7.0 PUBLIC PARTICIPATION AND AGENCY COORDINATION

The DEP is committed to implementing a proactive and robust public participation program to inform the public of the development of the watershed-specific and citywide LTCPs. Public outreach and public participation are important aspects of plans designed to reduce CSO-related impacts to achieve waterbody-specific WQS, consistent with the federal CSO Policy and the CWA, and in accordance with EPA and DEC mandates.

DEP's Public Participation Plan was released to the public on June 26, 2012, and describes the tools and activities DEP will use to inform, involve and engage a diverse group of stakeholders and the broader public throughout the LTCP process. The purpose of the Plan is to create a framework for communicating with and soliciting input from interested stakeholders and the broader public, concerning water quality and the challenges and opportunities for CSO controls. As described in the Public Participation Plan, DEP will strategically and systematically implement activities that meet the information needs of a variety of stakeholders in an effort to meet critical milestones in the overall LTCP schedule outlined in the amended 2012 CSO Order on Consent signed by DEC and DEP on March 8, 2012.

As part of the CSO Quarterly Reports, DEP will report to DEC on public participation activities outlined in the Public Participation Plan. Updates to the Public Participation Plan that are implemented as a result of public comments received will be posted annually to DEP's website, along with the quarterly summary of public participation activities reported to DEC.

7.1 Local Stakeholder Team

DEP began the public participation process for the Gowanus Canal LTCP by reaching out to the Brooklyn Community Board 6, to identify the stakeholders who would be instrumental to the development of this LTCP. Stakeholders identified included both citywide and regional groups, including: environmental organizations (Gowanus Dredgers, Community Advisory Group, New Yorkers for Parks, New York Environment Report, Gowanus Canal Community Development Corporation, Riverkeeper, Gowanus Canal Conservancy); interest groups (University College London, Columbia University, St. Lydia's Church, Fifth Avenue Committee, Louis Berger, National Grid, HWA, Steven Winter Association, NYCC); NYC governmental entities (Brooklyn Borough Office and Council members, NYC Department of Parks and Recreation, NYC Department of City Planning) and State assembly and senate members.

7.2 Summaries of Stakeholder Meetings

DEP has held public meetings and several stakeholder group meetings to aid in the development and execution of the LTCP. The objective of the public meetings and a summary of the discussion are presented below:

Public Meetings

- <u>Public Meeting #1: Gowanus Canal LTCP Kickoff Meeting (November 19, 2014)</u>

  Objectives: Provide overview of LTCP process, public participation schedule, watershed characteristics and improvement projects; solicit input on waterbody uses.

DEP and DEC co-hosted a Public Kickoff Meeting to initiate the water quality planning process for long term control of CSOs in the Gowanus Canal waterbody. The two-hour event, held at Public School 32, 317 Hoyt Street in Brooklyn, served to provide overview information about DEP's LTCP Program, present information on the Gowanus Canal watershed characteristics and status of waterbody improvement projects, obtain public information on waterbody uses in the Gowanus Canal, and describe additional opportunities for public input and outreach. The presentation can be found at http://www.nyc.gov/dep/ltcp. Approximately 55 stakeholders from 32 different non-profit, community, planning, environmental, economic development, governmental organizations and the broader public attended the event, and two reporters from local newspapers.

The Gowanus Canal LTCP Kickoff Public Meeting was the first opportunity for public participation in the development of this LTCP. In response to stakeholder comments, DEP provided detailed information about each of the following:

- CSO reductions and potential existing and future CSO-related projects in the Gowanus Canal;
- Modeling baseline assumptions utilized during LTCP development;
- Rainfall amounts and other assumptions utilized during LTCP development;
- Water quality data collection;
- Existing Gowanus Canal CSO discharges; and
- Future public meeting announcements.

Stakeholder comments and DEP's responses are posted to DEP's website and are included in Appendix B, Public Participation Materials.

- Public Meeting #2: Gowanus Canal LTCP Alternatives Review Meeting (May 14, 2015)

Objectives: Review proposed alternatives, related waterbody uses and water quality conditions.

DEP hosted the second of three public meetings for the water quality planning process for long term control of CSOs in the Gowanus Canal waterbody. The two-hour event was held at Public School 32, 317 Hoyt Street in Brooklyn. DEP presented information on the LTCP process, the Gowanus Canal watershed characteristics, and the status of engineering alternatives evaluations, and provided opportunities for public input. The presentation can be found at http://www.nyc.gov/dep/ltcp. Approximately 35 stakeholders from 20 different non-profit, community, planning, environmental, economic development, governmental organizations and the broader public attended the event and one representative from the local media.

In response to stakeholder comments, DEP provided detailed information about each of the following:

- Modeling baseline assumptions utilized during LTCP development, including the rainfall conditions utilized;
- Existing and future predicted CSO discharges;
- Water quality data collection;
- Stormwater inputs/contributions to the Gowanus Canal;

- Green infrastructure and grey infrastructure potential alternatives;
- Opportunity to review and comment on the draft Gowanus Canal LTCP; and
- Future public meeting announcements.

Stakeholder comments and DEP's responses are posted on DEP's website, and are included in Appendix B, Public Participation Materials.

- Public Meeting #3: Draft LTCP Review Meeting (not yet scheduled)

  Objectives: Present LTCP after review by DEC

  The purpose of this meeting will be to present the final recommended plan to the public after DEC review. Outcomes of the discussion and a copy of presentation materials will be posted to DEP's website.

Stakeholder Meetings

- Public Meeting at Wyckoff Gardens Community Center (September 17, 2014)

  DEP held a meeting to present information on tank siting in connection with the EPA September 2013 ROD for the Gowanus Canal Superfund Site.

- Meeting with Riverkeeper and Bronx Alliance (November 18, 2014)

  DEP held a meeting with Riverkeeper on November 18, 2014. During this meeting, DEP staff presented sampling data obtained during the LTCP2 Gowanus Canal sampling programs, as well as data from Harbor Survey and Sentinel monitoring.

- Expo Gowanus (May 28, 2015)

  DEP attended a community event featuring design, stewardship and investigation projects and ideas that enhance the health of the Gowanus Canal and the watershed.

Public Comments Received

No public comments were received following the Gowanus Canal Public Kickoff and Alternatives Review Meetings.

7.3 Coordination with Highest Attainable Use

DEC has established WQS for all navigable waters within its jurisdiction. The Gowanus Canal is classified Class SD in its upper section, and Class I in its lower section. A Class SD waterbody is defined in 6 NYCRR 701.13 as "suitable for fish, shellfish, and wildlife survival" and Class I is defined as "suitable for fish propagation and survival". The best usage of Class SD waters is fishing; for Class I, "secondary contact recreation and fishing" (6 NYCRR 701.14. Class SD does not currently have assigned numerical bacteria criteria. DEC has publicly noticed a proposed rulemaking to amend 6 NYCRR Parts 701 and

703. The proposed total and fecal coliform bacteria criteria of 200 cfu/100mL would be the same for Class SD, Class I and SC waters.

Detailed analyses performed during the Gowanus Canal LTCP concluded that the standards for the Primary Contact WQ criteria for bacteria will be fully attained. A variance for DO levels would be still be required. However, consideration of upgrading the Gowanus Canal to Class SC should await completion of the construction associated with Superfund remedial measures as well as post-construction compliance monitoring.

7.4 Internet Accessible Information Outreach and Inquiries

Both traditional and electronic outreach tools are important elements of DEP's overall communication effort. DEP will ensure that outreach tools are accurate, informative, up-to-date and consistent, and are widely distributed and easily accessible. Table 7-1 presents a summary of the Gowanus Canal LTCP public participation activities.

DEP launched its LTCP Program website on June 26, 2012. The website provides links to documents related to the LTCP Program, including CSO Orders on Consent, approved WWFPs, CSO Quarterly Reports, links to related programs such as the Green Infrastructure Plan, and handouts and poster boards distributed and displayed at public meetings and open houses. An LTCP feedback email account was also created to receive LTCP-related feedback, and stakeholders can sign up to receive LTCP Program announcements via email. DEP's LTCP Program website:

- Describes the LTCP process, CSO-related information and citywide water quality improvement programs to-date;
- Describes waterbody-specific information including historical and existing conditions;
- Provides the public and stakeholders with timely updates and relevant information during the LTCP process including meeting announcements;
- Broadens DEP's outreach campaign to further engage and educate the public on the LTCP process and related issues; and
- Provides an online portal for submission of comments, letters, suggestions, and other feedback.

Table 7-1. Summary of Gowanus Canal LTCP Public Participation Activities Performed

Category	Mechanisms Utilized	Dates (if applicable) and Comments
Regional LTCP Participation	Citywide LTCP Kickoff Meeting and Open House	• June 26, 2012
	Annual Citywide LTCP Meeting – Modeling Meeting	• February 28, 2013
Waterbody-specific Community Outreach	Public meetings and open houses	• Kickoff Meeting: November 19, 2014 • Meeting #2: May 14, 2015 • Meeting #3: TBD

Table 7-1. Summary of Gowanus Canal LTCP Public Participation Activities Performed

Category	Mechanisms Utilized	Dates (if applicable) and Comments
	Elected officials briefings	• November 18, 2014
Data Collection and Planning	Establish online comment area and process for responding to comments	• Comment area added to website on October 1, 2012 • Online comments receive response within two weeks of receipt
	Update mailing list database	• DEP updates master stakeholder database (700+ stakeholders) before each meeting
Communication Tools	Program Website or Dedicated Page	• LTCP Program website launched June 26, 2012 and frequently updated • Gowanus Canal LTCP webpage launched November 20, 2014 and frequently updated
	Social Media	• TBD
	Media Outreach	• Published advertisements in newspapers, Caribbean Life, Corier Life, and The Brooklyn Paper
	FAQs	• LTCP FAQs developed and disseminated beginning June 2014 via website, meetings and email
Communication Tools	Print Materials	• LTCP FAQs: November 19, 2014 • LTCP Goal Statement: June 26, 2012 • LTCP Public Participation Plan: June 26, 2012 • Gowanus Canal Summary: November 19, 2014 • LTCP Program Brochure: November 19, 2014 • Glossary of Modeling Terms: February 28, 2013 • Meeting advertisements, agendas and presentations • PDFs of poster board displays from meetings • Meeting summaries and responses to comments • Quarterly Reports • WWFPs
	Translated Materials	• As-needed basis
	Portable Informational Displays	• Poster board displays at meetings
Student Education	Participate in ongoing education events	• N/A
	Provide specific green and grey infrastructure educational modules	• N/A

A dedicated Gowanus Canal LTCP webpage was created on November 20, 2014, and includes:

- Gowanus Canal public participation and education materials
  - Gowanus Canal Summary Paper
  - LTCP Public Participation Plan
- Gowanus Canal LTCP Meeting Announcements
- Gowanus Canal Kickoff Meeting Documents – November 19, 2014
  - Advertisement
  - Meeting Presentation
  - Meeting Summary and Response to Comments
- Gowanus Canal Meeting #2 Meeting Documents – May 14, 2015
  - Meeting Advertisement
  - Meeting Presentation
  - Meeting Summaries and Responses to Comments

8.0 EVALUATION OF ALTERNATIVES

This section describes the development and evaluation of 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 GI) 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 the Gowanus Canal.

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).

To evaluate attainment with WQS that would be achieved by the various CSO control alternatives evaluated in this section, the bacteria and DO water quality criteria presented in Section 6.0, Table 6-3 were applied. The Gowanus Canal is the focus of an EPA program conducted under CERCLA (or "Superfund") in connection with the Gowanus Canal Superfund Site through an EPA Administrative Order for Remedial Design, Index No. CERCLA 02-2014-2019, issued to NYC in advance, and independent of this LTCP, but with has a CSO-related mitigation component. Where that effort intersects with, and has an impact on, the evaluation of the CSO controls discussed below, it has been noted throughout this section.

8.1 Considerations for LTCP Alternatives under the Federal CSO Policy

This LTCP addresses the water quality objectives of the CWA, the EPA CSO Control Policy, and the NYS ECL. This LTCP also builds upon the conclusions presented in DEP's August 2008 Gowanus Canal WWFP. As required by the 2012 CSO Order on Consent, when the proposed alternative set forth in the LTCP will not achieve Existing WQ Criteria or the Section 101(a)(2) goals, a UAA is required.. A UAA is the mechanism to determine whether applicable waterbody classifications, criteria, or standards should be adjusted by the State. If deemed necessary,, the UAA assesses compliance with the next higher classification that the State would consider in adjusting WQS. For the reasons detailed in Section 8.6, a UAA was deemed unnecessary for this LTCP.

The remainder of Section 8.1 discusses the development and evaluation of CSO control measures and watershed-wide alternatives to comply with applicable WQS and with the CSO Control Policy. The evaluation factors considered for each alternative are described below followed by an overview of the evaluation process.

8.1.a Performance

Section 6.0 presented evaluations of baseline LTCP conditions, and concluded that no performance gaps exist because of attainment of existing designated WQS (Classes SD and I) projected for baseline conditions, (i.e., 2040 CY design dry-weather flow and load projections; 2xDDWF at Owls Head and Red Hook WWTPs; implementation of WWFP recommended cost-effective grey; GI implementation rate of 12 percent; and completion of Superfund dredging to the depths specified in the *Feasibility Study Report for the Gowanus Canal Site Brooklyn, NY, December 2011)*. The analyses presented in Section 6.0 show that the Gowanus Canal currently attains the recreational season (May 1^{st} through October 31^{st}) fecal coliform component of the Primary Contact WQ Criteria (200 cfu/100mL). Annual attainment of the fecal coliform criterion of the Primary Contact WQ Criteria is achieved approximately 92 percent of the time based on the typical year (2008) rainfall, based WWFP control alone, even without any additional CSO controls. In addition, baseline enterococci concentrations are projected to meet the Potential Future Primary Contact GM component of the WQ Criteria even without further CSO controls. However, performance gaps exist between baseline projected water quality and the STV criterion of the Potential Future Primary Contact WQ Criteria (2012 EPA RWQC).

The analyses in Section 6.0 showed that the waterbody also attains the applicable DO criteria (Classes SD and I) without additional CSO controls. Thus, through implementation of the projects recommended in the August 2008 WWFP and other CSO planning documents, including the Flushing Tunnel and Gowanus PS upgrades, water quality in the Gowanus Canal has steadily improved to the point where the waterbody is in full compliance with current WQS, and also largely attains the Section 101(a)(2) goals, as projected by the 10-year model runs presented later in this section. Moreover, current water quality of the Gowanus Canal substantially meets the fishable/swimmable goals of the CWA.

As a result of the substantial investments made through the WWFP projects, the Gowanus Canal meets both existing WQS the Potential Future Primary Contact GM. Nevertheless, this section reviews alternatives that could improve water quality still further. A major focus of the development and evaluation of control alternatives for LTCPs is the ability to achieve bacteria load reduction and to attain applicable water quality criteria using a two-step process. First, based upon watershed (IW) model runs for typical year (2008) rainfall, the level of CSO control of each alternative was established, including the reduction of CSO volume, fecal coliform and enterococci loading. The second step used the previously estimated levels of CSO control to project levels of attainment in the receiving waters. This step used the Gowanus Canal water quality model. LTCPs are typically developed with alternatives that span a range of CSO volumetric and loadings reductions. Accordingly, this LTCP includes alternatives that consider a wide range of reductions in CSO - up to 100% CSO control - including investments that would be made by DEP through green and grey infrastructure. Intermediate levels of CSO volume control - approximately 50% and 75% - were also evaluated. The intermediate levels of CSO control analyzed in this LTCP were selected based on the CSO controls evaluated under the Superfund framework, as well as by other controls conceptualized under the LTCP framework. Performance of each control alternative was measured against its ability to meet the CWA and water quality requirements for the 2040 planning horizon as described in Section 6.0.

8.1.b Impact on Sensitive Areas

In developing LTCP alternatives, special effort is made to minimize the impact of construction, to protect existing environmentally sensitive areas, and to enhance water quality in those areas. As described in

Section 2.0, no environmentally sensitive areas exist within the Gowanus Canal, so this criteria is not applicable to this LTCP.

8.1.c Cost

For the purpose of this LTCP, three sources/methods of estimating the construction costs of CSO control alternatives were used to determine their PBC, namely:

- Preliminary estimation based on historical construction costs of equivalent projects.
- Costs estimated used in the Superfund evaluations.
- Typical LTCP methodology 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 purposes of this LTCP, all costs are reported in 2015 dollars.

For the alternatives evaluated, annual O&M costs were used to calculate the total or NPW over the projected useful life of the project. A lifecycle of 20 years and an interest rate of three percent were assumed resulting in a Present Worth Factor of 14.877. The O&M costs for all alternatives were derived from historical costs of operating equivalent facilities and equipment within NYC, or were developed within the Superfund framework. In some instances, as costs are further refined through the Superfund framework, the O&M costs may differ from those reported herein based on different estimation methods.

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. A pronounced inflection point appearing in the resulting graphs, the so-called “knee-of-the-curve” (KOTC), suggests 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, or preferred, alternative must be capable of improving 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 environmental benefits, 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
- Implementability

The effectiveness of CSO control measures was assessed based on their ability to reduce CSO frequency, volume, and loadings. 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 to evaluate the implementability of a given control measure or basin-wide alternative, including available space, neighborhood assimilation, impact on parks and green space, and overall practicability of installing, and later maintaining, CSO controls. 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 were evaluated under the 2040 design year sanitary flows (dry-weather flow), 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.

Breaking construction into segments allowed adjustment of the design of future phases based on monitoring the performance of already-constructed phases. Lessons learned during operation of the current infrastructure can be incorporated into the design of future infrastructure. However, phased construction also exposes the local community to a longer construction period. Where applicable, the LTCP discusses constructability, potentially required additional infrastructure and land acquisition, as well as adaptive management strategies.

As regulatory requirements change, other water quality improvements may be required. The ability of a CSO control technology to be retrofitted to handle process improvements improves the assessment of that technology.

Finally, all LTCPs include provisions for PCM, as appropriate, to monitor the effectiveness of the implemented control measures.

8.1.f Long Term Phased Implementation

According to the CSO Control Policy, implementation steps are structured in a way that makes them adaptable to change by expansion and modification, 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 must be identified prior to selection of the alternative.

8.1.g Other Environmental Considerations

When construction is required, impacts on the environment and surrounding neighborhood will be minimized as much as possible. 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. The specific details on the mitigation of the identified concerns and/or impacts, such as erosion control measures and the rerouting of traffic, for example, will be addressed in a pre-construction environmental impact 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 to the public throughout the development of this LTCP. Community acceptance of the recommended plan is essential to its success.

As such, DEP has used the LTCP public participation process to gain that acceptance. The public's health and safety are a priority of the Plan. DEP's goal of raising awareness of and access to waterbodies was considered throughout the alternative analysis. Several CSO control measures, such as GI, have been shown to enhance communities while increasing local property values. As such, the benefits of GI were considered in the formation of the baseline and the final recommended plan. DEP also has considered, and planned other projects to enhance community well-being, such as projects targeting flood mitigation.

8.1.i Methodology for Ranking Alternatives

The multi-step evaluation process that DEP employed in developing this alternatives analysis included the following:

1. Evaluating benchmarking scenarios, including baseline and 100% CSO control, to establish the full range of controls within the Gowanus Canal watershed. The results of this step were described in Section 6.0.
2. Developing a list of promising control measures for further evaluation based, in part, on a prioritized list of CSO outfalls.
3. Conducting a series of "brainstorming" workshops to review and further advance the most promising control measures and to solicit additional options to explore.
4. Estimating both costs and performance of the most promising control measures to establish a listing of retained measures for inclusion in basin-wide alternatives.
5. Establishing the preferred alternative from the steps above.

Unique to the Gowanus Canal LTCP, there were also a number of coordination meetings with EPA concerning the Gowanus Canal Superfund program. During these meetings, these two independent legal mandates (CWA and Superfund) were discussed with respect to their possible overlap of purpose and/or points of coordination. The range of CSO control measures that were considered for this and other LTCPs fall under the categories of Source Control, System Optimization, CSO Relocation, Water Quality/Ecological Enhancement, Treatment, and Storage, with the following constituents:

Source Control
- Additional GI Infrastructure
- HLSS

System Optimization
- Fixed Weir Modifications
- Parallel Interceptor Sewer
- Inflatable Dams, Bending Weirs and Control Gates
- PS Expansion

CSO Relocation
- Gravity Flow Tipping to Other Watersheds
- Pump Station Modifications
- Flow Tipping with Conduit/Tunnels and Pumping

Water Quality/Ecological Enhancement

- Floatables Control
- Dredging
- DO Improvement
- Flushing Tunnel

Treatment

- Outfall Disinfection
- Retention Treatment Basin (RTB)
- High Rate Clarification (HRC)

Storage

- In-System
- Shaft
- Tank
- Tunnel

Figure 8-1 presents these control measures according to their relative cost and level of complexity. The control measures in the upper left hand corner are generally the least costly and least complex to construct and/or operate, while those towards the lower right are the most costly and most complex to construct and/or operate. The level of loads removal performance of each measure typically corresponds with the level of cost and complexity.

The vast majority of the control measures shown above were screened-out early in the evaluation process upon the results of the performance gap from Section 6.0, analysis of the collection system and compatibility with the available sites. Unique to this LTCP, the EPA Superfund evaluations also informed the evaluation process. For example, the Superfund evaluations focused primarily on storage tanks due to their ability to reduce TSS loadings to the Gowanus Canal, a priority for the CSO-related portion of the Superfund ROD for this site. Thus, to provide consistency in both sets of evaluations, storage tanks were evaluated here as well.

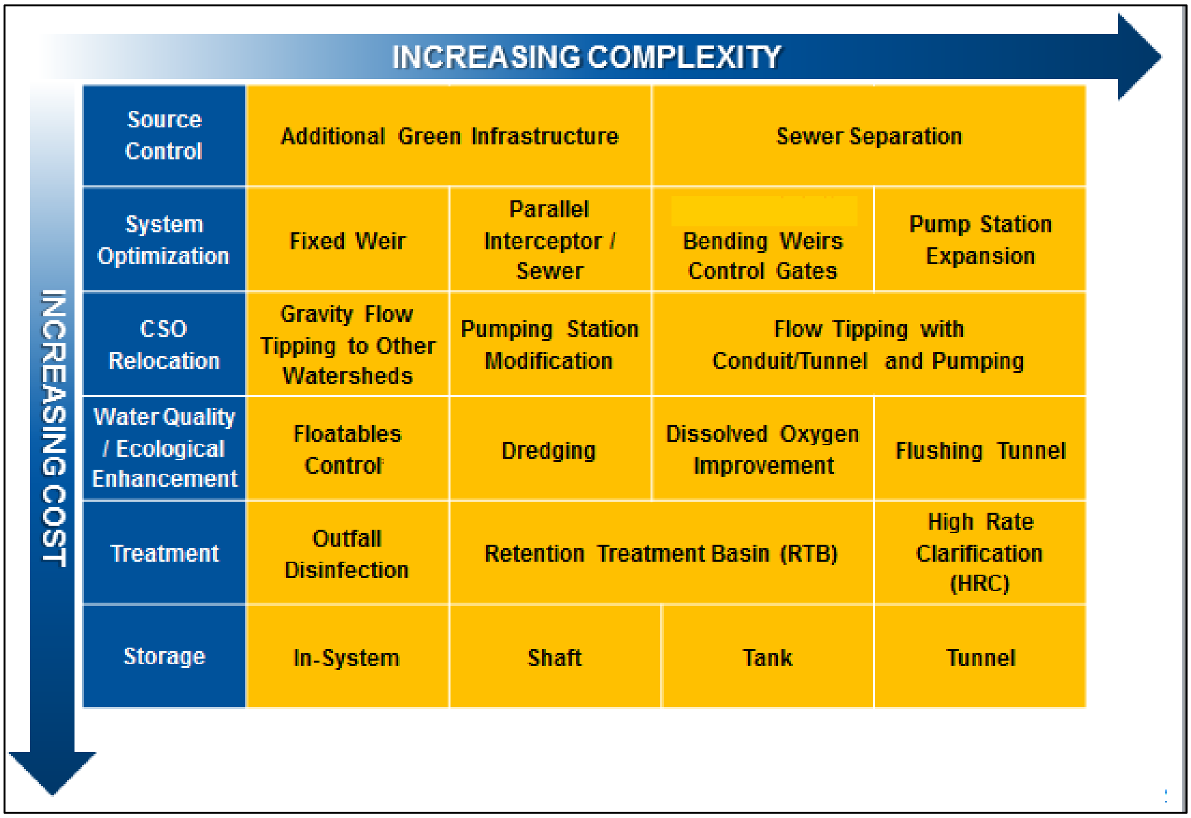


Figure 8-1. Matrix of CSO Control Measures for the Gowanus Canal

Alternatives to tanks were also evaluated, including those in the System Optimization category (directing flow to other watersheds through flow tipping, weir modification and parallel or increased sewer capacity of the Bond Lorraine Sewer), as were deep tunnels in the Storage Category to provide higher levels of volumetric control (75 and 100% CSO Control).

8.2 Matrix of Potential CSO Reduction Alternatives to Close Performance Gap from Baseline

The performance gap for the typical year (2008) water quality model simulation of baseline conditions described in Section 6.0 is quite small with respect to the annual minimum attainment of the 200 cfu/100mL fecal coliform criterion, a key component of the Primary Contact WQ Criteria. Using the 2008 typical year computer run, projected attainment for this criterion is 92 percent; it is 100 percent for the recreational season (May 1st through October 31st). As described later in this section, when the full 10-year simulation is run, seasonal attainment of the 200 cfu/100mL criterion exceeds 95 percent, which is the target level of attainment for this analysis as established by the DEC. Thus, based on this latter, more representative analysis, there is no performance gap with Existing WQ Criteria or Primary Contact WQ GM Criteria. Under either typical year or 10-year model runs, a performance gap exists between baseline conditions and the STV 110 cfu/100mL enterococci criterion of the Potential Future Primary Contact WQ Criteria.

In summary, the evaluation of control measures for the Gowanus Canal LTCP focused on improving attainment of the Potential Future Primary Contact WQ Criteria, and to determine whether additional water quality benefits would be derived from implementing the Superfund CSO control measures.

With the above context, control measures that advanced beyond initial screening were evaluated against three of the key considerations described in Section 8.1: (1) benefits, as expressed by levels of CSO control and WQS attainment; (2) costs; and (3) challenges, such as siting, construction, and operations. Using this methodology, the control measures that were deemed most viable for the Gowanus Canal 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.

The evaluations of control measures and basin-wide alternatives focused on Outfalls RH-034 and OH-007, the two largest contributing CSOs in the Gowanus Canal watershed. However, alternatives also were considered for other, smaller overflows in conjunction with the two tunnel alternatives.

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 that were 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 projects implemented under previous CSO control programs and facility plans, such as the 2008 WWFP, were described in Section 4.0. These include refurbishment of the Gowanus Canal Flushing Tunnel system, construction of a new force main to the Columbia Street interceptor, and the reconstruction of the Gowanus PS.

8.2.a.1 High Level Sewer Separation

HLSS is a form of partial separation that separates stormwater from streets or other public rights-of-way from combined sewers, while leaving roof leaders or other building connections unaltered. In NYC, this is typically accomplished by constructing a new shallow stormwater system and directing flow from street inlets and catch basins to the new storm sewers and reducing CSO volumes. Challenges associated with HLSS include constructing new sewers with minimal disruption to the neighborhoods along the proposed alignment, and finding a viable location for necessary new stormwater outfalls. Separation of sewers reduces the amount of CSO being discharged to receiving waters, but results in increased separate stormwater discharges to receiving waters.

HLSS was considered in the 2008 WWFP, but was not recommended at that time. However, DEP does plan to implement a HLSS project in the watershed to address localized flooding, scoped outside the LTCP process. As noted, although HLSS was not recommended in prior CSO planning efforts, it has been included in the baseline conditions described in Section 6.0, as its multi-phased implementation is scheduled to commence in the near-term. Figure 8-2 shows the affected area.

As described earlier, the HLSS is planned to be implemented in two phases. Details of the projects were provided in Sections 2.0 and 6.0.

Figure 8-2. Proposed Gowanus Canal HLSS

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: regulator or weir modifications including fixed and bending weirs; control gate modifications; real time control (RTC); and increasing the capacity of select conveyance system components, such as gravity lines, pump stations and/or force mains. Force main relocation or interceptor flow regulation also 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.

As part of the control measure review process described in Section 8.1, two system optimization measures made it past the initial screening process and were subsequently developed and evaluated for the Gowanus Canal:

- Reconstruction of the Bond Lorraine Sewer targeting CSO reduction at Outfall RH-034
- Regulator modifications targeting CSO reduction at Outfalls OH-006, OH-007 and OH-024

Each is described as follows:

Reconstruction of the Bond Lorraine Sewer

The Bond Lorraine Sewer, shown in Figure 8-3, is a 72-inch-diameter sewer that runs from the Gowanus PS southward along Bond Street on the western side of the Gowanus Canal to Lorraine Street. The Bond Lorraine Sewer originates at Bond and Douglas Streets and terminates at the beginning of the Red Hook Interceptor Sewer on Columbia Street. It is approximately 2.5 miles in length and accepts gravity flow from its tributary drainage area. The Bond Lorraine Sewer has two relief points that can discharge into the Gowanus Canal via Outfalls RH-035 and RH-031. Prior to the recent reconstruction, the Gowanus PS discharged its flow into the Bond Lorraine Sewer.

Figure 8-3. Bond Lorraine Sewer

A general chronology of the Bond Lorraine Sewer over the last hundred-plus years follows:

- 1890s – Bond Lorraine Sewer Constructed (72-inch diameter).
- 1947 – Gowanus PS (22 MGD) constructed to reduce dry-weather overflows at Outfall RH-034 into the Gowanus Canal.
- 1970s – Bond Lorraine Sewer control structures raised to eliminate dry-weather overflows into the Gowanus Canal.
- 1980s – Gowanus PS Upgrade including construction of a high density polyethylene (HDPE) force main within the Flushing Tunnel to reduce overflows from the Bond Lorraine Sewer into the Gowanus Canal.
- 1990s – Gowanus PS flow routed to Bond Lorraine Sewer because force main within Flushing Tunnel failed.
- Current – Reconstruction of the Gowanus PS increased capacity and replaced original HDPE force main with a concrete encased ductile iron force main within the Flushing Tunnel removing the pumped flow from Bond Lorraine Sewer.

With respect to this LTCP, the reconstruction and enlarging of the Bond Lorraine Sewer was evaluated as a means of reducing CSO loadings to the Gowanus Canal from Outfall RH-034 and potentially eliminating the need for a CSO storage tank at this outfall as was recommended by the EPA ROD. Specifically, this control measure consists of replacing the existing Bond Lorraine Sewer with an enlarged 6-ft-by-8-ft box sewer for improved conveyance capacity. Two alternative concepts were considered: Alternative 1 evaluated a new pump station to be constructed in the vicinity of Outfall RH-034 near the existing Gowanus PS to convey up to 20 MGD of CSO flow to the enlarged Bond Lorraine Sewer. Alternative 2 would redirect approximately 200 acres of tributary area away from the Gowanus PS and divert it directly by gravity to the enlarged Bond Lorraine Sewer, thus eliminating the need for a new pump station. The layout of both alternatives is shown in Figure 8-4. The enlarged Bond Lorraine Sewer is a common element to both alternatives.

Weir elevations at Outfalls RH-035 and RH-031 would also be raised to prevent increased CSO discharges into the Gowanus Canal. Alternative 1 includes a 0.75-ft increase at the Outfall RH-035 weir and a 0.65-ft increase at the Outfall RH-031 weir. Other existing weir elevations need not be modified.

The benefits, costs and challenges associated with enlarging the Bond Lorraine Sewer are as follows:

<u>Benefits:</u>

The primary benefit for both alternatives involves CSO loading reductions into the Gowanus Canal from Outfall RH-034. Alternative 1 achieves a 47% CSO volume reduction at RH-034 as a result of the higher pump capacity realized by the new dedicated pump station. However, the corresponding CSO discharges into Gowanus Bay and Buttermilk Channel increase by 16 MGY and 48 MGY, respectively. This is due to the conveyance capacity of the Red Hook Interceptor not being able to convey the additional CSO flows from the Bond Lorraine Sewer. However, the increased discharges into Gowanus Bay and Buttermilk Channel are unlikely to have significant water quality impacts on these waterbodies, as the incremental volumes are small in comparison to the available assimilation capacity. The overflow reduction at Outfall RH-034 obtained by Alternative 2 was 59 percent, with flows conveyed by gravity instead of pumping. Similarly, the corresponding CSO discharges into Gowanus Bay and Buttermilk Channel increase by 16 MGY and 49 MGY, respectively.

Figure 8-4. Alternatives Layout for Bond Lorraine Sewer

Both alternatives will also likely alleviate flooding in this area. An additional benefit is it eliminates the need to site a structure on a highly contaminated manufacturing gas plant (MGP) site with extensive remediation of the site required before construction can begin.

Both alternatives will reduce CSO volumes by removing stormwater from the combined sewer system. It is not simply a redirection of CSO flow.

<u>Costs</u>:

The Probable Bid Cost for the Bond Lorraine Sewer options are $313M for Alternative 1 and $334M for Alternative 2.

<u>Challenges:</u>

The Bond Lorraine Sewer poses significant challenges. Principal among them are complex construction issues associated with removing the existing 72-inch-diameter Bond Lorraine Sewer and replacing it with an enlarged 6-ft-by-8-ft box structure. Construction would require very conservative methods including:

- Extensive soil borings and test pits
- Sheeting
- Dewatering

- Pile supports
- Underpinning of structures, where needed
- Every structure within a 300-ft radius of the construction route will need to be inspected and continuously monitored
- Relocation of all subsurface and surface utilities
- Temporary bypass pumping (24/7) of sewage to facilitate new sewer construction
- Likelihood that some buildings will need to be condemned and demolished.

Alternative 1 would require a site to construct a new pump station in the vicinity of Outfall RH-034, whereas Alternative 2 would require additional sewer construction to direct up to 200 acres of drainage directly to the Bond Lorraine Sewer by gravity. Under both alternatives, the enlarged Bond Lorraine Sewer remains surcharged along its entire length, in conflict with the drainage plan criteria for new sewer construction. Because of the conveyance limitations of the beginning section of the Red Hook interceptor, both alternatives will redistribute CSO volume from the Gowanus Canal to downstream portions of Gowanus Bay and Buttermilk Channel. Finally, hydraulics in the new Bond Lorraine Sewer would not be improved because the elevations at the beginning and end locations are fixed by the other existing sewer connections. Low sewer slopes and the potential for grit accumulation will limit the conveyance capacity of the new Bond Lorraine Sewer. However, reconstruction of the portion of the Bond Lorraine Sewer, which runs through the Citizens MGP site, is expected to be rebuilt under the remediation activities at that site.

While there are many challenges associated with enlarging the Bond Lorraine Sewer, Alternative 1 will be further evaluated within this LTCP because it offers an alternative to tank construction for Outfall RH-034. While a new pump station would be involved, Alternative 1 provides less constructability concerns than does Alternative 2’s gravity approach, in which rerouting up to 200 acres of drainage area would require the construction of up to 2,000 feet of sewer and the minimum pipe cover requirements would not be met.

Weir Modifications at Outfalls OH-006, OH-007 and OH-024

DEP also evaluated a control measure that would relocate the affected CSO discharges along the collection system that run generally parallel to the Gowanus Canal, essentially, “flow tipping” to outfalls outside of the watershed. This control measure would modify weirs at three regulators that discharge to Outfalls OH-006, OH-007 and OH-024 as a means of reducing CSO discharges to the Gowanus Canal. This measure would be employed in lieu of a storage tank at Outfall OH-007. The weir modification concept is illustrated in Figures 8-5 and 8-6 for Outfall OH-007.

As shown, the existing regulator structures and weirs would be enlarged to increase the wet weather flow conveyed by the 3rd Avenue combined sewer, thus reducing CSO discharges to the Gowanus Canal.

The benefits, costs and challenges associated with weir modifications at Outfalls OH-006, OH-007 and OH-024 are as follows:

<u>Benefits</u>

The primary benefit of this measure is that it avoids the construction of a storage tank, shaft or tunnel by relocating CSO discharges outside of the watershed. Further, all construction would be in public rights-of-way, thus avoiding the need to site a control measure on private property or public property that could provide other, more valuable uses to the community. Finally, unlike any of the other off-line storage measures, the annual additional O&M requirements of the weir modifications would be minimal. Also, the weir modifications would result in a hydraulically neutral solution, i.e., the water elevations at and upstream of the improvement should not change or rise under the 5-year design storm. This would allow DEP to maintain the same level of service.

<u>Cost</u>

The estimated NPW for this control measure is $22M.

<u>Challenges</u>

The most pressing challenge for this and any system optimization measure that involves a significant weir adjustment is to prevent upstream hydraulic impacts. Other challenges include the temporary traffic disruption that would occur during construction and the periodic inconveniences to the public during routine O&M functions due to its location beneath an active public street.

