Capital Project No. WP-169
Long Term Control Plan II

Combined Sewer Overflow Long Term Control Plan for Westchester Creek

Appendix E: Supplemental Documentation

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Department of Environmental Protection
Bureau of Wastewater Treatment

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1. INTRODUCTION

1. Purpose

This Supplemental Documentation contains DEP's responses to DEC's comment letter, dated January 14, 2015, on the June 2014 Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) for the Westchester Creek. The Supplemental Documentation is now made part of the referenced LTCP as Appendix E.

The LTCP, as supplemented herein, summarizes DEP's plans for managing the CSO discharges into the Westchester Creek including the findings and recommendations to advance the waterbody's level of compliance with applicable Water Quality Standards.

2. Format

This Supplemental Documentation is divided into sections reflecting specific areas of concern, such as Executive Summary and the various sections of the LTCP about which DEC comments were received.

In addition, the Supplemental Documentation also includes a revised Executive Summary as Attachment 1, Revised Section 6 as Attachment 2, Revised Section 8 as Attachment 3 and revised Appendix D, Use Attainability Analysis as Attachment 4. Collectively, the Supplemental Documentation and attachments, plus the original June 2014 submittal, constitute the overall revised Westchester Creek LTCP.

The following conventions were used with respect to the numbering of figures and tables:

- When revisions were made to existing tables from the June 2014 LTCP, both the original and the revised tables are included in the response along with their original numbering (e.g., **Table 2-3. "Title"**) plus the revised numbering (e.g., **Table 2-3. "Title" (Revised)).**

- When revisions were made to existing figures from the June 2014 LTCP, the original figures were not included and only the revised figure is shown in the Supplemental Documentation (e.g., **Figure 4-3. "Title" (Revised)**).

2. RESPONSE TO COMMENTS

2.1 SPECIFIC COMMENTS

2.1.1 EXECUTIVE SUMMARY

DEC Comment No. 1a
In Table ES-4, include a footnote to clarify that the "Baseline Condition" is also the selected alternative.

***DEP Response*:**
The title of Table ES-4 in the Revised ES indicates that the levels of attainment shown are valid for the selected alternative and are the same as for baseline conditions.

DEC Comment No. 1b
Table ES-4 and ES-5 both list sample point E11, but it appears the sample point should be E13.

***DEP Response*:**
Revised ES has been revised to correctly mention Station E13 throughout.

2.1.2 SECTION 1.0 - INTRODUCTION

DEC Comment No. 2a

In Section 1.2.d, the LTCP states that adoption of the Green Infrastructure Plan resulted in elimination of some grey infrastructure, which is not correct. The changes made to the CSO Order 2012 did not reflect a tradeoff between green and grey infrastructure and the LTCP must be revised to reflect this fact.

DEP Response:

The statement in Section 1.2.d has been revised as follows.

Current language: *"In March 2012, DEP and DEC amended the 2005 Order to provide for incorporation of Green Infrastructure (GI) into the LTCP process as proposed under the City's Green Infrastructure Plan, and to update certain project plans and milestone dates. In doing so, some of the grey infrastructure projects planned earlier were eliminated from the Order."*

Proposed language: *"In March 2012, DEP and DEC amended the 2005 CSO Order on Consent to provide for incorporation of Green Infrastructure (GI) into the LTCP process as proposed under the City's Green Infrastructure Plan, and to update certain project plans and milestone dates."*

2.1.3 SECTION 2.0 – WATERSHED/WATERBODY CHARACTERISTICS

DEC Comment No. 3a
Sections 2.1.c.2 and 2.2.a.6 summarize the field data for Westchester Creek obtained during recent sampling effort; however, the City did not submit an approvable sampling plan in advance of this sampling effort. If the City includes these data within the LTCP, then it must also provide a Data Usability Assessment Report in an appendix to the LTC. The Department again requests that the City submit a sampling plan in advance of starting the sampling for the waterbodies where the City is planning to conduct sampling for the LTCPs. The City shall also provide all available data from the sampling efforts to the Department.

DEP Response:
A DUAR will not be provided and is not necessary. DEP provided DEC with the Westchester Creek Field Sampling Analysis Plan in January 2014 and sampling data resulting from the Field Sampling Analysis Plan Program in May 2014.

DEC Comment No. 3b
In Table 2-3, include in a separate column the average annual flows for each stormwater outfall for the year 2008.

DEP Response:
The stormwater volumes requested have been added to Table 2-3. Additionally, incorrect reference to Outfall HP-054 had been previously made. The revised table correctly refers to Outfall HP-504.

Current Table:

Table 2-3. Hunts Point WWTP Stormwater Discharges to Westchester Creek and Pugsley Creek

Stormwater Outfall	Outfall Location	Drainage Area (ac)
HP-054	Pugsley Creek park	46
HP-602	Lafayette Avenue, Westchester Creek	30
HP-623	Clason's Point	47
HP-625	Castle Hill Point	2
HP-635	Yznaga Place, Westchester Creek	93
HP-839	Head end of Westchester Creek	123
	Total	340

Proposed Table:

Table 2-3. Hunts Point WWTP Stormwater Discharges to Westchester Creek and Pugsley Creek (Revised)

Stormwater Outfall	Outfall Location	Drainage Area (ac)	2008 Discharge Volume (MG)
HP-504	Pugsley Creek Park	46	9
HP-602	Lafayette Avenue, Westchester Creek	30	18
HP-623	Clason's Point	47	27
HP-625	Castle Hill Point	2	1
HP-635	Yznaga Place, Westchester Creek	93	51
HP-839	Head end of Westchester Creek	123	55
	Total	340	161

DEC Comment No. 3c

In Tables 2-4 and 6-1, include the stormwater concentrations used for HP-839 as discussed in the City's November 24, 2014 letter.

DEP Response:

The stormwater concentrations for highway runoff have been added to these tables. Modifications to Table 2-4 are presented below, whereas revisions to Table 6-1 are reflected in the Revised Section 6.0, Attachment 2 of this supplemental document. In both instances, the concentrations of pollutants that were not the primary focus of the LTCP analyses (Total Coliform and TSS) were removed from the tables.

Current Table:

Table 2-4. Sanitary and Stormwater Discharge Concentrations, Hunts Point WWTP

Constituent	Sanitary Concentration	Stormwater Concentration
$CBOD_5$ (mg/L) [1]	105	15
TSS (mg/L) [1]	110	15
Total Coliform Bacteria (MPN/100mL) [2,3]	$25x10^6$	150,000
Fecal Coliform Bacteria (MPN/100mL) [2,3]	$4x10^6$	120,000
Enterococci (MPN/100mL) [2,3]	$1x10^6$	50,000

[1] 2011, 2012, 2013 DEP Process Control Hunts Point WWTP operational records
[2] HydroQual Memo to DEP, 2005a.
[3] Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100mL.

Proposed Table:

Table 2-4. Sanitary and Stormwater Discharge Concentrations, Hunts Point WWTP (Revised)			
Constituent	Sanitary Concentration	Stormwater Concentration	Highway Runoff Concentration (HP-839)[4]
$CBOD_5$ (mg/L) [1]	105	15	15
Fecal Coliform Bacteria (MPN/100mL) [2,3]	$4x10^6$	120,000	20,000
Enterococci (MPN/100mL) [2,3]	$1x10^6$	50,000	8,000

Notes:
(1) 2011, 2012, 2013 DEP Process Control Hunts Point WWTP operational records.
(2) HydroQual Memo to DEP, 2005a.
(3) Bacterial concentrations expressed as "most probable number" (MPN) of cells per 100mL.
(4) Pitt et al. (2004) and CH2MHill (1998).

DEC Comment No. 3d

The City's November 24, 2014 letter includes a 2005 memo from HydroQual that provided the basis for the stormwater concentrations that have been used in the InfoWorks model. However, according to the memo, the City eliminated several data points that represented very high levels of bacterial load in some of the stormwater discharges. The Department recognizes that the analysis of stormwater data was completed almost a decade ago, and the results have been incorporated into all of the InfoWorks model analysis to date, however, in principle, the Department believes that data points should not be excluded from an analysis unless there is a verified basis for doing so. Given this lack of verification and the considerable variability in the stormwater concentrations from the 2004 sampling program, the Department reiterates its position that the City should continue to characterize its storm water on an ongoing basis. Moreover, the City should be continuously updating the analysis of stormwater concentrations presented in the 2005 HydroQual memo with more recent stormwater data, such as data from the Hutchinson River sampling effort. Incorporating more data into these analyses should increase the level of confidence in the model results.

DEP Response:

DEP continues to sample CSOs and stormwater data as part of each LTCP to update the typical stormwater concentrations used in the IW modeling.

DEC Comment No. 3e

Figure 2-8 presents the fecal coliform and enterococci concentrations from the sampling of CSO Outfalls HP-014 and HP-016, however, according to the data provided to the Department in the file "Westchester Raw data for DEC May, 14, 2014", one data point for HP-016 had a count of bacteria of over 2 million cfu/100mL. This data point does not appear to be included in Figure 2-8 and should be included to accurately to assess concentrations of CSO.

DEP Response:

The data noted by DEC were not excluded from the analysis. The labels "Fecal Coliform" and "Enterococci" used in Figure 2-8 were mistakenly placed over a few data points with low return frequencies including the 2 million value noted by the DEC. The figure has been replaced.

Current Figure:

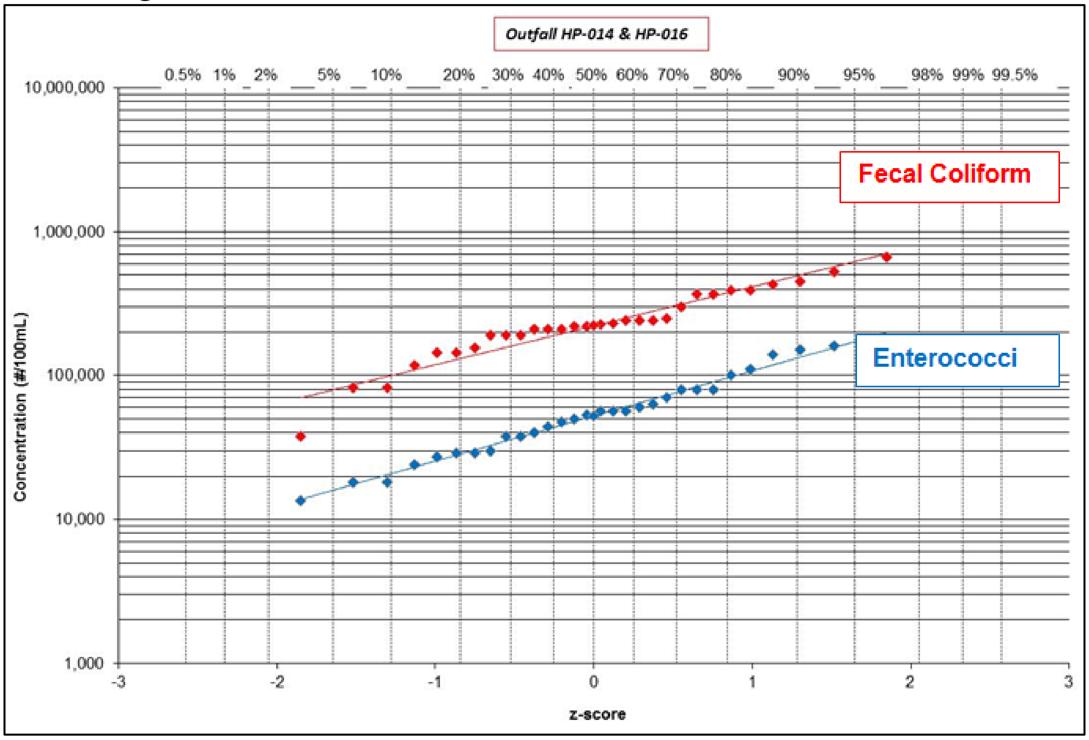

Figure 2-8. HP CSO Bacteria 2014 Sampling Data

Proposed Figure:

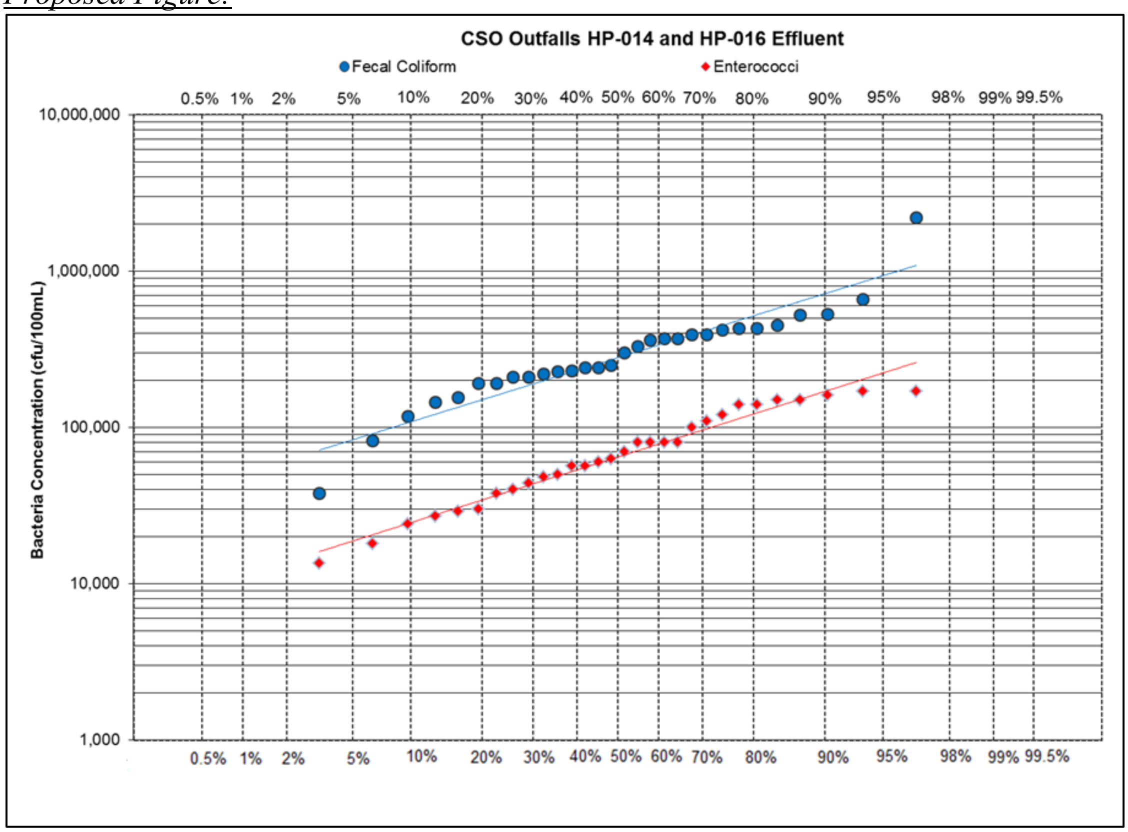

Figure 2-8. HP CSO Bacteria 2014 Sampling Data (Revised)

DEC Comment No. 3f
In Section 2.1.c.6, provide a current status of construction or equipment conditions at the Hunts Point WWTP and, in particular, confirm that ongoing construction has no impact on hydraulic capacity of the treatment plan.

DEP Response:
There is no ongoing construction at the Hunts Point WWTP that would affect the hydraulic capacity of the plant. The language in Section 2.1.c.6 has been modified as follows.

Current language: *"The Westchester Creek watershed is entirely served by the Hunts Point WWTP. The Plant is undergoing rehabilitation to enhance nitrogen removal, and other miscellaneous improvements to existing facilities"*

Proposed language: *"The Westchester Creek watershed is entirely served by the Hunts Point WWTP. Headworks construction activities at the Plant have been completed and there are currently no ongoing construction activities affecting the hydraulic capacity of the plant"*

DEC Comment No. 3g
Section 2.2.a.2 describes the characteristics of the waterbody, but does not discuss odors. If information is available on the odors within the waterbody, especially at the head end, at low and high tides, it should be provided. If no data are available on odors in this waterbody, the City should consider conducting an odor study.

DEP Response:
DEP has investigated odor complaints collected by the Bureau of Environmental Compliance and Bureau of Wastewater Treatment for 2009 through 2013. There were approximately 4 odor complaints within 5,300 feet of Westchester Creek over the 5 year period. This represents about 5 percent of the total complaints. DEP does not intend to conduct an odor study as part of the LTCP process as the DEP believes odors due to Westchester Creek are not significant. DEP did visit the area where sediments have been reported in the past. A photo of the water way is shown in DEC Comment 6c below.

DEC Comment No. 3h
Discuss somewhere in Section 2 whether or not the houseboats located on Westchester Creek are connected to the City's sewer system.

DEP Response:
Per notification letter issued on July 3, 2007 by the DEC to the Metro Marina responsible party, based on observations conducted by the DEP, and immediately after confirmed by the DEC, all illegal discharges were to be ceased, taking effect immediately. Given that these are illegal discharges subject to enforcement by the DEC and a request for prompt correction was issued to the Metro Marina owners, DEP considers that, for planning purposes such as the LTCP process, these illegal discharges have been eliminated and no specific mention to such discharges is necessary under the LTCP framework.

2.1.4 SECTION 4.0 – GREY INFRASTRUCTURE

DEC Comment No. 4a
Figure 4-3 should include a more legible illustration of the parallel sewer for Pugsley Creek.

DEP Response:
The figure has been revised.

Current Figure:

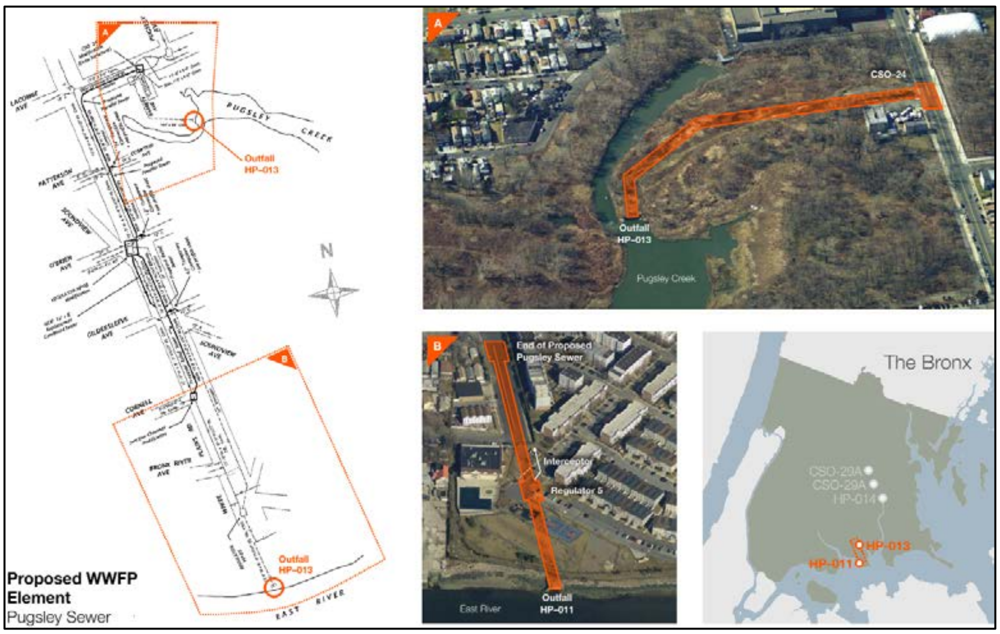

Figure 4-3. Proposed WWFP Element CSO-29A Modification, Pugsley Parallel Sewer

Proposed Figure:

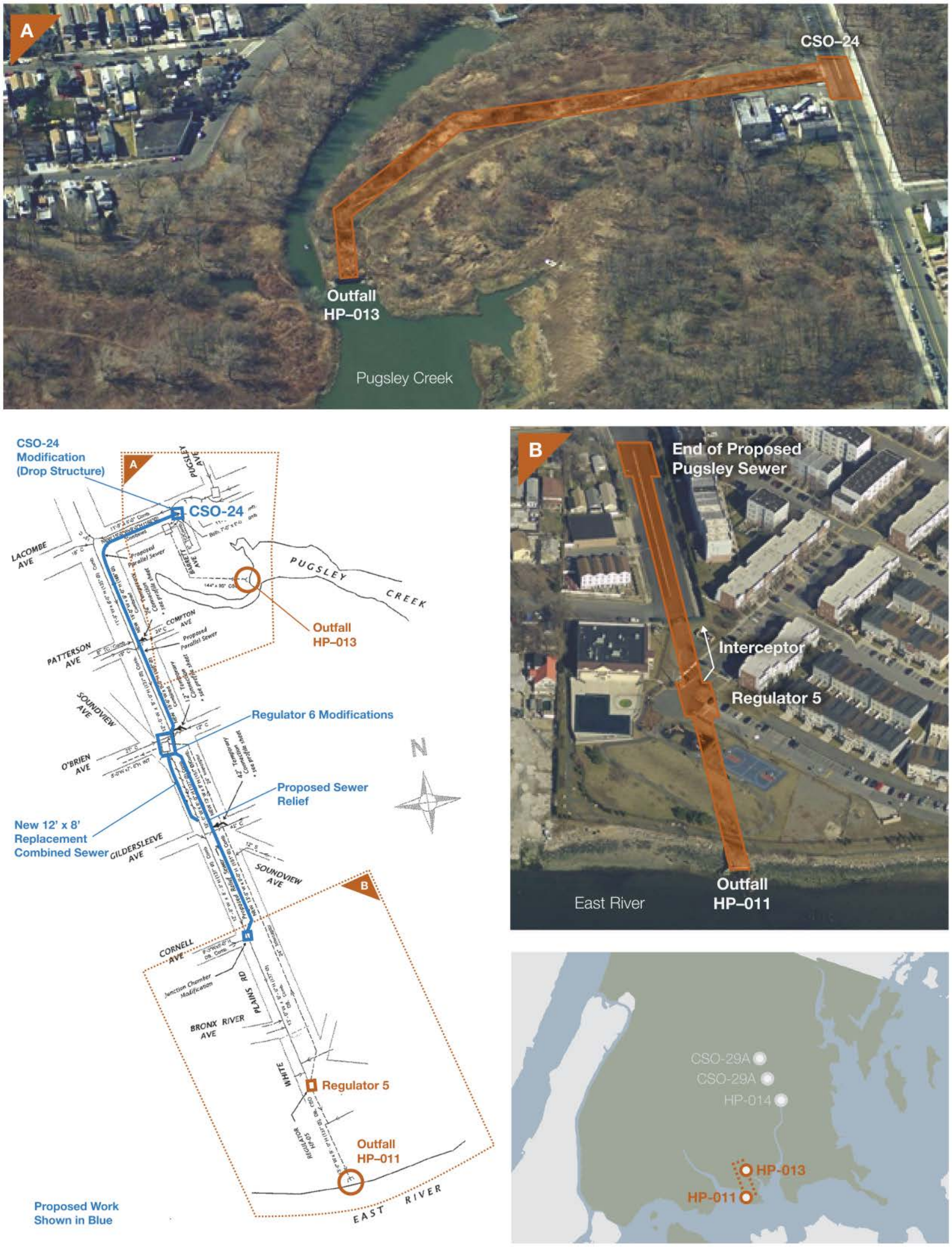

Figure 4-3. Proposed WWFP Element CSO-29A Modification, Pugsley Parallel Sewer (Revised)

2.1.5 SECTION 6.0 – BASELINE CONDITIONS AND PERFORMANACE GAP

DEC Comment No 5a.
Revise Section 6.2 to clearly indicate if the LTCP will use the mass balance approach or the Monte Carlo method for calculating pollutant loads for CSO, as discussed in the City's November 24, 2014 1etter.

DEP Response:
For the modeling simulations, CSO effluent concentrations were calculated using two methodologies: the mass balance and Monte Carlo approach. Refer to Table 6-1 and Revised Section 6 for further clarification.

DEC Comment No 5b.
Section 6-2, give the fractions of sewage in the overflows calculated in the IW model to range from 3.8% to 18%, please explain the reason for the wide range.

DEP Response:
The range is associated with the fact that the regulators overflow at different rainfall intensities and are modeled as such in IW. The outfall with the lower fraction of sanitary sewage overflows during higher intensity rainfall events, and thus contains more runoff than the other location where overflows occur at lower rainfall intensities.

DEC Comment No 5c.
Per the discussion between the Department and City on January 12, 2015, revise the performance gap analysis to assess performance against the 30-day rolling GM for enterococci of 30 cfu/100mL and STV of 110 cfu/100mL. Provide the results from the performance gap analysis using these Future Primary Contact WQ Criteria.

DEP Response:
Revised Section 6, Revised Section 8 and Revised ES reflect attainment computed for the numerical criteria as requested in the comment by the DEC.

DEC Comment No 5d.
Table 6-11 should also indicate the number of rainfall events included in each "bin".

DEP Response:
Based on direction provided by DEC, the Time to Recovery analysis for baseline, 100 percent control and recommended plan is to be conducted for the August 14-15, 2008 storm. Therefore, the categorization of rainfall events based on ranges of rainfall depth abstracted from the input to the 10-yr WQ model runs no longer applies and is removed from the text.

DEC Comment No 5e.
Section 6.2 states "As DEP has moved the program forward, it has been determined that monitoring of CSO overflow quality is required at key locations and sampling sanitary concentrations in the combined sewer lines is also required to develop a better database that can be used to improve the accuracy of the CSO loadings". The Department agrees with the need for additional monitoring and requests that the City include stormwater and direct

runoff in the monitoring plan as well, to ensure all sources of pollutants are adequately characterized. The sampling plan should be reviewed and approved by the Department.

DEP Response:
The LTCP does not plan to sample stormwater and direct drainage. DEP's MS4 program will address any stormwater and direct drainage monitoring plans.

2.1.6 SECTION 8.0 – EVALUATION OF ALTERNATIVES

DEC Comment No. 6a
In Section 8.1.a (as well as other sections, e.g. Section 7.3), the LTCP states that there are no performance gaps for the baseline conditions to attain the current Class I water quality standards, however, Sections 6.3.a and 9.4 clearly indicate that the dissolved oxygen standard is not fully attained under the baseline conditions. The discussion or performance of the Westchester Creek alternatives and cost-attainment analysis must also consider attainment of dissolved oxygen standard.

DEP Response:
LTCP Section 6 and 8, as well as the Executive Summary have been revised to clarify the fact that there is an attainment gap of applicable DO standards for baseline conditions and the recommended plan. Per agreement between DEP and DEC, a discussion on the DO attainment gap has been added in the revised Executive Summary and no DO knee-of-the-curve (KOTC) analysis of retained alternatives has been included in these revised sections.

DEC Comment No. 6b
On page 8-27, the DEP states that the extension of a force main from the Throgs Neck PS to the Hunts Point WWTP will have adverse impacts on the Hutch River and Bronx River, however, the detailed discussion of this alternative on pages 8-6 et seq. do not mention any adverse impacts. Please provide more information on the adverse impacts.

DEP Response:
The Revised Section 8 addresses this inconsistency identified by the DEC.

DEC Comment No. 6c
Section 8.1.i states that dredging was eliminated because there are no exposed CSO sediments within Westchester Creek. To substantiate this claim, the City should provide a figure with the current bathymetry of the waterbody and elevations at low tide.

DEP Response:
DEP went to the site on April 1, 2015 during low tide to observe the waterway for sediments. There were no mound sediments observed or odors. A photo of the waterway is shown below and in Revised Section 8.1, Page SD-58. Dredging was eliminated from further consideration because the DEP dredging program is targeted for exposed CSO sediment mounds. No such mounds were evident at the head end of Westchester Creek, even during monthly low tide, as depicted in Figure 8-1 below. This photo was captured on April 1, 2015 at 5:26 PM. A bathymetry study is not needed for Westchester Creek.

Figure 8-1. Head End of Westchester Creek at Low Tide
(April 1, 2015 at 5:26 PM)

DEC Comment No. 6d
In Table 8-5, footnote 1 states that the floatables control and Bronx River siphon enhancement will be evaluated under the Citywide LTCP, but it should read "Bronx River LTCP".

DEP Response:
The footnote has been corrected in Revised Section 8.

DEC Comment No. 6e
Section 8.2.a.2 states that a future analysis of a Bronx River siphon will be conducted under the Bronx River LTCP, and consist of a third barrel next to the existing two barrels. Given the preliminary results for this alternative presented in the Westchester Creek LTCP, it seems that there will be very little CSO reduction from this alternative for the Bronx River and East River, and it is likely due to the complex hydraulics of the sewer system immediately upstream of the existing siphons. As such, for the Bronx River LTCP, the City shall also evaluate construction or a siphon under the Bronx River and parallel interceptor/force main further upstream in the sewershed, such as at Regulators 27, 26, 25, and 13 or Metcalf Avenue pump station that would create a new conveyance line directly to the Hunts Point WWTP.

DEP Response:
The evaluation proposed by the DEC will be addressed under the Bronx River LTCP.

DEC Comment No. 6f
In Section 8.2.a.3, the City eliminated the floatables control without providing any detailed discussion on the magnitude of floatables present within Westchester Creek or the evaluation of other control technologies, such as underflow baffles, or baffle boxes (sec e.g.

http://www.suntreetech.com/Products/Nutrien+ Separating+ Baffle+ Box/default.aspx). The evaluation of alternatives must provide a more detailed discussion of existing floatables and control options.

