The New Jersey Harbor Dischargers Group

2010 Water Quality Report

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ON THE COVER—Perth Amboy Marina—confluence of Arthur Kill, Raritan River and Raritan Bay

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Staten Island Ferry in Hudson River with Manhattan skyline in background

Introduction

The New Jersey Harbor Dischargers Group (NJHDG) is made up of nine (9) sewerage agencies, representing eleven (11) wastewater treatment plants in northeastern New Jersey. All of these plants discharge their treated effluents into the New Jersey portion of the NY/NJ Harbor Estuary.

The member agencies of the NJHDG are:

Bergen County Utilities Authority
Joint Meeting of Essex and Union Counties
Linden Roselle Sewerage Authority
Middlesex County Utilities Authority
North Bergen Municipal Utilities Authority
North Hudson Sewerage Authority
Passaic Valley Sewerage Commission
Rahway Valley Sewerage Authority
Secaucus Municipal Utilities Authority

In 1992, these agencies agreed to collaborate and jointly fund and perform various water quality studies in the region to add to the water quality knowledge base for the Harbor. In 2003, the NJHDG began a Long-Term Ambient Water Quality Monitoring Program for the waters in the New Jersey portion of the NY/NJ Harbor Estuary, modeled after the successful New York City Department of Environmental Protection (NYCDEP) Harbor Survey. The Passaic Valley Sewerage Commission (PVSC) had previously initiated a long-term ambient water quality monitoring program of the Passaic River, Hackensack River, and Newark Bay in 2000, and has taken the lead for the NJHDG monitoring program. Due to the need for a Harbor-wide monitoring effort, the NJHDG decided to expand upon PVSC's original water quality monitoring program, with additional resources and personnel to cover all of the NJ Harbor waters.

The main objective of the NJHDG Long-Term Ambient Water Quality Monitoring Program is to develop a comprehensive database for conventional chemical water quality parameters on the existing water quality of the NY/NJ Harbor, by routinely and extensively sampling the waters of the Passaic River, Hackensack River, Newark Bay, Arthur Kill, Raritan River, Raritan Bay, and the Hudson River. To date, the NJHDG has gathered six (6) years of high quality data from the NJ Harbor waters.

The NJHDG program has effectively served to eliminate the data gap for NJ waters of the NY/NJ Harbor Estuary system by monitoring waterbodies that are not currently monitored by the New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Monitoring Network, United States Geological Survey (USGS) Surface Water Quality Gages, or the United States Environmental Protection Agency (USEPA) New York Bight Water Quality Monitoring Program.

The NJHDG Long-Term Ambient Water Quality Monitoring Program has become recognized among agencies and groups working on water quality in the NY/NJ Harbor. The NJHDG has a seat on the Management Committee of the NY-NJ Harbor & Estuary Program (HEP) and actively participates in numerous HEP subcommittees. NJHDG water quality data is being used in the development of Total Maximum Daily Loads (TMDLs) in the Harbor by HEP and the states of New York and New Jersey. The NJDEP Bureau of Water Quality Standards and Assessment utilizes the NJHDG water quality data in the development of the biennial New Jersey Integrated Water Quality Monitoring and Assessment Report, which includes the 305(b) Integrated List of Waters and the 303(d) List of Water Quality Limited Waters. The NJDEP has also recognized the NJHDG Long-Term Ambient Water Quality Monitoring Program in the NJ Water Monitoring and Assessment Strategy document, the State's long-term monitoring plan for 2005-2014. The NJHDG was recently appointed to the NJ Water Monitoring Council (NJWMC), a statewide body that promotes coordination, collaboration and communication among the state's ambient water quality monitoring community.

PVSC's Mobile Laboratory

R.V. Passaic River and sampling crew

Methods

The NJHDG program monitors thirty-three (33) locations (Figure 1) throughout the region for a list of conventional chemical water quality parameters: temperature, pH, dissolved oxygen (DO), salinity, secchi depth, total suspended solids (TSS), 5-day carbonaceous biochemical oxygen demand (CBOD-5), total kjeldahl nitrogen (TKN), nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), ammonia-nitrogen (NH_3-N), total phosphorus (TP), orthophosphate (OP), dissolved organic carbon (DOC), chlorophyll-a (Chlor-a), Fecal coliform bacteria and Enterococcus bacteria. Monitoring is performed for all parameters at each station weekly during the summer sampling season from May through September and monthly during the winter sampling season from October through April. Tributary sites (Hackensack River head-of-tide, Raritan River head-of-tide, Elizabeth River and Rahway River) are monitored for all parameters twice monthly from May through September and monthly from October through April.

Passaic River sites are accessed from bridges by PVSC's mobile laboratory vehicle and are sampled at mid-depth in mid-stream. Deep-water sites throughout the Harbor are accessed by PVSC's 27-foor research vessel, the R.V. Passaic River, and are sampled at two discrete depths (1 meter below the surface and 1 meter above the substrate). Remote tributary sites are sampled from bridges by tributary field sampling crews from Middlesex County Utilities Authority (MCUA), Rahway Valley Sewerage Authority (RVSA), and Joint Meeting of Essex and Union Counties (JMEUC).

NJHDG member agencies contribute to the Long-Term Ambient Water Quality Monitoring Program by providing additional personnel for sampling, by monitoring tributary sites, or by providing laboratory services. All chemical analyses performed on NJHDG Harbor samples are the responsibility of the NJDEP certified laboratories of the Passaic Valley Sewerage Commission (PVSC), Middlesex County Utilities Authority (MCUA), and Bergen County Utilities Authority (BCUA).

Figure 1. NJHDG Water Quality Monitoring Site Map

New Jersey Surface Water Quality Standards (SWQS)

The New Jersey Department of Environmental Protection (NJDEP) issues Surface Water Quality Standards (SWQS), which establish designated uses for the all of the state's surface waters, classify those surface waters based on their designated uses, and establish water quality criteria that the State considers sufficient for the attainment of the designated uses for each waterbody classification (Table 1).

Waterbodies monitored by the NJHDG Long-Term Ambient Water Quality Monitoring Program are categorized as FW2-NT (non-trout freshwater), and SE1, SE2 and SE3 (saline estuary water) classifications.
The corresponding designated uses for each of these classifications are as follows:

FW2-NT:
Maintenance, migration and propagation of the natural and established biota
Primary and secondary contact recreation
Industrial and agricultural water supply
Public potable water supply after conventional filtration treatment and disinfection
Any other reasonable uses

SE1:
Shellfish harvesting in accordance with N.J.A.C. 7:12
Maintenance, migration and propagation of the natural and established biota
Primary and secondary contact recreation
Any other reasonable uses

SE2:
Maintenance, migration, and propagation of the natural and established biota
Migration of diadromous fish
Maintenance of wildlife
Secondary contact recreation
Any other reasonable uses

SE3:
Secondary contact recreation
Maintenance and migration of fish populations
Migration of diadromous fish
Maintenance of wildlife
Any other reasonable uses

Table 1. Selected NJ Water Quality Criteria for NJHDG Sites

Class	Bacteria		DO
FW2-NT ***Sites 1-9, 25***	E.coli	Geometric Mean[1] ≤126 cfu/100mL Never >235 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L
SE1 ***Sites 13, 26-27***	Enterococcus	Geometric Mean[1] ≤35 cfu/100mL Never >104 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L
SE2 ***Sites 14-15, 31-33***	Fecal Coliform	Geometric Mean[1] ≤770 cfu/100mL	Never <4.0 mg/L
SE3 ***Sites 10-12, 16-24***	Fecal Coliform	Geometric Mean[1] ≤1500 cfu/100mL	Never <3.0 mg/L
Shellfish Waters (SE1) ***Sites 28-30***	Fecal Coliform[2]	Geometric Mean[1] ≤14 cfu/100mL 90%[3] ≤49 cfu/100mL	24hr Avg ≥5.0 mg/L Never <4.0 mg/L
	Enterococcus	Geometric Mean[1] ≤35 cfu/100mL Never >104 cfu/100mL	

[1] *Based on Geometric Mean of a minimum of 5 samples in 30 days*
[2] *Based on National Shellfish Sanitation Program standards for shellfish waters, direct harvest*
[3] *Based on total number of samples taken in a 30-day period*

RESULTS

Fecal Coliform Bacteria

Fecal coliform bacteria are a group of microorganisms that live in the large intestines of warm-blooded animals to aid in the digestion of food. The presence of fecal coliform bacteria in surface waters is a sign of contamination with fecal matter from humans and other animals, including feces from pets, geese, and other wildlife. While fecal coliform bacteria do not necessarily cause disease, high concentrations are indicative of poor water quality. Thus, fecal coliform bacteria are considered “indicator organisms”, and high fecal coliform concentrations indicate that other disease-causing agents may also be present.

Prior to October 2006, waters classified as SE1 and FW2 had water quality standards based on fecal coliform concentrations, expressed as colony forming units per 100mL of sample (cfu/100mL). The current standards for these waterbody classifications are based on different bacteria as indicator organisms (Enterococcus for SE1 waters, and E.coli for FW2 waters). For consistency in comparing data between years 2004-2010, the analysis of fecal coliform levels in this report is based on the former fecal coliform standards (30-day geometric mean ≤200 cfu/100mL and 90% of samples ≤400 cfu/100mL).

Pathogen indicator standards are based on monthly geometric mean values for a minimum of five (5) samples in a thirty (30) day period. The NJHDG Long-Term Ambient Water Quality Monitoring Program has established a schedule of monitoring every site once per week during the summer season from May through September, and monitoring every site once per month during the winter season from October through April. For a variety of reasons, such as scheduling limitations (sampling once/week usually results in 4 samples/month), inclement weather conditions, unscheduled equipment maintenance, or inconclusive laboratory results, it is not always possible to obtain 5 viable bacterial samples at each site in a 30-day period to directly compare the geometric means to the standards. Therefore, for this report, summer seasonal geometric means (from May 15—Sept 15) were calculated instead of 30-day monthly geometric means (Figures 1-2). This timeframe coincides with the beach bathing season, when compliance with the pathogen indicators is mandatory to ensure the protection of human health. The NY-NJ Harbor & Estuary Program (HEP) Pathogens Workgroup is also using this averaging period in their efforts to establish a Total Maximum Daily Load (TMDL) for pathogens in the NY/NJ Harbor.

The highest fecal coliform concentrations have consistently been observed in the tributaries: the Saddle River (Site 6) and Second River (Site 9) are tributaries of the Passaic River, and the Elizabeth River (Site 20) and Rahway River (Site 22) are tributaries of the Arthur Kill. In 2009, the highest summer seasonal geometric mean of 2,923 cfu/100mL was calculated at the Second River site (Site 9). The second highest summer seasonal geometric mean of 816 cfu/100mL was calculated at the Elizabeth River site (Site 20). 2009 summer seasonal geometric means at the other monitoring locations ranged from 4 cfu/100mL in Raritan Bay (Site 30) to 689 cfu/100mL in the Passaic River (Site 7).

