Environmental Protection

City-Wide Long-Term CSO Control Planning Project

Westchester Creek Waterbody/Watershed Facility Plan Report

The City of New York

Department of Environmental Protection

Bureau of Wastewater Treatment

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Executive Summary

The New York City Department of Environmental Protection (DEP) has prepared this Westchester Creek Waterbody/Watershed (WB/WS) Facility Plan as required by the Administrative Order on Consent between the DEP and the New York State Department of Environmental Conservation (DEC). Designated as DEC Case #CO2-20000107-8 (January 14, 2005, as modified April 14, 2008 as DEC Case #CO2-20070101-1 and September 3, 2009 as DEC Case #CO2-20090318-30) and also known as the Combined Sewer Overflow (CSO) Consent Order, the Administrative Consent Order requires DEP to submit an "approvable WB/WS Facility Plan" for the Westchester Creek to the DEC by June 2007.

DEP submitted a draft report in June 2007 for Westchester Creek. DEP received comments from DEC on January 20, 2010, and DEC requested that DEP finalize the revised Westchester Creek WB/WS Facility Plan by November 30, 2010. This WB/WS Facility Plan expands on the numerous CSO facility planning studies conducted over the past 20 years in the Upper East River and its tributaries. Westchester Creek is one of 18 drainage areas defined by the 2005 CSO Consent Order that encompass the entirety of the waters of the City of New York. All WB/WS Facility Plans, including the Westchester Creek WB/WS Plan, contain all elements required by the *Federal CSO Policy* and the United States Environmental Protection Agency (USEPA). A final Citywide Long Term Control Plan (LTCP) incorporating the plans for all watersheds within the City of New York is scheduled for completion by 2017.

Purpose

The purpose of this WB/WS Facility Plan is to take the first step toward the development of an LTCP for Westchester Creek. This WB/WS Facility Plan assesses the ability of the existing New York City CSO Facility Plan for the tributaries of the Upper East River (2003) to attain the existing water quality standards in Westchester Creek. Where these facilities will not result in full attainment of the existing standards, certain additional alternatives have been evaluated.

Context

This WB/WS Facility Plan is one element of the City's extensive multi-phase approach to CSO control that was started in the early 1970s. As described in more detail in Section 5, New York City has been investing in CSO control for decades. DEP has already built or is planning to build over $2.9 billion in targeted grey infrastructure to reduce CSO volumes. This does not include millions spent annually on the Nine Minimum Controls that have been in place since 1994 to control CSOs.

Regulatory Setting

This WB/WS Facility Plan has been developed in fulfillment of and pursuant to the 2005 CSO Consent Order requirements. It represents one in a series of several WB/WS Facility Plans that will be developed prior to development of a final approvable Citywide LTCP. All WB/WS Facility Plans, including the Westchester Creek WB/WS Facility Plan, contain all the elements required by the USEPA of an LTCP.

Goal of Plan

The goal of this WB/WS Facility Plan is to reduce CSO overflows to Westchester Creek through a cost-effective reduction in CSO volume and pollutants to attain existing water quality standards. This WB/WS Facility Plan assesses the effectiveness of CSO controls now in place within New York City and those that are required by the CSO Consent Order to be put in place, to attain water quality that complies with the DEC water quality standards. Where existing or proposed controls are expected to fall short of attaining water quality standards, this WB/WS Facility Plan also assesses certain additional cost-effective CSO control alternatives and strategies (i.e., water quality standards revisions) that can be employed to provide attainment with the water quality standards. The goal of the LTCP will be to quantify effectiveness of the WB/WS Facility Plan recommended CSO controls and to evaluate additional CSO controls necessary to attain existing water quality standards and/or highest attainable appropriate use.

Adaptive Management Approach

Post-construction compliance monitoring, discussed in detail in Section 8, is an integral part of the WB/WS Facility Plan, and provides the basis for adaptive management. Monitoring will commence just prior to implementation of CSO controls and will continue for several years thereafter in order to quantify the difference between the expected and actual performance once controls are fully implemented. Any performance gap identified by the monitoring program can then be addressed through design modifications, operational adjustments or additional controls. . If further CSO reductions are needed to attain water quality standards, the DEP will identify and implement additional technically feasible and cost-effective alternatives under the Long-Term Control Plan. If it becomes clear that the implemented plan will not result in full attainment of applicable standards then DEP will pursue the necessary regulatory mechanism for a Variance and/or Water Quality Standards Revision.

If additional controls are required, protocols established by the DEP and the City of New York for capital expenditures require that certain evaluations are completed prior to the construction of the additional CSO controls. Depending on the technology implemented and on the engineer's cost estimate for the project, these evaluations may include pilot testing, detailed facility planning, preliminary design, and value engineering. Each of these steps provides additional opportunities for refinement and adaptation so that the fully implemented program achieves the goals of the original WB/WS Facility Plan.

Project Description

Located in the Bronx, Westchester Creek extends from Lehmann High School on East Tremont Avenue at its head-end terminus to approximately the line between Clason's Point and Old Ferry Point where it drains to the Upper East River. For the purposes of CSO facility planning, Westchester Creek also includes Pugsley Creek, the small tidal tributary that defines the southwestern extent of the waterbody. The eastern shoreline is paralleled by the Hutchinson River Parkway along most of its northern extent, and the western shoreline is occupied by commercial and manufacturing uses. The Westchester Creek watershed is served by the Hunts Point Wastewater Treatment Plant (WWTP), which first came on-line in 1952 and has been providing full secondary treatment since that time.

Although 285,000 people presently live within the drainage area, population growth in the southern Bronx is relatively recent. The area was once comprised of an expansive complex of tidal marshland and meandering, natural streams that drained the small villages and agricultural areas along its periphery. Population growth during the 20th Century has led to a progressively more urban landscape, and the associated land development pressures triggered wetlands reclamation and shoreline filling activities. Combined with the comparatively long history of continuous commercial navigation, urbanization has deprived the waterbody of virtually all natural response mechanisms that helped absorb increased hydraulic and pollutant loads associated with it (see Table 1). Today, access to Westchester Creek is limited to City parks along the southern shorelines, none of which have formal bathing beaches or other shoreline access that might encourage swimming.

Combined and separated sewers have replaced natural freshwater streams such that the only source of freshwater to Westchester Creek is CSO and stormwater discharges. Nearly one billion gallons of combined sewage and stormwater are discharged through permitted outfalls annually (Table 1). Partly as a consequence of these discharges, depressed dissolved oxygen levels have impacted aquatic health, and water clarity is poor, especially following wet-weather events.

Westchester Creek is classified by the State of New York as a Class I waterbody, with designated best uses of secondary contact recreation and fishing. To support these uses, numerical criteria for dissolved oxygen (DO) and bacteria concentrations have been established. Historical dissolved oxygen concentrations were frequently found to show impairments and excursions below the applicable numerical criteria. Total and fecal coliform bacteria data indicate that recreational uses of Westchester Creek are also impaired, and the very high variability of bacteria data is indicative of intermittent wet-weather impacts.

In 2004 DEC listed Westchester Creek in Part 3c of the 303(d) List – Waterbodies for which TMDL Development May be Deferred (Pending Implementation/ Evaluation of Other Restoration Measures) due to low DO caused by urban sources, stormwater runoff, and CSO discharges. Westchester Creek remains listed in this section as of the 2010 303(d) List.

Table 1. Urbanization of the Westchester Creek Watershed

Watershed Characteristic	*Pre-Urbanized*	*Urbanized*[1]
Drainage area, acres	*3,624*	*4,952*
Adjacent wetlands, acres[2]	*335*	*56*
Waterbody surface area, acres	*806*	*252*
Population[4]	*43,000*	*285,000*
Percent surface imperviousness	*10%*	*70%*
Average annual runoff, MG[3]	*116*	*921*
Peak storm runoff, MG[3]	*10*	*96*

Notes: (1) Existing condition (2) Approximated from historical maps (3) For an average precipitation year (JFK, 1988), including stormwater and CSO (4) Pre-urbanized is estimated for year 1900; urbanized estimate based on Year 2000 U.S. Census.

Based on the evaluations of other restoration measures completed to date, a TMDL may not be required and may in fact delay the ability to meet the DO requirements as compared to the various control measures included in this WB/WS Facility Plan. If the WB/WS Plan for Westchester Creek attains the DO criterion the waterbody would be removed from the 303(d) List.

A variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Westchester Creek, as summarized in Table 2. Evaluated alternatives corresponded to a range of CSO reductions from the Baseline condition up to approximately 100 percent CSO abatement. Full-year model simulations were performed for each engineering alternative and the results were compared to those for a Baseline condition to determine the relative benefit of each alternative.

As a result of the evaluations completed for the Westchester Creek WB/WS Facility Plan, the greatest benefit would result from alternatives that reduce CSO volumes discharged from HP-014, the largest point of discharge at the head end of Westchester Creek. The preferred alternative, therefore, included modifications to the regulator structures that discharge to HP-014 (CSO-29 and CSO-29A), along with the WWTP upgrade and sewer cleaning alternative—the least cost alternative—for an combined probable total project cost (PTPC) of $82.6 million in June 2011 dollars. However, weir modifications at the regulators would significantly increase CSO discharges to Pugsley Creek via outfall HP-013. This increase is undesirable because the small tributary lacks the capacity to dilute CSO discharges and access by the public to this public park is expected to increase as Parks Department plans for Pugsley Creek Park are implemented. Therefore, additional alternatives to divert or mitigate the impact of the increased flow to Pugsley Creek were considered in combination with the weir modifications and WWTP upgrade. The most cost-effective of these alternatives included the construction of a parallel sewer from the regulator structure that discharges to HP-013 (CSO-24) a new junction chamber at Cornell Avenue on White Plains Road. This alternative diverts flow away from Pugsley Creek into the well-mixed Upper East River. In combination with the weir modifications, WWTP upgrade, and sewer cleaning, the PTPC is $203.9 million, 54 percent less than the cost of the $440.2 million detention facility recommended in the 2003 CSO Facility Plan.

Additional storage alternatives beyond the 2003 CSO Facility Plan were developed to capture 100 percent of the discharge for a typical year from HP-014, HP-014 and HP-016, and finally HP-014, HP-016, and HP-013. The volumes required to achieve full removal of these outfalls would be conducive to constructing CSO tunnels, but the PTCPs for these three scenarios are between approximately $1.0 and $1.2 billion.

The Selected Plan

After a complete examination of the costs and benefits of these CSO control alternatives, the scheme involving the additional capture for treatment through modifying the regulating structures at CSO-29 and CSO-29A in addition to a Pugsley Creek Parallel Sewer was selected. The weirs at CSO-29 and CSO-29A will be raised two feet from their existing crest elevations and lengthened such that the hydraulic capacities under design conditions will be greater or equal to those of the existing structures. The parallel sewer from CSO-24 to Regulator 6 will divert flow from Pugsley Creek to the Upper East River where there is considerably more dilution capacity. The additional capture for treatment along with the Pugsley Creek Parallel Sewer will reduce annual CSO volume discharged to Westchester Creek by 68 percent (from 767 MG to

Table 2. Summary of Alternatives Evaluated and Projected Performance*

Alternative	***November 2010 PTPC ($M)***	***Volume Reduction (Percent)***	***CSO Volume (MG)***	***CSO Events***	***Attainment of Criteria***			
					Dissolved Oxygen	***Total Coliform***	***Fecal Coliform***	***Floatables****
Baseline	*-*	*-*	*767*	*53*	*56%*	*67%*	*75%*	*0%*
Hunts Point WWTP Headworks Improvements and Sewer Cleaning	*$26.3*	*16%*	*648*	*46*	*60%*	*92%*	*92%*	*16%*
Additional Capture at CSO-29 and CSO-29A	*$82.6*	*30%*	*539*	*33*	*87%*	*100%*	*100%*	*30%*
Additional Capture and Floatables Control	*$94.0*	*30%*	*539*	*33*	*87%*	*100%*	*100%*	*62%*
Additional Capture and HLSS in Area 1	*$142.7*	*33%*	*514*	*33*	*87%*	*100%*	*100%*	*33%*
Additional Capture and Pugsley Creek Parallel Sewer	*$203.9*	*68%*	*247*	*33*	*87%*	*100%*	*100%*	*68%*
6. Additional Capture and HLSS in Areas 1 and 2	*$212.9*	*36%*	*494*	*33*	*87%*	*100%*	*100%*	*36%*
7. Additional Capture and HLSS in Areas 1 and 3	*$251.0*	*40%*	*462*	*33*	*87%*	*100%*	*100%*	*40%*
9. Additional Capture and HLSS in all 3 Areas	*$321.2*	*42%*	*444*	*33*	*87%*	*100%*	*100%*	*42%*
2003 Westchester Creek CSO Facility Plan	*$440.2*	*49%*	*392*	*33*	*88%*	*100%*	*100%*	*49%*
Removal of HP-014	*$1,027.6*	*78%*	*170*	*33*	*99%*	*100%*	*100%*	*78%*
Removal of HP-014 and HP-016	*$1,083.8*	*87%*	*97*	*17*	*100%*	*100%*	*100%*	*87%*
Removal of HP-013, HP-014, and HP-016	*$1,154.5*	*99%*	*10*	*5*	*100%*	*100%*	*100%*	*99%*

**Estimated; equivalent to CSO volume reduction except for floatables control, which assumes 100% removal of floatables from the remaining CSO discharges from outfall HP-013 under the 1988 rainfall conditions*

247 MG) and reduce CSO events in the waterbody from 53 events to 33 events. This alternative is expected to increase the portion of time that the dissolved oxygen criterion is attained at the head end to 87 percent, and the coliform bacteria criteria to 100 percent, roughly equivalent to the 2003 CSO Facility Plan at a much reduced cost. This is achieved by local reductions in CSO at the head end of Westchester Creek, where attainment of numerical criteria was projected to be the lowest: HP-014 is predicted to discharge 19 times in a typical year under the proposed WB/WS Facility Plan, discharging an annual CSO volume of 114 MG versus 516 MG under Baseline conditions (i.e., a 78 percent reduction).

The success of this alternative is predicated on the headworks improvements at the Hunts Point WWTP and all scenarios included the cost of these improvements along with sewer cleaning for comparison purposes. However, the costs of the upgrade is accounted for in the East River and Open Waters WB/WS Facility Plan to be submitted to DEC under separate cover, and sewer cleaning is included as part of DEP's programmatic controls. Thus, the PTPC in June 2011 dollars for implementing the proposed WB/WS Facility Plan is estimated to be $177.6 million, calculated as the alternatives evaluation cost of $203.9 million less the $26.3 million for the WWTP upgrade and sewer cleaning.

The Plan was selected based on a “knee-of-curve” analysis and is expected to attain the existing numerical criteria for a Class I waterbody under typical conditions. Dissolved oxygen attainment may not occur at all times, but the WB/WS Facility Plan is adaptive and will address any shortcoming identified during post-construction monitoring. Further, it should be noted that the Hunts Point WWTP removes more mass of BOD and TSS than required by USEPA under the presumptive approach, and the Westchester Creek WB/WS Facility Plan is expected to further improve WWTP capture performance.

Post-construction monitoring will provide feedback to facility operations, data for modeling, and information for compliance evaluations by DEC. Each year’s data set will be compiled and evaluated to refine the understanding of the interaction between Westchester Creek and the CSOs tributary to it, with the ultimate goal of improving water quality and fully attaining the numerical water quality criteria protective of the existing designated uses. DEP will monitor the performance of the proposed elements of the Plan for a number of years, during which the SPDES Permit for the Hunts Point WWTP may require variance relief from water quality-based effluent limits (WQBELs).

The *NYC Green Infrastructure Plan*, as described in Section 5.8, includes five key components: construct cost effective grey infrastructure; optimize the existing wastewater system through interceptor cleaning and other maintenance measures; control runoff from 10 percent of impervious surfaces through green infrastructure; institute an adaptive management approach to better inform decisions moving forward; and engage stakeholders in the development/implementation of these green strategies.

As part of the LTCP process, DEP will evaluate green infrastructure in combination with other LTCP strategies to better understand the extent to which green infrastructure would provide incremental benefits and would be cost-effective. DEP models will be refined by including new data collected from green infrastructure pilots, new impervious cover data and extending predictions to ambient water quality for the development of the LTCP. Based on these evaluations, and in combination with cost effective grey infrastructure, DEP will reassess the green infrastructure strategy.

In addition to the proposed WB/WS Facility Plan and Citywide implementation of green infrastructure, DEP currently operates several programs designed to reduce CSO to a minimum and provide levels of treatment appropriate to protect waterbody uses. As the effects of implementation become understood through long-term monitoring, the following ongoing programs will be routinely evaluated based on receiving water quality considerations.

- The 14 BMPs for CSO control required under the City's 14 WWTP SPDES permits will continue. In general, the BMPs address operation and maintenance procedures, maximum use of existing systems and facilities and reduce contaminants in the combined sewer system, thereby reducing water quality impacts. A detailed discussion of the existing BMP program is included in Section 5.3.
- Maintaining the capability of the recently constructed headworks upgrade at the Hunts Point WWTP to convey up to 400 mgd (2×DDWF) through preliminary treatment, primary clarification and chlorination along with a portion of the wet weather flow through secondary treatment is a key component to capture CSO for all WB/WS Facility Plans in the Hunts Point WWTP service area, including Westchester Creek.
- The Citywide Comprehensive CSO Floatable Plan (DEP, 2005a) provides substantial control of floatables discharges from CSOs throughout the City and provides for compliance with appropriate DEC and IEC requirements. The Floatables Plan is a living program that is expected to change over time based on continual assessment and changes in related programs.

Although initiated well before the development and issuance of the federal CSO policy, the East River CSO Facility Plan accurately identified outfall HP-014 at the head end of Westchester Creek as the most critical outfall to water quality in the waterbody. Using the watershed-based approach that the federal CSO policy expects, the Westchester Creek WB/WS Facility Plan builds on the previous work, and with the benefit of increased computational ability arrived at essentially the same conclusion reached in the 1990s. However, a low-cost alternative was identified that achieves equivalent or superior water quality benefits to the more cost-intensive tank construction and is therefore the preferred alternative recommended in this Plan.

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1.0. Introduction

The City of New York owns and operates 14 wastewater treatment plants (WWTPs) and their associated collection systems. The collection system contains approximately 450 combined sewer overflows (CSOs) located throughout the New York Harbor complex. The New York City Department of Environmental Protection (DEP) operates and maintains the wastewater collection system and WWTPs and has executed a comprehensive watershed-based approach to address the impacts of these CSOs on water quality and uses of the waters of New York Harbor. As illustrated in Figure 1-1, multiple waterbody assessments are being conducted that consider all causes of non-attainment of water quality standards and identify opportunities and requirements for maximizing beneficial uses. This Waterbody/Watershed (WB/WS) Facility Plan Report provides the details of the assessment and the actions that will be taken to improve water quality in one of these waterbodies, Westchester Creek (item 12 on Figure 1-1), which includes Pugsley Creek for the purposes of Plan development.

New York City's environmental stewardship of the New York Harbor began in 1909 with water quality monitoring "to assess the effectiveness of New York City's various water pollution control programs and their combined impact on water quality" that continues to this day. (DEP, 2000). CSO abatement has been ongoing since at least the 1950s, when conceptual plans were first developed for the reduction of CSO discharges into Spring Creek, other confined tributaries in Jamaica Bay, and the East River. From 1975 through 1977, the City conducted a harbor-wide water quality study funded by a Federal Grant under Section 208 of the Water Pollution Control Act Amendments of 1972. This study confirmed tributary waters in the New York Harbor were negatively impacted by CSOs. In addition, occurrences of dry weather discharges – which DEP has since eliminated – were also confirmed. In 1984 a Citywide CSO abatement program was developed that initially focused on establishing planning areas and defining how facility planning should be accomplished. As part of that plan, the City was divided into eight individual project areas that together encompass the entirety of the New York Harbor. Four open water project areas (East River, Jamaica Bay, Inner Harbor and Outer Harbor), and four tributary project areas (Flushing Bay, Paerdegat Basin, Newtown Creek, and Jamaica Tributaries) were defined. For each project area, water-quality CSO Facility Plans were developed as required under the State Pollutant Discharge Elimination System (SPDES) permits for each WWTP. The SPDES permits, administered by the New York State Department of Environmental Conservation (DEC), apply to CSO outfalls as well as plant discharges and contain conditions for compliance with applicable federal and New York State requirements for CSOs.

In 1992, DEP entered into an Administrative Consent Order with DEC which incorporated into the SPDES permits a provision stating that the consent order governs DEP's obligations for its CSO program. The 1992 Order was modified in 1996 to add a catch basin cleaning, construction, and repair program. A new Consent Order became effective in 2005 that superseded the 1992 Consent Order and its 1996 modifications, with the intent to bring all CSO-related matters into compliance with the provisions of the Federal Clean Water Act (CWA) and New York State Environmental Conservation Law. The new Order contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for

Citywide long-term CSO control. DEP and DEC also entered into a separate Memorandum of Understanding (MOU) to facilitate water quality standards (WQS) reviews in accordance with the federal CSO control policy. The 2005 Order was subsequently modified in 2008 and 2009.

This Westchester Creek WB/WS Facility Plan Report is explicitly required by item IX.B.1, Appendix A of the 2005 Consent Order, and is intended to be consistent with the United States Environmental Protection Agency's (USEPA) CSO Control Policy, promulgated in 1994. This policy requires municipalities to develop a long-term plan for controlling CSOs (i.e., a Long-Term Control Plan or LTCP). The CSO policy became law in December 2000 with the passage of the Wet Weather Water Quality Act of 2000. The approach to developing the LTCP is specified in USEPA's CSO Control Policy and Guidance Documents, and involves the following nine minimum elements:

1. System Characterization, Monitoring and Modeling;
2. Public Participation;
3. Consideration of Sensitive Areas;
4. Evaluation of Alternatives;
5. Cost/Performance Consideration;
6. Operational Plan;
7. Maximizing Treatment at the Treatment Plant;
8. Implementation Schedule; and
9. Post Construction Compliance Monitoring Program.

Subsequent sections of this WB/WS Facility Plan report will discuss each of these elements in more depth, along with the simultaneous coordination with State Water Quality Standard (WQS) review and revision as appropriate.

1.1. WATERBODY/WATERSHED ASSESSMENT AREA

Located in the eastern section of the Bronx, Westchester Creek generally extends south of Westchester Avenue in the Bronx and parallels the Hutchinson River Parkway until Westchester and Pugsley Creeks merge with the Upper East River. This waterbody/watershed straddles, the border between Bronx Community Districts 9 and 10, and includes all tidal wetlands, riparian areas, and associated upland areas. Figure 1-1 illustrates the Westchester Creek assessment area. Parks and undeveloped properties adjacent to Westchester Creek that drain to the waterbody via overland runoff are included in the 5,000 acre study area. The sewershed includes portions of the combined and separately sewered service areas of the Hunts Point WWTP, spanning Bronx Community Districts 9, 10, 11, and 12.

Although considered tributary to the Upper East River, neither Westchester nor Pugsley Creeks have any natural freshwater flow. Based on topography, the natural tributary watershed would be approximately 3,600 acres. However, sewer system construction, urban development and other alterations to the watershed and runoff pathways have resulted in approximately 5,000 acres of drainage area tributary to Westchester and Pugsley Creeks. Combined sewers from the Hunts Point

WWTP collection system serve 4,271 acres of this area and include six CSO outfalls that discharge directly to Westchester and Pugsley Creeks. An additional 61 point source discharges have also been identified during shoreline surveys of the waterbody, nearly all of which were identified as stormwater conveyances from adjacent properties.

The legal definition of a "waterbody" is codified in Title 6 of the New York State Code of Rules and Regulations. Table I of 6 NYCRR 935.6 lists waterbodies of the Upper East River and Long Island Sound. For the purpose of this WB/WS Facility Plan, the Westchester Creek waterbody includes both Westchester and Pugsley Creeks from their respective headwaters to their confluence with the Upper East River, as defined by Item 47 in Table I of the state code (ER-4 and trib. 1, respectively), and as shown in Figure 1-2.

1.2. REGULATORY CONSIDERATIONS

The waters of the City of New York are primarily subject to New York State regulation, but must also comply with the policies of the United States Environmental Protection Agency (USEPA), as well as water quality standards established by the Interstate Environmental Commission (IEC). The following sections detail the regulatory issues relevant to long-term CSO planning.

1.2.1. Clean Water Act

Although federal laws protecting water quality were passed as early as 1948, the most comprehensive approach to clean water protection was enacted in 1972, with the adoption of the Federal Water Pollution Control Act Amendments commonly known as the Clean Water Act (CWA) including the amendments adopted in 1977. The CWA established the regulatory framework to control surface water pollution, and gave the USEPA the authority to implement pollution control programs. Among the key elements of the CWA was the establishment of the National Pollutant Discharge Elimination System (NPDES) permit program, which regulates point sources that discharge pollutants into waters of the United States. CSOs and municipal separate storm sewer systems (MS4) are also subject to regulatory control under the NPDES program. In New York State, the NPDES permit program is administered by the DEC, through its SPDES program. New York State has had an approved SPDES program since 1975.

The CWA requires that discharge permit limits be based on receiving water quality standards (WQS) established by the State of New York. These standards should "wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation" (40 CFR 131.2). The standards must also include an antidegradation policy for maintaining water quality at acceptable levels, and a strategy for meeting those standards must be developed for those waters not meeting WQS. The most common type of strategy is the development of a Total Maximum Daily Load (TMDL). TMDLs determine what level of pollutant load would be consistent with achieving WQS. TMDLs also allocate acceptable loads among the various sources of the relevant pollutants which discharge to the waterbody.

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City-Wide Assessment Areas

FIGURE 1-1

H&S File: 5905\002\011\Mp1-Base Map.cdr 11-23-10

NYC Environmental Protection

Westchester Creek Study Area

FIGURE 1-2

Section 305(b) of the CWA requires states to periodically report the water quality of waterbodies under their respective jurisdictions, and Section 303(d) requires states to identify impaired waters where specific designated uses are not fully supported. The DEC Division of Water addresses these requirements by following its Consolidated Assessment and Listing Methodology (CALM). The CALM includes monitoring and assessment components that determine water quality standards attainment and designated use support for all waters of New York State. Waterbodies are monitored and evaluated on a five-year cycle. Information developed during monitoring and assessment is inventoried in the Waterbody Inventory/Priority Waterbody List (WI/PWL). The WI/PWL incorporates monitoring data, information from state and other agencies, and public participation. The Waterbody Inventory refers to the listing of all waters, identified as specific individual waterbodies, within the state that are assessed. The Priority Waterbodies List is the subset of waters in the Waterbody Inventory that have documented water quality impacts, impairments or threats. The Priority Waterbodies List provides the candidate list of waters to be considered for inclusion on the Section 303(d) List.

In 1998 DEC listed Westchester Creek as a high priority waterbody for TMDL development with its inclusion on the Section 303(d) List. Fish propagation was believed to be affected by sludge/sediment from CSO discharges. In 2000, Westchester Creek was listed as a waterbody needing verification of impairment. Westchester Creek was de-listed from the 2002 Section 303(d) List based on the implementation of the New York City CSO Abatement Program and Catch Basin Hooding Program in place at the time to address floatables and pathogens. In 2004, DEC listed Westchester Creek in Part 3c of the 303(d) List – Waterbodies for which TMDL Development May be Deferred (Pending Implementation/Evaluation of Other Restoration Measures) due to low dissolved oxygen (DO) concentrations caused by urban sources, stormwater runoff, and CSO discharges. Westchester Creek remains listed in this section as of the 2010 303(d) List. A TMDL may not be required and may in fact delay the ability to meet the DO requirements as compared to the various control measures currently being developed and implemented which include this WB/WS Facility Plan. If after implementation of this WB/WS Plan, Westchester Creek achieves DO requirements, it would then be removed from the 303(d) list.

Another important component of the CWA is the protection of uses. USEPA regulations state that a designated use for a waterbody may be refined under limited circumstances through a Use Attainability Analysis (UAA), which is defined as *"a structured scientific assessment of the chemical, biological, and economic condition in a waterway"* (USEPA , 2000). In the UAA, the DEC would demonstrate that one or more of a limited set of circumstances exists to make such a modification. It could be shown that the current designated use cannot be achieved through implementation of applicable technology-based limits on point sources, or be a cost-effective and reasonable best management practice for non-point sources. Additionally, a determination could be made that the cause of non-attainment is due to natural background conditions or irreversible human-caused conditions. Another circumstance might be to establish that attaining the designated use would cause substantial environmental damage or substantial and widespread social and economic hardship. If the findings of a UAA suggest authorizing the revision of a use or modification of a WQS is appropriate, the analysis and accompanying proposal for such a modification must go through the public review and participation process and the USEPA approval process.

1.2.2. Federal CSO Policy

The first national CSO Control Strategy was published by USEPA in the Federal Register on September 8, 1989 (54 FR 37370). The goals of that strategy were to minimize impacts to water quality, aquatic biota, and human health from CSOs by ensuring that CSO discharges comply with the technology and water quality based requirements of the CWA. On April 19, 1994, USEPA officially noticed the CSO Control Policy (59 FR 18688), which established a consistent national approach for controlling discharges from all CSOs to the waters of the United States. The CSO Control Policy provides guidance to permittees and NPDES permitting authorities such as DEC on the development and implementation of a LTCP in accordance with the provisions of the CWA to attain water quality standards. On December 15, 2000, amendments to Section 402 of the CWA (known as the Wet Weather Water Quality Act of 2000) were enacted, incorporating the CSO Control Policy by reference.

USEPA has stated that its CSO Control Policy represents a comprehensive national strategy to ensure that municipalities, permitting authorities, water quality standards authorities and the public engage in a comprehensive and coordinated planning effort to achieve cost-effective CSO controls that ultimately meet appropriate health and environmental objectives and requirements (USEPA, 1995a). Four key principles of the CSO Control Policy ensure that CSO controls are cost-effective and meet the objectives of the CWA:

1. Clear levels of control are provided that would be presumed to meet appropriate health and environmental objectives;
2. Sufficient flexibility is allowed to municipalities to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements;
3. A phased approach to implementation of CSO controls is acceptable; and
4. Water quality standards and their implementation procedures may be reviewed and revised, as appropriate, when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs.

In addition, the CSO Control Policy clearly defines expectations for permittees, WQS authorities, and NPDES permitting and enforcement authorities. Permittees were expected to have implemented USEPA's nine minimum controls (NMCs) by 1997, after which long-term control plans should be developed. The NMCs are embodied in the 14 Best Management Practices (BMPs) required by DEC as discussed in Section 5.3, and include:

1. Proper operations and maintenance of combined sewer systems and combined sewer overflow outfalls;
2. Maximum use of the collection system for storage;
3. Review and modification of pretreatment requirements to determine whether non-domestic sources are contributing to CSO impacts;
4. Maximizing flow to the Publicly Owned Treatment Works (POTWs);
5. Elimination of CSOs during dry weather;

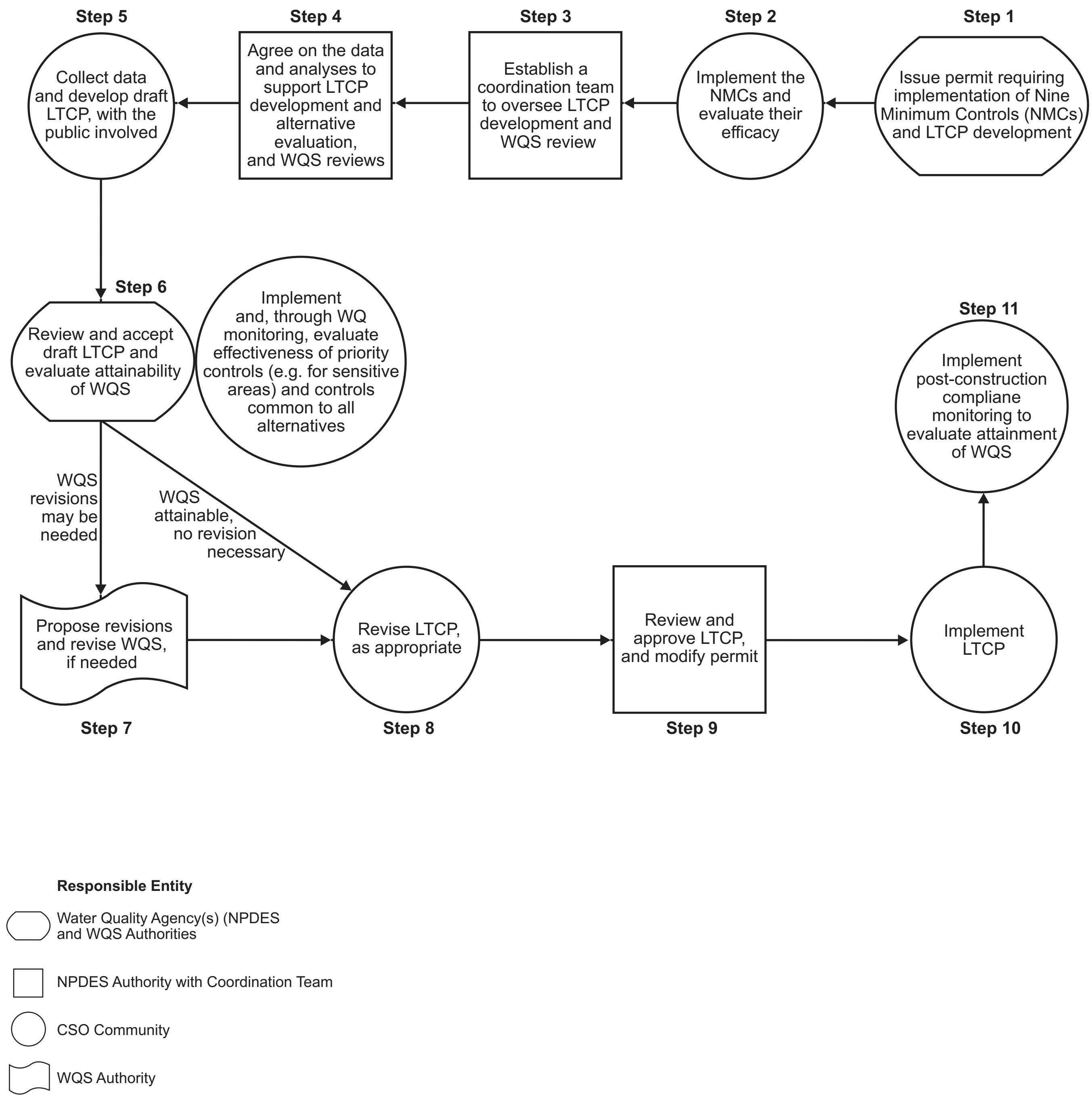
6. Control of solid and floatable material in CSOs;
7. Pollution prevention programs to reduce contaminants in CSOs;
8. Public notification; and
9. Monitoring to characterize CSO impacts and the efficacy of CSO controls.

WQS authorities should review and revise, as appropriate, State WQS during the CSO long-term planning process. NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.

In July 2001, USEPA published *Coordinating CSO Long-Term Planning with Water Quality Standards Reviews*, additional guidance to address questions and describe the process of integrating development of CSO long-term control plans with water quality standards reviews (USEPA, 2001a). The guidance acknowledged that the successful implementation of an LTCP requires coordination and cooperation among CSO communities, constituency groups, states and USEPA using a watershed approach. As part of the LTCP development, USEPA recommended that WQS authorities review the LTCP to evaluate the attainability of applicable water quality standards. The data collected, analyses and planning performed by all parties may be sufficient to justify a water quality standards revision if a higher level of designated uses is attainable or if existing designated uses are not reasonably attainable. If the latter is true, then the USEPA allows the State WQS authorities to consider several options:

- Apply site-specific criteria;
- Apply criteria at the point of contact rather than at the end-of-pipe through the establishment of a mixing zone, waterbody segmentation, or similar;
- Apply less stringent criteria when it is unlikely that recreational uses will occur or when water is unlikely to be ingested;
- Consider subcategories of uses, such as precluding swimming during or immediately following a CSO event or developing a CSO subcategory of recreational uses; and
- Consider a tiered aquatic life system with subcategories for urban systems.

If the waterbody supports a use with more stringent water quality requirements than the designated use, USEPA requires the State to revise the designated use to reflect the higher use being supported. Conversely, USEPA requires that a UAA be performed whenever the state proposes to reduce the level of protection for the waterbody. States are not required to conduct UAAs when adopting more stringent criteria for a waterbody. Once water quality standards are revised, the CSO Control Policy requires post-implementation compliance monitoring to evaluate the attainment of designated uses and water quality standards and to determine if further water quality revisions and/or additional long-term control planning is necessary. USEPA provided a schematic chart (Figure 1-3) in its guidance for describing the coordination of LTCP development and water quality standards review and revision.



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Long-Term CSO Control Planning Procedures

FIGURE 1-3

It is important to note that New York City's CSO abatement efforts were prominently displayed as model case studies by USEPA during a series of seminars held across the United States in 1994 to discuss the CSO Control Policy with permittees, WQS authorities, and NPDES permitting authorities (USEPA, 1994). New York City's field investigations, watershed and receiving water modeling, and facility planning conducted during the Paerdegat Basin Water Quality Facility Planning Project were specifically described as a case study during the seminars. Additional City efforts in combined sewer system characterization, mathematical modeling, water quality monitoring, floatables source and impact assessments, and use attainment were also displayed as model approaches to these elements of long-term CSO planning.

1.2.3. New York State Policies and Regulations

In accordance with the provisions of the Clean Water Act, the State of New York has promulgated water quality standards for all waters within its jurisdiction. The State has developed a system of waterbody classifications based on designated uses that includes five marine classifications, as shown in **Table 1-1**. New York State water quality classifications for the assessment area are shown in Figure 1-4.

Table 1-1. New York State Numeric Surface Water Quality Standards (Saline)

Class	Usage	DO (mg/L)	Total Coliform[1,3] (per 100 mL)	Fecal Coliform[2,3] (per 100 mL)
SA	Shellfishing for market purposes, primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8[1] ≥3.0[2]	70 [3]	N/A
SB	Primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8[1] ≥3.0[2]	2,400 [4] 5,000 [5]	≤ 200 [6]
SC	Limited primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.8[1] ≥3.0[2]	2,400 [4] 5,000 [5]	≤ 200 [6]
I	Secondary contact recreation, fishing. Suitable for fish propagation and survival.	≥ 4.0	10,000 [6]	≤ 2,000 [6]
SD	Fishing. Suitable for fish survival. Waters with natural or man-made conditions limiting attainment of higher standards.	≥ 3.0	N/A	N/A

Notes:

(1) Chronic standard based on daily average. The DO concentration may fall below 4.8 mg/L for a limited number of days as defined by

$$DO_i = \frac{13.0}{2.80 + 1.84e^{-0.1t_i}}$$

Where DO_i = DO concentration in mg/L between 3.0-4.8 mg/L and t_i = time in days. This equation is applied by dividing the DO range of 3.0-4.8 mg/L into a number of equal intervals. DO_i is the lower bound of each interval (i) and t_i is the allowable number of days that the DO concentration can be within that interval. The actual number of days that the measured DO concentration falls within each interval (i) is divided by the allowable number of days that the DO can fall within interval (T_i). The sum of the quotients of all intervals (I …. N) cannot exceed 1.0: i.e.,

Table 1-1. New York State Numeric Surface Water Quality Standards (Saline)

$$\sum_{i=1}^{n} \frac{t_i\ (actual)}{t_i\ (allowed)} < 1.0$$

(2) Acute standard (never less than 3.0 mg/L.

(3) Median most probable number (MPN) value in any series of representative samples

(4) Monthly median value of five or more samples

(5) Monthly 80th percentile of five or more samples

(6) Monthly geometric mean of five or more samples

(7) Daily avg. min for non-trout waters

DEC considers the SA and SB classifications to fulfill the Clean Water Act goals of fully supporting aquatic life and recreation. Class SC supports aquatic life and recreation but the recreational use of the waterbody is limited due to other factors. Class I supports the Clean Water Act goal of aquatic life protection and supports secondary contact recreation. SD waters shall be suitable for fish survival only because natural or manmade conditions limit the attainment of higher standards. It should also be noted that the DEC regulations state that the total and fecal coliform standards for Classes SB, SC and I "shall be met during all periods when disinfection is practiced". As disinfection is practiced at all WWTPs year-round, these standards are applicable to all Class SA, SB, SC and I New York Harbor waters.

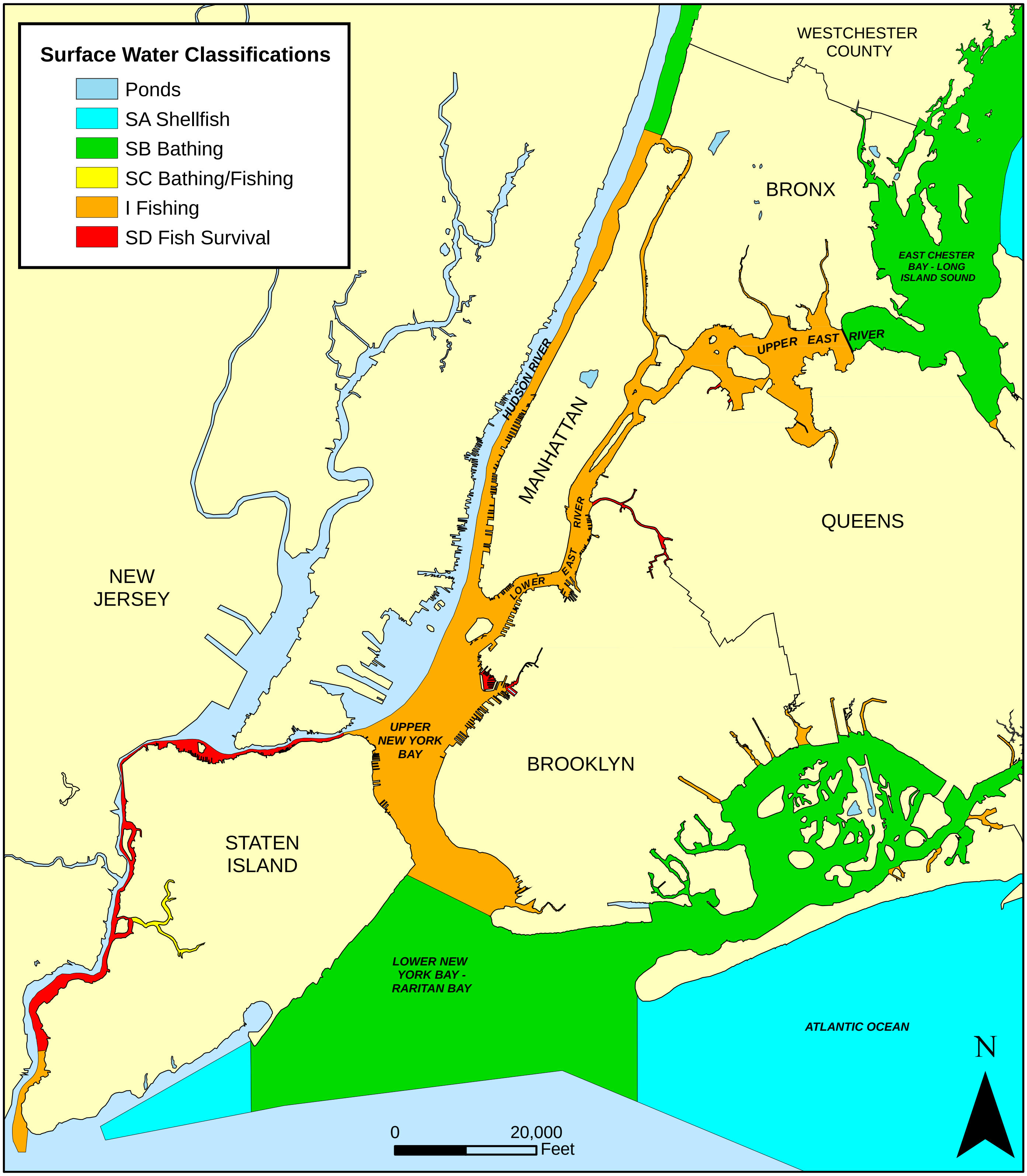
Dissolved Oxygen

DO is the water quality parameter that DEC uses to establish whether a waterbody supports aquatic life uses. The numerical DO standard for Westchester Creek (Class I) requires that DO concentrations are at or above 4.0 mg/L at all times at all locations within the waterbody.

Bacteria

Total and fecal coliform bacteria concentrations are the numerical standards used by the DEC to establish whether a waterbody supports recreational uses. The numerical bacteria standards for Class I waters require that total coliform bacteria must have a monthly geometric mean of less than 10,000 per 100 milliliters (mL) from a minimum of five examinations. Fecal coliform (Class I) must have a monthly geometric mean of less than 2,000 per 100 mL from a minimum of five examinations. However, DEC applies these standards where disinfection is practiced to protect uses. As disinfection is not practiced or required in Westchester Creek, the pathogen standards are not applied to this waterbody by DEC.

An additional DEC standard for primary contact recreational waters (not applicable to Westchester Creek or any other Class I waters) is a maximum allowable enterococci concentration of a geometric mean of 35 per 100 mL for a representative number of samples. This standard, although not promulgated, is now an enforceable standard in New York State as USEPA established January 1, 2005 as the date upon which the criteria must be adopted for all coastal recreational waters.



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Best Use Water Classification

FIGURE 1-4

For areas of primary contact recreation that are used infrequently and are not designated as bathing beaches, the USEPA criteria suggest that a reference level indicative of pollution events be considered to be a single sample maxima enterococci concentration of 501 per 100 mL. This reference levels, in accordance with the USEPA documents is not standards but is to be used as determined by the state agencies in making decisions related to recreational uses and pollution control needs. For bathing beaches, these reference levels (104 per 100 mL single sample maxima enterococci concentration) are to be used for announcing bathing advisories or beach closings in response to pollution events. In this WB/WS Facility Plan, the reference level of 501 per 100 mL is considered in the assessment of the potential for bathing in Westchester Creek, since there are no bathing beaches in the waterbody. In anticipation of the new bacteria standards, DEP has started measuring enterococci in its Harbor Survey program and at WWTP influents and effluents and the New York City Department of Health and Mental Hygiene has started to monitor enterococci concentrations at designated bathing beaches.

Narrative Standards

In addition to numerical standards, New York State also has narrative criteria to protect aesthetics in all waters within its jurisdiction, regardless of classification. These standards also serve as limits on discharges to receiving waters within the State. Unlike the numeric standards, which provide an acceptable concentration, narrative criteria generally prohibit quantities that would impair the designated use or have a substantial deleterious effect on aesthetics. Important exceptions include garbage, cinders, ashes, oils, sludge and other refuse, which are prohibited in any amounts. The term "other refuse" has been interpreted to include floatable materials such as street litter that finds its way into receiving waters via uncontrolled CSO discharges. It should be noted that, in August 2004, USEPA Region II recommended that the DEC "revise the narrative criteria for aesthetics to clarify that these criteria are meant to protect the best use(s) of the water, and not literally require 'none' in any amount, or provide a written clarification to this end" (Mugdan, 2004). Table 1-2 summarizes the narrative water quality standards.

Table 1-2. New York State Narrative Water Quality Standards

Parameters	Classes	Standard
Taste, color, and odor producing toxic and other deleterious substances	SA, SB, SC, I, SD A, B, C, D	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	SA, SB, SC, I, SD A, B, C, D	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	SA, SB, SC, I, SD A, B, C, D	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	SA, SB, SC, I, SD A, B, C, D	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
Garbage, cinders, ashes, oils, sludge and other refuse	SA, SB, SC, I, SD A, B, C, D	None in any amounts.
Phosphorus and nitrogen	SA, SB, SC, I, SD A, B, C, D	None in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages.

1.2.4. Interstate Environmental Commission (IEC)

The States of New York, New Jersey, and Connecticut are signatories to the Tri-State Compact that designated the Interstate Environmental District and created the IEC. The Interstate Environmental District includes all tidal waters of greater New York City. Originally established as the Interstate Sanitation Commission, the IEC may develop and enforce waterbody classifications and effluent standards to protect waterbody uses within the Interstate Environmental District. The applied classifications and effluent standards are intended to be consistent with those applied by the signatory states. There are three waterbody classifications defined by the IEC, as shown in Table 1-3.

In general, IEC water quality regulations require that all waters of the Interstate Environmental District are free from floating and settleable solids, oil, grease, sludge deposits, and unnatural color or turbidity to the extent necessary to avoid unpleasant aesthetics, detrimental impacts to the natural biota, or use impacts. The regulations also prohibit the presence of toxic or deleterious substances that would be detrimental to fish, offensive to humans, or unhealthful in biota used for human consumption. The IEC also restricts CSO discharges to within 24 hours of a precipitation event, consistent with the DEC definition of a prohibited dry weather discharge. Beyond that restriction, however, IEC effluent quality regulations do not apply to CSOs if the combined sewer system is being operated with reasonable care, maintenance, and efficiency.

Although IEC regulations are intended to be consistent with State water quality standards, the three-tiered IEC system and the five New York State marine classifications in New York Harbor do not overlap exactly; for example, the Class A DO numeric criterion (5 mg/L) differs from New York State's Class I criterion (4 mg/L). Primary contact recreation is defined in the IEC regulations as recreational activity that involves significant ingestion risk, including but not limited to wading, swimming, diving, surfing, and waterskiing. It defines secondary contact recreation as activities in which the probability of significant contact with the water or water ingestion is minimal, including but not limited to boating, fishing, and shoreline recreational activities involving limited contact with surface waters.

Table 1-3. Interstate Environmental Commission Numeric Water Quality Criteria

Class	Usage	DO (mg/L)	Waterbodies
A	All forms of primary and secondary contact recreation, fish propagation, and shellfish harvesting in designated areas	$\geq$ 5.0	East R. east of the Whitestone Br.; Hudson R. north of confluence with the Harlem R; Raritan R. east of the Victory Br. into Raritan Bay; Sandy Hook Bay; lower New York Bay; Atlantic Ocean
B-1	Fishing and secondary contact recreation, growth and maintenance of fish and other forms of marine life naturally occurring therein, but may not be suitable for fish propagation.	$\geq$ 4.0	Hudson R. south of confluence with Harlem R.; upper New York Harbor; East R. from the Battery to the Whitestone Bridge; Harlem R.; Arthur Kill between Raritan Bay and Outerbridge Crossing.
B-2	Passage of anadromous fish, maintenance of fish life	$\geq$ 3.0	Arthur Kill north of Outerbridge Crossing; Newark Bay; Kill Van Kull

Westchester Creek and nearby waters of the East River are within the Interstate Environmental District and are designated by the IEC as Class A. This classification requires that the waterbody be suitable for all forms of primary and secondary contact recreation and for fish propagation. In designated areas, Class A waters shall be suitable for shellfish harvesting; Westchester Creek is not designated as such.

1.2.5. Administrative Consent Order

New York City's 14 WWTP SPDES permits include conditions which require compliance with Federal and State CSO requirements. DEP was unable to comply with deadlines included within their 1988 SPDES permits for completion of four CSO abatement projects initiated in the early 1980s. As a result, DEP entered into an Administrative Consent Order with DEC on June 26, 1992 which was incorporated into the SPDES permits with a provision stating that the Consent Order governs DEP's obligations for its CSO program. It also required that DEP implement CSO abatement projects within nine facility planning areas in two tracks: those areas where DO and coliform standards were being contravened (Track One), and those areas where floatables control was necessary (Track Two). The 1992 Order was modified on September 19, 1996 to add catch basin cleaning, construction, and repair programs.

DEP and DEC negotiated a new Consent Order, signed January 14, 2005, that supersedes the 1992 Order and its 1996 Modifications, with the intent to bring all DEP CSO-related matters into compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The new Order contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for Citywide long-term CSO control in accordance with USEPA CSO Control Policy. This Order was recently modified and signed on April 14, 2008 and again on September 3, 2009. DEP and DEC also entered into a separate MOU to facilitate water quality standards reviews in accordance with the CSO Control Policy.

1.3. CITY POLICIES AND OTHER LOCAL CONSIDERATIONS

New York City's waterfront is approximately 578 miles long, encompassing 17 percent of the total shoreline of the State. This resource is managed through multiple tiers of zoning, regulation, public policy, and investment incentives to accommodate the diverse interests of the waterfront communities and encourage environmental stewardship. The local regulatory considerations are primarily applicable to proposed projects and do not preclude the existence of non-conforming waterfront uses. However, evaluation of existing conditions within the context of these land use controls and public policy anticipate the nature of long-term growth in the watershed.

1.3.1. New York City Waterfront Revitalization Program

The New York City Waterfront Revitalization Program (WRP) is the City's principal coastal zone management tool and is implemented by the New York City Department of City Planning (NYCDCP). The WRP establishes the City's policies for development and use of the waterfront and provides a framework for evaluating the consistency of all discretionary actions in the coastal zone with City coastal management policies. Projects subject to consistency review include any project located within the coastal zone requiring a local, state, or federal discretionary action, such as a

Uniform Land Use Review Procedure (ULURP) or a City Environmental Quality Review (CEQR). An action is determined to be consistent with the WRP if it would not substantially hinder and, where practicable, would advance one or more of the 10 WRP policies. The New York City WRP is authorized under the New York State Waterfront Revitalization and Coastal Resource Act of 1981, which, in turn, stems from the Federal Coastal Zone Management Act of 1972. The original WRP was adopted in 1982 as a local plan in accordance with Section 197-a of the City Charter, and incorporated the 44 state policies, added 12 local policies, and delineated a coastal zone in to which the policies would apply. The program was revised in 1999, and new policies were issued in September 2002. The revised WRP condensed the 12 original policies into 10 policies: (1) residential and commercial redevelopment; (2) water-dependent and industrial uses; (3) commercial and recreational boating; (4) coastal ecological systems; (5) water quality; (6) flooding and erosion; (7) solid waste and hazardous substances; (8) public access; (9) scenic resources; and (10) historical and cultural resources.

1.3.2. New York City Comprehensive Waterfront Plan

The City's long-range goals are contained in the Comprehensive Waterfront Plan (CWP). The CWP identifies four principal waterfront functional areas (natural, public, working, and redeveloping) and promotes use, protection, and redevelopment in appropriate waterfront areas. The companion Borough Waterfront Plans (1993-1994) assess local conditions and propose strategies to guide land use change, planning and coordination, and public investment for each of the waterfront functional areas. The CWP has been incorporated into local law through land use changes, zoning text amendments, public investment strategies, and regulatory revisions, which provide geographic specificity to the WRP and acknowledge that certain policies are more relevant than others in particular portions of the waterfront.

1.3.3. Department of City Planning Actions

The NYCDCP was contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Westchester Creek. NYCDCP reviews any proposal that would result in a fundamental alteration in land use, such as zoning map and text amendments, special permits under the Zoning Resolution, changes in the City Map, the disposition of City-owned property, and the siting of public facilities. In addition, NYCDCP maintains a library of Citywide plans, assessments of infrastructure, community needs evaluations, and land use impact studies. These records were reviewed and evaluated for their potential impacts to waterbody use and runoff characteristics, and the NYCDCP community district liaisons for Bronx Community Districts 9 and 10 were contacted to determine whether any proposals in process that required NYCDCP review might impact the LTCP.

1.3.4. New York City Economic Development Corporation

The New York City Economic Development Corporation (NYCEDC) was contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Westchester Creek. The NYCEDC is charged with dispensing City-owned property to businesses as a means of stimulating economic growth, employment, and tax revenue in the City of New York while simultaneously encouraging specific types of land use in targeted neighborhoods. As such, NYCEDC has the potential to alter land use on a large scale.

Additionally, the NYCEDC serves as a policy instrument for the Mayor's Office, and recently issued a white paper on industrial zoning (Office of the Mayor, 2005) intended to create and protect industrial land uses throughout the City. The policy directs the replacement of the current In-Place Industrial Parks (IPIPs) with Industrial Business Zones (IBZs) that more accurately reflect the City's industrial areas. Policies of this nature can have implications on future uses of a waterbody as well as impacts to collection systems. Accordingly, a thorough review of NYCEDC policy and future projects was performed to determine the extent to which they may impact the LTCP.

1.3.5. Local Law

Local law is a form of municipal legislation that has the same status as an act of the State Legislature. The power to enact local laws is granted by the New York State Constitution, with the scope and procedures for implementation established in the Municipal Home Rule Law. In New York City, local laws pertaining to the use of the City waterways and initiatives associated with aquatic health have been adopted beyond the requirements of New York State. Recent adoptions include Local Law 71 of 2005, which required the development of the Jamaica Bay Watershed Protection Plan (JBWPP) and Local Law 5 of 2008 which requires City-owned buildings or City-funded construction to include certain sustainable practices, as well as requiring the City to draft a sustainable stormwater management plan by October 1, 2008. These initiatives are discussed in Section 5 in detail.

1.3.6. Bathing Beaches

Bathing beaches in New York City are regulated, monitored and permitted by the City and State under Article 167 of the New York City Health Code and Section 6-2.19 of the New York City Sanitary Code. Siting requirements imposed by State and City codes must be considered to evaluate the potential use of a waterbody for primary contact recreation. These requirements include minimum distances from certain types of regulated discharges (such as CSO outfalls), maximum bottom slopes, acceptable bottom materials, minimum water quality levels, and physical conditions that ensure the highest level of safety for bathers.

1.4. REPORT ORGANIZATION

This report has been organized to clearly describe the proposed WB/WS Facility Plan that supports a Long-Term CSO Control Planning process and the environmental factors and engineering considerations that were evaluated in its development. The nine elements of long-term CSO control planning are listed in Table 1-4 along with relevant sections within this document for cross-referencing.

Section 1 describes general planning information and the regulatory considerations in order to describe the setting and genesis of the LTCP and the CSO Control Policy. Sections 2, 3, and 4 describe the existing watershed, collection system, and waterbody characteristics, respectively. Section 5 describes related waterbody improvement projects within the waterbody and the greater

New York Harbor. Section 6 describes the public participation and agency interaction that went into the development of this WB/WS Facility Plan, as well as an overview of the DEP public outreach program. Sections 7 and 8 describe the development of the plan for the waterbody. Section 9 discusses the review and revision of water quality standards. The report concludes with references in Section 10 and a glossary of terms and abbreviations is included in Section 11. Attached for reference is the Wet Weather Operating Plan for the Hunts Point WWTP and a Use Attainability Evaluation.

Table 1-4. Locations of the Nine Minimum Elements of Long-Term Control Planning

No.	Element	Section(s) within Report
1	Characterization of the Combined Sewer System	3.0
2	Public Participation	6.0
3	Consideration of Sensitive Areas	4.7
4	Evaluation of Alternatives	7.0
5	Cost/Performance Considerations	7.0
6	Operational Plan	3.1, 8.0, App. A
7	Maximizing Treatment at the Existing WWTP	7.0, 8.0
8	Implementation Schedule	8.0
9	Post-Construction Compliance Monitoring	8.0

NO TEXT ON THIS PAGE

2.0. Watershed Characteristics

For the purposes of this Waterbody/Watershed Facility Plan, the Westchester Creek waterbody and watershed includes Westchester Creek and Pugsley Creek and their associated tributary sewershed. The downstream watercourse of Westchester Creek proceeds in a southerly direction from its northern terminus near Westchester Square in the Bronx, and parallels the Hutchinson River Parkway until the Creek merges with Pugsley Creek and the East River, defining a portion of the border between Bronx Community Districts 9 and 10. The sewershed extends into Community Districts 11 and 12 as well, spanning nearly 5,000 acres and serving portions of the Wakefield, Edenwald, Williamsbridge, Baychester, Pelham Gardens, Morris Park, Parkchester, Unionport, Castle Hill, Clason Point, Pelham Bay, Westchester Square, Schuylerville, and Throgs Neck neighborhoods in the eastern Bronx. Bound on the east by the Hutchinson River watershed and on the west by the Bronx River watershed, the Westchester Creek watershed contains numerous parks and open spaces, particularly along the lower portions of the waterbody, including Ferry Point Park, Clason's Point Park, Castle Hill Park, and Pugsley Creek Park. St. Raymond's Cemetery comprises a large portion of the eastern watershed as well. Although open spaces are significant, the predominant land use in the watershed by far is residential, although the land immediately adjacent to Westchester Creek is generally open space and mixed residential. An estimated 285,000 residents live within the watershed of Westchester and Pugsley Creeks.

The following sections present the historical context of changes in Westchester Creek, current and future land use, and shoreline characteristics that have influenced pollutant loadings from the watershed to the waterbody.

2.1. HISTORICAL CONTEXT OF WATERSHED URBANIZATION

European settlement of the Bronx began in the mid-17th Century. Jonas Bronck, the eponymous Swedish sea captain from the Netherlands, settled in the Bronx along with a handful of German, Dutch, and Danish indentured servants. The land was the subject of disputes between English and Dutch settlers, but by 1654, the village of West Chester became one of the first permanent settlements in the Bronx, located along Westchester Creek near the head of navigation. Indigenous Americans from the Sinoway tribe had lived on what became known as Castle Hill along the western shore of Westchester Creek near its mouth. Other than West Chester and the community of Unionport between Westchester and Pugsley Creeks, the area remained largely undeveloped until the end of the 19th Century, when the Third Avenue elevated train was extended into the Bronx (1886) and electricity was introduced (1887) to the area. The area east of the Bronx River, including the entirety of the Westchester Creek drainage area, was annexed to New York City in 1895 by local vote in the town of Westchester, the incorporated village of Wakefield, and the southern parts of the towns of Eastchester and Pelham. In 1898, the City of New York was incorporated as the five boroughs it currently comprises.

Beginning at the end of the 19th Century, the Bronx experienced accelerated growth and development, along with a major decline in water quality directly attributable to this growth. Until this time, Westchester Creek was part of a contiguous complex of marshlands, channels, and islands spanning the watersheds of the Bronx River, Westchester Creek, and the Hutchinson River. Westchester Creek was hydraulically connected to the Hutchinson River near its headwaters through uninterrupted marshland, isolating the area of Throgs Neck and Bay Chester from the mainland. There was limited useable land, particularly land directly adjacent to navigable waterways. In response to population pressures, the wetlands of Westchester Creek were filled in, its shorelines were bulkheaded and armored, and its channel was dredged to maintain navigation. The upper reaches of both Westchester and Pugsley Creeks were filled completely sometime prior to 1947, based on historical maps of the area (Figure 2-1). Westchester Creek was filled to its current terminus, possibly to allow for the construction of the Westchester Rail Yard. Pugsley Creek was filled north of Lacombe Avenue slowly between 1947 and 1966 as the area between Unionport and Clason Point was developed. These transformations affected the hydrology and water quality of the waterbody, limiting its capacity to absorb and buffer runoff to the Upper East River. Today, Westchester Creek is approximately 2½ miles long and 175 feet wide, with a depth ranging from 5 to 7 feet at mean low water (MLW). Pugsley Creek is no longer channelized, with only the embayment at its confluence with Westchester Creek and the Upper East River evident due to land creation.

The extent of the physical transformation is illustrated by reviewing Figure 2-1. The first panel is an excerpt from a historical map dated 1891, featuring the Upper East River, including Westchester Creek, Pugsley Creek, and the tributary watershed. The map indicates the development of small villages on the available highlands, and the complex of marshland and estuarine streams. The current configuration of Westchester Creek is shown on the third panel of Figure 2-1, which is an excerpt from the 7.5 minute quadrangle from the U.S. Geologic Service showing approximately the same geographic area as the 1891 map. The transformation of tidal wetlands into developable land is evident.

Water quality degradation was accelerated by the cumulative effects of waterbody and watershed alterations and the lack of wastewater treatment (the Hunts Point WWTP was not completed until 1952). Water quality problems were so pronounced by the early 1900s that the New York State legislature directed the City of New York to create the Metropolitan Sewerage Commission to study water quality in the New York Harbor (Metropolitan Sewerage Commission, 1912). The Sewerage Commission began sampling the harbor in 1909, and characterized several tributaries of the harbor as "little more than open sewers" based on this investigation. They recommended against swimming in the harbor, and suggested that the oyster industry be abandoned. By the middle of the 20th Century, New York City had eight WWTPs providing some level of secondary treatment, including the four WWTPs on the Upper East River (Hunts Point, Tallman Island, Wards Island, and Bowery Bay). Today, the City's 14 WWTPs and its many ongoing water quality programs have resulted in a steady improvement in water quality.

2.2. LAND USE CHARACTERIZATION

The current use of land in the watershed has a substantial impact on the water quality, volume, frequency, and timing of CSOs. The presence of structures, roads, parking lots, and other impervious surfaces alongside parkland, undeveloped open space, and other vegetated, water-retaining land uses creates a complex runoff dynamic. The current land use is largely an artifact of historical urbanization, but future use is controlled by zoning, public policy, and land use regulations intended to promote activities appropriate to neighborhood character and the larger community. The following sections detail existing land use and future changes based on zoning, known land use proposals, and current consistency with relevant land use policies.

2.2.1. Current Land Use

Land use in the immediate vicinity of Westchester Creek is generally dominated by open spaces, although industrial, manufacturing, transportation, and utility uses exist along the western shore and the middle reaches of the eastern shore (Figure 2-2). The Hutchinson River Parkway parallels Westchester Creek along its eastern shoreline in the northernmost reach, and Ferry Point Park, the largest section of open space within the assessment area, occupies the eastern shoreline from the mouth to approximately one mile upstream. Pugsley Creek, wholly contained within Pugsley Creek Park, is listed as open space and outdoor recreation on land use maps from the Department of City Planning. The northern terminus of Westchester Creek is adjacent to the athletic fields of the Herbert Lehman High School. A major interstate highway system interchange spans Westchester Creek, containing the Cross-Bronx Expressway (Interstate 95), the Bruckner Expressway (Interstate 278), the Whitestone Expressway (Interstate 678), and the Hutchinson River Parkway. The Unionport Bridge carries Bruckner Boulevard across Westchester Creek within this interchange.

Generalized land uses within a ¼ -mile radius of Westchester and Pugsley creeks include a mix of industrial, residential, and recreational uses. The relative distribution of land uses in the watershed and riparian area (within a ¼-mile radius) is summarized in Table 2-1. The area surrounding Pugsley Creek Park is primarily residential with some public facilities and institutions, and a smaller residential area is located northeast of the head of Westchester Creek. Industrial, manufacturing, transportation and utility uses occupy the land west of Westchester Creek. Open space and outdoor recreation areas include Castle Hill and Pugsley Creek Parks near Pugsley Creek, Ferry Point Park along the eastern shoreline of Westchester Creek, and the Saint Raymond's Cemetery along the Hutchinson River Parkway. Limited commercial and office uses exist, including the Whitestone Cineplex movie theater and a portion of the East Tremont Avenue (Fort Schuyler Road) commercial corridor in the Middletown neighborhood east of the head of Westchester Creek. The Bronx Psychiatric Center, Lehman Public High School, and a Metropolitan Transportation Authority (MTA) rail yard occupy the area north of the head of Westchester Creek.

Table 2-1. Westchester Creek Land Use Summary by Category[2]

Land Use Category	Watershed	Riparian Area (1/4 mile)	Shoreline
Open Space	15%	44%	69%
Residential	55%	20%	2%
Commercial	7%	8%	7%
Industrial	4%	12%	11%
Mixed Use[1]	18%	15%	10%

[1] Public facilities and institutional, commercial, manufacturing, transportation and vacant.
[2] Totals may not add to 100 percent due to rounding

2.2.2. Zoning

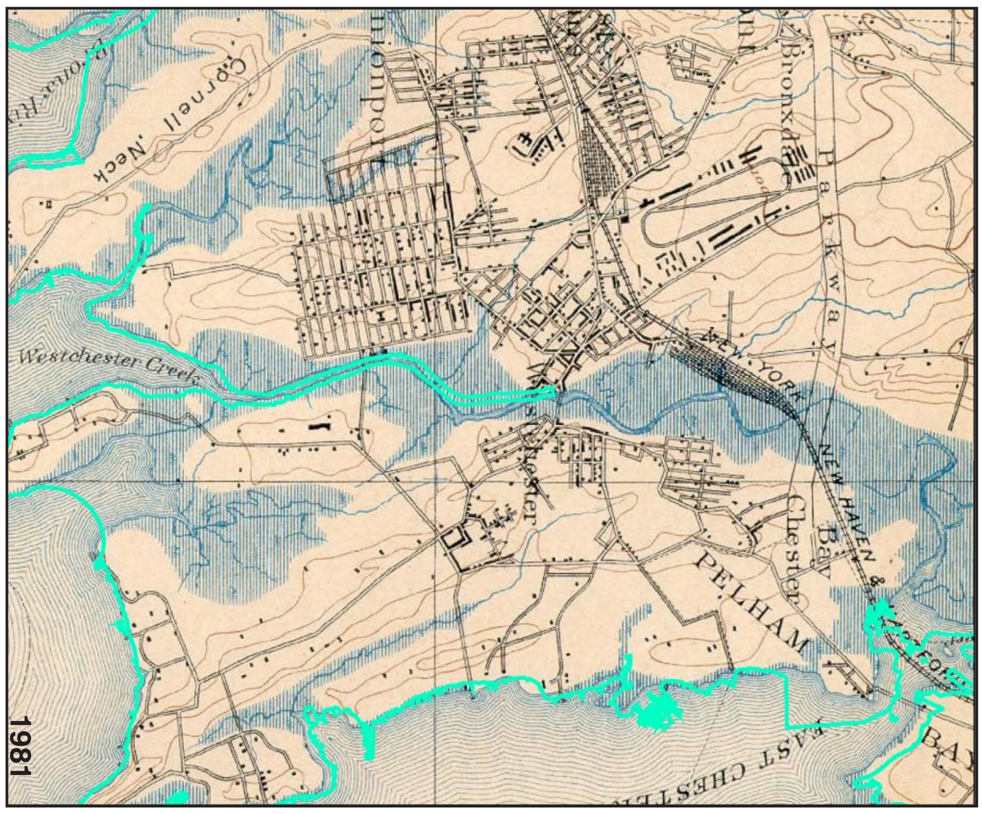
The Zoning Resolution of the City of New York regulates the size of buildings and properties, the density of populations, and the locations where trades, industries, and other activities are allowed to locate within the City limits. The Resolution divides the City into districts, defining residential, commercial, and manufacturing districts with use, bulk, and other controls. Residential districts are defined by the allowable density of housing, lot widths, and setbacks, with a higher number generally indicating a higher allowable density (e.g., single-family detached residential districts include R1 and R2, whereas R8 and R10 allow apartment buildings). Commercial Districts are divided primarily by usage type, such that local retail districts (C1) are distinguished from more regional commerce (C8). Manufacturing districts are divided based on the impact of uses on sensitive neighboring districts to ensure that heavy manufacturing (M3) is buffered from residential areas by lighter manufacturing zones (M1 and M2) that have higher performance levels and fewer objectionable influences.

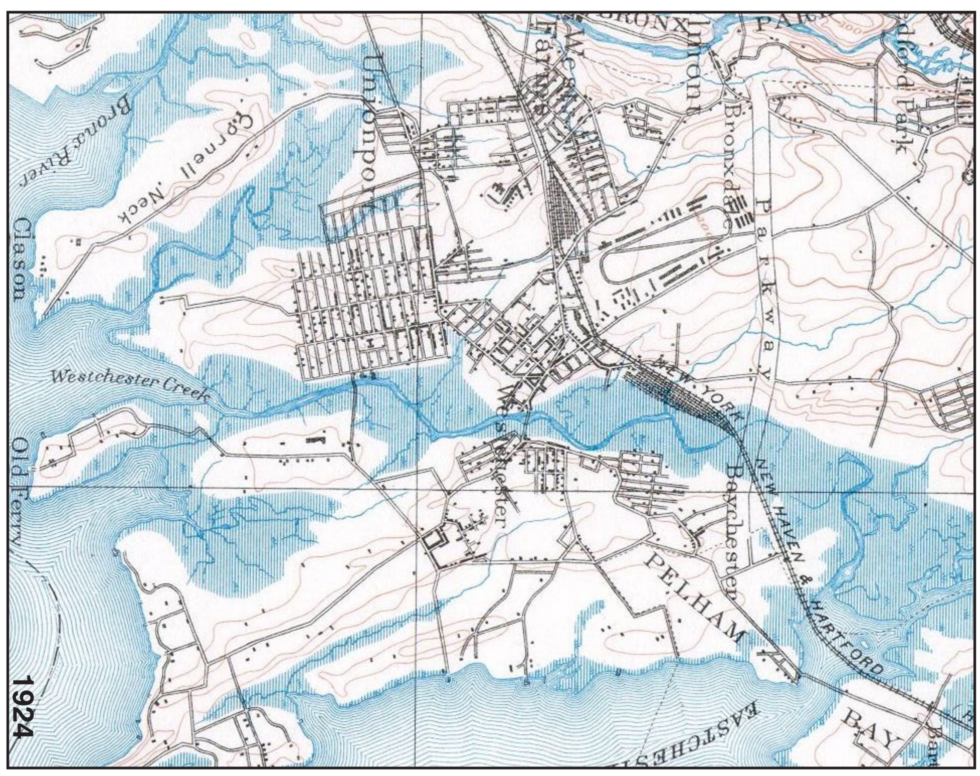
Figure 2-3 presents zoning within the Westchester Creek watershed. Zoning immediately adjacent to Westchester Creek is dominated by manufacturing districts. Zoning adjacent to Pugsley Creek is primarily park properties and residential districts. The majority of the western shore of Westchester Creek is zoned manufacturing, from the head to near its confluence with Pugsley's Creek. Areas to the north and northwest of Westchester Creek are primarily M1 zones, and the southern reaches contain M1, M2, and M3 zoning. The eastern shore of Westchester Creek is zoned M1 from the Bruckner Expressway southward to Ferry Point Park. Two large commercial blocks are located adjacent to Westchester Creek, one along the eastern shoreline north of the Bruckner Expressway (the Whitestone Cineplex movie theaters) and one along the western shoreline near the confluence of Westchester and Pugsley Creeks, owned by the YMCA of Greater New York. The area immediately adjacent to Pugsley Creek is parkland that is zoned residential. Mapped parkland administered by the New York City Department of Parks and Recreation (NYCDPR) is not subject to the Zoning Resolution.

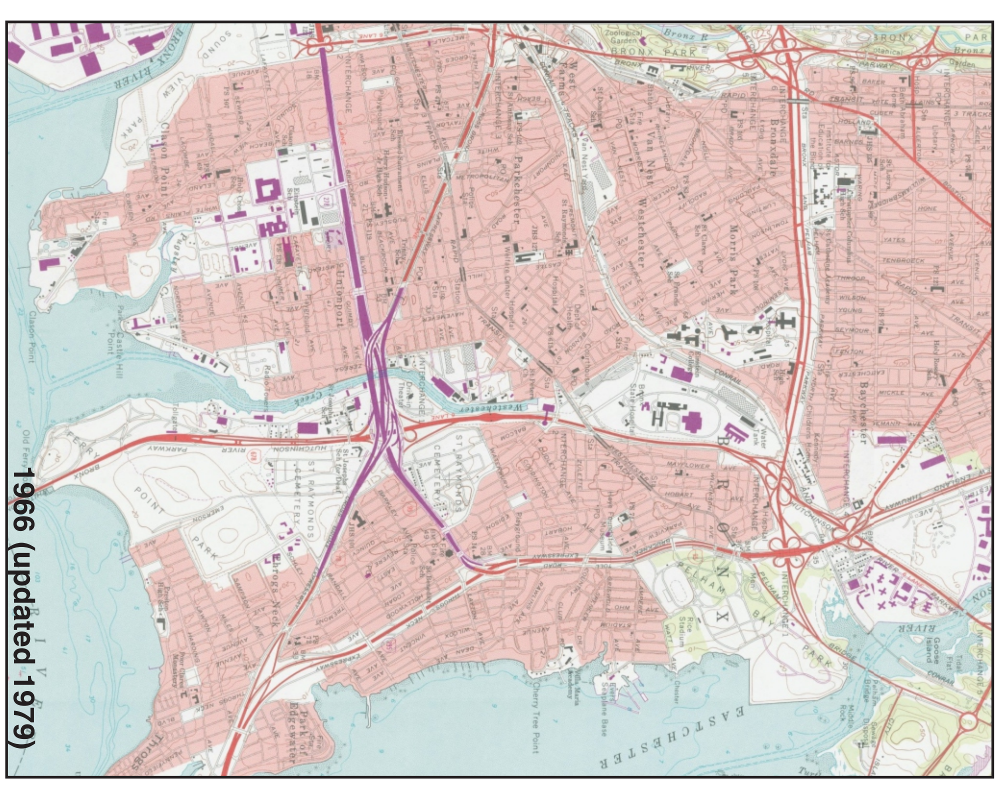
The land within a ¼- mile radius of the Westchester Creek waterbody is primarily residential, except for the aforementioned manufacturing zoning concentrated on the shores of Westchester Creek, and limited commercial districts concentrated along neighborhood thoroughfares within the residential zoning. Residential zoning includes R3, R4, R5, R6, and R7, all of which are General Residence Districts that permit a broad range of housing types, as well as community facilities and open uses which serve the residents of these districts or otherwise benefit from a residential environment. The entire western portion of the area within a ¼-mile radius of Westchester Creek is zoned as R4. Most of the communities to the east are zoned R5, with R4 and R3 interspersed. The area northeast of the head of Westchester Creek is zoned R5, R6, and R7.

2.2.3. Proposed Land Uses

Both NYCDCP and NYCEDC were contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Westchester Creek. NYCDCP reviews any proposal that would result in a fundamental alteration in land use, and the NYCEDC advances City land use policy through dispensing City-owned property. Inquiries were made in October 2004 and again in May 2007 to the NYCDCP Community Board





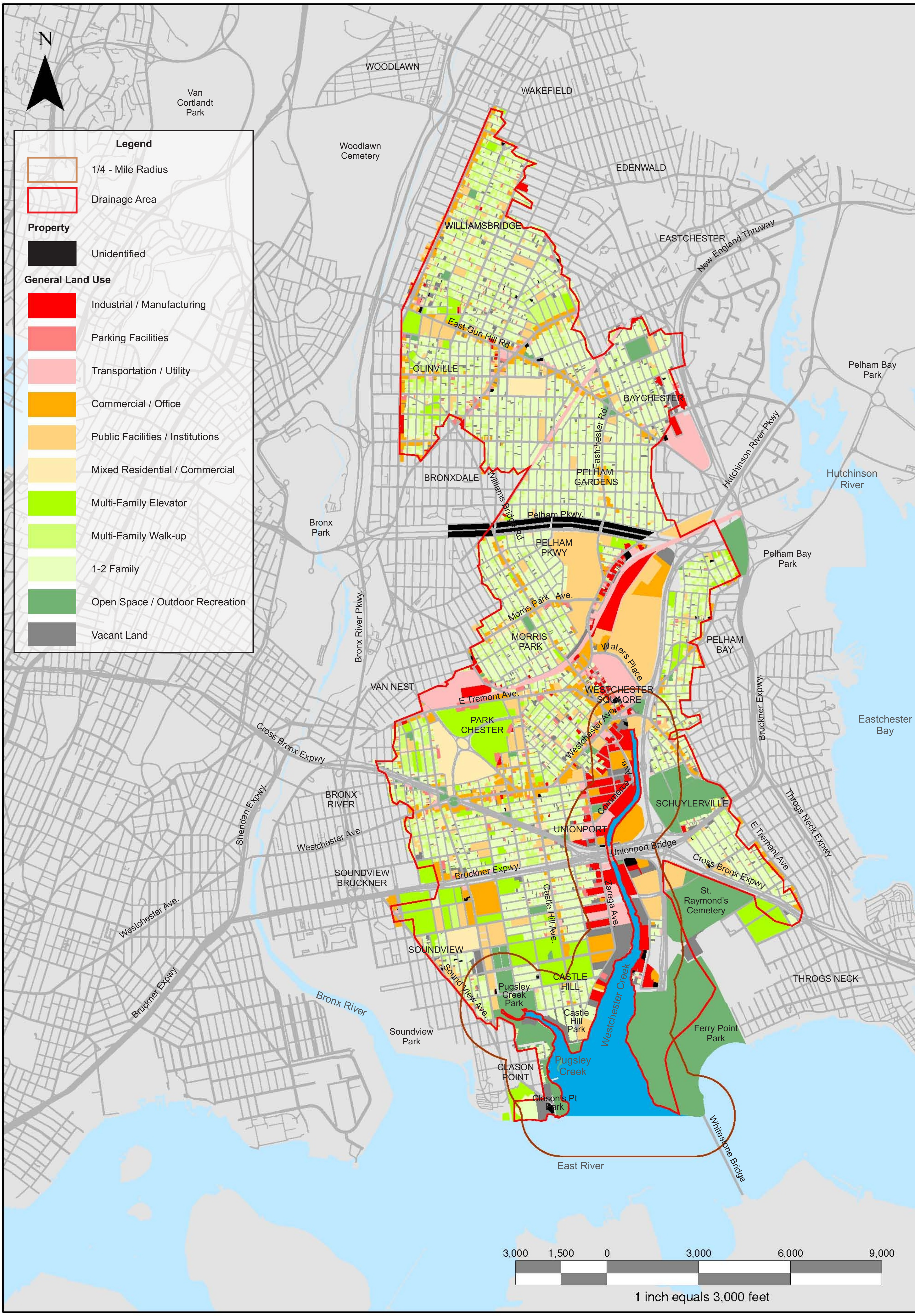


Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Urbanization in Vicinity of Westchester Creek

FIGURE 2-1

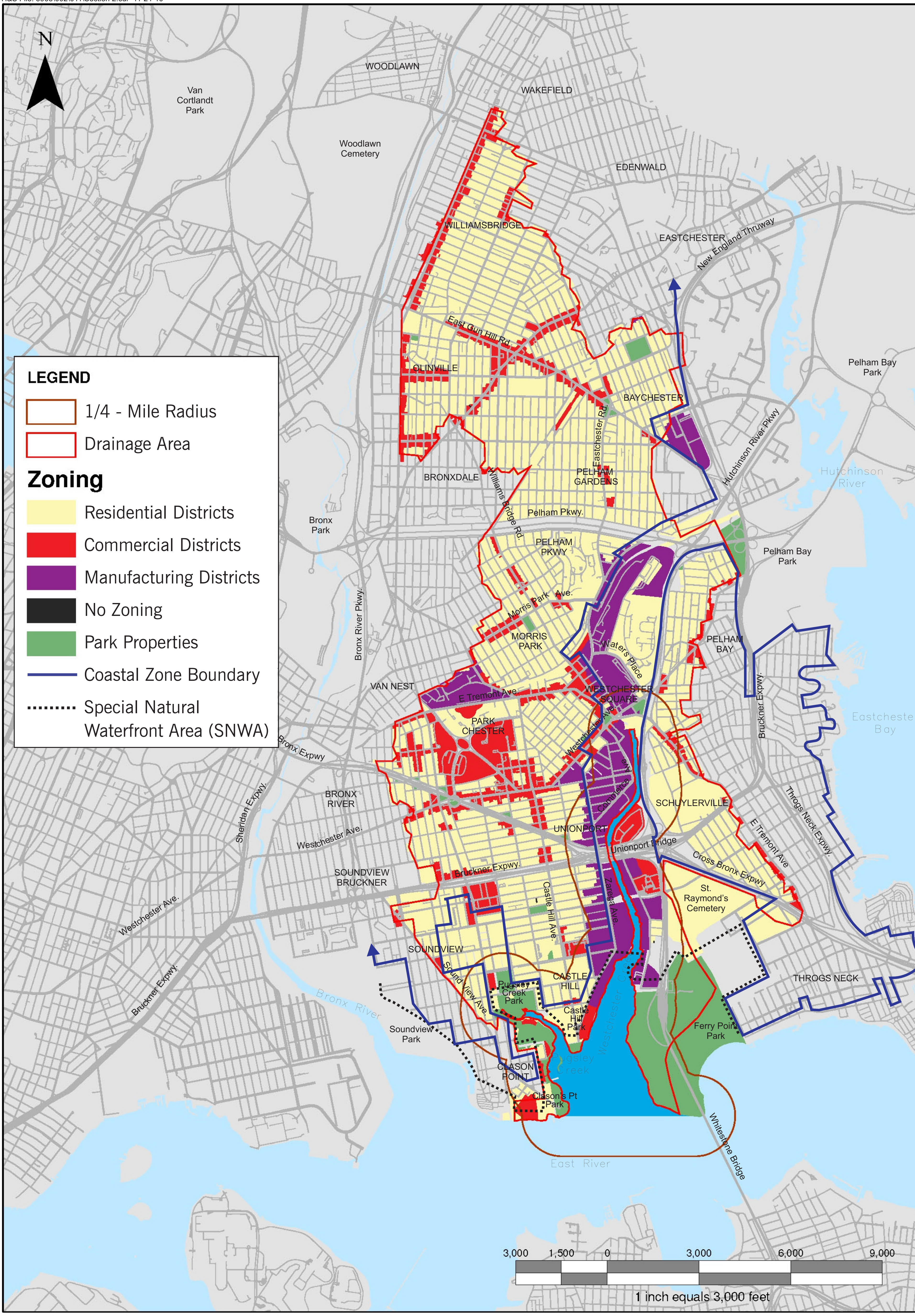


NYC Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Westchester Creek Watershed Generalized Land Use

FIGURE 2-2



NYC Environmental Protection

Westchester Creek Watershed Generalized Zoning

FIGURE 2-3

liaisons for Districts 9 and 10. Projects under review are summarized below, but generally do not substantially alter the existing land uses in the vicinity of Westchester and Pugsley Creeks.

Two new residential developments were under NYCDCP review as of May 2007. Located on the western shoreline of Westchester Creek and north-adjacent to the YMCA near Castle Hill Park, Vista Mar I and Vista Mar II are multi-residential complexes on the waterfront. When completed, an uninterrupted shoreline esplanade is expected to extend from Castle Hill Park along the water through these properties uninterrupted. Following the construction of Vista Mar I, the Department of Buildings would not issue a Certificate of Occupancy, and the building is not occupied, despite the fact that all of the residential units have been sold. A rezoning application for Vista Mar II is under review at NYCDCP as well, but is also delayed by failure to comply with City requirements. Neither property presently has an esplanade, nor is there a timetable for its completion. Nonetheless, it is expected that an esplanade will be built when the projects are finally completed.

Ferry Point Park is undergoing improvements east of the Whitestone Bridge. An 18-hole golf course and clubhouse / banquet hall structure are being built by a concessionaire to NYCDPR. In addition, the City is completely rebuilding an existing community park, as well as constructing a new, 19.5-acre waterfront park along the East River. The projects are under construction and include an extensive need for fill material, the receipt of which is funding the project through tipping fees. The concessioner is permitted under a Part 360 DEC permit to receive clean fill from approved sites, provided an independent monitor ensures that only clean fill is used at the site. As of May 2007, over 1.7 million cubic yards of clean fill had been placed. Ferry Point Park West refers to the area between the Whitestone Bridge and Westchester Creek, and there are plans to improve this portion of the park, including expanded access to the waterfront of Westchester Creek, but nothing has been formally implemented as of the date of this report.

The NYCEDC long-term plans for the Zerega Avenue corridor is to accommodate industrial users within the existing Manufacturing zoning as industrial uses throughout other parts of New York City are pushed out through market forces, gentrification, and environmental regulations. Industrial uses are encouraged by NYCEDC by dispensing City-owned property to reputable businesses and making these sales contingent upon the desired uses on the property. Industrial development over the past several years has included a new Pepsi distribution center on Brush Avenue, parking for UPS, the Home Depot on Zerega Avenue, and Consolidated Bus storage and dispatching facility. The last of these developments is tightly restricted because the City-owned parcel to the southeast is leased by a demolition company that stores explosives on site, and the bus company use was particularly suited to the development and use restrictions on a property adjacent to an explosives storage site. Because the Zerega Avenue corridor is general zoned for industrial uses, NYCEDC sales of City-owned property are not likely to be substantively inconsistent with existing land use and zoning in the vicinity of Westchester Creek.

2.2.4. Neighborhood and Community Character

The character of a neighborhood is defined both by physical patterns such as land use, architecture, and public spaces, and by activity patterns such as pedestrian traffic, commerce, and industry. The industrial character in the immediate vicinity of Westchester Creek is influenced by its historical use as a shipping port and industrial corridor. The area is zoned for activities such as warehousing, shipping distribution, and certain types of manufacturing, and is expected to remain so through zoning and incentives from the City Economic Development Corporation. The western shoreline is industrial in nature along its entire extent, from the historical neighborhood of Westchester Square south along Commerce Avenue through Unionport, then south along Zerega Avenue through Castle Hill. Businesses in the area rely heavily on local access to multiple major arteries in the interstate highway system, and a relatively few number of the industrial concerns appear to rely on Westchester Creek for commerce. Neighborhood and community character is disrupted by these major highways and interchanges, and by the large industrial facilities. The eastern shoreline is bordered by the Hutchinson River Parkway along its northern third, while Ferry Point Park and Saint Raymond’s Cemetery isolate a small two-block wide strip adjacent to Westchester Creek.

In contrast, Pugsley Creek is entirely surrounded by parkland, and the neighborhoods around the parkland are almost entirely residential with limited commercial zones to support the local community. Clason Point, located at the southeastern boundary of the study area and bound by the Bronx River, the East River, and Pugsley Creek, is almost entirely residential. Small detached single and two-family residences occupy the majority of the point, and a large development (Harbour Pointe) is under construction that will include two-family townhouses and condominiums. Residential areas north of Pugsley Creek, in the neighborhood of Castle Hill, include townhouse residences and several large residential towers.

The neighborhood of Westchester Square, northwest of the head of Westchester Creek, is historically significant and retains elements of its past, despite the elevated train operating along Westchester Avenue, a main thoroughfare through the community. The square itself is a commercial center and public space, with bus and elevated train stations, as well as highway access. The Huntington Free Library and Reading Room occupies a historically significant building on the square, designed by Frederick C. Withers, an architect renowned for his use of High Victorian Gothic and Gothic Revival styles. Additional historical character is evident at Saint Peter’s Church and Cemetery, less than two blocks from the square along Westchester Avenue. A church has occupied this site for over 200 years, and the cemetery contains the remains of numerous prominent New Yorkers. The surrounding residential areas contain detached single-family houses interspersed with small multi-family apartment buildings.

2.2.5. Consistency of Current Land Use with the Waterfront Revitalization Program

Although the New York City WRP policies are intended to be used to evaluate proposed actions to promote activities appropriate to various waterfront locations, evaluating the consistency of existing land use with those policies can be used to anticipate future waterfront conditions. Ten policies are included in the Program: (1) residential and commercial redevelopment; (2) water-dependent and industrial uses; (3) commercial and recreational boating; (4) coastal ecological systems; (5) water quality; (6) flooding and erosion; (7) solid waste and hazardous substances; (8) public access; (9) scenic resources; and (10) historical and cultural resources.

The Westchester Creek waterbody is entirely within the Coastal Zone Boundary (Figure 2-3). In addition, the lower reaches of Westchester Creek and Pugsley's Creek are within the East River - Long Island Sound Special Natural Waterfront Area (SNWA). An SNWA is a large area with concentrations of important coastal ecosystem features such as wetlands, habitats and buffer areas, many of which are regulated under other programs. The SNWA contains all of Pugsley Creek and Westchester Creek up to the northern end of Ferry Point Park. The WRP encourages public investment within the SNWA to focus on habitat protection and improvement and discourages activities that interfere with the habitat functions of the area. Acquisition of sites for habitat protection is presumed consistent with the goals of this policy. Similarly, fragmentation or loss of habitat areas within an SNWA should be avoided.

The Westchester Creek assessment area is currently not consistent with all policies of the WRP. Failure to attain water quality conditions suitable for fish propagation and survival directly contravenes both policy 4 (coastal ecological systems) and policy 5 (water quality). Further, negative aesthetics associated with floatables and poor water quality discourage redevelopment of the waterfront by residential and commercial users (policy 1) and commercial and recreational boating (policy 3), although the latter of these is an existing use in the waterbody. Although the Westchester Creek corridor contains a significant community of industrial users, historical land development has led to reliance on rail and roadway access, and not on water-dependent modes of transportation. The industry in this corridor is generally not water-dependent, and the corridor is therefore not wholly consistent with policy 2 (water-dependent and industrial uses). The remaining policies (6 through 10) are designed to review the impact of proposed actions and are therefore not applicable to existing conditions. A comprehensive WRP consistency determination would be performed as part of the environmental review process required for siting any facility DEP constructs.

2.3. REGULATED SHORELINE ACTIVITIES

As part of the WB/WS Facility Plan development, information was gathered from selected existing federal and state databases to identify possible landside sources that have the potential to directly impact water quality in Westchester Creek. The extent of the study area was limited, to the extent possible, to the shorelines of Westchester and Pugsley Creeks from their respective head ends to the East River, extending upland to the first mapped street paralleling the shoreline. For the purposes of this assessment, potential sources included the existence of underground storage tanks (UST), major oil storage facilities (MOSF), known contaminant spills, existence of state or federal superfund sites, the presence of SPDES permitted discharges to the waterbodies and other sources that may have the potential to adversely affect the water quality.

The USEPA Superfund Information System, which contains several databases with information on existing superfund sites, was reviewed. These databases included: the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), Resource Conservation and Recovery Act Information (RCRA info), Brownfields Management System, Site Spill Identifier List (SPIL) and the National Priorities List (NPL). In addition to these federal databases, several databases managed and maintained by the DEC were also reviewed. These included: the DEC Spill Incident and the Environmental Site Remediation databases, which allow searches of the DEC's Brownfield cleanup, state superfund (inactive hazardous waste disposal sites), environmental restoration, and voluntary cleanup programs. In addition, the DEC Petroleum Bulk Storage Program database was also reviewed for potential sources that may affect water quality.

A review of the USEPA Superfund Information System indicated that there are no federally listed sites located in proximity to Westchester and Pugsley Creeks. In addition, a review of the NPL and Brownfields Management System database indicated that there are no sites within the study area. A large quantity generator produces over 1,000 kilograms of hazardous waste or over 1 kilogram of acutely hazardous waste per month. Small quantity generators produce between 100 kilograms and 1,000 kilograms of waste per month. Conditionally-exempt, small quantity generators generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste. RCRA sites in proximity to the study area are listed in Table 2-2.

Table 2-2. RCRA Sites in the Waterbody Vicinity

RCRA Type	Site Name	Address
Large Quantity Generators	Industrial Acoustics Company Inc	1160 Commerce Avenue
	NYCT- Zerega Annex	750 Zerega Avenue
	NYS Dept of Transportation	Cross Bronx and Bruckner Expwys
Small Quantity Generators	Rimi Woodcraft Corp	1185 Commerce Avenue
	Bell Atlantic	1101 Zerega Avenue
	Cummins Metropower Inc.	890 Zerega Avenue
	Bell Atlantic (Garage 23549)	500 Zerega Avenue
	NYCEDC	745 Brush Avenue
	A-1 Intl. Heat Treating	907 Brush Avenue
Conditionally Exempt Generators	Hedco	1144 Zerega Avenue
	NYCDOT Bridge Bin 2075820	E Tremont Av Bridge, Westchester Cr
	Five Js Automotive Ltd.	809 Zerega Avenue
	Logan Bus Company	406 Zerega Avenue
	United Parcel Service	545 Brush Avenue
	H.O. Penn Machinery Company, Inc.	699 Brush Avenue
Non-Specified RCRA Sites (i.e., handler type not specified)	MTP Industries	1180 Commerce Avenue
	Lockheed Martin Electronic Defense System	1261 Commerce Avenue
	Fred M. Schildwachter & Sons	1400 Ferris Place
	Donble T. Service Station	2951 East Tremont Avenue
	Cibro	1066 Zerega Avenue
	Keystone Construction Corp.	1000 Zerega Avenue
	DEP	Zerega Ave & Bruckner Expwy
	Revlon Research Center	945 Zerega Avenue
	Bronx 12	850 Zerega Avenue
	NYC Dept of Sanitation Bronx District 9 Garage	850 Zerega Avenue
	Crystal Chemical Corp.	450 Zerega Avenue

Table 2-2. RCRA Sites in the Waterbody Vicinity

RCRA Type	Site Name	Address
	Ciminello P. Properties	900 Brush Avenue
	NYSDPT Contract D256830	Brush Ave under Bruckner Expwy
	NYCDOT Bridge Bin 1066510	Unionport Bridge, Westchester Cr

A review of the DEC State Superfund Program indicated that a Voluntary Cleanup Program site is located at Zerega Avenue between Blackrock and Watson Avenues at the Consolidated Edison - Zerega Avenue Station site. The Zerega Avenue Station is a series of former Manufacturing Gas Plant (MGP) gas holders. The holders were in use during and after the life of the MGP plant, from 1904 until 1966. The site is currently occupied by a school bus terminal. A site characterization is scheduled for 2006.

The DEC Petroleum Bulk Storage database identified several USTs in the study area. According to the database, there are a total of 15 UST sites in proximity to Westchester and Pugsley Creeks. These sites contain USTs that are either in-service or closed. The storage capacity of the identified USTs ranged between 550 and 20,000 gallons. These USTs were identified as storing gasoline, diesel, lube oil, No. 2 or No. 6 fuel oil, or other products. These UST sites and additional information are identified in Table 2-3. It should be noted that the complete DEC Petroleum Bulk Storage database was not available due to security reasons; therefore, the DEC petroleum bulk storage information presented within this section may not be comprehensive.

Table 2-3. Underground Storage Tanks in the Waterbody Vicinity

Site	Capa	Product(s) Stored	Qty.	Status
East Bronx Yard 930 Zerega Avenue	5,000 6,100 2,550	Diesel, Gasoline Diesel, Gasoline Gasoline	2 4 1	In Service Closed – Removed Tank Converted
Verizon New York, Inc. 500 Zerega Avenue	8,000 550	Gasoline, Diesel Gasoline	2 5	In Service Closed – Removed
Cummings Metropower, Inc. 890 Zerega Avenue	23,000	Diesel, Other	4	Closed – Removed
BP Amoco Service Station #17865 91 Westchester Square	12,550 4,550	Diesel, Gasoline Diesel, Gasoline	5 5	In Service Closed – Removed
Verizon New York, Inc. 1131 Zerega Avenue	8,250	Gasoline, Other	3	Closed – Removed
DSNY Bronx Districts 9/10 Garage 850 Zerega Avenue	22,000 2,550 19,550	Diesel, Fuel Oil, Fuel Oil, Lube Oil Diesel, Fuel Oil, Gasoline, Lube Oil	8 5 8	In Service Closed – Removed Closed – In Place
Trine Tolled Moulding Corp. 1141-1421 Ferris Place	2,500	Fuel Oil	1	In Service
H O Penn Machinery Co., Inc. 699 Brush Avenue	3,000 8,000	Diesel Diesel, Gasoline	1 2	In Service Closed – Removed
Ciminello Property Associates 711 Brush Avenue	2,000	Fuel Oil	1	Closed – Removed

Table 2-3. Underground Storage Tanks in the Waterbody Vicinity

Site	Capa	Product(s) Stored	Qty.	Status
Ciminello Property Associates 733 Brush Avenue	6,000	Fuel Oil	1	In Service
United Parcel Service 545 Brush Avenue	14,000 4,500	Fuel Oil, Gasoline Gasoline, Other	2 3	In Service Closed – Removed
Bronx Whitestone Bridge One Hutchinson River Pkwy	28,000 40,650	Diesel, Fuel Oil, Gasoline Diesel, Fuel Oil, Gasoline	5 9	In Service Closed - Removed
Monsignor Scanlan H.S. 915 Hutchinson River Pkwy	10,000	No. 6 Fuel Oil	1	In Service
Saint Joseph's School for Deaf 1000 Hutchinson River Pkwy	10,000 15,000	No. 2 Fuel Oil No. 6 Fuel Oil	1 2	In Service Closed – In Place

Review of the remaining DEC Environmental Site Remediation databases indicated that there are no brownfields or environmental restoration sites located in proximity to the Westchester Creek study area.

Review of the DEC SPILL databases indicate that there were 47 spills and LUSTs (leaking underground storage tanks) that had occurred or were located within a one-block radius of Westchester and Pugsley Creeks within the past 10 years. Of these 47 spills and LUSTs, eight remained open as of April 2006 and are listed in Table 2-4. The majority of these spills affected soil; however, contamination of other medium was also noted. The majority of the open spills occurred on Zerega Avenue, which runs parallel to Westchester Creek. These spills resulted in the release of No. 2 oil fuel, hydraulic/motor oil, gasoline and/or diesel fuel.

Two New York State SPDES discharges are located on Westchester Creek. These are located near the head of the creek along the western shoreline. The two discharge points are associated with two facilities operated by Fred M. Schildwachter and Sons, located at 1392 Commerce Avenue and 1400 Ferris Place. These facilities have been identified by the USEPA as petroleum bulk storage facilities and terminals. The SPDES permit limits are for flow, pH, oil and grease, toluene, benzene, and xylene.

Based upon a review of the available federal and state environmental databases, as well as the additional sources of information discussed above, none of these potential sources of contamination are associated with existing or previous combined sewer overflows to Westchester or Pugsley Creeks. These sources, however, have the potential to affect water quality within Westchester and Pugsley Creeks.

Table 2-4. DEC Open Spills and Leaking USTs in the Waterbody Vicinity

Location	Spill Date	Spill Number	Quantity	Material	Resource Affected	Spill Cause
Oil Masters, LLC 1066 Zerega Avenue	10/31/1996	9609601	*Unspecified*	No. 2 Oil Fuel	Soil	Tank Test Failure
Cummings Metropower 890 Zerega Avenue	11/15/1996	9610218	*Unspecified*	Diesel	Soil	Other
H O Penn 699 Brush Avenue	01/08/1997	9612128	*Unspecified*	Hydraulic/ Motor Oil	Soil	Tank Test Failure
Bronx East 09/10 DOS-DDC 850 Zerega Avenue	03/19/1999 05/22/2002	9815082 0201915	*Unspecified* *Unspecified*	No. 2 Oil Fuel Hydraulic/ Motor Oil	Soil Soil	Tank Test Failure Equipment Failure
Private Residence 1411 Ferris Place	09/05/2001	0105988	*Unspecified*	No. 2 Oil Fuel	Soil	Tank Test Failure
Verizon 1101 Zerega Avenue	02/14/2006	0513130	*Unspecified*	Gasoline	Groundwater	Unknown
East Bronx Yard DEP-DDC 930 Zerega Avenue	07/02/2004	0403562	*Unspecified*	No. 2 Fuel Oil	Soil	Equipment Failure

NO TEXT ON THIS PAGE

3.0. Existing Sewer System Facilities

The Westchester Creek watershed is wholly within the Hunts Point WWTP service area, although portions of the drainage area along the shorelines discharge directly to Westchester Creek. The following sections describe the Hunts Point WWTP, the collection system tributary to Westchester Creek, and the discharge characteristics.