DEP Response:
As reported in the Annual BMP Reports for the years 2012, 2013 and 2014, there are no records of floatables being collected at Westchester Creek. Therefore, the DEP does not consider that additional evaluation of floatable control measures in the LTCP for this waterbody is required. The text in Section 8.2.a.3 of Revised Section 8 has been modified to provide additional clarification.

DEC Comment No. 6g
The City's November 24, 2014 letter provided a justification for elimination of Green Infrastructure as a viable alternative for the LTCP. Although the response provides some additional information, it could be further developed and provide information on the extent and depth to bedrock for the watershed, etc. However, in the interest of expediting the revisions to this LTCP, the Department will not request any additional discussion on GI in this LTCP, but requests that for future LTCPs for other waterbodies, that the City provide a more detailed justification for eliminating GI as the preferred alternative if that occurs.

DEP Response:
DEP notes DEC's comment and will endeavor to provide the requested information for future LTCPs.

DEC Comment No. 6h
Figure 8-2 indicates that the size of the dewatering pump station for in-line storage is 509 MGD; however Table 8-2 indicates that the pump station would be 3 MGD. Reconcile the discrepancy.

DEP Response:
The size of the pump station is 3.0 MGD; Figure 8-2 and Table 8-2 have been reconciled.

DEC Comment No 6i.
In Table 8-5, include the number of overflow events for each of the alternatives considered.

DEP Response:
A column has been added to Table 8-5 of the Revised Section 8 indicating the number of CSO events.

DEC Comment No. 6j
Per the discussion between the Department and City on January 12, 2015, the Time to Recover analysis should be conducted for the August 15 design storm for the point of compliance of WC1 for the selected alternative using the fecal coliform single sample standard of 1000 cfu/100mL only. Table 8-12 can be deleted from the LTCP.

DEP Response:
Table 8-12 in Revised Section 8 has been revised to include the design storm analysis suggested in the comment by the DEC.

DEC Comment No. 6k

Per the discussion between the Department and City on January 8, 2015, eliminate the site specific standards from the LTCP but include a general discussion on the spatial and temporal extent of non-attainment with water quality standards within the waterbody during period of analysis.

<u>DEP Response:</u>

The site-specific standards have been eliminated from the Revised Section 8, Revised ES and Revised UAA. The spatial and temporal extent of non-attainment of WQS is discussed` throughout the Revised Section 8, Revised ES and Revised UAA.

2.1.7 SECTION 9.0 – LONG TERM CSO CONTROL PLAN IMPLEMENTATION

DEC Comment No. 7a

In Section 9.2, provide a more detailed discussion of' the implementation schedule for the Green Infrastructure. The schedule merely indicates that the GI will be implemented by 2030.

DEP Response:

For the early milestones, the DEP has prioritized investments and planning for the right-of-way because these types of practices are very efficient in managing stormwater and can be implemented systematically and quickly. The success rate of the ROW practices varies by neighborhood and contract area due to urban streetscape conditions and geotechnical investigation results. At the same time, DEP is queuing up many public property retrofits. These sites can take longer to design and complete because they require site-specific designs and often lengthy coordination with the owner agencies. As the Green Infrastructure Program progresses toward 2030, the proportion of resources will shift from ROW to retrofits on public and private sites, as well as increased focus on the aspects of adaptive management such as research and development, monitoring, and new green infrastructure designs and tools.

GI Milestones and Program Focuses

NYC Environmental Protection

2011-2015	2016-2020	2021-2025	2026-2030
1.5%	**4%**	**7%**	**10%**
Heavy ROW Focus *Inter-agency partnerships, ROW design standards, Area-wide approach for design, construction & maintenance*	**Continue and Expand ROW Projects** **Explore Additional ROW GI projects** *Porous Pavement*	**Continue ROW Projects**	**All work continuing until 10% target is reached**
Early Projects/Queue future projects *Site screening and analysis, design/construct projects with DPR, NYCHA, and DOE*	**Greater Onsite implementation** *Further design and construction, Ongoing site screening and analysis*	**Continue Onsite implementation**	
Planning/Analysis for additional GI tools *Pilot construction and monitoring*	**Continue analysis and monitoring** *R&D Program*	**Continue implementation of innovative designs and GI tools**	
Innovative design and development	**Further development of new tools** *R&D Program*		
Related LTCP Milestones	2016 Performance Metrics Report 2017 Citywide LTCP		

DEC Comment No. 7b
In Section 9.5, provide a reference to Section 4.3 which provides a more in-depth discussion of the post-construction compliance monitoring program.

DEP Response:
Reference has been added.

Current language: "As discussed in Section 4.0, a PCM program will be developed as part of the implementation of the LTCP."

Proposed language: "As discussed in Section 4.3, a PCM program will be developed as part of the implementation of the LTCP."

ATTACHMENT 1

Revised Executive Summary

EXECUTIVE SUMMARY

This Executive Summary is organized as follows:

- Background — An overview of the regulations, approach and existing waterbody information.
- Findings — A summary of the key findings of the water quality data analyses, the water quality modeling simulations and the alternatives analysis.
- Recommendations — A listing of recommendations that are consistent with the Federal CSO Control Policy and the Clean Water Act (CWA).

BACKGROUND

This Long Term Control Plan (LTCP) for Westchester Creek was prepared pursuant to the Combined Sewer Overflow (CSO) Order on Consent (DEC Case No. CO2-20110512-25), dated March 8, 2012 (2012 CSO Order on Consent). The 2012 CSO Order on Consent is a modification of the 2005 CSO Order on Consent (DEC Case No. CO2-20000107-8). Under the 2012 CSO Order on Consent, the New York City (NYC) Department of Environmental Protection (DEP) is required to submit 11 waterbody-specific LTCPs to the New York State Department of Environmental Conservation (DEC) by December 2017. The Westchester Creek LTCP is the second of the LTCPs under the 2012 CSO Order on Consent to be completed.

The goal of each LTCP, as described in the LTCP Goal Statement in the 2012 CSO Order on Consent, is to identify, with public input, appropriate CSO controls necessary to achieve waterbody-specific water quality standards (WQS) consistent with the Federal CSO Control Policy and related guidance. In addition, the Goal Statement provides: *"Where existing water quality standards do not meet the Section 101(a)(2) goals of the Clean Water Act, or where the proposed alternative set forth in the LTCP will not achieve existing water quality standards or the Section 101(a)(2) goals, the LTCP will include a Use Attainability Analysis examining whether applicable waterbody classifications, criteria, or standards should be adjusted by the State."* DEP conducted water quality assessments where the data is represented by percent attainment with pathogen targets and associated recovery times. For this LTCP, in accordance with guidance from DEC, 95 percent attainment of applicable water quality criteria constitutes compliance with the existing WQS or the Section 101(a)(2) goals[1] conditioned on verification through rigorous post-construction compliance monitoring (PCM).

Regulatory Requirements

The waters of the City of New York are subject to Federal and New York State laws and regulations. Particularly relevant to this LTCP is the U.S. Environmental Protection Agency (EPA) CSO Control Policy,

[1] This LTCP is designed to meet the existing WQS that have been promulgated by DEC. To the extent that this LTCP provides, analyzes, or selects alternatives that may lead to achievement of targets beyond what are required under existing WQS, DEP provides these analyses and/or commitments in order to improve water quality beyond the requirements of the CSO Control Policy and other applicable law.

which provides guidance on the development and implementation of LTCPs, and the setting of WQS. In New York State (NYS), CWA regulatory and permitting authority has been delegated to the DEC.

DEC has designated Westchester Creek as a Class I waterbody, defined as "suitable for fish, shellfish and wildlife propagation and survival." The best usages of Class I waters are "secondary contact recreation and fishing" (6 NYCRR 701.13).

The criteria assessed in this LTCP (Table ES-1) include the applicable Existing WQ Criteria (Class I – secondary contact recreation for Westchester Creek). Also assessed in this LTCP is what attainment would be if DEC were to reclassify Westchester Creek to a Class SC - limited primary contact recreation. The best usage of Class SC waters is fishing. The SC classification further states that water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use of the waterbody for these purposes. It should be also noted that enterococci criteria do not apply to tributaries such as Westchester Creek under the BEACH Act of 2000, therefore, Westchester Creek water quality assessments for Class SC considered the fecal coliform criterion only (Table ES-1). As described above, the 2012 EPA RWQC recommended certain changes to the bacterial water quality criteria for primary contact. DEC has indicated that NYS will seek to adopt those more stringent standards for both primary and secondary contact waterbodies. As such, this LTCP includes attainment analysis both for Existing WQ Criteria and for the proposed 2012 EPA RWQC that is referred to as the Potential Future Primary Contact WQ Criteria. Table ES-1 summarizes the Existing WQ Criteria, Primary Contact WQ Criteria and the Potential Future Primary Contact WQ Criteria applied in this LTCP.

Table ES- 1. Classifications and Standards Applied

Analysis	Numerical Criteria Applied
Existing WQ Criteria	I: Fecal Monthly GM ≤ 2,000 DO never < 4.0 mg/L
Primary Contact WQ Criteria[(1)]	SC: (Fecal Monthly GM – 200 cfu/100mL) DO daily average >= 4.8 mg/L; DO never < 3.0 mg/L
Potential Future Primary Contact WQ Criteria[(2)]	SC: Fecal Monthly GM≤200 Entero rolling 30-d GM – 30 cfu/100mL + STV – 110 cfu/100mL

Notes:
GM = Geometric Mean; STV = 90th Percentile Statistical Threshold Value.
(1) This water quality standard is not currently assigned to Westchester Creek.
(2) The Potential Future Primary Contact WQ Criteria have not yet been adopted by DEC.

Through analyses described in this LTCP, DEP has determined that the Potential Future Primary Contact WQ Criteria for bacteria would be more challenging to meet, with the STV value essentially impossible to meet.

Westchester Creek Watershed

Westchester Creek watershed characteristics and the CSO and stormwater outfalls are as shown in Figure ES-1. Westchester Creek is a tributary of the Upper East River and is located in the eastern section of the Bronx. The Westchester Creek LTCP Study Area comprises both Westchester Creek and Pugsley Creek and their highly urbanized watersheds. Bounded on the east by the Hutchinson River watershed and on the west by the Bronx River watershed, the Westchester Creek watershed contains numerous parks and open spaces, particularly along the lower portions of the waterbody. However, industrial, manufacturing, transportation and utility uses exist along the western shore and the middle reaches of the eastern shore. The natural watershed of Westchester and Pugsley Creeks consists of approximately 3,600 acres based on interpretation of the local topography. The majority of the Westchester Creek watershed is served by the Hunts Point Wastewater Treatment Plant (WWTP). Sanitary flows and a portion of combined sanitary and stormwater flows are conveyed to the Hunts Point WWTP for treatment. Flows that exceed the capacity of the conveyance and treatment system are discharged into the waterbodies via permitted CSO outfalls. Limited portions of the drainage area along the shorelines discharge their runoff directly to Westchester Creek.

The CSO regulators that discharge to Westchester Creek serve an area of approximately 4,271 acres; the total drainage to Westchester Creek is 4,952 acres. The remaining tributary area (681 acres) includes approximately equal areas of direct runoff, highway runoff and various types of urban stormwater service areas.

Green Infrastructure

Based upon Westchester Creek's characteristics, DEP has determined that the watershed is a CSO tributary that will receive green infrastructure (GI) improvements. The Westchester Creek watershed has a total combined sewer impervious area of 3,480 acres out of a total drainage area of 4,952 acres. DEP projects the following GI application rates by 2030:

- 348 acres (10 percent) to be managed using GI right-of-way bioswales (ROWBs);
- 122 acres (3.5 percent) to be managed in on-site private properties in Westchester Creek through new development and compliance with the Stormwater Performance Standard; and
- 17 acres (0.5 percent) to be managed in on-site public properties.

This acreage represents 14 percent of the total combined sewer impervious area in the watershed.

DEP conservatively estimated new development trends based on Department of Buildings (DOB) building permit data from 2000 to 2011 and has projected that data for the 2012-2030 period to account for compliance with the Stormwater Performance Standard.

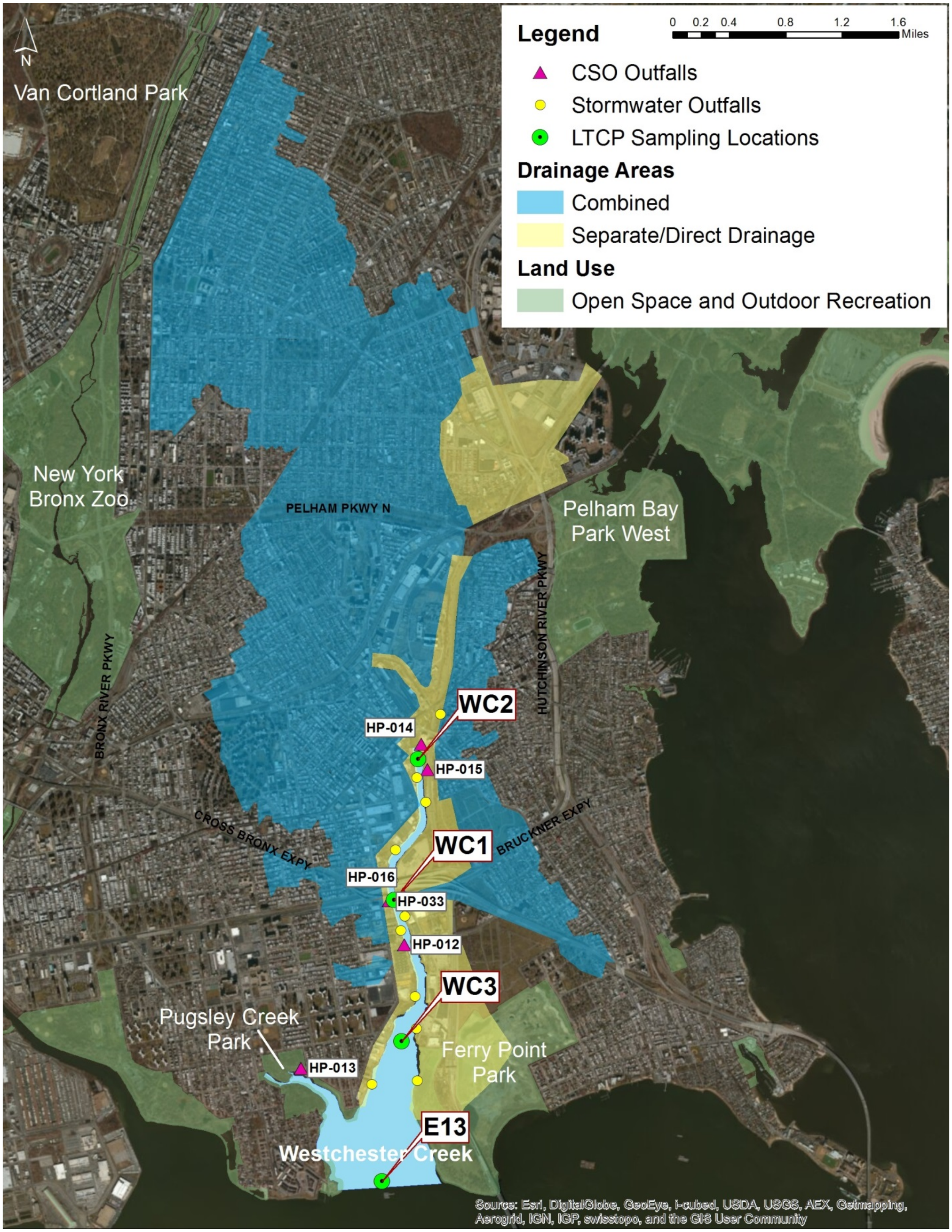

Figure ES-1. Watershed Characteristics and Sampling Locations

Findings

Analysis of water quality in Westchester Creek was based on data collected from December 2013 to April 2014 during the development of the Westchester Creek LTCP. Figure ES-2 presents fecal coliform bacteria data collected at Stations WC2, WC1, WC3 and E13, in Westchester Creek. The data in Figure ES-3 represents enterococci data collected at Stations WC2, WC1, WC3 and E13, in Westchester Creek for the period of December 2013 through April 2014. As the improvements from the 2011 Waterbody/Watershed Facility Plan (WWFP) have yet to be implemented in the Westchester Creek drainage area at the time of the LTCP sampling, the results represent pre-WWFP or pre-baseline conditions.

The data indicate that the bacteria concentrations at the head end of Westchester Creek (Station WC2) show GMs for enterococci at approximately 50 cfu/100mL and fecal coliform bacteria near 150 cfu/100mL. The 75th percentile excursions above these values reach nearly 100 cfu/100mL for enterococci and exceed 200 cfu/100mL for fecal coliform bacteria. Single wet weather sample excursions reach 30,000 cfu/100mL for enterococci and 50,000 cfu/100mL for fecal coliform.

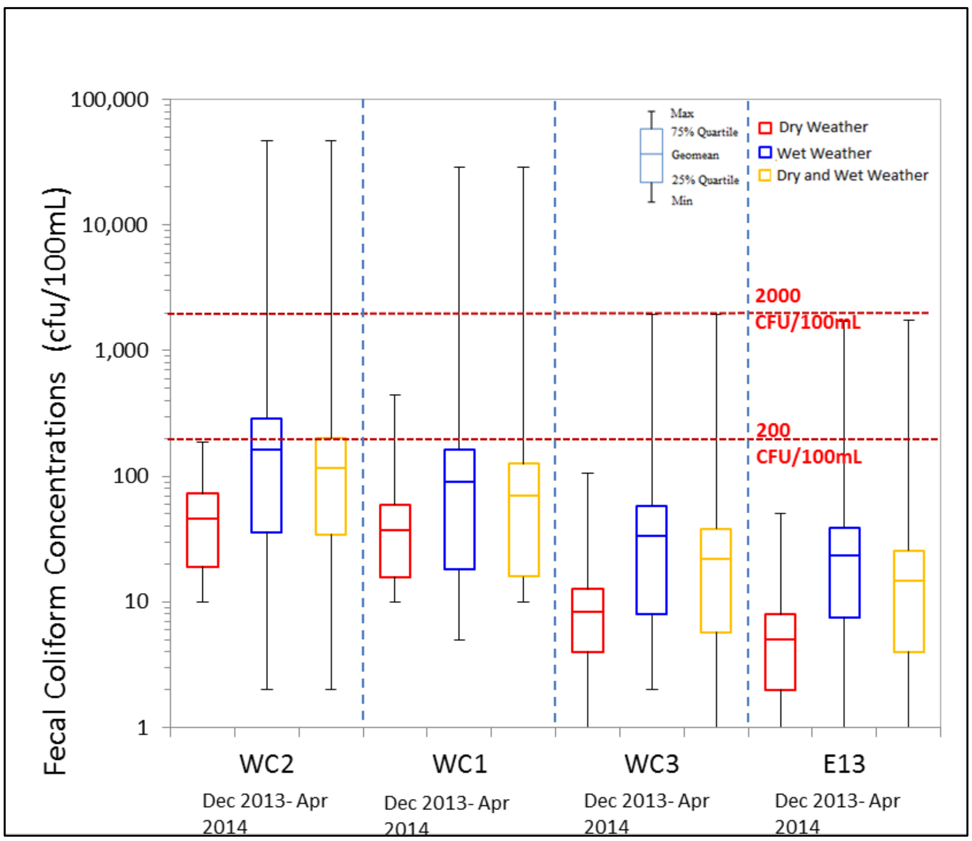

Figure ES-2. Fecal Coliform Data – Westchester Creek

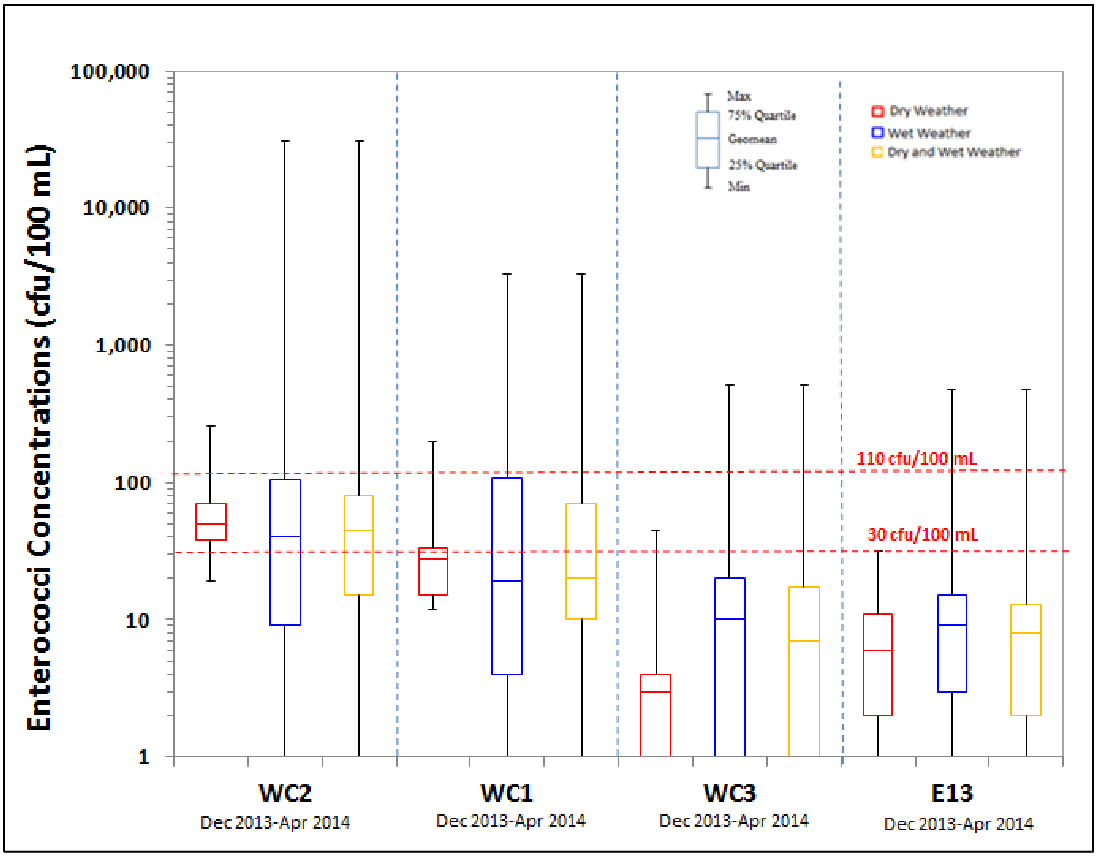

Figure ES-3. Enterococci Data – Westchester Creek

As noted in these graphics, dry weather fecal coliform concentrations are lower than those for wet weather conditions. Enterococci concentrations measured in dry weather approximated the wet weather concentrations at most locations. The general trend for both fecal coliform and enterococci bacteria is for the highest values to be at the head end of the Creek, and decreasing downstream towards the East River.

Baseline Conditions, 100 Percent CSO Control and Performance Gap

Analyses utilizing computer models were conducted as part of this LTCP to assess the attainment with existing Class I, Primary Contact WQ Criteria (Class SC) and the Potential Future Primary Contact WQ Criteria. The analyses focused on two primary objectives:

1. Determine the future baseline levels of compliance with water quality criteria with all sources being discharged at existing levels to the waterbody. These sources would primarily be direct drainage runoff, stormwater and CSO. This analysis is presented for Existing WQ Criteria, Primary Contact WQ Criteria (Class SC) and the Potential Future Primary Contact WQ Criteria.

2. Determine attainment levels with 100 percent of CSO controlled or no discharge of CSO to the waterbody, keeping the remaining non-CSO sources. This analysis is presented for the standards and bacteria criteria shown in Table ES-1.

DEP assessed water quality using the East River Tributary Model (ERTM), the receiving water quality model used in support of the Westchester Creek LTCP. Model outputs for fecal and enterococci bacteria as well as dissolved oxygen (DO) were compared with various monitored data sets during model testing in order to improve the accuracy and robustness of the models to adopt them for LTCP evaluations. The water quality model was then used to calculate ambient pathogen concentrations within the waterbody for a set of baseline conditions.

Baseline conditions were established in accordance with the guidance provided by DEC to represent future conditions. These included the following assumptions: the design year was established as 2040; Hunts Point Wastewater Treatment Plant (WWTP) would receive peak flows at 2xDDWF; grey infrastructure would include those elements recommended in the 2011 WWFP; and waterbody-specific GI application rates would be based on the best available information. In the case of Westchester Creek, GI was assumed to have 14 percent coverage.

The water quality assessments were conducted using continuous water quality simulations – a one-year (2008 rainfall) simulation for bacteria and DO assessment to support alternatives evaluation, and a 10-year (2002 to 2011 rainfall) simulation for bacteria attainment analysis of developed alternatives. The gaps between calculated baseline bacteria as well as DO were then compared to the applicable pathogen and DO criteria to quantify the level of non-attainment.

A summary of the baseline attainment results are presented in Table ES-2.

Table ES- 2. Baseline Compliance with Bacteria Water Quality Criteria

Location		Meets Existing WQ Criteria(1) (Class I)	Meets Primary Contact WQ Criteria(2) (Class SC)	Meets Potential Future Primary Contact WQ Criteria(2)
Westchester Creek	WC2	YES	NO3	NO
	WC1,WC3 and E13	YES	YES	NO

Notes:

YES indicates attainment is calculated to occur ≥ 95 percent of time.
NO indicates attainment is calculated to be less than 95 percent of time.
(1) Annual attainment
(2) Recreational season attainment
(3) Criteria not attained annually; attained during the recreational season

Westchester Creek meets the Existing WQ Criteria. Levels of attainment are less for the Primary Contact WQ Criteria (Class SC) in Westchester Creek and the Potential Future Primary Contact WQ Criteria.

Further, even with 100 percent control of all CSOs the projected attainment with the recreational season (May 1st through October 31st) enterococci criteria only increases marginally for the same 10-year period. Even less attainment occurs when the 2012 EPA RWQC enterococci STV value 90th upper percentile limits are applied. A more detailed discussion of the attainment modeling results is in Section 8.

In summary, the baseline modeling showed that Westchester Creek exhibits a high level of attainment with the Existing WQ Criteria. The attainment levels with the Primary Contact WQ Criteria (Class SC) and the Potential Future Primary Contact WQ Criteria are lower. The enterococci STV value 90th percentile limit cannot be met throughout the waterbody.

Public Outreach

DEP followed a comprehensive public participation plan in ensuring engagement of interested stakeholders in the LTCP process. Stakeholders included both citywide and regional groups, a number of who offered comments at two public meetings held for this LTCP. DEP will continue to gather public feedback on waterbody uses and will provide the public Use Attainability Analysis (UAA)-related information at the third Westchester Creek Public Meeting. The third meeting will present the final recommended plan to the public after DEC review of the LTCP.

At the second of two public meetings conducted to date, there was a high degree of public support for DEP's findings that additional grey infrastructure based-CSO controls were not warranted, due to the water quality improvements projected from the implementation of the 2011 WWFP recommendations. No support was expressed for additional CSO controls or improved use for Westchester Creek during the public participation meetings.

Evaluation of Alternatives

A multi-step process was used to evaluate control measures and CSO control alternatives. The evaluation process considered factors related to: environmental benefits; community and societal impacts; and implementation and operation and maintenance (O&M) considerations. Following the comments from two detailed technical workshops, the retained alternatives were subjected to cost-performance and cost-attainment evaluations where economic factors were introduced. Table ES-3 contains the six retained alternatives.

Table ES-3. Summary of Retained Alternatives

Alternative	Description
1. Throgs Neck PS Force Main (FM) Extension	Extend FM to Hunts Point WWTP, maintain capacity at 37.5 MGD, and modify pumps to account for additional head loss. Maintaining current capacity at 37.5 MGD and extending the force main directly to the Hunts Point WWTP.
2. 18 MG Storage Shaft	155-ft diameter vertical treatment shaft (VTS) at HP-033 and HP-016.
3. 24.5 MG Storage Tunnel	40-ft. dia., 2,600 LF tunnel deemed to be the most viable technology for capturing Outfall HP-014 volume. Includes 24.5 MGD dewatering PS.
4. 43 MG Storage Tunnel	40-ft. dia., 4,500 LF tunnel deemed to be the most viable technology for capturing CSO from Outfalls HP-014, HP-015, HP-016 and HP-033. Includes 43 MGD dewatering PS.
5. 50 MG Storage Tunnel	26-ft. dia., 12,600 LF tunnel deemed to be the most viable technology for capturing CSO from Outfalls HP-014, HP-015, HP-016, HP-033, HP-012 and HP-013. Includes 50 MGD dewatering PS.
6. Floatables Control	Targeting HP-011 at the East River to address the increased annual average overflow volume (AAOV) resulting from the planned WWFP recommendations; evaluation deferred to the Bronx River LTCP.
7. Bronx River Siphon Enhancement	Targeting HP-011 at the East River to address the increased AAOV resulting from the planned WWFP recommendations; evaluation deferred to the Bronx River LTCP.

CSO Reductions, WQ Impact with the Selected Alternative

A summary of the results of the final step of the evaluation process for enterococci and fecal coliform are illustrated by Figures ES-4 and ES-5, which is a cost-performance curve for the various alternatives regarding enterococci and fecal coliform loading reductions. The best-fit curve in the figure does not clearly show a knee-of-the-curve (KOTC).

