United States Department of the Interior

NATIONAL PARK SERVICE

Gateway National Recreation Area

Directorate Cultural/Natural Resources
Staten Island Unit
Fort Wadsworth
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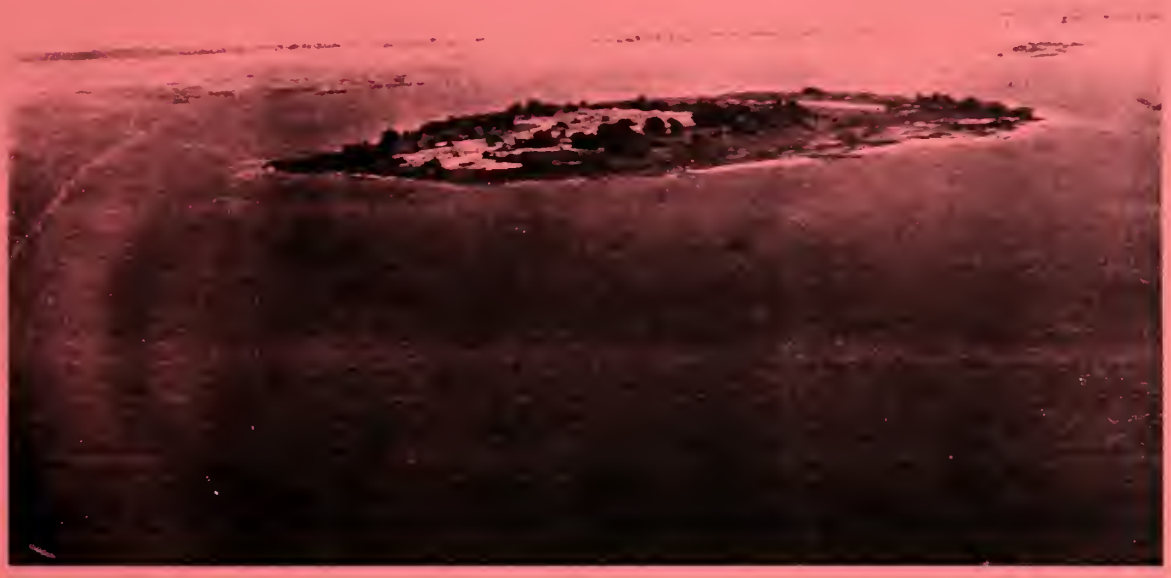
1998 Water Quality Sampling Program



Division of Natural Resources

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Gateway National Recreation Area

DIVISION OF NATURAL RESOURCES

1998 WATER QUALITY SURVEY REPORT

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Executive Summary:

This water quality report contains information about the bathing beaches and other ocean, or bay recreational areas, in Gateway's National Recreation Area (National Park Service). Many events, in and around this urban park, influence the quality of water within these hydrodynamic systems. We have collected data that is useful in many park management applications.

Gateway measures parameters in all locations in the park for: Total and Fecal Coliform Bacteria and in Jamaica Bay we also include: Chlorides (Total and Free); Chlorophyll-a; Conductivity; Dissolved Oxygen (DO); Nitrates (nutrient); Orthophosphate (nutrient); pH; Salinity; and Temperature. These parameters are critical in determining long-term water quality conditions Parkwide.

Criteria for determining detrimental conditions in the marine systems, are based on the type of contact (uses) people have with the water system. The United States Environmental Protection Agency (EPA) federal guidelines for primary contact (bathing) uses are used by Gateway as criteria to monitor water quality. Bathing is permitted only in designated area in Gateway (see enclosed maps). EPA strict guidelines and site location where selected to cover the immense size and variations in Gateway's water systems.

In providing recreational beach areas we should make every effort to protect the general public's health. During 1998, we saw the closure of one Gateway beach area, located in Staten Island Unit's southern beach at Great Kills (SI-6). This closure was due to high bacterial (coliform) counts detected by the National Park Service's, Division of Natural Resources and corroborated by New York State's Department of Environmental Conservation and New York City's Department of Environmental Protection. Normal Total Coliform Counts of less than 2,400 colonies/100mL and Fecal Coliforms of less than 200 colonies/100mL are used by the NPS and EPA as limits for contact recreational water quality.
Parameters measured from two sites, located in the upper bay regions of Jamaica Bay, 16 and 9A, deviated from other locations tested. This is a "normal" situation for these two locations and they usually exceed EPA guidelines for water quality.

JAMAICA BAY overview: (For more specific information please refer to charts, graphs, and figures in the sections ahead)

- Water temperatures in 1998, remained elevated for most of the summer season, and were generally higher, by about 1.5 °C, than in previous years since 1995.
- Chlorophyll-a values showed a number of peak values, which is indicative of eutraphication events.
- Conductivity and salinity were both steady throughout the season. However, sites 16 deviated considerably from most sites tested.
- DO values varied with the chlorophyll-a (algal) growth levels and were typically low at sites JB 16 and 9A in the upper bay and their weekly average ranging from 4.8 to 10.3 mg/L (5.0 mg/L as a lowest level value).
- Nutrients, such as, nitrates and orthophosphate were elevated in the upper bay regions of Jamaica Bay. This is based on only two data sets for nitrates so additional testing is required.
- pH levels in Jamaica Bay were fairly steady throughout the summer ranging from a weekly average of 7.4 to 8.5, which is normal.

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 aides in the evaluation of health conditions at public beaches, and in providing baseline data for research management decisions. Water quality data is 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 and to determine trends in water quality.**

3. **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. Standardization of Gateway site names. codes, and locations can be found in the front of this report. All data is available on the internet for public access via a computer-based template call STORET (http://www.epa.gov/owow/storet/retrieval.html).

We had just enough work completed in 1998 on our new laboratory facility at Fort Wadsworth to allow us to perform all the Water Quality testing in-house since May.

Use of a GPS (Global Position System) receiver to provide consistently accurate location site coordinates has been digitized this year on ArcView. All past data 1976 to present has also been incorporated into this new data application area.

Identical sample sites and methods have been used from 1981 to the present. This year, and last year two sites in Staten Island (South Beach and Midland Beach) were not tested, due to budgetary constraints. However the and two sites in Sandy Hook (Plum Island and Horseshoe Cove) which had been discontinued for two years have been reinstated in 1998. The remaining sites were tested from May 28th to September 2 1998, with Staten Island running until October 6th. 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, and were tested for: water temperature; pH; salinity; conductivity; dissolved oxygen (DO); nitrates; Secchi disk; total and free chlorine; orthophosphate; and chlorophyll-a; as well as total (TCC) and fecal coliform counts (FCC).

This monitoring program included some of Gateway's most heavily impacted sites and areas which are impacted by, sewage treatment plants/combined sewer outflows (CSO's), 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 (Standard Methods for the Examination of Water and Wastewater, 17th ed., 1989). Coliform's are a group of specific microorganisms whose densities can be related quantitatively to swimming related health hazards. The concern is with possible exposure to infectious enteric diseases, such as, cholera and typhoid fever, whose etiologic agents are excreted in feces and are spread by water and food contaminated with fecal wastes (Cabelli et al., 1983). Total coliform counts of 2,400 colonies/100mL (or Colony Forming Units; CFU) and fecal coliform counts of 200 colonies/100mL (col/mL) are the respective New York State and New Jersey State bacterial standard limits for direct human contact, 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 are as follows Breezy Point and Sandy Hook sites have been classified as acceptable, Jamaica Bay and some Staten Island sites have had intermittently unacceptable levels for contact recreations in 1998.

Atlantic Beaches (see Table's IV and V)

Water quality conditions at the two Atlantic Beach Sites, Riis Park (ATL-1) and Breezy Point (ATL-2), continue to be excellent in 1998. Average total coliform counts (TCC) for Atlantic Beach sites of 16 colonies/100mL (2,400 col/100mL standard) were recorded; fecal coliform counts (FCC) have also declined to 10 colonies/100mL (200 col/100mL standard). In 1998, total and fecal coliform counts remained consistently low over the summer. Neither, TCC or FCC exceeded 100 col/100mL, in 1998.

Riis Park (ATL-1) - Bathing Beach

Riis Park microbial counts have continuously tested below the standards limits of 2,400 colonies/100mL for TCC and 200 colonies/100mL and FCC. Average TCC for 1998 were 10 colonies/100mL, far below the standard of 2,400 col/100mL. Average fecal coliform counts were 7 col/100mL, also far below the fecal coliform standard of 200 col/100mL.

Breezy Point (ATL-2) - Bathing Beach

Breezy Point continues to have excellent quality water, with respect to coliform counts of Gateway's six bathing beaches. Average total coliform counts for 1998 were 22 colonies/100mL, far below the standard of 2,400 col/100mL (highest count of 1998, 100 colonies/100mL). Average fecal coliform counts were 13 colonies/100mL, also far below the fecal coliform standard of 200 col/100mL (highest count in 1998, 100 col/100mL).

Jamaica Bay (see Table's IV and V)

The waters of Jamaica Bay are the most heavily impacted bacteriologically in Gateway National Recreation Area. Sewage treatment plants employ CSO's which can empty into Jamaica Bay. This combined with, Jamaica Bay's poor flushing action (35 day residence time) and any heavy rainfall can produce elevated total coliform counts (TCC) and fecal coliform counts (FCC). Elevated coliform levels are primarily observed in peripheral channels and in areas where circulation is poor, such as, Bergen Basin, and the Grassy Bay areas. However, Jamaica Bay water continues to improve in quality. Increased average FCC of 826 colonies/100mL in top samples suggests a freshwater density gradient overlaying the saltwater with a value of 128 colonies/100mL (within 200 CFU/100mL limit). The percentage of samples that exceeded total coliform criteria decreased slightly from 6% (1997) to 4%, far below 1994's averages of 22%. The total yearly percentage of samples that exceeded fecal coliform standards (2,400 col/100mL), suggests a decreasing trend: from 1994, 30%; through 1996, 21% continuing to stabilize at about 20% from 1996 through 1998. Top and bottom seasonal averages for TCC and FCC's increased slightly from 1997, (22% top and 8% bottom), to 1998 (28% top and 12% bottom).
Note that the limits for total and fecal coliform counts are for primary contact recreation uses such as, bathing. However, primary uses are not necessarily designated for water uses in Jamaica Bay.

Rockaway Inlet (JB-3)

Located at the mouth of Jamaica Bay, Rockaway Inlet continues to feature low coliform counts. Rockaway Inlet's 1998 yearly average of 2 col/100mL fro TCC and 14 col/100mL for FCC. No values for TCC or FCC exceeded state and federal guidelines in 1998.

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 and 1997. 3% of fecal and 0% total coliform counts exceeded federal minimum criteria. Nova Scotia Bar's seasonal average TCC of 13 col/100mL has dropped to a three year low. Average fecal coliform counts of 33 col/100mL in 1998 increased from 6 col/100mL in 1997 back to the 1995 average off 29 col/100mL.

Canarsie Pier (JB-6)

Formerly called Hendrix Creek in 1994 and 1995, this site was renamed to more accurately reflect its location. 3% of this sites samples exceeded TCC standards, up only slightly form last year. However, FCC standards which have been decreasing for the past four years to a low of 7% in 1997 jumped to 17% of the samples surpassing minimal coliform levels. TCC averages of 193 col/100mL in 1998 is basically unchanged from 203 col/100mL in 1997. Seasonal average FCC decreased to 167 col/100mL from 1997's result of 758 col/100mL returning to the less than 300 col/100mL value observed in 1995 and 1996.

Pennsylvania Avenue Landfill (JB-6A)

The percentage of samples that exceeded TCC criteria decreased only slightly to 3%, in 1998, back to the 1996 low of 4%. Seasonal average TCC fell to a five year low in 1998, to 721 col/100mL. The percentage of FCC that exceeded standards varied from: 23%, in 1996; 14% in 1997; to 30% in 1998. FCC averages in 1998 decreased from a three year high of: 3,209 col/100mL, in 1996; 894 col/100mL, in 1997; to 721 col/100mL, in 1998.

Bergen Basin (JB-16)

This site continues to have the distinction of having the highest TCC and FCC values in Jamaica Bay. TCC averages for this site increased markedly from: 902 col/100mL, in 1996: 847 col/100mL, in 1997, to a value of 2,975 colonies/100mL. However, only 18% of TCC samples exceeded standard values in 1998, thus remaining below a 20% level, since 1996. FCC averages were 2,234 col/100mL in 1998, this is a three year low. 67% of both top and bottom samples exceeded FCC criteria limit, continuing with a trend of over half of the FCC values being elevated in recent years. 100% of the FCC top samples exceeding the minimum primary criteria of 200 col/100mL. Seasonal average values for both, FCC and TCC, remain the highest out of all the sites examined in Jamaica Bay.

Bergen Basin Outflow (JB-9A)

This site is located a short distance from the mouth of Bergen Basin, hence it's name. In 1998, TCC seasonal average value of 2,369 col/100mL increased over the previous two years by about 1,000 col/100mL. However, the percentage of values that exceeding the standard limit was a three year low of 7%. Therefore, the actual seasonal average value of TCC has increased, while the number of occurrences of this high values has decreased. Seasonal FCC's averaged: 850 col/100mL, in 1996; 1,763 col/100mL, in 1997; decreasing to 898 col/100mL, in 1998: basically the level that was observed in 1996. The percentage of FCC that exceed the minimum standard, has continued to stay about the same (40%) for the fifth year in a row, at 37%.

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. A TCC seasonal average of 270 col/100mL deceased significantly from values in the 600 col/100mL range in 1996-1997. The percentage of TCC samples exceeding standards: 12%, in 1996; and 11%, in 1997; dropped to a new low of 3%, in 1998. FCC 1998 seasonal averages of, 124 col/100mL and the percentage of FCC samples exceeding standard levels, 20% are relatively unchanged from 1997 results (151 col/100mL and 18%).

JoCo Marsh (JB-12)

This site was renamed in 1996, and in 1994 & 1995 it was called JFK South of Runway Extension. Total coliform seasonal top and bottom averages decreased substantially in 1997 to 81 col/100mL and continued to do so in 1998 to 11 col/100mL, a four year low. Neither, FCC (3%) or TCC (0%) results that exceed percentage standards varied form the previous years. Fecal coliform seasonal averages values for JB-12 continue to remain at about 30 col/100mL, for the past four years, to a low value of 30 col/100mL in 1998.

Beach Channel (JB-15)

TCC exceedance percentages was 0% in 1998. Total coliform seasonal average counts of: 441 col/100mL, in 1996; 50 col/100mL, in 1997; and 20 col/100mL, in 1998 reaching a three year low. JB-15 FCC percentages exceedance values for 1998 remained basically unchanged in 1998 at 3% (0% 1997), while the fecal coliform seasonal average count declined from: 114 col/100mL, in 1996; 11 col/100mL, in 1997; to 40 col/100mL, in 1998 generally unchanged and low as compared with other Jamaica Bay sites.

Staten Island (see Table's IV and V)

Water quality at sample sites in Staten Island (SI) has reversed its' improving trend, with SI-6 being closed to public bathing for a number of days in 1998 see table XIXa). Some of the SI sites had seasonal averages values below city and federal standard bathing limits, but showed occasional unhealthy counts throughout the 1998 season. Staten Island's seasonal percentage calculations for the total coliform counts (TCC) continued unchanged during the past three years, with only 1% of all the TCC exceeding state criteria. However, the seasonal percentage of fecal coliform counts (FCC) that exceeded the state's criteria exhibited a significant increase in 1998 to 13%. Previous values were: 12%, in 1994; 10%, in 1995; 8%, in 1996; and only 1%, in 1997. Both total and fecal coliform seasonal average values, for all SI sites, demonstrated low values in 1997, 44 col/100mL for TCC and 17 col/100mL for FCC; increasing to 116 col/100mL for TCC and 139 col/100mL for FCC, in 1998. These 1998 averages remain consistent with most past values of 100-200 col/100mL for both FCC and TCC. Note, that the above information does not include the miscellaneous samples, taken at SI-6 during the bathing beach closure periods. SI-6 is the only area in SI that is currently designated for primary contact water use - public bathing.

Fort Wadsworth (SI-1)

Fort Wadsworth percentages that exceeded limits were: TCC, 0%; and FCC, 5% in 1998 basically unchanged for the past three years. TCC seasonal averages varied from: 493 col/100mL, in 1996; 35 colonies/100mL, in 1997; to 101 col/100mL, in 1998 well within the 2,400 col/100mL criteria for primary recreational areas. Fecal coliform seasonal averages in 1996 were 2,011 colonies/100mL, which decreased to 4 col/100mL in 1997 and 86 col/100mL in 1998.

South Beach (SI-2)

Not monitored in 1998.

Midland Beach (SI-3)

Not monitored in 1998.

New Dorp Beach (SI-4)

New Dorp Beach (SI-4) total or fecal coliform percentages exceeded the states water quality criteria in 1998, for the first time in at least three years, and is probably related to elevated counts observed in SI sites 4, 5, and 6. Total coliform seasonal averages returned to previous year levels of about 200 col/100mL to a value of 210 colonies/100mL in 1998. 1998 FCC increased to a level of 88 colonies/100mL, last reported in 1995. Both TCC and FCC site averages for SI-4 are still within acceptable limits.

Oakwood Beach (SI-5)

In 1998, TCC percentage values did not exceeded standard limits and remained 0%. Average TCC for 1998 was 80 colonies/100mL, a slight increase form the previous year but lower than 1995-96 results. FCC however, jumped sharply in both: a percentage exceedance of 25%; and a seasonal average value of 351 colonies/100mL, each of which is elevated from 1995 to 1997 values.

Great Kills Beach (SI-6) - Bathing Beach

Great Kills Beach total coliform seasonal average value was 195 col/100mL, and the exceedance percentage value was 0%, in 1998. This SI site reported a seasonal average fecal coliform count of 351 col/mL exceeding the 200 col/100mL criteria limit, and a percentage of exceeding values of 30%.

Crooke's Point (SI-7)

Crooke's Point (SI-7) total or fecal coliform percentages that exceeded the states water quality criteria in 1998 remained low: TCC = 0%; FCC = 5%. Total coliform seasonal average decreased slightly for the third year too, 53 col/100mL in 1998. FCC average values have increased to 71 col/100mL in 1998, they have been 40 or less than for the past two years.

Great Kills Marina (SI-8)

The total coliform samples exceeded percentage standards 0% in 1998 maintaining a four year low. Total and fecal coliform seasonal averages were both slightly increased in 1998 with, TCC of 55 colonies/100mL, and a FCC of 49 col/100mL. These 1998 seasonal averages were far below the 1995 values of: TCC, 402 col/100mL and FCC of 712 col/100mL.

Sandy Hook (see Table's IV and V)

In 1998 Sandy Hook site locations 1 and 6 were reinstated in Gateway's testing program, neither of which is a bathing beach area. From 1994 through 1998, no total coliform counts (TCC) have exceeded percentages, for state and federal guidelines (0% in 1998), this is for all Sandy Hook sites. Four percent of the fecal coliform counts (FCC) exceeded state and federal guidelines, similar to values observed since 1996 (2%). Total seasonal average TCC decreased remained relatively low at 41 colonies/100mL in 1998. FCC's total seasonal average have been declining from: 153 col/100mL, in 1994; 134 col/100mL, in 1995; 15 col/100mL, in 1996; to a low of 12 col/100mL, in 1997; and then increasing slightly to 58 col/100mL, in 1998. The elevated values for the combined site results appears to be the result of high values observed at Spermaceti Cove (SH-2).

Plum Island (SH-1)

Reinstated in 1998. None of the total or fecal coliform samples exceeded standards and therefore the percentage values were zero. The TCC average value was 22 col/100mL and the FCC value was 41 col/100mL. No data has been acquired since 1995, both of which had a value of over 200 col/100mL.

Spermaceti Cove (SH-2)

TCC samples form SH-2 exceeded standard limits 0% of the time. However, the average value for TCC was elevated to a four year high of 177 colonies/100mL in 1998. Seasonal average fecal coliform count was 223 colonies/100mL, above the fecal coliform standard of 200 col/100mL (Note: SH-2 is not a bathing beach) with 25% of the values exceeding the limit.

Lot D (SH-3) - Bathing Beach

None of the samples exceeded total and fecal coliform standards, during 1997. TCC seasonal averages for the 1998 season were all zero colonies/mL. FCC seasonal average was only 5 col/100mL. Making SH-3 an exceptional bathing beach with good quality water results. Yearly summer samples, taken at Lot D, also mimic these low coliform parameter.

Gunnison Beach (SH-4) - Bathing Beach

No samples exceeded total and fecal coliform standards, during 1998 (0% exceedance). Both total and fecal coliform seasonal averages maintain a five year low trend in 1998. The seasonal average TCC for 1998 was 19 colonies/100mL, far below the standard of 2,400 col/100mL; while the fecal coliform count was 9 colonies/100mL, also below the fecal coliform standard of 200 col/100mL.

North Beach (SH-5) - Bathing Beach

No total and fecal coliform standards (0%) were exceeded during 1998 samplings of SH-5. While, the TCC seasonal average decreased to a new low in 1998 to 6 col/100mL, the FCC remain fairly constant at 13 col/100mL. This site, as well as, SH -4 and 5 have maintained a water quality acceptable for primary contact recreational uses in Gateway NRA for the summer of 1998.

Horseshoe Cove (SH-6)

This site was reinstated in 1998 but is not designated as a bathing area. Both TCC and FCC percentages were zero, that is , none of the results in 1998 exceed the standard limit of 2,400 col/100mL. This site has not been examined since 1995 with: TCC = 160 col/100mL and FCC = 138 col/100mL. In 1998 TCC = 23 col/100mL and FCC = 53 col/100mL, which are much lower than in 1995.

III. METHODS

Sampling And Coliform Analysis

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 Standard Methods for the Examination of Water and Wastewater, 17th ed., 1989; and Simon, 1984) provides a detailed description of methods employed. Total and fecal coliform measurements were obtained at all sample sites on a weekly basis between, May 28th and Labor Day 1998, extending through October 6th for Staten Island sites.

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 (approximately 18 inches for sample depth) in three feet of water. Samples were then stored in ice-filled coolers and transported to Fort Wadsworth were they where analyzed for coliform bacteria.

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 which are then tabulated on a computer worksheets.

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

Colony Count/100mL = {# colonies counted / volume filtered} x 100 mL

The arithmetic means for each site were calculated from, dilution's that showed densities of 20-200 colonies, for any individual sample.

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

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 are taken at both the surface and bottom locations in the water column. Nine sites in Jamaica Bay are analyzed, 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 (i.e. Nitrates, and Orthophosphates) from Jamaica Bay (JB). Results for all water quality sampling at Gateway National Recreation Area are expressed by (JB) sites listed numerically Section II (Tables VII-XV, Figures 7-42), and parameters, listed alphabetically in Section IV Tables XXI-XXXI, Figure 57-82) with coliforms listed separately in Section III (Tables XVI-XX, Figures 43-56). See index ahead.

Total and Fecal Coliform (Tables XVI and XVII)

Coliform's are an indicator species, or microorganisms, whose type and densities can be related health hazards associated with body contact, ingestion or inhalation. Total and fecal coliform serve as non-conservative tracers of sewage related pollution (Dyer, 1973). They are non-conservative in the sense that they are rapidly removed from the marine environment by die-offs and incorporated into the sediments. Decreases in their concentrations are not solely dependent on their physical transport and diffusion. Die-offs for total coliforms are estimated to be 1.3 days and for fecal coliform 1.5 days, in Jamaica Bay (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 normally in the intestinal tract of a host (human). 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 (human) pollution. Higher incubation temperatures can isolate them from the rest of the groups which make up total coliform. Fecal coliform tests are the standard measure for testing pollution in recreational and other waters. (Scaglione, 1989).

This year's (1998) total coliform (TCC) and fecal coliform (FCC) average counts for Jamaica Bay have demonstrated a marginal decrease over preceding years results (TABLE II) except, for top samples, which reached a level that has not been observed since 1994. Breezy Point and Sandy Hook, have remained relatively unchanged since 1996, or longer. Staten Island exhibited an increase from last year's average values however, they have not changed considerably over the past few years. Fecal coliform levels, considered to be the more reliable indication of the risk of gastric enteric diseases and high TCC values prompted the closure of Staten Island bathing beach (SI-6).

In 1998, one site Jamaica Bay (JB-16), on 8/10/98, was reported to be confluent (Tables XVI and XVII). Confluent means that, to many bacterial colonies were present to get an accurate value o no data result was used. This non-result may have had a value that would have increased the average seasonal results and percentage of values that exceeded state limits if, it was possible to incorporate it into the calculations.

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 (near 7.0), 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 total chlorine. US EPA criteria for total marine chlorine is 0.013 mg/L (US EPA).

In 1998 all total and free chlorine samples from Jamaica Bay were less than (<) the 0.02 mg/L minimum detection limit.

Chlorophyll-a

Chlorophyll-a is a common indicator of phytoplankton biomass. Phytoplankton are microscopic unicellular algae, which contribute oxygen to the ecosystem and are considered primary producers. They also function as a food source for most marine zooplankton and are an integral part of the estuary 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 and high reproductive rates. 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). In a natural environment nutrients such as, nitrates and phosphates, regulate reproductive rates by being a limiting resource in algae biomass expansion. Temperature variations also influence algal biomass. Average concentrations of greater than 20 ug/L (200 mg/m^3) of chlorophyll-a is generally indicative of eutraphication conditions or, the risk of low dissolved oxygen levels occurring (NYS DEP 1997 New York Harbor Water Quality Survey).

Chlorophyll-a seasonal averages (Table XXIII), for all sites, varied considerable between top samples (surface) and bottom samples, the largest difference can be seen in JB-12 (top = 193 mg/m^3, and bottom = 39 mg/m^3). Most sites had top chlorophyll-a averages that were elevated, as compared with bottom samples from the same location, this is consistent with availability of light for surface algal growth. However, all biweekly averages were all below 100 mg/ m^3. Five elevated chlorophyll-a values occurred: JB-6 top 241 mg/m^3 (8/3/98); JB-9A top 280 mg/m^3 and bottom 257 mg/m^3 (both on 7/21/98); JB-9 327 mg/ m^3 (6/15/98); and the highest value was JB-12 on 8/3/98, 802 mg/ m^3. Very little rainfall and sunny weather may have contributed to the chlorophyll-a levels during the summer of 1998.

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 equilibrium, the physiological effect on plants and animals, and the corrosion rate of the environment.

The conductivity in Jamaica Bay in 1998 featured baywide site seasonal averages that were fairly consistent throughout the summer, with readings between 17 and 33 mS/cm. Conductivity readings paralleled those of salinity; with top and bottom samples averaging nearly the same: except for JB-16 and 9A. Low readings in surface samples for conductivity and salinity, as compared to the bottom samples, is indicative of a freshwater density gradient at JB-16 and JB-9A. 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 utmost biological significance. Oxygen's ability to dissolve 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 heterotropic organisms "breath" oxygen dissolved in the water column. These organisms can recover from short periods of low DO but, prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/L or less can result in "dead" water bodies. U. S. EPA criteria for DO is 4.0 mg/L for 1 day minimum in cold water, and 7 day minimum in warm water (US EPA). New York State DEP standard limit for dissolved oxygen is greater than or equal to 5.0 mg/L (ppm) for bathing areas. 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 can also affect oxygen levels in the bay.

In Jamaica Bay seasonal and weekly DO averages (Table XXV) were all above 5.0 mg/l except for on 8/3/98 were bottom samples averaged 4.85 mg/L. JB-16's sample average continue to be among the lowest in the bay, with a top value of, 5.2 mg/L and bottom average of, 4.32 mg/L.

Referring to Table XXV note that, a number of individual weekly DO values, were less than 5.0 mg/L. This is true for primarily for JB-16, 9A, 9 with JB-16 demonstrating the lowest value on 8/17/98 of 1.7 mg/L of DO. Numerous low DO reading on during the summer of 1998 may be a result of eutraphication events. Note, the chlorophyll-a value, and the out-of-range-high (ORH) value obtained on 8/17/98 for JB-12. Numerous fluctuations can be seen in DO readings on a weekly bases and from site to site. A general trend can be seen of weekly and site averaged values, with top samples showing higher DO readings.

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, causing severe oxygen depletion during summer due to die-offs of high concentrations of algae. If all inorganic nitrogen (nitrate, nitrite and ammonia) exceeds 0.3 mg/L, algal blooms may result; more than 4.5 mg/L nitrate can be dangerous to most animals.

Baywide biweekly and seasonal nitrate results were limited in 1998 do to accidental contamination of numerous samples. Reviewing the two sets of samples that were analyzed, none of the nitrate values exceeded the 0.3 mg/L limit.

Orthophosphate

Phosphates can be found in fertilizers and like nitrates are commonly observed in sources including: human; animal; and industrial wastes. They are only deleterious in large quantities, and are utilized as nutrients by plant life and algae, as a limiting food source.

Jamaica Bay orthophosphate seasonal averages (Table XXVII) ranged from, less than 0.00 to 1.29 mg/L, with peak average values occurring at JB-16 (0.72 mg/L), and JB-09 (0.35 mg/L). Orthophosphate biweekly average values of top samples, from July 27th to August 24, were all elevated as compared with the bottom samples. This trend can be view on figure 71, were most top samples of orthophosphate run higher than the bottom sample values.

pH

pH is the standard measure of acidity, with a pH value of 7.0 representing 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 within 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 marine plant and animal life (US EPA).

Weekly sampling (Table XXVIII) indicated that Jamaica Bay's pH averaged between 7.3 and 8.5 for all sites tested. There was drop in average pH to 7.38 on June 23, 1998. JB-12 and 15 had the highest individual pH values of 9.2. Bergen Basin, and its Outflow (JB-16 and JB-09A) demonstrated slightly lower pH average seasonal values, than the other Jamaica Bay sites.

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 is 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 fluctuations, locations in the estuary, tidal and seasonal temperature current variations.

Salinity in Jamaica Bay in 1998 featured baywide weekly averages (Table XXIX) that remained between 17 and 21 parts per thousand (ppt) throughout the summer. Bottom samples were slightly more saline than top samples, running up to 7 ppt higher (JB-16). Seasonal site averages for both top and bottom samples were nearly identical for most sites with the exception of JB-16 and JB-09A, where top samples had far lower salinity than bottom samples, as they were in 1996 and 1997. Rockaway Inlet and Nova Scotia Bar, near the mouth of the bay, were the most saline locations.

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 (JB-03) near the mouth of Jamaica Bay, and at Nova Scotia Bar (JB-5A), averaging about 2.0 to 3.5 meters respectively. The northeastern part of the bay produced the lowest seasonal averages of: 0.9 meters for JB-16; 1.2 meters for JB-09A; & 1.0 meters for JB-09. All secchi disks readings with reduced depths are consistent with increased turbidity. Weekly averages for Jamaica Bay were generally in the 1-2 meter range. All these data are consistent with pervious years data.

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 or rapid temperature shifts (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. Solar radiation from the sun warms water 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 XXXI and Figures 80-82 seasonal averages by site were very consistent however, the weekly average temperatures increased throughout the summer. The upward trend during the summer can also bee reviewed on the plots of individual sites. Average water temperatures were highest at the JoCo Marsh (JB-12), with Grassy Bay (JB-09) and the Bergen Basin (JB-16) and its Outflow (JB-9A) average values being only slightly lower (0.2 °C). Bottom temperatures, while slightly depressed by up to 0.5° C from surface temperatures, closely paralleled each other throughout the summer. Temperatures were lowest at Rockaway Inlet (JB-3) and Nova Scotia Bar (JB-5A) sample sites, which are closest to the mouth of Jamaica Bay and normally maintain the greatest water depths. In 1998, water temperatures in Jamaica Bay averaged higher than in 1997.

Factors Effecting Water Quality

The quality of the waters surrounding Gateway is determined largely by pollutant inputs such as: treated and untreated sewage; combined sewage overflows (CSO's); industrial effluents; ocean dumping (prohibited as of September 1997); sewage sludge; and other 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 in the water column (by sun, wind and wave), biological oxygen demand (BOD), photosynthesis by phytoplankton, and water temperature.

Precipitation Tides And Temperature

Precipitation is a known cause of intermittent corruption of water quality. Introduction of shock load pollutants into local waters by storm waters and CSO's. (NYC DEP, 1987). Total and fecal coliform counts have been consistently higher following rainfall in local waters (NYC Department of Health, 1983) Table VI contains rainfall amounts that occurred within the 72 hours prior to sampling and are indicated in 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 (Section II). Note also that, miscellaneous testing parameters were performed biweekly.

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 discharges form outfalls prior to sampling and analysis. The 1998 season was very dry and warm. Water temperatures were higher than average which will sustain bacteria for longer periods of time. Minimal rainfall, kept most bacterial counts fairly constant throughout the summer. Seventy two hours prior to the June 15, 1998 samplings there was the only significant rainfall event (1.78 inches), reflecting the increased bacterial counts (see Table XVI, XVII, and Figure 6) at that time.

Two sites, JB-16 (Bergen Basin) and JB-9A (Bergen Basin Outflow), both located in close proximity to each other, are responsible for many total coliform samples exceeding a 2,400 col/mL limit. Of the nine Jamaica Bay sites analyzed in 1998, these two 16 an 9A, continue to maintain the highest and number of exceeded values for both TCC and FCC. There appears to be some type of direct removal affect at 9A where the counts demonstrate rapid shifts in coliform levels. These shifts may be due to, tidal changes, current fluctuations, and/or outfalls from storm or waste water facilities.

Water Quality Emergencies

Gateway's policy for protection of public health at bathing beaches has been to officially close beaches by public notice when, individual samples with total coliform counts (TCC) greater than 2,400 CFU's/100mL or fecal coliform counts (FCC) greater than 200/100mL are detected over a three consecutive day period, at a given beach location. This is an effective response to a persistent problem. Search of the literature indicates that swimmers stand a much greater risk of contacting disease from polluted water than non-swimmers, when swimmers are defined as those who undergo total immersion (Cabelli et al., 1983; Standard Methods for the Examination of Water and Wastewater, 20th ed., 1998).

Beach Closure Format (Bacterial Contamination)

The following procedures are followed when, a sample is determined to have a greater than 200 CFU/100mL FCC and/or greater than 2,400 CFU/100mL TCC, collected at one of Gateway's beaches:

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

2. Check with New York City Department of Health (NYC DOH) at 212/340-4494 or the Department of Environmental Pollution (DEP) at 718/337-4357, to determine if any overflow incident or accidental release of raw sewage has occurred at local sewage treatment plants. Advise park's Chief of Natural Resources (718)354-4547) and document all communications.

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

5. Note: Non-designated recreational areas such as: fishing, windsurfing, the superintendent may consider areas for closure.

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

1. Elevated daily average for TCC, greater than 2,400 colonies/100mL or a FCC greater than 200 colonies/100mL for all samples collected at a compromised beach location.

2. Visual 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.

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

Reinstating Beach: After Beach Closure

1. Results from samples analyzed after a beach closure shall be, reported to the unit Superintendent on each consecutive day following a closure for any samples that are retrieved.

2. The unit Superintendent may reinstate swimming in the affected area based on:

A) Any consecutive samples falling below both minimums of: 2,400 colonies/100mL for the total coliform count, **<u>and</u>** 200 colonies/100mL for the fecal coliform count.

B) Any adverse environmental condition/s existing at the closure location.

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 a beach area 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 loose-leaf 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.

Miscellaneous Notes

Coliform data throughout a season can display high variability, this may be due to errors implicit in the method (Fleisher and McFadden, 1979) and various environmental factors. TABLE III shows the percentage of sample days during which, coliform standard water quality values were exceeded.

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VII. ABBREVIATIONS:

ATL = Atlantic

BOD = Biological Oxygen Demand

CSO = Combined Sewer Outflows

CFU = colony forming units, or number of colonies (col) that are counted on a bacteriologic growth plate.

ch-a = chlorophyll-a

DO = Dissolved Oxygen

FCC = Fecal Coliform Count/s

JB = Jamaica Bay

NRA = National Recreation Area

NYS = New York State

SI = Staten Island

SH = Sandy Hook

TCC = Total Coliform Count/s

SECTION I

Miscellaneous Tables and Figures

Table I

Dilution's (Volumes) By Site For MF Analysis

	Volumes To Be Filtered (mL)					
Sample Site	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 Lan	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 and Notes:
20 colonies/0.5 mL X 100 = 4,000 CFU's/100mL
The density would then be logged as 4,000/100mL or 4,000 col/100mL.

CFU's = Colony Forming Units
Smallest volume filtered = 0.5mL

Table II

Gateway National Recreation Area

Total and Fecal Coliform Seasonal Averages For All Sites

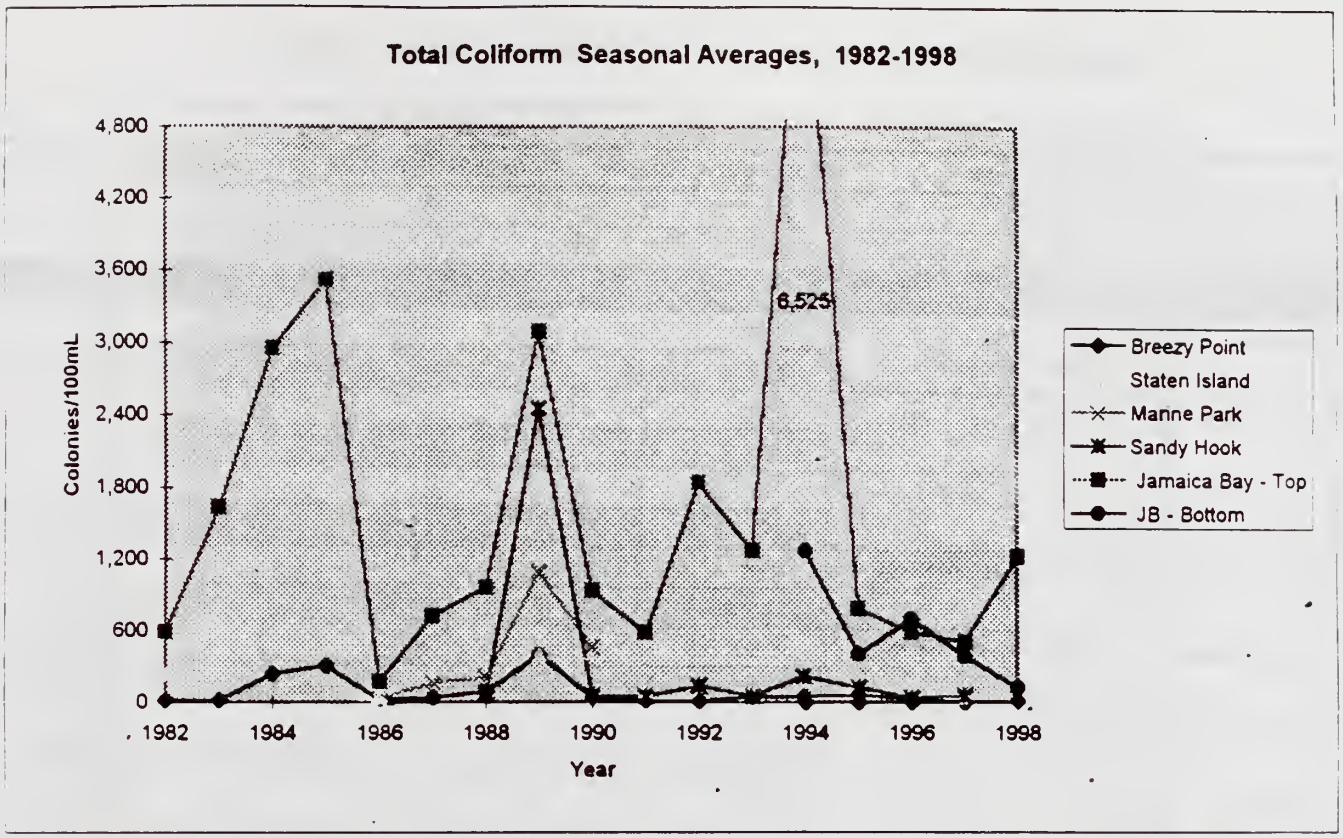
1982-1998

		Breezy Point		Jamaica Bay		Staten Island		Marine Park		Sandy Hook	
Year	Site	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
1982		15	8	588	217	229	71				
1983		18	14	1,631	1,150	466	229				
1984		242	18	2,955	500	1,812	87				
1985		307	37	3,513	429	3,508	42				
1986		21	7	176	277	47	23	85	36		
1987		37	21	731	277	589	307	167	49		
1988		85	29	964	336	464	261	208	45	78	43
1989		401	77	3,077	1,324	401	77	1,097	266	2,450	29
1990		34	29	932	301	408	105	454	69	56	20
1991		16	29	580	900	92	88			49	38
1992		62	24	1,832	1,098	344	56			135	31
1993		42	24	1,268	435	130	113			49	130
1994	Top	47	34	6,525	4,355	198	144			220	150
	Bottom			1,266	243						
1995	Top	62	49	786	660	197	169			124	134
	Bottom			406	280						
1996	Top	25	11	587	1,785	177	387			41	15
	Bottom			699	219						
1997	Top	3	3	512	1,290	44	17			57	12
	Bottom			388	153						
1998	Top	16	11	1,222	826	116	139			41	58
	Bottom			124	128						

Black cells indicate seasonal averages that exceeded total coliform levels of 2,400CFU/100ml & fecal coliform counts of 200CFU/100ml (New York & New Jersey State bacterial standard limits).

Note: Calcualtion of 1997 seasonal averages 20,000CFU's/100mL was used in place of To-Numerous-To-Count (TNTC) values.

Gateway National Recreation Area Total and Fecal Coliform Averages, 1982-1998



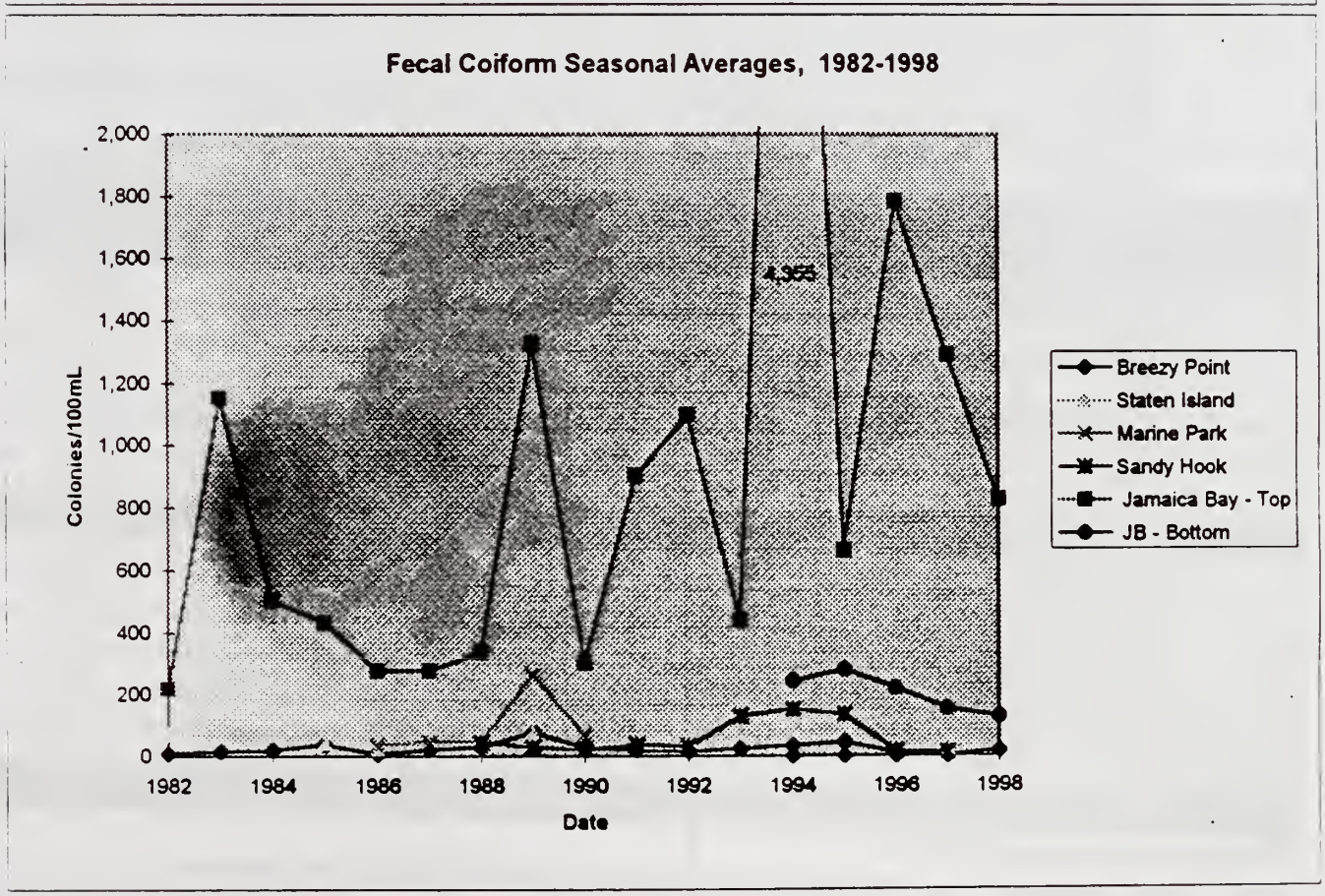


Figure 1

Table III

Sample Days Surpassing Fecal Coliform Criteria, 1998

Sites and Averages		Location	Sample Days		
			Number	# Surpassing Criteria	% Surpassing Criteria
Riis Park	**ALT-1**	Surf	15	0	0%
Breezy Point	**ALT-2**	Surf	15	0	0%
Atlantic Beaches Averages			**15**	**0**	**0%**
Rockaway Inlet	JB-3	Top	14	0	0%
		Bottom	14	0	0%
Nova Scotia Bar	JB-5A	Top	15	1	6.67%
		Bottom	15	0	0%
Canarsie Pier	JB-6	Top	15	3	20.0%
		Bottom	15	2	13.33%
Pennsylvania Avenue Landfill	JB-6A	Top	15	5	33.33%
		Bottom	15	4	26.67%
Bergen Basin	JB-16	Top	15	15	100.00%
		Bottom	15	5	33.33%
Bergen Basin Outflow	JB-9A	Top	15	8	53.33%
		Bottom	15	3	20.00%
Grassy Bay	JB-9	Top	15	5	33.33%
		Bottom	15	1	6.67%
JoCo Marsh	JB-12	Top	15	1	6.67%
		Bottom	15	0	0%
Beach Channel	JB-15	Top	15	0	0%
		Bottom	15	1	6.67%
Jamaica Bay Averages		Top	14.9	4.22	28.36%
		Bottom	14.9	1.78	11.94%
Fort Wadsworth	SI-1	Surf	20	1	5.00%
New Dorp Beach	SI-4	Surf	20	2	10.00%
Oakwood Beach	SI-5	Surf	20	5	25.00%
Great Kills	**SI-6**	Surf	20	6	30.00%
Crooke's Point	SI-7	Surf	20	1	5.00%
Great Kills Marina	SI-8	Dock	20	1	5.00%
Staten Island Averages			**20**	**2.67**	**13.33%**
Plum Island	SH-1	Surf	16	0	0%
Spermaceti Cove	SH-2	Surf	16	4	25.00%
Lot D	**SH-3**	Surf	16	0	0%
Gunnison Beach	**SH-4**	Surf	16	0	0%
North Beach	**SH-5**	Surf	16	0	0%
Horseshoe Cove	SH-6	Surf	15	0	0%
Sandy Hook Averages			**16**	**0.67**	**4.21%**

Bathing beach sites are in **Bold** face.

Note: Great Kills bathing beach was closed during 1998 due to elevated bacterial contamination. All other bathing areas remained opened in 1998.

Percentage of Sample Days Surpassing Fecal Coliform Criteria, 1998

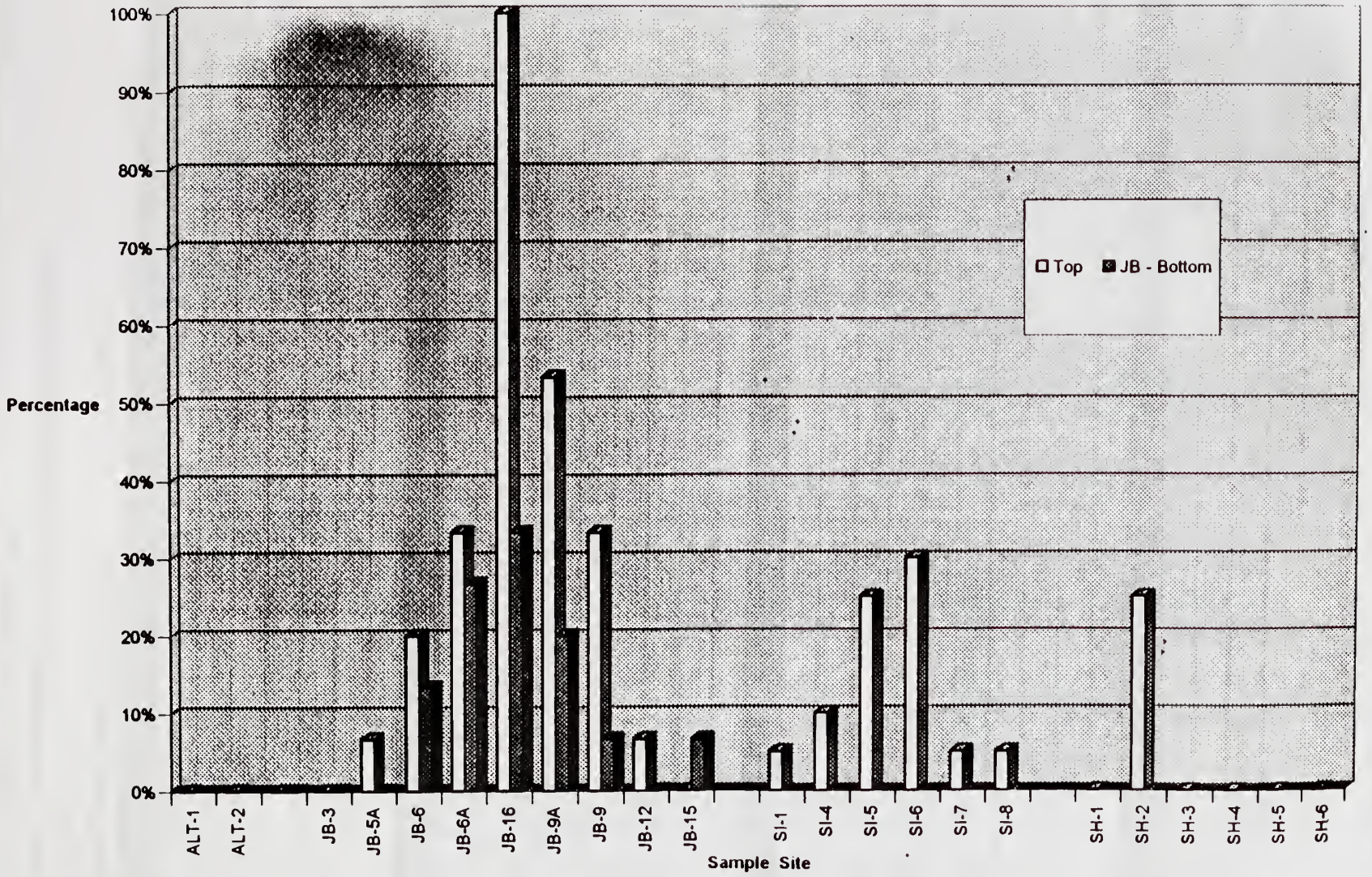


Table IV

Gateway National Recreation Area
Percentage of Total & Fecal Coliform Samples that Exceeded State & Federal Standards, 1996-1998

		% of Total Coliform Samples			% of Fecal Coliform Samples		
Location	Site	1996	1997	1998	1996	1997	1998
Riis Park	ATL-1	0	0	0	0	0	0
Breezy Point	ATL-2	0	0	0	0	0	0
Atlantic Beach Averages	All	0%	0%	0%	0%	0%	0%
Rockaway Inlet	JB-3	0	4	0	0	0	0
)va Scotia Bar	JB-5A	4	0	0	4	0	3
Canarsie Pier	JB-6	15	0	3	8	7	17
Pennsylvania Avenue Landfill	JB-6A	4	11	3	23	14	30
Bergen Basin	JB-16	15	7	18	58	54	67
Bergen Basin Outflow	JB-9A	23	18	7	46	43	37
Grassy Bay	JB-9	12	11	3	27	18	20
JoCo Marsh	JB-12	4	0	0	8	4	3
Beach Channel	JB-15	8	0	0	15	0	3
Jamaica Bay Averages	All	9%	6%	4%	21%	16%	20%
Fort Wadsworth	SI-1	8	0	0	8	0	5
South Beach	SI-2	-----	-----	-----	-----	-----	-----
Midland Beach	SI-3	-----	-----	-----	-----	-----	-----
New Dorp Beach	SI-4	0	0	5	0	0	10
Oakwood Beach	SI-5	0	0	0	8	0	25
Great Kills Beach	SI-6	0	0	0	25	7	30
Crooke's Point	SI-7	0	0	0	8	0	5
Great Kills Marina	SI-8	0	0	0	0	0	5
Staten Island Averages	All	1%	0%	1%	8%	1%	13%
Plum Island	SH-1	-----	-----	0	-----	-----	0
Spermaceti Cove	SH-2	0	0	0	8	0	25
Lot D	SH-3	0	0	0	0	0	0
Gunnison Beach	SH-4	0	0	0	0	0	0
North Beach	SH-5	0	0	0	0	8	0
Horseshoe Cove	SH-6	-----	-----	0	-----	-----	0
Sandy Hook Averages	All	0%	0%	0%	2%	2%	4%

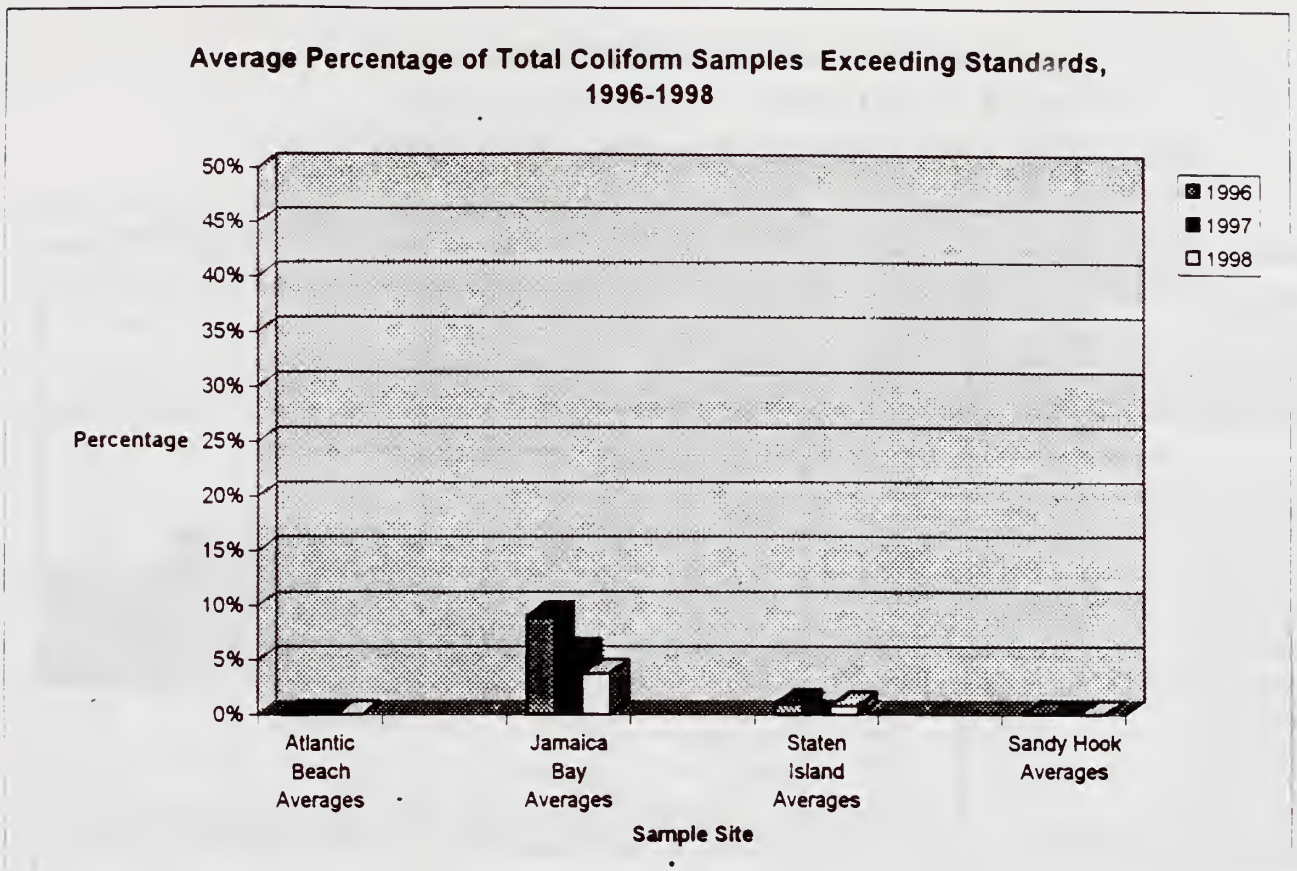
Bathing beach sites are in **Bold** face.

No Data: ------

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

Approximate testing dates from June through the beginning of September, weekly sampling only.

Percentage of Total and Fecal Coliform Samples Exceeding Federal Standards, 1996-1998



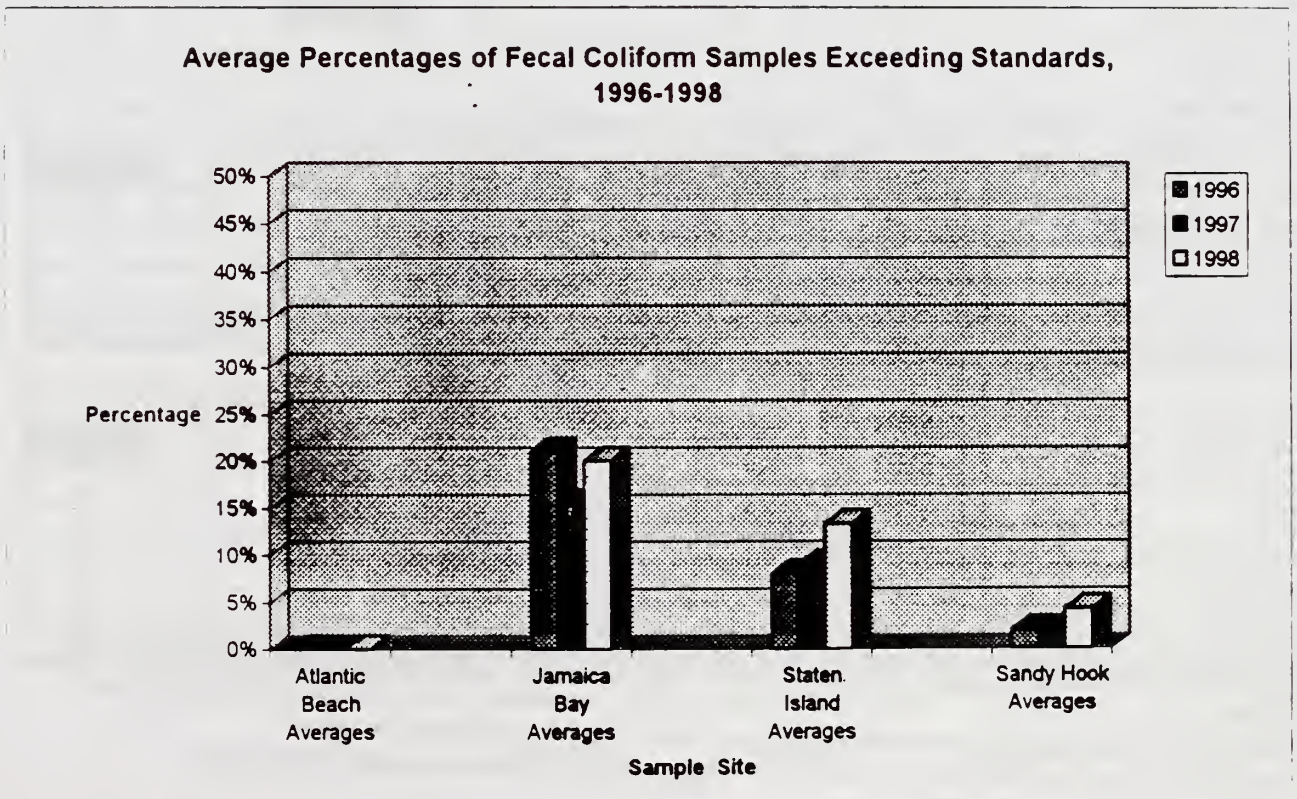


Figure 3

Table V

Gateway National Recreation Area
Total & Fecal Coliform Seasonal Averages:
Both Top and Bottom Samples, 1996 - 1998

		Total Coliform Averages			Fecal Coliform Averages		
Location	Site	1996	1997	1998	1996	1997	1998
Riis Park	ATL-1	36	11	10	12	4	7
Breezy Point	ATL-2	13	5	22	9	2	13
Atlantic Beach Averages	**All**	**25**	**8**	**16**	**11**	**3**	**10**
Rockaway Inlet	JB-3	113	266	2	1	1	14
Nova Scotia Bar	JB-5A	344	37	13	29	6	33
Canarsie Pier	JB-6	827	203	193	286	758	167
Pennsylvania Avenue Landfill	JB-6A	687	667	302	3,209	894	721
Bergen Basin	JB-16	902	847	2,975	3,749	2,462	2,234
Bergen Basin Outflow	JB-9A	1,455	1,182	2,369	850	1,763	898
Grassy Bay	JB-9	682	666	270	668	151	124
JoCo Marsh	JB-12	266	81	11	35	21	30
Beach Channel	JB-15	441	50	20	114	11	40
Jamaica Bay Averages	**All**	**635**	**444**	**684**	**993**	**674**	**473**
Fort Wadsworth	SI-1	493	35	101	2,011	4	86
South Beach	SI-2	-----	-----	-----	-----	-----	-----
Midland Beach	SI-3	-----	-----	-----	-----	-----	-----
New Dorp Beach	SI-4	161	27	210	38	8	88
Oakwood Beach	SI-5	112	56	80	36	17	351
Great Kills Beach	SI-6	163	75	195	188	41	188
Crooke's Point	SI-7	100	56	53	40	21	71
Great Kills Marina	SI-8	33	17	55	7	8	49
Staten Island Averages	**All**	**177**	**44**	**116**	**387**	**17**	**139**
Plum Island	SH-1	-----	-----	22	-----	-----	41
Spermaceti Cove	SH-2	40	47	177	36	22	223
Lot D	SH-3	23	0	0	13	0	6
Gunnison Beach	SH-4	13	9	19	11	7	9
North Beach	SH-5	89	172	6	9	20	13
Horseshoe Cove	SH-6	-----	-----	23	-----	-----	53
Sandy Hook Averages	**All**	**41**	**57**	**41**	**17**	**12**	**58**

No Data: ----- 20,000 CFU's/100mL FCC were used for TNTC values in calulations.

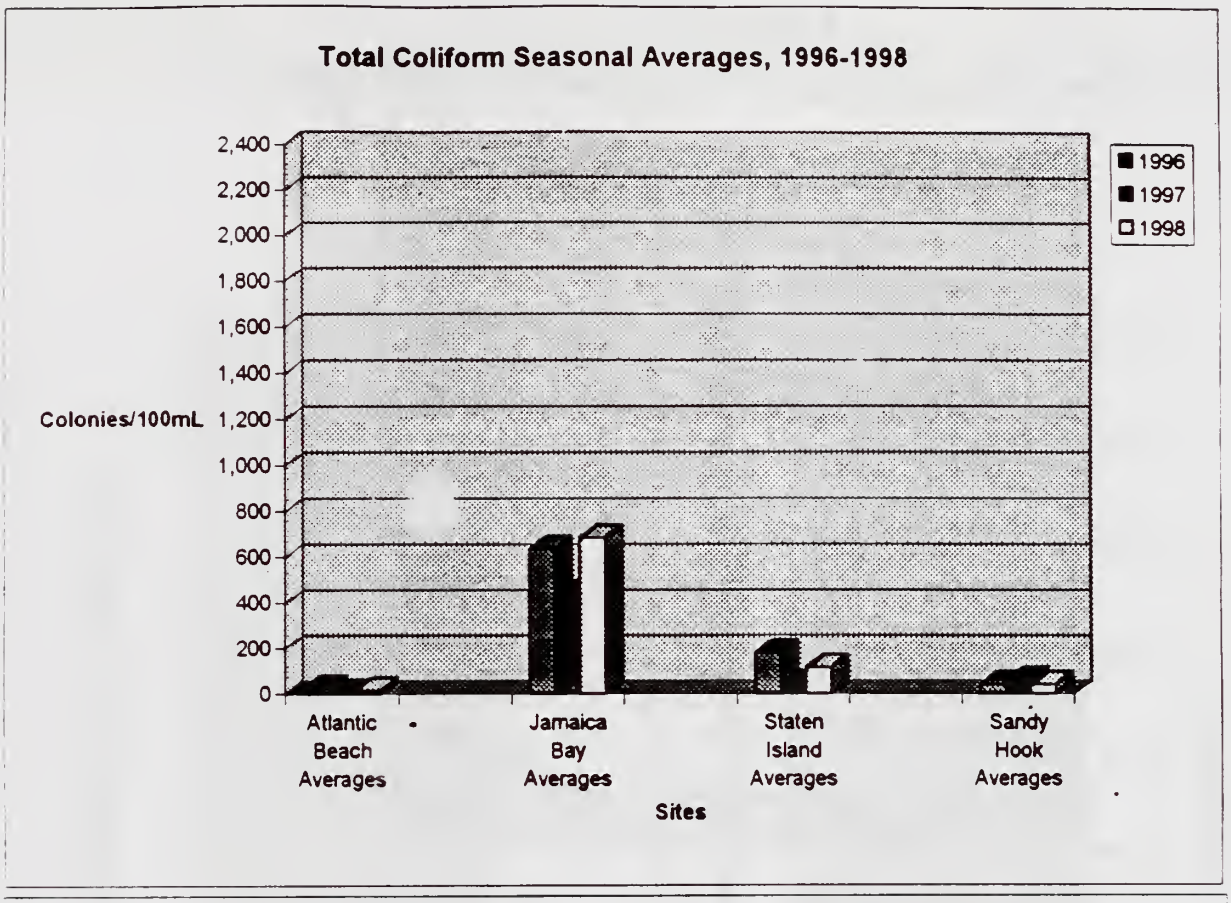
Black cells indicate samples that exceeded total coliform counts of 2,400/100mL and fecal coliform counts of 200/100mL (New York & New Jersey State bacterial standard limits).

Bathing beach sites are in **Bold** face.

Jamaica Bay percent averages are of both top and bottom samples, all other samples are top samples.

Approximate testing dates run from June through the beginning of September, with weekly sampling.

Gateway N.R.A. Average Total and Fecal Coliform Counts, 1996 - 1998



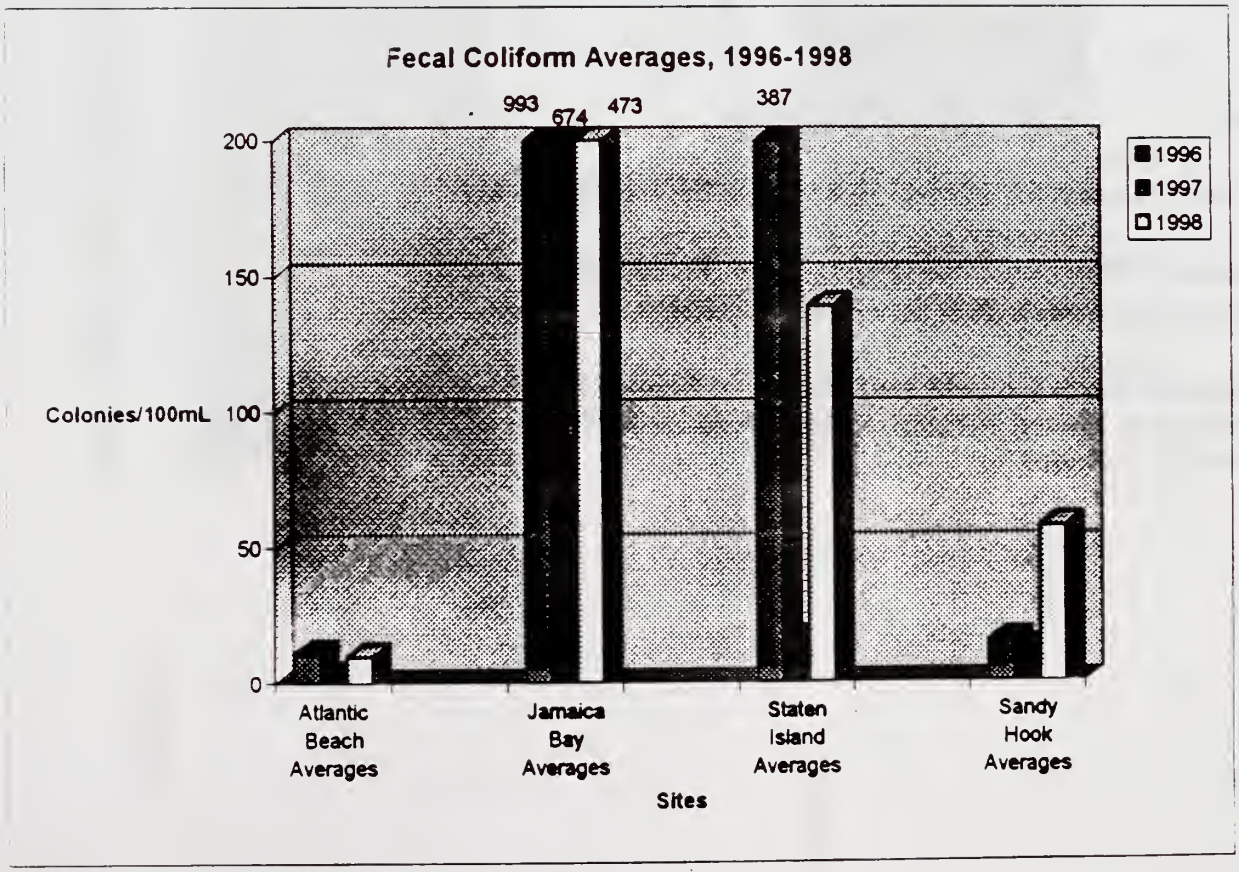


Figure 4

Table VI

June, July, & August Precipitation, 1986-1998

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	2.5	3.51	12.36	18.37
1991	-----	-----	-----	-----
1992	0.08	0.24	0.23	0.55
1993	0.1	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
1997	2.10	2.07	5.92	10.09
1998	5.62	0.97	2.78	9.37
Average	3.03	3.74	4.16	10.90

No Data: ----- **All values are in inches.**

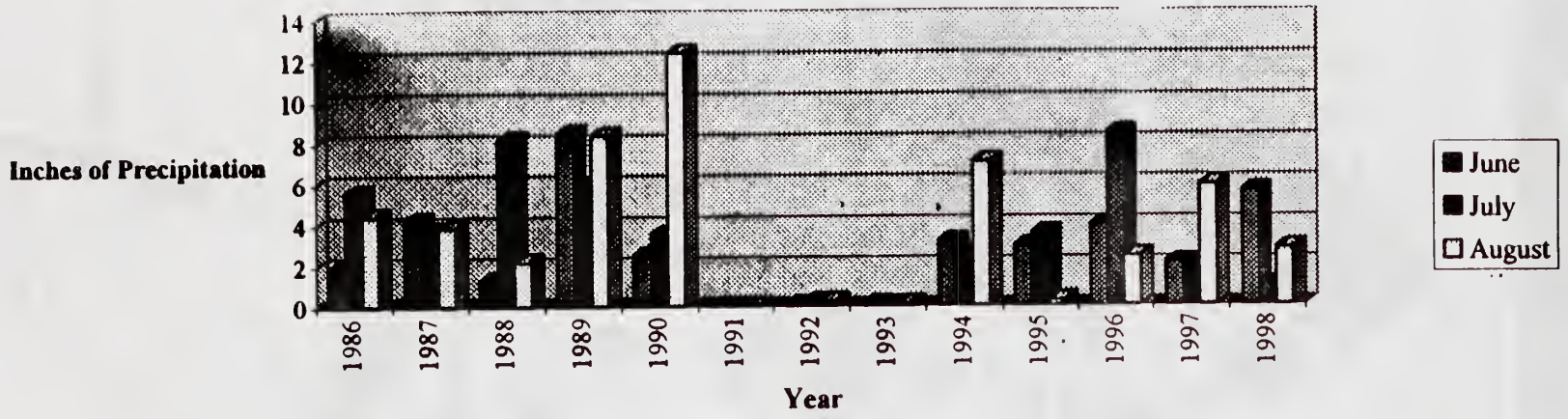
Precipitation amounts for 1986-1990 are from the New York Area.

Precipitation amounts for 1992-1997 are from Floyd Bennett Field, taken from Gateway's N.R.A weather station.