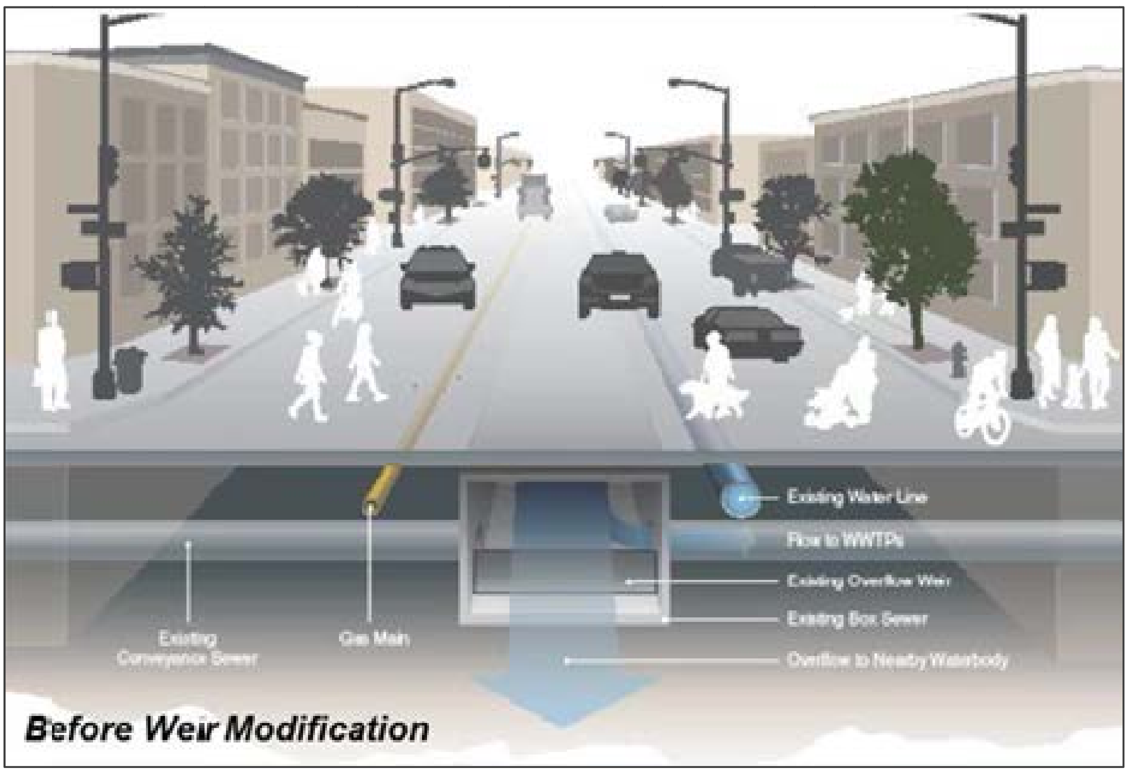


Figure 8-5. Current Weir Schematic at Outfall OH-007

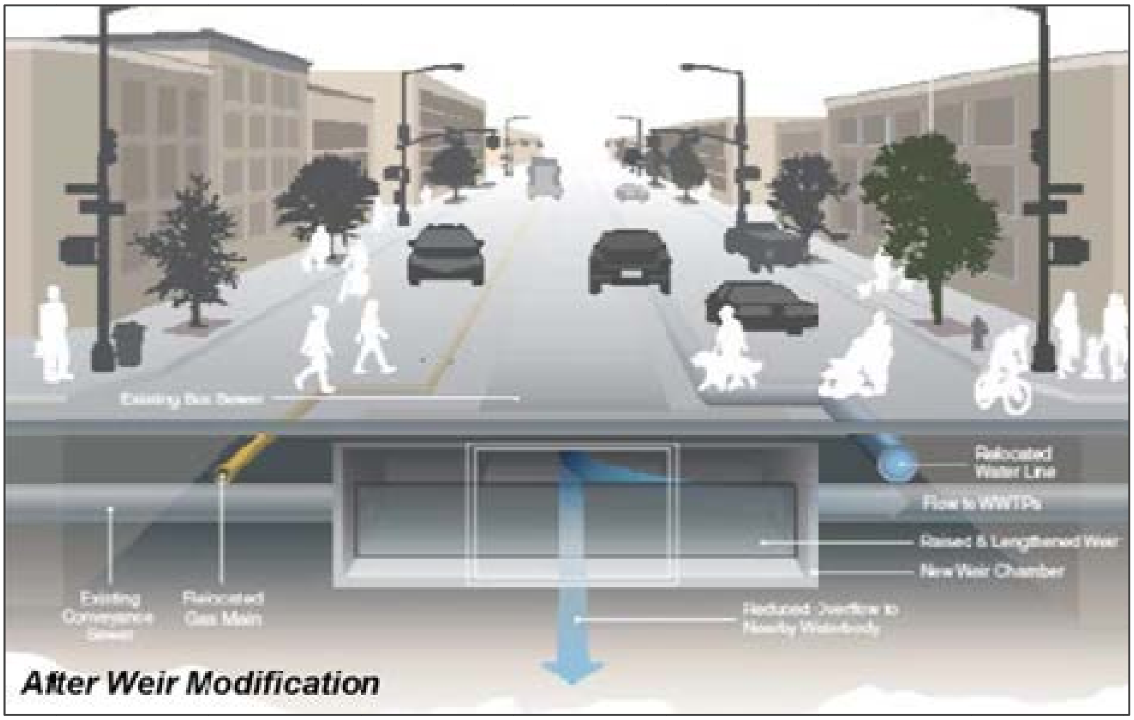


Figure 8-6. Proposed Weir Modification at Outfall OH-007

Sewer Enhancement/Optimization Findings

Both of the system optimization measures described above were found to be worthy of the next level of evaluation for possible inclusion in basin-wide alternatives.

8.2.a.3 Retention/Treatment Alternatives

A number of the control measures considered for the Gowanus Canal fall under this dual category of treatment and retention. The term “retention” is also referred to as “storage”. For the purposes of this LTCP, the term “storage” is used in lieu of “retention”. These control measures include in-line or in-system storage and off-line shaft, tank, and deep-tunnel storage. Treatment refers to RTBs, disinfection, in either CSO outfalls or RTBs, and other, more advanced, treatment processes such as HRC.

EPA’s Superfund ROD focused on tank storage, which for consistency was incorporated into the LTCP evaluations. However, tunnels were evaluated as well for their ability to provide a high level of volumetric control, up to and including 100% CSO control as upper boundary water quality endpoint.

While DEP initially considered some treatment control measures, most notably RTBs, these were eliminated early in the screening process in favor of tank and tunnel storage. Disinfection was also screened out early in the evaluation process due to the high level of the projected attainment of bacterial WQS.

Additional in-line storage was also screened-out from further consideration because the existing combined sewer system has little available in-line storage capacity as demonstrated by the results of the weir modification evaluations.

The storage and treatment control measures that advanced beyond the initial screening steps described in Section 8.1 were:

- Tank storage at Outfalls RH-034 and OH-007, consistent with the DEP Superfund evaluations
- Tunnel storage for all CSO outfalls along the Gowanus Canal

Each is described below.

Retention Alternative - Tank Storage at Outfalls RH-034 and OH-007

Storage tanks were evaluated for Outfalls RH-034 and OH-007. The evaluation included an 8 MG tank for Outfall RH-034 and a 4 MG tank for Outfall OH-007, as preliminarily estimated in the ROD, and which are referred to herein as the “EPA ROD Tanks” or Alternative 1. Other combinations of tank sizes were also evaluated, as summarized in Table 8-1.

Table 8-1. LTCP Evaluated Storage Tank Sizes

Alternative	Outfall Tank Size (MG)	
	Outfall RH-034	Outfall OH-007
1. EPA ROD Tanks	8	4
2.	5.7	2.5
3.	3.5	1.4

The other tank size options included 5.7 MG and 3.5 MG tanks at Outfall RH-034, coupled with 2.5 MG and 1.4 MG tanks at Outfall OH-007. These are referred to as Alternatives 2 and 3, respectively. As discussed below, these tank sizes were evaluated in this LTCP because they represent the sizes estimated necessary to meet the preliminary estimates of TSS reductions set forth in the ROD. The reduction range set forth in the ROD is 58-74%. Alternative 2 represents tank sizes that would achieve a 74% reduction, while Alternative 3 represents tank sizes that would achieve a 58% reduction.

The LTCP evaluations led to a determination that a combination of smaller tanks would provide a similar level of CSO control when implemented in conjunction with the reductions in CSO discharges realized from the reconstruction of the Gowanus PS and other measures included in the baseline conditions described in Section 6.0. The results of the LTCP evaluation of the tank options is summarized in Tables 8-2 and 8-3.

Table 8-2. Performance of Storage Tank Combinations from LTCP Evaluations for Outfall RH-034

Outfall RH-034	Pre-WWFP	LTCP Baseline	ROD Proposed	Volumetric Reduction	
				74%	58%
Tank Size	-	-	8 MG	5.7 MG	3.5 MG
% Reduction	-	25%	82%	74%	58%
Remaining CSO Volume	182 MG	137 MG	33 MG	47 MG	76 MG
Annual Overflow Frequency	45	40	6	7	12

Table 8-3. Performance of Storage Tank Combinations from LTCP Evaluations for Outfall OH-007

Outfall OH-007	Pre-WWFP	LTCP Baseline	ROD Proposed	Volumetric Reduction	
				74%	58%
Tank Size	-	-	4 MG	2.5 MG	1.4 MG
% Reduction	-	16%	87%	74%	58%
Remaining CSO Volume	69 MG	58 MG	9 MG	18 MG	28 MG
Annual Overflow Frequency	48	44	5	6	13

Both of the smaller tank combinations (Alternatives 2 and 3) meet or exceed the ROD TSS targeted reduction for each outfall.

CSO overflow frequency is also included in the table. All three tank options significantly reduce the frequency of overflows from LTCP baseline conditions of over 40 per year to a maximum of between 12 and 13 per year with the smallest tanks.

DEP considered other options that are consistent with the ROD findings, one including a single 3.5 MG tank at Outfall RH-034 coupled with a system optimization measure, and the other using only system optimization measures and containing no tanks. These two options are discussed following this discussion of tanks.

Following an extensive siting evaluation conducted as part of the Superfund work, two sites each for both the Outfall RH-034 and Outfall OH-007 tanks were identified, designated Sites RH-3, RH-4, OH-4 and OH-5, respectively, as shown on Figures 8-7 through 8-10. The details of the siting evaluation can be found in the Superfund submittals referenced in Section 8.8. All of the sites would accommodate the largest tanks associated with the ROD: 8 MG for the two Outfall RH-034 sites and 4 MG for the two Outfall OH-007 sites. As shown, RH-3 is closer to the actual RH-034 Outfall than is Site RH-4. Similarly, Outfall OH-007 Site OH-4 is also closer to the actual OH-007 outfall than is Site OH-5.

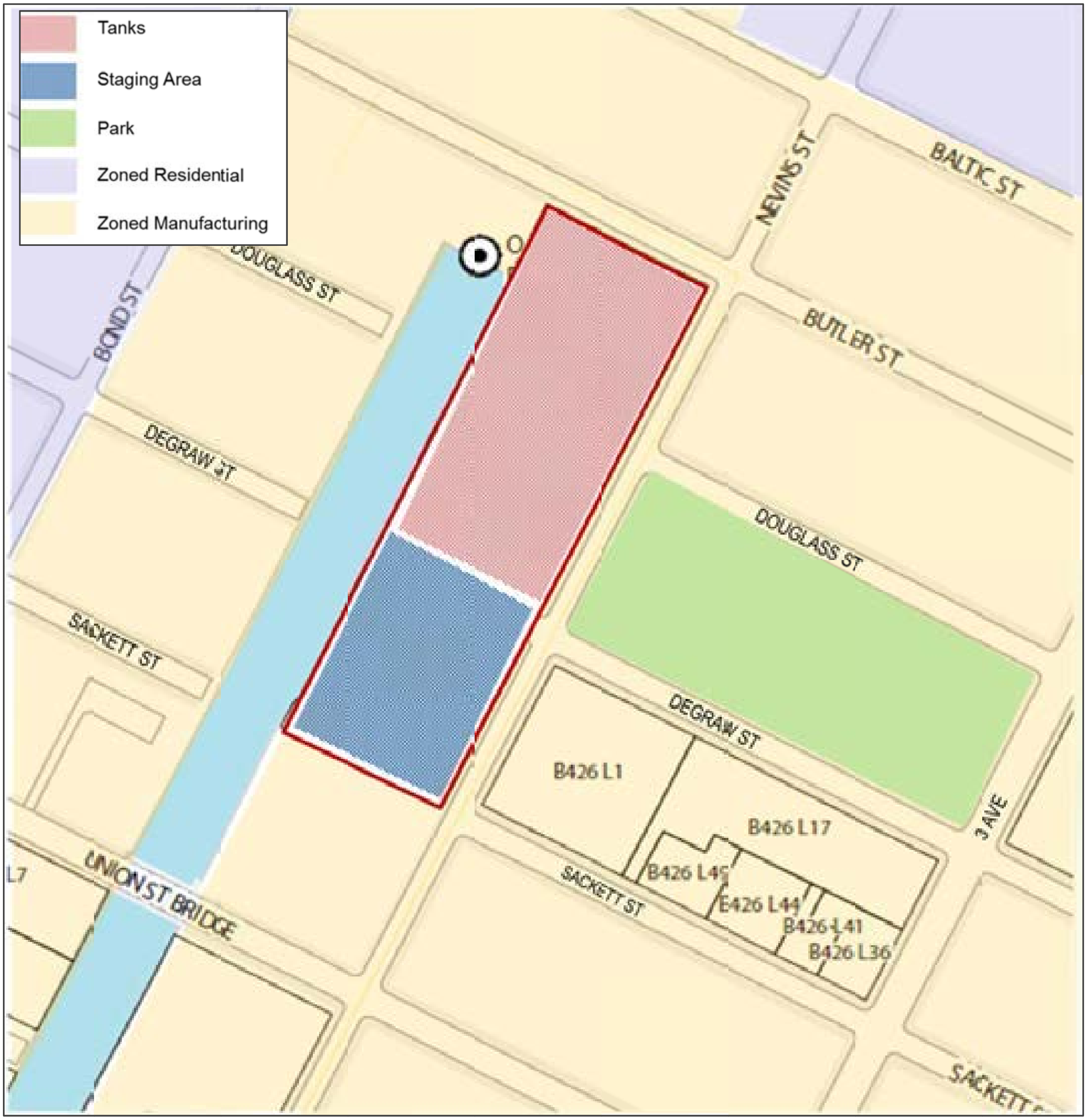


Figure 8-7. Outfall RH-034 Site RH-3

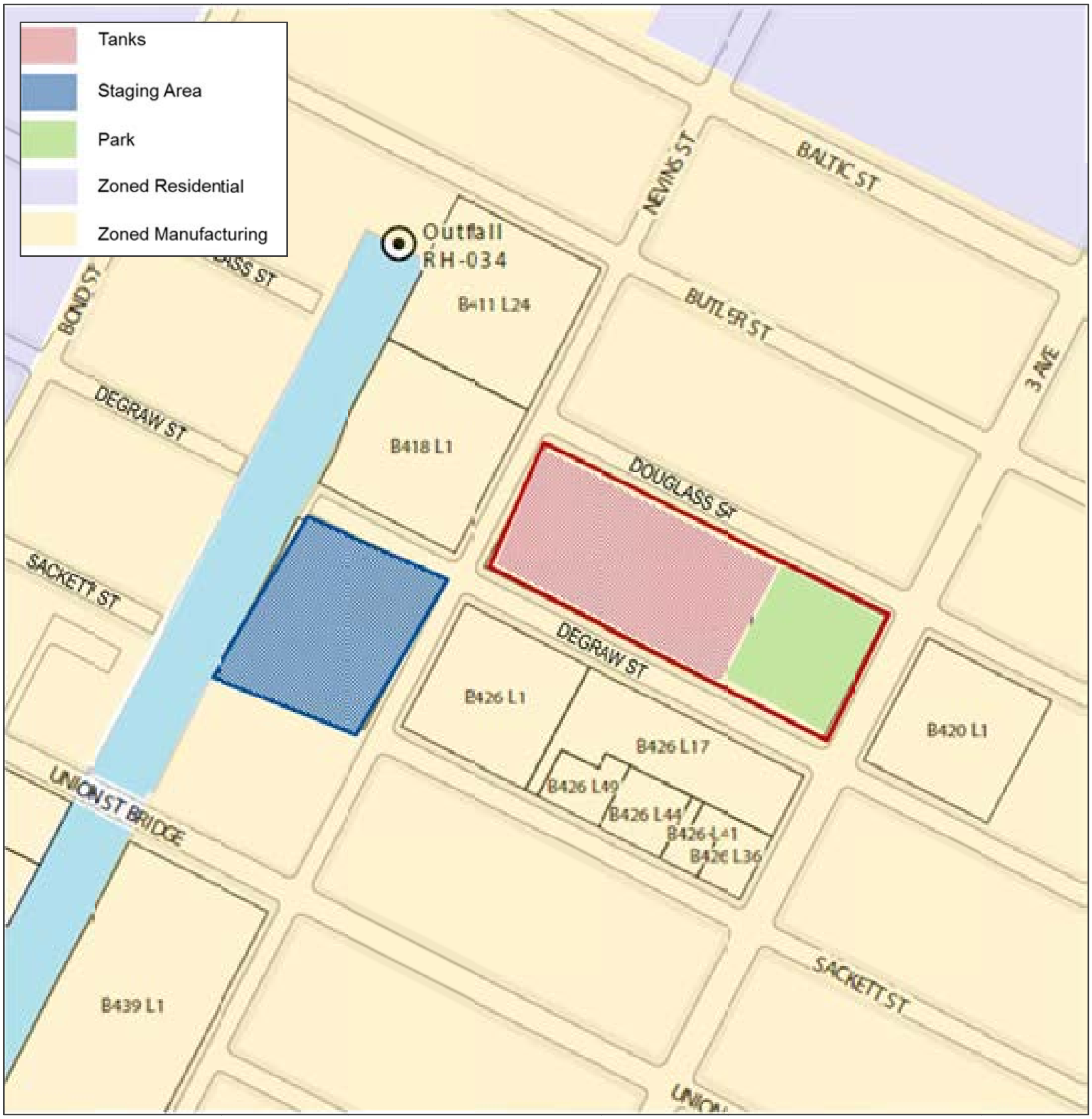


Figure 8-8. Outfall RH-034 Site RH-4

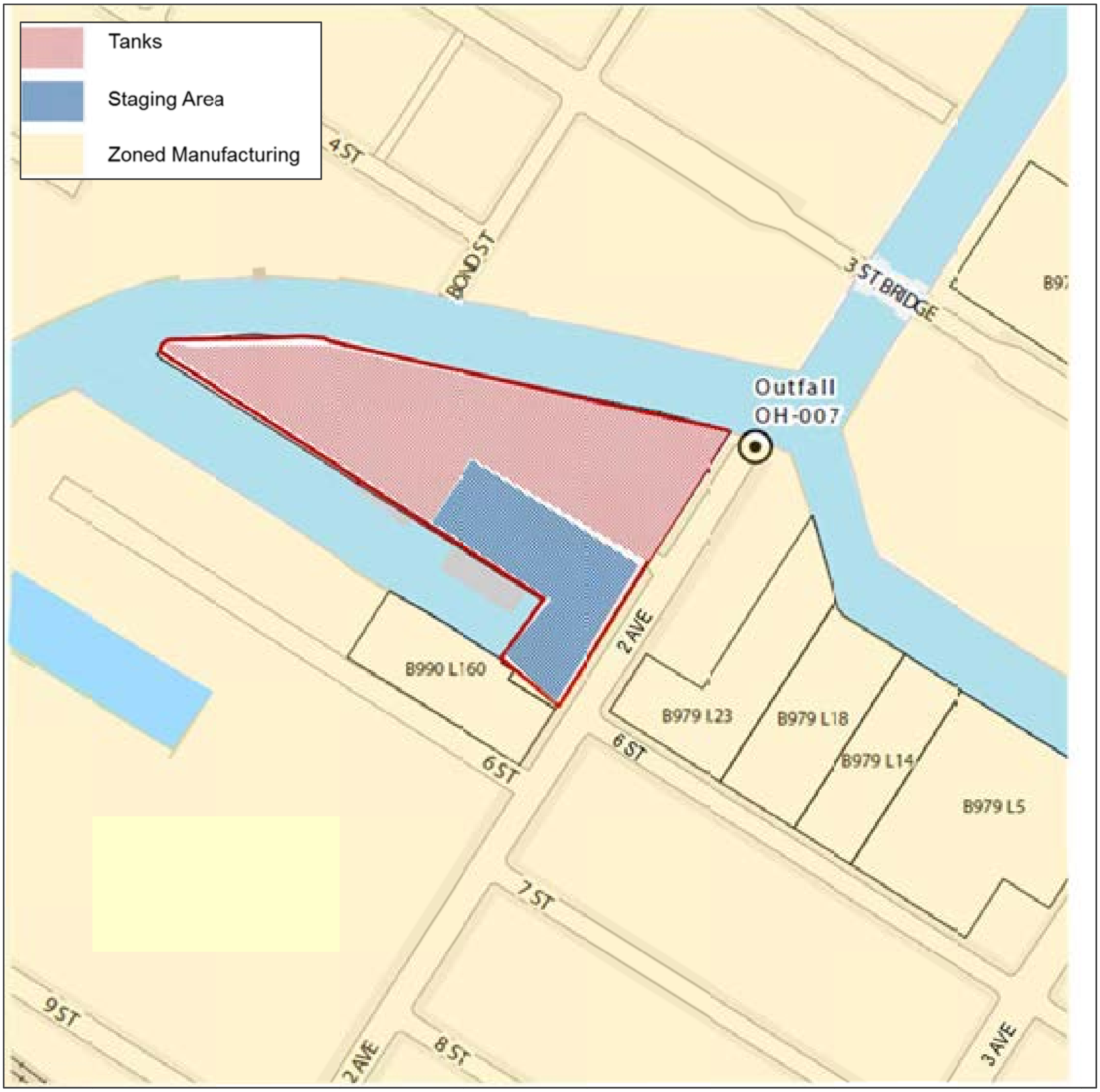


Figure 8-9. Outfall OH-007 Site OH-4

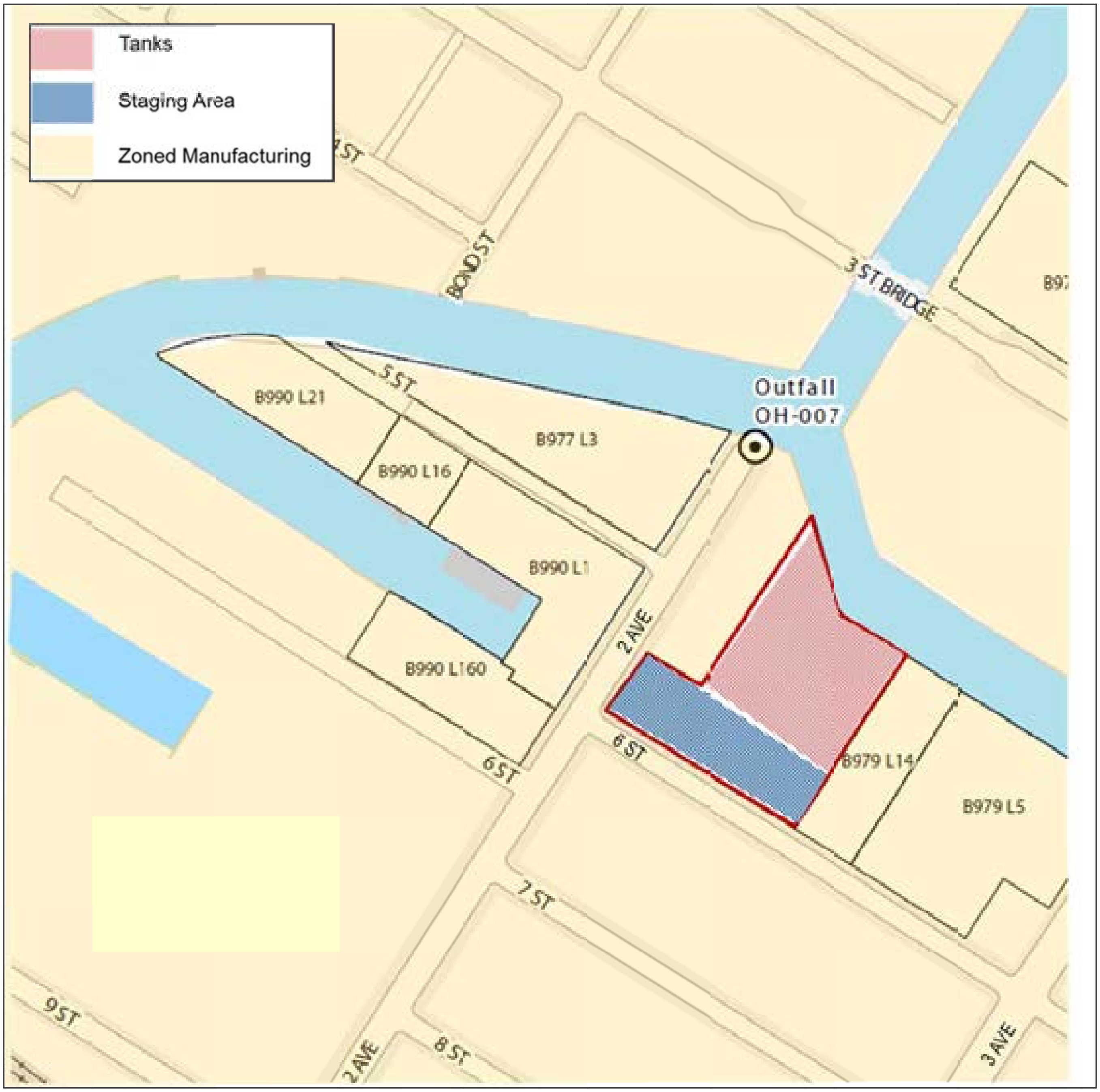


Figure 8-10. Outfall OH-007 Site OH-5

The benefits, costs and challenges associated with tank storage at Outfalls RH-034 and OH-007 are as follows:

Benefits

The primary benefit of this control measure is that it employs a technology that DEP is familiar with during both construction and operations. In essence, it is proven technology both locally and nationwide for CSO volumetric control. The tanks sizes presented also meet the ROD TSS reduction targets and will provide floatables control.

Cost

The estimated NPW for these storage tank options was $829M for the largest EPA ROD Tanks; $683M for the mid-size Alternative 2 tanks (5.7 MG and 2.5 MG); and $507M for the smaller Alternative 3 tanks (3.5 MG and1.4 MG). Details of these estimates are presented in Section 8.4.

Challenges

The most critical challenge to implementing storage tanks or any major CSO control facility is siting, followed by constructability. Even with the smaller tanks, major excavation and soil contamination mitigation is required, excavation sheeting and dewatering, and truck traffic during construction. There are also operational challenges, even with current DEP experience, with such facilities as each new tank requires significant pre- and post-storm O&M functions. Other challenges are aboveground support facilities, odor control and grit removal. All activities would require close coordination with planned clean-up efforts within the Superfund framework. Additionally, one of the two possible RH-034 sites is located within parkland which raises community impacts and presents park alienation challenges.

Retention Alternative – Variants to Tank Storage at Outfalls RH-034 and OH-007

As noted above, there were two variants to what were referred to as Alternatives 1, 2 and 3, all three of which included a tank at both Outfalls RH-034 and OH-007. The first variant, referred to as Alternative 4, would retain the smaller 3.5 MG tank at Outfall RH-034 but replace the Outfall OH-007 tank with the weir modifications, described above, at Outfalls OH-006, OH-007 and OH-024. The second variant, referred to as Alternative 5, includes no tanks. Alternative 5 includes a combination of both system optimization measures: reconstruction of the Bond Lorraine Sewer for Outfall RH-034 and the weir modifications that were described above at Outfalls OH-006, OH-007 and OH-024.

The benefits, costs and challenges associated with these two variants to the two tank options are as follows:

Benefits

With respect to Alternative 4, the primary benefit is that it employs a technology that DEP is familiar with during both construction and operations. In essence, it is proven technology both locally and nationwide for CSO volumetric control.

With respect to Alternative 5, the primary benefit is that no tanks are included, thus eliminating the major siting process involved with such projects. Further, the additional O&M cost to DEP of the no-tank option would be eliminated over those involving two or even a single tank.

<u>Cost</u>

The estimated NPW for these two control measure options was $401M for the single tank at RH-034 Alternative 4 and $355M for the no-tank Alternative 5. The weir modifications would represent a small fraction of the NPW in both instances, at approximately $22M. Details of the estimates are presented in Section 8.4.

<u>Challenges</u>

With respect to Alternative 4, the most critical challenge to implementing storage tanks or any major CSO control facility is siting followed by constructability. Even with the smaller, single tank under this option, major excavation and site remediation at Outfall RH-034 is required with mitigation of subsurface conditions, excavation sheeting and dewatering, and truck traffic during construction. There are also operational challenges even with current DEP experience with such facilities, as each new tank requires significant pre- and post-storm O&M functions. Other challenges are aboveground support facilities, odor control and grit removal. All activities would require close coordination with planned clean-up efforts within the Superfund framework.

With respect to Alternative 5, there are significant challenges as previously noted under the individual discussion of the Bond Lorraine Sewer and weir modifications.

Retention Alternative Tunnel Storage for all CSO Outfalls

Tunnel construction involves the boring of a linear storage conduit deep in the ground, typically in bedrock. Shafts are required during both the initial construction, as well as during its operation for filling and O&M access. A dewatering pump station and odor control system is also included with such facilities.

The deep tunnel that was evaluated for the Gowanus Canal watershed would begin at Outfall RH-034 and terminate near the mouth of the Gowanus Canal in the vicinity of Outfall OH-024. The tunnel would be 8,400 feet long and have a 27-ft diameter for 100% volumetric control; an 18-ft diameter tunnel of the same length would provide 75% control. Both the mining shaft and dewatering pump station would be located at the downstream end of the tunnel. The layout of the tunnels is shown on Figure 8-11, following the route of the Gowanus Canal, and shows the intermediate shafts to collect flows from eight CSO outfalls along the route. Table 8-4 contains a summary of the key features of the two tunnel configurations, Alternatives 6 and 7, for the smaller and larger volume tunnel, respectively.

Table 8-4. Deep Tunnel Characteristics

Tunnel Options	Level of Service (CSO Volumetric Capture)	
	75%	100%
Tunnel Volume (MG)	15.8	34.6
Tunnel Length (lf)	8,400	8,400
Tunnel Diameter (ft)	18	27
NPW ($ Millions)	695	873

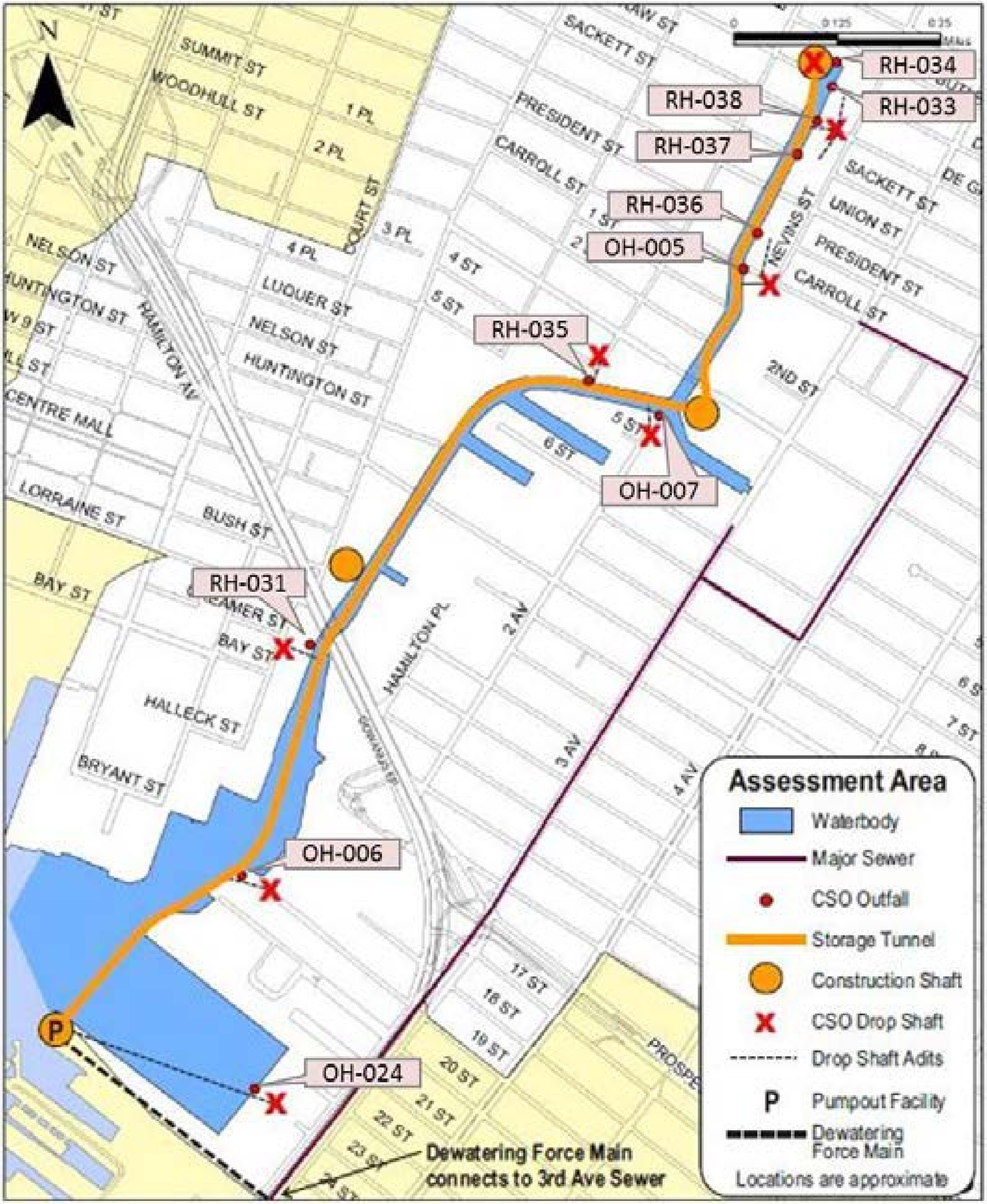


Figure 8-11. Route of Tunnels for 75% and 100% CSO Control

The 8,400-ft-long tunnel should be considered as a placeholder, particularly for the 75% control concept, where the length could possibly be reduced by focusing on the two largest outfalls, Outfalls RH-034 and OH-007.

The benefits, costs and challenges associated with tunnel storage are as follows:

Benefits

The primary benefit of the tunnel storage is the reduction of annual overflow volume with minimal permanent aboveground land requirements, unlike with other types of CSO controls. Also, as with the system optimization alternatives, the storage tunnel would preclude the need for chemical treatment and associated equipment.

Cost

The estimated NPW for this control measure is $695M for the 75% control tunnel and $873M for the 100% control tunnel. Details of the estimates are presented in Section 8-4.

Challenges

One of the major challenges with tunnel storage is the required O&M for deep, confined spaces. Also, DEP has no operating experience with tunnels in its wastewater system. Other challenges include: sediment deposition in the tunnel; potential for hydraulic surge conditions; unforeseen geotechnical conditions; and operation of the deep tunnel dewatering pump station. Providing electrical power to the mining shaft during construction, and permanent power for the dewatering pump station, would also present a challenge.

Both of these tunnel alternatives warrant the next level of evaluation for inclusion in basin-wide alternatives.

Storage Dewatering

Each of the control measures described above involving storage requires dewatering of the retained CSO volumes after wet weather events occur. The capacity of the required dewatering system is shown in Table 8-5 for each of the storage measures, based on a two-day dewatering period.

Table 8-5. Dewatering System Capacity of Retention Alternatives Based on Two-Day Tank Dewatering

Alternative	Storage Volume (MG)	PS Capacity (MGD)
1	8 (Outfall RH-034)	4
	4 (Outfall OH-007)	2.0
2	5.7 (Outfall RH-034)	2.9
	2.5 (Outfall OH-007)	1.3
3	3.5 (Outfall RH-034)	1.8
	1.4 (Outfall OH-007)	0.7
4	3.5 (Outfall RH-034)	1.8
6	15.8	7.9
7	34.6	17.4

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

As discussed in Section 5.0, DEP projects that GI penetration rates would manage 12 percent of the impervious surfaces within the Gowanus Canal watershed. This GI has been included as part of 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 in addition to those implemented under previous facility plans and those included in the baseline conditions. Because DEP is currently working on the implementation of GI area-wide contracts in the Gowanus Canal watershed, additional GI beyond the baseline is not recommended at this time. DEP intends to saturate each target tributary drainage area with as much GI as feasible, as discussed in Section 5.0. Should conditions show favorable feasibility for penetration rates above the current targets, DEP will seek to take advantage of those opportunities as they are identified.

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 discussed above, development of the baseline GI projects for this watershed is already underway and further GI is not planned at this time. Therefore, no controls in this category are proposed for the Gowanus Canal LTCP.

8.2.d Retained Alternatives

Based on the results of the preceding evaluations, a limited number of control measures were deemed suitable for inclusion in the development of basin-wide alternatives for the Gowanus Canal. These are shown in Table 8-6, together with the reason for excluding those control measures that were screened from further consideration.

Table 8-6. Summary of Next Level of Control Measure Screening

Control Measure	Category	Retained for Further Analysis?	Remarks
HLSS	Source Control	NO	Already planned for the watershed under flood mitigation efforts outside the LTCP framework.
Sewer Enhancements (Weir Modifications and Bond Lorraine Sewer Reconstruction)	System Optimization	YES	Not as stand-alone measures; included as part of basin-wide alternatives.
In-line Storage	Storage	NO	No available capacity.
Storage (Tanks)	Storage	YES	Included consistent with Superfund program.
Off-line Storage (Tunnels)	Storage	YES	For 75% and 100% control.

Table 8-6. Summary of Next Level of Control Measure Screening

Control Measure	Category	Retained for Further Analysis?	Remarks
Floatables Control	Floatables Control	YES	Not as a stand-alone measure; included as part of weir modifications and inherent with all storage measures.
Additional GI Build-out	Source Control	NO	Planned 12% GI build-out in the watershed (included in the baseline) is in development; additional available sites unlikely to be identified.

As shown, the retained control measures include two in the Sewer Optimization category and two in the Storage Category.

The retained alternatives are presented in Table 8-7.

Table 8-7. Retained Alternatives

Alternative	Description
1	• 8 MG Tank at Outfall RH-034 • 4 MG Tank at Outfall OH-007
2	• 5.7MG Tank at Outfall RH-034 • 2.5 MG Tank at Outfall OH-007
3	• 3.5 MG Tank at Outfall RH-034 • 1.4 MG Tank at Outfall OH-007
4	• 3.5 MG Tank at Outfall RH-034 • Weir Modifications at Outfalls OH-006, OH-007 and OH-024
5	• Bond Lorraine Sewer Reconstruction • Weir Modifications at Outfalls OH-006, OH-007 and OH-024
6	• 8,400 LF-long, 18 ft-diameter tunnel • 15.8 MG storage
7	• 8,400 LF-long, 27 ft-diameter tunnel • 34.6 MG storage

These retained alternatives for the Gowanus Canal were then analyzed on the basis of their cost-effectiveness in reducing CSO discharges and improving water quality. These more advanced analyses are described in Sections 8.3 through 8.5.

8.3 CSO Reductions and Water Quality Impact of Retained Alternatives

To evaluate their effects on the loadings and water quality impacts, the retained basin-wide alternatives listed in Table 8-7 were analyzed using both the Gowanus Canal (IW) and receiving water/waterbody or water quality models. Evaluations of levels of CSO control 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 reflect the fact that the grey infrastructure projects from the WWFP have been implemented, along with the 12 percent GI penetration and the HLSS project mentioned earlier in Section 8-2.