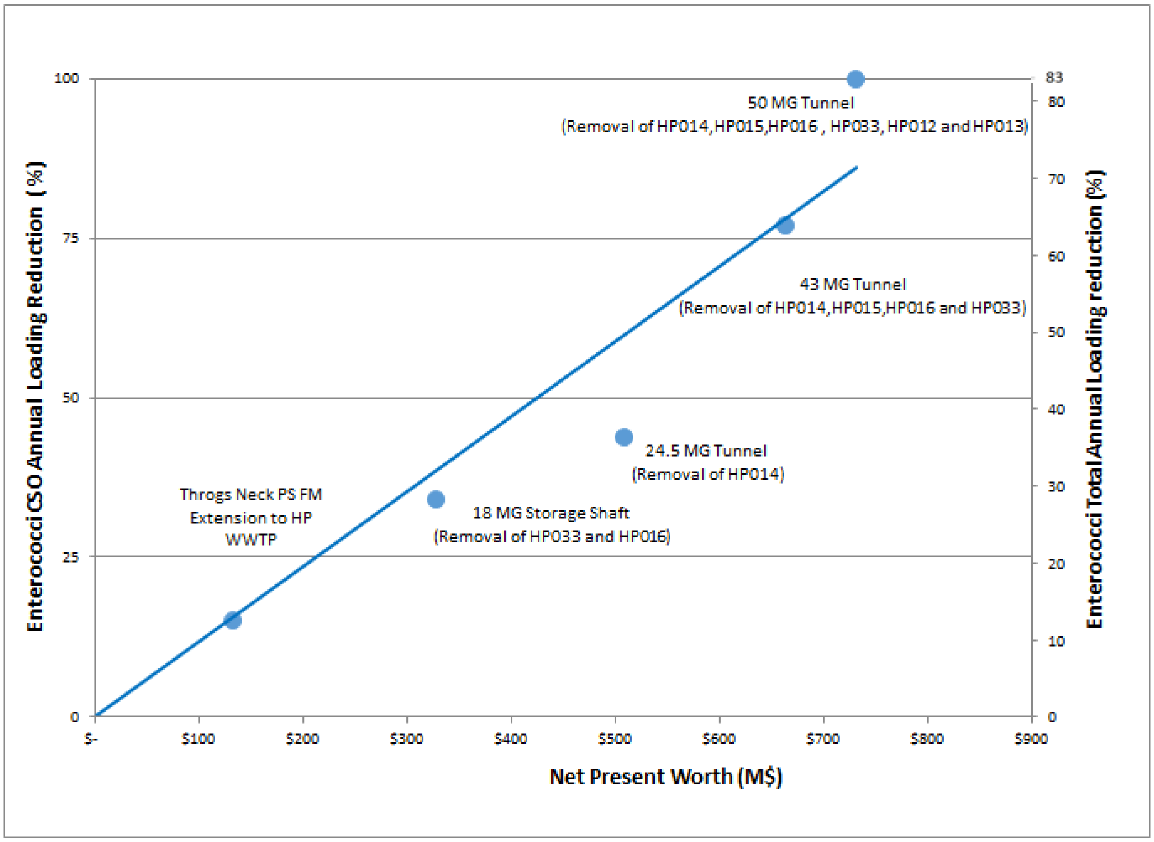

Figure ES-4. Cost vs. Enterococci Loading Reduction (2008 Rainfall)

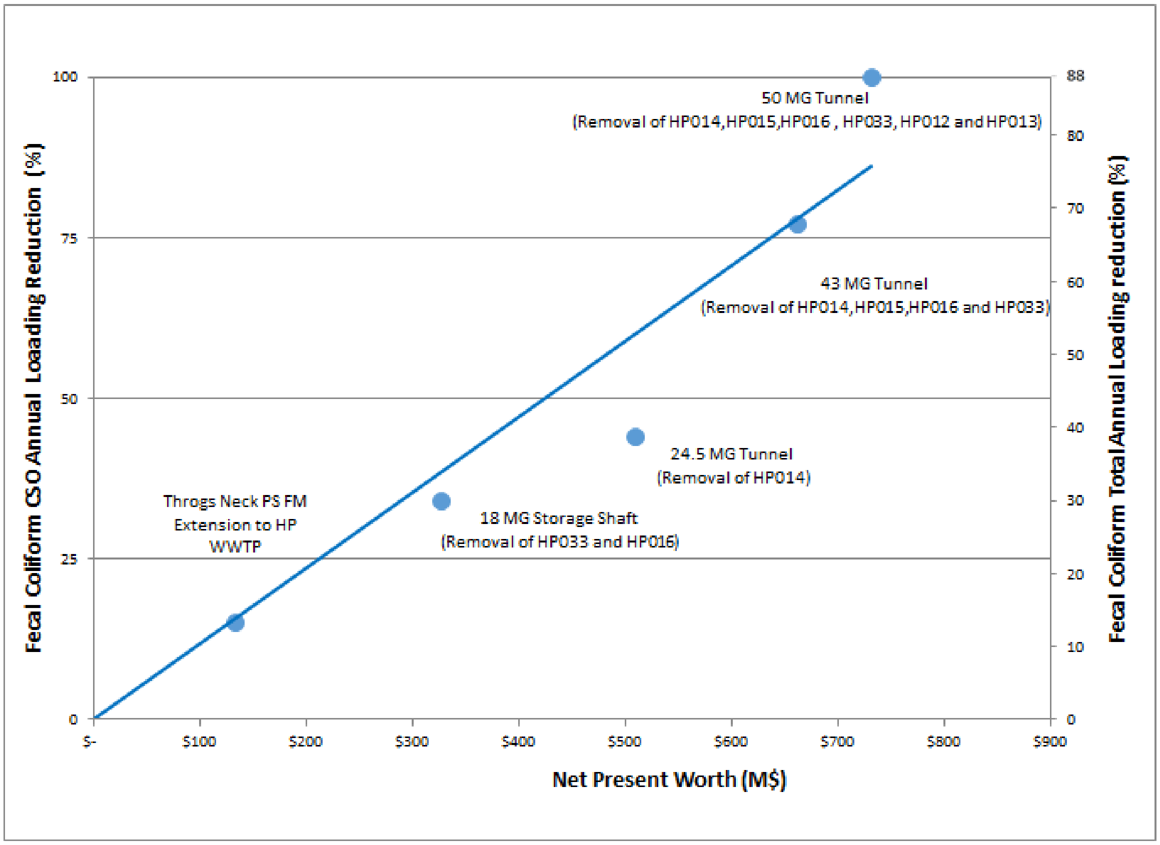

Figure ES-5. Cost vs. Fecal Coliform Loading Reduction (2008 Rainfall)

The cost-attainment curves that are presented in Section 8.5 did not show meaningful improvement in WQS attainment for any of the alternatives, including that with 100 percent CSO control.

RECOMMENDATIONS

Long Term CSO Control Plan Implementation, UAA and Summary of Recommendations

DEP will implement the plan elements identified in this section after approval of the LTCP by DEC. This LTCP recommends the continued implementation of WWFP recommendations and has identified means to protect uses based on the predicted performance of the selected CSO controls. Post-construction compliance monitoring data will be collected to assess and review attainment of WQS.

The LTCP analyses and recommendations for Westchester Creek LTCP are summarized below for the following items:

1. Water Quality Modeling Results.
2. UAA assessing attainment of WQS and identifying a wet weather advisory period based on Time to Recovery analysis.
3. Summary of Recommendations.

Water Quality Modeling Results

The water quality modeling results for Westchester Creek are shown in Table ES-4 for the recommended alternative. These results provide the calculated attainment of the fecal coliform and enterococci bacteria concentrations for the plan. The results show, for the different calculated levels of attainment, the percentage of time in which concentrations would be at, or lower, than the Existing WQ Criteria, Primary Contact WQ Criteria (Class SC) and the Potential Future Primary Contact WQ Criteria.

The recommended plan achieves annual attainment of the existing fecal coliform criteria. For the Primary Contact WQ Criteria (Class SC), Westchester Creek is projected to achieve a high level of attainment with the fecal coliform criterion. However, for the area closer to the head of the Creek, attainment of this criterion remains below what is considered to achieve the corresponding WQS or the Section 101(a)(2) goals on an annual basis. With the recommended plan, compliance with the Potential Future Primary Contact WQ Criteria with 2012 EPA RWQC remains the same in Westchester Creek.

Table ES-4. Calculated 10-year Bacteria Attainment for Recommended Plan (May 1st – October 31st)

Station	Existing WQ Criteria(Class I)		Primary Contact WQ Criteria (Class SC)		Potential Future Primary Contact WQ Criteria	
	Criterion (cfu/100mL)	Annual Attainment (%)	Criterion (cfu/100mL)	Annual Attainment (%)	Criterion (cfu/100mL)	Recreational Season Attainment (%)
WC2	Fecal ≤2,000	100	Fecal ≤200	93	Enterococci ≤30	84
					STV≤110	21
WC1	Fecal ≤2,000	100	Fecal ≤200	95	Enterococci ≤30	88
					STV≤110	23
WC3	Fecal ≤2,000	100	Fecal ≤200	97	Enterococci ≤30	93
					STV≤110	32
E11	Fecal ≤2,000	100	Fecal ≤200	100	Enterococci ≤30	98
					STV≤110	67

Attainment of the STV upper 90th percentile values contained in the Potential Future Primary Contact WQ Criteria is difficult, if not impossible to achieve. Maximum enterococci concentrations will far exceed the EPA recommended Potential Future Primary Contact WQ Criteria STV concentration of 110 cfu/100mL. Calculated 90th percentile concentrations are greater than the proposed value of 110 cfu/100mL. Additional information on the Potential Future Primary Contact WQ Criteria is presented in Section 8 and the UAA.

Westchester Creek does not attain the existing Class I dissolved oxygen criterion and both the chronic and acute Class SC dissolved oxygen criteria under baseline conditions. Water quality analyses also indicate (Table ES-5) that dissolved oxygen concentrations for the identified plan will not lead to attaining the DEC target of 95 percent of these criteria. 100 percent CSO control would lead to compliance with the acute criterion exclusively.

Table ES-5. Class SC Attainment With DO criteria

Station	Annual Attainment (%)	
	Chronic	Acute
Baseline	71	89
100 Percent CSO Control	88	98

Since the recommended LTCP projects will not result in full compliance in Westchester Creek with the Primary Contact WQ Criteria (Class SC), DEP has prepared a UAA for Westchester Creek that identifies wet weather advisories based on Time to Recovery analysis.

For such, DEP has performed an analysis to determine the amount of time following the end of rainfall required for Westchester Creek to recover and return to concentrations less than 1,000 cfu/100mL fecal coliform. The analysis consisted of examining the water quality model calculated fecal coliform concentrations for Westchester Creek during the recreational season (May 1st through October 31st) under the August 14-15, 2008 storm. Details on the selection of this storm are provided in Revised Section 6. The time to return to fecal coliform concentrations below 1,000 cfu/100mL was then tabulated for each WQ Station along the waterbody.

The results of these analyses are summarized in Table ES-6. As noted, the duration of time within which pathogen concentrations are expected to be higher than NYS Department of Health (DOH) considers safe for primary contact varies with location. Generally, a value of around 48 hours would be typical for Westchester Creek.

Table ES-6. Time to Recover Within Westchester Creek

Station	Time to Recover (hrs) Fecal Coliform Target (1,000 cfu/100mL)
	Preferred Alternative
WC2	43
WC1	36
WC3	24
E13	0

Summary of Recommendations

Water quality in Westchester Creek will be improved with the actions presented in this LTCP. Attainment with the pathogen standards will increase due to implementation of the WWFP and GI projects; however, the overall water quality will only marginally improve.

The actions items identified with the Westchester Creek LTCP are:

1. The LTCP includes a UAA that assesses attainment of WQS based on the projected performance of the selected CSO controls.
2. A Post-Construction Compliance Monitoring Program will be initiated after the WWFP improvements are operational. Based upon the results of such monitoring, the projected attainment will be reviewed.
3. DEP will establish with the NYC Department of Health and Mental Hygiene (DOHMH), through public notification, a 48-hour wet weather advisory during the recreational season (May 1st through October 31st), during which swimming and bathing would not be recommended in Westchester Creek. The LTCP includes a recovery time analysis that can be used to establish the duration of the wet weather advisory for public notification.
4. DEP will continue to implement the WWFP recommendations: Pugsley Creek parallel sewer and regulator modifications at CSO-29 and CSO-29A.
5. DEP will continue to implement the Green Infrastructure Program.
6. DEP will include in the Bronx River LTCP an analysis to control floatables at the HP-011 at the East River to address the increased CSO volume resulting from the planned WWFP recommendations.
7. DEP will investigate as part of the Bronx River LTCP a new siphon targeting HP-011 at the East River. This analysis will investigate the AAOV resulting from the planned WWFP recommendations with the goal of increasing CSO flow to the Hunts Point WWTP.

In summary, this LTCP is expected to reduce the human contributed CSO bacteria and pathogens discharged to Westchester Creek from CSOs. The overall water quality attainment in Westchester Creek is anticipated to marginally improve. The action items above are expected to provide improvement beyond the existing bacteria WQS, which are met throughout Westchester Creek during the recreational season and for the majority of the waterbody annually, except for the Class SC fecal coliform criterion at the head end of the waterway, on an annual basis.

DEP is committed to improving water quality in this waterbody, which will be advanced by the improvements and recommendations presented in this plan. These identified actions have been balanced with input from the public and awareness of the cost to the citizens of NYC.

ATTACHMENT 2

Revised Section 6.0: Baseline Conditions and Performance Gap

6.0 BASELINE CONDITIONS AND PERFORMANCE GAP

Key to development of the Westchester Creek Long Term Control Plan (LTCP) is the assessment of water quality with applicable water quality standards within the waterbody. Water quality was assessed using the ERTM water quality model, verified with both Harbor Survey and the synoptic water quality data collected in 2013 and 2014. The ERTM water quality model simulated ambient bacteria concentrations within Westchester Creek for a set of baseline conditions, as described in this section. The InfoWorks CS (IW) sewer system model was used to provide flows and loads from intermittent wet weather sources as input to the water quality model.

Two types of continuous water quality simulations were performed to evaluate the gap between the calculated bacteria levels under baseline conditions and the Existing WQ Criteria and Potential Future Primary Contact WQ Criteria. As detailed below, a one-year (using average 2008 rainfall) simulation was performed for bacteria and dissolved oxygen (DO). This shorter term continuous simulation served as a basis for evaluation of control alternatives. A 10-year (2002-2011) simulation was performed for bacteria, to assess the baseline conditions, evaluate the performance gap, and analyze the impacts of the final alternative.

This section of the LTCP describes the baseline conditions and the bacteria concentrations and loads calculated by the IW model and the resulting bacteria concentrations calculated by the ERTM water quality model. It further describes the gap between calculated baseline bacteria concentrations and the water quality standards (WQS), when the calculated baseline concentrations exceed the criteria. These analyses are presented for: the Existing WQ Criteria (Class I); the existing Primary Contact WQ Criteria (Class SC); and for Potential Future Primary Contact WQ Criteria (2012 EPA RWQC). It should be noted that enterococci criterion does not apply to tributaries such as Westchester Creek under the BEACH Act of 2000; therefore, Westchester Creek water quality assessments for existing Class SC considered the fecal coliform criterion only. Potential Future Primary Contact WQ Criteria assessments take into account both enterococci and fecal coliform criteria for primary contact recreation.

6.1 DEFINE BASELINE CONDITIONS

Establishing baseline conditions is an important step in the LTCP process, since the baseline conditions will be used to compare and contrast the effectiveness of combined sewer overflow (CSO) controls and to predict whether water quality goals would be attained after the implementation of the recommended LTCP. Baseline conditions for this LTCP were developed in accordance with guidance established by New York State Department of Environmental Conservation (DEC) to represent future conditions. Specifically, these conditions included the following assumptions:

- The design year was established as 2040.
- The Hunts Point Wastewater Treatment Plant (WWTP) receives peak flows at 2xDDWF.
- Grey infrastructure includes those recommended in the 2011 Waterbody/Watershed Facility Plan (WWFP).

- Green Infrastructure (GI) in 14 percent of the impervious surfaces within the combined sewer service areas.

Mathematical modeling tools were used to calculate the CSO volume and pollutants loads and their impacts on water quality. The performance gap between calculated WQS was assessed herein by comparing the baseline conditions with WQS. In addition, complete removal of CSO was evaluated. Further analyses were conducted for CSO control alternatives in Section 8.0.

The IW model was used to develop stormwater flows, conveyance system flows, and CSO volumes for a defined set of future or baseline conditions. For the Westchester Creek LTCP, the baseline conditions were developed in a manner consistent with the earlier WWFP approved by DEC. However, based on more recent data, as well as the public comments received on the WWFP, it was recognized that some of the baseline condition model input data needed to be updated, to reflect more recent meteorological conditions, as well as current operating characteristics of various collection and conveyance system components. Furthermore, the mathematical models were also updated from their configurations and levels of calibration developed and documented during development of the earlier WWFP. IW model alterations reflected a better understanding of dry and wet weather sources, catchment areas, and new or upgraded physical components of the system. In addition, a model recalibration report was issued in 2012 (*InfoWorks Citywide Recalibration Report – June 2012*) that used improved impervious surface satellite data. Water quality model updates included more refined model segmentation. The new IW model network was then used to calculate CSO overflows and loads for the baseline conditions and was used as a tool to evaluate the impact on CSO overflows of potential alternative operating strategies and other possible physical changes to the collection system.

Following are the baseline modeling conditions primarily related to dry weather flow (DWF) rates, wet weather capacity for the Hunts Point WWTP, sewer conditions, precipitation conditions, and tidal boundary conditions. Each of these is briefly discussed in the section below:

- **Wet Weather Capacity**: The rated wet weather capacity at the Hunts Point WWTP is 400 million gallons per day (MGD) (2xDDWF). A project was completed in 2004 to upgrade the treatment plant including the plant headworks and main sewage pumps so that the plant is capable of accepting, pumping and treating combined sewage to a maximum flow of 400 MGD. On May 8, 2014, DEC and New York City Department of Environmental Protection (DEP) entered into an administrative consent order that includes an enforceable compliance schedule to ensure that DEP maximizes flow to and through the WWTP during wet weather events.

- **Sewer Conditions**: The IW model was developed to represent the sewer system on a macro scale that included all conveyance elements greater than 48-in in equivalent diameter, along with all regulator structures and CSO outfall pipes. Post-cleaning levels of sediments were also included for the interceptors in the collection system, to better reflect actual conveyance capacities to the WWTPs.

6.1.a Hydrologic Conditions

Previous evaluations of the Westchester Creek watershed used the 1988 precipitation characteristics as the representative typical precipitation year. However, for this LTCP, the precipitation characteristics for 2008 were used for the baseline condition, as well as for alternatives evaluations. In addition to the 2008 precipitation pattern, the observed tide conditions that existed in 2008 were also applied in the models as the tidal boundary conditions at the CSO outfalls that discharge to tidally influenced waterbodies. For longer term 10-year evaluations, the period from 2002 through 2011 was analyzed.

6.1.b Flow Conservation

Consistent with previous studies, the dry weather sanitary sewage flows used in the baseline modeling were escalated to reflect anticipated population growth in New York City (NYC). In 2012, DEP completed detailed analysis for water demand and wastewater flow projections. A detailed GIS analysis was performed to apportion total population among the 14 WWTP drainage areas. For this analysis, Transportation Analysis Zones (TAZs) were overlaid with WWTP drainage areas. Population projections for 2010-2040 were derived from Population Projections developed by the Department of City Planning (DCP) and New York Metropolitan Transportation Council (NYMTC). These analyses used the 2010 census data to reassign population values to the watersheds in the model and project up to 2040 sanitary flows. These projections also reflect water conservation measures that have already significantly reduced flows to the WWTPs and freed-up capacity in the conveyance system.

6.1.c BMP Findings and Optimization

A list of best management practices (BMP), along with brief summaries of each and their respective relationships to the U.S. Environmental Protection Agency (EPA) Nine Minimum Controls (NMC), were reported in Section 3.0, as they pertain to Westchester Creek CSOs. 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 (CSS), thereby improving water quality conditions.

The following provides an overview of the specific elements of various DEP, State Pollutant Discharge Elimination System (SPDES) and BMP activities as they relate to development of the baseline conditions, specifically in setting up and using the IW models to simulate CSO discharges, and in establishing non-CSO discharges that impact water quality in Westchester Creek:

- Sentinel Monitoring – In accordance with BMPs #1 and #5, DEP collects quarterly samples of bacteria water quality at the mouth of Westchester Creek in dry weather to assess whether dry weather sewage overflows occur or illicit connections to storm sewers exist. No evidence of illicit sanitary sewer connections was observed based on these data. Although illicit sources of pollution were included in the water quality model calibration exercises to accurately simulate the observed ambient bacteria concentrations, these sources were excluded from the baseline conditions, to reflect future corrected conditions.

- Interceptor Sediments – Sewer sediment levels determined through the post-cleaning inspections are included in the IW model.

- Combined Sewer Sediments – The IW models assume no sediment in upstream combined trunk sewers in accordance with BMP #2.

- WWTP Flow Maximization – In accordance with BMP #3, the plant treats wet weather flows up to 2xDDWF that are conveyed to the Hunts Point WWTP. DEP follows the wet weather operating plan and receives and treats 2xDDWF regularly. Cleaning of the interceptor sediments has increased the ability of the system to convey 2xDDWF to the treatment plant.

- Wet Weather Operation Plans (WWOP) – The Hunts Point WWOP (BMP #4) establishes procedures for pumping at the plant headworks to assure treatment of 2xDDWF.

6.1.d Elements of Facility Plan and GI Plan

The Westchester Creek LTCP includes the following grey projects recommended in the 2011 WWFP:

- Modifications to the regulator structures (CSO-29 and CSO-29A) that discharge to HP-014 to capture more frequent smaller storms without increasing flooding risk in the collection system.

- Construction of a parallel sewer from the regulator structure (CSO-24) that discharges to HP-013 and a new junction chamber at Cornell Avenue on White Plains Road to divert flow away from Pugsley Creek into the well-mixed Upper East River.

These capital projects were included in the 2012 CSO Order on Consent with construction completion milestones of December 2019 for both projects. Design of the CSO-29 and CSO-29A modifications were completed in June 2014; the parallel sewer is being designed by NYC Design and Construction (DDC) and is expected to be completed by June 2015.

As discussed in Section 5.0, the Westchester Creek watershed is one of the more promising areas for GI build-out in NYC. DEP has projected 14 percent level of GI implementation, which has been assumed in the baseline model.

6.1.e Non-CSO Discharges

In several sections of the Hunts Point WWTP drainage area, stormwater drains directly to receiving waters without entering the combined system or separate storm sewer system. These areas were depicted as “Direct Drainage” in Figure 2-6 (Section 2.0), and were delineated based on topography and the direction of stormwater runoff flow in those areas. In general, shoreline areas adjacent to waterbodies comprise the direct drainage category. However, these areas are comparatively small; of the 4,952 acres of drainage area tributary to Westchester and Pugsley Creeks, 86 percent (4,271 acres) is served by combined sewers. The remaining 14 percent is evenly divided between direct drainage (341 acres) and separately sewered stormwater outfalls (340 acres). Overall, the Hunts Point WWTP receives flow from 12,241 acres, of which 11,435 acres (93 percent) is served by combined sewers.

6.2 BASELINE CONDITIONS – PROJECTED CSO VOLUMES AND LOADINGS AFTER THE FACILITY PLAN AND GI PLAN

The IW model was used to develop CSO volumes for the baseline conditions. It incorporated the implementation of a 14-percent GI build-out and operation of the recommended Westchester Creek WWFP elements. Using these overflow volumes, pollutant loadings from the CSOs were generated using the enterococci, fecal coliform, and BOD concentrations and provided input to the receiving water quality model, ERTM. ERTM was assessed against 2014 monitoring data collected in Westchester Creek under LTCP as well as Harbor Survey data for the same period. The assessment consisted of comparing the cumulative frequency distribution of 2014 collected concentration data against the cumulative frequency distribution of the model for storms of similar sizes from the pre-WWFP simulation. The year 2014 was used as the sampling cut off point in order to provide enough time to process the samples, calibrate and run the model for alternatives analysis comparison included in the LTCP by the submission date.

In addition to CSO pollutant loadings, storm sewer discharges and direct drainage impact the water quality in Westchester Creek. The pollutant concentrations assigned to the various sources of pollution to Westchester Creek are summarized in Table 6-1. Concentrations in Table 6-1 represent concentrations considered typical of stormwater, highway runoff, direct drainage and sanitary sewage for the Westchester Creek drainage area. These values were used in the analysis since sampling data were not available when the modeling simulations were performed.

Table 6-1. Pollutant Concentrations for Various Sources in Westchester Creek

Pollutant Source	Enterococci (cfu/100mL)	Fecal Coliform (cfu/100mL)	BOD_5[1] (mg/L)
Stormwater[2]	50,000	120,000	15
Highway Runoff (HP-839)[4]	8,000	20,000	15
Direct Drainage[3]	6,000	4,000	15
Sanitary Sewage[5] (Used for Mass Balance CSOs)	400,000	2,200,000	110
HP-014 and HP-016	Monte Carlo	Monte Carlo	Mass Balance

Notes:

(1) 2011, 2012, 2013 DEP Process Control Hunts Point WWTP operational records.
(2) HydroQual Memo to DEP, 2005a.
(3) Basis – NYS Stormwater Manual, Charles River LTCP, National Stormwater Data Base for commercial and industrial land uses.
(4) Pitt, et al. (2004) and CH2MHill (1998).
(5) Measured maximum likelihood estimate (MLE) concentrations.

Baseline (2008) volumes of CSO, stormwater, highway runoff and direct drainage to Westchester Creek are summarized in Table 6-2. The specific SPDES permitted outfalls associated with these sources were shown in Figure 2-7. Additional tables can be found in Appendix A. The information in these tables is provided for the 2008 rainfall condition.

For the modeling simulations, CSO effluent concentrations were calculated using two methodologies. Outfalls HP-014 and HP-016 were sampled as part of the LTCP2 monitoring program. The sampling provided enough information to apply the Monte Carlo approach to calculate bacteria concentrations during overflow events. For the other CSOs where sampling was not conducted, the Mass Balance Approach was used to calculate bacteria concentrations. In the Mass Balance Approach, the stormwater and sanitary concentrations listed in Table 6-1 are multiplied by the flow calculated by the IW model. The model provides a calculated fraction of flow from stormwater and flow from sanitary sources so that the CSO concentration can be calculated as follows:

$$C_{cso} = fr_{san}*C_{san} + fr_{sw}*C_{sw}$$

where: C_{cso} = CSO concentration
C_{san} = sanitary concentration
C_{sw} = stormwater concentration
fr_{san} = fraction of flow that is sanitary
fr_{sw} = fraction of flow that is stormwater

For the CSOs where the Mass Balance Approach was used, the fraction of the overflow that was calculated by the IW model to be associated with sanitary sewage typically ranges from 3.8 percent (HP-015) to 14.3 percent, (HP-012) with the remainder being stormwater. The percentage of sanitary flow varies depending on the amount of stormwater necessary to cause a CSO event. For example, HP-015 does not overflow very often and requires a large amount of stormwater to cause an overflow. Thus, the sanitary fraction tends to be lower at this outfall than other outfalls. The mixture of sanitary and stormwater flows and the associated concentrations in Table 6-1 results in CSO concentrations for enterococci of 63,000 to 100,000 cfu/100mL, for fecal coliform of 199,000 to 417,000 cfu/100mL, and for BOD_5 of 19 to 29 mg/L. An example of the IW CSO concentration calculation for CSO enterococci concentration is presented below using sanitary and storm runoff concentrations from Table 6-1:

63,300 cfu/100mL* = 0.038 x 400,000 cfu/100mL + 0.962 x 50,000 cfu/100mL

Table 6-2 provides the total annual average source loadings calculated to be discharged in to Westchester Creek during a typical one-year period. Refer to Figure 2-7 for the location of the Westchester Creek SPDES permitted outfalls.

Table 6-2. Annual CSO, Stormwater, and Direct Drainage Volumes and Loads (2008 Rainfall)

Source	Volumetric Discharge (MG/yr)	Enterococci Load (cfu x 10^{12})	Fecal Coliform Load (org x 10^{12})	BOD Load (lbs)
CSO	290	1,131	4,511	71,876
Stormwater	106	203	488	12,931
Highway Runoff (HP-839)	55	17	42	6,714
Direct Drainage	164	40	27	21,013
Total	**615**	**1,391**	**5,068**	**112,534**

6.3 PERFORMANCE GAP

Concentrations of bacteria and DO in Westchester Creek are controlled by a number of factors, including the volumes of all sources of pollutants into the waterbodies and the concentrations of the respective pollutants. Since almost all of the flow and pollutant loads discharged into this waterbody are the result of runoff from rainfall events, the frequency, duration and amounts of rainfall strongly influence Westchester Creek's water quality. The Westchester Creek portion of the ERTM model was used to simulate bacteria and DO concentrations in the Creek for the baseline conditions using 2002-2011 rainfall and tidal data. Hourly model calculations were saved for post-processing and comparison with the existing, swimmable/fishable, and Potential Future Primary Contact WQ Criteria as further discussed below in Section 6.3.c. The performance gap was then developed as the difference between the model calculated baseline waterbody DO and bacteria concentrations and the applicable numerical WQS. Accordingly, the analysis is broken up into three sections:

- Existing WQ Criteria (Class I);
- Assessment of Westchester Creek compliance with the Primary Contact WQ Criteria (Class SC); and
- Potential Future Primary Contact WQ Criteria (2012 EPA RWQC).