Precipitation amounts for 1998 are from Floyd Bennett Field,
and JFK Airport **(Station # 94789), Both stations are in NY.**
http://www.ncdc.**noaa.gov**

June, July and August Precipitation, 1986-1998

Figure 5



Precipitation Totals: 72 Hours, Preceding Sample Collection Dates

Figure 6

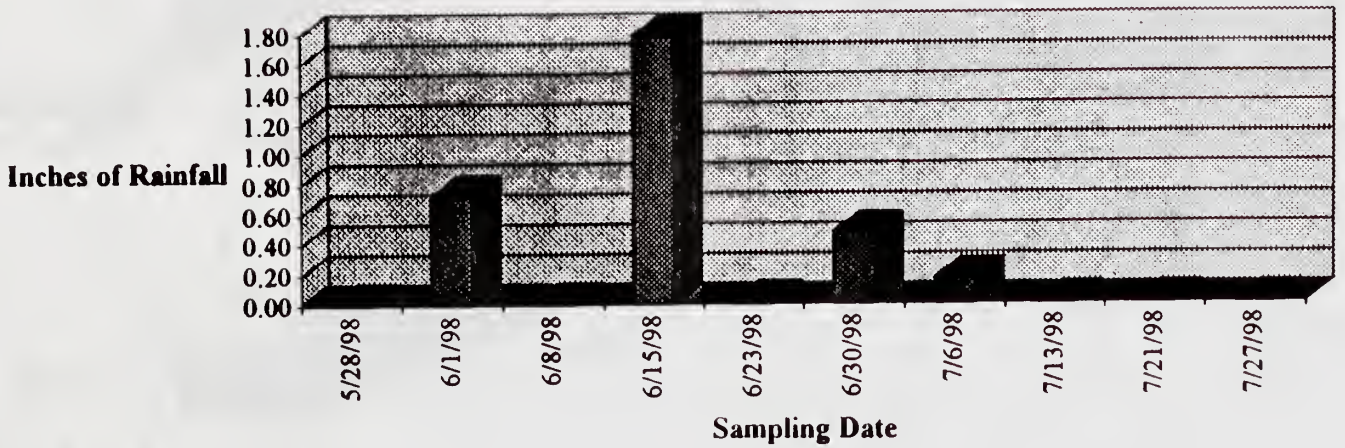
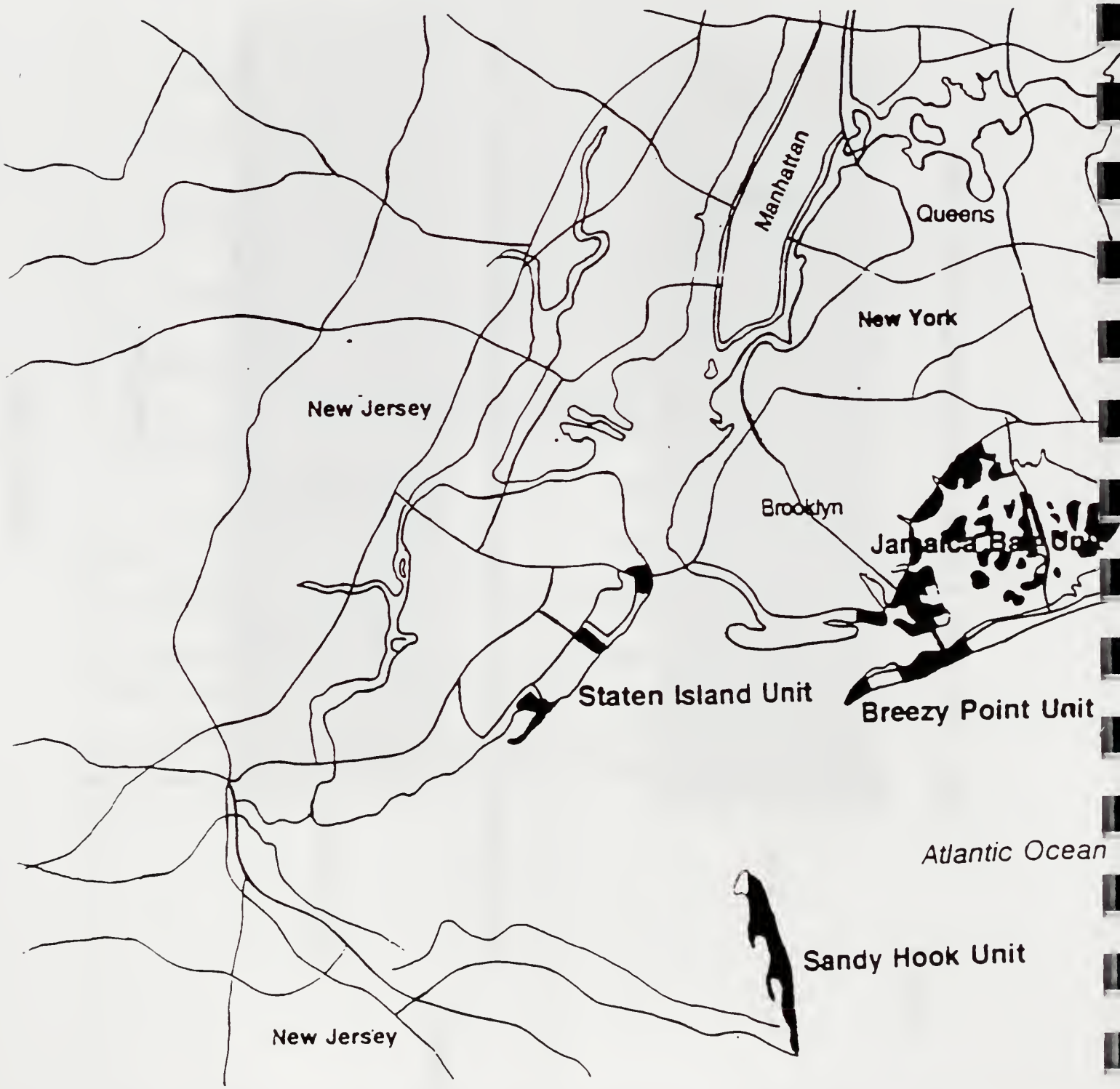
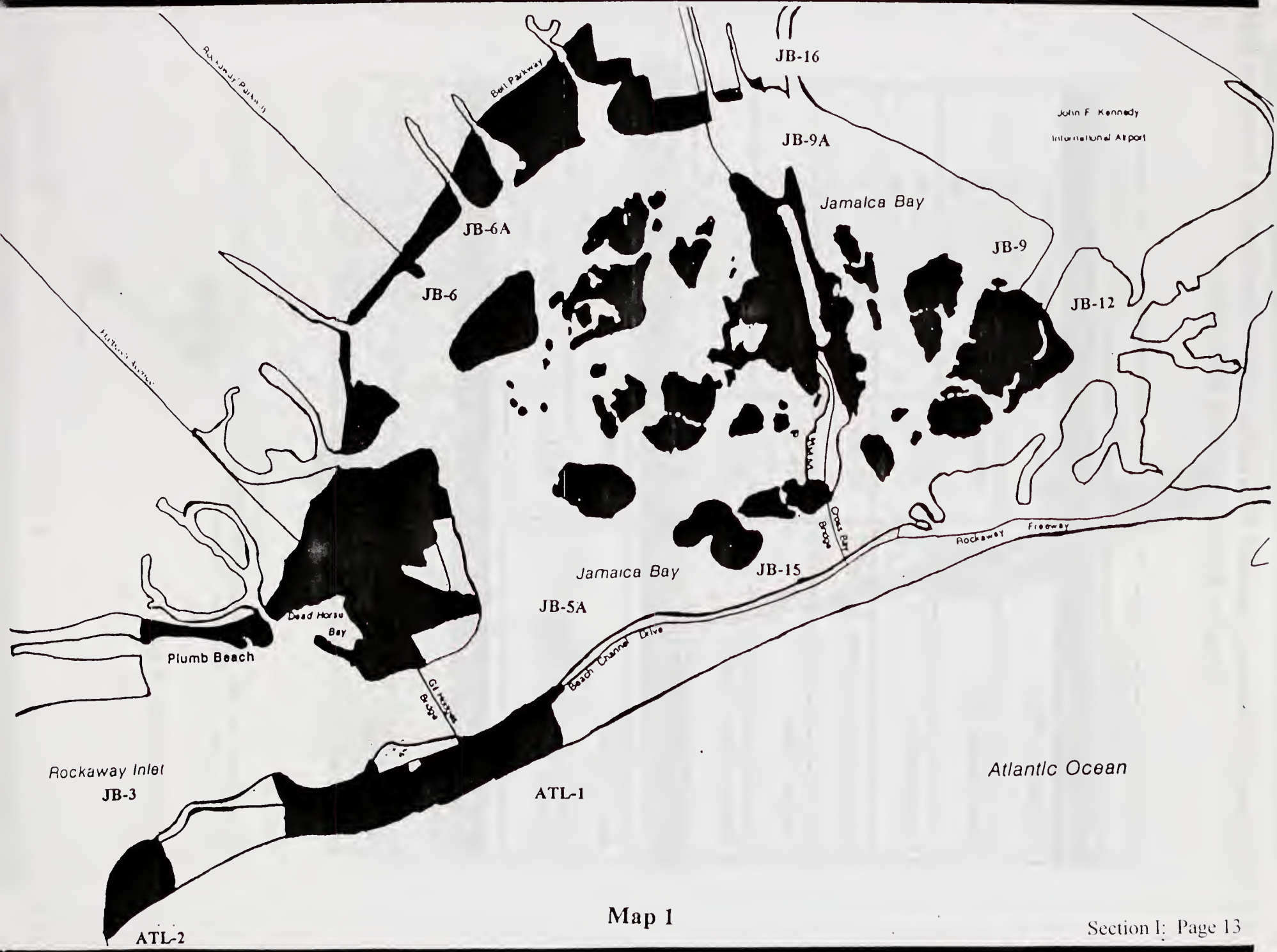


Figure 5 and 6

Gateway


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


JB-16
Belt Parkway
JB-9A
John F. Kennedy
International Airport
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
Beach Channel Drive
Rockaway Inlet
JB-3
ATL-1
Atlantic Ocean
ATL-2

Map 1

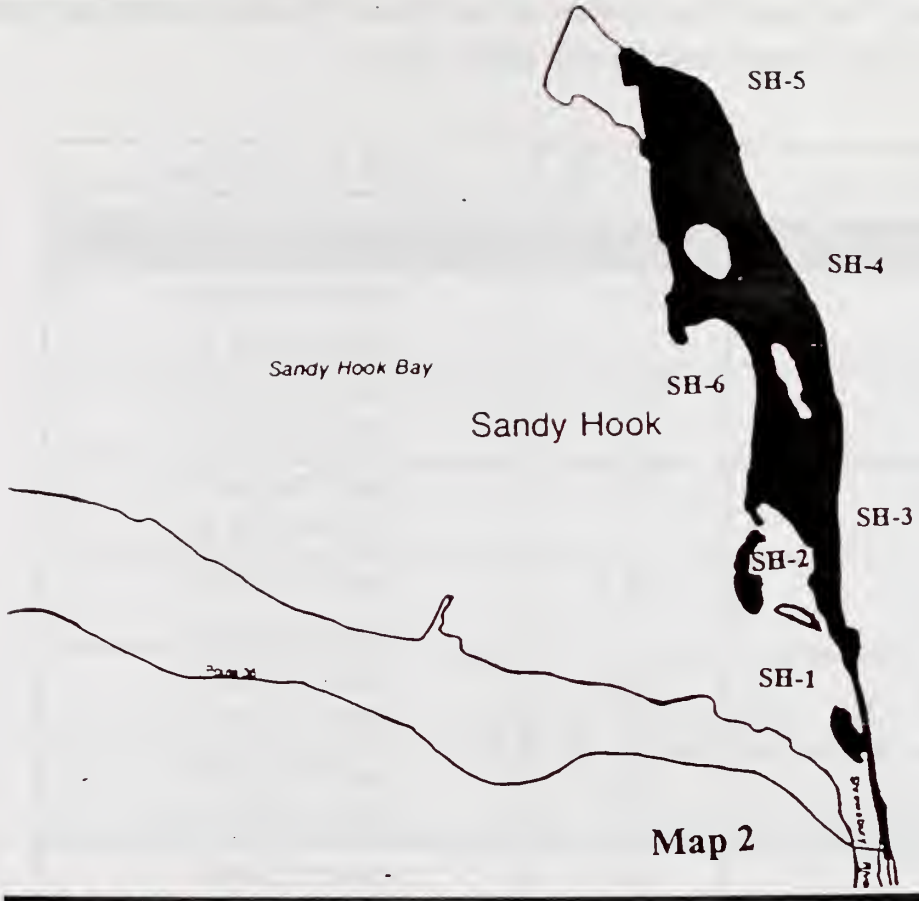
G.P.S. Positions for Gateway National Recreation Area Water Quality Sampling Site
Jamaica Bay and Atlantic Beach Sites

Site Name	Site Code	G.P.S. Position
Jamaica Bay Sites		
Rockaway Inlet	JB-3	040° 33.99 N 073° 56.26 W
Nova Scotia Bar	JB-5A	040° 34.66 N 073° 52.19 W
Canarsie Pier	JB-6	040° 37.66 N 073° 52.96 W
Pennsylvania Avenue Landfill	JB-6A	040° 38.30 N 073° 52.66 W
Bergen Basin	JB-16	040° 39.21 N 073° 49.34 W
Bergen Basin Outflow	JB-9A	040° 38.47 N 073° 49.21 W
Grassy Bay	JB-9	040° 38.08 N 073° 47.39 W
JoCo Marsh	JB-12	040° 37.43 N 073° 46.44 W
Beach Channel	JB-15	040° 35.17 N 073° 49.86 W
Atlantic Beach Sites		
Riis Park	ATL-1	040° 33.93 N 073° 52.12 W
Breezy Point	ATL-2	040° 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.

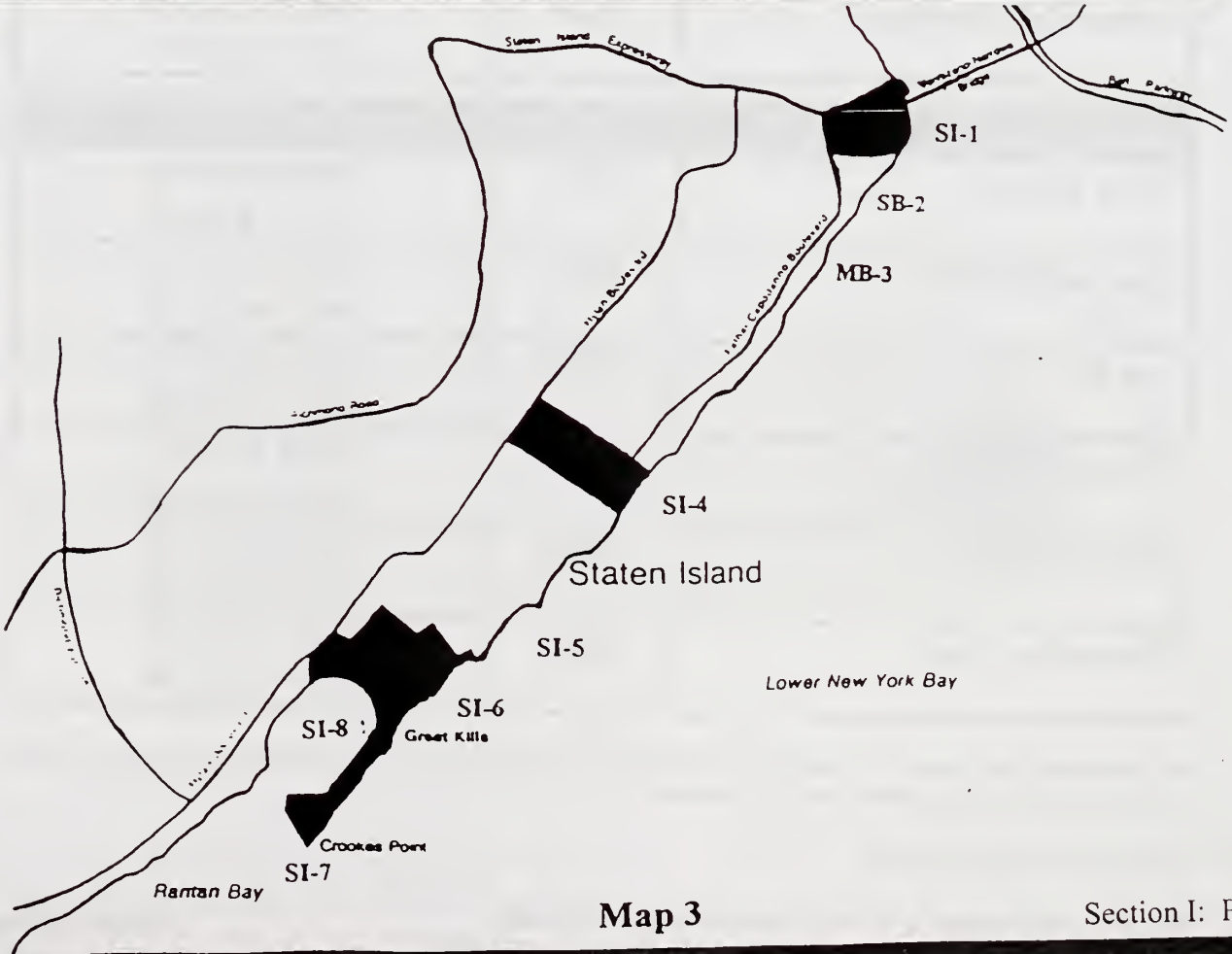
Bathing Beach Sites are shaded.

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	040° 35.84 N 074° 03.42 W
South Beach	SI-2	040° 35.37 N 074° 03.91 W
Midland Beach	SI-3	040° 34.34 N 074° 05.09 W
New Dorp Beach	SI-4	040° 33.78 N 074° 05.68 W
Oakwood Beach	SI-5	040° 33.06 N 074° 06.79 W
Great Kills	SI-6	040° 32.20 N 074° 07.85 W
Crooke's Point	SI-7	040° 31.84 N 074° 08.28 W
Great Kills Marina	SI-8	040° 32.62 N 074° 07.67 W
Sandy Hook Sites		
Plum Island	SH-1	040° 23.51 N 073° 58.39 W
Spermaceti Cove	SH-2	040° 25.41 N 073° 59.17 W
Lot D	SH-3	040° 25.39 N 073° 59.00 W
Gunnison Beach	SH-4	040° 27.45 N 073° 59.29 W
North Beach	SH-5	040° 28.13 N 073° 59.53 W
Horseshoe Cove	SH-6	040° 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 were not tested in 1996-98 due to budgetary constraints.
SH-1, and SH-6 were not tested in 1996-97 due to budgetary constraints.

SECTION II

Jamaica Bay Cumulative Data For 1998 (Listed Numerically)

Table VII

Environmental Water Quality Monitoring

Jamaica Bay: Rockaway Inlet [JB-3], 1998

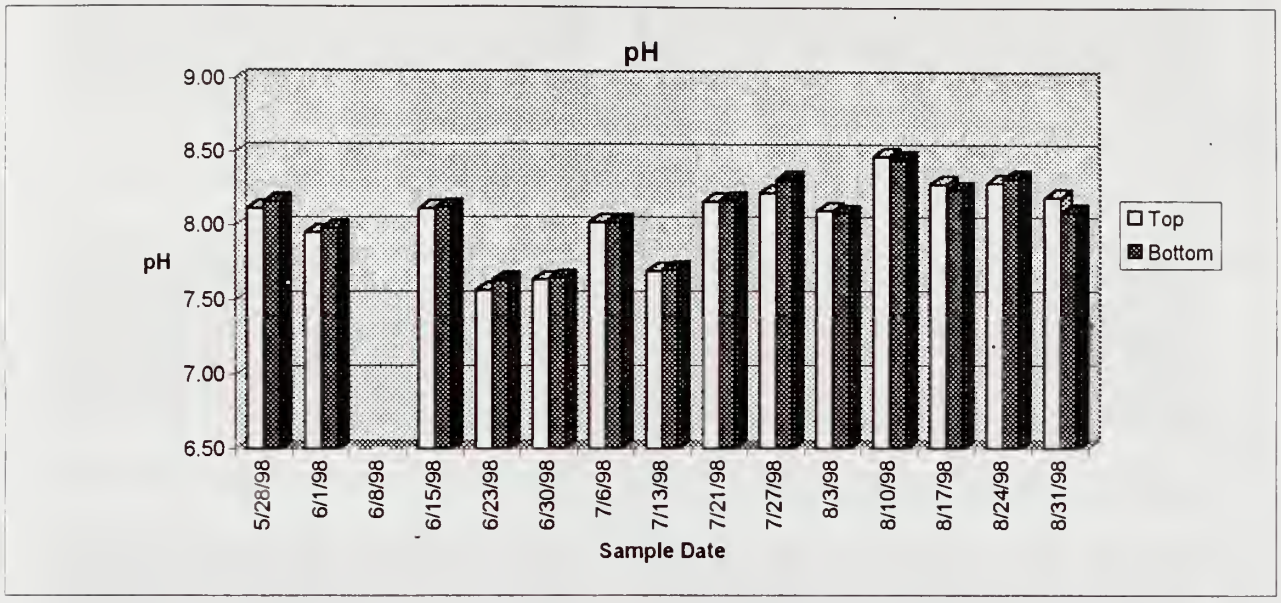
			Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
Date	Time	Tide		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:30 AM	H	15.5	14.3	14.5	19.6	19.8	8.11	8.16	31.8	31.9	9.56	8.46	----	----
6/1/98	01:30 PM	H	17.4	18.8	----	18.4	19.0	7.95	7.98	29.7	30.6	8.96	7.99	----	----
6/8/98	----		----	----	----	----	----	----	----	----	----	----	----	----	----
6/15/98	12:11 PM	H	17.5	16.3	16.2	19.7	19.7	8.11	8.12	31.7	31.7	6.09	7.72	----	----
6/23/98	10:19 AM	M	20.3	20.0	20.0	21.6	21.5	7.56	7.63	34.3	34.1	6.76	7.62	----	----
6/30/98	10:00 AM	M	21.1	20.9	20.9	19.6	19.7	7.63	7.64	31.4	31.5	7.29	8.04	----	----
7/6/98	10:15 AM	M	21.7	19.9	20.0	20.7	20.7	8.02	8.02	33.0	32.9	7.31	5.75	----	----
7/13/98	10:30 AM	H	20.6	19.7	19.4	21.3	21.4	7.69	7.70	33.8	34.0	6.67	7.47	----	0.02
7/21/98	02:23 PM	L	23.4	22.8	22.6	20.5	20.4	8.16	8.17	32.6	32.6	6.70	6.56	----	----
7/27/98	10:40 AM	H	24.5	21.5	21.6	20.9	21.6	8.22	8.31	33.3	34.2	7.33	7.25	----	----
8/3/98	10:50 AM	L	21.4	23.2	22.7	20.3	19.4	8.10	8.08	32.2	31.0	5.84	5.21	----	----
8/10/98	10:10 AM	H	25.4	25.2	25.0	21.2	21.3	8.47	8.45	33.4	33.7	7.08	6.24	----	----
8/17/98	11:20 AM	L	25.7	25.4	25.2	20.0	20.7	8.28	8.24	31.8	32.9	6.32	4.85	----	----
8/24/98	10:35 AM	H	25.1	23.9	23.8	20.8	21.0	8.29	8.32	31.8	32.9	7.48	7.25	----	----
8/31/98	10:35 AM	L	25.9	25.4	25.0	19.6	20.0	8.19	8.09	31.8	32.9	7.05	5.50	0.17	0.09

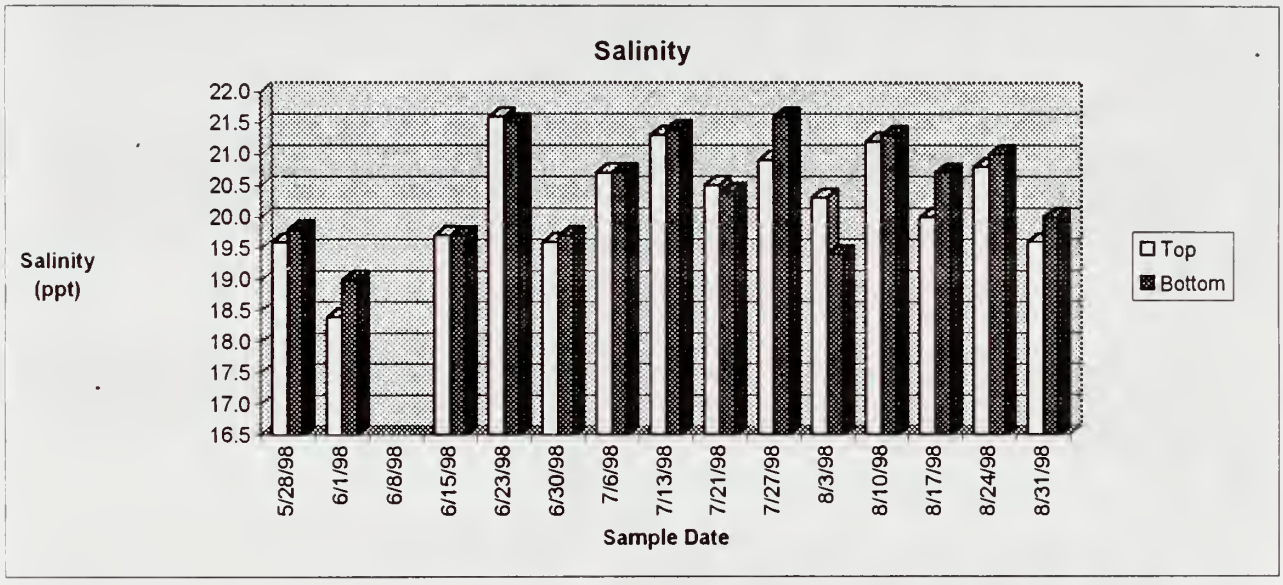
			Secchi Disk	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
Date	Time	Tide	(meters)	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:30 AM	H	5.1	----	----	----	----	----	----	----	----	0	0	0	0
6/1/98	01:30 PM	H	3.3	----	----	----	----	----	----	----	----	0	0	200	0
6/8/98			----	----	----	----	----	----	----	----	----	----	----	----	----
6/15/98	12:11 PM	H	2.5	----	----	----	----	----	----	0.0	0.0	0	0	0	0
6/23/98	10:19 AM	M	3.5	----	----	----	----	----	----	----	----	0	0	0	0
6/30/98	10:00 AM	M	2.8	<0.02	<0.02	<0.02	<0.02	0.05	0.06	----	----	0	0	0	200
7/6/98	10:15 AM	M	2.5	----	----	----	----	----	----	22.0	22.0	0	0	0	0
7/13/98	10:30 AM	H	3.2	----	----	----	----	<0.01	<0.01	----	----	0	0	0	0
7/21/98	02:23 PM	L	3.3	----	----	----	----	----	----	0.0	0.0	0	0	0	0
7/27/98	10:40 AM	H	3.9	<0.02	<0.02	<0.02	<0.02	0.08	0.08	----	----	50	0	0	0
8/3/98	10:50 AM	L	3.3	----	----	----	----	----	----	9.4	0.0	0	0	0	0
8/10/98	10:10 AM	H	4.2	----	----	----	----	0.02	0.03	----	----	0	0	0	0
8/17/98	11:20 AM	L	2.8	<0.02	<0.02	<0.02	<0.02	----	----	105.6	21.8	0	0	0	0
8/24/98	10:35 AM	H	4.5	----	----	----	----	0.05	0.04	----	----	0	0	0	0
8/31/98	10:35 AM	L	2.3	<0.02	<0.02	<0.02	<0.02	0.15	0.14	10.6	0.0	0	0	0	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

Rockaway Inlet (JB-3) Water Quality Measurements, 1998





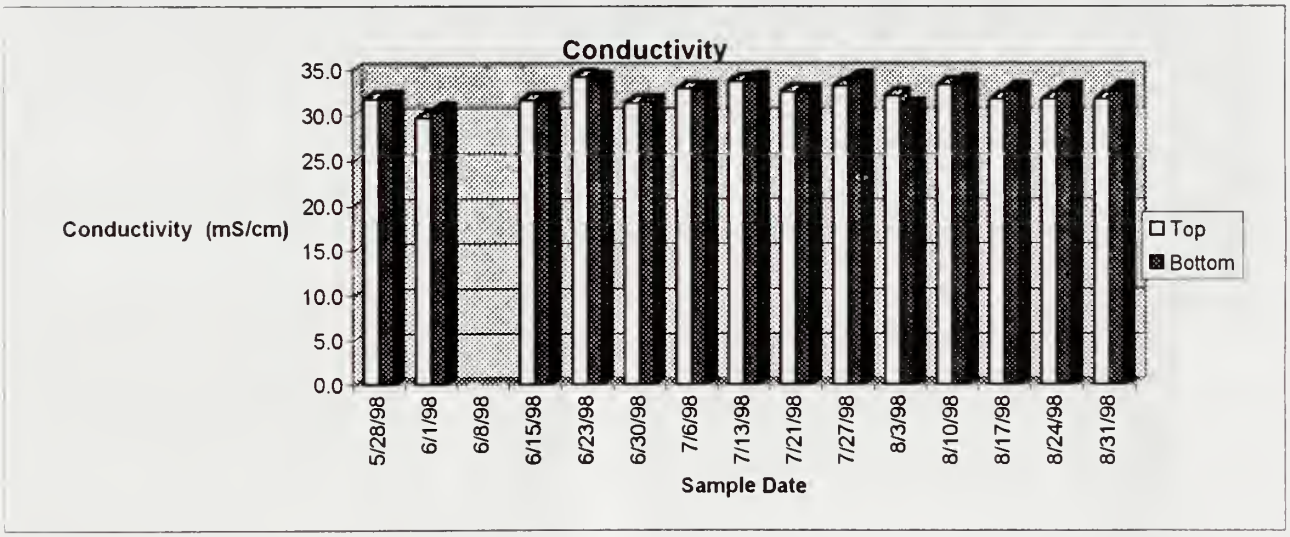
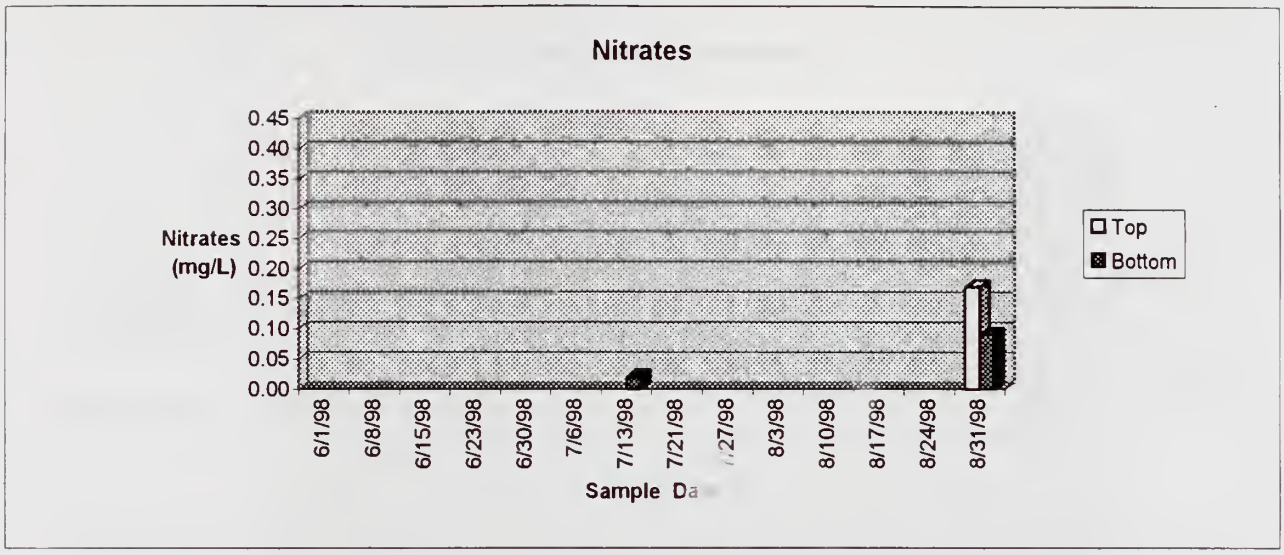
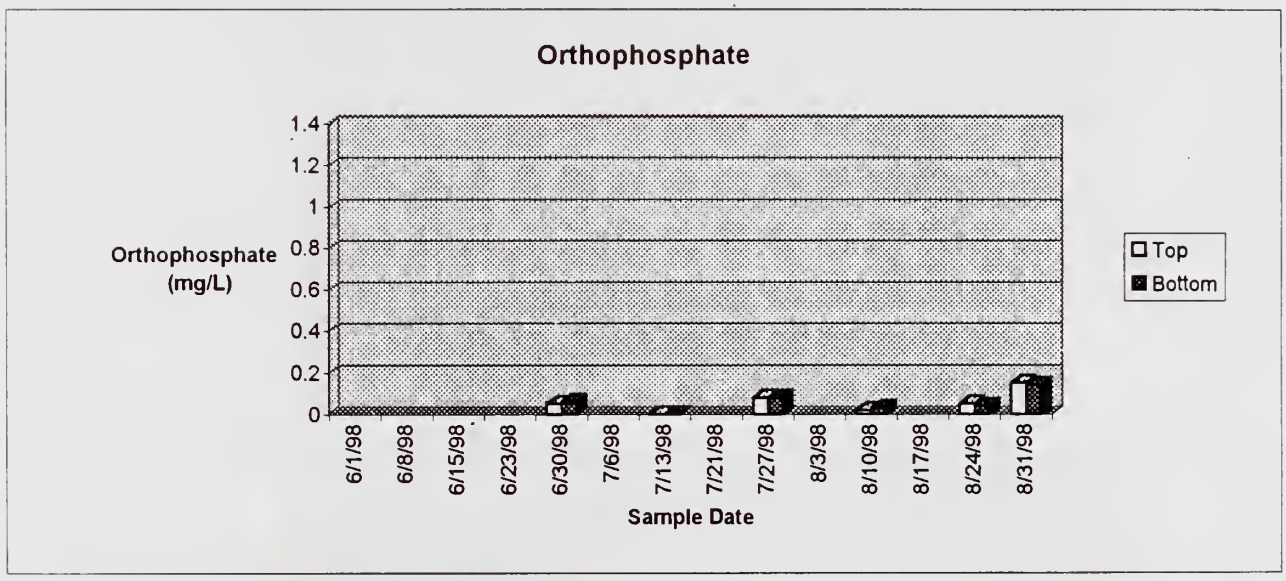


Figure 7

Rockaway Inlet (JB-3) Water Quality Measurements, 1998





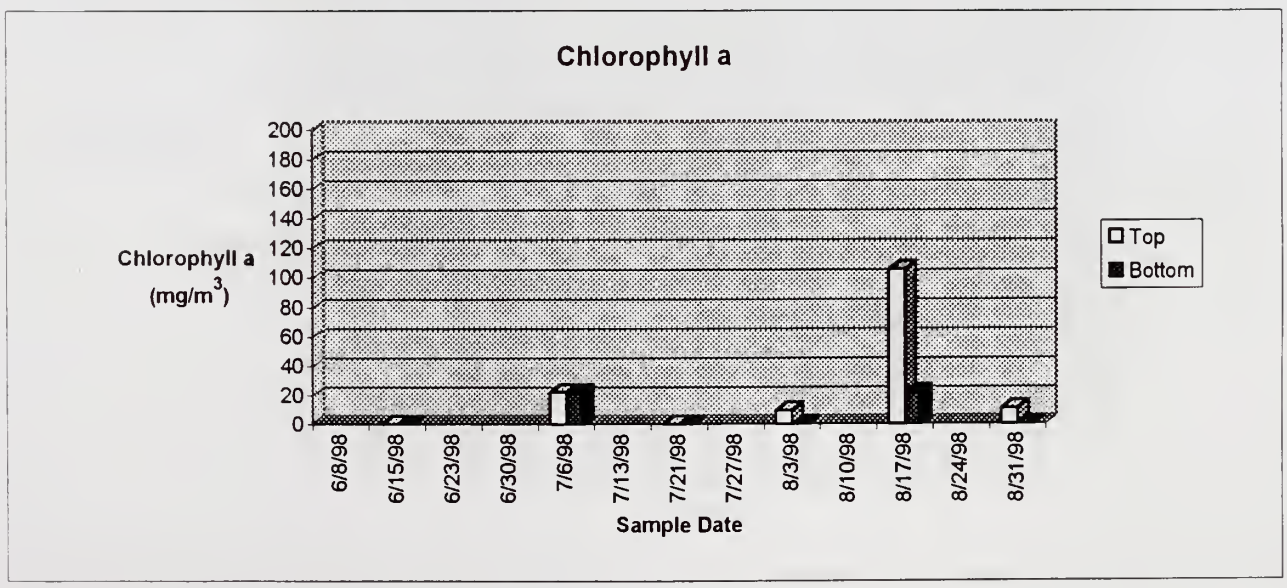
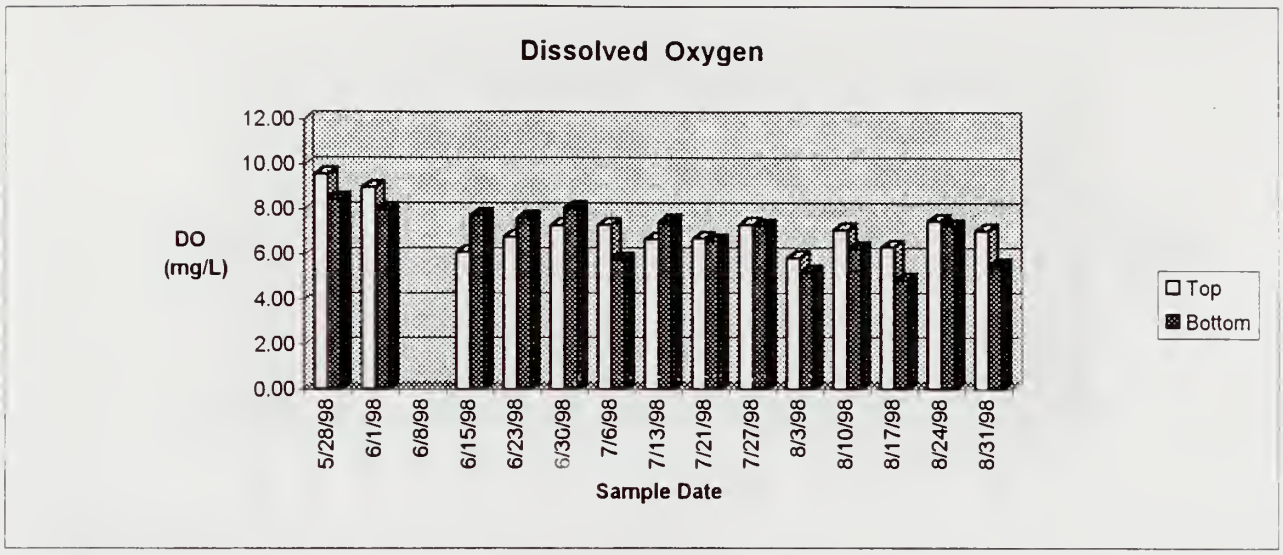
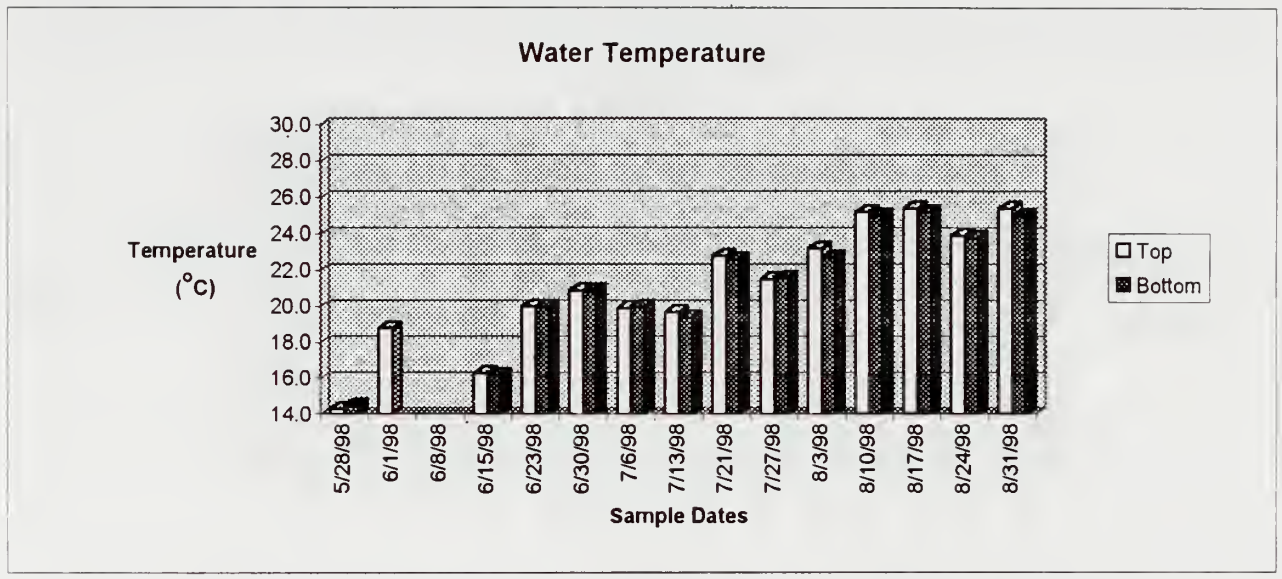


Figure 8

Rockaway Inlet (JB-3) Water Quality Measurements, 1998





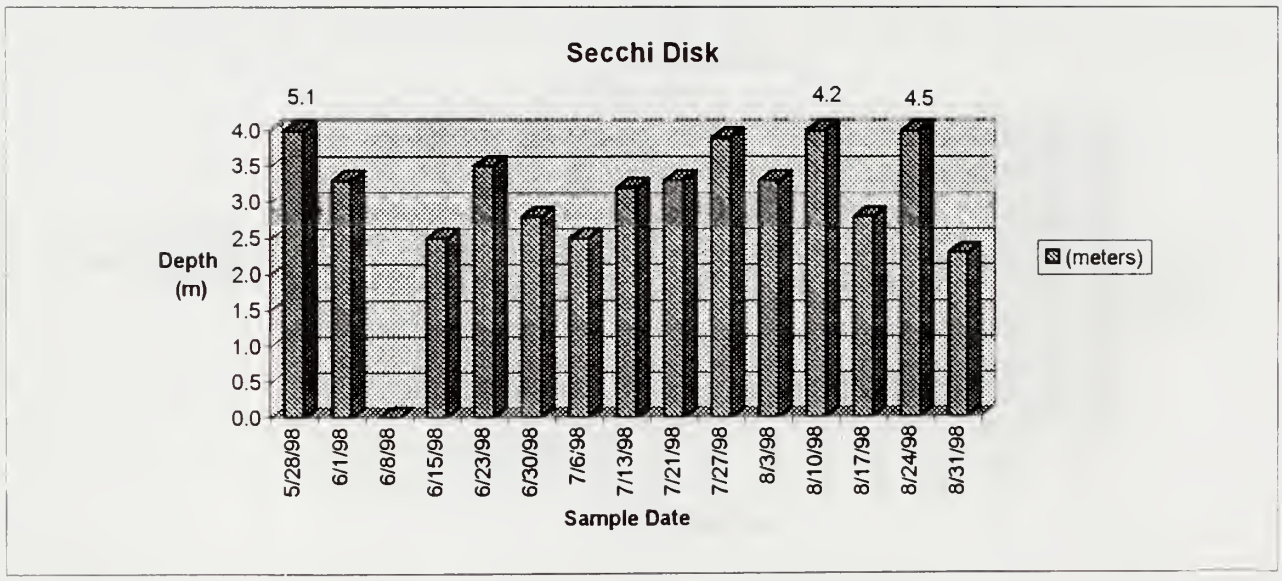
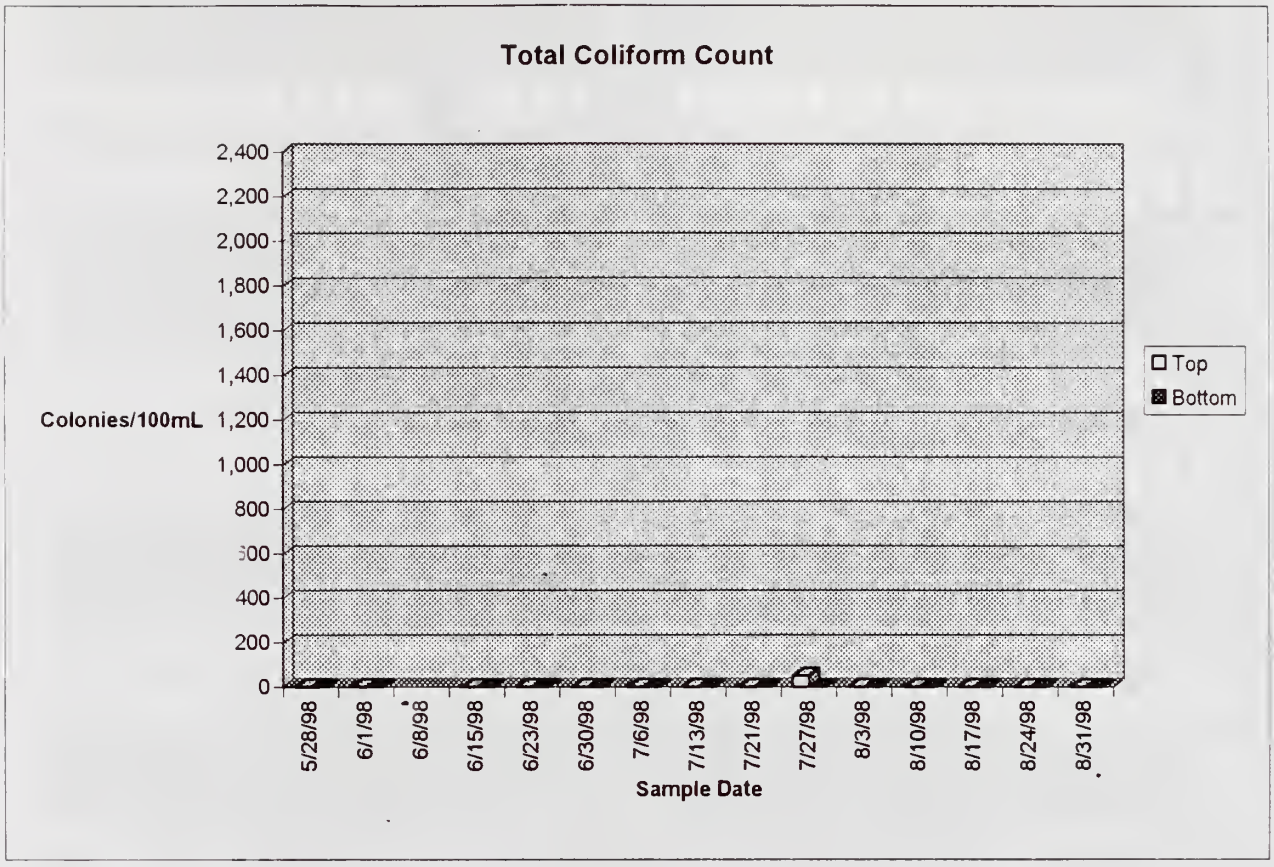


Figure 9

Rockaway Inlet (JB-3) Water Quality Measurements, 1998



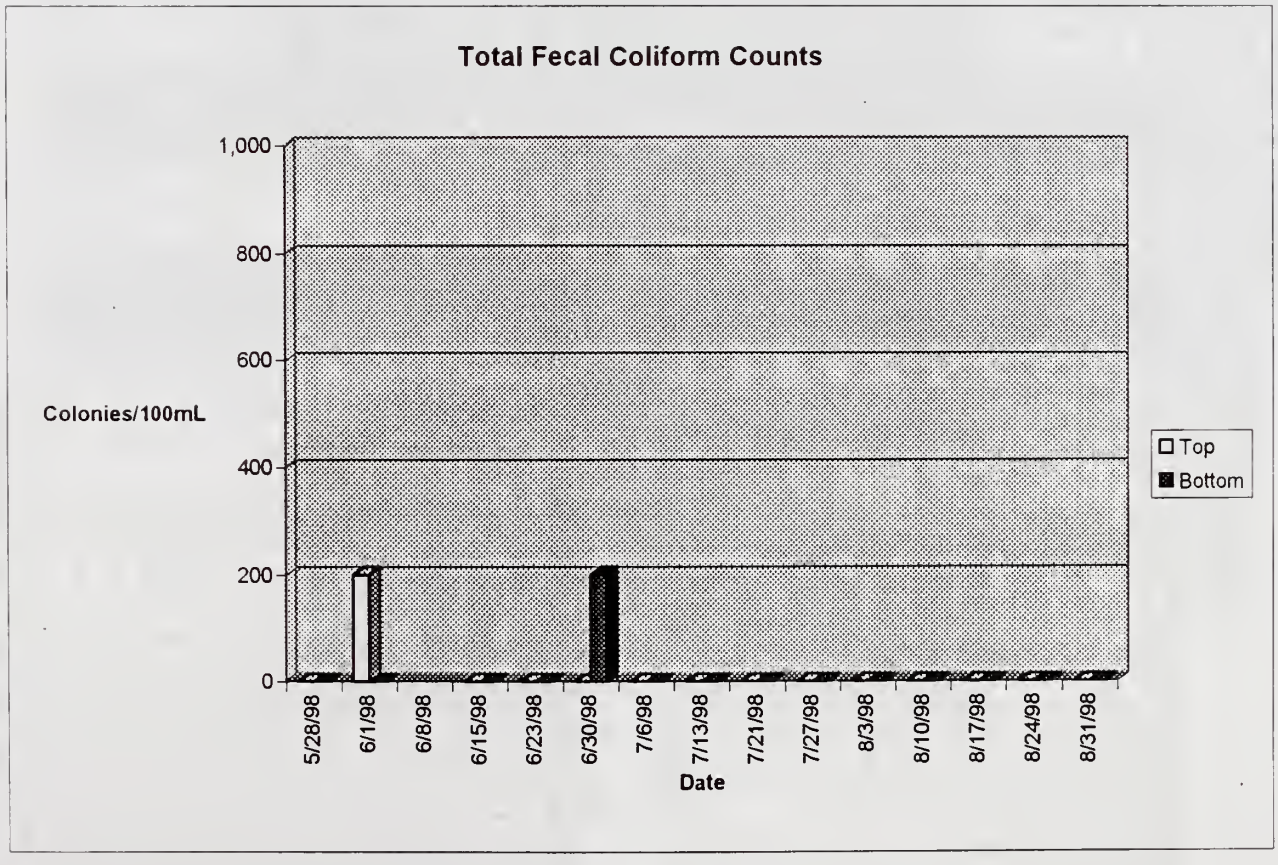


Figure 10

Table VIII

Environmental Water Quality Monitoring

Jamaica Bay: Nova Scotia Bar [JB-5A], 1998

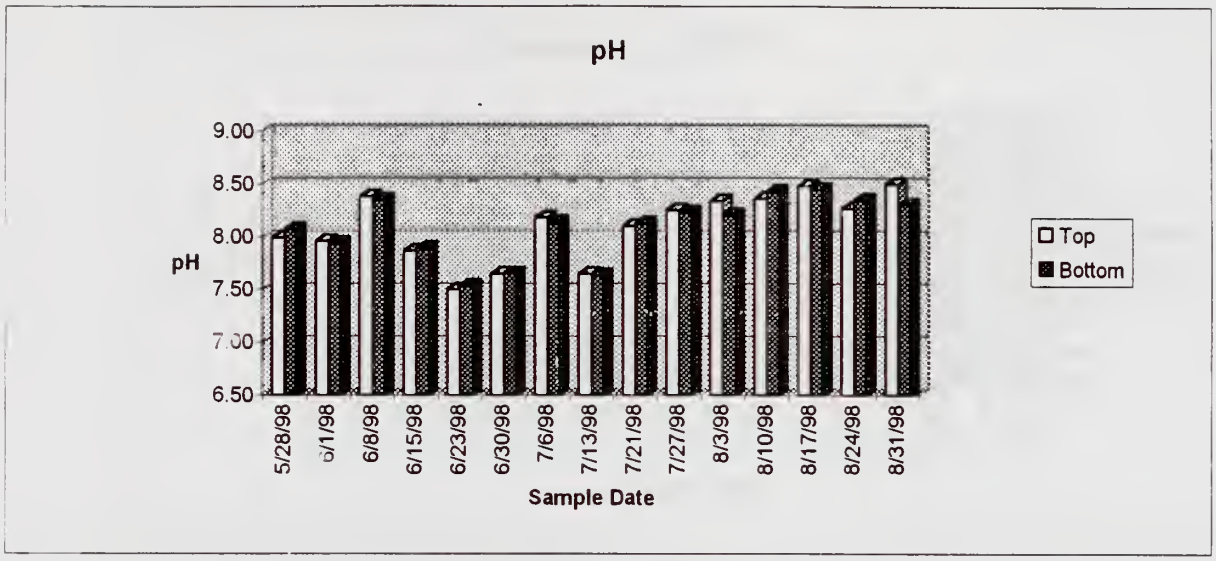
			Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
Date	Time	Tide		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:45 AM	H	15.9	15.6	14.8	18.6	19.4	7.99	8.07	30.5	31.6	7.80	8.75	----	----
6/1/98	01:50 PM	H	16.8	18.6	----	18.4	18.3	7.96	7.94	29.6	29.6	7.89	7.12	----	----
6/8/98	11:30 AM	M	15.1	16.1	16.0	18.1	18.1	8.38	8.35	29.2	29.3	9.52	9.49	----	----
6/15/98	10:00 AM	M	----	17.0	17.2	18.5	18.5	7.87	7.89	29.9	29.9	5.56	6.27	----	----
6/23/98	10:32 AM	M	20.2	20.3	20.2	20.5	20.7	7.50	7.54	32.7	32.4	7.23	6.61	----	----
6/30/98	10:12 AM	M	20.2	21.7	21.7	20.8	20.6	7.65	7.65	32.8	32.8	8.70	7.87	----	----
7/6/98	10:45 AM	M	20.6	22.0	21.3	20.0	20.1	8.18	8.14	31.6	32.0	5.54	5.95	----	----
7/13/98	10:45 AM	H	20.4	20.7	20.5	20.3	20.4	7.65	7.64	32.2	32.5	6.17	7.12	0.20	----
7/21/98	09:00 AM	M	22.9	23.2	22.0	20.1	20.5	8.10	8.13	32.1	32.6	6.14	5.74	----	----
7/27/98	10:50 AM	H	21.9	22.9	22.3	21.0	21.0	8.25	8.23	33.2	33.4	7.05	6.99	----	----
8/3/98	11:00 AM	L	21.7	24.2	23.3	19.9	20.1	8.34	8.21	31.6	32.1	7.80	5.84	----	----
8/10/98	10:25 AM	H	23.9	25.0	25.0	20.7	21.1	8.36	8.43	32.8	33.4	6.45	6.39	----	----
8/17/98	11:35 AM	L	25.5	25.9	25.6	20.0	20.1	8.48	8.45	31.8	32.0	7.77	6.35	----	----
8/24/98	10:50 AM	H	24.3	24.2	23.8	20.6	20.8	8.27	8.35	32.7	33.1	7.24	7.20	----	----
8/31/98	10:50 AM	L	24.5	25.7	25.2	19.8	19.9	8.50	8.31	31.3	31.7	10.94	7.41	0.20	0.15

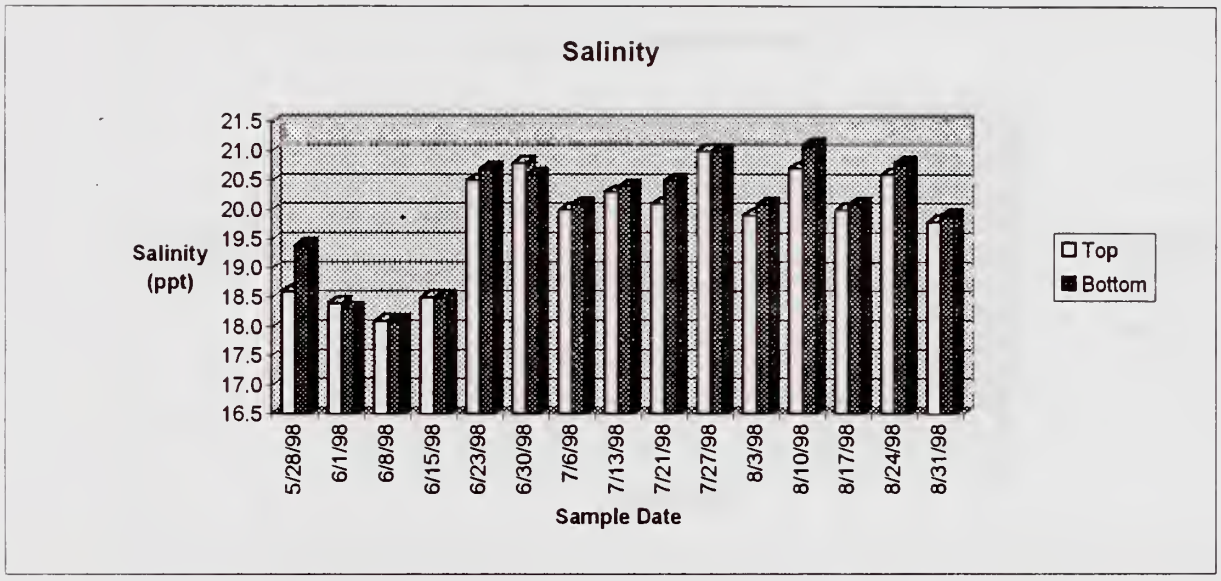
			Secchi Disk	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
Date	Time	Tide	(meters)	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:45 AM	H	2.7	----	----	----	----	----	----	----	----	0	0	0	0
6/1/98	01:50 PM	H	2.2	----	----	----	----	----	----	----	----	0	0	50	50
6/8/98	11:30 AM	M	1.6	----	----	----	----	----	----	----	----	0	0	0	50
6/15/98	10:00 AM	M	3.3	----	----	----	----	----	----	0.0	0.0	0	0	250	200
6/23/98	10:32 AM	M	2.8	<0.02	<0.02	<0.02	<0.02	----	----	----	----	0	0	0	0
6/30/98	10:12 AM	M	2.5	----	----	----	----	0.24	0.07	----	----	0	0	0	0
7/6/98	10:45 AM	M	1.1	----	----	----	----	----	----	69.2	55.2	0	0	50	0
7/13/98	10:45 AM	H	2.7	----	----	----	----	0.05	0.03	----	----	0	0	0	0
7/21/98	09:00 AM	M	2.6	----	----	----	----	----	----	0.0	0.0	0	0	0	0
7/27/98	10:50 AM	H	2.8	<0.02	<0.02	<0.02	<0.02	0.36	0.11	----	----	0	0	0	0
8/3/98	11:00 AM	L	1.4	----	----	----	----	----	----	32.4	0.0	150	100	50	0
8/10/98	10:25 AM	H	2.9	----	----	----	----	0.06	0.04	----	----	0	0	0	0
8/17/98	11:35 AM	L	1.3	<0.02	<0.02	<0.02	<0.02	----	----	47.2	40.9	50	0	150	50
8/24/98	10:50 AM	H	3.3	----	----	----	----	0.07	0.04	----	----	100	0	0	0
8/31/98	10:50 AM	L	1.3	<0.02	<0.02	<0.02	<0.02	0.08	0.11	89.3	26.9	0	0	100	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1998





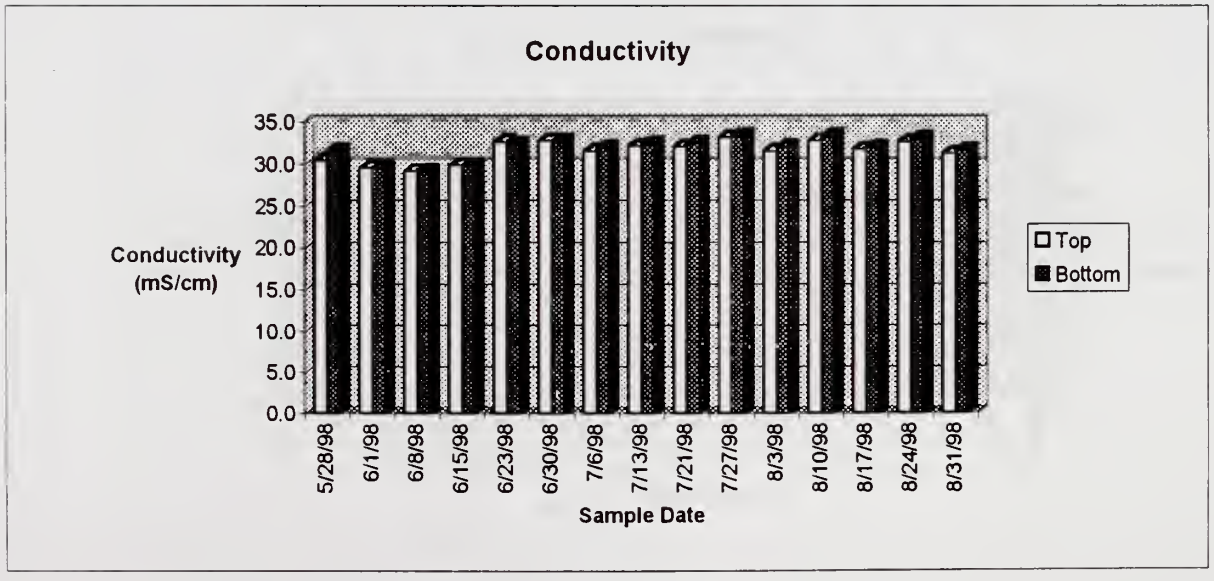
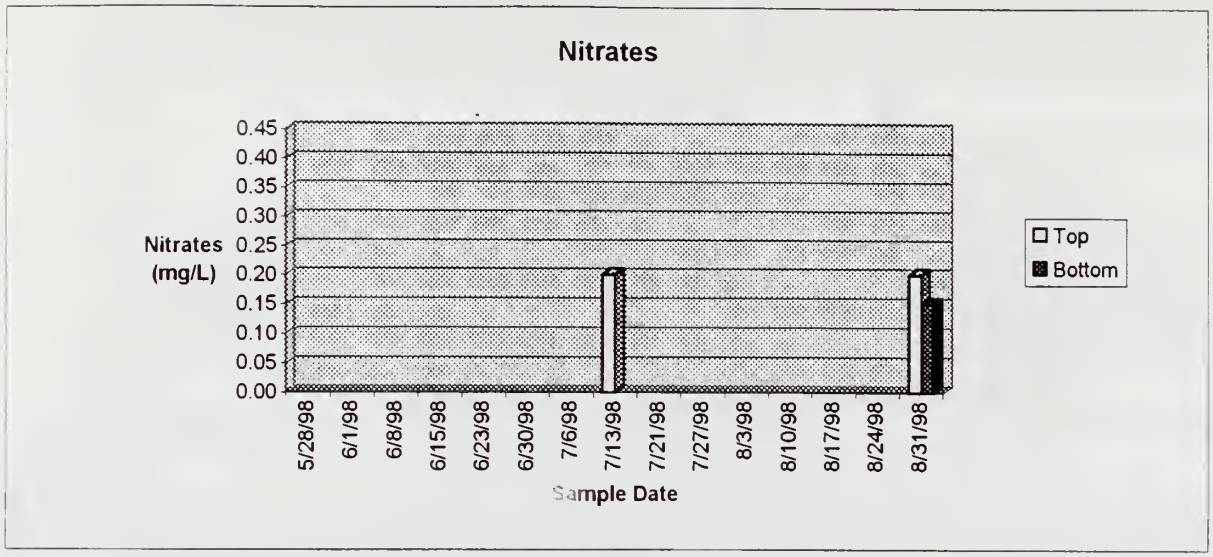
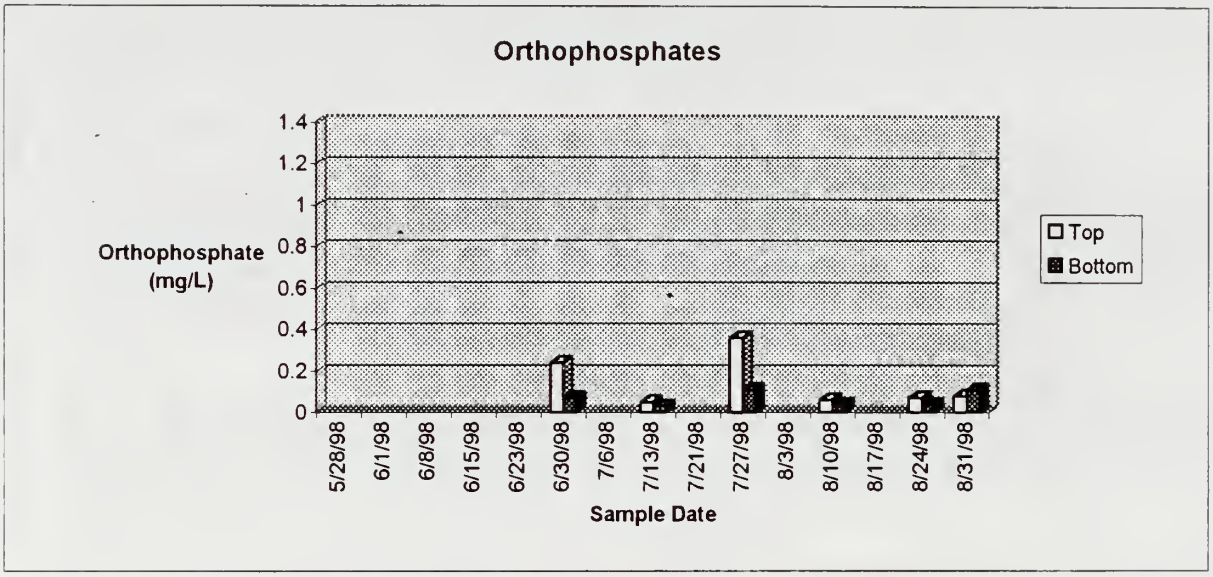


Figure 11

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1998





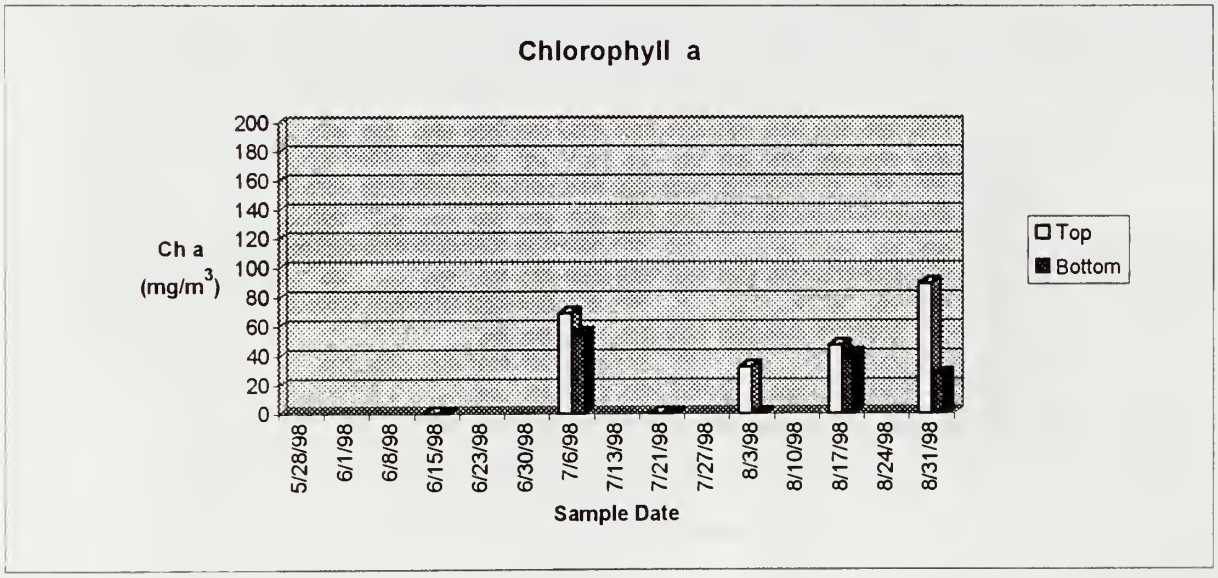
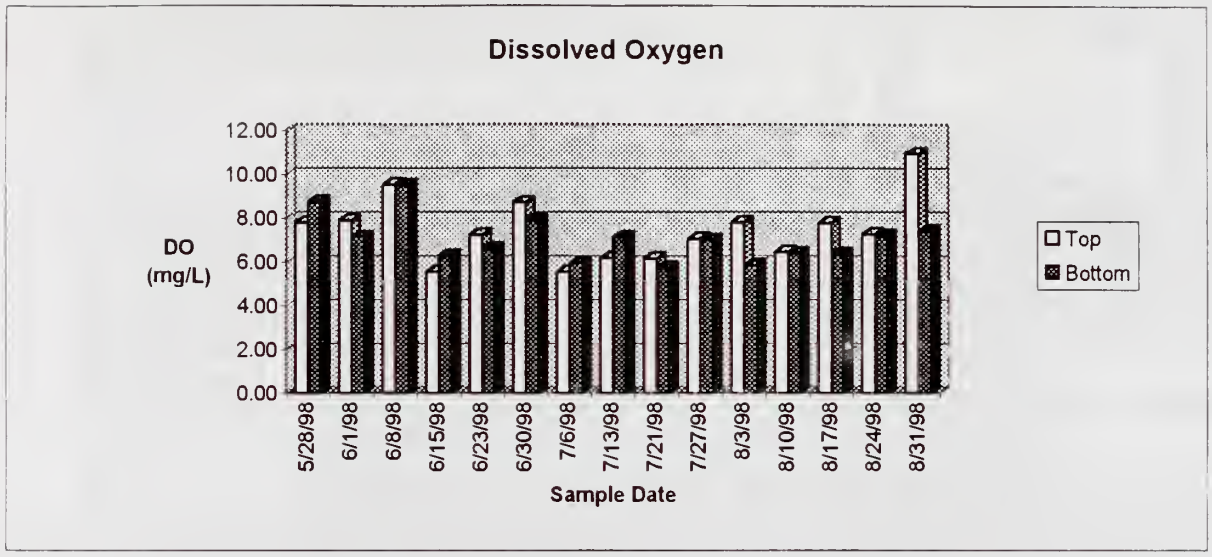
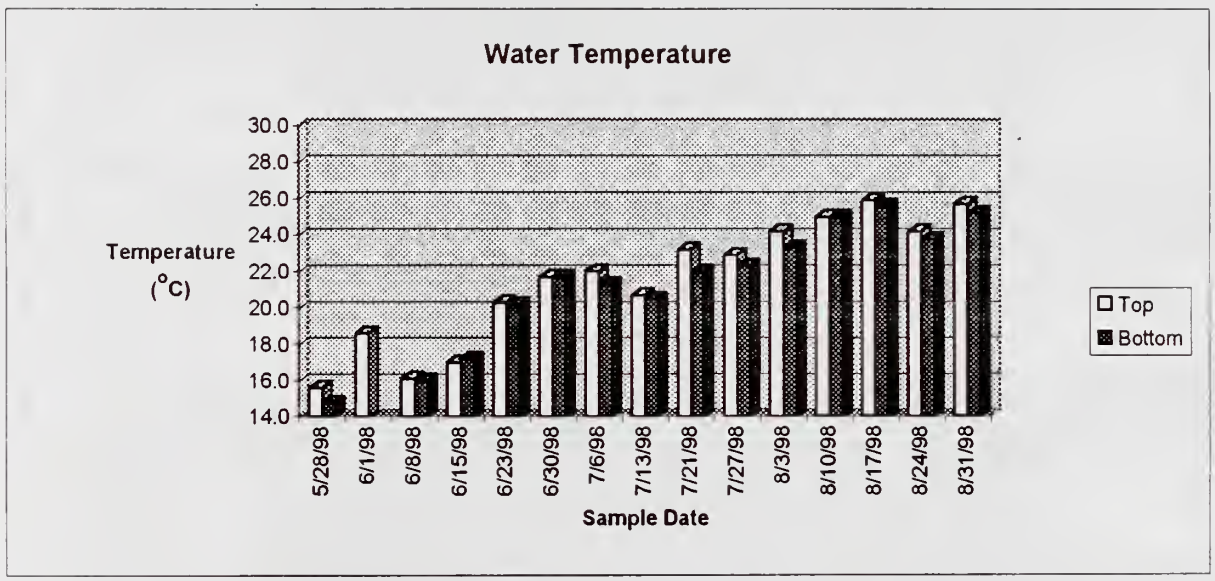


Figure 12

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1998





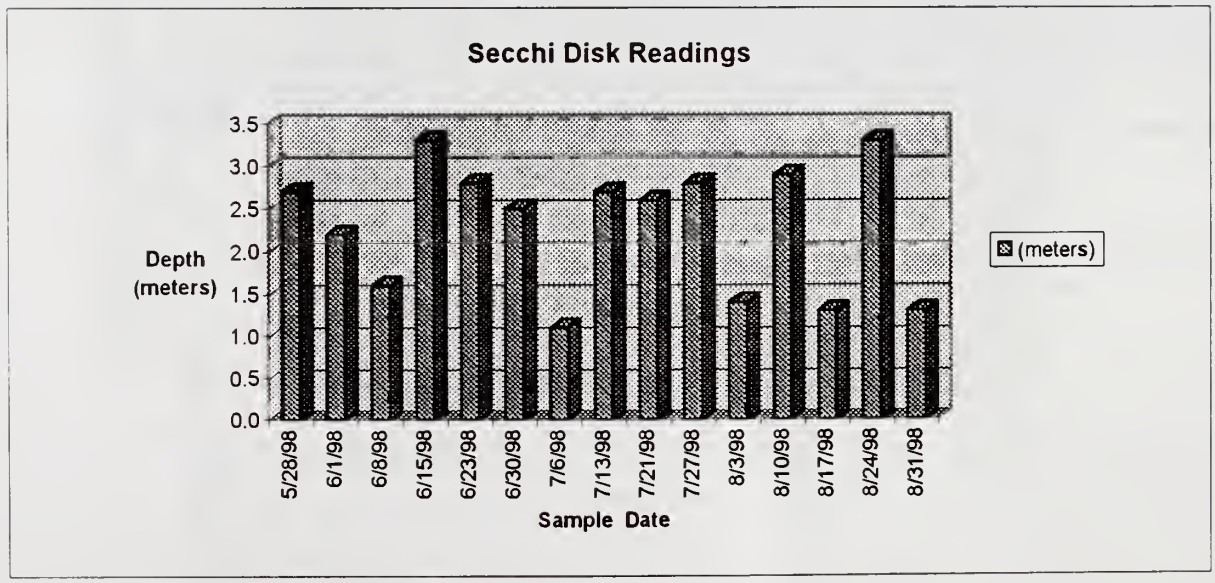
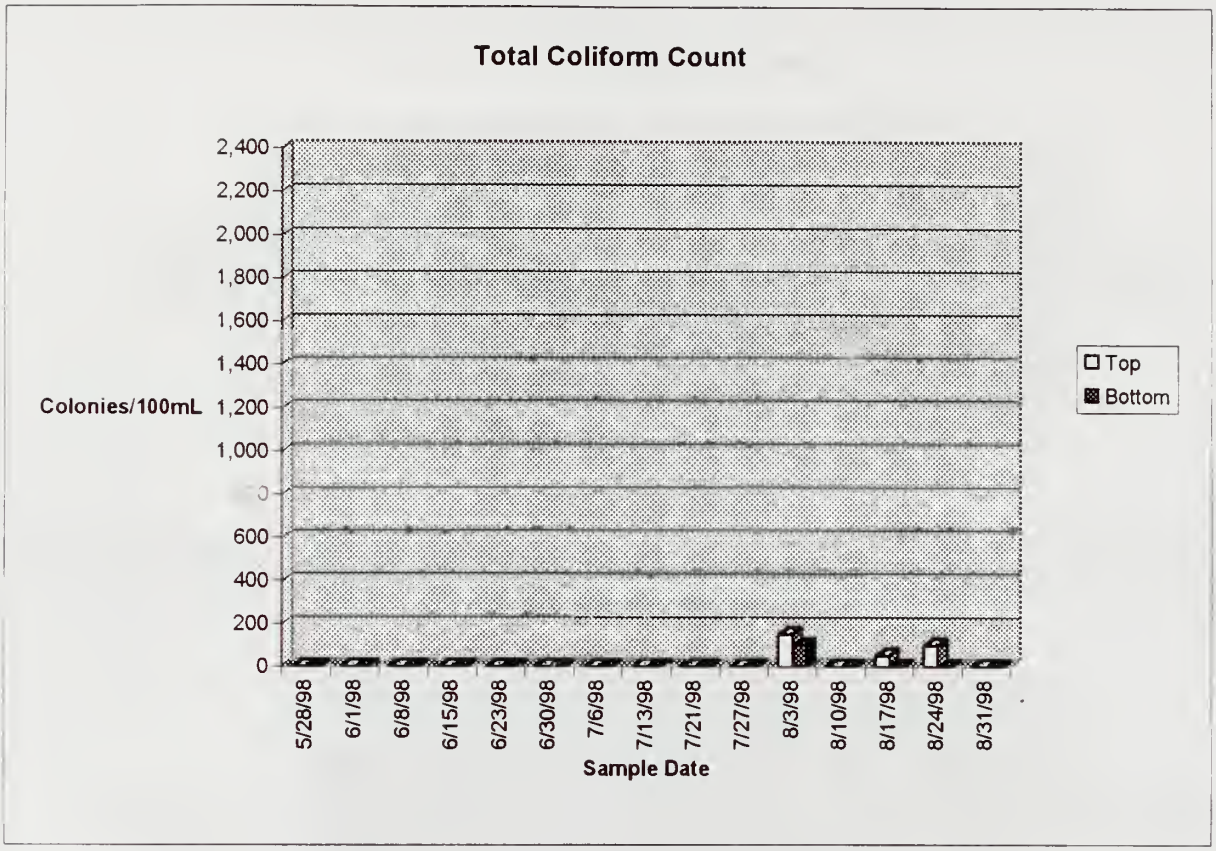