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

Table 8-8 summarizes the projected annual CSO volume and bacteria reductions for the retained alternatives. These data are plotted on Figure 8-12.

The bacteria loading reductions shown in Table 8-8 approximate the CSO volume reductions within a few percent. Both reductions are not exactly equal because both bacteria concentrations and percent reductions vary simultaneously for each wet weather event. This leads to the same loadings being computed for any given outfall at any given point in time during a CSO event, but to small variations when computing cumulative loadings. However, differences between volumetric reduction and bacteria loading reductions are small in any case.

8.3.b Water Quality Impacts

The Gowanus Canal is a Class I and Class SD waterbody. The water quality impact analysis is presented in Section 6.0, and is supported by the following: the 2008 baseline and 10-year East River Tributaries Model (ERTM) runs; as well as historic and recent water quality monitoring data; and baseline conditions modeling. The analysis reveals that all locations along the waterbody will be in attainment with the Class I (2,000 cfu/100mL) and primary contact fecal coliform criteria (200 cfu/100mL) under baseline conditions. As explained in the gap analysis presented in Section 6.3, bacteria loadings from other sources (particularly the tidal exchange with the Gowanus Bay, direct drainage and other urban wet weather discharges to the Gowanus Canal), influence the enterococci concentrations to the extent that even the removal or control of 100% of the CSO discharges would not result in full attainment of the Potential Future Primary Contact WQ Criteria STV component. The relationship between levels of CSO control through implementation of the retained alternatives, including 100% CSO control, and predicted levels of WQS attainment, are discussed in greater detail in Section 8.5. These analyses are based primarily on 2008 typical year water quality model runs.

Table 8-8. Gowanus Canal Projected Annual CSO Volume and Bacteria Reductions for the Retained Alternatives (2008 Rainfall)

Alternative	Annual CSO Volume to Gowanus Canal (MGY)	Increase in Annual CSO Volume Discharged to Other Waterbodies (MGY)	Net Change in Flow to both WWTPs (MGY)	Annual CSO Volume Reduction to Gowanus Canal (%)	Annual Fecal Coliform Reduction to Gowanus Canal (%)	Annual Enterococci Reduction to Gowanus Canal (%)	Frequency of Annual CSO Overflows to Gowanus Canal
Baseline Conditions	263	---	---	---	---	---	44
1. EPA ROD Tanks (8 MG Tank at Outfall RH-034 and 4 MG Tank at Outfall OH-007)	110	0	153	58	53	53	35
2. 5.7 MG Tank at Outfall RH-034 and 2.5 MG Tank at Outfall OH-007	133	0	130	50	44	44	35
3. 3.5 MG Tank at Outfall RH-034 and 1.4 MG Tank at Outfall OH-007	168	0	96	36	33	33	35
4. 3.5 MG Tank at Outfall RH-034 and Weir Modifications at Outfalls OH-006, OH-007 and OH-024	142	59	62	46	45	46	17
5. Bond Lorraine Sewer Reconstruction and Weir Modifications at Outfalls OH-006, OH-007 and OH-024	143	117	2	46	48	49	31
6. Tunnel (75% CSO Control)	65	0	198	75	75	75	6
7. Tunnel (100% CSO Control)	0	0	263	100	100	100	0

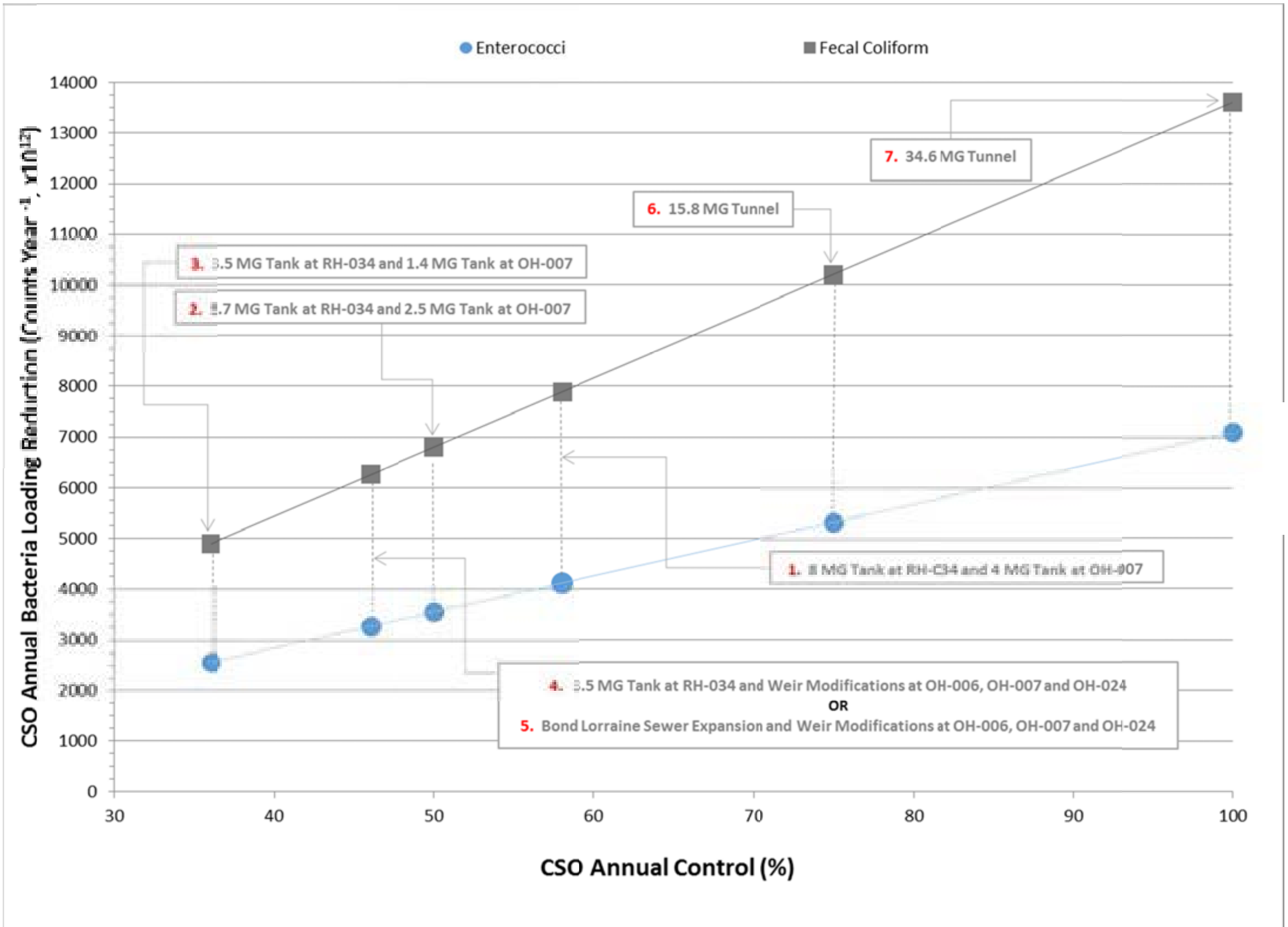


Figure 8-12. CSO Annual Control vs. Annual CSO Bacteria Loading Reduction (2008 Rainfall)

8.4 Cost Estimates for Retained Alternatives

Evaluation of the retained alternatives requires cost estimation. The methodology for developing these costs is dependent upon the type of technology or control measure under consideration, its annual O&M requirements, and, unique to this LTCP, cost data made available from the DEP Superfund analysis. The capital costs were developed as PBCs following various methodologies, and the total net present worth costs were determined using the PBC estimated, and then adding the NPW of the projected annual O&M costs at an assumed interest rate of 3 percent over a 20-year life cycle. O&M costs were derived from similar projects evaluated within NYC. All costs are reported in 2015 dollars.

8.4.a Alternative 1 – EPA ROD Tanks (8-MG Tank at Outfall RH-034 and 4-MG Tank at Outfall OH-007)

Costs for Alternative 1 include all of the construction, facilities and support systems required to build an 8 MG tank at Outfall RH-034 and a 4 MG tank at Outfall OH-007. These tanks are described in the Superfund References 1 and 2 listed in Section 8.8. As shown in Table 8-9, the total cost for Alternative 1, expressed as NPW, is estimated to be $829M.

Table 8-9. Costs For Alternative 1 – EPA ROD Tanks (8 MG Tank at Outfall RH-034 and 4 MG Tank at Outfall OH-007)

Item	8 MG Tank at Outfall RH-034	4 MG Tank at Outfall OH-007	2015 Cost ($ Million)
Capital Costs	490	311	801(1)
Annual O&M	1.2	0.7	1.9
Total Present Worth	508	321	829

Notes:
(1) EPA estimate for same tanks is $77M.

8.4.b Alternative 2 - (5.7-MG Tank at Outfall RH-034 and 2.5-MG Tank at Outfall OH-007)

Costs for Alternative 2 include all of the construction, facilities and support systems required to build a 5.7 MG Tank at Outfall RH-034 and a 2.5 MG Tank at Outfall OH-007. As shown in Table 8-10, the total cost for Alternative 2 is estimated to be $683M.

Table 8-10. Preliminary Costs for Alternative 2 (5.7 MG Tank at Outfall RH-034 and 2.5 MG Tank at Outfall OH-007)

Item	5.7 MG Tank at RH-034	2.5 MG Tank at OH-007	2015 Cost ($ Million)
Capital Costs	450	213	663
Annual O&M	0.9	0.5	1.4
Total Present Worth	462	221	683

8.4.c Alternative 3 (3.5 MG Tank at Outfall RH-034 and 1.4 MG Tank at Outfall OH-007)

Costs for Alternative 3 include all of the construction, facilities and support systems required to build a 3.5 MG Tank at Outfall RH-034 and a 1.4 MG Tank at Outfall OH-007. As shown in Table 8-11, the total cost for Alternative 3 is estimated to be $507M.

Table 8-11. Preliminary Costs for Alternative 3
(3.5 MG Tank at Outfall RH-034 and 1.4 MG Tank at Outfall OH-007)

Item	3.5 MG Tank at RH-034	1.4 MG Tank at OH-007	2015 Cost ($ Million)
Capital Costs	369	124	493
Annual O&M	0.6	0.3	0.9
Total Present Worth	379	129	507

8.4.d Alternative 4 (3.5-MG Tank at Outfall RH-034 and Weir Modifications at Outfalls OH-006, OH-007 and OH-024)

Costs for Alternative 4 include all of the construction, facilities and support systems required to construct a 3.5 MG Tank at Outfall RH-034 and Weir Modifications at regulators discharging to Outfalls OH-006, OH-007 and OH-024. As shown in Table 8-12, the total cost for Alternative 4 is estimated to be $401M.

Table 8-12. Preliminary Costs for Alternative 4
(3.5 MG Tank at RH-034 and Weir Modifications at Outfalls OH-006, 007 and OH-024)

Item	3.5 MG Tank at RH-034	Weir Modifications at Outfalls OH-006, 007 and OH-024	2015 Cost ($ Million)
Capital Costs	369	20	389
Annual O&M	0.6	0.2	0.8
Total Present Worth	379	22	401

8.4.e Alternative 5 (Bond Lorraine Sewer Reconstruction and Weir Modifications at Outfalls OH-006, OH-007 and OH-024)

Costs for Alternative 5 include all of the construction, facilities and support systems required to implement an expansion of the Bond Lorraine Sewer and Weir Modifications at Outfalls OH-006, OH-007 and OH-024. As shown in Table 8-13, the total cost for Alternative 5 is $355M.

Table 8-13. Preliminary Costs for Alternative 5
(Reconstruction of Bond Lorraine Sewer and Weir Modifications at Outfalls OH-006, OH-007 and OH-024)

Item	Reconstruction of Bond Lorraine Sewer	Weir Modifications at Outfalls OH-006, OH-007 and OH-024	2015 Cost ($ Million)
Capital Costs	314	20	334
Annual O&M	1.2	0.2	1.4
Total Present Worth	333	22	355

8.4.f Alternatives 6 and 7 (75% and 100% CSO Control Tunnels)

Cost estimates for 75% control and 100% control tunnels, Alternatives 6 and 7, are summarized in Table 8-14. The estimated total NPW ranges from $695M to $873M for the smallest and largest tunnel, respectively. These costs include the boring of the deep tunnel, multiple shafts, dewatering pump stations, odor control systems and other ancillary facilities as described in Section 8.2.

Table 8-14. Costs for Alternatives 6 and 7 (75% and 100% Control Tunnels)

Tunnel Control Level	75% Tunnel (Alternative 6)	100% Tunnel (Alternative 7)
2015 PBC ($ Million)	680	846
Annual O&M Cost ($ Million)	1.0	1.8
Total Present Worth ($ Million)	695	873

The cost estimates of the retained basin-wide alternatives are summarized below in Table 8-15 and are then used in the development of the cost-performance and cost-attainment plots presented in Section 8.5.

Table 8-15. Summary of Retained Alternatives Costs

Alternative	PBC(2) ($ Million)	Annual O&M Cost(2) ($ Million)	Total Present Worth ($ Million)
1. EPA ROD Tanks (8 MG Tank at Outfall RH-034 and 4 MG Tank at Outfall OH-007)	801(1)	1.9	829
2. 5.7 MG Tank at Outfall RH-034 and 2.5 MG Tank at Outfall OH-007	663	1.4	683
3. 3.5 MG Tank at Outfall RH-034 and 1.4 MG Tank at Outfall OH-007	493	0.9	507
4. 3.5 MG Tank at RH-034 and Weir Modifications at Outfalls OH-006, OH-007 and OH-024	389	0.8	401
5. Bond Lorraine Sewer Reconstruction and Weir Modifications at Outfalls OH-006, OH-007 and OH-024	334	1.4	355
6. 75% CSO Control Tunnel	680	1.0	695
7. 100% CSO Control Tunnel	846	1.8	873

Notes:
(1) EPA estimate for same tanks is $77M.
(2) PBCs estimated from various methods and sources, including LTCP and Superfund. Annual O&M costs estimated from historical costs of equivalent CSO control projects implemented or previously evaluated within NYC.

8.5 Cost-Attainment Curves for Retained Alternatives

The final step of the analysis is to evaluate the cost-effectiveness of the retained, basin-wide alternatives based on their NPW and projected impact in CSO loadings and attainment of applicable WQS.

8.5.a Cost-Performance Curves

Cost-performance curves were developed by plotting the costs of the retained alternatives against their predicted level of CSO control. Both the cost-performance and subsequent cost-attainment analyses focused on bacteria loadings and bacteria water quality criteria. A best-fit cost curve was developed based on those alternatives judged most cost-effective for a defined level of CSO control as estimated by IW for the typical year rainfall (2008).

The goal of the LTCP is to reduce CSO bacteria loadings to the waterbody to the extent such loadings are responsible for non-attainment of applicable WQS. Although the substantial improvements introduced by implementation of the 2008 WWFP resulted in the Gowanus Canal achieving full compliance with existing designated and primary contact bacteria WQS, an assessment of the CSO volumetric and bacteria loading reductions associated with the retained alternatives was conducted. Figure 8-13 shows the volumetric reductions achieved by each alternative, and bacteria reduction plots are presented in Figures 8-14 and 8-15. These latter curves 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 the percent of CSO bacteria loading reductions. The secondary vertical axis shows the corresponding total bacteria loading reductions, as a percentage, when loadings from other non-CSO sources of bacteria are included.

8.5.b Cost-Attainment Curves

This section evaluates the relationship of the costs of the retained alternatives to their expected level of attainment of the bacteria criteria associated with the Existing WQ Criteria (Class I), Primary Contact WQ Contact Criteria, and Potential Future Primary Contact WQ Criteria, as modeled using the water quality model with 2008 rainfall.

The cost-performance plot shown in Figure 8-13 indicates that Alternatives 2, 5, 6, and 7 represent incremental gains in marginal performance, i.e., an increase in CSO reduction for a given additional expenditure. The retained alternatives that do not show incremental gains in volumetric performance (shown in red in the Figure 8-13) include Alternatives 1, 3 and 4.

In addition to the current Class I WQS, the cost-attainment analysis considered other standards and bacteria criteria, including Primary Contact WQ Criteria and Potential Future Primary Contact WQ Criteria. Again, under the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, enterococci criteria do not apply to tributaries, such as the Gowanus Canal. The Primary Contact WQ Criteria evaluations thus only considered the fecal coliform criterion, specifically the monthly GM of 200 cfu/100mL both on an annual and recreational season (May 1st through October 31st) basis. Class SD does not have assigned numerical bacteria criteria and attainment of the Class I Existing WQ Criteria for fecal coliform is met 100 percent of the time at all stations. Thus, the Gowanus Canal is in compliance with designated bacteria criteria.

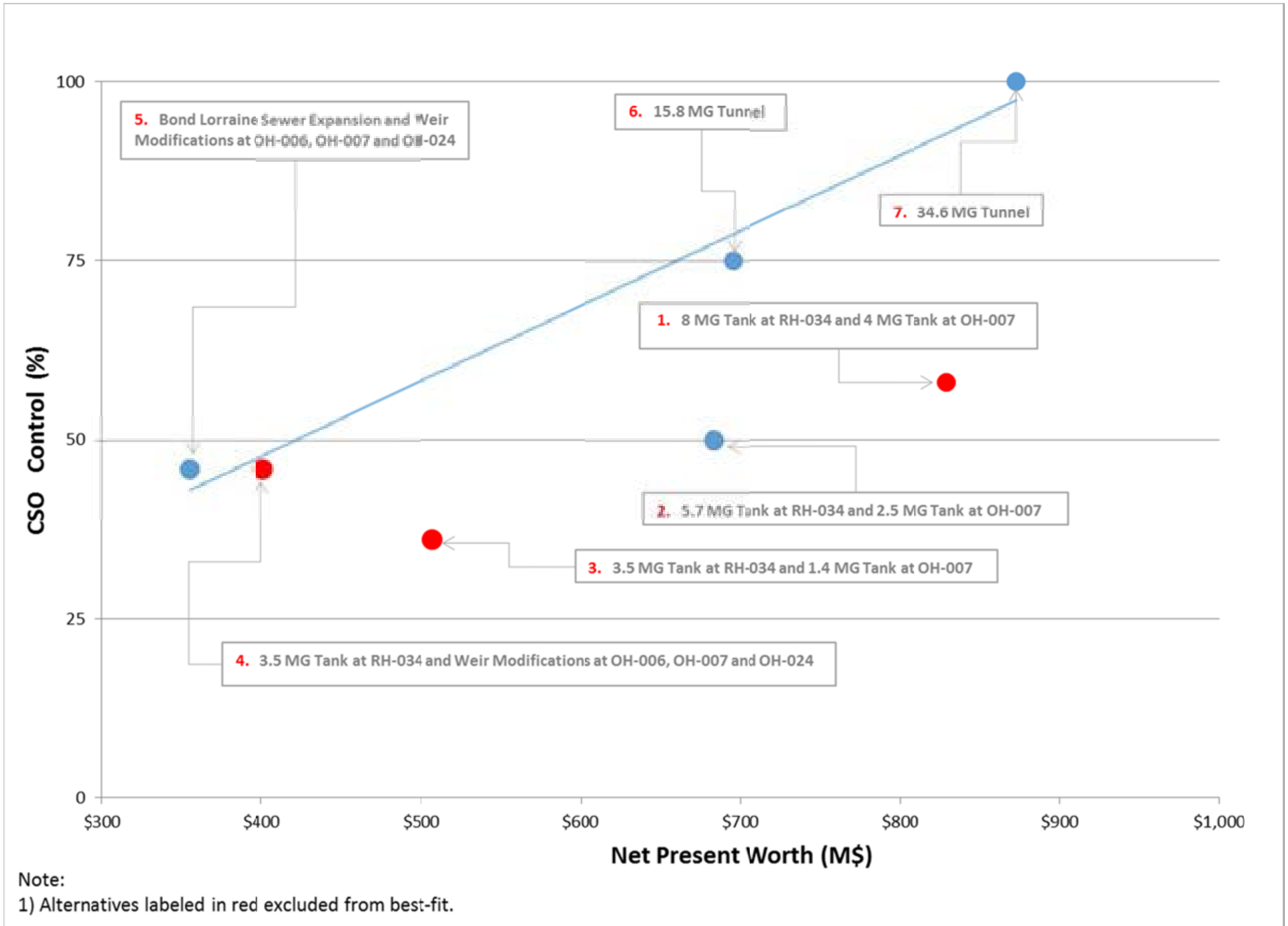


Figure 8-13. Cost vs. CSO Control (2008 Rainfall)

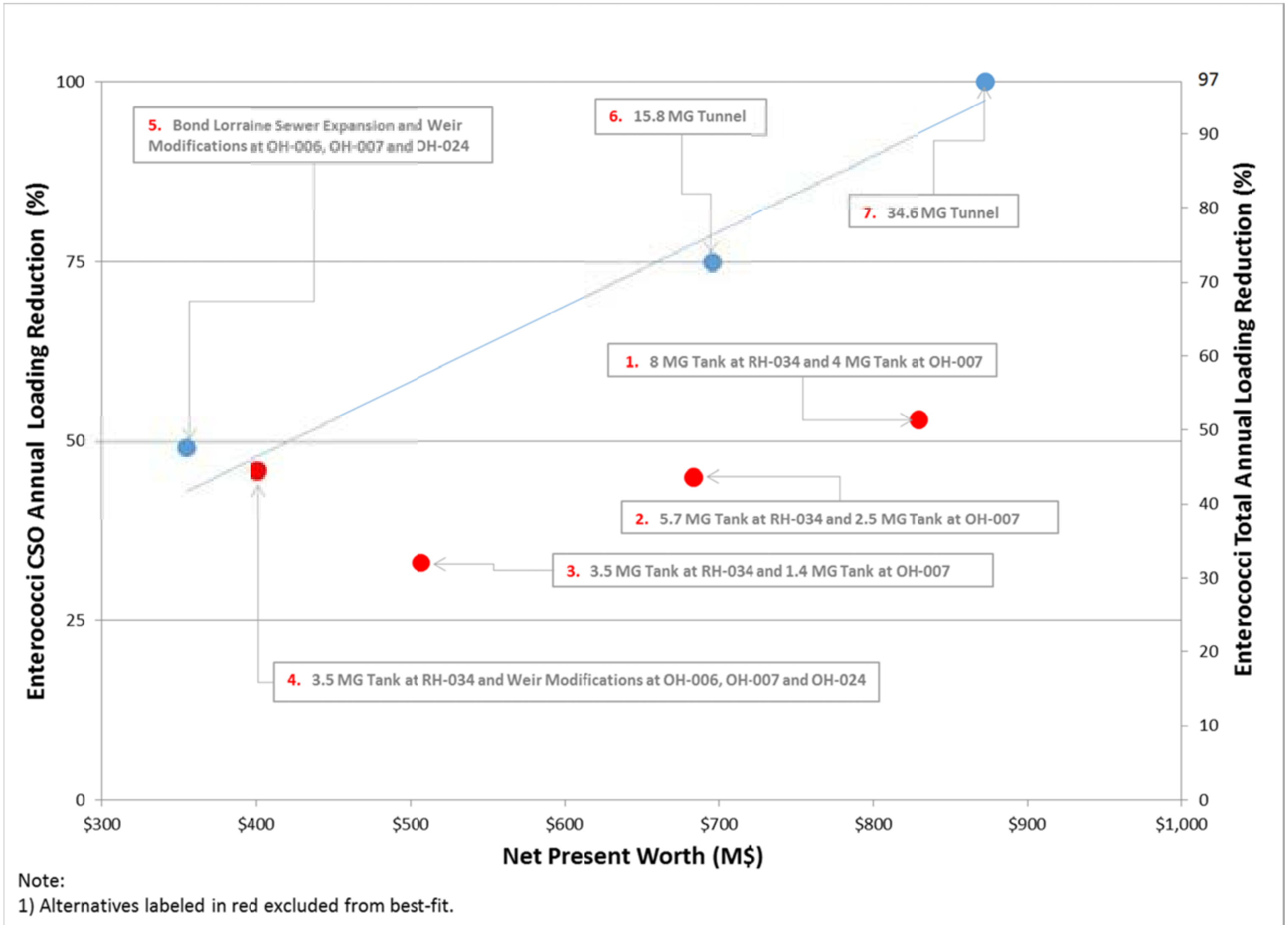


Figure 8-14. Cost vs. Enterococci Loading Reduction (2008 Rainfall)

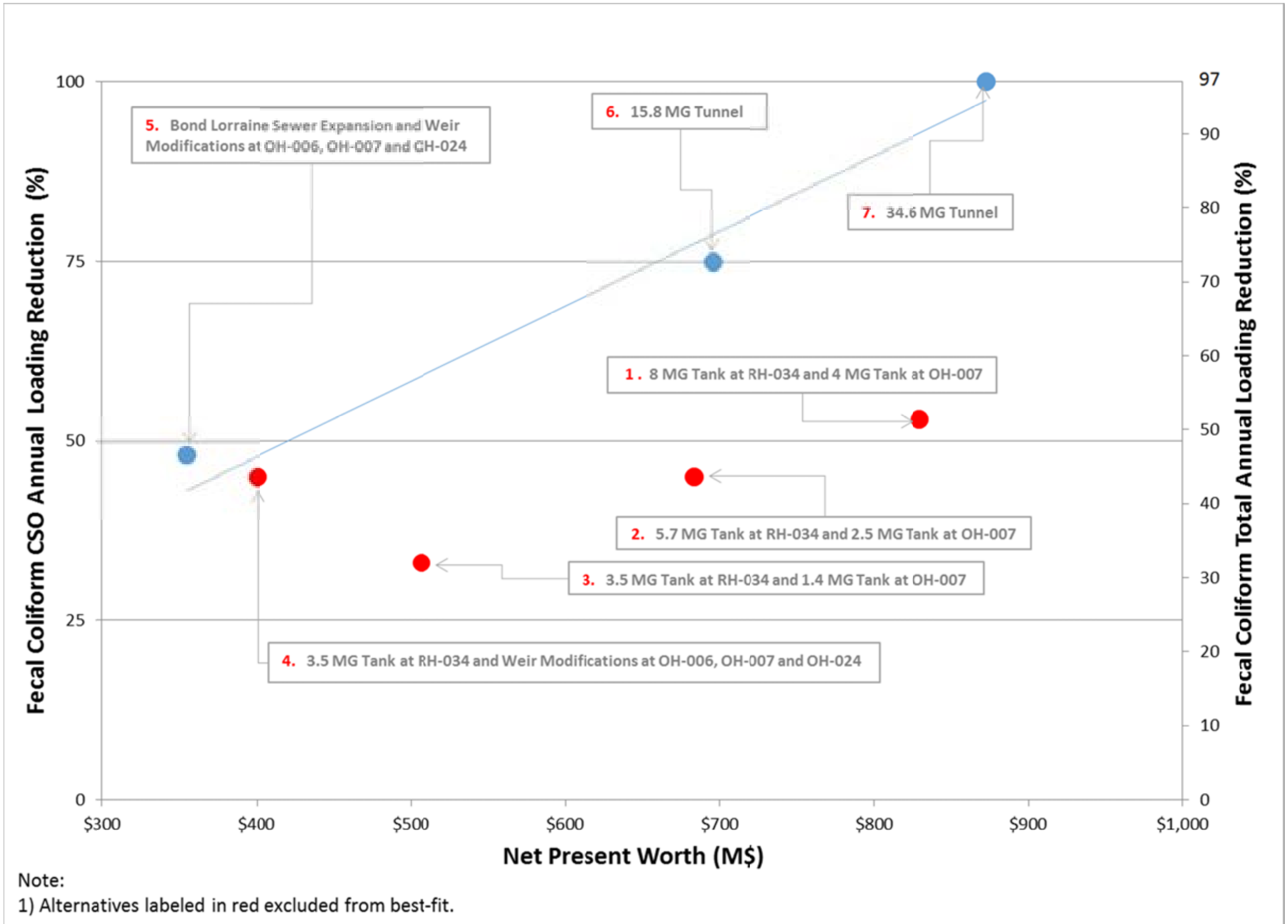


Figure 8-15. Cost vs. Fecal Coliform Loading Reduction (2008 Rainfall)

The resultant curves for all applicable standards and relevant criteria are presented as Figures 8-16 through 8-25 for ten locations along the Gowanus Canal, Stations GC-1 through GC-10. All of the curves are based on 2008 typical year water quality simulations. The annual attainment of the Primary Contact WQ Criteria under baseline conditions are slightly lower than with the current Class I criteria, with the lowest levels of attainment being 92 percent. However, this criterion is fully attained at all stations during the recreational season (May 1st through October 31st). Further, and again, this criterion is fully attained both annually and seasonally when the results from the broader 10-year water quality model runs are considered.

Figures 8-16 through 8-25 also show that, from a bacteria standpoint, and based on the 2008 model runs exclusively, all of the retained basin-wide alternatives will bring the waterbody into compliance with the Primary Contact WQ Criteria on an annual basis. But, as noted above, full compliance with the criterion is already projected for baseline conditions when evaluated under a 10-year timeframe.

8.5.c Time to Recovery Analysis

Analyses were conducted to evaluate the length of time fecal coliform concentrations would exceed target values of 1,000 cfu/100mL. This target value is discussed further in Section 8.7.a and represents a concentration above which primary contact would be unadvisable. The analyses were conducted for a rainfall event sequence that occurred on August 14, 2008 (0.96 inches) and August 15, 2008 (1.02 inches) and fell over approximately 4-hour periods each day. This event represents an approximate 90th percentile event on the cumulative distribution of event rainfall depths of the rainfall series recorded at La Guardia Airport in a 10-year period. Further details on the selection of this storm are presented in Section 6.0.

The results of this analysis are shown in Figure 8-26. The results represent the amount of time it takes after the end of an August 14-15, 2008, rainfall for the bacteria concentrations to return to the target levels at Station GC-6, the first station that is downstream of both Outfall RH-034 and Outfall OH-007.

As shown in Figure 8-26, the maximum baseline conditions time to recovery is 14 hours, well below the DEC target of 24 hours. The maximum reduction in time to recovery is realized by Alternative 7, a 34.6 MG Tunnel to provide 100% basin-wide CSO control. One hundred (100%) percent CSO control would bring the time to recovery to less than one hour. However, intermediate levels of CSO control can shorten the time to recovery only to a minimum of 10 hours, as illustrated by the time to recovery for Alternative 1 - EPA ROD (8 MG Tank at Outfall RH-034 and 4 MG Tank at Outfall OH-007). All alternatives lead to projected times to recovery ranging from 13 to 11 hours.

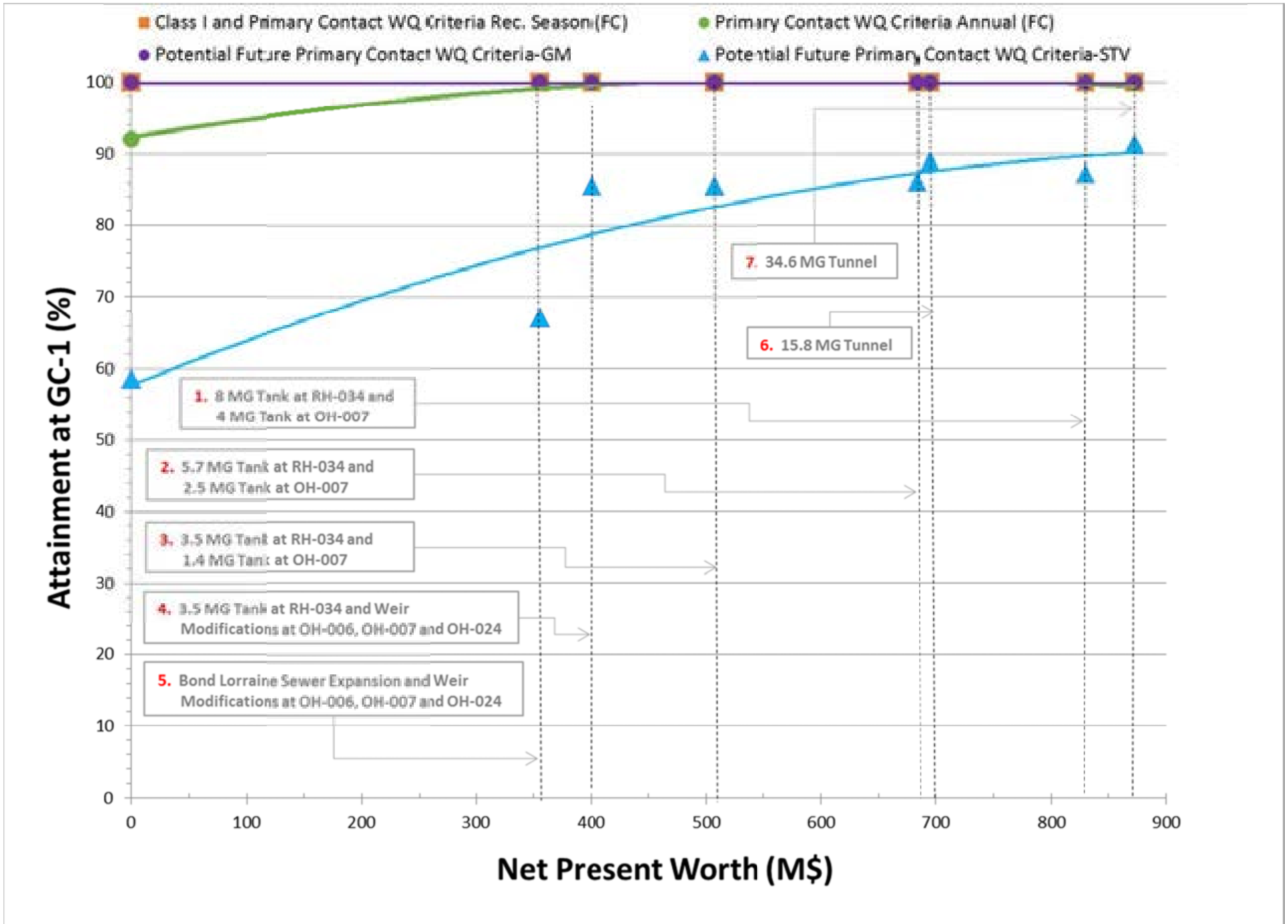


Figure 8-16. Cost vs. Bacteria Attainment at Station GC-1 (2008 Rainfall)

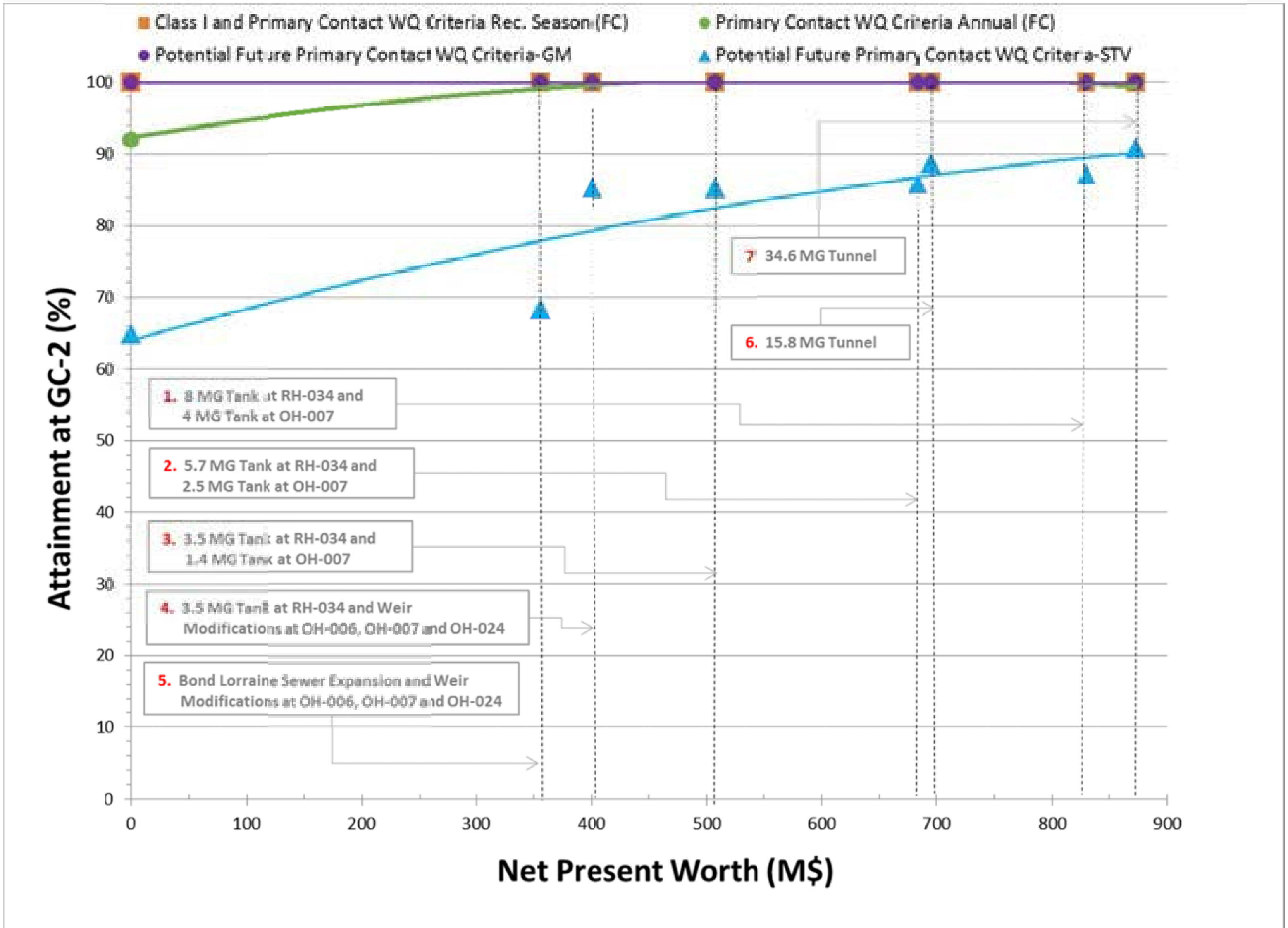


Figure 8-17. Cost vs. Bacteria Attainment at Station GC-2 (2008 Rainfall)