Within these sections, analyses are developed to reflect the differences in attainment both spatially and temporally. The spatial assessment mainly focuses on the two different waterbodies under evaluation herein: inner Westchester Creek at Stations WC2, WC1 and WC3 and outer Westchester Creek, E13. However, as noted in the discussions that follow, there are calculated spatial differences in the projected attainment of water quality criteria with each of those areas. The temporal assessment basically focuses on compliance with the applicable water quality criteria over the entire year or in the case of bacteria, during the recreational season of May 1st through October 31st inclusive.

A summary of the criteria that were applied is shown in Table 6-3.

Table 6-3. Classifications and Criteria Applied for Gap Analysis

Analysis	Numerical Criteria Applied
Existing WQ Criteria	I: Fecal Monthly GM ≤ 2,000 DO never < 4.0 mg/L
Primary Contact WQ Criteria(1)	SC: Fecal Monthly GM≤200 DO daily average >= 4.8 mg/L; DO never < 3.0 mg/L
Potential Future Primary Contact WQ Criteria(2)	Entero: rolling 30-d GM – 30 cfu/100mL Entero: STV – 110 cfu/100mL

Notes:
GM = Geometric Mean; STV = 90 Percent Statistical Threshold Value
(1) This water quality standard is not currently assigned to Westchester Creek.
(2) The Potential Future Primary Contact WQ Criteria have not yet been adopted by DEC.

6.3.a CSO Volumes and Loadings Needed to Attain Current Water Quality Standards

2008 Rainfall Annual Simulation

Typical water quality model results are shown in Figures 6-1 through 6-4 for Westchester Creek (Stations WC2, WC1, WC3, E13), with 2008 rainfall and tidal conditions. As described in Section 2.0, Westchester Creek is currently designated as a Class I waterbody and has a fecal coliform criterion. Although evaluated in this section, the recreational season geometric mean (GM) enterococci criterion is currently not applicable to Westchester Creek. The panels in each figure show the Class I fecal coliform criterion of 2,000 org/100mL (dashed green line). The post-processed monthly GM water quality output lines are shown as solid black lines. As shown by the figures, the modeling results indicate that Westchester Creek fecal coliform concentrations are calculated to be in full attainment with the Existing WQ Criterion of a monthly GM of 2,000 org/100mL.

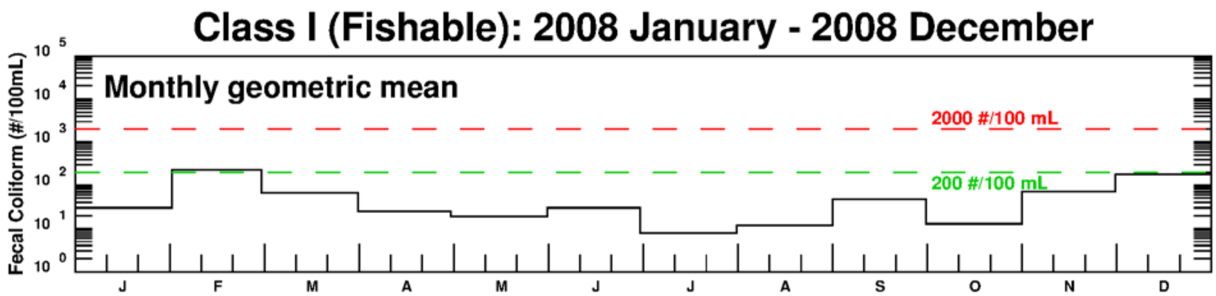

Figure 6-1. Calculated Baseline WC2 Fecal Coliform Concentration (2008 Rainfall)

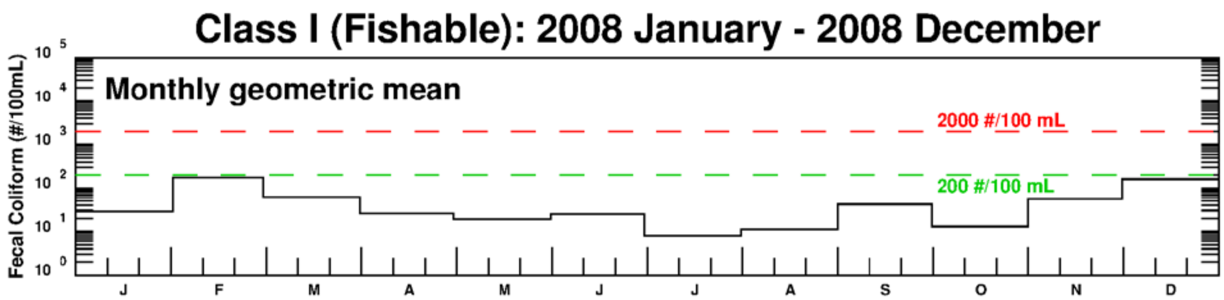

Figure 6-2. Calculated Baseline WC1 Fecal Coliform Concentration (2008 Rainfall)

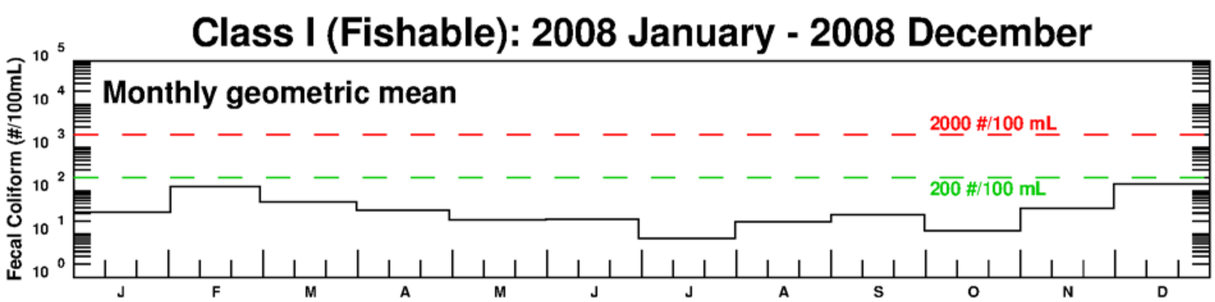

Figure 6-3. Calculated Baseline WC3 Fecal Coliform Concentration (2008 Rainfall)

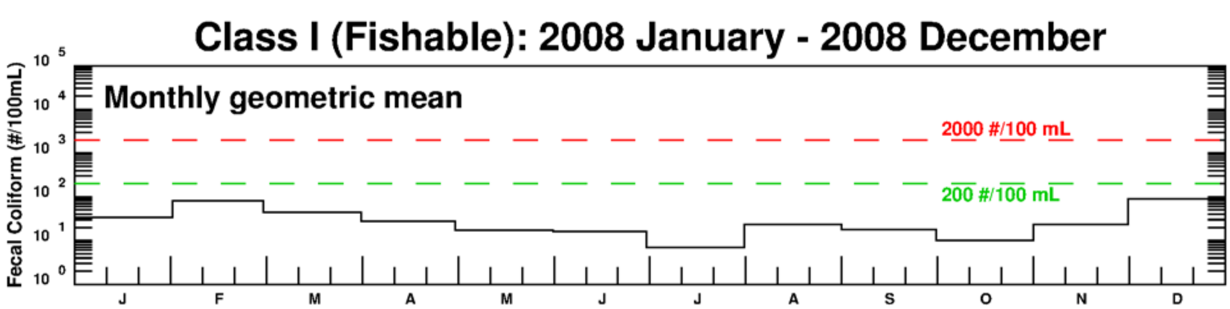

Figure 6-4. Calculated Baseline E13 Coliform Concentration (2008 Rainfall)

10-Year Long Term Simulation

A 10-year baseline simulation of bacteria water quality was also performed for the baseline loading conditions, to assess year-to-year variations in water quality. The results of these simulations are summarized in Table 6-4.

Table 6-4. Calculated 10-Year Baseline Fecal Coliform Attainment of Existing WQ Criteria (Class I) - Percent of Months in Attainment

Station	Projection Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Percent Attainment
WC2	100	100	100	100	100	100	100	100	100	100	100
WC1	100	100	100	100	100	100	100	100	100	100	100
WC2	100	100	100	100	100	100	100	100	100	100	100
E13	100	100	100	100	100	100	100	100	100	100	100

This table shows that the calculated 10-year long term attainment of the existing fecal coliform criterion under baseline conditions are in full attainment annually with the Existing WQ Criterion of a monthly GM of 2,000 org/100mL. As noted in the table, fecal coliform concentrations are calculated to be in attainment 100 percent of the time at all locations for each of the 10 years within the simulation period. It should be noted that because the waterbody is classified for secondary contact recreation, there is no enterococci limit for the Existing WQ Criteria. Because the model results for the 10-year baseline period indicate that Westchester Creek would meet the Existing WQ Criteria, there is no performance gap for bacteria based on the currently applicable bacteria criterion.

2008 Rainfall Annual Simulation – Dissolved Oxygen

Water quality model simulation of DO concentrations and measures of attainment with the numerical WQS are presented in Table 6-5. Water quality calculations indicate that the overall annual attainment of the Class I criterion of 4 mg/L is 80 percent for the year at the head end of the Creek. Even though there are excursions below the DO criteria in a few summer months, DO concentrations were calculated to be in attainment with the WQS a high percent of the time. As noted in Table 6-5, annual DO attainment is calculated to be between 97 and 99 percent, in the area of the Creek downstream of the head end.

Table 6-5. Model Calculated DO Attainment (2008)

Station	Annual Attainment (%)
WC2	80
WC1	97
WC3	99
E13	99

6.3.b CSO Volumes and Loadings that would be Needed to Support the Next Highest Use or Swimmable/Fishable Uses

Bacteria

The DEC is required to periodically review whether a waterbody can be reclassified to its next higher classification. This LTCP assessed the level of attainment for Westchester Creek, which is a Class I waterbody, if DEC were to reclassify it to Class SC (limited primary contact recreation).

Model calculations presented in Figures 6-1 through 6-3 show that Westchester Creek at Stations WC2, WC1, and WC3 would not be expected to meet the Class SC fecal coliform criteria during certain non-recreational months (February and December) for the 2008 rainfall condition. Table 6-6 presents the calculated compliance with the 200 cfu/100mL fecal coliform criterion for Class SC waters at the head end of Westchester Creek (Station WC2). As noted in the table, attainment is calculated to be less than 100 percent on an annual basis. At Station WC2, the annual attainment for the 10-year baseline period is calculated to be 93 percent. Attainment at the other sampling locations is higher.

Table 6-6. Calculated 10-Year Baseline Fecal Coliform Attainment of Class SC Criterion - Percent of Months in Attainment – Location WC2

Year	Annual Attainment (%)		Recreational Season Attainment (%)	
	Baseline	100% CSO Control	Baseline	100% CSO Control
2002	100	100	100	100
2003	92	100	83	100
2004	100	100	100	100
2005	92	100	100	100
2006	92	100	100	100
2007	92	100	100	100
2008	92	100	100	100
2009	83	100	83	100
2010	92	100	100	100
2011	92	100	83	100
10-year average	**93**	**100**	**95**	**100**

In addition, Table 6-6 provides a summary of the calculated fecal coliform compliance with the SC criterion during the recreational season (May 1st through October 31st). As shown in this table, fecal coliform bacteria are calculated to be in attainment during the recreational months a high percentage of the time (95 percent) for the baseline conditions for Station WC2. 100 percent CSO control improves attainment during both the recreational season and annually to 100 percent. Essentially, this analysis shows that, after completion of the grey and green projects included in the baseline condition, there is no gap between the baseline condition and the primary contact recreation criterion for fecal coliform.

Dissolved Oxygen

Upgrading Westchester Creek to Class SC would require that it meet the marine dissolved oxygen (DO) criterion of a daily average DO concentration of greater than or equal to 4.8 mg/L, with some allowance for excursions based on the DO exposure-duration curve, as well as an acute criterion of never less than 3.0 mg/L. Table 6-7 presents the annual attainment with the Class SC DO criteria at Station WC2, the location calculated to have the lowest DO concentrations. Attainment of the chronic criterion would be 71 percent measured over the year.

Table 6-7. Model Calculated DO Results for Class SC Criterion at WC2 – Baseline and 100 Percent CSO Control Conditions

Station	Annual Attainment (%)	
	Chronic	Acute
Baseline	71	89
100 Percent CSO Control	88	98

The 100 percent CSO control scenario was evaluated to assess the impact of CSO discharges on non-attainment of the DO criteria, or the gap between attainment and non-attainment caused by CSO discharges. The attainment of the Class SC criteria for DO at Station WC2 with 100 percent CSO control is also presented in Table 6-7. The annual attainment of the chronic criterion would increase from 71 percent to 88 percent. This scenario suggests that complete control of the CSO input into Westchester Creek would not be sufficient for it to meet the Class SC criteria for DO.

6.3.c Potential Future Primary Contact WQ Criteria

As noted in Section 2.0, EPA released its RWQC recommendations in December 2012. These included recommendations for recreational water quality criteria for protecting human health in all coastal and non-coastal waters designated for primary contact recreation use. The standards would include a rolling 30-day GM of either 30 cfu/100mL or 35 cfu/100mL, and a 90th percentile statistical threshold value (STV) during the rolling 30-day period of either 110 cfu/100mL or 130 cfu/100mL. An analysis of the 10-year baseline and 100 percent CSO control conditions model simulation results was conducted using the 30 cfu/100mL GM and 110 cfu/100mL 90th percentile criteria to assess attainment with these Potential Future Primary Contact WQ Criteria, which is the more stringent option presented by the 2012 EPA Recommended Recreational Water Quality Criteria.

10-Year Long Term Simulation

Table 6-8 presents the 10-year recreational season attainment of the Potential Future Primary Contact WQ Criteria of enterococci for the baseline and 100 percent CSO control scenarios. Comparison between the baseline and 100 percent CSO scenarios resulted in some improvements at Station WC2 with compliance increasing 13 percentage points, from 84 percent to 97 percent as measured against a GM of 30 cfu/100mL. Stations WC1, WC3 and E13 have lower increases in attainment for the 30-day rolling GM.

Attainment of the 90th percentile STV (<30 cfu/100mL) criteria would remain relatively low at all locations, regardless of whether CSOs are completely controlled or not.

Table 6-8. Recreational Season Attainment with Potential Future Primary Contact WQ Criteria with 2012 EPA RWQC for Enterococci

Station	Enterococci Attainment			
	Baseline		100 Percent CSO Control	
	30-day rolling GM	90th percentile	30-day rolling GM	90th percentile
	≤30 cfu/100mL	≤110 cfu/100mL	≤30 cfu/100mL	≤110 cfu/100mL
WC2	84	21	97	52
WC1	88	23	97	59
WC3	93	32	97	51
E13	98	67	98	72

These analyses indicate that complete removal of CSOs alone will not close the gap between the predicted baseline fecal coliform and Class SC criterion or the enterococci concentrations and the Potential Future Primary Contact WQ Criteria rolling 30-day 90th percentile criterion of 110 cfu/100mL to achieve 100 percent annual attainment.

6.3.d CSO Volumes and Loadings Needed to Attain Potential Future Primary Contact WQ Criteria

Additional water quality modeling analyses were performed to assess the extent to which CSO and non-CSO sources impact enterococci concentrations at key locations in Westchester Creek. A load source component analysis was conducted for the 2008 baseline condition, to provide a better understanding of how each source type contributes to bacteria concentrations in Westchester Creek. The source types include the East River at the mouth of Westchester Creek, stormwater (including highway runoff and direct drainage), and CSOs. The analysis was completed at Stations WC2, WC1, WC3, and E13 using the ERTM model. The analysis included the calculation of fecal coliform and enterococci GM in total and from each component. For fecal coliform, a maximum winter month was analyzed because the decay rate is lower in winter, resulting in generally higher fecal coliform concentrations, and a maximum summer month was selected in consideration of use impact during the recreational season (May 1st through October 31st). Enterococci were evaluated on both an annual and recreational season basis. The calculated values can then be compared to applicable numeric criteria to determine the relative contribution of a component to non-attainment of those criteria.

Table 6-9 summarizes the fecal coliform component analysis for 2008 conditions. In comparison with the Class SC fecal coliform concentration of 200 org/100mL, recreational season attainment occurs at all four stations and the only exceedances of this criterion occur in the non-recreational season (November 1st through April 30th), at Station WC2. Control of the CSOs could results in 100 percent attainment of the Class SC criterion.

Table 6-9. 2008 Fecal Coliform GM Source Components

Source	Station	Fecal Coliform Contribution, cfu/100mL	
		Recreational Season GM	Maximum Winter Month
East River	WC2	2	11
Stormwater	WC2	7	100
CSO	WC2	9	120
Total	**WC2**	**18**	**231**
East River	WC1	3	25
Stormwater	WC1	6	69
CSO	WC1	8	83
Total	**WC1**	**17**	**177**
East River	WC3	7	55
Stormwater	WC3	6	43
CSO	WC3	4	29
Total	**WC3**	**17**	**127**
East River	E13	13	78
Stormwater	E13	1	2
CSO	E13	0	0
Total	**E13**	**14**	**80**

Table 6-10 summarizes the enterococci component analysis. The maximum 30-day GM concentrations are calculated to exceed the 30 cfu/100mL criterion at locations within the Creek on an annual basis and at Station WC2 during the recreational season under 2008 conditions. The 30-day GM maximum concentration attributable to CSO sources, during the recreational season is calculated to be 17 cfu/100mL at Station WC2, which is less than 30 cfu/100mL, suggesting that CSO by itself would not have the potential to exceed the criterion. As this concentration is less than 30 cfu/100mL, CSO alone would not cause an excursion of 30 cfu/100mL during the recreational season. However, complete control of CSOs could result in attainment of the 30-day rolling GM of 30 cfu/100mL during the recreational season for 2008 conditions.

Table 6-10. 2008 Enterococci GM Source Components

Source	Station	Enterococci Contribution, 30-day Max GM, cfu/100mL	
		Annual	Recreational Season
East River	WC2	5	2
Stormwater, Highway Runoff, Direct Drainage	WC2	63	13
CSO	WC2	37	17
Total	**WC2**	**105**	**32**
East River	WC1	10	3
Stormwater, Highway Runoff, Direct Drainage	WC1	45	10
CSO	WC1	28	15
Total	**WC1**	**83**	**28**
East River	WC3	22	7
Stormwater, Highway Runoff, Direct Drainage	WC3	24	8
CSO	WC3	13	4
Total	**WC3**	**58**	**20**
East River	E13	31	13
Stormwater, Highway Runoff, Direct Drainage	E13	1	0
CSO	E13	0	1
Total	**E13**	**32**	**14**

CSO Contribution to Non-Attainment

Table 6-9 and Table 6-10 also indicate that CSO impacts to attainment are limited to the upper portions of Westchester Creek, although the CSO contribution varies both spatially and temporally at those locations. This LTCP identifies the alternatives focusing on reduction of the remaining CSO discharges to Westchester Creek.

6.3.e Time to Recover

Another analysis that consisted of examining the calculated hourly fecal coliform and enterococci water quality model simulation results was performed to gain additional insight with respect to the impacts of CSO and non-CSO sources on Westchester Creek water quality. Analyses provided above examine the longer term impacts of wet weather sources, as required by existing and potential future primary contact bacteria criteria (monthly GM and 30-day GM). Shorter term impacts are not brought out through these regulatory measures. To gain insight to the shorter term impacts of wet weather sources of bacteria, DEP has reviewed the New York State Department of Health (NYSDOH) guidelines relative to single sample maximum bacteria concentrations that they believe "constitute a potential hazard to health if used for bathing". The presumption being that if the bacteria concentrations are lower than these levels, then the waterbodies do not pose potential hazards if primary contact is practiced.

Fecal coliform concentrations that exceed 1,000 cfu/100mL, and or enterococci concentrations exceeding 104 cfu/100mL, are considered potential hazards by the NYSDOH. Water quality modeling analyses were conducted herein to assess the amount of time following the end of rainfall required for the outer portion of Westchester Creek to recover and return to concentrations less than 1,000 cfu/100mL fecal coliform.

> **FROM NYS DOH**
>
> **HTTPS://WWW.HEALTH.NY.GOV/REGULATIONS/NYCRR/TITLE_10/PART_6/SUBPART_6-2.HTM**
>
> **OPERATION AND SUPERVISION**
>
> 6-2.15 Water quality monitoring
> (a) No bathing beach shall be maintained … to constitute a potential hazard to health if used for bathing. To determine if the water quality constitutes a potential hazard … shall consider one or a combination of any of the following items: results of a sanitary survey; historical water quality model for rainfall and other factors; verified spill or discharge of contaminants affecting the bathing area; and water quality indicator levels specified in this section.
>
> (1) Based on a single sample, the upper value for the density of bacteria shall be: (i) 1,000 fecal coliform bacteria per 100 ml; or …(iii) 104 enterococci per 100 ml for marine water; ….

The process began with an analysis of the LaGuardia Airport rainfall data for the period of 2002-2011. The SYNOP model was used to identify each individual storm and calculate the storm volume, duration and start and end times. Rainfall periods separated by four hours or more were considered separate storms. Statistical analysis of the individual rainfall events for the recreational seasons of the 10-year period resulted in a 90th percentile rainfall event of 1.09 in. Based on this information, a storm approximating the 90th percentile storm was chosen from the 2008 recreational period as a design storm. This design storm was the August 14-15, 2008 JFK rainfall event, which resulted in 1.02 inches of precipitation. A principal feature of this storm, aside from its volume, was that the time until the next rainfall allows concentrations time to reach the fecal coliform target concentration.

Table 6-11 presents the recovery time for the baseline condition and the 100 percent CSO control scenario. Under the baseline conditions, Station WC2 has a recovery time of 43 hours. DEC has indicated that it is desirable to have a recovery time of less than 24 hours. The other stations in Westchester Creek have recovery times ranging between 24 and 36 hours. Station E13, in the East River, was not calculated to have a concentration greater than 1,000 cfu/100mL during the period after this precipitation event; thus, there is not time to recover. Once the CSO loading is completely removed, the maximum recovery time is 2 hours, at Station WC3, so Westchester Creek would be expected to have recovery times less than 24 hours for a storm of this magnitude. In the case of time to recovery, the gap between the existing recovery time and the desired recovery time can be achieved with complete CSO controls.

Table 6-11 Time to Recovery

Station	Time to Recovery (hours)	
	Fecal Coliform Threshold (1000 cfu/100mL)	
	Baseline	100% CSO Control
WC2	43	-
WC1	36	-
WC3	24	2
E13	0	-

ATTACHMENT 3

Revised Section 8.0 - Evaluation of Alternatives

8.0 EVALUATION OF ALTERNATIVES

This section of the Long Term Control Plan (LTCP) describes the development and evaluation of combined sewer overflow (CSO) control measures and watershed-wide alternatives. A CSO control measure is defined as a technology (e.g., treatment or storage), practice (e.g., NMC or BMP), or other method (e.g., source control or green infrastructure [GI]) capable of abating CSO discharges or the effects of such discharges on the environment. Alternatives evaluated herein are comprised of a single CSO control measure or a group of control measures that will collectively address the water quality objectives for Westchester Creek.

This section contains the following information:

- Process for developing and evaluating CSO control alternatives that reduce CSO discharges and improve water quality (Section 8.1).
- CSO control alternatives and their evaluation (Section 8.2).
- CSO reductions and water quality benefits achieved by the higher-ranked alternatives as well as their estimated costs (Sections 8.3 and 8.4).
- Cost-performance and water quality attainment assessment for the higher-ranked alternatives to select the preferred alternative (Section 8.5).

8.1 CONSIDERATIONS FOR LTCP ALTERNATIVES UNDER THE FEDERAL CSO POLICY

This LTCP addresses the water quality objectives of the Federal Clean Water Act (CWA) and Federal U.S. Environmental Protection Agency (EPA) CSO Control Policy and the New York State (NYS) Environmental Conservation Law. It builds upon the EPA Nine Minimum Controls (NMC), CSO Control Policy, as well as the conclusions presented in New York City Department of Environmental Protection's (DEP) June 2011 Waterbody/Watershed Facility Plan (WWFP). As required by the CSO Control Policy and the 2012 CSO Order on Consent, since the proposed alternative set forth in this LTCP will not (and cannot) achieve existing water quality (WQ) criteria or the Section 101(a)(2) goals, it includes a Use Attainability Analysis (UAA) to examine whether applicable waterbody classifications, criteria, or standards should be adjusted by the State. The UAA assesses compliance with applicable and the waterbody's next higher classification.

The remainder of Section 8.1 discusses the development and evaluation of CSO control measures and watershed-wide alternatives to comply with the CWA in general, and with the CSO Control Policy in particular. The evaluation factors considered for each alternative are described, followed by the process for evaluating and ranking the alternatives.

8.1.a Performance

Section 6.0 presented evaluations of baseline LTCP conditions and concluded that there are no performance gaps because baseline conditions attain the current Class I bacteria criterion. Also, Westchester Creek approaches, but does not fully attain, the Primary Contact WQ Criteria water quality classification (SC) for contact recreation even with complete CSO removal, due to limited tidal exchange and flushing, particularly at upstream locations, input from East River, and the presence of non-CSO sources of bacteria. Therefore, discussion of performance for Westchester Creek alternatives will focus on bacteria criteria for both Existing WQ Criteria (Class I), Primary Contact WQ Criteria (Class SC) and Potential Future Primary Contact WQ Criteria (2012 EPA RWQC).

During the development of control alternatives, DEP examined performance more closely to evaluate water quality standards (WQS) attainment. This was a two-step process that, based on the InfoWorks CS^{TM} (IW) and water quality model runs with typical year rainfall, established the level of CSO control of each alternative, including CSO volume, fecal coliform and enterococci loading reduction. The second step used the previously estimated levels of CSO control to project levels of attainment beyond baseline conditions. LTCPs are typically developed with alternatives that span a range of CSO volumetric reductions. Accordingly, this LTCP includes alternatives that consider zero and 100 percent reductions in CSO volume as the two extremes. Intermediate levels of CSO volume control, around 25, 50 and 75 percent, are also evaluated. However, for some alternative control measures, such as disinfection, there would be no reduction in CSO volume, but a reduction in bacteria loading instead. Performance of each control alternative is measured against its ability to meet the CWA and water quality requirements for the 2040 planning horizon.

8.1.b Impact on Sensitive Areas

During the development of alternatives, special consideration was made to minimize the impact of construction, to protect existing sensitive areas, and to enhance water quality in sensitive areas. As described in Section 2.0, there are no sensitive areas within Westchester Creek.

8.1.c Cost

Cost estimates for the alternatives were computed using a costing tool based on parametric costing data. This approach provides an Association for the Advancement of Cost Engineering (AACE) Class 5 estimate (accuracy range of minus 20 to 50 percent to plus 30 to 100 percent), which is typical and appropriate for this type of planning evaluation. For the purpose of this LTCP, all costs are in June 2014 dollars.

For the LTCP alternatives, Probable Bid Cost (PBC) was used as the estimate of the capital cost. Annual operation and maintenance (O&M) costs are then used to calculate the total or Net Present Worth (NPW) over the projected useful life of the project. For the purpose of this LTCP, a lifecycle of 20 years and an interest rate of 3 percent were used resulting in a Present Worth Factor of 14.877.

To quantify costs and benefits, alternatives are compared based on reductions of both CSO discharge volume and bacteria loading against the total cost of the alternative. These costs are then used to plot the performance and attainment curves. Should a pronounced inflection point appear in the resulting graphs, a so-called knee-of-the-curve (KOTC), it would designate a potential cost-effective alternative for further consideration. In essence, this would reflect the alternative that achieves the greatest appreciable water quality improvements per unit of cost. However, this may not necessarily be the lowest cost alternative.

The final recommended alternative must be capable of attaining water quality in a fiscally responsible and affordable manner to ensure that resources are properly allocated across the overall Citywide LTCP program. These monetary considerations also must be balanced with non-monetary factors such as technical feasibility and operability, which are discussed below.

8.1.d Technical Feasibility

Several factors were considered when evaluating technical feasibility, including:

- Effectiveness for controlling CSO
- Reliability
- Implementation

The effectiveness of CSO control measures was assessed based on their ability to reduce CSO frequency, volume, and pollutant load. Reliability is an important operational consideration, and can have an impact on overall effectiveness of a control measure. Therefore, reliability and proven history were used to assess the technical feasibility and cost-effectiveness of a control measure.

Several site-specific factors were considered when evaluating an alternative’s technical feasibility including available space, neighborhood assimilation, impact on parks and green space, and overall practicability of installing the CSO control. In addition, the method of construction was factored into the final selection. Some technologies require specialized construction methods that typically incur additional costs.

8.1.e Cost-Effective Expansion

All alternatives evaluated were sized to handle the 2040 design year CSO volume, with the understanding that the predicted and actual flows may differ. To help mitigate the difference between predicted and actual flows, adaptive management was considered for those CSO technologies that can be expanded in the future to capture additional CSO flows or volumes, should it be needed. In some cases, this may have affected where the facility would be constructed, or gave preference to a facility that could be expanded at a later date with minimal cost and disruption of operation.

Breaking construction into segments allowed adjustment of the design of future phases based on the performance of already-constructed phases. Lessons learned during operation of the current facilities can be incorporated into the design of the future facilities. However, phased construction also exposes the local community to a longer construction period. For those alternatives that can be expanded, the LTCP discusses how easily they can be expanded, what additional infrastructure may be required, and if additional land acquisition would be needed.