Figure 13

Nova Scotia Bar (JB-5A) Water Quality Measurements, 1998



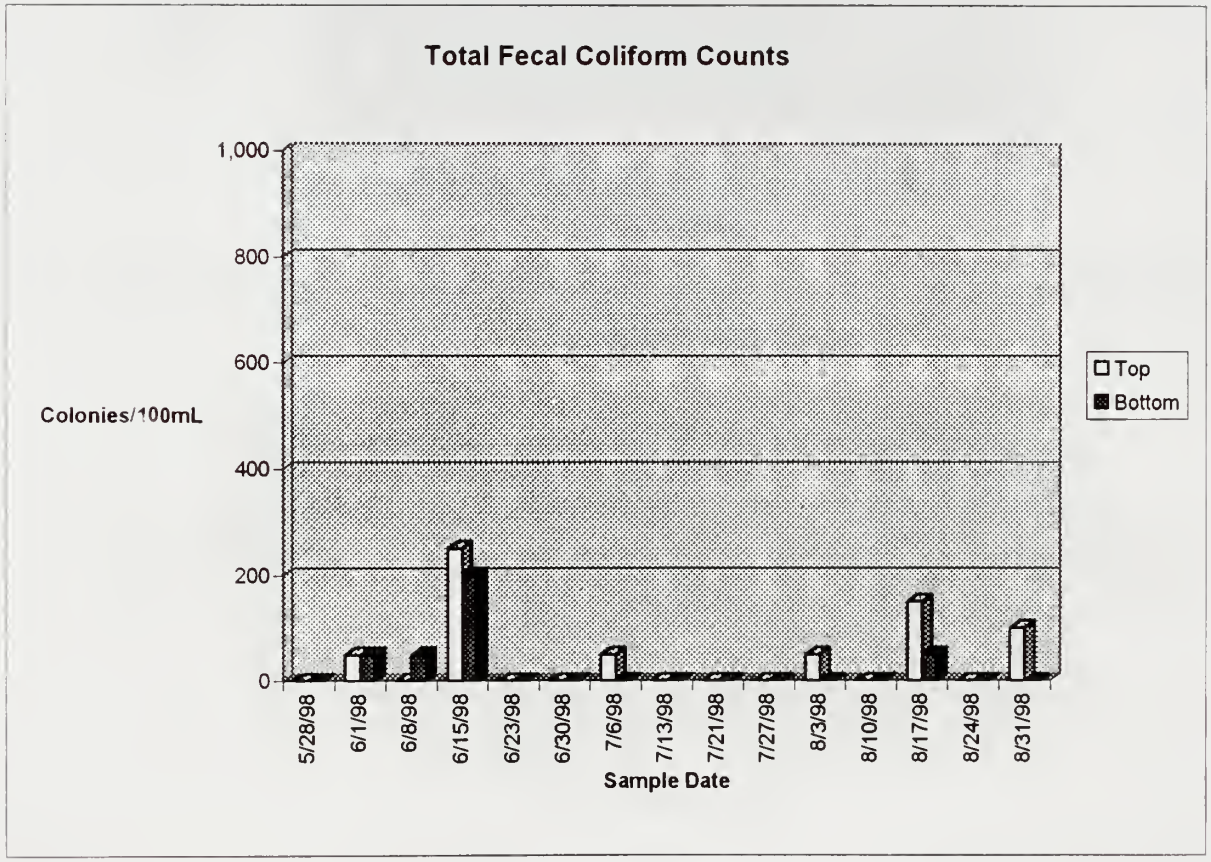


Figure 14

Table IX

Environmental Water Quality Monitoring

Jamaica Bay: Canarsie Pier [JB-6], 1998

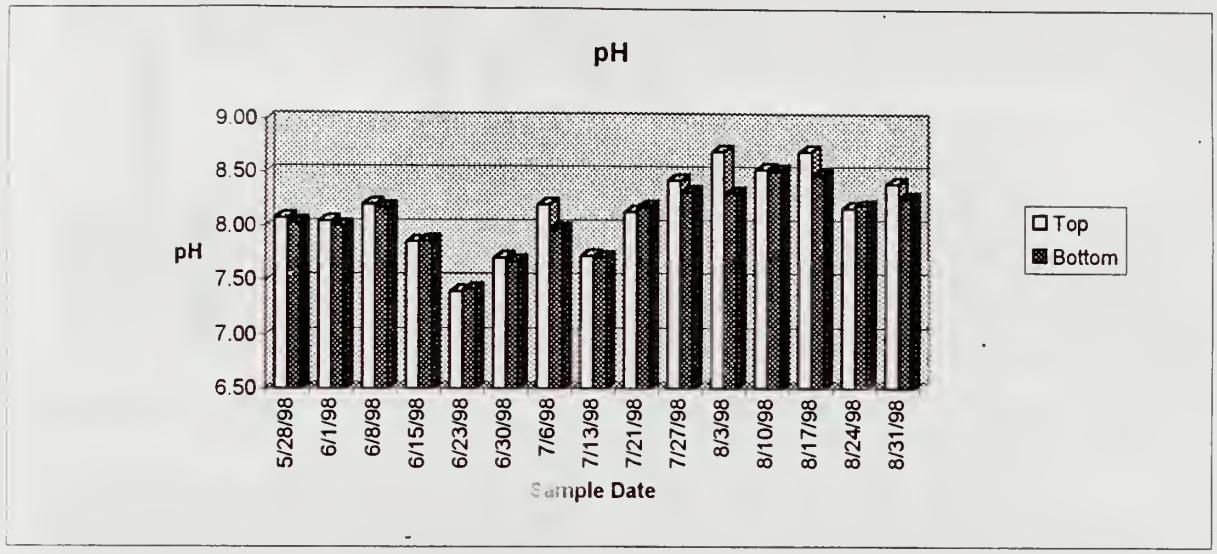
Date	Time	Tide	Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:55 AM	H	18.0	18.1	17.2	17.7	18.0	8.07	8.03	28.6	29.2	7.70	8.26	----	----
6/1/98	02:00 PM	H	17.0	----	----	17.5	18.0	8.04	8.00	28.3	29.1	7.86	6.45	----	----
6/8/98	11:45 AM	M	13.7	16.4	16.2	18.1	18.1	8.20	8.17	29.0	29.3	6.91	7.86	----	----
6/15/98	10:15 AM	M	17.7	17.6	17.3	17.5	18.0	7.85	7.86	28.3	29.1	4.24	5.43	----	----
6/23/98	10:50 AM	M	20.4	21.6	21.3	19.2	19.8	7.39	7.41	30.7	31.5	6.42	5.94	----	----
6/30/98	10:25 AM	M	20.4	22.9	27.7	19.9	20.0	7.70	7.67	31.5	31.9	6.55	7.50	----	----
7/6/98	11:05 AM	M	21.8	22.3	21.7	19.3	19.7	8.20	7.97	30.7	31.5	13.38	11.18	----	----
7/13/98	11:00 AM	H	20.5	22.1	22.0	19.5	19.6	7.72	7.70	31.1	31.3	6.03	6.27	<.01	0.11
7/21/98	10:45 AM	M	24.5	24.7	24.9	19.2	18.9	8.13	8.18	30.7	30.2	5.73	6.64	----	----
7/27/98	11:10 AM	H	22.9	24.4	23.9	20.0	20.2	8.43	8.32	31.7	32.1	9.41	7.01	----	----
8/3/98	11:15 AM	L	21.9	24.9	24.3	19.4	19.8	8.70	8.31	30.7	31.5	13.35	5.33	----	----
8/10/98	10:35 AM	H	24.3	25.8	25.6	19.7	19.9	8.53	8.52	31.4	31.7	7.80	7.30	----	----
8/17/98	11:45 AM	L	25.4	26.3	25.7	19.0	19.6	8.70	8.48	30.3	31.2	10.98	6.43	----	----
8/24/98	11:05 AM	H	24.8	24.8	24.8	19.8	19.8	8.17	8.19	31.5	31.6	5.76	5.43	----	----
8/31/98	11:00 AM	L	22.9	25.8	25.6	19.2	19.7	8.40	8.26	30.7	31.4	8.73	5.46	0.19	0.24

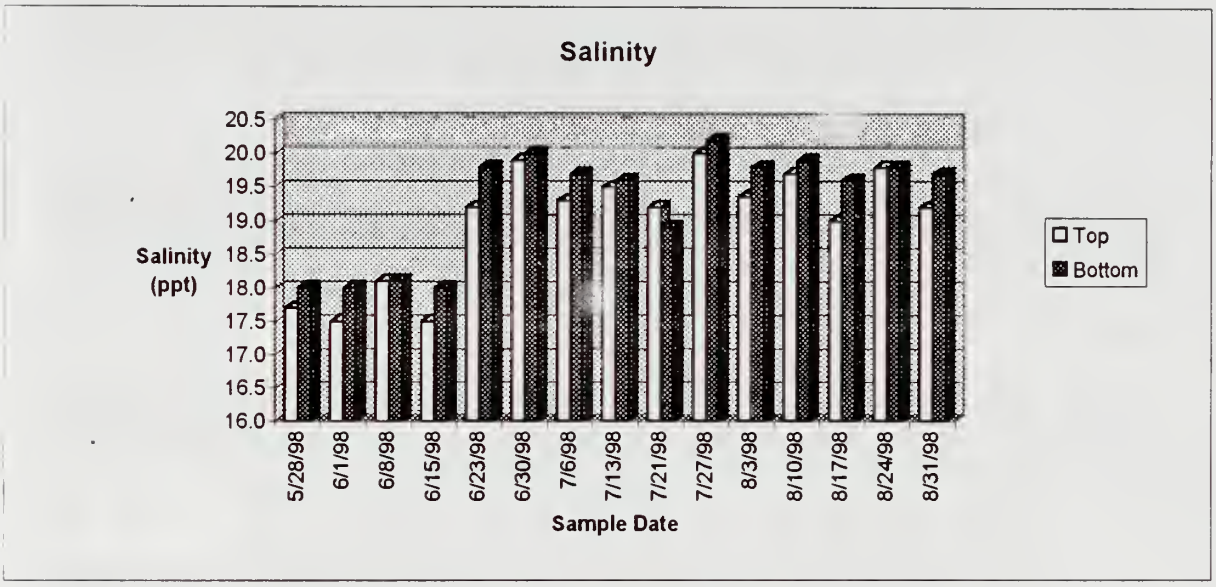
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	10:55 AM	H	1.6	----	----	----	----	----	----	----	----	0	0	50	0
6/1/98	02:00 PM	H	1.8	----	----	----	----	----	----	----	----	0	0	350	50
6/8/98	11:45 AM	M	1.8	----	----	----	----	----	----	----	----	0	0	0	0
6/15/98	10:15 AM	M	1.9	----	----	----	----	----	----	9.2	3.6	0	0	1,600	900
6/23/98	10:50 AM	M	1.8	<0.02	<0.02	<0.02	<0.02	----	----	----	----	0	0	0	50
6/30/98	10:25 AM	M	1.4	----	----	----	----	0.19	0.09	----	----	0	0	0	0
7/6/98	11:05 AM	M	1.2	----	----	----	----	----	----	77.8	33.5	0	0	50	100
7/13/98	11:00 AM	H	1.4	----	----	----	----	0.11	0.10	----	----	0	0	0	0
7/21/98	10:45 AM	M	1.8	<0.02	<0.02	<0.02	<0.02	----	----	25.6	10.6	450	300	0	50
7/27/98	11:10 AM	H	1.3	----	----	----	----	0.29	0.14	----	----	0	0	0	0
8/3/98	11:15 AM	L	0.4	----	----	----	----	----	----	241.1	12.7	0	3,200	50	1,250
8/10/98	10:35 AM	H	1.3	----	----	----	----	0.13	0.13	----	----	0	50	0	0
8/17/98	11:45 AM	L	1.0	<0.02	<0.02	<0.02	<0.02	----	----	80.8	55.2	900	150	250	100
8/24/98	11:05 AM	H	1.7	----	----	----	----	0.20	0.19	----	----	50	100	0	50
8/31/98	11:00 AM	L	1.3	<0.02	<0.02	<0.02	<0.02	0.16	0.15	76.5	53.8	500	75	100	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

Canarsie Pier (JB-6) Water Quality Measurements, 1998





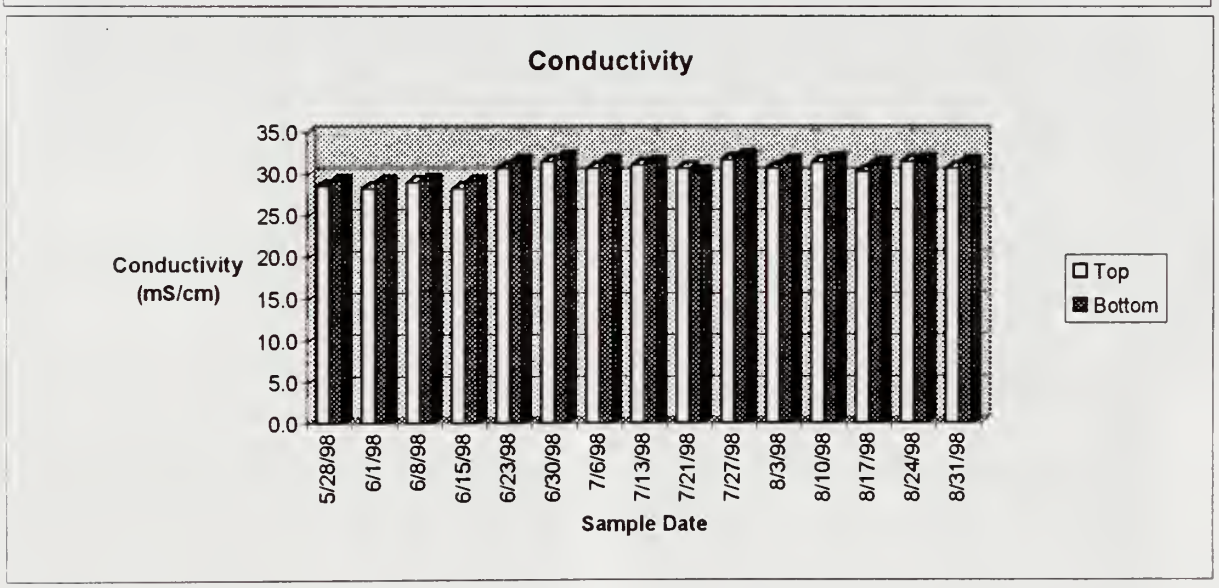
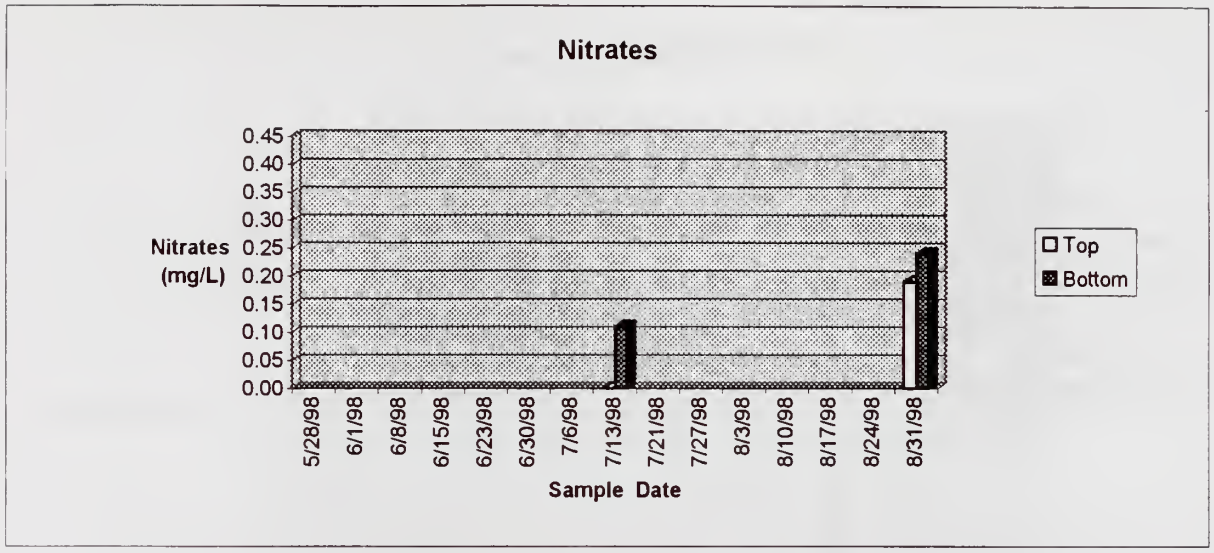
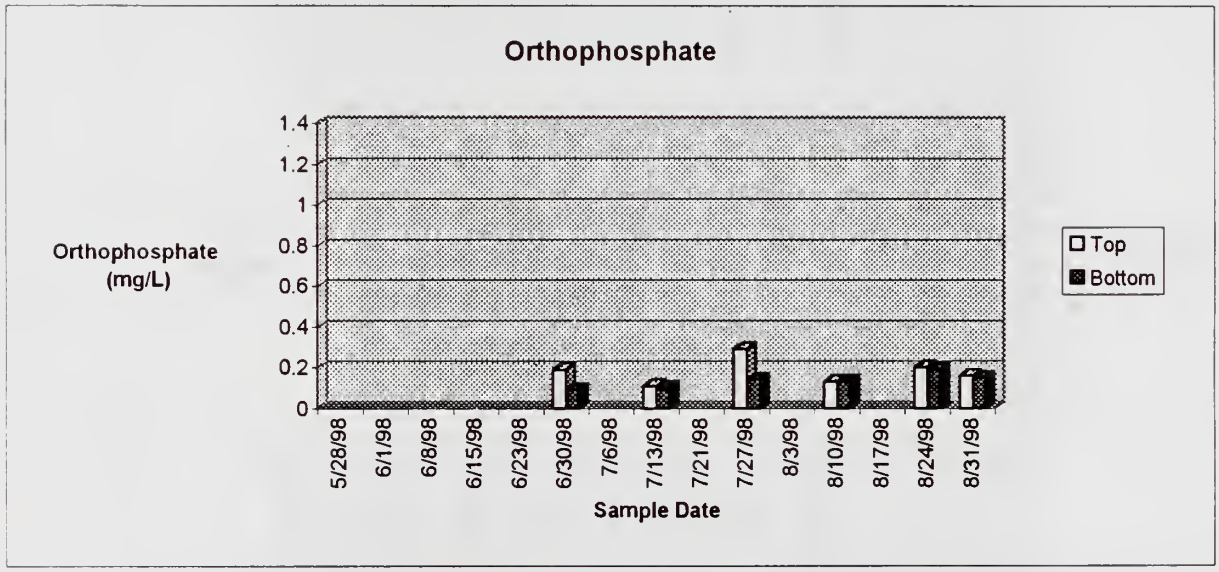


Figure 15

Canarsie Pier (JB-6) Water Quality Measurements, 1998





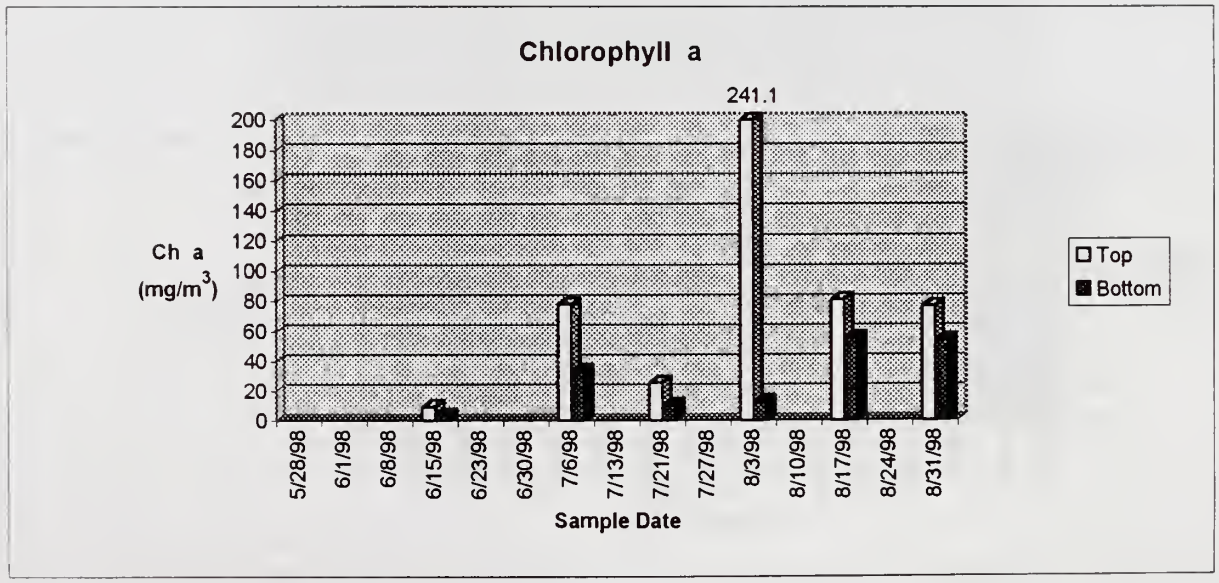
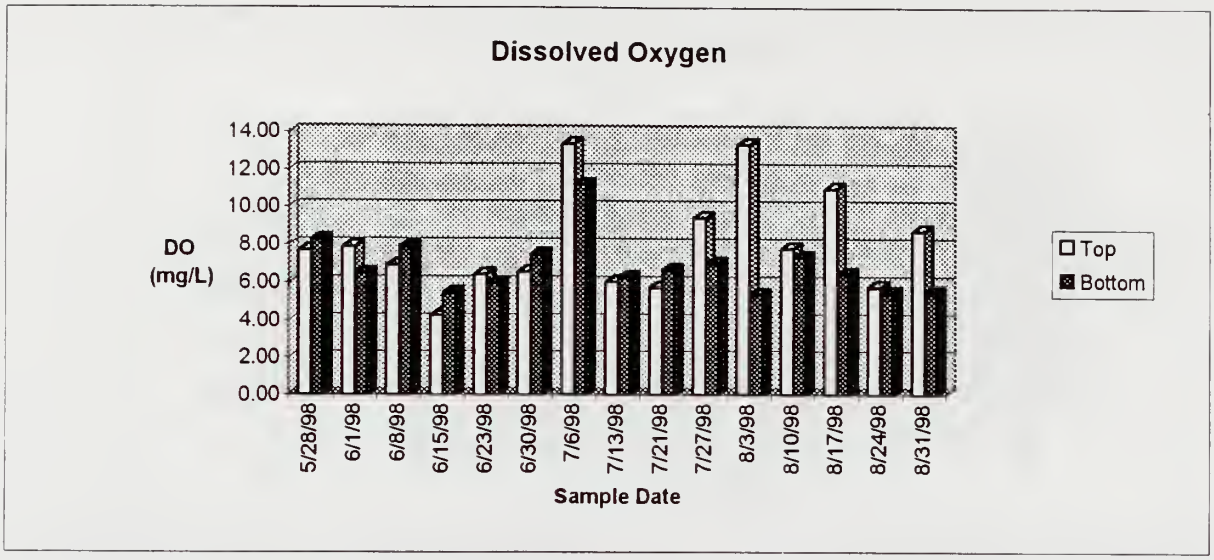
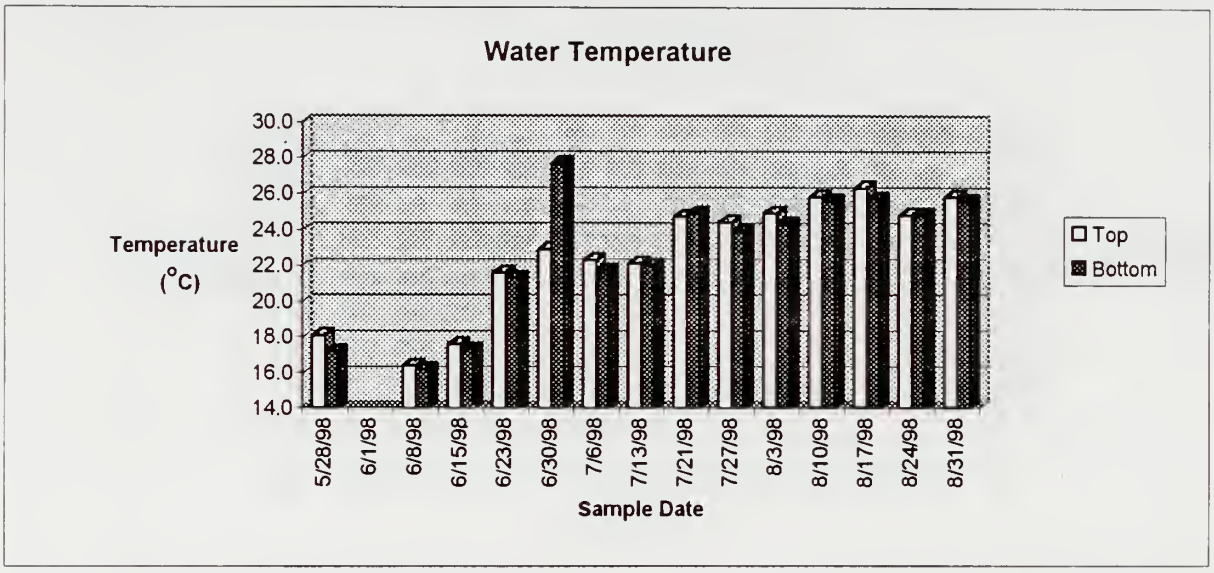


Figure 16

Canarsie Pier (JB-6) Water Quality Measurements, 1998





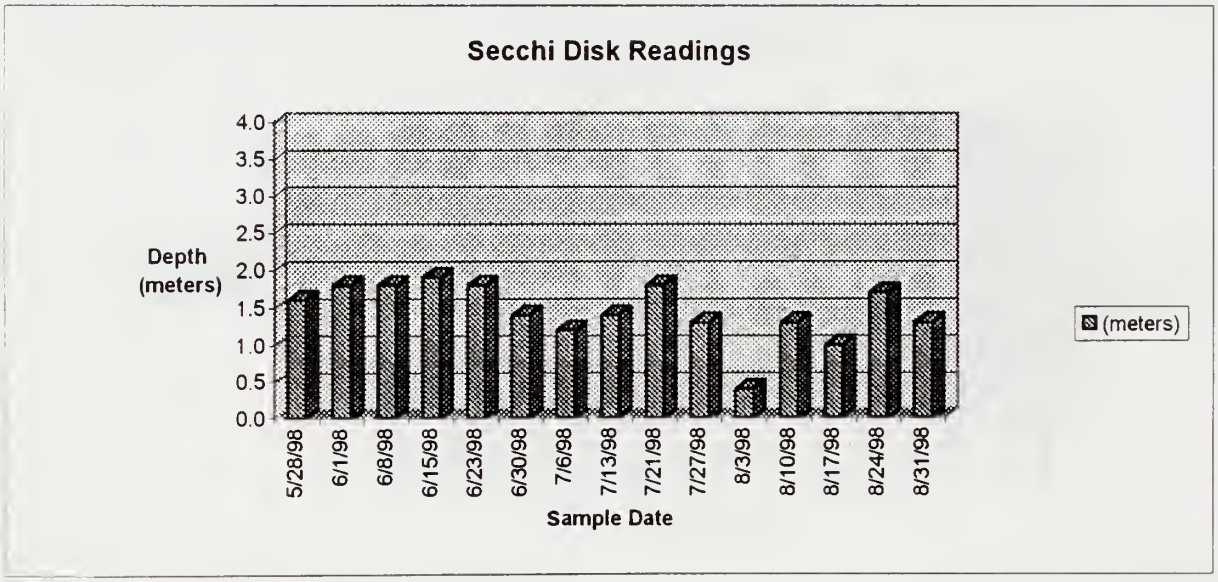
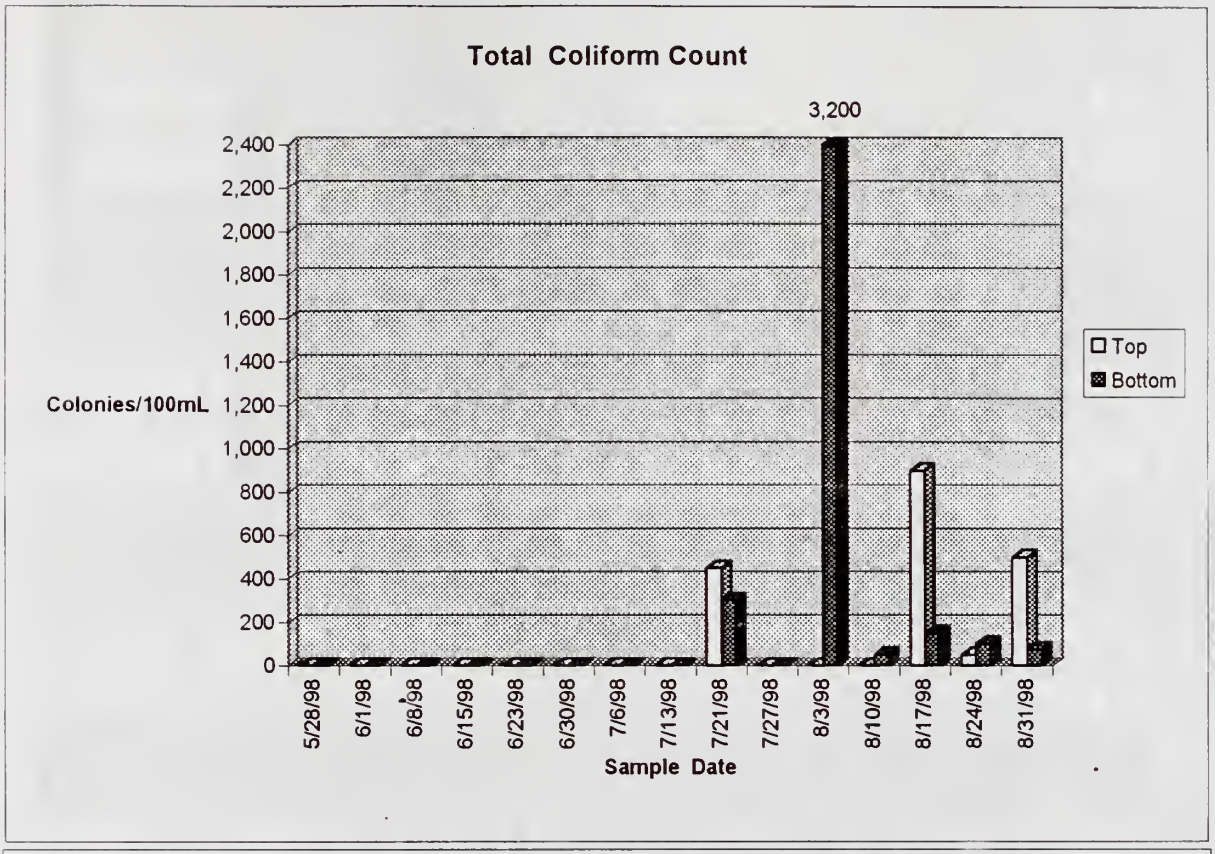


Figure 17

Canarsie Pier (JB-6) Water Quality Measurements, 1998



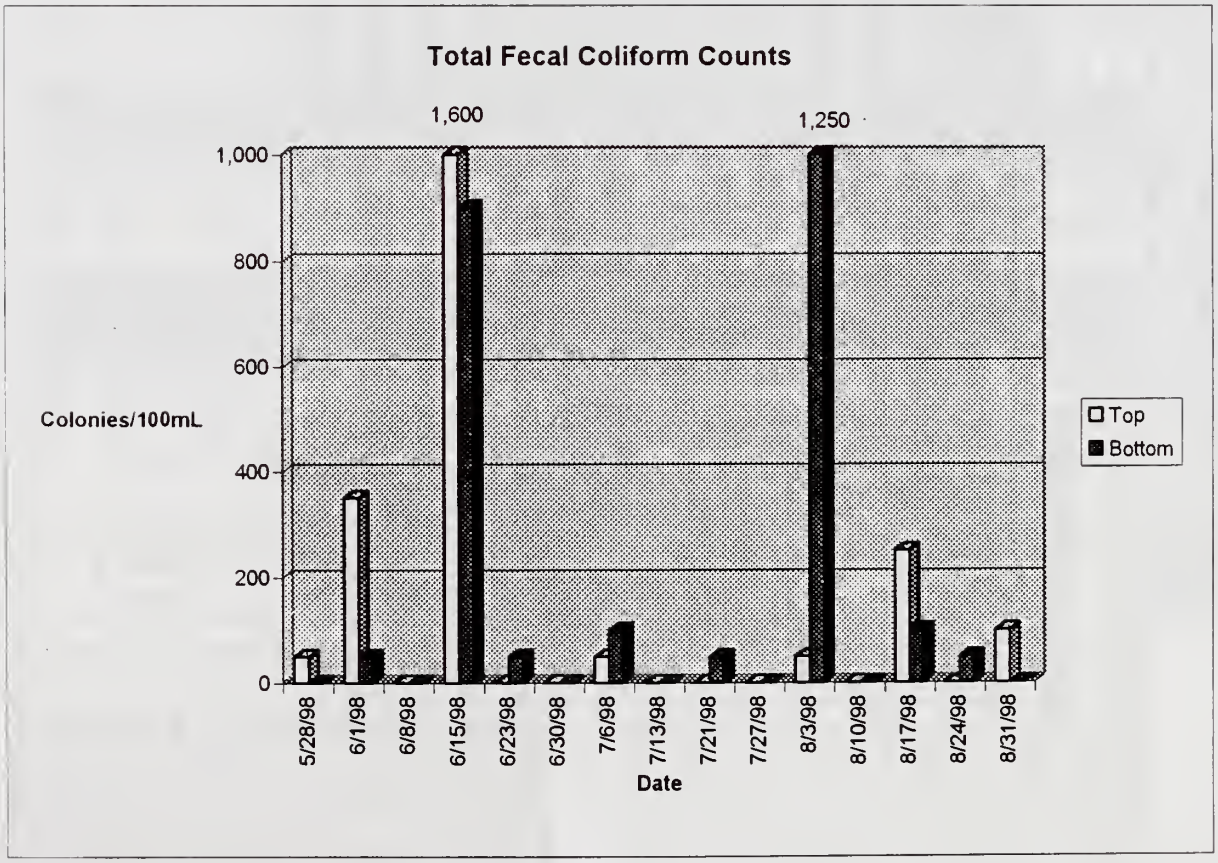


Figure 18

Table X

Environmental Water Quality Monitoring

Jamaica Bay: Pennsylvania Avenue Landfill [JB-6A], 1998

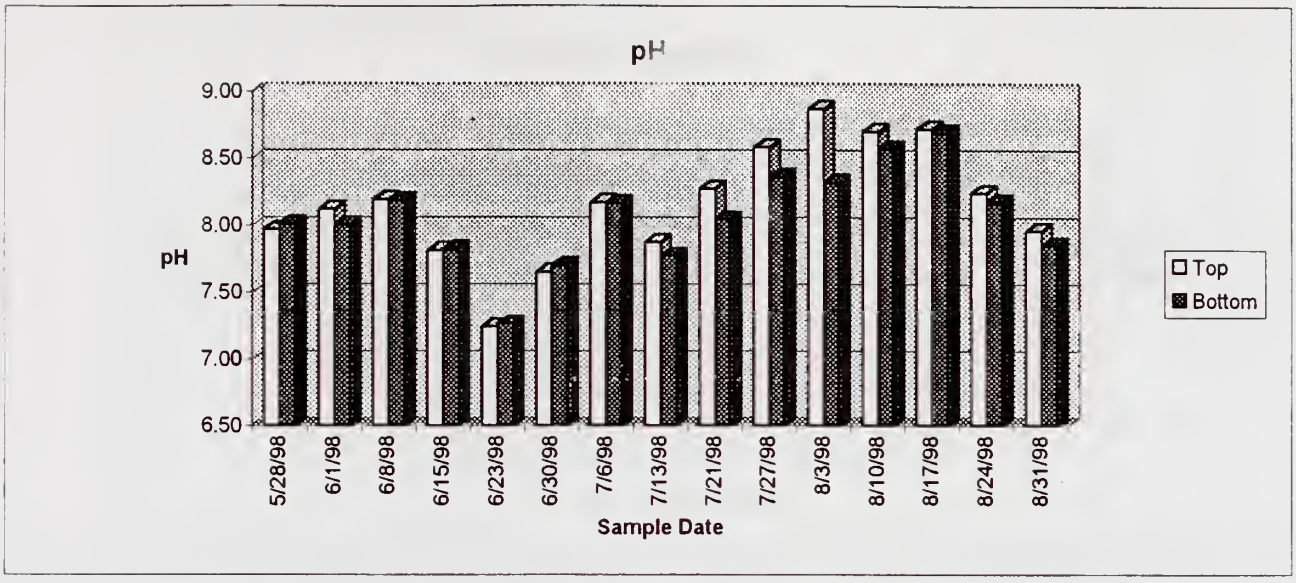
Date	Time	Tide	Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:05 AM	H	18.3	19.3	18.1	17.0	17.6	7.97	8.01	27.5	28.5	6.81	9.81	----	----
6/1/98	02:20 PM	H	17.0	18.8	----	13.7	17.2	8.12	8.00	22.6	28.0	6.86	5.89	----	----
6/8/98	11:50 AM	M	13.4	16.8	16.6	17.7	17.9	8.19	8.18	28.6	28.9	7.61	9.72	----	----
6/15/98	10:24 AM	M	18.0	18.4	17.8	16.8	17.3	7.81	7.82	27.2	28.0	4.41	5.29	----	----
6/23/98	10:57 AM	M	20.8	22.0	21.8	18.7	19.0	7.24	7.26	29.9	30.4	4.71	5.51	----	----
6/30/98	10:31 AM	M	20.9	23.1	23.0	19.5	19.0	7.65	7.70	30.6	31.0	6.51	7.30	----	----
7/6/98	11:15 AM	M	22.0	23.1	22.8	19.0	18.1	8.17	8.16	30.4	30.2	13.65	10.61	----	----
7/13/98	11:10 AM	H	20.6	23.6	22.7	18.8	19.0	7.87	7.77	30.1	30.3	7.77	6.88	0.18	0.00
7/21/98	11:00 AM	M	25.4	25.5	24.8	18.7	19.1	8.27	8.04	29.9	30.6	7.67	4.18	----	----
7/27/98	11:20 AM	H	22.5	25.0	24.4	19.3	19.8	8.58	8.36	30.8	31.6	12.21	7.72	----	----
8/3/98	11:25 AM	L	23.5	25.0	24.7	18.9	19.5	8.87	8.32	30.2	31.1	15.83	5.00	----	----
8/10/98	10:45 AM	H	24.9	26.3	26.1	19.2	19.4	8.70	8.57	30.7	31.0	11.13	6.90	----	----
8/17/98	11:55 AM	L	25.4	26.0	26.8	18.5	18.5	8.72	8.69	29.5	29.6	11.74	10.58	----	----
8/24/98	11:10 AM	H	25.0	26.0	25.2	18.8	19.6	8.24	8.17	30.0	31.3	8.12	5.44	----	----
8/31/98	11:10 AM	L	22.8	26.4	26.1	19.2	19.2	7.96	7.85	30.7	30.7	4.47	2.94	0.15	0.18

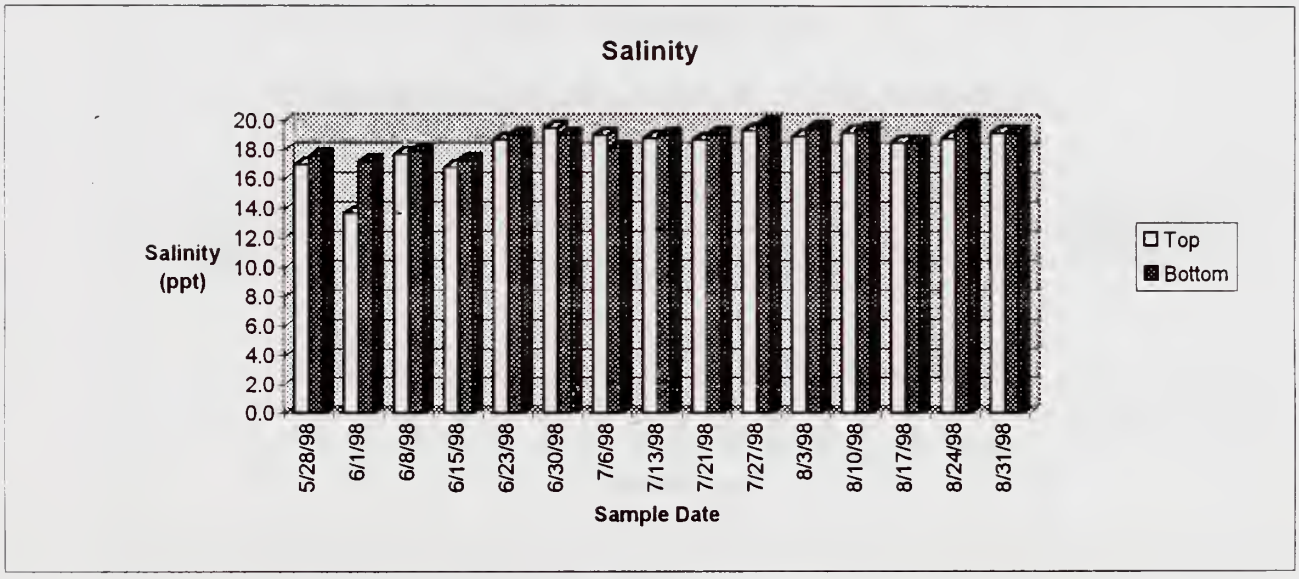
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:05 AM	H	1.7	----	----	----	----	----	----	----	----	0	0	100	0
6/1/98	02:20 PM	H	1.2	----	----	----	----	----	----	----	----	50	0	10,400	850
6/8/98	11:50 AM	M	1.2	----	----	----	----	----	----	----	----	0	0	300	300
6/15/98	10:24 AM	M	1.7	----	----	----	----	----	----	0.0	0.0	0	0	2,150	2,050
6/23/98	10:57 AM	M	1.7	<0.02	<0.02	<0.02	<0.02	----	----	----	----	0	0	125	200
6/30/98	10:31 AM	M	1.3	----	----	----	----	0.15	0.25	----	----	0	0	0	0
7/6/98	11:15 AM	M	1.0	----	----	----	----	----	----	99.9	94.2	0	0	50	50
7/13/98	11:10 AM	H	1.4	----	----	----	----	0.12	0.15	----	----	0	0	50	100
7/21/98	11:00 AM	M	1.3	----	----	----	----	----	----	59.7	16.1	4,050	400	3,375	200
7/27/98	11:20 AM	H	1.1	<0.02	<0.02	<0.02	<0.02	0.23	0.37	----	----	50	100	0	0
8/3/98	11:25 AM	L	0.5	----	----	----	----	----	----	140.5	41.1	250	400	175	50
8/10/98	10:45 AM	H	0.9	----	----	----	----	0.15	0.14	----	----	100	100	100	150
8/17/98	11:55 AM	L	1.0	<0.02	<0.02	<0.02	<0.02	----	----	64.5	73.6	0	0	0	0
8/24/98	11:10 AM	H	1.1	----	----	----	----	0.23	0.20	----	----	150	100	100	75
8/31/98	11:10 AM	L	1.2	<0.02	<0.02	<0.02	<0.02	0.22	0.22	32.5	23.2	2,050	1,250	375	300

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data ----

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1998





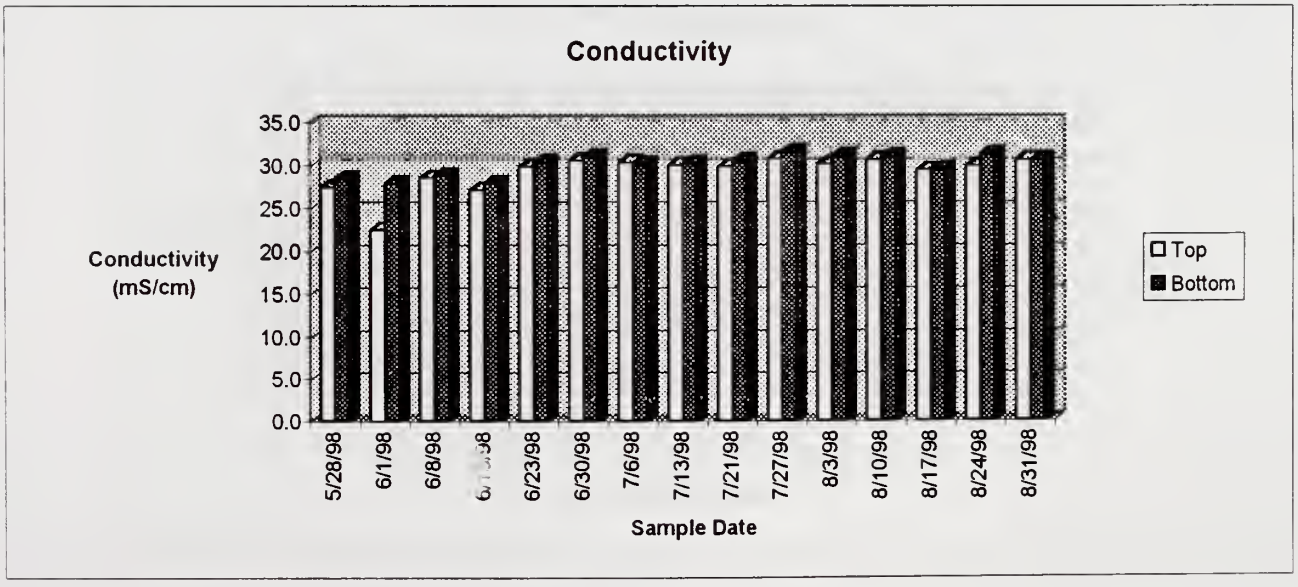
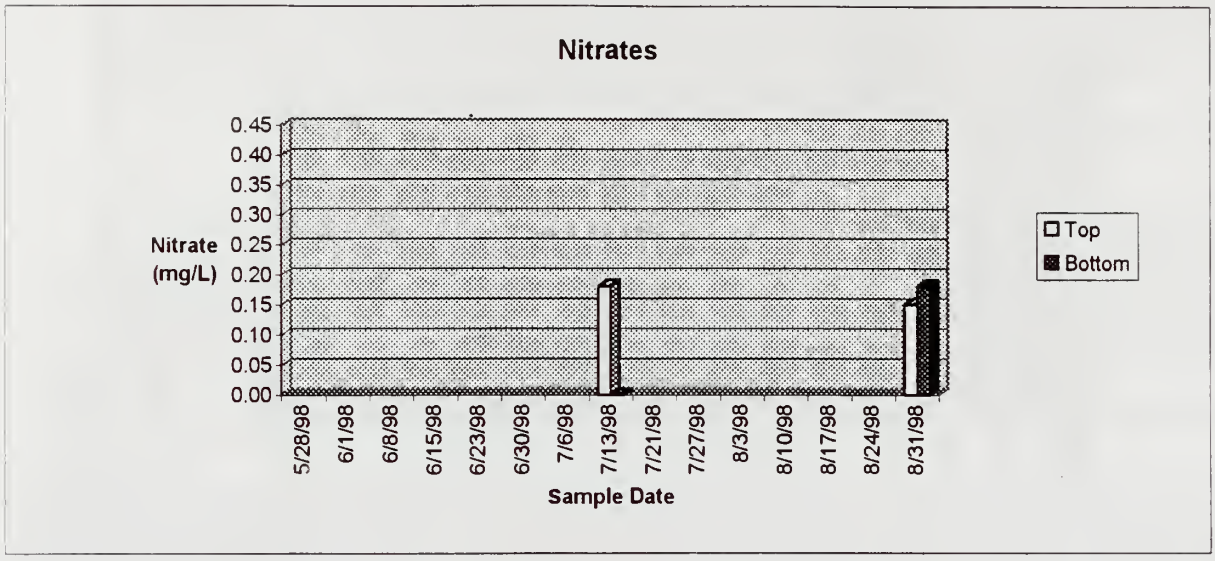
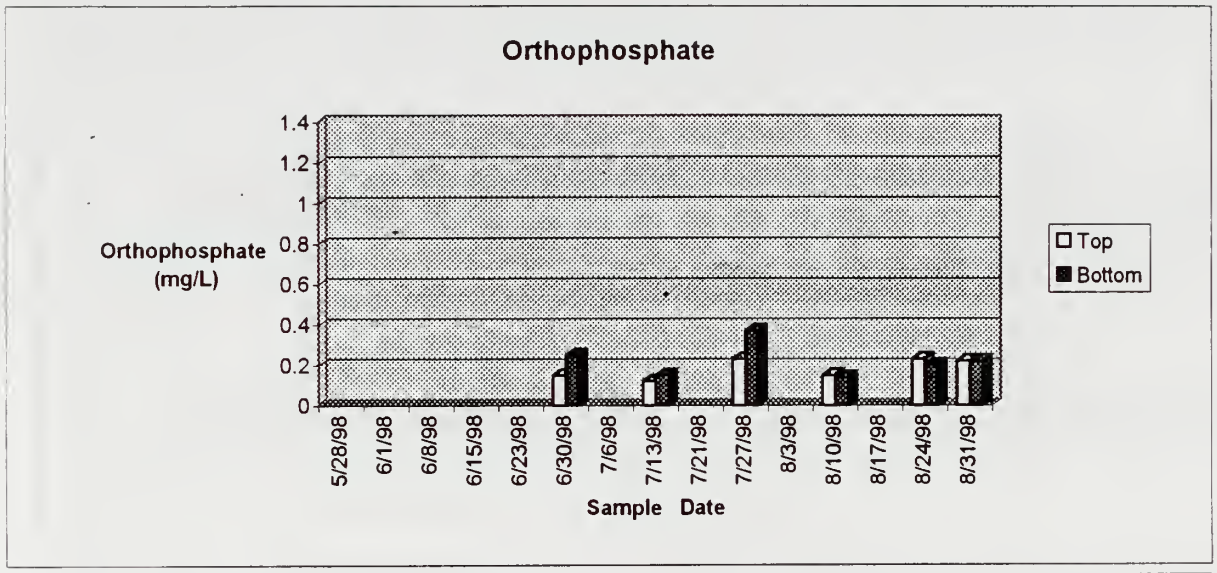


Figure 19

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1998





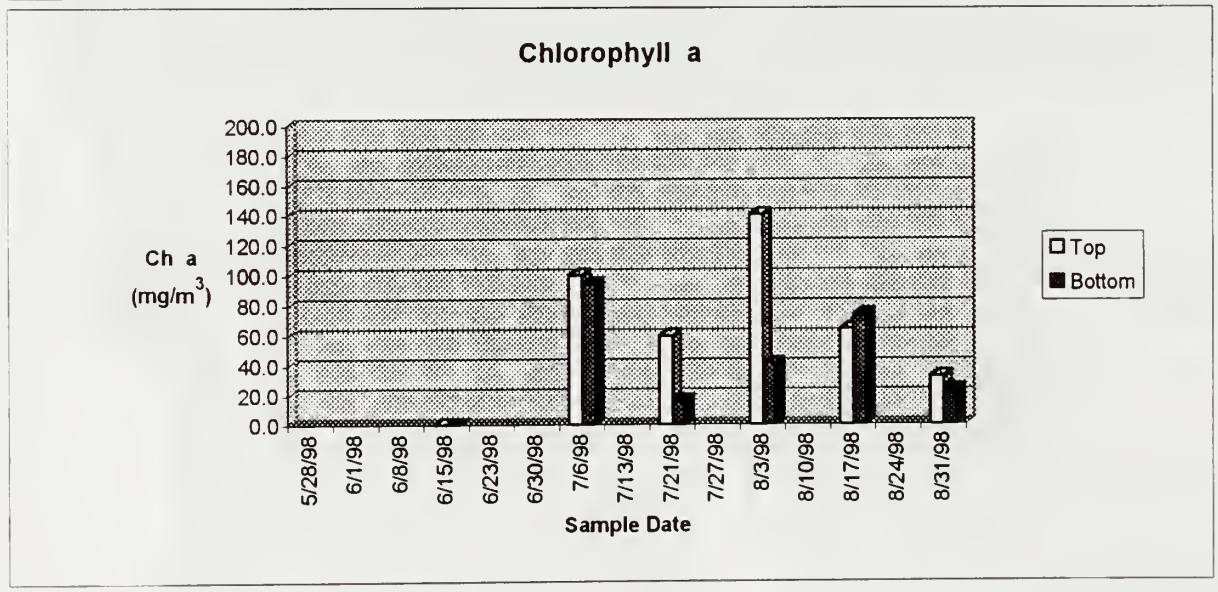
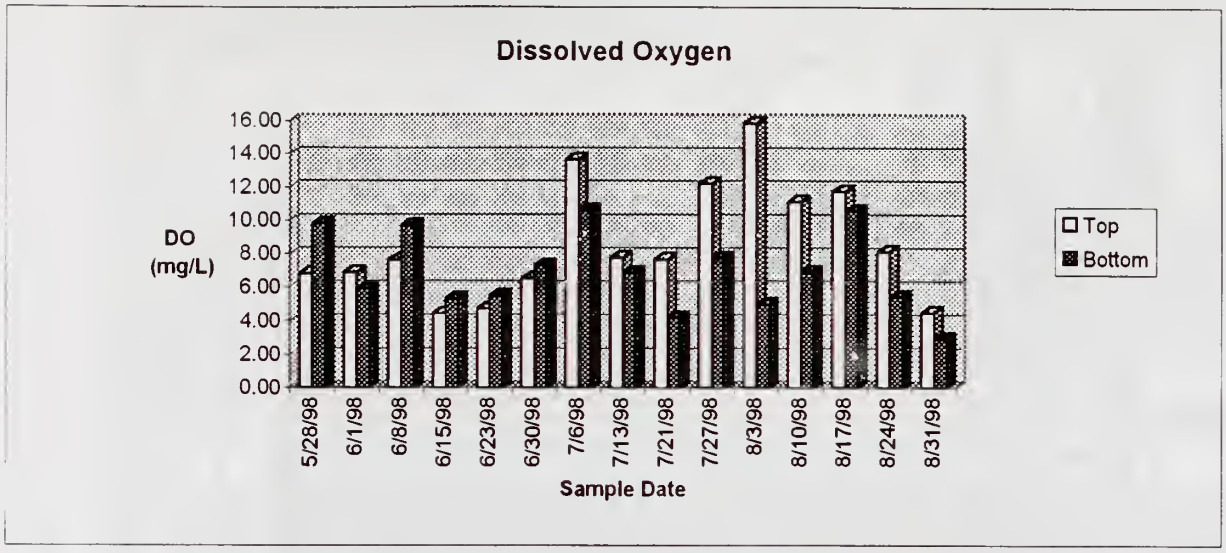
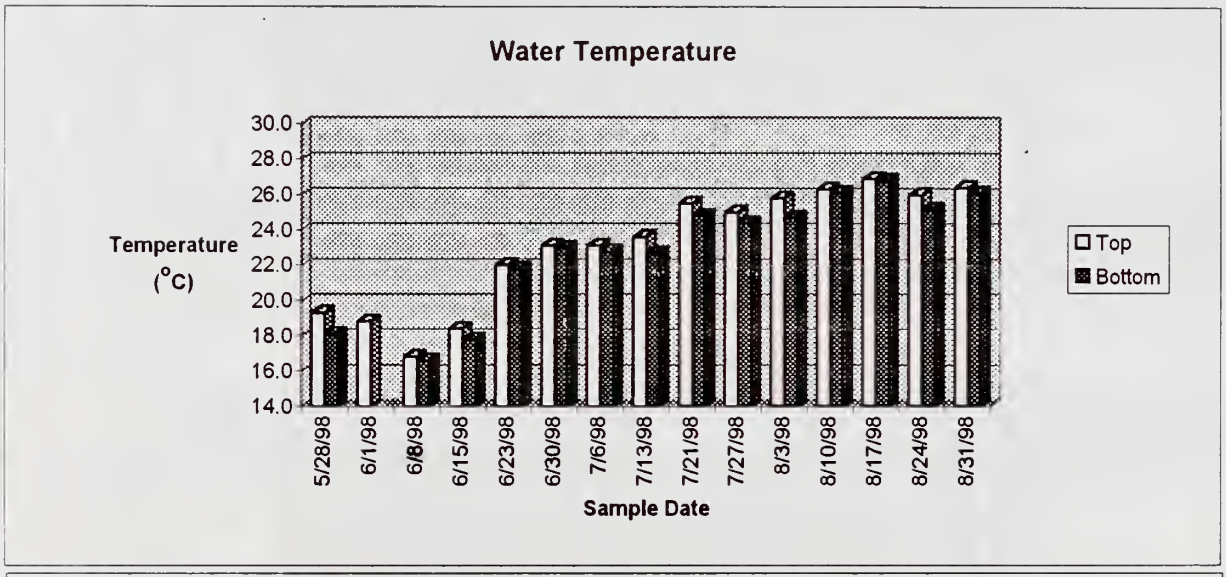


Figure 20

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1998





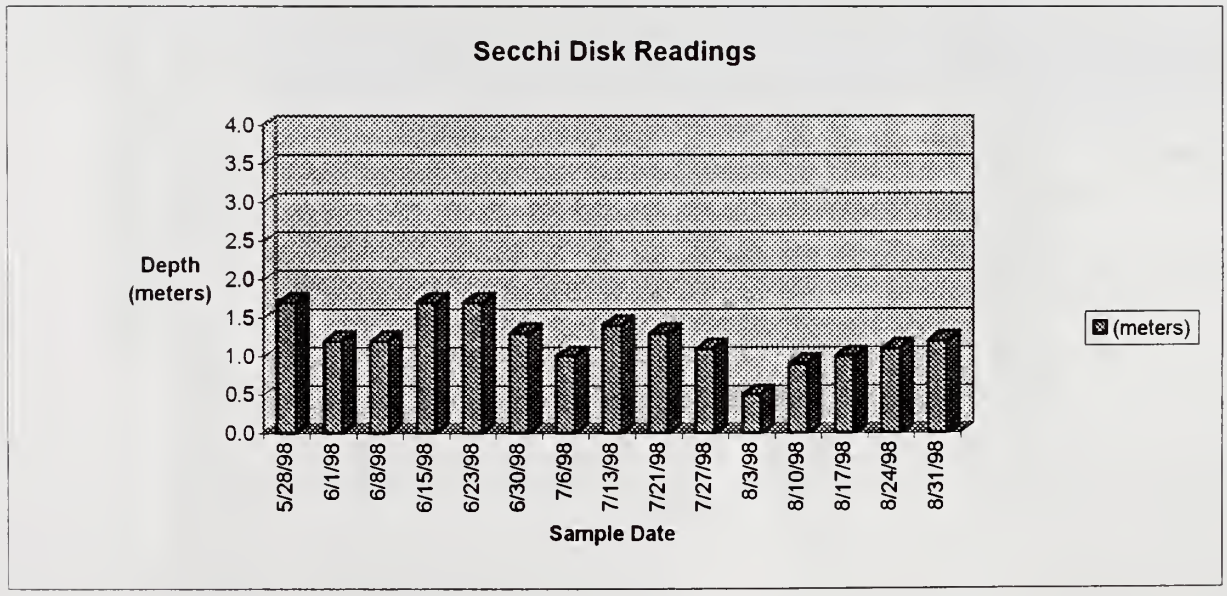
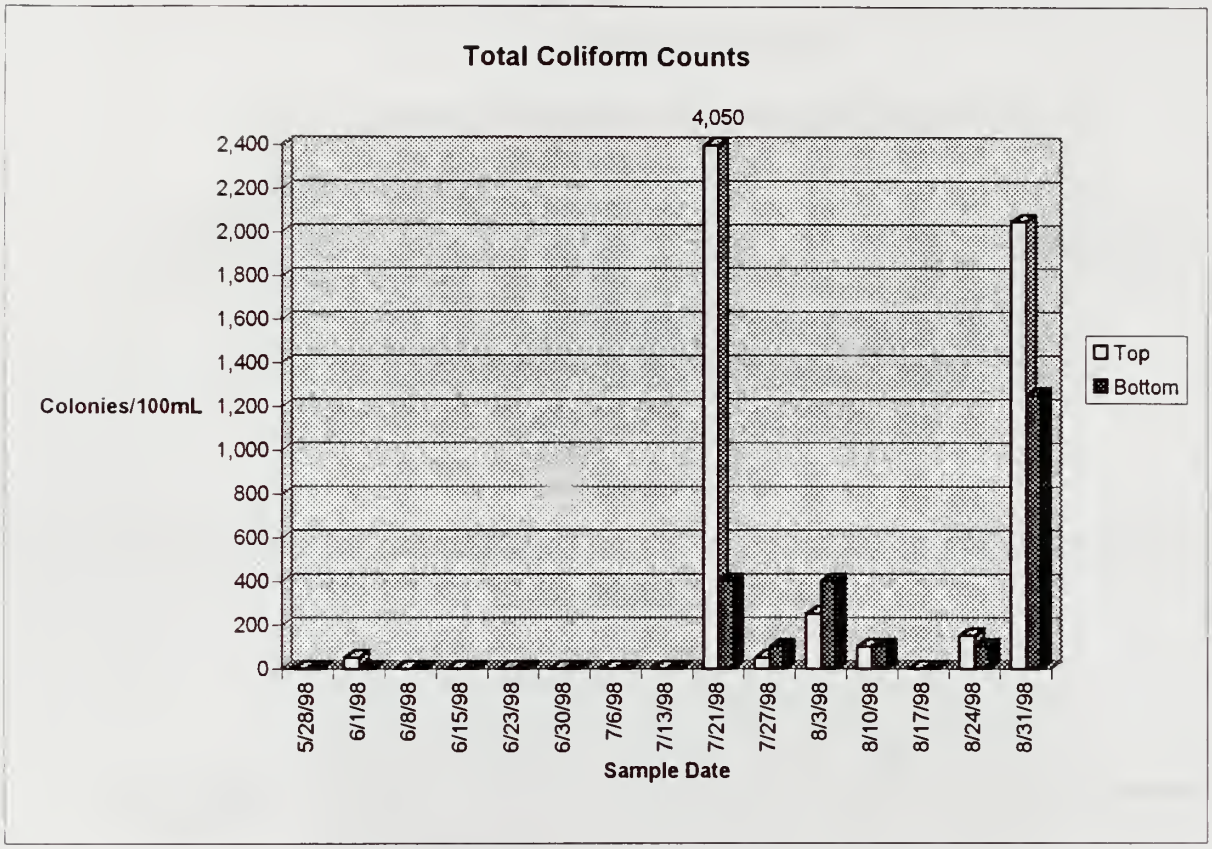


Figure 21

Pennsylvania Avenue Landfill (JB-6A) Water Quality Measurements, 1998



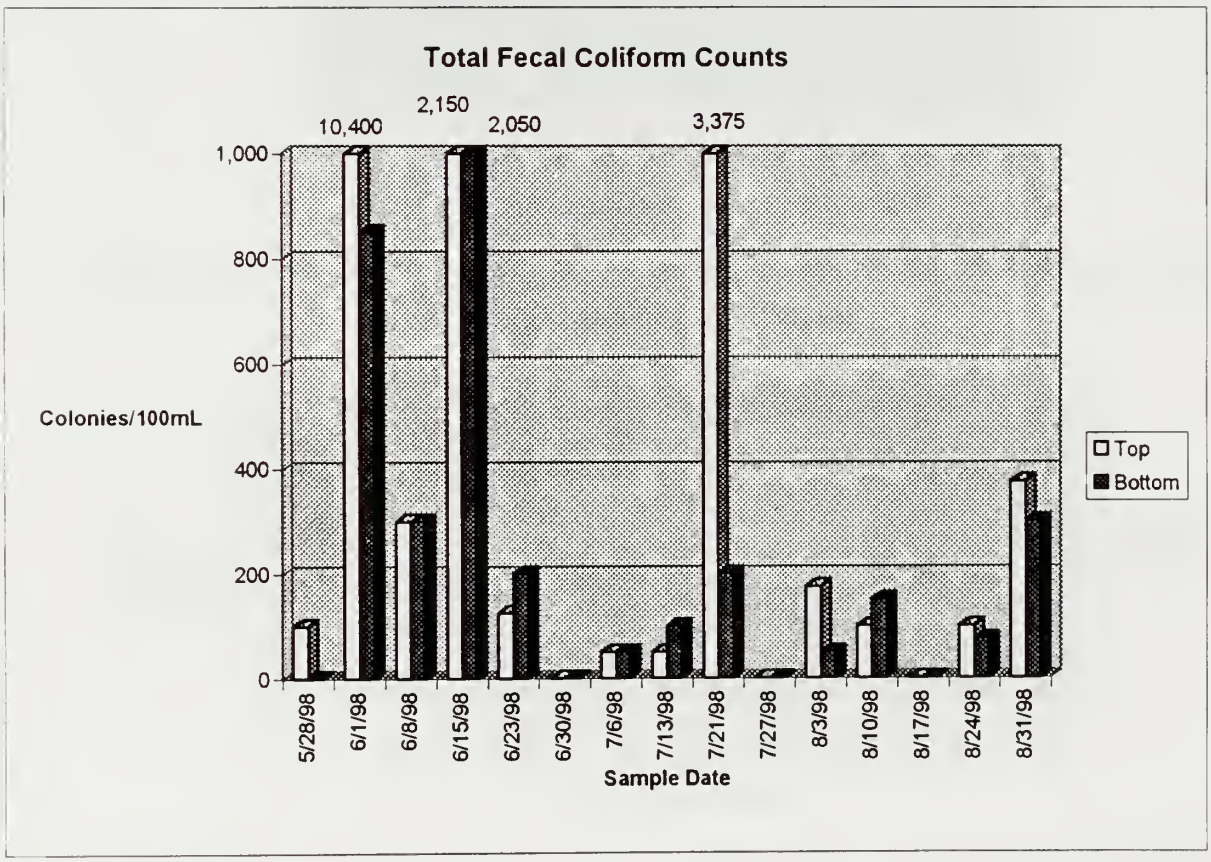


Figure 22

Table XI
Environmental Water Quality Monitoring
Jamaica Bay: Grassy Bay [JB-9], 1998

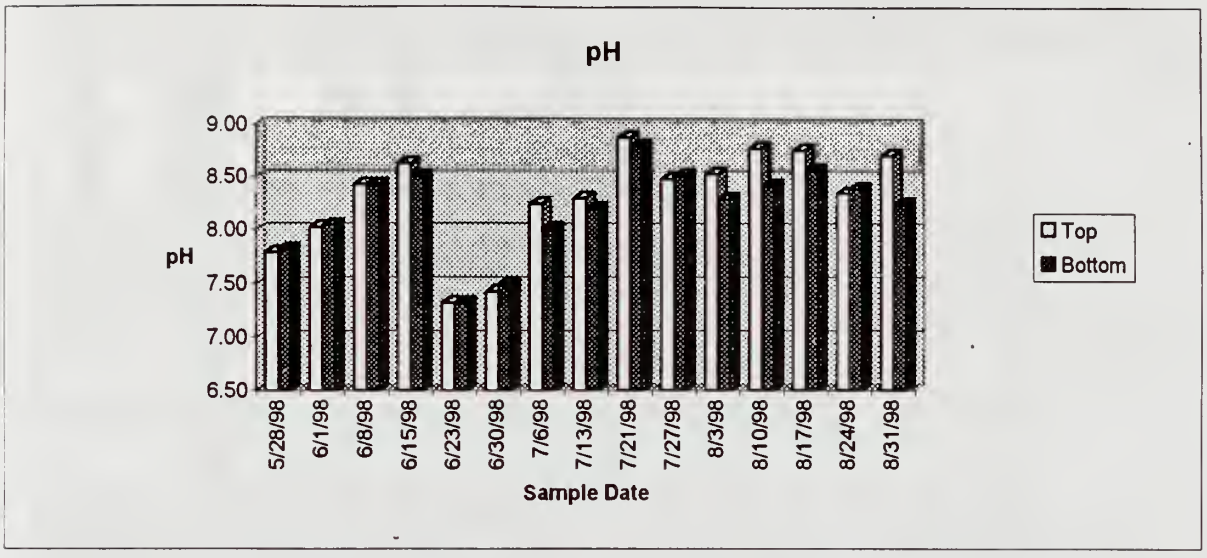
			Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
Date	Time	Tide		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:40 AM	M	19.7	20.7	20.3	14.0	14.5	7.79	7.81	23.0	23.9	6.65	7.61	----	----
6/1/98	02:50 PM	H	—	18.9	18.8	16.2	16.2	8.02	8.04	26.4	26.4	6.86	7.04	----	----
6/8/98	12:25 PM	L	14.3	17.8	17.6	16.6	16.5	8.43	8.43	26.9	26.9	8.64	10.03	----	----
6/15/98	10:55 AM	M	18.4	19.4	19.1	16.3	16.3	8.63	8.51	26.5	26.5	12.31	11.43	----	----
6/23/98	11:40 AM	M	20.9	21.7	21.6	18.6	18.6	7.31	7.31	29.8	29.8	3.64	5.35	----	----
6/30/98	11:00 AM	M	20.8	22.6	22.0	13.7	14.5	7.42	7.49	22.6	23.7	6.89	6.37	----	----
7/6/98	11:50 AM	L	21.9	23.5	22.9	18.5	18.5	8.24	8.01	29.5	29.7	10.43	9.93	----	----
7/13/98	11:45 AM	H	21.9	24.4	24.8	18.0	18.0	8.30	8.20	28.8	28.9	13.51	12.96	0.26	0.24
7/21/98	11:40 AM	M	24.6	26.6	26.7	17.7	17.8	8.88	8.80	28.5	28.7	16.78	13.04	----	----
7/27/98	11:50 AM	H	23.2	25.5	25.1	15.4	18.5	8.48	8.52	24.8	29.6	13.02	9.55	----	----
8/3/98	11:55 AM	L	21.7	25.9	24.9	17.7	17.9	8.53	8.29	28.4	28.8	11.66	6.09	----	----
8/10/98	12:15 PM	H	25.6	26.8	26.0	17.1	19.0	8.78	8.42	27.5	30.3	14.78	6.24	----	----
8/17/98	12:25 PM	L	25.7	26.5	26.1	18.9	18.8	8.76	8.57	30.1	30.1	12.07	8.16	----	----
8/24/98	11:40 AM	H	25.5	26.3	25.7	14.6	18.4	8.35	8.39	23.8	29.6	8.53	7.01	----	----
8/31/98	11:45 AM	M	25.2	27.0	26.2	18.5	18.4	8.71	8.24	29.6	29.5	14.90	5.85	0.11	0.15

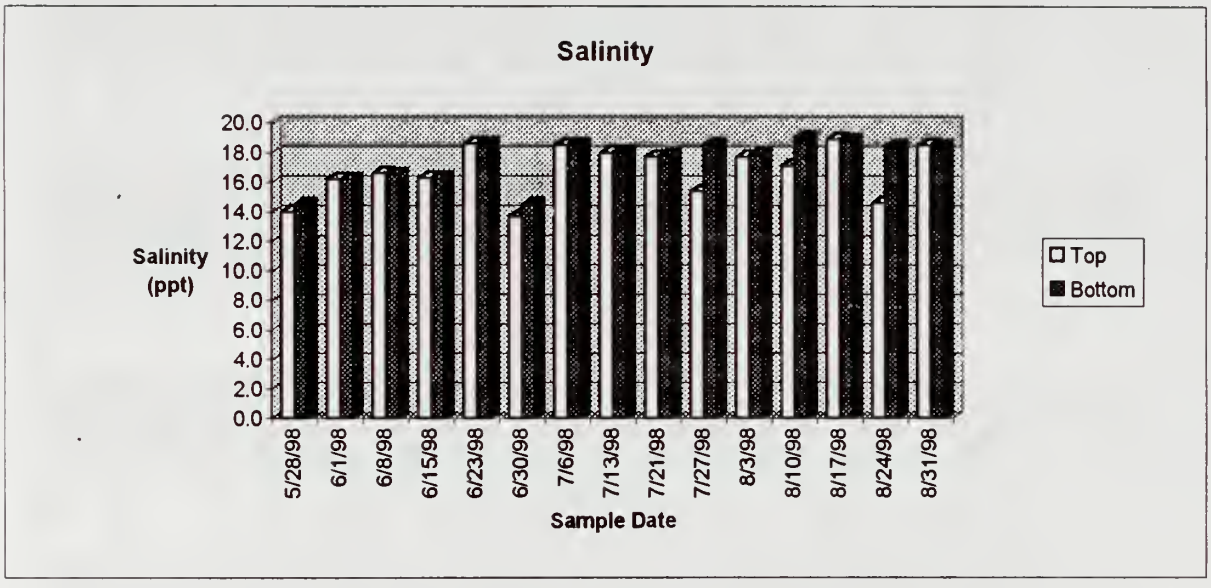
			Secchi Disk	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
Date	Time	Tide	(meters)	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:40 AM	M	1.3	—	—	—	—	—	—	—	—	0	0	125	0
6/1/98	02:50 PM	H	1.8	—	—	—	—	—	—	—	—	0	0	75	125
6/8/98	12:55 AM	L	1.1	—	----	—	----	—	----	—	----	0	0	0	0
6/15/98	10:55 AM	M	0.3	—	----	—	----	—	----	326.5	121.4	0	0	450	150
6/23/98	11:40 AM	M	2.0	<0.02	<0.02	<0.02	<0.02	—	----	—	----	0	0	50	200
6/30/98	11:00 AM	M	0.9	—	—	—	—	0.28	0.22	—	—	0	0	400	400
7/6/98	11:50 AM	L	1.2	—	----	—	----	—	----	97.9	67.3	0	0	0	0
7/13/98	11:45 AM	H	0.8	—	----	—	----	0.14	0.13	—	----	0	0	0	0
7/21/98	11:40 AM	M	0.7	—	—	—	—	—	—	15.3	9.4	100	200	0	0
7/27/98	11:50 AM	H	0.9	<0.02	<0.02	<0.02	<0.02	0.43	0.33	—	—	2,750	100	430	0
8/3/98	11:55 AM	L	1.2	—	----	—	----	—	----	3.5	0.0	850	500	450	100
8/10/98	12:15 PM	H	0.7	—	----	—	----	0.40	0.21	—	----	900	50	0	0
8/17/98	12:25 PM	L	0.6	<0.02	<0.02	<0.02	<0.02	—	—	159.4	127.8	150	375	50	150
8/24/98	11:40 AM	H	0.7	—	—	—	—	0.68	0.26	—	—	1,500	300	400	100
8/31/98	11:45 AM	M	0.9	<0.02	<0.02	<0.02	<0.02	0.15	0.23	174.5	113.9	117	200	50	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

Grassy Bay (JB-9) Water Quality Measurements, 1998





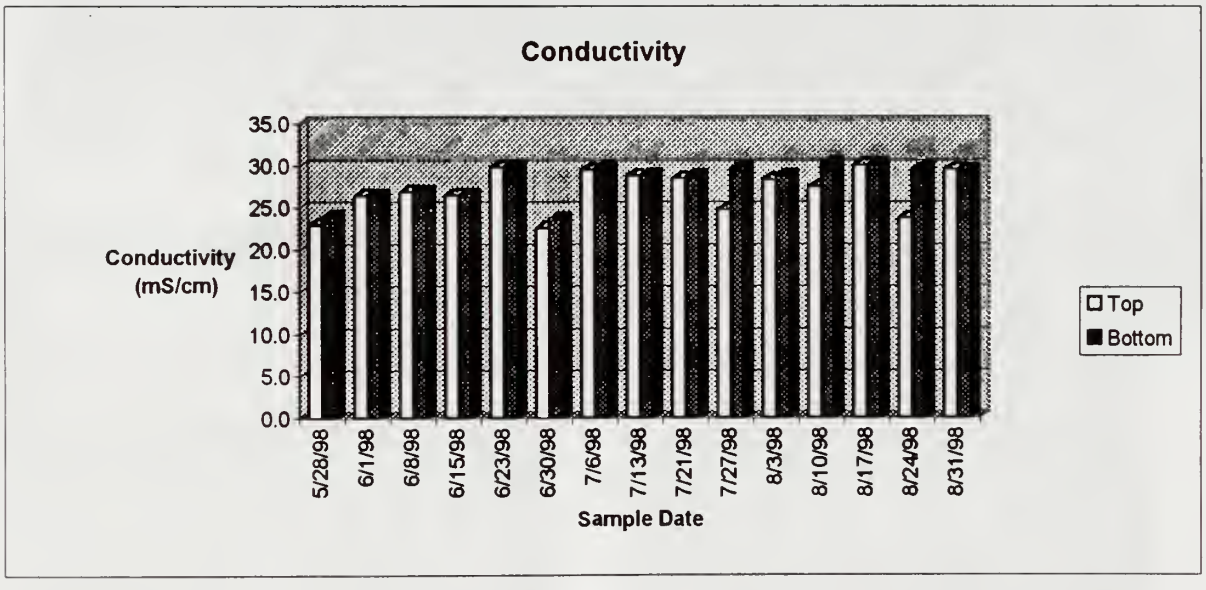
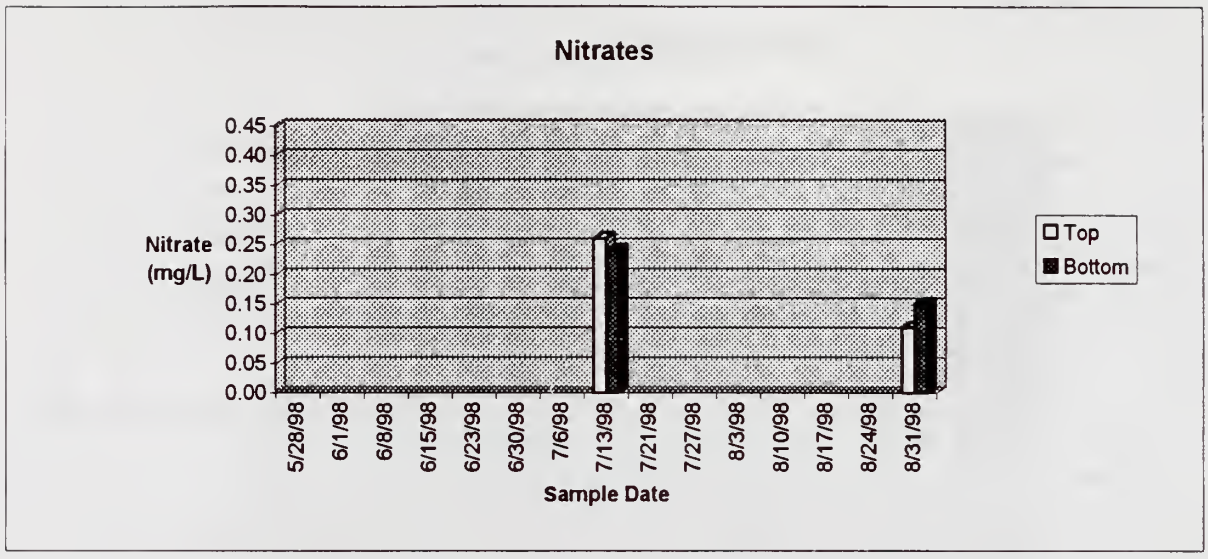
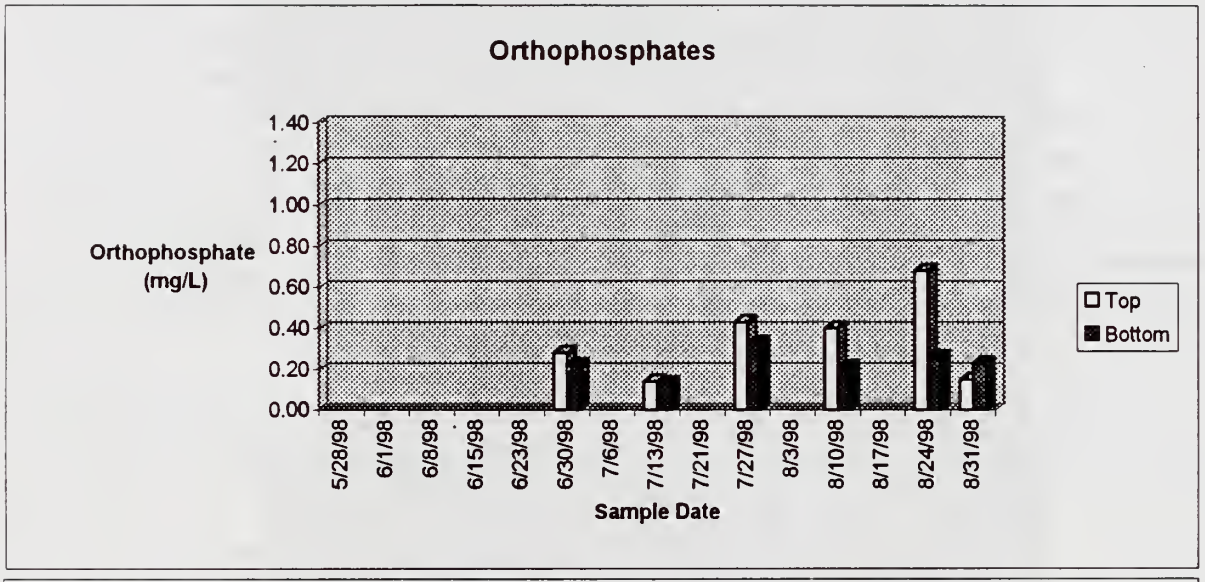


