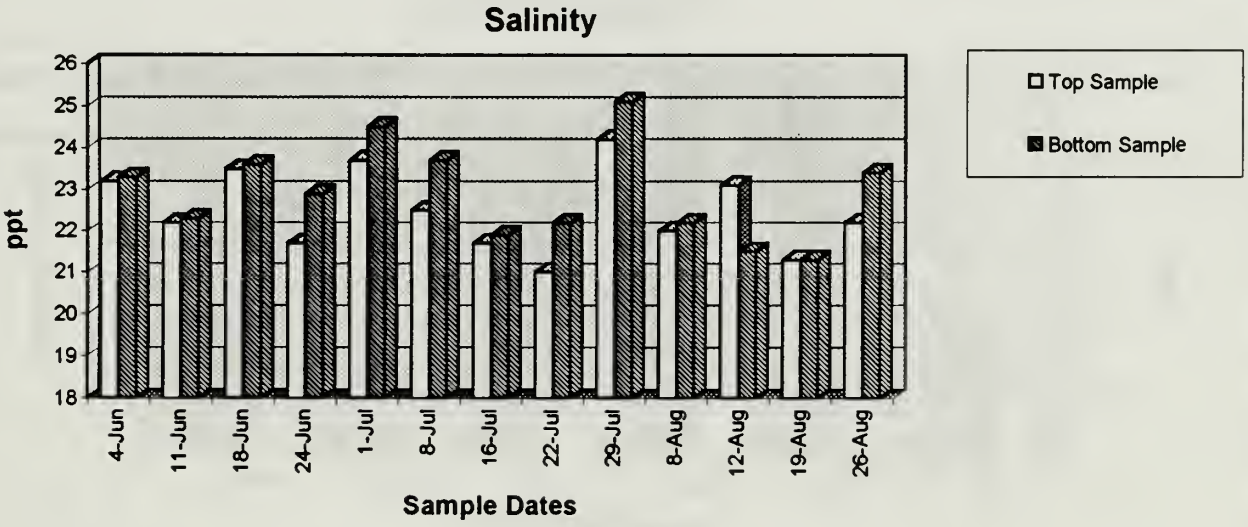
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0920	H	21.0	15.3	15.6	7.82	7.80	23.2	23.3	368	368	7.54	10.57	ND	ND
6/11	0830		19.5	19.2	19.0	7.66	7.66	22.2	22.3	351	354	6.36	9.60	0.20	0.18
6/18	0824	H	21.0	20.0	19.0	7.93	7.96	23.5	23.6	370	371	8.01	9.15	ND	ND
6/24	0814	L	21.5	21.7	20.8	7.95	7.61	21.7	22.9	343	361	7.80	9.30	0.28	0.14
7/01	0824	H	20.0	18.7	18.4	7.77	7.80	23.7	24.5	373	385	5.09	9.75	ND	ND
7/08	0827	L	22.0	22.1	20.3	7.44	7.47	22.5	23.7	355	373	4.23	9.91	0.37	0.21
7/16	0825	H	25.5	21.5	21.4	7.37	7.30	21.7	21.9	343	345	4.21	7.23	ND	ND
7/22	0817	L	22.5	22.0	20.7	7.35	7.46	21.0	22.2	332	351	5.15	9.34	0.42	0.32
7/29	0823	H	22.0	19.8	19.5	7.82	7.88	24.2	25.1	380	392	5.61	9.52	ND	ND
8/08	0840	L	22.0	23.8	23.6	7.96	7.86	22.0	22.2	347	351	8.09	8.47	ND	ND
8/12	0837	H	22.0	22.4	22.7	8.04	7.97	23.1	21.5	363	340	6.20	6.95	<0.1	<0.1
8/19	0818	L	24.0	23.4	23.4	7.55	7.56	21.3	21.3	337	338	8.50	8.44	ND	ND
8/26	0824	H	24.0	23.3	21.9	7.70	7.68	22.2	23.4	350	367	5.55	9.09	0.18	0.09

Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0920	H	2.00	ND	ND	ND	ND	ND	ND	ND	ND	3000	2610	319	174
6/11	0830		2.00	<0.05	<0.05	<0.05	<0.05	0.05	0.10	ND	ND	0	261	29	0
6/18	0824	H	3.00	ND	ND	ND	ND	ND	ND	2.370	2.370	29	87	0	0
6/24	0814	L	1.50	<0.05	<0.05	<0.05	<0.05	0.22	0.28	ND	ND	290	29	0	0
7/01	0824	H	1.85	ND	ND	ND	ND	ND	ND	ND	ND	174	609	0	0
7/08	0827	L	2.25	<0.05	<0.05	<0.05	<0.05	0.29	0.23	ND	ND	58	87	0	0
7/16	0825	H	2.25	ND	ND	ND	ND	ND	ND	2.046	2.370	377	493	0	0
7/22	0817	L	1.50	<0.05	<0.05	<0.05	<0.05	0.20	0.17	ND	ND	58	435	29	29
7/29	0823	H	3.00	ND	ND	ND	ND	ND	ND	ND	ND	0	87	29	0
8/08	0840	L	1.50	ND	ND	ND	ND	ND	ND	ND	ND	58	0	0	0
8/12	0837	H	2.25	<0.05	<0.05	<0.05	<0.05	0.05	0.05	2.062	8.848	0	29	0	0
8/19	0818	L	3.25	ND	ND	ND	ND	ND	ND	ND	ND	0	29	0	0
8/26	0824	H	2.25	<0.05	<0.05	<0.05	<0.05	0.10	0.10	ND	ND	87	58	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1996





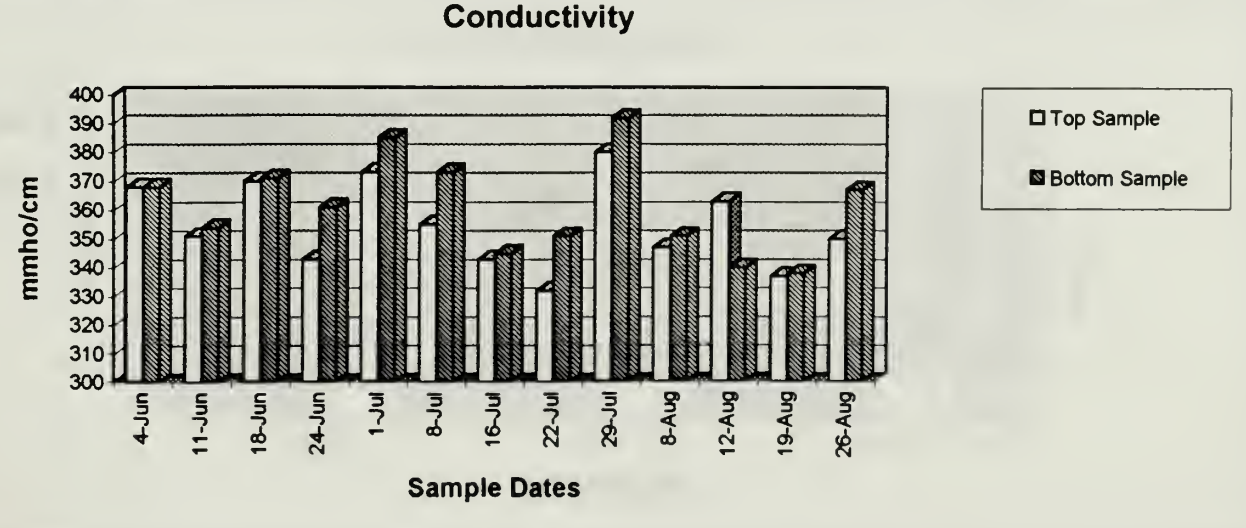
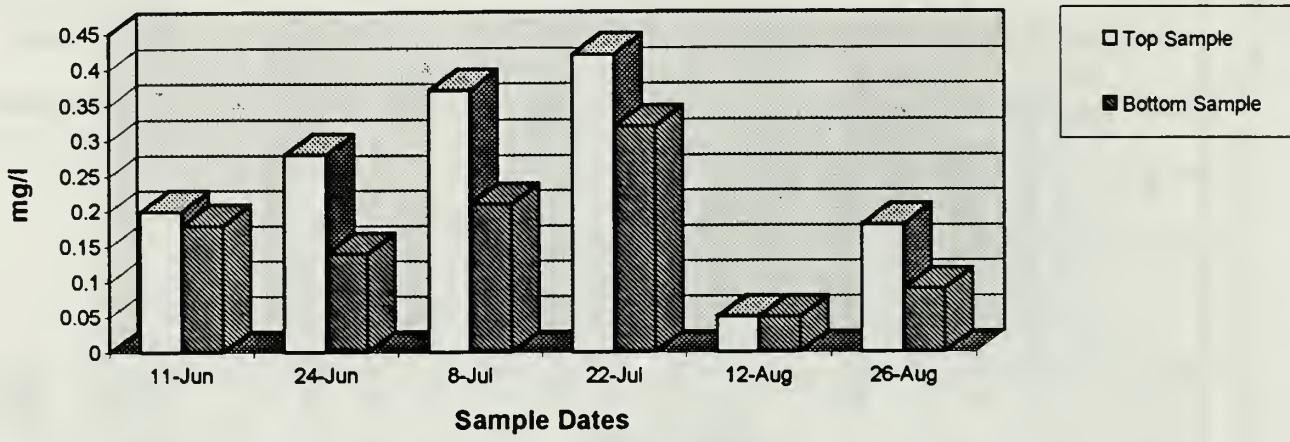


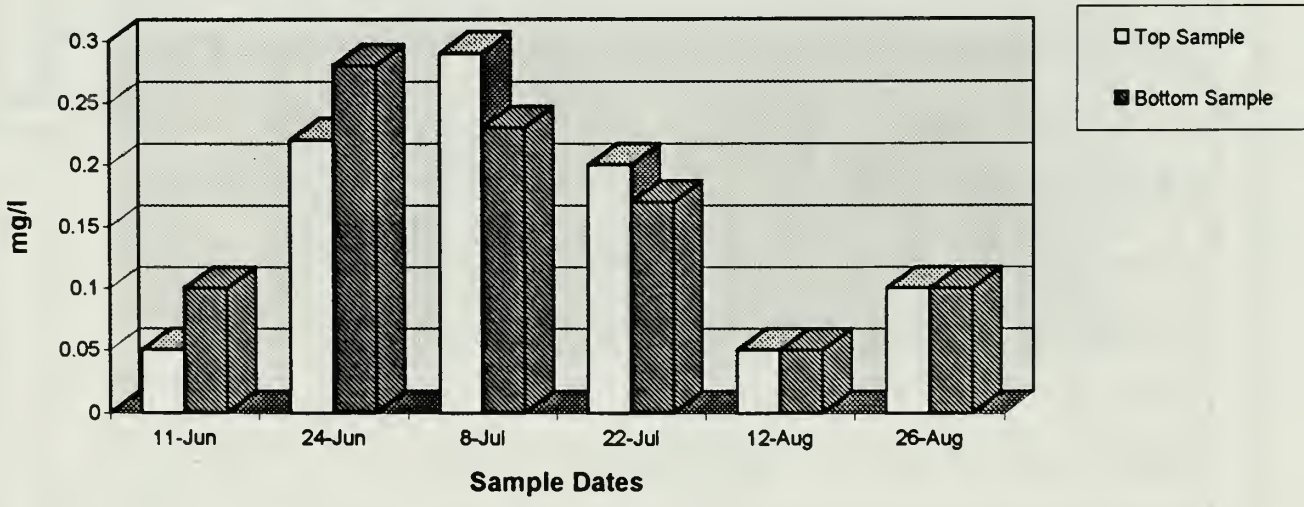
Figure 11

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

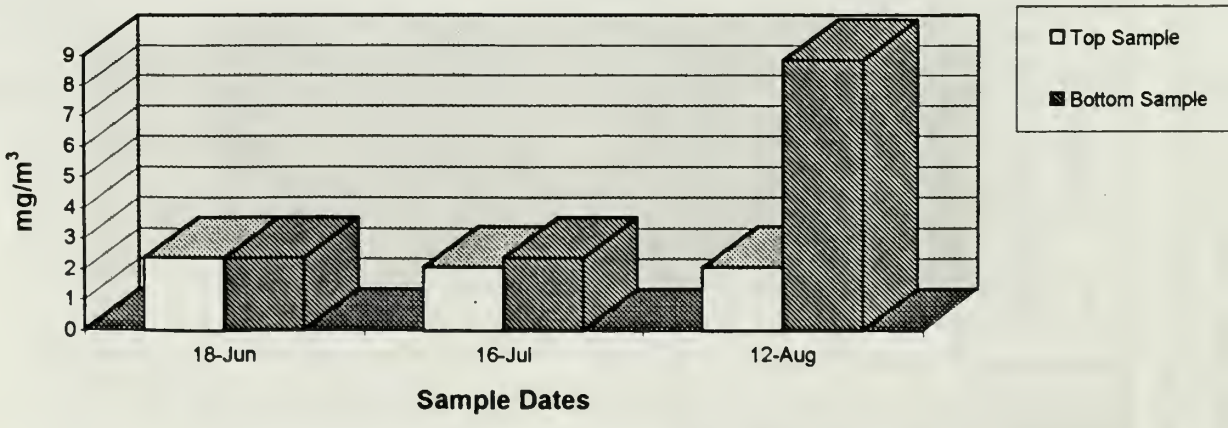
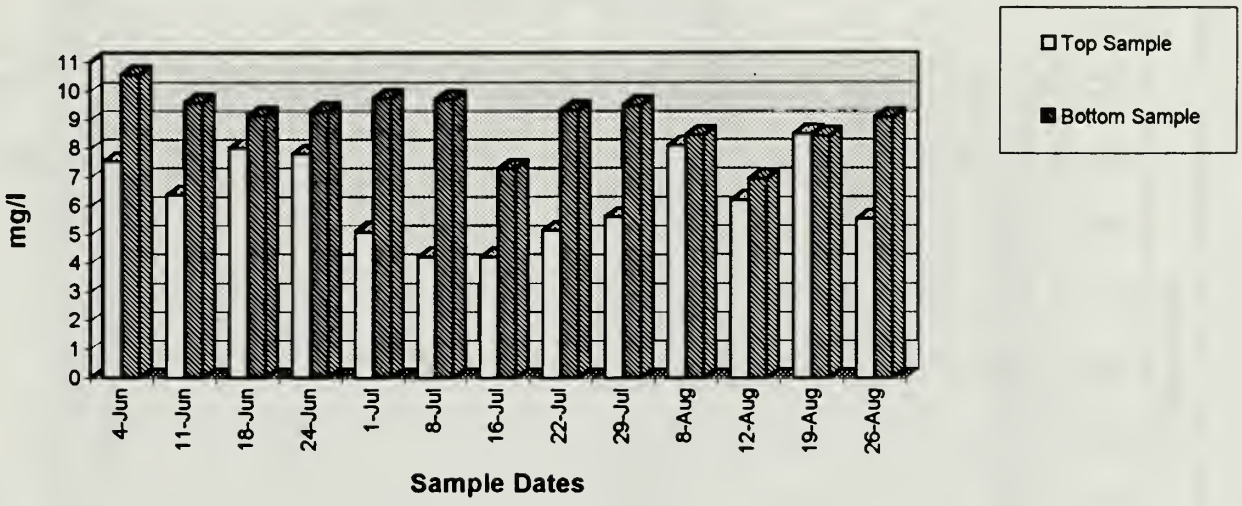
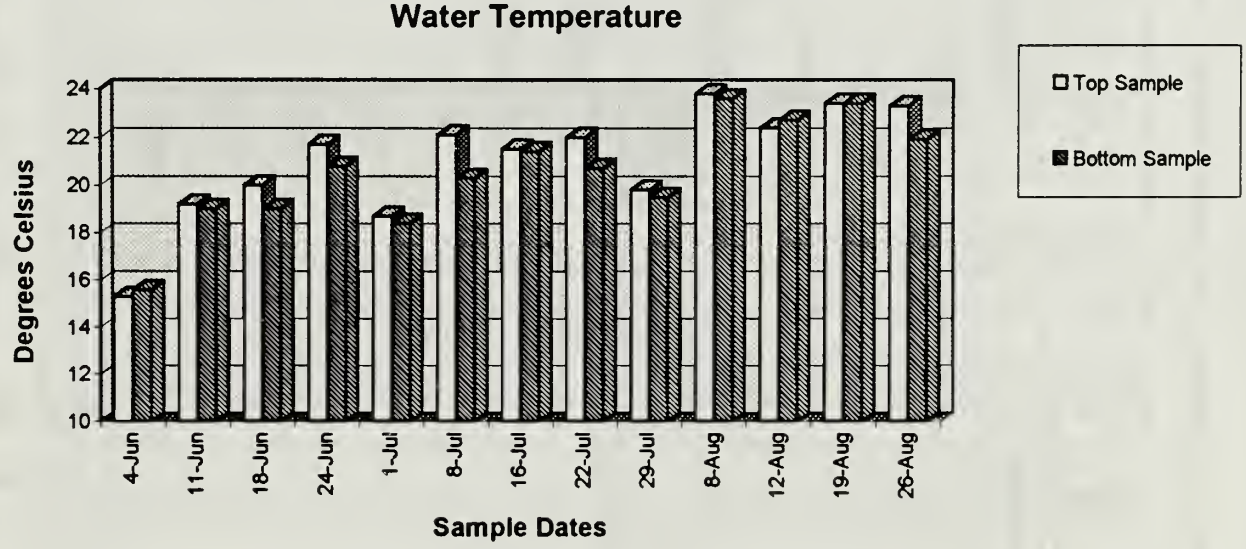


Figure 12

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1996





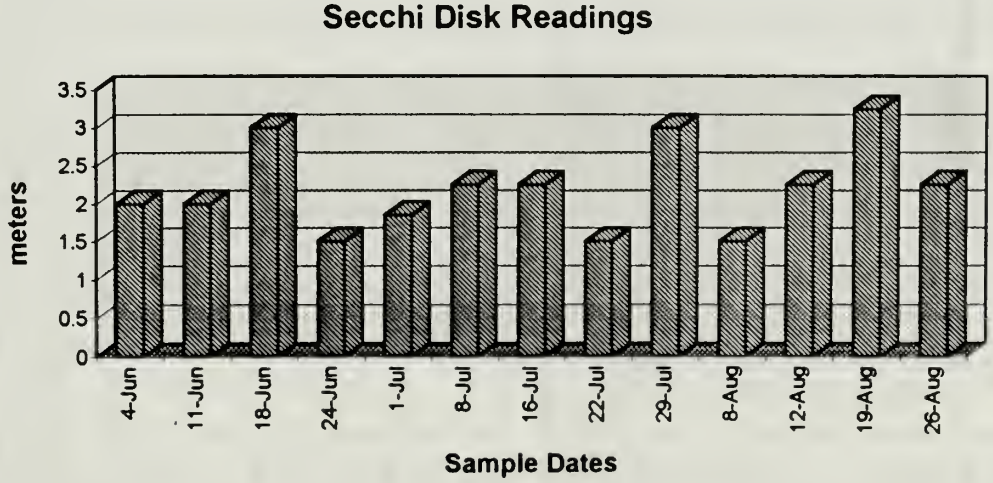
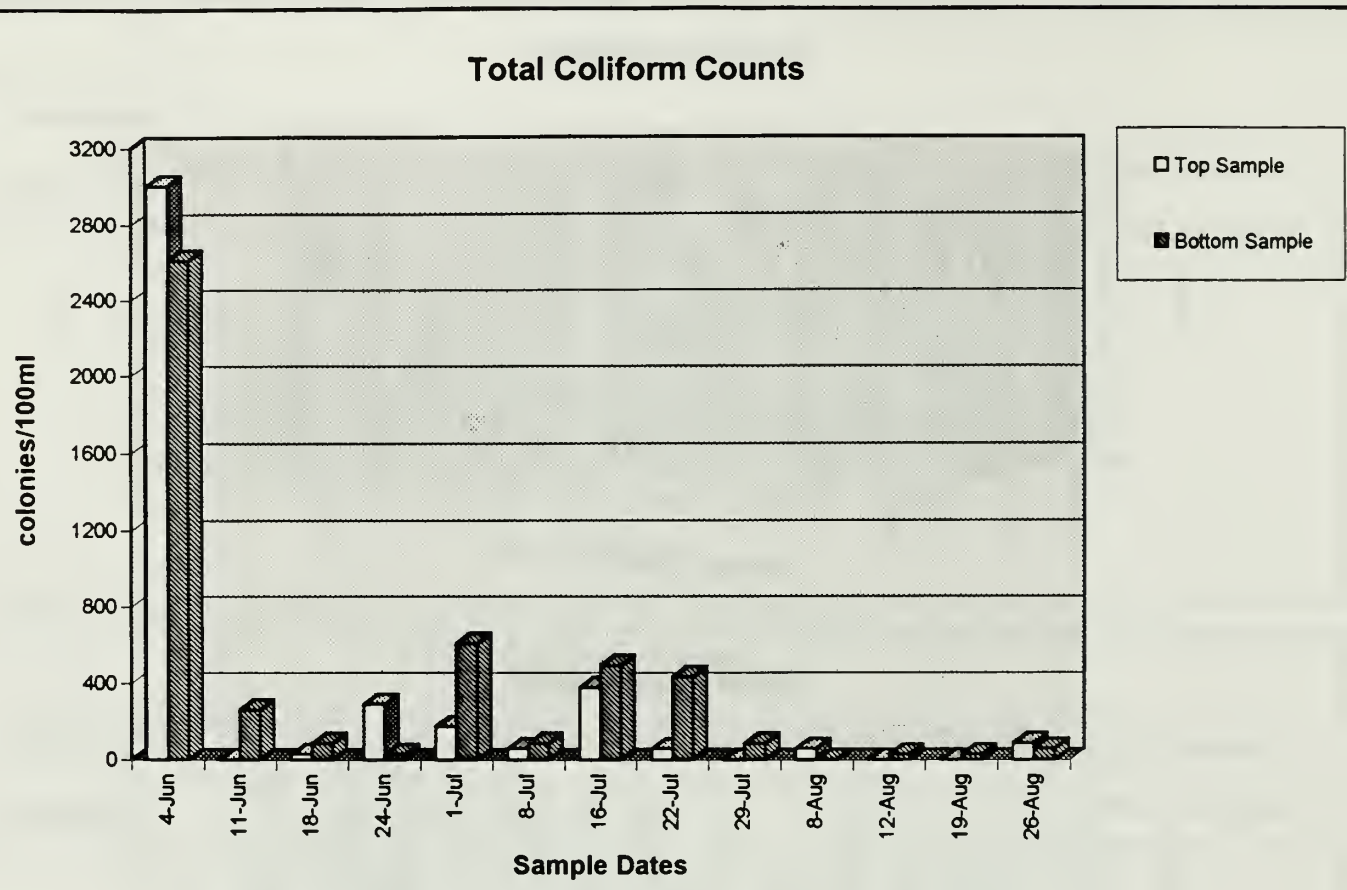


Figure 13

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1996



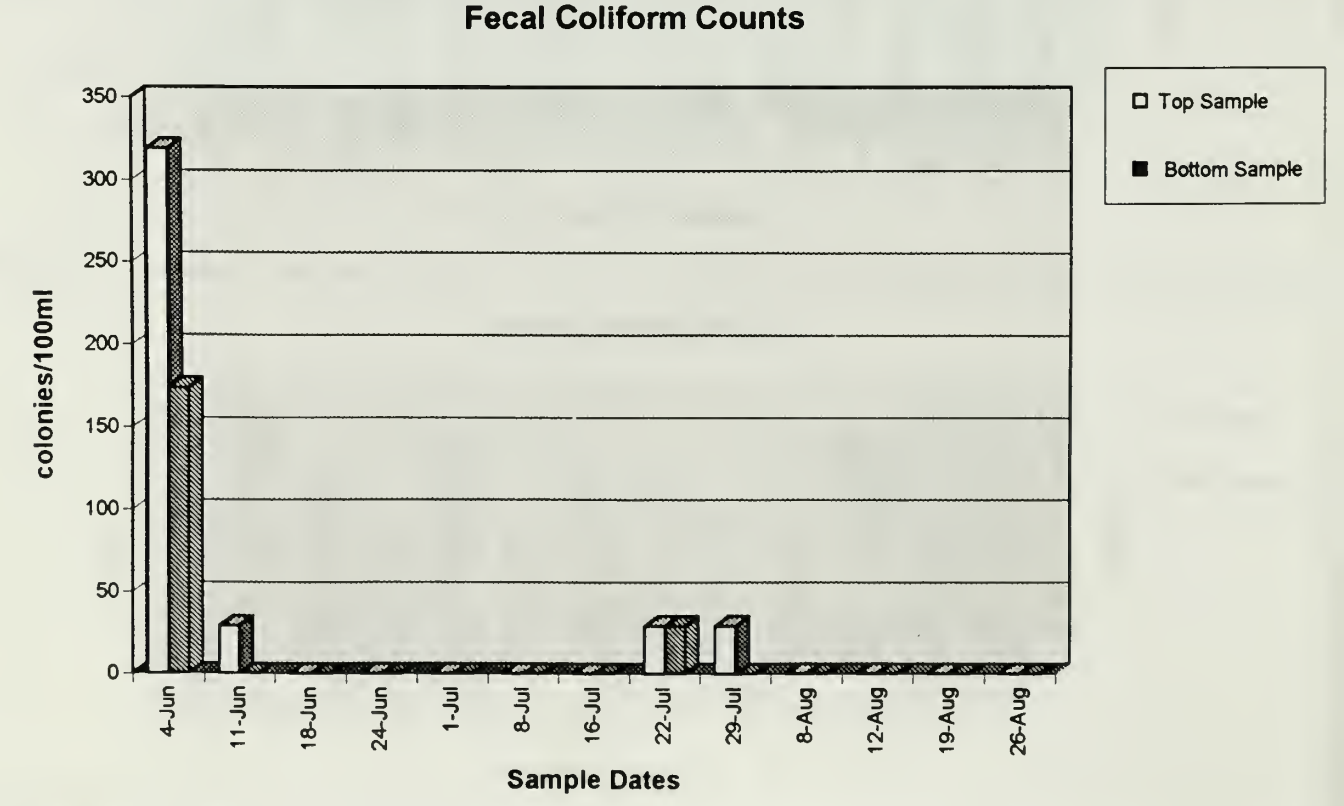


Figure 14

Table IX
Environmental Water Quality Monitoring
Jamaica Bay: Canarsie Pier [JB-6], 1996

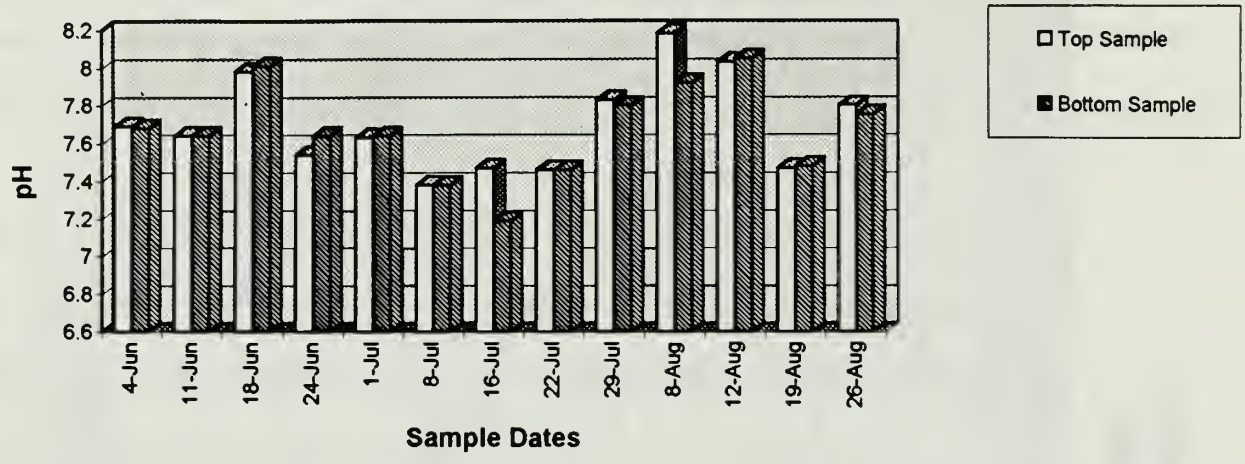
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0940	H	21.0	16.7	16.4	7.69	7.68	21.6	22.0	344	351	6.11	10.44	ND	ND
6/11	0849		20.0	20.4	20.2	7.64	7.64	19.0	21.4	306	340	6.76	9.40	0.38	0.27
6/18	0839	H	22.0	21.7	21.6	7.98	8.01	22.3	22.4	352	354	7.01	8.15	ND	ND
6/24	0833	L	22.0	21.5	21.3	7.54	7.64	21.2	21.9	336	346	4.17	9.11	0.33	0.32
7/01	0841	H	20.5	20.6	20.5	7.63	7.64	22.4	22.5	353	355	4.06	9.07	ND	ND
7/08	0846	L	22.0	23.0	22.3	7.38	7.38	20.9	22.5	332	355	4.18	8.79	0.43	0.46
7/16	0857	H	26.0	22.3	23.6	7.47	7.19	21.6	22.0	343	347	3.50	8.33	ND	ND
7/22	0839	L	24.0	21.7	20.8	7.46	7.46	21.1	22.2	335	351	3.84	9.05	0.42	0.39
7/29	0849	H	22.0	21.5	21.3	7.83	7.80	22.2	22.4	351	354	7.06	8.98	ND	ND
8/08	0900	L	23.0	24.1	24.0	8.18	7.92	20.3	21.5	322	341	8.55	8.18	ND	ND
8/12	1018		22.0	23.3	23.5	8.03	8.05	19.1	20.8	308	330	8.32	8.30	0.68	0.22
8/19	0830		24.0	23.7	23.7	7.47	7.48	20.4	20.5	324	327	8.09	8.20	ND	ND
8/26	0841		25.0	24.3	24.0	7.80	7.75	21.0	21.6	333	342	4.94	8.11	0.34	0.27

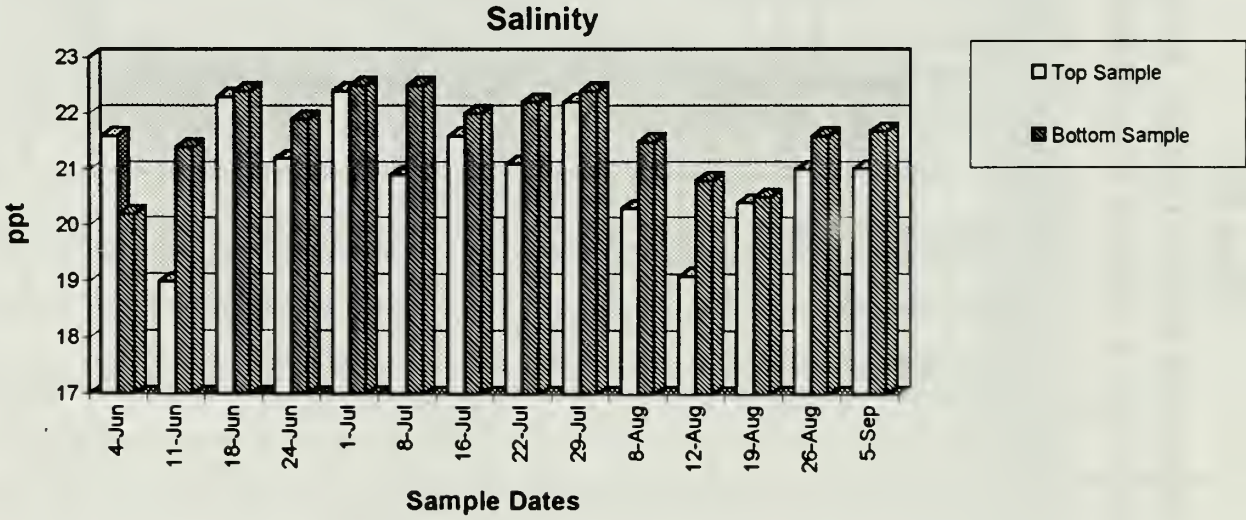
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0940	H	1.5	ND	ND	ND	ND	ND	ND	ND	ND	2717	5683	4925	1900
6/11	0849		1.0	<0.05	<0.05	<0.05	<0.05	0.23	0.09	ND	ND	203	58	29	0
6/18	0839	H	2.0	ND	ND	ND	ND	ND	ND	4.724	13.89	29	29	0	0
6/24	0845	L	1.75	<0.05	<0.05	<0.05	<0.05	0.24	0.43	ND	ND	841	37	0	0
7/01	0841	H	2.0	ND	ND	ND	ND	ND	ND	ND	ND	3450	2717	145	0
7/08	0846	L	1.75	<0.05	<0.05	<0.05	<0.05	0.16	0.10	ND	ND	609	348	0	0
7/16	0857	H	1.50	ND	ND	ND	ND	ND	ND	4.416	6.188	1015	2050	174	58
7/22	0839	L	1.75	<0.05	<0.05	<0.05	<0.05	0.21	0.15	ND	ND	580	58	0	0
7/29	0849	H	1.50	ND	ND	ND	ND	ND	ND	ND	ND	0	29	0	0
8/08	0900	L	0.75	ND	ND	ND	ND	ND	ND	ND	ND	29	0	0	0
8/12	1018		1.25	<0.05	<0.05	<0.05	ND	0.43	0.16	0.308	9.240	29	29	0	0
8/19	0830		2.25	ND	ND	ND	ND	ND	ND	ND	ND	0	29	0	0
8/26	0841		1.25	<0.05	<0.05	<0.05	<0.05	0.23	0.18	ND	ND	348	232	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

ND: No Data.

Canarsie Pier (JB-6) Water Quality Measurements, 1996





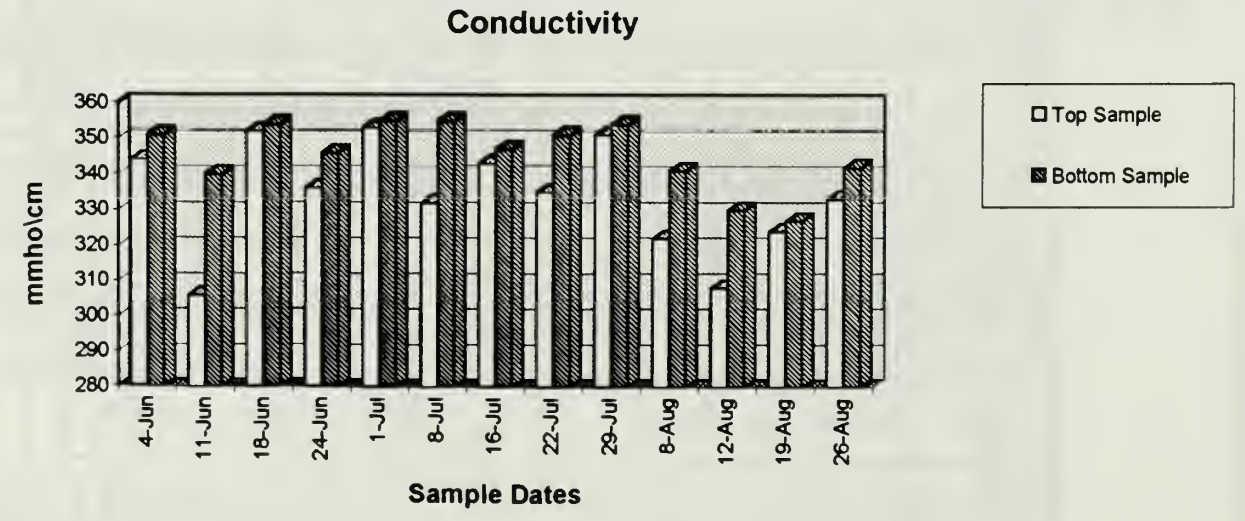
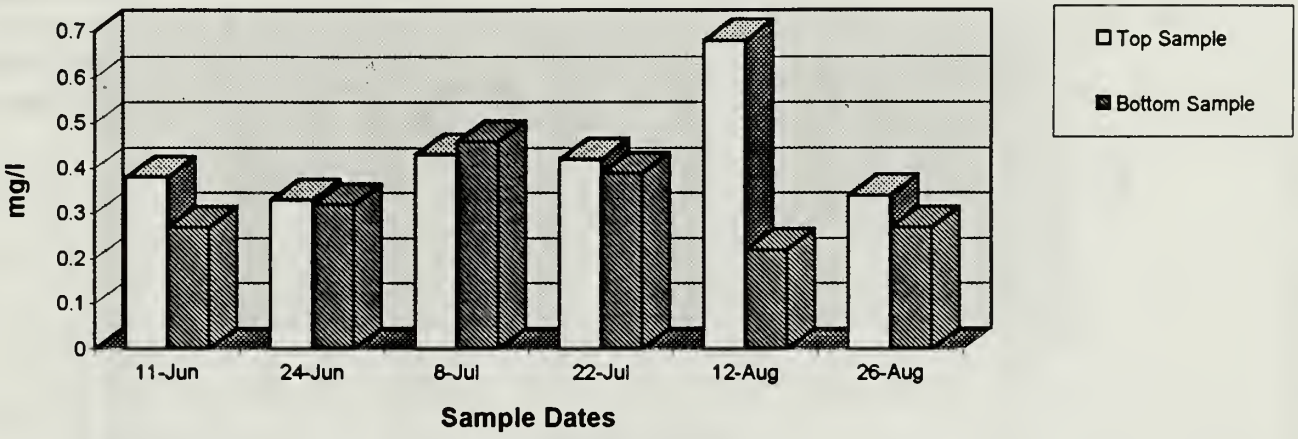


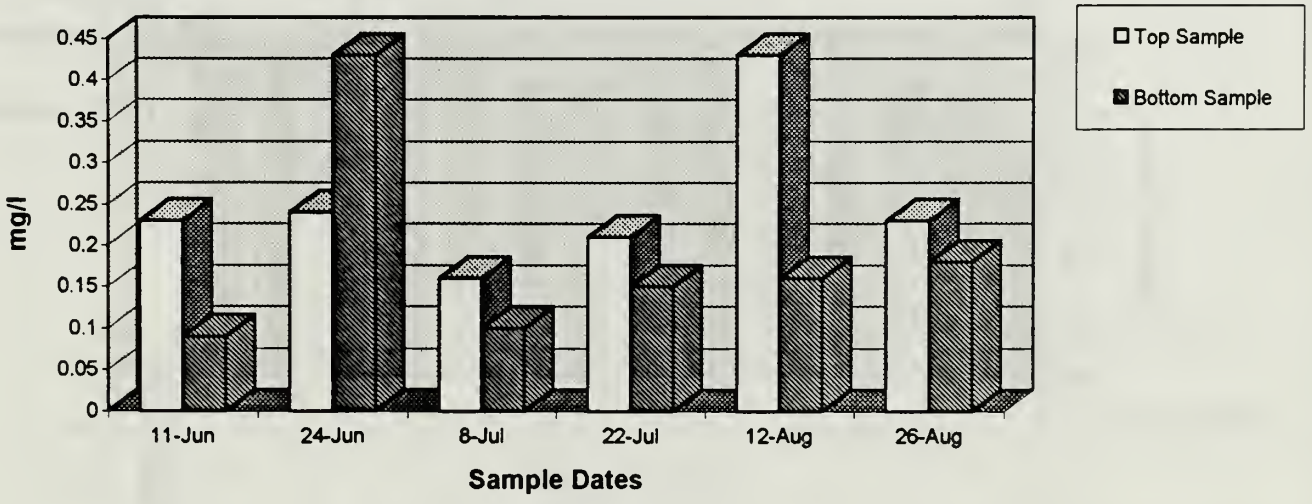
Figure 15

Canarsie Pier (JB-6) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

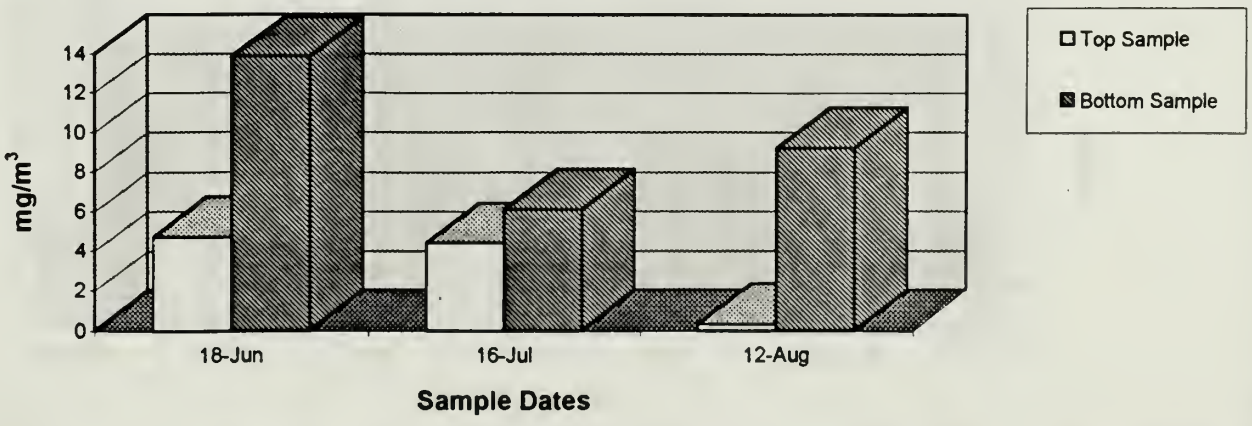
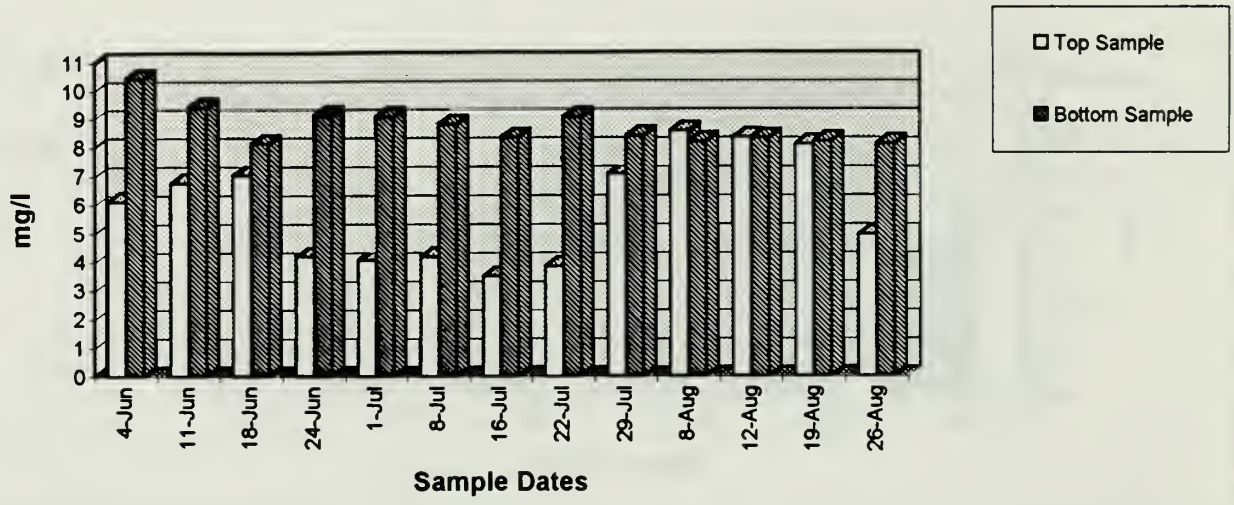
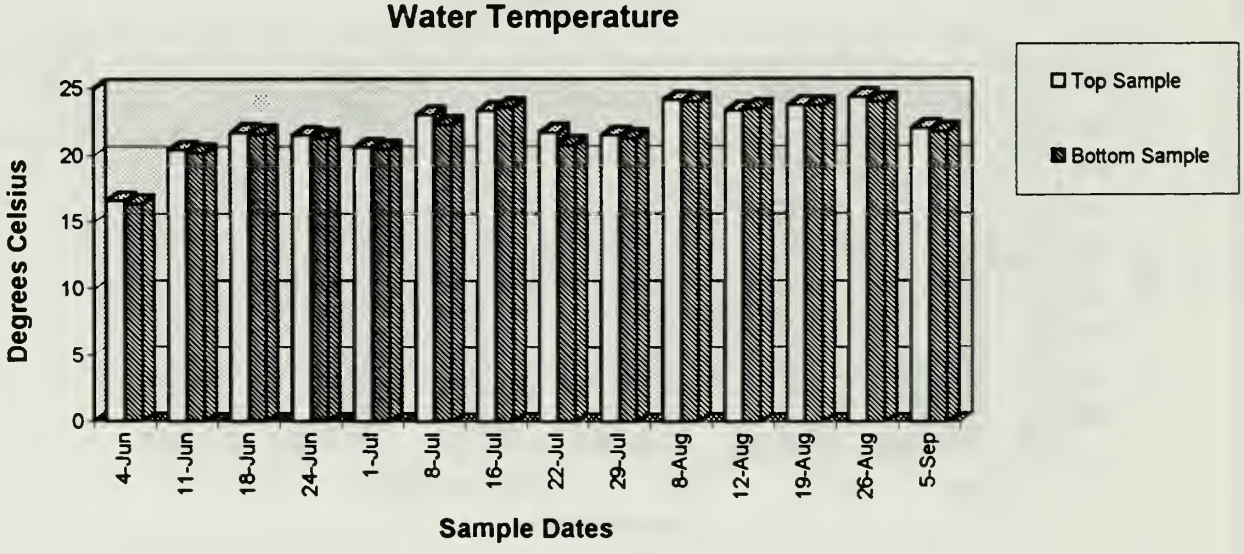


Figure 16

Canarsie Pier (JB-6) Water Quality Measurements, 1996





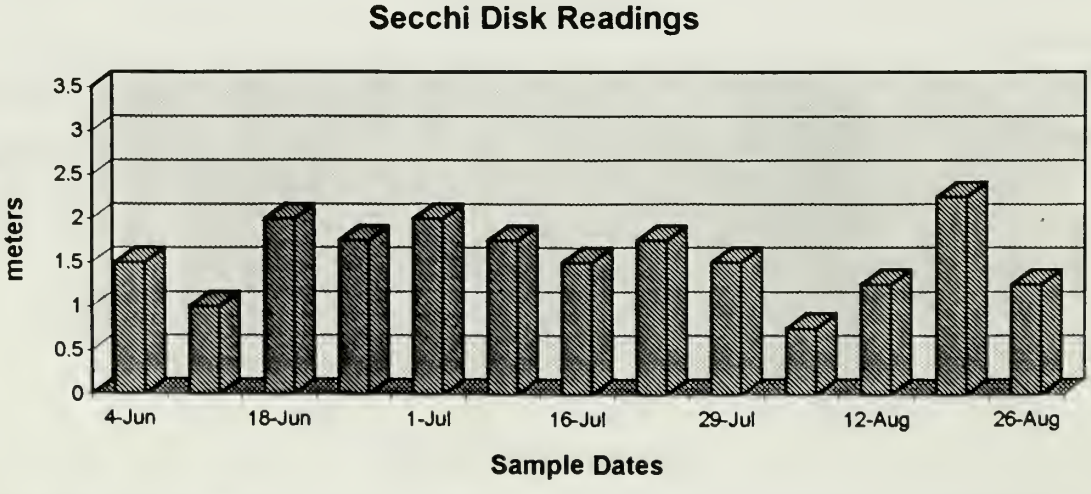
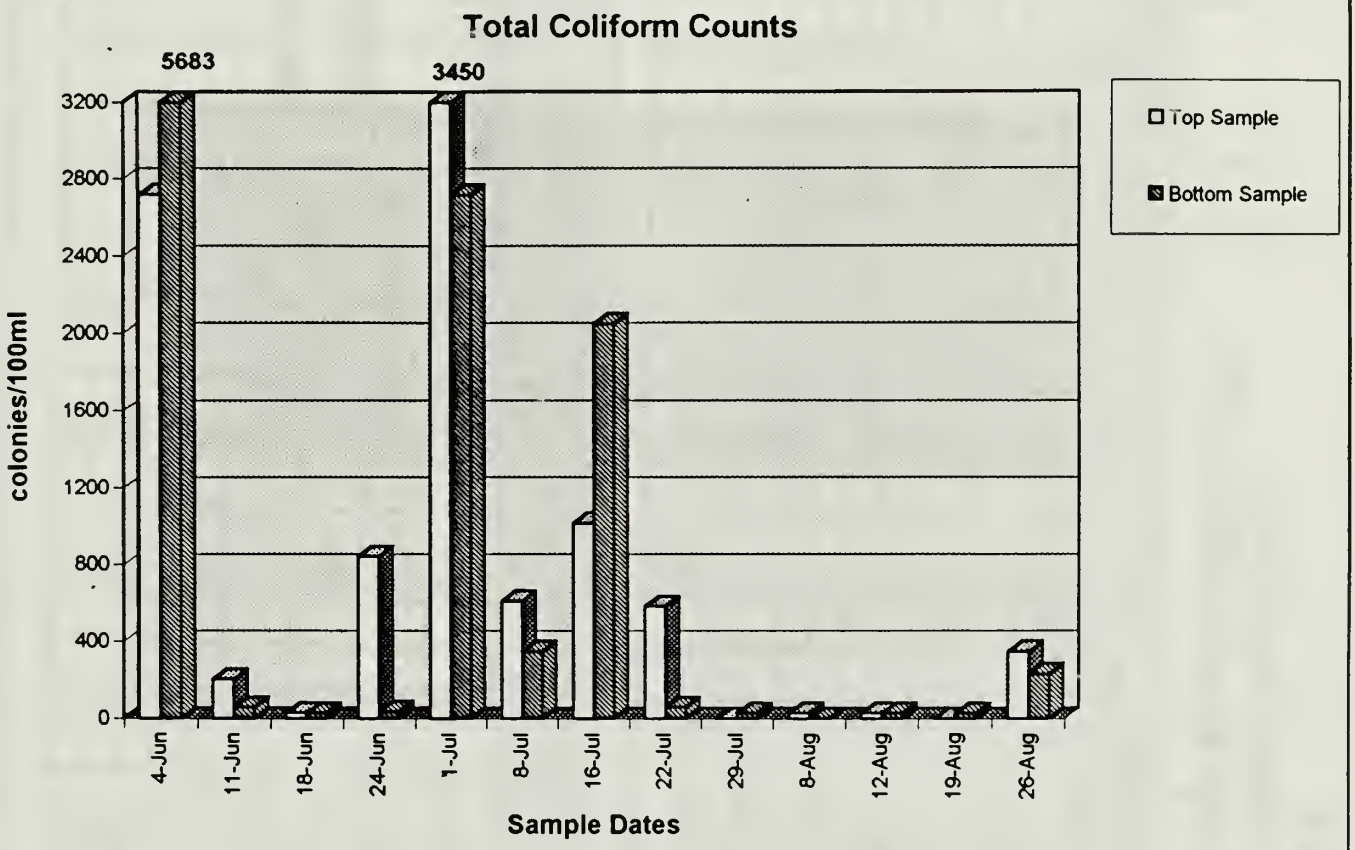


Figure 17

Canarsie Pier (JB-6) Water Quality Measurements, 1996



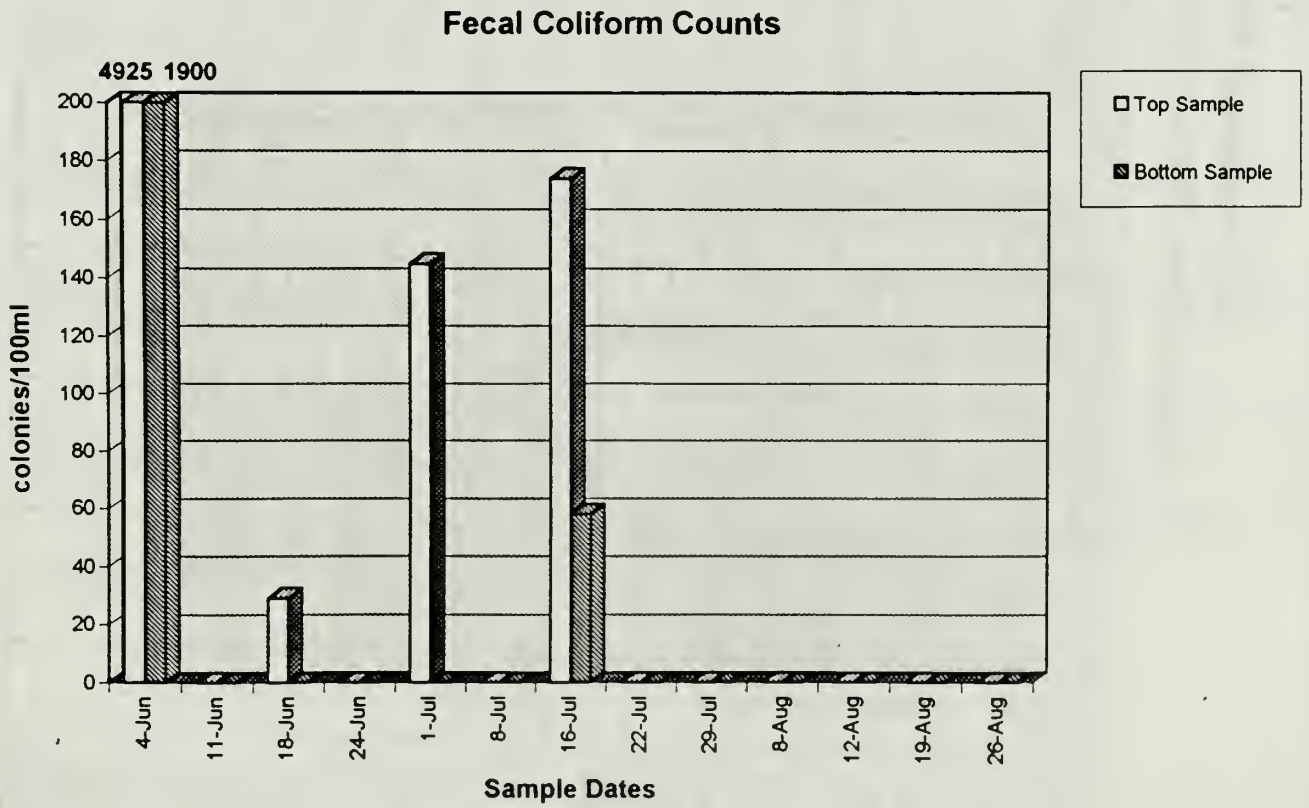


Figure 18

Table X
Environmental Water Quality Monitoring
Jamaica Bay: Pennsylvania Avenue Landfill [JB-6A], 1996

Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0952	H	22.0	17.8	17.0	7.54	7.59	19.0	21.2	306	338	5.27	10.48	ND	ND
6/11	0909		22.0	21.3	20.5	7.86	7.50	19.0	20.6	306	329	7.57	9.38	0.27	0.33
6/18	0851	H	22.0	22.2	22.0	7.91	7.92	21.4	21.9	339	347	5.16	8.89	ND	ND
6/24	0845	L	23.0	21.7	21.5	7.39	7.50	21.3	21.9	338	347	3.51	9.16	0.14	0.19
7/01	0854	H	21.0	21.2	21.1	7.57	7.61	20.9	21.8	332	344	2.48	9.11	ND	ND
7/08	0859	L	23.0	23.1	22.7	7.47	7.39	20.5	22.1	326	348	4.20	8.80	0.54	0.39
7/16	0912	H	28.0	23.6	23.2	7.32	7.41	19.6	21.3	313	337	3.48	6.35	ND	ND
7/22	0852	L	22.5	22.0	21.8	7.40	7.42	20.3	21.3	325	337	3.38	8.79	0.40	0.36
7/29	0902	H	22.5	22.4	21.9	7.89	7.81	21.2	21.6	337	342	8.69	8.66	ND	ND
8/08	0917	L	24.5	24.5	24.3	8.13	8.04	19.8	21.3	316	337	9.27	8.50	ND	ND
8/12	1011		22.0	23.7	23.5	8.05	8.01	19.7	20.5	314	326	8.13	8.25	0.39	0.30
8/19	0842		24.0	23.7	23.6	7.47	7.47	19.8	20.0	316	318	8.36	8.37	ND	ND
8/26	0853		25.0	24.9	24.7	7.68	7.67	20.5	20.9	326	331	4.33	8.42	0.36	0.34

Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0952	H	1.00	ND	ND	ND	ND	ND	ND	ND	ND	290	6467	67600	4600
6/11	0909		0.85	0.08	<0.05	<0.05	<0.05	0.48	0.44	ND	ND	1050	145	29	0
6/18	0851	H	1.75	ND	ND	ND	ND	ND	ND	4.416	4.416	551	319	29	0
6/24	0845	L	1.35	<0.05	<0.05	<0.05	<0.05	0.28	0.20	ND	ND	1875	261	0	0
7/01	0854	H	1.75	ND	ND	ND	ND	ND	ND	ND	ND	174	696	1100	1100
7/08	0859	L	1.50	<0.05	<0.05	<0.05	<0.05	0.51	0.47	ND	ND	1150	174	0	29
7/16	0912	H	1.50	ND	ND	ND	ND	ND	ND	4.108	6.462	0	319	7500	1150
7/22	0852	L	1.50	<0.05	<0.05	<0.05	<0.05	0.29	0.19	ND	ND	290	319	58	29
7/29	0902	H	1.00	ND	ND	ND	ND	ND	ND	ND	ND	174	29	87	0
8/08	0917	L	0.75	ND	ND	ND	ND	ND	ND	ND	ND	203	58	29	0
8/12	1011		1.00	<0.05	<0.05	<0.05	ND	0.14	0.10	8.232	0.308	203	29	0	0
8/19	0842		1.75	ND	ND	ND	<0.05	ND	ND	ND	ND	870	754	29	29
8/26	0853		1.00	<0.05	<0.05	<0.05	<0.05	0.24	0.19	ND	ND	899	551	58	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1996

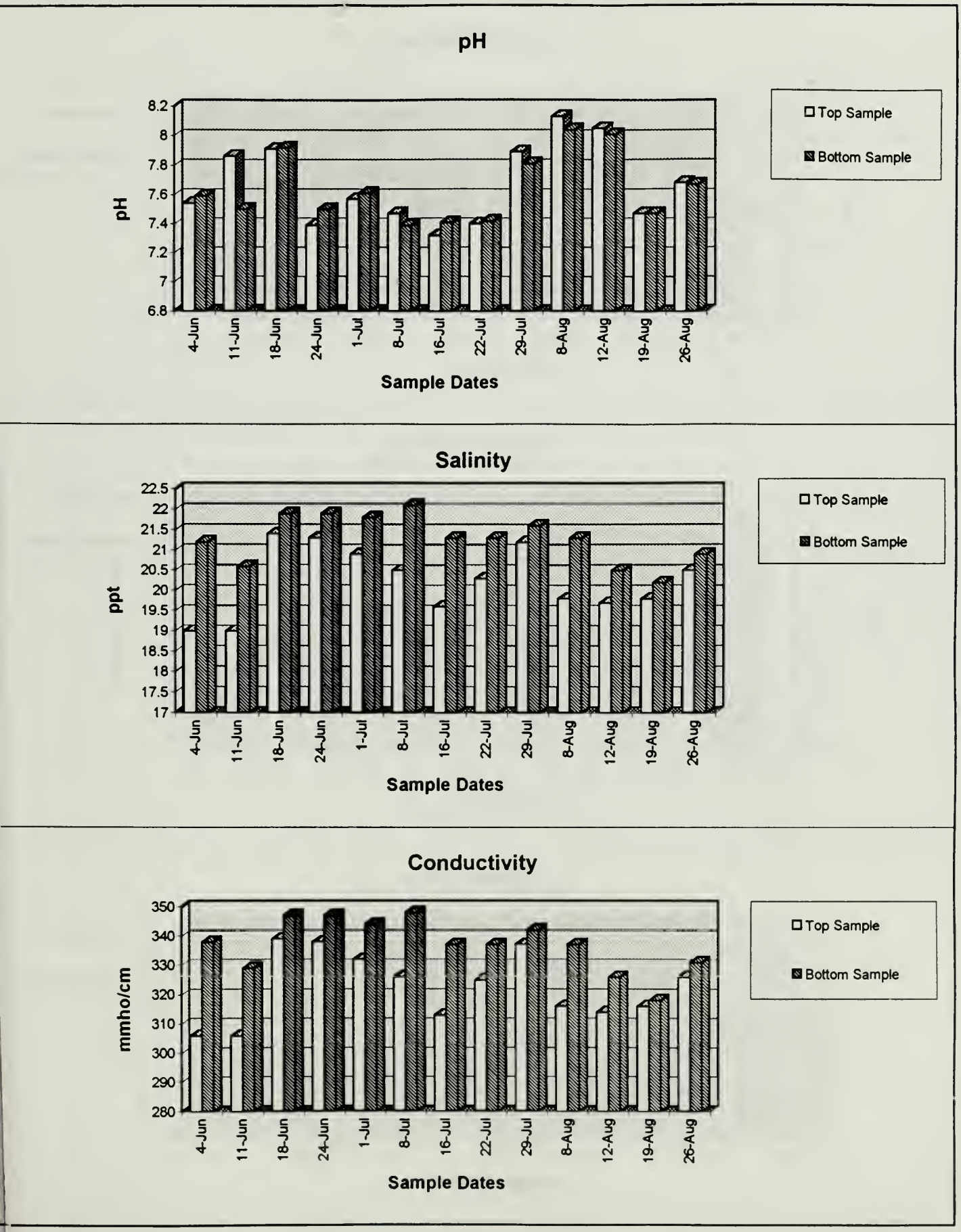
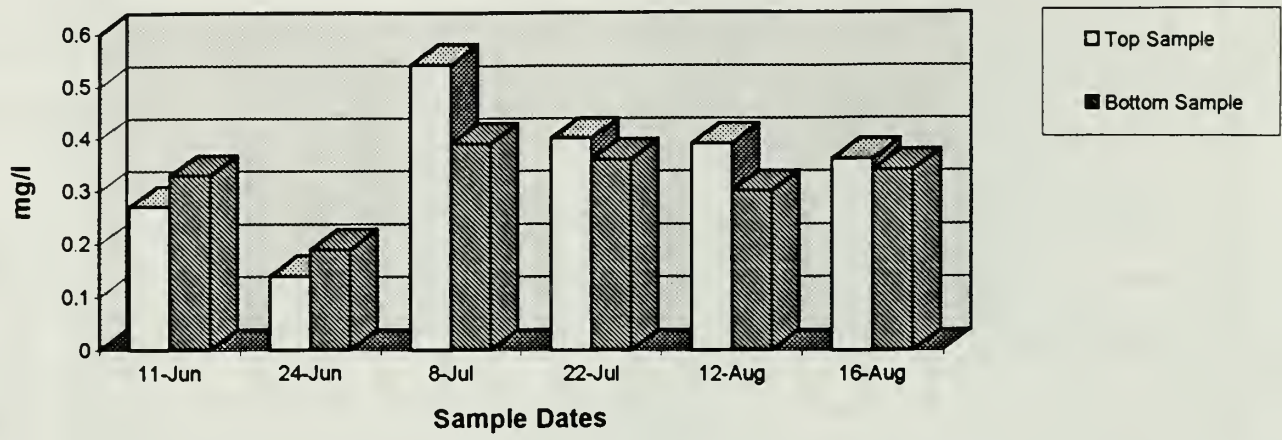


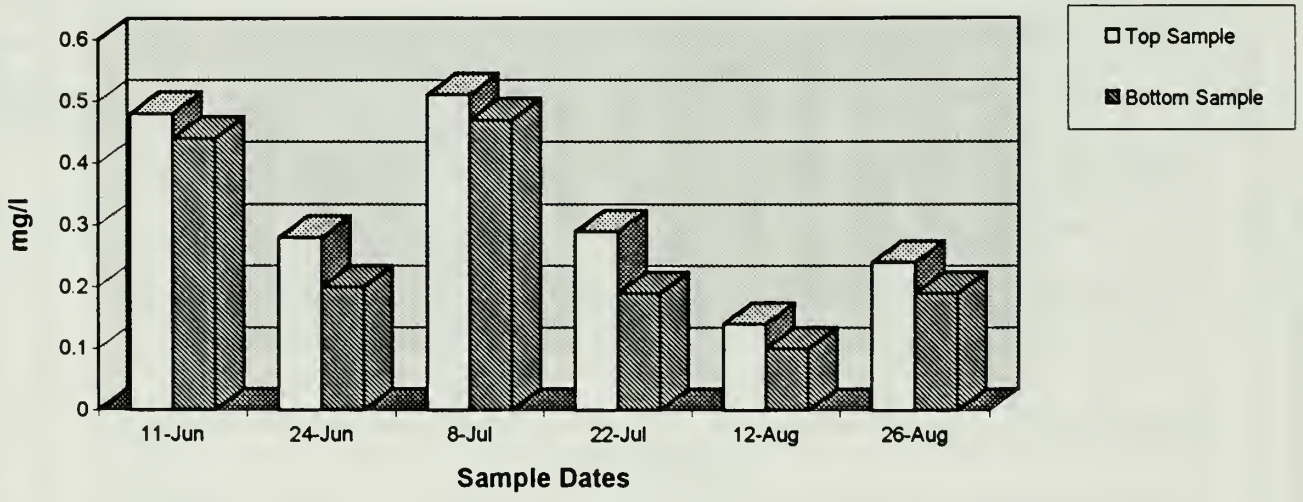
Figure 19

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

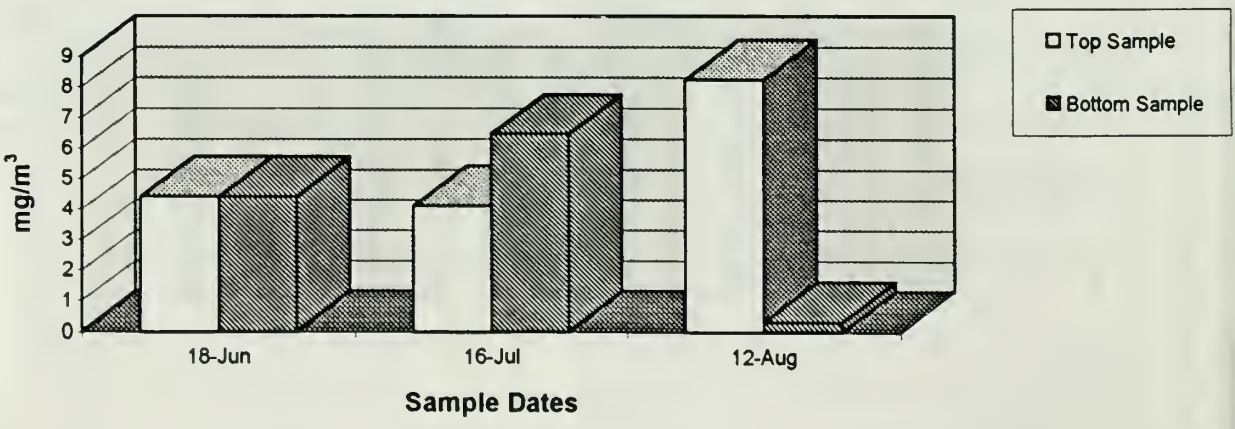
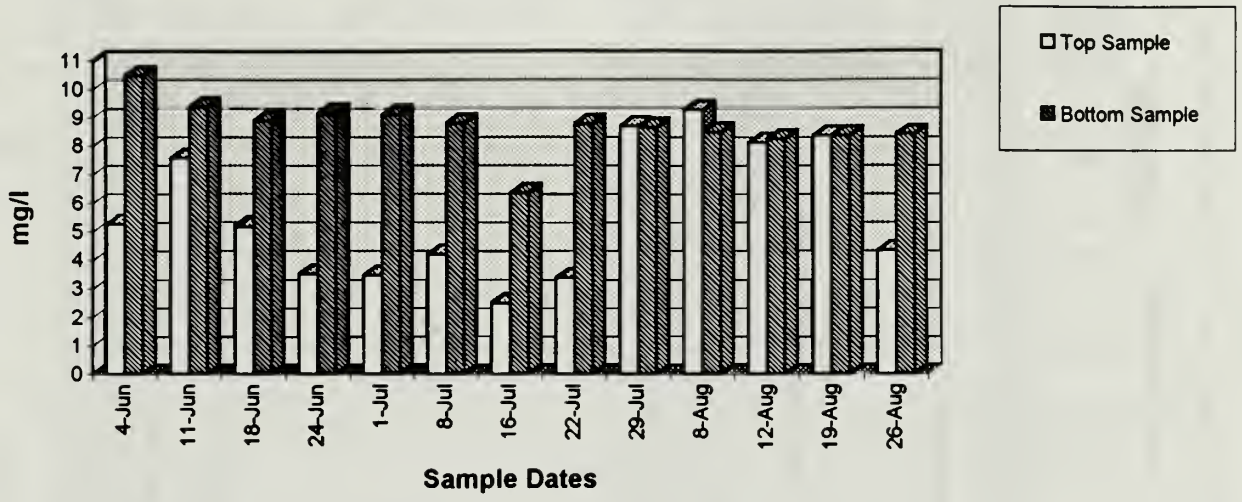


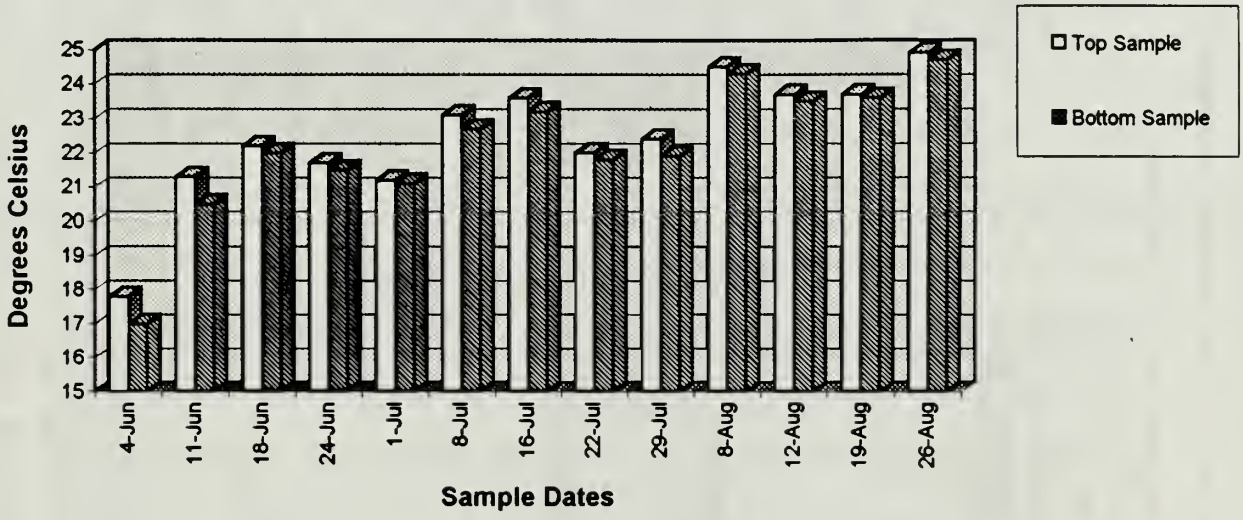
Figure 20

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1996

Dissolved Oxygen



Water Temperature



Secchi Disk Readings

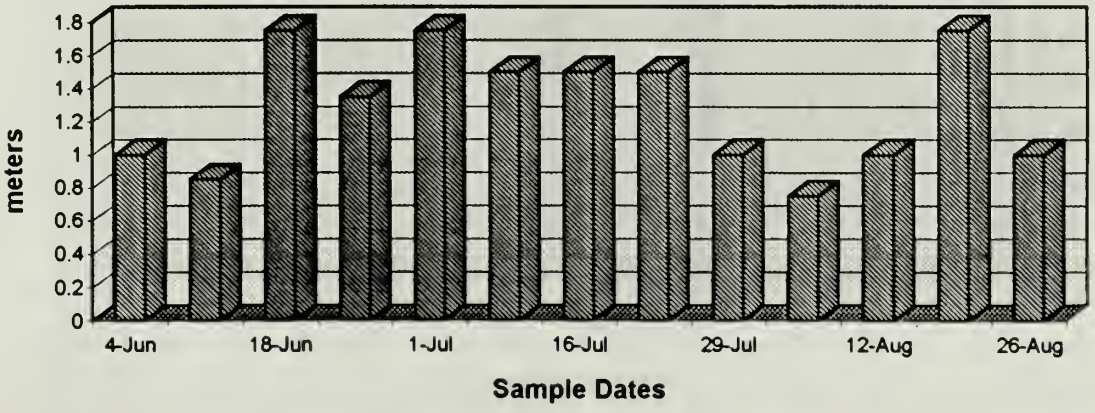
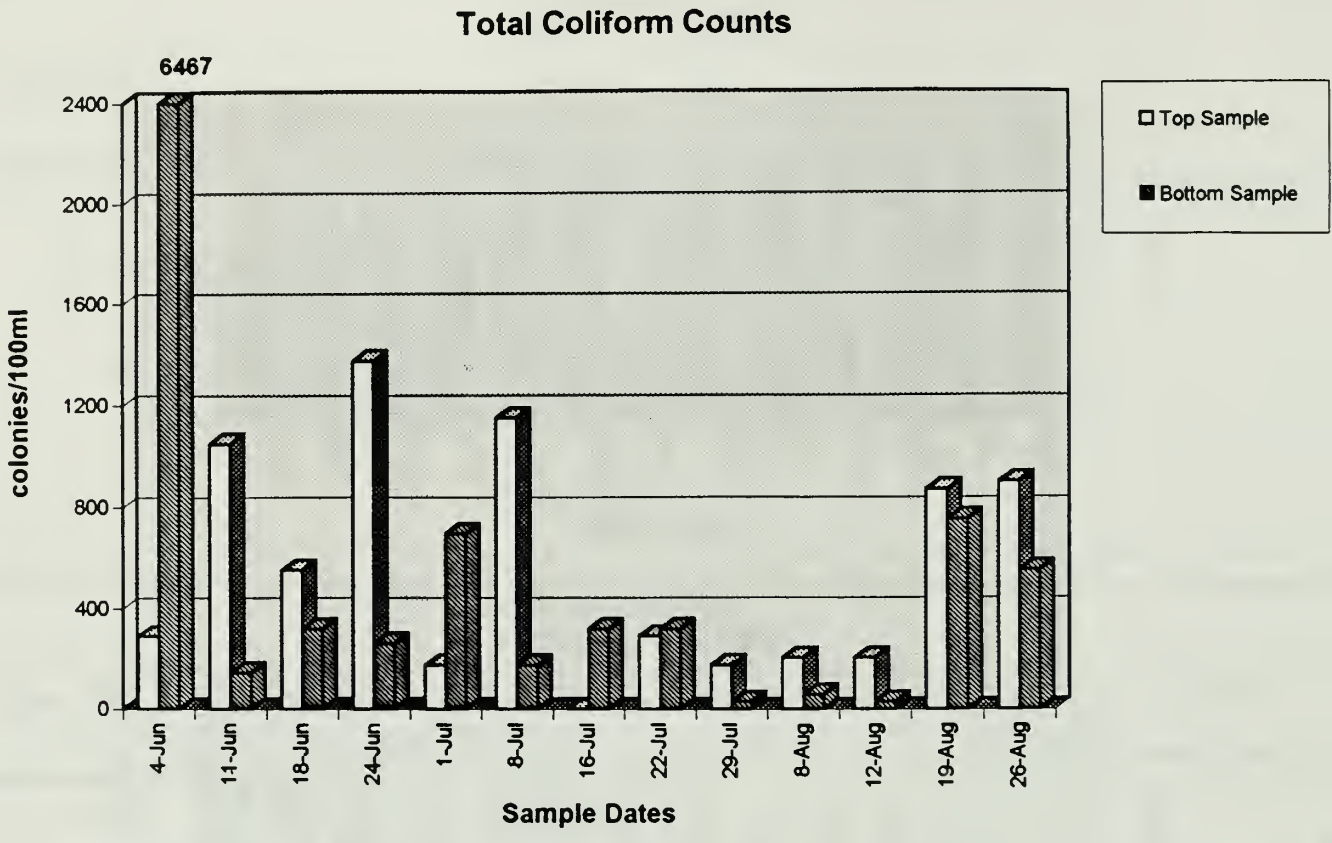


Figure 21

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1996



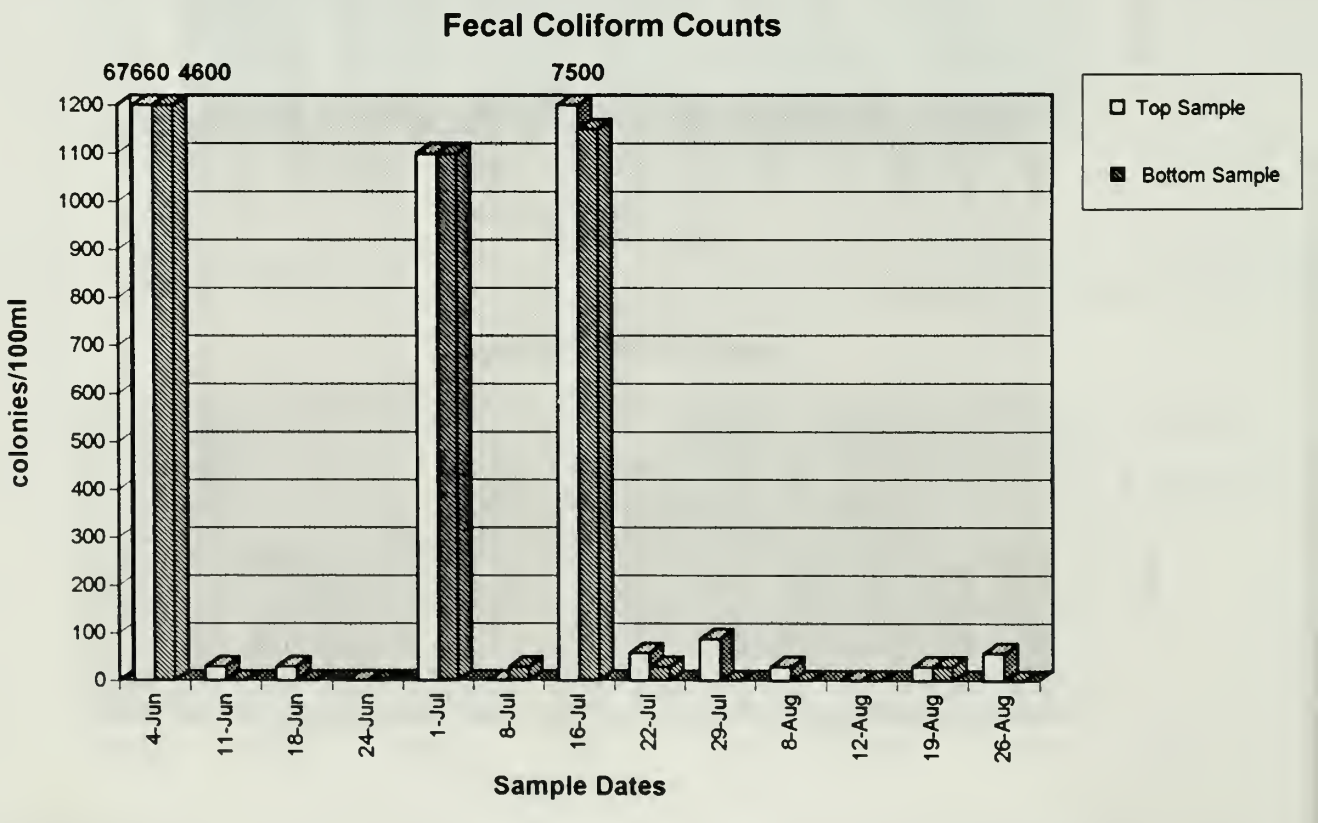


Figure 22

Table XI
Environmental Water Quality Monitoring
Jamaica Bay: Bergen Basin [JB-16], 1996

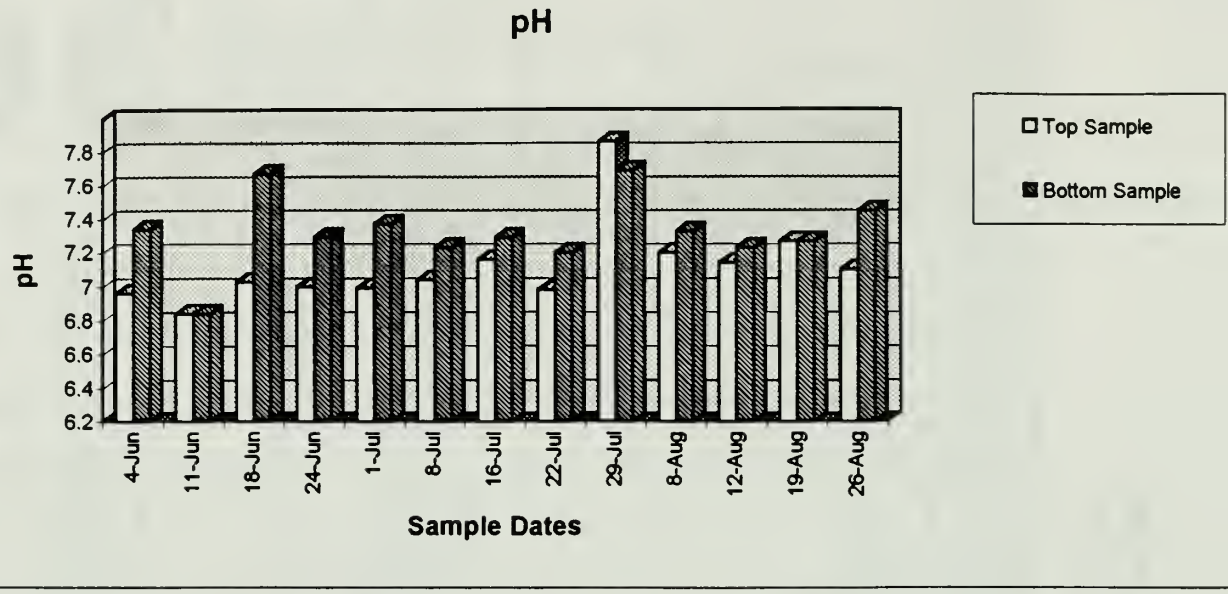
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1010	H	22.0	19.4	17.9	6.96	7.34	10.6	20.2	180	325	3.05	10.27	ND	ND
6/11	0930	L	24.0	20.2	20.3	6.84	6.84	6.9	19.4	122	313	0.67	9.67	0.25	<0.01
6/18	0907	H	23.0	22.3	22.7	7.03	7.67	11.6	21.0	195	332	6.77	8.67	ND	ND
6/24	0909	L	24.0	22.2	21.8	7.00	7.29	12.1	20.6	202	329	0.34	9.19	<0.1	0.18
7/01	0915	H	21.5	21.5	21.7	6.99	7.37	7.6	20.5	132	325	0.88	8.98	ND	ND
7/08	0916	L	23.0	22.9	23.0	7.04	7.23	9.4	21.1	161	335	1.87	8.55	0.23	0.32
7/16	0932	H	29.0	23.9	23.9	7.16	7.29	14.9	20.6	245	327	2.00	8.74	ND	ND
7/22	0921		24.0	22.4	22.8	6.98	7.20	9.5	20.3	162	322	0.95	8.66	0.24	0.38
7/29	0921	H	23.5	23.3	22.6	7.86	7.69	16.6	20.8	270	330	10.50	8.31	ND	ND
8/08	0940	L	25.0	23.5	23.6	7.20	7.33	8.1	20.2	139	319	5.06	8.66	ND	ND
8/12	0958	H	22.0	22.8	23.3	7.14	7.23	8.0	19.3	138	306	8.46	8.28	0.27	<0.1
8/19	0929		26.0	24.3	24.0	7.27	7.27	17.0	19.6	275	313	8.84	8.95	ND	ND
8/26	0912		27.0	24.9	24.9	7.10	7.45	14.3	19.9	235	319	8.25	3.30	0.30	0.30

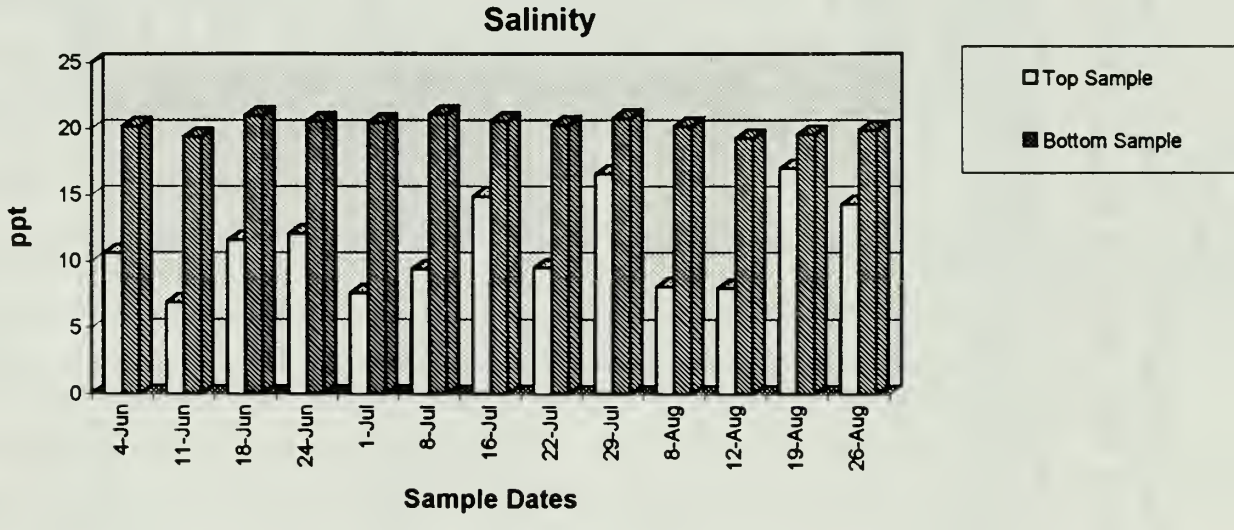
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1010	H	0.75	ND	ND	ND	ND	ND	ND	ND	ND	319	4383	30400	551
6/11	0930	L	0.25	<0.05	<0.05	<0.05	<0.05	1.6	0.7	ND	ND	87	4050	2300	58
6/18	0907	H	0.50	ND	ND	ND	ND	ND	ND	18.33	4.400	5000	1500	15005	0
6/24	0909	L	0.25	<0.05	<0.05	<0.05	<0.05	1.3	0.40	ND	ND	0	783	2100	149
7/01	0915	H	1.25	ND	ND	ND	ND	ND	ND	ND	ND	0	87	>12400	1150
7/08	0916	L	0.50	<0.05	<0.05	<0.05	<0.05	2.4	0.20	ND	ND	0	667	174	0
7/16	0932	H	1.00	ND	ND	ND	ND	ND	ND	8.832	4.416	0	116	7675	1950
7/22	0921		1.00	<0.05	<0.05	<0.05	<0.05	2.3	0.34	ND	ND	0	377	>14250	203
7/29	0921	H	0.75	ND	ND	ND	ND	ND	ND	ND	ND	0	986	1000	0
8/08	0940	L	0.75	ND	ND	ND	ND	ND	ND	ND	ND	145	174	116	0
8/12	0958	H	1.00	<0.05	<0.05	<0.05	<0.05	2.40	0.34	2.37	6.600	0	1247	2050	0
8/19	0929		1.50	ND	ND	ND	ND	ND	ND	ND	ND	232	638	2850	0
8/26	0912		0.75	<0.05	<0.05	<0.05	<0.05	1.1	0.47	ND	ND	29	3567	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

ND: No Data.

Bergen Basin (JB-16) Water Quality Measurements, 1996





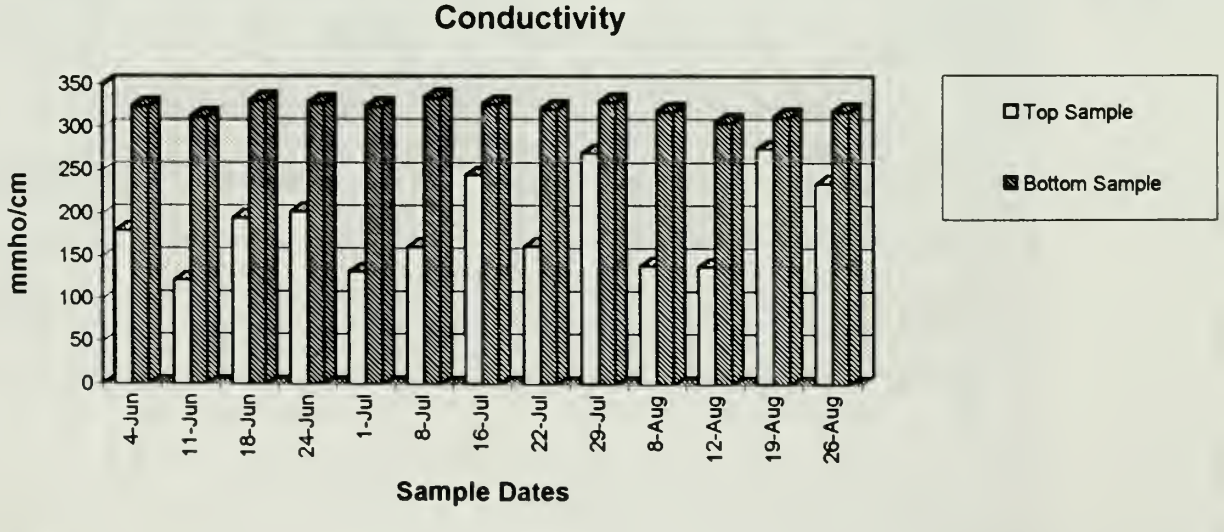
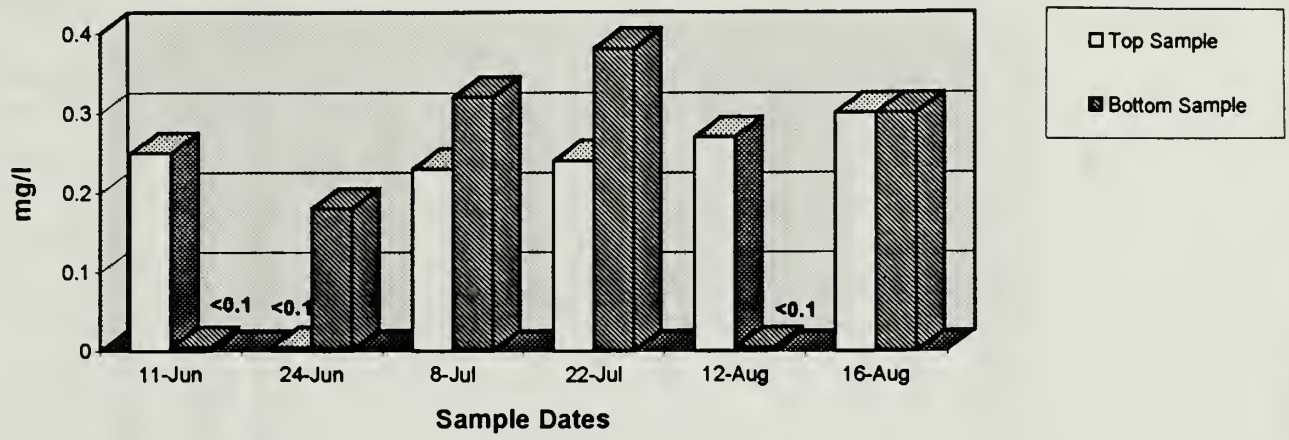


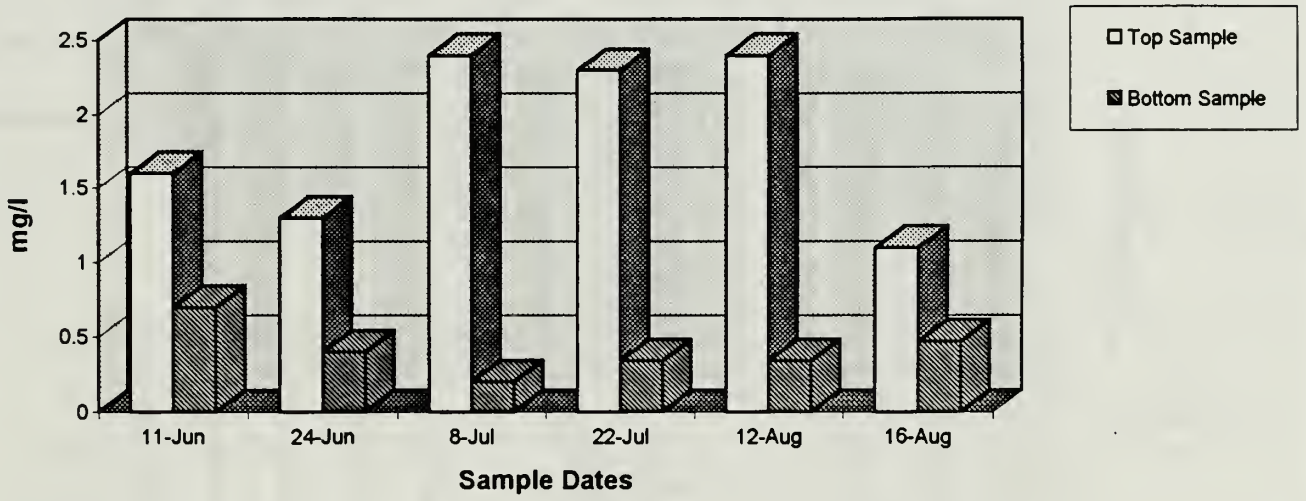
Figure 23

Bergen Basin (JB-16) Water Quality Measurements, 1996

Nitrates



Orthophospate



Chlorophyll a

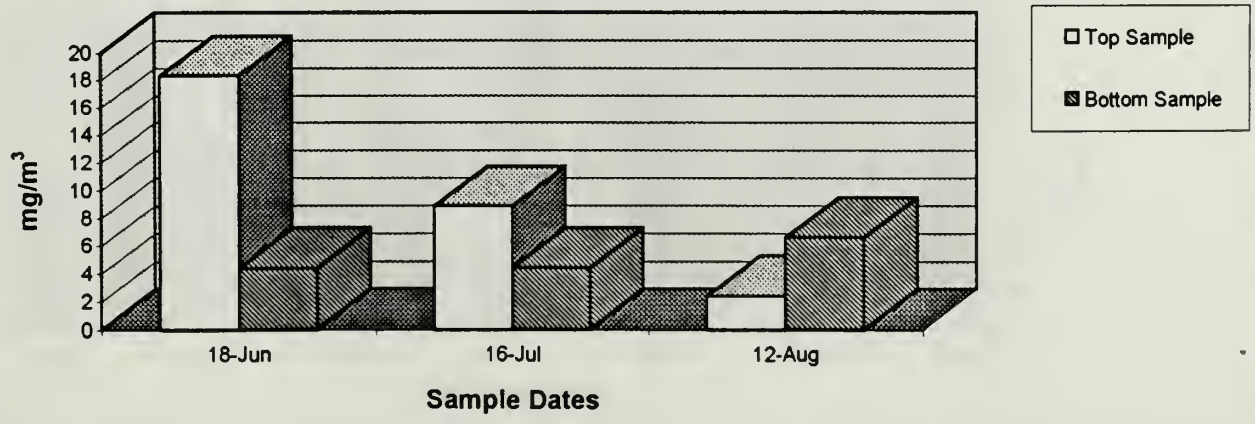
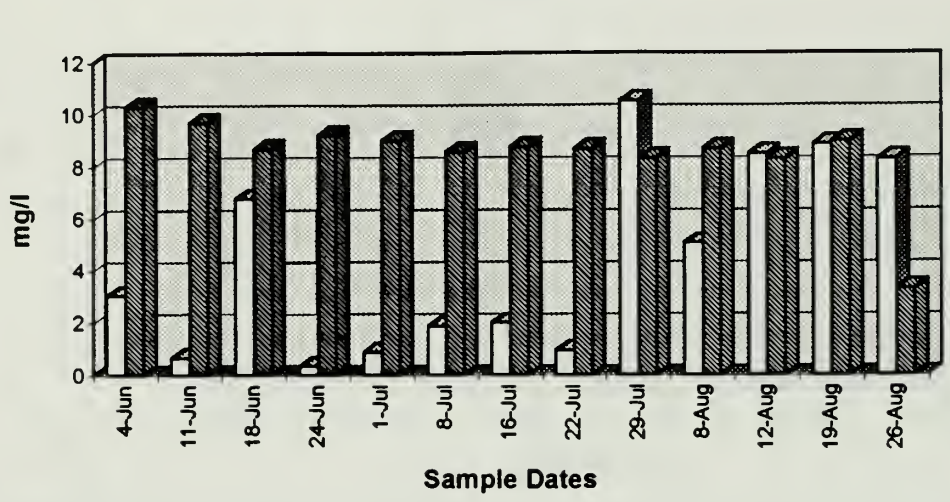
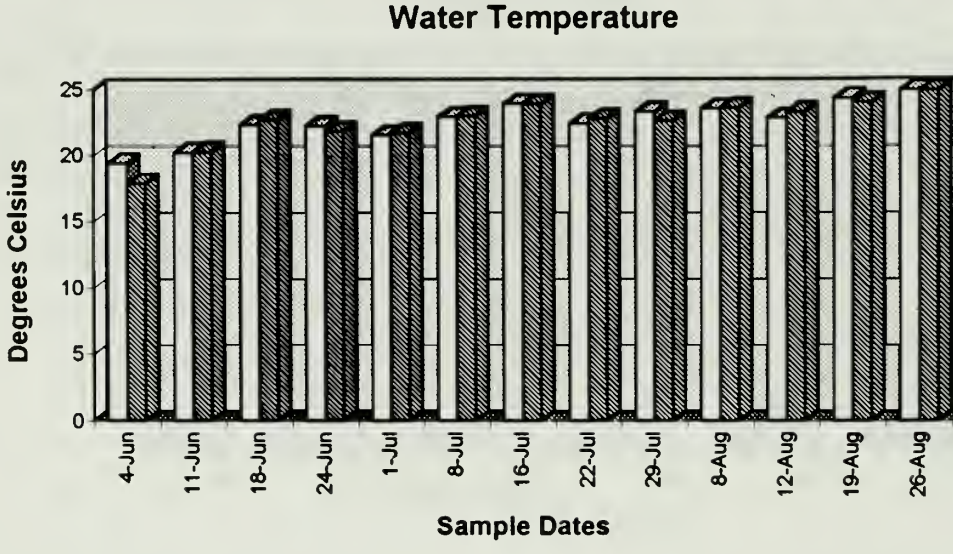


Figure 24

Bergen Basin (JB-16) Water Quality Measurements, 1996





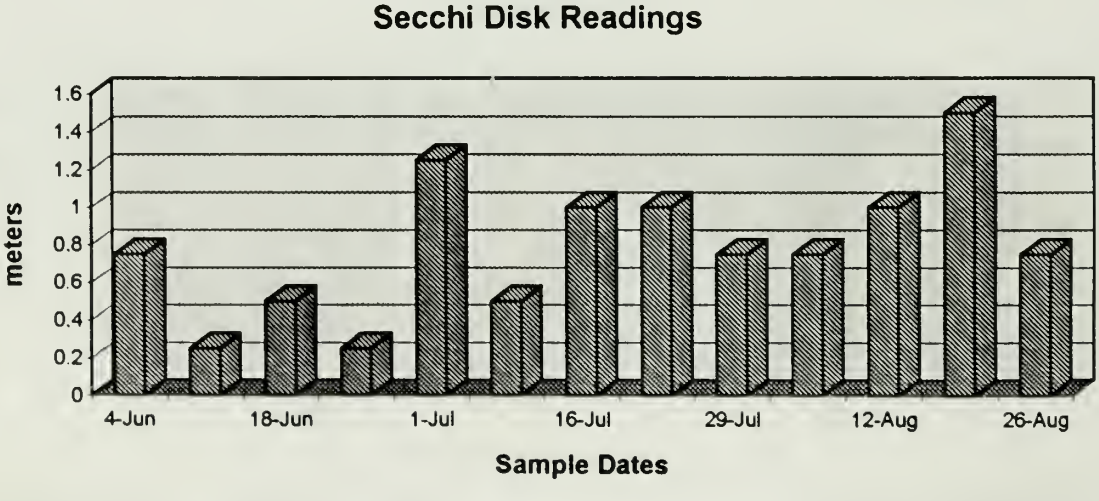
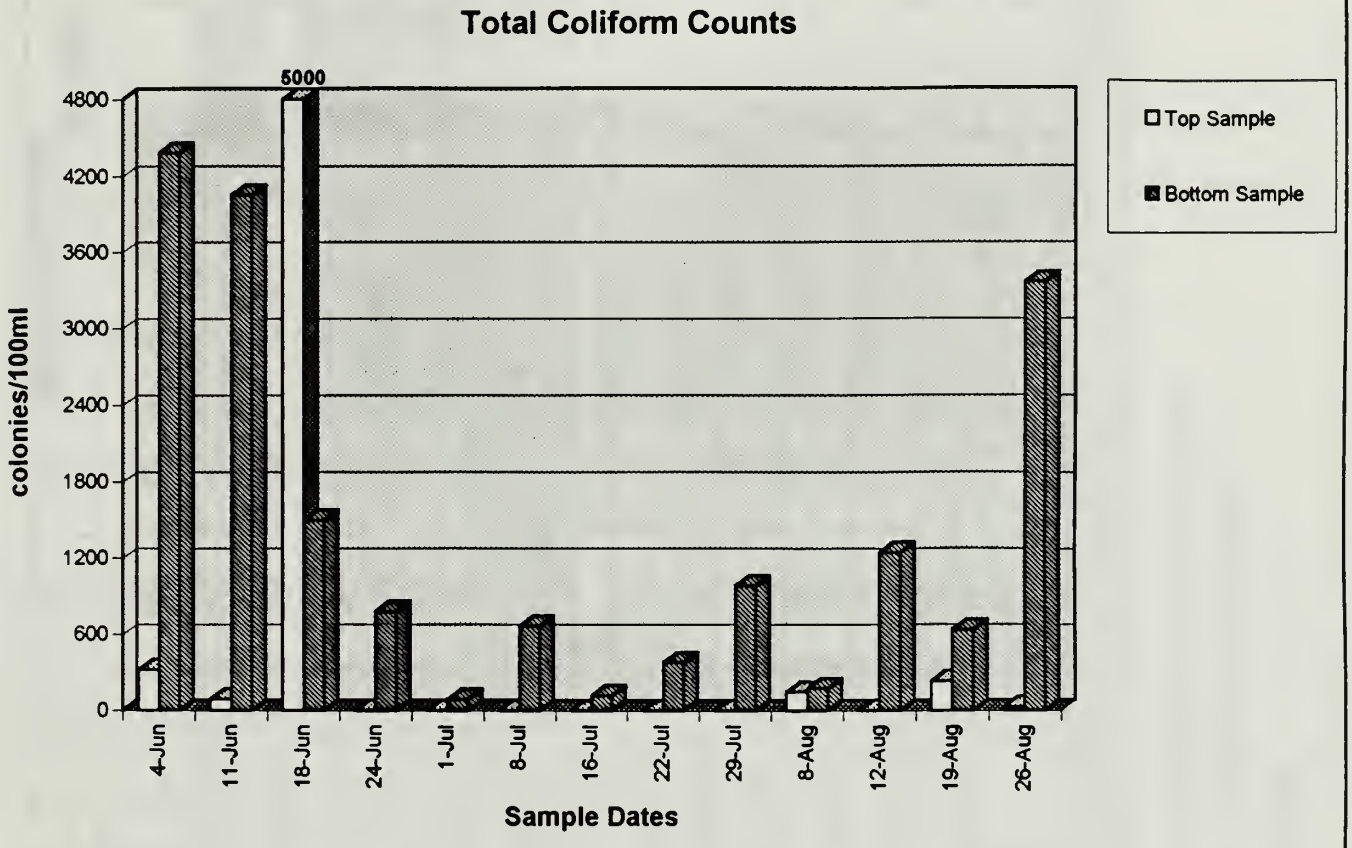


Figure 25

Bergen Basin (JB-16) Water Quality Measurements, 1996



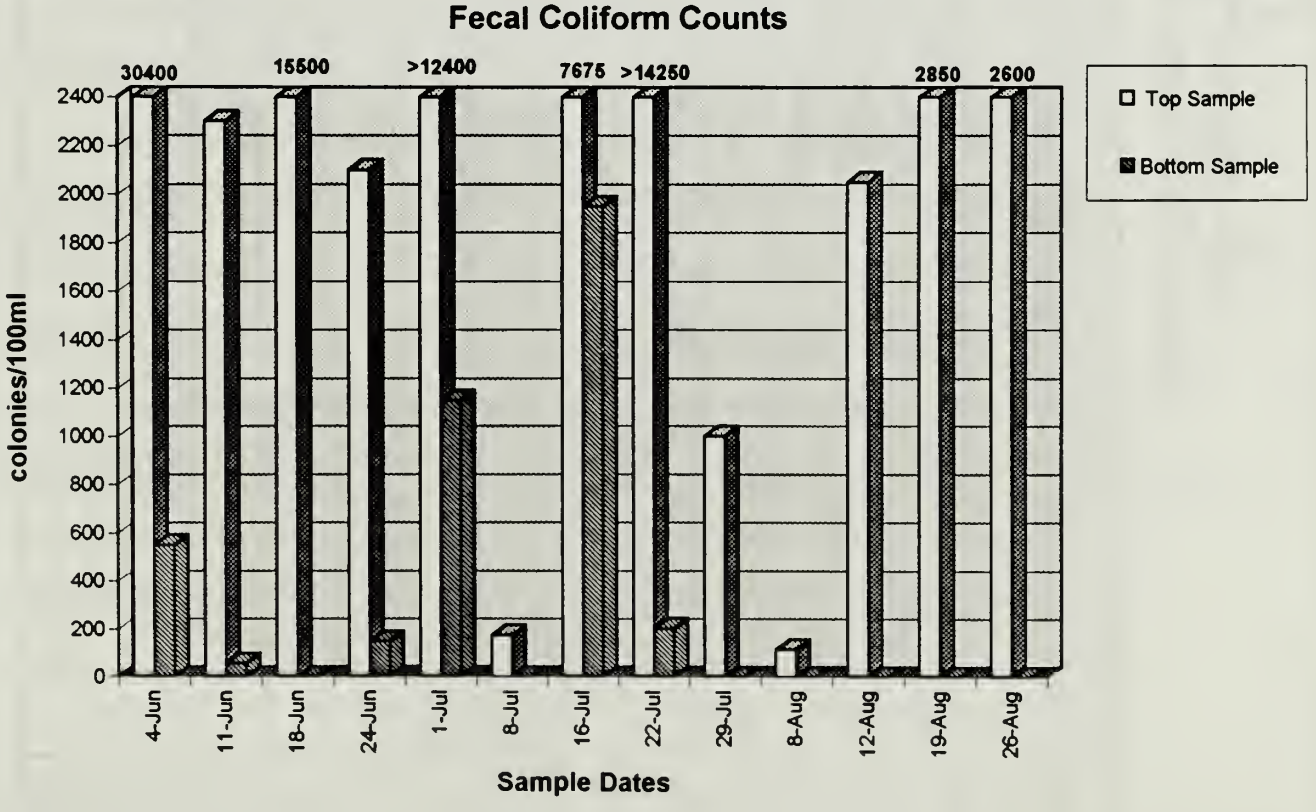


Figure 26

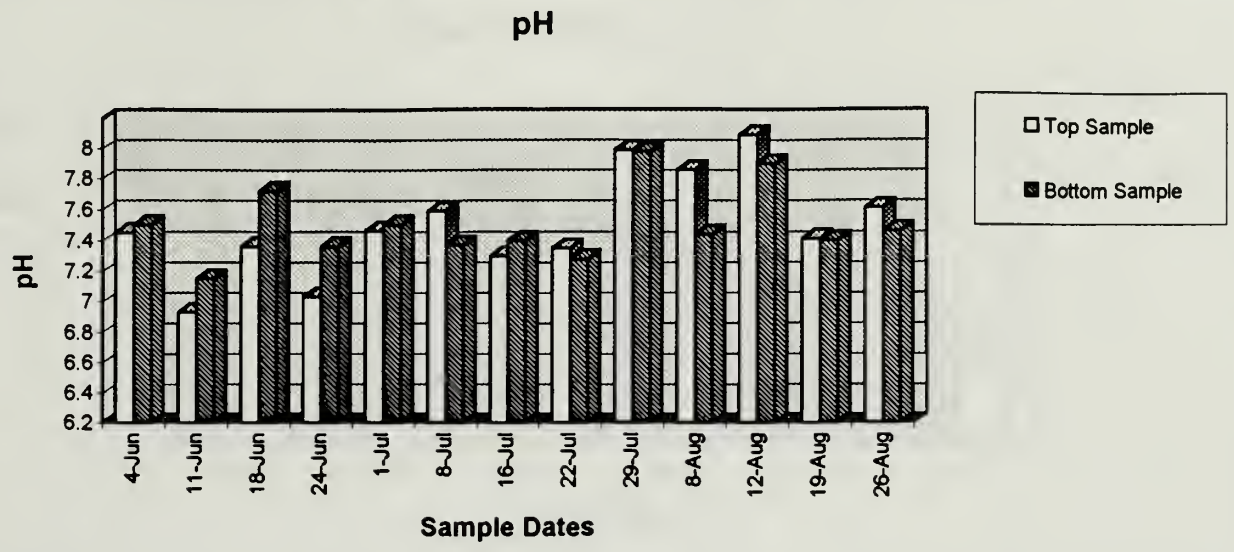
Table XII
Environmental Water Quality Monitoring
Jamaica Bay: Bergen Basin Outflow [JB-9A], 1996