As regulatory requirements change, for example, the need for improvements in nutrient removal or disinfection could arise. The ability of a CSO control technology to be retrofitted to handle process improvements improved the rating of that technology.

8.1.f Long Term Phased Implementation

The final recommended plan is structured in a way that makes it adaptable to change via expansion and modifications in response to new regulatory and/or local drivers. If applicable, the project(s) would be implemented over a multi-year schedule. Because of this, permitting and approval requirements have to be identified prior to selection of the alternative. These were identified along with permit schedules where appropriate. With the exception of GI, which is assumed to occur on both private and public property, most if not all of the CSO grey technologies are limited to City-owned property and right-of-way-acquisitions. DEP will work closely with other City agencies, and possibly NYS, to ensure proper coordination with these other agencies.

8.1.g Other Environmental Considerations

Impacts on the environment and surrounding neighborhood will be minimized as much as possible during construction. These considerations include traffic impacts, site access issues, park and wetland disruption, noise pollution, air quality, and odor emissions. To ensure that environmental impacts are minimized, they will be identified with the selection of the recommended plan and communicated to the public. Any identified potential concerns will be addressed in a pre-construction environmental assessment.

8.1.h Community Acceptance

As described in Section 7.0, DEP is committed to involving the public, regulators and other stakeholders throughout the planning process. The scope of the LTCP, background and newly collected data, WQS and the development and evaluation of alternatives were presented. Community acceptance of the recommended plan is essential to its success. The Westchester Creek LTCP is intended to improve water quality. The public's health and safety are a priority of the Plan. Raising awareness of and access to waterbodies is a goal for DEP and was considered during the alternative analysis. Several CSO control measures, such as GI, have been shown to enhance communities while increasing local property values and, as such, the benefits of GI were considered in the formation of the final recommended plan.

8.1.i Methodology for Ranking Alternatives

In developing the Westchester Creek LTCP, DEP employed a multi-step process to evaluate control measures and alternatives. These steps included:

1. Evaluating benchmarking scenarios, including baseline and 100 percent CSO control, to establish the range of control within the Westchester Creek watershed. The results of this step were described in Section 6.0.

2. Using baseline conditions prioritized the CSO outfalls for possible controls.

3. Developing a list of promising control measures for further evaluation based in part on the prioritized CSO list.

4. Conducting a "brainstorming" workshop on March 20, 2014, to review the most promising control measures and to solicit additional ideas to explore.

5. Establishing three levels of intermediate CSO control between baseline and 100 percent CSO removal for which receiving water quality simulations were conducted.

6. Evaluating alternatives according to the previously described LTCP criteria and the predicted (modeled) water quality benefits of each alternative.

7. Conducting a second LTCP workshop on April 29, 2014, which evaluated the water quality benefits, costs, and fatal flaws of the alternatives under consideration.

The focal points of this process were the two workshops listed above. Prior to the first workshop, the universe of control measures that were evaluated in the 2011 WWFP were revisited from the perspective of the LTCP Goal Statement and in light of the proposed WWFP projects: Pugsley sewer and CSO regulator 29/29A modifications. The resultant control measures were introduced at the first workshop where DEP operational and engineering staff applied their expertise for further analysis. A preliminary evaluation of these control measures was then conducted including an initial estimation of costs. The results of these evaluations became the topic of the second workshop which included a fatal-flaw analysis.

The range of the control measures that were considered included a variety of storage and conveyance improvement measures, including:

- In-line Storage at HP-014
- Disinfection and In-Line Storage at HP-014
- Throgs Neck Pump Station (PS) Enhancement
- Storage Tanks, Shafts or Tunnels
- Floatables Control
- Bronx River Siphon Enhancements
- Additional GI Build-out
- High level Sewer Separation
- Dredging

All but dredging advanced to the next level of evaluation. Dredging was eliminated from further consideration because the DEP dredging program has targeted exposed CSO sediment mounds. No such mounds were evident at the head end of Westchester Creek, even during a monthly low tide, as depicted in Figure 8-1, captured on April 1, 2015 at 5:26 PM. Further, the area that would be targeted for dredging near the CSO outfall would not have provided navigational benefit to the stakeholders who originally requested that DEP investigate this measure.

Figure 8-1. Head End of Westchester Creek at Low Tide
(April 1, 2015 at 5:26 PM)

The evaluation of these retained control measures is described in Section 8.2.

8.2 MATRIX OF POTENTIAL CSO REDUCTION ALTERNATIVES TO CLOSE PERFORMANCE GAP FROM BASELINE

Each control measure was initially evaluated on three of the key considerations described in Section 8.1. These include: (1) benefits, as expressed by level of CSO control and attainment; (2) costs; and (3) challenges, such as siting and operations. Using this methodology, the control measures listed in Section 8.1 were evaluated on a cost-performance basis and used to develop the basin-wide alternatives.

Following the LTCP outline, these control measures are described under the following categories: Other Future Grey Infrastructure, Other Future Green Infrastructure and Hybrid Green/Grey Alternatives, and subsets thereof. It should be noted that not all of the categories in the LTCP outline were applicable to Westchester Creek as will become evident in the subsequent discussions.

8.2.a Other Future Grey Infrastructure

For the purpose of this LTCP, "Other Future Grey Infrastructure" refers to potential grey infrastructure beyond existing control measures implemented based on previous planning documents. "Grey infrastructure" refers to systems used to control, reduce or eliminate discharges from CSOs. These are the technologies that have been traditionally employed by DEP and other wastewater utilities in their CSO planning and implementation programs, and includes retention tanks, tunnels and treatment facilities, including satellite facilities; and other similar capital-intensive facilities. Grey infrastructure implemented under previous CSO control programs and facility plans, such as the 2011 WWFP, is described in Section 4.0 and includes the Pugsley Creek Parallel Sewer and Weir Modifications to CSO Regulators 029 and 029A. When completed in 2019, these are predicted to provide a significant (64 percent) reduction in CSO volume.

8.2.a.1 High Level Sewer Separation

High Level Sewer Separation (HLSS), also referred to as High Level Storm Sewers, is a form of partial separation that separates the combined sewers only in the streets or other public rights-of way, while leaving roof leaders or other building connections unaltered. In New York City (NYC), this is typically accomplished by constructing a new stormwater system and directing flow from street inlets and catch basins to the new storm sewers. Challenges associated with HLSS include constructing new sewers with minimal disruption to the neighborhoods along the proposed alignment and finding a viable location for any necessary new stormwater outfalls. Separation of sewers minimizes the amount of sanitary wastewater being discharged to receiving waters, but also results in increased separate stormwater discharges (which also carry pollutants) to receiving waters.

HLSS was considered in the WWFP. However, the heightened concern of the additional and more frequent pollution loadings that would result from the new stormwater discharges resulted in the control measure to be dismissed. Typically, DEP implements HLSS projects to control localized flooding. DEP does not have any HLSS projects planned for the watershed.

8.2.a.2 Sewer Enhancements

Sewer enhancements, also known as system optimization, aim to reduce CSO through improved operating procedures or modifications to the existing collection system infrastructure. Examples include control gate modifications, regulator or weir modifications, inflatable dams and real time control (RTC) or increasing the capacity of select conveyance system components including gravity lines, pump stations and/or force mains. Also, force main relocation would fall under this category. These control measures generally retain more of the combined sewage within the collection system during storm events. The benefits of retaining this additional volume must be balanced against the potential for sewer back-ups and flooding, or the relocation of the CSO discharge elsewhere in the watershed or an adjacent watershed. Viability of these control measures is system-specific, depending on existing physical parameters such as pipeline diameter, length, slope and elevation.

Throgs Neck PS Enhancements

The most promising sewer enhancement concept for Westchester Creek revolves around the Throgs Neck PS. Initially evaluated under the WWFP, this control measure was further evaluated as part of this LTCP development as described below.

A variety of scenarios involving increases in the capacity of the PS and relocation of the force main (FM) were evaluated. According to the IW modeling, the most valuable concept was retaining the current PS's 37.5 million gallons per day (MGD) wet weather pumping capacity but extending the FM to the Hunts Point Wastewater Treatment Plant (WWTP) This scenario also did not cause displacement of CSOs to other outfalls and resulted in a net positive reduction within the entire Hunts Point WWTP tributary area. This control measure is illustrated in Figure 8-2 and described below.

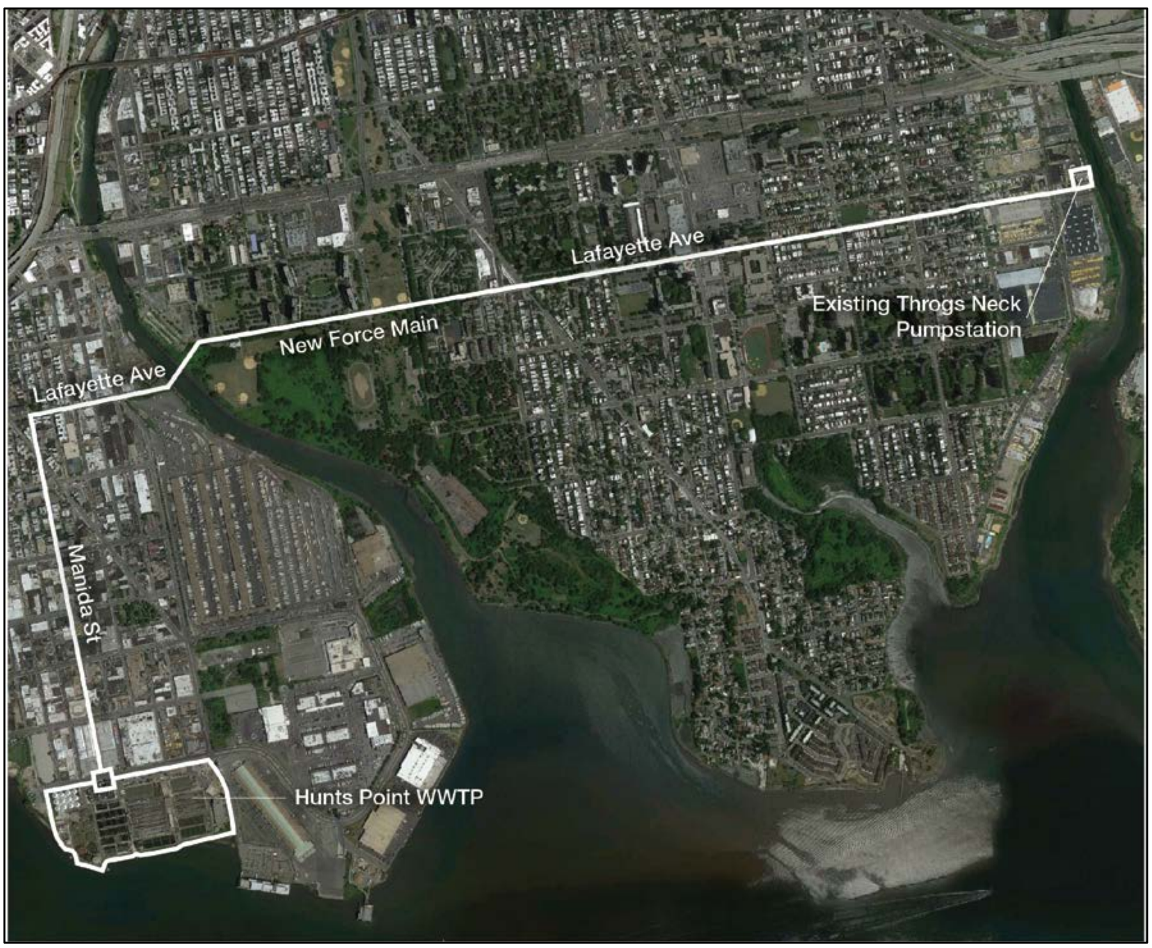

Figure 8-2. Proposed Route of Throgs Neck PS FM Extension to Hunts Point WWTP

A summary of the benefits, costs and challenges associated with this control measure include:

Benefits

There are two primary benefits associated with this control measure. First it reduces the CSO volume by 15 percent. Secondly, it builds on and expands upon existing grey infrastructure, thus saving cost.

Cost

The estimated NPW for this control measure is $137M. The development of this cost estimate is presented in Section 8.3.

Challenges

The major challenge associated with this control measure is the routing of the required 3.13-mile long, 42-inch diameter FM and the disruption that would occur during construction.

Bronx River Siphon Enhancements

Another promising sewer enhancement concept is to expand the capacity of the Bronx River Siphon to increase conveyance to the WWTP from the eastern portion of the service area, including the Westchester Creek watershed. An initial screening of the control measure was performed by adding a third 84-inch barrel to the existing 630-foot long, 84-inch double barrel siphon. According to the IW modeling, this control strategy did not benefit Westchester Creek in terms of CSO reduction; however, a net reduction of 46 MG of CSO was realized along the East River and the Bronx River. A summary of the benefits, costs and challenges associated with this control measure include:

Benefits

The primary benefit associated with this control measure is a 35 MG reduction in CSO from Outfall HP-011, with an additional CSO volume reduction of 8 MG spread across several Bronx River outfalls.

Cost

The estimated NPW for this control measure is $38M. The development of this cost estimate is presented in Section 8.3.

Challenges

Siphons in general are prone to clogging, and because of the drop shafts on either side of the siphon, they tend to be difficult to maintain, either because of dewatering requirements or because of difficulties in controlling remote detection and repair equipment. A specific challenge associated with adding a third barrel would be tunneling beneath the Bronx River without damaging the existing pipes and aligning the additional barrel with the existing pipes so that flow is distributed appropriately across all conveyances.

Although there is no benefit to CSO reduction in Westchester Creek, this control measure could reduce CSO from HP-011 on the East River, which is expected to experience an increase in CSO volume upon implementation of the recommended Westchester Creek WWFP elements. However, because this outfall is part of the Hunts Point WWTP service area, the specific analysis of the most appropriate technologies will be deferred to the Bronx River LTCP, one of the other waterbodies whose drainage area is served by the Hunts Point WWTP.

8.2.a.3 Retention/Treatment Alternatives

There were a number of the control measures considered for Westchester Creek that fall under this category. For the purposes of this LTCP, the term storage is used in lieu of retention. This includes in-line storage and deep tunnel storage. The only treatment technology being considered for this LTCP is disinfection. Each is described below.

Retention Alternatives – In-line Storage

In-line storage is typically used when existing conveyance elements can be retrofitted to provide cost-effective storage and resultant CSO volume reduction. Modifications to the existing system need to be made in order to realize the addition storage capacity in the form of bending weirs, inflatable dams or fixed weirs. In Westchester Creek, evaluations revealed that the HP-014 outfall sewer was the most conducive site for in-line storage. The storage capacity that would be realized was estimated at 5.9 MG. It was also determined that, due to the tidal influences, a fixed weir would be the most suitable modification.

Like all storage facilities, this in-line tank would need to have suitable access locations in order to periodically wash down and remove settled solids and debris that would accumulate in the tank. Also, due to hydraulic limitations, a PS would be required to dewater the tank following the event. Finally, an odor control system would also be needed to prevent unwanted odors emanating from the facility.

There are a number of challenges that this in-line storage concept presents. Most important of these are siting the access hatches and the dewatering pump station and odor control facility. As shown in Figure 8-3, the in-line storage facility would be located below a New York Transit Authority (NYTA) rail yard.

A summary of the benefits, costs and challenges associated with in-line storage include:

<u>Benefits</u>

There are two primary benefits associated with this control measure. First it reduces the CSO volume by 23 percent. Secondly, it would build on and expand existing grey infrastructure.

<u>Cost</u>

The estimated NPW for this control measure is $26M. The development of this cost estimate is presented in Section 8.3.

<u>Challenges</u>

As noted above, siting of the access hatches and the ancillary facilities within the NYTA rail yard that are needed to make this control measure viable, the dewatering PS and odor control system, present a major challenge to its implementation. Also, the physical condition of the outfall sewers would need to be evaluated.

Figure 8-3. Layout of In-line Storage at Outfall HP-014

Retention Alternatives - General

Due to the limited availability of suitable sites within the Westchester Creek watershed, storage shafts and deep storage tunnels were selected as the most viable type of off-line storage control measure for Westchester Creek. Each is described as follows.

Retention Alternatives - Deep Tunnels

Unlike traditional tank storage, tunnel storage requires less permanent above ground property per equivalent unit storage volume. Tunnel construction involves the boring of linear storage conduits deep in the ground and typically in bedrock. Shafts are required in both the initial construction as well as during its operation. A dewatering pump station and odor control systems are also included with such facilities.

For the purpose of the Westchester Creek LTCP, tunnel storage was evaluated to accomplish a range of CSO volume controls including 44, 77 and 100 percent. The 44 percent tunnel concept would capture 100 percent of the CSO discharges from Outfall HP-014. The 77 percent control concept would capture 100 percent of Outfall HP-014 plus those from CSOs HP-015, HP-016 and HP-033. Finally, the 100 percent control tunnel concept includes all of the discharges from the 77 percent concept plus those from Outfalls HP-012 and 013. Technical details of these tunnel concepts are summarized in Table 8-1. Figure 8-4 shows the layout of the 100 percent control tunnel concept.

Table 8-1. Deep Tunnel Characteristics

Tunnel Options	Contributing Outfalls		
	HP-014	HP-014 HP-015 HP-016 HP-033	HP-014 HP-015 HP-016 HP-033 HP-012 HP-013
CSO Reduction (%)	44	77	100
Tunnel Volume (MG)	24.5	43	50
Tunnel Length (lf)	2,600	4,500	12,600
Tunnel Diameter (ft)	40	40	26
Cost ($M)	530	683	760

A summary of the benefits, costs and challenges associated with tunnel storage include:

<u>Benefits</u>

The major benefit of tunnel storage is the high rate of CSO volume reduction. In this case, the range of reduction for the alternatives developed was a low of 44 percent to a high of 100 percent. A secondary benefit is in siting: tunnels require a smaller footprint than would be needed for traditional storage tanks of equivalent volume.

<u>Cost</u>

The estimated NPW ranges from a low of $530M for the 44 percent concept to a high of $760M for the 100 percent concept. The development of these cost estimates are presented in Section 8.3.

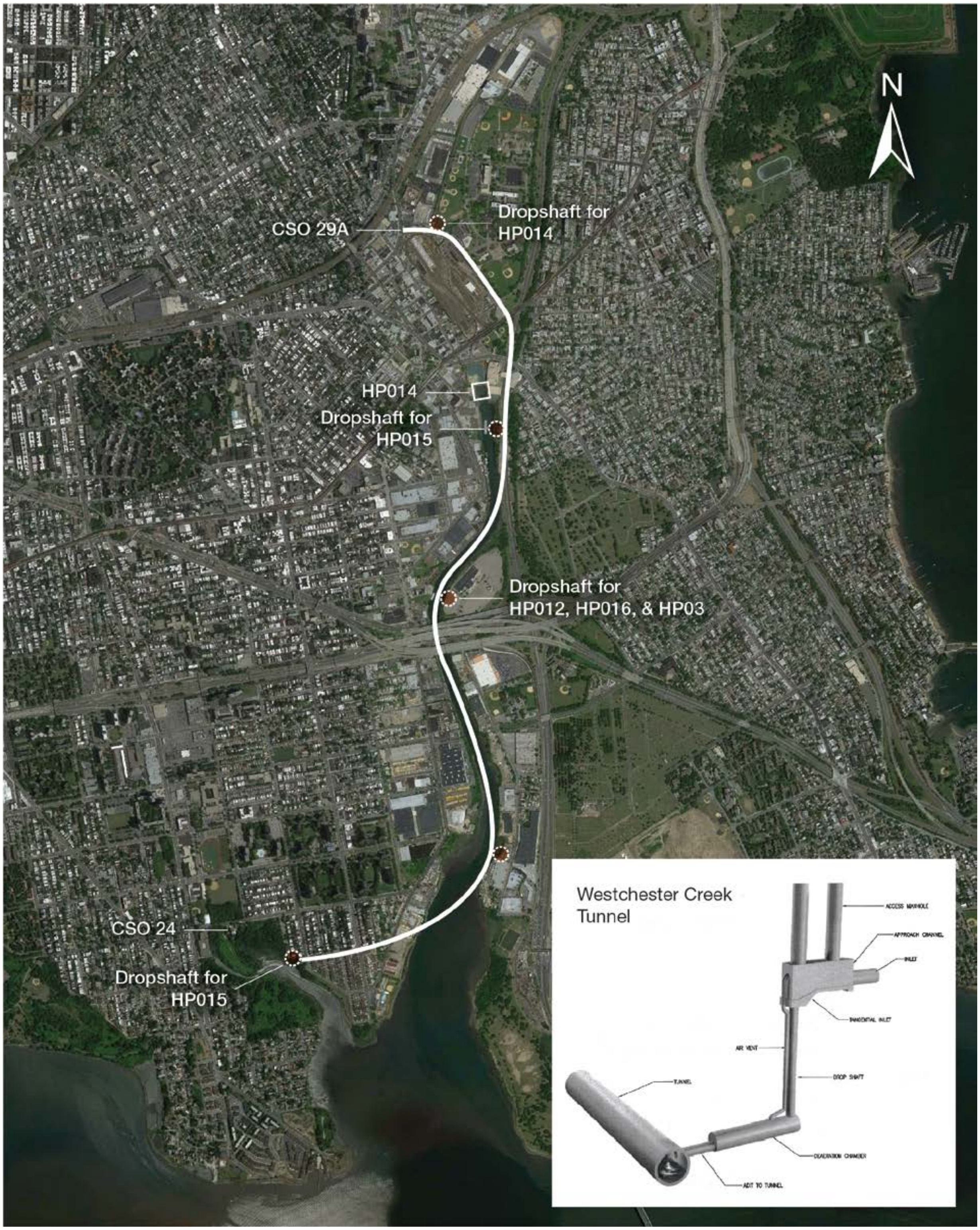

Figure 8-4. Proposed Route of 100 Percent CSO Volume Tunnel

Challenges

Even with the reduced footprint over traditional storage tanks, tunnels present a number of siting and operational challenges. In addition to the downstream shaft, each outfall under consideration would also require a feed shaft and its own odor control system. The dewatering PS would need to be sited, typically at the downstream end of the tunnel. Also, there could be major disruption during the actual construction with both the tunneling operation and trucking and disposal of the spoils. Land acquisition and easements may be required along the tunnel route. Periodic O&M of the tunnel components would pose a challenge due to their relative inaccessibility and depth.

Retention Alternatives – Storage Shafts

Shaft storage using Vertical Treatment Shaft (VTS) technology, is considered a cross between traditional off-line tank storage and tunnel storage. In essence, the shafts that would normally be constructed as part of a tunnel project are used instead as the prime means of storage. The shafts would be sized to provide an equivalent volume of storage as a traditional off-line tank, but because of their depth, they would take up less permanent land and, in theory, be possibly easier to site. As with tank and tunnel storage, shaft dewatering would be required after each event and between events to control seepage.

For Westchester Creek, storage shafts would be located where the tunnel shafts are shown on Figure 8-4. Two shaft sizes were considered: 8 MG and 18 MG. The smaller shaft for HP-033 would provide a level of volumetric control (12%) close to the optimal Throgs Neck PS alternative (15%). The larger shaft for Outfalls HP-016 and HP-033 would provide a level of volumetric control (34%) which is somewhat between the optimal Throgs Neck PS alternative and the 8 MG shaft (15% and 12%, respectively) and the smallest of the three tunnels (44%).

A summary of the benefits, costs and challenges associated with shaft storage include:

Benefits

The major benefit of shaft storage is the reduced land requirement from that of tank storage for the equivalent level of volumetric control. This equates to less permanent land requirements and improved siting opportunities.

Cost

The estimated NPW ranges from a low of $139M for the 12 percent concept for HP-033 (8 MG) to a high of $327M for the 34 percent concept (18 MG) for HP-016 and HP-033. The development of these cost estimates are presented in Section 8.3

Challenges

There are a number of challenges associated with shaft storage. First, VTS storage is a less proven technology than other forms of storage. Second, DEP has no operational experience with shafts for either CSO tunnels or storage while it has considerable operational experience with PSs and FMs associated with the Throgs Neck PS alternative. Third, even with the reduced footprint over traditional storage tanks, shafts present a number of siting and operational challenges. Periodic O&M of the shafts would pose a challenge due to their relative inaccessibility and depth.

Retention Alternatives – Tank Dewatering

As noted above, all categories of storage included tank dewatering. Table 8-2 summarizes the required pumping rates for each concept based on a maximum 2-day dewatering period. As shown in the table, pumping rates ranged from a high of 25 MGD for the 100 percent capture storage tunnel concept to a low of 3.0 MGD for the 23 percent capture in-line storage concept. Should any of these storage alternatives be considered further, an analysis of the affected capacity of the downstream conveyance components must be performed to ensure that the additional flow can be safely accommodated.

Table 8-2. Dewatering Rates for Retention Concepts (2-Day Pump-back)

	23% Capture (In-line)	34% Capture (Shaft)	44% Capture (Tunnel)	77% Capture (Tunnel)	100% Capture (Tunnel)
Additional Storage Volume (MG)	5.9	18	24.5	42.3	50
Pumping Capacity (MGD)	3.0	9	12.3	21.2	25

Treatment Alternative – Disinfection

As noted above, disinfection was the only treatment technology considered for this Westchester Creek LTCP. Disinfection would reduce the bacteria loading to the Creek associated with CSO discharges. Bacteria from the stormwater sources would not be controlled.

There are currently no facilities in the Westchester Creek watershed to which disinfection could be retrofitted, thus both disinfection storage and feed facilities would be required along a chlorine contact tank to provide the necessary contact time for effective kills. As such, its application was only considered in concert with in-line storage, described above, where the converted Outfall HP-014 could be used as the chlorine contact tank. In the typical year simulation (2008) the maximum projected flow rate of 647 MGD through the 5.9 MG storage volume would yield a contact time of 13 minutes. This is longer than what is considered necessary for high rate disinfection of CSO flows (5 to 10 minutes).

The disinfection system associated with in-line storage would include chlorine dosing, in the form of sodium hypochlorite, at the upstream end of the HP-014 outfall and dechlorination dosing, using sodium bisulfite, near the discharge end of the outfall. These two processes would be housed in separate buildings for chemical delivery, storage, and feed equipment. Ancillary electrical, controls and HVAC systems would also be included. Although the dosing points are over one-half mile apart, the facilities would probably be sited in a shared location with one or both dosing points being served by a long force main, and possibly requiring a carrier water system to convey the chemical to the dosing point.

Siting these facilities would pose a challenge because the area is densely developed. Candidate sites include taking a portion of a nearby parking lot at the corner of Eastchester Road and Waters Place, within the Lehmann High School grounds, and placing facilities within the Hutchinson River Parkway right-of-way adjacent to Westchester Creek, just south of the high school. All siting considerations would require further evaluation. It is unclear at this time what permit requirements would possibly be imposed by New York State Department of Environmental Conservation (DEC) for this satellite CSO disinfection facility. It would be logical to only provide disinfection during the recreation season to conserve chemical usage and minimize the discharge of total residual chlorine to the waterbody. It should be noted that, according to a nationwide survey of satellite CSO facilities, all had bacteria limits and only one (North Yonkers facility in neighboring Westchester County) did not have either total residual chlorine (TRC) permit limits. Thus, dechlorination would likely be needed for compliance with possible permit limits for TRC and to protect the biota in Westchester Creek.

Floatables Control

Floatables control technologies or control measures are designed to reduce or eliminate aesthetically objectionable items from the CSOs, such as plastic, paper, polystyrene and sanitary "toilet litter" matter, etc. However, because they do not reduce the volume or frequency of overflows, these control measures cannot be evaluated on the cost-performance or cost-attainment bases as with the other control measures.

Floatables control technologies were evaluated in detail in the 2011 Westchester Creek WWFP, including ongoing institutional programs such as catch basin hooding and other CSO BMPs. However, New York City has devoted considerable resources to reducing floatables throughout the New York Harbor. Examples of floatables control technologies in service or planned include:

- In-line netting at upstream regulators tributary to Outfalls HP-004 and HP-009 on the Bronx River;
- Mechanically cleaned bar screens within two Hunts Point control structures (CSO-27 and CSO-27A) tributary to Outfall HP-007 on the Bronx River;
- Bending weir pilot at Red Hook regulator 2 in Brooklyn that is anticipated to become a permanent facility;
- Bending weirs with underflow baffles at Newtown Creek Regulators B1, Q1, and the Saint Nicholas weir, and at Bowery Bay regulator L4, currently out to bid;
- Containment booms throughout the New York Harbor, including HP-014 in Westchester Creek; and
- Skimmer vessels to service containment boom sites and to conduct open-water operations.

DEP's current experience with end-of-pipe floatables control technologies, however, has not been favorable. The netting facilities and bar screens installed within the Bronx River watershed listed above have been particularly problematic, requiring maintenance and labor in excess of what was originally envisioned. These operational issues are compounded by the ongoing risk that the facilities may not be ready to treat the next CSO event because of the time required to reset the facilities. These negative experiences have led DEP to consider those technologies that require little to low maintenance. As such, low-maintenance floatables control technologies are being retained for further evaluation. Further, with respect to this LTCP, there has been no material recovered from the existing Interim Floatables Containment Program boom at HP-014 based on the Best Management Practices Annual Reports for calendar years 2012, 2013, and 2014 (the most recent available). The focus of floatables control will be Outfall HP-011 on the East River which is expected to experience an increase in CSO volume upon implementation of the recommended Westchester Creek WWFP elements. However, because this outfall is on the East River, the specific analysis of the most appropriate technologies will be deferred to the Bronx River LTCP which includes the East River CSOs.

