New York City
Department of Environmental Protection

City- Wide Long-Term CSO Control Planning

PAERDEGAT BASIN LTCP

DEC Case CO2 - 20000107-8

November 2005

Revised June 2006

City-Wide Long-Term CSO Control Planning Project

Paerdegat Basin Watershed-Specific Long-Term CSO Control Plan Report

Prepared by

The City of New York
Department of Environmental Protection
Bureau of Engineering Design & Construction

NOVEMBER 2005

REVISED JUNE 2006

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EXECUTIVE SUMMARY

The New York City Department of Environmental Protection (NYCDEP) has prepared this watershed-specific Long-Term Control Plan (LTCP) Report for controlling combined sewer overflows (CSO) to Paerdegat Basin, as required by the Administrative Consent Order between NYCDEP and the New York State Department of Environmental Conservation (NYSDEC) known as DEC Case #CO2-20000107-8 (January 14, 2005) or "the CSO Consent Order." This LTCP Report was developed from the Paerdegat Basin Waterbody/Watershed Facility Plan Report dated February 2003 and many other water quality planning studies conducted over the past 20 years. Paerdegat Basin 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. A final City-wide LTCP incorporating the plans for all watersheds within the City of New York is scheduled for completion by 2017.

Located in southeastern Brooklyn, Paerdegat Basin extends from Flatlands Avenue at its head-end terminus to approximately the centerline of the Belt Parkway Bridge near its mouth, and includes all tidal wetlands, riparian areas, and associated uplands. Paerdegat Basin was once a meandering, natural stream known as Bedford Creek, a freshwater tributary to Jamaica Bay. The original waterbody drained Canarsie, Flatbush, Flatlands, Kensington, Parklands and West Brooklyn, small villages with agricultural areas along the marshlands of Jamaica Bay. Explosive growth in Brooklyn in the 19th Century led to a progressively more urban landscape. Artificial channeling of runoff towards Bedford Creek via feeder streams most likely began prior to the 1920s, and as development encroached around Paerdegat Basin in the Flatlands and Canarsie sections after the 1940s, separated sewers were constructed to convey street runoff directly to surrounding waterways. One of those waterways was Paerdegat Basin, which had been created out of Bedford Creek in the 1930s by dredging and bulkheading a straight, rectangular dead-end channel 16 feet deep, 450 feet wide, and 6,675 feet long. The dredging was performed as part of a large-scale effort to bring commercial shipping to Jamaica Bay that never came to fruition.

Table 1. Urbanization of the Paerdegat Basin Watershed

Watershed Characteristic	*Pre-Urbanized*	*Urbanized*[1]
Drainage area, acres	*6,620*	*6,824*
Adjacent wetlands, acres[2]	*300*	*10*
Population[4]	*150,000*	*490,000*
Percent surface imperviousness	*10%*	*70%*
Average annual runoff, MG[3]	*730*	*3,300*
Peak storm runoff, MG[3]	*45*	*221*

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 1890; urbanized estimate based on Year 2000 U.S. Census.

The growing population led to concerns about sanitation and public health, and the first wastewater treatment plant servicing the area was built in 1892. Four additional chemical treatment plants were built during the first quarter of the 20th Century, and in 1935, the five plants were replaced with a single, new facility constructed on the present site of the Coney Island WPCP. This facility has been continuously operating since that time, and has been providing full secondary treatment since 1994.

As shown in Table 1, nearly half a million people live within the drainage area, and the urbanization which has resulted in an almost five-fold increase in annual runoff to the waterbody has all but eliminated any natural response mechanisms (tidal marshes and buffer zones) that might have helped absorb this hydraulic load. Combined and separated sewers have replaced natural freshwater streams such that the only source of freshwater to Paerdegat Basin is CSO and stormwater discharges. The result is the discharge of nearly 2.8 billion gallons a year of combined sewage to Paerdegat Basin through the permitted CSO outfalls to the Basin (Table 2). As a consequence of these discharges, nuisance conditions resulting from solids, floatables, and odors have impaired its recreational use, while depressed dissolved oxygen levels have impacted aquatic health. Elevated bacteria concentrations are common occurrences, and water clarity is poor, especially following wet-weather events. While restoring Paerdegat Basin to its pristine condition is no longer possible due to the hydraulic modifications that removed the natural wetlands habitat and urbanization that simply cannot be reversed, the community has indicated that the waterbody should be restored to prevent nuisance conditions and make it acceptable for boating. One of the major impairments in Paerdegat Basin is the mound of sediment that has accumulated at the head end of the Basin. The mound, which has resulted from the deposition of CSO solids, protrudes out of the water at low tides creating a visual impairment and producing noxious odors through the emanation of hydrogen sulfide gases. Further, when submerged during other periods in the tidal cycle, decay of organic matter contained in the mound consumes dissolved oxygen making it unavailable for fish.

Paerdegat Basin is classified by the State of New York as a Class I waterbody, with designated best usages of secondary contact recreation and fishing. To support these uses, numerical criteria for dissolved oxygen and bacteria concentrations have been established. Historical dissolved oxygen concentrations were frequently found to show impairements and excursions below the applicable numerical criteria. Figure 1 shows the percentages of historical data below 4.0 mg/L at the head, mid-basin, and near-mouth sections to be about 44%, 32%, and 18%, respectively, with over 20% of the samples collected near the head-end below 2.0 mg/L. Total and fecal coliform bacteria data indicate that recreational uses of Paerdegat Basin are also impaired. As shown in Figure 2, fecal coliform levels have been near or above the 2,000 per 100 mL level considered protective of secondary contact uses, and total coliform data are almost always greater than the secondary contact criteron of 10,000 per 100 mL. Both distributions show a very high variability of measurements (4 orders of magnitude), which is indicative of intermittent wet-weather impacts.

Table 2. CSO and Stormwater Discharges

Type	*Number of Events*	*Total Annual Volume (MG)*
CSO Total	*61*	*2,749*
Stormwater(1)	*100*	*243*
Total	**-**	***2,992***

(1) From separately sewered areas

In 1998 NYSDEC designated Paerdegat Basin as a high priority waterbody for TMDL development with its inclusion on the Section 303(d) List. The cause of the listing was oxygen demand due to CSO discharges that depressed dissolved oxygen levels with enough severity to preclude fish propagation. Paerdegat Basin was again listed on the 2002 Section 303(d) List as a high priority waterbody, but urban runoff and stormwater were added to the dischargers deemed responsible for depressed dissolved oxygen concentrations. Because the 303(d) List associated the cause of depressed dissolved oxygen with urban runoff and stormwater, this LTCP can serve as the TMDL when approved by NYSDEC as it will address the sources of the impairment.

A variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Paerdegat Basin and to achieve stakeholder use goals. Because Paerdegat Basin receives large quantities of combined sewage in short periods of time, most of the alternatives involve reduction in the volume of combined sewage discharged. CSO reduction schemes examined vary from the small

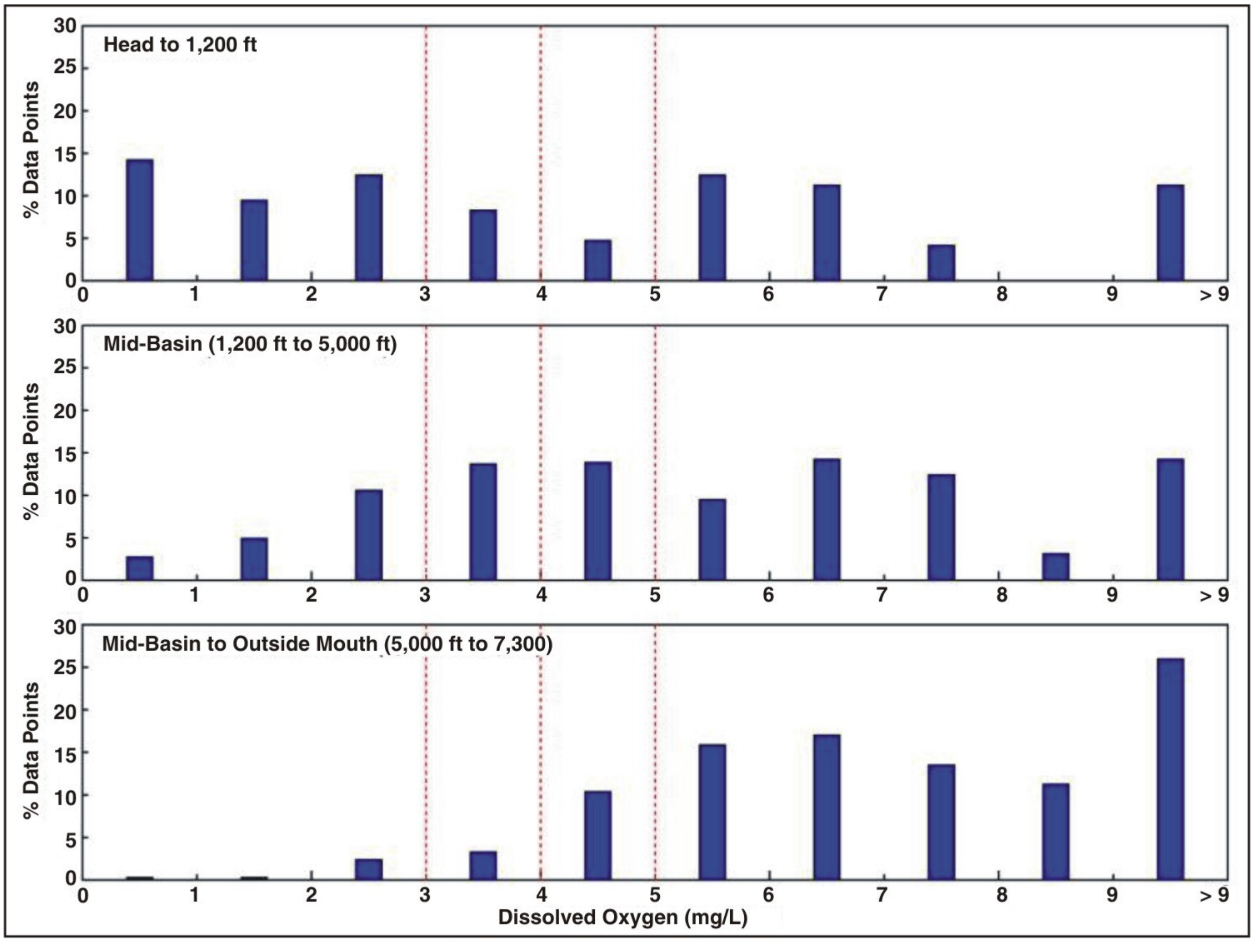

Figure 1 - Historical Dissolved Oxygen Measurements

reduction realized through diversion of wet-weather flows to complete CSO elimination achieved through load relocation or containment of all combined sewage generated under design conditions. The diverted overflows would be redirected to the Coney Island WPCP to maximize the use of its 220 million gallon per day (MGD) wet-weather capacity. These are summarized in Table 3.

Table3. Summary of Alternatives Performance

Effective Retention Volume (MG)	*Number of CSO Events*	*CSO Volume (MG)*	*Estimated Cost (millions)*
0	*61*	*2,749*	*$ -*
20	*60*	*1,875*	*$ 25.2*
40	*24*	*1,242*	*$ 165.0*
50	*21*	*1,046*	*$ 318.5*
70	*14*	*737*	*$ 808.2*
120	*9*	*297*	*$1,459.9*
200	*0*	*0*	*$2,205.9*

All of the storage alternatives evaluated are expected to induce 20 million gallons (MG) of inline storage in addition to whatever volume of storage is constructed. The least cost alternative considered was the installation of inflatable dams (in-line storage only), costing an estimated $25 million. The next alternative considered a tank half the size of the one currently under construction with the same influent structure and in-line storage (i.e., 40 MG of total storage). The estimated cost is $165 million, approximately half the $318.5 million cost for the

Paerdegat Basin Water Quality Facility currently under construction (50 MG total storage). Costs for additional storage beyond the Facility Plan are shown to escalate rapidly to $2.2 billion for complete

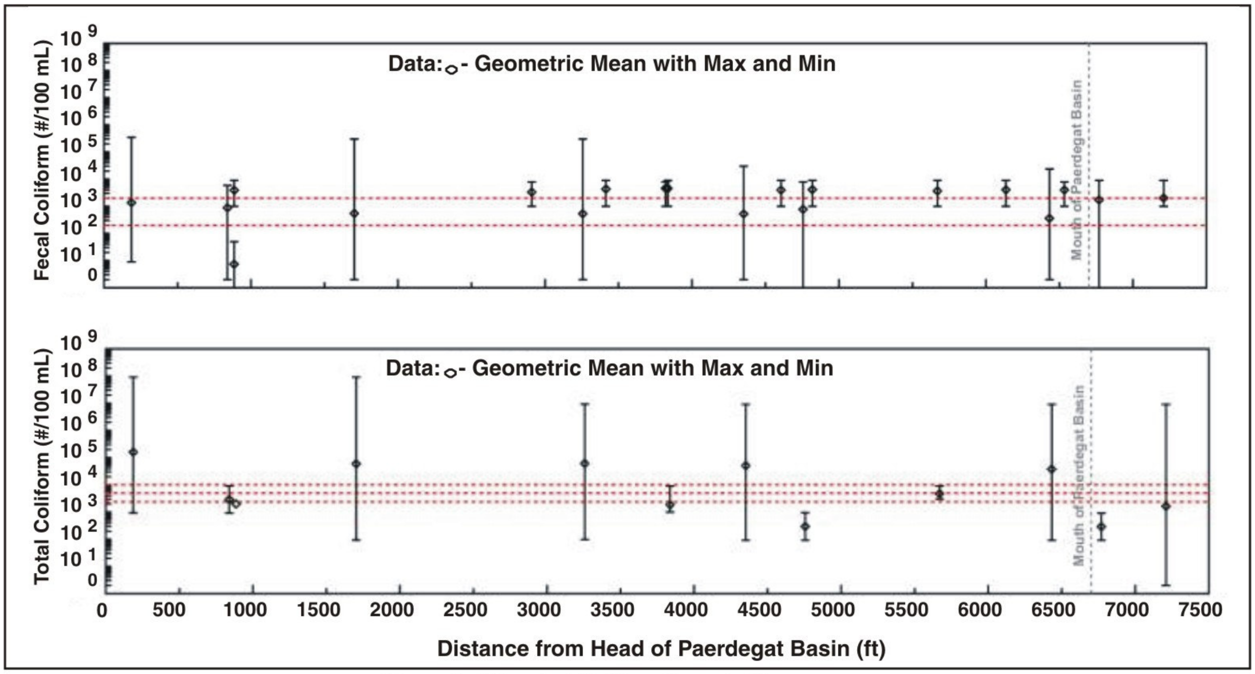

Figure 2 - Historical Coliform Bacteria Measurements

elimination of untreated overflows, nearly 700 percent more than the cost of the Facility Plan.

The Paerdegat Basin LTCP aims to abate the aesthetic impairments found in the Basin and to improve dissolved oxygen and pathogen concentrations within the Basin to provide for further protection of aquatic life and expanded recreation. This LTCP is the result of many previous studies conducted within Paerdegat Basin. In fact, a 1999 Paerdegat Basin CSO Water Quality Improvement Facility Plan recommended the 50 MG of CSO retention, which is the central element of this LTCP, and this plan was developed, approved by NYSDEC and memorialized in a Consent Order between New York City and New York State signed in 1992, prior to the United States Environmental Protection Agency adoption of the CSO Policy in 1994. Further, this 1999 CSO Facility Plan was designed and under construction when the requirement to develop an LTCP was included in New York City's State Pollution Discharge Elimination System (SPDES) Permits and when the requirement to develop an LTCP for Paerdegat Basin was made part of the 2005 CSO Consent Order. As such, unlike other LTCPs being developed around the country, this Plan was conducted with an emphasis on assessing the efficacy of the CSO control plan developed for Paerdegat Basin and to evaluate whether enhancements would be appropriate.

The central element of the LTCP is a 20 MG off-line storage tank currently under construction with 10 MG of additional storage in the influent channels and an additional 20 MG of in-line storage within the existing collection system, as required by both the 1992 and 2005 CSO Consent Orders. All five of the CSO outfalls at the head end of Paerdegat Basin are being rerouted into the storage facility such that the overwhelming majority of CSO events will pass through the tank prior to discharging. Hydraulic modeling indicates that the proposed facility will achieve significant reductions in settleable solids discharges, improvements in dissolved oxygen concentrations, the virtual elimination of nuisance odor conditions, and a reduction in substantial floatables discharges to less than once every two months on average. The LTCP supports several community elements, including the construction of offices and meeting areas for the use of Brooklyn Community Board 18, environmental and navigational dredging, and the continued commitment to local sponsorship of any restoration projects undertaken by USACE.

This LTCP was driven largely by the need to reduce the amount of CSO floatables and settleable solids discharged into Paerdegat Basin. Historical CSO solids continue to impact recreational uses through both aesthetic impairment and navigational limitations. The Plan focuses on addressing the visible floatables and noxious odors created by the CSOs to reduce the aesthetic impairments. Accomplishing this goal required a significant reduction in the long-term amount of floatables and organic solids exiting the combined sewer system. As documented herein, 97 percent of the combined sewage generated within the Paerdegat Basin drainage area (Coney Island WPCP sewer service area) will receive the equivalent of primary treatment with respect to CSO solids after construction of the 50 MG retention facility, with the added benefit of improving water quality conditions within the Basin. Previously conducted studies and this LTCP have concluded that providing control of CSO beyond that provided by this facility would result in only marginal improvement in the attainment of numerical criteria and support of designated uses at a disproportionately high cost.

Although initiated and substantially completed prior to the adoption of federal CSO policy, the evaluation of alternatives conducted by NYCDEP is consistent with the "presumption" approach defined by the policy. In contrast to a demonstration approach, in which a permittee must demonstrate that the selected control program is adequate to meet the water quality-based requirements of the Clean Water Act (CWA), the presumption approach allows a permittee to presume that water quality goals would be met if a certain level of control is implemented, specifically:

- The elimination or capture for treatment of 85% of the combined sewer volume collected in the system during precipitation events on an annual average basis; or
- The equivalent mass of pollutant that would be removed if the 85% capture volume were to receive primary treatment.

The presumption that control of a large percentage of the CSO discharges to Paerdegat Basin would achieve water quality goals was reasonable because the non-attainment of standards was attributed exclusively to CSO and stormwater. The Facility Plan, selected based on a "knee-of-curve" analysis at a cost of over $300 million, achieves removals well above those required for the presumption approach. Approximately 97 percent of the combined sewage generated within the Paerdegat Basin drainage area will receive the equivalent of primary treatment with respect to CSO solids following implementation of the Facility Plan, resulting in total and fecal coliform bacteria concentrations below the numerical criteria protective of secondary contact recreation at all times. Similarly, dissolved oxygen concentrations are expected to be above the numerical criterion of 4 mg/L over 90 percent of the time during a typical year. High levels of CSO solids and floatables reductions will also be achieved, resulting in consistency with the requirements of the NYSDEC narrative standards.

According to the policy, this alternative approach is provided "because data and modeling of wet weather events often do not give a clear picture of the level of CSO controls necessary to protect water quality standards." The uncertainty inherent in mathematical water quality modeling of future conditions is further accommodated by the post-construction monitoring program required by the CSO Policy. Under this LTCP, NYCDEP will monitor the performance of the facility after it is constructed for a number of years to validate the modeling used to quantify the ability of the Basin to consistently achieve the numerical criteria protective of designated uses. During this monitoring period, NYSDEC has indicated the SPDES Permit for the Coney Island WPCP may require a variance for the Paerdegat Basin Facility discharge if contraventions of the standards occur. If water quality standards are demonstrated to be unrealistic given the performance of the facility, NYCDEP will request that NYSDEC re-classify Paerdegat Basin based on a Use Attainability Analysis (UAA). Consideration should also be given to modifying the standards to allow independent designations of aquatic life protection and recreation water uses and recognition of the level of control provided by the LTCP.

In addition to the 50 MG CSO retention facility and the post-construction monitoring activities described above, LTCP for Paerdegat Basin contains the following additional elements.

Continue Implementation of Programmatic Controls

NYCDEP currently operates several programs designed to reduce CSO to a minimum and to provide levels of treatment appropriate to protect waterbody uses. As the effects of the 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 SPDES permits 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.
- The City-Wide Comprehensive CSO Floatable Plan (Modified Facility Planning Report, July 2005) will provide substantial reductions in floatables discharges from CSOs throughout the City to a level appropriate to NYSDEC and IEC requirements. Like the LTCP, the Floatables Plan is a living program which is expected to change over time based on continual assessment and changes in related programs.
- The recently-initiated Jamaica Bay Watershed Protection Plan (JBWPP) represents a long-term attempt by the City to protect Jamaica Bay. Operation of the Paerdegat CSO Facility may be influenced by the findings and protocols set forth in the JBWPP.

Environmental Dredging

NYCDEP will dredge the head end of Paerdegat Basin to three feet below mean lower low water (MLLW) and the mouth to the extent necessary to provide safe access to the recreational users of Paerdegat Basin. The dredging will be performed with the goal of encouraging secondary contact recreation consistent with the currently designated use by improving the navigational safety of Paerdegat Basin and by reducing the frequency and severity of deleterious aesthetic conditions that might discourage its recreational use. An added benefit of this dredging plan is that it will accomplish the necessary first step of any ecosystem restoration project: the removal of organic solids of low ecological value, thereby encouraging the establishment of healthier, more diverse benthic communities. Particular attention will be directed to any existing CSO sediment mound to remove the aesthetic impairment and provide an immediate relief from odors. This first step (dredging) in the restoration of Paerdegat Basin will set the stage for future environmental restoration work to be conducted by the United States Army Corps of Engineers who will focus their efforts on restoring damage done to the Basin during dredging and bulkhead construction many years ago.

Post-Construction Monitoring

Post-construction monitoring will be integral to the optimization of the facility currently under construction, providing feedback to facility operations, data for modeling, and information for compliance evaluations by NYSDEC. Each year's data set will be compiled and evaluated to refine the understanding of the interaction between the Paerdegat LTCP and Paerdegat Basin, with the ultimate goal of improving water quality and fully attaining the numerical water quality criteria protective of the existing designated uses.

Operational Plan

The operation of the Paerdegat CSO Facility is defined in the Wet Weather Operating Plan (WWOP) for the facility (Appendix B). The Coney Island WPCP WWOP (Appendix A) also alludes to details of interaction between the facilities under wet weather conditions. Although neither WWOP has been approved by NYSDEC at the time of issuance of this LTCP, NYCDEP intends to operate these facilities in accordance with the approved versions of the respective WWOPs, and will continue to refine operations protocols through the feedback mechanisms outlined in this LTCP to maximize CSO reduction and water quality improvement to the extent possible. A 12-month startup period will be used to establish enforceable operational limits to be included in a Coney Island WPCP SPDES permit modification.

Summary

Although initiated well before the development and issuance of the federal CSO policy, the Paerdegat Basin Long-Term Control Plan satisfies CSO policy requirements. Through extensive water quality and sewer system modeling, data collection, community involvement, and engineering analysis, NYCDEP has adopted a plan that incorporates the findings of over a decade of inquiry to achieve the highest reasonably attainable use of Paerdegat Basin. The LTCP addresses each of the nine minimum elements of long-term CSO control as defined by federal policy and also incorporates a review of water quality standards.

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1.0. Introduction

The City of New York owns and operates 14 water pollution control plants (WPCPs) and their associated collection systems through the New York City Department of Environmental Protection (NYCDEP). The system contains approximately 450 combined sewer overflows (CSOs) located throughout the New York Harbor complex. NYCDEP is executing a comprehensive watershed-based approach to long-term CSO control planning to address the impacts of these CSOs on the water quality and use 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 Long-Term CSO Plan (LTCP) Report provides the details of the assessment and the actions that will be taken to improve water quality in one of these waterbodies, Paerdegat Basin (item 5 on Figure 1-1).

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 today (NYCDEP, 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 in Jamaica Bay. 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 City-wide 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). At that time, dry weather discharges were occurring that have since been eliminated by NYCDEP. These facility plans were required under the State Pollutant Discharge Elimination System (SPDES) permits for each WPCP, which apply to CSO outfalls as well as plant discharges and therefore contain conditions for compliance with applicable CSO federal and state requirements. SPDES permits are administered by the New York State Department of Environmental Conservation (NYSDEC).

In 1992, NYCDEP entered into an Administrative Consent Order with NYSDEC that was incorporated into the SPDES permits with a provision stating that the consent order governs NYCDEP'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 that became effective in 2005 supersedes the 1992 Consent Order and its 1996 modifications, with the intent to bring all 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 drainage areas and, ultimately, for City-wide long-term CSO control. NYCDEP and NYSDEC also entered into a separate Memorandum of Understanding

(MOU) to facilitate water quality standards reviews in accordance with the federal CSO control policy.

This Paerdegat Basin LTCP Report is explicitly required by item IV.F., Appendix A of the 2005 Consent Order, and is intended to be consistent with the United States Environmental Protection Agency (USEPA) CSO Control Policy. In 1994, USEPA issued a national CSO Policy, which 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 the report will discuss each of these elements in more depth, along with the simultaneous coordination with State Water Quality Standards review and revision as appropriate. However, it should be noted that the CSO abatement plan discussed herein had been substantially developed by NYCDEP and approved by NYSDEC under the 1992 Order prior to implementation of the CSO policy. Therefore, some of the required LTCP requirements are more fully addressed in reference documents. For example, detailed evaluations of water quality and sewer system models and CSO control alternatives can be found in facility planning documents as referenced in the present document and/or other reports generated in associating with this report.

1.1. ASSESSMENT AREA

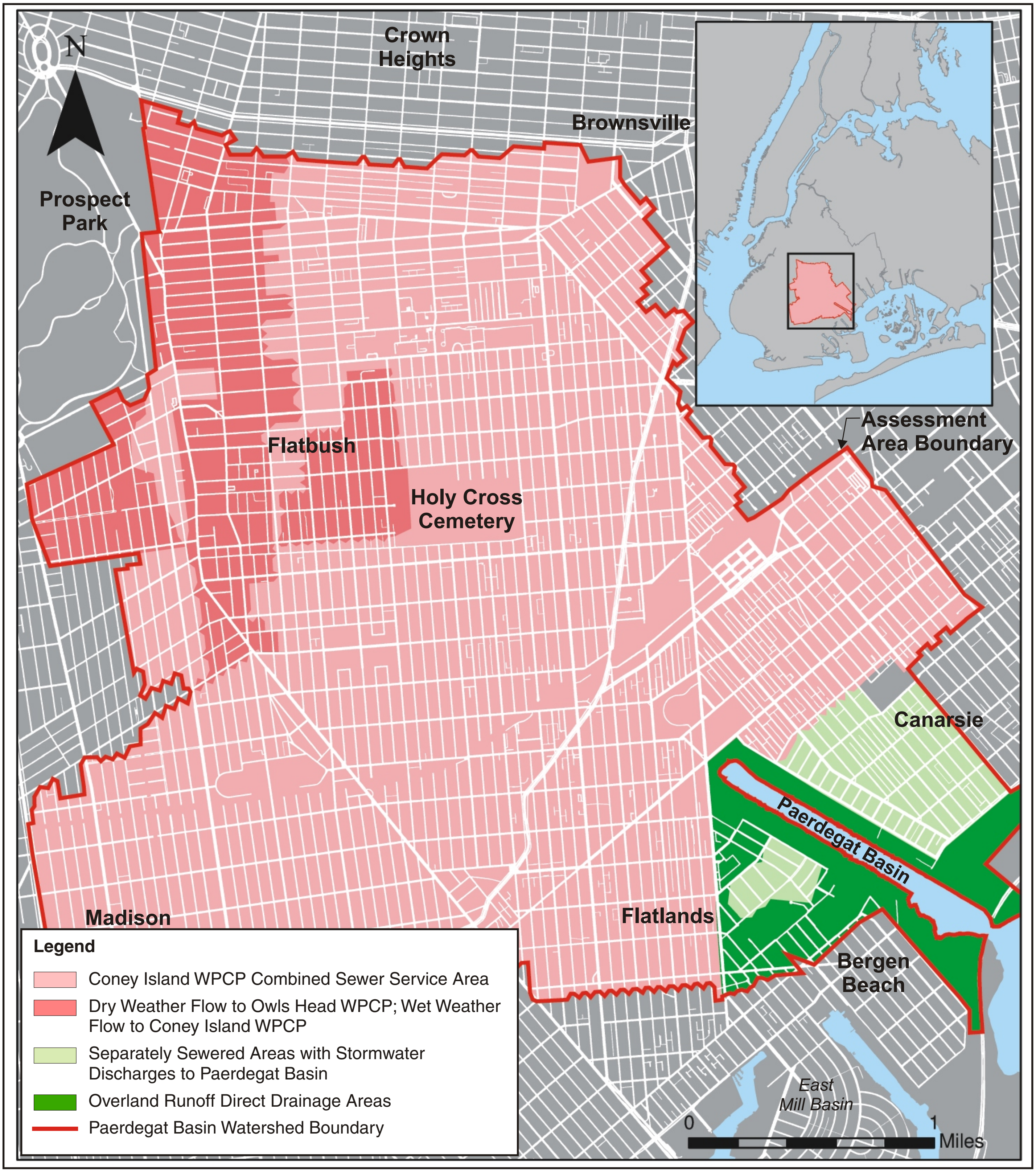
Located in southeastern Brooklyn, Paerdegat Basin extends from Flatlands Avenue at its head-end terminus to approximately the centerline of the Belt Parkway Bridge near its mouth, and includes all tidal wetlands, riparian areas, and associated uplands. Figure 1-2 illustrates the Paerdegat Basin assessment area. Parks and undeveloped properties adjacent to Paerdegat Basin that drain to the waterbody via overland runoff are included. The sewershed includes the entire combined sewer system serviced by the Coney Island WPCP, and a small portion of the separately sewered area serviced by the Coney Island WPCP. The sewershed spans Brooklyn Community Districts 9, 12, 14, 17, and 18, with 6,522 acres tributary to the five CSO outfalls that discharge directly to Paerdegat Basin.

New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

City-Wide Assessment Areas

FIGURE 1-1



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New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin LTCP Study Area

FIGURE 1-2

Although considered tributary to Jamaica Bay, Paerdegat Basin has no natural freshwater flow. Based on topography, the natural tributary watershed is similar in size (approximately 6,600 acres) but sewer system construction, urban development and other alterations to the watershed and runoff pathways have resulted in a distinctly different drainage area. Paerdegat Basin is entirely within Brooklyn Community District 18, a largely residential area with an unusually high percentage of open space and recreation area.

The legal definitions of waterbodies are codified in Title 6 of the New York State Code of Rules and Regulations (NYCRR). Table I of 6 NYCRR 891.6 lists waterbodies of the Jamaica Bay Drainage Basin, and includes Paerdegat Basin as "tributary 250a" under Item 17. The waterbody is classified by New York State as Class I saline surface waters with best uses designated for secondary contact recreation and fishing. These waters are best suited for fish propagation and survival. Paerdegat Basin was classified as a high-priority waterbody on the New York State 303(d) list in 1998, and remained on the list released in 2004 due to oxygen demanding pollution associated with urban stormwater and CSOs.

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 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 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. Combined sewer overflows 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 State through NYSDEC, and is thus a SPDES program. New York has had an approved SPDES program since 1975.

The CWA requires that discharge permit limits are based on receiving water quality standards (WQS) established by the State. 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 have an antidegradation policy for maintaining water quality at acceptable levels, and a strategy for meeting these 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 meeting WQS. TMDLs also allocate acceptable loads among sources of the relevant pollutants.

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 NYSDEC 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, NYSDEC listed Paerdegat Basin as a high priority waterbody for TMDL development with its inclusion on the Section 303(d) List. The cause of the listing was oxygen demand due to CSO discharges that depressed dissolved oxygen levels with enough severity to preclude fish propagation. Paerdegat Basin was again listed on the 2002 Section 303(d) List as a high priority waterbody, but urban runoff and stormwater were added to the dischargers deemed responsible for depressed dissolved oxygen concentrations. As the 303(d) List associates the cause of depressed dissolved oxygen with urban runoff and stormwater, this LTCP will serve as the TMDL when approved by NYSDEC as it will address the sources of the impairment. 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 UAA. In the UAA, the state would demonstrate that one or more of a limited set of situations exists to make such a modification. First, it could be shown that the current designated use cannot be achieved through implementation of applicable technology-based limits on point sources or cost-effective and reasonable management practices for nonpoint sources. Or, a determination could be made that the cause of non-attainment is due to natural background conditions or irreversible human-caused conditions. Another alternative would be to establish that attaining the designated use would cause substantial environmental damage or substantial and widespread social and economic costs. If the findings of a UAA suggest authorizing the revision to a use or modification of a water quality standard is appropriate, the analysis and the accompanying proposal for such a modification must go through the public review, participation, and the USEPA approval processes.

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 this strategy were to minimize water quality, aquatic biota, and human health impacts from CSOs by ensuring that CSO discharges comply with the technology and water quality based requirements of the Clean Water Act (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 NYSDEC on the development and implementation of a Long-Term CSO Control Plan 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 NYSDEC 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 nondomestic 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.

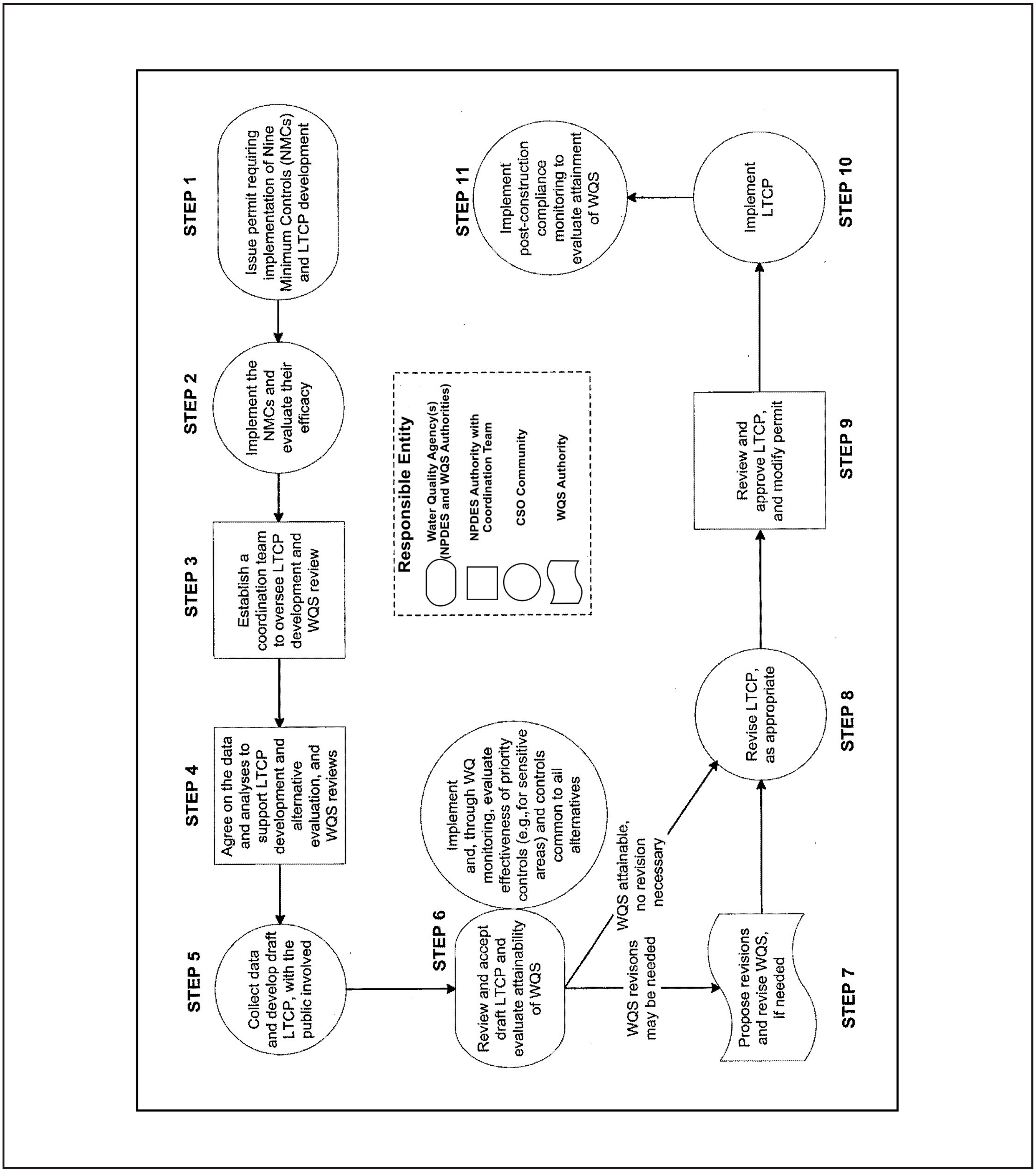
WQS authorities should review and revise, as appropriate, State WQS during the CSO long-term planning process. NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.

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, 2001d). The guidance acknowledges 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 recommends 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;
- Subcategories of uses, such as precluding swimming during or immediately following a CSO event or developing a CSO subcategory of recreational uses; and
- 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 provides a schematic chart (Figure 1-3) in its guidance for describing the coordination of LTCP development and water quality standards review and revision.

As discussed herein, the NYC CSO control program for Paerdegat Basin was initiated some time ago, prior to the adoption of the CSO Policy, at which time Steps 1 through 5 were essentially completed. This has led to development of the Water Quality Facility Plan described later in this document, currently under construction (element 10) and permitted in the existing SPDES permits (Step 9). With the requirement to develop a LTCP for Paerdegat Basin, the DEP has stepped back and re-initiated some of the activities in Step 4 of the flow chart and re-examined a number of CSO control alternatives beyond the approved CSO Facility Plan to evaluate whether additional water quality uses can be attained through cost effective controls (Step 6). The information presented in this report examines water quality standards revisions (Step 7), proposes a final LTCP (Step 8),



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Paerdegat Basin Long-Term CSO Control Plan

Long-Term CSO Control Planning Procedures

FIGURE 1-3

develops a permitting approach (Step 9), recommends completion of construction of the CSO Retention Facility with other enhancements as an LTCP (Step 10), and proposes a post construction-monitoring program (Step 11). Moving forward, NYSDEC will need to examine the water quality standards in accordance with Step 7 and further modify the SPDES permit, if appropriate, in accordance with Step 9. 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. As such, it is clear that, although this report is being produced while construction of the major element of the Paerdegat Basin LTCP is ongoing, much of the work that led to the development of the CSO Facility Plan for that facility was conducted very much inline with the EPA CSO Policy requirements.

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.

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.	> 5.0	70	n/a
SB	Primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	> 5.0	2,400 5,000	200
SC	Limited primary and secondary contact recreation, fishing. Suitable for fish propagation and survival.	> 5.0	2,400 5,000	200
I	Secondary contact recreation, fishing. Suitable for fish propagation and survival.	> 4.0	10,000	2,000
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) Total coliform criteria are based on monthly median, except for Class I, which is based on monthly geometric means; second criteria for SB and SC are for 80% of samples. (2) Fecal coliform criteria are based on monthly geometric means. (3) Per 6 NYCRR 703.4(c), bacteria standards are only applicable when disinfection is practiced. n/a: not applicable

NYSDEC 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.

Dissolved Oxygen

Dissolved oxygen is the numerical standard that NYSDEC uses to establish whether a waterbody supports aquatic life uses. The numerical dissolved oxygen standards for Paerdegat Basin (Class I) require that dissolved oxygen concentrations shall not be less than 4.0 mg/L at any time at any location within the waterbody.

Bacteria

Total and fecal coliform bacteria concentrations are the numerical standards that NYSDEC uses to establish whether a waterbody supports recreational uses. The numerical bacteria standards for Paerdegat Basin (Class I) require that total coliform bacteria must have a monthly geometric mean of less than 10,000 per 100 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.

An additional NYSDEC standard for primary contact recreational waters (not applicable to Paerdegat Basin 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 since USEPA established January 1, 2005 as the date upon which the criteria must be adopted for all coastal recreational waters.

For non-designated beach areas of primary contact recreation, which are used infrequently, the USEPA criteria suggest that a reference level indicative of pollution events be considered to be 501 per 100 mL. These reference levels according to the USEPA documents are not standards but are 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 are to be used for announcing bathing advisories or beach closings in response to pollution events.

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 find their way into receiving waters via uncontrolled CSO discharges. It should be noted that, in August 2004, USEPA Region II recommended NYSDEC "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." 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

The States of New York, New Jersey, and Connecticut are signatory 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.

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

Class	Usage	DO (mg/L)	Waterbodies
A	All forms of primary and secondary contact recreation, fish propagation, and shellfish harvesting in designated areas	> 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.	> 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	> 3.0	Arthur Kill north of Outerbridge Crossing; Newark Bay; Kill Van Kull

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, 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 dissolved oxygen standard (5 mg/L) differs from New York State's Class I standard (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.

Paerdegat Basin and nearby waters of Jamaica Bay 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; Paerdegat Basin is not designated as such.

1.2.5. Administrative Consent Order

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

NYCDEP and NYSDEC negotiated a new Consent Order that was signed January 15, 2005 that supersedes the 1992 Order and its 1996 Modifications with the intent to bring all NYCDEP CSO-related matters into compliance with the provisions of the Clean Water Act and Environmental Conservation Law. The new Order, noticed by NYSDEC in September 2004, contains requirements to evaluate and implement CSO abatement strategies on an enforceable timetable for 18 waterbodies and, ultimately, for City-wide long-term CSO control in accordance with USEPA CSO Control Policy. NYCDEP and NYSDEC 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, as such, 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 can 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 ten 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 to which the policies would apply. The program was revised in 1999, and the new WRP 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, providing geographic specificity to the WRP and acknowledging that certain policies are more relevant than others on particular portions of the waterfront.

1.3.3. Department of City Planning Actions

The New York City Department of City Planning (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 Paerdegat Basin. 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 City-wide 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 liaison for Brooklyn Community District 18 was 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 Paerdegat Basin. 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.

In addition, 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, so 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 explicitly prohibits the operation, construction, maintenance, and/or establishment of a bathing beach along all shorelines of Jamaica Bay, its estuaries and islands. Further, 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. 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.

1.4. REPORT ORGANIZATION

This report has been organized to clearly describe the proposed Long-Term CSO Control Plan 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 the present document for cross-referencing. Section 1.0 presents general planning information and regulatory considerations that informed the LTCP development. Sections 2.0, 3.0 and 4.0 describe the existing watershed, collection system, and waterbody characteristics, respectively. Section 5.0 describes related waterbody improvement projects within the waterbody and the greater New York Harbor. Section 6.0 describes the public participation and agency interaction that went into the development of this LTCP, as well as an overview of the NYCDEP public outreach program. Sections 7.0 and 8.0 describe the development of the draft LTCP. Section 9.0 discusses the review and revision of water quality standards. The report concludes with references in Section 10.0 and a list of terms and abbreviations in Section 11.0. Attached for reference are the Wet Weather Operating Plans for the Coney Island WPCP and the Paerdegat Basin Water Quality Facility, two modeling supplements, and the Use Attainability Evaluation.

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

No.	Element	Location(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	8.0
7	Maximizing Treatment at the Existing WPCP	7.0, 8.0
8	Implementation Schedule	8.0
9	Post-Construction Compliance Monitoring	8.0

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2.0. Watershed Characteristics

Paerdegat Basin is located within Brooklyn Community District 18 on the northwestern edge of Jamaica Bay between the neighborhoods of Flatlands and Canarsie. It is bounded to the north by Flatlands and Ralph Avenues, to the east by Paerdegat Avenue North and to the west by Bergen Avenue. At the southwestern edge of the waterbody lies Joseph Thomas McGuire Park, while at the southeastern edge lies Canarsie Beach Park. The downstream watercourse of Paerdegat Basin proceeds in a southeast direction from Flatlands Avenue to Jamaica Bay under a bridge for the Belt Parkway (a.k.a. Shore Parkway). Portions of the Gateway National Recreation Area are on both banks at its mouth. The tributary watershed to Paerdegat Basin includes 6,825 acres spanning portions of the Canarsie, Brownsville, Crown Heights, Flatbush, East Flatbush, Madison, and Flatlands neighborhoods of Brooklyn. Land use is primarily residential, with extensive parkland areas and a smaller mix of public facilities and commercial, manufacturing, and transportation uses. Most of the land immediately adjacent to Paerdegat Basin is parkland, except near the head end where a number of public facilities are located.

The following sections present the historical context of changes in Paerdegat Basin, 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

An intense history of urbanization in Brooklyn during the 19^{th} and 20^{th} centuries has resulted in a highly impervious watershed and has substantially replaced the natural overland runoff pathways with faster, unattenuated stormwater conveyances from the sewer collection system. Combined with the limited ability of the waterbody to assimilate and dilute stormwater-based pollutants due to physical modifications, urbanization has contributed directly to water quality in Paerdegat Basin.

A review of historical photographs, nautical charts and topographic maps indicate that, prior to anthropomorphic alterations, Paerdegat Basin was known as Bedford Creek, a shallow, meandering tidal creek approximately 4,000 feet in length and 100 feet wide that conveyed a constant supply of freshwater runoff onto tidal flats in Jamaica Bay (Tanacredi et al., 2002). The original topographic watershed of Bedford Creek encompassed portions of the villages of Canarsie, Flatbush, Flatlands, Kensington, Parklands and West Brooklyn prior to their incorporation into the City of Brooklyn during the mid-to late1800s and subsequently into the City of New York in 1898 (Allee King Rosen & Fleming, 1994). These areas were primarily small villages with agricultural areas bordering on the marshlands of Jamaica Bay. Throughout the 18^{th} and 19^{th} centuries, these areas were transformed from undeveloped uplands to villages and farms. As Brooklyn experienced explosive growth during the mid- to late Nineteenth Century, uplands were leveled, wetlands were filled, and a progressively more urban landscape developed. Channeling of runoff towards Bedford Creek via feeder streams most likely began prior to the 1920s, and as development encroached around Paerdegat Basin in the Flatlands and Canarsie sections after the 1940s, storm sewers were constructed to convey street runoff directly to Paerdegat Basin. Beginning in the early 1900s and ending in the 1930s, Paerdegat Basin was dredged to 16 feet below mean low water (MLW) and bulkheaded to its present configuration: a straight, 6,675-foot long, 450-foot wide tidal embayment, opening onto dredged navigation channels in Jamaica Bay.

Figure 2-1 shows the changes in Jamaica Bay from 1899 to 2002. Many of the natural tributaries have been altered for navigational purposes, and large changes in bathymetry and marshland are evident, likely resulting in different circulation patterns than in the natural condition. The alteration that turned Bedford Creek into Paerdegat Basin is similar in nature to many of the tributaries of Jamaica Bay, and its physical transformation is shown in Figure 2-2. The top panel is an excerpt from a U.S. Coast and Geodetic Survey topographic map featuring Bedford Creek and its watershed from 1897. The current configuration of Paerdegat Basin is shown on the bottom panel of Figure 2-2, which is an excerpt from aerial photography taken in 2002 showing the same geographic area as the 1897 map. The channelization, elimination of freshwater sources, and loss of wetlands and open space due to urban development in the watershed is evident.

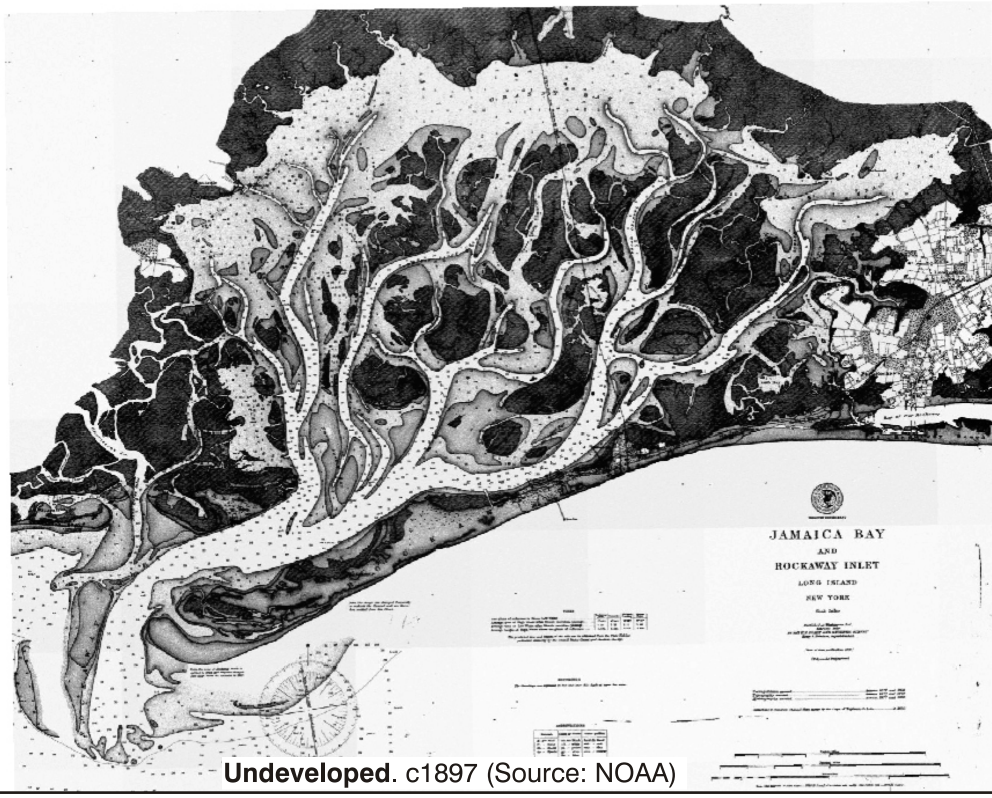
2.2. LAND USE CHARACTERIZATION

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.

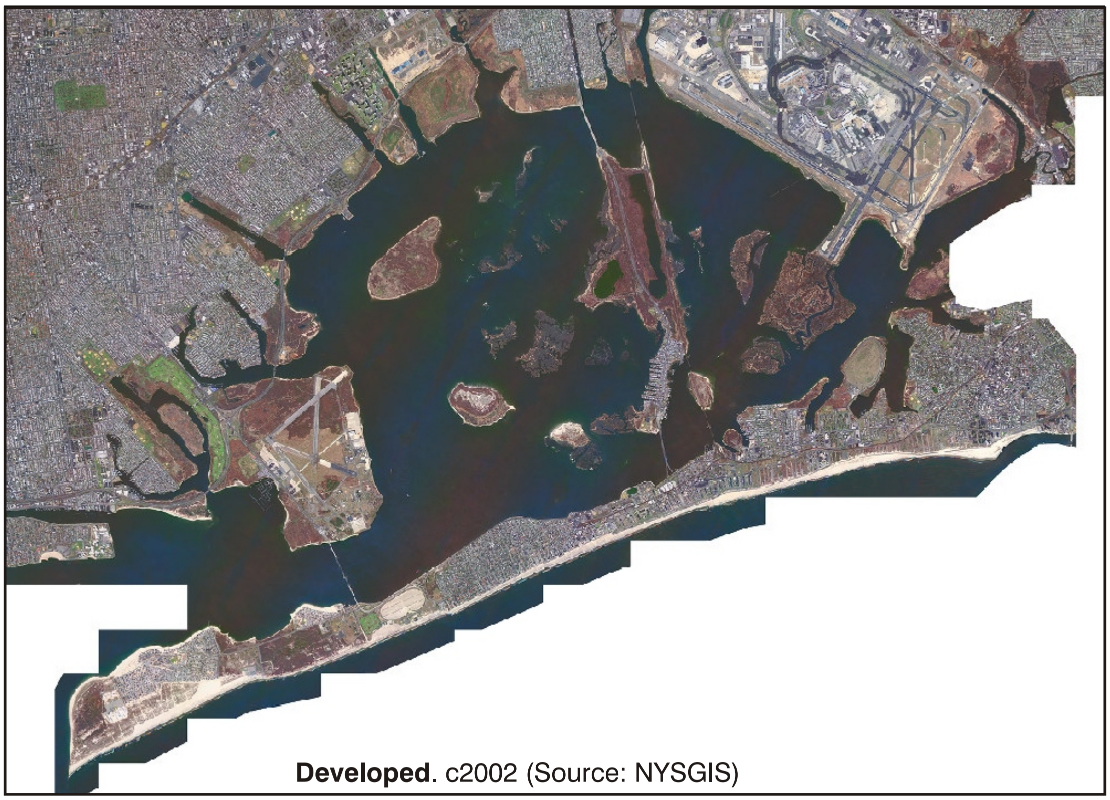
2.2.1. Existing Land Use

Land use immediately adjacent to Paerdegat Basin is dominated by open space and outdoor recreation, institutional, and waterfront recreation with larger areas of residential uses located further north, south and west of the waterbody as shown in Figure 2-3. North of the waterbody, the predominant land use is residential with some commercial, industrial and vacant land uses interspersed. The southern shore of the waterbody is slightly more diversified in land use types, although it is also dominated by residential uses. Within this area, however, are large sections of vacant land with intermittent commercial, industrial, and institutional uses.

The area surrounding the head of Paerdegat Basin supports New York City infrastructure. The New York City Department of Transportation (NYCDOT) operates a maintenance and storage facility at the northwest corner. NYCDEP operates the Paerdegat Pumping Station, located at the headwater terminus of Paerdegat Basin. In addition, NYCDEP is presently constructing a CSO retention facility on the southeastern corner of their property as part of the Paerdegat Basin Water Quality Facility Plan. These uses encompass the entire head of the waterbody. Further inland is South Shore High School, located on the north side of Flatlands Avenue, north of the head of the waterbody. The remaining area surrounding the head of the waterbody, north of Flatlands Avenue and west of Ralph Avenue, is comprised of a mixture of residential uses with large areas of commercial uses primarily located along Flatlands and Ralph Avenues.



Undeveloped. c1897 (Source: NOAA)



Developed. c2002 (Source: NYSGIS)

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Comparison of Undeveloped and Developed Conditions Jamaica Bay

FIGURE 2-1

Undeveloped. Bedford Creek c1897 (Source: USCGS)

Developed. Paerdegat Basin c2002 (Source: NYSGIS)

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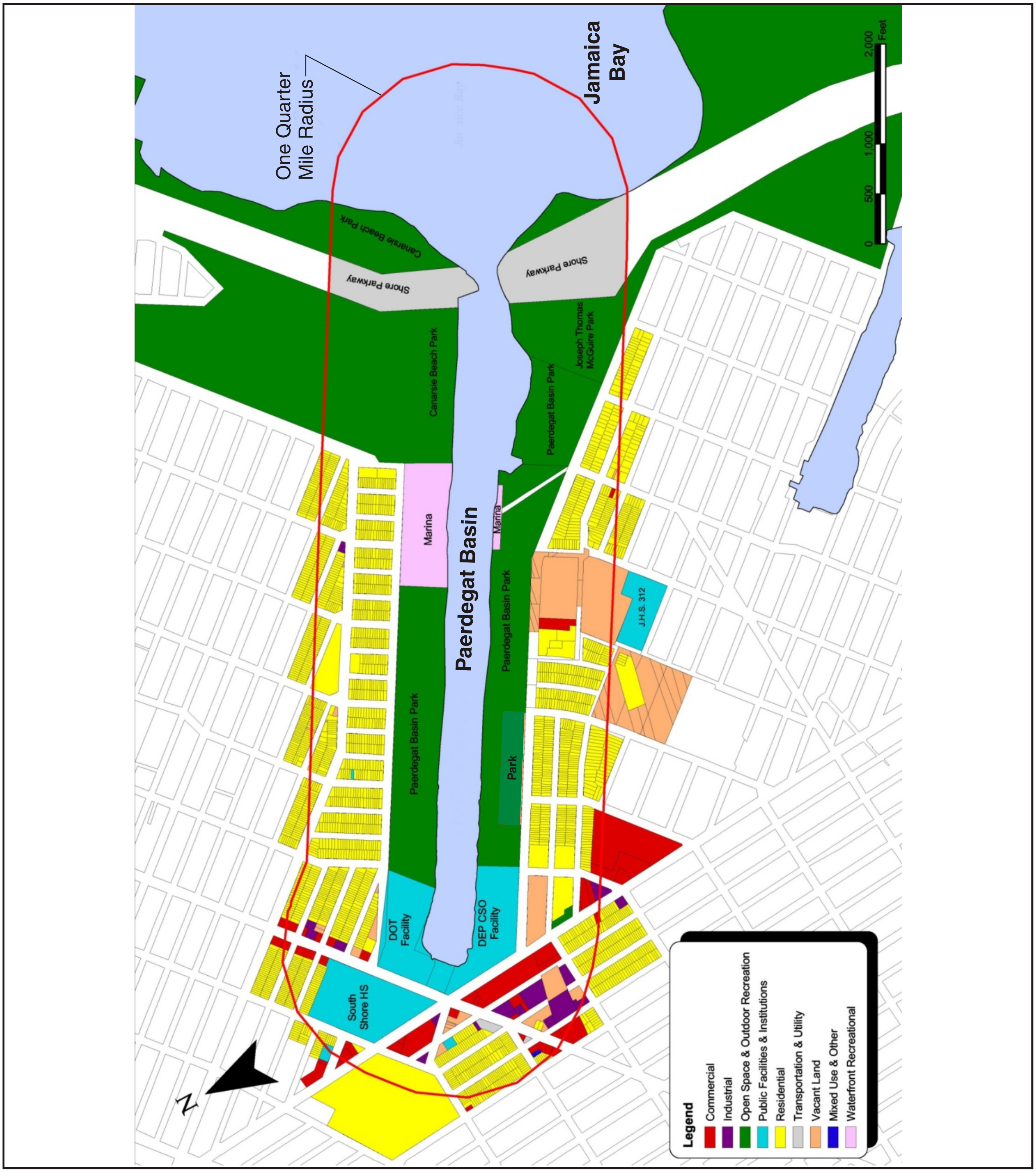
Paerdegat Basin Long-Term CSO Control Plan

Comparison of Undeveloped and Developed Conditions Paerdegat Basin

FIGURE 2-2



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Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Generalized Land Use Map
(1/4-Mile Radius)

FIGURE 2-3

Land uses along the northern shoreline include Paerdegat Basin Park, which extends from 1st to 11th Street, and Canarsie Beach Park located near the mouth of the waterbody south of Seaview Avenue. The Diamond Point Yacht Club, Paerdegat Yacht Club, Midget Squadron Yacht Club, Sebago Canoe Club and the Paerdegat Racquet Club each support structured, waterfront recreational uses on property located approximately 1,700 feet upstream from the mouth that is leased from the City. With the exception of these sites, land uses along the northern shoreline are comprised of parkland or open space for outdoor recreational uses. North of Paerdegat Avenue North, which parallels the northern shore of the waterbody, land uses are almost entirely residential with a few vacant lots and institutional properties interspersed.

Land uses along the southern shore of Paerdegat Basin are dominated by open space and outdoor recreational uses. Paerdegat Basin Park is also located along the southern shoreline of Paerdegat Basin from Avenue K to Avenue V. Joseph Thomas McGuire Park extends south of Avenue U to Jamaica Bay. The Hudson River Yacht Club is located at the terminus of Avenue U on property leased from the City and represents the only non-park related land use along the southern shore. The areas south of Bergen Avenue, which parallels the southern shoreline of the waterbody, contain a mix of mostly residential uses and vacant areas, with some commercial uses and Junior High School 312.

Table 2-1 summarizes the land use distribution shown on Figure 2-3, along with a breakdown of land use watershed-wide. The Paerdegat Basin watershed includes portions or the entirety of the Canarsie, Brownsville, Crown Heights, Flatbush, East Flatbush, Madison, and Flatlands neighborhoods of Brooklyn. Land uses in the watershed are characterized as 64 percent residential, 16 percent park, and the remaining as a mix of public facilities and institutions, commercial, manufacturing and transportation. Within the riparian area of Paerdegat Basin (¼-mile radius) the distribution of residential and park use is nearly the reverse (i.e., 73 percent parks and only 16 percent residential).

Table 2-1. Paerdegat Basin Land Use Summary by Category

Land Use Category	Watershed Area	Riparian Area (Within 1/4 Mile Radius)
Residential	64 %	16 %
Park and Recreation	16 %	73 %
Mixed Use*	20 %	11 %
*Public facilities and institutional, commercial, manufacturing, transportation and vacant.		

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 that trades, industries, and other activities are allowed 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 2-4 presents zoning within a ¼-mile radius of Paerdegat Basin. Zoning to the immediate north and south of Paerdegat Basin is dominated by large areas of mapped parkland. Mapped parkland administered by the New York City Department of Parks and Recreation (NYCDPR) is not subject to the Zoning Resolution. The area further south of the waterbody, beyond Bergen Avenue, is zoned residential, specifically R3-1 (detached and semi detached residential), R3-2 (general residential) and R5 (general residential). North of Paerdegat Basin is zoned R5. The head of the waterbody at the NYCDEP facilities is zoned as M1-1 (light manufacturing) and R5. North of Flatlands Avenue are areas of residential zoning, R3 2 and R5, and an area of commercial zoning, C4-2 (general commercial), which encompasses South Shore High School. A small strip of C3 (waterfront recreation) zoning is located adjacent to the marinas on the northern shore between Paerdegat 12th Street and Seaview Avenue.

2.2.3. Proposed Land Uses

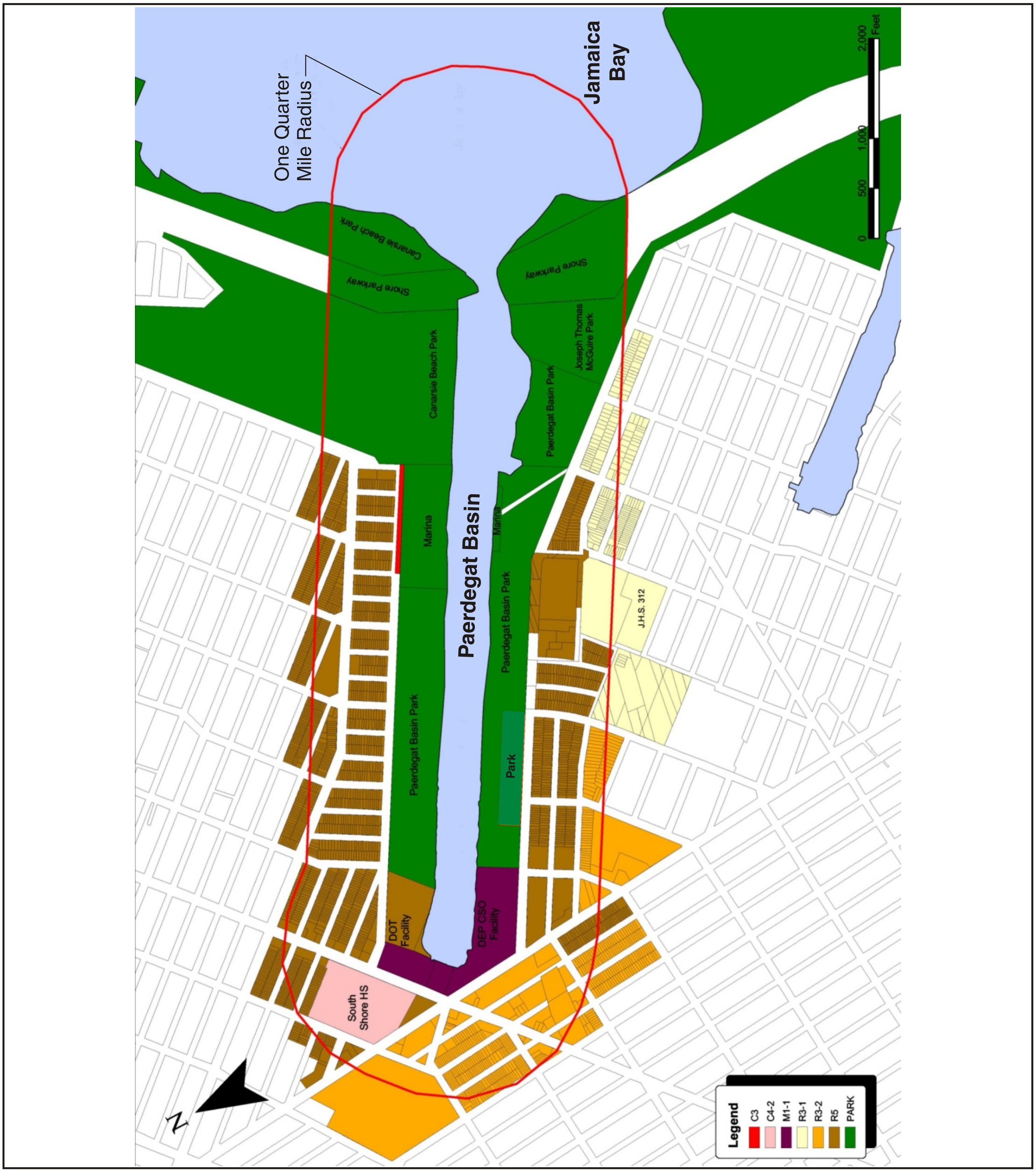
Both NYCDCP and NYCEDC were contacted to identify any projects either under consideration or in the planning stages that could substantially alter the land use in the vicinity of Paerdegat Basin. NYCDCP reviews any proposal that would result in a fundamental alteration in land use, and NYCEDC advances City land use policy through dispensing City-owned property.

Two NYCEDC projects were identified in the vicinity of Paerdegat Basin. The Mill Basin Development is a vacant property scheduled to be converted to 100,000 square feet of retail, 40,000 square feet of car dealership, and associated parking (400 spaces). Construction is anticipated to be completed in 2007. The other project is at the Brooklyn Terminal Market, where an existing 566,530 square foot vacant building may be redeveloped with big box and smaller retail, parking, office, warehouse and self-storage uses. Reconstruction is anticipated to be completed in 2008. Neither of these projects will substantially change existing land uses, nor will either increase the dry weather flow (DWF) in the collection system significantly.

There are currently no proposed land uses or new facilities identified by either of these agencies that are inconsistent with existing zoning and existing land use in the area of Paerdegat Basin.

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 neighborhood character in the immediate vicinity of Paerdegat Basin is influenced by the intersection of two of Brooklyn's major thoroughfares (Ralph and Flatlands Avenues) which are intensely commercial, containing street-front stores, restaurants, strip malls, supermarkets, automobile-related facilities, and large amounts of parking relative to similar neighborhoods. The presence of numerous public uses, including the South Shore High School, the Paerdegat Pumping Station, and the NYCDOT facility also define the neighborhood. Finally, the largely residential areas surrounding the commercial thoroughfare contain both the two and three-story attached housing with



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Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Generalized Zoning Map

(1/4-Mile Radius)

FIGURE 2-4

private parking and rear yards typical of the outer boroughs of New York City and the large detached one-family homes more typically associated with suburban areas.

The open space and recreational uses in proximity to the waterbody consist of a mix of both passive and active recreation that also provide varying levels of structured and unstructured access to Paerdegat Basin for the surrounding residential communities. Two of the larger parks, Canarsie Beach Park and Joseph Thomas McGuire Park, contain open lawns and sitting areas that offer opportunities for passive recreation; neither contains any bathing beaches. The Diamond Point, Paerdegat Squadron, Midget Squadron and Hudson River Yacht Clubs, as well as the Sebago Canoe Club and Paerdegat Racquet Club, are private clubs that provide active recreational waterfront uses and access to Paerdegat Basin for their members. In addition, Paerdegat Basin Park is located along the northern and southern shorelines of the Basin. The Park is currently largely undeveloped and provides for limited, unstructured access to the waterbody due to extensive overgrowth and restricted access. The existing and proposed open space and waterfront recreational uses limit or prevent direct views of the waterbody from the surrounding residential areas.

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.

Paerdegat Basin is entirely within the City-defined Coastal Zone Boundary (CZB) and the Special Natural Waterfront Area (SNWA) of Jamaica Bay (Figure 2-5). 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 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 Paerdegat Basin 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. Most of the industrial uses near the head end of the waterbody are not water-dependent, and 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.

2.3. REGULATED SHORELINE ACTIVITIES

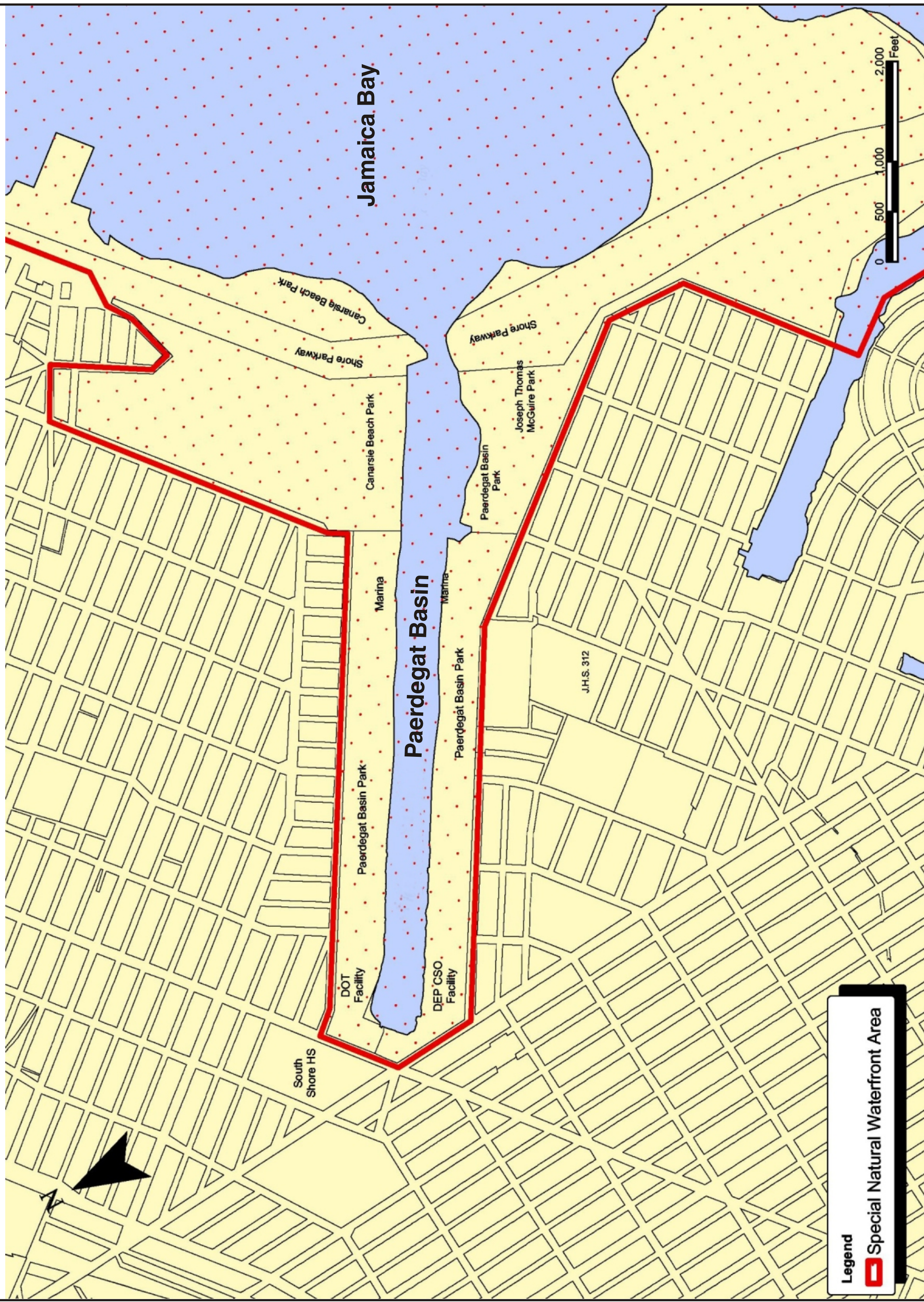
As part of the LTCP development, information was gathered from selected existing federal and state databases to identify possible landside sources that have the potential to directly impact water quality in Paerdegat Basin. The extent of the study area was limited, to the extent possible, to the area in immediate proximity to Paerdegat Basin. For the purposes of this investigation, potential sources included, but were not limited to, the existence of underground storage tanks (UST), major oil storage facilities (MOSF), known contaminant spills, existence of state or federal superfund sites and other sources that may have the potential to degrade the water quality, and the presence of SPDES permitted discharges to the waterbody other than CSOs.

The USEPA Superfund Information System, which contains several databases with information on existing superfund sites, was accessed. These databases included: the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), Resource Conservation and Recovery Act Information (RCRAinfo), Brownfields Management System, Site Spill Identifier List (SPIL) and the National Priorities List (NPL). In addition to the federal databases, several databases managed by NYSDEC were also reviewed. The following NYSDEC databases were reviewed: the Spill Incident Database, UST and leaking UST (LUST) programs and the Environmental Site Remediation Database, which allows searches in the NYSDEC brownfield cleanup, state superfund (inactive hazardous waste disposal sites), environmental restoration and voluntary cleanup programs. In addition to these federal and state databases, additional readily available information that focused on the immediate vicinity of Paerdegat Basin was reviewed.

According to the USEPA databases, no known superfund sites are located within the immediate vicinity of Paerdegat Basin. Review of the NYSDEC databases indicates that several spill incidents have occurred within the immediate vicinity of Paerdegat Basin within the past ten years. During 1995, five spills (NYSDEC Spill Nos. 9414046, 9416814, 9503490, 9509377 and 9510615) were reported in the immediate vicinity of Paerdegat Basin and involved contamination to surface water, soil and/or groundwater due to equipment failure or unknown causes. Of the five incidents, one spill incident (9503490), which involved a gas station on Flatlands Avenue, has not been closed by the NYSDEC and remains open. In 1996, one spill (NYSDEC Spill No. 9601148) occurred at an auto facility on Ralph Avenue due to tank failure that affected the soil. This spill was closed by the NYSDEC. Two additional spill incidents (NYSDEC Spill Nos. 9713366 and 9711141) involving poor housekeeping and equipment failure at two gas stations on Flatlands Avenue were reported in 1998. These spills resulted in impacts to soil and groundwater and have not yet been closed by the NYSDEC. No other spills were reported in the area.

According to additional resources, fuel storage facilities are located in close proximity to the Basin. At the Hudson River Yacht Club, on-site gasoline storage includes four 550-gallon USTs and one aboveground fuel tank. Additional tanks are also recorded for the NYCDOT maintenance yard, which is located on the northeast corner of Paerdegat Basin. These include two 250-gallon tanks for kerosene, two 550-gallon tanks for gasoline, one 550-gallon tank for diesel and three 750-gallon tanks for No. 2 fuel oil. No other tanks were identified in the area based upon the review of available information.

The available information indicates that none of these sources of contamination are associated with existing or previous combined sewer overflow events, and there is no evidence of



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Jamaica Bay Special Natural Waterfront Area In the Vicinity of Paerdegat Basin

FIGURE 2-5

direct impact to Paerdegat Basin from the regulatory records identified. No additional SPDES-permitted dischargers were identified near Paerdegat Basin.

NO TEXT ON THIS PAGE

3.0. Existing Sewer System Facilities

The Paerdegat Basin watershed is wholly within the Coney Island WPCP service area, although portions of the drainage area divert dry weather flow to the Owls Head WPCP collection system, and other portions discharge directly to Paerdegat Basin. The following sections describe the Coney Island WPCP, the collection system tributary to Paerdegat Basin, and the discharge characteristics. Details in this section were derived from Hazen and Sawyer (1991), Hazen and Sawyer (2004), and Malcolm Pirnie (2004).

3.1. CONEY ISLAND WPCP

The Coney Island WPCP is permitted by NYSDEC under SPDES permit number NY-0026182. The facility is located at 2591 Knapp Street, Brooklyn, NY, 11235 in the Sheepshead Bay section of Brooklyn, on a 30-acre site adjacent to the Rockaway Inlet/Shell Bank Creek, leading into Jamaica Bay, located between Avenue Y and Voorhies Avenue, near Joseph P. Cierro Stadium. The Coney Island WPCP serves an area of approximately 15,087 acres in Southern/Central Brooklyn, including the communities of Sea Gate, Coney Island, Brighton Beach, Homecrest, Manhattan Beach, Sheepshead Bay, Manhattan Terrace, Midwood, Gerritsen Beach, Plum Beach, Flatlands, Canarsie, Paerdegat Basin, Georgetown, Mill Basin, Marine Park, Bergen Beach, Mill Island, Rugby, Remsen Village, East Flatbush, Ditmas Park, and Wingate. The total sewer length, including sanitary, combined, and interceptor sewers, that feeds into the Coney Island WPCP is 374 miles.

The first wastewater treatment plant servicing the area was built in 1892 and was equipped with a chemical treatment process. During the first quarter of the 20th Century, four additional chemical treatment plants were built in the Coney Island drainage area. In 1935, the five plants were replaced with a single, new facility constructed on the present site that provided chemical treatment with sedimentation and sludge digestion. Additions to this treatment plant were made in 1940 and 1947. The plant was upgraded in 1958 from plain sedimentation with chemical treatment to biological treatment by modified aeration. New aeration tanks were constructed, along with grit tanks, three new sedimentation tanks, two sludge thickeners, two new raw sewage pumps, and four process air blowers. Additional improvements to the sludge digestion and storage tanks were made in 1966. The most recent upgrades commenced in the 1980s and included new screen chambers, new main sewage pumps, rehabilitated grit tanks, new primary settling tanks, expanded aeration and final settling facilities, and new chlorine contact tanks with hypochlorite disinfection. The sludge handling facilities were upgraded to include primary sludge degritting, waste sludge screening, gravity thickeners, anaerobic digesters, sludge storage and gas holding tanks. Finally, the plant capacity rating was increased from 100 million gallons per day (MGD) to 110 MGD subsequent to these upgrades. The Coney Island WPCP has been providing full secondary treatment since 1994. Table 3-1 summarizes the Coney Island WPCP permit limits.

Figure 3-1 shows the current layout of the Coney Island WPCP. 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. The Coney Island WPCP has a design dry weather flow (DDWF) capacity of 110 MGD, and is designed to receive a maximum flow of 220 MGD (2 times DDWF) with 165 MGD (1.5 times DDWF) receiving secondary treatment, as required by the SPDES permit. Flows over 165 MGD receive primary treatment and disinfection. The daily average flow during 2004 was 88 MGD, with a dry weather flow average of 83 MGD. During wet weather events in 2004, the plant treated 128 to 231 MGD.

Table 3-1. Select Coney Island WPCP SPDES Effluent Permit Limits

Parameter	Basis	Value	Units
Flow	DDWF Maximum secondary treatment Maximum primary treatment	110 165 220	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	45,300*	lb/day
*Total for four Jamaica Bay WPCPs (Coney Island, 26th Ward, Jamaica, and Rockaway)			

NYCDEP has examined the feasibility of processing all 220 MGD through the complete WPCP and has found that because of treatment process constraints and site boundaries, it is not feasible to route all 220 MGD through the existing secondary treatment portion of the facility nor would it be feasible to construct new secondary facilities as the WPCP is located in a residential neighborhood and completely occupies the available land. For a further discussion of this subject, see Section 7.0

3.1.1. Process Information

Figure 3-2 shows the current process treatment for the Coney Island WPCP. Raw sewage flows into the WPCP from the existing 120-inch Paerdegat Interceptor and 84-inch Coney Island Interceptor. The Coney Island Interceptor conveys sanitary (dry weather) flow only. The Paerdegat Interceptor conveys combined sewage flow. The plant's influent interceptors split into three separate screening channels with mechanically-cleaned bar screens with 1-inch clear openings. Each screening channel is equipped with a proportional weir downstream of the screens to provide the proper velocity control through the screens. Hydraulically-operated sluice gates are located up and downstream of the bar screens for isolation of each bar screen for repair. The upstream sluice gates are used to throttle flow, when necessary, during wet weather.

Screened wastewater flows to a wet well, where six main variable speed sewage pumps are provided to pump the maximum design flow of 220 MGD. The pumps are connected by vertical shafts to wound rotor induction motors on the main operating floor in the pump and power house. The six pumps are rated at 55 MGD each, with four pumps in simultaneous service and the remaining two serving as standby pumps (i.e., the so-called 'N +1+1' NYCDEP design standard). The pump motors are powered by four reciprocating engines. The main sewage pumps discharge into a vented riser, which, in turn, discharges into the top of a 90-inch header. The 90-inch header conveys the sewage to four 0.41 million gallon (MG) aerated grit tanks. A grit removal system is provided to extract captured grit from the tanks and to deposit the grit into the master hopper. All

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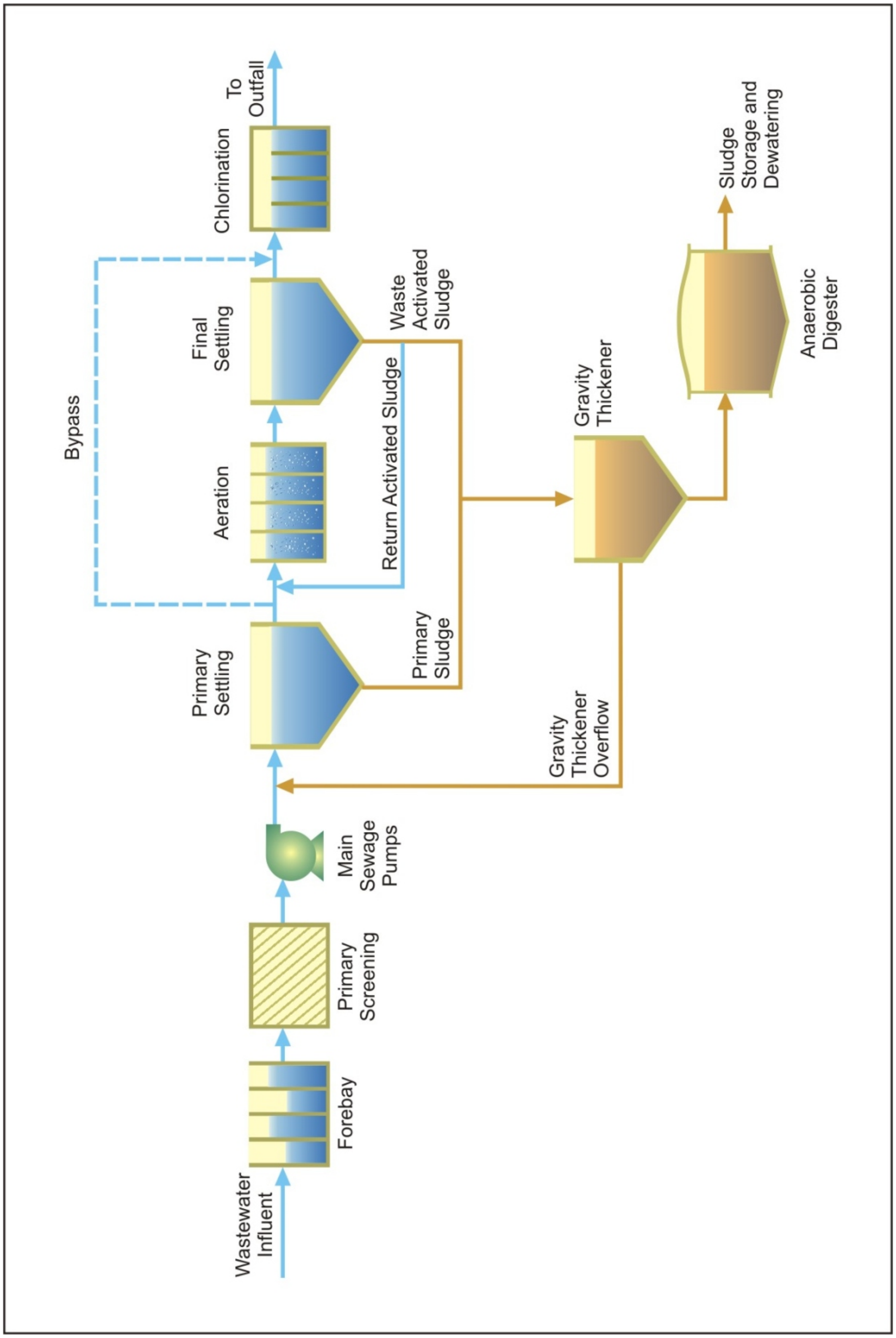
Coney Island WPCP Existing Facility Layout

FIGURE 3-1



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Paerdegat Basin Long-Term CSO Control Plan

Coney Island WPCP Process Flow Diagram

FIGURE 3-2

facilities are enclosed and provided with an odor control system. Grit is trucked off site for disposal by landfill.

Eight primary settling tanks provide removal of settleable solids and biochemical oxygen demand (BOD). Each tank has three bays equipped with sludge and skimming collectors, one cross collector, inlet sluice gates and overflow weirs. Collected sludge is pumped to cyclone degritters before flowing by gravity to the waste sludge well. With all tanks in service, the total volume is 5.6 MG, the overflow rate at DDWF is 1,623 gallons per day per square feet (gpd/sq ft), and the weir loading is 15,000 gallons per day per foot (gpd/ft).

Two clusters equipped with four cyclone degritters each are installed in the degritter building. The cyclone degritters are designed to remove 95 percent of the grit particles of mesh size 150 and larger. The grit is discharged into grit classifiers located directly below the degritters to wash and separate the grit. The washed grit is conveyed to containers for trucking off-site for disposal by landfill. Classifier overflow is returned by gravity to the primary tank influent channel.

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 165 MGD. The bypass channel capacity is believed to be around 75 MGD.

Four 4-pass aeration tanks provide 4.0 hours of detention at DDWF. The aeration tanks and channels are equipped with manually operated motorized sluice gates to permit operation in several step aeration modes. The total aeration tank volume is 16.7 MG and four 23,800 standard cubic feet per minute (scfm) blowers provide air through ceramic disc, full-floor coverage, fine-bubble diffusers. A weir is installed to maintain a constant liquid level in the aeration tanks. The mixed liquor is discharged over the control weir flows by gravity in a new mixed liquor channel along the west boundary of the plant site to the new and existing final settling tanks.

There are 11 final settling tanks with a total volume of 16.9 MG and a total overflow rate of 600 gpd per square foot at the DDWF, and a weir loading at DDWF is 10,000 gpd per foot. Effluent from the final settling tanks is disinfected on a year-round basis, prior to discharge in the Rockaway Inlet.

Disinfection of plant effluent is accomplished by the addition of purchased sodium hypochlorite at a maximum dosage of 20 mg/L as chlorine at 220 MGD. Storage tanks provide 15 days of supply at DDWF. Automatic sampling equipment is furnished for measurement of plant effluent and chlorine residuals. Plant effluent, after injection with hypochlorite, flows through three chlorine contact tanks that provide 15 minutes detention at 220 MGD. The plant effluent is then discharged through the existing 72-inch and 90-inch submerged outfalls to Rockaway Inlet.

Sludge thickening is accomplished by gravity thickeners. Six new 60-foot diameter thickeners were constructed to supplement the two existing units (60-foot diameter with 9.25-foot side water depth or SWD). A distribution box for every four thickeners permits uniform flow distribution to the thickeners. The system is designed to allow either separate or combined thickening of primary waste-activated and recirculated digested sludge. Thickener overflow is returned to the plant influent wet well by gravity in a plant drain. Thickened sludge is transferred to anaerobic digesters by means of positive displacement plunger pumps.

Thickened sludge is stabilized by the existing fixed cover high-rate anaerobic digesters; six 71-foot diameter digesters are all equipped with fixed covers and gas mixers. Each digester is rehabilitated and furnished with equipment permitting operation as a primary unit. In addition, two tanks are designed to permit operation as secondary digesters. At average daily flow and all units in service, five digesters provide a detention of 18.5 days and volatile solids loading of 0.13 pounds per day per cubic foot (lb/day/cf). The remaining digester provides three days for supplemental digestion and gas extraction. The three existing sludge boxes are expanded to permit gravity transfer of primary digested sludge to either digester No. 9 or No. 10. The boxes for digester Nos. 9 and 10 permit gravity transfer to the sludge storage tanks. As a backup, six digested sludge transfer pumps are installed to permit pump transfer to the sludge storage tanks.

Digested sludge is pumped via a 12-inch diameter force main to the 26th Ward WPCP for dewatering and beneficial reuse. Capacity for 10 days storage of digested sludge is provided at Coney Island WPCP by five rehabilitated 55-foot diameter tanks. Methane gas generated by anaerobic digestion is being stored in the remaining three 55-foot diameter tanks. The rehabilitated tanks provide a reservoir of gas for the on-site power generation system.

3.1.2. Wet Weather Operating Plan

NYCDEP is required by its SPDES permit to maximize the treatment of combined sewage at the Coney Island WPCP. The permit requires treatment of flows of up to 165 MGD through complete secondary treatment. Further, to maximize combined sewage treatment, the SPDES permit requires flows of up to 220 MGD to be processed through all elements of the WPCP except the aeration basins and the final settling clarifiers.

New York State requires the development of a Wet Weather Operating Plan (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 WPCP, one of the nine elements of long-term CSO control planning. NYCDEP has developed a WWOP for each of its 14 WPCPs, and Table 3-2 summarizes the requirements for the Coney Island WPCP, and notes that flows beyond the maximum capacity of the aeration basins and final clarifiers (i.e., over 165 MGD) would cause damage to the WPCP by creating washout of biological solids and clarifier flooding. The WWOP therefore suggests that the facility is operating at or near its maximum capacity as designed, configured and permitted by NYSDEC. The WWOP for Coney Island was submitted to DEC in April 2005 as required by the SPDES permit and is attached as Appendix A.

3.1.3. Other Operational Constraints

The NYSDEC and the NYCDEP entered into a Nitrogen Control Consent Order that updated the New York City SPDES permits to reduce their nitrogen discharge. The Consent Order was partly a result of the Long Island Sound Study, which determined that a 58.5 percent load reduction of nitrogen discharge would be needed to meet their water quality standards.

Table 3-2. Wet Weather Operating Plan for Coney Island WPCP

Unit Operation	General Protocols	Rationale
Influent Gates and Screens	Leave gate in full open position until screen channel level exceeds acceptable level with maximum pumping, bar screens become overloaded, or primary influent diversion box overflows. Set the gates to maintain acceptable wet well water level and channel levels and put a third primary screen into operation with screen rakes on auto operation in order to accommodate increased flow.	To regulate flow to the plant and prevent damage to plant equipment.
Main Sewage Pumps	As wet well level rises put off-line pumps in service and increase speed of variable speed pumps up to maximum capacity always leaving one pump out of service as standby.	Maximize flow to treatment plant and minimize need for flow storage in collection system and associated overflow from collection system into receiving water body.
Primary Settling Tanks	Keep all eight primary sludge pumps on-line and operational to keep flow balanced to the primary tanks.	Maximize suspended solids and CBOD5 removal, prevent premature weir flooding, prevent short circuiting, prevent excessive sludge and grit accumulation in individual clarifiers, and maximize scum removal.
Bypass Channel	The bypass weirs (actually fixed gates) are designed to bypass flow over 165 MGD or when secondary clarifier weirs are flooded. Because the secondary bypass channel is surcharged with final effluent (due to outfall configuration), the parshall flume located at the bypass channel cannot be utilized to precisely measure secondary bypass flow.	To relieve flow to the aeration system and avoid excessive loss of biological solids and to relieve primary clarifier flooding.
Aeration Tanks	Keep at least four aeration tanks in operation and adjust the airflow to maintain a dissolved oxygen greater than 2 mg/L.	Low DO filaments can grow causing poorly settling sludge.
Final Settling Tanks	Observe the clarity of the effluent and watch for solids loss.	High flows will substantially increase solids loadings to the clarifiers, which may result in high clarifier sludge blankets or high effluent TSS. This can lead to loss of biological solids that may destabilize treatment efficiency in dry weather conditions.
Chlorination	Check, adjust (increase), and maintain the hypochlorite feed rates to provide a chlorine effluent residual of about 0.8 mg/L.	Hypochlorite demand will increase as flow rises and secondary bypasses occur.
Sludge Handling	Proceed as normal.	Uninfluenced by wet weather.

One of the goals of the Nitrogen Consent Order is to control the occurrence of eutrophic conditions in Jamaica Bay by reducing the total nitrogen load discharged to the open waters of the Bay, thus improving compliance with dissolved oxygen standards. The Consent Order obligates the City of New York to undertake and complete the Comprehensive Water Quality Studies for Jamaica Bay by October 2006 and submit recommendations that will become requirements in the SPDES permits of the four Jamaica Bay WPCPs (Rockaway, Jamaica, 26th Ward, and Coney Island). An engineering feasibility analysis was performed at each of these plants as part of the studies, and water quality modeling was performed using the Jamaica Eutrophication Model (JEM) to evaluate combinations of biological nitrogen removal (BNR) processes at each of the WPCPs, ranging from simple process modifications to major capital improvements. The Consent Order also specified process modifications at the 26th Ward WPCP, which have been addressed in the report entitled "Phase I BNR Facility Plan for the Upper East River and the 26th Ward Water Pollution Control Plants" prepared by NYCDEP in 2004. The plan includes modifications to existing aeration tanks at 26th Ward to convert from step-feed aeration to step-feed BNR by modifying aeration and installing baffles to sequentially impose anoxic and oxic conditions favorable to nitrification and denitrification.

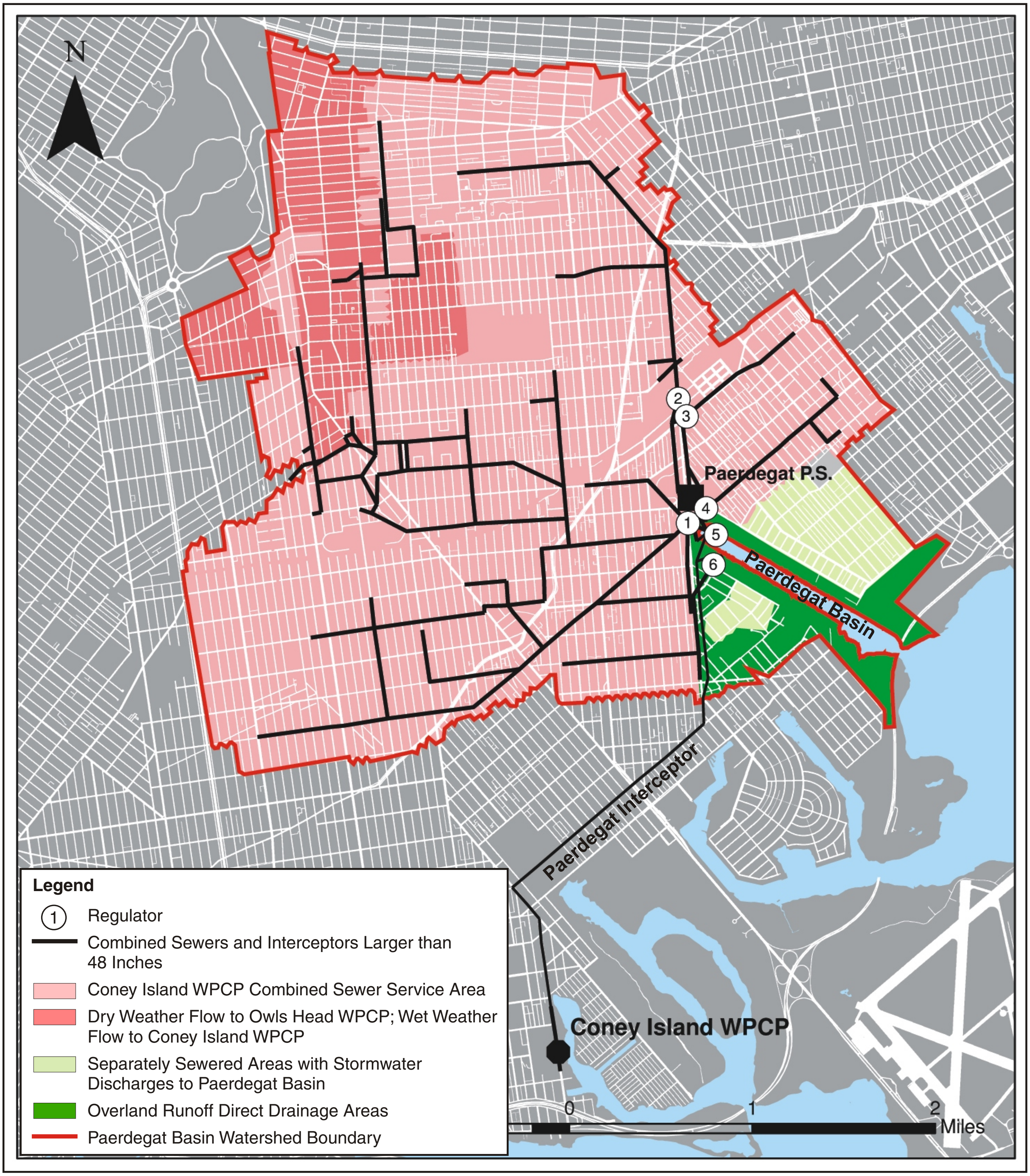
No process modifications were specified for the other three WPCPs in the Consent Order, and the preliminary analysis indicates that no water quality benefits would be realized by retrofitting BNR processes at the Coney Island WPCP.

3.2. COLLECTION SYSTEM

The combined and separated sewer systems within the Paerdegat Basin watershed are in the Coney Island WPCP service area, which is illustrated in Figure 3-3. The service area can be divided into two areas: the Coney Island area, a separately sewered area serviced by the 84-inch Coney Island Interceptor, and the Paerdegat area, a mix of combined and separately sewered areas serviced by the 3.25-mile long 120-inch Paerdegat Interceptor. The latter interceptor begins at the head of Paerdegat Basin, where five CSO flow regulator structures divert flow to the interceptor and provide flow relief during wet weather, discharging to the head of Paerdegat Basin through three large combined sewer outfalls. Three of the regulators discharge dry weather flow to the Paerdegat Pumping Station; the remaining two regulators discharge directly to the 120-inch Paerdegat Interceptor. The CSO discharges to Paerdegat Basin provide the only relief to the combined sewer portion of the Coney Island WPCP collection system. The service area tributary to the CSO regulator structures at the head of Paerdegat Basin is approximately 6,522 acres, of which 6,145 acres (94%) is served by combined sewers and 377 acres (6%) by separate sanitary and storm sewers (i.e., only sanitary flow is conveyed to the regulators). An additional 302 acres drain directly to Paerdegat Basin from parks and other undeveloped lands adjacent to the Basin. The tributary sewer network contains approximately 200 miles of sewer line, of which 163 miles are combined and 37 miles are sanitary sewers.

3.2.1. Combined Sewer System

The combined sewer system tributary to Paerdegat Basin is relieved during wet weather events via five regulators. The five regulators discharge through three outfalls at the headwater terminus of Paerdegat Basin. The three outfalls are designated as CI-004, CI-005, and CI-006, and are permitted by NYSDEC under the Coney Island WPCP SPDES permit (NY-0026182). These discharges are shown on Figure 3-4 and summarized in Table 3-3.



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Sewer System Schematic
Sewershed Tributary to Paerdegat Basin

Paerdegat Basin Long-Term CSO Control Plan

FIGURE 3-3

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Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin CSO and Stormwater Discharge Locations

FIGURE 3-4

Table 3-3. Physical Characteristics Summary of CSOs

Regulator	Location	Outfall	Outfall Size	Drainage Area(ac)
1*	Flatlands Ave. & Paerdegat Ave.	CI-004, 005	2 @ 12' X 9'	3,845
2	Ralph Ave. & Chase Ct.	CI-005	5 @ 12' X 9'	1,273
3	Ralph Ave. & Foster Ave.	CI-005	5 @ 12' X 9'	158
4	Flatlands Ave. & Paerdegat Ave. North	CI-005	5 @ 12' X 9'	414
6	Ralph Ave. & Avenue K	CI-006	2 @ 138" dia	455
Total Combined Sewer Area (acres)				6,145
*Regulator 1 receives wet weather overflow from Regulator 6 (730 acres) and from 883 acres of the Owls Head WPCP service area (included in the value shown above)				

Figure 3-5 shows the schematic of the collection system in the vicinity of these regulators. Three sewers flow into R-1: a 216-inch combined sewer, a 90-inch combined sewer, and an 84-inch combined sewer. R-1 is a diversion chamber consisting of a bench that is dissected by a multi-branched trough. The bench, with a top elevation of 4.28 ft below the Brooklyn Sewer Datum (BSD), is used to separate the flow. Regulators R-2, R-3, and R-4, are dam-type diversion structures, with top elevations of +2.5 ft BSD, +2.5 ft BSD, and -3.51 ft BSD, respectively. Regulator R-6 is a bench-type diversion structure with a top elevation of -2.5 ft BSD. Regulator R-2 receives flow from a single 138-inch combined sewer; R-3 receives flow from a single 90-inch combined sewer; R-4 from a single 108-inch combined sewers; and R-6 from a twin barrel 204-inch combined sewer.

Dry Weather Flow (DWF) from regulator R-3 flows to the Paerdegat Basin Pumping Station via an 18-inch sanitary sewer that combines with (DWF) from R-2 and R-4, and is conveyed to the pumping station via a 72-inch sewer. The flow is then pumped to the 120-inch Paerdegat Interceptor. DWF from R-1 and R-6 flows directly to the interceptor. Excessive (wet weather) flow overtops the bench and flows through tide gates into a 3-section 180-inch storm sewer. It then combines with overflows from R-2, R-3 and R-4 before discharging into Paerdegat Basin. Continued excess flow enters a secondary 138-inch sewer at El. -4.09 ft BSD, and then passes through tide gates, identified as R5, which discharges into the Basin. The CSO outfalls are at relatively low elevations, and are routinely submerged by high tide. Tide gates prevent the backflow of Paerdegat Basin into the collection system.

Simply stated, the combined sewer system consists of 5-regulators, 3-outfalls, 1 pump station and one interceptor that direct sanitary sewage and combined sewage to the Coney Island WPCP. The collection system is not known to have any chronic historical problems or bottlenecks that have not been resolved over the time that the system has been built out. Further, as will be discussed later in this report, the solution to the water quality problems experienced within Paerdegat Basin require large reductions in CSO overflow volumes that lend themselves to a centralized retention facility. With that reality, small improvements that could be possible within the sewer system (i.e.: enhanced Paerdegat Pump Station pumping, raising regulator weirs, expanding the size of branch interceptors) do not require further attention, as part of an LTCP, as they would not contribute to additional wet weather flow being treated beyond what is being proposed in the LTCP (Section 8.0).

3.2.2. Paerdegat Pumping Station

The Paerdegat Pumping Station was originally a treatment plant built in the early 1900s to service trunk sewers that were constructed on Ralph and Flatlands Avenues in the early 1920s to drain upland areas (Hazen and Sawyer, 1991). By the time construction began the design was changed to a pump station to convey sewage to the present-day Coney Island WPCP. The station has a maximum capacity of 57 MGD, and receives dry weather flow from regulators R-2, R-3, and R-4, representing approximately one-third of the combined sewer area tributary to Paerdegat Basin. The Pumping Station also receives sanitary flow from the separately sewered Canarsie area.

The Paerdegat Pumping Station has a battery of six pumps, three variable speed units rated at 12.25 MGD and three constant speed units rated at 10 MGD. The nominal capacity (57 MGD) is achieved with one constant speed pump on standby. The current practice is to allow the variable speed units to handle the flow by themselves since they have large capacities and can vary automatically with the wet well level. The constant speed units start up only during rain events. There are two sewer lines entering the station: a 48-inch sanitary line from the separately sewered Canarsie area, and a 72-inch combined sewer line from regulators R-2, R-3, and R-4. Both pipes enter the low level wet well, where all six pump intakes draw flow via 16-inch inlets. The station discharges to the beginning of the 120-inch Paerdegat Interceptor via a 48-inch force main and drop connection.