3.1. HUNTS POINT WWTP

The Hunts Point WWTP is permitted by DEC under SPDES permit number NY-0026191. The facility is located at 1270 Ryawa Avenue in the Hunts Point section of the Bronx, on a 45-acre site adjacent to the Upper East River located between Halleck Street and Manida Street. The Hunts Point WWTP serves an area of 16,664 acres in the East Side of the Bronx, including the communities of City Island, Throgs Neck, Edgewater Park, Schuylerville, Country Club, Pelham Bay, Westchester Square, Clason Point, Castle Hill, Union Port, Soundview, Parkchester, Van Nest, Co-op City, Morris Park, Pelham Parkway, Pelham Gardens, Baychester, Olinville, Willimasbridge, Edenwald, Eastchester, Hunts Point, Woodlawn, Wakefield, East Tremont, West Farms, and Longwood. The total sewer length, including sanitary, combined, and interceptor sewers, that feeds into the Hunts Point WWTP is 424 miles. Figure 3-1 provides an aerial site plan of the Hunts Point WWTP.

The Hunts Point WWTP has been providing full secondary treatment since 1978. Processes include primary screening, raw sewage pumping, grit removal and primary settling, air activated sludge capable of operating in the step aeration mode, final settling, and chlorine disinfection (see Figure 3-2). The Hunts Point WWTP has a design dry weather flow (DDWF) capacity of 200 million gallons per day (MGD), and is designed to receive a maximum flow of 400 MGD (2×DDWF) with up to 260 MGD receiving secondary treatment, (1.3 times DDWF to protect BNR control processes). Flows over 260 MGD receive primary treatment and disinfection. During 2008, the Hunts Point WWTP processed a daily average flow of 132.2 MGD and a dry weather flow average of 119.5 MGD. Table 3-1 summarizes the Hunts Point WWTP permit limits.

The Hunts Point plant began operation in 1952, with a design average flow capacity of 120 MGD. The plant was expanded in capacity in 1962 to 150 MGD, and again in the 1970s to its current design average dry weather flow capacity of 200 MGD. The upgraded plant was designed to provide primary treatment and chlorination to a wet weather peak flow of two times design average dry weather flow (400 MGD) and secondary treatment to 1.5 times average dry weather flow. In the 1990s, a sludge dewatering building was constructed at the plant under the Citywide Sludge Management System. In December 1999, construction was completed for Basic Step Feed Biological Nitrogen Removal (BNR) retrofit at Hunts Point. This included the installation of baffles in each pass of the aeration tanks to create anoxic zones, submersible mixers in each anoxic zone to prevent solids settling, and froth-control chlorine spray hoods for filament suppression. Currently, the Hunts Point WWTP is undergoing construction to rehabilitate and upgrade its facilities to provide stable BNR operation. The original Nitrogen Consent Order called for the Phase II BNR upgrade to be completed by June 30, 2007. The Modified Phase I BNR Facility Plan calls for the

Phase II upgrade to be completed by June 30, 2008. DEP did not meet this revised milestone and requested an additional extension of 20 months to March 2010.

Table 3-1. Select Hunts Point WWTP SPDES Effluent Permit Limits

Parameter	Basis	Value	Units
Flow	DDWF Maximum secondary treatment Maximum primary treatment	200 300(1) 400	MGD
$CBOD_5$	Monthly average 7-day average	25 40	mg/L
TSS	Monthly average 7-day average	30 45	mg/L
Total Nitrogen	12-month rolling average	108,375(2)	lb/day

Notes:
(1) As recommended in the WWOP max. secondary flow should be 260 MGD upon completion of Phase II BNR upgrades to maintain biological nitrogen removal.
(2) Nitrogen limit for the Combined East River Management zone, calculated as the sum of the discharges from the four Upper East River WWTPs (Bowery Bay, Hunts Point, Wards Island, Tallman Island) and one quarter of the discharges from the 2 Lower East River WWTPs (Newtown Creek, Red Hook). This limit is effective through November 2009, then decreases stepwise until the limit of 44,325 lb/day takes effect in 2017.

3.1.1. Hunts Point WWTP Process Information

Figure 3-2 shows the current process treatment for the Hunts Point WWTP. Flow is conveyed to the Hunts Point WWTP via a 12-foot by 10-foot interceptor. The forebay gate chamber has recently been constructed, as part of the Phase I Modified BNR Facility Plan. It is located at the terminus of the 12-foot by 10-foot interceptor, approximately 50 feet north of the screening building. The hydraulically operated 10-foot by 9-foot roller gate is intended to be used to regulate the flow from the interceptor. The forebay gate chamber is connected to the screening forebay by an influent conduit that splits into four screen channel influent conduits. The intent is for the high velocities from under the roller gate during wet weather throttling to be dissipated within the influent conduit, prior to entry to the screenings channels. At the entrance to the screen chamber, there is a set of stop log grooves in each channel that can isolate the flow to the screen channel, in the event that repair work downstream becomes necessary.

Four screening channels connect the screenings forebay to the afterbay. Each screening channel has a 60-inch by 84-inch hydraulically operated influent sluice gate and an effluent sluice gate that can isolate the channel when the screen is not needed or in the event that screen or channel repair work becomes necessary. The new screens, installed in 2004 as part of the BNR upgrade, are 6 feet wide with 1-inch openings and are cleaned with a vertical traveling rake. Each screen is designed to handle 133 MGD; thus, three screens are required for 400 MGD, providing a standby or spare channel. DEP generally refers to this configuration as "N+1," i.e., the total number of units available is one more than required to process the design flow. Certain critical components, such as main sewer pumps (MSPs), are rated at "N+1+1," i.e., the total number of pumps capable of being placed into service must be one more than required to accommodate the design flow, and an additional pump must be on-site as a spare to be installed to maintain N+1 rating during repairs.

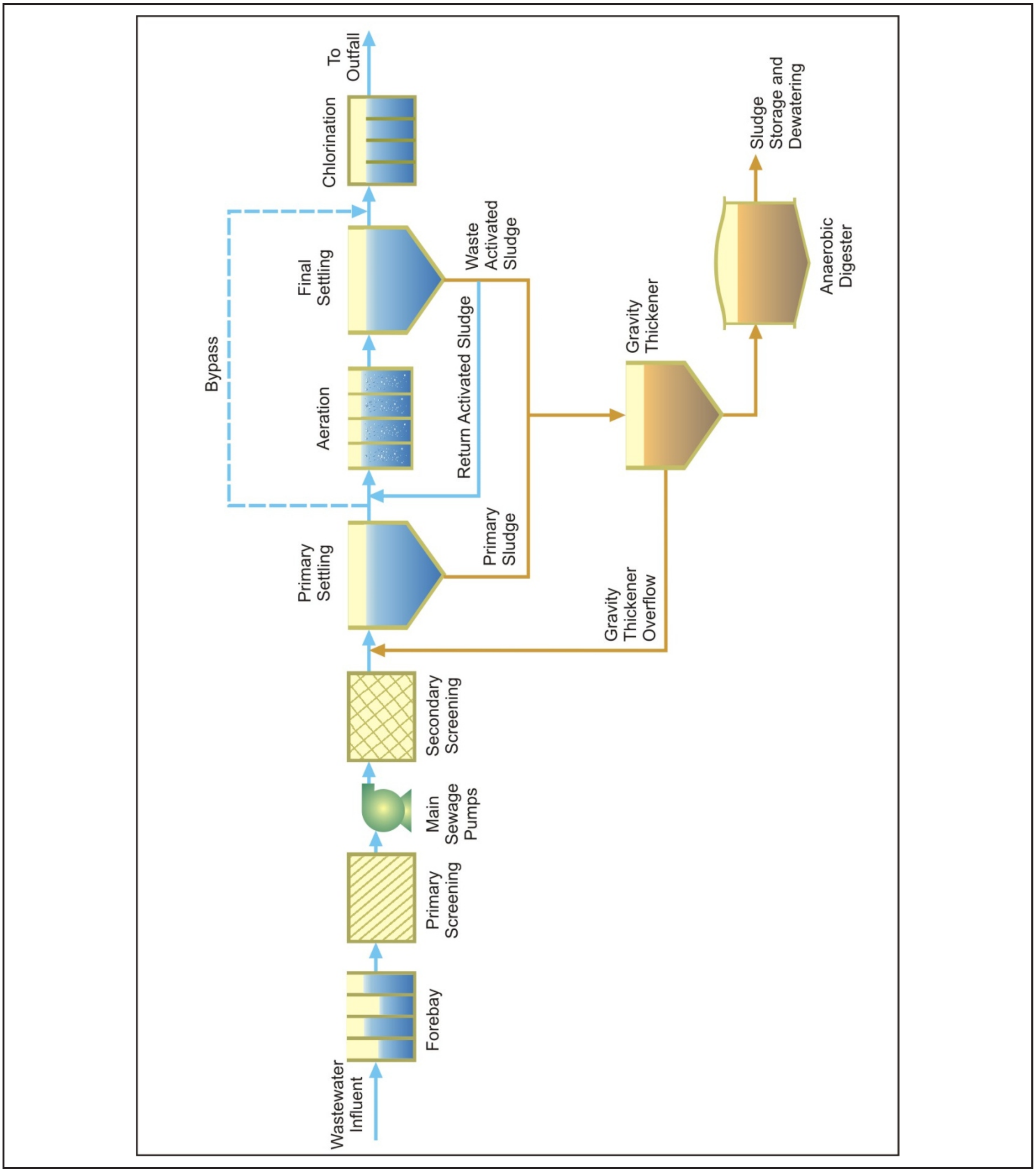
H&S File: 5905\002\011\Section 3.cdr 11-23-10

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Hunts Point WWTP Existing Facility Layout

FIGURE 3-1



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Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Hunts Point WWTP Process Flow Diagram

FIGURE 3-2

The Hunts Point WWTP pumping capacity attained the N+1+1 criterion in late October 2004, following the installation of six new main sewage pumps (MSPs) as part of the BNR upgrades, and the plant has successfully sustained wet weather flows of 385 to 400 MGD with the new pumping system in service. The MSPs are each rated at 98.6 MGD at a total dynamic head of 32.5 feet and a speed of 360 rpm. The vertical, centrifugal, mixed-flow, bottom-suction, flooded-suction pumps are driven by 800 hp, 360 rpm, vertical, close-coupled, variable frequency drive (VFD) motors. Each pump draws flow from one of the two pump suction channels that are connected to the screening chamber afterbay. The cast-in-place pump suction conduit is 49 inches in diameter. Each 42-inch discharge line contains a cone check valve and terminates in a separate enclosed discharge chamber that connects to the secondary screen forebay by an opening with a sluice gate and stop log channel.

There are five new secondary screens with ½-inch bar openings and vertical traveling rakes. The secondary screens were installed during the 2004 BNR upgrades, and are designed to handle 100 MGD (i.e., N+1 at 2DDWF). There are two secondary screen bypass channels that are used to bypass a portion of the flow when more than one secondary screen is out of service or blinding results in excess head loss through the screens. Effluent from the secondary screen afterbay is conveyed through an effluent conduit and venturi meter to the primary settling tanks. A manifold structure distributes the flow across three parallel conduits to the primary settling tanks.

There are six primary settling tanks with a total volume of 9.4 million gallons (MG) and a surface overflow rate of 1,914 gallons per day per square foot (gpd/sf) at DDWF. Primary tank effluent is conveyed to the aeration tanks in a primary effluent channel. Five 4-pass aeration tanks provide biological treatment and one aeration tank provides centrate nitrification. The total aeration tank volume is 27.9 MG. Five 42,000 standard cubic feet per minute (scfm) blowers provide air through ceramic tube diffusers.

The plant has a secondary bypass channel, which conveys primary effluent to the chlorine contact tanks when the flow into the secondary treatment process exceeds 260 MGD. The bypass channel capacity has been estimated to be 140 MGD. Aeration tank effluent is conveyed to the final settling tanks in an aeration tank effluent channel. The secondary flow passes through up to 30 final settling tanks with a total volume of 25.8 MG and a surface overflow rate of 760 gpd/sf at DDWF. Final settling tank effluent and bypass flow are recombined and conveyed to the two chlorine contact tanks. The two tanks have a total volume of 4.4 MG and a detention time of 15.8 minutes at DDWF. Chlorinated effluent is discharged to the East River via an outfall.

Primary sludge is degritted in cyclones and mixed with waste activated sludge. The combined mixed sludge is thickened in twelve 65-foot diameter gravity thickeners. Each thickening tank unit has a 10-foot side water depth (SWD) and a total surface area of 39,800 square feet. The gravity thickener overflow is returned upstream of the venturi meter, with effluent from the secondary screens, and the thickened sludge is sent to the anaerobic digesters. Sludge digestion is accomplished in four 118-foot diameter digestion tanks arranged so that all four tanks are run as primary digesters with a total volume of 11 MG. Five sludge storage tanks provide 9.2 MG for the storage of digested sludge. Digested sludge is dewatered via on-site centrifuges on site in preparation for final disposal and the centrate is recycled through the plant. Sludge cake, grit, scum, and screenings are removed from the plant by truck for disposal at an off-site facility.

3.1.2. Hunts Point WWTP Wet Weather Operating Plan

The DEP is required by its SPDES permit to maximize the treatment of combined sewage at the Hunts Point WWTP. The DEC has approved the Wet Weather Operating Plan (WWOP) for the WWTP, which limits flow to 300 MGD through the secondary treatment processes and up to 260 MGD upon completion of Phase II BNR upgrades in March 2010. The Biological Nutrient Removal BNR process is more sensitive to flow variation than the conventional activated sludge process, thus there is a greater need to limit the flows through the BNR tanks to protect the BNR biology. This allowance permits the plant to remove a much greater amount of ammonia and nitrate, pollutants that impact fish populations in natural waterbodies. Further to maximize combined sewage treatment, the SPDES permit requires flows of up to 400 MGD to be processed through all processes of the WWTP except in the aeration basins and final sedimentation tanks.

DEC required the development of a WWOP as one of the 14 BMPs for collection systems that include combined sewers. The goal of the WWOP is to maximize flow to the WWTP which is one of the nine elements of long-term CSO control planning. The DEP has developed a WWOP for each of its 14 WWTPs. Table 3-2 summarizes the requirements for the Hunts Point WWTP. As noted in the table, flows above 1.3 times DDWF (260 MGD) could potentially cause excessive loss of biological solids in the aeration tanks. The most recent version of the WWOP for Hunts Point was submitted to the DEC in April 2010 as required by the SPDES permit and is provided herein as Appendix A. At time of publication of this report, DEC approval is still pending.

Table 3-2. Wet Weather Operating Plan for Hunts Point WWTP

Unit Operation	General Protocols	Rationale
Influent Gates and Screens	Gates full open until pump capacity is hit, screen channel target level is exceeded at maximum pumping, bar screens become overloaded, or grit removal exceeds capacity. Additional primary or secondary screens into service, set screen rakes to continuous operation	Regulate flow to the plant; Prevent excessive flows from destabilizing plant performance
Main Sewage Pumps	As afterbay level rises, put off-line pumps in service and increase speed of variable speed pumps up to maximum capacity.	Maximize flow to WWTP; Minimize need for collection system storage; Reduce CSOs
Primary Settling Tanks	One primary sludge pump per tank on-line, monitor water levels at weirs for flooding and flow imbalances. If sludge withdrawal too slow, grit accumulation too high, or a primary tank is out of service, reduce flow from primaries	Provide settling for the increased flows
Bypass Channel	Open bypass channel if the primary clarifier weirs flood or if final clarifier blanket levels go over the weirs. Maintain flow of 260 MGD to secondary treatment BNR treatment process must be protected against high wet weather flows due to the constraints on the secondary clarifier solids separation capability by limiting the secondary treatment flow to 1.3 DDWF.	Relieve flow to the aeration system; Avoid excessive loss of biological solids; Relieve primary clarifier flooding; Maintain nitrogen removal by limiting secondary treatment
Aeration Tanks	Keep all available aeration tanks in operation and adjust the airflow to maintain a DO > 2 mg/L.	Povide effective secondary treatment up to 1.3 DDWF (260 MGD)

Table 3-2. Wet Weather Operating Plan for Hunts Point WWTP

Unit Operation	General Protocols	Rationale
Final Settling Tanks	Balance flows to the tanks to keep the blanket levels even, observe the clarity of the effluent and watch for solids loss, and increase the RAS/WAS rate to maintain low blanket levels.	Accommodate increased solids loadings to clarifiers; Reduce sludge blanket depth; Reduce effluent TSS; Minimize loss of biological solids and destabilization of dry weather treatment
Chlorination	Check, adjust, and maintain the hypochlorite feed rates to maintain the target chlorine residual.	Satisfy increased chlorine demand during high flow/secondary bypass
Sludge Handling	Proceed as normal.	Uninfluenced by wet weather

3.1.3. Other Operational Constraints

DEC and DEP entered into a Nitrogen Control Consent Order that updated the WWTP New York City SPDES permits to reduce the nitrogen discharged to the Long Island Sound and Jamaica Bay in order to reduce the occurrence of eutrophic conditions and improve attainment of DO numerical criteria. The Consent Order was partly a result of the Long Island Sound Study, which recommended a 58.5 percent load reduction of nitrogen discharge. The Consent Order specified process modifications at the four WWTPs that discharge into the Upper East River (Bowery Bay, Hunts Point, Tallman Island, Wards Island) and one of the WWTPs that discharge to Jamaica Bay (26th Ward) for nitrogen removal. "The Modified Phase I BNR Facility Plan for the Upper East River and the 26th Ward Wastewater Treatment Plants" was prepared by DEP and submitted to DEC in 2005, and outlines the modifications necessary to upgrade these five WWTPs. The critical BNR upgrade items for Phase I construction are as follows:

1. Aeration tank equipment modifications:

   -Baffles for the creation of anoxic/switch zones and pre-anoxic zones
   -Mixers in the anoxic zones

2. Process aeration system upgrades:

   -New blowers or retrofit of existing blowers
   -New diffusers (fine bubble)
   -Air distribution control equipment
   -Metering and DO monitoring and control

3. Return activated sludge (RAS) / Waste activated sludge (WAS) systems:
   -Expanded capacity or upgrade of existing RAS/WAS system, as applicable

4. Froth control system:

   -Implemented to prevent or control filamentous growth

5. Chemical addition facilities:

   -Sodium hypochlorite for froth control (RAS and surface chlorination)
   -Alkalinity addition for nitrification and pH buffering (except at Tallman Island)

DEP has agreed to perform interim measures during the Phase I construction period to make best efforts to reduce the levels of nitrogen being discharged into the East River. These measures include:

1. Wards Island Battery E additional upgrades:
   - -Enhanced Flow Control in the Aeration Tanks
   - -Supplemental carbon addition facilities
   - -Additional baffles to enhance flow distribution and settling in final settling tanks
2. The SHARON Process will be constructed at Wards Island including:
   - -Reactor tanks with both aerated and anoxic zones;
   - -Influent centrate pumping station and controls;
   - -Blowers and process air piping, distribution grid and diffusers;
   - -Mixers for the denitrification zone;
   - -Alkalinity storage and pumping station;
   - -Supplemental carbon (methanol) storage and pumping station;
   - -Recycle pumps;
   - -Temperature control units; and
   - -Electrical power substation.
3. Relocation of Bowery Bay and Tallman Island digested sludge and/or centrate via shipping with DEP marine vessels or contract services. The DEP can send this material to either a NYC facility or an out-of-city facility.

Concurrent with the BNR upgrades, DEP continues to perform extensive upgrade work as part of the Plant Upgrade (PU) Program at all WWTPs, including the five that are undergoing BNR retrofits. Plant upgrades are required to stabilize or replace equipment that has reached its intended design life to ensure reliable plant performance that is in compliance with the existing SPDES permits for each WWTP.

3.1.4. Hunts Point WWTP Upgrade

Although the Hunts Point WWTP had a design capacity to treat up to 260 MGD through secondary treatment and up to 400 MGD through screenings, primary treatment and disinfection, the WWTP had limitations at the headworks that precluded flows from reaching these levels. Through 2004, the Hunts Point WWTP was generally able to treat peak flows up to approximately 260 MGD. As part of CSO reduction activities and as required by the Omnibus IV Consent Order, DEP redesigned the WWTP headworks as part of Phase I upgrade to the WWTP. To ensure treatment of 2xDDWF and prevent the liquid level in the afterbay channel from exceeding elevation -8.00 feet BSD, a new forebay gate chamber with a new gate was installed under Phase I upgrade of the plant. As a result of this construction, in 2008, the WWTP processed influent flows during the top-ten storm events that averaged 396 MGD and had a maximum peak flow of 415 MGD. The cost for the headworks portion of the Hunts Point WWTP improvements in 2004 was $26.0 million. As discussed in Sections 7 and 8 of this Report, this plant upgrade is included within the selected alternative for the Bronx River; however the cost of the upgrade is reflected in the East River Open Water WB/WS Facility Plan.

3.2. COLLECTION SYSTEM

The watershed tributary to Westchester Creek includes combined and separated sewer service areas within the Hunts Point WWTP collection system which serves the eastern Bronx from the Bronx River to the Long Island Sound (Figure 3-3). The plant is located in the southwestern portion of the collection system, and the orientation of the Upper East River tributaries are generally north-south such that flow from the Throgs Neck and Hutchinson River areas must pass through the Westchester Creek drainage basin to be treated at the WWTP. There are 15 pumping stations located in the Hunts Point WWTP drainage area. Of these, 12 handle combined sewage; the remaining three pump storm water only.

The CSO regulators that discharge to Westchester Creek serve an area of approximately 4,271 acres, but the total drainage area tributary to Westchester Creek is 4,952 acres. The remaining tributary area (681 acres) includes approximately equal areas of direct runoff and stormwater service areas. Each portion of the drainage area is discussed separately below.

3.2.1. Combined Sewer System

The combined sewer system tributary to Westchester and Pugsley Creeks is relieved during wet weather events via seven regulators that discharge through six outfalls distributed along the shoreline of the waterbody. The outfalls are permitted by DEC under the Hunts Point WWTP SPDES permit (NY-0026191). These discharges are shown on Figure 3-4 and their physical characteristics are summarized in Table 3-3. The majority of these regulating structures overflow to Westchester Creek along the western shoreline from a double barrel combined sewer that generally follows Zerega Avenue to Castle Hill Point, then veers westward past the head of Pugsley Creek. The entire Throgs Neck service area is conveyed toward the Hunts Point WWTP via the 37 MGD Throgs Neck Pumping Station located on the western shoreline of Westchester Creek, and overflow relief is provided at the upstream end by regulator R-04 and by CSO-23A on the discharge side. Both Westchester Creek and Pugsley Creek have relatively large outfalls at their respective head ends, and both regulating structures have dry-weather drainage areas much larger than their wet-weather areas due to the conveyance of dry-weather flow from the Hutchinson River and Throgs Neck service areas to the Hunts Point WWTP. Outfall HP-014, located at the head end of Westchester Creek, is the single largest discharge to the waterbody, and currently has a boom mounted to the outfall headwall structure intended to serve as a temporary floatables control measure.

Several of the regulating structures are unique in configuration, due in part to the age of the system, and to the relatively low-lying, shallow slopes. For example, CSO-23A consists of a sequence of semi-circular holes cut into the inside walls of the two barrels of the sewer near the crown, overflowing into a conduit that passes beneath one of the barrels and discharging to Westchester Creek. CSO-23 has a similar configuration, but the length of the overflow conduit suggests that the side weir orifices may extend for over 1,000 feet. CSO-24 overflows to the head of Pugsley Creek and consists of 100 feet of weir length two feet below the crown of the interceptor. Although capable of regulating flow, these devices are not regulators as such, but are static structures designed or retrofitted to relieve excess flows or shift flow from one pipe to another without active controls.

Table 3-3. Physical Characteristics Summary of CSOs

Outfall	Location	Waterbody	Outfall Size	Regulator(s) Served	Drainage Area (ac)*
HP-014	East Tremont Avenue	Westchester Creek , head end	14' x 8'6"	CSO-29 CSO-29A	1,907 114
HP-013	Newman Avenue	Pugsley Creek, head end	10'6" x 8'	CSO-24	994
HP-033	Unionport Bridge	Westchester Creek, western shore	2 @ 10'6" x 9'	CSO-23	694
HP-016**	Unionport Bridge	Westchester Creek, eastern shore	10' x 8'6"	REG #4	259
HP-015	Latting Street	Westchester Creek, eastern shore	4'9" x 4'	CSO-22	199
HP-012	Lafayette Avenue	Westchester Creek, western shore	12' x 8'	CSO-23A	104
				Total	**4,271**

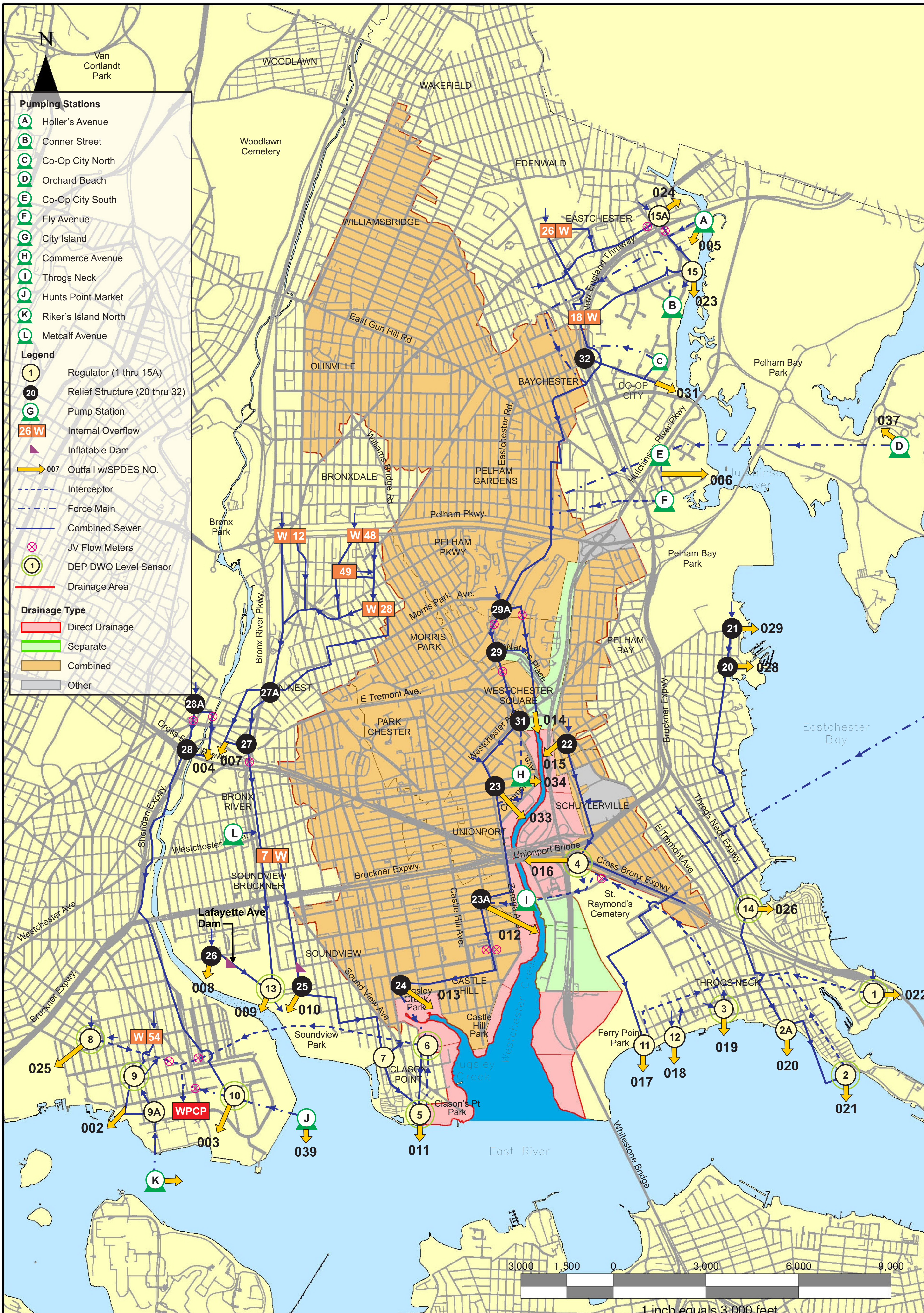
Notes: *Wet weather only. Values may not total due to rounding
**HP-016 indirectly relieves Throgs Neck Pumping Station.

3.2.2. Throgs Neck Pumping Station

The Throgs Neck Combined Flow Pumping Station (TNPS) is a 37 MGD facility that serves the entire portion of the Hunts Point WWTP collection system east of Westchester Creek, including all of the neighborhoods south of Co-Op City along Eastchester Bay to Throgs Neck (Figure 3-5). The station currently functions as a sanitary lift station; there is no wet weather bypass. Flow in excess of the TNPS capacity is pushed back through the collection system and out to Westchester Creek as a CSO discharge from outfall HP-016 via regulator R-04. The TNPS utilizes three large dry-pit submersible centrifugal pumps to convey combined flow from the eastern side of Westchester Creek to the double barrel combined sewer that parallels the western shoreline via a force main. The KSB pumps are rated at 13,500 gallons per minute (gpm) at 715 RPM and 53 feet of head, each powered by a dedicated 244 horsepower (hp), 460 3-phase electrical motor. The suction line diameter is 24 inches; the discharge line diameter is 20 inches. The station is located along the western shore of Westchester Creek south of the Unionport Bridge on a Department of Sanitation of New York (DSNY) facility.

Electrical and mechanical equipment is generally outdated and not performing as desired. There is inadequate electrical power to operate all three pumps simultaneously. The TNPS was last upgraded in 2000. At that time, the existing pumps were removed and replaced with new units from the same manufacturer (KSB Pumps). There is an ongoing heavy grit problem that has caused accelerated wear of the impellers in the new pumps to the point of needing replacement. The impellers are to be replaced with new hardened-material impellers from the original equipment manufacturer, and were installed in 2005. Despite the heavy impeller wear, the pump casings themselves were reported to be in very good condition. The 1.75-inch spacing stainless steel bar screens are cleaned daily, and were also determined to be in good operational condition during inspection.

DEP had reported that the force main was leaking upstream of the dissipation manhole at Zerega Avenue and would require repair or replacement. The 36-inch force main runs south from



Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Sewer System Schematic, Sewershed Tributary to Westchester Creek Study Area

FIGURE 3-3

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Environmental Protection

Westchester Creek CSO and Stormwater Discharge Locations

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 3-4

the TNPS for approximately 100 feet, then turns southwest for the remainder of the 400-foot run through the DSNY lot to the dissipation/drop manhole near Zerega Avenue but still on the property.

These operational limitations have compromised the operation of the TNPS and must be rectified. A rehabilitation contract (PS-225) is currently underway to address most of the operational issues at TNPS. In 2007, as part of the facility planning for PS-225, the existing dry pit submersible pumps were inspected and found to be in good condition. They had been replaced in 2000. Hydraulic evaluations indicated that the existing pumping capacity slightly exceeds the design point (41.26 mgd with two pumps operating versus the required capacity of 37 mgd). Therefore, it was recommended that the main pumps did not need to be replaced. However, it was recommended that the electrical system and internal piping be upgraded, and the construction of a new discharge force main adjacent to the existing force main was recommended so that the latter could be taken out of service, inspected, and repaired. That inspection has not occurred to date. For construction and rehabilitation purposes, the TNPS was able to be shut down during an 8-hour nighttime low flow for force main work performed by DEP without leading to upstream flooding.

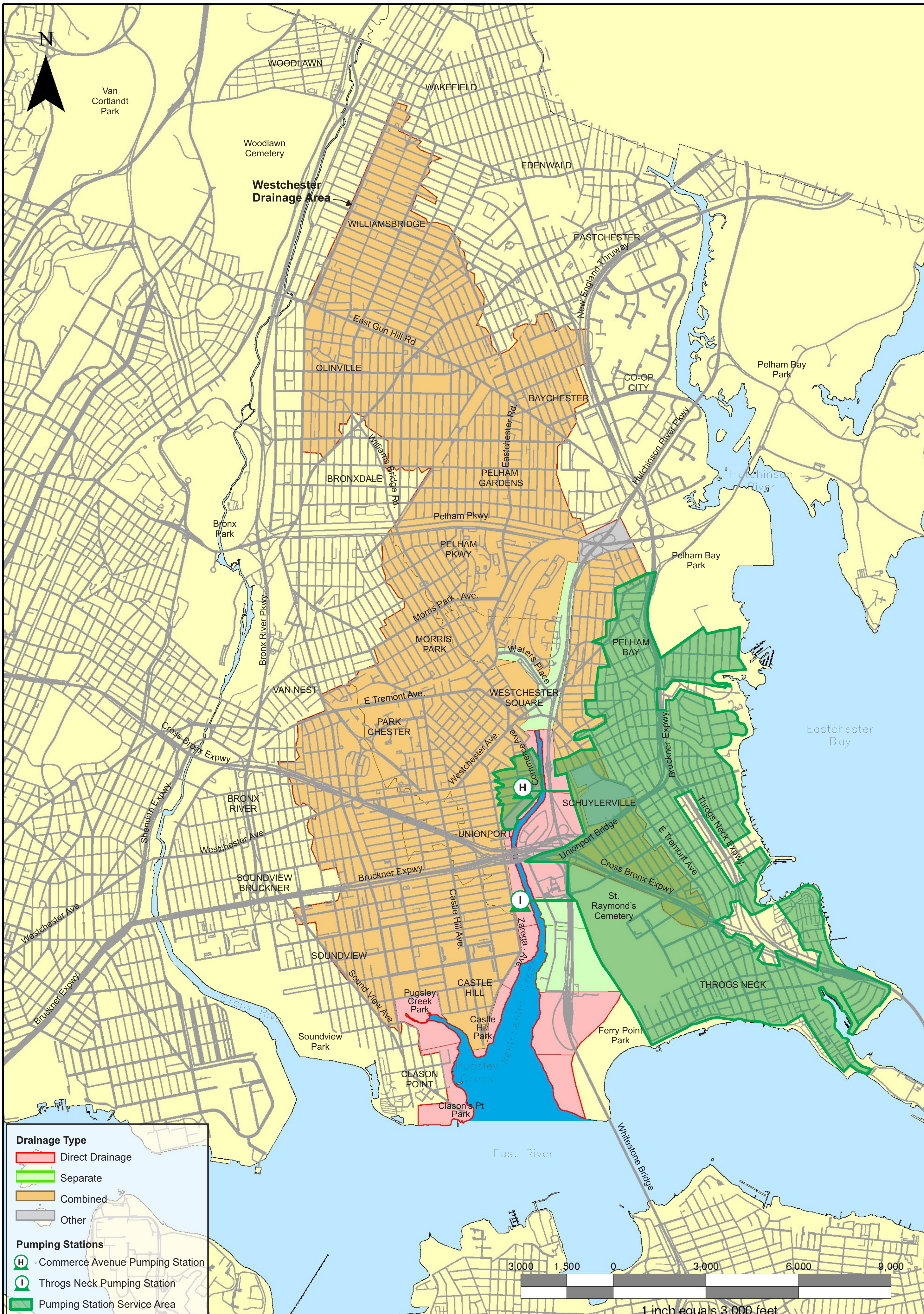
3.2.3. Commerce Avenue Pumping Station

The Commerce Avenue Pumping Station discharges to a 117-inch by 96-inch double-barrel combined sewer at Ellis and Zerega avenues via a 6-inch force main extending approximately 926 feet. Its emergency relief is about four feet below the ground surface, connecting to a 54-inch storm sewer along Commerce Avenue. This storm sewer meets two other storm lines at Commerce and Newbold Avenues and discharges to Westchester Creek via outfall HP-034. Because it provides relief to the Commerce Avenue Pumping Station, HP-034 is designated as a CSO outfall despite the fact that it discharges stormwater only during normal operating conditions. The elevation of the outfall invert is such that there would only be an overflow in the event of a prolonged period of service interruption at the pumping station.

The total drainage area of the Commerce Avenue Pumping Station is 54.7 acres, as shown in Figure 3-5, consisting primarily of commercial and industrial land uses as summarized in Table 3-4. A large portion of the drainage area (37.5 percent) is devoted to industrial and manufacturing use while commercial and office buildings comprise the second largest use of developed land (16.3 percent). Streets account for approximately 19 percent of the area. There are very few residential properties within the Commerce Avenue Pumping Station service area.

Table 3-4. Land Use in the Tributary Area of Commerce Avenue Pumping Station

Land Use Type	Acreage	Percent
Commercial and Office Buildings	8.9	16.3
Industrial and Manufacturing	20.5	37.5
Transportation and Utility	4.4	8.0
Open Space and Outdoor Recreation	1.1	2.0
Vacant Land	3.9	7.1
Streets	10.4	18.9
Other	5.6	10.2
Total	**54.7**	**100**



NYC Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Pumping Station Service Areas Westchester Creek

FIGURE 3-5

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Although the Commerce Avenue Pumping Station is designated as a combined pumping station, its drainage area is fully separate, with complete sanitary and storm sewers built under every street. This pumping station only collects sanitary flow and rainfall-dependent inflow-infiltration; there is no surface runoff entering the pumping station. The peak flow, measured by O'Brien and Gere in 1996 during the Hunts Point Infiltration/Inflow Analysis, was about 0.3 MGD, far less than the pumping station capacity of 1.44 MGD. Hence the Commerce Avenue Pumping Station has sufficient capacity. The total flow to and from the Commerce Avenue Pumping Station is negligible compared to the flow conveyed by the 117-inch by 96-inch double barrel sewer to which the pumping station discharges. The capacity of the pumping station has little impact on the overflows to either Westchester Creek or the Upper East River.

3.2.4. Stormwater System

The DEP Shoreline Survey included water- and land-based surveys of all New York City shorelines to identify, characterize, and document all untreated discharges from the New York City sewer system. DEP was further required to execute abatement programs to eliminate all untreated dry weather discharges. CSOs, stormwater discharges, highway drains, industrial discharges, etc. were all identified and mapped during the program, including those tributary to Westchester and Pugsley Creeks. The Hunts Point WWTP service area includes several permitted MS4 outfalls, and those that are tributary to Westchester and Pugsley Creeks are summarized in Table 3-5. Outfall locations are illustrated on Figure 3-4.

Table 3-5. Hunts Point WWTP Stormwater Discharges to Westchester and Pugsley Creeks

Stormwater Outfall	Outfall Location	Drainage Area (ac)
HP-504	Pugsley Creek Park	46
HP-602	Lafayette Avenue, Westchester Creek	30
HP-623	Clason's Point	47
HP-625	Castle Hill Point	2
HP-635	Yznaga Place, Westchester Creek	93
HP-839	Head end of Westchester Creek	123
	Total	340

Note: column may not total due to rounding

3.3. SEWER SYSTEM MODELING

3.3.1. InfoWorks CS™

Numerical simulations of the Hunts Point WWTP service area response to varying rainfall conditions were performed using the InfoWorks CS™ modeling program from Wallingford Software. InfoWorks CS™ combines a relational database with geographical analysis to provide a single environment to integrate asset planning with detailed and accurate modeling. The system provides fast, accurate, and stable modeling of key elements of stormwater sewer systems. The software incorporates full solution modeling of backwater effects and reverse flow, open channels, sewers, detention ponds, complex pipe connections and complex ancillary structures such as culverts, orifices and weirs.

InfoWorks CS^{TM} incorporates the Storm Water Management Model (SWMM) to route overland runoff, a non-linear reservoir routing model developed for the USEPA. Idealized sub-basins are analyzed as spatially lumped non-linear reservoirs, and hydraulic routing obeys the Saint-Venant equations of conservation of mass and momentum. As in any hydrologic-hydraulic model, InfoWorks CS^{TM} calculates runoff volumes first and routes the runoff over sub-areas (sub-basins) to generate runoff hydrographs. It then applies the hydrographs to the channel-sewer system for hydraulic routing. Runoff from pervious areas is generated by the model if the rainfall intensity is greater than the soil infiltration rate.

The first step in constructing the runoff volume model is to divide each sub-basin into impervious and pervious areas. The fixed runoff coefficient method was used to calculate runoff volume in impervious areas. It is assumed that there is no rainfall infiltration in impervious areas and there is an initial loss of 0.01 inches due to initial interception which was derived empirically. The rest of the rainfall in the impervious area becomes runoff. In the pervious areas, the initial rainfall loss is assumed to be 0.1 inches after which the rainfall begins to infiltrate the soil, a process modeled using Horton's equation for cumulative rainfall infiltration, which can be expressed as a function of time.

3.3.2. Application of Model to Hunts Point WWTP Collection System

The collection system model for the Hunts Point WWTP service area was constructed using information and data compiled from the DEP's as-built drawings, WWTP data, previous and ongoing planning projects, regulator improvement programs, and inflow/infiltration analyses. This information includes invert and ground elevations for manholes, pipe dimensions, pump station characteristics, and regulator configurations and dimensions.

Model simulations include WWTP headworks, interceptors, branch interceptors, major trunk sewers, all sewers greater than 48 inches in diameter plus other smaller, significant sewers, and control structures such as pump stations, diversion chambers, tipping locations, reliefs, regulators and tide gates. The model was calibrated and validated using flow and hydraulic-elevation data collected for this purpose. All CSO and stormwater outfalls permitted by the State of New York are represented in the models, with stormwater discharges from separately sewered areas simulated using separate models as necessary. Conceptual alternative scenarios representing no-action and other alternatives were simulated for the average year (1988 JFK rainfall). Tidally influenced discharges were calculated on a time-variable basis. Pollutant concentrations selected from field data and best professional judgment were assigned to the sanitary and stormwater components of the combined sewer discharges to calculate variable pollutant discharges. Similar assignments were made for stormwater discharges. Discharges and pollutant loadings were then post-processed and used as inputs to the receiving water model, described in Section 4.0.

3.3.3. Baseline Design Condition

Watershed modeling can be an important tool in evaluating the impact of proposed physical changes to the sewer system and/or of proposed changes to the operation of the system. In order to provide a basis for these comparisons, a "Baseline condition" was developed. For the Hunts Point WWTP Model, the Baseline conditions parameters were as follows:

- Dry-weather flow rates based on 2045 population projections;
- Wet-weather capacity at the Hunts Point WWTP of 259 MGD; and
- Documented Sediments in the sewers.

The WWTP capacity for baseline conditions was set at the "average sustained flow" observed during the top ten storms of 2003 as tabulated in the BMP Report for 2003 to represent facility performance prior to both the 2005 CSO Consent Order and the full implementation of the wet-weather operating plan (WWOP). The alternatives evaluated in Section 7 were modeled with the WWTP capacity at full 2DDWF to incorporate the improvements to WWTP capacity expected to result from the capital and operational upgrades.

Establishing the future Hunts Point WWTP dry weather sewage flow is a critical step in the WB/WS Planning analysis because the City's CSO control program relies on its WWTP treatment capacity to reduce CSO overflows. Increases in sanitary sewage flows associated with increased populations would use part of the WWTP wet weather capacity, thus reducing the amount of CSO flow that can be treated at the existing WWTP. Dry weather sanitary sewage flows used in the Baseline modeling were escalated to reflect anticipated growth within the City. At the direction of the Mayor's Office, NYCDCP made assessments of the growth and movement of the City's population using the year 2000 census data and 2010 and 2030 (NYCDCP, 2006) population projections. This information is contained in a set of projections made for 188 neighborhoods within the City. DEP has escalated these populations forward to 2045 by assuming the rate of growth between 2030 and 2045 would be 50 percent of the rate of growth between 2000 and 2030. These populations were associated with each of the landside modeling sub-catchment areas tributary to each CSO regulator using geographical information system (GIS) calculations. Dry sanitary sewage flows were then calculated for each of these sub-catchment areas by associating a conservatively high per capita sanitary sewage flow with the population estimate. The per capita sewage flow was established as the ratio of the year 2000 dry weather sanitary sewage flow and the year 2000 population of the Hunts Point WWTP area. Increasing the sewage flows for the Hunts Point WWTP from the current 2005 flow of 114 MGD to an estimated 130.46 MGD in 2045 will properly account for the potential reduction in wet weather treatment capacity associated with projections of a larger population.

In addition to the above watershed/sewer-system conditions, a comparison between model calculations also dictates that the same meteorological (rainfall) conditions are used in each case. In accordance with the Federal CSO Control Policy the average rainfall year was used. Long-term rainfall records measured in the New York City metropolitan area were analyzed to identify potential rainfall design years to represent long-term, annual average conditions. Annual statistics compiled included:

- Total rainfall depth and number of storms;
- Average storm volume and intensity;
- Total and average storm duration; and
- Average interevent time.

A more detailed description of these analyses is provided under separate cover (HydroQual, 2004). Although no year was found having the long-term average statistics for all of these parameters, the rainfall record measured at the National Weather Service gage at John F. Kennedy (JFK) International Airport during calendar year 1988 is representative of the overall, long-term average conditions in terms of annual total rainfall and storm duration. In addition, the JFK 1988 rainfall record includes high-rainfall conditions during July (recreational) and November (shellfish) periods, which are useful for evaluating potential CSO impacts on water quality during those particular periods. As a result, the JFK 1988 rainfall record was selected as an appropriate design condition for which to evaluate sewer system response to rainfall. The JFK 1988 record has also been adopted by the New York Harbor Estuary Program and the New Jersey Department of Environmental Protection for water quality and CSO performance evaluations. Table 3-6 summarizes the precipitation data used.

Table 3-6. Comparison of Annual 1988 and Long-Term Statistics

Statistic	**1970-2002 Median**	**1988**	
		Value	**Return Period (years)**
Total Volume (inches)	39.4	40.7	2.6
Intensity, (in/hr)	0.057	0.068	11.3
Number of Storms	112	100	1.1
Storm Duration (hours)	6.08	6.12	2.1

An important distinction must be made between Baseline and other representative conditions as discussed throughout this document. Because dry weather flow is based on a 2045 population projection, and wet weather flow is based on 1988 precipitation, the Baseline condition should not be construed as analogous to any actual conditions that might have been observable. The Baseline condition was developed to provide a basis for comparison of CSO abatement alternatives, thus representing a “no-build” alternative, i.e., the expected future CSO under typical rainfall conditions if no additional abatement efforts were implemented beyond the current SPDES permit requirements. However, satisfaction of those SPDES requirements that are operational (as opposed to performance) in nature may not result in an explicitly defined outcome. For example, having an approved sewer cleaning and maintenance program does not guarantee that the sewers will be free of debris, or satisfying the 2DDWF treatment target does not necessarily mean it is possible to do so during all wet weather hours when less intense storms do not convey adequate flow.

To evaluate the impacts of these operational constraints, an “Existing Facilities” condition was defined. Collection system modeling was unable to fully explain consistently observed, persistent high pathogen concentrations during dry weather field programs in the summer of 2005, a season with below-average precipitation. There was no direct visual evidence of dry-weather overflows to the Hutchinson River or Westchester Creek, but the summer sampling data suggested a source of pathogens other than CSO, possibly from nearby storm sewers or unidentified sources within the combined collection system. Like the Baseline condition, dry weather flow is based on a 2045 population projection and wet weather flow is based on 1988 precipitation, so conditions predicted by this scenario should not be construed as actual conditions.

3.4. DISCHARGE CHARACTERISTICS

Similar to much of the City of New York, the Westchester Creek study area is highly urbanized in nature. The original watershed has been altered by sewer system construction and other forms of urbanization and development. Combined and separated sewers have replaced natural freshwater streams such that the only source of freshwater to Westchester Creek is CSO and stormwater discharges. Direct overland runoff from parkland and undeveloped areas immediately adjacent to the waterbody still occurs, but is insignificant when compared to combined and stormwater discharges in terms of both quantity and impact. Table 3-7 shows that 86 percent of the watershed is within the combined sewer collection system, and an additional 7 percent of the drainage area is captured and conveyed by stormwater collection systems. Thus, 93 percent of the watershed runoff arrives at Westchester Creek via artificial conveyance systems through point source discharges. This runoff is generally from remote locations in comparison to direct runoff areas, accelerating the peak stormflow arrival time, compressing the duration, and increasing the magnitude of peak events.

Compounding this effect is the change in land use, which has transformed the runoff yield of the watershed from the relatively low yield of undeveloped uplands and expansive wetlands to a high runoff yield typical of urban landscapes. The urbanized nature also affects the water quality of watershed runoff to Westchester Creek. In comparison to pristine conditions such as natural meadows, forests, and wetlands, the mixture of sanitary sewage and stormwater discharged during wet weather is significantly stronger in pollutant concentrations and includes anthropogenic pollutants such as oil and grease in addition to pathogenic bacteria, oxygen depleting matter, floatables, and suspended and settleable solids. Table 3-8 shows the typical concentrations of traditional pollutants based on observed data. Coupled with the volume discharges predicted by the collection system model of the Hunts Point WWTP service area (Table 3-9), Table 3-10 summarizes the pollutant loadings to Westchester Creek under Baseline conditions. For details related to these tables, refer to the Landside Modeling Report.

Table 3-7. Westchester Creek Watershed Summary

Source Category	Drainage Area (Acres)	Percent of Watershed
CSO	4,271	86%
Stormwater	340	7%
Direct Runoff	341	7%
Total Watershed	**4,952**	**100%**

Table 3-8. Typical Sanitary, Stormwater, and CSO Concentrations for the Hunts Point WWTP Service Area

Parameter	Sanitary	Stormwater	CSO
TSS, mg/L	(1)	15	110
BOD, mg/L	(1)	15	110
DO, mg/L	(1)	6.3	3.8
Total Coliform, per 100 mL	25,000,000	300,000	(2)
Fecal Coliform, per 100 mL	4,000,000	120,000	(2)
Enterococci, per 100 mL	1,000,000	50,000	(2)

Notes: (1) Concentrations were not established for sanitary flow. (2) CSO pathogen concentrations are calculated based on sanitary and stormwater volumetric flow fractions

Table 3-9. Discharge Flows for Existing and Baseline Conditions from InfoWorks CS™

Type	Existing Facilities		Baseline Conditions	
	Number of Events	**Total Annual Volume (MG)**	**Number of Events**	**Total Annual Volume (MG)**
HP-014	42	746		516
HP-013	21	103	54	144
HP-016	33	72	24	72
HP-012	10	27	338	27
HP-033	5	11	5	78
HP-015	1	0	2	0
CSO Total	-	959	-	767
Stormwater (1)	-	71	-	71
Direct Runoff	-	83	-	83
Total	-	1,1,113	-	921

(1) 6 outfalls. Note: columns may not total due to rounding

Table 3-10. Discharge Loading Rates for Baseline Conditions

Parameter	CSO Load	Stormwater Load	Total Load
TSS (lbs)	703,656	19,266	722,922
BOD (lbs)	703,656	19,266	722,922
DO (lbs)	24,308	8,091	32,399
Total Coliform (No.)	1.19E+17	1.75E+15	1.37E+17
Fecal Coliform (No.)	2.08E+16	6.99E+14	2.15 E+16
Enterococci (No.)	5.70E+15	2.91E+14	5.99E+15

3.4.1. Effect of Urbanization on Discharge Characteristics

There has been a significant increase in the amount of runoff discharged to Westchester Creek compared to its undisturbed, pristine condition three centuries ago, due to a combination of watershed urbanization and waterbody modifications. The watershed is home to a population of 285,000 and, as shown previously in Table 2-1, 85 percent of the watershed is characteristically residential and other developed uses in which ground surfaces are predominately hardened by rooftops, sidewalks, paved playgrounds, parks and schoolyards, and streets, thoroughfares and highways. The imperviousness of such a watershed is typically altered from a 10 to 15 percent level for natural areas to 70 percent or more for urban, areas as natural runoff pathways are eliminated and surface and subsurface storage within the watershed disappears. All natural streams previously tributary to Westchester Creek, including the northernmost reach of the Creek itself, have been eliminated and there are now no freshwater tributaries to the waterbody. Tidal wetlands and sinuous stream beds would attenuate transport further, but land use pressures have eliminated these features as well. The combined and storm sewers provide the only remaining pathway for runoff, entering via roof leaders, catch basins, manholes, etc., and discharging directly to Westchester Creek in a substantially shorter duration. By decreasing the travel time, peak discharge rates to the waterbody are correspondingly more severe.

A summary of the hydrologic changes caused by urbanization in the watershed is presented in Table 3-11, and pre- and post-urbanization watersheds are shown in Figure 3-6. The pre-urbanized condition is assumed circa 1891. The overall size of the watershed has increased by about 36 percent due to sewer construction and wetland and waterbody reclamation, resulting in an increase in runoff yield for an average precipitation year from an estimated 116 MG to over 824 MG, a seven-fold increase. At the same time, the size of the waterbody has been decreased by 25 percent and wetland areas have been virtually eliminated. Thus, larger discharges are now made directly to Westchester Creek at dramatically higher rates that are no longer attenuated, filtered, or mitigated by the adjoining wetlands, resulting in deteriorated water quality conditions.

A pollutant loading comparison is summarized in Table 3-12 using the same pollutant concentrations from table 3-8. The table compares pre-urbanized pollutant loadings of TSS and BOD to the existing urbanized condition. The annual volumes used for this table are taken from those of Table 3-11 assuming an average precipitation year. Typical stormwater concentrations are used for the pre-urbanized condition, which are higher than those for a rural or pristine condition. The urbanized condition accounts for existing CSO and stormwater discharges. The table demonstrates that urbanization of the watershed has increased pollutant loadings to Westchester Creek by a factor of 20.

Table 3-11. Effects of Urbanization on Watershed Yield

Watershed Characteristic	Pre-Urbanized	Urbanized[1]	Change
Upland Drainage Area (acres)	3,624	4,952	+37%
Adjacent Wetland Area (acres)[2]	335	56	-83%
Waterbody Surface Area (acres)	806	252	-69%
Population[4]	43,000	285,000	+563%
Average Imperviousness	10%	70%	+600%
Average Annual Runoff Yield (MG)[3]	116	921	+694%
Peak Storm Runoff Yield (MG)[3]	10	96	+860%

Notes: (1) Existing condition (2) Approximated from historical maps (3) For an average precipitation year (JFK, 1988), including stormwater (4) Pre-urbanized population is estimated based on 1900 census for the Bronx; urbanized estimate based on 2000 census.

Table 3-12. Effects of Urbanization on Watershed Loadings

Annual Pollutant Load[1]	Pre-Urbanized[2]	Urbanized[3]	Change
Total Suspended Solids (lb/year)	37,691	722,922	1,918%
Biochemical Oxygen Demand (lb/year)	37,691	722,922	1,918%

Notes: (1) For an average precipitation year (JFK, 1988) (2) c1891, using stormwater concentrations (3) Existing condition, including CSO and stormwater discharges

3.4.2. Toxic Discharge Potential

For industrial source control in separate and combined sewer systems, the USEPA required approximately 1,500 municipalities nationwide to implement Industrial Pretreatment Programs (IPPs). The intent of the IPP is to control toxic discharges to public sewers that are tributary to sewage wastewater treatment plants by regulating Significant Industrial Users (SIU). If a proposed Industrial Pretreatment Program is deemed acceptable, the USEPA decrees the local municipality a Control Authority. DEP has been a Control Authority since January 1987, and enforces the IPP through Chapter 19 of Title 15 of the Rules of the City of New York (Use of the Public Sewers), which specifies excluded and conditionally accepted toxic substances along with required management practices for several common discharges such as photographic processing waste, grease from restaurants and other businesses, and perchloroethylene from dry cleaning. DEP has been submitting annual reports on its activities since 1996. The 310 SIUs that were active at the end of 2004 discharged an estimated average total mass of 38.2 lbs/day of the following metals of concern: arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver and zinc.

Early efforts to reduce the amount of toxic contaminants being discharged to the New York City open and tributary waters focused on industrial sources and metals. As part of the IPP, DEP analyzed the toxic metals contribution of sanitary flow to CSOs by measuring toxic metals concentrations in WWTP influent during dry weather in 1993. This program determined that only 2.6 lbs/day (1.5 percent) of the 177 lbs/day of regulated metals being discharged by regulated industrial users were bypassed to CSOs. Of the remaining 174.4 lbs, approximately 100 lbs ended up in biosolids, and the remainder was discharged through the WWTP effluent outfall. Recent data suggest even lower discharges. In 2004, the average mass of total metals discharged by all regulated industries to the New York City WWTPs would translate into less than 1 lb/day bypassed to CSOs from regulated industries if the mass balance calculated in 1993 is assumed to be maintained. A similarly developed projection was cited by the 1997 DEP report on meeting the nine minimum CSO control standards required by federal CSO policy, in which DEP considered the impacts of discharges of toxic pollutants from SIUs tributary to CSOs (DEP, 1997). The report, audited and accepted by USEPA, includes evaluations of sewer system requirements and industrial user practices to minimize toxic discharges through CSOs. It was determined that most regulated industrial users (of which SIUs are a subset) were discharging relatively small quantities of toxic metals to the NYC sewer system.

According to the 2004 data, only one SIU is within the Westchester Creek sewershed area. Located in the portion of the sewershed most remote from the waterbody, the 2004 daily average flow was reported to be approximately 22,000 gallons per day, much less than 0.1 percent of the dry weather flow at the Hunts Point WWTP, and less than 0.5 percent of all SIU flow for the year. It can be inferred that, of the 38.2 lb/day of metals in the sanitary flow Citywide, less than 0.2 pounds per day were conveyed to the Hunts Point WWTP from this location. Considering how infrequently CSO discharges occur in comparison to the continuous operation of the WWTP, the total mass of heavy metals that is discharged during wet weather as CSO is even less on a daily average basis. Given its remote location, dilution during a CSO event would likely render any permitted concentration of pollutant from this SIU undetectable at the discharge. As a result of the virtually insignificant potential for toxic discharge from SIUs, DEC has not listed Westchester Creek as being impaired by toxic pollutants associated with CSO discharges.

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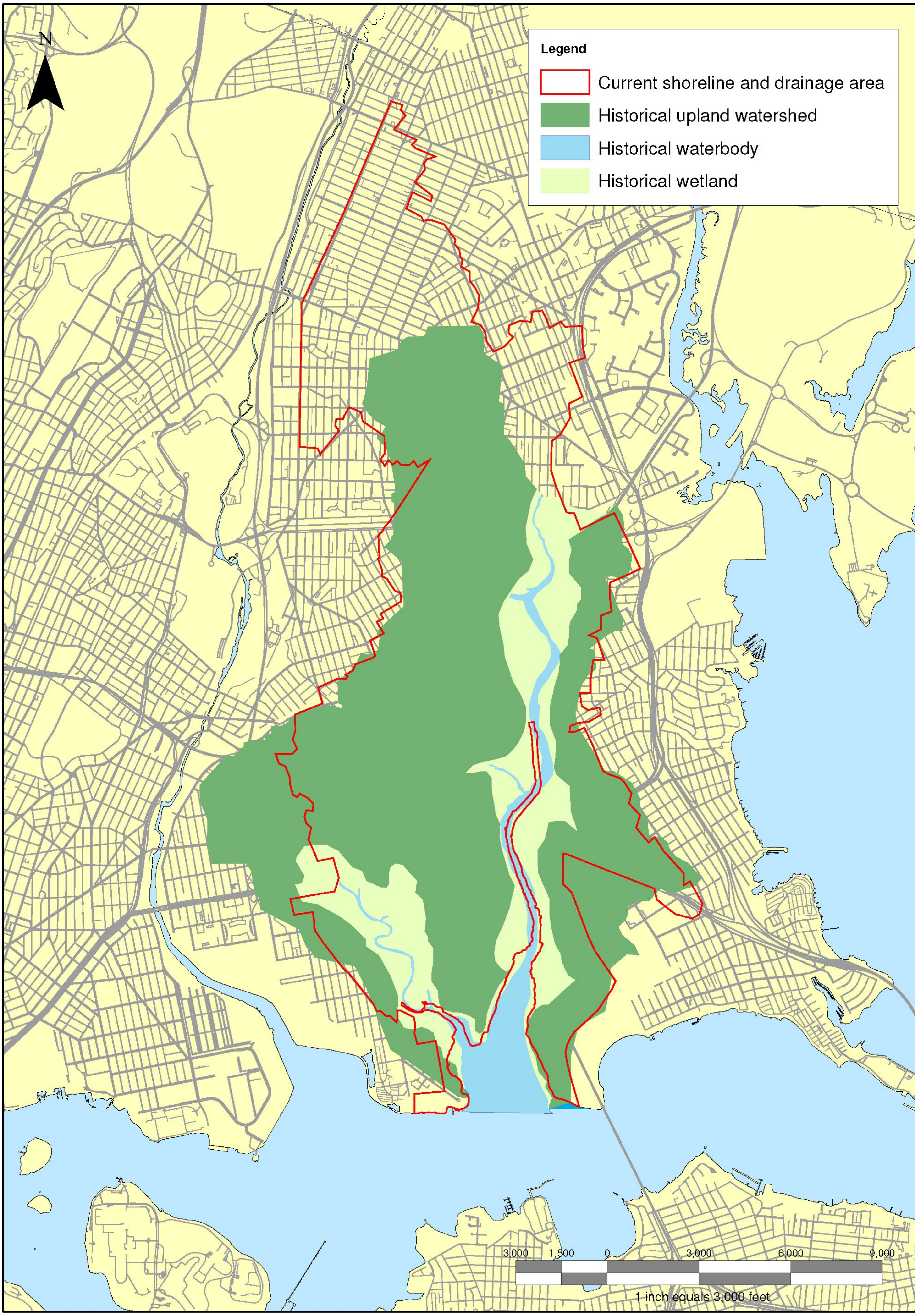

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Westchester Creek Waterbody/Watershed Facility Plan

Westchester Creek Topographic Watershed Compared to Existing Watershed

FIGURE 3-6

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4.0. Waterbody Characteristics

Westchester Creek and Pugsley Creek are classified as saline tributaries to the Upper East River and Long Island Sound according to Title 6 of the New York State Code of Rules and Regulations (NYCRR), Chapter X, Part 935. For the purposes of the WB/WS Facility Plan, the Westchester Creek waterbody is considered to encompass Item 47 in Table I of 6 NYCRR 935.6, which lists ER-4 and trib. 1 as Westchester Creek and Pugsley Creek, respectively, and includes both waterbodies from their respective headwaters to their combined confluence with the Upper East River. Although both Creeks are considered tributaries to the Upper East River, neither waterbody receives any natural freshwater flow. The Creeks were once part of a complex of wetlands that interconnected all watersheds in the eastern Bronx, but urbanization has substantially reduced the adjacent wetland areas and truncated the Westchester Creek channel at a point approximately 2 ½ river miles from the mouth, reducing its natural length by approximately half. Figure 4-1 illustrates the delineation of Westchester Creek and the Upper East River waterbody types.

The following sections discuss the physical, chemical, and ecological conditions in Westchester and Pugsley creeks.

4.1. CHARACTERIZATION METHODOLOGY

The DEP's comprehensive watershed-based approach to long-term CSO control planning follows the USEPA's guidance for monitoring and modeling (USEPA, 1999). The watershed approach "represents a holistic approach to understanding and addressing all surface water, ground water, and habitat stressors within a geographically defined area, instead of addressing individual pollutant sources in isolation" (USEPA, 1999). The guidance recommends identifying appropriate measures of success based on site-specific conditions to both characterize water quality conditions and measure the success of long-term control plans. The measures of success are recommended to be objective, measureable, and quantifiable indicators that illustrate trends and results over time. USEPA's recommended measures of success are administrative (programmatic) measures, end-of-pipe measures, receiving waterbody measures, and ecological, human health, and use measures. USEPA further states that collecting data and information on CSOs and CSO impacts provides an important opportunity to establish a solid understanding of the "baseline" conditions and to consider what information and data are necessary to evaluate and demonstrate the results of CSO control. USEPA acknowledges that since CSO controls must ultimately provide for the attainment of water quality standards, the analysis of CSO control alternatives should be tailored to the applicable standards such as those for DO and coliform bacteria. Since the CSO Control Policy recommends reviews and revision of water quality standards, as appropriate, investigations should reflect the site-specific wet weather impacts of CSOs. The waterbody/watershed assessment of Westchester Creek therefore required a compilation of existing data, identification of data gaps, collection of new data, and cooperation with field investigations being conducted by other agencies.

DEP has implemented its CSO facility planning projects consistent with this guidance and has developed the above noted categories of information on waterbodies such as Westchester Creek. Waterbody/watershed characterization activities were conducted following the work plans and field sampling programs developed during the Use and Standards Attainment (USA) Project. These efforts yielded valuable information for characterizing Westchester Creek and its watershed as well as supporting mathematical modeling and engineering efforts. The following describes these activities.

4.1.1. Compilation of Existing Data

A comprehensive review of past and ongoing data collection efforts was conducted to identify programs focused on or including Westchester Creek and nearby waterbodies. DEP has conducted facility planning in the Upper East River since at least the 1950s, when conceptual plans were first developed for the reduction of CSO discharges into certain receiving waters. The 208 Study of 1978 identified Westchester Creek for CSO abatement as part of the Upper East River CSO program. Facility planning has been ongoing since that time, resulting in a large body of pertinent data. Several other parallel projects by DEP and others have also been conducted that further contribute to the abundance of data available (see Section 5). Much of this data was not collected directly within the limits of Westchester Creek, and the age of many of these data sets may limit their applicability to waterbody characterization. However, an adequate body of data is available for qualitative characterizations and to compare abatement alternatives quantitatively. In addition, DEP continues to conduct investigative programs yielding useful watershed and waterbody data to address these limitations. Additional sources of data are available from other stakeholders in the New York Harbor, including the US Army Corps of Engineers.

4.1.2. Biological Field Sampling and Analysis Programs

USEPA has for a long time indicated that water quality based planning should follow a watershed based approach. Such an approach considers all factors impacting water quality including both point and nonpoint (watershed) impacts on the waterbody. A key component of such watershed based planning is an assessment of the biological quality on the waterbody. Fish and aquatic life use evaluations require identifying regulatory issues (aquatic life protection and fish survival), selecting and applying the appropriate criteria, and determining the attainability of criteria and uses. According to guidance published by the Water Environment Research Foundation (Michael and Moore, 1997; Novotny et al., 1997), biological assessments of use attainability should include contemporaneous and comprehensive field sampling and analysis of all ecosystem components. These components include phytoplankton, macrophytes, zooplankton, benthic invertebrates, fish and wildlife. The relevant factors are DO, habitat (substrate composition, organic carbon deposition, sediment pore water chemistry), and toxicity. Biological components and factors were prioritized to determine the greatest need of contemporary information relative to existing data or information expected to be generated by other ongoing studies, and/or, which biotic communities would provide the most information relative to the definition of use classifications and the applicability of particular water quality criteria and standards. The biotic communities selected for sampling included:

- Subtidal benthic invertebrates, historically used as indicators of environmental quality because most are sessile;
- Epibenthic organisms colonizing standardized substrate arrays suspended in the water column, thus eliminating substrate type as a variable in assessing water quality;
- Fish eggs and larvae, whose presence is related to fish procreation; and

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Westchester Creek Waterbody/Watershed Facility Plan

Westchester Creek Waterbody Type

FIGURE 4-1

- Juvenile and adult fish, whose presence is related to habitat preferences and water quality tolerances

The waterbody/watershed assessment conducted a Biological Field Sampling and Analysis Program (FSAP) designed to fill ecosystems data gaps in New York Harbor. Field and laboratory standard operating procedures (SOP) were developed and implemented for each element of the FSAP in conformance with the USEPA's Quality Assurance Project Plan guidance (USEPA, 1998, 2001b, 2001c), its standard operation and procedure guidance (USEPA, 2001d), and in consultation with USEPA's Division of Environmental Science and Assessment in Edison, NJ. The FSAPs collected information to identify uses and use limitations within waterbodies assessing aquatic organisms and factors that contribute to use limitations (DO, substrate, habitat, and toxicity). Some of these FSAPs were related to specific waterbodies; others to specific ecological communities or habitat variables throughout the harbor; and still others to trying to answer specific questions about habitat and/or water quality effects on aquatic life. The results of these FSAPs are provided in Appendix B.

Several FSAPs were conducted by DEP during the USA Project that included investigations of Westchester Creek. The Bronx River FSAP was executed in 2000-2001 and included sampling locations in Westchester Creek to characterize subtidal benthos, sediment oxygen demand, water column toxicity, and aquatic species abundance and diversity. Other complimentary FSAPs were developed and implemented in 2001, including one dealing with fish and benthic invertebrates of the entire East River and its tributaries (HydroQual, 2001a), one dealing with Harbor-wide (i.e., all 23 waterbodies) assessment of fish propagation (HydroQual, 2001b), and one dealing with epibenthic invertebrate recruitment (HydroQual, 2001c). Figure 4-2 provides a composite map of the biological FSAP sampling station locations.

DEP conducted its Harbor-Wide Ichthyoplankton FSAP in 2001 to identify and characterize ichthyoplankton communities in the open waters and tributaries of New York Harbor (HydroQual, 2001b). Information developed by this FSAP identified what species are spawning, as well as where and when spawning may be occurring in New York City's waterbodies. The FSAP was executed on a harbor-wide basis to assure that evaluations would be performed at the same time and general water quality conditions for all waterbodies would be assessed during the same temporal period. Sampling was performed at 50 stations throughout New York Harbor, its tributaries, and at reference stations outside the harbor complex. The locations of relevant sampling stations are shown on Figure 4-2. One station was located in Westchester Creek. Samples were collected using fine-mesh plankton nets with two replicate tows taken at 50 stations in March, May, and July 2001. In August 2001, 21 of the stations were re-sampled to evaluate ichthyoplankton during generally the worst case temperature and DO conditions.

DEP conducted a Harbor-Wide Epibenthic Recruitment and Survival FSAP in 2001 to characterize the abundance and community structure of epibenthic organisms in the open waters and tributaries of New York Harbor (HydroQual, 2001c). The recruitment and survival of epibenthic communities on hard substrates was evaluated because these sessile organisms are good indicators of long-term water quality. This FSAP provided a good indication of both intra- and inter- waterbody variation in organism recruitment and community composition. Artificial substrate arrays were deployed at 37 stations throughout New York Harbor, its tributaries, and at reference stations outside the harbor complex. The locations of relevant sampling stations are shown on Figure 4-2. Two stations were located in Westchester Creek. The findings of previous waterbody-specific FSAPs indicated that six months was sufficient time to characterize the peak times of recruitment, which are the spring and summer seasons. Therefore arrays were deployed in April 2001 at two depths (where depth permitted) and retrieved in September 2001.

A special field investigation was conducted during the summer of 2002 to evaluate benthic substrate characteristics in New York Harbor tributaries (HydroQual, 2002). The goals of this FSAP were to assist in the assessment of physical habitat components on overall habitat suitability and water quality and, assist in the calibration of the water quality models as they compute bottom sediment concentrations of total organic carbon (TOC). Physical characteristics of benthic habitat directly and critically relate to the variety and abundance of the organisms living on the waterbody bottom. These benthic organisms represent a crucial component of the food web, and, therefore, the survival and propagation of fish. Samples were collected from 103 stations in New York Harbor tributaries using a petit ponar grab sampler in July 2002. The locations of relevant sampling stations are shown on Figure 4-2. Five of the stations were located in Westchester Creek. Two samples from each station were tested for TOC, grain size, and percent solids.

A Tributary Toxicity Characterization FSAP was executed in 2003 to determine whether toxicity is a significant issue of concern for the waterbody evaluations (HydroQual, 2003). Water column and sediment samples were collected from a total of 20 locations in Gowanus Canal, Newtown Creek, Flushing Bay and Creek, the Bronx River, and Westchester Creek. Two stations were located in Westchester Creek (Figure 4-2), and one station was located in Pugsley Creek. Water column toxicity was tested using 7 day survival and growth toxicity tests with Sheepshead minnow and 7 day survival, growth and consistency toxicity tests with mysid shrimp. Sediment chronic toxicity was evaluated using 28 day whole sediment chronic toxicity tests with Leptocheirus plumulosus. Survival, growth and fecundity of the species were evaluated. In addition to the toxicity tests, sediment samples were collected using an Ekomar dredge sampler and tested TOC, percent solids, and grain size to help determine the benthic substrate characteristics of the subtidal sediments related to sediment toxicity (if any). Sampling was conducted in August 2003.

4.1.3. Water Quality Sampling and Analysis Programs

Supplemental water quality sampling was performed in the Hutchinson River and Westchester Creek during the summer of 2005 in support of receiving water model calibration (Figure 4-3). The program included five water quality stations in Westchester Creek and two stations in Pugsley Creek. In addition, five sediment coring locations were selected within Westchester Creek for laboratory analysis of sediment oxygen demand (SOD). Dry weather surveys (i.e., at least 72 hours of antecedent dry weather) and sediment sampling were performed monthly during the four months from June through September 2005, and two wet weather surveys were performed, in August and September. Field measurements of salinity, temperature, and secchi depth were made, and water samples were collected from near-surface and near-bottom depths for laboratory analysis of nutrients, carbon, chlorophyll a, DO, and pathogen-indicator bacteria. Data from this supplemental study are discussed in detail in Section 4.5.

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Westchester Creek Biological Sampling Locations

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 4-2

H&S File: 5905\002\011\Section 4.cdr 11-23-10

Westchester Creek Summer 2005 Water Quality Sampling Locations

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Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 4-3

From 1975 through 1977, the City conducted a Harbor-wide water quality study funded by a Federal Grant under Section 208 of the Water Pollution Control Act Amendments of 1972. This study confirmed tributary waters in the New York Harbor were negatively affected by CSOs. In 1984 a Citywide CSO abatement program was developed that initially focused on establishing planning areas and defining how facility planning should be accomplished. The City was divided into eight individual project areas that together encompass the entire harbor area. Four open water project areas were developed (East River, Jamaica Bay, Inner Harbor and Outer Harbor), and four tributary project areas were defined (Flushing Bay, Paerdegat Basin, Newtown Creek, and Jamaica Tributaries). Samples were collected from sewer discharges at several locations that characterized dry and wet weather discharges. Receiving water sampling locations were established for receiving water modeling support. Station locations are shown on Figure 4-4. Physical measurements of tidal dynamics, current velocity, and bathymetry were made in addition to sample collection for chemical analysis. As part of the East River Combined Sewer Overflow (ERCSO) Facilities Planning Project, dry weather and wet weather surveys paired with special studies were conducted during 1988 to characterize water quality and sediment conditions and identify sources of impairments (URS, 1991). Westchester Creek and Pugsley Creek were included in that program.

DEP and its predecessor city agencies have been monitoring water quality in New York Harbor waters since 1909, reporting annually in the New York City Regional Harbor Survey. The stated purpose of the program is "to assess the effectiveness of New York City's various water pollution control programs and their combined impact on water quality" (DEP, 2000). Among the Harbor-wide sampling locations, data has been collected at one station near the mouth of Westchester Creek in the Upper East River (Station E13), and at two stations in the Creek (WC1 and WC2, Figure 4-5). Sampling at Station E13 was discontinued in the late 1990s, while the Westchester Creek stations continue to be sampled on a limited basis. In 1998, DEP began supplementing this data with the Sentinel Monitoring Program, in which stations are sampled quarterly for fecal coliform bacteria, and the results are compared with baseline conditions to trigger intensive surveillance of the adjacent shoreline. The Sentinel Monitoring Program includes one station in Westchester Creek, near the Unionport Bridge.

4.1.4. Other Data Gathering Programs

Data has been collected by agencies and organizations other than DEP throughout New York Harbor. The USEPA Regional Environmental Monitoring and Assessment Program (Adams et al., 1998) has evaluated sediment quality throughout New York Harbor, as has the agency's more recent five-year National Coastal Assessment (a.k.a. "Coastal 2000") Program (Figure 4-6). The New York State Department of Transportation (NYSDOT; TAMS, 1999) conducted studies of the biota of the East River at the Queensboro Bridge, while the New York City Public Development Corporation (EEA, 1991) studied the ecology of Wallabout Bay in the East River. The United States Army Corps of Engineers (USACE) performed sediment profile imagery and benthic sampling in Jamaica, Upper New York, Newark, Bowery, and Flushing Bays during June and October, 1995. In Upper New York Bay, the USACE conducted a two-year study of flatfish distribution and abundance. The data from these programs are useful for comparing Westchester Creek to similar waterbodies in the New York Harbor to ascertain its relative aquatic and ecological health.

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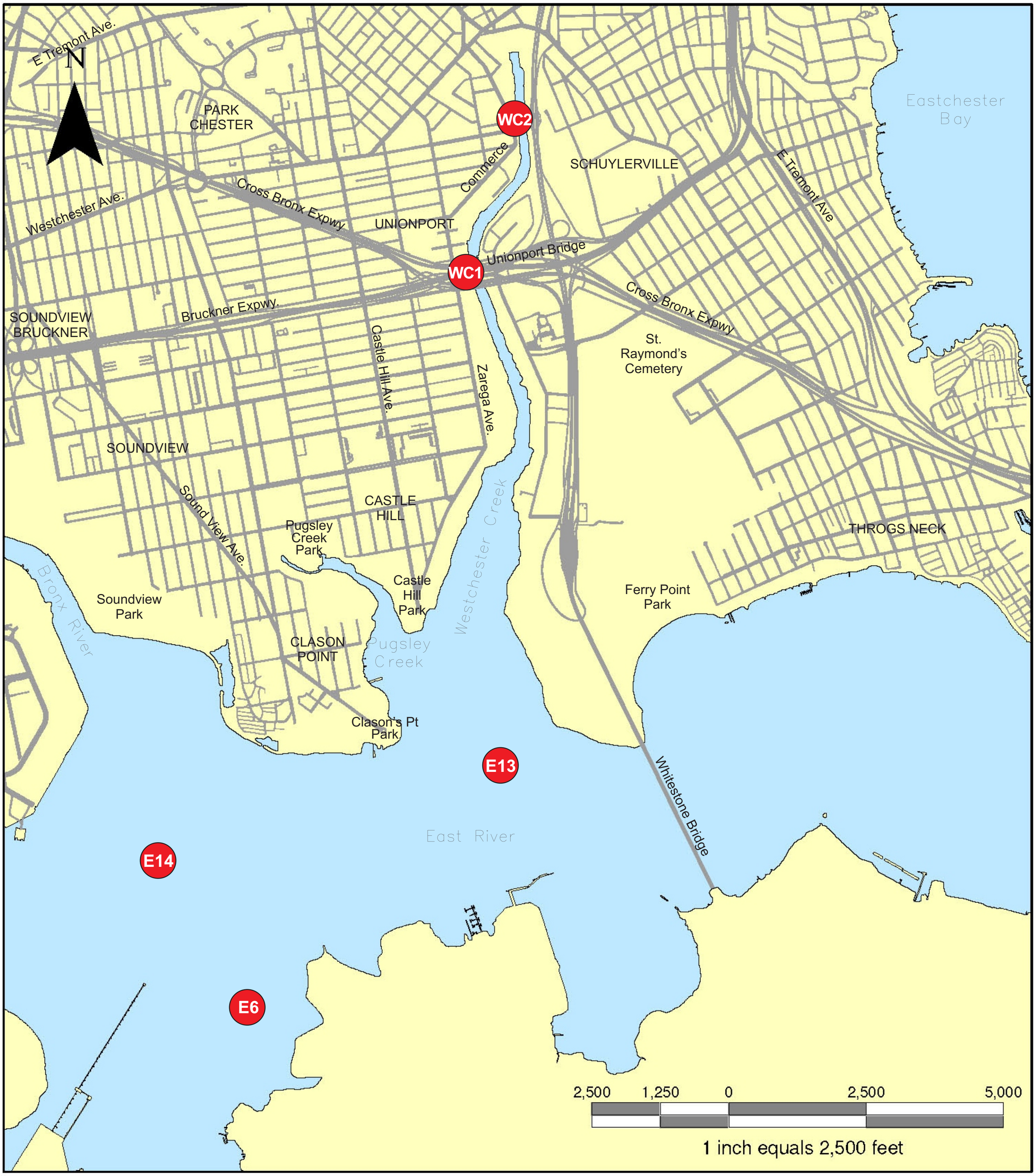
East River CSO Facility Plan
Water Quality Sampling Locations

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 4-4



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Westchester Creek Waterbody/Watershed Facility Plan

Harbor Survey Sampling Locations

FIGURE 4-5

H&S File: 5905\002\011\Section 4.cdr 11-23-10

Coastal 2000 Sampling Locations in New York Harbor

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Westchester Creek Waterbody/Watershed Facility Plan

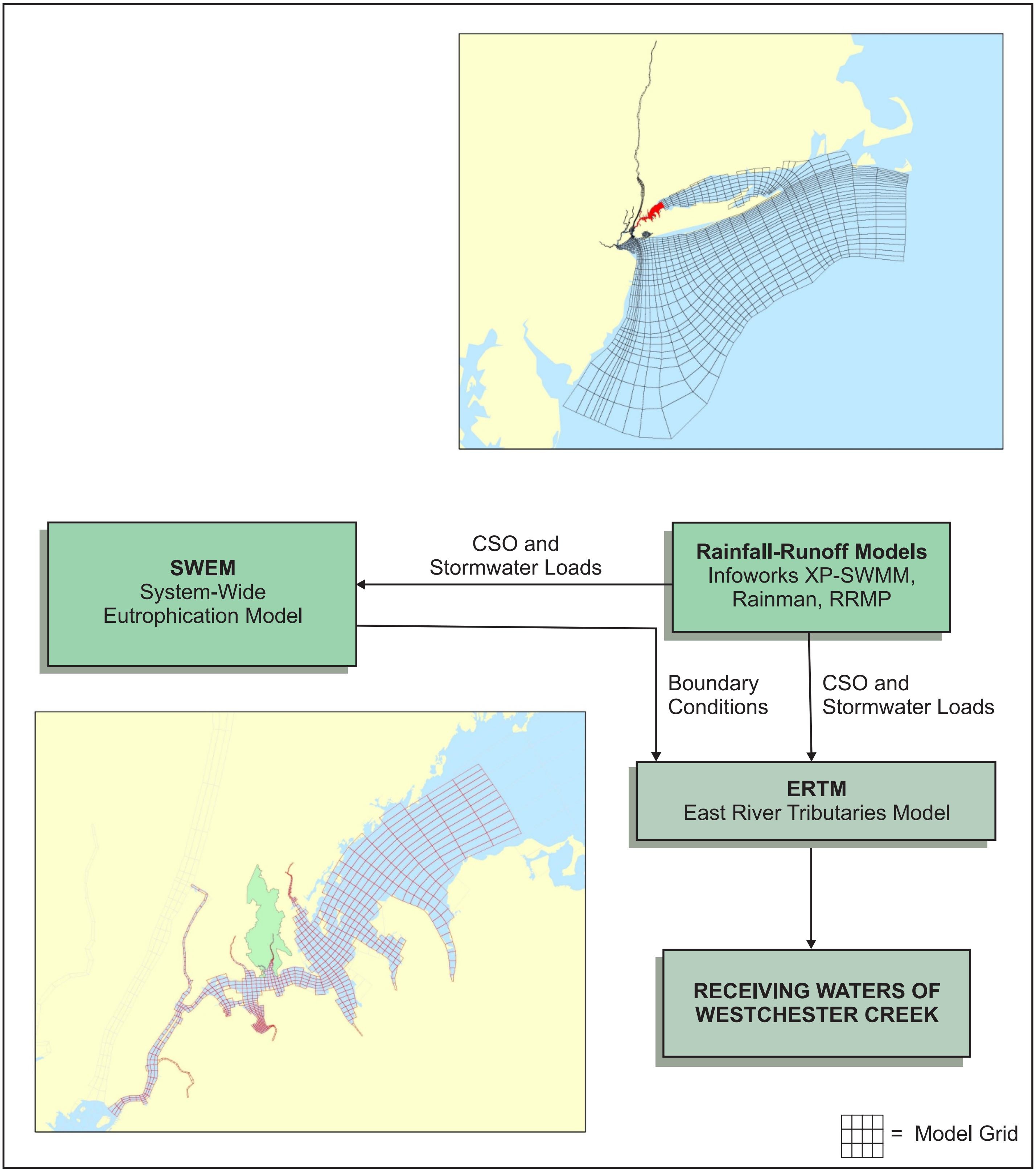
FIGURE 4-6

A significant source of data on fish populations in the New York Harbor comes from the numerous studies associated with electric power generating station cooling water system. Along with cooling water, intakes inadvertently withdraw planktonic biota and smaller fish incapable of escaping the pressure gradients generated by pumping. These organisms either pass through the cooling system (entrainment), or are trapped against the screens and other protective barriers (impingement). Permit conditions at these facilities require entrainment and impingement sampling, providing an abundance of data on fish populations and other aquatic organisms. These data are biased towards younger life-stages (fish eggs and larvae) and smaller fish species, but can provide evidence of the viability of fish species in the waterbody. Local power plants include the East River plant in lower Manhattan; the Arthur Kill plant on Staten Island; and the Ravenswood, Astoria and Poletti plants on the Queens side of the East River. ENSR (1999) reported on the East River generating station, but the most recent summary of these data was produced by Sunset Energy Fleet LLC, in its Article X application to the New York State Public Service Commission, to build and operate a power plant in Gowanus Bay (Sunset Energy Fleet, 2002). Sunset Energy also collected and analyzed numerous samples of benthic infauna, and ichthyoplankton, in Gowanus Bay in 1999 and 2000. Again, these data are useful for comparative and baseline evaluations, but do not generally provide meaningful information on the effects of water pollution control efforts by DEP.

4.1.5. Receiving Water Modeling

A set of coupled mathematical models were developed and calibrated to simulate the influence of CSO and stormwater loads on water quality in Westchester Creek. A schematic of the mathematical models used for this analysis is shown on Figure 4-7. Westchester Creek is part of the East River Tributaries Model (ERTM), which encompasses the lower and upper East River and its principal tributaries and embayments, as well as part of western Long Island Sound. Hydrodynamic and water-quality information at ERTM's open boundaries are provided by the larger-scale System-Wide Eutrophication Model (SWEM), which encompasses all of the New York Harbor, the Hudson River as far upstream as Poughkeepsie, the East River, Long Island Sound, and the continental shelf of the New York-New Jersey Bight from Cape May, New Jersey in the southwest to the Nantucket Shoals in the northeast (HydroQual, 2001d). Whereas SWEM's coarse-resolution grid provides basic hydrodynamic and water-quality results in the open waters of the model's large domain, ERTM's finer-resolution grid was designed specifically to provide more detailed hydrodynamic and water-quality results in the smaller CSO-impacted waterbodies of the East River. ERTM and SWEM are both three-dimensional, time-variable, coupled hydrodynamic and water-quality models based on finite-difference approximations. A variety of calibrated watershed/ sewershed models (InfoWorks CS™, XP-SWMM, RAINMAN, RMMP) were used to determine stormwater and CSO flows and loads to the receiving waters in different parts of the model domains.

The hydrodynamic component solves the three-dimensional advection-diffusion equations for water motion and includes forcing due to winds, tides, surface heat flux, freshwater discharge, and other lateral boundary conditions. Vertical turbulent mixing is driven by a Mellor Yamada (1982) level-2.5 turbulence closure scheme as modified by Galperin et al. (1988). ERTM hydrodynamics include a "wetting and drying" algorithm that allows the model to simulate the emergence and submergence of extensive intertidal mudflats that occur in many of the East River tributaries and embayments.



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Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Westchester Creek Receiving Water Modeling

FIGURE 4-7

The water-quality component incorporates advection-diffusion and temperature-salinity results from the hydrodynamic models to solve three-dimensional coupled kinetic mass-balance equations describing the biochemical interactions between aquatic biota (phytoplankton, zooplankton, and benthic bivalves), nutrients (nitrogen, phosphorus, and silica), various forms of organic carbon, DO, as well as special contaminants of interest (e.g., total and fecal coliforms and enterococci, as appropriate). A sediment-flux submodel couples water-column biochemistry with sediment diagenesis, remineralization of settled particulate organic matter (POM), and the resultant uptake of near-bottom DO through SOD. Sources of nutrient and contaminant loads to the water-quality models include wet and dry atmospheric deposition, rivers and creeks, stormwater, CSOs, and effluent from major municipal and industrial wastewater treatment plants. DO kinetics include surface reaeration, nitrification, photosythesis, metabolic oxidation, and SOD. In-stream aeration can be included as required to by water-quality projection alternatives.

The model system described above was used to establish baseline conditions against which all alternatives are compared for quantifying water-quality benefits. Table 4-1 summarizes the assumptions used for the Baseline simulation.

Table 4-1. Baseline Water Quality Modeling Conditions

Model Component	Model	Baseline Conditions
Watershed Pollutant Flows and Loads	InfoWorks CS™, XP-SWMM, RRMP, RAINMAN	1988 precipitation for wet-weather flows; 2045 population projection for dry-weather flows; twice design dry-weather flow capacity at Hunts Point WWTP
Boundary Conditions	SWEM	1988 precipitation, meteorological and tidal forcing, river and creek discharge, and insolation; nitrogen loads in Long Island Sound adjusted to meet Phase III TMDL requirements
Regional Water Quality	ERTM	1988 precipitation, meteorological and tidal forcing, river and creek discharge, and insolation; 2045 projected WWTP loads
Receiving Water	Westchester Creek	Calculated results

4.2. PHYSICAL WATERBODY CHARACTERISTICS

Westchester and Pugsley Creeks are located in the eastern section of the Bronx, New York, and are tributary to the Upper East River, although neither Creek carries natural freshwater flow. Bound by Community District 10 on the east and Community District 9 on the west, the headwaters of both Creeks have been filled to create usable land, resulting in lengths of about 2.6 miles and less than a mile for Westchester and Pugsley Creeks, respectively. The waterbody can collectively be divided into three distinct reaches that have physically different characteristics: Westchester Creek, Pugsley Creek, and an embayment area at the confluence of the two creeks with the Upper East River.

Westchester Creek is a narrow, highly channelized, navigable waterway extending in a north-south orientation approximately 2 ½ miles from its confluence with the Upper East River to its head. The Creek is approximately 165 feet wide at its head, and widens to about 300 feet within about a mile of the Upper East River, where its confluence with Pugsley Creek results in an open bay area. Pugsley Creek enters this bay from the northwest, extending approximately ½-mile from its head to the tip of Castle Hill Point, the dividing feature between Westchester Creek and Pugsley Creek. Land around Pugsley Creek at its confluence with Westchester Creek is residential with the majority of the shoreline properties containing parkland. In contrast, the navigable Westchester Creek is bordered by industrial uses. The mouth of the waterbody is approximately 3,000 feet wide.

Westchester Creek is historically significant for supporting commerce in the eastern Bronx, leading to the establishment of early settlements along its shoreline. With the increase in ship sizes over the years and sedimentation of the Creek, regular maintenance dredging of a navigable channel up Westchester Creek is performed by the USACE. The last dredging project conducted by the USACE for navigational purposes was performed in 1977, based on sediment sampling by the USACE during that time in preparation for dredging. The control depth for Westchester Creek is reported to be 12 feet below mean lower low water (MLLW). According to the USACE database of Port and Waterway Facilities, in 1999 there were three berthing locations for the receipt of petroleum products by barge and small tank vessel in Westchester Creek with reported depths of 20 feet, 13 feet, and 10 feet, all with respect to mean low water (MLW; less than 0.5 feet above the MLLW datum). There is only one bridge crossing location along Westchester Creek, however it includes a large interchange involving three expressways, a parkway, and local streets. The Unionport Bridge, a drawbridge operated by the City of New York, carries Bruckner Boulevard across Westchester Creek; the remaining spans are elevated and do not restrict vessel traffic. Pugsley Creek is non-navigable except by small recreational boats during high tide conditions.

4.2.1. Shoreline

Most of the shoreline of Westchester Creek has been altered, by construction of either bulkheads or rip-rap armoring, as illustrated on Figure 4-8. The western shoreline is mostly natural along the southern reaches, but extensively bulkheaded and armored from the Unionport Bridge northward with few breaks. Areas of rip-rap are located along publicly accessible areas of Castle Hill Point, Clason's Point, and along Ferry Point Park, as well as along many of the privately owned industrial properties. Piers are only located in Pugsley Creek along the western shore and are associated with private single-family residences, and do not appear to be in operation based on their relatively dilapidated condition. The eastern shoreline is mostly natural with patches of rip rap armoring and bulkheads concentrated in the middle reaches of its length. The multiple barrel CSO outfall located at the head of the waterbody has concrete bulkheads and wingwalls that support the athletic fields of Lehman High School above it. Other CSO and stormwater outfalls can be found along the length of the waterbody that are protected by visible head walls.

4.2.2. Benthos

It is increasingly recognized that conditions in the benthic sediment are as critical to attainment of beneficial uses as water column numeric criteria. Recent field investigations have collected samples from the sediments of Westchester Creek, and have shown that, based on grain size, the entire bottom appears to be predominately mud, silt, and clay. The waterbody bottom is typically covered with a layer of very wet, very soft, dark brown silt, often with a trace of sand and some occasional gravel. Areas exhibiting these characteristics are represented as mud/silt/clay on Figure 4-9. Additional cores collected during Summer 2005 indicate the presence of black material containing large amounts of organic matter and a low percentage of solids (commonly described as "black mayonnaise") on top of the natural bottom sediments. This material is often attributed to historical discharges of CSO and stormwater. The original bottom material is most evident in the vicinity of the mouth. Dredging in Westchester Creek has substantially altered the natural slopes and depths of the waterbody, which may have resulted in changes to sediment accretion and removal dynamics, and limited the potential for the establishment of submerged aquatic vegetation beds, and other benthic and epibenthic processes.

4.2.3. Waterbody Access

Public waterbody access to Westchester Creek is mostly precluded in the upper reaches by private ownership of industrial facilities along the shoreline, and by the limited pedestrian access to the Creek across the Hutchinson River Parkway (Figure 4-10). In fact, the Creek is not even visible from most of public streets along its upper reaches due to obstructions such as fencing, buildings, and operational materiel (vehicles, equipment, staged raw materials, etc.). The head end of the Creek abuts the athletic fields of Lehman High School, but these fields are fenced in and not publicly accessible. The only access to Westchester Creek north of the Unionport Bridge is the Metro Marine marina located near the intersection of Newbold and Commerce Avenues on the western shore of Westchester Creek, which is a private marina with restricted access. In the lower reaches, access is possible via Ferry Point Park and Castle Hill Park.

Access to the shoreline of Pugsley Creek is encouraged at several locations by walkways, parkland, boat ramps, and Parks Department concessions, but this access is concentrated along the lower reaches of the Creek. Castle Hill Park includes pathways and stair access along Howe and Barrett's avenues, and the entire Creek is visible from unobstructed views along these streets. Access to the western shoreline is possible from Clason's Point Park, which includes a public boat launching site as well as the Point Yacht Club, run by Commodore Concessioners, a concessioner to the Department of Parks and Recreation. The upper reaches of Pugsley Creek are publicly inaccessible due to 8-foot tall fences along much of its perimeter, but are privately accessible from several homes along Clason Point and through occasional breaches in the fencing. Evidence of recreational boating exists behind several of these houses, but the presence of dilapidated docks and abandoned boat hulls suggest that this is no longer common. Further, the entire creek is emptied during low tide, exposing unvegetated mudflats throughout its extent.

4.2.4. Hydrodynamics

As with any coastal embayment, actual tidal conditions depend on meteorological conditions and local bathymetry, in addition to celestial periodicities. However, the lack of natural freshwater flow and its narrow configuration makes Westchester Creek water quality particularly dependant on tidal flushing with the Upper East River waters. The Upper East River is a tidal strait, bound on the east by the Long Island Sound and on the west by Hell Gate, a narrow strait that connects to the Lower East River, which opens to the Upper New York Bay and is tidally dominated by the New York Bight. By convention, the tide is ebbing when the Upper East River is flowing towards the Long Island Sound to the east, and flooding when flowing westward.

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Westchester Creek Existing Shoreline Physical Characteristics

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NYC Environmental Protection

Westchester Creek Surficial Geology

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 4-9

Source: Metropolitan Waterfront Alliance, December 2004.

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NYC Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Waterbody Access Locations

FIGURE 4-10

Westchester Creek has a semidiurnal tidal cycle with a mean range of approximately 7 feet and a spring tide range of 8.0 to 8.5 feet. Maximum current velocities are between 1.0 and 1.5 feet per second near the mouth, and normally occur approximately three hours after peak high or low water surface levels (i.e., 90 degrees out of phase with water levels). Tidal heights vary with wind direction, and are most influenced when the wind blows from the north or south. Winds can similarly alter the timing of the tidal cycle. Pugsley Creek completely drains during most tidal cycles, exposing a largely unvegetated mudflat. Based on tidal exchange, the time it takes to exchange the entire Creek volume with the Upper East River (the hydraulic residence time) is on the order of 1-3 tidal cycles. Residence times this short indicate a high sensitivity of resident water quality to boundary conditions.

4.3. CURRENT WATERBODY USES

Westchester Creek was a principal waterway in the settlement of the Bronx beginning in the 17th Century, and had a maintained navigational channel extending its entire length by 1955, based on historic topographic quadrangle maps. The Westchester Creek corridor remains an active industrial area, although it is transitioning to lighter commercial uses and water-dependent uses have diminished from historic levels. The only water-reliant industrial user is the Schildwachter Fuel Oil facility located near the head end of Westchester Creek, which receives oil deliveries by barge periodically. As discussed previously, the City intends to encourage continued use of the Westchester Creek corridor by industrial and manufacturing concerns displaced from other areas Citywide due to gentrification. In addition, one City-owned property on Westchester Creek is leased to a demolition company that uses the property as an explosives storage depot. The property is regulated by the Federal Bureau of Alcohol, Tobacco, and Firearms, which severely curtails adjacent allowable uses. For example, no development of any kind is allowed within 210 feet, and no buildings are allowed within 635 feet.

The waterbody is accessible from the various parks along the southern shorelines, including Castle Hill Park, Clasons Point Park, and Ferry Point Park. Elsewhere, public access is extremely limited due to the private ownership of shorelines and the presence of highway rights-of-way, fencing, and other obstacles. Public spaces adjacent to waterbody, such as the YMCA playground on Castle Hill Point, and the Lehman High School athletic field at the head end of Westchester Creek, are fenced in and do not encourage water usage. Very few of the privately-owned properties adjacent to the waterbody encourage its use either.

There are no public beaches on or near Westchester Creek, and NYCDPR has no plans for utilizing the waterbody in the future for swimming. The establishment of bathing beaches within the East River or its tributaries is prohibited by local law, and the physical characteristics of Westchester Creek functionally preclude bathing without substantial physical modifications to conform with local and state health department requirements.

Despite these restrictions, limited recreational use of the waterbody occurs. One recreational marina, Metro Marine (formerly known as Conroy Marine Sales and Service) is located at the end of Newbold Avenue on the western shore of Westchester Creek, and has approximately 12 year-round residents in addition to a similar number of slips for recreational users. A boat ramp and yacht club are located at Clasons Point Park and are run by a NYCDPR concessioner. Private docks are located along the western shoreline of lower Pugsley Creek, although the overall dilapidated state and shallow water suggest they are largely unused. Shoreline fishing does occur along the accessible areas in the southern portion of the waterbody. Based on a number of informal conversations with anglers, most are apparently local residents.

4.4. OTHER POINT SOURCES AND LOADS

The DEP Shoreline Survey Program (DEP, 1993) identified approximately 46 point source discharges to Westchester and Pugsley Creeks in addition to the CSO and MS4 outfalls it operates, as described in Section 3. Two of these were identified as SPDES-permitted dischargers to Westchester Creek, both of which are associated with petroleum storage facilities and have reporting requirements and limits for pH, flow, and BTEX. The remaining 44 are not permitted by a regulatory authority and none have dry weather discharges. The unpermitted point sources were classified by the Shoreline Survey Program as general or direct discharges and are most likely storm drains from privately owned properties with an insignificant discharge as compared to CSO and stormwater and were not observed to be discharging during dry weather.

The overland runoff drainage areas immediately adjacent to Westchester and Pugsley Creeks represent non-point sources to the waterbody, and are comprised primarily of parkland and privately owned properties totaling approximately 341 acres. These areas are mostly grassy, highly pervious, relatively flat and undeveloped areas that drain towards the waterbody. Although not specifically investigated during this assessment, non-point source runoff is most likely insignificant as compared to CSO and stormwater.

4.5. CURRENT WATER QUALITY CONDITIONS

Water quality conditions in Westchester Creek were quantified by field investigations performed by DEP in association with the 2003 CSO Facility Plan, the Harbor Survey on a limited basis, the USA Project, and the LTCP Project under which the present document was developed. Receiving water modeling corroborates low DO and high bacteria measurements, and predicts other deleterious conditions that these projects have documented, such as poor water clarity, floatables, and odor. Both data and water quality modeling results show that aquatic life, recreation, and aesthetics are periodically impaired, and that impaired conditions regularly persist during and following wet weather events when CSOs and stormwater discharges occur. Discharges of total suspended solids (TSS), biochemical oxygen demand (BOD), settleable solids, and floatables induce odors and other deleterious aesthetic conditions in Westchester Creek. Depressed DO in the water column reaches anoxic conditions in summertime due to BOD and sediment oxygen demand fed by settleable solids discharges. Elevated bacteria concentrations and noticeable floatables are common occurrences and represent a nuisance condition throughout Westchester Creek. Water clarity is poor, especially following wet weather events. It should be noted that data are not available for Pugsley Creek.

The following sections describe the current water quality conditions using both existing water quality data and model simulations. The advantage of using observed data is that it is the most reliable source of information; a water quality model may not capture all the dynamic features of the sewer system and the natural water system (i.e., loading spikes, localized circulation patterns). However, data collection is not continuous and therefore generally limited. In contrast, model results have a greater spatial resolution (horizontal and vertical) and better represent temporal variability and overall system response, including important seasonal impacts. Calculated water column concentrations are the result of three major modeling components:

- The collection system model, which quantifies flow discharges and pollutant loadings to Westchester Creek;
- The hydrodynamic receiving water model, which defines the water circulation patterns within Westchester Creek and the Upper East River; and
- The receiving water quality model, which calculates the fate of pollutants and their impact on water quality parameters such as DO.

In order to assess the impacts of engineering alternatives, a baseline condition was developed for comparison purposes. The baseline condition closely represents existing conditions with some modifications with regard to population projections, and sewer system conveyance to the Hunts Point WWTP. The baseline model simulation computes hourly water column concentrations for an annual cycle considering rainfall driven CSO and stormwater discharges and annual temperature fluctuations. The major features of the baseline condition are as follows:

- 1988 precipitation measured at JFK airport, which contains average annual precipitation consistent with the expectations of the USEPA CSO policy, as well as an unusually "wet" July, which is important for evaluating pathogen impacts;
- 2045 population projections for the dry weather sanitary flow estimate (130.5 MGD);
- A maximum operating capacity of the Hunts Point WWTP of 259 MGD;
- Documented Sediments in sewers; and
- Boundary conditions calculated by SWEM.

The analysis of current water quality conditions based on observed measurements and the model analysis of Baseline conditions are described below.