8.2.b Other Future Green Infrastructure (Various Levels of Penetration)

As discussed in Section 5.0, DEP expects 487 acres of total implemented GI to be managed in the Westchester Creek watershed by 2030. This acreage includes 348 acres of right-of-way (ROW) implemented GI, 122 acres of implemented GI to be managed in on-site private properties and 17 acres of GI to be managed in on-site public property. This acreage represents 14 percent of the total combined sewer system impervious area in the watershed. This GI has been included in the baseline model projections, and is thus not categorized as an LTCP alternative.

For the purpose of this LTCP, "Other Future Green Infrastructure" is defined as GI alternatives that are in addition to those implemented under previous facility plans and those included in the baseline conditions. Because the baseline level of GI penetration for this watershed is well above the 10 percent citywide goal, and due to the difficulties in finding sites to implement GI control measures in general, additional GI is not being considered for this LTCP at this time.

8.2.c Hybrid Green/Grey Alternatives

Hybrid green/grey alternatives are those that combine traditional grey control measures with GI control measures, to achieve the benefits of both. However, as noted above, the baseline GI penetration rate for this watershed is already substantial and further GI is not planned at this time. Therefore, this control is not proposed for the Westchester Creek LTCP.

8.2.d Retained Alternatives

A summary of the evaluation of the control measures presented above is contained in Table 8-3, including those which were retained for further evaluation as basin-wide alternatives. The reasons for dropping the non-retained controls from further consideration are also noted in the table.

Table 8-3. Summary of Preliminary Evaluations

Control Measure	Retained for Further Analysis?	Remarks
In-line Storage at HP-014	NO	Existing outfall pipes located beneath active NYTA rail yard resulting in very difficult construction and severely limited O&M access. Would also require complex control structure and dewatering pumping.
Disinfection with Dechlorination on In-line Storage at HP-014	NO	Without in-line storage, would require siting of a new, separate chlorine contact tank in a highly congested area in close proximity to a high school and medical institutions. Also, not justified on a water quality standard attainment basis.
Throgs Neck PS Enhancements	YES	See Table 8-4 below

Table 8-3. Summary of Preliminary Evaluations

Control Measure	Retained for Further Analysis?	Remarks
Storage Tunnels	YES	See Table 8-4 below
Storage Shafts	YES	See Table 8-4 below
Floatables Control	YES	See Table 8-4 below
Bronx River Siphon Enhancement	YES	See Table 8-4 below
Additional GI Build-out	NO	Planned GI build-out in the watershed (included in the baseline) is greater than citywide average; additional sites unlikely to be identified.
High Level Sewer Separation	NO	No HLSS projects planned in watershed and no potential cross-benefit with flood mitigation identified.
Dredging	NO	No visible sediment mound at head end and no navigational benefit to local stakeholders.

The alternatives controls that were not retained include in-line storage and several of the Throgs Neck PS and force main concepts. Also not retained was the smaller of the two VTS, the 8 MG shaft at HP-033 as a similar Throgs Neck alternative provided slightly higher performance and a lower cost. In-line storage presented a number of technical and siting challenges that were deemed to be insurmountable. Disinfection, which would have been tied to the in-line storage concept, was also dismissed accordingly. Further details of the retained alternatives are presented in Table 8-4.

Table 8-4. Summary of Retained Alternatives

Alternative	Description
1. Throgs Neck PS Force Main (FM) Extension	Extend FM to Hunts Point WWTP, maintain capacity at 37.5 MGD, and modify pumps to account for additional head loss. Maintaining current capacity at 37.5 MGD and extending the force main directly to the Hunts Point WWTP.
2. 18 MG Storage Shaft	155-ft diameter VTS at HP-033 and HP-016.
3. 24.5 MG Storage Tunnel	40-ft. dia., 2,600 LF tunnel deemed to be the most viable technology for capturing Outfall HP-014 volume. Includes 24.5 MGD dewatering PS.
4. 43 MG Storage Tunnel	40-ft. dia., 4,500 LF tunnel deemed to be the most viable technology for capturing CSO from Outfalls HP-014, HP-015, HP-016 and HP-033. Includes 43 MGD dewatering PS.

Table 8-4. Summary of Retained Alternatives

Alternative	Description
5. 50 MG Storage Tunnel	26-ft. dia., 12,600 LF tunnel deemed to be the most viable technology for capturing CSO from Outfalls HP-014, HP-015, HP-016, HP-033, HP-012 and HP-013. Includes 50 MGD dewatering PS.
6. Floatables Control	Targeting HP-011 at the East River to address the increased CSO volume resulting from the planned WWFP recommendations; evaluation deferred to the Bronx River LTCP.
7. Bronx River Siphon Enhancement	Targeting HP-011 at the East River to address the increased CSO volume resulting from the planned WWFP recommendations; evaluation deferred to the Bronx River LTCP.

The retained alternatives for Westchester Creek (Alternatives 1 through 5) were then analyzed further for their ability to reduce pollutants and improve water quality, as described in Sections 8.3 through 8.5 including the critically important cost-performance and cost-attainment evaluations.

8.3 CSO REDUCTIONS AND WATER QUALITY IMPACT OF RETAINED ALTERNATIVES

To evaluate their effects on the pollutant loadings and water quality impacts, the retained alternatives listed in Table 8-3 were analyzed using both the Westchester Creek watershed (IW) and receiving water/waterbody or water quality (East River Tributaries Model [ERTM[) models. Evaluations of CSO volume reductions and/or bacteria load reductions for each alternative are presented below. In all cases, the reductions shown are relative to the baseline conditions using 2008 JFK rainfall as described in Section 6.0. The baseline assumptions were described in detail in Section 6.0 and assume that the grey infrastructure projects from the WWFP have been implemented, along with the 14 percent GI penetration.

8.3.a CSO Volume and Bacteria Loading Reductions of Retained Alternatives

Table 8-5 summarizes the projected CSO volume reductions and bacteria reductions for the retained alternatives. These data are plotted on Figure 8-5. Floatables control, Alternative 6, does not result in either CSO volume or bacteria control and thus not included on the subsequent plots.

Table 8-5. Westchester Creek Retained Alternatives[1] Summary (2008 Rainfall)

Alternative	CSO Volume (MGY)	CSO Events	CSO Volume Reduction[2] (Percent)	Fecal Coliform Reduction (Percent)	Enterococci Reduction (Percent)
Baseline Conditions	289	31	-	-	-
1. Throgs Neck PS FM Extension	245	31	15	15	15
2. 18 MG Shaft	191	18	34	34	34
3. 24.5 MG Tunnel	162	31	44	44	44
4. 43 MG Tunnel	66	18	77	77	77
5. 50 MG Tunnel	0	0	100	100	100

Notes:

(1) Floatables control and Bronx River Siphon Enhancement did not directly benefit Westchester Creek and are retained for consideration under the Bronx River LTCP.

(2) CSO volume reduction from baseline conditions.

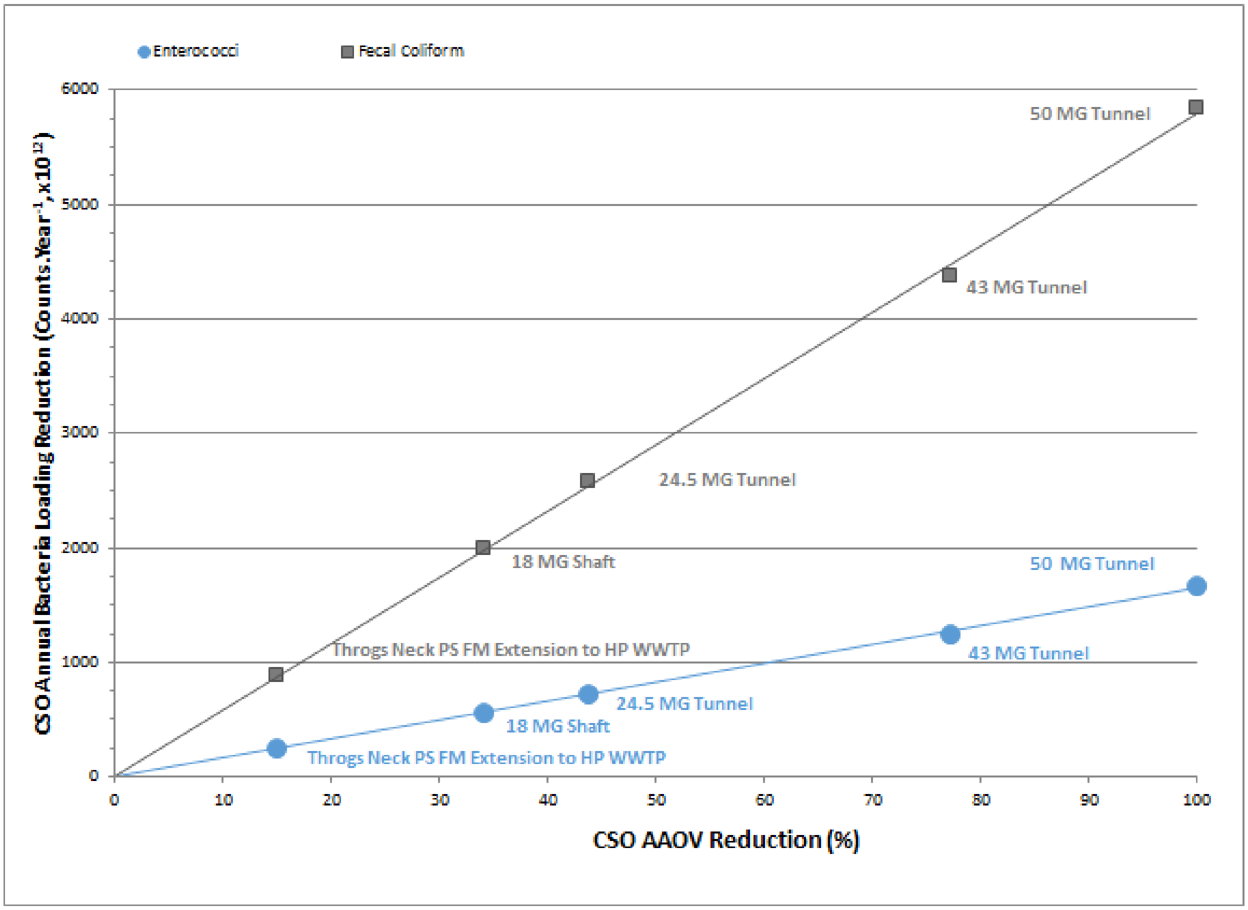

Figure 8-5. CSO Volume Reductions vs. Annual Total Bacteria Loading Reduction (2008 Rainfall)

It should be noted that because the Westchester Creek alternatives serve outfalls in predominantly combined areas, the bacteria loading reductions of the alternatives are aligned with their projected CSO volume reductions.

8.3.b Water Quality Impacts

This section qualitatively describes the levels of attainment with applicable bacteria criteria within Westchester Creek that would be achieved through implementation of the retained CSO control alternatives listed in Table 8-5.

Westchester Creek is a Class I waterbody. Historic and recent water quality monitoring, along with baseline condition modeling using ERTM, revealed that Westchester Creek is currently in attainment with the Class I fecal coliform criterion. When the attainment is assessed with the existing Primary Contact WQ Criteria of Class SC, none of the alternatives would result in full attainment. As explained in the gap analysis presented in Section 6.3, bacteria loadings from other sources influence the fecal and enterococci concentrations, to the extent that even removal of 100 percent of the CSO would not result in full attainment of the Class SC criteria.

8.4 COST ESTIMATES FOR RETAINED ALTERNATIVES

Evaluation of the proposed alternatives requires an appropriate level of cost estimating for each alternative. The methodology for developing these costs is dependent on the type of technology and its unique O&M requirements. As noted previously, the capital costs were developed as PBC and the total NPW costs were determined using the PBC estimated plus the NPW of the projected O&M costs at an assumed interest rate of 3 percent over a 20-year life cycle. All costs are in June 2014 dollars.

8.4.a Alternative 1 – Throgs Neck PS FM Extension to Hunts Point WWTP

Costs for Alternative 1 include the 3.13-mile, 48-inch FM and required modifications to the existing 37.5 MGD PS. The FM costs are based on the sewer diameter, length, and depth of cover.

The total cost for Alternative 1 is $133M (June 2014 dollars) as shown in Table 8-6.

Table 8-6. Costs for Alternative 1 - Throgs Neck PS FM Extension to Hunts Point WWTP

<table>
<tr><th colspan="2">Item</th><th>June 2014 Cost ($ Million)</th></tr>
<tr><td rowspan="3">PBC</td><td>PS Modifications</td><td>24.5</td></tr>
<tr><td>FM</td><td>109.0</td></tr>
<tr><td>Total</td><td>132.5</td></tr>
<tr><td colspan="2">Annual O&M</td><td>0.04</td></tr>
<tr><td colspan="2">Total Present Worth</td><td>133.0</td></tr>
</table>

8.4.b Shaft Alternative

A cost estimate was prepared for the 18 MG retained shaft alternative, Alternative 2. As shown in Table 8-7, it was estimated at $327M. This estimate includes construction of the shaft, dewatering PS, odor control systems and other ancillary facilities. The cost estimate was then used in the development of the cost-performance and cost-attainment plots presented in Section 8.5.

Table 8-7. Costs for Alternative 2 – 18 MG Storage Shaft at HP-033 and HP-016

Item	June 2014 Cost ($ Million)
PBC	326
Annual O&M	0.05
Total Present Worth	327

8.4.c Tunnel Alternatives

Cost estimates for the three retained tunnel alternatives; Alternative 3 – 24.5 MG Tunnel, Alternative 4 – 43 MG Tunnel and Alternative 5 – 50 MG Tunnel, are summarized in Table 8-8. The estimated total NPW ranges between $509M to $731.4M for the smallest and largest tunnel, respectively. These costs include the boring of the deep tunnel, multiple shafts, dewatering PS, odor control systems and other ancillary facilities. The cost estimates of these retained alternatives were then used in the development of the cost-performance and cost-attainment plots presented in Section 8.5.

Table 8-8. Tunnel Alternatives Costs – Alternatives 3, 4 and 5

Retention Alternative	24.5 MG Tunnel	43 MG Tunnel	50 MG Tunnel
June 2014 PBC ($ Million)	507.3	660.2	728.9
Annual O&M Cost ($ Million)	0.12	0.15	0.17
Total Present Worth ($ Million)	509.0	662.4	731.4

8.5 COST-ATTAINMENT CURVES FOR RETAINED ALTERNATIVES

The final step of the analysis is the evaluation of the cost-effectiveness of the alternatives based on their NPW and projected impact in attainment of applicable WQS.

8.5.a Cost-Performance Curves

Figure 8-6 presents the relationship of percent CSO control to the NPW of the retained alternatives. Percent CSO control ranges from a low of 15 percent (Alternative 1 – Throgs Neck PS FM Extension to Hunts Point WWTP) to a high of 100 percent control (Alternative 5 - 50 MG Tunnel), with costs spanning from a low of $133M to a high of $731M, for Alternative 1 and Alternative 5, respectively. A linear best-fit cost curve was developed based on alternatives that were judged more cost-effective for the CSO control level estimated by IW, based on the typical year rainfall.

Along with overall CSO control, a goal of the LTCP is to reduce bacteria loadings to the waterbody to the extent that such loadings are caused by CSOs. Figures 8-7 and 8-8 plot the cost of the retained alternatives against their associated projected annual CSO enterococci and fecal coliform loading reductions, respectively. The primary vertical axis shows percent CSO bacteria loading reductions and the secondary vertical axis shows the corresponding total bacteria loading reductions, as a percentage, when loadings from other sources of bacteria are included.

Enterococci values range from a low of 15 percent (Throgs Neck PS FM Extension to Hunts Point WWTP) to a high of 100 percent (50 MG Tunnel) with costs spanning up to $731M for the tunnel. Similarly, linearity is also observed when considering the total bacteria loading reductions. These reductions span from 13 percent to 88 percent for fecal coliform and from 12 percent to 83 percent for enterococci, as shown in Figures 8-7 and 8-8.

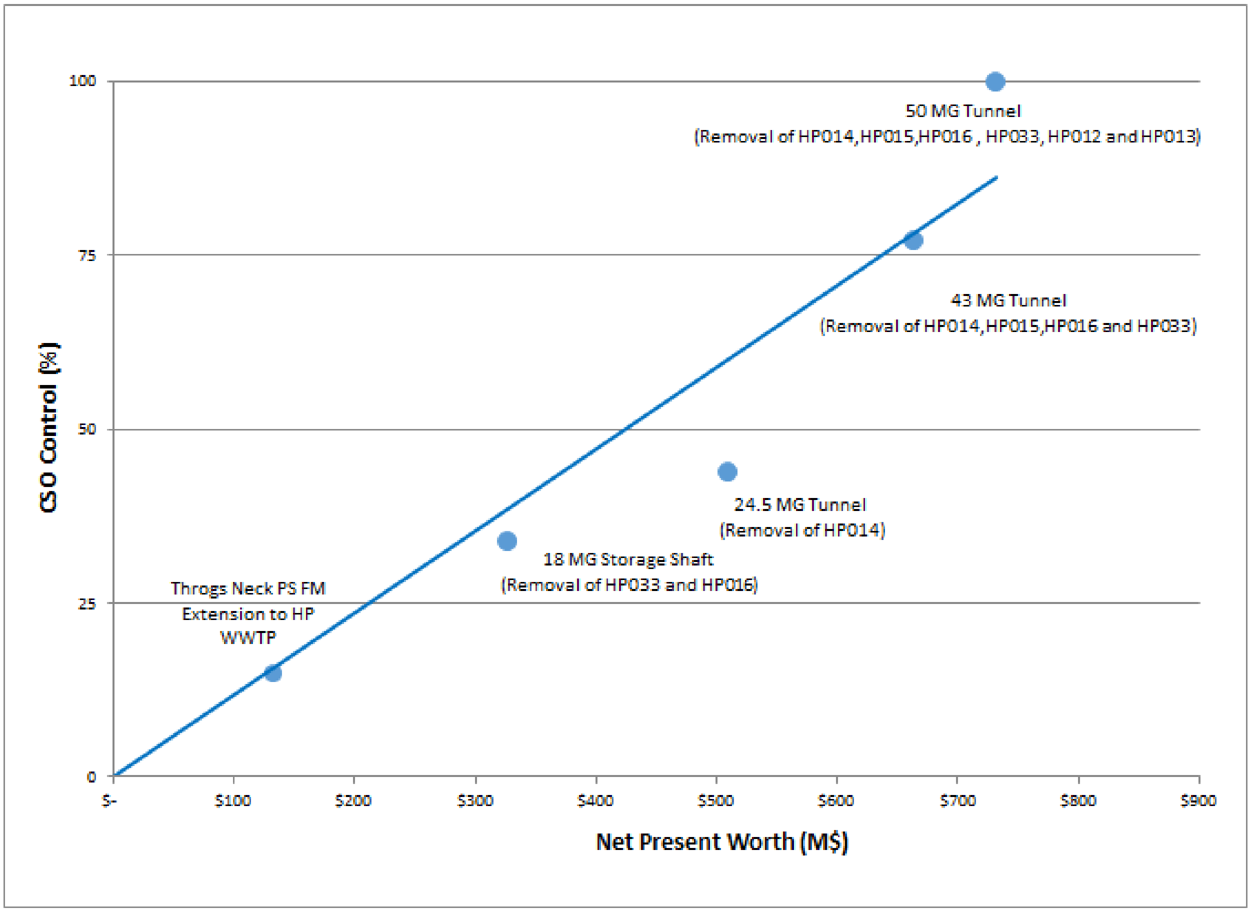

Figure 8-6. Cost vs. CSO Control (2008 Rainfall)

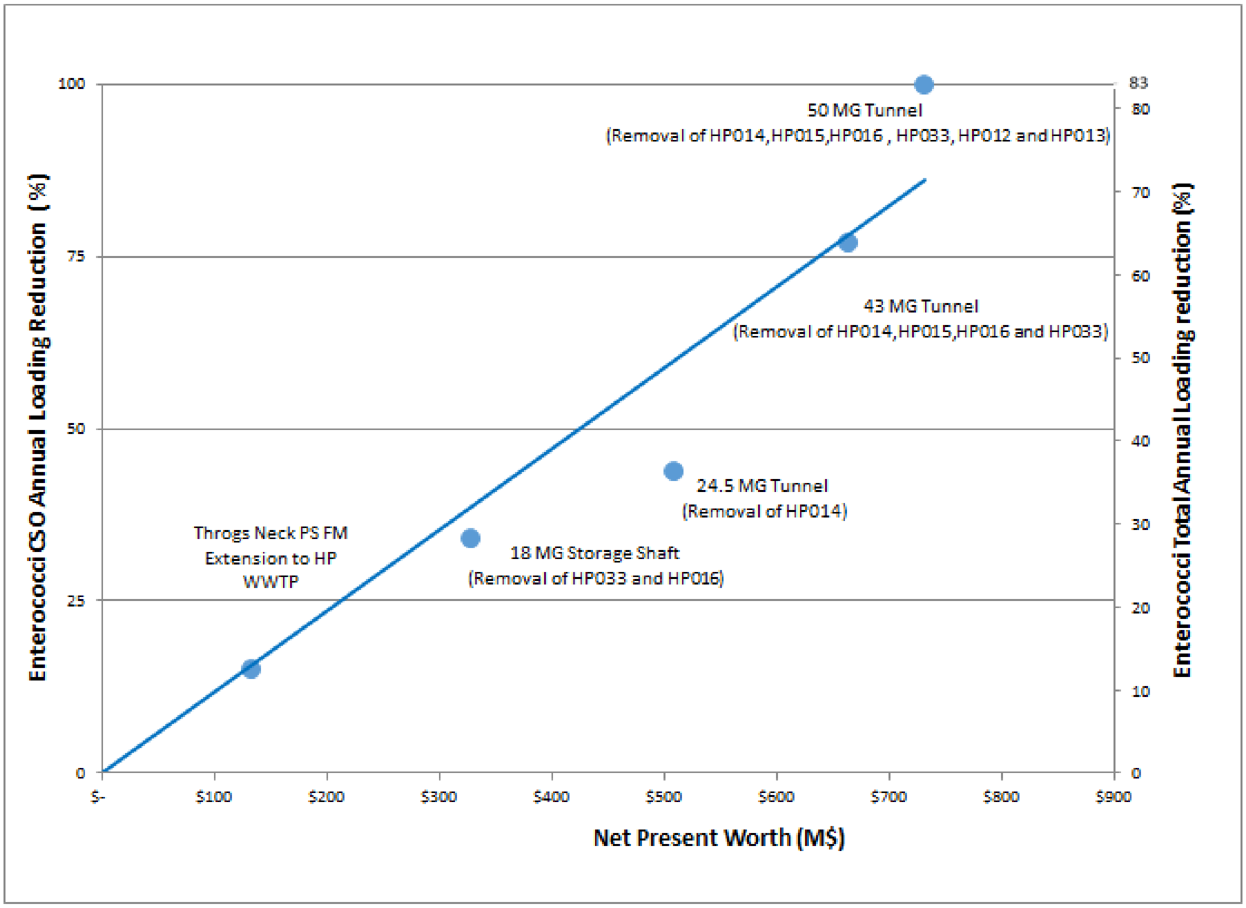

Figure 8-7. Cost vs. Enterococci Loading Reduction (2008 Rainfall)

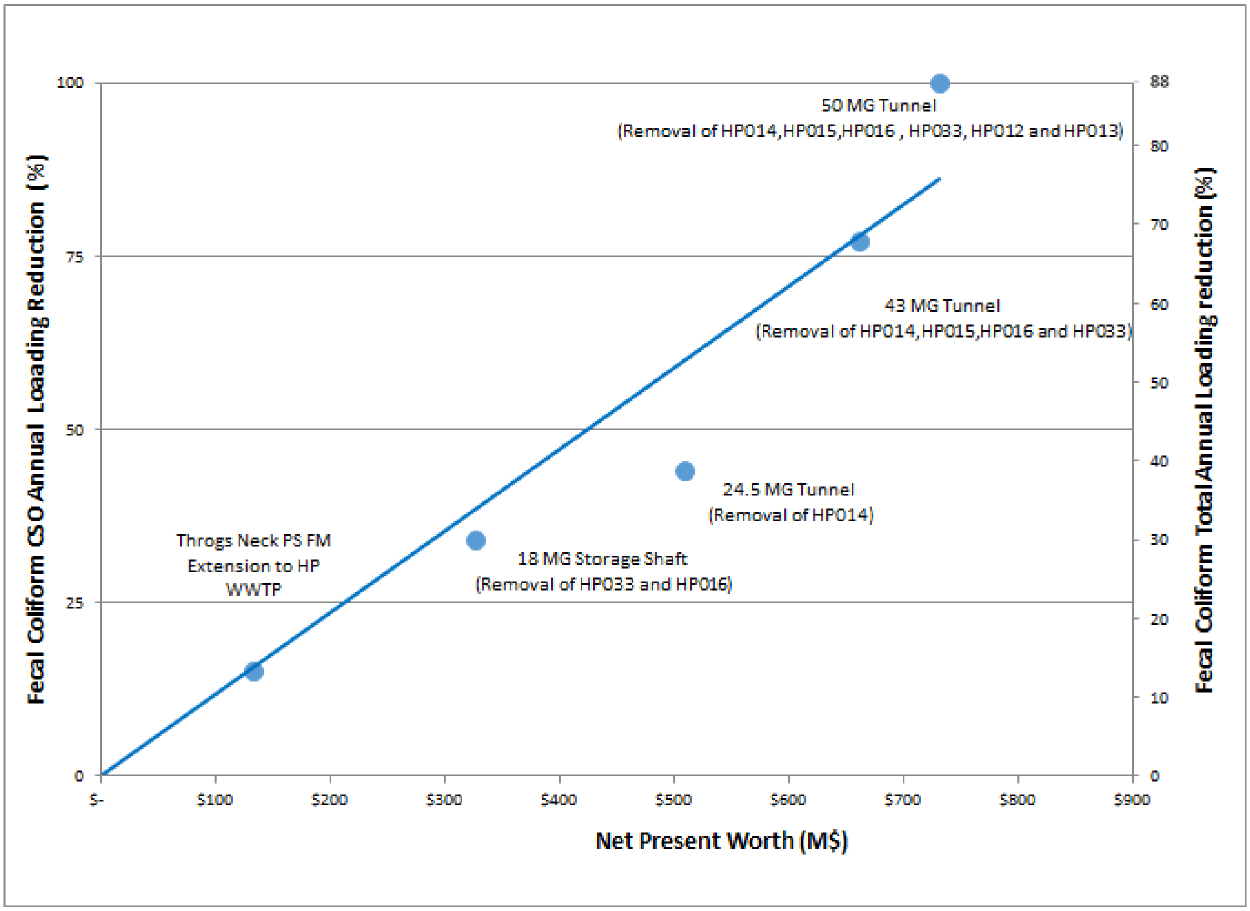

Figure 8-8. Cost vs. Fecal Coliform Loading Reduction (2008 Rainfall)

As with the previous best-fit curve comparing costs versus level of CSO control (Figure 8-6), there are no KOTCs for enterococci or fecal coliform. In summary, Figures 8-6 through 8-8 indicate that none of the retained alternatives represents an optimal gain in marginal performance.

8.5.b Cost-Attainment Curves

This section addresses costs of the CSO alternatives versus attainment of existing and Primary Contact WQ Criteria (Class SC) WQS modeled with the 2008 rainfall. As previously discussed in Section 6.0, attainment of existing applicable Class I bacteria standard, 2,000 cfu/100mL fecal coliform monthly geometric mean (GM), occurs 100 percent of the time in Westchester Creek under baseline conditions. Also, it should be noted that enterococci criteria do not apply to tributaries such as Westchester Creek under the BEACH Act of 2000. Water quality assessments for Class SC considered fecal coliform (FC) criterion only. Accordingly, attainment curves are shown for the FC criterion only, specifically, the monthly GM of 200 cfu/100mL. These curves are presented as Figures 8-9 through 8-12 for four select locations along Westchester Creek. It is noted that the lowest attainment of the fecal coliform criterion of the existing Primary Contact WQ Criteria under the baseline condition is 92 percent and occurs at Station WC2, at the head of the Creek. When 2008 average rainfall year is used for alternative comparison purposes, even by implementing 100 percent CSO control, the baseline attainment with the Primary Contact WQ Criteria remains unaltered at this station although results vary slightly under the 10 year based projections.

Attainment of the Potential Future Primary Contact WQ Criteria with 2012 EPA RWQC modification to the standards is also plotted in the figures where cost-attainment curves are shown for the proposed GM and statistical threshold value (STV) criteria. Figure 8-9 shows the modeled improvement in annual attainment at Station E13 for each alternative. When considering an STV of 110 cfu/100mL, the performance gap is considerable, with annual attainment occurring 69 percent of the time under baseline conditions. At this WQ Station, the attainment of Potential Future Primary Contact WQ Criteria with 2012 EPA RWQC shown is virtually the same as for the alternative with the greatest improvement, the 54 MG Tunnel.

