2005 New York Harbor Water Quality Report

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Michael R. Bloomberg, Mayor
Emily Lloyd, Commissioner

2006 New York Harbor Water Quality Report

The 2006 New York Harbor Water Quality Report marks the 97th year of comprehensive water quality monitoring in New York Harbor. This year's data demonstrates the continued flourishing of critical Harbor ecosystems and overall aquatic health. Key indicators show that the Harbor is currently at its cleanest level in over a century.

Though this achievement is significant, further progress is necessary to ensure that the Harbor and its many tributaries remain robust, integral components of New York's landscape for generations to come.

That is why I have made water quality improvement one of my ten sustainability goals for the City. As part of PlaNYC's strategic vision for the New York City's future, we will work to enhance aquatic health, so that 90% of City waterways will be viable for recreation by 2030 and New York's many residents and visitors can enjoy the iconic natural features that have defined the City's history and growth for centuries.

I encourage all New Yorkers to review this detailed account of New York Harbor's biological health in order to appreciate the dramatic improvements in water quality made in recent decades and to learn more about the many projects that will guide the City toward further improvements in the future.

Sincerely,
Michael R. Bloomberg
Mayor

The New York City Department of Environmental Protection is proud to present this year's Harbor Water Quality Report, which documents continued improvements to the health and vitality of New York's waterways. These achievements reflect the continued success of DEP's extensive pollution control programs and comprehensive upgrades to our wastewater treatment infrastructure.

Despite these successes, combined sewer overflows (CSOs) continue to impact the Harbor's aquatic health. DEP's Ten-Year Capital Investment Strategy calls for continued upgrades to key wastewater treatment facilities, storm sewer expansions and the construction of several, large CSO retention tanks to further mitigate this chronic source of pollution. Existing infrastructure developments have already increased DEP's CSO capture rate from 30% in 1980 to 70%, and this rate is expected to increase again, to 75%, once all current construction is complete.

To supplement this extensive infrastructure and further enhance CSO capture rates, DEP is beginning to identify new, comprehensive engineering solutions and develop innovative and sustainable storm water management techniques, known as best management practices. These techniques will allow DEP to meet the water quality goals set by Mayor Bloomberg as part of his PlaNYC initiative and open 90% of New York's waterways to recreation by the year 2030.

I hope you will find this report useful and informative. DEP is proud of the consistent improvements to aquatic health in the Harbor, and appreciates your interest in our continuing efforts to further enhance the health of New York's waterways and meet the Mayor's ambitious but achievable goal for 2030.

Sincerely,
Emily Lloyd,
Commissioner

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Table of Contents

Introduction 4

Inner Harbor Area

- Fecal Coliform 6
- Dissolved Oxygen 7
- Chlorophyll a 8
- Secchi Transparency 9

Upper East River - Western Long Island Sound

- Fecal Coliform 10
- Dissolved Oxygen 11
- Chlorophyll a 12
- Secchi Transparency 13

Jamaica Bay

- Fecal Coliform 14
- Dissolved Oxygen 15
- Chlorophyll a 16
- Secchi Transparency 17

Lower New York Bay-Raritan Bay

- Fecal Coliform 18
- Dissolved Oxygen 19
- Chlorophyll a 20
- Secchi Transparency 21

Harbor-Wide Improvements 22

Harbor-Wide Quality Improvements

- Fecal Coliform 23
- Dissolved Oxygen 24
- Chlorophyll a 25

2006 NYC DEP Harbor Survey Stations 26

NYCDEP Water Pollution Control Plants and CSOs 27

Acknowledgments 28

Introduction

The City of New York has been collecting water quality data in New York Harbor since 1909. These data are utilized by regulators, scientists, educators and citizens to assess impacts, trends and improvements in the water quality of New York Harbor.

The Harbor Survey Program has been the responsibility of the New York City Department of Environmental Protection's (NYCDEP) Marine Sciences Section (MSS) for the past 22 years. This effort evolved from the initial surveys by the Metropolitan Sewerage Commission that began 98 years ago and encompassed 12 stations around Manhattan. These initial surveys were performed in response to public complaints about their quality of life near polluted waterways. The initial effort has grown into a Survey that consists of 62 stations; 35 stations located throughout the open waters of the Harbor, and upwards of 27 stations located in smaller tributaries within the City. The number of water quality parameters measured has also increased from five in 1909 to over 20 at present.

Harbor water quality has improved dramatically since the initial surveys. Infrastructure improvements and the capture and treatment of virtually all dry-weather sewage are the primary reasons for this improvement. During the last decade, water quality in NY harbor has improved to the point that the waters are now utilized for recreation and commerce throughout the year. Still, there remain areas within the harbor that are impaired.

The NYCDEP's Long Term Control Program (LTCP) has begun to focus on those areas within the harbor that remain impacted. This project will look at 18 waterbodies and their drainage basins and will develop a comprehensive plan for each waterbody.

This year's Harbor Survey report will focus on the water quality data collected by the NYCDEP during 2006. Data will be presented in four sections, each delineating a geographic region within the Harbor.

The Harbor Survey is in the midst of a transition in the way these data will be presented. The Survey is transitioning to a geographic information system (GIS) that will allow for more accurate maps and more detailed analyses. The Survey is also working on a data distribution system that should allow a more streamlined method of displaying and accessing both historical and current data generated by the program.

This brief synopsis examines trends of four major indicators of environmental change in the Harbor Estuary. These four indicators are:

Fecal Coliform (FC) Bacteria - Fecal coliform concentrations are measured in NY Harbor as human-health related indicators of sewage-related pollution. Fecal coliform are a group of bacteria primarily found in human and animal intestines and are associated with sewage waste. These bacteria are widely used as indicator organisms to show the presence of such wastes in water and the possible presence of pathogenic (disease-producing) bacteria.

Chlorophyll a - Chlorophyll a is a plant pigment. The concentration of chlorophyll a in water is used as an estimate of productivity or phytoplankton abundance.

Phytoplankton, minute free-floating aquatic plants, form the basis of the food web. Since these organisms respond quickly to environmental changes, their abundance may serve as a measure of water quality and an indicator of greater ecosystem change.

The Harbor Survey measures chlorophyll a (as a surrogate for phytoplankton) to provide an assessment of ecosystem health. Levels above 20 ug/L are considered indicative of enriched or eutrophic conditions, indicating a decline in water quality.

Dissolved Oxygen (DO) - The levels of oxygen dissolved in the water column are critical for respiration of most aquatic life forms, including fish and invertebrates, such as crabs, clams, zooplankton, etc. Dissolved oxygen concentration is therefore one of the most universal indicators of overall water quality and a means of determining habitat and ecosystem conditions.

Secchi Transparency - A Secchi disk is used to estimate the clarity of surface waters. High Secchi transparency (greater than 5 feet) is indicative of clear water, with declines in transparency typically due to high suspended solid concentrations or plankton blooms. Low Secchi readings (less than 3 feet) are typically associated with degraded waters. These conditions are indicative of light limiting conditions, which in turn affect primary productivity and nutrient cycling.

Coliform and dissolved oxygen indicators are used in New York State Department of Environmental Conservation (NYS DEC) standards, to quantify ecosystem health or degradation. NYS DEC standards reflect a range of acceptable water quality conditions corresponding to the State-designated "best usage" of the water body. Common uses and NYS DEC standards for fecal coliform and dissolved oxygen are noted in the adjacent chart.

Common Water Use And NYS DEC Standards For Fresh And Saline Waters

Class	Best Usage of Waters	Fecal Coliform	Dissolved Oxygen (never-less-than)
SA	Shellfishing and all other recreational use.	_	5.0 mg/L
SB	Bathing and other recreational use	Monthly geometric mean less than or equal to 200 cells/100mL from 5 or more samples	5.0 mg/L
I	Fishing or boating	Monthly geometric mean less than or equal to 2,000 cells/100mL from 5 or more samples	4.0 mg/L
SD	Fish survival	No standard	3.0 mg/L

Inner Harbor Area

The Inner Harbor is defined as the area including: the Hudson River from the NYC-Westchester line, through the Battery to the Verrazano Narrows; the Lower East River to the Battery; and the Kill Van Kull-Arthur Kill system. This area contains 13 Harbor Survey monitoring stations that have been grouped together due to common water uses and functions, as well as similarities in point source loadings. Waters of the Inner Harbor are often continuous, through connecting branches or straits, and cover a large and diverse geographic expanse.