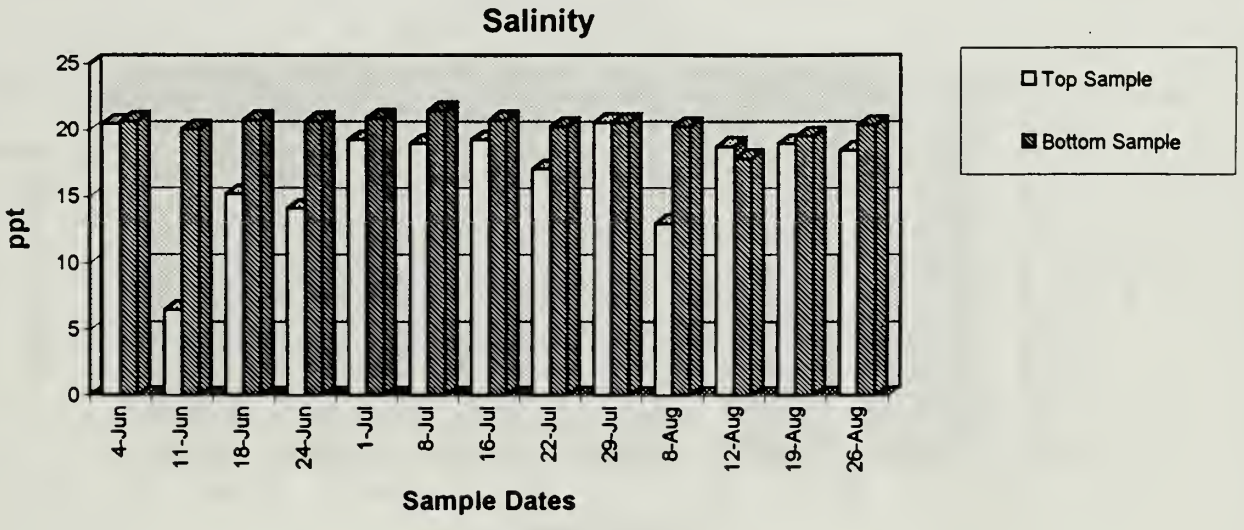
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1020	H	23.0	17.7	17.7	7.45	7.50	20.5	20.7	327	331	4.40	9.14	ND	ND
6/11	0940	L	24.0	21.1	20.2	6.93	7.15	6.50	20.1	116	318	1.40	9.64	0.12	0.20
6/18	0919	H	23.5	22.7	22.7	7.36	7.72	15.2	20.8	249	331	3.57	8.84	ND	ND
6/24	0920	L	23.5	22.1	22.1	7.03	7.36	14.1	20.7	232	329	1.68	9.21	<0.1	0.23
7/01	0925	H	23.0	21.8	21.6	7.46	7.50	19.3	20.9	309	331	2.81	9.01	ND	ND
7/08	0928	L	23.0	23.2	22.9	7.59	7.37	19.0	21.5	304	347	8.53	8.68	0.28	0.35
7/16	0941	H	26.0	24.0	23.8	7.30	7.40	19.3	20.8	308	329	2.84	8.89	ND	ND
7/22	0940		24.0	22.9	22.9	7.35	7.28	17.1	20.3	276	323	4.18	8.79	0.30	0.41
7/29	0937	H	23.0	22.9	22.9	7.99	7.98	20.6	20.6	327	327	7.89	8.71	ND	ND
8/08	0947	L	25.0	23.7	23.4	7.86	7.44	13.0	20.3	216	322	10.87	8.81	ND	ND
8/12	0946	H	22.0	23.7	23.2	8.09	7.90	18.8	17.9	302	298	7.95	8.60	0.36	0.36
8/19	0936		25.5	24.2	24.0	7.41	7.40	19.0	19.6	303	313	3.35	8.73	ND	ND
8/26	0920		26.0	25.1	24.9	7.61	7.46	18.5	20.4	297	321	4.39	8.55	0.33	0.21

Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1020	H	1.75	ND	ND	ND	ND	ND	ND	ND	ND	3450	4400	667	2100
6/11	0940	L	0.50	<0.05	<0.05	<0.05	<0.05	1.40	0.30	ND	ND	0	1200	4900	58
6/18	0919	H	1.00	ND	ND	ND	ND	ND	ND	10.89	12.92	4200	625	2575	203
6/24	0920	L	0.50	<0.05	<0.05	<0.05	<0.05	1.00	0.30	ND	ND	0	580	416	58
7/01	0925	H	1.75	ND	ND	ND	ND	ND	ND	ND	ND	29	870	2700	1800
7/08	0928	L	1.25	<0.05	<0.05	<0.05	<0.05	0.45	0.12	ND	ND	580	232	0	0
7/16	0941	H	1.50	ND	ND	ND	ND	ND	ND	2.046	2.354	0	0	4650	1450
7/22	0940		1.25	<0.05	<0.05	<0.05	<0.05	0.58	0.47	ND	ND	0	957	493	0
7/29	0937	H	1.00	ND	ND	ND	ND	ND	ND	ND	ND	899	580	0	0
8/08	0947	L	0.75	ND	ND	ND	ND	ND	ND	ND	ND	406	5167	29	0
8/12	0946	H	1.00	<0.05	<0.05	<0.05	<0.05	0.18	0.15	2.370	0	551	493	0	0
8/19	0936		2.00	ND	ND	ND	ND	ND	ND	ND	ND	1189	899	203	0
8/26	0920		1.00	<0.05	<0.05	<0.05	<0.05	0.50	0.37	ND	ND	6183	3075	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1996





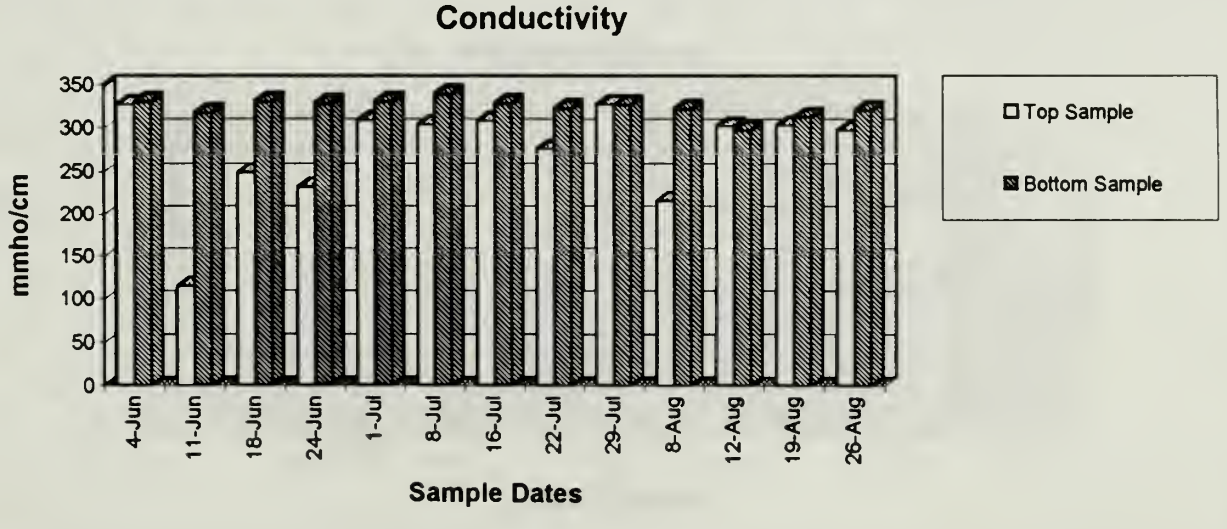
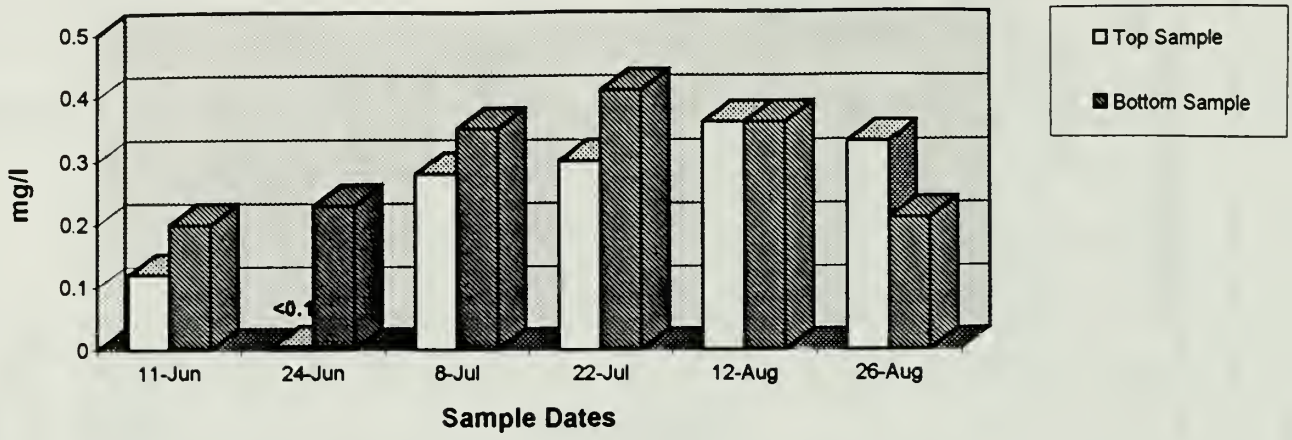


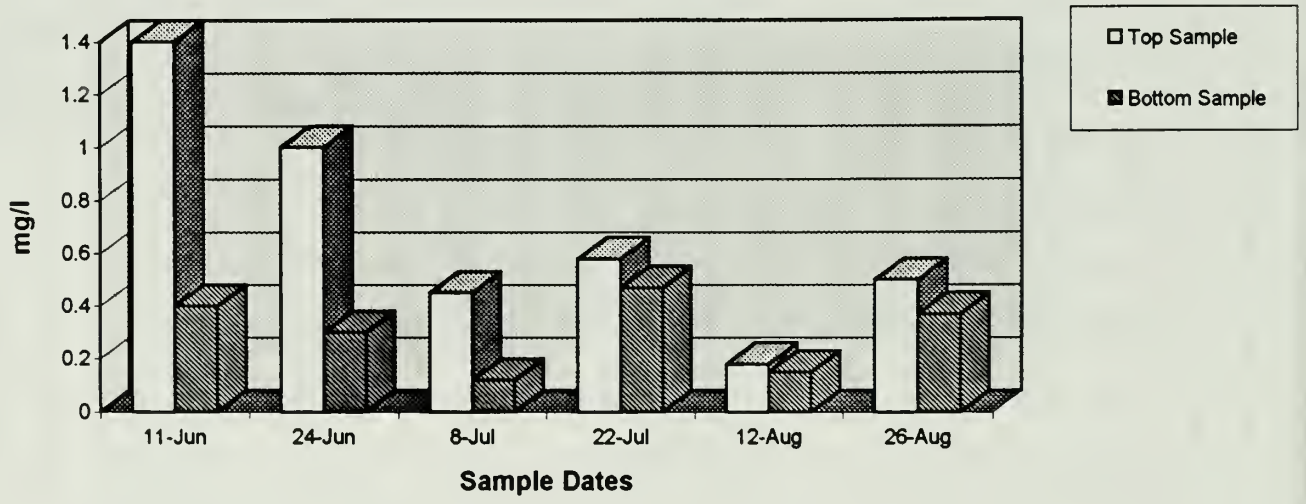
Figure 27

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1996

Nitrates



Orthophospate



Chlorophyll a

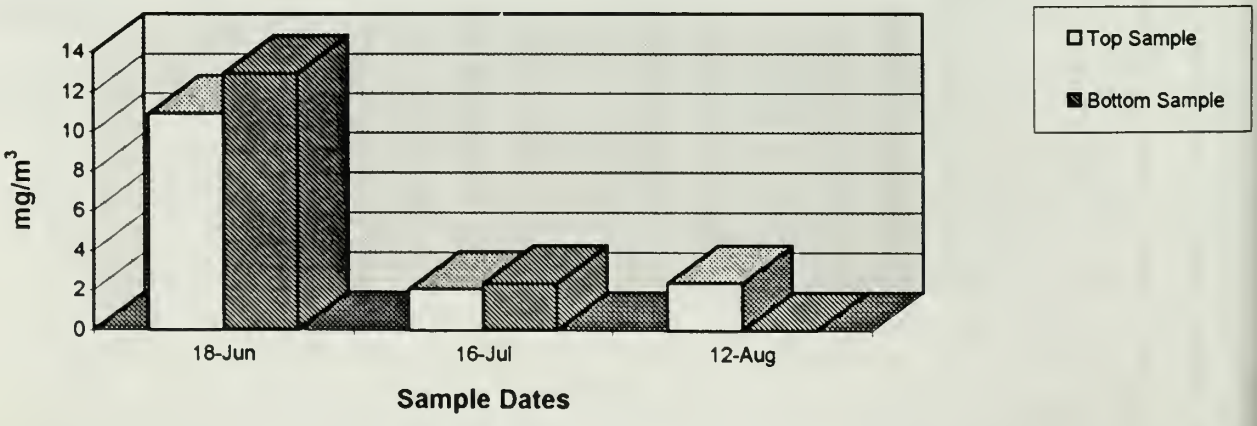
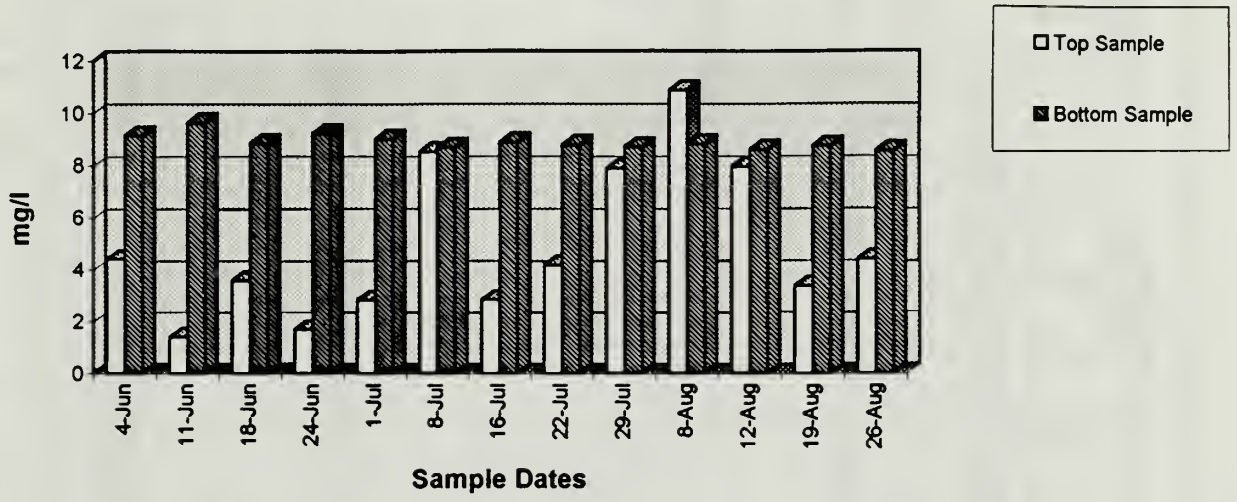


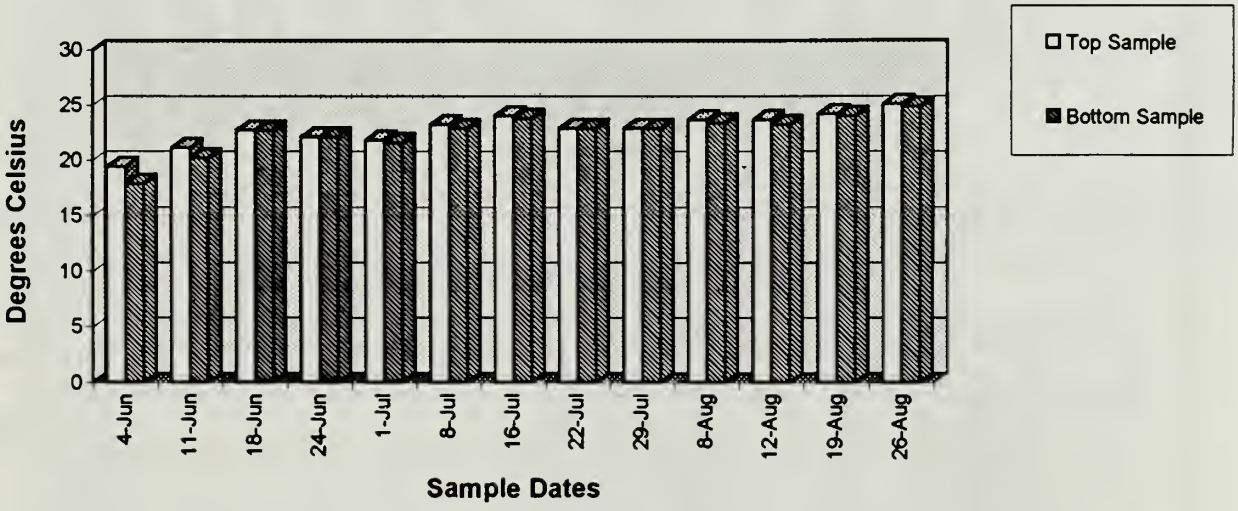
Figure 28

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1996

Dissolved Oxygen



Water Temperature



Secchi Disk Readings

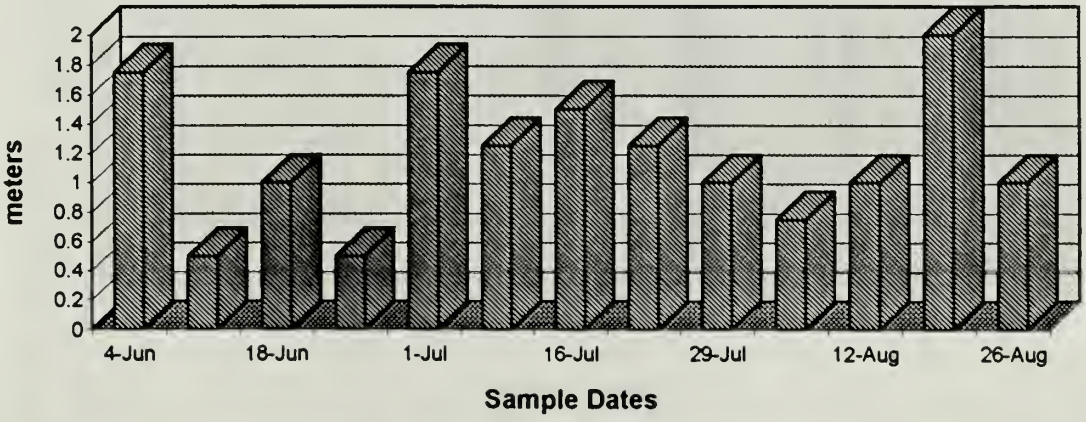
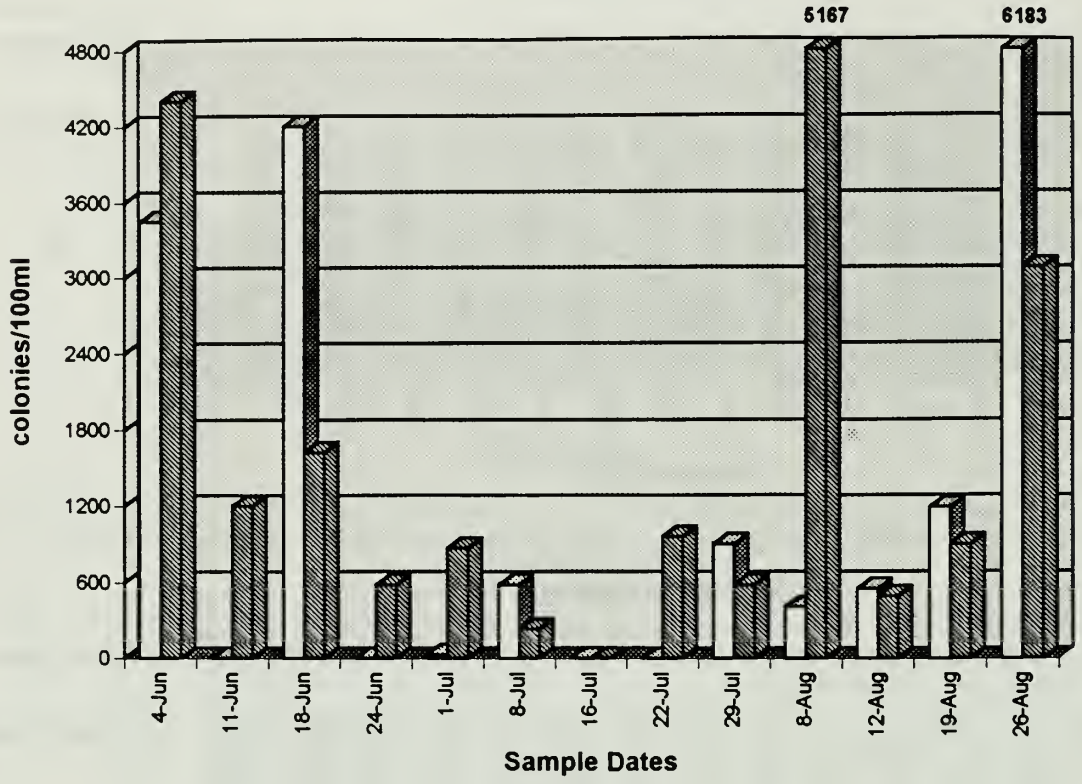


Figure 29

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1996



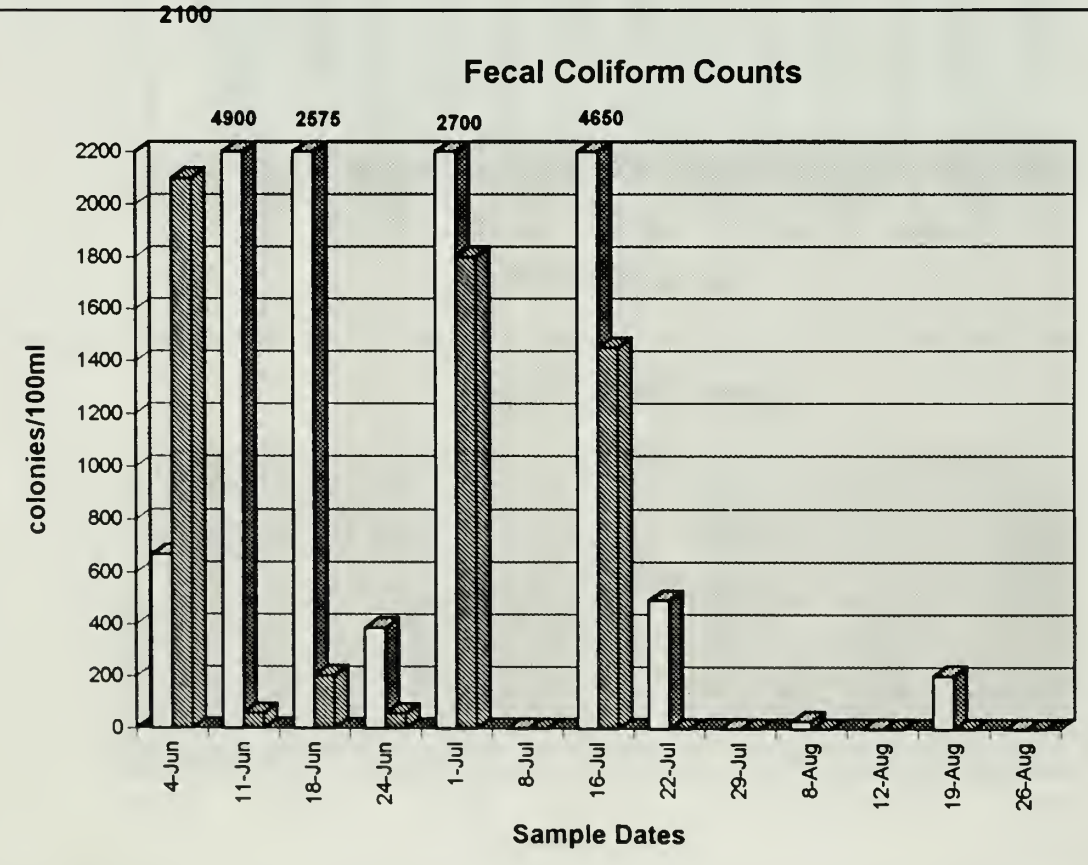


Figure 30

Table XIII
Environmental Water Quality Monitoring
Jamaica Bay: Grassy Bay [JB-9], 1996

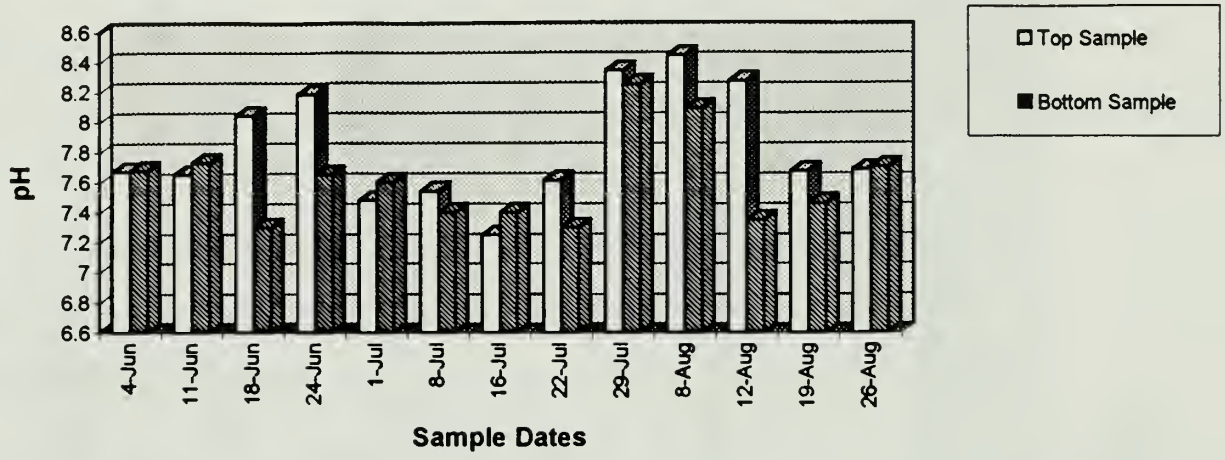
Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1030	H	22.0	18.2	18.1	31.6	31.5	19.7	19.7	316	315	7.67	7.68	ND	ND
6/11	0950	L	21.5	20.7	20.7	7.65	7.73	19.9	20.0	318	319	6.22	9.17	0.25	0.25
6/18	0933	H	24.0	22.9	21.0	8.04	7.30	20.9	21.0	331	333	7.97	9.31	ND	ND
6/24	0937	L	24.0	22.2	22.0	8.18	7.65	20.4	20.6	325	328	9.43	8.97	0.20	0.18
7/01	0938	H	22.5	21.8	21.8	7.48	7.60	18.5	20.4	297	325	5.04	8.97	ND	ND
7/08	0944	L	22.5	23.0	22.8	7.54	7.40	20.8	21.1	329	334	5.48	8.57	0.24	0.26
7/16	0950	H	27.0	24.2	23.7	7.25	7.40	13.2	20.5	218	325	3.20	8.59	ND	ND
7/22	0952		23.5	22.9	23.0	7.61	7.30	19.6	20.7	313	320	4.69	8.54	0.35	0.26
7/29	0948	H	23.0	23.7	23.5	8.34	8.25	20.4	20.5	325	325	9.73	8.43	ND	ND
8/08	0959	L	26.0	23.9	24.1	8.44	8.09	17.2	20.0	279	318	13.70	8.52	ND	ND
8/12	0935	H	22.0	23.6	23.3	8.27	7.35	19.1	19.3	305	309	7.74	8.65	0.39	0.29
8/19	0948		27.0	24.3	23.9	7.67	7.46	19.4	19.5	310	311	8.06	8.82	ND	ND
8/26	0933		28.5	24.1	24.6	7.68	7.70	17.5	19.3	283	309	8.76	8.57	0.19	0.29

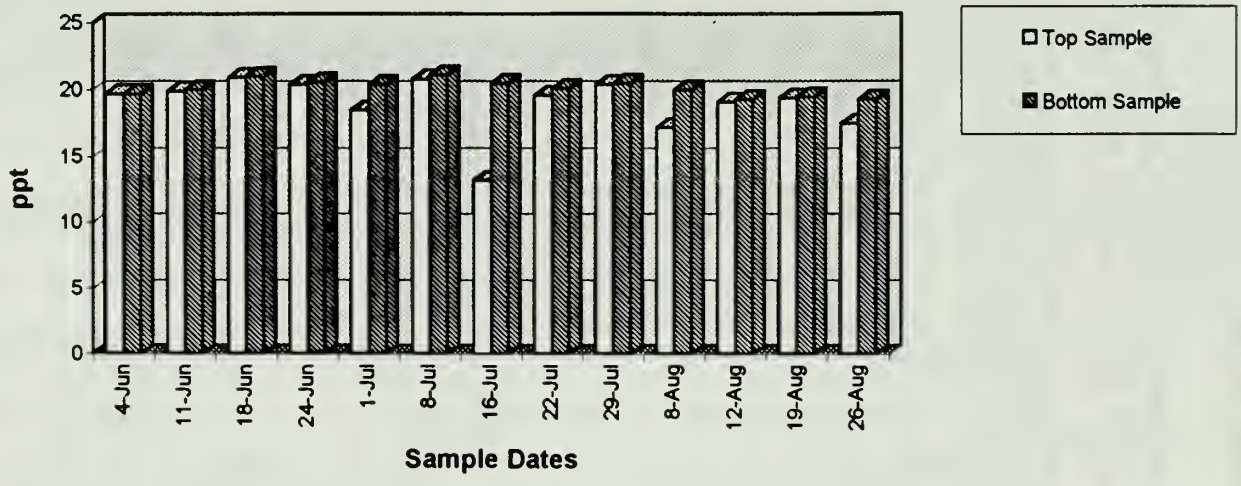
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1030	H	1.50	ND	ND	ND	ND	ND	ND	ND	ND	3200	2325	522	522
6/11	0950	L	2.00	<0.05	<0.05	<0.05	<0.05	0.35	0.12	ND	ND	58	58	0	0
6/18	0933	H	0.25	ND	ND	ND	ND	ND	ND	112.4	8.863	0	0	29	29
6/24	0937	L	0.75	<0.05	<0.05	<0.05	<0.05	0.19	0.50	ND	ND	116	87	0	0
7/01	0938	H	1.75	ND	ND	ND	ND	ND	ND	ND	ND	0	1189	8050	319
7/08	0944	L	1.50	<0.05	<0.05	<0.05	<0.05	0.10	0.10	ND	ND	203	116	0	0
7/16	0950	H	1.50	ND	ND	ND	ND	ND	ND	1.738	4.416	0	232	>6450	1000
7/22	0952		1.50	<0.05	<0.05	<0.05	<0.05	0.30	0.39	ND	ND	87	58	29	29
7/29	1011	H	0.50	ND	ND	ND	ND	ND	ND	ND	ND	0	116	0	0
8/08	0959	L	0.75	ND	ND	ND	ND	ND	ND	ND	ND	232	116	0	0
8/12	0935	H	1.25	<0.05	<0.05	<0.05	<0.05	0.10	0.23	7.924	2.354	290	29	0	0
8/19	0948		1.00	ND	ND	ND	ND	ND	ND	ND	ND	493	87	0	0
8/26	0933		1.00	<0.05	<0.05	<0.05	<0.05	0.60	0.34	ND	ND	6483	2150	261	116

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

ND: No Data.

Grassy Bay (JB-9) Water Quality Measurements, 1996





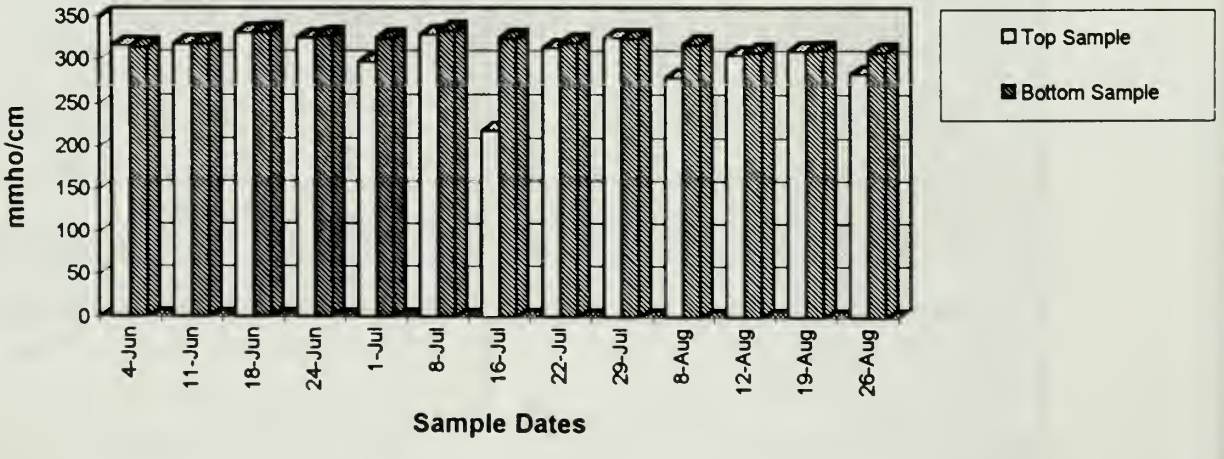
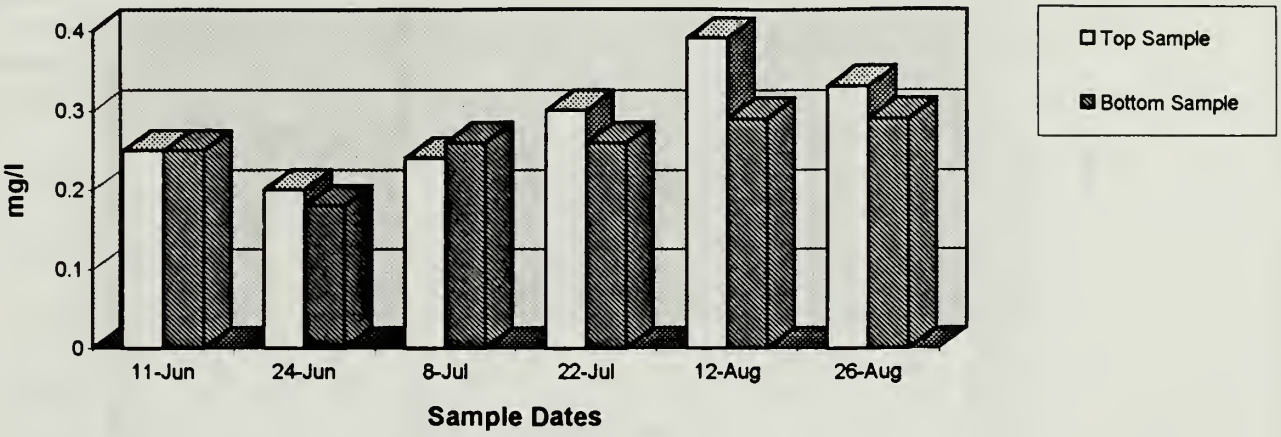


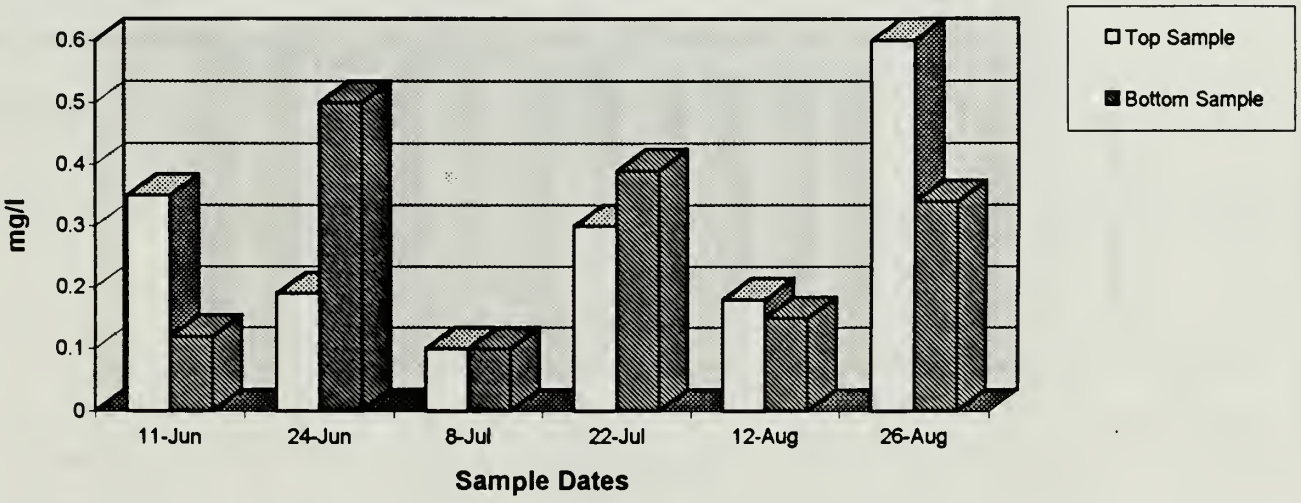
Figure 31

Grassy Bay (JB-9) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

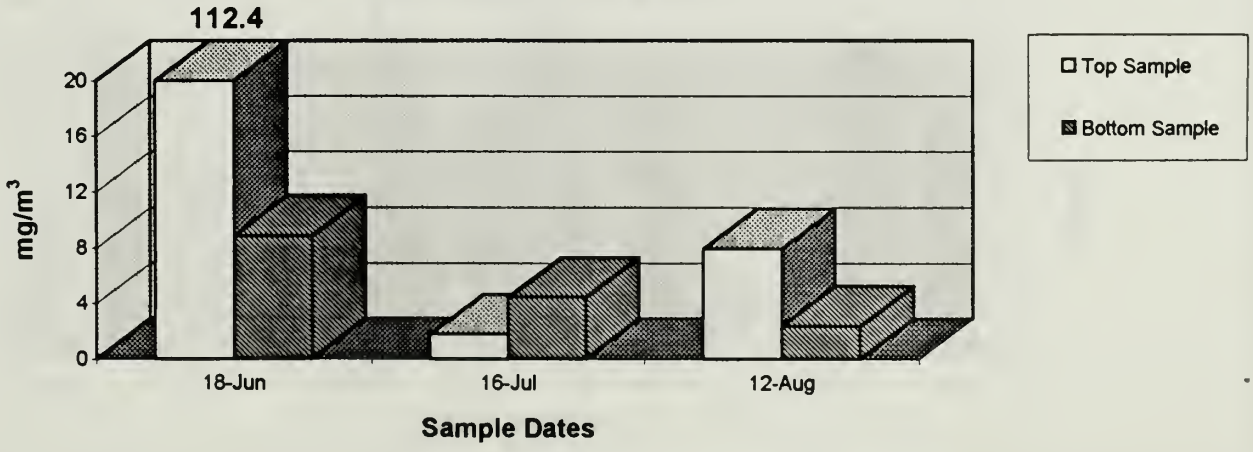
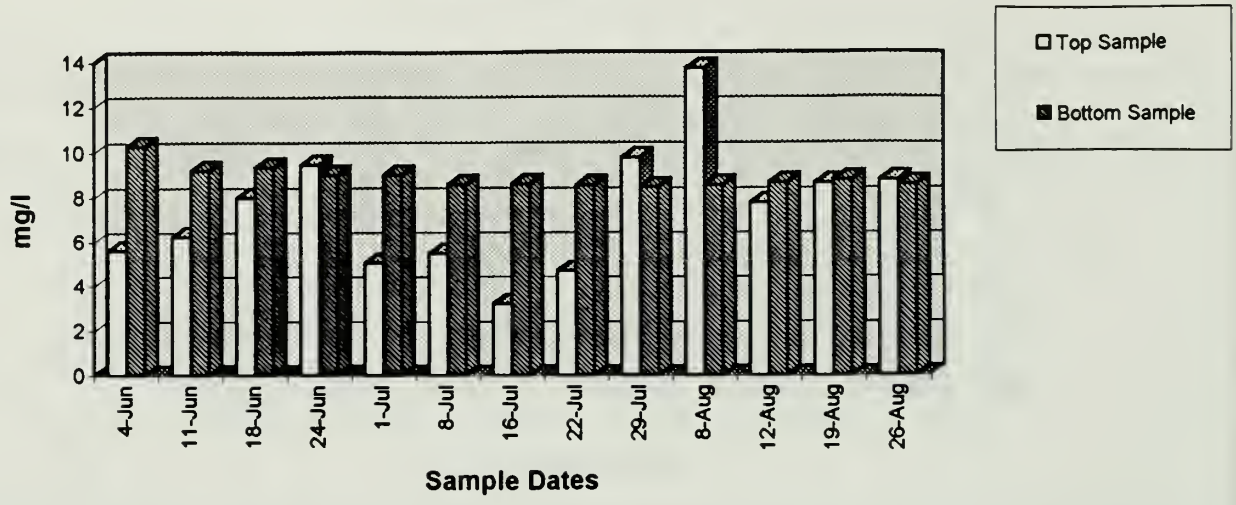
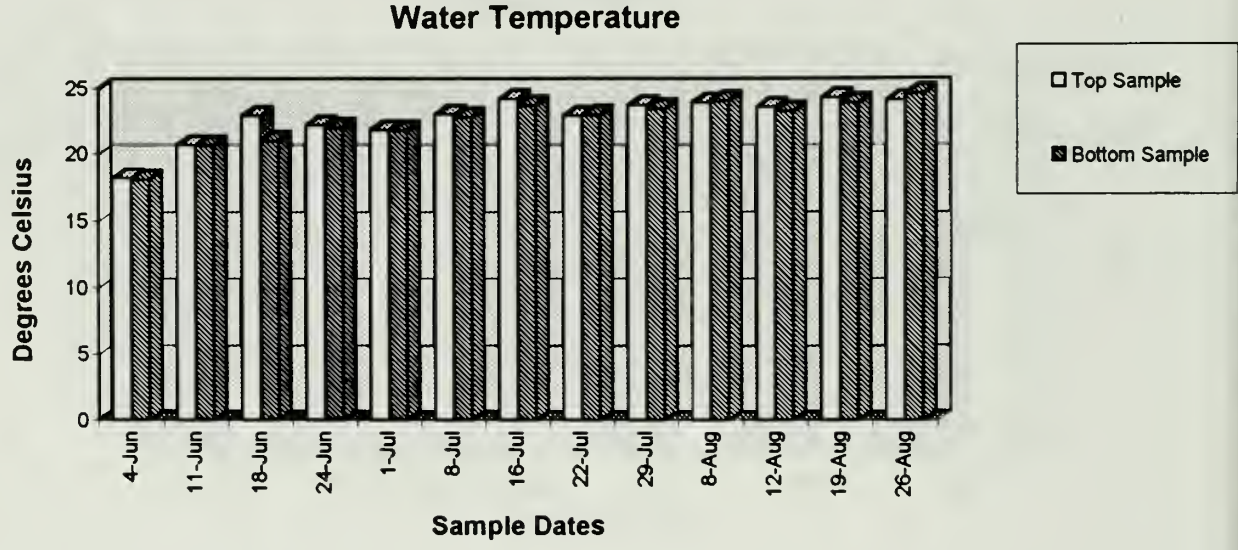


Figure 32

Grassy Bay (JB-9) Water Quality Measurements, 1996





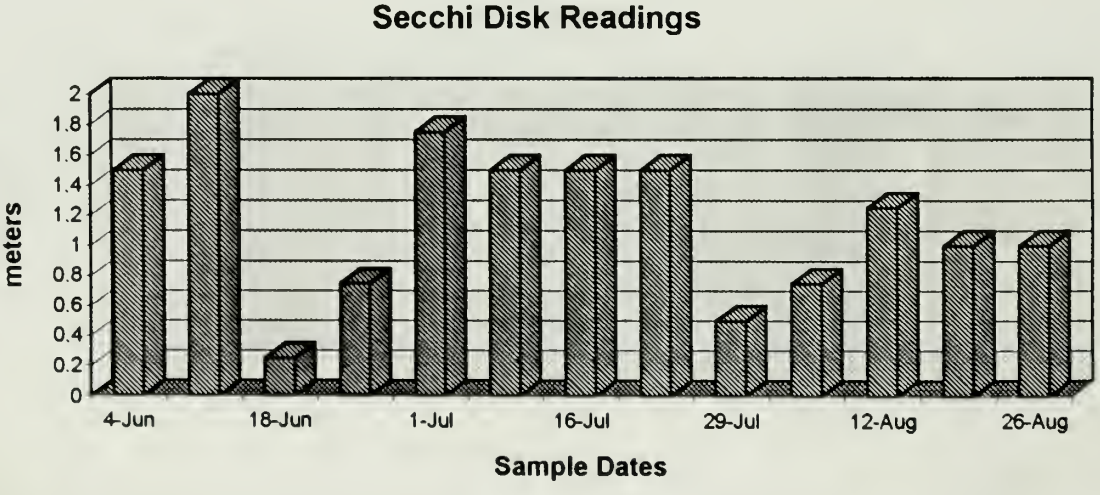
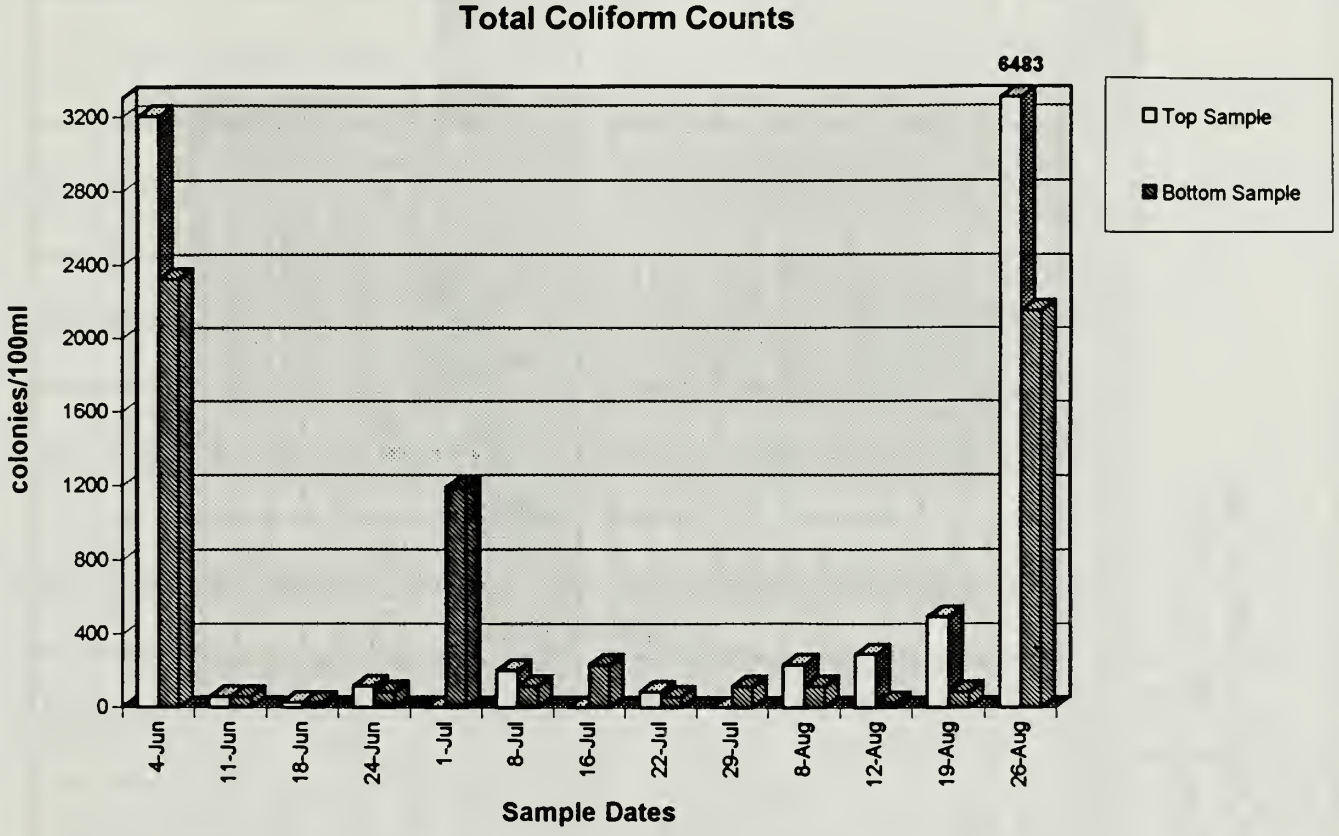


Figure 33

Grassy Bay (JB-9) Water Quality Measurements, 1996



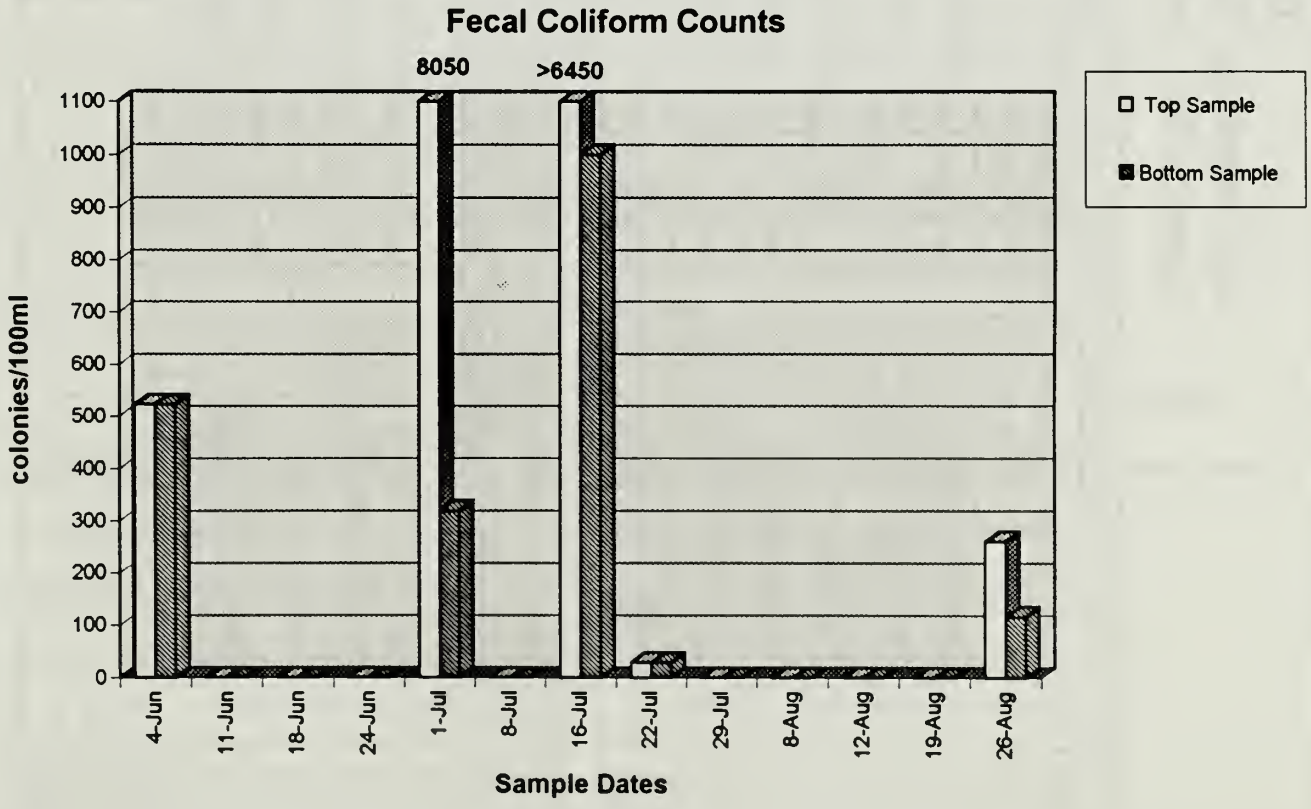


Figure 34

Table XIV
Environmental Water Quality Monitoring
Jamaica Bay: JoCo Marsh [JB-12], 1996

Date	Time	Tide	Air Temp. °C	Water Temp. (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1050	H	20.0	17.9	17.4	7.47	7.47	20.3	21.2	324	338	5.03	10.34	ND	ND
6/11	1007	L	21.5	21.3	20.1	8.20	7.52	20.3	20.8	324	330	8.33	9.54	<0.1	0.22
6/18	0958	H	24.5	23.0	22.3	8.02	7.65	21.5	21.7	340	244	6.47	9.06	ND	ND
6/25	0957	L	24.0	22.9	22.3	8.49	7.82	21.0	21.2	334	336	12.43	9.06	<0.1	0.19
7/01	0957	H	22.5	21.9	21.7	7.66	7.55	21.1	21.6	334	341	3.66	8.99	ND	ND
7/08	1000	L	22.0	23.3	22.3	7.55	7.29	21.6	21.8	340	344	4.45	8.59	0.26	0.24
7/16	1012	H	27.0	24.1	23.5	7.68	7.48	20.7	21.7	328	343	5.39	8.49	ND	ND
7/22	1013		24.0	22.8	22.8	8.05	7.54	20.1	20.8	320	331	7.50	8.39	0.30	0.28
7/29	1011		22.5	22.7	22.6	7.69	7.63	21.0	21.0	334	336	8.48	8.64	ND	ND
8/08	1018	L	24.5	24.8	23.4	8.63	7.60	20.2	20.8	321	331	12.09	8.83	ND	ND
8/12	0919	H	22.5	23.9	23.7	8.28	7.59	19.6	19.9	313	317	8.22	8.34	<0.1	0.18
8/19	1005		28.5	24.5	23.7	7.59	7.36	19.7	20.1	315	319	8.06	8.82	ND	ND
8/26	0952		27.0	25.2	24.9	7.81	7.57	20.2	20.8	321	330	8.32	8.48	0.19	0.27

Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1030	H	1.50	ND	ND	ND	ND	ND	ND	ND	ND	3167	522	348	232
6/11	0950	L	2.00	<0.05	<0.05	<0.05	<0.05	0.06	0.07	ND	ND	0	116	29	0
6/18	0958	H	1.50	ND	ND	ND	ND	ND	ND	13.25	2.062	0	0	0	29
6/24	0957	L	0.75	<0.05	<0.05	<0.05	<0.05	0.10	0.12	ND	ND	58	29	0	0
7/01	0957	H	1.50	ND	ND	ND	ND	ND	ND	ND	ND	145	377	0	58
7/08	1000	L	2.00	<0.05	<0.05	<0.05	<0.05	0.75	0.75	ND	ND	0	29	0	0
7/16	1012	H	1.75	ND	ND	ND	ND	ND	ND	4.416	4.416	754	812	29	87
7/22	1013		1.00	<0.05	<0.05	<0.05	<0.05	0.12	0.30	ND	ND	87	0	0	0
7/29	1011		1.50	ND	ND	ND	ND	ND	ND	ND	ND	29	116	0	29
8/08	1018	L	1.00	ND	ND	ND	ND	ND	ND	ND	ND	0	0	0	0
8/12	0919	H	1.25	<0.05	<0.05	<0.05	<0.05	0.05	0.80	0.160	0	29	0	0	0
8/19	1015		2.25	ND	ND	ND	ND	ND	ND	ND	ND	0	0	0	0
8/26	0952		1.00	<0.05	<0.05	<0.05	<0.05	0.30	0.34	ND	ND	290	348	0	29