Figure 23

Grassy Bay (JB-9) Water Quality Measurements, 1998





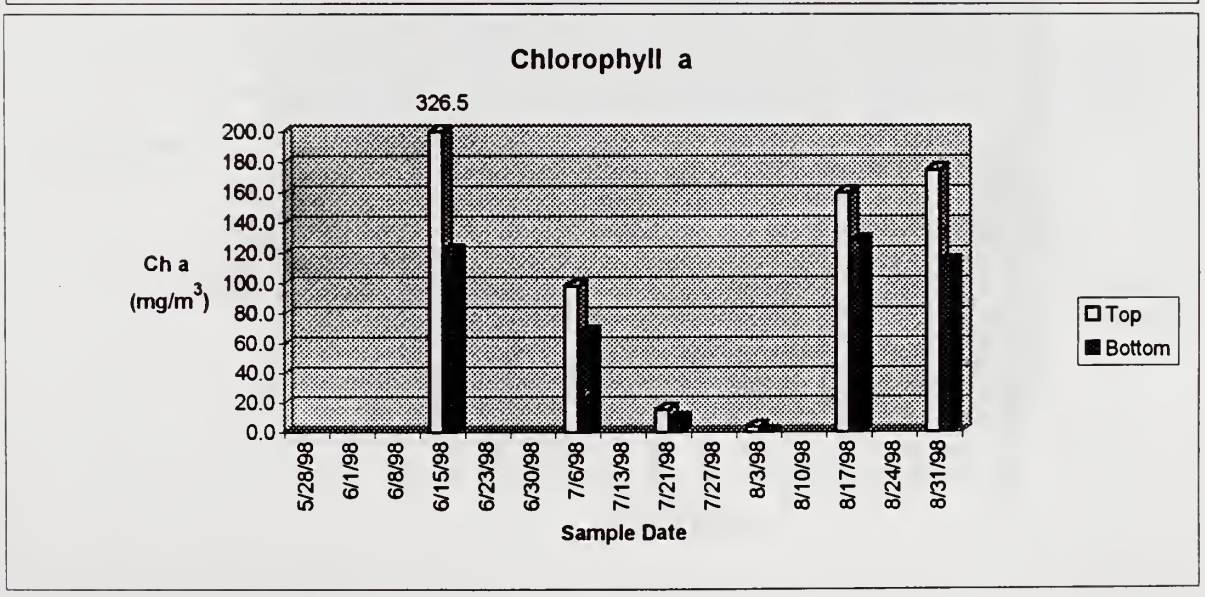
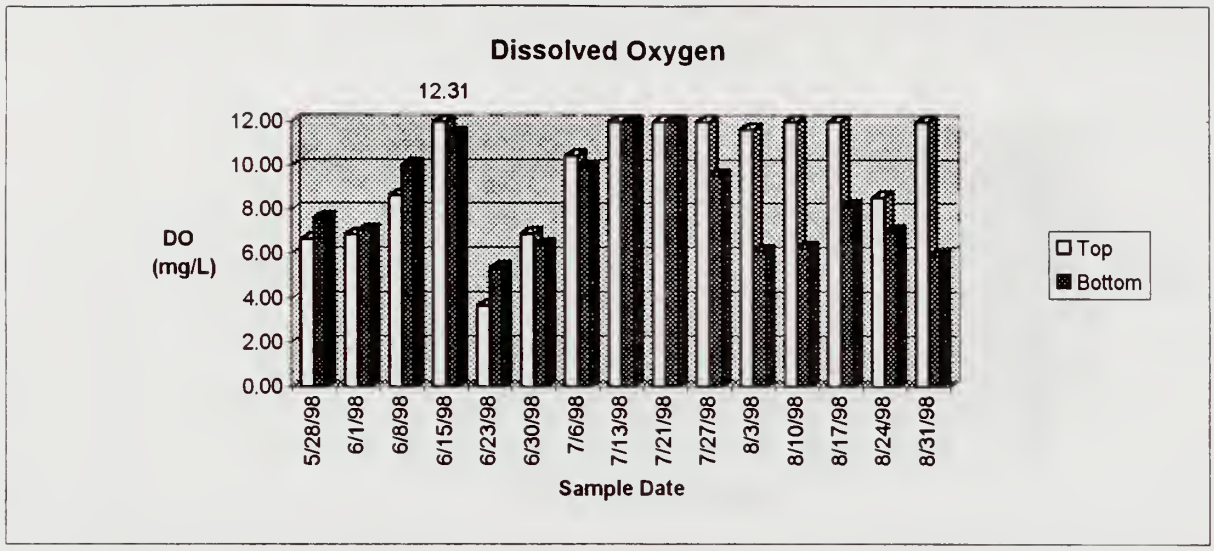
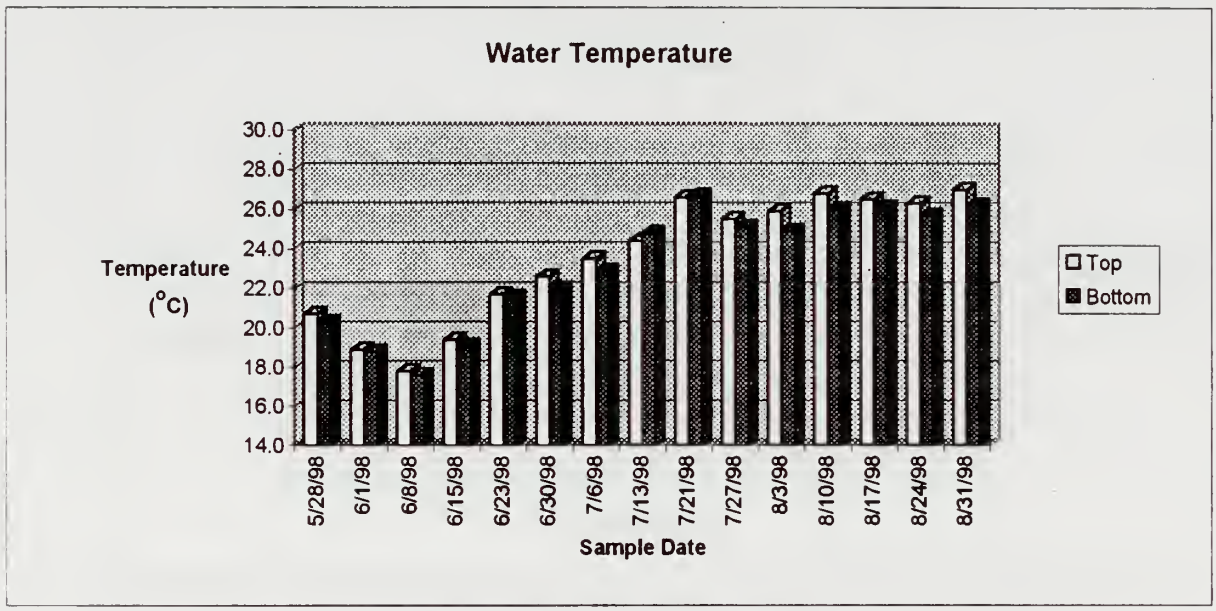


Figure 24

Grassy Bay (JB-9) Water Quality Measurements, 1998





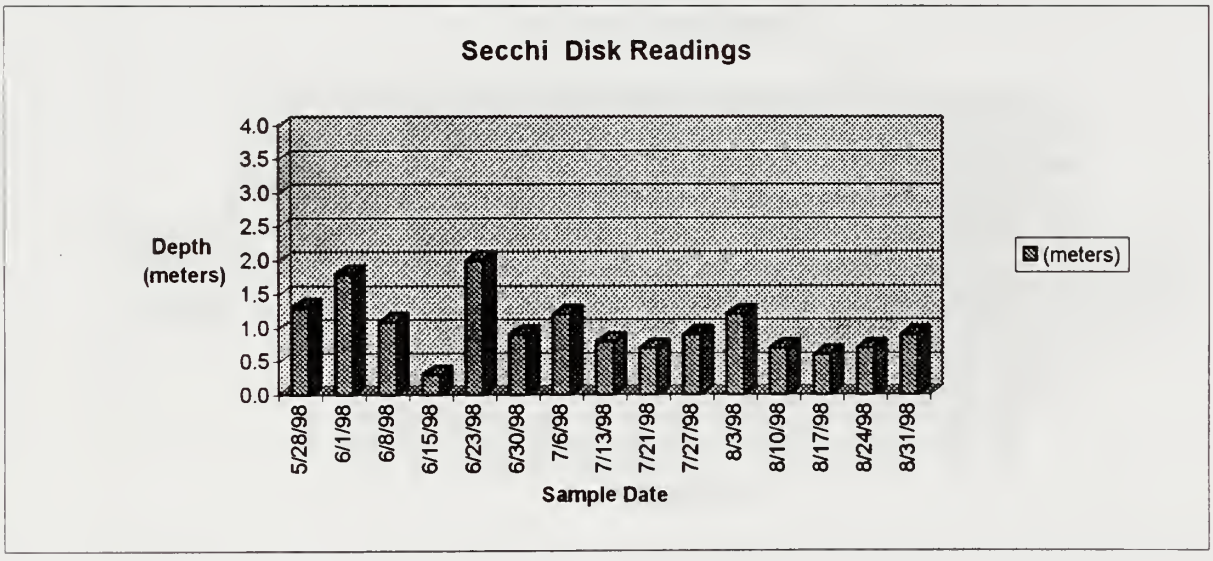
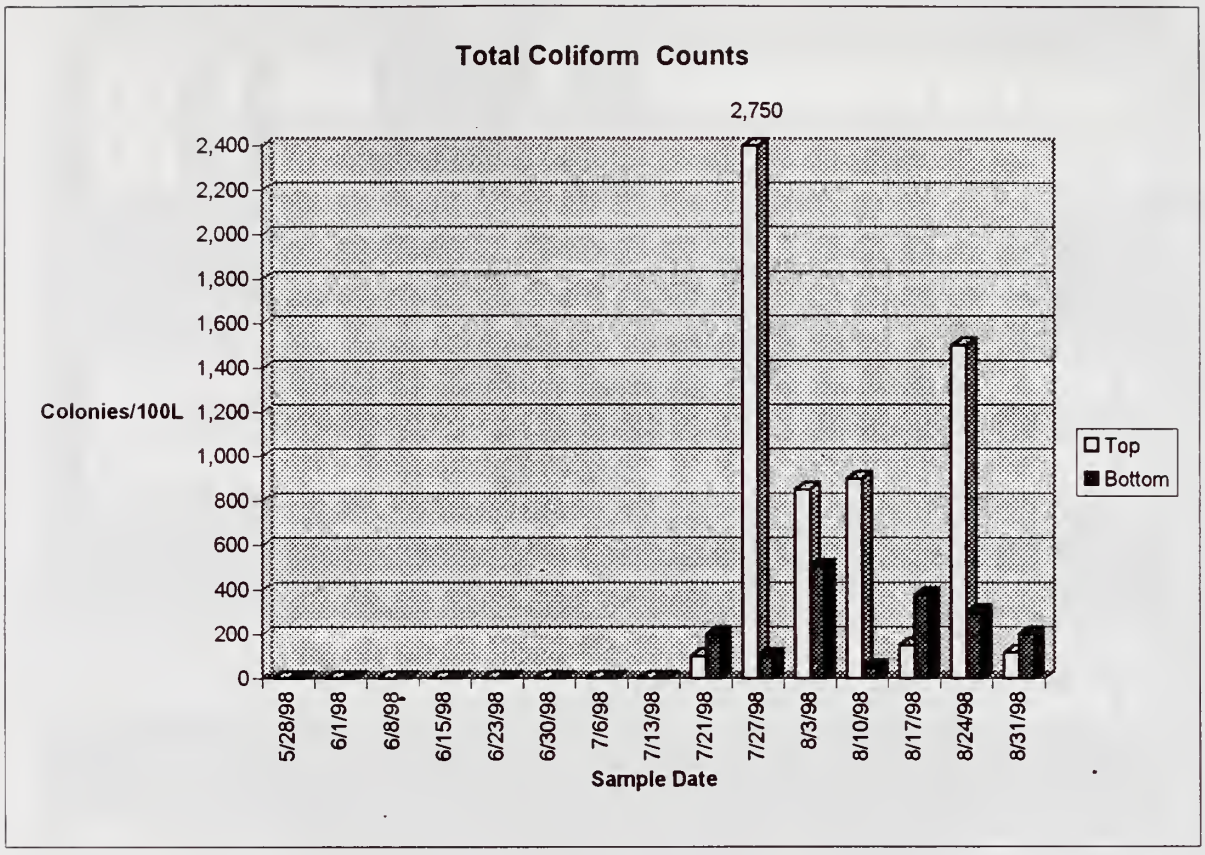


Figure 25

Grassy Bay (JB-9) Water Quality Measurements, 1998



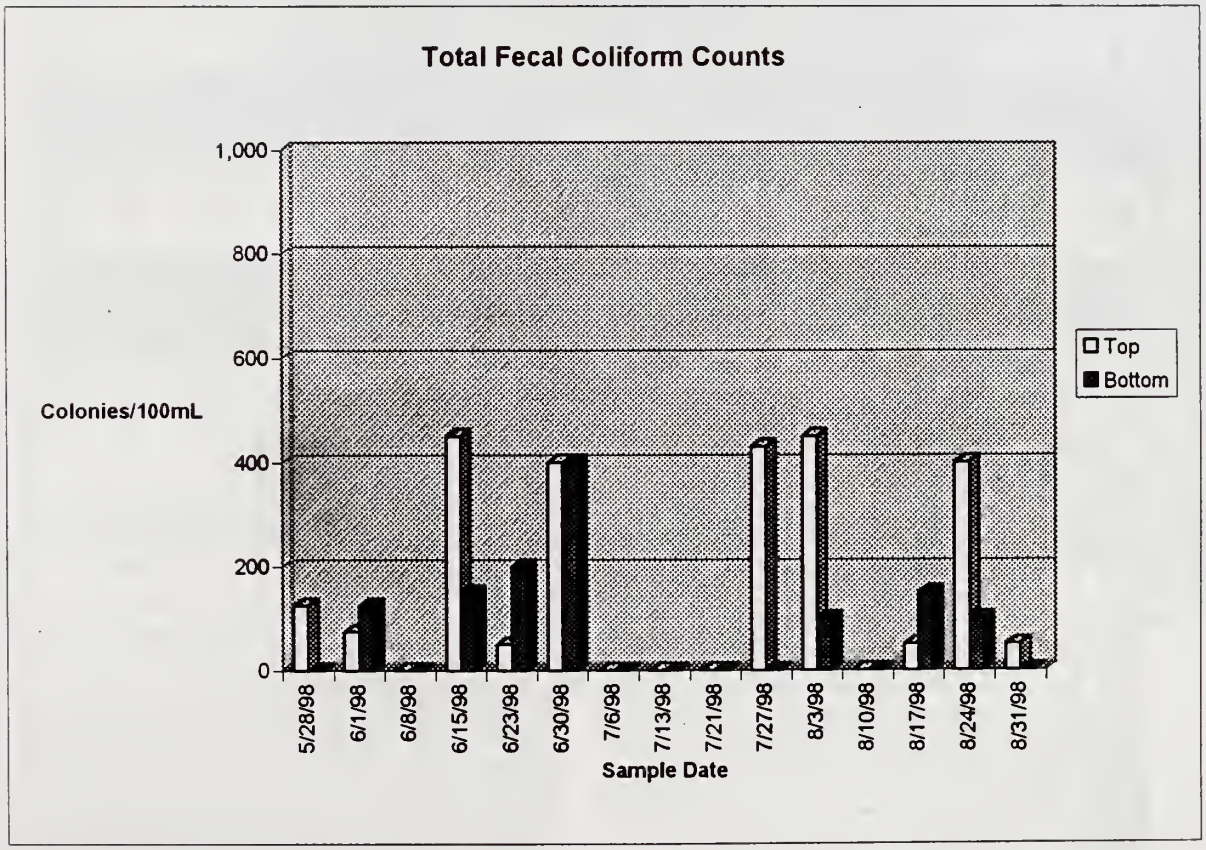


Figure 26

Table XII
Environmental Water Quality Monitoring
Jamaica Bay: Bergen Basin Outflow [JB-9A], 1998

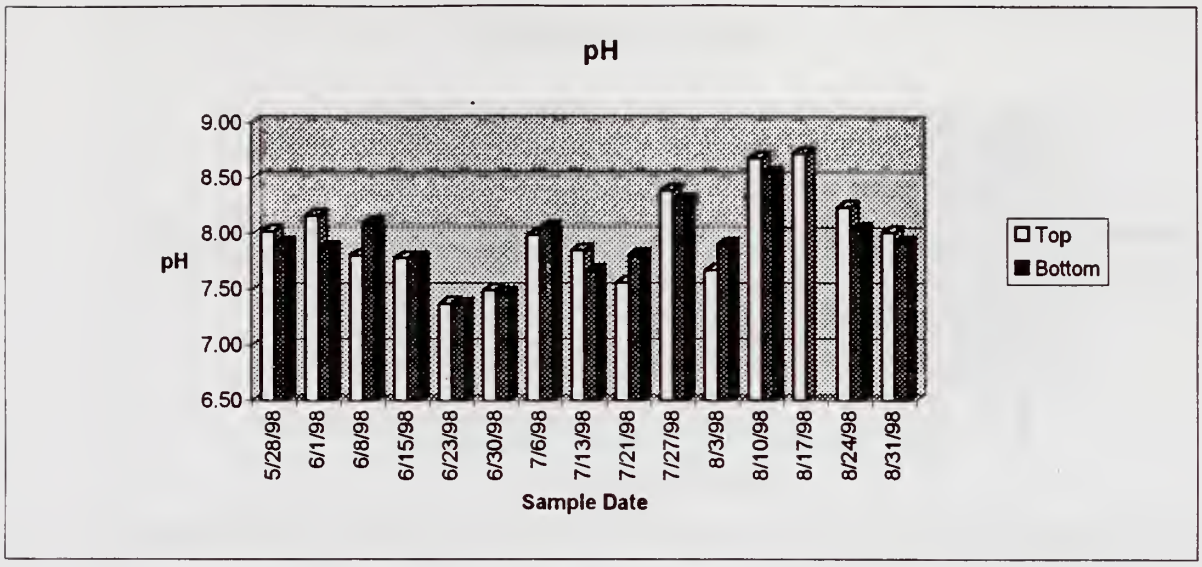
			Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
Date	Time	Tide		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:30 AM	M	19.2	20.0	18.9	16.2	16.7	8.02	7.91	26.3	27.2	7.42	9.78	---	---
6/1/98	02:30 PM	H	---	19.1	-----	15.1	16.9	8.16	7.87	24.7	27.1	6.56	5.45	---	---
6/8/98	12:10 PM	L	14.2	18.6	17.7	13.5	17.0	7.8	8.1	22.3	27.7	5.34	6.36	---	---
6/15/98	10:45 AM	M	18.4	18.8	18.2	15.7	17.0	7.78	7.78	25.6	27.6	4.37	4.66	---	---
6/23/98	11:30 AM	M	22.0	22.0	21.9	18.4	18.6	7.37	7.36	29.5	29.8	5.06	5.42	---	---
6/30/98	10:52 AM	M	20.3	23.3	23.2	18.0	18.8	7.49	7.46	29.0	30.2	5.93	4.90	---	---
7/6/98	11:40 AM	L	22.0	23.5	23.1	17.6	18.5	7.99	8.06	28.4	29.7	8.99	9.89	---	---
7/13/98	11:30 AM	H	22.0	23.6	23.1	18.2	18.6	7.85	7.66	29.2	29.8	7.17	6.35	0.27	0.20
7/21/98	11:25 AM	M	24.4	25.9	25.0	9.3	18.1	7.56	7.81	15.9	29.3	2.41	3.50	---	---
7/27/98	11:40 AM	H	23.9	25.7	25.1	18.5	19.0	8.39	8.3	29.5	30.4	9.80	7.50	---	---
8/3/98	11:45 AM	L	22.0	26.3	24.9	9.3	18.9	7.67	7.9	15.8	30.4	4.62	2.61	---	---
8/10/98	12:10 PM	H	25.2	26.6	26.2	19	19.0	8.68	8.54	30.3	30.4	11.34	6.55	---	---
8/17/98	12:25 PM	L	25.2	26.8	25.9	17.8	19.0	8.72	-----	28.6	30.5	12.65	3.98	---	---
8/24/98	11:30 AM	H	25.2	25.7	25.2	18.6	18.9	8.24	8.04	29.8	30.2	7.41	4.15	---	---
8/31/98	11:35 AM	M	22.3	26.5	25.9	13.6	18.8	8.01	7.92	22.4	30.2	8.69	3.88	0.21	0.10

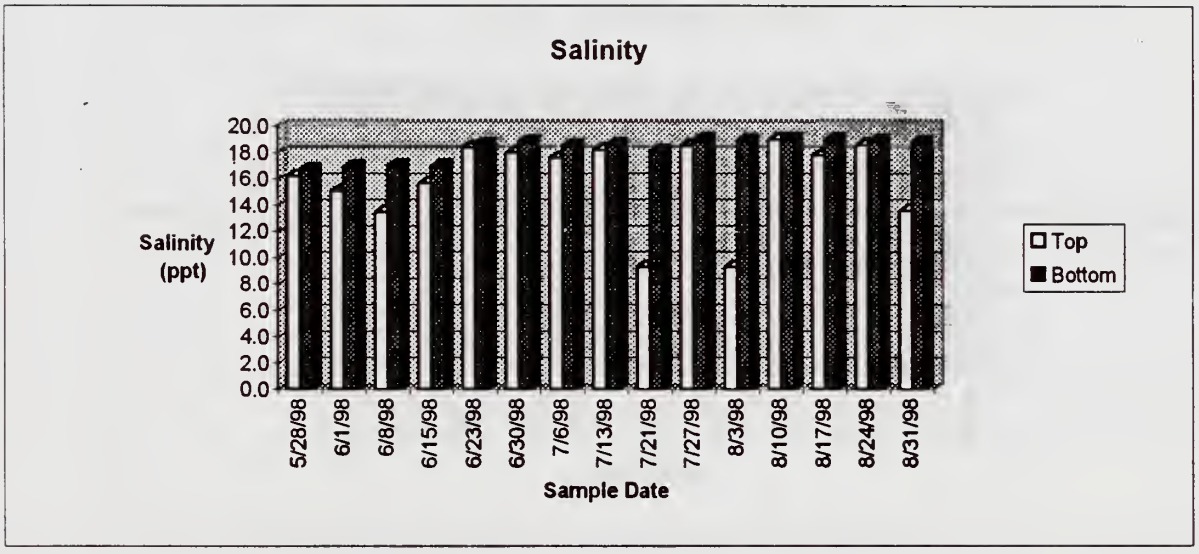
			Secchi Disk	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
Date	Time	Tide	(meters)	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:30 AM	M	1.6	---	---	---	---	---	---	---	---	20,000	600	1,700	450
6/1/98	02:30 PM	H	1.2	---	---	---	---	---	---	---	---	0	0	2,075	125
6/8/98	12:55 AM	L	1.2	---	---	---	---	---	---	---	---	0	0	350	25
6/15/98	10:45 AM	M	1.7	---	---	---	---	---	---	0.0	0.0	0	0	5,800	2,075
6/23/98	11:30 AM	M	1.3	<0.02	<0.02	<0.02	<0.02	---	---	---	---	0	0	4,350	950
6/30/98	10:52 AM	M	1.7	---	---	---	---	0.20	0.19	---	---	0	0	0	0
7/6/98	11:40 AM	L	1.3	---	---	---	---	---	---	67.5	79.9	0	0	0	0
7/13/98	11:30 AM	H	1.3	---	---	---	---	0.17	0.17	---	---	0	0	0	0
7/21/98	11:25 AM	M	1.2	---	---	---	---	---	---	280.3	257.1	2,300	550	1,400	100
7/27/98	11:40 AM	H	1.2	<0.02	<0.02	<0.02	<0.02	0.30	0.29	---	---	650	125	50	0
8/3/98	11:45 AM	L	1.3	---	---	---	---	---	---	58.2	24.0	1,850	150	1,400	0
8/10/98	12:10 PM	H	0.8	---	---	---	---	0.16	0.17	---	---	0	200	0	100
8/17/98	12:25 PM	L	0.9	<0.02	<0.02	<0.02	<0.02	---	---	64.6	26.8	0	0	0	0
8/24/98	11:30 AM	H	1.1	---	---	---	---	0.29	0.29	---	---	50	0	0	50
8/31/98	11:35 AM	M	1.0	<0.02	<0.02	<0.02	<0.02	0.35	0.30	44.2	31.8	43,800	800	5,850	100

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ---

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1998





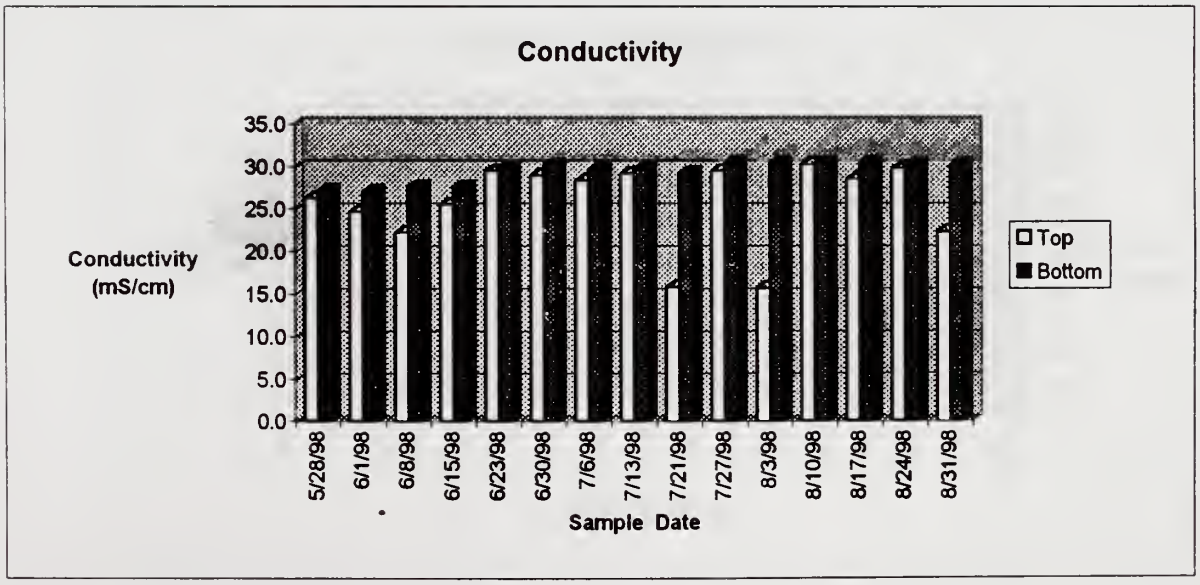
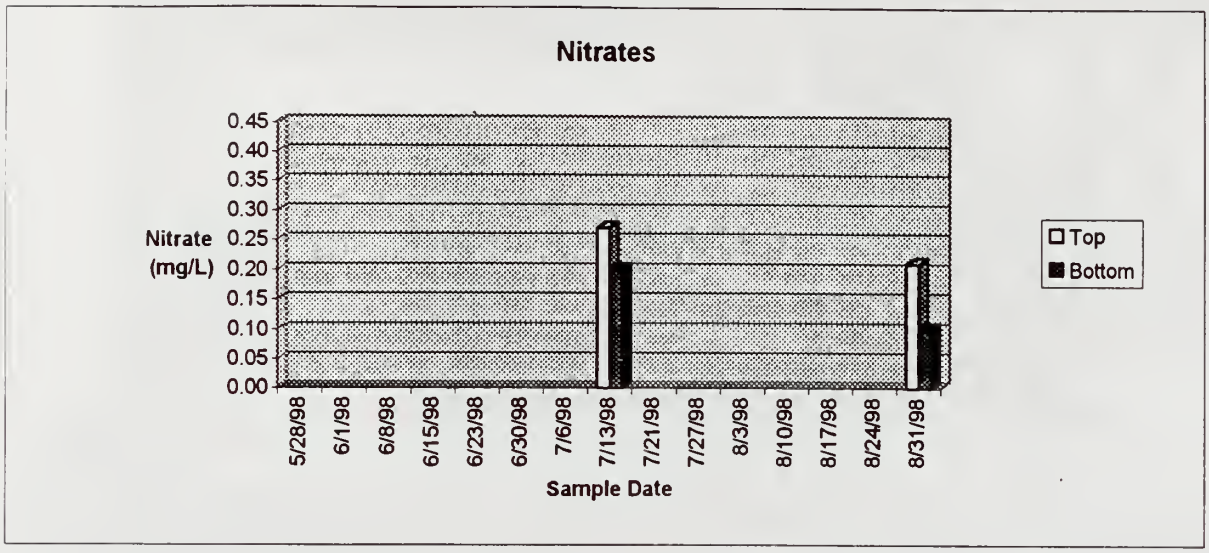
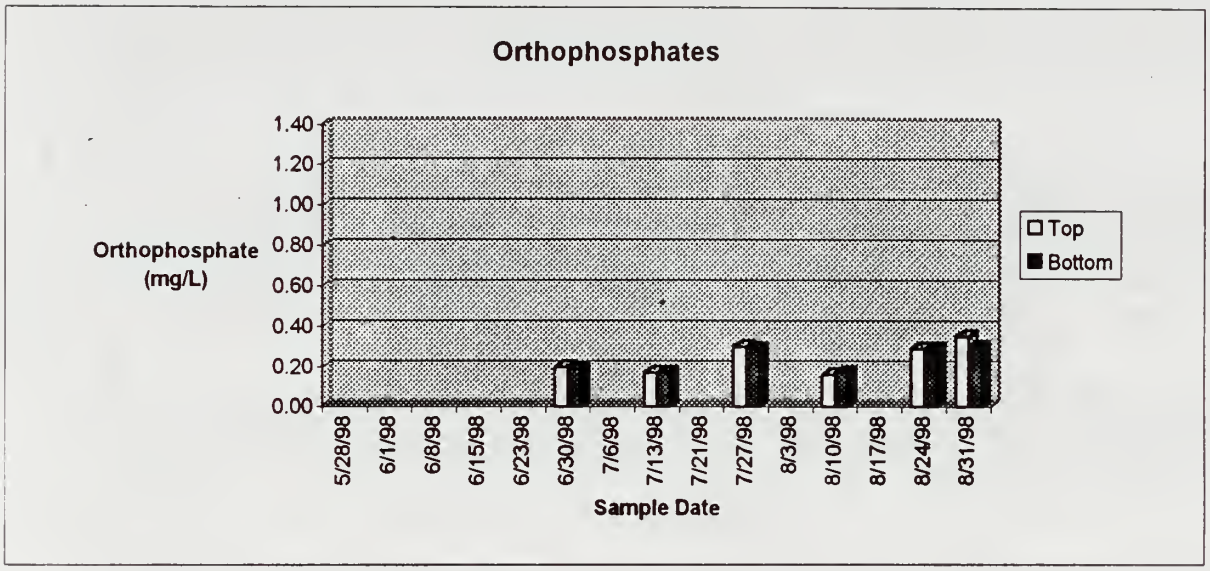


Figure 27

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1998





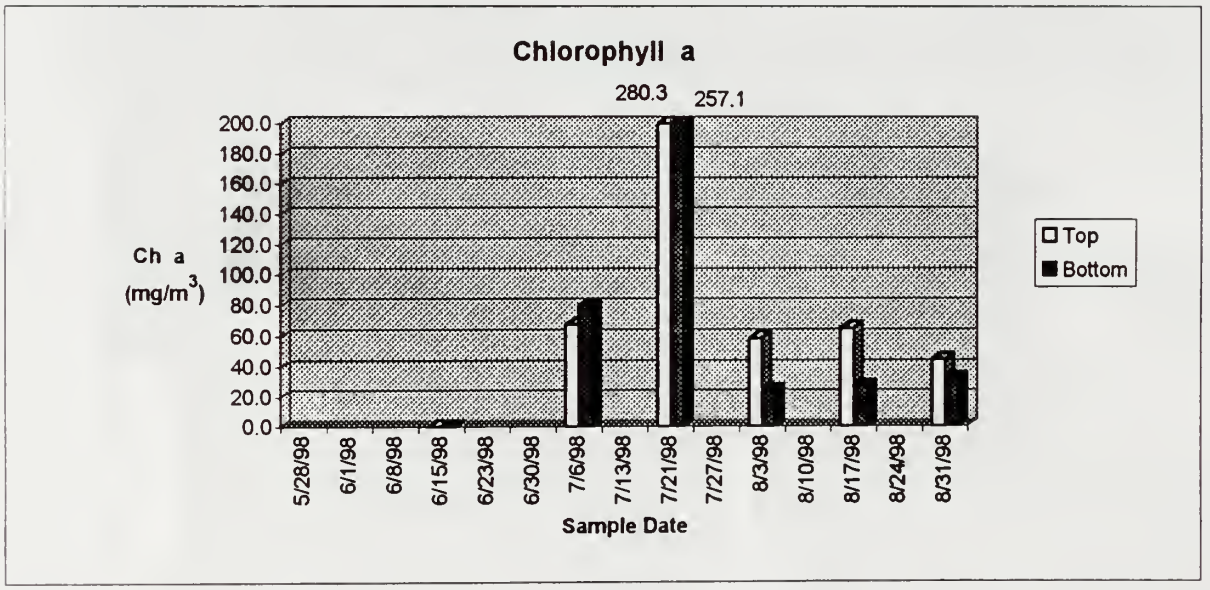
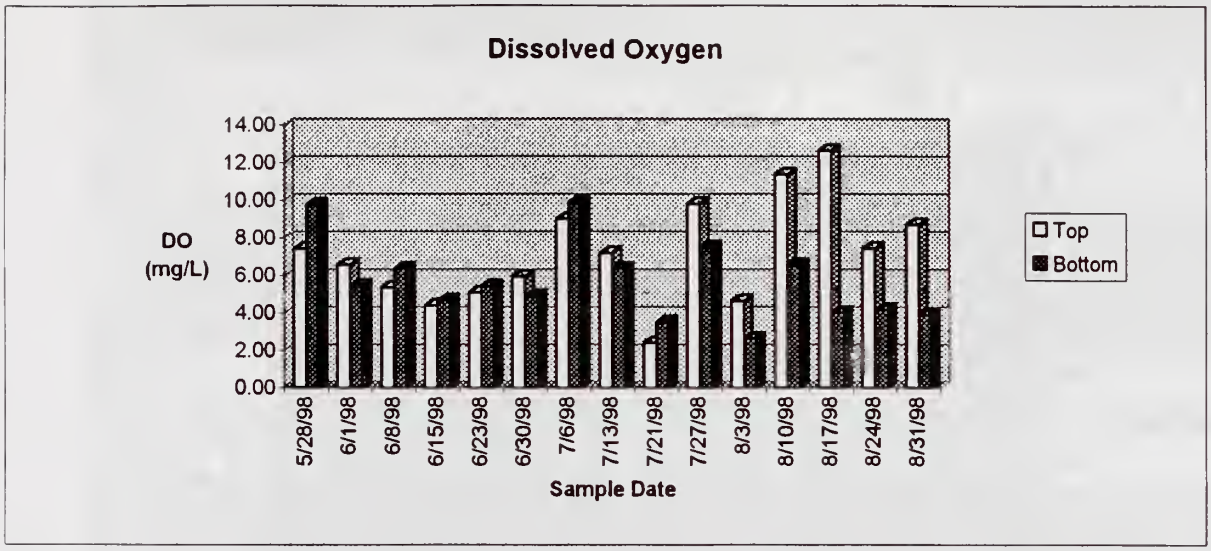
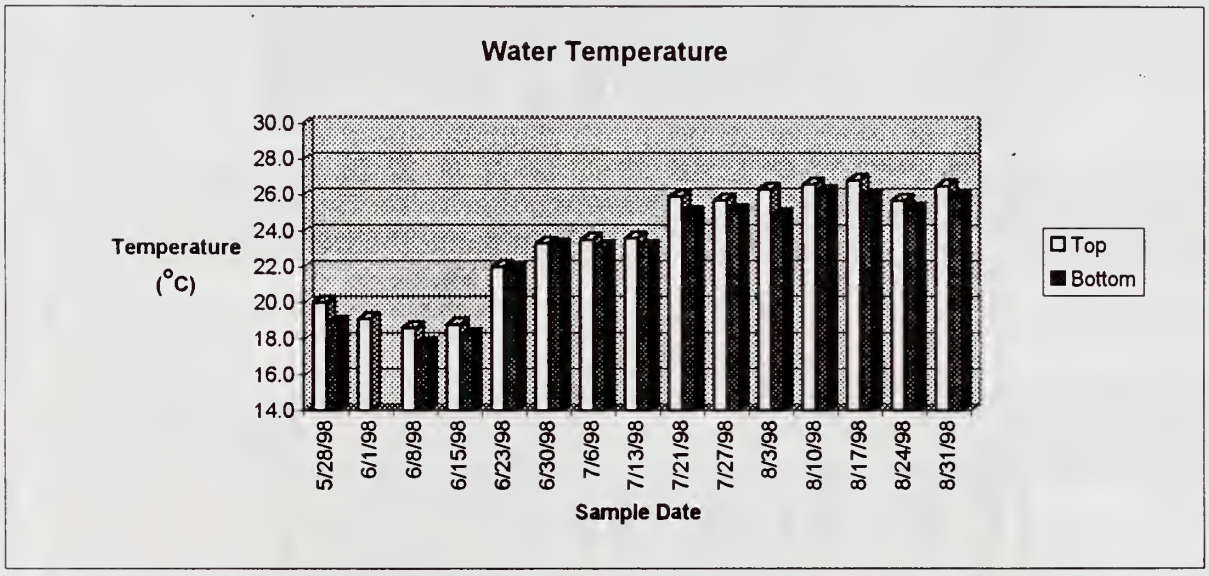


Figure 28

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1998





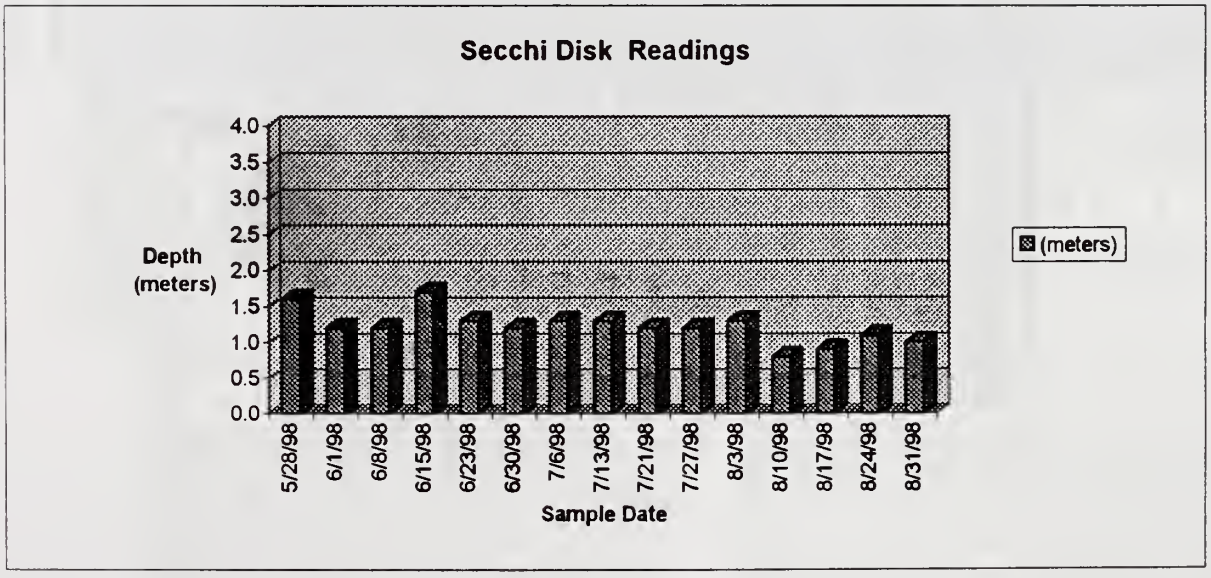
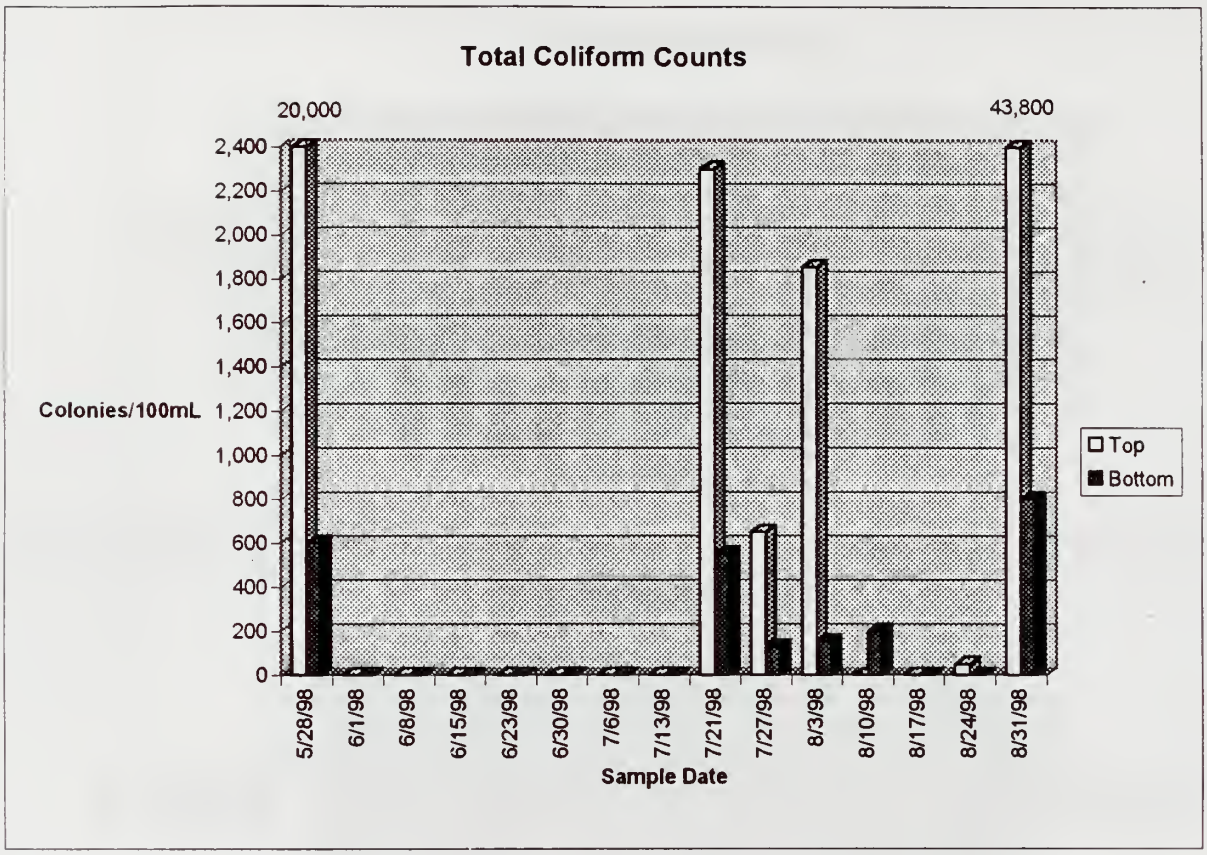


Figure 29

Bergen Basin Outflow (JB-9A) Water Quality Measurements, 1998



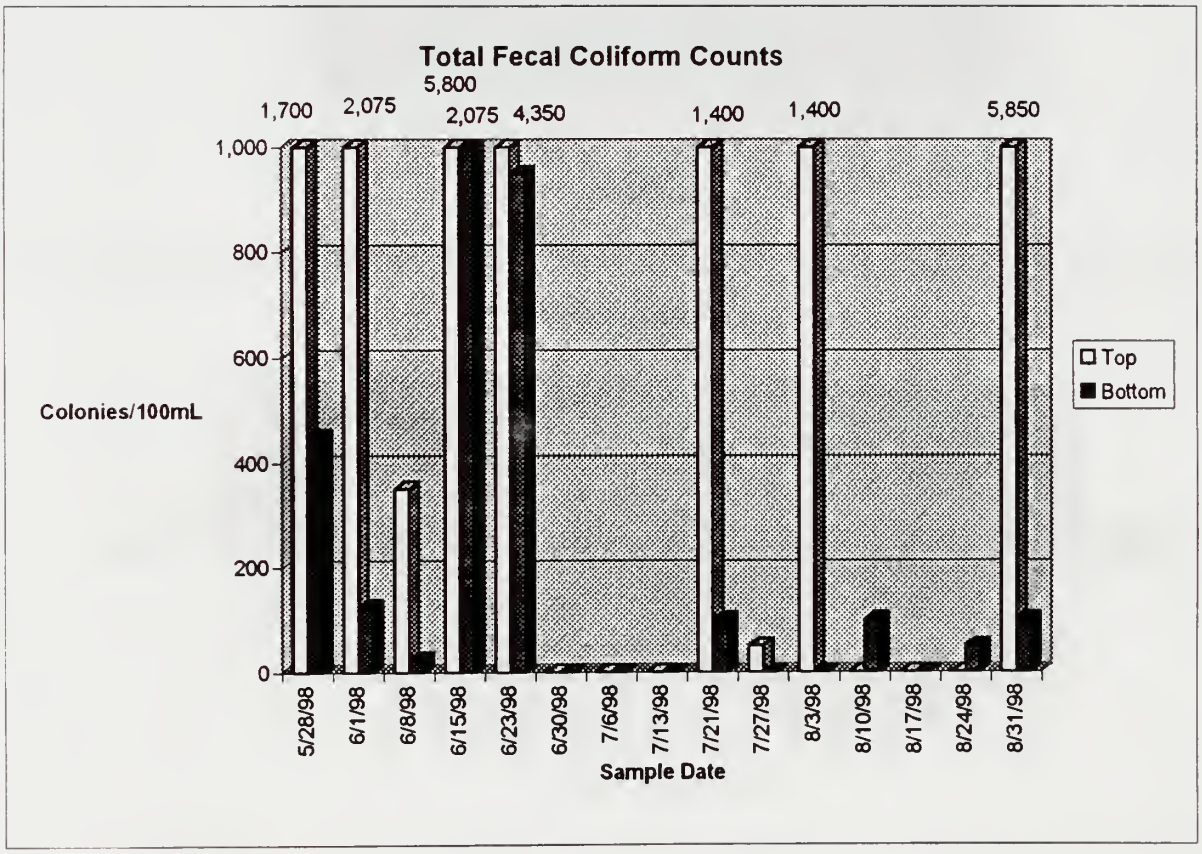


Figure 30

Table XIII
Environmental Water Quality Monitoring
Jamaica Bay: JoCo Marsh [JB-12], 1998

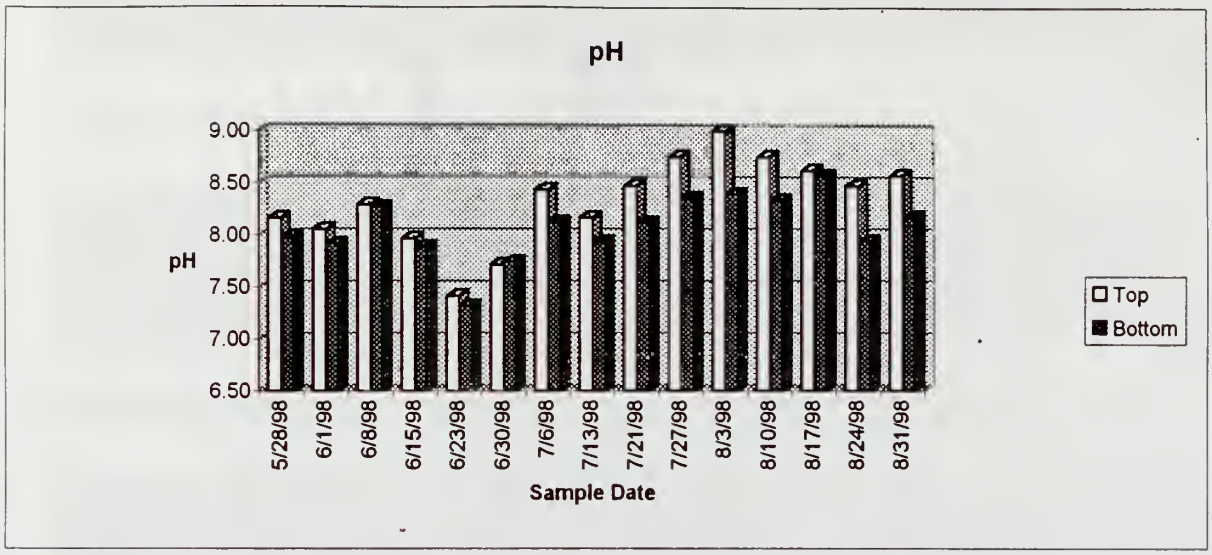
			Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
Date	Time	Tide		Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	12:10 PM	M	19.1	20.1	18.6	16.5	17.0	8.16	7.98	26.7	27.5	9.65	7.58	----	----
6/1/98	03:10 PM	H	----	20.2	----	16.9	17.1	8.05	7.91	25.5	27.7	7.65	6.98	----	----
6/8/98	12:45 PM	L	14.0	17.7	17.7	17.2	15.9	8.29	8.26	27.8	26.0	6.71	7.23	----	----
6/15/98	11:15 AM	M	18.4	18.8	17.8	16.2	17.5	7.96	7.88	26.4	28.4	5.01	4.91	----	----
6/23/98	11:58 AM	M	20.7	21.7	21.6	18.1	19.3	7.41	7.31	29.0	30.9	5.37	5.05	----	----
6/30/98	11:25 AM	M	21.9	23.3	23.0	19.3	19.2	7.71	7.74	30.7	30.7	7.76	6.74	----	----
7/6/98	12:15 AM	L	22.0	23.9	23.1	19.0	19.1	8.43	8.12	30.3	30.6	12.05	10.74	----	----
7/13/98	12:00 PM	H	21.9	24.2	23.7	18.6	18.6	8.16	7.93	29.3	29.7	11.05	9.30	----	0.03
7/21/98	12:40 PM	M	26.0	27.0	25.5	18.8	18.9	8.47	8.11	30.0	30.3	9.11	4.82	----	----
7/27/98	12:10 PM	H	24.4	25.9	25.2	19.4	19.3	8.75	8.35	30.7	30.8	15.17	7.61	----	----
8/3/98	12:10 PM	L	23.1	27.0	25.1	19.0	19.4	9.21	8.39	30.2	30.9	ORH	5.02	----	----
8/10/98	12:30 PM	M	25.4	26.7	26.0	19.3	19.5	8.75	8.33	30.7	31.5	11.27	5.30	----	----
8/17/98	12:45 PM	L	25.0	27.0	26.8	19.6	19.6	8.62	8.57	31.3	31.2	10.81	8.95	----	----
8/24/98	11:55 AM	H	26.2	26.4	25.2	19.1	19.3	8.47	7.94	30.5	30.8	10.73	3.35	----	----
8/31/98	12:05 PM	M	24.6	26.7	26.3	19.3	19.2	8.57	8.17	30.8	30.7	12.62	5.88	0.16	0.09

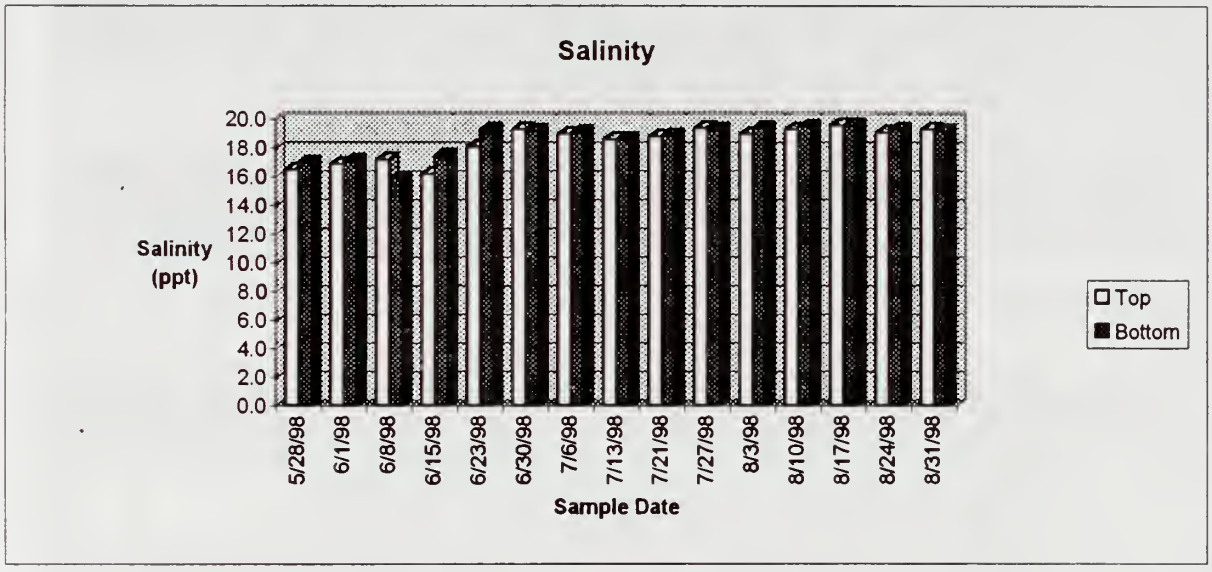
			Secchi Disk	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
Date	Time	Tide	(meters)	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	12:10 PM	M	1.5	----	----	----	----	----	----	----	----	0	0	0	0
6/1/98	03:10 PM	H	1.6	----	----	----	----	----	----	----	----	0	0	50	0
6/8/98	12:45 PM	L	1.9	----	----	----	----	----	----	----	----	0	0	50	0
6/15/98	11:15 AM	M	2.0	----	----	----	----	----	----	1.2	0.0	0	0	300	50
6/23/98	11:58 AM	M	1.4	<0.02	<0.02	<0.02	<0.02	----	----	----	----	0	0	0	100
6/30/98	11:25 AM	M	1.2	----	----	----	----	0.10	0.12	----	----	0	0	0	50
7/6/98	12:15 AM	L	0.9	----	----	----	----	----	----	109.5	61.9	0	0	0	0
7/13/98	12:00 PM	H	0.9	----	----	----	----	0.17	0.15	----	----	0	0	0	0
7/21/98	12:40 PM	M	1.3	----	----	----	----	----	----	39.8	16.5	0	50	0	0
7/27/98	12:10 PM	H	0.8	<0.02	<0.02	<0.02	<0.02	0.14	0.18	----	----	0	0	0	0
8/3/98	12:10 PM	L	0.2	----	----	----	----	----	----	802.2	11.6	100	100	50	50
8/10/98	12:30 PM	M	0.8	----	----	----	----	0.29	0.22	----	----	0	0	0	0
8/17/98	12:45 PM	L	0.8	<0.02	<0.02	<0.02	<0.02	----	----	112.1	96.4	0	0	0	0
8/24/98	11:55 AM	H	1.0	----	----	----	----	0.23	0.29	----	----	75	0	100	100
8/31/98	12:05 PM	M	1.2	<0.02	<0.02	<0.02	<0.02	0.14	0.25	40.9	32.3	0	0	0	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ---- ORH = Out-of-range-high

JoCo Marsh (JB-12) Water Quality Measurements, 1998





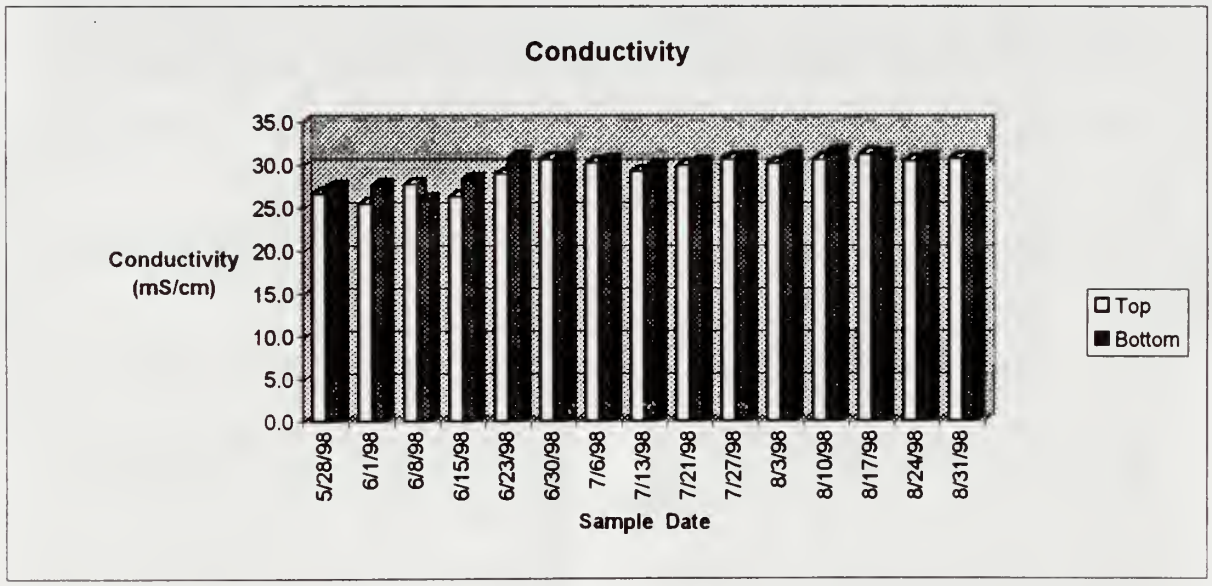
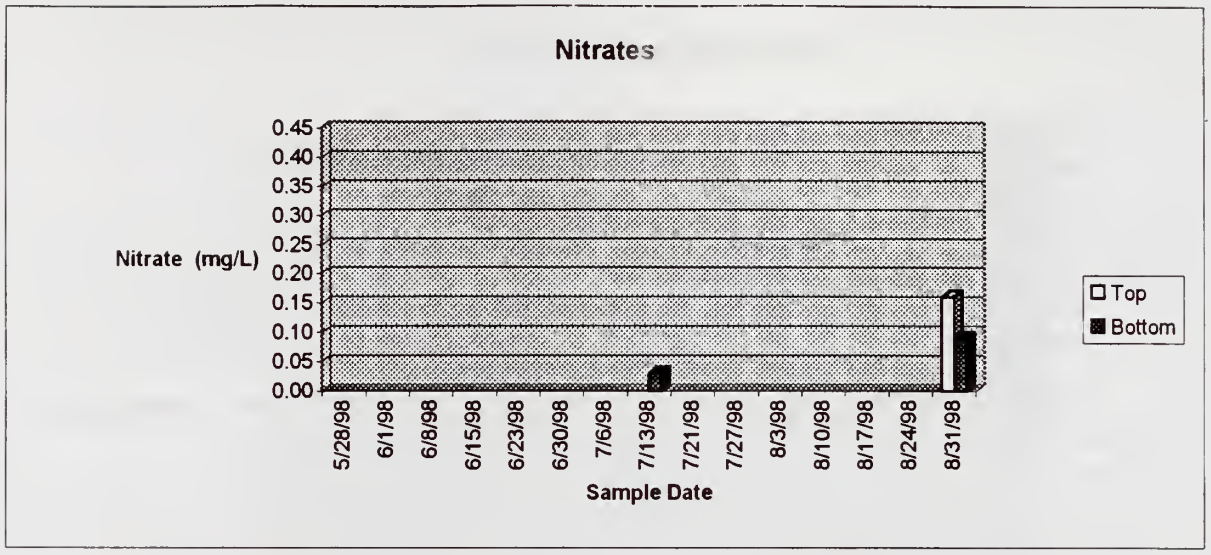
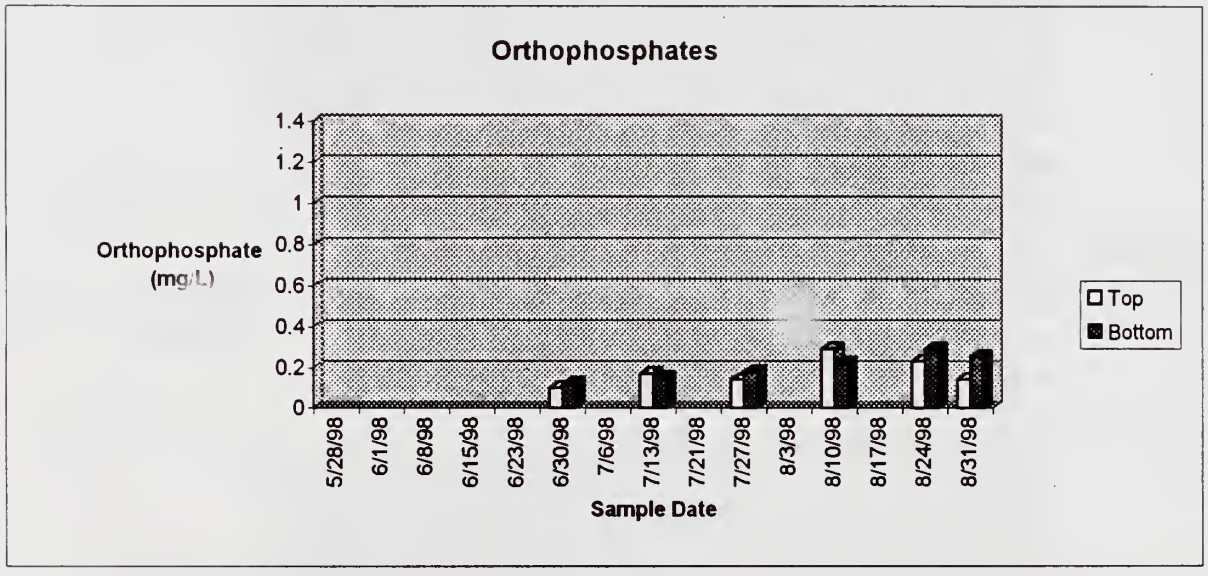


Figure 31

JoCo Marsh (JB-12) Water Quality Measurements, 1998





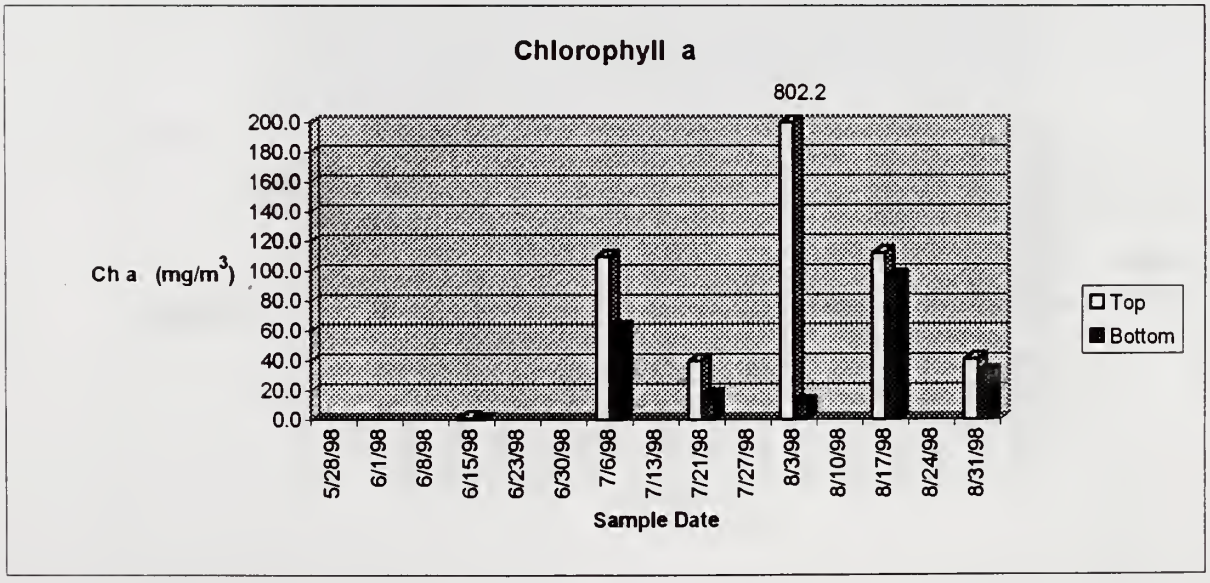
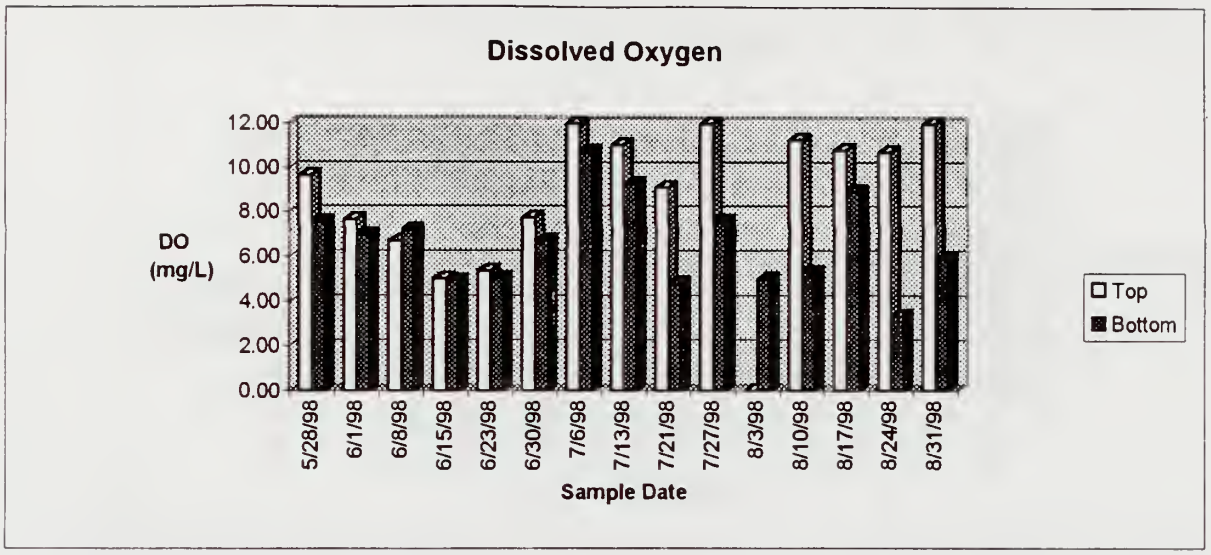
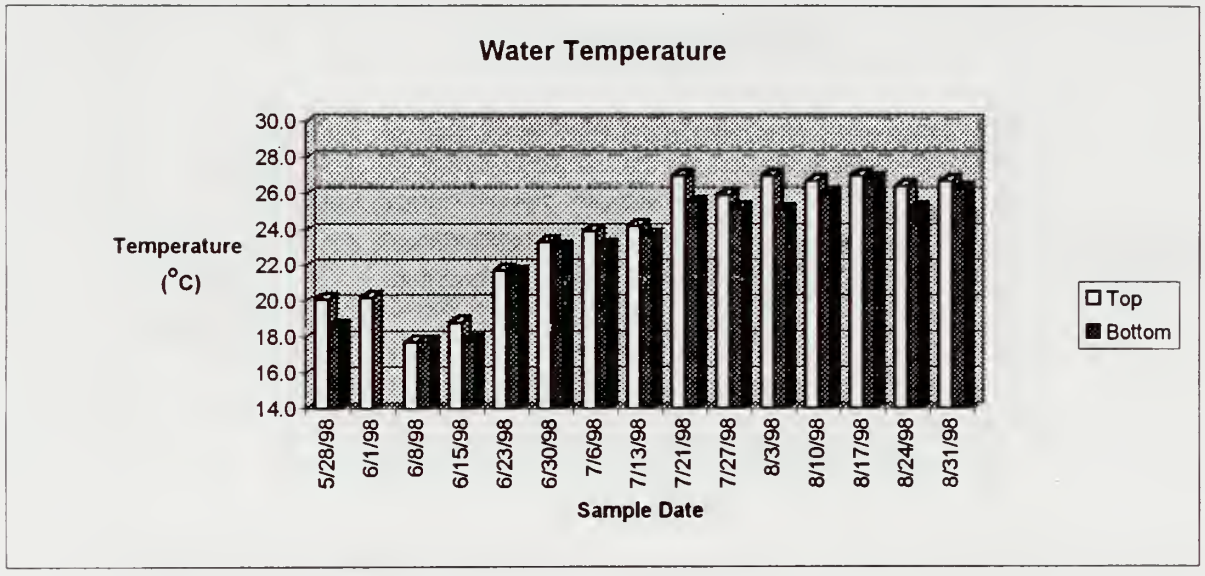


Figure 32

JoCo Marsh (JB-12) Water Quality Measurements, 1998





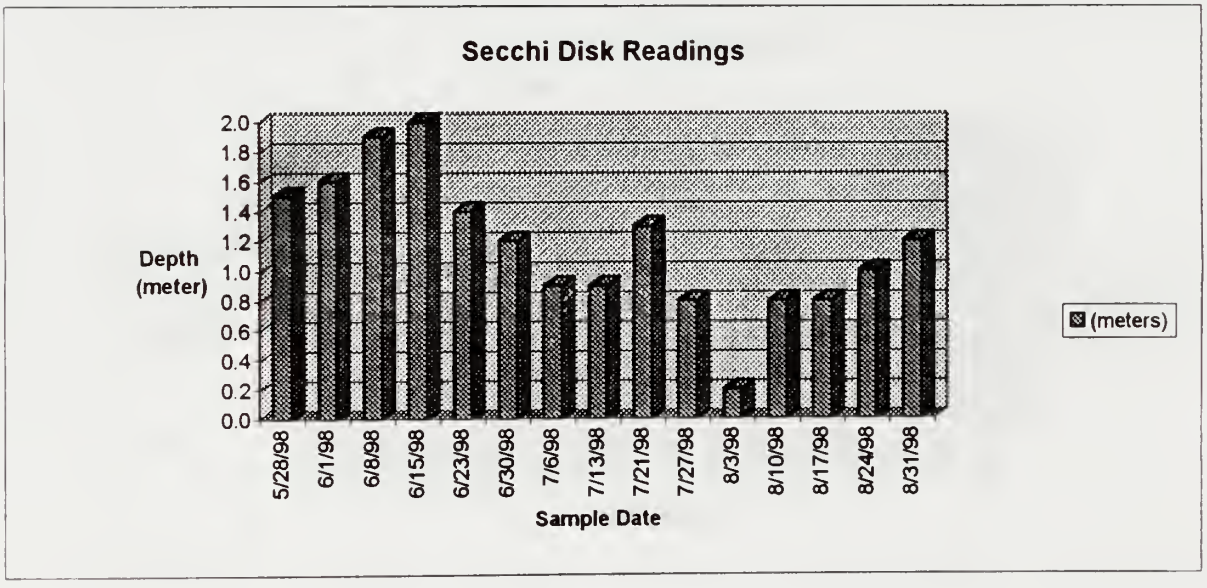
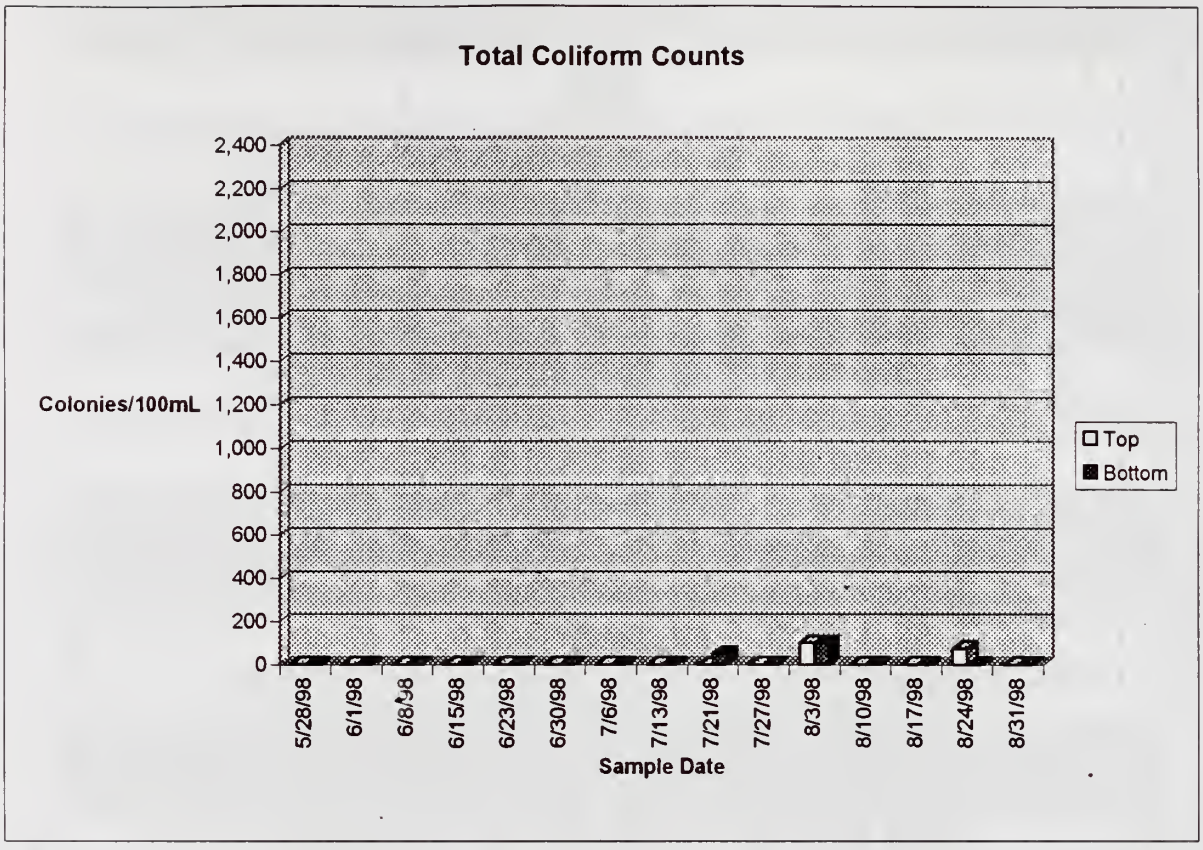