Most of the Inner Harbor Area, excluding the Kills, is classified by NYS DEC as I, for uses such as fishing or boating. Most area in the Kills is classified for fish survival only (SD), with the exception of the far southern reach of Arthur Kill which is designated as Class I. The Hudson River, from North of Spuyten Duyvil to Westchester County is designated for bathing (SB).

Fecal Coliform

Sanitary water quality as estimated by fecal coliform (FC) concentrations was superior for the Inner Harbor in the Summer of 2006. The regional summer mean is 36 cells/100mL, increased slightly from 26 cells/100mL in 2005. All Inner Harbor Area monitoring sites complied with monthly FC Standards of 200 cells/100mL. Only three sites had geometric means greater than 100 cells/100mL.

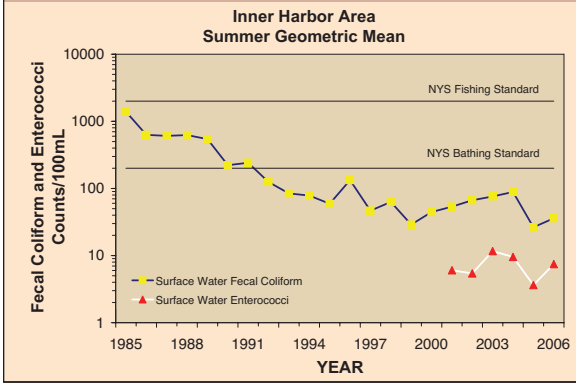
Past data has indicated that the Inner Harbor is prone to episodic degradation following rain events due to additional FC loadings from storm drains and combined sewer overflows (CSOs). Under these conditions, all sites exceeded the SB standard 200 cells/100mL.

Note: Wet Weather advisories for certain beaches in this region may still be issued by NYCDOH under certain conditions for rainfall amounts and duration after the rain event. The NYCDOH website provides details.

TRENDS

Fecal coliform levels in the Inner Harbor have dramatically declined over the last three decades. The levels are well below the Bathing Standard. The averaged FC counts have declined from 2000 cells/100mL in the early 70s to below 100 cells/100mL since early 1990. This improvement has allowed for the opening of Inner Harbor waters for most recreational activities. This improvement has been attributed to the treatment of virtually all dry-weather sewage, the elimination of illegal discharges into the waterbody, and the reduction of CSOs. Year to year variations have become more apparent with the reduction of FC to levels below standards.

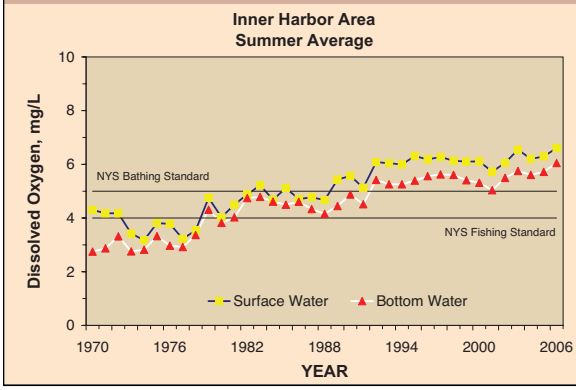
Fecal Coliform and Enterococci



DISSOLVED OXYGEN

Dissolved oxygen (DO) values increased from 2005 values. Summer DO values averaged 6.6 mg/L for surface waters and 6.1 mg/L for bottom waters, up from 2005 values of 6.3 mg/L for surface waters and 5.7 mg/L for bottom waters. Discrete DO measurements of surface waters failed to comply with NYS DEC standards 1% of the time, down from 3% of the time in 2005. Discrete DO measurements of bottom waters failed to comply with NYS DEC standards 3% of the time, down from 5% of the time.

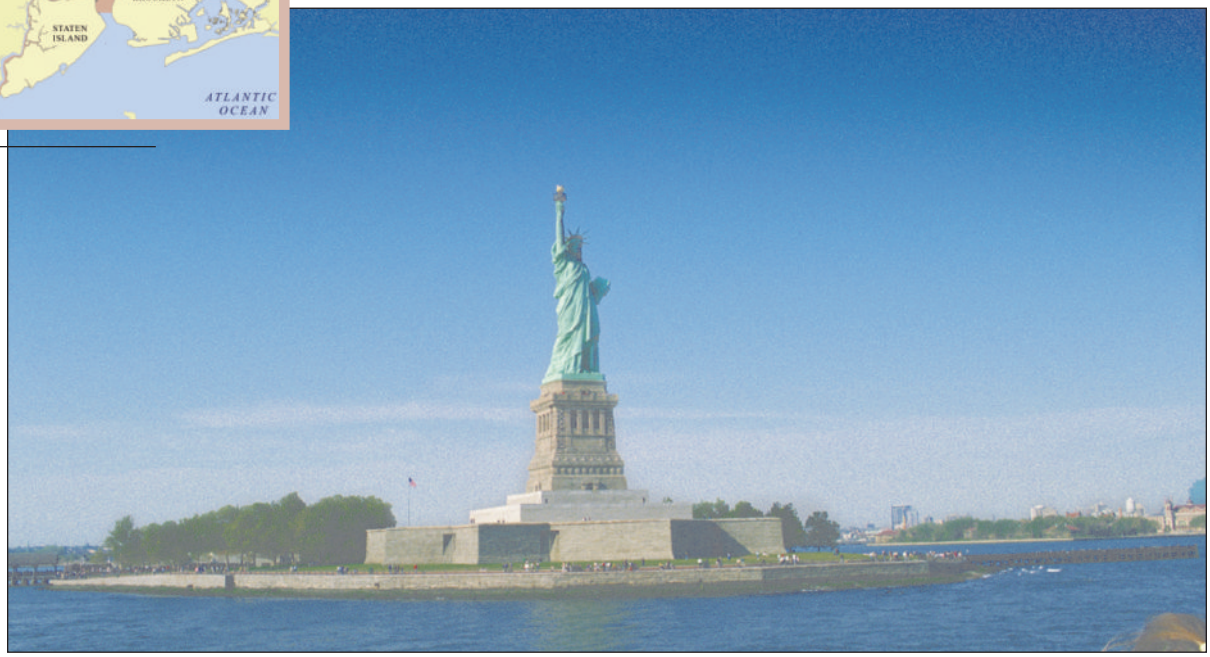
Dissolved Oxygen



TRENDS

Average summer DO values in the Inner Harbor have risen to levels above NYS DEC standards for primary contact recreation and commercial fisheries. Bottom water values have risen from approximately 3 mg/L in 1970 to 6.1 mg/L at present.

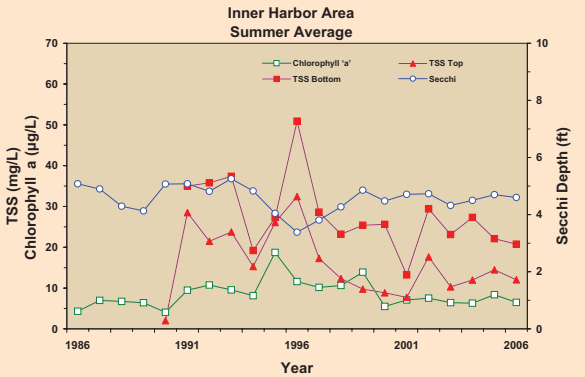
Inner Harbor Area



Chlorophyll a

While water quality standards do not exist for chlorophyll a, concentrations in excess of 20 ug/L are considered indicative of eutrophic conditions. All stations within the Inner Harbor area had average summer chlorophyll a values below the 20 ug/L level. Twelve of thirteen stations had summer averages <10 ug/L (K5 averaged 17.8 ug/L). These values are slightly better than 2005, when ten of thirteen stations had summer averages <10 ug/L. In 2005, K5 has averages of 13.6 ug/L, G2 and N1 had averages of 11.0 and 10.7 ug/L, respectively. In summer 2006, only seven discrete samples of 163 had values were >20 ug/L (4%). On August 8th, chlorophyll a samples at Hudson River (N1-N5) were between 36-58 ug/L, associated with high pH (8.25-8.35) and DO (9-12 mg/L).