In 2010, the highest summer seasonal geometric mean of 2,921 cfu/100mL was also calculated at the Second River site (Site 9). However, the second highest summer seasonal geometric mean of 834 cfu/100mL was calculated at the Rahway River site (Site 22). 2010 summer seasonal geometric means at the other monitoring locations ranged from 3 cfu/100mL in Raritan Bay (Sites 29 & 30) to 759 cfu/100mL at the Elizabeth River site (Site 20).

Figure 2. 2009 Fecal Coliform Summer Seasonal GeoMeans

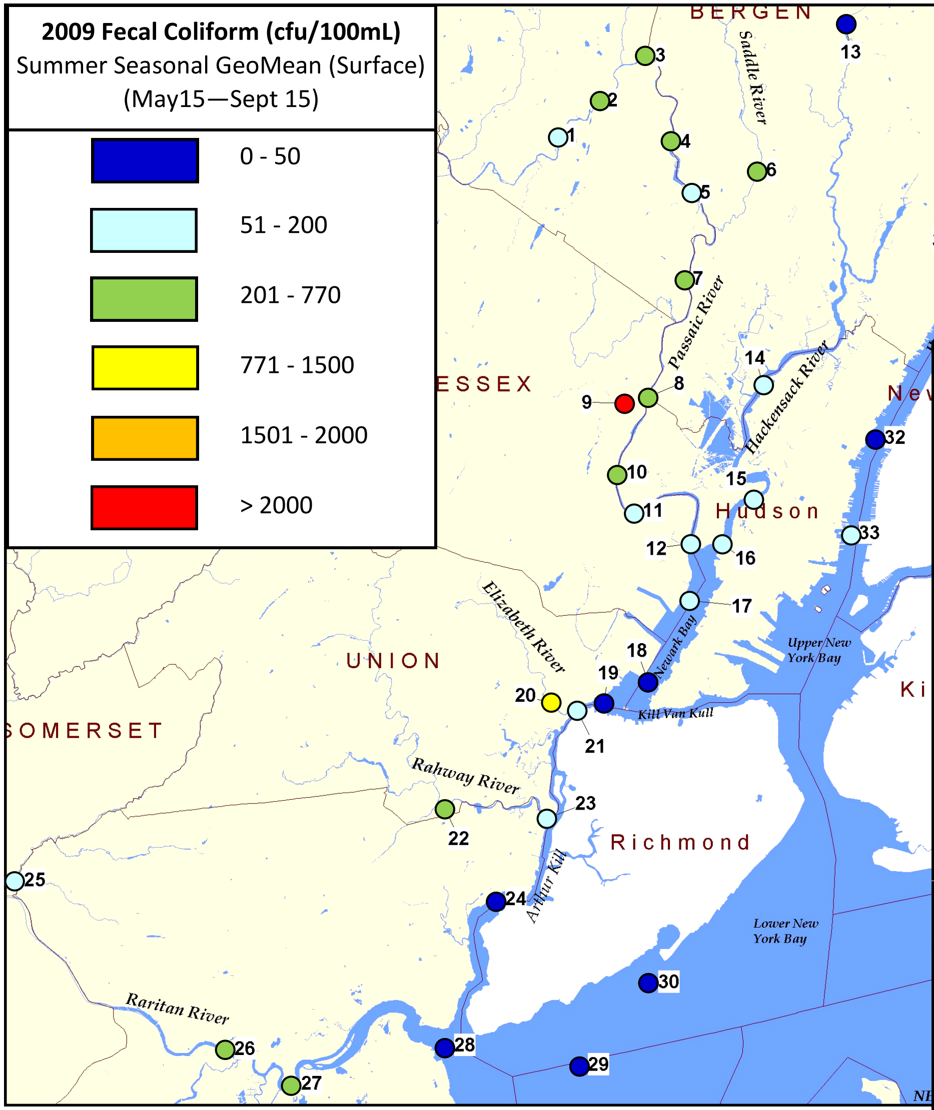
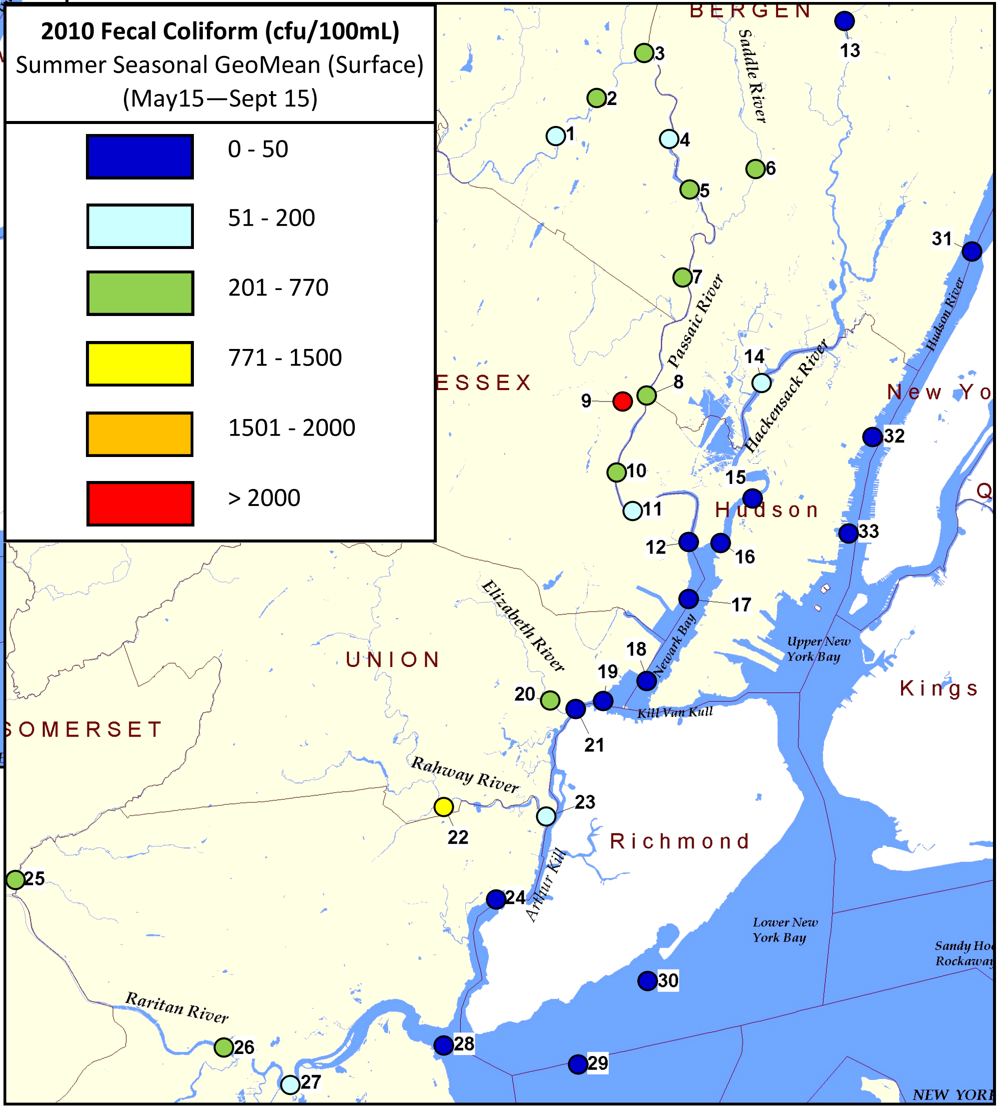