Figure 33

JoCo Marsh (JB-12) Water Quality Measurements, 1998



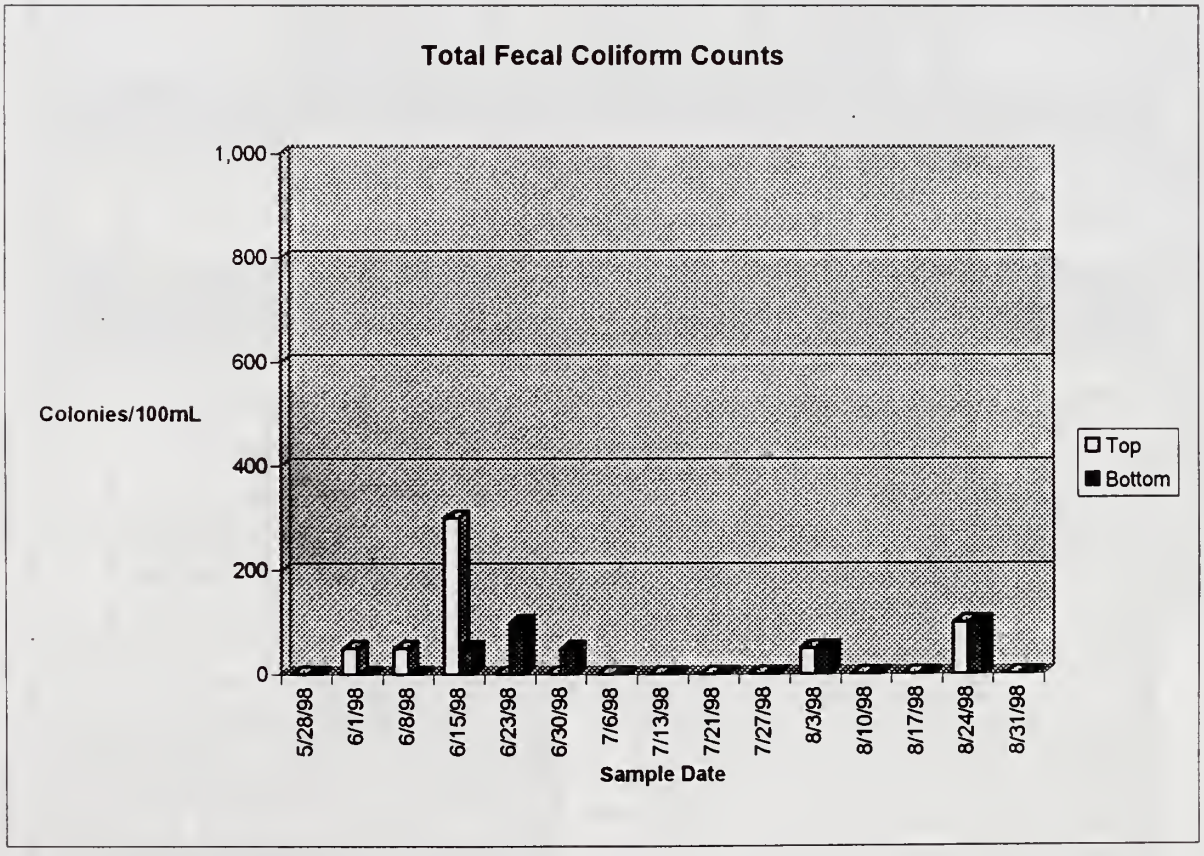


Figure 34

Table XIV
Environmental Water Quality Monitoring
Jamaica Bay: Beach Channel [JB-15], 1998

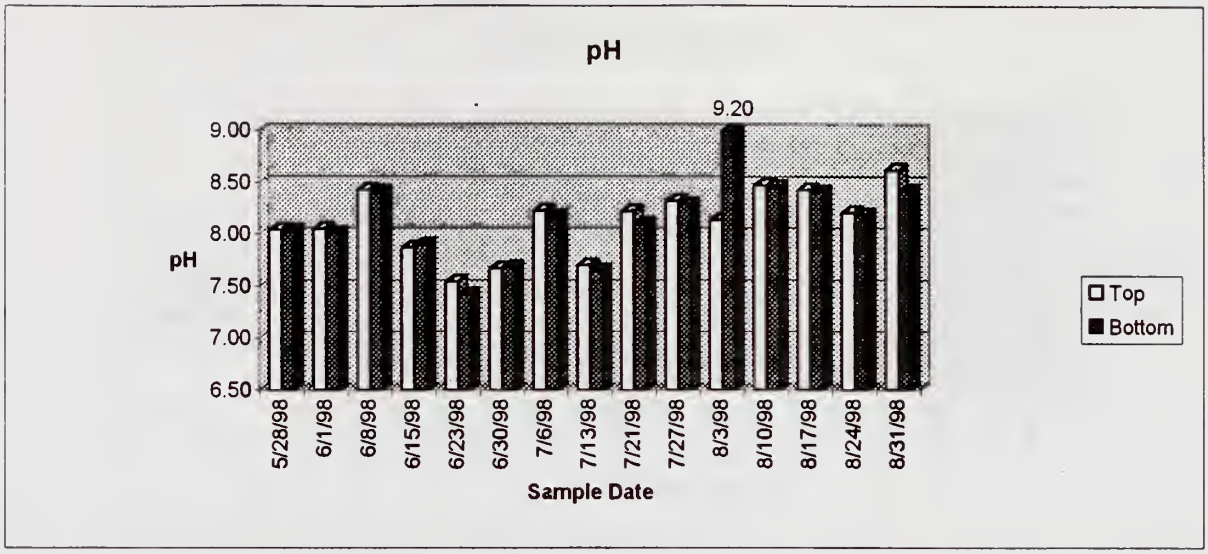
Date	Time	Tide	Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	12:25 PM	M	18.5	17.5	17.6	18.0	18.1	8.04	8.03	29.1	29.3	7.77	7.93	----	----
6/1/98	03:30 PM	H	18.8	19.3	18.7	17.4	18.1	8.05	8.01	28.8	29.2	7.21	7.95	----	----
6/8/98	01:45 PM	L	14.4	17.1	16.8	17.3	17.3	8.43	8.41	28.0	28.1	8.57	9.44	----	----
6/15/98	11:36 AM	M	17.7	17.3	17.2	18.1	18.1	7.87	7.90	29.4	29.2	4.55	6.12	----	----
6/23/98	12:50 PM	M	20.5	21.4	21.4	19.1	19.6	7.54	7.42	30.5	31.0	5.56	4.56	----	----
6/30/98	11:45 AM	M	20.6	22.3	22.1	20.5	20.4	7.67	7.68	32.3	32.4	4.94	5.77	----	----
7/6/98	12:30 PM	L	22.4	23.2	23.1	19.2	19.1	8.23	8.17	30.6	30.6	8.69	8.57	----	----
7/13/98	12:10 PM	H	20.9	22.1	21.8	19.7	20.0	7.70	7.65	31.3	31.8	5.40	6.32	0.06	0.08
7/21/98	01:41 PM	L	26.3	26.0	25.5	18.7	19.0	8.22	8.10	30.0	30.4	11.21	9.33	----	----
7/27/98	12:20 PM	H	23.6	24.0	23.7	19.7	20.3	8.32	8.29	31.4	32.3	7.83	6.36	----	----
8/3/98	12:30 PM	L	21.2	24.3	24.0	19.5	19.7	8.14	9.20	31.2	31.3	5.27	5.34	----	----
8/10/98	12:50 PM	M	25.5	25.7	25.7	20.1	20.0	8.47	8.46	31.9	31.8	7.33	6.22	----	----
8/17/98	01:10 PM	M	25.9	25.8	25.7	20.0	20.0	8.43	8.41	31.8	31.8	6.59	6.20	----	----
8/24/98	12:10 PM	H	25.6	24.8	24.8	19.9	19.9	8.21	8.19	31.8	31.8	6.38	5.16	----	----
8/31/98	12:25 PM	M	24.7	26.1	25.6	19.5	19.7	8.62	8.42	31.1	31.4	12.41	7.64	0.10	0.13

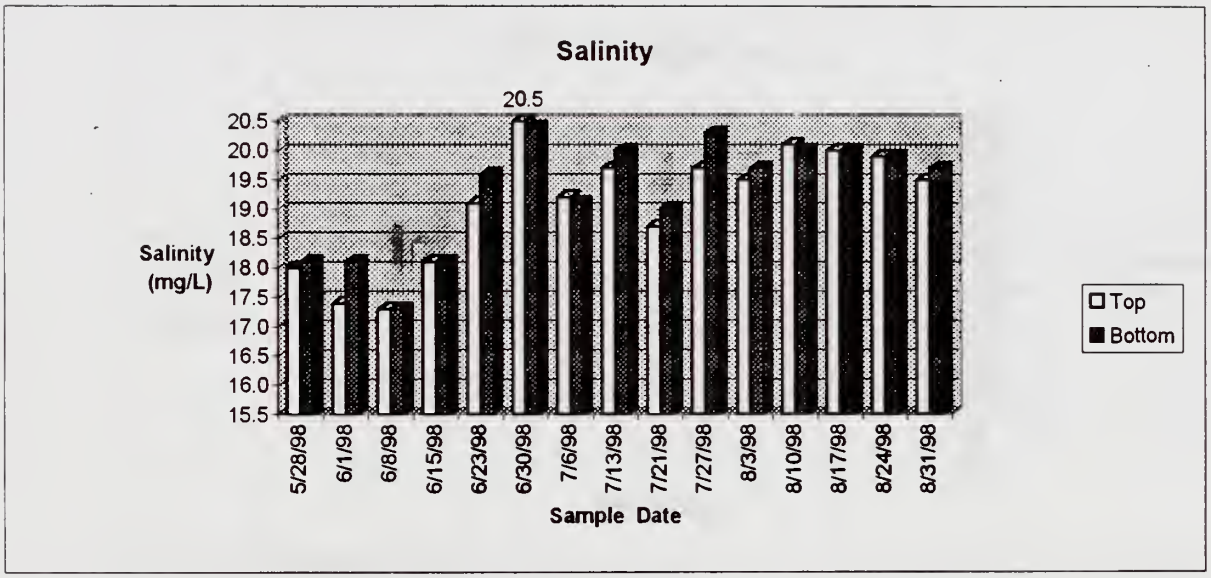
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	12:25 PM	M	2.1	----	----	----	----	----	----	----	----	0	0	0	50
6/1/98	3:30 PM	H	1.8	----	----	----	----	----	----	----	----	0	0	0	50
6/8/98	01:45 PM	L	1.5	----	----	----	----	----	----	----	----	0	0	50	0
6/15/98	11:36 AM	M	2.3	----	----	----	----	----	----	0.0	0.0	0	0	100	450
6/23/98	12:50 PM	M	2.2	<0.02	<0.02	<0.02	<0.02	----	----	----	----	0	0	0	0
6/30/98	11:45 AM	M	1.7	----	----	----	----	0.12	0.15	----	----	0	0	50	50
7/6/98	12:30 PM	L	1.2	----	----	----	----	----	----	78.6	78.9	0	0	0	0
7/13/98	12:10 PM	H	2.2	----	----	----	----	0.10	0.07	----	----	0	0	0	0
7/21/98	01:41 PM	L	1.7	----	----	----	----	----	----	22.4	22.4	200	50	50	0
7/27/98	12:20 PM	H	1.7	<0.02	<0.02	<0.02	<0.02	0.19	0.23	----	----	0	0	0	0
8/3/98	12:30 PM	L	1.8	----	----	----	----	----	----	10.6	11.8	0	150	150	100
8/10/98	12:50 PM	M	1.7	----	----	----	----	0.12	0.13	----	----	0	0	0	0
8/17/98	01:10 PM	M	1.3	<0.02	<0.02	<0.02	<0.02	----	----	40.9	32.2	100	0	50	0
8/24/98	12:10 PM	H	1.7	----	----	----	----	0.15	0.15	----	----	50	0	0	0
8/31/98	12:25 PM	M	1.1	<0.02	<0.02	<0.02	<0.02	0.09	0.11	100.2	76.1	0	50	50	0

Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

Beach Channel (JB-15) Water Quality Measurements, 1998





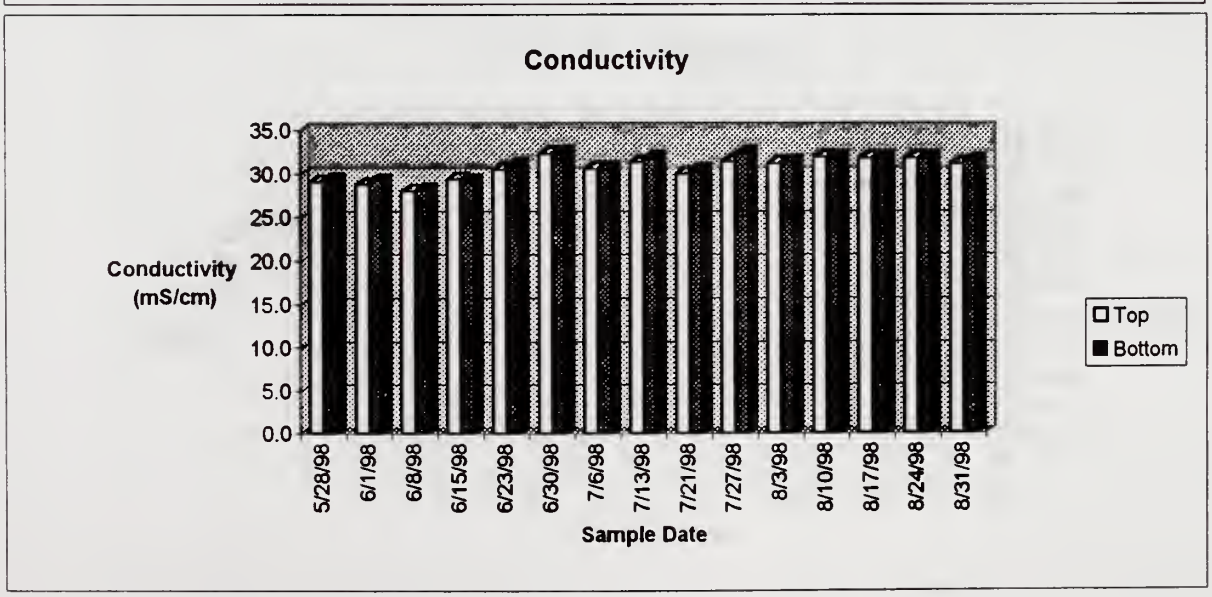
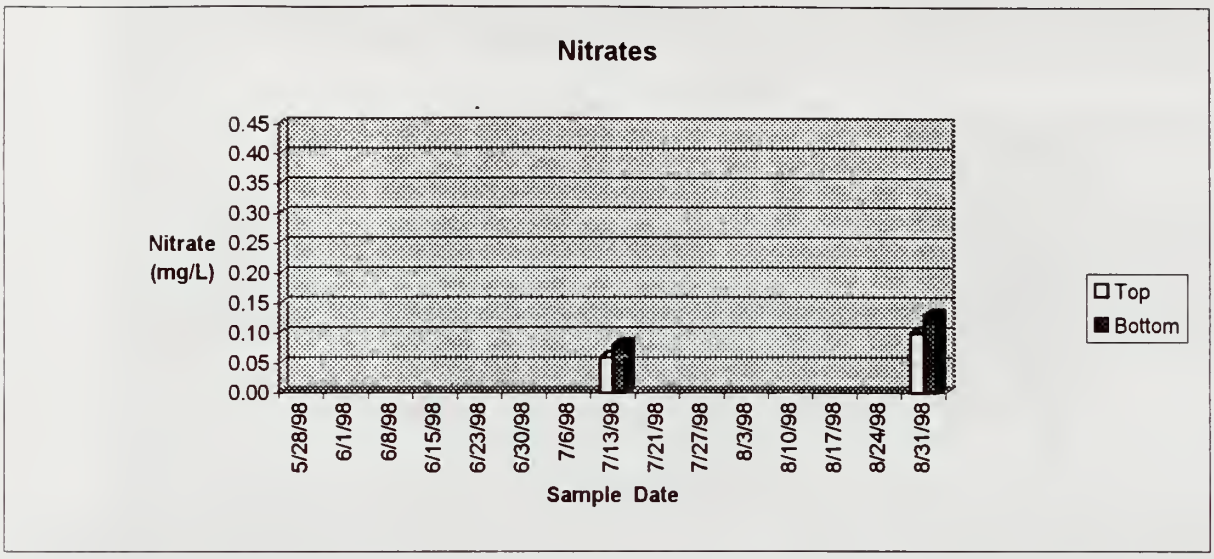
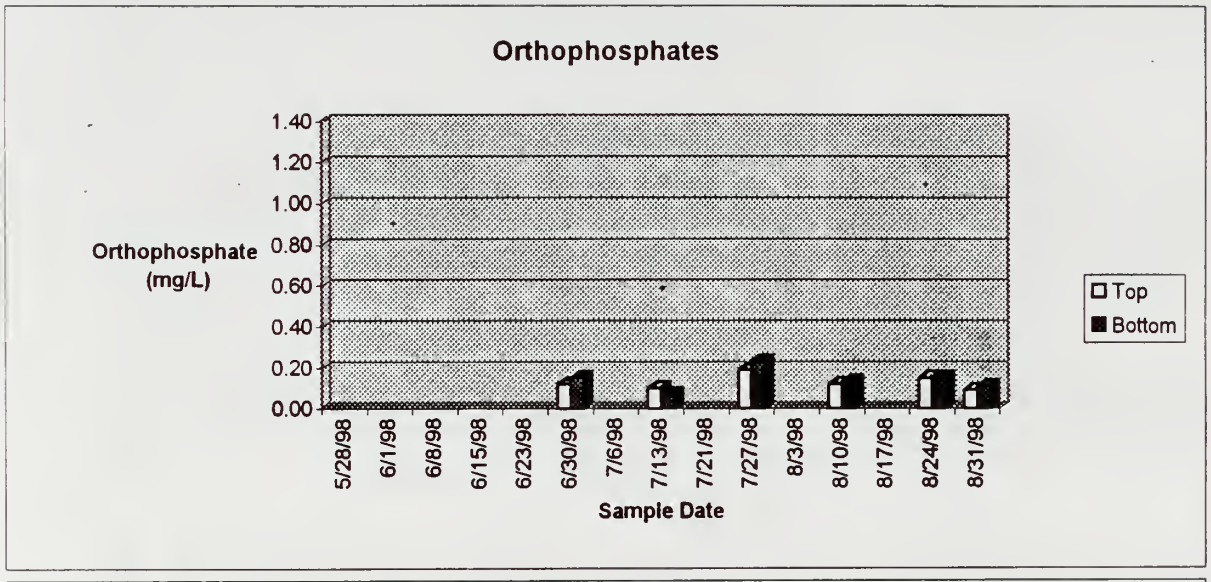


Figure 35

Beach Channel (JB-15) Water Quality Measurements, 1998





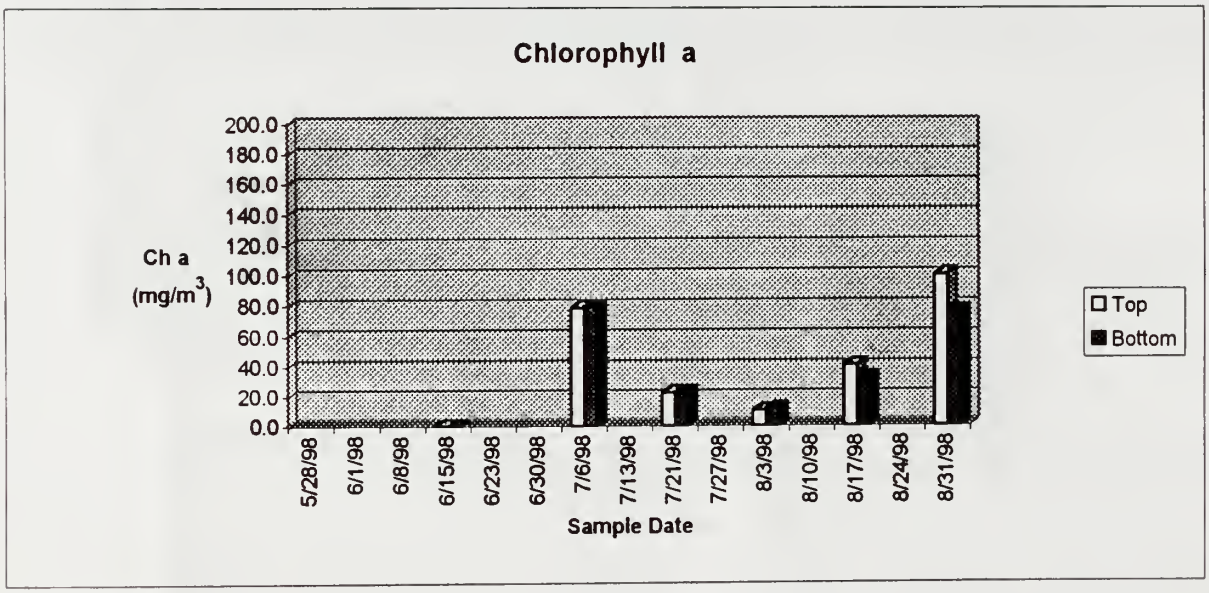
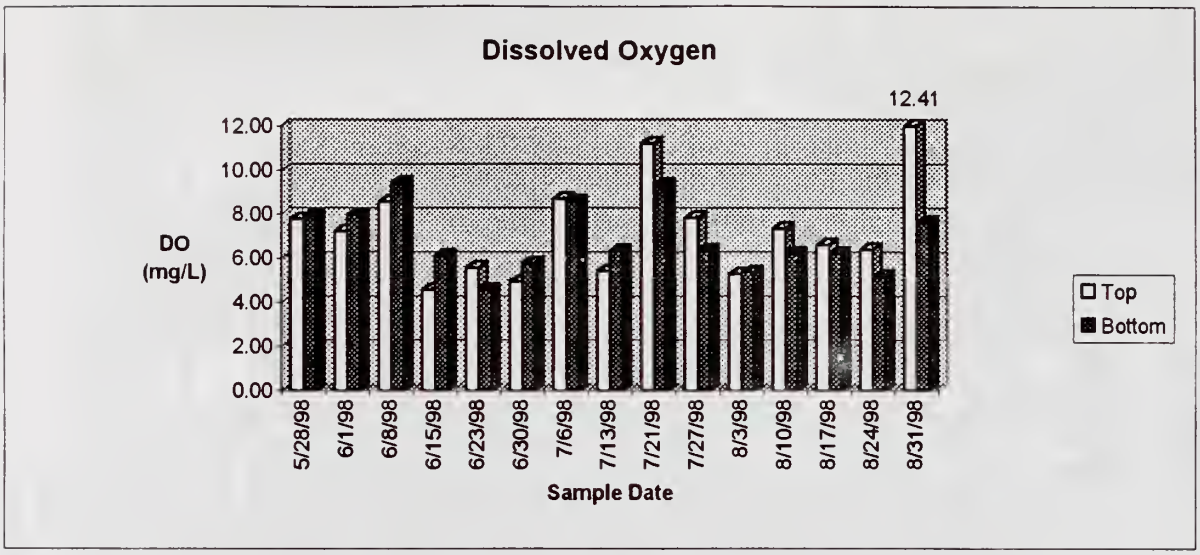
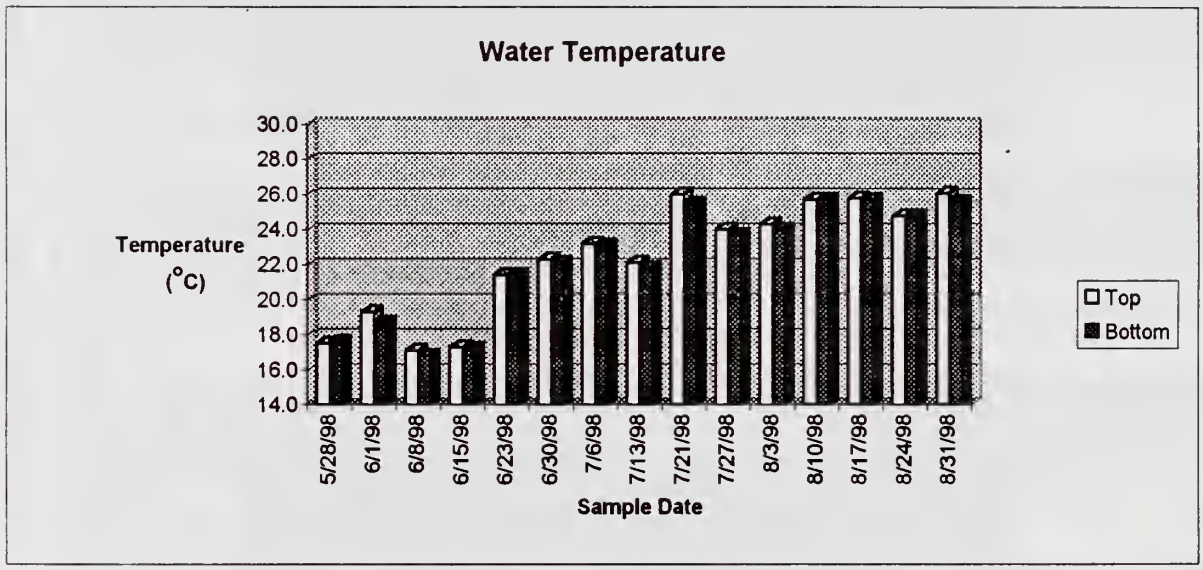


Figure 36

Beach Channel (JB-15) Water Quality Measurements, 1998





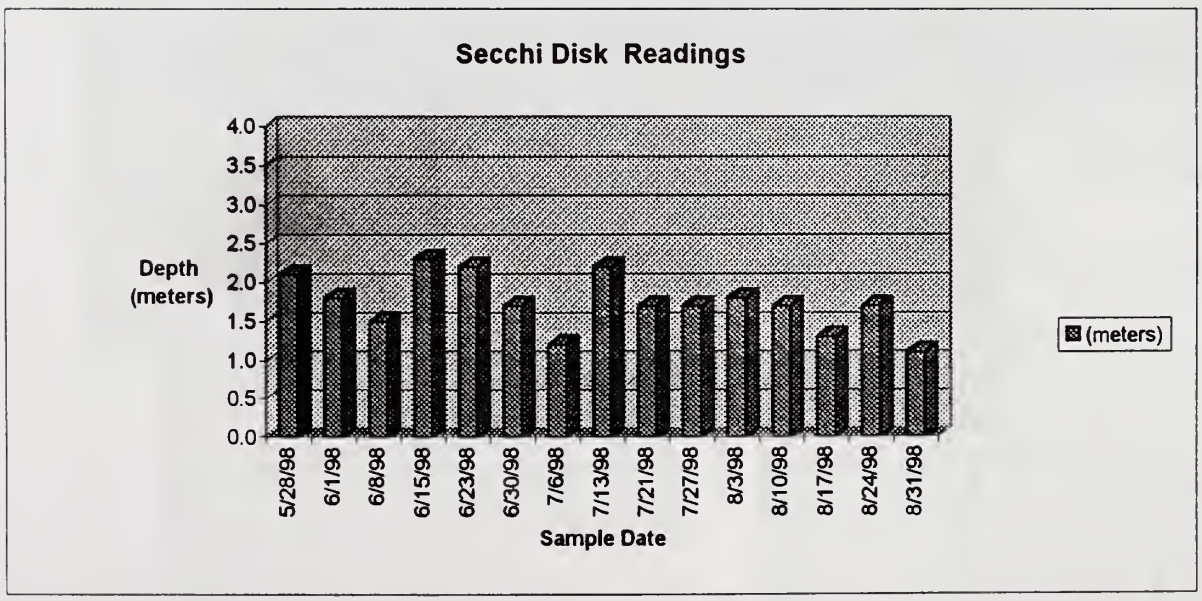
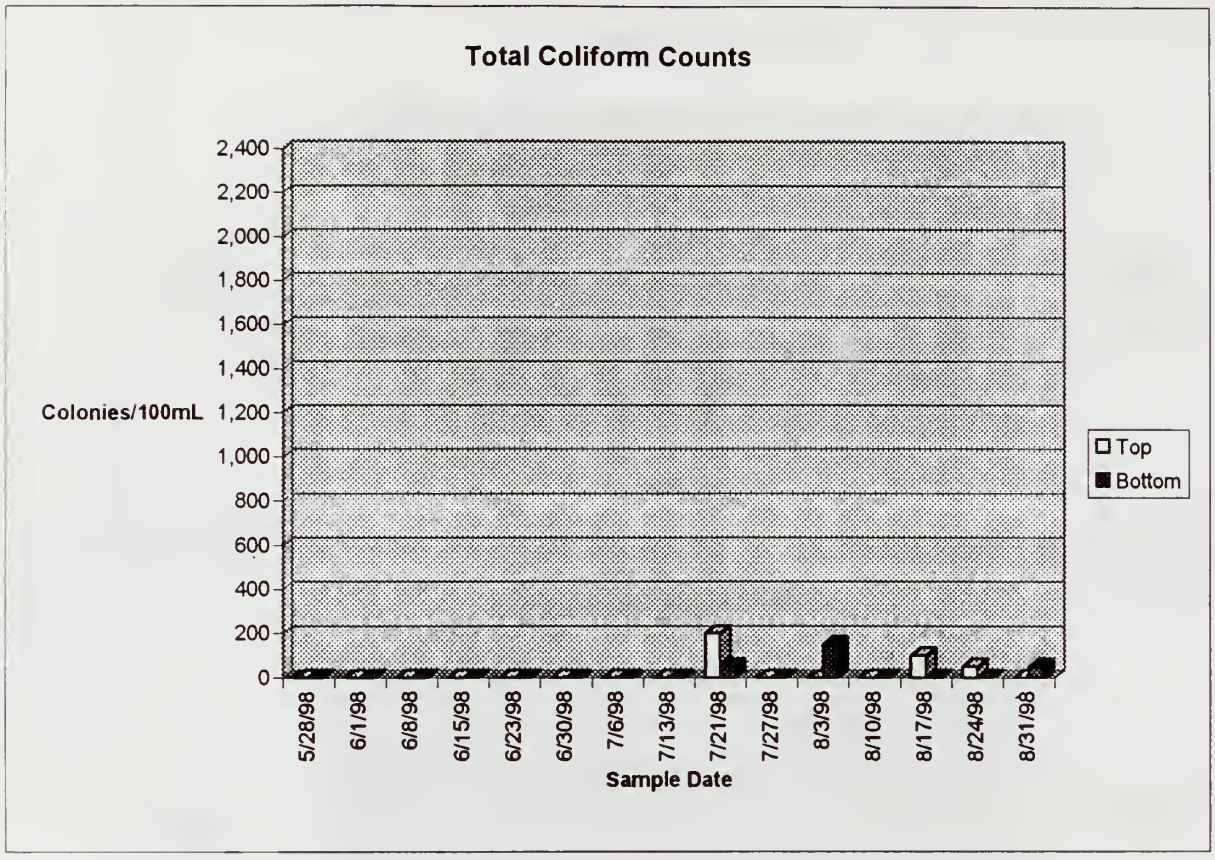


Figure 37

Beach Channel (JB-15) Water Quality Measurements, 1998



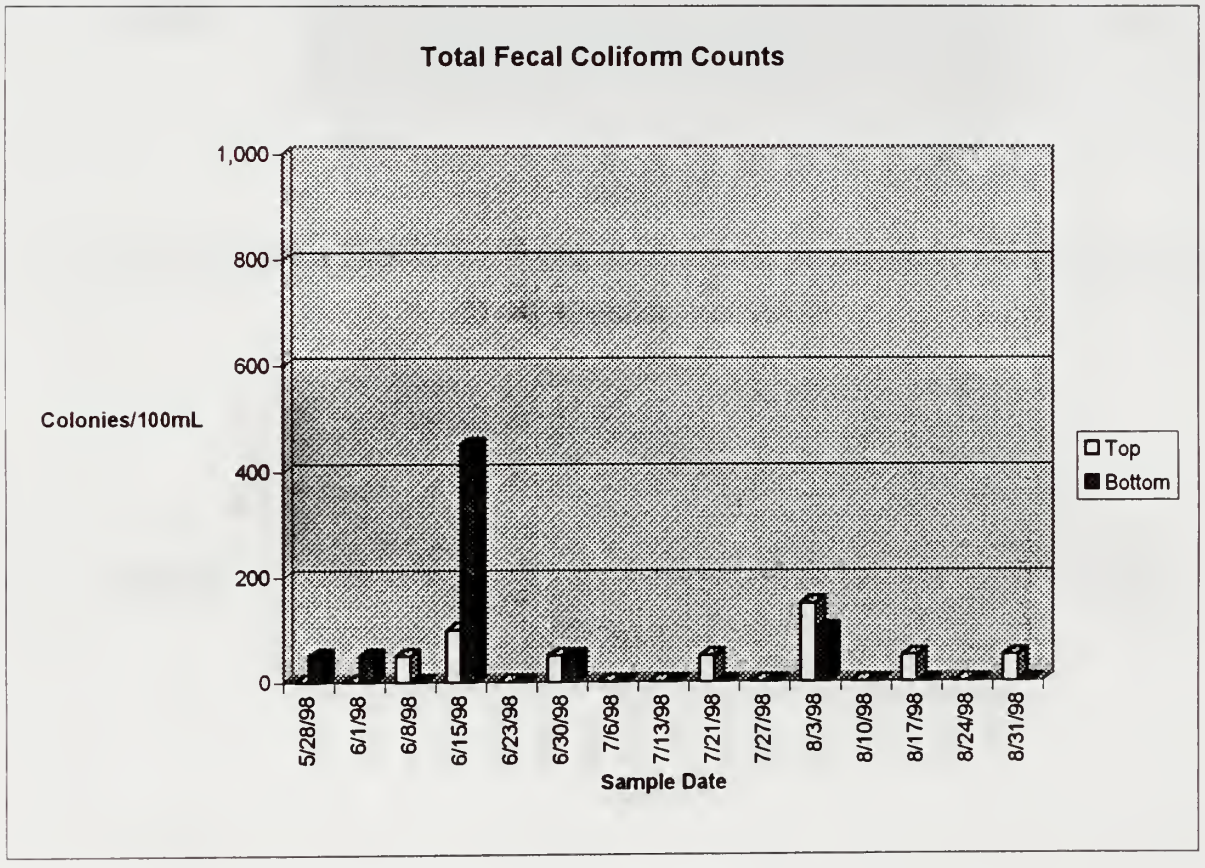


Figure 38

Table XV

Environmental Water Quality Monitoring

Jamaica Bay: Bergen Basin [JB-16], 1998

Date	Time	Tide	Air Temp. (°C)	Water Temp. (°C)		Salinity (ppt)		pH		Conductivity (mS/cm)		DO (mg/L)		Nitrates (mg/L)	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:20 AM	H	18.9	19.9	18.7	14.9	16.5	7.76	7.76	24.3	27.0	5.44	5.41	----	----
6/1/98	02:25 PM	H	----	20.8	----	12.0	16.5	8.05	7.95	20.1	26.9	6.03	4.99	----	----
6/8/98	12:05 PM	M	13.8	19.3	17.9	8.9	16.9	7.57	8.07	15.1	27.5	4.01	5.51	----	----
6/15/98	10:35 AM	M	18.2	19.3	18.4	11.9	16.8	7.36	7.73	19.9	27.3	2.42	4.53	----	----
6/23/98	11:20 AM	M	21.0	21.2	21.7	6.4	18.1	7.00	7.14	11.3	29.3	2.05	3.83	----	----
6/30/98	10:46 AM	M	21.4	22.6	22.2	13.7	17.9	7.28	7.48	22.6	28.7	4.21	5.15	----	----
7/6/98	11:30 AM	L	22.0	23.5	22.7	10.7	18.9	7.35	7.45	17.9	30.4	5.65	5.37	----	----
7/13/98	11:20 AM	H	20.8	25.0	23.3	14.1	18.3	7.88	7.57	23.0	29.4	11.02	5.26	0.19	0.22
7/21/98	11:20 AM	M	24.7	25.4	25.3	8.4	18.4	7.54	7.83	14.4	29.5	2.55	2.71	----	----
7/27/98	11:35 AM	H	23.5	26.0	25.1	13.3	18.4	8.20	8.17	21.8	29.6	10.87	6.35	----	----
8/3/98	11:40 AM	L	22.7	25.7	24.8	8.3	19.0	7.65	7.95	14.3	30.4	3.95	2.99	----	----
8/10/98	12:00 PM	H	24.8	26.8	26.3	7.7	18.5	7.76	8.31	13.4	29.6	5.27	5.19	----	----
8/17/98	12:10 PM	L	26.1	27.0	25.8	10.0	18.8	7.84	8.06	16.9	30.1	4.78	1.65	----	----
8/24/98	11:25 AM	H	25.5	25.9	25.4	8.7	18.6	7.68	7.96	14.9	29.8	5.17	3.06	----	----
8/31/98	11:30 AM	M	22.4	26.0	25.8	9.6	18.8	7.61	7.80	16.3	30.0	4.25	2.78	0.15	0.10

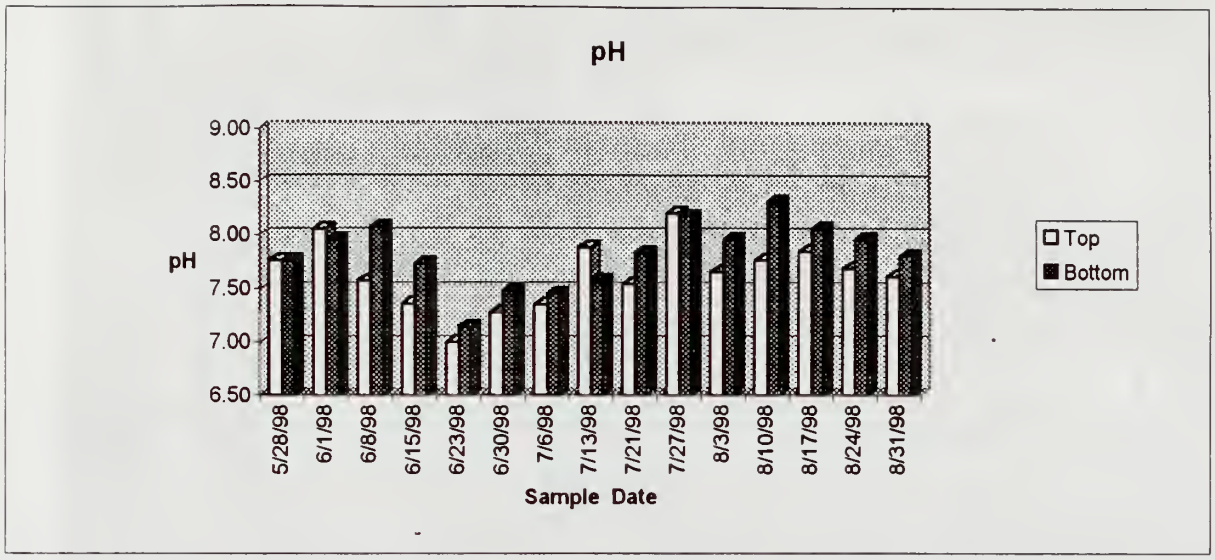
Date	Time	Tide	Secchi Disk (meters)	Total Chlorine (mg/L)		Free Chlorine (mg/L)		Orthophosphate (mg/L)		Chlorophyll a (mg/m^3)		Total Coliform Counts /100mL		Fecal Coliform Counts /100mL	
				Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
5/28/98	11:20 AM	H	1.4	----	----	----	----	----	----	----	----	300	0	600	100
6/1/98	02:25 PM	H	0.7	----	----	----	----	----	----	----	----	25	0	11,600	275
6/8/98	12:05 PM	M	0.8	----	----	----	----	----	----	----	----	100	0	2,575	100
6/15/98	10:35 AM	M	1.3	----	----	----	----	----	----	0.0	0.0	250	0	14,850	850
6/23/98	11:20 AM	M	0.8	<0.02	<0.02	<0.02	<0.02	----	----	----	----	350	0	3,000	1,200
6/30/98	10:46 AM	M	0.8	----	----	----	----	0.44	0.28	----	----	0	0	775	100
7/6/98	11:30 AM	L	0.9	----	----	----	----	----	----	45.1	22.2	0	0	2,100	75
7/13/98	11:20 AM	H	0.8	----	----	----	----	0.34	0.22	----	----	0	0	1,150	0
7/21/98	11:20 AM	M	0.9	----	----	----	----	----	----	0.0	0.0	1,100	2,050	3,250	50
7/27/98	11:35 AM	H	0.8	<0.02	<0.02	<0.02	<0.02	0.66	0.42	----	----	6,400	200	1,375	25
8/3/98	11:40 AM	L	1.3	----	----	----	----	----	----	0.0	0.0	8,800	450	2,100	0
8/10/98	12:00 PM	H	0.6	----	----	----	----	1.29	0.24	----	----	Confluent	850	450	0
8/17/98	12:10 PM	L	0.7	<0.02	<0.02	<0.02	<0.02	----	----	30.6	51.5	11,800	850	3,900	250
8/24/98	11:25 AM	H	0.9	----	----	----	----	1.20	0.31	----	----	12,450	300	2,000	50
8/31/98	11:30 AM	M	1.0	<0.02	<0.02	<0.02	<0.02	0.38	0.32	11.6	22.7	36,400	1,000	13,850	383

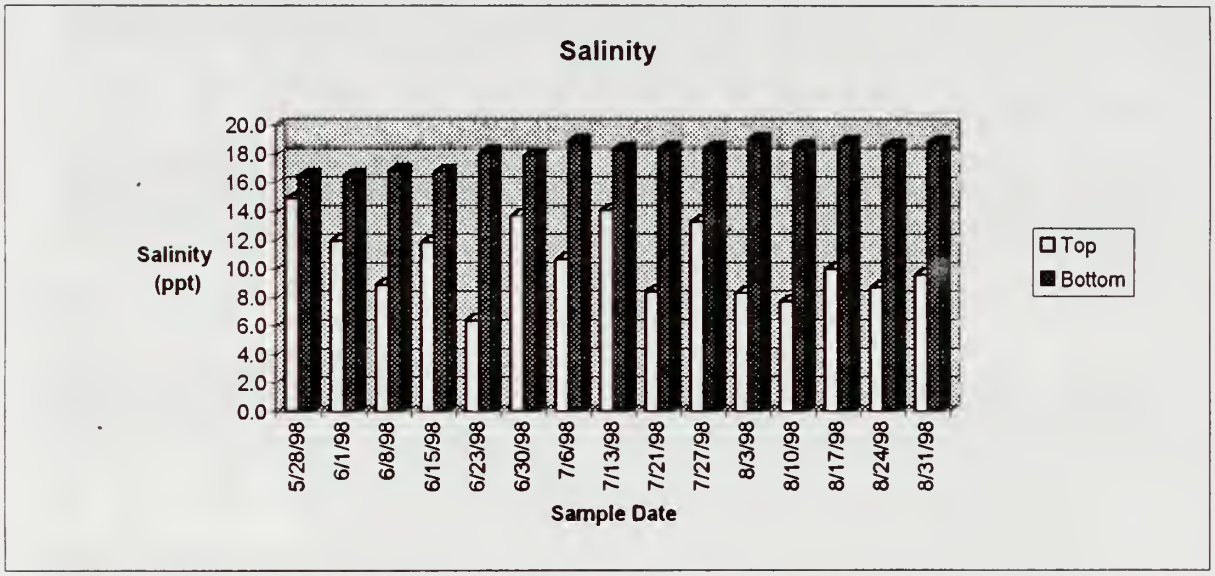
Black cells indicate samples that exceeded TCC of 2,400 CFU's/100mL and FCC's of 200 CFU's/100mL (New York & New Jersey State bacterial standard limits).

No Data = ----

NOTE: 8/10/98 Top sample had confluent bacterial growth for TCC therefore no value was recorded.

Bergin Basin (JB-16) Water Quality Measurements, 1998





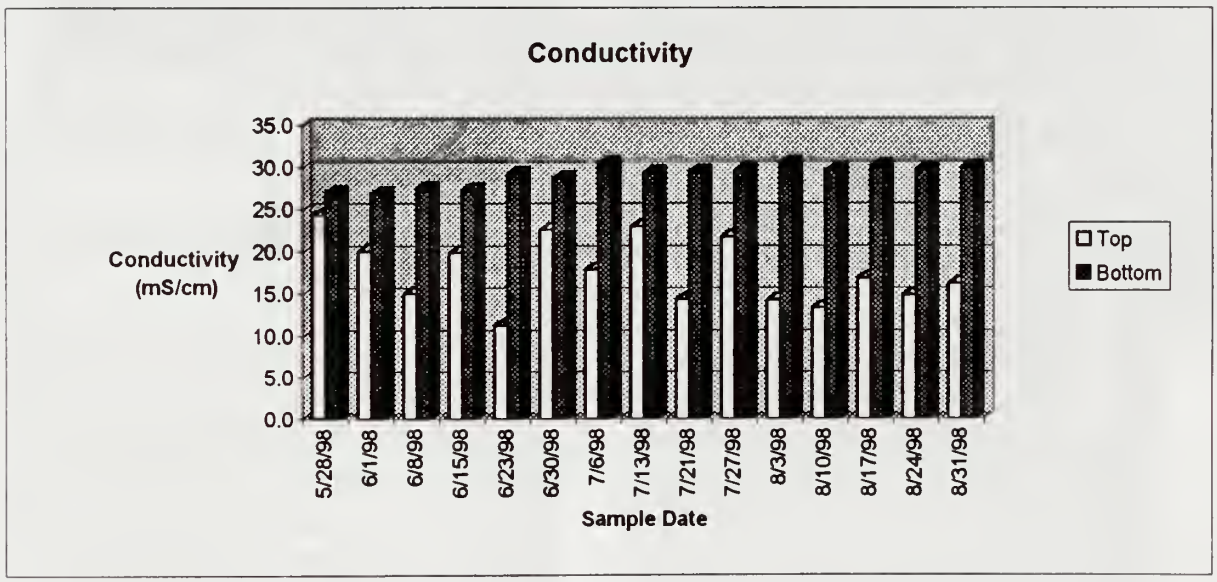
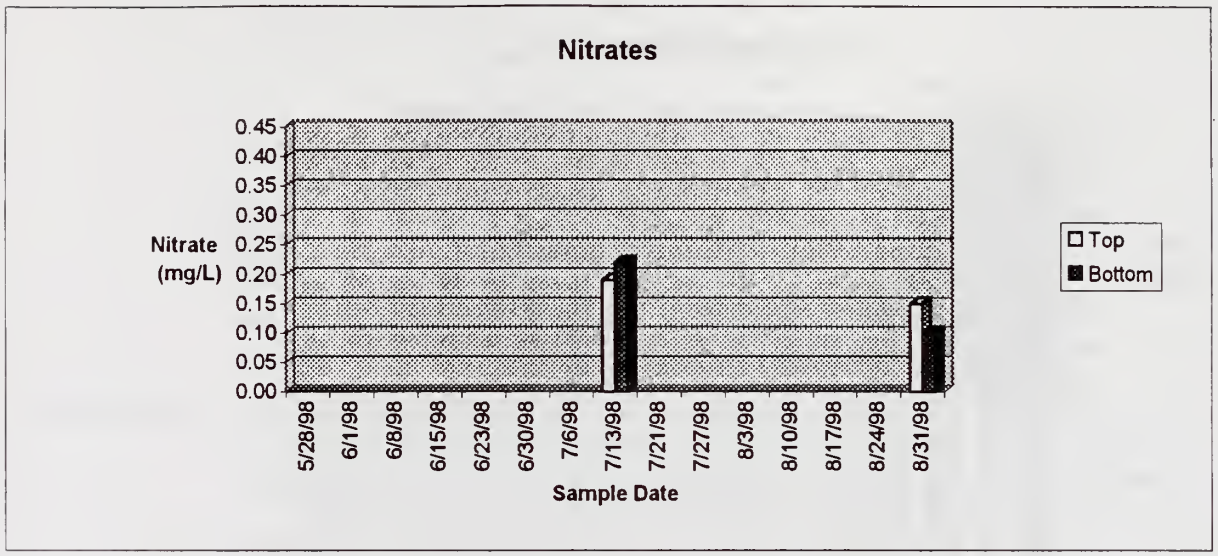
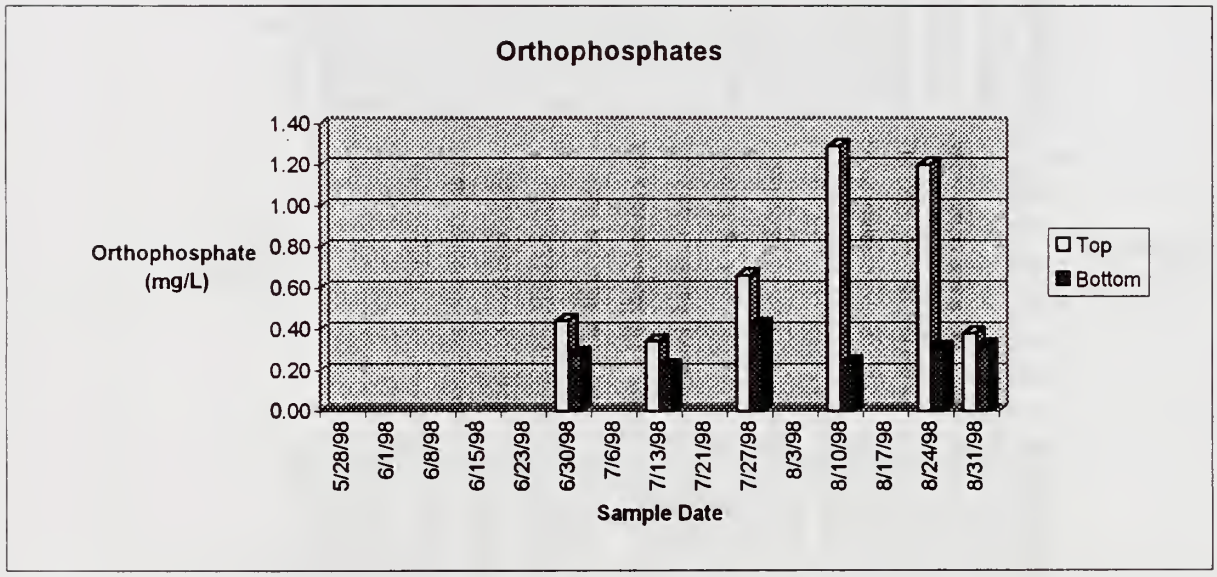


Figure 39

Bergin Basin (JB-16) Water Quality Measurements, 1998





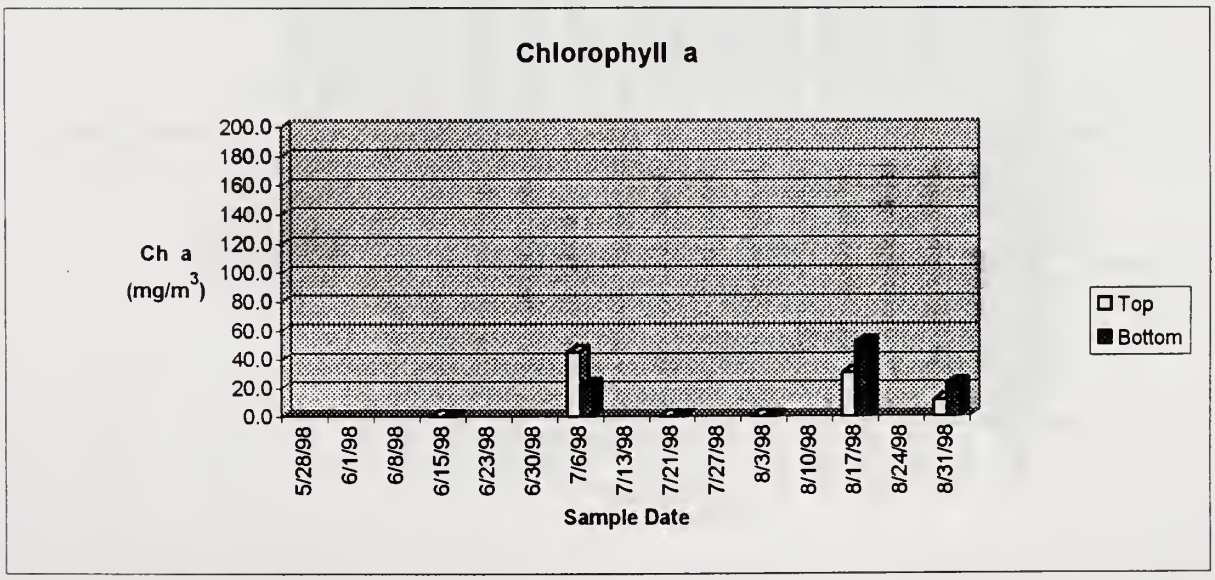


Figure 40

Bergin Basin (JB-16) Water Quality Measurements, 1998

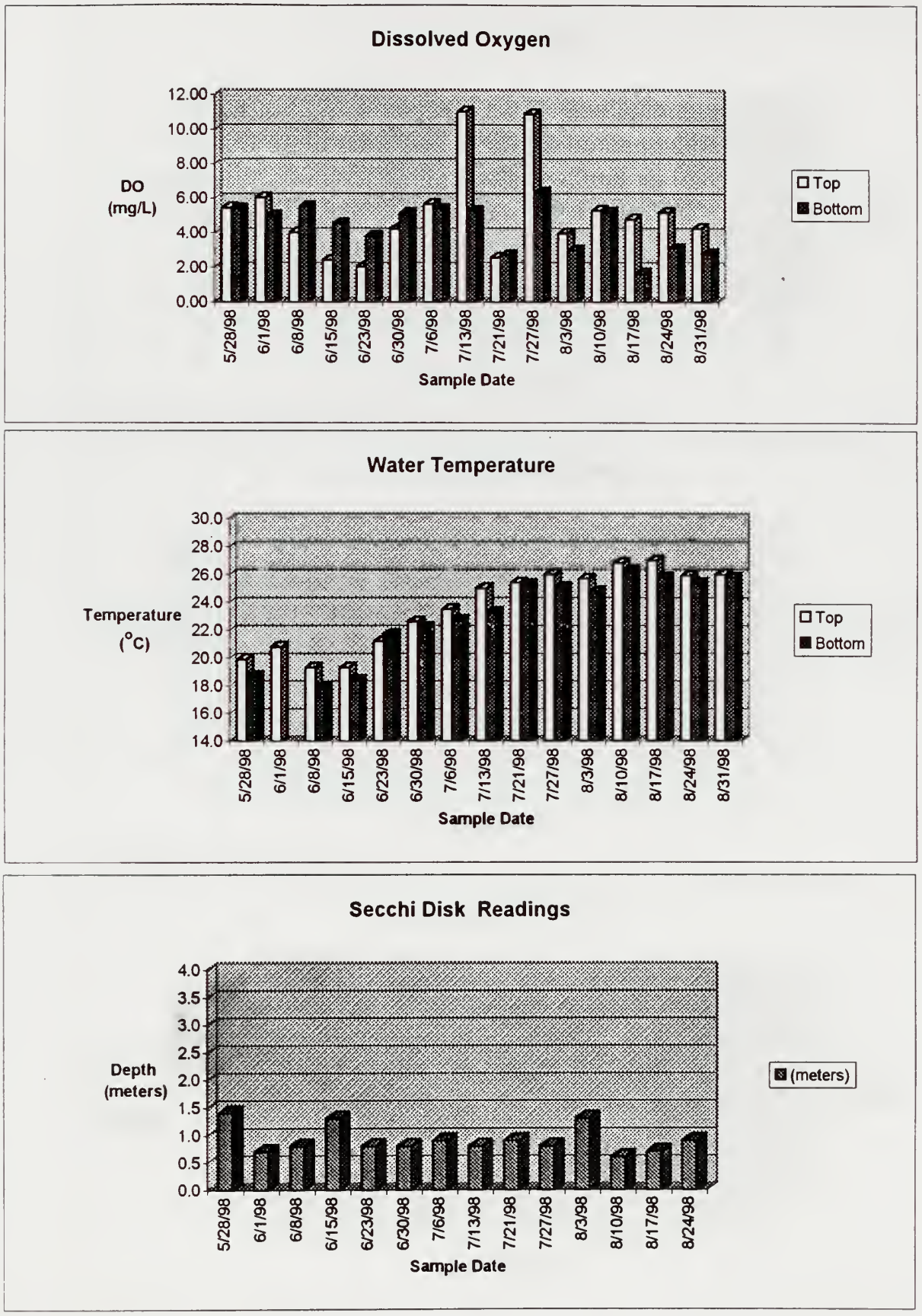
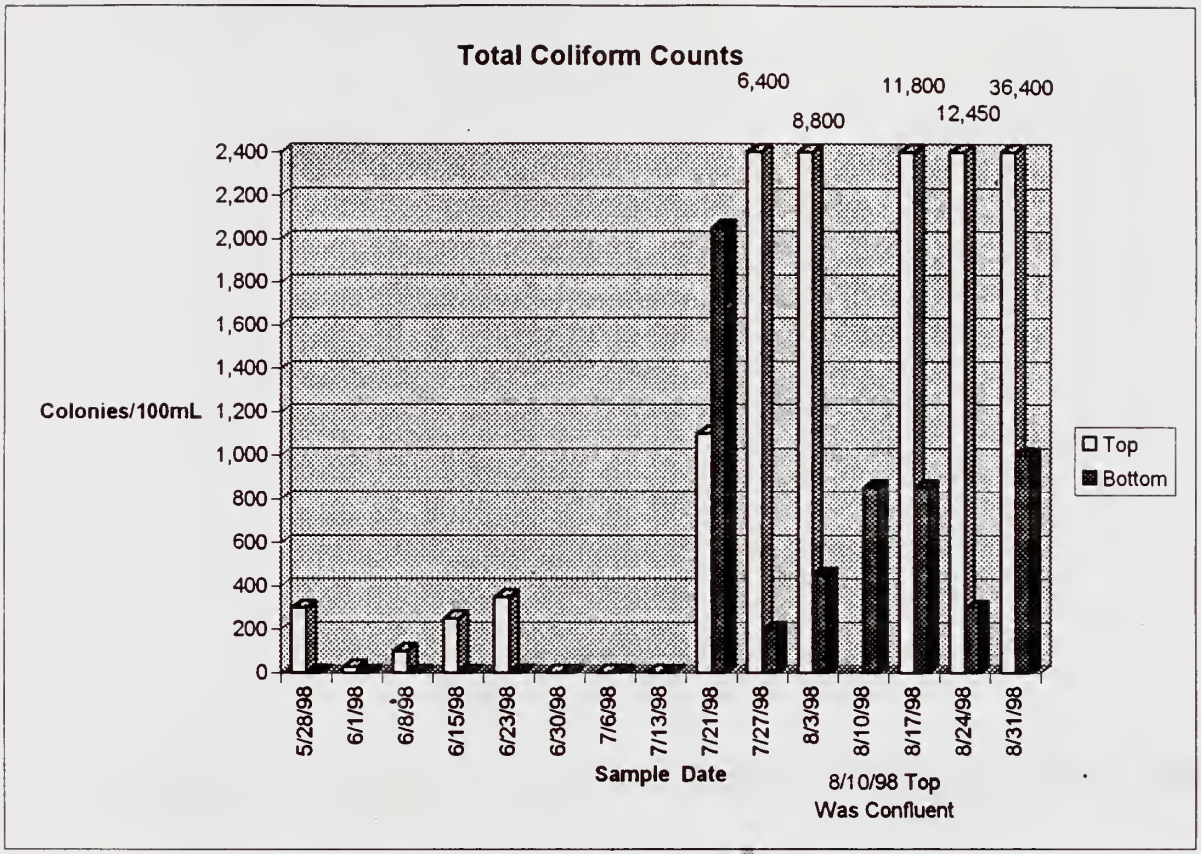


Figure 41

Bergin Basin (JB-16) Water Quality Measurements, 1998



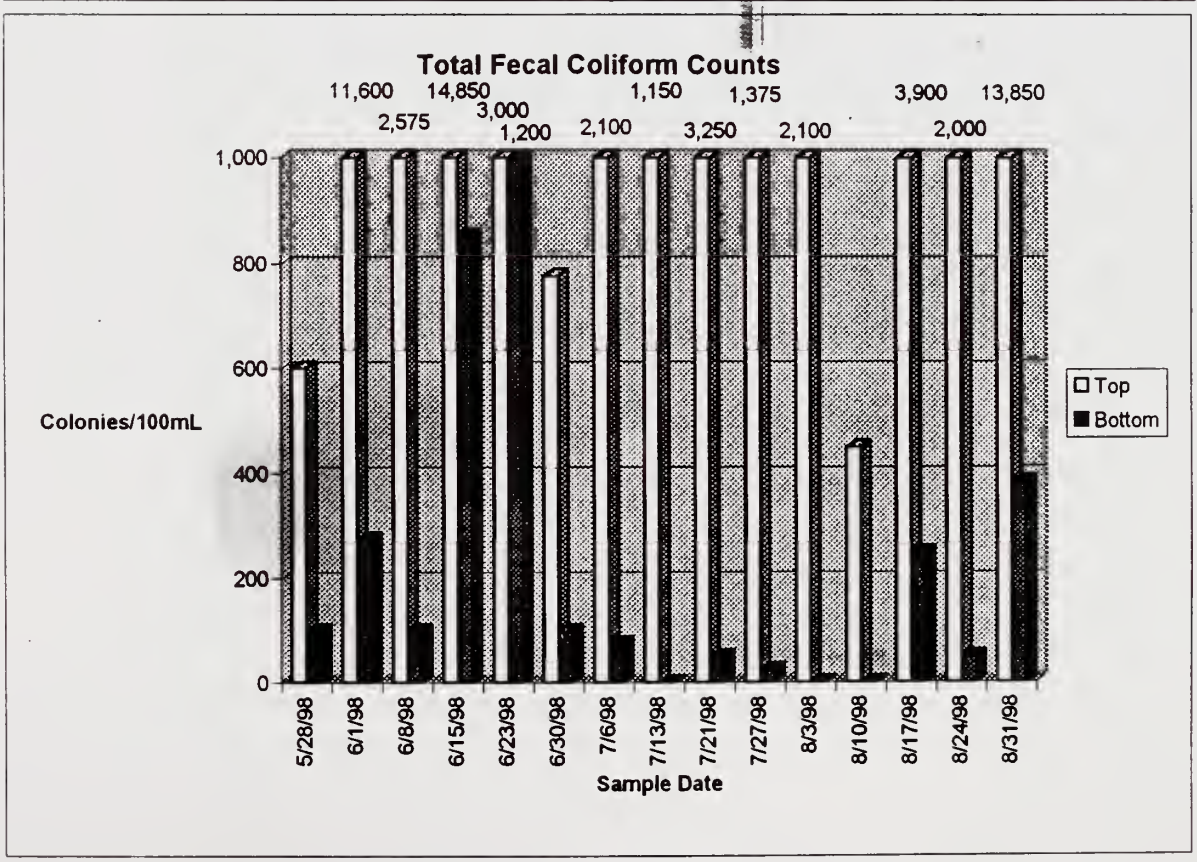


Figure 42

SECTION III

Coliform Counts: Total and Fecal All Sites/Units, 1998

Table XVI

Total Coliform Counts (colonies/100mL): Jamaica Bay, 1998

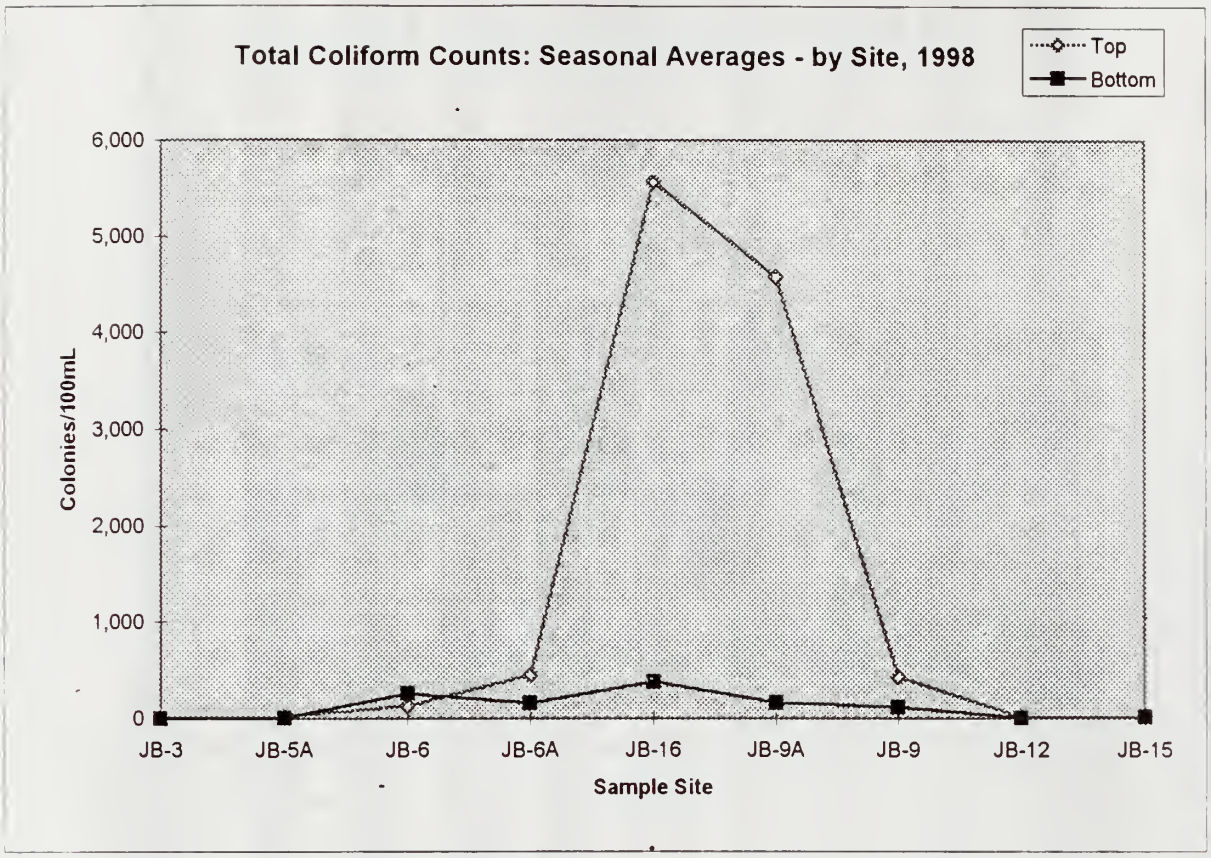
			Sample Dates													
Sample Location	Site	Depth	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	0	0	----	0	0	0	0	0	0	50	0	0	0	0	0
		Bottom	0	0	-----	0	0	0	0	0	0	0	0	0	0	0	0
Nova Scotia Bar	JB-5A	Top	0	0	0	0	0	0	0	0	0	0	150	0	50	100	0
		Bottom	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0
Canarsie Pier	JB-6	Top	0	0	0	0	0	0	0	0	450	0	0	0	900	50	500
		Bottom	0	0	0	0	0	0	0	0	300	0	3,200	50	150	100	75
Pennsylvania Ave Landfill	JB-6A	Top	0	50	0	0	0	0	0	0	4,050	50	250	100	0	150	2,050
		Bottom	0	0	0	0	0	0	0	0	400	100	400	100	0	100	1,250
Bergen Basin	JB-16	Top	300	25	100	250	350	0	0	0	1,100	6,400	8,800	-----	11,800	12,450	36,400
		Bottom	0	0	0	0	0	0	0	0	2,050	200	450	850	850	300	1,000
Bergen Basin Outflow	JB-9A	Top	20,000	0	0	0	0	0	0	0	2,300	650	1,850	0	0	50	43,800
		Bottom	600	0	0	0	0	0	0	0	550	125	150	200	0	0	800
Grassy Bay	JB-9	Top	0	0	0	0	0	0	0	0	100	2,750	850	900	150	1,500	117
		Bottom	0	0	0	0	0	0	0	0	200	100	500	50	375	300	200
JoCo Marsh	JB-12	Top	0	0	0	0	0	0	0	0	0	0	100	0	0	75	0
		Bottom	0	0	0	0	0	0	0	0	50	0	100	0	0	0	0
Beach Channel	JB-15	Top	0	0	0	0	0	0	0	0	200	0	0	0	100	50	0
		Bottom	0	0	0	0	0	0	0	0	50	0	150	0	0	0	50

Black cells indicate samples that exceeded a total coliform counts (TCC) of 2,400 CFU/100mL (New York & New Jersey State bacterial standard limits).

No Data: ----- CFU' s = Colony Forming Units

NOTE: 8/10/98 TCC Top sample was confluent.