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



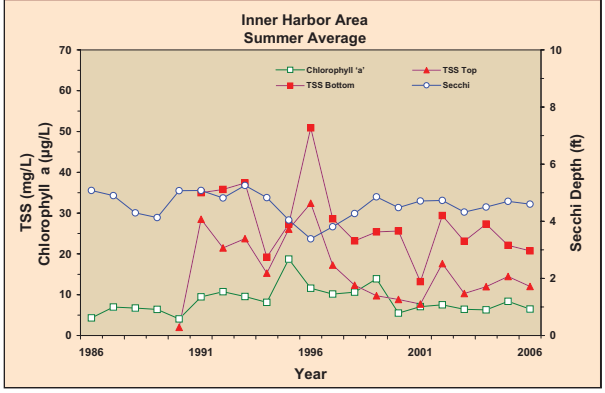
Trends

The Inner Harbor shows the least inter-annual variability in chlorophyll a concentrations. Levels rarely vary more than a few percent, most likely as a result of higher flow rates from Hudson River upstream.

Secchi Transparency

No water quality standards exist for the Secchi transparency. In general, high Secchi numbers (depths of five feet or greater) are associated with clearer water, while low secchi numbers (depths of three feet or less) are indicative of turbid (or light limiting) conditions. In summer 2006, average Secchi reading was 4.6 feet in the Inner Harbor area. The average values for the thireen stations were between 3.4-7.0 feet. Out of total 162 samples, Secchi values ranged from 2.0-3.0 feet (10 times, half of them at N1) to a high of 5.0-10.0 feet (72 times, highest at G2).

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



Trends

Average summer Secchi values have remained relatively constant (>4 feet) in the Inner Harbor area since measurements began in 1986, except around middle 1990 (1996 and 1997). There has been only a couple of percent variation over the past 21 years. This can most likely be attributed to the normal flow from the Hudson River.

Upper East River – Western Long Island Sound

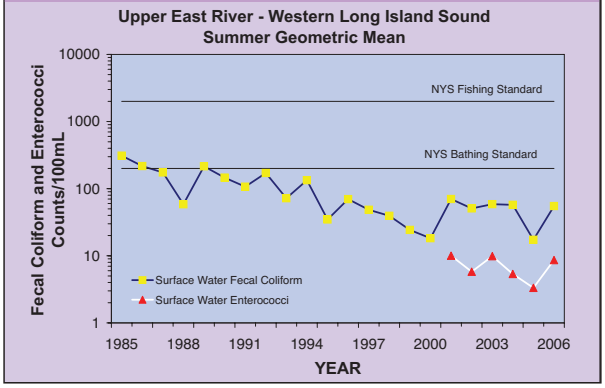
The Upper East River-Western Long Island Sound (UER-WLIS) represents the north-eastern portion of NY Harbor, from Hell Gate in the East River, up into the Western Long Island Sound (WLIS). ***The Harbor Survey Program*** *provides coverage of this area, including the Harlem River and the East River, from Roosevelt Island to Hart Island at the NYC-Westchester County boundary. This area contains 8 Harbor Survey monitoring stations. Waters of this vicinity, though divergent in salinity and depth, share similarities in pollutant loadings and are targeted for intensive management efforts as part of the* ***Long Island Sound National Estuary Program****.*

The majority of the Upper East River-Western Long Island Sound complex is classified as I, for uses such as fishing or boating, with the area east of the Bronx-Whitestone Bridge designated for bathing (SB).

Fecal Coliform

In 2006, sanitary water quality continued to be good for Upper East River-Western Long Island Sound. Fecal coliform (FC) concentrations for all monitoring sites were in compliance with their specified best use classifications for bathing and fishing. The summer geometric mean for this region was 55 cells/100mL, up from 17 cells/100mL in 2005. Only two sites had summer geometric means greater than 100 cells/100mL.

Fecal Coliform and Enterococci



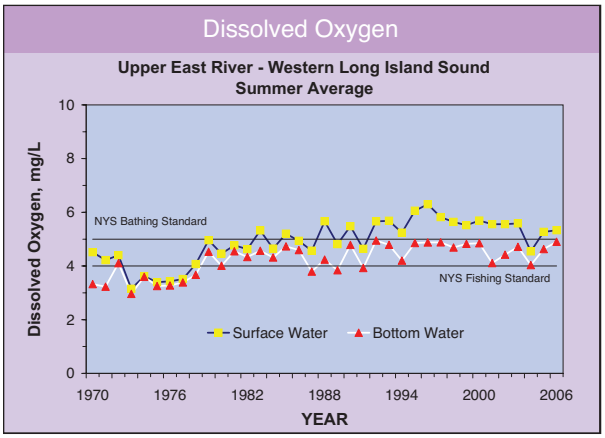
Trends

Fecal coliform concentrations have shown a downward trend for more than twenty years in the Upper East River-Western Long Island Sound (UER-WLIS) region. This improvement, measuring about two orders of magnitude, indicates FC concentrations met standards suitable for bathing 90% of the time over the past 15 years. The ongoing upgrade of wastewater treatment facilities and combined sewer overflow facilities will continue to have a major impact on fecal coliform levels.

Dissolved Oxygen

Average summer DO values for the Upper East River and Western Long Island Sound vicinity met and exceeded 4 mg/L (conditions suitable for fishing) in surface waters at all sites. In addition, average values at the two stations designated as SB were below the acceptable 5 mg/L standard for bathing use for bottom (E8 and E10) waters. The UER-WLIS were areas of concern during summer 2006. Long-term trends remain positive. Average DO levels were near ten year highs. Still, 2006 DO levels in the UER-WLIS did not continually attain NYS DEC standards. Discrete DO measurements of surface and bottom waters did not comply with the standards 17% and 30% for surface and bottom waters, respectively. Non-compliance incidents in both surface and bottom waters improved from 42% and 50% in 2004 to 29% and 38% in 2005 to 17% and 30% in 2006.

2006 DO levels in the Upper East River and Western Long Island Sound are the lowest throughout the harbor. Summer DO averaged 5.3 mg/L and 4.9 mg/L for surface and bottom waters, slightly higher than 5.3 mg/L and 4.6 mg/L in 2005. Incidents of hypoxia (DO < 3.0 mg/L) were measured in bottom waters at stations E10, E8, and E2 from July 24th through August 21st. Minimum DO levels were recorded on August 8th marking the extent of hypoxia events. It is suggested that the spatial extent of hypoxia has inproved. Fewer hypoxia events are recorded over a smaller regional area in 2006 compared with the past two years.



Trends

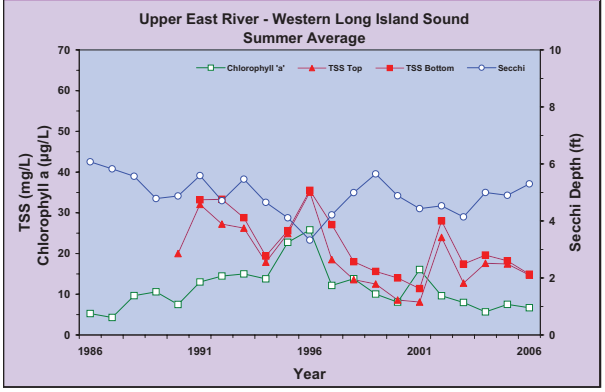
Since 1970, trend analysis for the UER-WLIS area shows an increase in DO of about 1.5 mg/L for surface waters and 2 mg/L for bottom water. Most notable are improvements in bottom waters that have risen from well below fishable (4 mg/L) to close to bathing standards (5 mg/L). Trends, however, also demonstrate high DO variability, with an increasing gap between surface and bottom water improvements since the mid-1980s (This suggests the formation of two separate water masses or pronounced stratification). In the WLIS in particular, conditions symptomatic of eutrophic waters have been observed since the late 1980s. These conditions include extremely high surface water DO (often associated with algae blooms) and sporadic, but extremely low, bottom DO. This decline in water quality is being addressed by the Long Island Sound Study, under which NYCDEP is upgrading four sewage treatment plants to reduce nitrogen loads to UER-WLIS.