Figure 8-10 shows the modeled improvement in annual attainment at Station WC3 for each alternative. When considering an STV of 110 cfu/100mL, the performance gap is large, with annual attainment occurring only 18 percent of the time under baseline conditions. For Station WC3, the improvements in attainment of Potential Future Primary Contact WQ Criteria with 2012 EPA RWQC shown are discernible, rising a maximum of 27 percent for the alternative with the greatest improvement (54 MG Tunnel), at a cost of $731M.

Figure 8-11 shows that improvements in attainment of Potential Future Primary Contact WQ Criteria, i.e., enterococci GM and STV, begin to be realized at Station WC1. Specifically, attainment gains of 13 percent and 38 percent between the baseline condition and the 50 MG Tunnel alternative are estimated for the GM and STV criteria, respectively. These improvements are realized upon corresponding baseline condition attainments of 72 percent for GM criterion and 7 percent for the STV criterion.

Figure 8-12 depicts the attainment gain that would result from multiple alternatives at Station WC2, close to the head of the Creek. As shown, the largest improvement in annual attainment would be realized for the Potential Future Primary Contact WQ Criteria enterococci GM criterion by the 54 MG Tunnel alternative, for which the projected increase in attainment is 16 percent, from 64 percent under the baseline condition to 80 percent.

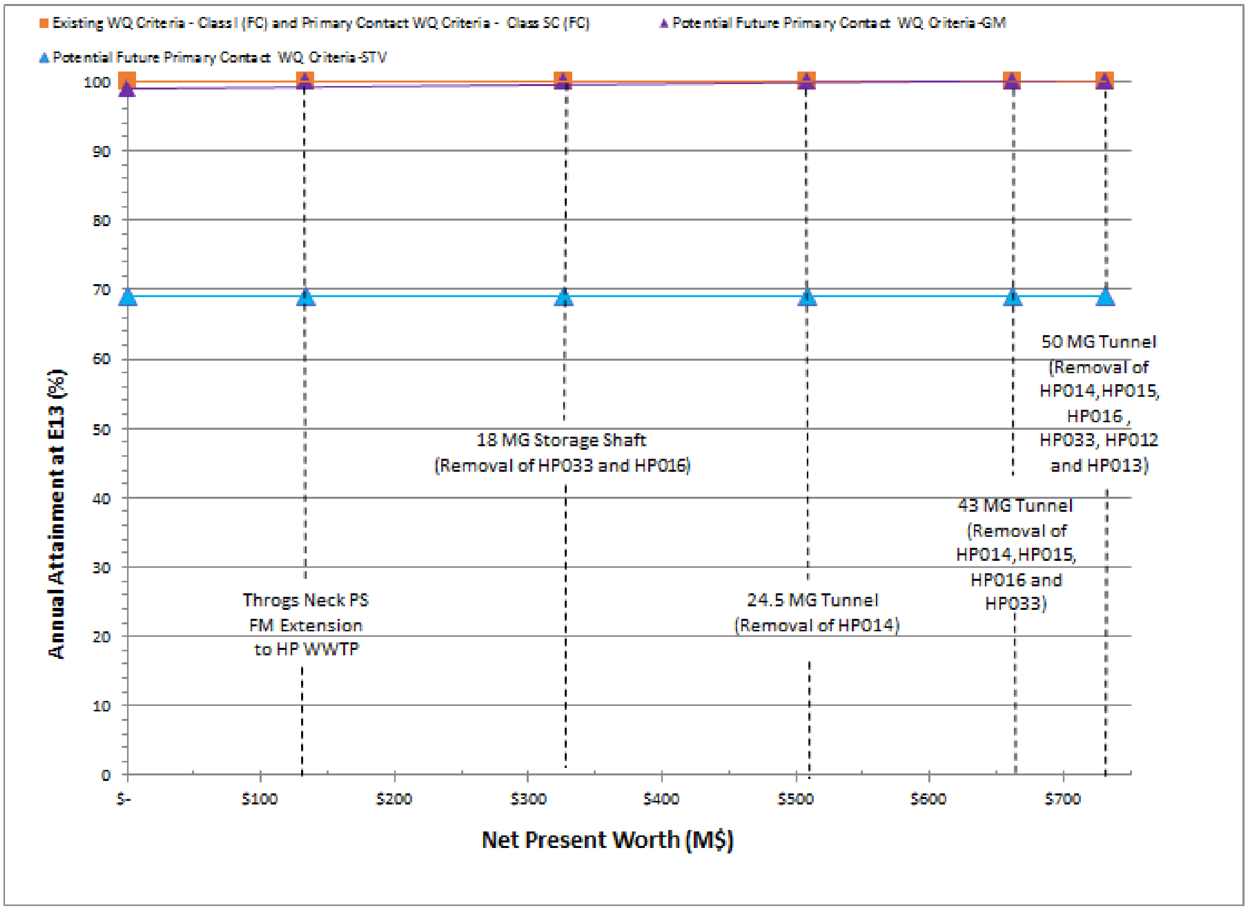

Figure 8-9. Cost vs. Bacteria Attainment at Station E13 (2008 Rainfall)

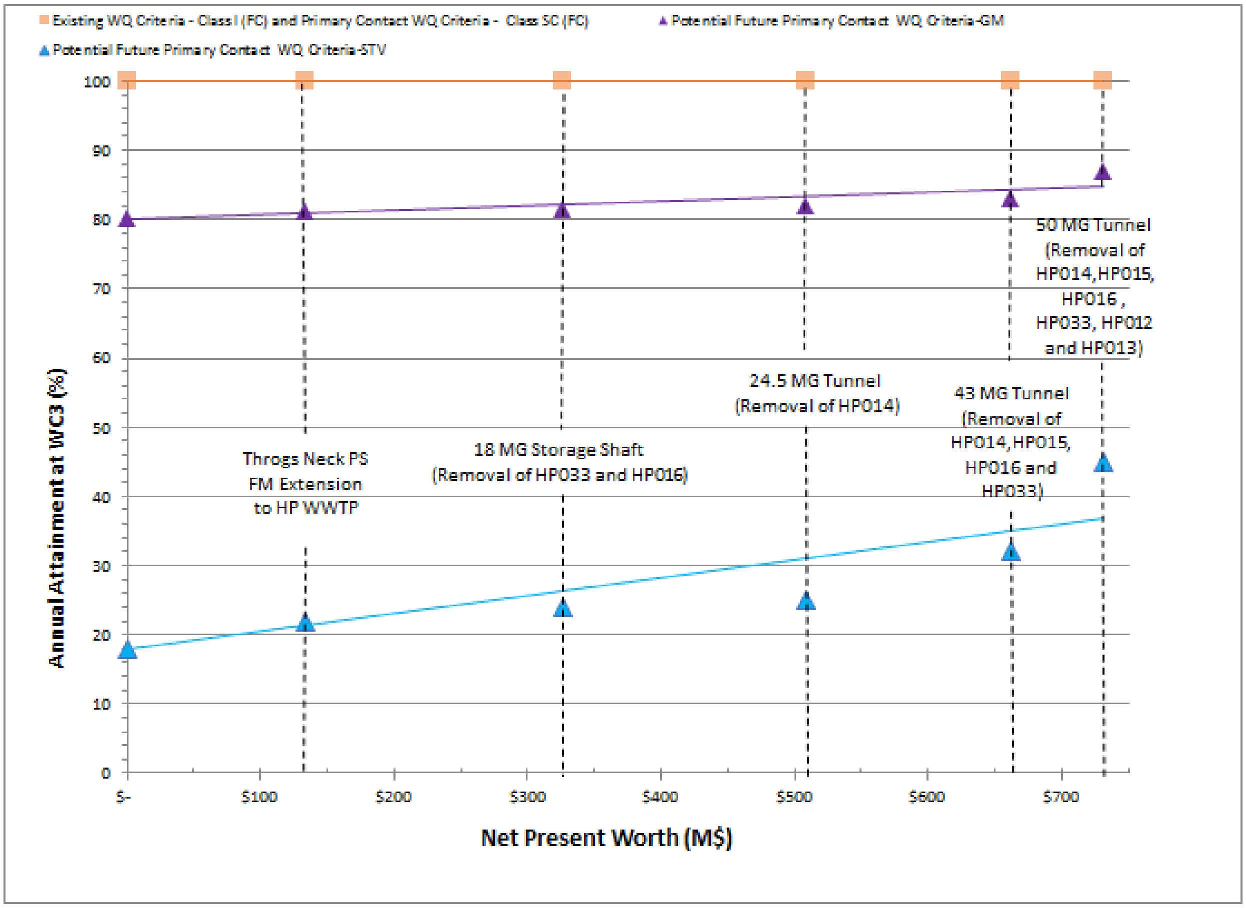

Figure 8-10. Cost vs. Bacteria Attainment at Station WC3 (2008 Rainfall)

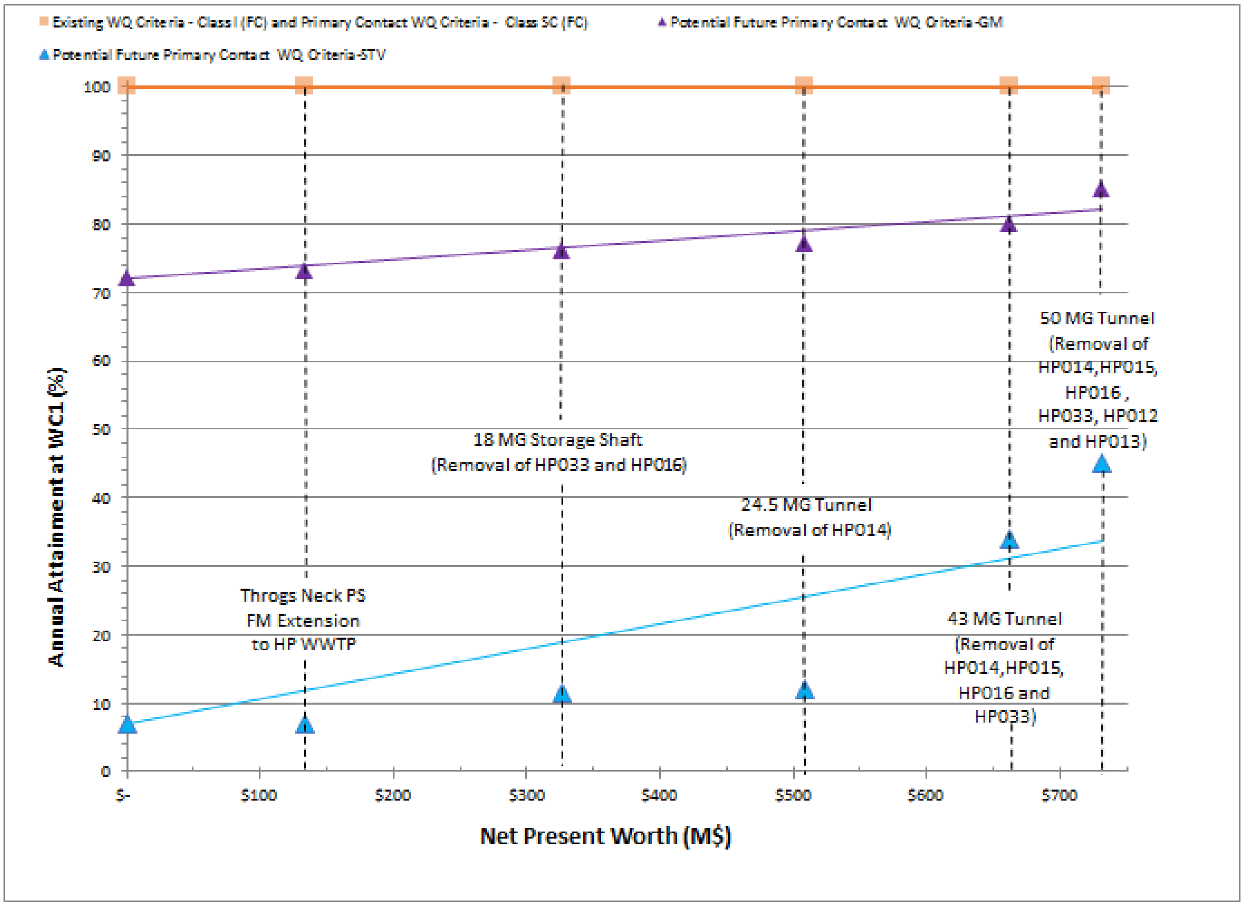

Figure 8-11. Cost vs. Bacteria Attainment at Station WC1 (2008 Rainfall)

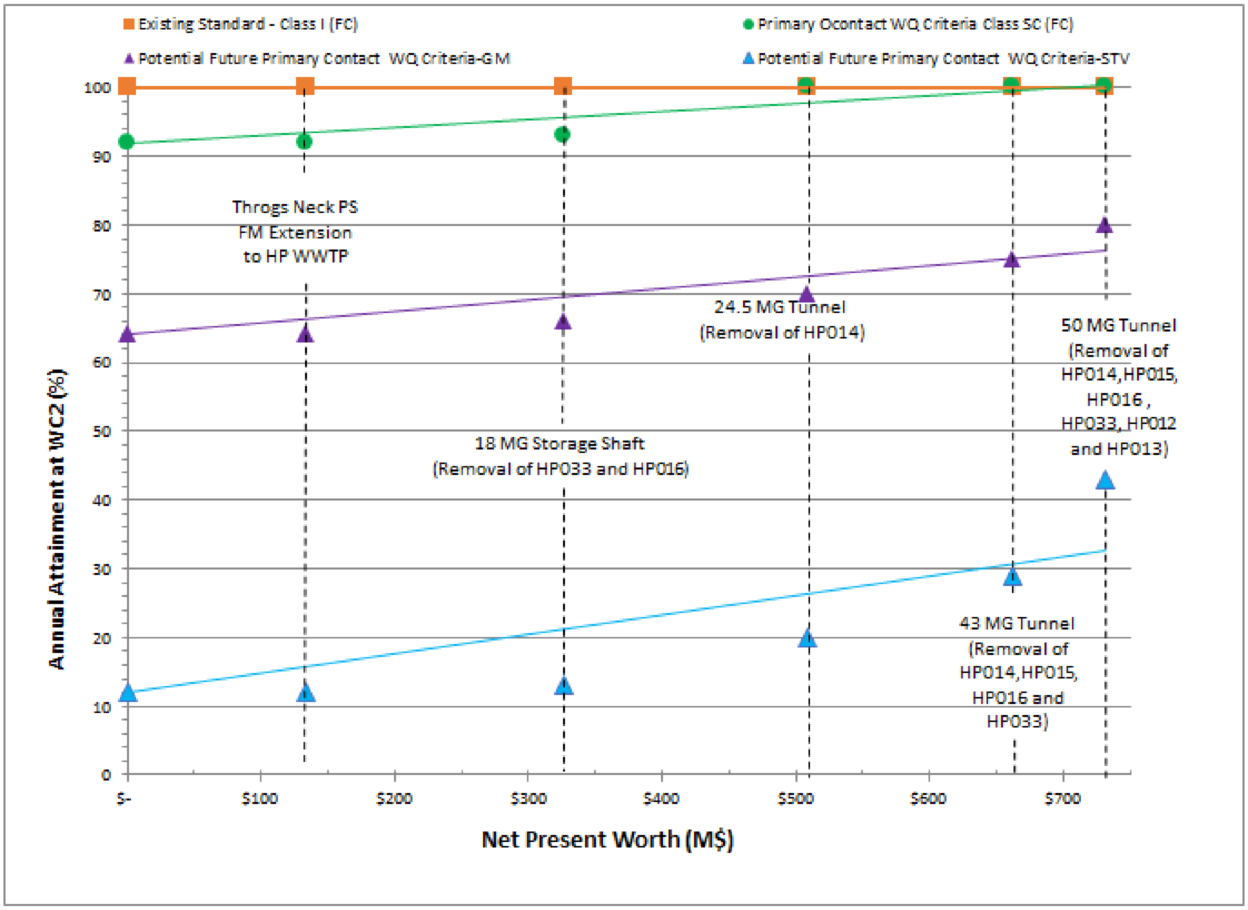

Figure 8-12. Cost vs. Bacteria Attainment at Station WC2 (2008 Rainfall)

These results clearly demonstrate that capturing additional volume of CSO, regardless of the degree of capture, does not cost-effectively improve the attainment of WQ criteria in Westchester Creek. In all cases, there are no clear inflection points (KOTCs), indicating a potential cost-effective degree of control. The remaining non-attainment of Primary Contact WQ Criteria and Potential Future Primary Contact WQ Criteria is caused by other sources of pollution, as was discussed in earlier sections of this LTCP. Overall, the attainment status is more dependent on the criterion used than on the CSO control alternative evaluated.

8.5.c Conclusion on Preferred Alternative

Based upon the series of cost-performance (Figures 8-6 through 8-8) and cost-attainment (Figures 8-8 through 8-12) curves developed for this Westchester Creek LTCP, there is no preferred basin-wide alternative recommended to move forward into implementation. Even Alternative 1 - Throgs Neck PS FM Extension to Hunts Point WWTP, the lowest cost alternative with a NPW of $133M, was predicted to result in marginal increases in WQS attainment.

In summary, the following conclusions can be drawn from these analyses:

- Continued implementation of the 2011 WWFP recommendations will provide significant improvement in the WQS attainment of Westchester Creek over existing conditions. Water quality modeling projections indicate that attainment of the fecal coliform primary contact recreation standard will approach DEC’s desired goal of 95 percent attainment.

- PCM will document these improvements.

- Committing at this time to extending the Throgs Neck PS FM to the Hunts Point WWTP, while providing some slight increase in attainment in Westchester Creek, could result in adverse impacts to other watersheds that are also served by that plant, especially the Bronx River, where increased discharges from HP-009 were indicated.

- During the development of the Citywide LTCP, Alternative 1, and others as well, could be reconsidered in order to determine if the Hunts Point WWTP capacity was still available and could be effectively used for Westchester Creek flows.

As there is no single alternative that is cost-effective with respect to CSO control, DEP is proposing to move forward with the construction of the grey infrastructure controls proposed in the WWFP as described in Section 4.0, and the GI as described in Section 5.0, collectively constituting the LTCP Baseline Conditions as defined in Section 6.0, as the recommended LTCP plan.

The WQ model was used to characterize WQS attainment for this recommended alternative by running the model for the full 10 years simulation period. As no additional grey or green infrastructures are being proposed at this time, this simulation is the same as the Section 6.0 Baseline Conditions. The results of these runs are summarized in Tables 8-9 (annual attainment) and 8-10 (recreational season attainment).

Table 8-9. Calculated 10-year Bacteria Attainment for Recommended Plan (Baseline Conditions) – Annual Period

Station	Existing WQ Criteria (Class I)		Primary Contact WQ Criteria (Class SC)	
	Criterion (cfu/100mL)	Attainment (%)	Criterion (cfu/100mL)	Attainment (%)
WC2	Fecal ≤2,000	100	Fecal ≤200	93
WC1	Fecal ≤2,000	100	Fecal ≤200	95
WC3	Fecal ≤2,000	100	Fecal ≤200	97
E13	Fecal ≤2,000	100	Fecal ≤200	100

Table 8-10. Calculated 10-year Bacteria Attainment for Recommended Plan (Baseline Conditions) – Recreational Season (May 1st – October 31st)

Station	Existing WQ Criteria (Class I)		Primary Contact WQ Criteria (Class SC)		Potential Future Primary Contact WQ Criteria	
	Criterion (cfu/100mL)	Attainment (%)	Criterion (cfu/100mL)	Attainment (%)	Criterion (cfu/100mL)	Attainment (%)
WC2	Fecal ≤2,000	100	Fecal ≤200	95	Enterococci ≤30	84
					STV≤110	21
WC1	Fecal ≤2,000	100	Fecal ≤200	98	Enterococci ≤30	88
					STV≤110	23
WC3	Fecal ≤2,000	100	Fecal ≤200	98	Enterococci ≤30	93
					STV≤110	32
E13	Fecal ≤2,000	100	Fecal ≤200	100	Enterococci ≤30	98
					STV≤110	67

Spatial and temporal examination of projected attainment in Westchester Creek (Table 8-8 and Table 8-9) shows that the fecal coliform Primary Contact WQ Criterion is not attained for the annual period at the head end of the Creek (WC2) but is attained a high percent of the time for the recreational season there and throughout the Creek. Attainment is lowest for the Primary Contact WQ Criteria (Class SC) at the upstream portions of the Creek near WC2 and WC1. Further, the Potential Future Primary Contact WQ Criteria are not attained either during the recreational season for all, but the very downstream end of the waterbody for GM criterion of 30 cfu/100mL. No areas of the Creek are shown to be capable of attaining the STV value of 110 cfu/100mL. Figure 8-13 shows the location of the WQ Stations within Westchester Creek as defined in this LTCP.

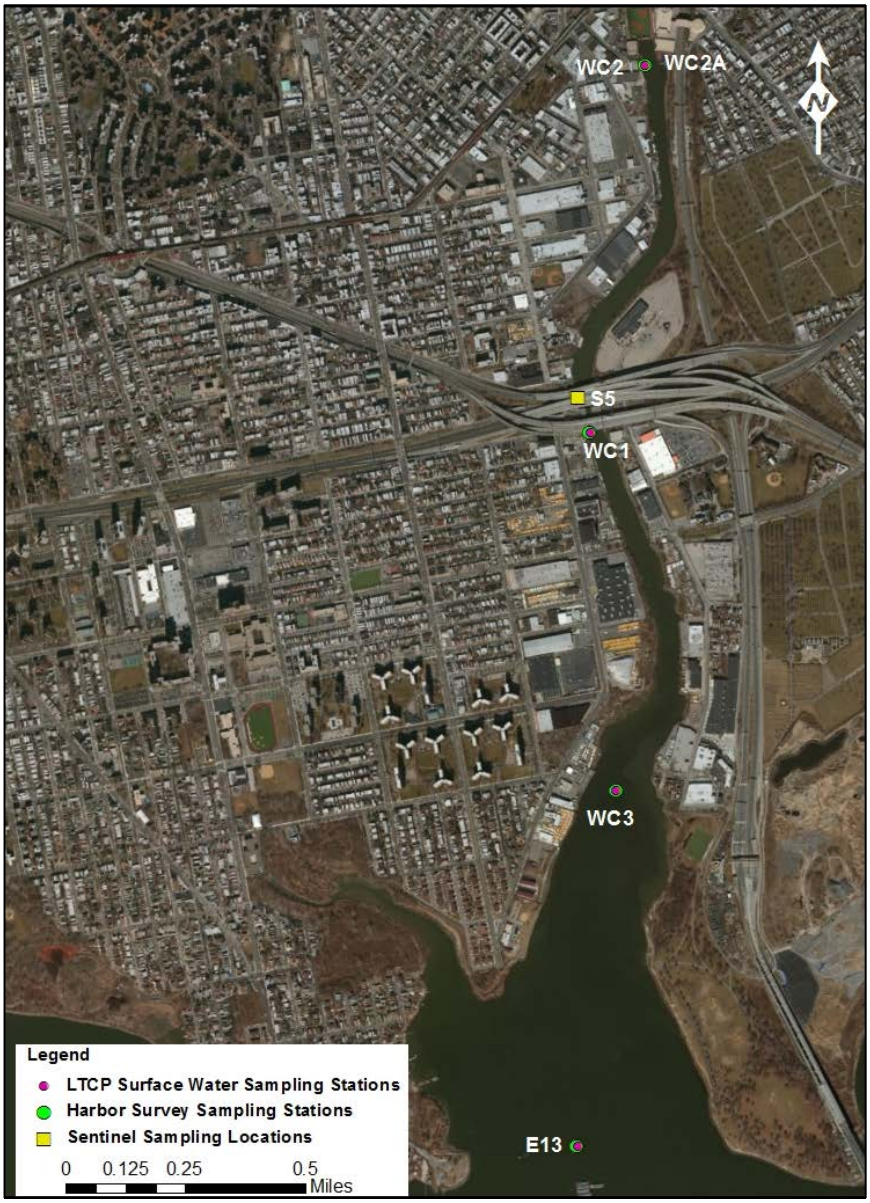

Figure 8-13. LTCP WQ Stations within Westchester Creek

The water quality model for baseline conditions was also used to characterize WQS attainment of dissolved oxygen for the recommended alternative. As described in Section 6.0, this analysis comprised a 1-year simulation period. It was used to assess the dissolved oxygen levels of attainment under baseline conditions and impacts of the recommended plan, as the plan does not affect CSO volumes or organic carbon loadings. Model results indicate that Westchester Creek will not fully attain the existing and Class SC dissolved oxygen criteria (71 percent annual attainment of the chronic standard and 89 percent attainment of the acute standard).

8.6 USE ATTAINABILITY ANALYSIS

The 2012 CSO Order on Consent requires a UAA to be included in the LTCPs "where existing WQS do not meet the Section 101(a)(2) goals of the CWA, or where the proposed alternative set forth in the LTCP will not achieve existing WQS or the Section101(a)(2) goals. The UAA shall "examine whether applicable waterbody classifications, criteria, or standards should be adjusted by the State". The UAA process specifies that States can remove a designated use which is not an existing use if the scientific assessment can demonstrate that attaining the designated use is not feasible for at least one of six reasons:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, 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 the attainment of the use; or

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 water quality, preclude attainment of aquatic life protection uses; or

6. Controls more stringent than those required by Sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

As part of the LTCP, elements of a UAA, including the six conditions presented above, will be used to determine if changes to the designated use is warranted, considering a potential adjustment to the designated use classification as appropriate. A UAA for Westchester Creek is attached hereto as Appendix D.

8.6.a Use Attainability Analysis Elements

The objectives of the CWA are to provide for the protection and propagation of fish, shellfish, wildlife, and recreation (CWA sect. 101(a)(2). Cost-effectively maximizing the water quality benefits associated with CSO reduction is a cornerstone of this LTCP. The 2012 CSO Consent Order on Consent Goal Statement stipulates that, in situations where the proposed alternatives presented in the LTCP will not achieve these objectives, the LTCP will include a UAA.

To simplify this process, DEP and DEC have developed a framework that outlines the steps taken under the LTCP in two possible scenarios:

- Waterbody meets WQ requirements. This may either be the Existing WQ Criteria (where primary contact is already designated) or assess for an upgrade (where the existing standard is not a Primary Contact WQ standard). In either case, a high-level assessment of the factors that define a given designated use is performed, and if the level of control required to meet this goal can be reasonably implemented, the State may make a change in designation.

- Waterbody does not meet WQ requirements. In this case, if a higher level of control is not feasible, the UAA must justify the shortcoming using at least one of the six criteria (see Section 8.6 above). For this LTCP, it is assumed that if 100 percent elimination of CSO sources does not result in attainment, the UAA would include factor number 3 at a minimum as justification (human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied, or would cause more environmental damage to correct than to leave in place).

8.6.b Fishable/Swimmable Waters

Bacteria Criteria

As discussed in Sections 2.0 and 6.0, municipal stormwater and direct drainage introduced through the urbanization of the Westchester Creek watershed contributes to bacteria levels in Westchester Creek to some extent based on model predictions. East River is also identified as a potential contributor to the bacteria loadings where its influence varies spatially and temporally. As noted in Table 6-9 of Section 6.0, stormwater discharges and direct drainage contribute a maximum summer monthly fecal coliform GM concentration of 7 cfu/100mL at Station WC2, whereas CSOs contribute 9 cfu/100mL and East River contributes 2 cfu/100mL. At the outer Bay location (E13), East River contribution becomes predominant, contributing a maximum summer month fecal coliform of 13 cfu/100mL, whereas CSOs contribute only <1 cfu/100mL and stormwater contribution is 1 cfu/100mL. Modeling component analyses for GM components for enterococci indicate similar observations and variation among sources temporally and spatially. As noted in Section 8.1, and in other previous sections, the goal of this LTCP is to identify appropriate CSO controls necessary to achieve attainment of WQS, consistent with EPA's CSO policy and subsequent guidance. SA, SB, and SC classifications are fully supportive of the CWA. The recommended alternative summarized in Section 8.5 results in the following levels of attainment with fishable/swimmable criterion.

Water quality modeling analyses, conducted for Westchester Creek and summarized in Table 8-9, shows that Westchester Creek is predicted to approach the Primary Contact WQ Criteria (Class SC) monthly fecal coliform criterion of 200 cfu/100mL 93 percent of the time during the recreational season but not on an annual basis at location WC2 in the 10-year simulation period. Compliance with the Potential Future Primary Contact WQ Criteria for enterococci 30-day GM recreational season criterion of 30 cfu/100mL is predicted (Table 8-9) to be lower; 84 percent of the time at the head end, 93 percent of the time at location WC3 and 98 percent at E13 under the recommended plan conditions. Attainment of the associated STV values is much worse throughout. As such, this upper portion of Westchester Creek near the head end would not comply with the Primary Contact WQ Criteria (Class SC) under the recommended plan conditions. As noted in Table 8-9, compliance with the Potential Future Primary Contact WQ Criteria is predicted to be very low. Figure 8-13 shows the location of the WQ Stations within Westchester Creek as defined in this LTCP.