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

JoCo Marsh (JB-12) Water Quality Measurements, 1996

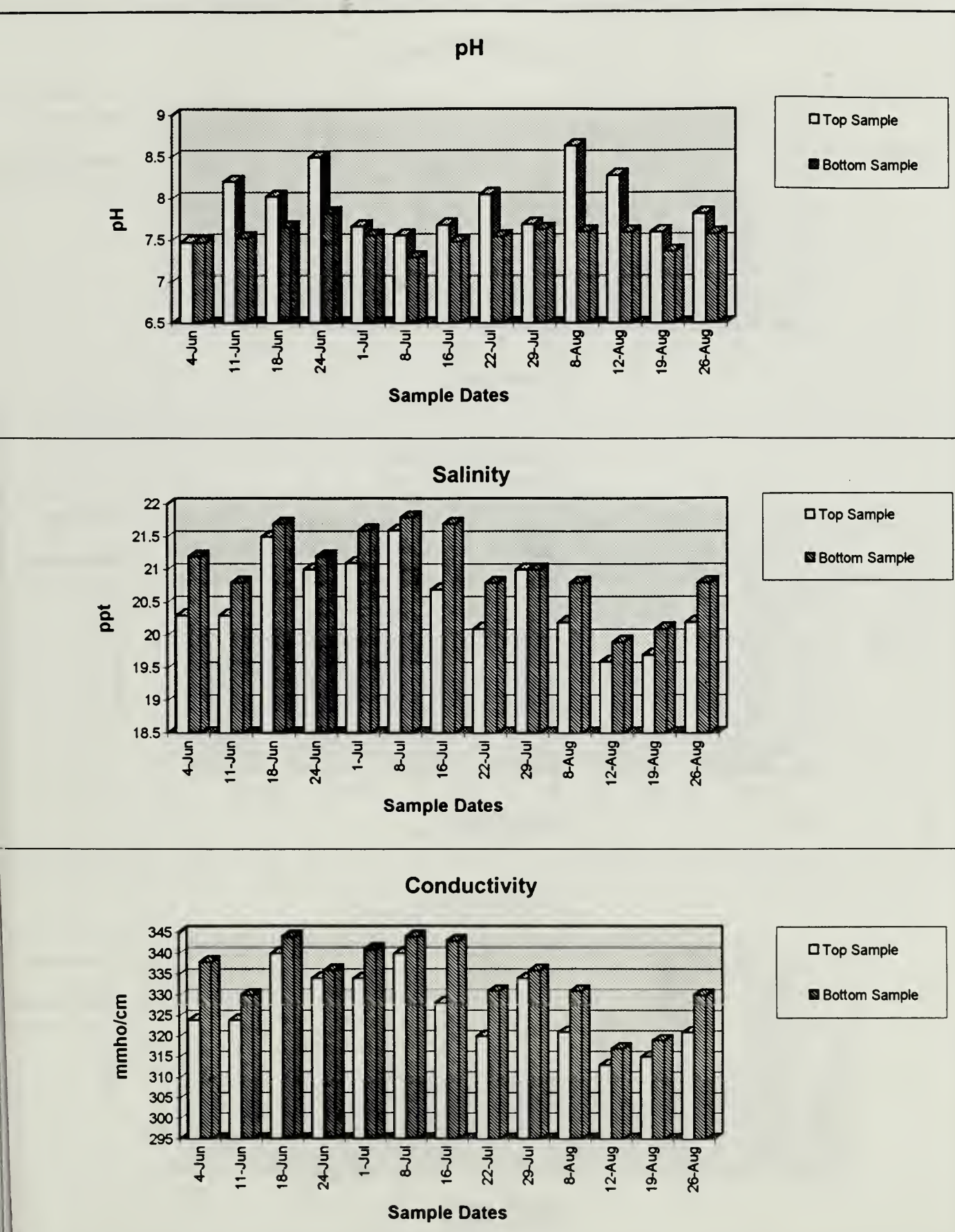
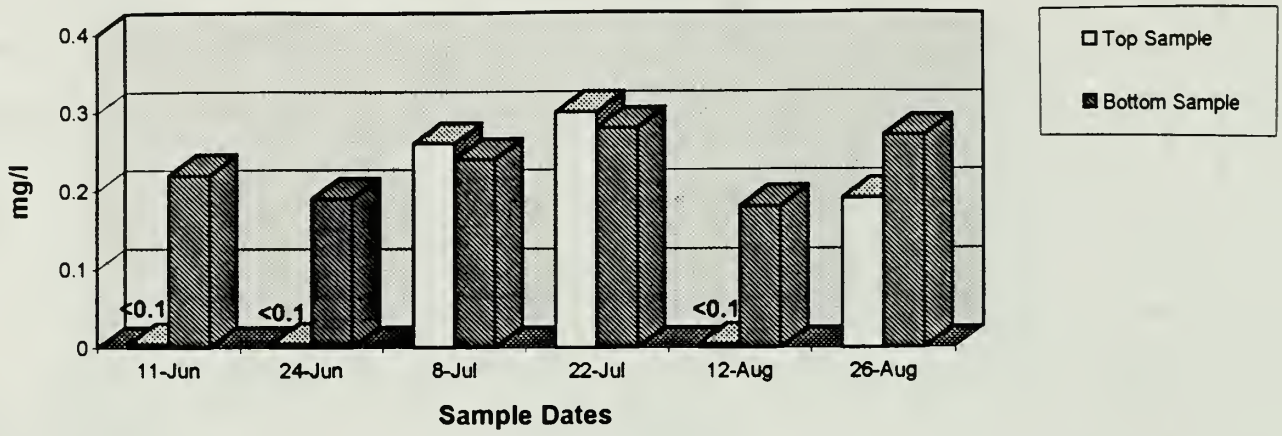


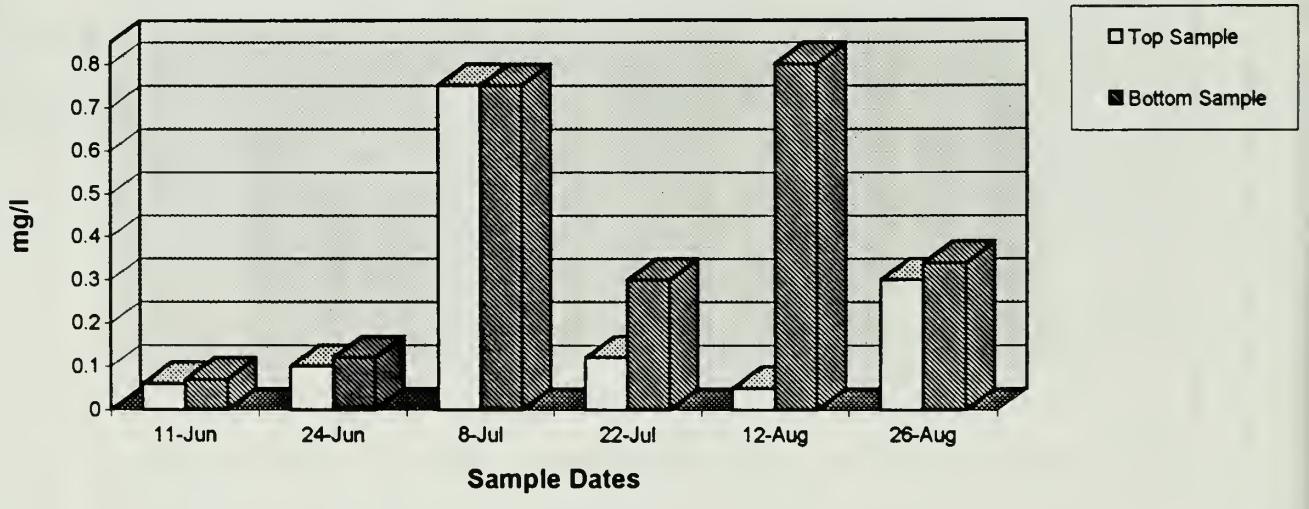
Figure 35

JoCo Marsh (JB-12) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

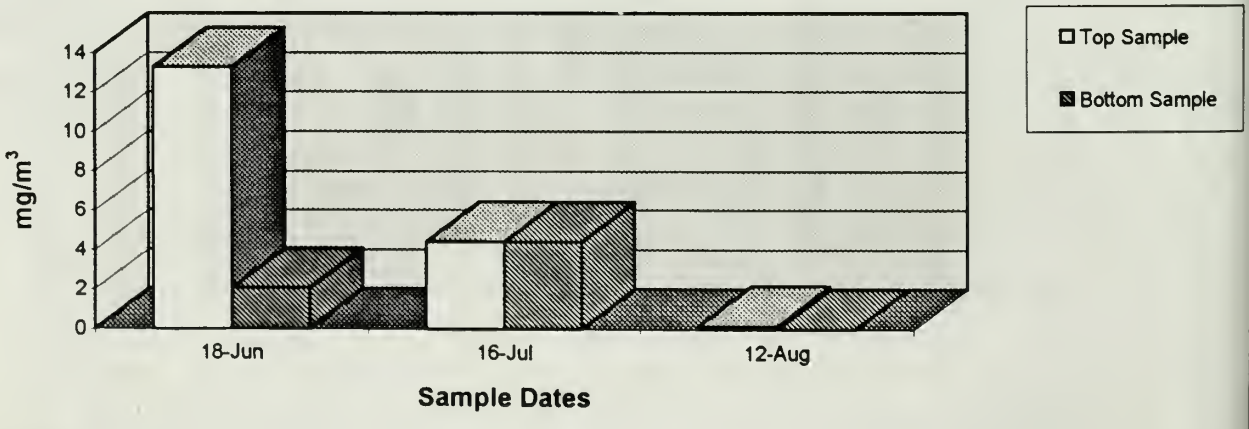
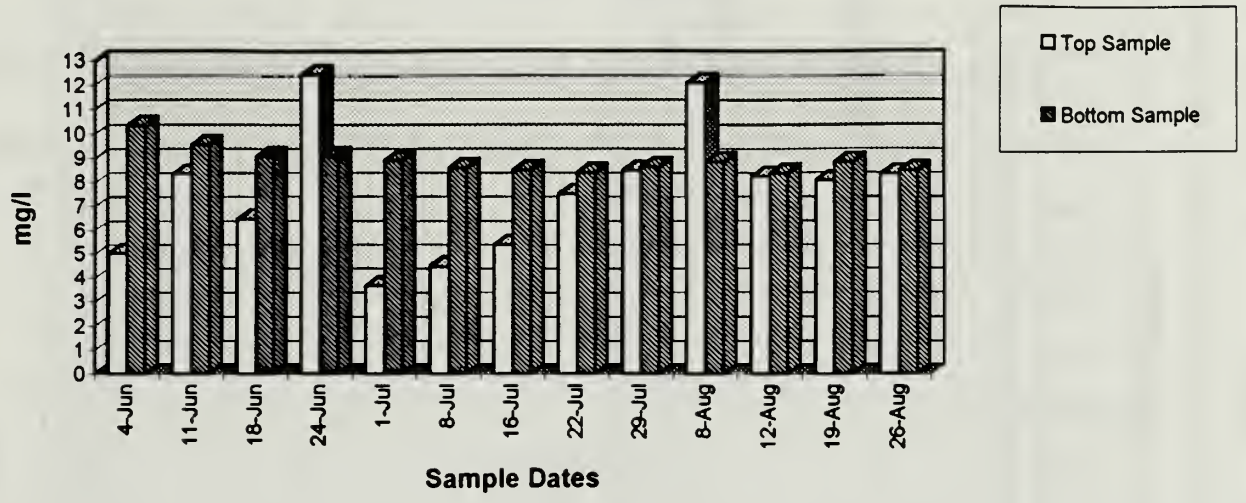
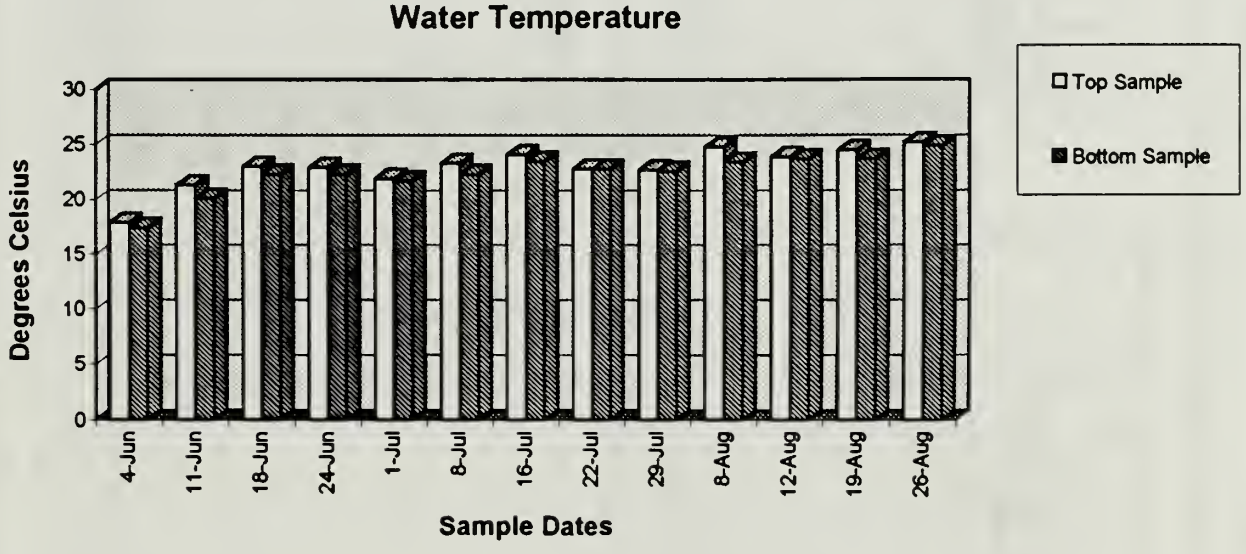


Figure 36

JoCo Marsh (JB-12) Water Quality Measurements, 1996





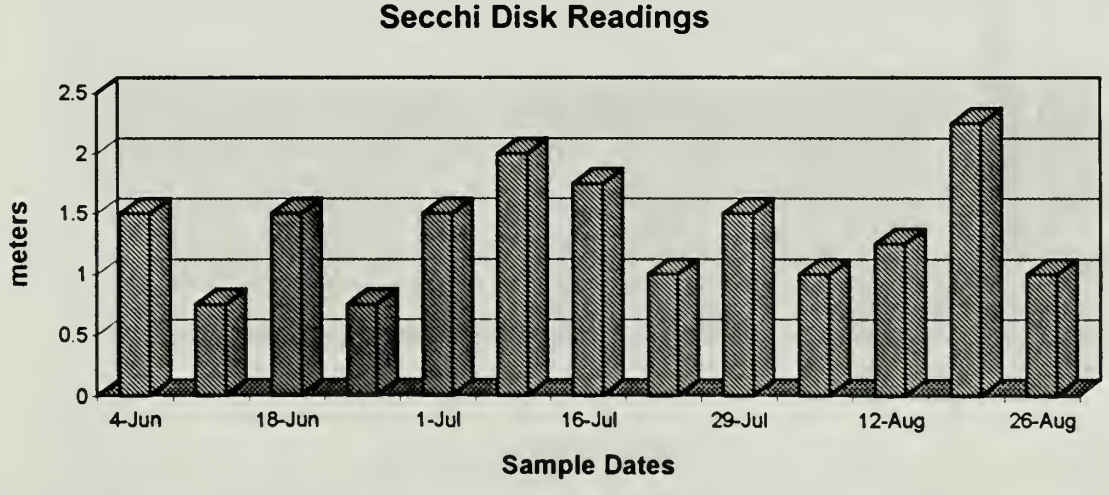
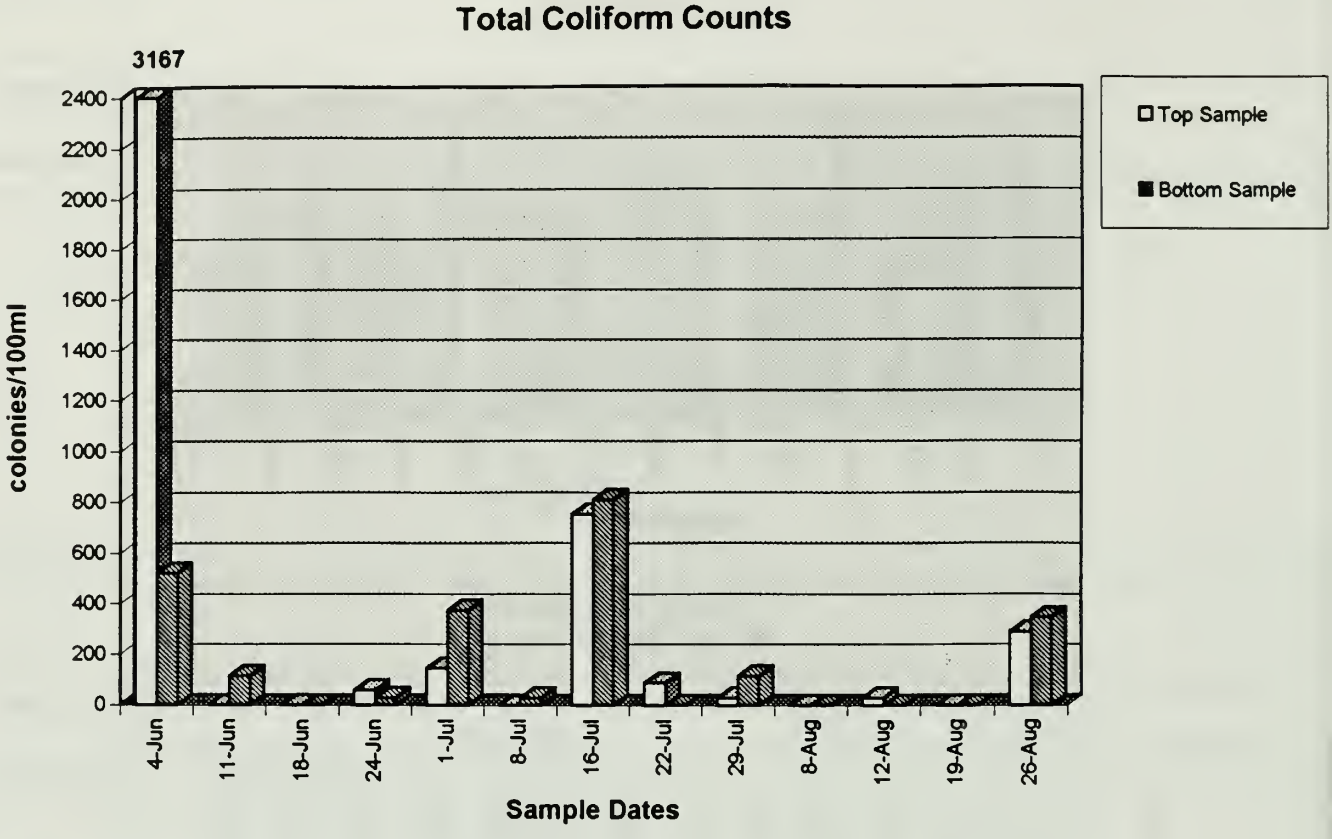


Figure 37

JoCo Marsh (JB-12) Water Quality Measurements, 1996



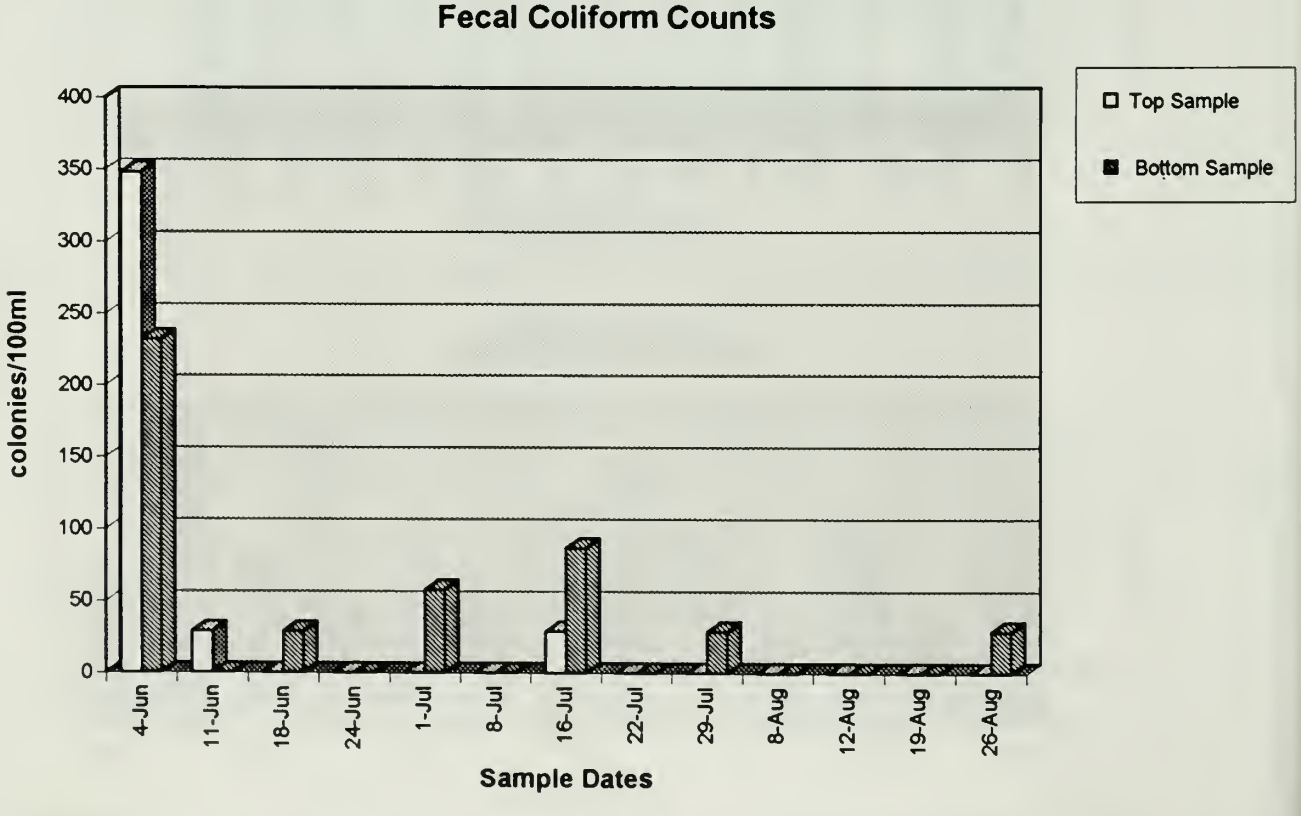


Figure 38

Table XV
Environmental Water Quality Monitoring
Jamaica Bay: Beach Channel [JB-15], 1996

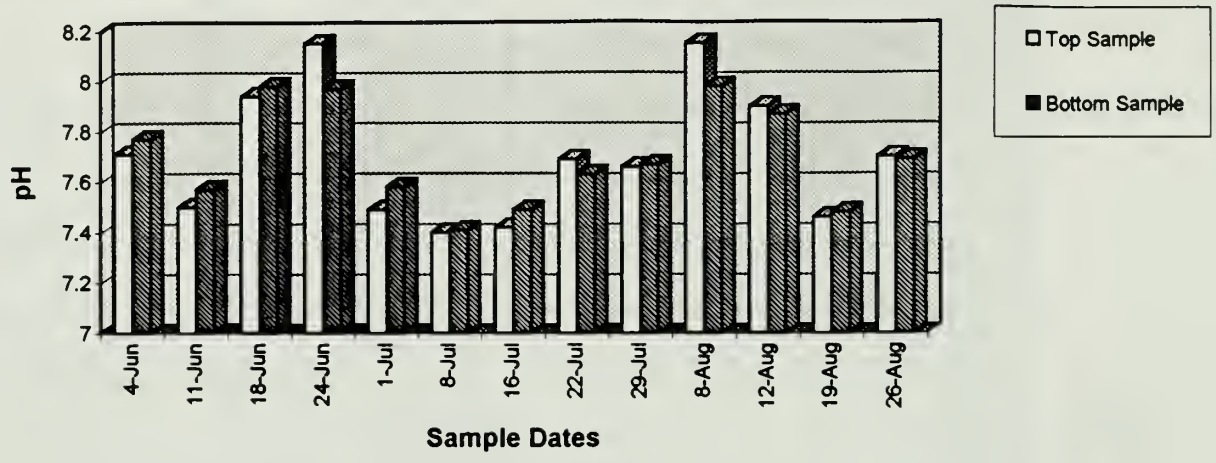
Date	Time	Tide	Air Temp. °C	Water Temp (°C)		pH		Salinity (ppt)		Conductivity (MMHO/cm)		DO (mg/l)		Nitrates (mg/l)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	1004	H	13.5	16.6	12.4	7.71	7.77	21.5	22.4	343	355	6.93	10.47	ND	ND
6/11	1028	L	24.0	20.6	20.4	7.50	7.57	20.8	21.2	330	336	4.71	9.15	0.27	0.31
6/18	1013	H	24.5	21.3	21.1	7.94	7.98	22.2	22.9	351	361	5.80	9.17	ND	ND
6/24	1016	L	21.5	22.4	22.1	8.15	7.97	21.2	21.6	337	340	9.30	8.99	0.27	0.26
7/01	1013	H	20.5	20.8	20.6	7.49	7.58	22.2	22.6	351	357	3.81	9.28	ND	ND
7/08	1016	L	22.0	22.5	22.3	7.40	7.41	22.1	22.3	349	352	3.67	8.94	0.30	0.36
7/16	1035	H	29.0	23.1	22.7	7.42	7.49	22.0	22.1	348	349	3.90	9.00	ND	ND
7/22	1034		21.0	20.7	20.4	7.69	7.63	22.0	22.3	348	352	9.02	8.99	0.32	0.30
7/29	1027		23.0	22.2	21.8	7.66	7.67	21.7	22.0	344	348	7.27	9.08	ND	ND
8/08	1036	L	25.5	24.3	24.4	8.15	7.98	20.9	20.8	331	332	8.37	8.72	ND	ND
8/12	0903	H	21.5	23.2	22.9	7.90	7.87	20.5	21.3	326	332	7.56	8.92	0.16	0.14
8/19	1019		26.5	23.9	23.8	7.46	7.48	20.9	20.9	332	332	3.39	8.34	ND	ND
8/26	1005		25.0	24.7	24.7	7.70	7.69	20.9	21.0	331	333	5.16	7.95	0.30	0.29

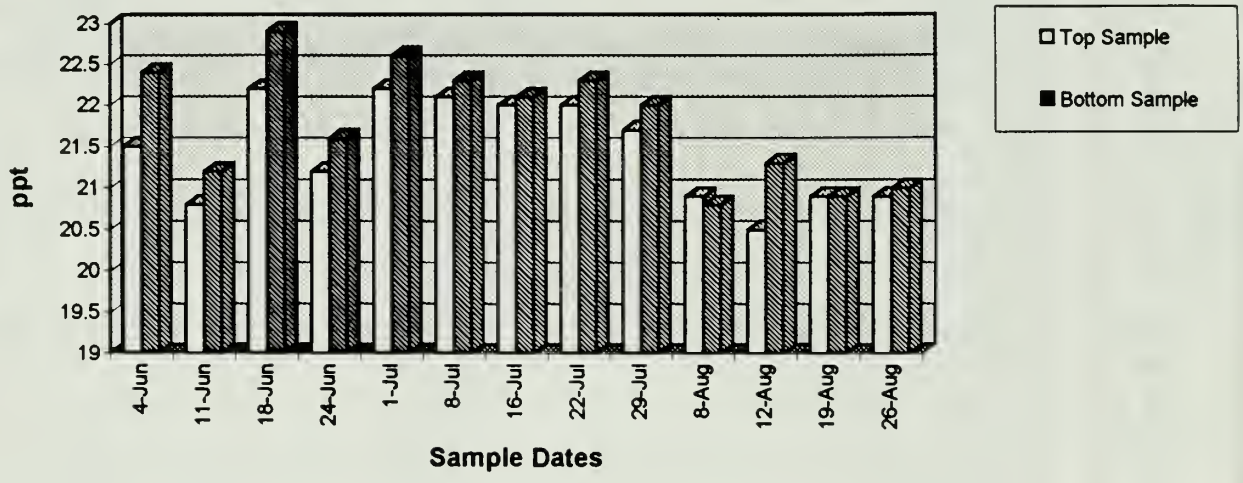
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine mg/l		Free Chlorine mg/l		Orthophosphate mg/l		Chlorophyll a mg/m^3		Total Coliform Counts/100 ml		Fecal Coliform Counts/100 ml	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
6/04	0905	H	2.00	ND	ND	ND	ND	ND	ND	ND	ND	3150	2100	957	1000
6/11	1028	L	2.25	<0.05	<0.05	<0.05	<0.05	<0.02	0.31	ND	ND	29	118	29	0
6/18	1013	H	2.25	ND	ND	ND	ND	ND	ND	2.046	2.046	29	87	0	0
6/24	1016	L	1.25	<0.05	<0.05	<0.05	<0.05	0.10	0.13	ND	ND	116	0	29	0
7/01	1013	H	2.00	ND	ND	ND	ND	ND	ND	ND	ND	899	2675	203	609
7/08	1016	L	2.25	<0.05	<0.05	<0.05	<0.05	0.08	0.30	ND	ND	0	87	0	29
7/16	1035	H	2.75	ND	ND	ND	ND	ND	ND	2.354	4.416	406	1131	0	87
7/22	1034		1.75	<0.05	<0.05	<0.05	<0.05	0.24	0.25	ND	ND	29	29	0	0
7/29	1027		1.75	ND	ND	ND	ND	ND	ND	ND	ND	29	29	29	0
8/08	1036	L	1.00	ND	ND	ND	ND	ND	ND	ND	ND	58	29	0	0
8/12	0903	H	1.25	<0.05	<0.05	<0.05	<0.05	0.40	0.30	0	0	58	58	0	0
8/19	1019		2.50	ND	ND	ND	ND	ND	ND	ND	ND	58	29	0	0
8/26	1005		1.25	<0.05	<0.05	<0.05	<0.05	0.17	0.17	ND	ND	145	87	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

ND: No Data.

Beach Channel (JB-15) Water Quality Measurements, 1996





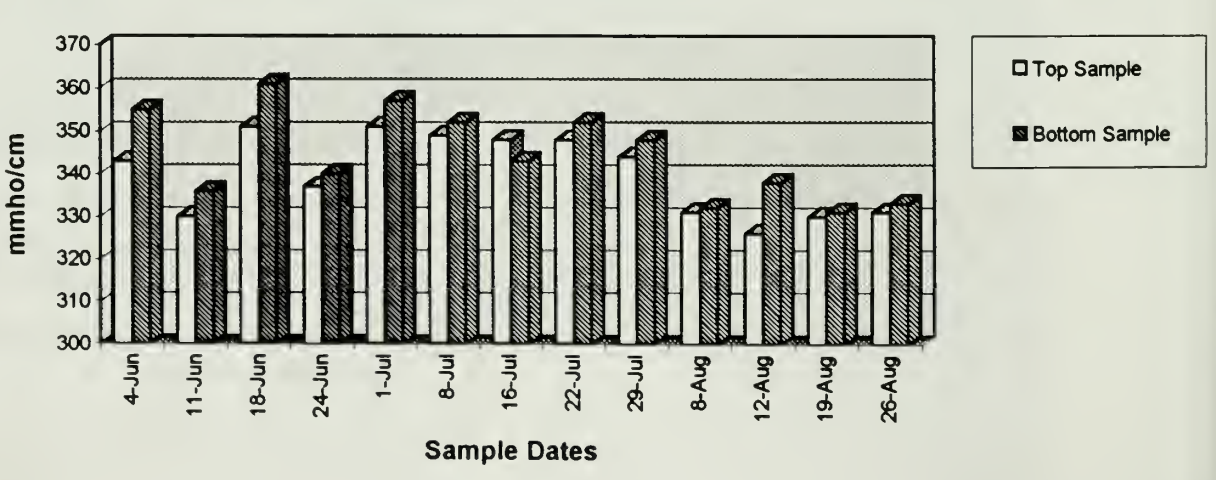
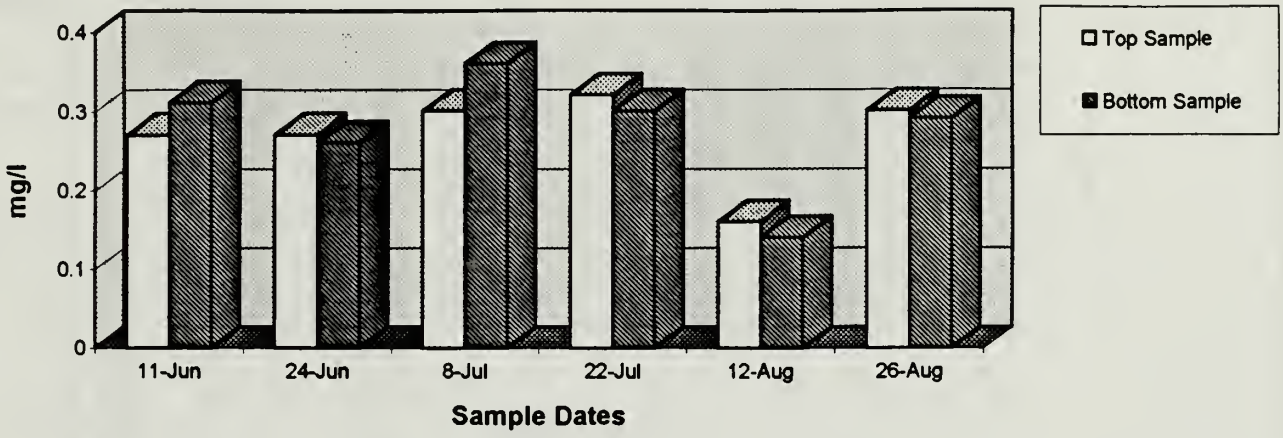


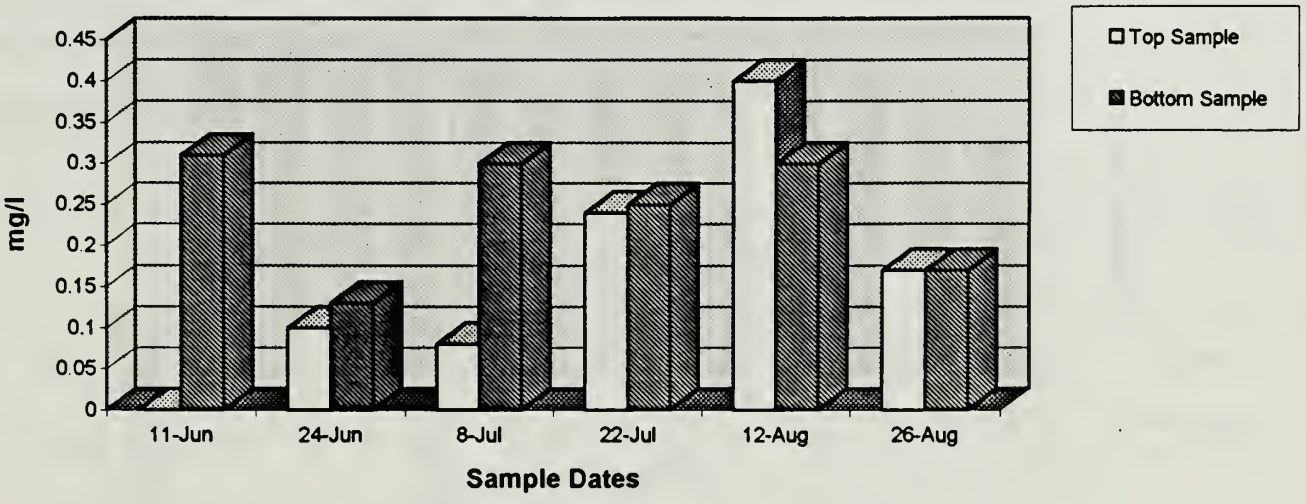
Figure 39

Beach Channel (JB-15) Water Quality Measurements, 1996

Nitrates



Orthophosphate



Chlorophyll a

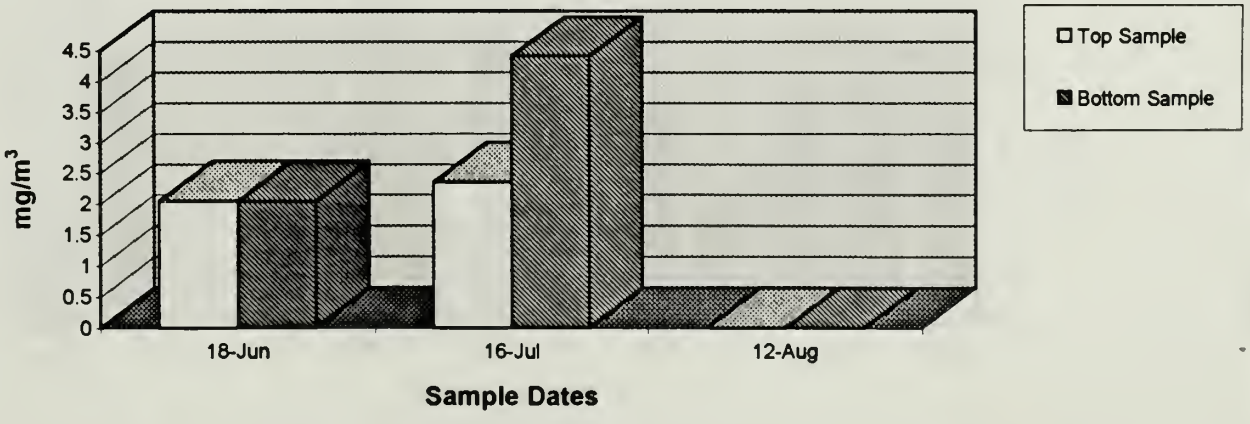
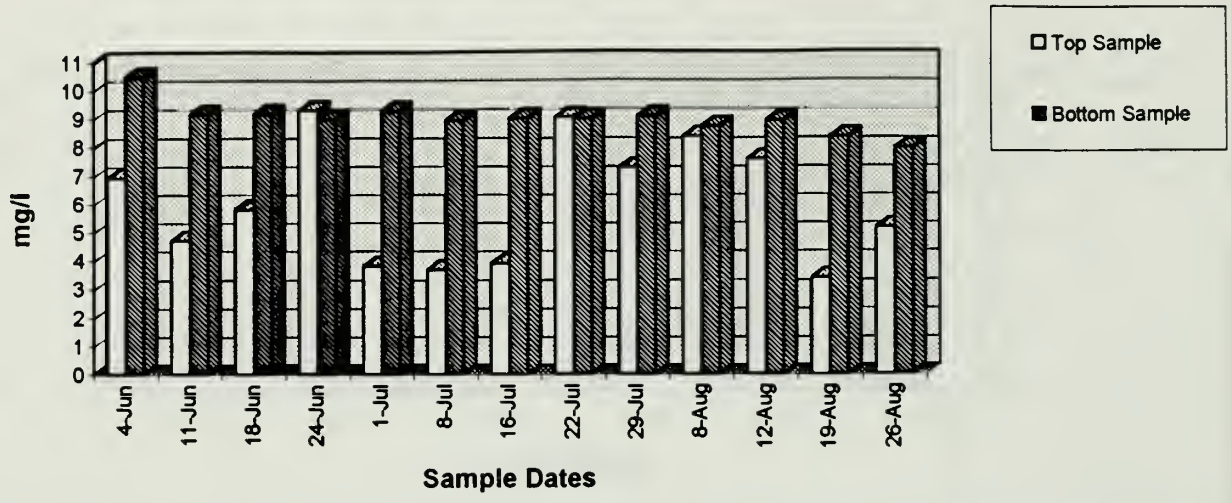
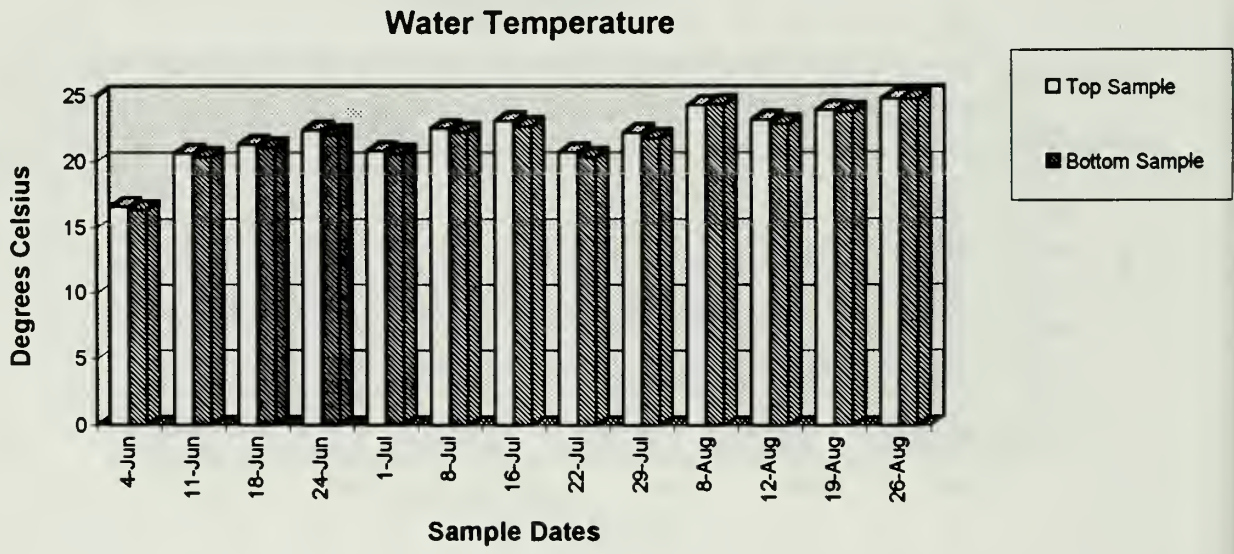


Figure 40

Beach Channel (JB-15) Water Quality Measurements, 1996





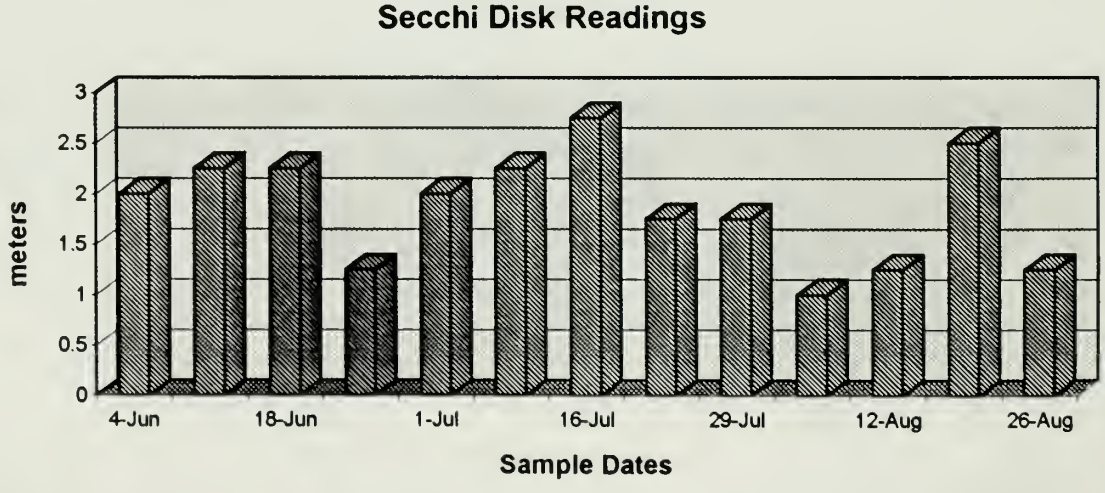
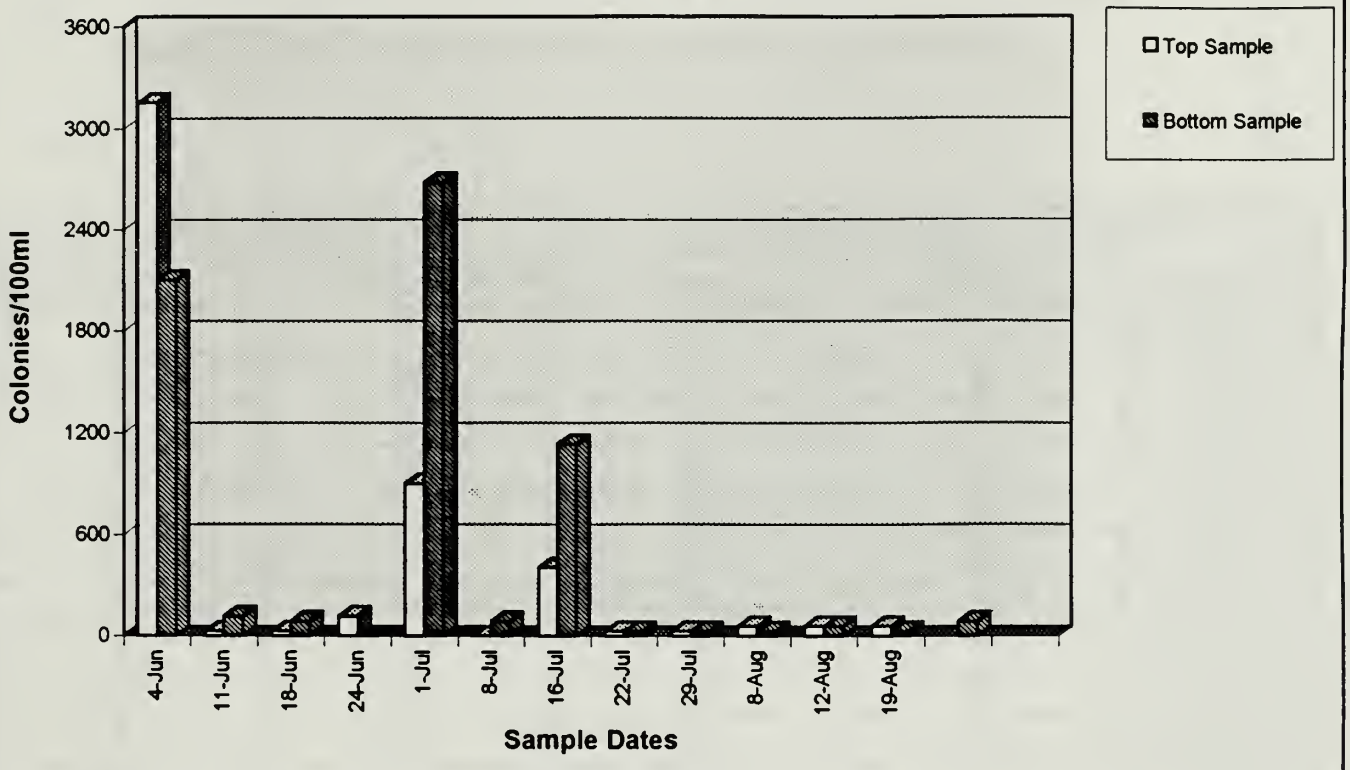


Figure 41

Beach Channel (JB-15) Water Quality Measurements, 1996



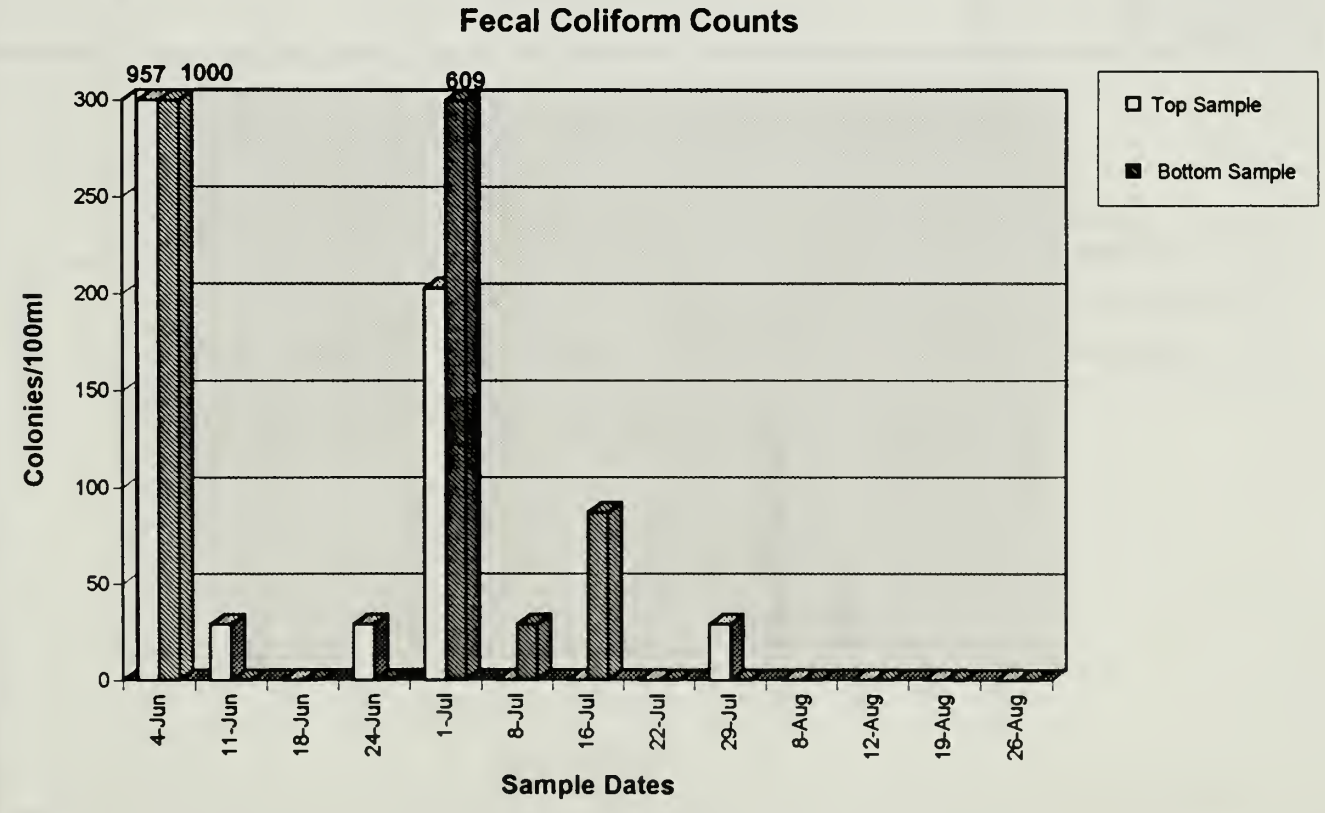
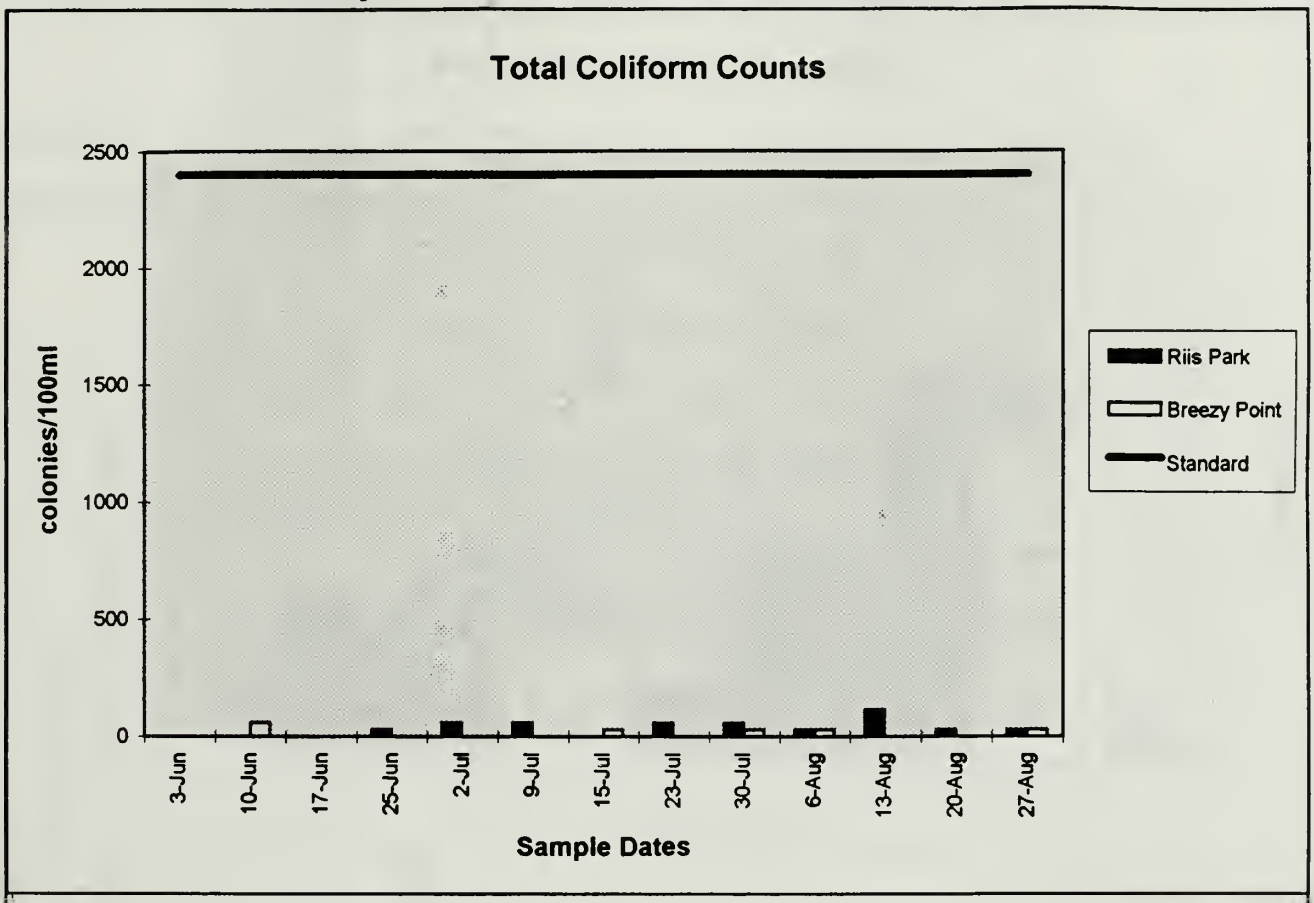


Figure 42

Table XVI
Beach Water Quality: Atlantic Beaches
Total & Fecal Coliform Counts (colonies/100ml), 1996

Date	Riis Park (ATL-1)		Surf Club (ATL-2)	
	Total	Fecal	Total	Fecal
6/03	0	0	0	0
6/10	0	0	58	0
6/17	0	0	0	0
6/25	29	0	0	0
7/02	58	58	0	0
7/09	58	0	0	0
7/15	0	0	29	0
7/23	58	0	0	0
7/30	58	0	29	29
8/06	29	87	29	0
8/13	116	29	0	87
8/20	29	0	0	0
8/27	29	0	29	0