Upper East River – Western Long Island Sound

Chlorophyll a

Chlorophyll a concentrations for the Upper East River-Western Long Island Sound were slightly better than last year, with an average summer concentration of 6.67 ug/L, down from 7.50 ug/L. All stations had average summer values <20 ug/L. Seven of eight stations had summer values <10 ug/L (E15 averaged 18.6 ug/L). The seven sites had more or less decrease on average chlorophyll a values. In 2006, nine of 118 chlorophyll a mesurements were >20 ug/L, which six of the nine were at E15, two at E14, and one at E10.

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



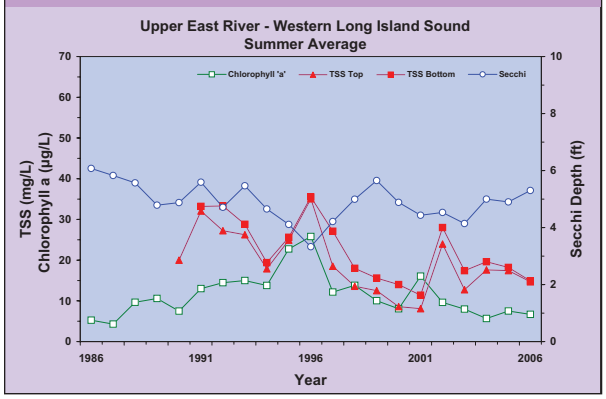
Trends

Chlorophyll a analysis showed fairly consistant changes every 3-4 years. The summer average readings varied between 6-16 ug/L with exceptions of 22.8 ug/L and 25.8 ug/L in 1995 and 1996, respectively. For the past five years, average chlorophyll a values were all less than 10 ug/L and within pre-1991 levels.

Secchi Transparency

In summer 2006, average Secchi transparencies for four of all eight stations were >5 feet (E6, E7, E8, and E10). Total 71 out of 117 readings were >5 feet, with E10 had higest value of 12 feet on September 9th. Lower readings (1.0-2.5 feet) were observed mostly in Flushing Creek (E15) and Bronx River (E14) two times each, and in Flushing Bay (E6) one time.

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



Trends

For UER-WLIS stations as a group, the Secchi transparency has varied between about 4 and 6 feet since 1986. The transparency once dropped to 3.3 feet in 1996 but climbed back. Improved Secchi transparency depths may coincide with a significant decrease in Chlorophyll a since 1996 for the same waters.

Jamaica Bay

Jamaica Bay is located at the southwestern end of Long Island. This urban, estuarine embayment and national park consists primarily of tidal wetlands, upland areas, and open waters. The Bay and its drainage area are almost entirely within the boroughs of Brooklyn and Queens, except for a small area at the eastern end that is in Nassau County. Jamaica Bay joins the New York Harbor to the west, via the Rockaway Inlet at the tip of Breezy Point, and includes the Rockaway Peninsula which forms the southern limit of the Bay and separates it from the Atlantic Ocean. This estuarine water body, consisting of approximately 20 square miles of open water, is covered by 9 Harbor Survey monitoring stations.

Open waters of Jamaica Bay are classified for bathing or other recreational use (SB). Areas within the Bay's tributaries and dead-end canals are prone to reduced water quality due to direct surface runoff and poor flushing. These areas are designated for secondary contact use (I), such as fishing or boating.

Fecal Coliform

In 2006, sanitary water quality was superior for much of Jamaica Bay, with summer fecal coliform (FC) concentrations below 200 cells/100mL (SB) standards for all stations.

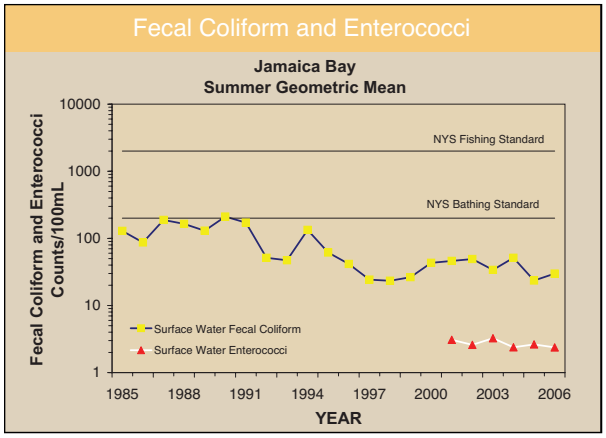
Seven of nine sites had geometric means below 50 cells/100mL. Four stations' geometric means were less than 20 cells/100mL (an order of magnitude below State Standards).

Under wet weather conditions, the Bay experiences localized degradation. At these times, spikes in FC may temporarily exceed the SB standard of 200 cells/100mL for the entire northern portion of the Bay (from Mill Basin to Bergen Basin). This decrease in water quality is limited to the Bay proper, as Lower NY Bay waters (immediately outside of the mouth of Jamaica Bay) are not typically affected by wet weather events.

TRENDS

Mean FC levels in Jamaica Bay as a whole have been at or below 200 cells/100mL State Standards for bathing over the past 20 years. FC levels peaked at 200 in 1990, reached at low of 23 in 1998, and have since increased to 51 cells/100mL.

The DEP continues to improve sewage system operations. Design and construction of CSO storage tanks continue in JB tributaries. Additionally, DEP skimmer vessels work to control floatable debris in Jamaica Bay as part of the "Boom and Skim" program.

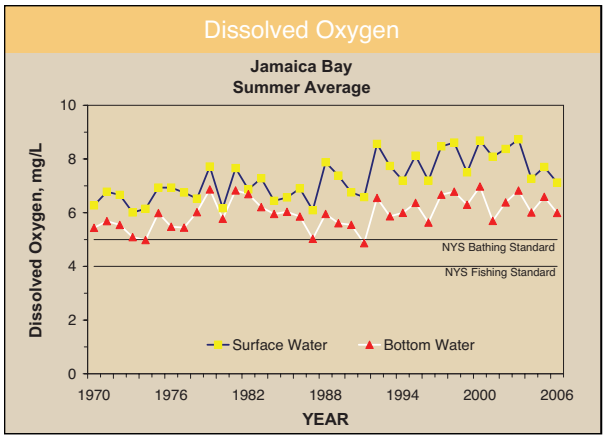


DISSOLVED OXYGEN

The 2006 summer averages for dissolved oxygen (DO) for surface and bottom waters surpassed the New York State standard of 5 mg/L for bathing (SB) at all stations except for bottom waters at station J12(Grassy Bay). Individual measurements failed to comply with the applicable standard 54 times of 255 measurements. Several hypoxia events (DO <3.0 mg/L) were recorded at 7 of 9 stations, most frequently at northeastern most stations J7 (Bergen Basin) and J12 (Grassy Bay).

TRENDS

Average DO levels were well above 5.0 mg/L bathing standards as early as 1970. DO variability is high within and between years and the gap between surface and bottom waters is increasing since the mid 1980s. High surface DO levels are often due to supersaturated conditions attributable to algae blooms and eutrophic waters.