Total Coliform Count Averages (Top and Bottom): Jamaica Bay, 1998



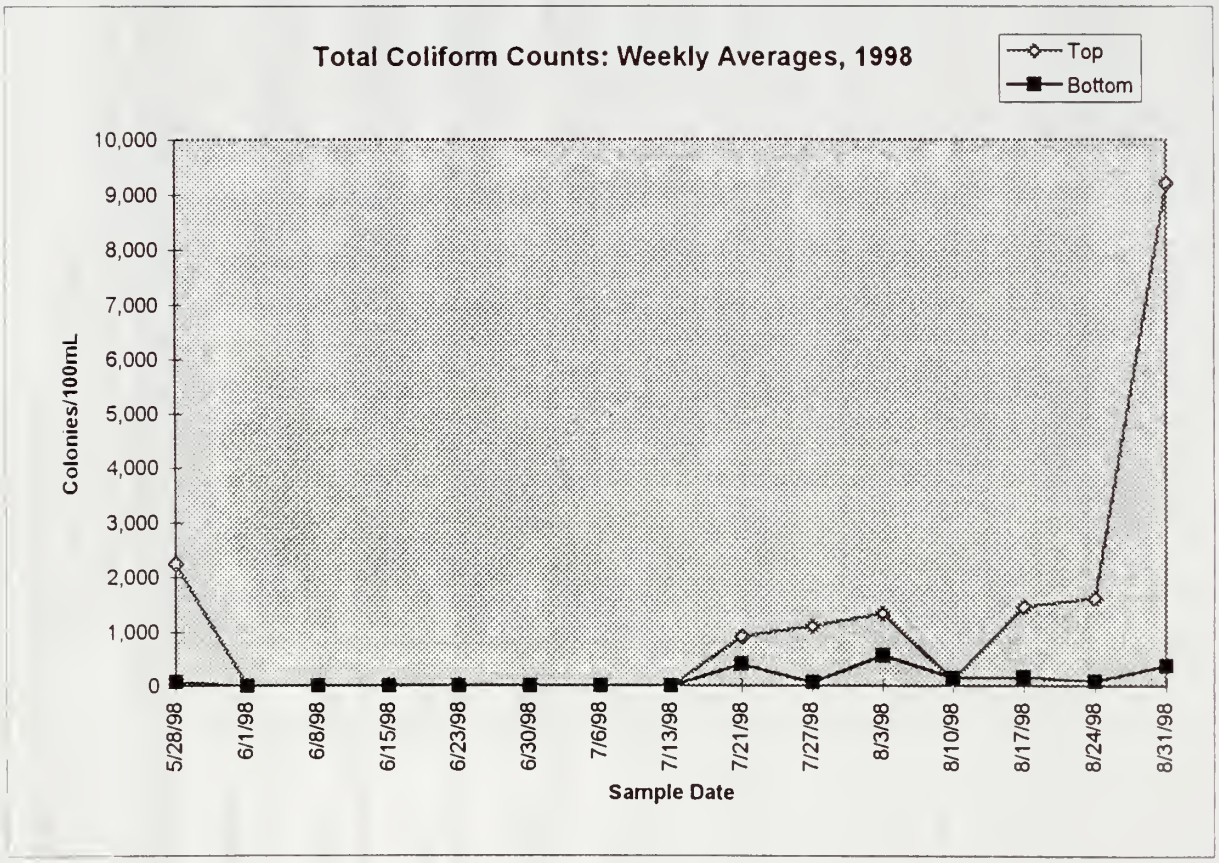


Figure 43

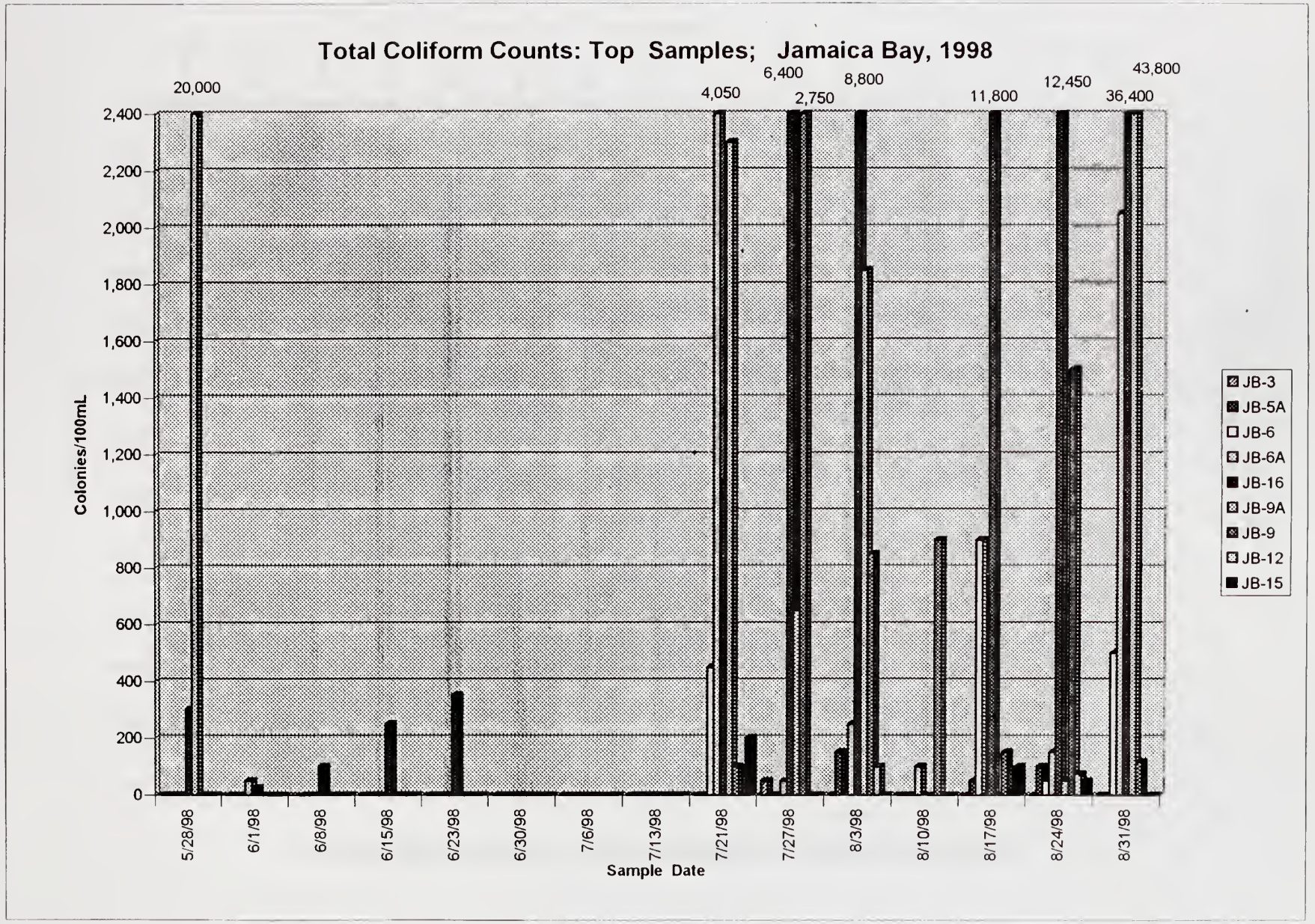

Total Coliform Counts: Top Samples; Jamaica Bay, 1998
20,000
4,050
6,400
2,750
8,800
11,800
12,450
36,400
43,800
Colonies/100mL
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 44

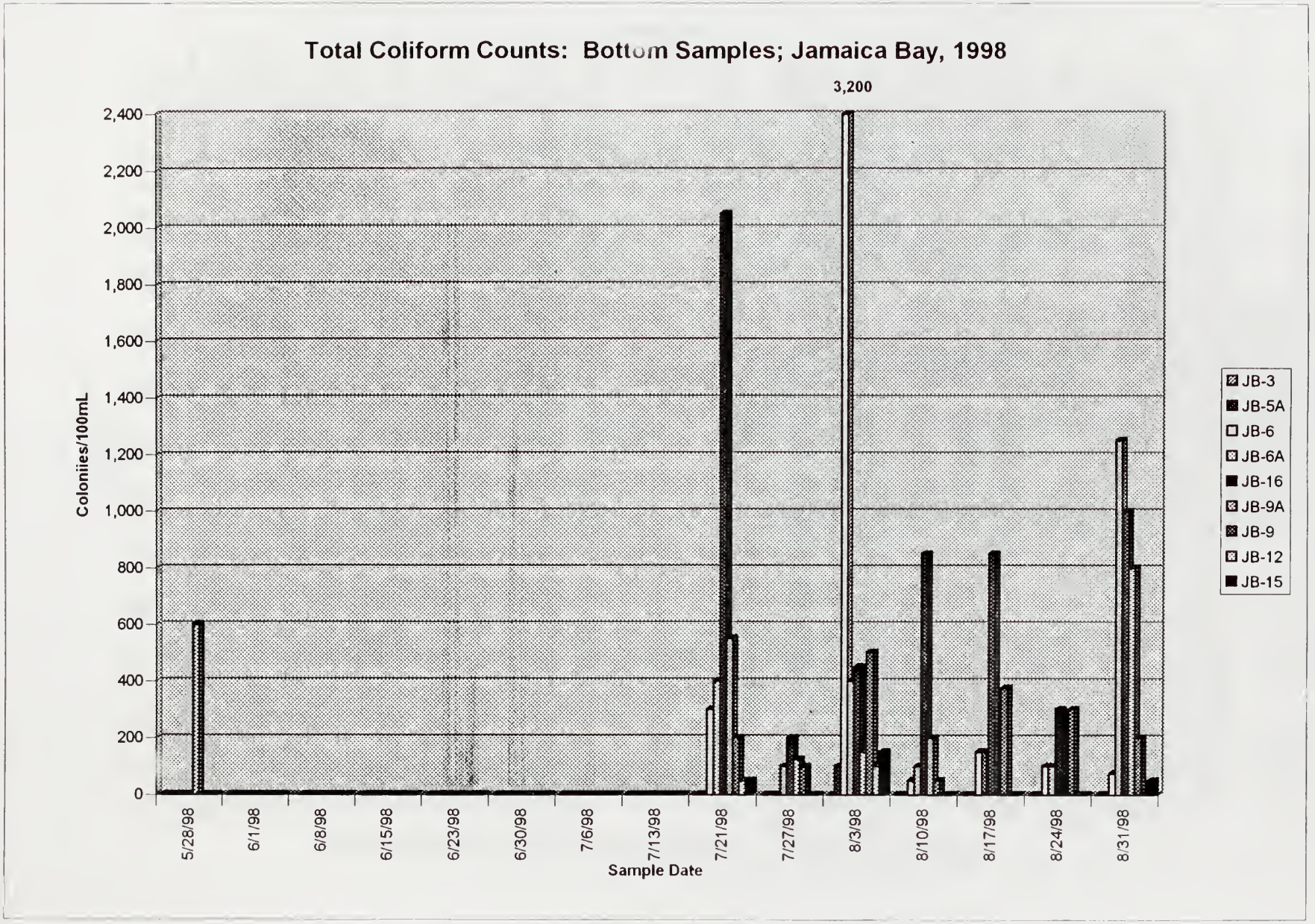

Total Coliform Counts: Bottom Samples; Jamaica Bay, 1998
3,200
Colonies/100mL
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 45

Percentile of Total Coliforms That Exceeded Limts:
Jamaica Bay, 1998

Percentile of Samples Exceeding:
2,400 col/100mL

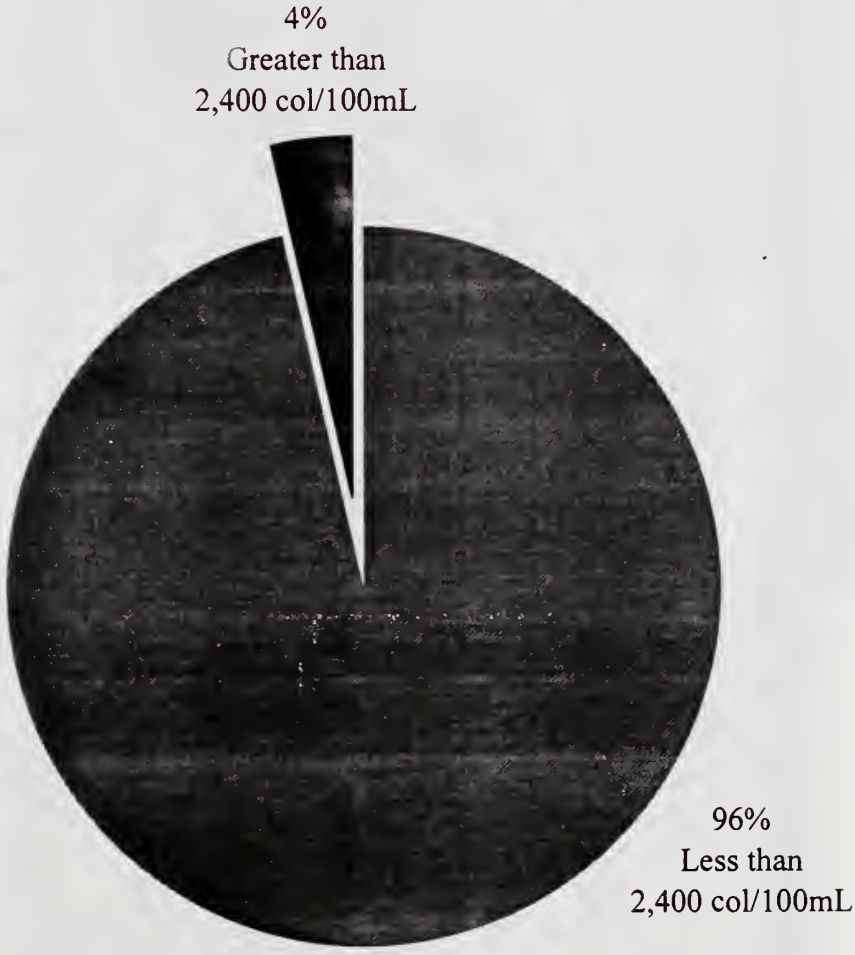


Table XVII
Fecal Coliform Counts (colonies/100mL): Jamaica Bay, 1998

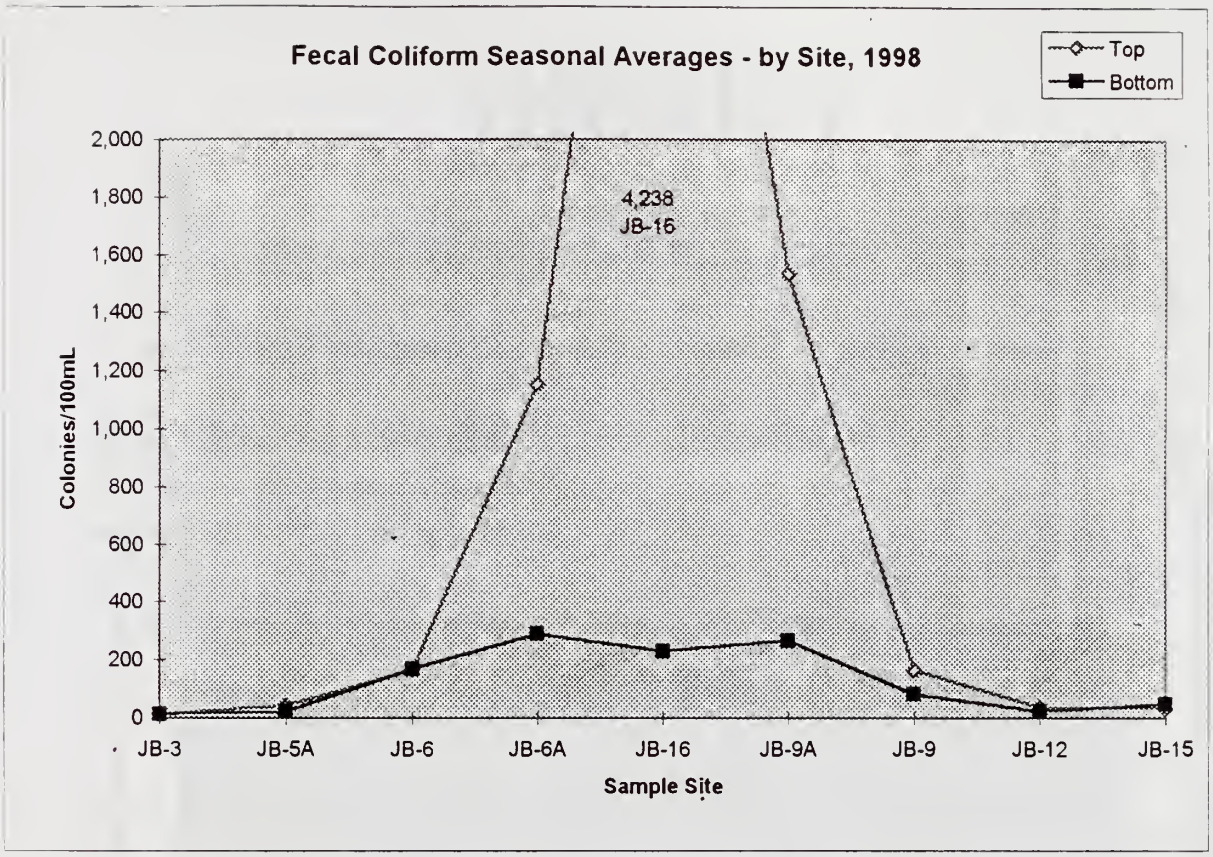
			Sample Dates													
Sample Location	Site	Depth	5/26/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	0	200	-----	0	0	0	0	0	0	0	0	0	0	0	0
		Bottom	0	0	-----	0	0	200	0	0	0	0	0	0	0	0	0
Nova Scotia Bar	JB-5A	Top	0	50	0	250	0	0	50	0	0	0	50	0	150	0	100
		Bottom	0	50	50	200	0	0	0	0	0	0	0	0	50	0	0
Canarsie Pier	JB-6	Top	50	350	0	1,600	0	0	50	0	0	0	50	0	250	0	100
		Bottom	0	50	0	900	50	0	100	0	50	0	1,250	0	100	50	0
Pennsylvania Ave Landfill	JB-6A	Top	100	10,400	300	2,150	125	0	50	50	3,375	0	175	100	0	100	375
		Bottom	0	850	300	2,050	200	0	50	100	200	0	50	150	0	75	300
Bergen Basin	JB-16	Top	600	11,600	2,575	14,850	3,000	775	2,100	1,150	3,250	1,375	2,100	450	3,900	2,000	13,850
		Bottom	100	275	100	850	1,200	100	75	0	50	25	0	0	250	50	383
Bergen Basin Outflow	JB-9A	Top	1,700	2,075	350	5,800	4,350	0	0	0	1,400	50	1,400	0	0	0	5,850
		Bottom	450	125	25	2,075	950	0	0	0	100	0	0	100	0	50	100
Grassy Bay	JB-9	Top	125	75	0	450	50	400	0	0	0	430	450	0	50	400	50
		Bottom	0	125	0	150	200	400	0	0	0	0	100	0	150	100	0
JoCo Marsh	JB-12	Top	0	50	50	300	0	0	0	0	0	0	50	0	0	100	0
		Bottom	0	0	0	50	100	50	0	0	0	0	50	0	0	100	0
Beach Channel	JB-15	Top	0	0	50	100	0	50	0	0	50	0	150	0	50	0	50
		Bottom	50	50	0	450	0	50	0	0	0	0	100	0	0	0	0

Black cells indicate samples that exceeded a fecal coliform count (FCC) limit of 200 CFU/100mL (New York & New Jersey State bacterial standard limits).
(New York & New Jersey State bacterial standard limits).

CFU' s = Colony Forming Units

No Data: -----

Fecal Coliform Averages (Top and Bottom): Jamaica Bay, 1998



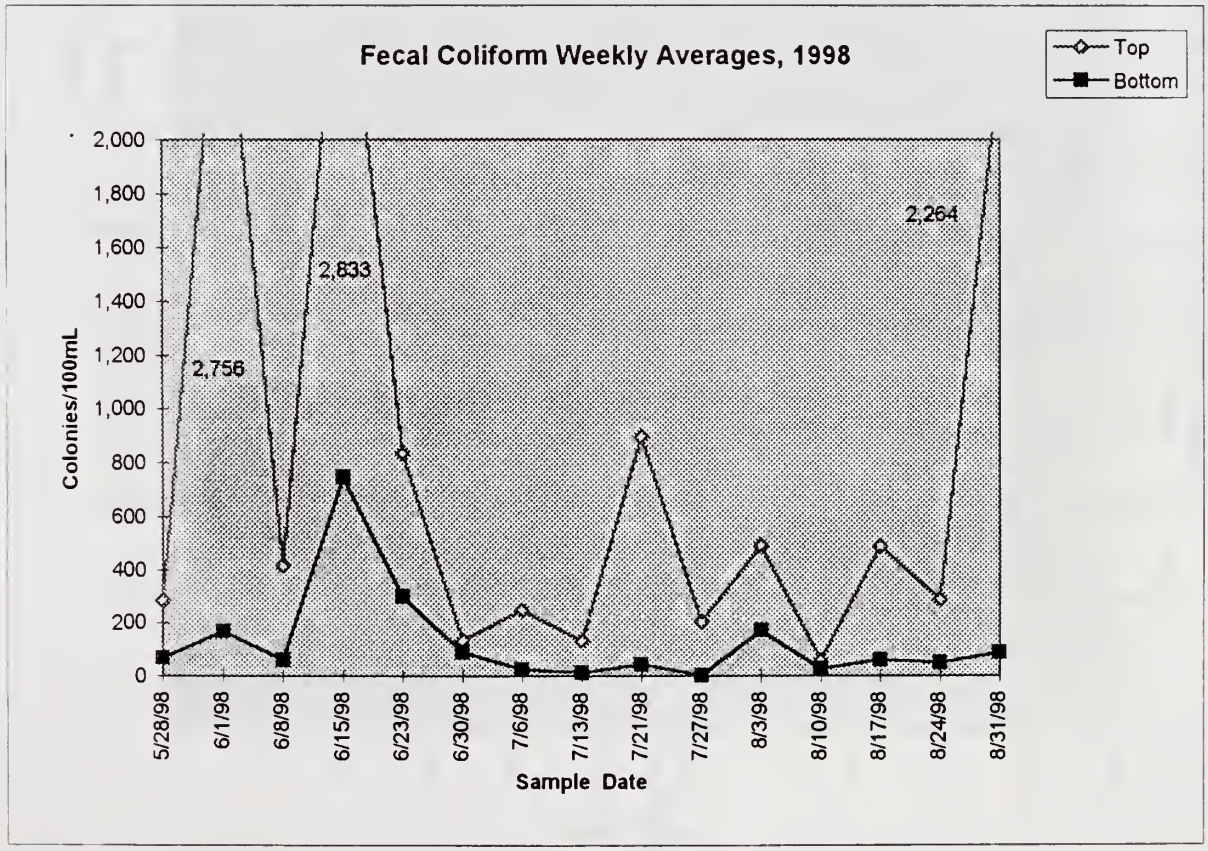


Figure 46

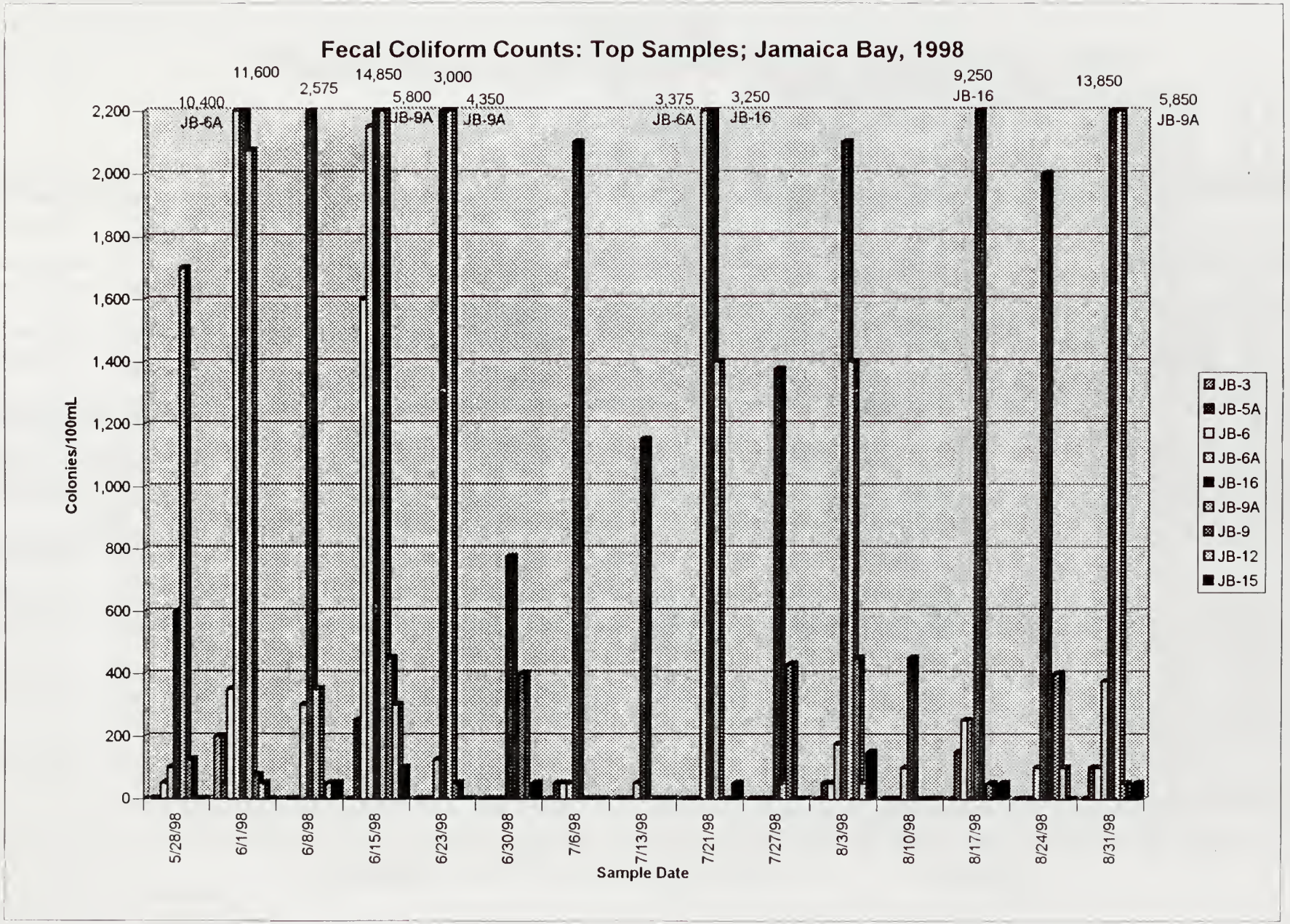

Fecal Coliform Counts: Top Samples; Jamaica Bay, 1998
10,400
JB-6A
11,600
2,575
14,850
5,800
JB-9A
3,000
4,350
JB-9A
3,375
JB-6A
3,250
JB-16
9,250
JB-16
13,850
5,850
JB-9A
Colonies/100mL
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 47

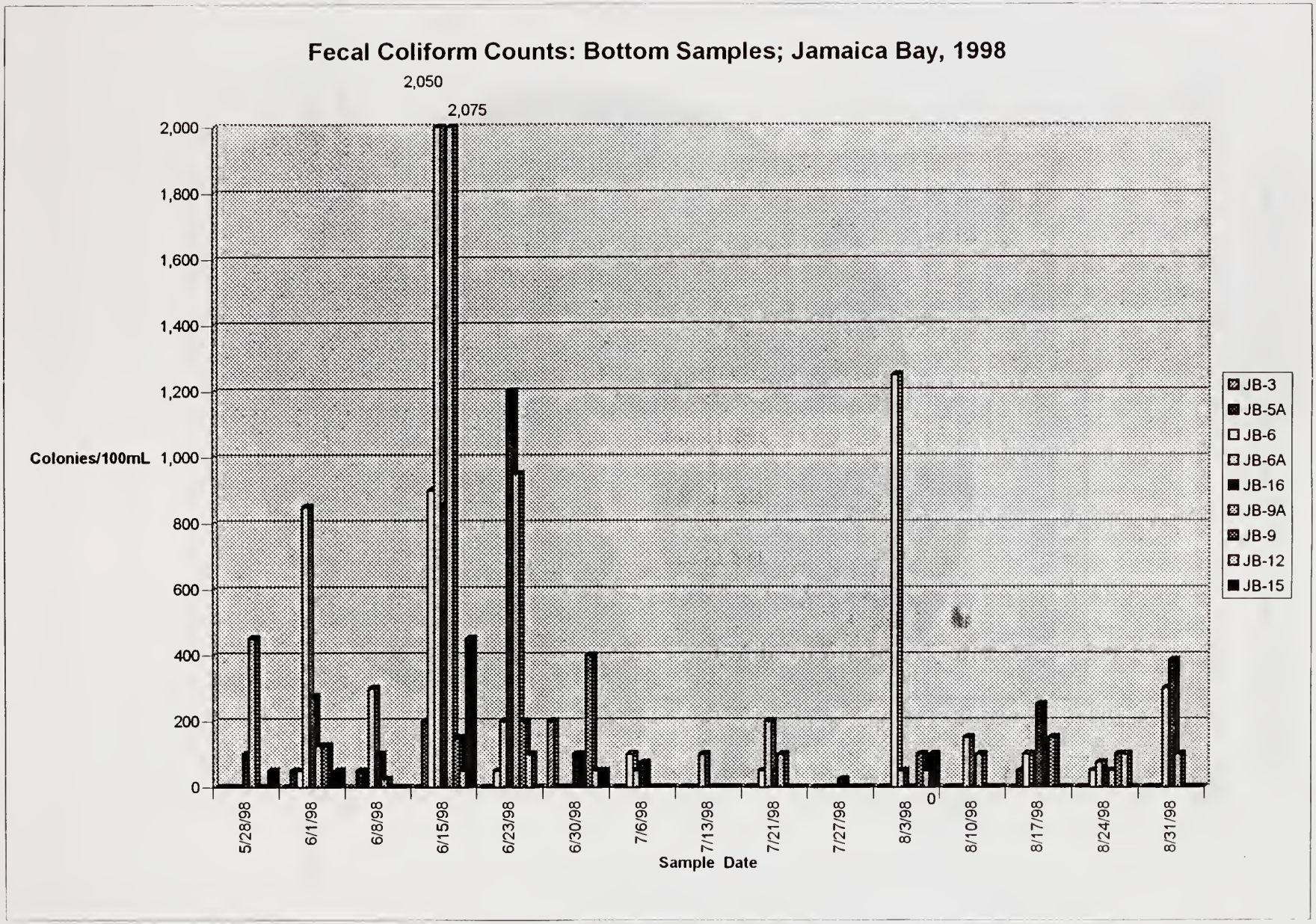

Fecal Coliform Counts: Bottom Samples; Jamaica Bay, 1998
2,050
2,075
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Colonies/100mL
0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 48

Percentile of Fecal Coliforms That Exceed Limit:
Jamaica Bay, 1998

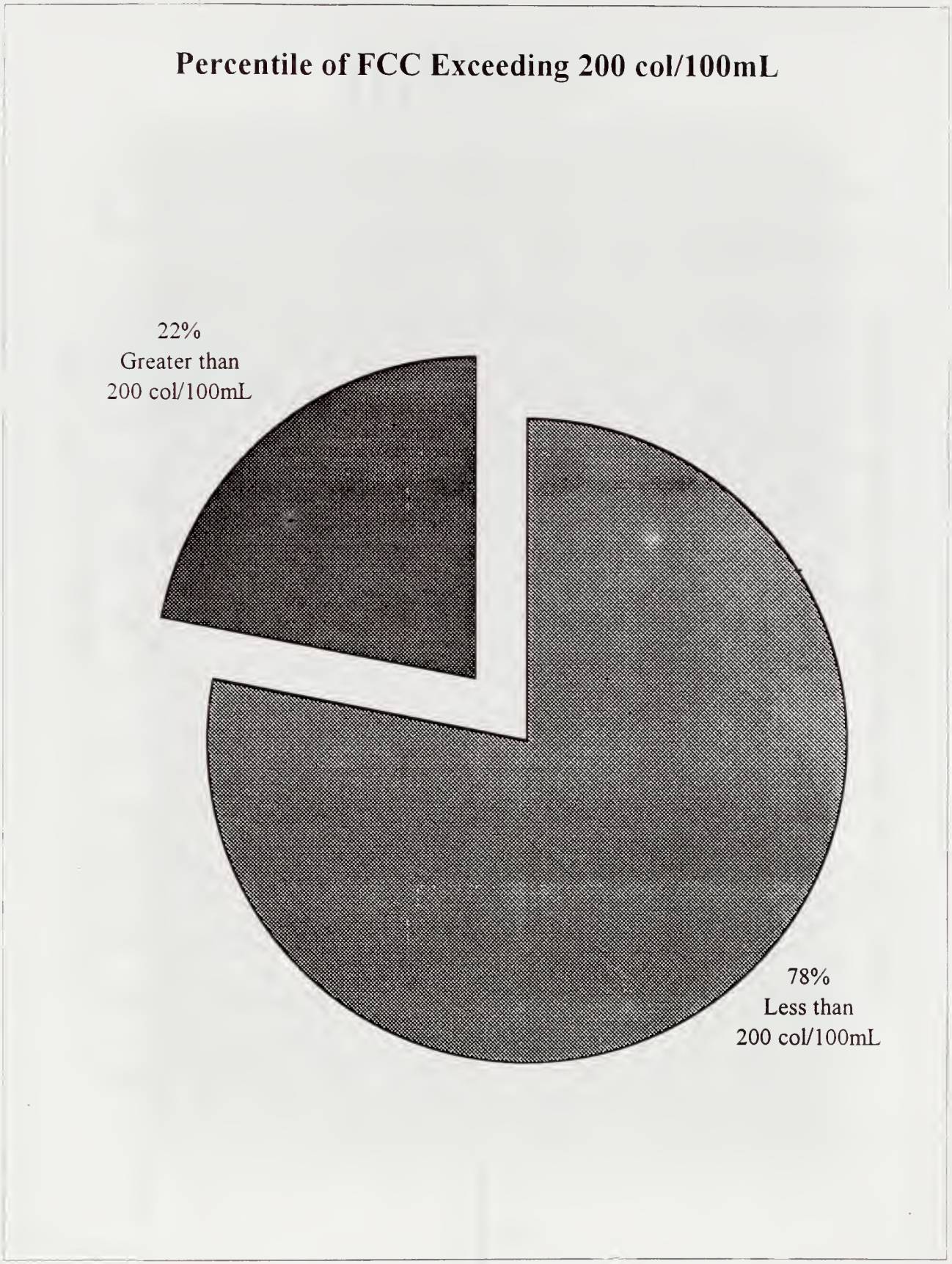


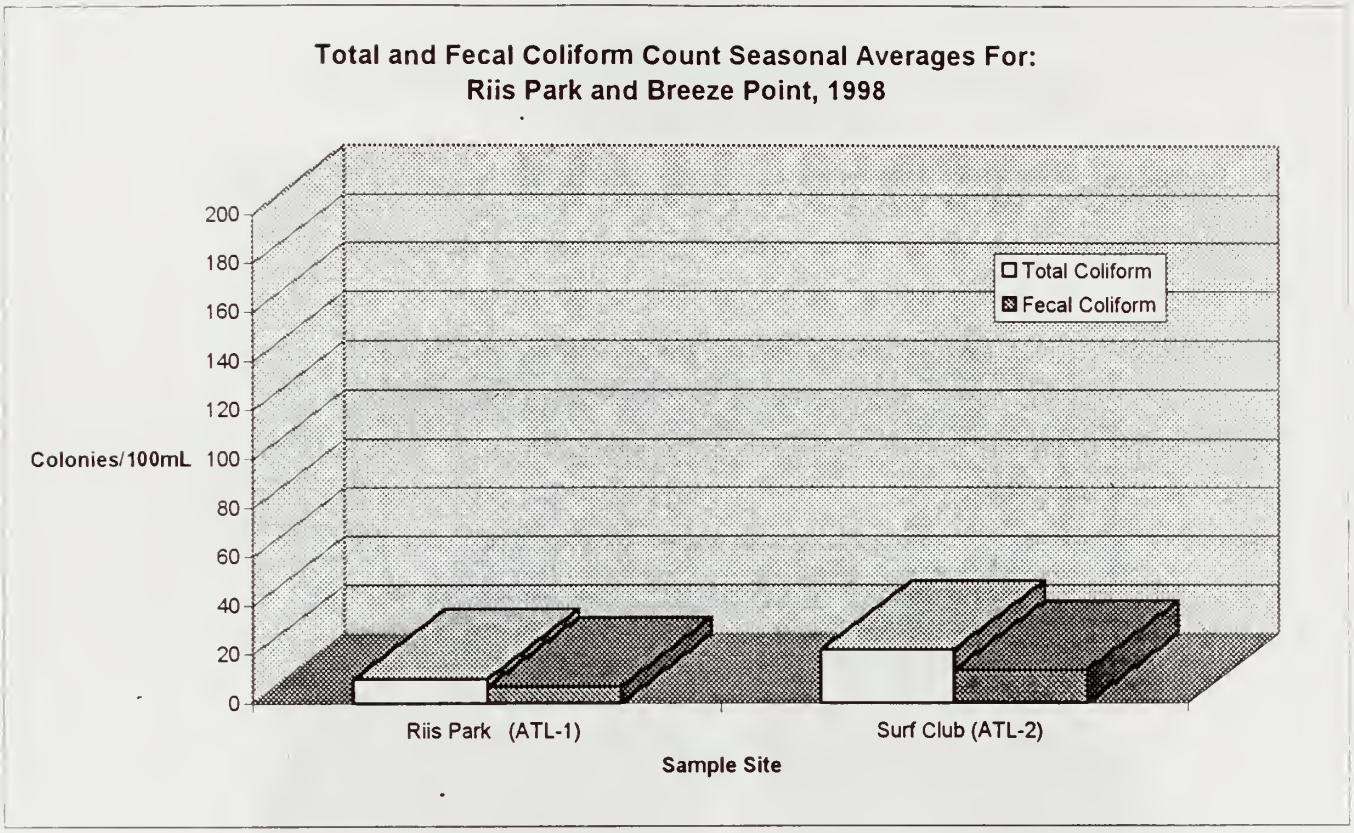
Table XVIII
Atlantic Beaches
Total & Fecal Coliform Counts (colonies/100mL), 1998

	Riis Park (ATL-1)		Surf Club (ATL-2)	
Date	Total	Fecal	Total	Fecal
5/20/98	0	0	0	0
5/27/98	0	0	0	0
6/5/98	0	0	0	0
6/10/98	0	0	25	0
6/18/98	0	0	0	0
6/24/98	0	0	0	50
6/30/98	0	0	0	100
7/7/98	0	50	0	0
7/16/98	0	0	50	0
7/22/98	0	0	0	0
7/28/98	50	0	100	0
8/4/98	100	50	50	0
8/12/98	0	0	0	0
8/27/98	0	0	0	50
9/2/98	0	0	100	0
Averages	10	7	22	13

No Data = -----

Black cells indicate samples that exceeded TCC of 2,400 Colonies/100mL & FCC of 200 Colonies/100mL (New York & New Jersey State bacterial standard limits).

Atlantic Beaches: Total And Fecal Coliform Count Averages, 1998



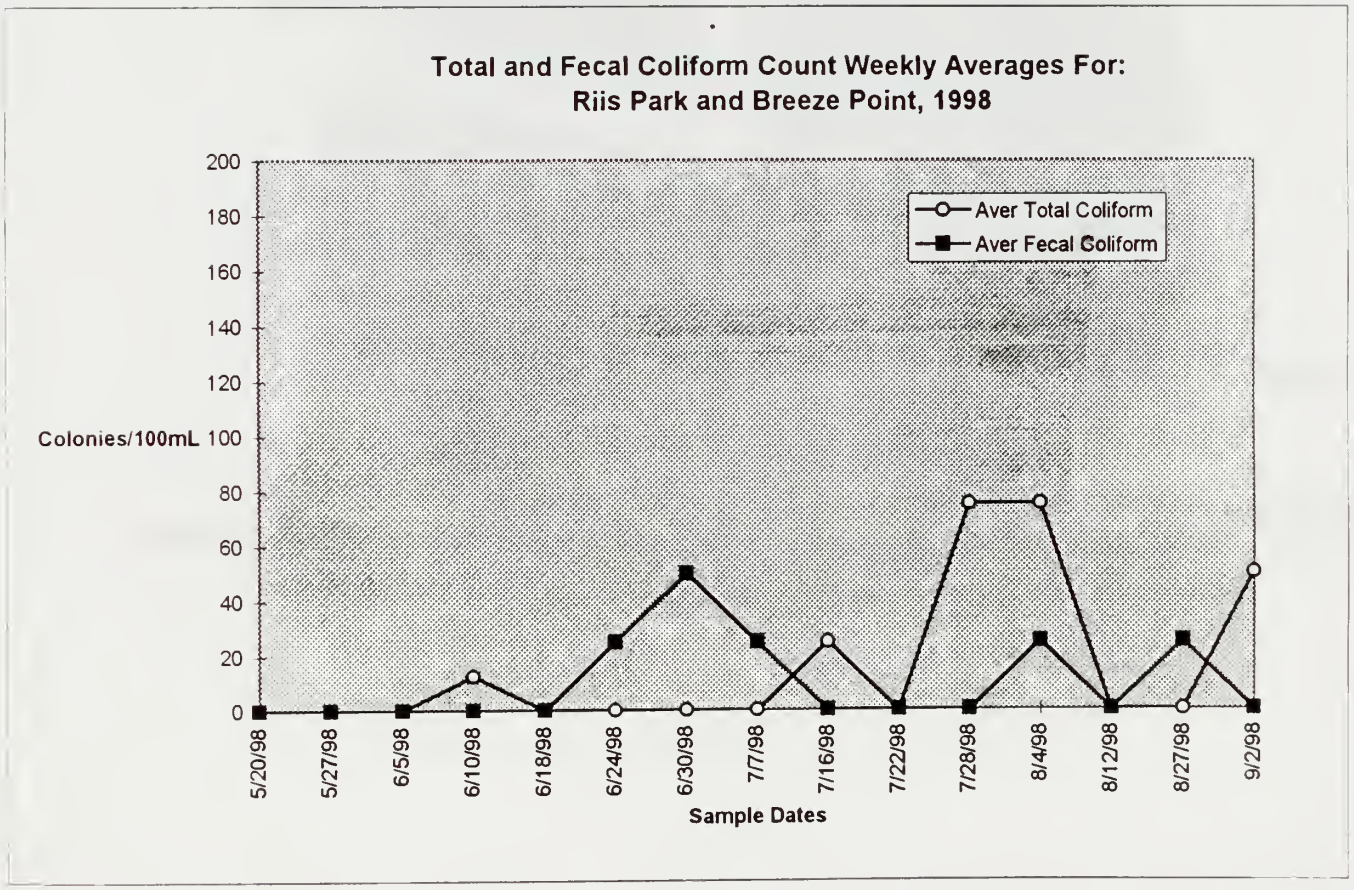
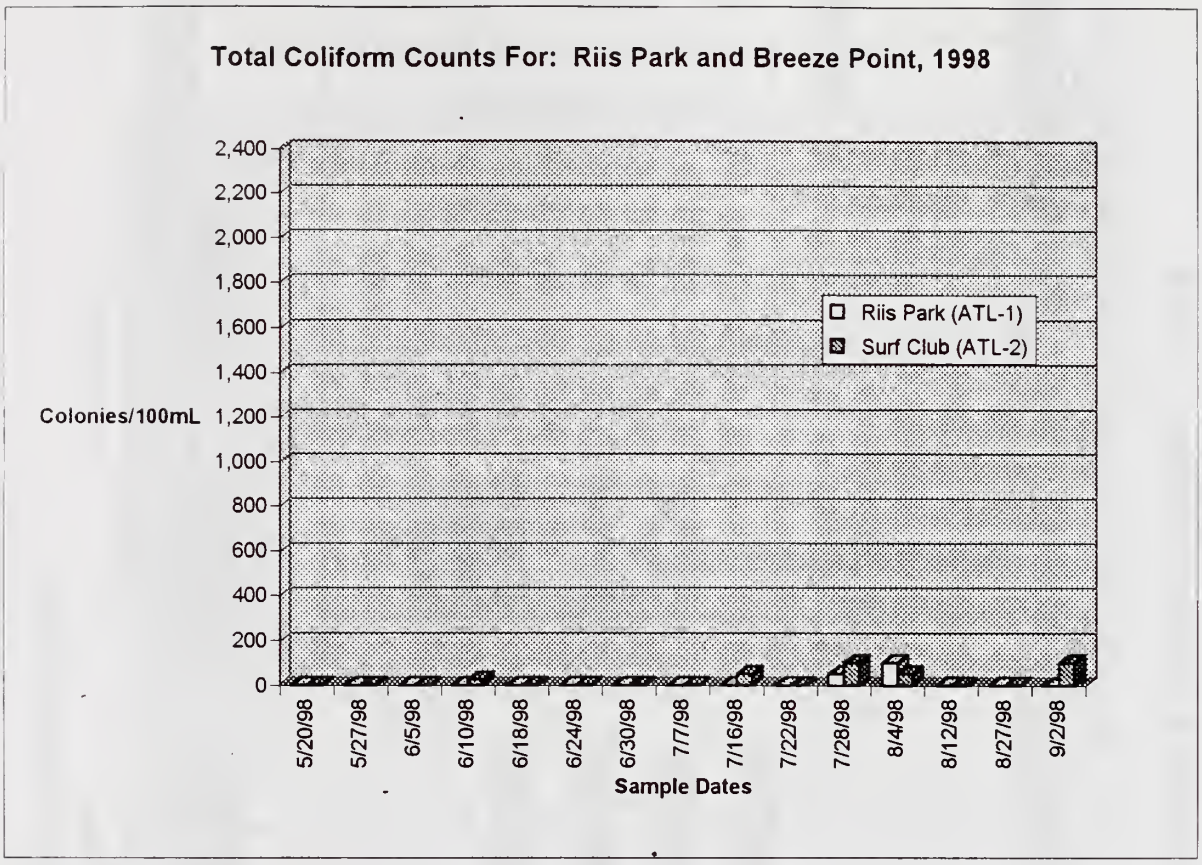


Figure 49

Atlantic Beaches: Total and Fecal Coliform Counts, 1998



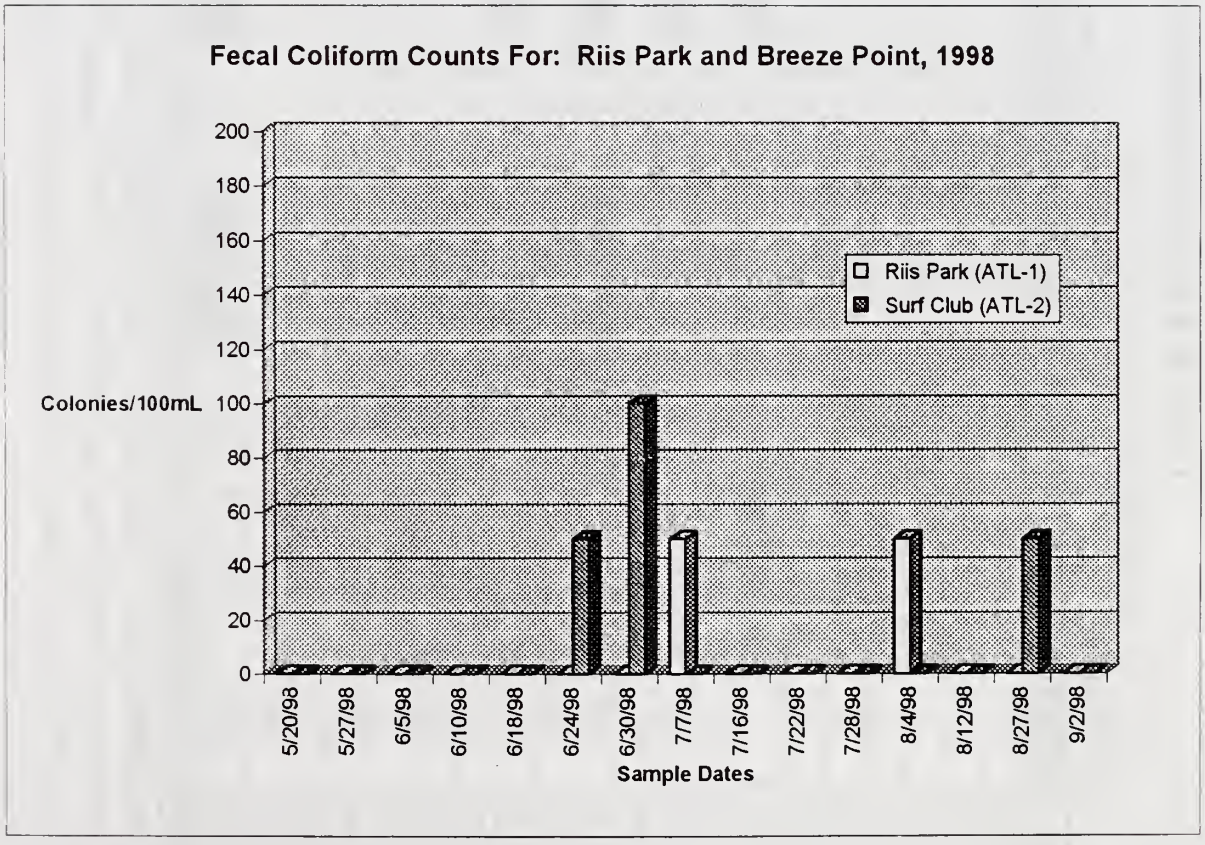


Figure 50

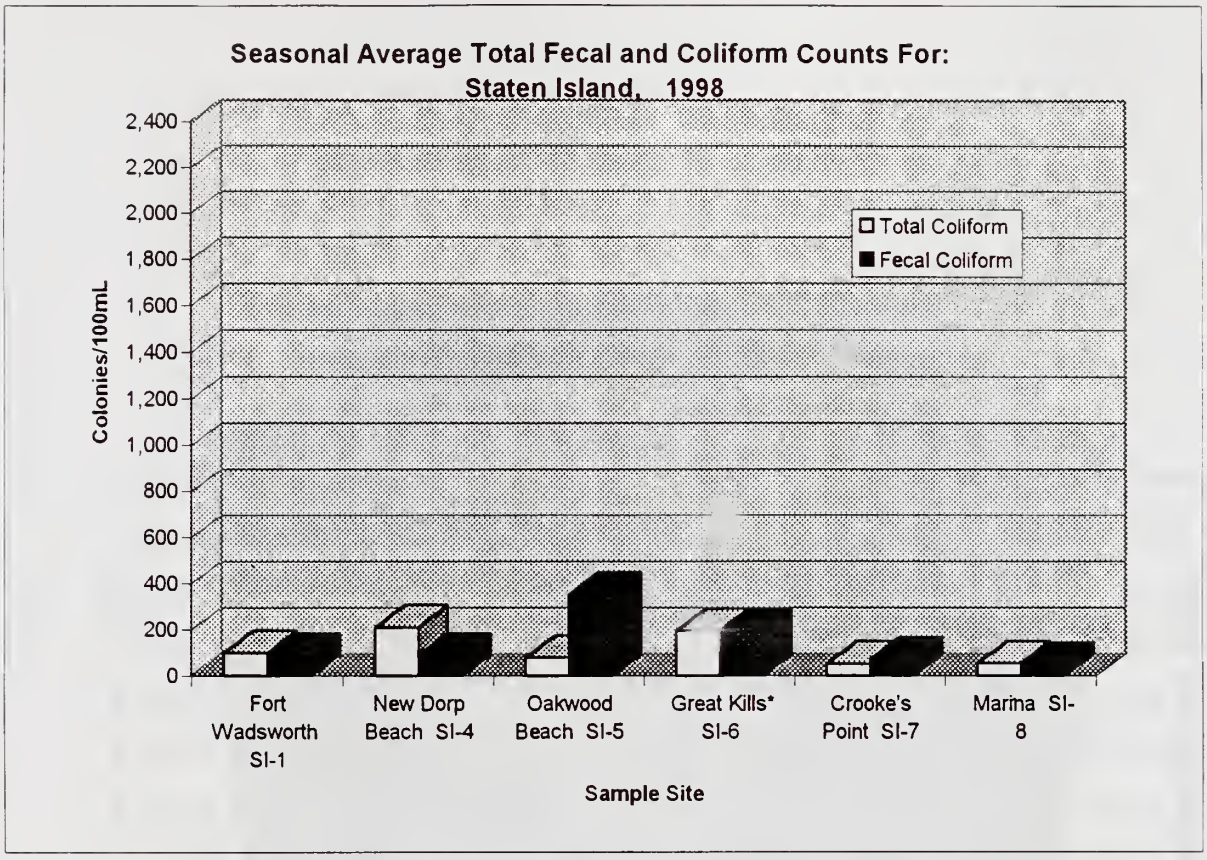
Table XIX
Staten Island
Total & Fecal Coliform Counts (colonies\100mL), 1998

	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
5/20/98	0	50	0	0	0	0	0	50	0	100	0	0
5/27/98	0	0	0	50	0	50	0	50	0	0	0	0
6/3/98	0	0	0	150	0	0	0	0	0	0	0	50
6/10/98	0	0	0	0	0	50	0	150	0	0	0	0
6/17/98	0	50	0	50	0	0	50	100	0	50	50	350
6/24/98	0	50	0	50	50	0	0	0	0	150	0	0
7/1/98	0	750	0	0	0	300	0	50	0	0	0	0
7/8/98	0	50	0	50	0	50	0	0	0	0	0	0
7/15/98	100	0	0	0	600	300	500	300	50	0	0	50
7/22/98	0	0	150	50	0	0	0	0	50	0	50	0
7/29/98	100	0	3,150	450	200	5,150	600	450	50	50	0	0
8/5/98	150	150	0	0	50	50	0	0	0	0	0	0
8/12/98	100	0	50	25	250	500	650	500	100	100	50	50
8/19/98	1,150	150	375	400	200	175	352	310	75	0	100	100
8/26/98	100	50	100	100	0	0	300	233	150	100	0	0
9/2/98	0	100	0	0	0	0	100	200	0	50	0	50
9/14/98	50	50	0	100	0	100	25	75	200	0	50	50
9/21/98	0	50	50	0	0	0	129	175	75	100	100	75
9/29/98	100	100	0	0	0	0	125	134	0	0	600	200
10/6/98	175	125	325	275	250	300	1,075	984	300	725	100	0
Averages	101	86	210	88	80	351	195	188	53	71	55	49

Note: See additional data for Staten Island - 6, Great Kills Bathing Beach, below. *Great Kills is a bathing beach site.

Black cells indicate samples that exceeded TCC of 2,400 Colonies/100mL
& FCC of 200 Colonies/100mL (New York & New Jersey State bacterial standard limits).

Staten Island: Total and Fecal Coliform Averages, 1998



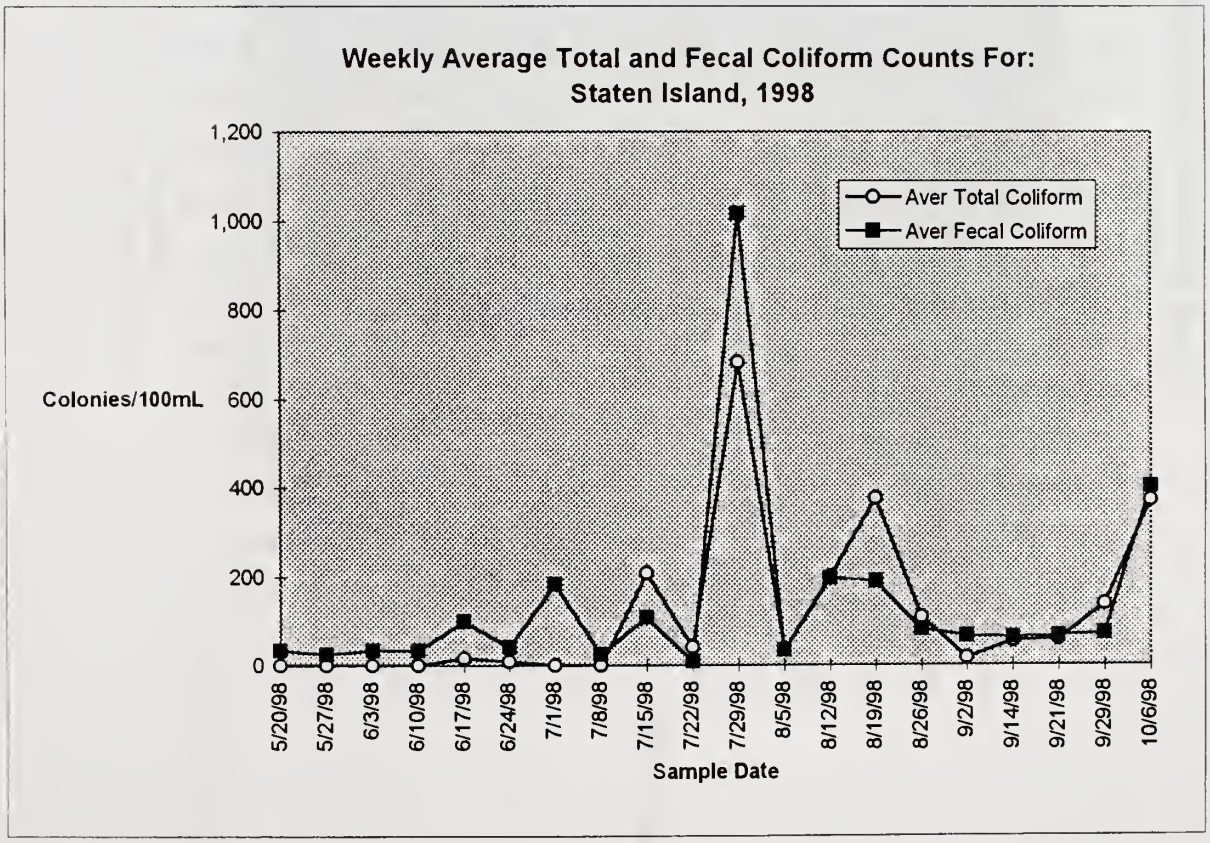


Figure 51

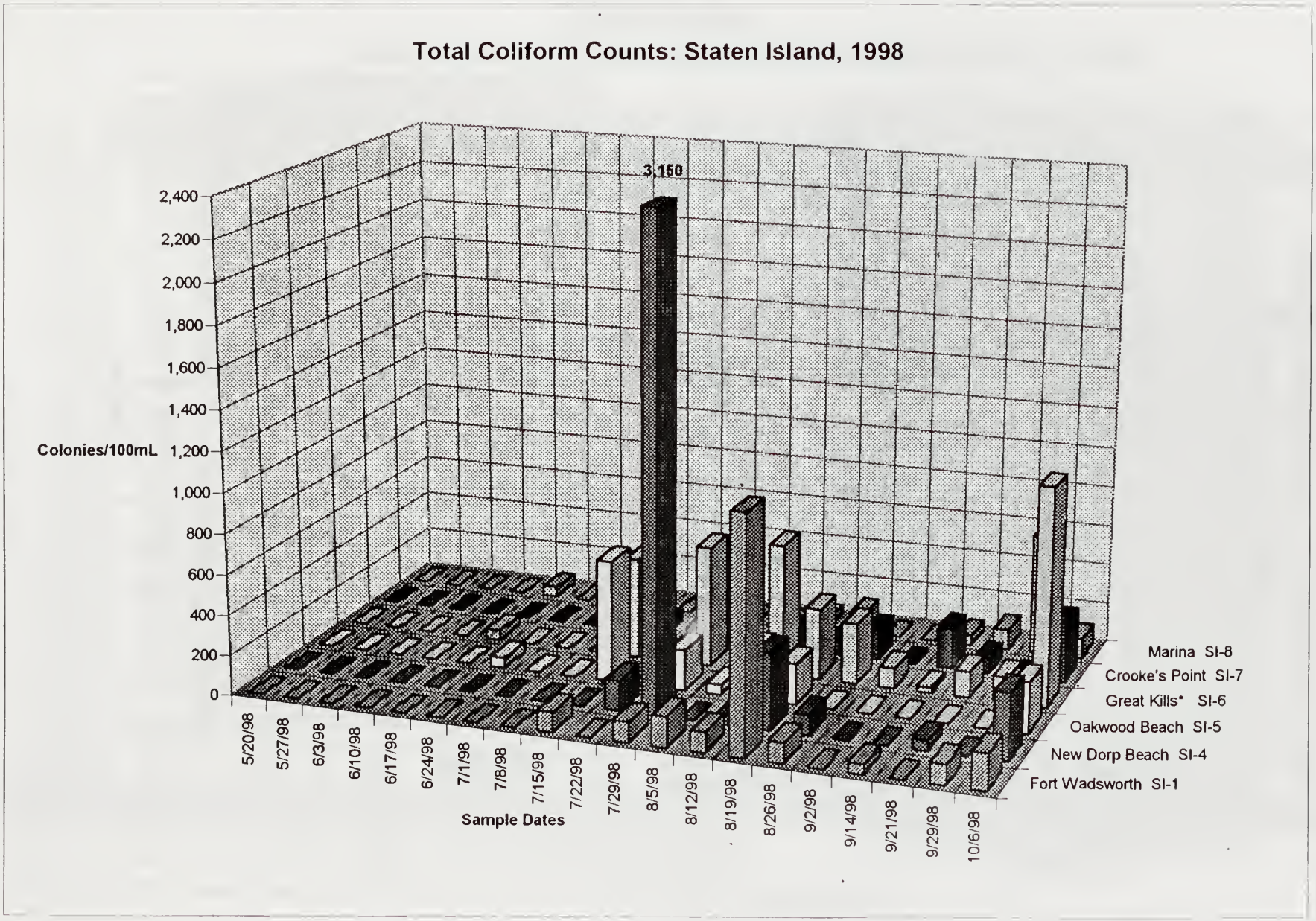

Total Coliform Counts: Staten Island, 1998
3,150
Colonies/100mL
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/20/98
5/27/98
6/3/98
6/10/98
6/17/98
6/24/98
7/1/98
7/8/98
7/15/98
7/22/98
7/29/98
8/5/98
8/12/98
8/19/98
8/26/98
9/2/98
9/14/98
9/21/98
9/29/98
10/6/98
Sample Dates
Marina SI-8
Crooke's Point SI-7
Great Kills* SI-6
Oakwood Beach SI-5
New Dorp Beach SI-4
Fort Wadsworth SI-1

Figure 52

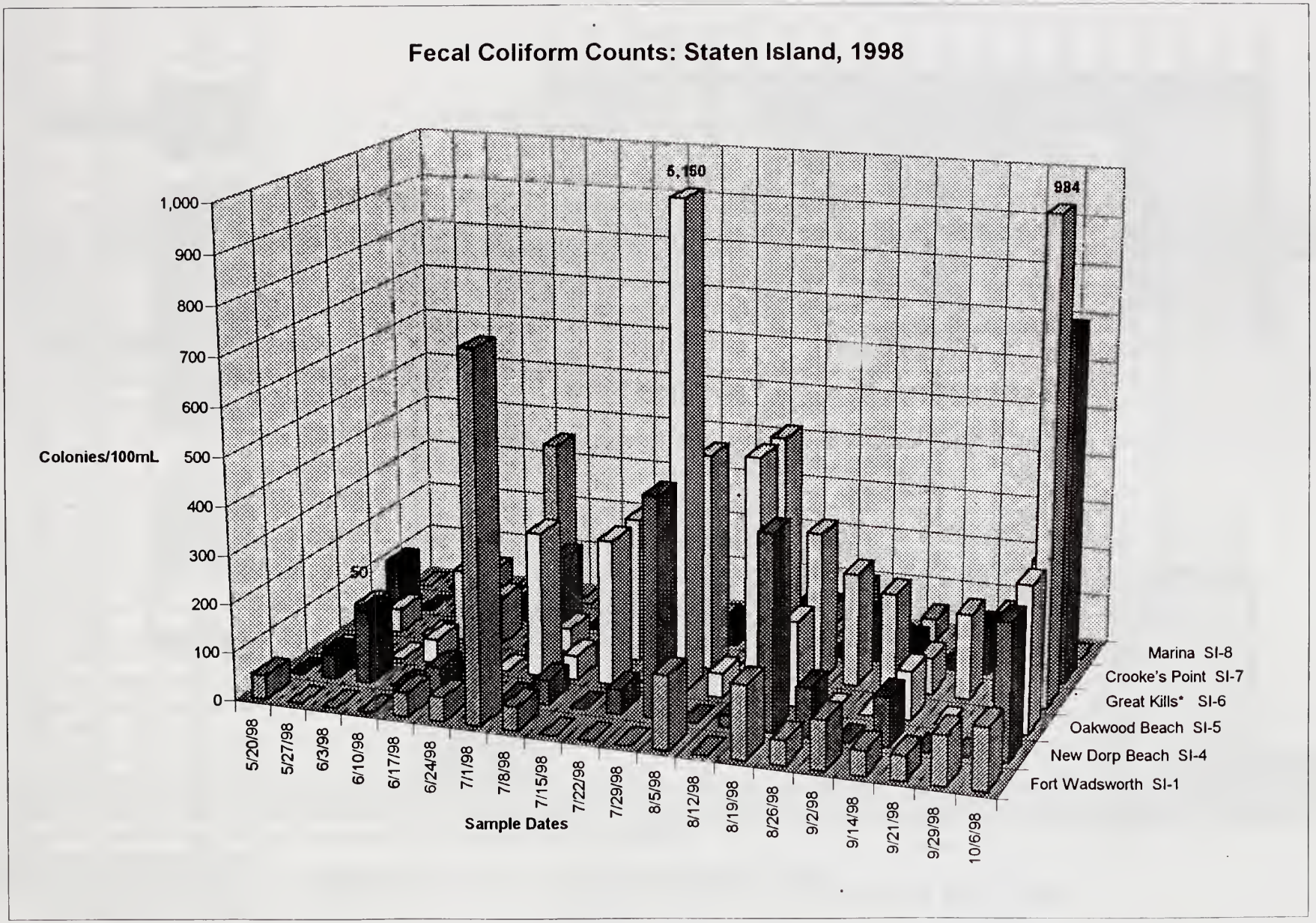

Fecal Coliform Counts: Staten Island, 1998
Colonies/100mL
1,000
900
800
700
600
500
400
300
200
100
0
5,150
984
50
5/20/98
5/27/98
6/3/98
6/10/98
6/17/98
6/24/98
7/1/98
7/8/98
7/15/98
7/22/98
7/29/98
8/5/98
8/12/98
8/19/98
8/26/98
9/2/98
9/14/98
9/21/98
9/29/98
10/6/98
Sample Dates
Marina SI-8
Crooke's Point SI-7
Great Kills* SI-6
Oakwood Beach SI-5
New Dorp Beach SI-4
Fort Wadsworth SI-1

Figure 53

Staten Island - 6 (Great Kills): Total And Fecal Coliform Counts, 1998

XIX (a)

Date	Great Kills* SI-6 TCC	FCC
5/20/98	0	50
5/27/98	0	50
6/3/98	0	0
6/10/98	0	150
6/17/98	50	100
6/24/98	0	0
7/1/98	0	50
7/8/98	0	0
7/15/98	500	300
7/16/98	300	25
7/22/98	0	0
7/29/98	600	450
7/30/98	125	225
7/31/98	600	475
8/1/98	675	521
8/2/98	0	100
8/5/98	0	0
8/12/98	650	500
8/13/98	172	316
8/14/98	1,410	1,353
8/15/98	2,563	2,481
8/17/98	317	257
8/18/98	433	370
8/19/98	352	310
8/20/98	863	292
8/21/98	355	340
8/23/98	743	620
8/24/98	187	170
8/26/98	300	233
8/27/98	5,138	5,982
8/28/98	873	873
8/30/98	250	155
9/2/98	100	200
9/14/98	25	75
9/21/98	129	175
9/29/98	125	134
10/6/98	1,075	984

Figure: A

Total Coliform Counts: Great Kills, 1998

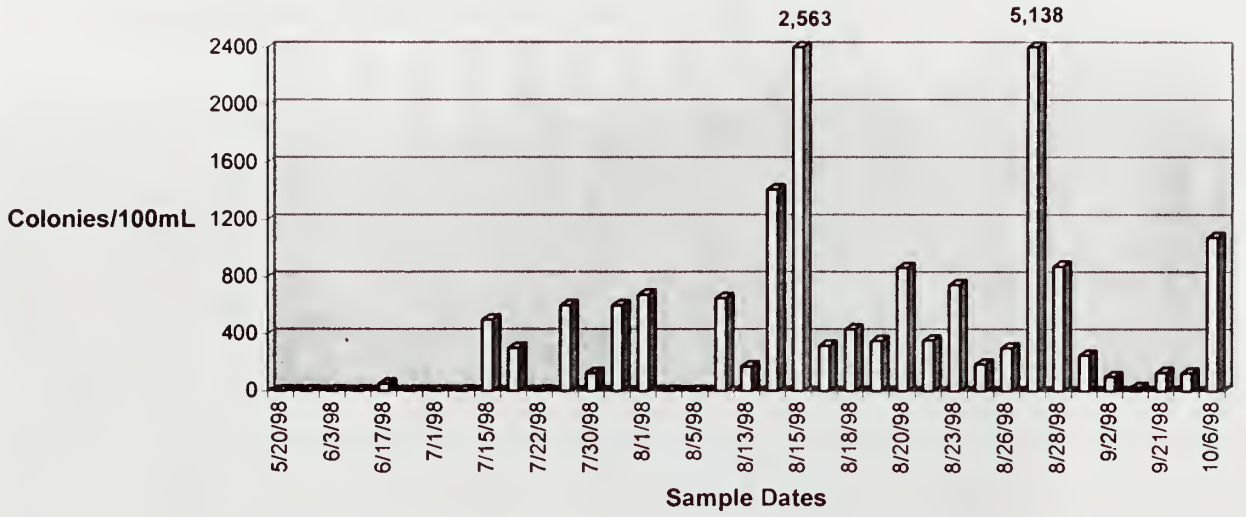


Figure: B

Fecal Coliform Counts: Great Kills, 1998

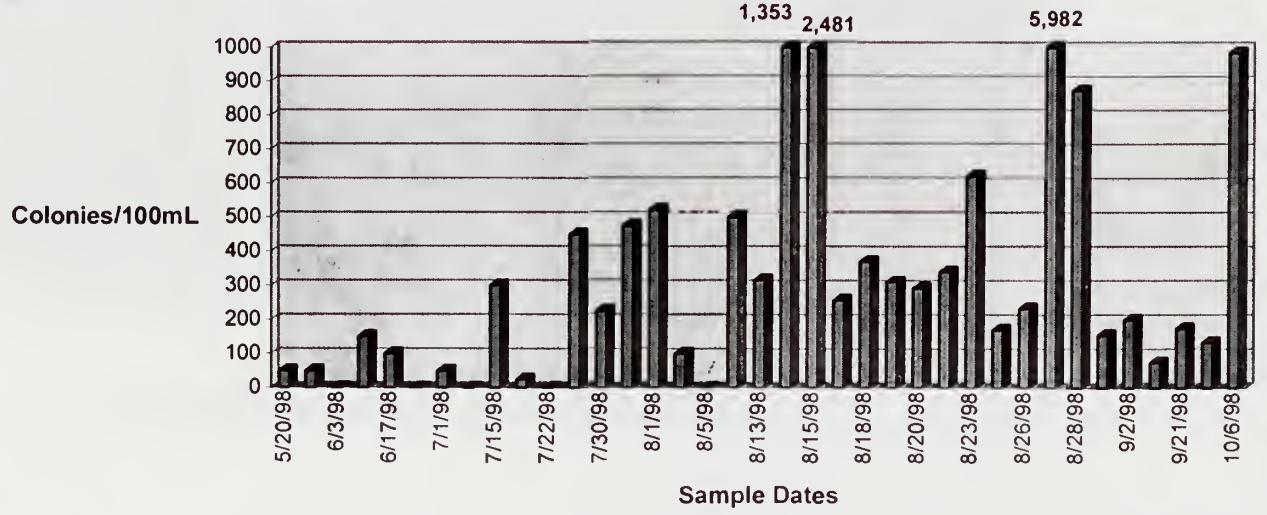


Table XX
Sandy Hook
Total & Fecal Coliform Counts (colonies/100ml), 1998

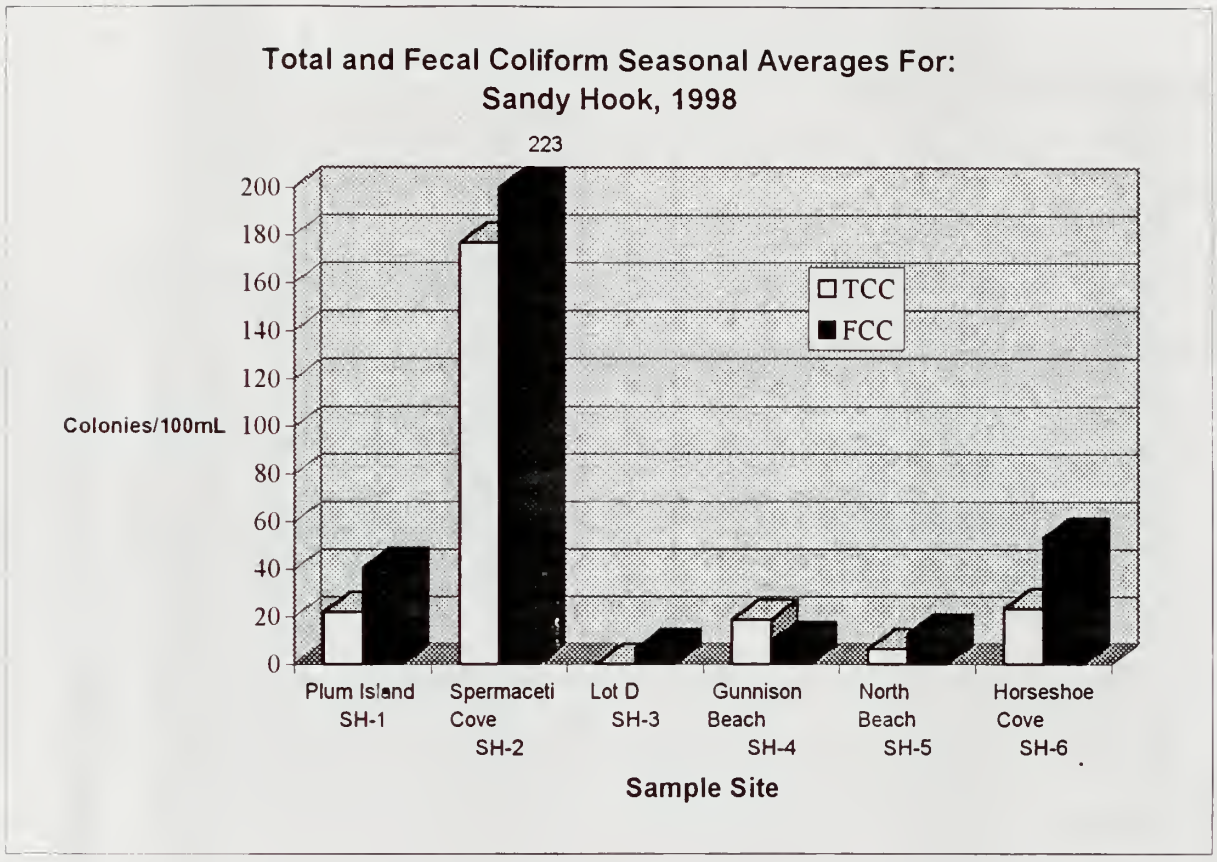
	Plum Island SH-1		Spermaceti Cove SH-2		Lot D *SH-3		Gunnison Beach *SH-4		North Beach *SH-5		Horseshoe Cove SH-6	
Date	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal	Total	Fecal
5/20/98	0	0	0	100	0	0	0	0	0	0	50	50
5/27/98	0	50	0	50	0	0	0	0	0	0	0	100
6/3/98	0	150	0	150	0	0	0	0	0	0	0	200
6/10/98	0	0	0	0	0	0	0	0	0	0	0	50
6/17/98	0	0	0	0	0	0	0	0	0	0	0	0
6/24/98	0	50	0	0	0	0	0	0	0	0	0	50
7/1/98	0	0	0	0	0	0	0	50	0	0	0	0
7/8/98	0	100	0	0	0	0	0	0	0	0	0	0
7/15/98	0	50	100	100	0	0	150	0	50	0	100	50
7/22/98	0	50	150	100	0	0	50	0	0	0	150	100
7/29/98	150	100	50	50	0	50	50	0	50	100	0	50
8/5/98	0	0	900	1,000	0	0	0	0	0	0	0	150
8/12/98	0	0	0	50	0	0	0	0	0	0	0	0
8/19/98	150	50	750	250	0	50	50	100	0	100	0	0
8/26/98	50	50	225	500	0	0	0	0	0	0	50	0
9/2/98	0	0	650	1,225	0	0	0	0	0	0	-----	-----
Averages	22	41	177	223	0	6	19	9	6	13	23	53

Black cells indicate samples that exceeded TCC of 2,400 Colonies/100mL

& FCC of 200 Colonies/100mL (New York & New Jersey State bacterial standard limits).