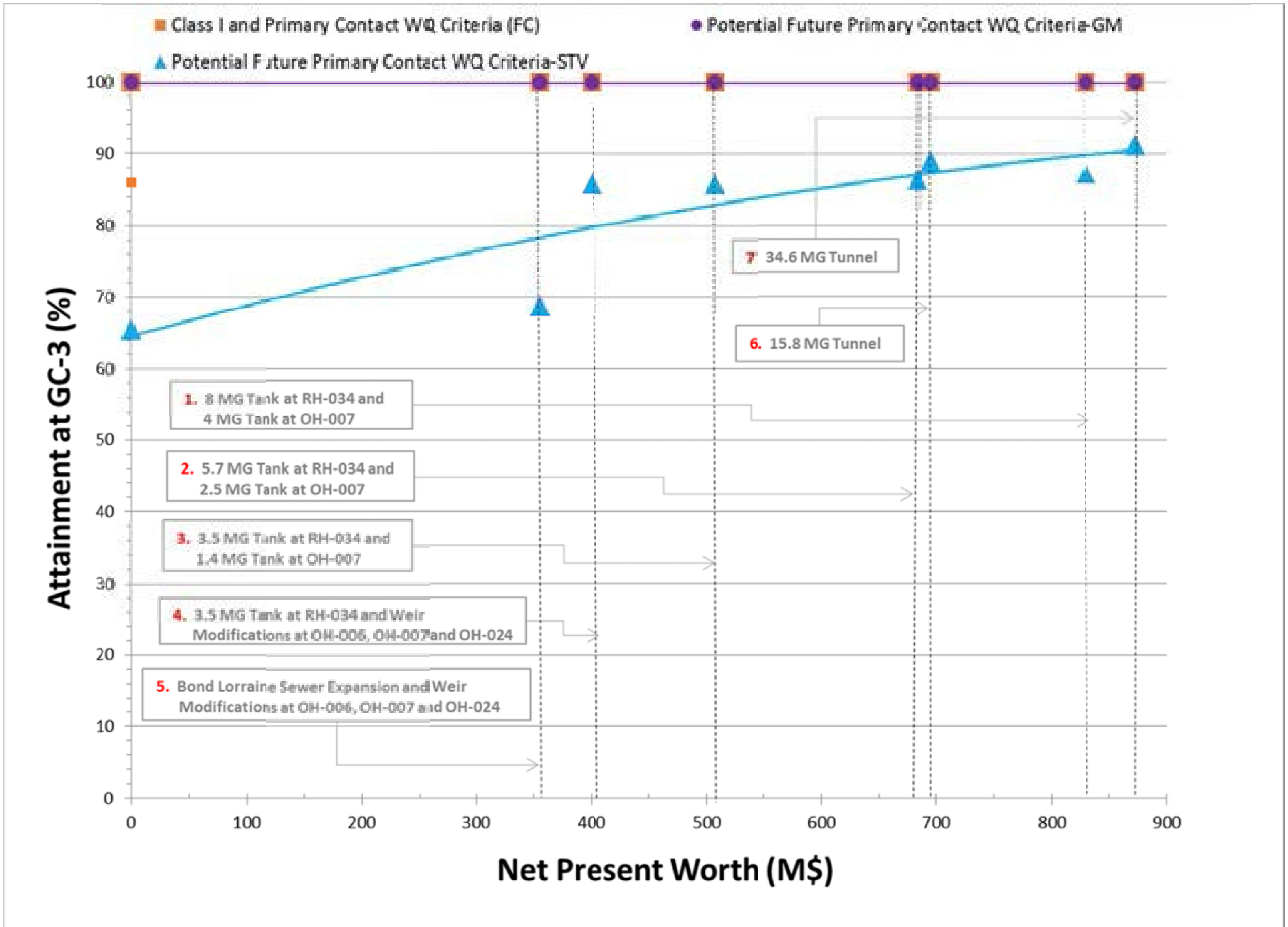


Figure 8-18. Cost vs. Bacteria Attainment at Station GC-3 (2008 Rainfall)

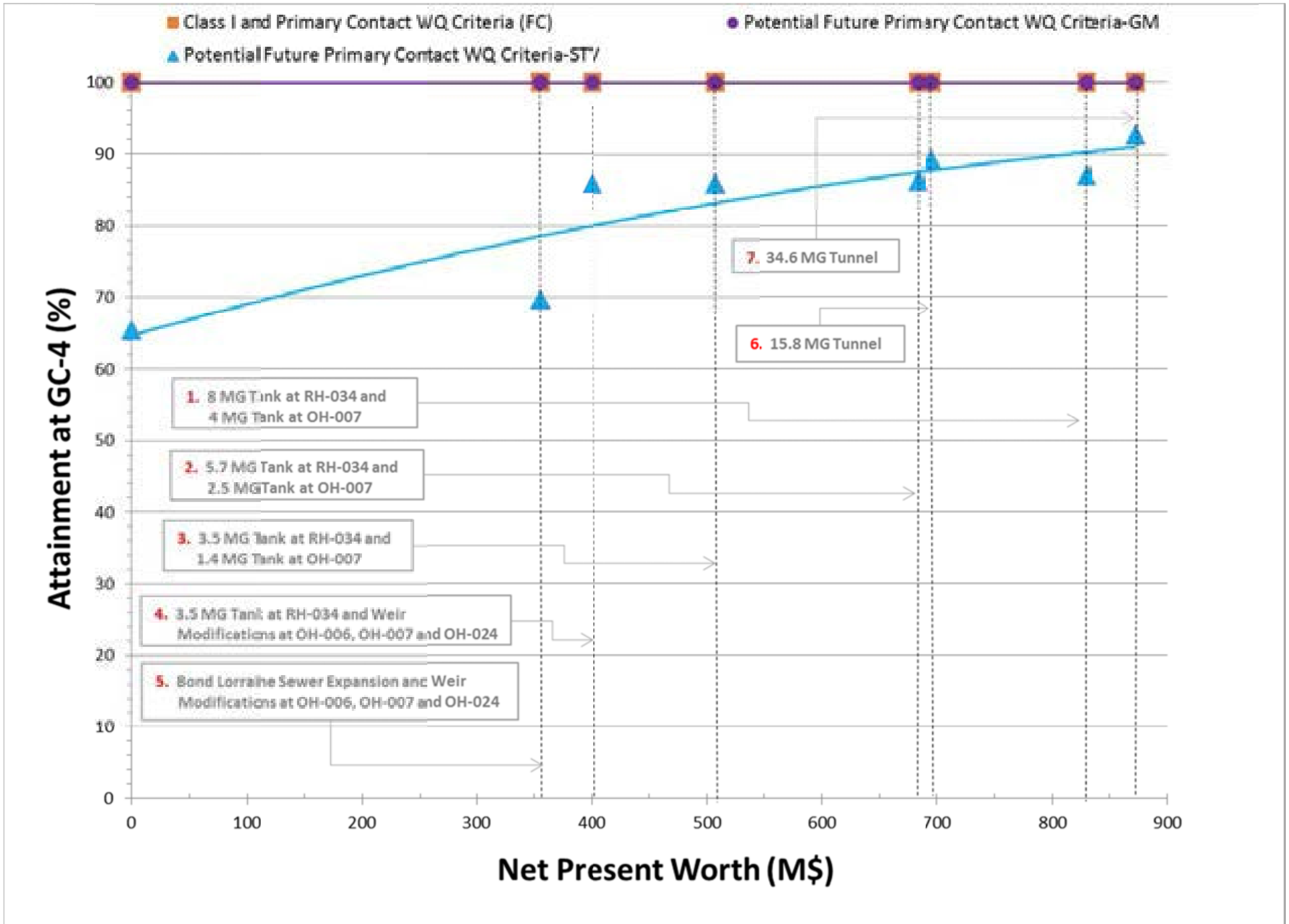


Figure 8-19. Cost vs. Bacteria Attainment at Station GC-4 (2008 Rainfall)

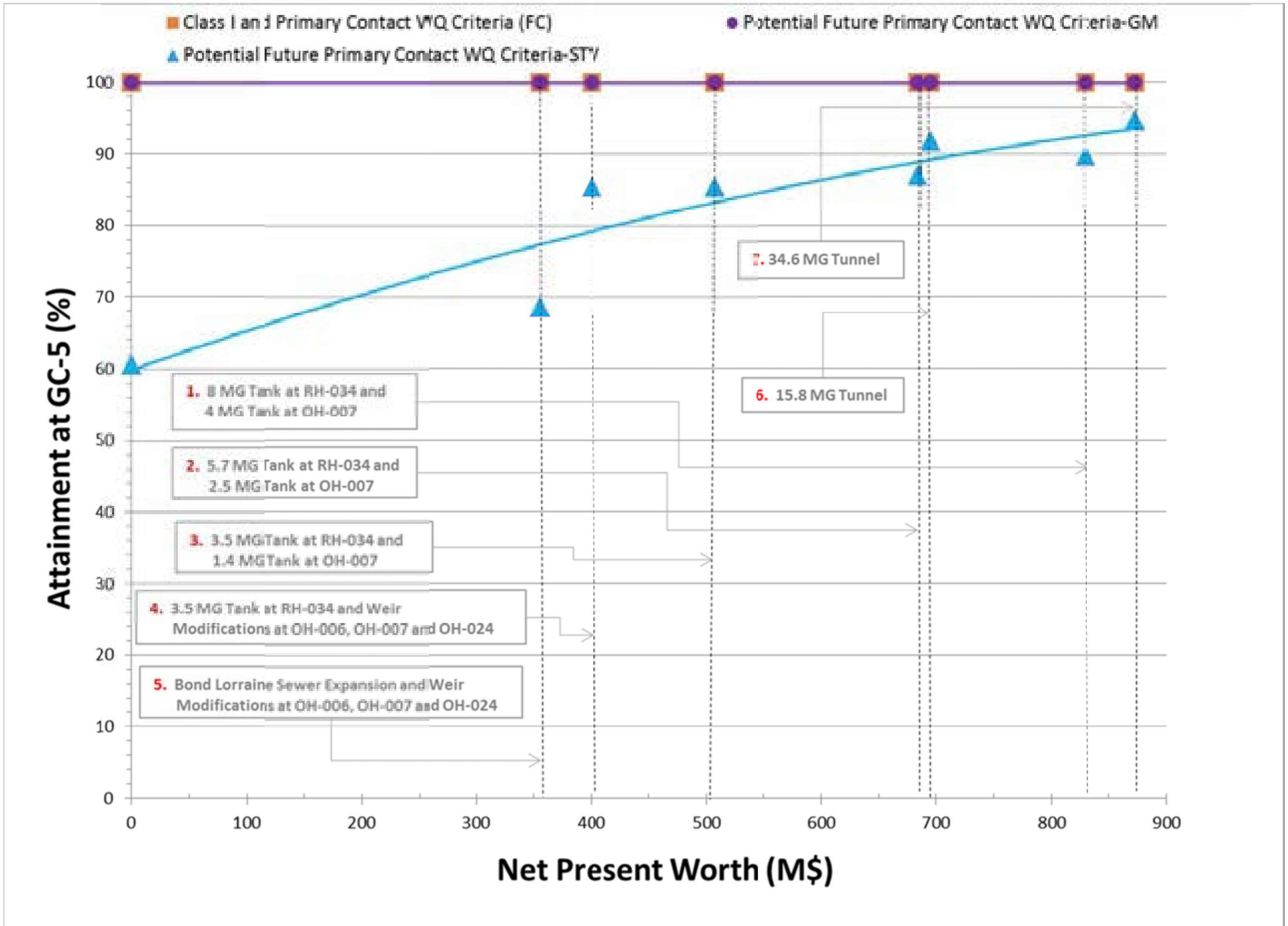


Figure 8-20. Cost vs. Bacteria Attainment at Station GC-5 (2008 Rainfall)

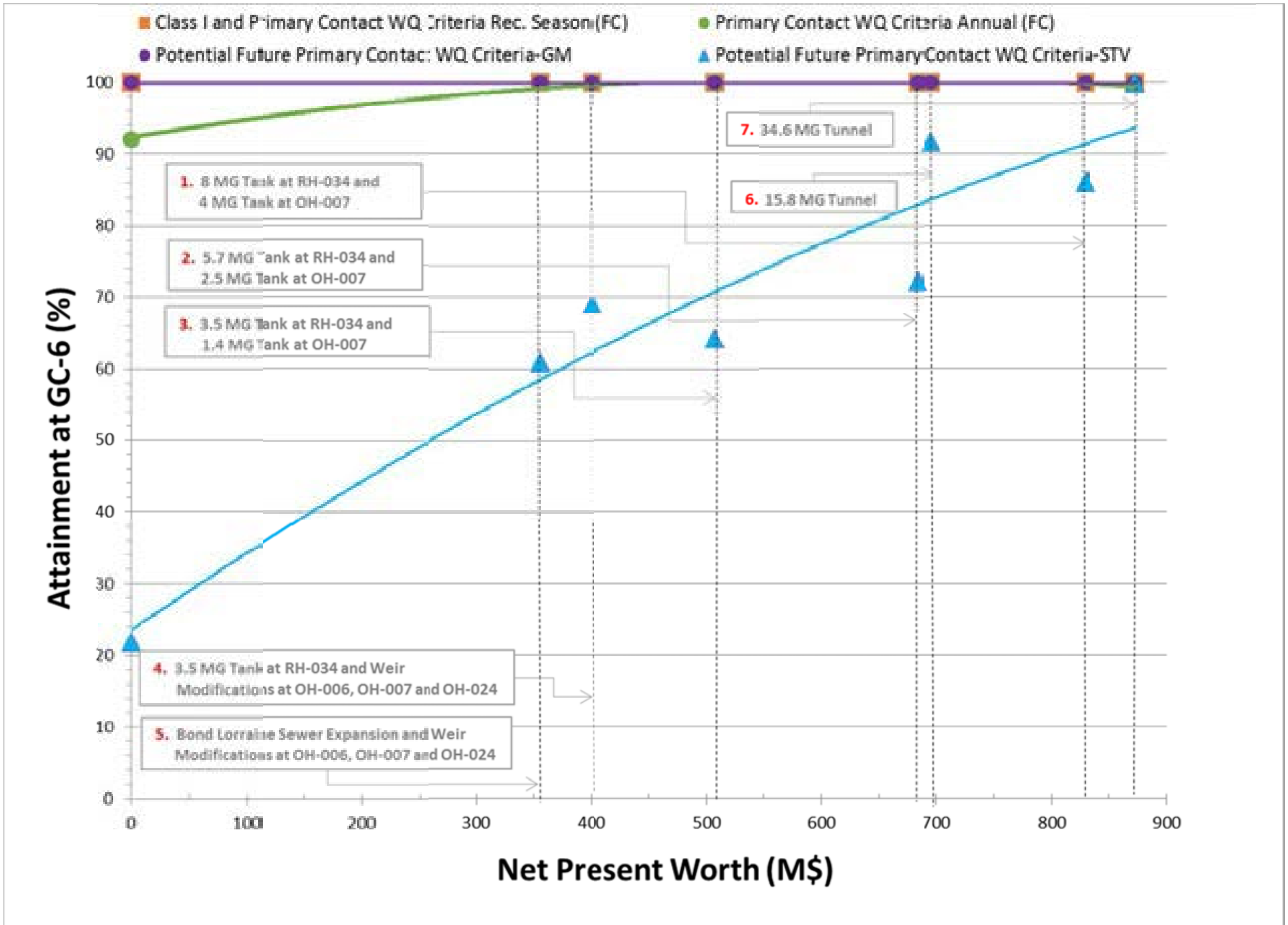


Figure 8-21. Cost vs. Bacteria Attainment at Station GC-6 (2008 Rainfall)

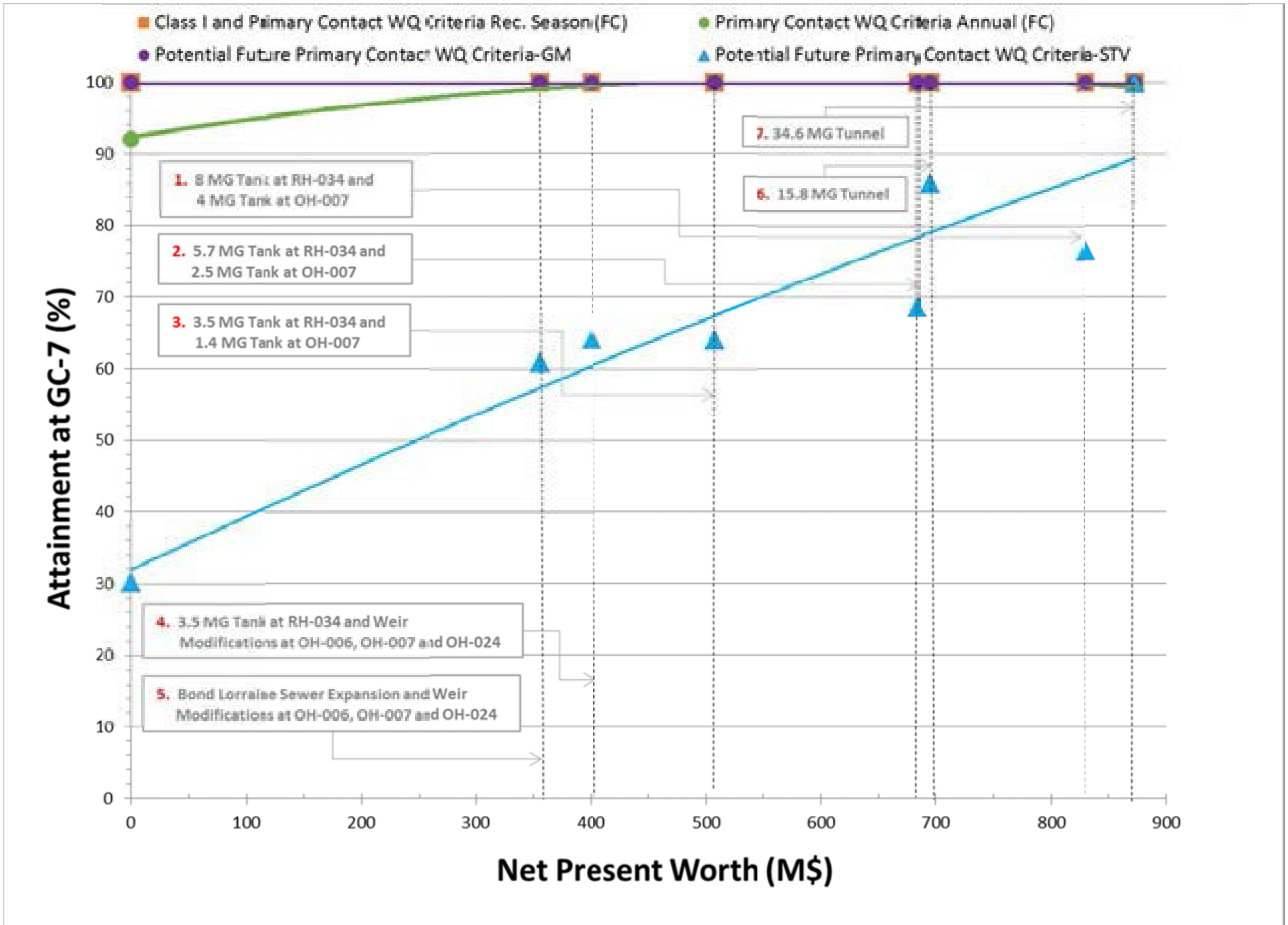


Figure 8-22. Cost vs. Bacteria Attainment at Station GC-7 (2008 Rainfall)

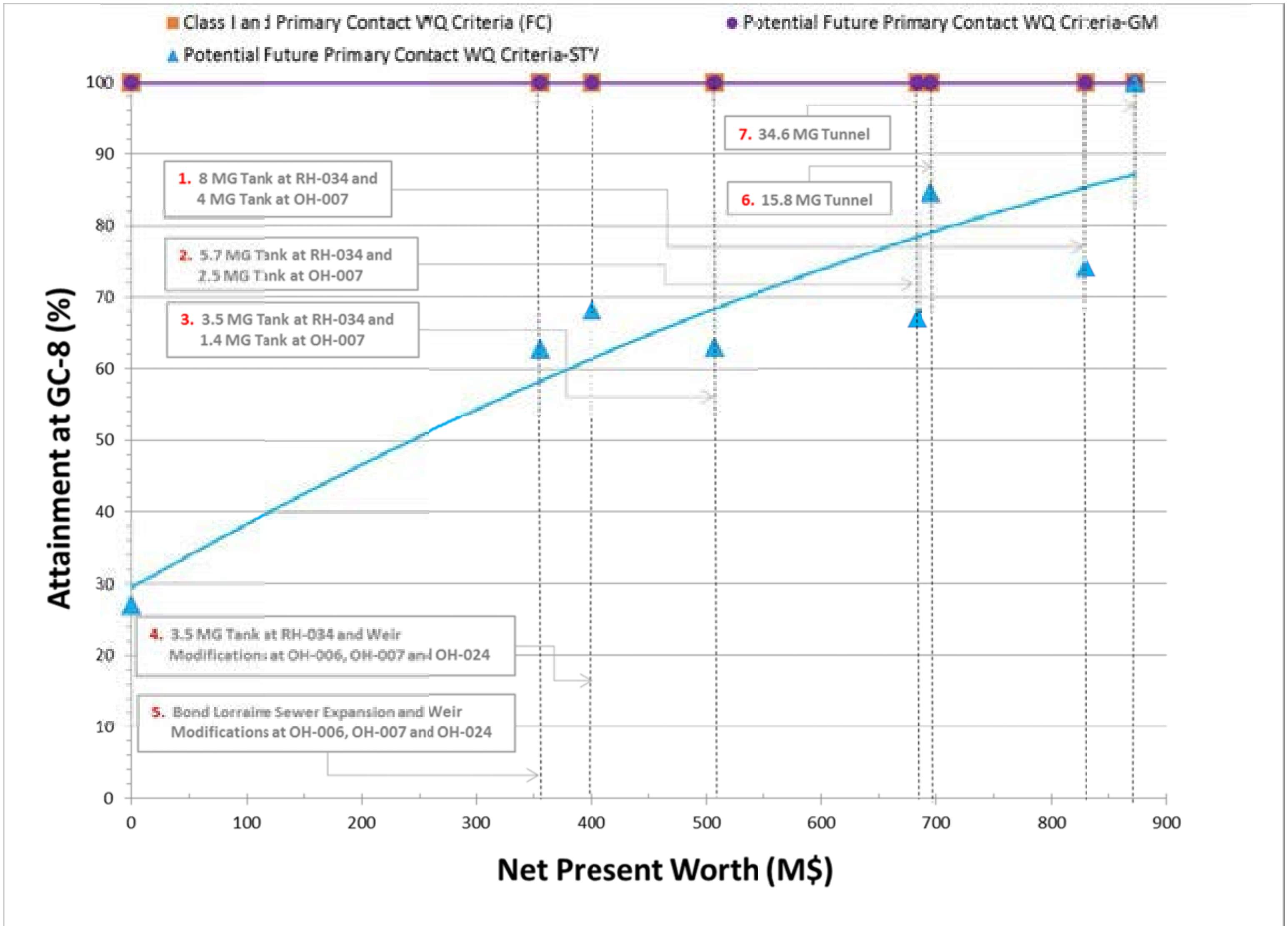


Figure 8-23. Cost vs. Bacteria Attainment at Station GC-8 (2008 Rainfall)

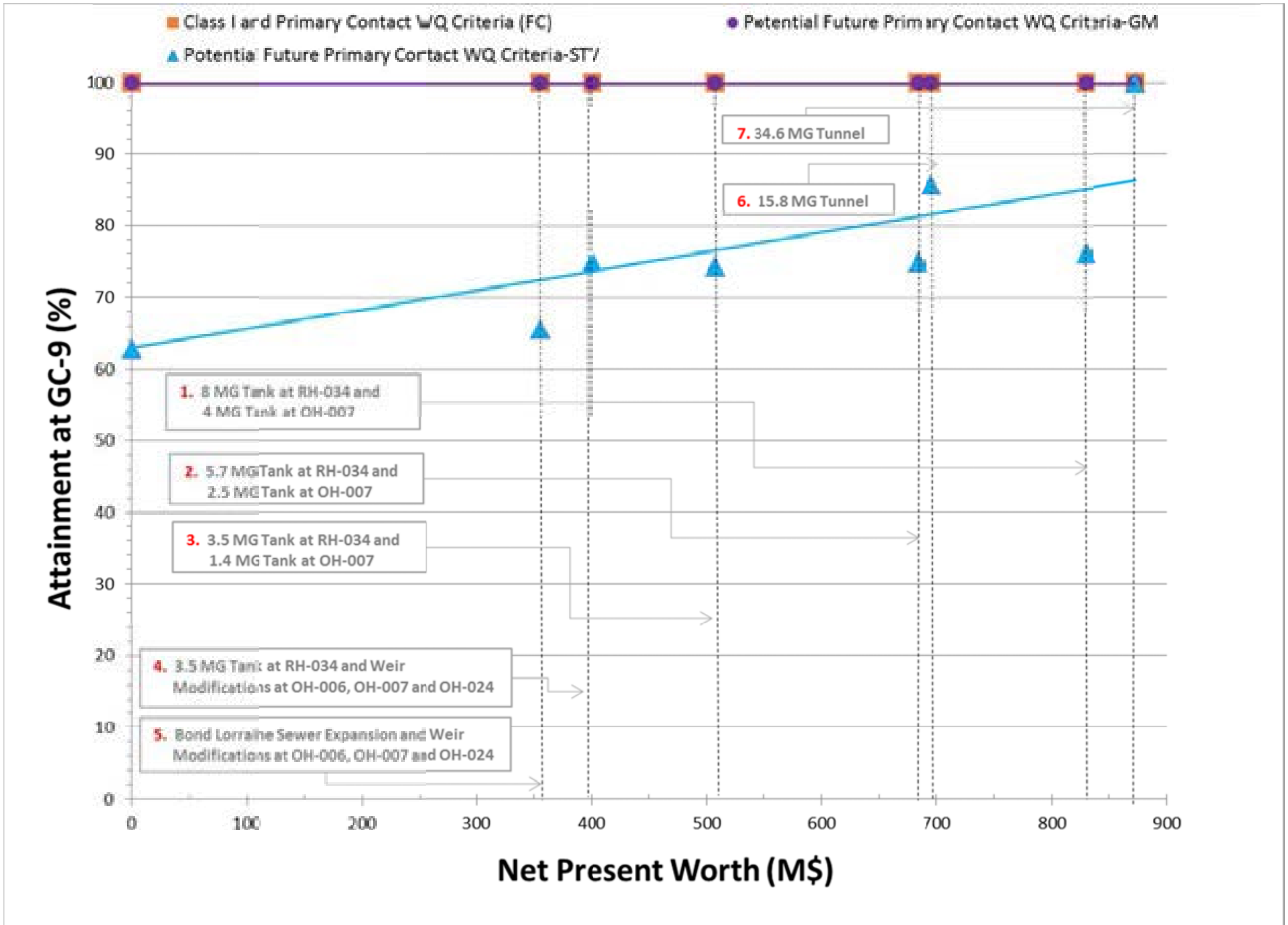


Figure 8-24. Cost vs. Bacteria Attainment at Station GC-9 (2008 Rainfall)

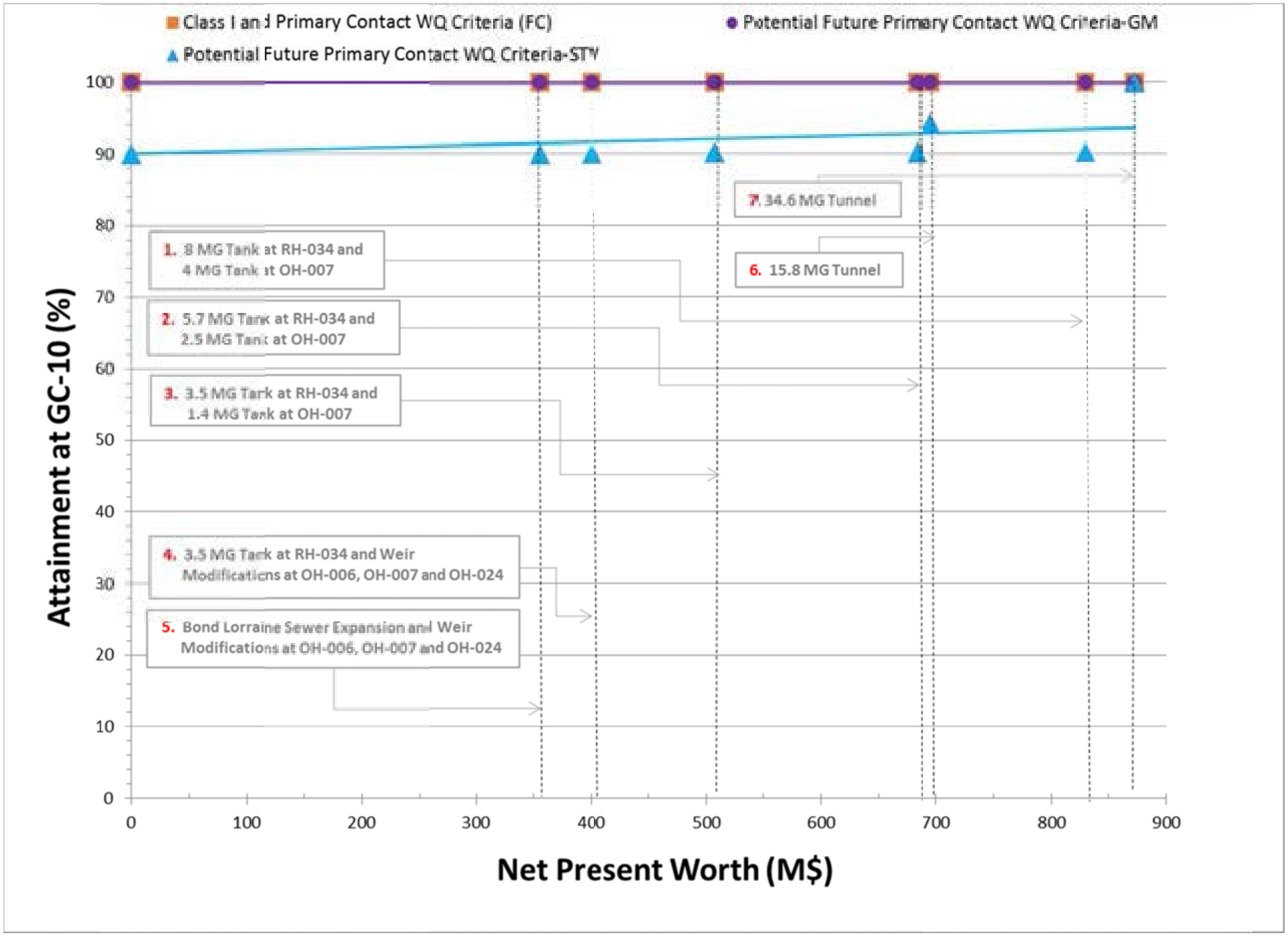


Figure 8-25. Cost vs. Bacteria Attainment at Station GC-10 (2008 Rainfall)

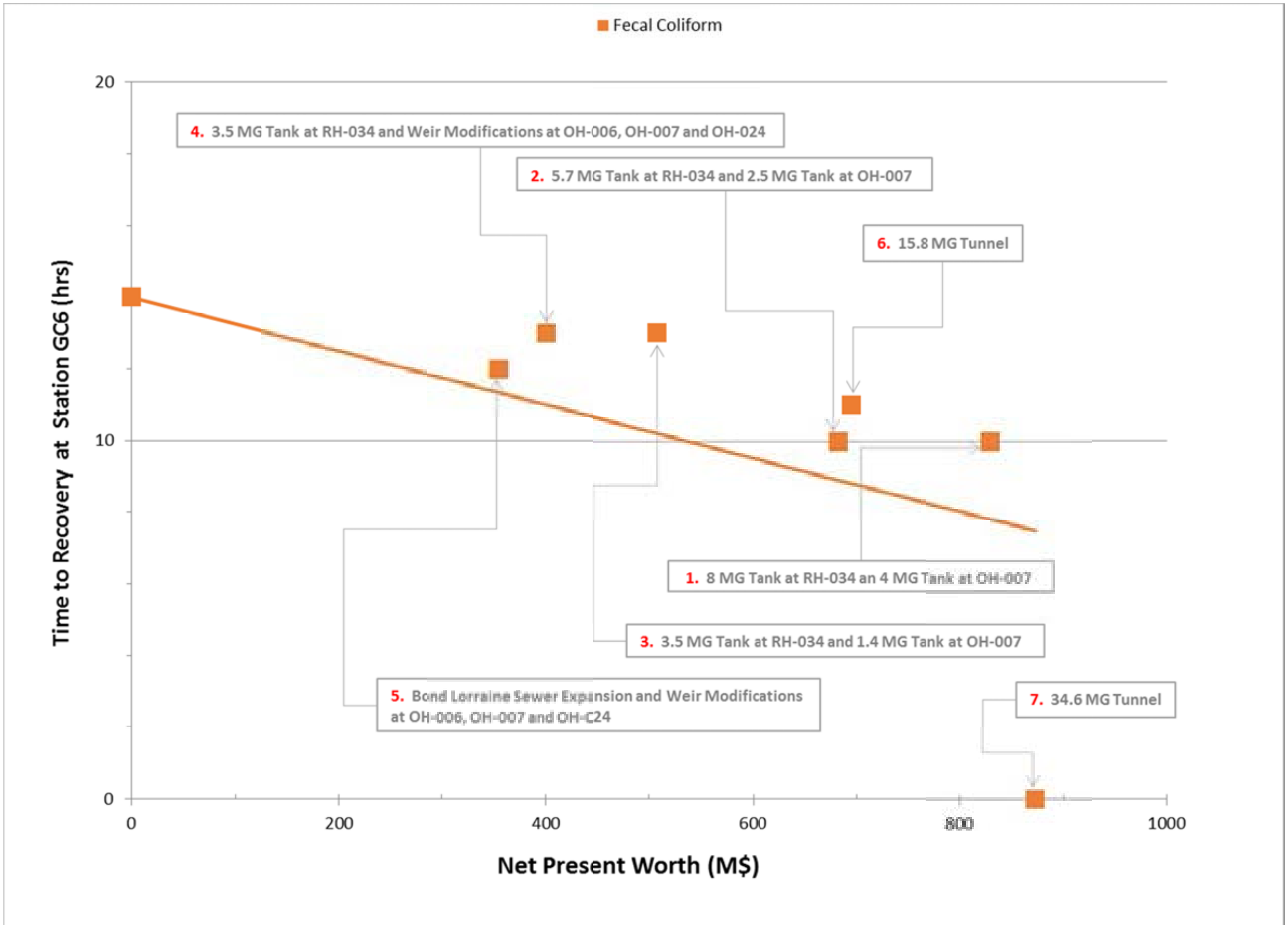


Figure 8-26. Time to Recovery at Station GC-6

8.5.d Conclusion on LTCP Preferred Alternative

The selection of the LTCP Preferred Alternative for any given waterbody typically includes multiple considerations, including public input, environmental and water quality benefits, capital and O&M costs, and projected attainment of WQS under baseline conditions.

For the Gowanus Canal LTCP, dramatic improvements in water quality have been achieved through an effective planning process between DEC and DEP to develop and implement infrastructure improvements in the Gowanus sewershed. These improvements, proposed in DEP's 2008 WWFP, and approved by DEC in 2009, have led to projected full compliance with the bacteria components of applicable WQS.

The Gowanus Canal Superfund program requires DEP to construct additional CSO controls to further reduce CSO discharges. As demonstrated throughout this section, this work will further improve the water quality in the Gowanus Canal beyond the current greatly improved state. Schedules for this work would be established pursuant to the Superfund program.

Data presented in Tables 8-16 through 8-18 show the attainment levels, without additional CSO controls, with regard to various water quality criteria, evaluated under a 10-year model run (2002-2011) and for the 2008 typical year for DO. The data reflected in these tables demonstrates that, with the exception of the primary contact chronic standard for DO, whose attainment level ranges from 87 percent to 94 percent at two of the water quality stations, full compliance with existing and Primary Contact WQ Criteria is achieved. Full compliance with the GM component of the Potential Future Primary Contact WQ Criteria is also achieved. Attainment of the STV component of the Potential Future WQ Criteria falls below 95 percent in most stations; therefore, the waterbody would not comply with this bacteria criterion. Nonetheless, implementation of any configuration of the Superfund remedy (two CSO tanks as included in Alternatives 1, 2 or 3) will improve water quality still further.

Table 8-16. Calculated 10-Year Bacteria Attainment for LTCP Baseline Conditions – Annual

Station	Existing WQ Criteria (Class I) (1)		Primary Contact WQ Criteria	
	Criterion (cfu/100mL)	Attainment (%)	Fecal Coliform Criterion (cfu/100mL)	Attainment (%)
GC-1	Fecal ≤ 2,000	100	Fecal ≤ 200	98
GC-2	Fecal ≤ 2,000	100	Fecal ≤ 200	99
GC-3	Fecal ≤ 2,000	100	Fecal ≤ 200	100
GC-4	Fecal ≤ 2,000	100	Fecal ≤ 200	100
GC-5	Fecal ≤ 2,000	100	Fecal ≤ 200	100
GC-6	Fecal ≤ 2,000	100	Fecal ≤ 200	98
GC-7	Fecal ≤ 2,000	100	Fecal ≤ 200	98
GC-8	Fecal ≤ 2,000	100	Fecal ≤ 200	99
GC-9	Fecal ≤ 2,000	100	Fecal ≤ 200	100
GC-10	Fecal ≤ 2,000	100	Fecal ≤ 200	100

Notes:
(1) Not currently designated to stations GC-1 through GC-7

Table 8-17. Calculated 10-Year Bacteria Attainment for LTCP Baseline Conditions - Recreational Season (May 1st through October 31st)

Station	Existing WQ Criteria (Class I)[1]		Primary Contact WQ Criteria		Potential Future Primary Contact WQ Criteria			
	Criterion (cfu/100mL)	Attainment (%)	Criterion (cfu/100mL)	Attainment (%)	Criterion (cfu/100mL)	Attainme nt (%)	Criterion (cfu/100mL)	Attainment (%)
GC-1	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	70
GC-2	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	73
GC-3	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	73
GC-4	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	74
GC-5	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	66
GC-6	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	95	Enterococci STV ≤ 110	34
GC-7	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	95	Enterococci STV ≤ 110	35
GC-8	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	97	Enterococci STV ≤ 110	36
GC-9	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	99	Enterococci STV ≤ 110	59
GC-10	Fecal ≤ 2,000	100	Fecal ≤ 200	100	Enterococci ≤ 30	100	Enterococci STV ≤ 110	86

Notes:

(1) Not currently designated to stations GC-1 through GC-7

Table 8-18. Calculated 2008 DO Attainment Baseline Conditions - Annual

Station	Existing WQ Criteria		Primary Contact WQ Criteria			
	Criterion	Attainment (%)	Criterion(1)	Attainment (%)	Criterion(2)	Attainment (%)
GC-1	≥3.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100
GC-2	≥3.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100
GC-3	≥3.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100
GC-4	≥3.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100
GC-5	≥3.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100
GC-6	≥3.0 mg/L	100	≥4.8 mg/L	94	≥3.0 mg/L	98
GC-7	≥3.0 mg/L	100	≥4.8 mg/L	95	≥3.0 mg/L	99
GC-8	≥4.0 mg/L	100	≥4.8 mg/L	87	≥3.0 mg/L	100
GC-9	≥4.0 mg/L	100	≥4.8 mg/L	99	≥3.0 mg/L	100
GC-10	≥4.0 mg/L	100	≥4.8 mg/L	100	≥3.0 mg/L	100

Notes:
(1) Chronic standard.
(2) Acute standard.