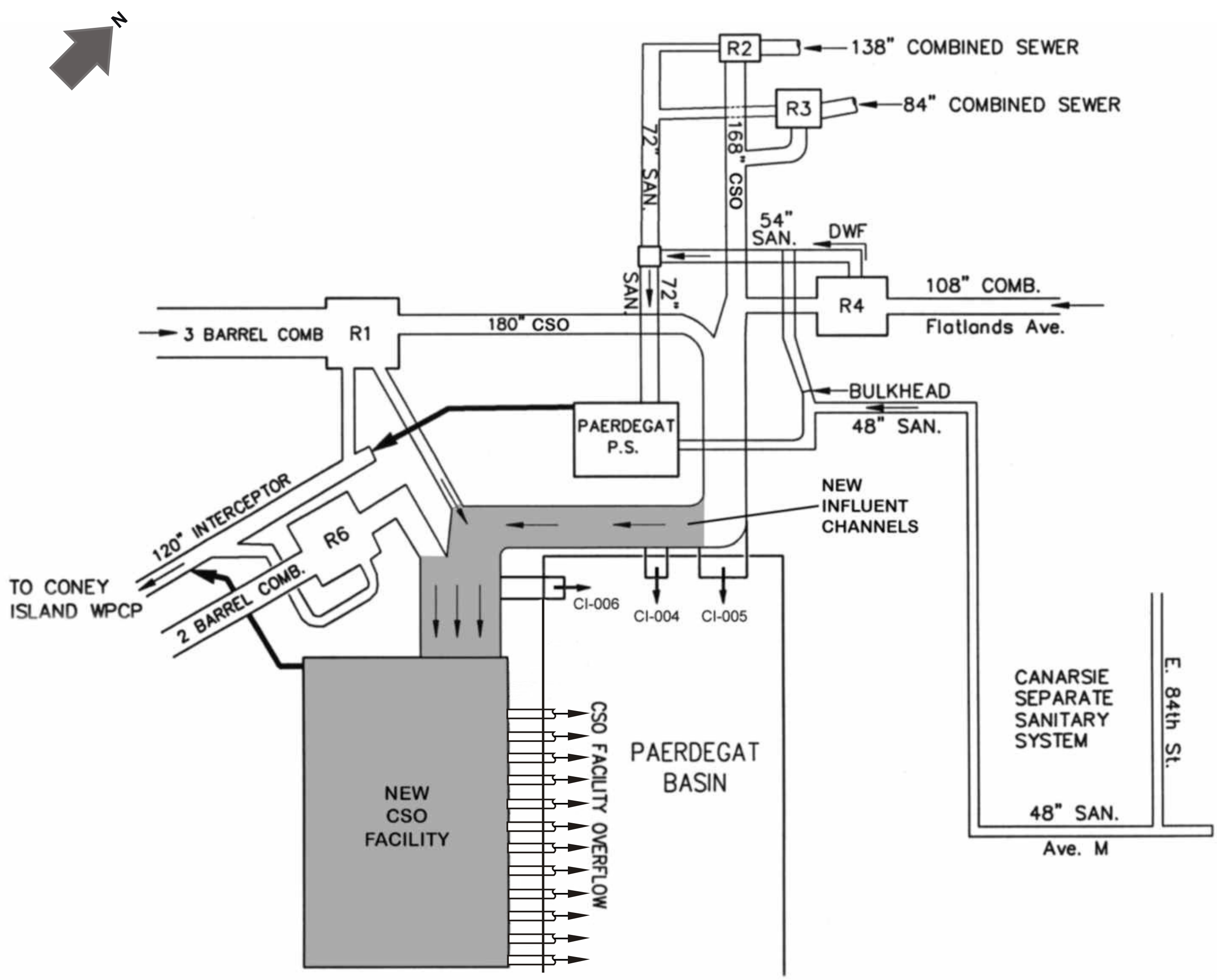
Combined sewage is routed to the interceptor from the drainage area tributary to the Pumping Station and cannot exceed the Station's maximum capacity. Flow in excess of the Station overflows out to Paerdegat Basin as a CSO discharge.

3.2.3. Stormwater System

The separately sewered areas to the north and south of Paerdegat Basin discharge stormwater directly to the waterbody at five locations. The total separately sewered drainage area is 377 acres. The NYCDEP 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. NYCDEP was further required to execute abatement programs to eliminate all untreated discharges. CSOs, stormwater discharges, highway drains, industrial discharges, etc. were all identified and mapped during the program, including those for Paerdegat Basin. Building on their SPDES numbering system, stormwater discharges are numbered in the Shoreline Survey program with a 600 series. Four stormwater discharges are located on the north shore (CI-629, CI-630, CI-631 and CI-632) and one discharge is on the south shore (CI-628). The stormwater discharge locations, their drainage areas and outfall sizes are summarized in Table 3-4. Outfall locations are illustrated on Figure 3-4.

3.3. DISCHARGE CHARACTERISTICS

The Paerdegat Basin watershed is highly urbanized in nature. The original topographic watershed of approximately 6,600 acres has been altered to 6,825 acres (Figure 3-6) 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 Paerdegat Basin



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Sewer System Schematic Near the Head End of Paerdegat Basin

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Comparison of Natural and Urbanized Watershed Tributary to Paerdegat Basin

FIGURE 3-6

is CSO and stormwater discharges. Direct overland runoff from parkland and undeveloped areas immediately adjacent to the waterbody still occurs, but is insignificant in terms of quantity and impact in comparison to combined and stormwater discharges. Table 3-5 shows that 88 percent of the Paerdegat Basin watershed is within the combined sewer collection system, and an additional eight percent of the drainage area is captured and conveyed by stormwater collection systems. Thus, 96 percent of the watershed runoff arrives at Paerdegat Basin via artificial conveyance systems through point source discharges. 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 to a high runoff yield typical of urban landscapes. The urbanized nature also affects the water quality of watershed runoff to Paerdegat Basin. In comparison to pristine conditions such as rural landscapes of forests, fields, 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 3-4. Physical Characteristics Summary of Stormwater Outfalls

Stormwater Outfalls	Outfall Location	Outfall Size	Drainage Area (ac)
CI-628	Avenue L & Paerdegat Basin	66" dia	81
CI-629	Paerdegat 4th Street & Paerdegat Basin	78" dia	79
CI-630	Paerdegat 7th Street & Paerdegat Basin	78" dia	81
CI-631	Paerdegat 10th Street & Paerdegat Basin	60" dia	44
CI-632	Paerdegat 13th Street & Paerdegat Basin	78" dia	93
Total Stormwater Drainage Area			377
NOTE: Numbers may not add exactly due to rounding			

Table 3-5. Paerdegat Basin Watershed Summary

Source Category	Drainage Area (Acres)	Percent of Watershed
CSO	6,145	90%
Stormwater	377	6%
Direct Runoff	302	4%
Total Watershed	6,824	100 %

3.3.1. Landside Modeling

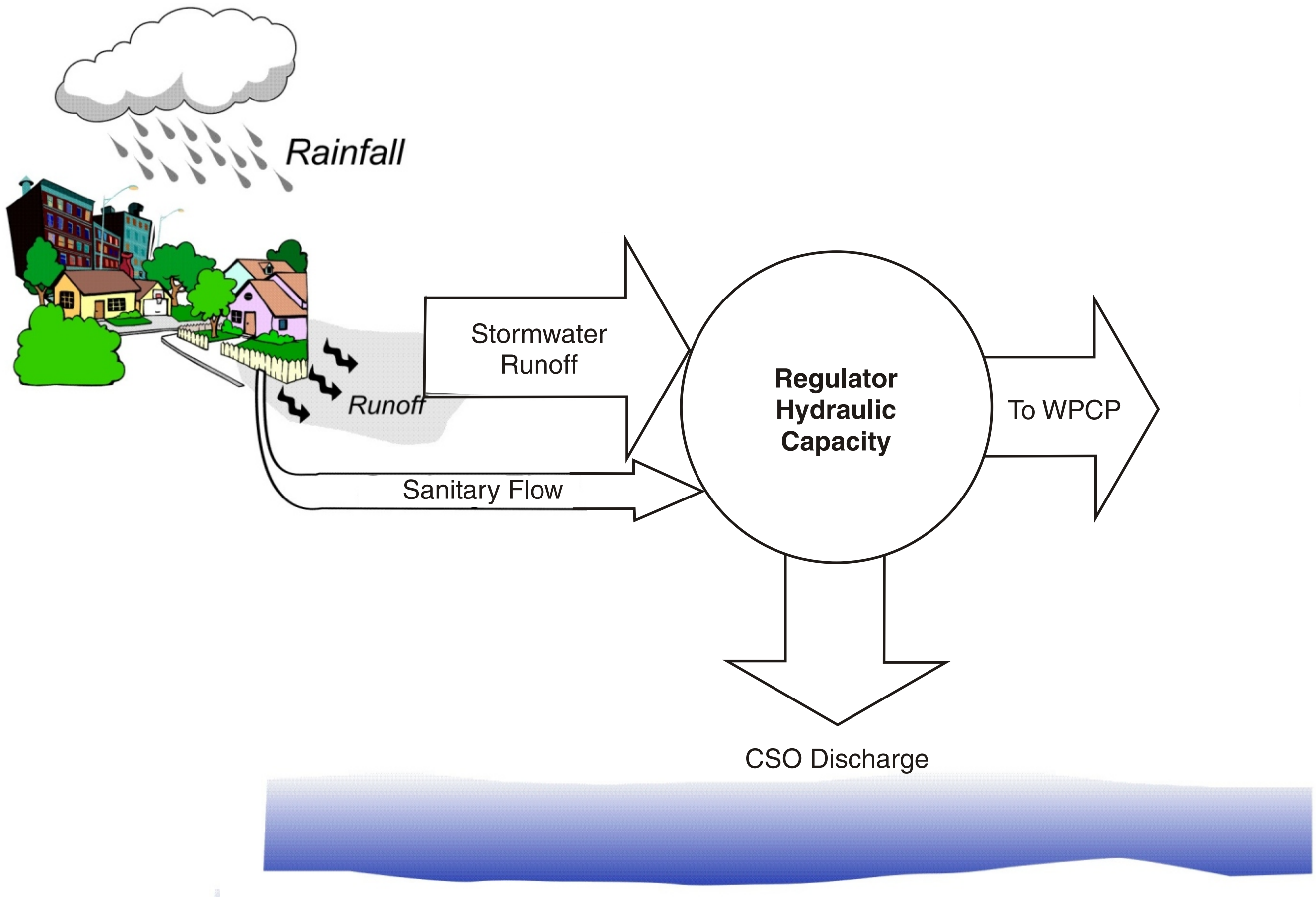
During the development of the Paerdegat Basin CSO Facility Plan, the collection system was modeled using the Stormwater Management Model (SWMM), a simplified version of SWMM, and the proprietary RAINMAN rainfall-runoff model. The SWMM model was calibrated to actual CSO flow and quality measurements. Subsequently, RAINMAN was calibrated to both the SWMM model results and influent data at the WPCPs during dry weather and wet weather conditions. RAINMAN, therefore, is considered a viable tool for calculating CSO and stormwater discharges to Paerdegat Basin to the resolution necessary for facility planning purposes. A third modeling tool, TANK, was also developed during facility planning to analyze retention facility performance with respect to CSO flow and pollutant loading reductions for both the storage overflows and system bypasses which may occur during very intense rainfall events. The models calculated flow (Q), total suspended solids (TSS), total organic carbon, BOD, dissolved oxygen, and total coliform bacteria (TC) for combined sewer overflows to Paerdegat Basin based on 1988 precipitation. Additional pathogen modeling for enterococci was performed at a later date to address changes in regulations.

Schematics of the RAINMAN and TANK models are shown on Figure 3-7 and Figure 3-8. RAINMAN was used to calculate the total flow to a CSO regulator based on existing dry weather flow, rainfall, drainage areas, and runoff coefficients. The combination of sanitary flow and stormwater flow is mixed at the regulator and is either discharged through the CSO or conveyed to the WPCP depending on the hydraulic capacity of the regulator. The TANK model takes the output from RAINMAN and computes the volume retention that will eventually be treated or discharged to the receiving waters. Both the RAINMAN and TANK models are used to calculate flow and loading information for all modeling scenarios.

Because the loading rates are based on the mixture of sanitary sewage and street surface runoff that is discharged, concentrations must be associated with each of these fractions. A significant amount of CSO quality data was collected during the initial stages of CSO facility planning for Paerdegat Basin. A sampling program was conducted during the summer of 2002, to supplement the historical data with more recent total and fecal coliform bacteria and enterococci data that would be reasonably representative of sanitary sewage in New York City's combined sewer system. Influent sampling of all 14 New York City WPCPs was conducted. Each WPCP was sampled on at least five distinct days, with samples being collected several times during the day, on a random basis such that no WPCP was sampled on two successive days or on the same day of the week. At least one day of dry weather (preferably two or more) was required prior to the sampling event to assure that sample collection represented sanitary sewage only. In addition, in 2004 an additional sampling program was conducted in the City to target sampling on the characterization of stormwater (street surface runoff) pollutant concentrations for conventional pollutants and pathogens. This program was conducted through the NYCDEP Total Residual Chlorine (TRC) Management Program (NYCDEP, 2005) for development of the NYCDEP Long-Term Control Plans and for the USEPA Harbor Estuary Program TMDL Development. Based on the 2002 Influent sampling, the 2004 stormwater sampling, and sampling performed for the Paerdegat Basin CSO Facility Planning Project (Hazen and Sawyer, 1991) sanitary and stormwater pollutant concentrations were developed and incorporated into RAINMAN to calculate pollutant-loading rates. These concentrations and the average calculated CSO concentrations based on the sanitary/stormwater mixture are summarized in Table 3-6.

The RAINMAN model was used to simulate Baseline conditions to compute discharge flows and pollutant loading rates to Paerdegat Basin. For the baseline simulation, the following conditions were assumed:

- Precipitation was based on rainfall measured in 1988 at JFK airport;
- Dry weather flows were based on 2045 population projections;
- The Coney Island WPCP could receive up to twice the design dry-weather flow (i.e., 220 MGD).



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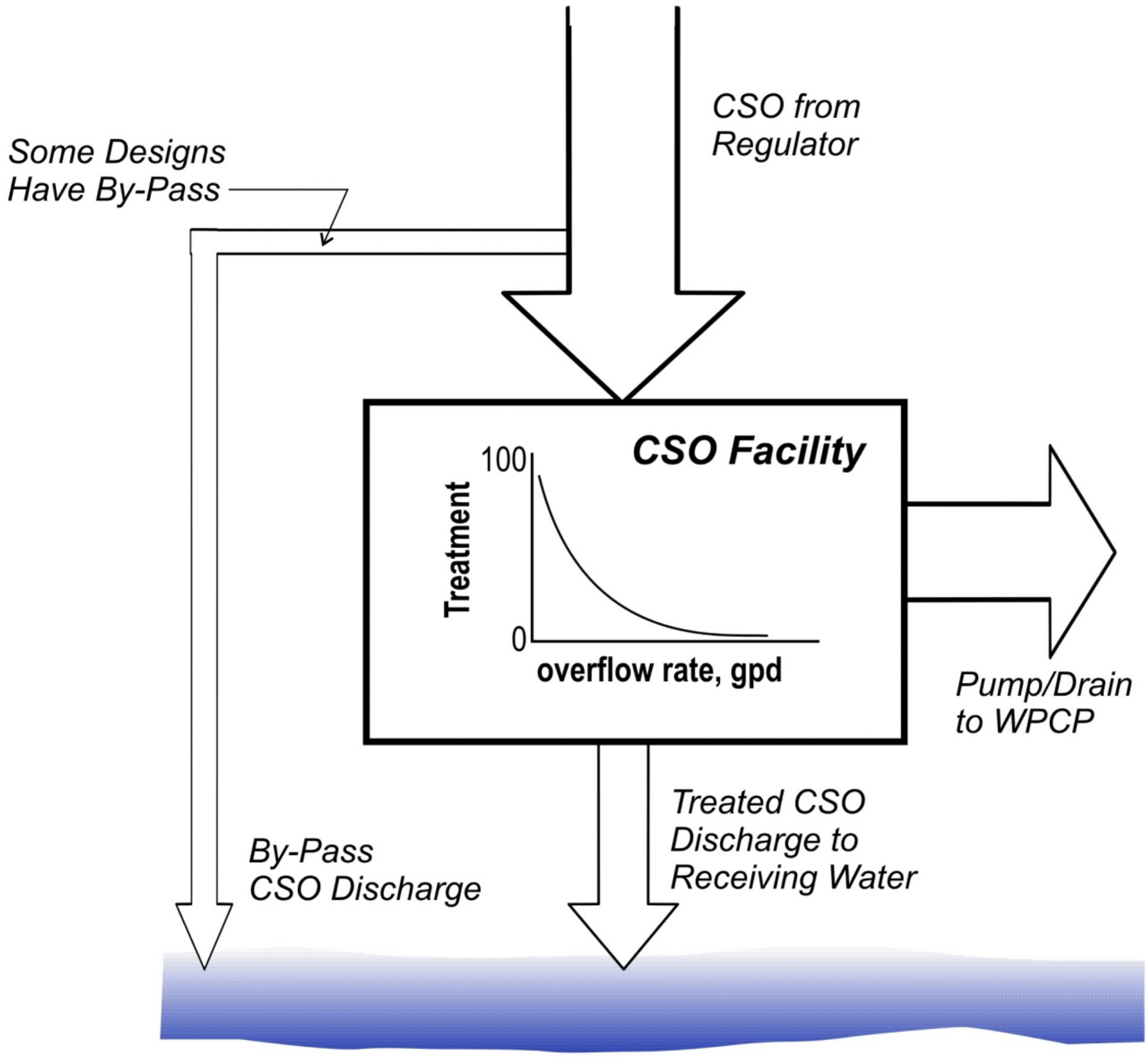
Schematic of the RAINMAN Model for the Coney Island WPCP Collection System

FIGURE 3-7



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Schematic of the TANK Model Used for the Evaluation of Retention Alternatives

FIGURE 3-8

The calculated annual CSO and stormwater flows and pollutant loading rates for baseline conditions are summarized in Table 3-7 and Table 3-8, respectively.

Table 3-6. Estimated CSO and Stormwater Concentrations

Parameter	Sanitary	Surface Runoff	CSO(1)
TSS, mg/L	130	60	170(2)
BOD, mg/L	110	15	70(2)
DO, mg/L	1.0	6.5	5.5
Total Coliform, per 100 mL	$1.5 \cdot 10^7$	$2.0 \cdot 10^5$	$2.4 \cdot 10^6$
Fecal Coliform, per 100 mL	$4.0 \cdot 10^6$	$1.2 \cdot 10^5$	$7.4 \cdot 10^5$
Enterococci, per 100 mL	$1.0 \cdot 10^6$	$5.0 \cdot 10^4$	$2.0 \cdot 10^5$
(1) Based on average mixture of sanitary and surface runoff (2) Includes an estimate of the effect of scour			

Table 3-7. Discharge Flows for Baseline Conditions from RAINMAN

Type	Number of Events	Total Annual Volume (MG)
CSO Total	-	2,749
CI-004/5	61	1,210
CI-005	61	973
CI-006	61	566
Stormwater(1)	100	243
Total	-	2,992
(1) Five outfalls serving separately sewered areas		

Table 3-8. Discharge Loading Rates for Baseline Conditions

Parameter	CSO Load	Stormwater Load	Total Load
TSS (lbs)	$3.97 \cdot 10^6$	$1.22 \cdot 10^5$	$4.09 \cdot 10^6$
BOD (lbs)	$1.62 \cdot 10^6$	$3.04 \cdot 10^4$	$1.65 \cdot 10^6$
DO (lbs)	$1.27 \cdot 10^5$	$1.32 \cdot 10^5$	$1.40 \cdot 10^5$
Total Coliform (No.)	$2.25 \cdot 10^{17}$	$1.84 \cdot 10^{15}$	$2.27 \cdot 10^{17}$
Fecal Coliform (No.)	$6.93 \cdot 10^{16}$	$1.10 \cdot 10^{15}$	$7.04 \cdot 10^{16}$
Enterococci (No.)	$1.87 \cdot 10^{16}$	$4.59 \cdot 10^{14}$	$1.92 \cdot 10^{16}$

The Paerdegat Basin landside model referred to above as RAINMAN is the result of many previous sewer system-modeling activities conducted using models, such as US EPA SWMM, summarized in various reports (Hazen and Sawyer, 1991). The ability of RAINMAN to reproduce overflows and volumes has received extensive calibration in various areas of New York City as well as other municipalities. The calibration and use of RAINMAN to calculate overflows and pollutant concentrations is documented in an associated report (LTCP Joint Venture, 2006a).

3.3.2. Effect of Urbanization on Discharge Characteristics

There has been a significant increase in the amount of runoff discharged to Paerdegat Basin compared to when it was Bedford Creek, due primarily to the urbanization of the watershed and the corresponding increase in imperviousness. The watershed is home to a population of 490,000 and, as shown in Table 2-1, 84 percent of the watershed is characteristically residential and mixed use (public facilities and institutional, commercial, manufacturing and transportation). Ground surfaces in neighborhoods of this nature are predominately hardened by rooftops, sidewalks, paved playgrounds, parks and schoolyards, and streets, thoroughfares and highways. The imperviousness of such a watershed is typically around 70 percent. During the period of early development, the impervious cover was likely around 5 percent. The increase in impervious cover from 5 percent to 70 percent or more occurred as natural runoff pathways were eliminated by the creation of streets, rooftops, and parking lots. During this build-out, surface and subsurface storage within the watershed disappeared. All natural streams previously tributary to Bedford Creek have been eliminated and there are now no freshwater tributaries to Paerdegat Basin and as such the vast majority of runoff from rainfall enters the Basin through huge concrete sewers. Tidal wetlands and sinuous streambeds 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 Paerdegat Basin in a substantially shorter duration. By decreasing the travel time, peak discharge rates to the waterbody are correspondingly more severe: RAINMAN modeling of 1988 calculated a maximum instantaneous peak flow of 3 billion gallons per day (BGD).

A summary of the hydrologic changes caused by urbanization in Paerdegat Basin's watershed is presented in Table 3-9. The pre-urbanized condition is assumed circa 1900. The table demonstrates that the overall size of the watershed has increased by only about 3 percent as a result of sewer construction, but the runoff volume has increased dramatically. Runoff yield for an average precipitation year as calculated by RAINMAIN has increased from approximately 730 MG of natural runoff to 3,300 MG discharged by combined and separate sewer systems to Paerdegat Basin, an increase of 450 percent. By volume, CSO discharges to Paerdegat Basin represent a quarter of all CSO discharges to Jamaica Bay, and Paerdegat Basin represents less than 0.5 percent of the volume of Jamaica Bay. Significantly larger discharges are now made directly to Paerdegat Basin at dramatically higher rates that are no longer attenuated, filtered, or mitigated by the adjoining wetlands that have been virtually eliminated.

A pollutant loading comparison is summarized in Table 3-10 using typical pollutant concentrations from literature sources. The table compares pre-urbanized pollutant loadings of total suspended solids and biochemical oxygen demand – two pollutants with significant impact on Paerdegat Basin water quality – to the existing urbanized condition. The annual volumes used for this table are taken from those of Table 3-9 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 Paerdegat Basin by orders of magnitudes.

Table 3-9. Effects of Urbanization on Watershed Yield

Watershed Characteristic	Pre-Urbanized	Urbanized[1]
Drainage Area (acres)	6,620	6,824
Adjacent Wetlands (acres) [2]	300	10
Population[4]	150,000	490,000
Imperviousness	10%	70%
Average Annual Runoff Yield (MG)[3]	730	3,300
Peak Storm Runoff Yield (MG)[3]	45	221
Notes: (1) Existing condition (2) Approximated from historical maps (3) For an average precipitation year (JFK, 1988), including stormwater (4) Pre-urbanized is estimated for year 1890; urbanized estimate based on Year 2000 U.S. Census.		

Table 3-10. Effects of Urbanization on Watershed Loadings

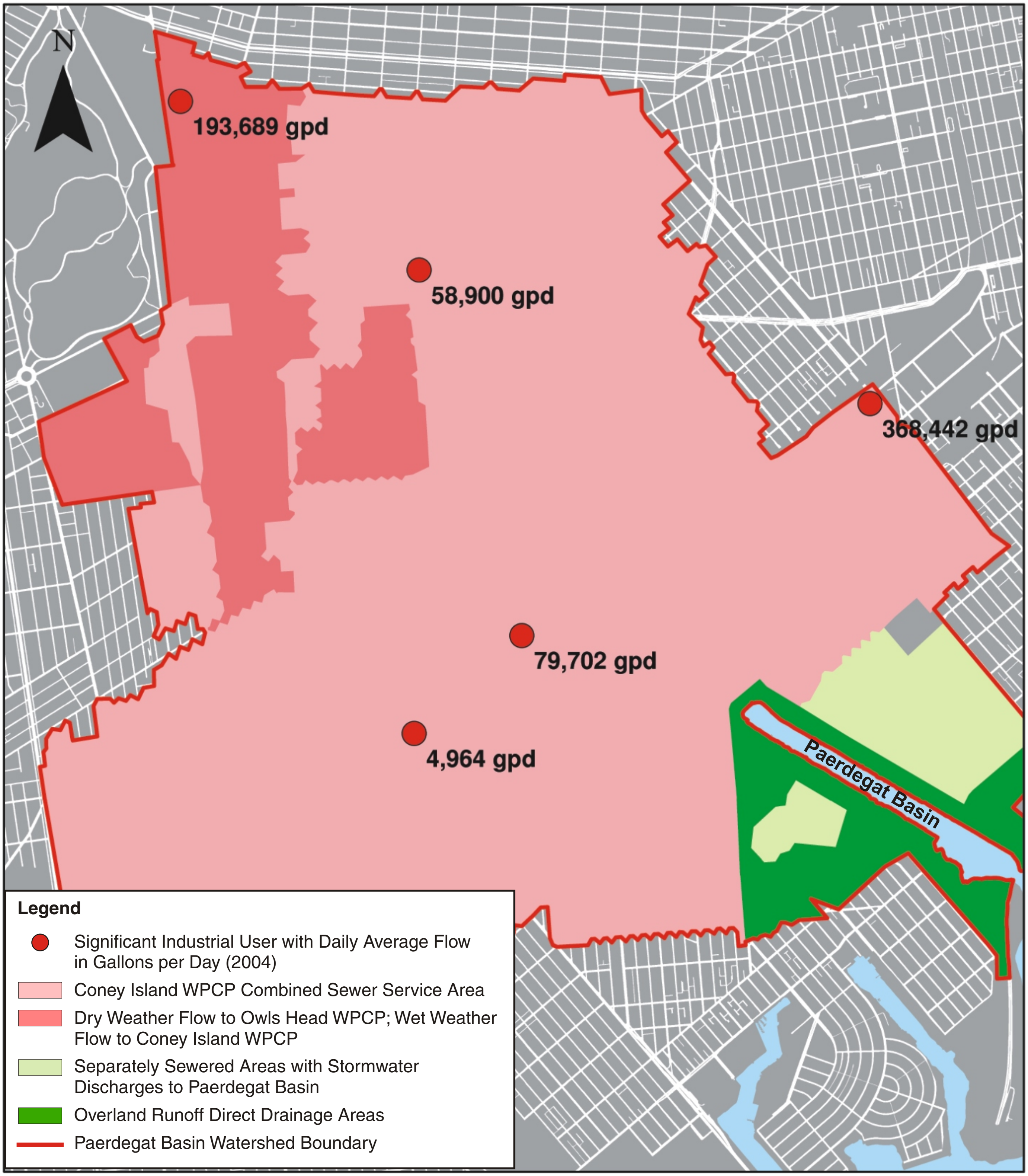
Annual Pollutant Load[1]	Pre-Urbanized[2]	Urbanized[3]	Change
Total Suspended Solids (lb/year)	365,000	4,530,000	1,240%
Biochemical Oxygen Demand (lb/year)	91,200	1,830,000	2,000%
Notes: (1) For an average precipitation year (JFK, 1988) (2) Circa 1900, using stormwater concentrations (3) Existing condition, including CSO and stormwater discharges			

3.3.3. Toxic Discharge Potential

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. For industrial source control in separate and combined sewer systems, USEPA requires 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 treatment plants by regulating Significant Industrial Users (SIU). If a proposed Industrial Pretreatment Program is deemed acceptable, USEPA will decree the local municipality a Control Authority. NYCDEP 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 non-residential users, and perchloroethylene from dry cleaning. NYCDEP 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.

As part of the IPP, NYCDEP analyzed the toxic metals contribution of sanitary flow to CSOs by measuring toxic metals concentrations in WPCP 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 main WPCP outfalls. Recent data suggest even lower discharges. In 2004, the average mass of total metals discharged by all regulated industries to the New York City WPCPs 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 NYCDEP report on meeting the nine minimum CSO control standards required by federal CSO policy, in which NYCDEP considered the impacts of discharges of toxic pollutants from SIUs tributary to CSOs (NYCDEP, 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.

Figure 3-9 shows the SIUs in the Paerdegat Basin sewershed area, along with their 2004 daily average flow rates. The total daily flow of these five SIUs was approximately 0.71 MGD, or approximately 2.8 percent of the dry weather flow at the Paerdegat Pumping Station (25 MGD), and approximately 14.4 percent of the City-wide SIU flow. It can be inferred from these flows that, of the 38.2 lb/day of metals in the sanitary flow City-wide, approximately 5.5 pounds per day were conveyed by the Paerdegat Pumping Station to the Coney Island WPCP. Considering how infrequently CSO discharges occur in comparison to the continuous operation of the pumping station, the total mass of heavy metals that is discharged during wet weather as CSO is even less on a daily average basis. As a result of the small scale of this discharge, NYSDEC has not listed Paerdegat Basin as being impaired by toxic pollutants associated with CSO discharges. As such, metals and toxic pollutants are not considered to be pollutants of concern for the development of this LTCP.



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Paerdegat Basin Long-Term CSO Control Plan

Significant Industrial Users in the Paerdegat Basin Sewershed

FIGURE 3-9

4.0. Waterbody Characteristics

Paerdegat Basin is classified as a saline tributary to Jamaica Bay according to Title 6 of the New York Code of Rules and Regulations (NYCRR), Chapter X, Part 891. All of Paerdegat Basin is classified as a minor river tidal tributary, although the only freshwater inflows to the waterbody are CSO and stormwater discharges. It is approximately 6,675 feet long and 450 feet wide on average, opening onto the dredged navigational channels in Jamaica Bay. The Bay is a shallow estuary located on the south shore of western Long Island, New York classified as an embayment in the New York code. Roughly semi-circular in shape, Jamaica Bay is approximately four miles wide, north to south, and eight miles long, east to west. Much of the area in the center of Jamaica Bay consists of narrow channels and tidal marsh islands that are exposed during low tides while navigable channels, of approximately 30 feet in depth, encircle most of the outer ring of the Bay, with navigable tributaries such as Paerdegat Basin connecting to the main channel. Tidal exchange with the Atlantic Ocean is through Rockaway Inlet. The Jamaica Bay watershed includes portions of Brooklyn, Queens and Nassau County. Figure 4-1 illustrates the delineation of Paerdegat Basin and Jamaica Bay waterbody types.

The following sections discuss the physical, chemical, and ecological conditions in Paerdegat Basin and Jamaica Bay.

4.1. CHARACTERIZATION METHODOLOGY

The USEPA guidance for monitoring and modeling notes that the watershed-based methodology "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 quantitative measures of both water quality conditions and the success of long-term control plans based on site-specific conditions, and in a manner that illustrates trends and results over time. Measures may be based on administrative (programmatic), end-of-pipe, ecological, or human health and use. Collecting data and background information to establish a solid understanding of "baseline" conditions is critical to analyzing CSO impacts and evaluating the results of CSO control. Although essential elements of many of the CSO facility planning projects undertaken by NYCDEP were initiated prior to the establishment of long-term CSO control policy, these elements were consistent with this guidance in most cases. Nonetheless, the waterbody assessment began with the compilation and analysis of existing data from investigations conducted by NYCDEP and other agencies spanning several decades. Deficiencies in these existing data sets were identified and sampling programs were developed to address those data gaps. Characterization activities followed the Work Plans developed under the USA Project, the progenitor of the current LTCP Project. These efforts yielded valuable information in support of characterization, mathematical modeling, and engineering efforts. The following describes these activities.

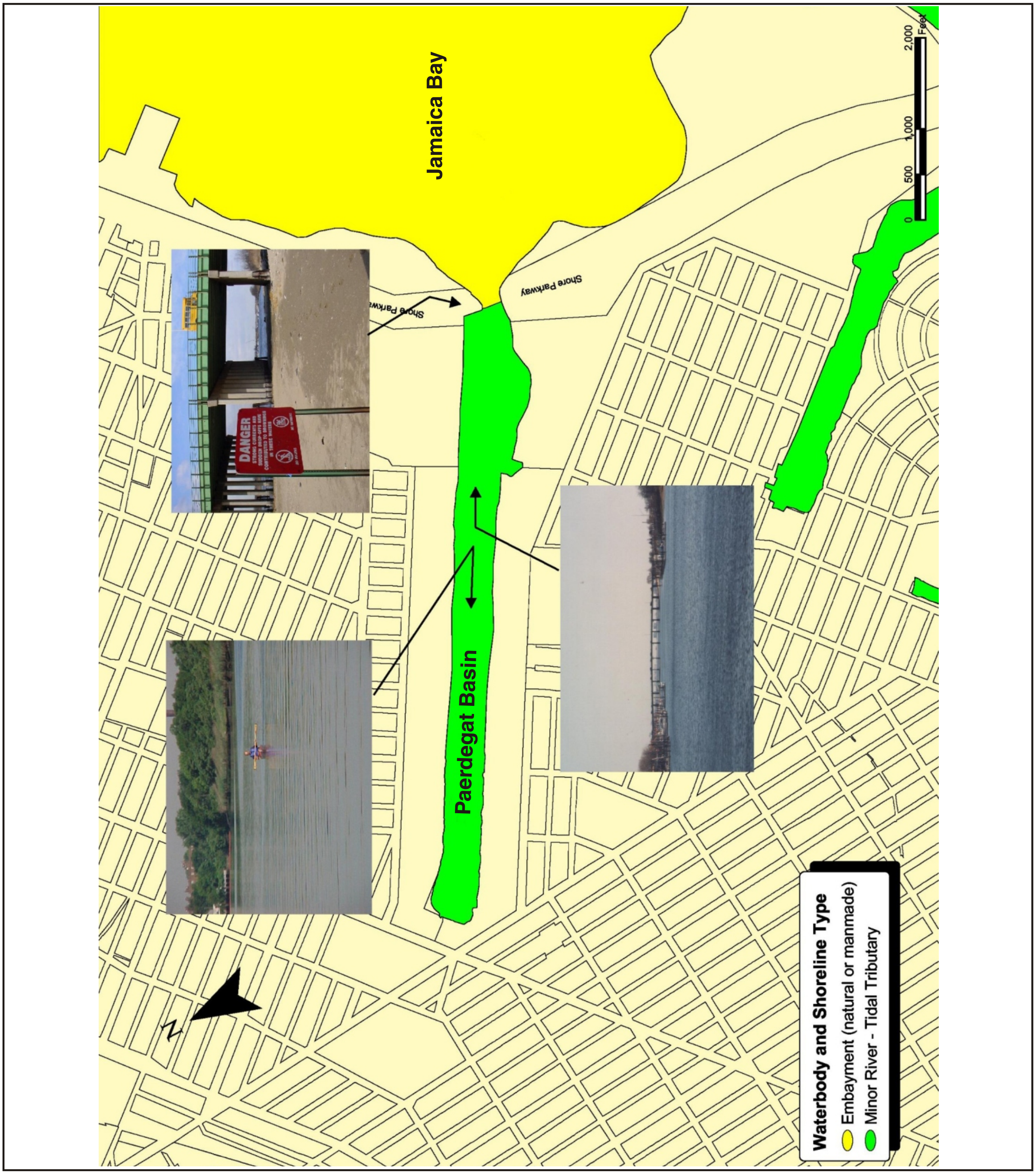
4.1.1. Compilation of Existing Data

A comprehensive review of past and ongoing data collection efforts was conducted to identify programs focused on or including Paerdegat Basin and nearby waterbodies. NYCDEP has conducted facility planning in Paerdegat Basin since at least 1978, when the 208 Study identified the waterbody for CSO abatement. Facility planning has been ongoing since that time, resulting in a large body of pertinent data. Several other parallel projects by NYCDEP and others have also been conducted that further contribute to the abundance of data available (see Section 5.0). Much of this data was not collected directly within the limits of Paerdegat Basin, but was collected in Jamaica Bay for various purposes, and the age of many of these data sets may limit their applicability to waterbody characterization. NYCDEP 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, and various utility concerns.

4.1.2. Biological and Habitat Assessments

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 dissolved oxygen, 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 (which, being largely sessile, have historically been used as indicators of environmental quality); 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 (their presence being related to fish procreation); and juvenile and adult fish (their presence being a function of habitat preferences and/or dissolved oxygen tolerances).

These field investigations were executed under a harbor-wide biological Field Sampling and Analysis Program (FSAP) designed to fill ecosystem 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 USEPA's Quality Assurance Project Plan guidance (USEPA, 1998, 2001a, 2001b), its standard operation and procedure guidance (USEPA, 2001c), 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



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Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Waterbody Type

FIGURE 4-1

aquatic organisms and factors that contribute to use limitations (dissolved oxygen, 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.

Several FSAPs were conducted by NYCDEP during the Use and Standards Attainment (USA) Project that included investigations of Paerdegat Basin. Following review by the NYSDEC and other members of the Project Steering Committee, the Paerdegat Basin FSAP was initiated in early summer, 2000. Simultaneously, other FSAPs were developed to complement this FSAP, while also providing data for each of the other USA Project waterbodies. These FSAPs, including one dealing with fish and benthic invertebrates of Jamaica Bay and the rest of its tributaries (HydroQual, 2001a), one dealing with waterbody wide (i.e., all 23 waterbodies) assessment of fish propagation (HydroQual, 2001b), and one dealing with epibenthic invertebrate recruitment (HydroQual, 2001c), were implemented in 2001. In 2002 another FSAP was developed to further evaluate fish larvae distribution and abundance in Paerdegat Basin and nearby stations in Mill Basin and Jamaica Bay (HydroQual, 2002a). Figure 4-2 provides a composite map of the biological FSAP sampling station locations, and Figure 4-3 is a composite of the Jamaica Bay area sampling station locations specified in the three other FSAPs.

NYCDEP 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. 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 and Figure 4-3. One station was located in Paerdegat Basin. 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 dissolved oxygen conditions.

NYCDEP 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 and Figure 4-3. Three stations were located in Paerdegat Basin. 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, 2002b). 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. One facet of water quality model computations is to be able to project changes in benthic invertebrate community composition, species richness, and diversity that may result from changes in bottom sediment TOC. Combined sewer overflows are a primary source of TOC in New York Harbor tributaries. Abating CSO will reduce TOC sources and have a beneficial impact on tributaries. Therefore, a key component in determining the reliability of benefit projections is to have well-calibrated model computations of sediment TOC. 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 and Figure 4-3. Three of the stations were located in Paerdegat Basin. Two samples from each station were tested for TOC, grain size, and percent solids.

4.1.3. Other Data Gathering Programs

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 City-wide 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 Paerdegat Basin Water Quality Facility Plan, two dry weather and three wet weather surveys paired with special studies were conducted during 1986 to characterize water quality and sediment conditions and identify sources of impairments (Hazen and Sawyer, 1991).

NYCDEP 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" (NYCDEP, 2000). Among the harbor-wide sampling locations, data has been collected at one station near the mouth of Paerdegat Basin in Jamaica Bay (Station J2), and at three special monitoring locations in Paerdegat Basin during 1993, 1994, 1995 and 2000 in response to water quality complaints. The Harbor Survey recently established a tributary monitoring station in Paerdegat Basin during the summer of 2002. Harbor Survey stations are shown on Figure 4-5.

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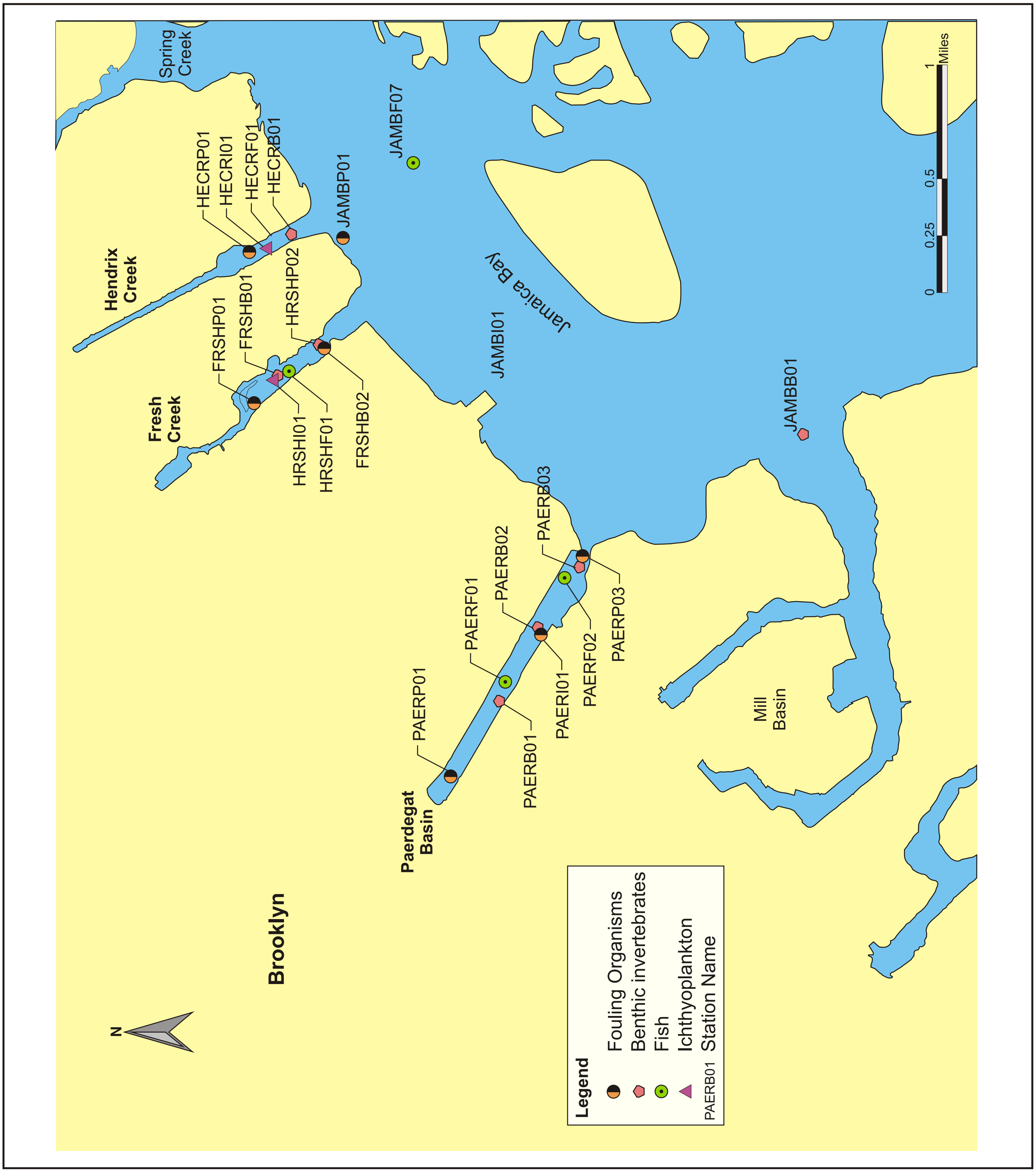

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Paerdegat Basin
Biological FSAP Sampling Stations

FIGURE 4-2

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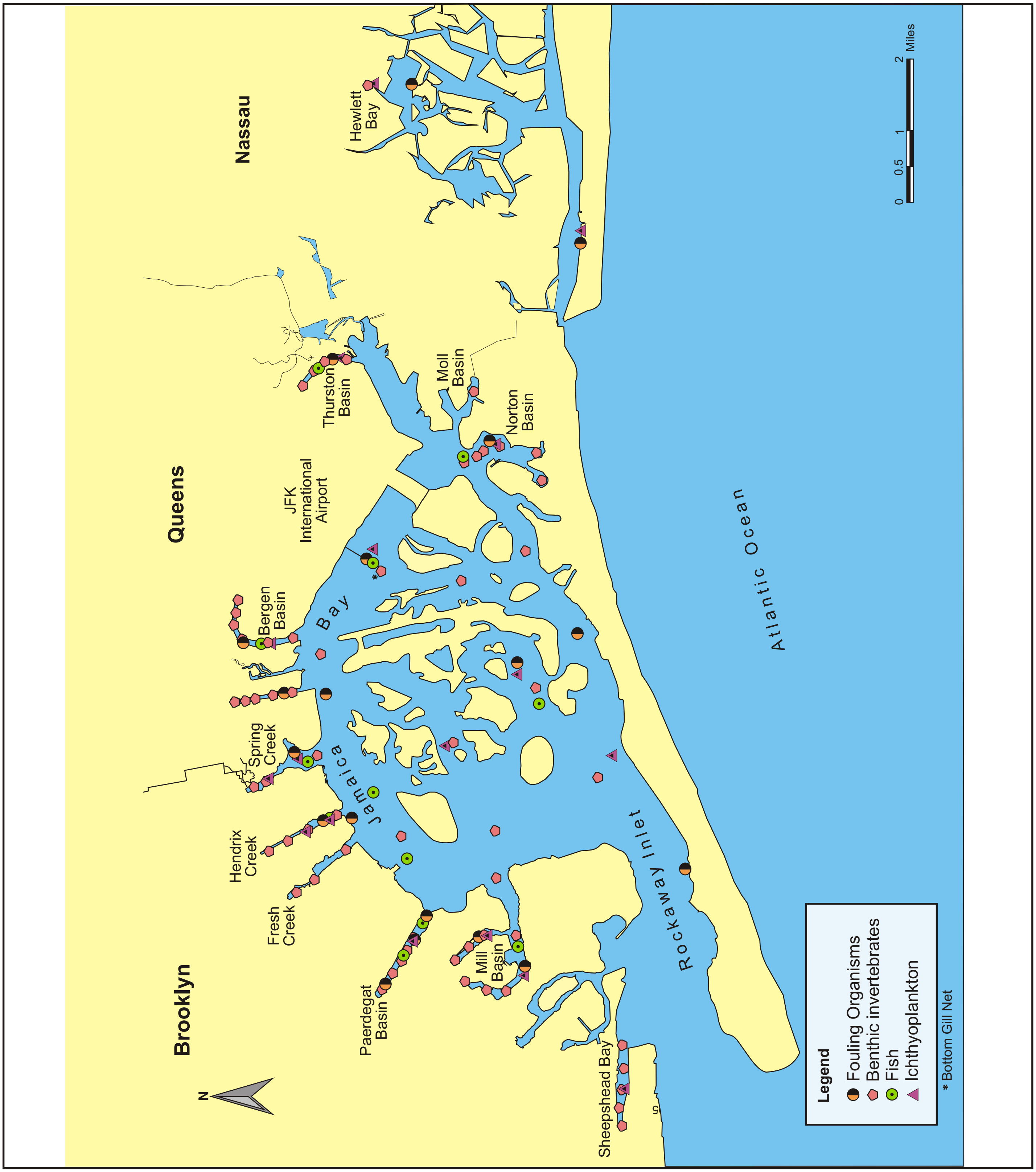

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Other Sampling Stations In and Around Jamaica Bay

FIGURE 4-3

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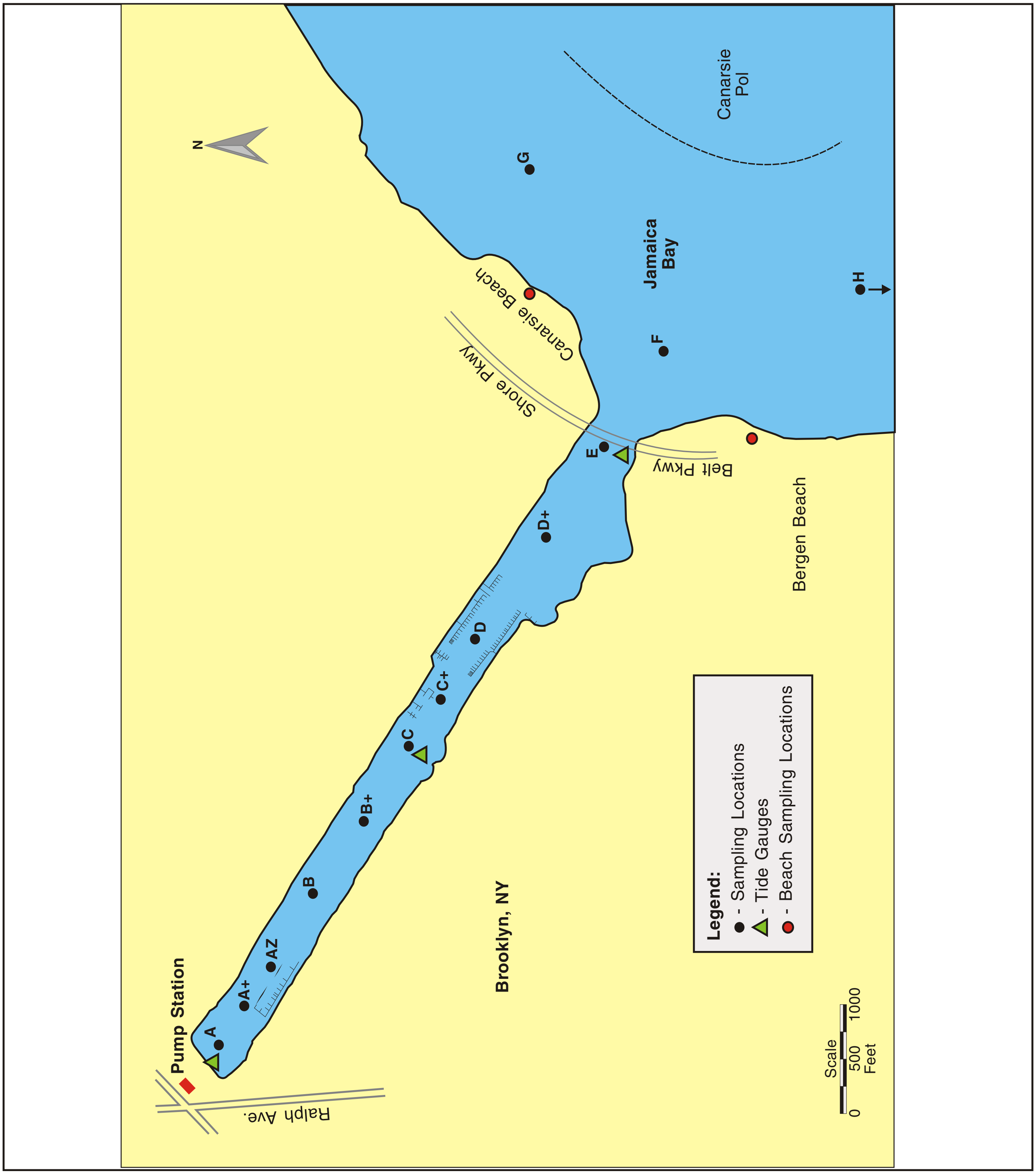

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Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Water Quality Facility Plan
Sampling Locations

FIGURE 4-4

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Current Harbor Survey Sampling Locations

FIGURE 4-5

Data has been collected by agencies and organizations throughout New York Harbor in addition to harbor monitoring and project-specific sampling programs conducted by NYCDEP. 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 (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 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 Paerdegat Basin to similar waterbodies in the New York Harbor to ascertain its relative aquatic and ecological health.

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 NYCDEP.

4.1.4. Receiving Water Modeling

A set of mathematical models were developed and calibrated to develop relationships between CSO/storm loads discharged to Paerdegat Basin and the water quality in the waterbody. A schematic of the mathematical models used in the Paerdegat Basin analysis is shown on Figure 4-7. The CSO models (RAINMAN and TANK) discussed in Section 3.3.1 are used to calculate the flows and loadings of pollutants that are fed to the receiving water models. Boundary condition input is provided by the Jamaica Bay Eutrophication Model (JEM), a three dimensional, time variable hydrodynamic and water quality model containing a 28 state variable eutrophication model for computing nutrient forms and chlorophyll a concentrations (HydroQual, 2002c). A schematic of JEM is also shown on Figure 4-7.

The Paerdegat Basin receiving water model consists of three dimensional, time variable hydrodynamic and water quality models that simulate temperature, salinity, TSS, BOD, dissolved oxygen, coliform bacteria, and enterococci. The hydrodynamic model uses input data and a set of equations that describe the movement of water to calculate the volume and velocity of water at any time and location. The water quality model uses the volume and velocity information along with additional water quality input information and water quality kinetic equations, to calculate receiving water concentrations for different types of pollutants. The water quality model includes a sediment component to compute the interaction between the water column and the sediment, and was modified during the USA Project to track total organic carbon for benthic habitat evaluations. The Paerdegat Basin model was calibrated during the Paerdegat Basin Water Quality Facility Planning Project (Hazen and Sawyer, 1991) and refined during LTCP development, as discussed in LTCP Joint Venture (2006b). The model system was used to establish Baseline conditions against which all alternatives are compared for quantifying the 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 Loads	RAINMAN	1988 precipitation for wet weather flows; 2045 population projection for dry weather flows; twice design dry weather flow capacity at Coney Island WPCP; sewer separation in Rockaway; sewers in Broad Channel.
Boundary Conditions	JEM	1988 precipitation, tidal conditions, and water quality
Receiving Water	Paerdegat	Calculated results

An additional post-processing step is required to evaluate compliance with numerical water quality standards. These post-processing procedures and results are described in Section 4.5.

4.2. PHYSICAL WATERBODY CHARACTERISTICS

Paerdegat Basin is an estuarine waterbody within the Jamaica Bay estuary with a semi-diurnal tidal cycle and a tidal range between five and seven feet. There are no freshwater sources other than CSO and stormwater discharges. It is approximately 6,675 feet long with varying widths that are 450 feet wide on average, and is oriented in a northwest to southeast direction. The upstream two-thirds of the waterbody is long and narrow and maintains its original dredged and bulkheaded configuration. The downstream reach of the waterbody is significantly wider with areas of tidal flats and wetlands. The mouth of Paerdegat Basin is only approximately 100 feet wide and 100 feet long opening onto Jamaica Bay. A fixed bridge conveying the Belt Parkway is located at the mouth with two bridge piers straddling and somewhat restricting navigable access to Paerdegat Basin. The bridge has a horizontal clearance of 61 feet and a vertical clearance of 29 feet above mean high water. The surface area of the waterbody is approximately 80 acres.

In the 1930s, Paerdegat Basin was dredged with a main-channel depth of 16 feet below mean low water for its entire length and connected to the dredged shipping channels in Jamaica Bay. U.S. Pierhead and Bulkhead Lines extend into the waterbody for its entire length delineating the original dredged channel. However, the navigable channel has not been maintained since its original

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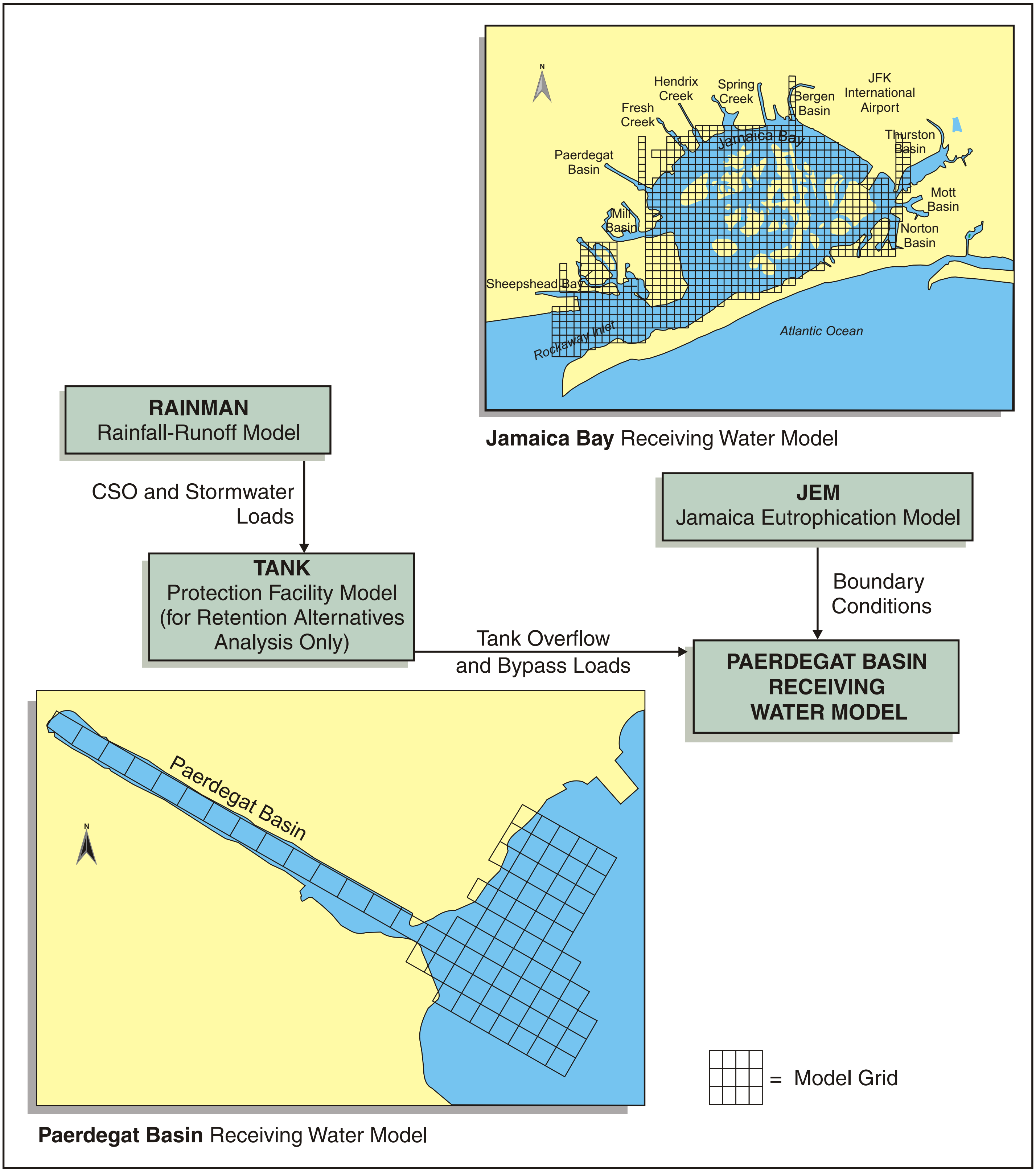
Coastal 2000 Sampling Locations in New York Harbor

FIGURE 4-6



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Paerdegat Basin Receiving Water Modeling

FIGURE 4-7

dredging. At its deepest points, depth reaches a maximum of 16 feet, primarily in the vicinity of the marinas and small craft clubs approximately 1,700 feet upstream from the mouth. The remainder of the waterbody has shallow depths, especially at the mouth and head-end terminus. Waterbody users' access to Paerdegat Basin is restricted at its mouth on Jamaica Bay by growing sand bars that are reducing depths, restricting and at times prohibiting vessel traffic at low tide, and reducing tidal interaction with Jamaica Bay. At the head end, the lack of tidal exchange has created a stilling effect on pollutant discharges that allows heavy organic material and grit to settle to the bottom of the waterbody. CSO discharges have created a sediment mound that is exposed in some spots at low tide and restricts access to small craft users.

Paerdegat Basin is a recreational waterway with predominantly waterfront parkland and is classified as a minor river tidal tributary due to the heavy influence of the waters of Jamaica Bay. Most of the immediate shoreline along the waterbody is undeveloped, with the exception of active marinas near its mouth and the NYCDOT and NYCDEP facilities at the headwater terminus. All of Paerdegat Basin shoreline has been designated part of a SNWA by NYCDCP. In addition, the mouth is also part of the Jamaica Bay Significant Coastal Fish and Wildlife Habitat as designated by the New York State Department of State (NYSDOS). The Basin and the portions of Jamaica Bay have also been designated a Critical Environmental Area (CEA) by NYSDEC.

4.2.1. Shoreline

Outside of developed areas (i.e., City facilities and private marinas), Paerdegat Basin shorelines are generally characterized by dilapidated timber bulkheads with wetlands and undeveloped, vegetated shorelines located on the water-side of bulkheaded areas as illustrated on Figure 4-8. These shorelines may appear to be natural shorelines, but closer observations often reveal evidence of degraded, undermined, or overgrown timber bulkheads, most likely constructed when Paerdegat Basin was dredged in the 1930s. Sandy stretches of natural shoreline also exist, especially near the mouth on Jamaica Bay. Rip-rap shorelines can be found near the headwater terminus on both shores. Multi-barrel CSO outfalls at the head of the waterbody have intact concrete bulkheads. A separate CSO outfall in the southwest corner of the waterbody and several stormwater outfalls along the length of the waterbody are protected by visible head walls.

Active marinas and clubs are located approximately 1,700 feet upstream from the mouth on both shores of Paerdegat Basin. These marinas and clubs occupy approximately 1,900 feet of shoreline, which is about 13 percent of the entire shoreline of the waterbody. An abandoned marina located near the head of Paerdegat Basin on the south shore is being removed as part of the Paerdegat Basin Water Quality Facility Plan. Outside of the developed areas, the shoreline is interspersed with small, abandoned piers in various stages of decay and various debris including abandoned automobiles.

Shoreline slope can be qualitatively characterized along natural shoreline banks where the banks are not channelized or otherwise developed with regard to physical condition. The Paerdegat Basin shoreline is characterized by a gentle slope (less than five degrees or an 18-foot vertical rise for each 200-foot horizontal distance), except for two areas of intermediate slope (five to twenty degrees) underneath the Belt Parkway bridge near the mouth of the waterbody as illustrated on Figure 4-9. At the water's edge, decay of some existing timber bulkheads has allowed natural development of a gradual slope from the shore into the water, while other areas still retain a near-vertical bank. The near-vertical bank is especially prominent at low tides.

4.2.2. Benthos

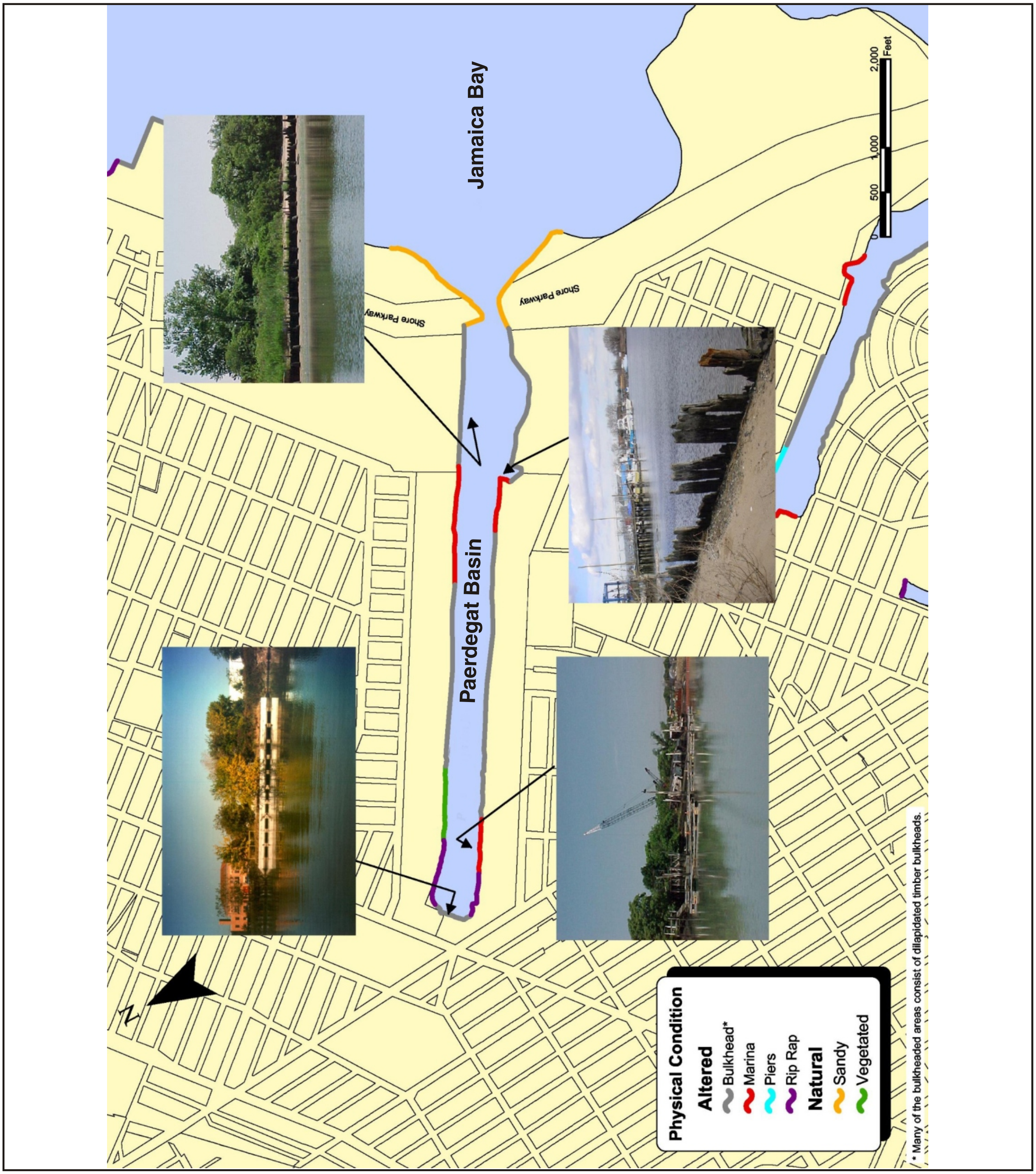
Qualitative and analytical characterizations of benthic sediments were performed by the USA Project in June and July 2000 and January 2001. Visual observations of the bottom were recorded while benthic sampling programs progressed. The natural bottom of Paerdegat Basin is generally characterized as a mixture of sand and mud/silt/clay (Figure 4-10). However, historical discharges by CSOs and stormwater have impacted almost the entire Paerdegat bottom, resulting in a 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 and extending approximately two-thirds downstream of the headwater terminus of the waterbody. At the head end of the Basin near the CSO outfalls, deposition of solids has resulted in a mound of this highly organic material that becomes exposed at some points during low tide. Anaerobic decay of the carbon contained within this sediment mound creates noxious odors, which have been a complaint of the community.

Only near the mouth can one observe the original bottom. A total of 27 grab samples, obtained using a Ponar dredge, were analyzed for grain size distribution using sieves. For the purposes of defining surficial geology/substrata, those areas where bottom sample grain size indicated more than 50 percent sand were listed as sand. Areas where samples were more than 50 percent mud/silt/clay were listed as mud/silt/clay. As a result, the natural bottom of head and mouth are characterized as sand. The sandy areas near the mouth had mud/silt/clay percentages ranging from 4 to 28 percent. Areas near the head had mud/silt/clay percentages ranging from 17 to 48 percent. Between the head and the mouth, roughly 2,300 feet of the bottom is characterized by mud/silt/clay. Sand comprised from 28 to 48 percent of each bottom sample in this area.

4.2.3. Waterbody Access

Although Paerdegat Basin is almost completely surrounded by undeveloped areas, waterbody access is limited by the physical characteristics of riparian areas, the setback of local streets and neighborhoods, and private waterfront clubs and marinas. The NYCDEP and NYCDOT facilities occupy approximately 2,000 feet of shoreline (20 percent of the total) at the headwater terminus. These properties are restricted and provide no public access to the waterbody. Developed recreational properties (marinas and clubs) immediately adjacent to the waterbody support the only structured recreational uses of shorelines providing private waterbody access to members. However, these properties occupy only about 18 percent of the shoreline. The fencing and undeveloped nature of Paerdegat Basin Park virtually blocks the neighboring residential communities from accessing the waterbody. Viewsheds are obstructed by fences, overgrown vegetation, and vertical land profiles to residences and sidewalks along streets bordering Paerdegat Basin Park.

Canarsie Beach Park and Joseph Thomas McGuire Park provide the only unimpeded access to Paerdegat Basin for the general public. Open lawns and sitting areas offer opportunities for relaxing and passive recreation with open viewsheds to the waterbody. Unstructured walking paths in Canarsie Beach Park provide views of Paerdegat Basin and access to waterfront areas at the mouth. There are no structured access points to Paerdegat Basin in these parks. These parks occupy



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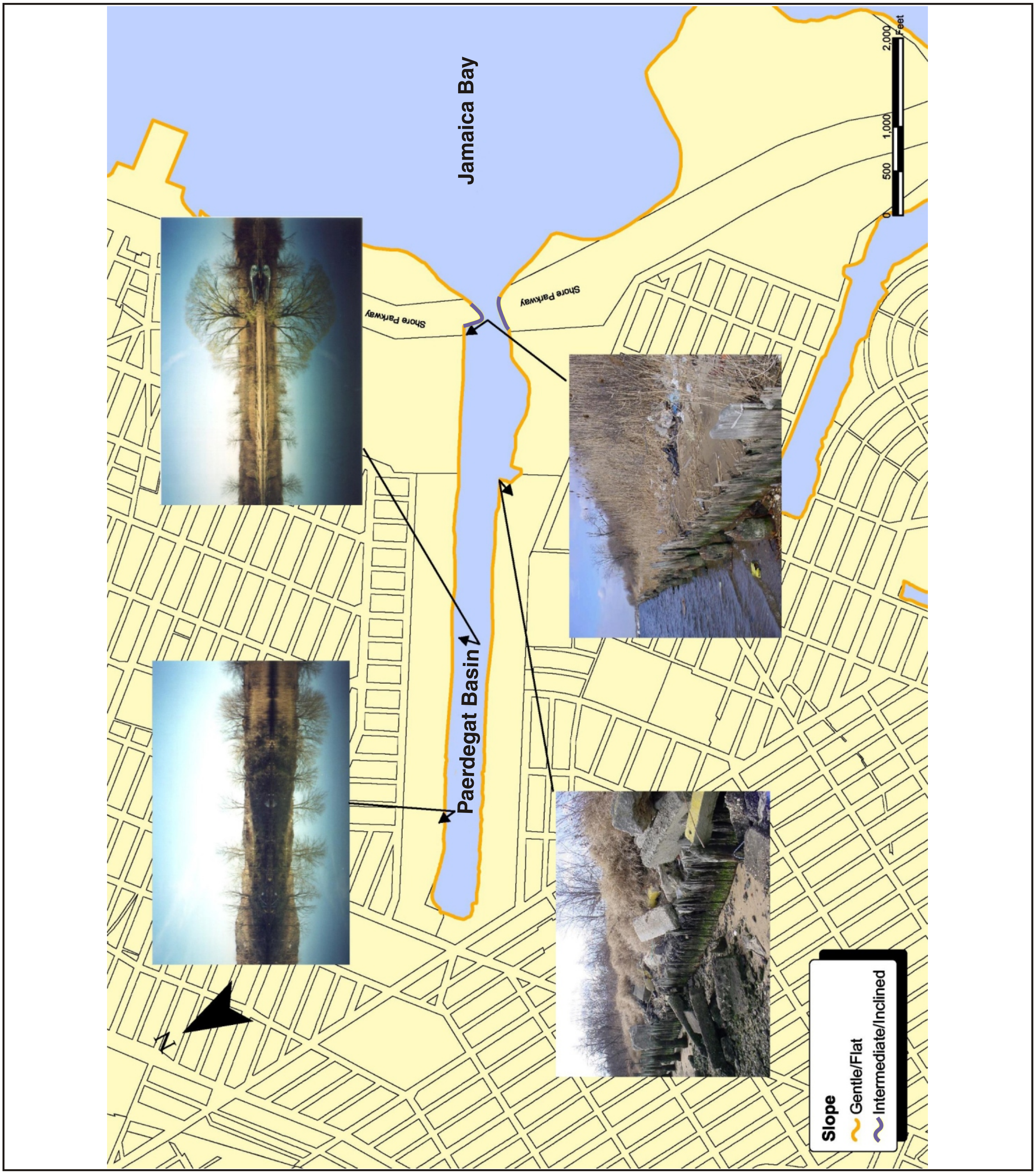
Paerdegat Basin Existing Shoreline Physical Characteristics

FIGURE 4-8



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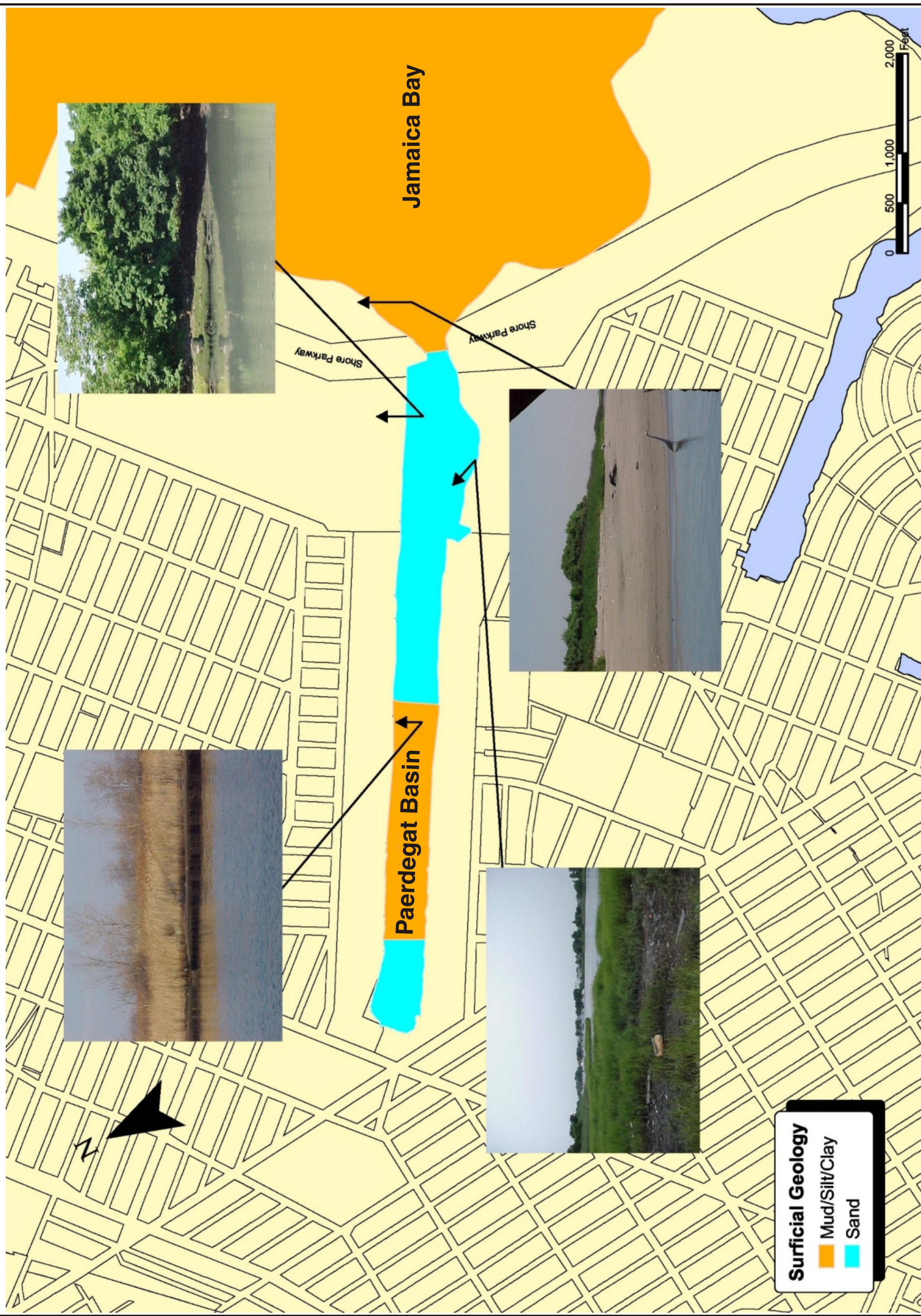
Paerdegat Basin
Existing Shoreline Slope

FIGURE 4-9



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Paerdegat Basin Surficial Geology

FIGURE 4-10

approximately 2,000 linear feet of shoreline combined. Only 20 percent of all waterbody shorelines, therefore, afford visible or direct access to Paerdegat Basin for the general public.

4.2.4. Hydrodynamics

As with any coastal embayment, actual tidal conditions depend on meteorological conditions, local bathymetry, and celestial periodicities. Generally, Paerdegat Basin has a semidiurnal tidal cycle with a mean range of approximately 5 feet, and a spring tide range in excess of 6 feet. Maximum current velocities are relatively low (0.5 feet per second near the Belt Parkway overpass), and are normally 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, increasing when the wind blows from the south or east (off-shore), and decreasing when the winds are from the north and west (on-shore), and will alter the timing of the tidal cycle similarly.

One aspect of Jamaica Bay hydrodynamics that is relevant to Paerdegat Basin is its residence time, or the time it takes to exchange the entire bay volume with the Atlantic Ocean. Estimates on residence time for Jamaica Bay vary from 10 to 35 days (West-Valle et al., 1992), although Houghton et al. (2002) estimated that as little as 7 days was adequate to flush peripheral channels (such as Paerdegat Basin) and the top 5 meters of Grassy Bay (i.e., the area most remote from Rockaway Inlet). Residence times on this scale can influence water quality by compounding precipitation events that occur more frequently than this timescale on average.

4.3. CURRENT WATERBODY USES

The most common use of Paerdegat Basin is for secondary contact recreation in the form of boating, although this activity is being increasingly restricted due to siltation by shifting sands at the mouth of the waterbody that makes navigation hazardous near low tide. The waterbody is used primarily by the local community to access Jamaica Bay, the Gateway National Recreation Area, and the greater New York/New Jersey Harbor Estuary. Several marinas and the canoe club are located near its mouth on park property with leasing agreements. The current recreational water use of Paerdegat Basin is primarily secondary contact recreation. The Diamond Point Yacht Club, Paerdegat Yacht Club, Midget Squadron Yacht Club, Sebago Canoe Club and the Paerdegat Racquet Club each support structured, waterfront recreational uses on property located approximately 1,700 feet upstream from the mouth, and leased from the City. Power boating and kayaking are considered by NYSDEC to be secondary contact activities. The marinas provide docking facilities for recreational vessels and outdoor social activities on the waterfront. The canoe club takes advantage of the light boat traffic and weather protection in Paerdegat Basin itself for instruction and training sessions from the early spring through the late fall. However, by far most boats use the more open waters in Jamaica Bay for kayaking, canoeing, rowing, flatwater racing, fishing, and sailing. Generally, in-basin activities occur between the marinas and the canoe club and the mouth. These activities are defined by the State of New York as secondary contact recreation. Until recently, Paerdegat Basin was also used for personal watercraft (i.e., jet skis) access to Jamaica Bay. However, the National Park Service has recently banned the use of these craft in Gateway National Recreation Area and is developing a long-term use plan for the future that may not include this activity. However, personal watercraft use is defined by the State of New York as secondary contact recreation and is, therefore, the same use category as kayaking and other forms of boating.

The marinas and clubs provide the only structured access points to the waterbody with boat docks, slips, ramps, and facilities for social activities. As a result, use of the waterbody from the shoreline for fishing and similar uses is limited. In addition, most of the shorelines are elevated high above the high tide line with some steep drop-offs of several feet. Safely sloping shorelines that allow direct access to the waterbody are found only near the mouth, near the small intertidal wetlands areas, and near the constricted waterway access used by the resident boat traffic. Recreational opportunities for residents in the surrounding neighborhoods are available in Canarsie Beach Park on the north shore and Joseph Thomas McGuire Park on the south shore, with unimproved trails that pass near the water's edge, baseball fields, and other facilities.

Local stakeholders have indicated that they prefer the limited access currently available to Paerdegat Basin (See Section 6.3). The marinas, canoe club, and park areas at the downstream end provide the only access to the waterbody from the surrounding neighborhoods, and neither the City of New York nor the National Park Service has public policies or facilities that encourage structured public access to Paerdegat Basin. Bathing does not occur in any organized fashion within the Basin. There are no official or even un-official swimming areas currently being used in the Basin. In fact, the establishment of bathing beaches within Jamaica Bay or its tributaries is prohibited by local law (New York City Health Code). Further, local stakeholders view public bathing in Paerdegat Basin as conflicting with their continued use for recreational boating based on safety considerations. Regardless, the physical characteristics of Paerdegat Basin functionally preclude bathing, and the establishment of a bathing beach that would satisfy local and state health department requirements would require physical modifications to the waterbody that would conflict with other uses (e.g., habitat) and any such action would require a modification to the City's Health Code.

4.4. OTHER POINT SOURCES AND LOADS

The NYCDEP Shoreline Survey Program has identified several point source discharges to Paerdegat Basin in addition to those it operates, as described in Section 3.2. None of these are permitted by a regulatory authority and none have dry weather discharges. They were classified by the Shoreline Survey Program as general or direct discharges and are most likely storm drains from the NYCDEP and NYCDOT properties, marinas, and clubs with an insignificant discharge as compared to CSO and stormwater. In addition, as discussed in Section 2.3, there were no SPDES-permitted dischargers to Paerdegat Basin.

The overland runoff drainage area immediately adjacent to Paerdegat Basin represents non-point source discharges to the waterbody. Runoff from Paerdegat Basin Park, Canarsie Beach Park, and Joseph Thomas McGuire Park almost entirely represents this discharge category and totals approximately 179 acres. These parks are mostly grassy, highly pervious, and gently sloping. The Holy Name Cemetery is located within the Paerdegat Basin watershed; however, there is no drainage pathway for significant runoff to influence Paerdegat Basin. Non-point source runoff is most likely insignificant as compared to CSO and stormwater.

4.5. CURRENT WATER QUALITY CONDITIONS

Water quality conditions in Paerdegat Basin have been extensively characterized by field investigations performed by NYCDEP in association with the Paerdegat Basin Water Quality Facility Planning Project, the Harbor Survey, and the USA Project. Receiving water modeling corroborates low dissolved oxygen and high bacteria measurements, and predicts other deleterious conditions that these projects have documented, such as poor water clarity, floatables, and odor. Because little has changed since the facility planning efforts of the late 1980s, data collected during that program is assumed to reflect current conditions.

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 Paerdegat Basin. Depressed dissolved oxygen 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 in Paerdegat Basin are common occurrences. A sediment mound has formed caused by settling solids discharged by the CSOs and extends approximately 1,000 feet downstream from the head of the waterbody, is dry in some spots at low tides, limiting boat access. Noticeable odors are caused by sediments exposed at low tides and chemical/biological reactions within the sediment and overlying water during hypoxic or anoxic conditions that release hydrogen sulfide and methane gas. The sediment mound depletes dissolved oxygen in overlying waters and is of limited habitat value. Floatables discharged by the CSOs and storm sewers are noticeable and represent a nuisance condition throughout Paerdegat Basin. Water clarity is poor, especially following wet weather events.

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 may be somewhat limited. The advantage of a model calculation is that it has a greater spatial resolution (horizontal and vertical) and better represents temporal variability and overall system response. The model also has the ability to distinguish seasonal impacts, which may be important depending on the parameter and criteria to be evaluated.

Calculated water column concentrations are the result of three major modeling components:

- RAINMAN, which quantifies flow discharges and pollutant loadings to Paerdegat Basin;
- The hydrodynamic receiving water model, which defines the water circulation patterns within the Basin; and the receiving water quality model, which calculates the fate of pollutants and their impact on water quality parameters such as dissolved oxygen.

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 Coney Island WPCP. 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 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 (94 MGD);
- An assumed capacity of twice design dry-weather flow (2xDDWF) at the Coney Island WPCP (220 MGD); and
- Boundary conditions calculated by the Jamaica Bay Eutrophication Model (JEM).

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

Paerdegat Basin periodically exhibits hypoxic and anoxic dissolved oxygen conditions primarily due to CSO discharges. Hazen and Sawyer (1991) summarized the field investigations conducted in 1986 during the Paerdegat Basin Water Quality Facility Planning. Dissolved oxygen was typically measured as being hypoxic or anoxic throughout the waterbody, especially at the head-end terminus following wet weather discharges. Fifty percent of all samples collected during wet weather surveys were less than 4 mg/L, and the effects of wet weather persisted for several days following the events. Dissolved oxygen levels below 4 mg/L were observed during both wet and dry weather surveys, and were especially low when water temperatures were higher. The lowest levels were observed at the head of the Basin with conditions gradually improving towards Jamaica Bay. Data from other sources corroborated these findings, most notably 13 years of NYCDEP Harbor Survey data during which eight of the surveys showed DO concentrations in Paerdegat Basin lower than 4 mg/L, and five years of low DO in Jamaica Bay. Based on the frequency of dissolved oxygen excursions below 4 mg/L, it was determined that the water quality in Paerdegat Basin did not support aquatic life at all times, and CSO abatement was recommended. Additional water quality investigations have been conducted subsequent to the original 1986 work that supports the original findings. Data developed during the supplemental Harbor Survey sampling in Paerdegat Basin during 1993, 1994, 1995 and 2000, and during the USA studies in 2000 and 2002 indicated periodically impaired water quality conditions consistent with the findings of the 1986 investigations.

A dissolved oxygen histogram of all available historical data in Paerdegat Basin is shown on Figure 4-11. The figure shows the percentage of data observations between dissolved oxygen intervals of 1.0 mg/L. The observed data were grouped into three spatial sections: head (0 to 1,200 feet), mid-basin (1,200 to 5,000 feet), and near-mouth (5,000 to 7,300 feet). The figure demonstrates the longitudinal distribution of the observed data. The percentage of data below 4.0 mg/L at the head, mid-basin, and near-mouth sections are about 44, 32, and 18 percent, respectively. Note also that more than 20 percent of the samples are below 2.0 mg/L near the head of Paerdegat Basin.

The Baseline water quality modeling scenario, which included modeled collection system performance based on 1988 rainfall, generally corroborates the overall level of dissolved oxygen less

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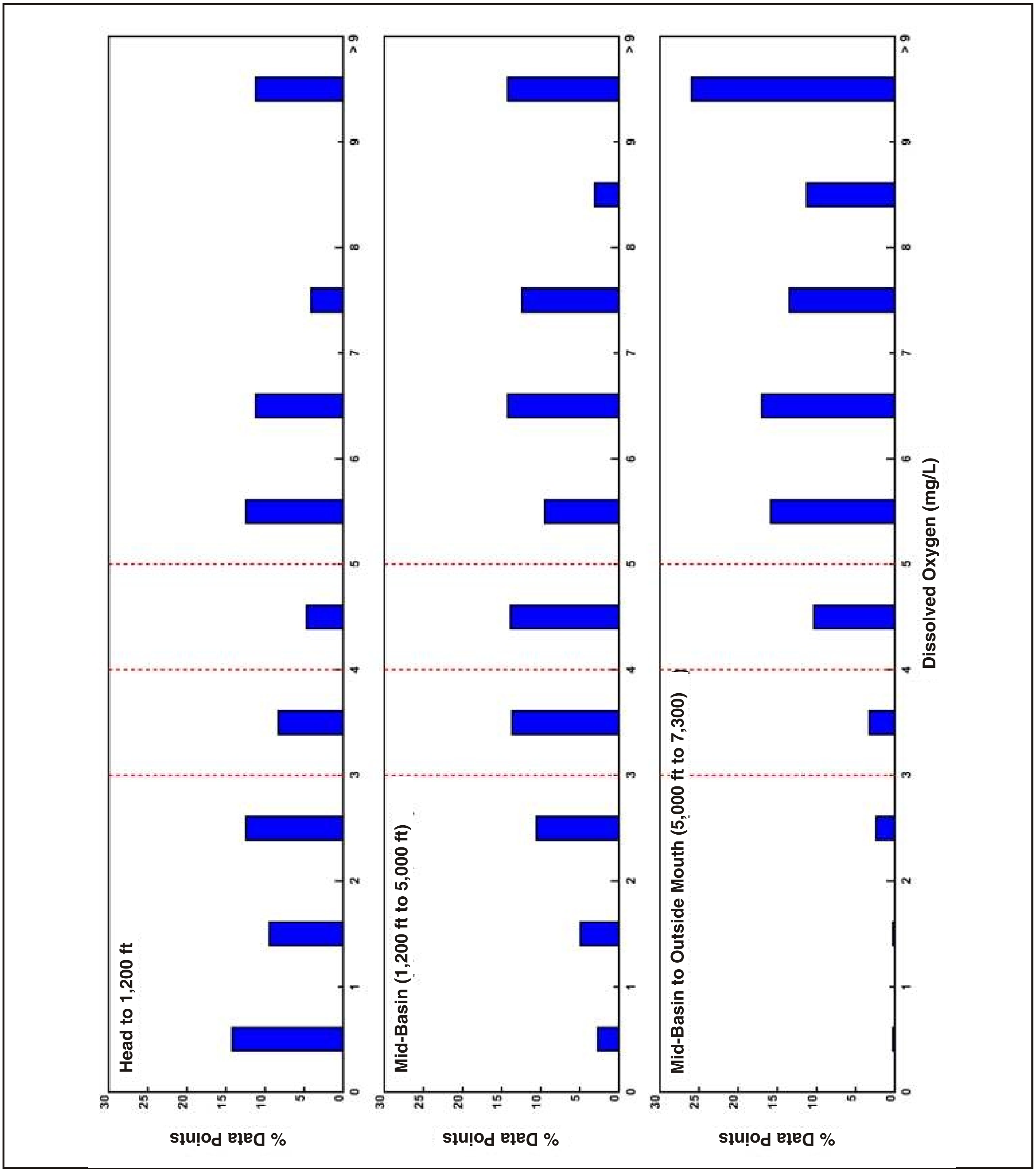

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Dissolved Oxygen Concentrations Distribution of Measurements Historical Conditions

FIGURE 4-11

than 4 mg/L, and there is an increasing trend from the head to the mouth. The calculated dissolved oxygen concentrations at Baseline conditions are illustrated on Figure 4-12. The figure shows monthly statistics of average daily concentrations and minimum daily concentrations for model segments at the head end, mid-basin, and mouth of Paerdegat Basin. The figure demonstrates the clear seasonal fluctuation of dissolved oxygen due to temperature variations; the summer months are considerably lower than the winter months. The figure also demonstrates that the minimum daily dissolved oxygen concentrations are below 3.0 mg/L from May through September and less than 1.0 mg/L in July near the head-end of the Basin. The figure also illustrates how there is an improvement in dissolved oxygen levels toward the mouth of the Basin.

Figure 4-13 shows a longitudinal plot of the percent of time dissolved oxygen concentrations are greater than 4 mg/L for the Baseline conditions. These calculations indicate that the 4.0 mg/L target is exceeded 80% of the time at the head of Paerdegat Basin and 100% of the time near the mouth over the period of a typical year.

4.5.2. Total and Fecal Coliform Bacteria

Data collected in Paerdegat Basin during the facility planning in 1986 (three wet weather surveys) show a strong correlation between fecal coliform concentrations and CSO events; dramatic increases in fecal coliform concentrations occurred during each wet weather survey, and as a result the geometric mean for each survey was greater than the Class I fecal coliform geometric mean criteria of 2,000 per 100 mL. However, because the geometric mean was computed on a survey basis rather than a monthly basis, these results were considered to be biased high. For example, only 60 of 336 samples collected during wet weather surveys in October 1986 were collected during periods of dry weather, which is not a representative distribution of conditions in any given month, and NYCDEP Harbor Survey data from October 1986 showed a monthly geometric mean of 66 based on eight samples. Regardless, eight months of Harbor Survey data during that period yielded two months (July and August 1986) where the geometric mean concentration was greater than 2,000 per 100 mL and an additional three months that were within a fairly small margin above this concentration (October 1985, November 1985, and September 1986).

The standard for total coliform is 10,000 per 100 mL, based on a monthly geometric mean, for Class I waterbodies. All three wet weather surveys exceeded this level and one of the two dry weathers surveys was within a small margin of error. Figure 4-14 and Figure 4-15 show spatial distributions of historical fecal and total coliform data, respectively. The fecal coliform data are compared to the present Class I geometric mean level of 2,000 per 100 mL. Likewise, the total coliform data are compared to the Class I geometric mean standard of 10,000 per 100 mL. As illustrated on the figures, the geometric mean fecal coliform levels are near or above the 2,000 per 100 mL level and the total coliform data are almost always greater than the 10,000 per 100 mL level. Both distributions show a very high variability of observed measurements (4 orders of magnitude), indicative of intermittent wet-weather impacts.

Modeling results for fecal coliform at Baseline conditions are shown in Figure 4-16 with respect to secondary contact recreation concentrations (2,000 per 100 mL). This charts show the percentage of months that the geometric mean of computed concentrations is less than 2,000 per 100 mL both annually and during bathing season. Figure 4-17 summarizes the calculated concentrations by month, expressed as geometric means and monthly maximum concentrations.

Similar plots have been developed for total coliform bacteria at Baseline conditions. Comparisons are made to the secondary contact level (10,000). Again these results are compared on an annual basis (% months below levels) and for the bathing season. These comparisons are shown on Figure 4-18. The results show concentrations lower than the secondary contact level greater than 80% of months and 100% during the bathing season. A summary of these results, by month is illustrated on Figure 4-19.

4.5.3. Enterococci Bacteria

In response to the addition of enterococci standards for marine waters by NYSDEC based on the USEPA guidance, additional analysis was necessary to fully understand existing water quality conditions with respect to bacteria compliance. Because Paerdegat Basin is not designated for primary contact recreation, it is not subject to any enterococci numerical standards. An assessment of enterococci concentrations is provided herein, however, in anticipation of potential use refinement evaluations.

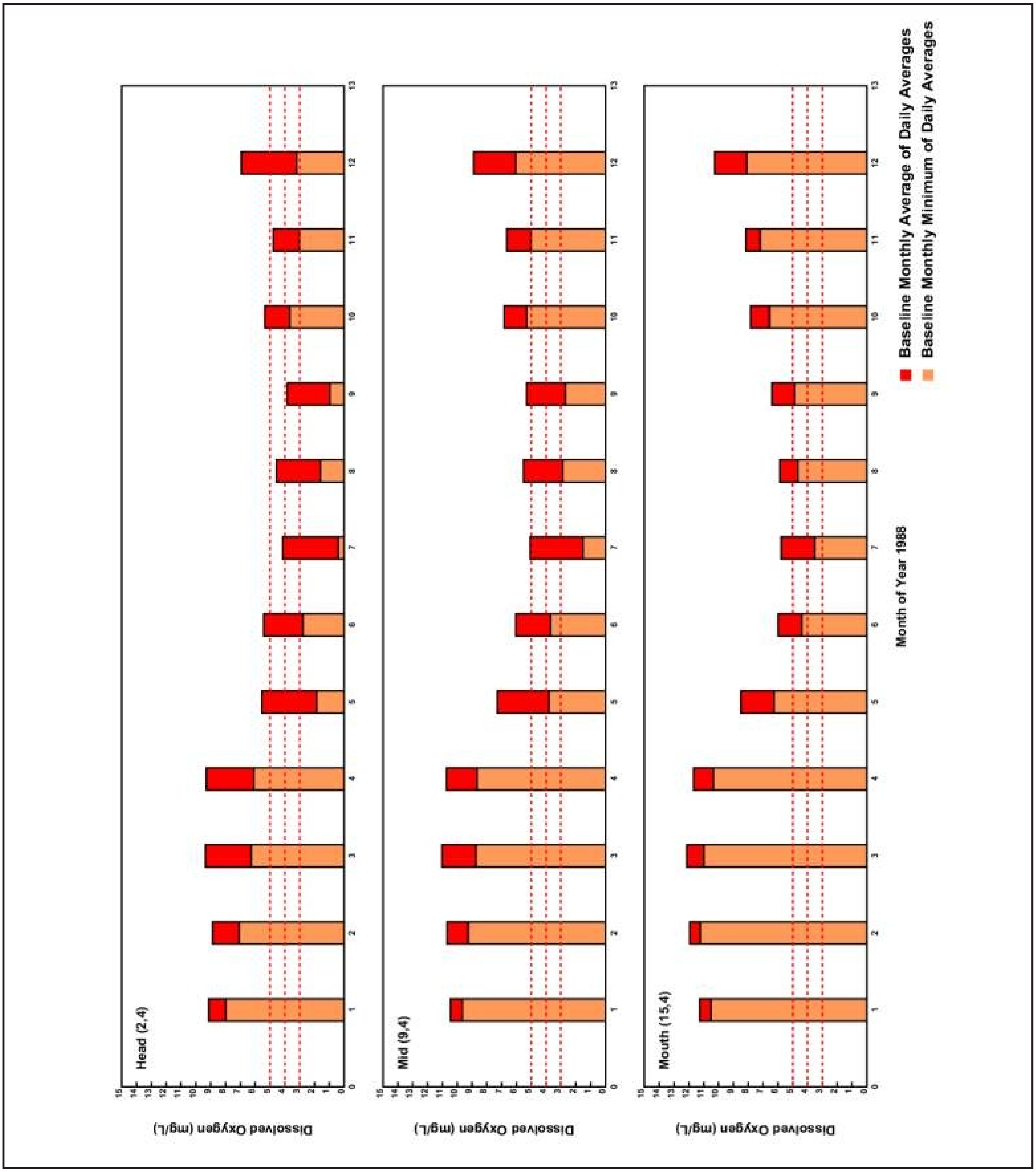
As enterococci data for Paerdegat Basin are limited, modeling results are an important source for characterizing existing conditions. Modeling results are shown in Figure 4-20 which summarizes the calculated geometric mean concentrations on a monthly basis with the maximum concentrations calculated in each month. Modeling results show that for each month, the maximum concentrations are greater than the 501 reference level. In addition, monthly geometric means are greater than 35 per 100 mL for most throughout the Basin.

4.5.4. Other Pollutants of Concern

In 1998 NYSDEC listed Paerdegat Basin as a high priority waterbody for TMDL development with its inclusion on the Section 303(d) List. The cause of the listing was oxygen demand due to CSO discharges that depressed DO levels with enough severity to preclude fish propagation. Paerdegat Basin was again listed on the 2002 Section 303(d) List as a high priority waterbody, but urban runoff and stormwater were added to the dischargers deemed responsible for depressed dissolved oxygen concentrations. The analyses discussed above in Section 4 confirm these findings. These analyses also indicate that pathogens are a pollutant of concern as well. Based on this NYSDEC 303(d) List and the analyses conducted herein, no additional pollutants beyond those previously identified are pollutants of concern with respect to CSO discharges to the Basin.