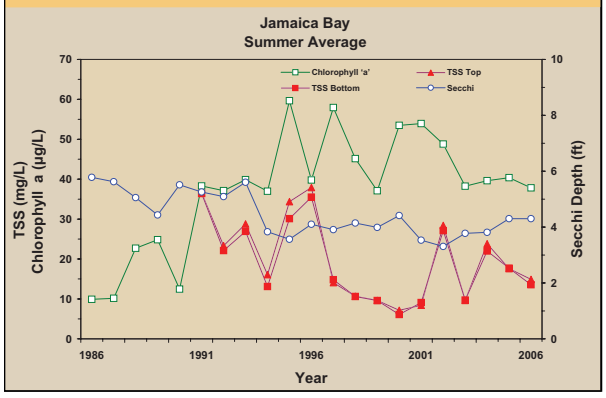
JAMAICA BAY

CHLOROPHYLL a

High chlorophyll a concentrations in Jamaica Bay are indicative of eutrophic conditions. The slow turnover of water within the Bay allows for development of large standing phytoplankton populations. Of the four geographic Harbor Survey regions, Jamaica Bay continues to display the widest range of individual chlorophyll a measurements. All nine stations have summer averages above 20 ug/L. On average, chlorophyll a concentrations for the Bay measured 37.8 ug/L. This is consistent with recent years, but well above levels tell-tale of enriched or eutrophic waters.

During summer 2006, 82 out of 129 chlorophyll a values were > 20 ug/L. On June 6th, 2006, high readings (102-138 ug/L) were recorded inside the Jamaica Bay (J2, J3, J7, J8, J9A), associated with higher pH (8.12-8.56) and lower Secchi depths (2.5-3.0 feet).

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



Trends

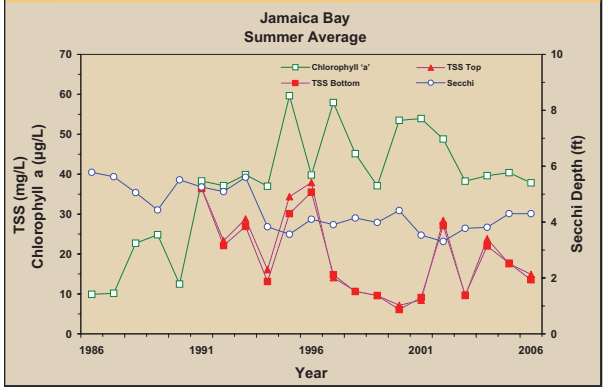
Chlorophyll a summer averages in Jamaica Bay were less than 25 ug/L before 1990. The values jumped to 38.3 ug/L in 1991 and have remained above 36 ug/L since then. High average values can be found in middle 1990s (1995, 1997) and early 2000s (2000-2002). For the past four years, average chlorophyll a concentrations stayed close to 40 ug/L (same level as in early 1990s).

These conditions have coincided with prolonged algae blooms in Jamaica Bay and reports of nuisance algae in the tributaries and canals.

Secchi Transparency

The Secchi transparencies range from 2.0 to 9.0 feet in the Jamaica Bay area. Two stations at Rockaway Inlet (J1, J11) had average readings above 5 feet (depths associated with cleaner waters). These two sites are located outside the Bay proper and experience greater water exchange than sites within the Bay. Average Secchi values for interior Bay survey sites ranged from 3.8 to 4.2 feet. Inside Jamaica Bay, the lowest Secchi readings (2.5 feet) were recorded on June 6th, associated with higher chlorophyll a and pH measurements.

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



Trends

The Secchi transparency depth decreases as chlorophyll levels increase. Secchi average depths greater than 5.0 feet were typical before 1993. After that, the average depths stayed between 3.5 to 4.0 feet. For the recent two years, average Secchi transparency depths were 4.3 feet.

Lower New York Bay–Raritan Bay

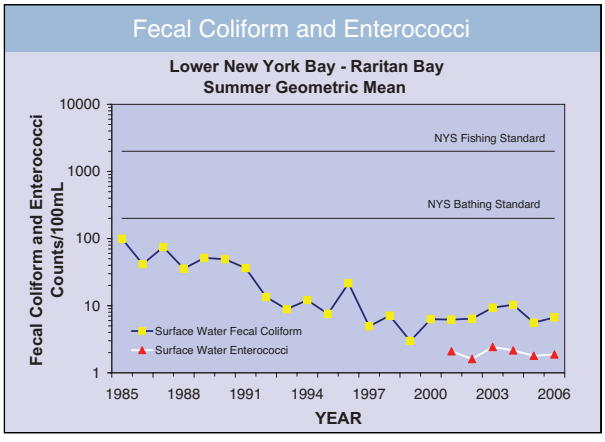
*The Lower NY Bay-Raritan Bay (LNYB-RB) vicinity represents the most oceanic portion of the **Harbor Survey Program**. This area of 100 square miles is represented by 5 Harbor Survey monitoring stations and is composed mostly of open shallow waters, partially confined by Brooklyn's Coney Island to the north, Staten Island to the northwest, and New Jersey's Middlesex and Monmouth Counties and Sandy Hook to the south. The remainder of its eastern boundary is open to Rockaway Inlet and the greater Atlantic Ocean.*

This area of the Harbor is classified for bathing and other recreational use (SB). Portions of those waters are also designated for the permitted use of shellfishing (for relay to cleaner waters, but not direct consumption), having a stricter use classification of SA.

Fecal Coliform

In 2006, Sanitary water quality as estimated by fecal coliform (FC) was superior for the Lower New York Bay-Raritan Bay (LNYB-RB).

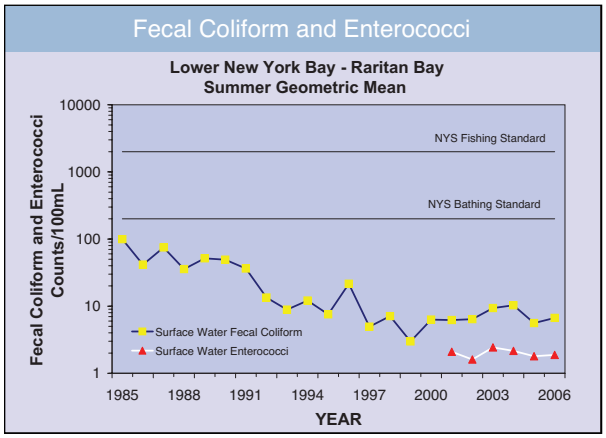
Summer averages FC numbers show waters of the LNYB-RB meet and surpass NYS standards for this area. All 5 Stations had geometric means less than 20 cells/100mL (an order of magnitude below State Standards).



TRENDS

Coliform concentrations for LNYB-RB show significant declines (more than an order of magnitude) from the mid 1980s to the present time. While FC concentrations for surface waters were always below 200 cells/100mL, recent average FC levels in 1999 were 3 cells/100mL. Levels have increased to 10 cells/100mL since 1999.

These improvements have allowed for the opening of all NYC public beaches and the lifting of wet weather swimming advisories.

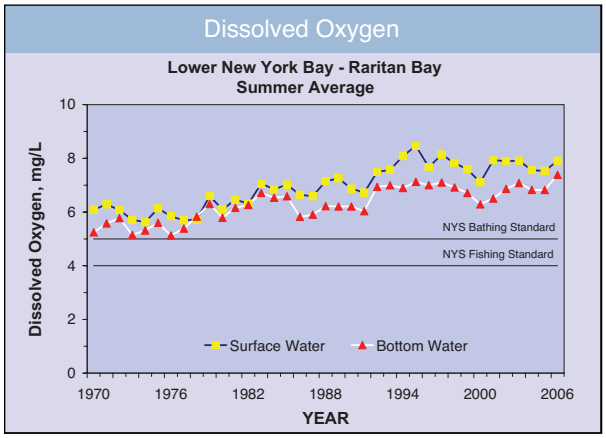


DISSOLVED OXYGEN

Dissolved oxygen (DO) values for top and bottom waters show good compliance with the NYS DO standard of 5 mg/L. Average DO values failed to comply with state standards at a single station (K5A). Actual DO values were found to be below 5 mg/L 5 times out of 124 measurements and minimum DO values were below 4.0 mg/L only at bottom waters of station K5A. This is true despite K5A proximity to more degraded waters in the Arthur Kill, Narrows, and mouth of Jamaica Bay.