8.6 Use Attainability Analysis

The 2012 CSO Order on Consent requires that a UAA be included in an LTCP “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 Section 101(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, can be used to determine if changes to the designated use is warranted, considering a potential adjustment to the designated use classification, as appropriate. As noted in previous sections, the Gowanus Canal meets existing WQS and is predicted to fully meet the primary contact fecal coliform bacteria criterion of 200 cfu/100mL with the implementation of the 2008 WWFP plan and the other control measures included in the Section 6.0 baseline conditions. As discussed above, DO criteria are achieved for the existing WQS under the existing classification. However, Class SC DO criteria, the next higher classification above Class I, would not be achieved. DO levels appear to be related to non-CSO related conditions in the Gowanus Canal. Based on the projected bacteria water quality for baseline conditions, it is anticipated that the Gowanus Canal could be upgraded to a higher classification, although a variance for DO levels would be required. However, consideration of upgrading the Gowanus Canal to Class SC should await completion of the construction associated with Superfund remedial measures as well as the results from the PCM.

DEP will implement additional CSO controls as are required in the EPA ROD, which will result in further reductions in CSO overflows. These additional CSO controls will improve the level of compliance with primary contact DO WQS as described later in this section.

8.6.a Use Attainability Analysis Elements

Cost-effectively maximizing the water quality benefits associated with CSO controls is a cornerstone of this LTCP. The 2012 CSO Order on Consent Goal Statement stipulates that, in situations where the proposed alternatives presented in the LTCP will not achieve the CWA Section 101(a)(2) goals, the LTCP will include a UAA. The analyses developed herein indicate that the Gowanus Canal is projected to fully attain the Primary Contact WQ Criteria and, as a result, that a separate UAA need not be performed.

8.6.b Fishable/Swimmable Waters

The goal of this LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific WQS, consistent with EPA's CSO Policy and subsequent guidance. Currently, SA, SB, and SC classifications are fully supportive of the CWA Section 101(a)(2) fishable/swimmable goals. However, DEC has proposed a rule to adopt a fecal coliform bacteria criterion of 200 cfu/100mL to SD and I classifications as well.

The 10-year water quality modeling analyses conducted for the Gowanus Canal, summarized in Tables 8-16 through 8-18, show that, upon implementation of the baseline projects, whose results were summarized in Section 8.5, the waterbody is predicted to fully comply with the Existing WQ Criteria (Classes SD and I) and the Primary Contact WQ Criteria. The Potential Future Primary Contact WQ Criterion of 30-day GM of 30 cfu/100mL for enterococci is fully met during the recreational season (May 1st through October 31st). The Potential Future Primary Contact WQ Criterion of the 90th Percentile STV of 110 cfu/100mL is projected to be below the DEC target of 95 percent attainment.

Overall, there has been significant water quality improvement in the Gowanus Canal due to the recent improvements made by DEP. The water quality meets current WQS and the Proposed Primary Contact WQ Criteria of 200 cfu/100mL fecal coliform both during the recreational season (May 1st through October 31st) and on an annual basis.

8.6.c Assessment of Highest Attainable Use

The 2012 CSO Order on Consent Goal Statement stipulates that, in situations where the proposed alternatives presented in the LTCP will not achieve the CWA Section 101(a)(2) goals, the LTCP will include a UAA. Because the analyses developed herein indicate that the Gowanus Canal is projected to fully attain primary contact bacteria water quality criteria, fully attain the Existing DO Criteria and largely attain the primary contact DO criteria, a UAA is not required under the 2012 CSO Order on Consent.

Table 8-19 summarizes the projected compliance of WQS with the baseline projects.

Table 8-19. LTCP Baseline Compliance with Classifications and Standards – 10 Year Model Simulation

Analysis	Numerical Criteria Applied		Compliance
Existing WQ Criteria Fish Survival (Class SD) and Boating/Fishing (Class I)	Gowanus Canal Above Hamilton Ave (Class SD)	Fecal - None	Yes
		DO never < 3.0 mg/L[4]	Yes
	Gowanus Bay Below Hamilton Ave (Class I)	Fecal Monthly GM ≤ 2,000	Yes
		DO never <4.0 mg/L[4]	Yes
Primary Contact WQ Criteria[1]	Saline Water	Fecal Monthly GM ≤ 200	Yes
		Daily Average DO ≥ 4.8 mg/L[3] [4]	No[5]
		DO never < 3.0 mg/L[4]	Yes
Potential Future Primary Contact WQ Criteria[2]	Entero: rolling 30-d GM – 30 cfu/100mL		Yes
	Entero: STV – 110 cfu/100mL		No

Notes:

GM = Geometric Mean; STV = 90 Percent Statistical Threshold Value

(1) This water quality standard is not currently assigned to the Gowanus Canal or Gowanus Bay.
(2) The Potential Future Primary Contact WQ Criteria have not yet been adopted by DEC.
(3) 24-hr average DO ≥ 4.8 mg/L with allowable excursions to ≥ 3.0 mg/L for certain periods of time. See Section 2.0 for the equation and calculation description.
(4) DO based on 2008 typical year model simulations.
(5) DO Attainment ranges from 87% to 94% at Stations GC-8 and GC-6.

In summary, applicable water quality criteria essentially are met.

8.7 Water Quality Goals

Based on the analyses of the Gowanus Canal, and the WQS associated with the designated uses, the following conclusions can be drawn for both existing and future water quality goals:

8.7.a Existing WQ Criteria

The Gowanus Canal is a Class SD and I waterbody that can support existing uses where applicable: kayaking and wildlife propagation in the lower Class I reach and wildlife propagation in the upper Class SD reach. The waterbody is in full attainment with its current classifications regarding bacteria and DO criteria. Furthermore, man-made features, shoreline access and industrial uses limit opportunity for and render infeasible primary contact recreation in the Gowanus Canal, the significant improvements in water quality notwithstanding.

8.7.b Primary Contact WQ Criteria

As presented in Section 8.5, this LTCP incorporates assessments for attainment with the proposed primary contact recreational WQS, both spatially and temporally, using 10-year simulations for bacteria runs and a typical year (2008) run for DO. Projected bacteria levels comply fully with primary contact standards.

DO levels largely comply with the primary contact standards except at Stations GC-6 and GC-8 at which attainment with the chronic standard ranges from 87 to 94 percent.

8.7.c Potential Future Water Quality Criteria

The Potential Future Primary Contact WQ Criteria is achieved for the GM 30 cfu/100mL enterococci criterion 100 percent of the time for the 10-year model simulations. However, the 110 cfu/100mL STV criterion, is not. DEP is committed to improving water quality in the Gowanus Canal, as evidenced by the water quality improvements that resulted from implementation of the 2008 WWFP recommendations. Further improvements are already planned, including the build-out of GI and completion of the multi-phase HLSS.

8.7.d Time to Recovery

The DEC has requested DEP to analyze the Time to Recovery for the Gowanus Canal. Time to Recovery is not a current water quality criterion, but is an assessment of the time it takes for bacteria levels to return to fecal coliform concentrations below 1,000 cfu/100mL concentration, the a level deemed safe by New York State Department of Health (DOH) for primary contact use. The results of the time to recovery analysis for the Gowanus Canal are presented in Table 8-20. DEC agreed with this analysis, which was conducted for the August 14-15, 2008, storm. Details on the selection of this storm are presented in Section 6.0.

Table 8-20. Time to Recovery in Gowanus Canal (August 14-15, 2008 Storm)

Class	Stations	LTCP Baseline Conditions Projected Time to Recovery (hours)
SD	GC-1 to GC-7	8 – 14
I	GC-8 to GC-10	7 – 10

As shown, the time to recovery to the 1,000 cfu/100mL fecal coliform concentration following rain events is below 14 hours for all locations along the Gowanus Canal, well below the 24 hour duration guideline agreed upon by DEC and the DEP.

8.8 Recommended LTCP Elements to Meet Water Quality Goals

As has been emphasized throughout this section, the analyses performed for the Gowanus Canal LTCP CWA assessments were conducted with consideration of the EPA Superfund program. EPA's ROD preliminarily estimated a range of CSO reductions from Outfalls RH-034 and OH-007 of 58-74%, with a capital cost estimate of $77M for construction of two CSO storage tanks. Because of the common focus of these two efforts, i.e., CSO reduction, the preparation of the LTCP was coordinated with the development of the following DEP Superfund reports:

1. Preliminary Remedial Design Report for CSO Facility at Red Hook Outfall RH-034.
2. Preliminary Remedial Design Report for CSO Facility at Owl's Head Outfall OH-007.
3. CSO Facility Site Recommendation Report for Red Hook Outfall RH-034.
4. CSO Facility Site Recommendation Report for Owl's Head Outfall OH-007.

These reports are being submitted to EPA on June 30, 2015, the same date that this LTCP is being submitted to DEC.

The evaluations performed as part of the referenced Superfund documents work will result in additional CSO controls, as required by EPA, and will result in further improvements to water quality.

8.8.a LTCP Findings

The Gowanus Canal LTCP process has yielded the following conclusions:

1. Current WQS are being met with the newly refurbished Flushing Tunnel and reconstructed Gowanus PS.

2. Water quality will further improve with the build-out of the planned GI and construction of the proposed HLSS, currently planned and thus included in the LTCP baseline but yet to be fully implemented. The LTCP evaluated alternatives to further reduce CSO loadings to the Gowanus Canal beyond baseline conditions and determined that these additional control measures had little to no impact on projected water quality criteria for primary contract recreation.

3. The Superfund program will require grey infrastructure improvements in the form of CSO storage tanks. The anticipated water quality improvements resulting from the Superfund alternatives are presented later in this section.

8.8.b Water Quality Projections with Baseline

No numerical bacteria criteria currently exist for Class SD waters in NYS, the classification of the upper reaches of the Gowanus Canal. The existing fecal coliform bacteria criterion for Class I waters, the classification of the majority of the Gowanus Canal, is a monthly GM below 2,000 cfu/100mL. However, DEC has proposed a rule to adopt total and fecal coliform bacteria criteria consistent with the swimmable goals of the CWA for all waters of NYS. To that end, the Gowanus Canal LTCP attainment analyses focused on attainment of the fecal coliform Primary Contact WQ criterion of 200 cfu/100mL proposed for Class I and Class SD waters. Additionally, an analysis of attainment of the Potential Future Primary Contact WQ Criteria was conducted. It is not known whether these criteria, if adopted, will apply to urban tributaries within NYC.

The water quality projections under baseline conditions are presented in Tables 8-21 and 8-22, respectively. As discussed in Section 6.0 and earlier in this Section 8.0, both the refurbished Flushing Tunnel and the reconstructed Gowanus Canal PS - two of the key CSO control components included in baseline conditions - have improved the water quality to a point where the proposed primary contact fecal coliform criterion of 200 cfu/100mL is met 100 percent of the time for the 10-year model simulations.

Table 8-21. Attainment of Primary Contact WQ Criteria (Fecal Coliform) and Potential Future Primary Contact WQ Criteria (Enterococci) (Baseline) – 10 Year Model Simulation

Station	Attainment of Primary Contact WQ Criterion (200 cfu/100mL) (%)	Attainment of Potential Future Primary Contact WQ Criteria	
		GM (30 enterococci/100mL) (%)	STV (110 cfu/100mL) (%)
GC-1	100	≥95	70
GC-2	100	≥95	73
GC-3	100	≥95	73
GC-4	100	≥95	74
GC-5	100	≥95	66
GC-6	100	≥95	34
GC-7	100	≥95	35
GC-8	100	≥95	36
GC-9	100	≥95	59
GC-10	100	≥95	86

As shown, both the Primary Contact WQ and the Potential Future Primary Contact WQ GM 30 cfu/100mL criteria are predicted to be achieved with the baseline projects. Again, the Potential Future Primary Contact WQ Criterion of 110 cfu/100mL STV is not projected to be achieved.

Table 8-22. Water Quality DO Criteria Attainment (Baseline) – 2008 Model Simulation

Class	Stations	Criteria		Attainment (%)
SD	GC-1 to GC-7	Designated	≥ 3 mg/L	98
I	GC-8 to GC-10		≥ 4 mg/L	95
SC/SB	GC-1 to GC-7	Next Higher Classification	≥ 4.8 mg/L(1)	94
	GC-8 to GC-10			87
	GC-1 to GC-7		≥ 3 mg/L(2)	98
	GC-8 to GC-10			100

Notes:

(1) Chronic Standard.
(2) Acute Standard.

With respect to DO, all existing criteria for Class I and SD waters are fully achieved. The DO criteria applicable to the next higher waterbody classifications are largely achieved. Thus, DO WQS are essentially being met in the Gowanus Canal.

8.8.c Water Quality Projections- EPA ROD Superfund

The ROD targets a range of TSS reductions of 58-74%, and identified tank ranges between 4 MG and 8 MG. Tank size will be refined during the remedial design phase. Accordingly, DEP evaluated TSS loading reductions associated with a range of tank sizes. Notably, all three tank alternatives significantly reduce the frequency of overflows from LTCP baseline conditions of over 40 per year to a maximum of between 12 and 13 per year. In addition, based upon 10-year model simulations, all Superfund tanks improve the attainment of the 110 cfu/100mL STV criterion for enterococci over baseline conditions. However, even the largest Superfund tanks do not lead to full compliance, i.e., attainment of the criterion at least 95 percent of the time.

Evaluations of the various tank sizes led to the conclusion that smaller tanks at the two outfalls can meet the ROD's TSS reduction estimates, and at considerably lower cost than if the 8 MG and 4 MG tanks were constructed. These findings became the basis for Alternatives 2 and 3 described in Section 8.2. Details of the investigations performed under the Superfund analysis are not included in this LTCP, but can be found in the reports referenced earlier in this section.

8.8.d Water Quality Compliance Projections with Implementation of LTCP Alternatives 1, 2 or 3

This section provides the WQS compliance projections for bacteria and DO for Alternatives 1, 2 or 3. The results are shown in Tables 8-23 and 8-24 for Stations GC-1 through GC-10. These alternatives include the tanks sizes listed in Table 8-7: 8 MG, 5.7 MG and 3.5 MG tanks at Outfall RH-034 and 4 MG, 2.5 MG and 1.4 MG tanks at Outfall OH-007. Each of these alternatives meets the Existing WQ Criteria and Proposed Primary Contact WQ Criteria. The Potential Future Primary Contact WQ Criteria would be met for the enterococci GM 30/100mL criterion. The STV 110 cfu/100mL criterion would not be met.

Table 8-23. Attainment of Primary Contact WQ and Potential Future Primary Contact WQ Criteria with Alternatives 1, 2 and 3 – 2008 Model Simulation for Alternative 1 and 10 Year Model Simulations for Alternatives 2 and 3

Station	Alternatives 1, 2 and 3 Attainment with Primary Contact WQ Criteria (200 cfu/100mL fecal coliform) (%)	Attainment with Potential Future Primary Contact WQ Criteria for Enterococci					
		GM (30 cfu/100mL)			STV (110 cfu/100mL)		
		Alternative 1 (%)	Alternative 2 (%)	Alternative 3 (%)	Alternative 1(1) (%)	Alternative 2 (%)	Alternative 3 (%)
GC-1	100	≥95	≥95	≥95	87	87	86
GC-2	100	≥95	≥95	≥95	87	87	87
GC-3	100	≥95	≥95	≥95	87	87	86
GC-4	100	≥95	≥95	≥95	87	87	87
GC-5	100	≥95	≥95	≥95	90	87	84
GC-6	100	≥95	≥95	≥95	86	71	68
GC-7	100	≥95	≥95	≥95	77	71	69
GC-8	100	≥95	≥95	≥95	74	74	62
GC-9	100	≥95	≥95	≥95	76	75	72
GC-10	100	≥95	≥95	≥95	90	90	87

Notes:
(1) Alternative 1 is based on the 2008 model simulation and Alternatives 2 and 3 are based on the 10 year model simulations

Table 8-24. Water Quality Criteria Dissolved Oxygen Attainment with LTCP Alternatives 1, 2 and 3 - 2008 Model Simulation

Class	Stations	Criteria		Attainment		
				Alternative 1 (%)	Alternative 2 (%)	Alternative 3 (%)
SD	GC-1 to GC-7	Designated	≥ 3 mg/L	99	99	99
I	GC-8 to GC-10		≥ 4 mg/L	96	96	96
SC/SB	GC-1 to GC-7	Next Higher Classification	≥ 4.8 mg/L(1)	95	95	95
	GC-8 to GC-10			88	88	88
	GC-1 to GC-7		≥ 3 mg/L(2)	99	99	99
	GC-8 to GC-10			100	100	100

Notes:

(1) Chronic Standard
(2) Acute Standard

The water quality benefits achieved with Alternatives 1, 2 and 3 include reductions in CSO discharges to the Gowanus Canal. However, the 10-year water quality model runs do not show an appreciable elevation in WQS attainment. In all instances, the primary benefit will be fewer overflows to the Gowanus Canal and a greater removal of floatables.

The compliance with WQS realized by Alternatives 1, 2 and 3 is summarized in Table 8-25.

Table 8-25. Alternatives 1, 2 and 3 – Compliance with Classifications and Standards - 2008 Model Simulation for Alternative 1 and 10 Year Model Simulations for Alternatives 2 and 3

Analysis	Numerical Criteria Applied		Compliance
Existing WQ Criteria Fish Survival (Class SD) and Boating/Fishing (Class I)	Gowanus Canal Above Hamilton Ave (Class SD)	Fecal - None	Yes
		DO never < 3.0 mg/L(4)	Yes
	Gowanus Bay Below Hamilton Ave (Class I)	Fecal Monthly GM ≤ 2,000	Yes
		DO never <4.0 mg/L(4)	Yes
Primary Contact WQ Criteria(1)	Saline Water	Fecal Monthly GM ≤ 200	Yes
		Daily Average DO ≥4.8 mg/L(3) (4)	No(5)
		DO never < 3.0 mg/L(4)	Yes
Potential Future Primary Contact WQ Criteria(2)	Entero: rolling 30-d GM – 30 cfu/100mL Entero: STV – 110 cfu/100mL		Yes
			No

Notes:
GM = Geometric Mean; STV = 90 Percent Statistical Threshold Value
(1) This water quality standard is not currently assigned to the Gowanus Canal or Gowanus Bay.
(2) The Potential Future Primary Contact WQ Criteria have not yet been adopted by DEC.
(3) 24-hr average DO ≥ 4.8 mg/L with allowable excursions to ≥ 3.0 mg/L for certain periods of time. See Section 2.0 for the equation and calculation description.
(4) DO based on 2008 typical year model simulations.
(5) DO Attainment is 88% at Station GC-8.

The estimated construction and O&M costs for the Alternatives 1, 2 and 3, as well as the corresponding NPWs are shown in Table 8-26.

Table 8-26. Cost of Alternatives 1, 2 and 3

Alternative		Capital Cost ($M)	Annual O&M ($M)	NPW ($M)
1	8 MG Tank at Outfall RH-034	490	1.2	508
	4 MG Tank at Outfall OH-007	311	0.7	321
	Total	801	1.9	829
2	5.7 MG Tank at Outfall RH-034	450	0.9	462
	2.5 MG Tank at Outfall OH-007	213	0.5	221
	Total	663	1.4	683
3	3.5 MG Tank at Outfall RH-034	369	0.6	378
	1.4 MG Tank at Outfall OH-007	124	0.3	129
	Total	493	0.9	507

A comparison of the attainment results between Alternatives 1, 2 and 3 and a scenario where no additional CSO controls are constructed reveals that both existing and the primary contact WQS are largely met under all cases. As required in the EPA ROD, DEP will implement additional CSO controls which will result in still further reductions in CSO overflows and loadings, and improved water quality conditions.

8.8.e Conclusion

DEC and DEP have achieved dramatic improvements in water quality in the Gowanus Canal through an effective process that resulted in significant infrastructure improvements in the sewershed. These improvements were proposed in the 2008 WWFP submitted by DEP to DEC that was approved by DEC in 2009. That work included:

- Gowanus PS upgrade – increase capacity from 20 to 30 MGD and add screening facility to outfall for floatables control.
- Flushing Tunnel upgrade – three new pumps increasing average design flow to 215 MGD, and making it possible for more continuous flushing even during periods of low tide, with additional screening.
- Total project capital cost - $190M.

These WWFP projects, when coupled with the planned GI build-out and the proposed HLSS that collectively comprise the LTCP baseline conditions, are projected to achieve full compliance with designated WQS.

In accordance with EPA Superfund requirements to reduce TSS loadings to the Canal, DEP has evaluated a range of alternatives including various CSO storage tank sizes for Outfalls RH-034 and OH-007. Such tanks, while reducing TSS loadings, also significantly reduce the frequency of overflows from LTCP baseline conditions of over 40 per year to a maximum of approximately 12 to 13 per year. These tanks will, to a certain extent, improve the level of attainment with the potential future enterococci criteria. Schedules for construction of the two tanks would be established pursuant to the Superfund program.

As noted above, the baseline projects have led to projected full compliance with designated WQS. As a result, DEP is proposing upgrading the designated Class SD portion of the Gowanus Canal to a Class I. DEP plans to extend the period of PCM to assess the potential for even further upgrades to the waterbody classification (e.g., Class SC) as it appears, based on the monitoring to date, that water quality might support the uses associated with this classification during the recreational period. The Gowanus Canal should be considered for further upgraded WQS upon completion of the Superfund remediation work and results of water quality conditions after a longer trend of data can be analyzed from further PCM.

9.0 LONG-TERM CSO CONTROL PLAN IMPLEMENTATION

The evaluations performed for this Gowanus Canal LTCP concluded that the recommendations being implemented by DEP as part of the DEC-approved 2011 WWFP, plus the planned GI penetration throughout the watershed as part of the citywide GI plan as incorporated into the LTCP program, have significantly improved the water quality of the waterbody. It is projected that the Gowanus Canal will meet and exceed the Existing WQ Criteria classification of SC and I for bacteria. It is therefore recommended that DEP continue with implementation of the WWFP and GI projects, including PCM and other ongoing monitoring programs.

In addition, and in accordance with EPA Superfund requirements, DEP will be constructing additional CSO storage which will meet the EPA TSS target loading reductions; such work will lead to the reduction of the number of CSO overflow events from over 40 per year to between 12 and 13 per year. Selection of tank locations and tank sizes, and schedule will be established through the Superfund program which will be overseen by EPA. The schedule for this tank construction and work will be informed by future EPA decisions including site selection, tank sizing, and other factors, some of which may be beyond the control of DEP (including certain site remediation work). The schedule for the RH-034 site, in particular, could be impacted by sequencing of work which may be dependent on actions beyond the control of DEP, or activities that may need to be coordinated with other regulatory programs.

9.1 Adaptive Management (Phased Implementation)

Adaptive management, as defined by EPA, is the process by which new information about the characteristics of a watershed is incorporated into a watershed management plan. The process relies on establishing a monitoring program, evaluating monitoring data and trends, and making adjustments or changes to the plan. In the case of this LTCP, DEP will continue to apply the principles of adaptive management based on its annual evaluation of PCM data which will be collected to optimize the operation and effectiveness once the planned LTCP components are constructed.

Finally, the findings from the EPA ROD Superfund studies could have a bearing on the Gowanus Canal and possible post-LTCP CSO control measures.

9.2 Implementation Schedule

The implementation schedule for the Gowanus Canal LTCP will be based on the planned grey infrastructure from the WWFP and the planned GI build-out. The completion dates of the LTCP components are listed in the CSO Order as follows:

1. High Level Storm Sewers (HLSS) Project
2. GI Build-out

Additional CSO controls required by the Superfund program will be determined according to the process required by that program. Thus, storage alternatives have been presented as a range of tank sizes. These alternatives will be reviewed by EPA and the final schedule will be established in accordance with the Superfund process.

9.3 Operation Plan/O&M

DEP is committed to effectively operating the Gowanus Canal LTCP components as they are built-out during the implementation period.

9.4 Projected Water Quality Improvements

As previously noted, the construction and build-out of the LTCP components are expected to result in improved water quality in the Gowanus Canal and full attainment of the Existing WQ Criteria, currently Class SD and I.

9.5 Post-Construction Monitoring Plan and Program Reassessment

As discussed in Section 4.0, a PCM program will continue as part of the implementation of the LTCP. Specifically these include the WWFP components described in that section plus the build-out of the GI described in Section 5.0, which collectively comprises the LTCP Baseline Conditions of Section 6.0. DEP will continue to perform its ongoing monitoring programs including Harbor Survey Monitoring and Sentinel Monitoring of the shoreline, the former being described in Section 4.0.

9.6 Consistency with Federal CSO Control Policy

The Gowanus Canal LTCP was developed to comply with the requirements of the Federal or EPA CSO Control Policy and associated guidance documents, and the CWA. The LTCP revealed that the Gowanus Canal currently attains the Existing WQ Criteria and will meet the Primary Contact WQ Criteria (Class SC). The Potential Future Primary Contact WQ Criteria will also be met with the exception of the enterococci 110 STV criteria.

9.6.a Affordability and Financial Capability

EPA has recognized the importance of taking a community's financial status into consideration, and in 1997, issued "Combined Sewer Overflows: Guidance for Financial Capability Assessment and Schedule Development." This financial capability guidance contains a two-phased assessment approach. Phase I examines affordability in terms of impacts to residential households. This analysis applies the residential indicator (RI), which examines the average cost of household water pollution costs (wastewater and stormwater), relative to a benchmark of two percent of service area-wide median household income (MHI). The results of this preliminary screening analysis are assessed by placing the community in one of three categories:

- Low economic impact: average wastewater bills are less than one percent of MHI.
- Mid-range economic impact: average wastewater bills are between one percent and two percent of MHI.
- Large economic impact: average wastewater bills are greater than two percent of MHI.

The second phase develops the Permittee Financial Capability Indicators (FCI), which examine several metrics related to the financial health and capabilities of the impacted community. The indicators are compared to national benchmarks and are used to generate a score that is the average of six economic indicators, including bond rating, net debt, MHI, local unemployment, property tax burden, and property tax collection rate within a service area. Lower FCI scores imply weaker economic conditions and thus the increased likelihood that additional controls would cause substantial economic impact.

The results of the RI and the FCI are then combined in a Financial Capability Matrix to give an overall assessment of the permittee's financial capability. The result of this combined assessment can be used to establish an appropriate CSO control implementation schedule.

Importantly, EPA recognizes that the procedures set out in its guidance are not the only appropriate analyses to evaluate a community's ability to comply with CWA requirements. EPA's 2001 "Guidance: Coordinating CSO Long-term Planning with Water Quality Standards Reviews" emphasizes this by stating:

> *The 1997 Guidance "identifies the analyses States may use to support this determination [substantial and widespread impact] for water pollution control projects, including CSO LTCPs. States may also use alternative analyses and criteria to support this determination, provided they explain the basis for these alternative analyses and/or criteria* (U.S. EPA, 2001, p. 31,)".

Likewise, EPA has recognized that its RI and FCI metrics are not the sole socioeconomic basis for considering an appropriate CSO compliance schedule. EPA's 1997 guidance recognizes that there may be other important factors in determining an appropriate compliance schedule for a community, and contains the following statement that authorizes communities to submit information beyond that which is contained in the guidance:

> *It must be emphasized that the financial indicators found in this guidance might not present the most complete picture of a permittee's financial capability to fund the CSO controls. … Since flexibility is an important aspect of the CSO Policy, permittees are encouraged to submit any additional documentation that would create a more accurate and complete picture of their financial capability* (U.S. EPA, 1997, p. 7,).

Furthermore, EPA in 2012 released its "Integrated Municipal Stormwater and Wastewater Planning Approach Framework," which is supportive of a flexible approach to prioritizing projects with the greatest water quality benefits and the use of innovative approaches like GI (U.S. EPA, 2012). In November of 2014, EPA released its "Financial Capability Assessment Framework" clarifying the flexibility within their CSO guidance.

This section of this LTCP begins to explore affordability and financial capability concerns as outlined in the 1997 and 2001 guidance documents and the 2014 Framework. This section will also explore additional socioeconomic indicators that reflect affordability concerns within the NYC context. As DEP is tasked with preparing ten LTCPs for individual waterbodies and one LTCP for the East River and Open Waters, DEP expects that a complete picture of the effect of the comprehensive CSO program would be available in 2017 to coincide with the schedule for completion of all the plans. This affordability and financial capability section will be refined in each LTCP submittal as project costs are further developed and to reflect the latest available socioeconomic metrics.

9.6.a.1 Background on DEP Spending

As the largest water and wastewater utility in the nation, DEP provides over a billion gallons of drinking water daily to more than eight million NYC residents, visitors and commuters, as well as, one million upstate customers. DEP maintains over 2,000 square miles of watershed comprised of 19 reservoirs, three controlled lakes, several aqueducts, and 6,600 miles of water mains and distribution pipes. DEP also collects and treats wastewater. Averaged across the year, the system treats approximately 1.3 billion gallons of wastewater per day collected through 7,400 miles of sewers, 95 pump stations and 14 in-NYC WWTPs. In wet-weather, the system can treat up to 3.5 billion gallons per day of combined storm and sanitary flow. In addition to the WWTPs, DEP has four CSO storage facilities. DEP recently launched a $2.4B GI program, of which $1.5B will be funded by DEP, and the remainder will be funded through private partnerships.

9.6.a.2 Currently Budgeted and Recent Completed Mandated Programs

As shown in Figure 9-1, from FY 2005 through FY 2014, 59 percent of DEP's capital spending was for wastewater and water mandates. Figure 9-2 identifies associated historical wastewater and water operating expenses from FY 2003 through FY 2014, which have generally increased over time reflecting the additional operational costs associated with the NYC's investments. Many projects have been important investments that safe-guard our water supply and improve the water quality of our receiving waters in the Harbor and its estuaries. These mandates and associated programs are described below.

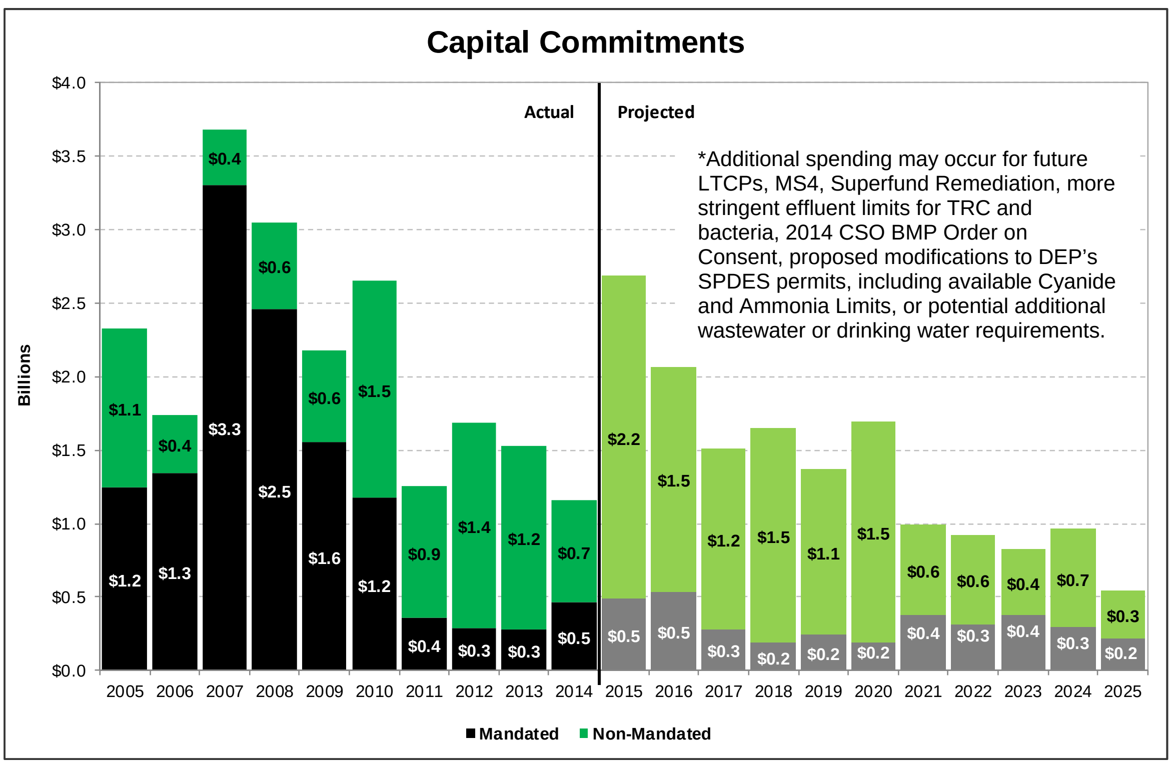


Figure 9-1. Historical and Projected Capital Commitments

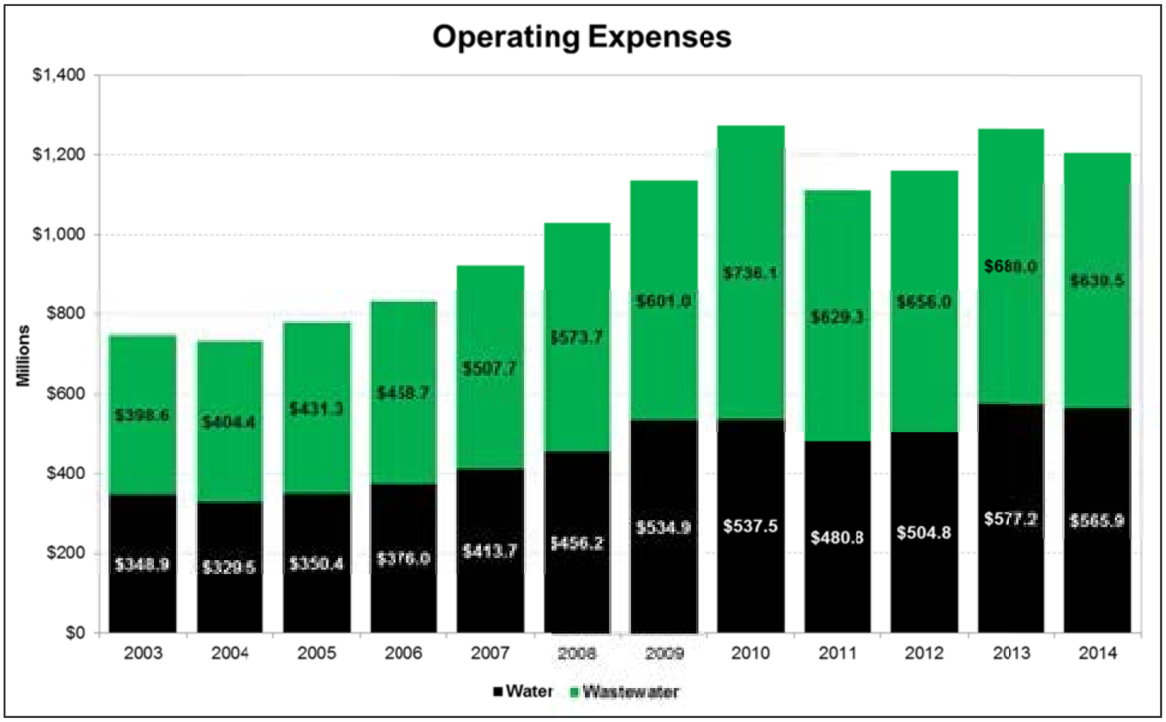


Figure 9-2. Historical Operating Expenses

Wastewater Mandated Programs

The following wastewater programs and projects have been initiated to comply with Federal and State laws and permits:

- CSO Abatement and Stormwater Management Programs

  DEP has initiated a number of projects to reduce CSOs and eliminate excess infiltration and inflow of groundwater and stormwater into the wastewater system. These projects include: construction of CSO abatement facilities; optimization of the wastewater system to reduce the volume of CSO discharge; controls to prevent debris that enters the combined wastewater system from being discharged; dredging of CSO sediments that contribute to low DO and poor aesthetic conditions; and other water quality based enhancements to enable attainment of the WQS. These initiatives impact both the capital investments that must be made by DEP, as well as O&M expenses. Historical commitments and those currently in DEP's ten year capital plan for CSOs are estimated to be about $3.4B. FY 2013 annual operating costs for stormwater expenses are estimated to have been about $63M. DEP expects that additional investments in stormwater controls will be required of DEP, as well as other NYC agencies, pursuant to MS4 requirements.

- Biological Nutrient Removal

  In 2006, NYC entered into a Consent Judgment (Judgment) with the DEC, which required DEP to upgrade five WWTPs by 2017 in order to reduce nitrogen discharges and comply with draft SPDES nitrogen limits. Pursuant to a modification and amendment to the Judgment, DEP has agreed to upgrade three additional WWTPs and to install additional nitrogen controls at one of the WWTPs, which was included in the original Judgment. As in the case of CSOs and stormwater, these initiatives include capital investments made by DEP (over $1B to-date and an additional $50M in the 10-year capital plan) as well as O&M expenses (chemicals alone in FY 2014 amounted to $3.2M per year, and by FY 2017 are estimated to be about $20M per year).

- Wastewater Treatment Plant Upgrades

  The Newtown Creek WWTP has been upgraded to secondary treatment pursuant to the terms of a Consent Judgment with DEC. The total cost of the upgrade is estimated to be $5B. In 2011, DEP certified that the Newtown Creek WWTP met the effluent discharge requirements of the CWA, bringing all 14 WWTPs into compliance with the secondary treatment requirements.