4.6. BIOLOGY

Paerdegat Basin supports aquatic communities which are similar to those found throughout the other tributaries in Jamaica Bay. These aquatic communities contain typical estuarine species, but the highly modified physical environment constrains Paerdegat Basin in reaching its full potential to support a diverse aquatic life community and to provide a fishery resource for anglers. Paerdegat Basin has been significantly modified through dredging, channelization, timber bulkheading (most of which is now dilapidated), marina construction, and filling, resulting in adverse physical effects on aquatic habitats that 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



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Dissolved Oxygen Concentrations Monthly Averages and Minimum Daily Averages Baseline Conditions

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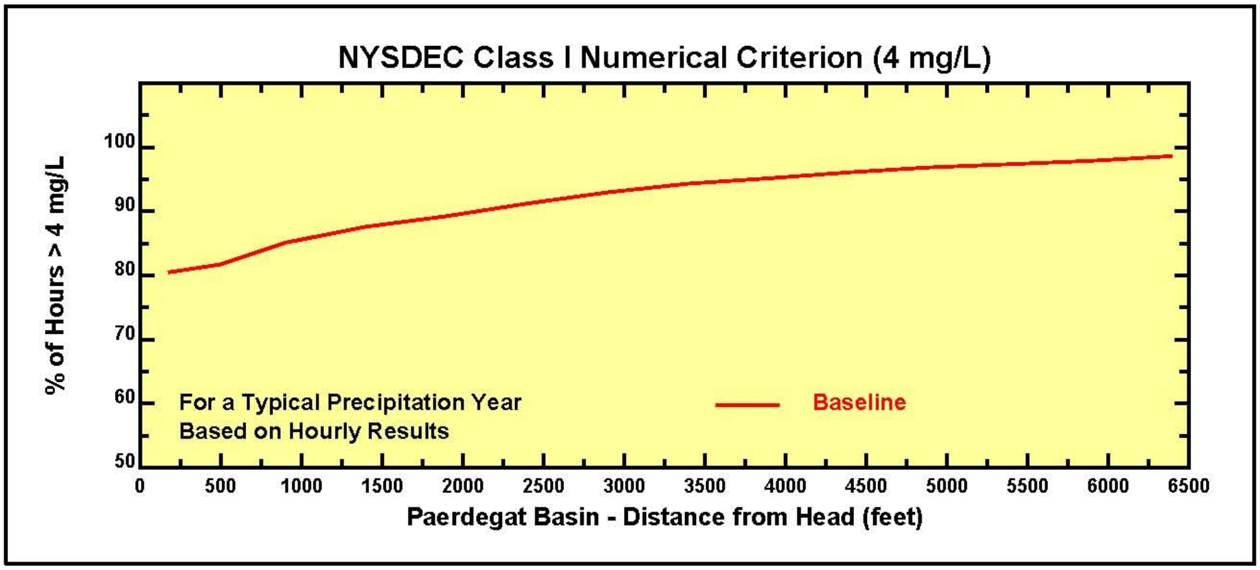
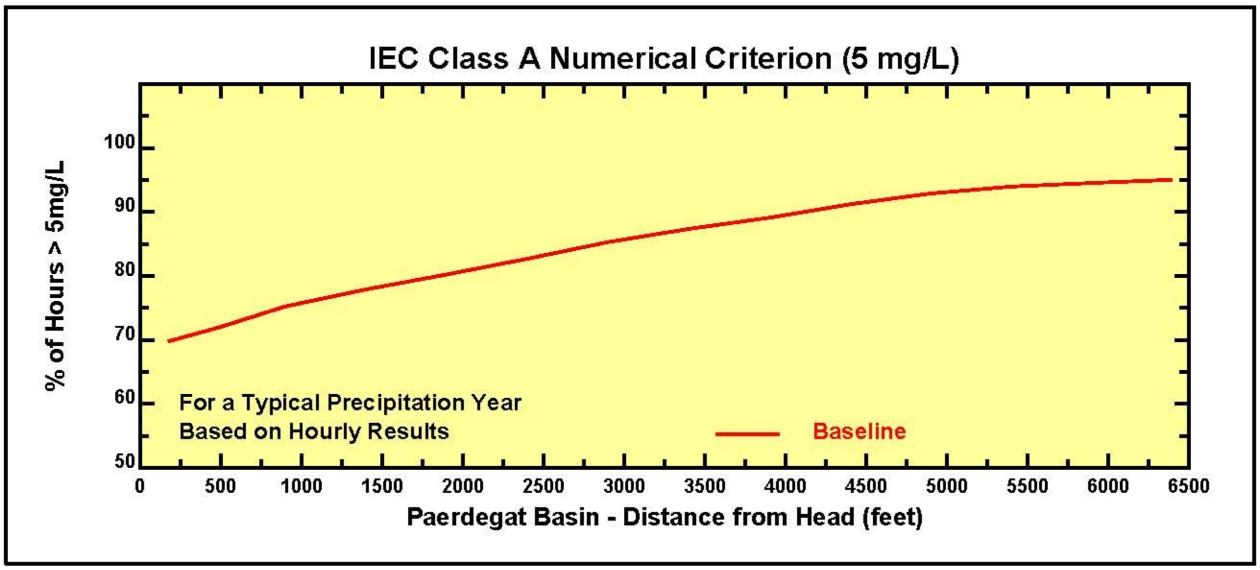
FIGURE 4-12





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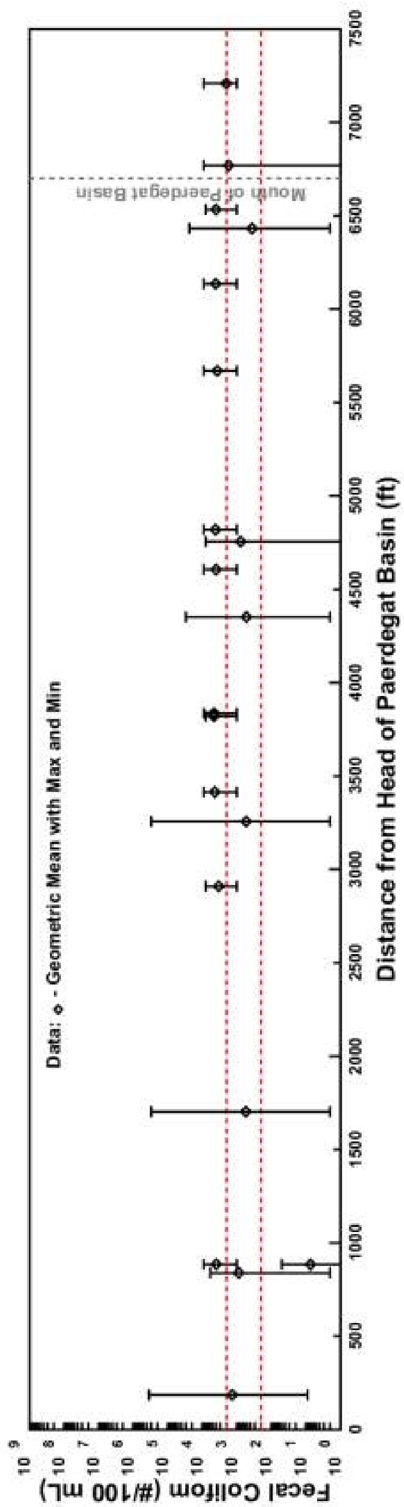
Dissolved Oxygen Concentrations Percentage of Time above Numerical Criteria Baseline Conditions

FIGURE 4-13



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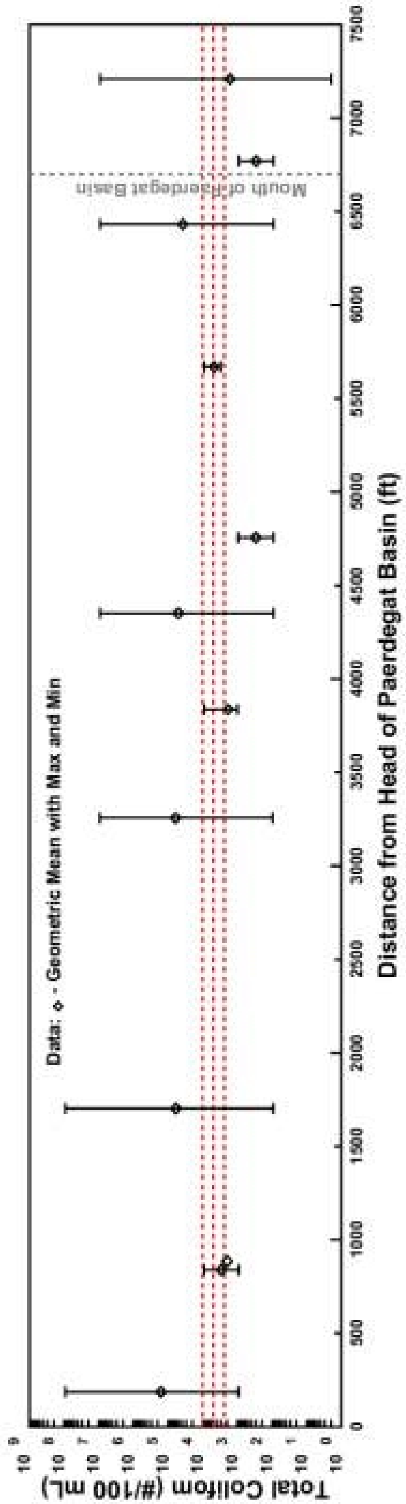
Fecal Coliform Concentrations Distribution of Measurements Historical Conditions

FIGURE 4-14



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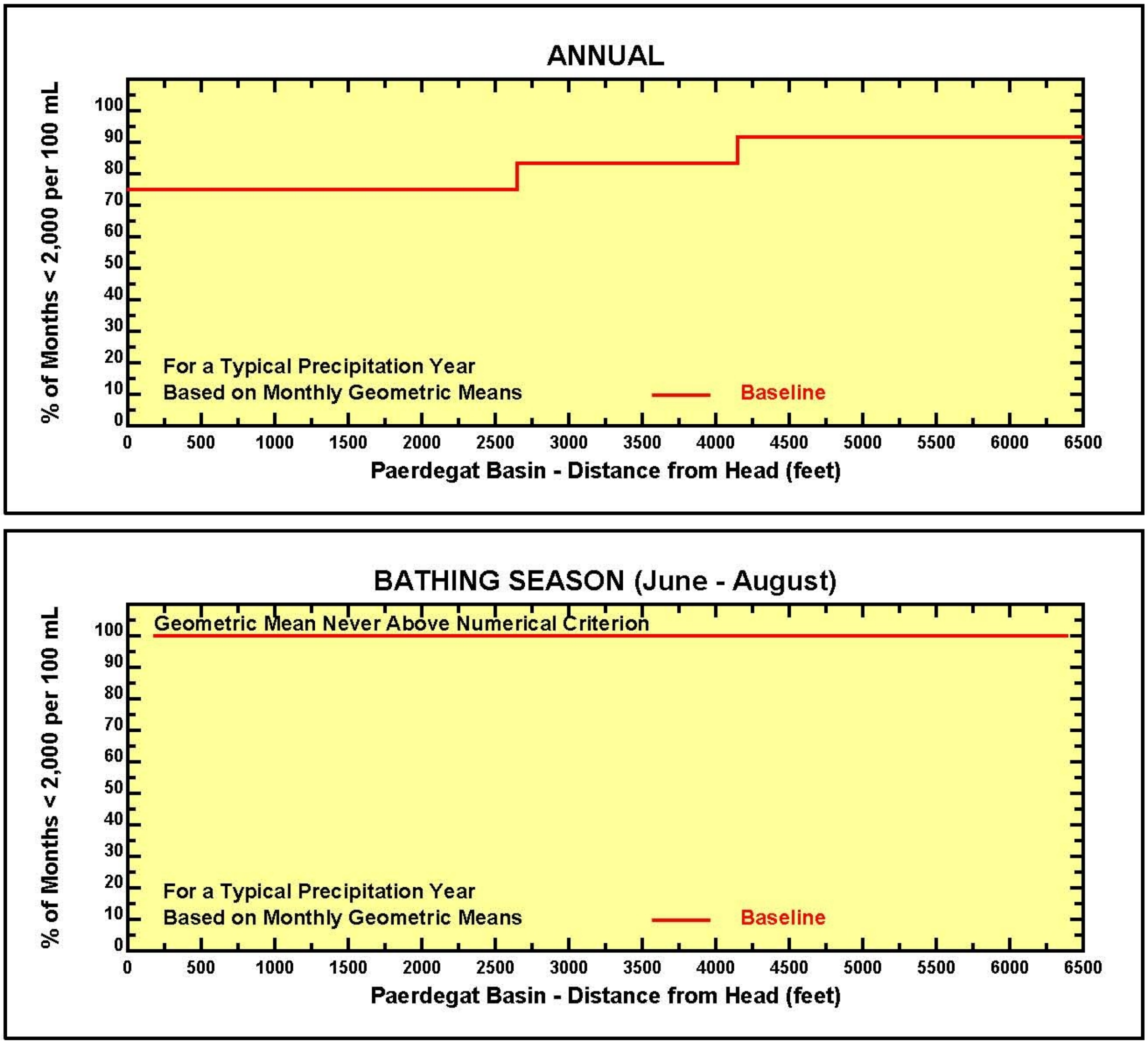
Total Coliform Concentrations Distribution of Measurements Historical Conditions

FIGURE 4-15



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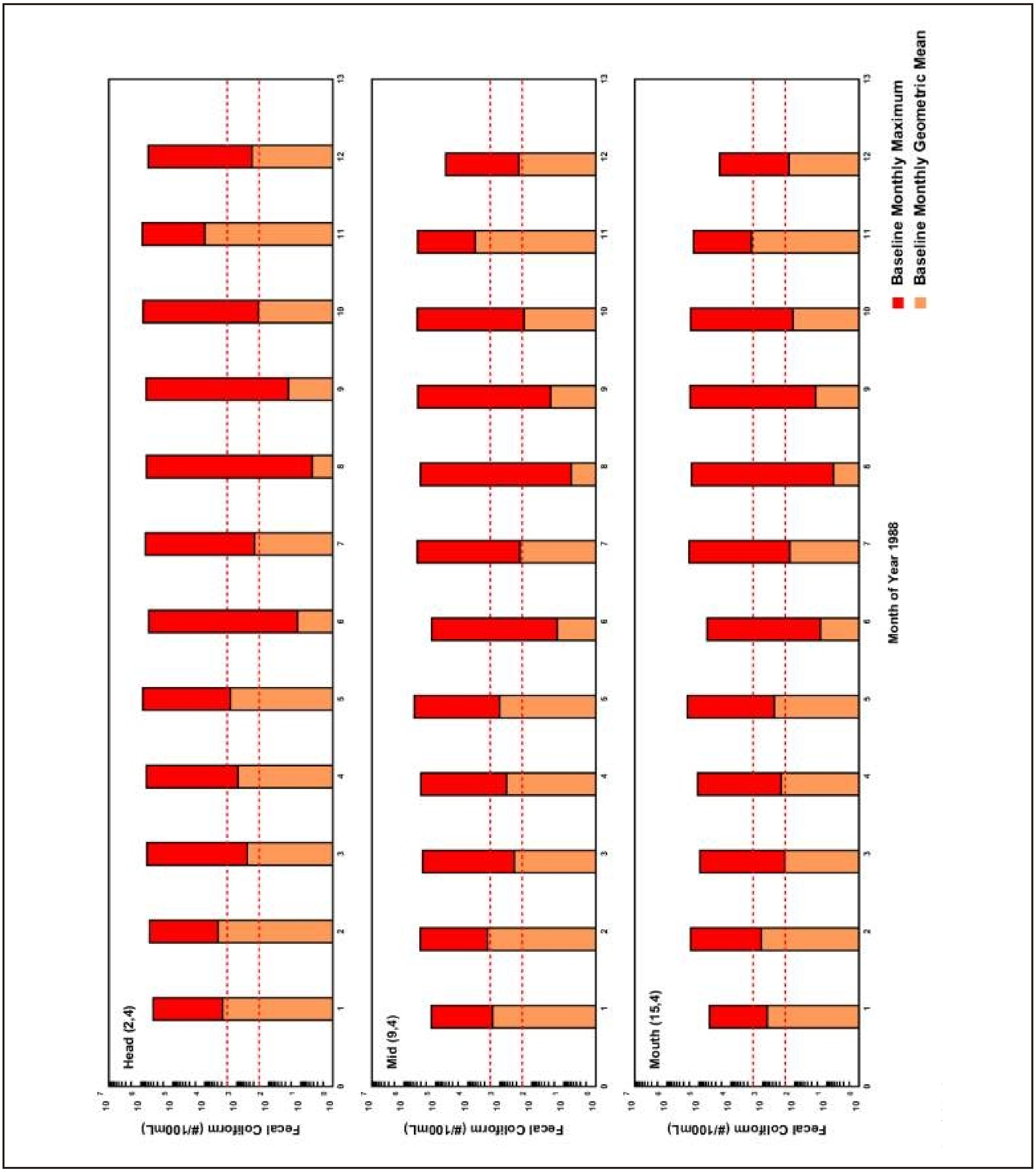
Fecal Coliform Concentrations
Percentage of Time below Numerical Criterion
Baseline Conditions



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Fecal Coliform Concentrations Monthly Geometric Means and Maximums Baseline Conditions

FIGURE 4-17

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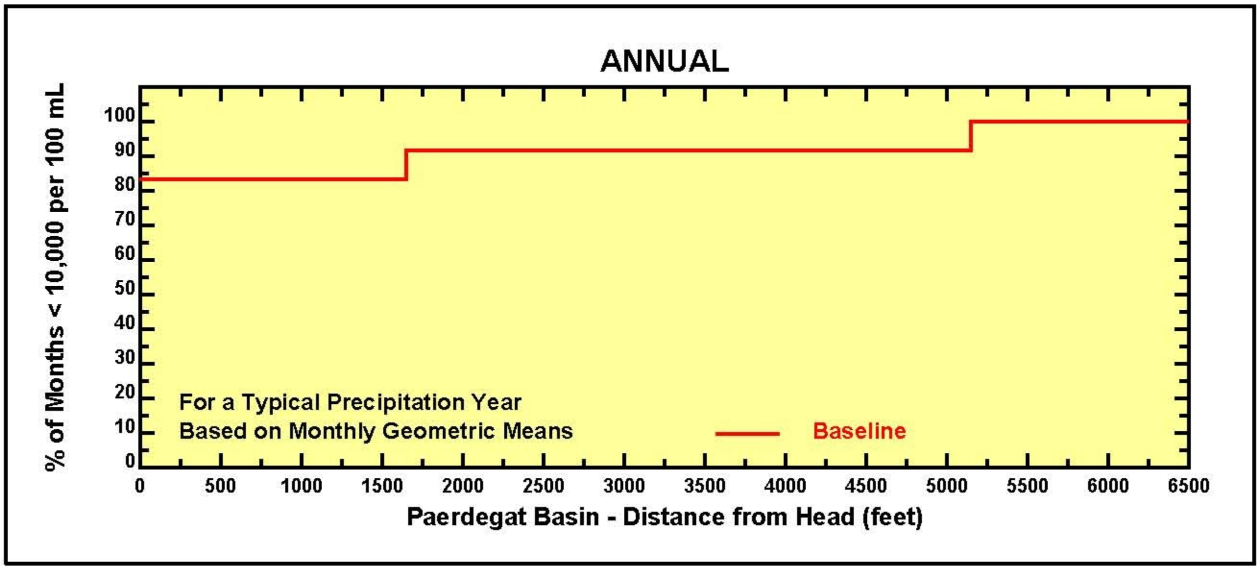

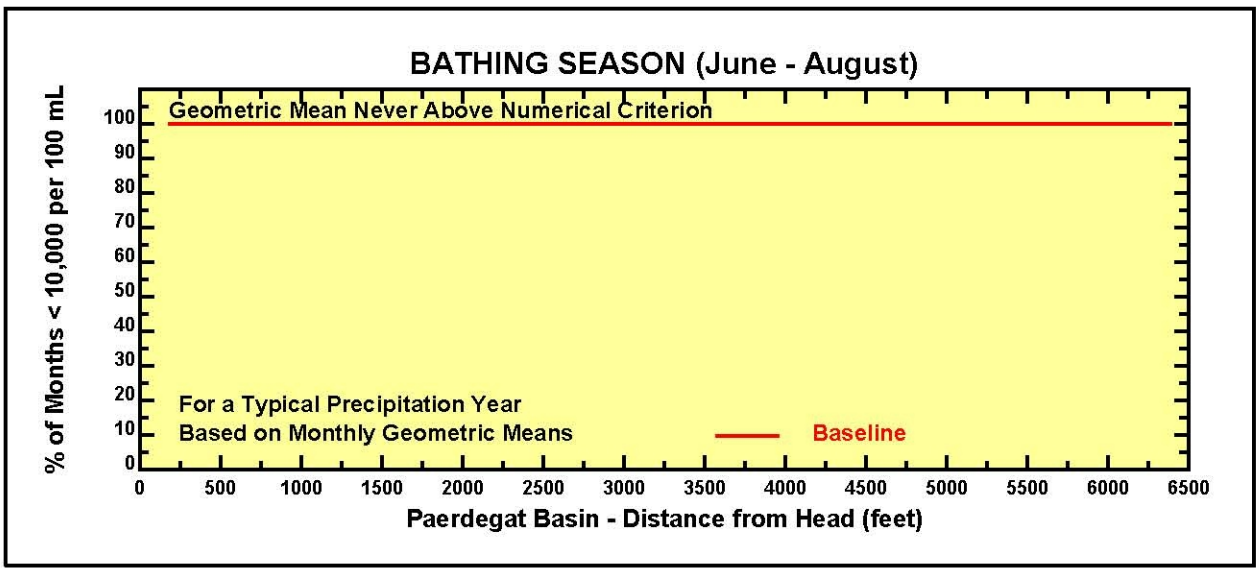

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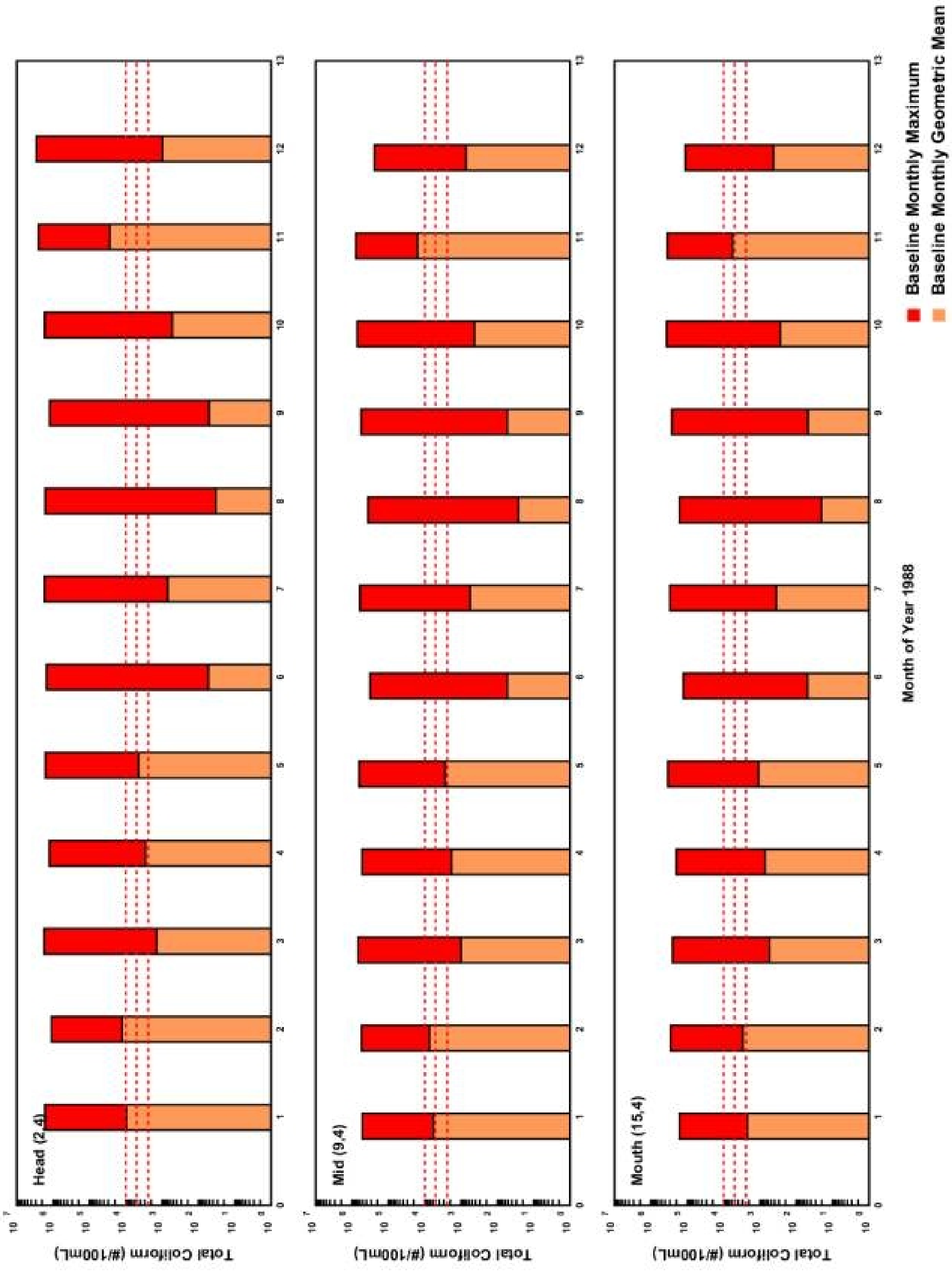
Total Coliform Concentrations Percentage of Time below Numerical Criterion Baseline Conditions

FIGURE 4-18



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Total Coliform Concentrations Monthly Geometric Means and Maximums Baseline Conditions

FIGURE 4-19

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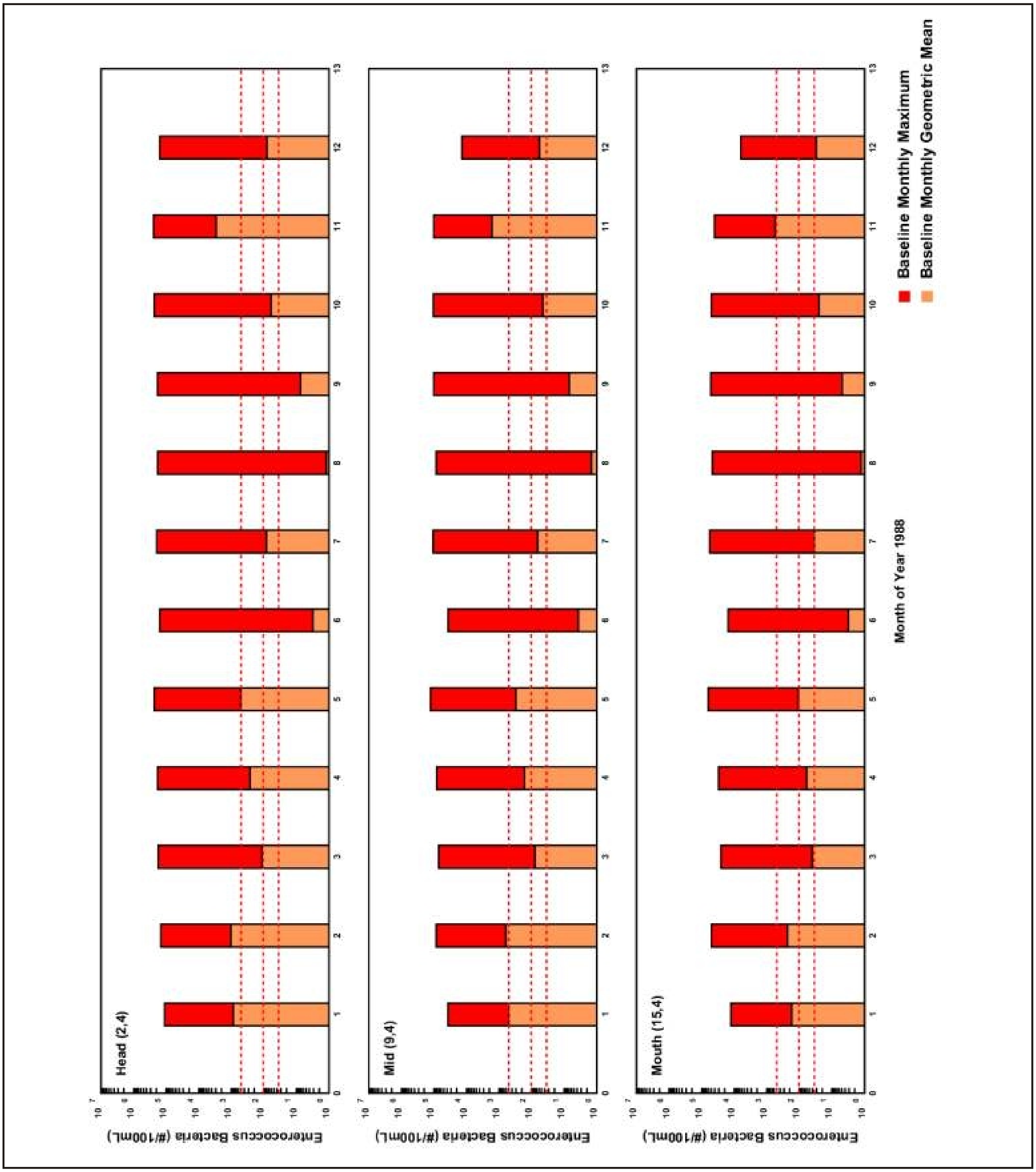

Enterococci Concentrations Monthly Geometric Means and Maximums Baseline Conditions

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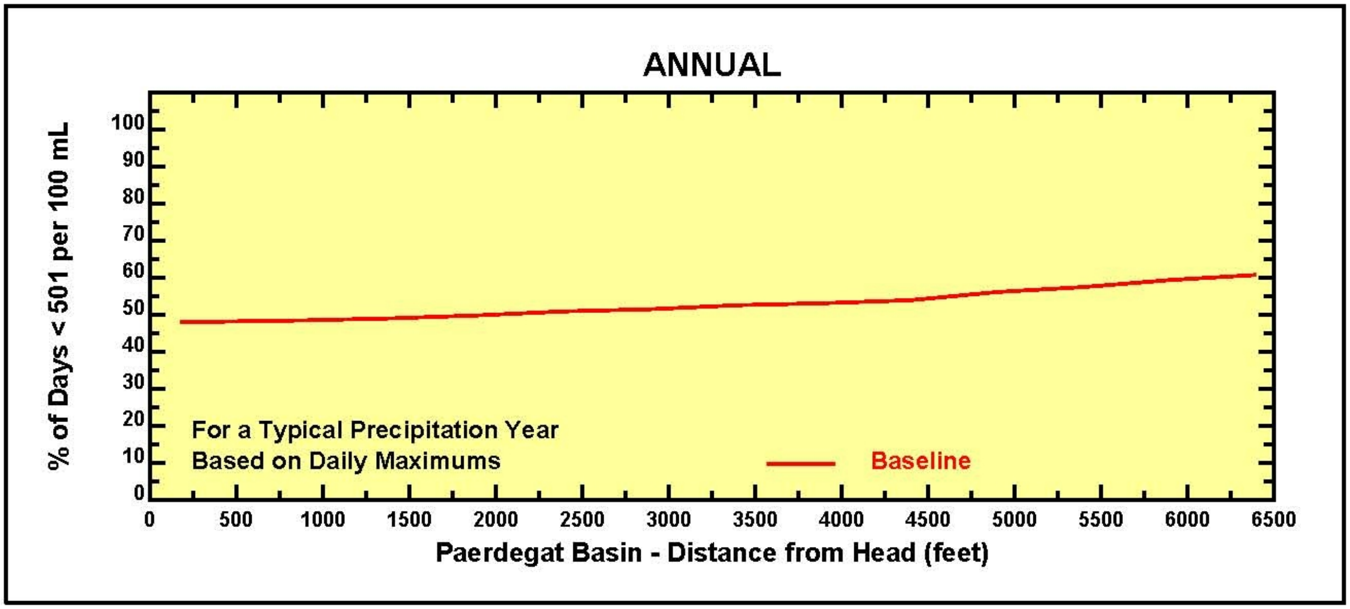
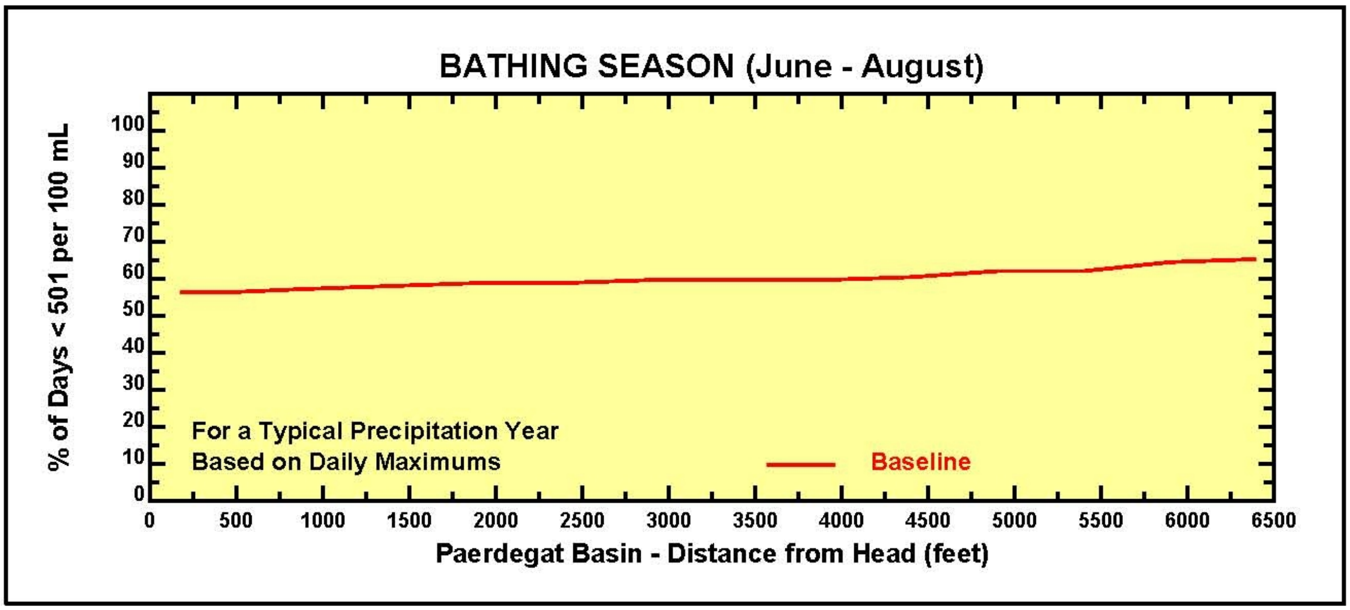
FIGURE 4-20





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Enterococci Concentrations Percentage of Time below Numerical Criterion Baseline Conditions

FIGURE 4-21

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 Paerdegat Basin, but major irreversible changes to the watershed and the waterbody place limits on the extent of these enhancements. In addition, because Paerdegat Basin is part of a much larger modified marine system that is a major source of recruitment of aquatic life to the waterbody, its ability to attain use standards is closely tied to overall ecological conditions in Jamaica Bay and New York Harbor.

This section describes existing aquatic communities in Paerdegat Basin and provides comparisons to aquatic communities found in the nearby tributaries and open waters of Jamaica Bay and New York Harbor. The principal source of data is USA Project FSAPs that were initiated in the year 2000. 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 Harbor and experience with the response of aquatic life to water quality and habitat restoration in the Harbor provides the foundation for assessing the response of aquatic life to CSO abatement alternatives for Paerdegat Basin.

4.6.1. Tidal Wetlands Habitat

The State of New York delineates waterbody and shoreline areas as wetlands. Current NYSDEC tidal wetland maps for Paerdegat Basin, dated 1974, indicate a variety of designated tidal wetlands along its shorelines. The waters of Paerdegat Basin are designated as a littoral zone. The north shore of the waterbody is designated as intertidal marsh as far east as Paerdegat 11th Street. East of the Midget Squadron Yacht Club, the north shore is designated as coastal shoals, bars, and mudflats. Areas on the south shore at the headwater terminus of the waterbody are designated as coastal shoals, bars, and mudflats. The wetland area west of the Belt Parkway on the south shore near the mouth of Paerdegat Basin includes coastal shoals, bars, and mudflats, intertidal marsh, and high marsh or salt meadow wetlands. East of the Belt Parkway, the NYSDEC designates the wetlands on both the north and south shores as coastal shoals, bars, and mudflats, with smaller areas of intertidal marsh wetlands. The coastal shoals, bars, and mudflats extend along the shores of Jamaica Bay. Figure 4-22 illustrates the existing NYSDEC mapped wetlands in the Paerdegat Basin assessment area.

The U.S. Fish and Wildlife Service National Wetland Inventory (NWI) designates the shorelines of Paerdegat Basin as predominantly estuarine, subtidal, open water/unknown bottom, subtidal, excavated (E1OWLx). The wetland areas on the southern shore, west of the Belt Parkway and east of the Hudson River Yacht Club, are designated as estuarine, intertidal, emergent (E2EM5N) and estuarine, intertidal, flat, irregularly exposed (E2FLM). The wetland areas on both shores east of the Belt Parkway bridge are designated estuarine, intertidal, flat, irregularly exposed (E2FLM), and these extend along the shoreline of Jamaica Bay. An area of estuarine, intertidal, emergent (E2EM5P) wetland also exists on the north shore, east of the overpass.

The Final Environmental Impact Statement (FEIS) for the Paerdegat Basin Water Quality Facility Plan (Allee King Rosen & Fleming, 1994) indicated some of the mapped wetland areas support vegetation atypical of NYSDEC designations. Coastal shoals, bars, and mudflats wetlands are typically unvegetated. The FEIS noted that common reed grass (*Phragmites australis*) often existed in these mapped areas in Paerdegat Basin, especially in the coastal, shoals, bars, and mudflats at the head of the waterbody. Phragmites is an invasive, opportunistic species that establishes itself quickly in disturbed intertidal and fresh marshy areas. The typical predominant vegetation of intertidal wetlands is low marsh cordgrass (*Spartina sp.*). The mapped areas of intertidal marsh from the Paerdegat Pumping Station to the Hudson River Yacht Club are dominated by Phragmites without any Spartina.

The FEIS also identified the wetlands located west of the Belt Parkway on the south shore near the mouth of the waterbody as the most valuable wetlands within the waterbody. This area includes coastal shoals, bars, and mudflats, intertidal marsh, and high marsh or salt meadow wetlands that support vegetation consistent with the NYSDEC wetlands designations. In this area, the coastal shoals, bars, and mudflats are unvegetated, while the intertidal marsh is dominated by Spartina. Qualitative field verifications during May and June of 2001 revealed that the intertidal marshlands to the west of the marinas tend to occur in very thin strips along the banks where plant life common to intertidal marshes exist. No freshwater wetlands exist within 150 feet of the shorelines of Paerdegat Basin.

4.6.2. Benthic Invertebrates

Because benthic organisms are closely associated with the sediment and have limited mobility, the abundance, diversity, and composition of benthic species in combination with their relative pollution tolerance are indicators of habitat quality. 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. Organisms living in the surficial sediments can be subjected to stresses from low dissolved oxygen (Diaz and Rosenberg, 1995) and organic matter deposition (Rhoads and Germano, 1986). Lerberg et al. (2000) also indicate that macrobenthic communities were significantly degraded when the percent imperviousness increased above 50 percent.

Paerdegat Basin FSAP samples (Figure 4-2) were collected in July 2000, and July and August 2001. The other sampling stations throughout Jamaica Bay shown in Figure 4-3 (Paerdegat Basin, Fresh and Hendrix Creeks) were not sampled in 2000. Five replicate samples were taken at each station in 2000, but the number of replicates at each station was reduced to four in 2001. In addition, one sample was taken at each station for analysis of sediment grain size and Total Organic Carbon (TOC) content. No subtidal benthic samples were collected using a Ponar® grab dredge.

The benthic communities in Paerdegat Basin were higher in diversity near the mouth than in the upper reaches. Figure 4-23 illustrates the differences in numbers of taxa cumulated over the five replicates/station sampled in 2000. At PAERB01, well below the head of the Basin (more than a third of the way down-basin), only one individual (and therefore a single taxa) was found, this being an unidentifiable polychaete worm. The increase in number of taxa at the mouth reflects the change in the percent solids of the sediment, which increases from the head to the mouth (a higher percentage of solids retains less water).

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Existing NYSDEC Mapped Wetlands In and Around Paerdegat Basin

FIGURE 4-22

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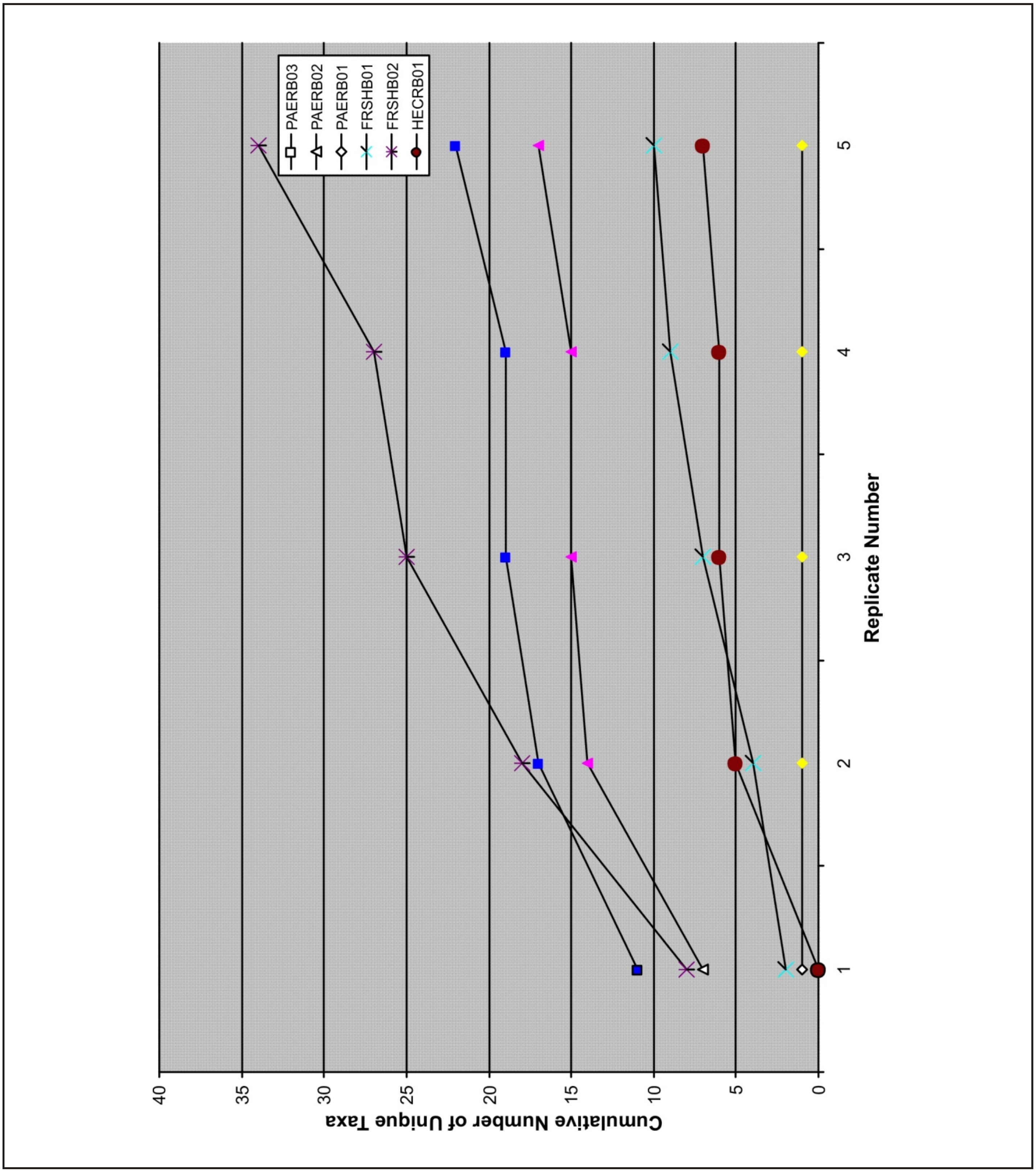

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Cumulative Benthic Taxa in Paerdegat Basin, Fresh Creek and Hendrix Creek

FIGURE 4-23

Figure 4-24 shows that the number of taxa in Paerdegat Basin sediments increases as the percentage of solids increases, and the percent TOC decreases. This relationship also held true in other tributaries sampled in 2000. Figure 4-25 and Figure 4-26 show the relationships between taxa vs. TOC and taxa vs. solids, respectively, observed over all stations sampled in 2000 (these figures include points for stations in the Bronx and Hutchinson Rivers, and Westchester Creek, which were sampled as part of a Bronx River FSAP also implemented in 2000). The highest percentages of TOC, and the lowest percentages of solids, were characteristic of strong-smelling black substrates often referred to as "black mayonnaise." The substrate changes from this low-solids form to that of a more stable substrate as one progresses from head to mouth, and a corresponding increase in abundance is evident. The maximum numbers of taxa per tributary (as defined in this study), were 21 and 29 (PAERB03 and FRSHB02, respectively), and sampling data for both 2000 (JAMBB01) and 2001 (JAMBB02-11) revealed that numbers of taxa were no higher than this in Jamaica Bay. Numbers of taxa in the Bay ranged from 3 (Grassy Bay) to 19 (several stations, stretching from Norton Basin and Grass Hassock Channel, through Pumpkin Patch Channel), and the types of taxa were generally similar to those of the tributary mouths. Figure 4-27, Figure 4-28, and Figure 4-29 show similar relationships between numbers of taxa observed and dissolved oxygen conditions observed for comparison purposes.

Numbers of individuals per station ranged from a low of eight per square meter at PAERB01, to some 20,000 per square meter at PAERB02 (Table 4-2). Most of these were polychaete worms. Those species considered useful as indicators of pollution (*Capitella capitata*, *Streblospio benedicti*, *Mulinia lateralis*) comprised 12 and 9 percent of the taxa, and 96 and 75 percent of the individuals, at PAERB02 and PAERB03, respectively. Few, if any, pollution sensitive taxa or individuals were found at any of the stations sampled in 2000 (PAERB02 had two *Clymenella torquata* [polychaete]; and PAERB03 had two *Mercenaria mercenaria* [hard clams]). However, even the Hutchinson River, sampled as part of the Bronx River FSAP and possibly the best habitat sampled during 2000, only had one species (but a few more individuals) of pollution sensitive taxa (the fingernail clam, *Telina agilis*). In 2001, several of the additional Jamaica Bay stations sampled as part of the Jamaica Bay FSAP (HydroQual, 2001a) also had numerous hard clams, while also harboring the tolerant polychaete *Capitella*. Like numbers of taxa, the numbers of individuals per station were also somewhat lower in the Jamaica Bay samples than they were at the mouth of Paerdegat Basin.

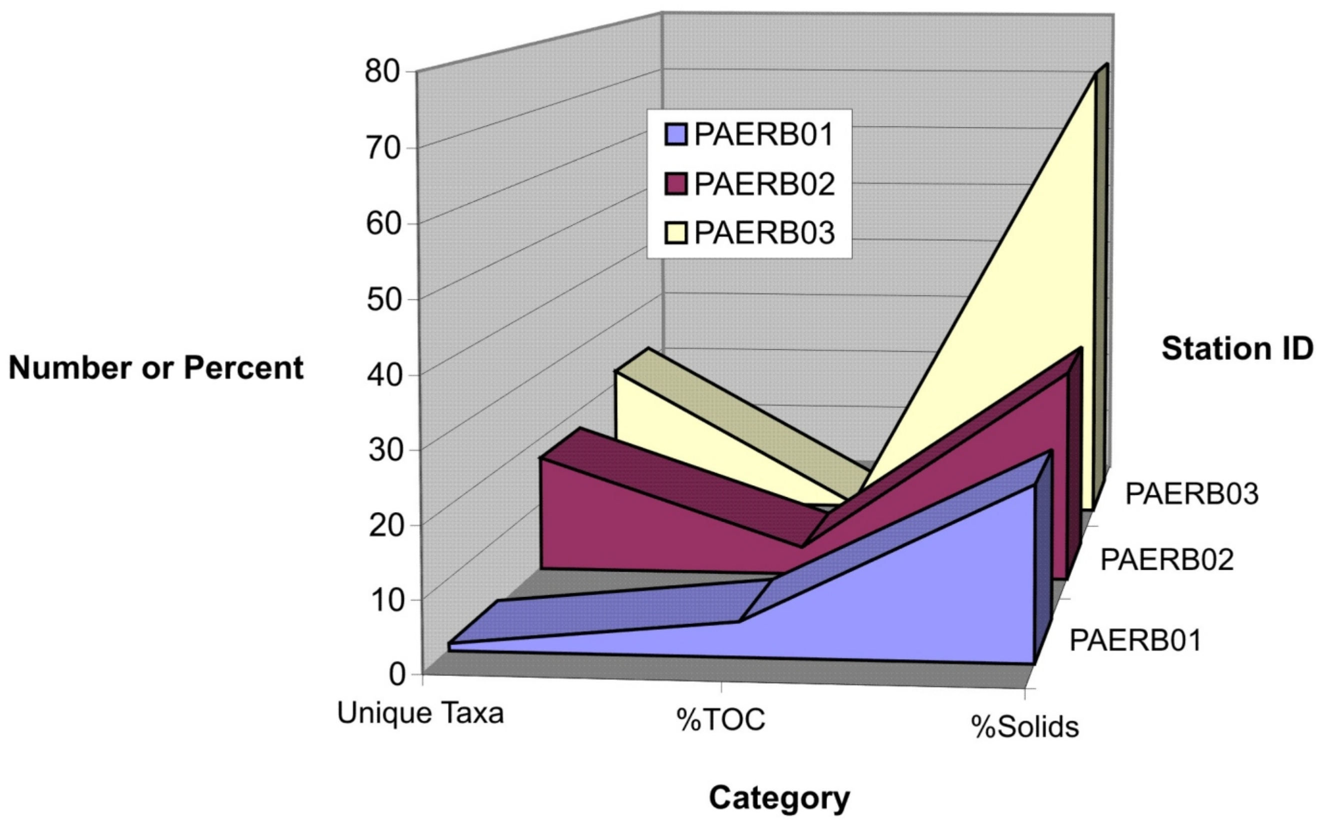
Table 4-2. Number of Individual Organisms per Taxa per Square Meter

Taxonomic Order	FRSH1	FRSH2	PAER1	PAER2	PAER3	HECR1	JAMB1
Ampelisca sp.	8	1,304	0	136	72	40	48
Ampharetidae	0	8	0	0	0	0	0
Amphipoda	0	136	0	0	32	0	0
Aoridae	0	56	0	0	0	0	0
Cabira incerta	8	0	0	0	0	0	0
Capitella capitata	3,576	752	0	14,608	312	8	0
Caprellidae	0	112	0	0	0	0	0
Clymanella torquata	0	0	0	16	0	0	0
Corophium sp.	0	2,760	0	0	88	0	0
Crangon septemspinosa	0	0	0	0	0	8	24
Decapod sp. (Unidentified)	0	8	0	0	0	0	0

Taxonomic Order	FRSH1	FRSH2	PAER1	PAER2	PAER3	HECR1	JAMB1
Erichthonius sp.	0	48	0	0	0	0	0
Eteone sp.	8	208	0	136	32	0	0
Eulalia sp.	0	0	0	8	0	0	0
Glycera sp.	0	8	0	0	8	0	0
Haploscoloplosus rubustus	0	0	0	8	16	0	8
Haploscoloplosus sp.	0	0	0	8	0	0	0
Harmothoe extenuate	0	8	0	0	0	0	0
Insecta sp.	0	0	0	8	0	8	0
Lysianopsis alba	0	48	0	0	0	0	0
Melita nitida	0	272	0	0	0	0	0
Mercenaria mercenaria	0	0	0	0	16	0	16
Microdeutopus gryllotalpa	0	368	0	0	0	0	0
Nassarius obsoletus	0	320	0	0	704	8	96
Nematoda sp. (Unidentified)	0	0	0	160	80	0	8
Nereis succinea	8	264	0	16	112	0	0
Nudibranchia sp. (Unidentified)	0	48	0	0	0	0	0
Oligochaeta	0	496	0	0	0	0	8
Orbiniidae	0	0	0	0	0	0	8
Pagurus sp.	0	64	0	0	16	0	0
Phyllodocidae	8	264	0	88	96	0	0
Platyhelminthes sp. (Unidentified)	0	48	0	0	0	0	0
Podarke obscura	8	0	0	0	64	0	0
Polychaeta	8	168	8	16	16	16	8
Polydora ligni	0	24	0	16	8	0	0
Polydora sp.	0	32	0	40	8	0	0
Polynoidae	0	0	0	8	0	0	0
Sabellaria valgaris	0	0	0	0	16	0	0
Sabelleria micropthalmla	0	0	0	0	8	0	0
Scolecolepides viridis	0	0	0	96	0	0	0
Serpulidae	0	96	0	0	0	0	0
Spionidae	0	0	0	24	0	0	0
Stauronereis rudolphi	8	0	0	0	0	0	0
Streblospio benedicti	8	10,952	0	4,800	3,944	8	3,000
Syllidae	0	32	0	0	0	0	0
Tharyl acutus	0	264	0	8	0	0	0
TOTAL (per square meter)	**3,648**	**19,168**	**8**	**20,200**	**5,648**	**96**	**3,224**

4.6.3. Epibenthic Communities

The epibenthic or fouling community was studied by suspending multiple-plate arrays of 8-inch by 8-inch synthetic plates in the water column. Multiple plates were used at each location to account for the variations in hard substrate throughout the harbor, and to eliminate the effect of substrate type on community composition. Stations were selected to be representative of portions of the waterbodies known to experience different DO regimes, and arrays were deployed at both near-surface (-3 ft MLW) and near-bottom (-7 ft MLW) depths at most stations in response to the DO



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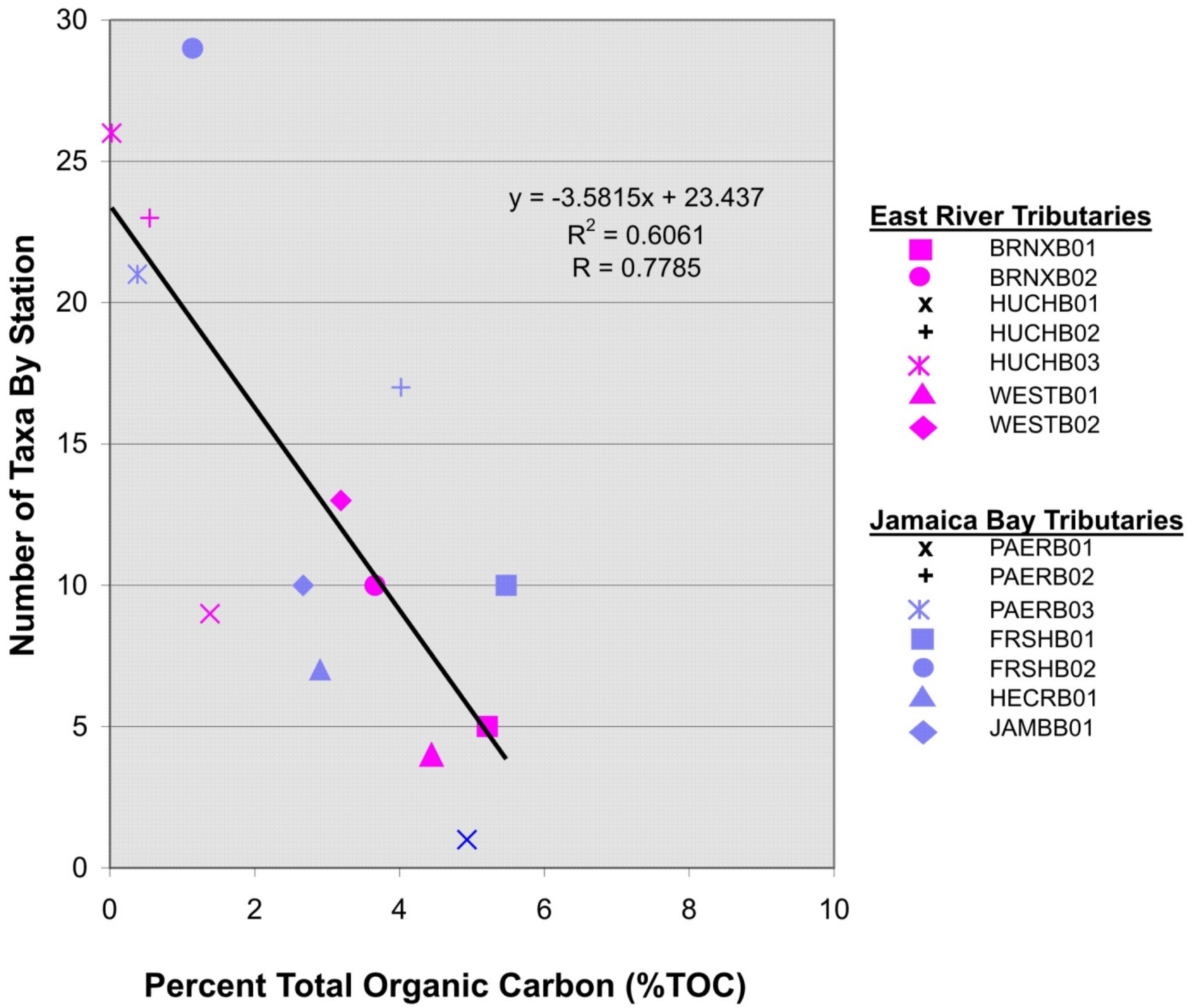
TOC and Percent Solids Effects on Number of Unique Taxa at Paerdegat Basin Stations

FIGURE 4-24



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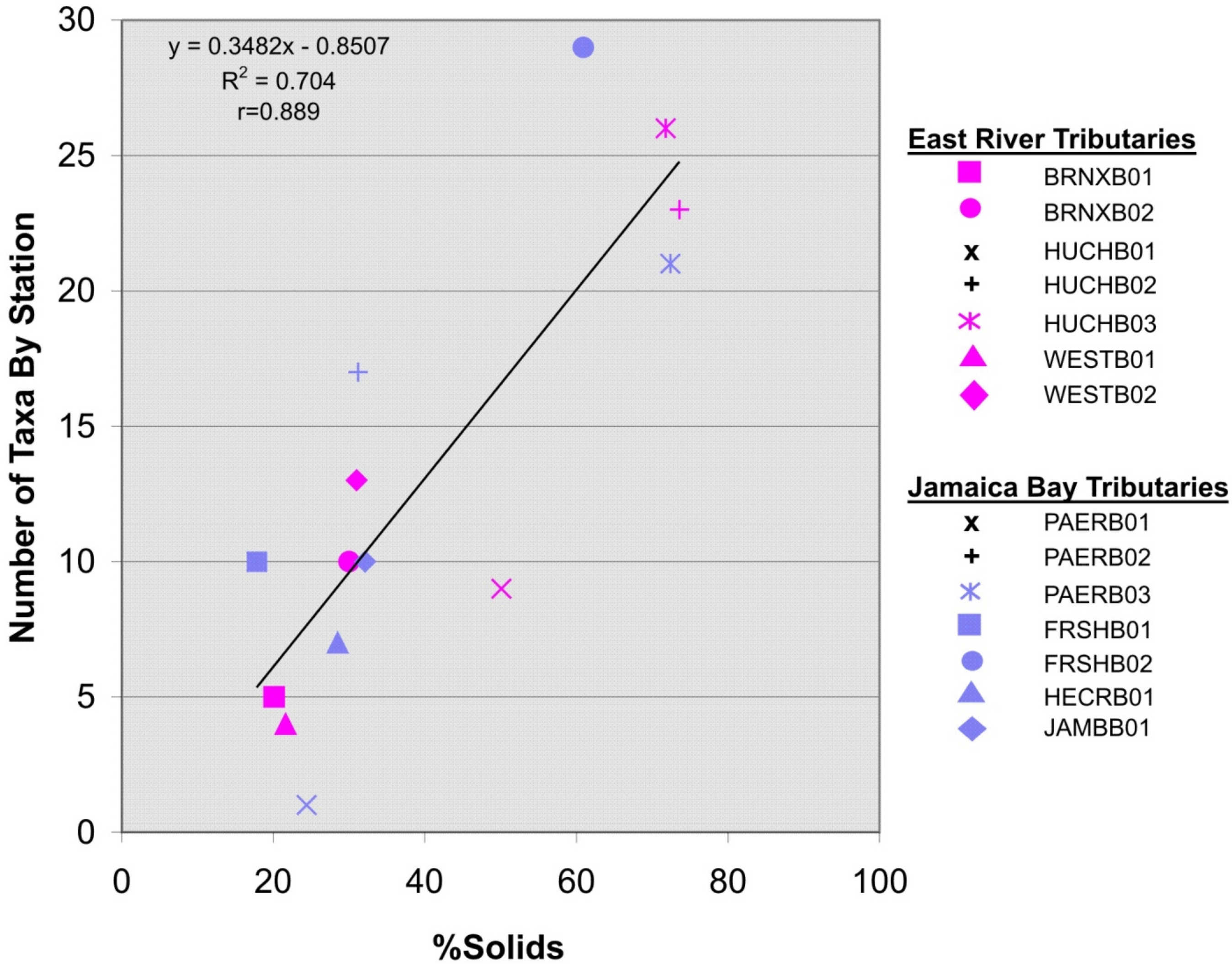
TOC and Percent Solids Effects on Number of Unique Taxa at East River and Jamaica Bay Stations

FIGURE 4-25



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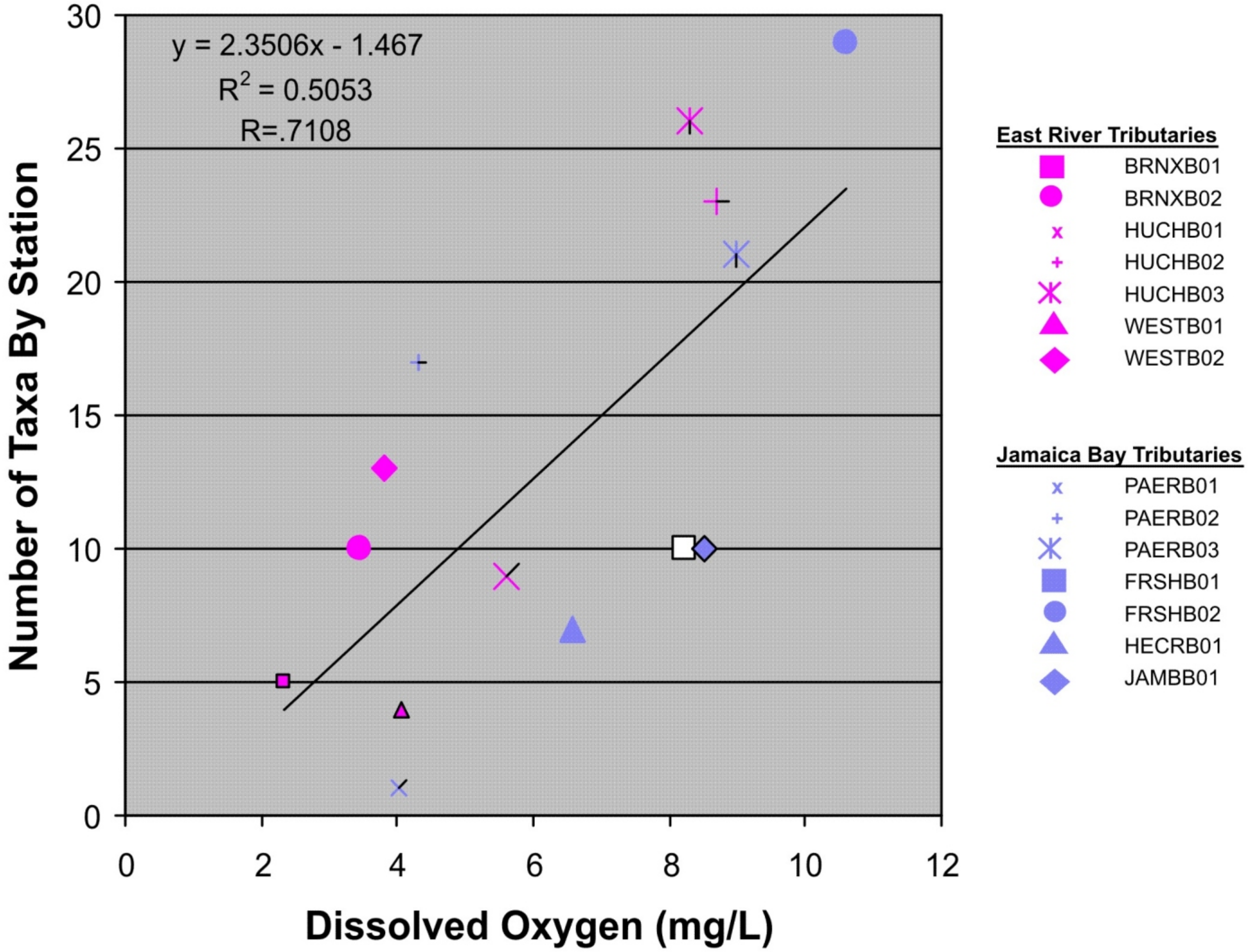
Percent Solids Effects on Number of Unique Taxa at East River and Jamaica Bay Stations

FIGURE 4-26



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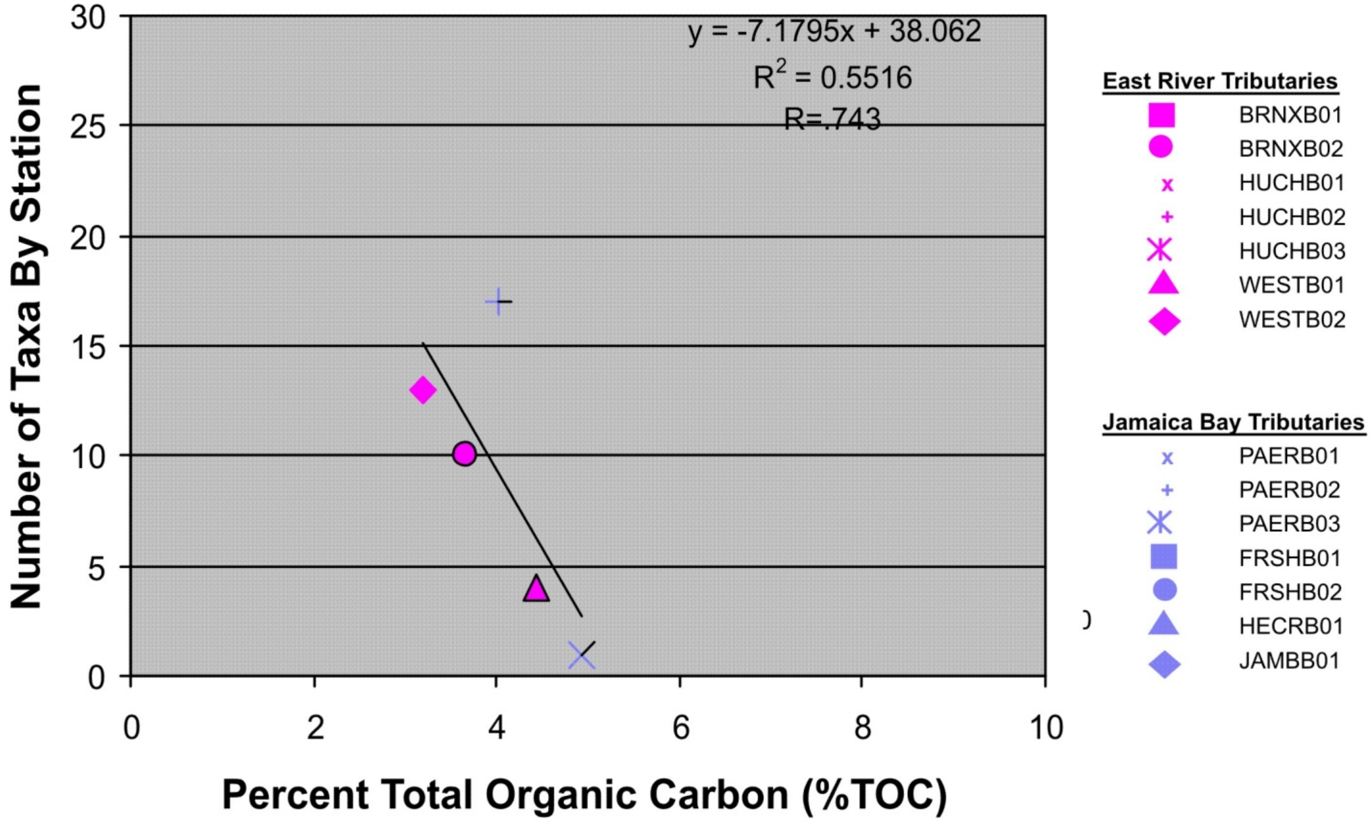
DO Effects on Number of Unique Taxa at East River and Jamaica Bay Stations

FIGURE 4-27



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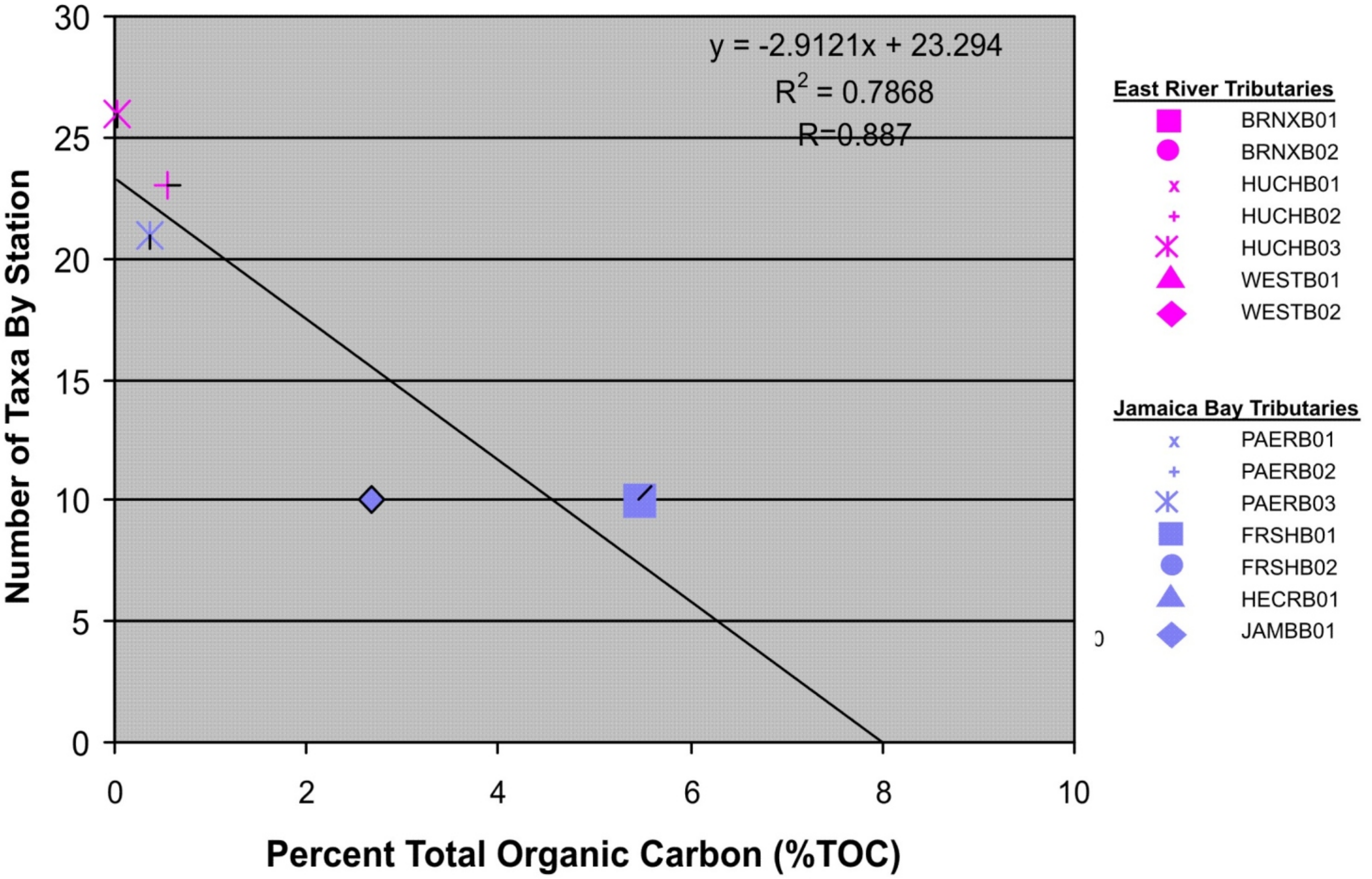
TOC Effects on Number of Unique Taxa at Low DO Stations

FIGURE 4-28



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Paerdegat Basin Long-Term CSO Control Plan

TOC Effects on Number of Unique Taxa at High DO Stations

FIGURE 4-29

stratification commonly found in New York Harbor waters. Paerdegat Basin FSAP station arrays (Figure 4-2) were deployed in June 2000, and tended (for external examination, photos, and removal of individual sample plates) in October 2000, and January, April and June, 2001. Short-term (~ 3-month exposure) plates were retrieved each time, and 6-, 9- and 12-month plates were retrieved on subsequent cruises. Laboratory results of the final set (12-month, or spring exposure period) are not available yet, but, as anticipated, the summer 2000 exposure period produced the greatest colonization and most instructive observations concerning epibenthic recruitment (to the arrays) and survival over the summer and early fall (as inferred by presence or absence, and biomass, of organisms).

Figure 4-30 shows what the Paerdegat Basin near-surface substrate arrays looked like upon retrieval in early October 2000. The station at the head of the Basin (PAERP01) was blanketed with an organic matrix not unlike that of the sediments there, but no animals were present. In contrast, as seen in the pie diagrams showing relative abundance of taxa (by weight) on 3-month plates removed from the arrays, station PAERP02-Top (midway down the Basin, -3 ft MSL) had heavy colonization and moderate diversity (including barnacles, worms and some crustaceans), and station PAERP03-Top (at the Belt Parkway bridge near the mouth of the Basin) had even greater diversity. At both stations, however, diversity and abundance were reduced on the plates taken from the bottom arrays. This is most pronounced at PAERP02, where bottom hypoxia is still frequent, but differences (especially in biomass of taxa) are also evident at PAERP03 (where mixing with Jamaica Bay waters is better, and bottom hypoxia is less frequent and prolonged). It should be noted that small fish, including gobies, cunner and juvenile tautog, were often found between the plates of arrays deployed at many stations, in testimony to their tenacity in search of worms and other small invertebrates integral to the epibenthic community even in suboptimal water quality conditions. A goby and a Tautog were found in the PAERP02 array in January and April, respectively, but the Hendrix Creek station harbored 10 cunner and 3 gobies in January, and 8 cunner and 7 tautog in April.

Most of the taxa found on these arrays are tolerant of organic enrichment and/or low DO (even barnacles, which are also found in very clean waters). A notable exception is the Say mud crab (*D. sayi*) which in its larval stage is intolerant of low DO and was a driving force in the derivation of new federal water quality criteria for DO (USEPA, 2000). Adult Say crabs were found living in and on substrate arrays placed throughout the harbor in June 2001 (Figure 4-31), including Paerdegat Basin (PAERP02, top and bottom) and many other waterbodies which experience low DO from late spring through early fall, and in PAERP03-Bottom in October, 2000. Larval *D. sayi* were found in ichthyoplankton samples taken throughout Jamaica Bay (including Grassy Bay), and in Mill Basin and Fresh Creek, during July 2001, all areas with documented hypoxic conditions. These results suggest that Say crab larval survival and growth may be less sensitive to low DO in nature than the laboratory results used by USEPA might indicate, although interpretation of plankton data is complicated by possible tidal transport of larvae among waterbodies. Regardless, the presence of epibenthic larvae sensitive to low DO conditions in waterbodies known to experience those same conditions suggests that full attainment of stringent DO standards 100 percent of the time is not necessary to ensure survival and recruitment of important species. In contrast, the severity of the conditions at the head of Paerdegat Basin probably precludes propagation and survival of most marine vertebrate or invertebrate species in this area, as evidenced by the PAERP01 artificial substrate array observations.

In conclusion, results of the artificial substrate study showed that water quality limits epibenthic recruitment and survival at the head of Paerdegat Basin, but (like the subtidal benthic community) marine life begins to return within about 2,000 feet of the head of the Basin. It is therefore expected that an increase in biomass and diversity could occur at the head of the Basin or in bottom waters of the mid-basin with reduction in CSO pollutant loadings to Paerdegat Basin, given availability of suitable substrate habitat. Reductions in solids loading would reduce TOC and improve light penetration in the water column, leading to increased DO levels on an average basis, and fewer incidences of hypoxia in the lower half of the water column.

4.6.4. Phytoplankton

Although phytoplankton was not included in the USA sampling program, there are several literature sources that have researched phytoplankton populations. West-Valle et al. (1992) reported on the physical, biological and chemical characteristics of Jamaica Bay. This report includes a summary of the findings of Peterson and Dam (1989), and Cosper et al. (1989) studies. These studies were conducted in the same locations, but at different times of the year. They measured the abundance of phytoplankton and primary productivity along with other variables such as salinity, temperature, oxygen and nutrients. Peterson and Dam (1989) characterized the taxonomic composition of the high salinity, well-mixed outer part of Jamaica Bay as being similar to that found in coastal waters. Whereas, the lower-salinity, partially-stratified inner bay area was characterized by cryptomonads and dinoflagellates. Spring blooms were found to be dominated by large diatoms and summer blooms were dominated by small diatoms and flagellates. The Cosper et al. (1989) study concluded that although the bay may experience eutrophic conditions at certain times of the year, the phytoplankton communities are similar to nearby embayments with less eutrophic conditions.

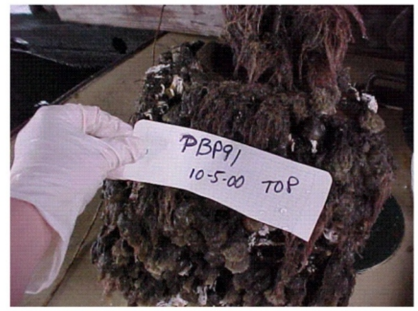
NYCDEP conducted a biological productivity study during 1995 and 1996 that included phytoplankton sampling in Jamaica Bay (EEA, 1997). Phytoplankton samples were collected monthly from August 1995 to July 1996 and collected twice monthly during September and October 1995 and March and April 1996. Results of this study show that Jamaica Bay had an average phytoplankton density of 17.8 x 106 cells/L with peak densities occurring during January and March 1996 and having average densities of 35.5 x 106 cells/L and 35.4 x 106 cells/L, respectively. A total of 83 species and taxa of phytoplankton were counted, with a majority of the species being classified as diatoms. The most abundant phytoplankton species found was the diatom *skeletonema costatum* which accounted for 21 percent of all species present. Densities of phytoplankton ranged from 0.372 x 106 cells/L to 68.6 x 106 cells/L, with the lowest and highest densities found at the Barren Island station and The Raunt station, respectively. Stations nearest to Paerdegat Basin had diversities ranging from 55 species or taxa at North Channel station, to 61 species or taxa at The Raunt station. Corroborating data are available from the NYCDEP Harbor survey, which has included limited phytoplankton sampling since 1978. The samples are collected monthly between June and September, when blooms are most common, and the results of the 2000 report show an increase phytoplankton abundance.

It should be noted that phytoplankton blooms may be responsible for the periodic water discoloration or “milky water” occurrences in Paerdegat Basin. The exact cause of the discoloration has not yet been determined, but several investigations have been conducted in Paerdegat Basin that have indicated that blooms of dinoflagellates, large bacteria populations, CSO conditions and

Photos of -3ft. MLW substrate arrays

PAERP01

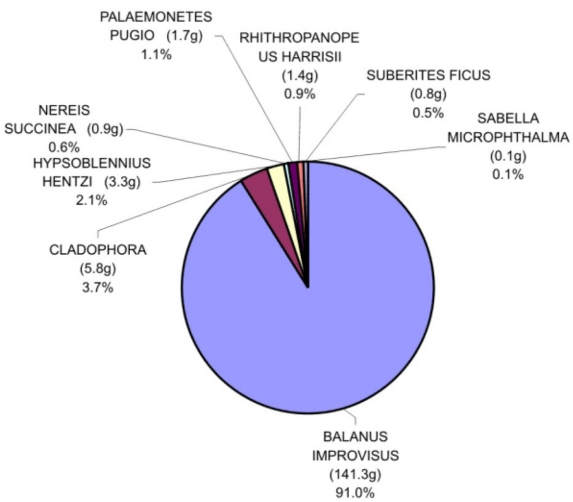
PAERP02



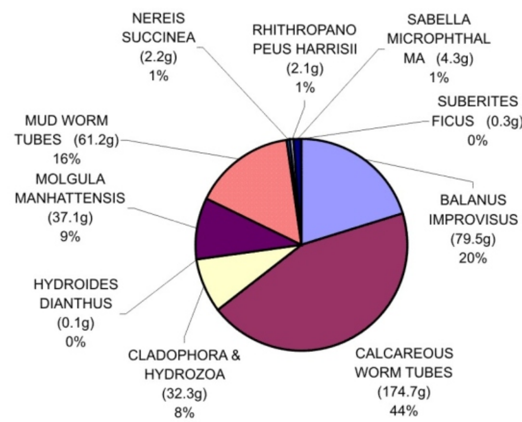
PAERP03

Percent Composition by Weight of Taxa on Plates

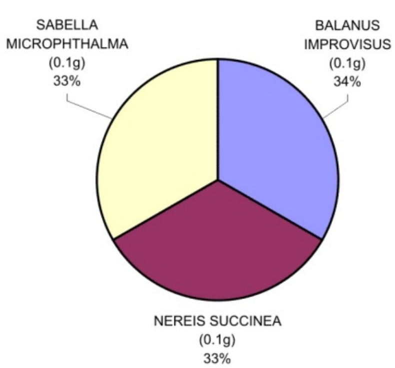
PAERP02: TOP



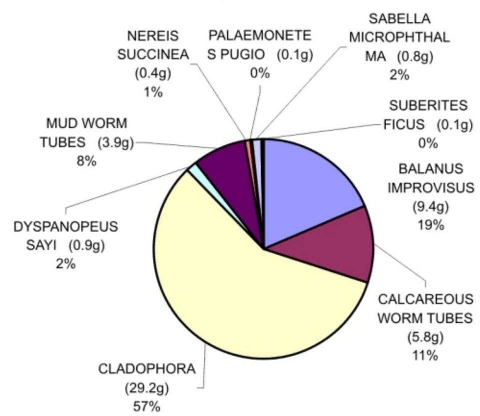
PAERP03: TOP



PAERP02: BOTTOM



PAERP03: BOTTOM



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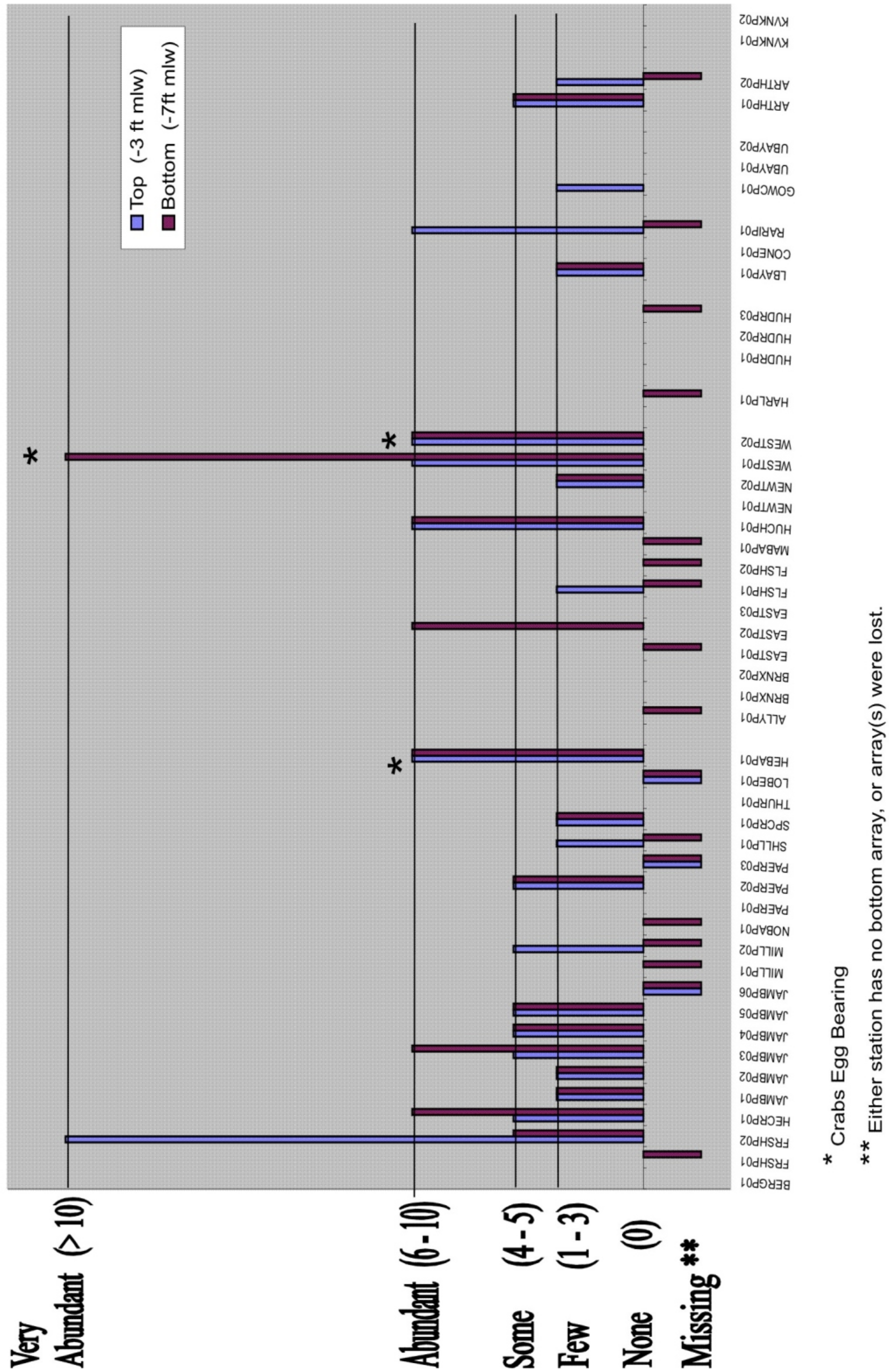
Paerdegat Basin Artificial Substrate Arrays: Jul-Sep 2000 Exposures

FIGURE 4-30



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Paerdegat Basin Long-Term CSO Control Plan

Apr-Jun 2001 Artificial Substrate Exposures and Relative Abundance

FIGURE 4-31

meteorological factors could all contribute to this condition (Cosper et al., 1989; Levandowsky, 1994; NYCDEP, 1997).

4.6.5. Zooplankton

Peterson and Dam (1989), as summarized by West-Valle et al. (1992), reported that zooplankton populations in Jamaica Bay were mostly dominated by adult and juvenile species of copepods. The dominant species found in the Bay during the fall and spring samplings were *Acartia tonsa*, *Acartis hudsonica*, and *Paracalanus parvus*. The summer sampling was dominated by *Oithona similis*. The study concluded that although the Bay may experience eutrophic conditions at certain times of the year, the phytoplankton communities are similar to nearby embayments with less eutrophic conditions (Cosper et al., 1989).

As part of the biological productivity study conducted by NYCDEP (EEA, 1997), micro-zooplankton and macro-zooplankton were sampled monthly from August 1995 through July 1996, and twice per month in September and October 1995, and March and April 1996. A total of 31species or taxa of zooplankton were observed, with copepods being the most dominant and abundant species. The most abundant individual species, which accounted for 39.5 percent of all organisms collected, was *Acartia hudsonica* (a copepod) followed by *Eurytermora sp.*, *Temora longicornis*, *Acartia tonsa*, and *Centropages sp.*

Although zooplankton sampling was not included in the 2000 and 2001 USA FSAPs, the ichthyoplankton sampling nets frequently became clogged with copepods and other common zooplankton taxa such as cladocerans, hydromedusae and decapod larvae. One form of decapod, the Say mud crab (*Dispanopeus sayi*) larvae, was singled-out in 2001 samples because of its reported lack of tolerance to DO (resulting in suboptimal growth, and increased mortality). Of note, *D. sayi* larvae were found in ichthyoplankton samples collected in Paerdegat Basin, Fresh Creek and Mill Basins, as well as two Jamaica Bay stations.

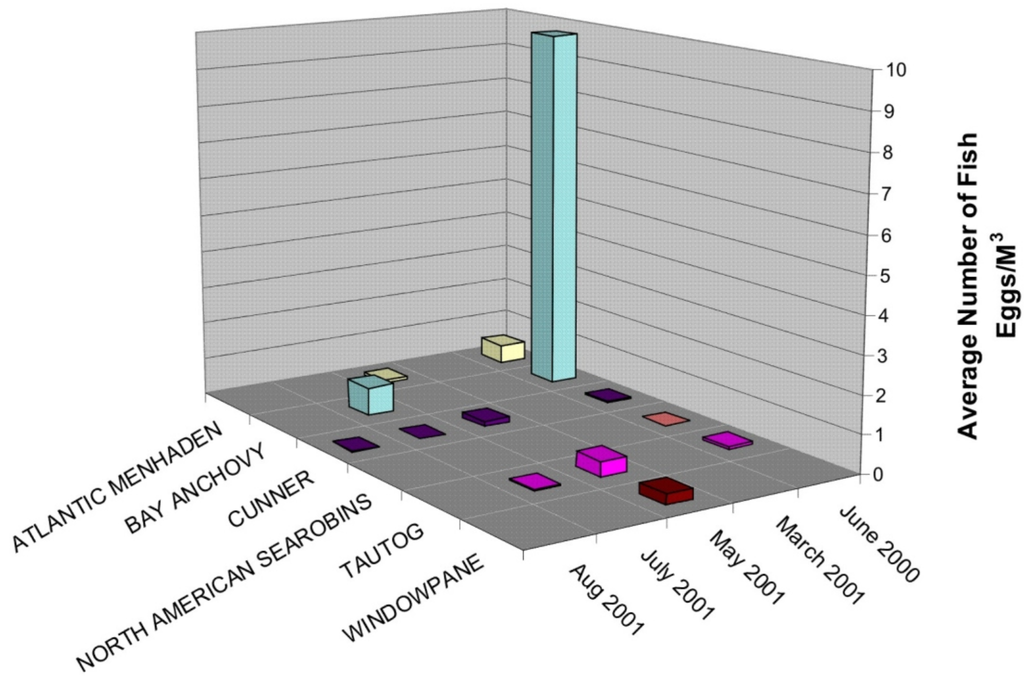
4.6.6. Ichthyoplankton

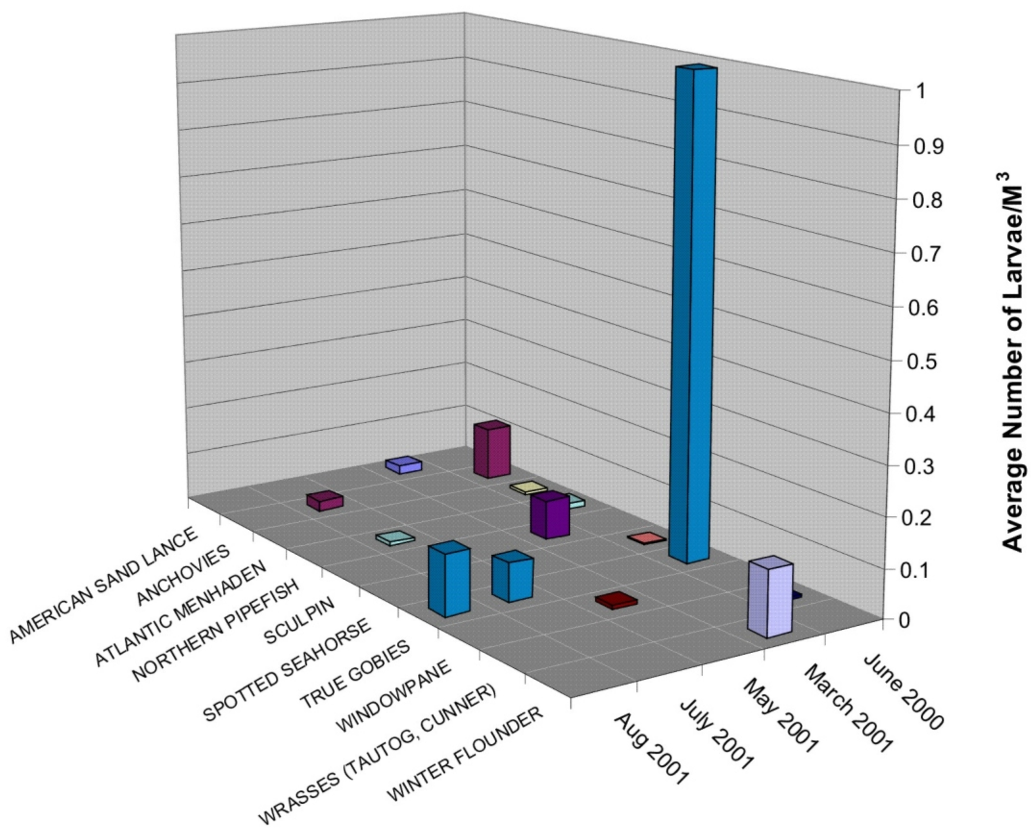
Ichthyoplankton sampling was performed to identify and characterize fish spawning in Paerdegat Basin under the USA Project. Ichthyoplankton samples were taken throughout Jamaica Bay and its tributaries (Figure 4-2), during months indexed to the life history of a variety of representative important species. Sampling was initially performed in late June 2000 as part of the Paerdegat Basin FSAP, and a more comprehensive effort was launched in 2001, when sampling was performed during March, May, July, and August to quantify the propagation of fish species with different spawning periods. Stations were located throughout New York Harbor, and were selected to be able to examine the relative abundance of each species' eggs and larvae in a variety of habitats, in the same time frame, using the same methods and materials. In 2002, additional sampling was performed in Paerdegat and Mill Basins and at three stations in Jamaica Bay to further evaluate differences in species richness and larval growth. Samples were taken on both ebb and flood tides in six sequential weeks during March/April (focusing on winter flounder larvae), and July/August (focusing on summer spawners such as bay anchovy, Atlantic menhaden, and tautog). Lab analyses for these samples included the measurement of larval sizes (lengths), and ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) content, in addition to simple counts on a life stage and species basis. The RNA/DNA ratio has been shown to be an indicator of larval and young-of-the-year growth and condition (Buckley, 1984; Buckley et al., 1999; Kuropat et al., 2002).

Figure 4-32 shows which species of fish eggs and larvae were found in Paerdegat Basin in each of the months sampled during 2001, and their average densities in the water column (based on conversion of average sample numbers in two replicates, to numbers per cubic meter of water filtered). Although a fair number of species were represented, results show that relatively few species and stages were found in abundance: bay anchovy eggs and larvae in June and July; menhaden eggs in June; sculpin and winter flounder larvae in March; goby larvae from June through August; and tautog and cunner (wrasses) eggs in early summer. The absence of certain life stages is likely the result of sampling bias; winter flounder eggs, for example, are not generally found in the water column, and cunner larvae adopt a structure-oriented habit relatively quickly, making them less vulnerable to the sampling gear. Regardless, the only ichthyoplankton found in Paerdegat Basin in August were cunner eggs and goby larvae, whereas anchovy eggs were found in places like Mill Basin and Hewlett Bay (a reference station removed from the Jamaica Bay system, inside the Long Beach peninsula).

Figure 4-33 through Figure 4-35 illustrate ichthyoplankton distribution and abundance in March, May, and July 2001, respectively. The March results are noteworthy in that they demonstrate the overall dominance of the winter flounder larvae at most stations and that more winter flounder larvae are found in open waterbodies like Jamaica Bay than in the tributaries. An analysis of variance revealed that the concentrations of eggs and larvae were significantly higher in open waterbodies than in the tributaries on a total basis during both March and May. In May and July, when Paerdegat Basin had few eggs and larvae of any species, other similar waterbodies contained more diverse assemblages of ichthyoplankton, such as Shellbank Basin (anchovy, sea robin, mackerel), Jamaica Bay (menhaden, scup), and Hendrix Creek (herring, pipefish, and weakfish). Silverside larvae, not found in Paerdegat Basin, were found during May in Jamaica Bay, Norton Basin, Spring and Hendrix Creeks, as well as Shellbank and Thurston Basins. In July, they were found in Jamaica Bay and Mill Basin. The absence of silverside larvae in Paerdegat Basin was expected given the minimal amount of suitable marsh habitat for spawning and their relative intolerance to low DO (USEPA, 2000). However, their presence in Mill and Shellbank Basins was unexpected, considering the similar physical environment these waterbodies possess. These differences could be due to tidal exchange, or simply random sampling variation. Thurston Basin, while experiencing similarly low DO levels in summer, does have more marsh habitat. Anchovy eggs, found in low abundance during July in Paerdegat Basin, were found to be roughly four to five times more abundant in Norton and Mill Basins and up to twenty times more abundant at the Jamaica Bay station nearest Kennedy Airport. Anchovies, which can withstand DO levels in the 2 mg/L range, are present in large numbers in many waters, and evidence of spawning spanned several months, reducing the vulnerability of egg and larval populations to predation and episodic environmental changes such as hypoxia.

The 2002 analyses showed that lengths of winter flounder and bay anchovy larvae, per stage (yolk sac through post-flexure), were not significantly different among stations. Nor were RNA/DNA ratios significantly different among stations having more than five measurements (replicates). These findings indicate that the larvae represent the same population, and not discrete units residing wholly in, and being affected by, conditions at any given station.





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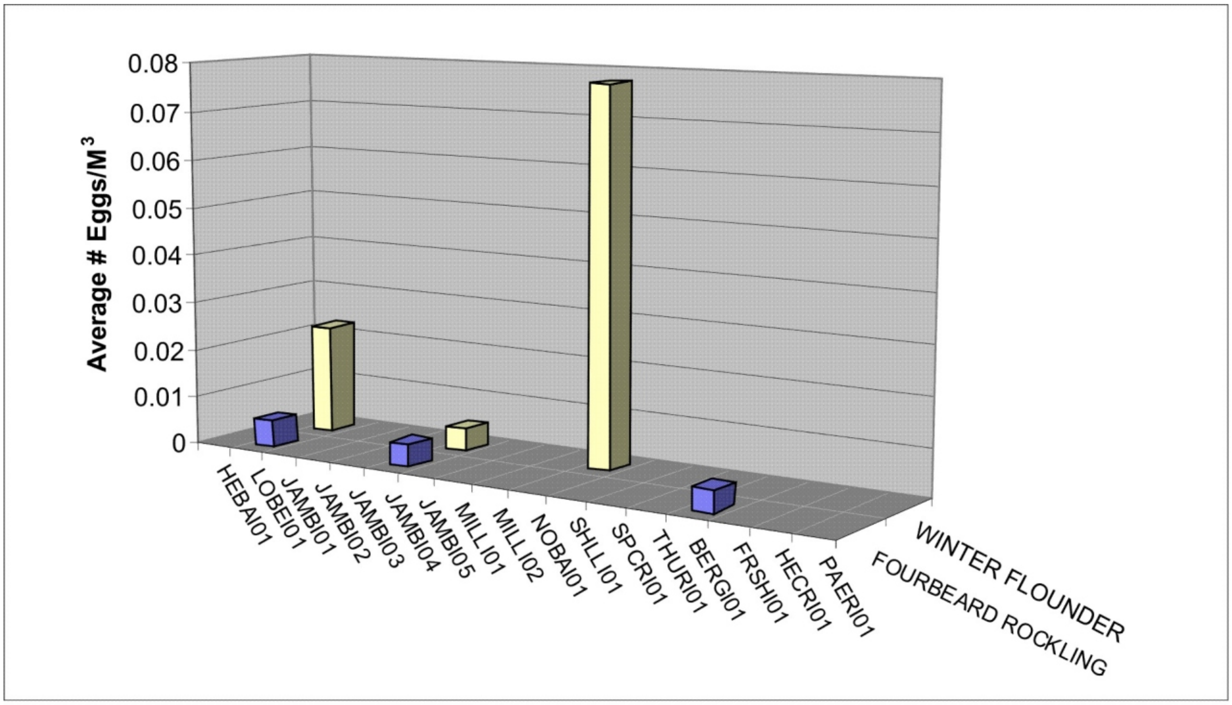
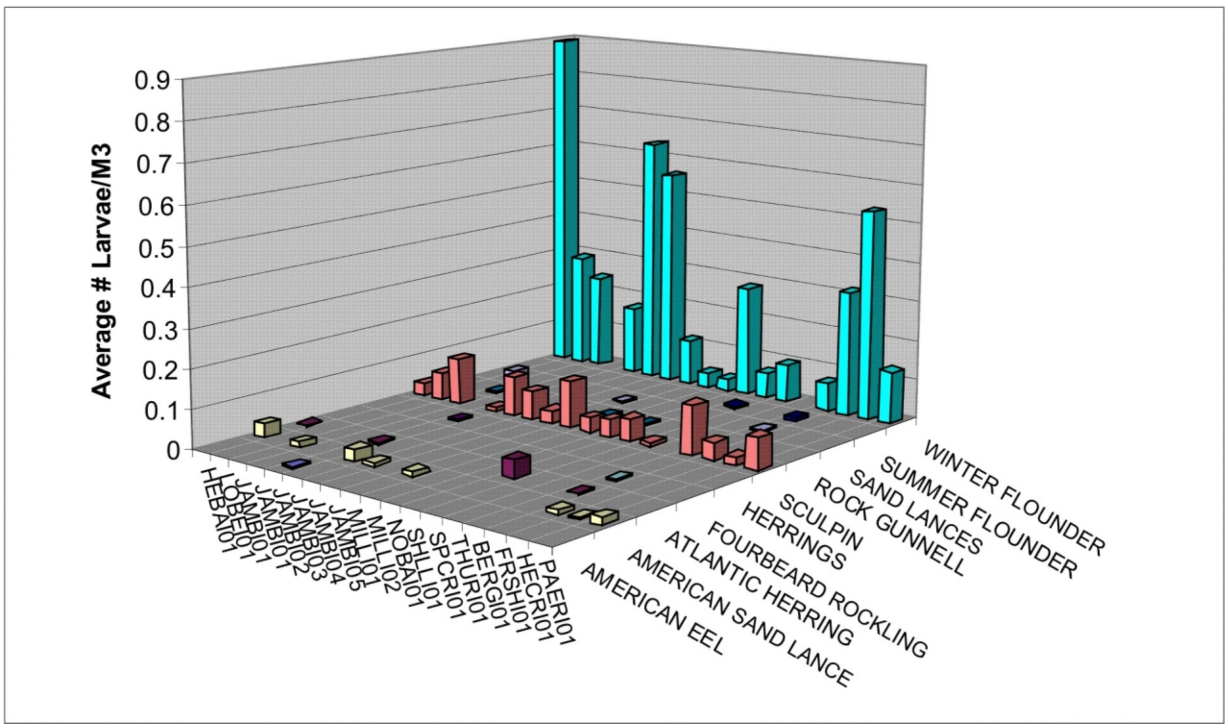
Fish Egg and Larvae Counts per Cubic Meter, Paerdegat Basin

FIGURE 4-32





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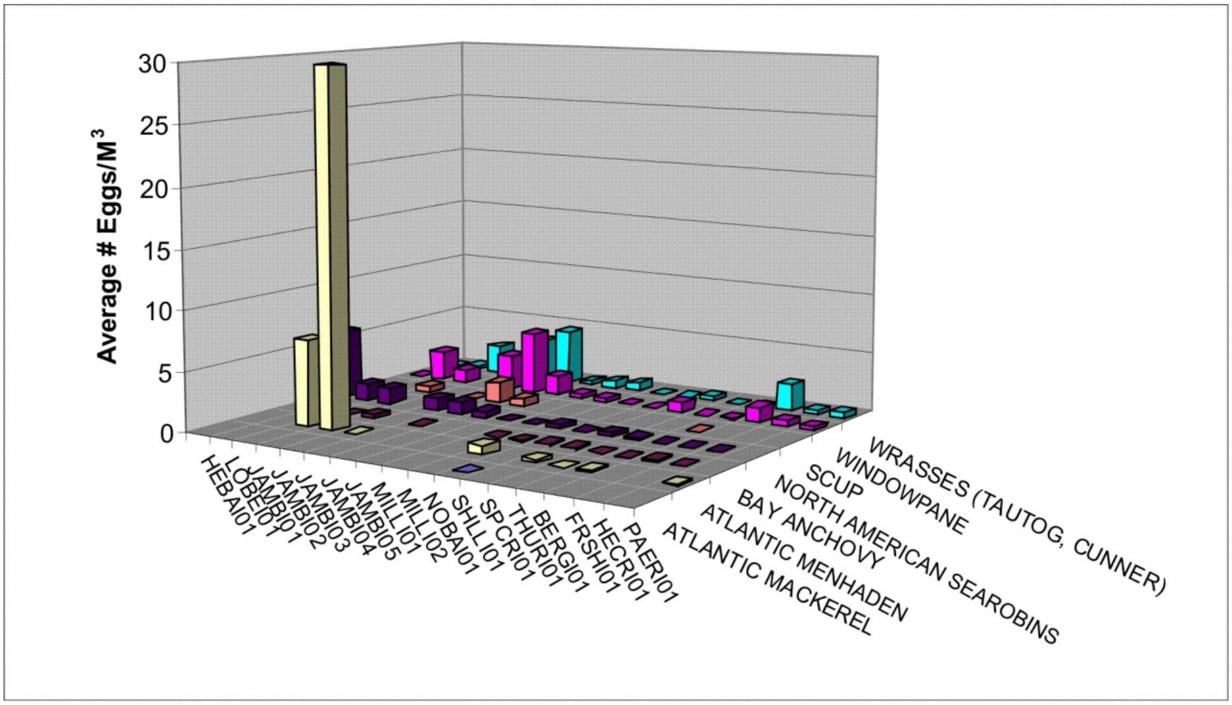
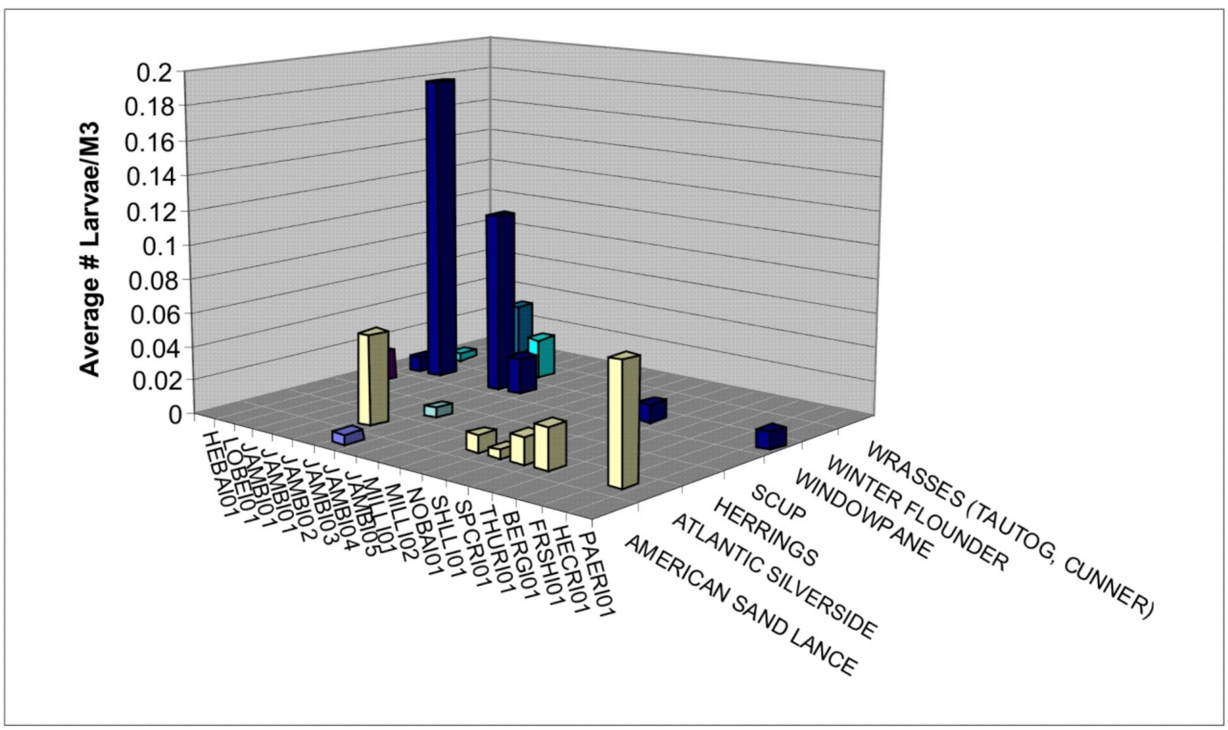
Paerdegat Basin Long-Term CSO Control Plan

Fish Egg and Larvae Counts per Cubic Meter, Mar 2001

FIGURE 4-33





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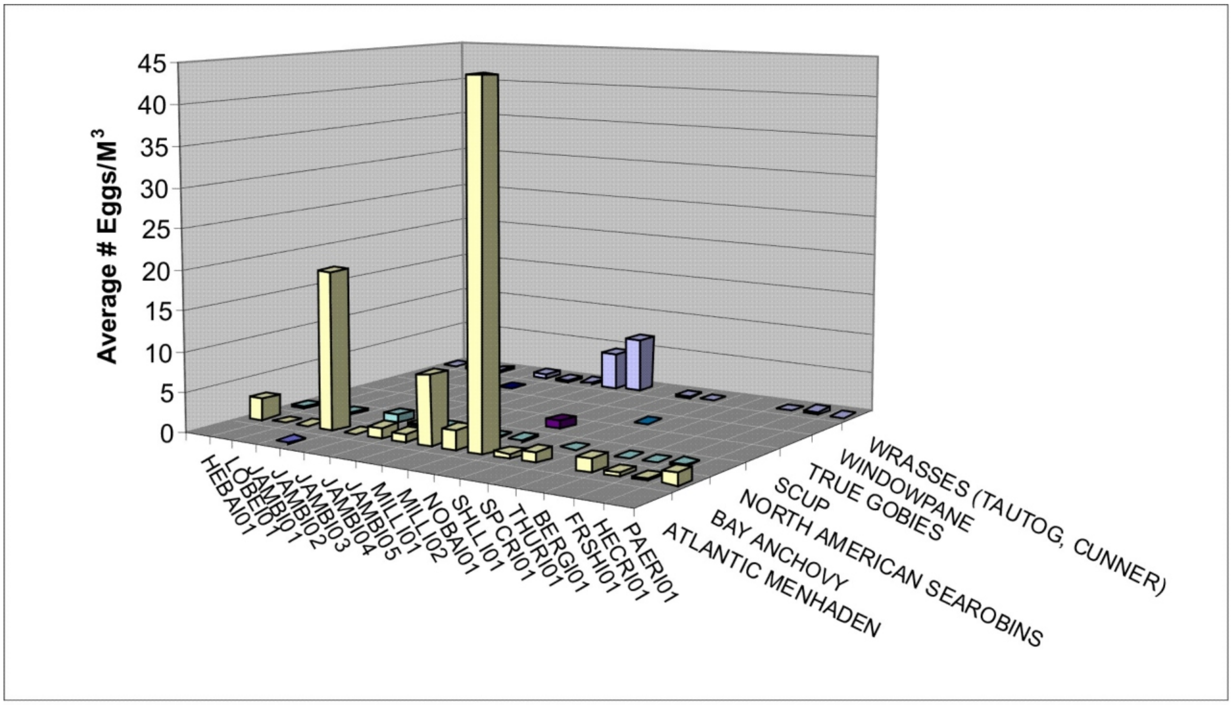
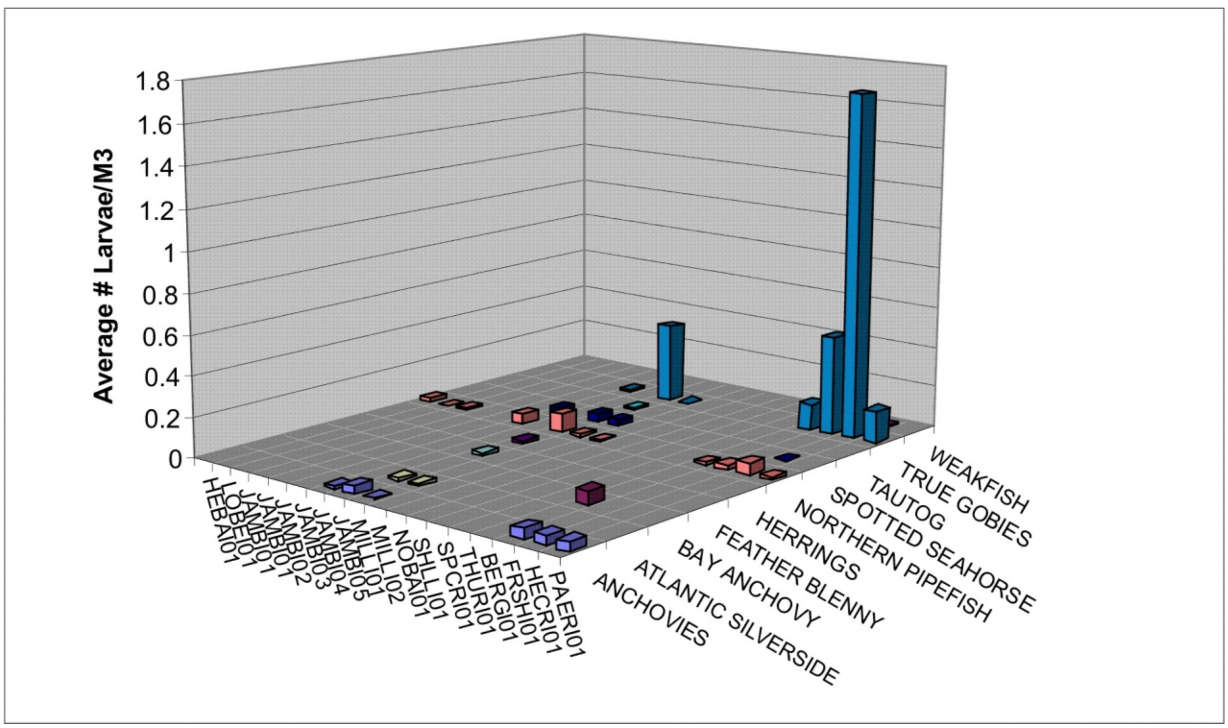
Paerdegat Basin Long-Term CSO Control Plan

Fish Egg and Larvae Counts per Cubic Meter, May 2001

FIGURE 4-34





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Fish Egg and Larvae Counts per Cubic Meter, Jul 2001

FIGURE 4-35

In conclusion, the relative abundance of fish larvae and eggs in Paerdegat Basin is generally lower than in other portions of the Jamaica Bay system. It is likely that some spawning of wrasses, gobies, menhaden and anchovies does occur in Paerdegat Basin during late spring and summer, but because Paerdegat Basin comprises less than 0.2 percent of the water volume of the system and has much less prime spawning habitat for species like tautog and silversides, the impact of low DO within Paerdegat Basin would not be likely to impact these populations on a system-wide scale.