Figure 3. 2010 Fecal Coliform Summer Seasonal GeoMeans



Fecal Coliform Trends

Figure 4. Fecal Coliform Trends—FW2-NT Passaic River & Tributaries

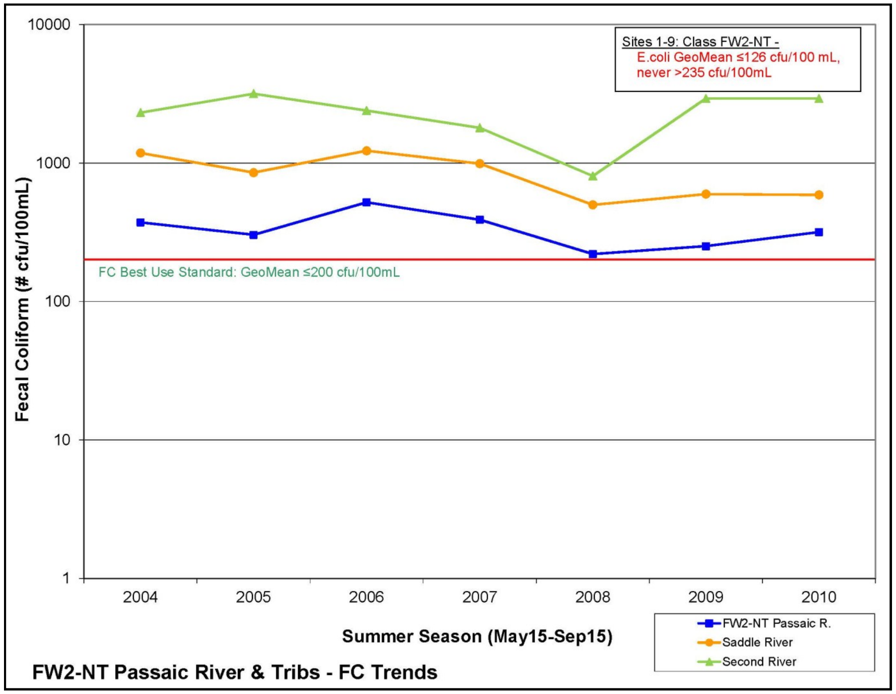


Figure 5. Fecal Coliform Trends—SE3 Passaic River

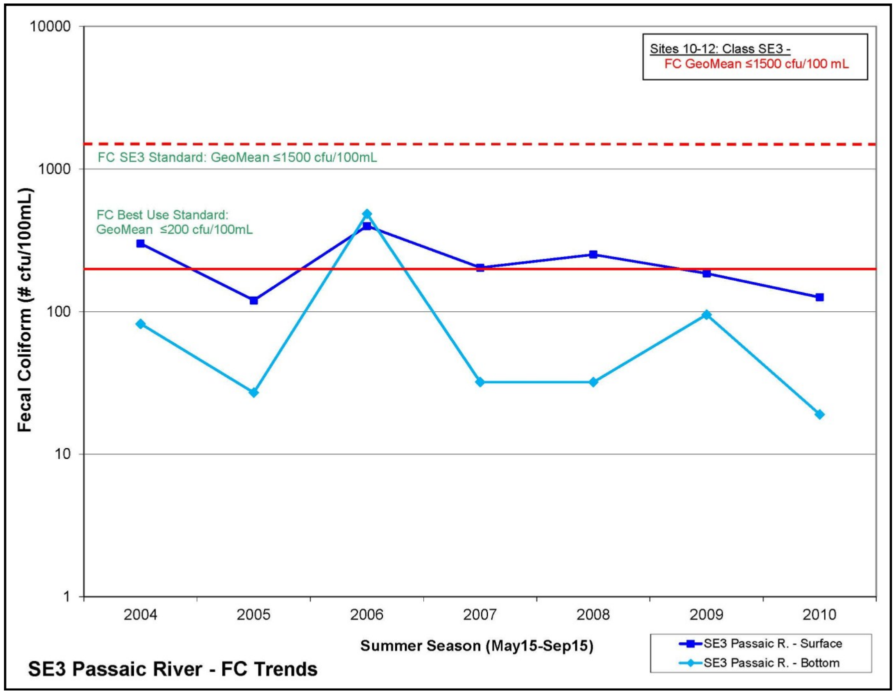


Figure 6. Fecal Coliform Trends—Hackensack River

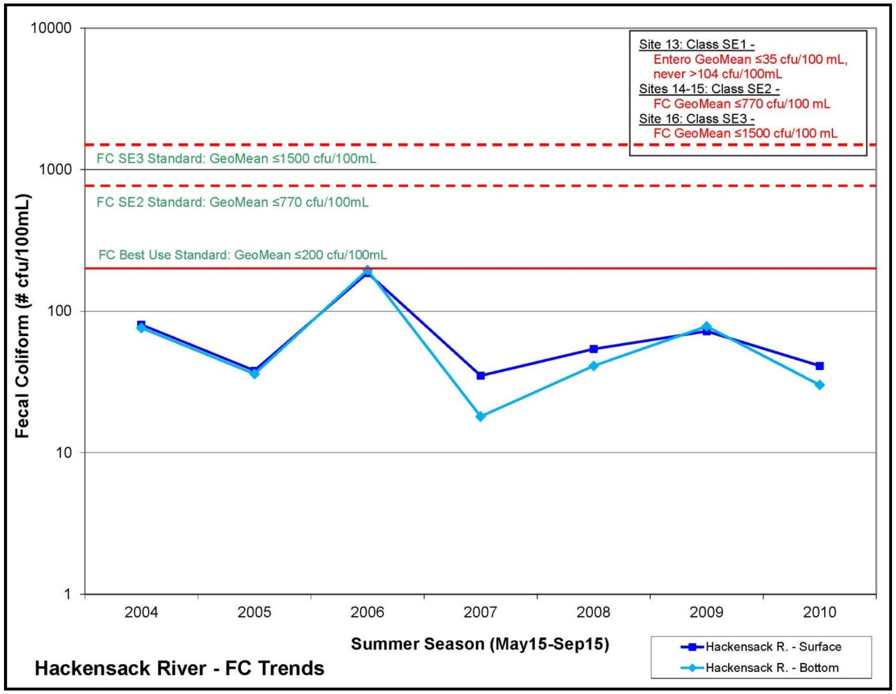
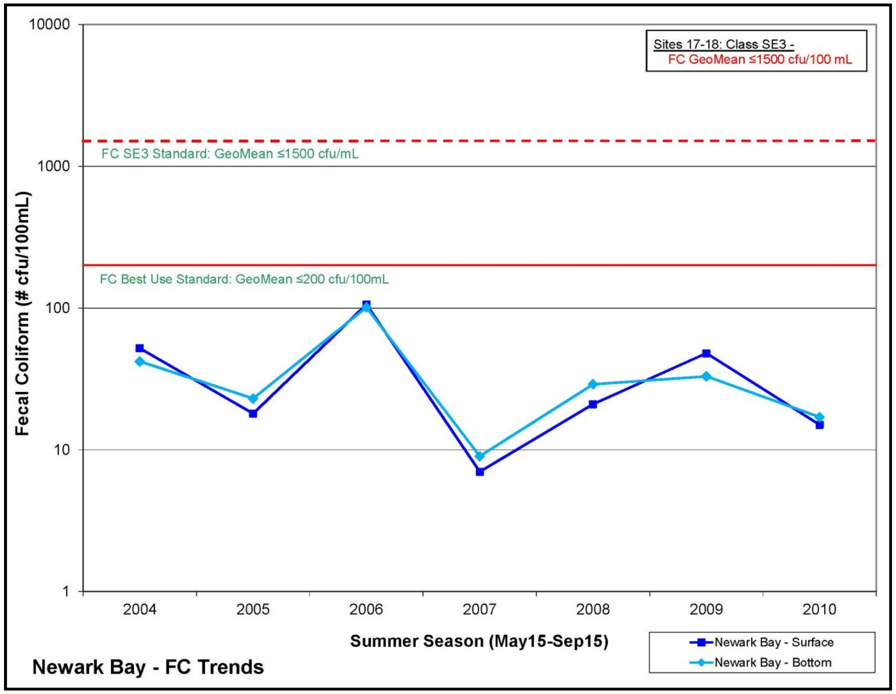