TRENDS

Since 1970, average DO concentrations have increased over 1.5 mg/L from 6.1 to 7.9 mg/L for surface waters, and from 5.2 to 7.4 mg/L for bottom waters. Most of the improvement in the LNYB-RB area is attributable to improved water quality at station K5A. This improvement reflects loading decreases in sanitary waste into Arthur Kill and the Raritan River.

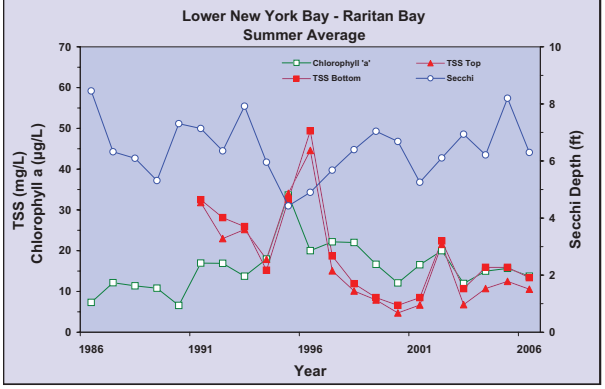


Lower New York Bay–Raritan Bay

Chlorophyll a

Chlorophyll a concentrations above 20 ug/L indicate eutrophic conditions. Area known as Raritan bay (K5A, K6) has relatively shallow, slower moving water appears ideal for phytoplankton (algae slicks) bloom formation, as nutrient rich Harbor waters empty into the Bay area. Slower moving waters allow for the condensing organic material and the growth of algae into tangible slicks, often visible from shore bathing areas. Contact with nutrient-rich oceanic waters only further serves to fuel additional phytoplankton growth until slicks are dispersed again or washed out of the Bay area. The two most eastern LNYB-RB stations (N9, N16) and Varrazano Narrows (N8) station had average concentrations less than 9.0 ug/L. This is likely due to better tidal flux–a more active exchange of Harbor and oceanic waters.

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



Chlorophyll a summer averages at Raritan Bay sites K5A and K6 were 15.9 and 29.5 ug/L, respectively. 14 out of 62 samples at the area had chlorophyll a readings > 20 ug/L. Eight of them were observed at K6 and 4 of them at K5A.

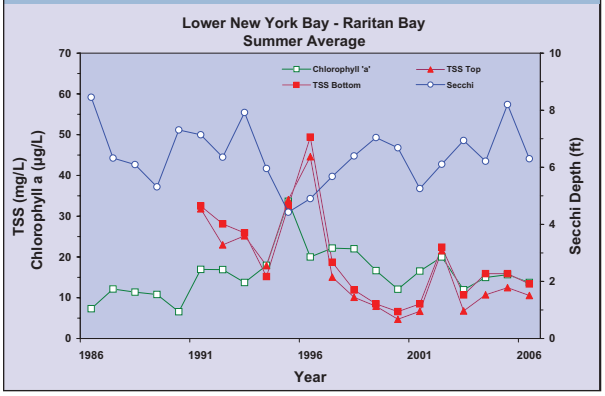
TRENDS

Average summer chlorophyll a concentrations for the Lower New York Bay-Raritan Bay area remained at or below 20 ug/L for the past 21 years, except for three years (1995, 1997, 1998). In 2006, the average chlorophyll a measurement was 13.75 ug/L.

SECCHI TRANSPARENCY

Average Secchi values for LNYB-RB stations were all above 5 feet at stations N8, N9, and N16. As usual, a highest average value of 10 feet was located at Rockaway Point (N16). This site, the most oceanic of the Harbor Survey's 35 monitoring stations, commonly experiences the widest range in Secchi values. In 2006, measurements at N16 ranged from 5.0 to 18 feet. Levels above 5 feet indicate clean conditions and superior water quality. At this region, 19 out of 62 secchi readings were below 5 feet. The lowest readings of 0.5 and 2.5 feet were recorded at K5A.

Chlorophyll a and Secchi Depth vs. Total Suspended Solid



TRENDS

While group average values for the LNYB-RB stations are typically 1 to 2 feet higher than those of Jamaica Bay, Secchi trends show similar patterns for both waterbodies.

Averages of Secchi transparency in LNYB-RB have remained above 5 feet since 1986 with exceptions of 1995 and 1996. The drop coincided with the big jump of chlorophyll a in 1995.

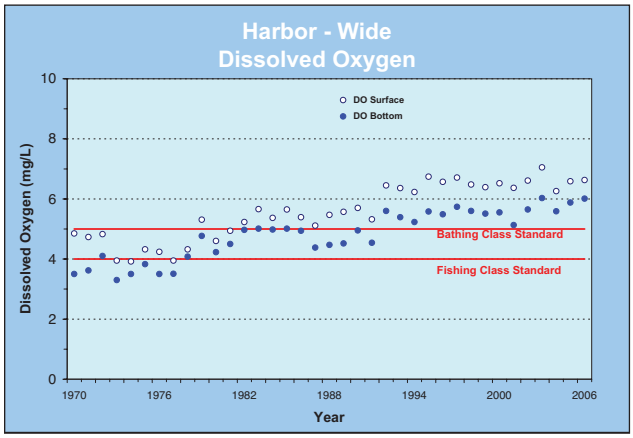
Harbor-Wide Improvements

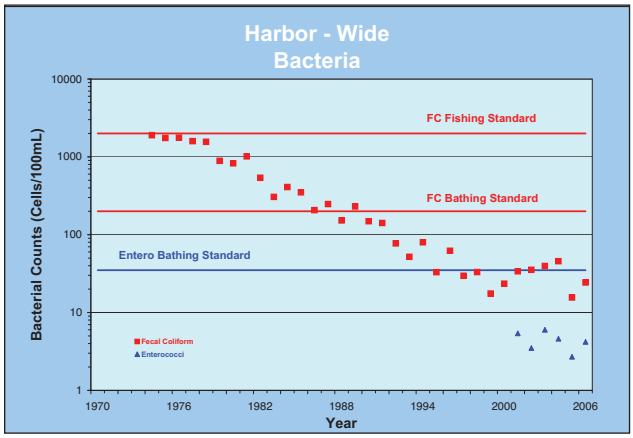
Harbor-wide, water quality trends for 2006 showed a general improvement but for the most part retained the status quo form the previous year. The open waters of the Harbor have, over the last several years, remained largely stable. The areas that have shown the most variability are the UER/LIS and Jamaica Bay, a trend that continued in 2006. The Inner Harbor did show a significant change for both oxygen and bacteria in 2006, but further data collection will determine if this trend continues.

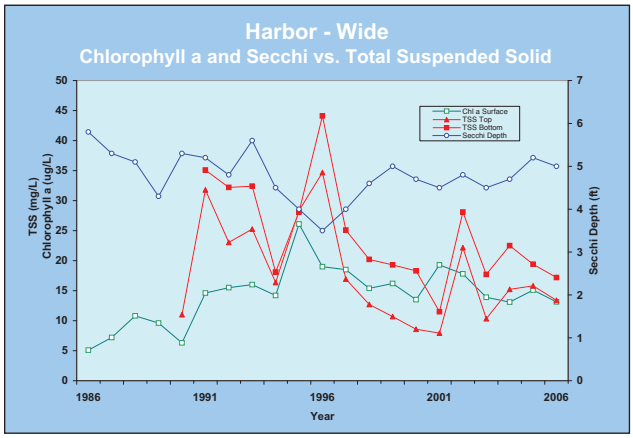
Fecal coliform trends, while showing a slight increase, have for the most part remained stable for the past several seasons. The NYCDEP Harbor Survey Program began sampling Enterococcus in 2001. This additional effort was made to prepare for the change from fecal coliform to Enterococcus as an indicator of bacterial contamination. Currently we do not have enough data to confidently discuss any trends related to Enterococcus. We have presented the data in conjunction with the fecal coliform data for illustration purposes only.