4.5.1. Dissolved Oxygen

Westchester Creek does not always meet the requirements of Class I waters for DO (i.e., never-less-than 4.0 mg/L). The waterbody exhibits hypoxic and anoxic DO conditions primarily due to CSO discharges. URS (1991) summarized the field investigations conducted in 1986 during the East River CSO Facility Planning. DO was typically measured as being hypoxic or anoxic throughout the waterbody, especially at the head-end terminus following wet weather discharges. A component analysis at that time suggested that attainment of the DO standard was limited by the availability of oxygen in the Upper East River water that mixed with Westchester Creek through tidal exchange. DO was generally near the 4.0 mg/L standard in the East River, and although there is evidence that DO concentrations in the Upper East River have been increasing (Figure 4-11), the balance of oxygen demand and replenishment in Westchester Creek does not appear to have improved proportionately. This conclusion is based in part on data collected under the LTCP program during the summer of 2005, provided as a histogram in 1.0 mg/L intervals on Figure 4-12.

Approximately 74 percent of the data collected was below 4.0 mg/L, and more than 34 percent of the samples were below 2.0 mg/L. The head-end DO deficit is even more acute: about 87 percent of the bottom data collected near the head end was below 4.0 mg/L, and 67 percent of the bottom data collected at this location was below 2.0 mg/L during the summer of 2005.

The Baseline water quality modeling scenario, which included modeled collection system performance based on 1988 rainfall, generally corroborates the overall level of DO impairment, i.e., DO concentrations are lower than the water quality numerical criterion, and there is a spatial trend from the head to the mouth. The calculated DO concentrations under Baseline conditions are illustrated on Figure 4-13, and Figure 4-14 shows a longitudinal plot of the percentage of time the DO exceeds different thresholds. The calculated DO concentrations are less than the New York State Class I numerical criterion 56 percent of the hours of the analysis year at the head of Westchester Creek and attains the numerical criterion nearly 100 percent of the time from the midpoint of the Creek (approximately one mile downstream) to the mouth at the East River, a region indicative of the influence of Pugsley Creek on water quality. The monthly results reveal clear seasonal variability in DO, with the summer months (July, August, and September) demonstrating the furthest downstream excursion of less than 100 percent attainment of the Class I numerical criteria. During the remainder of the year, the impaired section of Westchester Creek is limited to the upper half-mile. Pugsley Creek discharges appear to have minimal impacts on water quality near its confluence with Westchester Creek. The applicable IEC numerical criterion for DO is also 4 mg/L; thus attainment of the IEC criteria is the same.

4.5.2. Total and Fecal Coliform Bacteria

Westchester Creek does not always meet the requirements of Class I waters for bacteria standards, based on the results of the summer 2005 sampling program, DEP Harbor Survey data, USA studies, and water quality modeling. Figure 4-15 and Figure 4-16 show spatial distributions of recent total and fecal coliform sampling data, respectively. The total coliform data are compared to the Class I geometric mean numerical criterion of 10,000 per 100 mL and the fecal coliform data are compared to the present Class I geometric mean numerical criterion of 2,000 per 100 mL. The data shown include samples collected in Westchester Creek during the summer of 2005 at seven locations from June to September. As illustrated on the figures, the four monthly dry-weather surveys consistently observed high bacteria concentrations. The data did not strongly indicate a specific location for the source of bacteria, but generally trended downward towards the mouths of the tributaries. Elevated bacteria levels seemed to be persistent despite the fact that rainfall was substantially below the historical average during this period, and subsequent quality control tests indicated that the data was most likely valid.

Modeling results for total and fecal coliform at Baseline conditions are shown in Figure 4-17 and Figure 4-18, respectively. Each chart shows the monthly geometric mean compared with the relevant criterion at a particular location. At the head end of Westchester Creek, the monthly total coliform and fecal coliform geometric means exceed the respective criteria during four and three months, respectively, none of which is during the bathing season. Neither criterion is exceeded downstream of the industrial areas along Westchester Creek, such that the waters in the vicinity of the park areas along the East River are predicted to have total and fecal coliform bacteria levels below those established by DEC as protective of secondary contact recreation. Similar to the DO response, Pugsley Creek appears to have limited negative impact to pathogen concentrations near its confluence with Westchester Creek.

4.5.3. Other Pollutants of Concern

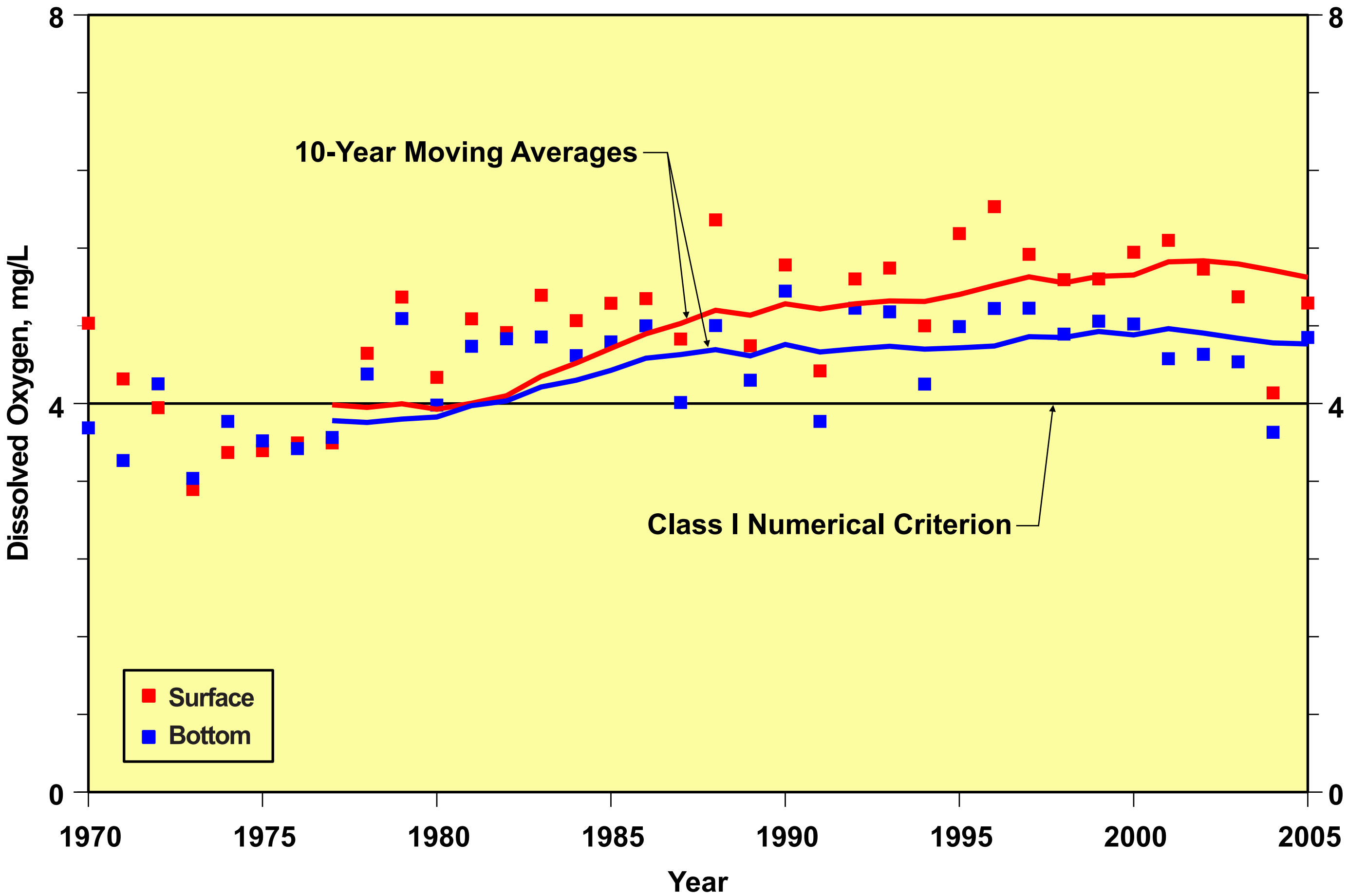
In 1998 the DEC listed Westchester Creek as a high priority waterbody for TMDL development with its inclusion on the Section 303(d) List. Fish propagation was believed to be affected by sludge/sediment from CSO discharges. In 2000, Westchester Creek was listed as a waterbody needing verification of impairment. Westchester Creek was de-listed from the 2002 Section 303(d) List based on the implementation of the New York City CSO Abatement Program and Catch Basin Hooding Program in place at the time to address floatables and pathogens. The 2002 WI/PWL lists aquatic life and recreation uses as impaired, and aesthetics as stressed by CSO, stormwater, and urban runoff discharging floatables and oxygen demanding pollutants. There are no other pollutants of concern for Westchester Creek based on the DEC high priority waterbody listing. Westchester Creek is not on the 2004 303(d) list.

4.6. BIOLOGY

Westchester Creek supports aquatic communities which are similar to those found throughout the New York Harbor in other urban tributaries. These aquatic communities contain typical estuarine species but they have been highly modified by physical changes to the original watershed, shoreline, and to water and sediment quality. These changes represent constraints to Westchester Creek in reaching its full potential to support a diverse aquatic life community and to provide a fishery resource for anglers.

Adverse physical effects on aquatic habitats interact with water and sediment quality to limit the diversity and productivity of aquatic systems. Water and sediment quality can be limiting to aquatic life when they are below thresholds for survival, growth, and reproduction. However, when these thresholds are reached or exceeded, physical habitat factors may continue to limit diversity and productivity. Improvements to water and sediment quality can enhance aquatic life use in degraded areas such as Westchester Creek, but major irreversible changes to the watershed and the waterbody place limits on the extent of these enhancements. In addition, because Westchester Creek is part of a much larger modified estuarine/marine system, which is a major source of recruitment of aquatic life to Westchester Creek, its ability to attain use standards is closely tied to overall ecological conditions in the New York Harbor.

This section describes existing aquatic communities in Westchester Creek and provides comparison to aquatic communities found in the nearby Hutchinson and Bronx Rivers, as well as the open waters of the New York Harbor. This baseline information, in conjunction with projections of water and sediment quality from modeling, technical literature on the water quality and habitat tolerances of aquatic life, long term baseline aquatic life sampling data from the New York Harbor and experience with the response of aquatic life to water quality and habitat restoration in the New York Harbor provides the foundation for assessing the response of aquatic life to CSO treatment alternatives for Westchester Creek. Unless noted otherwise, the data discussed in this section are provided in Appendix B.



Source: Summer average valves for NYCDEP Harbor Survey stations E6, E7, E8, E13, and E14 as available.

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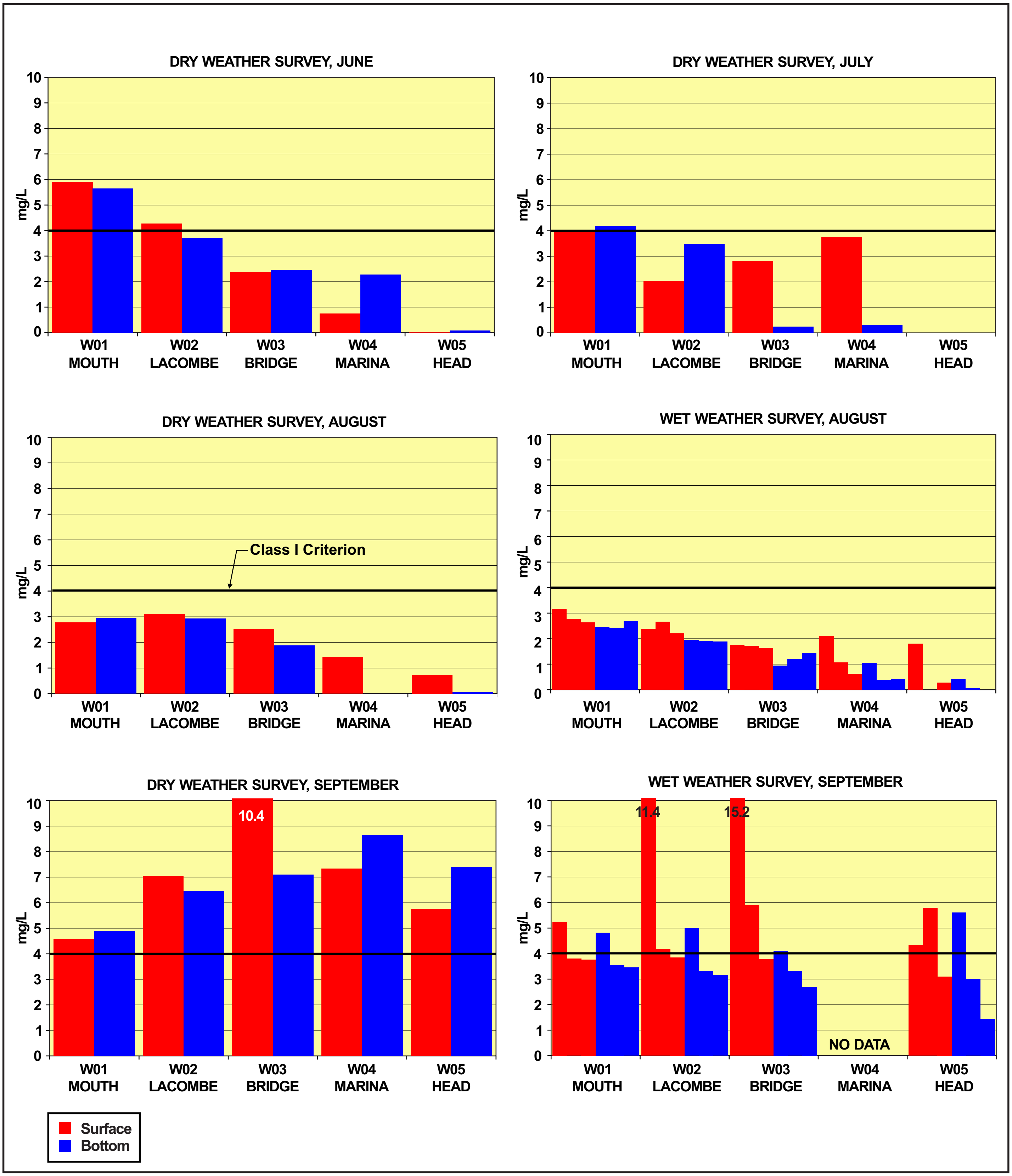
Westchester Creek Waterbody/Watershed Facility Plan

Historical Trend in Dissolved Oxygen in the Upper East River

FIGURE 4-11



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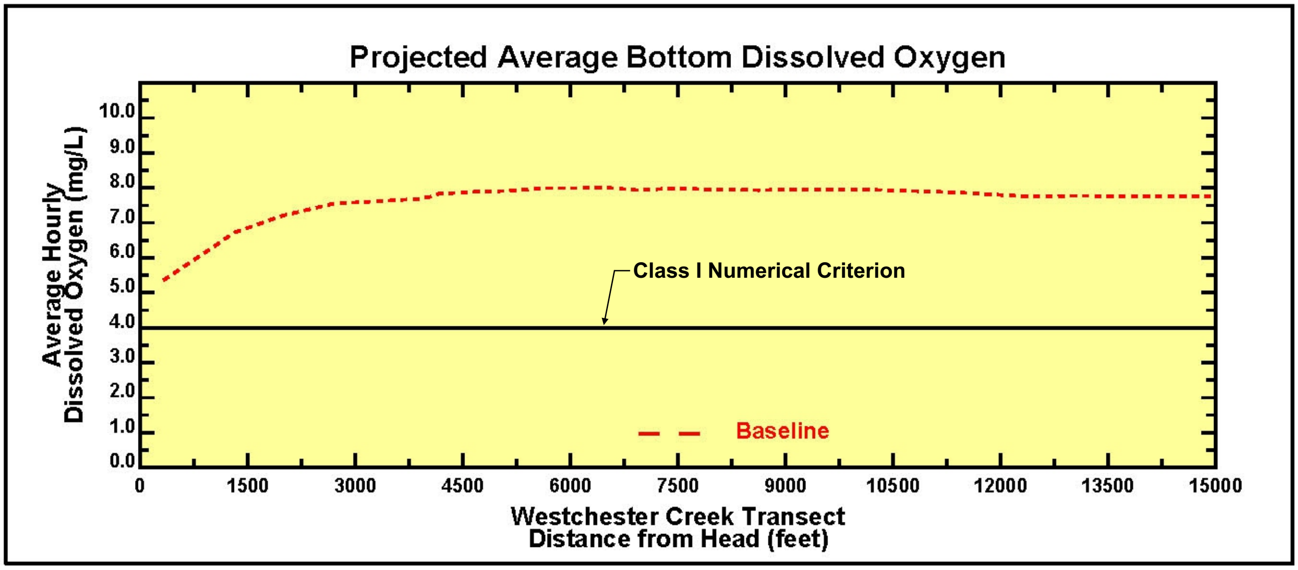
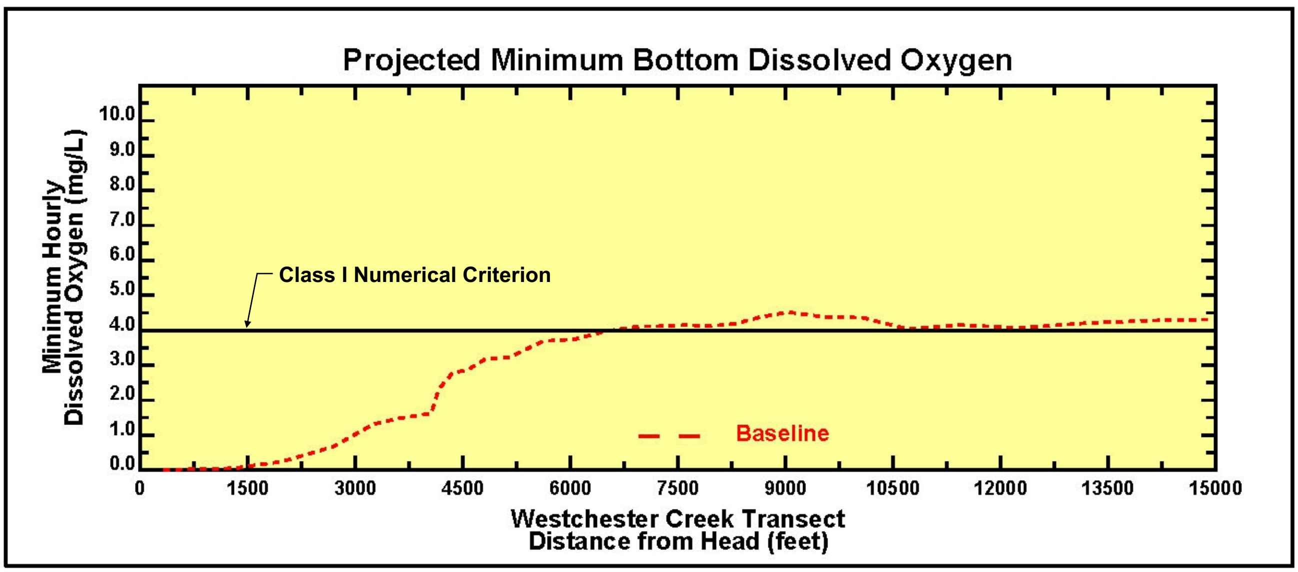
Measurements of Dissolved Oxygen in Westchester Creek Summer 2005

FIGURE 4-12





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Dissolved Oxygen Concentrations Annual Averages and Minima Baseline Conditions

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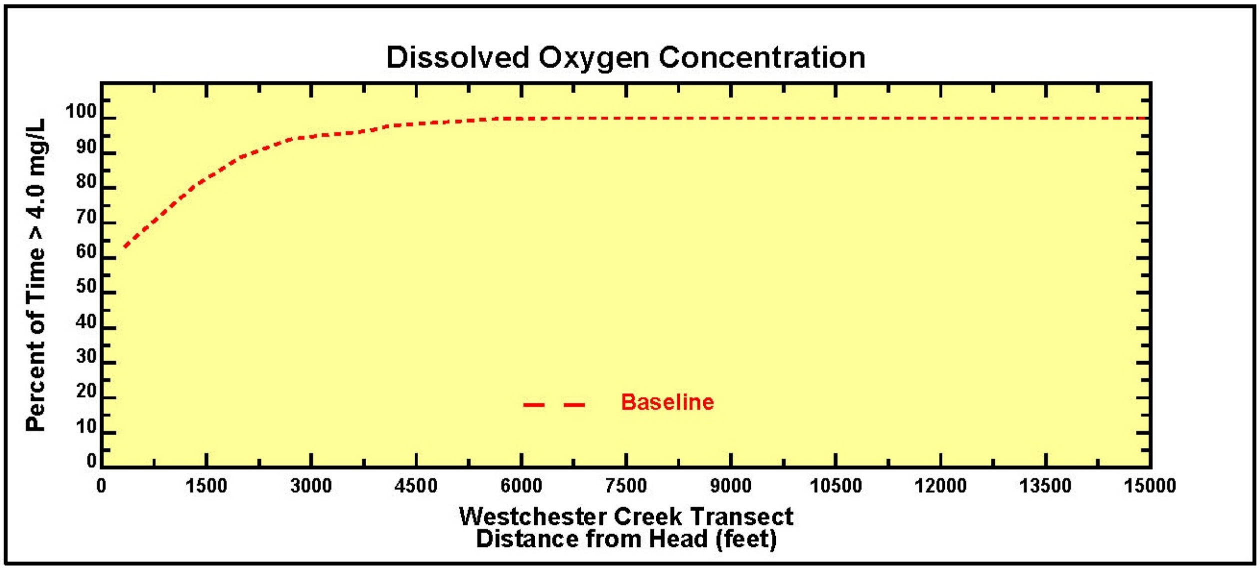

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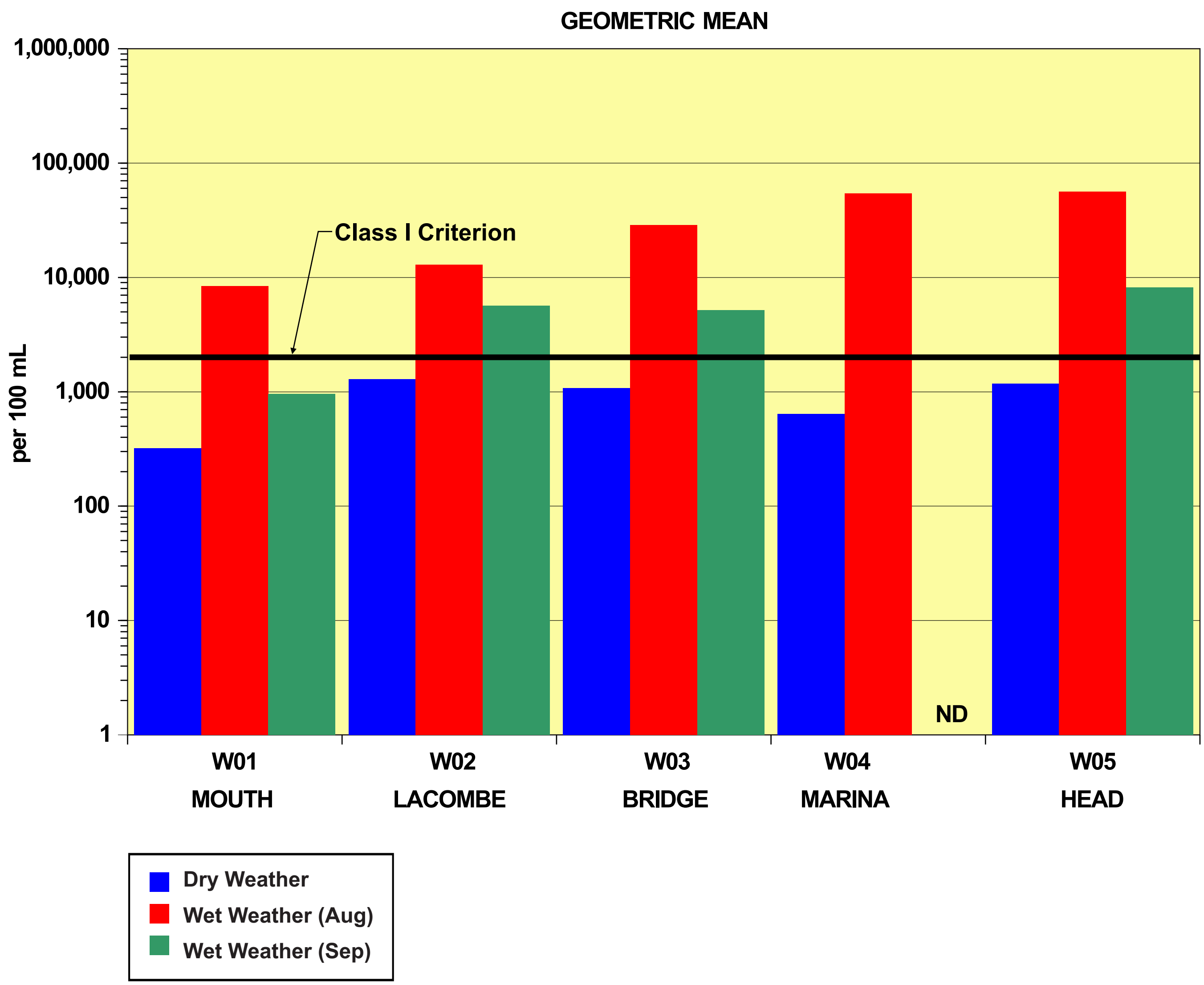
Dissolved Oxygen Concentrations Percentage of Time above Numerical Criterion Baseline Conditions

FIGURE 4-14



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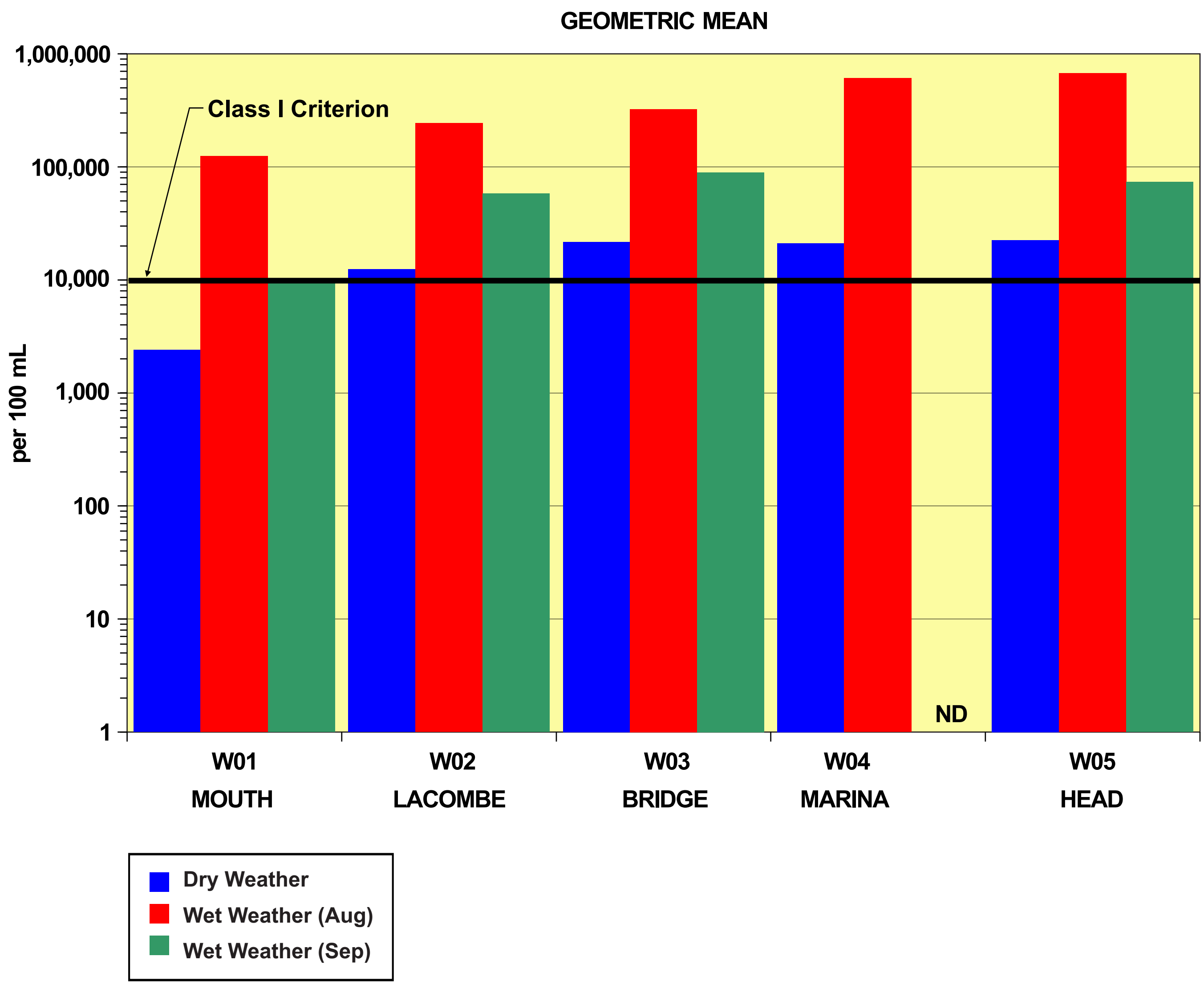
Measurements of Fecal Coliform Concentrations in Westchester Creek Summer 2005

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 4-15



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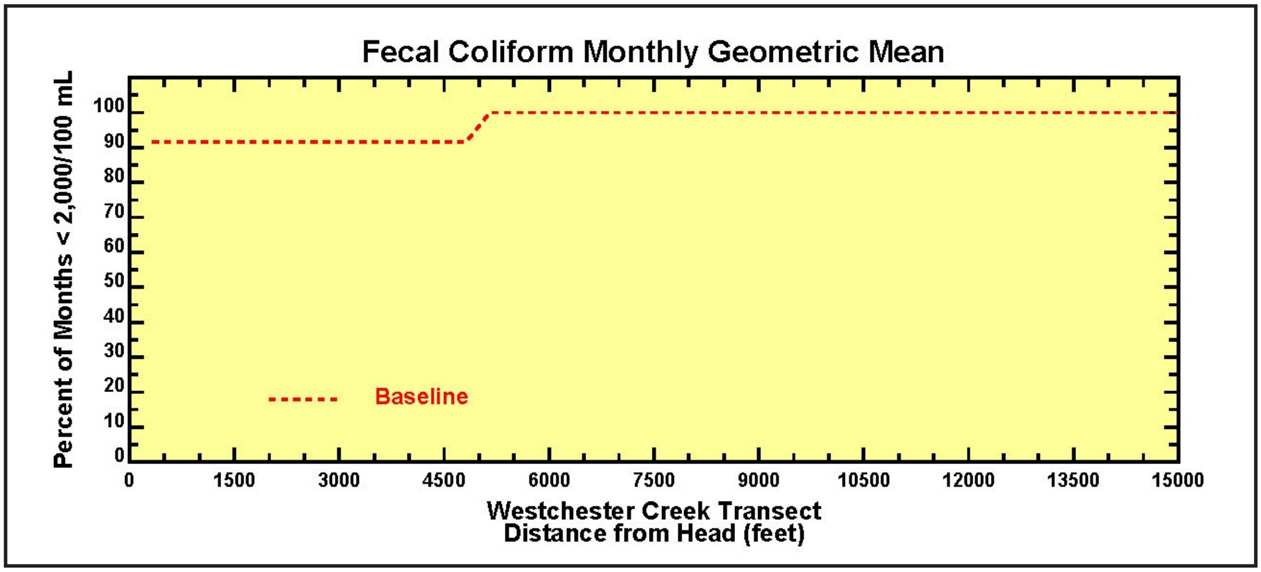
Measurements of Total Coliform Concentrations in Westchester Creek Summer 2005



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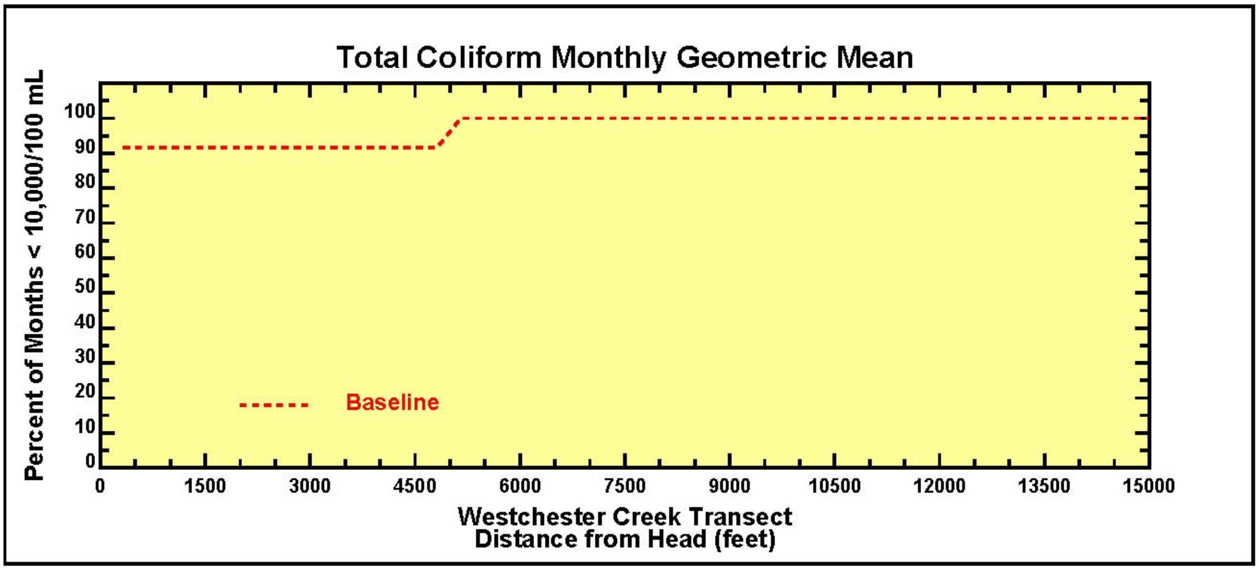
Environmental Protection

Fecal Coliform Concentrations
Percentage of Time Below Numerical Criterion
Baseline Conditions

FIGURE 4-17



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Total Coliform Concentrations Percentage of Time Below Numerical Criterion Baseline Conditions

FIGURE 4-18

4.6.1. Wetlands

The marshes at the head of Westchester Creek were completely filled by 1961 and the Bronx State Hospital was constructed in this area (DEP, 2003a). The DEC aerial photographs from 1974 documented the presence of intertidal and high marsh areas along both shores of Westchester Creek. Current information on wetlands along Westchester Creek is based on a review of United States Fish and Wildlife Service National Wetland Inventory (NWI) wetland maps and on the results of field investigations (Figure 4-19), and based on the classification scheme defined by Cowardin (1979). The distribution of wetlands is generally fragmented, and total area is less than 15 acres according to DEC. The small wetland area located at the head of Pugsley Creek is classified as estuarine, intertidal, emergent, persistent, irregularly flooded wetlands (E2EM1P). Emergent vegetation of estuaries is characterized by erect, rooted, herbaceous hydrophytes (excluding mosses and lichens) and is dominated by perennial plants. The larger wetland area in Pugsley Creek is classified as estuarine, intertidal, flat, regularly flooded wetlands (E2FLN). The wetland area along the western shore near the mid-reach of Westchester Creek is also classified as E2FLN. There are no New York State regulated freshwater wetlands in the watershed of Westchester Creek (i.e., freshwater wetlands greater than 12.4 contiguous acres).

4.6.2. Benthic Invertebrates

The benthic community consists of a wide variety of small aquatic invertebrates, such as worms and snails, which live burrowed into or in contact with bottom sediments. Benthic organisms cycle nutrients from the sediment and water column to higher trophic levels through feeding activities. Suspension feeders filter particles out of the water column, and deposit feeders consume particles on or in the sediment. The sediment is modified by the benthos through bioturbation and formation of fecal pellets (Wildish and Kristmanson, 1997). Grain size, chemistry, and physical properties of the sediment are the primary factors determining which organisms inhabit a given area of the substrate. Because benthic organisms are closely associated with the sediment and have limited mobility, the benthic community structure reflects local water and sediment quality.

Benthic inventories have been conducted in Westchester Creek as part of the Bronx River Field Sampling and Analysis Program (Hydroqual, 2002). In July 2000, benthic sampling was conducted at the mouth of Westchester Creek and at an upstream location. Subtidal benthic samples were collected using a Ponar® grab dredge. One sediment sample per station was taken for analysis of sediment grain size and TOC content.

The upstream sampling site was located halfway up the Creek where the Bruckner and Cross Bronx Expressways cross over the water. At this location, polychaete worms comprised the entire benthic community and were present in relatively high numbers (4,256/m^2). *Haploscoloplosus* sp. and *Scoloplos* sp. were the most abundant polychaetes. *Capitella capitata* and *Haploscoloplos robustus* polychaete worms were also present. All of these polychaete species are pollution tolerant organisms. They are important indicators of pollution because of their tolerance to organic enrichment (Gosner, 1978; Weiss, 1995).

The benthic community at the mouth of Westchester Creek was higher in diversity (13 taxa) but lower in abundance (768/m^2) than the benthic community living in the middle portion of Westchester Creek. Worms (polychaetes and oligochaetes) were the dominant organisms.

Haploscoloplos robustus, Streblospio benedicti, and an unidentified polychaete species were the dominant polychaetes, comprising 53 percent of the infaunal community by number. Clams, amphipods, and shrimp were also present but in low numbers.

Overall, the benthic community in Westchester Creek was low in abundance and diversity (Appendix B). Polychaetes and oligochaetes were the dominant organisms, comprising 98 percent of the individuals in the community. The abundance, diversity, and composition of benthic species, in combination with their relative pollution tolerance, are indicators of habitat quality. The low species diversity and high proportion of pollution tolerant organisms indicates degraded benthic habitat quality in Westchester Creek. Based on the greater number of taxa and the presence of clams, amphipods, and shrimp, the habitat quality at the mouth of the Creek appears to be better than in the middle reach. The increase in number of taxa at the mouth of the Creek reflects the relationship between diversity and percent TOC presented in Field Sampling and Analysis Program (Appendix B). It also reflects the change in the percent solids of the sediment, which increases from the head (20.2 percent) to the mouth (29.6 percent) in this water body. The percentage of solids in sediment infers the amount of water retained by the sediment, i.e., a higher percentage of solids retains less water.

4.6.3. Epibenthic Invertebrates

Epibenthos live on or move over the substrate surface. Epibenthic organisms include sessile suspension feeders (mussels and barnacles), free swimming crustaceans (amphipods, shrimp, and blue crabs) and tube-dwelling polychaete worms found around the base of attached organisms. Epibenthic organisms require hard substrate, they cannot attach to substrates composed of soft mud and fine sands (Dean and Bellis, 1975). In general, the main factors that limit the distribution of epibenthic communities are: the amount of available hard surface for settlement, species interactions, and water exchange rates. In Westchester Creek, pier piles and bulkheads provide the majority of underwater substrates that can support epibenthic communities. The epibenthic communities living on underwater structures impact the ecology of the nearshore zone. Suspension feeding organisms continuously filter large volumes of water, removing seston (particulate matter which is in suspension in the water) and releasing organic particles to the sediment. This flux of organic particles (from feeding and feces) enriches the benthic community living in the sediment below piers and bulkheads (Zappala, 2001).

The epibenthic community was studied in Westchester Creek by suspending multi-plate arrays of 8-inch x 8-inch synthetic plates in the water column. Epibenthic arrays were deployed in June 2000 in the upper portion and mouth of Westchester Creek. Plates were retrieved in October 2000 and January, April and June of 2001. Upon retrieval, the arrays were inspected and weighed and motile organisms clinging to or stuck in the arrays (i.e., crabs and fish) were counted and identified.

In Westchester Creek, 26 taxa were identified on the epibenthic arrays (Appendix B, Table 2). The major groups found were barnacles, tunicates, hydroids, annelids, and crabs. Some plates contained gastropods, sponges, and shrimp. Fish (tautog and gobies) were found feeding between the plates of the arrays.

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Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Westchester Creek Wetlands

FIGURE 4-19

In the middle portion of Westchester Creek, barnacles (*Balanus eburneus)* were the dominant organisms. However, the tunicate (*Molgula manhattensis*) was the dominant organism on the bottom array. As expected, epibenthic biomass increased as plate in-water time increased; the longer the plates were in the water the more organisms colonized the plates.

Near the mouth of Westchester Creek, *Balanus eburneus* were the dominant organisms on both top and bottom plates, followed by *Molgula manhattensis* and *Botryllus schlosseri*. The site near the mouth of the Creek was similar to the site near the middle of the Creek in that the number of species collected from the top and bottom arrays was similar (Appendix B, Table 2). At both sites, more species and greater weights of individual species were collected from the bottom array. The epibenthic community structure was slightly different near the mouth of Westchester Creek compared to the middle of the Creek. The mouth of the Creek had more hydroids and barnacles and an additional tunicate species. Individual species of bryozoans, nudibranchs and algae were present in the mouth of Westchester Creek, but were not present in the middle. However, the middle of the Creek had more mud crabs than the mouth, and mud snails, shrimp, and fish were present in the middle portion of the Creek but were not present near the mouth of the Creek.

Typically, epibenthic communities in the New York Harbor exhibit a vertical distribution on pier piles and bulkheads (Zappala, 2001). This vertical distribution coincides with changes in water level, salinity and DO associated with the tides and water stratification. The epibenthic community in Westchester Creek that developed on test plates did not exhibit a specific vertical distribution. However, the greater diversity of the epibenthic community on the bottom array suggests that the entire water column is being used as habitat for epibenthic organisms and that low DO levels do not limit epibenthic organism growth in the lower water column. Further evidence is provided by the presence of the mud crab *Dyspanopeus sayi* on bottom plates collected from both the middle and the mouth of the Creek. In laboratory studies, this species of mud crab has a low tolerance to hypoxia and the sensitivity of *D. sayi* to low DO was a main factor in USEPA's calculation of larval growth criteria (USEPA, 2000). In Westchester Creek, DO concentrations are likely less limiting to the development of epibenthic communities than the amount of available hard substrate for settlement, recruitment and species interactions (predation and competition).

4.6.4. Phytoplankton

Phytoplankton are the dominant primary producers in the East River. Factors that affect phytoplankton community structure include: temperature, light, nutrients, and grazing by other organisms. Phytoplankton are also affected by all hydrodynamic forces in a waterbody. Resident times of phytoplankton species within the New York Harbor are short and these organisms move quickly through the system, limiting the time they are available to grazers (NYSDOT and MTA, 2004).

There is little historical published data on the phytoplankton communities of Westchester Creek and sampling for these communities was not conducted as part of the Bronx River FSAP program (DEP, 2004). As part of the New York Harbor Water Quality Survey, DEP collected plankton samples at a station in the mouth of Westchester Creek (E13) in the spring, summer, and fall from 1991 to 1999. Eighty-seven samples were collected during this time period. In addition, the phytoplankton and zooplankton communities of the lower East River were investigated in the 1980s (Hazen and Sawyer, 1981). The East River is the source of plankton in Westchester Creek.

A total of 77 species of phytoplankton were collected in the mouth of Westchester Creek over the course of the DEP sampling (Appendix B, Table 3). Diatoms were the dominant class of phytoplankton, followed by dinoflagellates and green algae. The most frequently collected species were *Nannochloris atomus* (green algae), *Skeletonema costatum* (diatom), *Rhizosolenia delicatula* (diatom), *Thallassoionema nitzchoides* (diatom), and *Prorocentrum redfieldii* (dinoflagellate). Hazen and Sawyer (1981) found that the East River phytoplankton community was dominated by diatoms and *Skeletonema costatum* comprised 25 percent of the community in May, July, August, and September.

Three toxic species of phytoplankton were collected in Westchester Creek over the course of the DEP sampling. *Pseudo nitzchia pungens* (diatom) is associated with amnesic shellfish poisoning and was collected five times. *Prorocentrum micans* (dinoflagellate) is associated with diarrhetic shellfish poisoning and was also collected five times. *Dinophysis caudata* (dinoflagellate) is associated fish kills and with diarrhetic shellfish poisoning and was collected once.

4.6.5. Zooplankton

Like phytoplankton, there is little historical published data on zooplankton communities in Westchester Creek and sampling was not conducted as part of the USA FSAP program. A total of 16 species of zooplankton were collected in the mouth of Westchester Creek (Station E13) over the course of the Harbor Survey special study in 1991-1999 (Appendix B, Table 4), and Protozoans and copepods comprised the zooplankton community. *Tintinnopsis* sp. (Protozoa) and copepod nauplii were the most frequently collected forms.

The Hazen and Sawyer study in the 1980s identified 26 zooplankton species in the East River. The zooplankton community was composed of three different groups based on biological and life cycle characteristics: holoplankton (organisms planktonic throughout their life cycle); meroplankton (free swimming larvae of benthic organisms) and tychoplankton (benthic organisms swept into the water column) (Hazen and Sawyer, 1981). Holoplankton comprised about 70 percent of the abundance of the zooplankton community and was dominated by larval and adult forms of the copepods *Acartia clausi* and *A. tonsa* (Hazen and Sawyer, 1981). Barnacle larvae were dominant in the meroplankton. The tychoplankton was comprised of amphipods, isopods, and benthic protozoans.

The difference in the composition of the zooplankton measured by the two studies may be due to the fact that the DEP study was targeting phytoplankton and zooplankton collections were incidental, whereas the study conducted by Hazen and Sawyer (1981) specifically targeted the zooplankton community.

4.6.6. Ichthyoplankton

Because the issue of fish propagation is integral to defining use classifications and attainment of associated water quality standards and criteria, ichthyoplankton sampling was conducted to identify any fish species spawning in Westchester Creek or using its waters during the planktonic larval stage. Ichthyoplankton sampling was conducted in the upper reach of Westchester Creek in March, May, July, and August 2001. March and May were chosen based on spawning of a variety of important species, and July and August were chosen to observe activity during anticipated worst case DO conditions.

The ichthyoplankton community found in Westchester Creek varied seasonally. There was a shift from Labridae and Anchoa species in March, May and July to a community dominated by gobies in August. This shift in community structure follows species spawning activity (Appendix B, Table 5). Menhaden and anchovy larvae were present in Westchester Creek during July, when bottom DO concentrations tend to be their lowest. However, the larvae of these species were found in near-surface waters where DO concentrations tend to be higher than in bottom waters.

Overall, ichthyoplankton abundances were highest in March and May, when the majority of estuarine species are spawning. A total of 15 taxa were collected in Westchester Creek (Appendix B, Table 6). In March, the station in upper Westchester Creek ranked number two out of all the harborwide stations in concentration of fourbeard rockling eggs (548/100 m^2). This member of the cod family spawns in the winter and spring. Its eggs are pelagic and are typically found throughout the East River and its tributaries.

Ichthyoplankton are planktonic (organisms drift in the water column) and some questions remain as to whether fish are spawning in Westchester Creek or if fish are spawning in the East River with their eggs and larvae transported into the Creek by the tides. Because the duration of the egg stage is short (about two days after fertilization) compared to the larval stage (2-3 months depending on species) there is a relatively higher degree of confidence that an egg found in the upper Westchester Creek may have been spawned there. The majority of the eggs collected in upper Westchester Creek were of structure oriented species such as cunner, tautog and fourbeard rockling. The majority of structure in Westchester Creek is probably provided by pier pilings, rather than natural structure such as rock piles and complex shorelines.

4.6.7. Adult and Juvenile Fish

The fish community of Westchester Creek was sampled in August 2000, and in July and August of 2001, when bottom water DO concentrations are at their lowest. Sampling was conducted with an otter trawl to catch bottom oriented species and a gill net suspended in the water column to capture pelagic species.

A total of 7 taxa were collected from the Westchester Creek site (Appendix B, Table 7). In August 2000, when an otter trawl was used to sample the fish community, only three striped bass and one northern searobin were collected. In July and August 2001 both gill nets and otter trawls were used to sample the fish community. Striped bass and weakfish were the most abundant species collected in July, whereas Atlantic menhaden and bluefish dominated catches in August. Demersal fish species, winter and summer flounder, were present in low numbers during July but were not present in August.

4.6.8. Inter-waterbody Comparison

The aquatic communities of Westchester Creek were compared with those found in the Hutchinson and Bronx Rivers in order to further evaluate the potential of Westchester Creek to support fish propagation and survival, and to evaluate the interactions of the tributaries with the ecology of the Upper East River. The FSAP conducted in 2000 and 2001 included sampling stations located in the Bronx River, Westchester Creek, and the Hutchinson River. This study characterized the existing water quality and aquatic communities of these three tributaries of the Upper East River. The following sections briefly compare the results from these three tributaries.

The aquatic communities found in Westchester Creek are similar to those in the Bronx and Hutchinson Rivers in terms of the species composition of the invertebrate and fish communities. However, the differences in water quality, available substrate, and food resources have resulted in differences in abundance and diversity of the aquatic communities in these three tributaries of the East River. In addition, Westchester Creek is physically different than both the Hutchinson and Bronx Rivers, which also contributes to differences in aquatic community composition. Westchester Creek is a smaller waterbody with very limited natural freshwater inflows, and as such is more dominated by tidal exchange than the lower Bronx and Hutchinson Rivers. A larger portion of its shoreline is urbanized, resulting in fewer opportunities for wetland habitat to establish.

As part of the FSAP, the benthic community was sampled to determine the community composition, number of species (richness), and the relationship between the number of species and their relative abundance (diversity). Sediment sampling was also conducted in order to determine grain size distribution and percent TOC. Results of the FSAP showed that the benthic community in Westchester Creek was not statistically different from that of the Bronx River, but it was significantly lower in diversity and abundance than the Hutchinson River (Appendix B, Table 1) (Hydroqual, 2000; DEP, 2004). The mean number of individuals per station ranged from a low of 2,512/m^2 in Westchester Creek to more than 23,440/m^2 in the Hutchinson River. Overall the benthic community was dominated by polychaetes and pollution tolerant organisms in all three tributaries. The only exceptions were the two stations at the mouth of the Hutchinson River which had a large number of amphipods and the pollution sensitive fingernail clam, *Telina agilis*.

The recruitment and survival of epibenthic communities on hard substrates was evaluated because these assemblages reflect the average water quality conditions of an area over an extended period of time (Day et al., 1989). A total of 29 epibenthic taxa were identified on hard substrates in Westchester Creek, Bronx River, and Hutchinson River. Tunicates, hydrozoans, polychaetes and amphipods were the dominant organisms (Appendix B). The total weight of organisms on top plates exposed for three months in Westchester Creek was less than the Bronx River plates. However, the total weight of organism on bottom plates exposed for three months at Westchester Creek was greater than the Bronx River Plates. The epibenthic community in Westchester Creek was higher in abundance and more diverse than the epibenthic community in the Bronx River. The Bronx River community was dominated by barnacles and bryzoans. In Westchester Creek, barnacles and bryzoans were present, but these communities did not exclude crabs, tunicates, and a variety of polychaetes from settling. The Hutchinson River epibenthic community was also more diverse than the Bronx River with crabs, sponges, tunicates and algae dominating the community. The differences in the epibenthic community between the three tributaries may be due to differences in recruitment. Recruitment is affected by the presence of a spawning population, which is determined by availability of substrates, DO concentrations, temperature, and salinity (Dean and Bellis 1975). Differences in salinity between the three tributaries may be caused by differences in the amount of freshwater discharge. The Bronx River and Hutchinson River have non-tidal freshwater sources but Westchester Creek does not. Recruitment can also result from transport of planktonic life stages from other areas, and this may differ between the tributaries.

The Hutchinson River ichthyoplankton community was substantially more diverse and abundant than the Bronx River and Westchester Creek (Appendix B, Table 6). This could be due to the availability of several different habitat types not available in Westchester Creek and the Bronx River and its proximity to relatively good habitat conditions in Western Long Island Sound. The abundance and diversity of an ichthyoplankton community is dependent on several factors (per DEP, 2004):

- spawning season;
- type of eggs and larvae (demersal or pelagic); and
- adult life stage habitat requirements.

The spawning season of a fish species will determine if water quality is a limiting factor in the potential survivability of the eggs and larvae. For example, winter flounder spawn in the winter and larvae are present in the spring, when hypoxia is infrequent. Based on the DO levels in Westchester Creek winter flounder eggs and larvae would be able to survive there. However, winter flounder spawn on sandy substrates and the bottom substrates are dominated by fine grain sediments in Westchester Creek, as well as the Bronx and Hutchinson Rivers. Thus, winter flounder eggs and larvae were not collected in large numbers in these tributaries.

Bay anchovy spawn in the summer, when DO levels are at their lowest, but their eggs and larvae are found in surface waters. In May and July, bay anchovy eggs and larvae were present in all three tributaries, with the greatest abundances in the Hutchinson River. Anchovy larvae could be exposed to low DO conditions; their duration of exposure dependent upon the location of adult spawning and larval dispersal by tidal currents.

The development of the ichthyoplankton community is affected by the type of habitat present for juvenile and adult fish, the differences in habitat diversity, relative habitat quality and the type of bottom substrate. Based on the results of the FSAP, the eggs and larvae of structure oriented species such as cunner, tautog and fourbeard rockling dominated the ichthyoplankton community found in Westchester Creek. The majority of structure in Westchester Creek is probably provided by pier pilings, rather than natural structure such as rock piles and complex shorelines.

Fish are motile organisms that can choose which habitats they enter and utilize. As such, their presence or absence can be used to evaluate water quality. The lower Hutchinson River, with its more diverse and higher quality habitat, has the greatest fish diversity and abundance among the three tributaries. In addition, the Hutchinson River trawl samples caught more invertebrate taxa and greater numbers of organisms including starfish, sponges, clams, shrimp, and crabs than the other tributaries (DEP 2004). The Westchester Creek fish community was substantially lower in diversity and abundance than the other two tributaries (Appendix B, Table 7). Although cunner and fourbeard rockling were not collected in fish samples from Westchester Creek, their presence in substantial numbers in ichthyoplankton sampling suggests that they are present, and possibly spawning in the Creek, but were not susceptible to the gear used to sample juvenile and adult fish.

4.7. SENSITIVE AREAS

4.7.1. CSO Policy Requirements

Federal CSO Policy requires that the long-term CSO control plan give the highest priority to controlling overflows to sensitive areas. For such areas, the CSO Policy indicates the LTCP should: (a) prohibit new or significantly increased overflows; (b) eliminate or relocate overflows that discharge to sensitive areas if physically possible, economically achievable, and as protective as additional treatment, or provide a level of treatment for remaining overflows adequate to meet standards; and (c) provide reassessments in each permit term based on changes in technology, economics, or other circumstances for those locations not eliminated or relocated (USEPA, 1995a). The policy defines sensitive areas as:

- Waters designated as Outstanding National Resource Waters (ONRW);
- National Marine Sanctuaries;
- Public drinking water intakes;
- Waters designated as protected areas for public water supply intakes;
- Shellfish beds;
- Waters with threatened or endangered species and their habitat;
- Additional areas determined by the Permitting Authority (i.e., DEC).

The last item in the list was derived from the policy statement that the final determination should be the prerogative of the NPDES Permitting Authority. The Natural Resources Division of DEC was consulted during the development of the assessment approach, and provided additional sensitive areas for CSO abatement prioritization based on local environmental issues. Their response listed the following: Jamaica Bay; Bird Conservation Areas; Hudson River Park; ‘important tributaries’ such as the Bronx River in the Bronx, and Mill, Richmond, Old Place, and Main Creeks in Staten Island; the Raritan Bay shellfish harvest area and waterbodies targeted for regional watershed management plans (Newtown Creek and Gowanus Canal).

4.7.2. Assessment

An assessment was performed to identify any areas within Westchester Creek that may be candidates for consideration as sensitive areas. The assessment was limited to a review of relevant regulatory designations, publicly-available information accessed through Freedom of Information Act (FOIA) requests, and direct communication with the permitting authority. Table summarizes the sensitive area analysis.

Table 4-2. Sensitive Areas in Westchester Creek

Designation	Present
Outstanding National Resource Waters	No
National Marine Sanctuaries	No
Threatened or Endangered Species	No
Primary Contact Recreation	No
Public Water Supply Intake	No
Public Water Supply Protected Areas	No
Shellfish Bed	No
Areas determined by DEC	No

There are no sensitive areas in the Westchester Creek assessment area, based on the following information:

- There are no ONRW waters, National Marine Sanctuaries, or public water supplies in or near the waters of New York Harbor;
- There are no designated shellfishing areas within Westchester Creek or the upper East River;
- There are no bathing beaches in or near Westchester Creek. Bathing beaches are explicitly prohibited in by local law in the upper East River and its tributaries;
- There are no threatened or endangered marine animal species or their designated habitat in Westchester Creek according to responses to FOIA letter requests to the New York Natural Heritage Program, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service (USFWS); and
- None of the items specifically listed by DEC are within or adjacent to the Westchester Creek study area.

5.0. Waterbody Improvement Projects

New York City is served primarily by a combined sewer system. Approximately 70 percent of the City is comprised of combined sewers totaling 4,800 miles within the five boroughs. The sewer system drains some 200,000 acres and serves a population of approximately 8 million New Yorkers. Approximately 460 outfalls are permitted to discharge during wet-weather through CSOs to the receiving waters of the New York Harbor complex. These discharges result in localized water-quality problems such as periodically high levels of coliform bacteria, nuisance levels of floatables, depressed DO, and, in some cases, sediment mounds and unpleasant odors.

The City of New York is committed to its role as an environmental steward of the New York Harbor and began addressing the issue of CSO discharges in the 1950s. To date, DEP has spent or committed over $2.1 billion in its Citywide CSO abatement program. As a result of this and other ongoing programs, water quality has improved dramatically over the past 30 years (DEP Harbor Survey Annual Reports). Implementation of many of these solutions within the current DEP 10-year capital plan will continue that trend as DEP continues to address CSO-related water quality issues through its Citywide CSO Floatables program, pump station and collection system improvements, and the ongoing analysis and implementation of CSO abatement solutions. The following sections present the history of DEP CSO abatement and describe the current and ongoing programs in detail.

5.1. CSO PROGRAMS 1950 TO 1992

Early CSO assessment programs began in the 1950s and culminated with the Spring Creek Auxiliary WWTP, a 12-million gallon CSO retention facility constructed on a tributary to Jamaica Bay. Completed in 1972, this project was one of the first such facilities constructed in the United States. Shortly thereafter, New York City was designated by the USEPA to conduct an Area-Wide Wastewater Management Plan authorized by Section 208 of the then recently enacted CWA. This plan, completed in 1979, identified a number of urban tributary waterways in need of CSO abatement throughout the City. During the period from the mid-1970s through the mid-1980s New York City's resources were devoted to the construction of wastewater treatment plant upgrades.

In 1983, DEP re-invigorated its CSO facility-planning program in accordance with DEC-issued SPDES permits for its WWTPs with a project in Flushing Bay and Creek. In 1985, a Citywide CSO Assessment was undertaken which assessed the existing CSO problem and established the framework for additional facility planning. From this program, the City was divided into eight areas, which together cover the entire harbor area. Four area-wide projects were developed (East River, Jamaica Bay, Inner Harbor and Outer Harbor) and four tributary project areas were defined (Flushing Bay, Paerdegat Basin, Newtown Creek, and the Jamaica tributaries). Detailed CSO Facility Planning Projects were conducted in each of these areas in the 1980s and early 1990s and resulted in a series of detailed, area-specific plans.

In 1989, DEP initiated the Citywide Floatables Study in response to a series of medical waste and floating material wash-ups and resulting bathing beach closures in New York and New

Jersey in the late 1980s. This comprehensive investigation determined that medical wastes were a small component of the full spectrum of material found in metropolitan area waters and beach wash-ups, and that the likely source of the medical wastes was illegal dumping. The study also found that, aside from natural materials and wood from decaying piers and vessels, the primary component of the floatable material is street litter in surface runoff that is discharged to area waters via CSOs and storm sewers. The Floatables Control Program is discussed in Section 5.4.

5.2. CITYWIDE CSO ABATEMENT ORDERS (1992, 1996, 2005, 2008, 2009)

In 1992, DEC and DEP entered into the original CSO Administrative Consent Order (1992 ACO). As a goal, the 1992 ACO required DEP to develop and implement a CSO abatement program to effectively address the contravention of water quality standards for coliforms, DO, and floatables attributable to CSOs. The 1992 ACO contained compliance schedules for the planning, design and construction of the numerous CSO projects in the eight CSO planning areas. The 1992 ACO was modified in 1996 to add a program for catch basin cleaning, construction, and repair to further control floatables.

The Flushing Bay and Paerdegat Basin CSO Retention Tanks were included in the 1992 ACO. In addition, two parallel "tracks" were identified for CSO planning purposes. Track 1 addressed DO (aquatic life protection) and coliform bacteria (recreation) issues. Track 2 addressed floatables, settleable solids and other water-use impairment issues. The 1992 ACO also provided for an Interim Floatables Containment Program to be implemented consisting of a booming and skimming program in confined tributaries, skimming in the open waters of the harbor, and an inventory of street catch basins where floatable materials enter the sewer systems. Open waters are defined as the Inner and Outer Harbors as well as Jamaica Bay.

In accordance with the 1992 ACO, DEP continued to implement its work for CSO abatement through the facility-planning phase into the preliminary engineering phase. Work proceeded on the planning and design of eight CSO retention tanks located on confined and highly urbanized tributaries throughout the City. The number of planned retention tank facilities was reduced from eight to six during the CSO facility planning phase. The Interim Floatables Containment Program was fully developed and implemented. The Corona Avenue Vortex Facility (CAVF) pilot project for floatables and settleable solids control was designed and implemented. The City's 141,000 catch basins were inventoried and a re-hooding program for floatables containment was implemented and substantially completed. Reconstruction and re-hooding of the remaining basins were completed in 2009.

For CSOs discharging to the open waters of the Inner and Outer Harbors areas, efforts were directed to the design of sewer system improvements and wastewater treatment plant modifications to increase the capture of combined sewage for processing at the plants. For the Jamaica Tributaries, efforts focused on correction of illegal connections to the sewer system and evaluation of sewer separation as control alternatives. For Coney Island Creek, attention was directed to corrections of illegal connections and other sewer system/pumping station improvements. These efforts and the combination of the preliminary engineering design phase work at six retention tank sites resulted in amendments to some of the original CSO Facility Plans included in the 1992 ACO and the development of additional CSO Facility Plans in 1999.

DEP and DEC negotiated a new Consent Order that was signed January 14, 2005 that supersedes the 1992 Order and its 1996 Modifications with the intent to bring all DEP CSO-related matters into compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The new Order, noticed by DEC in September 2004, contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for Citywide long-term CSO control in accordance with USEPA CSO Control Policy. DEP and DEC also entered into a separate Memorandum of Understanding to facilitate water quality standards reviews in accordance with the CSO Control Policy. The 2005 Consent Order was modified in 2008 and 2009. Table 5-1 presents the design and construction milestone dates for capital projects in the most current CSO Consent Order.

Table 5-1. CSO Consent Order Milestone Dates for Capital Projects

Planning Area	Project	Design Completion	Construction Completion
Alley Creek	Outfall & Sewer System Improvements	Mar 2002	Dec 2006
	CSO Retention Facility	Dec 2005	Dec 2009[1]
Outer Harbor	Regulator Improvements – Fixed Orifices	Apr 2005	Jul 2008
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	Port Richmond Throttling Facility	Aug 2005	Nov 2009 as modified
	In-Line Storage (Deleted per 2008 CSO Consent Order)	Nov 2006	Deleted
Inner Harbor	Regulator Improvements – Fixed Orifices	Sep 2002	Apr 2006
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	In-Line Storage	Nov 2006	Aug 2010
	Gowanus Flushing Tunnel Modernization	-	Sep 2014
	Gowanus Pumping Station Reconstruction	-	Sep 2014
	Dredging Gowanus Canal	Dec 2010	See Note 2
Paerdegat Basin	Influent Channel	Mar 1997	Feb 2002
	Foundations and Substructures	Aug 2001	Dec 2009
	Structures and Equipment	Nov 2004	May 2011
	Dredging Paerdegat Basin	See Note 2	See Note 3
Flushing Bay/Creek	CS4-1 Reroute & Construct Effluent Channel	Sep 1994	Jun 1996
	CS4-2 Relocate Ball fields	Sep 1994	Aug 1995
	CS4-3 Storage Tank	Sep 1996	Aug 2001
	CS4-4 Mechanical Structures	Feb 2000	Sep 2009
	CS4-5 Tide Gates	Nov 1999	Apr 2002
	CD-8 Manual Sluice Gates	May 2003	Jun 2005
	Tallman Island WWTP 2xDDWF	Dec 2010	Jul 2015
Jamaica Tributaries	Meadowmere & Warnerville DWO Abatement	May 2005	Jul 2009 as modified
	Expansion of Jamaica WWTP Wet Weather Capacity	Jun 2011	Jun 2015
	Destratification Facility	Dec 2007	Mar 2012
	Laurelton & Springfield Stormwater Buildout Drainage Plan	May 2008	-
	Regulator Automation	Nov 2006	Jun 2010
Coney Island Creek	Avenue V Pumping Station Upgrade	Jan 2005	Apr 2011
	Avenue V Force Main	Sep 2006	Jun 2012
Newtown	Aeration Zone I	Dec 2004	Dec 2008

Table 5-1. CSO Consent Order Milestone Dates for Capital Projects

Planning Area	Project	Design Completion	Construction Completion
Creek	Aeration Zone II	Jun 2010	Jun 2014
	Relief Sewer/Regulator Modification	Jun 2009	Jun 2014
	Throttling Facility	Jun 2008	Dec 2012
	CSO Storage Facility	Nov 2014	Dec 2022
Westchester Creek	Phase 1 (Influent Sewers)	Jun 2010	Jun 2015
	CSO Storage Facility	-	Dec 2022
Bronx River	Floatables Control	Jul 2008	Jun 2012
Hutchinson River	Phase I of Storage Facility	Jun 2010	Jun 2015
	Future Phases	-	Dec 2023
Jamaica Bay	Spring Creek AWWTP Upgrade	Feb 2002	Apr 2007
	26th Ward Drainage Area Sewer Cleaning & Evaluation	Jun 2007	Jun 2010
	Hendrix Creek Dredging	Jun 2007	Feb 2012
	26th Ward Wet Weather Expansion	Jun 2010	Dec 2015
	Rockaway WWTP 2xDDWF	-	Dec 2017

Notes: 1) A modification to the completion date from 12/31/2009 to 11/10/2010 was submitted to DEC on 10/30/2009 and a revised modification request was submitted for an extension to 2/28/2011
2) Dredging must be completed with 5 years of final permit issuance.
3) Design Completion = Permit + 18 months; Construction Completion = Permit + 60 months.

5.3. BEST MANAGEMENT PRACTICES

The SPDES permits for all 14 WWTPs in New York City require the DEP to report annually on the progress of 14 BMPs related to CSOs. The BMPs are equivalent to the Nine Minimum Controls (NMCs) required under the USEPA National Combined Sewer Overflow policy, which were developed by USEPA to represent best management practices that would serve as technology based CSO controls. They were intended to be "determined on a best professional judgment basis by the NPDES permitting authority" and to be the best available technology based controls that could be implemented within 2-years by permittees. USEPA developed two guidance manuals that embodied the underlying intent of the NMCs (USEPA 1995b, 1995c) for permit writers and municipalities, offering suggested language for SPDES permits and programmatic controls that may accomplish the goals of the NMCs.

A list of BMPs excerpted directly from the most recent SPDES permits follows, along with brief summaries of each BMP and their respective relationships to the federal NMCs. In general, the BMPs address operation and maintenance procedures, maximum use of existing systems and facilities, and related planning efforts to maximize capture of CSO and reduce contaminants in the combined sewer system, thereby reducing water quality impacts. Through the CSO BMP Annual Reports, which were initiated in 2004 for the reporting year 2003, DEP provides brief descriptions of the Citywide programs and any notable WWTP drainage area specific projects that address each BMP.

5.3.1. CSO Maintenance and Inspection Program

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). Through regularly scheduled inspection of the CSOs and the performance of required repair, cleaning, and maintenance, dry weather overflows and leakage can be prevented and maximization of flow to the WWTP can be ensured. Specific components of this BMP include:

- Inspection and maintenance of CSO tide gates;
- Telemetering of regulators;
- Reporting of regulator telemetry results;
- Recording and reporting of rain events that cause dry weather overflows; and
- DEC review of inspection program reports.

DEP reports on the status of the Citywide program components and highlights specific maintenance projects, such as the Enhanced Beach Protection Program, where additional inspections of infrastructure in proximity to sensitive beach areas were performed.

5.3.2. Maximum Use of Collection System for Storage

This BMP addresses NMC 2 (Maximum Use of the Collection System for Storage) and requires the performance of cleaning and flushing to remove and prevent solids deposition within the collection system as well as an evaluation of hydraulic capacity so that regulators and weirs can be adjusted to maximize the use of system capacity for CSO storage and thereby reduce the amount of overflow. DEP provides general information describing the status of Citywide SCADA, regulators, tide gates, interceptors, and collection system cleaning in the BMP Annual Report.

5.3.3. Maximize Flow to WWTP

This BMP addresses NMC 4 (Maximizing Flow to the Publicly Owned Treatment Works) and reiterates the WWTP operating targets established by the SPDES permits with regard to the ability of the WWTP to receive and treat minimum flows during wet weather. The collection systems are required to deliver and the WWTPs are required to accept the following flows for the associated levels of treatment:

- Receipt of flow through the headworks of the WWTP: 2xDDWF;
- Primary treatment capacity: 2xDDWF; and
- Secondary treatment capacity: 1.5xDDWF.

The BMP also refers to the establishment of collection system control points in the system's Wet Weather Operating Plan as required in BMP #4, and requires the creation of a capital compliance schedule within six months of the DEC approval of the Wet Weather Operating Plan should any physical limitations in flow delivery be detected.

In addition to describing WWTP upgrades and efforts underway to ensure appropriate flows to all 14 WWTPs, the CSO BMP Annual Report provides analysis of the largest 10 storms of the year and WWTP flow results for each of these storms at least during the peak portions of the events.

According to the CY2009 Annual BMP Report, the Hunts Point WWTP operated at 2xDDWF capacity or greater for 25 hours during storm events in 2009. Additionally, the WWTP processed 66 hours at flows 90 percent of 2xDDWF or greater. A summary of the plant's performance during the top ten storm events is summarized in Table 5-2 below.

Table 5-2. Hunts Point WWTP 2009 Summary of Wet-Weather Capacity and Treated Flows (MGD)

		Top-Ten Storm Maximum			Top-Ten Storm Average		
Plant	Permitted Capacity(1)	Reported Capacity(2)	Sustained Flow(3)	Peak Flow(4)	Reported Capacity(5)	Sustained Flow(6)	Peak Flow(7)
Hunts Point	400	400	410	417	400	388	405

(1) **Permitted Capacity** represents the design wet-weather capacity of the WWTP, except as noted. The design wet-weather capacity is typically equal to two times design dry-weather flow (2xDDWF). The design capacity is applicable when all process units are in service. Construction and repair activities can temporarily reduce capacity.

(2) **Maximum Reported Capacity** represents the single largest WWTP capacity reported by the WWTP for any of the top ten storms. Capacities reported by the WWTP are based on the process units in service during each storm and area in accordance with each WWTP's approved wet-weather operating plan. Process units may be taken out of service during construction for upgrades mandated by Consent Orders or for other reasons such as emergency repairs. If all process units are in service during a storm, the reported capacity equals the design capacity.

(3) **Maximum Sustained Flow** is the largest wet-weather "sustained flow" that occurred during any of the top ten storms. Sustained flows represent the average hourly WWTP flow during WWTP throttling periods or for events with no throttling, the average hourly flow over at least 3 hours including the peak wet-weather flow.

(4) **Maximum Peak Flow** represents the highest hourly flow observed during the top ten storms.

(5) **Average Reported Capacity** represents the average of the capacities reported by the WWTP for all top ten storms. Capacities reported by the WWTP are based on the process units in service during each storm and are in accordance with each WWTP's approved wet-weather operating plan. Process units may be taken out of service during construct for upgrades mandated by Consent Orders or for other reason such as emergency repairs. If all process units are in service during a storm, the reported capacity equals the design capacity.

(6) **Average Sustained Flow** represents the average of the largest, multi-hour flows that occurred during each of the top ten storm periods. Sustained flows represent the average hourly WWTP flow during WWTP-throttling periods or, for events with no throttling, the average hourly flow over at least 3 hours including the peak wet-weather flow.

(7) **Average Peak Flow** represents the average of the highest hourly flows observed during each of the top ten storms.

5.3.4. Wet Weather Operating Plan

In order to maximize treatment during wet weather events, WWOPs are required for each WWTP drainage area. Each WWOP should be written in accordance with the DEC publication entitled *Wet Weather Operations and Wet Weather Operating Plan Development for Wastewater Treatment Plants*, and should contains the following components:

- Unit process operating procedures;

- CSO retention/treatment facility operating procedures, if relevant for that drainage area; and,
- Process control procedures and set points to maintain the stability and efficiency of biological nutrient removal (BNR) processes, if required.

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 4 (Maximizing Flow to the Publicly Owned Treatment Works). The DEP provides a schedule of plan submittal dates as part of the BMP Annual Report. A revised Hunts Point WWTP WWOP was submitted to DEC in April 2010, and its approval is pending.

5.3.5. Prohibition of Dry Weather Overflow

This BMP addresses NMC 5 (Elimination of CSOs During Dry Weather) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls) and requires that any dry weather flow event be promptly abated and reported to DEC within 24 hours. A written report must follow within 14 days and contain information per SPDES permit requirements. The status of the shoreline survey, the Dry Weather Discharge Investigation report, and a summary of the total bypasses from the treatment and collection system are provided in the CSO BMP Annual Report.

5.3.6. Industrial Pretreatment

This BMP addresses three NMCs: No. 3 (Review and Modification of Pretreatment Requirements to Determine Whether Nondomestic Sources are Contributing to CSO Impacts); No. 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs); and No. 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). By regulating the discharges of toxic pollutants from unregulated, relocated, or new SIUs tributary to CSOs, this BMP addresses the maximization of persistent toxics treatment from industrial sources upstream of CSOs. Specific components of this BMP include:

- Consideration of CSOs in the calculation of local limits for indirect discharges of toxic pollutants;
- Scheduled discharge during conditions of non-CSO, if appropriate for batch discharges of industrial wastewater;
- Analysis of system capacity to maximize delivery of industrial wastewater to the WWTP, especially for continuous discharges;
- Exclusion of non-contact cooling water from the combined sewer system and permitting of direct discharges of cooling water; and
- Prioritization of industrial waste containing toxic pollutants for capture and treatment by the POTW over residential/commercial service areas.

The CSO BMP Annual Report addresses the components of the industrial pretreatment BMP through a description of the Citywide program.

5.3.7. Control of Floatable and Settleable Solids

This BMP addresses NMC 6 (Control of Solid and Floatable Material in CSOs), NMC 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs), and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls) by requiring the implementation of four practices to eliminate or minimize the discharge of floating solids, oil and grease, or solids of sewage origin which cause deposition in receiving waters, i.e.:

- Catch Basin Repair and Maintenance: This practice includes inspection and maintenance schedules to ensure proper operation of basins;
- Catch Basin Retrofitting: By upgrading basins with obsolete designs to contemporary designs with appropriate street litter capture capability, this program is intended to increase the control of floatable and settleable solids, Citywide;
- Booming, Skimming and Netting: This practice establishes the implementation of floatables containment systems within the receiving waterbody associated with applicable CSO outfalls. Requirements for system inspection, service, and maintenance are established, as well; and
- Institutional, Regulatory, and Public Education - A one-time report must be submitted examining the institutional, regulatory, and public education programs in place Citywide to reduce the generation of floatable litter. The report must also include recommendations for alternative City programs and an implementation schedule that will reduce the water quality impacts of street and toilet litter.

The annual report provides summary information regarding the status of the catch basin and booming, skimming, and netting programs Citywide. Several catch basin cleaning and hooding activities took place in the Westchester Creek service area in 2009. As described in the 2010 CSO BMP Annual Report, in the entire borough of the Bronx 7,280 catch basins were cleaned in 2009. Hoods were replaced in 88 of the catch basins within the Hunts Point service area in 2009. Of the 55 catch basins that required reconstruction or retrofitting in the Hunts Point collection system in 2009, the curb was closed at 47 and hoods were hung at eight.

As part of its floatables plan, DEP maintains one floatables containment facility in Westchester Creek, a boom at the head the Creek to capture floatables from HP-014. Table 5-3 summarizes the quantity of floatables retrieved from the Westchester Creek in CY 2009, as reported in the 2010 CSO BMP Annual Report.

Table 5-3. Floatable Material Collected in Westchester Creek (2009)

Month of Year	Westchester Creek (cy)
January	0
February	0
March	0
April	1.25
May	0
June	0
July	1.25
August	0
September	0
October	0
November	0
December	0
2009 Total	**2.5**

5.3.8. Combined Sewer System Replacement

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls), requiring all combined sewer replacements to be approved by the New York State Department of Health (NYSDOH) and to be specified within the DEP Master Plan for Sewage and Drainage. Whenever possible, separate sanitary and storm sewers should be used to replace combined sewers. The CSO BMP Annual Report describes the general, Citywide plan and addresses specific projects occurring in the reporting year. As reported in the 2010 CSO BMP Annual Report, currently there are no planned combined sewer system replacement projects located within the Westchester Creek drainage area.

5.3.9. Combined Sewer/Extension

In order to minimize storm water entering the combined sewer system, this BMP requires combined sewer extensions to be accomplished using separate sewers whenever possible. If separate sewers must be extended from combined sewers, analysis must occur to ensure that the sewage system and treatment plant are able to convey and treat the increased dry weather flows with minimal impact on receiving water quality.

This CSO BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and a brief status report is provided in each BMP Annual Report, including specific projects occurring in the reporting year. No combined sewer extension projects were completed in calendar year 2009.

5.3.10. Sewer Connection & Extension Prohibitions

This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and prohibits sewer connections and extensions that would exacerbate recurrent instances of either sewer back-up or manhole overflows. Wastewater connections to the combined sewer system downstream of the last regulator or diversion chamber are also prohibited. The CSO BMP Annual Report contains a brief status report for this BMP and provides details pertaining to chronic sewer back-up and manhole overflow notifications submitted to DEC when necessary.

For the calendar year 2009, no letter of notification was received from DEC concerning chronic sewer backups or manhole overflows which would prohibit additional sewer connections or sewer extensions.

5.3.11. Septage and Hauled Waste

The discharge or release of septage or hauled waste upstream of a CSO (i.e., scavenger waste) is prohibited under this BMP. Scavenger wastes may only be discharged at designated manholes that never drain into a CSO, and only with a valid permit. This BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls). The CSO BMP Annual Report summarizes the three scavenger waste acceptance facilities controlled by DEP, all of which are downstream of CSO regulators, and the regulations governing discharge of such material at the facilities.

5.3.12. Control of Run-off

This BMP addresses NMC 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs) by requiring all sewer certifications for new development to follow DEP rules and regulations, to be consistent with the DEP Master Plan for Sewers and Drainage, and to be permitted by DEP. This BMP ensures that only allowable flow is discharged into the combined or storm sewer system.

The CSO BMP Annual Report refers to the DEP permit regulations required of new development and sewer connections.

5.3.13. Public Notification

This BMP requires easy-to-read identification signage to be placed at or near CSO outfalls with contact information for DEP to allow the public to report observed dry weather overflows. All signage information and appearance must comply with the Discharge Notification Requirements listed in the SPDES permit. This BMP also requires that a system be in place to determine the nature and duration of an overflow event, and that potential users of the receiving waters are notified of any resulting, potentially harmful conditions. The BMP does allow New York City Department of Health and Mental Hygiene (NYCDHMH) to implement and manage the notification program.

BMP # 13 addresses NMC 8 (Public Notification) as well as NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and NMC 9 (Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls). DEP provides the status of the CSO signage program in the BMP Annual Report and lists those former CSO outfalls that no longer require signs. DEP is currently developing improvements to the CSO signs to increase their visibility and to include information relative to wet-weather warnings as required by the EPA CSO Policy. In addition, descriptions of new educational signage and public education-related partnerships are described. The NYCDHMH CSO public notification program is also summarized.

5.3.14. Annual Report

This BMP requires an annual report summarizing implementation of the BMPs, including lists of all existing documentation of implementation of the BMPs, be submitted by April 1st of each year. This BMP addresses all nine minimum controls. As of November 2010, the most recent BMP Annual Report submitted was for calendar year 2009.

5.4. CITYWIDE CSO PLAN FOR FLOATABLES ABATEMENT

In the late 1980s, New York City initiated the Citywide Floatables Study, a multi-year investigation of floatables in New York Harbor (HydroQual, 1993, 1995a, 1995b). In addition to examining floatables characteristics, this study investigated potential sources of floatables, floatables circulation and beach-deposition patterns throughout the Harbor, and potential structural and non-structural alternatives for floatables control. Findings of the study showed that the primary source of floatables (other than natural sources) in the Harbor was urban street litter carried into waterways along with rainfall runoff.

DEP developed a floatables abatement plan (Floatables Plan) for the CSO areas of New York City in June 1997 (HydroQual, 1997). The Floatables Plan was updated in 2005 to reflect the completion of some proposed action elements and the addition of a monitoring program, as well as changes appurtenant to SPDES permits and modifications of regional WB/WS Facility Plans and CSO Facility Plans. The DEC approved the updated Floatables Plan on March 17, 2006. The objectives of the Floatables Plan are to provide substantial control of floatables discharges from CSOs throughout the City and to provide for compliance with appropriate DEC and IEC requirements pertaining to floatables.

5.4.1. Program Description

The Citywide CSO Floatables Plan consists of the following action elements:

- Monitor Citywide street litter levels and inform the New York City Department of Sanitation of New York (DSNY) and/or the New York City Mayor’s Office of Operations when changes in litter levels at or in City policies would potentially result in increased discharges of CSO floatables;
- Continue the three-year cycle to inspect catch basins Citywide for missing hoods and to replace missing hoods to prevent floatables from entering the sewer system. In addition, proceed with the retrofit, repair, or reconstruction of catch basins requiring extensive repairs or reconstruction to accommodate a hood;
- Maximize collection system storage and capacity;
- Maximize wet-weather flow capture at WWTPs;
- Capture floatables at wet-weather CSO storage/treatment facilities;

- Capture floatables at end-of-pipe and in-water facilities, including the Interim Floatables Containment Program (IFCP);
- Continue the Illegal Dumping Notification Program (IDNP) in which DEP field personnel report any observed evidence of illegal shoreline dumping to the Sanitation Police section of DSNY, who have the authority to arrest dumpers who, if convicted, are responsible for proper disposal of the material;
- Engage in public outreach programs to increase public awareness of the consequences of littering and the importance of conserving water;
- As new floatables-control technologies emerge, continue to investigate their applicability, performance and cost-effectiveness in New York City.
- Provide support to DEC to review and revise water quality standards to provide for achievable goals; and
- Develop a floatables-monitoring program to track floatables levels in the Harbor and inform decisions to address both short- and long-term floatables-control requirements.

Overall, implementation of the Floatables Plan is expected to control approximately 96 percent of the floatable litter generated in New York City (HydroQual, 1997). The Floatables Plan is a living program that will undergo various changes over time in response to ongoing assessment of the program itself as well as changing facility plans associated with other ongoing programs. A key component of the Floatables Plan is self-assessment, including a new Floatables-Monitoring Program to evaluate the effectiveness of Plan elements and to provide for actions to address both short- and long-term floatables-control requirements (see Section 8.2.5). Evidence of increasing floatables levels that impede uses could require the addition of new floatables controls, expansion of BMPs, and modifications of WB/WS Facility Plans and/or drainage-basin specific LTCPs, as appropriate.

5.4.2. Interim Floatables Control Program Contaminant Boom

As part of the Interim Floatables Containment Program (IFCP), a boom was placed at the head end of Westchester Creek to retain floatables from outfall HP-014. The boom is regularly serviced by a subcontractor to the DEP who removes floatable debris with a skimmer boat. The skimmer boat collected a volume of about 2.5 yd^3 of floatables in 2009. The material collected from the boom is off-loaded at the Bowery Bay WPCP for disposal.

5.4.3. Shoreline Cleanup Program

As part of the Environmental Benefits Projects (EBP) program established under the Long Island Sound (LIS) Consent Judgment, DEP has implemented a beach clean-up program to clean up shorelines in areas where floatables are known to occur due to CSO overflows and stormwater discharges as well as careless behavior and illegal dumping. This project was undertaken in connection with the settlement of an enforcement action taken by New York State and the DEC for violations of New York State law and DEC regulations. DEP has conducted cleanups at several areas deemed to benefit from these efforts including:

- Coney Island Creek, Brooklyn
- Kaiser Park, Brooklyn

- Sheepshead Bay (Kingsborough Community College) Brooklyn
- Cryders Lane (Little Bay Park), Queens
- Flushing Bay, Queens
- Owls Head, Brooklyn

These cleanup efforts will include the following methods:

- Workboat assisted cleanup – Mechanical Cleanup: Where debris is caught up in riprap on the shoreline, a high-pressure pump will be used to spray water onto the shoreline to dislodge and flush debris and floatables from the riprap back into the water. A containment boom placed in the water around the site will allow a skimmer vessel to collect the material for proper disposal.
- Workboat-Assisted Cleanup: At a few locations where the shoreline is not readily accessible from the land side, a small work boat with an operator and crewmembers collects debris by hand or with nets and other tools. The debris will be placed onto the work boat for transport to a skimmer boat for ultimate disposal.
- Manual Cleanup: At some locations, simply raking and hand cleaning will provide the most efficient clean up method. Debris will then be removed and placed into plastic garbage bags, containers, or dumpsters and then loaded onto a pickup truck for proper disposal.

On average, DEP will generally be performing three cleanups per site each year for a four-year period at each of the above locations. Pending the outcome of this program, as well as the findings of the floatables monitoring program, an evaluation will be made of how DEP will proceed in the future.

5.5. LONG-TERM CSO CONTROL PLANNING

In June 2004, DEP authorized the LTCP Project. This work integrates all Track I and Track II CSO Facility Planning Projects and the Comprehensive Citywide Floatables Abatement Plan, incorporates on-going USA Project work in the remaining waterbodies, and developing WB/WS Facility Plan reports and the LTCP for each waterbody area. The LTCP Project monitors and assures compliance with applicable Administrative Consent Orders. This document is a work product of the LTCP Project.

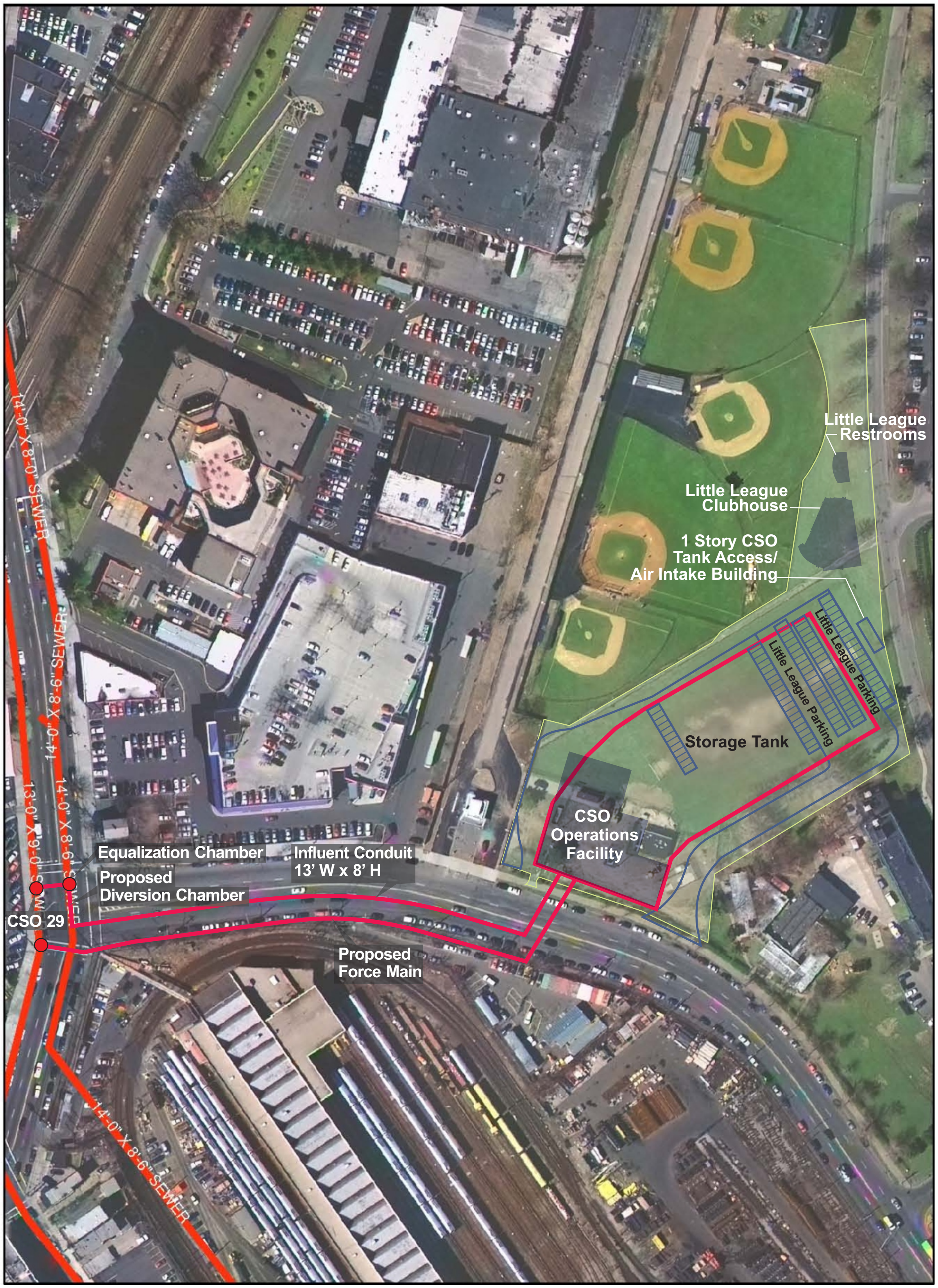
5.6. EAST RIVER CSO FACILITY PLAN

The East River CSO Facility Planning Project was focused on quantifying and assessing the impacts of CSO discharges to the Upper East River and those tributaries not delineated as their own planning areas. The tributaries included under this planning project were the Hutchinson River, Westchester Creek, and the Bronx River, and included the Bowery Bay, Hunts Point, Tallman Island, and Wards Island WWTP service areas. Field investigations and mathematical modeling were conducted for receiving waters and their watersheds. Engineering alternatives for abating CSO discharges were evaluated, and recommendations were made for improving receiving water quality. These assessments concluded that CSOs were not a major component of water quality impairments in the open waters because of favorable flushing and dispersion dynamics in the Upper East River. However, Westchester and Pugsley Creeks, like many of the other tributaries and embayments throughout the New York Harbor Complex, suffer from the synergistic effects of poor mixing abilities and disproportionately large CSO discharges, resulting in water quality conditions detrimentally influenced by CSOs. As a consequence, the Plan recommended retention facilities at several critical outfalls to reduce the total volume of CSO.

The East River CSO Facility Plan first evaluated CSO abatement alternatives, including numerous source load reduction, storage, treatment, and waterbody improvement strategies. The most viable CSO technology was determined to be retention, in which CSO is captured and stored until the flow to the WWTP drops following rainfall events, allowing the retained CSO to be pumped back to the WWTP for treatment. Hunts Point WWTP was determined to have adequate capacity to treat the storage volumes estimated without exceeding the average dry weather design flow. Underground storage tanks, underground silos and deep tunnels were all considered viable retention technologies, but the underground storage tank alternative was determined to be the most cost-effective on a net present value basis, and was therefore recommended for each of the five critical CSO outfalls identified in the original analysis, which included HP-014 at the head of Westchester Creek.

The initial recommendations for Westchester Creek were made in 1991, and have not been substantially modified since that time. Westchester Creek receives discharges from five outfalls, including outfall HP-014, which was found to be a significant component of water quality degradation in Westchester Creek in addition to being one of the five major CSO discharges targeted for abatement. A 12 MG flow-through tank was recommended based on a "knee-of-the-curve" analysis comparing tank size to incremental improvement in compliance with the DO standards based on receiving water modeling. The flow-through design originally recommended was replaced with a dead-end configuration after a hydraulic analysis indicated that the flow-through system would not be feasible. This modification eliminated the sedimentation and floatables treatment that a flow-through tank can provide to CSO discharges (once a dead-end tank is full, excess CSO discharges to the receiving water without passing through the tank). Despite this reduction in treatment, modeling results predicted that the modification would result in almost no change to projected DO and coliform concentrations anticipated for the original flow-through design. The current configuration for the 12 MG tank is shown in Figure 5-1.

The DEC approved the conceptual plan for a 12 MG underground storage facility for CSO abatement of outfall HP-014 in a March 15, 2002 letter to DEP. The CSO storage tank is to be located in the southwest section of the Bronx Psychiatric Center Campus adjacent to Waters Place, near the intersection of Eastchester Road (Figure 5-1). Although currently not on the DEP 10-year capital plan, the construction and operation of the proposed tank has received a declaration of "No Negative Environmental Impacts" from the Office of Environmental Protection and Assessment (OEPA), and site acquisition has passed through the ULURP process administered by the Department of City Planning. DEP has made numerous concessions in response to public comment, including the construction of a 1,500 square foot restroom facility and a 7,500 square foot clubhouse and storage facility for nearby Little League baseball organizations that will be temporarily displaced during construction.



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Environmental Protection

2003 CSO Facility Plan
Proposed CSO Retention Facility

FIGURE 5-1

The 12 MG retention facility for abating outfall HP-014 is the only element of the East River CSO Facility Plan that will directly impact Westchester Creek. The facility is expected to reduce CSO discharges by improving wet weather CSO capture, leading to significant improvements to water quality conditions in Westchester Creek, including an increase in the percentage of time compliance with the DEC water quality criteria will be achieved. Based on modeling projections for a representative average period in the summer of 1990, the compliance with the DEC DO criteria would be achieved 62.6 percent of the time versus 7.5 percent of the time without CSO retention. Further, the "knee-of-the-curve" analysis showed that the incremental improvement resulting from increasing the tank size from 12 MG to 52 MG (full CSO abatement) would result in less than a 0.1 mg/L improvement in average DO (from 4.04 mg/L to 4.09 mg/L). Finally, the water quality with respect to coliform bacteria was determined to be below the DEC total coliform criteria (10,000 colonies per 100 mL) in the baseline scenario, so no CSO storage was necessary to attain full compliance with the total coliform criterion.

The water quality conditions in Westchester Creek were not expected to fully meet the numerical and narrative water quality standards of its Class I designation following implementation of the East River CSO Facility Plan. The waterbody failed to meet water quality standards by consistently exhibiting low levels of DO, and was projected to continue to contravene these standards periodically following implementation of the plan. However, even full CSO abatement modeling projections indicated that compliance with DO standards could not be achieved consistently, a shortcoming attributed to low DO in the East River and to sediment oxygen demand. During these evaluations, it was noted that the ongoing DEP Harbor Survey and other data strongly suggest an increasing trend in DO concentrations in the Upper East River, and that current conditions would be more favorable for compliance than they were in 1988 and 1989, the period simulated by the water quality and sewer models, and the period when the data used to set the East River boundary DO was collected.

DEP recognizes that the analysis that led to selecting and sizing this CSO abatement technology was not wholly consistent with the evaluations expected by the federal CSO policy, due in large part to the fact that the effort pre-dated the issuance of the policy by several years. Further, the opportunity exists to reevaluate CSO abatement alternatives that might provide greater water quality benefit to Westchester Creek without incurring substantial additional costs because the design of the 12 MG facility is in its earliest phases. Therefore, implementation of the recommended East River CSO Facilities Plan will be treated as an alternative subject to the evaluation methodologies outlined in Section 7.0 rather than a predetermined component of the Westchester Creek Waterbody/Watershed Facility Plan, and will be referred to as "the 2003 CSO Facility Plan."

5.7. HUNTS POINT WET WEATHER CAPACITY IMPROVEMENTS

As required by their SPDES operating permits, DEP facilities are designed and operated to receive a maximum flow of 2DDWF, with 1.5 DDWF receiving secondary treatment and any remaining flow receiving primary treatment and disinfection. The Hunts Point WWTP design wet weather capacity (2DDWF) is 400 MGD; however, the WWTP had limitations at the headworks that precluded flows from reaching these levels on a consistent and sustained basis. Through 2003, the Hunts Point WWTP was generally only able to treat sustained wet weather flows up to 259 MGD. DEP redesigned the WWTP headworks as part of CSO reduction activities and as required by the Omnibus IV Consent Order. To ensure treatment of 2DDWF, a new forebay gate chamber was constructed to improve throttling of wet weather flows to the plant, and upgrades were made to the headworks and main sewage pump station. The cost of the upgrades associated with improved wet weather capacity was $26 million.

As a result of these upgrades, Hunts Point sustained wet weather capacity has already improved substantially: in 2006, the average sustained wet weather capacity during the ten largest storms was 366 MGD, and sustained 2DDWF (400 MGD) was fully achieved during 4 of the 10 events. Because DEP has largely completed these improvements, each of the alternatives evaluated in Section 7.0 include maximizing WWTP treatment as part of its cost and expected performance for comparison. However, the total cost of the selected plan does not include the WWTP upgrade, which will be included in the East River and Open Waters WB/WS Facility Plan Report issued under separate cover. The Baseline condition assumes that the WWTP has a wet weather capacity equal to its sustained wet weather capacity as reported in Table 3-2 in the 2003 BMP Annual Report, the most recent year prior to the current CSO Consent Order, allowing the expected wet weather performance to be quantified in terms of CSO reduction. The 2003 sustained wet weather capacity for the Hunts Point WWTP was 259 MGD.

5.8. NYC GREEN INFRASTRUCTURE PLAN

On September 28, 2010, Mayor Bloomberg and DEP Commissioner Cas Holloway unveiled the *NYC Green Infrastructure Plan* which presents a “green strategy” for CSO drainage areas that includes cost-effective grey infrastructure strategies, reduced flows to the WWTP, and 10 percent capture of impervious surfaces with green infrastructure. The green infrastructure component of the plan builds upon and reinforces strong support for green approaches to address water quality concerns. A key goal of the *NYC Green Infrastructure Plan* is to manage the first inch of runoff from 10 percent of the impervious surfaces in combined sewer watersheds through detention and infiltration source controls over the next 20 years.

The *NYC Green Infrastructure Plan* builds upon and extends the commitments made previously in Mayor Bloomberg’s PlaNYC to create a livable and sustainable New York City and, specific to water quality, open up 90 percent of the City’s waterways for recreation. PlaNYC included initiatives to promote green infrastructure implementation, including the formation of an Interagency Best Management Practices (BMP) Task Force, development of pilot projects for promising strategies, and providing incentives for green roofs toward these goals.

The Sustainable Stormwater Management Plan (SSMP) released in December 2008 was developed as a result of the Interagency BMP Task Force’s efforts to identify promising BMPs for New York City. The SSMP provided a framework for testing, assessing, and implementing pilot installations to control stormwater at its source as well as strategies to promote innovative and cost-effective source controls and secure funding for future implementation. A key conclusion of the SSMP was that green infrastructure is feasible in some areas and could be more cost-effective than certain large infrastructure projects such as CSO storage tunnels.

Based on the evaluations completed for the development of the *NYC Green Infrastructure Plan*, preventing one inch of precipitation from becoming runoff that surges into the sewers over 10 percent of each combined sewer watershed's impervious area will reduce CSOs by approximately 1.5 billion gallons per year. Green infrastructure technologies currently in use and being piloted throughout the City include green roofs, blue roofs, enhanced tree pits, bioinfiltration, vegetated swales, pocket wetlands, and porous and permeable pavements. The monitoring data collected from the pilots will improve our understanding of performance, costs and maintenance requirements under New York City's environmental conditions, and our modeling methods and assumptions will continue to be refined based on this information. Table 5-4 summarizes the opportunities available to achieve the 10 percent goal Citywide.

Table 5-4. Citywide Green Infrastructure Opportunities, Strategies, and Technologies

Land Use	% of Citywide Combined Sewer Watershed Areas	Potential Strategies and Technologies
New development and redevelopment	5.0%	- Stormwater performance standard for new and expanded development - Rooftop detention; green roofs; subsurface detention and infiltration
Streets and sidewalks	26.6%	- Integrate stormwater management into capital program in partnership with DOT, DDC, and DPR - Enlist Business Improvement Districts and other community partners - Create performance standard for sidewalk reconstruction - Swales; street trees; Greenstreets; permeable pavement
Multi-family residential complexes	3.4%	- Integrate stormwater management into capital program in partnership with NYCHA and HPD - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels or cisterns; rain gardens; swales; street trees; Greenstreets; permeable pavement
Parking lots	0.5%	- Sewer charge for stormwater - DCP zoning amendments - Continue demonstration projects in partnership with MTA and DOT - Swales; permeable pavement; engineered wetlands
Parks	11.6%	- Partner with DPR to integrate green infrastructure into capital program - Continue demonstration projects in partnership with DPR - Swales; permeable pavement; engineered wetlands
Schools	1.9%	- Integrate stormwater management into capital program in partnership with DOE - Rooftop detention; green roofs; subsurface detention and infiltration
Vacant lots	1.9%	- Grant programs - Potential sewer charge for stormwater - Rain gardens; green gardens
Other public properties	1.1%	- Integrate stormwater management into capital programs - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels; permeable pavement

Table 5-4. Citywide Green Infrastructure Opportunities, Strategies, and Technologies

Land Use	% of Citywide Combined Sewer Watershed Areas	Potential Strategies and Technologies
Other existing development	48.0%	- Green roof tax credit - Sewer charges for stormwater - Continue demonstration projects and data collection - Rooftop detention; green roofs; subsurface detention and infiltration; rain barrels or cisterns; rain gardens; swales; street trees; Greenstreets; permeable pavement

To begin implementation, the City has already created a Green Infrastructure Task Force to design and build stormwater controls into planned roadway reconstructions and other publicly funded projects. In addition, the City recognizes that partnerships with numerous community and civic groups and other stakeholders will be necessary to build and maintain green infrastructure throughout the City. DEP will provide resources and technical support so that communities can propose, build, and maintain green infrastructure projects.

Over the next year, the City will take on a number of other concrete steps to begin early implementation of the *NYC Green Infrastructure Plan* such as demonstrating green infrastructure installations on a variety of land uses (see Table 5-5); launching a comprehensive program to increase optimization of the existing system; piloting sewer charges for stormwater for stand-alone parking lots; refining DEP models by including new impervious cover data and extending predictions to ambient water quality; identifying alternative funding for additional elements of the plan; and replacing all CSO outfall signs to reduce potential exposure.