Figure 7. Fecal Coliform Trends—Newark Bay



Fecal Coliform Trends

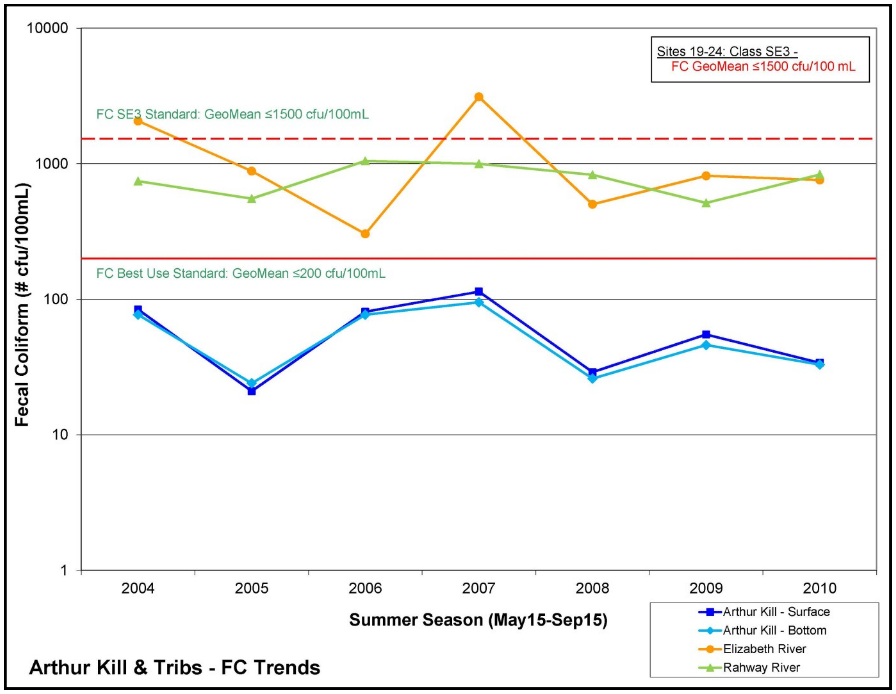


Figure 8. Fecal Coliform Trends—Arthur Kill & Tributaries

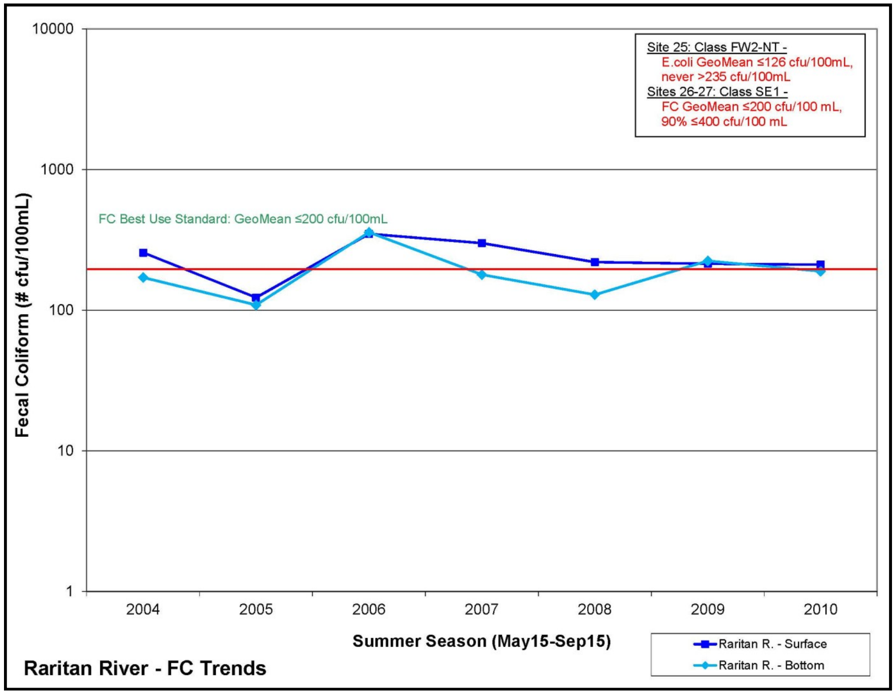


Figure 9. Fecal Coliform Trends—Raritan River

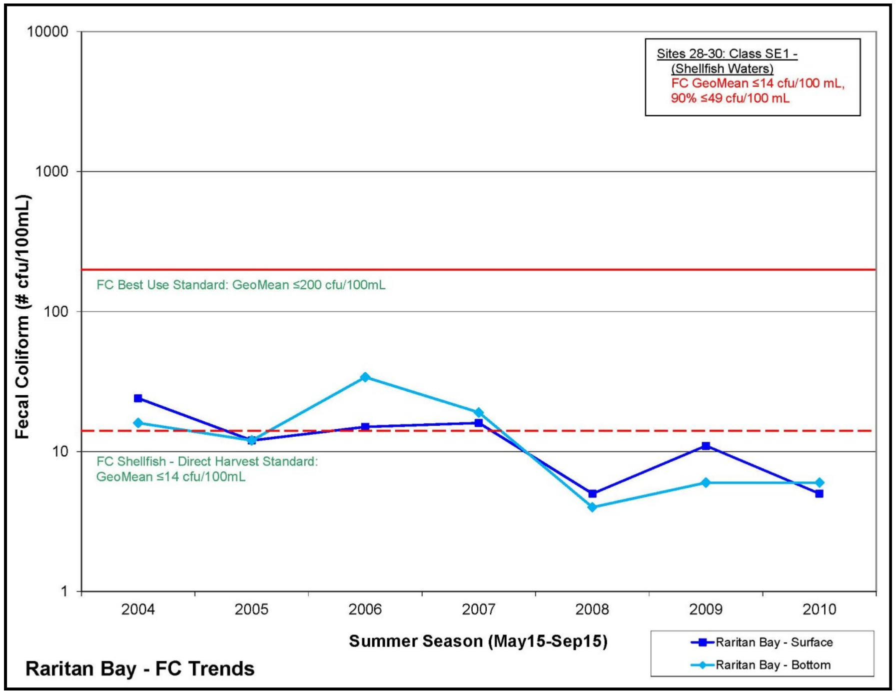


Figure 10. Fecal Coliform Trends—Raritan Bay

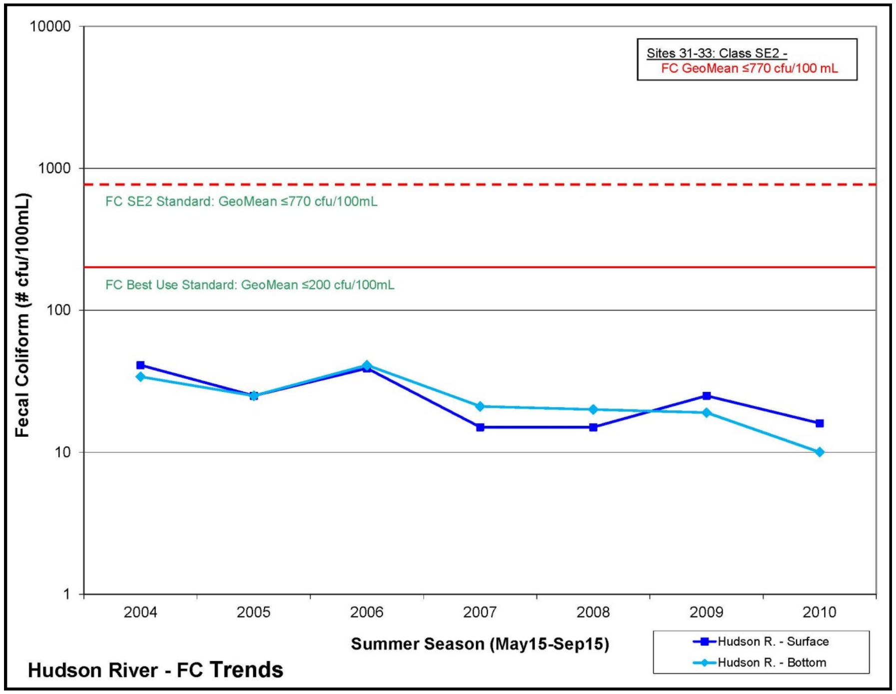


Figure 11. Fecal Coliform Trends—Hudson River

Enterococcus Bacteria

Enterococcus bacteria are a type of fecal streptococci bacteria that inhabit the gastrointestinal tracts of warm-blooded animals. Like fecal coliform bacteria, the presence of enterococcus bacteria in surface waters is a sign of contamination with fecal matter from humans and other animals. Enterococcus is another "indicator organism" for the presence of potential disease-causing organisms. Therefore, high concentrations of enterococcus bacteria in a waterbody is indicative of poor water quality.

In October 2006, the New Jersey Department of Environmental Protection (NJDEP) revised the Surface Water Quality Standards (SWQS) for pathogens. A new standard for SE1 Class waterbodies was put into place to replace the former fecal coliform standard. This action was based on the belief that enterococcus bacteria has a greater correlation with human-specific pathogens than fecal coliform bacteria, and therefore has a greater correlation with swimming-related gastrointestinal illness in humans. Enterococcus bacteria are also believed to survive longer in saline waters. For these reasons, enterococcus replaced fecal coliform as the standard for determining the water quality of bathing beaches and other marine recreational areas. The current SE1 Surface Water Quality Standards for SE1 waters based on enterococcus concentrations is a 30-day geometric mean ≤35 cfu/100mL and never >104 cfu/100mL. SE2 and SE3 water quality criteria are still based on fecal coliform standards, while freshwaters are now based on a new e.coli standard.

Like the fecal coliform standards, the enterococcus standard is based on a monthly geometric mean value for a minimum of five (5) samples in a thirty (30) day period. The NJHDG Long-Term Ambient Water Quality Program monitors for enterococcus bacteria at the same frequency as all other parameters (once per week during the summer season from May through September and once per month