4.6.7. Fish

Fish sampling was conducted in Paerdegat Basin during August 2000, July and August 2001, March and April 2002, and July and August 2002. The 2000 sampling effort was limited to stations in Paerdegat Basin, Fresh and Hendrix Creeks, and one station in Jamaica Bay opposite the channel from Hendrix Creek (Figure 4-2). The 2001 sampling included four more stations in Jamaica Bay, plus stations in each of the other tributaries to Jamaica Bay except Shellbank Basin, where development and boating activity precluded netting (Figure 4-3). The 2002 effort was limited to trawling at five stations (Paerdegat, Mill Basin, and three in Jamaica Bay), but 12 sampling dates (ebb and flood, six weeks/season) were included. Sampling was done with a small otter trawl, which drags the substrate to capture bottom-oriented organisms, and a gill net with 1-, 2-, 3-, and 4-inch mesh panels suspended in the water column to capture pelagic fish of various sizes. Minnow and crab traps were set in 2000, but results did not justify using them again in 2001. There were differences in weather conditions between the August 2000 and August 2001 sampling weeks, the former being cooler, thus resulting in cooler water temperatures and higher DO levels.

Table 4-3 and Table 4-4 list fish species taken by all gears, at each of the stations sampled in 2000 and 2001. Looking just at the right-hand columns (under PAER FSAP stations), it can be seen that more species were represented in 2000 when the weather was better than in 2001. In fact, during 2001, most of the Jamaica Bay tributaries had two or fewer species represented. However, the sampling effort was also higher in August 2000 than in 2001 (i.e., three trawls and two gill nets per station in 2000 as compared to a single trawl and gill net per station in 2001). Based on the relatively low catches per unit of effort of each piece of gear, and the similarity in taxa numbers among replicates in 2000, the differences in effort were less important than weather influences on observed diversity and catch rates in 2001.

Figure 4-36 through Figure 4-38 show the distribution and abundance of fishes caught in August 2000, July 2001, and August 2001, respectively. Notable differences between 2000 and 2001 include the much lower presence of bluefish and striped bass in 2001 and the greater frequency with which weakfish and menhaden were caught. Many of the weakfish were small juveniles, as shown later. Silversides and mummichogs (killiefish) were not represented in proportion to their abundance in the Jamaica Bay system due to the type of gear used; their presence and abundance is revealed in annual seine net monitoring surveys performed by NYSDEC (Figure 4-39). Again, these are marsh-dependent species, and none of the seine net samples collected by NYSDEC were actually taken inside the Jamaica Bay tributaries.

The presence or absence of fish species captured during the same sampling event can be used to illustrate the similarities among habitats in and around Jamaica Bay. The July 2001 data were subjected to cluster analysis using a basic Euclidian distance formula and clustering algorithm, producing a dendrogram of station similarities (Figure 4-40). This dendrogram clearly shows the similarity among tributaries and the Grassy Bay area in comparison to the other Jamaica Bay stations sampled: JAMBF02 and 03 and all the tributaries were experiencing low DO conditions during the sampling event.

Table 4-3. Fish Species Caught, Paerdegat FSAP, All Gears, August 2000, July 2001, and August 2001

Common Name	Station Name				
	FRSHF01	HECRF01	JAMBF01	PAERF01	PAERF02
Atlantic Menhaden	8/00	7/01		7/01	7/01, 8/00
Atlantic Silverside		8/00	7/01		
Bay Anchovy	8/00	8/00			8/00
Bluefish	8/00	ALL	7/01, 8/00	8/00	8/00
Cunner			8/00		
Gizzard Shad	8/00	8/00			8/00
Menhaden		8/01			
Mummichog				8/00	
Northern Pipefish			7/01, 8/00		
Pipefish			8/01		
Sand Tiger			8/00		
Silversides			8/01		
Snailfishes			8/00		
Spot	8/00	8/00		8/00	8/00
Striped Bass	8/00	7/01	8/00	8/00	
Summer Flounder			7/01, 8/00		7/01, 8/00
Weakfish	8/00	8/00	7/01, 8/00		8/00, 8/01

Table 4-4. Fish Species Caught, Jamaica Bay Stations, All Gears, July and August 2001

Common Name	Station Name							
	BERGF01	JAMBF02	JAMBF03	JAMBF04	JAMBF05	MILLF01	SPCRF01	THURF01
Atlantic Menhaden	7/01, 8/01			7/01, 8/01			7/01	7/01
Atlantic Silverside	8/01				8/01			
Bluefish	7/01, 8/01						7/01	
Cunner						7/01		
Smooth Dogfish					7/01			
Spotted Seahorse					7/01			
Striped Bass							7/01	
Striped Searobin				7/01	7/01			
Summer Flounder				7/01, 8/01	7/01			
Weakfish	8/01	7/01	7/01	7/01		7/01	7/01	7/01
Winter Flounder	8/01							

The effect of DO on the presence or absence of fish taxa is demonstrated in Figure 4-41, which shows the numbers of fish species caught by the various sampling gear plotted against the average mid- and bottom depth DO concentrations measured at the time. Points in this figure represent stations sampled as part of the Paerdegat Basin and Bronx River FSAPs that were performed in August 2000 and the Jamaica Bay and East River FSAPs that were performed in 2001.

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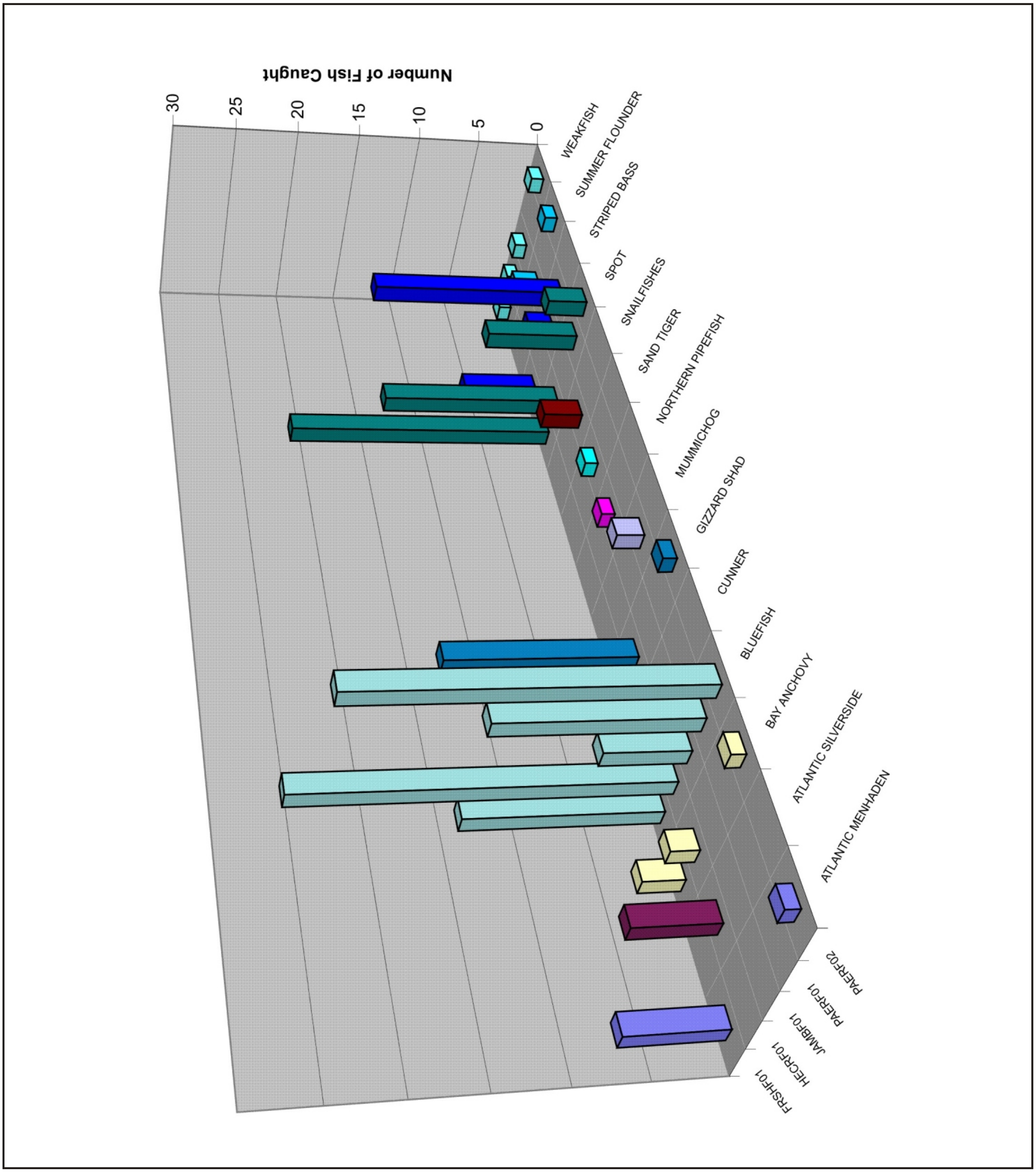

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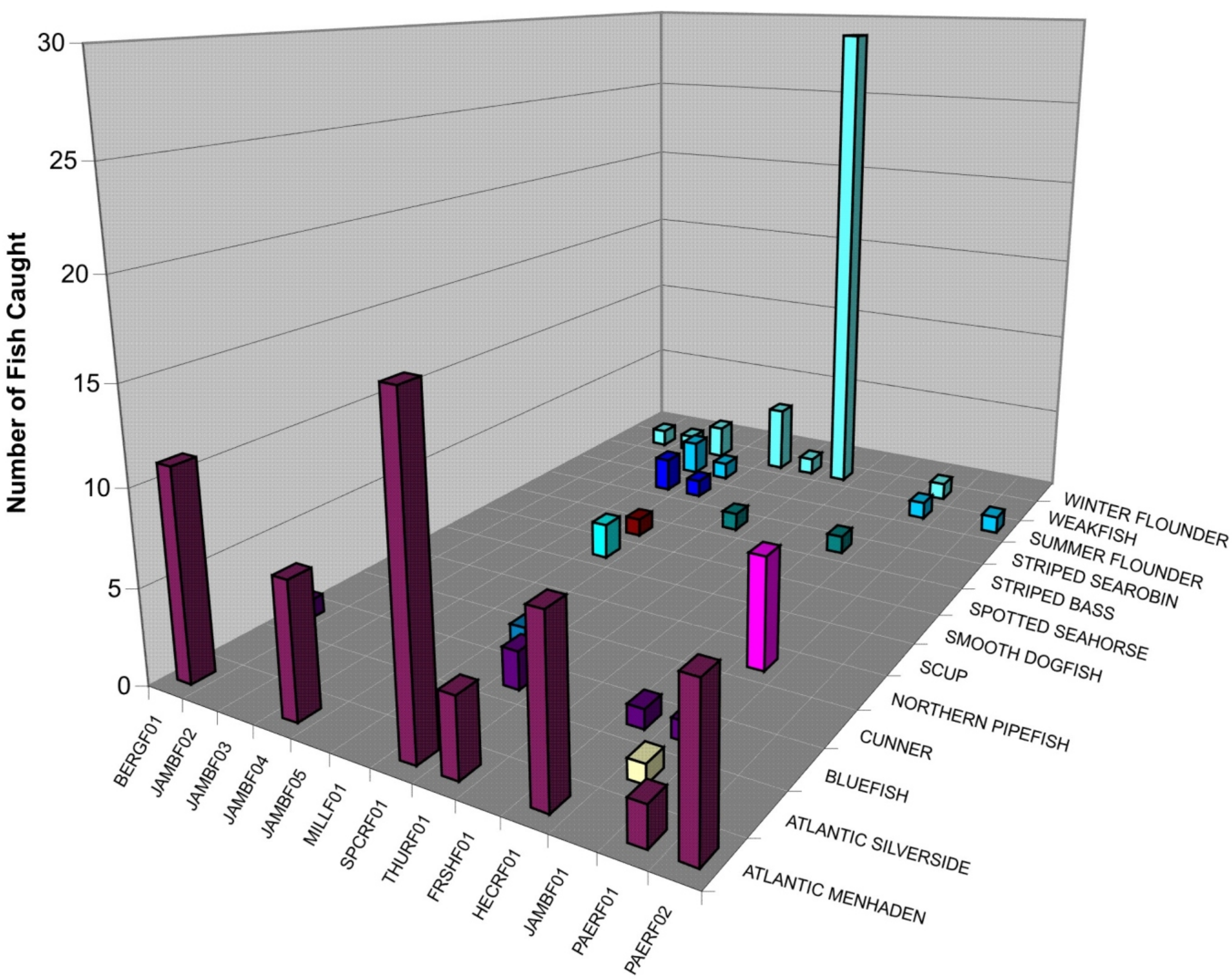
Paerdegat Basin Long-Term CSO Control Plan

Fish Counts by Species, Jamaica Bay, All Gears, Aug 2000

FIGURE 4-36



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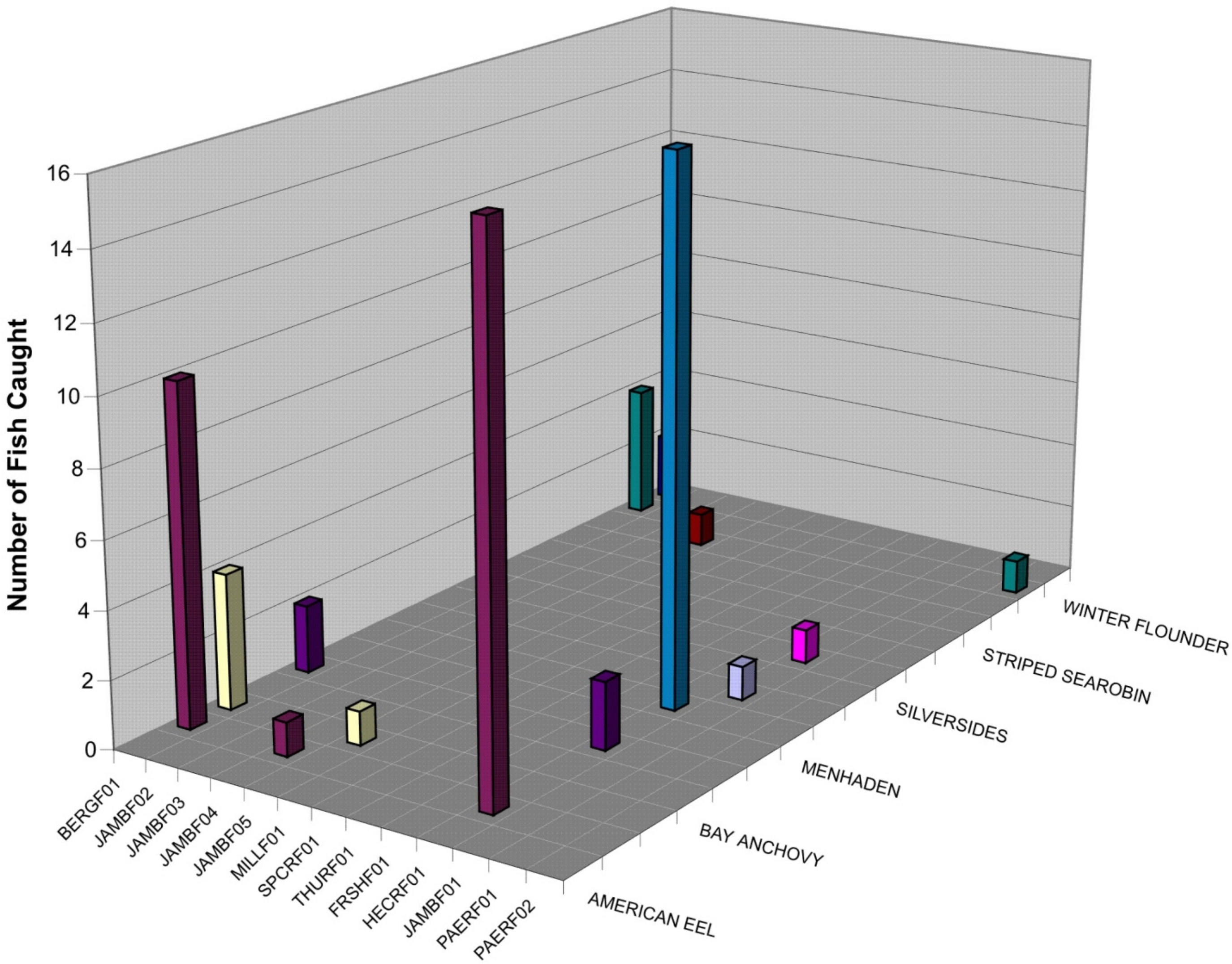
Fish Counts by Species, Jamaica Bay, All Gears, Jul 2001

FIGURE 4-37



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Paerdegat Basin Long-Term CSO Control Plan

Fish Counts by Species, Jamaica Bay, All Gears, Aug 2001

FIGURE 4-38

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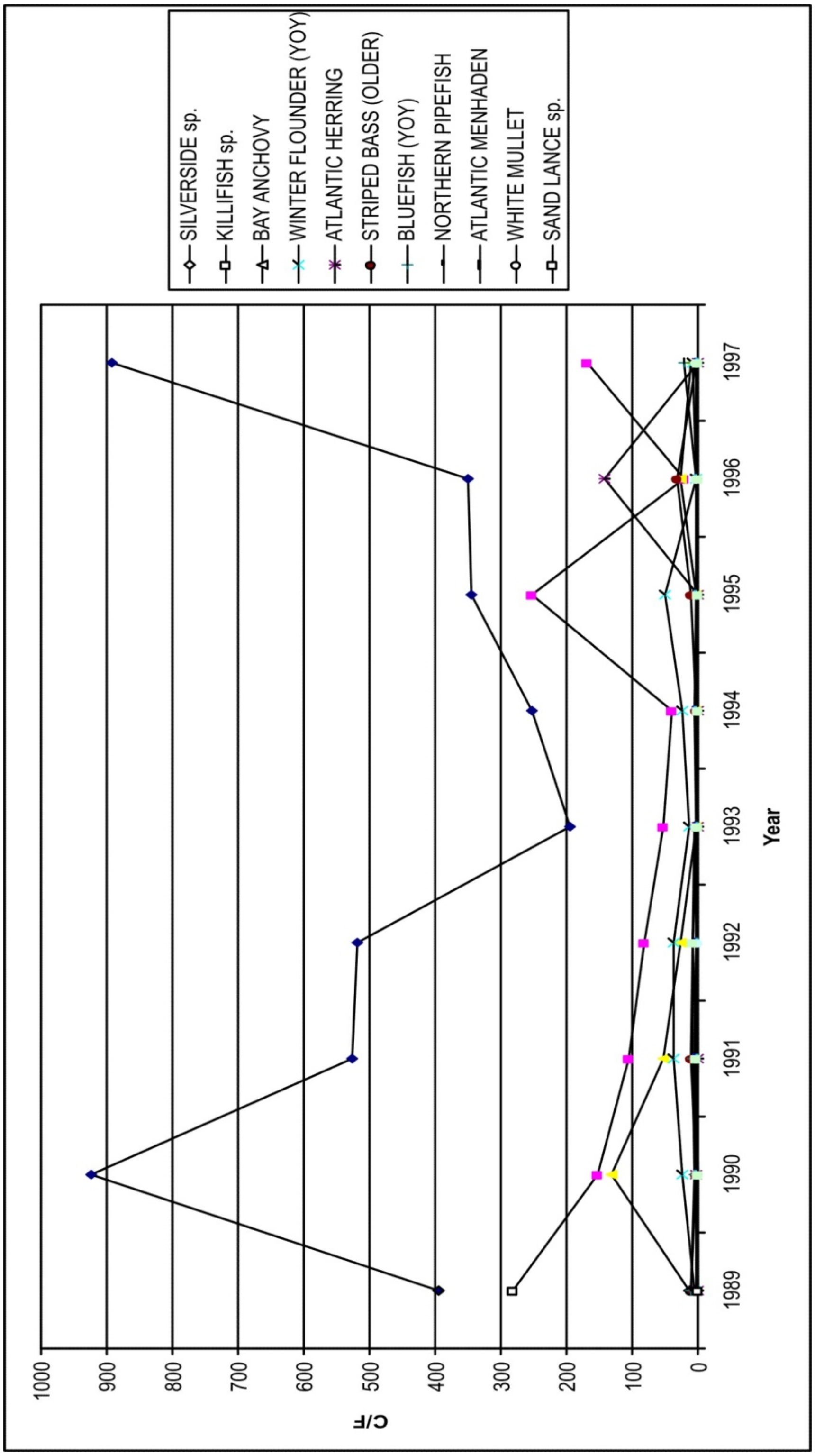

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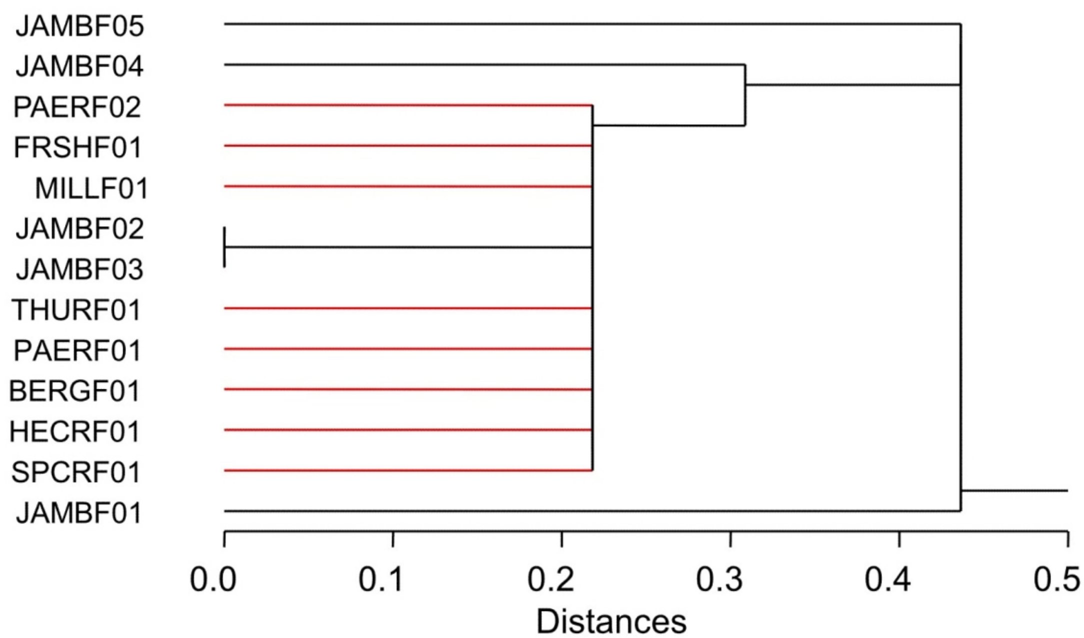
Paerdegat Basin Long-Term CSO Control Plan

NYSDEC C/F for Jamaica Bay Seine Net Sampling

FIGURE 4-39



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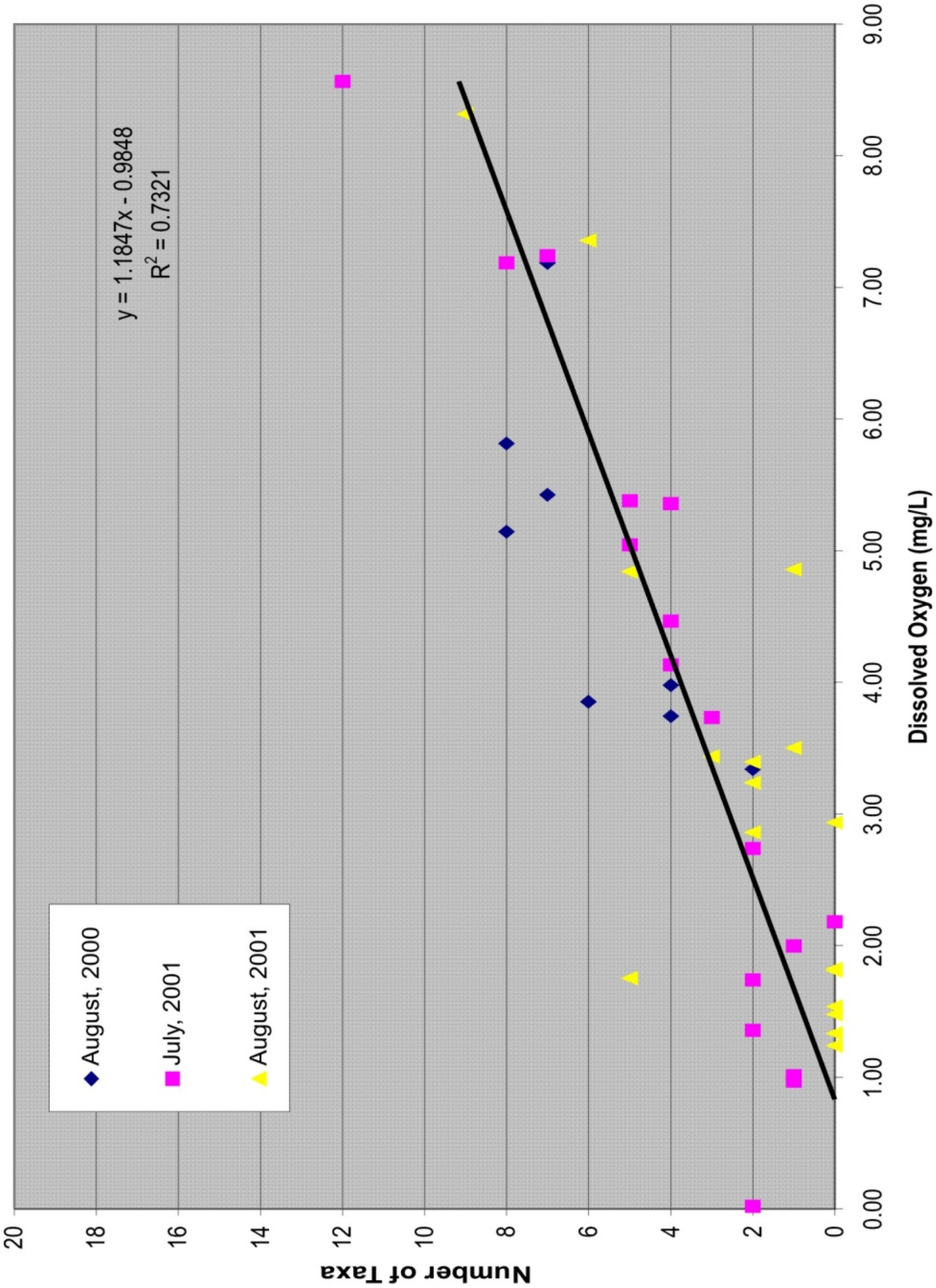
Paerdegat Basin Long-Term CSO Control Plan

Fish Species Presence/Absence, Jamaica Bay, All Gears, Jul 2001

FIGURE 4-40



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DO Effects on Numbers of Unique Taxa at All Stations All Gears

FIGURE 4-41

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A relationship can be seen above a DO concentration of 3 mg/L. Below that level, a maximum of two species was caught, except at the Alley Creek/Little Neck Bay station where five taxa were caught at a DO below 2 mg/L. When DO levels are this low, most fish will avoid the area, and the few fish caught presumably ventured into the area for a limited period of time. Above 5 or 6 mg/L, the DO-diversity relationship is expected to level-off in most habitats sampled. The two points at the extreme right of the figure represent the mid-section of the Hutchinson River (near the railroad bridge), which has some of the best, and most diverse, habitat in the New York Harbor. Nonetheless, the Hutchinson River station had only eight taxa in August 2000, when the DO was between 5 and 6 mg/L, and the sampling effort was greater. The relationships between habitat and DO are being studied further. Finally, Figure 4-42 is presented to illustrate species diversity at different DO levels measured by the Connecticut Department of Environmental Protection. Their program is based on several years of sampling on the western portion of the New York side of Long Island Sound, using large trawls. The reduction in species at DO levels below 3 mg/L is similarly apparent.

Table 4-5 and Table 4-6 show the average sizes of fish caught during studies conducted through 2001. It is interesting to note that many of the fish found in places with very low DO in July 2001 were small, juvenile weakfish, whereas other locations in Jamaica Bay had larger adult weakfish. No data are available on the DO tolerances of juvenile weakfish, although researchers at the University of Delaware are now studying the subject. It is possible that these fish may be entering areas of suboptimal DO in an attempt to avoid predation. This, and other aspects of the size distribution of species among the different waterbody habitat and DO conditions, is undergoing further scrutiny, as many young-of-the-year weakfish and other species were captured in Paerdegat Basin in summer 2002.

In conclusion, the relative abundance of fish in Paerdegat Basin is generally lower than in other portions of the Jamaica Bay system, but like the ichthyoplankton data, the fish capture may be influenced by tidal exchange, predation avoidance, and foraging that result in a short-term presence not necessarily indicative of normal conditions. It is unlikely that increases to the fish population in Paerdegat Basin would impact the population on a system-wide scale.

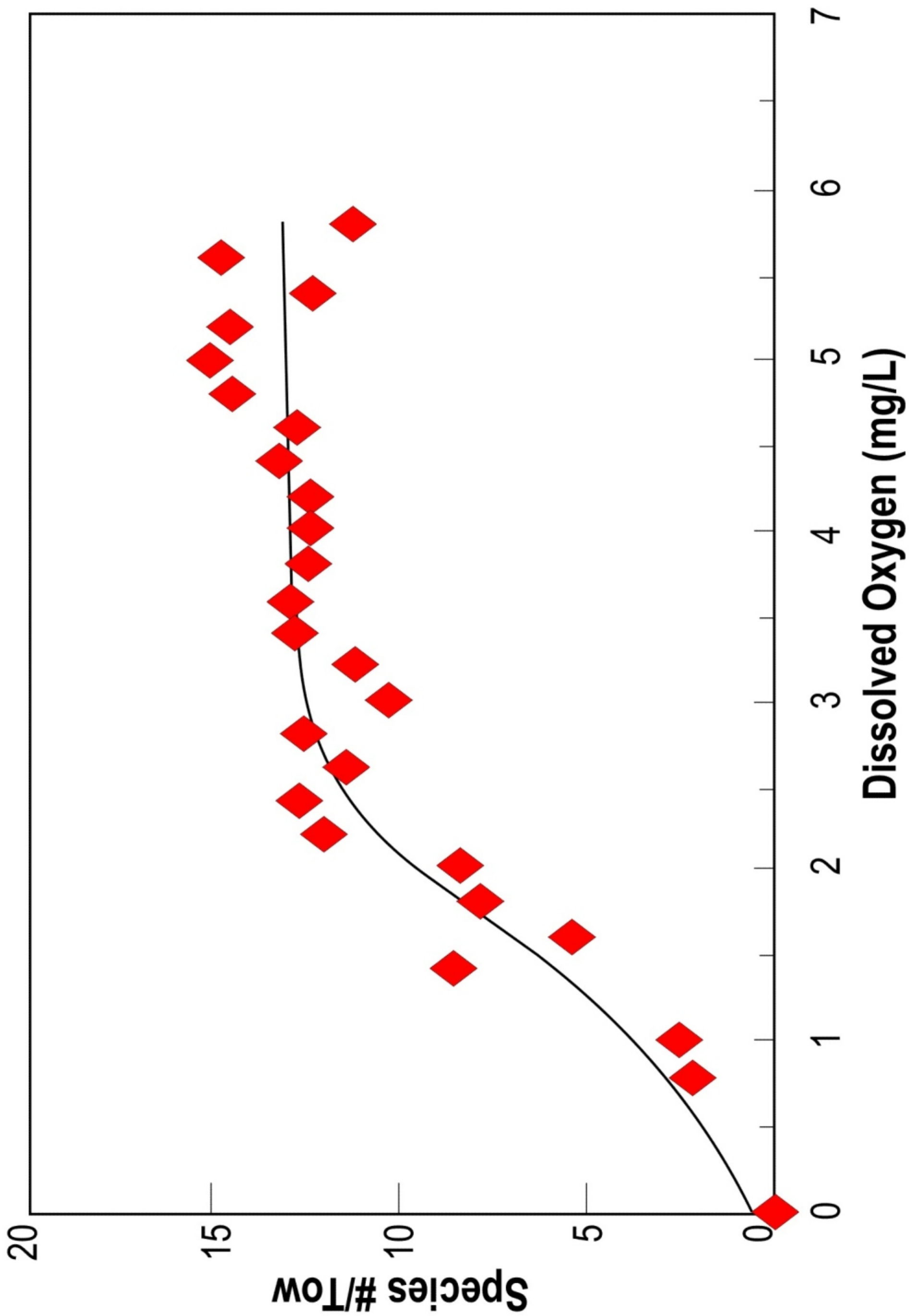
Table 4-5. Average Length of Fish Caught by Species, Paerdegat FSAP, August 2000, July 2001, August 2001

Common Name	Sampling Period	Station Name				
		FRSHF01	HECRF01	JAMBF01	PAERF01	PAERF02
Atlantic Menhaden	Aug-00	181.43				400.00
	Jul-01		322.22		365.00	336.63
Atlantic Silverside	Aug-00		61.67			
	Jul-01			50.00		
Bay Anchovy	Aug-00	48.67	42.00			-99
Bluefish	Aug-00	298.50	380.27	418.40	370.71	379.00
	Jul-01		330.00	44.00		
	Aug-01		-99			
Cunner	Aug-00			76.00		
Gizzard Shad	Aug-00	404.00	447.14			436.00
Menhaden	Aug-01		359.50			
Mummichog	Aug-00				40.00	

Common Name	Sampling Period	Station Name				
		FRSHF01	HECRF01	JAMBF01	PAERF01	PAERF02
Northern Pipefish	Aug-00			130.00		
	Jul-01			129.17		
Pipefish	Aug-01			87.00		
Sand Tiger	Aug-00			1448.00		
Silversides	Aug-01			68.00		
Snailfishes	Aug-00			29.67		
Spot	Aug-00	157.58	154.57		148.86	150.67
Striped Bass	Aug-00	302.00		-99	307.20	
	Jul-01		-99			
Summer Founder	Aug-00			413.00		435.00
	Jul-01			450.00		324.00
Weakfish	Aug-00	359.00	372.00	413.00		542.00
	Jul-01			290.00		
	Aug-01					127.00
Note: -99 indicates that item was too small to measure or length measurement was missing. Not included in averaging for multiple individuals; shown as -99 in the table to indicate presence without length measurement.						

Table 4-6. Average Length of Fish Caught by Species, Jamaica Stations, July and August 2001

Common Name	Sampling Period	Station Name							
		BERGF01	JAMBF02	JAMBF03	JAMBF04	JAMBF05	MILLF01	SPCRF01	THURF01
Atlantic Menhaden	Jul-01	366.00			370.43			360.88	370.00
	Aug-01	322.60			382.00				
Atlantic Silverside	Aug-01	47.50				76.00			
Bluefish	Jul-01	100.00						516.50	
	Aug-01	110.00							
Cunner	Jul-01						194.00		
Smooth Dogfish	Jul-01					675.50			
Spotted Seahorse	Jul-01					110.00			
Striped Bass	Jul-01							400.00	
Striped Searobin	Jul-01				412.50	370.00			
Summer Founder	Jul-01				160.00	350.00			
	Aug-01				23.00				
Weakfish	Jul-01		64.00	428.00	355.00		50.25	300.00	47.17
	Aug-01	38.50							
Winter Flounder	Aug-01	65.71							



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Paerdegat Basin Long-Term CSO Control Plan

Number of Fish Species vs. Dissolved Oxygen

FIGURE 4-42

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;
- Water with primary contact recreation; and
- Additional areas determined by the Permitting Authority (i.e., NYSDEC).

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 NYSDEC 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; 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 Paerdegat Basin 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 4-7 summarizes the sensitive areas assessment in Paerdegat Basin.

NYSDEC Natural Resources recommended that Jamaica Bay CSOs with the highest discharges of floatables and settleable solids be given priority in the LTCP. This recommendation was based on Jamaica Bay’s ecological significance in an otherwise urban environment. The 12,000 acre complex provides important habitat to fish and wildlife and is one of the largest open spaces in the City of New York. The Bay is used year-round for boating, fishing, and other recreational purposes, and is therefore sensitive to floatables and other aesthetic issues. The identification of the highest solids and floatables discharges will be addressed under the Jamaica Bay Long-Term CSO Control Plan, and will include Paerdegat Basin CSO discharges in the set of outfalls analyzed. Therefore, there are no sensitive areas based on NYSDEC guidance. Further, there are no sensitive areas of the remaining categories either, based on the following information:

Table 4-7. Sensitive Areas in Paerdegat Basin

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 NYSDEC	No

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 Jamaica Bay or its tributaries;
- There are no bathing beaches in or near Paerdegat Basin. Bathing beaches are explicitly prohibited in Jamaica Bay and its tributaries by local law; and
- There are no threatened or endangered marine animal species or their designated habitat in Paerdegat Basin.

The last of these was determined based on FOIA letter requests that were sent to each of the agencies that maintain databases regarding the presence of threatened or endangered species within the waterbody. The New York Natural Heritage Program maintains a comprehensive database on the status and location of State-designated rare species. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) respectively maintain the federal lists of marine and non-marine threatened or endangered species in accordance with the Endangered Species Act of 1973. The responses from these agencies were then filtered to exclude non water-dependent species, unverified historical records older than 40 years, and species that were not identified immediately within or adjacent to the waterbody. Although NMFS listed three species of threatened or endangered sea turtles that may be seasonally present in Jamaica Bay and Paerdegat Basin, there is no designated critical habitat in the area, and NMFS presumes that any sea turtles found in Jamaica Bay may also be found in Paerdegat Basin based on accessibility rather than on habitat or on direct observation. Because there is no specific information on the presence of these threatened or endangered marine animal species, there are no sensitive areas in Paerdegat Basin on this basis.

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 CSO during wet-weather 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 dissolved oxygen, and, in some cases, sediment mounds and unpleasant odors.

The City of New York is committed to its role as an environmental steward of its waterways and began addressing the issue of CSO discharges in the 1950s. To date, NYCDEP has spent or committed over $2.1 billion in its city-wide CSO abatement program. As a result of this and other ongoing programs, water quality has improved dramatically over the past 30 years (NYCDEP Harbor Survey Annual Reports). Implementation of many of these solutions within the current NYCDEP 10-year capital plan will continue that trend as NYCDEP continues to address CSO-related water quality issues through its City-Wide 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 NYCDEP 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 WPCP, a 12-million gallon CSO retention tank, constructed on a tributary to Jamaica Bay in 1972. This project was one of the first such facilities constructed in the United States. Shortly thereafter, New York City was designated by USEPA to conduct an Area-Wide Wastewater Management Plan authorized by Section 208 of the then recently enacted CWA. This plan was completed in 1979 and, in part, identified a number of urban tributary waterways throughout the City in need of CSO abatement. 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, NYCDEP re-invigorated its CSO facility-planning program in accordance with NYSDEC-issued SPDES permits for its wastewater treatment plants with a project in Flushing Bay and Creek. In 1985, a City-wide 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 resulting in a series of detailed plans.

In 1989, NYCDEP initiated the City-Wide 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 identified the primary sources of floatable materials in metropolitan urban area waters, aside from illegal dumping, as CSO and stormwater discharges. The study also concluded that street litter in surface runoff is the origin of floatable materials in these sources. The Floatables Control Program is discussed in Section 5.4.

5.2. 1992 CONSENT ORDER

In 1992, NYSDEC and NYCDEP entered into the original CSO Administrative Consent Order (1992 ACO). As a goal, the 1992 ACO required NYCDEP to develop and implement a CSO abatement program to effectively address the contravention of water quality standards for coliforms, dissolved oxygen, 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 Flushing Bay and Paerdegat Basin CSO Retention Tanks now under construction were included in the 1992 ACO. In addition, two parallel tracks were identified for CSO planning purposes. Track 1 addressed dissolved oxygen (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.

In accordance with the 1992 ACO, NYCDEP 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 CSO retention tanks at Flushing Bay and Paerdegat Basin proceeded to final design. The Interim Floatables Containment Program was fully developed and implemented. The Corona Avenue Vortex Facility pilot project for the floatables and settleable solids control was designed and implemented. The City's 130,000 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 (less than 4 %) will be completed by 2010.

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 changes to some of the original CSO Facility Plans included in the 1992 ACO and the development of additional CSO Facility Plans in 1999. CSO projects currently under design or construction are presented in Table 5-1.

Table 5-1. CSO Projects Under Design or Construction

Planning Area	Project	Design Completion	Construction Completion
Alley Creek	Outfall & Sewer System Improvements	Mar2002	Dec 2006
	CSO Retention Facility	Dec 2005	Dec 2009
Outer Harbor	Regulator Improvements – Fixed Orifices	Apr 2005	Jul 2008
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	Port Richmond Throttling Facility	Aug 2005	Dec 2008
	In-Line Storage	Nov 2006	Aug 2010
Inner Harbor	Regulator Improvements – Fixed Orifices	Sep 2002	Apr 2006
	Regulator Improvements – Automation	Nov 2006	Jun 2010
	In-Line Storage	Nov 2006	Aug 2010
Paerdegat Basin	Influent Channel	Mar 1997	Feb 2002
	Foundations and Substructures	Aug 2001	Dec 2006
	Structures and Equipment	Nov 2004	Aug 2011
Flushing Bay	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	Dec 2004
	CS4-5 Tide Gates	Nov 1999	Apr 2002
	CD-8 Manual Sluice Gates	May 2003	Jun 2005
Jamaica Tributaries	Meadowmere & Warnerville DWO Abatement	May 2005	Mar 2009
	Expansion of Jamaica WPCP Wet Weather Capacity	Jun 2011	Jun 2015
	Destratification Facility	Oct 2006	Dec 2008
	Laurelton & Springfield Stormwater Buildout Drainage Plan	Jan 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 Creek	Aeration Zone I	Dec 2004	Dec 2008
	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 AWPCP Upgrade	Feb 2002	Apr 2007
	26th Ward Drainage Area Sewer Cleaning & Evaluation	Jun 2007	Jun 2010
	Hendrix Creek Dredging	Jun 2007	Jun 2010
	26th Ward Wet Weather Expansion	Jun 2010	Dec 2015

5.3. BEST MANAGEMENT PRACTICES

The SPDES permits for all 14 WPCP in New York City require NYCDEP to report annually on the progress of fourteen best management practices (BMPs) related to CSOs. The BMPs are equivalent to the "Nine Minimum Control Measures" (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 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 February 2005 draft 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 annual reports, which were initiated in 2004 for the reporting year 2003, NYCDEP provides brief descriptions of the City-wide programs and any notable WPCP 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 WPCP 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
- New York State Department of Environmental Conservation (NYSDEC) review of inspection program reports.

In 2004, NYCDEP reported on the status of the City-wide program components and highlighted five drainage area specific maintenance projects. The Enhanced Beach Protection Program, where additional inspections of infrastructure in proximity to sensitive beach areas occurred, was also described.

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. NYCDEP reported on five drainage area specific efforts in 2004 and provided general information describing the status of City-wide SCADA, regulators, tide gates, interceptors, and collection system cleaning.

5.3.3. Maximize Flow to WPCP

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

- Receipt of flow through the headworks of the WPCP: 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 NYSDEC approval of the Wet Weather Operating Plan should any physical limitations in flow delivery be detected.

In addition to describing WPCP upgrades and efforts underway to ensure appropriate flows to all fourteen WPCPs, the annual report provided analysis of the largest ten storms of 2004 and WPCP flow results for each of these storms.

5.3.4. Wet Weather Operating Plan

In order to maximize treatment during wet weather events, WWOPs are required for each WPCP drainage area. Each WWOP should be written in accordance with the NYSDEC publication Wet Weather Operations and Wet Weather Operating Plan Development for Wastewater Treatment Plants, and should contain 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). NYCDEP provided a schedule of plan submittal dates as part of the 2004 annual report.

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 NYSDEC 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 were provided in the 2004 annual report.

5.3.6. Industrial Pretreatment

This BMP addresses three NMCs: 3 (Review and Modification of Pretreatment Requirements to Determine Whether Nondomestic Sources are Contributing to CSO Impacts); 7 (Pollution Prevention Programs to Reduce Contaminants in CSOs); and 9 (Monitoring to characterize CSO Impacts and the Efficacy of CSO Controls). By regulating the discharges of toxic pollutants from unregulated, relocated, or new significant industrial users (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 WPCP, 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 2004 annual report addresses the components of the industrial pretreatment BMP through a description of the City-wide 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, City-wide;
- 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 City-wide 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 City-wide.

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 NYSDOH and to be specified within the NYCDEP Master Plan for Sewage and Drainage. Whenever possible, separate sanitary and storm sewers should be used to replace combined sewers. The 2004 annual report describes the general, City-wide plan and addresses two drainage area specific projects.

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 BMP addresses NMC 1 (Proper Operations and Maintenance of Combined Sewer Systems and Combined Sewer Overflow Outfalls) and a brief status report was included in the 2004 annual report although no combined sewer extension projects were completed during that year.

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 annual report contains a brief status report for this BMP as no chronic sewer back-up or manhole overflow notifications were received from the NYSDEC.

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 2004 annual report summarizes the three scavenger waste acceptance facilities controlled by NYCDEP, 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 NYCDEP rules and regulations, to be consistent with the NYCDEP Master Plan for Sewers and Drainage, and to be permitted by NYCDEP. This BMP ensures that only allowable flow is discharged into the combined or storm sewer system.

The 2004 annual report refers to the NYCDEP 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 NYCDEP 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 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). NYCDEP provided the status of the CSO signage program and listed those former CSO outfalls that no longer require signs. In addition, descriptions of new educational signage and public education-related partnerships were described. The New York City Department of Health CSO public notification program was 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. The 2004 CSO BMP annual report was submitted to the NYSDEC in April 2005.

5.4. CITY-WIDE CSO PLAN FOR FLOATABLES ABATEMENT

NYCDEP developed a floatables abatement plan for the CSO areas of New York City in June 1997. An update of the Comprehensive Plan was subsequently drafted in 2004 and further modified in 2005 (HydroQual, 2005) to reflect the completion of some proposed action elements, as well as changes appurtenant to SPDES permits and modifications of regional Waterbody/Watershed Facility Plans and CSO Facility Plans. The objectives of this plan are to provide substantial reductions in floatables discharges from CSOs throughout the City and to provide for compliance with appropriate NYSDEC and IEC requirements pertaining to floatables.

The City-Wide CSO Floatables Plan consists of the following action elements:

- Monitor city-wide street litter levels and inform 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 city-wide 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 WPCPs;
- 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 NYCDEP 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;
- Review and revise water quality standards to provide for achievable goals; and
- Develop a floatables monitoring program.

However, the plan is a living program, which, between ongoing assessment of the program itself and changing facility plans with other ongoing programs, will undergo various changes over time. As such, the plan also includes a floatables monitoring program to evaluate the effectiveness of the plan and to provide that actions be taken (short- and long-term) where floatables are found in the harbor to impede water uses. Continuous evidence of floatables levels that impede uses could require the addition of control or expansion of BMPs and modifications of waterbody/watershed plans and/or drainage basin specific Long-Term CSO Control Plans, as appropriate. Overall, the Comprehensive Plan is expected to control roughly 96 percent of the floatable street litter generated in New York City.

5.5. LONG-TERM CSO CONTROL PLANNING

In June 2004, NYCDEP authorized the LTCP Project. This work will integrate all Track 1 and Track II CSO Facility Planning Projects and the Comprehensive City-wide Floatables Abatement Plan, will incorporate on-going USA Project work in the remaining waterbodies, and will develop Watershed/Waterbody Facility Plan reports and the LTCP for each waterbody area. The LTCP

Project monitors and assures compliance with applicable Administrative Consent Orders. The present document is a work product of the LTCP Project.

5.6. JAMAICA BAY WATER QUALITY IMPROVEMENT PROJECTS

Jamaica Bay is a highly confined waterbody that receives treated wastewater flow from the Coney Island, 26th Ward, Jamaica and Rockaway WPCPs owned and operated by NYCDEP. These WPCPs are part of a multi-billion dollar capital program that includes modernizations and enhancing nutrient removals in an effort to improve dissolved oxygen levels in Jamaica Bay. In addition, ongoing construction projects and operating plan changes will allow these facilities to treat up to 660 MGD during wet weather periods, resulting in a substantial reduction in CSO discharges.

NYCDEP is investigating treatment, relocation and other alternatives to address nitrogen discharges to the open waters of Jamaica Bay under the Comprehensive Jamaica Bay Water Quality Facility Plan. The Phase I BNR Facility Plan for the Upper East River and the 26th Ward WPCPs (Hazen and Sawyer, 2004) includes modification to existing aeration tanks at the 26th Ward WPCP to convert from step-feed aeration to step-feed BNR by modifying aeration and rehabilitating baffles to sequentially impose anoxic and oxic conditions favorable to nitrification and denitrification. The goal of the retrofit is to sustain nitrogen reductions in plant effluent realized during the separate centrate treatment process initiated in early 2000. The Jamaica Bay CSO Abatement Facility Planning Project (O'Brien & Gere, 1993) recommended investigating the relationship between WPCP discharges and eutrophic conditions evident in Jamaica Bay. A water quality model was developed and used to investigate the effectiveness of area-wide nutrient reduction management alternatives.

Because several studies indicated that full compliance with DO standards would not be possible with higher levels of treatment, relocation of existing WPCP discharges was also evaluated as an alternative. Other treatment plants in the region have used outfall siting to minimize water quality effects, including the Suffolk County Sewer District No. 3 WPCP, Nassau County's Cedar Creek WPCP, and the Passaic Valley Sewerage Commissioners WPCP. In response to this information, NYCDEP initiated the Long Outfall Study Project to assess the permitting requirements and impacts to the ocean of outfall relocation alternatives. This project is ongoing.

5.7. JAMAICA BAY WATERSHED PROTECTION PLAN

The troubling loss of cordgrass salt marsh continues to reduce the ecological viability of the bay, and the City of New York is looking for answers. Legislation signed into law by the Mayor in July 2005 establishes the initial pathway towards "restoring and maintaining the water quality and ecological integrity of the Bay by comprehensively assessing threats to the Bay and coordinating environmental remediation and protection efforts in a focused and cost-effective manner." The project has become known as the Jamaica Bay Watershed Protection Plan (JBWPP), and will include measures that the City can implement to help protect Jamaica Bay, such as:

- Consideration of CSOs in the calculation of local limits for indirect discharges of toxic pollutants;

- Offering incentives such as expedited permitting and property tax relief to encourage environmentally responsible and ecologically beneficial development;
- Restricting development that adversely impacts the Bay through land use planning practices, controls, and permitting;
- Restoring the ecosystem through land acquisition, salt marsh and wetlands restoration, and improved water quality;
- Raising awareness of the ecological significance of Jamaica Bay, its degradation, and the ongoing restoration and stewardship activities to encourage public involvement; and
- Establishing clear, quantitative goals and mechanisms for measuring success.

The Plan will be completed by September 2006, and will undergo a biennial review. It has not been determined whether this program will influence the Paerdegat Basin LTCP, but a component analysis conducted using the calibrated water quality modeling concluded that the influence of Jamaica Bay conditions on water quality conditions at the head end of Paerdegat Basin are minimal.

5.8. PAERDEGAT BASIN WATER QUALITY FACILITY PLAN

Paerdegat Basin was identified as requiring remedial water pollution measures during the City-Wide 208 Water Quality Study of 1978, which investigated Paerdegat Basin as a special tributary study (Hazen and Sawyer, 1991). The Paerdegat Basin Water Quality Facility Plan project began in 1986 with investigations of water quality and engineering alternatives, and the plan currently being implemented was substantially developed by 1991. Its primary goal is to improve water quality conditions in Paerdegat Basin by removing or minimizing the volume of combined sewage that currently discharges untreated during wet weather into the waterbody. NYCDEP investigated cost effective engineering options to improve conditions and meet currently designated water quality standards. CSO abatement and other alternatives were evaluated during the planning process with a particular focus on dissolved oxygen, coliform bacteria, floatables and settleable solids. NYCDEP evaluated the effectiveness of treatment alternatives such as maximizing CSO treatment, inline and offline CSO storage; in-stream and side-stream supplemental waterbody aeration; high-rate physical/chemical treatment of discharges; and other treatment alternatives. Non-treatment alternatives were also evaluated, including recontouring the waterbody through dredging and regrading the shoreline to create tidal marshes along adjoining uplands. A knee-of-the-curve approach was employed to develop the Facility Plan, which combines several of these alternatives at an approximate cost of $300 million (Hazen and Sawyer, 1991). With its resulting water quality improvements, the Facility Plan is expected to benefit the aquatic community in the waterbody and improve recreational use opportunities.

The Facility Plan project site comprises most of the Paerdegat Basin waterfront (Figure 5-1). A Paerdegat Basin CSO Storage Facility will be constructed at the head of the waterbody on its southwest corner adjacent to the Paerdegat Pumping Station. The irregularly shaped 13.4-acre facility site is bounded on the north by Flatlands Avenue, on the west by Ralph Avenue, and on the south by the mapped (but un-finished at this location) Bergen Avenue. The boundary extends east along Bergen Avenue to a point just beyond Avenue K. The remaining portions of the project site include all natural areas of Paerdegat Basin Park on both sides of the waterbody. On the south shore of Paerdegat Basin the site area extends from the Storage Facility at Avenue K to Joseph Thomas McGuire Park at Avenue V, and on the north shore from the NYCDOT facility at 1st Street to Canarsie Beach Park at Seaview Avenue.

The Paerdegat Basin CSO Storage Facility will comprise the following three components: sewer system modifications, a retention tank, and a facility operations building. Figure 5-2 provides a schematic representation of the facilities, which will comprise the major elements of the CSO storage facility. Sewer system modifications will be constructed such that CSOs from the three large outfalls that currently discharge to Paerdegat Basin will be rerouted via influent channels to the facility operations building for screening before flowing into the retention tank. These influent channels will provide approximately 10 million gallons (MG) of storage. The 36,000-square-foot operations building will be constructed at the north end of the site housing screening, pumping, and odor control systems. The screening system will have 1.75-inch screens that will remove large solids and floatables before they enter the retention tank. The odor control system will collect and treat/neutralize odors for the facility. The retention tank will be situated lengthwise along Bergen Avenue and will consist of four bays that will provide 20 MG of storage. As water levels rise in the retention tank, volumes will be backed up through the screening systems into the influent channels and into the sewer system upstream of the regulators.

The sewer system has an approximate inline storage capacity of 20 MG. Once the retention tanks are filled to their capacity, the retention bays will begin to overflow to Paerdegat Basin. During storms with high peak flow rates, some of the combined sewage will bypass the facility via an overflow weir on the influent channels that is at a slightly higher elevation in relation to the retention tank overflow weir. Combining the available volumes of the in-line storage potential, influent channels, screening facilities, and retention tank, the Facility Plan will provide 50 million gallons of CSO storage. Further, the facility will provide floatables and settleable solids control via weir and baffling structures.

The Facility Plan also has several community-based elements for restoring, enhancing, and protecting riparian uses. The Facility Plan recommended that the vacant land on both sides of Paerdegat Basin be permanently assigned as natural park area. Paerdegat Basin Park was formally established encompassing 78 acres of natural park area on both sides of the waterbody and virtually along its entire length – excluding the NYCDEP and NYCDOT facilities at the head end. Park Restoration and enhancement of shorelines will be undertaken in Paerdegat Basin Park to mitigate the impacts of construction and development at the facility site on the adjacent intertidal zone and wetlands area. Remedial work will also be conducted in Paerdegat Basin Park to remove debris such as trash and abandoned vehicles. Perimeter treatment along the street edge of the Park includes installation and repair of curbing and sidewalks. Decorative fencing and trees will be installed along the perimeter and street lighting will be installed and upgraded along adjacent streets. Bergen Avenue, which is presently not completed and is shown as a paper street on maps between Avenue K and Ralph Avenue, will be constructed for through traffic. Figure 5-3 illustrates the Facility Plan improvements to riparian areas around Paerdegat Basin.

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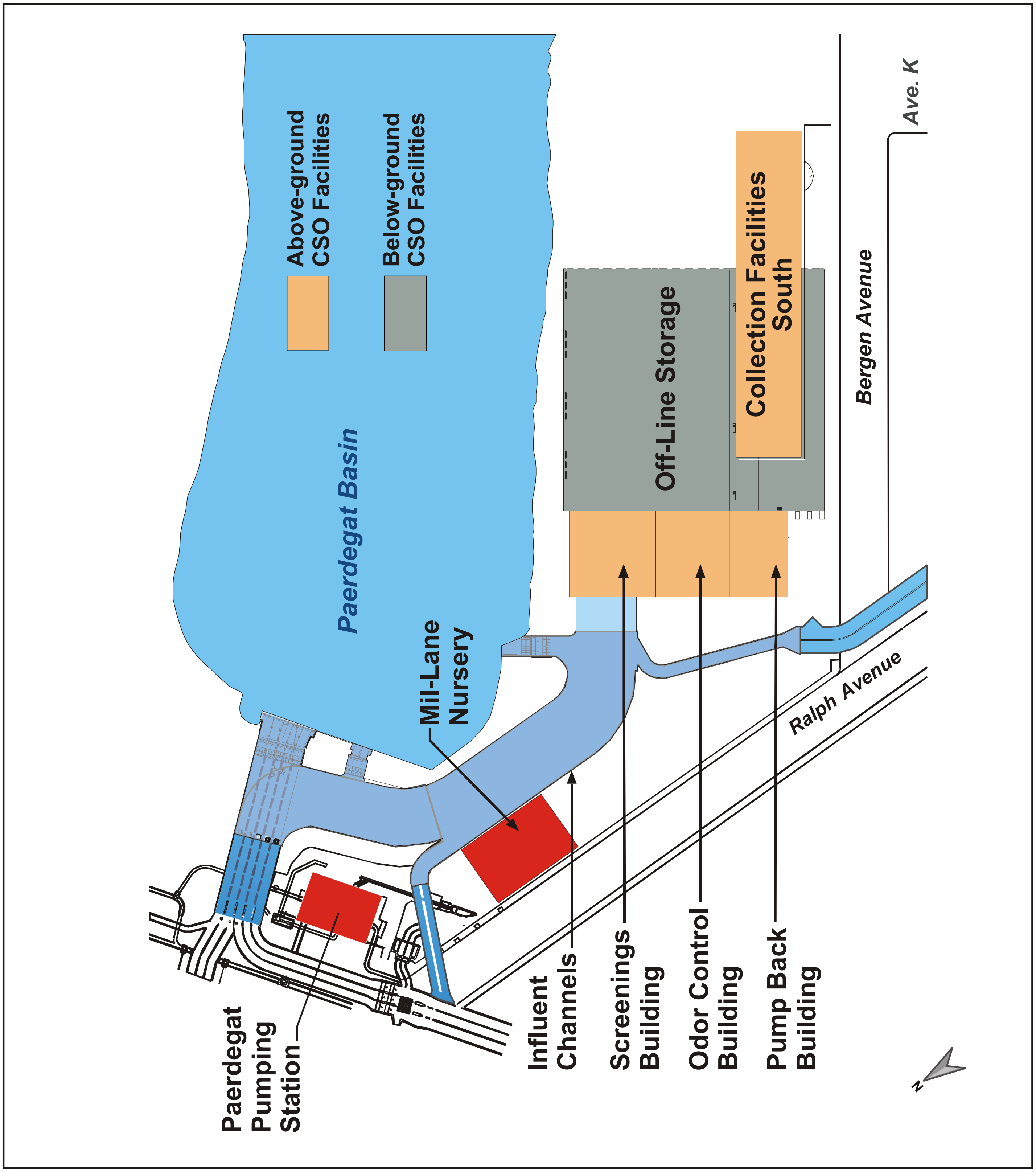
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Water Quality Facility Plan
CSO Retention Facility Site

FIGURE 5-1



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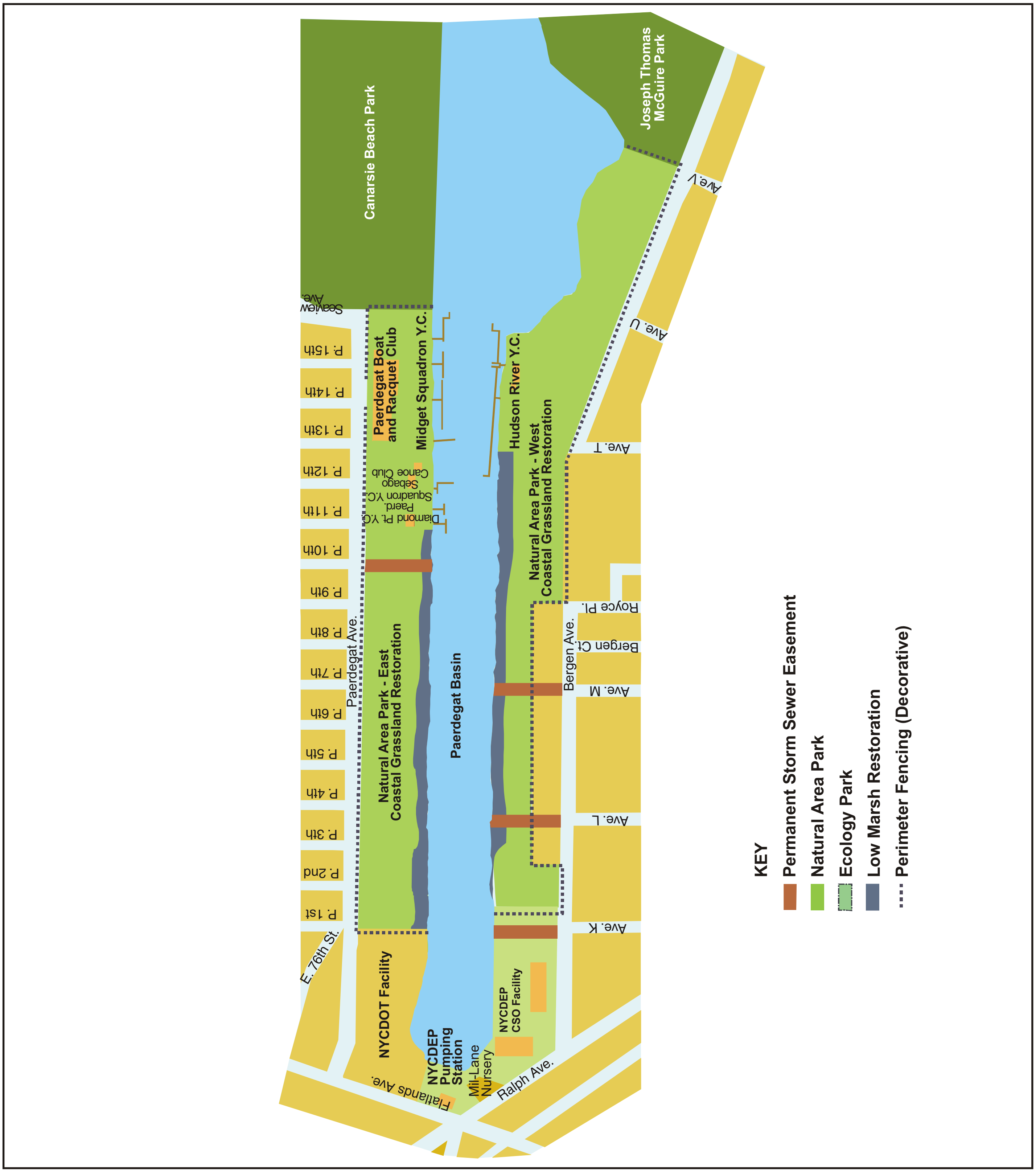
New York City
Department of Environmental Protection

Paerdegat Basin Water Quality Facility Plan
Proposed CSO Retention Facility Layout

FIGURE 5-2



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New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin Water Quality Facility Plan
Proposed Riparian Improvements

FIGURE 5-3

The Facility Plan also includes the construction of NYCDEP and community facilities on top of the retention tank. NYCDEP Collection Facility South Operations Division of the Bureau of Wastewater Treatment, which maintains the City's pumping and regulator systems in the southern portions of the City including Staten Island, will be relocated to a new structure here. These operations are currently housed in trailers behind the Paerdegat Pumping Station. Community meeting rooms and offices will also be constructed on top of the facility for the use of local residents and its Community Board.

Implementation of the Facility Plan began in February 1999 and is being conducted in several phases. Phase I included sewer system modifications and construction of the influent channels, which was substantially completed in February 2002. Phase II is the construction of the foundations and substructures including the retention tank, and dredging of the mouth and head end at the facility site (the dredging anticipated by the Facility Plan may not be necessary to complete the construction of the Paerdegat Basin CSO Storage Facility). The Notice to Proceed was issued on June 24, 2002 and construction is underway. The anticipated contract completion is December 2005. Phase III of the project is the construction of above-ground structures such as the Collection Facility South, community structures, and the facilities operations building as well as equipment installation for the screening, pumping and odor control systems. This phase was given a notice to proceed to construction in September 2005 and a three-year construction period is scheduled to begin once Phase II is substantially completed. The CSO facility will become operational during construction of this phase. Wetlands and uplands restoration, Paerdegat Basin Park remediation, and perimeter improvements will be performed as Phase IV with a planned eighteen-month duration, which is scheduled to begin while Phase III is ongoing.

5.9. ECOSYSTEM RESTORATION

The City is a non-federal local sponsor for the USACE Jamaica Bay Ecosystem Restoration Project. USACE is evaluating eight sites within Jamaica Bay for habitat restoration through their National Restoration initiative for coastal ecosystems. This effort officially began in 1992 when the New York District (NYD) received authorization from Congress to investigate environmental restoration options for Jamaica Bay. In 1996, a cost-sharing agreement was signed with NYCDEP, including $2.6 million with which a model for Jamaica Bay (Jamaica Bay Eutrophication Model) was prepared. In April of 2000, the National Park Service and the USACE entered into an Interagency Agreement to initially conduct site assessments for 12 sites within Jamaica Bay that were identified by NYCDEP, NYSDEC, and NPS for potential ecological restoration. Along with the National Park Service and the CUNY-AREAC Center at Brooklyn College, the USACE established the Jamaica Bay Ecosystem Research and Restoration Team (JABERRT), comprised of 18 scientists from 9 institutions conducting "the most detailed inventory and biogeochemical characterization of Jamaica Bay for the 2000-2001 period while compiling the most detailed literature search established" (Tanacredi et al., 2002). The ongoing effort has resulted in the issuance of several publicly-available reports containing ecological, hydrodynamic, and water quality data. Among these are Tanacredi, et al. (2002) and USACE (1999; 2002; 2003).

The project includes general restoration concepts for areas within Paerdegat Basin, including recontouring the waterbody, regrading shorelines to enhance tidal marshes, and improving adjoining uplands. The goals of these actions are to improve habitat for waterfowl and aquatic organisms and improve fish and wildlife habitat diversity. Specific locations for improvement actions have not been selected as of the date of the present report. However, studies are ongoing, and NYCDEP intends to maintain its partnership with USACE. Irrespective of the future direction of the USACE program, NYCDEP considers environmental dredging a legitimate CSO abatement alternative and a necessary first step to ecological restoration. Dredging is evaluated in Section 7.0.

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. NYCDEP 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 development of the Paerdegat Basin LTCP.

6.1. HARBOR-WIDE STEERING COMMITTEE

NYCDEP 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 NYCDEP water quality improvement programs, is represented on the Steering Committee and separately monitors and comments on the progress of CSO projects, among other NYCDEP 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 NYSDEC. The Central Office of NYSDEC in Albany was represented by its Associate Director of the Division of Water, the Director of the Bureau of Water Permits in 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 NYSDEC 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 Environmental Engineering and its Director of Planning and Capital Budget represented the NYCDEP. The Department of City Planning was represented 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 is responsible for reviewing the methodology and findings of NYCDEP 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, 2003), and was fully briefed on the ongoing 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 NYSDEC. Representatives of the NYSDEC reported that its agency was awaiting the results of the NYCDEP waterbody/watershed assessment before completing the 303(d) evaluation.

6.2. PAERDEGAT BASIN WATER QUALITY FACILITY PLAN

6.2.1. Paerdegat Basin Water Quality Citizens Advisory Committee

The Paerdegat Basin CAC represented a highly informed group of citizens who, throughout the study, provided insight into public reaction and played an active role in the formulation of the plan ultimately selected. Members of the CAC included private citizens, public interest/environmental groups, government officials, and business representatives. NYCDEP regularly met with the CAC to discuss the goals, progress and findings of its ongoing planning projects such as the waterbody/watershed assessment of Paerdegat Basin.

6.2.2. Facility Plan Development

Through its office of Community Outreach, NYCDEP encouraged and promoted public participation during the course of the development of the Paerdegat Basin Water Quality Facility Planning Project. A full scale program was designed and implemented to provide a high level of responsiveness from governmental agencies to public concerns and priorities. With the help of a CAC and the larger community, NYCDEP adopted a plan to improve the water quality in Paerdegat Basin while minimizing the potential short-term negative effects to the community. The public participation program is summarized in Hazen and Sawyer (1994).

The program was based on four inherent assumptions:

1. The project would involve decisions that could affect citizens in the planning area;
2. Public understanding of and support for the project would be necessary;
3. A public forum would be provided to accommodate community involvement; and
4. Public participation activities would be consistent with all relevant USEPA guidance.

Through public meetings, mass mailings, environmental and land use review procedures, the public was introduced to the water quality issues and solutions developed. As work continued and investigations progressed, public involvement expanded. At the project inception in August 1986 the facility plan was mailed to various document repositories for public review at this time, including the offices of the Brooklyn and Queens Borough Presidents, local public libraries, and the Jamaica Bay Wildlife Refuge. A public meeting was held in January 1987 to introduce and explain the objective of the project, and engineering plans for abating CSO discharges to Paerdegat Basin were discussed with the public during an October 1987 meeting. Final conclusions and recommendations were provided for comment at a December 1989 public hearing prior to adoption of the selected plan.

6.2.3. Environmental Review Procedures

In response to a Notice of Positive Declaration dated June 11, 1993, an Environmental Impact Statement (EIS) on the Paerdegat Basin Water Quality Facility Plan was developed by the NYCDEP Bureau of Environmental Engineering. Public scoping began with the Citizens Advisory Committee reviewing a draft scope of work in June 1993 that would be offered for public comment and the first public scoping hearing was held in August, in accordance with environmental quality review procedures in place at the time. Additional public hearings were held by Community Board 18, the Brooklyn Borough Presidents office, and the Department of City Planning during 1993 and 1994 to accept public comment on the ULURP application filed in 1993 as required by the procedure. Public comment on the Draft EIS was formally solicited beginning at a public hearing held on February 2, 1994. The comment period remained open for ten days, and responses to comments were provided in the March 1994 Final EIS. There were 22 recognized groups who offered comment on the draft document, representing elected officials, City agencies, civic associations, waterbody users, environmental groups, and other interested parties.

6.2.4. Facility Construction

NYCDEP gave a presentation to the community in May 2001, shortly before construction commenced, and a mechanism for complaints was put into place to facilitate public involvement during construction. The NYCDEP office of Community Outreach promptly responded to construction-related complaints received by the resident engineer at the jobsite. Contract documents contained monitoring requirements for noise and other nuisance environmental conditions.

Excessive dust was controlled with periodic site watering, and seeding soil stockpiles to control erosion.

6.3. LOCAL STAKEHOLDER TEAM

A Local Stakeholder Team was convened under the USA Project. Through initial outreach to local Community Boards, the Stakeholder Team was comprised of representatives of the Community Boards, local community organizations, involved citizens, and waterbody users. The goal of the Stakeholder Team was to inform the planning process with community knowledge, experience, and expectations for the waterbody, and to identify and prioritize waterbody issues. Meetings were held at key points in the study process to provide an opportunity for the community representatives to comment on the analyses and recommendations. Notes of each meeting are recorded, distributed, and published to provide a public record of the proceedings. Four documented Paerdegat Basin Stakeholder Team meetings were held as part of the USA Project: February 15, 2001; April 4, 2001; May 17, 2001; and October 3, 2001. All meetings were convened in the evening at the Hudson River Yacht Club, Avenue U & Bergen Avenue, Brooklyn, New York. The four meetings are broadly summarized below within the context of long-term control planning; full meeting summary notes are on file.

The Stakeholder Team meetings served as information exchanges between NYCDEP and the stakeholders to identify existing and desired waterbody and riparian uses, water quality issues, and a prioritization of use goals. It was found that the community desired continued contact and information on the status of Paerdegat Basin Water Quality Facility Plan implementation and construction, which had previously ceased once the facility-planning phase was completed. Existing and attainable water quality was also discussed, and the Stakeholder Team recognized that the principal impairment to the use of Paerdegat Basin is CSO discharges.

The Stakeholder Team expressed a desire to limit the periodic fish kills that had been reported during periods of anoxia near the head end. They were also concerned about the quality and safety of fishing in Paerdegat Basin and consuming fish caught there. NYCDEP informed the Stakeholders Team that fish survival, fishing and fish presence and aquatic life propagation are issues which will be addressed within the present project. The adequacy of marine fish for human consumption related to the presence of toxicants in fish tissue is a state-wide and regional problem which is not directly addressed in this project.

During meetings, unanimous agreement was reached supporting a use classification of secondary contact recreation. The stakeholders, however, agreed that water quality capable of supporting primary contact recreation would be desirable. However, primary contact recreation (swimming) was considered inappropriate in Paerdegat Basin for safety reasons and the potential conflict this use would have with existing boating and kayaking activities. In addition, the treatment additions to the Facility Plan (mainly involving chlorination) were understood to be potentially detrimental to wildlife, thus sacrificing an existing use (fishing) in order to attain water quality supporting a non-existing use (swimming). Nonetheless, the Stakeholder Team noted that water quality should support kayaking and jet-skiing, and representatives of the Sebago Canoe Club in particular felt that water quality should be supportive of primary contact uses to protect kayaking.

The deposition of settleable solids has resulted in a sediment mound at the head of the basin which generates considerable odor during certain tidal conditions. Although the problem of the sediment mound further increasing in size and the associated odor will be minimized in the future by the CSO retention tank, removal of the present sediment mound and elimination of its odor by dredging is favored by the Stakeholders. Expanding the basin linkage to Jamaica Bay by dredging at Paerdegat Basin mouth was also advocated, as it was noted that boat entry and egress is limited to high tide periods due to deposition of settleable solids near the mouth of Paerdegat Basin. Other aesthetic impairments identified by the Stakeholder Team included the odor generated by the sediment mound, the "milky" appearance of the water after a CSO discharge, and the presence of floatables that not only create a visual impairment but also interfere with boating and kayaking when they become entrapped around docks and marina facilities in Paerdegat Basin.

6.4. PUBLIC OPINION SURVEY

The NYCDEP 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 city-wide issues as well as those for local waterbodies. Primary and secondary waterbody survey results (dependent on residential location within watersheds) were analyzed discreetly and summarized to provide additional insight public into waterbody uses and goals in addition to those identified via other public participation programs run by NYCDEP.

Survey interviews were conducted using Computer Assisted Telephone Interviews (CATI) among residents of the five New York City boroughs that were 18 years of age 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 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 in 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 of New York City residents, and a minimum of 300 interviews for each of 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 46 percent of Paerdegat Basin area residents that participated in the survey were aware of the basin but only one percent could identify Paerdegat Basin as their primary waterbody without any prompting or aid in their response. Less than 0.5 percent of all New York City residents who participated in the survey had unprompted awareness of Paerdegat Basin. Most of the City residents identified the East River or the Hudson River as the waterway closest to their home.

6.4.2. Water and Riparian Uses

Approximately 15 percent of Paerdegat Basin area residents that participated in the survey visit waterbodies in their community or elsewhere in New York City on a regular basis and 40 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 14 percent of area residents have visited Paerdegat Basin at some point, and 9 percent have done so in the prior twelve months. The median number of visits reported by those who have visited the Basin within the prior 12 months was five times per year, higher than the City-wide median of four visits per year. Among those area residents who are aware of Paerdegat Basin but have never visited the canal, the majority (56 percent) responded that there was no particular reason, six percent cited waterbody conditions, and eight percent cited riparian conditions.

The number of area residents that have participated in waterbody-related activities at Paerdegat Basin represents 11 percent of those who have ever visited the basin and only two percent of the total area residents surveyed. The most common response was on-water activities such as boating, canoeing, kayaking, and sailing among those who have ever visited the Basin. No respondents cited fishing, and only one percent cited in-water activities such as jet skiing, surfing, swimming, and wading. Among the respondents who have never participated in water activities while visiting Paerdegat Basin, six percent responded that pollution was the reason for not participating in water activities and eight percent responded that limited access was their main reason for not participating.

Riparian-based activities appear to be more popular in general than in-water activities. Forty percent of area residents who have visited Paerdegat Basin, and six percent of all area residents surveyed, responded that they had participated in activities in riparian areas of Paerdegat Basin. In comparison to all New York City residents being surveyed, riparian activities at Paerdegat Basin is a slightly less popular activity than at other primary waterways in New York City. The compilation of Paerdegat area responses suggest that sports are the most-favored land-based activity, followed by walking or strolling along riparian areas.

6.4.3. Improvements Noted

The City-wide respondents to the telephone survey mentioned negative perceptions more than positive perceptions by 44 percent to 35 percent. Although 48% have noticed improvements compared to 31% who have not on a City-wide basis, only one percent of Paerdegat Basin area residents responded that they have noticed improvements in the Basin. Slightly less than half of the New York City residents have noticed water quality improvements in all City waters, and NYCDEP is most often credited with this improvement. Only five percent of Paerdegat Basin residents would like it to be their local waterway, which is substantially below the median of 15 percent for all 26 waterbodies, but on par with City-wide residents, among whom less than 0.5 percent expressed a desire for cleaning up Paerdegat Basin if funds were available to improve only one City waterbody. Only 25 percent of Paerdegat Basin area residents who were aware of the Basin as their primary waterbody cited water quality appearance or odor, which was the lowest among the 26 waterbodies. Another 13 percent cited improvements to cleanliness, sanitation, or maintenance as desirable, compared to a City-wide median of 12 percent. One in five (22%) New Yorkers who specified their most desired improvement in their waterway said they would not be willing to pay anything for that improvement when asked, and half of those remaining (41% overall) said they would be willing to pay less than $25 a year for their most desired improvement.

6.5. ADMINISTRATIVE CONSENT ORDER

The Administrative Consent Order was published for public comments on September 8, 2004, as part of the overall responsiveness effort on behalf of NYSDEC. 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, NYSDEC 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 NYSDEC. 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 NYSDEC and NYCDEP 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 NYSDEC to indicate that "NYC citizenry places CSO abatement as a high ongoing priority" (NYSDEC, 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 Paerdegat CSO Facility and its associated overflow outfalls are contained within the Coney Island WPCP 2003 SPDES Permits. As such, the facility which is now being constructed was available for public comments when these permits were publicly noticed. No comments received resulted in changes in the SPDES Permit as it impacts the Paerdegat facility.

Public comments on the 2003 SPDES Permit have resulted in legal filings by a number of parties including the "Keepers" (Hudson River Keeper, Long Island Sound Keeper, New York Harbor Keeper) resulting in hearings in front of an Administrative Law Judge (ALJ). These proceedings are still ongoing and the ALJ has not made a final ruling. However, the hearing did not involve any actions that would impact the Paerdegat Facility SPDES requirements.

6.7. FINALIZATION OF PUBLIC PARTICIPATION

NYSDEC will publicly notice receipt of the Paerdegat LTCP in the Environmental Notice Bulletin (ENB) as required by law, and will provide an opportunity for public comment at that time. NYSDEC will make a determination as to whether a final public hearing is necessary, in accordance with State regulations.

7.0. Evaluation of Alternatives

7.1. METHODOLOGY

The Paerdegat Basin LTCP has a long history of development, as discussed in Section 5.8 New York City's CSO abatement effort at Paerdegat Basin was cited as a model case study during the seminars USEPA held across the United States in 1994 to discuss the CSO Control Policy with stakeholders (USEPA, 1994). As such, the field investigations, watershed and receiving water modeling, and control strategy development process that would ultimately lead to the CSO facility currently under construction were well developed before USEPA issued the 1994 CSO policy, and the approach to improving water quality has not been substantially modified since the draft facility planning report was issued in 1991. Many of the requirements that would follow were anticipated during that planning process, including a rigorous evaluation of alternatives that considered "a reasonable range of alternatives…sufficient to make a reasonable assessment of cost and performance" (59 FR 18692).

Because of its substantial consistency with federal CSO policy, the Paerdegat Basin CSO Facility is the central element of the long-term CSO control plan that will ultimately be implemented, and the evaluation of alternatives leading to its selection is provided here, along with additional investigations and analyses that incorporate stakeholder input and changes to water quality standards subsequent to the original facility planning effort.

7.1.1. Historical Development of the Paerdegat Basin CSO Facility

NYCDEP submitted the draft facility planning report to NYSDEC in September 1991, in which the development of the Paerdegat Basin Water Quality facility was described. The approach first considered all reasonable measures for reducing CSO discharges to Paerdegat Basin, then reduced the comprehensive list of alternatives to those that had potential application in Paerdegat Basin given the nature of the waterbody, its tributary area, and its sewerage facilities. The options were evaluated in light of the need to substantially reduce the amount of CSO solids entering Paerdegat Basin so as to minimize the nuisance problems (visual, odor, and oxygen demand) associated with the sediment mound formed at the head of the Basin through the settling of CSO solids. The planning activities also identified the need to substantially reduce the floatables entering Paerdegat Basin from the CSO outfalls. The options with the highest potential were fully developed and analyzed based on the following criteria:

- Attaining water quality goals;
- Public acceptance;
- Effective cost expenditures;
- Reliable operation;
- Regulatory concurrence; and
- Compatibility with Coney Island and other WPCPs under NYCDEP operation.

Numerous alternatives were considered, many that were capable of being implemented in combination. As summarized in Table 7-1, the alternatives generally fell into five categories: improvement of the existing collection system and WPCP; CSO abatement; in-basin modifications; programmatic controls; and end-of-pipe treatment. Issues of scaling (i.e., optimizing the utility of a particular alternative) were addressed only for those alternatives determined to have high potential for applicability during the preliminary screening, as described in Section 7.2.

Table 7-1. Summary of Preliminary Screening of Alternative Strategies

Category	Alternative	Screening Action	Basis
Improvements to Existing Facilities	Coney Island WPCP upgrade	Analyzed	Necessity
	Paerdegat Pumping Station upgrade	Analyzed	Necessity
	Regulator improvements	Analyzed	Economical
	Sewer separation	Analyzed	Addresses issue
	Discharge relocation	Analyzed	Relocates issue
CSO Abatement	Increase Coney Island WPCP throughput	Analyzed	Potential combination
	In-line storage	Analyzed	Potential combination
	Off-line storage in upstream locations	Analyzed	High potential
	Off-line storage near outfall locations	Analyzed	High potential
	Off-line storage via deep tunnels	Analyzed	High cost
In-Basin Modifications	Dredging	Analyzed	Temporary control
	Basin aeration	Rejected	Insufficient control
	Forced flushing	Rejected	Insufficient control
Programmatic Controls	Regulation of industrial discharges	Analyzed	Program in existence
	Zoning and land use	Rejected	Insufficient control
	Street sweeping	Rejected	Insufficient control
	Sewer flushing for ‘first flush’	Rejected	Wastes potable water
	Infiltration abatement	Analyzed	Studies completed
End-of-Pipe Treatment	Settling/storage/disinfection	Analyzed	High potential
	Disinfection only	Rejected	Insufficient control
	Screens	Rejected	Insufficient control
	Helical bends	Rejected	Insufficient control
	Swirl concentrators	Rejected	Insufficient control
	Filters	Rejected	Complexity

This preliminary screening analysis highlighted necessary system improvements in addition to reducing the number of viable alternatives considerably. Those alternatives that were not addressed in detail were generally dismissed based on a combination of cost and control limitations. In general, reasonable changes to land use, land use restrictions, and watershed BMPs were not expected to result in substantial pollutant discharge reduction within a timeframe suitable for facility planning. End-of-pipe treatment alternatives were dismissed individually because each technology had targeted effectiveness, but these same technologies in combination (screening, settling, storage, disinfection) constituted a high potential alterative collectively. Although basin aeration and dredging did not survive the preliminary screening, they were reintroduced based on stakeholder input, and the possibility that controls would not adequately elevate dissolved oxygen concentrations without either adding oxygen to the system or removing oxygen demand from sinks other than discharge loads. Further, these approaches are both viable candidates to supplement a larger control strategy.

7.1.2. Use and Standards Attainment Study

In recognition of the fact that approved levels of CSO abatement in the 1992 ACO would not meet water quality standards under all circumstances, NYCDEP initiated the USA Project in 1999 to bring the engineering program into compliance with the regulatory requirements of the CSO Control Policy and the subsequent 2001 Guidance. This project was designed to follow the step-by-step process outlined in the CSO Control Policy for the development of CSO abatement projects including: water quality analysis; facility planning; water quality standards compliance determination; water quality standards review and revision as appropriate; public outreach; and, development of LTCPs. The USA Project used the USEPA Watershed Approach Framework to investigate all causes of water use impairments, including CSOs. The goals of the USA Project were to examine desired and attainable water uses with stakeholder involvement, reconcile WQS with realistically attainable uses given the site-specific constraints, implement the WQS review process, and serve as the technical basis for waterbody specific UAAs as appropriate.

The USA Project developed and delivered to the NYSDEC a Waterbody/Watershed Facility Plan for Paerdegat Basin (HydroQual, 2003). This report examined Paerdegat Basin's uses and, using a watershed approach, evaluated improvements that could be anticipated as resulting from CSO controls. The report concluded that future water quality would not attain full compliance with water quality standards for a variety of reasons. Further, the report recommended that changes be made to the Water Quality Standards and that Paerdegat Basin retain its Class I classification.

7.1.3. Stakeholder Use Goals

Section 6.0 enumerated the various programs that NYCDEP has used to incorporate stakeholders in the capital planning process, the most recent of which was the series of waterbody/watershed Stakeholder Team meetings NYCDEP convened under the USA Project. These meetings provided a forum for information exchange between NYCDEP and the community at large. They also helped to identify existing and desired uses and the prioritization of use goals, the understanding of which is central to the evaluation of alternatives.

Existing uses of Paerdegat Basin are predominately secondary contact recreation such as boating, canoeing, kayaking, and fishing. The waterbody has several marinas that provide births and support structured, waterfront recreational activities. Although the stakeholders were unanimous in supporting continued secondary contact recreation, there was significant disagreement on primary contact recreation and associated water quality improvements as a goal. The highest level of water quality possible was desired, but primary contact recreation (swimming) was considered inappropriate in the Basin for safety reasons. Riparian land uses consist largely of restricted natural areas that are not supportive of bathing, and structured shorelines preclude direct waterbody access. Vessel traffic associated with existing recreational boating uses represents a serious hazard to swimming that was recognized by the stakeholders. Further, City and State health codes such as those addressing coliform bacteria and clarity, sediment composition and slope, and proximity to discharge points preclude establishing a dedicated bathing area in Paerdegat Basin unless significant modifications are made to the waterbody that may adversely impact habitat. Despite these considerations, certain stakeholders noted that water quality should be supportive of primary contact uses to protect kayaking and jet-skiing activities even though these activities are considered secondary contact recreation by NYSDEC.

Stakeholders generally favored a plan to support fishing uses, and raised issues related to recreational fishing and fish consumption health concerns. The stakeholders also expressed a desire that the periodic fish kills which have been reported during periods of anoxia at the Basin's head end be avoided in the future. They agreed that reasonable steps be taken to protect fish and aquatic life propagation. The issue was complicated by the fact that any potential treatment additions to the Facility Plan involving chlorination would improve contact recreation but would also expose fish populations to potentially toxic residual chlorine concentrations, thus impairing fishing uses that are already in existence and are expected to continue. The stakeholders were advised that fishing and aquatic life propagation in general can be addressed within the present project, but that the human consumption matter is related to the presence of toxicants in fish tissue, a documented state-wide and regional problem which is not directly addressed in this project.

One mechanism identified to maintain support of the various secondary contact activities is waterbody access improvement. Stakeholders noted the decreased access between Paerdegat Basin and Jamaica Bay due to settling of solids near the basin mouth, which, in turn, limited access to a narrow time window around peak high tide. In addition, the sediment mound located at the head of Paerdegat Basin has filled a portion of the Basin, and is exposed during some tidal conditions. Expanding the basin linkage to Jamaica Bay by dredging at Paerdegat Basin mouth was strongly advocated, as was removal of the sediment mound to provide more navigable area within Paerdegat Basin.

Aesthetics was also considered an important issue by the stakeholders. In addition to recreational boating, local residents use surrounding undeveloped land and park areas for bird watching (Jamaica Bay is along a major migratory flyway) and walking along shorelines on unstructured paths, and are exposed to odors and debris that are aesthetically unappealing. The sediment mound at the head end appears to have resulted from ongoing CSO solids deposition, and emits considerable odor when exposed. The appearance of the water after a CSO discharge event has been described as "milky." Floatables tend to become entrapped around docks and marina facilities and reportedly interfere with boating, particularly the kayaking use of the Basin.

In summary, designation of primary contact recreation use in Paerdegat Basin is not desired nor would it be consistent with other uses in the waterbody. Secondary contact recreation presently exists and is the highest level of use desired by most stakeholders. A high level of compliance with primary contact water quality standards was desired to protect those boating uses where incidental body contact with water occasionally occurs, such as kayaking and canoeing. And finally, nuisance conditions related to odors, water clarity, floatables, and settleable solids are expected to be addressed in the LTCP.

7.1.4. Supplemental Evaluations

The USEPA Region 2 office reviewed the February 2003 Paerdegat Basin Waterbody/Watershed (WB/WS) Facility Plan and offered recommendations regarding both water quality standards revisions and TMDL development in a letter dated August 10, 2004. In response to the guidance provided by USEPA in this letter (Section 7.1.4), NYCDEP performed additional analyses to quantify the attainment of water quality standards that would result from implementation of the proposed actions in the Facility Plan on an average monthly basis. Investigation of seasonal differences was also requested. Additional controls and actions necessary to fully attain any of the water quality standards all of the time was also evaluated on a cost-effective basis. Stormwater controls and actions were specifically mentioned as potential "additional controls" that may be necessary, as were disinfection of CSO.

The analysis was not limited to the water quality standards presently in force (Class I), but included more stringent standards and other guidance values that have not yet been formally adopted. For dissolved oxygen, anticipated dissolved oxygen standards for Class SC/SB waters will be the NYSDEC interpretation of the acute and chronic standards for marine waters as developed by USEPA. Coliform bacteria analyses were expected to include both total and fecal coliform concentrations to be compared to Class I and SB/SC standards. Finally, NYCDEP evaluated compliance with the enterococci standard (geometric mean < 35 per 100 mL) and a reference level of 501 per 100 mL. The geometric mean was calculated both on a 30-day and a seasonal basis.

Each of the evaluations is discussed in detail in the alternatives analysis, and in the review of water quality standards discussed in Section 9.0.

7.1.5. Receiving Water Modeling

The evaluation of alternatives necessarily relied on the calibrated modeling scheme to estimate the performance of the various alternatives, and was also used for baseline conditions to improve comparisons and to overcome data deficiencies in Paerdegat Basin. Collection system and receiving water modeling was performed in a similar manner to the protocols outlined in Sections 3.3.1 and 4.1.4 i.e., RAINMAN and TANK were used to model the collection system, and the Paerdegat receiving model was used to model Paerdegat Basin. The inputs were intended to be identical to those used in the Baseline condition except for the particular element that was being evaluated for its performance in order to isolate differences in results exclusively attributable to that element. However, in the baseline condition stormwater and CSO concentrations were assigned based on available data, whereas the model calculated CSO concentrations by flow-weighted averaging of stormwater and sanitary loads for the Facility Plan. TSS, BOD, and DO concentrations were assigned to CSO directly for all scenarios.

The water quality modeling was used to determine the level of compliance with the various water quality standards, affording a high spatial resolution of relative compliance spanning any time period desired, from any given day to the entire year. The additional pathogen modeling for enterococci performed at a later date also used this model framework. Modeling was limited to those alternatives that had the highest potential for implementation, and the results are discussed in Sections 7.4 and 7.5.

7.2. DETAILED ANALYSIS OF FEASIBLE ALTERNATIVES

7.2.1. Collection System Improvements

At the time of the facility planning efforts, the Coney Island WPCP was undergoing improvements to expand peak capacity to 200 MGD (The facility was re-rated subsequent to this evaluation to 220 MGD peak capacity). Approximately 50 MGD was allocated for the flows from other areas within the collection system, primarily because those areas are separately sewered and have no relief structures. The existing Paerdegat Interceptor, Pumping Station, and regulators (with improvements) can already provide 150 MGD to Coney Island WPCP, thus rendering collection system capacity expansion useless unless the WPCP capacity could be expanded. The cost of an adequate WPCP expansion was estimated to be between $500 and $750 million, with an additional $60 to $70 million for interceptor capacity expansion. These capital cost estimates do not include costs for land acquisition or costs for additional conveyance systems to the expanded facilities if nearby land is available. The availability of land in the vicinity of the Coney Island WPCP is extremely limited, and it would be necessary to keep the facility in operation during any plant expansion. In light of these constraints and the very high cost of this alternative in comparison to others achieving similar levels of abatement, it was precluded from further consideration.

7.2.2. Sewer Separation

Sewer separation is attractive because it diverts much of the pollutant load associated with the discharge of untreated sewage from the receiving water. However, with separate storm sewers stormwater would be discharging at a much higher rate into receiving waters, with corresponding increases in floatables, street runoff, and unnatural freshwater flows to the ecosystem, along with lower BOD and bacteria loads. Further, construction would be very disruptive and complete separation would be difficult to implement. This control is also very costly, particularly in high density areas like the Paerdegat Basin watershed where numerous drainage structures, sump pumps, roof drains and footer drains would also need to be disconnected. The 1991 facility planning effort estimated the total sewer length based on the Infiltration and Inflow (I/I) study as 163 miles, which would have cost between $260 and $430 million. The high cost and extensive disruption that would occur precluded it from further consideration. In addition, recent evaluations based on comparable nationwide data and escalation of the 1991 estimates to July 2005 indicate that sewer separation in the Paerdegat Basin watershed would likely exceed $2 billion.

7.2.3. Relocation

Two approaches to combined sewer overflow relocation were considered: pumping the CSO to another drainage area, or constructing a long outfall to discharge to Jamaica Bay. Both are limited in effectiveness because no treatment is occurring, and no flow is diverted from the environment to the WPCP. In addition, there are logistical limitations due to the location of the existing outfalls. There are no areas convenient for receiving the diversion, and locating an outfall in Jamaica Bay would be relocating the discharge from a lower water quality use classification (Class I) to a higher one (Class SB). The cost of extending the outfall was projected to be in excess of $200 million in 1991, or about $325 million in 2005 dollars. Neither option offered environmental advantages but would have relatively high costs. Therefore, relocation was not considered to be an attractive option.

7.2.4. In-Line Storage

In-line storage can be the most cost-effective form of CSO control because of its ease of operation, low capital cost, and maximization of the existing facilities. However, if improperly operated, in-line storage can induce basement flooding, and increased sewer maintenance is usually required due to the more rapid buildup of solids in the areas of the sewer system in which storage is induced. There is also a need for fail-safe operation; the system must be designed such that the structure used to induce in-line storage will revert to the open position if it fails.

The collection system tributary to the Paerdegat Basin CSOs was considered to be conducive to in-line storage, based on the low slopes in the larger sewer lines, and the absence of evidence of basement or street flooding in the service area. Surcharging at high tide was known to occur, inducing an estimated 25 MG of in-line storage at high tide. Up to 40 MG of in-line storage was thought to be possible with a multiple-tier in-line storage system, although this scenario was ruled out during facility planning owing to its complexity and the unknown impact such a system would have on flooding. This alternative, at a lower storage volume, was determined to be suitable for abatement of CSO at Paerdegat Basin and was developed in detail, along with additional off-line storage. A conservative in-line storage volume of 20 MG was used in subsequent detailed evaluations.

7.2.5. Off-line Storage

The centralized location of the CSO outfalls at the head of Paerdegat Basin strongly suggested off-line storage as the most economical answer. There are only three CSOs, all of which are located at the head of Paerdegat Basin in close proximity to one another. This provided a high potential for a joint facility at that location. The outfalls are also near the Paerdegat Pumping Station, which made incorporation of it into a CSO abatement scheme more feasible. Since there are three large combined sewers, implementing upstream facilities remote from Paerdegat Basin would have required at least one upstream facility on each sewer line, thereby complicating operations and increasing construction, operation, and maintenance costs. In addition, upstream locations would not capture flows entering the system further downstream. Storage tunnels were also considered because they can be cost-effective, particularly when they serve as combination conveyance and storage conduits. This was not the case for Paerdegat Basin because the depth to bedrock is about 600 feet, and the existing interceptor capacity is adequate, thus obviating the need for conveyance. As a result, the cost of storage tunnels did not compare favorably with other CSO abatement measures that would also offer other advantages. Off-line retention was determined to be the best available alternative for abatement of CSO at Paerdegat Basin and was developed in detail. A constructed underground storage tank was the method of off-line storage selected, to be sited near the head of Paerdegat Basin.

Additional evaluations were necessary to refine the tank volume. Multiple storage volumes were modeled to develop cost-benefit curves from which the knee-of-curve could be identified (the point of diminishing return on incremental capacity increases). Off-line storage was also considered as equivalent to outfall relocation when sized for 100% capture of all storms during the design year.