Beach Water Quality: Atlantic Beaches Total and Fecal Coliform Counts, 1996



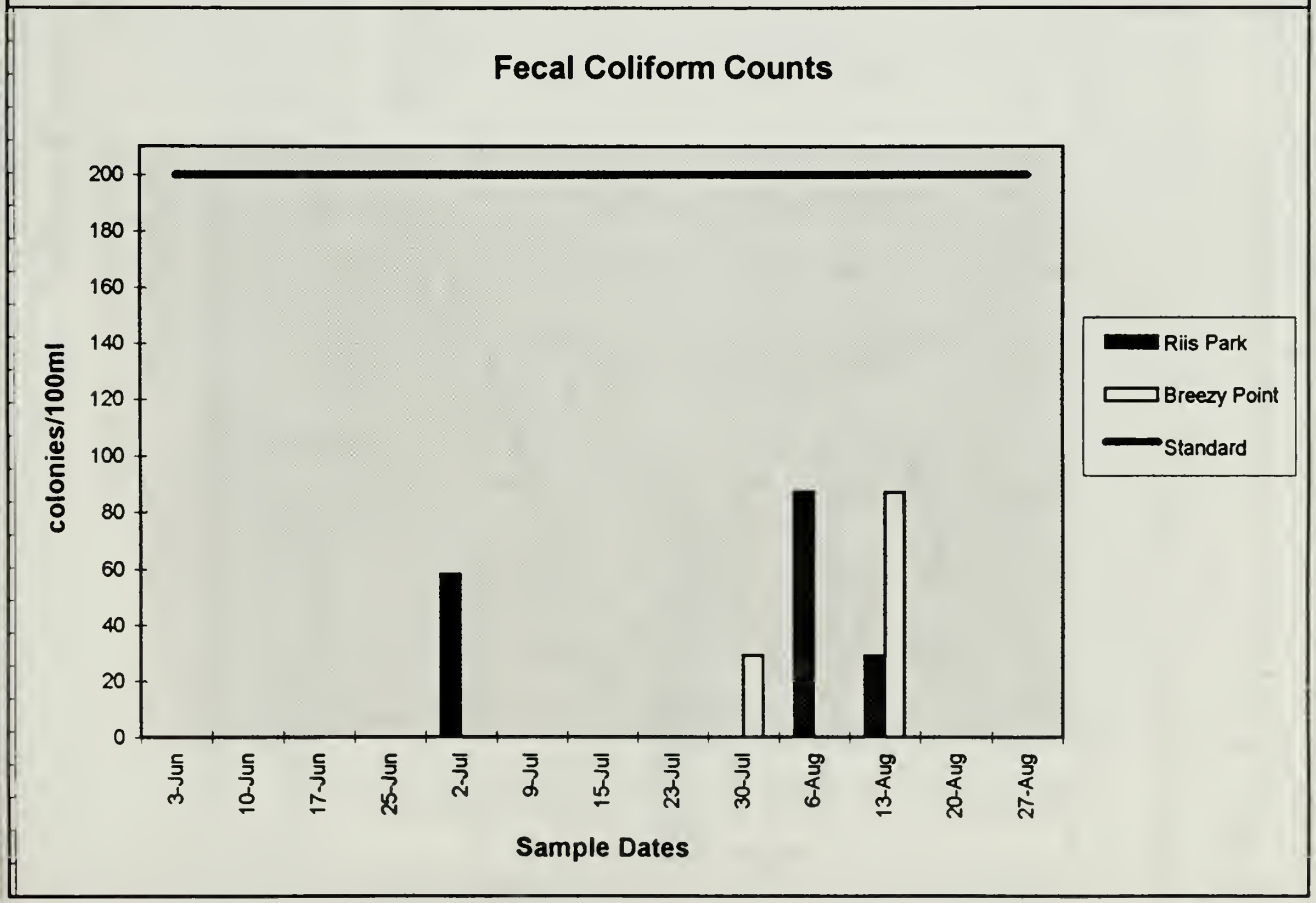
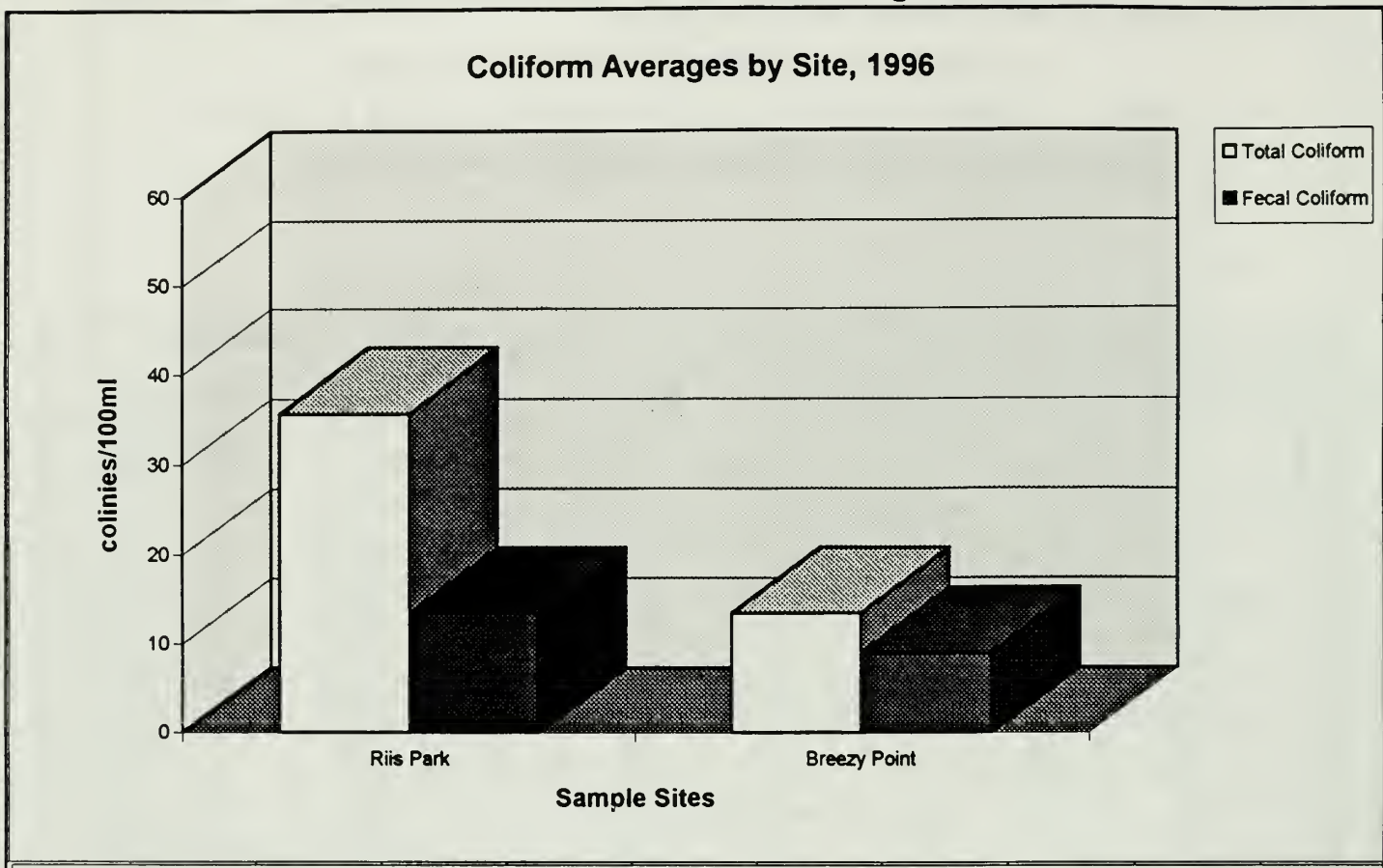


Figure 43

Atlantic Beaches Coliform Averages, 1996



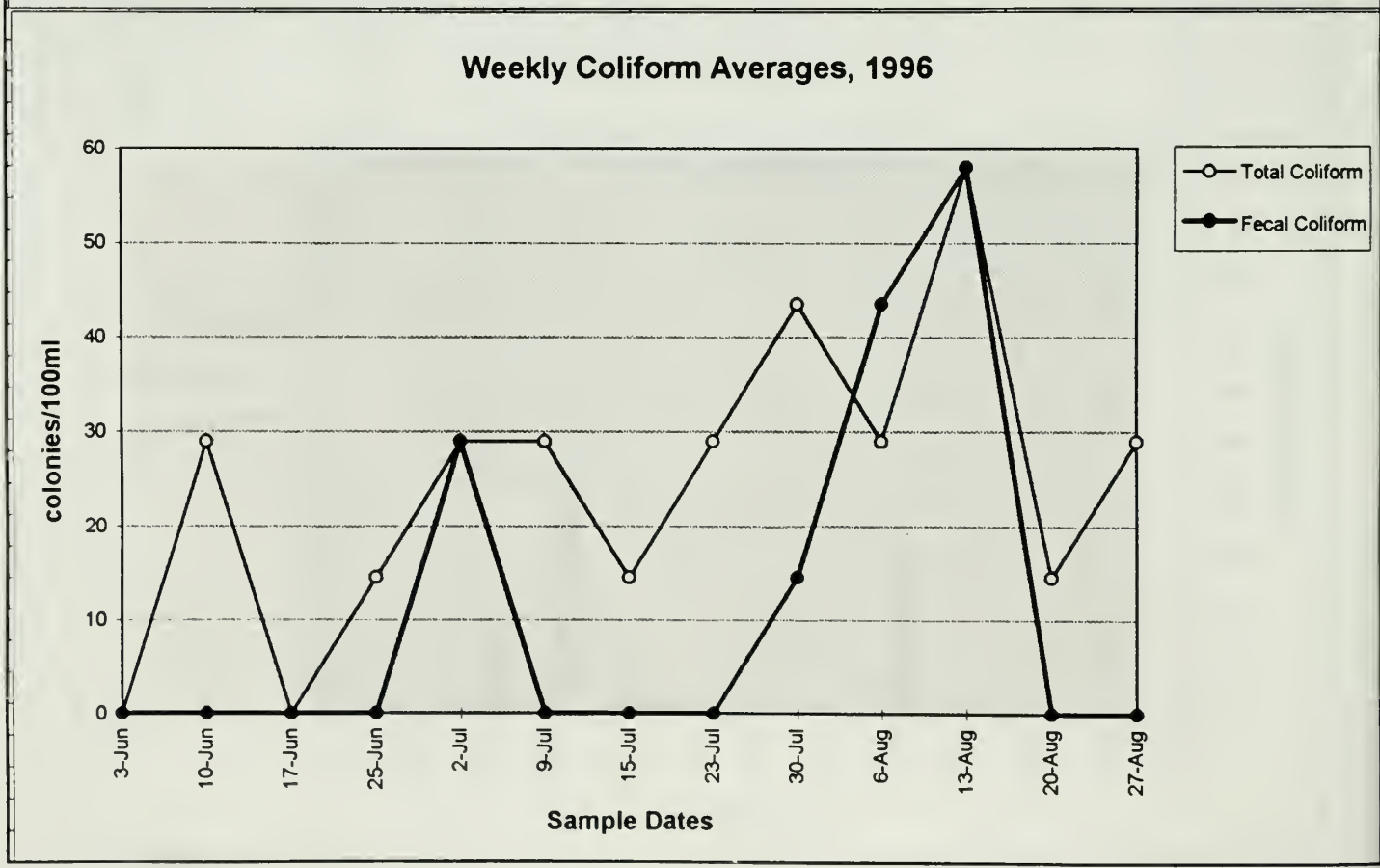


Figure 44

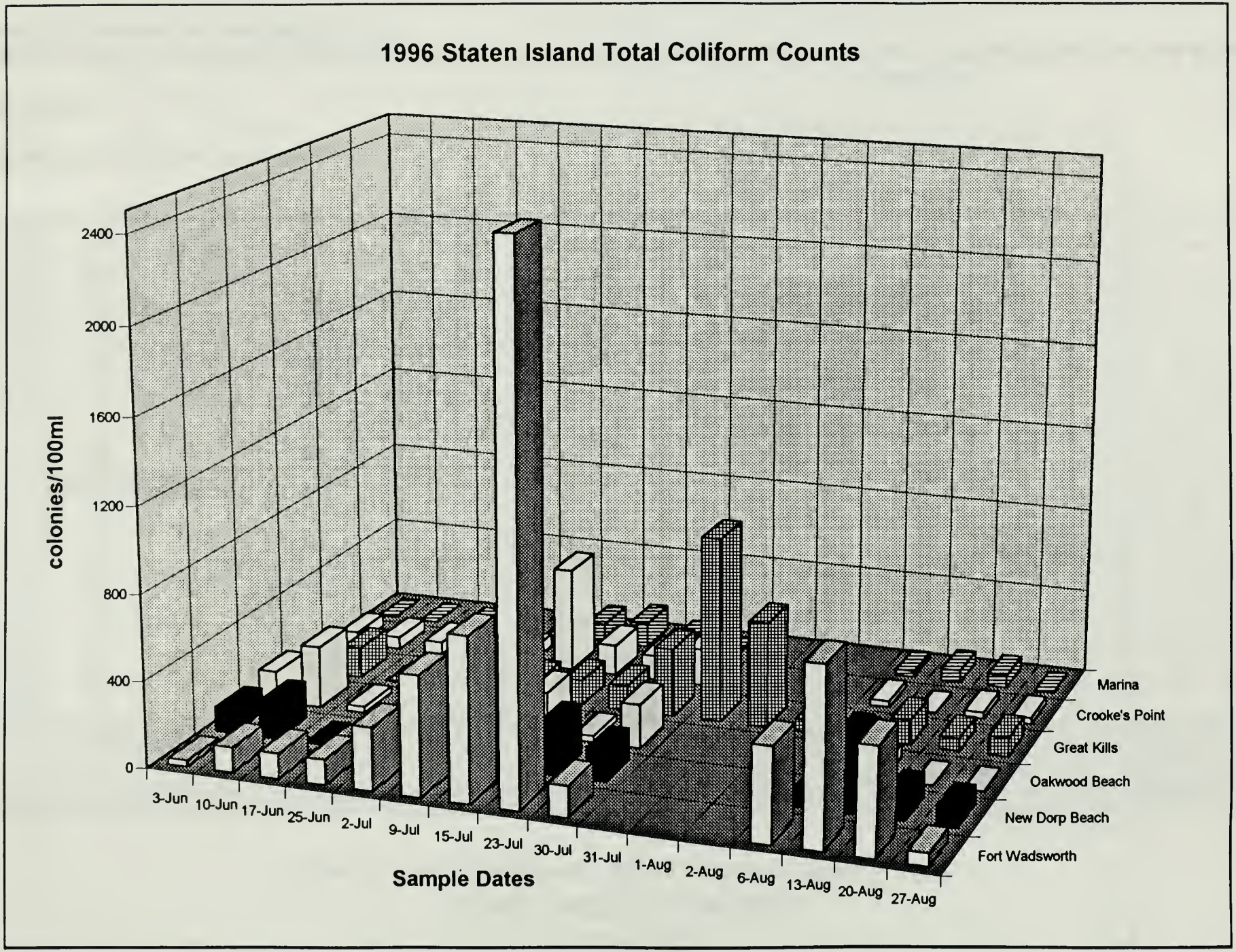
Table XVII
Water Quality: Staten Island
Total & Fecal Coliform Counts (colonies\100ml), 1996

	Fort Wadsworth SI-1		New Dorp Beach SI-4		Oakwood Beach SI-5		Great Kills* SI-6		Crooke's Point SI-7		Marina SI-8	
Date	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
6/03	29	0	116	29	145	0	87	116	58	29	0	0
6/10	116	29	174	58	290	232	145	87	58	0	0	0
6/17	116	0	0	58	29	29	0	29	58	0	0	0
6/25	166	0	29	0	0	0	0	29	58	0	29	0
7/02	290	29	232	0	29	0	58	174	58	0	0	0
7/09	551	0	435	58	464	58	87	0	493	261	87	0
7/15	754	145	145	58	203	0	116	58	145	29	116	0
7/23	2500	>25,800	232	58	29	0	116	0	116	0	58	0
7/30	145	29	145	58	203	58	319	203	174	58	0	0
7/31	ND	ND	ND	ND	ND	ND	1150	870	ND	ND	ND	ND
8/01	ND	ND	ND	ND	ND	ND	493	725	ND	ND	ND	ND
8/02	ND	ND	ND	ND	ND	ND	58	174	ND	ND	ND	ND
8/06	435	29	29	0	0	0	0	0	29	0	29	0
8/13	812	87	348	87	58	58	116	203	0	29	58	87
8/20	493	0	116	0	0	29	58	0	29	116	58	0
8/27	58	0	87	29	0	0	87	58	29	0	0	0

*Great Kills is a bathing beach site.

ND: No Data

Black cells indicate samples that exceeded total coliform counts of 2400mg/100ml & fecal coliform counts of 200mg/100ml (New York & New Jersey State bacterial standard limits).


1996 Staten Island Total Coliform Counts
colonies/100ml
2400
2000
1600
1200
800
400
0
3-Jun
10-Jun
17-Jun
25-Jun
2-Jul
9-Jul
15-Jul
23-Jul
30-Jul
31-Jul
1-Aug
2-Aug
6-Aug
13-Aug
20-Aug
27-Aug
Sample Dates
Marina
Crooke's Point
Great Kills
Oakwood Beach
New Dorp Beach
Fort Wadsworth

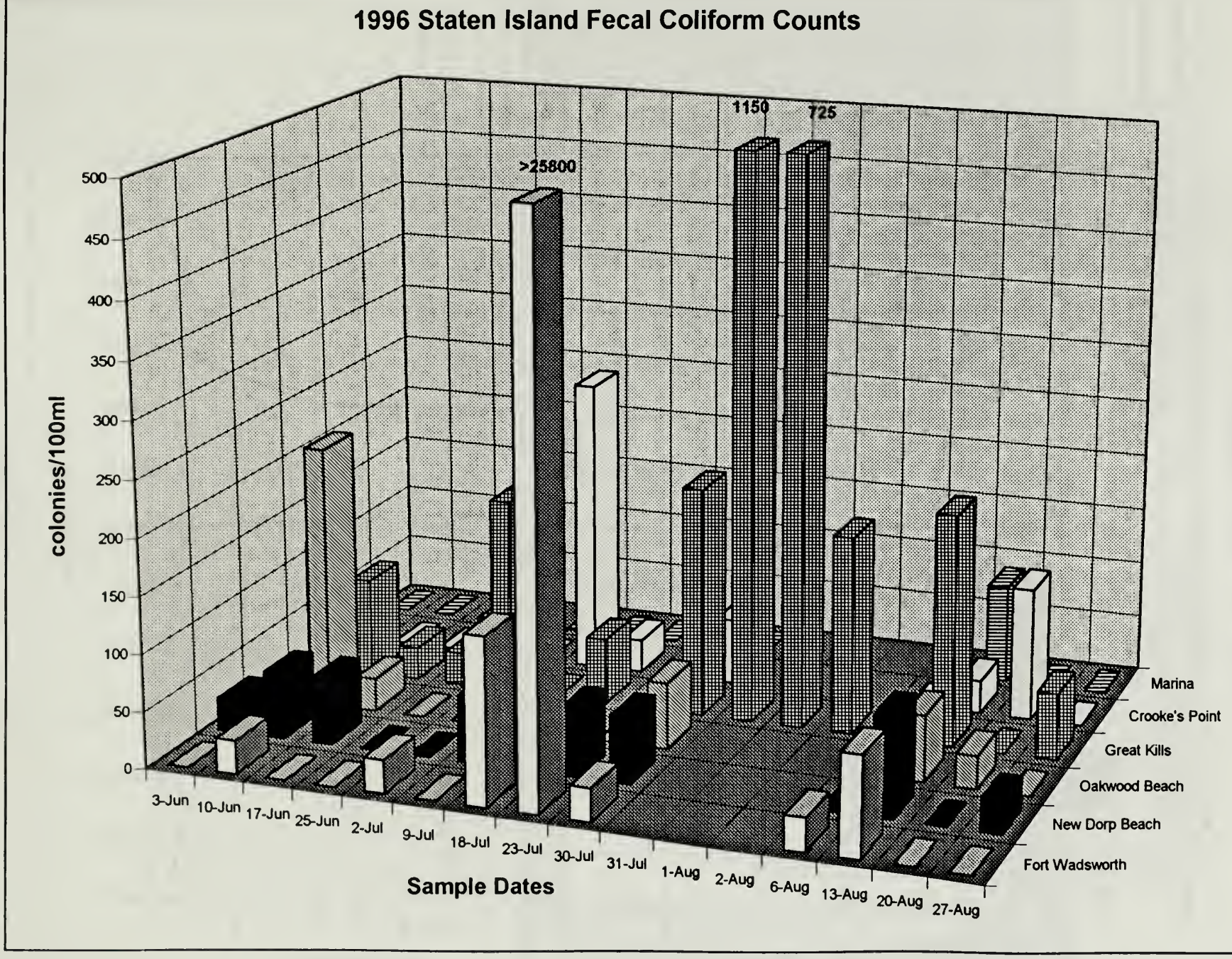
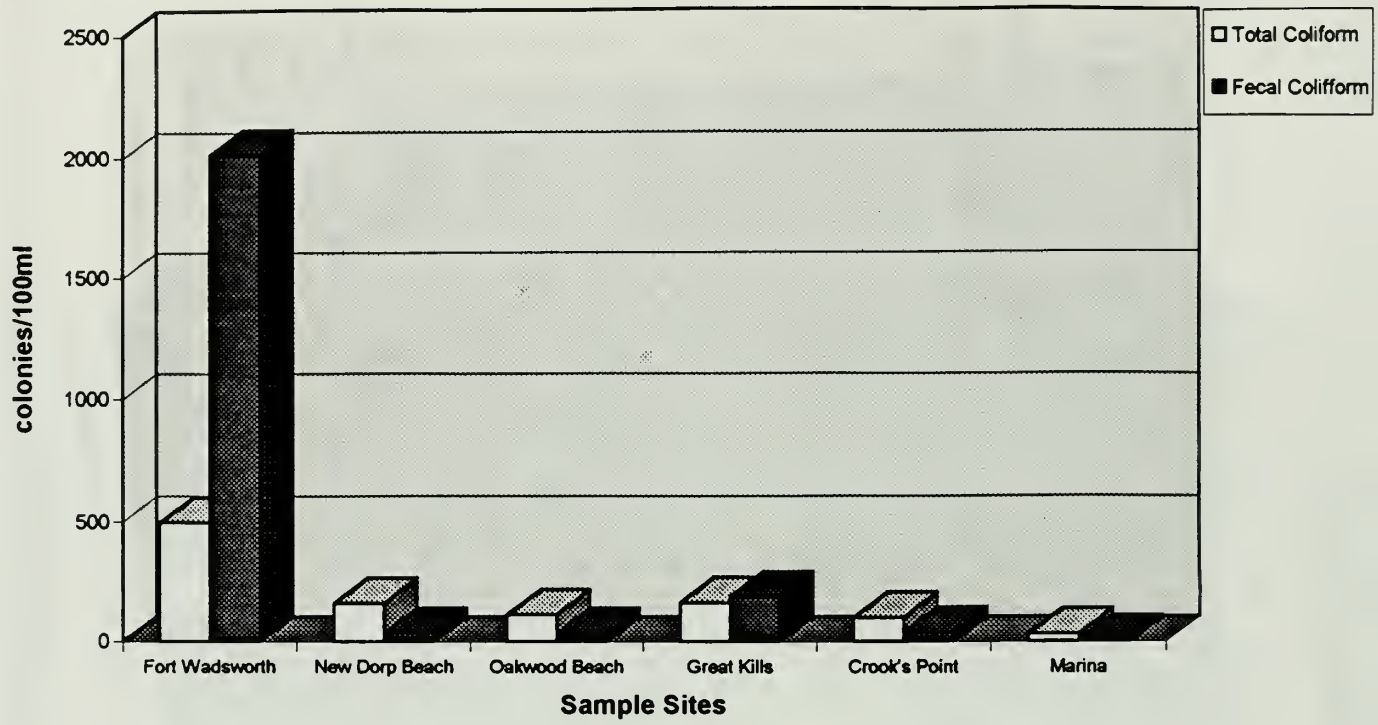

1996 Staten Island Fecal Coliform Counts
1150
725
>25800
500
450
400
350
300
250
200
150
100
50
0
colonies/100ml
3-Jun
10-Jun
17-Jun
25-Jun
2-Jul
9-Jul
18-Jul
23-Jul
30-Jul
31-Jul
1-Aug
2-Aug
6-Aug
13-Aug
20-Aug
27-Aug
Sample Dates
Marina
Crooke's Point
Great Kills
Oakwood Beach
New Dorp Beach
Fort Wadsworth

Figure 46

Staten Island Coliform Averages, 1996

Seasonal Coliform Averages by Site, 1996



Weekly Coliform Averages, 1996

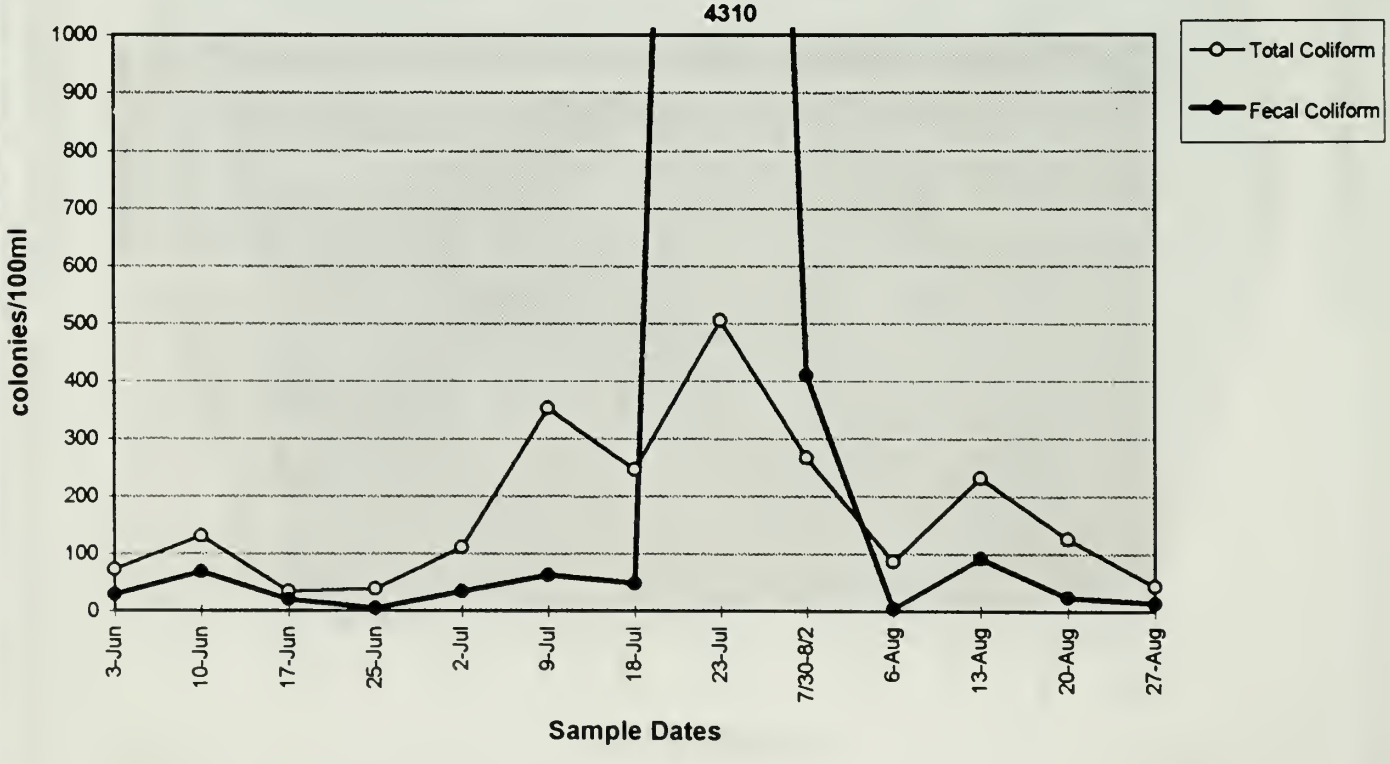


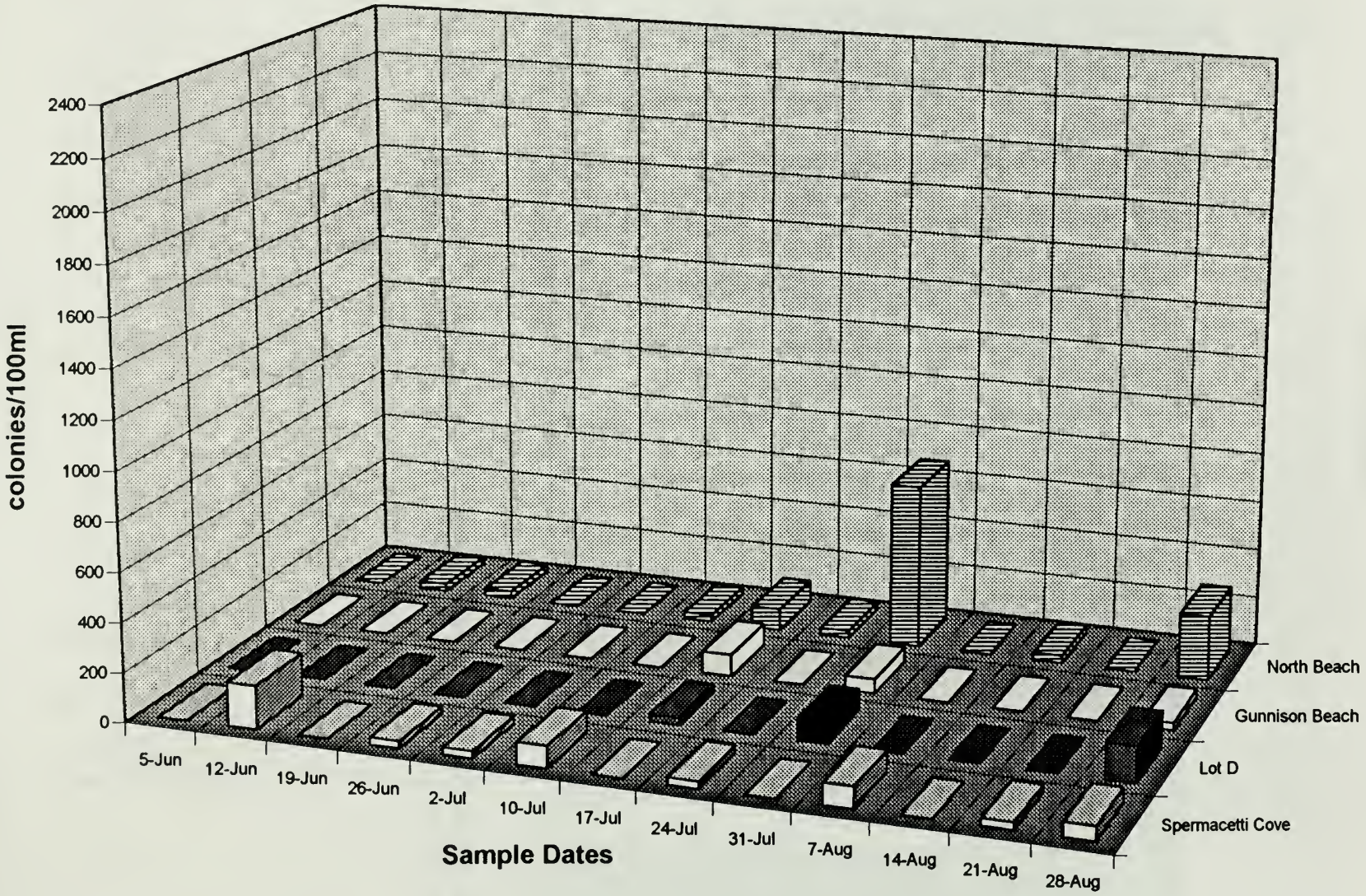
Figure 47

Table XVIII
Water Quality: Sandy Hook
Total & Fecal Coliform Counts (colonies/100ml), 1996

Date	Spermaceti Cove SH-2		Lot D SH-3		Gunnison Beach SH-4		North Beach SH-5	
	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
6/05	0	29	0	0	0	0	0	0
6/12	174	261	0	29	0	0	29	0
6/19	0	0	0	58	0	0	29	29
6/26	29	29	0	0	0	0	0	0
7/02	29	0	0	0	0	0	0	0
7/10	87	29	0	0	0	0	29	0
7/17	0	58	29	0	87	0	87	0
7/24	29	0	0	0	0	0	29	0
7/31	0	0	87	29	58	0	667	0
8/07	87	29	0	0	0	0	0	0
8/14	0	29	0	0	0	0	29	29
8/21	29	0	0	29	0	0	0	0
8/28	58	0	145	29	29	145	261	58

Black cells indicate samples that exceeded total coliform levels of 2400mg/100ml & fecal coliform counts of 200mg/100ml (New York & New Jersey State bacterial standard limits).

1996 Sandy Hook Total Coliform Counts



1996 Sandy Hook Fecal Coliform Counts

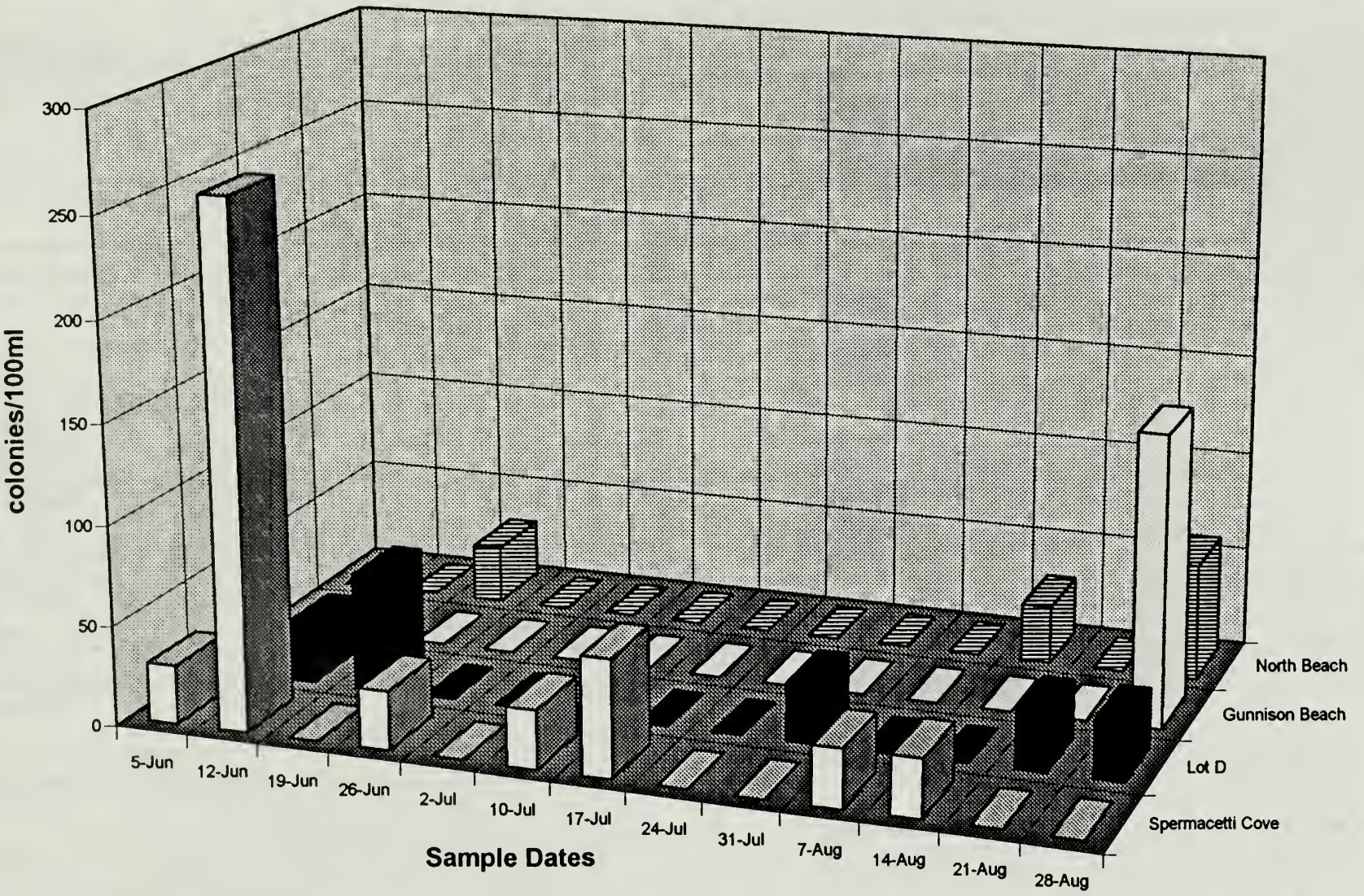
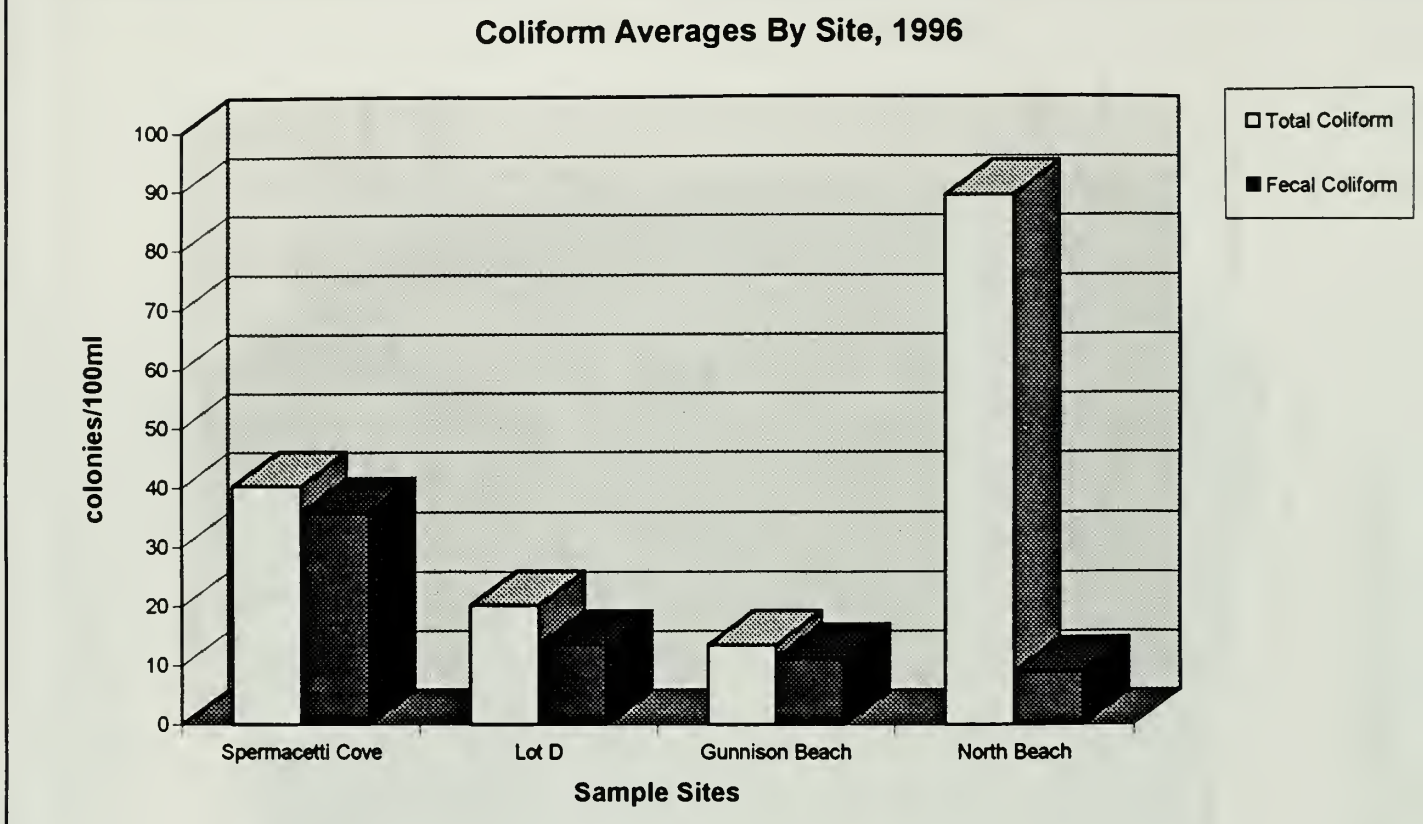


Figure 49

Sandy Hook Coliform Averages, 1996



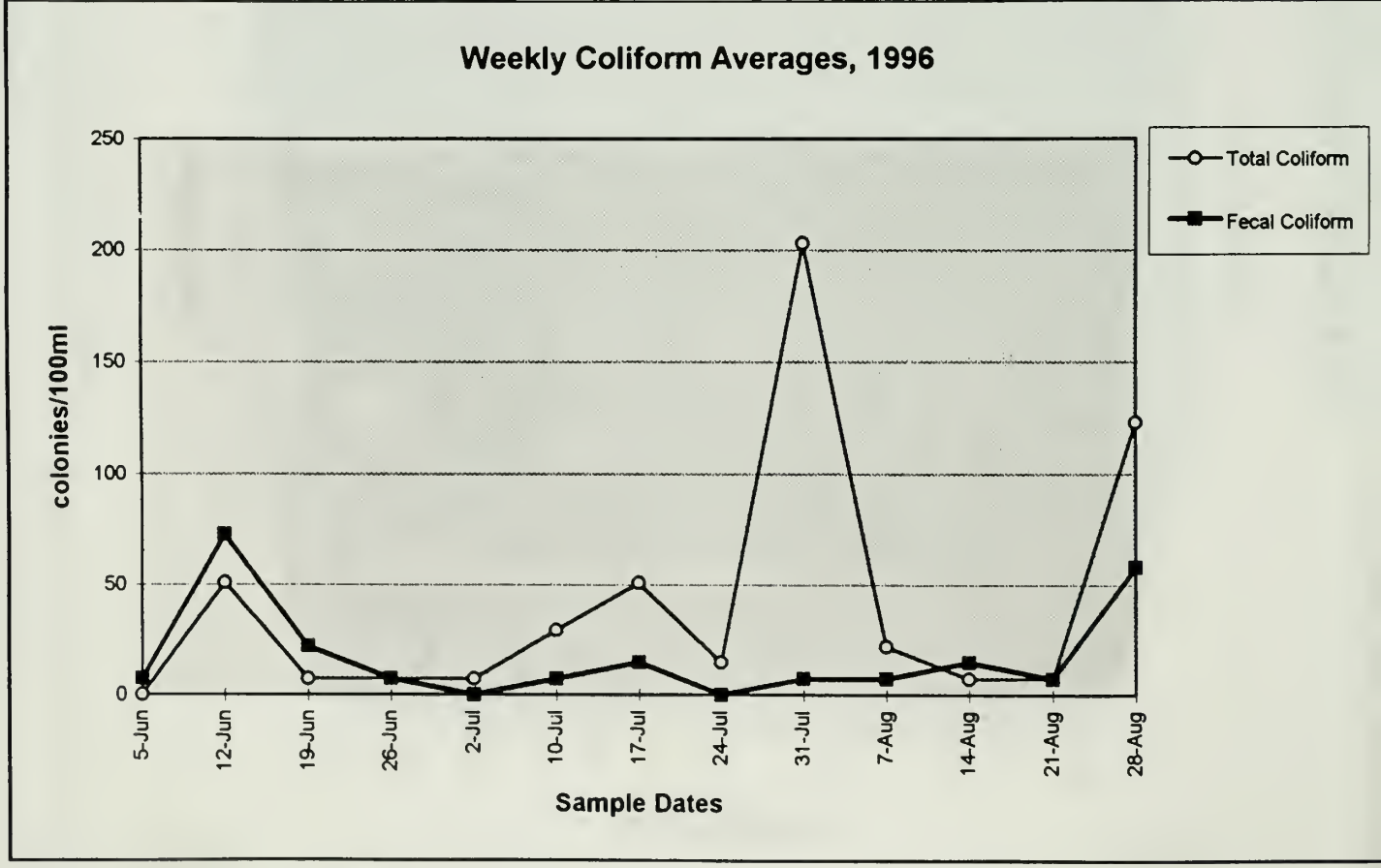
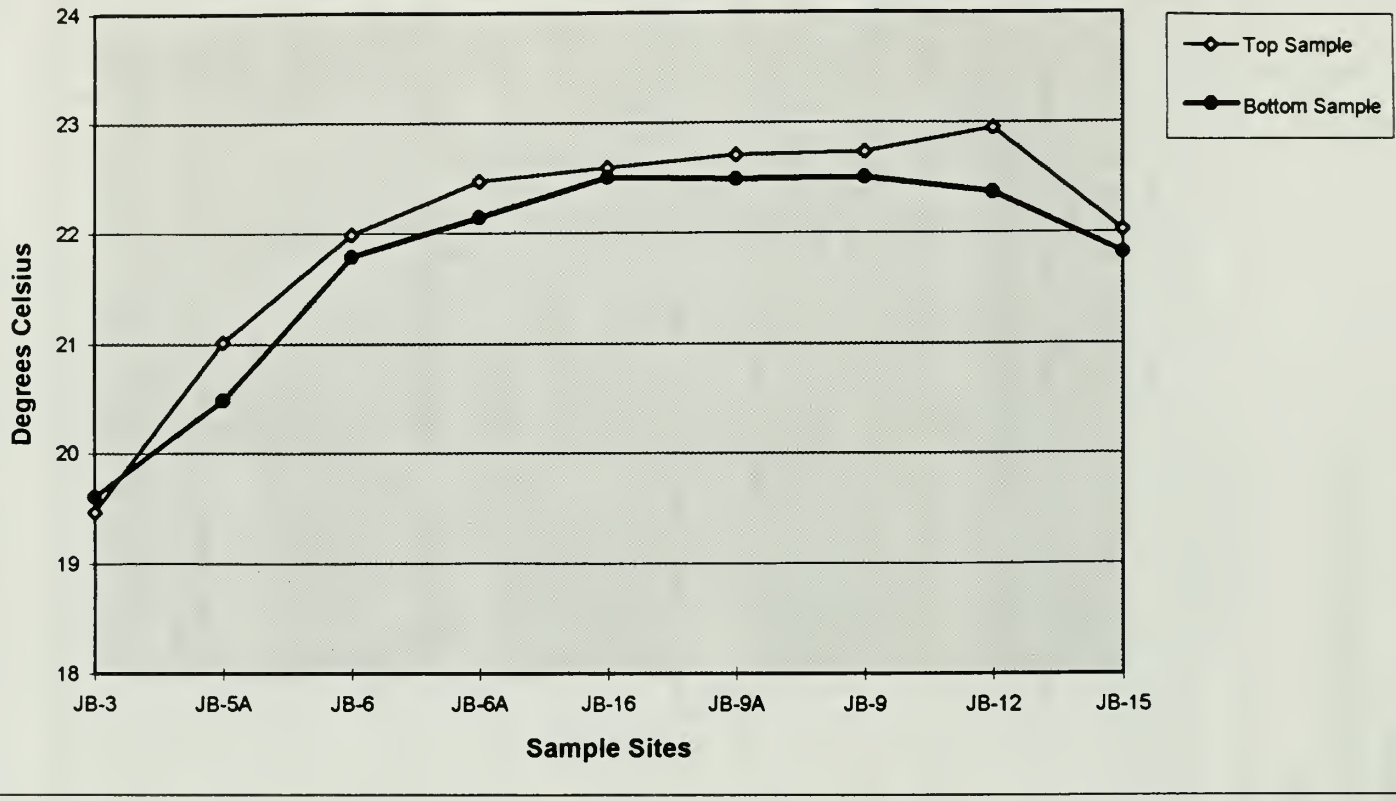


Figure 50

Table XIX
Jamaica Bay Water Temperature (°C), 1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	14.9	17.7	19.0	20.7	17.8	20.0	22.0	13.6	19.0	22.7	21.6	22.6	21.5
		Bottom	14.8	17.6	18.8	20.5	17.8	19.6	20.8	13.4	18.8	22.9	21.1	22.6	21.2
Nova Scotia Bar	JB-5A	Top	15.3	19.2	20.0	21.7	18.7	22.1	21.5	22.0	19.8	23.8	22.4	23.4	23.3
		Bottom	15.6	19.0	19.0	20.8	18.4	20.3	21.4	20.7	19.5	23.6	22.7	23.4	21.9
Canarsie Pier	JB-6	Top	16.7	20.4	21.7	21.5	20.6	23.0	23.3	21.7	21.5	24.1	23.3	23.7	24.3
		Bottom	16.4	20.2	21.6	21.3	20.5	22.3	23.6	20.8	21.3	24.0	23.5	23.7	24.0
Pennsylvania Avenue Landfill	JB-6A	Top	17.8	20.6	22.2	21.7	21.2	23.1	23.6	22.0	22.4	24.5	23.7	23.7	24.9
		Bottom	17.0	20.4	20.2	21.5	21.1	22.7	23.2	21.8	21.9	24.3	23.5	23.6	24.7
Bergen Basin	JB-16	Top	19.4	20.2	22.3	22.2	21.5	22.9	23.9	22.4	23.3	23.5	22.8	24.3	24.9
		Bottom	17.9	20.3	22.7	21.8	21.7	23.0	23.9	22.8	22.6	23.6	23.3	24.0	24.9
Bergen Basin Outflow	JB-9A	Top	17.7	21.1	22.7	22.1	21.8	23.2	24.0	22.9	22.9	23.7	23.7	24.2	25.1
		Bottom	17.7	20.2	22.7	22.1	21.6	22.9	23.8	22.9	22.9	23.4	23.2	24.0	24.9
Grassy Bay	JB-9	Top	18.2	20.7	22.9	22.2	21.8	23.0	24.2	22.9	23.7	23.9	23.6	24.3	24.1
		Bottom	18.1	20.7	21.0	22.0	21.8	22.8	23.7	23.0	23.5	24.1	23.3	23.9	24.6
JoCo Marsh	JB-12	Top	17.9	21.3	23.0	22.9	21.9	23.3	24.1	22.8	22.7	24.8	23.9	24.5	25.2
		Bottom	17.4	20.1	22.3	22.3	21.7	22.3	23.5	22.8	22.6	23.4	23.7	23.7	24.9
Beach Channel	JB-15	Top	16.6	20.6	21.3	22.4	20.8	22.5	23.1	20.7	22.2	24.3	23.2	23.9	24.7
		Bottom	16.4	20.4	21.1	22.1	20.6	22.3	22.7	20.4	21.8	24.4	22.9	23.8	24.7

Jamaica Bay Water Temperature Averages, 1996



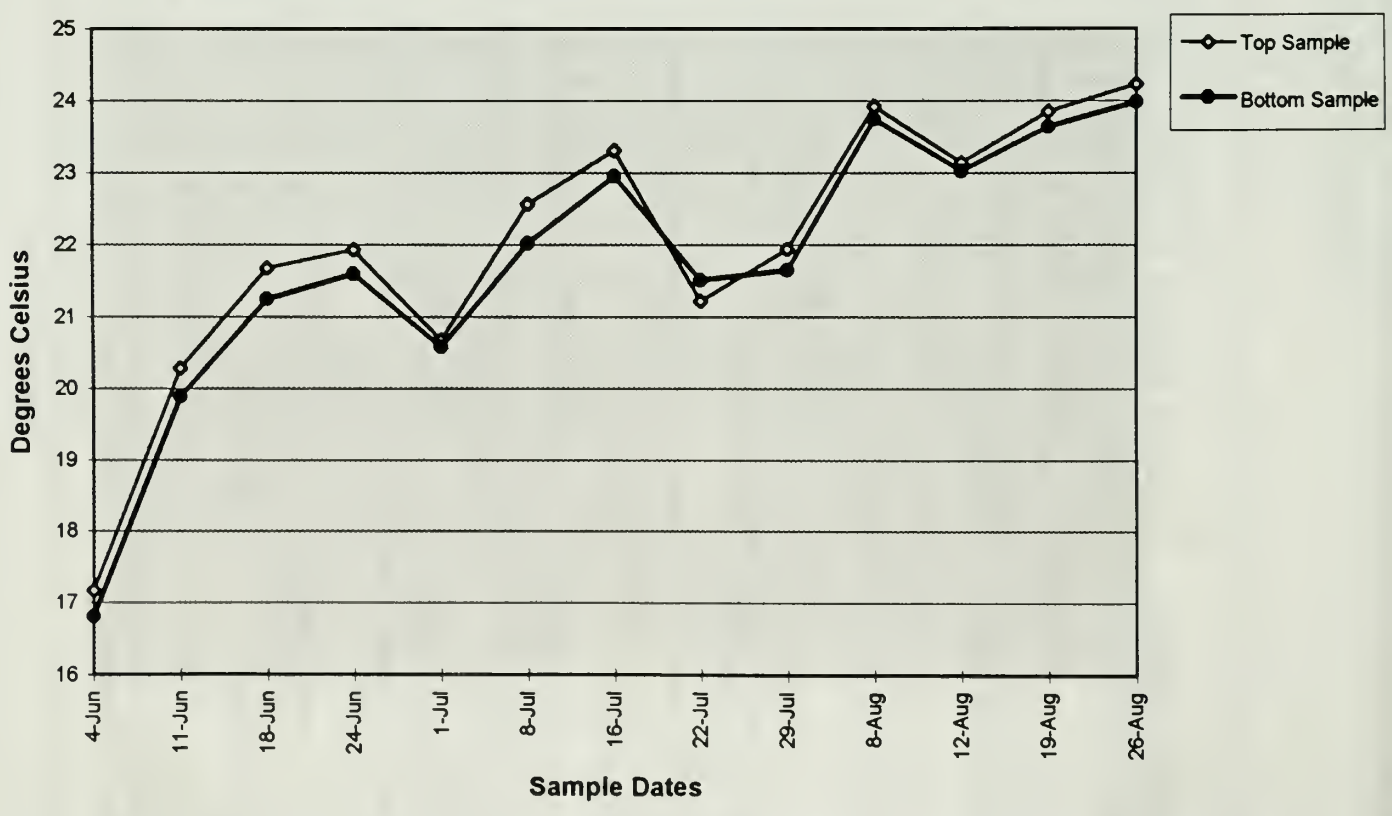


Figure 51

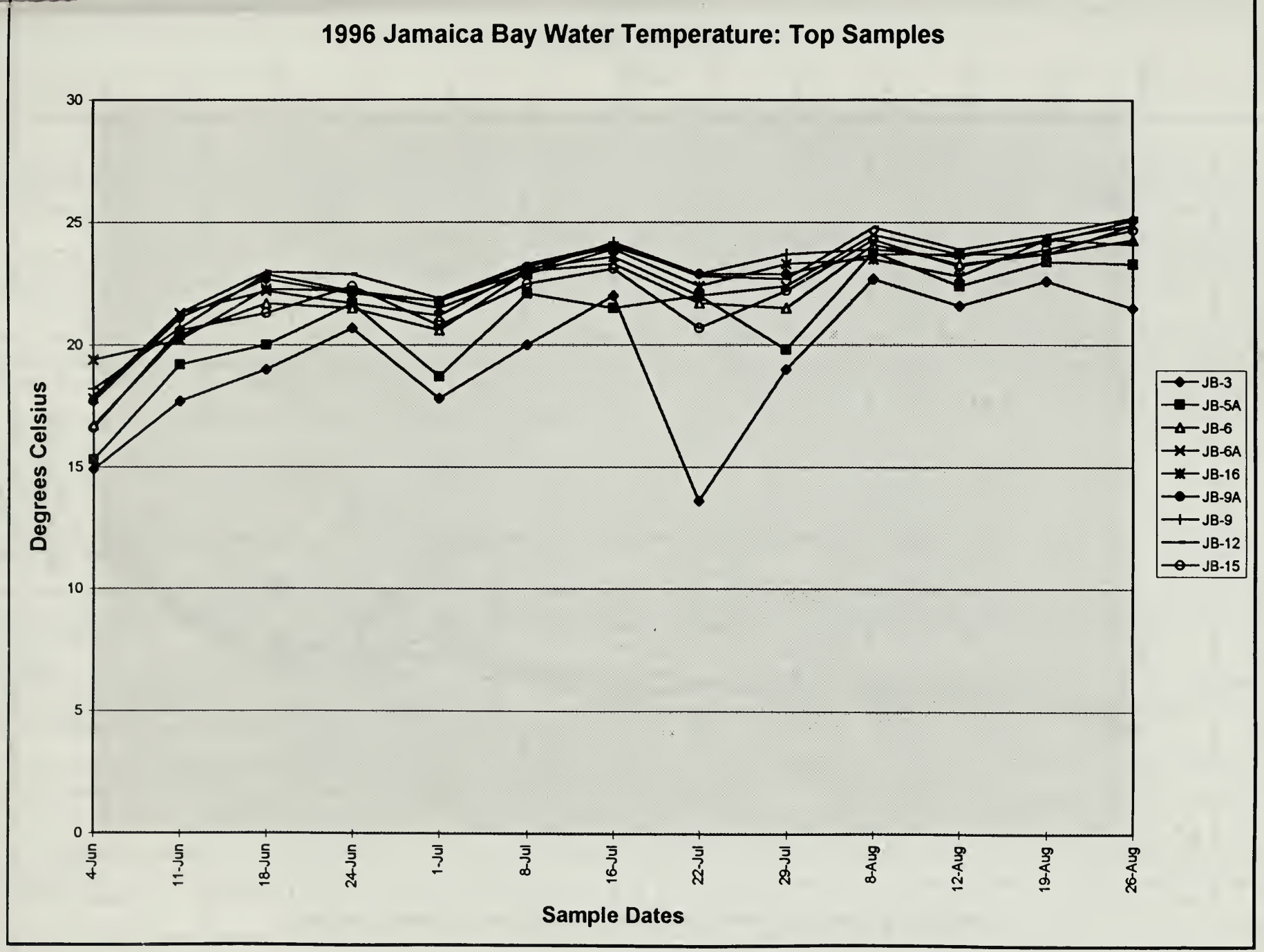

1996 Jamaica Bay Water Temperature: Top Samples
Degrees Celsius
30
25
20
15
10
5
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 52