Drinking Water Mandated Programs

Under the Federal Safe Drinking Water Act and the New York State Sanitary Code, water suppliers are required to either filter their surface water supplies or obtain and comply with a determination from EPA that allows them to avoid filtration. In addition, EPA has promulgated a rule known as Long Term 2 (LT2) that requires that unfiltered water supplies receive a second level of pathogen treatment (e.g., ultraviolet [UV] treatment in addition to chlorination) by April 2012. LT2 also requires water suppliers to cover or treat water from storage water reservoirs. The following DEP projects have been undertaken in response to these mandates:

- Croton Watershed - Croton Water Treatment Plant

  Historically, NYC's water has not been filtered because of its good quality and long retention times in reservoirs. However, more stringent Federal standards relating to surface water treatment have resulted in a Federal court consent decree (the Croton Water Treatment Plant Consent Decree), which mandates the construction of a full-scale water treatment facility to filter water from NYC's Croton watershed. Construction on the Croton Water Treatment Plant began in late 2004. DEP estimates that the facility will begin operating in 2015. To-date, DEP has committed roughly $3.2B in capital costs. During start-up and after commencement of operations, DEP will also incur annual expenses for labor, power, chemicals, and other costs associated with plant O&M. For FY 2015, O&M costs are estimated to be about $23M.

- Catskill/Delaware Watershed - Filtration Avoidance Determination

  Since 1993, DEP has been operating under a series of Filtration Avoidance Determinations (FADs), which allow NYC to avoid filtering surface water from the Catskill and Delaware systems. In 2007, EPA issued a new FAD (2007 FAD), which requires NYC to take certain actions over a ten year period to protect the Catskill and Delaware water supplies. In 2014, the DOH issued mid-term revisions to the 2007 FAD. Additional funding has been added to the Capital Improvement

Plan (CIP) through 2017 to support these mid-term FAD revisions. DEP has committed about $1.5B to-date and anticipates that expenditures for the current FAD will amount to $200M.

- UV Disinfection Facility

  In January 2007, DEP entered into an Administrative Order on Consent (UV Order) with EPA pursuant to EPA's authority under LT2 requiring DEP to construct a UV facility by 2012. Since late 2012, water from the Catskill and Delaware watersheds has been treated at DEP's new UV disinfection facility in order to achieve Cryptosporidium inactivation. To-date, capital costs committed to the project amount to $1.6B. DEP is also now incurring annual expenses for property taxes, labor, power, and other costs related to plant O&M. FY 2013 O&M costs were $20.8M including taxes.

9.6.a.3 Future System Investment

Over the next nine years, the percentage of already identified mandated project costs in the CIP is anticipated to decrease, but DEP will be funding critical but non-mandated state of good repair projects and other projects needed to maintain NYC's infrastructure to deliver clean water and treat wastewater. Moreover, DEP anticipates that there will be additional mandated investments as a result of MS4 compliance, proposed modifications to DEP's in-NYC WWTP SPDES permits, Superfund remediation, CSO LTCPs, and the 2014 CSO BMP Order on Consent. It is also possible that DEP will be required to invest in an expensive cover for Hillview Reservoir as well as other additional wastewater and drinking water mandates. Additional details for anticipated future mandated and non-mandated wastewater programs are provided below, with the exception of CSO LTCPs which are presented in Section 9.6.f.

Potential or Unbudgeted Wastewater Regulations

- MS4 Permit Compliance

  Currently, DEP's separate stormwater system is regulated through DEP's 14 WWTP-specific SPDES permits. On February 5, 2014, DEC issued a draft MS4 permit that will cover MS4 separate stormwater systems for all NYC agencies. Under the proposed MS4 permit, the permittee will be NYC.

  DEP is delegated to coordinate efforts with other NYC agencies and to develop a stormwater management program plan for NYC to facilitate compliance with the proposed permit terms as required by DEC. This plan will also develop the legal authority to implement and enforce the stormwater management program, as well as develop enforcement and tracking measures and provide adequate resources to comply with the MS4 permit. Some of the potential permit conditions identified through this plan may result in increased costs to DEP and those costs will be more clearly defined upon completion of the plan. The permit also requires NYC to conduct fiscal analysis of the capital and O&M expenditures necessary to meet the requirements of this permit, including any development, implementation and enforcement activities required, within three years of the Effective Permit date.

  The draft MS4 permit compliance costs are yet to be estimated. DEP's annual historic stormwater capital and O&M costs have averaged $131.6M. However, given the more stringent draft permit requirements, future MS4 compliance costs are anticipated to be significantly higher than DEP's current stormwater program costs. The future compliance costs will also be shared by other NYC departments that are responsible for managing stormwater. The projected cost for stormwater and CSO programs in other major urban areas such as Philadelphia and Washington DC are quite high, $2.4B and $2.6B, respectively. According to preliminary estimates completed by Washington District Department of Environment, the MS4 cost could be $7B (green build-out scenario) or as high as $10B (traditional infrastructure) to meet the TMDLs. In FY 2014, Philadelphia reported $95.4M for MS4 spending, whereas Washington DC reported $19.5M as part of these annual reports (Philadelphia, 2014; Washington DC, 2014).

MS4 compliance cost estimates for Chesapeake Bay communities provide additional data for consideration. On December 29, 2010, the EPA established the Chesapeake Bay TMDL, for nitrogen, phosphorus, and sediment. Each state has been given its quota – the pounds of nitrogen and phosphorus, and the tons of sediment it may contribute to the bay on an annual basis. To achieve these quotas and meet the WQS in the bay by 2025, each state must implement aggressive reductions incrementally across several pollution source sectors. The cost estimates vary within the bay communities. For example, the Maryland State Highway Administration estimates the cost to comply with the Chesapeake Bay TMDL at $700M for engineering and construction, and $300M for utility, right-of-way, and contingencies, whereas Fairfax County, Va., estimates its cost of compliance with the Chesapeake Bay TMDL at $845M (Civil and Structural Engineer, 2012).

There is currently limited data for estimating future NYC MS4 compliance cost. Based on estimates from other cities, stormwater retrofit costs have been estimated on the low end between $25,000 to $35,000 per impervious acre to $100,000 to $150,000 on the high end. Costs would vary on the type and level of control selected. For the purposes of developing preliminary MS4 cost estimates for NYC for this analysis, a stormwater retrofit cost of $35,000 per impervious acre was assumed, which resulted in a MS4 compliance cost of about $2B.

- Draft SPDES Permit Compliance

In June 2013, DEC issued draft SPDES permits which, if finalized, will have a substantial impact on DEP's Total Residual Chlorine (TRC) program and set more stringent ammonia and available cyanide limits. These proposed modifications include requirements that DEP:

– Perform a degradation study to evaluate the degradation of TRC from the chlorine contact tanks to the edge of the designated mixing zone for comparison to the water quality based effluent limit and standard. The scope of work for this study is required within six months of the effective date of the SPDES permit, and the study must be completed 18 months after the approval of the scope of work. Based upon verbal discussions with DEC, DEP believes that this study may result in the elimination of the 0.4 mg/L uptake credit previously included in the calculation of TRC limits thereby decreasing the effective TRC limits by 0.4 mg/L at every WWTP.

– Comply with new unionized ammonia limits. These proposed limits will, at some WWTPs, potentially interfere with the chlorination process, particularly at 26th Ward and Jamaica.

– Monitor for available cyanide and ultimately comply with a final effluent limit for available cyanide. Available cyanide can be a byproduct of the chlorination process.

– DEC has also advised DEP that fecal coliform, the parameter that has been historically used to evaluate pathogen kills and chlorination performance/control, will be changing to enterococcus. This change will likely be incorporated in the next round of SPDES permits scheduled in the next five years. Enterococcus has been shown to be harder to kill with chlorine and may require process changes to disinfection that would eliminate the option of adding de-chlorination after the existing chlorination process.

The potential future costs for these programs have yet to be determined. Preliminary compliance costs for TRC control and ammonia control are estimated to be up to $560M and $840M, respectively.

- CSO Best Management Practices Order

On May 8, 2014, DEC and DEP entered into an agreement for the monitoring of CSO compliance, reporting requirements for bypasses, and notification of equipment out-of-service at the WWTP during rain events. The 2014 CSO BMP Order on Consent incorporates, expands, and supersedes the 2010 CSO BMP Order by requiring DEP to install new monitoring equipment at identified key regulators and outfalls and to assess compliance with requirements to "Maximize Flow to the WWTP". The costs for compliance for this Order have not yet been determined, but DEP expects this program to have significant capital costs as well as expense costs.

- Superfund Remediation

There are two major Superfund sites in NYC that may affect our Long Term Control Plans and which are at various stages of investigation. The Gowanus Canal Remedial Investigation/Feasibility Study (RI/FS) is complete, and remedial design work will take place in the next three to five years. The Newtown Creek RI/FS completion is anticipated for 2018.

DEP's ongoing costs for these projects are estimated at about $50-60M for the next ten years, not including design or construction costs for the Gowanus Canal. EPA's selected remedy for the Gowanus Canal requires that NYC build two combined sewage overflow retention tanks. As more fully described in Section 8, DEP has evaluated potential alternatives to the EPA selected remedy, including smaller storage tanks than the ROD recommended tanks. Potential Superfund costs for the Gowanus Canal range from $507M to $829M. Similar Superfund mandated CSO controls at Newtown Creek could add costs of $1B-$2B

Potential, Unbudgeted Drinking Water Regulation

- Hillview Reservoir Cover

LT2 also mandates that water from uncovered storage facilities (including DEP's Hillview Reservoir) be treated or that the reservoir be covered. DEP has entered into an Administrative Order with the DOH and an Administrative Order with EPA, which mandates NYC to begin work on a reservoir cover by the end of 2018. In August 2011, EPA announced that it would review LT2 and its requirement to cover uncovered finished storage reservoirs such as Hillview. DEP has spent significant funds analyzing water quality, engineering options, and other matters relating to the Hillview Reservoir. Potential costs affiliated with construction are estimated to be on the order of $1.6B.

Other: State of Good Repair Projects and Sustainability/Resiliency Initiatives

Wastewater Projects

- Climate Resiliency

  In October 2013, on the first anniversary of Hurricane Sandy, DEP released the NYC Wastewater Resiliency Plan, the nation's most detailed and comprehensive assessment of the risks that climate change poses to a wastewater collection and treatment system. The groundbreaking study, initiated in 2011 and expanded after Hurricane Sandy, was based on an asset-by-asset analysis of the risks from storm surge under new flood maps at all 14 WWTPs and 58 of NYC's pumping stations, representing more than $1B in infrastructure.

  DEP estimates to spend $447M in cost-effective upgrades at these facilities to protect valuable equipment and minimize disruptions to critical services during future storms. It is estimated that investing in these protective measures today will help protect this infrastructure from over $2B in repeated flooding losses over the next 50 years. DEP is currently pursuing funding through the EPA State Revolving Fund Storm Mitigation Loan Program.

  DEP will coordinate this work with the broader coastal protection initiatives, such as engineered barriers and wetlands, described in the 2013 report, "A Stronger, More Resilient New York," and continue to implement the energy, drinking water, and drainage strategies identified in the report to mitigate the impacts of future extreme events and climate change. This includes ongoing efforts to reduce CSOs with GI as part of LTCPs and build-out of HLSS that reduce both flooding and CSOs. It also includes build-out of storm sewers in areas of Queens with limited drainage and continued investments and build-out of the Bluebelt system.

- Energy projects at WWTPs

  NYC's blueprint for sustainability, *PlaNYC 2030: A Greener, Greater New York*, set a goal of reducing NYC's greenhouse gases (GHG) emissions from 2006 levels by 30 percent by 2017. This goal was codified in 2008 under Local Law 22. In April 2015, NYC launched an update to PlaNYC called *One New York: The Plan for a Strong and Just City* (OneNYC), which calls for reducing NYC's greenhouse gas emissions by 80 percent by 2050, over 2005 levels. In order to meet the OneNYC goal, DEP is working to reduce energy consumption and GHG emissions through: reduction of fugitive methane emissions; investment in cost-effective, clean energy projects; and energy efficiency improvements.

  Fugitive methane emissions from WWTPs currently account for approximately 170,000 metric tons (MT) of carbon emissions per year and 30 percent of DEP's overall emissions. To reduce GHG emissions and to increase on-site, clean energy generation, DEP has set a target of 60 percent beneficial use of the biogas produced by 2017. Recent investments by DEP to repair leaks and upgrade emissions control equipment have already resulted in a 30 percent reduction of methane emissions since a peak in 2009. Going forward, DEP has approximately $500M allocated in its CIP to make additional system repairs to flares, digester domes, and digester gas piping, in order to maximize capture of fugitive emissions for beneficial use or flaring.

A 12 megawatt cogeneration system is currently in design for the North River WWTP and estimated to be in operation in Spring 2019. This project will replace ten direct-drive combustion engines, which are over 25 years old and use fuel oil, with five new gas engines enhancing the WWTP's operational flexibility, reliability, and resiliency. The cogeneration system will produce enough energy to meet the WWTP's base electrical demand and the thermal demand from the treatment process and building heat, in addition to meeting all of the WWTPs emergency power requirements. The project is taking a holistic approach and includes: (1) improvements to the solids handling process to increase biogas production and reduce treatment, transportation and disposal costs; (2) optimization of biogas usage through treatment and balancing improvements; and (3) flood proofing the facility to the latest Federal Emergency Management Agency (FEMA) 100-year flood elevations plus 30 inches to account for sea level rise. The cogeneration system will double the use of anaerobic digester gas produced on-site, eliminate fuel oil use, and off-set utility electricity use, which will reduce carbon emissions by over 10,000 MT per year, the equivalent of removing ~2,000 vehicles from the road. The total project cost is estimated at $212M. DEP is also initiating an investment-grade feasibility study to evaluate the installation of cogeneration at the Wards Island WWTP, NYC's second largest WWTP.

To reduce energy use and increase energy efficiency, DEP has completed energy audits at all 14 in-NYC WWTPs. Close to 150 energy conservation measures (ECMs) relating to operational and equipment improvements to aeration, boilers, dewatering, digesters, HVAC, electrical, thickening and main sewage pumping systems have been identified and accepted for implementation. Energy reductions from these ECMs have the potential to reduce greenhouse gas emissions by over 160,000 MT of carbon emissions at an approximate cost of $140M. DEP is developing implementation plans for these measures.

Water Projects

- Water for the Future

In 2011, DEP unveiled Water for the Future: a comprehensive program to permanently repair the leaks in the Delaware Aqueduct, which supplies half of New York's drinking water. Based on a 10-year investigation and more than $200M of preparatory construction work, DEP is currently designing a bypass for a section of the Delaware Aqueduct in Roseton and internal repairs for a tunnel section in Wawarsing. Since DEP must shut down the Aqueduct when it is ready to connect the bypass tunnel, DEP is working on projects that will supplement NYC's drinking water supply during the shutdown, such as developing the groundwater aquifers in Jamaica, Queens, and implementing demand reduction initiatives, such as offering a toilet replacement program. Construction of the shafts for the bypass tunnel is underway, and the project will culminate with the connection of the bypass tunnel in 2021. The cost for this project is estimated to be about $1.5B.

- Gilboa Dam

  DEP is currently investing in a major rehabilitation project at Gilboa Dam at Schoharie Reservoir. Reconstruction of the dam is the largest public works project in Schoharie County, and one of the largest in the entire Catskills. This project is estimated to cost roughly $440M.

As shown in Figure 9-3, increases in capital expenditures have resulted in increased debt. While confirmed expenditures may be on the decline over the next few years, debt service continues to be on the rise in future years, occupying a large percentage of DEP's operating budget (approximately 45 percent in FY 2015).

- Kensico Eastview Connection 2

  To ensure the resilience and provide critical redundancy of infrastructure in the NYC Water Supply system, DEP will be constructing a new tunnel between the Kensico Reservoir and the Ultraviolet Disinfection Facility. This project is included in the current capital improvement plan and has an estimated cost of about $511M.

9.6.b Background on History of DEP Water and Sewer Rates

The NYC Water Board is responsible for setting water and wastewater rates sufficient to cover the costs of operating NYC's water supply and wastewater systems (the "system"). Water supply costs include those associated with water treatment, transmission, distribution, and maintaining a state of good repair. Wastewater service costs include those associated with wastewater conveyance and treatment, as well as stormwater service, and maintaining a state of good repair. The NYC Municipal Water Finance Authority (MWFA) issues revenue bonds to finance NYC's water and wastewater capital programs, and the costs associated with debt service consume a significant portion of the system revenues.

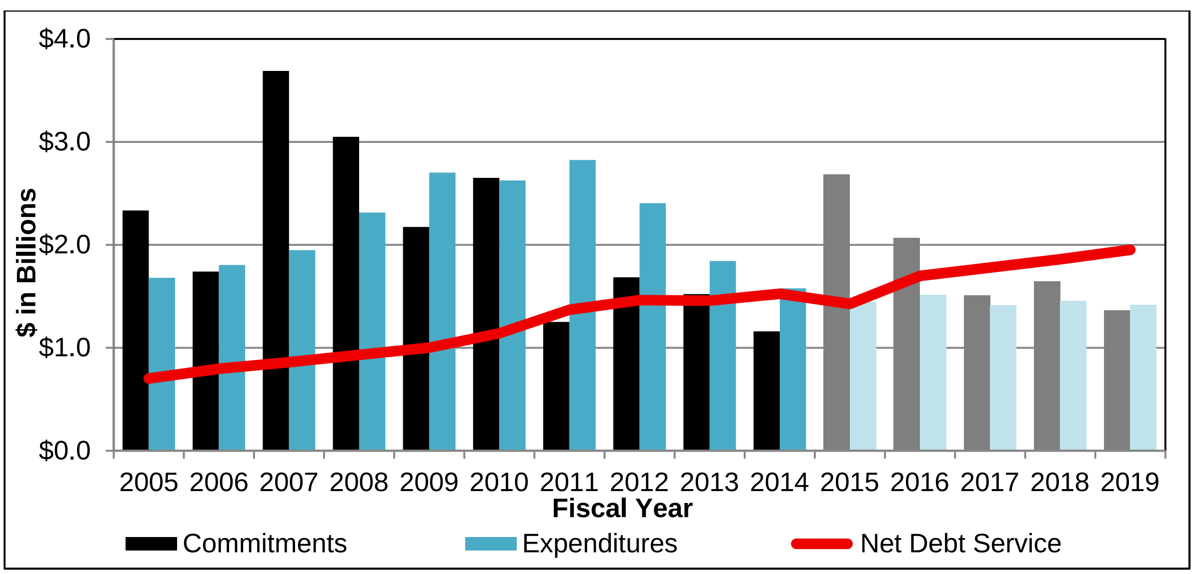


Figure 9-3. Past Costs and Debt Service

Actual Projected

For FY 2016, most customers will be charged a uniform water rate of $0.51 per 100 gallons of water. Wastewater charges are levied at 159 percent of water charges ($0.81 per 100 gallons). There is a small percentage of properties that are billed a fixed rate. Under the Multi-family Conservation Program (MCP), some properties are billed at a fixed per-unit rate if they comply with certain conservation measures. Some nonprofit institutions are also granted exemption from water and wastewater charges on the condition that their consumption is metered and their consumption falls within specified consumption threshold levels. Select properties can also be granted exemption from wastewater charges (i.e. pay only for water services) if they can prove that they do not burden the wastewater system (e.g., they recycle wastewater for subsequent use on-site).

There are also currently a few programs that provide support and assistance for customers in financial distress. The Safety Net Referral Program uses an existing network of NYC agency and not-for-profit programs to help customers with financial counseling, low-cost loans, and legal services. The Water Debt Assistance Program (WDAP) provides temporary water debt relief for qualified property owners who are at risk of mortgage foreclosure. While water and wastewater charges are a lien on the property served, and NYC has the authority to sell these liens to a third party, or lienholder, in a process called a lien sale, DEP offers payment plans for customers who may have difficulty paying their entire bill at one time. The agency has undertaken an aggressive communications campaign to ensure customers know about these programs and any exclusions they may be qualified to receive, such as the Senior Citizens Homeowner's Exemption and the Disabled Homeowner's Exemption. DEP also just announced the creation of a Home Water Assistance Program (HWAP) to assist low-income homeowners. In this program, DEP will partner with the NYC Human Resources Administration (HRA), which administers the Federal Home Energy Assistance Program (HEAP), to identify homeowners who would be eligible to receive a credit on their DEP bill. In FY 2016, this program will be expanded to include senior or disabled customers based on prequalified lists maintained by the Department of Finance for property tax exemptions.

Figure 9-4 shows how water and sewer rates have increased over time and how that compares with system demand and population. Despite a modest rise in population, water consumption rates have been falling since the 1990s due to metering and increases in water efficiency measures. At the same time, rates have been rising to meet the cost of service associated with DEP's capital commitments. DEP operations are funded almost entirely through rates paid by our customers with less than two percent of spending supported by Federal and State assistance over the past ten years. From FY 2002 to FY 2016, water and sewer rates have risen 182 percent. This is despite the fact that DEP has diligently tried to control operating costs. To mitigate rate increases, DEP has diligently managed operating expenses, and since 2011, the agency has had four budget cuts to be able to self-fund critical agency operating needs. Additionally, DEP has undertaken an agency-wide Operational Excellence (OpX) program to review and improve the efficiency of the agency's operations. DEP has already implemented changes through this program that will result in a financial benefit of approximately $98.2M in FY 2016.

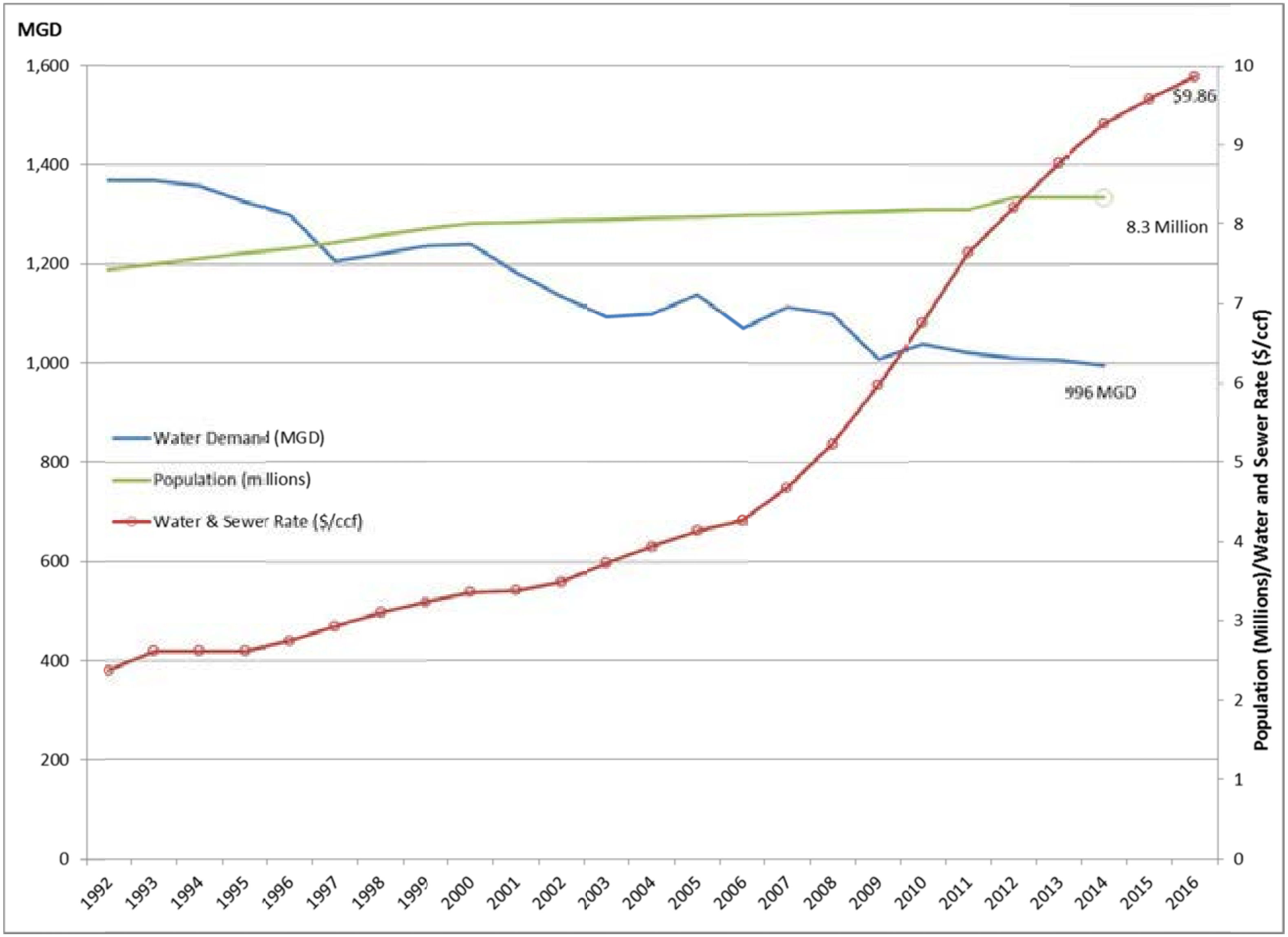


Figure 9-4. Population, Consumption Demand, and Water and Sewer Rates Over Time

9.6.c Residential Indicator

As discussed above, the first economic test as part of EPA's 1997 CSO guidance is the RI, which compares the average annual household water pollution control cost (wastewater and stormwater related charges) to the MHI of the service area. Average household wastewater cost can be estimated by approximating the residential share of wastewater treatment and dividing it by total number of households. Since the wastewater bill in NYC is a function of water consumption, average household costs are estimated based on consumption rates by household type in Table 9-1.

Table 9-1. Residential Water and Wastewater Costs compared to MHI

	Average Annual Wastewater Bill ($/year)	Wastewater RI (Wastewater Bill/MHI(1)) (%)	Total Water and Wastewater Bill ($/Year)	Water and Wastewater RI (Water and Wastewater Bill/MHI) (%)
Single-family(2)	648	**1.21**	1,056	**1.97**
Multi-family(3)	421	**0.79**	686	**1.28**
Average Household Consumption(4)	531	**0.99**	865	**1.61**
MCP	617	**1.15**	1,005	**1.87**

Notes:
(1) Latest MHI data is $52,223 based on 2013 ACS data, estimated MHI adjusted to present is $53,614.
(2) Based on 80,000 gallons/year consumption and FY 2016 Rates.
(3) Based on 52,000 gallons/year consumption and FY 2016 Rates.
(4) Based on average consumption across all metered residential units of 65,530 gallons/year and FY 2016 Rates.

As shown in Table 9-1, the RI for wastewater costs varies between 0.79 percent of MHI to 1.21 percent of MHI, depending on household type. Since DEP is a water and wastewater utility and the ratepayers receive one bill for both charges, it is also appropriate to look at the total water and wastewater bill in considering the RI, which varies from 1.28 percent to 1.97 percent of MHI.

Based on this initial screen, current wastewater costs pose a low to mid-range economic impact according to the 1997 CSO guidance. However, there are several limitations to using MHI in the context of a City like New York. NYC has a large population and more than three million households. Even if a relatively small percentage of households were facing unaffordable water and wastewater bills, there would still be a significant number of households experiencing this hardship. For example, more than 685,000 households in NYC (about 22 percent of NYC's total) earn less than $20,000 per year and have estimated wastewater costs well above 2 percent of their household income. Therefore, there are several other socioeconomic indicators to consider in assessing residential affordability, as described below.

9.6.c.1 Income Levels

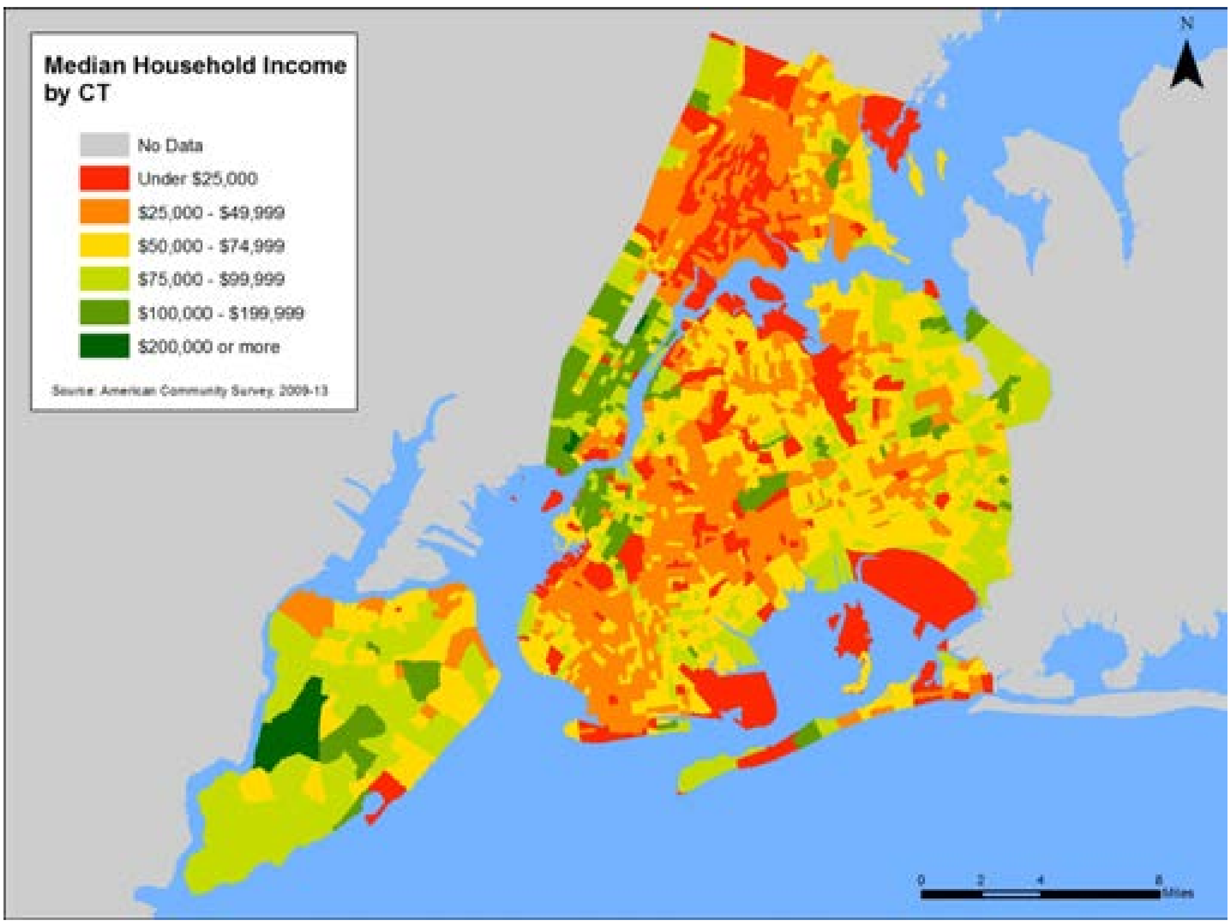
In 2013, the latest year for which Census data is available, the MHI in NYC was $52,223. As shown in Table 9-2, across the NYC boroughs, MHI ranged from $32,009 in the Bronx to $72,190 in Manhattan.

Figure 9-5 shows that income levels also vary considerably across NYC neighborhoods, and there are several areas in NYC with high concentrations of low-income households.

Table 9-2. Median Household Income

Location	2013 (MHI)
United States	$52,250
New York City	$52,223
Bronx	$33,009
Brooklyn	$47,520
Manhattan	$72,190
Queens	$56,599
Staten Island	$69,633

Source: U.S. Census Bureau 2013 ACS 1-Year Estimates.



Source: U.S. Census Bureau 2009-2013 ACS 5-Year Estimates.

Figure 9-5. Median Household Income by Census Tract

As shown in Figure 9-6, after 2008, MHI in NYC actually decreased for several years, and it has just begun to recover to the 2008 level. At this same time, the cost of living continued to increase.

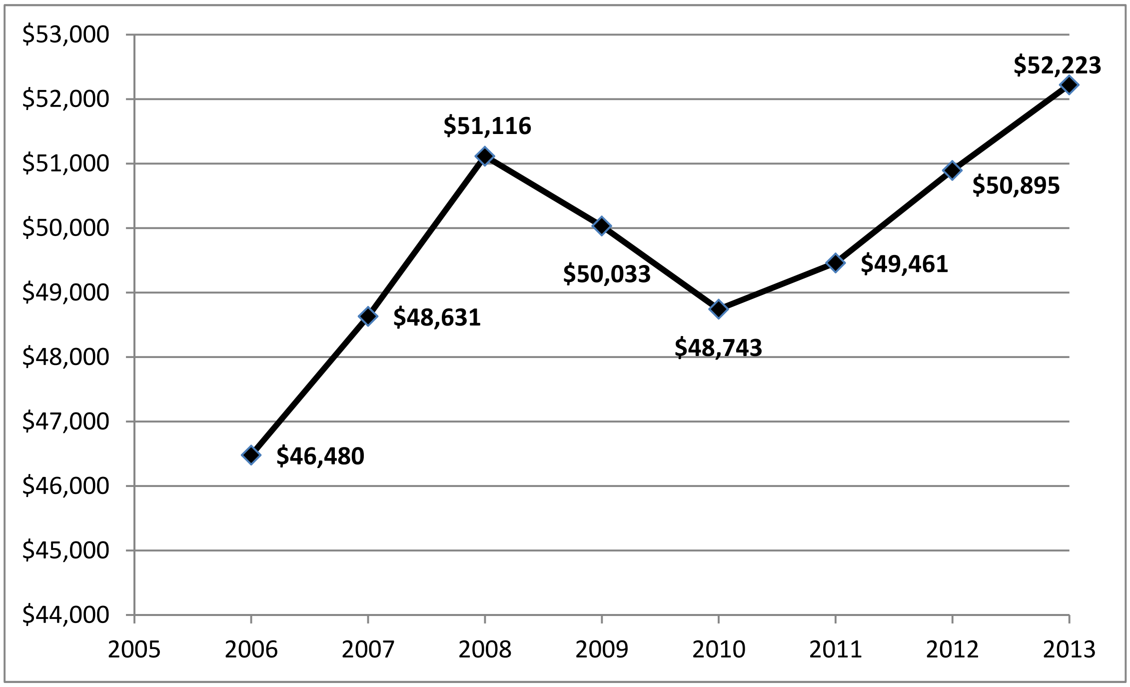


Figure 9-6. NYC Median Household Income Over Time

9.6.c.2 Income Distribution

NYC currently ranks as one of the most unequal cities in the United States (U.S.) in terms of income distribution. NYC's income distribution highlights the need to focus on metrics other than citywide MHI in order to capture the disproportionate impact on households in the lowest income brackets. It is clear that MHI does not represent "the typical household" in NYC. As shown in Figure 9-7, incomes in NYC are not clustered around the median, but rather there are greater percentages of households at both ends of the economic spectrum. Also, the percentage of the population with middle-class incomes between $20,000 and $100,000 is 7.4 percent less in NYC than in the U.S. generally.

Source: U.S. Census Bureau 2013 ACS 1-Year Estimates.

Figure 9-7. Income Distribution for NYC and U.S.

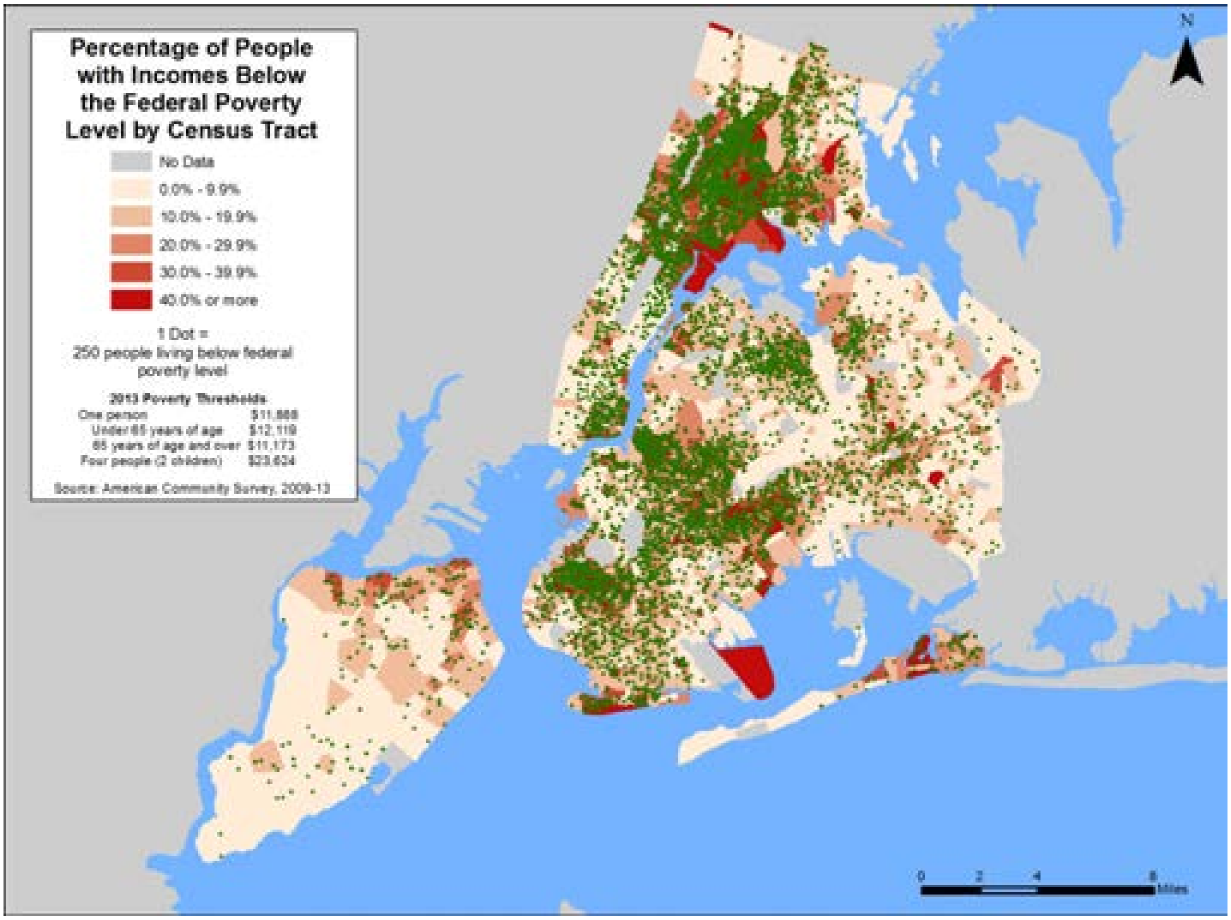
9.6.c.3 Poverty Rates

Based on the latest available Census data, 20.9 percent of NYC residents are living below the Federal poverty level (more than 1.7 million people, which is greater than the entire population of Philadelphia). This compares to a national poverty rate of 15.8 percent despite the similar MHI levels for NYC and the U.S. as a whole. As shown in Table 9-3, across the NYC boroughs, poverty rates vary from 12.8 percent in Staten Island to 30.9 percent in the Bronx.