during the winter season from October through April). It is not always possible to obtain 5 viable enterococcus results at each site in a 30-day period due to a variety of reasons (e.g. scheduling, inclement weather, unscheduled equipment maintenance, inconclusive laboratory results). Therefore, it is not possible to calculate 30-day geometric means with at least 5 samples in 30 days for direct comparison to the enterococcus standard. For this report, summer seasonal geometric means (from May 15—Sept 15) were calculated (Figures 11-12). This timeframe coincides with the beach bathing season, when compliance with the enterococcus standard is mandatory to ensure the protection of human health. May 15—Sept 15 is also the timeline used by the NY-NJ Harbor & Estuary Program (HEP) Pathogens Workgroup in their efforts to determine a Total Maximum Daily Load (TMDL) for pathogens in the NY/NJ Harbor.

In 2009, the highest enterococcus summer seasonal geometric mean of 718 cfu/100mL was calculated at the Second River site (Site 9), followed by 311 cfu/100mL at the Saddle River site (Site 6). 2009 summer seasonal geometric means at the other monitoring locations ranged from 2 cfu/100mL in Raritan Bay (Site 29) to 256 cfu/100mL in the Rahway River (Site 22).

Again in 2010, the highest enterococcus summer seasonal geometric mean of 1,036 cfu/100mL was calculated at the Second River site (Site 9), followed by 615 cfu/100mL at the Saddle River site (Site 6). 2010 summer seasonal geometric means at the other monitoring locations ranged from 3 cfu/100mL in Raritan Bay (Site 30) to 489 cfu/100mL in the Rahway River (Site 22).

It is not surprising that enterococcus results are similar to fecal coliform results in that the highest concentrations are observed at the tributary sites: the Saddle River (Site 6) and Second River (Site 9) are tributaries of the Passaic River, and the Elizabeth River (Site 20) and Rahway River (Site 22) are tributaries of the Arthur Kill.

Enterococcus summer seasonal geometric means were routinely well below the standard for primary contact recreation (geometric mean ≤35 cfu/100mL, never >104 cfu/100mL) in open waters where bathing would most likely occur within the NY/NJ Harbor (i.e. Raritan Bay).

Figure 12. 2009 Enterococcus Summer Seasonal GeoMeans

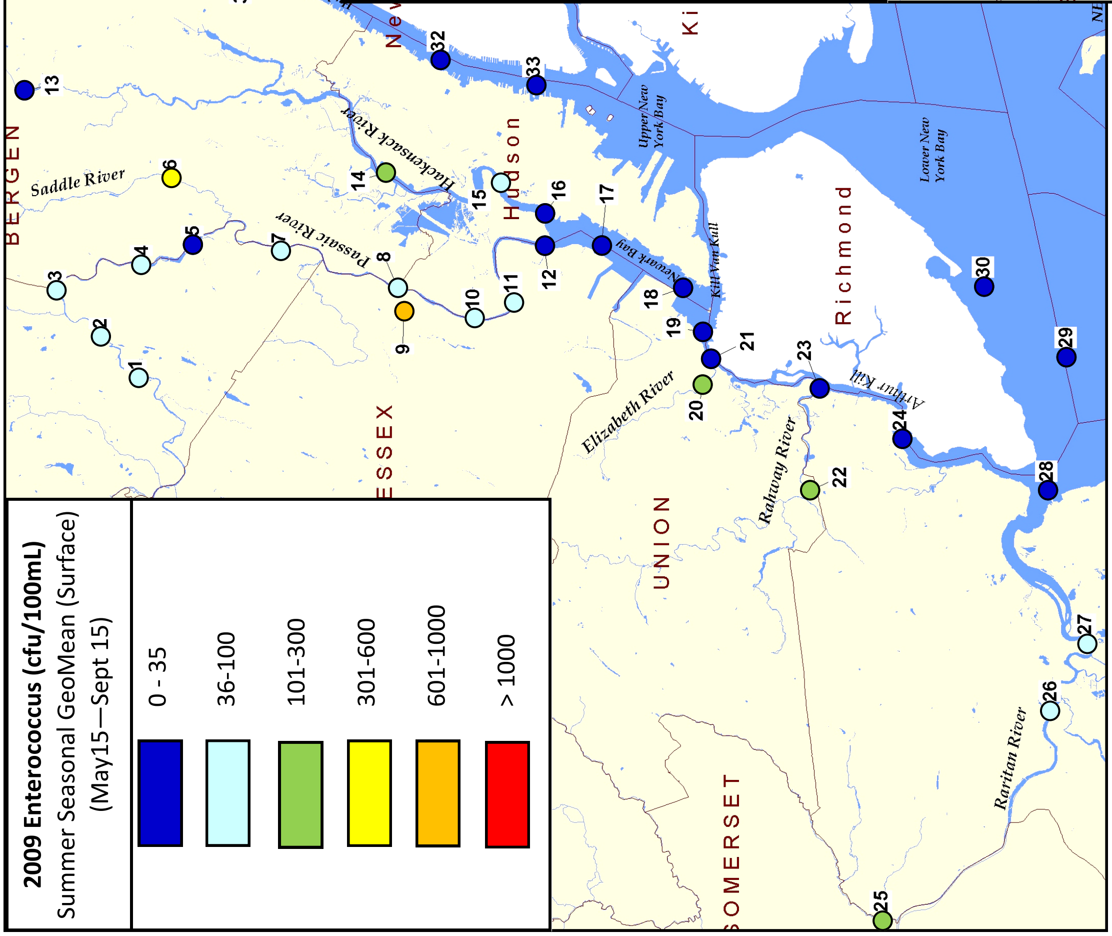
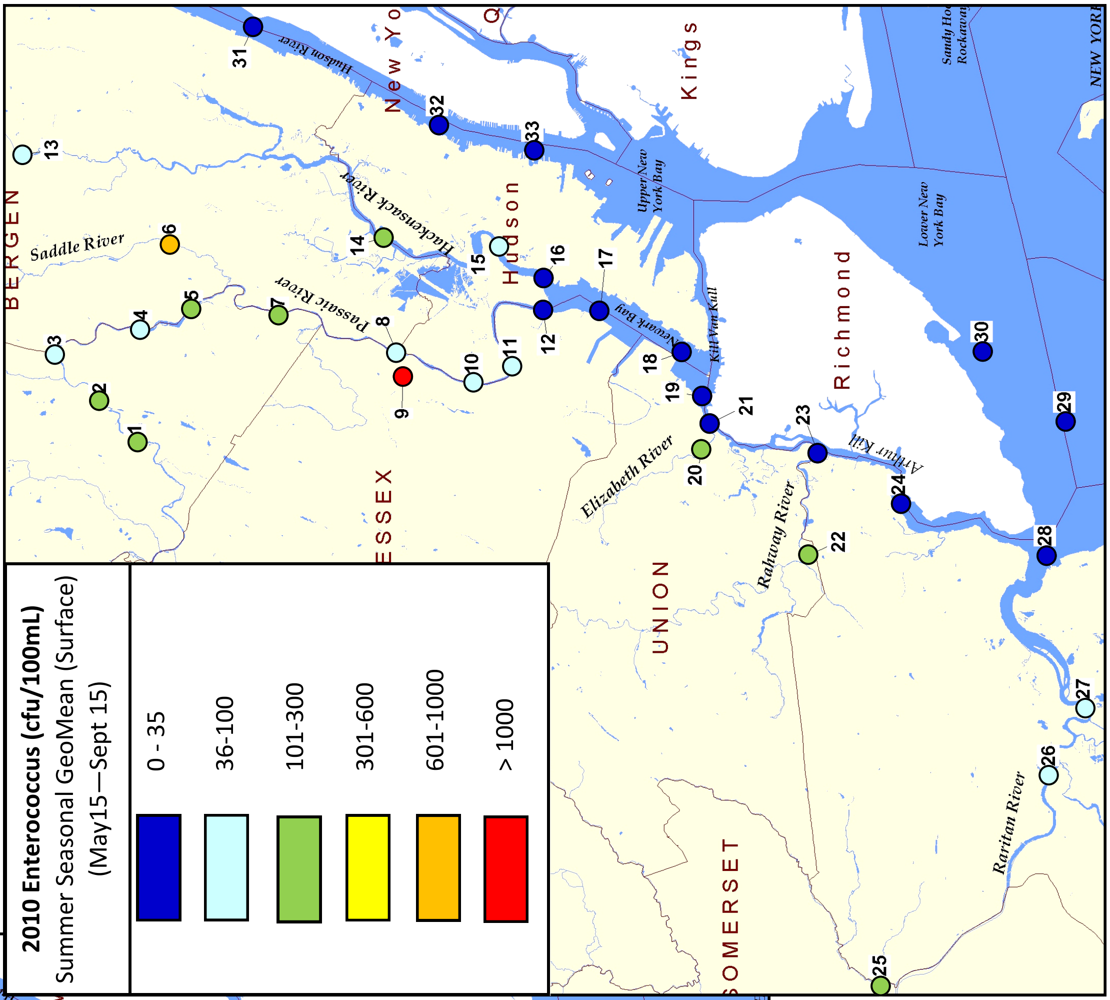