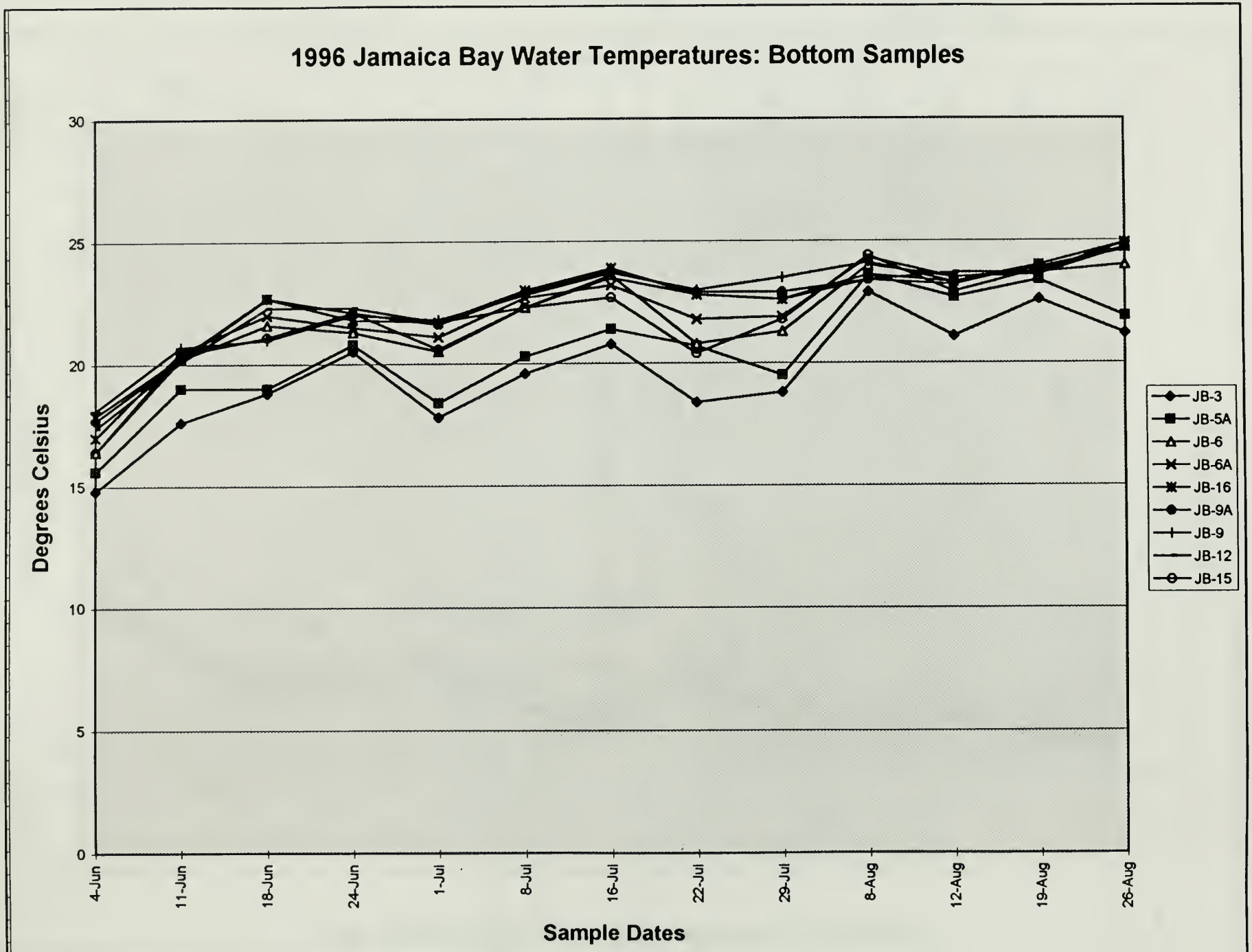
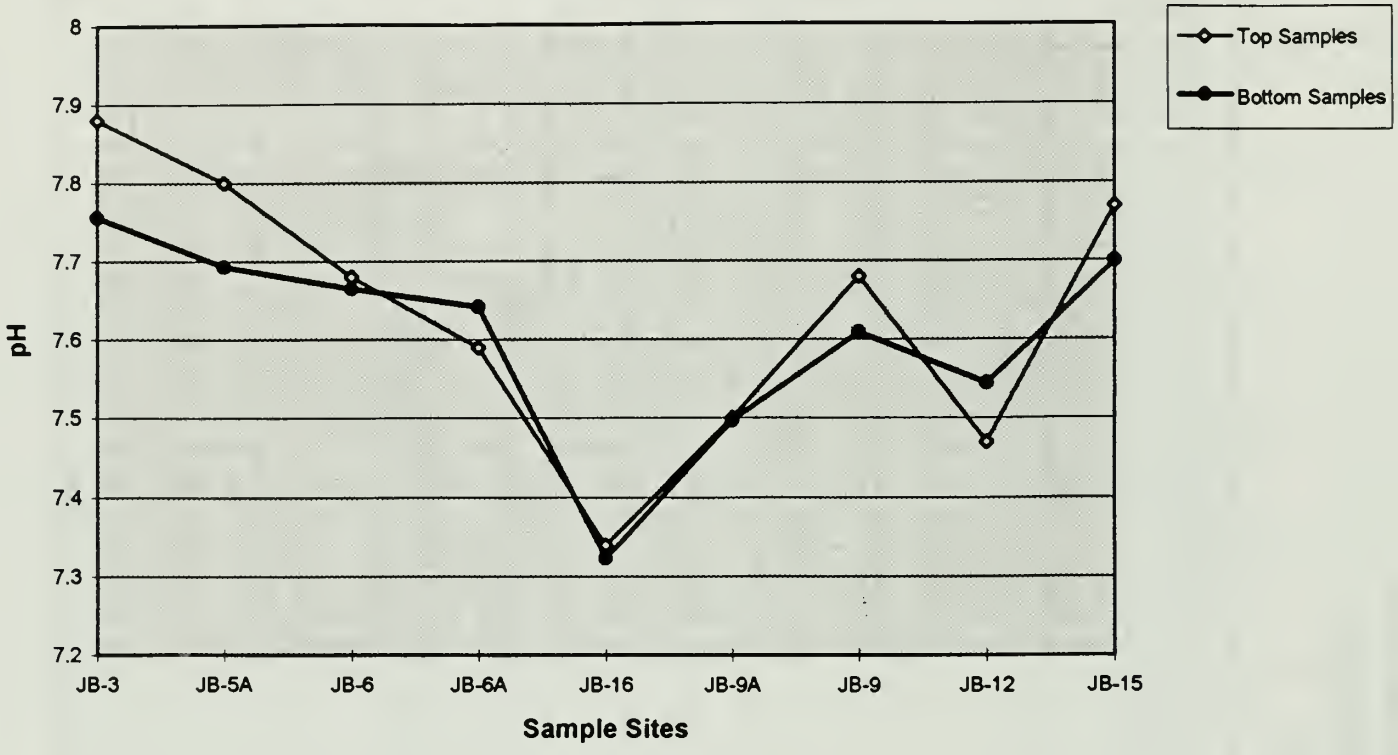

1996 Jamaica Bay Water Temperatures: Bottom Samples
Degrees Celsius
30
25
20
15
10
5
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Table XX
Jamaica Bay pH,
1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	7.68	7.55	7.69	7.58	7.54	7.16	7.61	7.74	7.72	6.64	7.90	7.44	7.54
		Bottom	7.88	7.75	7.91	7.71	7.74	7.50	7.68	7.74	7.87	7.73	7.96	7.64	7.77
Nova Scotia Bar	JB-5A	Top	7.82	7.66	7.93	7.95	7.77	7.44	7.37	7.35	7.82	7.96	8.04	7.55	7.70
		Bottom	7.80	7.66	7.96	7.61	7.80	7.47	7.30	7.46	7.88	7.86	7.97	7.56	7.68
Canarsie Pier	JB-6	Top	7.69	7.64	7.98	7.54	7.63	7.38	7.47	7.46	7.83	8.18	8.03	7.47	7.80
		Bottom	7.68	7.64	8.01	7.64	7.64	7.38	7.19	7.46	7.80	7.92	8.05	7.48	7.75
Pennsylvania Avenue Landfill	JB-6A	Top	7.54	7.86	7.91	7.39	7.57	7.47	7.32	7.40	7.89	8.13	8.05	7.47	7.68
		Bottom	7.59	7.50	7.92	7.50	7.61	7.39	7.41	7.42	7.81	8.04	8.01	7.47	7.67
Bergen Basin	JB-16	Top	6.96	6.84	7.03	7.00	6.99	7.04	7.16	6.98	7.86	7.20	7.14	7.27	7.10
		Bottom	7.34	6.84	7.67	7.29	7.37	7.23	7.29	7.20	7.69	7.33	7.23	7.27	7.45
Bergen Basin Outflow	JB-9A	Top	7.45	6.93	7.36	7.03	7.46	7.59	7.30	7.35	7.99	7.86	8.09	7.41	7.61
		Bottom	7.50	7.15	7.72	7.36	7.50	7.37	7.40	7.28	7.98	7.44	7.90	7.40	7.46
Grassy Bay	JB-9	Top	7.67	7.65	8.04	8.18	7.48	7.54	7.25	7.61	8.34	8.44	8.27	7.67	7.68
		Bottom	7.68	7.73	7.30	7.65	7.60	7.40	7.40	7.30	8.25	8.09	7.35	7.46	7.70
JoCo Marsh	JB-12	Top	7.47	8.20	8.02	8.49	7.66	7.55	7.68	8.05	7.69	8.63	8.28	7.59	7.81
		Bottom	7.47	7.52	7.65	7.82	7.55	7.29	7.48	7.54	7.63	7.60	7.59	7.36	7.57
Beach Channel	JB-15	Top	7.71	7.50	7.94	8.15	7.49	7.40	7.42	7.69	7.66	8.15	7.90	7.46	7.70
		Bottom	7.77	7.57	7.98	7.97	7.58	7.41	7.49	7.63	7.67	7.98	7.87	7.48	7.69

Jamaica Bay pH Averages, 1996



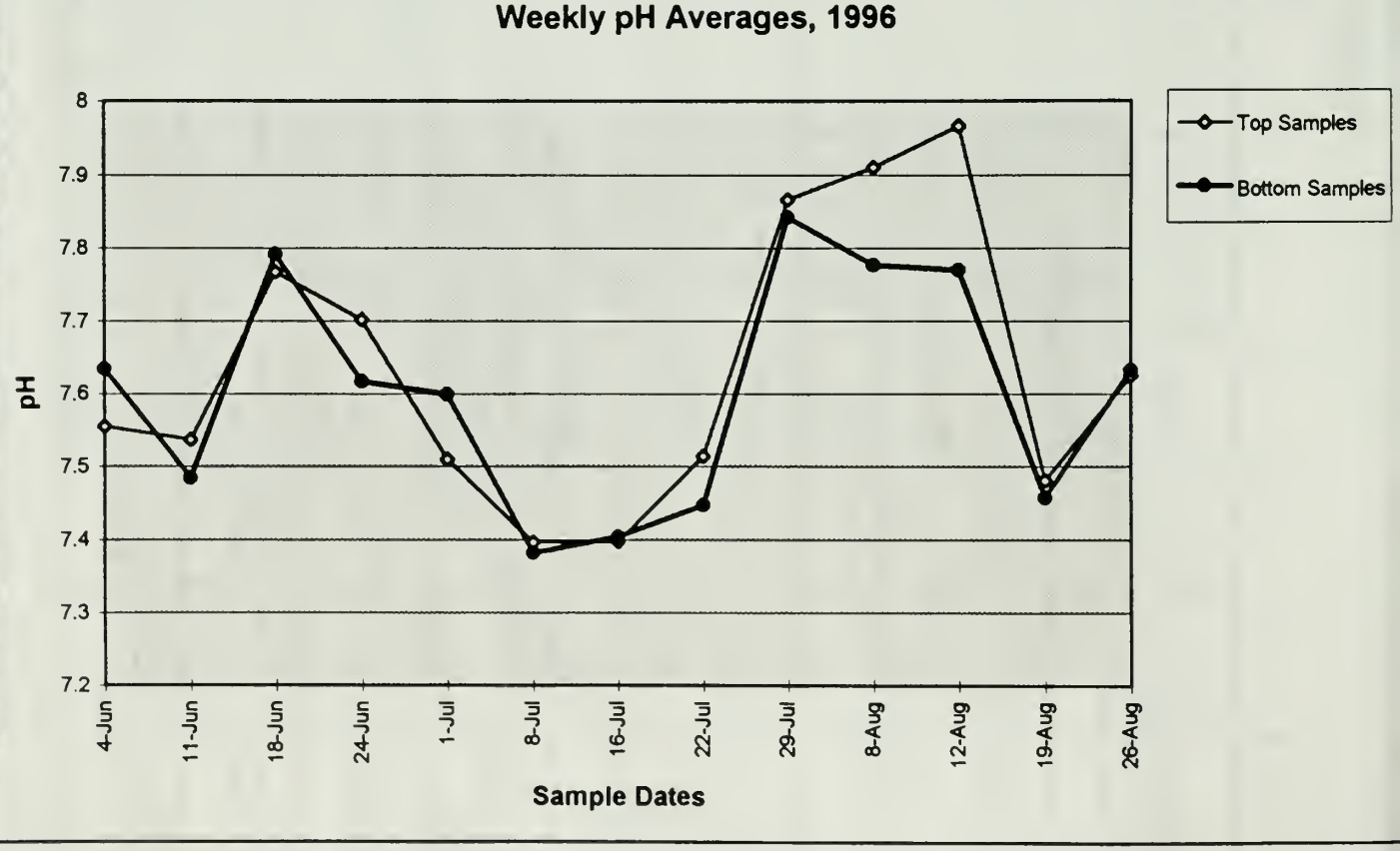


Figure 54

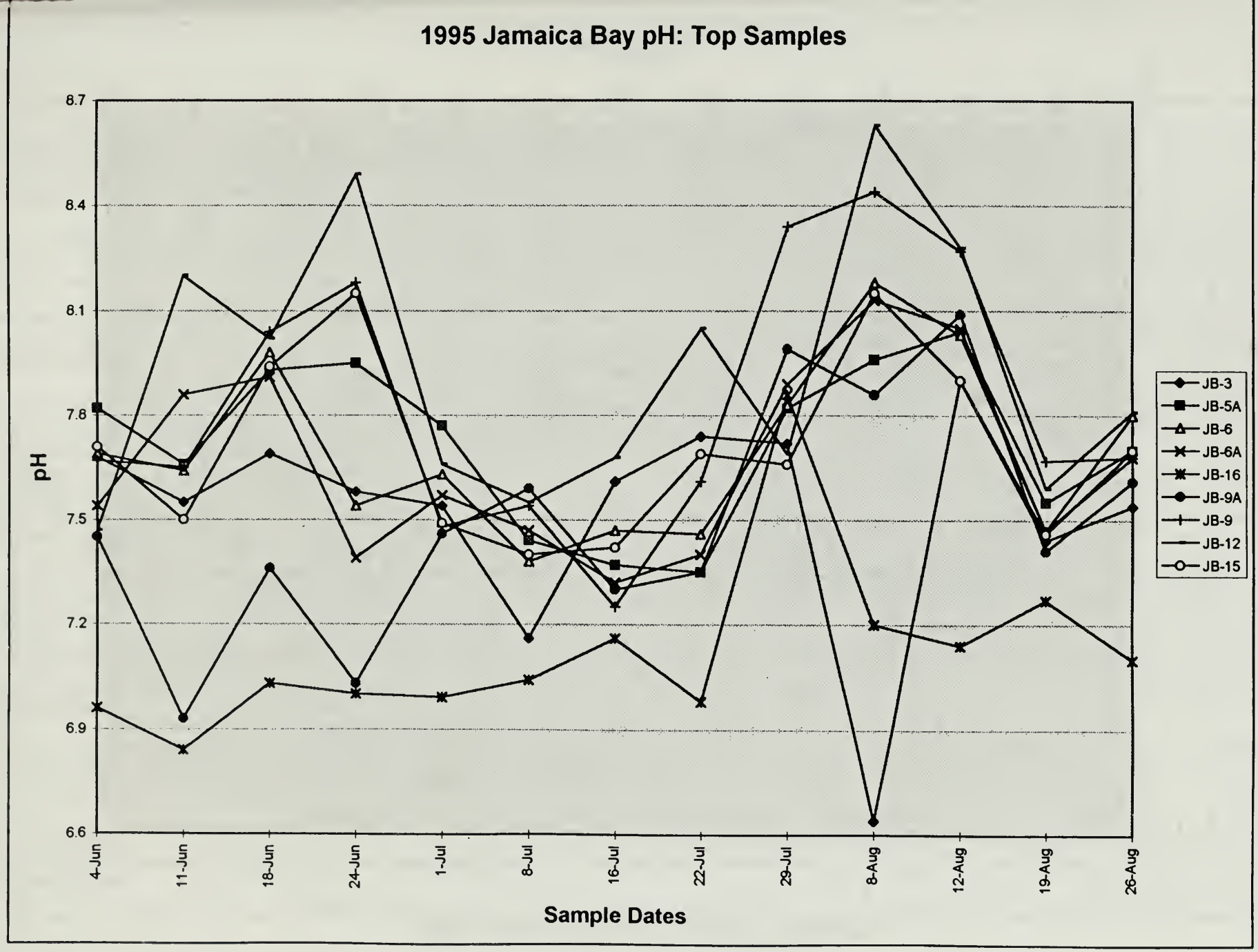
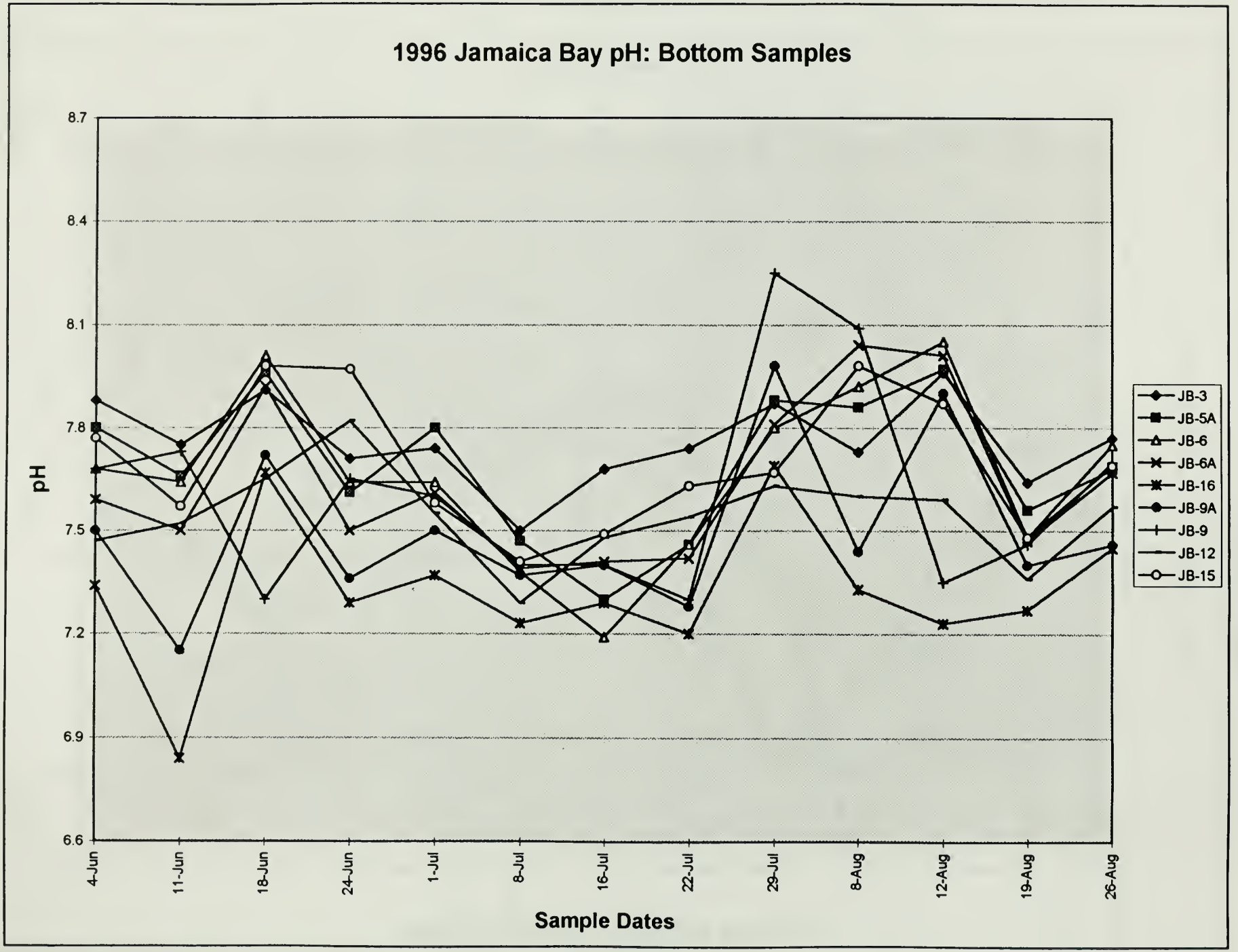

1995 Jamaica Bay pH: Top Samples
8.7
8.4
8.1
7.8
7.5
7.2
6.9
6.6
pH
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 55

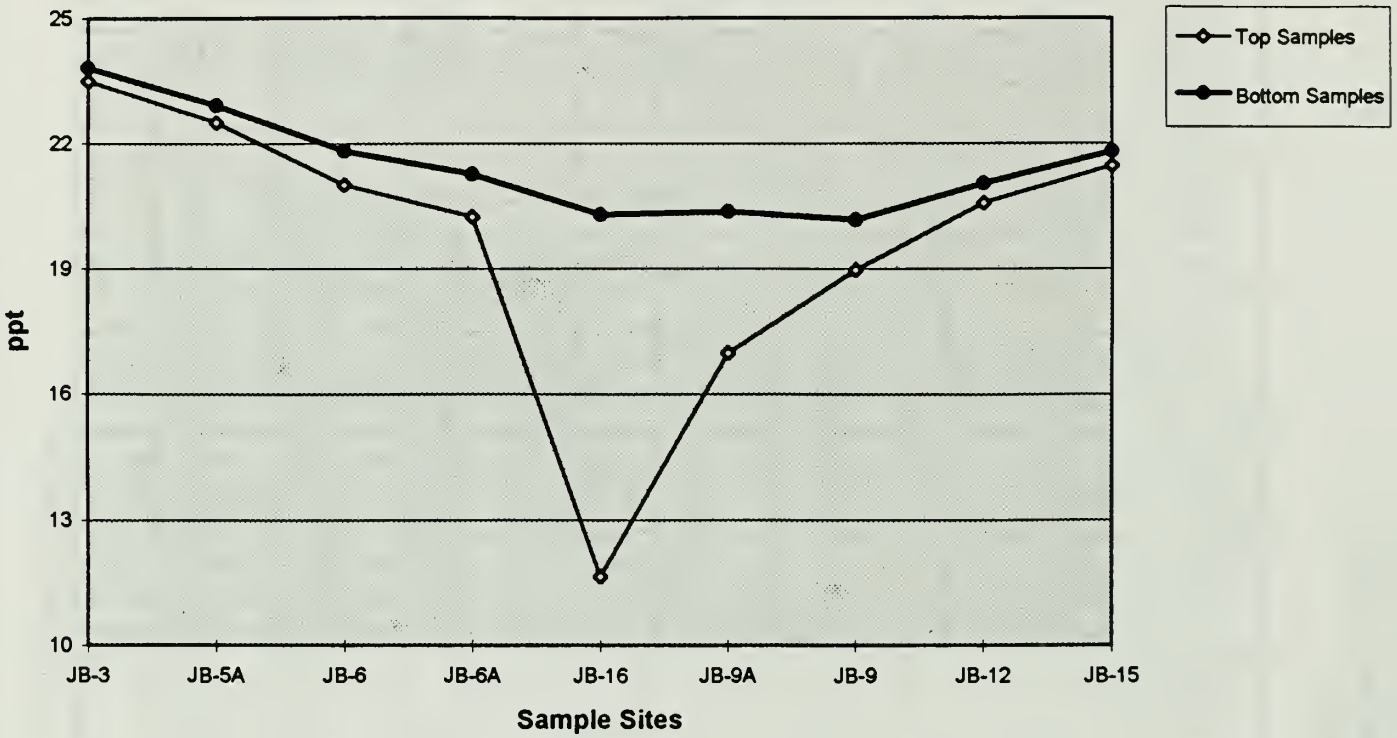

1996 Jamaica Bay pH: Bottom Samples
8.7
8.4
8.1
7.8
7.5
7.2
6.9
6.6
pH
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Jamaica Bay Salinity (ppt), 1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	23.7	23.1	24.4	22.9	24.9	23.8	21.6	24.5	25.2	23.0	23.2	21.7	23.5
		Bottom	23.5	23.2	24.9	23.1	25.0	24.1	22.9	24.7	25.5	23.2	24.3	21.7	23.6
Nova Scotia Bar	JB-5A	Top	23.2	22.2	23.5	21.7	23.7	22.5	21.7	21.0	24.2	22.0	23.1	21.3	22.2
		Bottom	23.3	22.3	23.6	22.9	24.5	23.7	21.9	22.2	25.1	22.2	21.5	21.3	23.4
Canarsie Pier	JB-6	Top	21.6	19.0	22.3	21.2	22.4	20.9	21.6	21.1	22.2	20.3	19.1	20.4	21.0
		Bottom	22.0	21.4	22.4	21.9	22.5	22.5	22.0	22.2	22.4	21.5	20.8	20.5	21.6
Pennsylvania Avenue Landfill	JB-6A	Top	19.0	19.0	21.4	21.3	20.9	20.5	19.6	20.3	21.2	19.8	19.7	19.8	20.5
		Bottom	21.2	20.6	21.9	21.9	21.8	22.1	21.3	21.3	21.6	21.3	20.5	20.0	20.9
Bergen Basin	JB-16	Top	10.6	6.9	11.6	17.1	7.6	9.4	14.9	9.5	16.6	8.1	8.0	17.0	14.3
		Bottom	20.2	20.1	21.0	20.6	20.5	21.1	20.6	20.3	20.8	20.2	19.3	19.6	19.9
Bergen Basin Outflow	JB-9A	Top	20.5	06.5	15.2	14.1	19.3	19.0	19.3	17.1	20.6	13.0	18.8	19.0	18.5
		Bottom	20.7	20.1	20.8	20.7	20.9	21.5	20.8	20.3	20.6	20.3	17.9	19.6	20.4
Grassy Bay	JB-9	Top	19.7	19.9	20.9	20.4	18.5	20.8	13.2	19.6	20.4	17.2	19.1	19.4	17.5
		Bottom	19.7	20.0	21.0	20.6	20.4	21.1	20.5	20.1	20.5	20.0	19.3	19.5	19.3
JoCo Marsh	JB-12	Top	20.3	20.3	21.5	21.0	21.1	21.6	20.7	20.1	21.0	20.2	19.6	19.7	20.2
		Bottom	21.2	20.8	21.7	21.2	21.6	21.8	21.7	20.8	21.0	20.8	19.9	20.1	20.8
Beach Channel	JB-15	Top	21.5	20.8	22.2	21.2	22.2	22.1	22.0	22.0	21.7	20.9	20.5	20.9	20.9
		Bottom	22.4	21.2	22.9	21.6	22.6	22.3	22.1	22.3	22.0	20.8	21.3	20.9	21.0

Jamaica Bay Salinity Averages, 1996

Salinity Seasonal Averages by Site, 1996



Weekly Salinity Averages, 1996

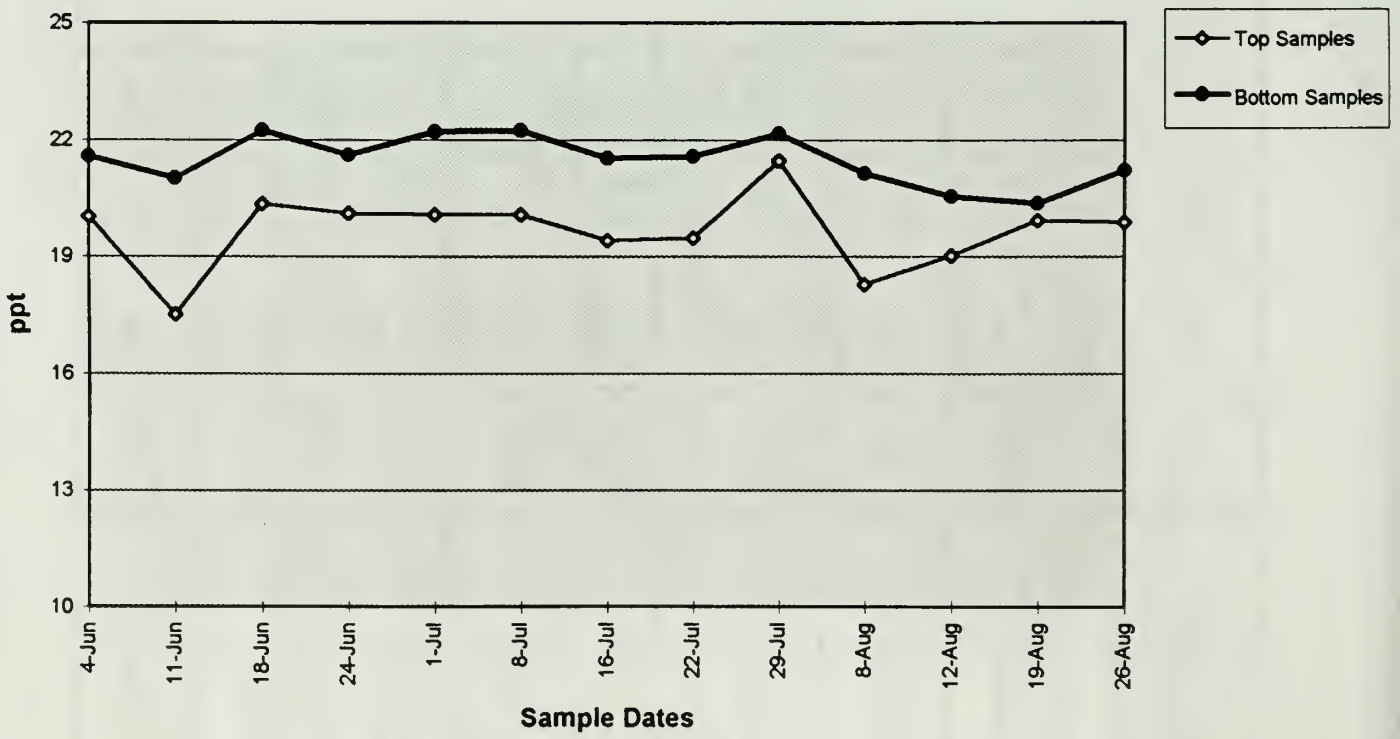


Figure 57

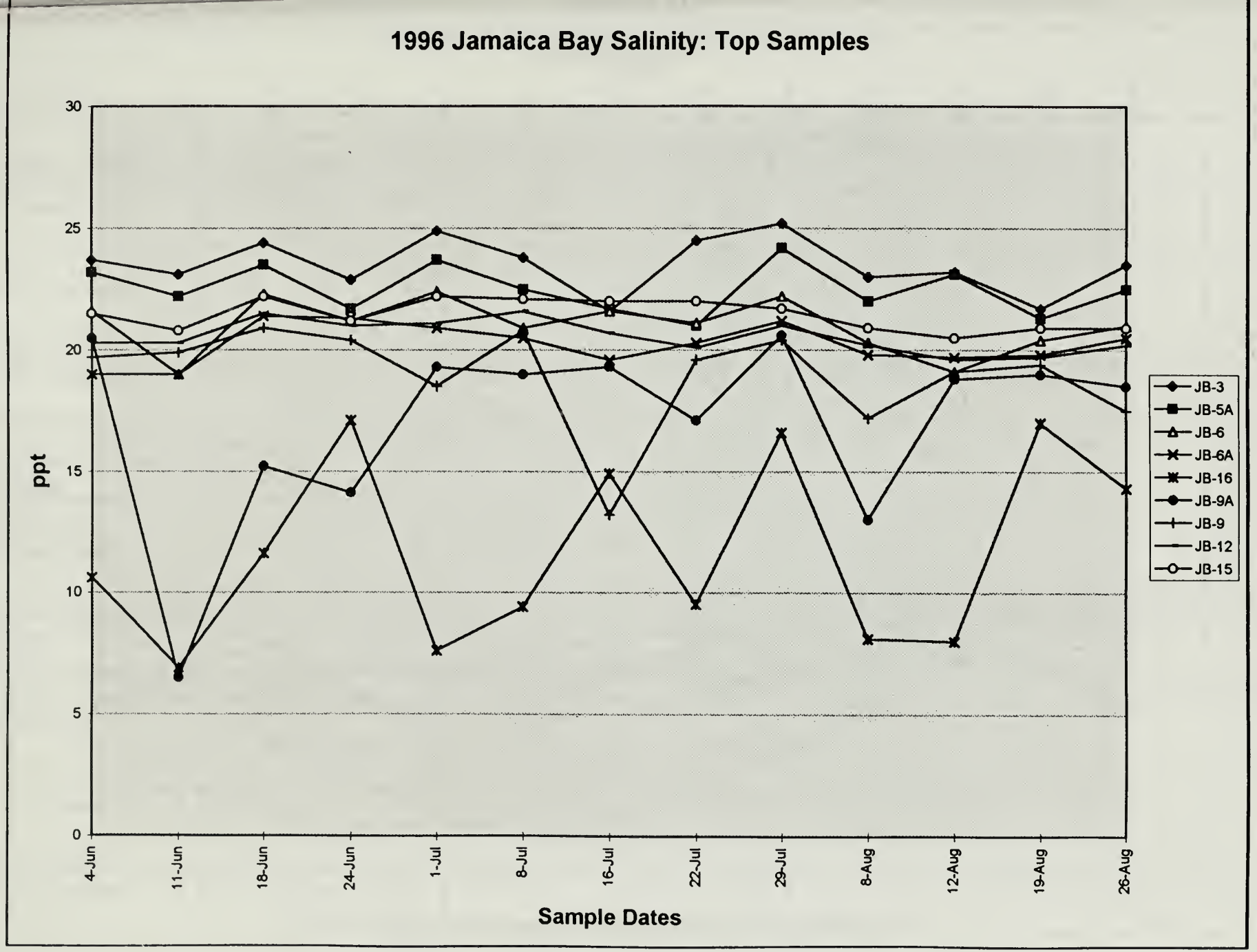

1996 Jamaica Bay Salinity: Top Samples
ppt
30
25
20
15
10
5
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 58

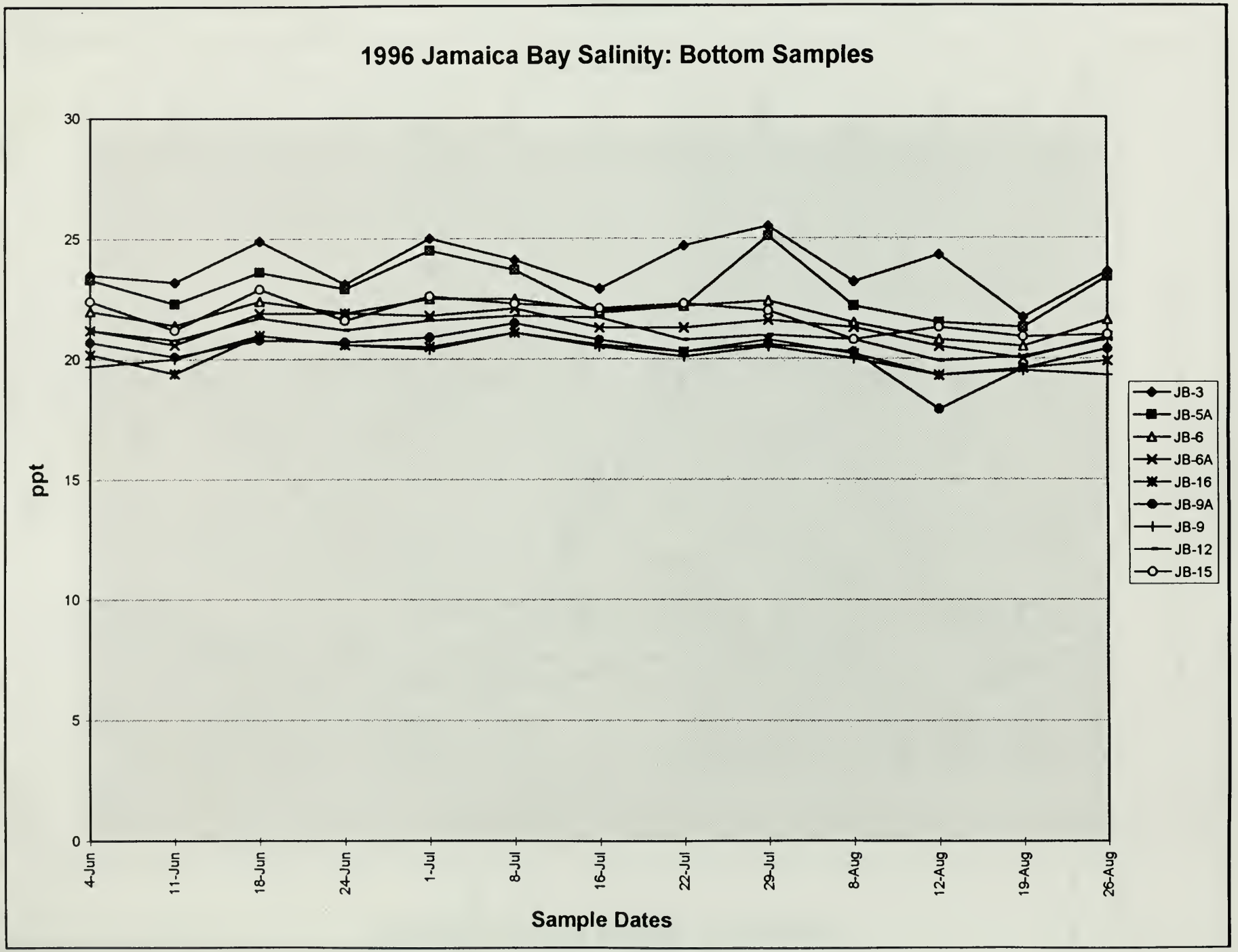
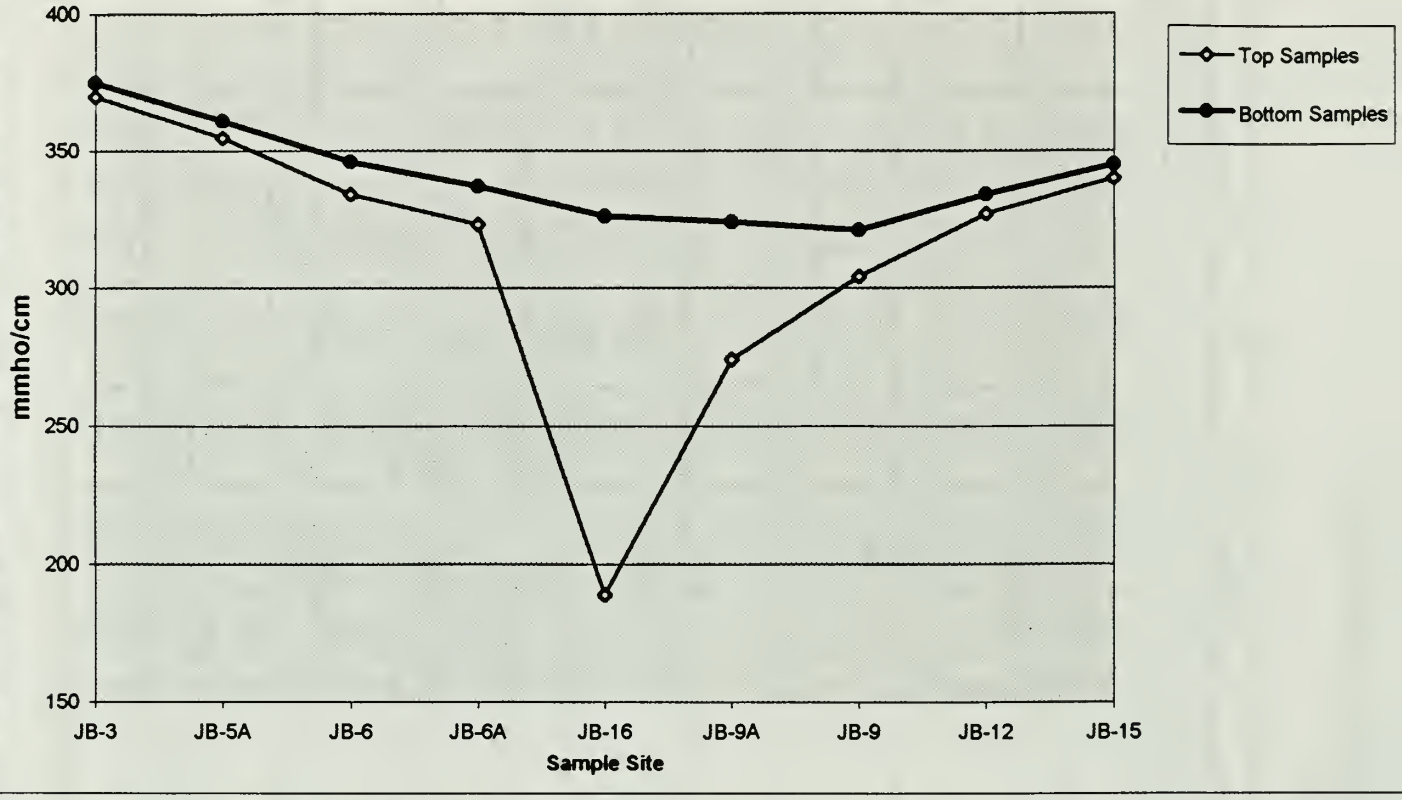

1996 Jamaica Bay Salinity: Bottom Samples
ppt
30
25
20
15
10
5
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Table XXII
Jamaica Bay Conductivity (mmho/cm)
1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	376	365	383	360	390	374	342	389	394	362	365	342	369
		Bottom	374	366	390	364	392	378	361	390	399	365	382	343	371
Nova Scotia Bar	JB-5A	Top	368	351	370	343	373	355	343	332	380	347	363	337	350
		Bottom	368	354	371	361	385	373	345	351	397	351	340	338	367
Canarsie Pier	JB-6	Top	344	306	350	336	353	332	343	335	351	322	308	324	333
		Bottom	351	340	354	346	355	355	347	351	354	341	330	327	342
Pennsylvania Avenue Landfill	JB-6A	Top	306	306	339	338	332	326	313	325	337	316	314	316	326
		Bottom	338	329	347	347	344	348	337	337	342	337	326	318	331
Bergen Basin	JB-16	Top	180	122	195	202	132	161	245	162	270	139	138	275	235
		Bottom	325	313	332	329	325	335	327	322	330	319	306	313	319
Bergen Basin Outflow	JB-9A	Top	327	116	249	232	309	304	308	276	327	216	302	303	297
		Bottom	331	318	330	329	331	340	329	326	327	322	298	313	321
Grassy Bay	JB-9	Top	316	318	331	325	297	329	218	313	325	279	305	310	283
		Bottom	315	319	333	328	325	334	325	320	325	318	309	311	309
JoCo Marsh	JB-12	Top	324	324	340	334	334	340	328	320	334	321	313	315	321
		Bottom	338	330	344	236	341	344	343	331	336	331	317	319	330
Beach Channel	JB-15	Top	343	330	351	337	351	349	348	348	344	331	326	332	331
		Bottom	355	336	361	340	357	352	349	352	348	332	338	332	333

Jamaica Bay Conductivity Averages, 1996



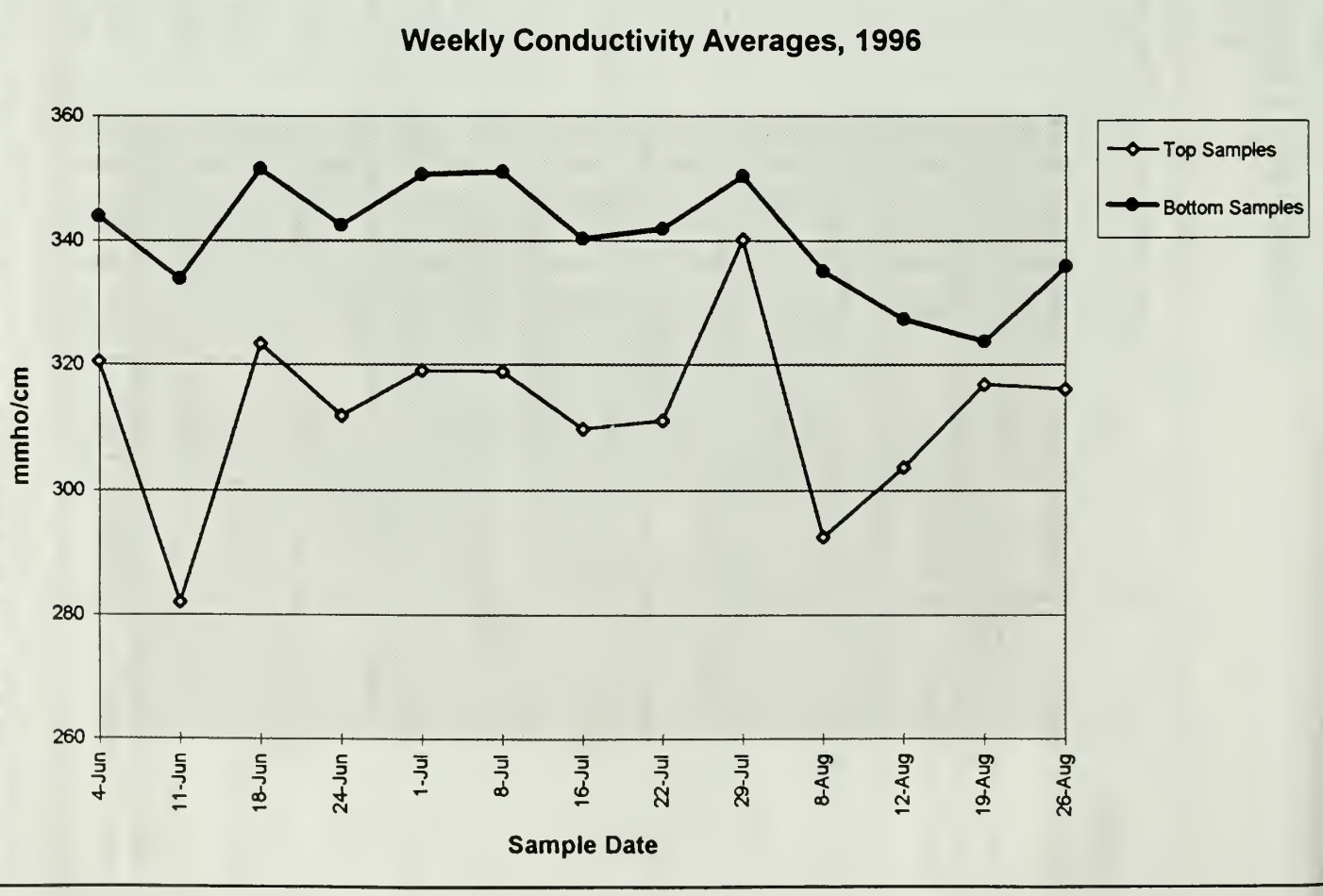


Figure 60

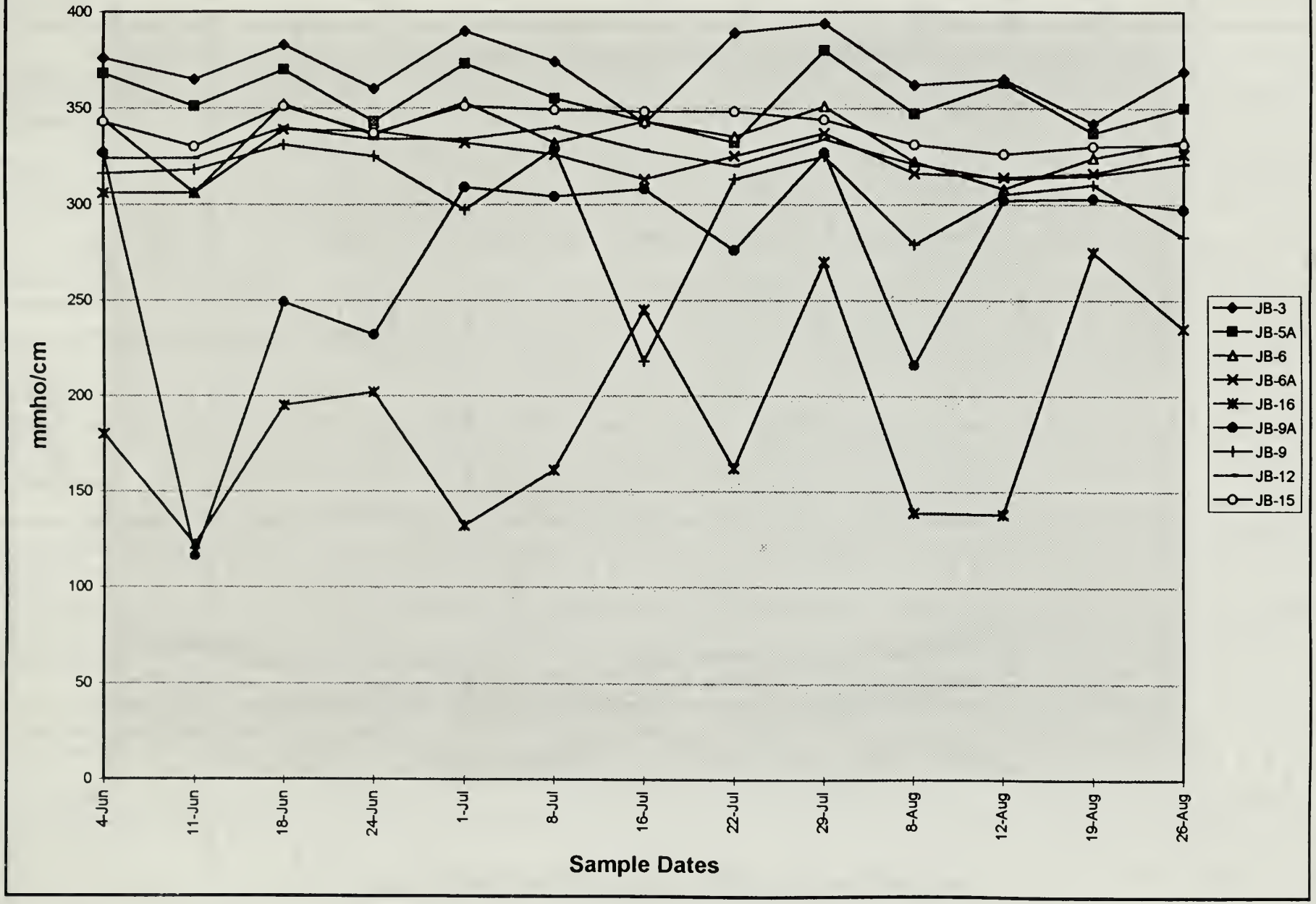

1996 Jamaica Bay Conductivity: Top Samples
mmho/cm
400
350
300
250
200
150
100
50
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 61

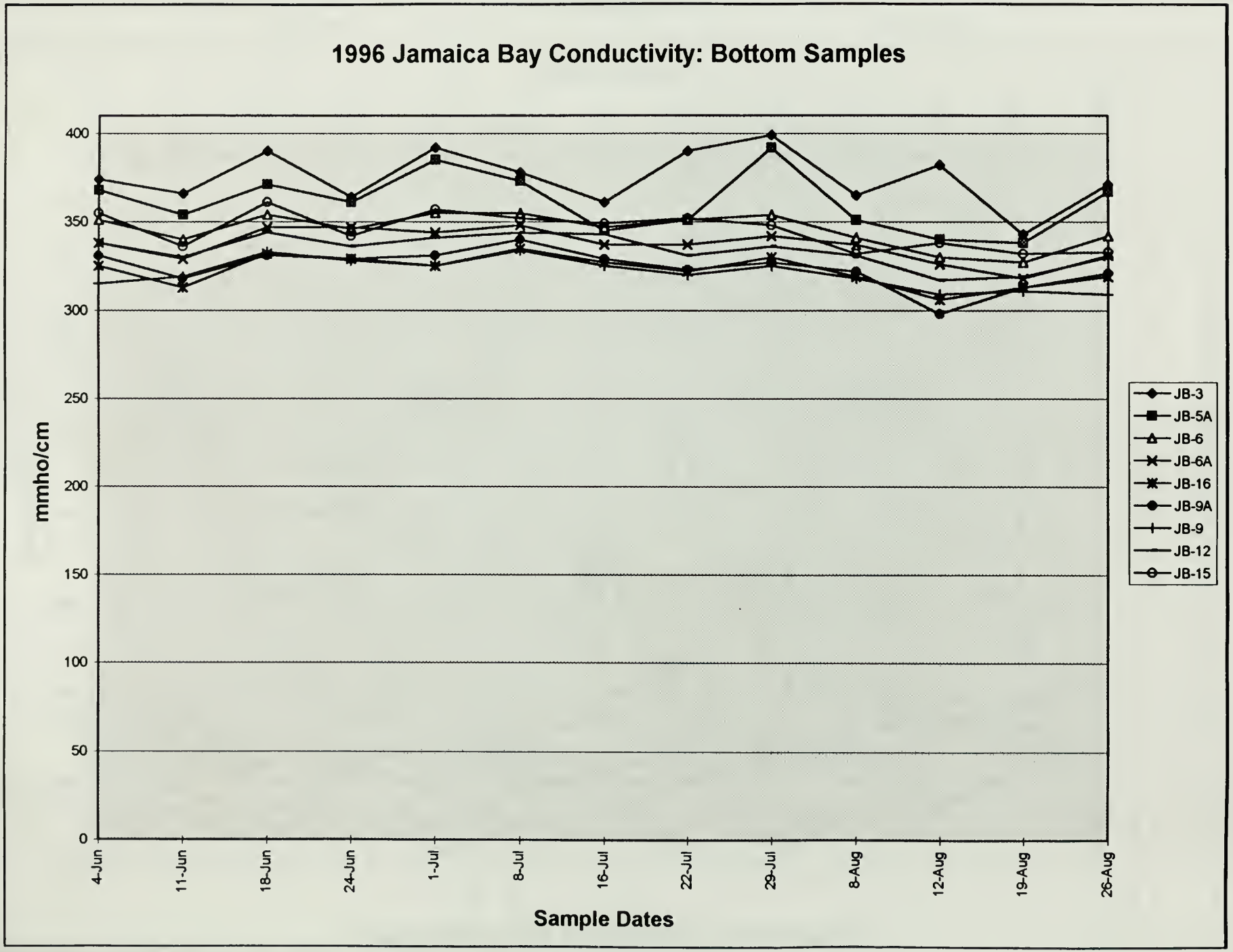
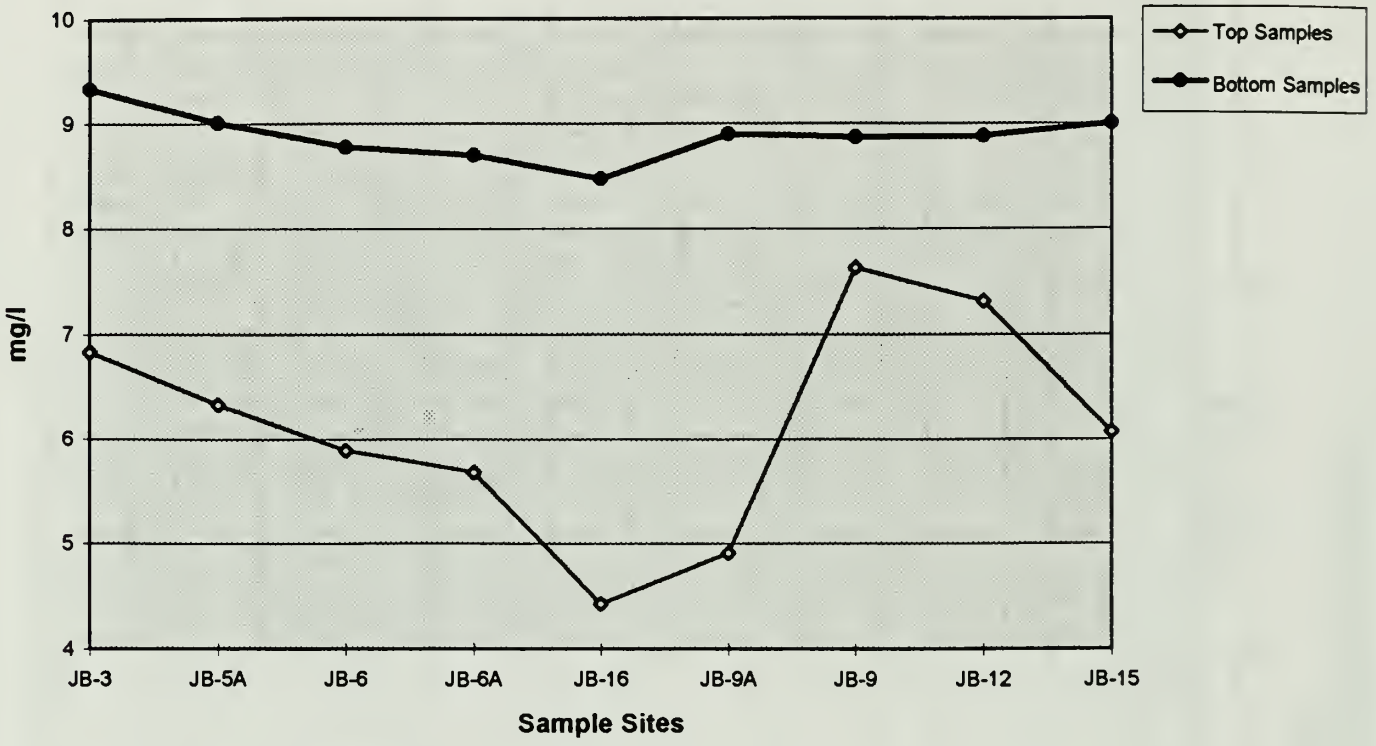