Table 9-3. NYC Poverty Rates

Location	Percentage of Residents Living Below the Federal Poverty Level (%) (ACS 2013)
United States	15.8
New York City	20.9
Bronx	30.9
Brooklyn	23.3
Manhattan	18.9
Queens	15.3
Staten Island	12.8

Figure 9-8 shows that poverty rates also vary across neighborhoods, with several areas in NYC having a relatively high concentration of people living below the Federal poverty level. Each green dot represents 250 people living in poverty. While poverty levels are concentrated in some areas, there are pockets of poverty throughout NYC. An RI that relies on MHI alone fails to capture these other indicators of economic distress. Two cities with similar MHI could have varying levels of poverty.



Source: U.S. Census Bureau 2009-2013 ACS 5-Year Estimates.

Figure 9-8. Poverty Clusters and Rates in NYC

The New York City Center for Economic Opportunity (CEO) has argued that the official (Federal) poverty rate does not provide an accurate measure of the number of households truly living in poverty conditions (CEO, 2011). This is especially relevant in NYC, where the cost of living is among the highest in the nation. According to CEO, Federal poverty thresholds do not reflect current spending patterns, differences in the cost of living across the nation, or changes in the American standard of living (CEO, 2011). To provide a more accurate accounting of the percentage of NYC's population living in poverty, CEO developed an alternative poverty measure based on methodology developed by the National Academy of Sciences (NAS).

The NAS-based poverty threshold reflects the need for clothing, shelter, and utilities, as well as food (which is the sole basis for the official poverty threshold). The threshold is established by choosing a point in the distribution of expenditures for these items, plus a small multiplier to account for miscellaneous expenses such as personal care, household supplies, and non-work-related transportation. CEO adjusted the NAS-based threshold to account for the high cost of living in NYC.

In addition, the NAS-based income measure uses a more inclusive definition of resources available to households compared to the Federal measure, which is based on pre-tax income. Along with cash income after taxes, it accounts for the cash-equivalent value of nutritional assistance and housing programs (i.e. food stamps and Section 8 housing vouchers). It also recognizes that many families face the costs of commuting to work, child care, and medical out-of-pocket expenses that reduce the income available to meet other needs. This spending is accounted for as deductions from income. Taken together, these adjustments create a level of disposable income that, for some low-income households, can be greater than pre-tax cash income.

CEO's methodology shows that in NYC, poverty level incomes are actually much higher than those defined at the Federal level, which results in a higher percentage of NYC residents living in poverty than is portrayed by national measures. As an example, in 2008, CEO's poverty threshold for a two-adult, two-child household was $30,419. The Federal poverty threshold for the same type of household was $21,834. In that year, 22.0 percent of NYC residents (about 1.8 million people) were living below the CEO poverty threshold income; 18.7 percent were living below the Federal poverty threshold.

More recently, the U.S. Census Bureau developed a Supplemental Poverty Measure (SPM), reflecting the same general approach as that of CEO. The Federal SPM factors in some of the financial and other support offered to low-income households (e.g., housing subsidies, low-income home energy assistance) and also recognizes some nondiscretionary expenses that such households bear (e.g., taxes, out-of-pocket medical expenses, and geographic adjustments for differences in housing costs) (U.S. Census Bureau, 2014).

Nationwide, the SPM indicates that there are 6.39 percent more people in poverty than the official poverty threshold would indicate. The SPM also indicates that inside Metropolitan Statistical Areas the difference is 11.45 percent more people in poverty, and within "principal cities," the SPM-implied number of people in poverty is 4.27 percent higher than the official poverty measure indicates.

9.6.c.4 Unemployment Rates

In 2014 the annual average unemployment rate for NYC was 7.2 percent according to the U.S. Bureau of Labor Statistics, compared to a national average of 6.2 percent. Over the past two decades, NYC's unemployment rate has generally been significantly higher than the national average. Due to the recent recession, the national unemployment rate has increased, moving closer to that of NYC.

9.6.c.5 Cost of Living and Housing Burden

NYC residents face relatively high costs for nondiscretionary items (e.g., housing, utilities) compared to individuals living almost anywhere else in the nation as shown in Figure 9-9. While water costs are slightly less than the average for other major U.S. cities, the housing burden is substantially higher.

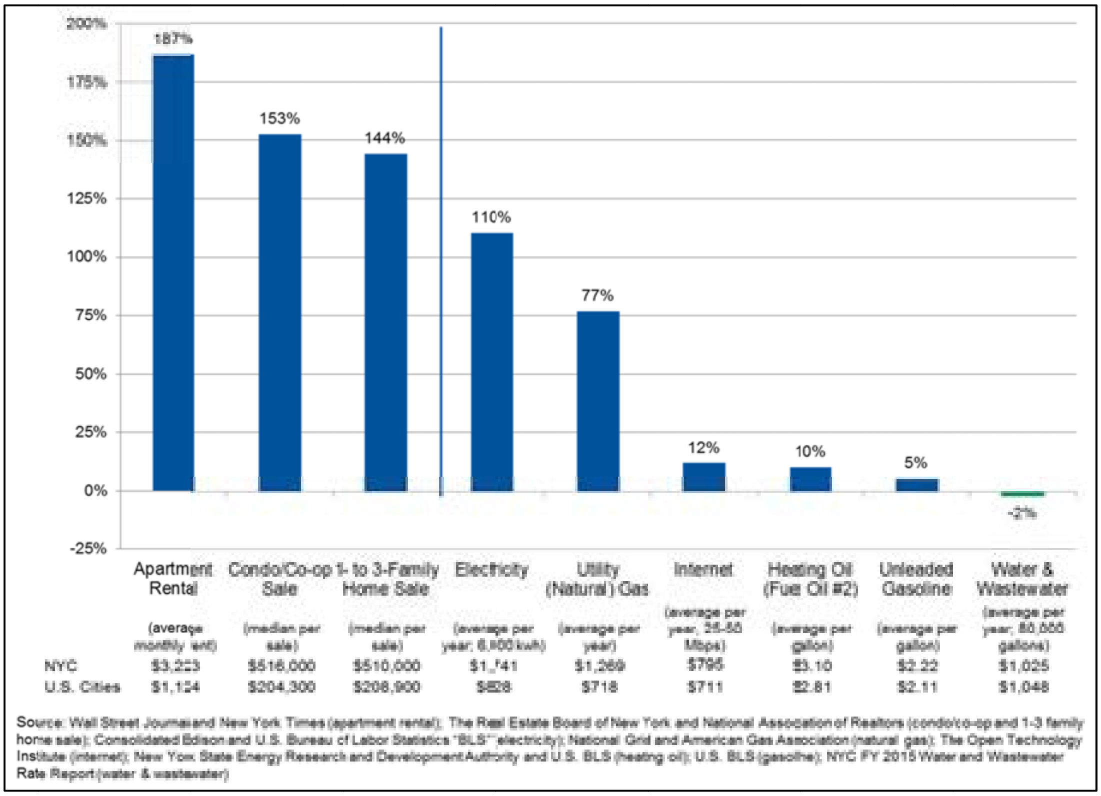


Figure 9-9. Comparison of Costs Between NYC and other U.S. Cities

Approximately 67 percent of all households in NYC are renter-occupied, compared to about 35 percent of households nationally. For most renter households in NYC, water and wastewater bills are included in the total rent payment. Rate increases may be passed on to the tenant in the form of a rental increase, or born by the landlord. In recent years, affordability concerns have been compounded by the fact that gross median rents have increased, while median renter income has declined as shown in Figure 9-10 (NYC Housing, 2014).

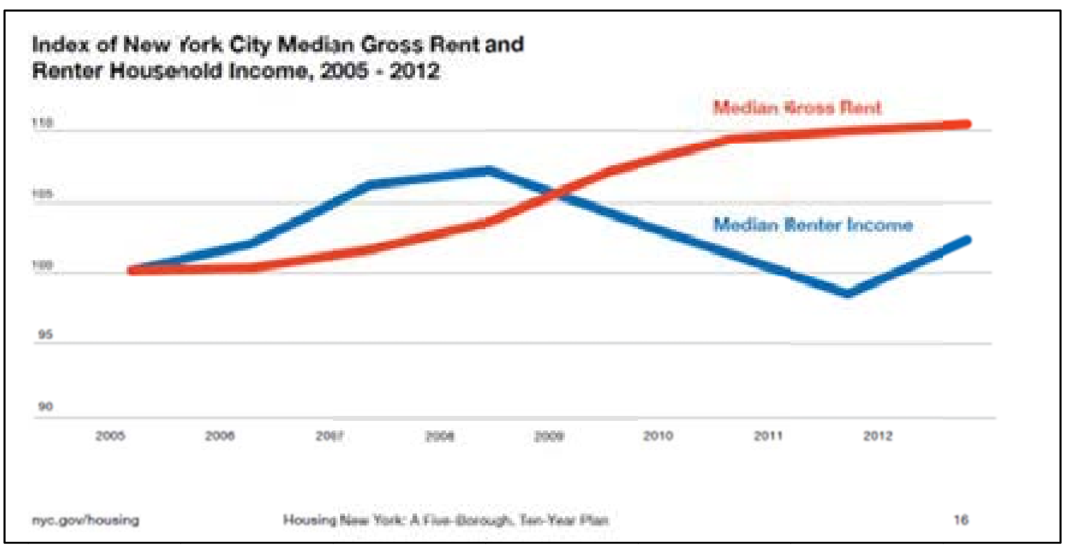


Figure 9-10. Median Gross Rent vs. Median Renter Income

Most government agencies consider housing costs of between 30 percent and 50 percent of household income to be a moderate burden in terms of affordability; costs greater than 50 percent of household income are considered a severe burden.

A review of Census data shows approximately 21 percent of NYC households (close to 645,000 households) spent between 30 percent and 50 percent of their income on housing, while about 25 percent (748,000 households) spent more than 50 percent. This compares to 20 percent of households nationally that spent between 30 percent and 50 percent of their income on housing and 16.2 percent of households nationally that spent more than 50 percent. This means that 46 percent of households in NYC versus 36.2 percent of households nationally spent more than 30 percent of their income on housing.

The NYCHA is responsible for 172,223 affordable housing units (9 percent of the total renter households in NYC). The agency is estimated to pay about $186M for water and wastewater in FY 2015. This total represents about 5.9 percent of their $3.14B operating budget. Even a small increase in rates could potentially impact the agency's ability to provide affordable housing and/or other programs.

9.6.d Financial Capability Indicators

The second phase of the 1997 CSO guidance develops the Permittee FCI, which are compared to national benchmarks and are used to generate a score that is the average of six economic indicators. Lower FCI scores imply weaker economic conditions. Table 9-4 summarizes the FCI scoring as presented in the 1997 CSO guidance.

Table 9-4. Financial Capability Indicator Scoring

Financial Capability Metric	Strong (Score = 3)	Mid-range (Score = 2)	Weak (Score = 1)
Debt indicator			
Bond rating (G.O. bonds, revenue bonds)	AAA-A (S&P) Aaa-A (Moody's)	BBB (S&P) Baa (Moody's)	BB-D (S&P) Ba-C (Moody's)
Overall net debt as percentage of full market value	Below 2%	2–5%	Above 5%
Socioeconomic indicator			
Unemployment rate	More than 1 percentage point below the national average	+/- 1 percentage point of national average	More than 1 percentage point of national average
MHI	More than 25% above adjusted national MHI	+/- 25% of adjusted national MHI	More than 25% below adjusted national MHI
Financial management indicator			
Property tax revenues as percentage of Full Market Property Value (FMPV)	Below 2%	2–4%	Above 4%
Property tax revenue collection rate	Above 98%	94–98%	Below 94%

Notes:
G.O. = general obligation

NYC's FCI score based on this test is presented in Table 9-5 and further described below.

Table 9-5. NYC Financial Capability Indicator Score

Financial Capability Metric	Actual Value	Score
Debt indicators		
Bond rating (G.O. bonds)	AA (S&P) AA (Fitch) Aa2 (Moody's)	Strong/3
Bond rating (Revenue bonds)	AAA (S&P) AA+ (Fitch) Aa1 (Moody's)	
Overall net debt as percentage of FMPV	4.5%	Mid-range/2
G.O. Debt	$41.6B	
Market value	$988.3B	
Socioeconomic indicators		
Unemployment rate (2013 annual average)	1.0 percentage point above the national average	Mid-range/2
NYC unemployment rate	7.2%	
United States unemployment rate	6.2%	
MHI as percentage of national average	99.9%	Mid-range/2
Financial management indicators		
Property tax revenues as percentage of FMPV	2.4%	Mid-range/2
Property tax revenue collection rate	98.5%	Strong/3
Permittee Indicators Score		2.3

Notes:
G.O. = general obligation

9.6.d.1 Bond Rating

The first financial benchmark is NYC's bond rating for both general obligation (G.O.) and revenue bonds. A bond rating performs the isolated function of credit risk evaluation. While many factors go into the investment decision-making process, bond ratings can significantly affect the interest that the issuer is required to pay, and thus the cost of capital projects financed with bonds. According to EPA's criteria – based on the ratings NYC has received from all three rating agencies (Moody's, Standard & Poor's [S&P], and Fitch Ratings – NYC's financing capability is considered "strong." Specifically, NYC's G.O. bonds are rated AA by S&P and Fitch and Aa2 by Moody's; and MWFA's General Resolution revenue bonds are rated AAA by S&P, AA+ by Fitch, and Aa1 by Moody's, while MWFA's Second General Resolution revenue bonds (under which most of the Authority's recent debt has been issued) are rated AA+ by S&P, AA+ by Fitch, and Aa2 by Moody's. This results in a "strong" rating for this category.

Nonetheless, NYC's G.O. rating and MWFA's revenue bond ratings are high due to prudent fiscal management, the legal structure of the system, and the Water Board's historical ability to raise water and wastewater rates. However, mandates over the last decade have significantly increased the leverage of the system, and future bond ratings could be impacted by further increases to debt beyond what is currently forecasted.

9.6.d.2 Net Debt as a Percentage of Full Market Property Value (FMPV)

The second financial benchmark measures NYC's outstanding debt as a percentage of FMPV. Currently NYC has over $41.6B in outstanding G.O. debt, and the FMPV within NYC is $929.1B. This results in a ratio of outstanding debt to FMPV of 4.5 percent and a "mid-range" rating for this indicator. If $29.7B of MWFA revenue bonds that support the system are included, net debt as a percentage of FMPV increases to 7.7 percent, which results in a "weak" rating for this indicator. Furthermore, if NYC's $39.5B of additional debt that is related to other services and infrastructure is also included, the resulting ratio is 11.9 percent net debt as a percentage of FMPV.

9.6.d.3 Unemployment Rate

For the unemployment benchmark, the 2014 annual average unemployment rate for NYC was compared to that for the U.S. NYC's 2014 unemployment rate of 7.2 percent is 1.0 percent higher than the national average of 6.2 percent. Based on EPA guidance, NYC's unemployment benchmark would be classified as "mid-range". It is important to note that over the past two decades, NYC's unemployment rate has generally been significantly higher than the national average. Due to the recession, the national unemployment is closer to NYC's unemployment rate. Additionally, the unemployment rate measure identified in the 1997 financial guidance sets a relative comparison at a snapshot in time. It is difficult to predict whether the unemployment gap between the U.S. and NYC will once again widen further, and it may be more relevant to look at longer term historical trends of the service area.

9.6.d.4 Median Household Income (MHI)

The MHI benchmark compares the community's MHI to the national average. Using American Community Survey (ACS) 2013 single-year estimates, NYC's MHI is $52,223 and the nation's MHI is $52,250. Thus, NYC's MHI is nearly 100 percent of the national MHI, resulting in a "mid-range" rating for this indicator. However, as discussed above in this section, MHI does not provide an adequate measure of affordability or financial capability. MHI is a poor indicator of economic distress and bears little relationship to poverty or other measures of economic need. In addition, reliance on MHI alone can be a very misleading indicator of the affordability impacts in a large and diverse City such as NYC.

9.6.d.5 Tax Revenues as a Percentage of Full Market Property Value

This indicator, which EPA also refers to as the "property tax burden", attempts to measure "the funding capacity available to support debt based on the wealth of the community," as well as "the effectiveness of management in providing community services". According to the NYC Property Tax Annual report issued for FY 2014, NYC had collected $21.0B in real property taxes against an $858.1B FMPV, which amounts to 2.4 percent of FMPV. For this benchmark, NYC received a "mid-range" score. Also, this figure does not include water and wastewater revenues. Including $3.6B of FY 2014 system revenues increases the ratio to 2.7percent of FMPV.

However, this indicator (including or excluding water and wastewater revenues) is misleading because NYC obtains a relatively low percentage of its tax revenues from property taxes. In 2007, property taxes accounted for less than 41 percent of NYC's total non-exported taxes, meaning that taxes other than property taxes (e.g., income taxes, sales taxes) account for nearly 60 percent of the locally borne NYC tax burden.

9.6.d.6 Property Tax Collection Rate

The property tax collection rate is a measure of “the efficiency of the tax collection system and the acceptability of tax levels to residents”. The FY 2014 NYC Property Tax Annual report indicates NYC’s total property tax levy was $21.3B, of which 98.5 percent was collected, resulting in a “strong” rating for this indicator.

It should be noted, however, that the processes used to collect water and wastewater charges and the enforcement tools available to water and wastewater agencies differ from those used to collect and enforce real property taxes. The DOF, for example, can sell real property tax liens on all types of non-exempt properties to third parties, who can then take action against the delinquent property owners. DEP, in contrast, can sell liens on multi-family residential and commercial buildings whose owners have been delinquent on water bills for more than one year, but it cannot sell liens on single-family homes. The real property tax collection rate thus may not accurately reflect the local agency’s ability to collect the revenues used to support water supply and wastewater capital spending.

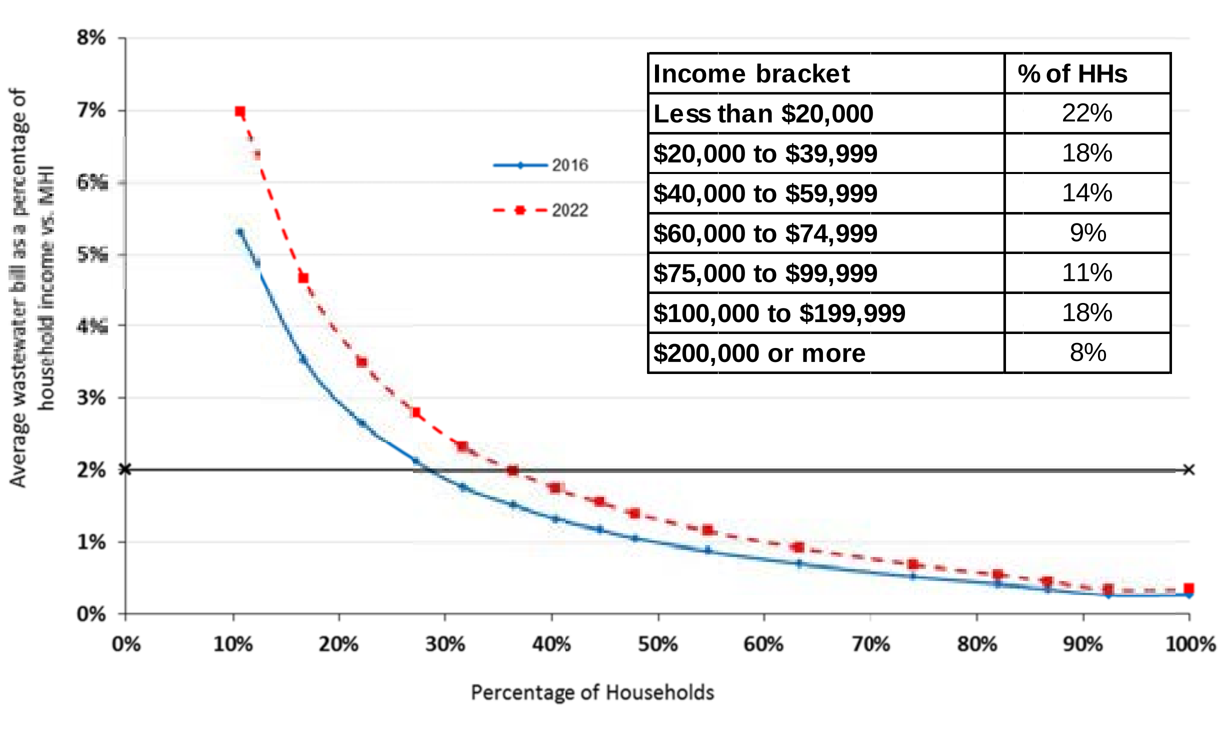
9.6.e Future Household Costs

For illustration purposes, Figure 9-11 shows the average estimated household cost for wastewater services compared to household income, versus the percentage of households in various income brackets for the years 2016 and 2022. As shown, 48 percent of households are estimated to pay more than one percent of their income on wastewater service in 2016. Roughly 27 percent of households are estimated to pay two percent or more of their income on wastewater service alone in 2016. Estimating modest future rate and income increases (based on costs in the CIP and historic Consumer Price Index data, respectively), up to 36 percent of households could be paying more than two percent of their income on wastewater services by 2022. These projections are preliminary and do not include additional future wastewater spending associated with the programs outlined in Section 9.6.a.3 - Future System Investment. When accounting for these additional costs, it is likely that an even greater percentage of households could be paying well above two percent of their income on wastewater services in the future.

DEP, like many utilities in the nation, provides both water and wastewater service, and its rate payers see one bill. Currently the average combined water and sewer bill is around 1.6 percent of MHI, but 22 percent of households are estimated to be currently paying more than 4.5 percent of their income, and that could increase to about 28 percent of households in future years as shown in Figure 9-12. Again, this estimate does not include additional spending for the additional water and wastewater programs outlined in Section 9.6.a.3 - Future System Investment.

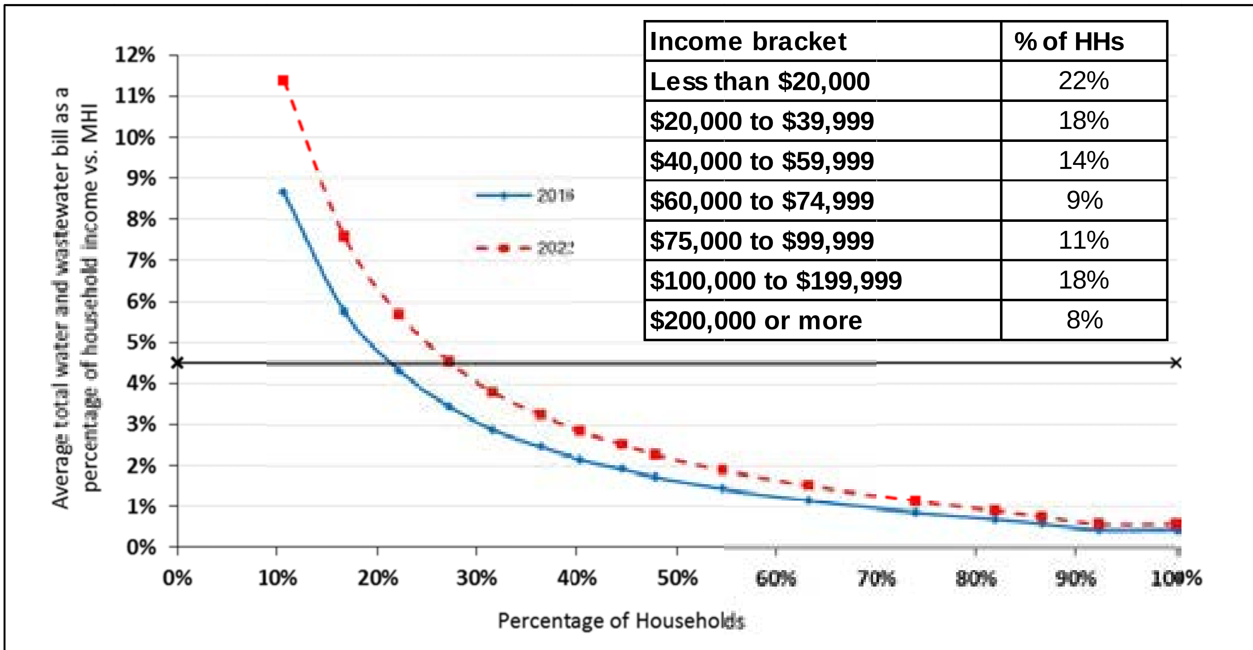
9.6.f Potential Impacts of CSO LTCPs to Future Household Costs

As previously discussed, DEP is facing significant future wastewater spending commitments associated with several regulatory compliance programs. This section presents the potential range of CSO LTCP implementation costs for NYC and describes the potential resulting impacts to future household costs for wastewater service. The information in this section reflects a simplified household impact analysis that will be refined in future LTCP waterbody submittals. All referenced WWFP costs presented in this section have been escalated to June 2014 dollars using the Engineering News-Record City Cost Index (ENRCCI) for New York for comparison purposes.



Income bracket	% of HHs
Less than $20,000	22%
$20,000 to $39,999	18%
$40,000 to $59,999	14%
$60,000 to $74,999	9%
$75,000 to $99,999	11%
$100,000 to $199,999	18%
$200,000 or more	8%

Figure 9-11. Estimated Average Wastewater Household Cost Compared to Household Income (FY 2016 and FY 2022)



Income bracket	% of HHs
Less than $20,000	22%
$20,000 to $39,999	18%
$40,000 to $59,999	14%
$60,000 to $74,999	9%
$75,000 to $99,999	11%
$100,000 to $199,999	18%
$200,000 or more	8%

Figure 9-12. Estimated Average Total Water and Wastewater Cost as a Percentage of Household Income (FY 2016 and FY 2022)

9.6.f.1 Estimated Costs for Waterbody CSO Preferred Alternative

As discussed in Section 8.5, the preferred LTCP alternative for the Gowanus Canal does not include any additional CSO controls as projected attainment levels with current or potential WQS are very high. The preferred LTCP alternative, current baseline conditions, includes the recently-completed control measures from the 2008 WWFP (refurbished flushing tunnel and reconstructed Gowanus PS), plus the planned GI build-out and proposed HLSS in the watershed. To-date, approximately $485M has been committed to grey CSO control infrastructure in the Gowanus Canal system.

As discussed in Section 9.6.a.3 - Future System Investment, NYC will incur costs associated with the EPA ROD requirements. These costs are considered separate from the LTCP costs and are included as potential future household cost impact scenarios in Section 9.6.f.3 below.

9.6.f.2 Overall Estimated Citywide CSO Program Costs

DEP's LTCP planning process was initiated in 2012 and will extend until the end of 2017 per the 2012 CSO Order on Consent schedule. Overall anticipated CSO program costs for NYC will not be known until all of the LTCPs have been developed and approved. Capital costs for the LTCP preferred alternatives that have been identified to-date are presented in Table 9-6a. Also, GI is a major component of the 2012 CSO Order on Consent. The overall GI program cost is estimated at $2.4B, of which $1.5B will be spent by DEP. The GI program costs are in addition to the grey CSO program costs and are therefore presented as a separate line item.

Projected disinfection costs as well as 25%, 50%, and 100% CSO control alternatives (developed as part of a previous WWFP effort) are provided in Table 9-6b for waterbodies where a LTCP has not yet been completed to identify a possible range of future CSO program costs. The actual LTCP preferred alternatives for these waterbodies could be a mix of treatment and storage options.

Based on the information contained in Tables 9-6a and 9-6b, overall future CSO program capital costs could range from $2.6B to $74.7B when considering costs for the LTCP preferred alternatives plus the range of costs presented for the other waterbodies.

9.6.f.3 Potential Impacts to Future Household Costs

To estimate the impact of the possible range of future CSO control capital costs to ratepayers, the annual household cost impact of the future citywide CSO control costs was calculated for the CSO spending scenarios. The cost estimates presented will evolve over the next few years as the LTCPs are completed for the ten waterbodies. The cost estimates will be updated as the LTCPs are completed. Also, it is important to note that the current analysis does not include rate impacts of future O&M and other incremental costs, which would contribute to additional increases to the rate.

Table 9-6a. Committed Costs and LTCP Preferred Alternative Costs(1)

Waterbody / Watershed	Historical and Current CIP Commitments	Baseline Committed Grey Infrastructure Costs			LTCP Preferred Alternative	LTCP Preferred Alternative Cost
		Committed FY 2002-FY 2014	Committed in FY 2015-FY 2025 CIP	Total Existing Committed		
Alley Creek and Little Neck Bay	CSO Abatement Facilities and East River CSO	$139,131,521	$13,000,000	$152,131,521	Alternative 4 - Disinfection in Existing CSO Retention Facility	$7,600,000
Westchester Creek	Hunts Point WWTP Headworks	$7,800,000	$0	$7,800,000	Green Infrastructure Implementation and Post-Construction Compliance Monitoring	$0
Hutchinson River	Hunts Point WPCP Headworks	$3,000,000	$108,000,000	$111,000,000	Alternative 12 - 50 MGD Seasonal Disinfection in New Outfall HP-024	$90,000,000
Flushing Creek	Flushing Bay Corona Avenue Vortex Facility, Flushing Bay CSO Retention, Flushing Bay CSO Storage	$357,015,599	$75,195,000	$432,210,599	Alternative 3 - TI-010 Outfall Disinfection at Tank and Diversion Chamber 5 plus TI-011 Outfall Disinfection	$6,890,000
Bronx River	Installation of Floatable Control Facilities, Hunts Point Headworks	$46,866,831	$0	$46,866,831	Alternative 2 - Combination of former Alts. 7-1 and 9-1	$110,100,000
Gowanus Canal	Gowanus Flushing Tunnel Reactivation, Gowanus PS Upgrade	$176,165,050	$308,954,000	$485,119,050	Current Baseline Plus Green Infrastructure, Proposed HLSS, and Future Superfund Commitments	Included in Superfund Costs(2)
Green Infrastructure Program	Miscellaneous Projects Associated with Citywide Green Infrastructure Program	$173,462,000	$940,074,000	$1,113,536,000	Full Implementation of Green Infrastructure Program	$1,500,000,000
TOTAL		*$903,441,001*	*$1,445,223,000*	*$2,348,664,001*		*$1,714,590,000*

Notes:

(1) All costs reported in this table reflect estimated capital costs only (i.e. probable bid cost). Projected O&M costs are not included in this analysis.

(2) The DEP Superfund tank costs for the Gowanus Canal are not shown here as LTCP costs but are included with the future mandated programs in Tables 9.7 and 9.8. Potential Superfund costs for the Gowanus Canal range from $507M to $829M.

Table 9-6b. Committed Costs and Range of Future CSO Program Costs for Waterbodies without Completed LTCP[(1)]

Waterbody / Watershed	Historical and Current CIP Commitments	Baseline Committed Grey Infrastructure Costs			Range of Potential Future CSO Program Costs			
					Treatment / Disinfection Cost[(2)]	Storage Alternatives		
		Committed FY 2002-FY 2014	Committed in FY 2015-FY 2025 CIP	Total Existing Committed		25% CSO Control Cost[(3)]	50% CSO Control Cost[(3)]	100% CSO Control Cost[(3)]
Coney Island Creek	Avenue V Pumping Station, Force Main Upgrade	$196,885,560	$0	$196,885,560	$53,955,000	$59,646,395	$119,292,789	$1,163,462,575
Jamaica Bay	Improvements of Flow Capacity to Fresh Creek-26th Ward Drainage Area, Hendrix Creek Canal Dredging, Shellbank Destratification, Spring Creek AWCP Upgrade	$161,378,669	$21,010,000	$182,388,669	$0	$180,881,883	$367,416,325	$4,142,534,281
Flushing Bay[(4)]	See Flushing Creek in Table 9-6a	$0	$0	$0	$333,431,000	$222,270,368	$791,802,838	$4,787,918,645
Newtown Creek	English Kills Aeration, Newtown Creek Water Quality Facility, Newtown Creek Headworks	$159,639,614	$90,404,000	$250,043,614	$537,766,000	$566,569,452	$1,586,394,467	$3,421,512,923
East River and Open Waters	Bowery Bay Headworks, Inner Harbor In-Harbor Storage Facilities, Reconstruction of the Port Richmond East Interceptor Throttling Facility, Outer Harbor CSO Regulator Improvements, Hutchinson River CSO	$153,145,476	$19,094,000	$172,239,476	$0	$534,921,268	$7,016,829,726	$59,488,594,159
Bergen and Thurston Basins[(5)]	Pumping Station and Force Main Warnerville	$41,876,325	$0	$41,876,325	NA	NA	NA	NA

Table 9-6b. Committed Costs and Range of Future CSO Program Costs for Waterbodies without Completed LTCP(1)

Waterbody / Watershed	Historical and Current CIP Commitments	Baseline Committed Grey Infrastructure Costs			Range of Potential Future CSO Program Costs			
					Treatment / Disinfection Cost(2)	Storage Alternatives		
		Committed FY 2002-FY 2014	Committed in FY 2015-FY 2025 CIP	Total Existing Committed		25% CSO Control Cost(3)	50% CSO Control Cost(3)	100% CSO Control Cost(3)
Paerdegat Basin	Retention Tanks, Paerdegat Basin Water Quality Facility	$397,046,298	$ (2,643,000)(6)	$394,403,298	NA	NA	NA	NA
TOTAL		*$1,109,971,941*	*$127,865,000*	*$1,237,836,941*	*$925,152,000*	*$1,564,289,366*	*$9,881,736,146*	*$73,004,022,583*

Notes:

(1) All costs reported in this table reflect estimated capital costs only (i.e. probable bid cost). Projected O&M costs are not included in this analysis.
(2) Values reflect current estimated disinfection costs projected by DEP; costs will be refined in future LTCP submittals.
(3) 25%, 50%, and 100% CSO costs are estimated using knee-of-the-curve / cost vs. CSO control plots from WWFPs as needed and do not subtract historic and currently committed costs, which are presented separately. All costs taken from the WWFPs have been escalated to June 2014 dollars for comparison purposes using the ENRCCI for New York.
(4) Committed costs for Flushing Bay are captured in the committed costs reported for Flushing Creek; see Table 9-6a.
(5) Bergen and Thurston Basins and Paerdegat Basin are not part of the current LTCP effort; thus, no LTCP detail is provided for them.
(6) Negative value for Paerdegat Basin reflects a de-registration of committed funds.

A 4.75 percent interest rate was used to determine the estimated annual interest cost associated with the capital costs, and the annual debt service was divided by the FY 2016 Revenue Plan value to determine the resulting percent rate increase. This also assumes bonds are structured for a level debt service amortization over 32 years. Note that interest rates on debt could be significantly higher in the future. As Table 9-7 shows, the LTCP preferred alternatives plus disinfection for the remaining waterbodies would result in a two percent rate increase the LTCP preferred alternatives plus 25 percent CSO control scenario would result in a three percent rate increase; the LTCP preferred alternatives plus 50 percent CSO control scenario would result in a double-digit rate increase of 17 percent; and the LTCP preferred alternatives plus 100% CSO control scenario would result in a substantial 125 percent rate increase. These rate increases translate into additional annual household costs of up to $1,318. Both the 50 percent and 100% CSO control scenarios represent a substantial increase in annual household costs, which only reflects possible future CSO control program costs. The cost of the additional future mandated and non-mandated programs discussed in Section 9.6.a.3 - Future System Investment, would further increase the annual burden to ratepayers. For illustrative purposes, estimates for future spending on TRC, Ammonia, MS4, Superfund and Hillview Cover have been assumed in Table 9-7 and Table 9-8, and these are subject to change.

Table 9-8 shows the potential range of future spending and its impact on household cost compared to MHI. While these estimates are preliminary, it should be noted (as discussed in detail earlier in this section) that comparing household cost to MHI alone does not tell the full story since a large percentage of households below the median could be paying a larger percentage of their income on these costs.

9.6.g Benefits of Program Investments

DEP has been in the midst of an unprecedented period of investment to improve water quality in New York Harbor. Projects worth $9.9B have been completed or are under way since 2002 alone, including projects for nutrient removal, CSO abatement, marshland restoration in Jamaica Bay, and hundreds of other projects. In-NYC investments are improving water quality in the Harbor and restoring a world-class estuary while creating new public recreational opportunities and inviting people to return to NYC's 578 miles of waterfront. A description of citywide water quality benefits resulting from previous and ongoing programs is provided below, followed by the anticipated benefits of water quality improvements to the Gowanus Canal resulting from implementation of the preferred alternative.

Table 9-7. CSO Control Program Household Cost Impact

Capital Spending Scenario	Projected Capital Cost ($M)(1)	Additional O&M and other Incremental Costs(2)	Annual Debt Service ($M)(3)	% Rate Increase from FY 2016 Rates	Additional Annual Household Cost	
					Single-family Home	Multi-family Unit
Current CIP	$17,312	*TBD*	$1,063	30	$312	$203
Future Potential Mandated Program Costs for MS4, TRC, Ammonia, Superfund, and Hillview Cover(4)	$6,500	*TBD*	$399	11	$117	$76
LTCP Preferred Alternatives + 100% CSO Control(5)	$73,146	*TBD*	$4,492	125	$1,318	$856
LTCP Preferred Alternatives + 50% CSO Control(5)	$10,023	*TBD*	$616	17	$181	$117
LTCP Preferred Alternatives + 25% CSO Control(5)	$1,706	*TBD*	$105	3	$31	$20
LTCP Preferred Alternatives + Disinfection(5)	$1,067	*TBD*	$66	2	$19	$12
Citywide LTCP CSO Control Alternatives(6)	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*

Notes:

TBD – To be determined

(1) CSO Capital costs have been reduced to reflect currently committed costs for CSO control projects (see Tables 9-6a and 9-6b).

(2) This analysis does not include rate impacts of future O&M and other incremental costs, which would contribute to additional increases to the rate.

(3) Assumes bonds are structured for a level debt service amortization over 32 years at a 4.75% interest rate.

(4) DEP will face additional future wastewater mandated program costs. While these costs have not been finalized and actual costs could be very different due to compliance uncertainties (particularly with respect to MS4), the following estimated costs for select programs are included to represent potential future annual household cost on top of costs for the CSO control program: MS4 Permit Compliance - $2.0B, TRC - $560M, Ammonia - $840M, Superfund Remediation - $1.5B, and $1.6B for Hillview Cover.

(5) Reflects LTCP Preferred Alternatives (see Table 9-6a) plus the identified level of control or treatment for the remaining waterbodies (see Table 9-6b).

(6) Projected capital cost for the citywide preferred LTCP CSO control alternatives is not currently available. This information will be included in the citywide LTCP following completion of the individual waterbody LTCPs.