Figure 13. 2010 Enterococcus Summer Seasonal GeoMeans



Enterococcus Trends

Figure 14. Enterococcus Trends—FW2-NT Passaic River & Tributaries

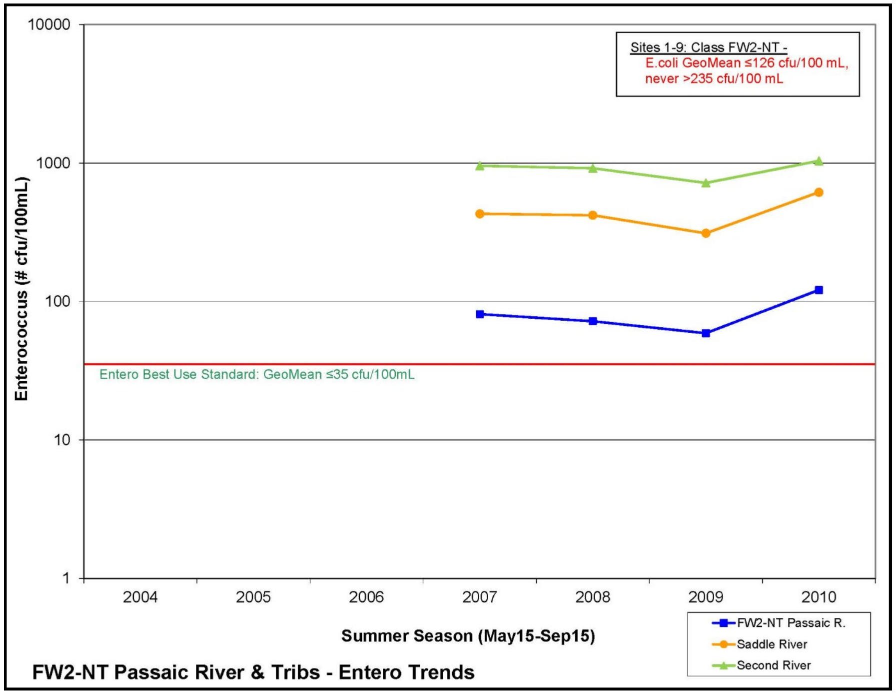


Figure 15. Enterococcus Trends—SE3 Passaic River

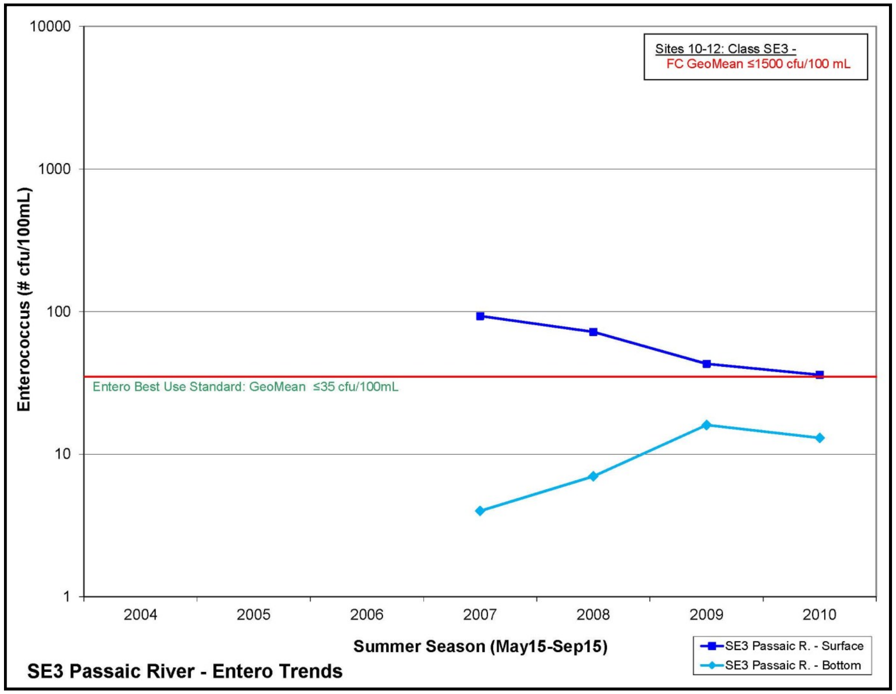


Figure 16. Enterococcus Trends—Hackensack River

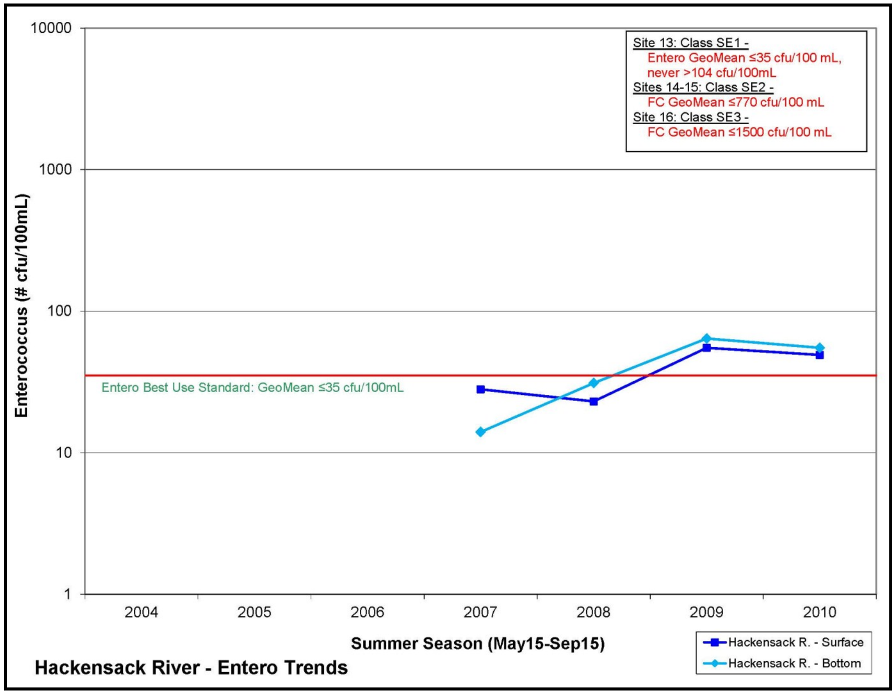


Figure 17. Enterococcus Trends—Newark Bay

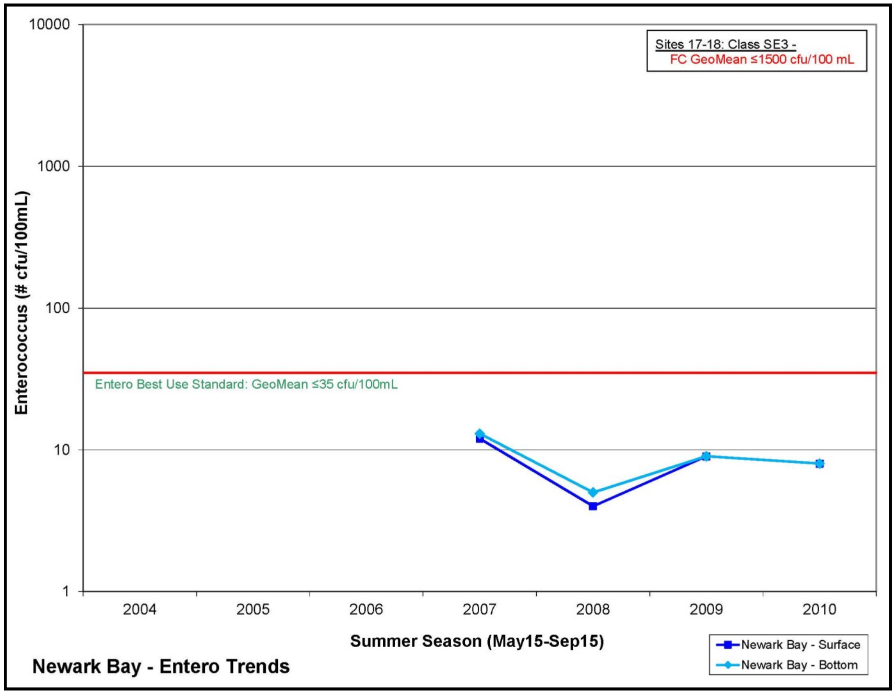


Figure 18. Enterococcus Trends—Arthur Kill & Tributaries

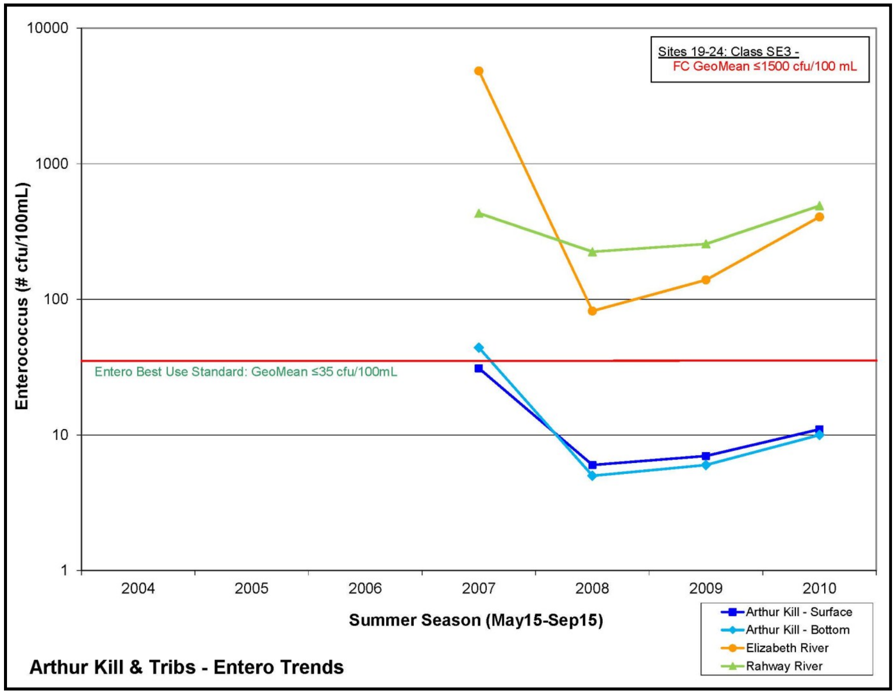


Figure 19. Enterococcus Trends—Raritan River

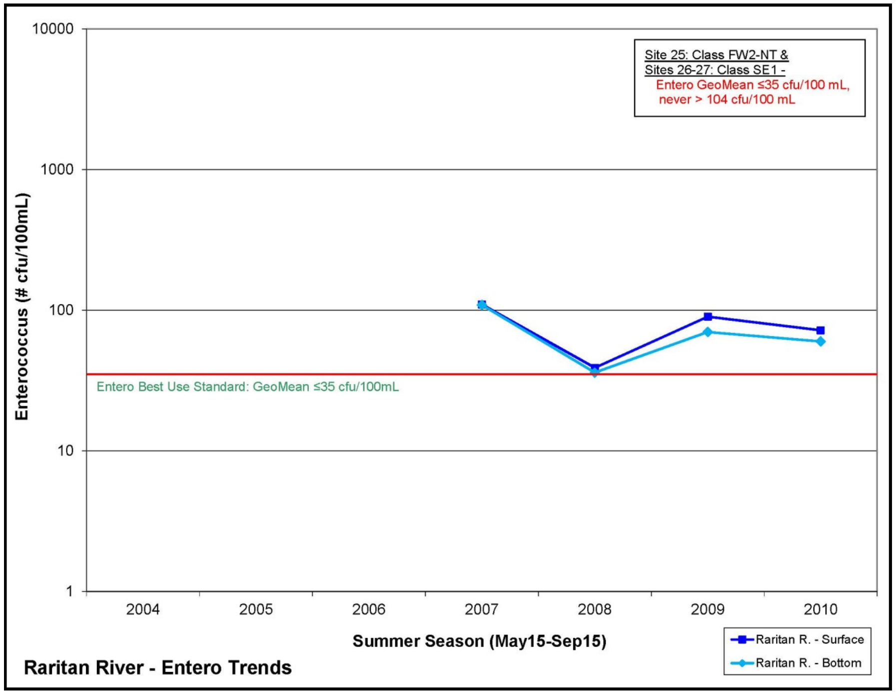


Figure 20. Enterococcus Trends—Raritan Bay

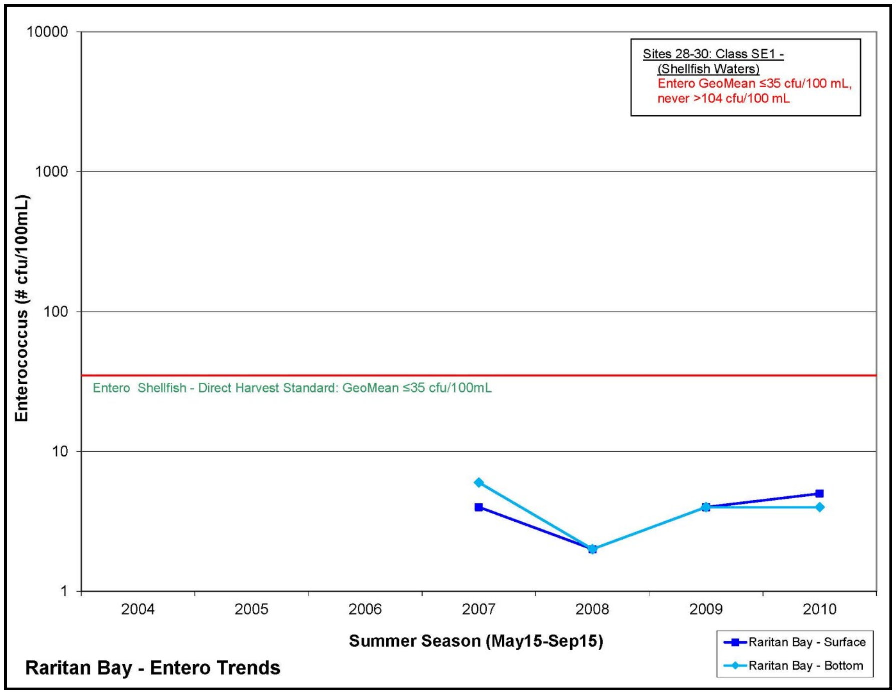
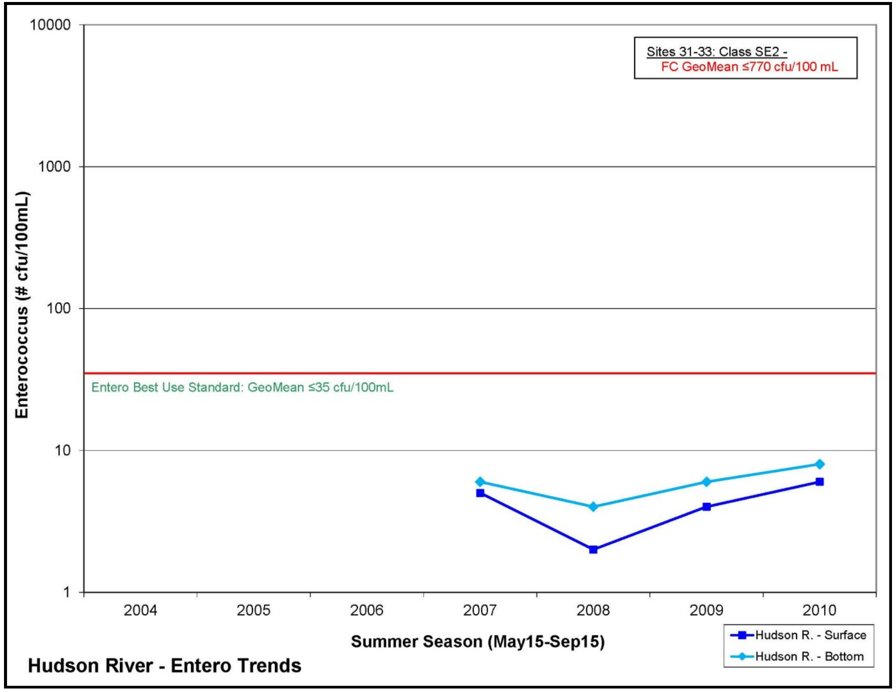


Figure 21. Enterococcus Trends—Hudson River



Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important parameters used to monitor water quality and the overall health of an aquatic system. Sufficient levels of oxygen dissolved in the water are necessary for the survival of aerobic aquatic species, including fish and the organisms upon which fish feed. Aquatic life generally require dissolved oxygen concentrations above 3.0 mg/L to survive, and some species become stressed when DO levels drop below 5.0 mg/L.

It should be noted that all dissolved oxygen measurements for the NJHDG Long-Term Ambient Water Quality Monitoring Program were taken during daylight hours, when DO levels are expected to be highest as a result of photosynthetic activity in algae and aquatic plants.

Since measurements of dissolved oxygen were only taken once per day, it is not possible to compare results to the standards involving 24-hour averages (FW2, SE1, and shellfish waters). Therefore, the DO data can only be compared to the "never less than" standards for each waterbody classification. FW2-NT, SE1, SE2, and shellfish waterbodies were compared to the "never less than 4.0 mg/L" standard, and the SE3 waterbodies were compared to the "never less than 3.0 mg/L" standard by looking at the minimum measured DO concentrations.

Summer seasonal dissolved oxygen minima (from May 15—Sept 15) were depicted on maps of NJHDG monitoring locations (Figures 21-22), since DO levels are expected to be lowest in the warm summer months and at deeper depths within the water column. High water temperatures and low stream flows also contribute to lower DO levels during the summer season.

The greatest summer seasonal minimum dissolved oxygen concentrations were observed at the Second River site (Site 9), where minimum DO concentrations were 8.54 mg/L in 2009 and 7.92 mg/L in 2010.

In contrast, there were a number of observed DO measurements below 3.0 mg/L observed throughout the Harbor. In 2009, a minimum DO concentration of 1.05 mg/L was observed at the Hackensack River head-of-tide site (Site 13), 2.70 mg/L in the Hackensack River (Site 14), 2.96 in the Arthur Kill (Site 24), and 2.63 mg/L in Raritan Bay (Site 18). In 2010, a minimum DO concentration of 2.31 mg/L was observed in the Passaic River at Clay Street (Site 10), 2.38 mg/L in the Passaic River at Jackson Street (Site 11), 2.67 mg/L in both the Hackensack River (Site 14) and at the Raritan River head-of-tide site (Site 25), and 2.87 in the Rahway River (Site 22).