1996 Jamaica Bay Conductivity: Bottom Samples
mmho/cm
400
350
300
250
200
150
100
50
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Table XXIII
Jamaica Bay Dissolved Oxygen (mg/l), 1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	8.06	7.46	7.13	6.33	6.13	4.61	5.25	7.30	5.97	6.22	6.12	8.99	9.17
		Bottom	10.44	10.02	9.68	7.94	9.92	9.86	9.71	11.21	9.50	8.52	9.22	9.02	6.26
Nova Scotia Bar	JB-5A	Top	7.54	6.36	8.01	7.80	5.09	4.23	4.21	5.15	5.61	8.09	6.20	8.50	5.55
		Bottom	10.57	9.60	9.15	9.30	9.75	9.71	7.29	9.34	9.52	8.47	6.95	8.44	9.07
Canarsie Pier	JB-6	Top	6.11	6.76	7.01	4.17	4.06	4.18	3.50	3.84	7.06	8.55	8.32	8.09	4.94
		Bottom	10.44	9.40	8.15	9.11	9.07	8.79	8.33	9.05	8.98	8.18	8.30	8.20	8.11
Pennsylvania Avenue Landfill	JB-6A	Top	5.27	7.57	5.16	3.51	3.48	4.20	2.48	3.38	8.69	9.27	8.13	8.36	4.33
		Bottom	10.48	9.38	8.89	9.16	9.11	8.80	6.35	8.79	8.66	8.50	8.25	8.37	8.42
Bergen Basin	JB-16	Top	3.05	0.67	6.77	0.34	0.88	1.87	2.00	0.95	10.50	5.06	8.46	8.84	8.25
		Bottom	10.27	9.67	8.67	9.19	8.98	8.55	8.74	8.66	8.31	8.66	8.28	8.95	3.30
Bergen Basin Outflow	JB-9A	Top	4.40	1.40	3.57	1.68	2.81	8.53	2.84	4.18	7.89	10.87	7.95	3.35	4.39
		Bottom	9.14	9.64	8.84	9.21	9.01	8.68	8.89	8.79	8.71	8.81	8.60	8.73	8.55
Grassy Bay	JB-9	Top	5.60	6.22	7.97	9.43	5.04	5.48	3.20	4.69	9.73	13.70	7.74	8.62	8.76
		Bottom	10.25	9.17	9.31	8.97	8.97	8.57	8.59	8.54	8.43	8.52	8.65	8.76	8.57
JoCo Marsh	JB-12	Top	5.03	8.33	6.47	12.43	3.66	4.45	5.39	7.50	8.48	12.09	8.22	8.06	8.32
		Bottom	10.34	9.54	9.06	9.06	8.89	8.59	8.49	8.39	8.64	8.83	8.34	8.82	8.48
Beach Channel	JB-15	Top	6.93	4.71	5.80	9.30	3.81	3.67	3.90	9.02	7.27	8.37	7.56	3.39	5.16
		Bottom	10.47	9.15	9.17	8.99	9.28	8.94	9.00	8.99	9.08	8.72	8.92	8.34	7.95

Jamaica Bay Dissolved Oxygen Averages, 1996

Dissolved Oxygen Seasonal Averages by Site, 1996



Weekly Dissolved Oxygen Averages, 1996

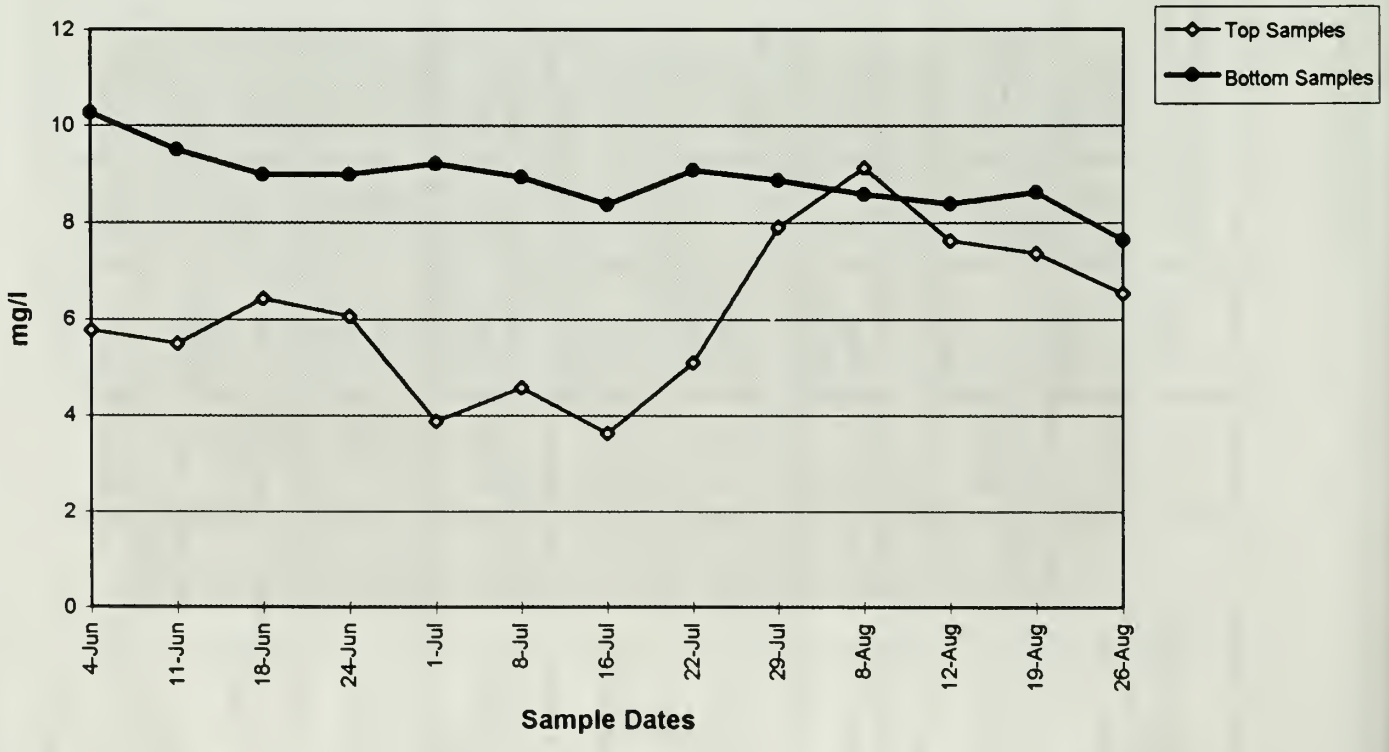


Figure 63

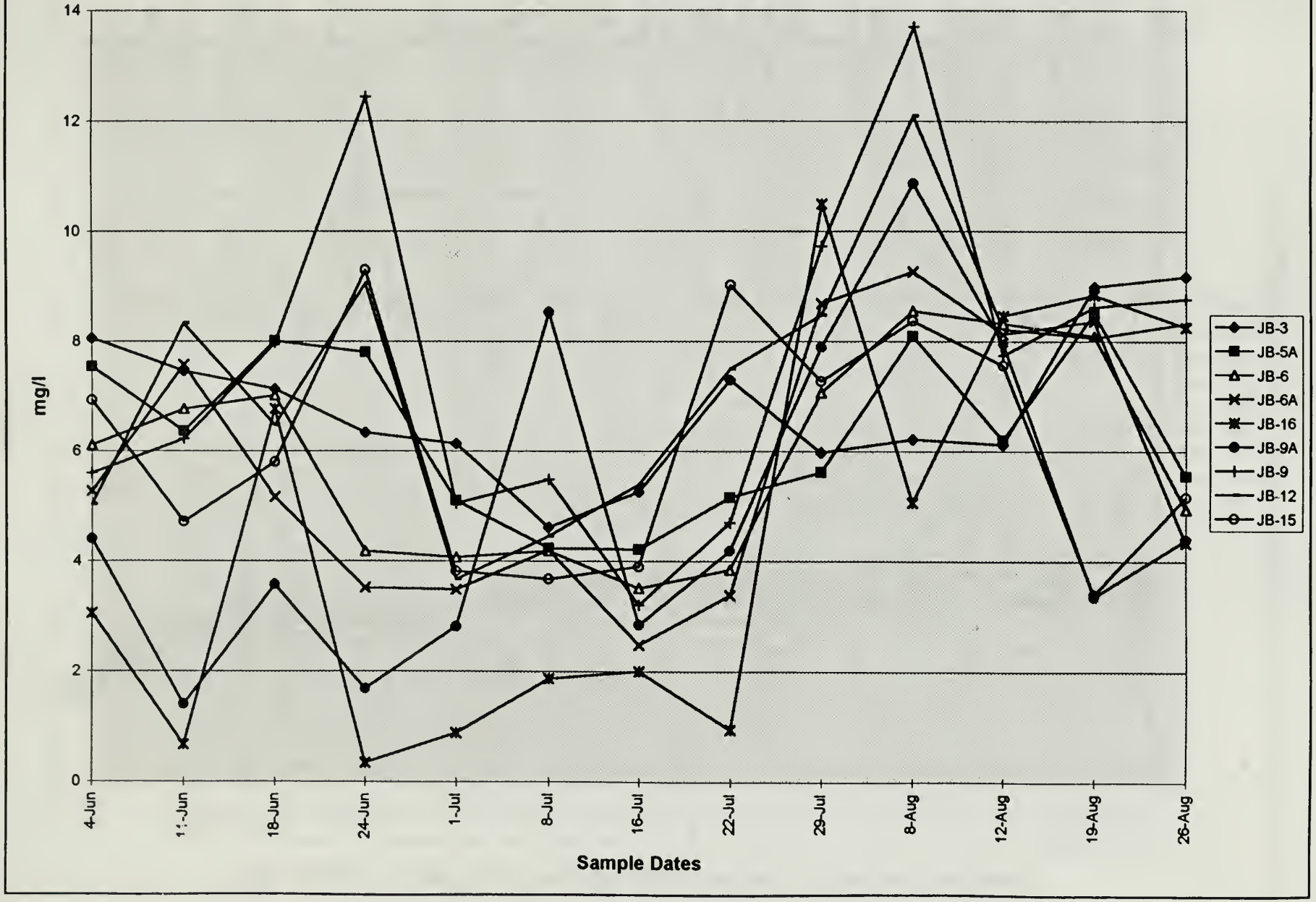

1996 Jamaica Bay Dissolved Oxygen Readings: Top Samples
mg/l
0
2
4
6
8
10
12
14
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 64

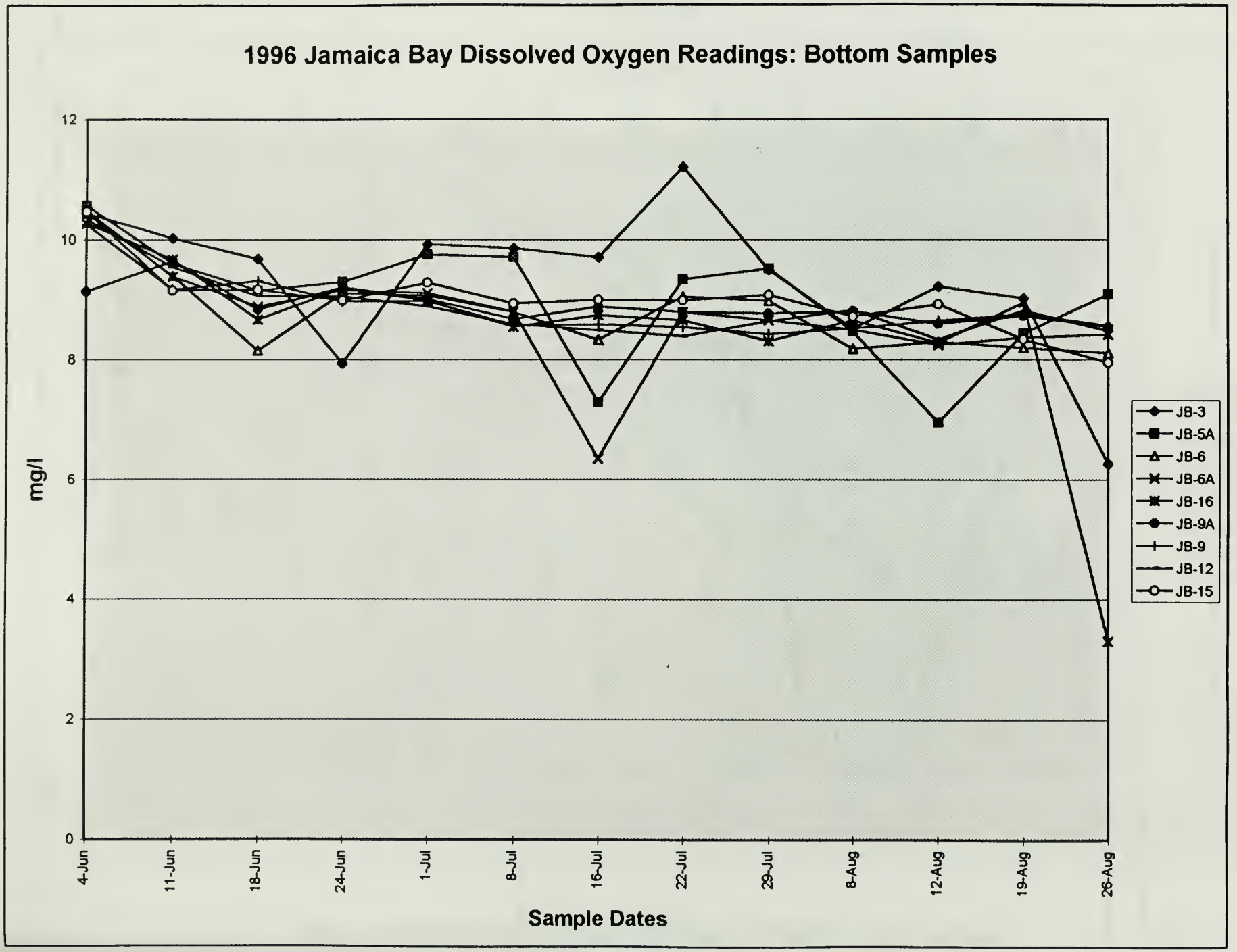
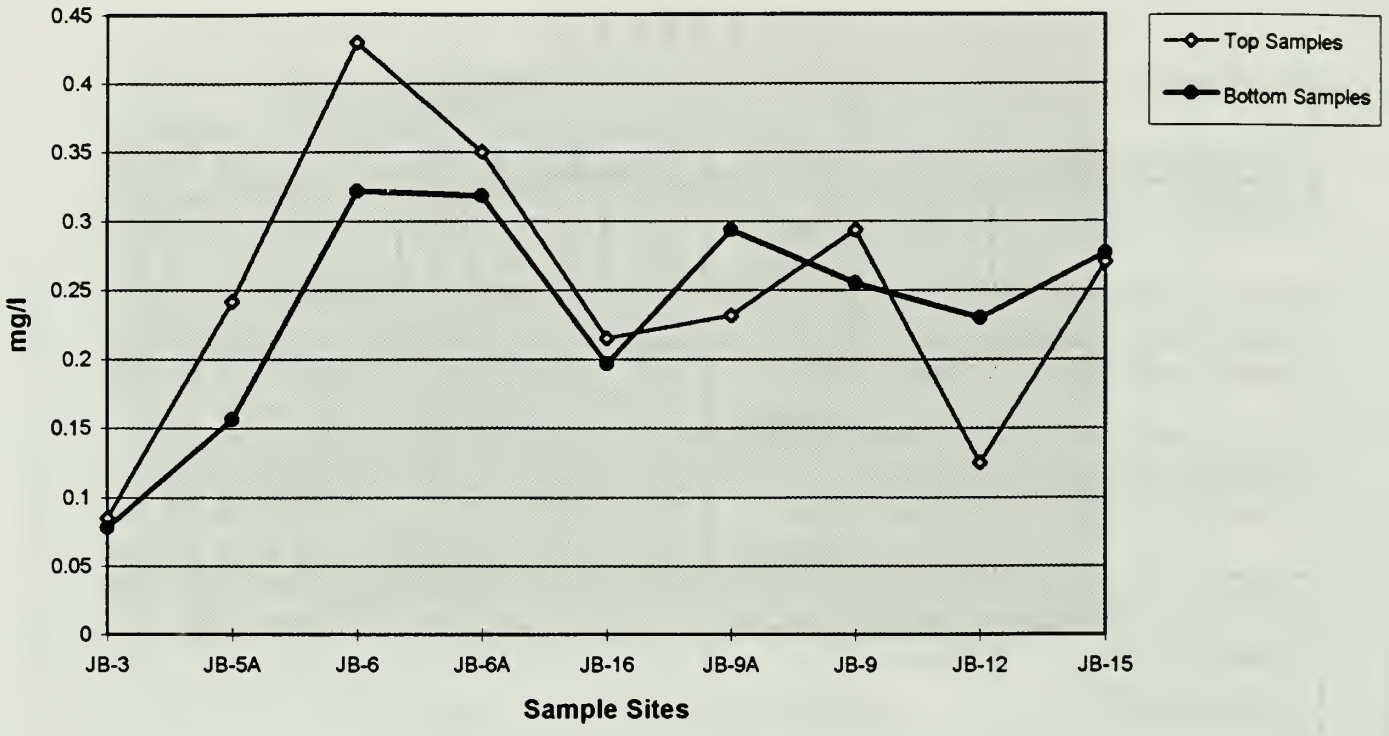

1996 Jamaica Bay Dissolved Oxygen Readings: Bottom Samples
mg/l
12
10
8
6
4
2
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Table XXIV
Jamaica Bay Nitrates (mg/l), 1996

Sample Location	Site	Depth	Sample Dates					
			6/11	6/24	7/08	7/22	8/12	8/26
Rockaway Inlet	JB-3	Top	<0.1	0.15	0.18	0.11	<0.1	0.07
		Bottom	<0.1	0.14	0.16	0.11	<0.1	0.06
Nova Scotia Bar	JB-5A	Top	0.20	0.28	0.37	0.42	<0.1	0.18
		Bottom	0.18	0.14	0.21	0.32	<0.1	0.09
Canarsie Pier	JB-6	Top	0.38	0.33	0.43	0.42	0.68	0.34
		Bottom	0.27	0.32	0.46	0.39	0.22	0.27
Pennsylvania Avenue Landfill	JB-6A	Top	0.27	0.14	0.54	0.40	0.39	0.36
		Bottom	0.33	0.19	0.39	0.36	0.30	0.27
Bergen Basin	JB-16	Top	0.25	<0.1	0.23	0.24	0.27	0.30
		Bottom	<0.1	0.18	0.32	0.38	<0.1	0.30
Bergen Basin Outflow	JB-9A	Top	0.12	<0.1	0.28	0.30	0.36	0.33
		Bottom	0.20	0.23	0.35	0.41	0.36	0.21
Grassy Bay	JB-9	Top	0.25	0.20	0.24	0.30	0.39	0.33
		Bottom	0.25	0.18	0.26	0.26	0.29	0.29
JoCo Marsh	JB-12	Top	<0.1	<0.1	0.26	0.30	<0.1	0.19
		Bottom	0.22	0.19	0.24	0.28	0.18	0.27
Beach Channel	JB-15	Top	0.27	0.27	0.30	0.32	0.16	0.30
		Bottom	0.31	0.26	0.36	0.30	0.14	0.29

Jamaica Bay Nitrate Averages, 1996



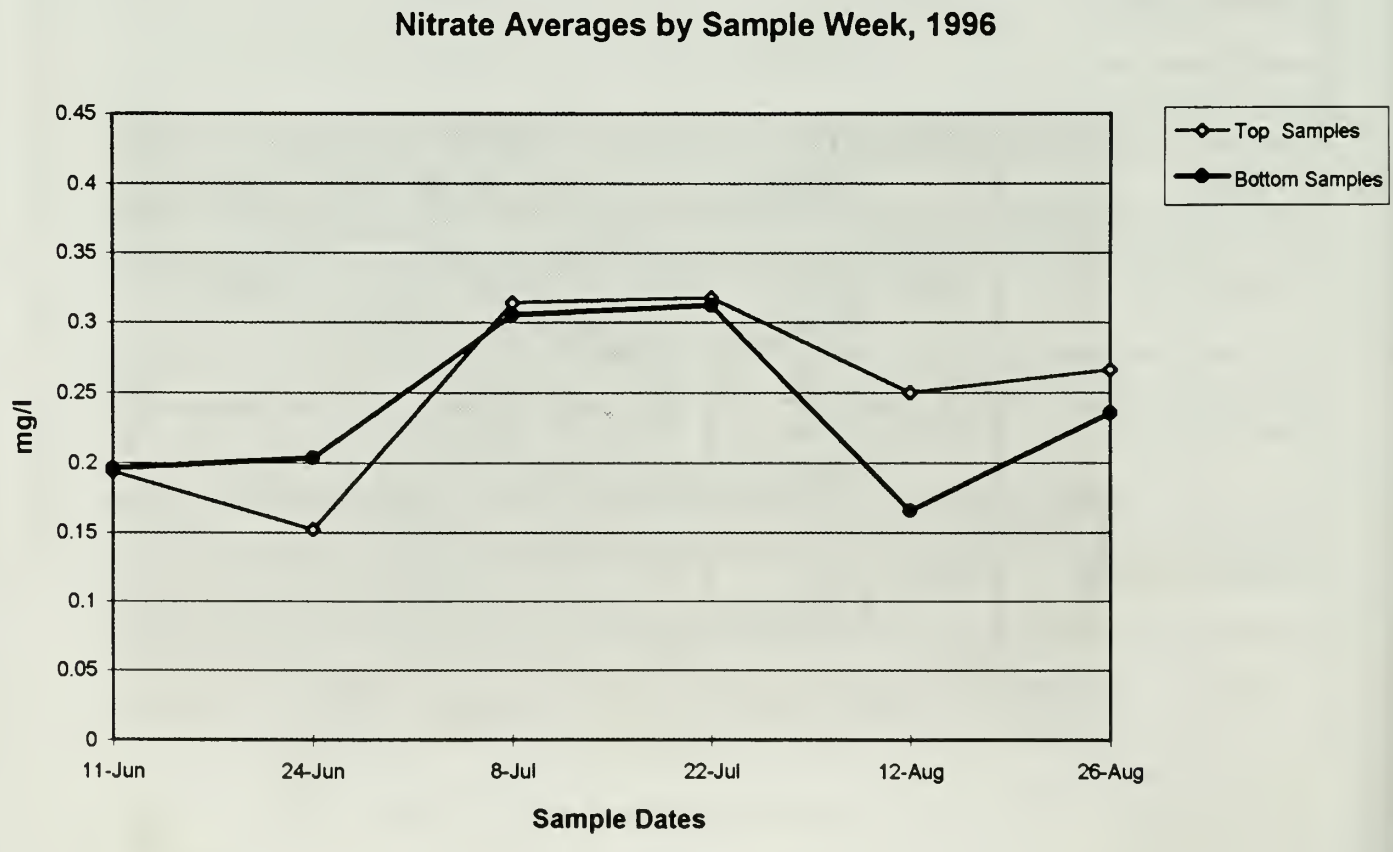


Figure 66

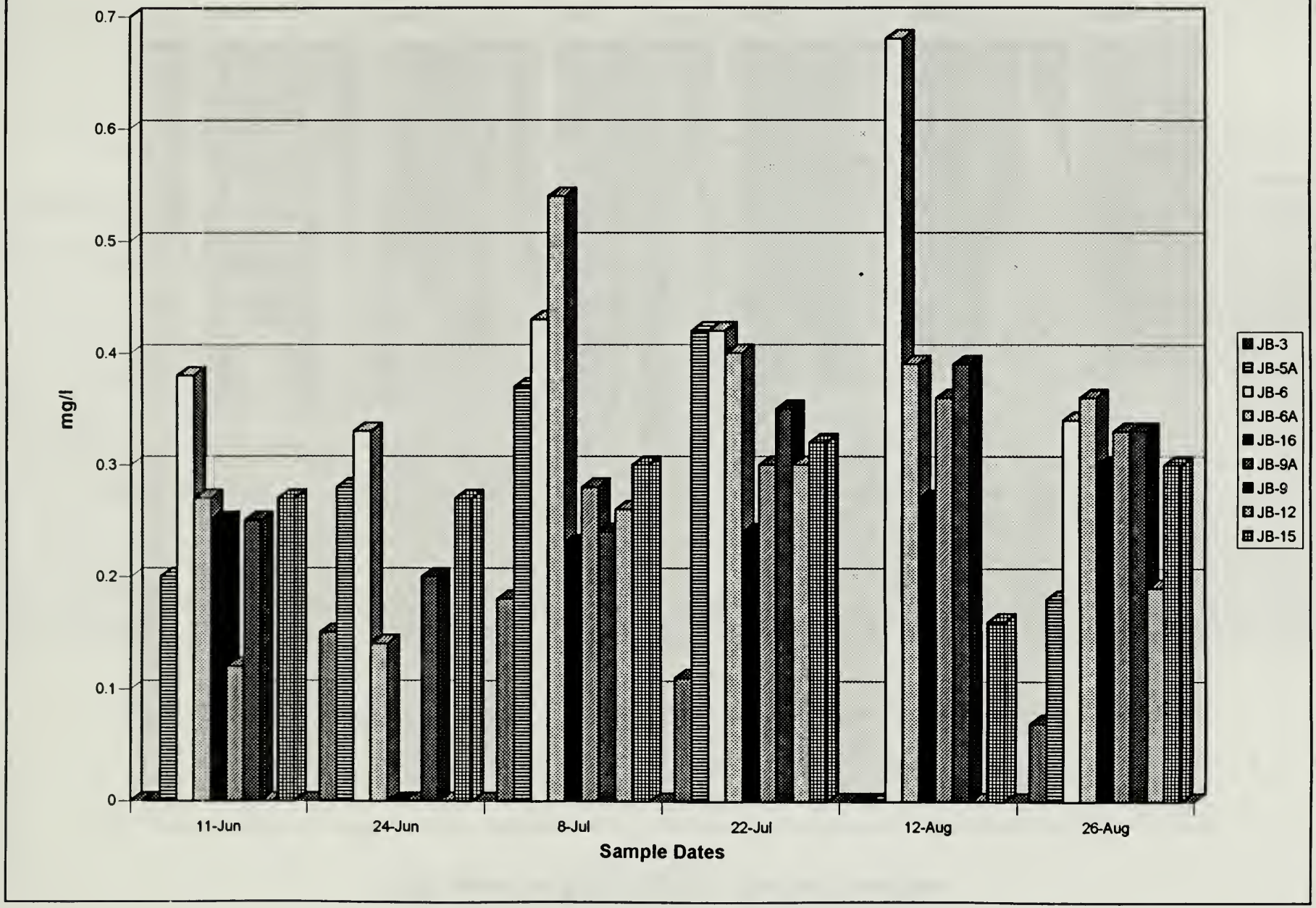

1996 Jamaica Bay Nitrates: Top Samples
mg/l
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11-Jun
24-Jun
8-Jul
22-Jul
12-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 67

1996 Jamaica Bay Nitrates: Bottom Samples

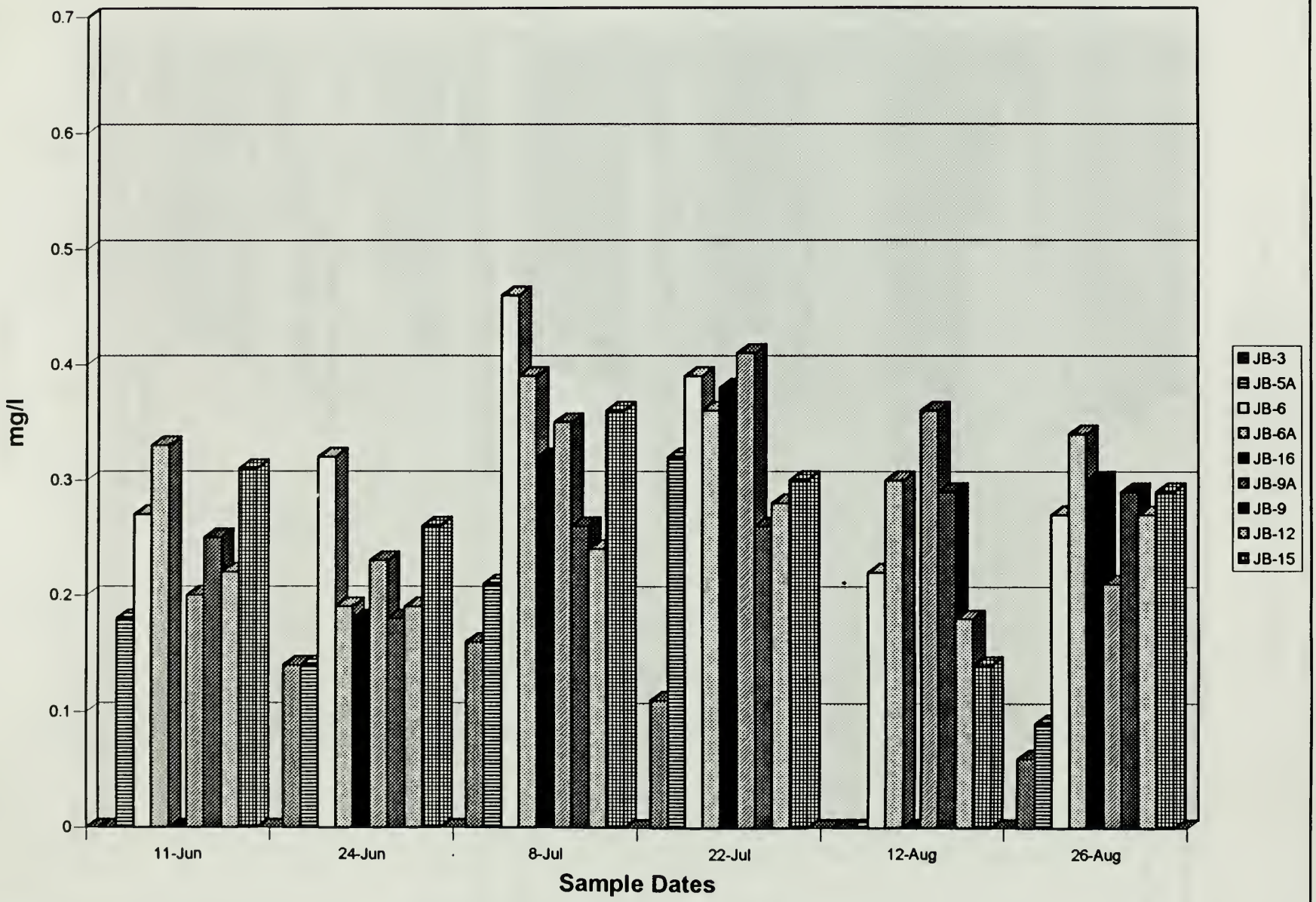
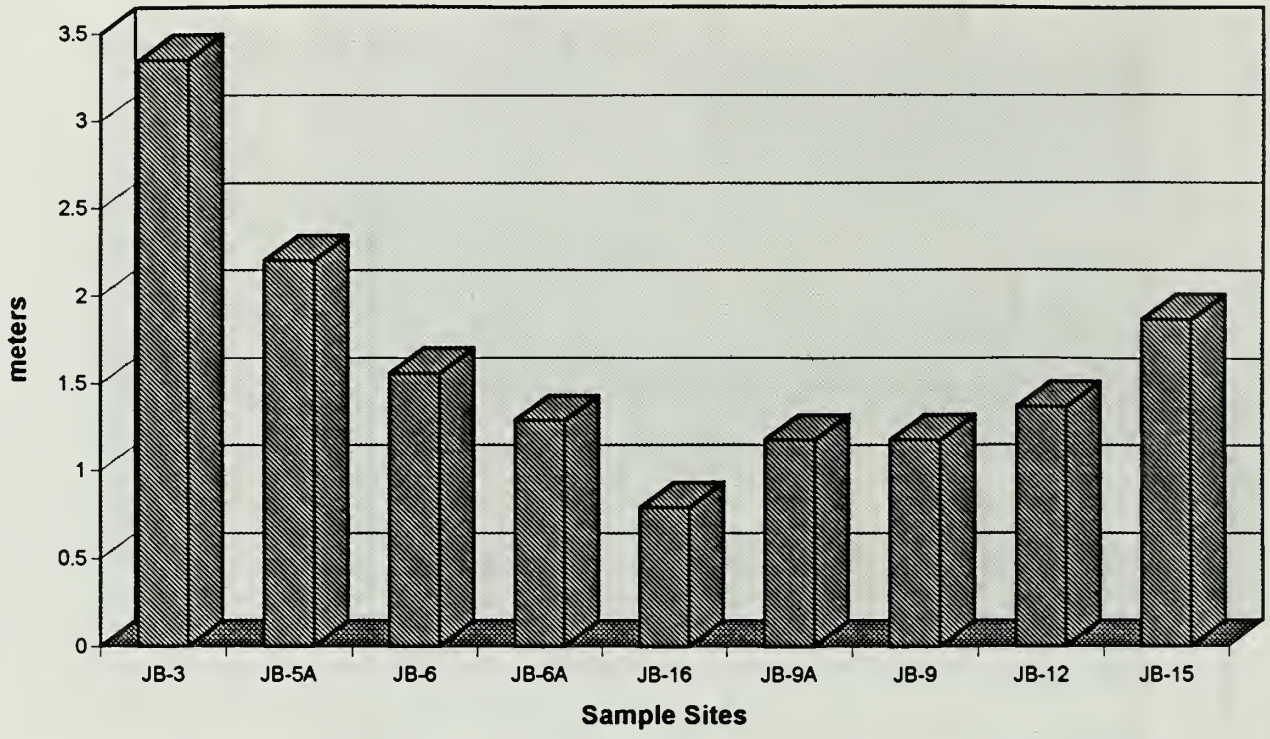


Table XXV
Jamaica Bay Secchi Disk Readings (meters), 1996

Sample Location	Site	Sample Dates												
		6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	6.00	2.75	2.75	1.75	3.75	3.75	2.75	4.50	3.50	3.00	2.75	3.25	3.00
Nova Scotia Bar	JB-5A	2.00	2.00	3.00	1.50	1.85	2.25	2.25	1.50	3.00	1.50	2.25	3.25	2.25
Canarsie Pier	JB-6	1.50	1.00	2.00	1.75	2.00	1.75	1.50	1.75	1.50	0.75	1.25	2.25	1.25
Pennsylvania Avenue Landfill	JB-6A	1.00	0.85	1.75	1.35	1.75	1.50	1.50	1.50	1.00	0.75	1.00	1.75	1.00
Bergen Basin	JB-16	0.75	0.25	0.50	0.25	1.25	0.50	1.00	1.00	0.75	0.75	1.00	1.50	0.75
Bergen Basin Outflow	JB-9A	1.75	0.50	1.00	0.50	1.50	1.25	1.50	1.25	1.00	0.75	1.00	2.00	1.00
Grassy Bay	JB-9	1.50	2.00	0.25	0.75	1.75	1.50	1.50	1.50	0.50	0.75	1.25	1.00	1.00
JoCo Marsh	JB-12	1.50	0.75	1.50	0.75	1.50	2.00	1.75	1.00	1.50	1.00	1.25	2.25	1.00
Beach Channel	JB-15	2.00	2.25	2.25	1.25	2.0	2.25	2.75	1.75	1.75	1.00	1.25	2.50	1.25

Jamaica Bay Secchi Disk Averages, 1996

Secchi Disk Seasonal Averages by Site, 1996



Weekly Secchi Disk Averages, 1996

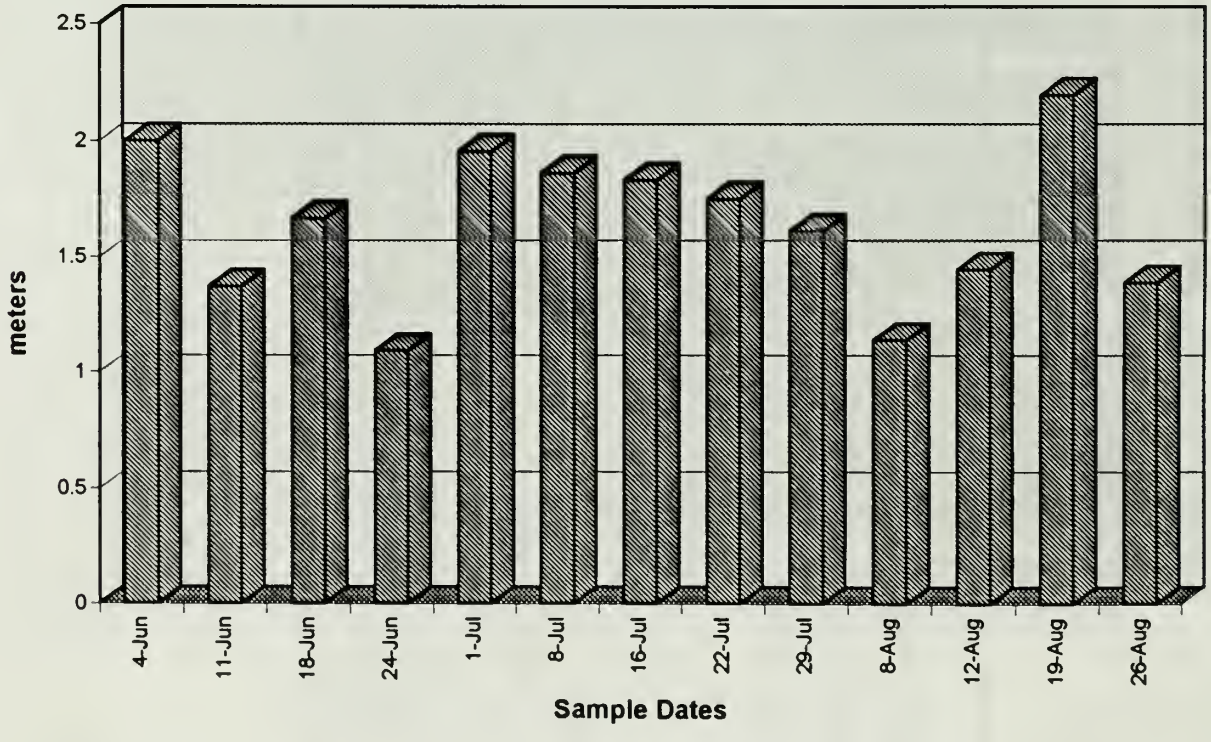


Figure 69

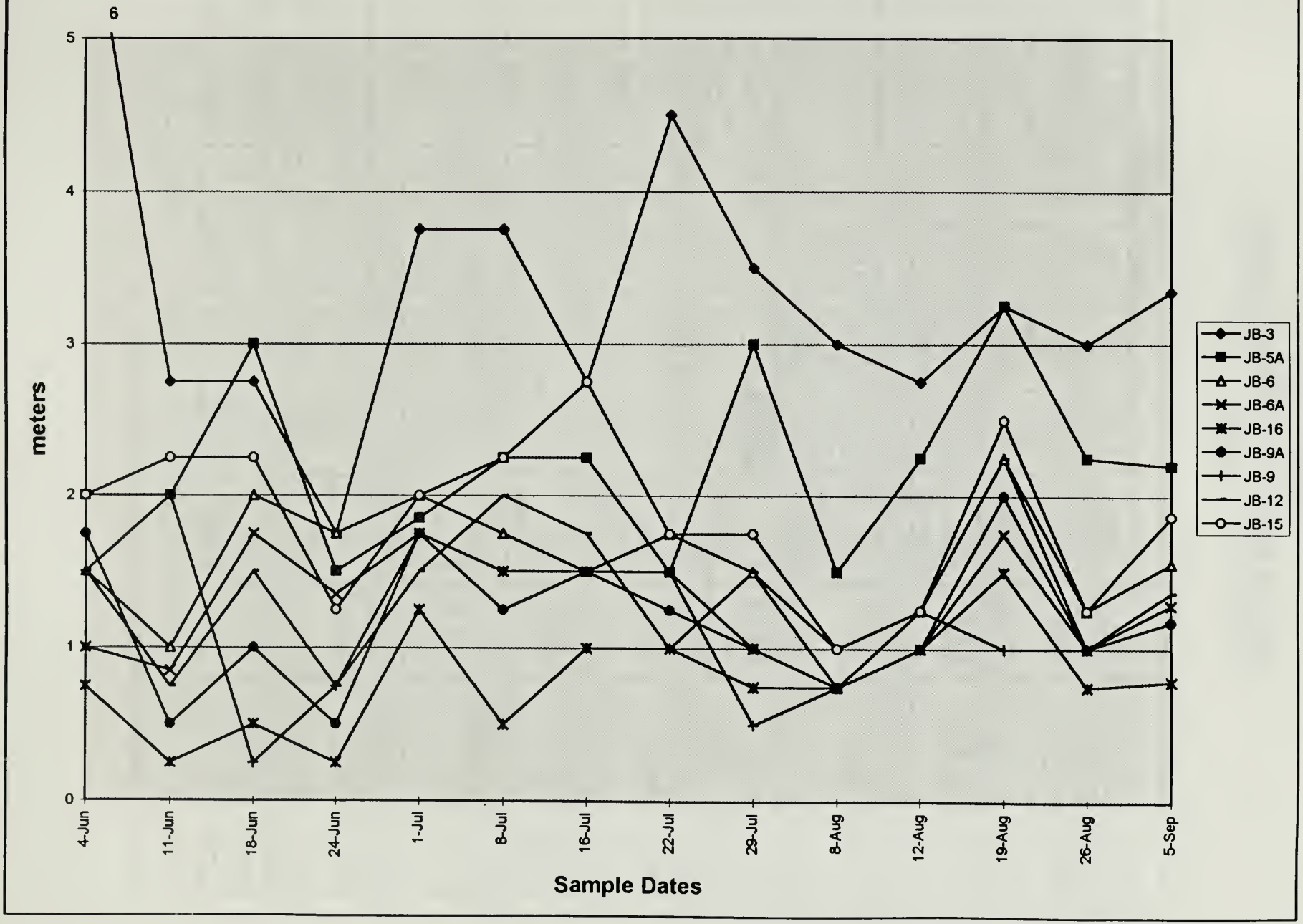

1996 Jamaica Bay Secchi Disk Readings
6
5
4
3
2
1
0
meters
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
5-Sep
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 70

Table XXVI
Jamaica Bay Total Chlorine (mg/l), 1996

Sample Location	Site	Depth	Sample Dates					
			6/11	6/24	7/08	7/22	8/12	8/26
Rockaway Inlet	JB-3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nova Scotia Bar	JB-5A	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Canarsie Pier	JB-6	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pennsylvania Avenue Landfill	JB-6A	Top	0.08	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bergen Basin	JB-16	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bergen Basin Outflow	JB-9A	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Grassy Bay	JB-9	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
JoCo Marsh	JB-12	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Beach Channel	JB-15	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Black cell indicates only sample that exceed minimum detection limit.

Table XXVII
Jamaica Bay Free Chlorine (mg/l), 1996

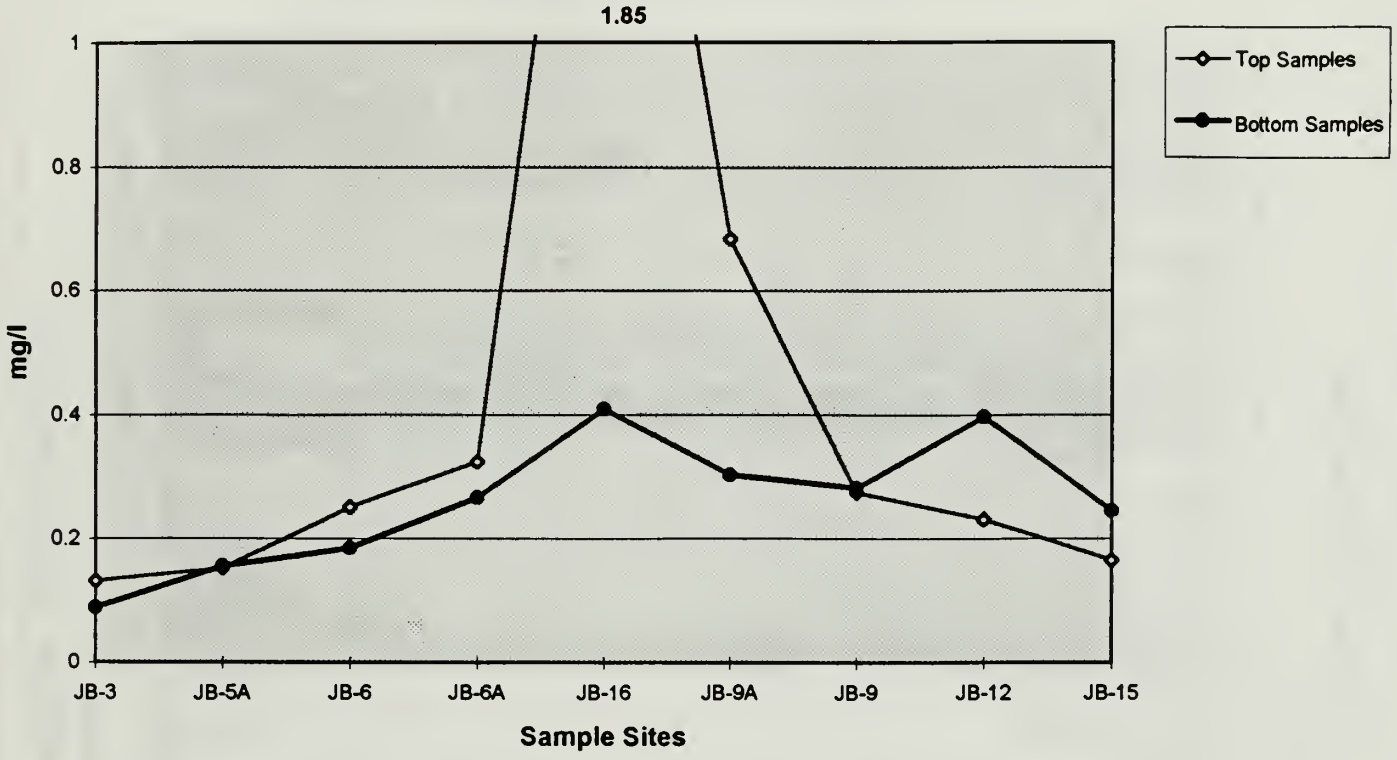
Sample Location	Site	Depth	Sample Dates					
			6/11	6/24	7/08	7/22	8/12	8/26
Rockaway Inlet	JB-3	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nova Scotia Bar	JB-5A	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Canarsie Pier	JB-6	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pennsylvania Avenue Landfill	JB-6A	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bergen Basin	JB-16	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bergen Basin Outflow	JB-9A	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Grassy Bay	JB-9	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
JoCo Marsh	JB-12	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Beach Channel	JB-15	Top	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
		Bottom	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Table XXVIII
Jamaica Bay Orthophosphates (mg/l), 1996

Sample Location	Site	Depth	Sample Dates					
			6/11	6/24	7/08	7/22	8/12	8/26
Rockaway Inlet	JB-3	Top	0.39	0.12	0.15	0.05	0.04	0.04
		Bottom	0.05	0.20	0.13	0.06	0.05	0.04
Nova Scotia Bar	JB-5A	Top	0.05	0.22	0.29	0.20	0.05	0.10
		Bottom	0.10	0.28	0.23	0.17	0.05	0.10
Canarsie Pier	JB-6	Top	0.23	0.24	0.16	0.21	0.43	0.23
		Bottom	0.09	0.43	0.10	0.15	0.16	0.18
Pennsylvania Avenue Landfill	JB-6A	Top	0.48	0.28	0.51	0.29	0.14	0.24
		Bottom	0.44	0.20	0.47	0.19	0.10	0.19
Bergen Basin	JB-16	Top	1.60	1.30	2.40	2.30	2.40	1.10
		Bottom	0.70	0.40	0.20	0.34	0.34	0.47
Bergen Basin Outflow	JB-9A	Top	1.40	1.00	0.45	0.58	0.18	0.50
		Bottom	0.40	0.30	0.12	0.47	0.15	0.37
Grassy Bay	JB-9	Top	0.35	0.19	0.10	0.35	0.10	0.60
		Bottom	0.12	0.50	0.10	0.39	0.23	0.34
JoCo Marsh	JB-12	Top	0.06	0.10	0.75	0.12	0.05	0.30
		Bottom	0.07	0.12	0.75	0.30	0.80	0.34
Beach Channel	JB-15	Top	<0.02	0.10	0.08	0.24	0.40	0.17
		Bottom	0.31	0.13	0.30	0.25	0.30	0.17

Jamaica Bay Orthophosphate Averages, 1996

Orthophosphate Seasonal Averages by Site, 1996



Orthophosphate Averages by Sample Week, 1996

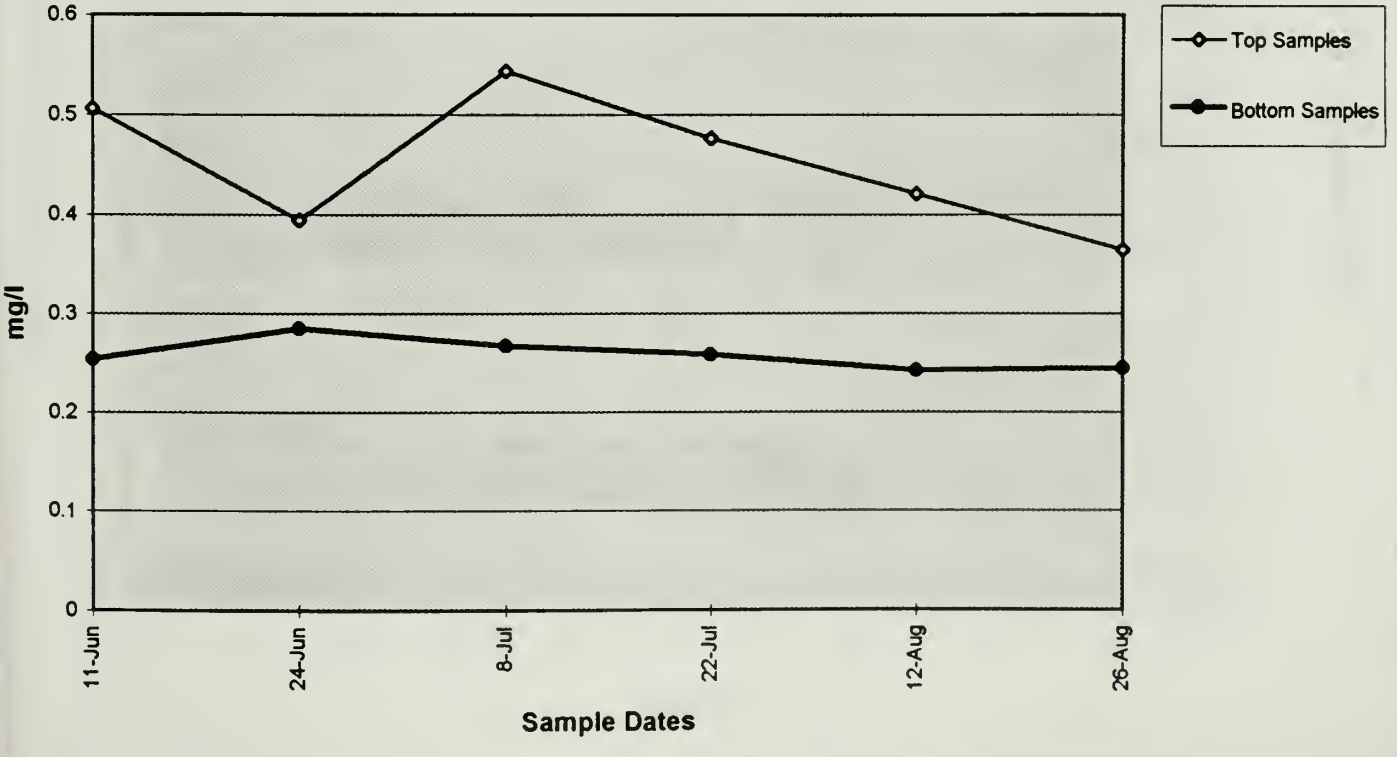
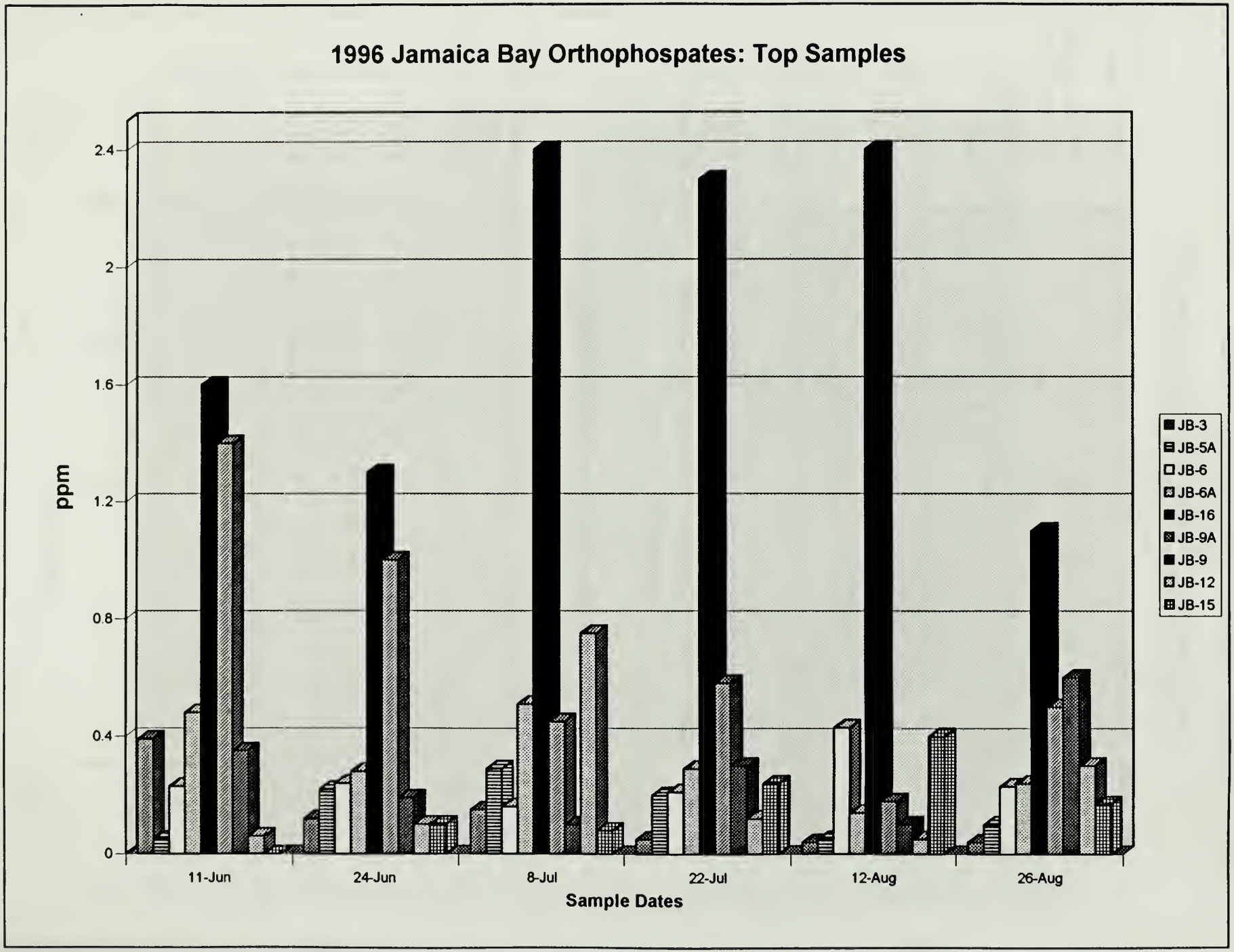