Table 9-8. Total Estimated Cumulative Future Household Costs/MHI(1)

Capital Spending Scenario	Total Projected Annual Household Cost(2)		Total Water and Wastewater Household Cost / MHI(3)		Total Wastewater Household Cost / MHI(3)	
	Single-family Home	Multi-family Unit	Single-family Home (%)	Multi-family Unit (%)	Single-family Home (%)	Multi-family Unit (%)
FY 2016 Rates	$1,056	$686	2.0	1.3	1.2	0.79
Current CIP	$1,368	$889	2.2	1.5	1.4	0.89
Other Future Potential Mandated Program Costs for MS4, TRC, Ammonia, Superfund, and Hillview Cover(4)	$1,485	$965	2.4	1.6	1.5	0.97
CIP+Other+LTCP Preferred Alternatives+100% CSO Control(5)	$2,803	$1,821	4.6	3.0	2.8	1.83
CIP+Other+LTCP Preferred Alternatives+50% CSO Control(5)	$1,666	$1,082	2.7	1.8	1.7	1.09
CIP+Other+LTCP Preferred Alternatives+25% CSO Control(5)	$1,516	$985	2.5	1.6	1.5	0.99
CIP+Other+LTCP Preferred Alternatives+Disinfection(5)	$1,504	$977	2.5	1.6	1.5	0.98
CIP+Other+Citywide LTCP CSO Control Alternatives	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*

Notes:

(1) Future costs reported in this table reflect capital costs only and do not include projected O&M costs.
(2) Projected household costs are estimated from rate increases presented in Table 9-7.
(3) Future costs were compared to assumed 2025 MHI projection ($61,142), which was estimated using Census and Consumer Price Index data.
(4) Reflects estimated costs for additional future wastewater mandated program costs. These costs have not been finalized and actual costs could be very different due to compliance uncertainties (particularly with respect to MS4).
(5) Reflects LTCP Preferred Alternatives (see Table 9-6a) plus the identified level of control or treatment for the remaining waterbodies (see Table 9-6b), current CIP, and other future potential mandated program costs.

9.6.g.1 Citywide Water Quality Benefits from Previous and Ongoing Programs and Anticipated Gowanus Canal Water Quality Benefits

Water quality benefits have been documented in the Harbor and its tributaries from the almost $10B investment that NYC has already made in grey and GI since 2002. Approximately 95 percent of the Harbor is available for boating and kayaking and 14 of NYC's beaches provide access to swimmable waters in the Bronx, Brooklyn, Queens and Staten Island.

Of the $10B already invested, almost 20 percent has been dedicated to controlling CSOs and stormwater. That investment has resulted in NYC capturing and treating over 70 percent of the combined stormwater and wastewater that otherwise would be directly discharged to our waterways during periods of heavy rain or runoff. Projects that have already been completed include: GI projects in 26th Ward, Hutchinson River and Newtown Creek watersheds; area-wide GI contracts; Avenue V Pump Station and Force Main; and the Bronx River Floatables Control. Several other major projects are in active construction or design. The water quality improvements already achieved have allowed greater access of the waterways and shorelines for recreation as well as enhanced environmental habitat and aesthetic conditions in many of NYC's neighborhoods.

More work is needed, and DEP has committed to working with DEC to further reduce CSOs and make other infrastructure improvements to gain additional water quality improvements. The 2012 CSO Order on Consent between DEP and DEC outlines a combined grey and green approach to reduce CSOs. This LTCP for the Gowanus Canal is just one of the detailed plans that DEP is preparing by the year 2017 to evaluate and identify additional control measures for reducing CSO and improving water quality in the Harbor. DEP is also committed to extensive water quality monitoring throughout the Harbor which will allow better assessment of the effectiveness of the controls implemented.

As noted above, a major component of the 2012 CSO Order on Consent that DEP and DEC developed is GI stormwater control measures. DEP is targeting a 10 percent application rate for implementing GI in combined sewer areas citywide. The GI will take multiple forms including green or blue roofs, bioinfiltration systems, right-of-way bioswales, rain barrels, and porous pavement. These measures provide benefits beyond the associated water quality improvements. Depending on the measure installed, they can recharge groundwater, provide localized flood attenuation, provide sources of water for non-potable use, such as watering lawns or gardens, reduce heat island effects on streets and sidewalks, improve air quality, enhance aesthetic quality, and provide recreational opportunities. These are all benefits that contribute to the overall quality of life for residents of NYC.

A detailed discussion of anticipated water quality improvements to the Gowanus Canal is included in Section 8.0.

9.6.h Conclusions

As part of the LTCP process, DEP will continue to develop and refine the affordability and financial capability assessments for each individual waterbody as it works toward an expanded analysis for the citywide LTCP. In addition to what is outlined in the Federal CSO guidance on financial capability, DEP has presented in this section a number of additional socioeconomic factors for consideration in the context of affordability and assessing potential impacts to our ratepayers. Furthermore, it is important to include a fuller range of future spending obligations and DEP has sought to present an initial picture of that here. Ultimately the environmental, social, and financial benefits of all water-related obligations should be considered when priorities for spending are developed and implementation of mandates are scheduled, so that resources can be focused where the community will get the most environmental benefit.

9.7 Compliance with Water Quality Goals

The Gowanus Canal is currently attaining the Class I bacteria criteria. The assessment of the waterbody indicates that the Gowanus Canal can support bathing water quality (Class SC), however, swimming in the Gowanus Canal is not recommended, nor is it suitable for that use because of natural and manmade features, such as lack of access and large boat traffic. In addition, consideration of upgrading of the Gowanus Canal to an SC classification should await completion of the Superfund remedial work and related post-construction compliance monitoring.

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11.0 GLOSSARY

1.5xDDWF:	One and One-half Times Design Dry Weather Flow
2xDDWF:	Two Times Design Dry Weather Flow
AACE:	Association for the Advancement of Cost Engineering
ACS:	American Community Survey
B:	Billion
BEACH:	Beaches Environmental Assessment and Coastal Health
BEPA	Bureau of Environmental Planning and Analysis
BGY:	Billon Gallons Per Year
BMP:	Best Management Practice
BNR:	Biological Nutrient Removal
BOD:	Biochemical Oxygen Demand
BODR:	Basis of Design Report
BWSO:	Bureau of Water and Sewer Operations
CAC:	Citizens Advisory Committee
$CBOD_5$:	Carbonaceous Biochemical Oxygen Demand
CEG:	Cost Effective Grey
CEO:	New York City Center for Economic Opportunity
CERCLA:	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR:	Code of Federal Regulation
CFS:	Cubic Feet Per Second
CFU:	Colony-Forming Unit
CIP:	Capital Improvement Plan
CMMS:	Computerized Maintenance and Management Systems
CMS:	Compliance Monitoring System

CPK:	Central Park
CSO:	Combined Sewer Overflow
CSS:	Combined Sewer System
CWA:	Clean Water Act
DCIA:	Directly Connected Impervious Areas
DCP:	New York City Department of City Planning
DDC:	New York City Department of Design and Construction
DDWF:	Design Dry Weather Flow
DEC:	New York State Department of Environmental Conservation
DEP:	New York City Department of Environmental Protection
DO:	Dissolved Oxygen
DOB:	New York City Department of Buildings
DOC:	Dissolved Organic Carbon
DOE:	New York City Department of Education
DOF:	New York City Department of Finance
DOH:	New York State Department of Health
DOHMH:	New York City Department of Health and Mental Hygiene
DOT:	New York City Department of Transportation
DPR:	New York City Department of Parks and Recreation
DSNY:	New York City Department of Sanitation
DW:	Dry Weather
DWF:	Dry Weather Flow
E. Coli:	Escherichia Coli.
EBP:	Environmental Benefit Project
ECL:	New York State Environmental Conservation Law
ECM:	Energy Conservation Measure

EDC:	New York City Economic Development Corporation
EMC:	Event Mean Concentration
ENRCCI:	Engineering News-Record City Cost Index
EPA:	United States Environmental Protection Agency
ERTM:	East River Tributaries Model
ET:	Evapotranspiration
EWR:	Newark Liberty International Airport
FAD:	Filtration Avoidance Determination
FAQ:	Frequently Asked Question
FC:	Fecal Coliform
FCI:	Financial Capability Indicators
FEMA:	Federal Emergency Management Agency
FMPV:	Full Market Property Value
FSAP:	Field Sampling Analysis Program
FS:	Feasibility Study
FT:	Abbreviation for “Feet”
FY:	Fiscal Year
GC:	Gowanus Canal
GC-PATH:	Gowanus Canal Water Pathogen Model
GC-STEM:	Gowanus Canal Sediment Transport and Eutrophication Model
GC WQM:	Gowanus Canal Water Quality Model
GHG:	Greenhouse Gases
GI:	Green Infrastructure
GIS:	Geographical Information System
GM:	Geometric Mean
G.O.:	General Obligation

GRTA:	NYC Green Roof Tax Abatement
HDPE:	High Density Polyethylene
HEAP:	Home Energy Assistance Program
HGL:	Hydraulic Grade Line
HLSS:	High Level Storm Sewers or can referenced as High Level Sewer Separation
Hp:	Horsepower
HRA:	New York City Human Resources Administration
HRC:	High Rate Clarification
HSM:	Harbor Survey Monitoring Program
HVAC:	Heating, Ventilation and Air Conditioning
HWAP:	Home Water Assistance Program
IEC:	Interstate Environmental Commission
I/I:	Inflow and Infiltration
in:	Abbreviation for "Inches".
in/hr:	Inches per hour
IW:	InfoWorks CS^{TM}
JFK:	John F. Kennedy International Airport
KOTC:	Knee-of-the-Curve
lbs/day:	pounds per day
LF:	Linear Feet
LGA:	LaGuardia Airport
LIRR:	Long Island Rail Road
LT2:	Long Term 2
LTCP:	Long Term Control Plan
MCP:	Multifamily Conservation Program
mg/L:	milligrams per liter

MG:	Million Gallons
MGD:	Million Gallons Per Day
MGP:	Manufacturing Gas Plant
MGY:	Million Gallons Per Year
MHI:	Median Household Income
MLLW:	Mean Lower Low Water
MOU:	Memorandum of Understanding
MPN:	Most probable number
MS4:	Municipal separate storm sewer systems
MSS:	Marine Sciences Section
MT:	Metric Ton
MTA:	Metropolitan Transit Authority
MWFA:	New York City Municipal Water Finance Authority
NAPL:	Non-Aqueous Phase Liquid
NAS:	National Academy of Sciences
NEIWPCC:	New England Interstate Water Pollution Control Commission
NMC:	Nine Minimum Control
NOAA:	National Oceanic and Atmospheric Administration
NPDES:	National Pollutant Discharge Elimination System
NPW:	Net Present Worth
NWI:	National Wetlands Inventory
NYC:	New York City
NYCHA:	New York City Housing Authority
NYCRR:	New York State Code of Rules and Regulations
NYMTC:	New York Metropolitan Transportation Council
NYS:	New York State

NYSDOH:	New York State Department of Health
NYSDOS:	New York State Department of State
O&M:	Operation and Maintenance
OGI:	Office of Green Infrastructure
OH:	Owls Head
OLTPS:	Mayor's Office of Long Term Planning and Sustainability
OMB:	Office of Management and Budget
ONRW:	Outstanding National Resource Waters
OpX:	Operational Excellence
PAH:	Polycyclic Aromatic Hydrocarbons
PBC:	Probable Bid Cost
PCM:	Post-Construction Compliance Monitoring
POC:	Particulate Organic Carbon
POTW:	Publicly Owned Treatment Plant
ppm:	Parts per Million
ppt:	Parts per thousand
PRAP:	Proposed Remedial Action Plan
PS:	Pump Station or Pumping Station
Q:	Symbol for Flow (designation when used in equations)
RH:	Red Hook
RI:	Residential Indicator
RI/FS:	Remedial Investigation/Feasibility Study
ROD:	Record of Decision
ROW:	Right-of-Way
ROWB:	Right-of-Way Bioswales
ROWRG:	Right-of-Way Rain Gardens

RPM:	Revolutions per Minute
RTB:	Retention Treatment Basin
RTC:	Real-Time Control
RWQC:	Recreational Water Quality Criteria
S&P:	Standard and Poor
SBMT:	South Brooklyn Marine Terminal
SBU:	Sewer back-up
SCA:	NYC School Construction Authority
SCADA:	Supervisory Control and Data Acquisition
SGS:	Stormwater Greenstreets
SIU:	Significant Industrial User
SPDES:	State Pollutant Discharge Elimination System
SPM:	Supplemental Poverty Measure
SSS:	Sanitary Sewer Systems
STV:	Statistical Threshold Value
SWIM:	Stormwater Infrastructure Matters Coalition
SWMM:	Stormwater Management Model
SYNOP:	Surface Synoptic Observations
TAZ:	Transportation Analysis Zone
TBD:	To Be Determined
TDA:	Tributary Drainage Areas
TMDL:	Total Maximum Daily Load
TNTC:	Too Numerous to Count
TOC:	Total Organic Carbon
TPL:	Trust for Public Land
TRC:	Total Residual Chlorine

TSS:	Total Suspended Solids
UAA:	Use Attainability Analysis
ULURP:	Uniform Land Use Review Procedure
U.S.:	United States
USACE:	United States Army Corps of Engineers
USEPA:	United States Environmental Protection Agency
USFWS:	United States Fish and Wildlife Service
UV:	Ultraviolet Light
WDAP:	Water Debt Assistance Program
WQ:	Water Quality
WQS:	Water Quality Standards
WWFP:	Waterbody/Watershed Facility Plan
WWOP:	Wet Weather Operating Plan
WWTP:	Wastewater Treatment Plant

Appendix A: Supplemental Tables

Annual CSO, Non-CSO,
Local Source Baseline Volumes (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Gowanus Canal	OH-003	7A,7B,7C	372.8
Gowanus Canal	OH-004	7D	5.9
Gowanus Canal	OH-005	Carrol St CSO	0.5
Gowanus Canal	OH-006	19th St-3rd Ave	15.6
Gowanus Canal	OH-007	2nd Avenue PS CSO	57.6
Gowanus Canal	OH-023	Bush Terminal CSO	0.9
Gowanus Canal	OH-024	23st-3rd Ave Relief	26.4
Gowanus Canal	RH-030	CSO4	16.2
Gowanus Canal	RH-031	CSO3	16.7
Gowanus Canal	RH-033	R-25	0.3
Gowanus Canal	RH-034	CSO	137.5
Gowanus Canal	RH-035	CSO2	5.4
Gowanus Canal	RH-036	R-22	1.8
Gowanus Canal	RH-037	R-23	0.4
Gowanus Canal	RH-038	R-24	0.6
		Total CSO	**658.6**

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Discharge, (MG/Yr)**
Gowanus Canal	OH-607	NA	4.5
Gowanus Canal	OH-616	NA	13.8
Gowanus Canal	OH-403	NA	6.3
Gowanus Canal	OH--12	NA	1.5
Gowanus Canal	OH--74	NA	2.6
Gowanus Canal	OH--75	NA	21.5
Gowanus Canal	OH--80	NA	10.7
Gowanus Canal	OH--81	NA	6.3
Gowanus Canal	OH--82	NA	6.9
Gowanus Canal	OH--83	NA	26.3
Gowanus Canal	OH--84	NA	2.5
Gowanus Canal	OH--85	NA	2.5
Gowanus Canal	OH--90	NA	6.7
Gowanus Canal	OH-344	NA	19.6
Gowanus Canal	OH-415	NA	7.0

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Discharge, (MG/Yr)**
Gowanus Canal	OH-419	NA	19.7
Gowanus Canal	OH-514	NA	1.1
Gowanus Canal	OH-519	NA	4.7
Gowanus Canal	OH-590	NA	3.1
Gowanus Canal	OH-902	NA	2.7
Gowanus Canal	RH-601	NA	1.5
Gowanus Canal	RH--71	NA	10.6
Gowanus Canal	RH--72	NA	4.1
Gowanus Canal	RH-329	NA	3.8
Gowanus Canal	RH-393	NA	28.9
Gowanus Canal	RH-523	NA	9.6
Gowanus Canal	RH-524	NA	17.5
Gowanus Canal	RH-525	NA	3.0
Gowanus Canal	RH-857	NA	13.3
Gowanus Canal		**Total Non-CSO**	**262.3**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Discharge (MG/Yr)**
Gowanus Canal	Flushing Tunnel	NA	80,554.1
		Total	**80,554.1**

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Percent**	**Total Discharge (MG/Yr)**
Gowanus Canal	CSO	0.8	658.6
	Non-CSO	0.3	262.3
	Flushing Tunnel	98.9	**80**,554.1
		Total	**81,475.0**

**Annual CSO, Non-CSO,
Local Sources Enterococci Loads (2008 Rainfall)**

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-003	7A,7B,7C	4354.4
Gowanus Canal	OH-004	7D	47.6
Gowanus Canal	OH-005	Carrol St CSO	3.9
Gowanus Canal	OH-006	19th St-3rd Ave	156.8
Gowanus Canal	OH-007	2nd Avenue PS CSO	573.2
Gowanus Canal	OH-023	Bush Terminal CSO	8.5
Gowanus Canal	OH-024	23st-3rd Ave Relief	273.7
Gowanus Canal	RH-030	CSO4	168.6
Gowanus Canal	RH-031	CSO3	167.2
Gowanus Canal	RH-033	R-25	2.5
Gowanus Canal	RH-034	CSO	1272.5
Gowanus Canal	RH-035	CSO2	52.0
Gowanus Canal	RH-036	R-22	16.4
Gowanus Canal	RH-037	R-23	2.9
Gowanus Canal	RH-038	R-24	5.9
		Total CSO	**7,106.2**

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-607	NA	8.5
Gowanus Canal	OH-616	NA	26.1
Gowanus Canal	OH-403	NA	11.9
Gowanus Canal	OH--12	NA	0.3
Gowanus Canal	OH--74	NA	0.6
Gowanus Canal	OH--75	NA	4.9
Gowanus Canal	OH--80	NA	2.4
Gowanus Canal	OH--81	NA	1.4
Gowanus Canal	OH--82	NA	1.6
Gowanus Canal	OH--83	NA	6.0
Gowanus Canal	OH--84	NA	0.6
Gowanus Canal	OH--85	NA	0.6
Gowanus Canal	OH--90	NA	1.5
Gowanus Canal	OH-344	NA	4.5
Gowanus Canal	OH-415	NA	1.6
Gowanus Canal	OH-419	NA	4.5
Gowanus Canal	OH-514	NA	0.2

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-519	NA	1.1
Gowanus Canal	OH-590	NA	0.7
Gowanus Canal	OH-902	NA	0.8
Gowanus Canal	RH-601	NA	2.8
Gowanus Canal	RH--71	NA	2.4
Gowanus Canal	RH--72	NA	0.9
Gowanus Canal	RH-329	NA	0.9
Gowanus Canal	RH-393	NA	6.6
Gowanus Canal	RH-523	NA	2.2
Gowanus Canal	RH-524	NA	4.0
Gowanus Canal	RH-525	NA	0.7
Gowanus Canal	RH-857	NA	4.0
		Total Non-CSO	**104.3**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	Flushing Tunnel	NA	118.2
		Total	**118.2**

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Percent**	**Total Org.x10^{12}**
Gowanus Canal	CSO	97.0	7,106.2
	Non-CSO	1.4	104.2
	Flushing Tunnel	1.6	118.2
		Total	**7,328.6**

Annual CSO, Non-CSO,
Local Sources Fecal Coliform Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-003	7A,7B,7C	8322.4
Gowanus Canal	OH-004	7D	90.5
Gowanus Canal	OH-005	Carrol St CSO	7.9
Gowanus Canal	OH-006	19th St-3rd Ave	302.1
Gowanus Canal	OH-007	2nd Avenue PS CSO	1095.0
Gowanus Canal	OH-023	Bush Terminal CSO	16.5
Gowanus Canal	OH-024	23st-3rd Ave Relief	523.9
Gowanus Canal	RH-030	CSO4	324.7
Gowanus Canal	RH-031	CSO3	322.0
Gowanus Canal	RH-033	R-25	5.2
Gowanus Canal	RH-034	CSO	2444.6
Gowanus Canal	RH-035	CSO2	100.4
Gowanus Canal	RH-036	R-22	32.4
Gowanus Canal	RH-037	R-23	5.8
Gowanus Canal	RH-038	R-24	1.2
		Total CSO	**13,605.2**

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-607	NA	20.4
Gowanus Canal	OH-616	NA	62.7
Gowanus Canal	OH-403	NA	28.6
Gowanus Canal	OH--12	NA	0.2
Gowanus Canal	OH--74	NA	0.4
Gowanus Canal	OH--75	NA	3.3
Gowanus Canal	OH--80	NA	1.6
Gowanus Canal	OH--81	NA	1.0
Gowanus Canal	OH--82	NA	1.0
Gowanus Canal	OH--83	NA	4.0
Gowanus Canal	OH--84	NA	0.4
Gowanus Canal	OH--85	NA	0.4
Gowanus Canal	OH--90	NA	1.0
Gowanus Canal	OH-344	NA	3.0
Gowanus Canal	OH-415	NA	1.1
Gowanus Canal	OH-419	NA	3.0
Gowanus Canal	OH-514	NA	0.2

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	OH-519	NA	0.7
Gowanus Canal	OH-590	NA	0.5
Gowanus Canal	OH-902	NA	2.0
Gowanus Canal	RH-601	NA	6.8
Gowanus Canal	RH--71	NA	1.6
Gowanus Canal	RH--72	NA	0.6
Gowanus Canal	RH-329	NA	0.6
Gowanus Canal	RH-393	NA	4.4
Gowanus Canal	RH-523	NA	1.5
Gowanus Canal	RH-524	NA	2.6
Gowanus Canal	RH-525	NA	0.5
Gowanus Canal	RH-857	NA	10.1
		Total Non-CSO	**164.0**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Org.x10^{12}**
Gowanus Canal	Flushing Tunnel	NA	429.6
		Total	**429.6**

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Percent**	**Total Org.x10^{12}**
Gowanus Canal	CSO	95.8	13,605.2
	Non-CSO	1.2	164.0
	Flushing Tunnel	3.0	429.6
		Total	**14,198.8**

Annual CSO, Non-CSO,
Local Sources BOD_5 Loads (2008 Rainfall)

Combined Sewer Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Gowanus Canal	OH-003	7A,7B,7C	228,019.8
Gowanus Canal	OH-004	7D	3,591.1
Gowanus Canal	OH-005	Carrol St CSO	325.8
Gowanus Canal	OH-006	19th St-3rd Ave	9,525.0
Gowanus Canal	OH-007	2nd Avenue PS CSO	35,250.0
Gowanus Canal	OH-023	Bush Terminal CSO	541.6
Gowanus Canal	OH-024	23st-3rd Ave Relief	16,141.8
Gowanus Canal	RH-030	CSO4	9,887.4
Gowanus Canal	RH-031	CSO3	12,223.1
Gowanus Canal	RH-033	R-25	197.2
Gowanus Canal	RH-034	CSO	84,091.9
Gowanus Canal	RH-035	CSO2	3,314.8
Gowanus Canal	RH-036	R-22	1,094.3
Gowanus Canal	RH-037	R-23	243.2
Gowanus Canal	RH-038	R-24	359.5
		Total CSO	**402,806.5**

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Gowanus Canal	OH-607	NA	561.0
Gowanus Canal	OH-616	NA	1,734.2
Gowanus Canal	OH-403	NA	793.4
Gowanus Canal	OH--12	NA	193.3
Gowanus Canal	OH--74	NA	327.9
Gowanus Canal	OH--75	NA	2,713.0
Gowanus Canal	OH--80	NA	1,347.4
Gowanus Canal	OH--81	NA	793.6
Gowanus Canal	OH--82	NA	865.0
Gowanus Canal	OH--83	NA	3,319.0
Gowanus Canal	OH--84	NA	318.3
Gowanus Canal	OH--85	NA	310.6
Gowanus Canal	OH--90	NA	843.4
Gowanus Canal	OH-344	NA	2,464.0
Gowanus Canal	OH-415	NA	878.6
Gowanus Canal	OH-419	NA	2,480.3
Gowanus Canal	OH-514	NA	143.8

InfoWorks Non-CSO Outfalls			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Gowanus Canal	OH-519	NA	597.1
Gowanus Canal	OH-590	NA	391.4
Gowanus Canal	OH-902	NA	339.3
Gowanus Canal	RH-601	NA	185.6
Gowanus Canal	RH--71	NA	1,341.8
Gowanus Canal	RH--72	NA	513.9
Gowanus Canal	RH-329	NA	473.7
Gowanus Canal	RH-393	NA	3,643.9
Gowanus Canal	RH-523	NA	1,209.3
Gowanus Canal	RH-524	NA	2,205.3
Gowanus Canal	RH-525	NA	371.9
Gowanus Canal	RH-857	NA	1,676.8
		Total Non-CSO	**33,036.7**

Local Sources			
Waterbody	**Outfall**	**Regulator**	**Total Lbs**
Gowanus Canal	Flushing Tunnel	NA	863,376.2
		Total	**863,376.2**

Totals by Source by Waterbody			
Waterbody	**Outfall**	**Percent**	**Total Lbs**
Gowanus Canal	CSO	31.0	402,806.5
	Non-CSO	2.5	33,036.7
	Flushing Tunnel	66.5	863,376.2
		Total	**1,299,219.4**

Appendix B: Long Term Control Plan (LTCP) Gowanus Canal Meeting #1 – Summary of Meeting and Public Comments Received

On November 19, 2014, DEP hosted a Public Kickoff Meeting to initiate the water quality planning process for long term control of combined sewer overflows in the Gowanus Canal waterbody. The two-hour event, held at Public School 32, 317 Hoyt Street in Brooklyn, provided overview information about DEP's Long Term Control Plan (LTCP) Program, presented information on the Gowanus Canal watershed characteristics and status of waterbody improvement projects, obtained public information on waterbody uses in Gowanus Canal, and described additional opportunities for public input and outreach. The presentation can be found at http://www.nyc.gov/dep/ltcp. Approximately 50 stakeholders from different non-profit, community, planning, environmental, economic development, governmental organizations and the broader public attended the event and two reporters from local Brooklyn papers.

The Gowanus Canal LTCP Kickoff Public Meeting was an opportunity for public participation in the LTCP. As part of DEP's LTCP Public Participation Plan, Gowanus Canal Long Term Control Planning process will be posted on DEP's website, shown above. The public will have more opportunities to provide feedback and participate in the development of Gowanus Canal waterbody-specific LTCP. Specific questions asked during the public kickoff meeting are summarized below with DEP's responses to each.

- Is sewage being brought to the Canal?
  - *The Flushing Tunnel and Pump Station do not bring sewage to the canal. They bring clean river water from the Buttermilk Channel to the head end of the canal. It is clean river water and is improving the water quality in the canal significantly.*
- Where is the 3 times the flow mentioned in the presentation going?
  - *The flows go to the Red Hook Wastewater Treatment Plant (WWTP) for treatment. The plant is designed for 2 times the dry weather flow.*
- Does the City monitor bioswale performance?
  - *Yes, DEP constructed three Neighborhood Demonstration Areas and installed equipment to monitor the performance of individual bioswales. Equipment was also installed in the sewers to monitor the performance of multiple bioswales within the same tributary area. A Post-Construction Compliance Monitoring Report will be available on the website in early 2015.*
- What is being done to control runoff for non-city properties such as the new Atlantic Yards?
  - *In 2012 the City promulgated a new stormwater rule for new construction and major building alteration projects. The rule requires these projects to detain significantly more stormwater on their property than what the previous rule required. These projects can also use green infrastructure practices such as rain gardens and perforated pipes to meet the new detention requirement.*

- Why is DEP in the process of suing the DEC?
  - *The issues associated with the current litigation are complex. DEP and DEC are working to determine the best plan for water quality improvements. The social and economic impacts are being evaluated. DEP hopes a resolution will be reached in the near future.*
- Why is DEP just getting going on this since the guidance dates back to 1994?
  - *DEP has been working on CSO issues for over two decades with significant progress made in improving water quality throughout the City during that time period. The recently completed upgrade of the Gowanus Flushing Tunnel and Wastewater Pumping Station is one example of the projects that the City has invested in to reduce CSOs and improve water quality. DEP and DEC have worked together in 2012 to develop schedules for the LTCPs and related work which will set the direction for future water quality improvements throughout the City.*
- What are the water quality objectives for the Gowanus Canal?
  - *The DEP and DEC goal is to improve the water quality in the canal. The recent operation of the Flushing Tunnel and Pump Station brings clean water from the East River to the head end of the canal and significant improvement in water quality has resulted. The canal may be upgraded to Class SB in the future.*
- Did you include hurricane Sandy in the modeling forecasts?
  - *The water quality modeling is done for a full 10 year period to account for fluctuations in rainfall. Sandy was not a high rainfall event and is not included in the 10 year modeling data. Most of the damage was due to tidal surge and wind.*
- Is DEP going to look at other data such as citizens' data?
  - *DEP will look at all data. Please submit any data to DEP.*
- How do DEP and EPA goals intersect?
  - *DEP uses a toolbox of alternatives for the evaluation step. The EPA tanks are included in the toolbox. Different levels of CSO control and cost are evaluated with a cost effective preferred alternative ultimately recommended for DEC and EPA review.*
- Does the use of weir adjustments cause house flooding?
  - *The hydraulic sewer analysis is required to say hydraulically neutral. This means an increase in the water levels in the sewers is not allowed. Any adjustments in weirs must not cause an increase in the water levels.*
- Will DEP and EPA coordinate the sewer construction along Carroll Street?
  - *The high level storm sewer (HLSS) study and design work is underway. The schedule for these projects will be coordinated when the design work is completed.*

- Citizen data shows there is more pollution in the turning basins; can HLSS be discharged to the turning basins?

    - *DEP will look into the option of discharging to the turning basins. Other projects may be planned for the turning basins.*

- Shouldn't all planning be coordinated with EPA to save time?

    - *DEP is coordinating with EPA and DEC. The consent decrees all have schedules that have been reviewed and approved by EPA and DEC as appropriate.*

- Superfund is based on toxins, are toxins being monitored?

    - *Yes, sampling, analysis and modeling of the chemical constituents is being done.*

- Will the cost of the EPA tanks be included in the DEP budgets?

    - *Yes, construction costs are paid for by the rate payers of the City. The cost of the tanks will become part of the DEP budget once the concept is approved.*

- Odors in the canal continue and are worse than other neighborhoods. Can the odors be reduced? Raw sewage exists in the canal.

    - *Odors will be reduced with the Flushing Tunnel and future improvements.*

- Is there higher water use for Gowanus Canal citizens?

    - *DEP's recent records show flows to the wastewater treatment plants (WWTPs) are declining. This is due to water conservation and improved sewer controls. The WWTPs have excess capacity at this time.*

- How is the CSO pilot project going?

    - *The CSO flow monitoring pilot project data analysis is ongoing. Preliminary conclusions are that CSO flow monitoring is challenging in the existing regulators due to complex hydraulics and infrastructure configuration. Based on previous NYC investments in calibrated models and telemetry, the effectiveness of these tools in estimating and predicting CSOs, the need to minimize instrumentation complexity and operation and maintenance requirements, DEP has chosen to implement CSO flow monitoring on a temporary basis for critical outfalls under the CSO LTCP program. This decision allows DEP to make strategic investments to gain valuable insight into the collection system and CSO outfall dynamics while minimizing the long-term burden of ongoing O&M, instrumentation replacement and recalibration requirements.*

- Is DEP looking at synthetic and natural Green Infrastructure mitigation? Can more trees be incorporated?

    - *Green infrastructure promotes the natural movement of water by collecting and managing stormwater runoff from streets, sidewalks, parking lots and rooftops and directing it to* *engineered systems that typically feature, stones, soils, plants and trees. Over the course of 2015, DEP will construct approximately 90 bioswales in the Gowanus watershed and many will include trees. DEP also works with City agencies such as the Department of Parks and Recreation and New York City Housing Authority to design green infrastructure practices such as rain gardens which may feature new trees as well.*

- Why not wait until the EPA work is completed?
    - *EPA is targeting chemicals and DEC is targeting water quality. DEP is working on integrating both agencies objectives into a common approach that is cost effective and affordable.*
- Aren't we playing catch-up with these programs?
    - *The programs are working with agreed upon consent orders and schedules. DEP has fourteen WWTPs operational, 90 pump stations and they meet secondary standards. DEP also has plans to improve the treatment processes to meet more stringent water quality regulations.*
- With the increase in development in the area, is additional flow being considered?
    - *DEP is working with the Bridging Gowanus group and the zoning department and is aware of the newer developments being planned. The impacts to the entire system are small for these developments. The local sewers and new connections are reviewed in the planning and permit reviews. The LTCP includes population projects through 2040.*
- The DEP website does not have a Gowanus Canal page, how does the public comment?
    - *The information presented tonight will be posted tomorrow on the DEP website listed in the handouts. Questions can be posted to the site or sent to the representatives listed in the handout.*
- Will CSO flows increase at the head end of the canal?
    - *Flow projections for the outfall at the head of the canal (RH-034) are declining. The projects have reduced for 182 MG to 142 MG. These projections are still being developed and the values may change somewhat.*

Long Term Control Plan (LTCP) Gowanus Canal Meeting # 2 – Summary of Meeting and Public Comments Received

On May 14, 2015, DEP hosted the second of three public meetings for the water quality planning process for long term control of combined sewer overflows in the Gowanus Canal waterbody. The two-hour event was held at Public School 32, 317 Hoyt Street in Brooklyn. DEP presented information on the LTCP process, Gowanus Canal watershed characteristics, and the status of engineering alternatives evaluations, and provided opportunities for public input. The presentation can be found at http://www.nyc.gov/dep/ltcp. Approximately 35 stakeholders from 20 different non-profit, community, planning, environmental, economic development, governmental organizations and the broader public attended the event and one representative from the local media.

The Gowanus Canal LTCP Meeting #2 was an opportunity for public participation in the LTCP. As part of DEP's LTCP Public Participation Plan, Gowanus Canal Long Term Control Planning process will be posted on DEP's website, shown above. The public will have more opportunities to provide feedback and participate in the development of Gowanus Canal waterbody-specific LTCP. Specific questions asked during the public meeting #2 are summarized below with DEP's responses to each.

- Why is there foaming in the Canal? People are referring to it as the "Gowanus milk shake" and it appears to be some type of soap.
    - *DEP responded that an investigation is underway to determine the cause of the foaming. Preliminary thoughts are that it is due to the aeration/air entrainment but DEP will continue to investigate.*
- Why has visibility in the Canal gotten worse? It used to be you could see to the bottom in some locations.
    - *Algae from Buttermilk Channel are suspected. Investigations of the cause are continuing.*
- There is a history of dry-weather discharges in the Canal. Has this stopped?
    - *DEP responded that there has been an investigation into past discharges over the past 20-25 years and those results indicate that dry weather discharges have decreased drastically.*
- How do the measurements in the turning basins change?
    - *The bacteria and dissolved oxygen levels are reasonably consistent between the Canal and the turning basins. They seem to be well mixed.*
- Has DEP used flow metering?
    - *DEP has performed flow measurements throughout the City. Recently Outfalls OH-007, OH-026 and RH-034 have been studied. The model predictions and flow metering measurement have corresponded. DEP is a co-author of a recent study being published by WERF (Water Environment Research Federation) that presents the technical findings of the metering efforts.*

- If the park location is chosen for a retention facility, is there funding?
  - o *There is no current funding assigned for construction as DEP is still in the siting and design phase. Whatever alternatives are chosen, DEP will allocate funding.*
- Is it possible to send flow from Outfall OH-003 to Outfall OH-007?
  - o *No, the regulators do not allow this.*
- Does the DEP include population and development growth in the plan?
  - o *Yes, the plan includes projected development and growth.*
- Are you going to recommend a smaller tank than the ROD recommended?
  - o *We are looking at smaller tanks that meet the criteria as they are less costly. No decision has been made.*
- Has the DEP talked with land owners about the possibility of eminent domain?
  - o *Yes, DEP has talked with the land owners.*
- The Bond-Lorraine Sewer is still a flooding problem and should be repaired. In addition the impacts of climate change should be considered.
  - o *The DEP has a separate group that is studying the impacts of climate change and the impact on the sewer system.*
- Why is the DEP not using more Green Infrastructure?
  - o *DEP has already installed 18 green infrastructure assets and will begin construction on 92 bioswales in the public right of way in June 2015. Preliminary investigations have also begun to retrofit two New York City Housing Authority properties with green infrastructure. DEP will continue to work with city agencies to identify other opportunities for green infrastructure. DEP also offers a grant program for private property owners to install green infrastructure on their property. The GI Program is a 20-year program and more green infrastructure will be added to the Gowanus watershed over time.*
- *How are bioswales maintained and how does DEP select the locations?*
  - o *City crews regularly maintain the bioswales. They are responsible for removing litter, preserving the grading, and caring for the tree and plants. In selecting bioswale locations, DEP begins by conducting a hydraulic analysis. Then walkthroughs are conducted with the Departments of Transportation and Parks & Recreation to review potential locations. If potential locations meet City requirements for access and pedestrian safety, then geotechnical investigations and surveys are performed. This step requires collecting and testing the underlying soil to ensure it can absorb stormwater. If the soil conditions are*

acceptable, the design team then prepares construction drawings (including specific bioswale placements) in conjunction with utility companies to avoid and eliminate conflicts with existing service lines.

- Why is a head house needed for the new facility?
    - *The head house is where the mechanical and electrical equipment are kept. It includes items such as electrical power, odor control equipment, pumps and other equipment needed to operate the facility/tank.*
- What is the annual operation cost?
    - *DEP has yet to determine this.*
- Can a new pool facility be built at the park to replace the old one?
    - *The City Parks Department would determine the feasibility of this. DEP would work with the Parks Department as needed.*
- What kind of absorption is expected with a bio swale?
    - *A 20x5 bioswale can manage approximately 2,992 gallons of stormwater runoff.*
- Will the GI improvements be coordinated with NYCHA (New York City Housing Authority)?
    - *DEP works closely with the New York City Housing Authority on identifying opportunities for green infrastructure improvements on NYCHA properties. Preliminary investigations are currently underway at Gowanus and Wyckoff Houses.*
- Can more rainfall runoff be absorbed by green infrastructure as opposed to catch basins?
    - *Green infrastructure practices such as bioswales, green roofs, and rain gardens collect and manage stormwater runoff. DEP is currently planning, designing, and constructing green infrastructure practices in the CSO areas of the Gowanus Canal watershed. Even with these green infrastructure practices, catch basins will continue to be an important component of the City's drainage system.*