7.2.6. Disinfection Technologies

Three disinfection technologies were preliminarily evaluated as an additional unit operation for treating overflows that would still occur with the Facility Plan in place based upon technical feasibility, effectiveness, adverse side effects (e.g., residuals), and comparative cost. Chlorination, the least expensive of the three technologies by far, has the advantages of low complexity, adequate contact time, and NYCDEP experience. The other two, ozonation and ultraviolet light (UV) exposure, have had successful applications in the potable water and wastewater industry, but are relatively untested technologies for CSO on the scale necessary for Paerdegat Basin. Chlorine disinfection using sodium hypochlorite was considered the preferred option because of its demonstrated ability and because of the high costs associated with UV and ozonation.

Disinfection of tank overflows is currently not part of the Paerdegat Basin CSO Facility although space was allocated within the facility for the future installation of sodium hypochlorite chlorination equipment and instrumentation in the screening building was included in the facility design in the event that the disinfection of tank overflows were to be required at some time in the future. The current design allows for the addition of four 8,000-gallon tanks for the storage of necessary chemicals. Implementing the current design would not require a great deal of ancillary construction or modification to the facility. Escalating the 1994 $16 million cost estimates for the disinfection portion (design peak flow rates of 2,500 MGD) proposed for the 31 MG Fresh Creek CSO Retention Facility (O'Brien & Gere, 1994), the estimated cost for implementing a similar process at Paerdegat Basin in 2005 (design flow rate of 1,000 MGD) is approximately $22.5 million.

The actual ability of a disinfection system to perform consistently, when applied to a CSO discharge, remains a technical challenge in the industry and is a subject that the NYCDEP has investigated on several occasions. The highly variable nature of CSO flows and water quality (i.e., chlorine demand) would make it difficult to flow pace chlorine addition to maintain the appropriate dosage for disinfection. Because TRC is toxic to the aquatic ecosystem and has a marine standard of 7.5 micrograms per liter, and because there is presently a lack of a defined spatial or time-variable mixing zone, dechlorination would be required. The dechlorination operation envisioned would use sodium bisulfite, and would require virtually no residence time. However, the same difficulties noted above for a chlorination system would apply to a dechlorination system as well. Use of this technology could result in fluctuating chlorine and sodium bisulfite feeds that may not be appropriately timed and, as a result, could potentially discharge ecologically damaging levels of these chemicals in receiving waters whenever the system was utilized.

Even if it was possible to establish flow pacing control, the required level of disinfection (the kill rate) remains undefined at this time. The disinfection operation would need to be highly automated to ensure proper disinfection of all overflows whenever they may occur. This would add a substantial degree of complexity to the operation of the proposed CSO abatement facilities. A chemical feed system with complex feedback control instrumentation is likely to require additional maintenance to ensure reliability, and additional maintenance would likely mean additional staffing at the proposed facilities during precipitation events. The current Facility Plan envisions minimal staffing requirements because major operations such as screening and pumping are generally rugged and reliable, and do not rely on complex instrumentation.

Regardless of these caveats, the feasibility of retrofitting a disinfection system to the Paerdegat Basin Water Quality Facility was evaluated to determine whether primary contact bacteria concentrations could be attainable without exceeding the toxic limits of TRC in the receiving water. An effluent TRC of 1 mg/L was assumed for these analyses, a conservative value in the sense that dechlorination may yield a much lower number but operational difficulties could lead to higher effluent TRC concentrations. A 2-log-kill of total coliform, fecal coliform, and enterococci was assumed to be attainable, with the tank bypass receiving no disinfection and thus realizing no reduction in pathogen concentrations.

Chlorine residual in a receiving water body is toxic to aquatic life survival, and NYSDEC water quality standards require chlorine residuals to never be greater than 13 ug/L for acute protection and the 4-day running average to never be greater than 7.5 ug/L for chronic protection. The results of receiving water modeling indicate that chlorine residual concentrations in the head-end of the Basin would exceed the acute standard about 18 times per year with peak concentrations reaching as high as 200 ug/L. In addition, the impact of the chorine residual during a high storm event may reach an area in the Basin of about 1,500 feet downstream of the head-end. The marginal improvement in bacteria would result in a substantial impairment to the aquatic ecosystem, sacrificing attainment of an existing use (fishing) for a non-existent one (swimming). Because this system has a high potential to result in toxic TRC levels in Paerdegat Basin, disinfection was precluded from further analysis.

7.2.7. Maximizing WPCP Treatment

As discussed in Section 7.2.1, approximately 50 MGD of the Coney Island WPCP capacity of 200 MGD at the time of the facility planning process was allocated to flows from other areas within the collection system, primarily because those areas are separately sewered and have no relief structures. This resulted in an effective capacity of 150 MGD available for treating CSOs, which is the flow the existing collection system, was capable of delivering. Expansion of the WPCP to provide for additional CSO treatment, as it was evaluated in the 1991 Facility Plan, would also require expansion of the collection system, which was estimated to cost between $560 and $820 million in 1991 (Hazen and Sawyer, 1991), and would be on the order of $1 billion in 2005. Significantly, this does not include land acquisition, a necessary and expensive item considering the limited space near the Coney Island WPCP and economic pressures on real property City-wide. The very high cost of this alternative in comparison to others achieving similar levels of abatement precluded it from further consideration in the 1991 analysis.

In light of upgrades and technological advances, the potential for maximizing WPCP treatment was revisited during the final development of the LTCP and evaluated in further detail. The DDWF is 110 MGD due to the plant having been re-rated from 100 MGD subsequent to the facility plan work. Like many NYCDEP facilities and as required by its SPDES operating permit, Coney Island WPCP is designed and operated to receive a maximum flow of 2 times DDWF with 1.5 times DDWF receiving secondary treatment and any remaining flow receiving primary treatment and disinfection. For Coney Island WPCP, DDWF is 110 MGD, 1.5 DDWF is 165 MGD, and 2 DDWF is 220 MGD. The daily average flow during 2005 was 92 MGD, with a dry weather flow average of 86 MGD.

Historically, the Coney Island WPCP has demonstrated an ability to treat 150 to 230 MGD during wet weather. During the 2005 Top Ten storms (a method of analyzing peak storm events for defining the plant's wet weather capacity) the plant consistently sustained 2xDDWF, achieving an average wet weather flow of 218 MGD. The plant sustained wet weather flows of 210 to 229 MGD with peak hourly flows up to 235 MGD. These flows include approximately 2 MGD of plant returns. The plant throttled during all of these events.

The existing process operations at Coney Island WPCP are at or near the reasonably attainable facility capacity within the existing infrastructure. As such, they would not be capable of processing all 220 MGD through secondary treatment without modification. Simple modifications within existing tankage are unlikely to increase capacity, because many of the existing tanks are operating at or near the upper limit of loading rates. The final settling tanks operate at a total overflow rate of 900 gpd/sf at 1.5 DDWF; standards specify 1,000 gpd/sf as the upper limit for secondary tanks where 20 mg/L TSS must be achieved. If all wastewater were to be passed through secondary treatment, the secondary clarifiers would see hydraulic loading rates of upwards of 1,200 gpd per square foot. This is well above the recommended standard of 1,000 gpd per square foot and as such the WPCP would not be able to provide secondary treatment. Further, the flow distribution systems were not designed to have flows over 165 MGD passing through the secondary clarifiers and flooding would likely occur if flows beyond 1.5 DDWF were forced through them.

The existing plant site comprises three parcels of property totaling approximately 30 acres, seven acres of which is occupied by a park. The remaining 23 acres of the plant site is fully developed with wastewater treatment facilities. Expansion of secondary treatment to twice DDWF would require a 33% expansion of the existing aeration tanks, clarifiers and other associated facilities. However, any expansion should be done with tanks of similar size to the existing tanks to avoid the problems inherent with dissimilar facilities, such as flow and loading balances. Also, any consideration of secondary treatment expansion should try to site the new tanks adjacent to the existing tanks to minimize additional infrastructure expansion such as air distribution, primary effluent channels, return activated sludge piping and pumping and secondary clarifier effluent conveyance. The Coney Island WPCP has four aeration tanks and 11 secondary clarifiers. An expansion of two additional aeration tanks and four additional clarifiers would be required to provide 2xDDWF capacity in secondary treatment. This would require an area of approximately 2.5 acres which is not available at the existing site.

Given these restrictions, expanding facility capacity to process 220 MGD through full secondary treatment would not be feasible within the existing infrastructure. The construction of new facilities would be required to handle this additional flow through secondary treatment and/or to increase plant capacity, but space constraints remain as limiting as they were when the original Paerdegat Basin Facility Planning work began in the late 1980s. Coney Island WPCP is bound on four sides by public streets and part of the plant property is a public park. The property is surrounded on all sides by fully developed residential areas. Further, the facility is completely enclosed to reduce odor impacts to nearby neighborhoods, so expansion would require a similar level of odor control. Finally, the conveyance capacity would become limiting, so expansion of the collection system would be necessary. Therefore, the conclusion reached during the Facility Planning remains true: expanding the Coney Island WPCP is not a feasible alternative for reducing CSO discharges to Paerdegat Basin.

7.2.8. Supplemental Aeration

In an effort to address the periodic drop in dissolved oxygen levels expected following the implementation of the proposed Facility Plan, supplemental aeration was proposed for use in at Paerdegat Basin and evaluated in a 1999 report (Hazen and Sawyer, 1999). Seven supplemental aeration technologies were identified and examined for their ability to artificially aerate the waterbody to bring DO levels up to standards at all times. Those alternatives investigated included direct in-stream aeration, which uses shore-mounted blowers, air distribution piping and a network of bottom-mounted diffusers, and side-stream aerations systems, which pump low DO water to a shoreline aeration tank for forced air diffusion or a passive cascade aeration system. Preliminary screening identified three potentially suitable alternatives that were further evaluated through engineering economic and water quality modeling analyses. This investigation indicated that full compliance with the NYSDEC dissolved oxygen standard of never less than 4.0 mg/L would not be achieved at all times, although some improvement would be realized. The costs estimated in the 1999 report would range from $20 million to $60 million in current (July 2005) dollars.

Because there were other issues, most significantly the high potential for impeding navigability in the waterbody, limiting shoreline restoration, and community aesthetic impacts, supplemental aeration is precluded from a more detailed consideration.

7.3. OTHER CSO ABATEMENT EVALUATIONS

NYCDEP has a demonstrated commitment to evaluating state-of-the-art alternatives that have the potential to provide cost effective solutions with maximum water quality benefits. Since the development of the 1997 Floatables Plan, NYCDEP has performed several evaluations of emerging CSO and floatable control technologies. The evaluations have been conducted on various scales, including preliminary-design (“white paper”), bench-scale laboratory evaluations, full-scale laboratory, and full-scale field evaluations (Table 7-2).

A full-scale, laboratory test for floatables retention in a hooded catch basin was conducted to determine the effect of catch basin outlet orientation, floatables burden, and grit burden. A bench-scale, laboratory test for floatables retention using fixed and hinged baffle configurations was also conducted. In addition, preliminary-design evaluations have been completed for a number of technologies, including baffles, rotating brush screens, in-line netting, raked vertical bar screens, raked horizontal bar screens, and bending weirs (final reports containing detailed evaluation results are pending).

Table 7-2. NYCDEP Emerging CSO Control Technologies Evaluations

1997 Planning Items and Actions	2005 Status
Corona Avenue Vortex Evaluation	Completed, report submitted to NYSDEC
Hunts Point Inflatable Dam Prototype Evaluation	Completed, report pending
Catch Basin Pilot Study	Completed, report pending
Baffle Hydraulic Study	Completed
Paper Studies: baffles, screens, weirs	Partially Completed; assessing field tests of hinged baffle systems

These testing programs have been instrumental in NYCDEP efforts to advance the technology of CSO floatables controls. Through these investigations, NYCDEP has developed the catch basin control program and the floatables booming and skimming program—both of which have become successful best management practices. These investigations and the enhanced understandings they foster have also led NYCDEP to move forward on the use of horizontally raked regulator screens and in-line netting technologies for site-specific floatables controls. Further, NYCDEP continues to advance the knowledge base on the use of in-line storage within combined sewers, which could potentially result in additional CSO floatables controls. Future investigations may also result in additional cost-effective floatables controls, such as the hinged baffle.

Details of these evaluations and others are described in detail below.

7.3.1. The Corona Avenue Vortex Facility

The Corona Avenue Vortex Facility (CAVF) was developed as a full-scale test facility to demonstrate the effectiveness of vortex technology for control of CSO pollutants, primarily floatables, oil and grease, settleable solids, and total suspended solids. Completed in late 1999 for a cost of $43 million, the CAVF is located in the Borough of Queens, under Corona Avenue just east of Saultell Avenue. Combined sewage from 1,528 acres drains to a large conduit with a maximum capacity of about 650 MGD. The design capacity of the CAVF allows up to about 400 MGD to be diverted from the conduit into the CAVF. A baffle/weir arrangement is designed to divert both buoyant and heavier materials in to the CAVF. See Figure 7-1.

The CAVF itself features three different vortex units, the USEPA "Swirl Concentrator," the British "Storm King," and the German "Fluid Separator," arranged in parallel to allow testing on any unit singly or in any combination. Each of these designs was developed in the 1980s as a high-rate CSO treatment methodology. In each case, flow is routed tangentially into a cylindrical basin designed to promote a circular flow path to effect solid-liquid separation. Each device acts as a flow splitter, concentrating heavier solids in one flow path ("underflow," routed to the treatment plant) and clarified "effluent" in a second, larger flow path (which is then allowed to discharge to the water body). Depending on the individual vortex design, floatable material is either routed directly to the underflow during the storm, or is retained and released to the underflow at the end of the storm. Each unit was designed to have the same diameter (43 feet) and to process a peak flow rate of 130 MGD, with a corresponding maximum underflow rate up to about 13 MGD.

A two-year testing program evaluated the floatables-removal performance of the CAVF for a total of 22 rainfall events. During these events, testing was conducted on either a single vortex unit or on two units simultaneously. In all, each vortex unit was tested for at least 10 different events.

The floatables-sampling program utilized two parallel approaches to experimentally measure floatables-removal performance. The first approach was based on sampling the vortex effluent flow for "seed" items injected into the vortex influent. The second approach was based on sampling the intrinsic conbined sewer (CS) floatables present in the influent and effluent of the vortex units. The two approaches produced consistent results, though the "seed items" approach provided more definitive results and more insight into the removal mechanisms involved, while the "intrinsic CS floatables" approach provided mostly qualitative information.

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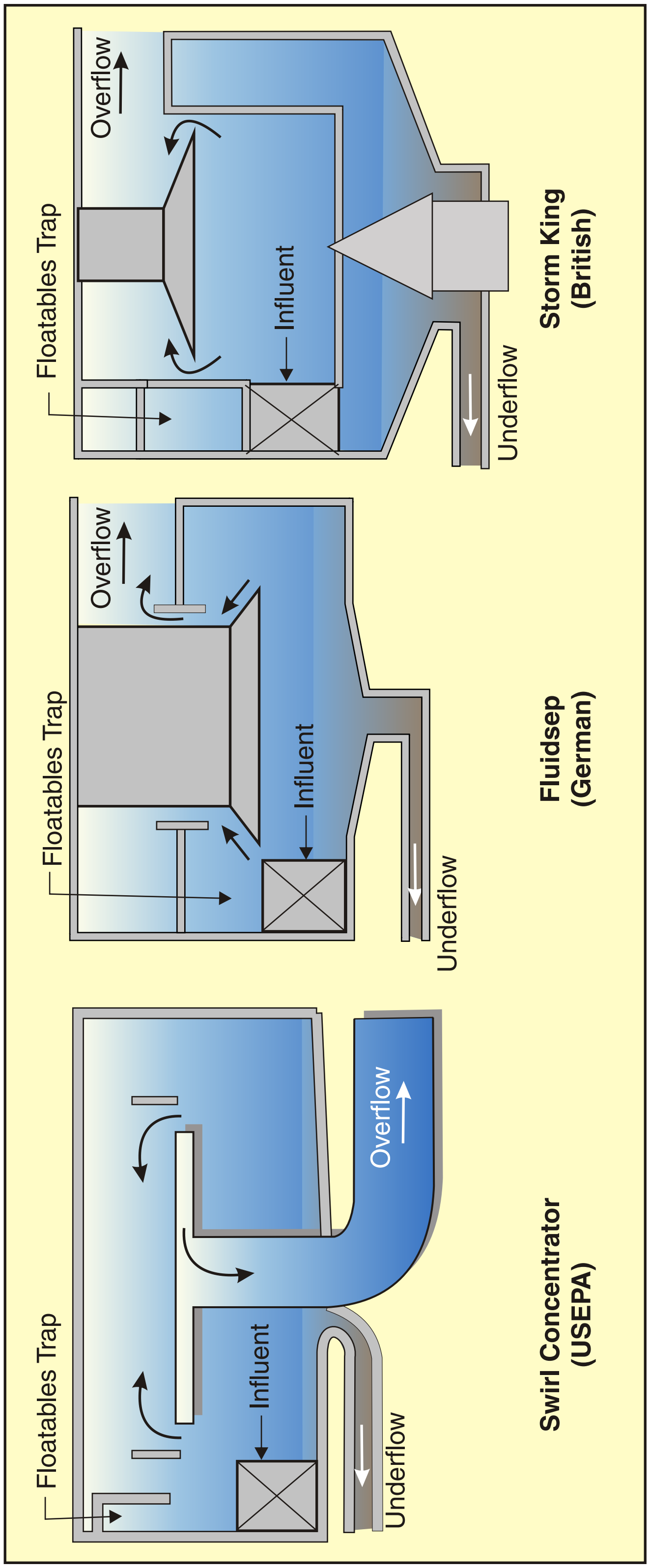

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Schematic Diagrams of the Three Vortex Technologies Tested at CAVF

FIGURE 7-1

Overall, the results indicated that the vortex units provided an average floatables removal of roughly 60 percent during the tested events. Two factors significantly affected floatables removal effectiveness. The first factor is the character of the litter itself. Specifically, the item "rise velocity" (a parameter linked to the item's buoyancy) has a strong influence on whether it is captured in the vortex unit. The higher the rise velocity, the greater the chance that it will be captured; items that are neutrally buoyant with a rise velocity close to zero travel with the water and do not appear to be effectively concentrated in the vortex underflow.

The second factor affecting floatables removal performance is the hydraulic loading rate of the vortex units. Simply put, higher influent flow rates adversely affected floatables removal rates. For the lowest tested event-average hydraulic loading rates of about 4 gpm per square foot, overall floatables-removal rates of about 80 percent were observed; however, the removal rates fell to just under 40 percent for the highest event-averaged hydraulic loading rates of about 20 gpm per square foot. The deterioration in floatables removal effectiveness was greater for items with lower rise velocities than for more highly buoyant items. As the hydraulic loading rate increases, more buoyant items pass through the vortex units and the floatables capture rate converges to the hydraulic capture rate. Therefore, at the design peak hydraulic loading rate of about 60 gpm per square foot, the projected removal rate is no better than the hydraulic capture.

The detailed results of this testing program are summarized in HydroQual (2005). Based on the results in these two reports, NYCDEP has concluded that widespread application of vortex technology is not effective for control of settleable solids, and not a cost effective way to control floatables. As such, application of vortex technologies will be limited. Furthermore, based on these testing results, NYCDEP will not be progressing with development of vortex floatables controls in and around Flushing Bay as originally proposed. As part of its long-term CSO control planning, NYCDEP will be assessing other methods to control floatables discharges into Flushing Bay and the greater New York Harbor complex, and this technology is rejected from further consideration for use at Paerdegat Basin.

7.3.2. Regulator Screens and Outfall Nets

NYCDEP has actively evaluated the application of both regulator screens and outfall nets for the control of floatables. A series of workshops were conducted within NYCDEP to review and evaluate the different types of technologies available to control CSO floatables. Workshop discussions centered on design and maintenance issues. Representatives for manufacturers and distributors of COPA screens and Fresh Creek Nets presented their materials and demonstrated the equipment. Field Inspections were made in numerous municipalities throughout New York State and New Jersey to observe ROMAG and COPA regulator screens and netting systems.

Based on these evaluations, as well as a series of hydraulic design evaluation meetings intended to assess the value of these technologies, NYCDEP developed several design decisions for application of these technologies. Chief among these was that the hydraulic grade line under full pipe conditions would not be modified by the installation, and that care should be taken to avoid flooding local residents. Systems would be designed to treat flows on the order of the one-year flow and to bypass flows up to full pipe flows through an internal bypass. Finally, the local sewer drainage plans would be modified to reflect the internal system changes where nets or screens are to be employed.

As a result of these actions, NYCDEP has begun to employ regulator screens and end-of-pipe and inline netting technologies at site specific locations, and will continue to evaluate it as an alternative in those situations where floatables control is determined to be necessary. However, this technology is rejected for applicability at Paerdegat Basin.

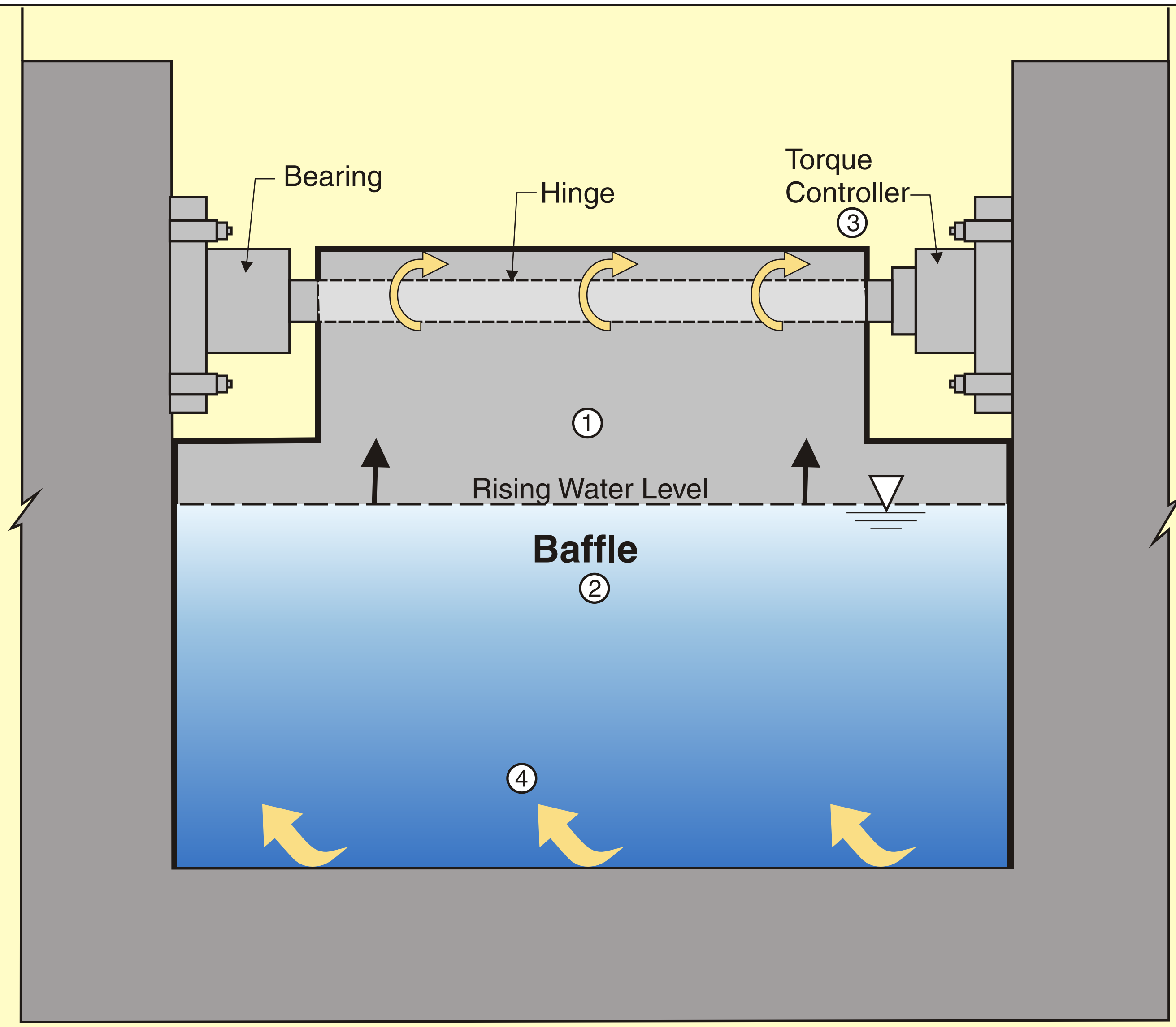
7.3.3. Hinged Baffle/Bending Weir System

The hinged baffle system concept incorporates two technologies, the hinged baffle and the bending weir. The major benefit of the system is embodied in a built-in mechanical emergency release mechanism, eliminating the need for emergency by-pass construction required by many other in-line CSO control technologies. In addition, the hinged baffle system has no utility requirements and its simple design results in low operation and maintenance costs.

The major system components, the hinged baffle and bending weir, are presented in Figure 7-2 and Figure 7-3, respectively. 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 WPCP. 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. As flow to the regulator increases, liquid height behind the baffle increases producing torque on the baffle shaft. When torque required to maintain baffle position is exceeded, the torque limiting device releases the baffle, allowing it to swing open. The baffle then swings with the water level during high flow conditions. When the water level subsides, the baffle swings down to its original position and the torque-limiting device resets.

The bending weir provides additional storage of storm water 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 regulator rises.

This alternative was evaluated as a potential low-cost retrofit CSO technology. The demonstration included a three-stage regulator screening study to select appropriate combinations of regulators for pilot testing. The screening study also assessed the overall applicability and construction costs of each of several in-line CSO control technologies. Hydraulic analyses that considered various flow scenarios, operating conditions and existing and proposed regulator conditions with and without the selected CSO control technologies, were conducted to evaluate the potential impact of the CSO control technologies on water levels in the regulator and in the upstream sewer. The hinged baffle and bending weir technologies were found to be suitable for retrofit in existing regulators in comparison to screens, in-line netting, and by-pass piping. Full implementation of this technology remains under consideration. However, this technology is not applicable at Paerdegat Basin because the configurations of existing regulators are not suitable for retrofitting without substantial modifications.



Note: As water level rises ①, pressure on the baffle ② increases exerting increased torque on the controller ③. The controller releases baffle, allowing it to swing open ④ and discharge retained water.

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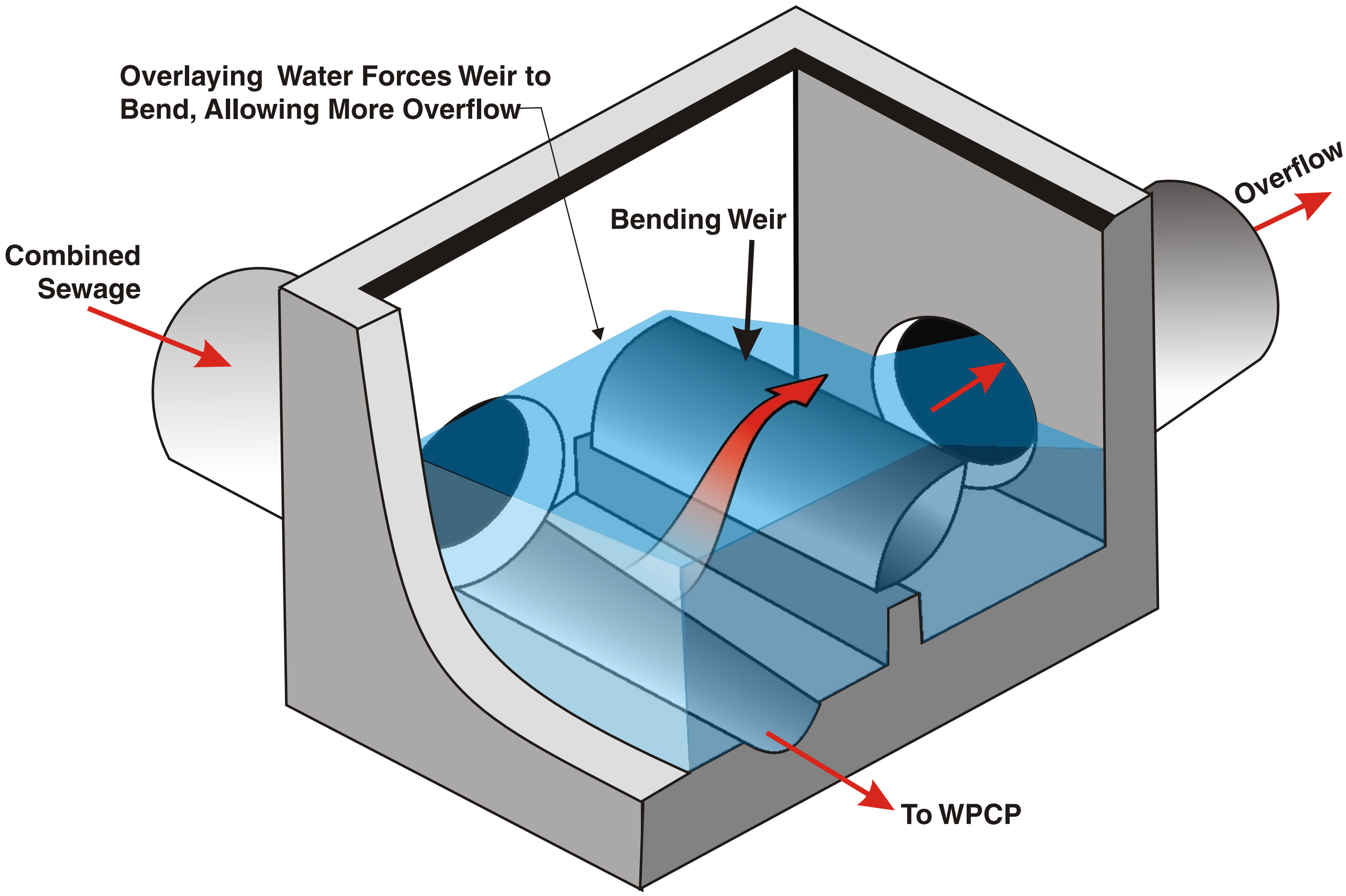
Conceptual Schematic of a Hinged Baffle

FIGURE 7-2

Typical Bending Weir



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Conceptual Schematic of a Bending Weir

FIGURE 7-3

7.3.4. Shellbank Basin Destratification Facility

NYCDEP is operating a destratification system designed to address poor water quality in Shellbank Basin (Jamaica Bay) in the Howard Beach community in Queens. The technology has been used successfully in lakes and reservoirs to vertically mix the waterbody, preventing undesirable water quality conditions associated with stratified conditions from occurring. In the absence of natural mixing processes from tidal exchange or freshwater inflow, a waterbody of sufficient depth will tend to develop a stable vertical temperature gradient that impedes vertical mixing. As a result, dissolved oxygen does not reach the deeper waters and eventually the bottom layer becomes anoxic. Episodic events such as high winds, unusual tides, or precipitation can destabilize the stratification, leading to "turn over" that brings anoxic waters to the surface, killing marine life that is intolerant of low dissolved oxygen. In addition, turn over can lead to noxious odors as anoxic sediments exposed to oxygen release hydrogen sulfide, characterized by the smell of rotten eggs.

A vertically well-mixed waterbody would not undergo turn over, and would not induce the various deleterious water quality condition associated with it. Therefore, one alternative to counteracting this effect is to destratify the waterbody. The destratification system uses air diffusers mounted near the bottom of the waterbody. A shoreline-based compressor feeds three air diffuser lines running along the bottom of the basin. The compressed air delivered through the diffuser lines is released as air bubbles that induce vertical turbulence as they rise to the water surface, destabilizing the water column and preventing stratification from occurring.

Water quality samples were gathered at 2-week intervals for two consecutive summer seasons (2000 and 2001) at varying depths and were analyzed for dissolved oxygen concentrations, salinity, and temperature. Stratification was evident at the start of each summer season based on a 10 Celsius degree temperature difference between near-surface and near-bottom measurements. Once the system was placed into service, temperature data indicated an average gradient of less than one Celsius degree in the water column at all stations. This constant gradient was maintained throughout the course of the study, and no odor complaints were received from the residents living on or near Shellbank Basin during the period of operation. Because the full-scale demonstration test produced positive results, the program has been extended. The facility has been in operation for six seasons, and NYCDEP is developing plans to replace the system with a more permanent facility expected to cost between $500,000 and $800,000.

This technology is well suited for Shellbank Basin, a long narrow basin that is very deep at the head end (50 ft) and comparatively shallow (10 ft) near its confluence with Jamaica Bay. Although Paerdegat Basin shares the trait of relatively poor tidal exchange, it is comparatively shallow and does not experience episodic stratification-destratification cycles. Therefore, this technology would not be expected to have utility in Paerdegat Basin.

7.3.5. Inflatable Dams

The Hunts Point In-Line Storage (ILS) prototype project was a pilot program to evaluate the viability of using inflatable dams in the collection system to reduce the occurrence of CSO. The CSO Consent Order calls for the commencement of inflatable dam design for Inner and Outer Harbor CSO abatement projects in July 2005, contingent on the findings of the prototype evaluations. The

Hunts Point ILS prototype systems are located in the Hunts Point WPCP service area in the Bronx; the study area includes approximately 1,800 acres spanning the entire length of the east bank of the Bronx River, containing 4.5 miles of combined sewers ranging from 48 to 168 inches in width and up to 96 inches in height. Two inflatable dam systems were installed and operated simultaneously: a single Sumitomo inflatable dam with a Rodney Hunt control system and a Bridgestone two-dam and control system. NYCDEP personnel were trained in their operation and analyzed the viability of these systems for functionality, making recommendations following the extended trial period. The general consensus was that the dams were operable, but that certain improvements would better facilitate operation and maintenance activities. In July 2005, NYCDEP initiated design for the two Inner Harbor in-line storage locations, based on the relative success of the pilot program. Implementation of inflatable dams was determined to be impossible at the two Outer Harbor locations based on site-specific hydraulic constraints.

Inflatable dams were considered as the induced in-line storage alternative with zero off-line storage for the present analysis. Costs were based on most recent data available (July 2005).

7.3.6. Low Impact Development (LID)

NYCDEP has contracted a consulting team to assess the cost-effectiveness of LID as a means of reducing CSO. LID technologies can be used to divert and delay stormwater from combined sewers to reduce the frequency and volume of overflows, particularly in highly developed urban watersheds, resulting in a reduction in downstream conveyance and an effective increase in collection system capacity. During facility planning, the implementation of LID technologies was determined to be required on an unreasonable level to produce measureable reductions in stormwater runoff, and is therefore not under further consideration for Paerdegat Basin as a central element of the LTCP. However, because implementation of any LID technology is expected to improve water quality on at least a marginal level, NYCDEP will continue to support innovation.

7.3.7. High-Rate Physical-Chemical Treatment Demonstration Facility

High-Rate Physical-Chemical Treatment (HRPCT) can be a preferred alternative to retention facilities at locations where there is a minimal amount of available land to expand existing wastewater treatment plant capacity, and where property costs are significant, such as in New York City. The basic HRPCT process includes fine screening, coagulant and polymer addition, ballast addition, ballast recirculation, and lamellar settling. Pilot testing of HRPCT was performed at the 26th Ward WPCP 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 were the Ballasted Floc Reactor™ from Microsep/US Filter, the Actiflo™ from Krüger, and the Densadeg 4D™ from Infilco Degremont. Pilot testing results suggested good to excellent performance of all units, often in excess of 80% for TSS and 50% for BOD_5. Based on this past success of the technology, a HRPCT demonstration facility will be undertaken to encompass three different process units, and would be capable of treating CSOs between 3 MGD and 9 MGD.

The proposed 9,400 square foot HRPCT demonstration facility will be located on a newly acquired property east of the Port Richmond WPCP on Staten Island. The new facility would receive up to 9 MGD of combined sewer flow from the 84-inch Richmond Terrace interceptor over an 18-month demonstration period. The proposed HRPCT demonstration facility would include an Actiflo unit, Densadeg 4D unit, and a new High Rate Primary unit. It should be noted that the Ballasted Floc Reactor process would not be included due to the takeover of US Filter by Krüger's parent company, Vivendi. Construction costs are expected to be approximately $30 million, with a construction start date scheduled for 2008. The evaluation of HRPCT is ongoing and was not available for full consideration as an alternative for Paerdegat Basin within the mandated timeframe of LTCP development. Therefore, HRPCT was precluded from further consideration in this waterbody.

7.3.8. Interagency and Other Partnerships

The City of New York continues to support new and ongoing research into technologies that improve the urban environment. In 1997 the City Department of Design and Construction (DDC) formed an internal Office of Sustainable Design that developed high performance building guidelines that embody sustainable building design and construction methods, including LID technologies. The Mayor's Office co-sponsored a "green building" design competition encouraging low impact development techniques in 2003 with USEPA. Local universities (Pratt Institute, Cooper Union, and Columbia University, among others) and organizations like GAIA Institute are supported in their small and large scale pilot investigations of runoff reduction management practices such as infiltration and green roofs. The New York City Water Board is sponsoring an Earth Pledge project involving a large-scale pilot green roof on top of Pace University in lower Manhattan. As part of that project, GAIA is developing a micro-model of the green roof dynamics that is being linked with one of the NYCDEP collection system models to develop a tool to accurately assess the benefits of green roof rainfall retention. Studies of this nature will continue to receive NYCDEP support in an ongoing effort to identify feasible state-of-the-art technologies to improve collection system performance and reduce the occurrence and severity of CSOs. Although no opportunity was identified that would lead to the substantial reductions in CSO loadings to Paerdegat Basin during LTCP development, NYCDEP will continue to seek interagency partnerships to advance the goal of improved water quality and CSO performance in New York Harbor.

7.4. CSO VOLUME REDUCTION BENEFITS OF ALTERNATIVES

A variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Paerdegat Basin, to provide for compliance with water quality standards and to improve water quality to attain stakeholder use goals. Because Paerdegat Basin receives large quantities of combined sewage in short periods of time, most of the alternatives involve reduction in the volume of combined sewage discharged. CSO reduction schemes vary from the small reduction realized through diversion of wet weather flows to complete CSO elimination through load relocation or containment of all combined sewage generated under design conditions. The diverted overflows would be redirected to the Coney Island WPCP to maximize the use of its 220 MGD wet weather capacity.

As discussed in Section 4.5, the Baseline scenario was established for planning purposes, and reductions in CSO resulting from each alternative was compared to this Baseline condition. The reduction in overflow events as a function of retention volume is shown in Figure 7-4; the reduction in overflow volumes is shown in Figure 7-5. Figure 7-6 shows the relative cost of CSO volume reductions based on estimated construction costs for the relevant alternatives. Tables 7-3 and 7-4 summarize the data presented in these figures.

Table 7-3. Cost-Benefit of Volume Retention on an Overflow Reduction Basis

CSO Overflow Events	Total Retention Volume (MG)	Estimated Cost (millions)
61	0	$0
60	20	$25
24	40	$165
21	50	$318
14	70	$808
9	120	$1,460
0	200	$2,206

Table 7-4. Cost-Benefit of Volume Retention on an Overflow Volume Reduction Basis

CSO Reduction From Baseline	Total Retention Volume (MG)	Estimated Cost (millions)
0%	0	$0
32%	20	$25
55%	40	$165
62%	50	$318
73%	70	$808
89%	120	$1,460
100%	200	$2,206

The Baseline condition was calculated to result in 61 pollution overflow events to Paerdegat Basin with about 2,750 MG a year of combined sewage being discharged into the Basin. This overflow would occur with the WPCP treating wet weather flow to its maximum capacity of 220 MGD, which was consistently achieved at the Coney Island WPCP during 2005. The least intrusive and lowest cost alternative of using inflatable dams (20 MG inline storage) within the CSO barrels or as controllable barriers on the existing outfalls would result in a reduction of one overflow event a year resulting in a total of 60 overflow events but would result in a reduction of CSO of about 875 MG a year to a total of 1,875 MG per year. This alternative would result in an overall decrease in CSO of about 32%. Inline storage would provide diversion of the 875 MG per year of combined sewage to the Coney Island WPCP but would not provide any additional pollutant removal than is attained through volume reduction, i.e., discharges would be untreated.

Alternatives that decrease overflow volumes and also provide for treatment of pollutants (settleable solids, suspended solids, oil & grease, floatables, turbidity, BOD, pathogens, nitrogen, phosphorus, toxics, etc.) require the addition of an offline or flow-through storage facility from which contained combined sewage would be pumped back to the Coney Island WPCP after the CSO event is over. When the combined sewage flow passes through the retention facility, settleable pollutants are removed by passive sedimentation, floatables as well as oils and grease are removed through screens and overflow baffles and other pollutants are removed through volume reduction.

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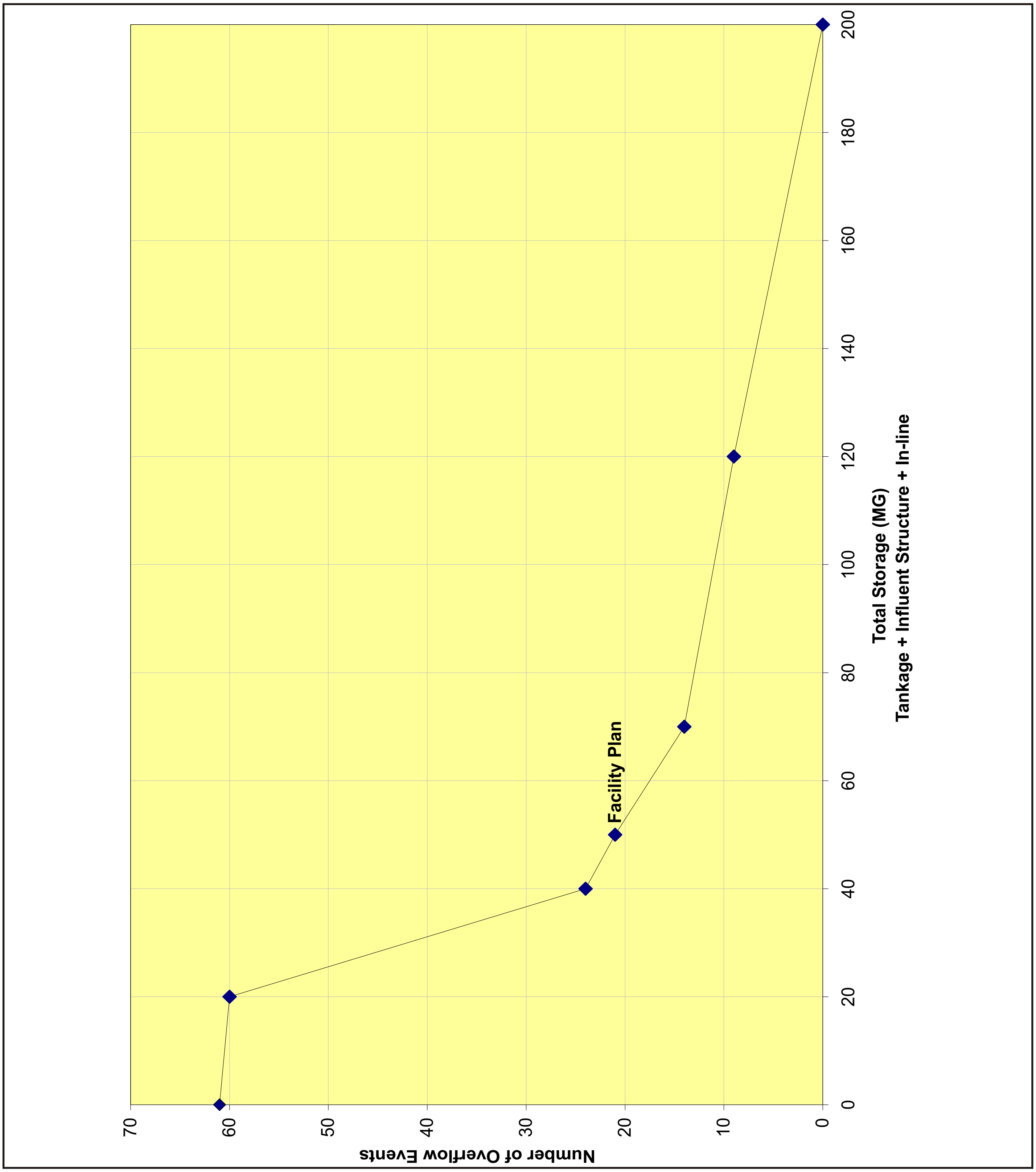

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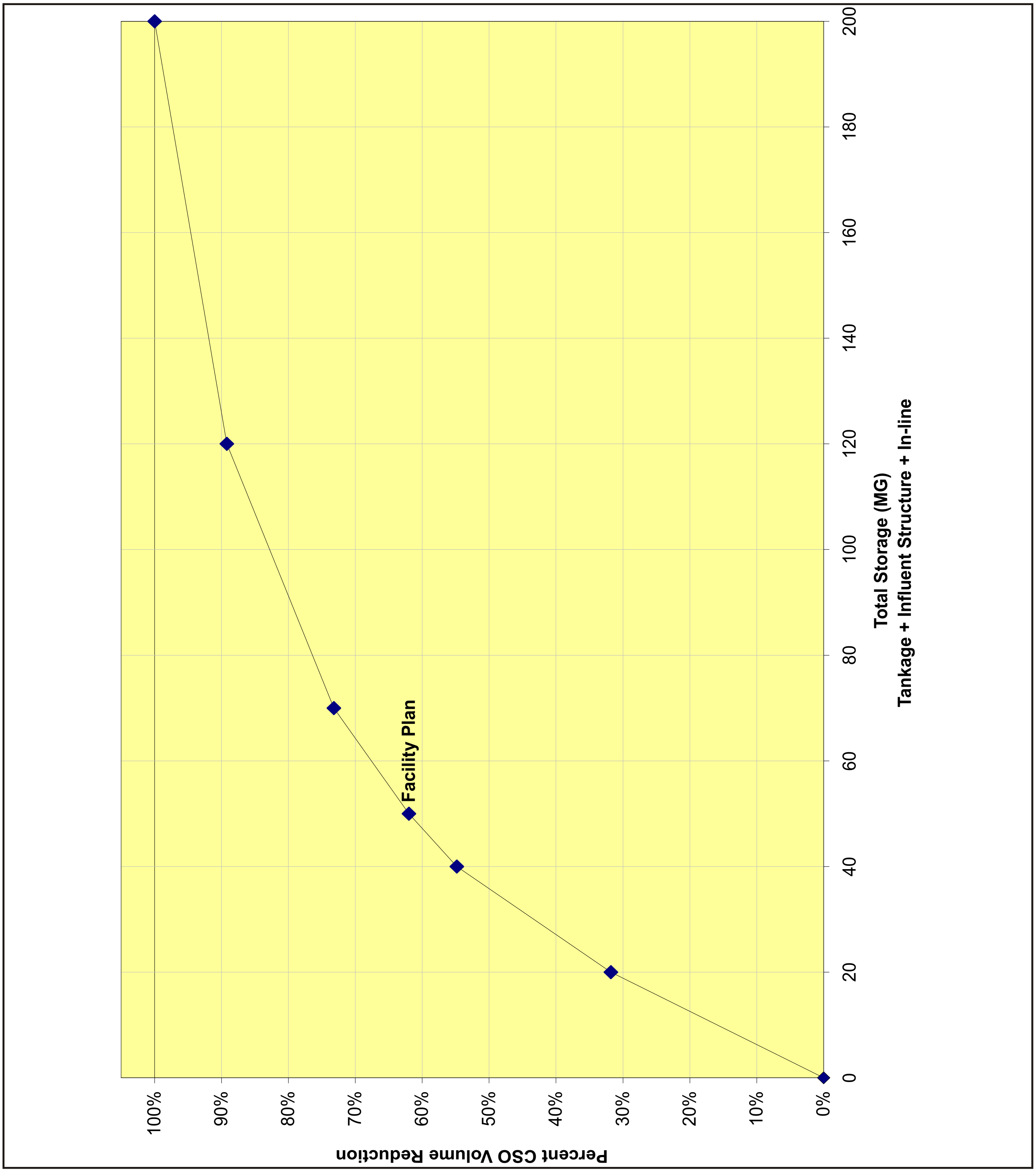
Event Reduction vs. Total Storage Volume

FIGURE 7-4



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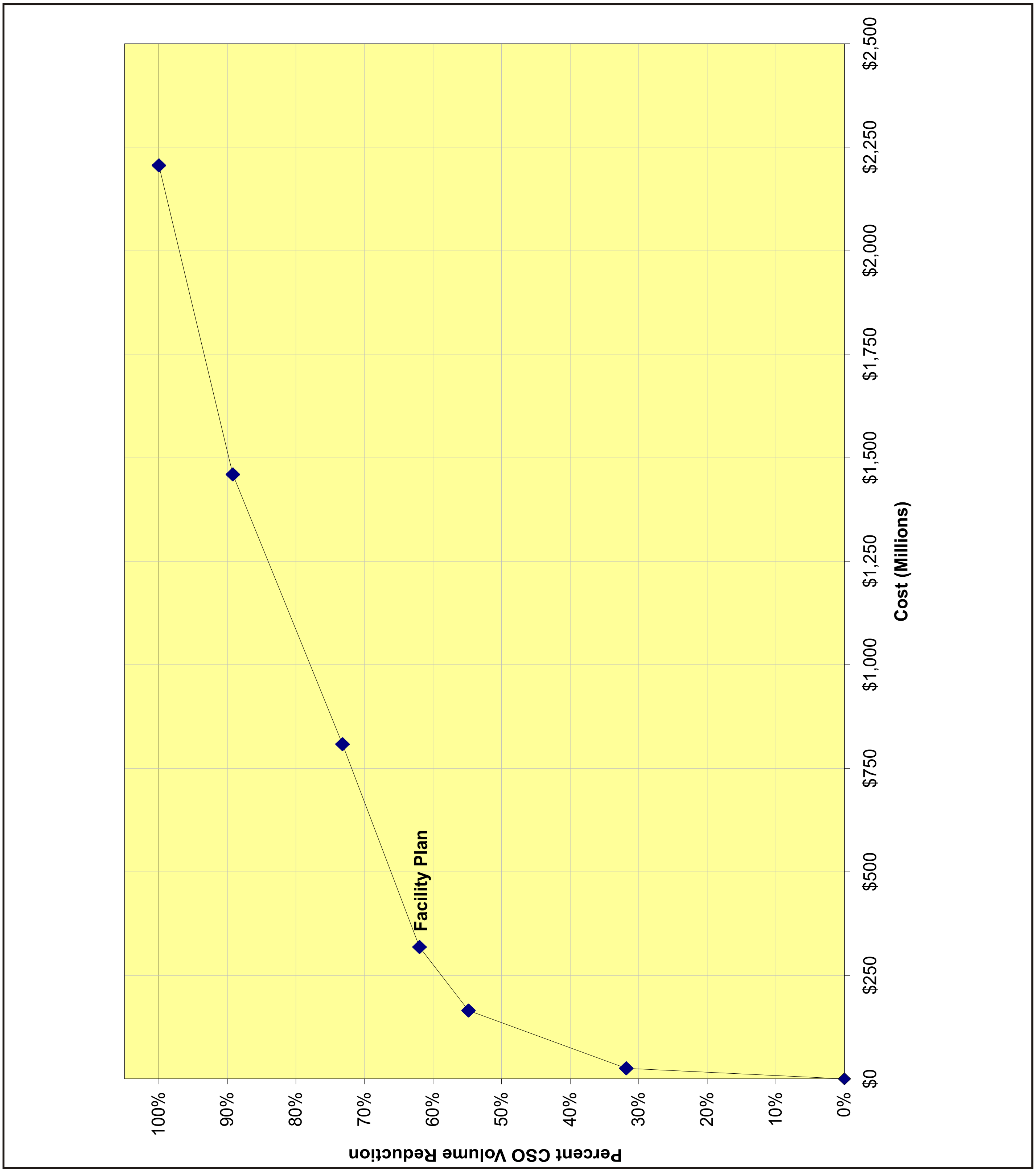
Percent Volume Reduction vs. Total Storage Volume

FIGURE 7-5



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Percent Volume Reduction vs. Cost

FIGURE 7-6

A 10 MG retention facility with the 10 MG influent structure and 20 MG of inline storage (40 MG of total storage) was calculated to reduce the number of overflow events to 24 events a year with all but 75 MG (6.4%) of the 1,242 MG of annual CSO remaining receiving passive settling and floatables treatment by passing through the retention facility. Therefore, although the CSO volume is only reduced by 55% by this alternative, nearly 94% of the remaining overflow (or 97.3% of the Baseline 2,750 MG per year) receives the equivalent of primary treatment or better by passing through the facility or by being contained and pumped back to the Coney Island WPCP for secondary treatment.

An increase in total CSO retention to 50 MG (20 MG of inline storage, 10 MG influent structure, and 20 MG tank) reduces the number of overflow events to 21 events a year resulting in about 1,046 MG per year total overflow, a 62% reduction from the Baseline. Only 75 MG of this amount would be untreated. As such, this alternative (the existing Facility Plan) would result in over 97% of the combined sewage discharged during the Baseline condition receiving some level of treatment.

An incremental addition of 20 MG of retention capacity, which brings the total retention capacity to 70 MG, results in a decrease in overflow events to 14 per year, reducing the total CSO volume to 737 MG discharged to Paerdegat Basin, an overall volume decrease of 73%. An additional 70 MG of retention capacity would increase the retention volume to 120 MG and result in a decrease to 9 events per year, totaling about 297 MG of combined sewage annually discharge to the Basin. All but 75 MG of this 297 MG is treated, again totaling over 97 percent of the combined sewage receiving treatment. Overall, this is an 89% reduction in combined sewage overflowing to the Basin from the Baseline condition. Complete elimination of all combined sewage from entering the Basin (100 % CSO removal) would require about 200 MG of total storage (in-line, influent, and flow-through retention).

Costs for each of the retention alternatives are provided in Figure 7-6. As indicated in this figure, the low cost alternative of inflatable dams to achieve 20 MG inline storage amounts to about $25 million. The next alternative introduces a small 10 MG storage facility plus the 20 MG inline storage and 10 MG influent structure (40 MG of total storage). This is estimated to cost $163 million. The Facility Plan (50 MG total retention) is estimated to cost about $314 million. Costs for additional storage beyond the Facility Plan are show on Figure 7-6 to escalate rapidly above $314 million. The cost estimate for complete elimination of untreated overflows is $2.9 billion, nine times the cost of the Facility Plan.

7.5. WATER QUALITY BENEFITS

The final stage of the alternatives evaluation was to quantify the water quality benefits of those technologies that had not been precluded in the preliminary screening and detailed technical analysis stages. This was done by modeling the technologies that meet these criteria, and comparing the compliance with existing water quality standards to Baseline conditions. See Section 4.0 for a description of the water quality modeling.

As discussed previously, the centralized location of the CSO outfalls at the head of Paerdegat Basin and the close proximity of the Paerdegat Pumping Station strongly indicate retention as the best answer on a cost-benefit basis, particularly given that the Paerdegat Basin CSO Retention

Facility is substantially constructed. Further, the knee-of-curve analysis that was used during facility planning to optimize the storage volume for the CSO Retention Facility was corroborated by the updated modeling. Therefore, those technologies that could be readily implemented in conjunction with the facility currently under construction would be most likely to further improve water quality without excessive cost. The engineering alternatives evaluated for water quality benefits include the following:

- The Facility Plan (50 MG of storage, including a 20 MG tank, 10 MG of storage in the new influent conduit, and 20 MG of induced in-line storage);
- Two (2) retention alternatives in which the Facility Plan storage is supplemented with additional storage: the addition of 20 MG of storage (70 MG total); and the addition of 150 MG (200 MG total), with the latter also serving as the 100% CSO removal alternative;
- Two (2) retention alternatives smaller than the Facility Plan: 10 MG of in-line storage induced using inflatable dams at the existing outfalls; and a 10 MG off-line storage tank with 10 MG of in-line storage induced (20 MG total); and
- Sewer Separation.

Although the smaller retention volumes were not realistic alternatives (the 50 MG of storage is substantially constructed), evaluation of these was necessary to define the portion of the "knee-of-curve" between no-build (Baseline) and the Facility Plan. Landside modeling of the smaller retention volume alternatives was performed to determine the expected volume and frequency of overflows. However, receiving water modeling was not performed for these alternatives, but compliance was interpolated based on the landside modeling and corresponding receiving water modeling results of other alternatives. Table 7-5 summarizes the data developed from this analysis.

Table 7-5. Comparison of Predicted Water Quality with Current Numerical Criteria

Alternative (Total Storage)	Estimated Cost (millions)	Dissolved Oxygen (>=4.0 mg/L)		Fecal Coliform[3] (<=2,000 per 100 mL)		Total Coliform[3] (<= 10,000 per 100 mL)	
		Head	Mid	Head	Mid	Head	Mid
Baseline	$0	80%	94%	75%	83%	83%	92%
In-line storage (20 MG)[1]	$25	84%	95%	85%	90%	90%	95%
10 MG Tank (40 MG)[1,2]	$165	87%	96%	95%	97%	94%	98%
Facility Plan (50 MG)[2]	$318	89%	97%	100%	100%	100%	100%
Additional 20 MG Tank (70 MG)[2]	$808	94%	98%	100%	100%	100%	100%
Additional 70 MG Storage (120 MG)[1,2]	$1,460	98%	99%	100%	100%	100%	100%
Sewer Separation (0 MG)	$2,100	98%	99%	92%	100%	99%	99%
Full CSO Removal (200 MG)	$2,206	100%	100%	100%	100%	100%	100%

Notes: (1) Water quality results estimated from landside modeling results. (2) Majority of remaining overflow passes through retention facility. (3) Total and fecal coliform criteria are based on monthly geometric means and are only applicable when disinfection is practiced per 6 NYCRR 703.4(c).

The water quality for each alternative was compared to existing water quality numerical criteria to determine the percentage of time that water quality satisfied these criteria. The water quality parameters assessed were dissolved oxygen, total coliform bacteria, and fecal coliform bacteria. Minimum compliance at the head end and midpoint of Paerdegat Basin was determined for each alternative, expressed as a percentage of days in compliance for dissolved oxygen, and as a percentage of months in compliance for bacteria. For each alternative and each standard, overall compliance was compared with the Baseline conditions to quantify the improvement in water quality. This improvement was paired with the associated cost of the alternative, and a curve was developed from the set of alternatives, plotted from lowest cost to highest cost. Full compliance plots are attached as Appendix C.

7.6. SELECTION OF PLAN

The water quality results support continuing the implementation of the Paerdegat Basin Water Quality Facility Plan. The Facility Plan provides for a total storage volume of 50 MG, including 20 MG of in-line storage and 30 MG of off-line storage that would result in compliance with all relevant numerical standards for bacteria during a typical precipitation year, and in substantial compliance (90%) with dissolved oxygen numerical standards. When viewed on a monthly basis, the average daily concentrations at the head-end of the Basin by about 1.0 mg/L. In July, the minimum daily concentration predicted is approximately 0.4 mg/L, which increased to about 1.0 mg/L. Although this increase may appear small, it may substantially reduce the negative impacts associated with hypoxic conditions, such as potential odor problems during summer months, when use of the Basin is highest.

Although additional storage or sewer separation would improve compliance, the marginal improvements do not merit the disproportional cost of implementation. This is represented graphically in Figure 7-6, on which the “knee-of-curve” (i.e., the point of diminishing gains for incremental increases in cost) is evident near the cost of the Facility Plan (over $300 million). The Facility Plan is expected to keep total and fecal coliform concentrations below secondary contact criteria during all months of the typical year, and is as satisfactory as complete CSO removal by this metric. To increase the percentage of time dissolved oxygen is above 4 mg/L from over 90% to 100% would require a substantial capital investment above what is proposed in the Facility Plan, and it would probably not have a detectable benefit to the aquatic communities of Paerdegat Basin. In contrast, reducing the size of the facility could result in total and fecal coliform concentrations in excess of the secondary contact criteria, although dissolved oxygen concentrations would be above 4 mg/L for a similar fraction of the year as is expected to result from the Facility Plan. Despite its comparatively high cost, sewer separation would not be expected to achieve these numerical metrics, and would therefore not be an attractive option.

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8.0. Long-Term Control Plan

8.1. PLAN OVERVIEW

The central element of the Paerdegat Basin Long-Term CSO Control Plan (LTCP) is the retention of up to 50 million gallons of combined sewage though the construction of a retention facility and the inducement of in-line storage. As discussed in Section 7.0, a variety of CSO control alternatives have been examined to reduce CSO pollution impacts to Paerdegat Basin, ranging from watershed management approaches to total CSO removal, and retention based on a knee-of-curve type analysis yields the greatest improvement in water quality for the capital expenditure. The original retention facility concept was developed during the Paerdegat Basin Water Quality Facility Plan prior to the promulgation of the 1994 federal CSO policy. Although, there are some additional elements to the LTCP for Paerdegat Basin, the 50 MG retention facility remains the central element of the LTCP. This is primarily because the CSOs for the combined portion of the Coney Island WPCP service area are tightly concentrated at the head end of Paerdegat Basin, and the Basin receives no additional CSO loads. As a consequence, Paerdegat Basin receives large quantities of combined sewage in short periods of time, and volumetric reduction has the greatest effect on water quality.

The Facility Plan provides for significant mitigation of the nuisance conditions (odors, exposed sediment mound, floatables) within the basin, which was its primary focus when originally developed. The plan also improves DO compliance to over 90% in most areas, and total and fecal coliform would comply with secondary contact standards on an annual basis, allowing for the full attainment of the current use of Paerdegat Basin for boating, canoeing and kayaking. Water quality within the Basin will even achieve the numerical levels associated with primary contact bacteria standards during bathing season although primary contact is not a designated or desired use of the basin. The design, environmental review, and permitting of the retention facility have already been completed and construction is well along, making the retention facility even more attractive from both financial and scheduling standpoints.

Detailed consideration was given to alternatives that could be retrofitted to the Facility Plan, but none of these alternatives demonstrated high potential. Increasing the retention volume by 20 MG (essentially doubling the tank volume) only marginally improved DO compliance (1 to 4%) and did not significantly improve compliance with bacteria standards. Of the supplemental aeration alternatives, only the one specifically designed to attain standards 100% of the time is expected to do so, requiring the installation of several compressors at different locations along the shoreline, with the potential to adversely impact aquatic life and existing navigational uses. Retrofitting a sodium hypochlorite disinfection system onto the Facility Plan could achieve substantial bacteria reductions as would 100% CSO removal, but, like that alternative, additional stormwater control would be necessary for complete elimination of elevated enterococci concentrations. Further, residual chorine concentrations would exceed the acute toxicity standard regularly, threatening the aquatic life in the upper 1,500 feet. Ironically, attaining the swimmable goal of the CWA in this manner would threaten the current attainment of the fishable goal, directly contradicting existing uses and local laws prohibiting bathing beaches in Jamaica Bay and its tributaries.

This LTCP is expected to result in significant improvements to the water quality in Paerdegat Basin, but may not attain full compliance with all applicable water quality standards. However, the retention facility will be complimented with operational and analytical programs that provide feedback on facility performance and opportunities for improvement, so that the fullest potential for water quality improvements can be realized. In addition, NYCDEP will continue its ongoing programs and management practices that continue to improve water quality in the New York Harbor complex. Commitments as a local sponsor to USACE ecosystem restoration programs will continue to be honored. NYCDEP remains committed to attaining the highest reasonable use of Harbor waters, and the Paerdegat Basin CSO Retention Facility coupled with the flexibility of adaptive management and the continuation of proven programs will further advance this cause.

Each component of the LTCP is discussed in greater detail in the following sections.

8.2. LONG-TERM CSO CONTROL PLAN COMPONENTS

8.2.1. The Paerdegat Basin CSO Retention Facility

The Paerdegat Basin CSO Retention Facility is designed to provide in-line storage of up to 20 MG of CSO, and off-line storage of an additional 30 MG of CSO. As described in detail in Section 5.8 and shown in Figure 5-2, the proposed facility is comprised of three major structural components: (1) an operations building to house screening, pumping, odor control system, and crew areas; (2) the 20 MG underground retention tank; and (3) a new outfall bypass system with 10 MG of retention capacity. Sewer system modifications will be necessary to provide the 20 MG of in-line storage in the large trunk lines and to create the influent channels to collect flows from the three existing regulators the facility will serve.

Most of the CSO stored in-line and a portion of the off-line storage volume will drain by gravity to the Coney Island WPCP after a storm event via the existing 120-inch interceptor. The off-line storage is designed so that it can be used concurrently with in-line storage and so that it will have no adverse impact on the operation of the WPCP. Pump-back of the CSO stored off-line will be coordinated with WPCP operations to ensure optimal performance at both facilities.

After the retention tank is filled, CSO will be discharged to Paerdegat Basin through either the tank outfall or the three existing outfalls which will serve as relief. Flow needs to rise to the tank weir elevation +2.0 ft BSD before overflowing to the tank outfall. Similarly, flow needs to climb up to the relief weir elevation +2.8 ft BSD before overflowing to the relief outfalls. Relief overflow will not occur until hydraulic conditions exceed 1 BGD, which is expected to occur less than once every two months during a typical rainfall year. Flows up to 3 BGD can be conveyed by the retention facility without causing flooding upstream, a limit that is based on the existing collection system. Flows in excess of the 1 BGD tank capacity will be discharged via the relief overflow to Paerdegat Basin. The amount of CSO discharged through the tank outfall and the relief outfalls depends on the tides.

8.2.2. Continue Implementation of Programmatic Controls

As discussed in detail in Section 5.0 NYCDEP currently operates several programs designed to reduce CSO to a minimum and provide treatment levels appropriate to protect waterbody uses. As the effects of the 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 SPDES permits. 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.
- The City-Wide Comprehensive CSO Floatable Plan (Modified Facility Planning Report, July 2005) will provide substantial reductions in floatables discharges from CSOs throughout the City and to provide for compliance with appropriate NYSDEC and IEC requirements. Like the LTCP, the Floatables Plan is a living program which is expected to change over time based on continual assessment and changes in related programs.
- The recently-initiated Jamaica Bay Watershed Protection Plan (JBWPP), which represents a long-term attempt by the City to protect Jamaica Bay. Operation of the Paerdegat CSO Facility may be influenced by the findings and protocols set forth in the JBWPP.

8.2.3. Environmental Dredging

Paerdegat Basin has been altered by many years of urbanization that have degraded habitat and ecology. As such, ecosystem restoration would most likely be limited by the existence of unnatural water depths, bulkheads and other shoreline armor, and the absence of natural habitat on which to expand. Nonetheless, even limited restoration efforts would probably include as a first step the removal of CSO solids to the extent necessary to create an environment favorable to the reintroduction of formerly indigenous ecological communities. Subsequent restoration activities, such as the placement of native sands to support benthic communities, regrading and replanting shorelines to develop shallow-water habitats, and recontouring to promote better mixing and dilution dynamics, could then be initiated with the long-term goal of creating a robust, natural, and diverse ecology.

As discussed in Section 5.9, the City is a non-federal local sponsor for the U.S. Army Corps of Engineers (USACE) Jamaica Bay Ecosystem Restoration Project. The project has been considering additional general restoration concepts for Paerdegat Basin, including recontouring the waterbody, regrading shorelines to enhance tidal marshes, and improving adjoining uplands. The goals of the actions are to improve habitat for waterfowl and aquatic organisms and improve fish and wildlife habitat diversity. The study is ongoing and specific locations for improvement actions were not selected at the time of this analysis, but the City remains committed to its obligations as a non-federal local sponsor in anticipation of implementation. Particular attention would be directed to removal of the existing CSO mound to improve benthic habitat, aesthetics, and odors.

NYCDEP will continue to work with the USACE to investigate the potential to combine USACE habitat restoration efforts with the City's various water quality initiatives. However, regardless of the ultimate determinations by USACE for ecosystem restoration, NYCDEP will dredge the head end of Paerdegat Basin to three feet below mean lower low water. This enhancement to the LTCP will eliminate the view shed aesthetic impairment, reduce the odor problem by minimizing the exposure of sediment materials during low tides, and provide a platform for ecosystem restoration by others in the future. In addition, the mouth of Paerdegat Basin will be dredged in accordance with stakeholders' requests and as indicated in the Waterbody/Watershed Facility Plan (HydroQual, 2003). Dredging the mouth will be an immediate benefit to local users by providing greater access in and out of Paerdegat Basin.

Based on a bathymetric survey conducted in April 2006, the estimated dredge volume at the head end would be between 10,000 and 15,000 cubic yards to achieve the environmental goals. The USACE permit application of February 2004 lists a dredge volume at the mouth of 20,000 cubic yards for navigational purposes. Combined, dredging in Paerdegat Basin is expected to cost between $3.5 and $5.5 million.

8.3. POST-CONSTRUCTION COMPLIANCE MONITORING

Post-construction compliance monitoring will be integral to the optimization of the facility currently under construction, providing both feedback to facility operations and data for modeling and compliance determinations by NYSDEC. Each year's data set will be compiled and evaluated to refine the understanding of the interaction between the Paerdegat LTCP and Paerdegat Basin, with the ultimate goal of improving water quality and fully attaining compliance with water quality standards. The data collection monitoring will contain three basic components:

1. The facility monitoring requirements contained in the Coney Island WPCP SPDES permit;
2. Modification to the current NYCDEP Harbor Survey program to more rigorously collect data in Paerdegat Basin and nearby Jamaica Bay; and
3. Modeling of Paerdegat Basin to characterize compliance with numerical water quality standards.

These programs are discussed in detail below, along with anticipated data analyses and mechanisms for responsiveness. Because of 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 for any formal use attainability analysis (UAA) that may be indicated.

8.3.1. SPDES Facility Monitoring Requirements

Per the requirements of the Coney Island WPCP SPDES Permit, effluent overflow parameters will be monitored and results will be reported on a monthly basis as part of the Discharge Monitoring Report (DMR), and on an annual basis in the CSO BMP report. Sampling results and summary statistics will be provided in the DMR, including the number of overflow events, the volume of overflow during each event, the volume retained and pumped to the Coney Island WPCP, and the peak flow rate during each event. The program will begin following completion of facility construction. Table 8-1 lists the parameters to be monitored, sampling frequency, and other details.

8.3.2. Receiving Water Monitoring

The New York City Harbor Survey primarily measures four parameters related to water quality: dissolved oxygen, 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, 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. NYCDEP regularly samples 33 open water stations annually, which is 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.

Table 8-1. SPDES Permit Monitoring Parameters

Overflow Parameter	Report	Units	Sample Frequency	Sample Type	Footnotes
Overflow Volume	Event Total (7)	MG	See Footnote 5	Calculated	(1)(4)
Retained Volume	Monthly Total	MG	See Footnote 5	Recorded, Totalized	(8)
BOD5	Event Average	mg/L	Daily	Composite	(2)
TSS	Event Average	mg/L	Daily	Composite	(2)
Settleable Solids	Event Average	mL/L	Daily	Grab	(3)
Oil & Grease	Event Average	mg/L	Daily	Grab	(6)
Screenings	Monthly Total	cu. yd.	---	Calculated	
Fecal Coliform	Event Geometric Mean	per 100 mL	Daily	Grab	(3)
Precipitation	Event Total	inches	Hourly	Auto, Recording Gauge	

FOOTNOTES: (1) CSO facility and bypass only (2) Composite of grabs taken during event (3) When facility is manned, grabs taken every 4 hr (4) Based on approved model of the collection system (5) Annual summary to be included in CSO BMP report (6) Only when facility is manned. (7) An event starts once overflow out of the facility begins, and ends once the overflow stops and the pumpback to the WPCP has finished. (8) The total volume of flow retained and returned to the WPCP. SOURCE: SPDES Permit NY-0026182, 2004.

The post-construction compliance monitoring program will continue along the protocols of the Harbor Survey initially. As shown on Figure 8-1, Paerdegat Basin contains three locations (head, mid-channel, and mouth) that are currently not included in the annual sampling circuit but have been sampled historically. All three stations (PB1, PB2 and PB3) will be reintroduced to the program on a regular basis, to serve as the Paerdegat Basin LTCP post-construction monitoring sites. In addition, one Jamaica Bay station (J3, presently included in the Harbor Survey) will be monitored regularly with the specific purpose of providing boundary water quality conditions and benchmarking for observed changes in Paerdegat Basin water quality during the survey. All stations related to the Paerdegat Basin LTCP post-construction compliance monitoring program will be sampled a minimum of twice per month from June through August and a minimum of once per month during the remainder of the year.

Data collected during this program will be used primarily to verify the Paerdegat Basin water quality model that will be used to demonstrate relative compliance levels in Paerdegat Basin. 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 numeric WQS (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.).

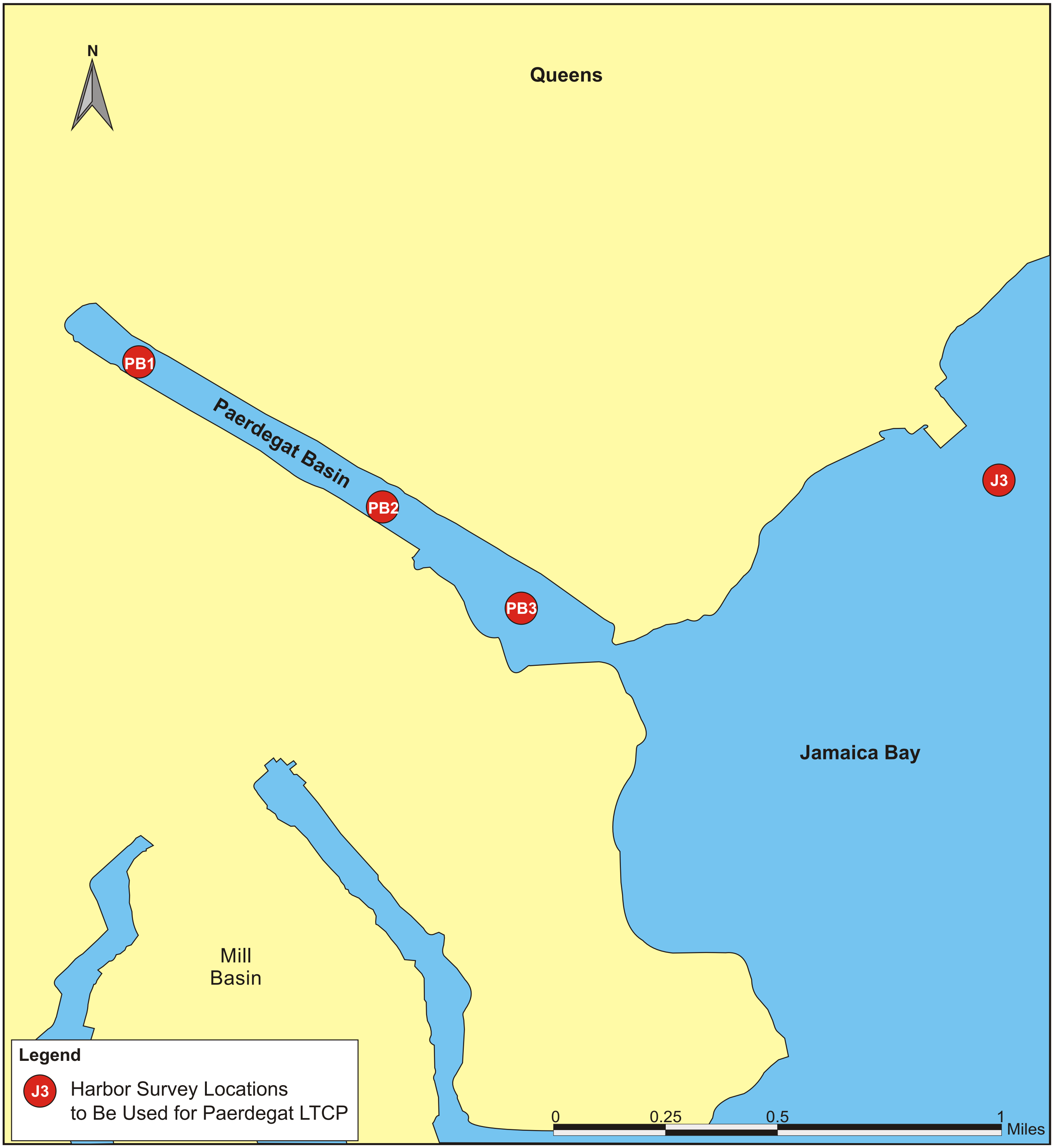
Post-construction monitoring protocols, QA/QC, and other details are being fully developed under the City-wide LTCP to assure adequate spatial coverage and a technically sound sampling program. The monitoring within each waterbody under NYCDEP's purview will commence no later than the activation of any constructed CSO abatement facility. The Paerdegat Basin Water Quality Facility is scheduled to be placed into service in the fall of 2011.

8.3.3. Meteorological Conditions

The performance of any CSO control facility 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 facility may be expected to control CSO completely. NYCDEP 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 8-2, and includes the return period for 1988 conditions.

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 recreational 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. The Paerdegat CSO Facility was modeled for two additional rainfall years determined to be representative of a wet year (1977) and a dry year (1982). The years were selected based on annual rainfall volumes approximately one standard deviation (7 inches) above and below the median, respectively. The RAINMAN results are summarized in Table 8-3. It is evident that performance does not simply correlate to annual volume: for example, the largest overflow predicted for the "typical" year is more similar to the dry year, but the overflow volumes and numbers of events predicted for the "typical" year are more similar to the wet year.

Given the uncertainty of the actual performance of the facility and the response of Paerdegat Basin with respect to widely varying precipitation conditions, rainfall analysis is an essential component of the post-construction compliance monitoring. Data from the Paerdegat Basin rain gage required under the SPDES permit will be summarized in a manner similar to that shown in Table 8-2.



H&S File: 5905\009\DEC Final\Section 8.cdr 5-10-06

New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin LTCP Proposed Post-Construction Compliance Monitoring Locations

FIGURE 8-1

Table 8-2. 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

Table 8-3. Paerdegat CSO Facility Performance under Typical, Wet, and Dry Annual Precipitation

Statistic		Condition		
		Typical Year (1988)	Dry Year (1982)	Wet Year (1977)
Annual Rainfall Volume (inches)		40.7	33.3	48.7
Tank	Overflows	21	14	19
	Total Volume (MG)	971	658	987
	Largest Overflow Event (MG)	127.3	124.5	243.6
Bypass	Overflows	5	2	5
	Total Volume (MG)	75	34	79
	Largest Overflow Event (MG)	23.2	24.2	32.7

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. The rain gauge located at the Paerdegat CSO Facility as required by the April 2003 SPDES permit will serve as a secondary source of rainfall data. 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 will be purchased for use in the landside modeling analysis. This will provide interpolated data over the entire 6,800 acres of the 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, NYCDEP may discontinue its use for that purpose.

8.3.4. Analysis

The performance of the Paerdegat CSO Facility will be evaluated on an annual basis using a landside mathematical computer model as approved by NYSDEC (HydroQual 2004). In addition, NYCDEP 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 dissolved oxygen to be promulgated by NYSDEC 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.

The RAINMAN collection system model has historically been used in the Paerdegat Basin facility planning, and was used for LTCP development primarily for continuity. However, an InfoWorks model of the Coney Island WPCP collection system has been under development, and will serve as the basis for all future model-related activities. InfoWorks is more comprehensive than RAINMAN, and includes travel time and other sophistications that RAINMAN lacks. The migration from RAINMAN to this state-of-the-art modeling package has already begun, and preliminary results suggest there may be considerable differences in high level details such as duration of overflow events, individual overflow event volumes, and the shape of the overflow time series curve. However, the gross statistics used for planning and alternative comparison purposes appear to be in reasonable agreement. In addition, Paerdegat Basin water quality may be relatively insensitive to any differences of this nature.

Overflow volumes (through the tank and the bypass) 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. 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 the Jamaica Bay station selected for the Harbor Survey. 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 LTCP.

Following completion of the tenth annual report containing data during facility operation, a more detailed evaluation of the capability of the Paerdegat CSO Facility 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, NYCDEP will revisit the feasibility of low-cost improvements such as in-stream aeration, alternative disinfection technologies, or other more structural controls. Alternately, the water quality, standards revision process may commence with a UAA that would likely rely in part on the findings of the LTCP 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 NYSDEC 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 NYCDEP in accordance with their SPDES permits, and will therefore constitute a modification to that report. The monitoring report will include an overview of the performance of the Paerdegat CSO Retention Facility, and will provide summary statistics on rainfall, the amount of combined sewage, and the proportions directed to the WPCP, passed through the facility overflow, and bypassed above the head end of the facility. Verification and refinement of the model framework as necessary will be documented, and modeling results will be presented to assess water quality impacts in lieu of high-resolution sampling. Analyses of precipitation, temperature effects, and other conditions external to the Paerdegat CSO Facility performance 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

The operation of the Paerdegat CSO Facility is defined in the Wet Weather Operating Plan for the facility (Appendix B). The Coney Island WPCP WWOP also alludes to details of interaction between the facilities under wet weather conditions (Appendix A). Both WWOPs are expected to be approved by NYSDEC before full implementation of the LTCP for Paerdegat Basin. NYCDEP intends to operate these facilities in strict accordance with their 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. The Paerdegat Basin Water Quality Facility will be operated in a startup mode for a 12-month period of time during which operation conditions including maintenance requirements will be developed. The focus of the 12-month period will be the development of such items as pump back time to empty the facility so that it achieves the following goals:

- Maximizes CSO retention and treatment;
- Minimizes impacts on the performance of the Coney Island WPCP;
- Does not produce odors to the neighborhood; and
- Maximizes the capture of floatables and settleable solids entering the facility.

At the end of the 12-month startup period, the Paerdegat Basin CSO Retention Facility WWOP will be modified and submitted to the NYSDEC in final form for review and approval. As part of the final WWOP, NYCDEP will provide a listing of operation conditions for consideration by NYSDEC for inclusion in the SPDES permits as narrative WQBELs (water quality based effluent limits). These narrative WQBELs could include, but are not limited to, storage volume, pumping capacity, time after end of rainfall for initiation of pump-out, pump-out time, emergency power provisions, and screening capability.

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. Figure 8-2 shows the decision-making process in flow chart form. During the first nine post-construction years, 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 the timing of pump-back, maximizing the retention available immediately prior to expected precipitation, and modification of maintenance schedules to improve performance. Modifications and retrofits that are implemented and demonstrate improvement will be documented through the issuance of an LTCP update, subject to NYSDEC approval.

8.5. SCHEDULE

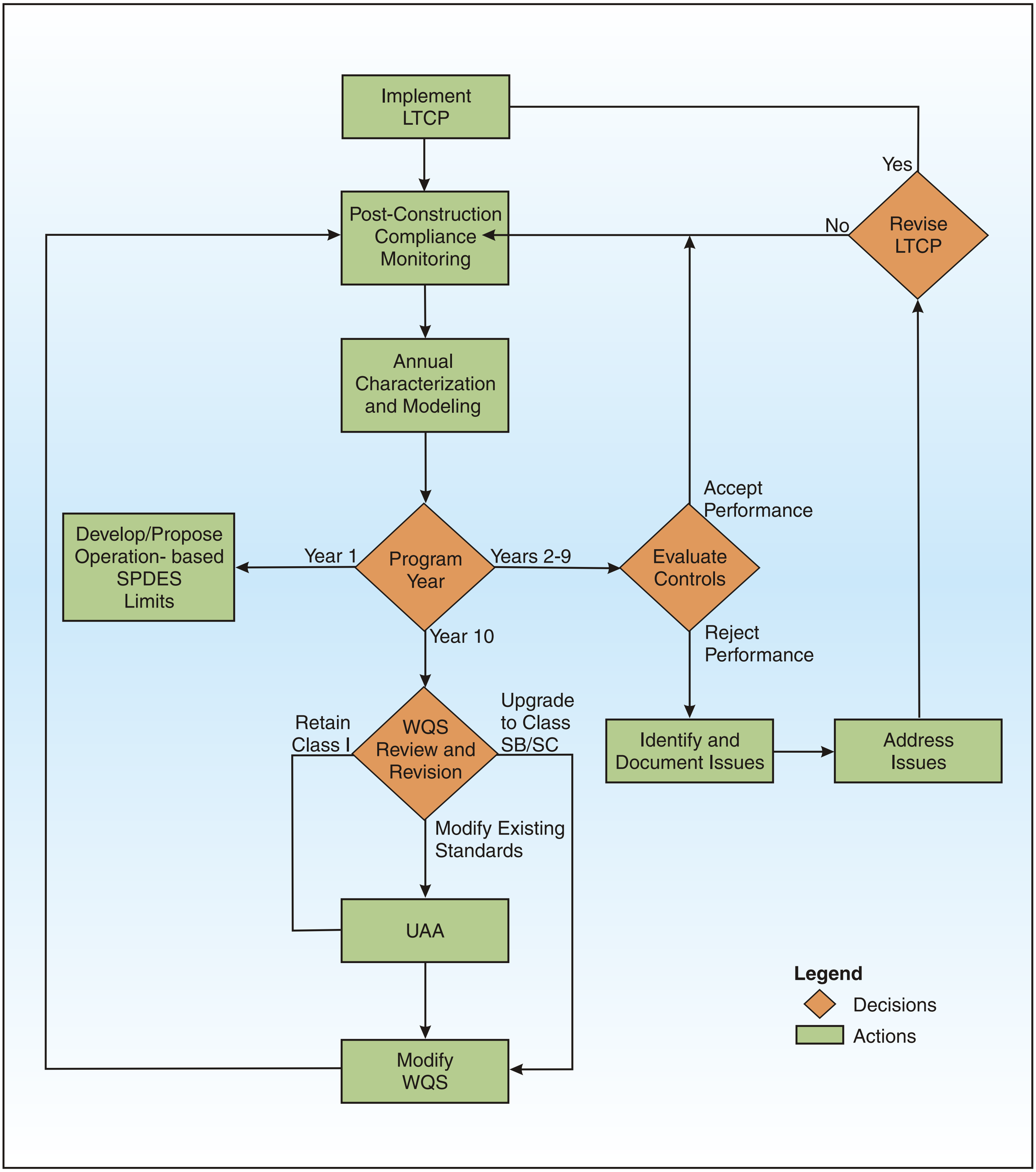
Figure 8-3 shows the construction schedule for the Paerdegat CSO Facility, along with relevant aspects of the programmatic controls, post-construction compliance monitoring, and dredging schedules.

8.6. CONSISTENCY WITH FEDERAL CSO POLICY

Although initiated well before the development and issuance of the federal CSO policy, the Paerdegat Basin LTCP will ultimately satisfy policy requirements. Through extensive water quality and sewer system modeling, data collection, community involvement, and engineering analysis, NYCDEP has adopted a plan that incorporates the findings of over a decade of inquiry to achieve the highest reasonably attainable use of Paerdegat Basin. The LTCP addresses each of the nine minimum elements of long-term CSO control as defined by federal policy and shown in Table 8-4.

8.7. ANTICIPATED WATER QUALITY IMPROVEMENTS

It has been demonstrated that water quality conditions in Paerdegat Basin do not meet the numerical and narrative water quality standards of its Class I designation all the time. The



H&S File: 5905\009\DEC Final\Section 8.cdr 5-10-06

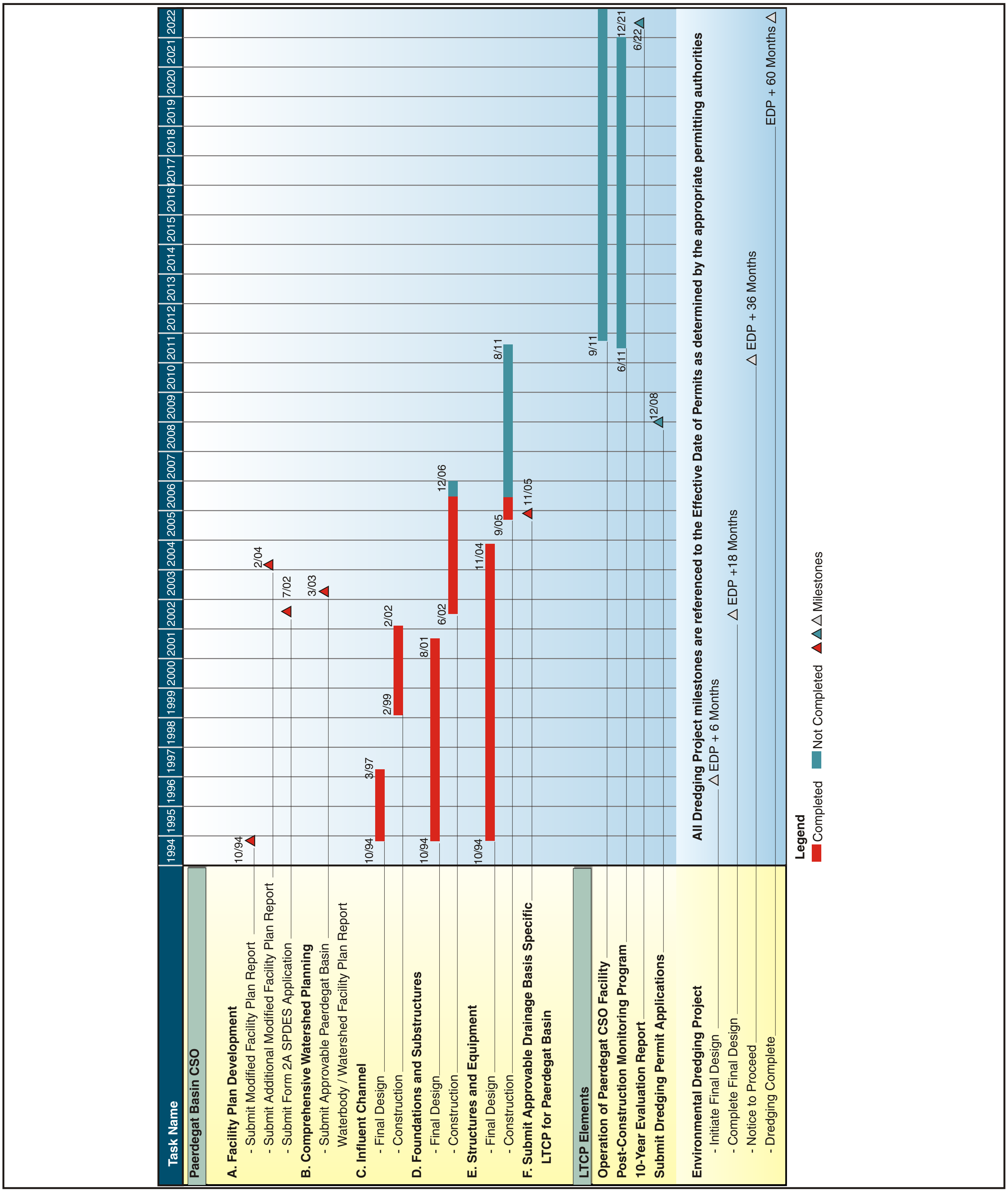
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin LTCP Flowchart

FIGURE 8-2

H&S File: 5905\009\DEC Final\Section 8.cdr 5-10-06



New York City Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Paerdegat Basin LTCP Schedule

FIGURE 8-3

waterbody fails to meet water quality standards by exhibiting high levels of coliform bacteria, low levels of dissolved oxygen, 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 Paerdegat Basin. This degradation is due primarily to deposition of organic settleable solids from the existing CSO discharges but, as demonstrated in this LTCP, certain human-caused conditions that cannot be remedied in an environmentally or fiscally responsible way also play an important role.

Table 8-4. Nine Minimum Elements of Long-Term CSO Control

Element	Section	Summary
1. Characterization, Monitoring, and Modeling of the Combined Sewer System	3.0	The waterbody is an artificial channel with limited assimilative capacity, and runoff from the highly urbanized drainage area tributary to Paerdegat Basin has resulted in non-attainment with existin (Class I) standards.
2. Public Participation	6.0	Stakeholder involvement began prior to the 1991 facility plan, and continued through the environmental quality review (1994) to the ongoing construction. Four additional stakeholder meetings and a telephone survey were included under the USA Project (2000-2001).
3. Consideration of Sensitive Areas	4.7	There were no sensitive areas identified within Paerdegat Basin.
4. Evaluation of Alternatives	7.0	Strongly points to retention at the head end of Paerdegat Basin, the only overflow relief in the combined system, due to the concentration of outfalls and the scale of the overflows.
5. Cost/Performance Considerations	7.0	Higher level controls (sewer separation, outfall relocation, 100% CSO capture) are not cost-effective. The CSO retention facility was sized according to a “knee-of-the-curve” type cost-benefit analysis.
6. Operational Plan	8.0	Includes compliance with the Coney Island WPCP and Paerdegat WQF WWOPs, 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 WPCP	7.0	Implementation of facility WWOPs and evaluation of Coney Island WPCP MSPs should enable the WPCP to achieve 2xDDWF. Further expansion is infeasible due primarily to space constraints.
8. Implementation Schedule	8.0	Construction of the retention facility began in 2001; foundation and substructures are scheduled for completion in 2005; the remainder of the facility construction schedule is on track to meet the ACO milestones (i.e., complete and online in 2009).
9. Post-Construction Compliance Monitoring	8.0	The CSO facility will be monitored per SPDES requirements. Receiving water will be monitored per Harbor Survey protocols at three stations within Paerdegat Basin and one station in Jamaica Bay. Monitoring data will be used to optimize facility performance and to support the modeling to be used in the evaluation of compliance by NYSDEC.

The Paerdegat Basin LTCP will address each of these issues to a high degree. As shown in Table 8-5, the LTCP was calculated to fully retain 62% of the baseline overflow volume of 2,750 MG for the typical year and return it to the collection system for treatment at Coney Island WPCP. Only 75 MG of the resulting overflow volume would be discharged untreated, as the majority of the overflow would pass through the retention facility and receive the equivalent to primary treatment via passive settling. Thus, 97% of the baseline overflow volume would receive some level of treatment, limiting the occurrence of untreated CSO to less than 5 per year during typical rainfall. These reductions in total CSO volume and occurrence will translate into substantial reductions in floatables, BOD, TSS, and settleable solids loads, and a significant portion of the bacteria load as well. Coupled with limited environmental dredging and improvements in bottom DO, the Plan is expected to reduce odor problems 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 loading reductions and the associated reduction in benthic total organic carbon will improve the benthic habitat and aquatic life diversity throughout the Basin.

Although overall dissolved oxygen conditions will generally improve throughout the waterbody, hypoxic conditions will still periodically occur following wet weather events when the Paerdegat Basin CSO Retention Facility overflows. Detailed water quality modeling calculations indicate that the LTCP will greatly improve dissolved oxygen in Paerdegat Basin from baseline conditions. Over a complete annual cycle, in the upper one-third of Paerdegat Basin, the New York State dissolved oxygen criterion of 4.0 mg/L will be achieved greater than 90 percent of the time. In the lower two-thirds of the Basin, compliance is predicted to improve from 95 to nearly 100 percent, depending upon location, for the average yearly rainfall. Fish life and propagation are, therefore, expected to be protected to a high degree.

Table 8-5. Facility Plan Flow Diversion of Baseline Overflow Volume

Flow Train	Annual Overflow (MG)	Percentage
Captured and Returned to WPCP (Secondary)	1,704	62%
Paerdegat CSO Facility Overflow (Primary*)	971	35%
Total LTCP CSO (Treated)	**2,675**	**97%**
Total LTCP Facility Bypass (Untreated)	**75**	**3%**

*Does not include disinfection

Paerdegat Basin is currently classified for secondary contact recreation for such uses as boating, kayaking, fishing and other non-primary contact activities. The secondary contact water quality criterion is not presently attained. As shown in Table 8-6, implementation of the LTCP will result in attainment of all secondary contact recreation standards throughout the waterbody all the time for an average precipitation year. During dry weather, when recreational use is likely to be maximized, the LTCP achieves primary contact criteria almost all the time throughout the year.

Table 8-6. 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 LTCP will achieve significant reductions of settleable solids discharges associated with the Paerdegat Basin CSOs, limiting the reformation of sediment mounds near the head end. Projected improvements in dissolved oxygen will virtually eliminate the persistent hypoxic and anoxic conditions that cause the release of noxious gases. It is anticipated that the LTCP will achieve a virtual elimination of odors during a typical precipitation year such that this aesthetic use will be protected. Reducing CSO discharges as a whole and reducing suspended solids concentrations associated with remaining discharges by treatment through the retention facility will reduce settleable solids concentrations in the receiving waters. This will somewhat improve water clarity in Paerdegat Basin, especially after CSO events. However, background turbidity and periodic eutrophic conditions caused by tidal exchange with Jamaica Bay will 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 Basin configuration and bottom substrate, it would not likely result in any material replacement of tolerant benthic species by sensitive ones.

NO TEXT ON THIS PAGE

9.0. Water Quality Standards Review

The Paerdegat Basin Long-Term Control Plan (LTCP) is a component of the New York City Department of Environmental Protection'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 Paerdegat Basin LTCP 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 LTCP receiving water impact evaluations were performed for average annual rainfall conditions consistent with CSO Policy guidance. The plan resulting from following the USEPA regulations and guidance is expected to result in substantial benefits to Paerdegat Basin. However, 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 applicable to 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 Paerdegat Basin are shown in Table 9-1. Paerdegat Basin is classified as Class I at present with best usages as secondary contact recreation and fishing. Although this classification 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 Paerdegat Basin to Class SB or SC which are suitable for primary contact recreation.

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

Class	DO (mg/L)	Bacteria (Pathogens)		
		Total Coliform(1,4) (per 100 mL)	Fecal Coliform(2,4) (per 100 mL)	Enterococci(3) (per 100 mL)
1	> 4.0	<10,000	<2,000	n/a
SB, SC	> 5.0	<2,400 <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% 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% 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.

It is understood at present that the Class I dissolved oxygen criterion of never-less-than 4.0 mg/L is considered satisfactory for fish propagation and survival and therefore consistent with the fishable goal of the CWA. Reclassification of Paerdegat Basin to the fishable/swimmable Class SB/SC requires more stringent numerical coliform bacteria criteria and also increases the minimum dissolved oxygen requirement to never-less-than 5.0 mg/L from 4.0 mg/L.

The Interstate Environmental Commission (IEC) waterbody classifications applicable to waters within the Interstate Environmental District are shown in Table 9-2. Jamaica Bay and its tidal tributaries including Paerdegat Basin are classified as Class A with best intended uses of fish propagation and primary and secondary contact recreation.

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

Class	Dissolved Oxygen	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.

9.1.2. Narrative Water Quality Standards

The New York State narrative water quality standards which are applicable to Paerdegat Basin and all waterbody classifications are shown in Table 1-2 and restated here in Table 9-3.

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.

It is noted that, in all cases, the narrative water quality standards apply a limit of "no" or "none" and only for selected parameters are these restrictions conditioned on the impairment of waters for their best usages.

The IEC narrative water quality regulations which are applicable to Paerdegat Basin and all waters of the Interstate Environmental District are shown in Table 9-4.

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

Section 7.5 describes water quality modeling analyses which were performed to evaluate attainability of water quality standards under Baseline and LTCP conditions. The results of these analyses are summarized graphically in Appendix C and in tabular form in Table 9-5 through Table

9-12 for the various numerical criteria for dissolved oxygen and bacteria for current and fishable/swimmable classifications.

Attainability of Currently Applicable Standards

Table 9-5 summarizes the projected percentage annual attainability of dissolved oxygen for current Class I and Class A criteria for Baseline and LTCP conditions at the head-end, mid-basin and mouth of Paerdegat Basin. For Class I, the LTCP improves attainment at the head-end to almost 90% from 80% under Baseline conditions and achieves 100% attainment at the mouth. The LTCP attains the IEC Class A criterion approximately 85 to 95 percent of the time annually along the length of Paerdegat Basin.

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

Location	Class I (>4.0 mg/L) Percent Attainment		Class A (>5.0 mg/L) Percent Attainment	
	Baseline	LTCP	Baseline	LTCP
Head End	80%	89%	70%	85%
Mid-Basin	94%	97%	86%	92%
Mouth	99%	100%	95%	95%

Table 9-6 summarizes the projected percentage annual attainability of total coliform for current Class I secondary contact criteria. The table indicates that the LTCP achieves complete attainment along the length of Paerdegat Basin from non-attainment under Baseline conditions.

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

Location	Class I (GM < 10,000) Percent Attainment	
	Baseline	LTCP
Head End	83%	100%
Mid-Basin	92%	100%
Mouth	100%	100%

Table 9-7 shows similar conditions for fecal coliform. For current Class I secondary contact criteria, the LTCP achieves complete attainment throughout Paerdegat Basin from Baseline conditions of non-attainment.

Table 9-7. Annual Attainability of Fecal Coliform Criteria for Design Year

Location	Class I (GM < 2,000) Percent Attainment	
	Baseline	LTCP
Head End	75%	100%
Mid-Basin	83%	100%
Mouth	92%	100%

Attainability of Potential Future Standards

NYSDEC considers Class I dissolved oxygen standards supportive of aquatic life uses and thus consistent with the "fishable" goal of the CWA. Therefore, a standards reclassification would not be necessary for full use attainment in Paerdegat Basin. However, the Class I secondary contact use is not considered consistent with the "swimmable" goal. To revise the classification of Paerdegat Basin to be fully supportive of primary contact uses, it would be necessary to comply with Class SB/SC criteria for total and fecal coliform, and with 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. The recreation season is defined as 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 LTCP achieves almost complete attainment of the primary contact median for total coliform on an annual average basis, but not with the upper limit, despite resulting in a pronounced improvement in attainment with these criteria (Table 9-8).

Table 9-8. Annual Attainability of SB/SC Total Coliform Criteria

Location	Class SB/SC Percent Attainment			
	Median < 2,400		80% < 5,000	
	Baseline	LTCP	Baseline	LTCP
Head End	50%	92%	17%	67%
Mid-Basin	67%	100%	17%	67%
Mouth	83%	100%	25%	92%

Table 9-9 shows monthly attainment during the recreation season; the LTCP achieves complete attainment of the primary contact median criterion and attains the upper limit criterion for two of the three months of the recreation season. Similar results are evident for fecal coliform (Table 9-10 and Table 9-11): the LTCP achieves complete attainment during the summer months, and significantly improves attainment from the Baseline (but does not achieve full attainment) as determined on an annual basis.

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	LTCP	Baseline	LTCP
Head End	67%	100%	33%	67%
Mid-Basin	100%	100%	33%	67%
Mouth	100%	100%	67%	100%

Table 9-12 summarizes the projected attainability of potential enterococci criteria which could be applied to Paerdegat Basin for primary contact water use. It is noted that the attainment values shown on Table 9-12 are for the three month period of June, July and August as the enterococci criteria were developed for the bathing season. The table shows that the LTCP achieves 100% attainment of the seasonal geometric mean throughout Paerdegat Basin but does not completely attain the infrequent use coastal recreation water reference level (upper 95% confidence limit).

Table 9-10. Annual Attainability of SB/SC Fecal Coliform Criteria

Location	Class SB/SC GM < 200 Percent Attainment	
	Baseline	LTCP
Head End	25%	75%
Mid-Basin	33%	75%
Mouth	50%	83%

Table 9-11. Recreation Season Attainability of SB/SC Fecal Coliform Criteria

Location	Class SB/SC GM < 200 Percent Attainment	
	Baseline	LTCP
Head End	67%	100%
Mid Basin	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	LTCP	Baseline	LTCP
Head End	100%	100%	56%	73%
Mid-Basin	100%	100%	60%	73%
Mouth	100%	100%	65%	83%

9.1.4. Attainment of Narrative Water Quality Standards

Table 9-3 summarizes NYSDEC narrative water quality standards which are applicable to Paerdegat Basin and all waters of the state. The existing CSO discharges to the Basin and the stormwater from the separately sewered area discharge some amounts of materials which affect some of the listed parameters to some degree. Odors at the head end of Paerdegat Basin are the result of deposition of organic solids and oil and floating substances and floatable materials (refuse) are discharged.