*SH - 3,4, and 5 are Bathing Beach sites. No Data = -----

Sandy Hook: Total And Fecal Coliform Averages, 1998



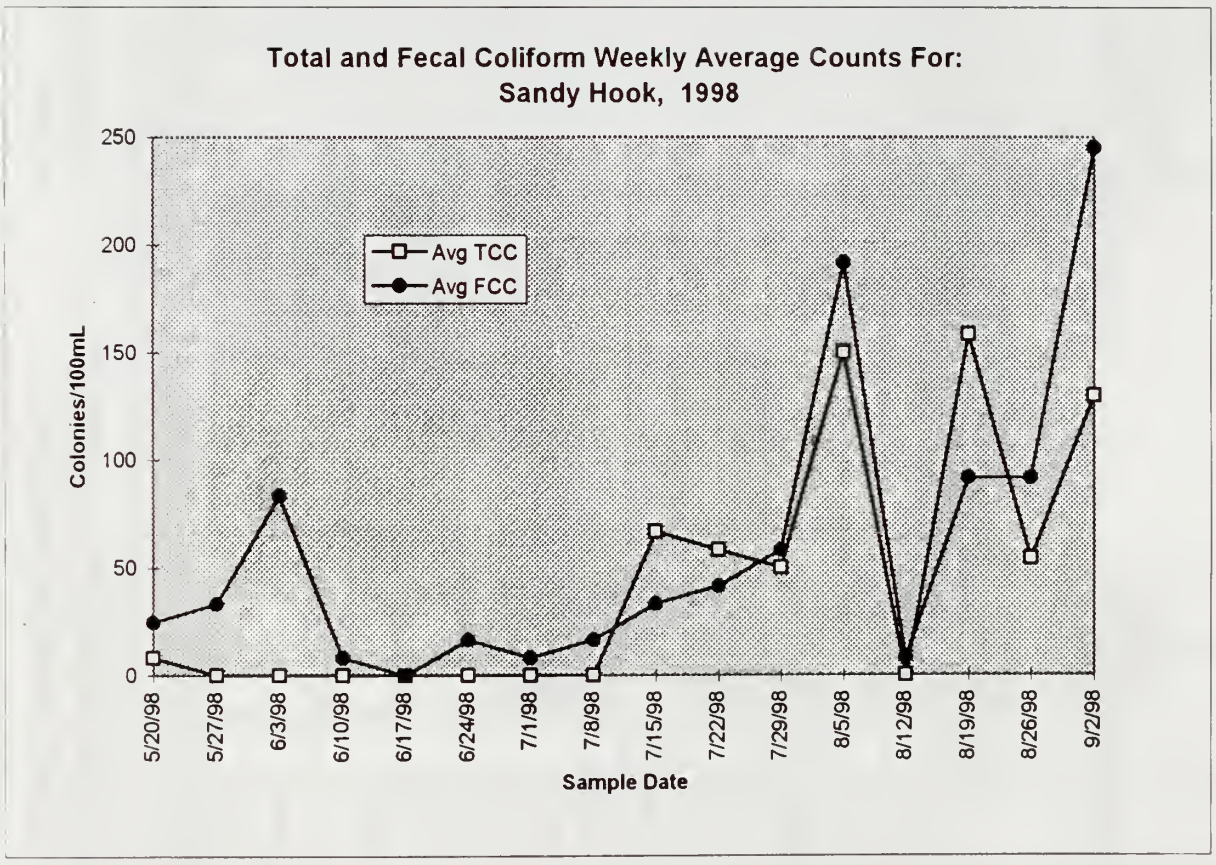


Figure 54

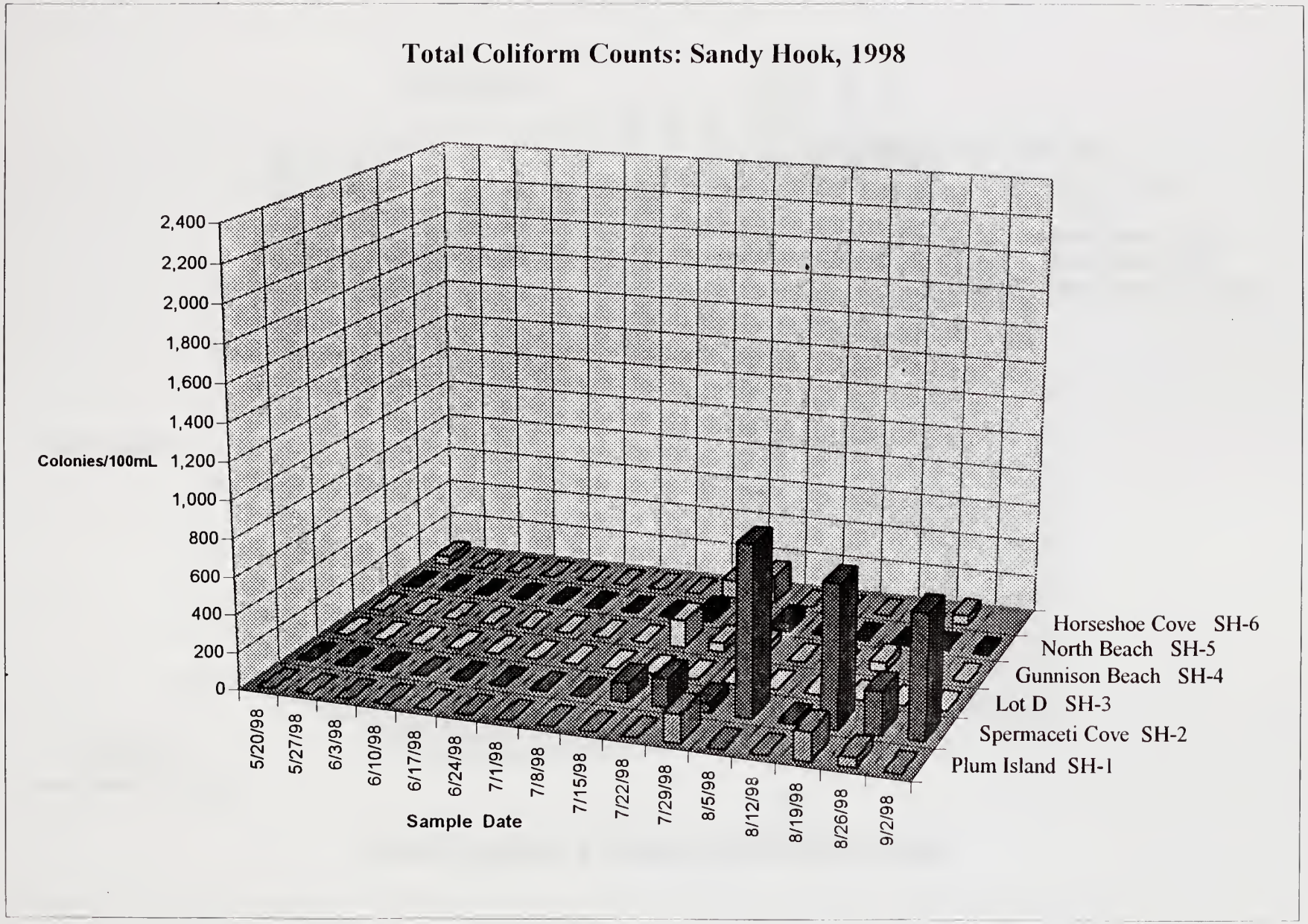

Total Coliform Counts: Sandy Hook, 1998
Colonies/100mL
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/20/98
5/27/98
6/3/98
6/10/98
6/17/98
6/24/98
7/1/98
7/8/98
7/15/98
7/22/98
7/29/98
8/5/98
8/12/98
8/19/98
8/26/98
9/2/98
Sample Date
Horseshoe Cove SH-6
North Beach SH-5
Gunnison Beach SH-4
Lot D SH-3
Spermaceti Cove SH-2
Plum Island SH-1

Figure 55

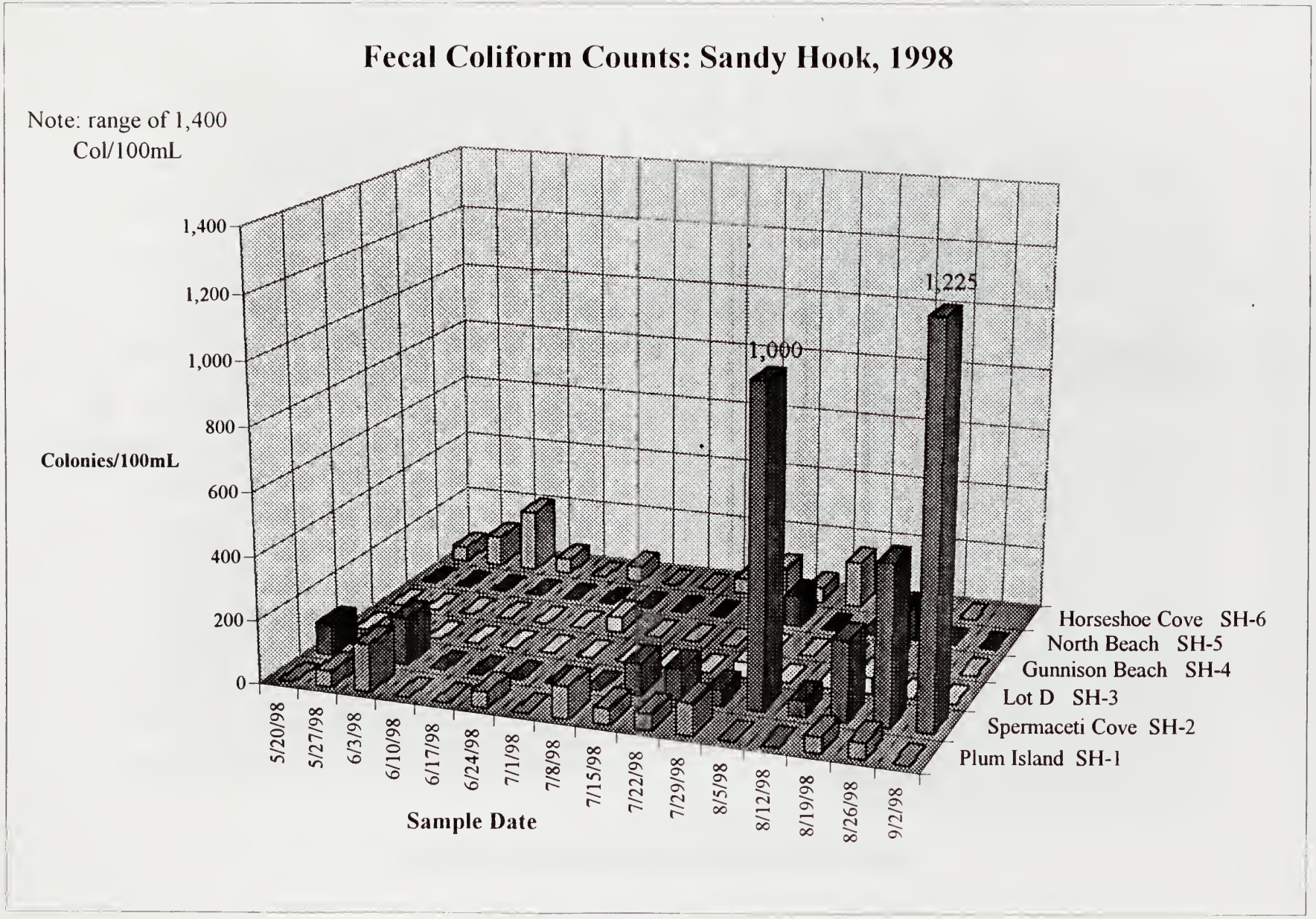

Fecal Coliform Counts: Sandy Hook, 1998
Note: range of 1,400 Col/100mL
1,400
1,200
1,000
800
600
400
200
0
Colonies/100mL
1,000
1,225
5/20/98
5/27/98
6/3/98
6/10/98
6/17/98
6/24/98
7/1/98
7/8/98
7/15/98
7/22/98
7/29/98
8/5/98
8/12/98
8/19/98
8/26/98
9/2/98
Sample Date
Horseshoe Cove SH-6
North Beach SH-5
Gunnison Beach SH-4
Lot D SH-3
Spermaceti Cove SH-2
Plum Island SH-1

Figure 56

SECTION IV

Jamaica Bay Parameters: Tables and Figures, 1998
(Listed Alphabetically)

Table XXI
Total Chlorine (mg/L), Jamaica Bay 1998

			Sample Dates			
Sample Location	Site	Depth	6/23/98	7/27/98	8/17/98	8/31/98
Rockaway Inlet	JB-3	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Nova Scotia Bar	JB-5A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Canarsie Pier	JB-6	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Pennsylvania Avenue Landf	JB-6A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Bergen Basin	JB-16	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Bergen Basin Outflow	JB-9A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Grassy Bay	JB-9	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
JoCo Marsh	JB-12	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Beach Channel	JB-15	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02

No Data = ----

Table XXII
Free Chlorine (mg/L), Jamaica Bay 1998

Sample Location	Site	Depth	Sample Dates			
			6/23/98	7/27/98	8/17/98	8/31/98
Rockaway Inlet	JB-3	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Nova Scotia Bar	JB-5A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Canarsie Pier	JB-6	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Pennsylvania Avenue Landf	JB-6A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Bergen Basin	JB-16	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Bergen Basin Outflow	JB-9A	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Grassy Bay	JB-9	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
JoCo Marsh	JB-12	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02
Beach Channel	JB-15	Top	<0.02	<0.02	<0.02	<0.02
		Bottom	<0.02	<0.02	<0.02	<0.02

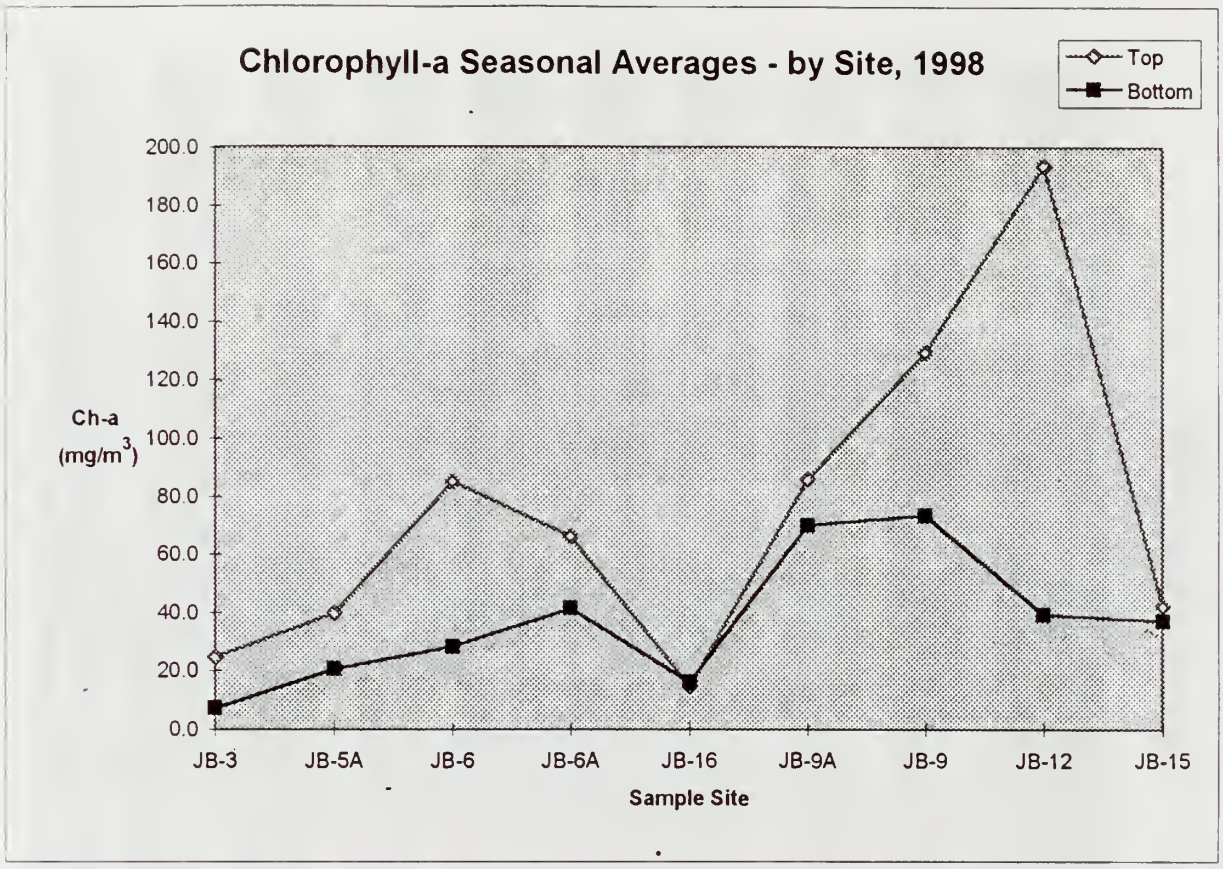
No Data = ----

Table XXIII

Chlorophyll-a (mg/m^3), Jamaica Bay 1998

			Sample Dates					
Sample Location	Site	Depth	6/15/98	7/6/98	7/21/98	8/3/98	8/17/98	8/31/98
Rockaway Inlet	JB-3	Top	0.0	22.0	0.0	9.4	105.6	10.6
		Bottom	0.0	22.0	0.0	0.0	21.8	0.0
Nova Scotia Bar	JB-5A	Top	0.0	69.2	0.0	32.4	47.2	89.3
		Bottom	0.0	55.2	0.0	0.0	40.9	26.9
Canarsie Pier	JB-6	Top	9.2	77.8	25.6	241.1	80.8	76.5
		Bottom	3.6	33.5	10.6	12.7	55.2	53.8
Pennsylvania Aven	JB-6A	Top	0.0	99.9	59.7	140.5	64.5	32.5
Landfill		Bottom	0.0	94.2	16.1	41.1	73.6	23.2
Bergen Basin	JB-16	Top	0.0	45.1	0.0	0.0	30.6	11.6
		Bottom	0.0	22.2	0.0	0.0	51.5	22.7
Bergen Basin	JB-9A	Top	0.0	67.5	280.3	58.2	64.6	44.2
Outflow		Bottom	0.0	79.9	257.1	24.0	26.8	31.8
Grassy Bay	JB-9	Top	326.5	97.9	15.3	3.5	159.4	174.5
		Bottom	121.4	67.3	9.4	0.0	127.8	113.9
JoCo Marsh	JB-12	Top	1.2	109.5	39.8	802.2	112.1	98.0
		Bottom	0.0	61.9	16.5	11.6	96.4	49.5
Beach Channel	JB-15	Top	0.0	78.6	22.4	10.6	40.9	100.2
		Bottom	0.0	78.9	22.4	11.8	32.3	76.1

Jamaica Bay:
Chlorophyll-a Averages, 1998



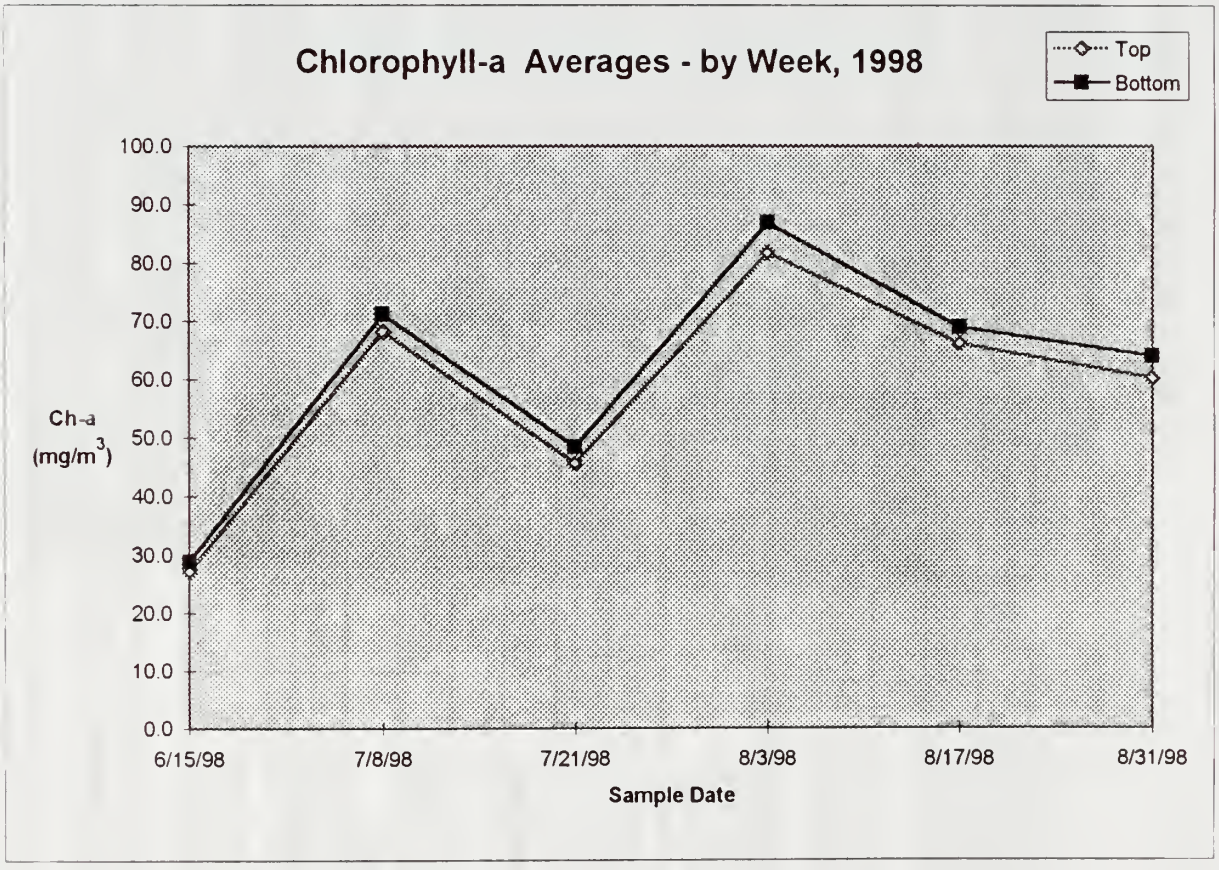


Figure 57

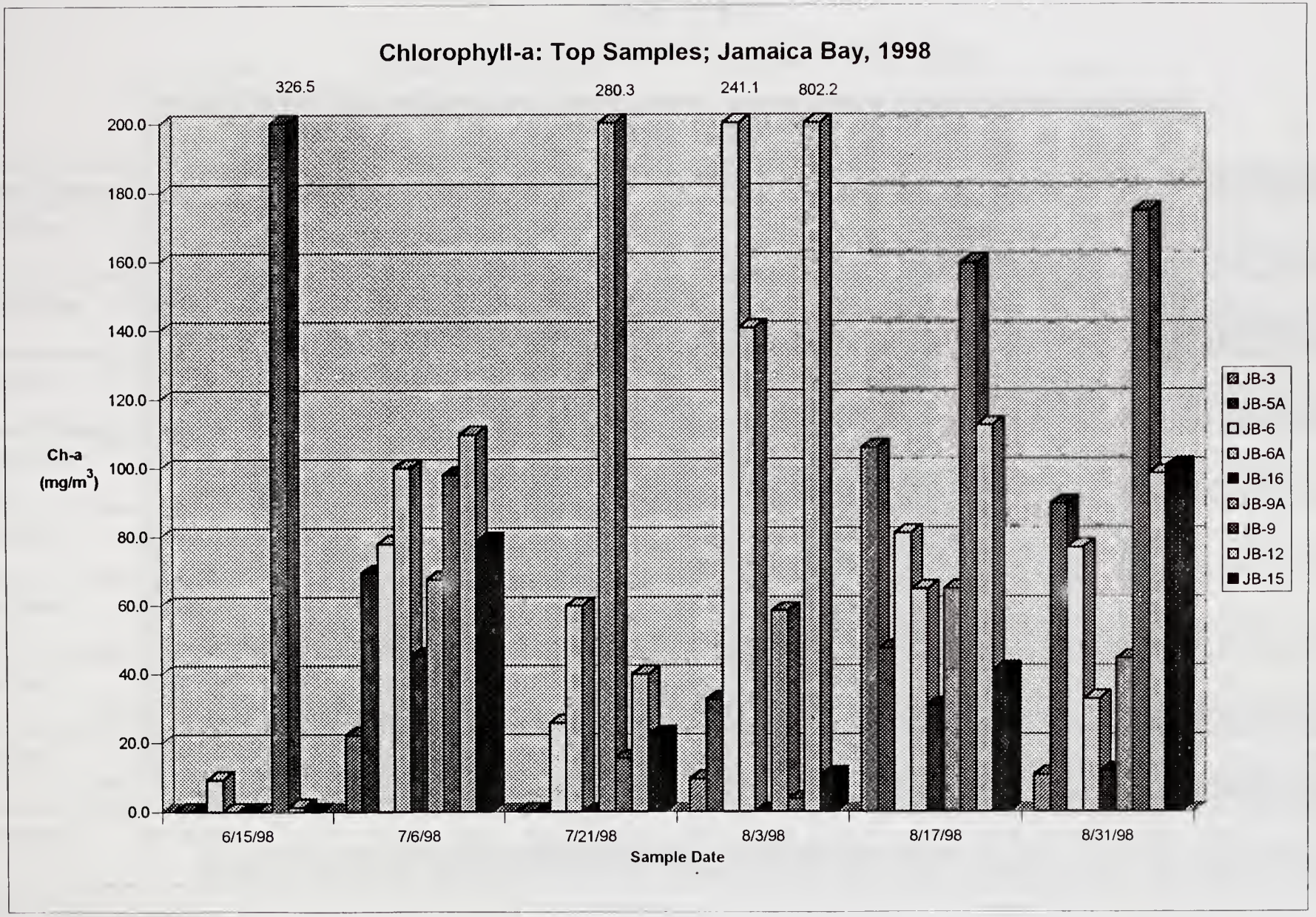

Chlorophyll-a: Top Samples; Jamaica Bay, 1998
326.5
280.3
241.1
802.2
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Ch-a (mg/m3)
6/15/98
7/6/98
7/21/98
8/3/98
8/17/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 58

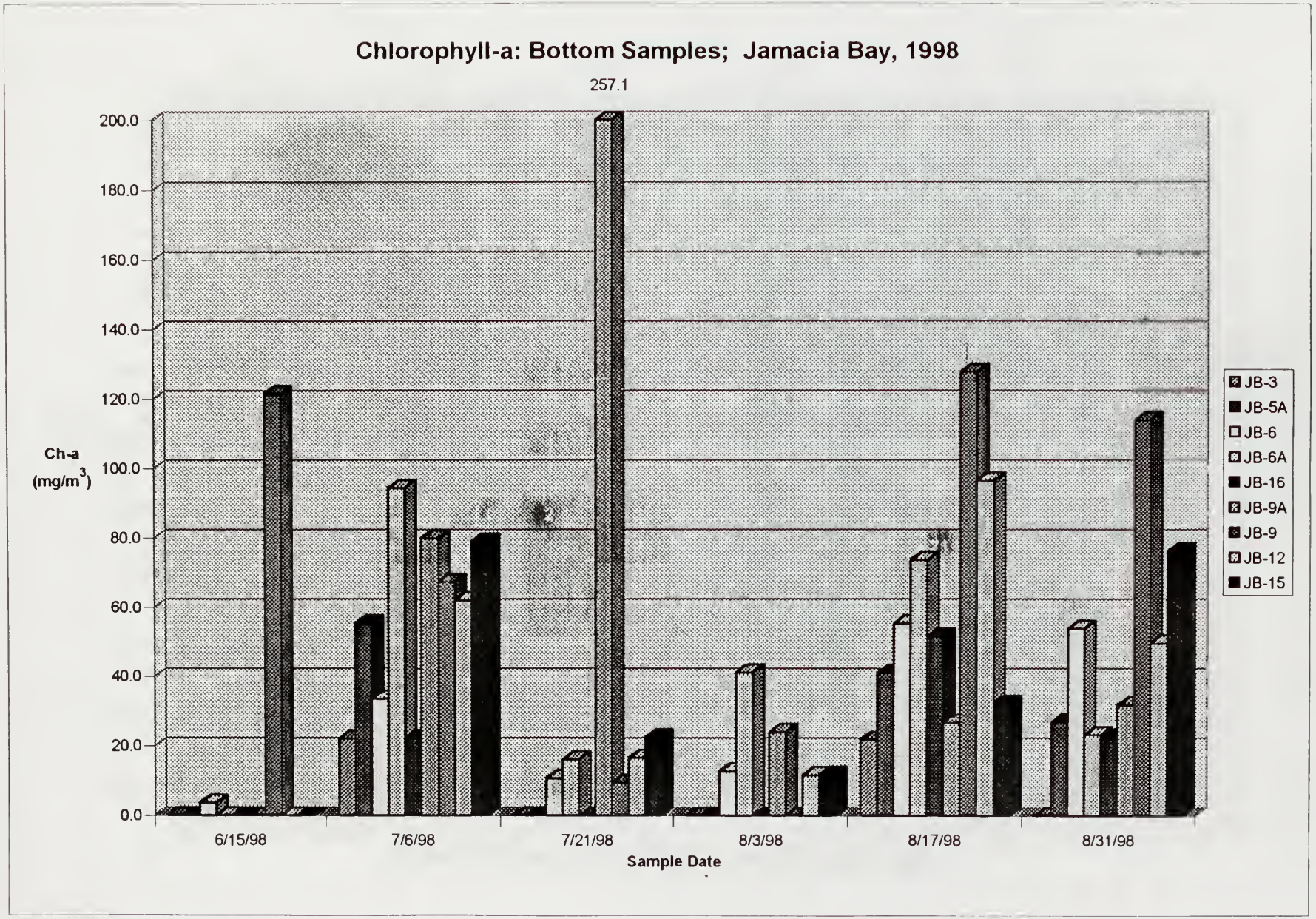

Chlorophyll-a: Bottom Samples; Jamacia Bay, 1998
257.1
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Ch-a
(mg/m3)
6/15/98
7/6/98
7/21/98
8/3/98
8/17/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

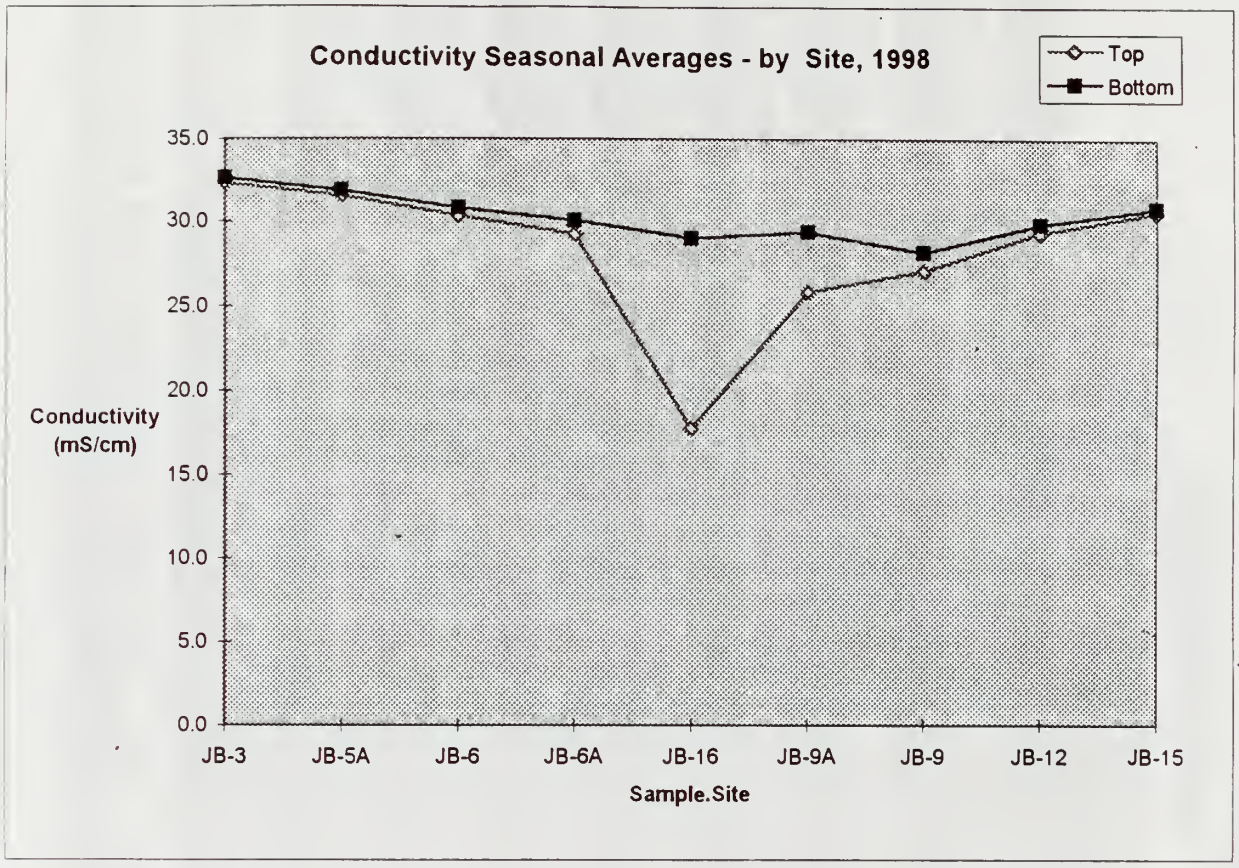
Figure 59

Table XXIV
Conductivity (mS/cm), Jamaica Bay 1998

			Sample Dates													
Sample Location	Site	Depth	5/25/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	31.8	29.7	----	31.7	34.3	31.4	33.0	33.8	32.6	33.3	32.2	33.4	31.8	31.8	31.8
		Bottom	31.9	30.6	----	31.7	34.1	31.5	32.9	34.0	32.6	34.2	31.0	33.7	32.9	32.9	32.9
Nova Scotia Bar	JB-5A	Top	30.5	29.6	29.2	29.9	32.7	32.8	31.6	32.2	32.1	33.2	31.6	32.8	31.8	32.7	31.3
		Bottom	31.6	29.6	29.3	29.9	32.4	32.8	32.0	32.5	32.6	33.4	32.1	33.4	32.0	33.1	31.7
Canarsie Pier	JB-6	Top	28.6	28.3	29.0	28.3	30.7	31.5	30.7	31.1	30.7	31.7	30.7	31.4	30.3	31.5	30.7
		Bottom	29.2	29.1	29.3	29.1	31.5	31.9	31.5	31.3	30.2	32.1	31.5	31.7	31.2	31.6	31.4
Pennsylvania Ave	JB-6A	Top	27.5	22.6	28.6	27.2	29.9	30.6	30.4	30.1	29.9	30.8	30.2	30.7	29.5	30.0	30.7
Landfill		Bottom	28.5	28.0	28.9	28.0	30.4	31.0	30.2	30.3	30.6	31.6	31.1	31.0	29.6	31.3	30.7
Bergen Basin	JB-16	Top	24.3	20.1	15.1	19.9	11.3	22.6	17.9	23.0	14.4	21.8	14.3	13.4	16.9	14.9	16.3
		Bottom	27.0	26.9	27.5	27.3	29.3	28.7	30.4	29.4	29.5	29.6	30.4	29.6	30.1	29.8	30.0
Bergen Basin	JB-9A	Top	26.3	24.7	22.3	25.6	29.5	29.0	28.4	29.2	15.9	29.5	15.8	30.3	28.6	29.8	22.4
Outflow		Bottom	27.2	27.1	27.7	27.6	29.8	30.2	29.7	29.8	29.3	30.4	30.4	30.4	30.5	30.2	30.2
Grassy Bay	JB-9	Top	23.0	26.4	26.9	26.5	29.8	22.6	29.5	28.8	28.5	24.8	28.4	27.5	30.1	23.8	29.6
		Bottom	23.9	26.4	26.9	26.5	29.8	23.7	29.7	28.9	28.7	29.6	28.8	30.3	30.1	29.6	29.5
JoCo Marsh	JB-12	Top	26.7	25.5	27.8	26.4	29.0	30.7	30.3	29.3	30.0	30.7	30.2	30.7	31.3	30.5	30.8
		Bottom	27.5	27.7	26.0	28.4	30.9	30.7	30.5	29.7	30.3	30.8	30.9	31.5	31.2	30.8	30.7
Beach Channel	JB-15	Top	29.1	28.8	28.0	29.4	30.5	32.3	30.6	31.3	30.0	31.4	31.2	31.9	31.8	31.8	31.1
		Bottom	29.3	29.2	28.1	29.2	31.0	32.4	30.6	31.8	30.4	32.3	31.3	31.8	31.8	31.8	31.4

No Data = ----

Conductivity Averages For: Jamaica Bay 1998



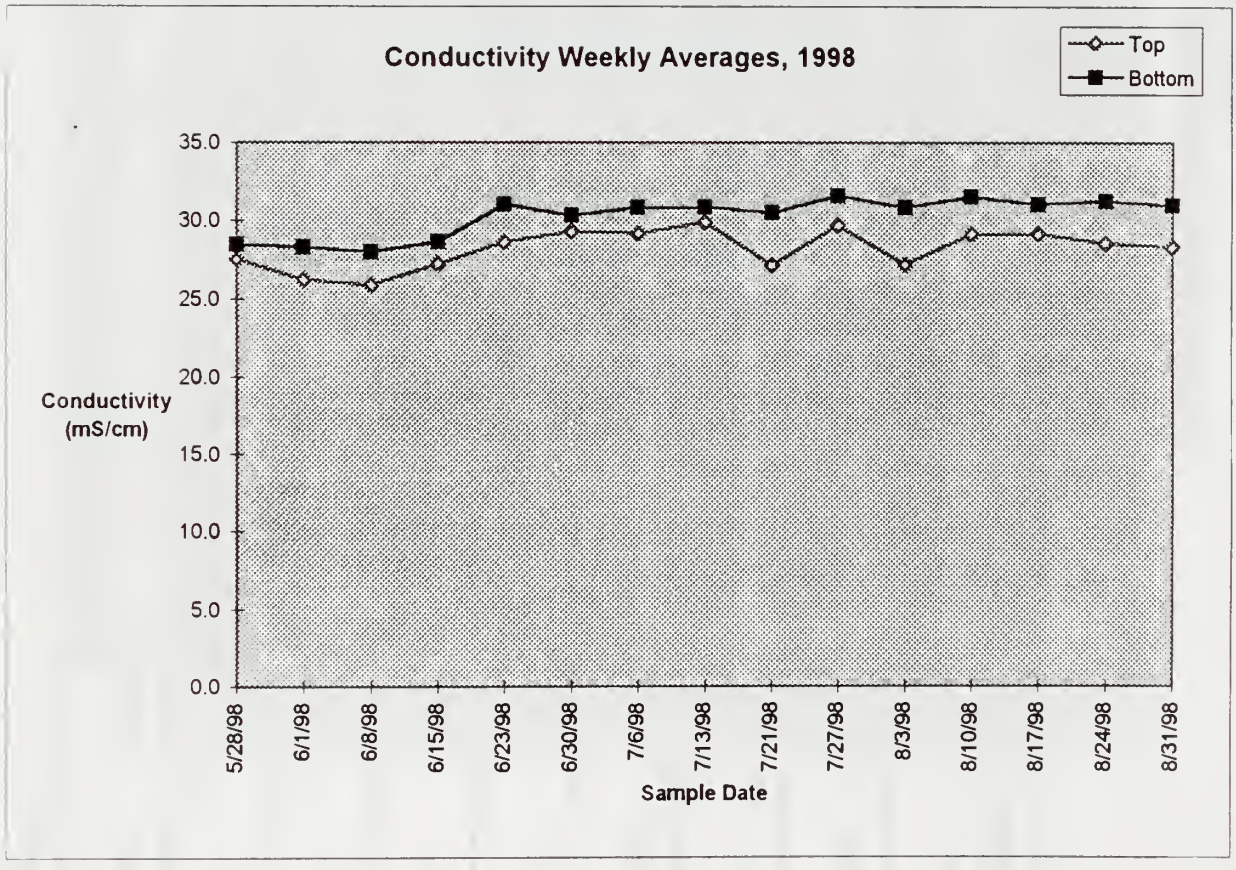


Figure 60

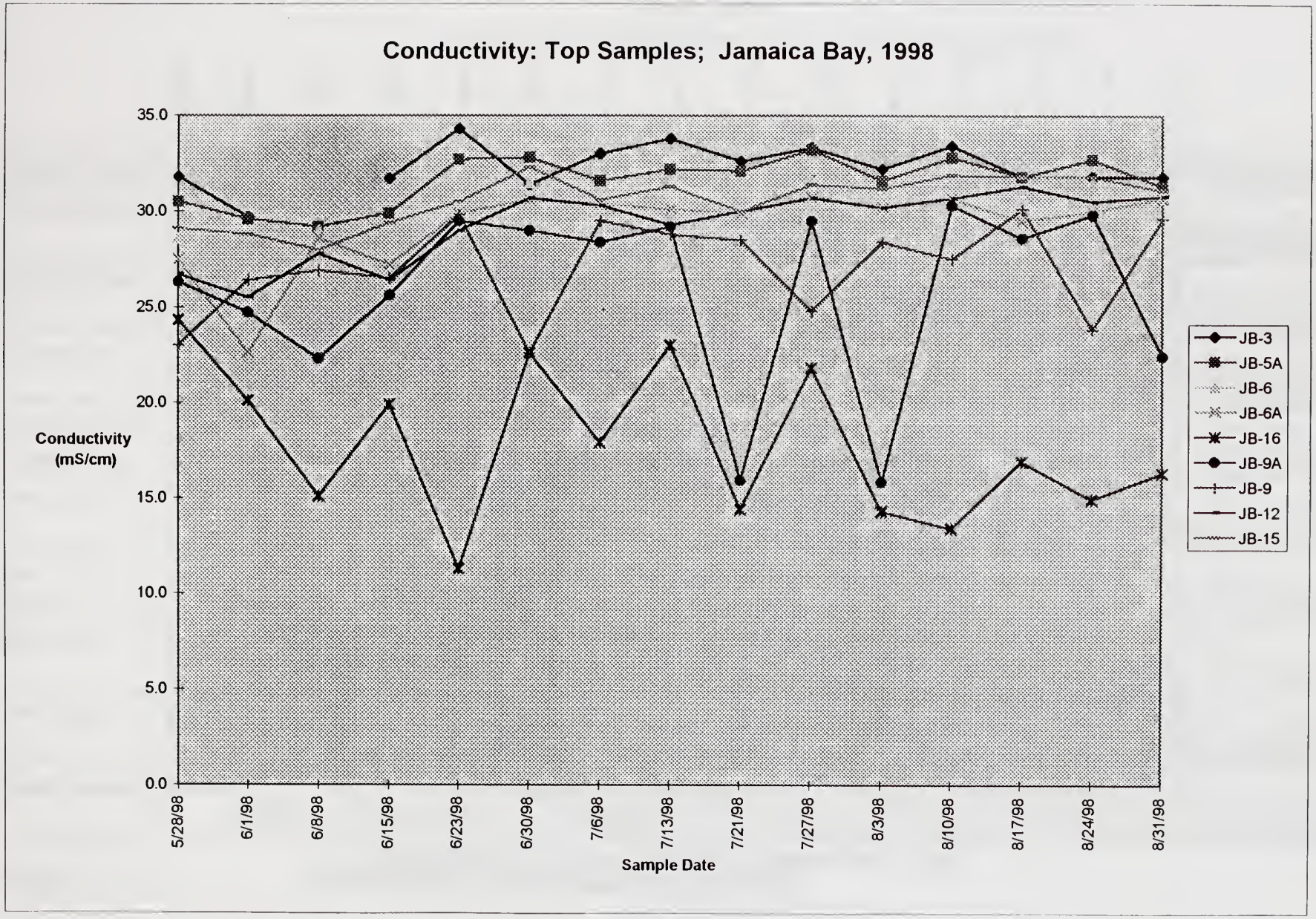

Conductivity: Top Samples; Jamaica Bay, 1998
Conductivity (mS/cm)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 61

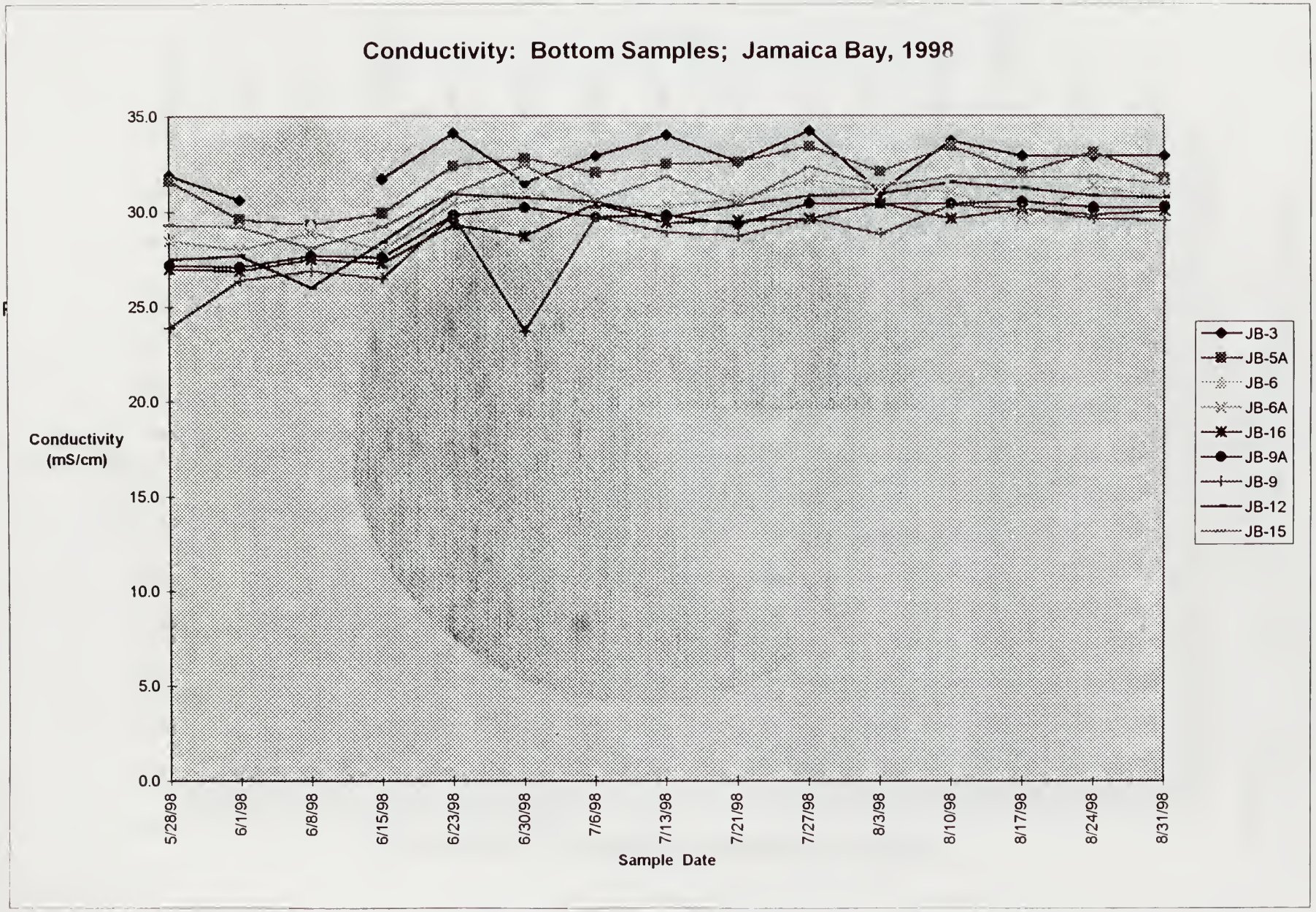

Conductivity: Bottom Samples; Jamaica Bay, 1998
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Conductivity (mS/cm)
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 62

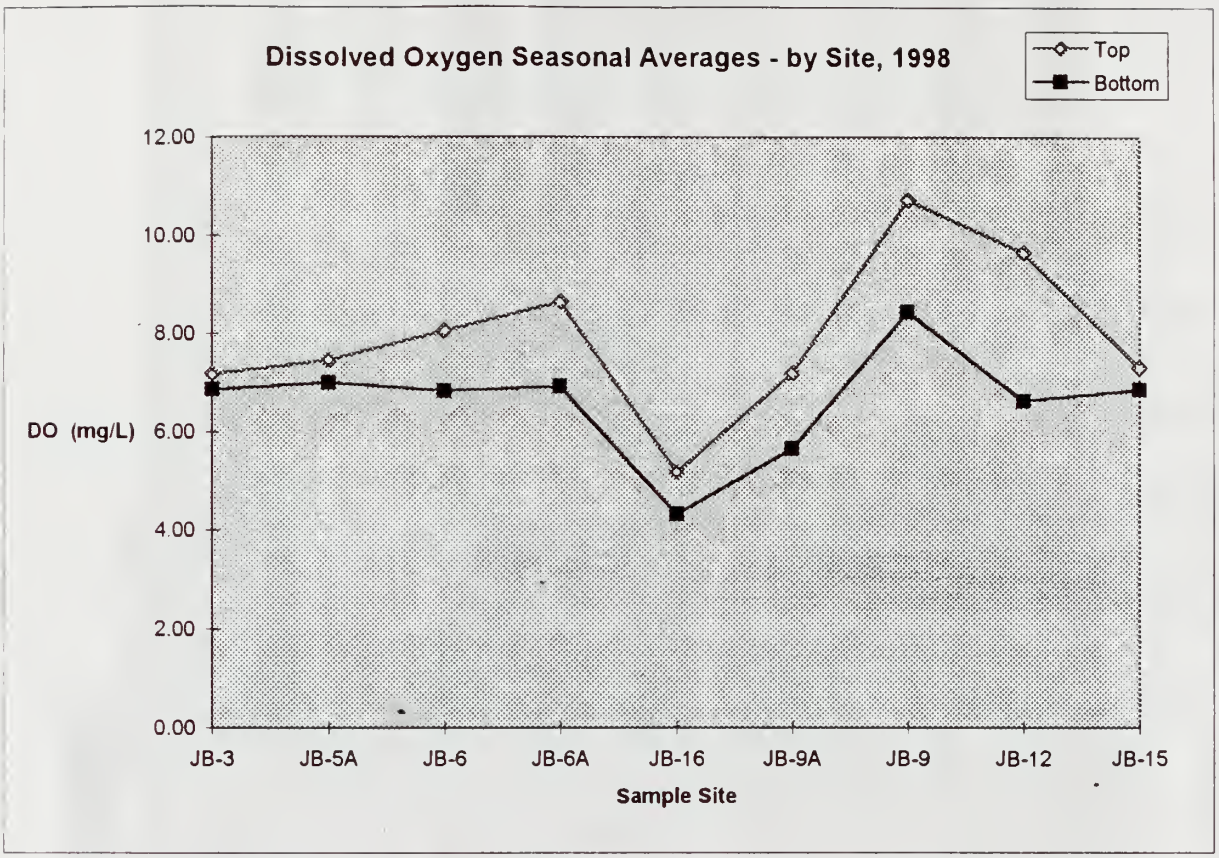
Table XXV
Dissolved Oxygen (mg/L), Jamaica Bay 1998

			Sample Dates														
Sample Location	Site	Depth	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	9.56	8.96	----	6.09	6.76	7.29	7.31	6.67	6.70	7.33	5.84	7.08	6.32	7.48	7.05
		Bottom	8.46	7.99	----	7.72	7.62	8.04	5.75	7.47	6.56	7.25	5.21	6.24	4.85	7.25	5.50
Nova Scotia Bar	JB-5A	Top	7.80	7.89	9.52	5.56	7.23	8.70	5.54	6.17	6.14	7.05	7.80	6.45	7.77	7.24	10.94
		Bottom	8.75	7.12	9.49	6.27	6.61	7.87	5.95	7.12	5.74	6.99	5.84	6.39	6.35	7.20	7.41
Canarsie Pier	JB-6	Top	7.70	7.86	6.91	4.24	6.42	6.55	13.38	6.03	5.73	9.41	13.35	7.80	10.98	5.76	8.73
		Bottom	8.26	6.45	7.86	5.43	5.94	7.50	11.18	6.27	6.64	7.01	5.33	7.30	6.43	5.43	5.46
Pennsylvania Ave	JB-6A	Top	6.81	6.86	7.61	4.41	4.71	6.51	13.65	7.77	7.67	12.21	15.83	11.13	11.74	8.12	4.47
Landfill		Bottom	9.81	5.89	9.72	5.29	5.51	7.30	10.61	6.88	4.18	7.72	5.00	6.90	10.58	5.44	2.94
Bergen Basin	JB-16	Top	5.44	6.03	4.01	2.42	2.05	4.21	5.65	11.02	2.55	10.87	3.95	5.27	4.78	5.17	4.25
		Bottom	5.41	4.99	5.51	4.53	3.83	5.15	5.37	5.26	2.71	6.35	2.99	5.19	1.65	3.06	2.78
Bergen Basin	JB-9A	Top	7.42	6.56	5.34	4.37	5.06	5.93	8.99	7.17	2.41	9.80	4.62	11.34	12.65	7.41	8.69
Outflow		Bottom	9.78	5.45	6.36	4.66	5.42	4.90	9.89	6.35	3.50	7.50	2.61	6.55	3.98	4.15	3.88
Grassy Bay	JB-9	Top	6.65	6.86	8.64	12.31	3.64	6.89	10.43	13.51	16.78	13.02	11.66	14.78	12.07	8.53	14.90
		Bottom	7.61	7.04	10.03	11.43	5.35	6.37	9.93	12.96	13.04	9.55	6.09	6.24	8.16	7.01	5.85
JoCo Marsh	JB-12	Top	9.65	7.65	6.71	5.01	5.37	7.76	12.05	11.05	9.11	15.17	ORH	11.27	10.81	10.73	12.62
		Bottom	7.58	6.98	7.23	4.91	5.05	6.74	10.74	9.30	4.82	7.61	5.02	5.30	8.95	3.35	5.88
Beach Channel	JB-15	Top	7.77	7.21	8.57	4.55	5.56	4.94	8.69	5.40	11.21	7.83	5.27	7.33	6.59	6.38	12.41
		Bottom	7.93	7.95	9.44	6.12	4.56	5.77	8.57	6.32	9.33	6.36	5.34	6.22	6.20	5.16	7.64

No Data = ----

Black cells indicate DO values less than 5.0 mg/L

Jamaica Bay:
Dissolved Oxygen Averages, 1998



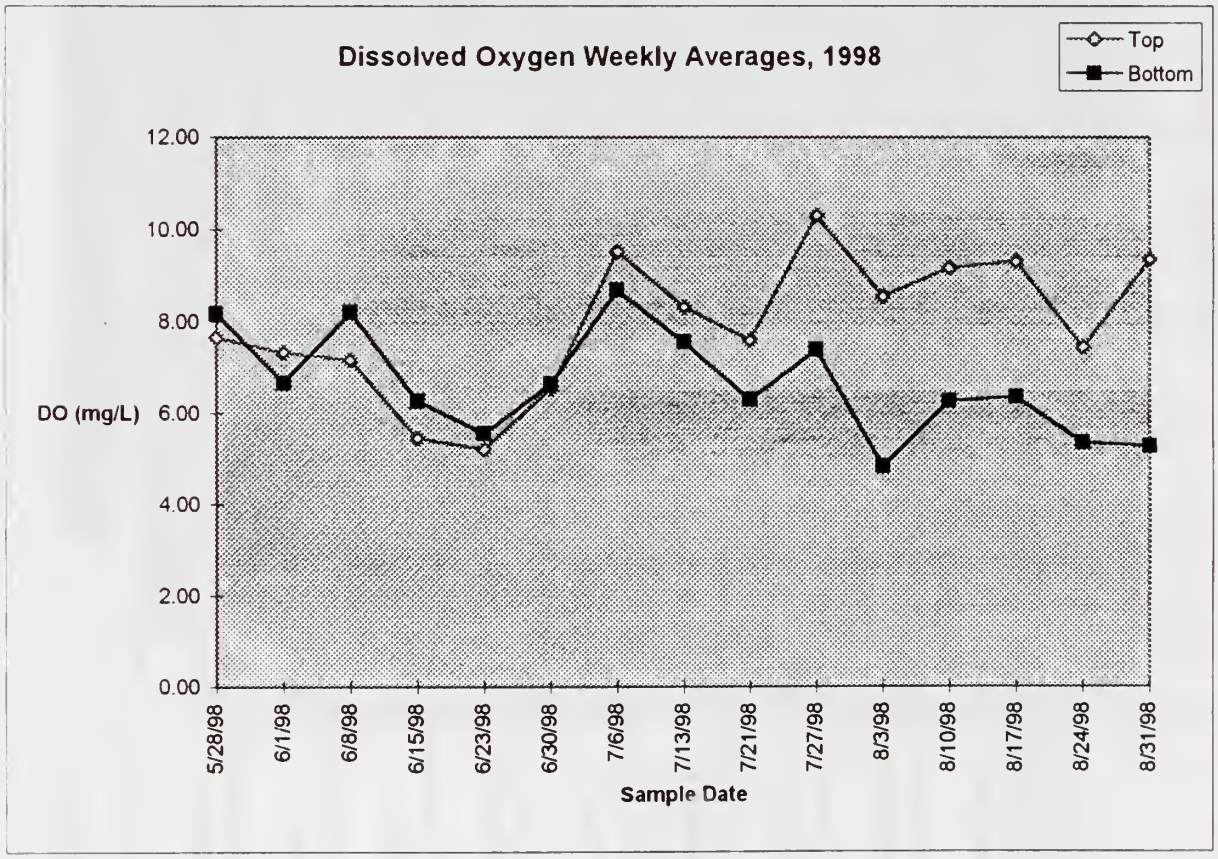


Figure 63

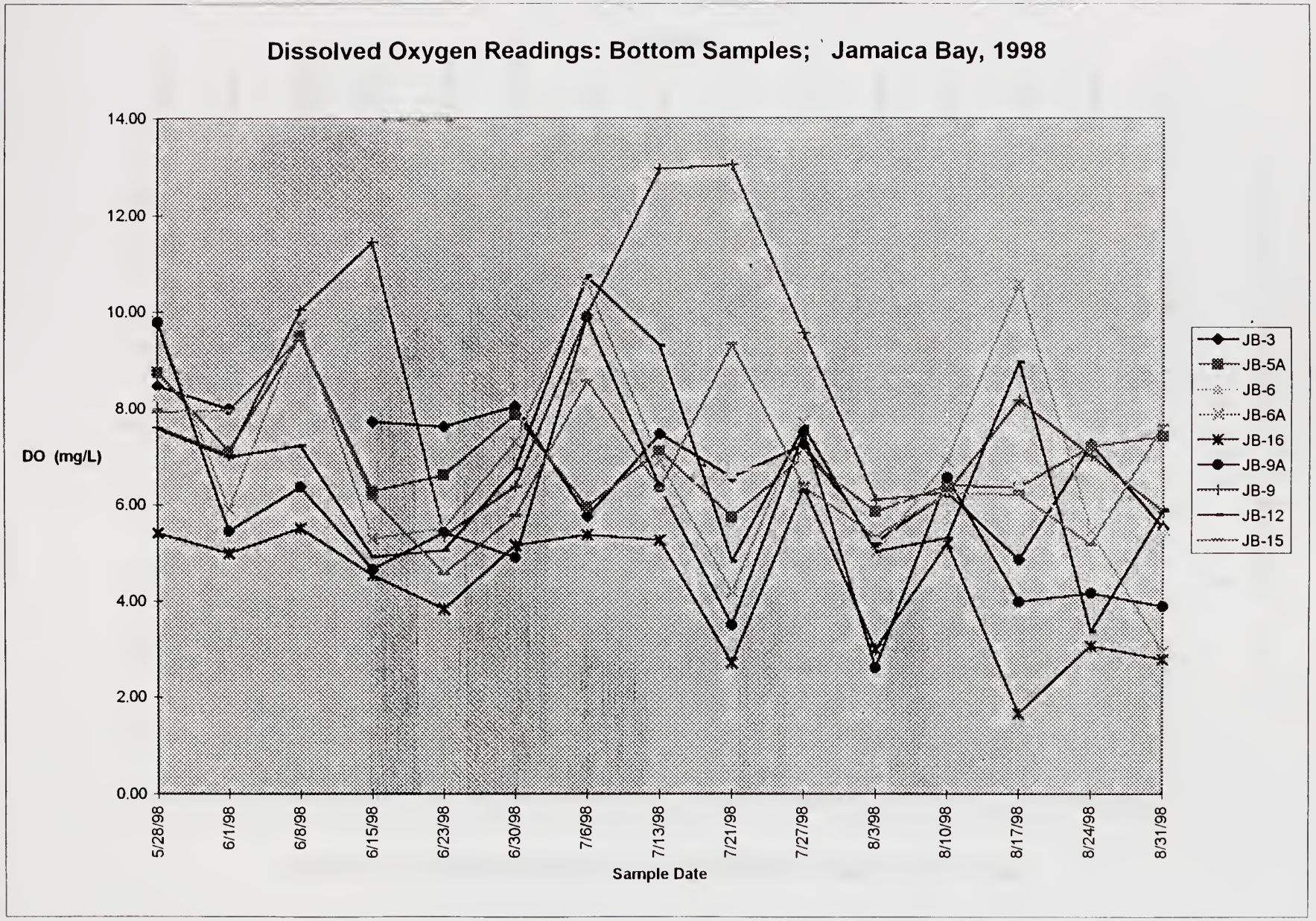

Dissolved Oxygen Readings: Bottom Samples; Jamaica Bay, 1998
DO (mg/L)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 65

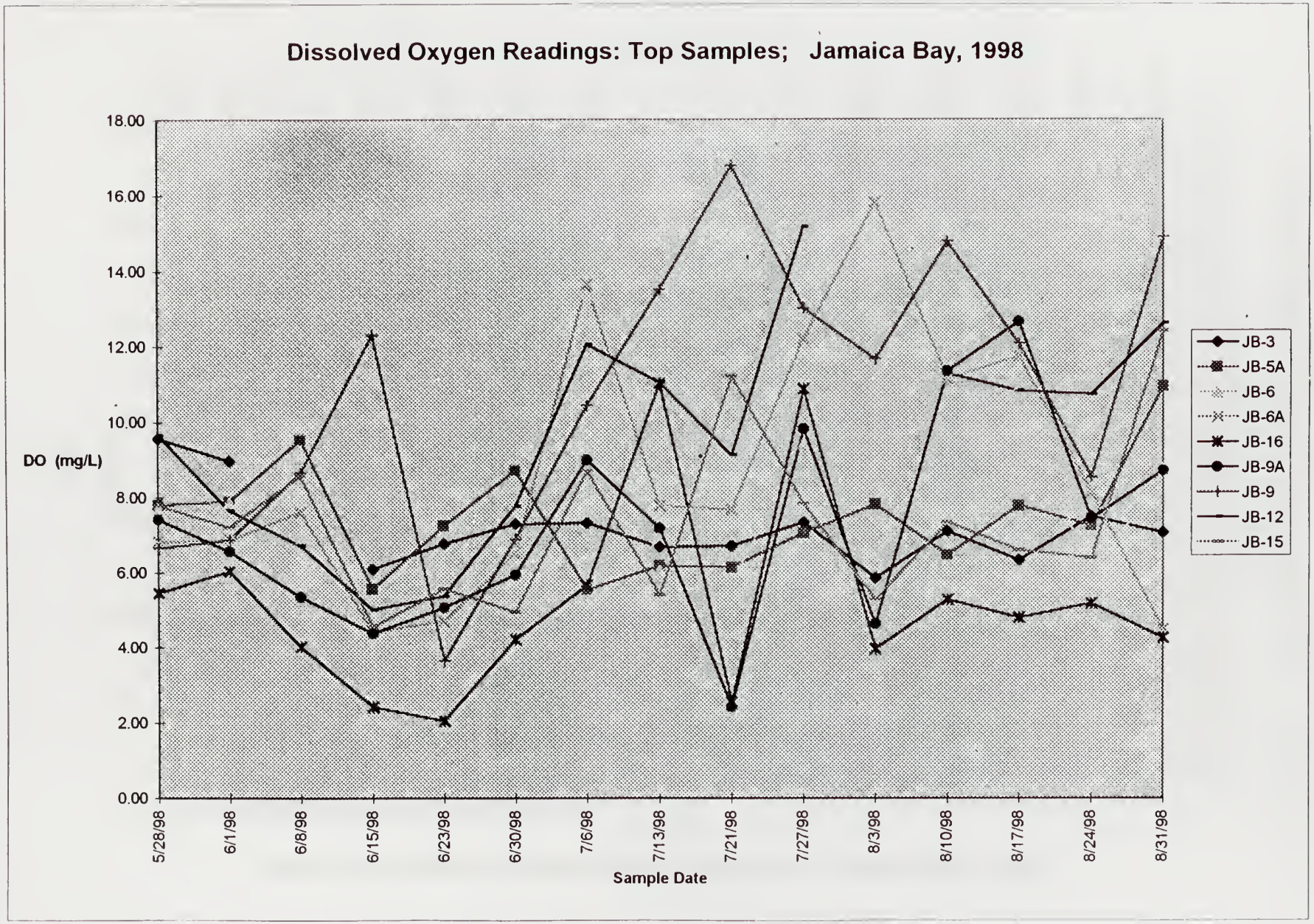

Dissolved Oxygen Readings: Top Samples; Jamaica Bay, 1998
DO (mg/L)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 64

Percentile of Dissolved Oxygen Exceeding Limits: Jamaica Bay, 1998

Percentile of Samples Exceeding 5.0 mg/L

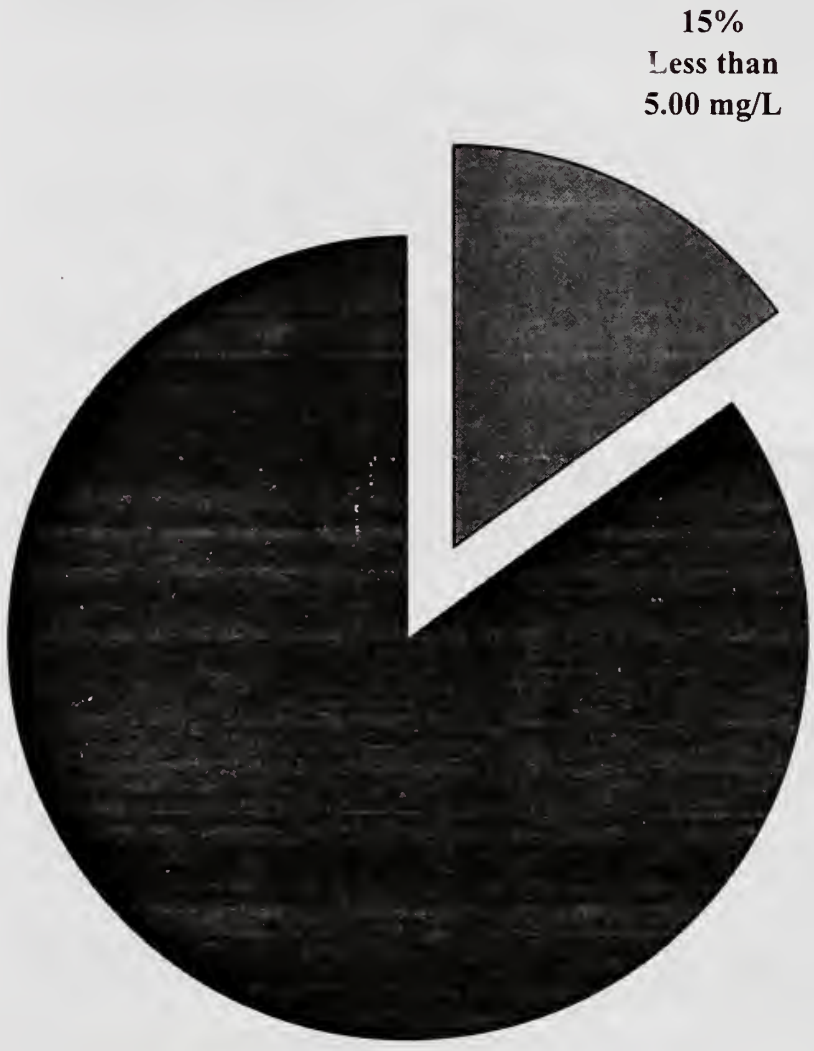


Table XXVI
Jamaica Bay Nitrates (mg/L), 1998

			Sample Dates	
Sample Location	Site	Depth	7/13/98	8/31/98
Rockaway Inlet	JB-3	Top	-----	0.17
		Bottom	0.02	0.09
Nova Scotia Bar	JB-5A	Top	0.20	0.20
		Bottom	-----	0.15
Canarsie Pier	JB-6	Top	0.00	0.19
		Bottom	0.11	0.24
Pennsylvania Avenue Landfill	JB-6A	Top	0.18	0.15
		Bottom	0.00	0.18
Bergen Basin	JB-16	Top	0.19	0.15
		Bottom	0.22	0.10
Bergen Basin Outflow	JB-9A	Top	0.27	0.21
		Bottom	0.20	0.10
Grassy Bay	JB-9	Top	0.26	0.11
		Bottom	0.24	0.15
JoCo Marsh	JB-12	Top	-----	0.16
		Bottom	0.03	0.09
Beach Channel	JB-15	Top	0.06	0.10
		Bottom	0.08	0.13

No other data available due to corruption of specimens on other sample weeks.

No Data = ----

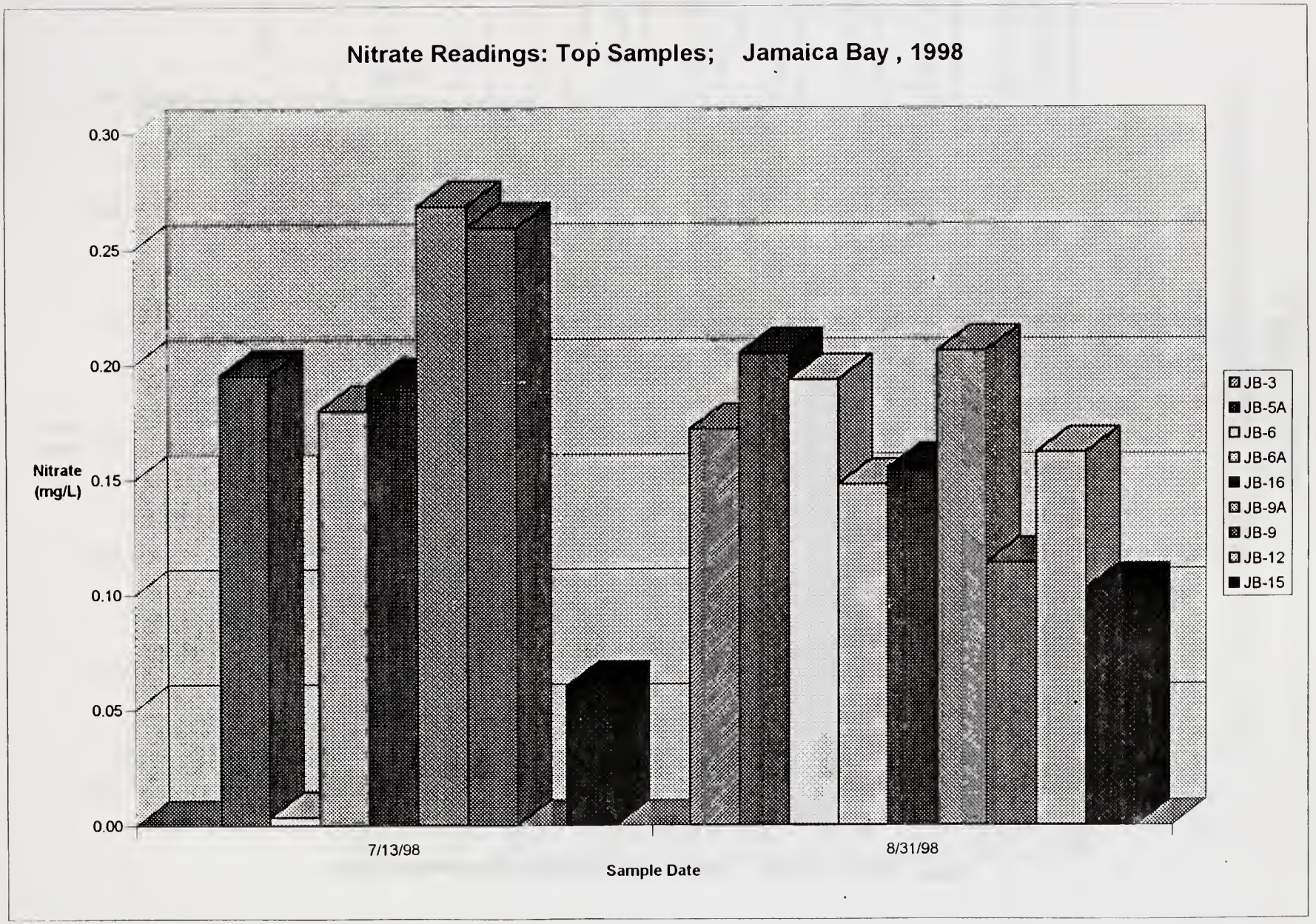

Nitrate Readings: Top Samples; Jamaica Bay , 1998
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Nitrate (mg/L)
7/13/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 67

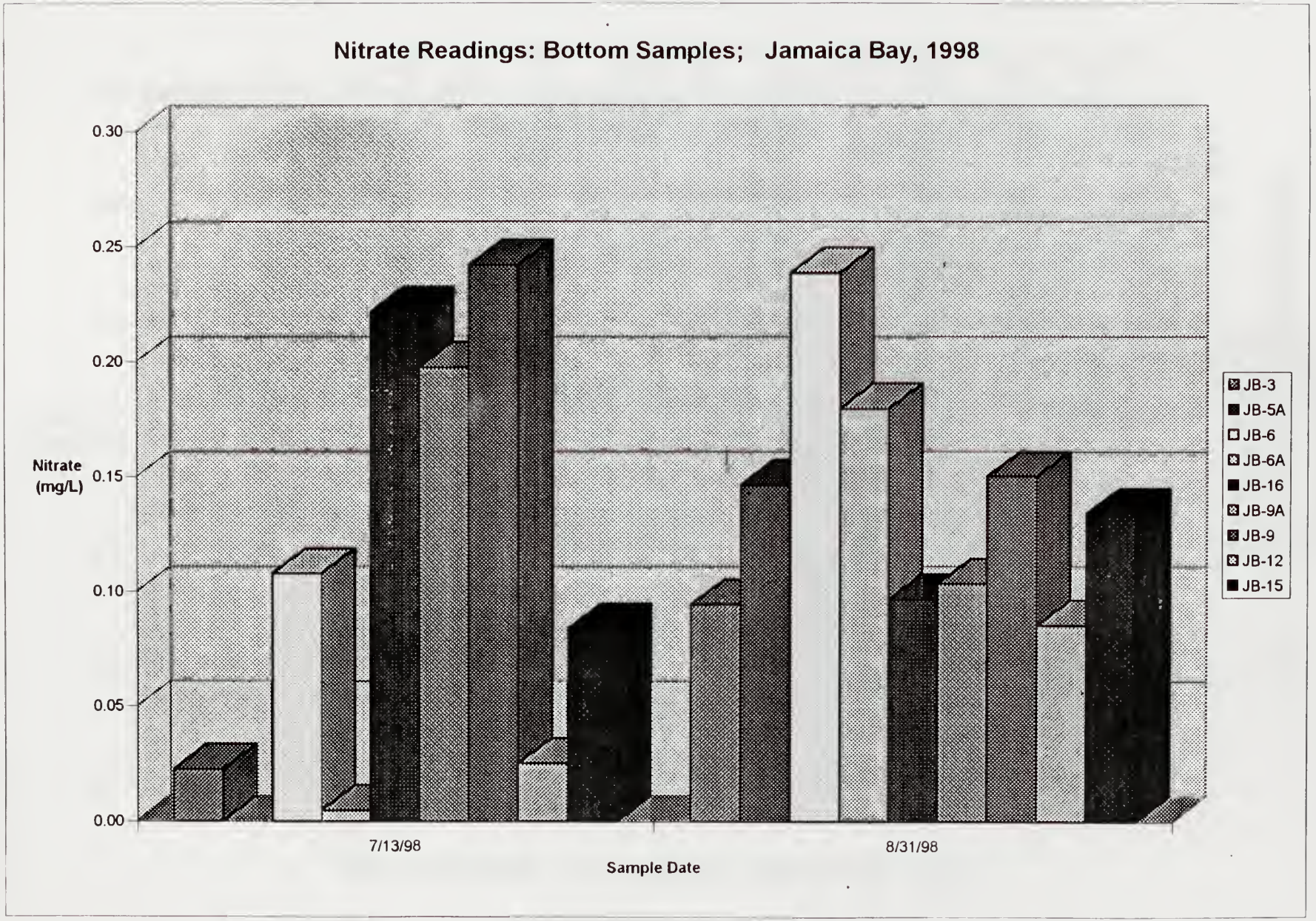

Nitrate Readings: Bottom Samples; Jamaica Bay, 1998
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Nitrate (mg/L)
7/13/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

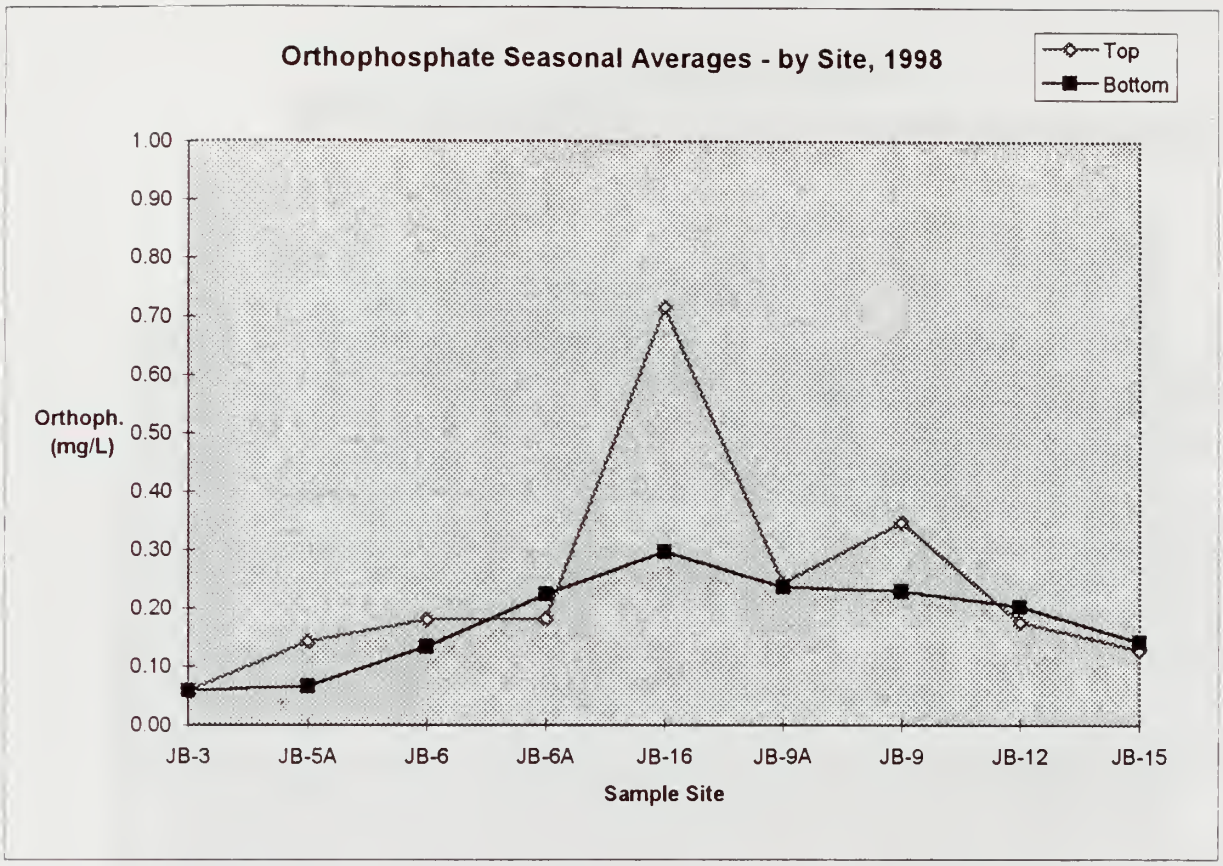
Figure 68

Table XXVII
Orthophosphates (mg/L), Jamaica Bay 1998

			Sample Dates					
Sample Location	Site	Depth	6/30/98	7/13/98	7/27/98	8/10/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	0.05	<0.01	0.08	0.02	0.05	0.15
		Bottom	0.06	<0.01	0.08	0.03	0.04	0.14
Nova Scotia Bar	JB-5A	Top	0.24	0.05	0.36	0.06	0.07	0.08
		Bottom	0.07	0.03	0.11	0.04	0.04	0.11
Canarsie Pier	JB-6	Top	0.19	0.11	0.29	0.13	0.20	0.16
		Bottom	0.09	0.10	0.14	0.13	0.19	0.15
Pennsylvania Avenue Landfill	JB-6A	Top	0.15	0.12	0.23	0.15	0.23	0.22
		Bottom	0.25	0.15	0.37	0.14	0.20	0.22
Bergen Basin	JB-16	Top	0.44	0.34	0.66	1.29	1.20	0.38
		Bottom	0.28	0.22	0.42	0.24	0.31	0.32
Bergen Basin Outflow	JB-9A	Top	0.20	0.17	0.30	0.16	0.29	0.35
		Bottom	0.19	0.17	0.29	0.17	0.29	0.30
Grassy Bay	JB-9	Top	0.28	0.14	0.43	0.40	0.68	0.15
		Bottom	0.22	0.13	0.33	0.21	0.26	0.23
JoCo Marsh	JB-12	Top	0.10	0.17	0.14	0.29	0.23	0.14
		Bottom	0.12	0.15	0.18	0.22	0.29	0.25
Beach Channel	JB-15	Top	0.12	0.10	0.19	0.12	0.15	0.09
		Bottom	0.15	0.07	0.23	0.13	0.15	0.11