Dundee Dam on the Passaic River

Figure 22. 2009 Dissolved Oxygen Summer Seasonal Minimum Results

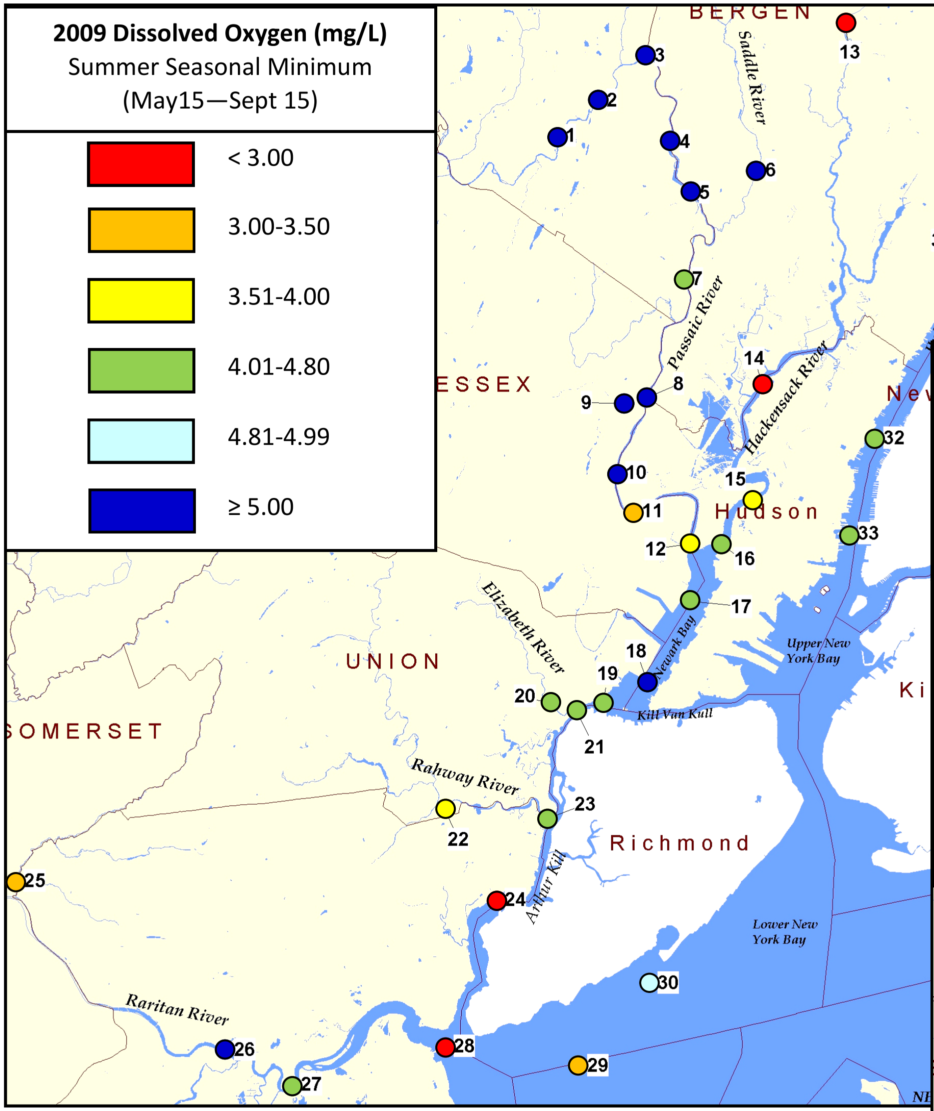
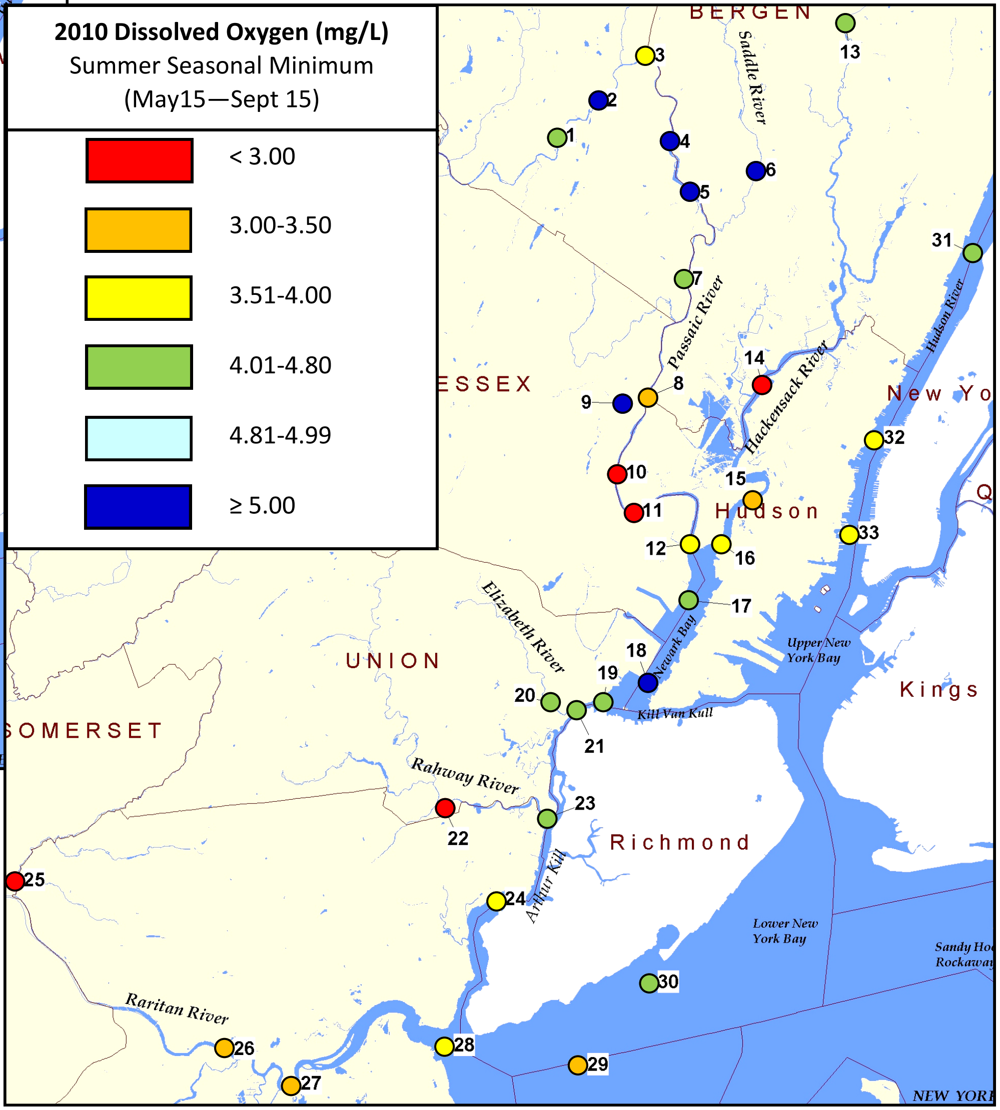