Figure 71


1996 Jamaica Bay Orthophospates: Top Samples
ppm
2.4
2
1.6
1.2
0.8
0.4
0
11-Jun
24-Jun
8-Jul
22-Jul
12-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

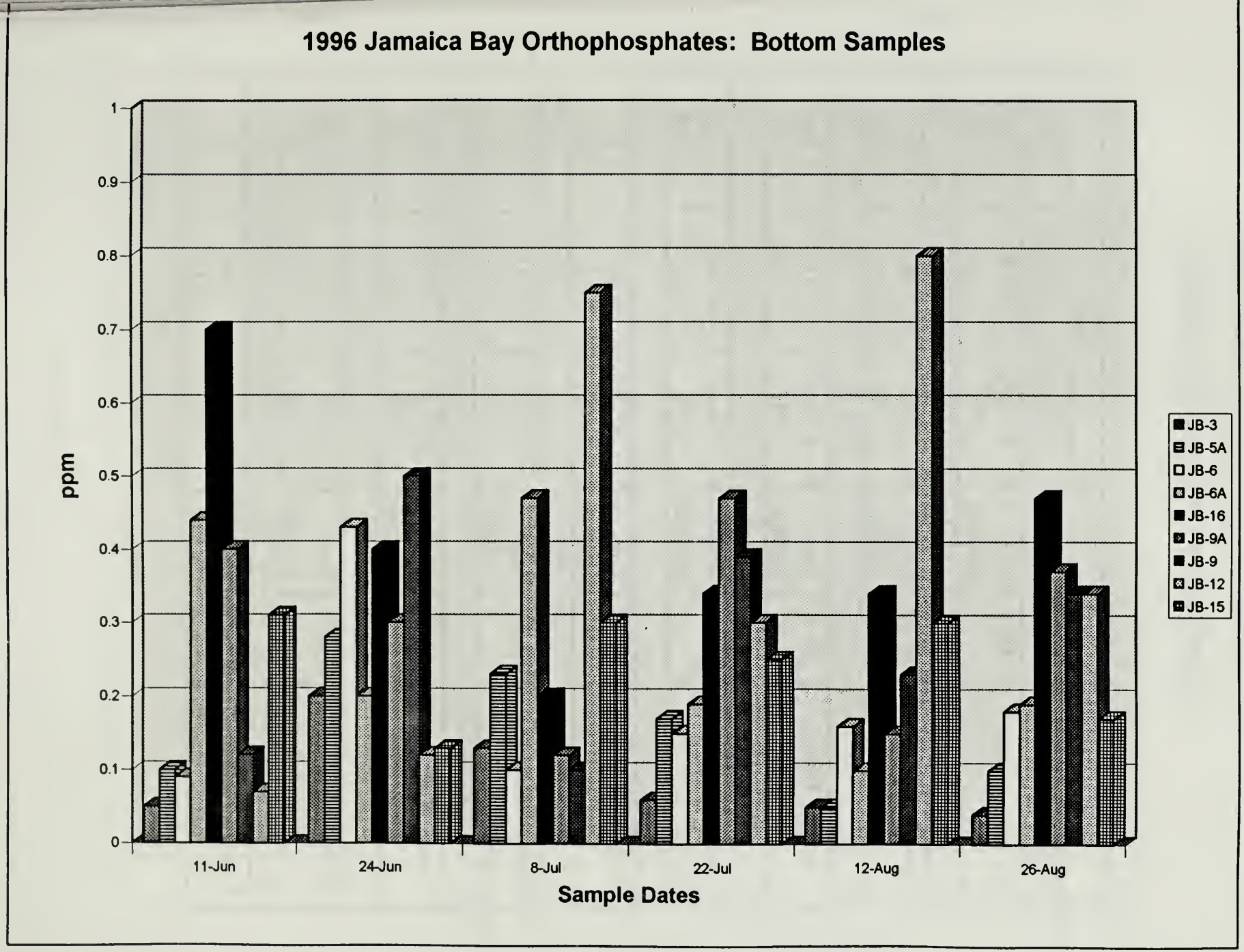
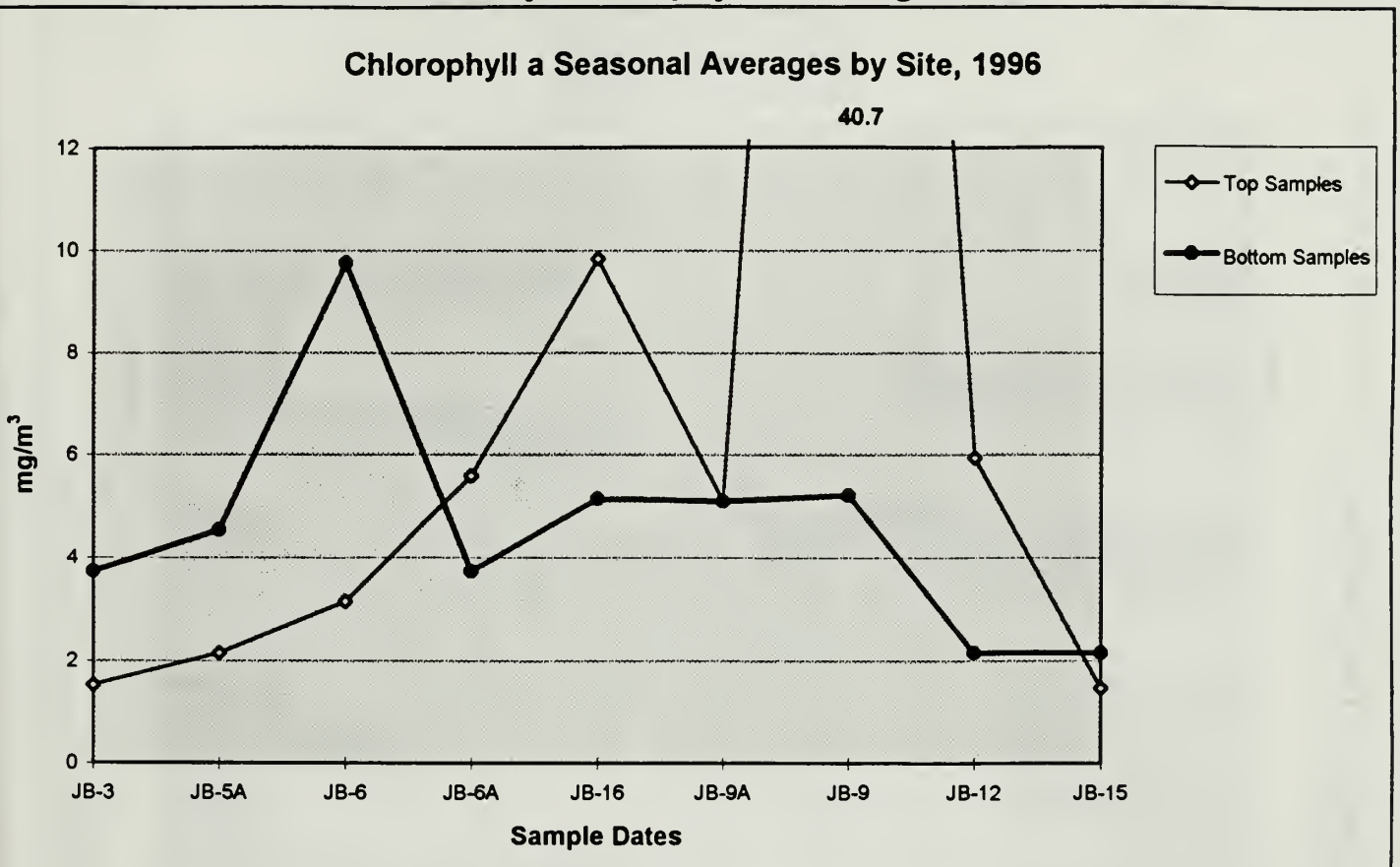

1996 Jamaica Bay Orthophosphates: Bottom Samples
ppm
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11-Jun
24-Jun
8-Jul
22-Jul
12-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 73

Table XXIX
Jamaica Bay Chlorophyll a (mg/l), 1996

Sample Location	Site	Depth	Sample Dates		
			6/18	7/16	8/12
Rockaway Inlet	JB-3	Top	2.370	2.046	0.160
		Bottom	2.370	4.092	4.740
Nova Scotia Bar	JB-5A	Top	2.370	2.046	2.062
		Bottom	2.370	2.370	8.848
Canarsie Pier	JB-6	Top	4.724	4.416	0.308
		Bottom	13.89	6.138	9.240
Pennsylvania Avenue Landfill	JB-6A	Top	4.416	4.108	8.232
		Bottom	4.416	6.462	0.308
Bergen Basin	JB-16	Top	18.33	8.832	2.370
		Bottom	4.400	4.416	6.600
Bergen Basin Outflow	JB-9A	Top	10.89	2.046	2.370
		Bottom	12.92	2.354	0
Grassy Bay	JB-9	Top	112.4	1.738	7.924
		Bottom	8.863	4.416	2.354
JoCo Marsh	JB-12	Top	13.25	4.416	0.160
		Bottom	2.062	4.416	0
Beach Channel	JB-15	Top	2.046	2.354	0
		Bottom	2.046	4.416	0

Jamaica Bay Chlorophyll a Averages, 1996



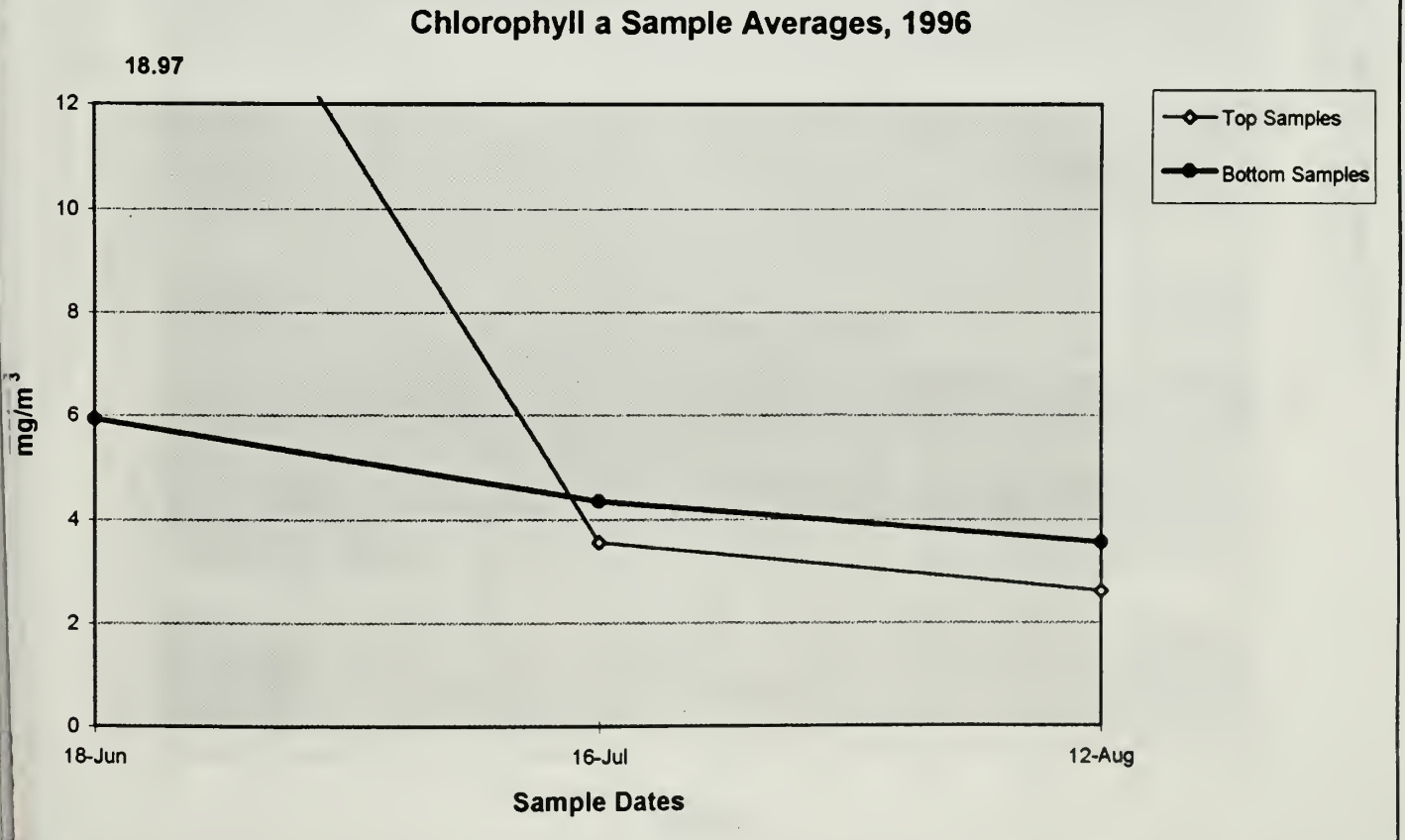
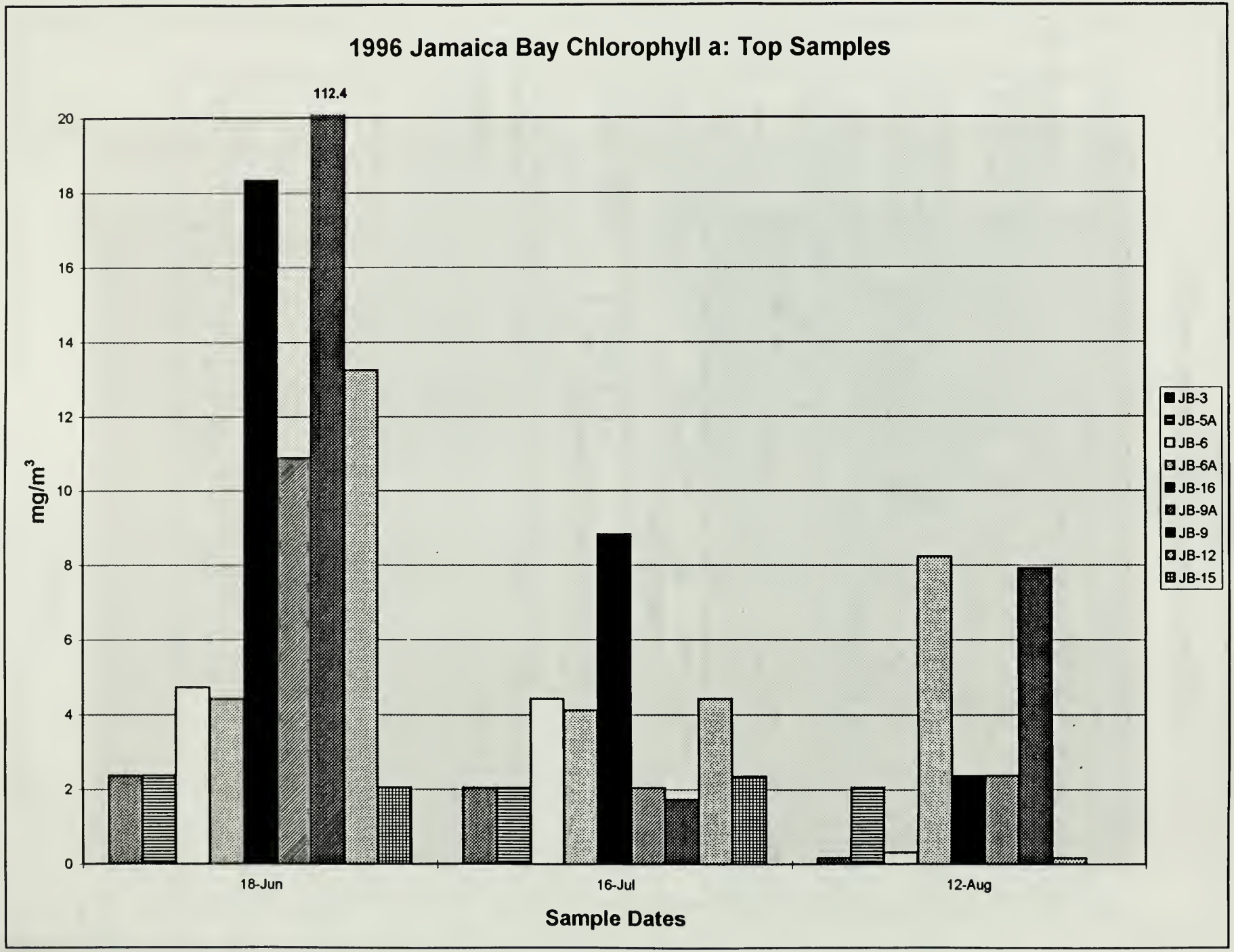


Figure 74


1996 Jamaica Bay Chlorophyll a: Top Samples
112.4
20
18
16
14
12
10
8
6
4
2
0
mg/m3
18-Jun
16-Jul
12-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

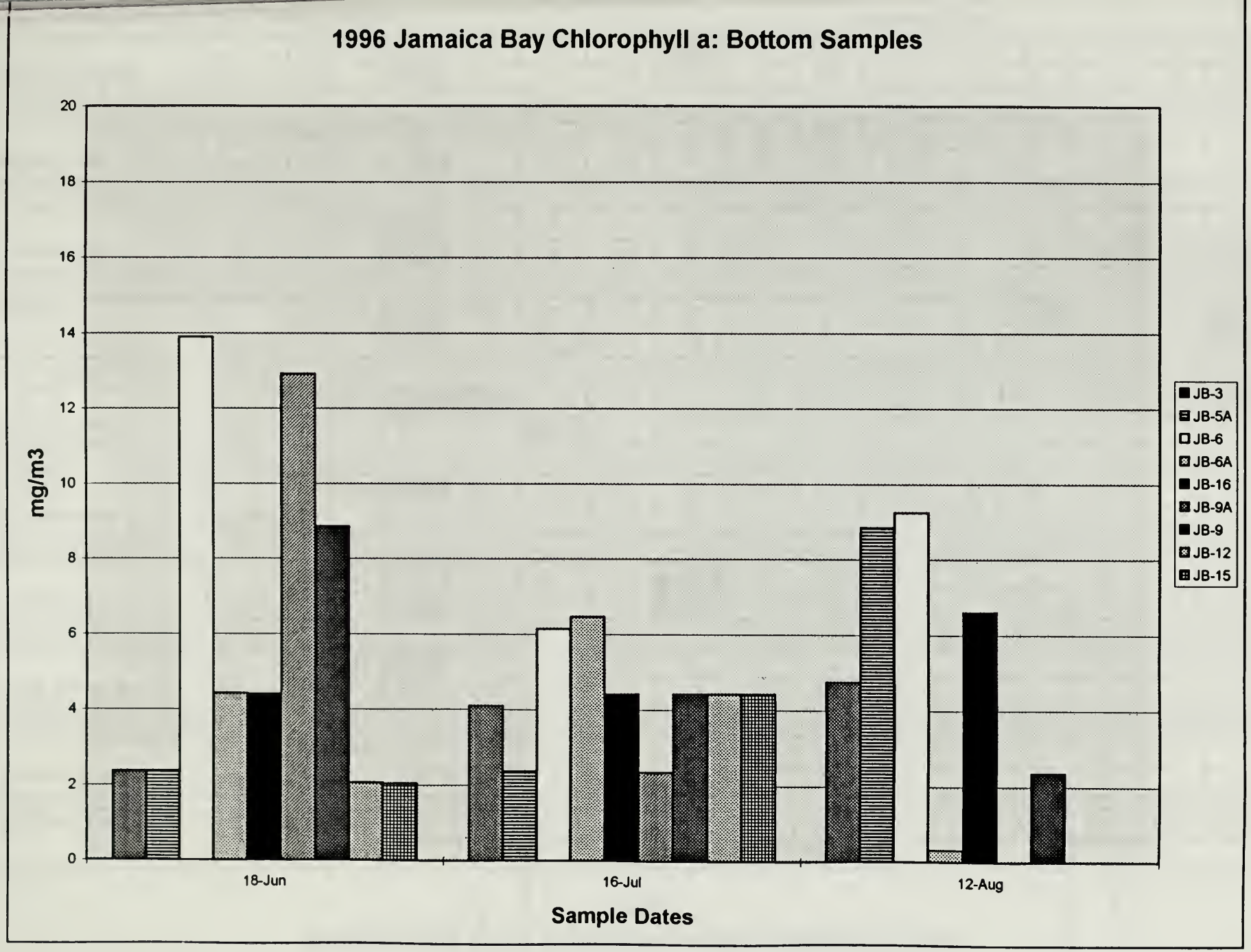

1996 Jamaica Bay Chlorophyll a: Bottom Samples
mg/m3
20
18
16
14
12
10
8
6
4
2
0
18-Jun
16-Jul
12-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 76

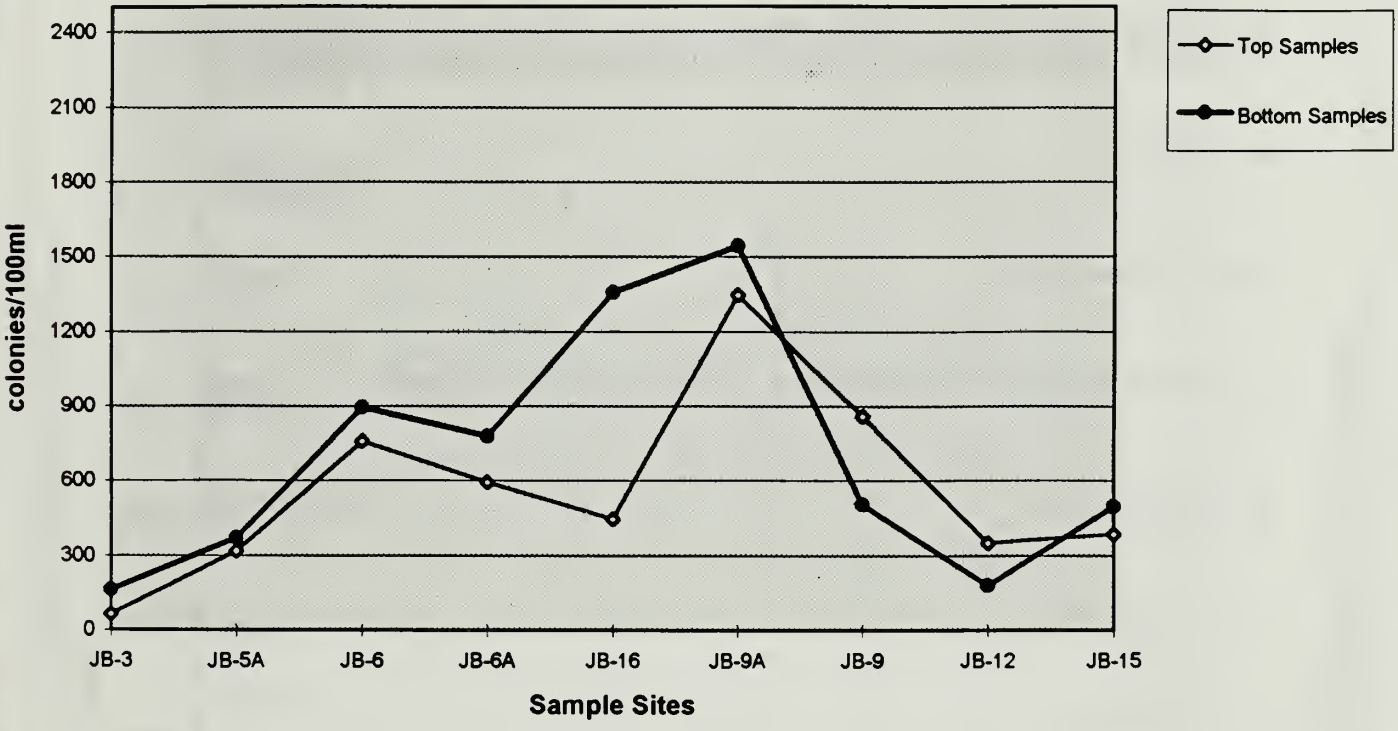
Table XXX
Jamaica Bay Total Coliform Counts (colonies/100ml), 1996

Sample Location	Site	Depth	Sample Dates											
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	638	29	0	0	0	0	87	29	0	0	0	0	29
		Bottom	609	145	261	116	174	145	377	116	116	0	29	29	0
Nova Scotia Bar	JB-5A	Top	3000	0	29	290	174	58	377	58	0	58	0	0	87
		Bottom	**2610**	261	87	29	609	87	493	435	87	0	29	29	58
Canarsie Pier	JB-6	Top	**2717**	203	29	841	**3450**	609	1015	580	0	29	29	0	348
		Bottom	**5683**	58	29	377	**2717**	348	2050	58	29	0	29	29	232
Pennsylvania Avenue Landfill	JB-6A	Top	290	1050	551	1875	174	1150	0	290	174	203	203	870	899
		Bottom	**6467**	145	319	261	696	174	319	319	29	58	29	754	551
Bergen Basin	JB-16	Top	319	87	**5000**	0	0	0	0	0	0	145	0	232	29
		Bottom	**4383**	**3306**	1500	783	87	667	116	377	986	174	1247	638	**3367**
Bergen Basin Outflow	JB-9A	Top	**3450**	0	**4200**	0	29	580	0	0	899	406	551	1189	**6183**
		Bottom	**4400**	1200	1625	580	870	232	0	957	580	**5167**	493	899	**3075**
Grassy Bay	JB-9	Top	**3200**	58	0	116	0	203	0	87	0	232	290	493	**6483**
		Bottom	**2325**	58	0	87	1189	116	232	58	116	116	29	87	2150
JoCo Marsh	JB-12	Top	**3167**	0	0	58	145	0	754	87	29	0	29	0	290
		Bottom	522	116	0	29	377	29	812	0	116	0	0	0	348
Beach Channel	JB-15	Top	**3150**	29	29	116	899	0	406	29	29	58	58	58	145
		Bottom	2100	116	87	0	**2675**	87	1131	29	29	29	58	29	87

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits)

Jamaica Bay Total Coliform Averages, 1996

Total Coliform Seasonal Averages by Site, 1996



Weekly Total Coliform Averages, 1996

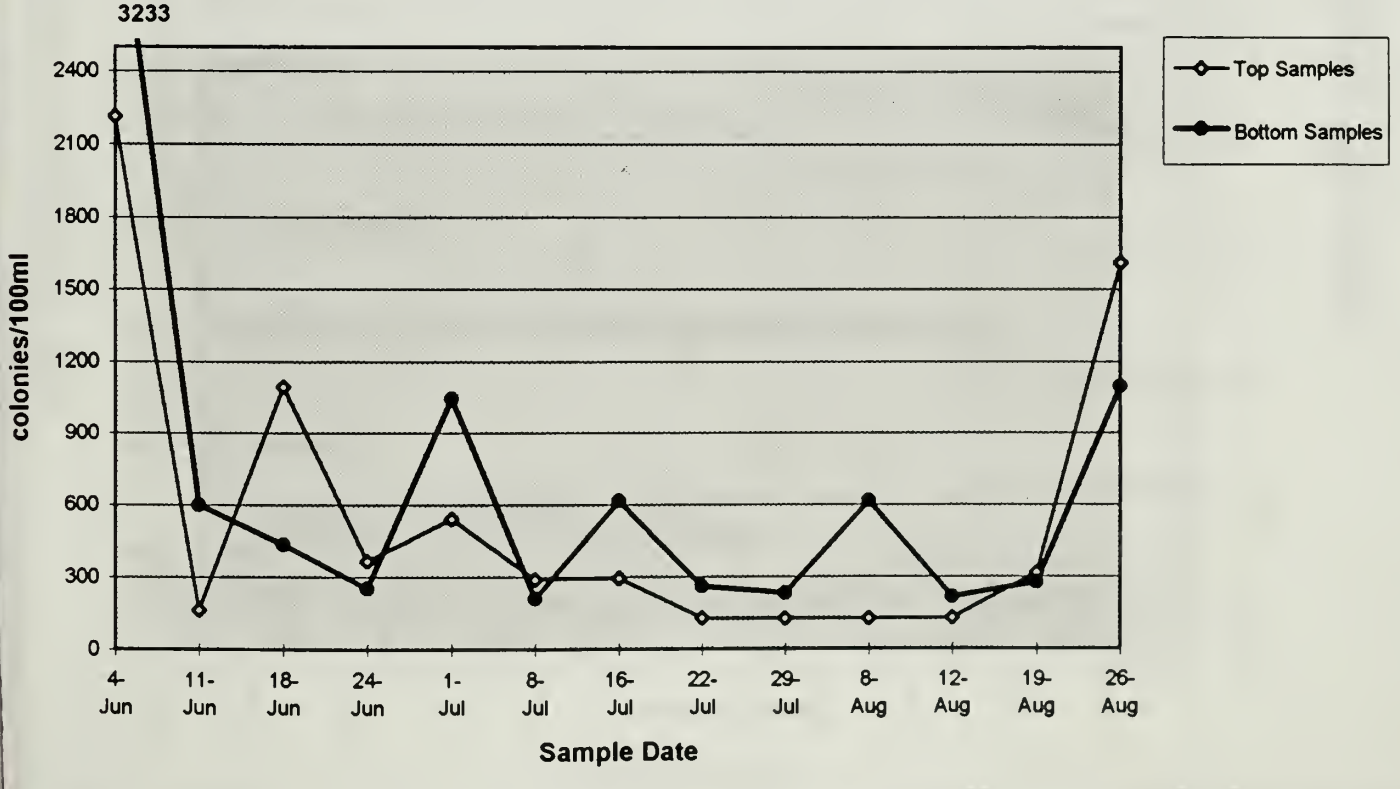
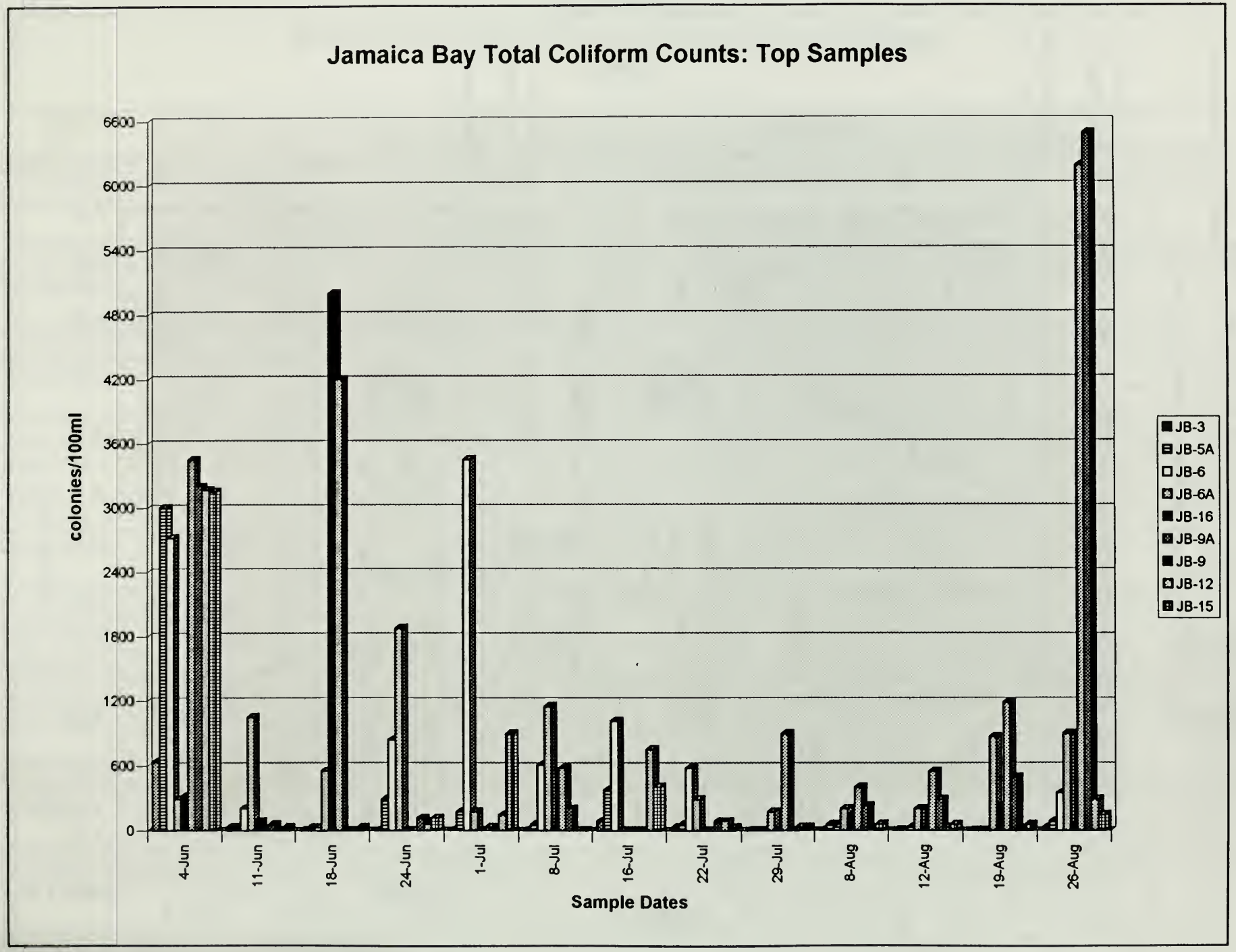


Figure 77


Jamaica Bay Total Coliform Counts: Top Samples
colonies/100ml
6600
6000
5400
4800
4200
3600
3000
2400
1800
1200
600
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

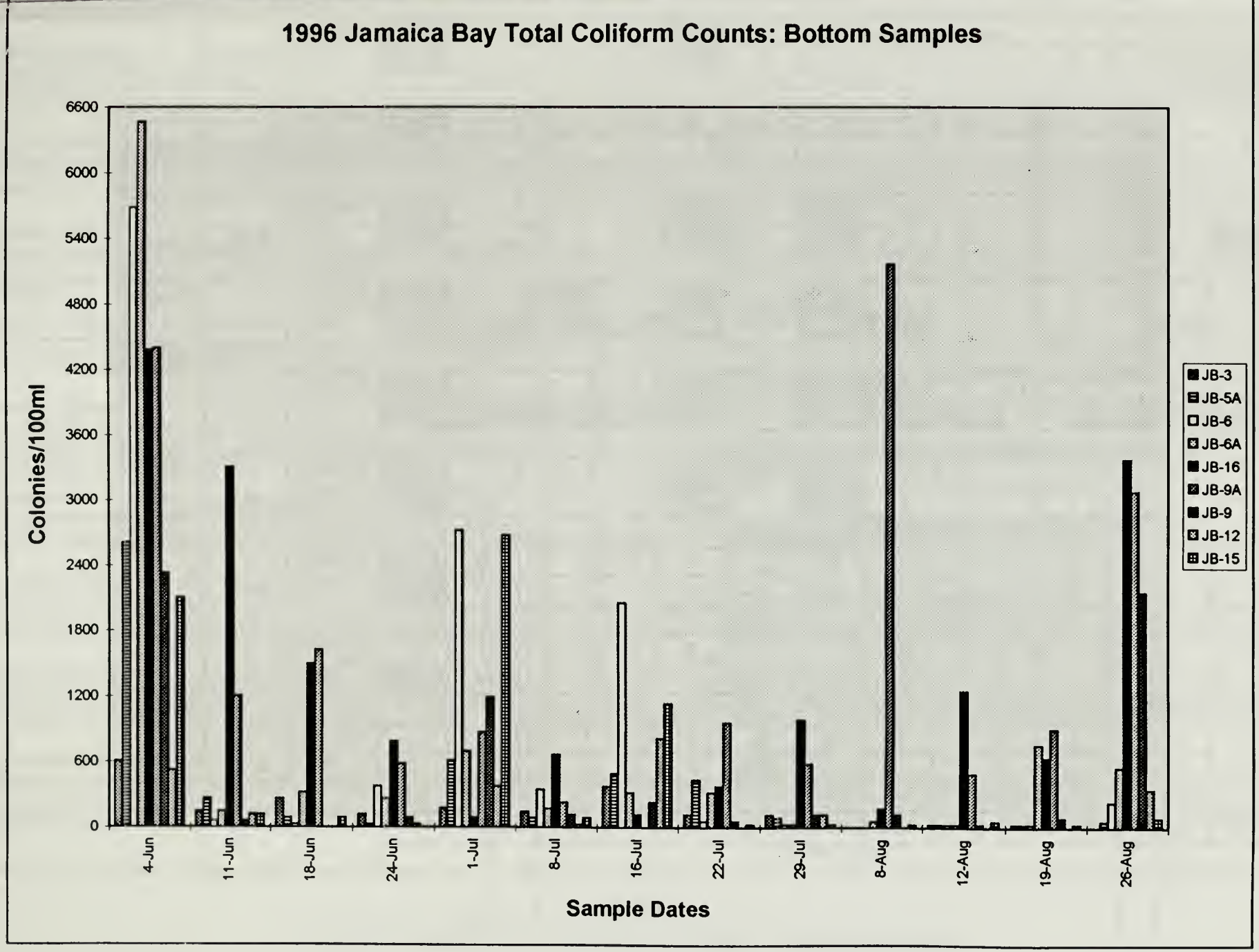

1996 Jamaica Bay Total Coliform Counts: Bottom Samples
Colonies/100ml
6600
6000
5400
4800
4200
3600
3000
2400
1800
1200
600
0
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

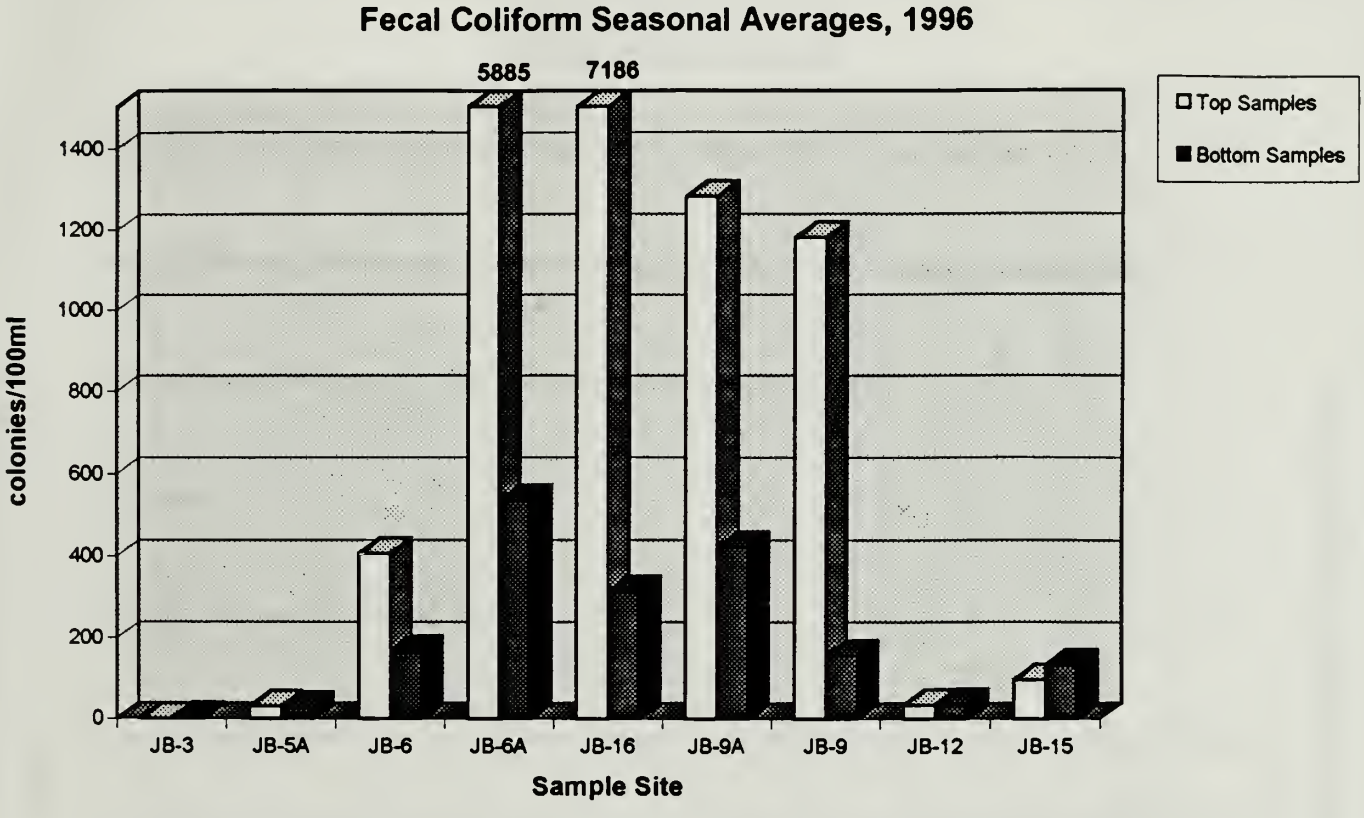
Figure 79

Table XXXI
Jamaica Bay Fecal Coliform Counts (colonies/100ml), 1996

Sample Location	Site	Depth	Sample Dates												
			6/04	6/11	6/18	6/24	7/01	7/08	7/16	7/22	7/29	8/08	8/12	8/19	8/26
Rockaway Inlet	JB-3	Top	0	0	0	0	0	0	0	0	0	0	0	0	0
		Bottom	0	0	0	0	0	0	0	0	0	0	0	0	29
Nova Scotia Bar	JB-5A	Top	319	29	0	0	0	0	0	29	29	0	0	0	0
		Bottom	174	145	0	0	0	0	0	29	0	0	0	0	0
Canarsie Pier	JB-6	Top	4925	0	29	0	145	0	174	0	0	0	0	0	0
		Bottom	2100	0	0	0	0	0	58	0	0	0	0	0	0
Pennsylvania Avenue Landfill	JB-6A	Top	67600	29	29	0	1100	0	7500	58	87	29	0	29	58
		Bottom	4600	0	0	0	1100	29	1150	29	0	0	0	29	0
Bergen Basin	JB-16	Top	30400	2300	15500	2100	>12400	174	7675	>14250	1000	116	2050	2850	2600
		Bottom	551	58	0	148	1150	0	1950	203	0	0	0	0	0
Bergen Basin Outflow	JB-9A	Top	667	4900	2675	406	2700	0	4650	493	0	29	0	203	0
		Bottom	1900	58	203	58	1800	0	1450	0	0	0	0	0	0
Grassy Bay	JB-9	Top	522	0	29	0	8050	0	>6450	29	0	0	0	0	261
		Bottom	522	0	29	0	319	0	1100	29	0	0	0	0	116
JoCo Marsh	JB-12	Top	348	29	0	0	0	0	29	0	0	0	0	0	0
		Bottom	232	0	29	0	58	0	87	0	29	0	0	0	29
Beach Channel	JB-15	Top	957	29	0	29	203	0	0	0	29	0	0	0	0
		Bottom	1276	0	0	0	609	29	87	0	0	0	0	0	0

Black cells indicate samples that exceeded total coliform counts of 2400/100ml and fecal coliform counts of 200/100ml (New York & New Jersey State bacterial standard limits).

Jamaica Bay Fecal Coliform Averages, 1996



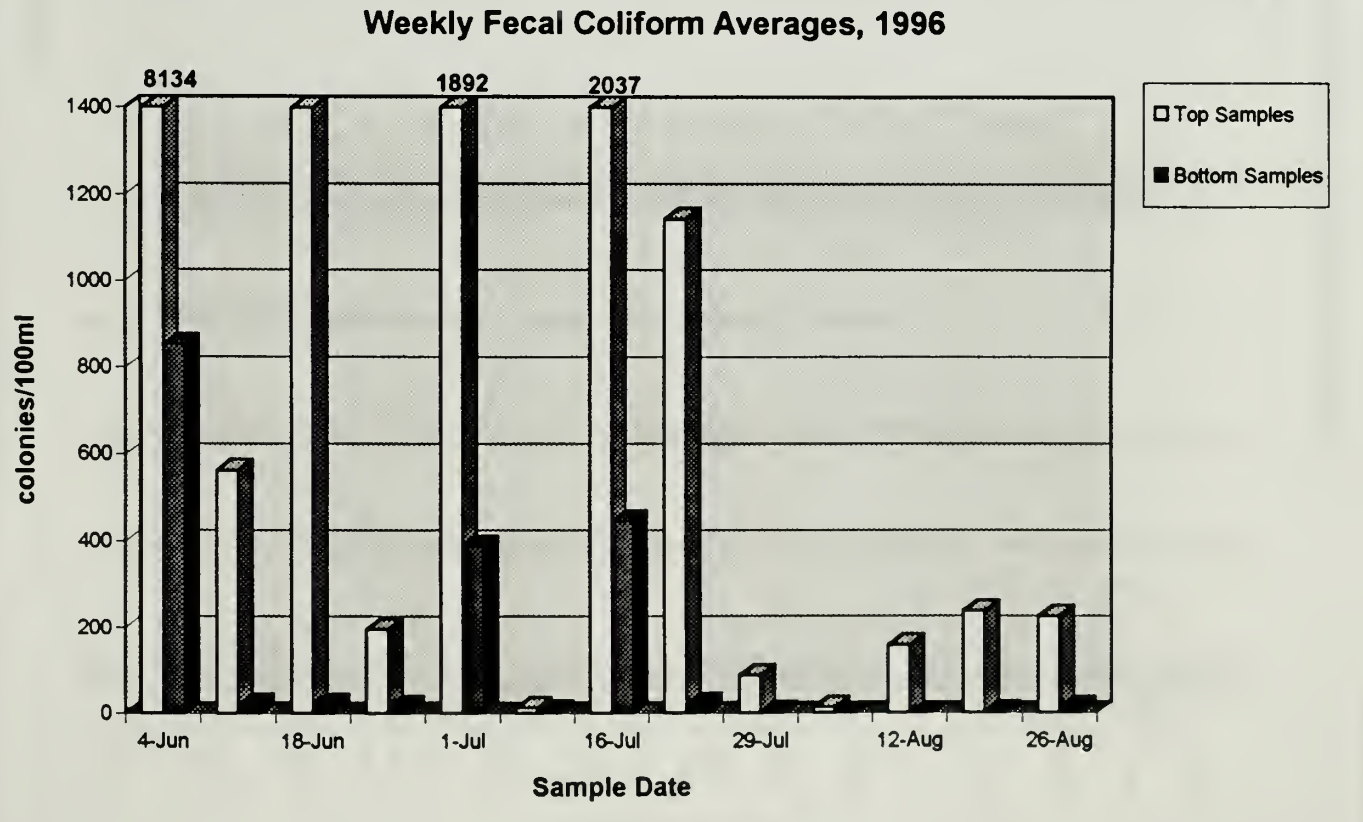


Figure 80

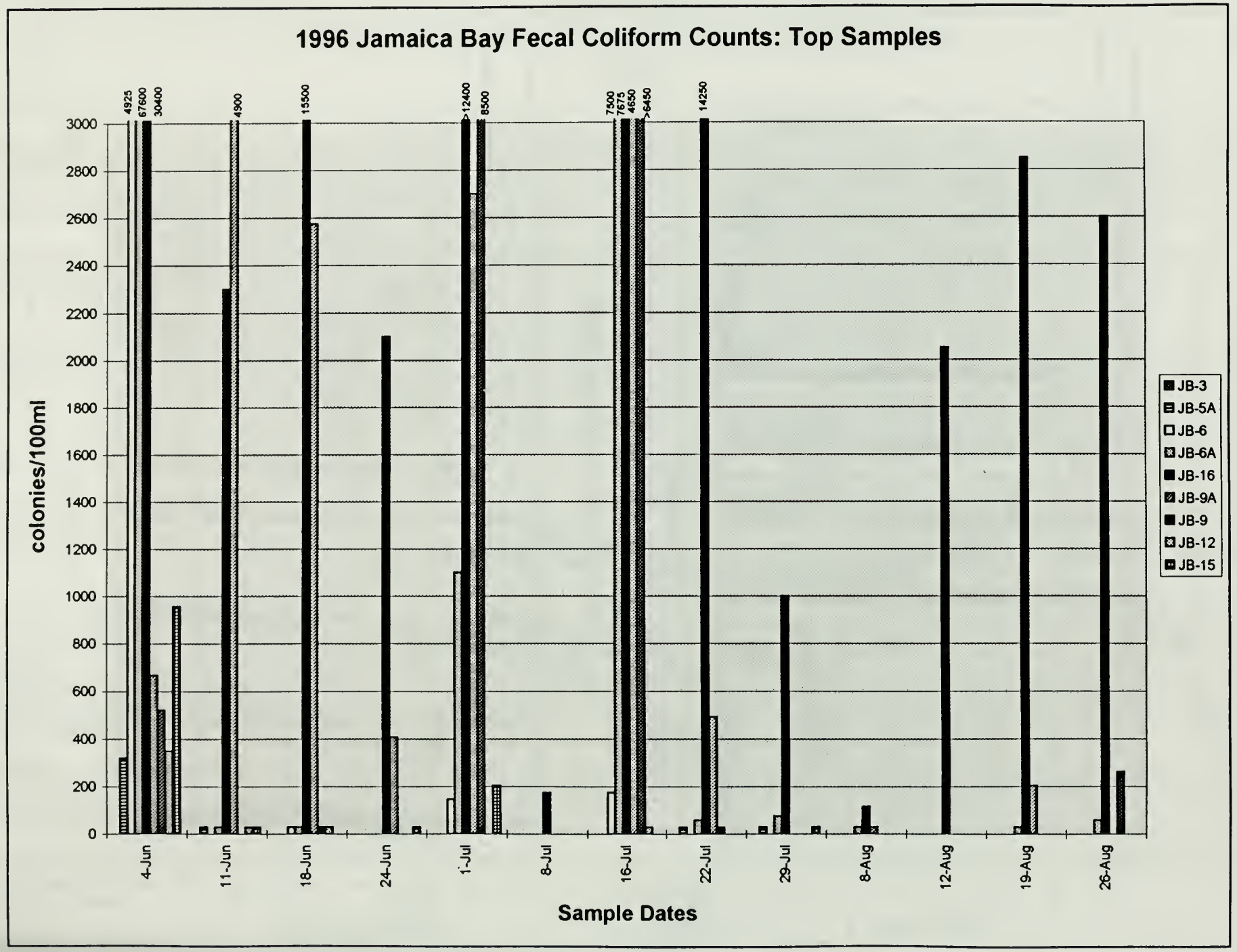

1996 Jamaica Bay Fecal Coliform Counts: Top Samples
colonies/100ml
Sample Dates
4925
67600
30400
4900
15500
>12400
8500
7500
7675
4650
>6450
14250
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug

Figure 81

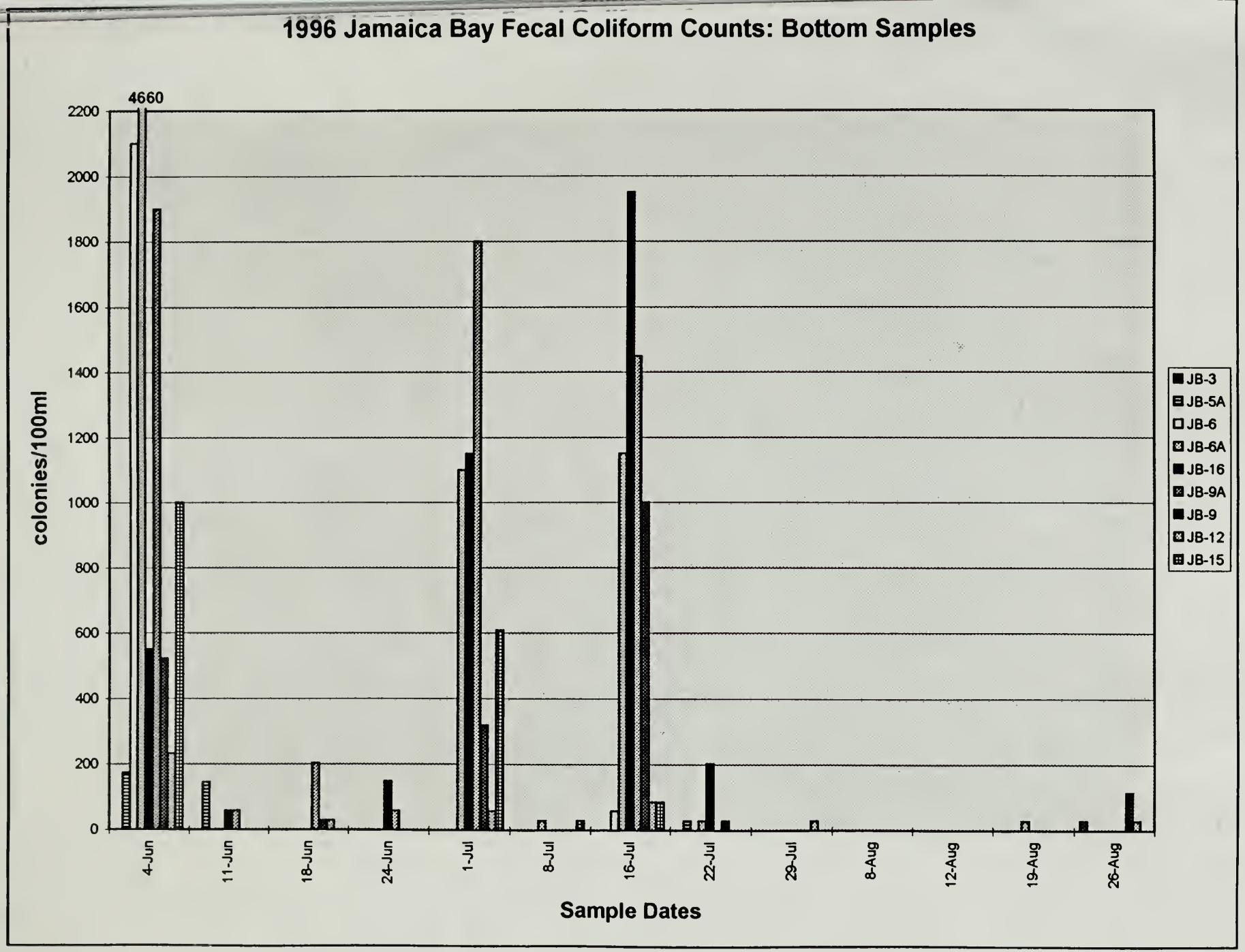

1996 Jamaica Bay Fecal Coliform Counts: Bottom Samples
4660
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
colonies/100ml
4-Jun
11-Jun
18-Jun
24-Jun
1-Jul
8-Jul
16-Jul
22-Jul
29-Jul
8-Aug
12-Aug
19-Aug
26-Aug
Sample Dates
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 82