No Data = ----

Jamaica Bay:
Orthophosphate Averages, 1998



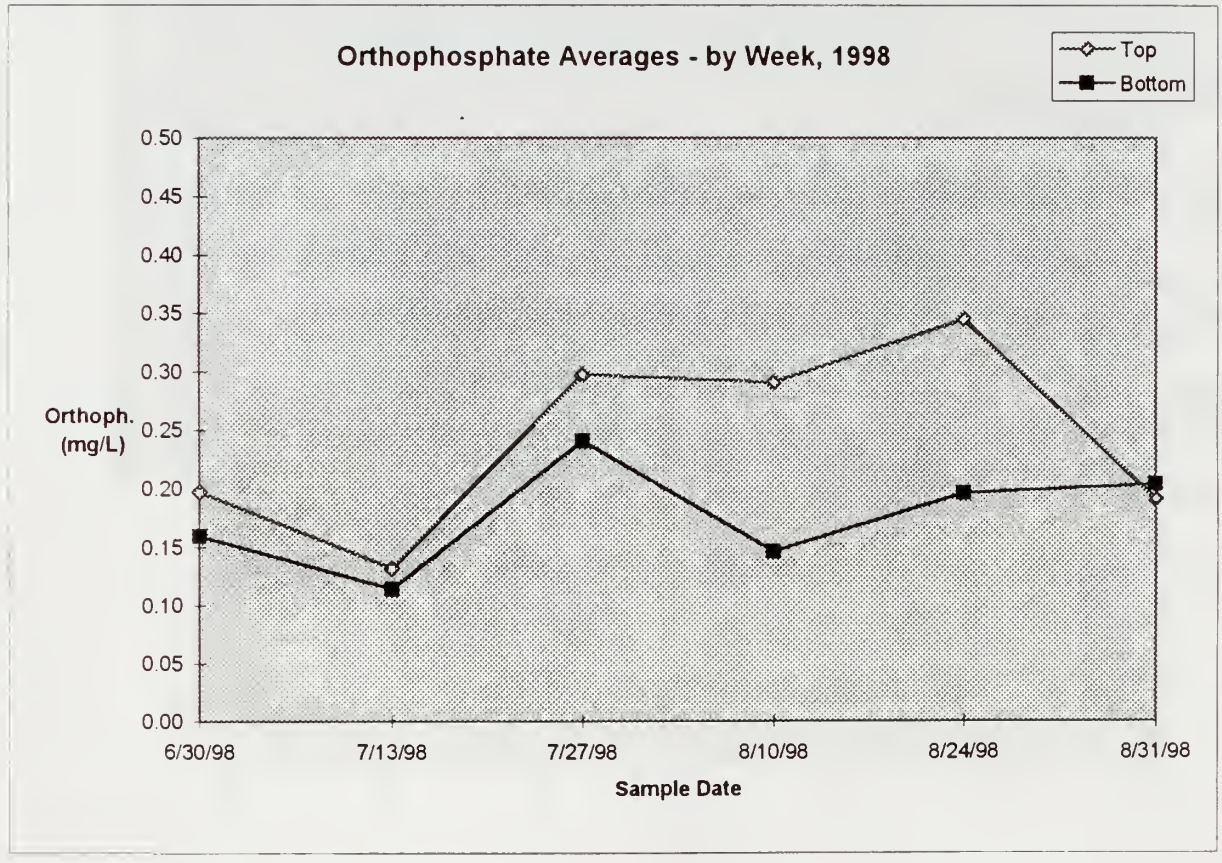


Figure 69

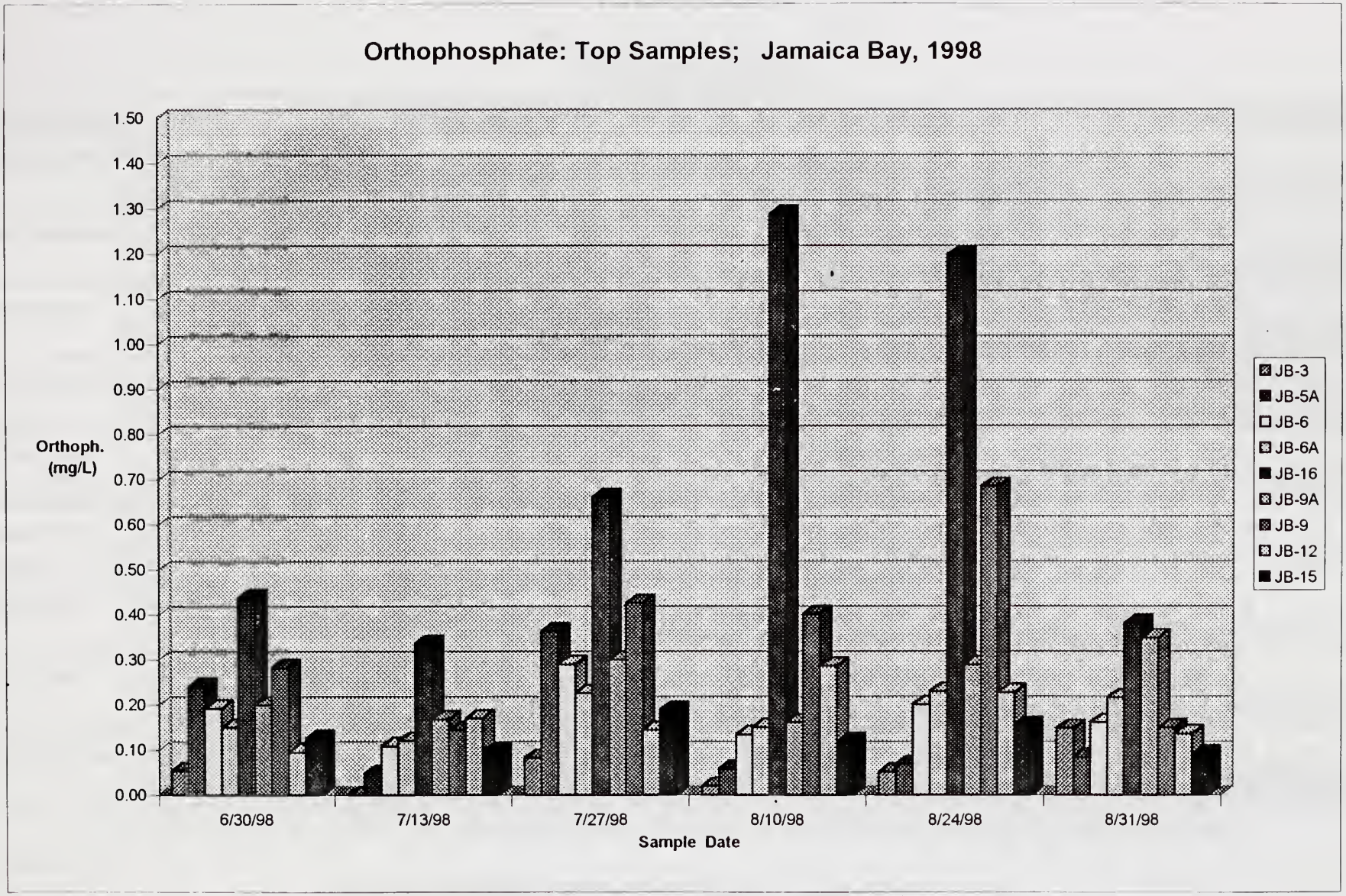

Orthophosphate: Top Samples; Jamaica Bay, 1998
Orthoph. (mg/L)
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
6/30/98
7/13/98
7/27/98
8/10/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 70

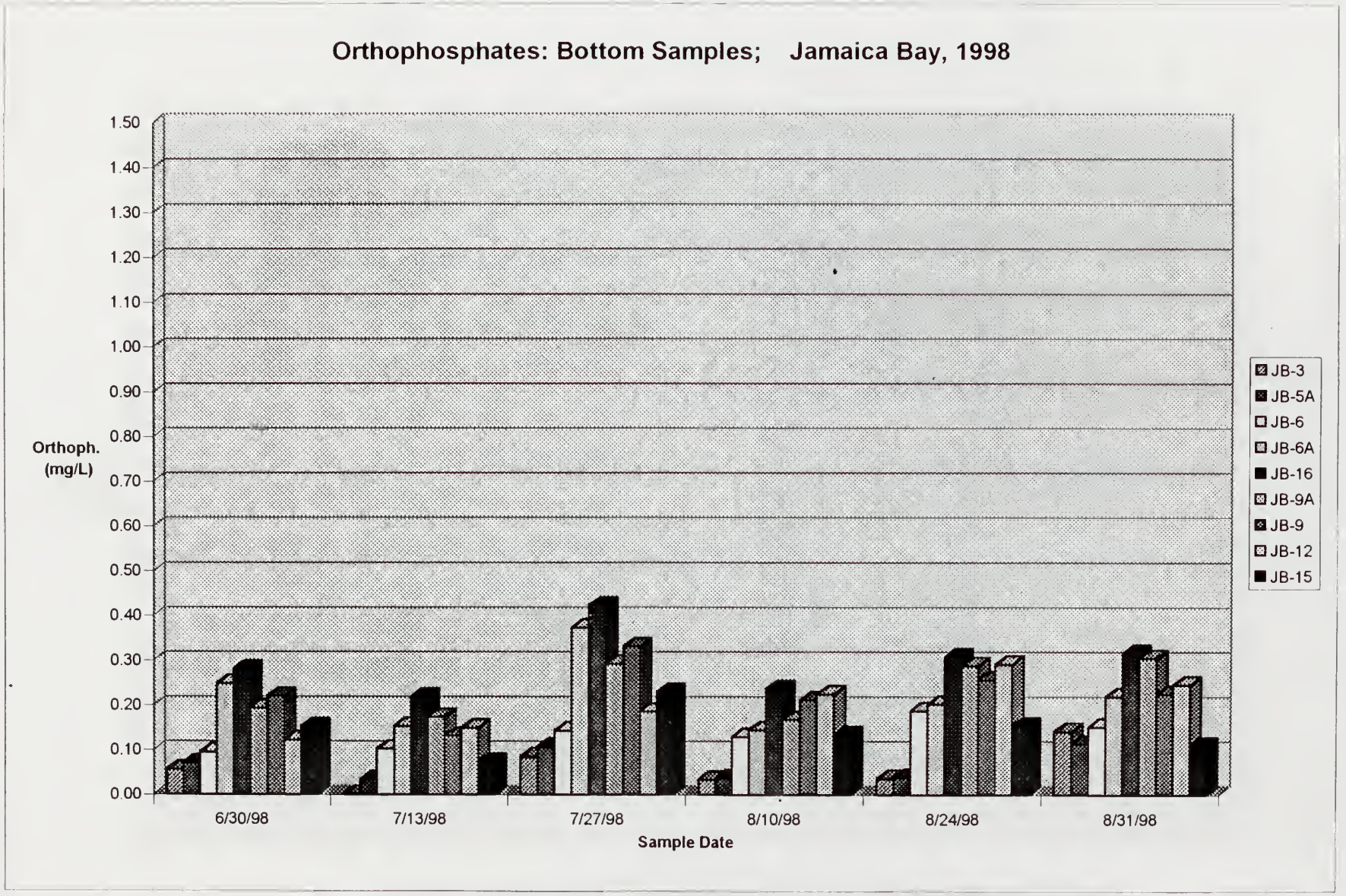

Orthophosphates: Bottom Samples; Jamaica Bay, 1998
Orthoph. (mg/L)
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
6/30/98
7/13/98
7/27/98
8/10/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

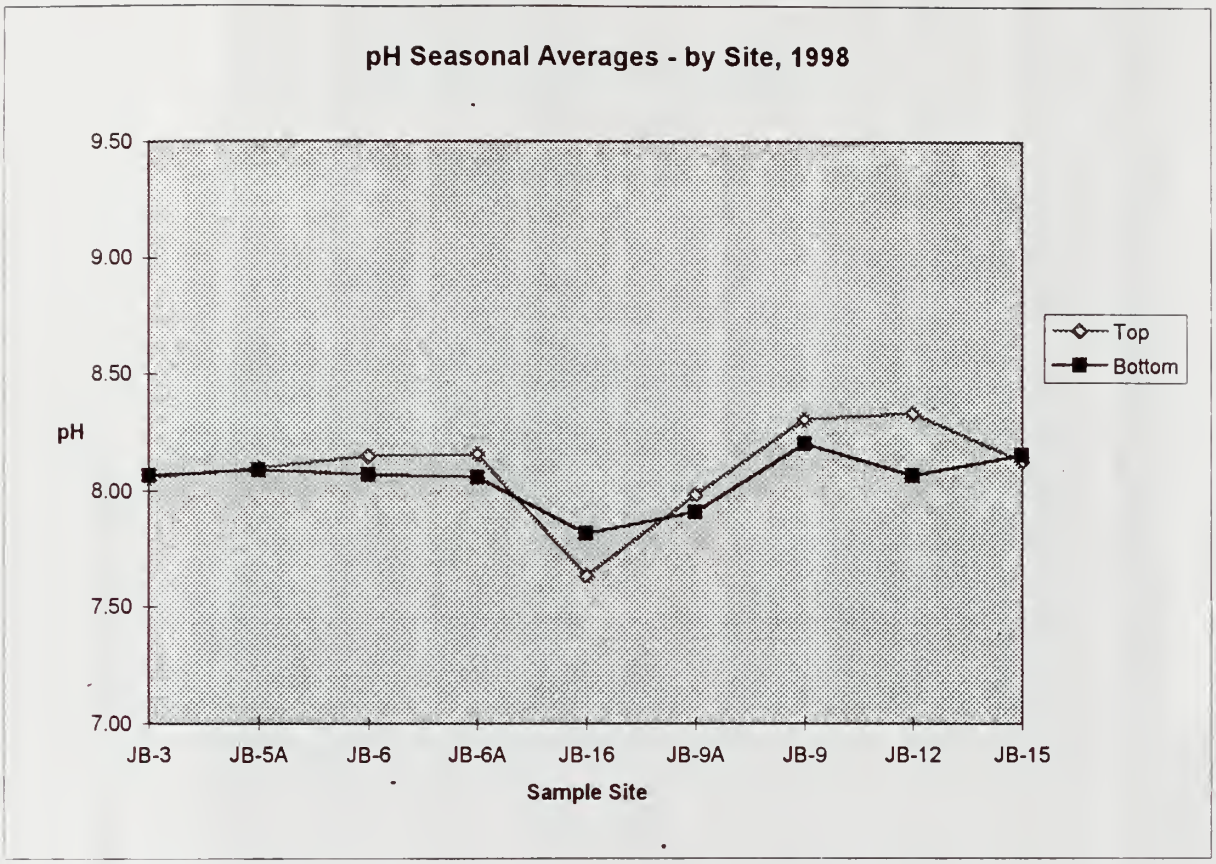
Figure 71

Table XXVIII
pH: Jamaica Bay, 1998

			Sample Dates														
Sample Location	Site	Depth	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	8.11	7.95	----	8.11	7.56	7.63	8.02	7.69	8.16	8.22	8.10	8.47	8.28	8.29	8.19
		Bottom	8.16	7.98	----	8.12	7.63	7.64	8.02	7.70	8.17	8.31	8.08	8.45	8.24	8.32	8.09
Nova Scotia Bar	JB-5A	Top	7.99	7.96	8.38	7.87	7.50	7.65	8.18	7.65	8.10	8.25	8.34	8.36	8.48	8.27	8.50
		Bottom	8.07	7.94	8.35	7.89	7.54	7.65	8.14	7.64	8.13	8.23	8.21	8.43	8.45	8.35	8.31
Canarsie Pier	JB-6	Top	8.07	8.04	8.20	7.85	7.39	7.70	8.20	7.72	8.13	8.43	8.70	8.53	8.70	8.17	8.40
		Bottom	8.03	8.00	8.17	7.86	7.41	7.67	7.97	7.70	8.18	8.32	8.31	8.52	8.48	8.19	8.26
Pennsylvania Ave Landfill	JB-6A	Top	7.97	8.12	8.19	7.81	7.24	7.65	8.17	7.87	8.27	8.58	8.87	8.70	8.72	8.24	7.96
		Bottom	8.01	8.00	8.18	7.82	7.26	7.70	8.16	7.77	8.04	8.36	8.32	8.57	8.69	8.17	7.85
Bergen Basin	JB-16	Top	7.76	8.05	7.57	7.36	7.00	7.28	7.35	7.88	7.54	8.20	7.65	7.76	7.84	7.68	7.61
		Bottom	7.76	7.95	8.07	7.73	7.14	7.48	7.45	7.57	7.83	8.17	7.95	8.31	8.06	7.96	7.80
Bergen Basin Outflow	JB-9A	Top	8.02	8.16	7.80	7.78	7.37	7.49	7.99	7.85	7.56	8.39	7.67	8.68	8.72	8.24	8.01
		Bottom	7.91	7.87	8.10	7.78	7.36	7.46	8.06	7.66	7.81	8.30	7.90	8.54		8.04	7.92
Grassy Bay	JB-9	Top	7.79	8.02	8.43	8.63	7.31	7.42	8.24	8.30	8.88	8.48	8.53	8.78	8.76	8.35	8.71
		Bottom	7.81	8.04	8.43	8.51	7.31	7.49	8.01	8.20	8.80	8.52	8.29	8.42	8.57	8.39	8.24
JoCo Marsh	JB-12	Top	8.16	8.05	8.29	7.96	7.41	7.71	8.43	8.16	8.47	8.75	9.21	8.75	8.62	8.47	8.57
		Bottom	7.98	7.91	8.26	7.88	7.31	7.74	8.12	7.93	8.11	8.35	8.39	8.33	8.57	7.94	8.17
Beach Channel	JB-15	Top	8.04	8.05	8.43	7.87	7.54	7.67	8.23	7.70	8.22	8.32	8.14	8.47	8.43	8.21	8.62
		Bottom	8.03	8.01	8.41	7.90	7.42	7.68	8.17	7.65	8.10	8.29	9.20	8.46	8.41	8.19	8.42

No Data = ----

Jamaica Bay:
pH Averages, 1998



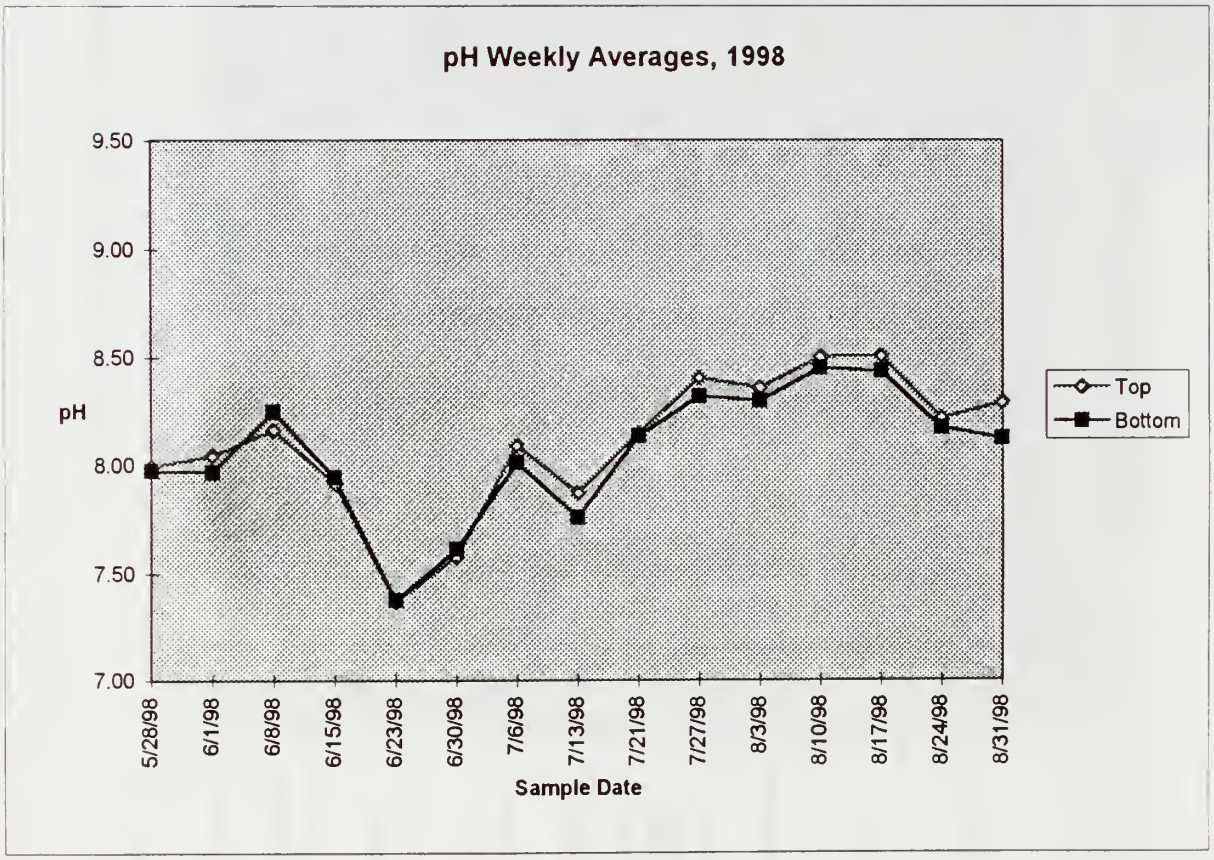


Figure 72

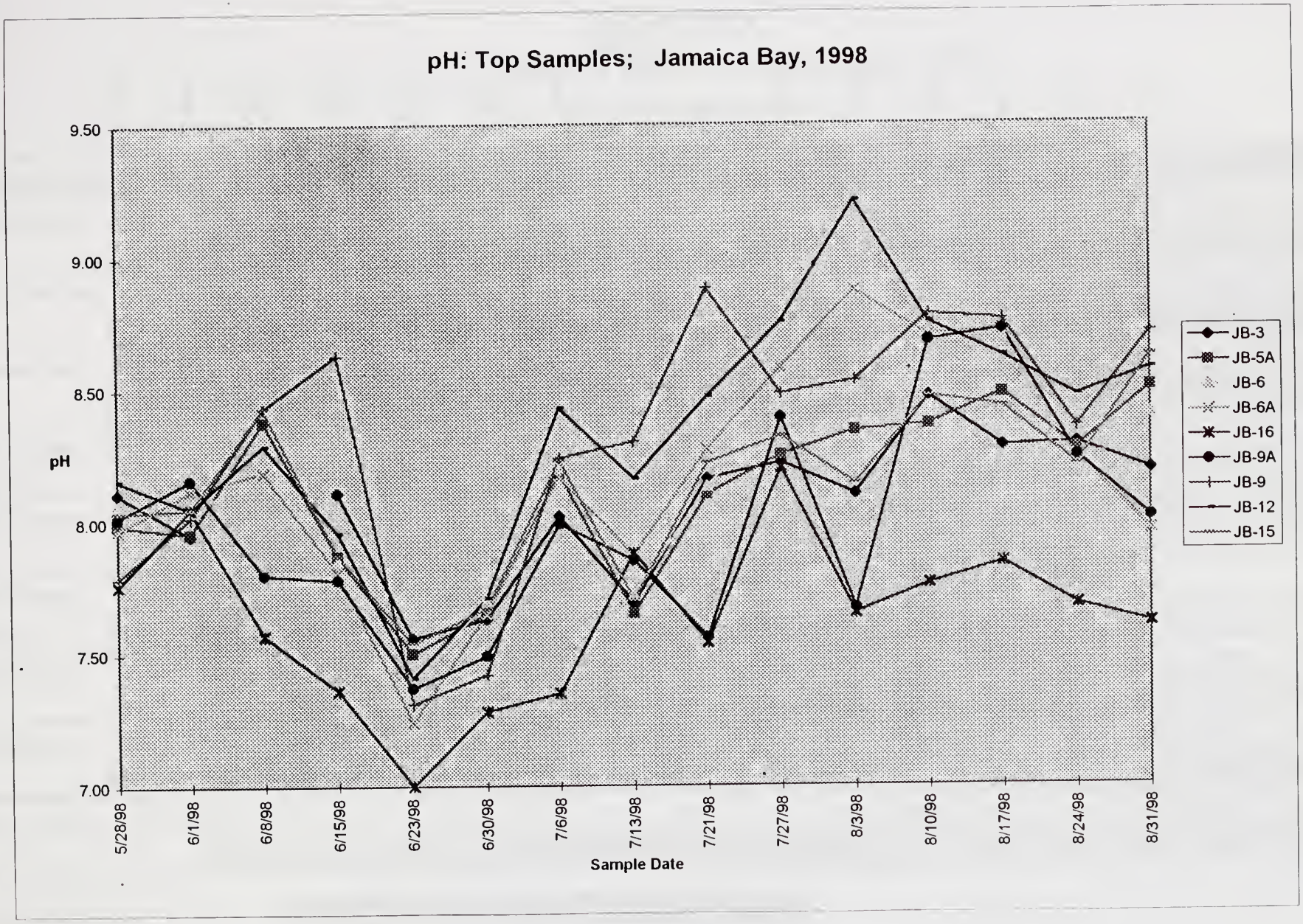

pH: Top Samples; Jamaica Bay, 1998
9.50
9.00
8.50
8.00
7.50
7.00
pH
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 73

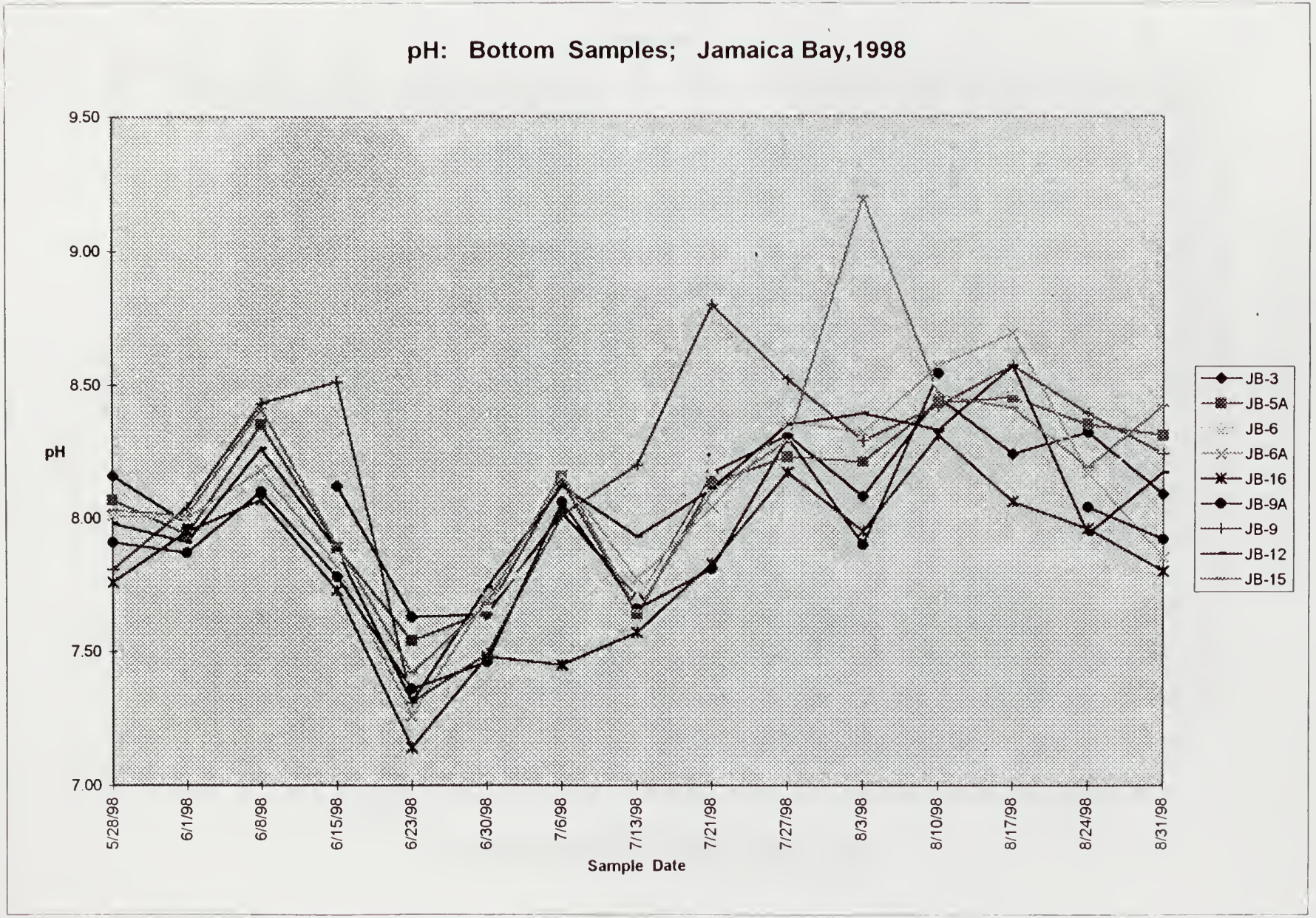

pH: Bottom Samples; Jamaica Bay,1998
9.50
9.00
8.50
8.00
7.50
7.00
pH
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 74

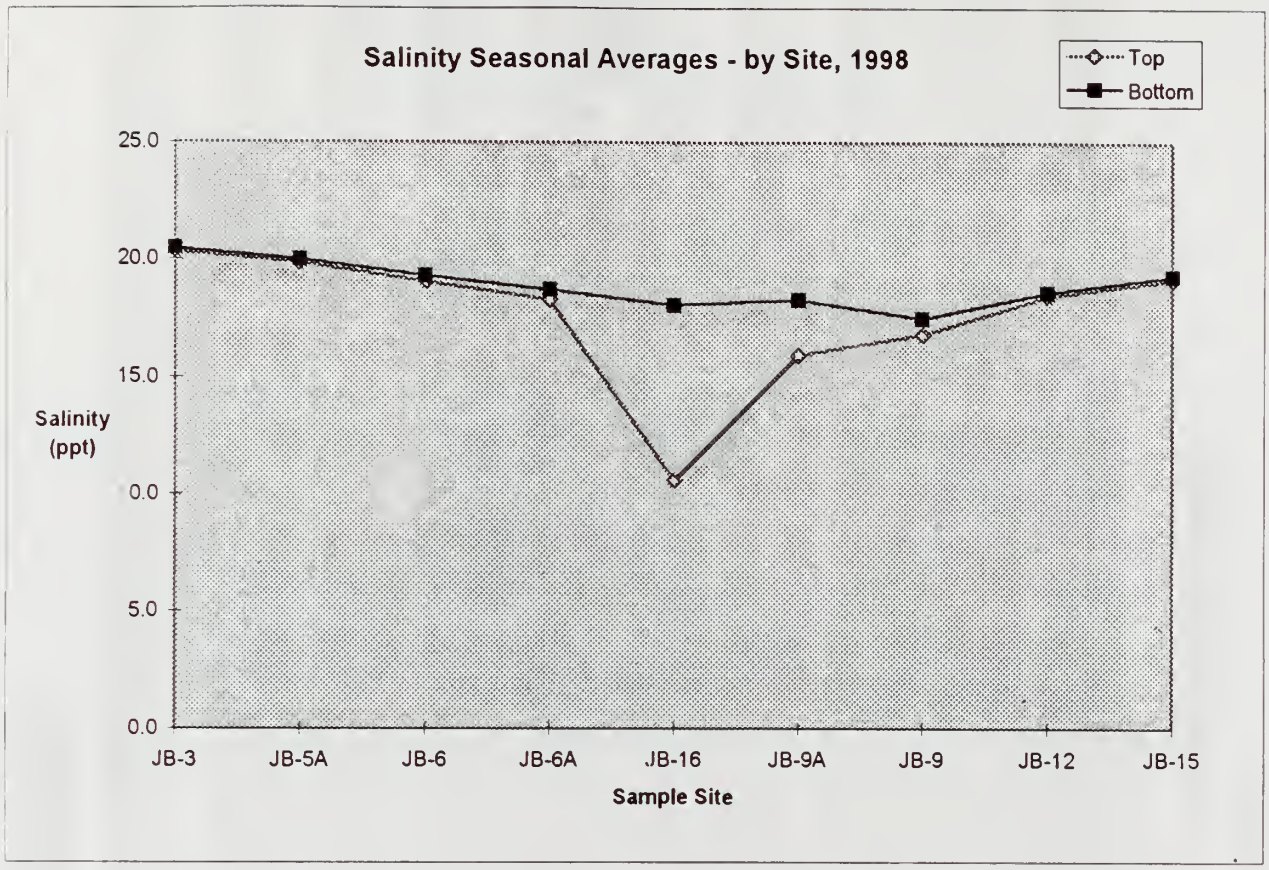
Table XXIX
Salinity (ppt): Jamaica Bay 1998

			Sample Dates													
Sample Location	Site	Depth	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	19.6	18.4	----	19.7	21.6	19.6	20.7	21.3	20.5	20.9	20.3	21.2	20.0	20.8	19.6
		Bottom	19.8	19.0	----	19.7	21.5	19.7	20.7	21.4	20.4	21.6	19.4	21.3	20.7	21.0	20.0
Nova Scotia Bar	JB-5A	Top	18.6	18.4	18.1	18.5	20.5	20.8	20.0	20.3	20.1	21.0	19.9	20.7	20.0	20.6	19.8
		Bottom	19.4	18.3	18.1	18.5	20.7	20.6	20.1	20.4	20.5	21.0	20.1	21.1	20.1	20.8	19.9
Canarsie Pier	JB-6	Top	17.7	17.5	18.1	17.5	19.2	19.9	19.3	19.5	19.2	20.0	19.4	19.7	19.0	19.8	19.2
		Bottom	18.0	18.0	18.1	18.0	19.8	20.0	19.7	19.6	18.9	20.2	19.8	19.9	19.6	19.8	19.7
Pennsylvania Ave	JB-6A	Top	17.0	13.7	17.7	16.8	18.7	19.5	19.0	18.8	18.7	19.3	18.9	19.2	18.5	18.8	19.2
Landfill		Bottom	17.6	17.2	17.9	17.3	19.0	19.0	18.1	19.0	19.1	19.8	19.5	19.4	18.5	19.6	19.2
Bergen Basin	JB-16	Top	14.9	12.0	8.9	11.9	6.4	13.7	10.7	14.1	8.4	13.3	8.3	7.7	10.0	8.7	9.6
		Bottom	16.5	16.5	16.9	16.8	18.1	17.9	18.9	18.3	18.4	18.4	19.0	18.5	18.8	18.6	18.8
Bergen Basin	JB-9A	Top	16.2	15.1	13.5	15.7	18.4	18.0	17.6	18.2	9.3	18.5	9.3	19.0	17.8	18.6	13.6
Outflow		Bottom	16.7	16.9	17.0	17.0	18.6	18.8	18.5	18.6	18.1	19.0	18.9	19.0	19.0	18.9	18.8
Grassy Bay	JB-9	Top	14.0	16.2	16.6	16.3	18.6	13.7	18.5	18.0	17.7	15.4	17.7	17.1	18.9	14.6	18.5
		Bottom	14.5	16.2	16.5	16.3	18.6	14.5	18.5	18.0	17.8	18.5	17.9	19.0	18.8	18.4	18.4
JoCo Marsh	JB-12	Top	16.5	16.9	17.2	16.2	18.1	19.3	19.0	18.6	18.8	19.4	19.0	19.3	19.6	19.1	19.3
		Bottom	17.0	17.1	15.9	17.5	19.3	19.2	19.1	18.6	18.9	19.3	19.4	19.5	19.6	19.3	19.2
Beach Channel	JB-15	Top	18.0	17.4	17.3	18.1	19.1	20.5	19.2	19.7	18.7	19.7	19.5	20.1	20.0	19.9	19.5
		Bottom	18.1	18.1	17.3	18.1	19.6	20.4	19.1	20.0	19.0	20.3	19.7	20.0	20.0	19.9	19.7

No Data = ----

Black cells indicate salinity values of less than 10 ppt

Jamaica Bay:
Salinity Averages, 1998



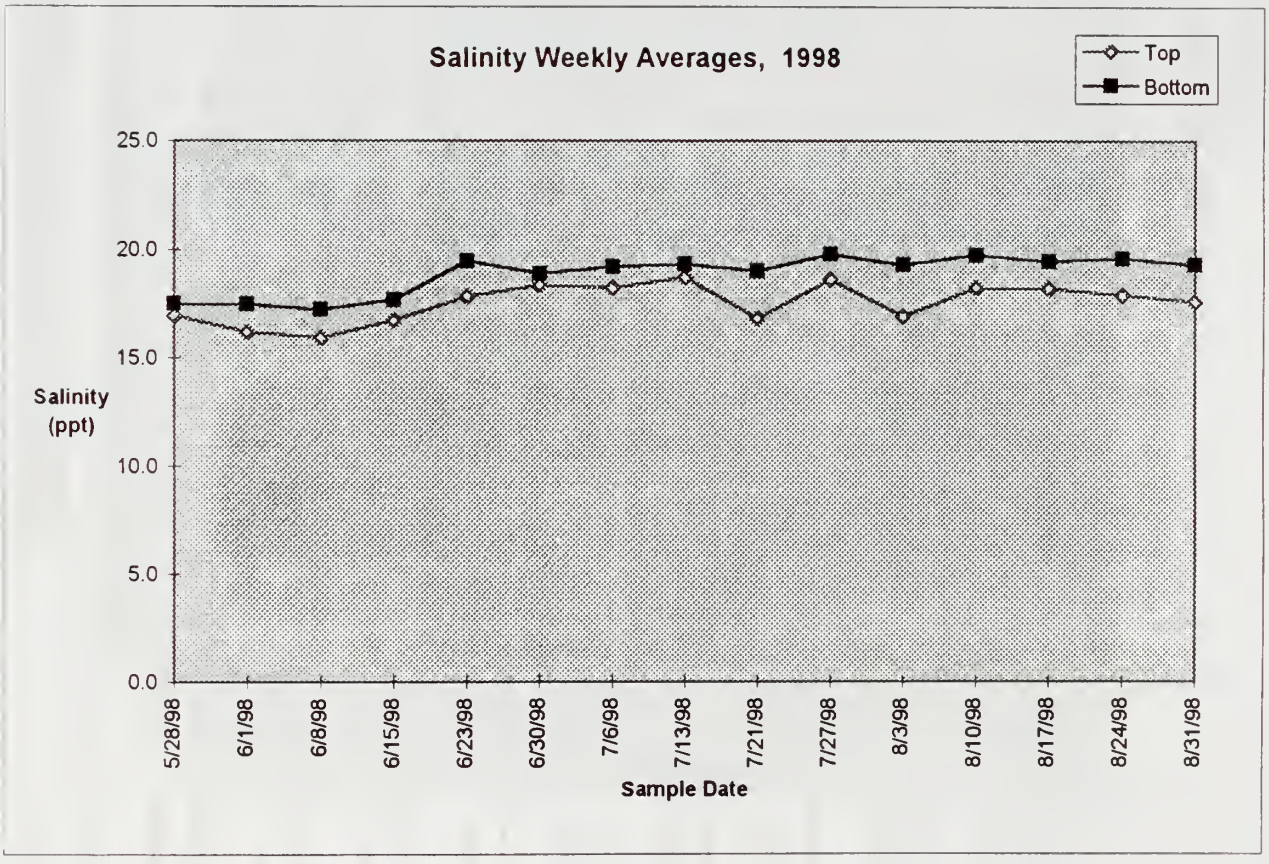


Figure 75

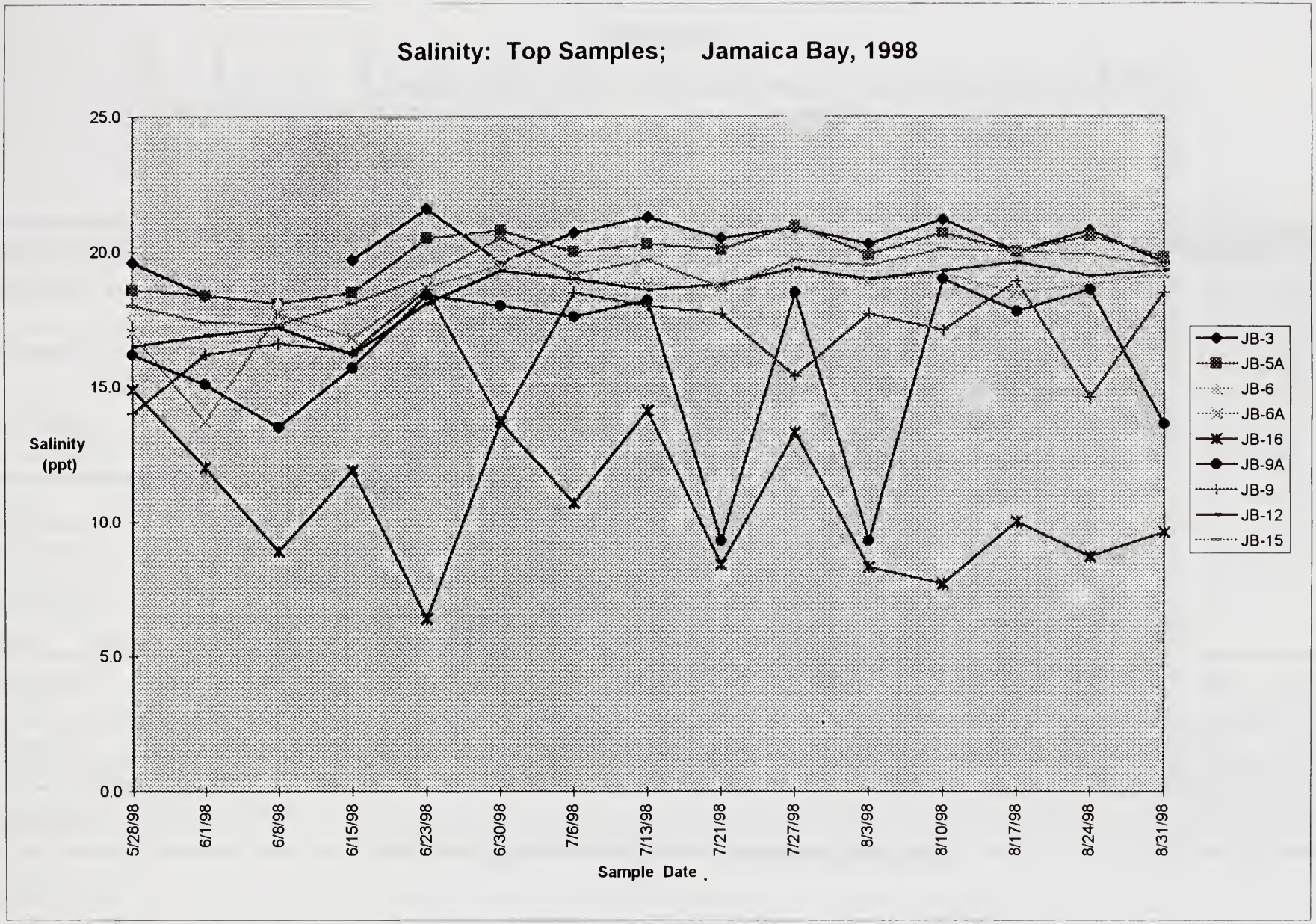

Salinity: Top Samples; Jamaica Bay, 1998
25.0
20.0
15.0
10.0
5.0
0.0
Salinity (ppt)
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 76

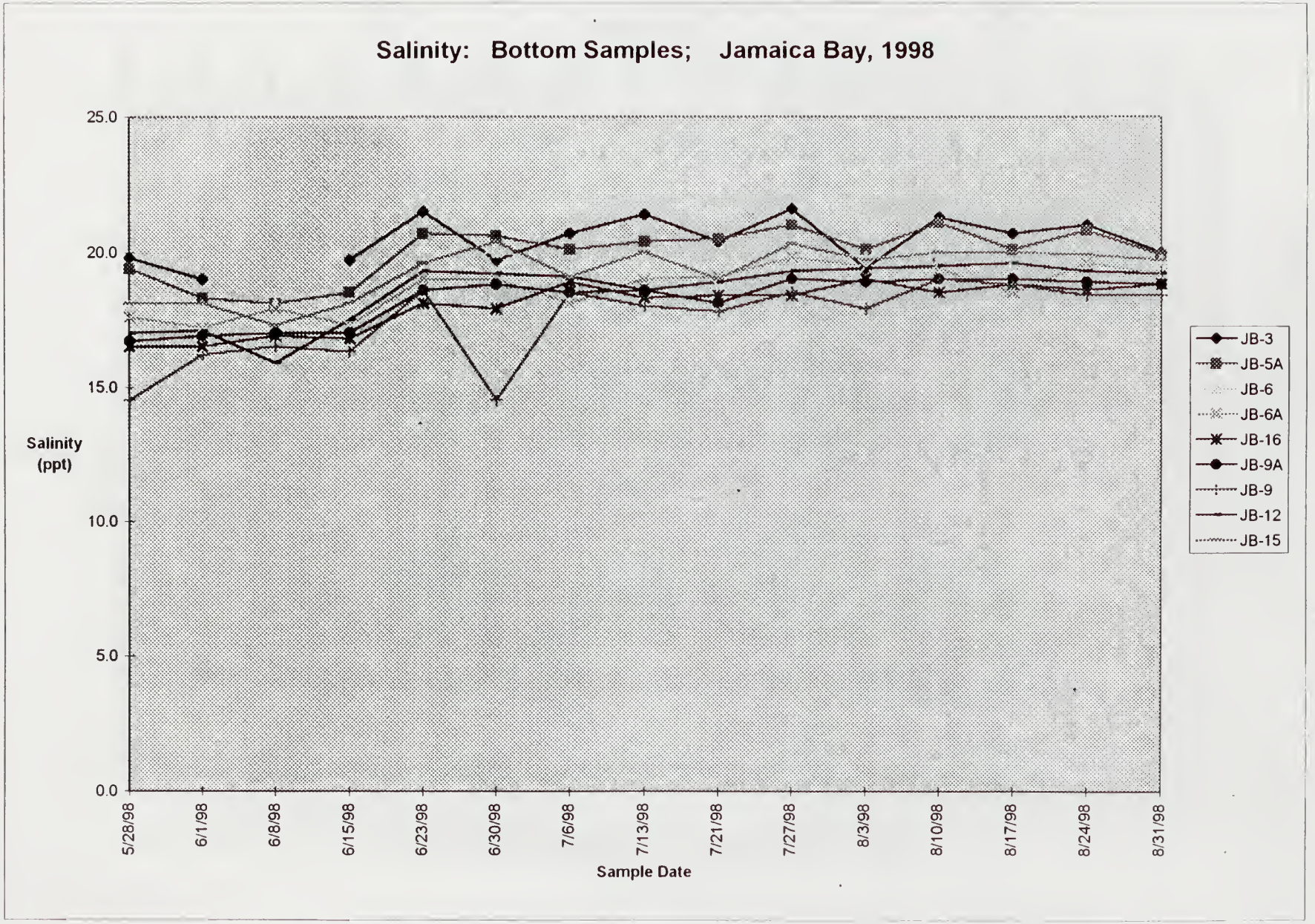

Salinity: Bottom Samples; Jamaica Bay, 1998
25.0
20.0
15.0
10.0
5.0
0.0
Salinity (ppt)
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

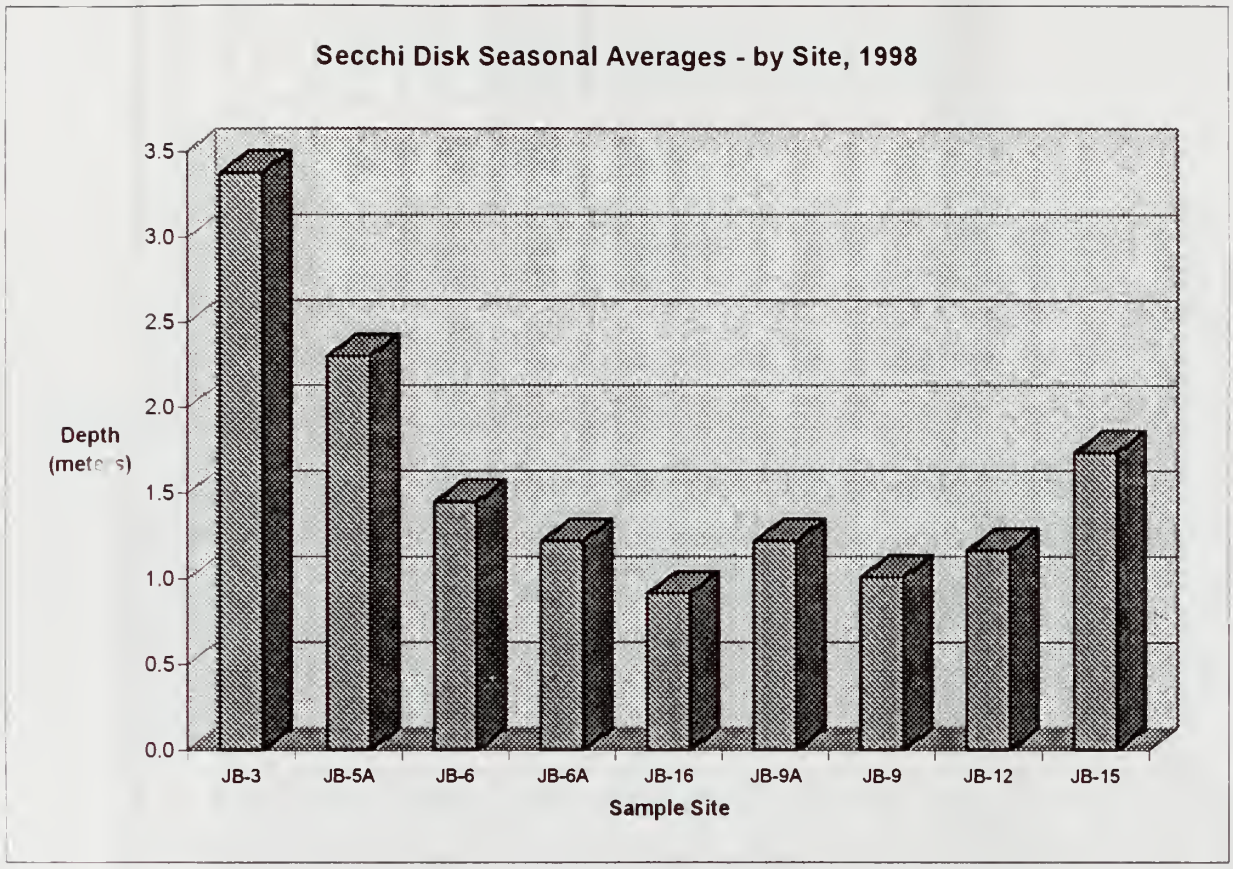
Figure 59

Table XXX
Secchi Disk Readings (meters): Jamaica Bay 1998

		Sample Dates														
Sample Location	Site	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	5.1	3.3	-----	2.5	3.5	2.8	2.5	3.2	3.3	3.9	3.3	4.2	2.8	4.5	2.3
Nova Scotia Bar	JB-5A	2.7	2.2	1.6	3.3	2.8	2.5	1.1	2.7	2.6	2.8	1.4	2.9	1.3	3.3	1.3
Canarsie Pier	JB-6	1.6	1.8	1.8	1.9	1.8	1.4	1.2	1.4	1.8	1.3	0.4	1.3	1.0	1.7	1.3
Pennsylvania Ave Landfill	JB-6A	1.7	1.2	1.2	1.7	1.7	1.3	1.0	1.4	1.3	1.1	0.5	0.9	1.0	1.1	1.2
Bergen Basin	JB-16	1.4	0.7	0.8	1.3	0.8	0.8	0.9	0.8	0.9	0.8	1.3	0.6	0.7	0.9	1.0
Bergen Basin Outflow	JB-9A	1.6	1.2	1.2	1.7	1.3	1.2	1.3	1.3	1.2	1.2	1.3	0.8	0.9	1.1	1.0
Grassy Bay	JB-9	1.3	1.8	1.1	0.3	2.0	0.9	1.2	0.8	0.7	0.9	1.2	0.7	0.6	0.7	0.9
JoCo Marsh	JB-12	1.5	1.6	1.9	2.0	1.4	1.2	0.9	0.9	1.3	0.8	0.2	0.8	0.8	1.0	1.2
Beach Channel	JB-15	2.1	1.8	1.5	2.3	2.2	1.7	1.2	2.2	1.7	1.7	1.8	1.7	1.3	1.7	1.1

No Data: -----

Jamaica Bay:
Secchi Disk Averages, 1998



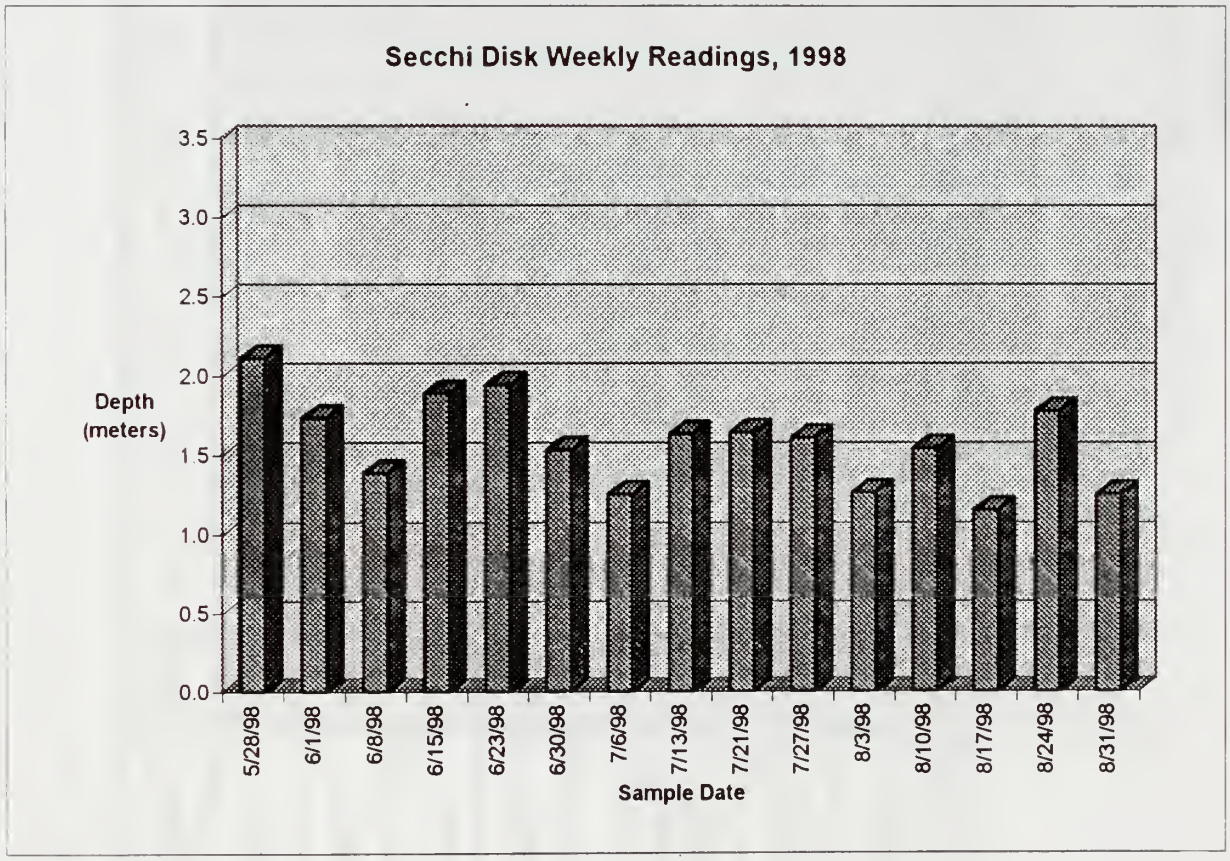


Figure 78

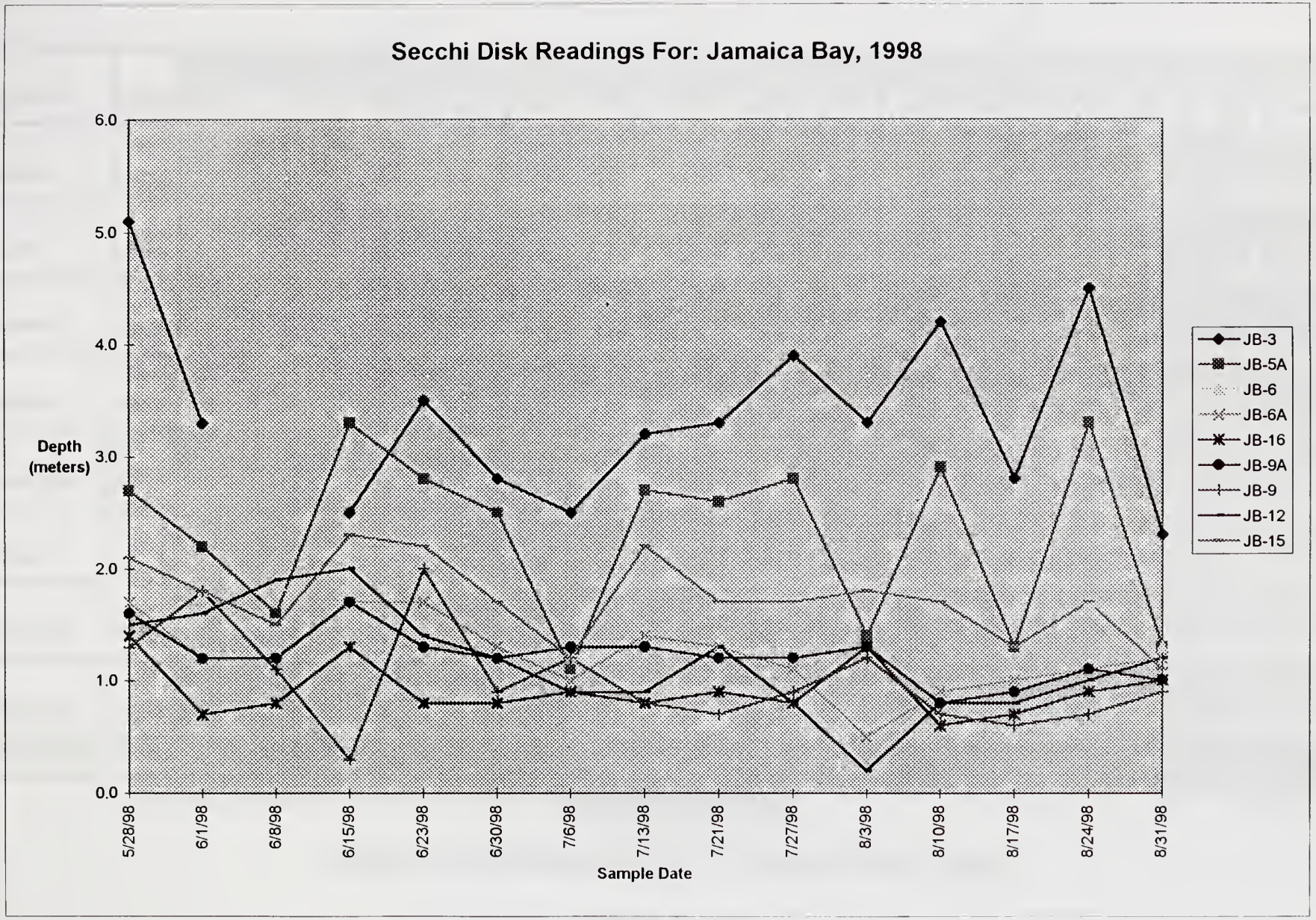

Secchi Disk Readings For: Jamaica Bay, 1998
Depth (meters)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 79

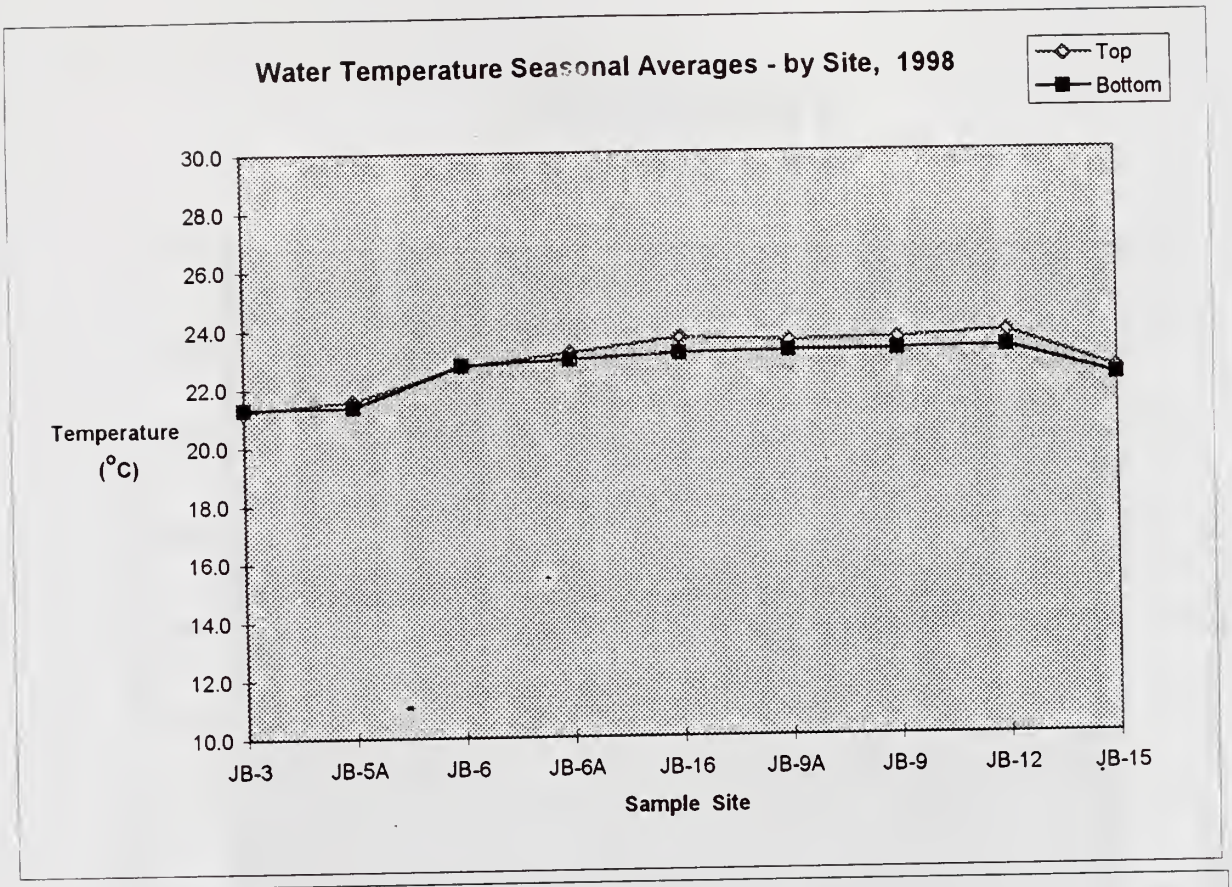
Table XXXI

Water Temperature (°C): Jamaica Bay, 1998

			Sample Dates													
Sample Location	Site	Depth	5/28/98	6/1/98	6/8/98	6/15/98	6/23/98	6/30/98	7/6/98	7/13/98	7/21/98	7/27/98	8/3/98	8/10/98	8/17/98	8/24/98	8/31/98
Rockaway Inlet	JB-3	Top	14.3	18.8	----	16.3	20.0	20.9	19.9	19.7	22.8	21.5	23.2	25.2	25.4	23.9	25.4
		Bottom	14.5	----	----	16.2	20.0	20.9	20.0	19.4	22.6	21.6	22.7	25.0	25.2	23.8	25.0
Nova Scotia Bar	JB-5A	Top	15.6	18.6	16.1	17.0	20.3	21.7	22.0	20.7	23.2	22.9	24.2	25.0	25.9	24.2	25.7
		Bottom	14.8	----	16.0	17.2	20.2	21.7	21.3	20.5	22.0	22.3	23.3	25.0	25.6	23.8	25.2
Canarsie Pier	JB-6	Top	18.1	----	16.4	17.6	21.6	22.9	22.3	22.1	24.7	24.4	24.9	25.8	26.3	24.8	25.8
		Bottom	17.2	----	16.2	17.3	21.3	27.7	21.7	22.0	24.9	23.9	24.3	25.6	25.7	24.8	25.6
Pennsylvania Ave	JB-6A	Top	19.3	18.8	16.8	18.4	22.0	23.1	23.1	23.6	25.5	25.0	25.8	26.3	26.9	26.0	26.4
Landfill		Bottom	18.1	----	16.6	17.8	21.8	23.0	22.8	22.7	24.8	24.4	24.7	26.1	26.8	25.2	26.1
Bergen Basin	JB-16	Top	19.9	20.8	19.3	19.3	21.2	22.6	23.5	25.0	25.4	26.0	25.7	26.8	27.0	25.9	26.0
		Bottom	18.7	----	17.9	18.4	21.7	22.2	22.7	23.3	25.3	25.1	24.8	26.3	25.8	25.4	25.8
Bergen Basin	JB-9A	Top	20.0	19.1	18.6	18.8	22.0	23.3	23.5	23.6	25.9	25.7	26.3	26.6	26.8	25.7	26.5
Outflow		Bottom	18.9	----	17.7	18.2	21.9	23.2	23.1	23.1	25.0	25.1	24.9	26.2	25.9	25.2	25.9
Grassy Bay	JB-9	Top	20.7	18.9	17.8	19.4	21.7	22.6	23.5	24.4	26.6	25.5	25.9	26.8	26.5	26.3	27.0
		Bottom	20.3	18.8	17.6	19.1	21.6	22.0	22.9	24.8	26.7	25.1	24.9	26.0	26.1	25.7	26.2
JoCo Marsh	JB-12	Top	20.1	20.2	17.7	18.8	21.7	23.3	23.9	24.2	27.0	25.9	27.0	26.7	27.0	26.4	26.7
		Bottom	18.6	----	17.7	17.8	21.6	23.0	23.1	23.7	25.5	25.2	25.1	26.0	26.8	25.2	26.3
Beach Channel	JB-15	Top	17.5	19.3	17.1	17.3	21.4	22.3	23.2	22.1	26.0	24.0	24.3	25.7	25.8	24.8	26.1
		Bottom	17.6	18.7	16.8	17.2	21.4	22.1	23.1	21.8	25.5	23.7	24.0	25.7	25.7	24.8	25.6

No Data = ----

Jamaica Bay:
Water Temperature Averages, 1998



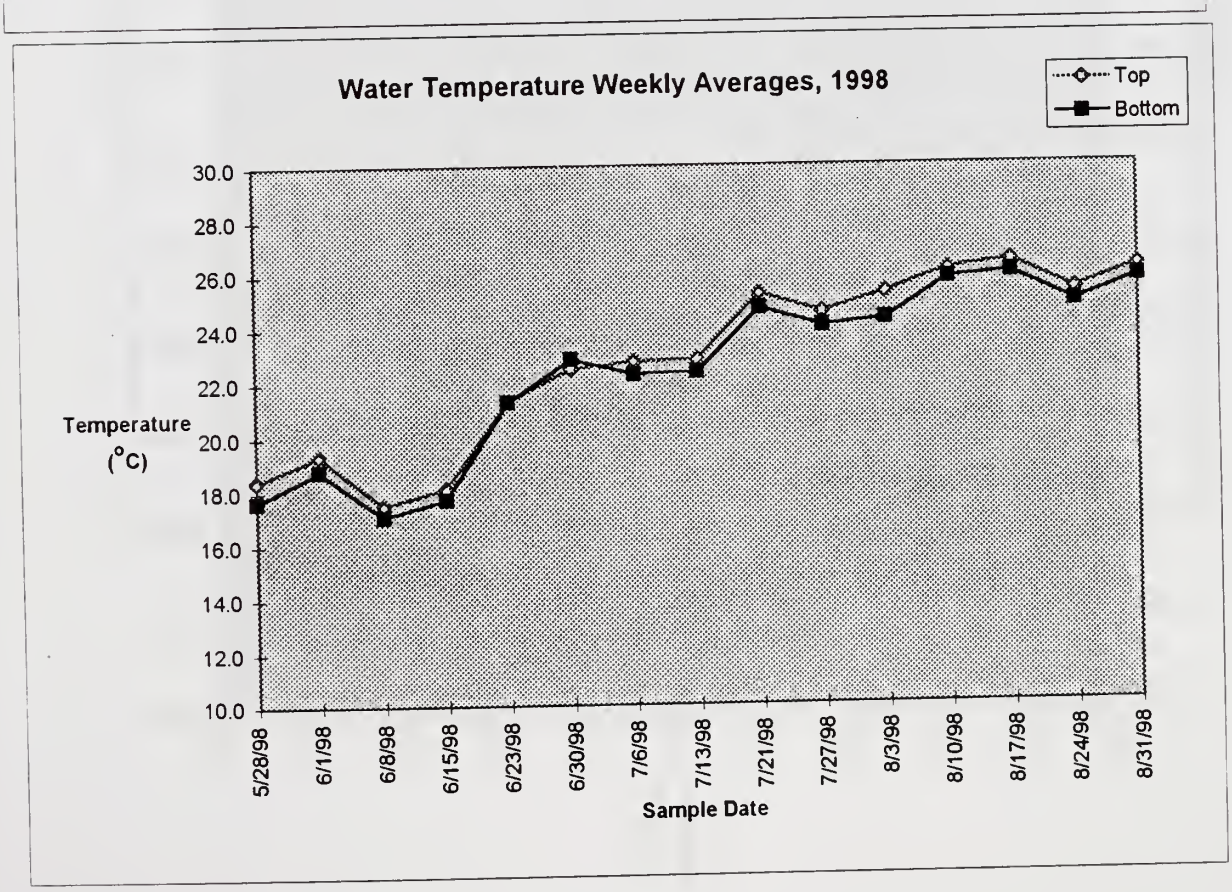


Figure 80

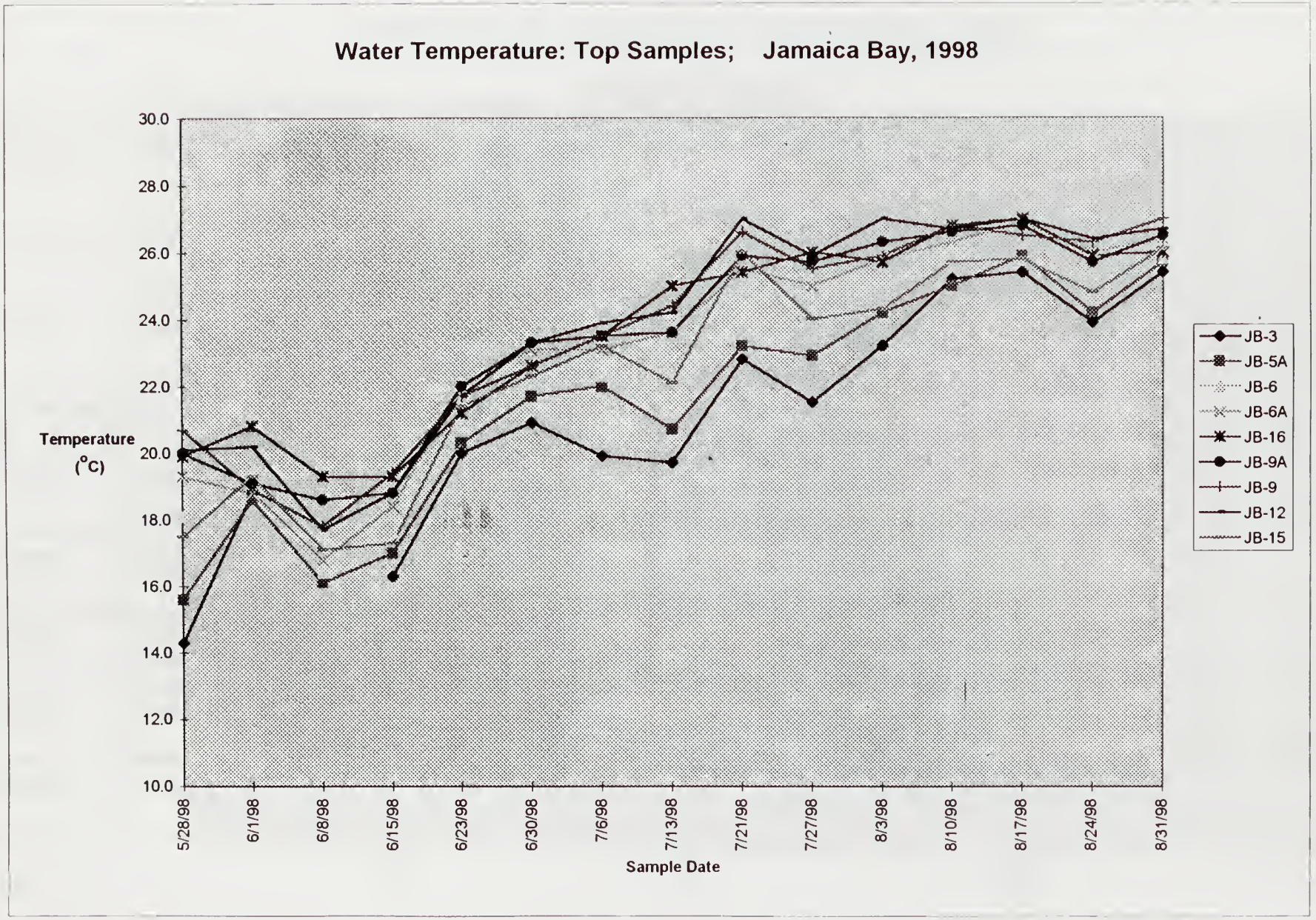

Water Temperature: Top Samples; Jamaica Bay, 1998
Temperature (°C)
30.0
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 81

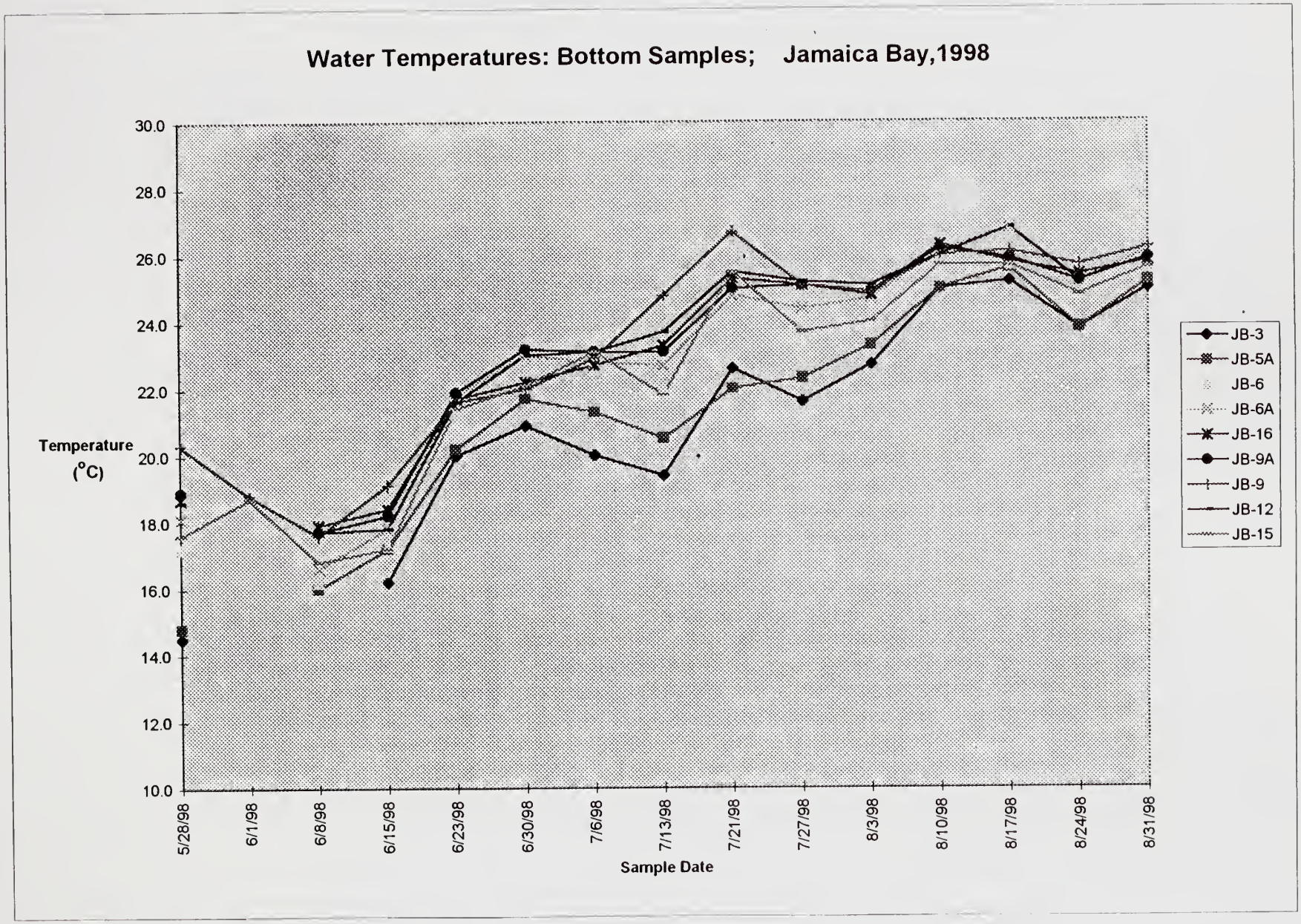

Water Temperatures: Bottom Samples; Jamaica Bay,1998
Temperature (°C)
30.0
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
5/28/98
6/1/98
6/8/98
6/15/98
6/23/98
6/30/98
7/6/98
7/13/98
7/21/98
7/27/98
8/3/98
8/10/98
8/17/98
8/24/98
8/31/98
Sample Date
JB-3
JB-5A
JB-6
JB-6A
JB-16
JB-9A
JB-9
JB-12
JB-15

Figure 82

United States Department of the Interior

NATIONAL PARK SERVICE

Gateway National Recreation Area

Directorate Cultural/Natural Resources
Fort Wadsworth
Building 210 Rm. 2506
Staten Island Unit
Staten Island, New York 10305