Currently we are investigating possible links to weather as the trigger for the variability of water quality throughout New York Harbor. The Survey is beginning a long term analysis of a possible linkage between wet weather and our observed water quality measurements. Several years of correlating weather and sampling will be necessary to determine if there is a direct link. The Survey will also be expanding it's sampling to include tributaries and waterbodies as a part of the Long Term Control Plan. These additional stations will be included as they are added according to the LTCP schedule.

Water quality throughout the open waters of New York Harbor still meets standards a vast majority of the time.

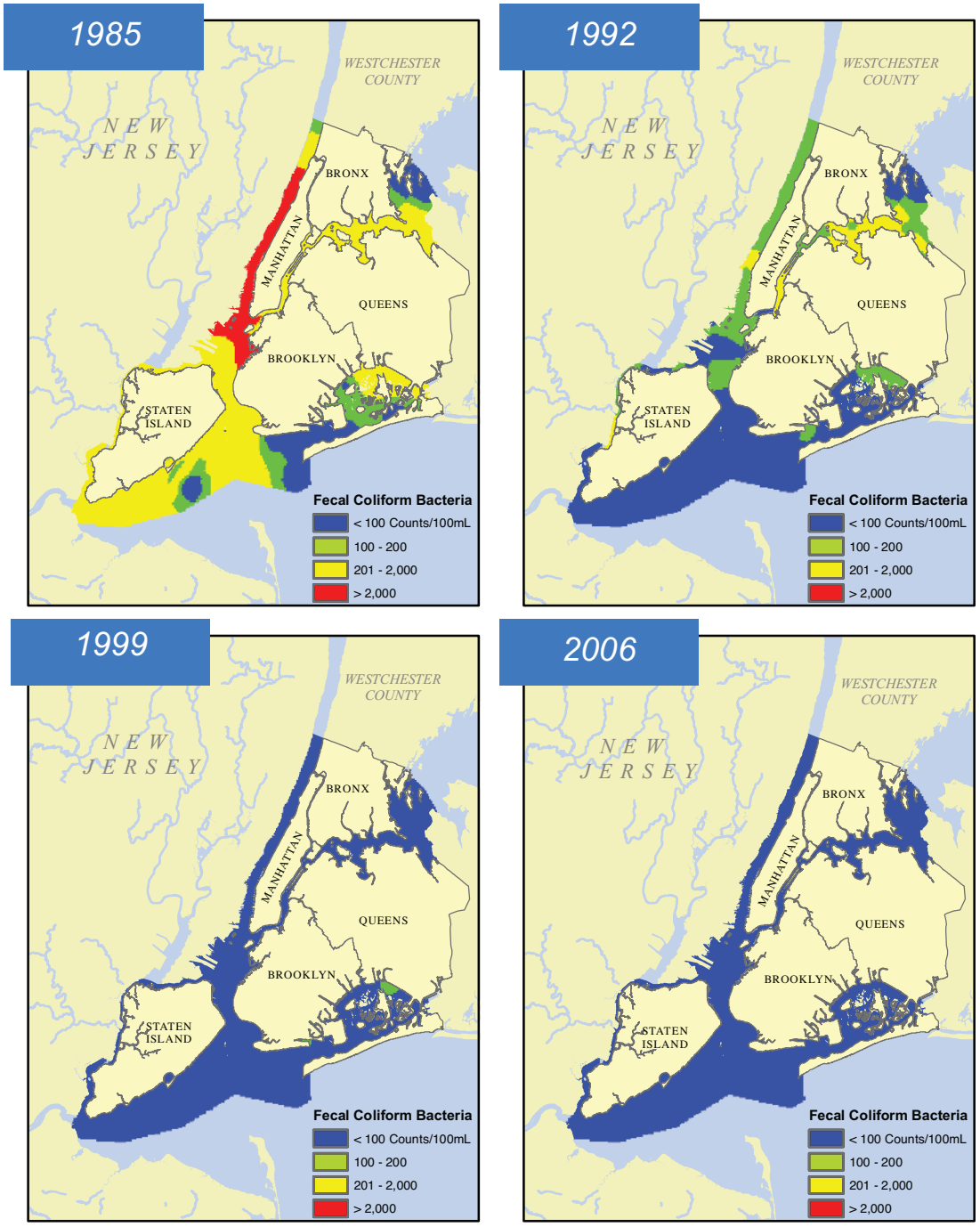






Harbor-Wide Water Quality Improvements Over Four Time Periods

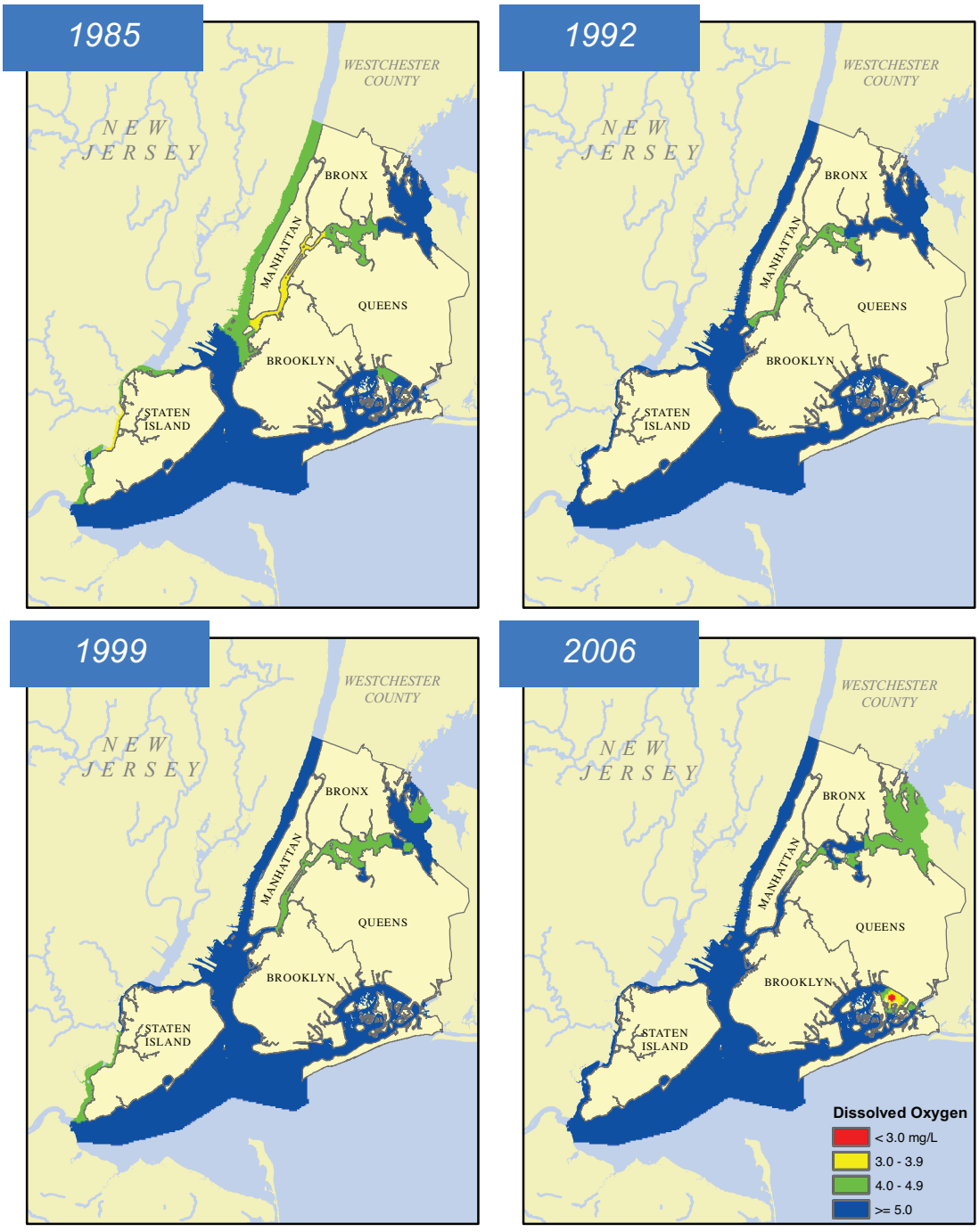
SUMMER GEOMETRIC MEAN FOR
FECAL COLIFORM IN SURFACE WATERS



NYS Best-Use Classifications: ≤ 200 FC/100mL=SB (Bathing); ≤ 2000 FC/100mL=I (Fishing).
NYC DOH requirements preclude bathing near sewer outfalls and where rainfall may substantially increase coliform levels.