Figure 23. 2010 Dissolved Oxygen Summer Seasonal Minimum Results



Dissolved Oxygen Trends

Figure 24. Dissolved Oxygen Trends—FW2-NT Passaic River & Tributaries

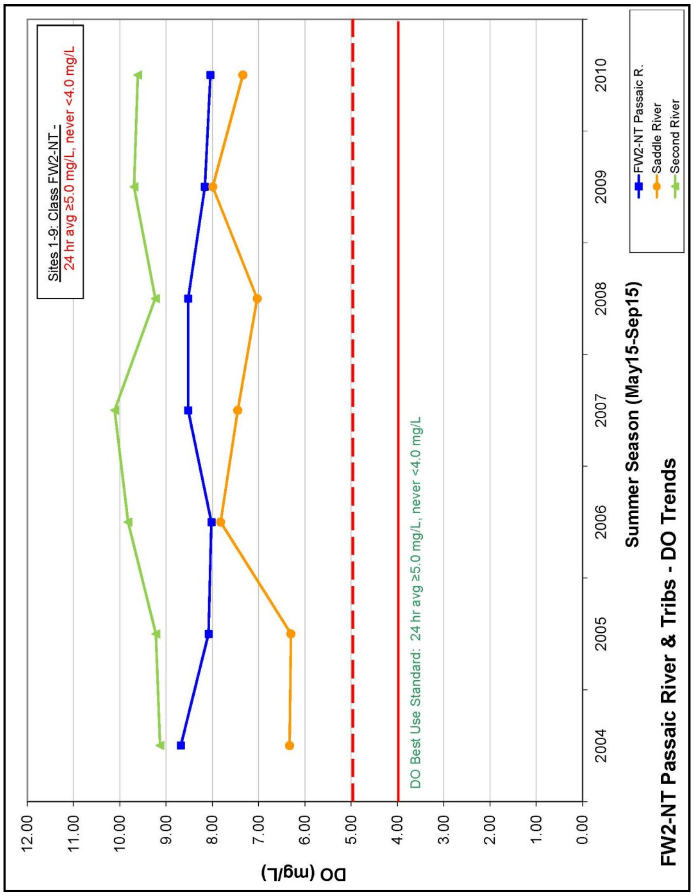


Figure 25. Dissolved Oxygen Trends—SE3 Passaic River

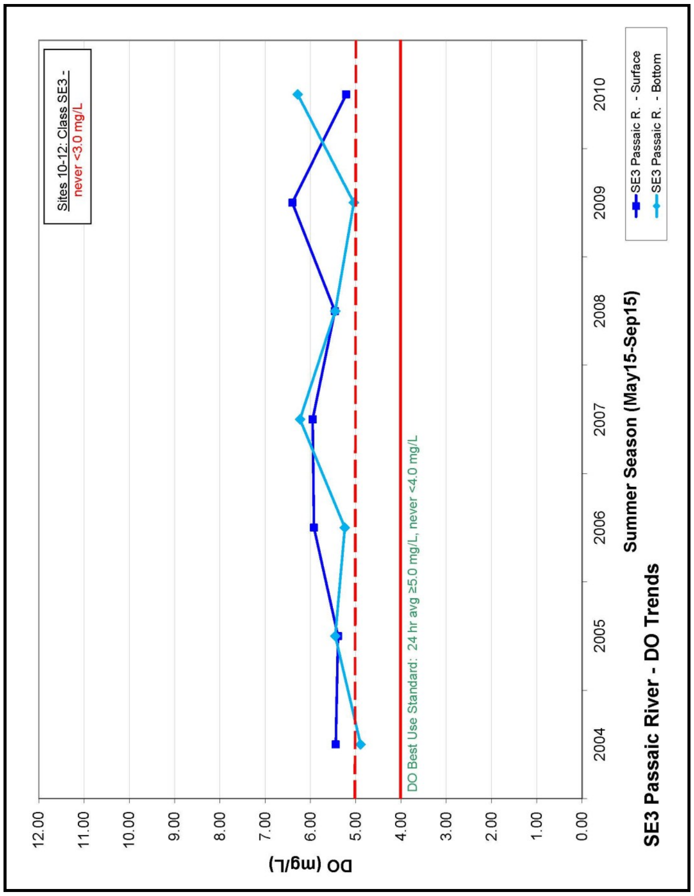


Figure 26. Dissolved Oxygen Trends—Hackensack River

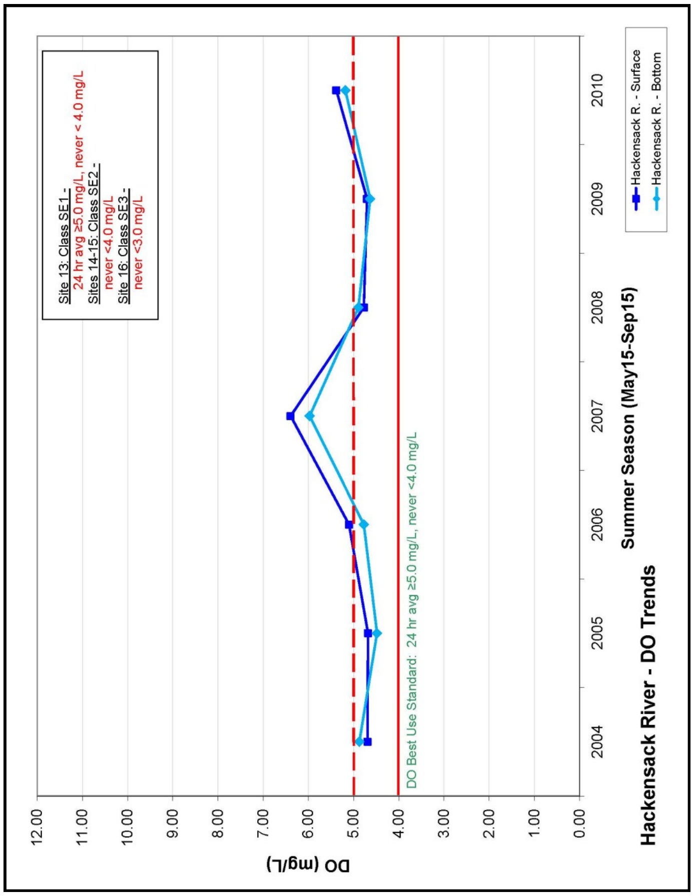
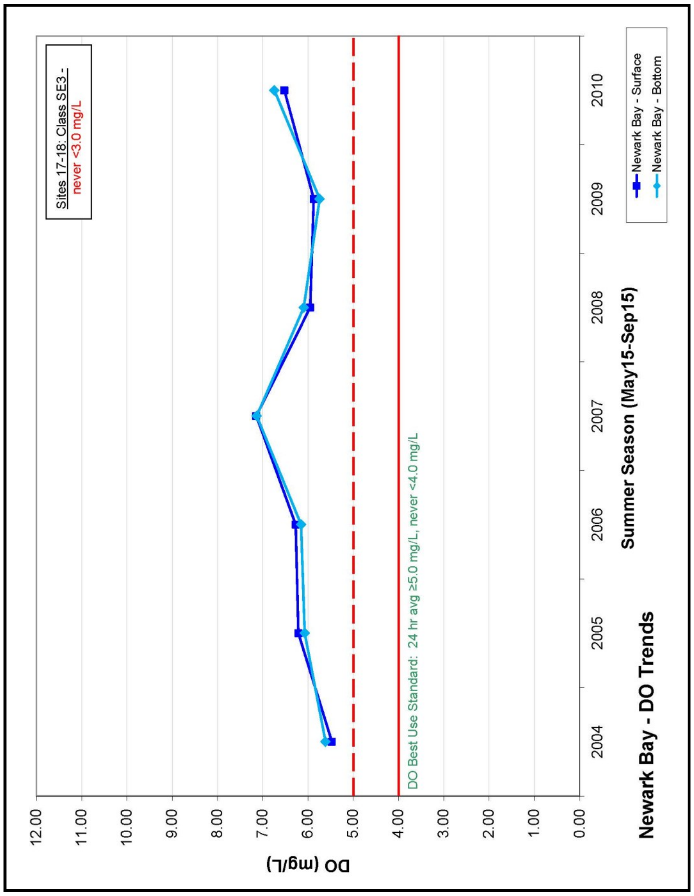


Figure 27. Dissolved Oxygen Trends—Newark Bay



Dissolved Oxygen Trends

Figure 28. Dissolved Oxygen Trends—Arthur Kill & Tributaries

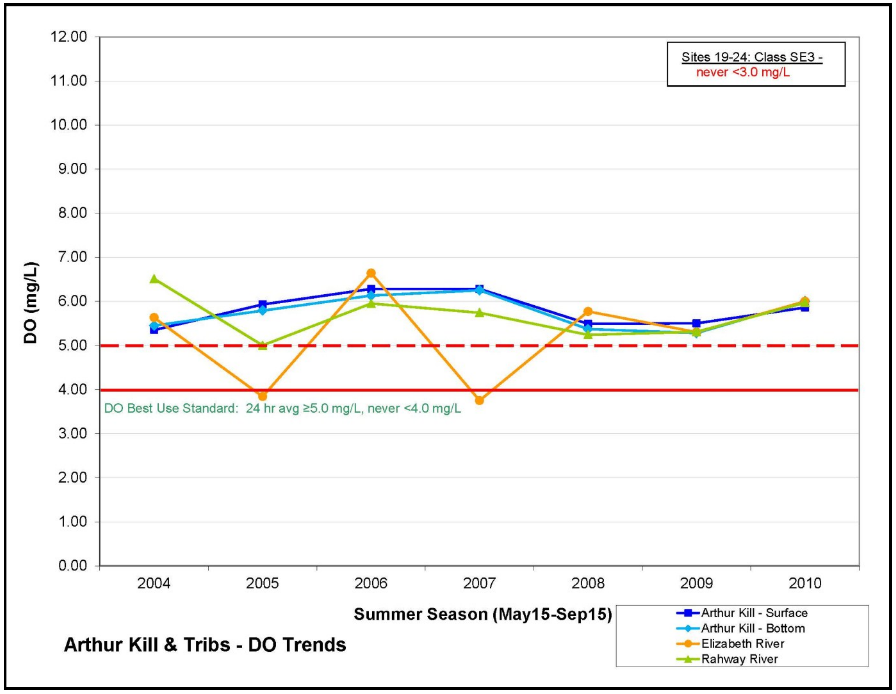


Figure 29. Dissolved Oxygen Trends—Raritan River

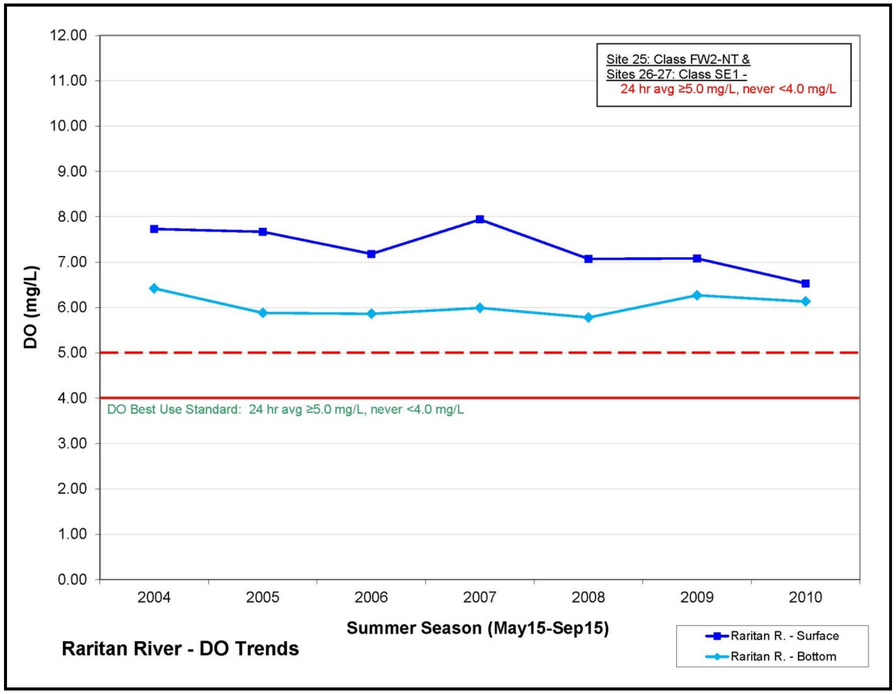


Figure 30. Dissolved Oxygen Trends—Raritan Bay

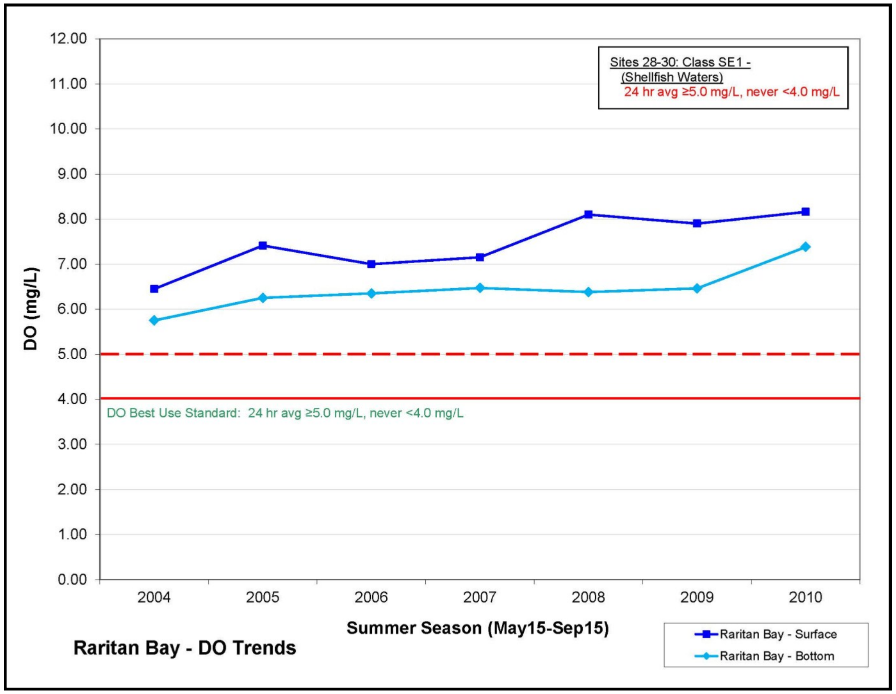
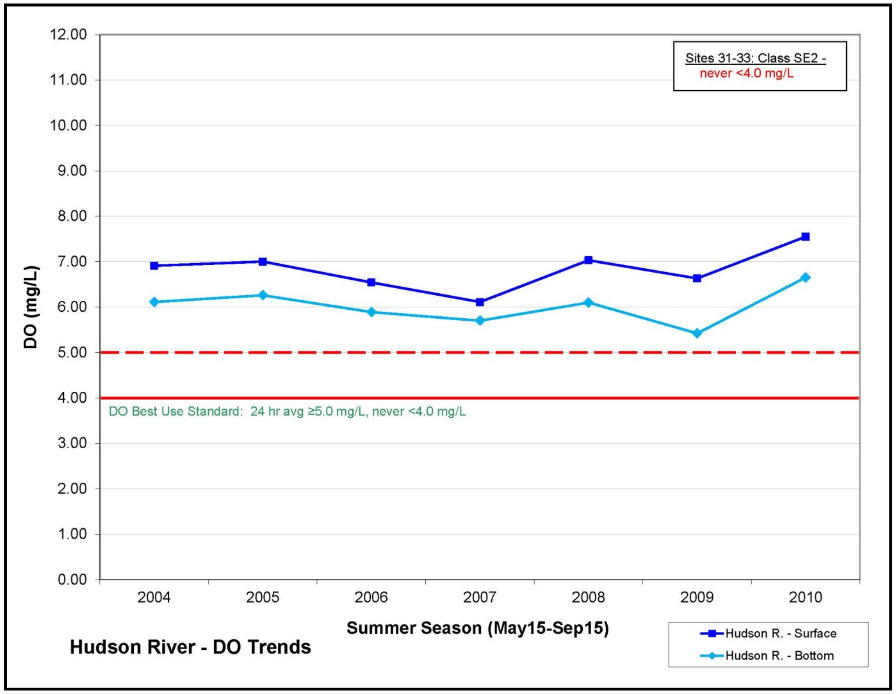


Figure 31. Dissolved Oxygen Trends—Hudson River



New Jersey Harbor
Dischargers Group

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