Table 5-5. DEP Retrofit Demonstration Projects

Green Infrastructure Pilot	Location	Type	Status	Construction Completion
Rain Barrel give-away program	Jamaica Bay	1,000 rain barrels	Completed	2008-2009
5 tree pits/5 swales*	Jamaica Bay	Tree pits and streetside swales in the right-of-way	Completed	Fall 2010
MTA constructed wetland/parking lot*	Jamaica Bay	Biofiltration	In Construction	Spring 2011
Blue roof/green roof comparison*	Jamaica Bay	Blue/green roofs	Completed	August 2010
DEP rooftop detention	Newtown Creek	Various blue roof technologies	Design	Fall 2010
High Density residential retrofit	Bronx River	Variety of on-site BMPs at a New York City Housing Authority development	In Construction	Spring 2011
DOT parking lots*	Jamaica Bay	Detention/bioinfiltration/porous pavement	Design	Spring 2011

Table 5-5. DEP Retrofit Demonstration Projects

Green Infrastructure Pilot	Location	Type	Status	Construction Completion
North/South Conduit	Jamaica Bay	Detention/bioinfiltration in roadway median	In construction	Spring 2011
Shoelace Park	Bronx River	Detention/bioinfiltration	Redesign underway	Spring 2011

* This project was undertaken in connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State Law and DEC Regulations.

5.9. DEP ENVIRONMENTAL BENEFIT PROJECTS

In connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State law and DEC regulations, DEP submitted a Nitrogen Consent Judgment Environmental Benefit Project (EBP) Plan to DEC in January 2007 that proposed a stormwater pilot study in the Jamaica Bay drainage area. This project will use Nitrogen Consent Judgment EBP funds to conduct a three year pilot study program to implement and monitor several stormwater treatment technologies and volume reduction stormwater BMPs for potential application within the Jamaica Bay watershed. The goals of Jamaica Bay Watershed Stormwater Pilot Project include documenting the quality of New York City stormwater and refining the specific capture rates and treatment efficiencies that may be expected locally. Once this information has been gathered, effective stormwater strategies would be developed for potential future applications.

The project is expected to cost approximately $1.75 million and will include infiltration swales for street-side and parking lot applications, parking lot curb water capture systems, enhanced tree pits, and a commercial green roof and a blue roof comparison installation (see Table 5-5). The EBP is being conducted through an innovative collaborative effort between DEP and the Gaia Institute. DEP entered into a contract with the Gaia Institute to complete the pilot study. The Gaia Institute is a 501(c)3 not-for-profit corporation, located on City Island in the Bronx, that explores how human activities can be attenuated to increase ecological productivity, biodiversity, environmental quality, and economic well being.

In connection with the settlement of an enforcement action taken by New York State and DEC for violations of New York State law and DEC regulations, DEP also submitted a CSO EBP Work Plan in March 2008 (approved by the DEC in April 2008) that is expected to partially mitigate the impacts of stormwater and CSO discharges in the New York Harbor Estuary through stormwater BMP implementation. Practices such as bio-infiltration swales, enlarged street tree pits with underground water storage, constructed wetlands, and others would be evaluated. The CSO EBP Work Plan proposes pilots in the Bronx River, Flushing Bay and Creek, and Gowanus Canal watersheds using the $4 million which has been placed in an EBP Fund.

6.0. Public Participation and Agency Interaction

Establishing early communication with both the general public, regulatory agencies, and other stakeholders is important to the successful development of the long-term CSO control planning approach (USEPA, 1995a), and is one of the nine elements of a long-term control plan enumerated in federal CSO policy. Permittees are expected to meet early and frequently with water quality standards authorities, permitting authorities, and USEPA regional offices throughout the process to facilitate such coordinated efforts as water quality standards review and scoping data, modeling, and monitoring requirements to support the long-term control plan. DEP has a well-established commitment to stakeholder involvement in the planning and development of capital projects through the formation and support of advisory committees, information sharing at public meetings, and providing opportunity for comment regarding any capital improvement. The following sections describe the public participation and agency interaction programs integral to the continued development of the Westchester Creek LTCP.

6.1. HARBOR-WIDE STEERING COMMITTEE

DEP convened a Harbor-Wide Government Steering Committee to ensure overall program coordination and integration of management planning and implementation activities by holding quarterly meetings, exploring regulatory issues, prioritizing planning and goals, developing strategies, reviewing and approving assessment-related work plans and coordinating actions. A Steering Committee was comprised of city, state, interstate, and federal stakeholders representing regulatory, planning, and public concerns in the New York Harbor watershed. The Citizens Advisory Committee on Water Quality (CAC), which reviews and comments on DEP water quality improvement programs, is represented on the Steering Committee and separately monitors and comments on the progress of CSO projects, among other DEP activities.

Federal government members of the Harbor-Wide Government Steering Committee included representatives of the USEPA, USACE and the National Park Service. USEPA Region 2 was represented by its Deputy Director and its Water Quality Standards Coordinator. The USACE was represented by its Chief of the Technical Support Section, Planning Division, New York District. The National Park Service member was a representative of its Division of Natural Resources at the Gateway National Recreational Area.

The State of New York was represented by the central and regional offices of the DEC. The Central Office of DEC in Albany was represented by its Associate Director of the Division of Water, the Director of the Bureau of Water Assessment and Management Branch of the Division of Water, and the Director of the Bureau of Water Compliance in the Division of Water. The Region II office of the DEC was represented by the Regional Engineer for the Region II Water Division.

Several departments of the City of New York were represented on the Harbor-Wide Government Steering Committee. The Deputy Commissioner of the Bureau of Engineering Design and Construction and its Director of Planning and Capital Budget represented the DEP. The Department of City Planning was directed by its Director of Waterfront/Open Space. The New York City Department of Parks and Recreation was represented by the Chief of its Natural Resources Group.

Public interests were represented on the Steering Committee by the General Counsel of Environmental Defense at the New York headquarters and the Real Estate Board of New York. These two members also co-chaired the Citizens Advisory Committee on Water Quality.

Interstate interests were represented by the Executive Director and Chief Engineer of IEC. The IEC is a joint agency of the states of New York, New Jersey, and Connecticut. The IEC was established in 1936 under a Compact between New York and New Jersey and approved by Congress. The State of Connecticut joined the IEC in 1941. The mandates of the IEC are governed by the Tri State Compact, Statutes, and the IEC's Water Quality Regulations. Its responsibilities and programs include activities in areas such as air pollution, resource recovery facilities and toxics; however, the IEC's continuing emphasis is on water quality, an area in which the IEC is a regulatory and enforcement agency. The IEC's area of jurisdiction runs west from Port Jefferson and New Haven on Long Island Sound, from Bear Mountain on the Hudson River down to Sandy Hook, New Jersey (including Upper and Lower New York Bays, Newark Bay, Arthur Kill and Kill Van Kull), the Atlantic Ocean out to Fire Island Inlet on the southern shore of Long Island, and the waters abutting all five boroughs of New York City.

The Steering Committee was responsible for reviewing the methodology and findings of DEP water quality-related projects, and to offer recommendations for improvement. The Steering Committee reviewed and approved the waterbody work plan developed by the USA Project (HydroQual, 2001e), and was fully briefed on the on-going assessments and analyses for each waterbody. Among the recommendations provided by the Steering Committee was the investigation of cost-effective engineering alternatives that improve water quality conditions to remove harbor waters from the State of New York 303(d) List, to pursue ecosystem restoration actions with USACE, and to coordinate use attainment evaluations with the DEC. Representatives of the DEC reported that its agency was awaiting the results of the DEP waterbody/watershed assessment before completing the 303(d) evaluations.

6.2. EAST RIVER CSO FACILITY PLANNING PROJECT PUBLIC PARTICIPATION PROGRAM

From April 1988 to February 1996, the East River CSO Facility Planning Project was conducted by DEP as a water quality planning project. The East River CSO Facility Planning Project (a.k.a., the 2003 CSO Facility Plan) included a full-scale public participation program that was coordinated by DEP. This program, which was structured in accordance with the USEPA's public participation guidelines, was designed to provide a solid foundation for informed citizen input to agency decision-making. Specifically, it encouraged ongoing dialogue between DEP and interested, affected citizens by providing them with up-to-date project information; encouraging open and ongoing communication; and facilitating timely receipt of informed public input to be used by DEP. Through a combination of informational and interactional activities, the project team attempted to involve the public to the maximum extent possible in all aspects of planning for facilities to improve water quality in the study area. Specific activities included the formation of and regular meetings with a CAC, formal public meeting and hearings, meeting with Community Boards, informal small group meetings, and dissemination of technical reports and executive and responsiveness summaries through local repositories and direct mailings.

6.2.1. Interactional Activities

An ongoing program of community interaction was implemented as the principal means of fostering substantive public involvement. The program included formal public meetings and hearings at milestones in project development, smaller, less structured meetings to provide opportunities for informal dialogue, and continuing liaison with the CAC, state and local agencies, community organizations, and interested individuals. This active approach enabled DEP and the project team to keep the public informed through the facilities planning effort, encourage discussion of controversial and community specific issues, guide input and recommendations to decision makers, and monitor community attitudes and concerns throughout the facilities planning process.

Citizens Advisory Committee

The CAC was established at the onset of the project and functioned as a significant source of project review and discussion throughout facilities planning. The CAC, which included representatives of Community Boards, public officials, civic, environmental, and public interest groups, business organizations, and individuals, served the dual function of generating and channeling vital input to DEP and the project team and providing outreach and information to interested constituencies.

The CAC focused on overall project goals and objective, immediate and long-range issues relating to the water quality study, specifically the effect of dry weather overflows, CSOs, and Long Island Sound discharges on the East River system, and issues related to the City's WWTPs, including flows, capacities, etc. The CAC also discussed current water quality standards and potential changes to state classifications for local water bodies. As the facilities planning effort progressed, emphasis was placed on the investigation of alternative CSO abatement techniques, specifically issues related to the use of underground CSO storage tanks (site selection, evaluation criteria, possible on-site amenities, odor control, short-and long-range impacts, etc.). Other areas of concern related to the removal of floatables and the impact of CSO abatement measures on WWTPs in the affect drainage areas.

In an attempt to address water quality concerns from a broader perspective, members of the East River CSO CAC also participated in a number of meetings with CACs of other water quality projects to discuss the interrelationship between the area-wide CSO projects and related issues of mutual interests. These issues included WWTP flows and plant design capacities, floatables and nutrient removal, types and levels of metals, oils, and chemicals in wastewater, water quality standards, and sampling and modeling procedures.

Public Meetings and Hearings

The East River CSO Facility Planning Project included a series of public meetings and hearings to keep the public informed of the project and to integrate public comments and recommendations into the planning process. The meetings presented background, scope, and objectives of the East River CSO Facility Planning Project, introduced the planned technical studies, procedures, and public participations activities, presented findings from water quality studies, identified CSO outfalls requiring abatement, presented the alternative CSO abatement technologies under consideration and how they would address water quality concerns, and the use and possible locations of storage facilities. The question and comments sessions at the meetings highlighted concerns about:

- Operating capacities on WWTPs and impact of future developments on plants
- Process for granting permits that allow sewer hook-ups
- Methods of conserving water and limiting inflow and infiltration
- Existing wastewater treatment standards and pollutants found in sewer discharges
- Level of CSO discharge during wet weather events
- Notification of swimmers regarding water quality
- Effectiveness of regulators and tide gates
- Presence of floatables in Long Island Sound
- Effect of local industries on water quality in Westchester Creek
- Ratio of rainwater to sanitary sewage in CSO discharges
- Status of regulator maintenance program
- Project schedule, funding, and costs
- Public education regarding water use and conservation

DEP's recommended facilities (underground CSO storage tanks) were presented at the public hearing along with explanations, preliminary results, and advantages and disadvantages associated with each proposed storage facility location. A discussion was held of the facilities planning process, a review of the technical, community, and environmental criteria and presentation of the project schedule. Public comments following the hearing included concerns about:

- Evaluation criteria for the selection of proposed sites for underground storage tanks and the procedure for determination of above-ground amenities for the community
- Storage tank operation, cost, capacity, and effectiveness
- The need for long-term groundwater monitoring at the storage facilities after construction is completed
- The use of wetlands and other biologically-based solutions for the treatment of CSOs
- The need for an evaluation of DEP's overall CSO abatement program rather than individual projects

Meetings and Presentations

During the course of the project, meetings and presentations were held with the staffs of the Bronx Borough President as well as members of affected Bronx Community Boards to discuss potential locations for siting the proposed underground CSO storage facilities. Each meeting included a brief project overview, a review of the criteria used to evaluate CSO abatement alternatives, discussion of the sites under consideration, a description of the construction impacts, and operation and maintenance of the proposed storage facilities. Comments received from these meetings and presentations were related to:

- Environmental and community impacts associated with construction and operation of storage tanks

- Development and maintenance of amenities on site following construction of the facilities
- Staffing, maintenance, and security of the facilities
- Effectiveness of odor control systems
- Methodology utilized in developing water quality models
- Cost and funding sources
- Schedule

6.2.2. Informational Activities

An essential element of the public participation program was the development of written and graphic materials to present project information for the public in a clear and comprehensive manner. Materials were designed to facilitate public understanding of the need for the project, review the range of alternatives under consideration and present potential community and environmental impacts. The principle means of disseminating information to the community was through the distribution of executive summaries and responsiveness summaries, which detailed issues and concerns raised at public meetings and hearings. Other materials developed as part of the project included a draft Public Participation Work Plan, meeting/hearing handouts, press releases, and display ads. All informational materials were available for public review at repositories established and maintained as part of the public participation program.

6.3. WESTCHESTER CREEK WATER QUALITY FACILITY PLAN

6.3.1. Site Selection and Property Acquisition

The proposed Westchester Creek CSO Storage Facility Project would be located in the Morris Park section of the Borough of the Bronx, New York City on the southwest corner of the Bronx Psychiatric Center (BPC) campus. The BPC is under the jurisdiction of the Dormitory Authority of the State of New York (DASNY). Negotiations for purchase of the selected site from the DASNY are currently underway, but are on hold until the finalization of the Uniform Land Use Review Procedure Application.

The decision for the location of the site for the Westchester Creek CSO Storage Facility took into account minimizing the impact on the Bronxchester and Van Nest Little League ballfields. Ultimately, the southwest corner of the BPC campus, where a soccer field used by the Italian American Soccer League of New York is located, was chosen as the site for the underground CSO storage tank and related facilities. This decision avoided encroachment on the Little League ballfields.

6.3.2. Public Participation in Site Selection

From 1997 to present, numerous meetings were held between Senator Guy J. Velella, the Bronxchester and Van Nest Little Leagues, BPC, Bronx Community Board No. 11, the Italian American Soccer League of New York, DEP-Bureau of Environmental Engineering (BEE), and the project's engineering consultant, URS, in an effort to obtain feedback and negotiate selection of the site for the Westchester Creek CSO Storage Facility. Several steps were taken in order to ensure that all parties would be amenable to the desired CSO storage facility site and were comfortable with the eventual construction.

In order to ensure that DEP coordinated with and met the needs of other agencies and parties that may have been interested in using the land marked for the CSO storage tank site on the BPC campus, the DEP confirmed, at the request of Senator Guy J. Velella, with the Empire State Development Corporation that the storage tank will not interfere with any development plans that the Corporation may have for the proposed tank site.

Also, it was decided that amenities for the Bronxchester and Van Nest Little Leagues would be provided as part of the Westchester Creek CSO Storage Facility Project. These amenities include the following:

- Women's and Men's restrooms
- Clubhouse with indoor practice area, restrooms, and office and storage areas for the two Little Leagues
- Concession stand attached to the clubhouse
- Paved parking area on top of the storage tank
- Fencing to enclose the Little League area so as to keep the ballfields and parking area separated from the BPC facilities

After the selection of the soccer field as the site for the proposed Westchester Creek CSO Storage Tank, the need for an alternative site for a soccer field, once construction is initiated for the storage tank, was addressed. The DEP agreed to provide a replacement soccer field for the Soccer League as compensation for the loss of the existing soccer field. However, subsequent negotiations resulted in the elimination of the replacement soccer field which would result in the permanent displacement of the existing soccer field, both during and after construction.

6.3.3. Uniform Land Use Review Procedure

A draft ULURP Application was submitted by URS to DEP-BEE in May 2002 for review. It included that, upon completion of the site acquisition and construction of the restroom and clubhouse/ storage facilities, the DEP would enter into a revocable license agreement, without fee, with the Bronxchester and Van Nest Little Leagues as licensees for their joint use, occupation, and maintenance of part of the site. The license agreement would contain certain terms and conditions including the licensees' obligation to maintain the facilities, provide adequate insurance, and indemnify the City for any and all losses and liabilities arising out of the Little Leagues' use and occupancy of the site. The Bronxchester and Van Nest Little Leagues have agreed to be jointly responsible for any and all costs with respect to the use and operation of the restroom and clubhouse/storage facilities including costs of operation, maintenance, repair, security, and all water, sewer and electric utilities.

The ULURP Application also included the construction of the parking lot and playground facilities on top of the CSO storage tank, intended for use by the Bronxchester and Van Nest Little Leagues. At the time of completion of construction of the parking lot and playground facilities, the revocable license agreement would likely be amended by the DEP to provide for the use of the parking lot and playground facilities by the Bronxchester and Van Nest Little Leagues in addition to the use and operation of the restroom and clubhouse/storage facilities.

As part of the ULURP, a fence would be constructed separating the Little League playing fields, restroom facilities, clubhouse/storage facilities, playground, and parking lot from the DEP facilities.

The ULURP Application was certified as complete by the NYCDCP in May, 2004 and then submitted to the Bronx Community Board No. 11 to initiate the approval process. The Bronx Community Board No. 11 approved the ULURP Application in June, 2004 and subsequently forwarded the Application to the Bronx Borough President's Office for review and approval. The ULURP Application was finally approved September 22, 2004.

6.3.4. Environmental Review Procedures

A draft Negative Declaration was submitted February 21, 2003, indicating that the construction of the Westchester Creek CSO storage facility would not have a significant effect on the environment.

An Environmental Assessment Statement was included in the Negative Declaration which incorporated measures to be taken to prevent fugitive dust from excavation and construction activities from becoming airborne as well as to prevent exposure to any contaminated fill on the proposed construction site. A Health and Safety Plan is to be drafted and submitted prior to the start of soil disturbance to reduce worker exposure to any contaminants. The Environmental Assessment determined that the Westchester Creek CSO storage facility project would result in water quality improvements in Westchester Creek and would have no adverse effects on the environment which would require the preparation of an Environmental Impact Statement.

6.3.5. Facility Construction

Facility construction has been delayed by site acquisition issues. The construction schedule for the CSO storage tank included in the 2005 CSO Consent Order between the DEP and DEC indicates that the construction will be undertaken in two phases, with the second phase extending from December 2015 through December 2022, during which the public amenities would be constructed. The Little League restroom facilities were to be constructed under the Site Preparation Contract in advance of the Phase I contract, but these facilities have not been constructed as of June 2007. As noted in Section 5, DEP is considering the recommended East River CSO Facilities Plan as an alternative rather than a predetermined component of the Westchester Creek Waterbody/Watershed Facility Plan. Therefore, the public amenity commitments made under the East River CSO Facilities Plan may be modified based on anticipated community impacts from the selected alternative that is ultimately implemented.

6.4. PUBLIC OPINION SURVEY

The DEP conducted a telephone survey in order to assess and measure the use of waterbodies in New York City, and obtain feedback from New York City residents about their attitudes towards the water resources in their community and elsewhere. Surveys addressed Citywide issues as well as those for local waterbodies. Primary and secondary waterbody survey results (dependent on residential location within watersheds) were analyzed discretely and summarized to provide additional insight into the public's waterbody uses and goals in addition to those identified via other public participation programs run by DEP.

Survey interviews were conducted using Computer Assisted Telephone Interviews (CATI) among residents of the five New York City boroughs that were 18 years or older. Residents were asked about specific waterways depending on their zip code. A total of 7,424 interviews with New York City residents were conducted during these telephone surveys and a total of 8,031 primary waterway responses were recorded. Questionnaire development involved a pre-test prior to the full field application of the survey to ensure that the survey covered all relevant issues and it was presented in a way that would be clear to all respondents. The pre-test was conducted via a series of five focus groups representing residents of each of the five New York City boroughs. Final presentation of results involved editing, cleaning, and weighting collected data. The weights were applied to the data to correct for unequal probability of household selection due to households with more than one telephone number, and different numbers of individuals available to be interviewed at different households. Post-stratification weighting was also applied for each waterbody to balance the sample data to 2000 U.S. Census population data that takes into account household composition, age, gender, and race/ethnicity. The survey data then was projected to actual population counts from the 2000 U.S. Census so that areas could easily be combined to yield an appropriate weighted sample for all five boroughs of New York City.

The telephone survey included 7,424 interviews with New York City residents, and a minimum of 300 interviews for each of the 26 watersheds within the scope of the USA Project. The survey was analyzed to quantify the extent of existing uses of the waterbody and riparian areas, and to record interest in future uses. Elements of the survey focused on awareness of the waterbody, uses of the waterbody and riparian areas, recreational activities involving these areas and how enjoyable these activities were, reasons why residents do not partake in recreational activities in or around the waterbody, overall perceptions of New York City waterbodies; and what improvements have been recognized or are desired.

6.4.1. Waterbody Awareness

Approximately 43 percent of Westchester Creek area residents that participated in the survey were aware of the Creek but only two percent could identify Westchester Creek as their primary waterbody without any prompting or aid in their response. Only one percent of all area residents who participated in the survey recognized Westchester Creek as the waterway closest to their home. Most of the City residents identified the Long Island Sound, Orchard Beach, or the Hudson River as the waterways closest to their home.

6.4.2. Water and Riparian Uses

Approximately 16 percent of Westchester Creek area residents that participated in the survey visit waterbodies in their community or elsewhere in New York City on a regular basis and 37 percent occasionally visit waterbodies. The remaining percentage visit waterbodies rarely or never. This is less frequent than New York City residents in general, 60 percent of whom visit city waterbodies either regularly or occasionally. Only seven percent of area residents have visited Westchester Creek at some point, and three percent have done so in the prior 12 months. Among those area residents who are aware of Westchester Creek but have never visited the Creek, the majority (59 percent) responded that there was no particular reason, seven percent cited waterbody conditions, and nine percent cited riparian conditions.

Only one percent of area residents have participated in water activities at Westchester Creek. In comparison, five percent of New York City residents have participated in water activities in Spring Creek. Also, only one percent of area residents have participated in land activities at Westchester Creek. In comparison, 15 percent of New York City residents have participated in land activities at Spring Creek. Due to the small base sizes, no data was collected for Westchester Creek regarding the most frequent activities participated in, how enjoyable activities are, what makes activities enjoyable or not enjoyable, or why residents never participate in activities.

6.4.3. Improvements Noted

The number of area resident respondents to the telephone survey that mentioned noticing an overall improvement to the New York City waterways was 48 percent, however less than 0.5 percent of Westchester Creek area residents responded that they have noticed improvements specifically in the Creek. Thirty-one percent of New York City residents have not noticed water quality improvements in any city waters.

Given the option of choosing one waterway for improvement, only three percent of Westchester Creek residents chose their primary waterway for improvement, which is substantially below the median of 15 percent of Citywide respondents who would like the primary waterway in their assessment area to be the one improved. Thirty-four percent of Westchester Creek area residents, who were aware of the Creek as their primary waterbody, cited water quality appearance or odor as the most important aspect of the Creek to be improved. Another 11 percent cited improvements to cleanliness, sanitation, or maintenance as desirable, compared to a Citywide median of 12 percent.

When asked how much they would be willing to pay, 43 percent of residents who felt primary waterbody improvements were extremely important responded that they would be willing to pay a range of $10 to $25 a year for that improvement, but 31 percent responded that they would not be willing to pay for the desired improvement at all. In general, 39 percent of the New York City residents with similar attitudes towards improvements to their primary waterbody responded that they would be willing to pay for those improvements, and 22 percent responded that they would not be willing to pay for anything. Of area residents that specifically felt water quality improvements were extremely important, 40 percent responded that they would be willing to pay a range of $10 to $25 a year for that improvement, but 41 percent responded that they would not be willing to pay for the improvement. For New York City residents desiring water quality improvements in their primary waterway, 41 percent responded that they would be willing to pay for those improvements, and 22 percent responded that they would not be willing to pay for anything.

6.5. ADMINISTRATIVE CONSENT ORDER

The 2005 CSO Consent Order was published for public comments on September 8, 2004, as part of the overall responsiveness effort on behalf of the DEC. The public comment period, originally limited to 30 days, was extended twice to November 15, 2004, to allow for additional commentary. Comments were received from public agencies, elected officials, private and non-profit organizations, and private individuals. In total, the DEC received in excess of 600 official comments via letter, facsimile, or email during the comment period. All comments received were carefully reviewed and evaluated, then categorized by thematic elements deemed similar in nature by DEC. Each set of similar comments received a specific, focused response. Many of the comments received, although differing in detail, contained thematic elements similar in nature regarding DEC and DEP efforts toward CSO abatement, water quality issues, standards, and regulatory requirements.

None of the comments received changed the terms of the Order, but the volume of commentary was interpreted by the DEC to indicate that "NYC citizenry places CSO abatement as a high ongoing priority" (DEC, 2005). The terms of the Order offer numerous opportunities for public participation and input for future CSO abatement measures and regulatory decisions, such as the requirement to comply with federal CSO policy with regard to public participation during LTCP development.

6.6. SPDES PERMITTING AUTHORITY

The Westchester Creek WB/WS Facility Plan will be incorporated into the Hunts Point WWTP SPDES Permits. Any action by DEP that results in changes to their SPDES permits will be available for public comments when these permits are publicly noticed.

6.7. WB/WS FACILITY PLAN STAKEHOLDER MEETINGS

A Local Stakeholder Team was convened under the LTCP Project comprised of representatives of Bronx Community Boards 9 and 10, local community organizations, involved citizens, and waterbody users with the goal of informing the planning process of community knowledge, experience, and expectations for the waterbody. Three documented Westchester Creek Stakeholder Team meetings were held jointly with the Hutchinson River Stakeholder Team as part of the WB/WS Facility Plan development: September 6, 2006; October 26, 2006; and May 8, 2007. Notes of each meeting were recorded, distributed, and published to provide a public record of the proceedings. All meetings were convened at the Community Board 10 offices at 3165 East Tremont Avenue in the Bronx. The three meetings are broadly summarized below within the context of long-term CSO control planning; full meeting summary notes are included in Appendix C.

The first Stakeholder Team meeting was held on September 6, 2006. The purpose of this meeting was to introduce the team to long-term CSO control planning, and to discuss the implications for the waterbody and the larger community. DEP presented their understanding of Westchester Creek, its water quality issues, and it uses, and explained fundamental concepts such as how the sewage collection system works, what a CSO is, ongoing DEP initiatives to improve water quality, and the regulatory process that partly motivates CSO control. Stakeholders expressed interest in water conservation and Best Management Practices (BMPs), and how DEP is incorporating solutions of this nature into CSO control.

The Stakeholder Team had several questions and comments, but were generally aware of the 2003 CSO Facility Plan that had been proposed (i.e., the 12 MG retention facility), and expressed particular concern regarding construction-related disturbances to their community. The stakeholders asked for information on peripheral construction, the size of the site, and probable schedule, citing the 8-year construction schedule of the Flushing Tank as an example that caused their concern. DEP informed the group that the facility proposed under the 2003 CSO Facility Plan was only one among many alternatives under consideration, and that they should not presume that it would be the selected alternative to be implemented. Nonetheless, numerous stakeholders spoke about traffic concerns and emphasized that quality of life and traffic disruption issues should be considered while formulating the plan. They expressed frustration with the Economic Development Corporation, whose goals include encouraging industrial uses in the Westchester Creek corridor while the area is undergoing rapid conversion to residential use, conflicting uses that impact the quality of life in the community.

The second meeting was held on October 26, 2006. The Westchester Creek drainage area was reviewed and the largest CSO outfall to Westchester Creek was identified. DEP presented the findings of a water quality sampling program conducted in Westchester Creek and the Hutchinson River during the summer of 2005. Data for DO and fecal and total coliform from surveys taken during dry and wet weather were presented, along with historical DO data that demonstrate an improving trend from around 1972. The stakeholders were also informed that DEP and Westchester County were discussing collaborating on sampling efforts, responding to a question from the previous meeting. DEP then presented the modeling tools that were to be used to guide the project team in evaluating the performance of different alternatives through predicting the resulting receiving water quality during an average year with the projected population in the service area. The interaction of water sampling and computer modeling was also discussed. DEP then reviewed typical alternatives for abating CSOs, their relative costs, and the performance expectations associated with each.

The stakeholders offered input on the desired uses and goals for both Westchester Creek and the Hutchinson River, indicating that they would like to boat and paddle on Westchester Creek without fear of illness. Many of them remember swimming on the Creek and said that they would like to be able to do so again, particularly at Ferry Point Park. Construction and traffic concerns associated with the proposed 2003 CSO Facility Plan (i.e., the 12 MG retention facility) was restated, and DEP reiterated that the goal of the LTCP project was to bring the waterbodies in question into compliance and that the CSO retention tank previously proposed was only one of several alternatives under consideration. In response to a discussion at the last meeting about water conservation, the project team spoke about a number of different programs, including green roofs and catch basin replacements. DEP noted that they are actively investigating measures of this nature on a watershed scale, but that this effort is on a different time frame from the LTCP. There was a specific request regarding dredging Westchester Creek made on behalf of a commercial operation on the waterbody, according to the individual who made the request.

The final meeting was held on May 8, 2007 to discuss the Waterbody/Watershed Facility Plan that will be submitted to DEC. After reviewing the factors that were considered and the alternative abatement technologies that were evaluated, the waterbody/watershed facility plans for the Hutchinson River and Westchester Creek were presented. The costs and water quality benefits associated with each alternative were plotted to reveal a "knee-of-the-curve". It was noted that upgrades to the Hunts Point WWTP that had been recently completed resulted in substantial CSO reductions by improving conveyance to the plant, improving the water quality in Westchester Creek. Graphs showing the attainment of existing water quality numerical criteria comparing baseline conditions, a 100% capture scenario, and certain alternatives were shown to illustrate the spatial extent of water quality problems and to demonstrate the expected range of water quality improvements achievable. DEP also presented their ongoing investigations into Low Impact

Development and stormwater Best Management Practices that are being performed under the Jamaica Bay Watershed Protection Plan created by local law in 2005.

The stakeholders offered comments on the presented plans and asked questions about possible impacts beyond water quality. One stakeholder expressed dissatisfaction with the plan, and although she expressed opposition to constructing a tank, she stated that the presented plan was not adequate. Another stakeholder asked about the actual performance of other tanks New York City has constructed and was informed that neither Flushing Creek nor Paerdegat Basin was in service. Construction impacts were also discussed.

The representative from DEC explained the sequence of subsequent public participation opportunities, including when DEC provides DEP comments on the submitted plan, and when the WB/WS Plan is converted into a Long-Term Control Plan (LTCP). DEP noted that they were on schedule to submit the WB/WS Facility Plan by the June 2007 Milestone.

7.0. Evaluation of Alternatives

This section discusses the CSO abatement alternatives that were developed and analyzed to improve water quality within Westchester Creek. Alternatives were evaluated with regards to several parameters, including: feasibility of construction and implementation; improvements to the waterbody in terms of numerical water quality criteria (DO, total coliform and fecal coliform) and aesthetics (floatables); reduction in the number of CSO events and annual CSO volume; and construction costs. At the conclusion of this section, the Westchester Creek WB/WS Facility Plan is selected, incorporating technologies that satisfy these constraints at a reasonable cost, improving water quality in the Creek and complying with the requirements of long-term CSO control planning.

The current Westchester Creek CSO Abatement Facilities Plan (URS, 2003), as outlined in the Administrative CSO Consent Order, consists of facilities to divert combined sewage to a CSO storage tank, as well as rehabilitation of an existing tide gate chamber. The Consent Order, however, does provide some flexibility with respect to the eventual construction of these facilities as noted below:

> "The Plans will also provide the technical framework to complete facility planning in those drainage basins (Westchester Creek, Hutchinson River, and Newtown Creek) contained in Appendix A that do not have final conceptual designs. Subject to the Department's approval, the Waterbody/Watershed Facility Plans may refine, and/or propose minor modifications to, the existing approved and/or pending CSO facility plans. In the Newtown Creek, Westchester Creek and Hutchinson River drainage basins only, the Waterbody/Watershed Facility Plans may propose final modifications to the scope of the projects set forth in the existing Facility Plans."

For this CSO planning area, the WB/WS Facility Plan analyzes cost-effective CSO control measures for this waterbody and potentially proposed modifications to the scope of the existing CSO facilities plan, as permitted in the Order in Section III, Paragraph A, Section 3, as noted above. Toward that end, this WB/WS Facility Plan does not approach the storage tank as a project that will be constructed and only assess alternatives to improve the water quality beyond that which would result from the storage tank. Instead, this WB/WS Facility Plan considers the storage tank as one of many potential CSO control alternatives that could possibly be implemented and evaluates the merits of the storage tank in relation to these other alternatives.

7.1. REGULATORY FRAMEWORK FOR EVALUATION OF ALTERNATIVES

The evaluation of alternatives to address CSO discharges and water quality problems in a particular waterbody involves regulatory considerations that are in addition to those presented in Section 1. The following subsections present a summary of these considerations.

7.1.1 Water Quality Objectives

As previously described in Sections 1.2.1, Westchester Creek appears on the 2010 DEC "Section 303(d) List of Impaired Waters" due to a DO/Oxygen Demand impairment caused by "urban/storm/CSO" inputs.

DEC has designated Westchester Creek as a Class I waterbody. The New York State numerical and narrative surface water quality standards for Class I waters are listed below in Table 7-1.

Table 7-1. New York State Numerical and Narrative Surface Water Quality Standards for Westchester Creek

Class	Class I (Saline)
Usage	Secondary contact recreation, fishing. Suitable for fish propagation and survival.
DO (mg/L)	≥ 4.0
Total Coliform (#/100mL)	10,000 (4)
Fecal Coliform (#/100mL)	$\leq$ 2,000 (4)
Taste-, color-, and odor producing toxic and other deleterious substances	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	No increase that will cause a substantial visible contrast to natural conditions.
Oil and floating substances	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Garbage, cinders, ashes, oils, sludge and other refuse	None in any amounts.
Phosphorus and nitrogen	None in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages.

(1) Daily avg. min for non-trout waters
(2) Monthly median value of five or more samples
(3) Monthly 80th percentile of five or more samples
(4) Monthly geometric mean of five or more samples

7.1.2 Range of Alternatives

The federal CSO Policy calls for LTCPs to consider a number of factors when evaluating CSO control alternatives, as described in Sections II.C.4 and II.C.5 of the Policy (40 CFR 122 [FRL-4732-7]). USEPA expects the analysis of alternatives to be sufficient to make a reasonable assessment of the expected performance and the cost of the alternatives. With regard to performance, USEPA expects the LTCP to “consider a reasonable range of alternatives” in the selection process. The LTCP should consider four or more alternatives, providing a range of control above the existing condition and extending to full elimination of CSOs, as measured in terms of CSO frequency or CSO capture.

7.1.3 “Presumption” and “Demonstration” Approaches

Whether a particular alternative provides sufficient control can be determined in two different manners. In the “Presumption Approach,” alternatives that meet any of a number of discharge-based criteria may be “presumed” to provide sufficient CSO control to meet the water-quality based requirements of the CWA. These discharge-based criteria, which are applicable to an entire combined sewer system (i.e., a WWTP drainage area) and not necessarily to the drainage area of a particular waterbody include:

i. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a CSS as the result of a precipitation event that does not receive a minimum treatment specified below;
ii. The elimination or the capture for treatment of no less than 85 percent by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis; or
iii. The elimination or removal of no less than the mass of the pollutants […] for the volumes that would be eliminated or captured for treatment under item ii above.

Combined sewer flows remaining after implementation of the Nine Minimum Controls and within the criteria specified at II.C.4.a.i or ii should receive a minimum of:

- Primary clarification (Removal of floatables and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification.);

- Solids and floatables disposal; and

- Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residuals, where necessary

In the “Demonstration Approach,” alternatives providing sufficient CSO control are those that, through modeling and/or other analyses, are expected to provide sufficient CSO control as to meet the water-quality based requirements of the CWA. The criteria associated with the Demonstration Approach are:

i. The planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSOs;

ii. The CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribute to their impairment. Where WQS and designated uses are not met in part because of natural background conditions or pollution sources other than CSOs, a total maximum daily load, including a wasteload allocation and a load allocation, or other means should be used to apportion pollutant loads;
iii. The planned control program will provide the maximum pollution reduction benefits reasonably attainable; and
iv. The planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS or designated uses.

7.1.4 Cost/Performance Consideration

USEPA expects the permittee to use the costs associated with each of these alternatives to demonstrate the relationships among a comprehensive set of reasonable control alternatives that correspond to the different ranges specified in Section II.C.4 of the federal CSO policy. This should include an analysis to determine where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs. This analysis, often known as "knee of the curve," should be among the considerations used to help guide selection of controls.

7.1.5 Consideration of Other Parameters

Other parameters such as existing waterbody uses and stakeholder goals for waterbody use were taken into account when determining the necessary level of CSO control. Other parameters considered as part of the evaluations of alternatives for the Westchester Creek include the following:

- Waterbody Use: As discussed in Section 2.2.5, the lower reaches of Westchester Creek and Pugsley Creek are designated a Special Natural Waterfront Area (SNWA) through the Waterfront Revitalization Program (WRP), which promotes public investment to protect and enhance the city's natural resources. This designation will help continuing efforts to provide better access and restore the natural conditions in Pugsley Creek and Westchester Creek up to the northern end of Ferry Point Park.

- Aquatic Life Uses: Aquatic life in Westchester Creek was characterized under the USA project and is described in detail in Section 4.

- Sensitive Areas: As discussed in Section 4, the DEC, as the permitting authority, has not designated the Westchester Creek as a sensitive area. There are no areas within the Creek that satisfy the CSO Control Policy criteria for sensitive areas. Therefore, prioritization of goals, selection of control alternatives, and scheduled implementation of these alternatives can be given to those alternatives that most reasonably attain the maximum benefit to water quality throughout the river.

- Stakeholder Goals: As discussed in Section 6.0, the East River CSO Facility Planning Project included a full-scale public participation program coordinated by DEP. This program, which was structured in accordance with the USEPA's public participation guidelines, was designed to provide a solid foundation for informed citizen input to agency decision-making. In addition, the Local Stakeholder Team convened under the LTCP Project met three times during the WB/WS Facility Plan development in 2006 and 2007, in accordance with federal CSO policy. Meeting notes are provided in Appendix C. Numerous public meetings were held to encourage ongoing dialogue between DEP and stakeholder groups, providing a forum in which DEP could present up-to-date project information and could receive informed stakeholders input in a timely manner. This public dialog informed the site selection process for the Westchester Creek CSO storage facility proposed under the 2003 CSO Facility Plan, and defined public priorities as they pertain to CSO abatement efforts.

  The public comments generated during both the 2003 CSO Facility Plan and the present WB/WS Plan did not demonstrate a high level of community interest in recreational uses in Westchester Creek. The majority of discussions focused on construction-related disturbances to the quality of life in their community, acquiring background information about WWTPs and the CSO program, and deciding what amenities might be provided to the community. Prior to revisiting the Westchester Creek CSO abatement effort, amenities were to be provided to the Little League organizations that would have been displaced by the construction of the retention tank, including a clubhouse with indoor practice area, offices and storage areas, a concession stand, restrooms, paved parking, and fencing. Such amenities will not be provided if the displacement of the Little League organizations does not occur as a result of the recommended projects in this Westchester Creek WB/WS Facility Plan.

7.2. SCREENING OF CSO CONTROL TECHNOLOGIES

A wide range of CSO control technologies was considered for application to New York City's Combined Sewer System (CSS). The technologies are grouped into the following general categories:

- Watershed-Wide Non-Structural Controls
- Inflow Control
- Green Infrastructure
- Sewer System Optimization
- Sewer Separation
- Storage
- Treatment
- Receiving Water Improvement
- Solids and Floatables Control

Each technology is described below, and a summary assessment is provided in Table 7-2.

Table 7-2. Preliminary Screening of Technologies

CSO Control Technology	Performance				Implementation and Operational Factors
	CSO Volume Reduction	Bacteria Removal	Floatables Control	Suspended Solids Reduction	
Watershed-Wide Non-Structural Controls (Section 7.2.1)					
Public Education	None	Low	Medium	Low	Cannot reduce the volume, frequency or duration of CSO overflows.
Street Sweeping	None	Low	Medium	Medium	Effective at floatables removal, cost-intensive O&M. Ineffective at reducing CSO volume, bacteria and very fine particulate pollution.
Construction Site Erosion Control	None	Low	Low	Medium	Reduces sewer sediment loading, enforcement required. Contractor pays for controls.
Catch Basin Cleaning	None	Very Low	Medium	Low	Labor intensive, requires specialized equipment.
Industrial Pretreatment	Low	Low	Low	Low	There is limited industrial activity in this sewer area.
Inflow Control (Sections 7.2.2)					
Storm Water Detention	Medium	Medium	Medium	Medium	Requires large area in congested urban environment, potential siting difficulties and public opposition, construction would be disruptive to affected areas, increased O&M.
Street Storage of Storm Water	Medium	Medium	Medium	Medium	Potential flooding and freezing problems, public opposition, low operational cost.
Water Conservation	Low	Low	Low	Low	Potentially reduces dry weather flow making room for CSO, ancillary benefit is reduced water consumption
Inflow/Infiltration Control	Low	Low	Low	Low	Infiltration usually lower volume than inflow, infiltration can be difficult to control
Green Infrastructure (See Sections 5.8 and 8.8)					
Sewer System Optimization (Section 7.2.4)					
Optimize Existing System	Medium	Medium	Medium	Medium	Low cost relative to large scale structural BMPs, limited by existing system volume and dry weather flow dam elevations.
Real Time Control	Medium	Medium	Medium	Medium	Highly automated system, increased O&M, increased potential for sewer backups.
Sewer Separation (Section 7.2.5)					
Complete Separation	High	Medium	Low	Low	Disruptive to affected areas, cost intensive, potential for increased stormwater pollutant loads, requires homeowner participation.
Partial Separation	High	Medium	Low	Low	Disruptive to affected areas, cost intensive, potential for increased stormwater pollutant loads.
Rain Leader Disconnection	Medium	Medium	Low	Low	Low cost, requires home and business owner participation, potential for increased storm water pollutant loads.
Storage (Section 7.2.6)					
Closed Concrete Tanks	High	High	High	High	Requires large space, disruptive to affected area, cost intensive, aesthetically acceptable.
Storage Pipelines/Conduits	High	High	High	High	Disruptive to affected areas, potentially expensive in congested urban areas, aesthetically acceptable, provides storage and conveyance.
Tunnels	High	High	High	High	Non-disruptive, requires little area at ground level, capital intensive, provides storage and conveyance, pump station required to lift stored flow out of tunnel.
Treatment (Section 7.2.7)					
Screening/Netting Systems	None	None	High	None	Controls only floatables.

CSO Control Technology	Performance				Implementation and Operational Factors
	CSO Volume Reduction	Bacteria Removal	Floatables Control	Suspended Solids Reduction	
Primary Sedimentation[1]	Low	Medium	High	Medium	Limited space at WWTP, difficult to site in urban areas.
Vortex Separator (includes Swirl Concentrators)	None	Low	High	Low	Variable pollutant removal performance. Depending on available head, may require foul sewer flows to be pumped to the WWTP and other flow controls, increased O&M costs.
High Rate Physical/Chemical Treatment[1]	None	Medium	High	High	Limited space at WWTP, requires construction of extensive new conveyance conduits, high O&M costs.
Disinfection	None	High	None	None	Cost Intensive/Increased O&M.
Expansion of WWTP	High	High	High	High	Limited by space at WWTP, increased O&M.
Receiving Water Improvement (Section 7.2.8)					
Outfall Relocation	High	High	High	High	Relocates discharge to different area, requires the construction of extensive new conveyance conduits.
In-stream Aeration	None	None	None	None	High O&M, only effective for increasing DO, limited effective area, may require dredging.
Maintenance Dredging	None	None	None	None	Removes deposited solids after build-up occurs.
Solids and Floatables Controls (Section 7.2.9)					
Netting Systems	None	None	High	None	Easy to implement, potential negative aesthetic impact.
Containment Booms	None	None	High	None	Simple to install, difficult to clean, negative aesthetic impact.
Skimming Vessels	None	None	High	None	Easy to implement but limited to navigable waters.
Manual Bar Screens	None	None	High	None	Prone to clogging, requires manual maintenance.
Weir Mounted Screens	None	None	High	None	Relatively low maintenance, requires suitable physical configuration, must bring power to site.
Fixed baffles	None	None	High	None	Low maintenance, easy to install, requires proper hydraulic configuration.
Floating Baffles	None	None	High	None	Moving parts make them susceptible to failure.
Catch Basin Modifications/Hooding	None	None	High	None	Requires suitable catch basin configuration and increases maintenance efforts.
1. Process includes pretreatment screening and disinfection.					

7.2.1. Watershed-Wide Controls or Non-Structural Controls

To control pollutants at their source, management practices can be applied where pollutants accumulate. Source management practices are described below.

Public Education

Public education programs can be aimed at reducing (1) littering by the public and the potential for litter to be discharged to receiving waters during CSO events and (2) illegal dumping of contaminants in the sewer system that could be discharged to receiving waters during rain events. Public education programs cannot reduce the volume, frequency, or duration of CSO overflows, but can help improve CSO quality by reducing floatable debris. Public education and information is an integral part of any LTCP. Public education is also an ongoing DEP program (DEP, 2005b) and is also part of the *NYC Green Infrastructure Plan* to engage and enlist stakeholders in stormwater management and *Green Infrastructure Plan* implementation.

Street Sweeping

The major objectives of municipal street cleaning are to enhance the aesthetic appearance of streets by periodically removing the surface accumulation of litter, debris, dust, and dirt, and to prevent these pollutants from entering storm or combined sewer systems. Common methods of street cleaning are manual, mechanical and vacuum sweepers, and street flushing. Studies on the effect of street sweeping on the reduction of floatables and pollutants in runoff have been conducted. New York City found that street cleaning can be effective in removing floatables. Increasing street cleaning frequency from two times per week to six times per week reduced floatables by approximately 42 percent on an item count basis at a very high cost. A significant quantity of floatables was found to be located on sidewalks that were not cleanable by conventional equipment (HydroQual, 1995). However, in spite of these limitations, the Department of Sanitation of New York City (DSNY) does have a regular street sweeping program targeting litter reduction. DSNY also has an aggressive enforcement program targeting property owners to minimize the amount of litter on their sidewalks. These programs are described in New York City's Citywide Comprehensive CSO Floatables Plan. (DEP, 2005a).

Studies, funded by the National Urban Renewal Program (NURP) during the late 1970s to the early 1980s, reported that street sweeping was generally ineffective at removing pollutants and improving the quality of urban runoff (MWCOG, 1983; USEPA, 1983). The principal reason for this is that mechanical sweepers employed at that time could not pick up the finer particles (diameter < 60 microns). Studies have shown that these fine particles contain a majority of the target pollutants on city streets that are washed into sewer systems (Sutherland, 1995). In the early 1990s, new vacuum-assisted sweeper technology was introduced that can pick up the finer particles along city streets. A recent study showed that these vacuum-assisted sweepers have a 70 percent pickup efficiency for particles less than 60 microns (Sutherland, 1995).

Street sweeping only affects the pollutant concentration in the runoff component of combined sewer flows. Thus, a street sweeping program is ineffective at reducing the volume and frequency of CSO events. Furthermore, the total area accessible to sweepers is limited. Areas such as sidewalks, traffic islands, and congested street parking areas cannot be cleaned using this method.

Although a street sweeping program employing high efficiency sweepers could reduce the concentrations of some pollutants in CSOs, bacteriological pollution originates primarily from the sanitary component of sewer flows. Thus, minimal reductions in fecal coliform and E. coli concentrations of CSOs would be expected.

Construction Site Erosion Control

Construction site erosion control involves management practices aimed at controlling the washing of sediment and silt from disturbed land associated with construction activity. Erosion control has the potential to reduce solids concentrations in CSOs and reduce sewer cleanout operation and maintenance (O&M) costs. For applicable projects, New York City's CEQR requirements addresses potential impacts associated with sediment runoff as well as required measures to be employed to mitigate any potential impacts.

Catch Basin Cleaning

The major objective of catch basin cleaning is to reduce conveyance of solids and floatables to the combined sewer system by regularly removing accumulated catch basin deposits. Methods to clean catch basins include manual, bucket and vacuum removal. Cleaning catch basins can only remove an average of 1 to 2 percent of the five day biochemical oxygen demand (BOD_5) produced by a combined sewer watershed (USEPA, 1977). As a result, catch basins cannot be considered an effective pollution control alternative for BOD_5 removal.

New York City has an aggressive catch basin hooding program to contain floatables within catch basins and remove the material through catch basin cleaning (Citywide Comprehensive CSO Floatables Plan, Modified Facility Planning Report, City of New York, Department of Environmental Protection, July 2005). While catch basins can be effective in reducing floatables in combined sewers, catch basin cleaning does not necessarily increase floatables retention in the catch basin. Results of a pilot scale study showed that floatables capture improves as material accumulates in the catch basin (HydroQual, 2001f). During a rain event, the accumulated floatables can dissipate the hydraulic load entering a catch basin, thereby reducing turbulence in the standing water and reducing the escape of floatables to the combined sewer system. Thus, while hooding of catch basins will improve floatables capture, the hooding program is not expected to require an increase in catch basin cleaning.

Industrial Pretreatment

Industrial pretreatment programs are geared toward reducing potential contaminants in CSO by controlling industrial discharges to the sewer system. As discussed in Section 3.4.2, DEP has an industrial pretreatment program in place and has successfully controlled industrial discharges to the sewer system.

7.2.2. Inflow Control

Inflow control involves eliminating or retarding stormwater inflow to the combined sewer system, lowering the magnitude of the peak flow through the system, thereby reducing overflows. Methods for inflow control are described below:

Stormwater Detention

Stormwater detention utilizes a surface storage basin or facility to capture stormwater before it enters the combined sewer system. Typically, a flow restriction device is added to the catch basin to effectively block stormwater from entering the catch basin. The stormwater is then diverted along natural or man-made drainage routes to a surface storage basin or "pond-like" facility where evaporation and/or natural soil percolation eventually empties the basin. Such systems are applicable for smaller land areas, typically up to 75 acres, and are more suitable for non-urban areas. Such a system is not considered viable for a highly congested urban area such as New York City. Stormwater blocked from entering catch basins would be routed along city streets to a detention pond which would be built in a nearby vacant lot. Extensive public education and testing is required to build support for this control technology and to address public concerns such as resultant potentially unsafe road conditions and flood damage.

Street Storage of Stormwater

Street storage of stormwater utilizes the City's streets to temporarily store stormwater on the road surface. Typically, the catch basin is modified to include a flow restriction device. This device would limit the rate at which surface runoff enters the combined sewer system. The excess stormwater would be retained on the roadway and enter the catch basin at a controlled rate. Street storage can effectively reduce inflow during peak periods and can decrease CSO volume. However, it also would promote street flooding and must be carefully evaluated and planned to ensure that unsafe travel conditions and damage to roadway surfaces do not occur. For these reasons, street storage of stormwater is not considered a viable CSO control technology in New York City.

Water Conservation

Water conservation is geared toward reducing the dry weather flow in the combined sewer system, thereby increasing the system's ability to accommodate more stormwater and reduce CSO discharges. Water conservation includes measures such as installing low flow fixtures, public education to reduce wasted water, leak detection and correction, and other similar programs. The City of New York has an on-going water conservation and public education program. The DEP's ongoing efforts to save water that reduce inflows to the combined sewers include installing individual water meters on water service lines to encourage conservation and equipping fire hydrants with special locking devices. Water conservation programs have resulted in the reduction of water consumption Citywide by approximately 230 MGD over a 10-year period or a reduction of 43 gallons per person per day from 1996 to 2006 (DEP, 2007). This change equates to a 17.5 percent reduction in overall daily water consumption, even as the population increased by approximately nine percent. The water consumption on a daily per capita basis decreased by 24.5 percent. Water conservation, as a CSO control technology, is effectively implemented to a satisfactory level, and New York City has achieved significant reductions in wastewater flow through its existing water conservation program.

The green strategy described in the *NYC Green Infrastructure Plan* includes reduced flow impacts on CSO volume reductions estimated based on InfoWorks modeling. However, as described above, Reduced flow strategies are expected to require little incremental expenditure as water consumption and wastewater flows have been on the decline in recent years. Furthermore, the combination of automated meter reading, the ability of customers to track water usage, and national water efficient fixture standards is expected to keep flows stable. Additional conservation measures, such as toilet and other fixture rebate programs, are expected to have only nominal costs associated with them, and would be necessary only if the declining trend reverses. See 7.2.3 below for detailed information on the green strategy described in the *NYC Green Infrastructure Plan.*

Infiltration/Inflow (I/I) Reduction

Infiltration and inflow is ground water and other undesired water that enters the collection system through leaking pipe joints, cracked pipes, and manholes. Excessive amounts of infiltration and inflow take up the hydraulic capacity of the collection system. In contrast, the inflow of surface drainage is intended to enter the CSS the combined sewer system. Sources of inflow that might be controlled include leaking or missing tide gates and inflow in the separate sanitary system located upstream of the combined sewer system.

DEP conducted an Infiltration/Inflow (I/I) analysis in the late 1980s (O'Brien & Gere, 1986) and a follow-up Sewer System Evaluation Survey (SSES) in 1991 (O'Brien & Gere, 1991). These investigations identified excessive I/I within the Hunts Point WWTP service area by comparing measured nighttime flow rates to estimates of water usage developed from a derived per capita water usage rate and data from available records. The initial estimate of 66.7 MGD of extraneous flow led to the recommendation of the SSES, which focused on the 50 percent of the Hunts Point collection system believed to be responsible for about 80 percent of the extraneous flow volume. These sub-areas included 138.5 miles of sewer, some of which was within the Westchester Creek portion of the service area. An estimate of I/I was made based on the comparison of nighttime calculated and measured flows. After reevaluation of the base flow used in both the per capita water consumption and the diurnal flow variation used in the calculations and validated flow monitoring, the I/I estimate was adjusted downward to 21.6 MGD system-wide. For comparison, current DEP drainage plan design criteria account for I/I by assuming 0.00242 cfs/ac, resulting in 18.8 MGD of I/I in the Hunts Point system (DEP, 2000b). This would be the amount of I/I that DEP would consider normal when designing their sewers.

Despite a comprehensive track down program, the sources of only about 35 percent of the 21.6 MGD of I/I anticipated were positively identified in the field. The sewer system was generally found to be in good condition, and the TV program was stopped after 18 miles because only about 1 MGD of I/I had been positively identified where at least 13.5 MGD had been expected. The questionable validity of the base flow used to estimate the I/I, the inability to positively identify I/I sources, and the generally good conditions observed in the sewers suggest that infiltration and inflow are not significant problems in the Hunts Point service area with respect to inducing CSO and further I/I reductions would be unlikely to result in appreciable reductions in CSO discharges to surrounding waters. Infiltration and inflow control will be reevaluated during the development of the Drainage Basin Specific LTCP.

7.2.3. Green Infrastructure

See Sections 5.8 and 8.8.

7.2.4. DEP Sewer System Optimization

This CSO control technology involves making the best use of existing facilities to limit overflows. The techniques are described below:

Optimize Existing System

This approach involves evaluating the current standard operating procedures for facilities such as pump stations, control gates, inflatable dams, weir modifications, and treatment facilities to determine if improved operating procedures can be developed to provide benefit in terms of CSO control. This technology will be retained for further consideration.

Real Time Control (RTC)

RTC is any response – manual or automatic – made in response to changes in the sewer system condition. For example, the depth of flow of sewage within the sewer system and flow data can be monitored in "real time" at key points in the sewer system and transferred to a control device such as a central computer where decisions can be made to operate control components (such as gates, pump stations or inflatable dams) to maximize use of the existing sewer system and to limit overflows. Data monitoring need not be centralized; local dynamic controls can be used to control regulators to prevent localized flooding. However, system wide dynamic controls are typically used to implement control objectives such as maximizing flow to the WWTP or transferring flows from one portion of the CSS to another to fully utilize the system. Predictive control, which incorporates use of weather forecast data, is also possible, but is complex and requires sophisticated operational capabilities. RTC can reduce CSO volumes when in-system storage capacity is available. In-system storage is a method of using excess sewer capacity by containing combined sewage within a sewer and releasing it to the WWTP after the storm event when capacity for treatment becomes available. Technologies available for equipping sewers for in-system storage include inflatable dams, mechanical gates and increased overflow weir elevations. RTC has been used in other cities such as Louisville, Kentucky; Cleveland, Ohio; and Quebec, Canada. Refer to Figure 7-1 for a diagram of an example inflatable dam system.

New York City has conducted an extensive pilot study of the use of inflatable dams (O'Brien & Gere, 2004) within the City's combined sewers. This pilot study involved the use of inflatable dams and RTC at two locations (Metcalf Avenue and Lafayette Avenue) in the Bronx. Testing was completed in early 2007 and the equipment remained idle until August 2009, when decommissioning was completed. From this study, the City found that the technology was feasible for further consideration. However, widespread application of inflatable dams and RTC is limited in NYC as it does not provide for storage of large enough volumes of combined sewage to adequately improve water quality, especially in areas where tributary water quality is degraded.

In addition to these factors, the City's has considerable doubts about the viability of inflatable dams. At other locations in the city where inflatable dam systems were being designed, acquiring a bidder was difficult. Historically, there were only two manufacturers of inflatable dam systems. One no longer manufactures the dams and the other has curtailed service in the United States market. This creates a problem purchasing the system and does not ensure a reliable supply of replacement parts. While the use of dams may be manageable for a limited number of facilities, wide spread application of dams may lead to ineffective operation creating a massive maintenance and operation issue and possible flooding due to malfunctions.

7.2.5. Sewer Separation

Sewer separation is the conversion of a combined sewer system into a system of separate sanitary and storm sewers. This alternative prevents sanitary wastewater from being discharged to receiving waters. However, when combined sewers are separated, storm sewer discharges to the receiving waters will increase since stormwater will no longer be captured and treated at the downstream WWTP. In addition, this alternative involves substantial excavation that could exacerbate traffic problems within the City. Varying degrees of sewer separation could be achieved as follows:

Rain Leader (Gutters and Downspouts) Disconnection

Rain leaders are disconnected from the combined sewer system with storm runoff diverted elsewhere. Depending on location, leaders may be run to a dry well, vegetation bed, a lawn, a storm sewer or the street. Unfortunately, this scheme is inconsistent with existing city codes and regulations but these regulations may be modified in the future to support future green initiatives. Rain leader disconnection could contribute to nuisance street flooding and may only briefly delay the water from entering the combined sewer system through catch basins.

Partial Separation

Combined sewers are separated in the streets only, or other public rights-of-way. This is accomplished by constructing either a new sanitary wastewater system or a new storm water system. In areas adjacent to the waterbody, particularly those undergoing new development projects, partial separation through construction of high level storm sewers (HLSS) is a potentially feasible alternative that is featured in the New York City Mayor's "PlaNYC 2030" initiative. Therefore, the DEP will continue to promote and support opportunities for local partial separation in select locations throughout those areas of the City undergoing new development. This technology is retained for further consideration on a site specific basis and is believed to be most viable in small areas near the shorelines where there is no need to build large diameter and long storm sewers to convey the separated stormwater to the receiving water body.

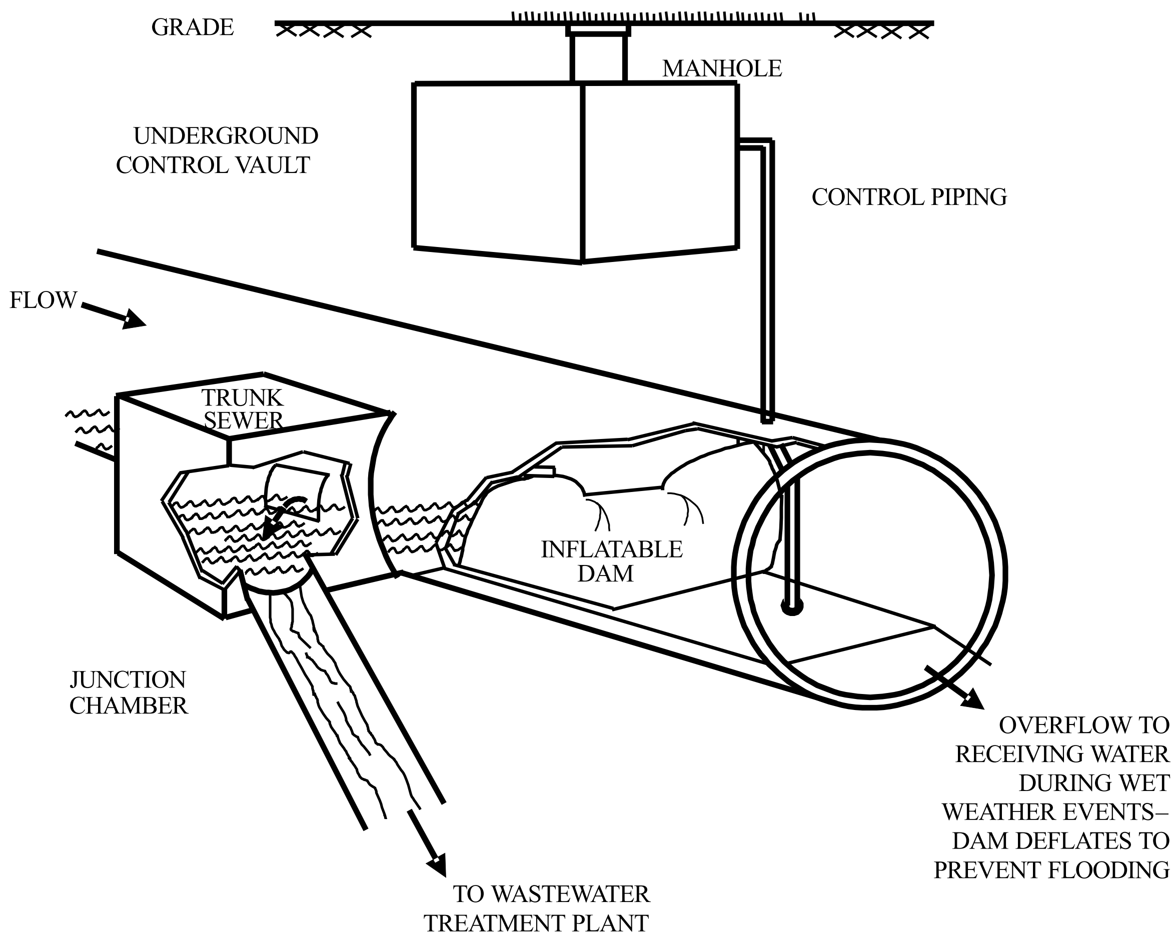
Complete Separation

In addition to separation of sewers in the streets, storm water runoff from private residences or buildings (i.e. rooftops and parking lots) is also separated. Complete separation is almost impossible to attain in New York City since it requires re-plumbing of apartment, office , and commercial buildings where roof drains are interconnected to the sanitary plumbing inside the building. In urban areas there is a lack of pervious surface areas to disperse the storm runoff into the ground, which could lead to nuisance flooding, and wet foundations and basements. These risks have led to the prohibition of stormwater disconnections from the combined sewers in the City Building Code. In addition, the widespread excavation and lengthy timeframes required to broadly implement separation would lead to unacceptable street disruptions and may not be feasible in areas with dense buried infrastructure. Figure 7-2 shows a diagram of these methods of separation.

7.2.6. Storage and Conveyance

The objective of retention basins (also referred to as off-line storage) is to reduce overflows by capturing combined sewage in excess of WWTP capacity during wet weather for controlled release into the WWTP after the storm event. Retention basins can provide a relatively constant flow into the treatment plant thereby reducing the hydraulic impact on downstream WWTPs. Retention basins have had considerable use and are well documented. Retention facilities may be located at overflow points or near dry weather or wet weather treatment facilities. A major factor determining the feasibility of using retention basins is land availability. Operation and maintenance costs are generally small, typically requiring only collection and disposal cost for residual sludge solids, unless inlet or outlet pumping is required. Many demonstration projects have included storage of peak stormwater flows, including those in Richmond, Virginia; Chippewa Falls, Wisconsin; Boston, Massachusetts; Milwaukee, Wisconsin; and Columbus, Ohio.

The following subsections describe types of CSO retention facilities.



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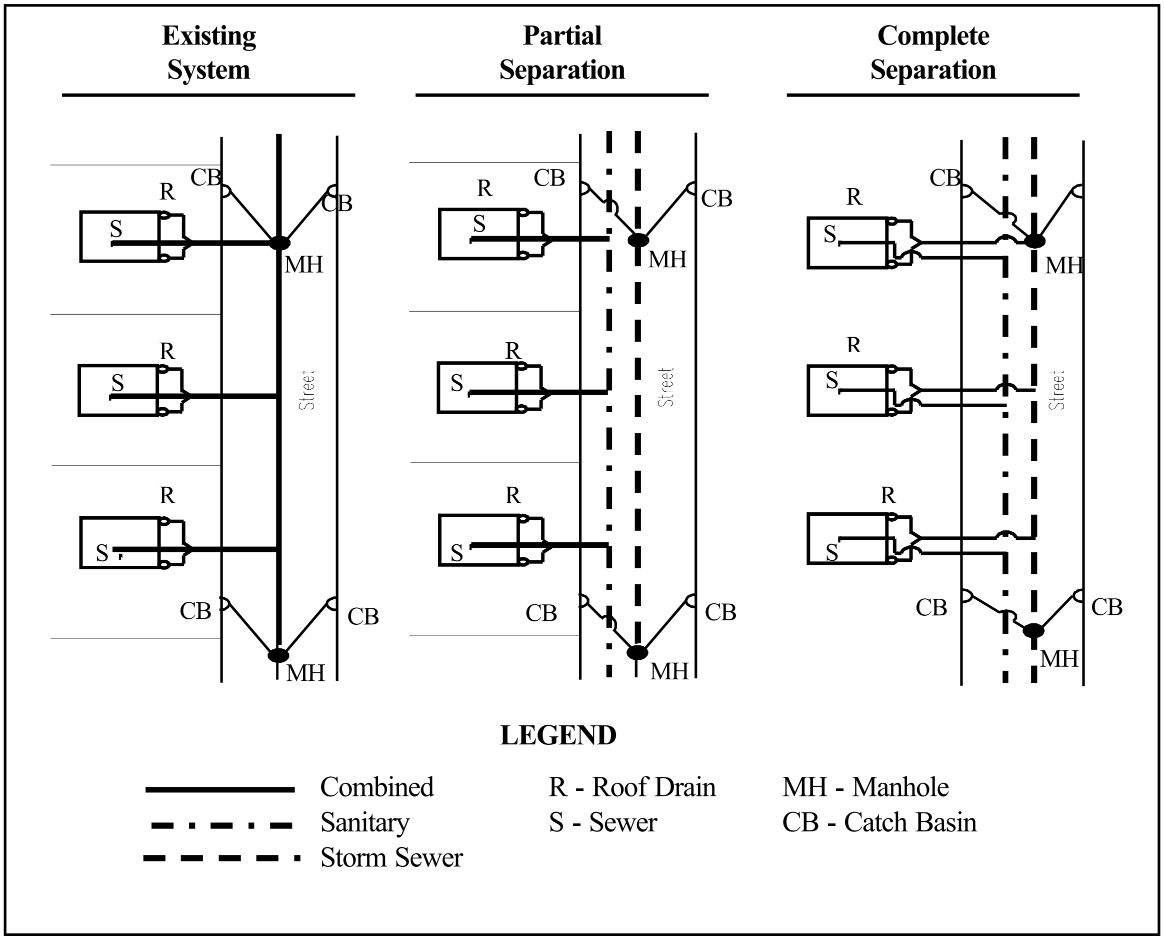
Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Inflatable Dam System

FIGURE 7-1



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Environmental Protection

Sewer Separation Alternatives

FIGURE 7-2

Closed Concrete Tanks

Closed concrete tanks are similar to open tanks except that the tanks are covered and include many mechanical facilities to minimize their aesthetic and environmental impact. Closed concrete tanks typically include odor control systems, washdown/solids removal systems and access for cleaning and maintenance of the tank. Closed concrete tanks have been constructed below grade such that the overlying surface can be used for parks, playgrounds, parking or other light public uses.

Storage Pipelines/Conduits

Large diameter pipelines or conduits can provide significant storage in addition to the ability to convey flow. The pipelines are fitted with some type of discharge control to allow flow to be stored within the pipeline during wet weather. After the rain event, the contents of the pipeline are allowed to flow by gravity to downstream WWTPs for ultimate treatment. A pipeline has the advantage of requiring a relatively small right-of-way for construction. The primary disadvantage is that it takes a relatively large diameter pipeline or cast-in-place conduit to provide the volume required to accommodate large periodic CSO flows requiring a greater construction effort than a pipeline used only for conveyance. For large CSO areas, pipeline size requirements may be so large that construction of a tunnel is more feasible.

Tunnels

Tunnels are similar to storage pipelines in that they can provide both significant storage volume and conveyance capacity. Tunnels have the advantage of causing minimal surface disruption and of requiring little right-of-way for construction. Excavation to construct the tunnel is carried out deep beneath the city and therefore would not impact traffic. The ability to construct tunnels at a reasonable cost depends on the geology. Tunnels have been used in many CSO control plans including Chicago, Illinois; Rochester, New York; Cleveland, Ohio; Richmond, Virginia; and Toronto, Canada, among others. A schematic diagram of a typical storage tunnel system is shown in Figure 7-3. The storage tunnel stores flow and then conveys it to a dewatering station where floatables are removed at a screening house and then flows are lifted for conveyance to the WWTP.

The three storage alternatives discussed above – closed concrete tanks, storage pipelines / conduits, and tunnels – will be retained for further consideration.

7.2.7. Treatment

Treatment alternatives include technologies intended to separate solids and/or floatables from the combined sewer flow, disinfect for pathogen treatment or provide secondary treatment for some portion of the combined flow. The following are types of treatment technologies:

Screening

The major objective of screening is to provide high rate solids/liquid separation for combined sewer floatables and debris thereby preventing floatables from entering receiving waters. The following categories of screens are applicable to CSO outfall applications:

- Trash Racks and Manually Cleaned Bar Racks – Trash racks are intended to remove large objects from overflow and have a clear spacing of between 1.5 to 3.0 inches. Manually cleaned bar racks are similar to trash racks and have clear spacings of between 1.0 to 2.0 inches. Both screens must be manually raked and the screenings must be allowed to drain before disposal.

- Netting Systems – Netting systems are intended to remove floatables and debris at CSO outfalls. A system of disposable mesh bags is installed in either a floating structure at the end of the outfall or in an underground chamber on the land side of the outfall. Nets and captured debris must be periodically removed using a boom truck and disposed of in a landfill.
- Mechanically Cleaned Bar Screens – Mechanically cleaned bar screens typically have clear spacing between 0.25 and 1.0 inches. Bars are mounted 0 to 39 degrees from the vertical and rake mechanisms periodically remove material trapped on the bar screen. Facilities are typically located in a building to house collected screenings that must be collected after a CSO event and then transported to a landfill.
- Fine Screens – Fine screens in CSO facilities typically follow bar screens and have openings between 0.010 and 0.5 inches. Flow is passed through the openings and solids are retained on the surface. Screens can be in the shape of a rotary drum or linear horizontal or vertical screens. Proprietary screens such as ROMAG have been specifically designed for wet weather applications. These screens retain solids on the dry weather side of the overflow diversion structure so they can be conveyed to the wastewater treatment plant with the sanitary wastewater, thereby minimizing the need for on-site collection of screenings for truck transport.

Manually cleaned screens for CSO control at remote locations have not been widely applied due to the need to clean screens and the potential to cause flooding if screens blind. Mechanically cleaned screens have had much greater application at CSO facilities. Due to the widely varying nature of CSO flow rates, even mechanically cleaned screens are subject to blinding under certain conditions. In addition, the screening must be housed in a building to address aesthetic concerns and odor facilities may be required as well. Fine screens have had more limited application for CSOs in the United States. ROMAG reports that over 250 fine screens have been installed in Europe and several screens have been installed in the United States (USEPA, 1999).

While screening provides an aesthetic benefit to the waterbody, it would not provide any improvement to the measured water quality parameters, such as DO, total coliform and fecal coliform. Also, screening the combined sewer flow does not involve the capture of storm sewer floatables that would discharge into Westchester Creek. Screening technologies are generally considered to have significant operational and maintenance requirements.

Primary Sedimentation

The objective of sedimentation is to produce a clarified effluent by gravitational settling of the suspended particles that are heavier than water. It is one of the most common and well-established unit operations for wastewater treatment. Sedimentation tanks also provide storage capacity, and disinfection can occur concurrently in the same tank. It is also very adaptable to chemical additives, such as lime, alum, ferric chloride and polymers, which provide higher suspended solids and BOD removal. Many CSO control demonstration projects have included sedimentation. These include Dallas, Texas; Saginaw, Michigan; and Mt. Clements, Michigan

(USEPA, 1977). Studies on existing storm water basins indicate suspended solids removals of 15 to 89 percent; BOD_5 removals of 10 to 52 percent (USEPA, 1977, Fair and Geyer, 1965, Ferrara and Witkowski, 1983, Oliver and Gigoropolulos, 1981).

The DEP's WWTPs are designed to accept their respective 2×DDWF for primary treatment during wet weather events. As such, NYC already controls a significant portion of combined sewage through the use of this technology.

Vortex Separation

Vortex separation technologies currently marketed include: USEPA Swirl Concentrator, Storm King Hydrodynamic Separator of British design, and the FluidSep vortex separator of German design. Although each of the three is configured somewhat differently, the operation of each unit and the mechanisms for solids separation are similar. Flow enters the unit tangentially and is directed around the perimeter of a cylinder, creating a swirling, vortex pattern. The swirling action causes solids to move to the outside wall and fall toward the bottom, where the solids concentrated flow is conveyed through a sewer line to the WWTP. The overflow is discharged over a weir at the top of the unit. Various baffle arrangements capture floatables that are subsequently carried out in the underflow. Principal attributes of the vortex separator are the ability to treat high flows in a very small footprint and a lack of mechanical components and moving parts, thereby reducing operation and maintenance.

Vortex separators have been operated in Decatur, Illinois; Columbus, Georgia; Syracuse, New York; West Roxbury, Massachusetts; Rochester, New York; Lancaster, Pennsylvania; Toronto, Ontario, Canada. Vortex separator prototypes have achieved suspended solids removals of 12 to 86 percent in Lancaster, Pennsylvania; 18 to 55 percent in Syracuse, New York; and 6 to 36 percent in West Roxbury, Massachusetts. BOD_5 removals from 29 to 79 percent have been achieved with the swirl concentrator prototype in Syracuse, New York (Alquier, 1982).

New York City constructed the Corona Avenue Vortex Facility (CAVF) in the late 1990s to evaluate the performance of three swirl/vortex technologies at a full-scale test facility (133 MGD each). The purpose of the test was to demonstrate the effectiveness of the vortex technology for control of CSO pollutants, primarily floatables, oil and grease, settleable solids and total suspended solids. The two-year testing program, completed in late 1999, evaluated the floatables-removal performance of the facility for a total of 22 wet weather events. Overall, the results indicated that the vortex units provided virtually no reductions in total suspended solids and an average floatables removal of approximately 60 percent during the tested events. Based on the results of the testing, DEP concluded that widespread application of the vortex technology is not effective for control of CSOs and was not a cost effective way to control floatables. As such, the application of this technology will be limited and other methods to control floatable discharges into receiving waters will need to be assessed.

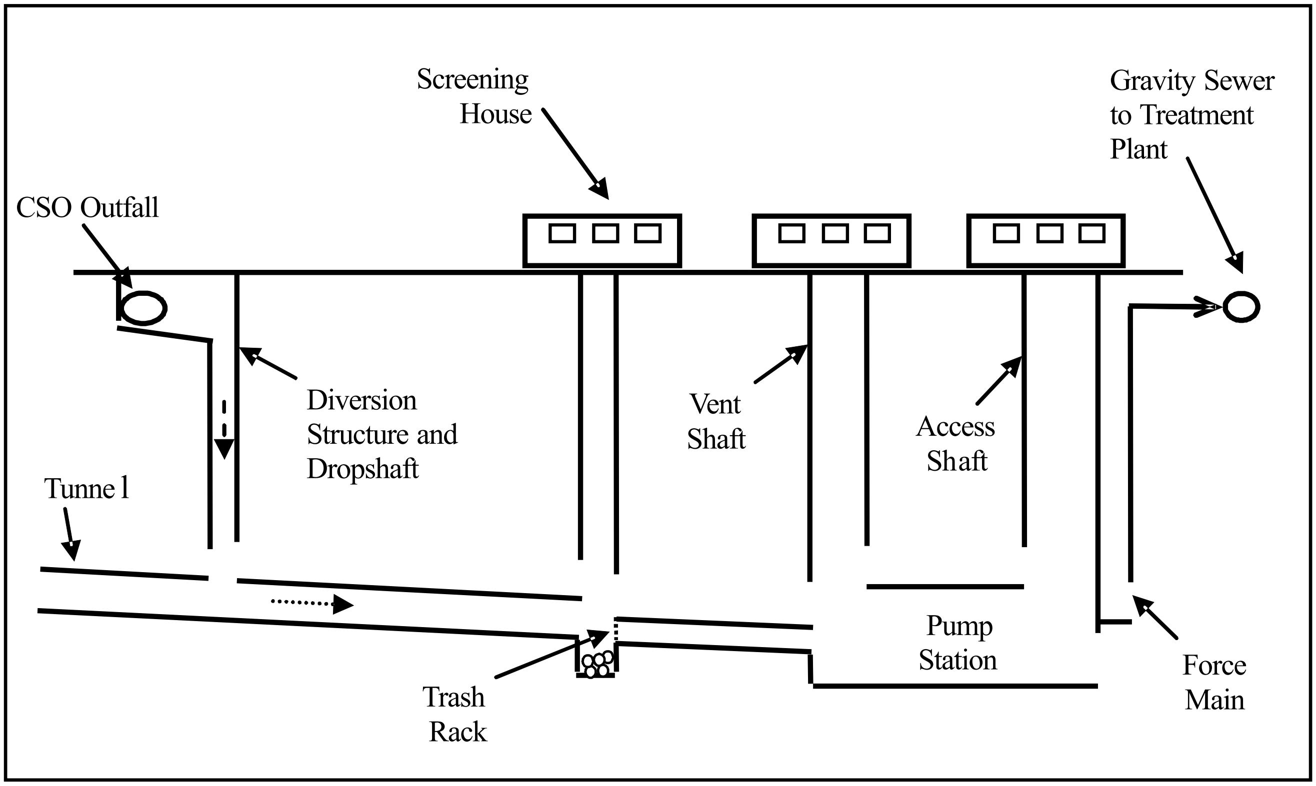
Also, the performance of vortex separators has been found to be inconsistent in other demonstrations. A pilot study in Richmond, Virginia showed that the performance of two vortex separators was irregular and ranged from 0 percent to 26 percent with an average removal efficiency of about 6 percent (Greeley and Hansen, 1995). The performance of vortex separators is also a strong function of influent TSS concentrations. A high average influent TSS concentration will yield a higher percent removal. As a result, if influent CSO is very dilute with stormwater, the overall TSS removal will be low. Suspended solids removal in the beginning of a storm event may be better if there is a pronounced first flush period with high solids concentrations (City of Indianapolis, 1996). Removal effectiveness is also a function of the hydraulic loading rate with better performance observed at lower loading rates. Furthermore, one of the advantages of vortex separation – the lack of required moving parts – requires sufficient driving head. Based on the poor results of the testing at the Corona Vortex Facility (DEP, 2003b and 2005c), and the general lack of available head, vortex separators have been removed from further consideration in New York City.

High Rate Physical Chemical Treatment (HRPCT)

High rate physical/chemical treatment is a traditional gravity settling process enhanced with flocculation and settling aids to increase loading rates and improve performance. The pretreatment requirements for high rate treatment are screening and degritting, identical to that required prior to primary sedimentation. The first stage of HRPCT is coagulant addition, where ferric chloride, alum or a similar coagulant is added and rapidly mixed into solution. Degritting may be incorporated into the coagulation stage with a larger tank designed for gravity settling of grit material. The coagulation stage is followed by a flocculation stage where polymer is added and mixed to form floc particles that will settle in the following stage. Also in this stage, recycled sludge or micro sand from the settling stage is added back in to improve the flocculation process. Finally, the wastewater enters the gravity settling stage that is enhanced by lamella tubes or plates. Disinfection, which is not part of the HRPCT process, typically is completed after treatment to the HRPCT effluent. Sludge is collected at the bottom of the clarifier and either pumped back to the flocculation stage or wasted periodically when sludge blanket depths become too high. The two principal manufacturers of HRPCT processes are Infilco Degremont Incorporated (IDI), which manufacturers the DensaDeg process, and US Filter, which manufactures the Actiflo process.

IDI offers the DensaDeg 2D and 4D processes, both of which require screening upstream. The 2D process requires upstream grit removal as well, but the 4D process integrates grit removal into the coagulation stage. Otherwise the 2D and 4D processes are identical. DensaDeg performance varies with surface overflow rate and chemical dosages, but in general removal rates of 80 to 95 percent for TSS and 30 to 60 percent for BOD can be expected. Phosphorous and nitrogen can also be removed with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Removal efficiencies are also dependent on start-up time. Typically the DensaDeg process requires approximately 30 minutes before optimum removal rates are achieved to allow for the build-up of sludge solids.

Figure 7-4 shows the components of a typical US Filter Actiflo system. The Actiflo process is different from the DensaDeg process in that fine sand is used to ballast the sludge solids. As a result, the solids settle faster, but specialized equipment must be incorporated in the system to accommodate the handling sand throughout the system. The process does require screening upstream. Grit removal is recommended, but since the system uses microsand as ballast in the process, the presence of grit is tolerable in the system. If grit removal does not precede the process, the tanks must be flushed of accumulated grit every few months to a year, depending on the accumulation of grit and system run times.



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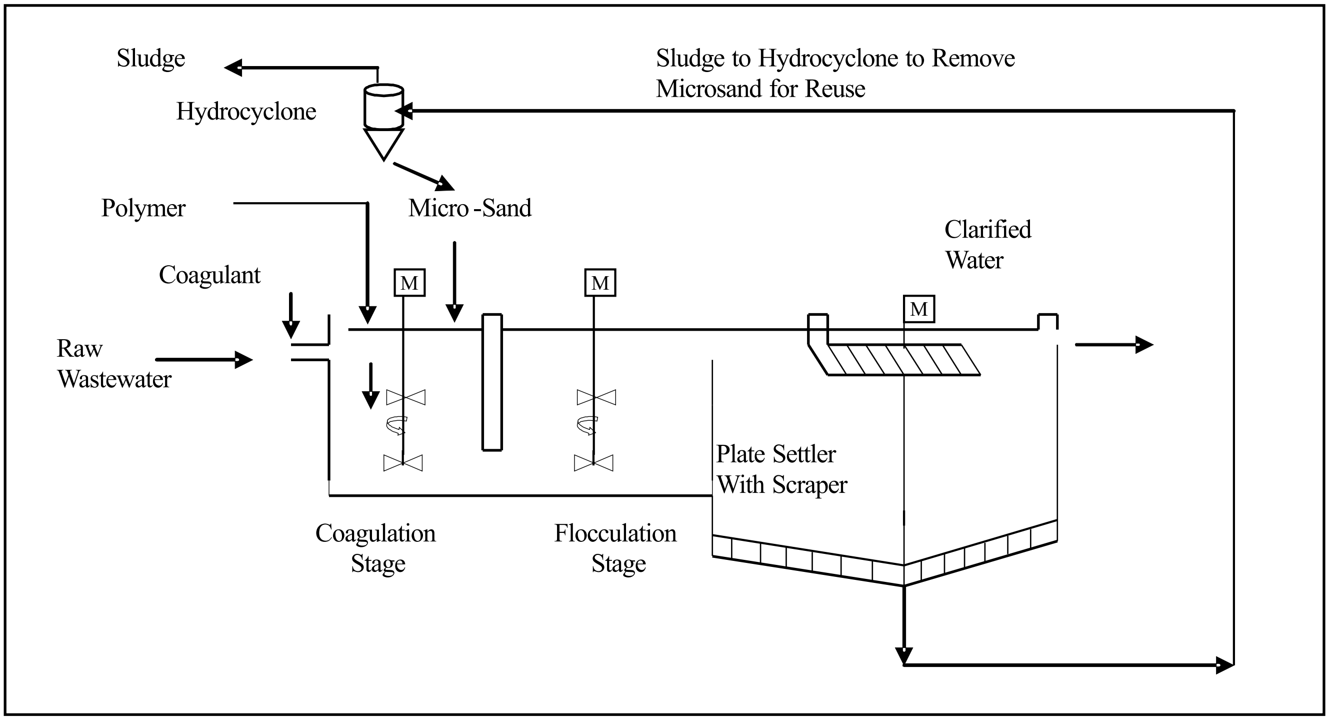
Environmental Protection

Storage Tunnel Schematic

FIGURE 7-3



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Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

US Filter Actiflo HRPCT

FIGURE 7-4

Actiflo performance varies with surface overflow rate and chemical dosages, but in general removal rates of 80 to 95 percent for TSS and 30 to 60 percent for BOD are typical. Phosphorous and nitrogen are also removable with this process, although the removal efficiencies are dependent on the solubility of these compounds present in the wastewater. Phosphorous removal is typically between 60 and 90 percent and nitrogen removal is typically between 15 and 35 percent. Removal efficiencies are also dependent on start-up time. Typically the Actiflo process takes about 15 minutes before optimum removal rates are achieved.

Pilot testing of HRPCT was performed at the 26th Ward WWTP in Brooklyn and consisted of evaluating equipment from three leading HRPCT manufacturers from May through August 1999. The three leading processes tested during the pilot test were the Ballasted Floc Reactor™ from Microsep/US Filter, the Actiflo™ from Kruger, and the Densadeg 4D™ from Infilco Degremont. Pilot testing suggested good to excellent performance on all units, often in excess of 80 percent for TSS and 50 percent for BOD_5. A preliminary analysis for utilizing a HRPCT facility at the head end of Westchester Creek (HP-014) was completed by the DEP. The analysis indicated that, for an equivalent level of CSO reduction/treatment, an HRPCT facility would cost approximately 30 to 40 percent more than a CSO storage tank. As a result of this analysis, HRPCT was precluded from further consideration.

Disinfection

The major objective of disinfection is to control the discharge of pathogenic microorganisms in receiving waters. Disinfection of combined sewer overflow is included as part of many CSO treatment facilities, including those in Washington, D.C.; Boston, Massachusetts; Rochester, New York; and Syracuse, New York. The disinfection methods considered for use in combined sewer overflow treatment are chlorine gas, calcium or sodium hypochlorite, chloride dioxide, peracetic acid, ozone, ultraviolet radiation and electron beam irradiation. The chemicals are all oxidizing agents that are corrosive to equipment and in concentrated forms are highly toxic to both microorganisms and people. Each is described in the ensuing section:

- Chlorine gas – Chlorine gas is extremely effective and relatively inexpensive. However, it is extremely toxic and its use and transportation must be monitored or controlled to protect the public. Chlorine gas is a respiratory irritant and in high concentrations can be deadly. Therefore, it is not well suited to populous or potentially non-secure areas.
- Calcium or Sodium Hypochlorite – Hypochlorite systems are common in wastewater treatment installations. For years, large, densely populated metropolitan areas have employed hypochlorite systems in lieu of chlorine gas for safety reasons. The hypochlorite system uses sodium hypochlorite in a liquid form much like household bleach and is similarly effective as chlorine gas, although more expensive. It can be delivered in tank trucks and stored in aboveground tanks. The storage life of the solution is 60 to 90 days.
- Chlorine Dioxide – Chlorine dioxide is an extremely unstable and explosive gas and any means of transport is potentially very hazardous. Therefore, it must be generated on site. The overall system is relatively complex to operate and maintain compared to more conventional chlorination.

- Ozone – Ozone is a strong oxidizer and must be applied to CSO as a gas. Due to the instability of ozone, it must also be generated on site. The principle advantage of ozone is that there is no trace residual chlorine remaining in the treated effluent. Disadvantages associated with ozone use as a disinfectant is that it is relatively expensive, with the cost of the ozone generation equipment being the primary capital cost item. Operating costs can be very high depending on power costs, since ozonation is a power intensive system. Ozonation is also relatively complex to operate and maintain compared to chlorination. Ozone is not considered practical for CSO applications because it must be generated on site in an intermittent fashion in response to variable and fluctuating CSO flow rates.
- UV Disinfection –UV disinfection uses light with wavelengths between 40 and 400 nanometers for disinfection. Light of the correct wavelength can penetrate cells of pathogenic organisms, structurally altering DNA and preventing cell function. As with ozone, the principle advantage of UV disinfection is that no trace chlorine residual remains in the treated effluent. However, because UV light must penetrate the water to be effective, the TSS level of CSOs can affect the disinfection ability. As such, to be effective UV must be preceded by thorough separation of solids from the combined sewage. Pretreatment by sedimentation, high-rate sedimentation and/or filtration may be required to reduce suspended solids concentrations to less than 20 to 40 mg/l or so depending on the water quality goals.

Disinfection reduces potential public health impacts from CSOs but needs to be used in conjunction with other technologies, as it cannot reduce CSO volume, settleable solids, or floatables.

In order to protect aquatic life in the receiving waters, dechlorination facilities would need to be installed whenever chlorination is used as a disinfectant. Dechlorination would be accomplished by injection of sodium bisulfite in the flow stream before discharge of treated CSO flow to waterways. Dechlorination with sodium bisulfite is rapid; hence no contact chamber is required. However, even with the addition of dechlorination, the DEP believes that there could be a residual of as much as 1 mg/L from a CSO disinfection facility and there is still a potential to form other harmful disinfection bi-products.

Expansion of WWTP Treatment

Hunts Point WWTP recently completed a major headworks upgrade to consistently achieve primary treatment and disinfection for wet weather flows up to 400 MGD. Prior to this upgrade, the plant was only capable of handling a sustained wet weather flow of approximately 259 MGD. A Wet Weather Operating Plan for the Hunts Point WWTP (July 2003, as modified September 2004) was required as part of the Nitrogen Consent Order to provide recommendations for maximizing treatment of wet weather events during construction. The report outlined three primary objectives in maximizing treatment for wet weather flows: (1) consistently achieve primary treatment and disinfection for wet weather flows up to 400 MGD; (2) consistently provide secondary treatment for wet weather flows up to 260 MGD before bypassing the secondary treatment system (the plant will have the ability to provide a secondary level of treatment for 1.3×DDWF); and (3) do not appreciably diminish the effluent quality or destabilize treatment upon return to dry weather operations.

An expansion of the headworks does not appear viable because infrastructure constraints in the main sewage pump station preclude the installation of larger equipment, In addition, the BNR treatment process must be protected against high wet weather flows due to the concerns about washing out the biomass from the aeration tanks. The Step Feed BNR process requires higher aerator effluent suspended solids concentrations and results in higher solids loadings to the final settling tanks. Because of the higher solids loadings and deeper sludge blankets, solids may be washed out of the final clarifiers during major storm events unless secondary treatment flow is limited to 1.3×DDWF and contact stabilization mode is used during the wet weather flow to minimize the loss of the autotrophic organisms essential to BNR.

7.2.8. Receiving Water Improvement

Receiving waters can also be treated directly with various technologies that improve water quality. Below are described the different treatment options that could aid in improving water quality in conjunction with CSO control measures:

Outfall Relocation

Outfall relocation involves moving the combined sewer outfall to another location. For example, an outfall may be relocated away from a sensitive area to prevent negative impacts to that area. In general, outfall relocation is not considered a feasible alternative in New York City, due in part to extensive construction, disruption to City streets and high construction costs.

However, it may be feasible for a collection system to be modified such that CSO is shifted to a different existing outfall that may have better mixing characteristics or the capability to better handle a CSO discharge. For example, moving a CSO discharge from poorly mixed or narrow channel/tributary to a well-mixed/open waters area would improve water quality in a particular waterbody. In-Stream Aeration

In-stream aeration would improve the DO content of the Creek by adding air directly to the water column via diffusers placed within the waterbody. Air could be added in large enough volumes to bring any waterbody into compliance with the ambient water quality standards. However, depending on the amount of air that would be required to be transferred into the water column, the facilities necessary and the delivery systems required could be extensive and impractical. An alternative would be to deliver a lower volume of air and control short term anoxic conditions that may result from intermittent wet weather overflows. DEP continues to investigate in-stream aeration as a method of meeting DO standards at the recently constructed English Kills in-stream aeration facility. The first of three years of testing was completed in the summer of 2009 and preliminary data analysis was completed in February 2010.

Maintenance Dredging

The maintenance dredging technology is essentially the dredging of settled CSO solids from the bottom of waterbodies periodically. The settled solids would be dredged from the receiving waterbody as needed to prevent use impairments such as access by recreational boaters and kayakers, as well as abate nuisance conditions such as odors. The concept would be to conduct dredging periodically or routinely to prevent the use impairment/nuisance conditions from occurring. Dredging would be conducted as an alternative to structural CSO controls such as storage. Bottom water conditions between dredging operations would likely not comply with DO standards and bottom habitat would degrade following each dredging.

This technology allows CSO settleable solids to exit the sewer system and settle in the waterbody generally immediately downstream of the outfall, but without regular or periodic dredging, such mounds can extend a thousand feet or more. The settled solids usually combine with leaves and accumulate into a "CSO mound". This CSO mound would then be dredged and removed from the water environment. The assumption is that dredging would occur prior to the CSO mound creating an impairment or nuisance condition. Generally, it is envisioned that maintenance dredging would be performed prior to a CSO mound building to an elevation that it becomes exposed at low tide or mean lower low tide. The extent and depth of dredging would depend on the rate of accretion, or build-up of settleable solids, and preferred years between dredging.

Dredging can be accomplished by a number of acceptable methods. Methods of dredging generally fall into either floating mechanical or hydraulic techniques, with a variety of variants for both techniques. The actual method of dredging selected would depend on the physical characteristics (grain size, viscosity, etc.) of the sediments that require removal, the extent of entrained pollutants (metals, etc), the local water currents, the depth and width of the waterbody and other conditions such as bridges that could interfere with dredge/barge access. It is likely that CSO sediments would require removal with a closed bucket mechanical dredge or an auger/suction-head hydraulic dredge. Removal techniques, however, would be site specific.

After removal of CSO sediments, the material would likely be placed onto a barge for transport away from the site. On-site dewatering may be considered as well. Sediments would then be off-loaded from the barge and shipped by land methods to a landfill that accepts New York Harbor sediments. Recently, harbor sediments have been shipped to a facility licensed to accept such sediments. Regardless, there are no obvious sediment mounds near the head end of Westchester Creek, and commercial shipping traffic travels to within close proximity of the head end. Therefore, dredging is not retained for further consideration for Westchester Creek.

Flushing Tunnel

A flushing tunnel improves the water quality of a receiving waterbody by introducing a steady flow of oxygen-rich water into an area that is stagnant and/or suffers from oxygen depletion. In addition to improving the water quality, a flushing tunnel allows the waterbody to become self-cleansing. A flushing tunnel would involve the construction of tunnel well below existing grade elevation, from the source to the stagnant waterbody. In addition to the flushing tunnel, an intake structure with a trash rack would be located at the source of the water and a pumping station would be constructed to convey the flushing water from the tunnel entrance to the stagnant waterbody. If located in a navigable waterway, the intake structure and related infrastructure would have to be located so that it does not interfere with commercial and recreational maritime traffic.

While a flushing tunnel could improve the water quality at the head of the Creek, it would not reduce the number of CSO events or the volume of CSO that would be discharged into Westchester Creek. As a result, this alternative was not further evaluated.

7.2.9. Solids and Floatables Control

Technologies that provide solids and floatables control do not reduce the frequency or magnitude of CSO overflows, but can reduce the presence of aesthetically objectionable items such as plastic, paper, polystyrene and sanitary “toilet litter” matter, etc. These technologies include both end-of-pipe technologies such as netting and screens, as well as BMPs such as catch basin modifications and street cleaning which could be implemented upstream of outfalls in the drainage area. Each of these technologies is summarized below:

Netting Devices

Netting devices can be used to separate floatables from CSOs by passing the flow through a set of netted bags. Floatables are retained in the bags, and the bags are periodically removed for disposal. Netting systems can be located in-water at the end of the pipe, or can be placed in-line to remove the floatables before discharge to the receiving waters.

Containment Booms

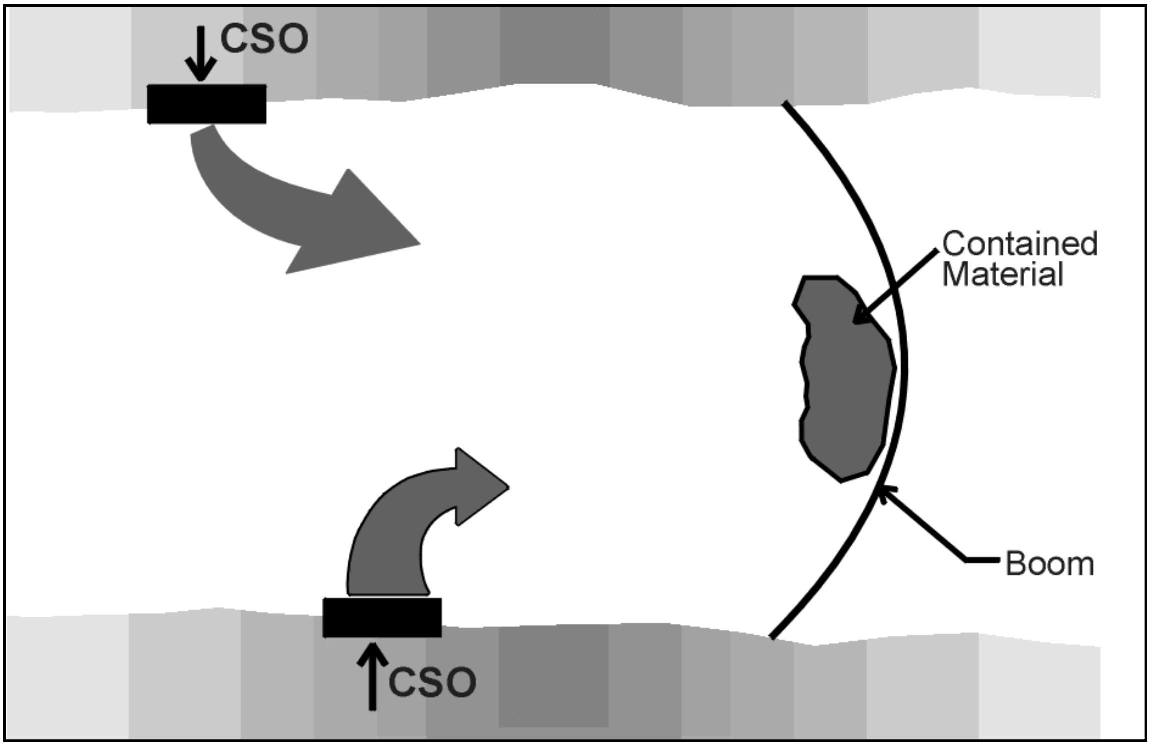
Containment booms are specially fabricated floatation structures with suspended curtains designed to capture buoyant materials. They are typically anchored to a shoreline structure and to the bottom of the receiving water. After a rain event, collected materials can be removed using either a skimmer vessel or a land-based vacuum truck. A 2-year pilot study of containment booms was conducted by New York City in Jamaica Bay. An assessment of the effectiveness indicated that the containment booms provided a retention efficiency of approximately 75 percent. An illustration of a containment boom is shown in Figure 7-5.

Skimmer Vessels

Skimmer vessels remove materials floating within a few inches of the water surface and are being used in various cities, including New York City. The vessels range in size from less than 30 feet to more than 100 feet long. They can be equipped with moving screens on a conveyor belt system to separate floatables from the water or with nets that can be lowered into the water to collect the materials. Skimmer vessels are typically effective in areas where currents are relatively slow-moving and can also be employed in open-water areas where slicks from floatables form due to tidal and meteorological conditions. New York City currently operates skimmer vessels to service containment boom sites.

Bar Screens (Manually Cleaned)

Manually cleaned bar screens can be located within in-line CSO chambers or at the point of outfall to capture floatables. The configuration of the screen would be similar to that found in the influent channels of small wastewater pumping stations or treatment facilities. Retained materials must be manually raked and removed from the sites after every storm. For multiple CSOs, this would result in very high maintenance requirements. Previous experience with manually cleaned screens in CSO applications has shown these units to have a propensity for clogging. In Louisville, KY, screens installed in CSO locations became almost completely clogged with leaves from fall runoff. Because of the high frequency of cleaning required, it was decided to remove the screens. Thus, manually cleaned bar screens will be eliminated from further consideration.



Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Containment Boom

FIGURE 7-5

Weir-Mounted Screens (Mechanically Cleaned)

Horizontal mechanical screens are weir-mounted mechanically cleaned screens driven by electric motors or hydraulic power packs. The rake mechanism is triggered by a float switch in the influent channel and returns the screened materials to the interceptor sewer. Various screen configurations and bar openings are available depending on the manufacturer. Horizontal screens can be installed in new overflow weir chambers or retrofitted into existing structures if adequate space is available. Electric power service must be brought to each site.

Baffles Mounted in Regulator

- Fixed Underflow Baffles - Underflow baffles consist of a transverse baffle mounted in front of and typically perpendicular to the overflow pipe. During a storm event, the baffle prevents the discharge of floatables by blocking their path to the overflow pipe. As the storm subsides, the floatables are conveyed to downstream facilities by the dry weather flow in the interceptor sewer. The applicability and effectiveness of the baffle depends on the configuration and hydraulic conditions at the regulator structure. Baffles are being used in CSO applications in several locations including Boston, Massachusetts and Louisville, Kentucky. However, the typical regulator structures in New York City are not amenable to fixed baffle retrofits. Therefore, fixed underflow baffles will be eliminated from further consideration.

- Floating Underflow Baffles - A variation on the fixed underflow baffle is the floating underflow baffle developed in Germany and marketed under the name HydroSwitch by Grande, Novac & Associates. The floating baffle is mounted within a regulator chamber sized to provide floatables storage during wet weather events. All floatables trapped behind the floating baffle are directed to the WWTP through the dry weather flow pipe. By allowing the baffle to float, a greater range of hydraulic conditions can be accommodated. Although this technology has not yet been demonstrated in the United States, there are operating units in Germany.