Dissolved Oxygen

Westchester Creek is not expected to attain the dissolved oxygen criterion at least 95 percent of the time throughout the desired target of the DEC. As that goal is not attained, the upper area near the head end is deemed not to be in compliance with the DO criterion and a UAA is also required as it pertains to DO

Conditions are predicted to be somewhat better in the remainder of the waterbody. In this outer portion of Westchester Creek, downstream of WQ Station WC1, predictions indicate that compliance with the Primary Contact WQ Criteria (Class SC) monthly fecal coliform criterion of 200 cfu/100mL would be at least 98 percent of the time (annually – Table 8-8) and 100 percent of the time during the recreational season (Table 8-9). Within this area of the Creek, the lowest level of attainment with the 30-day GM recreational season criterion of 30 cfu/100mL is predicted to be 88 percent of the time at Station WC1. These results indicate that this outer portion of Westchester Creek could potentially support Primary Contact WQ Criteria (Class SC). As mentioned previously, in the upper portion of the waterbody, near the head end, the fecal coliform Primary Contact WQ Criteria could be attained seasonally but not on an annual basis.

Again, the Potential Future Primary Contact STV Criterion could not be attained throughout the Creek.

8.6.c Assessment of Highest Attainable Use

The analyses contained herein, as noted above in Section 8.5.c and summarized in Table 8-10, indicate that the Primary Contact WQ Criteria (Class SC), is approached but not projected to be attained 100 percent of the time annually within most of Westchester Creek with the recommended alternative. For the purpose of this LTCP, attainment of the standards was calculated using a mathematical water quality model. As models are representations and simplifications of the actual receiving water conditions, they are not 100 percent accurate and provide only an estimate of the attainment with water quality criteria. As such, for this LTCP, a calculation of 93 to 95 percent attainment or higher is taken as fully attaining the criteria. A more accurate assessment of attainment will be performed once the regulator modifications and new parallel sewer constructed through the assessment of post-construction monitoring data.

The modeling analysis assessed whether the recommended plan would improve water quality to allow for the Primary Contact WQ Criteria (Class SC), both annually and during the recreational season. As shown in Tables 8-9 and 8-10, fecal coliform bacteria levels approach the Class SC criterion but still do not attain the criterion near the head end of the Creek on an annual basis, although attainment is high during the recreational season. With construction of the WWFP recommendations and planned GI, Westchester Creek is projected to approach but not fully attain a higher classification than the existing Class I. This means that a UAA could be required for Westchester Creek. Table 8-11 summarizes the compliance for the identified plan.

Table 8-11. Recommended Plan Compliance with Bacteria Water Quality Criteria

Location		Meets Existing WQ Criteria[(1)] (Class I)	Meets Primary Contact WQ Criteria[(2)] (Class SC)	Meets Potential Future Primary Contact WQ Criteria[(2)]
Westchester Creek	WC2	YES	NO[(3)]	NO
	WC1, WC3 and E13	YES	YES	NO

Notes:
YES indicates attainment is calculated to occur ≥ 95 percent of time.
NO indicates attainment is calculated to be less than 95 percent of time.
(1) Annual attainment.
(2) Recreational season attainment.
(3) Criteria not attained annually; attained during the recreational season.

8.7 WATER QUALITY GOALS

Based on the analyses of Westchester Creek, and the WQS associated with the designated uses, the following conclusions can be drawn:

- Westchester Creek remains a highly productive Class I waterbody that can fully support existing uses, kayaking and wildlife propagation. Westchester Creek is in attainment with its current Class I classification throughout. Furthermore, manmade features, shoreline access and industrial uses prevent the opportunity and feasibility of primary contact recreation in Westchester Creek.

- This LTCP conducted assessments for attainment with the primary recreation water quality standard spatially and temporally and identified instruments that will allow DEP to protect uses while continuing to improve water quality over time. As such, the existing Primary Contact WQ Criteria of Class SC could be considered for the recreational period in Westchester Creek.

Future Water Quality

DEP is committed to improving water quality in Westchester Creek. Toward that end, DEP has identified instruments for Westchester Creek that will allow DEP to continue to improve water quality in the system over time. Wet weather advisories based on Time to Recovery analysis are recommended for consideration while advancing towards the numerical criteria established, or others under consideration by DEC, including existing Class SC pathogen standards and Potential Future Primary Contact WQ Criteria consistent with the 2012 EPA RWQC.

Also as noted above, DEP does not believe that adoption of the STV portions of the proposed 2012 EPA RWQC is warranted at this time. Analyses presented herein clearly show that adoption of STV values of 110 cfu/100mL is not attainable. Alternatively, DEP believes that if an STV value is required, it should be derived specifically for individual portions of Westchester Creek based on measured enterococci concentrations and their variability.

Although Westchester Creek could possibly be upgraded to Primary Contact WQ Criteria (limited primary contact), it will not be capable of supporting primary contact 100 percent of the time. Even with anticipated reductions in CSO overflows resulting from grey and green infrastructure, the waterbody could possibly be protective of primary contact should it occur, as long as it did not occur during and following rainfall events. Toward that end, DEP has performed an analysis to assess the amount of time following the end of a rainfall event required for Westchester Creek to recover and return to fecal coliform concentrations less than 1,000 cfu/100mL. The analyses consisted of examining the water quality model calculated for outer Westchester Creek pathogen concentrations for recreation periods (May 1st through October 31st) abstracted from a model simulation of the August 14-15, 2008 storm. Details on the selection of this storm are provided in Section 6.0. The time to return to 1,000 cfu/100mL was then tabulated for each location along the Creek. The results of this analysis are summarized in Table 8-12 for Westchester Creek. As noted the duration of time within which pathogen concentrations are expected to be higher than New York State Department of Health (DOH) considers safe for primary contact varies with location along the Creek. Generally, a value of 48 hours would be typical for the upper portion of the waterbody near the head end and a value between 24 to 48 hours would be typical for the remainder of Westchester Creek.

Table 8-12. Time to Recovery within Westchester Creek

	Time to Recovery (hrs) Fecal Coliform Target (1,000 cfu/100mL)
Station	**Preferred Alternative**
WC2	43
WC1	36
WC3	24
E13	0

8.8 RECOMMENDED LTCP ELEMENTS TO MEET WATER QUALITY GOALS

The LTCP elements described in this section are the culmination of efforts by DEP to attain Existing WQ Criteria. DEP recognizes that achieving water quality objectives requires more than the reduction of CSO discharges.

The Westchester Creek LTCP identified the following actions:

1. The LTCP includes a UAA that assesses compliance with WQ criteria based on the projected performance of the selected CSO controls.

2. A post-construction monitoring program will be initiated after the WWFP improvements are operational. Based upon the results of such monitoring, the projected levels of attainment of WQ criteria may need to be reviewed.

3. DEP will establish with the NYC Department of Health and Mental Hygiene through public notification a wet weather advisory during the recreational season (May 1st through October 31st), during which swimming and bathing would not be recommended in Westchester Creek. The LTCP includes a recovery time analysis that can be used to establish the duration of the wet weather advisory for public notification.

4. DEP will continue to implement the WWFP recommendations: Pugsley Creek parallel sewer and regulator modifications at CSO-29 and CSO-29A.

5. DEP will continue to implement the Green Infrastructure program.

6. DEP will include in the Bronx River LTCP an analysis to control floatables at Outfall HP-011 at the East River to address the increased CSO volume resulting from the planned WWFP recommendations.

7. DEP will investigate a new siphon as part of the Bronx River LTCP targeting Outfall HP-011 at the East River. This analysis will investigate the annual average overflow volumes (AAOV) resulting from the planned WWFP recommendations with the goal of increasing CSO flow to the Hunts Point WWTP.

Section 9.0 presents the implementation of these actions.

When the WWFP construction is completed, CSO volumes are projected to be reduced from over 800 MG to 290 MG for the 2008 typical year. Several alternatives that captured a range of the remaining CSO discharges from the Westchester Creek outfalls were investigated. As a result, DEP has determined that a reasonable approach moving forward is to complete the construction of the facilities recommended in the WWFP as well as the planned GI throughout the watershed given the high levels of attainment with Existing WQ Criteria and Primary Contact WQ Criteria analyzed in this LTCP, both seasonally and annually. As noted earlier, simulated levels of attainment below 95 percent were only observed for WQ Station WC2, on an annual basis.

The water quality of Westchester Creek will be improved by the substantial reduction in CSO volume from the investments in grey and green infrastructure of over $100M in the next few years. Additional green or grey improvements are not identified at this time; however, DEP will issue wet weather advisories while continuing to advance the improvements in Westchester Creek.

ATTACHMENT 4

Revised Appendix D: Westchester Creek Use Attainability Analysis

EXECUTIVE SUMMARY

The New York City (NYC) Department of Environmental Protection (DEP) has performed a Use Attainability Analysis (UAA) in accordance with the 2012 CSO Order on Consent for Westchester Creek; a tributary of the Upper East River, currently designated as a Class I waterbody. Westchester Creek originates as a headwall at CSO Outfall HP-014 and flows in a southerly direction toward the East River (Figure 1). There is no natural base flow in the Creek since any natural flow has been incorporated into the NYC municipal drainage system.

Figure 1. Aerial View of Westchester Creek

Detailed analyses performed during the Westchester Creek Long Term Control Plan (LTCP) concluded that the standards for the Class SC primary contact uses in this waterbody are not attained for both the annual fecal coliform and dissolved oxygen criteria. These analyses suggested that the Class SC dissolved oxygen criterion will not be attained even with the implementation of 100 percent combined sewer overflow (CSO) control. Each criterion is discussed below:

Fecal Coliform

Detailed analyses performed during the Westchester Creek LTCP concluded that the designated Class I secondary contact recreational uses in Westchester Creek are in full attainment (100 percent) for the fecal coliform criterion. However, based on this technical assessment, it was found that Westchester Creek would approach but not be able to attain Primary Contact Water Quality (WQ) Criteria 100 percent of the time throughout its full extension on an annual basis.

Dissolved Oxygen

Based on the technical assessment, the waterbody is not projected to attain the existing Class I or the Class SC dissolved oxygen criteria.

The inability to meet a primary contact bacteria standard is primarily due to direct drainage, CSO and urban runoff. Based upon water quality modeling, DEP projects that with the completion of the grey and green projects listed in this LTCP, there will be improvements in water quality in Westchester Creek. On the basis of these findings, DEP is requesting, through the UAA process, that the New York State Department of Environmental Conservation (DEC) upgrade Westchester Creek to Class SC/SB on a recreational season basis and consider wet weather advisories for the waterbody while the DEP continues to implement measures that further improve water quality.

INTRODUCTION

Regulatory Considerations

DEC has designated Westchester Creek as a Class I waterbody. The Class I classification does not provide for primary contact. The best usages of Class I waters are "secondary contact recreation and fishing" (6 NYCRR 701.13). The next higher classification is Class SC. The best usages of Class SC waters are "limited primary and secondary contact recreation and fishing" (6 NYCRR 701.11). The SC classification is presumed by DEC to be equivalent to attaining the fishable and swimmable goals of the Clean Water Act (CWA).

Federal policy recognizes that the uses designated for a waterbody may not be attainable, and the UAA has been established as the mechanism to modify the water quality standards (WQS) in such a case. Here, Westchester Creek meets the existing designated use classification. However, elimination of all CSOs will not result in full attainment of the next higher classification of SC or SB (note that the bacteria criteria for both of these classifications are the same).

This UAA identifies the attainable and existing uses of Westchester Creek and compares them to those designated by DEC, in order to provide data to establish appropriate WQS for these waterways. An examination of several factors related to the physical condition of the waterbody and the actual and possible uses suggests that the uses listed in the SC classification may not be attainable.

Under Federal regulations (40 CFR 131.10), six factors may be considered in conducting a UAA:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the waterbody to its original conditions or to operate such modification in a way that would result in the attainment of the use; or

5. Physical conditions related to the natural features of the waterbody, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

6. Controls more stringent than those required by Sections 301(b) and 306 of the Act [CWA] would result in substantial and widespread economic and social impact.

Identification of Existing Uses

Although the Westchester Creek watershed is primarily residential with some commercial, industrial and open space uses, the bulk of those commercial and industrial uses are concentrated along the immediate shorelines of the Creek. This limits direct shoreline access to Westchester Creek by the public to the parkland areas near the mouth (Figure 2). The eastern shoreline is bordered by the Hutchinson River Parkway and commercial properties along its entire length. The head end of the Creek is inaccessible from the Lehman High School athletic fields that occupy the property to the north, and the western shoreline is characterized by large commercial and industrial uses (Figure 3). The limited residential areas in the vicinity of Westchester Creek do not have direct access other than the parkland areas near the mouth. One of the southern parkland access ways to the shoreline is at Pugsley Creek, where the NYC Parks Department has provided a walking platform along a portion of its shore. Pugsley Creek is tributary to Westchester Creek at the very downstream end of Westchester Creek, where it joins the East River (Figure 5). Access is possible from Ferry Point Park on the eastern shore near the mouth, and at Castle Hill Park between Pugsley and Westchester Creeks.

With no access to the shoreline, Westchester Creek is not suitable for bathing, and as such there are no NYC Department of Health and Mental Hygiene (DOHMH) certified bathing beaches anywhere within the waterbody. Furthermore, because of the industrial nature of the waterbody, there are limited opportunities for kayaking, although that is an existing use. There are no areas suitable for wading or bathing, although, at a public meeting, comment was provided that at an area near the mouth of the Creek there have been instances of body immersion (Figure 4). Other uses identified by the public included fishing and wading. Notwithstanding this input, the bulk of the waterbody is unsuitable for primary contact uses.

Figure 2. Westchester Creek Shoreline

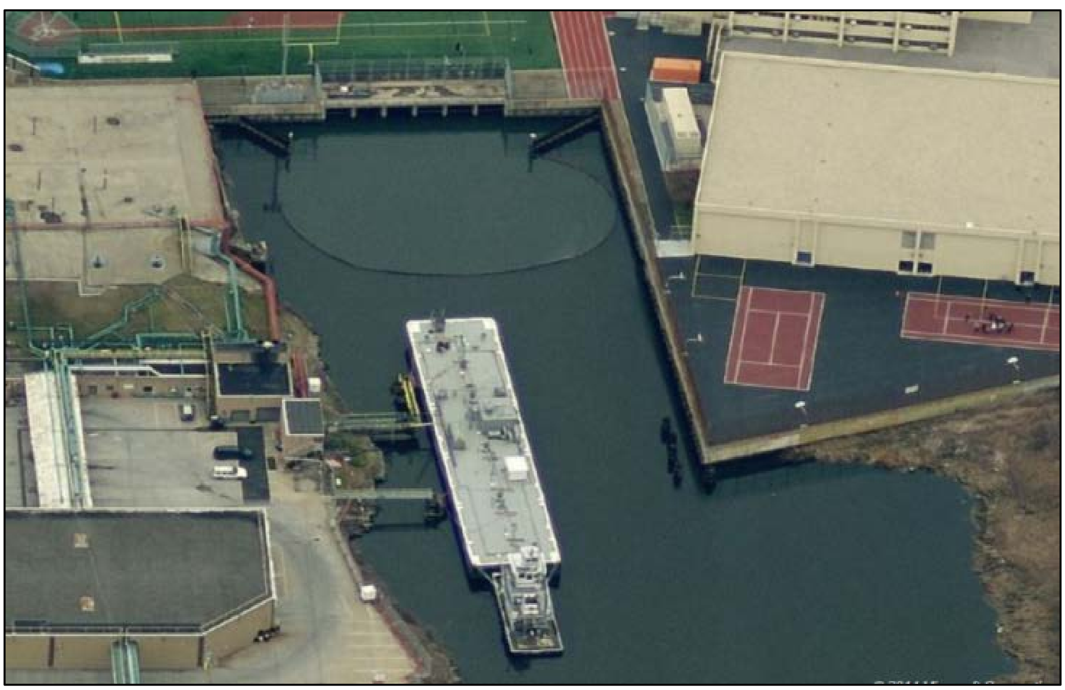

Figure 3. Head End of Westchester Creek Showing Outfall HP-014, Lehman H.S. and Fuel Barging Operation

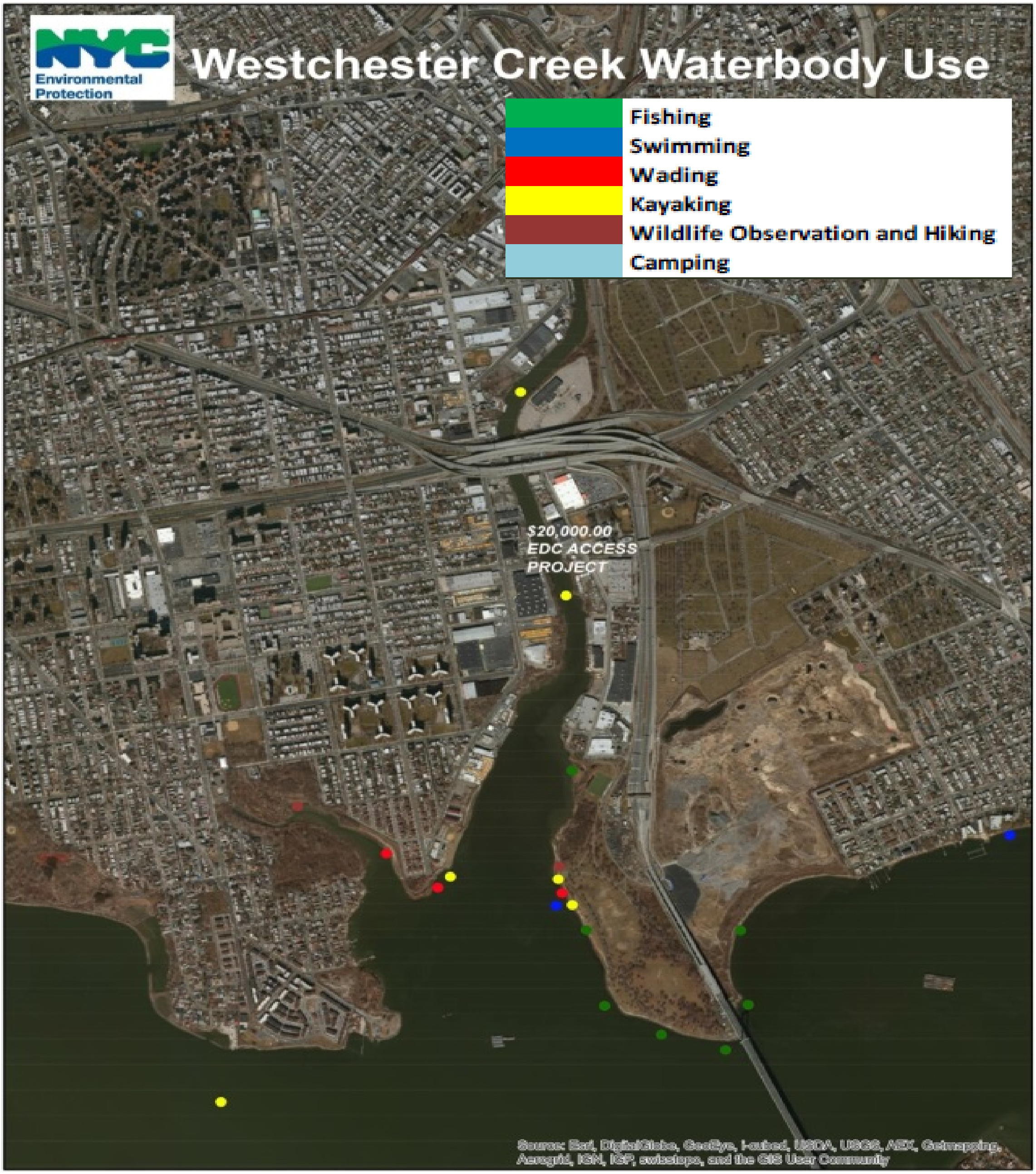

Figure 4. Uses Identified by the Public

Figure 5. Puglsey Creek Shoreline

ATTAINMENT OF DESIGNATED USES

Westchester Creek is a Class I waterbody, suitable for secondary contact recreation and aquatic life propagation and survival. As noted previously, Westchester Creek is used infrequently for secondary contact recreation, and although the public noted evidence of limited full body immersion, primary contact is not an existing use. However, as part of the LTCP, an analysis was performed to assess the level of attainment if DEC were to reclassify Westchester Creek to Class SC (limited primary contact recreation).

Water quality modeling and observed data indicate that the existing Class I (secondary contact) bacteria criterion is being achieved. With respect to the Class SC WQS, the annual attainment of the fecal coliform numeric criterion throughout the entirety of Westchester Creek is not possible 100 percent of the time due to CSOs, as well as additional pollutant sources other than CSOs (namely, direct drainage and urban stormwater). However, the analyses indicate that the waterbody would attain the SC/SB fecal coliform (monthly median) numeric criteria during the recreational season (May 1st through October 31st).

An analysis was also conducted during the development of the LTCP water quality model to predict the recovery time in Westchester Creek following a rain event. As primary contact uses could be attained in Westchester Creek during the recreational season a high percent of the time, DEP used the primary contact fecal coliform recreation warning level of 1,000 counts/100mL from the New York State Department of Health (DOH) guidelines in this analysis. The result of the analysis is summarized in Revised Section 8. As noted, the duration within which fecal coliform bacteria concentrations are expected to be higher than DOH considers safe for primary contact varies along the Creek. Generally, a value of around 48 hours or less appears to be reasonable for Westchester Creek.

DEP has been using model projections in various waterbodies and near beaches to assist with advisories that are typically issued twice a day. The recovery time is essentially the timeline that the waterbody will not support primary contact and is intended to advise the water users of the potential health risk associated with this use during this time period.

CONCLUSIONS

Westchester Creek attains the existing Class I WQS but cannot fully achieve the Primary Contact WQ Criteria of Class SC, based on fecal coliform on an annual basis. However, the analyses show that Primary Contact WQ Criteria can be attained throughout the recreational season a high percent of the time with the caveat that during and after rain events bacteria levels will be elevated. Westchester Creek is not used for primary contact recreation, so the non-attainment of fishable/swimmable standards during and after rainfall or during the non-recreational season would not impact existing waterbody uses. Non-attainment of Primary Contact WQ Criteria are attributable to the following UAA factors:

Fecal Coliform:

- Human caused conditions (direct drainage and urban runoff) create high bacteria levels that prevent the attainment of the use and that cannot be fully remedied for large storms (UAA factor #3).

- Changes to the shoreline to channelize it and create bulkheads have modified the water such that access to the Creek is limited [See UAA factor #4 (40 CFR 131.10(g)(2)].

Dissolved Oxygen

- Dams, diversions or other types of hydrologic modifications preclude the attainment of the use and it is not feasible to restore the waterbody to its original conditions or to operate such modification in a way that would result in attainment of the use (UAA factor #4).

- Physical conditions related to the natural features of the waterbody, such as the lack of proper substrate, cover, flow, depth, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses (UAA factor #5).

It should be emphasized that the Westchester Creek watershed surrounds an industrial waterbody with no shoreline access points for recreation and very limited known recreational uses of the waterway.

RECOMMENDATIONS

Westchester Creek attains the current Class I criterion for bacteria. Adopting Primary Contact WQ Criteria in Westchester Creek is possible on a limited basis although it may not result in increased uses given the existing industrial uses of the riparian area and the lack of adequate access points.

To protect such uses, DEP would implement wet weather advisories during the recreational season while advancing the waterbody towards the numerical limits established, or under consideration by DEC, including SC bacteria standards and the Potential Future Primary Contact WQ Criteria consistent with the 2012 EPA RWQC. With anticipated reductions in CSO overflows resulting from grey and green infrastructure, the Creek could be protective of limited primary contact should it occur, as long as it did not occur during and following rainfall events. Toward that end, DEP believes that a 48 hour wet weather advisory would be appropriate for the waterbody and should be implemented if DEC were to upgrade the Creek to a primary contact classification.

ATTACHMENT 5

Revised Appendix A: Supplemental Tables

Annual CSO and Stormwater Baseline Volumes (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total MG/Yr**
Westchester Creek	HP-012	CSO-23A	63
Pugsley Creek	HP-013	CSO-24	3
Westchester Creek	HP-014	CSO-29, CSO-29A	127
Westchester Creek	HP-015	CSO-22	1
Westchester Creek	HP-016	Regulator 4	63
Westchester Creek	HP-033	CSO-23	33
		Total CSO Volume	**290**

Stormwater Outfalls and Direct Drainage			
Waterbody	**Outfall**	**Regulator**	**Total MG/Yr**
Pugsley Creek	HP-504	NA	9
Westchester Creek	HP-602	NA	18
Pugsley Creek	HP-623	NA	27
Pugsley Creek	HP-625	NA	1
Westchester Creek	HP-635	NA	51
Westchester Creek	HP-839	NA	55
Direct Drainage	NA	NA	164
		Total Stormwater Volume	**325**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total MG/Yr**
Westchester Creek	-	-	575
Pugsley Creek	-	-	40

Totals by Source			
Source	**Outfall**	**Regulator**	**Total MG/Yr**
CSO	-	-	290
Stormwater/Direct Drainage	-	-	325

Totals by Source by Waterbody			
Waterbody	**Source**	**Percent**	**Total MG/Yr**
Westchester Creek	CSO	50%	287
	Stormwater/Direct Drainage	50%	288
	Total to Westchester Creek		**575**
Pugsley Creek	CSO	6%	3
	Stormwater/Direct Drainage	94%	37
	Total Volume to Pugsley Creek		**40**
		Total	**615**

Annual CSO and Stormwater Enterococci Baseline Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Westchester Creek	HP-012	CSO-23A	399
Pugsley Creek	HP-013	CSO-24	16
Westchester Creek	HP-014	CSO-29, CSO-29A	407
Westchester Creek	HP-015	CSO-22	2
Westchester Creek	HP-016	Regulator 4	116
Westchester Creek	HP-033	CSO-23	191
		Total CSO Load	**1,131**

Stormwater Outfalls and Direct Drainage			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Pugsley Creek	HP-504	NA	18
Westchester Creek	HP-602	NA	35
Pugsley Creek	HP-623	NA	51
Pugsley Creek	HP-625	NA	2
Westchester Creek	HP-635	NA	97
Westchester Creek	HP-839	NA	17
Direct Drainage	NA	NA	40
		Total Stormwater Load	**260**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Westchester Creek	-	-	1,303
Pugsley Creek	-	-	87

Totals by Source			
Source	**Outfall**	**Regulator**	**Total Org. x10^{12}**
CSO	-	-	1,131
Stormwater	-	-	260

Totals by Source by Waterbody			
Waterbody	**Source**	**Percent**	**Total Org. x10^{12}**
Westchester Creek	CSO	74	1,115
	Stormwater/Direct Drainage	26	189
	Total Load to Westchester Creek		**1,304**
Pugsley Creek	CSO	18	16
	Stormwater/Direct Drainage	82	71
	Total Load to Pugsley Creek		**87**
		Total	**1,391**

Annual CSO and Stormwater Fecal Coliform Baseline Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Westchester Creek	HP-012	CSO-23A	1,428
Pugsley Creek	HP-013	CSO-24	56
Westchester Creek	HP-014	CSO-29, CSO-29A	1,613
Westchester Creek	HP-015	CSO-22	6
Westchester Creek	HP-016	Regulator 4	732
Westchester Creek	HP-033	CSO-23	676
		Total CSO Load	**4,511**

Stormwater Outfalls and Direct Drainage			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Pugsley Creek	HP-504	NA	43
Westchester Creek	HP-602	NA	83
Pugsley Creek	HP-623	NA	123
Pugsley Creek	HP-625	NA	5
Westchester Creek	HP-635	NA	233
Westchester Creek	HP-839	NA	42
Direct Drainage	NA	NA	27
		Total Stormwater Load	**557**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Org. x10^{12}**
Westchester Creek	-	-	4,841
Pugsley Creek	-	-	227

Totals by Source			
Source	**Outfall**	**Regulator**	**Total Org. x10^{12}**
CSO	-	-	4,511
Stormwater	-	-	557

Totals by Source by Waterbody			
Waterbody	**Source**	**Percent**	**Total Org. x10^{12}**
Westchester Creek	CSO	81	4,455
	Stormwater/Direct Drainage	19	386
	Total Load to Westchester Creek		**4,841**
Pugsley Creek	CSO	25	56
	Stormwater/Direct Drainage	75	171
	Total Load to Pugsley Creek		**227**
		Total	**5,067**

Annual CSO and Stormwater BOD_5 Baseline Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Westchester Creek	HP-012	CSO-23A	15,019
Pugsley Creek	HP-013	CSO-24	644
Westchester Creek	HP-014	CSO-29, CSO-29A	29,572
Westchester Creek	HP-015	CSO-22	2,483
Westchester Creek	HP-016	Regulator 4	16,866
Westchester Creek	HP-033	CSO-23	7,292
		Total CSO BOD_5 Load	**71.876**

Stormwater Outfalls and Direct Drainage			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Pugsley Creek	HP-504	NA	1,126
Westchester Creek	HP-602	NA	2,252
Pugsley Creek	HP-623	NA	3,378
Pugsley Creek	HP-625	NA	125
Westchester Creek	HP-635	NA	6,380
Westchester Creek	HP-839	NA	6,881
Direct Drainage	NA	NA	20,516
		Total Stormwater Load	**40,658**

Totals by Waterbody			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Westchester Creek	-	-	107,261
Pugsley Creek	-	-	5,273

Totals by Source			
Source	**Outfall**	**Regulator**	**Total Lbs**
CSO	-	-	71,876
Stormwater	-	-	40,658

Totals by Source by Waterbody			
Waterbody	**Source**	**Percent**	**Total Lbs**
Westchester Creek	CSO		71,232
	Stormwater/Direct Drainage		36,029
	Total Load to Westchester Creek		**107,261**
Pugsley Creek	CSO		644
	Stormwater/Direct Drainage		4,629
	Total Load to Pugsley Creek		**5,273**
		Total	**112,534**