Harbor-Wide Water Quality Improvements Over Four Time Periods

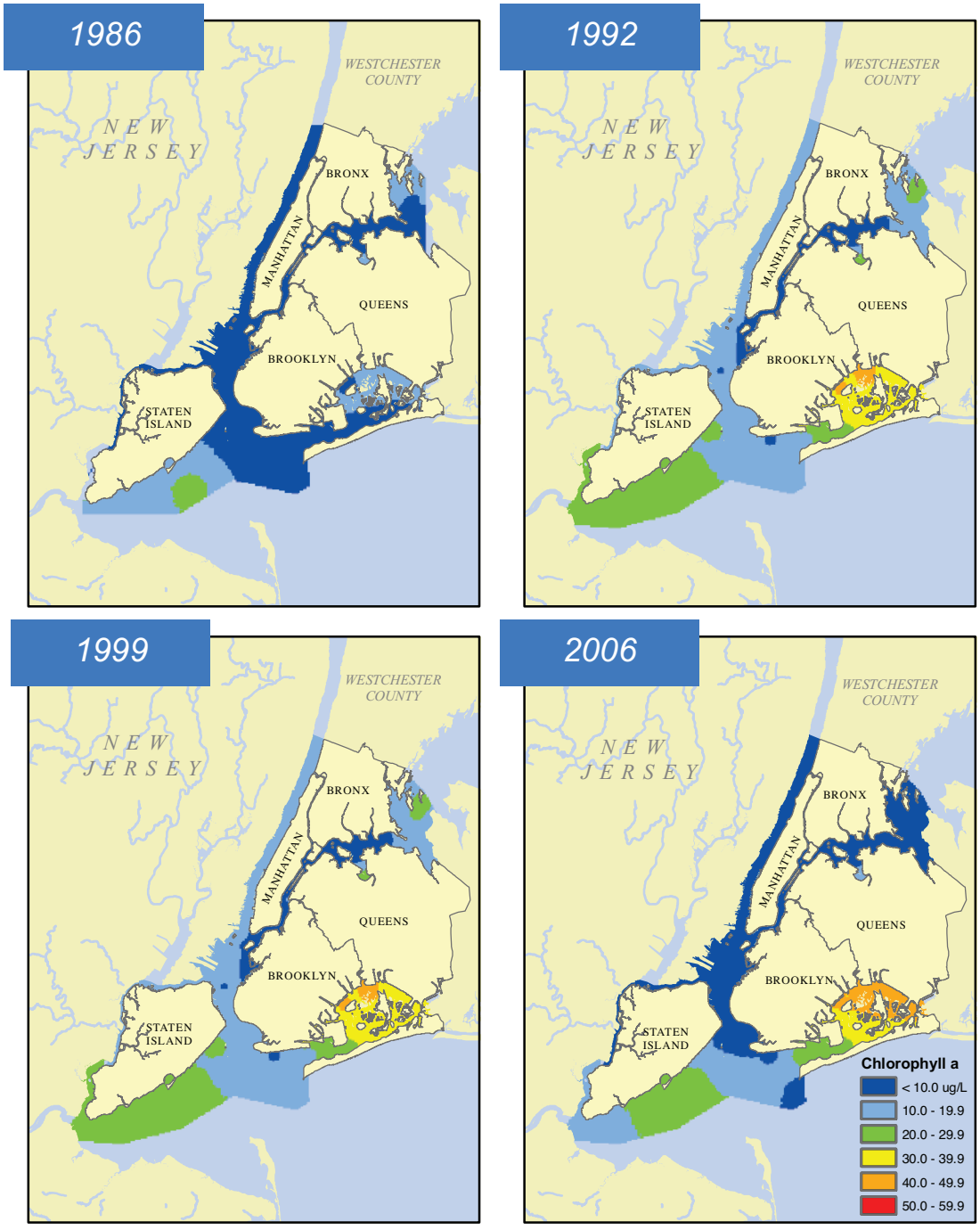
SUMMER AVERAGES FOR
DISSOLVED OXYGEN IN BOTTOM WATERS



NYS Best-Use Classifications: DO >5 mg/L=SB (Bathing); DO >4 mg/L=I (Fishing); DO >3 mg/L=SD (Fish Survival)

Harbor-Wide Water Quality Improvements Over Four Time Periods

SUMMER AVERAGES FOR
CHLOROPHYLL A IN SURFACE WATERS



Chlorophyll a >20 ug/L = Eutrophic conditions


2006 NYCDEP Harbor Survey Stations
WESTCHESTER COUNTY
NEW JERSEY
Hudson River
Long Island Sound
BRONX
Harlem River
MANHATTAN
Hackensack River
Passaic River
East River
QUEENS
Upper New York Bay
Newark Bay
Kill Van Kull
BROOKLYN
STATEN ISLAND
Lower New York Bay
Arthur Kill
Rockaway
ATLANTIC OCEAN
Raritan Bay
Sandy Hook
Jamaica Bay
N1
H3
N3B
E10
E14
E7
E8
E6
E4
E15
N4
E2
N5
GC3
GC4
GC5
GC6
G2
N6
K1
K3
K2
N7
SB1
BB2
SB3
BB4
J8
J7
PB2
PB3
J9A
J12
EMB1
J3
EMB2
MB1
J2
MB3
J5
N8
SHB1
J11
J1
K4
N9
N16
K6
K5
K5A
N
0
5
10
Miles
Legend
Inner Harbor
Upper East River - Western LIS
Lower Bay
Jamaica Bay


NYCDEP Water Pollution Control Plants and CSOs
WESTCHESTER COUNTY
NEW JERSEY
BRONX
Long Island Sound
North River
Hunts Point
Hudson River
MANHATTAN
Wards Island
Bowery Bay
Tallman Island
QUEENS
Newtown Creek
Upper New York Bay
Red Hook
26th Ward
Jamacia
BROOKLYN
Owls Head
Port Richmond
Jamaica Bay
STATEN ISLAND
Coney Island
Rockaway
Lower New York Bay
Oakwod Beach
Rockaway
ATLANTIC OCEAN
N
Raritan Bay
Sandy Hook
0
5
10
Miles
CSO
NYC WPCP

Acknowledgments

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The responsible personnel for the Harbor Survey from Marine Sciences Section included: Section Chief Beau Ranheim, Bernadette Boniecki, Markus Koelbl, William Lopez, Dan Marcktell, Carrie Munill, Andrew Owens, Yin Ren, and Naji Yao.

Marine Section personnel involved with the Harbor Survey include: Francis Bryn, Joseph Capiris, William Edgar, Francisco Faundez, Jeffrey Ferenczy, Rudy Ferro, Carl Jeremie, Michael Jonas, Christopher Reil, Francisco Rodriguez, and Brian Vaughan.

The Special Project Laboratory is supervised by Trikan Patel and Patrick Jagessaar, with analyses performed by: Lovely Chacko, Liji Isaac, Osafo Barker, Anna Chemyak, Shyam Mahilall, Nicole Pinede, and Rachel Torchenaud.

The Wards Island Micro Lab was supervised by Shirley B. George, Lorraine Johnson, Pari Malakkhani, Claudette Williams, and Esmerado Castro.

This Summary was revised by Naji Yao, Carrie Munill, Yin Ren, Bernadette Boniecki, Dan Marcktell, and Beau Ranheim.

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