- Hinged Baffle – The hinged baffle system incorporates two technologies, the hinged baffle and the bending weir. The system design is intended to retain floatables in regulators during storm events. During a storm event, the hinged baffle provides floatables retention while the bending weir increases flow to the plant. After a storm event, retained floatables drop into the regulator channel and then into the sewer interceptor to be removed at the treatment plant. During large storm events that exceed the capacity of the regulator, more flow backs up behind the baffle. To prevent flooding, the hinged baffle opens to allow more flow to pass through the regulator. The bending weir provides additional storage of stormwater and floatables within the regulator during storm events by raising the overflow weir elevation. Similar to the hinged baffle, the bending weir also helps to prevent flooding during large storm events by opening and allowing additional combined sewage to overflow the weir. The bending weir allows an increasing volume of combined sewage to overflow the weir as the water level inside the regulators rises. The major benefit of the system is that it includes a built-in mechanical emergency release mechanism. This feature eliminates the need for the construction of an emergency bypass that many other in-line CSO control technologies require. In addition, the system has no utility requirements and therefore has low O&M costs. A three dimensional view of a bending weir installation is shown in Figure 7-6 (from John Meunier, Inc.)

Catch Basin Modifications

Catch basin modifications consist of various devices to prevent floatables from entering the CSS. Inlet grates and closed curb pieces reduce the amount of street litter and debris that enters the catch basin. Catch basin modifications such as hoods, submerged outlets and vortex valves, alter the outlet pipe conditions and keep floatables from entering the CSS. Catch basin hoods are similar to the underflow baffle concept described previously for installation in regulator chambers. These devices also provide a water seal for containing sewer gas. The success of a catch basin modification program is dependent on having catch basins with sumps deep enough to accommodate hood-type devices. A potential disadvantage of catch basin outlet modifications and other insert-type devices is the fact that retained materials could clog the outlet if cleaning is not performed frequently enough. This could result in backup of storm flows and increased street flooding. New York City has moved forward with a program to hood all of its catch basins.

Floatables Control Best Management Practices (BMPs)

BMPs, such as street cleaning and public education, have the potential to reduce solids and floatables in CSO. These are described in the beginning of this section.

Table 7-Table 7-4 provides a comparison of the floatables control technologies discussed above in terms of the effort to implement the technology, its required maintenance, effectiveness and relative cost.

Table 7-4. Comparison of Solids and Floatable Control Technologies

Technology	Implementation Effort	Required Maintenance	Effectiveness	Relative Capital Cost
Public Education	Moderate	High	Variable	Moderate
Street Cleaning	Low	High	Moderate	Moderate
Catch Basin Modifications	Low	Moderate	Moderate	Low
Weir-Mounted Screens	Low	Moderate	High	Moderate
Screen with Backwash	High	Low	High	High
Fixed Baffles	Low	Low	Moderate	Low
Floating Baffles	High	Low	Moderate	Moderate
Bar Screens – Manual	Low	High	Moderate	Low
In-Line Netting	High	Moderate	High	High
End-of-Pipe Netting	Moderate	Moderate	High	Moderate
Containment Booms	Moderate	Moderate	Moderate	Moderate

For implementation effort and required maintenance, technologies that require little to low effort are preferable to those requiring moderate or high effort. When considering effectiveness, a technology is preferable if the rating is high.

7.2.10. CSO Control Technology Evaluation Summary

Table 7-5 presents a tabular summary of the results of the preliminary technology screening discussed in this section. Technologies that will advance to the alternatives development screening phase are noted under the column entitled "Retain for Consideration."

These technologies have proven successful and have the potential for producing some measurable level of CSO control for Westchester and Pugsley Creeks.

Other technologies were considered as having a positive impact on CSOs but either could only be implemented to a certain degree or could only provide a specific benefit level and, thusly, would have a variable effect on CSO overflow. For instance, DEP has implemented a water conservation program which, to date, has been largely effective. This program, which will be maintained in the future, directly affects dry weather flow since it pertains to water usage patterns. As such, technologies included in this category provide some level of CSO control but in-and-of-themselves do not provide the level of control sought by this program.

Technologies included under the heading "Consider Combining with Other Control Technologies" are those that would be more effective if combined with another control or would provide an added benefit if coupled with another control technology.

The last classification is for those technologies which did not advance through the preliminary screening process.

Table 7-5. Screening of CSO Control Technologies

CSO Control Technology	Retain for Consideration	Implemented to Satisfactory Level	Consider Combining with Other Control Technologies	Eliminate from Further Consideration
Source Control				
Public Education		X		
Street Sweeping		X		
Construction Site Erosion Control		X		
Catch Basin Cleaning		X		
Industrial Pretreatment		X		
Inflow Control				
Storm Water Detention				X
Street Storage of Storm Water				X
Water Conservation		X		
Infiltration/Inflow Reduction	X		X	
Green Strategy				
Various Solutions	X		X	
Sewer System Optimization				
Optimize Existing System	X			
Real Time Control				X
Sewer Separation				
Complete Separation				X
Partial Separation	X		X	
Rain Leader Disconnection				X
Storage				
Closed Concrete Tanks	X			
Storage Pipelines/Conduits	X			
Tunnels	X			

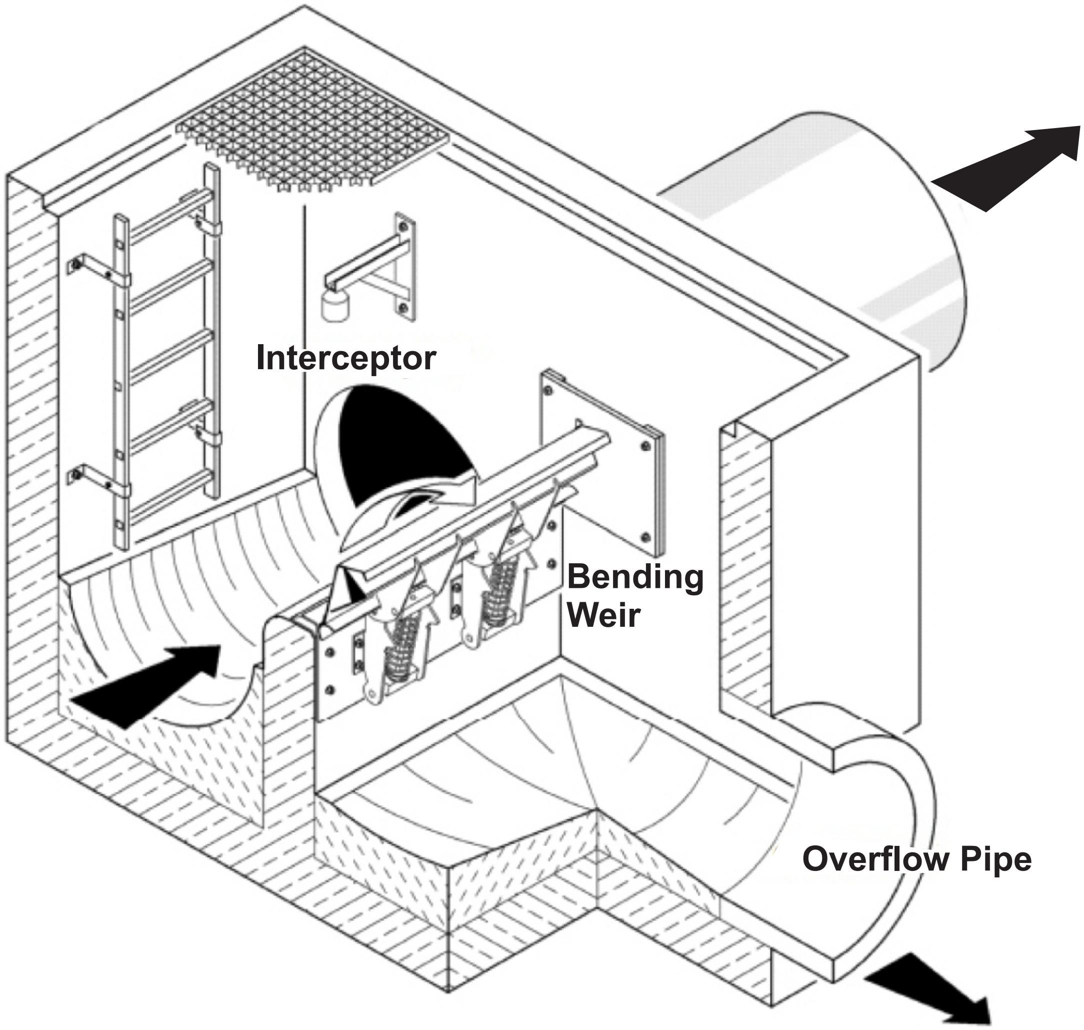
Table 7-5. Screening of CSO Control Technologies

CSO Control Technology	Retain for Consideration	Implemented to Satisfactory Level	Consider Combining with Other Control Technologies	Eliminate from Further Consideration
Treatment				
Screening	X			
Primary Sedimentation		X		
Vortex Separator				X
High Rate Physical Chemical Treatment				X
Disinfection				X
Expansion/Upgrade of WWTP	X		X	
Receiving Water Improvement				
Outfall Relocation	X			
In-stream Aeration			X	
Maintenance Dredging				X
Solids and Floatable Controls				
Netting Systems	X		X	
Containment Booms		X		
Manual Bar Screens				X
Weir Mounted Screens	X		X	
Fixed baffles				X
Floating Baffles				X
Hinged Baffle (Bending Weir)	X		X	
Catch Basin Modifications		X		

The technologies successively moving through the preliminary screening process will be formed into alternatives that will be further screened in subsequent subsections of this section.

7.3. ANALYSIS OF FEASIBLE ALTERNATIVES

The analysis of feasible alternatives will review the control technologies that were retained from Table 7-5 to "consider a reasonable range of alternatives" as expected by federal CSO policy. Full-year model simulations were performed for each engineering alternative selected, and each of these alternatives was then evaluated in terms of compliance with applicable water quality criteria, designated uses, and overall improvement from the established Baseline condition. Compliance with fish and aquatic-life uses was evaluated by comparing projected DO conditions to the applicable New York State numerical criterion. Compliance with recreational uses was evaluated by comparing projected indicator bacteria levels to New York State numerical criteria for secondary recreation. Aesthetics and riparian uses were evaluated by comparing projected levels of floatables, odors and other aesthetic conditions (based on CSO volume reduction) to narrative water quality standards.



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Environmental Protection

Bending Weir

FIGURE 7-6

The retained technologies, summarized below, are considered to be feasible insofar as there is no fatal flaw or obvious cost-benefit limitation, and implementation is expected to result in substantial improvements to water quality.

- *Baseline* (Section 7.3.1). The future "no build" case is not a retained technology as such because water quality goals are not currently attained. However, the Baseline serves as a metric for the other alternatives.
- *Treatment* (Section 7.3.2). Improvements were completed in 2004 to the Hunts Point WWTP Headworks to overcome limitations with treating 2XDDWF. These improvements improve CSO capture.
- *Sewer System Optimization* (Sections 7.3.3, 7.3.6, 7.3.7, and 7.3.8). During the formulation of the Facility Plan for the Reconstruction of the Throgs Neck Pumping Station (Hazen and Sawyer, 2006), two alternatives were identified to reduce CSO in Westchester Creek: relocation of the Throgs Neck Pump Station force main discharge point, and adjusting the Throgs Neck Pump Station capacity. Also, regulator modifications at CSO-29 and CSO-29A to increase in-system capture were evaluated in Section 7.3.6. Additionally, various concepts are evaluated in Section 7.3.8 to optimize the system to remove CSO discharge from poorly mixed Pugsley Creek to a well mixed/open waters area.
- *Storage* (Sections 7.3.5, 7.3.10, 7.3.11, and 7.3.12). All three technologies considered under this category remain feasible alternatives based on cost-effectiveness and DEP experience. Closed concrete tanks, such as the 12 MG storage facility proposed at the head end of Westchester Creek (HP-014) under the 2003 Westchester Creek CSO Facility Plan (URS, 2003), will be further discussed in Section 7.3.5. In-line storage (Section 7.3.6) has potential based on review of the sewer system layout, as-builts, contract drawings, other documents, and drainage calculations. Deep storage tunnels are not usually as cost-effective as tanks, but have an advantage where siting issues present a major challenge, such as in an urban environment. For very large volumes, they are often the only feasible approach, and were therefore used to develop alternatives to provide 80 to 100 percent CSO reduction in Westchester Creek. These alternatives are discussed in Sections 7.3.11 through 7.3.13.
- *Solids and Floatables Controls* (Sections 7.3.7). Screening, weir screens, and netting technologies all provide floatables control at a low cost. These technologies were evaluated for applicability at HP-013 in particular in Section 7.3.7. .
- *Sewer Separation* (Section 7.3.9). High Level Sewer Separation (HLSS) is an ongoing program in DEP and was evaluated specifically for the Pugsley Creek drainage area in Section 7.3.9.

This list of feasible alternatives retained from the preliminary screening represents a toolbox from which a suitable technology may be applied to a particular level of CSO abatement. As suggested in USEPA guidance for long-term CSO control plans, water quality modeling was performed for a "reasonable range" of CSO volume reductions, from no reduction up to 100 percent CSO abatement. The technology employed at each level of this range was selected based on engineering judgment and established principles. For example, any of the storage technologies may be employed to achieve a certain reduction in CSO discharged, but the water quality response would be the same, so the manner of achieving that level of control is a matter of balancing cost-effectiveness and feasibility. In that sense the alternatives discussed below each represents an estimate of the optimal manner of achieving that particular level of control. All costs presented in this section are in June 2011 dollars.

7.3.1. Baseline Condition

Federal CSO policy acknowledges the utility and supports the use of mathematical modeling analyses to improve understanding of waterbody response to CSO controls and other factors affecting the waterbody. The modeling framework described in Section 4.1.1 was constructed for the specific purpose of simulating water quality responses to changes in landside discharges of CSO. The Baseline condition was developed so that the impacts of various alternatives retained for further analysis could be assessed and compared. All model simulations were performed using the same conditions as established for the Baseline condition to isolate the effects and impacts of each assessed alternative. In this way, all evaluated alternatives were compared on the same basis. The specific design conditions established for the Baseline scenario represent the state and operation of the sewer system and other facilities in a manner that predates implementation of any long-term CSO abatement plans, but does include implementation of the CSO Policy Nine Minimum Controls and existing permit requirements regarding system wet-weather capacity, and a projected future condition with regard to population and water use. Briefly, the Baseline condition represents the following:

- Typical annual precipitation data and other environmental conditions (meteorology, tidal conditions, water temperature, salinity, winds, etc.) from calendar year 1988;
- Dry-weather flow at year 2045 projections for the Hunts Point WWTP (130.5 MGD);
- Primary treatment limited by headworks at the Hunts Point WWTP to 259 MGD; and
- Secondary treatment limited by BNR process to 260 MGD (1.3 times DDWF).
- Documented sediments in sewers.

Table 7-6 presents the predicted annual CSO volume discharged to Westchester Creek and the water quality response to these inputs.

Table 7-6. Baseline Conditions Summary

Item	Value
Probable Total Project Cost ($ millions)	n/a
Annual CSO Volume (MG)	767
Percent reduction in Annual CSO Volume	n/a
Number of Projected Overflow Events per Year*	53
Percent hours DO > 4.0 mg/L**	63%
Percent months total coliform < 10,000 per 100 mL**	67%
Percent months fecal coliform < 2,000 per 100 mL**	75%

*CSO events >0.01 MG; **At head end

7.3.2. Hunts Point WWTP Headworks Improvements with Sewer Cleaning

Prior to 2004, Hunts Point WWTP had a design capacity to treat up to 300 MGD through secondary treatment and up to 400 MGD through screenings, primary treatment and disinfection, but the WWTP had limitations at the headworks that precluded flows from reaching these levels. Through 2004, the Hunts Point WWTP was generally only able to treat sustained wet weather flows up to about 260 MGD. As part of CSO reduction activities and as required by the Omnibus IV Consent order, the DEP redesigned the WWTP headworks as part of BNR Phase I upgrades to the WWTP. Headworks improvements included new pumps, headworks influent structures, screens, and influent throttling facility (see Section 3.1.1). These new facilities were installed at a cost of $26.0 million in 2004 as part of a recently completed a major headworks upgrade. To ensure a treatment of 2×DDWF (400 MGD), a new forebay gate chamber to improve throttling of wet weather flows to the plant and an upgrade of the headworks and main sewage pump station (6 new VFD pumps) were accomplished as part of Phase I of the construction upgrade. As a result of this construction Hunts Point WWTP experiences peak flows up to 417 MGD as of 2009.

Note that all subsequent alternatives (Sections 7.3.3 through 7.3.10) were modeled to incorporate the improvements to Hunts Point WWTP headworks. The Hunts Point headworks improvements are included as an element of the East River Open Water WB/WS Facility Plan. As such, the actual cost ($26.0M) for this alternative will be included in all subsequent alternatives for comparison purposes only. In addition, all alternatives were modeled to with the documented sediments removed from the sewer system at CSO-23, CSO-23A, CSO-24, and Internal Overflows 18 and 26. This work was completed and accepted on September 18, 2009. The probable total project cost (PTPC) of sewer cleaning ($0.3M) is included in all alternatives for comparison purposes only. Table 7-7 presents the expected water quality improvements from this alternative.

Table 7-7. Cost/Benefit Summary, Hunts Point WWTP Headworks Improvements

Item	Value
Probable Total Project Cost ($ millions)	$26.3
Annual CSO Volume (MG)	648
Percent reduction in Annual CSO Volume	16%
Number of Projected Overflow Events per Year*	46
Percent hours DO > 4.0 mg/L**	60%
Percent months total coliform < 10,000 per 100 mL**	92%
Percent months fecal coliform < 2,000 per 100 mL**	92%

*CSO events >0.01 MG; **At head end

7.3.3. Relocation of the Throgs Neck Pump Station Force Main Discharge Point

An alternative that was evaluated during the formulation of the Facility Plan for the Reconstruction of the Throgs Neck Pumping Station (March 2006, Hazen and Sawyer) was relocating the pump station’s force main discharge point further downstream (Figure 7-7). The pump station’s existing 36-inch diameter force main ties into a double barrel combined sewer that is located less than 100 feet from the outfall piping that discharges to HP-012. During wet weather conditions, the double barrel combined sewer runs at/near full capacity, which when combined with the Throgs Neck Pumping Station discharge, may cause increased CSO discharges to Westchester Creek.

Four alternative force main discharge locations were modeled to determine what effect, if any, they would have on annual CSO discharge volumes in Westchester Creek:

- 860 feet downstream (arbitrary point);
- 3,050 feet downstream (arbitrary point);
- 5,850 feet downstream to CSO-24; and
- 8,220 feet downstream to Regulator 6.

The model indicated that relocating the Throgs Neck Pumping Station force main discharge point would have minimal impact, at best, on reducing annual CSO volume discharge into Westchester Creek. The reduction in annual CSO volume ranged from 1.5 percent (for 860 feet downstream) to 11 percent (for 8,220 feet downstream). At an estimated cost of over $7,300 per linear foot for extending a 36-inch diameter force main, relocating the force main discharge point is considered cost-prohibitive in comparison to the CSO reduction expected. Note that this cost is exclusive of any pump capacity improvements that might be necessary to overcome the increased head losses a longer force main would have. As a result, this alternative was not further considered.

7.3.4. Adjusting the Throgs Neck Pump Station Capacity

A second alternative that was evaluated during the formulation of the Facility Plan for the Reconstruction of the Throgs Neck Pumping Station (March 2006, Hazen and Sawyer) was adjusting the pump station's discharge capacity. Currently, the pump station has 3 dry-pit submersible centrifugal pumps that can convey a maximum of 37 MGD. However, due to existing pump and force main conditions, as well as electrical service limitations, the existing pump station capacity is considered to be less than 37 MGD. Four alternate new pump station capacities were modeled to determine what effect, if any, they would have on annual CSO discharge volumes to Westchester Creek:

- 18.35 MGD (≈1/2 existing design capacity);
- 45 MGD (≈1.25 existing design capacity);
- 55 MGD (≈1.50 existing design capacity); and,
- 65 MGD (≈1.75 existing design capacity).

The model indicated that adjusting the capacity of the Throgs Neck Pumping Station would increase the annual CSO volume discharge into Westchester Creek by 1 percent to 3 percent. As this alternative increases CSO volume discharge to Westchester Creek, it was not further considered.

7.3.5. 2003 Westchester Creek CSO Facility Plan

The East River Combined Sewer Overflow Abatement Facilities Plan – Westchester Creek (URS, 2003) outlined a plan to improve water quality in Westchester Creek. By focusing on the evaluation of existing water quality conditions in comparison to State numeric water quality standards and identified CSO controls, the 2003 Westchester Creek CSO Facility Plan proposed the construction of an off-line underground CSO storage facility of 12 MG near the head end of Westchester Creek (HP-014), as shown on Figure 7-8. The proposed CSO storage facility would involve the construction of the following:

1. A diversion chamber to re-route the combined sewage flow from the existing outfall conduit to the proposed CSO storage tank;
2. Approximately 900 linear feet of CSO influent conduit between the diversion chamber and the CSO storage tank that would provide 2 MG of in-line storage prior to the CSO storage tank;
3. An underground tank with 10 MG of storage. The tank would have a footprint of approximately 410 feet long by 155 feet wide and would be located on the grounds of the Bronx Psychiatric Center Campus;
4. A screening facility to mechanically screen the influent flow;
5. An underground pumping station and force main system to pump the CSO tank effluent to the Hunts Point WWTP. The pump station would have a rated capacity of 14 MGD;
6. An odor control system to satisfy DEP's air quality requirements; and,
7. Several community improvement projects, including a restroom and clubhouse/storage facility for the Bronxchester and Van Nest Little League organizations and a soccer field (on top of the proposed CSO storage tank) for the Italian American Soccer League of New York.

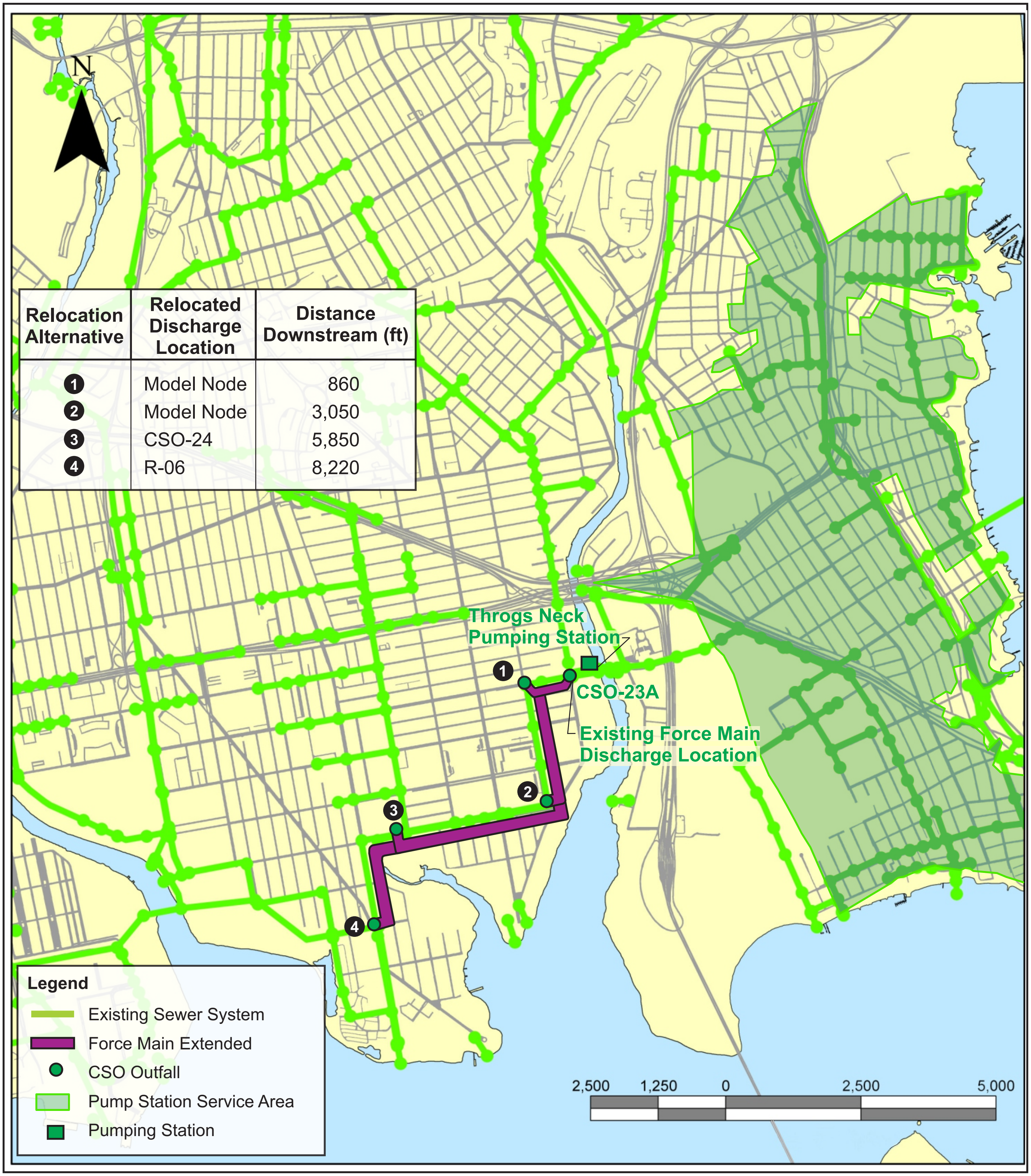
Due to the hydraulic limitations of the existing sewer system, the facility would be designed as a "dead end" or "lock-out" tank. After the tank has completely filled with captured combined sewage, the additional CSO is bypassed directly to the head of Westchester Creek without passing through the tank, thus receiving no treatment.

The PTPC for this alternative is approximately $440.2 million. The water quality benefits derived from implementation of this alternative (in conjunction with the Hunts Point WWTP Headworks Improvements alternative) are presented in Table 7-8.

Table 7-8. Cost/Benefit Summary, 2003 Westchester Creek CSO Facility Plan

Item	Value
Probable Total Project Cost ($ millions)	$440.2
Annual CSO Volume (MG)	392
Percent reduction in Annual CSO Volume	49%
Number of Projected Overflow Events per Year*	33
Percent hours DO > 4.0 mg/L**	88%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end



Throgs Neck Pumping Station Force Main Discharge Relocation Alternatives

NYC Environmental Protection

Environmental Protection

Westchester Creek
2003 CSO Facility Plan

FIGURE 7-8

7.3.6. Additional Capture for Treatment (HP-014)

CSO-29 and 29A are two weir/relief structures located along Eastchester Road that convey excess flow from the main combined sewer into the outfall pipe that discharges to HP-014 at the head of Westchester Creek, as shown on Figure 7-9. The main combined sewer collects flow from as far north as 242nd Street, ultimately conveying peak flows of 392 MGD through CSO-29A and 125 MGD through CSO-29 during a wet weather event (1988, JFK data). The HP-014 outfall is responsible for 70 percent of the annual CSO discharge volume to Westchester Creek under the Baseline condition. The weirs in both CSO-29 and 29A are fixed concrete weirs, set at an elevation that is approximately halfway up the 9 foot high sewer main invert, leaving 4-5 feet of unused pipe volume in the combined sewer.

After conducting stormwater calculations utilizing the DEP's "Design Criteria and Procedures for the Preparation of Drainage Plans" and analyzing CSO-29 & 29A, an alternative was developed to increase each structure's overflow weir height by two feet, thus providing additional CSO capture and reducing discharge at HP-014. DEP's internal design requirements stipulate that any sewer modification must satisfy certain design conditions to ensure the integrity of the collection system is unchanged or improved by the alteration. The 5-year peak flow immediately upstream of the weir is calculated through standard drainage plan calculations as defined in the DEP's "Design Criteria and Procedures for the Preparation of Drainage Plans" (revised on April 26, 2000). This required capacity is compared to the actual capacity of the downstream conveyance structures at the maximum design depth of flow, which is full for all circular and elliptical sewers and 95 percent full for flat-top monolithic sections with a minimum freeboard of 3 inches. This approach necessarily presumes that the system satisfied the drainage plan requirement before the proposed alteration since the capacity is assumed to occur under open-channel conditions. However, surcharging is presently known to occur, particularly in portions of the collection system that were designed using less-stringent criteria. Provided there is no flooding in the service area before the modification, the current configuration may be presumed to be adequate under design conditions regardless of surcharging that may be occurring, and the intent of the drainage plan may therefore be satisfied by simply maintaining the same capacity in the proposed configuration as was available in the existing configuration. The standard equation for a sharp-crested, unsubmerged weir suggests that lengthening of a weir whose crest has been elevated will conserve capacity at any given water level. In addition, the raised and lengthened weir will have greater capacity at higher flow depths. Therefore, raising these weirs will not change the drainage plan and will not create higher water levels upstream for storms greater than the storm creating the design flow depth in the combined sewer.

However, in order to raise the weirs at CSO-29 & 29A by two feet and maintain the existing flow conditions within the sewer system, the effective weir length at each overflow structure would have to be increased by approximately 150 percent. As the main sewer interceptor and the overflow sewer main that discharges to HP-014 are located in close proximity within Eastchester Road, it is feasible to consider constructing a new and significantly longer overflow weir structure at both CSO-29 & 29A. The new overflow weir structures would provide flow characteristics similar to the existing conditions, but also be capable providing an additional two feet of CSO capture.

Constructing an additional two feet of weir height at CSO-29 & 29A will reduce the annual CSO discharge volume from HP-014 by 401.1 MG, resulting in similar water quality benefits as the 2003 Westchester Creek CSO Facility Plan. This benefit is partially realized by exporting some of the CSO flow that would discharge at HP-014 to the downstream Westchester Creek outfalls. While the annual CSO volume at HP-014 would be reduced by 401 MG, the *net* overall CSO volume reduction in Westchester Creek is projected to be 228 MG, as the downstream outfalls (HP-012, HP-013, HP-016, and HP-033) are anticipated to have minor to somewhat moderate increases in annual CSO volume. While the Pugsley Creek outfall (HP-013) would receive the largest volume of exported CSO (from 144 MG to 244 MG) from the proposed improvements at CSO-29 and CSO-29A, there are ways to cost-effectively minimize the impacts to Pugsley Creek, which will be further discussed in Sections 7.3.7 and 7.3.8.

It should be noted that the retrofitting of bending weirs within the existing CSO-29 & 29A structures was also considered as a possible alternative to induce in-line storage, rather than the reconstruction of CSO-29 and 29A. However, due to physical limitations within the CSO-29 & 29A structures and the possibility of causing upstream flooding, bending weirs were ultimately disqualified as a viable alternative. However, as this technology continues to evolve, bending weirs may be re-evaluated as a possible low-cost alternative during the project design stage.

The PTPC for this alternative is approximately $82.6 million. The water quality benefits derived from implementation of this alternative (in conjunction with the Hunts Point WWTP Headworks Improvements alternative) are presented in Table 7-9. Note that the PTPC for this alternative is conceptual in nature and does not consider any utility relocation or significant traffic control measures that may be needed to accommodate construction.

Table 7-9. Cost/Benefit Summary, Raising Weirs at CSO-29 and CSO-29A

Item	Value
Probable Total Project Cost ($ millions)	$82.6
Annual CSO Volume (MG)	539
Percent reduction in Annual CSO Volume	30%
Number of Projected Overflow Events per Year*	33
Percent hours DO > 4.0 mg/L**	87%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.7. Additional Capture for Treatment (HP-014), Floatables Control (HP-013)

As discussed in Section 7.3.6, the Pugsley Creek outfall (HP-013) is projected to receive an additional 100 MG per year of CSO flow as a result of the proposed improvements to CSO-29 and CSO-29A. A significant adverse impact of the flow increase would be the potential increases in discharges of aesthetically deleterious floatables. In order to adequately manage the additional floatables load that would be discharged to Pugsley Creek, a 200 MGD floatables control facility is proposed to be constructed between CSO-24 and HP-013, as shown on Figure 7-10. CSO-24 is located within Lacombe Avenue, between Pugsley and Barrett Avenues, adjacent to New York City parkland. The outfall is located approximately 850 ft south of CSO-24 in the New York City parkland. As discussed below, among the different screening technologies that are available, all but netting can be disqualified from consideration for use at HP-013:

NYC Environmental Protection

Additional Capture for Treatment
Outfall HP-014

FIGURE 7-9

Floatables Control
Outfall HP-013

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 7-10

- *Manually Cleaned Bar Racks* – Potential flooding when screens blind.
- *Horizontally Raked Bar Screens* – Horizontal screens would keep the floatables in-line for removal at the downstream Hunts Point WWTP screening facility. Based on DEP evaluations associated with the Bronx River, the existing Hunts Point WWTP screening facilities might not be able to handle a significant new screenings load (URS, 2005). Thus, this technology cannot be further considered for evaluation. A 200 MGD horizontal screening facility would have a conceptual PTPC of $35.1 million.
- *Mechanical Screens* – This type of facility would require an above grade building and various site appurtenances (driveway, security fencing, etc.). The only land available in the vicinity of CSO-24 appears to be New York City parkland. The construction of an above grade building on parkland could be considered an alienation of parkland, thus requiring approval from the New York State Legislature. A 200 MGD mechanical catenary screening facility would have a conceptual PTPC of $83.5 million.
- *Netting Facility* – This technology can be constructed in an in-line configuration (within an underground vault) or in an end-of-pipe configuration (at the outfall), depending upon the exact location of the piping. One promising in-line arrangement would be to re-route the outfall piping through Barrett Avenue, allowing for the netting facility to be located within a lightly traveled, dead end street that backs up to the parkland. In the event that the netting facility has to be constructed within the New York City parkland, it could be done discretely, with only access hatches and a driveway being located above grade. In the event the nets become blinded or are taken out of service, the netting facility would be provided with a bypass capable of conveying the full capacity of the existing pipe. During a typical precipitation year, the nets would need to be replaced about 2 to 3 times per month. A 200 MGD netting facility would have a conceptual PTPC of $11.3 million.

The PTPC for this alternative is approximately $94.0 million. The water quality benefits derived from implementation of this alternative are presented in Table 7-10. As in 7.3.6, note that the PTPC for this alternative is conceptual in nature and does not consider any utility relocation or significant traffic control measures that may be needed to accommodate construction.

Table 7-10. Cost/Benefit Summary, Additional Capture for Treatment & Floatables Control

Item	Value
Probable Total Project Cost ($ millions)	$94.0
Annual CSO Volume (MG)	539
Percent reduction in Annual CSO Volume	30%
Number of Projected Overflow Events per Year*	33
Percent hours DO > 4.0 mg/L**	87%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.8. Additional Capture for Treatment (HP-014), Pugsley Creek Sewer (From CSO-24)

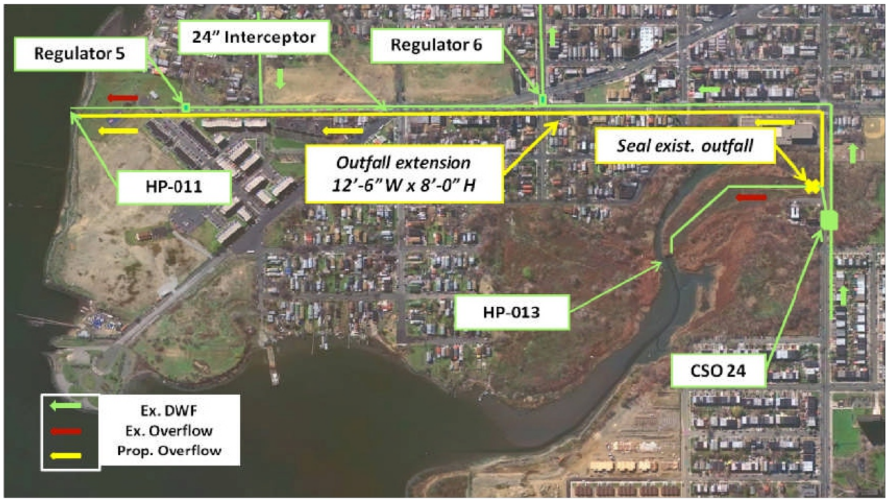
As noted in Section 7.3.6, although over half the CSO removed from HP-014 is projected to be conveyed to the Hunts Point WWTP for treatment, a portion of the additional CSO captured as a result of the proposed weir modifications at CSO-29A and CSO-29 would discharge at the head end of Pugsley Creek. It is expected that the additional CSO discharged to Pugsley Creek would be quickly transported from the head end of the Creek to the more open waters of the lower portion of Westchester Creek and the Upper East River where relatively large amounts of dilution are available. However, Pugsley Creek itself, which is generally dry during periods of low rainfall, does not have the same assimilative capacity of these larger waterbodies. Additionally, Pugsley Creek is located within a public park, and access to the Creek is expected to increase as Parks Department plans for Pugsley Creek Park are implemented. While the floatables control facilities discussed in Section 7.3.7 would mitigate adverse aesthetic impacts, they would not address other impacts to water quality in Pugsley Creek caused by the additional discharge. Due its lack of capacity to dilute CSO discharges and accessibility by the public, it is undesirable to divert additional CSO to Pugsley Creek even if the discharge of floatables is mitigated. Therefore, alternatives were evaluated, in conjunction with the weir modifications at CSO-29A and CSO-29, that could divert flow away from the head end of Pugsley Creek. The most promising approach identified was to construct additional sewer capacity from CSO-24 at the head end of Pugsley Creek downstream to Regulator R-6, which overflows to the Upper East River in relatively well-mixed open waters.

The abilities of various sewer modifications to cost-effectively reduce CSO discharges to Pugsley Creek were analyzed. Additionally, potential constructability issues and conformance with DEP's internal drainage plan criteria were also considered for each alternative. The following three basic approaches, each coupled with weir modifications at CSO-29A and CSO-29, were considered for hydraulic evaluations and are shown in Figure 7-11:

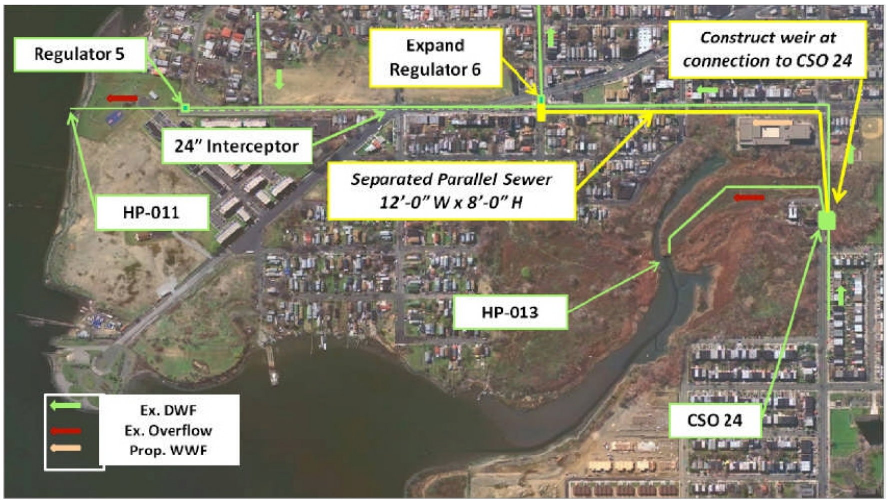
Concept #1: Outfall HP-013 Relocation. Relocate outfall HP-013 from Pugsley Creek to the Upper East River by constructing an outfall extension from CSO-24 to the vicinity of existing outfall HP-011.

Concept #2: New Wet Weather Parallel Sewer. Construct a new parallel sewer from CSO-24 to Regulator 6. The sewer would be the same size and with the same invert elevations and slopes as the existing combined sewer. The proposed sewer would convey only wet weather flows. A weir at the head end would divert wet weather flow at the upstream end via a new inlet weir so that dry weather flow (DWF) would remain in the existing combined sewer between CSO-24 and Regulator 6.

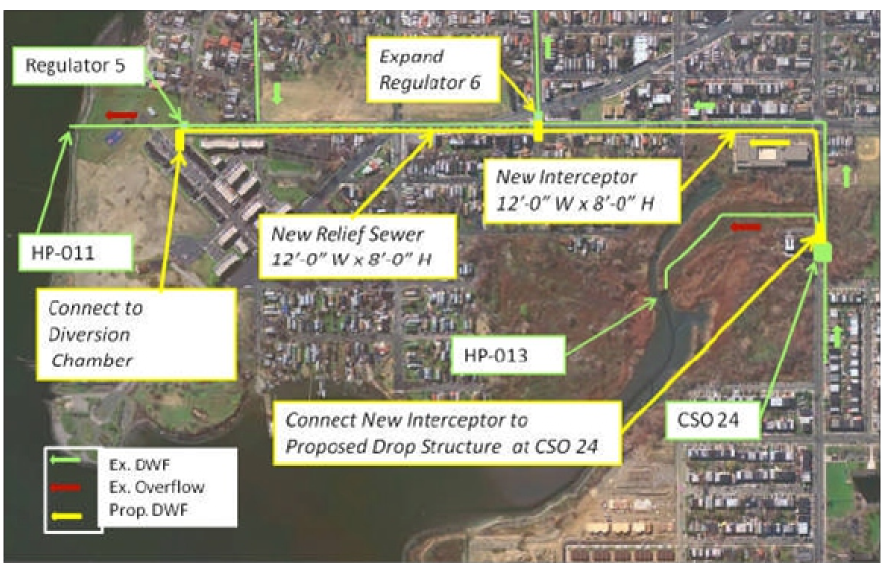
Concept #3: New Parallel Combined Sewer. Construct a new parallel sewer from CSO-24 to Regulator 6. The new sewer would be parallel and sized equivalent to the existing combined sewer, but with a steeper slope. The new combined sewer would convey all of the DWF from upstream of CSO-24 in addition to wet weather flows that exceed the capacity of the existing combined sewer which, combined with the increased slope, should minimize sediment deposition between the structures and reduce maintenance requirements. The existing combined sewer would then only be used to convey wet weather flows.



Concept 1. Outfall Relocation



Concept 2. Wet Weather Parallel Sewer



Concept 3. Parallel Sewer

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Environmental Protection

Alternate Concepts for Pugsley Sewer

FIGURE 7-11

Each of the preliminary concepts were modeled and evaluated for their ability to reduce CSO in Pugsley Creek and to maximize conveyance of flows to the Hunts Point WWTP. The results of these model runs are shown in Table 7-11. Additionally, multiple configurations of each concept were evaluated based on constructability, cost-effectiveness, and ability to conform with DEP's internal 5-year design storm drainage criteria. All three options appeared to address the objective to mitigate increased CSO discharges to Pugsley Creek, and all alternatives evaluated appear to be constructible. The parallel combined sewer concept, however, was determined to be the preferred option primarily because it is the most cost-effective solution that could comply with DEP drainage plan criteria. This concept is also the most constructible option because the work would be done within existing streets and it requires the least maintenance due to improved flow velocities that would minimize sediment deposition.

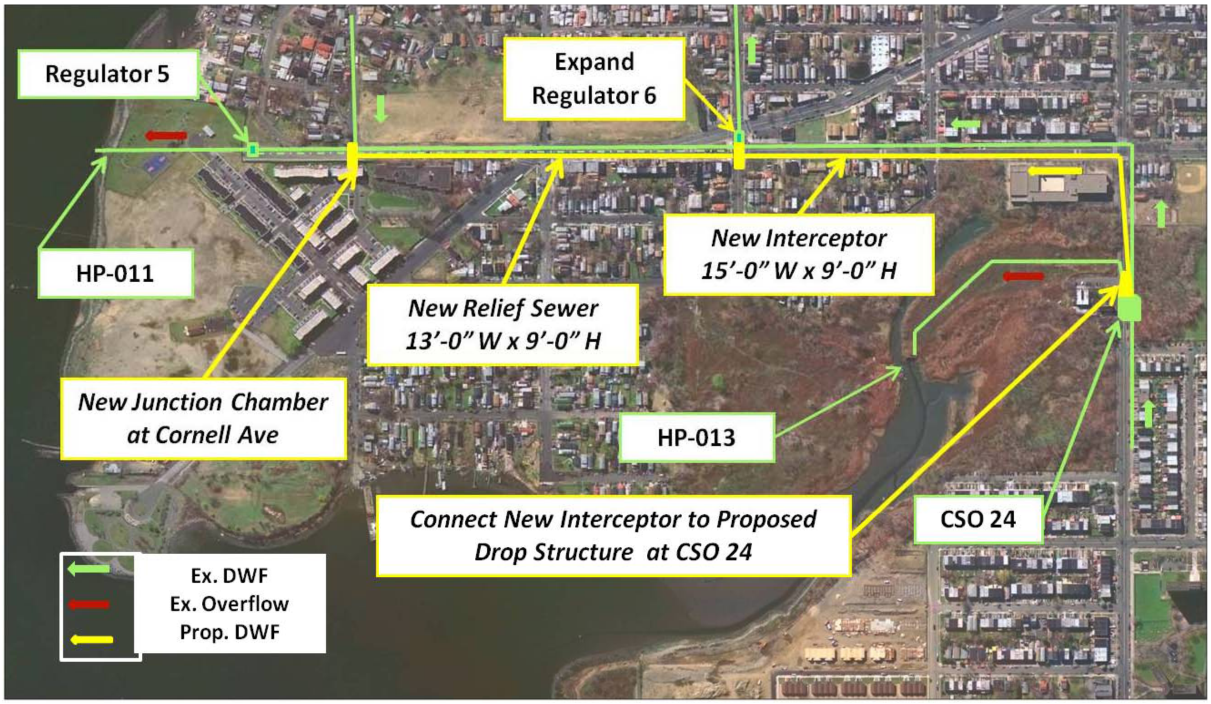
Subsequent to the preliminary Pugsley Sewer alternative analysis, a DEP drainage plan analysis was initiated to verify the design of the preferred relief sewer alternative with respect to its conformance with the 5-year design storm. Based on the drainage plan analysis, the design of the proposed sewer was refined. This alternative proposes a parallel sewer between CSO 24 and Regulator 6 that is 15 ft x 9 ft with invert elevations at the upstream and downstream ends of -5.0 ft and -10.28 ft, respectively. Additionally, a 13 ft x 9 ft sewer segment downstream of Regulator 6 will have the same invert elevations and slopes as the existing combined sewer on White Plains Road and will terminate at a new junction chamber at Cornell Avenue, where it will combine with the existing White Plains Road and Cornell Avenue sewers. A schematic of the parallel sewer is shown in Figure 7-12. Table 7-11 compares the modeling results of the Pugsley Creek Sewer and weir modifications to the Baseline modeling results.

Table 7-11. Annual CSO Volumes for Pugsley Creek Sewer (MG)

Waterbody	Baseline	New Parallel Sewer + Weir Modifications
Bronx River	938	607
East River	1,698	1,461
Pugsley Creek	144	0
Westchester Creek	622	247
Total CSO[1]	3,402	2,314
WWTP	51,185	52,344

(1) Total of waterbodies shown, not inclusive of entire service area.

The PTCP for this alternative, including the costs of the Hunts Point WWTP upgrade, sewer cleaning, and weir modifications at CSO-29 and CSO-29A, is $203.9 million. The water quality benefits derived from implementation of the alternative are presented in Table 7-13.



Environmental Protection

Pugsley Creek Sewer Schematic

Table 7-12. Cost/Benefit Summary, Additional Capture for Treatment & Pugsley Creek Sewer

Item	Value
Probable Total Project Cost ($ millions)	$203.9
Annual CSO Volume (MG)	247
Percent reduction in Annual CSO Volume	68%
Number of Projected Overflow Events per Year*	33
Percent hours DO > 4.0 mg/L**	87%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.9. High Level Sewer Separation

DEP routinely implements high level sewer separation (HLSS) through its Bureau of Water and Sewer Operations (BWSO) to address persistent flooding complaints and to provide a safe level-of-service in combined sewer service areas. Street catch basins are disconnected from the combined sewers and routed to a new storm sewer network constructed at a comparatively shallow depth. HLSS captures runoff from streets and sidewalks, which typically comprise about a third of the area in most neighborhoods in New York City. In addition, runoff from driveways, front yards, and other private properties often discharge to public rights-of-way so that, for drainage planning purposes, HLSS is expected to capture and divert 50 percent of stormwater runoff from the combined sewer collection system. The portion of stormwater that ultimately contributes to CSO is a function of the local collection system among other considerations, so this reduction in runoff does not necessarily translate directly into CSO reductions.

The HLSS alternative is retained by DEP as stated in the July 31, 2010 Modification Request to provide a detailed evaluation of the approach as a means of mitigating increased CSO from outfall HP-013 on Pugsley Creek resulting from upstream collection system enhancements. HLSS was evaluated in two phases; the preliminary evaluation was designed to determine whether a CSO reduction on a scale similar to the Pugsley relief sewer concept (another approach to mitigating increased CSO from HP-013 on Pugsley Creek) could be realized, and the second phase developed adequate engineering detail to develop an associated cost estimate and determine constructability.

The preliminary phase was performed as part of the technical support of the July 31, 2010 Modification Request submittal. Increasing levels of HLSS were modeled by reducing the percentage of combined service area tributary to regulator CSO-24 (outfall HP-013), first in the local contributing runoff area, then in the entire tributary area upstream of Pugsley Creek. CSO-24 at the head end of Pugsley Creek receives flow from two sewers: the Zerega Avenue sewer that conveys flow from most of the eastern portion of the Bronx and the Pugsley Avenue sewer that serves a landlocked portion of the service area directly north of CSO-24 (the “local” area). Changes in the “local” area would be expected to have more direct impacts to overflows from CSO-24. Sewer separation rates (i.e., combined sewer inflow reductions) of 10, 30, 50, and 75 percent were evaluated for the local runoff area, and the 50 percent separation rate was used for the overall area.

InfoWorks modeling results for HLSS are shown in Table 7-13. These preliminary results suggested that the local area could be targeted for HLSS and achieve the CSO reductions necessary. Separation of the local area catch basins could achieve the target of mitigating CSO increases to Pugsley Creek from upstream sources, and although the larger upstream area would reduce CSO further, it would be impractical to implement HLSS on such a large area on a reasonable timescale. The detailed evaluation therefore focused on the local area, roughly defined as all areas tributary to CSO-24 that do not have additional relief upstream.

Table 7-13. Estimated CSO Reduction from Preliminary HLSS Alternatives (MG/yr)

Sewer Separation	HP-013 (Pugsley Creek)	Total of all HP Outfalls
10% of Local Tributary Area	16	34
30% of Local Tributary Area	47	90
50% of Local Tributary Area	77	145
75% of Local Tributary Area	111	212
50% of Larger Upstream Area	185	941

To simulate HLSS in detail, GIS data was used to determine the area within each model subcatchment that is composed of property lots as defined by the Department of City Planning, then assuming that the "non-lot areas" would constitute the streets and sidewalks that would no longer contribute runoff to the combined sewers. Both the total subcatchment area and the percent impervious were recomputed and the model was rerun with the adjusted runoff properties. CSO reductions are shown in Table 7-14.

Table 7-14. Estimated CSO Reduction from Detailed HLSS Alternatives (MG/yr)

Sewer Separation	Area (acres)	Cost ($ millions)	HP-013 (Pugsley Creek)	Total of all HP Outfalls
Area 1	212.2	$60.1	26	52
Area 2*	460.3	$130.3	46	102
Area 3*	595.0	$168.4	78	146
All areas	843.2	$238.6	96	196
*Areas 2 and 3 include Area 1				

The areas targeted are shown in Figure 7-13. The area immediately adjacent to CSO-24 and extending northward to the Bruckner Expressway was targeted first. The next alternative added the area north of the Bruckner Expressway. A third approach added to the original area the upstream portion along the Zerega Avenue sewer. A final alternative evaluated all three areas together.

The City of New York is expecting to continue its program of high level sewer separation to improve the overall level-of-service. Both PlaNYC and the Green Infrastructure Plan submitted by the City consider HLSS as an integral component to cost-effective water quality improvements, and HLSS is therefore retained for further consideration. However, the anticipated schedule requirements for the Westchester Creek WB/WS Facility Plan do not allow adequate time to fully build out HLSS in the local area. Therefore, HLSS will be deferred to the LTCP phase for this waterbody.

Environmental Protection

Targeted High Level Sewer Separation (HLSS) Areas for Pugsley Creek

FIGURE 7-13

7.3.10. Removal of HP-014

This alternative involves the construction of a deep storage tunnel to intercept and store up to 85 MG of CSO that would normally be conveyed through HP-014 during a wet weather event. The CSO stored in the tunnel would be pumped back into the system after the flow in the sewer system and at the Hunts Point WWTP has returned to a “normal” pattern. This alternative would reduce annual CSO volume from 767 MG to 170 MG, a reduction of approximately 75 percent.

Figure 7-14 shows the tunnel alignment. The 32-foot diameter tunnel was conceptually designed to be 14,100 linear feet in length and at a depth of approximately 140 feet below grade. Due to the lack of available land in the general vicinity, it is anticipated that the tunnel would be constructed under existing roadway right-of-way and Westchester Creek. The tunnel is proposed to start in the vicinity of CSO-29 and roughly follow the route of Waters Place, Westchester Creek and Norton Avenue to its terminus point near the intersection of Norton and Olmstead Avenues. At the end of the tunnel, a 75 MGD pump station and 48-inch force main system would be constructed that would convey the flow to an interceptor located within O’Brien Avenue, near Regulators 6 and 7. This interceptor conveys flow under the Bronx River to the Hunts Point WWTP.

The deep tunnel would be provided with five shafts: a retrieving shaft (60 feet in diameter), three access shafts (8 feet in diameter), and a launch/pump station shaft (100 feet in diameter). In addition, diversion piping between the existing outfall and the deep tunnel infrastructure would also be required. The PTPC for this alternative is approximately $1,027.6 million. The water quality benefits derived from implementation of this alternative (in conjunction with the Hunts Point WWTP Headworks Improvements alternative) are presented in Table 7-15.

Table 7-15. Cost/Benefit Summary, Removal of HP-014

Item	Value
Probable Total Project Cost ($ millions)	$1,027.6
Annual CSO Volume (MG)	170
Percent reduction in Annual CSO Volume	78%
Number of Projected Overflow Events per Year*	33
Percent hours DO > 4.0 mg/L**	99%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.11. Removal of HP-014 and HP-016

This alternative involves the construction of a deep storage tunnel to intercept and store up to 96 MG of CSO that would normally be conveyed through outfalls HP-014 & HP-016 during a wet weather event. The CSO stored in the tunnel would be pumped back into the system after the flow in the sewer system and at the Hunts Point WWTP has returned to a “normal” pattern. This alternative would reduce annual CSO volume from 767 MG to 97 MG, a reduction of approximately 86 percent.

CSO Volume Reduction	Outfall(s) Diverted	Tunnel Dia (ft)
75%	HP-014	32
86%	HP-014, 016	34
99%	HP-014, 013, 016	36

CSO Storage Tunnel Alignment Alternatives Outfalls HP-013, HP-014, HP-016

NYC Environmental Protection

FIGURE 7-14

The 34-foot diameter tunnel was conceptually designed to be 14,100 linear feet in length at a depth of approximately 140 feet below grade, following the same route as the tunnel alternative described in Section 7.3.8 and shown on Figure 7-14. This tunnel alternative would also be provided with five shafts and would require diversion piping between the existing outfalls and the deep tunnel infrastructure. The PTPC for this alternative is approximately $1,083.8 million, including the 75 MGD pump station and 48-inch force main system. The water quality benefits derived from implementation of this alternative (in conjunction with the Hunts Point WWTP Headworks Improvements alternative) are presented in Table 7-16.

Table 7-16. Cost/Benefit Summary, Removal of HP-014 and HP-016

Item	Value
Probable Total Project Cost ($ millions)	$1,083.8
Annual CSO Volume (MG)	97
Percent reduction in Annual CSO Volume	87%
Number of Projected Overflow Events per Year*	17
Percent hours DO > 4.0 mg/L**	100%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.12. Removal of HP-013, HP-014, and HP-016 (100 percent CSO Retention)

This alternative involves the construction of a deep storage tunnel to intercept and store up to 107 MG of CSO that would normally be conveyed through outfalls HP-013, HP-014 and HP-016 during a wet weather event. The CSO stored in the tunnel would be pumped back into the system after the flow in the sewer system and at the Hunts Point WWTP has returned to a "normal" pattern. This alternative would reduce annual CSO volume from 767 MG to 10 MG, a reduction of approximately 99 percent.

The 36-foot diameter tunnel was conceptually designed to be 14,100 linear feet in length and at a depth of approximately 140 feet below grade, following the same alignment as the previous two tunnel alternatives and as shown on Figure 7-14. The deep tunnel would require five shafts and diversion piping between the existing outfalls and the deep tunnel infrastructure. The PTPC for this alternative is approximately $1,122.7 million, including the 75 MGD pump station and 48-inch force main system. The water quality benefits derived from implementation of this alternative (in conjunction with the Hunts Point WWTP Headworks Improvements alternative) are presented in Table 7-17.

Table 7-17. Cost/Benefit Summary, Removal of HP-013, HP-014, and HP-016

Item	Value
Probable Total Project Cost ($ millions)	$1,154.5
Annual CSO Volume (MG)	9.7
Percent reduction in Annual CSO Volume	99%
Number of Projected Overflow Events per Year*	5
Percent hours DO > 4.0 mg/L**	100%
Percent months total coliform < 10,000 per 100 mL**	100%
Percent months fecal coliform < 2,000 per 100 mL**	100%

*CSO events >0.01 MG; **At head end

7.3.13. Alternatives Summary

Fourteen grey infrastructure alternatives were evaluated to improve water quality in Westchester Creek. Of these, 12 were retained for further evaluation, and are listed in order of increasing PTPC escalated to June 2011 dollars in Table 7-18, and numbered as such to clarify the cost-performance curves used to identify the point of diminishing return, or "knee-of-the-curve."

Table 7-18. Costs and Elements of Evaluated Alternatives

Evaluated Alternative	PTPC June 2011 (million)	Element Description (PTPC June 2011 in millions)
1. Hunts Point WWTP Headworks Improvements and Sewer Cleaning	$26.3	New forebay gate chamber, headworks upgrade, main sewage pump station upgrade ($26.0M); sewer cleaning at CSO-23, CSO-23A, CSO-24, and Internal Overflows 18 and 26 ($0.3M)
2. Additional Capture at CSO-29 and CSO-29A	$82.6	Item 1 and weir modifications at CSO29/29A ($56.3M)
3. Additional Capture and Floatables Control	$94.0	Item 2 with screening facility at CSO-24 ($11.3M)
4. Additional Capture and HLSS in Area 1	$142.7	Item 2 with HLSS in Area 1 ($60.1M)
5. Additional Capture and Pugsley Creek sewer	$203.9	Item 2 with a new parallel sewer from CSO-24 to Cornell Ave (White Plains Rd) ($121.3M)
6. Additional Capture and HLSS in Areas 1 and 2	$212.9	Item 2 with HLSS in Areas 1 and 2 ($130.3M)
7. Additional Capture and HLSS in Areas 1 and 3	$251.0	Item 2 with HLSS in Areas 1 and 3 ($168.4M)
8. Additional Capture and HLSS in all 3 Areas	$321.2	Item 2 with HLSS in Areas 1, 2, and 3 ($238.6M)
9. 2003 Westchester Creek CSO Facility Plan	$440.2	Item 1 and 12 MG storage tank ($413.9M)
10. Removal of HP-014	$1,027.6	Item 1, 85 MG tunnel ($844.5M), 75 MGD pump station and force main ($156.8M)
11. Removal of HP-014 and HP-016	$1,083.8	Item 1, 96 MG tunnel ($900.7M), 75 MGD pump station and force main ($156.8M)
12. Removal of HP-013, HP-014, and HP-016	$1,154.5	Item 1, 107 MG tunnel ($971.4M); 75 MGD pump station and force main ($156.8M)

7.4. PERFORMANCE-COST ANALYSIS OF ALTERNATIVES

The CSO Policy (USEPA, 1994) expects that long-term CSO control planning will "consider a reasonable range of alternatives" that would achieve a range of CSO control levels, up to 100 percent capture. The Policy further states that the "analysis of alternatives should be sufficient to make a reasonable assessment of cost and performance" and that the selected alternative must provide "the maximum pollution reduction benefits reasonably attainable." For the alternatives presented in Section 7.3, an evaluation of cost and performance was conducted to assist in the alternative selection.

Figure 7-15 presents a graphic representation of the performance and cost of the shortlisted alternatives shown in Table 7-18. The upper panel shows the performance, in terms of CSO volume and number of events, versus cost, where each alternative is represented as a point along a curve connecting all of the alternatives from the least costly/effective to the most costly/effective. The blue line/closed squares represent calculated CSO volume and the red line/open triangles represent the number of CSO events (scale on right hand side). As shown, successive scenarios represent higher levels of CSO control and higher costs. The scenarios range from 767 MG to 10 MG in annual CSO volume and from 53 to 5 CSO events, for costs from $26.3 million to over $1.1 billion. The lower panel is similar, except that percentage reduction from Baseline CSO volume and number of CSO events is shown. The percentage reductions range from zero to approximately 100 percent.

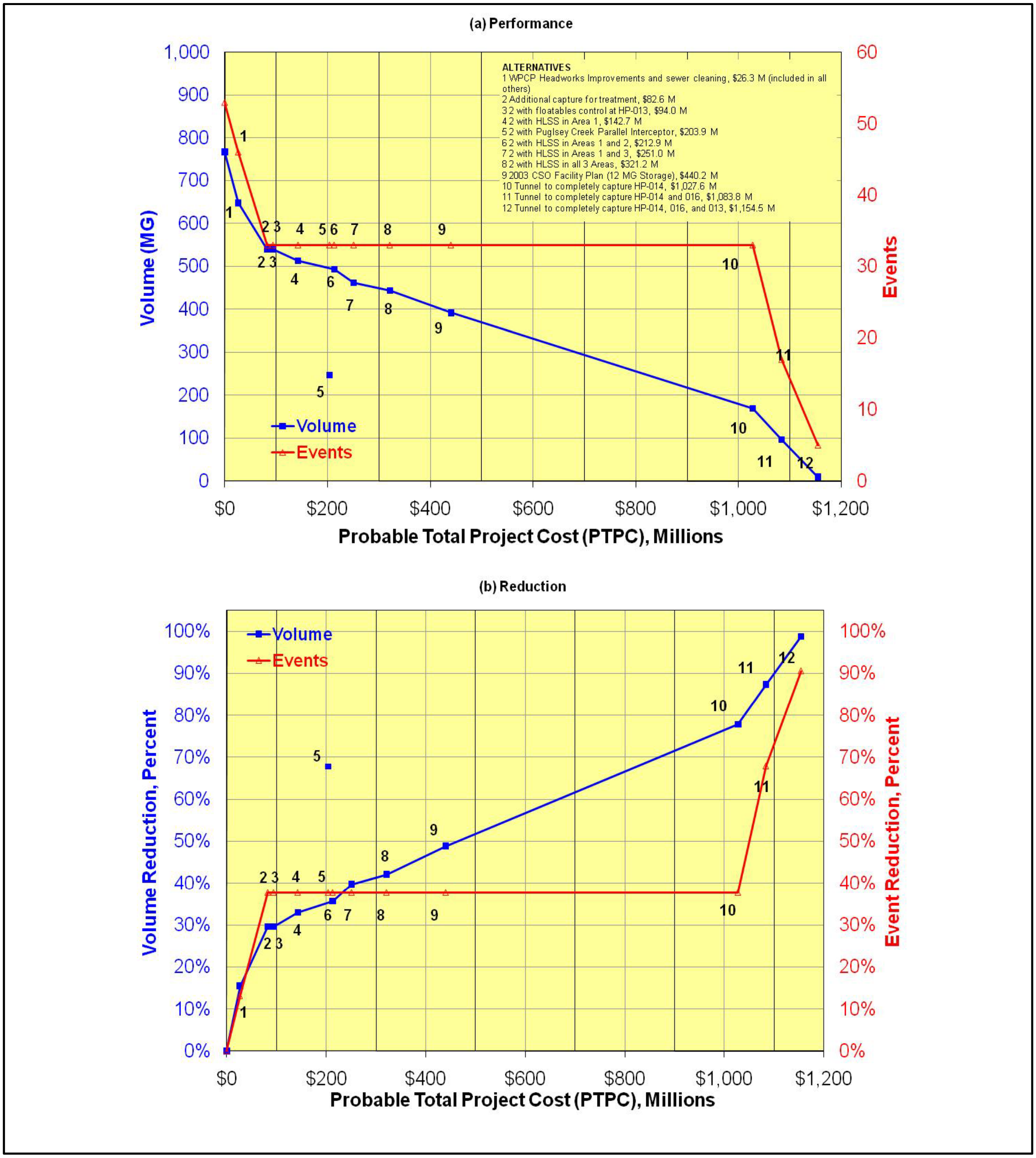
As shown in Figure 7-15, Alternative 5 clearly represents the best alternative in terms of CSO reduction attained in Westchester Creek for the costs incurred. This alternative includes modifying CSO-29 and CSO-29A to induce additional capture for treatment combined with construction of a parallel sewer from CSO-24 to mitigate CSO discharge in Pugsley Creek. It should be noted that part of the reduction in flow is due the diversion of CSO flow from Pugsley Creek to the Upper East River via outfall HP-011; however, model results indicate that CSO discharges from HP-011 will decrease from Baseline conditions even with the additional flows from Pugsley Creek due to the Hunts Point headworks upgrade.

7.5. WATER QUALITY AND USE BENEFITS OF ALTERNATIVES

To complete the assessment of alternatives, an evaluation was made of whether and how cost-effectively each alternative achieves water quality and water use objectives. According to the CSO Policy, a selected alternative must be adequate to meet water quality standards and designated uses unless those standards and uses are unattainable through CSO control.

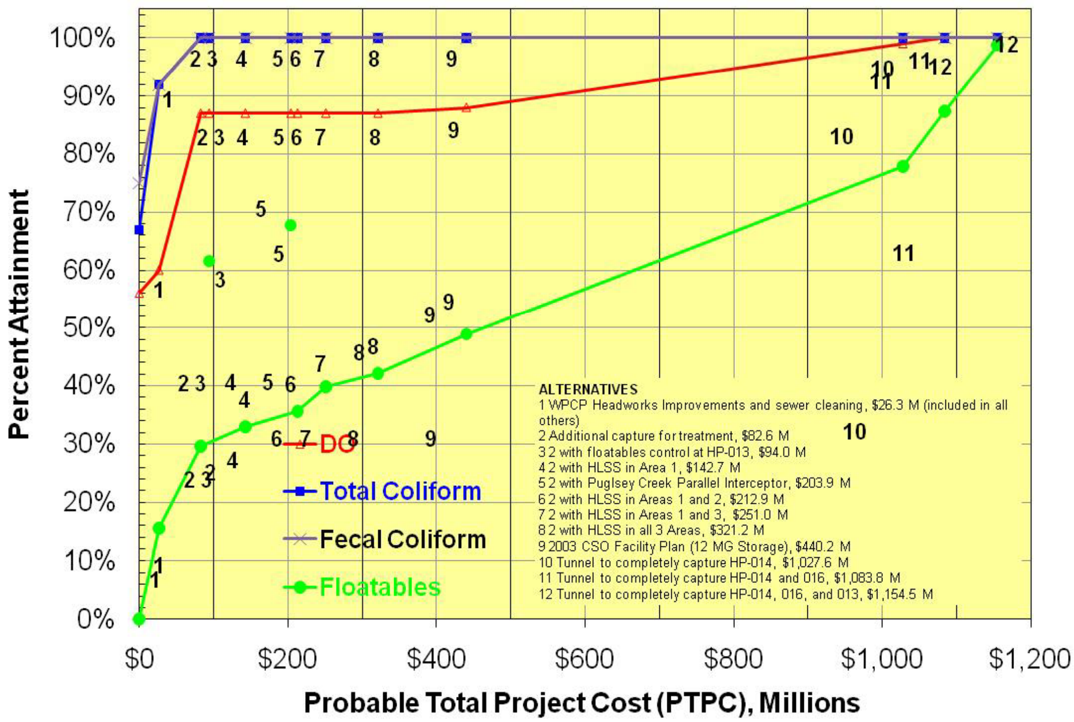
Figure 7-16 presents water quality benefits, in terms of DO, total coliform and fecal coliform, versus CSO control cost analysis, depicting attainment of numerical criteria versus costs for each evaluated scenario. Compliance for DO is determined as a percentage of hours during the year that comply with the applicable existing Class I criteria, while total and fecal coliform percentages are based upon meeting the geometric mean numerical criteria for a given month. As shown, Alternative 5 represents a point at which marginal water quality improvement becomes considerably more expensive.

Class I DO criterion is projected to be met 87 percent of the time (or more, depending on the location within the Creek) for Alternative 5, and coliform bacteria criteria are projected to be met 100 percent of the time. It is important to note that the selected alternative provides 100 percent attainment for fish propagation at the mouth of Westchester Creek and extending approximately 10,000 feet into the Creek (north of the Cross Bronx Expressway). Due to the general presence of existing commercial/industrial businesses and restrictive fencing along the length of Westchester Creek, it is unlikely that fishing could be conducted anywhere but in the vicinity of the mouth of the Creek. Regardless, it is possible that the higher aquatic use could be supported throughout the Creek given the inherent uncertainties and conservative assumptions associated with the receiving water modeling analyses.



Environmental Protection

Cost-Performance Curves
CSO Reduction vs. Cost



Environmental Protection

Cost-Benefit Curve
Water Quality vs. Cost

7.6. ATTAINMENT OF APPLICABLE NUMERICAL CRITERIA

A comparison of water quality improvements for applicable numerical criteria is presented for the selected alternative (Alternative 5), along with benchmark scenarios (Baseline and 100 percent CSO removal) to isolate the CSO impact to water quality from other influences. Table 7-19 summarizes the percentage of time the numerical criteria are attained for each of the three scenarios, and each numerical limit is discussed in the following subsections.

Table 7-19. Percent of Time Numerical Criteria are Attained for Selected Alternatives

Alternative	Cost ($M)	Percent of Time Criterion is Attained*		
		Dissolved Oxygen (Class I)	Total Coliform (Secondary Contact)	Fecal Coliform (Secondary Contact)
Baseline	-	56%	67%	75%
1. Hunts Point WWTP Headworks Improvements and Sewer Cleaning	$26.3	60%	92%	92%
2. Additional Capture at CSO-29 and CSO-29A	$82.6	87%	100%	100%
3. Additional Capture and Floatables Control	$94.0	87%	100%	100%
4. Additional Capture and HLSS in Area 1	$142.7	87%	100%	100%
4. Additional Capture and Pugsley Creek parallel sewer	$203.9	87%	100%	100%
5. Additional Capture and Pugsley Creek sewer	$212.9	87%	100%	100%
6. Additional Capture and HLSS in Areas 1 and 2	$251.0	87%	100%	100%
7. Additional Capture and HLSS in Areas 1 and 3	$321.2	87%	100%	100%
8. Additional Capture and HLSS in all 3 Areas	$440.2	88%	100%	100%
9. 2003 Westchester Creek CSO Facility Plan	$1,027.6	99%	100%	100%
10. Removal of HP-014	$1,083.8	100%	100%	100%
11. Removal of HP-014 and HP-016	$26.3	100%	100%	100%

*Percent of annual hours for DO; percent of annual months for pathogen criteria

7.6.1. Dissolved Oxygen

The Class I DO criterion is not less than 4.0 mg/L. At the head end under Baseline conditions, this criterion is exceeded less than two-thirds of the time during the 1988 precipitation year. Alternative 5 provides significant improvement (31 percent) over Baseline conditions. The complete removal of CSO only provides 13 percentage points of increased attainment over Alternative 5 at a substantially higher cost..

7.6.2. Total Coliform

With respect to the total coliform secondary contact standards of a geometric mean not greater than 10,000 per 100mL, the two evaluated alternatives provide significant improvement over the Baseline condition. Although 33 percentage points higher than Baseline, in both cases complete attainment of the numerical criterion is realized.

7.6.3. Fecal Coliform

As with total coliform, the fecal coliform secondary contact numerical criterion of a geometric mean not greater than 2,000 per 100mL is met 100 percent of the time for both evaluated alternatives. Although the magnitude of the increase may not be large, it is significant in that it brings the waterbody into full attainment of the existing numerical criterion.

7.7. SELECTED ALTERNATIVE

After a complete examination of the costs and benefits of a wide variety of CSO control alternatives, Alternative 5 described in Section 7.3.8 (Additional Capture at CSO-29 and 29A and a new Pugsley Creek parallel sewer) was selected as the Westchester Creek WB/WS Facility Plan to reduce pollutant loads to the Creek in a cost-effective manner. The selected alternative will reduce annual CSO volume discharge to Westchester Creek by 68 percent (from 767 MG to 247 MG) and CSO events by 38 percent (from 53 events to 33 events). In addition, this alternative will raise DO compliance to 87 percent and total/fecal coliform attainment to 100 percent at the head of Westchester Creek.

Note that, based on water quality response, this alternative is roughly equivalent to the 2003 Westchester Creek CSO Facility Plan, but at a much reduced cost, so supplemental low-cost system(s) could be added to meet or exceed the water quality benefits provided by the 2003 Westchester Creek CSO Facility Plan if necessary. With that in mind, the main components of the Westchester Creek WB/WS Facility Plan will include:

1. Construction of new weir/relief structures at CSO-29 and 29A to provide an additional two feet of CSO capture during wet weather events. To ensure similar flow pattern/characteristics as the existing structures, the new weir/relief structures would be between 150 and 200 percent its current length. The PTPC is approximately $56.4 million, exclusive of site-specific conditions that may result in higher costs.
2. The construction of a parallel sewer to divert the increased CSO discharge from the head end of Pugsley to the Upper East River as a result of the new CSO-29 & 29A structures. The PTPC is approximately $121.3 million.
3. The improvements to the Hunts Point WWTP headworks facilities (previously completed for $26 million and included as part of the East River and Open Waters WB/WS Facility Plan).
4. Continued implementation of programmatic controls.

8.0. Waterbody/Watershed Facility Plan

The WB/WS Facility Plan described in this section is the culmination of efforts by DEP to attain the existing water quality standards for Westchester Creek, and recognizes that achieving water quality objectives may require more than the simple reduction in CSO discharges. The multi-faceted approach incorporates several cost-effective engineering solutions with demonstrable positive impacts on water quality, including increased DO concentrations, decreased coliform concentrations, and reductions in nuisance odors and floatables that are a consequence of CSO discharges. The recommended approach also maximizes utilization of the existing collection system infrastructure and treatment of combined sewage at the Hunts Point WWTP.

The subsections that follow present the recommended CSO control components required to ensure the full implementation of the Westchester Creek WB/WS Facility Plan goals. Post-construction compliance monitoring (including modeling), discussed in detail in Section 8.3, is an integral part of the WB/WS Facility Plan, and provides the basis for adaptive management for Westchester Creek.

If post-construction monitoring indicates that additional controls are required, protocols established by DEP and the City of New York for capital expenditures require that certain evaluations are completed prior to the construction of the additional CSO controls. Depending on the technology implemented and on the engineer's cost estimate for the project, these evaluations may include pilot testing, detailed facility planning, preliminary design, and value engineering. Each of these steps provides additional opportunities for refinement and adaptation so that the fully implemented program achieves the goals of the original WB/WS Facility Plan.

8.1. PLAN OVERVIEW

The central element of the Westchester Creek WB/WS Facility Plan is the reduction of overflows from the largest and most upstream outfall on the waterbody (HP-014) by inducing additional capture for treatment and conveying flow away from Pugsley Creek to the East River. As discussed in Section 7.0, a variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Westchester and Pugsley Creeks, ranging from watershed management approaches to total CSO removal, and the regulator modifications necessary to achieve the additional capture yields the greatest improvement in water quality for the capital expenditure required, based on a knee-of-curve type analysis. Combined, the proposed adjustments to the overflow chambers at CSO-29 and CSO-29A and the proposed parallel Sewer from CSO-24 to Cornell Avenue will yield similar water quality results to the original 12 MG retention facility concept developed during the East River CSO Facility Planning at a fraction of the cost. That earlier planning evaluation was constrained by the perceived inability of the collection system to accommodate the design storm under raised weir conditions, but subsequent reevaluations suggest that the previous approach may have been overly conservative with regard to upstream flooding. The proposed modifications include the concomitant lengthening of each of the raised weirs to ensure that the design storm is conveyed without increasing critical hydraulic grade line elevations during wet weather. The projected PTPC of the Westchester Creek WB/WS Facility

Plan is $177.6 million in June 2011, less than half the cost of the 2003 CSO Facility Plan (i.e., $413.9 million).

The WB/WS Facility Plan improves DO compliance to 87 percent at the head end and 100 percent compliance for the lower 1-1/2 miles of Westchester Creek, extending into the Upper East River. Total and fecal coliform would comply with secondary contact numerical criteria on an annual basis in a typical precipitation year, fully protecting the current use of Westchester Creek for boating, canoeing, and kayaking. Water quality within the Creek will even achieve the numerical levels associated with primary contact bacteria standards during bathing season (June - September), although primary contact is not a designated use of Westchester Creek.

Detailed consideration was given to the previous 2003 CSO Facility Plan; however, as discussed above, the storage tank recommended in the 2003 CSO Facility Plan provided similar water quality results to the Additional Capture for Treatment & Pugsley Creek Parallel Sewer alternative recommended in this WB/WS Facility Plan, but at a much higher PTPC and with significant operation and maintenance responsibilities. The remaining alternatives evaluated herein either did not adequately address water quality or were not cost-effective. The two general categories of Throgs Neck Pumping Station alternatives (downstream force main relocation and capacity expansion) would require large capital expenditures that would be difficult to justify given nearly negligible benefit to Westchester Creek water quality. The 80, 90 and 100 percent CSO retention alternatives would require deep tunnels of varying storage capacity (with pumping stations) that would be capable of storing the CSO during wet weather events and conveying it to the Hunts Point WWTP. Although each of these deep tunnel alternatives was expected to increase the amount of time DO attains the numerical criterion at the head end of Westchester Creek to nearly 100 percent during a typical year, a PTPC between approximately $1 and $1.1 billion is not justified based on a knee-of-the-curve analysis.

Although this WB/WS Facility Plan is expected to result in significant improvements to the water quality in Westchester Creek, it is not expected to attain the applicable water quality criterion for DO at all times in a typical year. The DEP will may determine via post-construction monitoring that a WQS revision or variance is necessary in the future. The DEP will continue its ongoing programs and management practices that continue to improve water quality in the New York Harbor complex and the Westchester Creek WB/WS Facility Plan, coupled with the flexibility of adaptive management and the continuation of proven programs, will further advance this cause.

Each component of the Plan is discussed in greater detail in the following sections. As noted previously, the proposed Westchester Creek WB/WS Facility Plan updates the "grey" infrastructure portion of the green strategy outlined in the September 2010 *NYC Green Infrastructure Plan* as described in Section 8.8, with the green infrastructure portion deferred to the LTCP.

8.2. WATERBODY/WATERSHED FACILITY PLAN COMPONENTS

8.2.1. Weir Modifications

Outfall HP-014 is the largest discharge to Westchester Creek. HP-014 receives overflows from relief structures CSO-29A and CSO-29, and in a typical rainfall year discharges nearly 516 MG to the head end, which is 67 percent of the total of 767 MG of CSO discharged to Westchester Creek. In conjunction with other system improvements, a 2-ft increase in the weir crest elevations at CSO-29A and CSO-29, along with an increase in length would reduce discharges from HP-014 to 114 MG, and would reduce the occurrence of overflow from 53 to 19 at that outfall. Compared to other alternatives, raising and lengthening weirs is a very economical and effective solution. Figure 8-1 shows the locations of these two regulating structures; Figure 8-2 provides a schematic of the sewer system in the vicinity. The PTPC of this component of the WB/WS Facility Plan is $56.4 million in June 2011.

The Bureau of Water and Sewer Operations (BWSO) of DEP is responsible for ensuring that the collection system is operating properly, and that changes to the sewer system or in the service area do not impair the ability of the system to accommodate combined flows. Historically, raising weirs has been discouraged due to concerns that upstream flooding may be induced. However, after review by DEP it became evident that the design criteria that underlie this approach are not applicable in the Hunts Point collection system. Specifically, the 5-year peak flow is calculated immediately upstream of the weir, and the combined capacity of the downstream sewer and relief weir must be greater than or equal to the 5-year peak flow with the maximum design depth of flow in the sewer. In order to raise the weir, a required new weir length must be determined such that the combined conveyance capacity is not reduced.

Significantly, the drainage plan was implemented after the construction of much of the City's collection system, so that sewers in existence at that time would not necessarily have conformed to the design standard, and therefore may not be able to accommodate the 5-year peak flow without surcharging, a condition that previously triggered upgrade requirements to bring the system into alignment with the drainage plan. Recently, however, BWSO has recognized that certain portions of the collection system may experience surcharging under the drainage plan design condition without inducing upstream flooding or other functional limits, and that modifications that induce no change in capacity would not necessarily trigger the upgrade requirement. Therefore, weirs may be raised as long as the raised weir would have equal or greater capacity at the design flow depth. Further, a raised weir that is lengthened to provide the same capacity at some critical flow depth will have a *greater* capacity under higher flow depths, providing an additional measure of protection against flooding during extreme events.

8.2.2. Pugsley Creek Parallel Sewer

An additional element of the WB/WS Facility Plan is the construction of a parallel sewer from CSO-24 to a new junction chamber at Cornell Avenue on White Plains Road. Figure 7-12, reprinted as Figure 8-3 for clarity, shows a schematic of the parallel sewer. The new sewer will relieve CSO discharges to Pugsley Creek via outfall HP-013, which would otherwise increase from 144 MG to 244 MG in annual CSO discharge after the weir levels are increased by two feet at CSO-29 and CSO-29A. Diverting additional flow away from the head end of Pugsley Creek is desirable because the small waterbody lacks the capacity to dilute CSO discharges and access by the public to this public park is expected to increase as Parks Department plans for Pugsley Creek Park are implemented. As described in Section 7.3.8, a variety of sewer modifications were evaluated based on their ability to cost-effectively reduce CSO discharges to Pugsley Creek, address potential constructability issues, and conform with DEP's drainage plan. Conformance with the requirements of the drainage plan was considered critical, i.e., any configuration that would not conform was modified to satisfy the drainage plan requirements.

The parallel sewer alternative achieves both conformance with drainage plan criteria and the desired CSO reduction to Pugsley Creek and was preferable from both a maintenance and constructability standpoint. The steeper slope of the parallel sewer will minimize sediment deposition between the structures and reduce maintenance requirements. The routing of this alternative is preferable from a constructability standpoint because all the work will be done within existing streets and would have minimal impact to parkland or recreational facilities, as opposed to other alternatives evaluated which would have to cross such land uses. A full-scale drainage plan analysis has been performed to ensure that all new and existing facilities are capable of conveying flow at the level of service DEP must provide its customers. The PTPC of this component of the WB/WS Facility Plan is $121.3 million in June 2011. The size and route of this sewer may be refined during the design phase based on geotechnical investigations but such modifications will not materially impact the volume of CSO reduction into Pugsley Creek.

8.2.3. Continued Implementation of Programmatic Controls

As discussed in detail in Section 5.0, the DEP currently operates several programs intended to reduce CSO to a minimum and provide treatment levels appropriate to protect waterbody uses. As the effects of the WB/WS Facility Plan and subsequent LTCP become understood through long-term monitoring, ongoing programs will be routinely evaluated based on receiving water quality considerations. Floatables reduction plans, targeted sewer cleaning, real-time level monitoring, and other operations and maintenance controls and evaluations will continue, in addition to the following:

- The 14 BMPs for CSO control required under the City's 14 WWTP SPDES permits will continue. In general, the BMPs address operation and maintenance procedures, maximum use of existing systems and facilities and reduce contaminants in the combined sewer system, thereby reducing water quality impacts. A detailed discussion of the existing BMP program is included in Section 5.3.
- Maintaining the capability of the recently constructed headworks upgrade at the Hunts Point WWTP to convey up to 400 mgd (2×DDWF) through preliminary treatment, primary clarification and chlorination along with a portion of the wet weather flow through secondary treatment is a key component of Bronx River WB/WS Facility Plan to capture CSO.
- The Citywide Comprehensive CSO Floatable Plan (DEP, 2005a) provides substantial control of floatables discharges from CSOs throughout the City and provides for compliance with appropriate DEC and IEC requirements. The Floatables Plan is a living program that is expected to change over time based on continual assessment and changes in related programs.

8.3. POST-CONSTRUCTION COMPLIANCE MONITORING

1. Post-construction compliance monitoring will commence just prior to implementation of CSO controls and will continue for several years in order to quantify the difference between the expected performance (as described in this report) and the actual performance once those controls are fully implemented. Any performance gap identified by the monitoring program can then be addressed through operations adjustments, retrofitting additional controls, or through the implementation of additional technically feasible and cost effective alternatives under the Long Term Control Plan. If it becomes clear that CSO control will not result in full attainment of applicable standards, DEP will pursue the necessary regulatory mechanism for a Variance and/or Water Quality Standards Revision. Due to the dynamic nature of water quality standards and approaches to non-compliance conditions, a period of ten years of operation will be necessary to generate the minimal amount of data necessary to perform meaningful statistical analyses for water quality standards review and revision as discussed in Section 9. Modification to the current DEP Harbor Survey program to more rigorously collect data in Westchester Creek and the Upper East River; and
2. Modeling of Westchester Creek to characterize attainment with numerical water quality standards.

These programs are discussed in detail below, along with anticipated data analyses and mechanisms for responsiveness.

8.3.1. Receiving Water Monitoring

The New York City Harbor Survey primarily measures four parameters related to water quality: DO, fecal coliform, chlorophyll a, and secchi depth. These parameters have been used by the City to identify historical and spatial trends in water quality throughout New York Harbor. Secchi depth and chlorophyll a have been monitored since 1986; DO and fecal coliform have been monitored since before 1972. Recently, enterococci analysis has been added to the program. Except for secchi depth and pathogens, each parameter is collected and analyzed at surface and bottom locations, which are three feet from the surface and bottom, respectively, to eliminate influences external to the water column chemistry itself, such as wind and precipitation influences near the surface or benthic and near-bottom suspended sediments and aquatic vegetation near the bottom. DEP samples 33 open water stations routinely, which are supplemented each year with approximately 20 rotating tributary stations or periodic special stations sampled in coordination with capital projects, planning, changes in facility operation, or in response to regulatory changes.

The post-construction compliance monitoring program will continue along the protocols of the Harbor Survey initially. As shown on Figure 8-4, Westchester Creek contains two locations that are currently sampled or have been sampled historically. These two stations will serve as the Westchester Creek post-construction monitoring sites. All stations related to the Westchester Creek post-construction compliance monitoring program will be sampled a minimum of twice per month from May through September and monthly during the remainder of the year.

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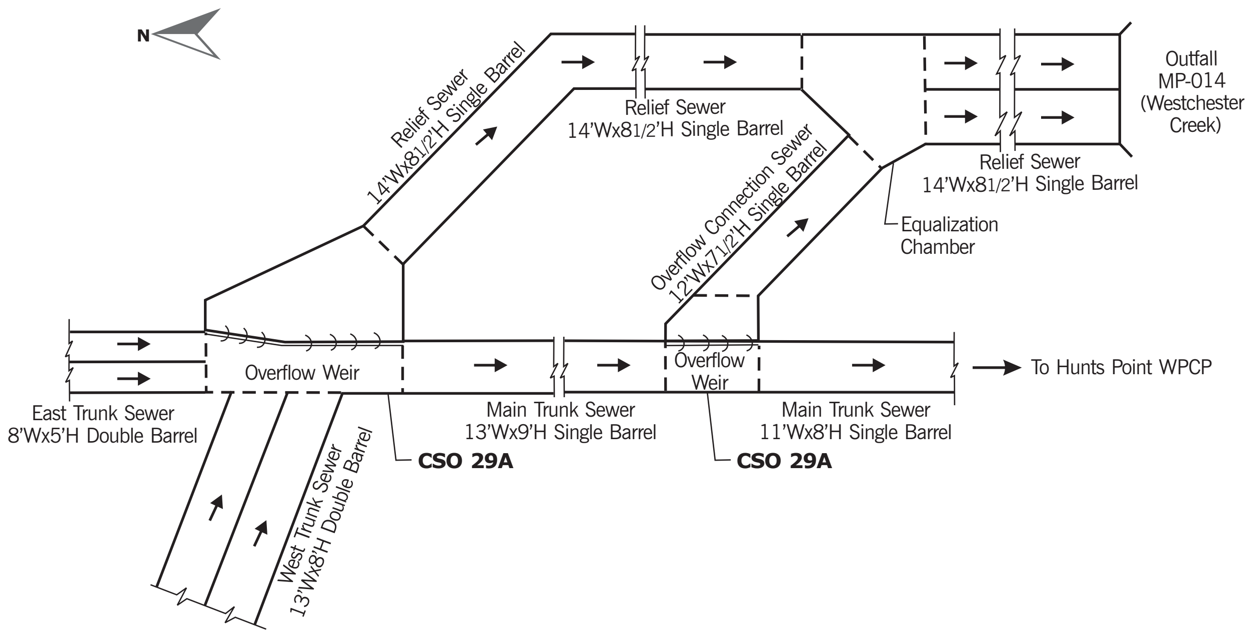
Environmental Protection

Locations of CSO-29A and CSO-29

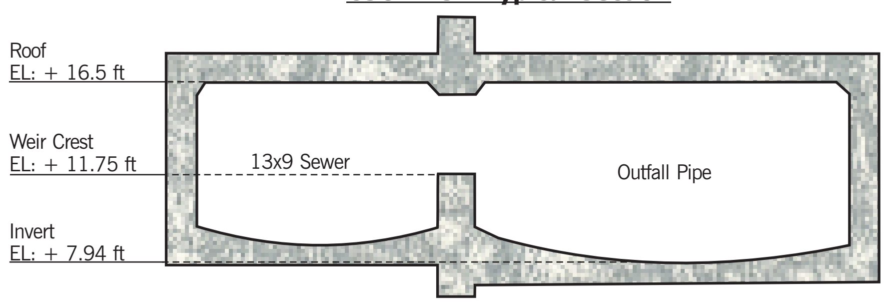
Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 8-1

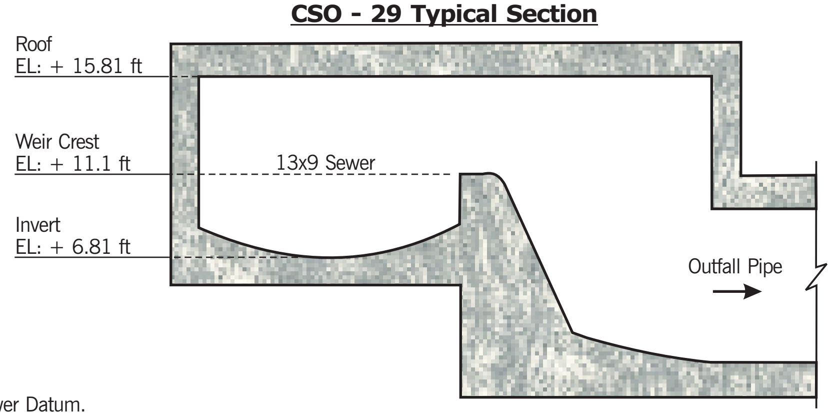
Sewer System Schematic



CSO - 29A Typical Section



CSO - 29 Typical Section



Elevations in Bronx Sewer Datum.

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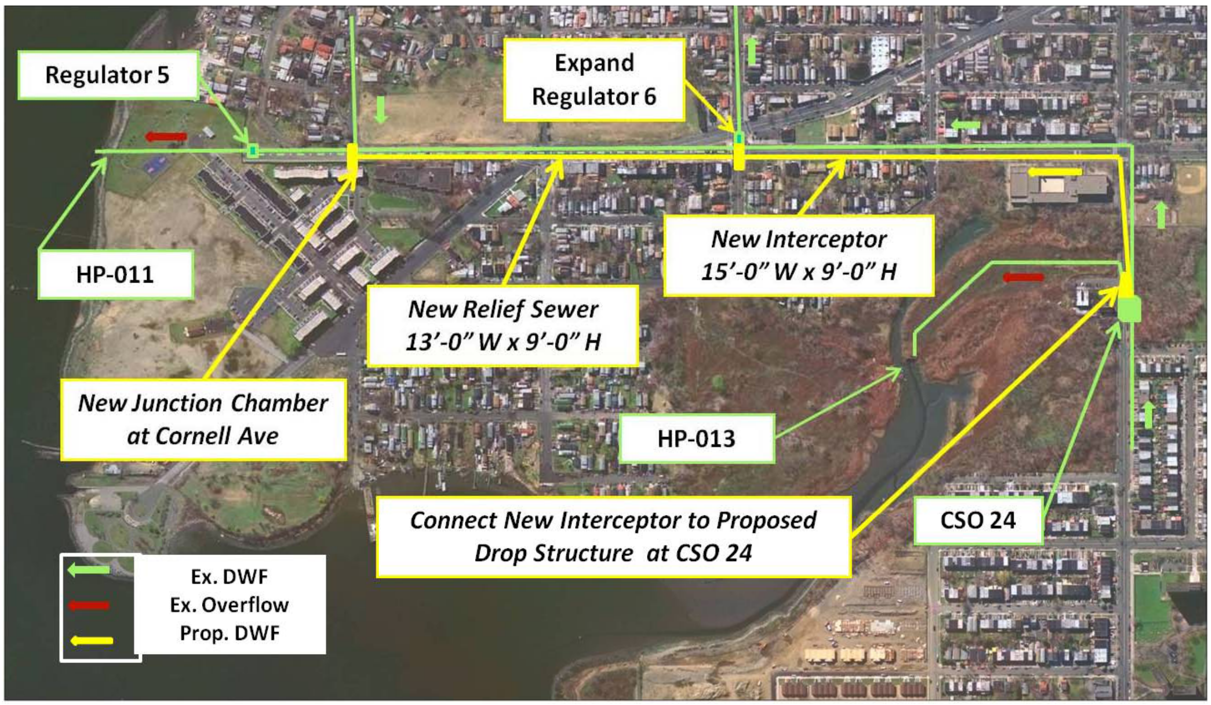
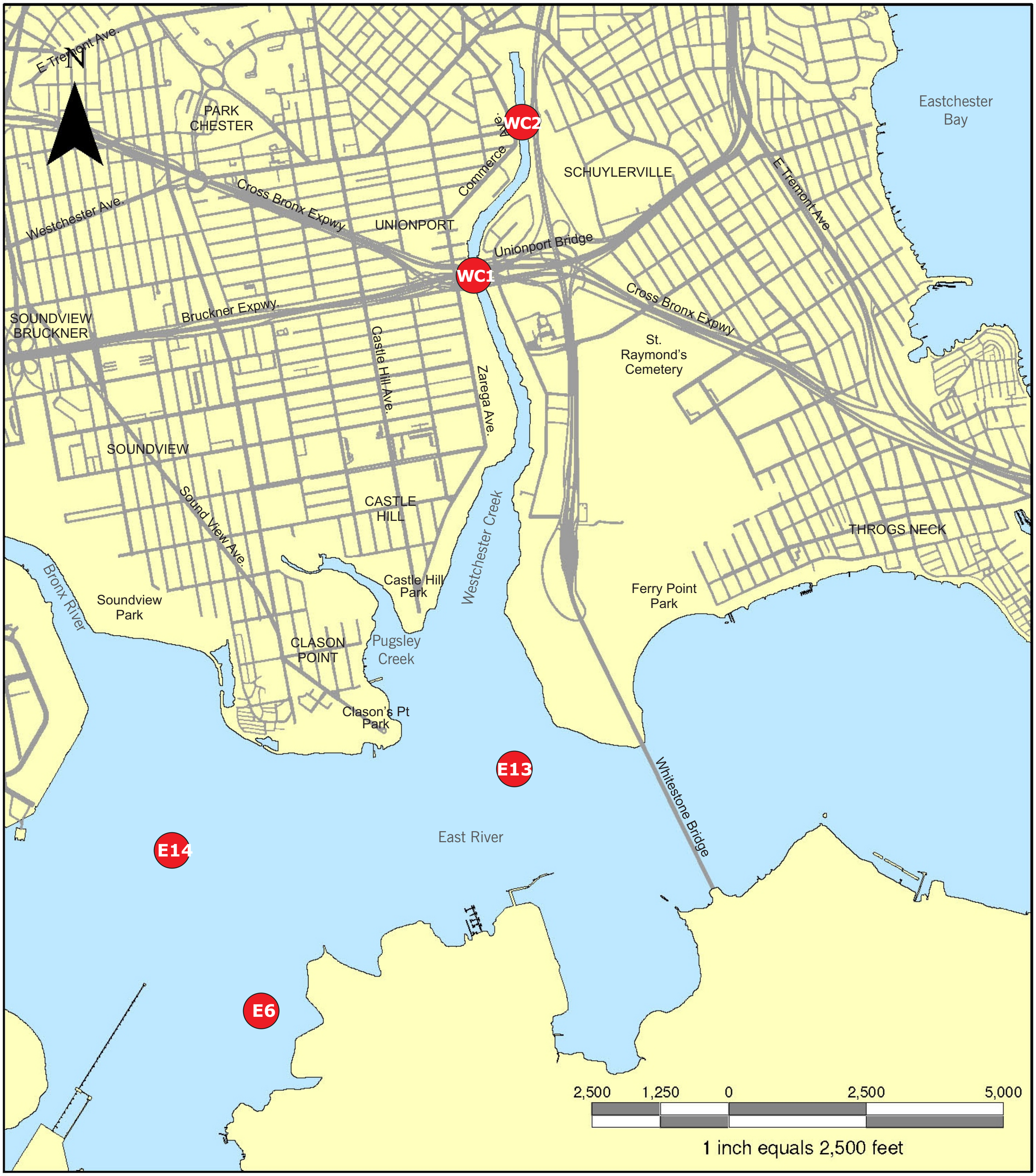
Environmental Protection

Schematic of Overflow Chambers



NYC Environmental Protection

Proposed Pugsley Creek Sewer



Environmental Protection

Proposed Post-Construction Compliance Monitoring Sampling Locations

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE 8-4

Data collected during this program will be used primarily to verify the East River Tributaries Model (ERTM) that will be used to demonstrate relative compliance levels in Westchester Creek. Therefore, during each annual cycle of compliance monitoring, the data collected will be evaluated for its utility in model verification, and stations may be added, eliminated, or relocated depending on this evaluation. Similarly, the parameters measured will be evaluated for their utility and appropriateness for verifying the receiving water model calibration. At a minimum, the program will collect those parameters with numerical water quality criteria (i.e., DO, fecal coliform, and enterococci). In addition, moored instrumentation may be added or substituted at one or more of these locations if continuous monitoring is determined to be beneficial to model verification, or if logistical considerations preclude the routine operation of the program (navigational limits, laboratory issues, etc.).

Post-construction monitoring protocols, QA/QC, and other details are being fully developed under the Citywide LTCP to assure adequate spatial coverage and a technically sound sampling program. The monitoring within each waterbody under DEP's purview will commence no later than the activation of any constructed CSO abatement facility. In those waterbodies where constructed facilities are not proposed, sampling will commence no later than the summer following DEC approval of the WB/WS Facility Plan.

8.3.2. Floatables Monitoring Program

The Westchester Creek WB/WS Facility Plan incorporates by reference the *Citywide Comprehensive CSO Floatables Plan Modified Facility Planning Report* (DEP, 2005a) and *Addendum 1 – Pilot Floatables Monitoring Program* (December 2005) to the Floatables Plan. These documents contain a conceptual framework for the monitoring of floatables conditions in New York Harbor and a work plan for the ongoing pilot program to develop and test the monitoring methodology envisioned in the framework. The objectives set forth in the Floatables Plan provides a metric for LTCP performance, and floatables monitoring will be conducted in conjunction with post-construction compliance monitoring with regard to staffing, timing, and location of monitoring sites. The program will include the collection of basic floatables presence / absence data from monitoring sites throughout the harbor that will be used to rate and track floatables conditions, correlate rating trends to floatables control programs where applicable, and trigger investigations into the possible causes of consistently poor ratings should they occur. Actions based on the floatables monitoring data and investigations could include short-term remediation in areas where monitored floatables conditions create acute human or navigation hazards and, as appropriate, longer-term remediation actions and modifications to the Westchester Creek WB/WS Facility Plan if monitored floatables trends indicate impairment of waters relative to their intended uses.

8.3.3. Meteorological Conditions

The performance of any CSO control cannot be fully evaluated without a detailed analysis of precipitation, including the intensity, duration, total rainfall volume, and precipitation event distribution that led to an overflow or, conversely, the statistical bounds within which the control may be expected to eliminate CSO completely. DEP has established 1988 as representative of long-term average conditions and therefore uses it for analyzing facilities where "typical" conditions (rather than extreme conditions) serve as the basis for design. The comparison of rainfall records at JFK airport from 1988 to the long-term rainfall record is shown on Table 8-1, and includes the return period for 1988 conditions.

Table 8-1. Rainfall Statistics, JFK Airport, 1988 and Long-Term Average

Statistic	1970-2002 Median	1988	
		Value	Return Period (years)
Total Volume (inches)	39.4	40.7	2.6
Intensity, (in/hr)	0.057	0.068	11.3
Number of Storms	112	100	1.1
Storm Duration (hours)	6.08	6.12	2.1

In addition to its aggregate statistics indicating that 1988 was representative of overall long-term average conditions, 1988 also includes critical rainfall conditions during both beach season and shellfishing periods. Further, the average storm intensity for 1988 is greater than one standard deviation from the mean, so that using 1988 as a design rainfall year would be conservative with regard to water quality impacts since CSOs and stormwater discharges are driven primarily by rainfall intensity. However, considering the complexity and stochastic nature of rainfall, selection of any year as "typical" is ultimately qualitative.

Given the uncertainty of the actual performance of the facility and the response of Westchester Creek with respect to widely varying precipitation conditions, rainfall analysis is an essential component of the post-construction compliance monitoring. Multiple sources of rainfall data will be compiled as part of the post-construction monitoring. The primary source of rainfall data will be from the local airports (JFK and La Guardia) and from the meteorological station at Central Park. A second source of rainfall data will be from the rain gages maintained by DEP at its WWTPs and other facilities. A final source of rainfall data will come from the National Weather Service radar NEXRAD data. NEXRAD provides cloud reflectivity data, which must be calibrated to local rainfall data before application. For the purpose of this analysis, one month of radar based rainfall may be purchased for use in the landside modeling analysis. This will provide interpolated data over the entire Westchester Creek tributary drainage area for use in the assessments described in the following section. If any of these data sets is determined to be of limited value in the analysis of compliance, DEP may discontinue its use for that purpose.