The LTCP will not completely eliminate, but will greatly reduce, the discharge of these materials to Paerdegat Basin. The Paerdegat Basin retention tank and in-line storage will reduce the discharge of the parameters of concern by at least 80 percent based on volumetric capture, heavy solids that would settle near the outfall will be virtually eliminated and, in the case of floatable materials, a 90 percent or more reduction is expected due to the baffles and screening systems. An additional safe guard for floatable materials will be the retention of the floatables boom and continuation of skimmer vessel operations. Consequently, the adverse impacts of the current CSO discharges will be greatly diminished and virtually although not completely eliminated as required by the narrative standards. Additionally, best management practices applied to the separate stormwater discharges will also not completely eliminate impacts from that source but will reduce loadings to the extent feasible.

The LTCP, although not completely eliminating all of the parameters of concern, will eliminate odors, greatly reduce the deposition of organic solids and floatable materials and restore the aesthetic uses of Paerdegat Basin 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 dissolved oxygen to be attained by the LTCP as compared to Baseline conditions for current dissolved oxygen criteria. The plan is expected to achieve between 89 to 100 percent attainment along the length of Paerdegat Basin for the current Class I dissolved oxygen criterion on an annual basis and 85 to 95 percent attainment of the IEC Class A criterion. This is considered to be a high level of attainment in terms of the protection of fish and aquatic life, various forms of which spawn throughout almost the entire year. In addition, the anoxia which currently exists near the head end of Paerdegat Basin will be eliminated thus producing habitat suitable for the restoration of a diversity of benthic organisms in this vicinity.

Primary and Secondary Contact Recreation Use

Table 9-6 through Table 9-12 present expected attainment of various bacteriological water quality criteria under both annual and recreational season conditions for the Baseline and LTCP conditions. It is observed from Table 9-6 (total coliform) and Table 9-7 (fecal coliform) that the LTCP will achieve the current Class I secondary contact water quality criteria along the length of the Basin throughout the year which is not currently attained thus restoring this important recreational use to Paerdegat Basin.

Table 9-8 and Table 9-10 indicate that, for a potential Class SB/SC primary contact designation, the LTCP produces significantly greater attainment of the criteria than exists under Baseline conditions, but that these primary contact water quality criteria would not be completely attained throughout the year.

For the summer recreation season, however, Table 9-9, Table 9-11, and Table 9-12 for total and fecal coliform and enterococci, respectively, indicate that the LTCP would achieve attainment of the required median or geometric mean requirement for primary contact for total and fecal coliform and enterococci throughout Paerdegat Basin.

It is noted that, for the summer recreation period, the upper limit criterion for total coliform is exceeded for one of the three months, although not significantly in terms of the modeling calculations and within the limits of model uncertainty. For fecal coliform, the NYSDEC criterion for Class SB/SC primary contact is a geometric mean limit only which is achieved by the LTCP. For enterococci, the infrequent use coastal recreation water reference level (upper 95% confidence limit) of 501, relevant to Paerdegat Basin will be exceeded due to periodic overflows and stormwater discharges in response to rainfall events. However, the geometric mean enterococci criterion which is more relevant to health protection and which is the enforceable numerical limit for this indicator is attained.

From the results presented in Table 9-9, Table 9-11, and Table 9-12, it is considered that the LTCP may achieve a level of bacteriological water quality during the summer recreation period sufficient to satisfy the numerical criteria supportive of primary contact.

Aesthetic Use

As discussed in Section 9.1.4, the LTCP will not completely eliminate all regulated parameters in the NYSDEC narrative water quality standards to zero discharge levels, but will greatly reduce the volumetric discharge of such substances. The effect of floatable materials from CSOs will be virtually eliminated by the proposed positive floatables controls, upgraded retention boom and skimmer vessel operations, and the effect of narrative materials from stormwater inputs will be reduced to the maximum extent practicable. Accordingly, the aesthetic conditions in Paerdegat Basin 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 Class I dissolved oxygen criterion which is expected to result from the LTCP. As noted, the annual attainment is expected to be high, but dissolved oxygen is projected to be below the Class I criterion for some limited periods of time over the annual cycle at certain locations in the Basin.

For the majority of months, complete attainment throughout the Basin is expected. In the other months where some criterion excursions are expected, it should be noted that any adverse impact on fish larval propagation may be limited. Fish larvae spawning in Paerdegat Basin will be exchanged with, and transported to, Jamaica Bay waters where dissolved oxygen will be greater. The organisms will therefore not be continuously exposed to Paerdegat Basin dissolved oxygen 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 essentially caged and exposed continuously to the same depressed dissolved oxygen level. Because of the significant amount of larval transport which occurs in Paerdegat Basin, and in Jamaica Bay and its other tributaries, and the exposure of the organisms to continuously varying, rather than static, dissolved oxygen concentrations, it is considered to be reasonable to view the Jamaica Bay 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 Paerdegat Basin should not occur as there exists no fish passage and the organisms would avoid any temporarily depressed dissolved oxygen. As noted, minimum dissolved oxygen projected for the head end should be sufficient for restoration and protection of benthic organisms.

For these reasons, it is considered that, for practical purposes, conditions in Paerdegat Basin would be supportive of the fishable goal of the CWA.

Section 9.1.5 also notes that during the summer recreation season, water quality may be supportive of numerical criteria for the swimmable (primary contact recreation) goal of the CWA within the uncertainty of modeling projections. However, swimming should not be considered as a best use due to periodic overflows from the LTCP and continuing stormwater discharges. This is consistent with the views of the majority of local stakeholders who view swimming as an undesirable use of Paerdegat Basin although desirous of a level of water quality supportive of this use. It is also noted that the bacteriological criteria for Paerdegat Basin 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 Paerdegat Basin 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 the Basin, organism transport to Jamaica Bay and the appropriateness of considering the Jamaica Bay ecosystem, both open waters and tributaries, in its entirety rather than as individual components. In addition, the Paerdegat Basin habitat has been significantly altered by human activity throughout the last century thus limiting its attractiveness as a fish habitat.

For recreational activity, the currently designated use of secondary contact recreation is expected to be attained by the LTCP. Further, numerical water quality conditions suitable to support primary contact may be attained during the summer recreation season and would be achieved for the most relevant bacteriological indicators, fecal coliform and enterococci, 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 Paerdegat Basin as a result of the LTCP, it is recommended that the current waterbody classification, Class I, be retained at this time. The water use goals for the Class I classification are expected to be achieved, either numerically or for practical purposes, once the LTCP is constructed and operational. However, the attainment of the designated uses, while expected, should be demonstrated from 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 LTCP be assessed from the multi-year post-construction compliance monitoring program described elsewhere in the LTCP report. The monitoring program will document the actual attainment of uses: whether the current Class I uses are attained as expected; whether higher levels of usage are actually achieved supporting a higher waterbody classification, for example, Class SC; 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, modeling calculations indicate that complete attainment of some of the Class I water quality criteria and all of the Class SB/SC criteria on an annual basis, both numerical and narrative, would require 100 percent retention of the CSO discharges to Paerdegat

Basin. This water quality based effluent limit (WQBEL) of zero annual overflows is neither cost-effective nor consistent with federal CSO policy. Therefore, until the long-term post-construction monitoring program is completed for Paerdegat Basin to document conditions actually attained, it is recommended that a variance to the WQBEL be applied for, and approved, for the Paerdegat Basin LTCP for appropriate effluent variables.

9.2.2. NYSDEC Requirements for Variances to Effluent Limitations

The requirements for variances to water quality based effluent limitations are described in Section 702.17 of NYSDEC's Water Quality Regulations. The following is an abbreviated summary of the variance requirements which are considered applicable to Paerdegat Basin. 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 NYSDEC to grant a variance to a "water quality based effluent limitation…included in a SPDES permit." It is assumed that the Paerdegat Basin LTCP, when referenced in the Coney Island WPCP SPDES permit, along with other presumed actions necessary to attain Class I 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, NYCDEP, 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 Paerdegat Basin, a variance would be needed for the following pollutants: oxygen demanding substances (BOD for dissolved oxygen attainability), and effluent constituents covered by narrative water quality standards (suspended, colloidal and settleable solids; oil and floating substances). A variance for total and fecal coliform bacteria would not be requested as the Paerdegat Basin LTCP is expected to fully attain Class I requirements.

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 Paerdegat Basin Use Attainability Evaluation report (Appendix E) 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 the department 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. The information documenting this analysis is contained elsewhere in the LTCP report. Report Section 7.0, Evaluation of Alternatives, describes bacteriological conditions which are expected under Baseline and LTCP conditions. As noted, the current Class I secondary contact recreation use is not attained under Baseline conditions but is expected to be achieved by the LTCP. Further, in the interim, and until the LTCP is constructed, very little risk to human health is anticipated.

Subdivision (d) of the variance regulations requires that the requestor submit a written application for a variance to NYSDEC which includes all relevant information pertaining to Subdivisions (b) and (c). NYCDEP will submit a variance application for the Paerdegat Basin LTCP to NYSDEC six months before the Facility Plan is placed in operation. The application will be accompanied by the Paerdegat Basin LTCP report, the Paerdegat Basin Use Attainability Evaluation, Appendix E, 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, be available to the public for review and contain a number of conditions:

- It is assumed that the initial effluent limitation achievable by the permittee at the time the variance becomes effective, after LTCP construction, will be based upon the performance characteristics of the LTCP as agreed upon between NYSDEC and NYCDEP. These interim operational conditions will be based on the facility'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 NYCDEP activities such as implementation of the long-term monitoring program and additional waterbody improvement projects as delineated in Section 5 of this LTCP 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 Paerdegat Basin, various Jamaica Bay water quality improvement projects, the Jamaica Bay watershed protection plan and various ecosystem restoration activities. These activities are also required under section (3) of the Subdivision.
- It is assumed that the SPDES permit authorizing the Paerdegat Basin LTCP variance(s) will contain a provision that allows the department to reopen and modify the permit for revisions to the variance(s).

Subdivision (g) indicates that a variance may be renewed. It is anticipated that a variance for the Paerdegat Basin LTCP 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 LTCP attains the current Class I classification water quality criteria and uses;
- The degree to which the LTCP achieves water quality criteria consistent with the fishable/swimmable goals of the CWA, whether any new low-cost technology is available to enhance the LTCP performance, if needed, whether the waterbody classification for Paerdegat Basin can be revised upward, or whether a Use Attainability Analysis should be approved.

In this manner, the approval of a WQBEL variance for Paerdegat Basin together with an appropriate long-term monitoring program can be considered as a step toward a determination of the following:

- Can Paerdegat Basin 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 Paerdegat Basin and for which water quality criteria?

Although Paerdegat Basin's current waterbody classification, Class I, is not wholly compatible with the goals of the Clean Water Act and would normally require upward 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 implementation of the LTCP, enable a proper determination for the appropriate waterbody classification for Paerdegat Basin, and perhaps avoid unnecessary, repetitive, and contradictory rulemaking.

9.2.4. Future Considerations

Urban Tributary Classification

The possibility is recognized that the long-term monitoring program recommended for Paerdegat Basin, 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 NYSDEC Water Quality Regulations, that being "Urban Tributary."

The Urban Tributary 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)
- Secondary contact recreation (if attainable)

Other attainable higher uses would be waterbody specific and dependent upon the effectiveness of the site-specific CSO 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 40CFR131.10(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 Paerdegat Basin LTCP would apply with regard to the narrative water quality criteria previously cited as well as to the Class I water quality criterion for dissolved oxygen. 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 NYSDEC 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 LTCP is expected to result in significant improvements to the water quality in Paerdegat Basin, it is not expected to completely attain all applicable water quality criteria. As such, the SPDES Permit for the Coney Island WPCP may require a variance for the Paerdegat Basin Facility discharge if contravention of some criteria continues to occur. If water quality criteria are demonstrated to be unrealistic after a period of monitoring, NYCDEP would request reclassification of Paerdegat Basin based on a Use Attainability Analysis (UAA). Until the recommended UAAs and required regulatory processes are completed, the current NYSDEC classification of Paerdegat Basin (Class I) should be temporarily retained.

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10.0. References

Adams, D.A., J.S. O'Connor, S.W. Weisberg. 1998. Sediment Quality of the NY/NJ Harbor System. An Investigation under the Regional Environmental Monitoring and Assessment Program (REMAP), March 1998.

Allee King Rosen & Fleming. 1994. Final Environmental Impact Statement for the Paerdegat Basin Water Quality Facility Plan. Prepared with Hazen and Sawyer, P.C., HydroQual, Inc., and Historical Perspectives, Inc. for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering and Office of Environmental Planning, March 1994.

Aller, R.C. 1982. The effects of macrobenthos on chemical properties of marine sediment and overlying water. Animal-Sediment Relations. The Biogenic Alteration of Sediments. Plenum Press, New York. pp.53-102.

Bopp, R.F., H.J. Simpson, S. N. Chillrud, and D.W. Robinson. 1993. Sediment-derived chronologies of persistent contaminants in Jamaica Bay - historical trends in contamination of estuarine and coastal sediments. Estuaries 16(3B): 608-616.

Buckley, L. J. 1984. RNA-DNA ratio: an index of larval fish growth in the sea. Marine Biology 80: 291-298.

Buckley, L., E. Caldarone, and T.L. Ong. 1999. RNA/DNA ratio and other nucleic acid-based indicators for growth and condition of marine fishes. Hydrobiologia 401: 265-277.

Cornwell, J.C. and M. Owens. 1998. Sediment biogeochemical processes in Jamaica Bay, New York. Final Report to HydroQual, Inc., Mahwah, NJ. Horn Point Laboratory, University of Maryland Center for Environmental Science.

Cosper, E.M., A. West, and W.S. Kim. 1989. A comparison of plankton and primary productivity in the waters of the waters of the Gateway National Recreation Area: A final data report to the National Park Service, Gateway National Recreation Area, Brooklyn, NY.

Diaz, R.J. and R. Rosenberg. 1995. Marine benthic hypoxia: a review of its ecological effects and the behavioral responses of benthic macrofauna. Oceanography and Marine Biology: An Annual Review, 33: 245-303.

DiToro, D.M. and J.J. Fitzpatrick. 1993. Chesapeake Bay Sediment Flux Model. Prepared for the USACE Waterways Experiment Station, Environmental Laboratory, Vicksburg, Mississippi by HydroQual, Inc., Mahwah, NJ.

EEA, Inc. 1991. East River Landing Aquatic Environmental Study Final Report. Prepared for the New York City Public Development Corporation, April 1991.

EEA, Inc. 1997. Jamaica Bay Eutrophication Study: Biological Productivity Study. Draft Prepared for the New York City Department of Environmental Protection, December 1997.

ENSR Consulting. 1999. East River Repowering Project at the East River Generating Station, New York, NY, September 1999.

Franz D. R. and W. H. Harris. 1985. Benthos Study: A final report to the National Parks Service. Jamaica Bay Wildlife Refuge (GNRA), New York.

Great Lakes – Upper Mississippi River Board. 2004. Recommended Standards for Wastewater Facilities – Policies for the Design, Review, and approval of Plans and Specifications for Wastewater Collection and Treatment Facilities. Report of the Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004 edition.

Hazen and Sawyer. 1989. Paerdegat Basin Water Quality Facility Plan Draft Task Reports 2.5 and 3.4: Receiving Water Conditions. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

Hazen and Sawyer. 1991. Paerdegat Basin Water Quality Facility Plan, Draft Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, September 1991.

Hazen and Sawyer. 1994. Public Participation for the Paerdegat Basin Water Quality Facility Planning Project. Prepared for the City of New York Department of Environmental Protection, February 1994.

Hazen and Sawyer. 1999. Evaluation of Supplemental Aeration for the Paerdegat Basin Water Quality Facility Project. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, February 1999.

Hazen and Sawyer. 2004. Paerdegat Basin Water Quality Facility Plan, Modified CSO Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, April 2003; revised February 2004.

Houghton, R, G. Gordon, and B. Huber. 2002. Dye Tracer Experiments in Jamaica Bay. Prepared for Gateway National Recreation Area by Columbia Earth Institute.

HydroQual . 1993. Sources, Fate and Control of Floatable Materials in New York Harbor (Final Report). Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, December, 1993.

HydroQual. 1995. Floatables Pilot Program - Evaluation of Non-Structural Methods to Control Combined and Storm Sewer Floatable Materials (Final Report). Prepared for the City of New York Department of Environmental Protection, January, 1995.

HydroQual. 2000a. Paerdegat Basin Field Sampling and Analysis Program, Years 2000-2001. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2000b. Develop and Evaluate Alternatives - Task 6.0 Technical Memorandum. Prepared for the City of New York Department of Environmental Engineering, June 2000.

HydroQual. 2001a. Jamaica Bay Field Sampling and Analysis Program, Years 2001-2002. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2001b. Ichthyoplankton Field Sampling and Analysis Program, Year 2001. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2001c. Epibenthic Recruitment and Survival Field Sampling and Analysis Program, Years 2001-2002. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2001d. Use and Standards Attainment Project Field and Laboratory Standard Operating Procedures. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2002a. Supplemental Aquatic Life Characterization of East River and Jamaica Bay Field Sampling and Analysis Program, Year 2002. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering.

HydroQual. 2002b. A water quality model for Jamaica Bay: Calibration of the Jamaica Bay Eutrophication Model (JEM). Prepared for the City of New York Department of Environmental Protection under subcontract to O'Brien & Gere.

HydroQual. 2003. The Paerdegat Basin Waterbody/Watershed Plan. Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering. Draft, February 2003.

HydroQual. 2005. City-Wide Comprehensive CSO Floatable Plan, Modified Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, Bureau of Engineering Design & Construction, July 2005.

Kuropat, C., R. Mercaldo-Allen, E. Caldarone, R. Goldberg, B. Phelan, and F. Thurberg. 2002. Evaluation of RNA concentration as an indicator of growth in young-of-the-year winter flounder Pseudopleuronectes americanus and tautog Tautoga onitis. Mar. Ecol. Prog. Ser. 230:265-274.

Lerberg, S.B., A.F. Holland, and D.M. Sanger. 2000. Responses of tidal creek macrobenthic communities to the effects of watershed development. Estuaries. 23:838-853.

Levandowsky, M. 1994. An Investigation of Water Discoloration and Odor in Paerdegat Basin, a Tributary of Jamaica Bay, During the Summer of 1994. Haskins Laboratories, Pace University, New York, NY.

Greeley and Hansen, LLC / Hazen and Sawyer, P.C. / O’Brien & Gere, Inc. (LTCP Joint Venture). 2006a. City-Wide Long-Term CSO Control Planning, Landside Modeling Report, Volume 3, Coney Island WPCP Sewershed. Prepared for the City of New York Department of Environmental Protection, Bureau of Engineering Design & Construction. Draft under review; finalization scheduled for September 2006.

Greeley and Hansen, LLC / Hazen and Sawyer, P.C. / O’Brien & Gere, Inc. (LTCP Joint Venture). 2006b. City-Wide Long-Term CSO Control Planning, Receiving Water Quality Modeling Report, Volume 13 – Paerdegat Basin. Prepared for the City of New York Department of Environmental Protection, Bureau of Engineering Design & Construction. Draft under review; finalization scheduled for September 2006.

Malcolm Pirnie. 2004. Coney Island Water Pollution Control Plant Conceptual Design -Evaluation of BNR Upgrades (Draft Report). Prepared for the City of New York Department of Environmental Protection, Bureau of Environmental Engineering, July 2004.

Michael, G.Y. and T.F. Moore. 1997. A suggested framework for conducting UAAs and interpreting results. Project 91-NPS-1. Prepared for the Water Environment Research Foundation.

New York City Department of Environmental Protection (NYCDEP). 1994. Final Environmental Impact Statement for the Paerdegat Basin Water Quality Facility Plan, March 1994.

New York City Department of Environmental Protection (NYCDEP). 1997. CSO Abatement in the City of New York: Report on Meeting the Nine Minimum CSO Control Standards.

New York City Department of Environmental Protection (NYCDEP). 2000. Harbor Survey Annual Report.

New York City Department of Environmental Protection (NYCDEP). 2005. Total Residual Chlorine Management Program, March, 2005.

New York State Department of Environmental Conservation (NYSDEC). 2005. Response to Comments on the 2004 Administrative Consent Order for Implementation of the Combined Sewer Overflow Abatement Program in New York City (Final Version), January 14, 2005.

Novotny, V., J. Braden, D. White, A. Capodaglio, R. Schonter, R. Larson, and K. Algozin. 1997. A Comprehensive UAA Technical Reference. Project 91-NPS-1. Prepared for the Water Environment Research Foundation.

O'Brien & Gere. 1993. Jamaica Bay CSO Abatement Facility Planning Project, Draft Facility Planning Report. Prepared for the City of New York Department of Environmental Protection, November 1993.

O'Brien & Gere. 1994. Fresh Creek CSO Facility Plan. Prepared for the City of New York Department of Environmental Protection.

Office of the Mayor. 2005. New York City Industrial Policy: Protecting and Growing New York City's Industrial Job Base, January 2005.

Peterson, W.T. and H.G. Dam. 1989. Hydrography and Plankton of Jamaica Bay (Internal Report). Marine Sciences Research Center, State University of New York at Stony Brook.

Rhoads, D.C. and J.D. Germano. 1986. Interpreting long-term changes in benthic community structure, a new protocol. Hydrobiologia. 142:291-308.

Sunset Energy Fleet. 2002. Summary of data from the East River Generating Station for Article X Application Gowanus Bay. New York State Public Service Commission, Case 99-F-0478.

TAMS Consulting. 1999. Environmental Report, FDR Drive Southbound Rehabilitation. New York, NY. Prepared for the New York Department of Transportation, October 1999.

Tanacredi, J.T., M.P. Schreibman, and G.W. Frame. 2002. Jamaica Bay Research and Restoration Team (JABERRT), Final Report.

U.S. Army Corps of Engineers (USACE). 1999. Dradeged Material Management Plan for the Port of New York and New Jersey: Draft Implementation Report, September 1999.

U.S. Army Corps of Engineers (USACE). 2002. Jamacia Bay Ecosystem Restorateion Project, Existing Conditions, Future without Project Conditions, Goals and Objectives, Final Report Prepared by the New York District, December 2002.

U.S. Army Corps of Engineers (USACE). 2003. Jamacia Bay Ecosystem Restoration Project: Land History Disturbance maps, Interagency Meeting, September 2003.

U.S. Environmental Protection Agency (USEPA), 1994. Seminars, Combined Sewer Overflow Control, EPA-625-K-94-003, Office of Research and Development, Washington, DC, July 1994.

U.S. Environmental Protection Agency (USEPA), 1995a. Combined Sewer Overflows, Guidance for Long-Term Control Plan, EPA-832-B-95-002, Office of Water, Washington, DC, September 1995.

U.S. Environmental Protection Agency (USEPA), 1995b. Combined Sewer Overflows, Guidance for Nine Minimum Controls, EPA 832-B-95-003

U.S. Environmental Protection Agency (USEPA), 1995c. Combined Sewer Overflows, Guidance for Permit Writers, EPA 832-B-95-008

U.S. Environmental Protection Agency (USEPA), 1997. Technical Guidance Manual For Developing Total Maximum Daily Loads, Book 2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/Dissolved Oxygen and Nutrients/Eutrophication, EPA 823 B 97 002. Office of Water, Washington, DC, March, 1997.

U.S. Environmental Protection Agency (USEPA), 1998. EPA Guidance for Quality Assurance Project Plans, EA QA/G-5. EPA/600/R-98/018, February 1998.

U.S. Environmental Protection Agency (USEPA), 1999. Combined Sewer Overflows – Guidance for Monitoring and Modeling. EPA 832-B-99-002, January 1999.

U.S. Environmental Protection Agency (USEPA), 2000. Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras, EPA 822 R 00 012. Office of Water, Washington, DC, November 2000.

U.S. Environmental Protection Agency (USEPA), 2001a. EPA Requirements for Quality Management Plans, EPA QA/R-2. EPA/240/B-01/002, March 2001.

U.S. Environmental Protection Agency (USEPA), 2001b. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. EPA/240/B-01/003, March 2001.

U.S. Environmental Protection Agency (USEPA), 2001c. Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6. EPA/240/B-01/004, March 2001.

U.S. Environmental Protection Agency (USEPA), 2001d. Guidance: Coordinating CSO Long-Term Planning With Water Quality Standards Reviews, EPA 833 R 01 002, Office of Water, Washington, DC, July 2001.

U.S. Environmental Protection Agency (USEPA), 2004. Water Quality Standards for Coastal and Great Lakes Recreation Waters (Final Rule). 69 FR 220, pp. 67218-67243, November 16, 2004.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1997. An Estuarine Benthic Index of Biotic Integrity (B-IBI) for Chesapeake Bay. Estuaries, 20 (1): 149-158.

West-Valle, A.S., C.J. Decker, and R.L. Swanson. 1992. Use Impairments of Jamaica Bay. Marine Sciences Research Center, University of New York, Stony Brook. May 1992.

Wildish, D. and D. Kristmanson. 1997. Benthic Suspension Feeders and Flow. Cambridge University Press: NY.

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 a 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 a 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 Soound 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

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).

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 (eg, 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 of flow

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, analyse 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 NYCDEP 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). NYCDEP 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 period 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 NYCDEP 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-off-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.

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 a 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 a 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 (NYCDEP): 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 (NYSDEC): New York State aagency 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

NYCDEP: New York City Department of Environmental Protection

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

NYSDEC: New York State Department of Environmental Conservation

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 a 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”.

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

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 unforseen pipe blockages or breaks, unforseen 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 NYCDEP 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 NYCDEP based on the City's drainage patterns and on New York State Department of Environmental Conservation (NYSDEC) 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 technologybased 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

CONEY ISLAND WATER POLLUTION CONTROL PLANT

WET WEATHER OPERATING PLAN

City of New York
Department of Environmental Protection
Bureau of Wastewater Treatment

Coney Island
Water Pollution Control Plant
Wet Weather Operating Plant

Prepared by:
The New York City Department of Environmental Protection
Bureau of Wastewater Treatment

April 2005

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Section 1 – Introduction

Section 2 – Unit Process Operations

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1.0 INTRODUCTION

One effective strategy to abate pollution resulting from 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 sewer overflow 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 Combined Sewer Overflows (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). The implementation of these plans will help The City to improve treatment of sewage during wet weather events, and will allow them to demonstrate compliance with the State and Federal BMP requirements.

1.1 BACKGROUND OF EXISTING SYSTEM

The Coney Island Water Pollution Control Plant (WPCP) is located in the Sheepshead Bay section of Brooklyn, New York, on the shore of the lower East River (see **Figure 1-1).** The Coney Island WPCP treats wastewater from a combined sewage collection system, which serves a population of approximately 660,000 and which drains stormwater flow from an area of almost 15,000 acres.

The first wastewater treatment plant on this site was built in 1892 and was equipped with a chemical treatment process. In 1936, the Coney Island plant began operation with a design average flow capacity of 60 mgd. The plant was expanded in capacity in 1942 to 70 mgd, and again in 1963 to an average dry weather flow capacity of 100 mgd. The upgraded plant was designed to provide primary treatment and chlorination to wet weather peak flow of twice design average dry weather flow, and secondary treatment to 1.5 times average dry weather flow.

The plant's dry weather flow capacity has been re-rated from 100 MGD to 110 MGD as of April 2003 as per the new SPDES permit. In fiscal year 2000, flow to the plant averaged 97 mgd. The trend of actual influent flow to the plant has been downward over the past several years, from 103 mgd in the early 1990's. The average flow readings are taken from the main sewage pump step operation.

In 1997, DEP's Office of Environmental Planning and Assessment (OEPA) developed water demand and wastewater flow projections for each of the City WPCPs. The high end projected flow to the Coney Island WPCP to the year 2045 is 109.1 mgd, and the low end flow projection is 99.5 mgd.

Maximum design wet weather flow to the plant is 220 mgd. The design maximum flow to secondary treatment is 1.5 times average flow, or 165 mgd. The design maximum capacity of the bypass system will be 55 mgd, or 0.5 times design average flow

1.2 DRAINAGE AREA

The Coney Island regulation system is comprised of five regulator stations and one independent tide gate chamber. 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.

There are two pumping stations located in the Coney Island WPCP Drainage Area. Of these, the Paerdergat pump station pumps combined sewage with a capacity of 57 MGD; the Avenue “M” pump station pumps sanitary only with a capacity of 7.1 MGD. The following **Table 1-1** lists the outfalls for the Coney Island WWTP drainage area. Figure 1-2 is a flow schematic which outlines the Coney Island Drainage Area.

1.3 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. Sludge treatment consists of cyclone degritting of primary sludge, gravity thickening of combined waste activated and primary sludge, and anaerobic digestion. Sludge is sent to be dewatered at other DEP plants and is transported by pipeline.

1.4 Effluent Permit Limits

The Coney Island WPCP is currently operating under SPDES Permit No. 0026182. Under this SPDES Permit, the plant is rated at 110 mgd dry weather flow and 220 mgd wet weather flow. The current effluent flow, CBOD, TSS, and fecal coliform limits and monitoring requirements from the permit are summarized in Table 1-3 below.

Table 1-3: Coney Island WPCP
Conventional Effluent Limitations and Monitoring Requirements

PARAMETER	Limit	Monitoring Requirement
DRY WEATHER FLOW	110 mgd	(30 day mean)
CBOD [1]	25 mg/l [2]	(30 day mean)
	40 mg/l	(7 day mean)
	50 mg/l [3]	6 consecutive hour avg.
TSS [1]	30 mg/l [2]	(30 day mean)
	45 mg/l	(7 day mean)
	50 mg/l	Daily maximum
	50 mg/l [3]	6 consecutive hour avg.
FECAL COLIFORM	Not exceed 200/100 ml	(30 day geom. mean)
	Not exceed 400/100 ml	(7 day geom. mean)
	Not exceed 800/100 ml	6 hour geom. mean
TOTAL CHLORINE RESIDUAL	2.0 mg/l [4]	Daily maximum
pH	6.0 – 9.0 SU	Range

(1) Frequency: 1/day; Sample Type: 24-hour composite
(2) Effluent values shall not exceed 15% of influent values.
(3) During periods of wet weather influence, it is recognized that permittee may not be able to meet CBOD5 and suspended solids limits for effluent concentrations and mass loadings. Relief from these requirements shall be granted, if permittee can demonstrate that treatment is being maximized while up to maximum treatable flow is being accepted.
(4) During periods of wet weather influence, in order to achieve proper fecal coliform kill it may be necessary to exceed the effluent chlorine residual limit. Relief shall be granted, if permittee can demonstrate that such exceedances are necessary in order to provide optimum disinfection.

1.5 Wet Weather Flow Control

Original design of the collection system assumed that when it was necessary to limit flow to the plant, the regulators should 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. The SCADA system is currently being set up at Coney Island WPCP.

1.6 Performance Goals for Wet Weather Events

The goal of this Wet Weather Operating Plan is to maximize treatment of wet weather flows at the Coney Island WPCP and, in doing so, reduce the volume of untreated CSO being discharged to the Jamaica Bay and its tributaries.

There are three primary objectives in maximizing treatment for wet weather flows:

1. Consistently achieve primary treatment and disinfection for wet weather flows up to 220 MGD before CSOs occur. In doing so this, the plant will satisfy the SPDES requirement of providing this level of treatment for 2xDDWF.

2. Consistently provide secondary treatment for wet weather flows up to 165 MGD before bypassing the secondary treatment system. In doing so this plant will provide a secondary level of treatment for 1.5 xDDWF.

3. Do not appreciably diminish the effluent quality or destabilize treatment upon return to dry weather operations.

1.7 Purpose of this Manual

The purpose of this manual is to provide a set of operating guidelines to assist the Coney Island WPCP staff in making operational decisions which will best meet their performance goals and the requirements of the NPDES 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 Coney Island 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.

1.8 Using this 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 Coney Island 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.

1.9 Revisions to this Manual

In additions 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 Coney Island WPCP that affect the plants 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 after automation is complete.
- **Future Construction Phases-** Future construction phases may impact the operation of the plant and may require revisions to this manual.
- **New Bar Screens -** The current bar screens will be replaced with similar ones in an effort to alleviate the impaction caused by trash and debris during a heavy rainstorm
- **Opening Outfall Gate –** The plant was originally set up so that all effluent flow exits the plant via an outfall gate. This set up, however caused foaming problems throughout the plant. The plant currently discharges all flow via effluent weirs,

which have controlled the foaming problem. However, several issues have been raised with this setup:

A – This set up backs up the flow through the plant including the final tanks, which does not allow for proper measurement of the secondary bypass flow. This also does not allow for proper verification the secondary treatment receives 1.5x design flow, or 165 MGD.

B – This set up also backs up flow through the chlorine contact tanks, which does not allow for proper measurement of effluent flow.

C – With the backup of flow, the plant experiences difficulties maintaining a flow of 220 MGD.

❖❖❖end of section❖❖❖

TABLE 1-2 CONEY ISLAND OUTFALLS			
Outfall No.	**Location**	**Outfall Type**	**Waterbody**
004	Flatlands Ave. (Reg. # 5)	DBL 12' x 9'	Paerdegat Basin
005	Flatlands Ave. (Reg. # 1-4)	5BL 12'X 9'	Paerdegat Basin
006	Ralph Ave. (Reg. # 6)	DBL 20' x 9'	Paerdegat Basin
007	Ave. M (MPS)	72" Dia.	Fresh Creek Basin
601	W. 28th St.	3' x 3'	Coney Island Creek
602	W. 33rd St.	60" Dia	Coney Island Creek
603	Dover St.	60" Dia	Sheepshead Bay
604	75' e/o Beaumont St.	10" Dia	Sheepshead Bay
605	n/o West End Ave.	DBL 9' x 5'	Sheepshead Bay
607	E. 21st St (under Pier 1)	10" Dia	Sheepshead Bay
608	E. 22nd St.	12" Dia	Sheepshead Bay
609	E. 23rd St.	12" Dia	Sheepshead Bay
610	E. 27th St.	DBL 10' x 7'	Sheepshead Bay
611	Devon Ave.	3' x 4'	Shell Bank Creek
612	Everett Ave.	48" Dia	Shell Bank Creek
613	Flatbush Ave.	DBL 12' x 7'	Mill Basin
614	e/o E. 58th St.	3' x 4'	Mill Basin
615	E. 61st St.	5'x 7'	Mill Basin
616	Strickland Ave.	3' x 4' EGG	Mill Basin
617	E. 64th St.	3' x 4' EGG	Mill Basin
618	Dakota Place	3' x 4' EGG	Mill Basin
619	Indiana Place	2' x 2'6"	Mill Basin
620	Bassett Ave.	3' x 4' EGG	East Mill Basin
621	Utah Walk	2' x 3'	East Mill Basin
622	Ohio Walk	4' x 4'	East Mill Basin
623	Strickland Ave.	3' x 4' EGG	East Mill Basin
624	E. 68th St.	5' x 6'	East Mill Basin
625	Avenue V	4' x 5'	East Mill Basin
626	Avenue W	3' x 4'	East Mill Basin
627	Avenue X	3' x 4'	East Mill Basin
628	Avenue L	66"Dia.	Paerdegat Basin
629	Paerdegat 4th St.	78" Dia.	Paerdegat Basin
630	Paerdegat 7th St.	78" Dia.	Paerdegat Basin
631	Paerdegat 10th St.	60" Dia.	Paerdegat Basin
632	Paerdegat 13th St.	78" Dia.	Paerdegat Basin
633	Canarsie Rd.	102" Dia.	Jamaica Bay
634	Avenue N	72" Square	Fresh Creek Basin
636	Avenue L	76" Square	Fresh Creek Basin
637	Avenue K	72" Square	Fresh Creek Basin
639	W. 12th St.	10' x 8'	Coney Island Creek
641	25' s/o Shore Pkwy (Head of Creek)	102" Dia	Coney Island Creek

TABLE 1-2 CONEY ISLAND OUTFALLS			
Outfall No.	**Location**	**Outfall Type**	**Waterbody**
653	1500' sw/o Shore Pkwy	6' x 4'	Coney Island Creek
654	Bragg Court	84" Dia.	Sheepshead Bay
655	Avenue Y	108" Dia.	Shell Bank Creek
656	Gerritsen Ave.	15" Dia.	Shell Bank Creek
657	Avenue X	36" Dia	Shell Bank Creek
658	Ivan Court	12" Dia.	Shell Bank Creek
659	Shore Blvd.	102" Dia.	Sheepshead Bay
660	E. 66th St.	30" Dia.	Mill Basin
661	Seaview Ave.	66" Dia.	Fresh Creek Basin
662	W. 32nd St.	42" Dia.	Atlantic Ocean
663	W. 23rd St.	42" Dia.	Atlantic Ocean
664	W. 15th St.	4' x 4'	Coney Island Creek
665	W. 21st St.	42" Dia.	Coney Island Creek
666	Shore Blvd. w/o West End Ave.	72" Dia.	Sheepshead Bay
667	Allen Ave.	12" Dia	Shell Bank Creek
668	Channel Ave.	3' x 4'	Shell Bank Creek
669	Florence Ave.	3' x 3'	Shell Bank Creek
670	Bartlett Place	48" Dia.	Shell Bank Creek
671	Cyrus Ave.	36" Dia.	Shell Bank Creek
672	Seba Ave.	48" Dia.	Shell Bank Creek
673	Just Court	30" Dia	Plum Beach Channel
674	Gerritsen Ave.	42" Dia.	Plum Beach Channel
675	Hendrickson Place	36" Dia.	Mill Basin
676	56th Drive	18" Dia.	Mill Basin
677	Ocean Avenue	DBL 17' x 5'	Sheepshead Bay

SG - Sluice Gate

FO - Fixed Orifice

SPDES - State Pollution Discharge Elimination System

DC - Diversion Chamber

FY - Fiscal Year

DB – Duckbill

2.0 EXISTING FACILITY - WET WEATHER OPERATING PROCEDURES AND GUIDELINES

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 address the rational trigger mechanisms and potential problem areas for wet weather operations.

2.1 INFLUENT GATES AND SCREENS

An analysis of Coney Island wet weather flow performance has shown recent favorable results with respect to effluent quality at the high end of observed flows.

2.1.1 Equipment for Influent Gate System

EQUIPMENT	NUMBER
Influent Sluice Gate	Total 6 (3 Coney, 3 Paerdegat) 1 Gate/Channel
Effluent Sluice Gate	Total 6 1 Gate/Channel
26 Cubic Yard (cy) Container	Total 1
Backup 10 cy Container	Total 4
SCREENS	
1¼ cy Grit Container	Total 6 1 Container/Channel
Bar Screen	Total 6 1 Bar Screen/Channel
Climber Rake	Total 6 1 Climber/Bar Screen
1¼ cy Screenings Container	Total 6 1 Container/Channel

2.1.2 Influent Gates and Screens

The Coney Island Plant has primary bar screens upstream of the main sewage pumps. The following information and protocol apply to the existing screens. At the time of preparing this protocol the existing screens are in the process of being replaced. This protocol will be revised as appropriate when upgrading of the screens is completed.

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td colspan="3">Before Wet Weather Event</td></tr>
<tr><td>Senior Sewage Treatment Worker (SSTW)</td><td>Sewage Treatment Worker (STW)</td><td>• Gates should be in full open position during dry weather and prior to wet weather.
• Check gate operation.
• 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. This applies only for the Paerdegat (Pad) Screens. The Coney Island (CI) interceptor receives only sanitary flow and normal operation consists of one screen in service, however during wet weather conditions two screens are used. General guide for number of primary screens in service for various flow ranges (CSO):
60 MGD 2 Primary Screen (1 Pad + 1 CI)
120MGD 4 Primary Screens (2 Pad + 2 CI)
220 MGD 5 Primary Screens (3 Pad + 2 CI)
• Rotate screen operation to ensure that all available screens are in working order. Make sure empty screenings containers are available.</td></tr>
<tr><td colspan="3">During Wet Weather Event</td></tr>
<tr><td>SSTW</td><td>STW</td><td>• Leave gates in full open position until:
1. Screen channel level exceeds acceptable level with maximum pumping, or
2. Bar screens become overloaded with screenings or
3. Primary influent diversion box overflows.
• Set the gates to maintain acceptable wet well water level and channel levels. (-16.00 EL. set point)
• Record open or throttling of the gates.
• As wet weather event subsides open the gate to maintain the wet well water level until the gate is completely open.</td></tr>
<tr><td colspan="3">During Wet Weather Event (Paerdegat Side Only)</td></tr>
<tr><td>SSTW</td><td>STW</td><td>• Put a third primary screen into operation.
• The screens are normally not set to manual operation (which would allow for greater operational error), instead the timer clock is set to “0” on auto operation.
• Regulate the plant flow with the influent gates if the screens become overwhelmed or the water elevation in the screen channel exceeds –11.0.
• Remove and replace screenings containers as necessary.</td></tr>
</table>

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td colspan="3">After Wet Weather Event</td></tr>
<tr><td>SSTW</td><td>STW</td><td>• Make sure the influent gates are in the full open position.
• Conduct maintenance or repair of the influent gates as necessary.
• Take extra screen out of operation. Return to two screens online.
• Remove screenings for disposal.</td></tr>
<tr><td colspan="3">Why do we do this?</td></tr>
<tr><td colspan="3">To regulate flow to the WWTP and prevent damage to plant equipment. Two screens can accommodate the plant design flow of 110 mgd. Three Paedegatt in conjunction with two Coney Island primary screens are required to handle 220 mgd.</td></tr>
<tr><td colspan="3">What triggers the change?</td></tr>
<tr><td colspan="3">High water levels in the wet well or other unacceptable plant conditions related to high flows. Flows in excess of 120 mgd will require a third primary screen to be put online. Screen rakes will operate as follows: When the differential is 12 inches or more, the rakes are on. When the differential is 4 inches or less, the rakes are off. Otherwise the rakes will run every 20 minutes. This schedule can be adjusted if necessary.</td></tr>
<tr><td colspan="3">What can go wrong?</td></tr>
<tr><td colspan="3">If the screens are highly impacted with debris, the influent channels will flood and will have to be shut down. The primary influent channel may flood and spill raw sewage onto the adjoining roadway. If an insufficient number of screens are online the screen channel may surcharge above the acceptable level set point namely –11.0 EL.</td></tr>
</table>

❖❖❖end of section❖❖❖

2.2 MAIN SEWAGE PUMPS

2.2.1 Equipment

EQUIPMENT	NUMBER
Influent Wet Wells	Total 2 (East & West) Wet Wells
Main Sewage Pumps (MSPs)	Total 6 –intermediate well

2.2.2. Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• Monitor wet well 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 both wet well 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		
SSTW	STW	• Continue to monitor wet well elevation. • As wet well level rises put off-line pumps in service and increase speed of variable speed pumps as necessary. • Pump to maximum capacity during wet weather events always leaving one pump out of service as standby. • All adjustments are made manually by operators in the pump control room based on maintaining a wet well level within desired operating range. (Current operational set point of -16.00 EL.) • Restrict flow through influent gates if pumping rate is maximized and wet well level continues to rise (See influent gate operations)
After Wet Weather Event		
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.

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td colspan="3">Why do we do this?</td></tr>
<tr><td colspan="3">Maximize flow to treatment plant, and minimize need for flow storage in collection system and associated overflow from collection system into receiving water body.</td></tr>
<tr><td colspan="3">What triggers the change?</td></tr>
<tr><td colspan="3">High flows, and the subsequent increase in the level of the screen chamber afterbay.</td></tr>
<tr><td colspan="3">What can go wrong?</td></tr>
<tr><td colspan="3">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.</td></tr>
</table>

❖❖❖end of section❖❖❖

2.3 PRIMARY SETTLING TANKS

The primary settling tanks are designed to effectively treat approximately 28 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.

2.3.1 Equipment

EQUIPMENT	NUMBER
Primary Settling Tanks (PSTs)	Total 8
Longitudinal Collectors	Each Pass
Cross Collector	Each Pass
Primary Sludge Pumps (PSPs)	Total 12 3 Pumps/PSPS (2 Duty, 1 Swing Standby) 1 Pump/PST

2.3.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• Under normal operations all available primary tanks should be in service. • Check the sludge collector. • Check sludge pump operation. • Repair any malfunctions or equipment out of service.
During Wet Weather Event		
SSTW	STW	• Make sure eight primary sludge pumps are on-line. • Check the collector and drive operation. • Make sure grit flushers are operating.
After Wet Weather Event		
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

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td colspan="3">Why do we do this?</td></tr>
<tr><td colspan="3">Flows need to be balanced to the primary tanks for the flowing reasons:
1. Maximize suspended solids and CBOD₅ removal,
2. Prevent premature weir flooding
3. Prevent short circuiting,
4. Prevent excessive sludge and grit accumulation in individual clarifiers,
Maximize scum removal.</td></tr>
<tr><td colspan="3">What triggers the change?</td></tr>
<tr><td colspan="3">Primary tank wet weather operations are similar to dry weather operations.</td></tr>
<tr><td colspan="3">What can go wrong?</td></tr>
<tr><td colspan="3">During wet weather the plant may experience high grit loads related to collection system and interceptor sediment being scoured into the plant. Operators must manage flow distribution, and sludge and grit collection equipment to prevent primary tank and grit clarifier failure.</td></tr>
</table>

❖❖❖end of section❖❖❖

2.4 AERATION TANKS AND BYPASS CHANNEL

2.4.1 Equipment

That portion of the primary settling tank flow, which is in excess of the secondary treatment process capacity, must be bypassed around secondary treatment. The bypass weirs (actually fixed gates) are designed to bypass flow over 165 MGD. Because the secondary bypass channel is surcharged with final effluent (due to outfall configuration), the parshall flume located at the bypass channel cannot be utilized to precisely measure secondary bypass flow. Until this problem is addressed and corrected, the amount of flow through secondary treatment cannot be fully corroborated.

EQUIPMENT	NUMBER
Aeration Tanks (ATs)	Total 4 4 Passes/AT
Diffuser System- Fine Bubble Dome	8101 diffusers/tank for 3.6 MG Tanks (2) 11677 diffusers/tank for 4.75 MG Tanks (2)
BYPASS CHANNEL	
Bypass Channel	One sluice gate and 4 weir gates
Location of Sluice Gates	Gallery between Primary and Aeration Tanks

2.4.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	**Bypass Channel** • It is a fixed weir gate designed for 165 MGD. (In actuality the gate is fixed and locked but can be adjusted if required.) **Aeration Tanks** • During normal dry weather operations, at least 4 aeration tanks should be in operation. • The plant operates with inlets at the Head of Passes A, B, and C. • Check the dissolved oxygen levels and control the air flow to maintain greater than 2 mg/L in the aeration tanks.
During Wet Weather Event		
SSTW	STW	**Aeration Tanks** During wet weather operations, normally all 4 aeration tanks should be in operation.
After Wet Weather Event		
SSTW	STW	**Aeration Tanks** Monitor the dissolved oxygen, and maintain greater than 2 mg/L dissolved oxygen in aeration tanks.

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	

Why do we do this?

Low DO filaments can grow causing poor settling sludge.

What triggers the change?

Dissolved oxygen levels, and a trigger flow of 165 MGD.

What can go wrong?

Potential impacts of wet weather events on the activated sludge process include:

- If the bypass operation does not operate properly a loss of biomass from the aeration tanks and secondary clarifiers can result due to an overloading condition.
- 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
- Decreased BOD removal efficiency due to shortened hydraulic retention time in the aeration tanks.

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 efficiency.

❖❖❖end of section❖❖❖

2.5 FINAL SETTLING TANKS

There are a total of 11 final settling tanks. They are not all identical, eight tanks have a volume of 1.38mg/tank while three tanks have a volume of 1.94mg/tank. Additionally the larger three tanks have 4 bays instead of 3 bays.

2.5.1 Equipment

EQUIPMENT	NUMBER
Final Settling Tanks (FSTs)	Total 11
Flight & Chain Sludge Collection System	Each Pass
Manually Rotary Dipping Weir	Each Pass?
Skimmings Concentration Pit	Total 4 1 Pit/Battery
Skimmings Trough	Total 4 1 Trough/Skimmings Concentration Pit
6 Cubic Yard (cy) Container	Total 4

2.5.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• During normal dry weather operation 10 final clarifiers are normally in service. • Check the cipolletti weirs for plugging. Free any plugged valves. • Skimming gates operate automatically on a set strategy. • Check the flow balance to all tanks in service by looking at effluent weirs.
During Wet Weather Event		
SSTW	STW	• Observe the clarity of the effluent and watch for solids loss. • Secondary Bypassing occurs automatically when flows exceed 165 MGD based on the bypass gate height. a. Secondary treatment flow exceeds 165 mgd (automatic function). b. Secondary clarifier weirs are flooded. (Due to the current outfall configuration, the secondary weirs and flights flood due to outfall gate being closed)
After Wet Weather Event		
SSTW	STW	• If necessary, modify the sludge wasting based on MLSS levels. • Observe the effluent clarity. • Skim the clarifiers if necessary.

<table>
<tr><th colspan="2">WHO DOES IT?</th><th rowspan="2">WHAT DO WE DO?</th></tr>
<tr><th>SUPERVISORY</th><th>IMPLEMENTATION</th></tr>
<tr><td colspan="3">Why do we do this?</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td colspan="3">What triggers the change?</td></tr>
<tr><td colspan="3">Loss of solids in secondary system.</td></tr>
<tr><td colspan="3">What can go wrong?</td></tr>
<tr><td colspan="3">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.</td></tr>
</table>

❖❖❖end of section❖❖❖

2.6 CHLORINATION

Proper chlorine disinfection relies on required exposure time to adequately disinfect secondary effluent. During periods of extreme wet weather, there may be insufficient exposure time in the chlorine contact tank to adequately disinfect the effluent. In addition, excessive solids in secondary effluent resulting from high flows can hinder disinfection as well. 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.
- Chlorine tanks can be modified with the addition of longitudinal baffles extending the plug flow pattern with less short-circuiting and more effective chlorine contact volume.
- Mixing has been optimized with the introduction of a Induction Mixing Unit and has resulted in a reduced required chlorine dosage.

2.6.1 Equipment

EQUIPMENT	NUMBER
Chlorine Contact Tanks (CCTs)	Total 3 2 Bays/Tank
Sodium Hypochlorite Storage Tanks	Total 6 14200 Gallons/Storage Tank
Sodium Hypochlorite Metering Pump	Total 4
Hydraulic Actuated Slide Gate	Total 6; these are electric actuator gates. 2 Gates/Tank

2.6.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
SSTW	STW	• All chlorination contact tanks must be in service between May 15th and September 30th • Make sure there is sufficient sodium hypochlorite. • Make sure there are sufficient chlorine residual test kit supplies. • Report problems within a two-hour period. • Perform preventative maintenance on equipment if necessary
During Wet Weather Event		
SSTW	STW	• Check, adjust and maintain the Hypochlorite feed rates to provide a chlorine residual of about 0.8 mg/L. • Check and maintain the Hypochlorite tank levels.
After Wet Weather Event		
SSTW	STW	• Drop the Hypochlorite feed rates as needed to maintain the chlorine residual of about 0.8mg/L • Maintain the Hypochlorite tank level • 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.		

The chlorination system at the Coney Island WPCP is currently being upgraded. The chlorination system is presently being controlled with chlorine probes that measure combined chlorine at the end of each contact tank. The chlorine probes will be replaced with ones that measure total chlorine, and they will be redirected to take measurements at the contact tank influent. This set up will allow the automatic controller to make flow paced chlorine adjustments, with an influent chlorine setting as the trim.

❖❖❖end of section❖❖❖

2.7 SLUDGE THICKENING, DIGESTION, AND STORAGE

Sludge Dewatering and the tracking of sludge, screenings, scum and grit shall proceed unimpeded throughout the duration of the wet weather event.

2.7.1 Equipment

EQUIPMENT	NUMBER
Waste Activated Sludge (WAS) Wet Well	1 Wet Well
WAS Pumps	Total 5 2 Standby

2.7.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
During Wet Weather Event		
SSTW	STW	• Sludge handling activities should proceed, as they normally would during dry weather flow.
Why do we do this?		
The nature of the Coney Island WPCP's solids handling system is such that it is a continuously run operation regardless of incoming flow conditions.		
What triggers the change?		
N/A		
What can go wrong?		
N/A		

Table 2-1. Coney Island WPCP Rated Capacities for Equipment in Service				
Process Equipment	Number of Units Installed Pad/CI Interceptors	Number of Units in Service	Minimum Plant Influent Flow	Minimum Secondary Treatment Flow
Screens *	3 (Pad) 3 (CI)	3+2 2+2 1+2 3+3 3+2 3+1	220 (Pad x 3)(CI x 2) 120 (Pad x 2)(CI x 2) 60 (Pad x 1)(CI x 1) 220 (Pad x 3)(CI x 3) 220 (Pad x 3)(CI x 2) 180 (Pad x 3)(CI x 1)	
Main Sewage Pump	6	5 4 3 2 1	220 200 150 100 50	
Primary Settling Tanks	8	8 7 6 5 4 3 2 1	220 192.5 165 137.5 110 83.5 55 27.5	

Aeration Tanks	4	4 3 2 1		165 123 82 41
Final Settling Tanks	11	11 10 9 8 7 6 5 4 3 2 1		165 165 148.5 132 115.5 99 82.5 66 50 33 16.5
Chlorine Contract Tanks	3	3 2 1	220 147 73	

* The Coney Island interceptor receives only sanitary flow. Normal operation consists of two (one as backup) screens in service even during wet weather conditions.

❖❖❖end of section❖❖❖

APPENDIX B

PAERDEGAT BASIN WATER QUALITY FACILITY

WET WEATHER OPERATING PLAN

Bureau of
Environmental Engineering

Capital Project No. WP-169

Paerdegat Basin Water Quality Facility Wet Weather Operating Plan

December 2003

HAZEN AND SAWYER
Environmental Engineers & Scientists

H&S File: 6006/501/Cr1-PBwqf.cdr 12/3/03

TABLE OF CONTENTS

1.0 INTRODUCTION

The Paerdegat Basin Water Quality Facility was designed to collect and retain Combined Sewer Overflow (CSO) from the Combined Sewer System in the Flatbush/Canarsie areas of Brooklyn New York, which currently discharges to Paerdegat Basin. The Facility will become operational in 2009. The CSO that will be retained in the Facility will be pumped to the Coney Island WPCP after a storm event for treatment. This Wet Weather Operating Plan (WWOP) will provide guidance to the Paerdegat Basin Water Quality Facility (Facility) operating personnel and assist them in making operational decisions which will best meet the performance goals and SPDES permit requirements of the Facility and Coney Island WPCP. The procedures presented in this WWOP were developed during the Facility design and will be modified as necessary based on operating experience.

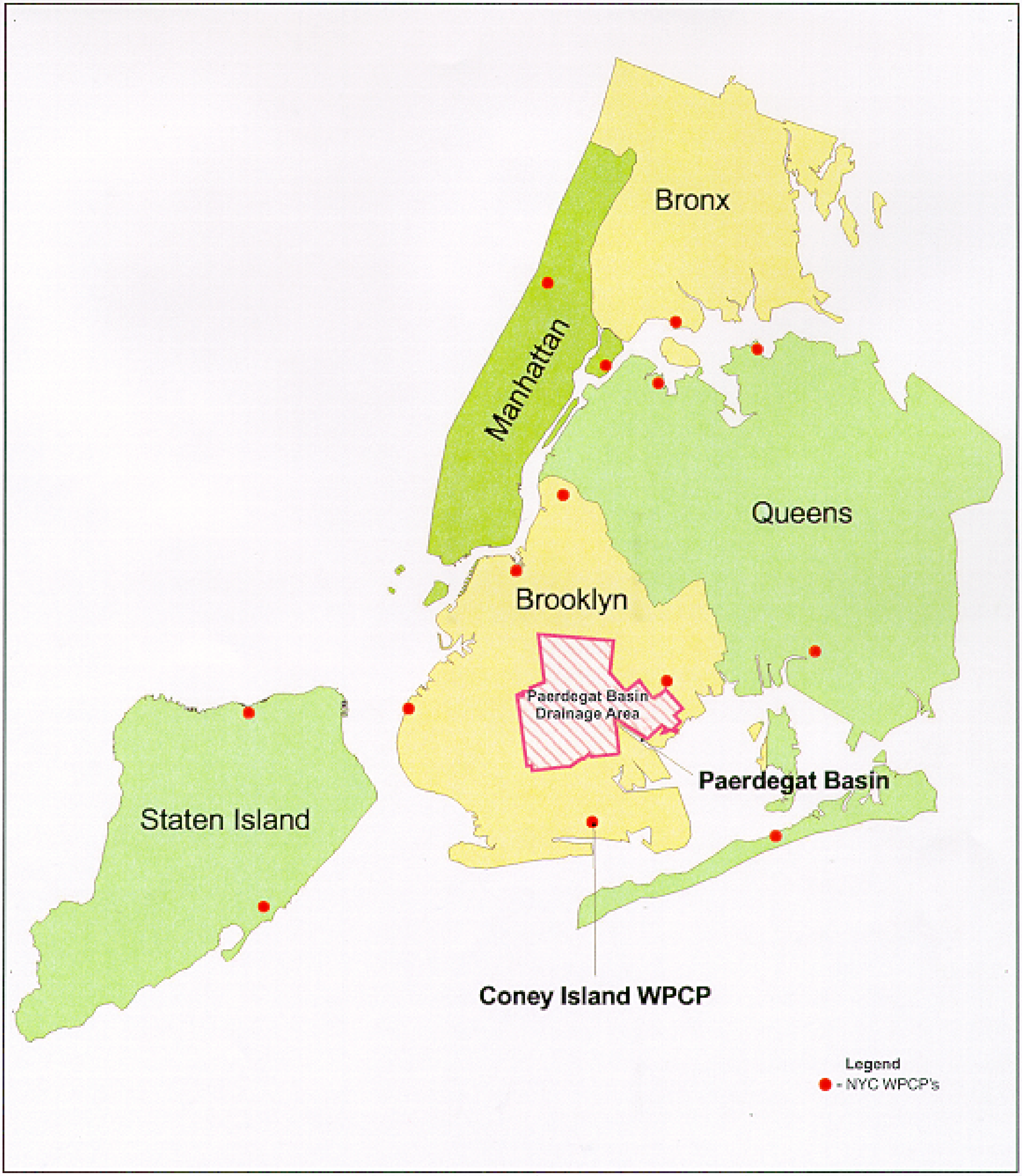
This WWOP also describes the Facility and how the Facility operates to achieve two major goals; the maximum use of existing facilities (combined sewers, interceptors and treatment plants) and reduction of CSO volume discharged to Paerdegat Basin.

1.1 Background Of The Existing System

Coney Island WPCP has a permitted dry weather capacity of 110 million gallons per day (mgd) and a wet weather capacity of 220 mgd. The two main sewer systems that flow to the Coney Island WPCP are the Coney Island System and the Paerdegat Basin/Canarsie System. The Coney Island Sewer System has a near constant flow of approximately 40 mgd, which is predominantly sanitary sewage, with some ground water infiltration. As a consequence, the wet weather flow does not vary significantly from the dry weather flow and therefore the flow from this system is not "throttled" at the WPCP during wet weather events.

The Paerdegat Basin/Canarsie System drainage area is approximately 6,189 acres, of which 85% is served by combined sewers and 15% by separate sanitary and storm sewers (Figure 1). There is a near constant sanitary flow of 13 mgd from the Avenue "M" pumping station which is in the Canarsie drainage area and from regulators R1, R2, R3, R4, and R6 in the combined sewer system. The sewage from the Avenue "M" pumping station and from regulators R2, R3 and R4 flow to the Paerdegat Pumping Station, which pumps this flow to the Coney Island WPCP 120-inch interceptor under Ralph Avenue (Figure 2). The flow through regulators R1 and R6 bypasses the Paredegat Basin Pumping Station and enters the interceptor directly by gravity.

During wet weather events, the Paerdegat Pumping Station has a maximum combined sewage pumping capacity of 57 mgd. The majority of the remaining Coney Island WPCP wet weather capacity, 113 mgd, comes from the Paerdegat Basin drainage area combined wet weather flow that enters the Coney Island WPCP interceptor by gravity. Regulator 1 drains an area of 2,483 acres, the largest sub-drainage area in the Paerdegat Basin system and Regulator 6 drains an area of 657 acres. There are also local sewers that discharge to the 120-inch interceptor without passing through any of the regulators. If the WPCP flow capacity is exceeded the influent gates on the Paerdegat Basin/Canarsie System side of the Coney Island plant are "throttled" by the operator and the excess combined sewage flow is currently discharged through the regulators to three large combined sewer outfalls that discharge to Paerdegat Basin.



Paerdegat Basin Water Quality Facility Drainage Area

New York City
Department of Environmental Protection

Paerdegat Basin Water Quality Facility Wet Weather Operating Plan

FIGURE 1

H&S File: 6006/5011Wp1-RegulatorsC1.Cdr 5/13/03

Regulators, Existing Outfalls and Coney Island WPCP Interceptor

New York City
Department of Environmental Protection

Paerdegat Basin Water Quality Facility Wet Weather Operating Plan

FIGURE 2

1.2 Performance Goals For Wet Weather Events

The Facility offers a number of pollution control functions and operational benefits. The Facility includes:

- Full capture of wet weather events up to 50 mg with subsequent gravity flow and pump back of the captured CSO to the interceptor for treatment at the Coney Island WPCP.
- Screening and settling of the captured CSO.
- Multiple overflow paths consisting of retention tank effluent weirs and an influent channel side relief weir to convey peak storm flows of 3,000 mgd.
- Hydraulic cleaning of CSO storage tanks using flushing gate technology.
- Retention tank isolation gates to allow for servicing and cleaning of each tank.
- Simultaneous flow into all operable retention tank bays for select storms to maintain a high initial flow velocity to minimize solids settling in the sewers and influent channels.
- Retention tank weirs at an elevation to allow gravity flow of a portion of the tank volume back through the sewer regulators to the Coney Island WPCP interceptor after a wet weather event.

1.3 Description Of The Paerdegat Basin Water Quality Facility

Two essential elements of the Facility design were the maximum use of existing facilities (combined sewers, interceptor and treatment plant) and reduction of CSO volume. The Facility consists of the following elements, which are described in greater detail in the following section.

1. Underground, off-line CSO Retention Tanks with a capacity of 30 million gallons and controlled pump back to the Coney Island WPCP. Of this 30 mg, 20 mg will be stored in the Facility retention tanks and 10 mg will be stored in the influent channels leading to the Facility.

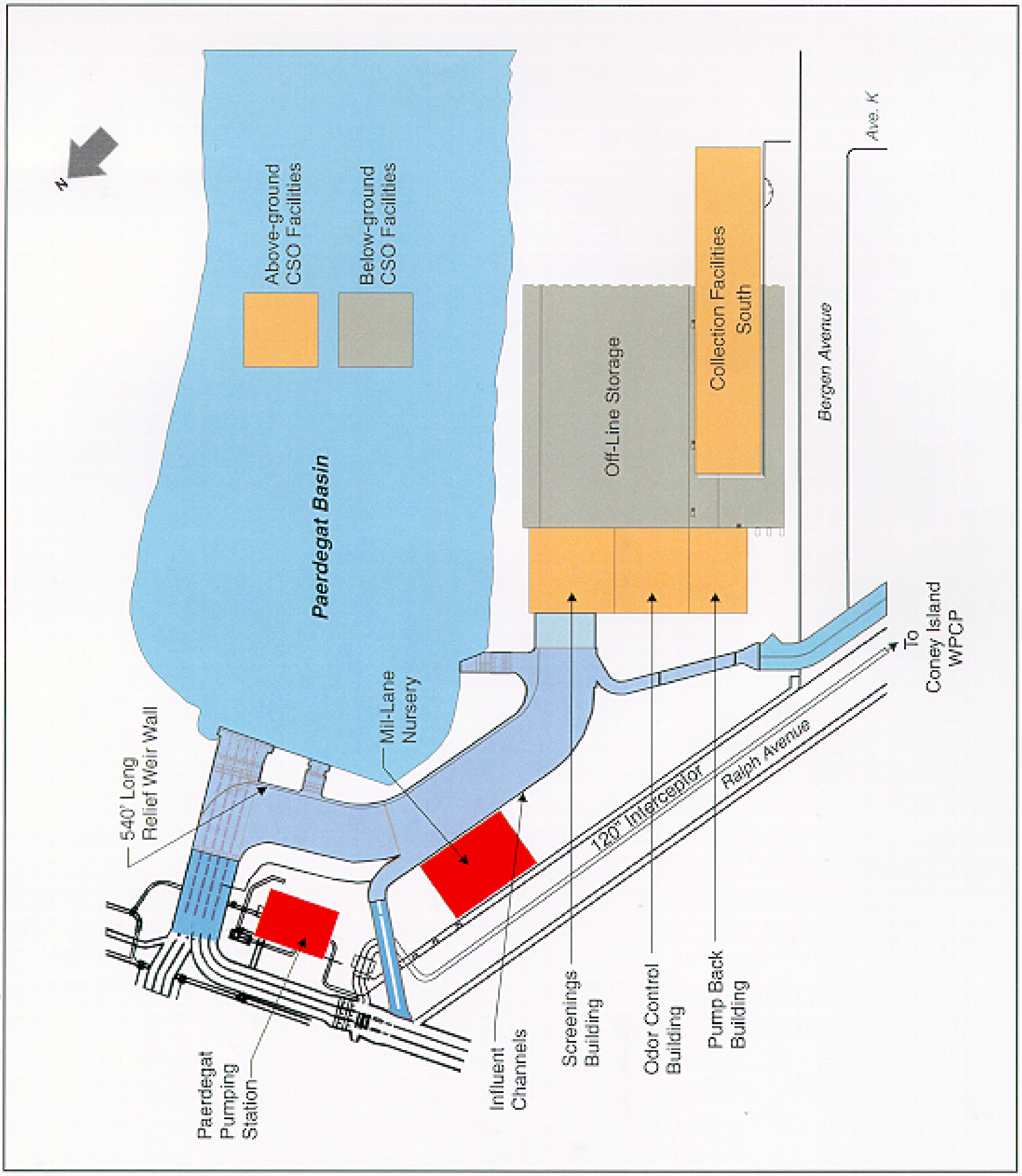
2. In-line sewer storage of up to 20 million gallons of CSO in the combined sewers upstream of the regulators.

3. Modifications to sewer regulators to insure that wet weather flow to the Coney Island Water Pollution Control Plant (WPCP) is maximized.

The CSO Facility will consist of the following structures (See Figure 3):

- Influent Channels
- Screenings Building
- CSO Retention Tanks
- Odor Control Building
- Pump Back Building
- Collection Facility South Building including Community Board 18 Office space.

The Paerdegat Basin Water Quality Facility (Facility) is operational only during wet weather and was designed to function with the minimum of operator control. The Facility operations will be automated and monitored by the operator through control panels in the Facility. The Facility is



Paerdegat Basin Site Plan

New York City
Department of Environmental Protection

Paerdegat Basin Water Quality Facility Wet Weather Operating Plan

FIGURE 3

designed to capture five out of seven storm events per month and provide screening and settling of overflows in excess of available retention tank capacity for flow rates up to 3,000 mgd. The weir relief system will prevent flooding of the Facility if pump back has not been completed prior to the next wet weather event or if a power outage prevents CSO pump back. Tide gates in each one of the outfall locations will prevent tidal flow from entering the Facility retention tanks.

The CSO that currently discharges to Paerdegat Basin will be diverted to the Facility retention tanks from the five existing re-designed regulators. CSO will flow by gravity through the influent channels, to mechanical screens in the screening building, and after passing through the screens will simultaneously enter each underground retention tank in service through dedicated tank influent channels. Each tank is designed with two bays, two tank influent channels, an overflow weir system, a flushing gate system, and a system of tank baffles. Settable material will settle to the bottom of the tanks and flotables that pass through the screens will be captured by the tank baffles. After a wet weather event CSO retained in the tanks will be pumped back to the Coney Island WPCP through the plant interceptor under Ralph Avenue. The odor control system will remove hydrogen sulfide from the Facility air (See Figures 3 and 4).

1.3.1 Influent Channels and Side Weir

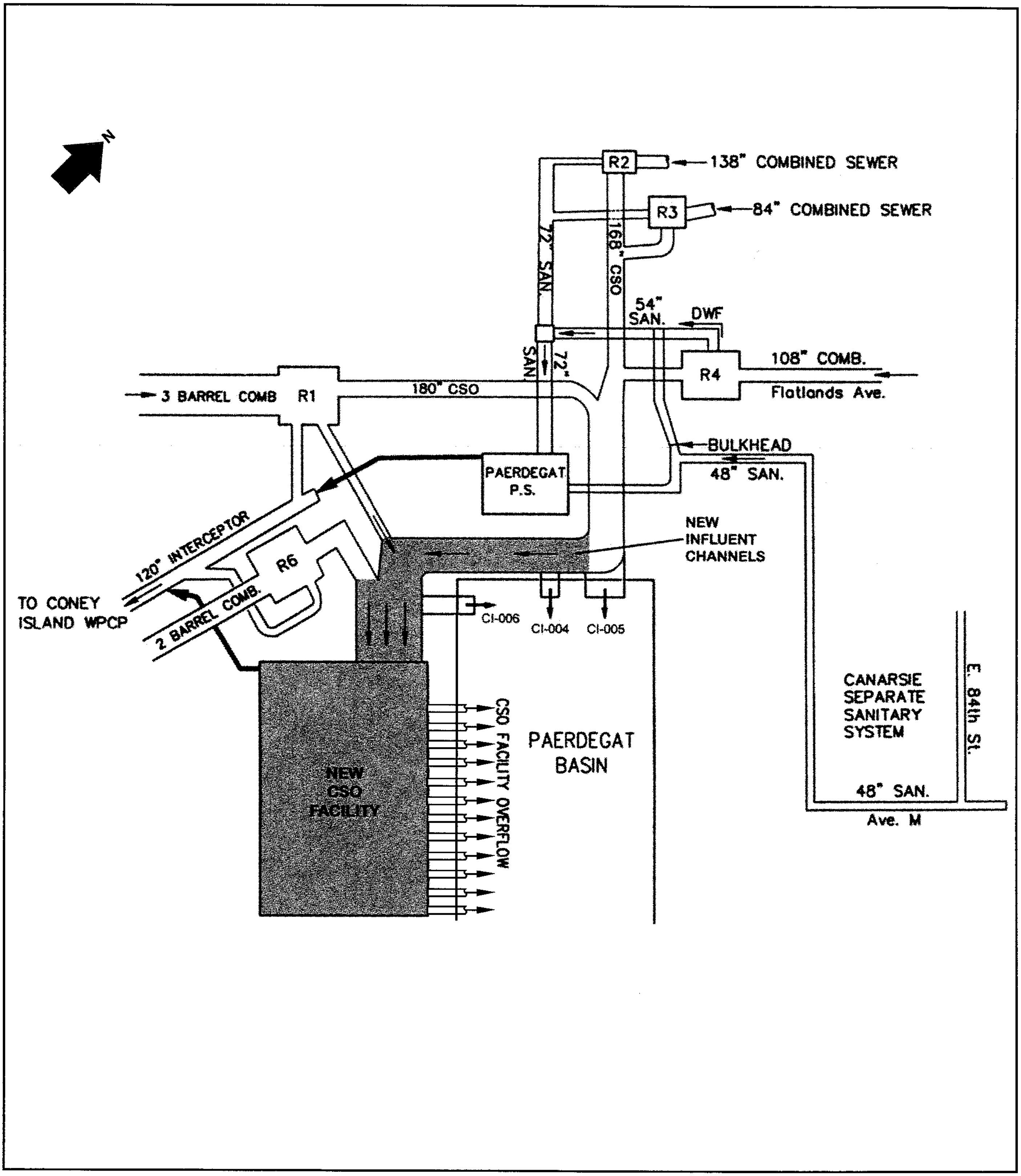
The existing sewers in the Facility drainage area have the capability of delivering up to 3,000 mgd during extreme high intensity rain events. However, based on the knee-of-the-curve cost benefit analysis, the Facility retention tanks were designed for a peak flow rate of 1,500 mgd. As a consequence, the influent channel was designed with side relief weirs with a capacity of 3,000 mgd to allow for discharge to the Basin of peak flows in excess of the tanks capacity. A 540-foot long relief weir wall running the length of the influent channels at elevation +2.8 will allow the discharge of CSO to the Basin through three outfall locations. The 540-foot long relief weir and three outfall locations are shown in Figure 3.

1.3.2 Screening Building

The CSO enters the retention tanks through isolation sluice gates and screens located in the Screening Building. The sluice gates can be closed by the Operator to isolate individual retention tanks for maintenance. The lower level of the Screenings Building will have six (6) screen channels, each with an inclined, mechanically cleaned automatically activated bar screen. Bar screens are automatically activated by ultrasonic level sensors that measure the water level in the bar screen channel before and after the screens. In addition to upstream isolation provided via a sluice gate, each screen channel will include stop log grooves for downstream isolation to facilitate periodic channel cleaning and screen maintenance.

Normal screenings disposal will be by belt conveyor to a roll-off filter container. A container handling system, located below the conveyor discharge, will index the container back and forth to achieve distribution of screenings within the filter container. Screenings will be removed and hauled off-site in covered, roll-off filter containers.

In the event that either the belt conveyor or container handling system is unavailable for service, Facility personnel will need to intervene and initiate screenings discharge to auxiliary (satellite)



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Sewer System Schematic

New York City
Department of Environmental Protection

containers, each with nominal one cubic yard capacity. In this case, Facility personnel will place the auxiliary chutes into position to span the conveyor and permit transfer of screenings from the bar screen aprons to the auxiliary containers.

Eight (8) slide gates are located within the Screening Building, immediately upstream of the CSO tank inlet channels. Each of the CSO retention tanks has two influent channels each with its own slide gate. In addition to upstream isolation provided via the slide gates, each CSO tank inlet channel will include stop plank grooves for upstream isolation to facilitate periodic tank inspection and maintenance.

1.3.3 Retention Tanks

Each of the four Facility retention tanks has two-bays, each bay consisting of forty-foot clear span. The invert of the tanks will be el. -26.00 sloping to central drainage channels. CSO will flow from the Facility inlet channels (two per tank) and will simultaneously enter the head of the first bay of each tank in service (see Figure 5). The initial storm flow to the tanks will carry a higher volume of heavy grit materials, therefore the tank inlets were be designed with a 10-foot drop into the tanks to prevent solids from settling in the Facility influent channels. Manhole access points will be provided in the inlet channels.

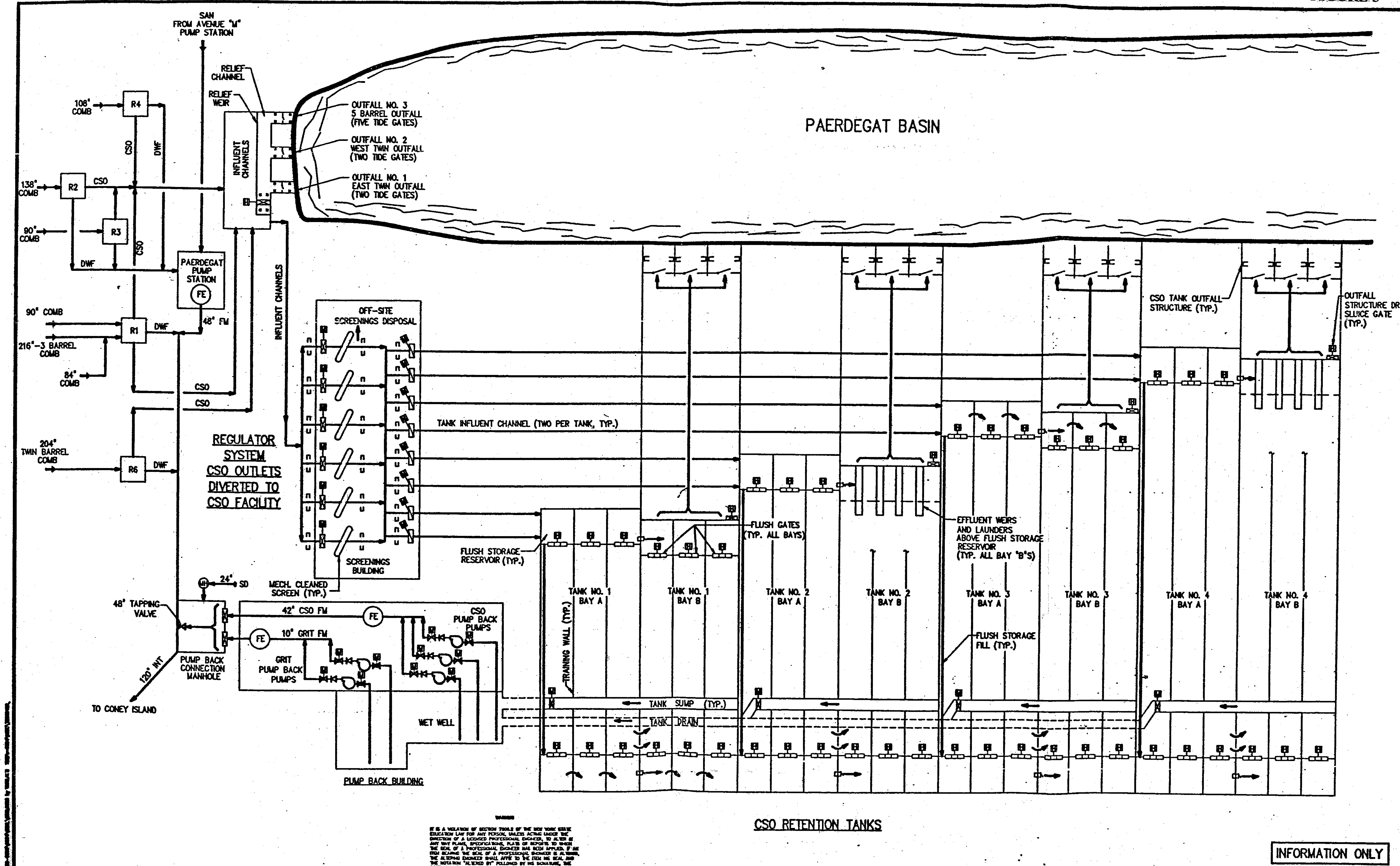
As each tank fills, CSO flow will enter reservoir areas located behind flushing gate structures in each tank. After the tanks are emptied, CSO retained in these reservoirs will be used to clean the tanks. Each of the four tanks has twelve gates, six at each end, that control the CSO stored in each reservoir. When opened sequentially, the hydraulic wave action of the released CSO will push settled solids to the tank sump and further downstream to the wet well in the Pump Back Building.

During rain events, CSO flows will fill the tanks to el. +2.0, the level of the tanks overflow weirs. Storm runoff in excess of the retention tank capacity will be discharged to Paerdegat Basin through tide gate chambers associated with each tank. Most of the particulates in the CSO flow will have sufficient time to settle out in the CSO retention tanks prior to discharge.

A tank overflow monitoring system will determine the quantity and quality of overflow discharged to Paerdegat Basin to ensure compliance with the Coney Island Water Pollution Control Plant's NYSDEC SPDES Discharge Permit. The overflow quantity will be measured using two ultrasonic level sensors that will monitor the differential water levels at two locations as overflow leaves the tank. One of two weir equations (i.e., normal/submerged weir equations) will automatically calculate the overflow volume at each location and these data will be processed and stored in one of the Area Process Control Panel's (APCPs) Redundant Processors. The APCPs will transmit these data to the Facility's Central Control Room computers to be archived on long term storage media, displayed on the computer workstations and report printers.

Overflow quality will be determined at four locations using automatic samplers to collect grab and composite samples according to criteria established in the SPDES discharge permit. Sampling will be automatically initiated when an overflow is detected by the level sensors.

FIGURE 5



INFORMATION ONLY

DESIGNED E.P.P. | DRAWN D.S. | CHECKED E.P.P. | SECT. CHIEF A.S.M. | PROJ. ENGR. A.M.

SCALE AS NOTED

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CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF ENVIRONMENTAL ENGINEERING
DIVISION OF FACILITIES DESIGN
WP-169 CITY WIDE CSO FACILITIES

PAERDEGAT BASIN WATER QUALITY FACILITY
CONTRACT CSO-4B-FOUNDATIONS AND SUBSTRUCTURES
GENERAL
CSO FLOW DIAGRAM

DATE AUGUST 2001
DWG. NO. 2G-G-GL006

Hourly rainfall would be measured by an on-site rain gauge. The rain gauge sensor signal is wired to one of the APCPs and displayed in the control room computer workstations.

Based on the collected overflow data, water quality results and rainfall data, DEP personnel will then prepare monthly operating reports and annual CSO Best Management Practice (BMP) reports, according to SPDES discharge permit requirements.

1.3.4 Pump Back

The CSO and grit retained in the retention tanks will be pumped back to the Coney Island WPCP through the 120-inch Coney Island WPCP interceptor. Three (3) pumps (two operating, one standby) will pump CSO flow from the Pump Back Building wet well through a 42-inch force main to a collection manhole. The collection manhole is located adjacent to the connection manhole, which connects into the 120-inch Coney Island WPCP interceptor located under Ralph Avenue. Two (2) grit pumps (one operating, one standby) will remove solids from the Pump Back Building wet well through a 10-inch force main into the collection manhole. Two (2) portable grit pumps will also be available at the Facility as additional backup.

The rate of CSO pump back will depend on the capacity of the Coney Island WPCP to accept the flow after a wet weather event. The pump back will be initiated by a telephone call from the Coney Island WPCP. The water level in the interceptor will be monitored automatically in the Facility by a level switch located in the connection manhole. The level switch will provide a "permissive" to the Facility operator to manually start the pumps in the Pump Back Building wet well. If the water elevation in the interceptor is above the level switch set point the wet well pumps will not go on. After pump start up, the level switch will automatically stop the pumps if the water level in the interceptor rises above the level switch set point. The pumps will operate on a lead/lag basis determined by the water level in the wet well. The control system will automatically select the lead, lag, and the pumps to be used based on a least run time algorithm. The pumps will be ramped up to maximum speed when the level in the wet well is at el. –4.28 feet. The pump speeds will be gradually slowed as the level in the wet well is reduced, and pump shut down will occur when the level in the wet well reaches el. –31.5 feet.

After an adjustable time delay of 2 minutes, one of the two grit pumps is automatically turned on and the remaining CSO in the wet well is pumped to the interceptor. When the level in the wet well reaches el. –39.13 feet, flushing gates in the CSO retention tanks are sequentially opened and the CSO and grit entering the wet well is pumped to the interceptor. At wet well el. –39.5 feet, the wet well service water spray header valve is automatically activated to clean the wet well. The spray header valve closes when the wet well level reaches el. –41.88 feet and the operating grit pump is stopped.

1.3.5 Odor Control Building

The Odor Control Building will contain odor control equipment, boiler room, HVAC equipment and electrical equipment. The odor control system consists of five carbon vessels that will remove hydrogen sulfide (H_2S) from the Facility and vent the scrubbed air to the atmosphere.

The Odor Control System (OCS) consists of five (5) exhaust air trains. Each of the exhaust air trains controlled motorized equipment includes: inlet and outlet dampers for isolating the train's activated carbon vessel and the train's variable speed blower/fan (B/F) with a isolating discharge damper.

The OCS processes odorous air from the following Facility areas:

- Screening Building and its screen channels,
- Retention Tanks including their individual influent channels and
- Pump Back Building's wet well.

1.4 Purpose Of This Plan

The purpose of this Wet Weather Operating Plan (WWOP) is to provide guidance to the Paerdegat Basin Water Quality Facility (Facility) operating personnel and to assist them in making operational decisions which will best meet the performance goals and SPDES permit requirements of the Facility and Coney Island WPCP. During a wet weather event there are some operational decisions that must be made at the Facility and at the Coney Island WPCP to effectively manage and optimize treatment of wet weather flows. The different durations and intensities of each wet weather event produce unique combinations of flow and treatment conditions, which must be taken into consideration. In spite of the unique nature of individual wet weather events this WWOP will serve as a useful reference tool for both new and experienced operators before, during and after a wet weather event. This WWOP will be useful in preparing for a wet weather event, for controlling equipment during an event, and as a checklist to prevent the omission of critical operational steps. Of critical importance is the rate of captured CSO pump back to the Coney Island WPCP after a wet weather event.

1.5 Using This Plan

Section 2.0 of this plan is designed to provide operator guidance before, during and after wet weather events. Each subsection covers a major unit process and describes specific protocols for operation of process equipment. The protocols include the following information:

- Actions to be taken prior to a wet weather event and who is responsible;
- Actions to be taken during a wet weather event and who is responsible;
- Actions to be taken after a wet weather event and who is responsible;
- Why these actions are performed;
- Conditions or circumstances that trigger a change in operations; and
- Identification of what can go wrong with process equipment.

1.6 Revisions To This Plan

This WWOP will be revised based on Facility operating experience and modifications to the Coney Island WPCP that effect the plant's ability to receive and treat wet weather flows.

2.0 FACILITY WET WEATHER OPERATIONAL PROCEDURES AND GUIDELINES

This section presents equipment summaries and wet weather operating protocols for each major unit in the Facility. The protocols are divided into procedures to be followed before, during and after a wet weather event. Also addressed are the bases for the protocols (Why we do this?), events of observations that trigger the protocols (What triggers the change?) and a discussion of potential problems (What can go wrong?).

2.1 Influent Channels Relief Overflow Weirs

2.1.1 Major Mechanical Equipment

UNIT	EQUIPMENT
Outfall Chamber No. 1	Number: 2 – Tide Gates Size: 11'-0" wide, 9'0" high
Outfall Chamber No. 2	Number: 2 – Tide Gates Size: 9'-9" wide, 9'-0" high
Outfall Chamber No. 3	Number: 5 – Tide Gates Size: 9'-9" wide, 9'-0" high

2.1.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Inspect for debris wedged in gates
During Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• No action
After Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Check gates for damage • Repair gates as necessary • Remove debris wedged in gates
Why do we do it?		
To prevent back flow of Basin water into Facility during high tide.		
What Triggers a Change?		
Damage to a tide gate requiring maintenance or debris wedged in gate		
What Can Go Wrong?		
Tide gate damage/failure, large flotable material blocking tide gate		

2.2 In-Line CSO Storage

When the CSO retention tanks are full an additional 20 mg of CSO can be stored in the drainage area trunk sewers upstream of the regulators. The tank relief weirs and the relief weirs in the influent channel prevent upstream flooding. **There is no equipment to be operated prior to or during a wet weather event and there is no operating protocol.**

2.3 Screenings Building

2.3.1 Major Mechanical Equipment

UNIT	EQUIPMENT
Relief Weir Sluice Gate (Outside Building)	Number: 1 Size: 48" x 48" Operator: Electric/hydraulic
Stop Planks Screen Inlet Channels (Outside Building)	Number: 6 Size: 9'-0" wide x 18'-0" high
Sluice Gates – Screen Inlet Channels	Number: 6 Size: 9'-0" wide x 12'-6" high Operator: Electric Ultrasonic level sensors
Mechanically Cleaned Bar Screens	Number: 6 Size: 9'-0" wide Screen Opening Size: 1¼" Screen angle of Inclination: 80 degrees Invert Elevation: -9.36 Design Water Surface Elevation: 3.74 Operating Floor Elevation: 17.50 Motor Size: 7.5 HP
Screenings Belt Conveyor	Number: 1 Belt Width: 36" Belt Type: Flat, Cross-rigid w/sidewalls Configuration: Flat w/ transition to 13° incline Conveyor Loading: 300 CF/HR (75 lbs/ft^3) Motor Size: 3 HP
Stop Planks – Screen Outlet Channels	Number: 6 Size: 9'0" wide x 18'-0" high
Stop Planks – Tank Inlet Channels	Number: 8 Size: 8'-0" wide x 18'-0" high
Slide Gates – Tank Inlet Channels	Number: 8 Size: 8'-0" wide x 14'-0" Operator: Electric
Hoist and Trolley No. 1 – Stop Logs (Downstream of Screens)	Number: 1 Capacity: 2 tons Type: Electric Monorail Configuration: U-shaped
Hoist and Trolley No. 2 – Above Bar Screens	Number: 1 Capacity: 3 tons Type: Electric
Hoist and Trolley No. 3 – Above Hatches	Number: 1

UNIT	EQUIPMENT
Upstream of Screens	Capacity: 2 tons Type: Electric
Screenings Containers (Main)	Number: 2 Type: Roll-off filter containers Capacity: 25 CY Capacity Above Filter Basket: 20 CY
Screenings Containers (Auxiliary)	Number: 12 Type: Satellite filter container w/pockets for forklift truck Capacity: 1.25 CY Capacity Above Filter Basket: 1.0 CY
Fork Lift Truck	Number: 1 Capacity: 6,500 lbs. Attachment: Rotator Capacity w/ Rotator: Approx. 5,000

2.3.2 Wet Weather Screening Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• All influent sluice gates are open • All screens are operational • All containers in place • Screen inlet channel stop logs removed
During Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Monitor equipment • Remove full containers as necessary • Check screens for damage
After Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Check screens for damage • Repair screens as necessary • Replace screenings containers
Why do we do it?		
To prevent flooding of screening building and to maximize flow into retention basins		
What Triggers a Change?		
Damage to a screen requiring maintenance		
What Can Go Wrong?		
Screen damage/failure, large flotable material blocking a screen channel		

2.4 CSO Retention Tanks

2.4.1 Major Mechanical Equipment

UNIT	EQUIPMENT
Flushing Gates	Number: 12 per tank, 48 total Size: 9'-2" x 1'-4" Type: Hydraulic
Hydraulic Power Packs	Number: 1 per tank; 4 total
Tank Drain Sluice Gates	Number: 1 per tank; 4 total Size: 48" wide x 36" high Operator: Electric
Outfall Drain Sluice Gates	Number: 1 per tank; 4 total Operator: Electric/hydraulic
Tank Outfall Tide Gates	Number: 3 per tank; 12 total
Automatic Samplers	Number: 1 per tank , 7 total (3 at Regualtors)
Rain Gauge	Number: 1 total

2.4.2 Wet Weather Operating Protocol CSO Retention Tanks

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Check position of 48 tank flushing gates • Check position of 4 tank drain sluice gates • Check condition of tank outfall drain sluice gates • Check condition of tank outfall tide gates • Check condition of automatic samplers and rain gauge
During Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Monitor 12 tank flushing gates • Monitor 4 tank drain sluice gates • Monitor tank outfall sluice gates • Monitor event overflow volume, automatic overflow sampling, and event precipitation

After Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Coordinate CSO pump back with CI WPCP • Monitor Pumps • Monitor tank flushing system • Monitor grit pumps • Collect overflow samples from automatic samplers • Determine event overflow volume, retained volume, BOD (5-day), total suspended solids, settable solids, oil & grease, screenings, fecal coliform, and event precipitation • Prepare event data summary for incorporation into the monthly operating report and annual CSO BMP reports
Why do we do this?		
To maximize CSO retention in the Facility, fulfill Coney Island WPCP NYSDEC SPDES Discharge Permit requirements, prevent odors by flushing the tanks and to prevent CSO pump back from disrupting Coney Island WPCP treatment processes		
What Triggers Change?		
Coney Island WPCP initiates CSO pump back and water level in the interceptor confirmed		
What can go wrong?		
Coney Island WPCP cannot accept all CSO pump back prior to next wet weather event and water level in the 120-inch Coney Island WPCP interceptor is above the pump back set point		

2.5 Pump Back Building

2.5.1 Major Mechanical Equipment

UNIT	EQUIPMENT
CSO Pump Back Pumps	Number: 3 Type: Dry Pit Submersible Capacity and Head: 10,417 gpm @ 35 ft. VFD Size: 150 Hp
Grit Pump Back Pumps	Number: 2 Type: Dry Pit Submersible Capacity and Head: 2,000 gpm @ 72 ft.

UNIT	EQUIPMENT
	Motor Size: 75 HP
Portable Grit Pumps	Number: 2 Type: Wet Pit Submersible Capacity and Head: 800 gpm @ 72 ft. Motor Size: 20 HP
Dry Well Sump Pumps	Number: 2 Capacity and Head: 250 gpm @ 28 ft. Motor Size: 5 HP
Bridge Crane	Number: 1 Capacity: 5 tons Type: Electric
Hoist and Trolley –Upper Wet Well	Number: 1 Capacity: 5 tons Type: Electric
Service Water Pumps	Number: 2 Type: Horizontal, end suction Capacity and Head: 100 gpm @ 100 ft. Motor Size: 7.5 HP
Break Tank	Capacity: 3,000 gals.
Well Water Pump	Number: 1 Type: Submersible Capacity and Head: 350 gpm @ 340 ft. Motor Size: 40 HP

2.5.2 Wet Weather Operational Protocol Pump Back Building

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Check CSO pumps • Check Grit pumps • Check wet well level sensors
During Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Confirm operation of CSO pumps
After Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Coordinate CSO pump back with CI WPCP • Manually turn on pumps • Monitor CSO pumps and wet well levels • Monitor grit pumps
Why do we do this?		