8.3.4. Analysis

The performance of the Westchester Creek WB/WS Facility Plan will be evaluated on an annual basis using landside mathematical computer models as approved by DEP. The collection system model that was used in the development of the present WB/WS Facility Plan is expected to serve as the basis for future model-related activities. The DEP believes that the analysis of water quality compliance is best accomplished using computer modeling supported and verified with a water quality monitoring program. Modeling has several advantages over monitoring:

1. Modeling provides a comprehensive vertical, spatial and temporal coverage that cannot reasonably be equaled with a monitoring program;

2. Modeling provides the data volume necessary to compute aggregate statistical compliance values, such as a geometric mean, an absolute limit (e.g., "never-less-than" or "not-to-exceed"), or a cumulative statistic (e.g., the 66-day deficit-duration standard for DO to be promulgated by DEC in the near future);
3. Discrete grab sampling for data collection is necessarily biased to locations and periods of logistical advantage, such as navigable waters, safe weather conditions, daylight hours, etc.; and
4. Quantification of certain chemical parameters must be performed in a laboratory setting which either (a) complicates the use of a smaller sampling vessel that is necessary to access shallower waters not navigable by a vessel with on-board laboratory facilities or (b) limits the number sampling locations that can be accessed due to holding times and other laboratory quality assurance requirements if remote laboratory (non-vessel mounted) facilities are used.

CSO volumes will be quantitatively analyzed on a monthly basis to isolate any periods of apparent noncompliance or performance issues and their impact on water quality. Water quality modeling re-assessment will be conducted every two years based on the previous two years water quality field data. Water quality modeling conditions will be based on the hydrodynamic and meteorological conditions for the study year, documented operational issues that may have impacted the facility performance, and water quality boundary conditions based on Station E13. Results will be compared to the relevant Harbor Survey data to validate the water quality modeling system, and performance will be expressed in a quantitative compliance level for applicable standards. Should this analysis indicate that progress towards the desired results is not being made, the analysis will:

- Re-verify all model inputs, collected data and available QA/QC reports;
- Consult with operations personnel to ensure unusual operational problems (e.g., screening channel o/s, pump repair, etc.) were adequately documented;
- Evaluate specific periods of noncompliance to identify attributable causes;
- Confirm that all operational protocols were implemented, and that these protocols are sufficient to avoid operationally-induced underperformance;
- Re-evaluate protocols as higher frequency and routine problems reveal themselves; and finally,
- Revise protocols as appropriate and conduct Use Attainability Analysis (UAA) and, if necessary, revise the WB/WS Facility Plan.

Following completion of the tenth annual report containing data during facility operation, a more detailed evaluation of the capability of the Westchester Creek WB/WS Facility Plan to achieve the desired water quality goals will take place, with appropriate weight given to the various issues identified during the evaluations documented in the annual reports. If it is determined that the desired results are not achieved, DEP will implement additional measures to improve levels of attainment under typical precipitation conditions. Alternately, the water quality standards revision process may commence with a UAA that would likely rely in part on the findings of the post-construction monitoring annual reports. The approach to future improvements beyond the 10-year post-construction monitoring program will be dictated by the findings of that program as well as the input from DEC SPDES permit and CSO Consent Order administrators.

8.3.5. Reporting

Post-construction compliance monitoring will be added to the annual BMP report submitted by DEP in accordance with their SPDES permits, and will therefore constitute a permit modification. The monitoring report will provide summary statistics on rainfall, the amount of combined sewage, and the fraction of the generated volume of combined sewage that discharged to Westchester Creek. Verification and refinement of the landside and water quality models will be documented as necessary, and modeling results will be presented to assess water quality effects, and other conditions affecting water quality impacts will also be included in the BMP report.

The SPDES DMR requirements will remain in force and will continue in addition to the reporting modifications to BMP 14 described above.

8.4. OPERATIONAL PLAN

USEPA guidance specifies that municipalities should be required to develop and document programs for operating and maintaining the components of their combined sewer systems (EPA, 1995a). Once a long-term control plan has been approved, the municipality’s operation and maintenance program should be modified to incorporate the facilities and operating strategies associated with selected controls.

The operation of the Hunts Point WWTP is defined in the Wet Weather Operating Plan for the facility (Appendix A). The WWOP is expected to be approved by DEC before full implementation of the Westchester Creek Plan. DEP intends to operate all of its facilities in strict accordance with the relevant WWOPs. However, it is both environmentally responsible and fiscally prudent to be responsive to changing and unforeseen limitations and conditions. An adaptive management approach will be employed to accomplish this flexibility. A startup period of 12-months will be used to identify any unforeseen issues that may arise from the changes to the collection system, including flooding, excessive head loss, solids handling difficulties at the WWTP, and similar operational matters. The specific goals include:

- Maximizing CSO retention and treatment;
- Minimizing impacts on the performance of the Hunts Point WWTP that cannot be readily modified to accommodate increased loads;
- No increase in odors to the neighborhood; and
- Maximizing the capture of floatables and settleable solids entering the facility.

After the end of the 12-month startup period, the Hunts Point WWTP WWOP may be modified and submitted to the DEC for review and approval.

As discussed in Section 8.3, the annual analysis of monitoring data during subsequent years will trigger a sequence of more detailed investigations. Similarly, these investigations may trigger corrective actions depending on the findings. The analysis will ultimately determine whether the performance of the CSO controls was adequate. If the performance is unacceptable, the finding will be verified, the causes will be identified, and reasonable corrective actions will be taken. Preferred control modifications will be operational and programmatic in nature, e.g., modification of maintenance schedules to improve performance. Modifications and retrofits that are implemented and demonstrate improvement will be documented through the issuance of the LTCP, or through LTCP updates, and will be subject to DEC approval.

8.5. SCHEDULE

Figure 8-5 shows the implementation schedule for the WB/WS Facility Plan, along with relevant aspects of the programmatic controls and post-construction compliance monitoring schedules. It should be noted that elements shown in this schedule address the implementation of the recommended WB/WS Facility Plan elements only. As noted in the Order on Consent once the DEC approves a WB/WS Facility Plan, the approved WB/WS Facility Plan is hereby incorporated by reference, and made an enforceable part of the Consent Order.

8.6. CONSISTENCY WITH FEDERAL CSO POLICY

The Westchester Creek WB/WS Facility Plan was developed so that it satisfies the requirements of the federal CSO control policy. Through extensive water quality and sewer system modeling, data collection, community involvement, and engineering analysis, the DEP has adopted a plan that incorporates the findings of over a decade of inquiry to achieve the highest reasonably attainable use of Westchester Creek. This Waterbody/Waterbody Facility Plan addresses each of the nine elements of long-term CSO control as defined by federal policy and as shown in Table 8-2. The CSO Consent Order requires submission of a Westchester Creek LTCP in February 2016. As this report addresses all the elements required in an LTCP it will become the foundation for the 2016 submittal, with the notable addition at that time of green infrastructure approaches in the alternatives analysis, as set forth in the *NYC Green Infrastructure Plan.*

Table 8-2. Nine Minimum Elements of Long-Term CSO Control

Element	Section	Summary
1. Characterization, Monitoring, and Modeling	3.0	The waterbody is a channel with limited assimilative capacity and runoff from the highly urbanized drainage area has resulted in non-attainment of existing (Class I) standards.
2. Public Participation	6.0	Stakeholder involvement during East River CSO Facility Plan, including the negotiations to locate the 10 MG tank at the head of Westchester Creek. Participation continued during WB/WS Facility Plan through the decision to discard the old plan in favor of a more cost-effective approach.
3. Consideration of Sensitive Areas	4.7	There were no sensitive areas identified within Westchester Creek.
4. Evaluation of Alternatives	7.0	Strongly points to additional capture for treatment at HP-014 and floatables control at HP-013. HP-014 has the greatest annual CSO discharge volume into Westchester Creek and has the greatest impact to water quality; the increase in CSO from HP-013 will be partly mitigated by floatables control that will reduce floatables discharge to below Baseline conditions.
5. Cost/Performance Considerations	7.0	Higher level controls, such as sewer separation and 100% CSO capture, are not cost-effective. The WB/WS Facility Plan was selected according to a “knee-of-the-

Table 8-2. Nine Minimum Elements of Long-Term CSO Control

Element	Section	Summary
		curve" type cost-benefit analysis expressly contemplated in the EPA's LTCP policy.
6. Operational Plan	8.0	Includes compliance with the Hunts Point WWTP WWOP, continued implementation of the 14 BMPs (which contain the USEPA NMCs) and other programmatic controls, a monitoring program, and a framework for adaptive management.
7. Maximizing Treatment at the Existing WWTP	7.0	Implementation of facility WWOP and recent upgrade of Hunts Point WWTP headworks infrastructure should enable the WWTP to achieve 2DDWF. Further expansion is infeasible due primarily to location and space constraints.
8. Implementation Schedule	8.0	Provided as Figure 8-5; contingent on DEC approval of the submitted WB/WS Facility Plan.
9. Post-Construction Compliance Monitoring	8.0	Post-construction monitoring will be performed per CSO policy requirements; Receiving water will be monitored per Harbor Survey protocols at three stations within Westchester Creek and the Upper East River. Monitoring data will be used to support the modeling to be used in the evaluation of compliance by DEC.

8.7. ANTICIPATED WATER QUALITY IMPROVEMENTS

It has been demonstrated that water quality conditions in Westchester Creek do not meet the numerical and narrative water quality standards of its Class I designation all the time. The waterbody fails to meet water quality standards by exhibiting high levels of coliform bacteria, low levels of DO, visible floatables and other aesthetic impairments. The benthic habitat and aquatic life diversity are substantially impacted at the present time near the head end of Westchester Creek. This degradation is due primarily to the existing CSO discharges but, as demonstrated in this WB/WS Facility Plan, certain human-caused conditions such as dredging, bulkheading, and wetlands reclamation also play an important role, and cannot be remedied in an environmentally or fiscally responsible way.

The Westchester Creek WB/WS Facility Plan will address the water quality conditions to the highest degree practical. As shown in Table 8-3, the proposed improvements will reduce the annual CSO volume in Westchester Creek by 68 percent and CSO events by 6 percent. This reduction in total CSO volume and occurrences will translate into equivalent reductions in floatables, BOD, TSS, settleable solids, and bacteria load as well. A portion of the CSO volume that previously discharged at HP-014 will be conveyed to the Hunts Point WWTP. Model results predict that the volume conveyed to the Hunts Point WWTP will increase by 1,159 MG annually. Additional flow will be exported to downstream outfalls (Table 8-3), where water quality modeling indicates that the impact to the receiving waters is marginal, most likely benefiting from better mixing conditions near the East River. The Pugsley Creek parallel sewer will divert CSO flow from Pugsley Creek to the Upper East River via outfall HP-011; however, model results indicate that CSO discharges from HP-011 will decrease from Baseline conditions even with the additional flows from Pugsley Creek due to the Hunts Point headworks upgrade. The Plan is expected to reduce odor and improve other aesthetic conditions such as water clarity. The resulting water quality improvements will benefit the aquatic community, improve recreational opportunities such as boating and fishing, and enhance waterbody aesthetics to conditions consistent with desired waterbody and riparian uses. Settleable solids loads are expected to be reduced in proportion to the CSO volume reductions, and the associated reduction in benthic total organic carbon will improve the benthic habitat and aquatic life diversity throughout Westchester Creek.

Table 8-3. Comparison of Annual CSO Volumes (MG) Predicted for Baseline, 2003 CSO Facility Plan, and Proposed WB/WS Facility Plan

		2003 CSO Facility Plan	Proposed WB/WS Facility Plan
Outfall	**Baseline CSO**	**CSO Remaining**	**CSO Remaining**
HP-014	516	121	115
HP-013	144	166	0
HP-016	72	73	76
HP-012	27	25	35
HP-033	8	7	20
HP-015	0.2	0.0	0.0
Westchester Creek Total	**767**	**392**	**247**
All Hunts Point WWTP Service Area CSOs Total	**3,924**	**2,421**	**2,774***
Flow Treated at Hunts Point WWTP	**51,185**	**52,685**	**52,344**

* Total CSO for all HP outfalls, including Westchester Creek. Of the HP outfalls not listed, only HP-021 (39.0 MG) and HP-031 (3 MG) realized net increases in CSO; all other outfalls had either a net reduction or no change in annual CSO volume compared to Baseline, and the total annual CSO volume decreased from the Baseline in all waterbodies.

Although overall DO conditions will generally improve throughout the waterbody, hypoxic conditions will still occur near the head end of Westchester Creek. However, anoxic conditions that may be contributing to noxious odors will be largely mitigated. Detailed water quality modeling calculations indicate that the WB/WS Facility Plan will greatly improve DO in Westchester Creek from the Baseline condition. Over a complete annual cycle, the New York State DO criterion of 4.0 mg/L will be achieved greater than 87 percent of the time in the upper one-third of Westchester Creek and 100 percent of the time in the lower two-thirds of the Creek. Therefore, fish life and propagation are expected to be protected to a high degree.

Westchester Creek is currently classified for secondary contact recreation, which includes boating, fishing, and other non-primary contact activities. The secondary contact water quality criterion is not presently attained. As shown in Table 8-4, implementation of the WB/WS Facility Plan will result in attainment of all secondary contact recreation standards throughout the waterbody all the time for an average precipitation year.

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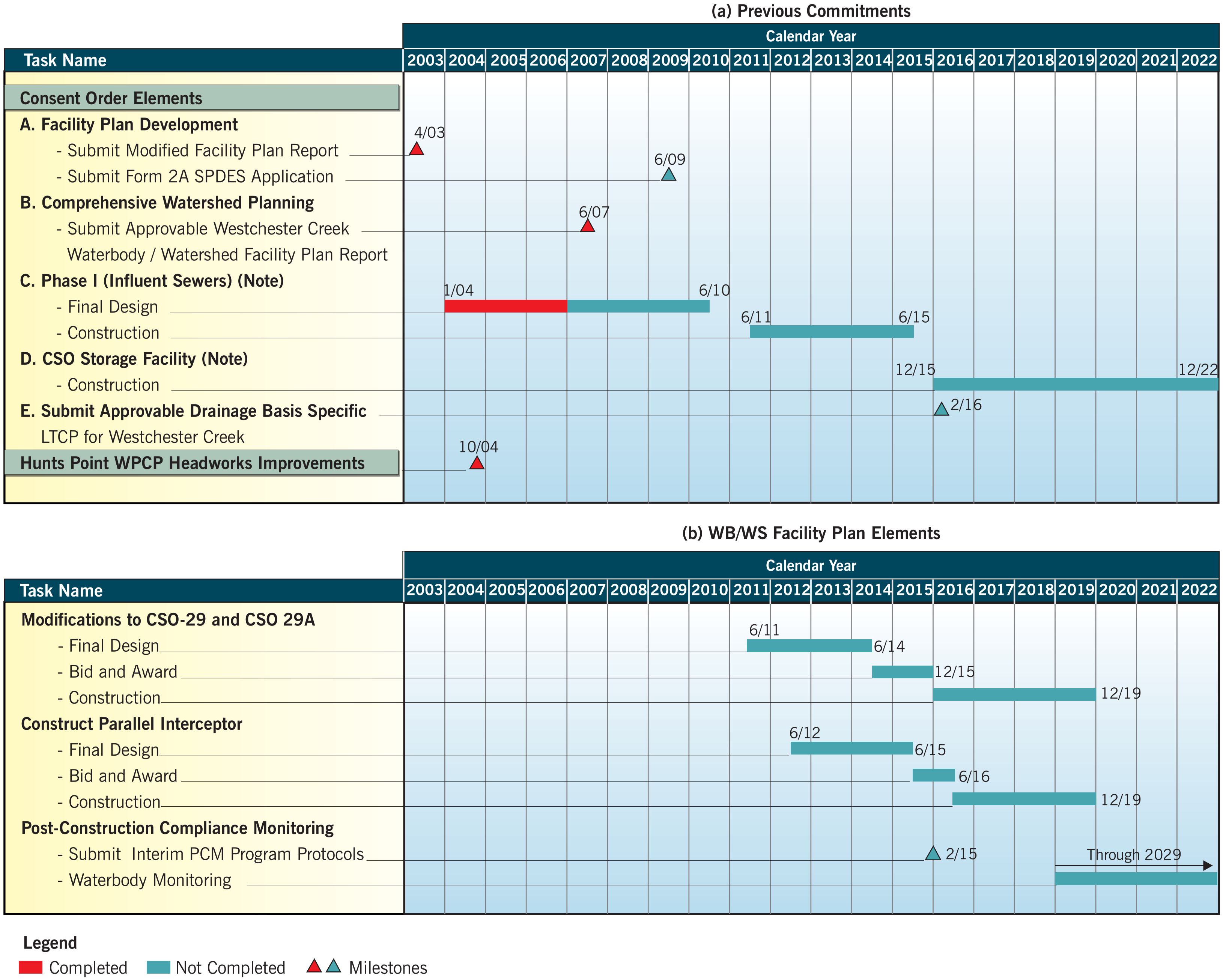

Notes: WB/WS Facility Plan Elements Proposed herein would replace items C and D in the Consent Order.

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Schedule

FIGURE 8-5

Table 8-4. Summary of Compliance with Recreational Use Standards, Head End Minima

Use	Standard	Annual	Bathing Season
Secondary Contact Recreation	Total Coliform	100%	100%
	Fecal Coliform	100%	100%
	Enterococci	n/a	n/a

The WB/WS Facility Plan will achieve significant reductions of settleable solids discharges associated with the Westchester CSOs, based on the CSO volume reductions predicted. This will limit the formation of sediment mounds near the head end. Projected improvements in DO will virtually eliminate the persistent hypoxic and anoxic conditions that cause the release of noxious gases. It is anticipated that the WB/WS Facility Plan will achieve a virtual elimination of odors during a typical precipitation year such that this aesthetic use will be protected. Reducing CSO discharges will reduce settleable solids concentrations in the receiving waters, which will somewhat improve water clarity in Westchester Creek, especially after CSO events. However, background turbidity and periodic eutrophic conditions caused by tidal exchange with the Upper East River may continue to hinder improvements in water clarity.

The anticipated reduction in total organic carbon and oxygen demand in CSO effluent should increase the diversity of benthic invertebrates and increase the abundance of species tolerant of urban aquatic ecosystems. This would result in a better food base for fish species such as spot, winter flounder, weakfish, and striped bass that feed largely or partially on benthic organisms. However, without more extensive rehabilitation of the configuration and bottom substrate, it would not likely result in any material replacement of tolerant benthic species by sensitive ones.

8.8. THE NYC GREEN INFRASTRUCTURE PLAN

The *NYC Green Infrastructure Plan*, as described in section 5.8, included five key components: construct cost effective grey infrastructure; optimize the existing wastewater system through interceptor cleaning and other maintenance; control runoff from 10 percent of impervious surfaces through green infrastructure; institute an adaptive management approach to better inform decisions moving forward; and engage stakeholders in the development/implementation of these green strategies.

As part of the LTCP process, DEP will evaluate green infrastructure in combination with other LTCP strategies to better understand the extent to which green infrastructure would provide incremental benefits and would be cost-effective. DEP models will be refined by including new data collected from green infrastructure pilots, new impervious cover data and extending predictions to ambient water quality for the development of the LTCP. Based on these evaluations, and in combination with cost effective grey infrastructure, DEP will reassess the green infrastructure strategy.

9.0. Water Quality Standards Review

The Westchester Creek Waterbody/Watershed Facility Plan is a component of the DEP's Combined Sewer Overflow Long-Term Control Plan. This Plan is being prepared in a manner fully consistent with USEPA's CSO Control Policy, the Wet Weather Water Quality Act of 2000 and applicable USEPA guidance.

As noted in Section 1.2 and as stated in the Clean Water Act (CWA), it is a national goal to achieve "fishable/swimmable" water quality in the nation's waters wherever attainable. The CSO Policy also reflects the CWA's objectives to achieve high water quality standards (WQS) by controlling CSO impacts, but the Policy recognizes the site-specific nature of CSOs and their impacts and provides the necessary flexibility to tailor controls to local situations. The key principles of the CSO Policy were developed to ensure that CSO controls are cost-effective and meet the objectives of the CWA. In doing so, the Policy provides flexibility to municipalities to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements. The Policy also provides for the review and revision, as appropriate, of water quality standards when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs.

In 2001, USEPA published guidance for coordinating CSO long-term planning with water quality standards reviews. This guidance re-affirmed that USEPA regulations and guidance provide states with the opportunity to adapt their WQS to reflect site-specific conditions related to CSOs. The guidance encouraged the States to define more explicitly their recreational and aquatic life uses and then, if appropriate, modify the criteria accordingly to protect the designated uses.

The Westchester Creek Waterbody/Watershed Facility Plan was developed in a manner consistent with the CSO Policy and applicable guidance. Specifically, cost-effectiveness and knee-of-the-curve evaluations were performed for CSO load reduction evaluations using long-term rainfall records. Baseline and Waterbody/Watershed Facility Plan receiving water impact evaluations were performed for average annual rainfall conditions consistent with CSO Policy guidance. Although the plan was developed following USEPA regulations and guidance and results in substantial benefits, it does not fully attain the "fishable/swimmable" goal. When the planning process has this result, the national policy calls for a review and, where appropriate, a revision to water quality standards. The purpose of this section therefore is to address the water quality standards review and revision guidance in the CSO Policy.

9.1. WATER QUALITY STANDARDS REVIEW

9.1.1. Numeric Water Quality Standards

New York State waterbody classifications and numerical criteria which are or may become applicable to Westchester Creek are shown in Table 9-1. Westchester Creek is classified as Class I at present with best usages of secondary contact recreation and fishing. Although this classification and the DO criterion of never-less-than 4.0 mg/L is also considered to be suitable for fish propagation and survival, a goal of the CWA, the recreational classification of secondary contact is not consistent with the "swimmable" or primary contact use goal. Satisfaction of this goal would require reclassification of Westchester Creek to Class SB or SC which are suitable for primary contact recreation. Reclassification of Westchester Creek to the fishable/swimmable Class SB/SC requires more stringent numerical coliform bacteria criteria and also increases the minimum DO requirement to never-less-than 5.0 mg/L from 4.0 mg/L.

Table 9-1. New York State Numeric Surface Water Quality Standards (Saline)

		Bacteria (Pathogens)		
Class	**DO (mg/L)**	**Total Coliform(1,4) (per 100 mL)**	**Fecal Coliform(2,4) (per 100 mL)**	**Enterococci(3) (per 100 mL)**
I	≥4.0	<10,000	<2,000	NA
SB, SC	≥5.0	<5,000	<200	<35

Notes: (1) Total coliform criteria are based on monthly geometric means for Class I, and on monthly medians for Classes SB and SC; second criterion for SC and SB is for 80 percent of samples. (2) Fecal coliform criteria are based on monthly geometric means. (3) The enterococci standard is based on monthly geometric means per the USEPA Bacteria Rule and applies to the bathing season. The enterococci coastal recreation water infrequent use reference level (upper 95 percent confidence limit) = 501/100 mL. (4) Per 6 NYCRR 703.4(c), bacteria standards are only applicable when disinfection is practiced. n/a: not applicable.

The Interstate Environmental Commission (IEC) waterbody classifications applicable to waters within the Interstate Environmental District are shown in Table 9-2. The Upper East River and its tidal tributaries including Westchester Creek are classified as Class B-1 with best intended uses of fishing and secondary contact recreation.

Table 9-2. Interstate Environmental Commission Classification, Criteria and Best Uses

Class	**DO**	**Best Intended Use**
A	≥5.0 mg/L	Suitable for all forms of primary and secondary contact recreation and for fish propagation. In designated areas, they also shall be suitable for shellfish harvesting.
B-1	≥4.0 mg/L	Suitable for fishing and secondary contact recreation. They shall be suitable for the growth and maintenance of fish life and other forms of marine life naturally occurring therein, but may not be suitable for fish propagation.
B-2	≥3.0 mg/L	Suitable for passage of anadromous fish and for the maintenance of fish life in a manner consistent with the criteria established in Sections 1.01 and 1.02 of these regulations.

IEC bacterial standards apply to effluent discharges from municipal and industrial wastewater treatment plants and not to receiving waters.

9.1.2. Narrative Water Quality Standards

The New York State narrative water quality standards which are applicable to Westchester Creek and all waterbody classifications are shown in Table 1-2 and restated here in Table 9-3. The IEC narrative water quality regulations which are applicable to Westchester Creek and all waters of the Interstate Environmental District are shown in Table 9-4. Note that the DEC narrative water quality standards apply a limit of "no" or "none" and that these restrictions are conditioned on the impairment of waters for their best usages for only selected parameters.

Table 9-3. New York State Narrative Water Quality Standards

Parameters	Classes	Standard
Taste-, color-, and odor producing toxic and other deleterious substances	SA, SB, SC, I, SD A, B, C, D	None in amounts that will adversely affect the taste, color or odor thereof, or impair the waters for their best usages.
Turbidity	SA, SB, SC, I, SD A, B, C, D	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	SA, SB, SC, I, SD A, B, C, D	None from sewage, industrial wastes or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	SA, SB, SC, I, SD A, B, C, D	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
Garbage, cinders, ashes, oils, sludge and other refuse	SA, SB, SC, I, SD A, B, C, D	None in any amounts.
Phosphorus and nitrogen	SA, SB, SC, I, SD A, B, C, D	None in any amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages.

Table 9-4. Interstate Environmental Commission Narrative Regulations

Classes	Regulation
A, B-1, B-2	All waters of the Interstate Environmental District (whether of Class A, Class B, or any subclass thereof) shall be of such quality and condition that they will be free from floating solids, settleable solids, oil, grease, sludge deposits, color or turbidity to the extent that none of the foregoing shall be noticeable in the water or deposited along the shore or on aquatic substrata in quantities detrimental to the natural biota; nor shall any of the foregoing be present in quantities that would render the waters in question unsuitable for use in accordance with their respective classifications.
A, B-1, B-2	No toxic or deleterious substances shall be present, either alone or in combination with other substances, in such concentrations as to be detrimental to fish or inhibit their natural migration or that will be offensive to humans or which would produce offensive tastes or odors or be unhealthful in biota used for human consumption.
A, B-1, B-2	No sewage or other polluting matters shall be discharged or permitted to flow into, or be placed in, or permitted to fall or move into the waters of the District, except in conformity with these regulations.

9.1.3. Attainability of Water Quality Standards

Sections 7.5 and 8.7 summarize the results of water quality modeling analyses which were performed to evaluate attainability of water quality standards under Baseline and Waterbody/Watershed (WB/WS) Facility Plan conditions. The results of these analyses are summarized graphically in the Appendix D and in tabular form in Table 9-5 through Table 9-12 for the various numerical criteria for DO and bacteria for current and fishable/swimmable classifications for Westchester Creek.

Attainability of Currently Applicable Standards

Table 9-5 summarizes the projected percentage annual attainability of DO for current Class I and Class B-1 criteria for Baseline and WB/WS Facility Plan conditions at the head end, mid-creek and mouth of Westchester Creek. Mid-creek is defined as a location at the Cross Bronx Expressway overpass, approximately 4,500 ft from the head-end; the mouth is defined as the confluence of Westchester Creek with Pugsley Creek near Castle Hill Park, approximately 11,000 ft from the head end. For both Class I and IEC Class B-1, the WB/WS Facility Plan improves attainment at the head end to 87 percent from 56 percent under Baseline conditions and achieves 100 percent attainment at the mouth.

Table 9-5. Annual Attainability of DO Criteria for Design Year

	Class I (>4.0 mg/L) Percent Attainment		Class B-1 (>4.0 mg/L) Percent Attainment	
Location	**Baseline**	**WB/WS FP**	**Baseline**	**WB/WS FP**
Head End	56	87	56	87
Mid-Creek	97	99	97	99
Mouth	100	100	100	100

Table 9-6 summarizes the projected percentage annual attainability of total coliform for the Class I secondary contact recreation criterion. As shown, the secondary contact recreation criterion is expected to be fully attained under WB/WS Facility Plan conditions on an annual basis, from non-attainment under Baseline conditions.

Table 9-6. Annual Attainability of Total Coliform Criterion for Design Year

	Class I GM <10,000 Percent Attainment	
Location	**Baseline**	**WB/WS FP**
Head End	67	100
Mid Creek	75	100
Mouth	100	100

Table 9-7 shows similar conditions for fecal coliform. As for total coliform, the current Class I secondary contact criterion is expected to be completely attained in Westchester Creek annually under WB/WS Facility Plan conditions from non-attainment under Baseline conditions.

Attainability of Potential Future Standards

DEC considers Class I DO standards supportive of aquatic life uses and consistent with the “fishable” goal of the CWA. Therefore, a standards reclassification would not be necessary for full use attainment in Westchester Creek. However, the Class I secondary contact use is not considered consistent with the "swimmable" goal. To revise the classification of Westchester Creek to be fully supportive of primary contact uses, it would be necessary to attain the Class SB/SC criteria for total and fecal coliform, and the enterococci criterion and reference level established by USEPA.

Table 9-8 through Table 9-12 summarize projected percentage annual and recreation season attainability of these potential criteria.

Table 9-7. Annual Attainability of Fecal Coliform Criterion for Design Year

	Class I GM <2,000 Percent Attainment	
Location	**Baseline**	**WB/WS FP**
Head End	75	100
Mid Creek	75	100
Mouth	100	100

Table 9-8 presents the annual attainability of Class SB/SC primary contract criteria for total coliform. As shown, the monthly median value is expected to be attained annually under WB/WS Facility Plan conditions throughout most of Westchester Creek except for an area near the head end. The annual attainability of the upper limit would be significantly improved by the WB/WS Facility Plan as compared with Baseline conditions but is not expected to be completely achieved. Table 9-9 shows monthly attainment during the recreation season, the three summer months of June, July and August which encompasses the official public bathing season at New York City's seven public bathing beaches. The WB/WS Facility Plan achieves complete attainment of the median value and is projected to attain the upper limit in two of the three summer months. Table 9-10 and Table 9-11 show similar results for fecal coliform: the WB/WS Facility Plan is projected to improve, but not achieve, attainment of the criterion annually, but complete attainment is expected during the summer recreation season.

Table 9-12 summarizes the projected attainability of potential enterococci criteria which could be applied to Westchester Creek for primary contact water use. The attainment values shown on Table 9-12 are for the three month period of June, July and August. The table shows that 100 percent attainment of the seasonal geometric mean throughout Westchester Creek is expected under WB/WS Facility Plan conditions. The infrequent use coastal recreation water reference level (upper 95% confidence limit) is not projected to be completely achieved but is attained at a higher level than under Baseline conditions.

Table 9-8. Annual Attainability of SB/SC Total Coliform Criteria

Location	Class SB/SC Percent Attainment			
	Median <2,400		80% <5,000	
	Baseline	WB/WS FP	Baseline	WB/WS FP
Head End	33	92	0	67
Mid-Creek	50	100	0	83
Mouth	100	100	58	83

Table 9-9. Recreation Season Attainability of SB/SC Total Coliform Criteria

Location	Class SB/SC Percent Attainment			
	Median <2,400		80% <5,000	
	Baseline	WB/WS FP	Baseline	WB/WS FP
Head End	67	100	0	67
Mid-Creek	67	100	0	67
Mouth	100	100	67	67

Table 9-10. Annual Attainability of SB/SC Fecal Coliform Criterion

Location	Class SB&A GM <200 Percent Attainment	
	Baseline	WB/WS FP
Head End	25	67
Mid-Creek	42	83
Mouth	92	100

Table 9-11. Recreation Season Attainability of SB/SC Fecal Coliform Criterion

Location	Class SB&A GM <200 Percent Attainment	
	Baseline	WB/WS FP
Head End	67	100
Mid-Creek	67	100
Mouth	100	100

Table 9-12. Recreation Season Attainability of Enterococci Bacteria for Design Year

Location	Water Quality Criterion Geometric Mean <35		Infrequent Use Reference Level <501	
	Baseline	WB/WS FP	Baseline	WB/WS FP
Head End	0	100	66	81
Mid-Creek	0	100	69	85
Mouth	100	100	94	96

9.1.4. Attainment of Narrative Water Quality Standards

Table 9-3 summarizes DEC narrative water quality standards which are applicable to Westchester Creek and all waters of the state. The existing CSO and stormwater discharges to the area include some quantity of materials that may impair attainment of narrative criteria. Specifically, suspended, colloidal and settleable solids, oil and floating substances and floatable materials (refuse) may be discharged. The WB/WS Facility Plan will not completely eliminate, but will greatly reduce, the discharge of these materials to Westchester Creek. The weir adjustments and regulator modifications to induce additional CSO capture and treatment and the parallel interceptor to divert flow from Pugsley Creek will reduce the discharge of the parameters of concern by at least 67 percent from Baseline conditions based on volumetric capture. Heavy solids that would settle near the CSO outfalls will be virtually eliminated and floatable materials will be substantially reduced. Consequently, the adverse impacts of the current CSO discharges will be greatly reduced, although not completely eliminated as required by the narrative standards. Additionally, best management practices applied to the separate stormwater discharges also can not completely eliminate impacts from that source but reduce loadings to the extent feasible.

The WB/WS Facility Plan, although not completely eliminating all of the parameters of concern, will eliminate odors, reduce the deposition of organic solids and floatable materials and restore the aesthetic uses of Westchester Creek to the maximum extent practicable.

9.1.5. Water Uses Restored

Fish and Aquatic Life Protection Use

Table 9-5 presents the expected improvements in DO in Westchester Creek resulting from the WB/WS Facility Plan as compared to Baseline conditions. The plan is expected to achieve between 87 and 100 percent attainment for the current Class I and IEC Class B-1 criteria on an annual basis. This is considered to be a relatively high level of attainment in terms of the protection of fish and aquatic life, various forms of which spawn throughout almost the entire year. The projected area of excursion from the current DEC criterion is projected to be confined to the upper 5,000 ft of Westchester Creek.

Primary and Secondary Contact Recreation Use

Table 9-6 and Table 9-7 present the expected attainment of current secondary contact recreation criteria in Westchester Creek. As shown, full annual attainment of all bacteriological criteria is expected from implementation of the WB/WS Facility Plan.

Table 9-8 through Table 9-12 present the expected attainability of potential Class SB/SC primary contact criteria in Westchester Creek. As shown in the tables, complete attainment of primary contact recreation criteria is not projected annually for WB/WS Facility Plan conditions. However, on the basis of the results presented in Table 9-9, Table 9-11, and Table 9-12, it is considered that the WB/WS Facility Plan may achieve a level of bacteriological water quality during the summer recreation period nearly sufficient to satisfy the numerical criteria supportive of primary contact.

Aesthetic Use

As discussed in Section 9.1.4, the WB/WS Facility Plan will not completely eliminate all regulated parameters in the DEC narrative water quality standards to zero discharge levels, but will significantly reduce the volumetric discharge of such substances. Settleable solids will be substantially reduced by the increased volumetric CSO capture and treatment. Floatable materials from CSOs will be reduced by the WB/WS Facility Plan to the limit of practicality, while stormwater floatable discharges are reduced to the maximum extent practicable by stormwater BMPs. Accordingly, the aesthetic conditions in Westchester Creek should improve to a level consistent with the other attained water uses and the nature of the adjacent shoreline uses.

9.1.6. Practical Considerations

The previous section describes the improvement in the level of attainment of the DEC Class I and IEC Class B-1 DO criteria that are expected to result from the WB/WS Facility Plan. As noted, the annual attainment is expected to be relatively high in Westchester Creek.

For the majority of months, complete attainment throughout the project area is expected. In the other months when some criterion excursions are expected in the upper reach of Westchester Creek, it should be noted that any adverse impact on fish larval propagation may be limited. Fish larvae spawning in Westchester Creek will be exchanged with, and transported to, East River waters where DO will be greater. The organisms will therefore not be continuously exposed to Westchester Creek DO which may be depressed below the criterion. Consequently, the impact on larval survival will be less than expected based on laboratory studies where organisms are confined and exposed continuously to the same depressed DO level. Because of the significant amount of larval transport which can occur in Westchester Creek, and the exposure of the organisms to continuously varying, rather than static, DO concentrations, it is considered to be reasonable to view the ecosystem in its entirety rather than by individual tributary or sub-region for purposes of fish and aquatic life protection.

Additionally, direct kills of juvenile fish at the head end of Westchester Creek should not occur as there exists no fish passage and the organisms would avoid any temporarily depressed DO. As noted, minimum DO projected for the head end should be sufficient for protection of benthic organisms.

For these reasons, it is considered that, for practical purposes, conditions in Westchester Creek may be supportive of the fishable goal of the CWA.

Section 9.1.5 also notes that during the summer recreation season, water quality in Westchester Creek may be supportive of numerical criteria for the swimmable (primary contact recreation) goal of the CWA. However, swimming should not be considered as a best use in this waterbody due to periodic overflows from the WB/WS Facility Plan, other regional CSO discharges and continuing stormwater discharges. It is also noted that the bacteriological criteria for Westchester Creek are not applicable under State Water Quality Regulations unless disinfection is practiced to protect primary contact as a best use.

9.2. WATER QUALITY STANDARDS REVISION

9.2.1. Overview of Use Attainability and Recommendations

Section 9.1 summarizes the existing and potential water quality standards for Westchester Creek and expected levels of attainment based on modeling calculations. For aquatic life protection, the attainment of the water use can be expected to be greater than that suggested by the attainability of numerical criteria during the summer period due to the limited larval residence time in Westchester Creek, organism transport to the East River and beyond and the appropriateness of considering the ecosystem, both open waters and tributary, in its entirety rather than as individual components.

For recreational activity, the currently designated use of secondary contact recreation in Westchester Creek is expected to be fully attained under WB/WS Facility Plan conditions. Further, numerical water quality conditions suitable to support primary contact may be attained possibly during the summer recreation season in Westchester Creek and would be achieved for all relevant bacteriological indicators, although bathing and swimming activities would not be considered the best use.

As a result of the water quality conditions and uses expected to be attained in Westchester Creek as a result of the WB/WS Facility Plan, it is recommended that the current waterbody classification, Class I, be retained at this time. The water use goals for the Class I classification in Westchester Creek are expected to be achieved, either numerically or for practical purposes, once the WB/WS Facility Plan is constructed and operational except periodically following CSO overflows after heavy rainfall events. However, the attainment of the designated uses, while expected, should be demonstrated with long-term post-construction water quality monitoring data and numerical modeling.

As noted previously, expected levels of water quality criteria compliance are based on modeling calculations which are subject to some level of uncertainty. In addition, calculations are based on a typical year with an average amount of annual rainfall. Therefore, it is recommended that the actual improvements in water quality conditions resulting from the WB/WS Facility Plan be assessed from the multi-year long-term post-construction monitoring program described elsewhere in this WB/WS Facility Plan report. The monitoring program will document the actual attainment of uses: whether the current Class I uses are attained as expected; whether other levels of usage are actually achieved supporting a waterbody reclassification, for example, Class SC in Westchester Creek; or whether CWA "fishable/swimmable" goals are not attained therefore requiring a Use Attainability Analysis and subsequent water quality standards revision.

As described in this report and shown on the water quality transect plots in the Appendix D, modeling calculations indicate that complete attainment throughout the Westchester Creek area of some of the Class I water quality criteria (DO, narratives) and all of the Class SB/SC criteria on an annual basis, both numerical and narrative, would be approached, but not fully achieved due to continued stormwater runoff, even with 100 percent retention of the area CSO discharges. This water quality based effluent limit (WQBEL) of zero annual CSO overflows to attain the highest achievable water quality is not cost-effective or consistent with the CSO Policy. Therefore, until the long-term post-construction monitoring program is completed for Westchester Creek to document conditions actually attained, it is recommended that a variance to the WQBEL be applied for, and approved, for the Westchester Creek WB/WS Facility Plan for appropriate effluent variables.

9.2.2. DEC Requirements for Variances to Effluent Limitations

The requirements for variances to water quality based effluent limitations are described in Section 702.17 of DEC's Water Quality Regulations. The following is an abbreviated summary of the variance requirements which are considered applicable to Westchester Creek. The lettering and numbering are those used in Section 702.17.

(a) The department may grant, to a SPDES permittee, a variance to a water quality-based effluent limitation included in a SPDES permit.

(1) A variance applies only to the permittee identified in such variance and only to the pollutant specified in the variance. A variance does not affect or require the department to modify a corresponding standard or guidance value.

(5) A variance term shall not exceed the term of the SPDES permit. Where the term of the variance is the same as the permit, the variance shall stay in effect until the permit is reissued, modified or revoked.

(b) A variance may be granted if the requester demonstrates that achieving the effluent limitation is not feasible because:

(1) Naturally occurring pollutant concentrations prevent attainment of the standard or guidance value;

(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent attainment, unless these conditions may be compensated for by the discharge of sufficient volume of effluent to enable the standard or guidance value to be met without violating water conservation requirements.

(3) human-caused conditions or sources of pollution prevent attainment of the standard or guidance value and cannot be remedied or would cause more environmental damage to correct them to leave in place.

(4) Dams, diversions or other types of hydrologic modifications preclude attainment of the standard or guidance value, and it is not feasible to restore the waterbody to its original condition or to operate such modification in a way that would result in such attainment.

(5) Physical conditions related to the natural features of the waterbody, such as the lack of a proper substrate cover, flow, depth, pools, riffles, and the like, unrelated to chemical water quality, preclude attainment of the standard or guidance value; or

(6) Controls more stringent than those required by section 754.1(a)(1) and (2) of this Title would result in substantial and widespread economic and social impact.

(c) In addition to the requirements of subdivision (b) of this section, the requestor shall also characterize, using adequate and sufficient data and principles, any increased risk to human health and the environment associated with granting the variance compared with attainment

of the standard or guidance value absent the variance, and demonstrate to the satisfaction of the department that the risk will not adversely affect the public health, safety and welfare.

(d) The requestor shall submit a written application for a variance to the department. The application shall include:

(1) all relevant information demonstrating that achieving the effluent limitation is not feasible based on subdivision (b) of this section; and

(2) All relevant information demonstrating compliance with the conditions is subdivision (c) of this section.

(e) Where a request for a variance satisfies the requirements of this section, the department shall authorize the variance through the SPDES permit. The variance request shall be available to the public for review during the public notice period for the permit. The permit shall contain all conditions needed to implement the variance. Such conditions shall, at minimum, include:

(1) Compliance with an initial effluent limitation that, at the time the variance is granted represents the level currently achievable by the requestor, and that is no less stringent than that achieved under the previous permit where applicable.

(2) that reasonable progress be made toward achieving the effluent limitations based on the standard or guidance value, including, where reasonable, an effluent limitation more stringent than the initial effluent limitations;

(3) Additional monitoring, biological studies and pollutant minimization measures as deemed necessary by the department.

(4) when the duration of a variance is shorter than the duration of a permit, compliance with an effluent limitation sufficient to meet the underlying standard or guidance value, upon the expiration of the variance; and

(5) A provision that allows the department to reopen and modify the permit for revisions to the variance.

(g) A variance may be renewed, subject to the requirements of this section. As part of any renewal application, the permittee shall again demonstrate that achieving the effluent limitation is not feasible based on the requirements of this section.

(i) The department will make available to the public a list of every variance that has been granted and that remains in effect.

9.2.3. Manner of Compliance with the Variance Requirements

Subdivision (a) authorizes DEC to grant a variance to a “water quality based effluent limitation…included in a SPDES permit.” It is understood that the Westchester Creek WB/WS Facility Plan, when referenced in the Hunts Point WWTP SPDES permit along with other presumed actions necessary to attain water quality standards, can be interpreted as the equivalent of an “effluent limitation” in accordance with the “alternative effluent control strategies” provision of Section 302(a) of the CWA.

Subdivision (a)(1) indicates that a variance will apply only to a specific permittee, in this case, DEP, and only to the pollutant specified in the variance. It is understood that "pollutant" can be interpreted in the plural, and one application and variance can be used for one or more relevant pollutants. In Westchester Creek, a variance would be needed for the following pollutants: oxygen demanding substances (BOD for DO attainability in Westchester Creek), and effluent constituents covered by narrative water quality standards (suspended, colloidal and settleable solids; oil and floating substances). A variance for bacteriological criteria would not be requested as the Westchester Creek WB/WS Facility Plan is expected to attain Class I requirements within the constraints of modeling uncertainty.

Subdivision (b) requires the permittee to demonstrate that achieving the water quality based effluent limitation is not feasible due to a number of factors. It is noted that these factors are the same as those in 40 CFR 131.10(g) which indicate federal requirements for a Use Attainability Analysis. As with the federal regulations, it is assumed that any one of the six factors is justification for the granting of a variance. The Westchester Creek Use Attainability Evaluation report in the Appendix D documents the applicability of two of the six factors cited in Subdivision (b): (3) human caused conditions and (4) hydrologic modifications.

Subdivision (c) requires the applicant to demonstrate to DEC any increased risk to human health associated with granting of the variance compared with attainment of the water quality standards absent the granting of the variance. As noted above, the variance application is needed for suspended, colloidal and settleable solids, and oil and floating substances in the periodic overflows from the Westchester Creek WB/WS Facility Plan. These substances pose no significant risk to human health. Further, as described above in Section 9.1.4, a 67 percent volumetric reduction is expected from Baseline CSO loadings to Westchester Creek. As summarized above in Section 9.1, the Westchester Creek WB/WS Facility Plan is expected to achieve the current Class I secondary contact recreation criteria in Westchester Creek. Therefore, no variance is requested for bacteriological conditions. The Westchester Creek WB/WS Facility Plan will achieve a relatively high level of attainment of the current Class I DO criterion in Westchester Creek, and for the reasons described above in Sections 9.1.5 and 9.1.6, very limited risk to the environment is expected absent attainment of the standard.

Subdivision (d) of the variance regulations requires that the requestor submit a written application for a variance to DEC which includes all relevant information pertaining to Subdivisions (b) and (c). DEP will submit a variance application for the Westchester Creek WB/WS Facility Plan to DEC eighteen months before the Plan is placed into operation. The application will be accompanied by the Westchester Creek WB/WS Facility Plan report, the Westchester Creek Use Attainability Evaluation, and all other supporting documentation pertaining to Subdivisions (b) and (c) and as required by any other subdivisions of the variance requirements.

Subdivision (e) stipulates that approved variances be authorized through the appropriate SPDES permit, and that they be available to the public for review. A number of assumptions are stipulated:

- It is assumed that the initial effluent limitation achievable by the permittee at the time the variance becomes effective, after WB/WS Facility Plan construction, will be based upon the performance characteristics of the WB/WS Facility Plan as agreed upon between

DEC and DEP. These interim operational conditions will be based on the WB/WS Facility Plan's design specifications. It is expected that a fact sheet outlining the basis for the WQBEL and interim operational conditions will be appended to the SPDES permit.

- It is assumed that the requirement for demonstration of reasonable progress after construction as required in the permit will include DEP activities such as implementation of the long-term post-construction monitoring program and additional waterbody improvement projects as delineated in Section 5 of this WB/WS Facility Plan report. Such actions and projects include: 14 best management practices, the City-wide CSO plan for floatables abatement, other long-term CSO control planning activities which may affect Westchester Creek, various East River water quality improvement projects, and various ecosystem restoration activities. These activities are also required by Subdivision (e), section (3).
- It is assumed that the SPDES permits authorizing the Westchester Creek WB/WS Facility Plan variance will contain a provision that allows the department to reopen and modify the permit for revisions to the variance.

Subdivision (g) indicates that a variance may be renewed. It is anticipated that a variance for the Westchester Creek WB/WS Facility Plan would require renewals to allow for sufficient long-term monitoring to assess the degree of water quality standards compliance. As appropriate, a variance renewal application will be submitted 180 days before SPDES permit expiration.

At the completion of the variance period(s), it is expected that the results of the long-term monitoring program will demonstrate each of the following:

- The degree to which the WB/WS Facility Plan attains the current Class I classification water quality criteria and uses;
- The degree to which the WB/WS Facility Plan achieves water quality criteria consistent with the fishable/swimmable goals of the CWA, whether any new low-cost technology is available to enhance the WB/WS Facility Plan performance, if needed, whether Westchester Creek should be reclassified, or whether a Use Attainability Analysis should be approved.

In this manner, the approval of a WQBEL variance for Westchester Creek together with an appropriate long-term post-construction monitoring program can be considered as a step toward a determination of the following:

- Can Westchester Creek be reclassified in a manner which is wholly or partially compatible with the fishable/swimmable goals of the Clean Water Act; or
- Is a Use Attainability Analysis needed for Westchester Creek and for which water quality criteria?

Although Westchester Creek's current waterbody classification, Class I, is not wholly compatible with the goals of the Clean Water Act and would normally require reclassification or a UAA in the State's triennial review obligation, it is considered to be more appropriate to proceed with the more deliberative variance approval/monitoring procedure outlined above. The recommended procedure will determine actual improvements resulting from WB/WS Facility Plan implementation, enable a proper determination for the appropriate waterbody classification for Westchester Creek and perhaps avoid unnecessary, repetitive and possibly contradictory rulemaking.

9.2.4. Future Considerations

Urban Tributary Classification

The possibility is recognized that the long-term post-construction monitoring program recommended for Westchester Creek, and ultimately for other confined waterbodies throughout the City, may indicate that the highest attainable uses are not compatible with the use goals of the Clean Water Act and State Water Quality Regulations. It is therefore recommended that consideration be given to the development of a new waterbody classification in DEC Water Quality Regulations, that being "Urban Tributary." This classification would have the following attributes:

- Recognition of wet weather conditions in the designation of uses and water quality criteria;
- Application to urban confined waterbodies which satisfy any of the UAA criteria enumerated in 40CFR131.10(g);
- Definition of required baseline water uses;
- Fish and aquatic life survival (if attainable); and
- Secondary contact recreation (if attainable).

Other attainable higher uses would be waterbody-specific and dependent upon the effectiveness of the site-specific CSO WB/WS Facility Plan /LTCP based upon knee-of-the-curve considerations, technical feasibility and ease of implementation.

The Urban Tributary classification could be implemented through the application of a generic UAA procedure for confined urban waterbodies based on the criteria of 40 CFR 131.10(g). This procedure could avoid the necessity for repeated UAAs on different waterbodies with similar characteristics. Those waterbodies which comply with the designation criteria can be identified at one time, and the reclassification completed in one rulemaking.

If either of the designated baseline uses of fish and aquatic life survival and secondary contact recreation did not appear to be attainable in a particular setting, then a site-specific UAA would be required.

Narrative Criteria

The recommendation for a WQBEL variance for the Westchester Creek WB/WS Facility Plan would apply with regard to the narrative water quality criteria previously cited as well as to the Class I water quality criterion for DO. However, a broad issue remains with the practical ability to attain the requirements of the narrative criteria in situations where wet weather discharges are unavoidable and will occasionally occur after controls. Therefore, it is recommended that DEC review the application of the narrative criteria, provide for a wet weather exclusion with demonstrated need, or make all narrative criteria conditional upon the impairment of waters for their best usage.

Synopsis

Although this WB/WS Facility Plan is expected to result in improvements to the water quality in Westchester Creek, it is not expected to completely attain all applicable water quality criteria. As such, the SPDES Permit for the Hunts Point WWTP may require a WQBEL variance for the Westchester Creek WB/WS Facility Plan if contravention of some criteria continues to occur. If water quality criteria are demonstrated to be unrealistic after a period of monitoring, DEP would request reclassification of portions of Westchester Creek based on a Use Attainability Analysis (UAA). Until the recommended UAAs and required regulatory processes are completed, the current DEC classification of Westchester Creek, Class I, should be retained.

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11.0. Glossary

A Posteriori Classification: A classification based on the results of experimentation.

A Priori Classification: A classification made prior to experimentation.

ACO: Administrative Consent Order

Activated Sludge: The product that results when primary effluent is mixed with bacteria-laden sludge and then agitated and aerated to promote biological treatment, speeding the breakdown of organic matter in raw sewage undergoing secondary waste treatment.

Acute Toxicity: The ability of a substance to cause severe biological harm or death soon after a single exposure or dose. Also, any poisonous effect resulting from a single short-term exposure to a toxic substance (see chronic toxicity, toxicity).

Administrative Consent Order (ACO): A legal agreement between a regulatory authority and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. It describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

Administrative Law Judge (ALJ): An officer in a government agency with quasi-judicial functions including conducting hearings, making findings of fact, and making recommendations for resolution of disputes concerning the agency's actions.

Advanced Treatment: A level of wastewater treatment more stringent than secondary treatment; requires an 85-percent reduction in conventional pollutant concentration or a significant reduction in non-conventional pollutants. Sometimes called tertiary treatment.

Advanced Wastewater Treatment: Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. (See primary, secondary treatment.)

Advection: Bulk transport of the mass of discrete chemical or biological constituents by fluid flow within receiving water. Advection describes the mass transport due to the velocity, or flow, of the waterbody. Example: The transport of pollution in a river: the motion of the water carries the polluted water downstream.

ADWF: Average Dry Weather Flow

Aeration: A process that promotes biological degradation of organic matter in water. The process may be passive (as when waste is exposed to air), or active (as when a mixing or bubbling device introduces the air). Exposure to additional air may be by means of natural of engineered systems.

Aerobic: Environmental conditions characterized by the presence of dissolved oxygen; used to describe biological or chemical processes that occur in the presence of oxygen.

Algae: Simple rootless plants that live floating or suspended in sunlit water or may be attached to structures, rocks or other submerged surfaces. Algae grow in proportion to the amount of available nutrients. They can affect water quality adversely since their biological activities can appreciably affect pH and low dissolved oxygen of the water. They are food for fish and small aquatic animals.

Algal Bloom: A heavy sudden growth of algae in and on a body of water which can affect water quality adversely and indicate potentially hazardous changes in local water chemistry. The growth results from excessive nutrient levels or other physical and chemical conditions that enable algae to reproduce rapidly.

ALJ: Administrative Law Judge

Allocations: Allocations are that portion of receiving water's loading capacity that is attributed to one of its existing or future sources (non-point or point) of pollution or to natural background sources. (Wasteload allocation (WLA) is that portion of the loading capacity allocated to an existing or future point source and a load allocation (LA) is that portion allocated to an existing or future non-point source or to a natural background source. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

Ambient Water Quality: Concentration of water quality constituent as measured within the waterbody.

Ammonia (NH_3): An inorganic form of nitrogen, is contained in fertilizers, septic system effluent, and animal wastes. It is also a product of bacterial decomposition of organic matter. NH3-N becomes a concern if high levels of the un-ionized form are present. In this form NH3-N can be toxic to aquatic organisms.

Anaerobic: Environmental condition characterized by zero oxygen levels. Describes biological and chemical processes that occur in the absence of oxygen. Anoxia. No dissolved oxygen in water.

Anthropogenic: Pertains to the [environmental] influence of human activities.

Antidegradation: Part of federal water quality requirements. Calls for all existing uses to be protected, for deterioration to be avoided or at least minimized when water quality meets or exceeds standards, and for outstanding waters to be strictly protected.

Aquatic Biota: Collective term describing the organisms living in or depending on the aquatic environment.

Aquatic Community: An association of interacting populations of aquatic organisms in a given waterbody or habitat.

Aquatic Ecosystem: Complex of biotic and abiotic components of natural waters. The aquatic ecosystem is an ecological unit that includes the physical characteristics (such as flow or velocity and depth), the biological community of the water column and benthos, and the chemical characteristics such as dissolved solids, dissolved oxygen, and nutrients. Both living and nonliving components of the aquatic ecosystem interact and influence the properties and status of each component.

Aquatic Life Uses: A beneficial use designation in which the waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.

Assemblage: An association of interacting populations of organisms in a given waterbody (e.g., fish assemblage or benthic macro-invertebrate assemblage).

Assessed Waters: Waters that states, tribes and other jurisdictions have assessed according to physical, chemical and biological parameters to determine whether or not the waters meet water quality standards and support designated beneficial uses.

Assimilation: The ability of a body of water to purify itself of pollutants.

Assimilative Capacity: The capacity of a natural body of water to receive wastewaters or toxic materials without deleterious efforts and without damage to aquatic life or humans who consume the water. Also, the amount of pollutant load that can be discharged to a specific waterbody without exceeding water quality standards. Assimilative capacity is used to define the ability of a waterbody to naturally absorb and use a discharged substance without impairing water quality or harming aquatic life.

Attribute: Physical and biological characteristics of habitats which can be measured or described.

Average Dry Weather Flow (ADWF): The average non-storm flow over 24 hours during the dry months of the year (May through September). It is composed of the average dry weather inflow/infiltration.

Bacteria: (Singular: bacterium) Microscopic living organisms that can aid in pollution control by metabolizing organic matter in sewage, oil spills or other pollutants. However, some types of bacteria in soil, water or air can also cause human, animal and plant health problems. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Measured in number of bacteria organisms per 100 milliliters of sample (No./mL or #/100 mL).

BASINS: Better Assessment Science Integrating Point and Non-point Sources

BEACH: Beaches Environmental Assessment and Coastal Health

Beaches Environmental Assessment and Coastal Health (BEACH): The BEACH Act requires coastal and Great Lakes States to adopt the 1986 USEPA Water Quality Criteria for Bacteria and to develop and implement beach monitoring and notification plans for bathing beaches.

Benthic: Refers to material, especially sediment, at the bottom of an aquatic ecosystem. It can be used to describe the organisms that live on, or in, the bottom of a waterbody.

Benthic Macroinvertebrates: See benthos.

Benthos: Animals without backbones, living in or on the sediments, of a size large enough to be seen by the unaided eye, and which can be retained by a U.S. Standard No. 30 sieve (28 openings/in, 0.595-mm openings). Also referred to as benthic macroinvertebrates, infauna, or macrobenthos.

Best Available Technology (BAT): The most stringent technology available for controlling emissions; major sources of emissions are required to use BAT, unless it can be demonstrated that it is unfeasible for energy, environmental, or economic reasons.

Best Management Practice (BMP): Methods, measures or practices that have been determined to be the most effective, practical and cost effective means of preventing or reducing pollution from non-point sources.

Better Assessment Science Integrating Point and Non-point Sources (BASINS): A computer tool that contains an assessment and planning component that allows users to organize and display geographic information for selected watersheds. It also contains a modeling component to examine impacts of pollutant loadings from point and non-point sources and to characterize the overall condition of specific watersheds.

Bioaccumulation: A process by which chemicals are taken up by aquatic organisms and plants directly from water as well as through exposure via other routes, such as consumption of food and sediment containing the chemicals.

Biochemical Oxygen Demand (BOD): A measure of the amount of oxygen per unit volume of water required to bacterially or chemically breakdown (stabilize) the organic matter in water. Biochemical oxygen demand measurements are usually conducted over specific time intervals (5,10,20,30 days). The term BOD generally refers to a standard 5-day BOD test. It is also considered a standard measure of the organic content in water and is expressed as mg/L. The greater the BOD, the greater the degree of pollution.

Bioconcentration: A process by which there is a net accumulation of a chemical directly from water into aquatic organisms resulting from simultaneous uptake (e.g., via gill or epithelial tissue) and elimination. In other words, the accumulation of a chemical in tissues of a fish or other organism to levels greater than the surrounding medium.

Biocriteria: A combination of narrative and numerical measures, such as the number and kinds of benthic, or bottom-dwelling, insects living in a stream, that describe the biological condition (structure and function) of aquatic communities inhabiting waters of a designated aquatic life use. Biocriteria are regulatory-based biological measurements and are part of a state's water quality standards.

Biodegradable: A substance or material that is capable of being decomposed (broken down) by natural biological processes.

Biodiversity: Refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the biological structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species and genes.

Biological Assemblage: A group of phylogenetically (e.g., fish) or ecologically (e.g., benthic macroinvertebrates) related organisms that are part of an aquatic community.

Biological Assessment or Bioassessment: An evaluation of the condition of a waterbody using biological surveys and other direct measures of the resident biota of the surface waters, in conjunction with biological criteria.

Biological Criteria or Biocriteria: Guidelines or benchmarks adopted by States to evaluate the relative biological integrity of surface waters. Biocriteria are narrative expressions or numerical values that describe biological integrity of aquatic communities inhabiting waters of a given classification or designated aquatic life use.

Biological Indicators: Plant or animal species or communities with a narrow range of environmental tolerances that may be selected for monitoring because their absence or presence and relative abundances serve as barometers of environmental conditions.

Biological Integrity: The condition of the aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by community structure and function.

Biological Monitoring or Biomonitoring: Multiple, routine biological surveys over time using consistent sampling and analysis methods for detection of changes in biological condition.

Biological Nutrient Removal (BNR): The removal of nutrients, such as nitrogen and/or phosphorous during wastewater treatment.

Biological Oxygen Demand (BOD): An indirect measure of the concentration of biologically degradable material present in organic wastes. It usually reflects the amount of oxygen consumed in five days by biological processes breaking down organic wastes.

Biological Survey or Biosurvey: Collecting, processing and analyzing representative portions of an estuarine or marine community to determine its structure and function.

Biological Magnification: Refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers and lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the food chain. he result of the processes of bioconcentration and bioaccumulation by which tissue concentrations of bioaccumulated chemicals increase as the chemical passes up through two or more trophic levels in the food chain. (See bioaccumulation.)

Biota: Plants, animals and other living resources in a given area.

Biotic Community: A naturally occurring assemblage of plants and animals that live in the same environment and are mutually sustaining and interdependent.

BMP: Best Management Practice

BNR: Biological Nutrient Removal

BOD: Biological Oxygen Demand; Biochemical Demand

Borrow Pit: See Subaqueous Borrow Pit.

Brackish: Water with salt content ranging between that of sea water and fresh water; commonly used to refer to Oligohaline waters.

Brooklyn Sewer Datum (BSD): Coordinate system and origins utilized by surveyors in the Borough of Brooklyn, New York City.

BSD: Brooklyn Sewer Datum

CAC: Citizens Advisory Committee

Calcareous: Pertaining to or containing calcium carbonate; Calibration; The process of adjusting model parameters within physically defensible ranges until the resulting predictions give a best possible fit to observed data.

Calibration: The process of adjusting model parameters within physically defensible ranges until the resulting predictions give a best possible fit to observed data.

CALM: Consolidated Assessment and Listing Methodology

Capital Improvement Program (CIP): A budget and planning tool used to implement non-recurring expenditures or any expenditure for physical improvements, including costs for: acquisition of existing buildings, land, or interests in land; construction of new buildings or other structures, including additions and major alterations; construction of streets and highways or utility lines; acquisition of fixed equipment; landscaping; and similar expenditures.

Capture: The total volume of flow collected in the combined sewer system during precipitation events on a system-wide, annual average basis (not percent of volume being discharged).

Catch Basin: (1) A buried chamber, usually built below curb grates seen at the curbline of a street, to relieve street flooding, which admits surface water for discharge into the sewer system and/or a receiving waterbody. (2) A sedimentation area designed to remove pollutants from runoff before being discharged into a stream or pond.

Carbonaceous Biochemical Oxygen Demand ($CBOD_5$): The amount of oxygen required to oxidize any carbon containing matter present in water in five days.

CATI: Computer Assisted Telephone Interviews

$CBOD_5$: Carbonaceous Biochemical Oxygen Demand

CEA: Critical Environmental Area

CEQR: City Environmental Quality Review

CERCLIS: Comprehensive Environmental Response, Compensation and Liability Information System

CFR: Code of Federal Regulation

Channel: A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channelization: Straightening and deepening streams so water will move faster or facilitate navigation - a tactic that can interfere with waste assimilation capacity, disturb fish and wildlife habitats, and aggravate flooding.

Chemical Oxygen Demand (COD): A measure of the oxygen required to oxidize all compounds, both organic and inorganic, in water.

Chlorination: The application of chlorine to drinking water, sewage, or industrial waste to disinfect or to oxidize undesirable compounds. Typically employed as a final process in water and wastewater treatment.

Chrome+6 (Cr+6): Chromium is a steel-gray, lustrous, hard metal that takes a high polish, is fusible with difficulty, and is resistant to corrosion and tarnishing. The most common oxidation states of chromium are +2, +3, and +6, with +3 being the most stable. +4 and +5 are relatively rare. Chromium compounds of oxidation state 6 are powerful oxidants.

Chronic Toxicity: The capacity of a substance to cause long-term poisonous health effects in humans, animals, fish and other organisms (see acute toxicity).

CIP: Capital Improvement Program

Citizens Advisory Committee (CAC): Committee comprised of various community stakeholders formed to provide input into a planning process.

City Environmental Quality Review (CEQR): CEQR is a process by which agencies of the City of New York review proposed discretionary actions to identify the effects those actions may have on the environment.

Clean Water Act (CWA): The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The CWA contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the Total maximum Daily Load (TMDL) program.

Coastal Waters: Marine waters adjacent to and receiving estuarine discharges and extending seaward over the continental shelf and/or the edge of the U.S. territorial sea.

Coastal Zone Boundary (CZB): Generally, the part of the land affected by its proximity to the sea and that part of the sea affected by its proximity to the land as the extent to which man's land-based activities have a measurable influence on water chemistry and marine ecology. Specifically, New York's Coastal zone varies from region to region while incorporating the following conditions: The inland boundary is approximately 1,000 feet from the shoreline of the mainland. In urbanized and developed coastal locations the landward boundary is approximately 500 feet from the mainland's shoreline, or less than 500 feet where a roadway or railroad line runs parallel to the shoreline at a distance of under 500 feet and defines the boundary. In locations where major state-owned lands and facilities or electric power generating facilities abut the shoreline, the boundary extends inland to include them. In some areas, such as Long Island Sound and the Hudson River Valley, the boundary may extend inland up to 10,000 feet to encompass significant coastal resources, such as areas of exceptional scenic value, agricultural ore recreational lands, and major tributaries and headlands.

Coastal Zone: Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or whose uses and ecology are affected by the sea.

COD: Chemical Oxygen Demand

Code of Federal Regulations (CFR): Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (references as 40 CFR) lists most environmental regulations.

Coliform Bacteria: Common name for Escherichia coli that is used as an indicator of fecal contamination of water, measured in terms of coliform count. (See Total Coliform Bacteria)

Coliforms: Bacteria found in the intestinal tract of warm-blooded animals; used as indicators of fecal contamination in water.

Collection System: Pipes used to collect and carry wastewater from individual sources to an interceptor sewer that will carry it to a treatment facility.

Collector Sewer: The first element of a wastewater collection system used to collect and carry wastewater from one or more building sewers to a main sewer. Also called a lateral sewer.

Combined Sewage: Wastewater and storm drainage carried in the same pipe.

Combined Sewer Overflow (CSO): Discharge of a mixture of storm water and domestic waste when the flow capacity of a sewer system is exceeded during rainstorms. CSOs discharged to receiving water can result in contamination problems that may prevent the attainment of water quality standards.

Combined Sewer Overflow Event: The discharges from any number of points in the combined sewer system resulting from a single wet weather event that do not receive minimum treatment (i.e., primary clarification, solids disposal, and disinfection, where appropriate). For example, if a storm occurs that results in untreated overflows from 50 different CSO outfalls within the combined sewer system (CSS), this is considered one overflow event.

Combined Sewer System (CSS): A sewer system that carries both sewage and storm-water runoff. Normally, its entire flow goes to a waste treatment plant, but during a heavy storm, the volume of water may be so great as to cause overflows of untreated mixtures of storm water and sewage into receiving waters. Storm-water runoff may also carry toxic chemicals from industrial areas or streets into the sewer system.

Comment Period: Time provided for the public to review and comment on a proposed USEPA action or rulemaking after publication in the Federal Register.

Community: In ecology, any group of organisms belonging to a number of different species that co-occur in the same habitat or area; an association of interacting assemblages in a given waterbody. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake.

Compliance Monitoring: Collection and evaluation of data, including self-monitoring reports, and verification to show whether pollutant concentrations and loads contained in permitted discharges are in compliance with the limits and conditions specified in the permit.

Compost: An aerobic mixture of decaying organic matter, such as leaves and manure, used as fertilizer.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS): Database that contains information on hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation. The database includes sites that are on the National Priorities List or being considered for the List.

Comprehensive Waterfront Plan (CWP): Plan proposed by the Department of City Planning that provides a framework to guide land use along the city's entire 578-mile shoreline in a way that recognizes its value as a natural resource and celebrates its diversity. The plan presents a long-range vision that balances the needs of environmentally sensitive areas and the working port with opportunities for waterside public access, open space, housing and commercial activity.

Computer Assisted Telephone Interviews (CATI): CATI is the use of computers to automate and control the key activities of a telephone interview.

Conc: Abbreviation for "Concentration".

Concentration: Amount of a substance or material in a given unit volume of solution. Usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Consolidated Assessment and Listing Methodology (CALM): USEPA framework for states and other jurisdictions to document how they collect and use water quality data and information for environmental decision making. The primary purposes of these data analyses are to determine the extent that all waters are attaining water quality standards, to identify waters that are impaired and need to be added to the 303(d) list, and to identify waters that can be removed from the list because they are attaining standards.

Contamination: Introduction into the water, air and soil of microorganisms, chemicals, toxic substances, wastes or wastewater in a concentration that makes the medium unfit for its next intended use.

Conventional Pollutants: Statutorily listed pollutants understood well by scientists. These may be in the form or organic waste, sediment, acid, bacteria, viruses, nutrients, oil and grease, or heat.

Cost-Benefit Analysis: A quantitative evaluation of the costs, which would be incurred by implementing an alternative versus the overall benefits to society of the proposed alternative.

Cost-Share Program: A publicly financed program through which society, as a beneficiary of environmental protection, allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The producer pays the remainder of the costs.

Cr+6: Hexavalent chromium

Critical Condition: The combination of environmental factors that results in just meeting water quality criterion and has an acceptably low frequency of occurrence.

Critical Environmental Area (CEA): A CEA is a specific geographic area designated by a state or local agency as having exceptional or unique environmental characteristics. In establishing a CEA, the fragile or threatened environmental conditions in the area are identified so that they will be taken into consideration in the site-specific environmental review under the State Environmental Quality Review Act.

Cross-Sectional Area: Wet area of a waterbody normal to the longitudinal component of the flow.

Cryptosporidium: A protozoan microbe associated with the disease cryptosporidiosis in man. The disease can be transmitted through ingestion of drinking water, person-to-person contact, or other pathways, and can cause acute diarrhea, abdominal pain, vomiting, fever and can be fatal. (See protozoa).

CSO: Combined Sewer Overflow

CSS: Combined Sewer System

Cumulative Exposure: The summation of exposures of an organism to a chemical over a period of time.

Clean Water Act (CWA): Federal law stipulating actions to be carried out to improve water quality in U.S. waters.

CWA: Clean Water Act

CWP: Comprehensive Waterfront Plan

CZB: Coastal Zone Boundary

DDWF: design dry weather flow

DEC: New York State Department of Environmental Conservation

Decay: Gradual decrease in the amount of a given substance in a given system due to various sink processes including chemical and biological transformation, dissipation to other environmental media, or deposition into storage areas.

Decomposition: Metabolic breakdown of organic materials; that releases energy and simple organics and inorganic compounds. (See Respiration)

Degradable: A substance or material that is capable of decomposition; chemical or biological.

Delegated State: A state (or other governmental entity such as a tribal government) that has received authority to administer an environmental regulatory program in lieu of a federal counterpart.

Demersal: Living on or near the bottom of a body of water (e.g., mid-water and bottom-dwelling fish and shellfish, as opposed to surface fish).

DEP: New York City Department of Environmental Protection

Department of Sanitation of New York (DSNY): New York City agency responsible for solid waste and refuse disposal in New York City

Design Capacity: The average daily flow that a treatment plant or other facility is designed to accommodate.

Design Dry Weather Flow (DDWF): The flow basis for design of New York City wastewater treatment plants. In general, the plants have been designed to treat 1.5 times this value to full secondary treatment standards and 2.0 times this value, through at least primary settling and disinfection, during stormwater events.

Designated Uses: Those water uses specified in state water quality standards for a waterbody, or segment of a waterbody, that must be achieved and maintained as required under the Clean Water Act. The uses, as defined by states, can include cold-water fisheries, natural fisheries, public water supply, irrigation, recreation, transportation, or mixed uses.

Deoxyribonucleic Acid (DNA): The genetic material of living organisms; the substance of heredity. It is a large, double-stranded, helical molecule that contains genetic instructions for growth, development, and replication.

Destratification: Vertical mixing within a lake or reservoir to totally or partially eliminate separate layers of temperature, plant, or animal life.

Deterministic Model: A model that does not include built-in variability: same input will always equal the same output.

Die-Off Rate: The first-order decay rate for bacteria, pathogens, and viruses. Die-off depends on the particular type of waterbody (i.e., stream, estuary , lake) and associated factors that influence mortality.

Dilution: Addition of less concentrated liquid (water) that results in a decrease in the original concentration.

Direct Runoff: Water that flows over the ground surface or through the ground directly into streams, rivers, and lakes.

Discharge Permits (NPDES): A permit issued by the USEPA or a state regulatory agency that sets specific limits on the type and amount of pollutants that a municipality or industry can discharge to a receiving water; it also includes a compliance schedule for achieving those limits. It is called the NPDES because the permit process was established under the National Pollutant Discharge Elimination System, under provisions of the Federal Clean Water Act.

Discharge: Flow of surface water in a stream or canal or the outflow of ground water from a flowing artesian well, ditch, or spring. It can also apply to discharges of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

Discriminant Analysis: A type of multivariate analysis used to distinguish between two groups.

Disinfect (Disinfected): A water and wastewater treatment process that kills harmful microorganisms and bacteria by means of physical, chemical and alternative processes such as ultraviolet radiation.

Disinfectant: A chemical or physical process that kills disease-causing organisms in water, air, or on surfaces. Chlorine is often used to disinfect sewage treatment effluent, water supplies, wells, and swimming pools.

Dispersion: The spreading of chemical or biological constituents, including pollutants, in various directions from a point source, at varying velocities depending on the differential instream flow characteristics.

Dissolved Organic Carbon (DOC): All organic carbon (e.g., compounds such as acids and sugars, leached from soils, excreted from roots, etc) dissolved in a given volume of water at a particular temperature and pressure.

Dissolved Oxygen (DO): The dissolved oxygen freely available in water that is vital to fish and other aquatic life and is needed for the prevention of odors. DO levels are considered a most important indicator of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatments are generally designed to ensure adequate DO in waste-receiving waters. It also refers to a measure of the amount of oxygen available for biochemical activity in a waterbody, and as an indicator of the quality of that water.

Dissolved Solids: The organic and inorganic particles that enter a waterbody in a solid phase and then dissolve in water.

DNA: deoxyribonucleic acid

DO: dissolved oxygen

DOC: Dissolved Organic Carbon

Drainage Area or Drainage Basin: An area drained by a main river and its tributaries (see Watershed).

Dredging: Dredging is the removal of mud from the bottom of waterbodies to facilitate navigation or remediate contamination. This can disturb the ecosystem and cause silting that can kill or harm aquatic life. Dredging of contaminated mud can expose biota to heavy metals and other toxics. Dredging activities are subject to regulation under Section 404 of the Clean Water Act.

Dry Weather Flow (DWF): Hydraulic flow conditions within a combined sewer system resulting from one or more of the following: flows of domestic sewage, ground water infiltration, commercial and industrial wastewaters, and any other non-precipitation event related flows (e.g., tidal infiltration under certain circumstances).

Dry Weather Overflow: A combined sewer overflow that occurs during dry weather flow conditions.

DSNY: Department of Sanitation of New York

DWF: Dry weather flow

Dynamic Model: A mathematical formulation describing the physical behavior of a system or a process and its temporal variability. Ecological Integrity. The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes.

E. Coli: Escherichia Coli.

Ecoregion: Geographic regions of ecological similarity defined by similar climate, landform, soil, natural vegetation, hydrology or other ecologically relevant variables.

Ecosystem: An interactive system that includes the organisms of a natural community association together with their abiotic physical, chemical, and geochemical environment.

Effects Range-Low: Concentration of a chemical in sediment below which toxic effects were rarely observed among sensitive species (10th percentile of all toxic effects).

Effects Range-Median: Concentration of a chemical in sediment above which toxic effects are frequently observed among sensitive species (50th percentile of all toxic effects).

Effluent: Wastewater, either municipal sewage or industrial liquid waste that flows out of a treatment plant, sewer or outfall untreated, partially treated, or completely treated.

Effluent Guidelines: Technical USEPA documents which set effluent limitations for given industries and pollutants.

Effluent Limitation: Restrictions established by a state or USEPA on quantities, rates, and concentrations in wastewater discharges.

Effluent Standard: See effluent limitation.

EIS: Environmental Impact Statement

EMAP: Environmental Monitoring and Assessment Program

EMC: Event Mean Concentration

Emergency Planning and Community Right-to-Know Act of 1986, The (SARA Title III): Law requiring federal, state and local governments and industry, which are involved in either emergency planning and/or reporting of hazardous chemicals, to allow public access to information about the presence of hazardous chemicals in the community and releases of such substances into the environment.

Endpoint: An endpoint is a characteristic of an ecosystem that may be affected by exposure to a stressor. Assessment endpoints and measurement endpoints are two distinct types of endpoints that are commonly used by resource managers. An assessment endpoint is the formal expression of a valued environmental characteristic and should have societal relevance. A measurement endpoint is the expression of an observed or measured response to a stress or disturbance. It is a measurable environmental characteristic that is related to the valued environmental characteristic chosen as the assessment endpoint. The numeric criteria that are part of traditional water quality standards are good examples of measurement endpoints.

Enforceable Requirements: Conditions or limitations in permits issued under the Clean Water Act Section 402 or 404 that, if violated, could result in the issuance of a compliance order or initiation of a civil or criminal action under federal or applicable state laws.

Enhancement: In the context of restoration ecology, any improvement of a structural or functional attribute.

Enteric: Of or within the gastrointestinal tract.

Enterococci: A subgroup of the fecal streptococci that includes S. faecalis and S. faecium. The enterococci are differentiated from other streptococci by their ability to grow in 6.5% sodium chloride, at pH 9.6, and at 10°C and 45°C. Enterococci are a valuable bacterial indicator for determining the extent of fecal contamination of recreational surface waters.

Environment: The sum of all external conditions and influences affecting the development and life of organisms.

Environmental Impact Statement (EIS): A document required of federal agencies by the National Environmental Policy Act for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and cites alternative actions.

Environmental Monitoring and Assessment Program (EMAP): The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources.

Epibenthic: Those animals/organisms located at the surface of the sediments on the bay bottom, generally referring to algae.

Epibenthos: Those animals (usually excluding fishes) living on the top of the sediment surface.

Epidemiology: All the elements contributing to the occurrence or non-occurrence of a disease in a population; ecology of a disease.

Epifauna: Benthic animals living on the sediment or on and among rocks and other structures.

EPMC: Engineering Program Management Consultant

Escherichia Coli: A subgroup of the fecal coliform bacteria. E. coli is part of the normal intestinal flora in humans and animals and is, therefore, a direct indicator of fecal contamination in a waterbody. The O157 strain, sometimes transmitted in contaminated waterbodies, can cause serious infection resulting in gastroenteritis. (See Fecal coliform bacteria)

Estuarine Number: Nondimensional parameter accounting for decay, tidal dispersion, and advection velocity. Used for classification of tidal rivers and estuarine systems.

Estuarine or Coastal Marine Classes: Classes that reflect basic biological communities and that are based on physical parameters such as salinity, depth, sediment grain size, dissolved oxygen and basin geomorphology.

Estuarine Waters: Semi-enclosed body of water which has a free connection with the open sea and within which seawater is measurably diluted with fresh water derived from land drainage.

Estuary: Region of interaction between rivers and near-shore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife (see wetlands).

Eutrophication: A process in which a waterbody becomes rich in dissolved nutrients, often leading to algal blooms, low dissolved oxygen and changes in the composition of plants and animals in the waterbody. This occurs naturally, but can be exacerbated by human activity which increases nutrient inputs to the waterbody.

Event Mean Concentration (EMC): Input data, typically for urban areas, for a water quality model. EMC represents the concentration of a specific pollutant contained in stormwater runoff coming from a particular land use type within a watershed.

Existing Use: Describes the use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).

Facility Plan: A planning project that uses engineering and science to address pollution control issues and will most likely result in the enhancement of existing water pollution control facilities or the construction of new facilities.

Facultative: Capable of adaptive response to varying environments.

Fecal Coliform Bacteria: A subset of total coliform bacteria that are present in the intestines or feces of warm-blooded animals. They are often used as indicators of the sanitary quality of water. They are measured by running the standard total coliform test at an elevated temperature (44.5EC). Fecal coliform is approximately 20 percent of total coliform. (See Total Coliform Bacteria)

Fecal Streptococci: These bacteria include several varieties of streptococci that originate in the gastrointestinal tract of warm-blooded animals such as humans (Streptococcus faecalis) and domesticated animals such as cattle (Streptococcus bovis) and horses (Streptococcus equinus).

Feedlot: A confined area for the controlled feeding of animals. The area tends to concentrate large amounts of animal waste that cannot be absorbed by the soil and, hence, may be carried to nearby streams or lakes by rainfall runoff.

FEIS: Final Environmental Impact Statement

Field Sampling and Analysis Program (FSAP): Biological sampling program undertaken to fill-in ecosystem data gaps in New York Harbor.

Final Environmental Impact Statement (FEIS): A document that responds to comments received on the Draft EIS and provides updated information that has become available after publication of the Draft EIS.

Fish Kill: A natural or artificial condition in which the sudden death of fish occurs due to the introduction of pollutants or the reduction of the dissolved oxygen concentration in a waterbody.

Floatables: Large waterborne materials, including litter and trash, that are buoyant or semi-buoyant and float either on or below the water surface. These materials, which are generally man-made and sometimes characteristic of sanitary wastewater and storm runoff, may be transported to sensitive environmental areas such as bathing beaches where they can become an aesthetic nuisance. Certain types of floatables also cause harm to marine wildlife and can be hazardous to navigation.

Flocculation: The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules that eventually settle out of suspension.

Flux: Movement and transport of mass of any water quality constituent over a given period of time. Units of mass flux are mass per unit time.

FOIA: Freedom of Information Act

Food Chain: A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

Freedom of Information Act (FOIA): A federal statute which allows any person the right to obtain federal agency records unless the records (or part of the records) are protected from disclosure by any of the nine exemptions in the law.

FSAP: Field Sampling and Analysis Program

gallons per day (gpd): unit of measure of flow

gallons per minute (gpm): unit of measure

Gastroenteritis: An inflammation of the stomach and the intestines.

General Permit: A permit applicable to a class or category of discharges.

Geochemical: Refers to chemical reactions related to earth materials such as soil, rocks, and water.

Geographical Information System (GIS): A computer system that combines database management system functionality with information about location. In this way it is able to capture, manage, integrate, manipulate, analyze and display data that is spatially referenced to the earth's surface.

Giardia lamblia: Protozoan in the feces of humans and animals that can cause severe gastrointestinal Ailments. It is a common contaminant of surface waters. (See protozoa).

GIS: Geographical Information System

Global Positioning System (GPS): A GPS comprises a group of satellites orbiting the earth (24 are now maintained by the U.S. Government) and a receiver, which can be highly portable. The receiver can generate accurate coordinates for a point, including elevation, by calculating its own position relative to three or more satellites that are above the visible horizon at the time of measurement.

gpd: Gallons per Day

gpd/ft: gallons per day per foot

gpd/sq ft: gallons per day per square foot

gpm: Gallons per minute

GPS: Global Positioning System

Gradient: The rate of decrease (or increase) of one quantity with respect to another; for example, the rate of decrease of temperature with depth in a lake.

Groundwater: The supply of fresh water found beneath the earth's surface, usually in aquifers, which supply wells and springs. Because groundwater is a major source of drinking water, there is growing concern over contamination from leaching agricultural or industrial pollutants and leaking underground storage tanks.

H_2S: Hydrogen Sulfide

Habitat Conservation Plans (HCPs): As part of the Endangered Species Act, Habitat Conservation Plans are designed to protect a species while allowing development. HCP's give the U.S. Fish and Wildlife Service the authority to permit "taking" of endangered or threatened species as long as the impact is reduced by conservation measures. They allow a landowner to determine how best to meet the agreed-upon fish and wildlife goals.

Habitat: A place where the physical and biological elements of ecosystems provide an environment and elements of the food, cover and space resources needed for plant and animal survival.

Halocline: A vertical gradient in salinity.

HCP: Habitat Conservation Plan

Heavy Metals: Metallic elements with high atomic weights (e.g., mercury, chromium, cadmium, arsenic, and lead); can damage living things at low concentrations and tend to accumulate in the food chain.

High Rate Treatment (HRT): A traditional gravity settling process enhanced with flocculation and settling aids to increase loading rates and improve performance.

Holding Pond: A pond or reservoir, usually made of earth, built to store polluted runoff.

Holoplankton: An aggregate of passively floating, drifting or somewhat motile organisms throughout their entire life cycle; Hot spot locations in waterbodies or sediments where hazardous substances have accumulated to levels which may pose risks to aquatic life, wildlife, fisheries, or human health.

HRT: High Rate Treatment

Hydrogen Sulfide (H_2S): A flammable, toxic, colorless gas with an offensive odor (similar to rotten eggs) that is a byproduct of degradation in anaerobic conditions.

Hydrology: The study of the distribution, properties, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypoxia: The condition of low dissolved oxygen in aquatic systems (typically with a dissolved oxygen concentration less than 3.0 mg/L).

Hypoxia/Hypoxic Waters: Waters with dissolved oxygen concentrations of less than 2 ppm, the level generally accepted as the minimum required for most marine life to survive and reproduce.

I/I: Inflow/Infiltration

Index of Biotic Integrity: A fish community assessment approach that incorporates the zoogeographic, ecosystem, community and population aspects of fisheries biology into a single ecologically-based index of the quality of a water resource.

IBI: Indices of Biological Integrity

IDNP: Illegal Dumping Notification Program

IEC: Interstate Environmental Commission

IFCP: Interim Floatables Containment Program

Illegal Dumping Notification Program (IDNP): New York City program wherein the DEP field personnel report any observed evidence of illegal shoreline dumping to the Sanitation Police section of DSNY, who have the authority to arrest dumpers who, if convicted, are responsible for proper disposal of the material.

Impact: A change in the chemical, physical or biological quality or condition of a waterbody caused by external sources.

Impaired Waters: Waterbodies not fully supporting their designated uses.

Impairment: A detrimental effect on the biological integrity of a waterbody caused by an impact.

Impermeable: Impassable; not permitting the passage of a fluid through it.

In situ: Measurements taken in the natural environment.

in.: Abbreviation for "Inches".

Index Period: A sampling period, with selection based on temporal behavior of the indicator(s) and the practical considerations for sampling.

Indicator Organism: Organism used to indicate the potential presence of other (usually pathogenic) organisms. Indicator organisms are usually associated with the other organisms, but are usually more easily sampled and measured.

Indicator Taxa or Indicator Species: Those organisms whose presence (or absence) at a site is indicative of specific environmental conditions.

Indicator: Measurable quantity that can be used to evaluate the relationship between pollutant sources and their impact on water quality. Abiotic and biotic indicators can provide quantitative information on environmental conditions.

Indices of Biological Integrity (IBI): A usually dimensionless numeric combination of scores derived from biological measures called metrics.

Industrial Pretreatment Programs (IPP): Program mandated by USEPA to control toxic discharges to public sewers that are tributary to sewage treatment plants by regulating Significant Industrial Users (SIUs). DEP enforces the IPP through Chapter 19 of Title 15 of the Rules of the City of New York (Use of Public Sewers).

Infauna: Animals living within submerged sediments. (See benthos.)

Infectivity: Ability to infect a host. Infiltration. 1. Water other than wastewater that enters a wastewater system and building sewers from the ground through such means as defective pipes, pipe joints, connections or manholes. (Infiltration does not include inflow.) 2. The gradual downward flow of water from the ground surfaces into the soil.

Infiltration: The penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Infiltration/Inflow (I/I): The total quantity of water entering a sewer system from both infiltration and inflow.

Inflow: Water other than wastewater that enters a wastewater system and building sewer from sources such as roof leaders, cellar drains, yard drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm drains and sanitary sewers, catch basins, cooling towers, stormwaters, surface runoff, street wash waters or drainage. (Inflow does not include infiltration.)

Influent: Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant.

Initial Mixing Zone: Region immediately downstream of an outfall where effluent dilution processes occur. Because of the combined effects of the effluent buoyancy, ambient stratification, and current, the prediction of initial dilution can be involved.

Insolation: Exposure to the sun's rays.

Instream Flow: The amount of flow required to sustain stream values, including fish, wildlife, and recreation.

Interceptor Sewers: Large sewer lines that, in a combined system, collect and carry sewage flows from main and trunk sewers to the treatment plant for treatment and discharge. The sewer has no building sewer connections. During some storm events, their capacity is exceeded and regulator structures relieve excess flow to receiving waters to prevent flooding basements, businesses and streets.

Interim Floatables Containment Program (IFCP): A New York City Program that includes containment booms at 24 locations, end-of-pipe nets, skimmer vessels that pick up floatables and transports them to loading stations.

Interstate Environmental Commission (IEC): The Interstate Environmental Commission is a joint agency of the States of New York, New Jersey, and Connecticut. The IEC was established in 1936 under a Compact between New York and New Jersey and approved by Congress. The State of Connecticut joined the Commission in 1941. The mission of the IEC is to protect and enhance environmental quality through cooperation, regulation, coordination, and mutual dialogue between government and citizens in the tri-state region.

Intertidal: The area between the high- and low-tide lines.

IPP: Industrial Pretreatment Programs

Irrigation: Applying water or wastewater to land areas to supply the water and nutrient needs of plants.

JABERRT: Jamaica Bay Ecosystem Research and Restoration Team

Jamaica Bay Ecosystem Research and Restoration Team (JABERRT): Team established by the Army Corps of Engineers to conduct a detailed inventory and biogeochemical characterization of Jamaica Bay for the 2000-2001 periods and to compile the most detailed literature search established.

Jamaica Eutrophication Model (JEM): Model developed for Jamaica Bay in 1996 as a result of a cost-sharing agreement between the DEP and US Army Corps of Engineers.

JEM: Jamaica Eutrophication Model

Karst Geology: Solution cavities and closely-spaced sinkholes formed as a result of dissolution of carbonate bedrock.

Knee-of-the-Curve: The point where the incremental change in the cost of the control alternative per change in performance of the control alternative changes most rapidly.

KOTC: Knee-of-the-Curve

Kurtosis: A measure of the departure of a frequency distribution from a normal distribution, in terms of its relative peakedness or flatness.

LA: Load Allocation

Land Application: Discharge of wastewater onto the ground for treatment or reuse. (See irrigation)

Land Use: How a certain area of land is utilized (examples: forestry, agriculture, urban, industry).

Landfill: A large, outdoor area for waste disposal; landfills where waste is exposed to the atmosphere (open dumps) are now illegal; in constructed landfills, waste is layered, covered with soil, and is built upon impermeable materials or barriers to prevent contamination of surroundings.

lb/day/cf: pounds per day per cubic foot

lbs/day: pounds per day

LC: Loading Capacity

Leachate: Water that collects contaminants as it trickles through wastes, pesticides, or fertilizers. Leaching can occur in farming areas, feedlots, and landfills and can result in hazardous substances entering surface water, groundwater, or soil.

Leaking Underground Storage Tank (LUST): An underground container used to store gasoline, diesel fuel, home heating oil, or other chemicals that is damaged in some way and is leaking its contents into the ground; may contaminate groundwater.

LID: Low Impact Development

LID-R: Low Impact Development - Retrofit

Limiting Factor: A factor whose absence exerts influence upon a population or organism and may be responsible for no growth, limited growth (decline) or rapid growth.

Littoral Zone: The intertidal zone of the estuarine or seashore; i.e., the shore zone between the highest and lowest tides.

Load Allocation (LA): The portion of receiving water's loading capacity that is attributed either to one of its existing or future non-point sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and non-point source loads should be distinguished. (40 CFR 130.2(g))

Load, Loading, Loading Rate: The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in mass per unit time.

Loading Capacity (LC): The greatest amount of loading that water can receive without violating water quality standards.

Long-Term Control Plan (LTCP): A document developed by CSO communities to describe existing waterway conditions and various CSO abatement technologies that will be used to control overflows.

Low-Flow: Stream flow during time periods where no precipitation is contributing to runoff to the stream and contributions from groundwater recharge are low. Low flow results in less water available for dilution of pollutants in the stream. Due to the limited flow, direct discharges to the stream dominate during low flow periods. Exceedences of water quality standards during low flow conditions are likely to be caused by direct discharges such as point sources, illicit discharges, and livestock or wildlife in the stream.

Low Impact Development (LID): A sustainable storm water management strategy implemented in response to burgeoning infrastructural costs of new development and redevelopment projects, more rigorous environmental regulations, concerns about the urban heat island effect, and the impacts of natural resources due to growth and development. The LID strategy controls water at the source—both rainfall and storm water runoff—which is known as 'source-control' technology. It is a decentralized system that distributes storm water across a project site in order to replenish groundwater supplies rather than sending it into a system of storm drain pipes and channelized networks that control water downstream in a large storm water management facility. The LID approach promotes the use of various devices that filter water and infiltrate water into the ground. It promotes the use of roofs of buildings, parking lots, and other horizontal surfaces to convey water to either distribute it into the ground or collect it for reuse.

Low Impact Development – Retrofit (LID-R): Modification of an existing site to accomplish LID goals.

LTCP: Long-Term CSO Control Plan

LUST: leaking underground storage tank

Macrobenthos: Benthic organisms (animals or plants) whose shortest dimension is greater than or equal to 0.5 mm. (See benthos.)

Macrofauna: Animals of a size large enough to be seen by the unaided eye and which can be retained by a U.S. Standard No. 30 sieve (28 meshes/in, 0.595-mm openings).

Macro-invertebrate: Animals/organism without backbones (Invertebrate) that is too large to pass through a No. 40 Screen (0.417mm) but can be retained by a U.S. Standard No. 30 sieve (28 meshes/in, 0.595-mm openings). The organism size is of sufficient size for it to be seen by the unaided eye and which can be retained

Macrophytes: Large aquatic plants that may be rooted, non-rooted, vascular or algiform (such as kelp); including submerged aquatic vegetation, emergent aquatic vegetation, and floating aquatic vegetation.

Major Oil Storage Facilities (MOSF): Onshore facility with a total combined storage capacity of 400,000 gallons or more of petroleum and/or vessels involved in the transport of petroleum on the waters of New York State.

Margin of Safety (MOS): A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by USEPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).

Marine Protection, Research and Sanctuaries Act of 1972, The Ocean Dumping Act: Legislation regulating the dumping of any material in the ocean that may adversely affect human health, marine environments or the economic potential of the ocean.

Mass Balance: A mathematical accounting of substances entering and leaving a system, such as a waterbody, from all sources. A mass balance model for a waterbody is useful to help understand the relationship between the loadings of a pollutant and the levels in the water, biota and sediments, as well as the amounts that can be safely assimilated by the waterbody.

Mass Loading: The quantity of a pollutant transported to a waterbody.

Mathematical Model: A system of mathematical expressions that describe the spatial and temporal distribution of water quality constituents resulting from fluid transport and the one, or more, individual processes and interactions within some prototype aquatic ecosystem. A mathematical water quality model is used as the basis for wasteload allocation evaluations.

Mean Low Water (MLW): A tidal level. The average of all low waters observed over a sufficiently long period.

Median Household Income (MHI): The median household income is one measure of average household income. It divides the household income distribution into two equal parts: one-half of the cases fall below the median household income, and one-half above it.

Meiofauna: Small interstitial; i.e., occurring between sediment particles, animals that pass through a 1-mm mesh sieve but are retained by a 0.1-mm mesh.

Memorandum of Understanding (MOU): An agreement between two or more public agencies defining the roles and responsibilities of each agency in relation to the other or others with respect to an issue over which the agencies have concurrent jurisdiction.

Meningitis: Inflammation of the meninges, especially as a result of infection by bacteria or viruses.

Meroplankton: Organisms that are planktonic only during the larval stage of their life history.

Mesohaline: The estuarine salinity zone with a salinity range of 5-18-ppt.

Metric: A calculated term or enumeration which represents some aspect of biological assemblage structure, function, or other measurable characteristic of the biota that changes in some predictable way in response to impacts to the waterbody.

mf/L: Million fibers per liter – A measure of concentration.

MG: Million Gallons – A measure of volume.

mg/L: Milligrams Per Liter – A measure of concentration.

MGD: Million Gallons Per Day – A measure of the rate of water flow.

MHI: Median Household Income

Microgram per liter (ug/L): A measure of concentration

Microorganisms: Organisms too small to be seen with the unaided eye, including bacteria, protozoans, yeasts, viruses and algae.

Milligrams per liter (mg/L): This weight per volume designation is used in water and wastewater analysis. 1 mg/L = 1 ppm.

milliliters (mL): A unit of length equal to one thousandth (10^{-3}) of a meter, or 0.0394 inch.

Million fibers per liter (mf/L): A measure of concentration.

million gallons (MG): A unit of measure used in water and wastewater to express volume. To visualize this volume, if a good-sized bath holds 50 gallons, so a million gallons would be equal to 20,000 baths.

million gallons per day (MGD): Term used to express water-use data. Denotes the volume of water utilized in a single day.

Mitigation: Actions taken to avoid, reduce, or compensate for the effects of environmental damage. Among the broad spectrum of possible actions are those which restore, enhance, create, or replace damaged ecosystems.

Mixing Zone: A portion of a waterbody where water quality criteria or rules are waived in order to allow for dilution of pollution. Mixing zones have been allowed by states in many NPDES permits when discharges were expected to have difficulty providing enough treatment to avoid violating standards for the receiving water at the point of discharge.

mL: milliliters

MLW: mean low water

Modeling: An investigative technique using a mathematical or physical representation of a system or theory, usually on a computer, that accounts for all or some of its known properties. Models are often used to test the effect of changes of system components on the overall performance of the system.

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Monte Carlo Simulation: A stochastic modeling technique that involves the random selection of sets of input data for use in repetitive model runs. Probability distributions of receiving water quality concentrations are generated as the output of a Monte Carlo simulation.

MOS: Margin of Safety

MOSF: major oil storage facilities

MOU: Memorandum of Understanding

MOUSE: Computer model developed by the Danish Hydraulic Institute used to model the combined sewer system.

MS4: municipal separate storm sewer systems

Multimetric Approach: An analysis technique that uses a combination of several measurable characteristics of the biological assemblage to provide an assessment of the status of water resources.

Multivariate Community Analysis: Statistical methods (e.g., ordination or discriminant analysis) for analyzing physical and biological community data using multiple variables.

Municipal Separate Storm Sewer Systems (MS4): A conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) that is 1) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage districts, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges to waters of the United States; 2) Designed or used for collecting or conveying stormwater; 3) Which is not a combined sewer; and 4) Which is not part of a publicly owned treatment works.

Municipal Sewage: Wastes (mostly liquid) originating from a community; may be composed of domestic wastewater and/or industrial discharges.

National Estuary Program: A program established under the Clean Water Act Amendments of 1987 to develop and implement conservation and management plans for protecting estuaries and restoring and maintaining their chemical, physical, and biological integrity, as well as controlling point and non-point pollution sources.

National Marine Fisheries Service (NMFS): A federal agency - with scientists, research vessels, and a data collection system - responsible for managing the nation's saltwater fish. It oversees the actions of the Councils under the Fishery Conservation and Management Act.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Clean Water Act. The program imposes discharge limitations on point sources by basing them on the effluent limitation capabilities of a control technology or on local water quality standards. It prohibits discharge of pollutants into water of the United States unless a special permit is issued by USEPA, a state, or, where delegated, a tribal government on an Indian reservation.

National Priorities List (NPL): **USEPA**'s list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System. USEPA is required to update the NPL at least once a year. A site must be on the NPL to receive money from the Trust Fund for remedial action.

National Wetland Inventory (NWI): The National Wetlands Inventory (NWI) of the U.S. Fish & Wildlife Service produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. The National Wetlands Inventory information is used by Federal, State, and local agencies, academic institutions, U.S. Congress, and the private sector. Congressional mandates in the Emergency Wetlands Resources Act requires the Service to map wetlands, and to digitize, archive and distribute the maps.

Natural Background Levels: Natural background levels represent the chemical, physical, and biological conditions that would result from natural geomorphological processes such as weathering or dissolution.

Natural Waters: Flowing water within a physical system that has developed without human intervention, in which natural processes continue to take place.

Navigable Waters: Traditionally, waters sufficiently deep and wide for navigation; such waters in the United States come under federal jurisdiction and are protected by the Clean Water Act.

New York City Department of City Planning (NYCDCP): New York City agency responsible for the city's physical and socioeconomic planning, including land use and environmental review; preparation of plans and policies; and provision of technical assistance and planning information to government agencies, public officials, and community boards.

New York City Department of Environmental Protection (DEP): New York City agency responsible for addressing the environmental needs of the City's residents in areas including water, wastewater, air, noise and hazmat.

New York City Department of Parks and Recreation (NYCDPR): The New York City Department of Parks and Recreation is the branch of government of the City of New York responsible for maintaining the city's parks system, preserving and maintaining the ecological diversity of the city's natural areas, and furnishing recreational opportunities for city's residents.

New York City Department of Transportation (NYCDOT): New York City agency responsible for maintaining and improving New York City's transportation network.

New York City Economic Development Corporation (NYCEDC): City's primary vehicle for promoting economic growth in each of the five boroughs. NYCEDC works to stimulate investment in New York and broaden the City's tax and employment base, while meeting the needs of businesses large and small. To realize these objectives, NYCEDC uses its real estate and financing tools to help companies that are expanding or relocating anywhere within the city.

New York District (NYD): The local division of the United States Army Corps of Engineers,

New York State Code of Rules and Regulations (NYCRR): Official statement of the policy(ies) that implement or apply the Laws of New York.

New York State Department of Environmental Conservation (DEC): New York State agency that *conserves, improves, and protects New York State's natural resources and environment, and controls water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well being.*

New York State Department of State (NYSDOS): Known as the "keeper of records" for the State of New York. Composed of two main divisions including the Office of Business and Licensing Services and the Office of Local Government Services. The latter office includes the Division of Coastal Resources and Waterfront Revitalization.

NH_3: Ammonia

Nine Minimum Controls (NMC): Controls recommended by the USEPA to minimize CSO impacts. The controls include: (1) proper operation and maintenance for sewer systems and CSOs; (2) maximum use of the collection system for storage; (3) review pretreatment requirements to minimize CSO impacts; (4) maximize flow to treatment facility; (5) prohibit combines sewer discharge during dry weather; (6) control solid and floatable materials in CSOs; (7) pollution prevention; (8) public notification of CSO occurrences and impacts; and, (9) monitor CSOs to characterize impacts and efficacy of CSO controls.

NMC: nine minimum controls

NMFS: National Marine Fisheries Service

No./mL (or #/mL): number of bacteria organisms per milliliter – measure of concentration

Non-Compliance: Not obeying all promulgated regulations, policies or standards that apply.