Prevent CSO pump back from disrupting Coney Island WPCP treatment processes
What Triggers Change?
Coney Island WPCP operations. Change in interceptor water elevation.
What can go wrong?
Coney Island WPCP cannot accept all CSO pump back prior to next wet weather event

2.6 Odor Control Building

2.6.1 Major Mechanical Equipment

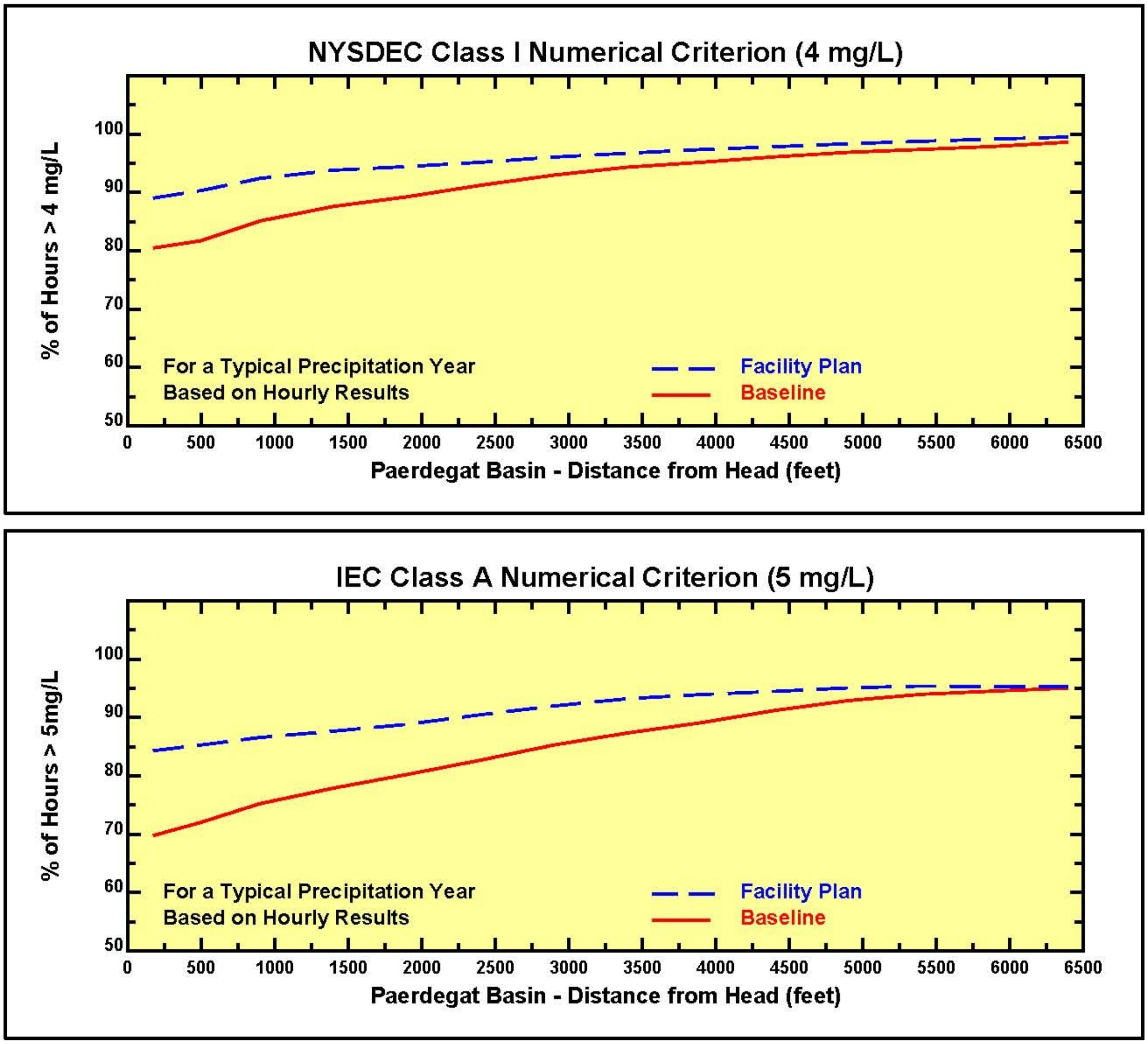
UNIT	EQUIPMENT
Odor Control Fans	Number: 5 Capacity: 36,000 cfm VFD Size: 150 HP
Carbon Vessel	Number: 5 Capacity: 36,000 cfm H_2S inlet concentration: 3.6 ppm Pressure Drop: 7.1 in. WC Carbon Volume per Vessel: 1,678 CF
Hoists and Trolleys (Above Carbon Vessels):	Number of Units: 10 Capacity: 1 ton Type: Electric

2.6.2 Wet Weather Operating Protocol

WHO DOES IT?		WHAT DO WE DO?
SUPERVISORY	IMPLEMENTATION	
Before Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Check Odor Control Fans • Check Instrumentation
During Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Monitor Operations
After Wet Weather Event		
Facility Shift Supervisor	Facility Operator	• Monitor System Operations during CSO and grit pump back
Why do we do this?		
To prevent hydrogen sulfide odors from escaping the Facility		
What triggers the change?		
Odor complaints from the surrounding neighborhood		
What can go wrong?		
Odor complaints associated with the Facility		

APPENDIX C

SUPPLEMENTAL WATER QUALITY MODELING RESULTS



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Department of Environmental Protection

Dissolved Oxygen Concentrations Percentage of Time Above Numerical Criteria 50 MG Storage (Facility Plan)

Paerdegat Basin Long-Term CSO Control Plan

FIGURE C-1

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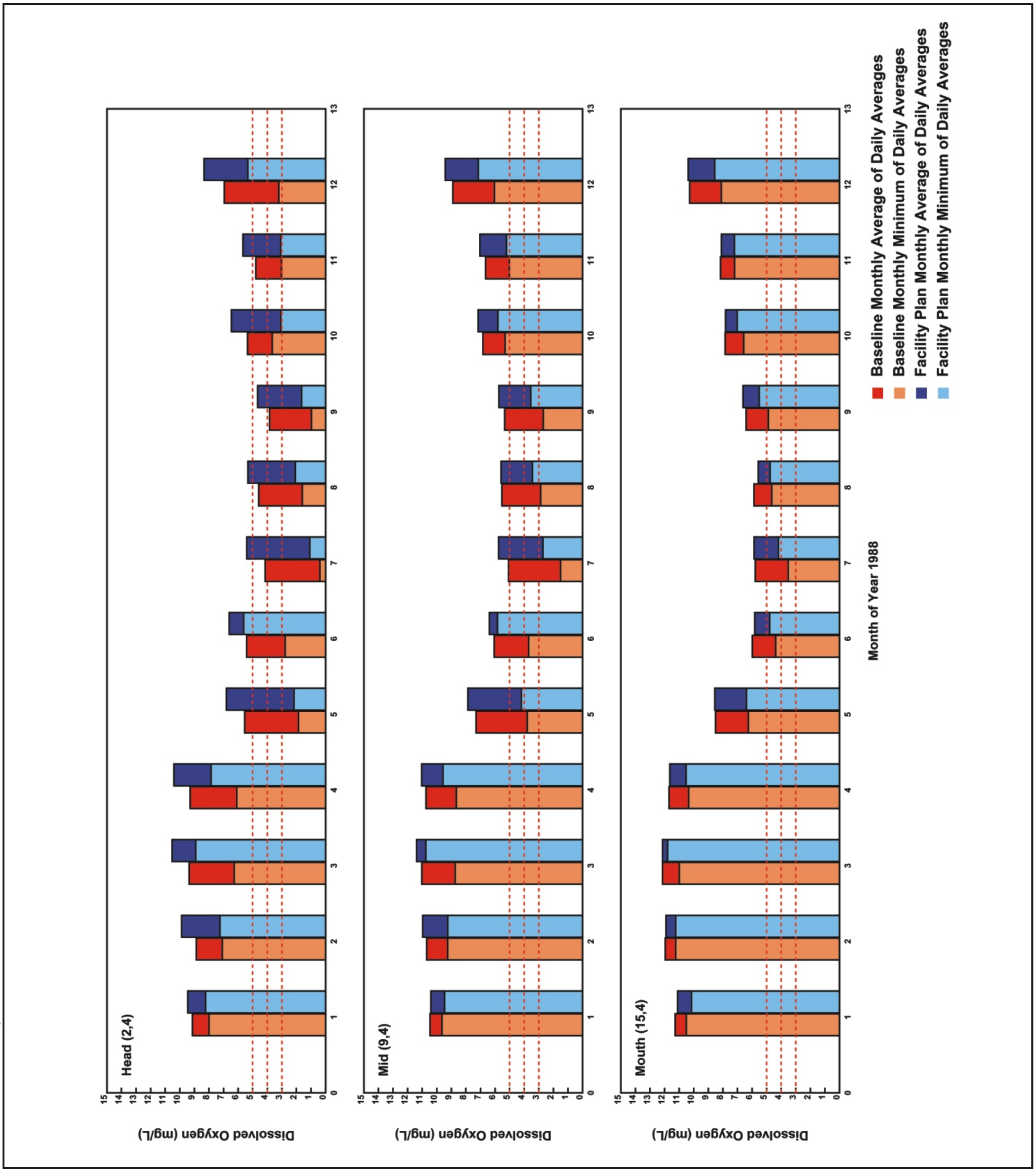

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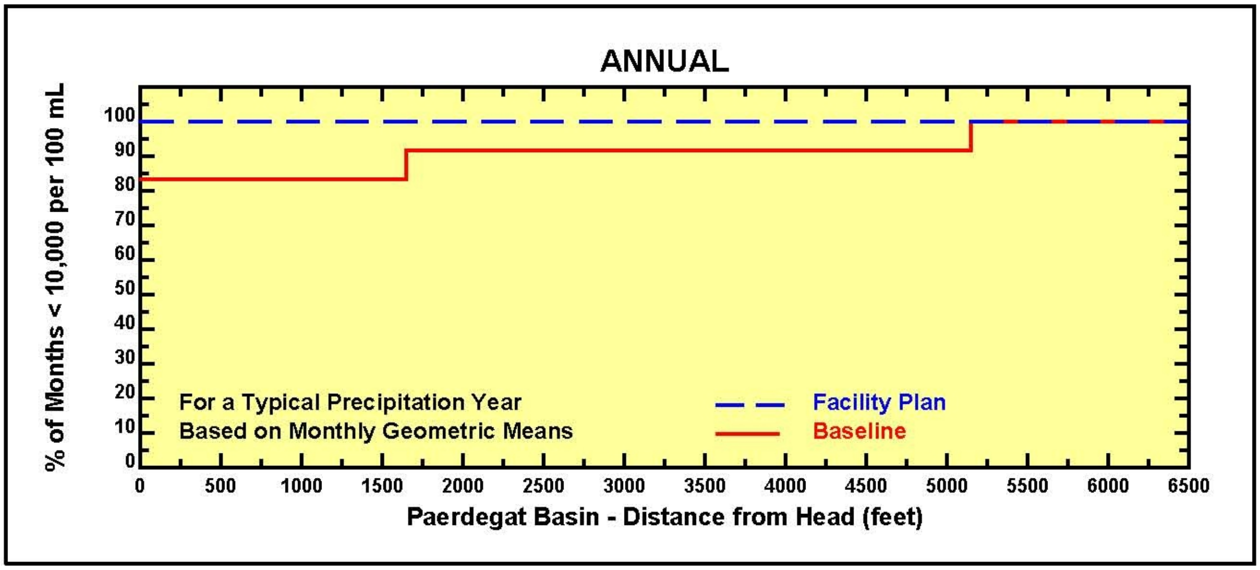
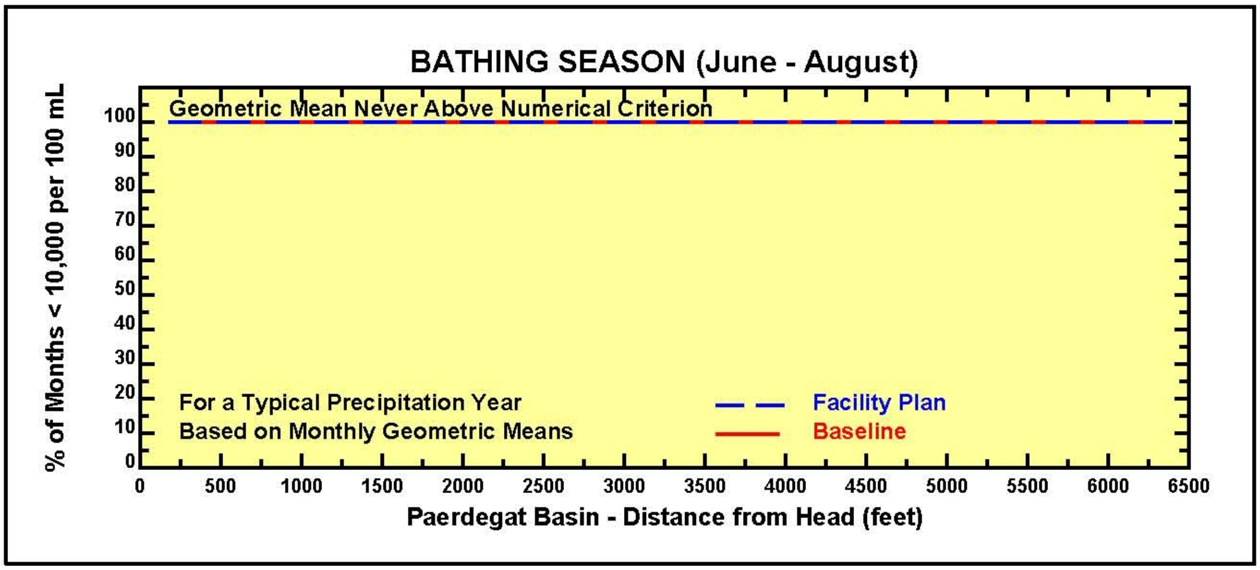
Department of Environmental Protection

Dissolved Oxygen Concentrations Monthly Average and Maximum Daily Average 50 MG Storage (Facility Plan)

Paerdegat Basin Long-Term CSO Control Plan

FIGURE C-2





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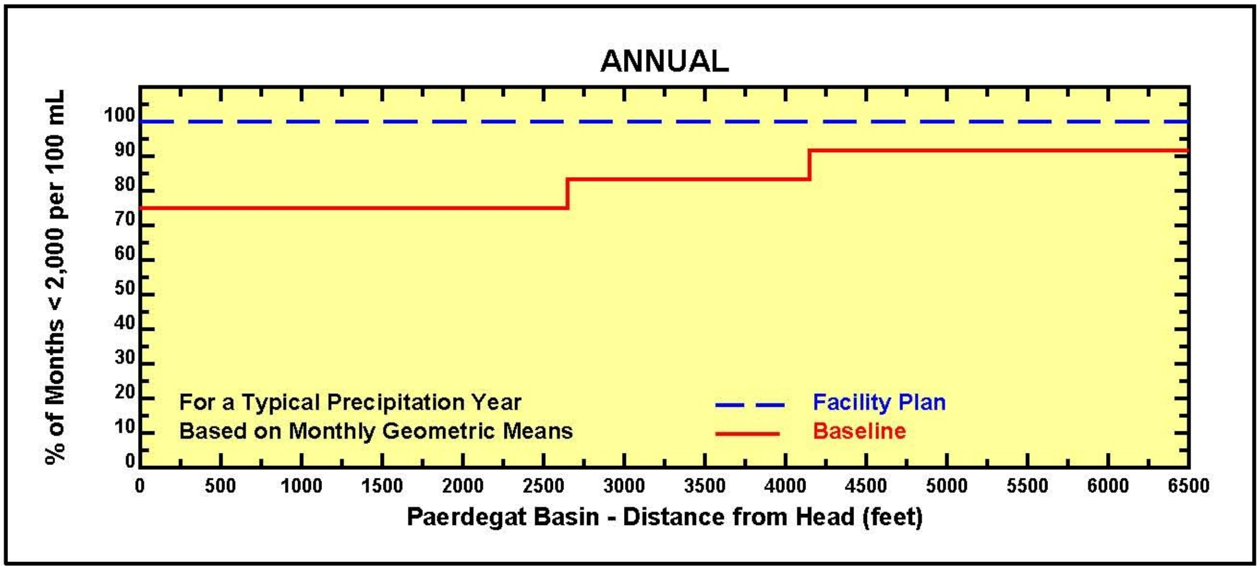
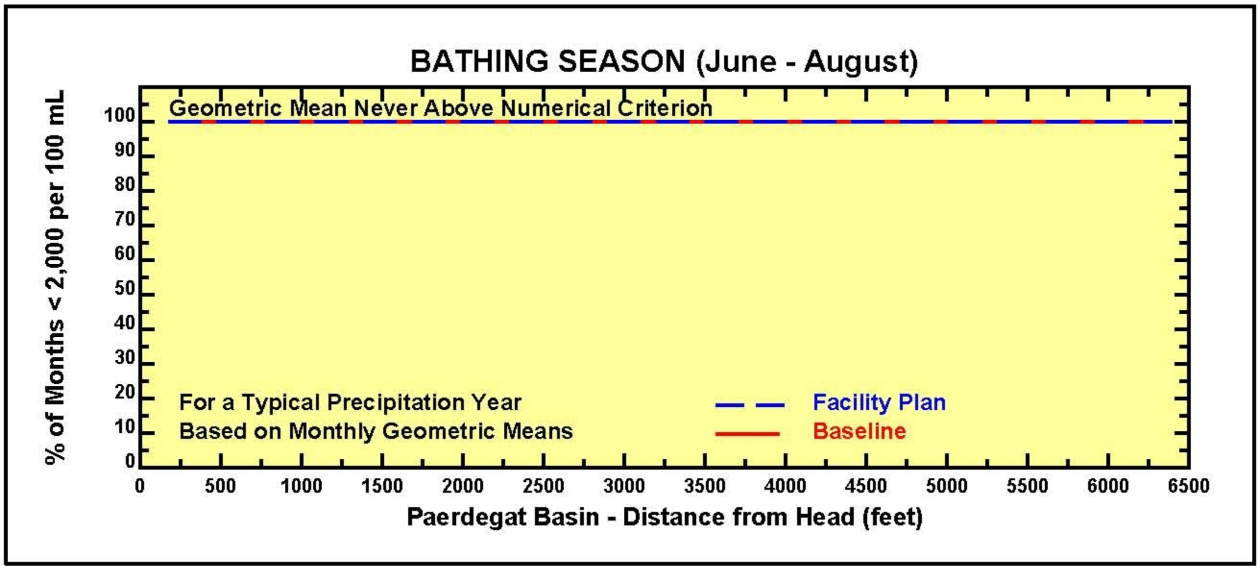
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Total Coliform Concentrations Percentage of Time Below Numerical Criterion 50 MG Storage (Facility Plan)

FIGURE C-3





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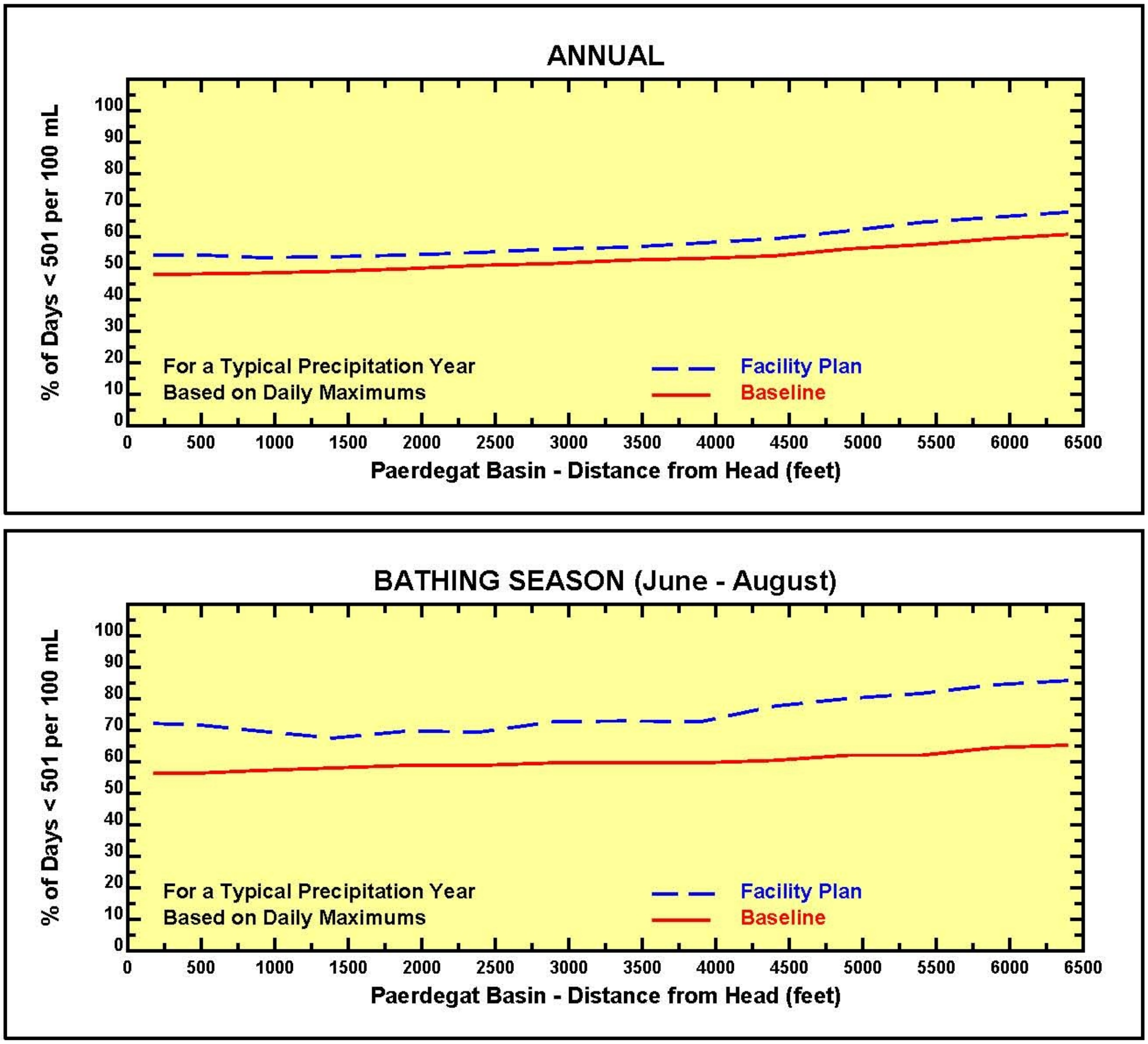
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Fecal Coliform Concentrations
Percentage of Time Below Numerical Criterion
50 MG Storage (Facility Plan)

FIGURE C-4



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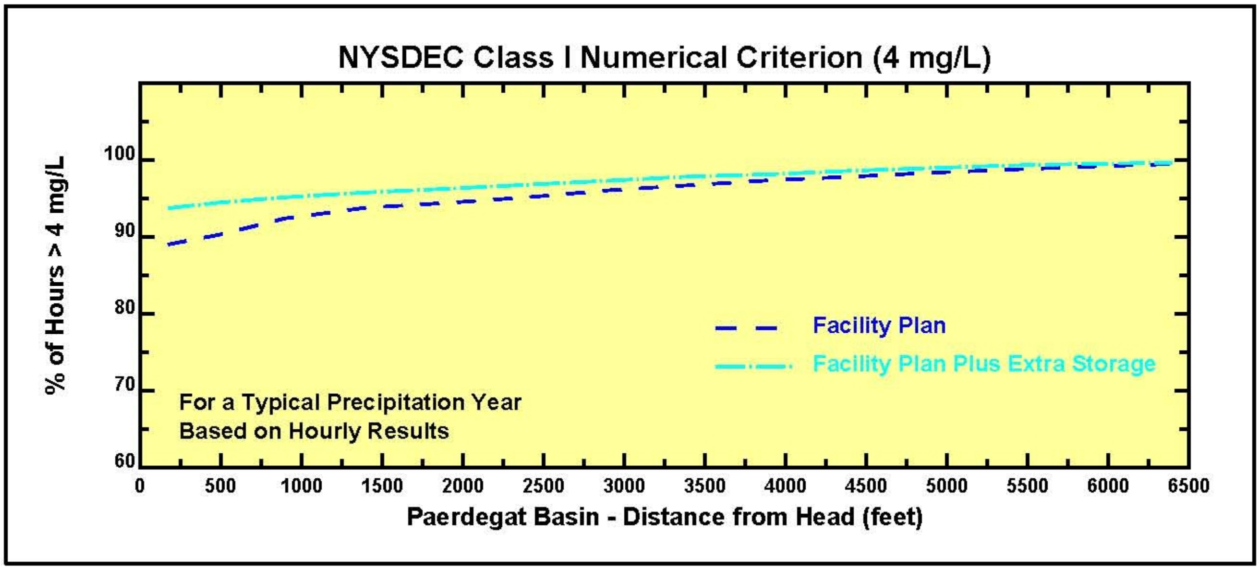
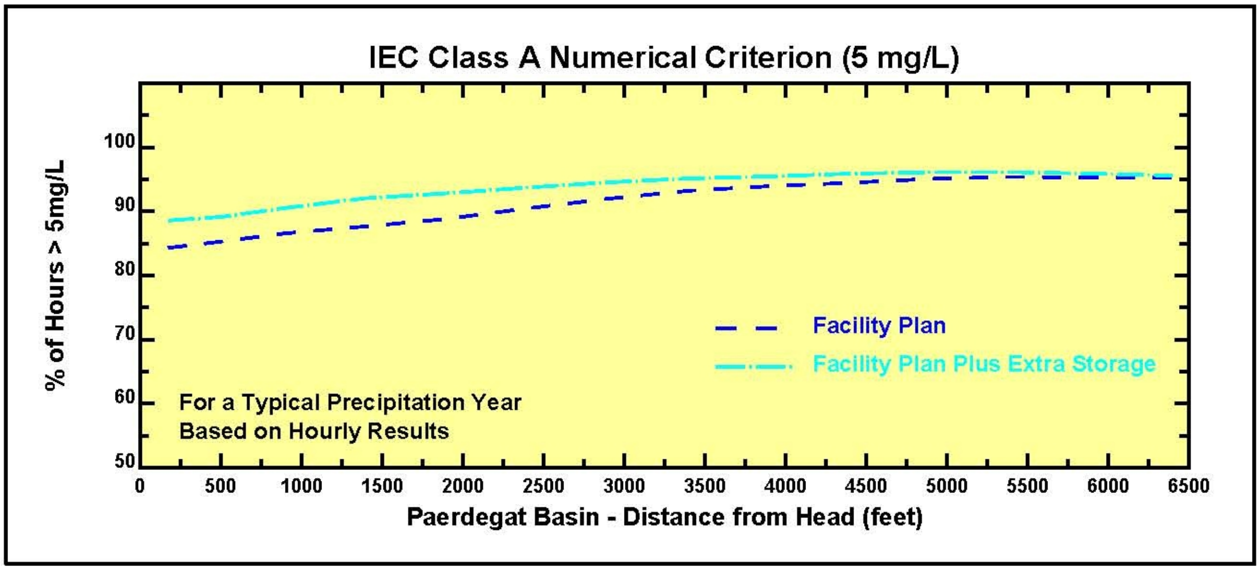
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Enterococci Concentrations
Percentage of Time Below Numerical Criterion
50 MG Storage (Facility Plan)

FIGURE C-5





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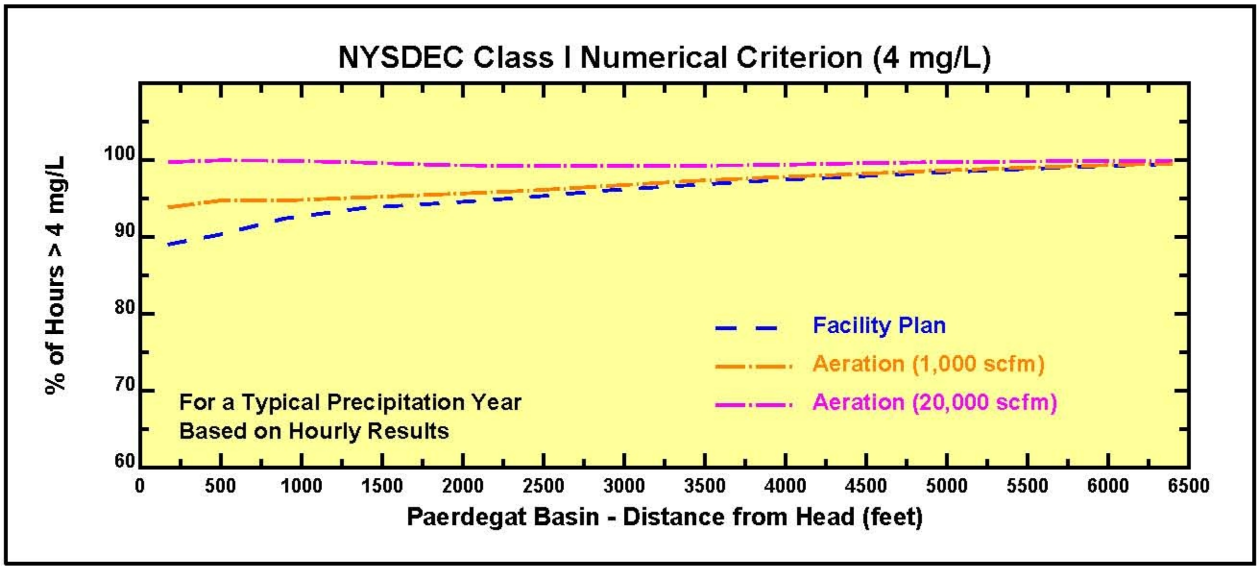
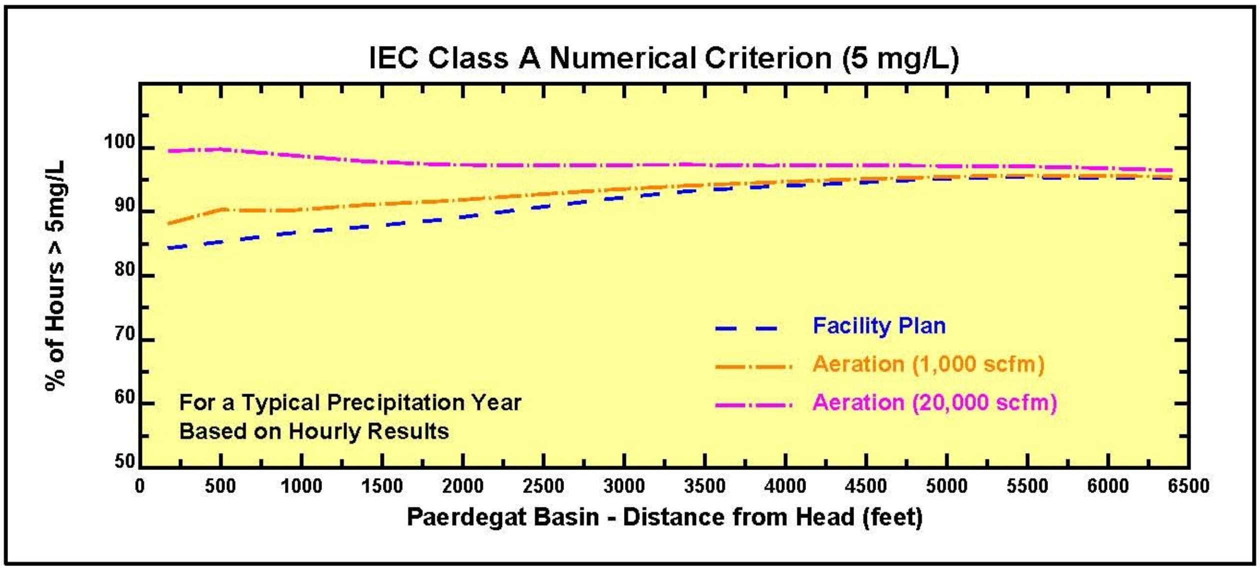
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Dissolved Oxygen Concentrations Percentage of Time Above Numerical Criterion Facility Plan + 20 MG

FIGURE C-6





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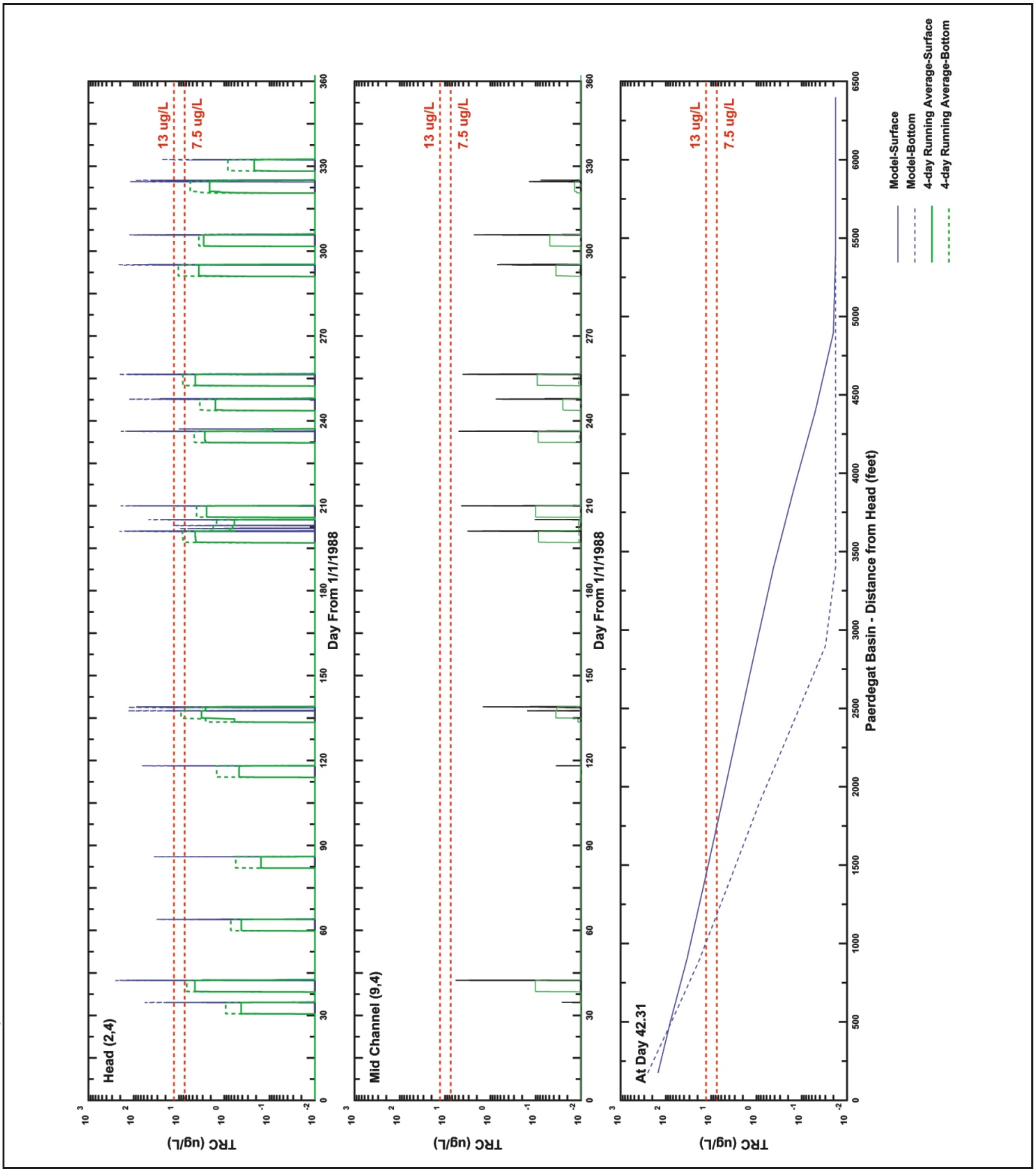
Department of Environmental Protection

Dissolved Oxygen
Percentage of Time Above Numerical Criterion
Facility Plan + Aeration

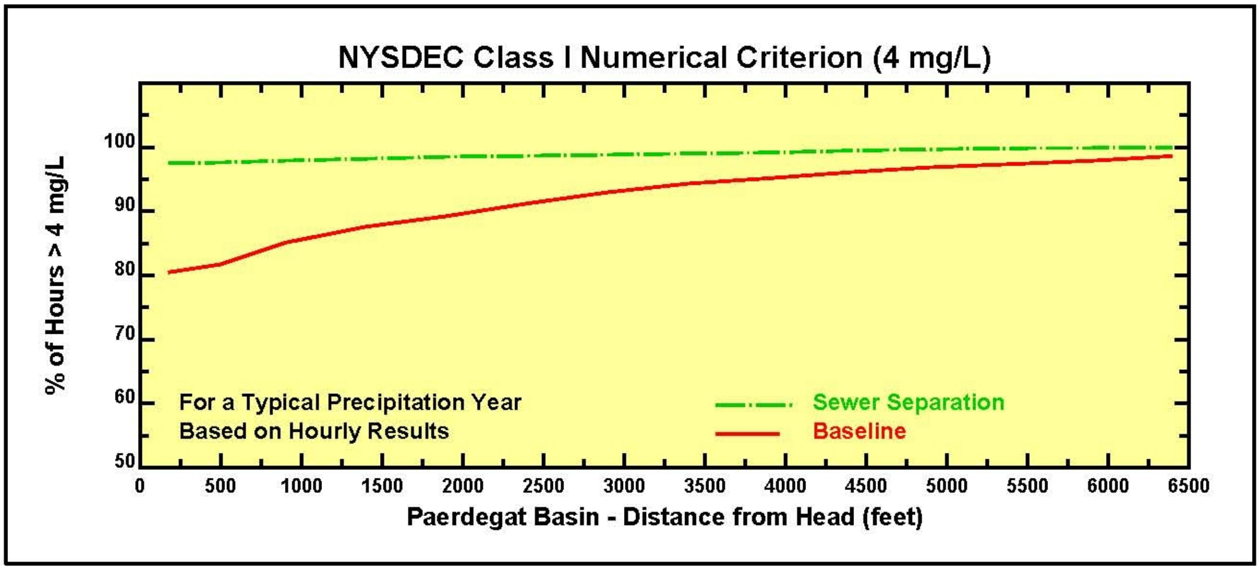


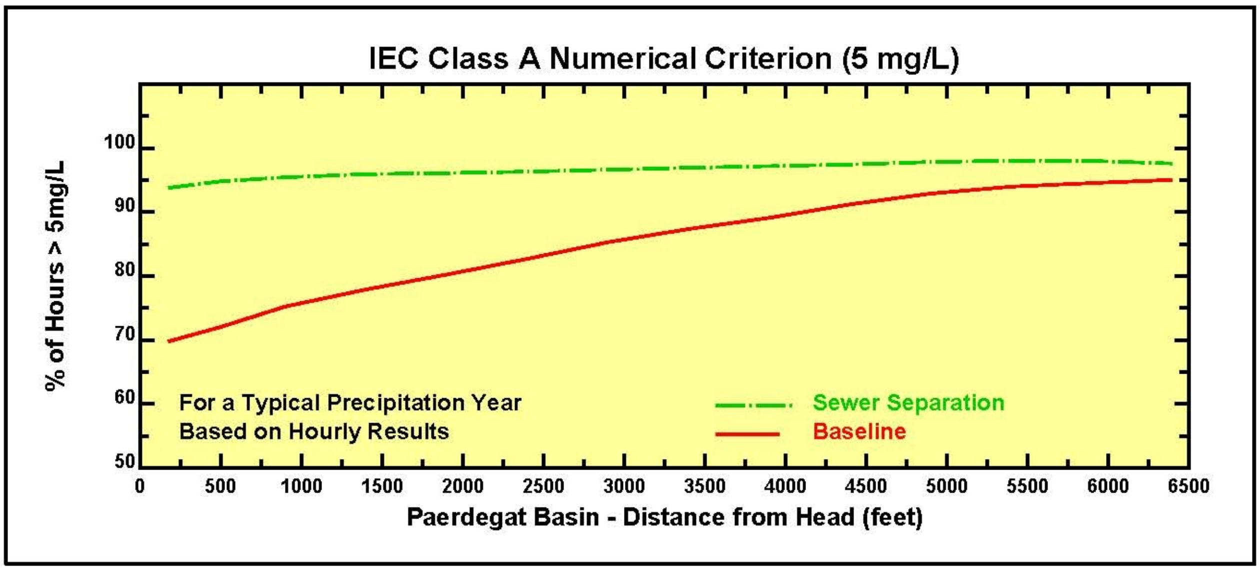
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Total Residual Chlorine Concentrations Calculated Values Facility Plan + Disinfection

FIGURE C-8





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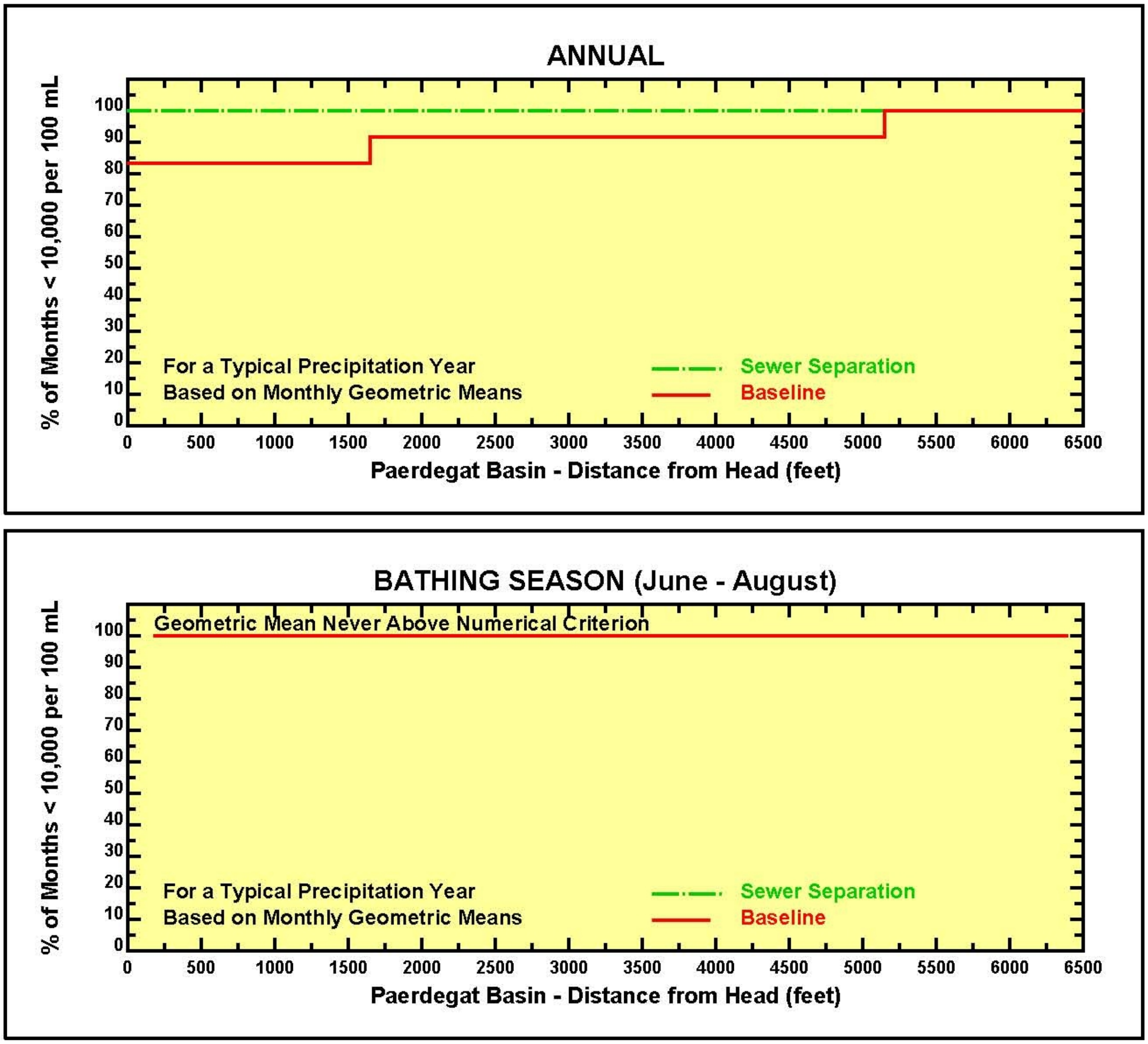
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Dissolved Oxygen Concentrations Percentage of Time Above Numerical Criteria Sewer Separation

FIGURE C-9



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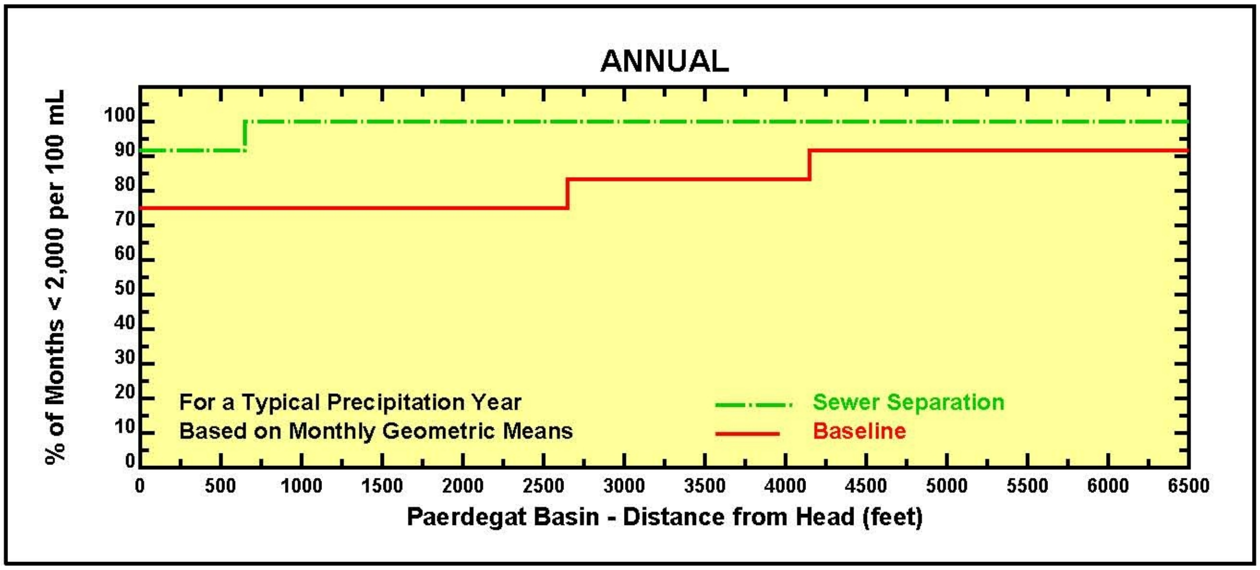
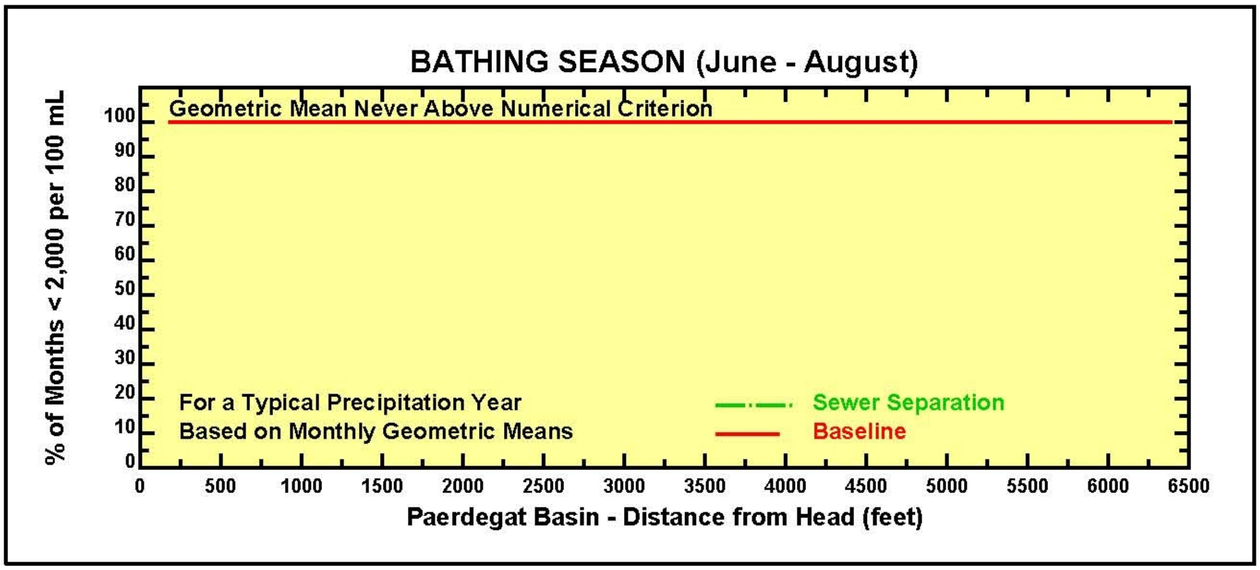
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Total Coliform Concentrations Percentage of Time Below Numerical Criterion Sewer Separation

FIGURE C-10





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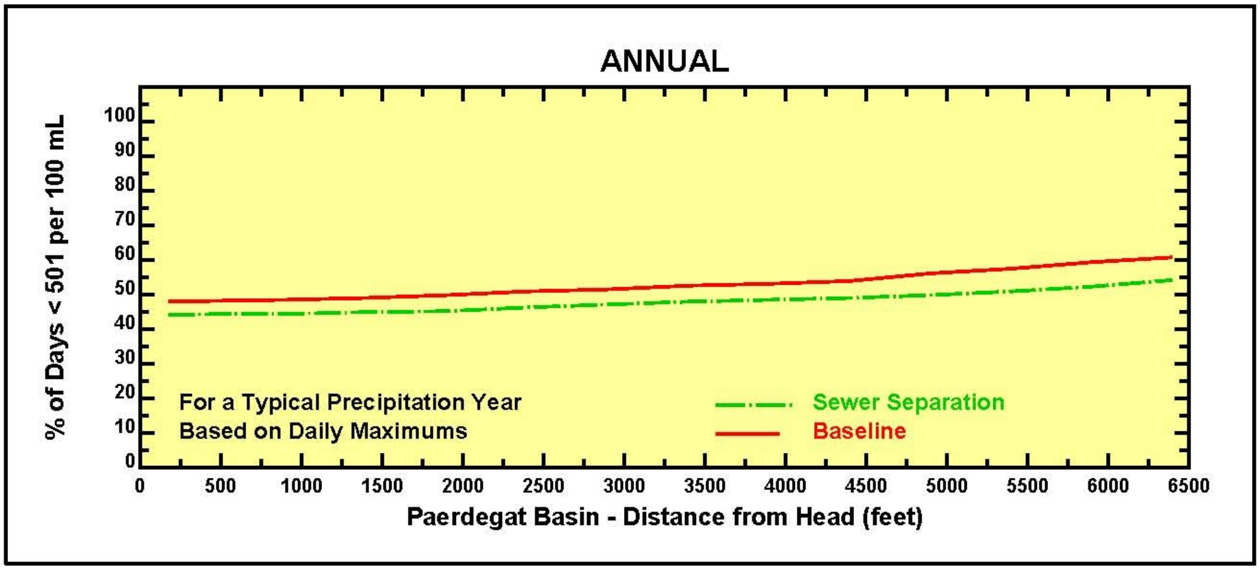
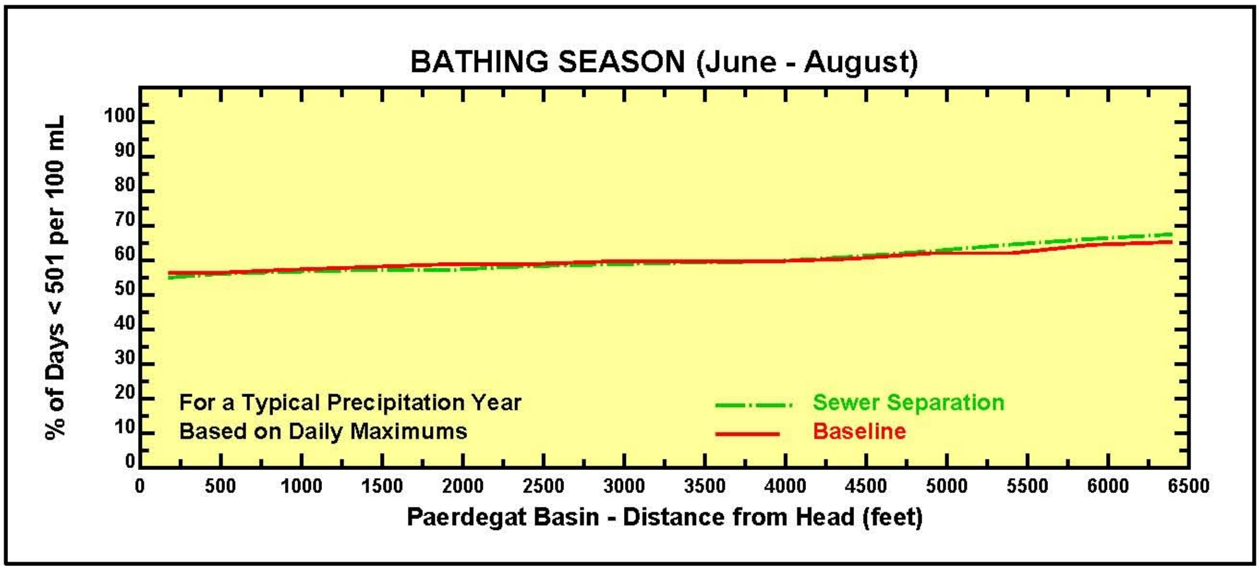
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Fecal Coliform Concentrations Percentage of Time Below Numerical Criterion Sewer Separation

FIGURE C-11





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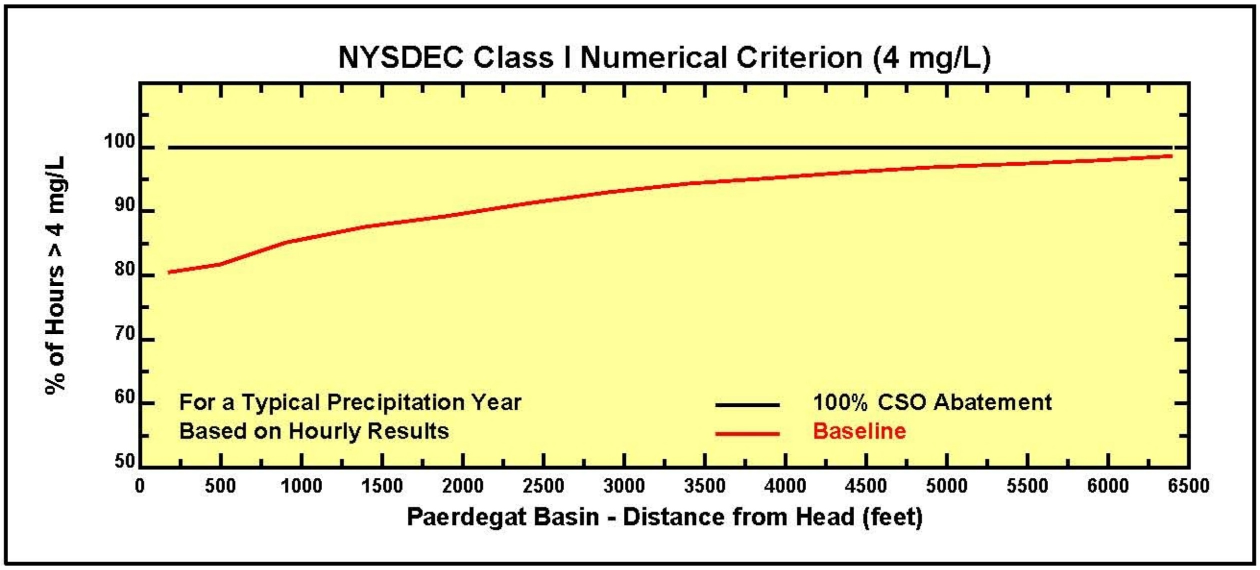
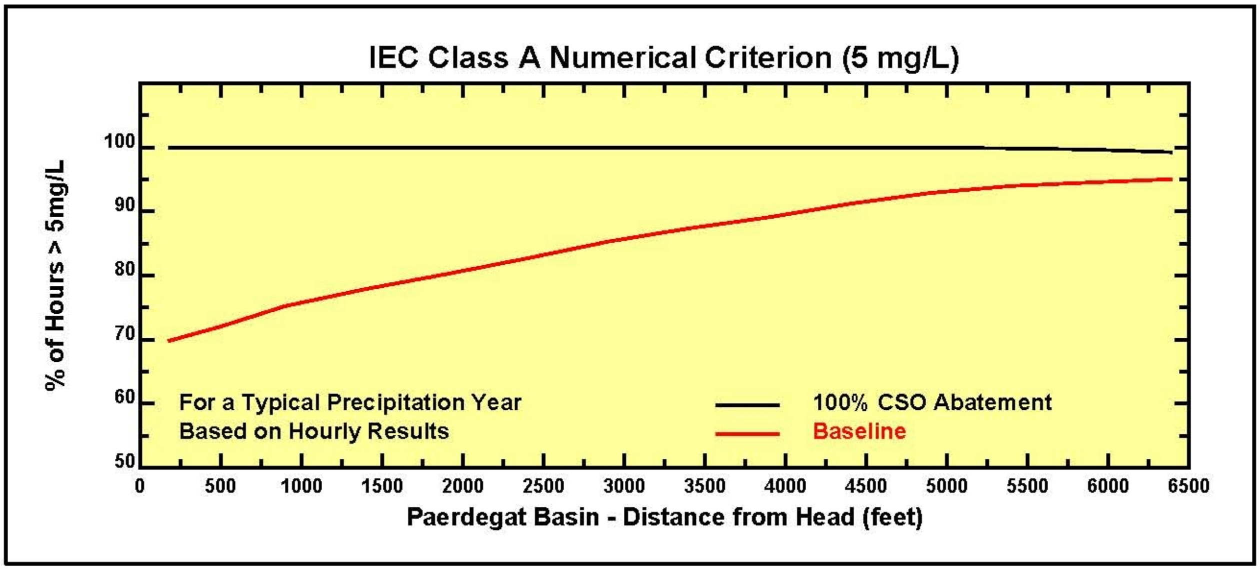
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Enterococci Concentrations
Percentage of Time Below Numerical Criterion
Sewer Separation

FIGURE C-12





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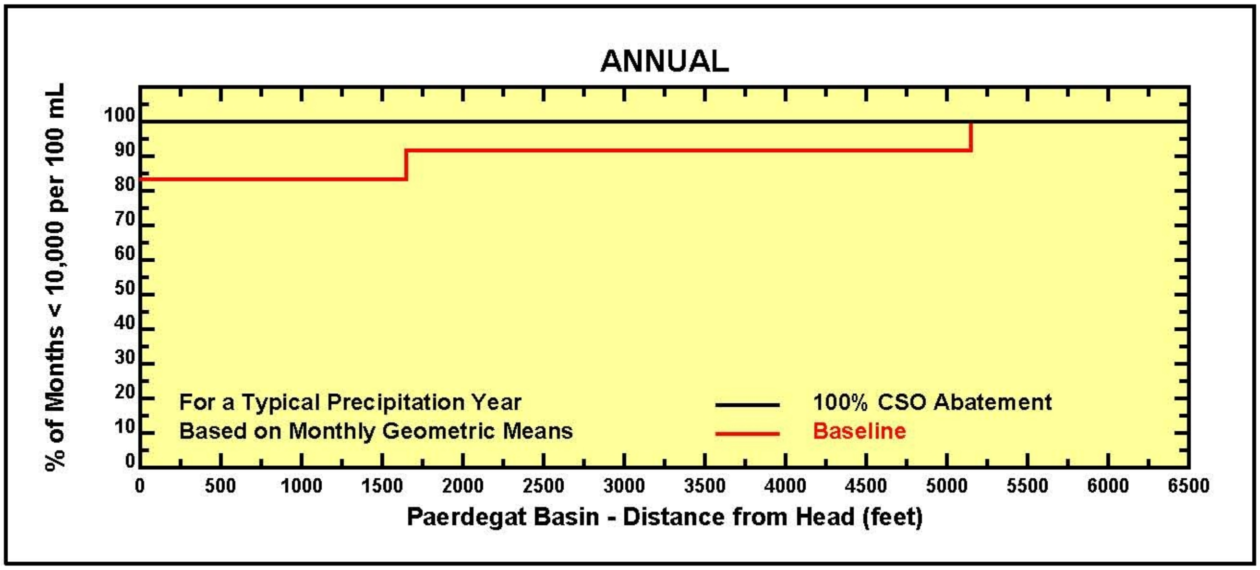
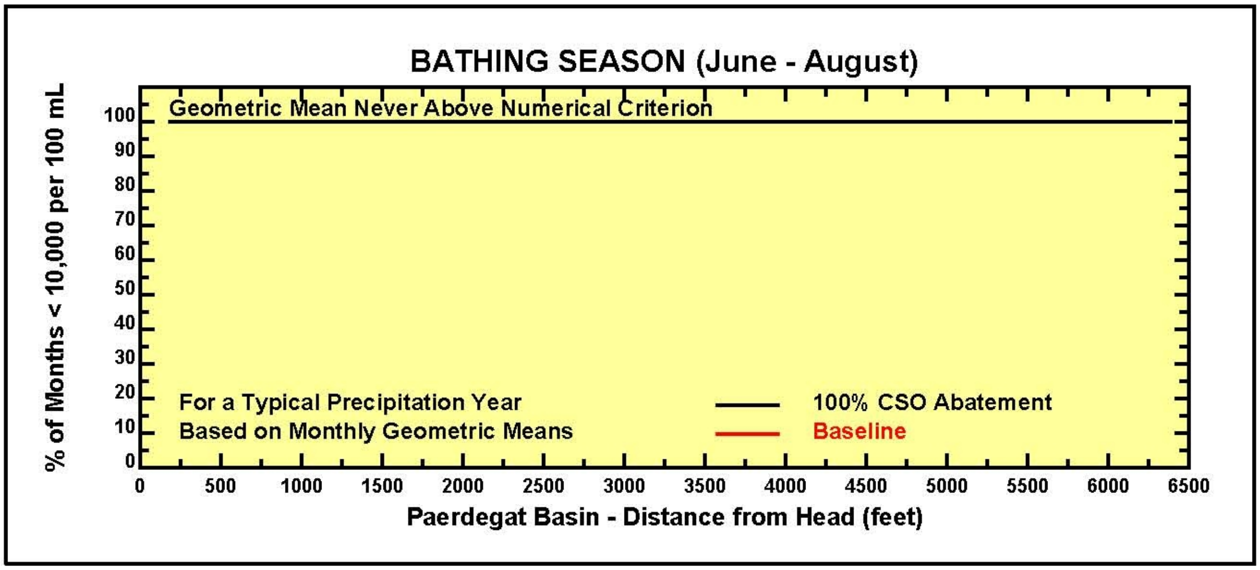
New York City
Department of Environmental Protection

Dissolved Oxygen Concentrations
Percentage of Time Above Numerical Criteria
100% CSO Removal





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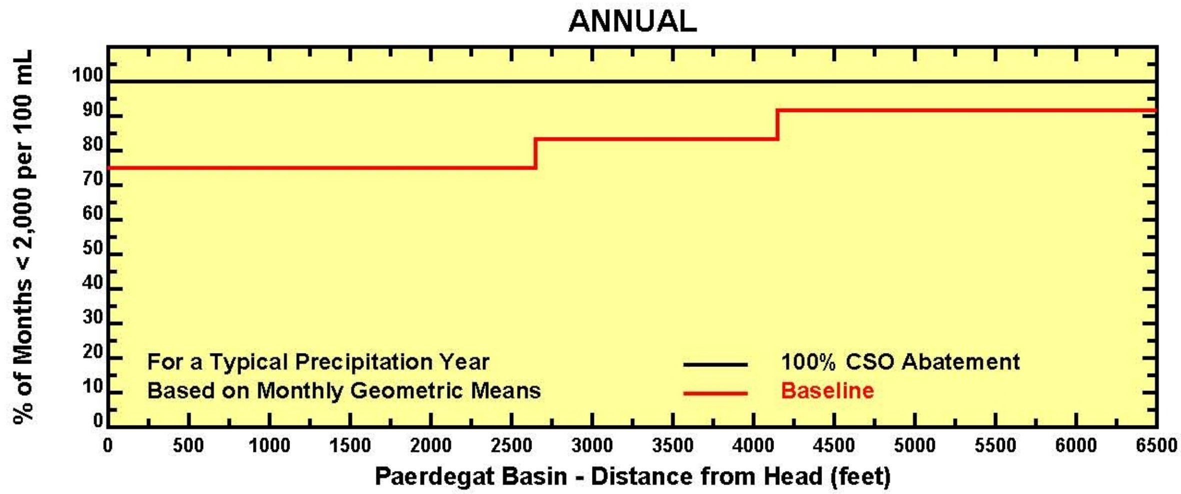
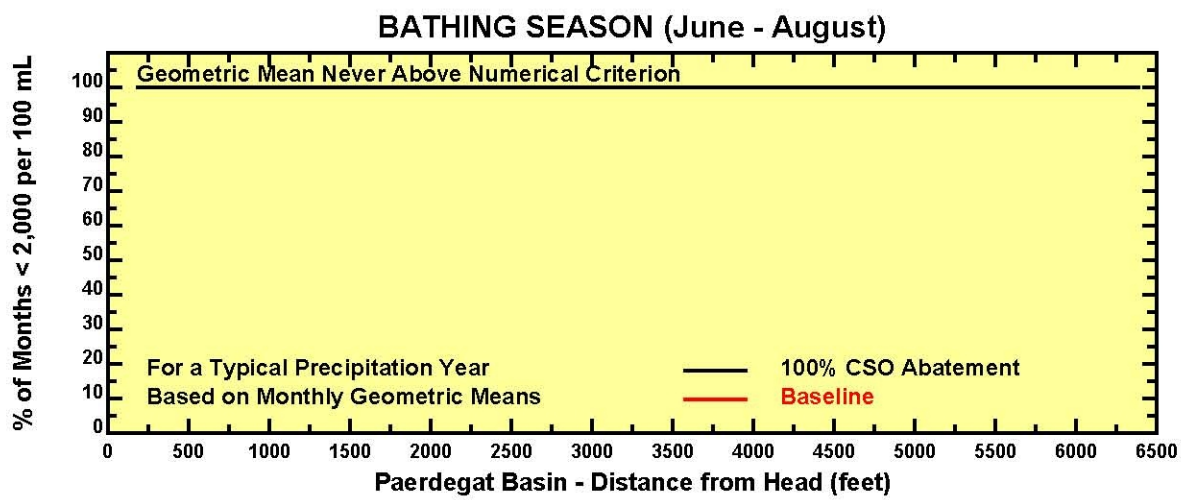
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Total Coliform Concentrations
Percentage of Time Below Numerical Criterion
100% CSO Removal

FIGURE C-14





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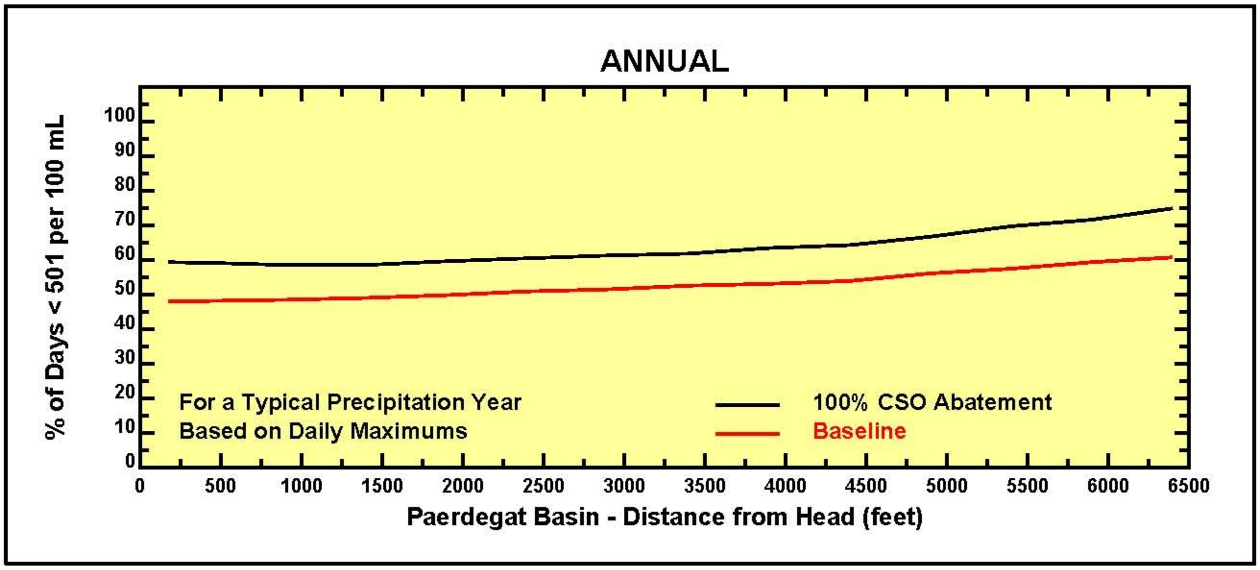
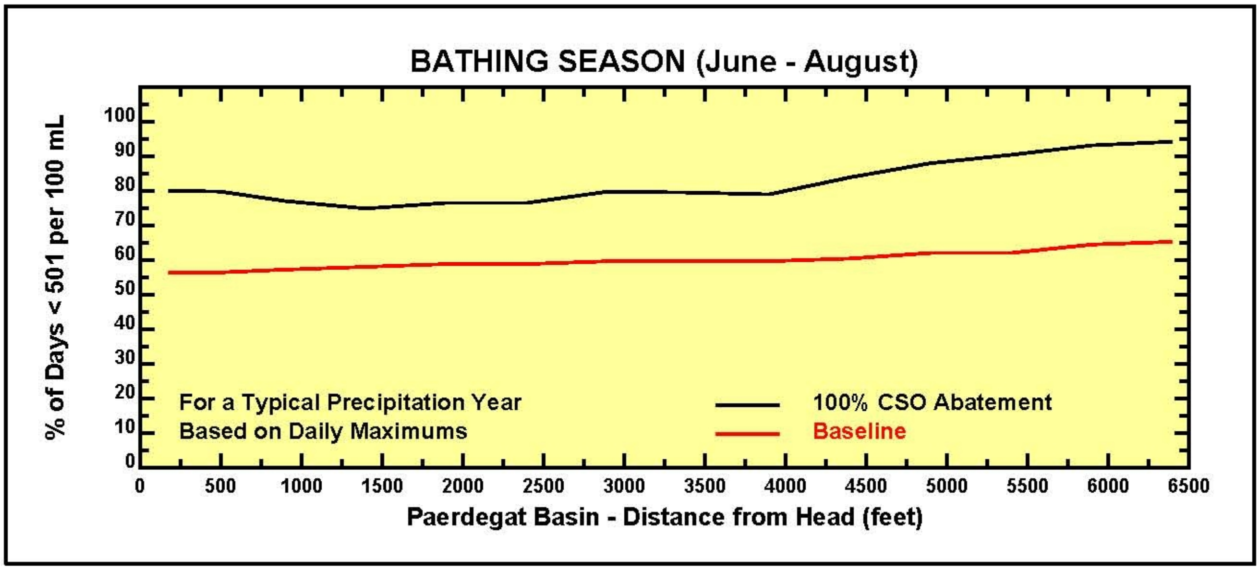
New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Fecal Coliform Concentrations
Percentage of Time Below Numerical Criterion
100% CSO Removal

FIGURE C-15





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New York City
Department of Environmental Protection

Paerdegat Basin Long-Term CSO Control Plan

Enterococci Concentrations
Percentage of Time Below Numerical Criterion
100% CSO Removal

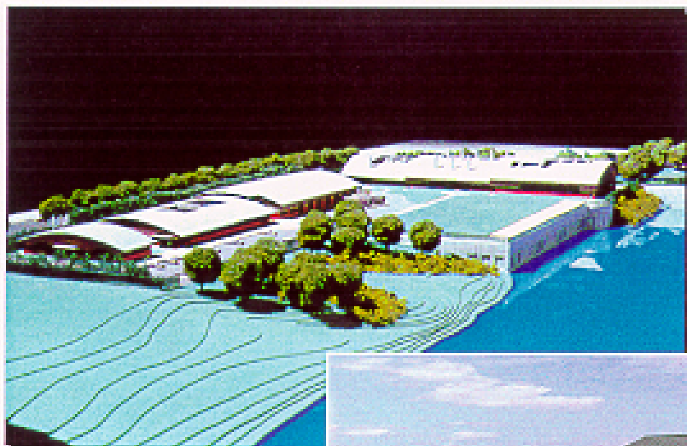
FIGURE C-16

APPENDIX D

CALCULATION OF CSO FROM REMOTE CONTROL FACILITIES

City of New York
Department of Environmental Protection
Division of Water Quality Improvements

CALCULATION OF COMBINED SEWER OVERFLOWS FROM REMOTE CONTROL FACILITIES



HydroQual Environmental Engineers and Scientists, P.C.
In Association With HydroQual, Inc.

March 2004
Project No: NYDP6013

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Environmental
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LIST OF FIGURES

SECTION 1

INTRODUCTION

The following outlines requirements of the new WPCP SPDES permits for those WPCPs that contain control treatment facilities (RCFs) or CSO control facilities that are offsite from the WPCPs. Permits for the Tallman Island, Coney Island, and 26th Ward WPCPs contain the language shown below (Figure 1-1). The RCFs for which monitoring and reporting are required include the Spring Creek Auxiliary WPCP, and the soon to be constructed Flushing Creek, Paerdegat Basin and Alley Creek CSO retention facilities.

VIII MONITORING REQUIREMENTS FOR CSO FACILITIES

FACILITY: **Outfall No:**

The permittee shall monitor the following effluent overflow parameters and report the sampling results on the monthly operating report [5] After review of the data, the Department may reopen the permit to add permit limits for these parameters at the CSO Retention Facility.

OVERFLOW PARAMETER	REPORT	UNITS	SAMPLE FREQUENCY	SAMPLE TYPE	FN
Overflow Volume	total, per event[4]	MG	See Footnote 5	Calculated	[1][2]
BOD, 5-day	average, per event	mg/l	1/Each day of event	Grab	
Total Suspended Solids	average, per event	mg/l	1/Each day of event	Grab	
Settleable Solids	average, per event	ml/l	1/Each day of event	Grab	
Oil & Grease	average, per event	mg/l	1/Each day of event	Grab	
Screenings	total, per month	cu. yds.	---	Calculated	
Fecal Coliform	geometric mean, per event	No./100 ml	1/Each day of event	Grab	[3]
Precipitation	total, per event	inches	Hourly/Each day of event	Auto, Recording Gauge within drainage area	

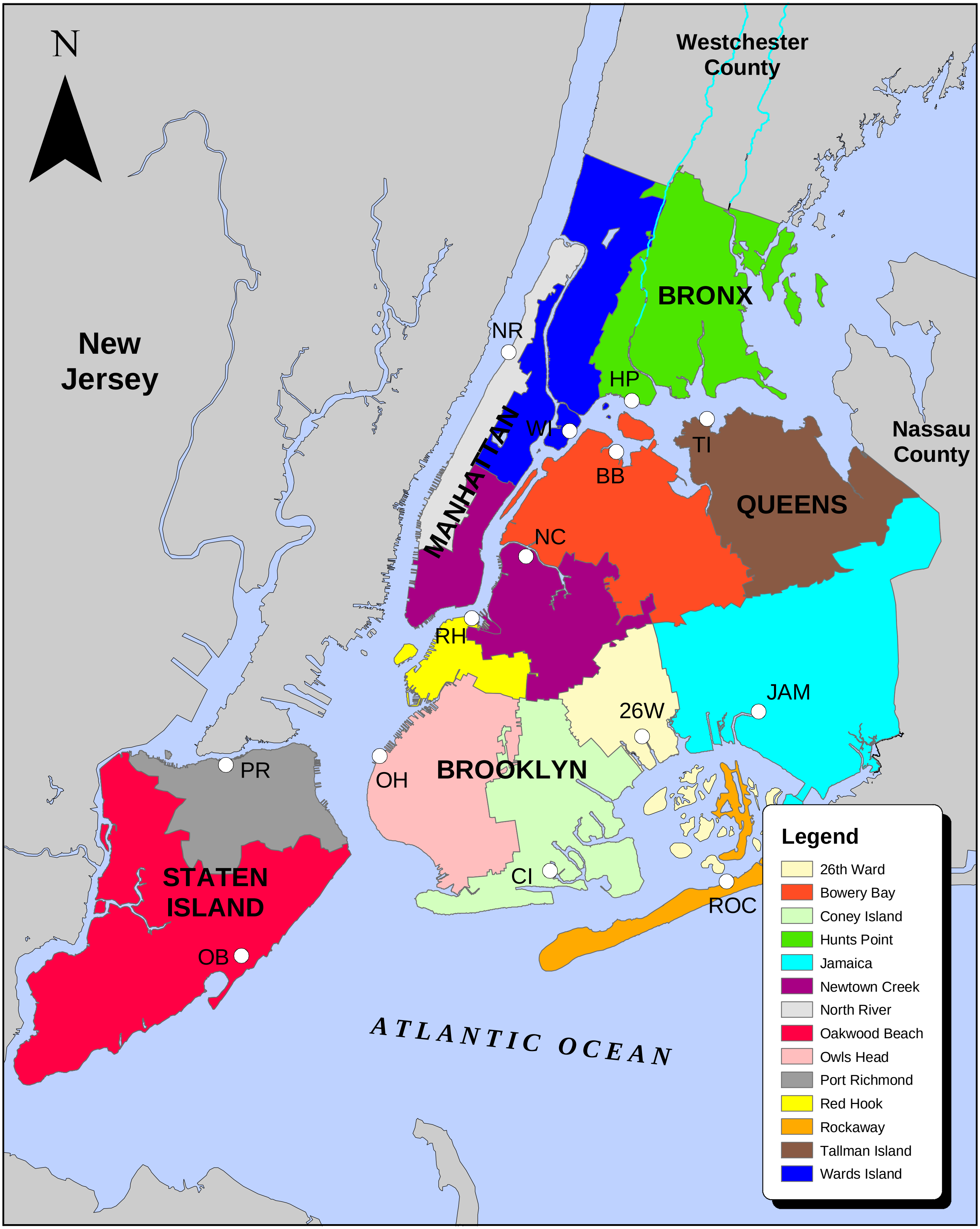
FOOTNOTES:

[1] Flows refers to effluent overflows associated with the design storm for the CSO ???? facility.

[2] Effluent overflow shall be calculated using a hydraulic model of the sewer system that is approved by the DEC. The permittee shall submit a report, with the first annual CSO BMP report, explaining the hydraulic model calibration of the combined sewer drainage system tributary to the facility for DEC approval.

[3] In addition to the data supplied on the monthly operating report, the permittee shall provide a summary of the required monitoring to be submitted annually as part of the CSO BMP report required in CSO BMP #14 of this permit. The report shall tabulate sampling results, summarize the number of overflow events, the volume of overflow during each event, volume retained and pumped to the WPCP, and the peak flow rate (a calculated number) during each event, and provide an evaluation of the performance of the facility.

[4]An event starts once overflow out of the CSO retention facility begins, and ends once the overflow stops.



HydroQual

1200 MacArthur Boulevard
Mahwah, New Jersey 07430
(201) 529-5151 f:(201) 529-5728

Figure 1-1
Water Pollution Control Plant Drainage Areas

Calculation of Combined Sewer Overflows
From Remote Control Facilities

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

3/30/04

This permit language requires monthly reporting of monitored overflow quality and annual reporting of estimated overflow volumes. In addition, the annual report should contain a summary of the individual sampling data for each facility as well as an assessment of the facilities performance during the year. The following sections of this report describe the basis for reporting of overflow volumes and flow rates and the reporting that will be done related to those items required in the SPDES permits.

SECTION 2

OVERVIEW OF PROPOSED CALCULATION PROCEDURE

The NYC SPDES discharge permits for the wastewater treatment plants with remote control facilities (RCFs) require that combined sewer overflows from retention facilities be reported on in the annual CSO BMP report. Because of the difficulty in measuring overflows from these facilities for each storm event, the SPDES permits allow DEP to report on the overflows using a calibrated sewer system hydraulic model. The following sections of this report summarize the approach to be taken relative to the calculation of overflows and overflow volumes.

A computer model will be used to simulate the amount of combined sewage that overflows from each RCF. The model will be the same model that DEP is using for the specific WPCP sewer service area for planning and design level calculations. The model will mix the dry weather sewage and the wet weather runoff during rainfall events and will include the CS regulator control decision-making rules that divert some of the wet weather flow to the WPCP with the remainder being diverted to the combined sewer overflows or as appropriate to the specific RCF.

The RCF that exists and is being operated by DEP is the Spring Creek Auxiliary WPCP (retention facility). It is anticipated that the Flushing Creek CSO retention facility will become operational within the next few years, with the Paerdegat Basin and Alley Creek CSO retention facilities becoming operational near the end of the decade. The Flushing Creek and Alley Creek CSO facilities are located within the Tallman Island WPCP drainage area. The existing Spring Creek retention facility receives combined sewage from both the Jamaica and 26^{th} Ward WPCP drainage areas.

Over the past 30 years, the DEP has performed various CSO facility planning, design, and construction projects to reduce CSO pollution. Mathematical models of combined sewer systems were an integral part of many of these projects. Such models were used to calculate the amount of combined sewage (CS) that overflows into NYC water bodies, the amount of CS that is treated at the different WPCPs and various specifics about the CS within the sewers such as velocity, flow, and water levels.

Many different mathematical models were used to accomplish these tasks. The models varied in complexity from simple desktop estimating techniques (e.g., spreadsheets) to sophisticated GIS based computer models. In practice, different models have been applied to different geographical areas of the City. The following models have been employed, during the recent past, to develop information related to the City's combined sewers. The models are listed in increasing levels of sophistication.

RAINMAN *– This is a computer program that was originally developed and applied City Wide during the NYC 208 Study in an earlier less sophisticated form. It is a Fortran program that is based on the rationale formula and does not employ any hydraulic equations. It simply performs a flow balance around a given WPCP drainage area. Individual outfall overflows are calculated hourly as is the flow to the WPCP. Since the model does not employ hydraulic calculations, it does require a high level of model calibration and knowledge about the conveyance system to provide reasonable estimates of flow volumes and pollutant loads.*

The model was applied to the Inner and Outer Harbor CSO Water Quality Facility Planning areas during the studies that led to the Track I CSO facilities. The model is currently being used in the Comprehensive CSO Floatables and Settleable Solids Planning Project and the Use and Standards Attainment Project. Its use in the Comprehensive Planning Project is to estimate the overflow characteristics for each regulator drainage area and outfall. Its use in the USA Project is to provide estimates of hourly overflows during annual water quality simulation periods. Before use in any recent applications, RAINMAN is cross calibrated against the results of the more sophisticated models discussed below. Once that is accomplished it is a very accurate tool for developing annual CSO volumes and loads.

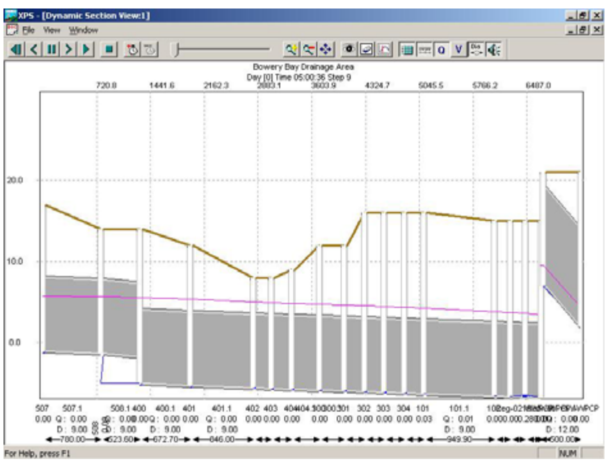
EPA SWMM *– The EPA SWMM model has many individual components that have been used over the past 20 years for various locations within the City. The following sections describe components of the model that have been applied during the Water Quality CSO Facility Planning.*

RUNOFF BLOCK – This is a module of the program that computes the amount of overland runoff for individual drainage areas. Generally, a runoff area would be a small regulator drainage area. For large regulator drainage areas, there would be many sub-catchment areas draining to the regulator. This element of the program allows accounting for depression storage, infiltration, impervious surfaces, sheet flow across land surfaces, curb and gutter flow to central collection points. This module converts rainfall to surface runoff.

TRANSPORT BLOCK – This section of the model accepts runoff flows (RUNOFF) at nodes, adds in dry weather sewage flows and creates combined sewage within individual pipes. Flows are then transmitted along the pipes using the Mannings equation. Flows in excess of the pipe capacity are simply not *transferred through the pipes and are stored in the immediate upstream node, and released once capacity becomes available in the pipes. The module does not calculate hydraulic grade-lines or account for backwater curves or surcharging within the pipes. Simple regulators can be included within the model providing there is information available on the flow diversion capacity.*

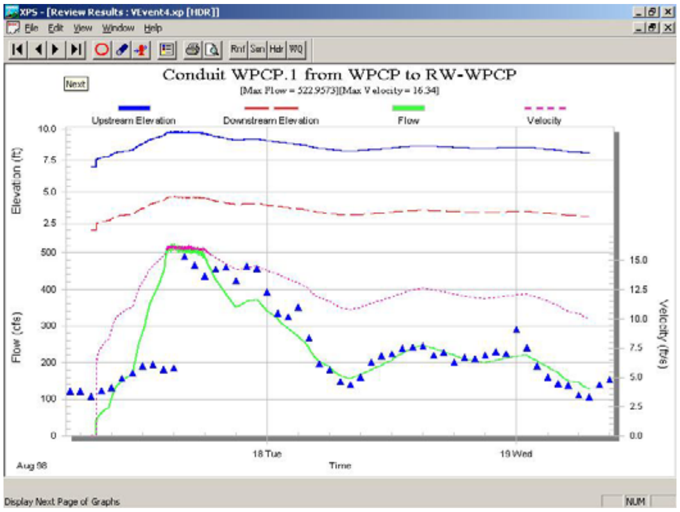
EXTRAN BLOCK – This is the extended transport module of the model, which improves on the transport block in that actual pipe and regulator hydraulics equations (full St. Venant's) are now included so that backwater curves, hydraulic grade-lines, sewer surcharging, and regulator hydraulics are calculated on finer spatial and temporal scales. The model has undergone 30+ years of development and 100's of applications around the world, although it requires extensive experience and effort for model setup and application.

XP-SWMM *- This model is an enhanced version of the EPA SWMM model that is commercially available and commercially supported. It incorporates all of the features of the EPA model, with addition of many graphical user interfaces (GUIs) that assist the user in setting up model inputs and viewing outputs.*



The graphical presentation in Figure 2-1 shows a section view through a pipe. It displays the hydraulic grade line in the pipe at a point in the simulation. Also shown are the invert and crown of the combined sewer and the street grade.

Figure 2-1. Section View: Hydraulic Grade Line

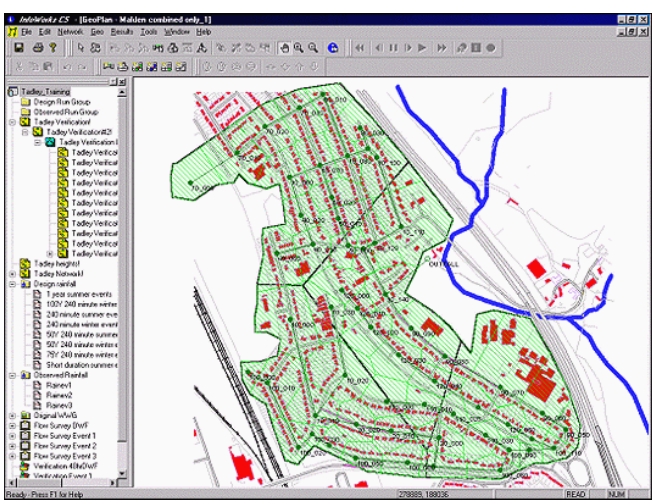


The graphic in Figure 2-2 shows comparison between calculated WPCP flow during a storm event and that measured at the WPCP shown as blue triangles.

Figure 2-2. Calibration of WPCP Flow

HydroWorks/InfoWorks *- This model comes from a suite of models that are commercially available from the Wallingford Software. HydroWorks and InfoWorks are essentially the same model with InfoWorks being the more current version with a much more user friendly GUI that is ARCVIEW GIS based (Figure 2-3). The model is one of among a variety of high-end computer models developed for use on desktop PC computers by European research/consulting organizations.*

The model has all of the features that exist in the EPA model but is not based directly on the EPA SWMM model. This model is based on many of the same basic energy and momentum equations of flow. However, it does use different solution techniques and has a number of advantages over the EPA SWMM and the XP-SWMM models including the following.



- *Enhanced ArcView based graphical user interface with an ability to calculate certain input parameters (e.g., percent imperviousness) from the data base*
- *Enhanced ability to evaluate Real Time Control Operations including the ability to interface with radar-based rainfall databases.*

Figure 2-3. InfoWorks Model Schematic

In the past, no single approach was followed on CSO projects to conduct landside modeling. Consultants chose to select different models, different calibration approaches and different projection/ CSO control evaluation approaches. On a project-by-project basis, this disparate approach was adequate and was even required in many cases. This approach, however, presents a complication when there is a need to share information between consultants or there is a need to report City-Wide results such as the number of CS system overflows, City-Wide overflow volumes or loadings.

With inception of the USA and the CSO Comprehensive Planning Projects, there was a need for information to be shared between HydroQual and the facility planning consultants. This need presented the opportunity to begin to develop a more standardized approach to combined sewer modeling within the City. During both of these two planning projects, a process was initiated to centralize the approach to landside modeling. This process included the following two features.

> ***Areawide RAINMAN*** *– A standard approach was developed for each of the 14 WPCP sewer networks. The RAINMAN model was used for this areawide uniform approach so that all information developed for landside loads and overflow volumes could be developed on the same basis. This approach included a thorough review of the drainage areas tributary to each regulator and a review of the outfall notations and their locations. In addition, a review, and where necessary, a recalibration of the model to the amount of flow being transported to the WPCP was completed. Finally, the model was cross-calibrated to the individual outfall (i.e., XP-SWMM and InfoWorks) by outfall overflow volumes estimated by the more rigorous hydraulic sewer system models.*

> ***XP-SWMM and Infoworks*** *–The City's design consultants were using these two modeling frameworks (Figure 2-4) to simulate CS system flows for different drainage areas. XP-SWMM is being applied to the Wards Island, Tallman Island, Bowery Bay, and Hunts Point drainage areas. In addition, Hydroworks, an earlier version of Infoworks, has been applied to the Hunts Point drainage area in the past. Recently, this approach has been abandoned in favor of the XP-SWMM model. The Infoworks model was being applied to the Newtown Creek and Red Hook drainage areas. Similarly, both of these models are being applied to the remaining drainage areas of the City. During recent work, standardized QA/QC procedures were adopted for these models similar to those described for the RAINMAN model. The USA and CSO Comprehensive Planning Projects served as a method to develop standard versions of each of these two hydraulic modeling tools and to enhance the calibration of these tools.*

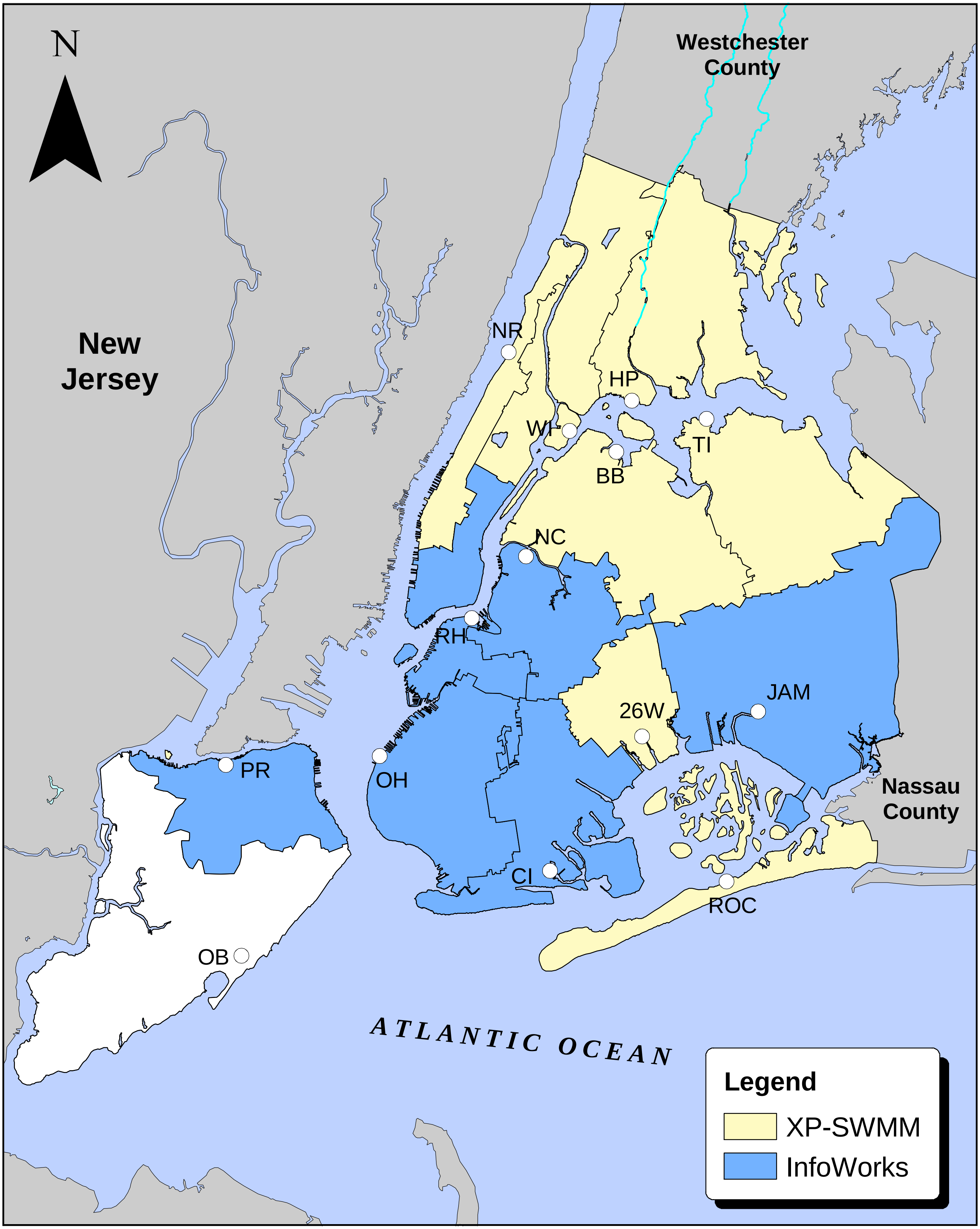


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Figure 2-4
Availability of Calibrated Models

Calculation of Combined Sewer Overflows
From Remote Control Facilities

With the onset of projects like the USA Project, the CSO Comprehensive Planning Project, and the anticipated start-up in mid-2004 of the Long Term Control Plan Project (LTCP), it has become evident that these projects will of necessity require integration of city-wide modeling activities. In addition, recent SPDES permits issued by the DEC include requirements for reporting of CSO related overflows and mass loadings for different functions. Models are required to report total nitrogen CSO mass loadings for the LIS Zone 8 and 9 WPCPs for SPDES compliance. Models are also required to calculate the amount of combined sewage captured by the 14 WPCPs each year as part of the SPDES Best Management Practices (BMP) annual reporting requirements. Finally, models are required to report the SPDES required CSO retention facility performance each year, as discussed herein.

As such, there needs to be a uniform approach applied to calculating CSO overflows and mass loadings. Toward that end, the LTCP Project will be developing a uniform citywide CSO landside hydraulic CSO model and conducting CS assessment analyses with that single landside-modeling tool. The approach that will be followed to develop such a uniform CS system model will take the following course of action.

Centralize Models *– The first step in the process will be to compile all of the hydraulic models from each of the City consultants. This will involve compilation of computer input files for each WPCP area for baseline calibration conditions and a limited set of projection conditions including the selected alternatives. In addition, hardcopy-modeling reports will be compiled as well as the electronic copies of calibration data (depth and flow).*

Standardize City-Wide Landside Model – *One of the most important steps in the process will be the standardization on a single hydraulic modeling tool that will serve as the main sewer system model for the future needs. This model will need to be capable of simulating the complex hydraulics that occur within the City's combined sewers and will need to be GIS compatible.*

Assess Calibrations – *The next step will be to review the model calibration analyses to extract and compile the individual model calibration coefficients from these reports and files. In addition, at this point an assessment will be made as to any recalibration work that maybe required assuring a similar level of model calibration throughout the City. As part of this step in the process, the City will develop an approach to calibration and minimum calibration requirements that will be required before a model would be considered acceptable for use in alternative evaluations. Before models are considered as being finalized, the changes will be reviewed with the consultants who developed the latest versions of the models. In addition, the model assumptions used in the calibration and validation process and procedures for derivation of input parameters will be documented as "metafile" information. If there are changes in system elements, e.g., upgrading of a pump station or cleaning up of a sewer that had sedimentation problems when the model was calibrated,* *future users can easily incorporate such changes and adopt them for their future model applications.*

Develop a model web site – *Once the models are fully assessed and considered as the most current versions, they will be placed on a landside model web site and available to each of the City consultants for use on ongoing and future assessments. A system to check out the models will be developed as part of this step. It is also envisioned that there will be ongoing model development within the proposed future work. As such, a system to check in newly developed or recalibrated versions of the models will also be developed as part of this step.*

As the City is ready to embark on a process of developing a uniform approach to sewer system modeling that will take them forward, the approach for developing CSO control facility overflow volumes using sewer system models will benefit from being flexible in approach. The approach that the City will follow is described below.

CY2004 *– The approach for next year will be to use the City-wide RAINMAN model as the tool for developing CSO overflows volumes for the annual SPDES reporting. This is a simple model that can rapidly produce the required information. Further, this model is being used to report the annual wet weather WPCP capture and will be used for reporting the Zone 8 and Zone 9 total nitrogen CSO loads in the annual report. The model has been well calibrated to the more complex hydraulic model results as well as to the amount of wet weather flow that is transported to each WPCP and as such will provide an accurate representation of reality. In addition, there will only be two CSO facilities discharging during this period (Corona Avenue vortex and Spring Creek AWPCP).*

February 2004, draft permit language for the Corona Avenue vortex facility does not require sampling and reporting of overflows until a later date after NYS DEC completes their review of the effluent sampling data and vortex performance analyses presented in the pilot study reports entitled "Evaluation of Corona Avenue Vortex Facility, Corona, New York, Volume I – Report & Volume II – Appendices, September 2003". The SPDES permit do not require sampling and reporting of the Spring Creek AWPCP until completion of the ongoing stabilization reconstruction.

This being the case, it is not likely that any reporting will be performed using the RAINMAN model as described herein.

CY2005 and following – *The approach for the following years will be to switch to the more complex hydraulic model once a uniform base model has been adopted and applied to the drainage areas of interest. As most of the RCF overflow reporting will be required on or after CY2005, the reporting will be done will be based on the use of the rigorous hydraulic sewer systems models to be developed citywide on a uniform basis.*

SECTION 3

MODEL CALIBRATION PROCEDURE

The sewer system hydraulic models have received high levels of calibration since their original development during the CSO Water Quality Facility planning or while the models were being used as tools in later CSO design efforts. Calibration of the models has been described in numerous previous Water Quality Facility planning project reports and will not be described herein. In addition, the models are constantly undergoing additional improvement and calibration as they are used as design tools for assisting in the development of site-specific CSO facilities during the Use and Standards Attainment Project and the Comprehensive CSO Floatables Planning Project. These models of the sewer system will be further updated in the LTCP Project as the single uniform citywide model is adopted. This section will focus on the calibration of the element of the model associated with the addition of the constructed facility to the model.

Before using the hydraulic models for reporting annual overflow volumes, each of the hydraulic models will be first configured to incorporate the relevant features of the RTF such as volume (dimensions), critical weir elevations, and internal features such as relief channels or weirs. The models will then be calibrated to short-term (2-year) flow and/or water level monitoring data collected at each of the facilities.

The following is a summary of each of the five RCFs listed in various SPDES permits. Schematic plans and/or flow diagrams are provided for each facility as attachments to this document.

Spring Creek Auxiliary Water Pollution Control Plant (AWPCP) – The Spring Creek AWPCP receives combined sewer overflows from Regulator #2 in the Jamaica WPCP drainage area and from regulator #3 in the 26th Ward drainage area. Currently, two different hydraulic models exist for this drainage area. The XP-SWMM model exists and has been calibrated for the 26th Ward WPCP drainage area. The Infoworks model exists and has been calibrated for the Jamaica WPCP drainage area. For CY2004 reporting of overflows, the Regulator 2 section of the Jamaica Bay drainage area will be incorporated into the XP-SWMM model and the model will be recalibrated to produce an accurate assessment of the combined sewer inflows to the Spring Creek AWPCP.

At the present time, the Spring Creek AWPCP does not have the ability to monitor overflow volumes. During the AWPCP reconstruction, water level sensors will be placed on the effluent weirs to provide information on the occurrence and duration of overflows. Once the AWPCP reconstruction is completed in 2007, there will be two-years of overflow sensor data available for re-calibration of the model. At that point in time, the City will have migrated the area to the uniform city-wide sewer system model, and it is that model that will be used for development of the overflow information to be provided in the annual report.

Flushing Creek CSO Retention Facility - The Flushing Creek CSO retention facility is in the Tallman Island WPCP drainage area. The sewer system for that drainage area is now being modeled using the XP-SWMM model. However, as this retention facility is not expected to be in operation until 2005 and not reported on until the CY2005 report is due in April of 2006, the model will be set-up in the new uniform city-wide software to be prepared under the LTCP Project. At the time that overflows will need to be reported on, the new landside model will be calibrated based on two-years of flow and water level monitoring to be conducted at the new facility. The current plans are that water levels and/or flows will be monitored within the retention facility, at the entrance to the facility, at the overflow points and within the bypass around the facility for a two-year period. These data will form the basis for model calibration. Reporting of overflows in April of 2006 will probably not be based on a fully calibrated model of the facility as little or no data will be available from the monitoring program at that point.

Alley Creek CSO Retention Facility - The Alley Creek CSO retention facility is in the Tallman Island WPCP drainage area. Although there are no requirements for this facility in the Tallman Island SPDES permit, they will soon be added and this facility is included herein for completeness. The sewer system for that drainage area is now being modeled using the XP-SWMM model. However, as this retention facility is not expected to be in operation until late 2009 and not be reported on until the CY2009 report is due in early 2010, the model will be set-up in the new uniform city-wide software to be prepared under the LTCP Project. At the time that overflow will need to be reported on, the model will be calibrated based on flow and water level monitoring to be conducted at the new facility. The current plans are that water levels and/or flows will be monitored within the retention facility, at the entrance to the facility, and within the bypass around the facility for a two-year period. These data will form the basis for model calibration. Early reporting results will likely not have the advantage of being able to use the sewer system model calibrated with the retention facility overflow data as the two-year sampling program will only be partially completed when the first annual report is submitted.

Paerdegat Basin CSO Retention Facility - The Paerdegat Basin CSO retention facility is in the Coney Island WPCP drainage area. The sewer system for that drainage area is now being modeled using the Infoworks hydraulic sewer system model. However as this retention facility is not expected to be in operation until 2011 and not reported on until the CY2011 report is due in April of 2012, the model will be set-up in the new uniform city-wide software to be prepared under the LTCP Project. At the time that overflow will need to be reported on, the model will be calibrated based on two-years of flow and water level monitoring to be conducted at the new facility. The current plans are that water levels will be monitored within the retention facility, at the entrance to the facility, at the overflow points and within the bypass around the facility for a two-year period. These data will form the basis for model calibration. Reporting of overflows in April of 2012 will probably not be based on a fully calibrated model of the facility as little or no data will be available from the monitoring program at that point.

As indicated in Section 2, reporting for CY2004, if required, will be done using the RAINMAN model, which will be used for reporting of overflow statistics for wet weather capture and Zone 8 and 9 LIS TN reporting. Before developing facility overflow estimates, the RAINMAN models for each of the aforementioned drainage areas will be cross-calibrated to the hydraulic models. After CY2004 when the new sewer system hydraulic models are available, reporting will be done using the new citywide sewer system hydraulic model.

SECTION 4

REPORTING

The models will be used to develop information on the CSO facilities for reporting in the annual report. The statistics that will be provided in the report will consist of the following measures of performance.

- Number of overflow events
- Amount of treated overflow discharged for each overflow event and the peak flow rate for each event
- Total annual amount of overflow treated by the facility
- Amount of combined sewage retained and pumped back to the local WPCP for treatment for each event and for the year

All of these analyses will be provided for the year for which the report is being provided. In addition, DEP will provide the reporting statistics for a standard rainfall year for comparison purposes. The intention is to use the rainfall data from JFK Airport for 1988 as the standardized year for reporting of the overflow statistics.

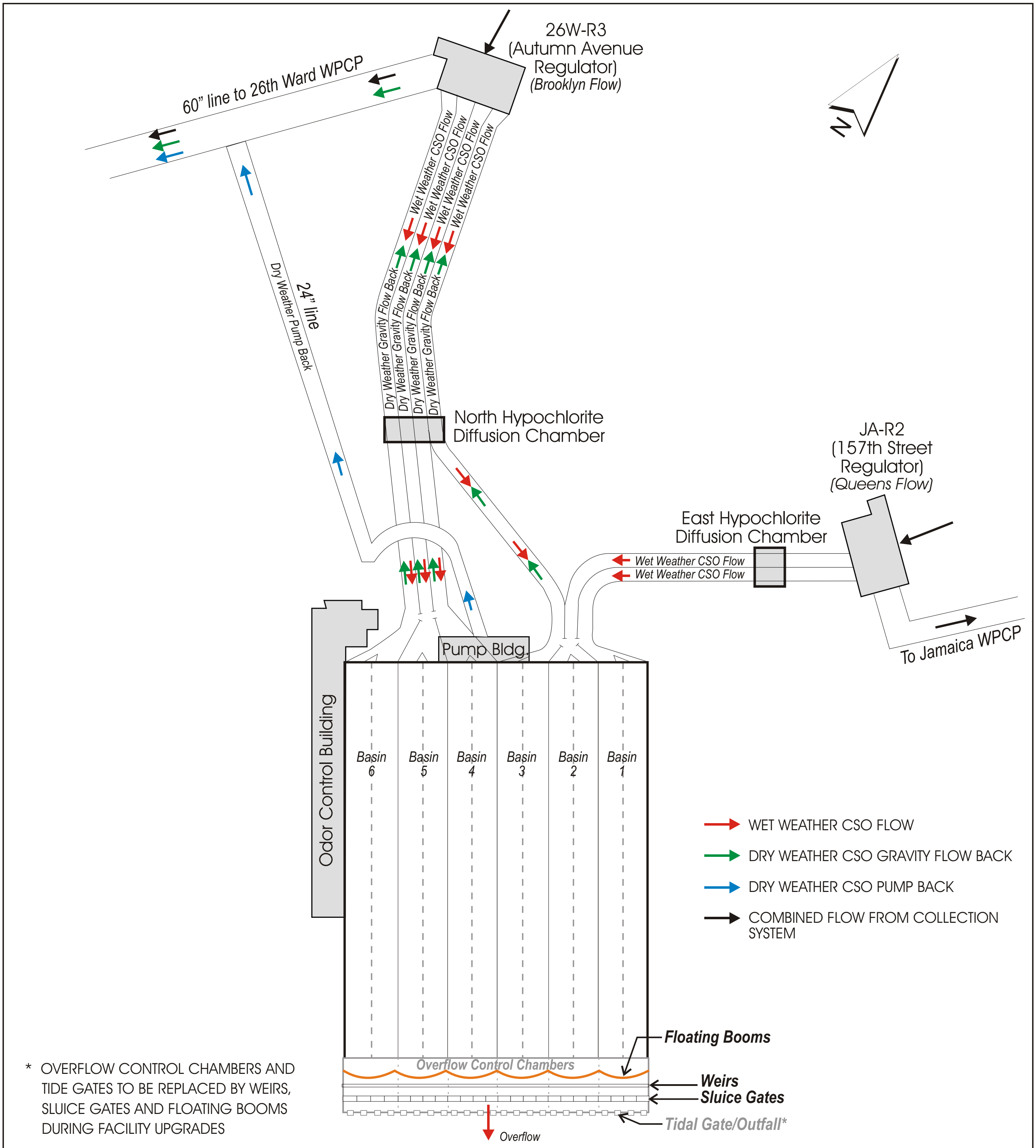
In addition, the report will contain all the individual overflow sampling quality data collected during the year for each facility as well as a summary and interpretation of the information. An overall assessment will be made of the performance of the facility as part of the annual report.

ATTACHMENT A

SCHEMATICS OF REMOTE CONTROL FACILITIES

HydroQual

Environmental
Engineers & Scientists



Spring Creek System (Old Mill Creek)

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Figure A-1
Facility Schematic Plan

26th Ward WPCP
Spring Creek CSO Retention Facility

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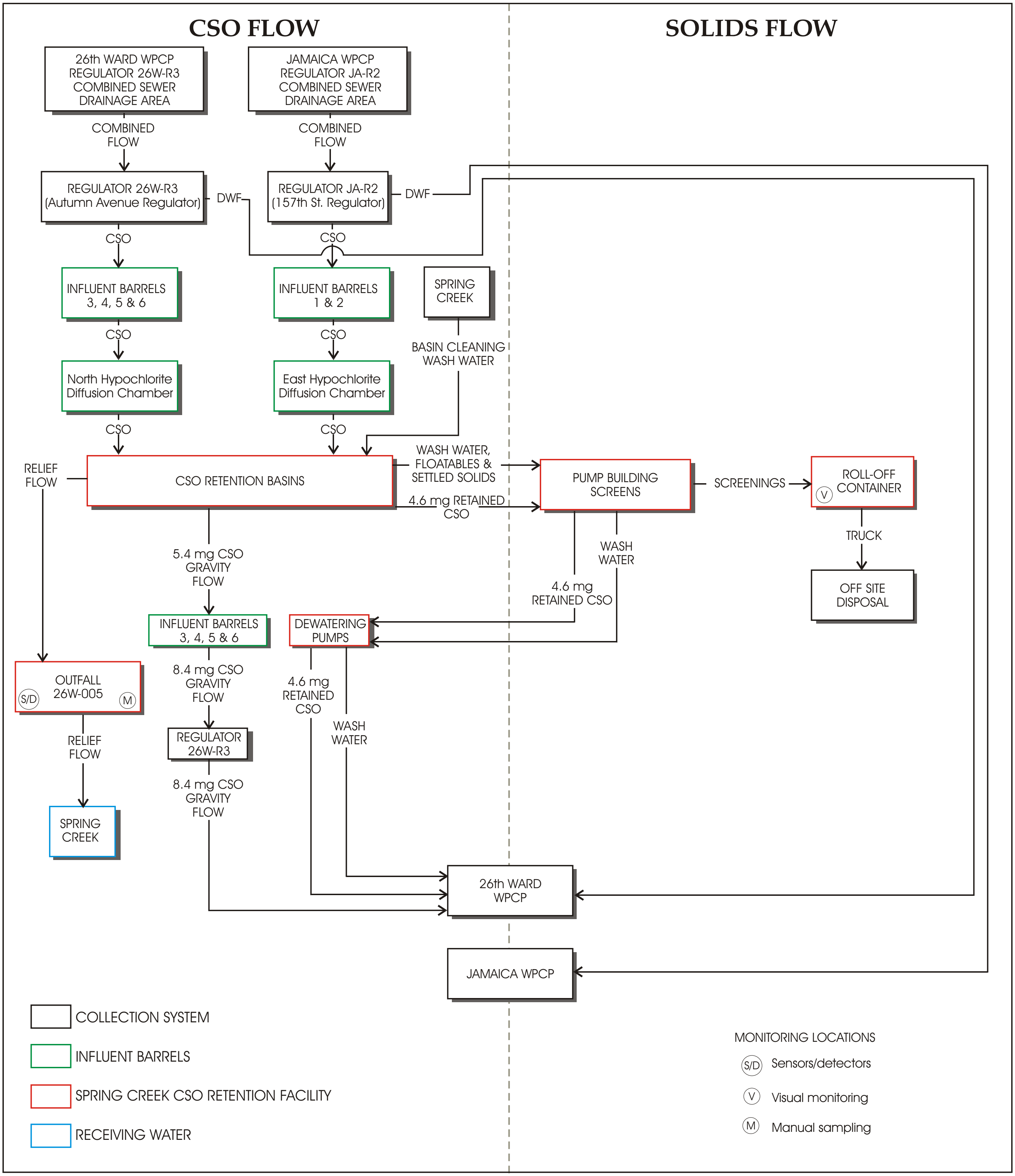

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Figure A-2
Flow Diagram

26th Ward WPCP
Spring Creek CSO Retention Facility

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DEP

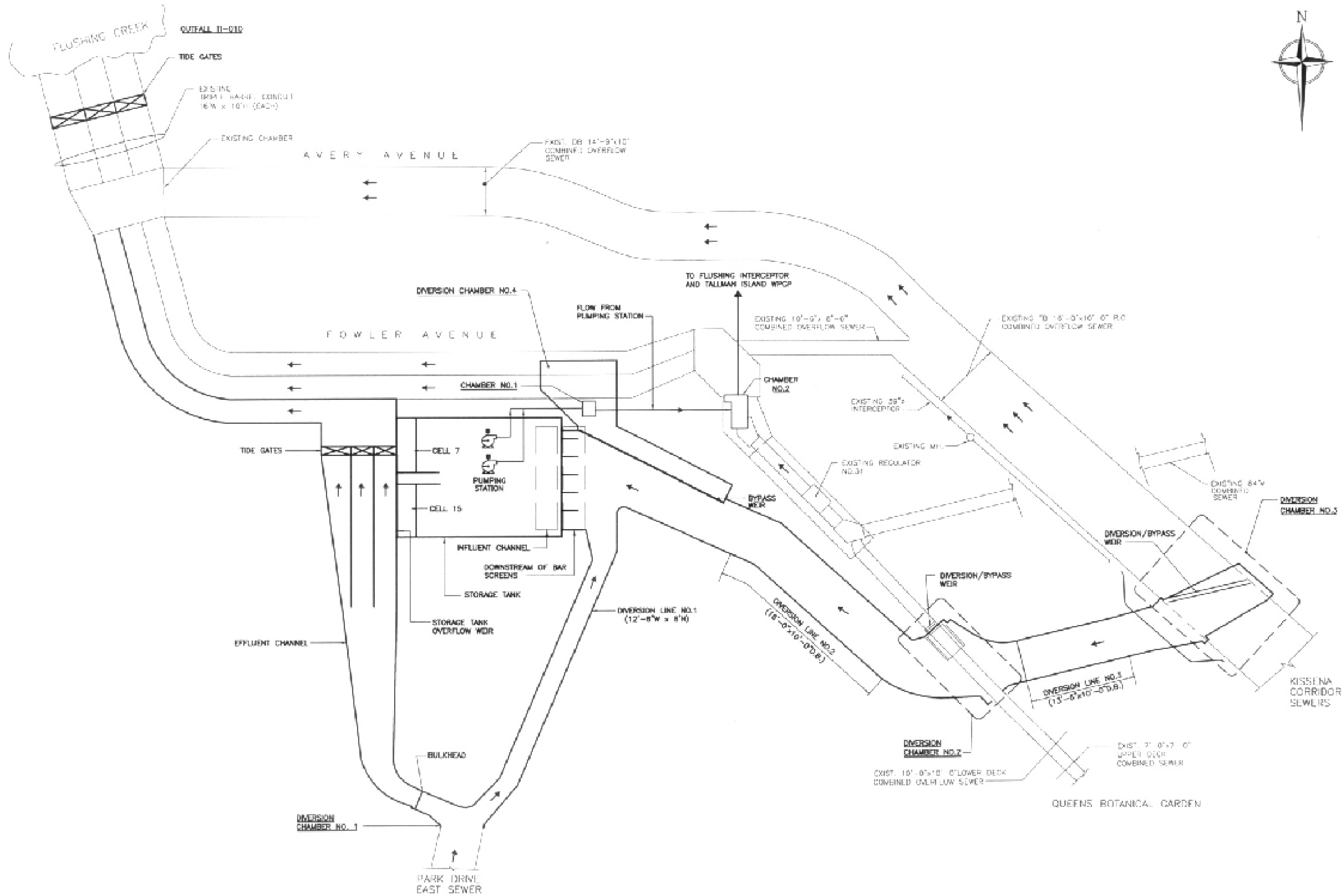

Figure A-3
Facility Schematic Plan

Tallman Island WPCP Flushing Creek CSO Retention Facility

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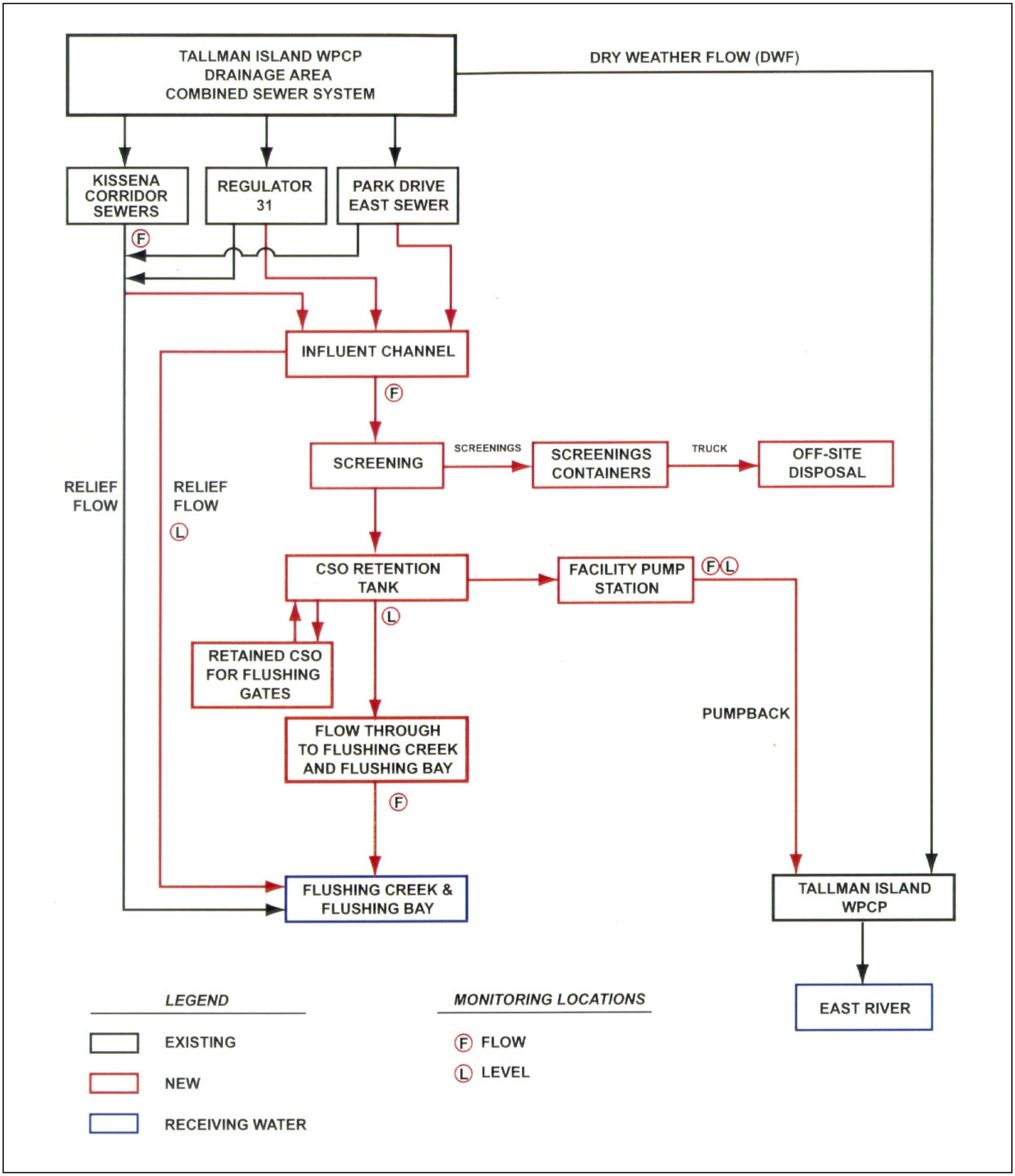

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Figure A-4
Flow Diagram

Tallman Island WPCP Flushing Creek CSO Retention Facility

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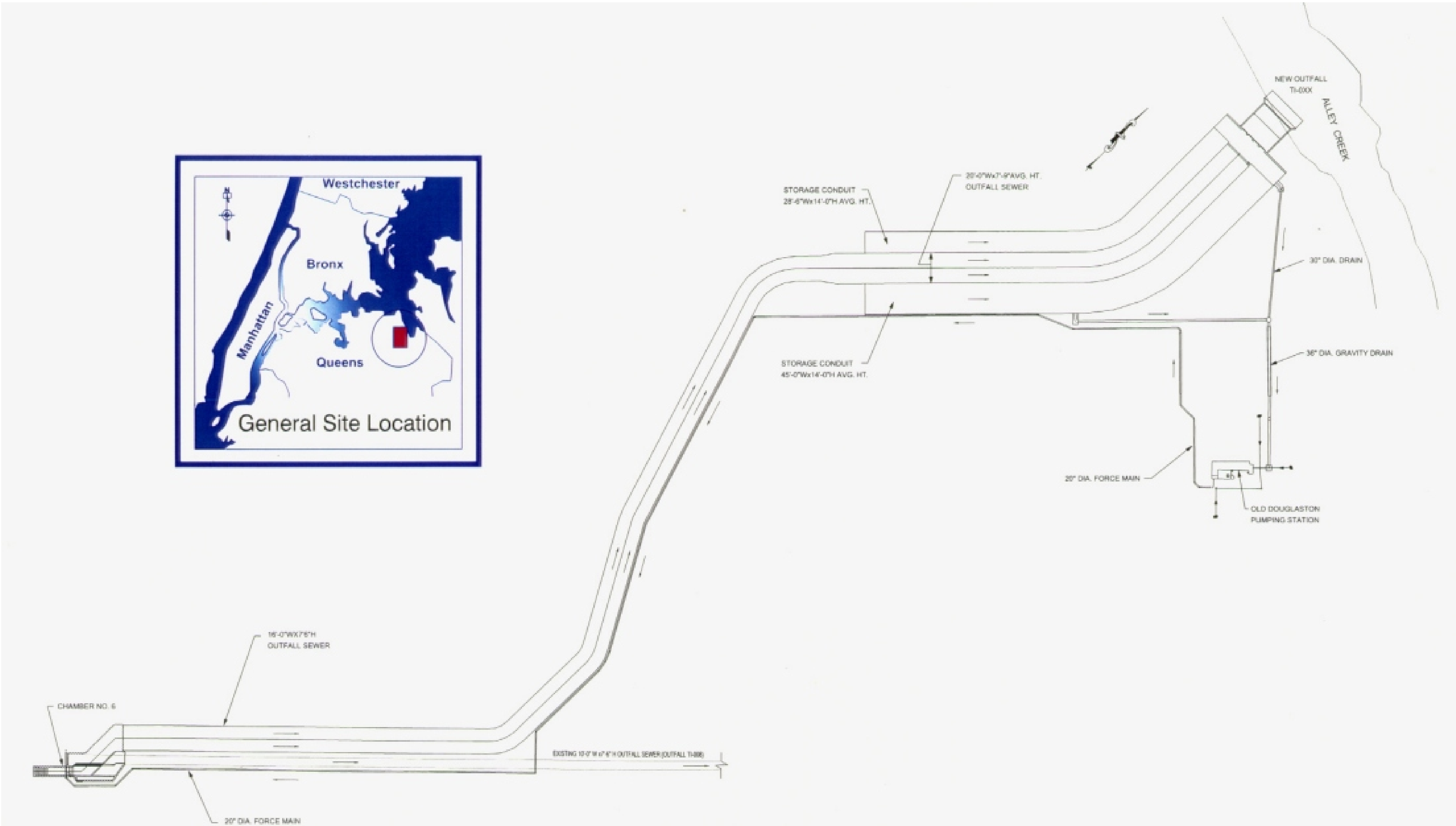

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Figure A-5
Retention Facility Schematic Plan

Tallman Island WPCP Alley Creek CSO Retention Facility

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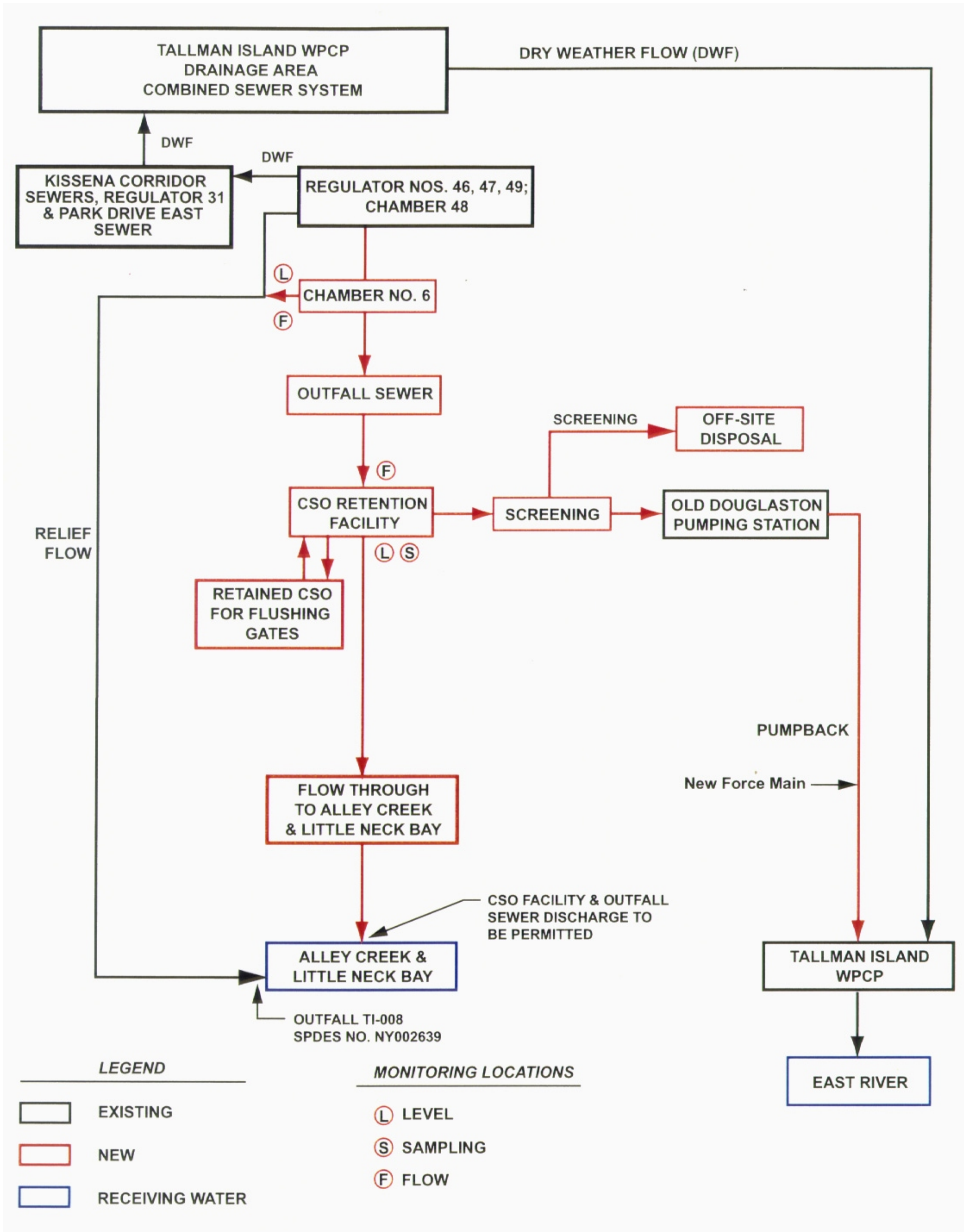

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Figure A-6
Flow Diagram

Tallman Island WPCP Alley Creek CSO Retention Facility

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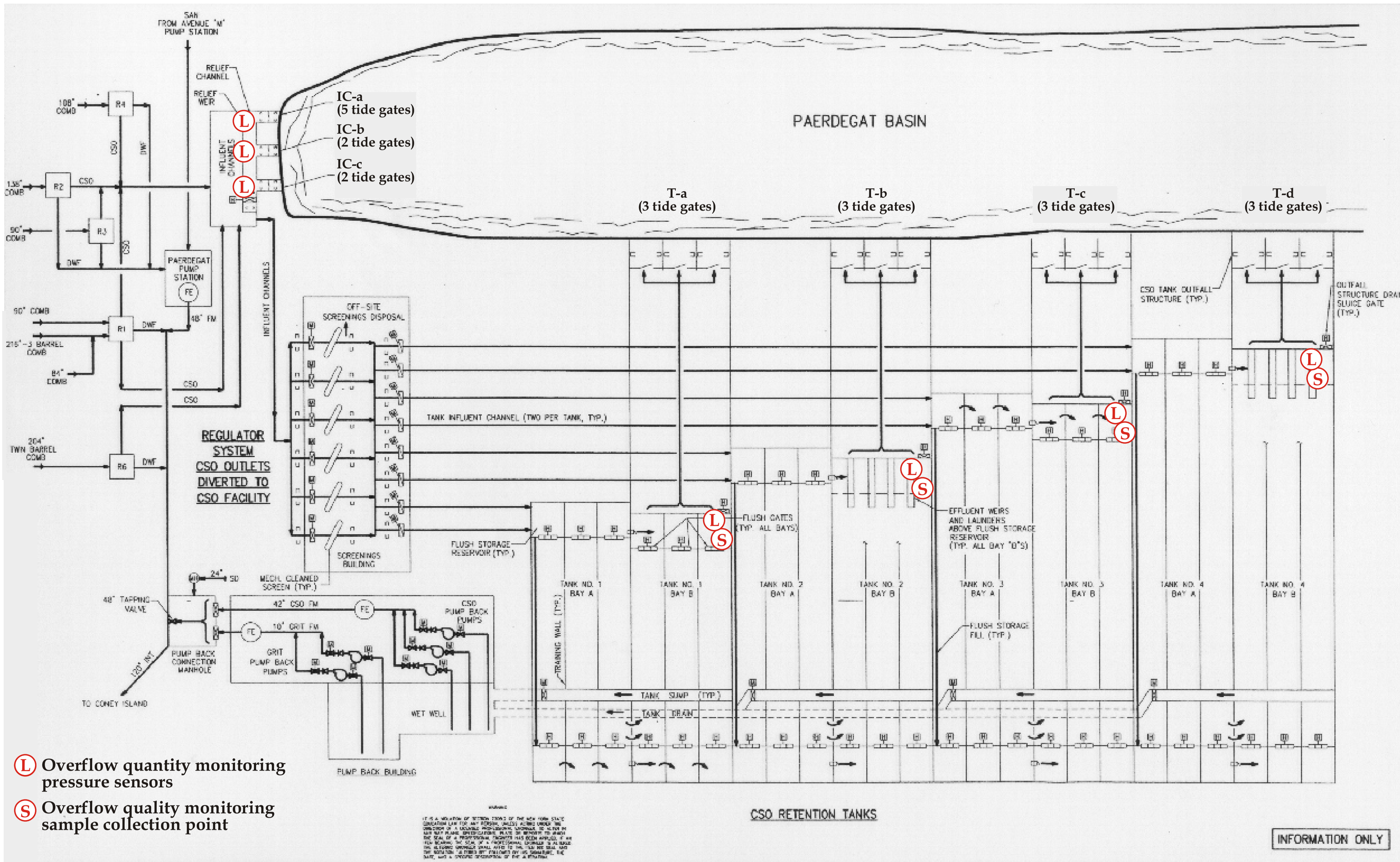

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Figure A-7
Facility Schematic Plan

Coney Island WPCP
Paerdegat Basin CSO Retention Facility

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DEP

APPENDIX E

USE ATTAINABILITY EVALUATION

City-Wide Long Term CSO Control Planning

PAERDEGAT BASIN LTCP

APPENDIX E
USE ATTAINABILITY EVALUATION

Prepared by

The City of New York

Department of Environmental Protection

Bureau of Engineering Design and Construction

NOVEMBER 2005

REVISED JUNE 2006

SUMMARY

Paerdegat Basin is a tributary of Jamaica Bay located in the southeastern section of Brooklyn, New York. The waterbody is presently designated for secondary contact recreation and fish propagation and survival. Water quality conditions in Paerdegat Basin do not presently meet the water quality numerical criteria protective of these uses. The secondary contact recreation designation assigned to the waterbody does not fully fulfill the swimmable goal of the Clean Water Act. The New York City Department of Environmental Protection (NYCDEP) has developed a Long-Term CSO Control Plan (LTCP) to abate combined sewer overflows and improve riparian zones. The plan will significantly improve water quality conditions in Paerdegat Basin but, despite a cost exceeding $300 million, water quality criteria associated with its current use designation will not be attained at all times. The analyses described herein characterize Paerdegat Basin, its watershed and riparian zone. The physical, chemical, and biological factors affecting use attainability were explored. Existing and attainable aquatic life, recreation, and aesthetic uses were evaluated. These analyses demonstrate that:

- The watershed of Paerdegat Basin has been urbanized to a high degree of imperviousness such that predevelopment water quality and beneficial uses cannot be reasonably restored. Cost-effective and reasonable management practices will not sufficiently reduce watershed runoff and pollutant loads to meet its designated uses. These conditions therefore represent human-caused conditions or sources of pollution that cannot be remedied or would cause more environmental damage to correct. It represents a limit on attaining aquatic life protection and primary contact recreation uses in Paerdegat Basin that cannot be reasonably overcome. Attaining aquatic life protection and primary contact recreation uses is not feasible, therefore use attainability factor number 3 in the Code of Federal Regulations [40 CFR 131.10(g)] applies.
- Paerdegat Basin has been transformed from a tidal creek surrounded by wetlands into a dredged channel with little or no wetlands. Historical dredging and alterations of the shorelines have altered physical estuarine conditions and eliminated original habitat. These conditions therefore represent hydrologic modifications that preclude the attainment of fishable/swimmable uses, and it is not feasible to restore the waterbody to its original condition. This factor represents a limit on attaining aquatic life protection and primary contact recreation uses in Paerdegat Basin that cannot be reasonably overcome. Attaining aquatic life protection and primary contact recreation uses is not feasible, therefore use attainability factor number 4 in the Code of Federal Regulations [40 CFR 131.10(g)] applies.

This analysis indicates that the high level of urbanization that has occurred in the Paerdegat Basin drainage area will continue to have some level of adverse impact on what is, in essence, an artificially constructed drainage channel. The analysis further demonstrates that the Paerdegat Basin LTCP will significantly improve water quality and ecological conditions, but will not completely eliminate impacts from CSOs. The resulting restored water uses, however, will be entirely consistent with, and supportive of, reasonable best uses of Paerdegat Basin and stakeholder use goals. A detailed description of the attainability evaluation is described herein.

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1.0. Introduction

Paerdegat Basin is an estuarine tributary of Jamaica Bay in New York City. Water quality and engineering investigations have demonstrated that Paerdegat Basin does not presently meet the water quality criteria for its designated uses. Physical alterations and combined sewer overflows (CSO) to the waterbody have been recognized as prime causes of use impairments. The New York City Department of Environmental Protection (NYCDEP) is developing a comprehensive plan that includes long-term CSO control planning. However, applicable numerical water quality criteria will not always be met in the future for its present designated uses, the attainment of which does not necessarily fulfill the fishable/swimmable goals of the federal Clean Water Act. As such, a use attainability evaluation of Paerdegat Basin was conducted to: determine the present use of the estuary; determine whether the present use corresponds to the designated use; if the present use does not correspond to the designated use, determine why; and determine the optimal use for the system. The analysis described herein provides a description of Paerdegat Basin and its impairment issues, the LTCP that is being implemented by the City, summaries of physical, chemical and biological factors influencing use attainment, existing and attainable uses, and recommendations.

Paerdegat Basin, a tributary of Jamaica Bay, is located in the southeastern section of Brooklyn, New York (Figure 1-1). The waterbody is a tidal tributary located on the northwestern edge of Jamaica Bay between the Flatlands and Canarsie sections of Brooklyn to the north and south, respectively. Its mouth opens to Jamaica Bay between Bergen Beach to the south and Canarsie Beach Park to the north. Prior to being dredged between 1912 and the 1930s, Paerdegat Basin was a freshwater-fed tidal creek known as Bedford Creek and was surrounded by wetlands. Now, channelized, bulkheaded, and bounded by filled uplands, Paerdegat Basin is a straight, dead-ended channel with a highly urbanized watershed.

Figure 1-1. Paerdegat Basin Site Location

Open space and recreation uses adjacent to the waterbody near the mouth consist of a mix of both passive and active recreation related to the waterbody. Canarsie Beach Park and Joseph Thomas McGuire Park contain open lawns and sitting areas that offer opportunities for relaxing and passive recreation. The two parks have baseball, softball and tennis courts that provide for more active recreational uses. There are no structured access points to Paerdegat Basin in these parks, and there are no bathing beaches in Paerdegat Basin or its vicinity. The yacht, racquet, and canoe clubs provide for active, structured waterfront uses and provide the only structured access to the waterbody.

The shorelines of Paerdegat Basin have been significantly modified through dredging, channelization, bulkheading, marina construction, and wetlands filling. Rip-rap shorelines can be found near the head on both shores at the DOT and NYCDEP facilities. Multi-barrel CSO outfalls at the head of the waterbody are supported by bulkheads. A separate CSO outfall in the southwest corner of the head of the waterbody and several stormwater outfalls along the length of the waterbody are protected by visible head walls. Outside of developed shorelines (i.e., marinas), Paerdegat Basin is generally characterized by dilapidated timber bulkheads with wetlands and undeveloped, vegetated shoreline located on the waterside of these bulkheaded areas. These shorelines are interspersed with small, abandoned wooden structures in various stages of decay and various debris including abandoned automobiles. They are characterized by a gentle slope (less than 5 degrees or 18-foot vertical rises for each 200-foot horizontal distance), except for two areas of intermediate slopes (5 to 20 degrees) underneath the Belt Parkway bridge near the mouth of the waterbody. At the water's edge, decay of some timber bulkheads has allowed a natural development of a gradual slope from the shore into the water, while other areas still retain a near vertical bank. Sandy stretches of natural shoreline exist near the mouth on Jamaica Bay.

Figure 1-2. Typical Paerdegat Basin Shoreline

Paerdegat Basin has a variety of designated tidal wetlands along its undeveloped shorelines. These shorelines are designated as coastal shoals, bars, and mudflats with interspersed intertidal marsh, and high marsh or salt meadow wetlands. The U.S. Fish and Wildlife Service National

Wetland Inventory designates the shorelines of Paerdegat Basin as predominantly estuarine, subtidal, open water/unknown bottom, subtidal, and excavated. The non-native, invasive common reed grass, *Phragmites australis*, dominates most of the coastal, shoals, bars, and mudflats. Intertidal marsh near the mouth is dominated by low marsh cordgrass (*Spartina* sp.). These intertidal marshlands tend to occur in very thin strips along the banks. No freshwater wetlands exist within 150 feet of the shorelines of Paerdegat Basin. The entire shoreline of Paerdegat Basin has been designated by the City of New York as a Special Natural Waterfront Area.

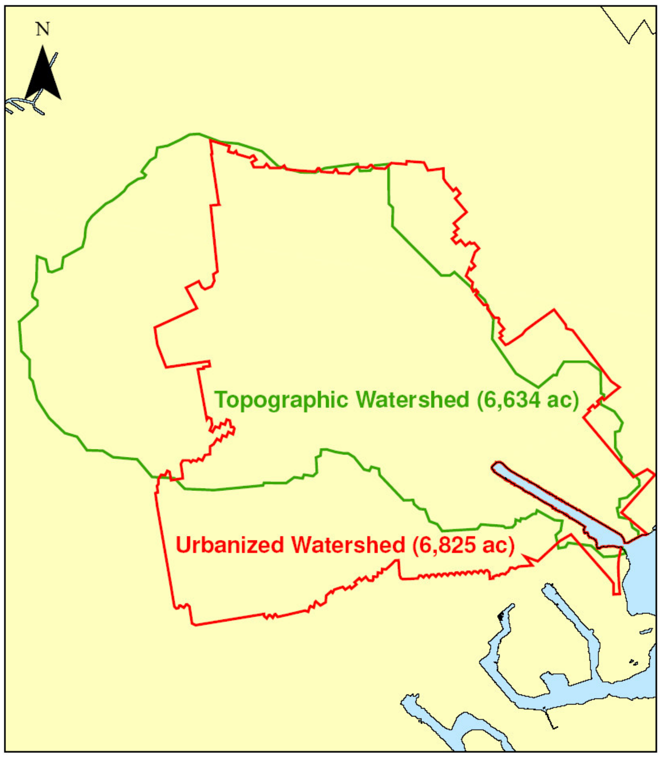

Figure 1-3. Paerdegat Basin's Topographic Watershed Compared to Existing Sewershed

The watershed of Paerdegat Basin has been completely altered from pre-development conditions to that of a sewershed that yields no freshwater inflow other than CSOs and stormwater discharges. The original topographic watershed for Bedford Creek was approximately 6,600 acres. The present drainage area is approximately 6,825 acres, including 6,145 acres of combined sewer service area that discharges to the head end of Paerdegat Basin, 375 acres of separately sewered area that discharges stormwater through five outfalls dispersed along both sides of the waterbody, and 302 acres of direct runoff areas. During rainfall events Paerdegat Basin CSOs are calculated to reach instantaneous peak flows of 3 billion gallons per day (BGD) and by volume represent a quarter of all CSO discharges to Jamaica Bay. CSO and stormwater discharges dominate the head end with freshwater that induces a temporary surface lens of fresh water sitting on the denser salt water underneath and causing strong vertical stratification. Saline conditions are restored as freshwater disperses with dilution and tidal action returns more saline waters from Jamaica Bay to Paerdegat Basin.

Figure 1-4. Paerdegat Basin Following a CSO Event

Combined sewer overflows and stormwater discharges are the primary sources of waterbody use impairments and of the failure to achieve numerical water quality criteria. Discharges of total suspended solids (TSS), biochemical oxygen demand (BOD), settleable solids, and floatables induce odors and other deleterious aesthetic conditions in Paerdegat Basin. Depressed dissolved oxygen 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 in Paerdegat Basin are common occurrences. A sediment mound has formed caused by settling solids discharged by the CSOs and extends approximately 1,000 feet downstream from the head of the waterbody, is dry in some spots at low tides, and restricts access by small craft users. Noticeable odors are caused by sediments exposed at low tides and chemical/biological reactions within the sediment and overlying water during hypoxic or anoxic conditions that release hydrogen sulfide and methane gas. The sediment mound depletes dissolved oxygen in overlying waters and is of limited habitat value. Floatables discharged by the CSOs and storm sewers are noticeable and represent a nuisance condition throughout Paerdegat Basin. Water clarity is poor, especially following wet weather events.

Paerdegat Basin is designated by the State of New York as a Class I waterbody. The best uses of a Class I waterbody are secondary contact recreation and fishing, the latter of which requiring that the waterbody be suitable for fish propagation and survival in addition to secondary human contact. The numerical dissolved oxygen water quality standard for Class I is never-less-than 4.0 mg/L. The Class I total coliform standard requires that the monthly geometric mean concentration, from a minimum of five examinations, shall not exceed 10,000 per 100 mL. The Class I fecal coliform standard requires a monthly geometric mean concentration, from a minimum of five examinations, not exceeding 2,000 per 100 mL.

The City has developed an LTCP for Paerdegat Basin that is being implemented by NYCDEP for improving water quality conditions in Paerdegat Basin. Facility planning under the Paerdegat Basin Water Quality Facility Plan ("Facility Plan") investigated cost-effective engineering options to improve conditions and meet currently designated water quality standards. A knee-of-the-curve approach was employed to develop the Facility Plan (Hazen and Sawyer, 1991). It has begun construction of influent channels to induce in-line storage capable of storing 20 million gallons (MG) and redirect CSOs through an off-line retention tank. NYCDEP is currently constructing the retention tank, which will retain up to 30 MG of combined sewage for treatment at the Coney Island Water Pollution Control Plant (WPCP). This retention tank will be situated lengthwise along the side of Paerdegat Basin at the head end. In addition to retention, screening facilities and baffles will control floatables discharges. The Facility Plan includes remapping the waterbody and adjacent undeveloped shorelines as parkland, which has been performed. The total capital cost of this plan is in excess of $300 million. These actions constitute NYCDEP's Long-Term CSO Control Plan for the Coney Island WPCP CSO service area and will achieve CSO capture greater than 85 percent, as defined by federal CSO policy, for an average precipitation year. Post-construction compliance monitoring will be conducted in Paerdegat Basin by NYCDEP.

The CSO abatement features of the LTCP will greatly reduce the number and volume of CSO discharges to Paerdegat Basin. Flow maximization for treatment and CSO retention will reduce discharges to less than two times per month for an average precipitation year. The facility will be bypassed during extreme wet weather events when hydraulic conditions exceed 1 BGD. These discharges will occur at the existing CSO outfalls less than once every two months for an average precipitation year. On a long-term basis, this plan will most likely retain over 60 percent of the overflow volume, returning it to the Coney Island WPCP for treatment. Over 97 percent of the total CSO volume will receive some level of treatment, thereby reducing 70 to 75 percent of the BOD and TSS load, 80 percent of the settleable solids load, 90 percent of the floatables load, and a significant portion of the bacteria loads to Paerdegat Basin. Reduced discharges of settleable solids and associated reductions in BOD and sediment oxygen demand (SOD) will result in a virtual elimination of odor problems. Reducing suspended solids discharges will improve water clarity.

The City of New York employs a proactive program for minimizing floatables discharges. Street sweeping reduces the amounts of floatables entering the sewer system via catch basins. The City has aggressively completed a catch basin hooding program and instituted maintenance programs to minimize floatables discharges from combined sewer and storm sewer systems, including those tributary to Paerdegat Basin. NYCDEP has constructed an interim containment boom as part of its Interim Floatables Containment Program near the head end to contain CSO floatables. A skimmer vessel, based in Paerdegat Basin, retrieves contained floatables after wet weather events. These programs will continue.

Water quality conditions in Paerdegat Basin do not meet the numerical and narrative water quality standards of its Class I designation at all times. The waterbody fails to meet water quality standards by exhibiting high levels of coliform bacteria, low levels of dissolved oxygen, visible floatables, and other aesthetic impairments. Paerdegat Basin is listed on New York State's 2004 303(d) list requiring Total Maximum Daily Load (TMDL) development. With its resulting water quality improvements, the Paerdegat Basin LTCP is expected to benefit Paerdegat Basin's aquatic community, improve recreational opportunities such as boating and fishing, and enhance waterbody aesthetics to conditions consistent with desired waterbody and riparian uses, although not fully achieving New York State's narrative and Class I numerical water quality standards.

The Clean Water Act requires states to establish water quality standards that 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 State of New York considers its Class I classification protective of fish propagation and survival and thus Paerdegat Basin's designated use meets the fishable goal of the Clean Water Act. However, since the Class I classification does not protect primary contact recreational uses, the present use designation of Paerdegat Basin does not fulfill the swimmable goals ("recreation in and on the water") of the Clean Water Act. New York State's Class SC or SB classification protects primary contact recreation and therefore does fulfill the goals of the Clean Water Act. Predicted conditions in Paerdegat Basin will not completely comply with the dissolved oxygen requirements of the current Class I designation. Conditions will also not completely comply with the USEPA's recently published marine dissolved oxygen guidance criteria.

Continued CSO discharges from the constructed facilities will result in periodic elevated coliform bacteria conditions. Predicted conditions in Paerdegat Basin will comply with the coliform bacteria requirements of the current Class I designation during an average precipitation year. However, the secondary contact recreation designation does not fully comply with the swimmable goals of the Clean Water Act. Furthermore, predicted conditions in Paerdegat Basin will not comply at all times with an upgraded designation for Paerdegat Basin to primary contact recreation that would meet these goals.

The level of abatement of CSOs achieved by the LTCP will greatly reduce (although not eliminate) the discharge of settleable solids. Discharges will result in continued settling of solids that will have some impact on habitat. Odors will be virtually eliminated and water clarity will improve. Continued CSO and stormwater discharges to Paerdegat Basin will result in some floatables discharges. This condition will not fully comply with narrative standards all of the time.

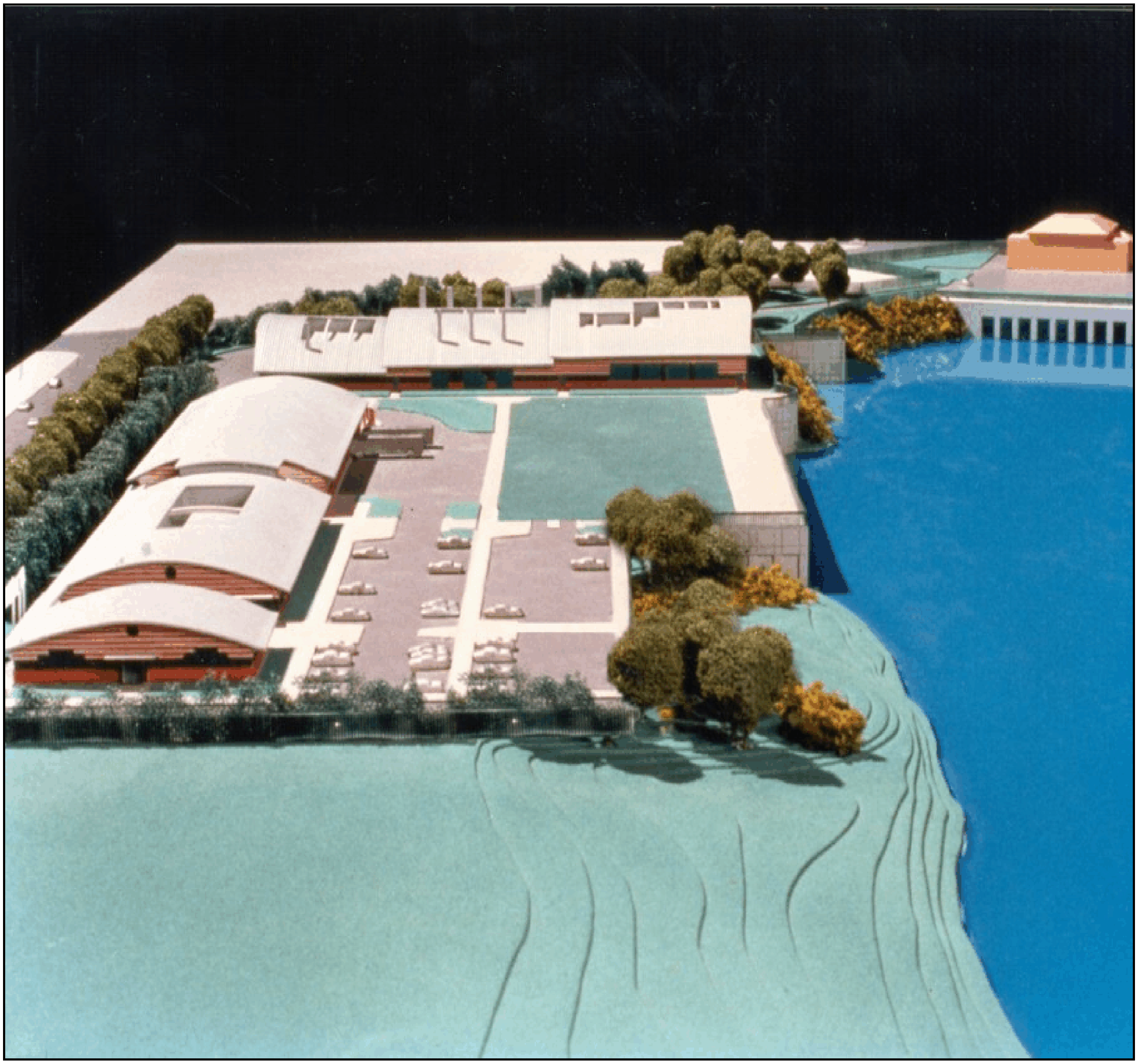

Figure 1-5. Conceptual Image of Paerdegat Basin CSO Retention Facility

2.0. Use Attainment Evaluation

Federal guidance suggests that "[w]aterbody surveys and assessments conducted by the States should be sufficiently detailed to answer the following questions: 1) What are the aquatic use(s) currently being achieved in the waterbody? 2) What are the causes of any impairment of the aquatic uses?, and 3) What are the aquatic use(s) that can be attained based on the physical, chemical, and biological characteristics of the waterbody?" (USEPA,1994). Considerations and methods for conducting a UAA are described in USEPA guidance (USEPA, 1993) and other literature (Novotny et al., 1997). Examples of UAA findings are summarized by USEPA as case studies in other guidance (USEPA, 1994). Physical, chemical and biological factors affecting use attainment are described herein in a manner consistent with the guidance and based on information gathered from previous and ongoing programs, projects, and studies relative to Paerdegat Basin.

Mathematical modeling analyses were conducted of the watershed to characterize sources of point source discharges to Paerdegat Basin. Receiving water modeling was conducted to simulate receiving water responses and to evaluate existing conditions and projected conditions expected with implementing engineering alternatives.

Projection scenarios were evaluated for assessing the benefits of combined sewer overflow (CSO) abatement: baseline and facility plan. The baseline scenario simulates engineering alternatives that are already planned and/or being implemented by NYCDEP; these include the capture of two times design dry weather flow, sewer extension to Broad Channel, and sewer separation in the Rockaways. The Facility Plan scenario is the baseline scenario plus implementation of the Paerdegat Basin LTCP and other facility plans throughout Jamaica Bay and its tributaries. Each of the scenarios was evaluated for the average precipitation year.

2.1. PHYSICAL FACTORS

Paerdegat Basin was originally a tidal creek called Bedford Creek that was surrounded by wetlands. Historical alterations made to the Paerdegat Basin watershed have increased its size, imperviousness, and water quality composition. The Bedford Creek watershed was characterized by natural areas that were urbanized into the present neighborhoods upland of and surrounding Paerdegat Basin. The size and location of the watershed has been altered by physical changes made to topography and the construction of sewer systems that overflow to Paerdegat Basin during wet weather. Sewer systems have replaced the natural overland pathway of runoff with a conveyance system. Runoff is conveyed much more quickly and directly to the waterbody without attenuation by surrounding wetlands that have been eliminated.

Urbanization of the watershed has altered its runoff yield tributary to Paerdegat Basin by increasing its imperviousness. Percent impervious is a measure of the amount of runoff that can potentially reach a waterbody and this is typically altered from a 10 to 15 percent level for natural areas to 70 percent or more for urban areas. The Paerdegat Basin watershed is typical of urbanization, with a population of approximately 490,000 (72 persons per acre) in single and multi-family dwellings, and thus has a significantly increased amount of runoff discharged to the waterbody compared to when it was Bedford Creek.

Figure 2-1. Paerdegat Basin's Urban Watershed

The original topographic watershed of Paerdegat Basin was approximately 6,600 acres encompassing the villages of Flatbush, Flatlands, Kensington, Parklands and West Brooklyn prior to their incorporation into the City of Brooklyn during the mid- to late-1800s and subsequently into the City of New York at the turn of the century (Allee King Rosen & Fleming, 1994). These areas were primarily small villages with agricultural areas bordering on the marshlands of Jamaica Bay. They were transformed from undeveloped uplands with minimum runoff characteristics to villages and farms in the eighteenth and nineteenth centuries, then to the current urban landscape with high runoff characteristics. The table below approximates the hydrologic changes in Paerdegat Basin's watershed. Runoff yields for an average precipitation year can be calculated using mathematical models. The table indicates that although the overall size of the drainage areas has been increased somewhat, its runoff characteristics have drastically changed. The overall runoff yield has increased from approximately 730 MG of overland runoff to 3,300 MG discharged by combined and stormwater sewer systems to Paerdegat Basin, an increase of 450 percent. Runoff characteristics have decreased the travel time to the waterbody that would naturally degrade pollutants and has increased peak discharge rates. These discharges are now made directly to Paerdegat Basin rather than being attenuated, filtered, and mitigated by adjoining wetlands that have been eliminated. The Paerdegat Basin LTCP will reduce these discharges by approximately 60 percent for an average precipitation year but other watershed characteristics will remain the same and discharges of pollutants to Paerdegat Basin will continue.

Table 2-1. Effects of Watershed Urbanization

Characteristic	Pre-Urbanized	Urbanized[(1)]	Plan[(2)]
Drainage Area (acres)	6,600	6,824	6,824
Adjacent Wetlands (acres)[(3)]	300	10	10
Imperviousness	10%	70%	70%
Average Runoff Yield (MG)[(4)]	730	3,300	1,300
Peak Storm Runoff Yield (MG)[(4)]	45	221	156
Population[(5)]	150,000	490,000	490,000

(1) Existing condition
(2) LTCP
(3) Approximated from historical topographic maps and dated tidal wetlands maps
(4) For an average precipitation year (JFK, 1988), including stormwater
(5) Pre-urbanized is estimated, Urbanized and Plan based on Year 2000 U.S. Census

The urban setting has also altered the water quality composition of runoff to Paerdegat Basin. During wet weather a combined sewer system mixes sanitary sewage with runoff to produce a mixed discharge that is significantly stronger in pollutant concentrations than natural runoff. These pollutants include oxygen demanding materials, suspended and settleable solids, floatables, etc. The water quality impacts of these pollutants on use attainment are further described in the chemical factor review to follow. Thus, physical alterations of the watershed have changed the amount, timing, and composition of runoff and its effect on Paerdegat Basin.

The transformation of Bedford Creek to Paerdegat Basin has affected the waterbody's size, shape, assimilation of runoff, and interaction with Jamaica Bay. Encroaching agriculture followed by urbanization that leveled uplands and filled tidal wetlands permanently altered riparian areas. Prior to waterbody alterations, historical photographs, nautical charts and topographic maps (like that shown to the right), indicate that Bedford Creek was a shallow, meandering tidal creek, approximately 4,000 feet in length and 100 feet wide that opened onto tidal flats in Jamaica Bay (USACE, 2002). Beginning in the early 1900s and ending in the 1930s, Paerdegat Basin was dredged to 16 feet below mean low water and bulkheaded to its present configuration of 6,675 feet long and 450 feet wide opening onto dredged shipping channels in Jamaica Bay. The increase of depth in the waterbody and lack of freshwater flow has created a stilling effect on pollutant discharges that causes heavy organic material and grit to settle to the bottom of the waterbody, especially at the head end, which has reduced depths at the head end of the waterbody exposing the bottom at low tides. The dredged channel has not been maintained and a sand bar has developed at the mouth of Paerdegat Basin restricting tidal exchange and vessel traffic with Jamaica Bay.

The urbanization of the Paerdegat Basin watershed has significantly increased the amount and characteristics of runoff. The Paerdegat Basin LTCP will reduce discharges but other watershed characteristics will remain the same and discharges of pollutants to Paerdegat Basin will continue. Historical alterations of Paerdegat Basin and elimination of wetlands hinders the waterbody from being able to assimilate pollutant loads and beneficially interact with adjoining boundary waters.

Figure 2-2. Paerdegat Basin (Bedford Creek) in 1897

2.2. CHEMICAL FACTORS

Water quality conditions in Paerdegat Basin have been extensively characterized by NYCDEP's field investigations. Observations of low dissolved oxygen, high coliform bacteria, poor water clarity, floatables, odors have been well documented by NYCDEP. These conditions regularly persist during and following CSO events. Data show that the numerical water quality criteria for the current Class I designation for aquatic life, recreation, and aesthetic uses are not achieved in Paerdegat Basin. Implementation of the Facility Plan aspects of the Paerdegat Basin LTCP will greatly improve chemical conditions in Paerdegat Basin. These conditions can best be described through mathematical modeling projections for the various levels of abatement that benefit aquatic life, recreational uses, and aesthetics.

Aquatic life benefits of the LTCP can be characterized by comparing projected annual-average dissolved oxygen conditions in Paerdegat Basin to current water quality numerical criteria. Implementing the Facility Plan will result in a significant increase in the percentage of time that the Class I dissolved oxygen numerical criterion will be met along the length of the waterbody on an annual average basis when compared to the Baseline scenario. In the upper two-thirds of the waterbody the Class I criterion will be attained greater than 90 percent of the time, while for the lower third of the waterbody the criterion will be met greater than 95 percent of the time. Figure 2-3 spatially represents the projected time above the Class I dissolved oxygen numerical criterion for an average precipitation year in Paerdegat Basin.

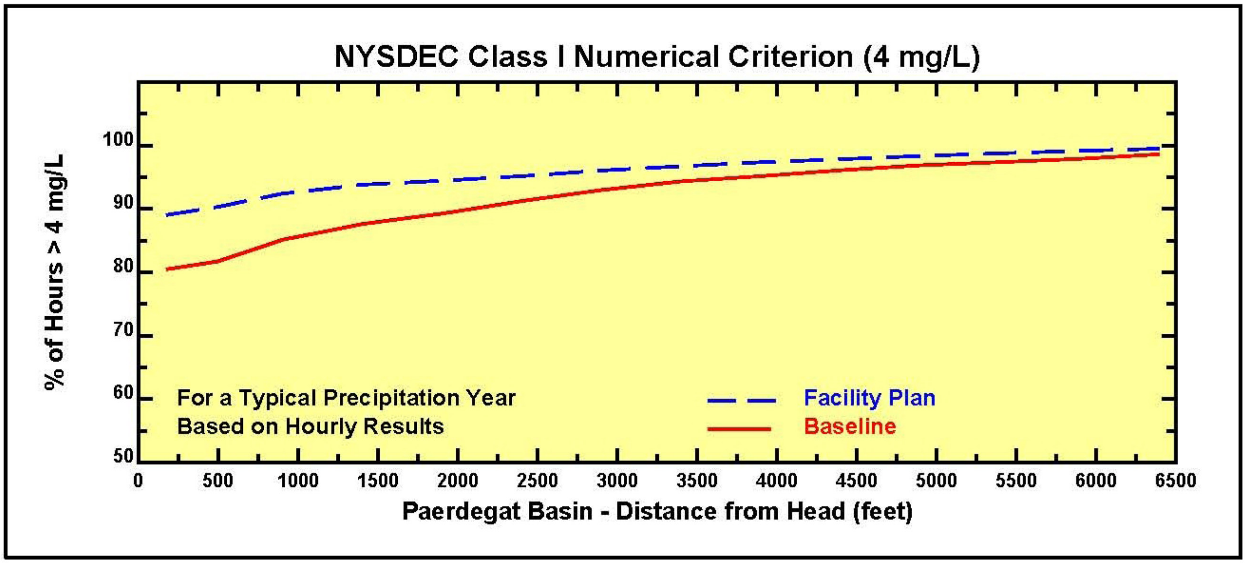

Figure 2-3. Projected Time above Class I Dissolved Oxygen Numerical Criterion

Recreational use benefits of the Paerdegat Basin LTCP can be characterized by comparing projected annual average total coliform conditions in Paerdegat Basin to current numerical criteria for water quality and to criteria for potential use designations. Implementing the Facility Plan will result in a significant increase in the percentage of time that Class I total coliform numerical criteria will be met along the length of the waterbody on an annual-average basis when compared to the Baseline scenario. Coliform bacteria discharge reduction achieved by the Facility Plan will result in water quality protective of Paerdegat Basin's current secondary contact recreation designation (Class I) 100 percent of the time. This is a significant improvement over the Baseline scenario. Figure 2-4 spatially represents the projected time below the Class I total coliform numerical criterion for an average precipitation year in Paerdegat Basin.

If modifying the use designation from secondary to primary contact recreation (Class SC or SB) is considered for Paerdegat Basin, the Paerdegat Basin LTCP will attain the two total coliform numerical criteria for primary contact recreation (thirty-day median and upper limit) part of the time. By implementing the Facility Plan, the thirty-day median concentration criterion (2,400 per 100 mL) will be met nearly all of the time in most of the waterbody for an average precipitation year. It will be met all of the time near the mouth. During the high recreational period (i.e., the time between May and October when water temperatures reasonably facilitate primary contact uses), the Facility Plan is projected to achieve these numerical criteria 100 percent of the time.

The Facility Plan is expected to significantly improve the period of time that Paerdegat Basin attains the Class SC/SB upper limit total coliform numerical criterion (80% of measurements at or below 5,000 per 100 mL), a target that is much more sensitive to expected peak coliform bacteria concentrations associated with wet weather events. On an annual basis, this value will not be met by any of the scenarios throughout the waterbody using the average precipitation year simulated in the projections. However, Facility Plan conditions are expected to achieve the upper limit value greater than 60 percent of the time (translating to approximately eight months), and during all but one month of the high recreational period (approximately 83 percent of the high recreation time). This is a significant improvement over the baseline scenario. The following figure spatially represents the projected time during which the upper limit total coliform numerical criterion for Class SC/SB would be achieved during an average precipitation year in Paerdegat Basin.

Further, the Facility Plan is expected to provide for primary contact recreation uses based on the fecal coliform numerical criterion 75 percent of the year (9 months) and 100 percent of the time during the recreation season. Full support of primary contact recreation is also predicted based on the geometric mean enterococci primary contact criterion during the recreation season, although it would only be achieved about 60 percent of the time over a full year. A reference level enterococci concentration of 501 per 100 mL will be exceeded about 30 percent of the time.

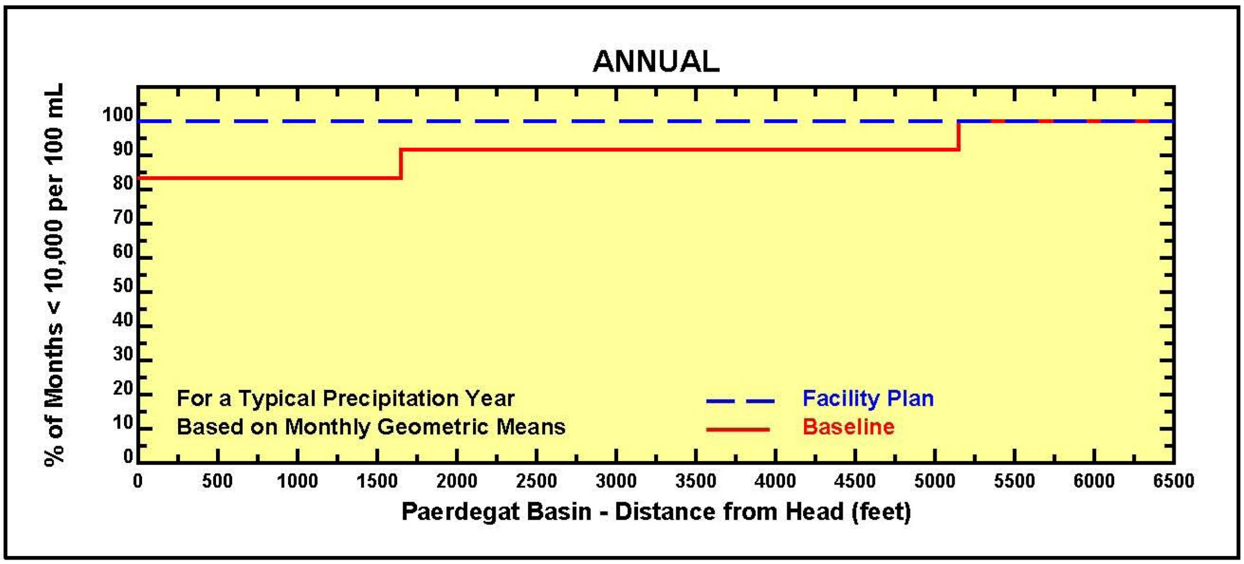

Figure 2-4. Projected Time below Class I Total Coliform Numerical Criterion

Implementation of the Paerdegat Basin LTCP will therefore result in attainment of the Class I numerical criteria throughout the waterbody all the time for an average precipitation year. The Facility Plan will thus protect desired secondary contact recreational water uses such as kayaking, canoeing, and boating throughout Paerdegat Basin all of the time. Water quality standards associated with an upgrade in recreational use classification to primary contact recreation will not be met at all times throughout the waterbody however it constitutes a significant improvement over Baseline conditions.

The Paerdegat Basin LTCP is also expected to capture a significant portion of settleable solids currently discharged by CSOs. Sediment oxygen demand is projected to be greatly reduced with the reduction of organic sources associated with settleable solids. Abatement of CSO discharges of BOD and other pollutants that deplete dissolved oxygen in the water column will result in improved dissolved oxygen conditions as stated above. As such, odors associated with anoxic and hypoxic conditions caused by these factors will be greatly reduced if not eliminated. CSO abatement will reduce discharges of suspended solids, which will also improve water clarity to some degree. However, water clarity in Paerdegat Basin is strongly influenced by background turbidity of the New York/New Jersey Harbor complex and periodic eutrophic conditions in Jamaica Bay.

2.3. BIOLOGICAL FACTORS

Sampling stations of the "Paerdegat Basin Field Sampling and Analysis Program, Years 2000-2001, Component 1: Waterbody Biology" (HydroQual, 2000, 2002a, 2002b) following a project SOP (HydroQual, 2002c) were located in Paerdegat Basin, with reference stations in nearby Fresh Creek, Hendrix Creek, and Jamaica Bay. Procedures characterized subtidal benthos, epibenthic recruitment and survival, fish abundance and diversity, ichthyoplankton, pathogens and water column toxicity. Benthos samples were collected to determine the invertebrate community composition, species richness and diversity as well as bottom sediment composition [grain size distribution and total organic carbon (TOC)]. In July 2000, six replicate benthos samples were collected with a modified Young ponar grab at seven stations. Sediment cores were collected for SOD analysis at the seven benthos stations in August 2000. The recruitment and survival of epibenthic communities on hard substrates was evaluated because these sessile organisms are good indicators of long-term water quality. The abundance and community structure of epibenthic organisms were characterized by deploying surface and bottom artificial substrate arrays at seven locations in July 2000 that were monitored quarterly until June 2001. Ichthyoplankton samples were collected to characterize the ichthyoplankton community and to determine what species, if any, spawn in Paerdegat Basin and nearby waterbodies. Samples were collected using a fine-mesh plankton net with three replicate tows performed at four stations in June 2000. Fish are motile organisms that can choose which habitats they enter and utilize and their presence or absence can be used to evaluate water quality. Relative abundances of fish populations were sampled using an otter trawl, gill net and crab/killi pots at five stations for three consecutive days in August 2000. Acute water column toxicity was also evaluated for surface water samples collected in August 2000 at three locations in Paerdegat Basin, two in Fresh Creek, and one each in Hendrix Creek and Jamaica Bay.

The biotic communities of Paerdegat Basin, as in any estuarine system, may include: rooted plants; benthic invertebrates; algae and epibenthic invertebrates; microscopic plants including different forms of algae (phytoplankton); microscopic animals that live in the water column including copepods, cladocerans and other invertebrates (zooplankton) plus fish eggs and/or larvae (ichthyoplankton); juvenile and adult fishes; and reptiles and amphibians. Data collected during the FSAPs characterized these communities.

High levels of organic matter inputs, such as those associated with CSO events or highly eutrophic systems, can have an adverse impact on benthic communities. In essence, high organic inputs, coupled with low oxygen levels, will produce anaerobic chemical conditions in the sediment bed. In turn, this increases microbial activity and reduces the redox potential of the sediments. Ultimately, this increases the production of toxins such as hydrogen sulfide and methane. The change in status to anaerobiosis will limit the benthic macroinfauna in anoxic/reducing muds to species that can form burrows or that have other mechanisms to obtain oxygen from the overlying water column. While moderate levels of organic enrichment as measured by TOC provides food to increase benthic community diversity and abundance, high levels of organic enrichment leads to a decrease in diversity. The benthic community then becomes increasingly dominated by a few pollution-tolerant, opportunistic species such as the polychaete *Capitella capitata*. In grossly polluted environments, the anoxic sediment is depopulated and may be covered by sulfur-reducing bacteria such as *Beggiatoa* spp. Subtidal benthic sampling by the USA Project clearly illustrated differences in taxa diversity between the upper and lower (near mouth) portions of Paerdegat Basin. Only one individual (and therefore a single taxa) was found more than a third of the way downstream of the head end. These differences are thought to be mostly a function of substrate quality (grain size heterogeneity and percent total organic carbon). The number of taxa in Paerdegat Basin sediments increases as the solids percentage increases, and the TOC decreases. This relationship also held true in other waterbodies sampled in 2000 and 2001.

Implementing the Facility Plan components of the Paerdegat Basin LTCP is expected to capture a significant portion of settleable solids currently discharged by CSOs. A significant reduction in the organic carbon content of the sediment bed is also expected, along with a corresponding increase in the number of taxa in the benthos. Projected habitat conditions will result in a better food base for fish species that feed largely or partially on benthic organisms (e.g. spot, winter flounder, and even weakfish and striped bass). Figure 2-5 below presents spatial projections of improvements in TOC and number of taxa in Paerdegat Basin for the Facility Plan scenario compared to the Baseline scenario. These improvements do not include the benefit of environmental dredging that will occur during LTCP implementation.

Epibenthic characterizations are based on sampling conducted at three locations in Paerdegat Basin and nearby reference stations. Artificial substrate panels deployed at the head of the waterbody were blanketed with an organic matrix not unlike that of the sediments there, but no animals were present. In contrast, a station midway down the waterbody had heavy colonization and moderate diversity (including barnacles, worms and some crustaceans), and a station at the mouth had even greater diversity. At both downstream stations, however, diversity and abundance were lower on the plates taken from the bottom arrays. It can be noted that the Say mud crab (*D. sayi*), whose larval stage lack of tolerance to low dissolved oxygen in the laboratory was a driving force in the derivation of USEPA's marine dissolved oxygen criteria, was found on these panels. Most of the taxa found on these arrays are tolerant of organic enrichment and/or low dissolved oxygen (even barnacles, which are also found in very clean waters). These observations are correlated with improving water quality conditions that occur with increasing distance from CSO discharges at the head end - a correlation that also held true in other waterbodies sampled in 2000 and 2001. Benefits of the LTCP include reduction in TOC and solids input; improved light penetration in the water column; and higher-than-average dissolved oxygen levels with less-frequent incidences of hypoxia in the lower half of the water column. It is therefore expected that an increase in epibenthic biomass and diversity could, given availability of hard substrate habitat, occur throughout the waterbody with the implementation of the LTCP. Figure 2-6 below illustrates the differences in epibenthic abundance (quantified by mass) and diversity between the head end and mouth measured in 2000 and 2001.

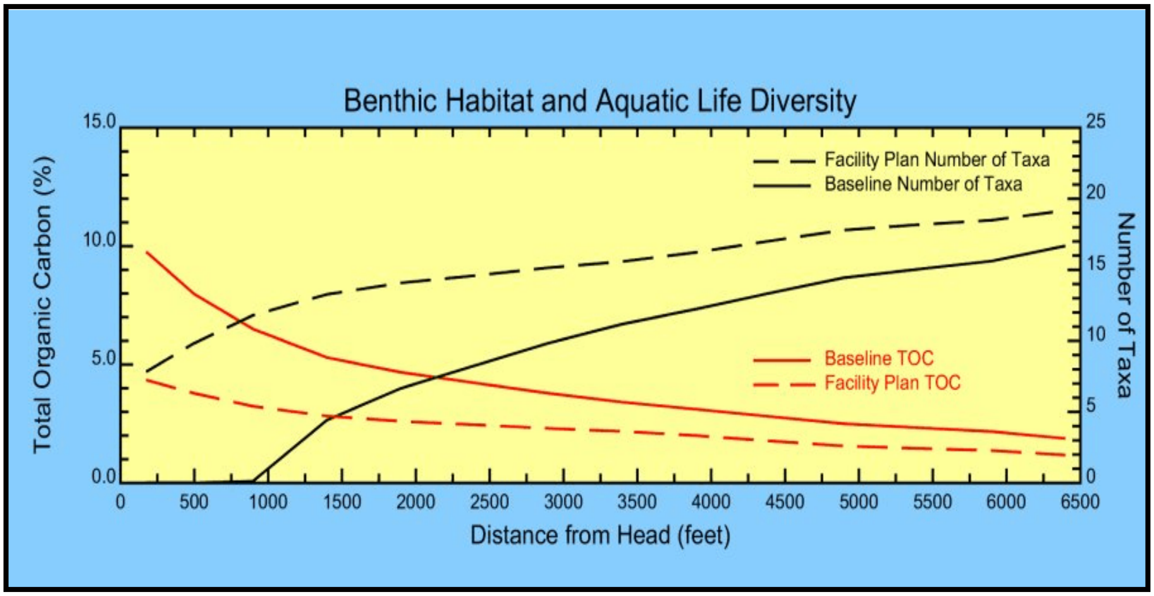

Figure 2-5. Projected Improvements in Benthic Habitat and Aquatic Life Diversity in Paerdegat Basin for an Average Precipitation Year

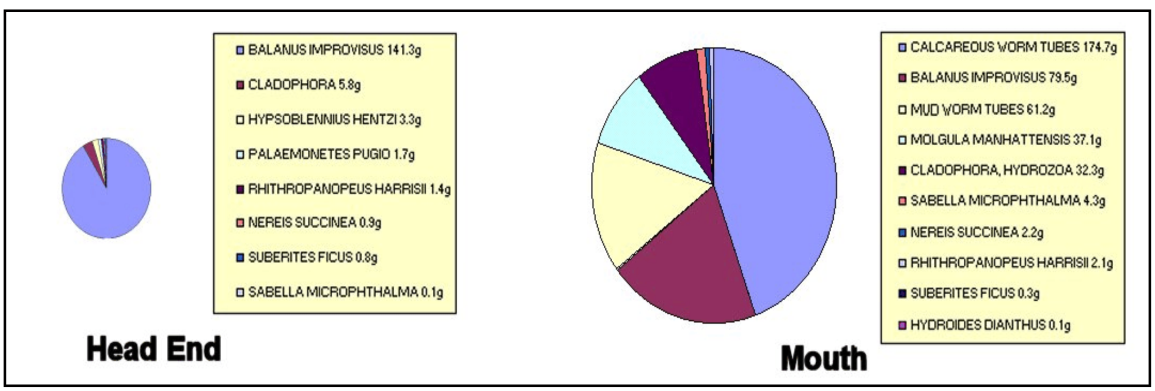

Figure 2-6. Epibenthic Abundance and Diversity in Paerdegat Basin, Years 2000-2001

Since the issue of fish propagation is integral to both the definition of the aquatic life use classifications and the attainment of associated water quality criteria, ichthyoplankton sampling was performed to find out what, if any, fish species may be spawning in Paerdegat Basin. Results show that while a fair number of species were represented, the only species and life stages found in abundance were bay anchovy eggs and larvae in June and July; menhaden eggs in June; scup in and winter flounder larvae in March; goby larvae from June through August; and tautog and cunner (wrasses) eggs in early summer. The only ichthyoplankton found in Paerdegat Basin in August were cunner eggs, and goby larvae, whereas anchovy eggs were found at reference stations elsewhere in Jamaica Bay. While it is likely that some spawning of wrasses, gobies, menhaden and anchovies does occur in Paerdegat Basin during late spring and summer, their relative abundance there is generally lower than in other portions of the Jamaica Bay system. In light of the fact that Paerdegat Basin comprises less than 0.2% of the water volume of the Jamaica Bay system and has a much lower availability of prime habitat for species like tautog and silversides, the impact of low dissolved oxygen is not significant at the Jamaica Bay population level. With implementation of the LTCP, and the anticipated components of the USACE ecosystem restoration project, the ability of the waterbody as a whole to support fish propagation during summer will be improved, though it is unlikely that this improvement would contribute significantly to the overall size of the fish populations of the Jamaica Bay ecosystem.

Fish sampling was conducted in Paerdegat Basin during August 2000, and July and August 2001. Atlantic menhaden, bay anchovy, bluefish, gizzard shad, mummichog, spot, striped bass, summer flounder, and weakfish were found. A consistent trend of greater numbers of fish taxa being found with increased dissolved oxygen concentrations is recognizable at stations within Paerdegat Basin and at the reference stations. It can be concluded that implementation of the LTCP will improve conditions for juvenile and adult survival in much of Paerdegat Basin during a greater portion of the summer, thus attaining the fishable goal of the Clean Water Act during the period.. More species, and individuals, would be undeterred by dissolved oxygen levels should they choose to enter the waterbody, and they would also be able to find a greater abundance and variety of prey organisms given improvement in the benthic invertebrate community (and, with better water clarity, zooplankton).

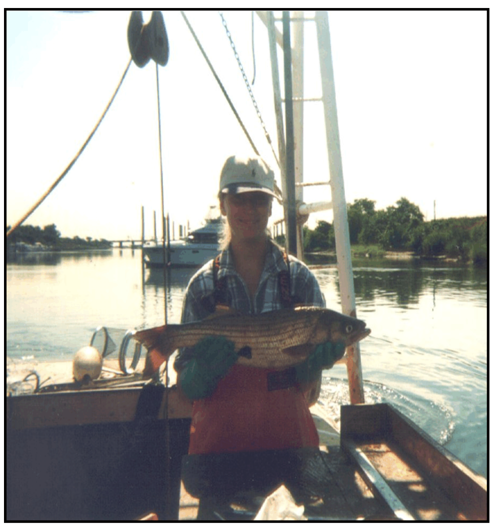

Figure 2-7. Striped Bass Caught in Paerdegat Basin during Monitoring

Summarizing, improvements in water column dissolved oxygen should also be sufficient to ensure the survival of the resulting benthic community. It is expected that an increase in epibenthic community biomass and diversity should occur at the head of Paerdegat Basin or in bottom waters of the mid-basin (as is the case in the rest of the waterbody). The ability of the waterbody as a whole to support fish propagation during summer will be much improved. Improved conditions for juvenile and adult survival are also expected in much of Paerdegat Basin. More species, and individuals, should be undeterred by dissolved oxygen levels should they choose to enter the waterbody, and they would also be able to find a greater abundance and variety of prey organisms given the expected improvement in the benthic invertebrate community. Environmental dredging will only improve this condition by providing a more attractive benthic character for the reestablishment of these aquatic communities. Shoreline mitigation actions and preservation of natural areas will also enhance habitat values.

3.0. Existing and Attainable Use Findings

Physical, chemical and biological factors have been reviewed to characterize the existing condition and future potential conditions for Paerdegat Basin. Although water quality conditions in Paerdegat Basin do not meet the criteria associated with a Class I waterbody, the characterization indicates that the designated uses are partially protected. The City of New York has begun implementation of a Facility Plan that provides a cost-effective level of CSO abatement that was selected based on a knee-of-the-curve analysis. This analysis measured the diminishing returns of water quality benefits associated with increasing expenditures.

In summary, the Paerdegat Basin LTCP will significantly improve water quality and achieve desired uses not presently attained. The LTCP will nearly meet Class I water quality criteria throughout the waterbody. Ancillary actions for shoreline mitigation and preservation of natural areas will also enhance habitat values, as will environmental dredging of the head end. The requirements of Class I recreation standards will be met throughout the waterbody and primary contact recreation standards will be met a majority of the time. However, these achievements will not attain the fishable/swimmable requirements of the Clean Water Act all the time.

This use attainment evaluation identified key factors that limit existing uses and will continue to limit attainable uses in the future. The following reviews existing and attainable aquatic life, recreational, and aesthetic uses for Paerdegat Basin.

3.1. AQUATIC LIFE

Paerdegat Basin is designated by the State of New York as a Class I waterbody. The best aquatic life use of a Class I waterbody is fishing, which shall be suitable for fish propagation and survival. Existing and attainable aquatic life uses of Paerdegat Basin are influenced by historical hydrologic modifications to the watershed, waterbody modifications, watershed impacts on the waterbody, tidal exchange with Jamaica Bay, and changes in habitat. Watershed impacts on the waterbody have been characterized by land use analyses and mathematical modeling of the watershed's influences on Paerdegat Basin water quality. Field investigations and mathematical modeling has characterized existing water quality conditions and projected conditions for the Paerdegat Basin LTCP. Given this information, the following are assessments of existing and attainable aquatic life uses for Paerdegat Basin.

3.1.1. Existing Uses

Paerdegat Basin is a highly modified tributary of Jamaica Bay that supports an aquatic life community despite various forms of habitat degradation. The existing aquatic ecosystem provides habitat for benthic life that in turn supports a fish community contributing production to adjacent coastal waters. Significant changes to the original watershed, to physical habitat within Paerdegat Basin, and to water and sediment quality represent constraints on the ability of the waterbody to reach its full potential of supporting aquatic life and providing a fishery resource for anglers. These constraints act in concert to limit aquatic life production, but differ significantly with regard to the potential for remediation to enhance conditions for aquatic life.

Urbanization of the watershed and physical reconfiguration of the wetlands and open waters of Paerdegat Basin are irreversible changes that will influence aquatic life under the best of conditions of water and sediment quality. There are some opportunities for physical habitat restoration of the wetland edge, but the existing configuration of the waterbody will remain in the future. On the other hand, water quality and sediment degradation can be partially reversed with abatement of CSO discharges, but complete remediation is impractical and unnecessary to provide for enhanced aquatic life usage of the waterbody. CSO abatement at the head end of Paerdegat Basin will improve conditions for aquatic life, but ultimately the level of enhancement will be constrained by the irreversible changes to the watershed and physical habitat of the waterbody, as well as by the conditions in, and associated influences of, Jamaica Bay.

Recent aquatic life sampling data collected in Paerdegat Basin and other New York/New Jersey Harbor tributaries provide a basis for evaluating existing benthic and fish communities. Sampling in adjacent open waters - areas not exposed directly to CSO discharges - provides perspective on both the potential CSO abatement has for enhancement in Paerdegat Basin and the identification of potential limiting factors for waterbody enhancement.

There is a marked gradient in benthic taxa richness along the axis of Paerdegat Basin, with the number of taxa increasing significantly from the midpoint of the waterbody to its mouth near Jamaica Bay. Data from benthic stations in the downstream half of the waterbody indicated the presence of taxa matching numbers found in several open water stations in Jamaica Bay. The number of benthic taxa was related to percentages of TOC and percent solids in their sediment habitat and that the overlying water column dissolved oxygen concentration. Number of taxa was reduced at high TOC, low solids, and low dissolved oxygen. These relationships were consistent among the tributaries and for all stations combined. The comparison of Paerdegat Basin stations to nearby Jamaica Bay stations suggests that the benthic community in the downstream half of the waterbody supports benthic invertebrate production equal to adjacent waters. The epibenthic community in the downstream half of Paerdegat Basin, as measured by species composition and weight of organisms on settling plates, exceeded that found at an open water station in Jamaica Bay (Canarsie). The station in the upstream half of Paerdegat Basin, to the contrary, had barely any growth. Thus, whereas the upstream half of Paerdegat Basin has potential for enhancement, the downstream half has a relatively lesser probability for enhancement, even after implementation of CSO abatement.

In general, low numbers of species and individuals were collected during fish sampling in Paerdegat Basin and Jamaica Bay during the summer in 2000 and 2001. These limited fish catches are due in part to the modest sampling efforts. However, fish diversity near the mouth of Paerdegat Basin exceeded that found halfway upstream in the waterbody. Sport species such as striped bass and bluefish were among those represented. The adverse effects of CSOs under existing conditions are episodic and may not be reflected in the sampling data, but the downstream portions of Paerdegat Basin should exhibit conditions similar to Jamaica Bay much of the time, and fish do enter the waterbody.

Paerdegat Basin presently provides some habitat, albeit impaired for aquatic life, but due to its size relative to the open waters of Jamaica Bay, fish production in Paerdegat Basin contributes marginally to local and coastal fishery resources. Under existing conditions there is a benthic food base to support fish production in the downstream half of the waterbody. CSO discharges undoubtedly affect the distribution of fish in Paerdegat Basin, but it is apparent in the downstream half of the waterbody that the benthic community can maintain itself with the current level of water and sediment quality degradation. The episodes of non-compliance with dissolved oxygen standards do not inhibit diversity levels in the downstream half of Paerdegat Basin from reaching levels similar to the open waters of Jamaica Bay. Aquatic life production in the upstream half of the waterbody is limited and does not involve species that can contribute to balanced ecological functions and fishery resources due to very degraded habitat and water quality conditions.

3.1.2. Attainable Uses

The significance of the contribution of aquatic life production from Paerdegat Basin to Jamaica Bay and coastal waters is limited by the small area and volume of the waterbody in relation to Jamaica Bay and larger areas. Paerdegat Basin represents 0.4% of the volume of Jamaica Bay and other semi-enclosed waterbodies around the perimeter of Jamaica Bay. Given that only the downstream half of the waterbody currently provides usable habitat for aquatic life, which is similar to adjacent areas of Jamaica Bay, and given that the downstream half of the waterbody contains the bulk of its volume, the portion of Paerdegat Basin currently providing only limited aquatic life production represents less than 0.2% of the Jamaica Bay ecosystem. Given the limited spatial area, this suggests that even with CSO abatement and an improvement of water and sediment quality, the potential increased production of Paerdegat Basin would likely remain a very small portion of overall aquatic life production in the Jamaica Bay ecosystem.

The original configuration of Paerdegat Basin as Bedford Creek was a narrow estuarine channel with little open water and extensive fringing wetlands. The reconfiguration of the waterbody eliminated almost all of the wetlands and created more open water compared to the original condition. The volume of Paerdegat Basin today is greater than the original channel, but changes to the shoreline of Jamaica Bay make such a comparison difficult to refine. The change from a small tidal channel with wetlands to the present configuration would have been accompanied by a change in species utilization by invertebrates and fish, and a change in the role of Paerdegat Basin in the Jamaica Bay ecosystem.

The existing physical conditions dictate that the invertebrate community forming the food base for fishes is one that utilizes unvegetated, soft substrates. The fish community will be those species that feed over this type of substrate, as well as open water predators that would utilize open water prey such as bay anchovy and juvenile menhaden. Both the bottom feeders (flounder) and open water predators (bluefish, weakfish, striped bass) would be the species of interest to anglers. Paerdegat Basin provides usable habitat for foraging juvenile fish, as well as foraging by larger individuals that would enter the waterbody when they are seasonally abundant in Jamaica Bay. With the CSO abatement components of the LTCP, the distribution of usable benthic habitat will increase and the frequency of occurrence of fishes, including those desirable to anglers will increase.

Mathematical modeling analyses described in the Paerdegat Basin LTCP Report have been performed to predict water column and sediment conditions in Paerdegat Basin with CSO abatement. These analyses can be related to the observed distribution of aquatic life in the waterbody and to the relationship developed for benthos and fish. Paerdegat Basin will achieve the existing dissolved oxygen criterion 100 percent of the time at its mouth and greater than 85 percent of the time at its head end. The periods during which this will not be the case are expected to be episodic and generally of short duration. This improvement in dissolved oxygen levels in combination with a reduction in the percentage of TOC in the sediments would improve conditions for benthic life to within 1,000 feet of the head end of the waterbody. Marine environments, however, have demonstrated an ability to recover and return to more natural settings once high levels of organic matter input have been reduced. In the case of Boston Harbor, the sediments of a sludge-dumping site were repopulated by amphipods (mainly *Ampelisca abdita*) and smaller numbers of polychaetes within one year after the cessation of sludge dumping. Similarly, Bellan et al. (1999) found evidence of recovery of the benthic community in an area surrounding a sewerage outfall of Marseille, France. The recovery was observed to occur within five to six years after the construction of a primary treatment facility. A possible reason for the more rapid recovery of the Boston Harbor sediments was the more oxygenated conditions of the overlying water column. Based on these experiences, it is reasonable to expect that the diversity of benthic life in Paerdegat Basin as a whole and especially in the upstream half would improve substantially and that fishes would respond by increasing their frequency and duration of occurrence in the upstream half of the waterbody. The downstream half of the waterbody would also improve, but the data suggest that conditions in Jamaica Bay would represent a limiting condition for Paerdegat Basin near its mouth. At the head of Paerdegat Basin, the physical conditions of the substrate, a portion of which is exposed at low tide, and the continuing occurrence of CSO discharges would have a strong influence on benthic life in this area. The benthic fauna in this area would likely remain dominated by opportunistic species that would recolonize the area following episodes of CSO discharges and low dissolved oxygen.

The mathematical model projections for Paerdegat Basin show that a portion of the waterbody would experience conditions that would cause larval fish mortality or a reduction in growth, which could lead to mortality. The loss of fish production represented by these conditions would involve very small numbers of early life stages in the waterbody. Fish egg and larvae densities observed in Paerdegat Basin were generally lower than those in Jamaica Bay, and the most abundant species were those that were spawned in open waters and are not dependent on inshore habitat or substrate quality (e.g. anchovy, menhaden). Although some winter flounder larvae, young-of-the-year, and weakfish were found in the sampling performed, Paerdegat Basin provides little or no significant spawning potential for the species that are of interest to anglers.

Many of the locally important fish species are migratory, spawning in the estuarine waters of the Hudson River (striped bass), or are marine forms that spawn in coastal waters with juveniles of these species moving in shore for feeding. Prey species may enter Paerdegat Basin as larvae, but these populations are widespread and spawn over a broad area. While there will be an adverse effect of dissolved oxygen on larval survival and growth based on a comparison of proposed standards and predicted conditions with LTCP implementation, larval survival in the waterbody would be enhanced substantially compared to existing conditions. The residual incremental impact on larval fish would not create an adverse effect at the population level for the species found in Paerdegat Basin.

Juvenile and adult fish would not be adversely affected by episodes of low dissolved oxygen in Paerdegat Basin because they are capable of avoiding such conditions. The physical features and hydrodynamics of the waterbody are such that there will be a detectable gradient of dissolved oxygen along its axis between head and mouth. Fish detecting undesirable conditions could retreat to more suitable conditions and would not become trapped in an area with potentially lethal conditions.

Implementation of the LTCP will provide conditions for aquatic life that would create fishable conditions over virtually all of Paerdegat Basin most of the time. Episodes of low dissolved oxygen could reduce the fishable area to the downstream half of the waterbody, but these episodes would be infrequent and of short duration. Fish would return to the entire waterbody shortly after conditions improved. The actual use of Paerdegat Basin by anglers may be limited by access to the shoreline and the perception that the area is still degraded. Over time, the suitability of Paerdegat Basin for recreational fishing can be expected to increase.

3.2. RECREATION

Paerdegat Basin is designated by the State of New York as a Class I waterbody. The best recreational use of a Class I waterbody is secondary contact recreation. Secondary contact recreation is defined as recreational activities where contact with the water is minimal and where ingestion of the water is not probable. State regulations specify "that it includes, but is not limited to, fishing and boating." NYSDEC representatives have indicated that these uses also include kayaking. If a recreational use designation upgrade is considered for Paerdegat Basin, and it is required to fulfill the swimmable goal of the Clean Water Act, it would be to primary contact recreation. Primary contact recreation is defined as recreational activities where the human body may come in direct contact with raw water to the point of complete body submergence. Primary contact recreation includes, but is not limited to, swimming, diving, water skiing, skin diving, and surfing.

Existing and attainable recreational uses of Paerdegat Basin are constrained by watershed impacts and waterbody access limitations. Watershed impacts on the waterbody have been characterized by land use analyses and mathematical modeling of the watershed's influences on Paerdegat Basin water quality. Land use and shoreline characterizations have identified existing and potential points of access to the waterbody and the character of nearby neighborhoods. Field investigations and mathematical modeling have characterized existing water quality conditions and projected conditions for the LTCP. Stakeholder outreach has provided information on the current uses of Paerdegat Basin by the local community. Given this information, the following are assessments of existing and attainable recreational uses for Paerdegat Basin.

3.2.1. Existing Uses

The shorelines surrounding Paerdegat Basin are mostly characterized as undeveloped park lands that are fenced off from local streets and contain sites of illegal dumping. Walking trails provide some limited access to shorelines near the mouth of the waterbody. The current uses of Paerdegat Basin are mostly recreational in nature. Marinas and the canoe club based in Paerdegat Basin use the waterbody primarily as access points to Jamaica Bay. This activity is being increasingly restricted due to siltation by shifting sands at the mouth of the waterbody that makes it difficult to navigate at low tide.

Land uses for the neighborhoods surrounding Paerdegat Basin are primarily urban residential, providing a major source of passive recreational users of the waterbody. However, existing NYCDEP and NYCDOT facilities, fenced undeveloped areas, and structured parks immediately adjacent to Paerdegat Basin provide little if no actual access to the waterbody. No access is possible to the waterbody at its head end due to security and safety requirements at the City facilities.

Paerdegat Basin Park has been created in the upland areas between these City facilities and the mouth. Upstream sections of Paerdegat Basin Park are separated from the surrounding neighborhoods by fencing in various states of disrepair. Once inside the fences, the upland areas are undeveloped and overgrown sites of historical filling and illegal dumping with unsafe areas that preclude safe access to the waterbody. Undeveloped areas between the marinas and the mouth in Canarsie Beach Park on the north shore and Joseph Thomas McGuire Park on the south shore have unstructured walking trails that provide views of Paerdegat Basin and walking opportunities near the water's edge. These trails also provide access under the Belt Parkway to the Jamaica Bay shorelines of Gateway National Recreation Area. Canarsie Beach Park and Joseph Thomas McGuire Park provide outdoor recreation to the local community with baseball fields and other activities but none associated with Paerdegat Basin.

Shorelines in undeveloped areas of Paerdegat Basin Park are mostly elevated high above the high tide line with some steep drop-offs of several feet. Only near the mouth are there gradually sloping shorelines that provide safe access to the waterbody. These shorelines constitute what little intertidal wetlands exist in Paerdegat Basin. The marinas and clubs provide the only structured access points to the waterbody with boat docks, slips, and ramps. These facilities also have bulkheaded shorelines that support elevated decks and other structures for social activities.

For waterborne activities, Paerdegat Basin is primarily used by the local community as a method of access to recreational uses of Jamaica Bay, the Gateway National Recreation Area, and the greater New York Harbor. Several marinas and the canoe club are located near its mouth on park property with leasing agreements. The marinas provide docking facilities for recreational vessels and outdoor social activities on the waterfront. The canoe club near the mouth uses it for paddling sessions from the early spring through the late fall. These sessions include instruction, training, and forays into Jamaica Bay for kayaking, canoeing, rowing, flatwater racing, and sailing. These activities are typically defined by the State of New York as secondary contact recreation, which will be protected by the LTCP. Most of these activities occur between the marinas and the canoe club and the mouth. Until recently, Paerdegat Basin was also used for personal watercraft (i.e. jet skis) access to Jamaica Bay. However, the National Park Service has recently banned the use of these craft in Gateway National Recreation Area and is developing a long-term use plan for the future that may not include this activity.

Local stakeholders have indicated that they are interested in maintaining their present levels of uses in Paerdegat Basin. The public is physically restricted by fences from accessing most of the waterbody, and the local community prefers that this be continued. The marinas, canoe club, and park areas at the downstream end provide the only access to the waterbody from the surrounding neighborhoods. Other than the marinas and canoe club that are located on leased park land, neither the City of New York nor the National Park Service has public policies or facilities that encourage structured public access to Paerdegat Basin. Waterborne access to the waterbody is possible through Jamaica Bay. There are no accessible locations along the waterbody where conditions attract adults to swim or children to play and splash. The physical characteristics of Paerdegat Basin practically preclude the establishment of a bathing beach that will satisfy local and State health department requirements without making physical modifications to the waterbody that will conflict with other uses (e.g. habitat). In addition, local stakeholders view public bathing in Paerdegat Basin as a safety conflict with their existing and desired uses (e.g. boating) and do not desire its establishment.

3.2.2. Attainable Uses

The attainable recreational uses of Paerdegat Basin will be restricted by its altered state and runoff impacts from its watershed. These conditions impart a considerable burden on the waterbody in its current physical state such that a primary contact recreation level of water quality will not be attained throughout Paerdegat Basin all the time. The present designation of secondary contact will be attained at all times throughout the waterbody during an average precipitation year. The major obstacles to fully supporting primary contact recreation are CSO and stormwater discharges. Analyses have been conducted to evaluate engineering alternatives that would reduce or eliminate these pollutant sources. However, the alternatives and their effectiveness are limited by historical alterations to the waterbody and its watershed, and the waterbody's ability to assimilate the pollutant loads it receives.

The physical and chemical characterizations described herein have identified that physical alterations to the watershed have changed the amount, timing, and composition of runoff to Paerdegat Basin. The coliform bacteria criteria are the primary evidence that CSO discharges cause the current impairment of the secondary contact recreation use and will preclude the attainment of a primary contact recreation use when the LTCP is implemented. Implementation of the LTCP will result in attainment of the coliform bacteria requirements of secondary contact recreation throughout the waterbody all the time for an average precipitation year. Coliform bacteria criteria associated with an upgrade in recreational use classification to primary contact recreation will not be met at all times throughout the waterbody. The thirty-day median criterion will be met nearly 100 percent of the time in most of the waterbody for an average precipitation year. It will be met all of the time near the mouth. Conditions are expected to satisfy the upper limit total coliform criterion greater than 60 percent of the time (translating to approximately eight months), and during all but one month of the high recreational period of an average precipitation year (83 percent attainment).

The LTCP includes the construction of CSO retention facilities that will maximize combined sewage to treatment and store approximately 50 million gallons for later treatment. Engineering and modeling analyses have been conducted that indicate a significantly greater amount of storage and/or treatment would be necessary to protect a primary contact recreation use in Paerdegat Basin. Employing disinfection or capturing nearly 100 percent of the coliform bacteria pollutant load by storage would most likely provide the necessary level of abatement to achieve a primary contact recreation use throughout Paerdegat Basin all the time. The amount of storage necessary to eliminate overflows would be nearly 200 MG, which is a substantially greater volume than is presently being constructed and would require utilizing a much greater amount of undeveloped upland at the head end of the waterbody, at a significant additional cost. Engineering and receiving water analyses have indicated that disinfection of CSO discharges would require advanced controls, dechlorination (thus expanding facility size and negatively impacting dissolved oxygen), and addressing residual chlorine issues in the receiving water that will negatively impact aquatic life (Allee King Rosen & Fleming, 1994).

Primary contact recreation uses are not desired by stakeholders and would not be consistent with other uses of Paerdegat Basin. Riparian and other land uses around the waterbody are primarily restricted natural areas that are not supportive of bathing. Adjacent parks and structured shoreline uses are consistent with secondary contact recreation uses. The marinas and canoe club located in

Paerdegat Basin and their associated vessel traffic in and out of the waterbody will represent a recognized safety conflict with swimming. City and State health codes such as those addressing sediment consistency, shoreline slope, and proximity to discharge points preclude establishing a dedicated bathing area in Paerdegat Basin unless significant modifications are made to the waterbody that may adversely impact habitat. In addition, local law would need to be modified to eliminate the prohibition of City beaches in Jamaica Bay and its tributaries. Therefore, a designation of primary contact recreation use in Paerdegat Basin would not be consistent with other uses in the waterbody. The level of CSO abatement achieved by the LTCP will ensure that a secondary contact recreation use, one that presently exists and is the highest level of use desired by stakeholders, will be protected for an average precipitation year.

3.3. AESTHETICS

Aesthetic uses of the New York State waters are protected by narrative water quality standards. The standards applicable to saline surface waters such as Paerdegat Basin limit the following water quality parameters: taste, color, and odor-producing, toxic and other deleterious substances; turbidity; suspended, colloidal and settleable solids; oil and floating substances; garbage, cinders, ashes, oils sludge and other refuse; and phosphorous and nitrogen. Physical and chemical characterizations have indicated that floatables, settleable solids, odors, and water clarity are aesthetic parameters of concern for Paerdegat Basin. Existing and attainable aesthetic uses of Paerdegat Basin are primarily influenced by watershed impacts on the waterbody. Field investigations and mathematical modeling have characterized existing aesthetic conditions and projected future conditions for the Paerdegat Basin LTCP. Given this information, the following are assessments of existing and attainable aesthetic uses for Paerdegat Basin.

3.3.1. Existing Uses

The upstream or head end of Paerdegat Basin in the vicinity of CSO and stormwater discharges currently experiences the most prevalent impairments of aesthetic uses. These are primarily caused by CSO discharges of floatables, settleable solids, and oxygen demanding pollutant loads. Once discharged, floatables are transported through and out of Paerdegat Basin into Jamaica Bay by wind and tidal exchange. The floatables are a noticeable and recognized impairment to the aesthetic value of Paerdegat Basin at the marinas, canoe club, and along shorelines at the mouth. Physical characterizations indicate that discharged settleable solids continually blanket sediments from the head end and for a significant distance downstream. The settleable solids smother habitat and provide organic material to fuel SOD that results in hypoxic and anoxic conditions in and above the sediments. This condition is exacerbated by the discharge of oxygen demanding pollutant loads that further depress dissolved oxygen following CSO discharges. During the summer months, chemical reactions that occur in the sediments under anoxic conditions release gases that cause odors that are regularly detected in neighborhoods surrounding the waterbody. Water clarity is poor in Paerdegat Basin due to the natural turbidity of tidal exchange with Jamaica Bay, CSO discharges, and periodic eutrophic conditions.

3.3.2. Attainable Uses

The narrative water quality standards for aesthetic parameters are applied to waterbodies and discharges and range from none in amounts that will cause impairments to none in any amounts. The practical attainability of these standards is questionable when having to address "no" or "none" as a discharge limit for CSOs and stormwater discharges and as such represents a problematic situation for designing controls. Only elimination of all CSO and stormwater discharges to Paerdegat Basin would totally abate floatables and settleable solids discharges to the waterbody. Although an insignificant load in comparison to CSOs and stormwater, recreational boating and riparian uses are and will continue to be a source of floatables in the waterbody such that the waterbody will rarely be completely free of floatables.

The LTCP will achieve significant reductions of floatables discharges associated with CSOs. These floatables discharges will occur approximately once per month for an average precipitation year. Street sweeping and catch basin controls in separately sewered areas in the Paerdegat Basin watershed provide at least 65 percent capture of stormwater floatables discharges. The combination of the street sweeping, catch basin controls, and the CSO abatement will achieve greater than 90 percent capture of CSO floatables discharges on average. The upstream end of the waterbody will remain limited access park such that it will not provide a view of the waterbody where floatables discharges will primarily occur and be recognized. Stormwater and CSO floatables will be less apparent at downstream locations. The LTCP includes the highest level of floatables control practicable and will be consistent with stakeholder desires for secondary contact recreation uses in Paerdegat Basin.

As is the case with floatables, the LTCP will achieve significant reductions of settleable solids discharges associated with CSOs. Settleable solids discharges will occur less than twice per month for an average precipitation year and will be greatly reduced compared to existing conditions. Projected improvements in dissolved oxygen will virtually eliminate the persistent hypoxic and anoxic conditions that cause the release of gases. As a result of both CSO reduction and environmental dredging, it is anticipated that the LTCP will achieve a virtual elimination of odors during an average precipitation year such that this aesthetic use will be protected. Reducing CSO discharges as a whole and reducing suspended solids concentrations associated with remaining discharges by treatment through the retention facility will reduce settleable solids concentrations in the receiving waters. This will somewhat improve water clarity in Paerdegat Basin, especially after CSO events. However, background turbidity and periodic eutrophic conditions caused by the waterbody's tidal exchange with Jamaica Bay will continue to hinder improvements in water clarity.

4.0. Applicability of UAA Criteria

Paerdegat Basin has been significantly altered by historical waterbody and watershed modifications from its original condition as Bedford Creek. This condition imparts permanent limitations on aquatic life, recreational, and aesthetic uses of the waterbody. Extensive investigations and planning have been conducted to identify a reasonable and cost-effective plan to improve water quality conditions in Paerdegat Basin. The planning effort identified reasonable levels of use attainment that would not cause significant upset to the local community and that would fulfill stakeholder goals. The following describes the applicability of federal UAA criteria to Paerdegat Basin.

4.1. HUMAN CAUSED CONDITIONS

Watershed modifications represent a key limitation to attaining the fishable/swimmable goals of the Clean Water Act in Paerdegat Basin. The Paerdegat Basin watershed has been urbanized, and like most areas of the City of New York, its hydrologic characteristics have changed and it is now highly impervious - a condition that is impractical to alter. The watershed has been urbanized such that the volume, timing, and composition of runoff to Paerdegat Basin has been permanently altered. Impervious pavement, sewering, and stormwater adversely affect water quality in receiving waters. This imparts significant adverse and irreversible impacts to aquatic life protection, primary contact recreation, and aesthetic uses.

Scientific literature cited by the USEPA in its guidance documents indicates that watershed urbanization and increasing imperviousness degrades waterbody biota (USEPA, 2001). The guidance states that there are a number of factors that affect the attainment of natural aquatic communities in urban areas, including the amount of impervious surface, human activities affecting discharges, and the type and extent of hydrologic modifications made to the watershed. Much of this research was focused on freshwater systems and indicated that restoration of natural aquatic life communities may not be feasible in small watersheds with heavily urbanized areas. Impervious cover in urban areas in the range of 8-percent to 20-percent were found to have a significant impairment on aquatic life (Schueler, 1994). Schueler noted that few urban streams can support diverse benthic habitat at imperviousness greater than 25 percent. Furthermore, this and similar research indicates that it is extremely difficult to maintain or return to predevelopment water quality when impervious cover exceeds 10 to 15 percent. Paerdegat Basin's watershed is approximately 70 percent impervious. Other factors, such as pollutant loadings, watershed development history, riparian buffers, CSOs, and types of land use also influenced the level of impairment (Yoder, 1999). Other literature shows clearly definable impacts to tidal creeks at imperviousness levels greater than 30 percent (Lerberg et al., 2000). These impacts are primarily attributable to surface runoff in general, not combined sewer overflows in particular. Water quality data collection efforts in other waterbodies throughout the New York Harbor complex that only receive stormwater discharges (e.g. Shellbank Basin, Mill and East Mill Basin) demonstrate that urban tributaries not experiencing CSOs also do not meet water quality standards and have impaired biotic communities. This reinforces the fact that the urbanization of the watershed has a significant effect on receiving waters and the reasonable attainment of beneficial uses. It is recognized that urbanization, with attendant high population density, pavement and road surfacing that necessarily follow, will have a measurable impact on what has become, in essence, an urban drainage channel.

Extensive engineering and planning investigations have determined that cost-effective and reasonable best management practices will not sufficiently reduce combined sewer and stormwater runoff and their associated pollutant loads. These conditions, therefore, represent human caused conditions or sources of pollution that cannot be remedied or would cause more environmental damage to correct. Any remedy would require returning a 70 percent impervious watershed to less than 15 percent imperviousness. This simply cannot be done without relocation of the entire population. Other remedies would involve a CSO retention tank of nearly 170 MG, an increase in size of a factor of 8.5 over the existing 20 MG retention tank currently under construction. This larger facility would cost over $2.2 billion and requires almost one entire side of Paerdegat Basin in land area.

Attaining aquatic life protection and primary contact recreation uses is not feasible. Therefore, use attainability factor number 3 in the Code of Federal Regulations [40 CFR 131.10(g)] applies. This factor represents a limit on attaining aquatic life protection and primary contact recreation uses in Paerdegat Basin that cannot be reasonably overcome.

4.2. HYDROLOGIC MODIFICATIONS

Physical modifications of Bedford Creek resulting in its existing configuration of Paerdegat Basin represents a second key limitation on attaining the fishable/swimmable goals of the Clean Water Act in Paerdegat Basin. Many estuarine tributaries in urban settings have been physically altered to become drainage channels or to support commercial activities. These waterbodies have been widened, deepened, and lengthened such that their natural watercourse and tidal exchange have been permanently altered. Industrialization and urbanization encroaches on these waterbodies such that uplands and adjacent wetlands are filled and eliminated. As such, original habitat and assimilation capacities are altered, reduced, or eliminated.

The nature of waterbody alteration (commercial development, bulkheading, etc.) and associated restrictions on access often impairs supporting primary contact recreation uses and represents a conflict of uses. Paerdegat Basin represents a typical example of these conditions. The waterbody has been transformed from a tidal creek surrounded by wetlands into a dredged channel with little or no wetlands. Historical dredging and alterations of the shorelines has altered physical estuarine conditions and eliminated original habitat. The mouth of Bedford Creek originally opened onto mud flats in Jamaica Bay that were eliminated by the establishment of navigation channels throughout the Bay and into Paerdegat Basin. This has altered the natural circulation patterns of Jamaica Bay and Paerdegat Basin and induces the creation of sand bars at the mouth of Paerdegat Basin that restrict estuarine exchange. Urbanization of the watershed has eliminated the base freshwater flow to Paerdegat Basin, which therefore reduces the natural flushing or cleansing of the waterbody.

Aside from implementing limited ecosystem restoration to reestablish some natural habitat, reversing these conditions is not feasible given the described urbanization of the watershed and riparian areas adjacent to Paerdegat Basin and the existing and desired recreational uses identified by stakeholders. These conditions, therefore, represent hydrologic modifications that preclude the attainment of fishable/swimmable uses, and it is not feasible to restore the waterbody to its original condition.

Attaining aquatic life protection and primary contact recreation uses is not feasible. Therefore, use attainability factor number 4 in the Code of Federal Regulations [40 CFR 131.10(g)] applies. This factor represents a limit on attaining aquatic life protection and primary contact recreation uses in Paerdegat Basin that cannot be reasonably overcome.

4.3. SYNOPSIS

The Paerdegat Basin LTCP will achieve significant improvements in water quality for Paerdegat Basin. A facility is being constructed to abate the number and volume of CSO discharges. Paerdegat Basin will be dredged, which will restore unimpeded vessel access to the waterbody, improve estuarine flushing, and reduce aesthetic impairments. Wetland restoration and enhancement along the water's edge and in upland zones will improve habitat condition. The waterbody and adjacent undeveloped shorelines have already been mapped as parkland that will include restored natural areas. The total capital cost of this plan is in excess of $300 million. Post-construction compliance monitoring will be conducted by NYCDEP to demonstrate attainment of water quality standards. The LTCP will create fishable conditions over virtually all of Paerdegat Basin most of the time. Over time, the use of Paerdegat Basin for recreational fishing can be expected to increase. Secondary contact recreation is an existing and desired use that will be protected by the plan. Aesthetic conditions will also greatly improve and will be consistent with secondary contact recreation uses, passive recreational activities in riparian areas, and surrounding land uses. These conditions represent the highest reasonably attainable uses that can be achieved for Paerdegat Basin.

5.0. References

Allee King Rosen & Fleming, 1994. Final Environmental Impact Statement for the Paerdegat Basin Water Quality Facility Plan. Prepared with Hazen and Sawyer, P.C., HydroQual, Inc., and Historical Perspectives, Inc. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering and Office of Environmental Planning, March 1994.

Bellan, G. M. Bourcier, C. Salen-Picard, A. Arnoux, S. Casserley, 1999. "Benthic Ecosystem Changes Associated with Wastewater Treatment at Marseille: Implications for the Protection and Restoration of the Mediterranean Coastal Shelf Ecosystems," Wastewater Environment Research. 71(4): p. 483-493, April 1999.

Hazen and Sawyer, 1991. Paerdegat Basin Water Quality Facility Plan Draft Facility Planning Report. Prepared with HydroQual, Inc. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering, September 1991.

HydroQual, 2000. Use and Standards Attainment Project, Paerdegat Basin Field Sampling and Analysis Program, Years 2000-2001, Component 1: Waterbody Biology," Prepared by HydroQual Environmental Engineers and Scientists, P.C. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering, May 2000, revised June 2001.

HydroQual, 2002a. Use and Standards Attainment Project, Tributary Benthos Characterization Field Sampling and Analysis Program, Year 2002, Prepared by HydroQual Environmental Engineers and Scientists, P.C. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering, June 2002.

HydroQual, 2002b. Use and Standards Attainment Project, Supplemental Aquatic Life Characterization of East River and Jamaica Bay Field Sampling and Analysis Program, Year 2002, Prepared by HydroQual Environmental Engineers and Scientists, P.C. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering, August 2002.

HydroQual, 2002c. Use and Standards Attainment Project, Field and Laboratory Standard Operating Procedures (SOP), Revision No. 2, Prepared by HydroQual Environmental Engineers and Scientists, P.C. for the City of New York, Department of Environmental Protection, Bureau of Environmental Engineering, November 2002.

Lerberg, S. B., A. F. Holland, and D. M. Sanger, 2000. "Responses of Tidal Creek Macrobenthic Communities to the Effects of Watershed Development," Estuaries, Vol. 23, No. 6, p. 838-853, December 2000.

Novotny, V., J. Braden, D. White, A. Capodaglio, R. Schonter, R. Larson, and K. Algozin 1997. A Comprehensive UAA Technical Reference. Water Environment Research Foundation, Alexandria, VA.

Schueler, T. R., 1994. "The Importance of Imperviousness," Watershed Protection Techniques 1:100-111.

U.S. Army Corps of Engineers (USACE), 2002. Jamaica Bay Ecosystem Restoration Project: Existing Conditions, Future Without Project Conditions, Goals and Objectives Report, New York District, Final Draft, October 2002.

U.S. Environmental Protection Agency (USEPA), 1994. Water Quality Standards Handbook: Second Edition, Update #1, EPA-823-B-94-005, Office of Water, Washington, DC, August 1994.

U.S. Environmental Protection Agency (USEPA), 1998. Guidance on Quality Assurance Project Plans (EPA QA/G-5), EPA-600-R-98-018, Office of Research and Development, Washington, DC, February 1998.

U.S. Environmental Protection Agency (USEPA), 1999a. EPA Requirements for Quality Management Plans (QA/R-2) Interim Final, EPA-600-R-99-032, Office of Research and Development, Washington, DC, November 1999.

U.S. Environmental Protection Agency (USEPA), 1999b. EPA Requirements for Quality Assurance Project Plans (QA/R-5) Interim Final, Office of Research and Development, Washington, DC, November 1999.

U.S. Environmental Protection Agency (USEPA), 2000a. Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras, EPA-822-R-00-012, Office of Water, Washington, DC, November 2000.

U.S. Environmental Protection Agency (USEPA), 2000b. Guidance for the Data Quality Objectives Process (EPA QA/G-4). EPA-600-R-96-055. Washington, DC, August 2000.

U.S. Environmental Protection Agency (USEPA), 2001. Guidance: Coordinating CSO Long-Term Planning With Water Quality Standards Reviews, EPA-833-R-01-002, Office of Water, Washington, DC, July 2001.

Yoder, C. O., et al. 1999. "Assessing The Status of Aquatic Life Designated Uses in Urban and Suburban Watersheds," pp.16-28. In Everson, A., et al. National Conference on Retrofit Opportunities for Water Resource Protection in Urban Environments, Chicago, Il. EPA-625-R-99-002.