Non-Permeable Surfaces: Surfaces which will not allow water to penetrate, such as sidewalks and parking lots.

Non-Point Source (NPS): Pollution that is not released through pipes but rather originates from multiple sources over a relatively large area (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Non-point sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

NPDES: National Pollution Discharge Elimination System

NPL: National Priorities List

NPS: Non-Point Source

Numeric Targets: A measurable value determined for the pollutant of concern which is expected to result in the attainment of water quality standards in the listed waterbody.

Nutrient Pollution: Contamination of water resources by excessive inputs of nutrients. In surface waters, excess algal production as a result of nutrient pollution is a major concern.

Nutrient: Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

NWI: National Wetland Inventory

NYCDCP: New York City Department of City Planning

NYCDOT: New York City Department of Transportation

NYCDPR: New York City Department of Parks and Recreation

NYCEDC: New York City Economic Development Corporation

NYCRR: New York State Code of Rules and Regulations

NYD: New York District

NYSDOS: New York State Department of State

O&M: Operation and Maintenance

Oligohaline: The estuarine salinity zone with a salinity range of 0.5-5-ppt.

ONRW: Outstanding National Resource Waters

Operation and Maintenance (O&M): Actions taken after construction to ensure that facilities constructed will be properly operated and maintained to achieve normative efficiency levels and prescribed effluent eliminations in an optimum manner.

Optimal: Most favorable point, degree, or amount of something for obtaining a given result; in ecology most natural or minimally disturbed sites.

Organic Chemicals/Compounds: Naturally occurring (animal or plant-produced or synthetic) substances containing mainly carbon, hydrogen, nitrogen, and oxygen.

Organic Material: Material derived from organic, or living, things; also, relating to or containing carbon compounds.

Organic Matter: Carbonaceous waste (organic fraction) that includes plant and animal residue at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population originating from domestic or industrial sources. It is commonly determined as the amount of organic material contained in a soil or water sample.

Organic: (1) Referring to other derived from living organisms. (2) In chemistry, any compound containing carbon.

Ortho P: Ortho Phosphorus

Ortho Phosphorus: Soluble reactive phosphorous readily available for uptake by plants. The amount found in a waterbody is an indicator of how much phosphorous is available for algae and plant growth. Since aquatic plant growth is typically limited by phosphorous, added phosphorous especially in the dissolved, bioavailable form can fuel plant growth and cause algae blooms.

Outfall: Point where water flows from a conduit, stream, or drain into receiving water.

Outstanding National Resource Waters (ONRW): Outstanding national resource waters (ONRW) designations offer special protection (i.e., no degradation) for designated waters, including wetlands. These are areas of exceptional water quality or recreational/ecological significance. State antidegradation policies should provide special protection to wetlands designated as outstanding national resource waters in the same manner as other surface waters; see Section 131.12(a)(3) of the WQS regulation and USEPA guidance (Water Quality Standards Handbook (USEPA 1983b), and Questions and Answers on: Antidegradation (USEPA 1985a)).

Overflow Rate: A measurement used in wastewater treatment calculations for determining solids settling. It is also used for CSO storage facility calculations and is defined as the flow through a storage basin divided by the surface area of the basin. It can be thought of as an average flow rate through the basin. Generally expressed as gallons per day per square foot (gpd/sq.ft.).

Oxidation Pond: A relatively shallow body of wastewater contained in an earthen basin; lagoon; stabilization pond.

Oxidation: The chemical union of oxygen with metals or organic compounds accompanied by a removal of hydrogen or another atom. It is an important factor for soil formation and permits the release of energy from cellular fuels.

Oxygen Demand: Measure of the dissolved oxygen used by a system (microorganisms) in the oxidation of organic matter. (See also biochemical oxygen demand)

Oxygen Depletion: The reduction of dissolved oxygen in a waterbody.

PAH: Polycyclic Aromatic Hydrocarbons

Partition Coefficients: Chemicals in solution are partitioned into dissolved and particulate adsorbed phase based on their corresponding sediment-to-water partitioning coefficient.

Parts per Million (ppm): The number of "parts" by weight of a substance per million parts of water. This unit is commonly used to represent pollutant concentrations. Large concentrations are expressed in percentages.

Pathogen: Disease-causing agent, especially microorganisms such as bacteria, protozoa, and viruses.

PCBs: Polychlorinated biphenyls

PCS: Permit Compliance System

PE: Primary Effluent

Peak Flow: The maximum flow that occurs over a specific length of time (e.g., daily, hourly, instantaneous).

Pelagic Zone: The area of open water beyond the littoral zone.

Pelagic: Pertaining to open waters or the organisms which inhabit those waters.

Percent Fines: In analysis of sediment grain size, the percent of fine (.062-mm) grained fraction of sediment in a sample.

Permit Compliance System (PCS): Computerized management information system which contains data on NPDES permit-holding facilities. PCS keeps extensive records on more than 65,000 active water-discharge permits on sites located throughout the nation. PCS tracks permit, compliance, and enforcement status of NPDES facilities.

Permit: An authorization, license, or equivalent control document issued by USEPA or an approved federal, state, or local agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Petit Ponar Grab Sampler: Dredge designed to take samples from all types of benthos sediments on all varieties of waterbody bottoms, except those of the hardest clay. When the jaws contact the bottom they obtain a good penetration with very little sample disturbance. Can be used in both fresh and salt water.

pH: An expression of the intensity of the basic or acid condition of a liquid. The pH may range from 0 to 14, where 0 is most acid, 14 most basic and 7 neutral. Natural waters usually have a pH between 6.5 and 8.5.

Phased Approach: Under the phased approach to TMDL development, load allocations (LAs) and wasteload allocations (WLAs) are calculated using the best available data and information recognizing the need for additional monitoring data to accurately characterize sources and loadings. The phased approach is typically employed when non-point sources dominate. It provides for the implementation of load reduction strategies while collecting additional data.

Photic Zone: The region in a waterbody extending from the surface to the depth of light penetration.

Photosynthesis: The process by which chlorophyll-containing plants make carbohydrates from water, and from carbon dioxide in the air, using energy derived from sunlight.

Phytoplankton: Free-floating or drifting microscopic algae with movements determined by the motion of the water.

Point Source: (1) A stationary location or fixed facility from which pollutant loads are discharged. (2) Any single identifiable source of pollutants including pipes, outfalls, and conveyance channels from either municipal wastewater treatment systems or industrial waste treatment facilities. (3) Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.

Pollutant: Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. (CWA Section 502(6)).

Pollution: Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Polychaete: Marine worms of the class Polychaeta of the invertebrate worm order Annelida. Polychaete species dominate the marine benthos, with dozens of species present in natural marine environments. These worms are highly diversified, ranging from detritivores to predators, with some species serving as good indicators of environmental stress.

Polychlorinated Biphenyls (PCBs): A group of synthetic polychlorinated aromatic hydrocarbons formerly used for such purposes as insulation in transformers and capacitors and lubrication in gas pipeline systems. Production, sale and new use was banned by law in 1977 following passage of the Toxic Substances Control Act. PCBs have a strong tendency to bioaccumulate. They are quite stable, and therefore persist in the environment for long periods of time. They are classified by USEPA as probable human carcinogens.

Polycyclic Aromatic Hydrocarbons (PAHs): A group of petroleum-derived hydrocarbon compounds, present in petroleum and related materials, and used in the manufacture of materials such as dyes, insecticides and solvents.

Population: An aggregate of interbreeding individuals of a biological species within a specified location.

POTW: Publicly Owned Treatment Plant

pounds per day per cubic foot: lb/day/cf

pounds per day: lbs/day; unit of measure

ppm: parts per million

Precipitation Event: An occurrence of rain, snow, sleet, hail, or other form of precipitation that is generally characterized by parameters of duration and intensity (inches or millimeters per unit of time).

Pretreatment: The treatment of wastewater from non-domestic sources using processes that reduce, eliminate, or alter contaminants in the wastewater before they are discharged into Publicly Owned Treatment Works (POTWs).

Primary Effluent (PE): Partially treated water (screened and undergoing settling) passing from the primary treatment processes a wastewater treatment plant.

Primary Treatment: A basic wastewater treatment method, typically the first step in treatment, that uses skimming, settling in tanks to remove most materials that float or will settle. Usually chlorination follows to remove pathogens from wastewater. Primary treatment typically removes about 35 percent of biochemical oxygen demand (BOD) and less than half of the metals and toxic organic substances.

Priority Pollutants: A list of 129 toxic pollutants including metals developed by the USEPA as a basis for defining toxics and is commonly referred to as "priority pollutants".\

Probable Total Project Cost (PTPC): Probable Total Project Cost represents the realistic total of all hard costs, soft costs, and ancillary costs associated with a particular CSO abatement technology per the definitions provided in O'Brien & Gere, April 2006. All PTPCs shown in this report are adjusted to July 2005 dollars (ENR CCI = 11667.99).

Protozoa: Single-celled organisms that reproduce by fission and occur primarily in the aquatic environment. Waterborne pathogenic protozoans of primary concern include Giardia lamblia and Cryptosporidium, both of which affect the gastrointestinal tract.

PS: Pump Station or Pumping Station

PTPC: Probable Total Project Cost

Pseudoreplication: The repeated measurement of a single experimental unit or sampling unit, with the treatment of the measurements as if they were independent replicates of the sampling unit.

Public Comment Period: The time allowed for the public to express its views and concerns regarding action by USEPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Publicly Owned Treatment Works (POTW): Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

Pump Station or Pumping Station: Sewer pipes are generally gravity driven. Wastewater flows slowly downhill until it reaches a certain low point. Then pump, or "lift," stations push the wastewater back uphill to a high point where gravity can once again take over the process.

Pycnocline: A zone of marked density gradient.

Q: Symbol for Flow (designation when used in equations)

R.L: Reporting Limit

Rainfall Duration: The length of time of a rainfall event.

Rainfall Intensity: The amount of rainfall occurring in a unit of time, usually expressed in inches per hour.

Raw Sewage: Untreated municipal sewage (wastewater) and its contents.

RCRAInfo: Resource Conservation and Recovery Act Information

Real-Time Control (RTC): A system of data gathering instrumentation used in conjunction with control components such as dams, gates and pumps to maximize storage in the existing sewer system.

Receiving Waters: Creeks, streams, rivers, lakes, estuaries, groundwater formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Red Tide: A reddish discoloration of coastal surface waters due to concentrations of certain toxin producing algae.

Reference Condition: The chemical, physical or biological quality or condition exhibited at either a single site or an aggregation of sites that represents the least impaired condition of a classification of waters to which the reference condition applies.

Reference Sites: Minimally impaired locations in similar waterbodies and habitat types at which data are collected for comparison with test sites. A separate set of reference sites are defined for each estuarine or coastal marine class.

Regional Environmental Monitoring and Assessment Program (REMAP): The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological condition and forecasts of future risks to our natural resources.

Regulator: A device in combined sewer systems for diverting wet weather flows which exceed downstream capacity to an overflow.

REMAP: Regional Environmental Monitoring and Assessment Program

Replicate: Taking more than one sample or performing more than one analysis.

Reporting Limit (RL): The lowest concentration at which a contaminant is reported.

Residence Time: Length of time that a pollutant remains within a section of a waterbody. The residence time is determined by the streamflow and the volume of the river reach or the average stream velocity and the length of the river reach.

Resource Conservation and Recovery Act Information (RCRAinfo): Database with information on existing hazardous materials sites. USEPA was authorized to develop a hazardous waste management system, including plans for the handling and storage of wastes and the licensing of treatment and disposal facilities. The states were required to implement the plans under authorized grants from the USEPA. The act generally encouraged "cradle to grave" management of certain products and emphasized the need for recycling and conservation.

Respiration: Biochemical process by means of which cellular fuels are oxidized with the aid of oxygen to permit the release of the energy required to sustain life; during respiration, oxygen is consumed and carbon dioxide is released.

Restoration: Return of an ecosystem to a close approximation of its condition prior to disturbance. Re-establishing the original character of an area such as a wetland or forest.

Riparian Zone: The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.

Ribonucleic acid (RNA): RNA is the generic term for polynucleotides, similar to DNA but containing ribose in place of deoxyribose and uracil in place of thymine. These molecules are involved in the transfer of information from DNA, programming protein synthesis and maintaining ribosome structure.

Riparian Habitat: Areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands.

Riparian: Relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

RNA: ribonucleic acid

RTC: Real-Time Control

Runoff: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

Safe Drinking Water Act: The Safe Drinking Water Act authorizes USEPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. USEPA, states, and water systems then work together to make sure these standards are met.

Sanitary Sewer Overflow (SSO): When wastewater treatment systems overflow due to unforeseen pipe blockages or breaks, unforeseen structural, mechanical, or electrical failures, unusually wet weather conditions, insufficient system capacity, or a deteriorating system.

Sanitary Sewer: Underground pipes that transport only wastewaters from domestic residences and/or industries to a wastewater treatment plant. No stormwater is carried.

Saprobien System: An ecological classification of a polluted aquatic system that is undergoing self-purification. Classification is based on relative levels of pollution, oxygen concentration and types of indicator microorganisms; i.e., saprophagic microorganisms – feeding on dead or decaying organic matter.

SCADA: Supervisory Control and Data Acquisition

scfm: standard cubic feet per minute

Scoping Modeling: Involves simple, steady-state analytical solutions for a rough analysis of the problem.

Scour: To abrade and wear away. Used to describe the weathering away of a terrace or diversion channel or streambed. The clearing and digging action of flowing water, especially the downward erosion by stream water in sweeping away mud and silt on the outside of a meander or during flood events.

Secchi Disk: Measures the transparency of water. Transparency can be affected by the color of the water, algae and suspended sediments. Transparency decreases as color, suspended sediments or algal abundance increases.

Secondary Treatment: The second step in most publicly owned waste treatment systems in which bacteria consume the organic parts of the waste. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 percent of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment. (See primary, tertiary treatment.)

Sediment Oxygen Demand (SOD): A measure of the amount of oxygen consumed in the biological process that breaks down organic matter in the sediment.

Sediment: Insoluble organic or inorganic material often suspended in liquid that consists mainly of particles derived from rocks, soils, and organic materials that eventually settles to the bottom of a waterbody; a major non-point source pollutant to which other pollutants may attach.

Sedimentation: Deposition or settling of suspended solids settle out of water, wastewater or other liquids by gravity during treatment.

Sediments: Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish and wildlife habitat, and clouding the water so that sunlight cannot reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to wash off the land after rainfall.

Seiche: A wave that oscillates (for a period of a few minutes to hours) in lakes, bays, lagoons or gulfs as a result of seismic or atmospheric disturbances (e.g., "wind tides").

Sensitive Areas: Areas of particular environmental significance or sensitivity that could be adversely affected by discharges, including Outstanding National Resource Waters, National Marine Sanctuaries, waters with threatened or endangered species, waters with primary contact recreation, public drinking water intakes, shellfish beds, and other areas identified by State or Federal agencies.

Separate Sewer System: Sewer systems that receive domestic wastewater, commercial and industrial wastewaters, and other sources but do not have connections to surface runoff and are not directly influenced by rainfall events.

Separate Storm Water System (SSWS): A system of catch basin, pipes, and other components that carry only surface run off to receiving waters.

Septic System: An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent (sludge) that remains after decomposition of the solids by bacteria in the tank; must be pumped out periodically.

SEQRA: State Environmental Quality Review Act

Settleable Solids: Material heavy enough to sink to the bottom of a wastewater treatment tank.

Settling Tank: A vessel in which solids settle out of water by gravity during drinking and wastewater treatment processes.

Sewage: The waste and wastewater produced by residential and commercial sources and discharged into sewers.

Sewer Sludge: Sludge produced at a Publicly Owned Treatment Works (POTW), the disposal of which is regulated under the Clean Water Act.

Sewer: A channel or conduit that carries wastewater and storm-water runoff from the source to a treatment plant or receiving stream. "Sanitary" sewers carry household, industrial, and commercial waste. "Storm" sewers carry runoff from rain or snow. "Combined" sewers handle both.

Sewerage: The entire system of sewage collection, treatment, and disposal.

Sewershed: A defined area that is tributary to a single point along an interceptor pipe (a community connection to an interceptor) or is tributary to a single lift station. Community boundaries are also used to define sewer-shed boundaries.

SF: Square foot, unit of area

Significant Industrial User (SIU): A Significant Industrial User is defined by the USEPA as an industrial user that discharges process wastewater into a publicly owned treatment works and meets at least one of the following: (1) All industrial users subject to *Categorical Pretreatment Standards* under the Code of Federal Regulations - Title 40 (40 CFR) Part 403.6, and CFR Title 40 Chapter I, Subchapter N- Effluent Guidelines and Standards; and (2) Any other industrial user that discharges an average of 25,000 gallons per day or more of process wastewater to the treatment plant (excluding sanitary, non-contact cooling and boiler blowdown wastewater); or contributes a process waste stream which makes up 5 percent or more of any design capacity of the treatment plant; or is designated as such by the municipal Industrial Waste Section on the basis that the industrial user has a reasonable potential for adversely affecting the treatment plants operation or for violating any pretreatment standard or requirement.

Siltation: The deposition of finely divided soil and rock particles upon the bottom of stream and river beds and reservoirs.

Simulation Models: Mathematical models (logical constructs following from first principles and assumptions), statistical models (built from observed relationships between variables), or a combination of the two.

Simulation: Refers to the use of mathematical models to approximate the observed behavior of a natural water system in response to a specific known set of input and forcing conditions. Models that have been validated, or verified, are then used to predict the response of a natural water system to changes in the input or forcing conditions.

Single Sample Maximum (SSM): A maximum allowable enterococci or E. Coli density for a single sample.

Site Spill Identifier List (SPIL): Federal database with information on existing Superfund Sites.

SIU: Significant Industrial User

Skewness: The degree of statistical asymmetry (or departure from symmetry) of a population. Positive or negative skewness indicates the presence of a long, thin tail on the right or left of a distribution respectively.

Slope: The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04); degrees (2 degrees 18 minutes), or percent (4 percent).

Sludge: Organic and Inorganic solid matter that settles to the bottom of septic or wastewater treatment plant sedimentation tanks, must be disposed of by bacterial digestion or other methods or pumped out for land disposal, incineration or recycled for fertilizer application.

SNWA: Special Natural Waterfront Area

SOD: Sediment Oxygen Demand

SOP: Standard Operating Procedure

Sorption: The adherence of ions or molecules in a gas or liquid to the surface of a solid particle with which they are in contact.

SPDES: State Pollutant Discharge Elimination System

Special Natural Waterfront Area (SNWA): A large area with concentrations of important coastal ecosystem features such as wetlands, habitats and buffer areas, many of which are regulated under other programs.

SPIL: Site Spill Identifier List

SRF: State Revolving Fund

SSM: single sample maximum

SSO: Sanitary Sewer Overflow

SSWS: Separate Storm Water System

Stakeholder: One who is interested in or impacted by a project.

Standard Cubic Feet per Minute (SCFM): A standard measurement of airflow that indicates how many cubic feet of air pass by a stationary point in one minute. The higher the number, the more air is being forced through the system. The volumetric flow rate of a liquid or gas in cubic feet per minute. 1 CFM equals approximately 2 liters per second.

State Environmental Quality Review Act (SEQRA): New York State program requiring all local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making. This means these agencies must assess the environmental significance of all actions they have discretion to approve, fund or directly undertake. SEQR requires the agencies to balance the environmental impacts with social and economic factors when deciding to approve or undertake an action.

Standard Operating Procedure (SOP): Document describing a procedure or set of procedures to perform a given operation or evolutions or in reaction to a given event.

State Pollutant Discharge Elimination System (SPDES): New York State has a state program which has been approved by the United States Environmental Protection Agency for the control of wastewater and stormwater discharges in accordance with the Clean Water Act. Under New York State law the program is known as the State Pollutant Discharge Elimination System (SPDES) and is broader in scope than that required by the Clean Water Act in that it controls point source discharges to groundwaters as well as surface waters.

State Revolving Fund (SRF): Revolving funds are financial institutions that make loans for specific water pollution control purposes and use loan repayment, including interest, to make new loans for additional water pollution control activities. The SRF program is based on the 1987 Amendments to the Clean Water Act, which established the SRF program as the CWA's original Construction Grants Program was phased out.

Steady-State Model: Mathematical model of fate and transport that uses constant values of input variables to predict constant values of receiving water quality concentrations.

Storage: Treatment holding of waste pending treatment or disposal, as in containers, tanks, waste piles, and surface impoundments.

STORET: U.S. Environmental Protection Agency (USEPA) national water quality database for STORage and RETrieval (STORET). Mainframe water quality database that includes physical, chemical, and biological data measured in waterbodies throughout the United States.

Storm Runoff: Stormwater runoff, snowmelt runoff, and surface runoff and drainage; rainfall that does not evaporate or infiltrate the ground because of impervious land surfaces or a soil infiltration rate lower than rainfall intensity, but instead flows onto adjacent land or waterbodies or is routed into a drain or sewer system.

Storm Sewer: A system of pipes (separate from sanitary sewers) that carries waste runoff from buildings and land surfaces.

Storm Sewer: Pipes (separate from sanitary sewers) that carry water runoff from buildings and land surfaces.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels or pipes into a defined surface water channel, or a constructed infiltration facility.

Stormwater Management Models (SWMM): USEPA mathematical model that simulates the hydraulic operation of the combined sewer system and storm drainage sewershed.

Stormwater Protection Plan (SWPP): A plan to describe a process whereby a facility thoroughly evaluates potential pollutant sources at a site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in stormwater runoff.

Stratification (of waterbody): Formation of water layers each with specific physical, chemical, and biological characteristics. As the density of water decreases due to surface heating, a stable situation develops with lighter water overlaying heavier and denser water.

Stressor: Any physical, chemical, or biological entity that can induce an adverse response.

Subaqueous Burrow Pit: An underwater depression left after the mining of large volumes of sand and gravel for projects ranging from landfilling and highway construction to beach nourishment.

Substrate: The substance acted upon by an enzyme or a fermenter, such as yeast, mold or bacteria.

Subtidal: The portion of a tidal-flat environment that lies below the level of mean low water for spring tides. Normally it is covered by water at all stages of the tide.

Supervisory Control and Data Acquisition (SCADA): System for controlling and collecting and recording data on certain elements of WASA combined sewer system.

Surcharge Flow: Flow in which the water level is above the crown of the pipe causing pressurized flow in pipe segments.

Surface Runoff: Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of non-point source pollutants in rivers, streams, and lakes.

Surface Water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other groundwater collectors directly influenced by surface water.

Surficial Geology: Geology relating to surface layers, such as soil, exposed bedrock, or glacial deposits.

Suspended Loads: Specific sediment particles maintained in the water column by turbulence and carried with the flow of water.

Suspended Solids or Load: Organic and inorganic particles (sediment) suspended in and carried by a fluid (water). The suspension is governed by the upward components of turbulence, currents, or colloidal suspension. Suspended sediment usually consists of particles <0.1 mm, although size may vary according to current hydrological conditions. Particles between 0.1 mm and 1 mm may move as suspended or bedload. It is a standard measure of the concentration of particulate matter in wastewater, expressed in mg/L. Technology-Based Standards. Minimum pollutant control standards for numerous categories of industrial discharges, sewage discharges and for a growing number of other types of discharges. In each industrial category, they represent levels of technology and pollution control performance that the USEPA expects all discharges in that category to employ.

SWEM: System-wide Eutrophication Model

SWMM: Stormwater Management Model

SWPP: Stormwater Protection Plan

System-wide Eutrophication Model (SWEM): Comprehensive hydrodynamic model developed for the New York/New Jersey Harbor System.

Taxa: The plural of taxon, a general term for any of the hierarchical classification groups for organisms, such as genus or species.

TC: Total coliform

TDS: Total Dissolved Solids

Technical and Operational Guidance Series (TOGS): Memorandums that provide information on determining compliance with a standard.

Tertiary Treatment: Advanced cleaning of wastewater that goes beyond the secondary or biological stage, removing nutrients such as phosphorus, nitrogen, and most biochemical oxygen demand (BOD) and suspended solids.

Test Sites: Those sites being tested for biological impairment.

Threatened Waters: Water whose quality supports beneficial uses now but may not in the future unless action is taken.

Three-Dimensional Model (3-D): Mathematical model defined along three spatial coordinates where the water quality constituents are considered to vary over all three spatial coordinates of length, width, and depth.

TKN: Total Kjeldahl Nitrogen

TMDL: Total Maximum Daily Loads

TOC: Total Organic Carbon

TOGS: Technical and Operational Guidance Series

Topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

Total Coliform Bacteria: A particular group of bacteria, found in the feces of warm-blooded animals, that are used as indicators of possible sewage pollution. They are characterized as aerobic or facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°. Note that many common soil bacteria are also total coliforms, but do not indicate fecal contamination. (See also fecal coliform bacteria)

Total Coliform (TC): The coliform bacteria group consists of several genera of bacteria belonging to the family *enterobacteriaceae*. These mostly harmless bacteria live in soil, water, and the digestive system of animals. Fecal coliform bacteria, which belong to this group, are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals, and can enter water bodies from human and animal waste. If a large number of fecal coliform bacteria (over 200 colonies/100 milliliters (mL) of water sample) are found in water, it is possible that pathogenic (disease- or illness-causing) organisms are also present in the water. Swimming in waters with high levels of fecal coliform bacteria increases the chance of developing illness (fever, nausea or stomach cramps) from pathogens entering the body through the mouth, nose, ears, or cuts in the skin.

Total Dissolved Solids (TDS): Solids that pass through a filter with a pore size of 2.0 micron or smaller. They are said to be non-filterable. After filtration the filtrate (liquid) is dried and the remaining residue is weighed and calculated as mg/L of Total Dissolved Solids.

Total Kjeldahl Nitrogen (TKN): The sum of organic nitrogen and ammonia nitrogen.

Total Maximum Daily Load (TMDL): The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for non-point sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Total Organic Carbon (TOC): A measure of the concentration of organic carbon in water, determined by oxidation of the organic matter into carbon dioxide (CO2). TOC includes all the carbon atoms covalently bonded in organic molecules. Most of the organic carbon in drinking water supplies is dissolved organic carbon, with the remainder referred to as particulate organic carbon. In natural waters, total organic carbon is composed primarily of nonspecific humic materials.

Total P: Total Phosphorus

Total Phosphorus (Total P): A nutrient essential to the growth of organisms, and is commonly the limiting factor in the primary productivity of surface water bodies. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particle form. Agricultural drainage, wastewater, and certain industrial discharges are typical sources of phosphorus, and can contribute to the eutrophication of surface water bodies. Measured in milligrams per liter (mg/L).

Total Suspended Solids (TSS): See Suspended Solids Toxic Substances. Those chemical substances which can potentially cause adverse effects on living organisms. Toxic substances include pesticides, plastics, heavy metals, detergent, solvent, or any other materials that are poisonous, carcinogenic, or otherwise directly harmful to human health and the environment as a result of dose or exposure concentration and exposure time. The toxicity of toxic substances is modified by variables such as temperature, chemical form, and availability.

Total Volatile Suspended Solids (VSS): Volatile solids are those solids lost on ignition (heating to 550 degrees C.) They are useful to the treatment plant operator because they give a rough approximation of the amount of organic matter present in the solid fraction of wastewater, activated sludge and industrial wastes.

Toxic Pollutants: Materials that cause death, disease, or birth defects in organisms that ingests or absorbs them. The quantities and exposures necessary to cause these effects can vary widely.

Toxicity: The degree to which a substance or mixture of substances can harm humans or animals. Acute toxicity involves harmful effects in an organism through a single or short-term exposure. Chronic toxicity is the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure sometimes lasting for the entire life of the exposed organism.

Treated Wastewater: Wastewater that has been subjected to one or more physical, chemical, and biological processes to reduce its potential of being a health hazard.

Treatment Plant: Facility for cleaning and treating freshwater for drinking, or cleaning and treating wastewater before discharging into a water body.

Treatment: (1) Any method, technique, or process designed to remove solids and/or pollutants from solid waste, waste-streams, effluents, and air emissions. (2) Methods used to change the biological character or composition of any regulated medical waste so as to substantially reduce or eliminate its potential for causing disease.

Tributary: A lower order stream compared to a receiving waterbody. "Tributary to" indicates the largest stream into which the reported stream or tributary flows.

Trophic Level: The functional classification of organisms in an ecological community based on feeding relationships. The first trophic level includes green plants; the second trophic level includes herbivores; and so on.

TSS: Total Suspended Solids

Turbidity: The cloudy or muddy appearance of a naturally clear liquid caused by the suspension of particulate matter. It can be measured by the amount of light that is scattered or absorbed by a fluid.

Two-Dimensional Model (2-D): Mathematical model defined along two spatial coordinates where the water quality constituents are considered averaged over the third remaining spatial coordinate. Examples of 2-D models include descriptions of the variability of water quality properties along: (a) the length and width of a river that incorporates vertical averaging or (b) length and depth of a river that incorporates lateral averaging across the width of the waterbody.

U.S. Army Corps of Engineers (USACE): The United States Army Corps of Engineers, or USACE, is made up of some 34,600 civilian and 650 military men and women. The Corps' mission is to provide engineering services to the United States, including: Planning, designing, building and operating dams and other civil engineering projects ; Designing and managing the construction of military facilities for the Army and Air Force; and, Providing design and construction management support for other Defense and federal agencies

United States Environmental Protection Agency (USEPA): The Environmental Protection Agency (EPA or sometimes USEPA) is an agency of the United States federal government charged with protecting human health and with safeguarding the natural environment: air, water, and land. The USEPA began operation on December 2, 1970. It is led by its Administrator, who is appointed by the President of the United States. The USEPA is not a cabinet agency, but the Administrator is normally given cabinet rank.

U.S. Fish and Wildlife Service (USFWS): The United States Fish and Wildlife Service is a unit of the United States Department of the Interior that is dedicated to managing and preserving wildlife. It began as the U.S. Commission on Fish and Fisheries in the United States Department of Commerce and the Division of Economic Ornithology and Mammalogy in the United States Department of Agriculture and took its present form in 1939.

U.S. Geological Survey (USGS): The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

UAA: Use Attainability Analysis

ug/L: Microgram per liter – A measure of concentration

Ultraviolet Light (UV): Similar to light produced by the sun; produced in treatment processes by special lamps. As organisms are exposed to this light, they are damaged or killed.

ULURP: Uniform Land Use Review Procedure

Underground Storage Tanks (UST): Buried storage tank systems that store petroleum or hazardous substances that can harm the environment and human health if the USTs release their stored contents.

Uniform Land Use Review Procedure (ULURP): New York City program wherein a standardized program would be used to publicly review and approve applications affecting the land use of the city would be publicly reviewed. The program also includes mandated time frames within which application review must take place.

Unstratified: Indicates a vertically uniform or well-mixed condition in a waterbody. (See also Stratification)

Urban Runoff: Storm water from city streets and adjacent domestic or commercial properties that carries pollutants of various kinds into the sewer systems and receiving waters.

Urban Runoff: Water containing pollutants like oil and grease from leaking cars and trucks; heavy metals from vehicle exhaust; soaps and grease removers; pesticides from gardens; domestic animal waste; and street debris, which washes into storm drains and enters receiving waters.

USA: Use and Standards Attainability Project

USACE: United States Army Corps of Engineers

Use and Standards Attainability Project (USA): A DEP program that supplements existing Harbor water quality achievements. The program involves the development of a four-year, expanded, comprehensive plan (the Use and Standards Attainment or "USA" Project) that is to be directed towards increasing water quality improvements in 26 specific bodies of water located throughout the entire City. These waterbodies were selected by DEP based on the City's drainage patterns and on New York State Department of Environmental Conservation (DEC) waterbody classification standards.

Use Attainability Analysis (UAA): An evaluation that provides the scientific and economic basis for a determination that the designated use of a water body is not attainable based on one or more factors (physical, chemical, biological, and economic) proscribed in federal regulations.

Use Designations: Predominant uses each State determines appropriate for a particular estuary, region, or area within the class.

USEPA: United States Environmental Protection Agency

USFWS: U.S. Fish and Wildlife Service

USGS: United States Geological Survey

UST: underground storage tanks

UV: ultraviolet light

Validation (of a model): Process of determining how well the mathematical representation of the physical processes of the model code describes the actual system behavior.

Verification (of a model): Testing the accuracy and predictive capabilities of the calibrated model on a data set independent of the data set used for calibration.

Viewsheds: The major segments of the natural terrain which are visible above the natural vegetation from designated scenic viewpoints.

Virus: Submicroscopic pathogen consisting of a nucleic acid core surrounded by a protein coat. Requires a host in which to replicate (reproduce).

VSS: Total Volatile Suspended Solids

Wasteload Allocation (WLA): The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).

Wastewater Treatment Plant (WWTP): A facility that receives wastewaters (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewaters to less harmful byproducts; known by the acronyms, STP (sewage treatment plant), POTW (publicly owned treatment works), WPCP (water pollution control plant) and WWTP.

Wastewater Treatment: Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water in order to remove, reduce, or neutralize contaminants.

Wastewater: The used water and solids from a community (including used water from industrial processes) that flows to a treatment plant. Stormwater, surface water and groundwater infiltration also may be included in the wastewater that enters a wastewater treatment plant. The term sewage usually refers to household wastes, but this word is being replaced by the term wastewater.

Water Pollution Control Plant (WPCP): A facility that receives wastewaters (and sometimes runoff) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes reduces (treats) the wastewaters to less harmful byproducts; known by the acronyms, STP (sewage treatment plant), POTW (publicly owned treatment works), WWTP (wastewater treatment) and WPCP.

Water Pollution: The presence in water of enough harmful or objectionable material to damage water quality.

Water Quality Criteria: Levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water Quality Standard (WQS): State or federal law or regulation consisting of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an antidegradation policy and implementation procedures. Water quality standards protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. Water Quality Standards may include numerical or narrative criteria.

Water Quality: The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.

Water Quality-Based Limitations: Effluent limitations applied to discharges when mere technology-based limitations would cause violations of water quality standards.

Water Quality-Based Permit: A permit with an effluent limit more stringent than technology based standards. Such limits may be necessary to protect the designated uses of receiving waters (e.g., recreation, aquatic life protection).

Waterbody/Watershed (WB/WS) Facility Plan: A predecessor document to the LTCP defined by the Administrative Consent Order. A waterbody/watershed facility plan supports the long-term CSO control planning process by describing the status of implementation of the nine USEPA recommended elements of an LTCP and by providing the technical framework to complete facility planning.

Waterbody Inventory/Priority Waterbody List (WI/PWL): The WI/PWL incorporates monitoring data, information from state and local communities and public participation. The Waterbody Inventory portion refers to the listing of all waters, identified as specific individual waterbodies, within the state that are assessed. The Priority Waterbodies List is the subset of waters in the Waterbody Inventory that have documented water quality impacts, impairments or threats.

Waterbody Segmentation: Implementation of a more systematic approach to defining the bounds of individual waterbodies using waterbody type, stream classification, hydrologic drainage, waterbody length/size and homogeneity of land use and watershed character as criteria.

Waterfront Revitalization Program (WRP): New York City's principal coastal zone management tool. As originally adopted in 1982 and revised in 1999, it establishes the city's policies for development and use of the waterfront and provides the framework for evaluating the consistency of all discretionary actions in the coastal zone with those policies. When a proposed project is located within the coastal zone and it requires a local, state, or federal discretionary action, a determination of the project's consistency with the policies and intent of the WRP must be made before the project can move forward.

Watershed Approach: A coordinated framework for environmental management that focuses public and private efforts on the highest priority problems within hydrologically-defined geographic area taking into consideration both ground and surface water flow.

Watershed: A drainage area or basin that drains or flows toward a central collector such as a stream, river, estuary or bay: the watershed for a major river may encompass a number of smaller watersheds that ultimately combined at a common point.

Weir: (1) A wall or plate placed in an open channel to measure the flow of water. (2) A wall or obstruction used to control flow from settling tanks and clarifiers to ensure a uniform flow rate and avoid short-circuiting.

Wet Weather Flow: Hydraulic flow conditions within a combined sewer system resulting from a precipitation event. Flow within a combined sewer system under these conditions may include street runoff, domestic sewage, ground water infiltration, commercial and industrial wastewaters, and any other non-precipitation event related flows. In a separately sewered system, this type of flow could result from dry weather flow being combined with inflow.

Wet Weather Operating Plan (WWOP): Document required by a permit holder's SPDES permit that optimizes the plant's wet weather performance.

Wetlands: An area that is constantly or seasonally saturated by surface water or groundwater with vegetation adapted for life under those soil conditions, as in swamps, bogs, fens, marshes, and estuaries. Wetlands form an interface between terrestrial (land-based) and aquatic environments; include freshwater marshes around ponds and channels (rivers and streams), brackish and salt marshes.

WI/PWL: Waterbody Inventory/Priority Waterbody List

WLA: Waste Load Allocation

WPCP: Water Pollution Control Plant

WQS: Water Quality Standards

WRP: Waterfront Revitalization Program

WWOP: Wet Weather Operating Plan

WWTP: Wastewater Treatment Plant

Zooplankton: Free-floating or drifting animals with movements determined by the motion of the water.

APPENDIX A

HUNTS POINT WATER POLLUTION CONTROL PLANT

WET WEATHER OPERATING PLAN

Hunts Point WPCP
Wet Weather Operating Plan

April 2010

Hunts Point Water Pollution Control Plant
Bronx, New York

Wet Weather Operating Plan for Maximizing Treatment of Wet Weather Flows at the Hunts Point Water Pollution Control Plant

Prepared by:
The New York City Department of Environmental Protection
Bureau of Wastewater Treatment

4/01/10

Table of Contents

SECTION 1

INTRODUCTION

1.0 Introduction

One effective strategy to abate pollution resulting from Combined Sewer Overflows (CSOs) is to maximize the delivery of flows during wet weather to a wastewater treatment plant for processing. Delivering these flows would maximize the use of available wastewater treatment plant capacity for wet weather flows and would ensure that combined sewers would receive at least primary treatment prior to discharge. To implement this goal, New York State requires the development of a Wet Weather Operating Plan (WWOP) for collection systems that include combined sewers. This requirement is one of 13 Best Management Practices (BMPs) that New York includes in the SPDES permit requirements of plants with CSOs. This particular provision has been included in consideration of the Federal CSO policy that mandates maximization of flow to Publicly Owned Treatment Works (POTWs).

Pursuant to Appendix A: Upper East River WPCPs Upgrade Schedule and Compliance Deadlines of the Nitrogen Administrative Order on Consent, DEC Case # CO2-2001O131-7 (the "Order"), entered into by the City of New York ("City") and the New York State Department of Environmental Conservation ("DEC")., the City submitted a Wet Weather Operating Plan (WWOP) for the Hunts Point Water Pollution Control Plant (WPCP) on July 20,2003. The WWOP describes procedures to maximize treatment during wet weather events. This is accomplished by having the WWOP specify procedures for the operation of unit processes to treat maximum flows, without materially diminishing effluent quality or destabilizing treatment upon return to dry weather operation. The WWOP establishes process control procedures and set points to maintain stability and efficiency of Biological Nutrient Removal (BNR) Processes. The WWOP specifies the treatment facilities that will be available at each WPCP during the construction period, as identified in the Hunts Point plan. The WWOP is based on operations of process units that are available and are operated at the peak hydraulic loading rate. The actual process control set points are established by the WWOP. Upon completion of construction, the WWOP has been revised to reflect the operation of the fully upgraded Facility. The revised WWOP for Hunts Point shall be submitted to DEC within 18 months of the completion of the construction of the Facility.

This document contains the WWOP for the operation of the Hunts Point WPCP. The implementation of these plans will help the City to improve treatment of sewage during wet weather events, and to demonstrate compliance with the State and Federal BMP requirements.

1.1 Background

The Hunts Point Water Pollution Control Plant (WPCP) is located in the Hunts Point section of the Bronx, New York, on the shore of the upper East River **(**see **Figure 1-1).** The Hunts Point WPCP treats wastewater from a combined sewage collection system, which serves a population of approximately 600,000 and which drains stormwater flow from an area of almost 16,000 acres.

The Hunts Point plant began operation in 1952, with a design average flow capacity of 120 mgd. The plant was expanded in capacity in 1962 to 150 mgd, and again in the 1970's to its current design average dry weather flow capacity of 200 mgd. The upgraded plant was designed to provide primary treatment and chlorination to wet weather peak flow of twice design average dry weather flow (400 mgd). In the 1990's, a sludge Dewatering Building was constructed at the plant under the City –Wide Sludge Management Program.

The Hunts Point WPCP design average dry weather flow capacity is 200 mgd. In fiscal year 2000, flow to the plant averaged 121 mgd. The trend of actual influent flow to the plant has been downward over the past several years, from 148 mgd in the early 1990's when the Hunts Point Stabilization began, to 121 mgd in 2000. The average readings from temporary meters installed under Task 8 (of the additional facility planning phase of the Hunts Point Interim Plant Upgrading) corroborated the plant operating records.

The Long Island Sound Study determined that a 58.5% load reduction of nitrogen discharge is necessary to meet the water quality standards in the western Long Island Sound. In response to this study, The New York State Department of Environmental Conservation (NYSDEC) modified New York City's WPCPs State Pollutant Discharge Elimination System (SPDES) permits to reduce their allowable nitrogen discharge, thereby initiating nitrogen control actions.

The Step BNR process will be operated at a higher sludge age, which will require a higher aerator effluent SS concentration and higher solids load on the final settling tanks. During storms, solids may be washed out of the final clarifiers because of the higher solids loading and deeper sludge blanket. The BNR treatment process must be protected against such high wet weather flows due to the constraints on the secondary-clarifier solids separation capability.

MAP SOURCE:
USGS 7.5 MINUTE SERIES
TOPOGRAPHIC QUADRANGLE
MAP OF CENTRAL PARK, N.Y.

0 2000 4000
SCALE IN FEET

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DEP
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

WP–56 HUNTS POINT WPCP
PLANT UPGRADE

SITE LOCATION MAP

FIGURE 1

Time: 4:31 P.M. Date: 5/11/2001 PCDJJP Drawing File: H:\32333\PHASE2\PREL_DESN_RPT\FIG1.dwg

Maximum design wet weather flow to the plant is 400 mgd. In order to protect the secondary BNR treatment process during storms, the secondary bypass system at Hunts Point will be designed with the capability to limit the peak flow to secondary treatment to 1.3 x DDWF, or 260 mgd. The design maximum capacity of the bypass system will be 140 mgd, or 0.7 time design average flow. This figure is referenced from Table 5.2 of the March 30th, 2001 Citywide Comprehensive Nitrogen Management Plan: Revised Interim Plant Upgrade Guidance Technical Memorandum. The table indicates that the maximum flow through the BNR System for Hunts Point is recommended to be 1.2 x DDWF + plant recycles or a total of 1.3 DDWF, the remaining flow would be diverted as Secondary Bypass Flow.

Another design objective developed to protect the BNR process includes the diversion of excess wet weather flow to Pass C of the Aeration Tank during wet weather events. This operational procedure is outlined further on in this manual under Section 2.6 Aeration Tanks.

1.2 Drainage Area

The Hunts Point regulation system is comprised of fifteen regulator stations (twelve of which incorporate tide gate chambers) and two independent tide gate chambers. A typical regulator consists of one or more float controlled sluice gates, which regulate the flow to the interceptors.

During dry weather the sluice gate is wide open to admit all sanitary flow. During storms each sluice gate is positioned to maintain a predetermined sewage depth downstream of the gate. Excess flow is discharged to tidal waters directly or through tide gates. In addition to the fifteen regulators, the City Island pumping station has an associated regulator. This regulator is controlled by wet well level in the pump station.

There are seventeen pumping stations located in the Hunts Point WPCP Drainage Area. Of these, twelve pump combined sewage; the remaining five pump storm water only. The following Tables **1-1, 1-1A & 1-1B** list the regulators, outfalls and pump stations for the Hunts Point WWTP drainage area. **Figure 1-2** is a schematic diagram of the wastewater collection system for the Hunts Point Drainage Area.

Table 1-1 Regulator Locations				
Regulator No.	**Regulator Location**	**Outfall Location**	**SPDES No.**	**Outfall Size**
	Hunts Point		**NY0026191**	
1	E 177th St. s/o Tierney Pl.	E. 177th St. & Eastchester Bay	022	8'-0"x 8'-0"
2	Ivy Pl. s/o Pennyfield Ave.	Pennyfield Ave. & East River	021	6'-3'x6'-6"
2A	Oak Ave. s/o Chaffee Ave.	Throgs Neck Blvd. & East River	020	8'-0'x6'-6"
3	Calhoun Ave. s/o Schurz Ave.	Calhoun Ave., & East River	019	7'-0'x5'-6"
4	Brush Ave., & Bruckner Blvd.	Bruckner Expwy & Westchester Creek	016	10'-0"x9'-6"
5	White Pl. Rd. s/o River Ave.	White Plains Rd. & East River	011	DBL 13'-0"x9'-0"
6	White Pl. Rd. & O'Brian Ave.	White Plains Rd. & East River	011	DBL 13'-0"x9'-0"
7	Leland Ave. & O'brian Ave.	White Plains Rd. & East River	011	DBL 13'-0"x9'-0"
8	Truxton St. & Oakpoint Ave	Truxton St. & East River	025	11'-6"x7'-3"
9	Tiffany St. & East Bay Ave.	Tiffany St., & East River	022	12'-0"x8'-2"
9A	Tiffany St. & Viele Ave.	Tiffany St., & East River	002	12'-0"x8'-2"
10	Hunts Point Ave & Ryawa Ave.	Faragut St. & East River	003	DBL 12'-0"x9'-5 3/4"
11	Emerson Ave. & Schurz Ave.	Emerson Ave. & East River	017	14'-0"x8'-0"
12	Robinson Ave. & Schurz Ave.	Robinson Ave. & East River	018	48" Diam.
13	Metcalf Ave. & Soundview Park	Metcalf Ave. & East River	009	14'x0"x8'-0"
14	Edgewater Park	Ellsworth Ave. & East River	026	9'-0"x9'-0"
15	Conners St e/o Hutchinson Ave.	Conners St e/o Hutchinson River	023	12'-0"x6'-6"
15A	E 233rd St. & Boston Post Rd.	E233rd St. & Hutchinson River	024	12'-6"x10'-0"
CSO	Bayshore Ave. & Griswold Ave.	Outlook Ave. & Eastchester Bay	028	12" Diam.
CSO	Watt Ave. & East chester Bay	Watt Ave. & Eastchester Bay	029	15" Diam. , 12" Diam.
CSO	Barkley Ave. & Shore Drive	Barkley Ave. & Eastchester Bay	030	15" Diam.
CSO	Balcom Ave. & Latting St.	Latting St., & Westchester Creek	015	4'-9"x4'-0"
CSO	Waterbury Ave., & Zerera Ave.	Lafayette Ave., & Westchester Creek	012	12'-0"x9'-0"
CSO	Barrett Ave. & Lacombe Ave.	Newman Ave. & Pugsley's Creek	013	10'-6"x8'-0"
CSO	Metcalf Ave. & Watson Ave.	Lacombe Ave. & Bronx River	010	9'-0"x6'-0"
CSO	Randell Ave. & Metcalf Ave.	Lacombe Ave. & Bronx River	010	9'-0"x6'-0"
CSO	Lafayette Ave. & Colgate Ave.	Lafayette Ave. & Bronx River	008	54" Diam.
CSO	Van Buren St. & Bronx Park Ave.	E. 177th St. & Bronx River	007	DBL 11'-6"x6'-6"
CSO	E. 177th St. & Bronx Park Ave.	E. 177th St. & Bronx River	007	DBL 11'-6"x6'-6"
CSO	Potters Place & Waterbury Ave.	Westchester Ave. & Eastchester Bay	027	12" Diam.
CSO	West Farm Rd. e/o East Tremont Ave.	West Farm Rd. & Bronx River	004	12'-0"x8'-0"
CSO	Eastchester Rd. & Waters Place	East Tremont Ave. & Westchester Creek	014	14'-0"x8'-6"
CSO	Morris Park Ave. & Eastchester Rd.	East Tremont Ave. & Westchester Creek	014	14'-0"x8'-6"
CSO	178th St. & Boston Rd.	West Farm Rd. & Bronx River	004	12'-0"x8'-0"
CSO	Pelham Pkway & Bronx Park East	E. 177th St. & Bronx River	007	DBL 11'-6"x6-'6"
CSO	Hollers Ave. Pump Station	Holler Ave & Hutchinson River	005	12" Diam.
Overflow	Co-op City (South) Pump Sation	Bartow Ave. & Hutchinson River	006	15'-0"x8'-6"
Overflow	Co-op City (North) Pump Sation	Bellamy Loop North & Hutchinson River	031	72" Diam.
Overflow	Rikers Island (North) Pump Station	Pump Station & East River	032	14" Diam.

Source: New York City Regulator Improvement Program, April 1985

Table 1-1A
Regulator Weir Elevations

Reg. No.	Regulator Location	Outfall Location	SPDES No.	Sluice Gate Size (W x H)	Weir Length	Weir Elevation
	Hunts Point		**NY0026191**			
1	E 177th St. s/o Tierney Pl.	E. 177th St. & Eastchester Bay	022	18" x 12"	9' 2"	-5.00
2	Ivy Pl. s/o Pennyfield Ave.	Pennyfield Ave. & East River	021	30" x 30"	8'-0"	-4.77
2A	Oak Ave. s/o Chaffee Ave.	Throgs Neck Blvd. & East River	020	-	-	-
3	Calhoun Ave. s/o Schurz Ave.	Calhoun Ave., & East River	019	12" x 12"	8'-0"	-2.88
4	Brush Ave., & Bruckner Blvd.	Bruckner Expwy & Westchester Creek	016	30" x 30"	8'-10"	-4.50
5	White Pl. Rd. s/o River Ave.	White Plains Rd. & East River	011	18" x 12"	26'-0"	-4.50
6	White Pl. Rd. & O'Brian Ave.	White Plains Rd. & East River	011	(2) 72" x 48"	8'-0"	-5.00
7	Leland Ave. & O'brian Ave.	White Plains Rd. & East River	011	36" x 30"	8'-9"	-2.35
8	Truxton St. & Oakpoint Ave	Truxton St. & East River	025	24" x 24"	9'-0"	-2.92
9	Tiffany St. & East Bay Ave.	Tiffany St., & East River	022	48" x 36"	12'-0"	-3.60
9A	Tiffany St. & Viele Ave.	Tiffany St., & East River	002	-	4'-0"	-2.33
10	Hunts Point Ave & Ryawa Ave.	Faragut St. & East River	003	(2) 36" x 30"	15'-0"	-3.65
11	Emerson Ave. & Schurz Ave.	Emerson Ave. & East River	017	18" x 18"	16'-6"	-4.00
12	Robinson Ave. & Schurz Ave.	Robinson Ave. & East River	018	12" x 12"	4'-0"	-2.72
13	Metcalf Ave. & Soundview Park	Metcalf Ave. & East River	009	36" x 30"	21'-0"	-5.00
14	Edgewater Park	Ellsworth Ave. & East River	026	-	-	-
15	Conners St e/o Hutchinson Ave.	Conners St e/o Hutchinson River	023	30" x 24"	14'-0"	-4.50

Source: New York City Regulator Improvement Program, April 1985

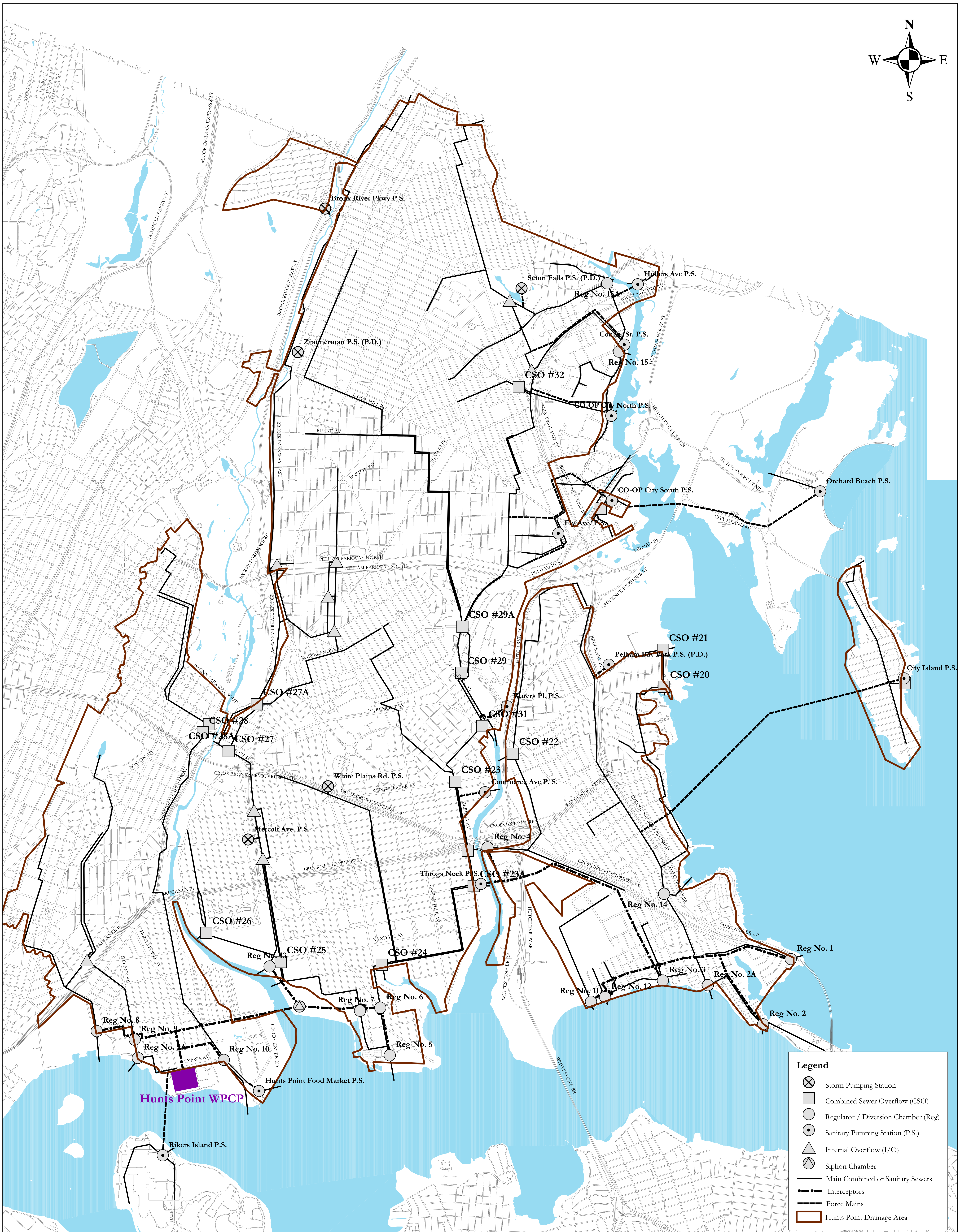
Table 1-1B

Pump Station within Hunts Point WPCP Tributary Area

Name	Location	No. Pumps	Pump Size
A. Storm Water			
Metcalf Avenue P.S.	Metcalf Ave. & Gleason St.	3	7000 gpm
White Plains Road P.S.	Cross Bronx Exp. & White Plains Rd.	3	7000 gpm
Seton Park P.S.	Marolla & Pratt Aves. (NYC Pks. & Rec.)	N/A	N/A
Bronx River Pkwy	South of 233rd Street	2	1430 gpm
B. Sanitary / Combined			
Hollers Ave. P.S.	Eastchester Creek & Hollers Ave.	2	610 gpm
Conners St. P.S.	Conners St. & Eastchester Creek	3	4000 gpm
Co-op City North P.S.	Co-Op City Blvd.	3	5600 gpm
Co-op City South P.S.	Co-Op City Blvd. & Einstein Loop	3	2620 gpm
Throgs Neck P.S.	Zerega & Lafayette Avenues	3	13,600 gpm
Ely Ave. P.S.	Ely & Waring Ave.	3	540 gpm
Commerce Ave. P.S.	Commerce, Seabury & Ellis Aves.	2	850 gpm
Hunts Point Market P.S.	Rywawa Ave. and Hunts Point Ave.	4	900 gpm
Pelham Bay Park P.S.	Pelham Bay Park (NYC Pks. & Rec.)	2	N/A
City Island P.S.	Schofield St. & City Island Blvd.	3	1800 gpm
Orchard Beach P.S.	Orchard Beach	2	600-1000 gpm
Rikers Island North P.S.	Rikers Island Oppos. Auto Mainten. Bldg.	2	1000 gpm
Waters Place P.S.	Bronx Occupational Training Center	2	N/A
Hart Island P.S.	Hart Island (No longer in use)	N/A	N/A
Zimmerman P.S.	Britton Olinville & Barker Aves. (NYC Pks. & Rec.)	2	N/A

N/A - Not Available

Source: Hunts Point I/I Analysis Report, December 1986



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URS Corporation
Hunts Point WPCP Drainage Area Map
Wet Weather Operating Plan

FIGURE 1-2

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1.3 Wet Weather Flow Control

The original design of the collection system assumed that when it was necessary to limit flow to the plant, the regulators would be used in preference to throttling the plant inlet gates. Throttling at the inlet gates surcharges the interceptors, which in turn may cause deposition behind the gates or produce damaging velocities through the inlet gates and into the screen units located just downstream.

Under Phase I of the upgrade, a new forebay gate chamber was constructed in Ryawa Avenue to improve throttling of wet weather flows to the plant. The new forebay gate chamber is located far enough upstream from the influent bar screens to eliminate problems with high velocity flow impinging on the screens. The plant's headworks and main sewage pump station were also upgraded under Phase I to ensure that the plant can reliably accept and treat two times design dry weather flow (DDWF), as required by the Omnibus IV Consent Decree.

1.4 Wastewater Treatment Plant Description

Wastewater treatment at the plant consists of screening, primary settling, step aeration activated sludge, final settling and chlorination with sodium hypochlorite. The existing aeration tanks have been retrofitted with the basic Step BNR (Biological Nutrient Removal) process to provide an intermediate degree of nitrogen removal. Sludge treatment consists of cyclone degritting of primary sludge, gravity thickening of combined waste activated and primary sludge, anaerobic digestion and centrifuge dewatering. Sludge from other DEP plants is transported to the plant by vessel and is stored and dewatered along with the Hunts Point plant's sludge. Centrate from the sludge dewatering facility is recycled through the plant, which adds a significant nitrogen load on the plant. Sludge cake, grit, scum and screenings are removed from the plant by truck for disposal to an off-site facility. The capacities of the unit processes at the existing Hunts Point plant are shown in **Table 1-2.**

Table 1-2
Unit Process Capacities

Process Equipment	Number of Units in Service	Minimum Plant Influent Flow / MGD	Minimum Secondary Treatment Flow / MGD
Screens	1 Primary & 2 Secondary Screens	133	
	2 Primary & 3 Secondary Screens	267	
	3 Primary & 4 Secondary Screens	400	
Main Sewage Pumps	1 Pump	100	
	2 Pumps	200	
	3 Pumps	300	
	4 Pumps	380	
	5 Pumps	400	
Primary Settling Tanks	1 Tank	140	
	2 Tanks	220	
	3 Tanks	300	
	4 Tanks	370	
	5 Tanks	400	
	6 Tanks	400	
Aeration Tanks	1 West Tank		60
	2 West Tanks		120
	3 West Tanks		180
	4 West Tanks		260
	1 East Tank		260
	2 East Tanks		260
	Total Design Capacity *		260
Final Settling Tanks**	West Tanks Numbered 31 thru 34, 41 thru 44 51 thru 54 & 61 thru 64		12 tanks @ 9.1 mgd each
	West Tanks Numbered 35, 45, 55 & 65		4 tanks @ 3.2 mgd each
	North & South Tanks 10, 20, 70, & 80		4 tanks @ 14.6 mgd each
	East Tanks 91 thru 96		6 tanks @ 23.4 mgd each
	Total Capacity, All Tanks in Service		260 MGD
Chlorine Contact Tanks****	1 Tank		330 MGD
	2 Tanks		400 MGD

*One east tank is used for centrate treatment.
**Maximum capacity based on maximum overflow rate of 1,200 gpd/sf.
**** Indicates chlorine contact tank capacity with East River Tide Elevation at or below mean high tide.

1.5 Performance Goals for Wet Weather Events

The goal of this Wet Weather Operating Plan is to maximize treatment of wet weather flows at the Hunts Point WPCP and, in doing so, reduce the volume of untreated CSO being discharged to the Long Island Sound and its tributaries. The Hunts Point WPCP will be maintained in continuous operation by the NYCDEP. The major operating requirements include:

1. Consistently achieve primary treatment and disinfection for wet weather flows up to 400 MGD. In doing so, the plant will satisfy the SPDES requirement of providing this level of treatment for 2x DDWF.

2. Consistently provide secondary treatment for wet weather flows up to 260 MGD before bypassing the secondary treatment system. The plant will have the ability to provide a secondary level of treatment for 1.3 x DDWF. A lower volume treatment configuration will be instituted if needed in order to maintain and protect the Step BNR Process, which is more susceptible to wet-weather shock loads. This scenario is in accordance with the recommendations the Comprehensive Nitrogen Management Team found in their March 2001 Refined Plant Upgrading Guidance Technical Memorandum.

3. Do not appreciably diminish the effluent quality or destabilize treatment upon return to dry weather operations. (This objective ties into the previous goal of protecting the dry weather Step BNR operation by providing secondary treatment for 1.3 x DDWF.)

1.6 Purpose of This Manual

The purpose of this manual is to provide a set of operating guidelines to assist the Hunts Point WPCP staff in making operational decisions which will best meet their performance goals and the requirements of the SPDES discharge permit. During a wet weather event, numerous operational decisions must be made to effectively manage and optimize treatment of wet weather flows. Plant flow is controlled through influent pump operations and adjustment of regulators. Flow rates at which the secondary bypass is used are dependant upon a complex set of factors, including conditions within specific treatment processes (such as sludge settling characteristics) and anticipated storm intensity and duration. Each storm event produces a unique combination of flow patterns and plant conditions. No manual can describe the decision making process for every possible wet weather scenario which will be encountered at the Hunts Point WPCP. This manual can, however, serve as a useful reference, which both new and experienced operators can utilize during wet weather events. The manual can be useful in preparing for a coming wet weather event, a source of ideas for controlling specific processes during the storm, and a checklist to avoid missing critical steps in monitoring and controlling processes during wet weather.

1.7 Using the Manual

This manual is designed to allow use as a reference during wet weather events. It is broken down into sections that cover major unit processes at the Hunts Point WPCP. Each protocol for the unit processes includes the following information:

- List of unit processes and equipment covered in the section
- Steps to take before a wet weather event and who is responsible for these steps
- Steps to take during a wet weather event and who is responsible for these steps
- Steps to take after a wet weather event and who is responsible for these steps
- Discussion of why the recommended control steps are performed
- Identification of specific circumstances that trigger the recommended changes
- Identification of things that can go wrong with the process

This manual is a living document. Users of the manual are encouraged to identify new steps, procedures, and recommendations to further the objectives of the manual. Modifications, which improve upon the manual's procedures to maximize treatment of wet weather, are encouraged. With continued input from the plant's experienced operations staff this manual will become a useful and effective tool.

1.8 Revisions to This Manual

In addition to revisions based on plant operating experience, this manual will also be revised as modifications and stabilizations are made to the collection system and the Hunts Point WPCP that affect the plant's ability to receive and treat wet weather flows. Applicable changes are listed as follows:

- **Regulator Automation-** Under DEP's SCADA system project, automatic control of the regulators will be provided to plant operators. Control strategies for these regulators should be incorporated into this manual in the future after automation is complete. Currently, Regulator HP-6 has an existing remote control system, which has been in operation for over five years. Approximately one-third to one half of the rainfall in the sewer system is controlled by Regulator HP-6. The plant has experienced problems with signal telemetry between the regulator and the plant.

- **Throttling Gate Automation-** A new forebay gate chamber with a new gate actuated by a hydraulic cylinder was installed under Phase I of the plant upgrade. The objective of the Forebay throttling gate system is to automatically throttle maximum flow into the plant to 400 MGD during wet weather conditions, and to prevent the level in the Afterbay channel from exceeding Elevation (-) 8.00.

- **Step BNR Process-** The increased sensitivity of the Step BNR system to wet weather flows and possible upsets will have to be alleviated with possible process flow changes during wet weather. Increased monitoring of system components such as flow, dissolved oxygen, sludge blankets, froth, etc, will certainly be a part of the new flow train. The operation protocol for this type of treatment should be reviewed and revised as necessary and incorporated into this manual as experience is gained.

- **Future Construction Phases-** Future construction phases may impact the operation of the plant and may require revisions to this manual.

SECTION 2
UNIT PROCESS OPERATIONS

This section presents equipment summaries and wet weather operating protocols for each major unit operation of the plant. The protocols are divided into steps to be followed before, during, and after a wet weather event that addresses the rational trigger mechanisms and potential problem areas for wet weather operations. A flow diagram of the plant headworks following completion of the plant upgrading is shown in **Figure 2-1.**

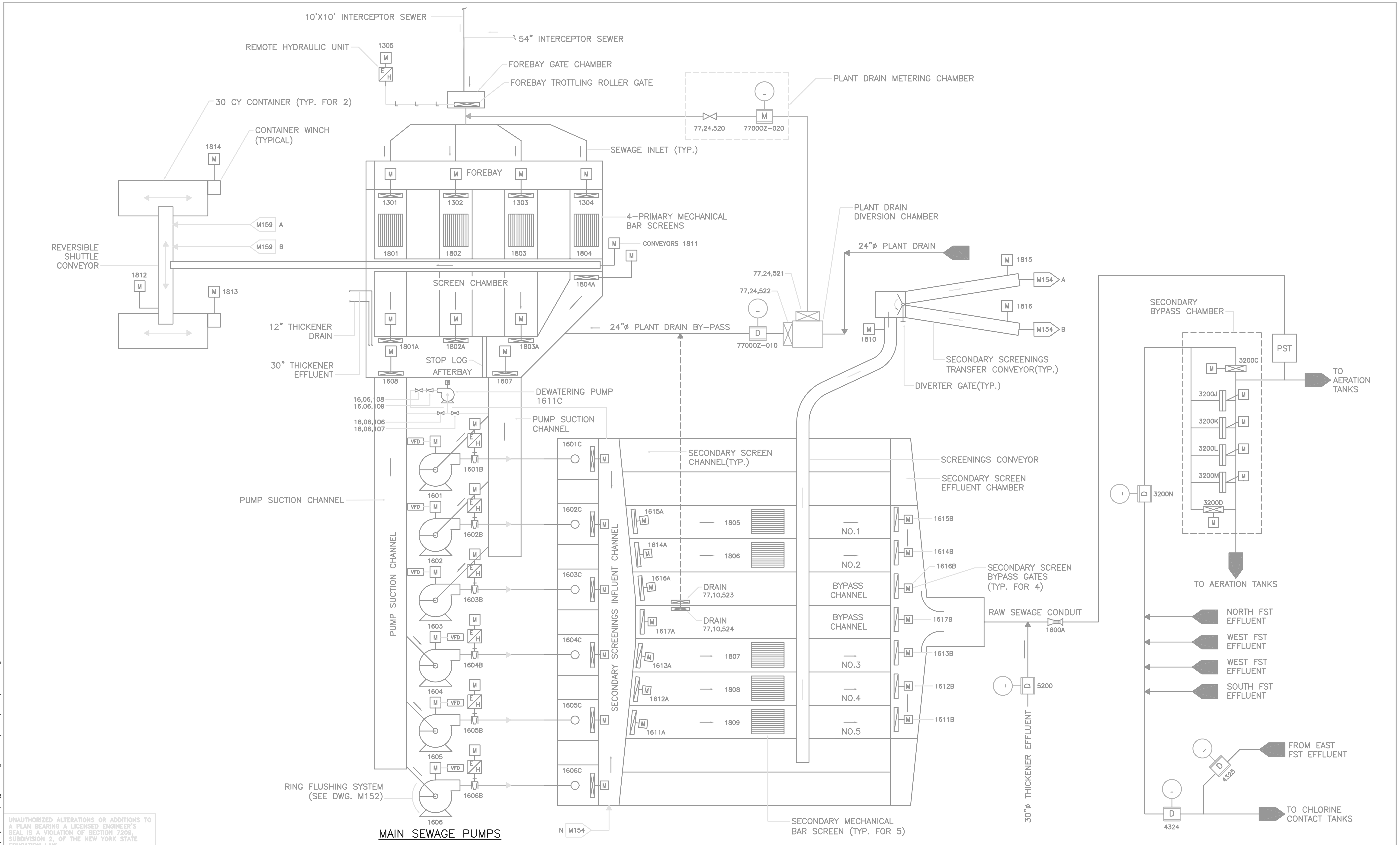
An analysis of the Hunts Point wet weather flow performance has shown favorable results with respect to effluent quality at the high end of observed flows.

2.1 Throttling Gate

Forebay Chamber (Proposed)	
Number of Gates	1
Service	Throttling
Type Operator	Hydraulic Actuator

During the plant upgrade, a forebay gate chamber was constructed in the interceptor sewer. A roller gate frame is anchored to the conduit walls.

The objective of the future forebay throttling gate system is to automatically throttle flow into the plant when flows exceed 400 mgd during maximum wet weather conditions, and to prevent the level in the Afterbay channel from exceeding Elevation (-) 8.00. To achieve both objectives the gate shall be controlled inversely proportional to the level in the Afterbay. The gate shall be fully open when the level in the Afterbay falls below Elevation (-) 10.5, and shall be at its lowest position when the level rises above Elevation (-) 8.00. The closure of the gate is physically limited such that the gate cannot be lowered below a fixed elevation corresponding to the maximum dry weather flow of 200 mgd (as per the Design Engineer) entering the plant. Key hydraulic control elevations for the plant headworks are shown on **Figure 2-2**. If the telemetry to Regulator 6 is operational, the gates at the regulator should be throttled before the screen channel influent gates are throttled.



UNAUTHORIZED ALTERATIONS OR ADDITIONS TO A PLAN BEARING A LICENSED ENGINEER'S SEAL IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW.

Time: 8:50 A.M. Date: 6/16/2003 pcdjp Drawing File: H:\32333\WWOP\FIG.2-1.dwg

NO.	DATE	ISSUED FOR	BY

DESIGNED —
DRAWN —
CHECKED —
SECT. CHIEF —
PROJ. MNGR. —

SCALE NONE

URS

APPROVED FOR THE CITY OF NEW YORK
P.E. PROJECT MANAGER
P.E. CHIEF, DIVISION OF FACILITIES DESIGN NORTH

CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENVIRONMENTAL ENGINEERING
DIVISION OF FACILITIES DESIGN
WP-56 HUNTS POINT WPCP
INTERIM PLANT UPGRADE

CONTRACT NO.1G
STRUCTURES & EQUIPMENT
MECHANICAL

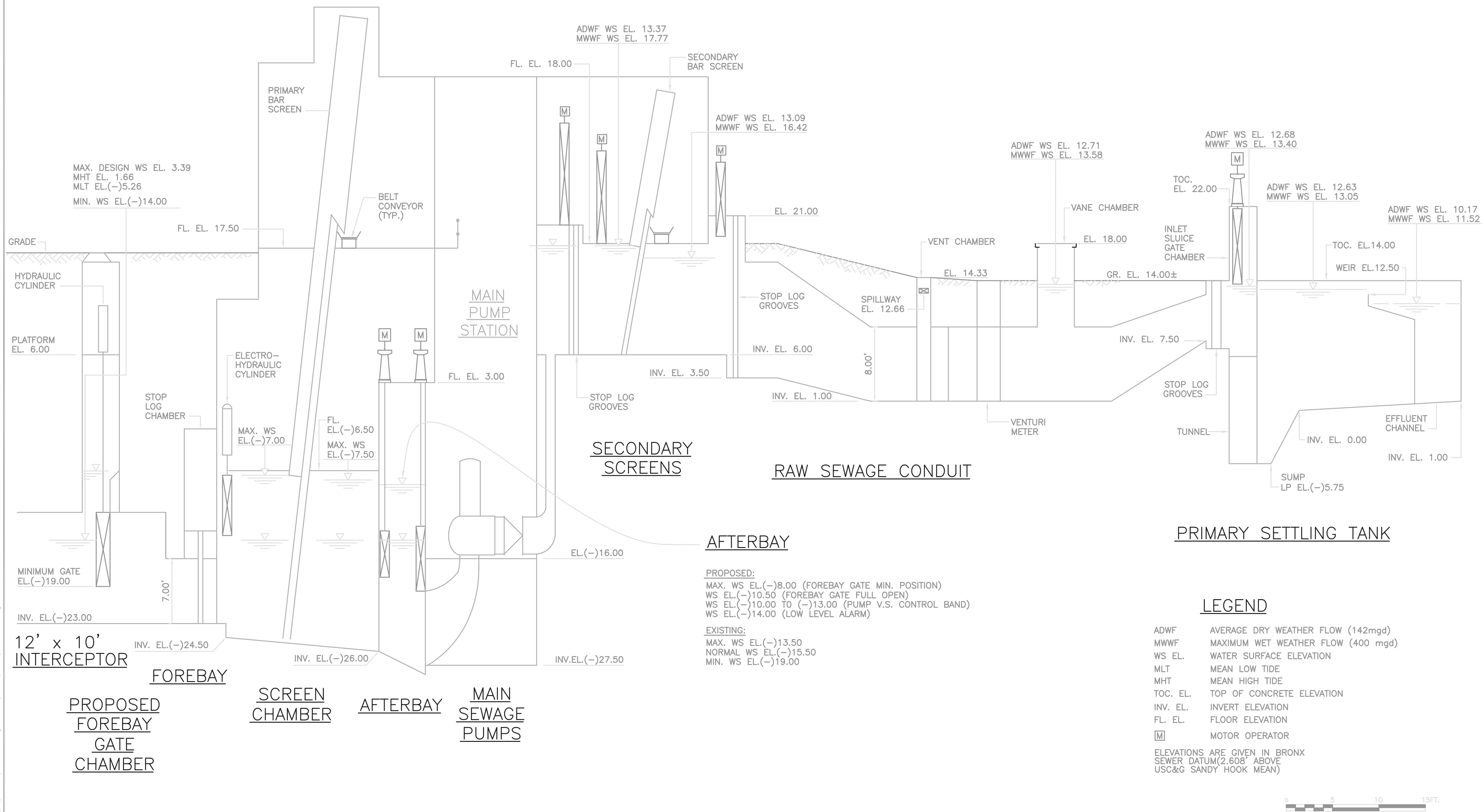
HEADWORKS FLOW DIAGRAM

DATE
SHEET OF
FIGURE 2-1

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Gates should be in full open position during dry weather and prior to wet weather. • Check gate operation.

During Wet Weather Event		
SEE	SSTW/STW	• Leave gate in full open position until: a. Plant flow approaches capacity of pumps in service, or b. Screen channel level exceeds acceptable level with maximum pumping, or c. Bar screens become overloaded with screenings, or d. Grit removal exceeds the plants grit handling capacity • Set the gate to maintain acceptable wet well water level. • Record all throttling gate adjustments on the Throttling Gate Log. • As wet weather event subsides open the gate to maintain the wet well water level until the gate is completely open.

After Wet Weather Event		
SEE	SSTW/STW	• Make sure the throttling gate is in the full open position. • Conduct maintenance or repair of the throttling gate as necessary.



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WP–56 HUNTS POINT WPCP
PLANT UPGRADE
WET WEATHER OPERATING PLAN
HYDRAULIC PROFILE PLANT HEADWORKS

FIGURE 2–2

Time: 3:08 P.M. Date: 6/17/2003 parcn Drawing File: H:\32333\WWOP\HYDRAPROF.dwg

Why Do We Do This?
To regulate flow to the WWTP and prevent excessive flows from destabilizing plant performance.
What Triggers the Change?
• High water levels in the screen channels or other unacceptable plant conditions related to high flows.
What Can Go Wrong?
• If the throttling gate is not operated when necessary, or fails to operate, high water levels in the wet well may result. • Flooding of the screen chamber may occur. • If the forebay gate fails to operate, flow to the plant should be manually throttled with the screen channel influent gates. • If extreme high tide or storm surge conditions occur, the water level in the interceptor may exceed the maximum design water level of the throttling gate (EL. +3.39). If this occurs, the screen chamber influent gates should be throttled manually.

2.2 Wastewater Screening

The Hunts Point Plant has primary bar screens upstream of the main sewage pumps and secondary screens downstream. At design average conditions, approach velocities to the screens should be no less than 1.25 feet per second to prevent settling in the channel. The velocity through the bars should normally be no greater than 3.0 feet per second to prevent forcing material through the openings.

Screens	
Primary Screens	
Number of Units	4 units
Bar Openings	1"
Screen Channel Width (nominal)	8' - 0"
Screen Channel Invert Elevation @ Screen	(-)23.5'
Operating Lower Floor Elevation	(-)6.5
Operating Higher Floor Elevation	17' - 6"
Secondary Screens	
Number of Units	5 units
Bar Openings	1/2"
Screen Channel Width (nominal)	7'-0"
Screen Channel Invert Elevation @ Screen	6'-0"
Operating Floor Elevation	18' -0"

Secondary Screen Bypass Channel

Under the plant upgrade, existing channels will be modified to provide a bypass around the secondary screens to prevent flooding. The proposed secondary screen bypass channel operation will be designed to operate as follows: The screen channel bypass gates shall open on high influent channel level. As wastewater in the screen influent channel reaches high level, operator action is required to place additional channels in service.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operations, operating experience will dictate the number of screens required based on parameters such as grit settling problems, and quantity of screenable material. General guides for number of primary and secondary screens in service for various flow ranges and the containers usage associated with the flow ranges during maximum and average conditions follows:

		Primary Screens			**Secondary Screens**		
	Flow, mgd	**Number of Channels in Service**	**Flow per Channel, mgd**	**Approach Velocity, fps**	**Number of Channels in Service**	**Flow per Channel, mgd**	**Approach Velocity, fps**
Minimum DWF	60	1	60	1.79	1	60	1.89
Current Average DWF	130	2	65	1.57	2	65	1.95
Daily Maximum DWF	170	2	85	1.64	2	85	2.43
Design Maximum DWF	300	3	100	1.93	3	100	1.98
Maximum WWF	400	3	133.3	2.58	4	100	1.96

SEE	SSTW/STW	• Rotate screen operation to ensure that all available screens are in working order. • Make sure sufficient empty screenings containers are available. Additional empty containers should be kept on-site before weekends and large storms.

During Wet Weather Event		
SEE	SSTW/STW	• Put additional primary or secondary screens into operation. • Set all screen rakes to continuous operation. • Regulate the plant flow with the throttling gate if the screens become overwhelmed or the water elevation in the screen channel exceeds EL. -14.0 (or EL. -8.0 when Phase I upgrading is complete). • Remove and replace screenings containers as necessary.

After Wet Weather Event		
SEE	SSTW/STW	• Take extra screen out of operation. Return to two screens online. • Remove screenings for disposal.
Why Do We Do This?		
• Two primary screens can accommodate the plant design average dry weather flow of 200 mgd. • Three primary screens are required to handle peak wet weather flows up to 400 mgd. • This leaves the fourth screen on standby in case of a screen failure or excessive loadings. • The same logic applies to the secondary screens except that there is an additional secondary screen so that the fifth can be left as standby.		

What Triggers The Change?
• Flows in excess of 267 mgd will require a third primary screen to be put online. • Screen rakes will operate on time mode or if the head differential across the screens exceeds 2 to 4 inches. If this occurs the fourth screen should be put on line.

What Can Go Wrong?
• If an insufficient number of screens are online the screen channel may surcharge above acceptable levels (EL. -8.0 • If screens clog with debris, the level in the screen channel may flood above acceptable levels. The influent gate to the clogged screen channel should be throttled to reduce flow. To clear an obstruction, the screen mechanism can be manually reversed and jogged forward. If doing this does not clear the obstruction, a standby screen channel should be placed in service, and the obstructed channel removed from service. • If an overload or other alarm condition occurs and the screen mechanism automatically stops, place a standby channel in service and attempt to determine the cause of the failure. • If the screening belt conveyors fail, the conveyor bypass chute should be installed, and screenings removed manually using 1¼ cu. yd. containers and a forklift truck.

2.3 Wastewater Pumping

The design capacities of the existing pumps are indicated in the following table.

Wastewater Pumping	
	Existing
Number of Pumps	6
Number of Standby Pumps	1
Type of Pump	Vertical, mixed flow pumps
Suction and Discharge Size, In.	42/48
Motor Horsepower/Type of Drive	800 HP/VFD
Maximum Speed , RPM	359
Minimum Speed, RPM	232
Flow, MGD	100
Head, Ft.	32.5

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Monitor afterbay elevation. • Number and speed of pumps in service are selected and manually adjusted by operator in the pump control room • Adjustments made based on maintaining the level in the screen chamber afterbay at a nominally constant level • Check that afterbay level monitors are functional. • If possible, prior to an anticipated wet weather event, draw down the interceptor by 1 to 3 feet.

During Wet Weather Event		
SEE	SSTW/STW	• Monitor afterbay elevation. • As afterbay level rises put off-line pumps in service and increase speed of variable speed pumps as necessary • Pump to maximum available capacity during wet weather events. • All adjustments are made manually by operators in the pump control room based on maintaining a nominal reference level of -15.0 ft. +/- 6″ in the afterbay. The reference level was chosen to allow the most efficient operation of both the screening equipment and main pumps. • Restrict flow through influent screen gates if pumping rate is maximized and wet well level continues to rise (see influent gate operations)

After Wet Weather Event		
SEE	SSTW/STW	• Maintain pumping rate as required to keep wet well level in operating range. • If the influent gates have been throttled, maintain maximum pumping rate until all previously constricted influent gates are returned to fully open position and flow begins to decrease lowering wet well level. • Reduce pump speeds and number in service to maintain wet well level and return to dry weather operation. The operator will decrease pumping by 10 MGD if the afterbay level drops below -15.5 ft. After an interval of approximately 10 minutes, the level remains below –15.5 ft, the operator will again decrease pumping.

Why Do We Do This?
• Maximize flow to treatment plant, and minimize need for flow storage in collection system and associated overflow from collection system into receiving water body.
What Triggers The Change?
• High flows, and the subsequent increase in the level of the screen chamber afterbay.
What Can Go Wrong?
• Pump fails to start. Pump fails while running. Screens blind, necessitating pump speed reduction or slowdown. Subsequent flooding of wet well and bar screen equipment.

2.4 Primary Tanks

The primary settling tanks are designed to effectively treat approximately 80 MGD each. If taking tanks out of service increases the flow to each tank above this amount, the primary settling effluent quality should be checked to avoid overloading and degradation of the secondary treatment process.

Number of Primary Settling Tanks in Service	Minimum Flow Rate (Approx.)
6	400 MGD
5	400 MGD
4	370 MGD
3	300 MGD
2	220 MGD
1	140 MGD

Number of Tanks	4 Units - West Side	2 Units - East Side
Unit Dimensions (Ft)		
Length	168.0	
Width	108.5	
Sidewater Depth	12.0	
Total Weir Length (Ft)	3,822	
	Design Average	Design Peak
Overflow Rate (gpd/sf)	1,829	3,657
Weir Loading (gpd/lf)	52,389	104,657
Detention Time (Hr)	1.17	0.59

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Under normal operations all available primary tanks should be in service. • Check the flow balance to all tanks in service by looking at the effluent weirs. • Check the sludge collector operation and inspect tanks for broken flights. • Check for floating sludge or bubbles on the tank surface as an indication of sludge collector problems. • Check sludge pump operation and flow. • Repair any malfunctions or equipment out of service.
		on-line. • Watch water surface elevations at the weirs for flooding and flow imbalances. • Check the collector and drive operation. • Make sure grit flushers are operating. • Assign additional operators to grit handling if necessary. • Reduce flow (sewage pumps and throttling gate) if: a. Sludge cannot be withdrawn quick enough from the primaries, b. Grit accumulation exceeds the plants ability to handle it, c. A primary tank must be taken out of service and maximum tolerable flow rate is exceeded. • Postpone dewatering tanks until storm has subsided.

After Wet Weather Event		
SEE	SSTW/STW	• Take tanks out of service for repair or maintenance if necessary. • Remove floating debris and scum on the tanks. • Repair any failures. • Clean the effluent weirs if needed.

2.5 Secondary Bypass Channel

Secondary Bypass	***Current***
Bypass Channel	4 Weir Gates
Location of Sluice Gates	Chamber 1 North of Aeration Gallery

That portion of the primary settling tank flow, which is in excess of the secondary treatment process capacity, must be bypassed around secondary treatment. This bypass is performed in control chamber Number 1 by a motor operated bypass sluice gate. Under the plant upgrade, downward opening weir gates will be installed to improve control of secondary bypass flow. The bypass gates will automatically lower to limit flow to secondary treatment to 260 MGD (1.3 times DDWF).

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Conduct routine bypass gate preventative maintenance. • Check the bypass flow meter operation.

During Wet Weather Event		
SEE	SSTW/STW	• Open or lower the bypass gate to bypass channel to maintain a flow of 260 to 300 mgd to secondary treatment. • Open or lower the bypass gate if the primary clarifier weirs flood. • Open or lower the bypass gate to protect final clarifier blanket levels from going over the weirs. • During bypasses record the bypass flow rate on the Bypass Log. • Bypassed primary effluent flow will exert a higher chlorine demand than secondary effluent. Increase hypochlorite dose to maintain target residual.

After Wet Weather Event		
SEE	SSTW/STW	• As the plant flow drops and stays below 260 mgd close or raise the bypass gate. • Repair faulty equipment

Why Do We Do This?
• To relieve flow to the aeration system and avoid excessive loss of biological solids. • To relieve primary clarifier flooding.
What Triggers The Change?
• High blankets in final clarifiers, as well as primary and/or secondary treatment system flooding.
What Can Go Wrong?
• If the bypass gate is not used properly the primary clarifiers may flood and secondary clarifier sludge blankets could rise and discharge large amounts of biological solids.

2.6 Aeration Tanks

During maintenance work, only one aeration tank at a time may be taken out of service. Plant operations will attempt to maintain centrate nitrification in a separate aeration tank. Centrate is currently being treated in Aeration Tank No. 4 or 5.

Aeration Tanks		
Number of Tanks	4 Units - West Side	2 Units - East Side
Unit Dimensions (Ft)	**West Side**	**East Side**
Length	438	355
Width	25	30
Number of Passes Per Tanks	4	4
Sidewater Depth	15	15

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operations, at least 5 aeration tanks should be in operation, including one for centrate treatment. • The plant operates in a Step BNR feed mode with Inlets at the Head of Passes A, B, C, and D. • Check the dissolved oxygen levels and control the airflow to maintain greater than 2 mg/l in the oxic zones of the aeration tanks. • Monitor Filamentous Growth

During Wet Weather Event		
SEE	SSTW/STW	• Monitor the dissolved oxygen and adjust the airflow to maintain greater than 2 mg/l in the oxic zones. • During wet weather operations, all available aeration tanks should be in operation

After Wet Weather Event		
SEE	SSTW/STW	• Monitor the dissolved oxygen, and maintain greater than 2 mg/l dissolved oxygen in oxic zones.

Why Do We Do This?
• The Hunts Point WPCP is hydraulically designed to convey peak flows up to 1.5 times the Design Dry Weather Flow (DDWF) through secondary treatment under typical operating conditions; however, the plant may not be able to maintain nitrogen removal under these conditions. The BNR treatment process can be protected against such high wet weather flows due to the constraints on the secondary clarifier solids separation capability by: a. Limiting the secondary treatment flow to 1.3 x DDWF with the balance bypassing the secondary system. b. During wet weather flows, flow configurations can be changed to Contact Stabilization Mode where all of the wet weather flow is diverted into Pass C (4-Pass System) in order to minimize the loss of the autotrophic organisms essential for BNR. BNR is more sensitive to biomass loss due to the relative low growth rate of the autotrophs.
What Triggers The Change?
• Increasing speed and/or starting raw wastewater pumps to accommodate high wet weather flows.
What Can Go Wrong?
• Potential impacts of wet weather events on the activated sludge process include: a. Loss of biomass from the aeration tanks and secondary clarifiers b. Overloading of the aeration system resulting from high BOD loadings caused by solids washout from the sewer system and solids washout from the primary clarifiers c. Decreased BOD and Nitrogen removal efficiency due to shortened hydraulic retention time in the aeration tanks. • Wet weather impacts on the activated sludge system can be corrected by decreasing the maximum flow to secondary treatment to 1.3 x DDWF. • The operator must be careful not to let the dissolved oxygen levels drop much below 2.0 mg/l in the Oxic Zones because this can adversely affect secondary treatment and nitrogen removal efficiency.

2.7 Final Clarifiers and Distribution

Minimum operating requirements for the settling tanks include that no more than one East Final Settling Tank, and one West, North or South Final Settling Tank may be taken out of service for construction at a time.

Final Settling Tanks			
	North-South Tanks	**East Tanks**	**West Tanks**
Number of Units	4	6	16/4
Sidewater Depth (Ft)	12.5	12.1	14
Unit Dimensions LxW (Ft)	300 x 40.5	325 x 60	
Unit Dimensions LxW (Ft) West Tanks No. 31-34, 41-44, 51-54 & 61-64			94.5 x 80
Unit Dimensions LxW (Ft) West Tanks No. 35, 45, 55 & 65			94.5 x 28.5

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• During normal dry weather operation all available final clarifiers should be in service. • Check the telescoping valves for plugging. Free any plugged valves. • Observe blanket levels, tank surface. • Skim tanks as necessary. • Check the flow balance to all tanks in service by looking at effluent weirs. • Normal operation is to set the RAS rates to maintain a minimal sludge blanket.

During Wet Weather Event		
SEE	SSTW/STW	• Balance flow to the tanks to keep the blanket levels even. • Observe the clarity of the effluent and watch for solids loss. • Monitor the sludge blanket levels. • If necessary, increase the RAS/WAS rate to maintain low blanket levels. • Open the secondary bypass if: a. Secondary treatment flow exceeds 260-300. b. Sludge blankets rise to within 6 feet of the effluent weirs. c. Secondary clarifier weirs are flooded.

Why Do We Do This?
• High flows will substantially increase solids loadings to the clarifiers, which may result in high clarifier sludge blankets or high effluent TSS. These conditions can lead to loss of biological solids, which can destabilize treatment efficiency when the plant returns to dry weather flow conditions.
What Triggers The Change?
• Rising sludge blankets that cannot be controlled.
What Can Go Wrong?
• Excessive loss of TSS will reduce the biomass inventory of the plant which will adversely affect secondary treatment efficiency when the plant returns to dry weather flow conditions.

2.8 Chlorination

Chlorination System		
Number of Contact Tanks	2	
Number of Bays Per Tank	2	
Hypochlorite Storage Tanks	5	
Total Capacity Hypochlorite Tanks	60000	
Detention Time - Minutes	**2 Tanks in Service**	**1 Tank in Service**
Design Average Flow, 200 mgd	32	16
Dry Weather Maximum, 300 mgd	22	11
Peak Weather Maximum, 400 mgd	16	8

Due to foaming problems at the chlorine contact tanks the overflow weirs were lowered to Elevation +1.00 from Elevation +3.00 to create a smoother flow and less agitation. Unfortunately this solution to the foaming problem created another problem with respect to flooding the effluent weirs when the tide surpasses Elevation +1.00.

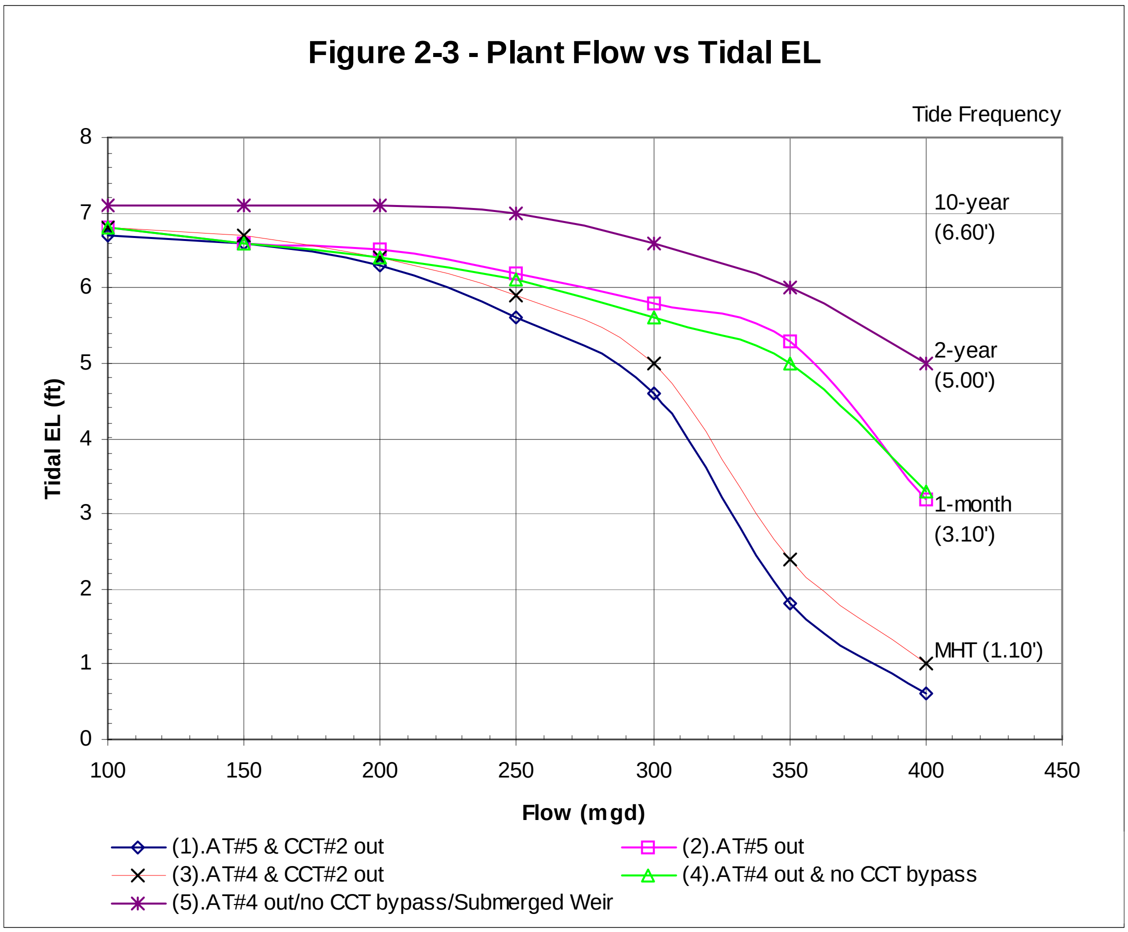
Hydraulic computer modeling indicates that the weirs of the upstream final settling tank will be flooded under the following conditions:

- Tide elevation +1.66 (Mean High Water)
- One chlorine contact tank is out of service

- Aeration Tank No. 5 used for centrate treatment
- Plant influent flow exceeds 330 mgd

Influent flow to the plant should be throttled under these conditions to avoid submerging the final settling tank weirs.

Figure 2-3 is a graph that indicates the plant hydraulic capacity versus tidal elevations and tank operating conditions. The graph indicates that with two chlorine contact tanks (CCTs) in service, the plant could accept a peak weather flow of 400 mgd if the tide elevation does not exceed EL. +3.10. However, if one CCT is out of service, and Aeration Tank No. 4 is being used for centrate treatment, influent flow would have to be throttled below 400 mgd to avoid submerging the final settling tank weirs if the tide elevation exceeds El. +1.10. If the weirs in the west final settling tanks (Crest El. 7.00) are allowed to be submerged, but the tank walkways (El. 8.50) are not flooded, then the plant could accept 400 mgd at a tide elevation of +5.0 with two CCTs in service, Aeration Tank. No. 4 out, and the CCT bypass closed.



Proper chlorine disinfection relies on exposure time to adequately disinfect secondary effluent. Excessive solids in secondary effluent resulting from high flows can hinder disinfection. In spite of the potential for reduced effectiveness, it is preferable to send as much flow through the disinfection units as possible to achieve some level of disinfection. Recommendations for maximizing chlorine disinfection efficiency during high flows include:

- Experiment with chlorine dosage at high flows. Adequate kills may be achievable at detention times of less than 15 minutes with the proper chlorine dosage.
- Optimize chlorine mixing. Poor mixing will greatly reduce chlorination effectiveness.
- When one chlorine contact tank will be taken out of service, the capacity of the plant to pass peak weather flows will be severely restricted as indicated above.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SEE	SSTW/STW	• Both chlorination tanks must be in service. • Normal operation is to maintain sufficient hypochlorite in the storage tanks. • Make sure there are sufficient chlorine residual test kit supplies. • Report problems immediately. • Perform preventative maintenance on equipment if necessary.

During Wet Weather Event		
SEE	SSTW/STW	• Check, adjust and maintain the Hypochlorite feed rates to maintain the target chlorine residual. Chlorine demand will increase as primary effluent bypass flow increases. • Increase the chlorine residual measurement frequency if needed. • Check and maintain the Hypochlorite tank levels.

After Wet Weather Event		
SEE	SSTW/STW	• Drop the Hypochlorite feed rates as needed to maintain the chlorine residual. • Maintain the Hypochlorite tank levels. • Repair equipment as necessary.

Why Do We Do This?
• Hypochlorite demand will increase as flow rises and secondary bypasses occur. Increase the Hypochlorite feed rates to maintain the target chlorine residual.
What Triggers The Change?
• High flows and secondary bypasses will increase Hypochlorite demand and usage.
What Can Go Wrong?
• Manual chlorination control with rapid flow changes and effluent quality changes can cause the chlorine residual to increase or decrease dramatically. Effluent chlorine residual must be monitored closely to maintain the target residual.

2.9 Sludge Thickening, Digestion and Storage

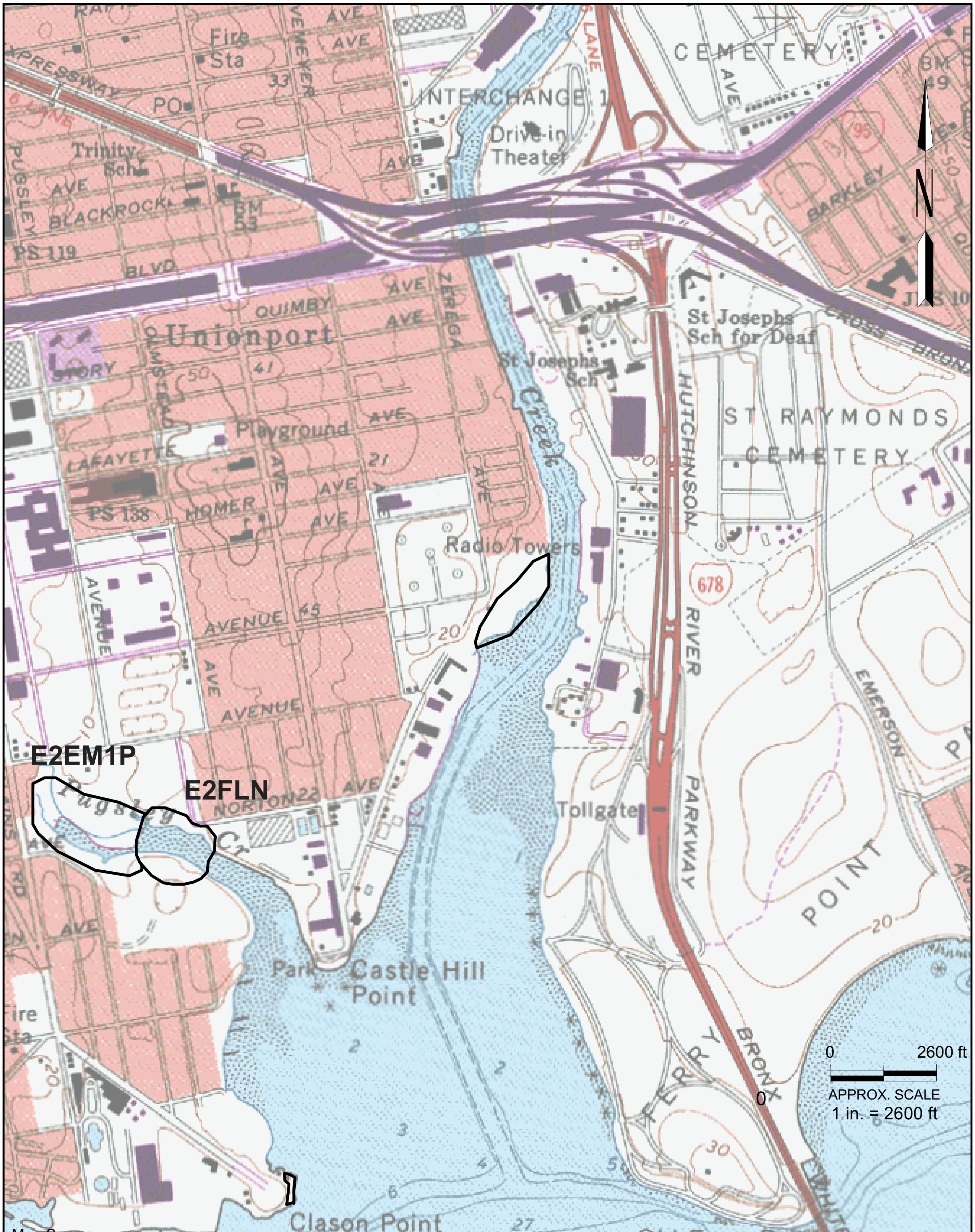
Sludge Dewatering and the tracking of sludge, screenings, scum and grit are affected by wet weather operations.

Sludge Thickening Digestion and Storage		
	Design Condition	**Present Condition**
Sludge Thickeners		
Installed	12	12
Operating	10	6
Anaerobic Sludge Digesters		
No. of Units	4	4
No. of Units Operating	4	3
Sludge Storage		
No. of Storage Tanks	5	5
Storage Capacity (Days)	20	35
Sludge Dewatering		
No. of Centrifuges	13	13
Unit Capacity	200	200

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
During Wet Weather Event		
SEE	SSTW/STW	• Sludge handling activities should proceed as they normally would during dry weather flow. A major component of the plant return stream is centrate, which is related to dewatering operations. • Balance-Water flow to the thickeners can also be reduced before any changes in sludge wasting are made.

APPENDIX B

BIOLOGICAL SAMPLING DATA



Map Source:
USGS 7.5-min. quadrangle series, Flushing, NY, 1966 - photorevised, 1979.

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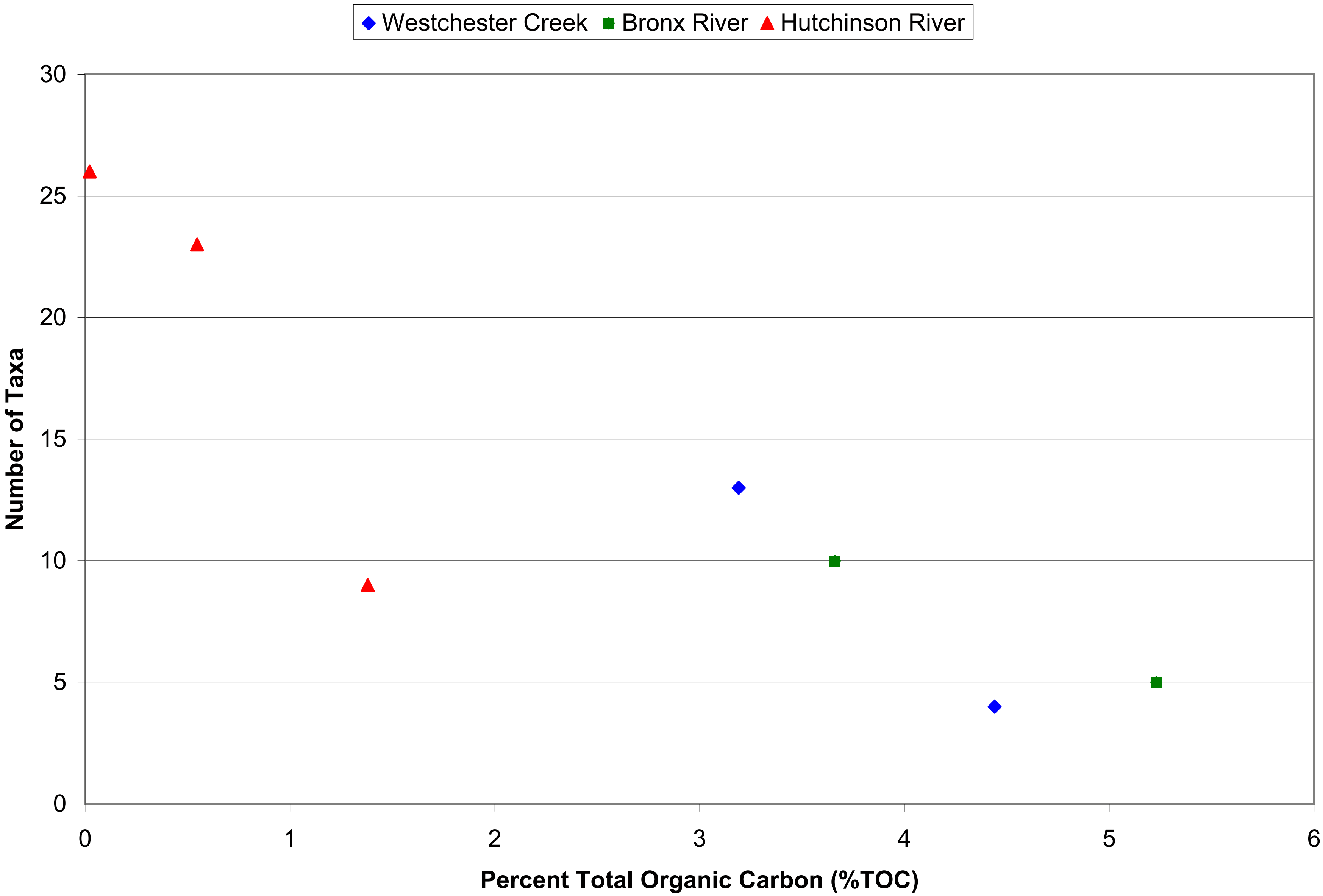
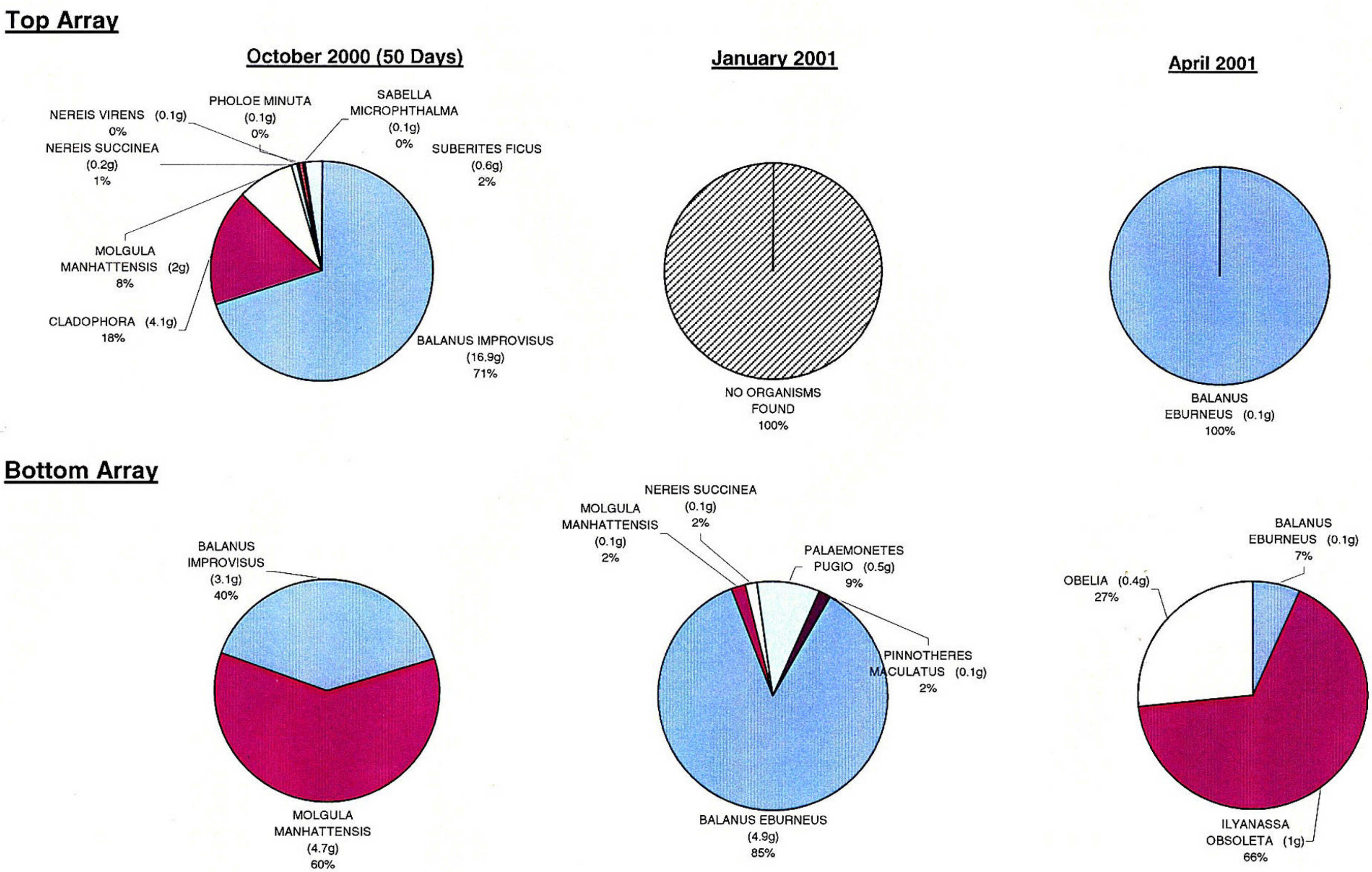
Wetlands in Westchester Creek

Figure 1

Figure 2. Number of Taxa versus Percent Total Organic Carbon (%TOC) at Westchester Creek, Bronx and Hutchinson Rivers.





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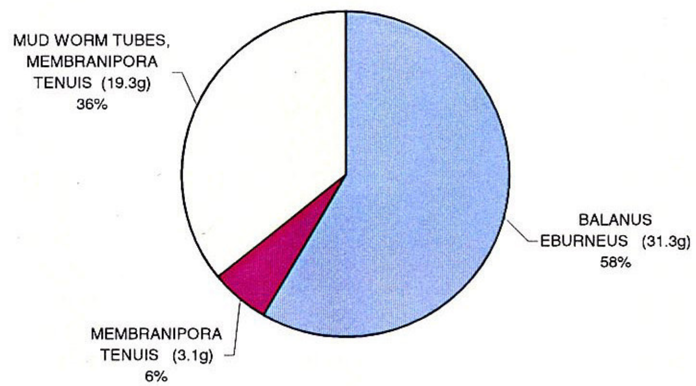
Percent Composition by Weight of Taxa on 3 Month Plate: WESTP01

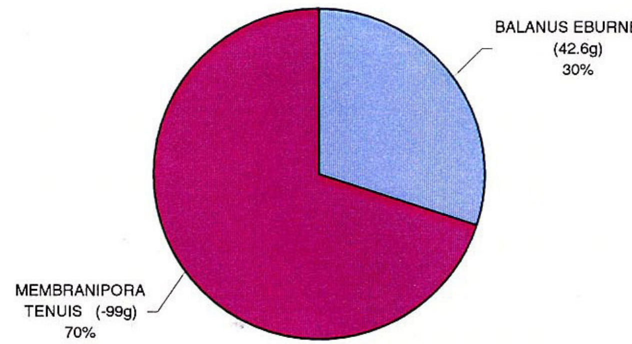
Figure 3a

Top Array

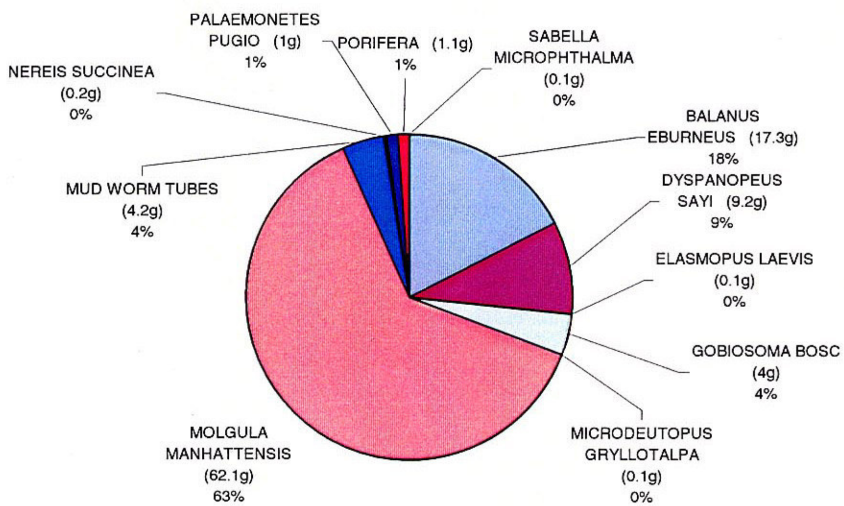
6 Month - January 2001

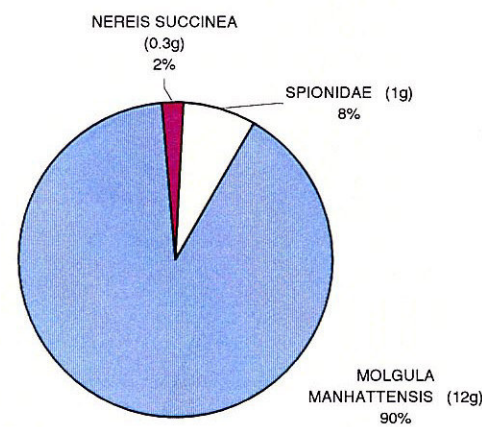


9 Month - April 2001



Bottom Array





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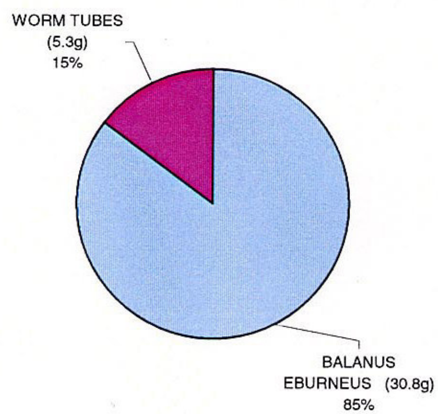
Percent Composition by Weight of Taxa on 6 & 9 Month Plates: WESTP01

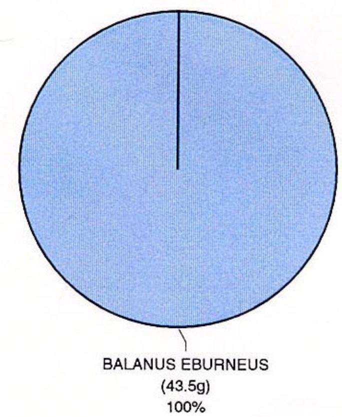
Figure 3b

Top Array

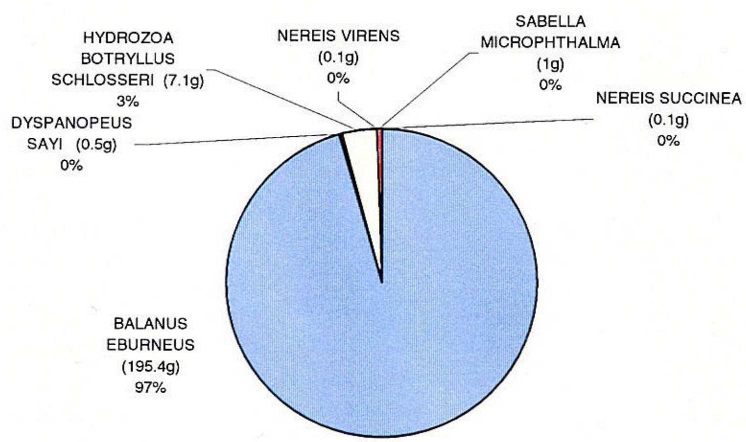
6 Month - January 2001

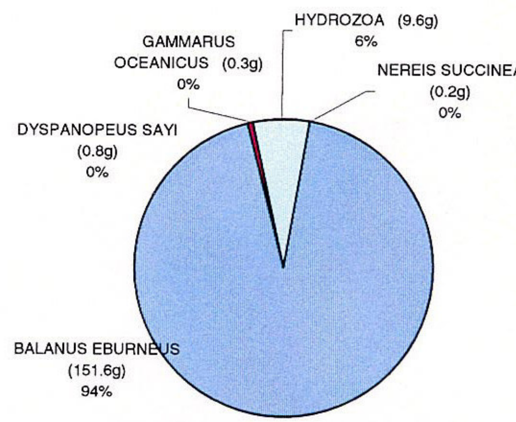


9 Month - April 2001



Bottom Array





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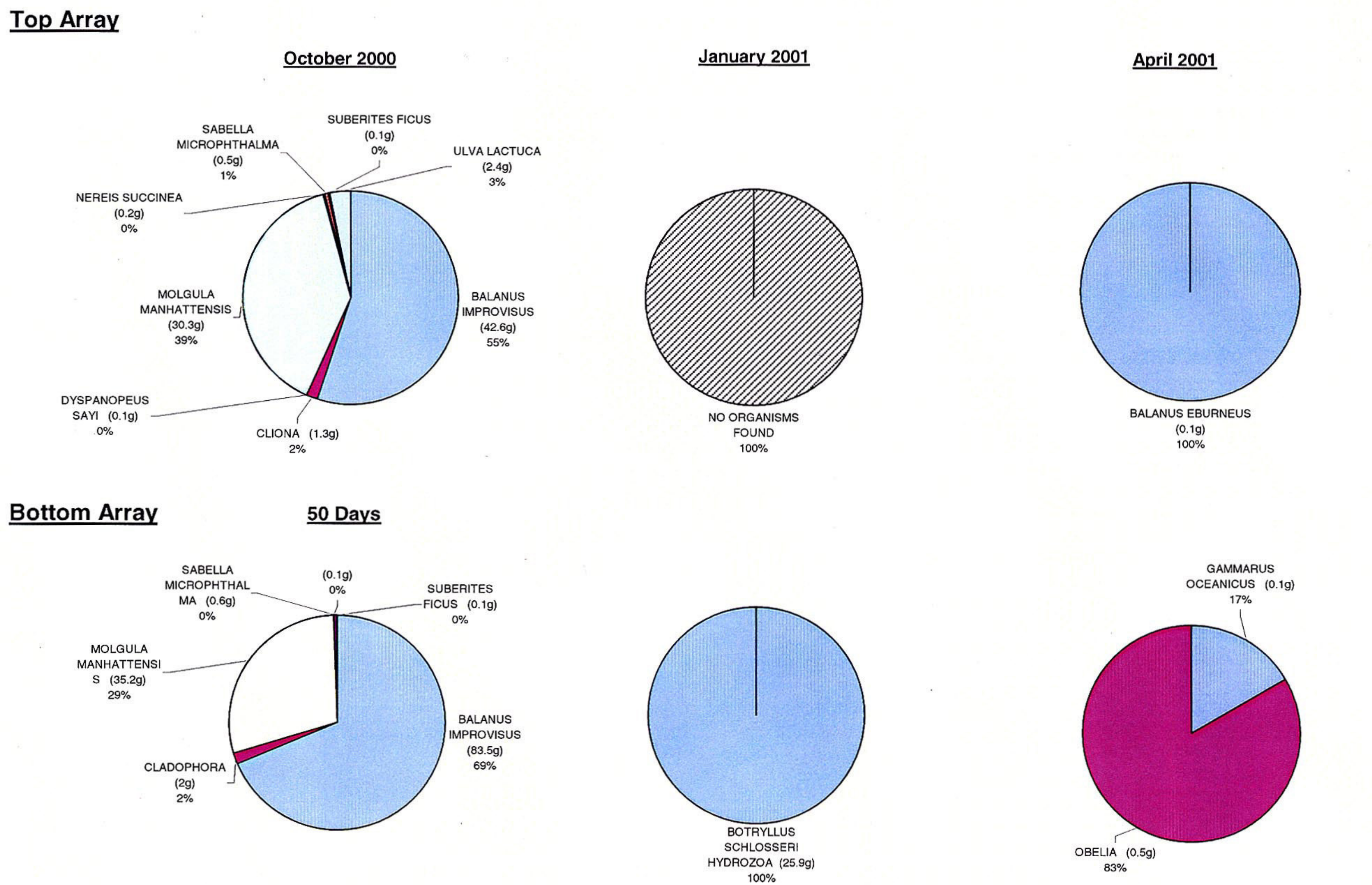
Percent Composition by Weight of Taxa on 6 & 9 Month Plates: WESTP02

Figure 3c



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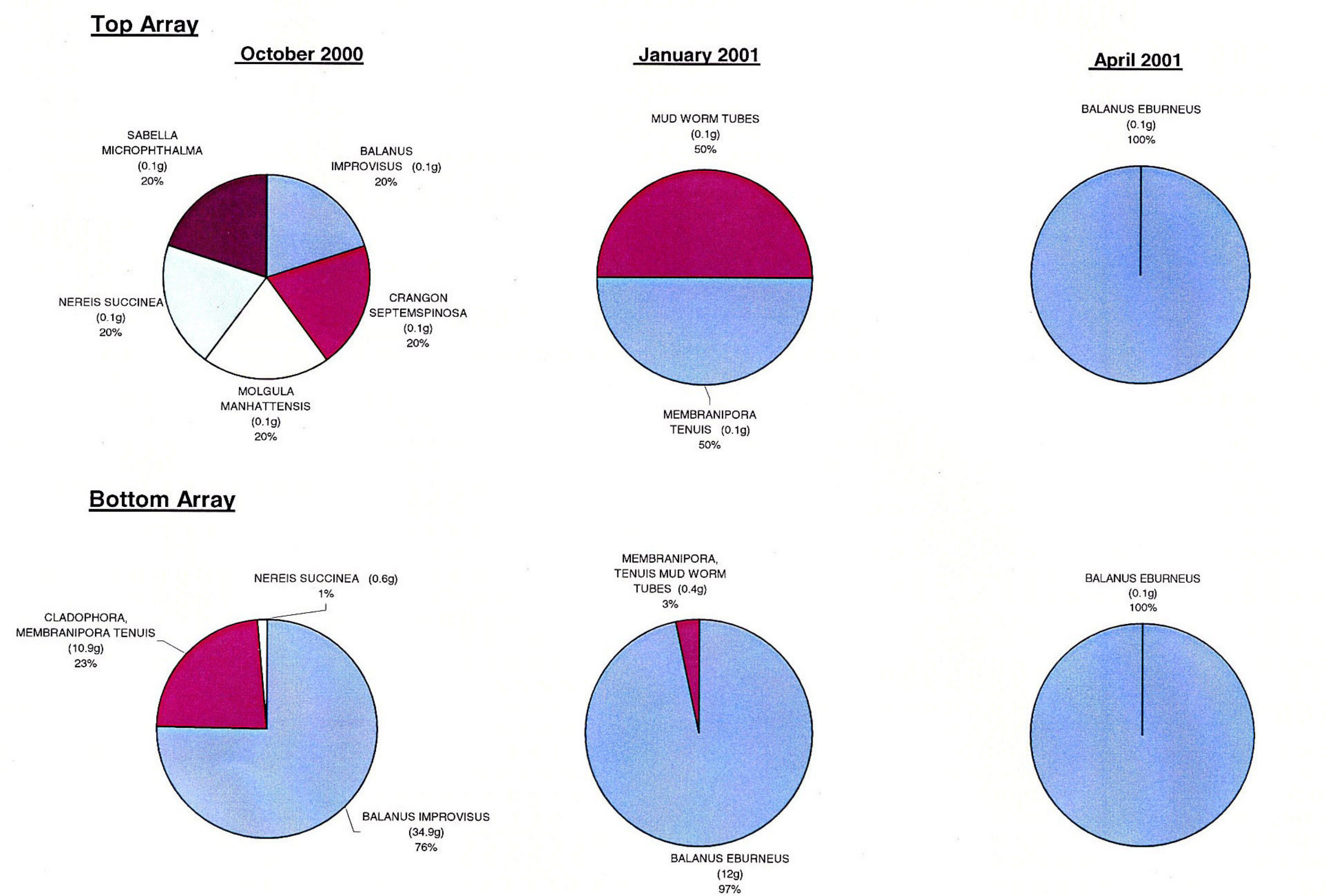
Percent Composition by Weight of Taxa on 3 Month Plate: WESTP02

Figure 3d



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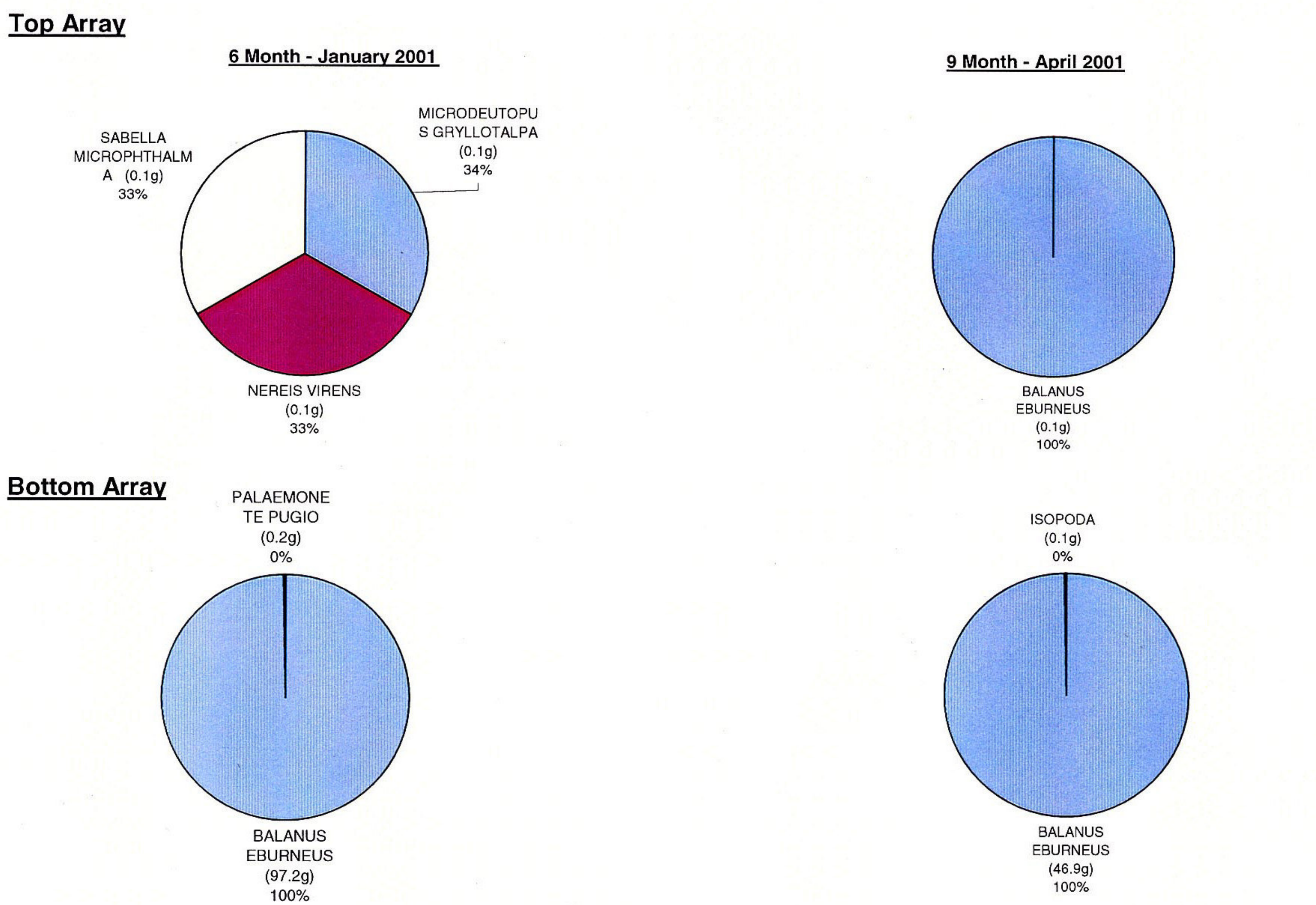
Percent Composition by Weight of Taxa on 3 Month Plate: BRNXP01

Figure 4a



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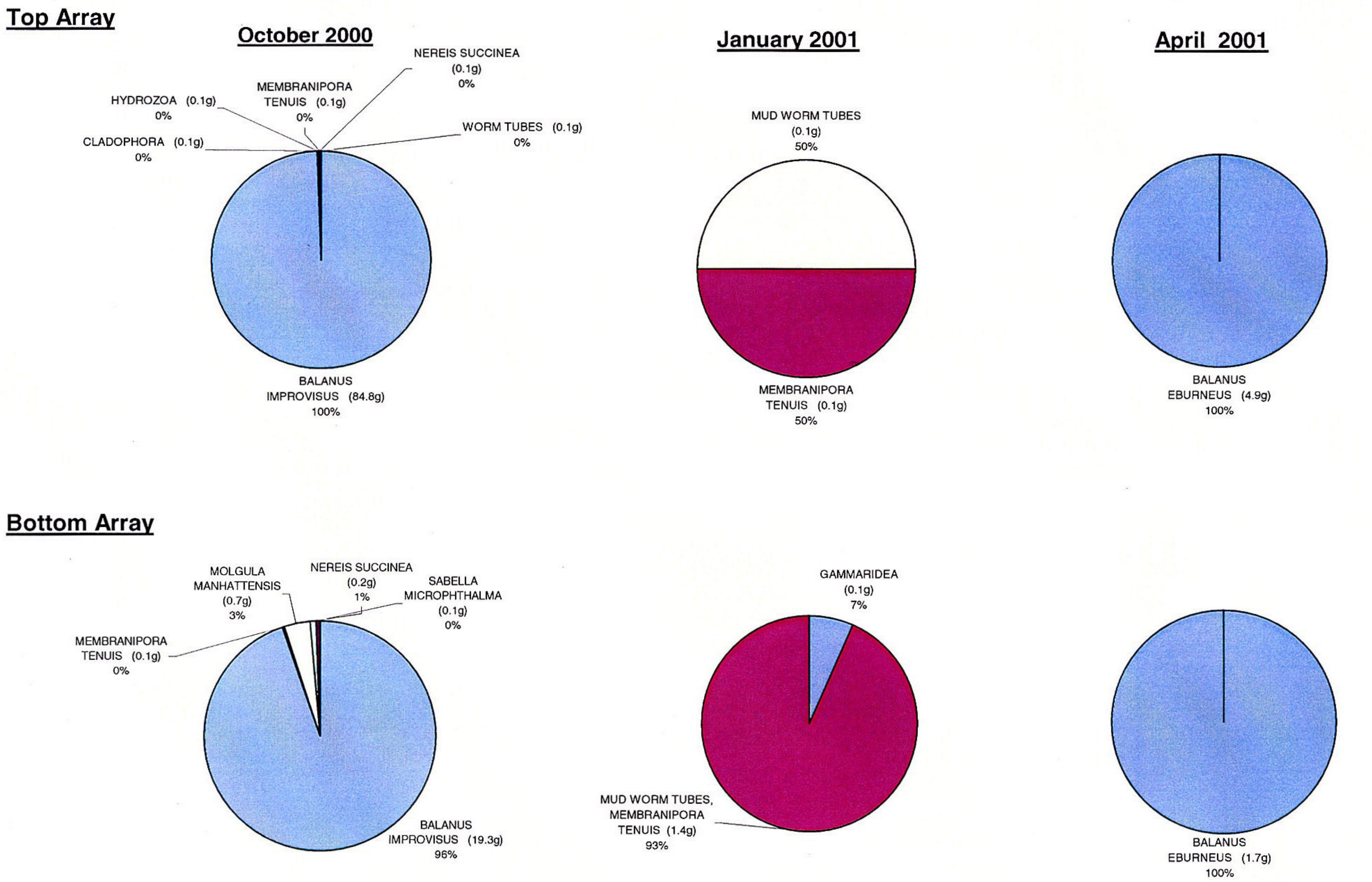
Percent Composition by Weight of Taxa on 6 & 9 Month Plates: BRNXP01

Figure 4b



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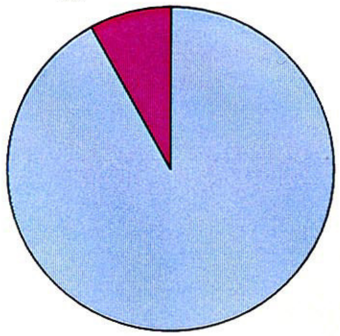
Percent Composition by Weight of Taxa on 3 Month Plate: BRNXP02

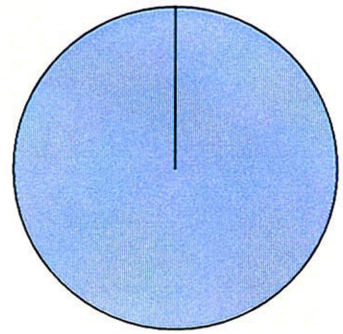
Figure 4c

Top Array

6 Month - January 2001



9 Month - April 2001



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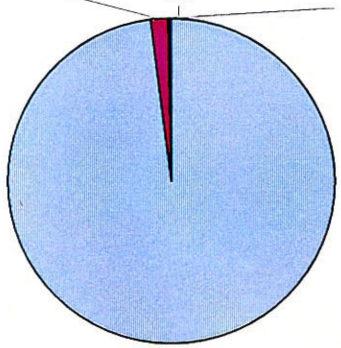

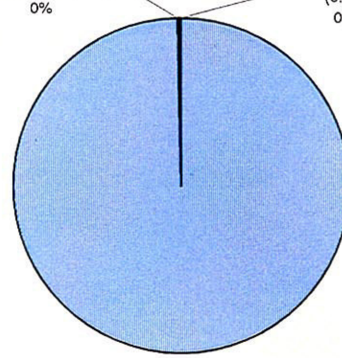

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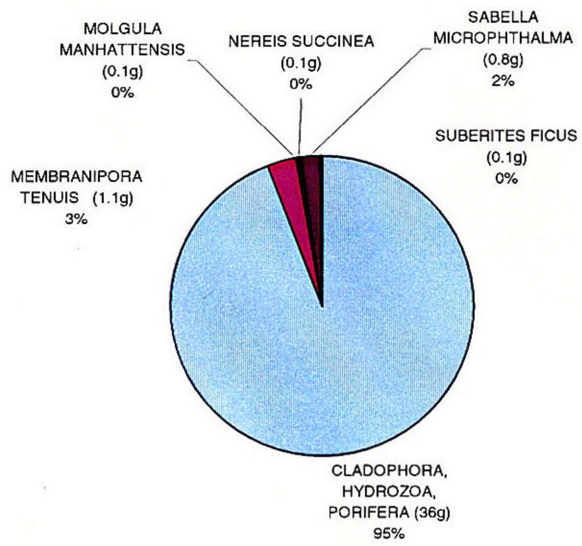
Percent Composition by Weight of Taxa on 6 & 9 Month Plates: BRNXP02

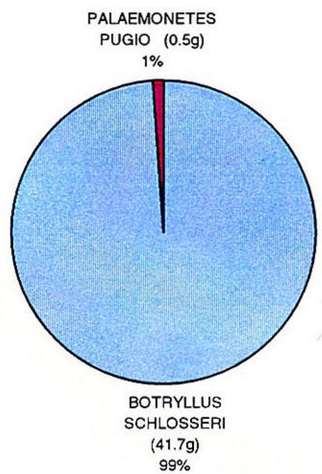
Figure 4d

Top Array

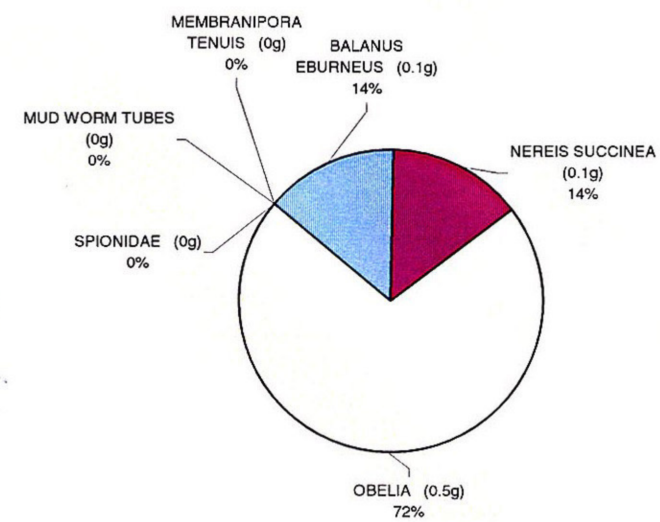
October 2000



January 2001



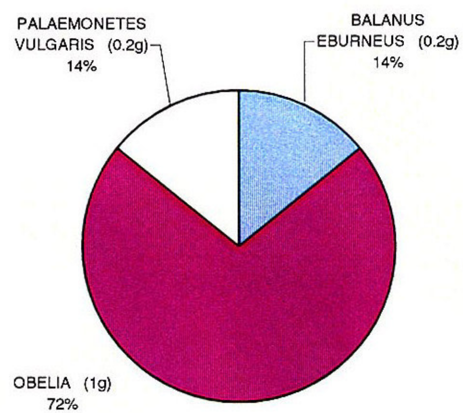
April 2001



Bottom Array

No Bottom Plate

Bottom Plate Added 1/17/01



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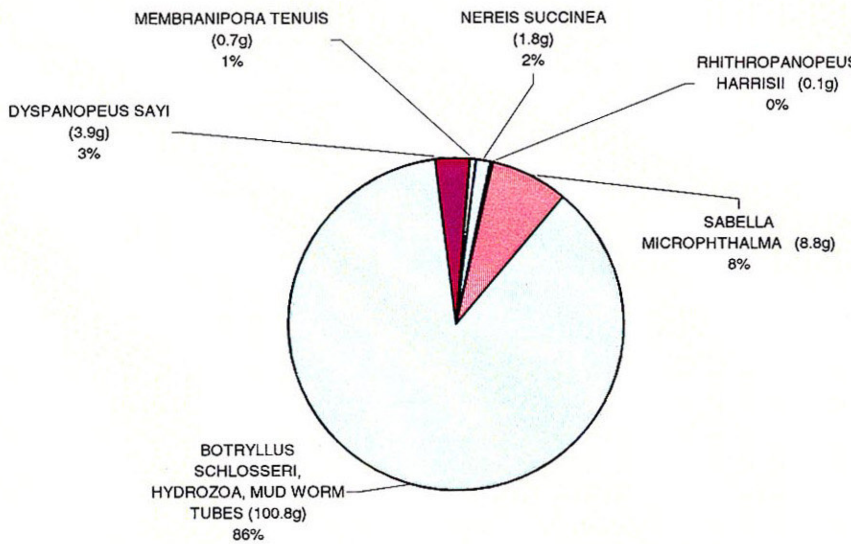
Percent Composition by Weight of Taxa on 3 Month Plate: HUCHP01

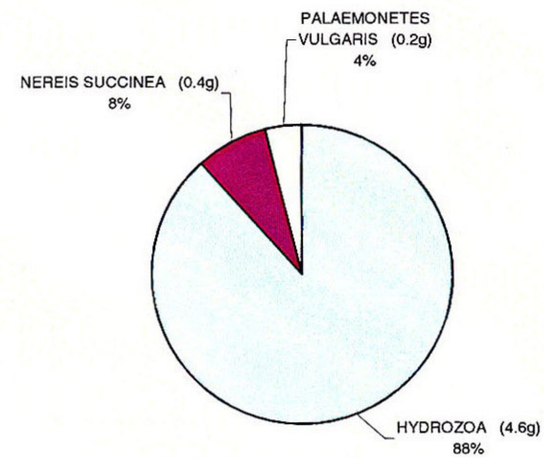
Figure 5a

Top Array

6 Month - January 2001



9 Month - April 2001



Bottom Array

No 6 Month Plate

No 9 Month Plate

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Percent Composition by Weight of Taxa on 6 & 9 Month Plates: HUCHP01

Figure 5b

Table 1. Abundance (#/m^2) of benthic organisms collected from Westchester Creek, Bronx and Hutchinson Rivers.

	Station Location						
Taxonomic Order	**Westchester Creek (middle)**	**Westchester Creek (mouth)**	**Bronx River (middle)**	**Bronx River (mouth)**	**Hutchinson River (upper)**	**Hutchinson River (mouth)**	**Hutchinson River (mouth)**
Unidentified Nematoda sp.	0	0	0	0	0	8	32
Polygordius trieslinus	0	0	0	0	0	760	72
Ampharetidae	0	0	0	0	0	0	0
Arabella iricolor	0	0	0	0	0	32	1152
Capitella capitata	24	16	0	120	0	1360	192
Eteone sp.	0	0	0	0	0	16	80
Eulalia sp.	0	0	48	0	0	0	0
Haploscoloplosus sp.	2520	96	0	8	0	0	0
Haploscoloplos rubustus	840	200	0	24	0	8	16
Lumbrineris acuta	0	0	0	0	0	0	56
Nephtys sp.	0	0	0	0	0	0	8
Nereis succinea	0	0	0	0	40	200	64
Orbiniidae	0	16	0	8	8	0	0
Phyllodocidae	0	0	0	0	8	40	24
Polychaeta	0	168	0	8	8	0	360
Polydora ligni	0	0	0	0	0	0	192
Polydora sp.	0	0	0	0	0	8	0
Sabella microphthalma	0	0	0	0	0	8	0
Scolecolepides viridis	0	0	0	0	248	96	64
Scoloplos sp.	872	0	0	0	0	0	0
Streblospio benedicti	0	32	248	8	9000	22744	2152
Tharyx acutus	0	0	0	8	40	296	264
Oligochaeta	0	184	32	224	32	72	896
Mulinia lateralis	0	8	0	0	0	0	0
Spisula solidissima	0	8	0	0	0	0	0
Tellina agilis	0	0	0	0	24	88	16
Yoldia sp.	0	8	0	0	0	0	0
Nassarius obsoletus	0	0	0	8	0	0	0
Ampelisca sp.	0	16	40	0	0	104	27824
Amphipoda	0	0	0	0	0	0	32
Corophium sp.	0	0	0	0	0	8	24
Lysianopsis alba	0	0	0	0	0	160	0
Lysianassidae	0	0	0	0	0	16	0
Microdeutopus gryllotalpa	0	0	0	0	0	8	1224
Paraphoxus epistomus	0	0	0	0	0	0	8
Crangon septemspinosa	0	8	0	16	0	16	8
Pagurus sp.	0	8	0	0	0	40	8
Sesarma sp.	0	0	0	0	0	40	0
Insecta sp.	0	0	8	0	0	0	8
Asteroidea	0	0	0	0	0	0	8
TOTAL INDIVIDUALS/m2	**4256**	**768**	**376**	**432**	**9408**	**26128**	**34784**

Table 2. Epibenthic organisms collected from suspended multi- plate arrays placed in Westchester Creek

Phylum	Lowest taxonomic level	Common name	Mid-reach	Mouth
Porifera	Porifera		P (C)	
	Suberites ficus		P (C)	P (C)
	Cliona sp.	Boring sponge		P (C)
Cnidaria	Hydrozoa			P (C)
	Obelia		P (C)	P (C)
Bryozoa	*Membranipora tenuis*	Coffin box bryozoan	P (C)	
Annelida	*Sabella microphthalma*	Fan worm	P	A
	Spionidae		A	
	Pholoe minuta		P	
	Nereis succinea	Common clam worm	P	P
	Nereis virens		P	P
Mollusca	*Ilyanassa obsoleta*	Eastern mud snail	P	
Arthropoda	*Balanus eburneus*	Ivory barnacle	A	A
	Balanus improvisus		A	A
	Microdentopus gryllotalpa		P	
	Palaemonetes pugio	Grass shrimp	P	
	Pinnotheres maculates	Oyster pea crab	P	
	Dyspanopeus sayi	Say mud crab	P	P
	Elasmopus laevis		P	
	Gammarus oceanicus			P
Chordata	*Molgula manhattensis*	Sea grape (sea squirt)	A	A
	Botryllus schlosseri	Golden star tunicate		P (C)
	Gobiosoma bosc	True goby	P	
Chlorophycota	Cladophora		P (C)	P (C)
	Ulva lactuca	Sea lettuce		P (C)

* A = abundant (>50 organisms), P = present (<50 organisms), P (C) = present, colonial organisms that could not be counted as individuals. Data were compiled from Hydroqual (2002).

Table 3. List of Phytoplankton found in the lower East River (Source Hazen and Sawyer 1980).

Group	Species		Group	Species
Diatoms	Achnanthes sp.		Diatoms	Navicula spp.
	Amphora sp.			Nitzschia closterium
	Asterionella formosa			Nitzschia sp.
	Asterionella gracillma			Paralia sulcata
	Asterionella japonica			Rhizosolenia setigera
	Biddulphia aurita			Rhizosolenia hepetata
	Biddulphia sp.			Rhizosolenia sp.
	Ceratulina bergoni			Skeletonema costatum
	Chaetoceros decipins			Stauroneis sp
	Chaetoceros lorenzianum			Surirella sp.
	Chaetoceros sp.			Synedra sp.
	Cocconeis costatum			Tabellaria ferestrata
	Cocconeis sp			Tabellaria flocculosa
	Coscinodiscus centralis			Thalassionema gravida
	Coscinodiscus rothii			Thalassionema nitzchoides
	Coscinodiscus sp.			Thalassiosira sp.
	Cyclotella sp			Thalassiothrix nitzchoides
	Cymbella sp.		Green Algae	Ankistrodesmus falactus
	Diploneis sp.			Nannochloris atomus
	Ditylum brightwelli			Scenedesmus quadricaudia
	Eucampia zoodiacus			Stichococcus sp.
	Fragilaria crotonensis		Blue - Green Algae	Oscillatoria sp
	Fragilaria sp.		Protozoan	Ceratium hirundinella
	Gyrosigma faciola			Ceratium tripos
	Gyrosigma sp.			Dirobryon sp.
	Leptocylindrus danicus			Distenphanus speculum
	Licmophroa sp.			Dynophysis acuta
	Lithodesium undulatum			Farella sp.
	Melosira granulata			Peridinum sp
	Melosira nummuloid			Tintinnidiidae
	Melosira sp.			

Table 4. List of Mircozooplankton found in the lower East River (Source Hazen and Sawyer 1980)

Plankton Group	Phylum	Species	Season of greatest abundance
Holoplankton		Acartia tonsa	Summer and Fall
Holoplankton		Eurytemora hirundoides	Summer and Fall
Holoplankton		Diaptomus	Summer and Fall
Holoplankton		Pseudodiaptomus coronatus	Summer and Fall
Holoplankton		Centropages typicus	Summer and Fall
Holoplankton		Calanus sp.	Summer and Fall
Holoplankton		Cyclopoida	Summer and Fall
Holoplankton		Oithona	Summer and Fall
Holoplankton		Cyclops sp.	Summer and Fall
Holoplankton		Halicyclops sp.	Summer and Fall
Holoplankton		Microarthridion sp.	Summer and Fall
Meroplankton		Balanus sp.	Spring
Meroplankton		Rhithropanopeus harrissi	Summer and Fall
Meroplankton	Mollusca	Gastropoda	Summer and Fall
Meroplankton	Polychaeta	Polydora sp.	Summer and Fall
Meroplankton	Urochordata	Molgula manhattensis	Summer and Fall
Tychoplankton	Arthropoda	Corophium sp	Summer and Fall
Tychoplankton	Arthropoda	Parametopella cypris	Summer and Fall
Tychoplankton	Arthropoda	Edotea trilboa	Summer and Fall
Tychoplankton	Protozoa	Folliculina sp.	Summer and Fall

Table 5. Seasonal distribution of fish eggs (E) and larvae (L) collected in Westchester Creek.

Lowest taxonomic level	**Common name**	**March**	**May**	**July**	**August**
Tautogolabrus adspersus	Cunner		E	E	
Tautoga onitis	Tautog		E	E	
Syngnathus fuscus	Northern pipefish				L
Scophthalmus aquosus	Windowpane		E, L		
Pseudopluronectes americanus	Winter flounder	L			
Prionotus	Searobin			E	E
Myoxocephalus	Sculpin	L			
Menidia menidia	Atlantic silverside		L		
Labridae	Wrasse		L		E
Gobiidae	True goby			L	L
Enchelyopus cimbrius	Fourbeard rockling	E	E, L		
Clupeidae	Herring		E, L		
Brevoortia tyrannus	Atlantic menhaden			L	
Anchoa mitchelli	Bay anchovy		E		
Anchoa	Anchovy			L	

*Compiled from the Hydroqual database

Table 6. Number of fish eggs and larvae collected from Westchester Creek, Bronx River and Hutchison River

Species	Common name	Westchester Creek	Bronx River	Hutchinson River
Ammodytes americanus		0	0	28
Anchoa sp.	Anchovies	34	0	0
Anchoa mitchelli	Bay anchovy	156	198	990
Brevoortia tyrannus	Atlantic menhaden	4	202	2012
Clupeidae	Herrings	470	488	2282
Cynoscion regalis	Weakfish	0	6	4
Enchelyopus cimbrius	Fourbeard rockling	1290	3766	932
Gobiidae	True goby	88	152	386
Hypsoblennius hentzi	Feather blenny	0	12	0
Labridae	Wrasse	14	0	6
Menidia menidia	Atlantic silverside	2	8	24
Myoxocephalus	Sculpin	84	26	10
Prionotus	Searobin	11	2	8
Pseudopleuronectes americanus	Winter flounder	16	64	168
Scophthalmus aquosus	Windowpane	18	166	270
Syngnathus fuscus	Northern pipefish	3	2	12
Stenotomus chrysops	Scup	0	2	0
Tautoga onitis	Tautog	80	806	1982
Tautogolabrus adspersus	Cunner	815	2908	4310
Total # of Taxa		**15**	**16**	**16**
Total Number		**3,085**	**8,808**	**13,424**

*Data compiled from the Hydroqual database. One station was sampled in Westchester Creek and two stations were sampled in both the Bronx and Hutchinson Rivers.

Table 7. Number of juvenile and adult fish collected from Westchester Creek, Bronx and Hutchinson Rivers.

Species	Common name	Westchester Creek	Bronx River	Hutchinson River
Alosa aestivalis	Blueback herring	0	155	46
Anchoa mitchelli	Bay anchovy	0	76	95
Anguilla rostrata	American eel	0	0	1
Brevoortia tyrannus	Atlantic menhaden	8	22	126
Brevoortia smithi	Yellofin menhaden	0	2	6
Caranx hippos	Crevalle jack	0	0	1
Centropristis striata	Black sea bass	0	0	3
Clupea harengus	Atlantic herring	0	6	1
Cynoscion regalis	Weakfish	7	544	217
Gobiosoma bosc	Naked goby	0	0	1
Menidia menidia	Atlantic silverside	0	0	2
Morone saxatilis	Striped bass	31	35	153
Opansus pardus	Leopard toadfish	0	0	1
Paralichthys dentatus	Summer flounder	2	3	6
Peprilus triacanthus	Butterfish	0	22	0
Pomantomus salatrix	Bluefish	13	15	9
Prionotus	Searobin	0	1	0
Prionotus carolinus	Northern searobin	1	0	0
Prionotus evolans	Striped searobin	0	1	8
Prionotus scitulus	Leopard searobin	0	1	0
Pseudopleuronectes americanus	Winter flounder	2	7	40
Scophthalmus aquosus	Windowpane	0	0	14
Sphoeroides maculatus	Northern puffer	0	0	1
Stenotomus chrysops	Scup	0	2	186
Syngnathus	Pipefish	0	0	1
Tautoga onitis	Tautog	0	0	1
Tautogolabrus adspersus	Cunner	0	6	10
Total # of Taxa		**7**	**16**	**23**
Total Number of individuals		**64**	**898**	**929**

* Data compiled from the Hydroqual database. One station was sampled in both Westchester Creek and Bronx River, and two stations were sampled in Hutchinson River.

Table 8. Comparison of Average total panel weights found for the Hutchinson and Bronx Rivers vs. the Westchester Creek Stations

Location	Station	3 Months - Average weight (g)			
		October 2000	January 2001	April 2001	June 2001
Top	Hutchinson and Bronx Rivers	124	43.1	5.7	4
	Westchester Creek (middle)	24.1	0	0.1	NS
	Westchester Creek (mouth)	77.5	0	0.1	NS
Bottom	Hutchinson and Bronx Rivers	66.8	13.9	3.2	6.9
	Westchester Creek (middle)	7.8	5.7	1.5	NS
	Westchester Creek (mouth)	121.5	25.9	0.6	NS

Location	Station	6,9,12 Months - Average weight (g)			
		January 2001 (6 months)	April 2001 (9 months)	June 2001 (12 months)	
Top	Hutchinson and Bronx Rivers	266.1	84.6	56.1	
	Westchester Creek (middle)	53.7	77.6	NS	
	Westchester Creek (mouth)	36.1	43.5	NS	
Bottom	Hutchinson and Bronx Rivers	215.8	202.8	18.9	
	Westchester Creek (middle)	99.4	13.3	NS	
	Westchester Creek (mouth)	204.2	162.5	NS	

APPENDIX C

STAKEHOLDER MEETING MINUTES

Westchester Creek and Hutchinson River Stakeholder Team
Meeting No. 1
September 6, 2006

The first Hutchinson River and Westchester Creek Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on September 6th at Bronx Community Board 10, 3165 E. Tremont Avenue. The purpose of the meeting was to introduce the LTCP for Combined Sewer Overflow (CSO) and discuss the implications for the Hutchinson River and Westchester Creek.

Virginia Gallagher and Kenneth Kearns, chair and district manager of Community Board 10, welcomed everyone. Mark Klein, Chief, Division of Water Quality Improvement, introduced the DEP staff, including Chris Villari and Fred Edmond. Introductions were made around the room. Stephen Whitehouse of Starr Whitehouse, the consultant coordinating public participation for the project, opened the meeting. He said the meeting would be introductory and that later meetings will focus on developing abatement alternatives. Stephen added that a city-wide stakeholder group is looking at CSO issues in the harbor and asked for a nominee for that committee.

Stephen began by explaining what a CSO is and showed a map of CSOs in New York. He then described the regulatory process that has led to the current LTCP project. In 2004, a Consent Order between NYS Department of Environmental Conservation and the DEP committed the City to a schedule of CSO abatement projects and set out the specific process and schedule for the LTCP. Part of the Consent Order stipulated that $1.5M of DEP funds be transferred to the State's Natural Heritage Trust for the environmental benefit projects. The Consent Order stipulates the completion of specific projects, including CSO holding tanks at Flushing Creek and Paerdegat Basin. Several stakeholders asked to visit the Flushing Tank, in order to familiarize themselves with tanks in the case that they receive one in their area. There were several questions concerning the construction of the tank, which took 8 years and is now close to completion. The stakeholders asked for information on peripheral construction, the size of the site, and the holding capacity of the tank for the next meeting.

Next, Tim Groninger of Hazen and Sawyer introduced Westchester Creek, a tributary to the Upper East River and its drainage area, which is served by Hunts Point WPCP collection system. He said that there were no sanctioned bathing beaches, endangered species habitat, or shellfish harvesting on the creek (sensitive areas per federal CSO policy). One stakeholder asked for an explanation of the sewage collection system. Tim described how the flow from local pipes goes into the interceptor main. In the case that there is particularly large volume, due to a storm event, the overflow is released at specific locations.

Tim described the waterbody uses, fishing and boating, and went over the shoreline uses, including industrial, commercial, institutional, parkland, and residential. Several stakeholders expressed frustration with the EDC, which is working to maintain industrial uses in the corridor, while the area is currently undergoing a conversion to residential use. Representatives from Community Board 9 added that the area was already residential in part and that quality of life issues, including waterfront access, beautification, and disruption caused by construction, are particularly important. He added that he was interested in seeing wetlands restoration and protection. Representatives from Community Board 10 voiced concern with the condition of Ferry Point Park West. Various stakeholders spoke about construction-related traffic concerns and emphasized that quality of life and traffic disruption issues should be considered while formulating the plan. One stakeholder suggested inviting EDC to the next meeting.

Tim showed pictures of the different land uses of Westchester Creek. He reviewed the CSO-related water quality issues, primarily high bacteria but also dissolved oxygen; odors and visible impairment; and floatable and settleable debris. One stakeholder said that dog droppings and outfalls in Westchester County have a detrimental effect on water quality in the creek. Tim showed pictures of the CSO outfalls and spoke about ongoing DEP initiatives to improve capture of stormwater and water quality. These include improvements to the Hunts Point WPCP, sentinel monitoring which documents discharges from Yonkers, identifying illegal sanitary hookups, and street sweeping. Tim mentioned that the Waters Place storage facility is just one among many alternatives under consideration.

A stakeholder asked how the LTCP will impact flooding during heavy rain. Tim answered that flooding occurs in the local system and the LTCP will likely not have an impact.

A stakeholder spoke about the effort to designate the Thomas Pell Wildlife Sanctuary as a protected wetlands and stated that the community was very interested in wetlands.

Angie Essner, of Greeley and Hansen, introduced the Hutchinson River. Like Westchester Creek, there are no sensitive areas per federal CSO policy. Stakeholders added that the Parks Department considers the Hutchinson to be an important site for wetlands and habitat for menhaden and bluefish.

Angie showed a map of historic infill, pictures of the different conditions along the river banks, and pictures of the outfalls. She also located the two main public access points, at Coop City North and Co-Op City South. One stakeholder expressed concern for the lack of access. A stakeholder asked whether a conduit, previously under consideration, would be constructed under Coop City Boulevard. Angie answered that the plan for the storage conduit under the street was no longer being considered and that a variety of alternatives were being analyzed including other types of storage and these would be discussed in future meetings as the plan is developed. Several stakeholders stated that they did not want any alternatives that would be constructed in the streets.

Stephen Whitehouse wrapped up, presenting the next steps of the process. There will be at least two additional meetings, the next covering the water quality modeling and proposed alternatives and the last presenting the costs and benefits of each alternatives.

The end result will be a Waterbody/Watershed plan that will be submitted to state by June 2007. When DEC approves the plan, it will become a LTCP and will be enforceable. He then opened the floor for discussion.

> One stakeholder asked about water sampling program for the development of the plan. Tim responded that additional sampling took place last summer and that the results of this effort would be presented at the next meeting.

> Another stakeholder wanted to know about efforts to monitor Westchester County and expressed frustration that the City is held to regulatory standards while inheriting Westchester's water quality problems. The consultant team described the seven advisory committees in Westchester that make up the Long Island Sound advisory board, which oversee water quality issues in Westchester.

> A stakeholder asked about DEP construction that he observed on September 4th at Bellamy and Coop City Boulevard. Fred Edmond, of DEP, said he would look into it.

> The community boards asked for the address of the Natural Heritage Trust. The consultant team clarified that DEP has no ongoing role relative to the Natural Heritage Trust's administration of grants for environmental benefit projects. They also expressed to have a Community Center incorporated into the plan like how the Center was built in conjunction with the Flushing Tank.

> A stakeholder asked what DEP is doing to encourage water conservation. Fred Edmund replied that, on the consumer end, there are a number of programs including low flush toilets and a water survey program for residents and for businesses, could be encouraged through incentives, such as a voucher system. Stakeholders expressed interest in Best Management Practices (BMPs), which reduce the volume of stormwater going into the combined sewers. Several stakeholders were very interested in seeing BMPs develop into a program. Stephen spoke about efforts in Jamaica Bay to determine a credible model of the effect of BMPs that will enable DEP to evaluate the performance of these alternatives. He added that BMPs may incrementally provide water quality benefits, but that the focus of the LTCP is to achieve compliance consent order requirements on a fixed schedule. He stated DEP was investigating BMPs and in conjunction with other City agencies on a separate track

The next meeting of the stakeholder team was set for Thursday, October 26th, subsequently confirmed.

Westchester Creek and Hutchinson River Stakeholder Team
Meeting No. 2
October 26, 2006

The second Hutchinson River and Westchester Creek Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on October 26th at Bronx Community Board 10, 3165 E. Tremont Avenue. Mark Klein of NYC DEP opened the meeting. He stated that the goal of the Long Term Control Plan project was to bring the waterbodies in question into compliance. A stakeholder said that the group had been informed previously that a CSO retention tank may be constructed in the area and asked whether other alternatives were being considered. Mark said that a number of alternatives, apart from the tank, are being considered and evaluated.

Next, Stephen Whitehouse, Starr Whitehouse, reviewed notes from the last meeting, including the policy framework of the Long Term Control Plan. Stephen said that the result of the process would be an enforceable plan that will bring the Westchester Creek and Hutchinson River in compliance with their water quality classifications. The group reviewed the questions put to the project team at the end of the last meeting. Fred Edmond, DEP, said that construction observed on December 4th near Co-op City was regular maintenance. Stephen Whitehouse said that the information for the disbursal of the Natural Heritage Trust funds by the State was still not available. In response to a discussion at the last meeting about water conservation, the project team spoke about a number of different programs, including green roofs and catch basin replacements. Stephen said that DEP is actively investigating these measures, which are referred to as low impact developments (LIDs). DEP is looking particularly to how LIDs work on the scale of a watershed. This project is on a different time frame from the LTCP. DEP is also collaborating with the Mayor's Office of Long Term Planning and Sustainability on this issue. The stakeholders did not propose changes to the notes. Stephen invited the stakeholders to attend the Open Waters stakeholder group, a city-wide group which is looking at the Open Waters, which include the Harbor, and the Hudson, Harlem and East Rivers. Several Stakeholders expressed interest in attending.

Next, Angela Essner of Greeley and Hansen, discussed water quality sampling programs in the Hutchinson River. She said that water quality sampling tests were completed for dissolved oxygen, pathogenic bacteria, and oxygen consuming chemicals, among other things. She showed graphs of historical trends in dissolved oxygen (DO) in Eastchester Bay and the East River. Angie noted that there has been an upward trend since 1972. She reviewed the Hutchinson River drainage area and outfalls, pointing out the active overflows: HP-023, HP-024, and HP-031. She also reviewed the historical Harbor Survey sampling locations on the Hutchinson River. This survey began at the beginning of the 20th century and is one of the longest running water quality sampling programs in the country. She pointed out the sampling locations where data was collected for the LTCP project in 2005. Angie added that NYCDEP and Westchester County were discussing collaborating on sampling efforts, responding to a question from the previous meeting. Next, she showed the fecal and total coliform concentrations in the river and stated the Hutchinson River was listed for low DO. One stakeholder asked whether the fish in the Hutchinson are edible and stated that, when she was growing up in the area, people ate crabs, eels, scallops, and fish from the river. Angie said that she had not examined fish consumption as those standards as toxics issues are being investigated in a separate program. Angie said that DO, one of the important metrics that the LTCP is being held to, is an important factor for fish survival but not consumption.

A stakeholder asked about the impacts of dredging on the Westchester Creek. Tim said that dredging is particularly useful for abating aesthetic issues, such as odors related to exposed CSO sediments. A stakeholder said that the river used to be significantly deeper and suggested that it be dredged to achieve previous depth. Tim stated that deepening the water does not change the waterbody's ability to absorb pollutants.

Another stakeholder brought up the issue of the lack of bathrooms in Ferry Point Park and the subsequent use of the river for that purpose. Tim Groninger, Hazen and Sawyer, said that if there was a major effect, it would be reflected in the water quality sampling and modeling. It has not been reflected in the model and therefore can be considered to have a negligible impact.

Next, Tim Groninger presented the Westchester Creek drainage area. He showed the sampling locations and the largest CSO outfalls on Westchester Creek. He said that, apart from CSOs, there is no other source of flow to the creek. One stakeholder asked where the original Westchester Creek now flows. Tim said that it joins a sewer pipe and enters the Creek as such. Tim then shared DO data from surveys taken during dry and wet weather. He said that DO responds to rainfall, with an increase in DO during the storm due to turbulence, followed by a decrease caused by the oxygen demand of organic matter in CSO. Tim shared data about fecal and total coliform.

Tim then spoke about the two models that have been developed as tools to guide the project team in evaluating the performance of different alternatives. He said that the landside model takes into account all pipes that are 40 inches or wider in diameter in the whole sewer system. Tim showed a diagram of surcharge conditions and said that this model helps the team to identify and analyze conveyance problems that may affect the system. The model includes sanitary flows based on the anticipated population in 2045. This landside model calculates CSO volumes that are then used in a second model, which is built to look at water quality. The receiving water model takes into account a number of inputs, such as flows, load and temperature. The synthesis of the models will allow the project team to estimate water quality during an average year. For this project in particular, it allows the project team to understand the benefits of different proposed alternatives on the water body. A stakeholder asked about how water sampling fit into the model. Tim said that sampling data is used to calibrate the model, so that the model outputs correspond to real life conditions. Tim added that after the plan is implemented, supplemental post construction monitoring will be performed to measure the real effect on the waterbody. The plan will be evaluated at this point if it is found that a waterbody is not compliant with water quality standards.

Tim then reviewed typical alternatives for abating CSOs. He said that optimizing the existing system is one of the easiest interventions on the table. On the other hand, full separation of storm and sanitary sewage collection systems is prohibitively costly. Storage tanks and tunnels, conveyance enhancements, floatables screening, and best management practices are also being considered.

Stephen led a discussion on the uses and goals for Westchester Creek and the Hutchinson River. The stakeholders said that they would like to boat and paddle on Westchester Creek. Many of them remember swimming on the creek and said that they would like to be able to do so again, particularly at Ferry Point Park. A stakeholder mentioned that the Hindu community in the Bronx uses the park for a yearly cleansing ritual that involves entering the water and casting away old garments into the water.

On the Hutchinson River, stakeholders noted recreational uses including pleasure boating, jet skiing, and fishing. They stated that there were no pervasive problems with access. The stakeholders asked that the request for the contact information for the Natural Heritage Trust remain in this meeting's notes. They reiterated their request for a tour of the Flushing CSO Facility Tank.

The stakeholders recommended a next meeting date of January 25th. The presentation will be put on the website and meeting notes will be distributed several weeks before the meeting. Stephen Whitehouse asked whether the names and contact information of stakeholders could be released and Kenneth Kearns, district manager, requested that all queries be directed to him.

Westchester Creek and Hutchinson River Stakeholder Team
Meeting No. 3
May 8, 2007

The third Hutchinson River and Westchester Creek Stakeholder team meeting of the Long Term Control Plan (LTCP) of the NYC Department of Environmental Protection (DEP) was held on May 8th at Bronx Community Board 10, 3165 E. Tremont Avenue. Kenneth Kearns, District Manager for Community Board 10, welcomed everyone. Stephen Whitehouse, Starr Whitehouse, introduced the project team. He reviewed the notes from the last meeting. There were no comments; the notes were finalized. Stephen also noted that, while Eastchester Bay would be referenced in the presentation, Eastchester Bay is mainly being considered as a component area of the East River and Open Waters Waterbody/Watershed Facility Plan. The East River and Open Waters stakeholder group is discussing the Bay. Their meetings are open to all. Stephen also stressed that the previously considered tank for Co-op City Boulevard was not included in the plans.

Ray Hyland, Greeley and Hansen, presented the plan for the Hutchinson River. He reviewed the drainage areas, outfalls, and current water quality standards. He shared the baseline conditions for CSOs, including the outfalls, number of events at each outfall, and annual volumes. Ray reviewed the alternatives that were assessed for the plan, including: pathogen source investigation.; continued inter-jurisdictional coordination with Westchester Co.; system optimization or improving storage in the existing systems; green alternatives; floatable controls; storage tanks and tunnels; sewer separation; and aeration. Ray said that upgrades to the Hunts Point Water Pollution Control Plan (WCPC), completed prior to this plan, resulted in improvements to water quality. He reviewed the cost of each alternative and shared a knee-of-the-curve analysis, plotting the cost of different combinations of alternatives against their benefit, or the percent reduction of CSO volume. He then showed the different alternatives against other metrics for water quality standard compliance: dissolved oxygen (DO) and pathogens in the form of total coliform. He showed the potential impact of non-compliant with Class B standards in Westchester County waters and said that, if the water quality in Westchester County improves, the water quality in the Hutchinson River would also improve. This suggests that CSOs are not the main source of water quality issues in the Hutchinson River.

Next, Ray presented the selected Waterbody/Watershed Facility plan (WB/WS) resulting from the preceding analysis. Selected alternatives include in-line netting at HP-023 and at HP-024. Each netting facility would be located in the pipe and out of sight. Ray showed the identified sites for the in-line netting but stressed that the team is in the planning stage and has not begun property acquisition. A continued investigation into Low Impact Development (LID) is also included in the plan. Lastly, Ray presented a chart that showed the percent compliance with primary contact standards at the Eastchester Bay beaches. The chart showed that the removal of all CSOs would only nominally improve water quality from baseline condition. Ray reiterated that upstream sources of pathogens from Westchester County are the main water quality issue and not CSO loading on the Hutchinson River. Ray also explained that during this bathing season, pathogens are typically in their highest concentration do not appear to be affecting beaches in Eastchester Bay. A stakeholder asked why raising weirs and system cleaning were not selected as alternatives. Ray said that raising weirs did not appear to have any substantive impact in the modeling. He said that there is a program of ongoing system cleaning. Ray said that the tank alternative, previously discussed, was not included in the plan because new technology had allowed them to better analyze it and it appeared to have no substantive impact. A stakeholder asked about construction impacts for the presented plan. Ray said that the construction would be localized with minimal vehicular and pedestrian interruptions, and would be considerably smaller than the previous proposed storage facilities. Former Assemblyman Stephen Kaufman asked whether the community could expect the passive park, which the Co-op City Community was promised when DEP was considering the tank. Ray responded by describing the differences in the approach to CSO control from the previous plan. He stated that the new EPA Policy requires or water quality based approach and with the advanced modeling we can see what will be the effect in the receiving waterbodies. Mr. Kaufman accepted this approach, but still requested that DEP provide a park. Finally Ray presented the selected plan cost and stressed that since the Hunts Point upgrade does not provide significant benefit in this area, the plan cost does not include the upgrade.

Next, Tim Groninger spoke about the WB/WS plan for Westchester Creek. Tim shared baseline modeling results, including number of CSO events at each outfall and annual volume of CSOs. Tim reviewed the alternatives assessed for the WB/WS plan, including: collection system modifications; floatable controls; a tank carried over from the previous facility plan; in-stream aeration; and storage sized to address alternatives evaluations expected by deferral CSO policy. Tim said that improvements to the Hunts Point WPCP, the construction of a new throttling facility, have decreased CSOs by improving conveyance to the plant, improving the water quality of Westchester Creek. Tim presented the costs for each alternative and noted that storage alternatives are particularly expensive.

Next, Tim presented cost-benefit analysis graphs which plot total project costs against overall benefit: volume reduction of CSO and percent attainment of water quality standards. The graphs suggest that a plan including weir modifications and new netting facilities provide the most benefit compared to their cost. Tim reviewed the selected alternatives. He showed the locations for the weir modifications. He said that approximately 20% of the volume of CSO under baseline conditions would be captured and diverted to the WPCP by raising the weirs. He showed the approximate location of the new netting facility at outfall HP-013. Several stakeholders voiced concern about operational issues such as the cleaning of netting facilities. Tim said that the nets are supposed to be cleaned after major rainfall. A stakeholder asked how other tanks in New York have performed. Tim said that the Flushing Tank was about to start operations and that the Paerdegat Tank was still under construction. One stakeholder expressed dissatisfaction with the plan. She did not feel that the presented plan was sufficiently vigorous. Although she was not pleased with the idea of tanks, she felt that they were, at least, proactive measures.

Next, Tim showed graphs plotting the percent of attainment with existing water quality standards, comparing the baseline conditions, a 100% capture scenario, the 2003 plan which included the tank, and the WB/WS plan currently under consideration. All scenarios were predicted to fully attain total coliform and fecal coliform numerical criteria during the summer months, when swimming and other recreational uses occur. Tim showed graphs looking at how these scenarios compare to DO standards. The graphs indicate that DO is a problem in the upper half of the Creek and show that the proposed WB/WS plan improves DO comparably to the 2003 CSO facility plan. This indicates that the tank brought no added benefit. The modeling results also suggested that the proposed plan would eliminate periods of extremely low DO problems that are believed to be contributing to odor problems in the vicinity.

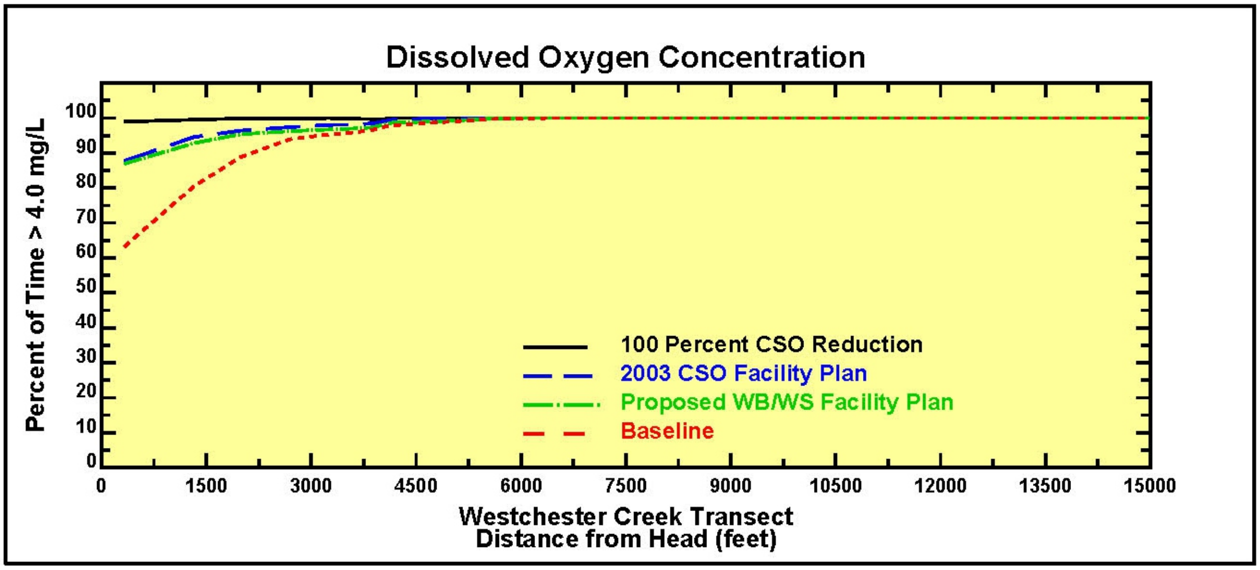
Next, Sue McCormick, New York State Department of Environmental Conservation (DEC), reviewed the next steps. A WB/WS plan will be drafted and given to the DEC for their review in June 2007. DEC will review the plan and submit comments. When DEC submits its comments to DEP, there will be a public meeting. There will be another meeting at the ratification of the WB/WS plan into a LTCP, when it becomes an enforceable element of the Hunts Point WPCP SPDES permit. Stephen said that DEP was currently on schedule for an on-time submission.

John McLaughlin, DEP, spoke about the Bureau of Environmental Planning and Assessment's (BEPA) work with stormwater management, which will be incorporated in the LTCP at a later date. He described ongoing work on LIDs under the Jamaica Bay Watershed Protection Plan (JBWPP) being developed as mandated by a 2005 local law. Among other things, the JBWPP is required to examine CSOs reduction through LIDs. In addition to abating CSOs, LIDs create open spaces, restore wetlands, and remove pollutants from the water. With the Gaia Institute, BEPA is developing pilot applications, including street tree planting pit modifications and constructed wetlands. They are also investigating different ways to implement LID technologies, such as zoning code modifications, incentives for private property owners, and restructuring water billing rates. Over time, these small measures will aggregate to decrease surges of storm flow. Several homeowners noted that maintenance of the planted strips near the sidewalk are expensive to water during drought conditions. Kenneth Kearns noted that DOT has already built a wetland near to the Long Island Expressway. He also noted that the Bronx Borough President stated that every civic building has should have a green roof.

A stakeholder asked about sewer repairs. Ray said that broken sewers are discovered with with sonar leak detection and repaired to their former state. He added that the team had examined the possibilities for separated sewer but had decided that it provided little benefit against high costs and would cause extensive vehicular and pedestrian disruptions. A stakeholder accused the MTA transit yards of discharging chemicals into Westchester Creek. Ken said that he would look into this issue. The meeting concluded at 8:30pm.

APPENDIX D

SUPPLEMENTAL WATER QUALITY MODELING RESULTS



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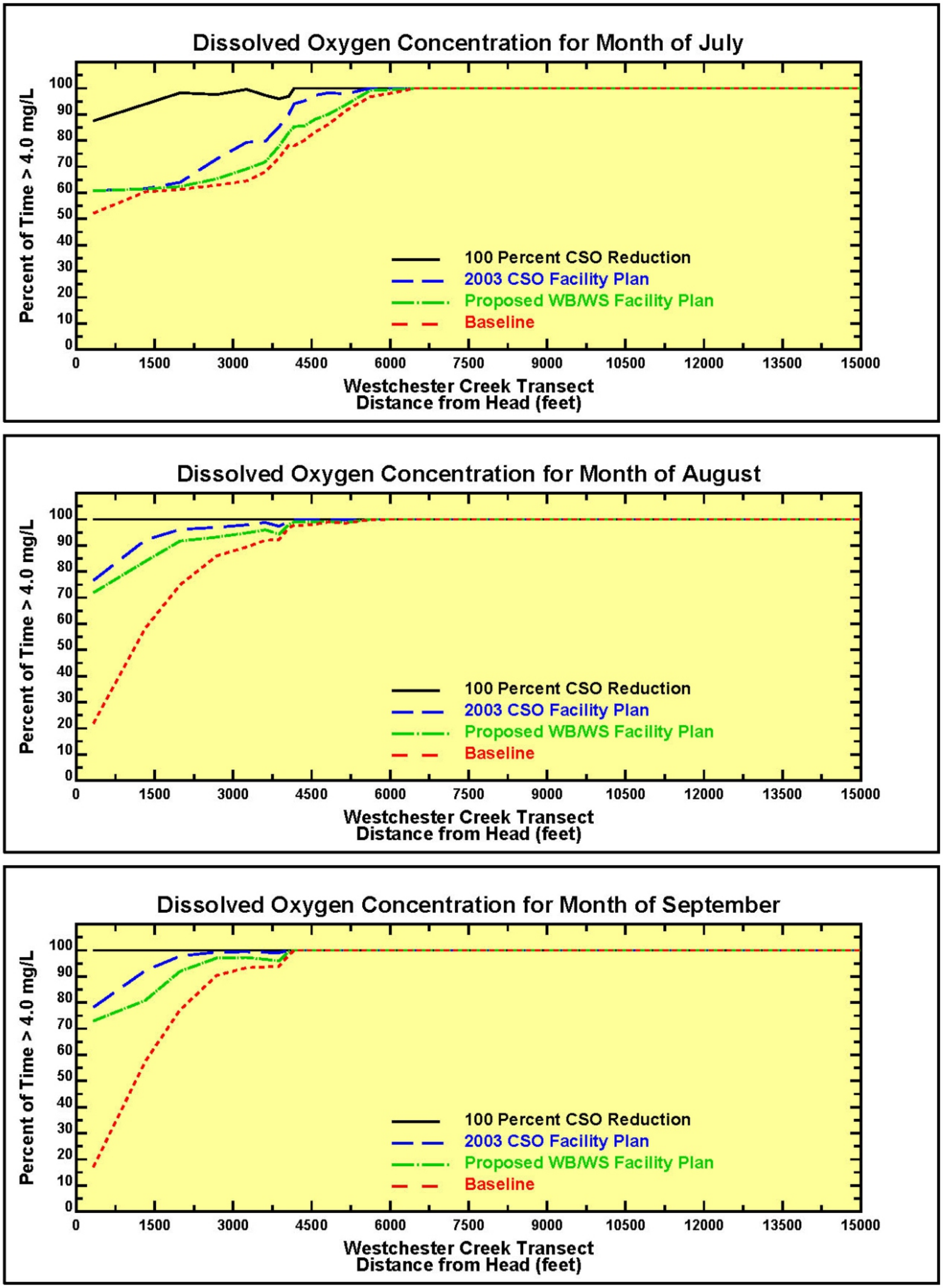
Environmental Protection

Dissolved Oxygen Annual Percent Attainment of 4 mg/L

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-1



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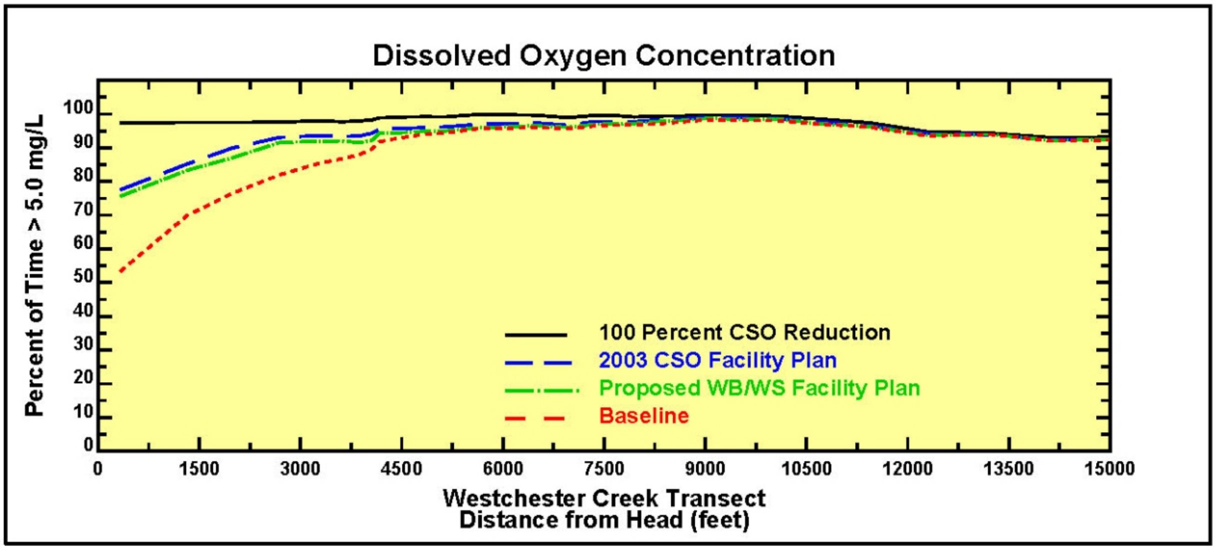
Dissolved Oxygen Monthly Percent Attainment of 4 mg/L Summer Months

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-2

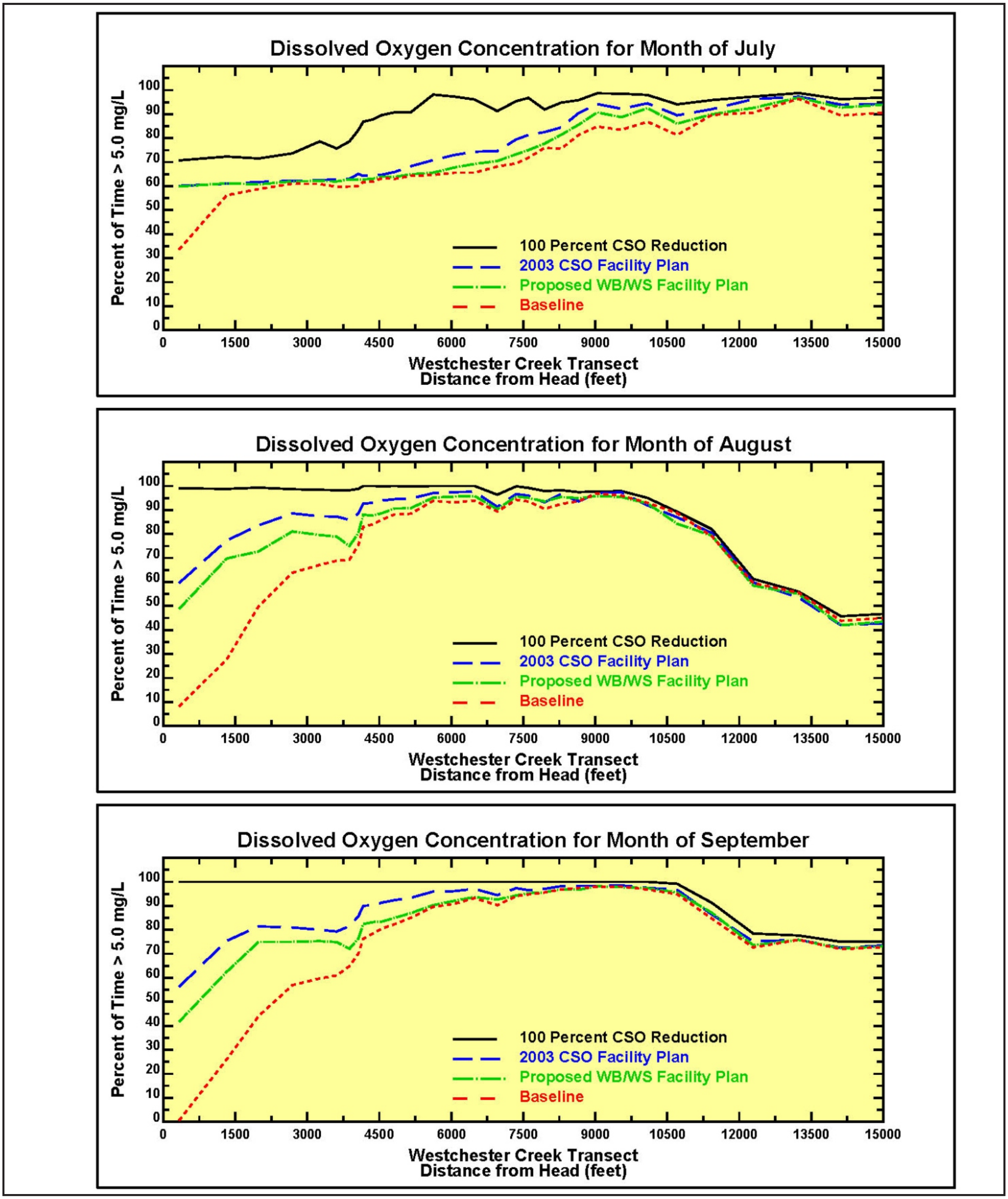


Environmental Protection

Dissolved Oxygen
Annual Percent Attainment of 5 mg/L

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-3



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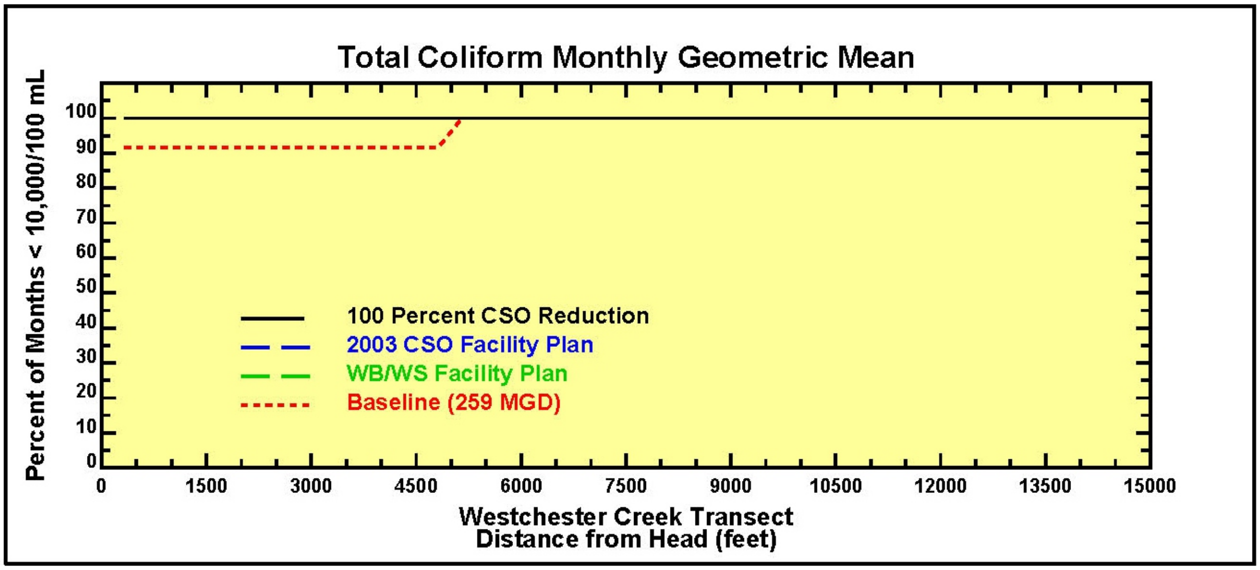
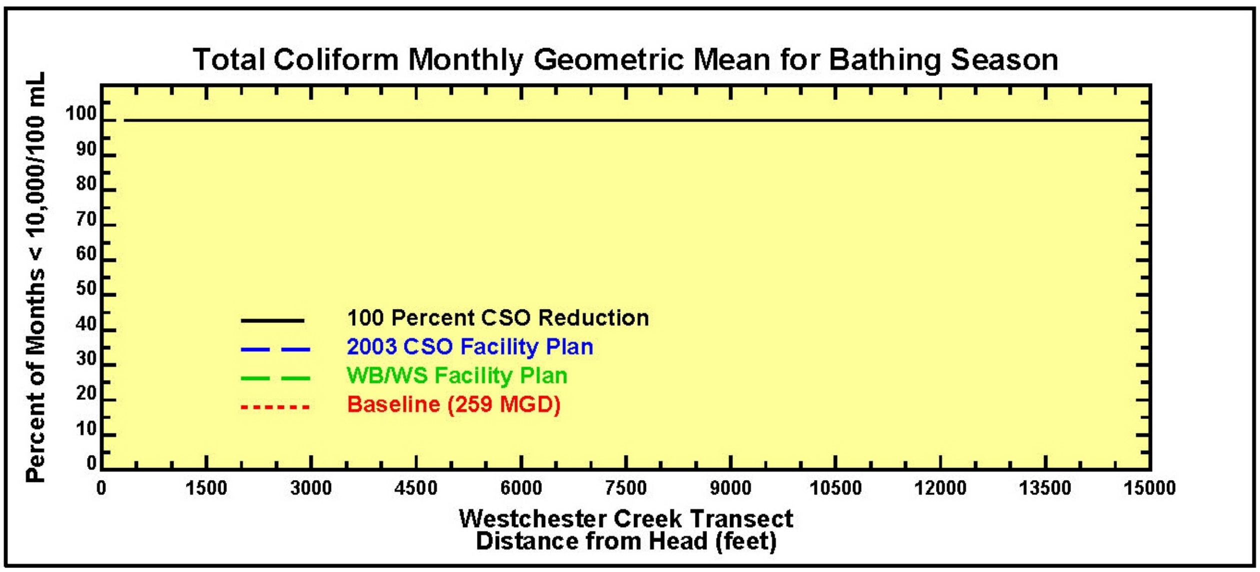
Dissolved Oxygen
Monthly Percent Attainment of 5 mg/L
Summer Months

Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-4





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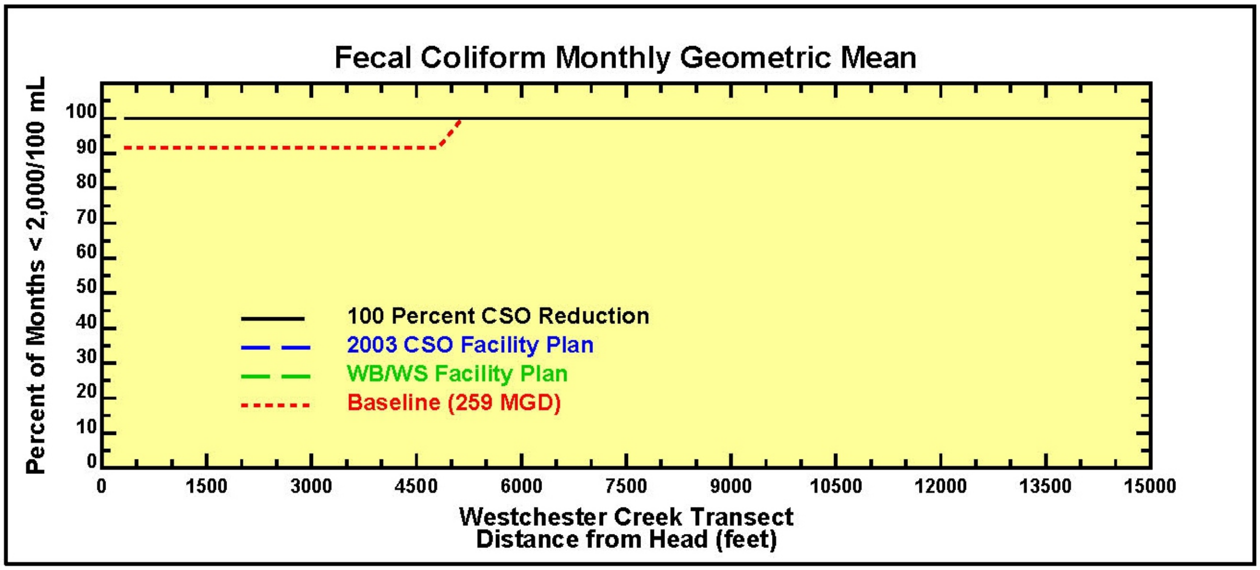
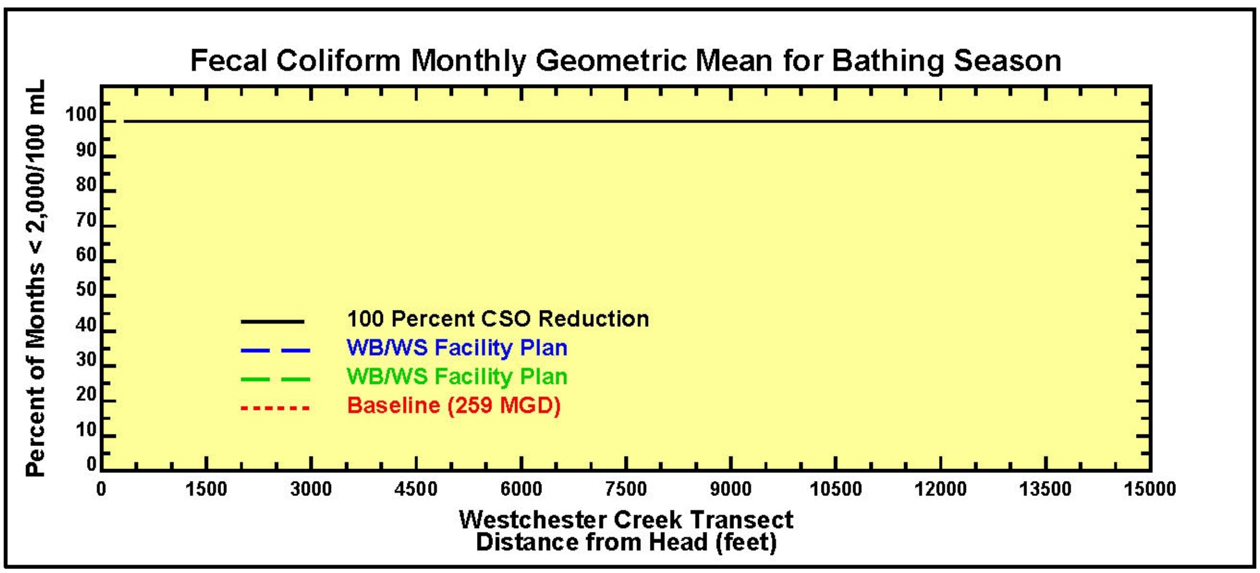
Environmental Protection

Total Coliform Annual and Seasonal Percent Attainment of Class I Limit

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-5





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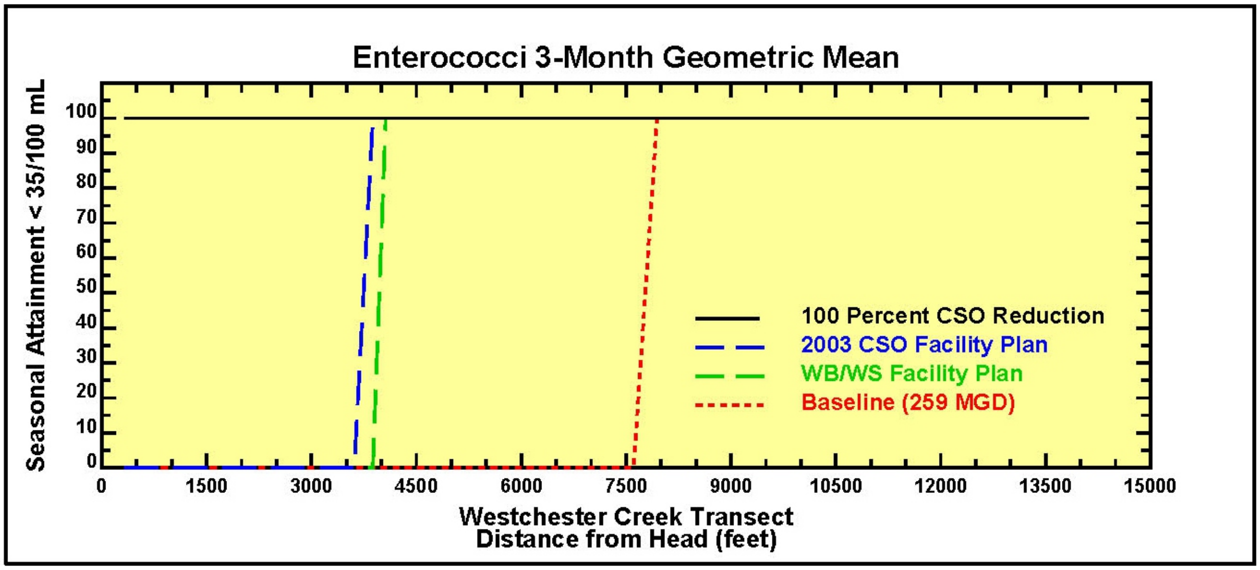
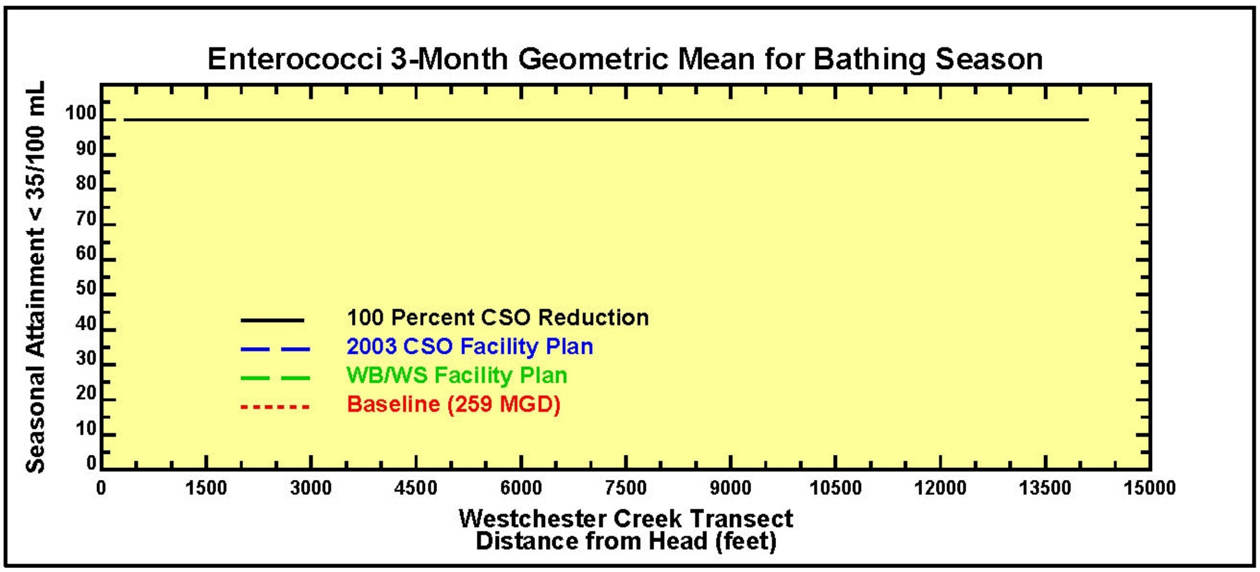
Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Fecal Coliform Annual and Seasonal Percent Attainment of Class I Limit

FIGURE D-6





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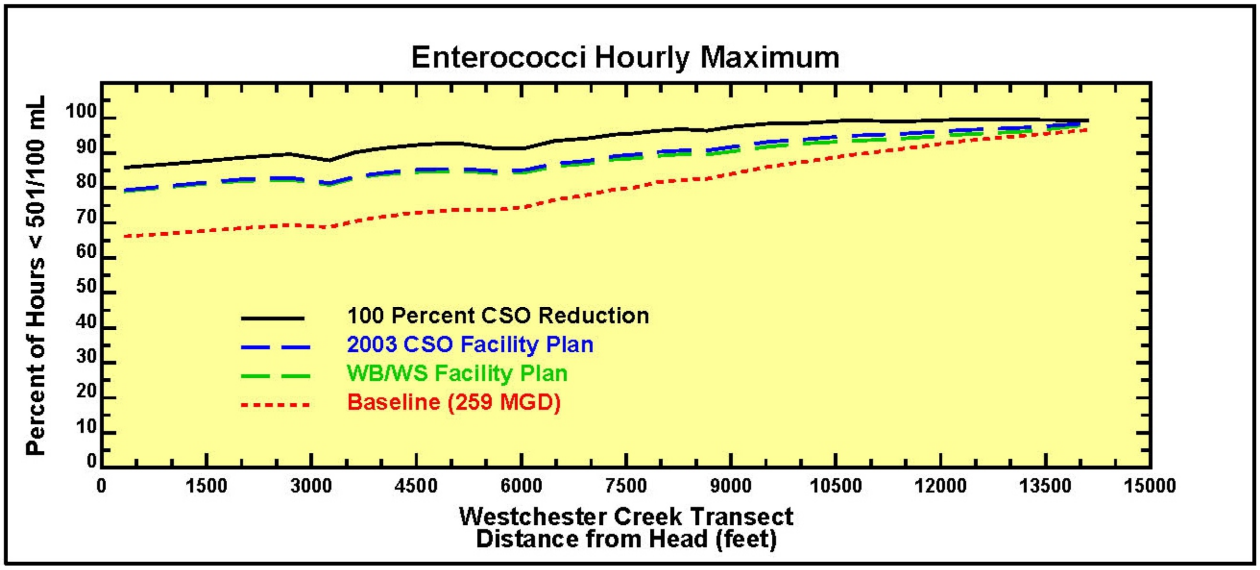
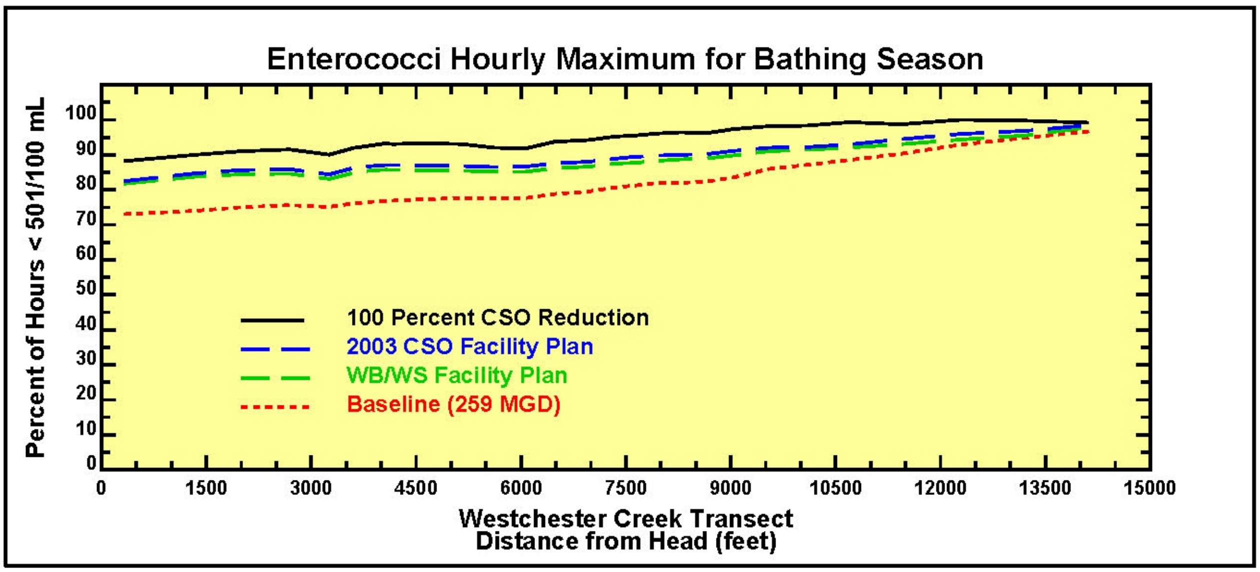
NYC Environmental Protection

Westchester Creek Waterbody/Watershed Facility Plan

Enterococci Annual and Seasonal Percent Attainment of Bathing Criterion

FIGURE D-7





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Environmental Protection

Enterococci
Annual and Seasonal Percent Attainment of Reference Level

Westchester Creek Waterbody/Watershed Facility Plan

FIGURE D-8